# *Seas of Borneo Expedition Report*

1997

*By Kate Stapleton*

# Seas of Borneo Expedition

## 23rd June – 4th September 1997

The expedition was a great success! As a whole the expedition was able to complete baseline data surveys for all macroinvertebrates, coral reef and fish for three selected areas along the coastline of Sabah. A comparative study and follow up surveys were carried out on the pristine and remote atoll of Pulau Layang Layang.

The results of coastline surveys assessed a considerable amount of damage on the coral reef due to dynamite and cyanide fishing. These are both fast and efficient methods used by local fisherman to gather large numbers of fish.

Dynamite fishing involves a small dynamite bomb being planted on the reef by a free diving fisherman. The explosion kills any fish in a 1km radius which then float to the surface for easy collection. We experienced the sound of exploding bombs when we were SCUBA diving at Kudat. Unfortunately the effects on the reef by this method of fishing are devastating, leaving huge piles of rubble in place of the coral reef devoiding it of all life. An invasive species of sea urchin, *Diastema sequina* , soon takes over in such places. The species counts of these urchins were much higher at damaged sites.

Cyanide fishing is similarly destructive. By this method a diver, often using only a hosepipe connected to a compressed air tank on the boat, takes a squeezable bottle of cyanide and seeks out prime target fish appropriate for the live fish market. The cyanide is squirted in the vicinity of the fish and acts to knock it unconscious for a few hours. It can then later be sold as a live fish and therefore is more valuable. The long term effects to both the fisherman and the fish are not known, but are no doubt of detrimental consequences.

## Individual Itinerary:

### 23rd June - 7th July: Initiation Phase.

I arrived in Kudat, Sabah and immediately started basic training to carry out transects whilst on SCUBA. My preliminary studies were to survey for all macroinvertebrates. This gave me a short initiation period to allow me to become familiar with the different macroinvertebrate species. There were few giant clams at Kudat due to a substantial amount of damage to the reef and previous harvesting. Therefore my individual project on giant clams could not be started until we reached Pulau Layang Layang. Other members of the expedition had already been carrying out baseline surveys for 6 weeks at Semporna and Pulau Sipadan along the east Sabah coastline.

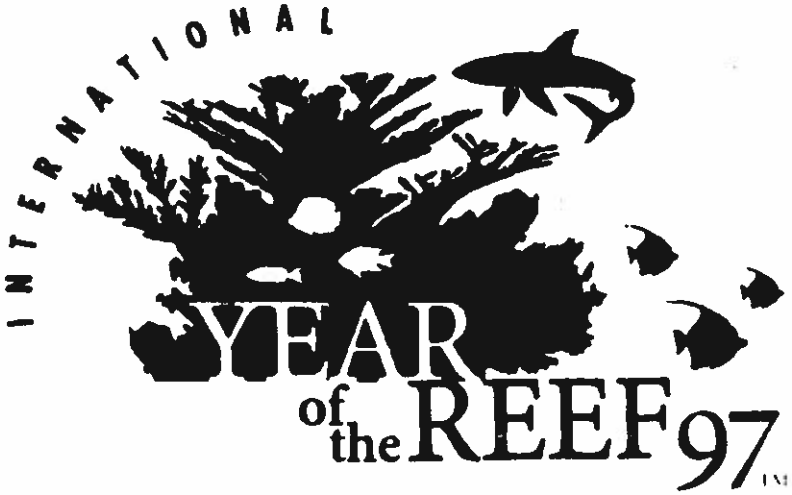
### 8th July - 3rd August: Education Phase.

This three week period was spent carrying out the educational part of our expedition. I worked alongside two other members of the group, often using my Malaysian to translate difficult concepts. We visited many schools in Kudat, a small fishing town and Kota Kinabalu, the capital of Sabah. We taught about the wonderful hidden life beneath the ocean and the continuous destruction that is taking place. The majority of the children that we taught could not swim and so few had had the luxury of being able to enjoy what we were experiencing.

I was extremely aware that we could not preach about the devastation caused to the reef through destructive fishing methods. This was the livelihood of many of the children's families. This is an issue that had to be approached with sensitivity and caution. An approach that we tried to use was to show the problems, but also to try and present solutions and ask them to think of their own solutions. An important part of our presentation was simply to increase the children's awareness of the marine life that exists. We showed slides of what exists now in untouched reefs and what no longer exists in fished reefs. In this way we were able to highlight the destructive nature of dynamite and cyanide fishing.

