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UNIVERSITY

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JAMES COOK

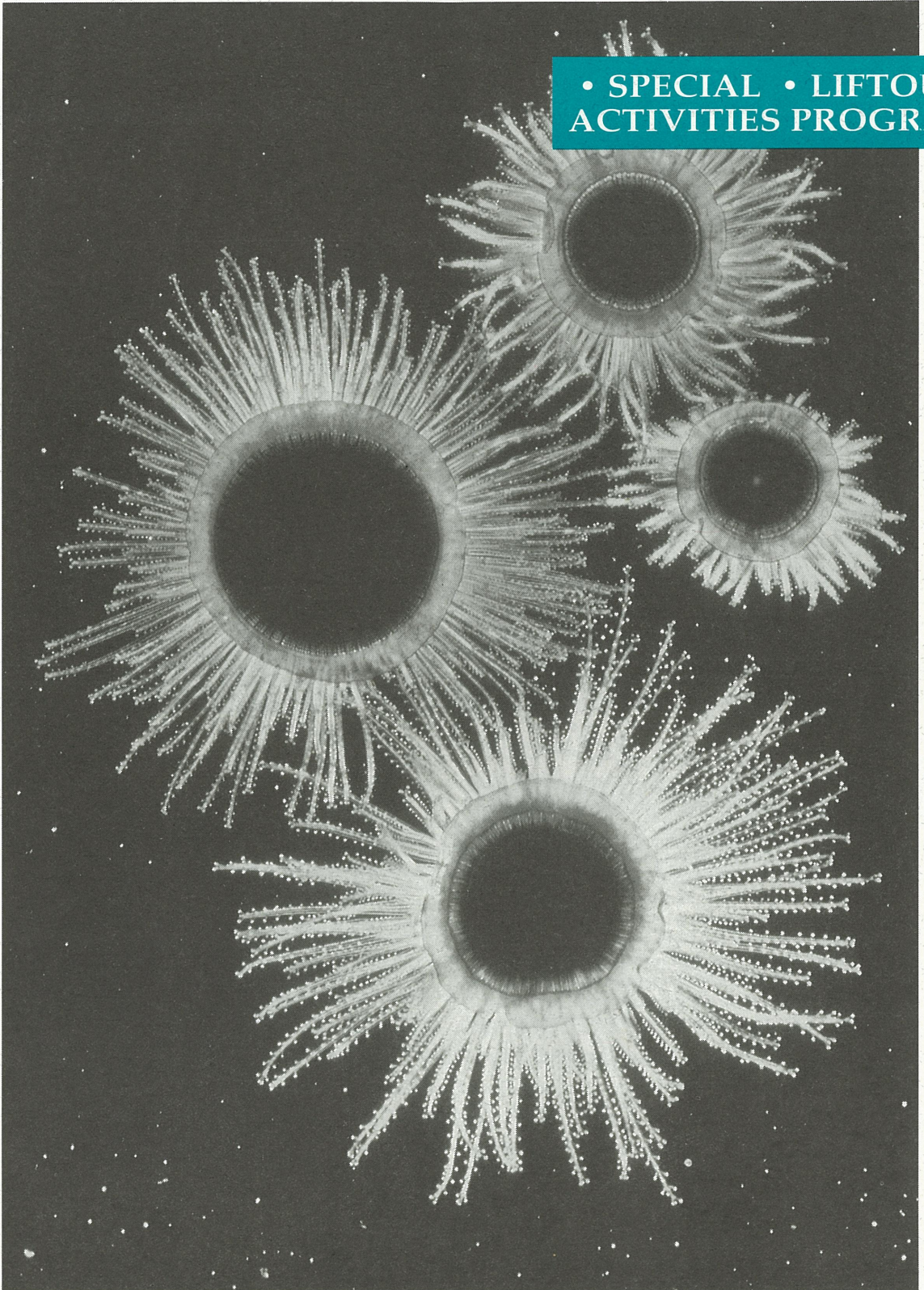
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MAGAZINE OF  
THE GREAT BARRIER REEF AQUARIUM



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ACTIVITIES PROGRAM





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The Great Barrier Reef Aquarium apologizes for inaccuracies and omissions in the first edition Sponsors List. The Sponsors List should have included Estate of Samuel & Eileen Gluyas, H. Gerstle (P.R. Gerstle Memorial) and The Byte Centre.			

# Coralines

ISSN 1037-0684

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 **Great Barrier Reef Park Authority**

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# EDITORIAL

The Aquarium continues to fulfil its role of educating visitors and locals about the Great Barrier Reef, its fragility and the need to protect it. This is achieved in a variety of ways, educationally, scientifically and creatively.

As regular visitors to the Aquarium know, exhibits change frequently. Many new animals are introduced and visual creativity abounds. In keeping with our aim of involving the community in Aquarium events, students from James Cook University's Faculty of Art are designing a new exhibit as part of their course. The talented Fibres and Fabrics group in Townsville are creating a soft sculpture reef, local high school students with a keen interest in science have participated in the 1991 CSIRO Student Research Scheme and Volunteers continue to assist both behind the scenes and on the floor.

Our first edition of *Coralines* brought an overwhelming response. In this issue our topics are varied. The myth about giant clams is dispelled by Associate Professor John Lucas who writes on the taming of the 'killer' clams.

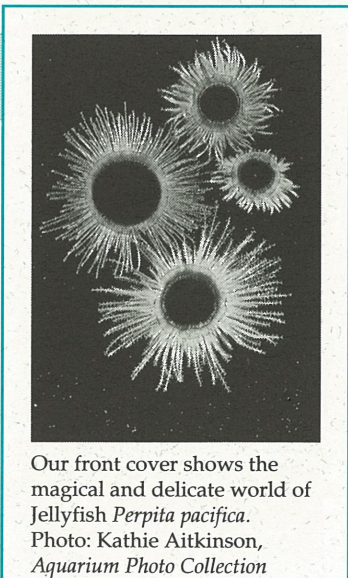
The crown-of-thorns starfish has been the focus of intense scientific and public debate. As the public becomes more aware, interest is widening and Dr. Peter Moran gives us an update and expands on the results of research. Many visitors to the Aquarium are often amazed that this animal is responsible for the destruction of corals not only in Australia but also in Japan, Samoa, Tahiti, Micronesia and the Maldives.

Visitors often wonder how scientists could bottle such a large piece of reef in the Aquarium. Curator Martin Jones, provides us with a fascinating insight into the development of the world's largest living coral reef aquarium, from its inception to today.

Like Mother Nature, the Aquarium is ever changing. This year will see the creation of a Junior Volunteer Scheme as well as new education programs for school children. The Aquarium is always seeking new and innovative programs and the development of Sidney Seahorse to guide children on an underwater adventure is but one of them. Children will see more of Sidney and his underwater friends in future editions. We thank you for your comments on our first edition and look forward to hearing from more readers.

Alison and Anna  
Editors

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Our front cover shows the magical and delicate world of Jellyfish *Peripita pacifica*.  
Photo: Kathie Aitkinson,  
Aquarium Photo Collection

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## Message from the Director

The Aquarium's Mission Statement is 'To be the best Aquarium in the world through excellence in exhibits, business and staff management, community involvement and education so that the Great Barrier Reef Aquarium plays a leading role in the conservation and wise use of the Great Barrier Reef'.

I share this with you because all Aquarium staff and Volunteers are proud of this vision and of what we are doing towards achieving it.

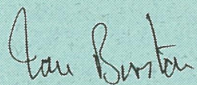
To provide us with sound commercial feedback and advice on business, marketing and display strategies for the Aquarium we recently established the Great Barrier Reef Aquarium Advisory Board. The Board consists of ten demonstrated high achievers from the local business, tourism and government sectors.

Talking of feedback, we are very conscious of the need to listen to our customers and have established a project entitled 'Let the Director Know What you Think'. It is a kind of suggestion box which encourages people to tell us what they think of the Aquarium's displays and services. We plan to expand this into a major display. The first 'victim' of this customer feedback was the early retirement of the live crocodile exhibit in favour of a new and much improved Touch Pool.

The Aquarium's Theatre now has an overhead video projector and as well as our usual audio-visual we are showing a twenty-five minute video entitled 'A Question of Balance'. The video deals with some major issues concerning the use and management of the Great Barrier Reef.