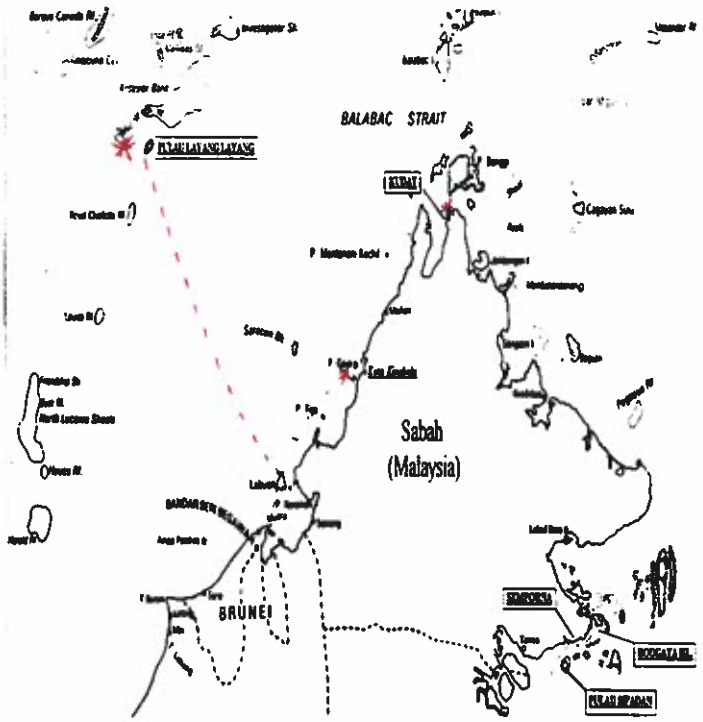
I feel we educated these children enough so that their generation is more aware of coral reef conservation issues. Hopefully with a new way of thinking, different, less destructive fishing methods, will be developed and the remaining reef will be saved.

I am optimistic about the future. The children's enthusiasm to learn about conservation issues was impressive. At the end of our lessons we would quiz them about what was good and what was bad for the ocean and already they were very determined about what was right and what was wrong. We asked the schools to produce posters illustrating conservation issues of the coral reefs around Sabah. We received many beautiful colourful pictures many of which depicted how sewage, litter and destructive fishing is harmful to the reef. We put these posters up on display, along with information about the work of our expedition, in local shopping malls. It was encouraging to see such a display of the children's work. It showed an obvious understanding of issues involved with coral reef ecology.

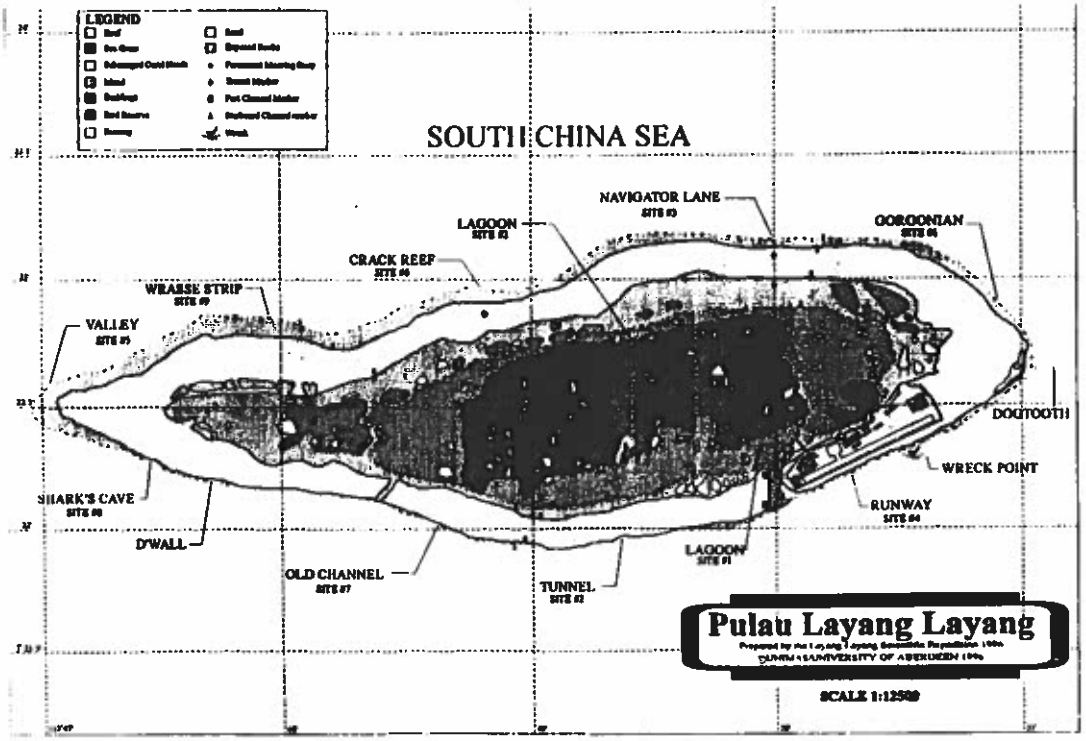


## 4th August – 4th September:
## Research Phase – Individual Project on Giant Clams.

Logistical problems delayed our departure to the remote atoll of Pulau Layang Layang in the South China Sea. We eventually arrived there aboard a cargo barge which took 27 hours to get there direct from the west coast of Sabah!




Research immediately got underway upon arrival. There were nine main dive sites around the atoll which had been pinpointed and used by the previous year's expedition. The nine sites were spread evenly around the atoll as shown on the map. We concentrated our research on four of these sites at Gorgonian, Wrasse Strip, Old Channel and Crack reef.



Due to safety concerns it was important that I always worked with one other SCUBA diver. Therefore a Malaysian master's student from the University of Malaysia, Sarawak and I collaborated our research.

## Introduction:

Giant clams of the family Tridacnidae live on coral reefs in the Indo Pacific, surrounded by clear, nutrient-poor seawater. In recent years giant clams of the genus *Tridacna* have been added to the IUCN Red Data List. The main purpose of this list is to catalogue the species that are regarded as threatened at the global level, i.e. at risk of overall extinction. Research into the ecology and conservation of the species on the list and preservation of their habitats are of top priority for conservation projects around the world.

*Tridacna* species, especially the largest *T.Gigas*, have been internationally poached for their adductor muscle meat. Low densities, erratic recruitment and a relatively long period to reach harvestable size, make these populations prone to overfishing.

The data collected during the 1996 Layang Layang expedition points towards heavy overfishing on this remote atoll with average clam sizes still being relatively small (Project Swallow Reef 1996). Direct intervention methods to control fishing have not proven to be very effective and methods of enforcement have proven to be very expensive.

The characteristics of giant clams: large, slow growing, showing erratic recruitment, coupled with the extent of overfishing mean that these species will most likely only survive if they are allowed to flourish in protected areas (Oakley and Pilcher 1996).

## Aims:

- To study population structures and distribution patterns of the endangered species of giant clams, family Tridacnidae on the pristine coral reef of Pulau Layang Layang.
- To mark individuals at the two focal sites of Gorgonian and Wrasse Strip for ongoing research to determine growth rates.
- To provide baseline data of macroinvertebrates for the collaborative database for International Year of the Reef (IYOR).