The Aquarium Theatre was the venue recently for the world premiere of 'A Walk in the Sea', a one hour television documentary about the Aquarium, Townsville and the Great Barrier Reef. 'A Walk in the Sea' attracted great interest at the recent Cannes film festival and has been sold to television networks in Brazil, Canada, U.S.A., Europe and the Middle East. It is being distributed in Australia and overseas through home-video outlets and is available from the Aquarium shop.

'A Walk in the Sea' will make an outstanding contribution to the promotion world-wide of Townsville and the Great Barrier Reef and will enhance the Aquarium's reputation as the best in the world.



Ian Burston  
Director

# W I N D O W O N T H E R E E F

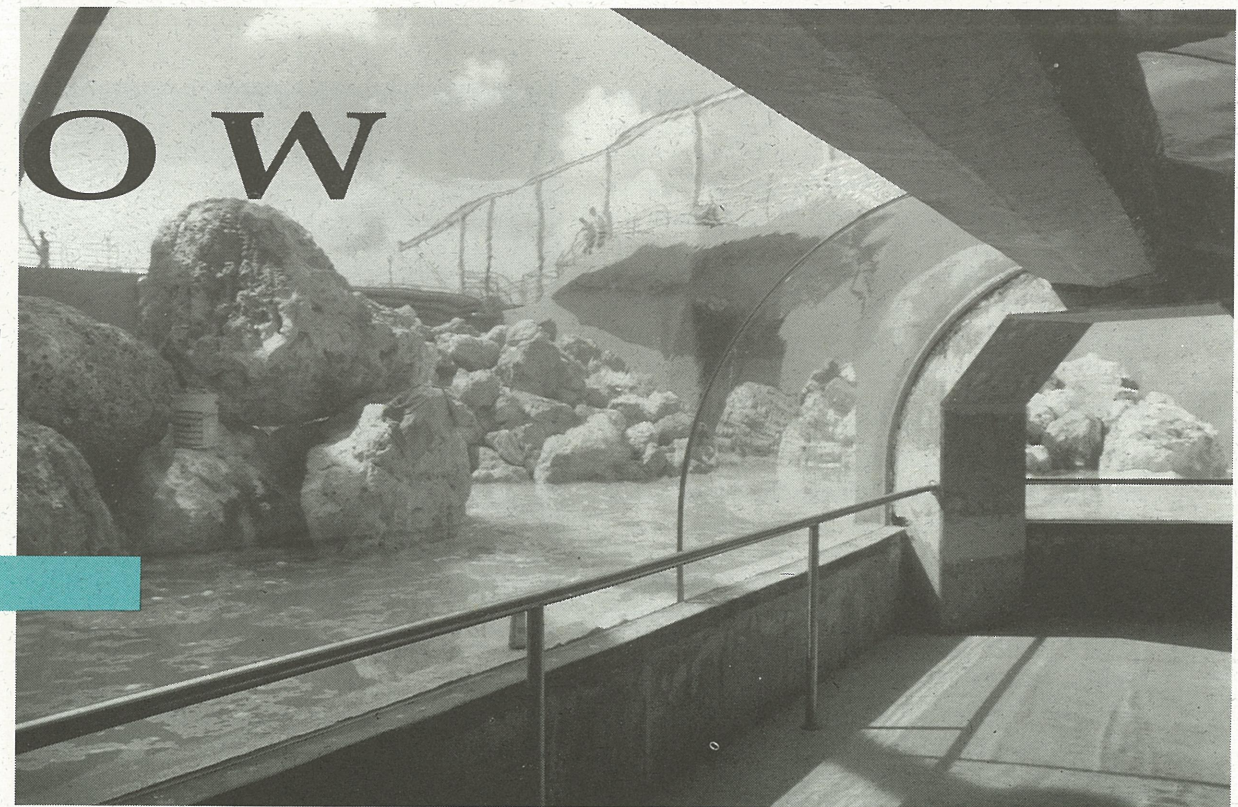
Martin Jones

Dawn was still 2 hours away as we set off on the 20 metre barge 'Thuppun' to collect live corals, fish, marine plants, shells, starfish and other animals for the living coral reef exhibit of the Great Barrier Reef Aquarium. Some 6 years in the making, the Great Barrier Reef Wonderland was funded as a bicentennial commemorative project by Commonwealth and State governments. It opened in Townsville on 24 June 1987 with financial support from local business and community groups for the internal outfitting of the Aquarium.

The Aquarium is a unique living museum built and operated by the Great Barrier Reef Marine Park Authority as an educational centre to support the management of the Great Barrier Reef. Most national parks are on land and much more accessible than the Great Barrier Reef; you just drive or walk in. Many people are not able to visit the Reef due to cost, bad weather or a dislike of sea travel. For these individuals, the Great Barrier Reef Aquarium is probably the closest they will get to the Reef. It is the largest interpretive facility dedicated to explaining a marine national park area. At the Aquarium you can come face to face with the Great Barrier Reef without getting your feet wet, trampling the coral or disturbing nesting turtles and sea birds.

### Construction

The original idea was to have a place where visitors could experience a walk in the sea. Two big tanks were designed with an acrylic walk-through tunnel separating them and large viewing windows. In the bigger tank, a coral reef would be displayed while the smaller tank



Reef rock was landscaped to form the home for the Aquarium's coral reef. Photo: Don Alcock.

would house large predatory animals.

The construction of the Aquarium began in December 1985 and was completed late in 1986. The Aquarium was built on a former muddy mangrove area and to support the 7000 tonnes weight of the two tanks, 75 concrete and steel piles were driven down 11m into the ground. In the warm tropical climate of Townsville pouring the huge quantities of concrete for the base and walls of the massive main tanks would have resulted in severe cracking as the concrete cured too rapidly. This was avoided by cooling a special concrete mix with liquid nitrogen prior to pouring.

### Putting a Coral Reef in a Bottle

Many people thought that it would not work. Reproducing a piece of the Great Barrier Reef on land would seem a relatively simple task. Not so, corals are very fussy animals. They require the right conditions of light, salinity, temperature, nutrients (like nitrogen and phosphorus), waves and currents.

Coral reefs do not occur in the tropical regions of the world's oceans by accident. Their tropical location is related to requirements for warm, clear, clean and well-lit water. Coral reefs are adapted to flourish in the ocean's equivalent of deserts. Soluble nutrients are in very low concentrations - typically 10 to 100 times lower in

concentration than temperate and polar seas. The low soluble nutrient levels in tropical oceans restrict the growth of microscopic plants in the seawater. Consequently the water is very clear allowing more light to penetrate deeper than in temperate regions. Corals are animals that cultivate microscopic plants called zooxanthellae in their tissues and they can take advantage of this situation.

The coral animal builds a protective case to expose the greatest area of zooxanthellae to the sunlight streaming down through the clear water. The surplus sugars and starches produced by the zooxanthellae feed the coral. Similarly the zooxanthellae get their growth requirements from the wastes of the coral. This close coupling of animals and plants in a mutually beneficial relationship is a common feature of coral reefs. Providing and maintaining the right conditions for a captive coral reef is an exacting task.

Aquarium staff had the task of building in a few years what Mother Nature has taken centuries to do. It would not do for the Great Barrier Reef Marine Park Authority to have a fibreglass coral reef, so we had to do it the hard way and create a natural system. Rather like putting together a jigsaw puzzle with a few pieces missing, we had to get the right arrangement of physical conditions of light, temperature, salinity, nutrients, waves and currents together with the right mix



of animals and plants. Only then would we have achieved our goal of creating a self-contained coral reef system.