## Methods:

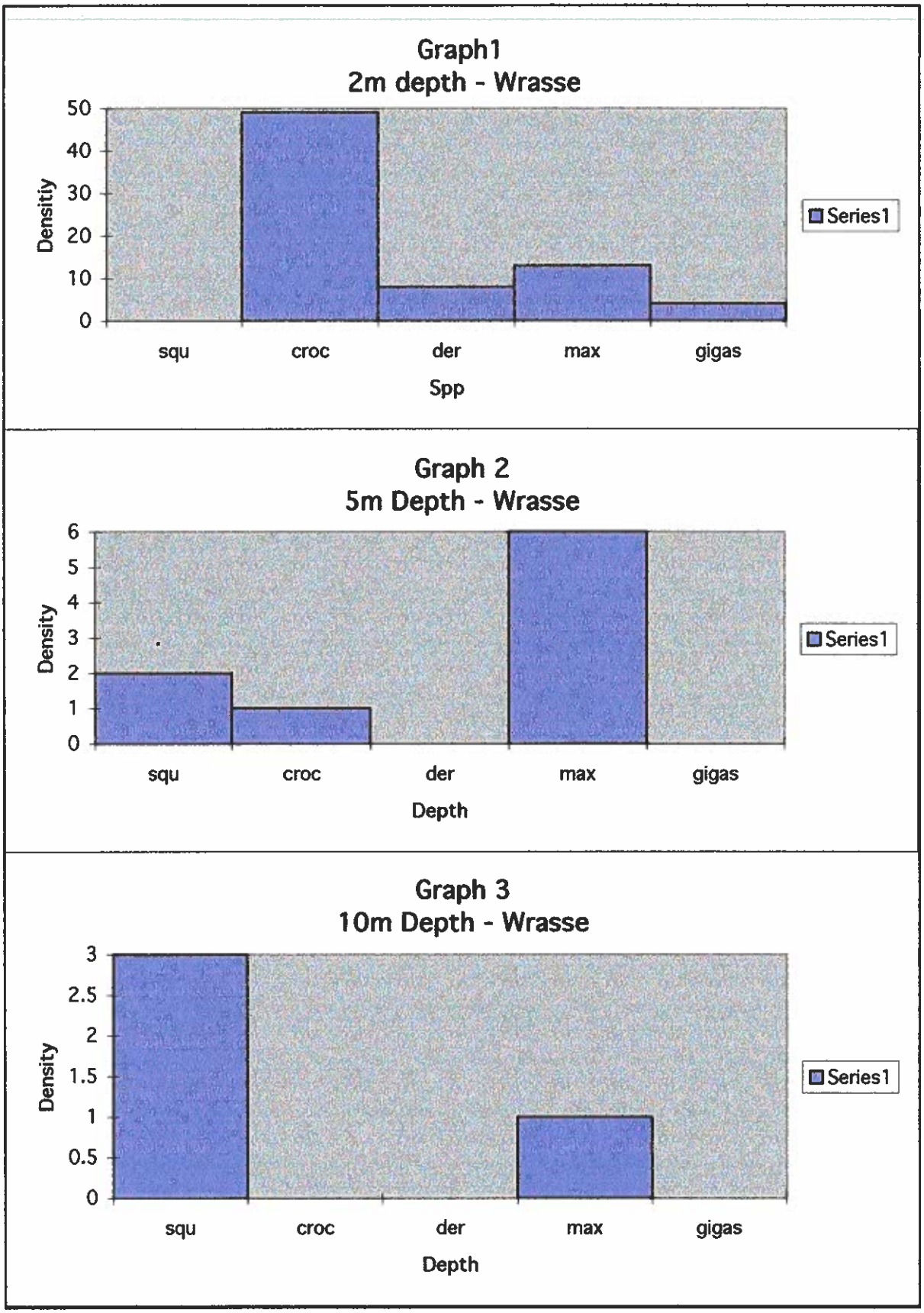
- 50m long transects were laid at depths of approximately 15m at the reef's crest and approximately 5m depth on the reef flat.
- All species of clams, 1m either side of the transect, were identified and measured.
- The straight length was measured from one end of the mantle* to the other using a pair of calipers, the distance that the calipers were set at was then measured using a straight ruler.
- The curved length was measured using a tape measure from one end of the mantle* to the other.
- Two replicates were carried out at each depth at each of the nine sites.
- At the two focal sites a square measuring 50mx50m was marked. Within this square all clams were identified, measured and tagged using plastic numbered labels.

* Mantle = the exposed lip of a clam which contains the photosynthetic zooxanthellae.

## Results:

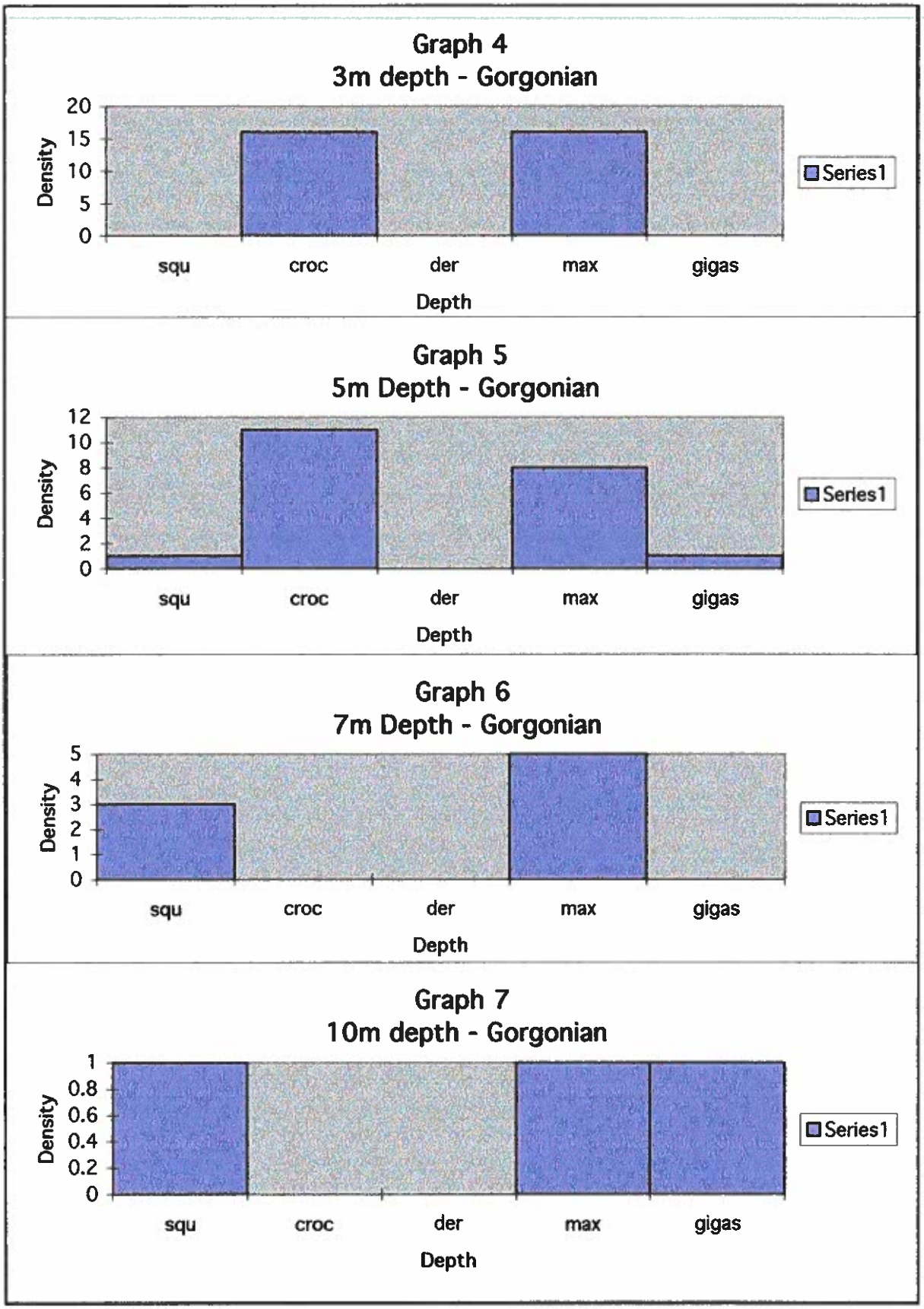
- For comparison of species density between Wrasse Strip and Gorgonian, see graphs 1-7.
- For straight and curved measurements of different species at different depths, see graph 8-13.
- The 5 giant clam species identified at Pulau Layang Layang include: *T. crocea, T. derasa, T. maxima, T. gigas and T. squamosa.*

Comparison of species at different depths.




All graphs represent the mean results from repetitive 50m transects.

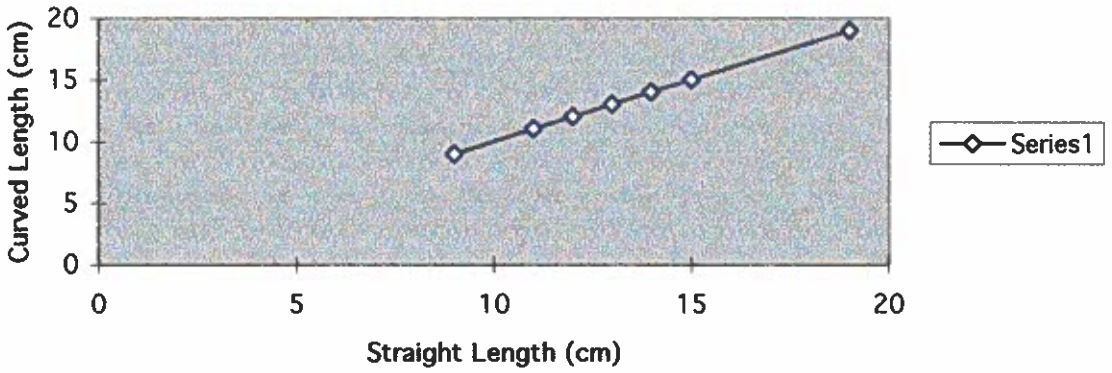
Comparison of species density at different depths.