### The Right Balance

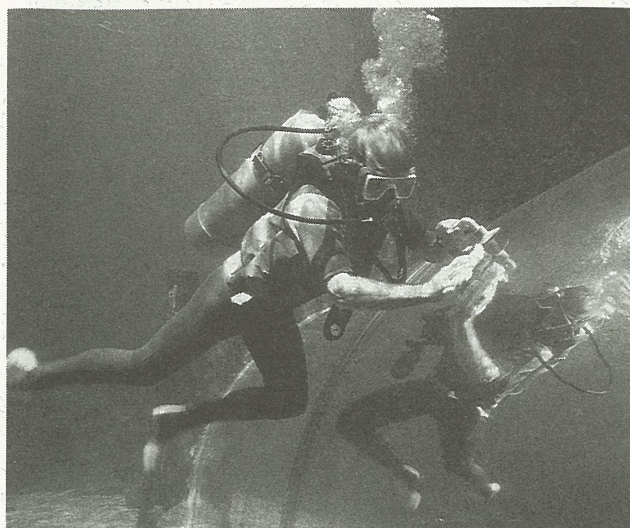
Because sunlight is essential to coral reefs, our tank is open at the top to allow plant life to proliferate. Other aquariums have not made it so difficult for themselves. They use artificial light in a covered tank. This makes it easy to keep out the rain and control the temperature but hard to grow plants and animals, particularly corals and giant clams that depend on microscopic plants.

Because the Great Barrier Reef is surrounded by a huge volume of water, keeping the water temperature constant is not a problem. In sweltering Townsville summers even the 2,500,000 litres of water in the coral reef tank heats up rapidly and we have to use a combination of refrigeration, evaporative cooling and shading to control the water temperature. Corals like their water warm but not hot!

Rain, a welcome sight for the local population, causes problems by rapidly altering the salinity and decreasing the sunlight, the main energy source for the reef tank system. Removing the surplus rain water is not a simple process and requires adapting a system used for providing drinking water from seawater on ships, but this can only compensate for 20 mm of rain per day. Controlling the various conditions requires a skilled juggler - too much shading and the tank does not get enough light, too much light and the water gets too hot, too much rain and the salinity drops affecting animal health, covering the tank to reduce the effect of rain lowers the light level and so on.

### Fine Tuning

The Great Barrier Reef Aquarium houses the only living coral reef in captivity. Its uniqueness means that there are no recipe books to follow to ensure success and we had to develop solutions to problems as they arose. Early in the establishment of the reef tank the new bare surfaces were soon overgrown with algae; algae that no tank inhabitant could be persuaded to eat. Controlling this algal growth kept the Aquarium divers busy scraping and vacuuming the walls and rocks all day non stop. Similarly before the animal population that normally keeps the sandy areas clean had established we spent hour upon hour raking and sieving the sand to remove the finer particles.



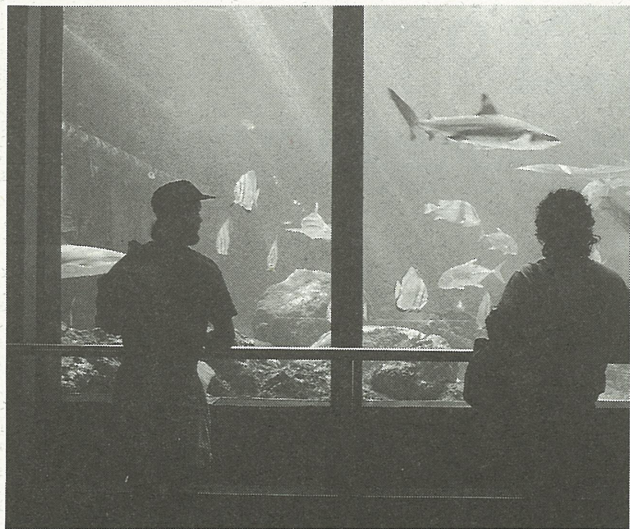
*Window cleaning is part of the daily 'housework' for Aquarium divers. Photo: Wade Hughes.*

Sometimes we have to add special types of animals - sea urchins, for example, to graze on the excess algae on the walls, or remove some parrotfish that develop a liking for eating coral. Particular species of fish have been added to improve the algal growth. Some damselfish defend a territory against all intruders. (Of all the fish in the predator tank the ones most likely to bite you are the small black-striped damselfish called Sergeant Majors. They are particularly aggressive when protecting their eggs.) The territorial damselfish in the coral reef tank facilitate the development of an algal lawn in the area they defend; elsewhere in the tank these algae are soon eaten by other fish and crustaceans. Some angelfish are fond of eating soft corals, so we have to provide their favourite species of soft coral for them to amuse themselves so they will leave the other soft corals in the tank alone.

One common difficulty faced by aquarium keepers is sick fish. With over 200 species of fish in the coral reef tank treatment of such a situation would be a nightmare. Fortunately fish disease has not been a problem. We believe this is a major benefit of our efforts to reproduce natural conditions in the coral reef tank. With good water quality and normal dietary choice our coral reef inhabitants are healthy. An indirect indication of their health is the spawning activity regularly witnessed in the tank.

Absence of disease does not mean that the coral reef inhabitants don't meet their deaths in the tank. We do not feed the coral reef tank and all animals must find their own food. Many animals fall prey to other animals. Only animals at





Visitors come face to face with sharks and fish in the Predator Tank. Photo: Lisa Shugg.

the top of the food chain (eg eels) have no predators in the tank. We must ensure that the number and appetite of these animals don't exceed their food supply. Our initial stocking program was designed to build a balanced food chain. Today, curatorial staff must constantly monitor the number and type of animals to ensure the self-sustaining nature of the tank is maintained.

### Constant Care

Coral reefs in nature don't look appealing all of the time. For instance, the coral-eating crown-of-thorns starfish can devastate reef areas and windy conditions on inshore reefs can reduce visibility to almost nothing. Our coral reef must look good all of the time and this requires continuous care. After more than four years of operation, curatorial staff still spend several hours daily underwater in the coral reef tank. Morning dives are devoted to vacuuming any debris which may have accumulated on the floor of the tank. Other 'housework' includes cleaning the large viewing windows and tunnel. Taking care to avoid scratching the window, dusting must occur daily to remove any settled sediment and prevent attachment of algae.

Coral reefs are always open for business. Staff are on duty to care for the Aquarium every day throughout the year. Many important events, such as coral spawning, occur at night. Mechanical failures for some reason are more prone to occur at 3.00 am. A series of alarms and nighttime security officers fill the gaps to provide the 24 hour care for the Aquarium.

### The Predator Tank

Most people think of fish when coral reefs are mentioned and conventional aquariums usually focus on fish. Compared to corals, these are relatively easy to keep in captivity. The open system aquariums are the easiest - just pump in seawater from the nearest harbour, beach or estuary. The greatest risks to these open system aquariums are sudden changes in water quality due to floods or some pollution or toxic spill event.

Closed-system marine aquariums are not restricted to being near the sea. They maintain the water's ability to support life by some form of purification. Many of the world's famous aquariums are nowhere near the ocean and rely on artificial seawater and bacterial water treatment systems. An important end product from this process is the nitrate nutrient. This accumulates in the water and is considered not to be toxic to fish. In these systems nitrate levels are controlled by water changes.

The Great Barrier Reef Aquarium uses a closed system with no new water added except for small amounts to make up for losses from spills and filter cleaning. The water is recirculated across algal scrubbers for purification. Algal scrubbers are beds of marine plants that grow by removing animal wastes from the aquarium water. Our predator tank also uses algal scrubbers to maintain water quality. Compared to the coral reef tank there is a lot more waste produced by the sharks and large fish of the predator tank, as they digest the 20 to 30 kg of food they are fed each week. This ends up as more than 80 kg per week of algae that must be harvested from the algal scrubbers. Although manual harvesting of the algal growth is a labour intensive process for Aquarium staff, the result is that the predator tank animals are very healthy and the seawater does not need any supplementary aeration or pH adjustment.

Keeping a living coral reef and large predators in captivity results in many headaches but brings many rewards. The large number and different types of animals living together provide plenty of drama as they interact with each other. Fights over food, disputes over territories, close-calls with predators, seduction of a potential partner and impatience in the queue at the cleaning station are all within easy view. In fact, the more you look the more you see! While this unique system is very difficult to maintain, we believe there is no better way of bringing the Reef to you.



# CURATORIAL NOTES

## Young Einsteins

A keen interest in science has taken a group of local high school students behind-the-scenes at the Great Barrier Reef Aquarium. The eight Year 12 science pupils were participating in the 1991 CSIRO Student Research Scheme. This unique program is run to increase awareness of the role of science in the future of our environment.

The students spent one afternoon per week at the Aquarium working on a special research project. Imagine unravelling the secrets behind the behaviour of the marine snail *Trochus* or exposing the hidden animal life in the Aquarium's algal scrubbers. The feeding habits of a coral also came under the microscope. The final project used computers to



Science student Gisela Wagner researching her Aquarium project. Photo: Andrew Elliott

describe the image effects caused by the Aquarium viewing tunnel. To complete their three month project, the young scientists prepared a poster and wrote a short report on their work.

In addition to finding out about their particular topics, the students confronted the realities of scientific research. Unlike the school science experiment which always works, their plans often went astray because of the unpredictability of the natural world. The

students also learnt that research requires creativity, helping dispel the myth that science is boring. Through these hands-on research experiences, the Aquarium is promoting science education and nurturing tomorrow's scientists.

Dr Jan Morrissey

## New Stinger Display

When initially establishing the Box Jellyfish exhibit, we spoke to other Aquarium personnel who had kept them with varying success. They informed us that the best results were obtained by using a circular tank with a slight circulating current.

In trialling this system we discovered problems, including the inability of the animal to rise from the bottom of the tank. I redesigned the unit to intermittently flush 60 litres of water, providing a circular and uplifting current. However these currents did not allow full extension of the animal's tentacles, resulting in a shortened life span due to inadequate feeding.

After several small experiments it was decided to utilize a still water tank. The water, which is filtered externally, enters and leaves the display tank through the sand on the bottom. The sand acts as a diffuser, keeping water movement to a minimum. The problem of feeding the specimen was overcome in this system, because the animal now fully extended its tentacles, enabling it to feed itself as well as allowing it to be fed.

After a period of time I observed that if the animal started to lose its translucence and become opaque, it required feeding as it was not obtaining sufficient food by itself. This became the normal occurrence as the specimen increased in size. The other observation was that lying on the tank bottom was not a problem, but was normal.

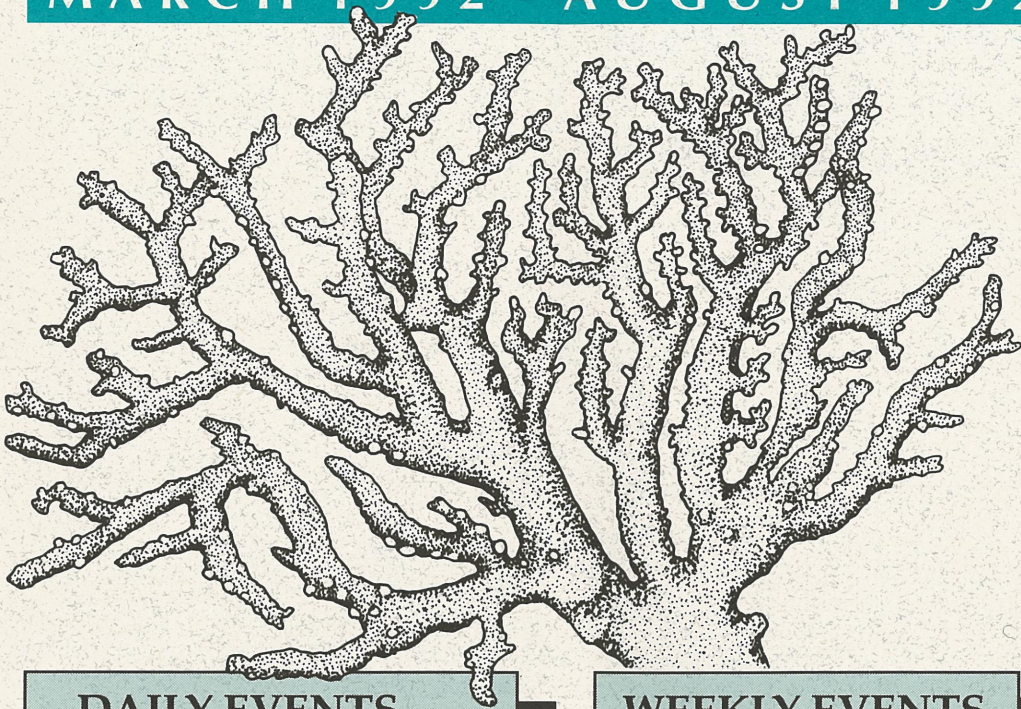
By utilizing our previous experience, we hope this year to further our knowledge by maintaining several specimens through to maturity and their subsequent breeding cycle.

Warren Haydon



# ACTIVITIES

MARCH 1992 - AUGUST 1992



## DAILY EVENTS

### **Crocodile Man: The Motion Picture**

For information on daily screening times  
phone (077) 81 8710

#### **Cost: Daytime Sessions**

Members	\$2.50 adult
	\$2.00 pensioner
	\$2.00 child (age 4-14 years)
Non-members	\$12.50 adult
	\$10.00 pensioner
	\$7.00 child (age 4-14 years)

(Non-members price includes Aquarium admission)

### **Guided Tours\***

11.30 am and 2.30 pm

### **Theatrette Presentations on the Great Barrier Reef**

10.00 & 11.00 am, 1.00,  
2.00 & 4.00 pm (Daily)

## WEEKLY EVENTS

### **Shark Talks\***

Tuesdays 3.20 pm

### **Shark Feeding\***

Tuesdays 3.30 pm

### **Children's Craft Activities**

Sundays 11.00 am - 12.00 noon

### **School Holiday Children's Activities**

Tuesdays and Thursdays  
11.00 am - 12.00 noon

\* *The Aquarium reserves the right to cancel  
or change program times. To confirm  
times please telephone the Aquarium on  
(077) 81 8886 Monday to Friday and  
(077) 81 8891 weekends only.*



# GREAT BARRIER REEF AQUARIUM



## COURSES AVAILABLE AT THE AQUARIUM

### ADVANCED MARINE BIOLOGY COURSE

Learn how to age your own fish. Find out the inside story on fish biology. Develop your own research program on the Reef, studying the ecological principles that shape the Reef.

**Pre-requisite :**

*Marine Biology for Beginners course*

**Dates:** Commences Monday, 20 April and every Monday and Wednesday nights for the following three weeks

**Time:** 7.00 - 9.00 pm

**Cost:** \$80.00

Members: \$20.00 discount

Pensioners: \$10.00 discount

Students: \$10.00 discount

Field trip costs will be advised.

**Bookings Close:** Monday, 13 April

**Minimum:** 30      **Maximum:** 60

Watch out for more advanced courses in September issue of Coralines.

### MARINE BIOLOGY FOR BEGINNERS COURSES

Due to popular demand the Marine Biology for Beginners course is back. Come and join our exciting and educational program and learn about animals, adaptations and ecosystems through interesting and informative lectures and workshops held at the Aquarium. The course is followed by an optional trip to the fabulous Kelso Reef on Pure Pleasure 2001 to help put into perspective all that you have learned. Divers can obtain a PADI research diver qualification through this course and training dives will be carried out during the Kelso Reef trip.

**Dates:** Course 1 commences Tuesday, 12 May and continues every Tuesday and Thursday nights for the following three weeks

**Time:** 7.00-9.00 pm

**Cost:** \$80.00

Members: \$20.00 discount

Pensioners: \$10.00 discount

Students: \$10.00 discount

Field trip cost will be advised

PADI research diver costs to be advised

*(Pre-requisite any Open-water certification).*

**Bookings Close:** Tuesday, 5 May

**Minimum:** 30      **Maximum:** 60

**Dates:** Course 2 (a repeat of Course 1) commences Monday, 7 September

**Cost:** To be confirmed prior to commencement of course.

### VOLUNTEER COURSE

GBR Aquarium Volunteers donate their time and considerable talents to help the Aquarium expand and improve our services to the local community and the visiting public. Depending on your time, talents and interests you can assist in a wide range of Aquarium activities: guiding, assisting with members' and schools programs, clerical assistance, helping behind the scenes, some animal husbandry and collecting to name a few. Application forms will be available from the Aquarium front desk from 17 February. Applications close 4 March.

#### Open Night for potential Volunteers

Find out exactly what Volunteers offer the Aquarium and what the Aquarium offers the Volunteers.

**Ages:** Minimum age 18 years

**Date:** Wednesday, 4 March

**Time:** 7.00 - 9.00 pm

#### Volunteer Course

**Dates:** Commences Wednesday, 11 March and continues every Monday and Wednesday night ending on Wednesday, 15 April

**Cost:** A fee of \$40 (\$65 per couple) is charged for the course to help cover some of the costs.



# M E M B E R S ' N E W S

Anna Harreboomee

## WHAT'S NEW?

In the past year the Aquarium has undergone many changes as we developed new and exciting displays. We also saw the redevelopment of the Aquarium entrance among the many plans.