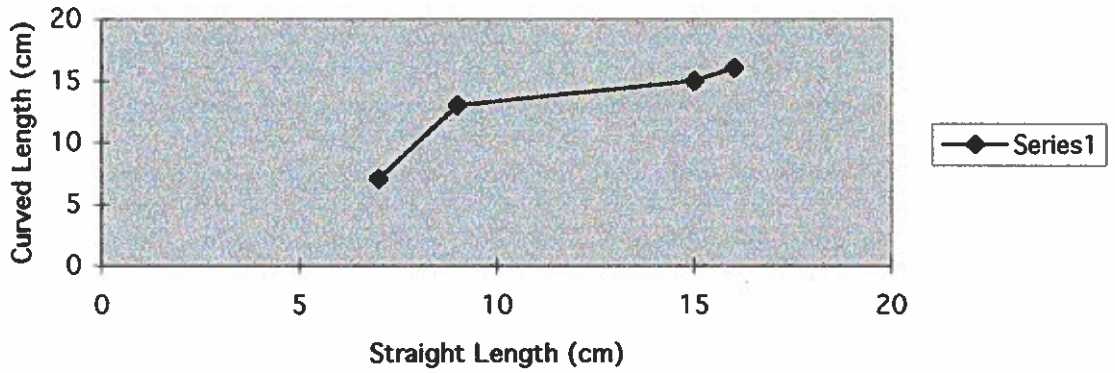

All graphs represent the mean results from repetitive 50m transects.

Graphs to show curved and straight measurements of clams at Wrasse Strip.