The new entrance incorporates see-through doors to enable people to look into the Aquarium even when our fish have gone to sleep for the evening. A spectacular tank is being established at the entrance to give people a hint of what marvels lie in store when they visit the Aquarium. The front desk position has been changed to allow visitors easier access to the Aquarium and improve traffic flow. The change in the front desk position gives visitors a chance to appreciate fully Robyn Gordon's sculpture 'Reef Dreaming' which was previously obscured by the old front desk.

Following the front entrance redesign the shop will be expanded to allow us to stock even more interesting marine based items. If you haven't been to the Aquarium recently you will find a lot of changes. Make a point of seeing the difference soon.

## SANTA'S REEF VISIT

Christmas saw Santa guided by Rudolf's new radar nose, make his regular splash down in the Aquarium. Children sang Christmas carols to ensure that Santa knew the way to the Aquarium. Eyes were bright as Santa appeared handing out Christmas presents while Santa's helper, Jenny, gave out sweet treats. Wally and Willy, two mischievous clowns, entertained 80 children with games and magic tricks. Children came dressed as their favourite fishy animal with a mermaid and crocodile sharing first prize in the fancy dress competition.

## A GALA AFFAIR

The Aquarium After Dark Gala evening had Sponsors and Patrons enjoying an evening of fine food and champagne. Guests saw the Australian premiere of 'A Walk in the Sea'. The documentary not only gave guests a rare insight into the Aquarium but also promoted Townsville and the reef environment. After the screening on the Aquarium's new video projector, visitors were able to see a deep-sea creatures display and crocodile feeding.



A facelift for the Aquarium entrance. Photo: Andrew Elliott



# E D U C A T I O N N E W S

Loretta Saunders

School holidays can lull Aquarium education staff into a false sense of security. Gone for a while is the hullabaloo of school students clamouring for the best view, the first feel or a microscopic encounter with our marine creatures. This time is a quiet time and allowed us to concentrate on the redevelopment of our whole Schools Program.

The new programs will be launched at the Aquarium Open House on the 31st March. This will give us the chance to meet teachers new to the region as well as catch up with those we see each year. The highlight will be the official launch of the Townsville City Council sponsored materials by the Mayor, Alderman Tony Mooney. Teachers will be treated to small group tours of our new exhibits and we hope to inspire teachers on how they can incorporate the Aquarium, such a unique learning centre, into their school program.

## Teacher Workshops

The workshops we have planned are going to be educational, inspirational and loads of fun. We will be able to share innovative ideas for teaching about the marine environment and add to our

knowledge and understanding about the Great Barrier Reef. For Primary educators, the weekend workshop will be at Magnetic Island and for Secondary educators, Orpheus Island is the workshop destination. You may want to test these as sites for future field trips or just relax, make new contacts, dive, snorkel and explore. Book early for these as numbers are limited. Contact the Aquarium on (077) 81 8886 for more details.

## The Triggerfish got lost on the Trail

Not long after the launch of the **Triggerfish Trail** (Preschool to Year Three) last year, our mascot for the program, the clown triggerfish was sent on sick leave from the Reef Tank. After spending time in our quarantine room on a weight-gain diet, it is now on display in a new tank in the Quicksilver Discovery Room. Added to this is the new Echinoderm tank and a whole new look to the room where the majority of our school activities take place.

If you haven't booked your class in yet, pick up the phone and dial (077) 81 8886 for a living classroom experience.

# E X H I B I T N E W S

Andi Cairns

The Aquarium is gaining a reputation and it's all good! Come in and see us every couple of months and you'll notice that things change around here - and often! Now we've worked out how to produce information material in a flash there's no stopping us. The small tanks are worth visiting regularly. Each shows an aspect of survival strategies for reef creatures. It is likely you'll still see the magnificent anemone and clownfish tank, but look again and you may have a close encounter with an octopus, learn about life lying down with the flatfish or find out the latest in camouflage in the fish world. There will always be something different to discover.

Our new Reef Geomorphology exhibit has taken a little more time to complete than we had hoped. We wanted to make an exhibit that would actively involve visitors in things to push and pull, ways for you to discover more information - an exhibit that was to be lots of fun too! I think its worth the wait. You will too!

Our Soft Sculpture Reef is gradually growing, just like our reef at the Aquarium. The Fibres and Fabrics group are doing a magnificent job. Their work is all voluntary and we are delighted with

their obvious skill and attention to detail.

Students from James Cook University's new Faculty of Art are, this year, designing a new World Heritage exhibit as part of their course. Later in the year there will be an exhibition of their designs in the Theatre, and who knows? Maybe the best design will become a reality in our World Heritage Area.

Upstairs to our lighter and brighter Observation Deck. What a difference a coat of paint made! Come along and see our beautiful Touch Pool, now re-established with coral, mangroves and even a beachcomber's tide line. Identification of animals is also easier with lots of identification labels round the edge of the Touch Pool. Now you know what it is you are touching. Our new underwater signs gently remind visitors not to take the animals out of the water.

All this as well as plans for Coral Biology, Coral Cay and Sea Birds Exhibits plus a new look for the light tunnel. We'll be busy!

If there is something really special that you'd like to see and learn about here in the Aquarium, let me know.





# AN UPDATE

Dr Peter Moran

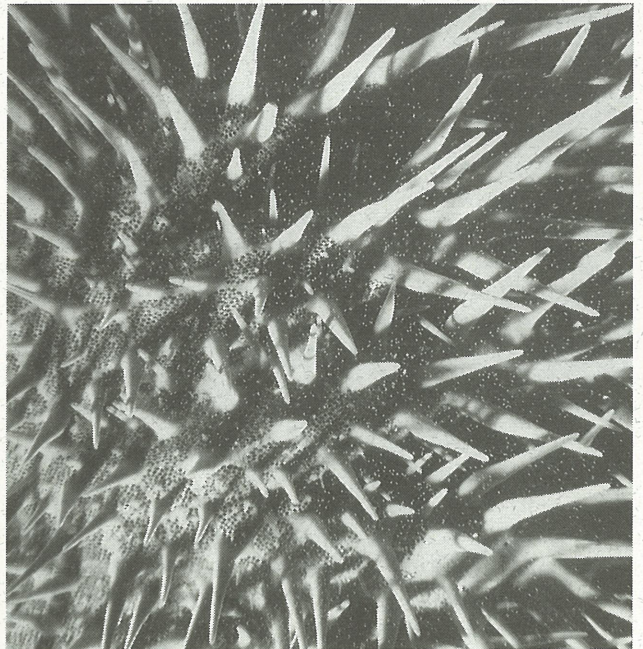
## The controversy

The crown-of-thorns starfish, *Acanthaster planci*, is a well known inhabitant of the Great Barrier Reef. It has been the focus of intense public and scientific debate since it was first observed in large numbers (termed outbreaks) in the early 1960s. These outbreaking populations have been responsible for extensive destruction of corals in many coral reef systems in the Indo-Pacific region including the Ryukyu Islands (Japan), Maldives, Tahiti, Samoa and Micronesia.

## The starfish

The crown-of-thorns starfish belongs to a group of animals called echinoderms (meaning warty or spiny skin) which includes sea cucumbers, brittle stars, feather stars and sea urchins. Although multicoloured (from red/grey with orange-tipped spines to green with yellow-tipped spines), it is somewhat sinister in appearance as it is covered by a large number of long, sharp spines which are toxic to a variety of animals, including humans. Adult crown-of-thorns starfish may have from 14-18 arms which they are able to regrow should they be attacked by predators or become stressed. Unlike some other starfish they are not able to regrow an entire new body from just one small part. The normal size of an adult starfish is about 25-35 cm in diameter (arm tip to arm tip). However, individuals as large as 70 cm have been reported, making it one of the biggest starfish in the world.

The first record of a crown-of-thorns starfish is attributed to a biologist called George Rumphius in 1705. Some fifty years later it was given a scientific name (*Acanthaster planci*) by Karl von Linne who originated the procedures currently used to classify plants and animals. It has been recorded by a number of naturalists and biologists since that time. Despite this early information, it has only been since the late 1950s that confirmed reports of outbreaks of crown-of-thorns starfish are available. These came from



A close up of a female crown-of-thorns spawning.  
Photo: Peter Moran

the Ryukyu Islands (stretching between mainland Japan and Taiwan). Reports of outbreaks were received a few years later on the Great Barrier Reef at Green Island and subsequently on reefs in Micronesia (e.g. Guam, Palau) the Red Sea and Hawaii.

## Extent of the problem on the Great Barrier Reef

Since 1985 the Australian Institute of Marine Science (AIMS) has been conducting broadscale synoptic surveys to determine the distribution and abundance of the starfish and its effects on corals along the Great Barrier Reef. These surveys have been an integral part of the research programs. The surveys are conducted using the manta tow technique, a rapid reconnaissance method for recording broad changes in certain reef populations. The technique is equivalent to aerial reconnaissance of terrestrial environments. It involves towing an observer for 2 minutes behind a small boat at about 4 km per hour. During that time information on certain factors of interest is recorded (normally coral cover and the number of crown-of-thorns starfish). The boat is then stopped to enable this information to be written down. Once this has been done another tow begins, and so on, until the entire perimeter of the reef has been searched.





*A crown-of-thorns feeding front on Little Broadhurst Reef. Photo: Peter Moran*

To date, a total of 378 reefs have been surveyed involving about 50,000 individual manta tows and covering a distance of about 6,860 km (equivalent to being towed from Townsville to Hawaii). To get to and from the reefs research vessels travelled a total of 56,000 km (equivalent to 1.4 times around the earth!). The results of these surveys indicate that:

1. About a third of all reefs surveyed have had an outbreak of crown-of-thorns starfish in the last 10 years. Of these, almost 20% were considered to be seriously affected.
2. Outbreaking populations have been mainly recorded in the region of reefs between Lizard Island and Bowen.
3. The proportion of reefs with outbreaking populations of starfish has declined over the last few years to approximately 4%. Most of these populations are found between Townsville and the Whitsunday Islands.
4. The latest series of outbreaks began in 1979/80 on reefs in the region of 16°S. They then moved in a southwards direction affecting reefs off Townsville by 1983/84.
5. Outbreaks of crown-of-thorns starfish produce an estimated 11% increase in the cover of dead coral on reefs. This represents over a threefold increase in the amount of dead coral.

#### **Results of research**

The broadscale surveys have greatly enhanced our understanding of how the Great Barrier Reef functions, particularly how the various

reefs are interconnected. Apart from knowing more about the extent of the problem on the Great Barrier Reef recent research has provided answers to many fundamental questions. For example, water currents have been shown to play an important part in transporting larvae in a southwards direction during the spawning season. The velocity of the currents is consistent with the rate at which the outbreaks have moved over the last 10 years. Furthermore, it would seem that certain reefs are good at providing larvae to reefs downstream whilst others are good at receiving larvae from reefs upstream. This is to do with the unique and quite complex water currents that surround some reefs. Given the right conditions mathematical models also have shown that a relatively high proportion of larvae may actually settle on the reef from which they were released.

Other research has shown that the larvae don't starve under normal food conditions and that they eat a wide variety of diatoms and dinoflagellates. Further on in the life cycle, adult starfish have been found to consume about 300 cm<sup>2</sup> of coral cover per day.

We've also learnt much more about the recovery of corals after outbreaks of the starfish. Whilst the cover of corals on reefs may return to pre-outbreak levels within 12-15 years, it is now clear from experimental and mathematical research that recovery of slower growing corals may take in excess of 50 years. Consequently if outbreaks of starfish occur at 15 year cycles (as has taken place recently) then there is the likelihood that these types of corals may never re-



cover and in some instances may be lost entirely from the system.

The effects of outbreaks on other organisms is still poorly understood however more is now known in relation to fish. Research undertaken at AIMS over the last 8 years has indicated that outbreaks have not caused dramatic changes in the abundance of fishes (as was originally thought) although they have led to a decline in abundance of coral feeding butterflyfishes and two species of damselfishes.

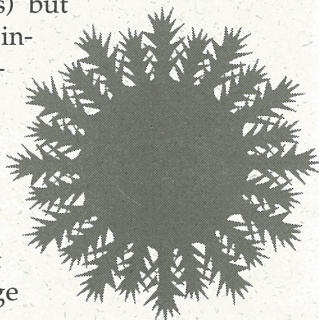
Research has been undertaken into the effectiveness of control programs. At present these programs are undertaken on the Great Barrier Reef only in small areas of special interest to science or tourism. Recent trials have indicated that it may cost up to \$17 to kill each starfish using volunteer labour. This could prove to be an expensive exercise where the population comprises hundreds of thousands of starfish. In 1980, it was estimated that the reef surrounding Green Island contained approximately 2 million individuals!

#### Cause or causes

Despite all the research we still do not know why outbreaking populations of crown-of-

thorns starfish occur. No one can give an answer with any degree of certainty. Recent results indicate that the starfish is capable of producing enormous numbers of larvae and so may be naturally predisposed to outbreaking from time to time. On the other hand, many outbreaks in the Indo-Pacific region have occurred close to human settlements (e.g. Maldives) raising the possibility that outbreaks are man-induced.

Whatever the reason it is apparent from our research that the problem is a complex one and there is no reason to expect that the answer will be simple. Indeed, it is possible that outbreaks have occurred in the past (as indicated by recent geological findings) but that man may have increased their intensity and frequency of occurrence. Further research is essential if we are to unravel the mysteries of this important problem and manage it wisely.



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## Reef Inspirations

An early memory I have of artist Gavin Ryan is him sitting on my lounge with a portable typewriter on his knee belting out an article for 'Fishing World'. Sprawled across the coffee table in front of him were photographs of the ones that **didn't** get away and a few cartoons he'd scribbled out between chuckles. This man has quite a relationship with fish. He writes about them, photographs and paints them and has no qualms about catching and eating them as well. Gavin says it all started with his first job after leaving school, illustrating Bay Books 'Fishing Encyclopedia'. He is well known to fishermen for his spectacular game fish posters in 'Modern Fishing' and many would know his marine life series of stamps for Australia Post.

The Aquarium commissioned Gavin a few years ago to paint identification labels for our tanks. It is always a thrill to receive this work; fresh vibrant watercolours which show amazing detail of our fish and other creatures. His work has varied from scientific artwork to cane toad collage to graphic artwork for boxes of plant fertilizer. It is the detail, the hidden detail, that I



really enjoy about his work. You can look at a piece time after time and still discover new insights into the subject and perhaps the artist himself. We have exhibited many of his paintings at the Aquarium - of Magnetic Island (his home), tourists being tourists, crazy reefsapes - all with a slightly bent sense of humour. Gavin has always been an avid supporter of our celebrations of National Art Week and we hope to be able to exhibit more of his work in the future.

Loretta Saunders





Farmed giant clams in the intertidal zone at Orpheus Island. Photo: John Lucas

# TAMING 'KILLER' CLAMS

Associate Professor John Lucas

What images come to mind when you think about giant clams? Divers trapped by their legs, struggling to get free and drowning?

This unfortunate image of giant clams has been promoted in films and stories of the Great Barrier Reef and other coral reefs. For example, a natural history magazine in 1939 featured a story of how a huge pearl was found: 'The giant clam yielded its treasure only after slaying a native diver trapped when its great jaws snapped shut'!

Stirring stuff, but misleading nonsense. Giant clams cannot 'snap shut'. The large ones close their shells together slowly as large volumes of water must be expelled. They close only to protect themselves, not to trap (and eat?) divers. This image of 'killer' clams is totally inappropriate for such benign animals that depend mainly on sunlight for their food.

Giant clams are bivalved (two-shelled) molluscs, related to oysters, scallops, mussels and other clams. Most clams live in fine sediments and sand, burrowing along through the sand using a large muscular foot. The Hard-shelled Clam, which is used in North America to make clam chowder, is a typical clam. Giant clams are quite different.