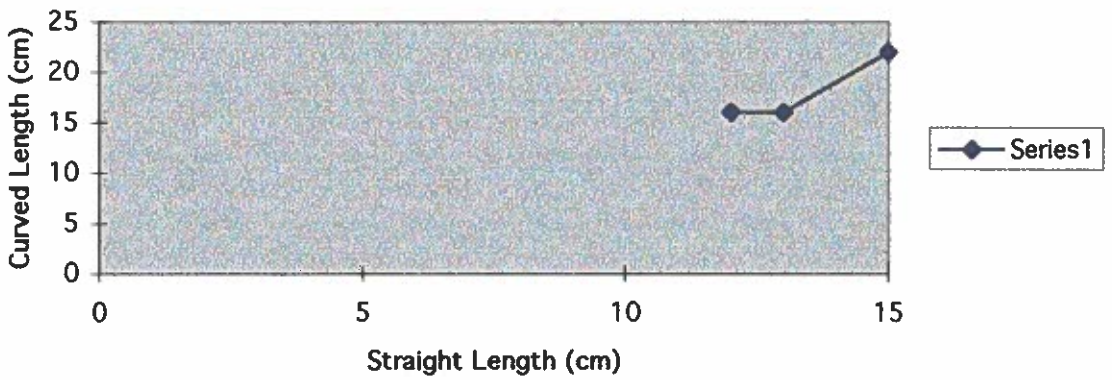
## Graph 8
## Derasa - Wrasse, 2m Depth




## Graph 9
## Gigas - Wrasse, 2m depth



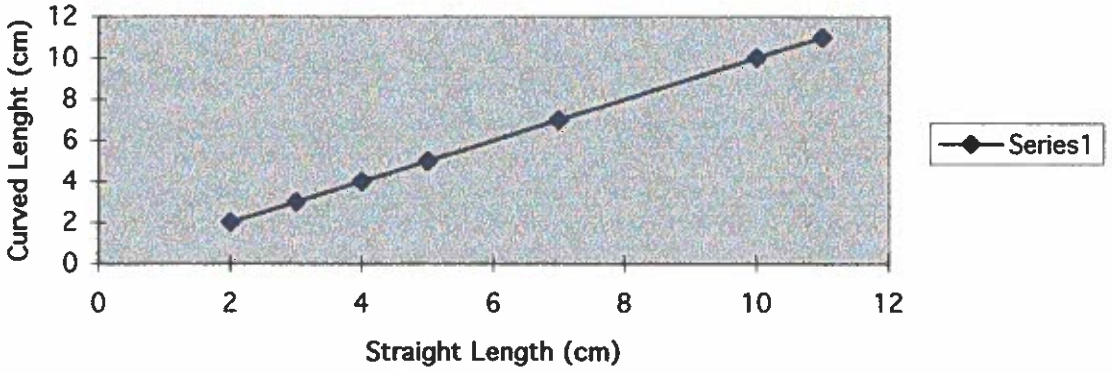

## Graph 10
## Squamosa - Wrasse, 10m depth.



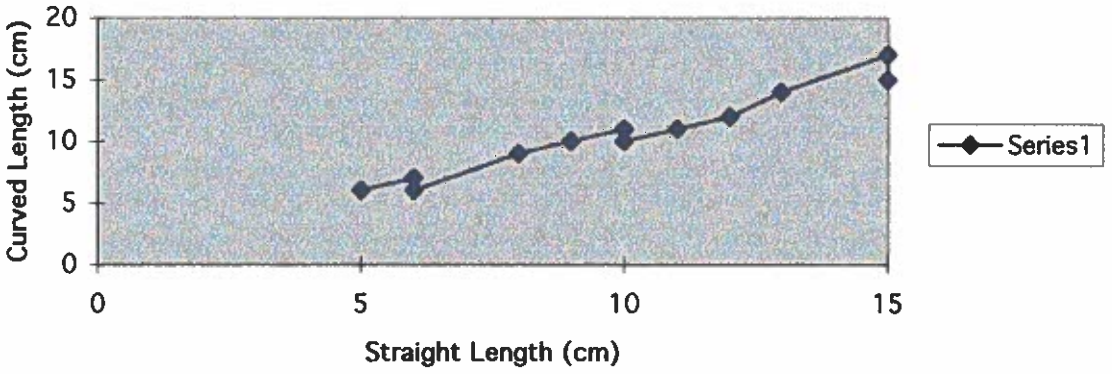

All graphs represent results from 1x50m transect.

Graphs to show curved and straight measurements of clams at Gorgonian.

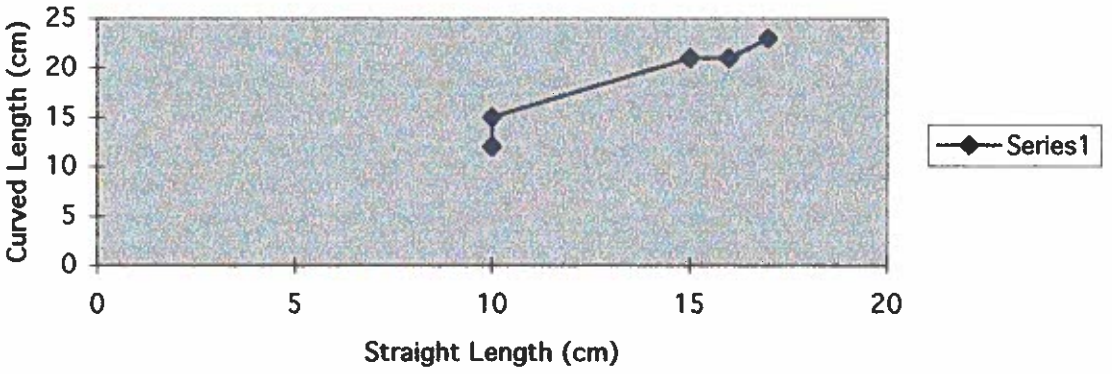
## Graph 11
## Crocea - Gorgonian, 3m Depth




## Graph 12
## Maxima - Gorgonian, 3m Depth




## Graph 13
## Maxima - Gorgonian, 7m Depth.




All graphs represent results from 1x50m transect.