Giant clams live on hard surfaces and are attached to the surface by threads when they are small. Their soft mantle tissue, which secretes the shells in bivalved molluscs, is greatly expanded and fills the upper region between their shells. This mantle tissue is conspicuously exposed to sunlight because this is how giant clams obtain most of their food. The mantle tissue is packed with minute, single-celled algae - the same kind of symbiotic algae as are present in hard corals. In the intense sunlight of shallow reef areas, these algae photosynthesise like other plants, producing food molecules which are absorbed by the host clam.

Other bivalved molluscs, such as oysters, feed by filtering microscopic algae from seawater. Giant clams get some food by filtering seawater, but they also 'farm' the algae resident within their tissues - a very appropriate adaptation to the clear, low-nutrient waters of coral reefs.

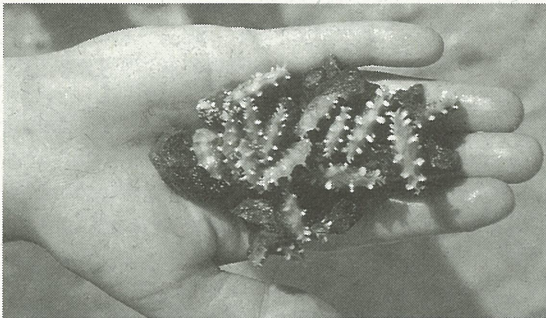
There are eight species of giant clams and they range in adult size from a mere 12 centimetres to more than a metre. They occur on coral reefs in the Indian and Pacific Oceans. The smallest species, *Tridacna crocea*, is brightly coloured and may be abundant in shallow reef areas where it burrows into coral heads and other surfaces. The truly giant clam is *Tridacna gigas*, which can



grow to more than a metre in shell length and weigh half a tonne. This giant species is the largest bivalved animal that has ever existed. They are big because they grow rapidly, not because they get very old. There is another false idea about giant clams - that they live for hundreds of years. Most adult clams are ten to thirty years old.

While Westerners think erroneously of giant clams as killers, many Pacific Islanders think about their delicious taste. The muscle meat is also highly prized in Chinese cooking as a flavouring and aphrodisiac. This is why giant clams were poached on the Great Barrier Reef by Asian fishermen in the 1960s. (There is a clam-boat on display at the Mackay tourist centre; one of many seized in northern Australia.)

Local and international demand for giant clam meat has resulted in heavy overfishing and extinction of some species in particular regions. Their sedentary lifestyle and shallow water habitats make giant clams very vulnerable to overfishing. In other regions their habitats are being destroyed by degradation of coral reefs through pollution, destructive fishing, etc. The Great Barrier Reef, where giant clams are protected, is one of the few regions of the world



Juvenile giant clams about 6 months old. Photo: John Lucas



Giant clams, about 90 cm long. Photo: John Lucas

where giant clams populations are safe.

This over-exploitation of giant clams has been the impetus for developing methods to farm them. That is, to turn 'killer' clams into farmed animals. Research at Orpheus Island, in the Palm Island group north of Townsville, has been part of an international program to develop farming methods for giant clams. The research was funded by the Australian Centre for International Agricultural Research as part of Australia's aid to the Pacific region. The result of this research at Orpheus and other centres is that giant clams are now being farmed in several Pacific countries. There is also a commercial farm on Fitzroy Island, off Cairns.

Mature clams held in large aquarium tanks are induced to spawn sperm and eggs by injection with a stimulant. Each giant clam is both male and female, but it releases its sperm and eggs separately. They are tremendously fecund and spawnings of hundreds of millions of eggs from one individual are common.

The fertilised eggs hatch into tiny swimming larvae, which develop shells and then settle a week later as tiny clams. During this metamorphosis from swimming larvae to bottom-dwelling juveniles they take up the special algae and commence their dependent relationship with algae. The juvenile clams grow slowly at first and reach 1-2 centimetres in six months. At this size they can be transferred from aquarium tanks to the ocean, but they must be protected from predators.

Small giant clams are food for fishes, octopuses, crabs and predatory snails - any predator that can crush or bore through their fragile shells. Thus, the farmed juvenile clams are protected from natural predators with meshes under and over them. The clams grow more rapidly as they get larger, reaching about 12 centimetres at two years of age. Then at 3-4 years old and 25-30 centimetres shell length they are too large to be troubled by most predators. They can be left unprotected on the ocean bottom to get on with growing until they are harvested.

It may seem strange that one of the great denizens of coral reefs is being farmed. However, by this means the natural populations of giant clams can be conserved and even re-established where they were fished to extinction. And Pacific Islanders will be able to enjoy giant clam meat without threatening the very existence of these magnificent creatures.



# VOLUNTEER NEWS

Alison Ferry

A visit to the Aquarium is often made very special by the activities of Volunteers. It has become a place where both locals and visitors want to come to be entertained and to learn more about the Reef.

One important project which has helped to 'spread the word' is the mobile aquarium which Volunteers initiated through fund raising and a successful grant application. The trailer was completed by early October and its first official function was at the Boat Show held in the Sheraton Hotel carpark. Interest was wide, Volunteers felt justifiably proud and requests have been made for further attendances at schools, fetes and shows in the Townsville region.

The Pacific Festival Parade was another successful promotional exercise. Entering into the spirit of the festival Volunteers donned their green shirts, walked or rode along the route and really got into the swing of the 'Let's Party' theme. Lollies, balloons, flyers and giveaways ensured that no spectator was left in any doubt as to where the float originated! One onlooker was heard to say 'They really enjoy themselves there don't they!'

Spot talks given by Volunteers throughout the course of the day vary and visitors often comment that their trips to the Reef have been enhanced by knowledge they have gained during their visit to the Aquarium. The inaugural Spot Talk Trophy was awarded this year to Kay Forwood who presents a lively and very interesting talk on anemones and clownfish. An important aspect of spot talks is the interaction with visitors and Volunteers are continually updating and creating new talks, often with unusual props!

Craft activities continue to be very popular and there is a dedicated group of Volunteers who come in every Sunday in order to play with the children and help them with craft. These activities continue on Tuesdays and Thursdays as well during the school holidays when, as everyone knows, boredom can be a monumental problem for a child.

It is not all work and no play. Volunteers have enjoyed many excursions but perhaps one of the most interesting was a trip to Charters Towers to see first hand the ancestors of modern day coral reefs. Guided by Alex Cooke from the Geology Department of James Cook Univer-

sity, Volunteers learnt about the geological situation of Australia during the Devonian period (approximately 360-400 million years ago) and the animals that existed during that time. As Lyn Hastings commented, 'We looked like children on a minty hunt as we scrambled over the ancient sea bed looking for small fossils to take home. The enthusiasm of all was very high. I believe that those Volunteers who went on the excursion are bonded a little closer together because of their shared experience. May the excursions continue!'



*Mobile aquarium at Boat Show*

Volunteers have a very special feeling for turtles at the Aquarium and this is partly due to the fact that at certain times the Discovery Room becomes a nursery and baby turtles hatch and then require feeding twice a day. In November the Turtle Headstart program was launched by Jeff Miller of the Queensland National Parks and Wildlife Service. A number of Volunteers took part in Turtle Watch, where each evening a group travelled to Turtle Bay to look for flatback turtles nesting. Eggs were collected on one evening and taken to the Aquarium to be incubated. After watching the eggs for several weeks it is no wonder that Volunteers become very maternal and concerned for the welfare of the hatchlings.

Our Marine Biology for Beginners course, so successful last year, will be on again during May and September. An advanced course is scheduled for April with another course planned for later in the year. These courses, structured by Richard Fitzpatrick and run by Volunteers are very popular and it is advisable to book early. The next intake for Volunteers is on 11th March and an open night for prospective Volunteers is planned for 4th March.



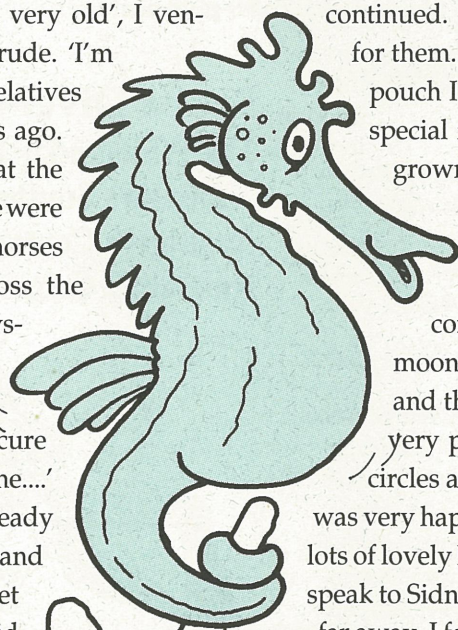
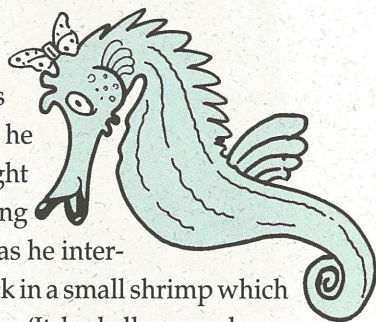
# Kids' Corner

*Hi Kids*, a very big welcome to Kids Corner again! In this issue we have a lovely story called "Sidney shares a secret" by Lyn Hastings (and its all about me). Well hope you enjoy it and drop me a line soon!

I was sitting in front of one of the small tanks in the Aquarium admiring the animals. As I looked I thought 'Head of horse, tail of monkey, pouch of kangaroo, body armour of crab.' It sounded like a witch's brew. No, the animals before me were not the result of a witch's concoction. These charming animals were seahorses, fashioned by the gentle hands of nature. It was very quiet and very relaxing and then I thought I heard a deep voice. There was nobody in sight, but again I heard the voice. 'Hello, I'm Sidney.' I looked hard at the largest seahorse. He was looking my way and had his tail clasped firmly around a piece of dead coral. Could it be that he had spoken to me? 'What's your name?' he asked. He had spoken, I was thrilled. 'My name is Robert', I replied. 'How are you?' 'Very well, thank you', Sidney answered. 'You look very old', I ventured, hoping I didn't sound rude. 'I'm not that old but some of my relatives were alive hundreds of years ago. The people then thought that the dead seahorses washed ashore were the young of King Neptune's horses that pulled his chariot across the waves', Sidney recalled. 'Mystery surrounded us years ago and still does today. In some countries we are considered a cure for back pain. Which reminds me....' It appeared that Sidney was ready to settle in and tell me a story and I was very eager to hear. 'I'll let you into a secret, Robert', said Sidney as he touched his big tummy. 'My pouch here is full of baby sea horses. Maybe I should have back pain? This giving birth is very demanding.

You know a father's work is never done', he confided to me. I thought maybe he was suffering hunger pains as well as he interrupted his story to suck in a small shrimp which had ventured too close. 'It had all seemed very romantic at first', said Sidney, resuming his tale. 'I remember meeting Sally Seahorse. That's Sally, the pretty one to the left. It was instant attraction. Both of us changed colour, clasped some seaweed with our tails and danced in circles. It was like a merry-go-round. Then we moved off together with tails clasped.' Sidney sighed deeply and another shrimp disappeared. Sidney glanced down at his swollen pouch. 'I remember how

Sally deposited her eggs in my pouch', he continued. 'She knew how I would care for them. After the eggs hatched in my pouch I proceeded to feed them on a special fluid. Soon they will be fully grown and I will deliver them into the watery world that will be their home. This will happen in the hours before dawn to coincide with a full or new moon.' Sidney paused for a moment and then concluded. 'Sally will be very pleased and we will dance in circles again.' I could see that Sidney was very happy. He and Sally would have lots of lovely little seahorses. I was about to speak to Sidney when I heard a voice from far away. I felt a gentle shake of my shoulder and my mother said, 'Robert, it's time to go. The Aquarium is closing. I think you have been day dreaming.' I looked at Sidney. No, Mother wouldn't understand, Sidney and I would have a secret.



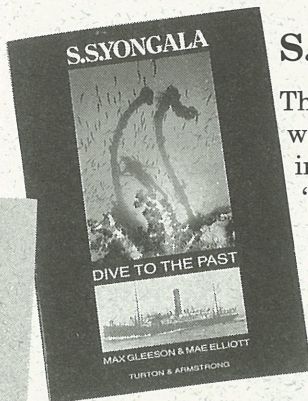
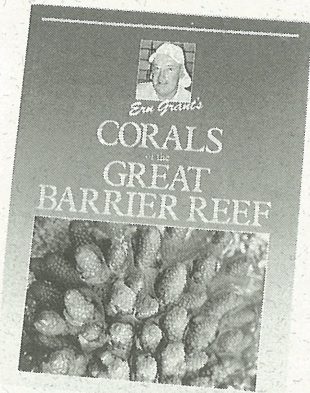


# Shop Talk

## Corals of the Great Barrier Reef

It has been established that most corals on the Great Barrier Reef spawn simultaneously. Learn more about corals and spawning from 'Corals of the Great Barrier Reef' by Ern Grant.

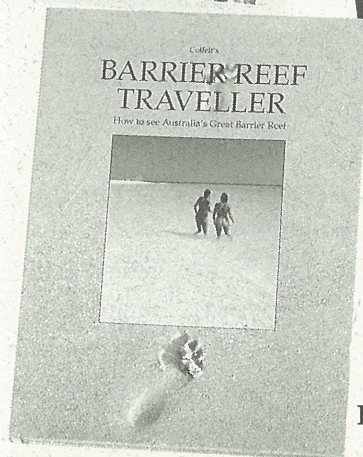
**It's a must for your library, priced at \$14.95 plus postage.**



## S.S. Yongala

The wreck of the Yongala has achieved world wide fame as a dive location of incredible beauty and wonder. The book 'S.S. Yongala' gives divers and those who appreciate history an insight into this historic wreck.

**Priced at \$17.95 plus postage.**



## Barrier Reef Traveller

'Barrier Reef Traveller' tells you how to see the Great Barrier Reef. Where to go, how to get there and what to do once you arrive. The ideal book to help plan your next Reef holiday.

**Priced at \$19.99 plus postage.**

## Fish Watcher's Field Guide

Camtas offers 286 fish illustrations on eight double sided cards, showing you the identification of each fish. This is a must when visiting the reef.

**Priced at \$20.00 plus postage.**

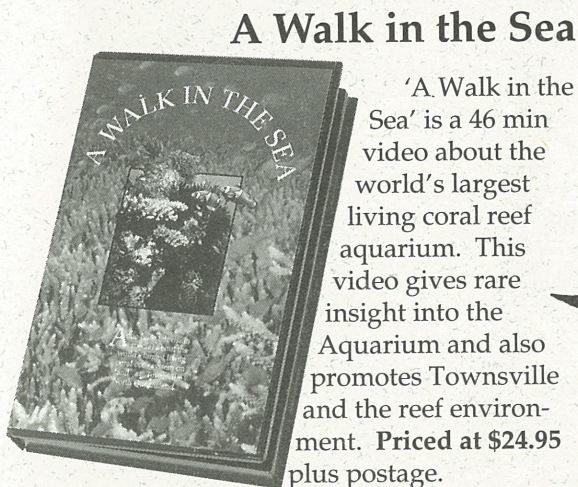
## Scuba Divers Guide to -

The Whitsunday Islands

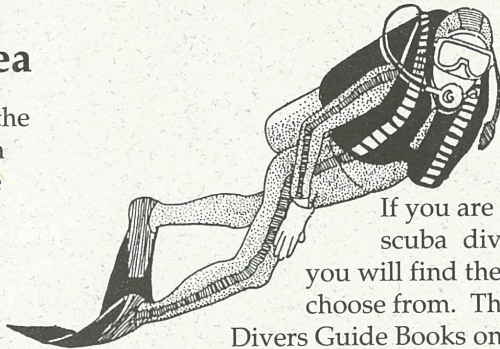
Australia's Southern Great Barrier Reef

Australia's Central Great Barrier Reef

Australia's Cairns Great Barrier Reef



'A Walk in the Sea' is a 46 min video about the world's largest living coral reef aquarium. This video gives rare insight into the Aquarium and also promotes Townsville and the reef environment. **Priced at \$24.95 plus postage.**



If you are planning a scuba diving holiday you will find there are many to choose from. The four Scuba

Divers Guide Books on the Cairns, Whitsunday Islands, Central and Southern Great Barrier Reef are what you will need to guide you to the right destinations.

**Priced between \$24.50 and \$28.00 plus postage.**

*Prices remain current to 30/8/92*