- All data collected by myself and my Malaysian counterpart was entered into the international database for IYOR. We recorded and identified all species of macroinvertebrates that we found on our transects. The purpose of IYOR is to provide information on the status of coral reefs around the world. Using data collected by global baseline surveys IYOR is able to determine which areas are particularly at risk. Conservation measures can then be conducted in the most vulnerable areas. The volume of data obtained is too much to include here so I will include a few of the main points.

- Largest clams measured around Pulau Layang Layang:
- *Tridacna Maxima* , curved = 1m, 24cm straight = 1m, 5 cm. Depth = 15m.
- *Tridacna gigas* , curved = 1m, 32cm straight = 1m, 10cm. Depth = 17m.
- *Tridacna gigas* , curved = 1m, 36cm straight = 1m, 12cm. Depth = 18m.

## Conclusion:

Results from the giant clam research was very encouraging for Pulau Layang Layang. The population of certain species was extremely high. However, a lack of extremely large clams is a sign of past harvesting and/or storm damage. Although it is a pristine atoll giant clams have been harvested in the past by fishermen and the Malaysian navy that have a base on the atoll.

All three of the largest giant clams found were found at depths of 15-18m. At these depths they were sheltered from wave action. None of them were surrounded by coral reef, but were free standing on sand or debris. These were the only 3 individuals that seem to have escaped harvesting and storm damage. It is estimated that these could be as much as 30 years old.

The clams which were most abundant around the atoll were *Tridacna Crocea* and *Tridacna maxima* (see graphs 1-7). Other species found, but not so abundant, were *Tridacna squamosa, Tridacna gigas* and*Tridacna derasa*. Another large species found in the lagoon which is not of the endangered giant clam genus was *Hippopus hippopus*.

Patterns of distribution for different species show a definite pattern for all sites around the atoll. Graphs 1-3 show the typical pattern found for one site where we concentrated our research - Wrasse strip. *Tridacna crocea* were always most abundant in shallow water. The optimum number was found at 2m depth at Wrasse strip and Gorgonian. All graphs show densities for 1x50m transect.

*Tridacna crocea* is a small species (see later). It is found half buried in dead coral. This can explain why this species is found in shallow waters. By burying themselves they are able to protect themselves from the turbulent waters characteristic of the shallow parts of coral reefs. The waves crash against the reef creating extremely rough conditions which would sweep away more exposed species. The few species of *Tridacna maxima* and*Tridacna gigas* found at these shallower depths were small and lying close to the coral reef, often positioned in crevices.

At deeper depths there is more abundant coral cover and the overall number of giant clams decreases. Those that are found include the larger more exposed species such as *Tridacna maxima* and *T. squamosa*. These are usually hidden amongst the coral. The relationship of curved to straight length shows that the smallest species of clam, T. crocea, is straight. This is due to the nature of the clam which buries into the dead coral. The curved shape of some clams is impractical for a buried life. T. crocea is able to expose its blue mantle above the dead coral. The overall small size of the clam is also indicative of its straight shape. T. derasa is also small in size and therefore straight in shape.

Size increases with depth. No significantly large species were seen in shallow waters. *T. maxima, T. squamosa* and *T. gigas* range in size from 7cm-20cm straight length and 5cm-25cm curved length. The ratio of straight length to curved length increases with size and with depth (see graphs 8-13). As the clams grow they become more curved. The reason why these bigger clams are only found at depth is because they are more fragile as larger, more curved clams. They generally have a larger surface area of mantle exposed when they are open and therefore they are vulnerable to wave action. At deeper depths the waters are more stable and create a safe environment for the clams to grow.

No clams were found at depths deeper than 17m. This is due to the reduced light intensity at these deeper depths. Light is a critical factor for the zooxanthellae, found in the mantle of giant clams.

These zooxanthellae are dinoflagellates of the genus *Symbodinium* ; brown symbiotic algae. These algae are important in fixing carbon and providing a portion of their photosynthate to the host. To be able to photosynthesise light is needed. Below depths of 17m there appeared to be insufficient light for photosynthesis to occur. Without the nutrients that the zooxanthellae provide, the giant clams cannot survive.

No *T. crocea* were ever found beyond a depth of 5m. At deeper depths there is very little bare or dead coral available for the*T. crocea* to bury into. Due to its smaller size this species has fewer zooxanthellae than others. The number of *Symbodium* species per clam increases exponentially with size (Fitt et al. 1993). It appears that *T. crocea* needs more light to allow the reduced number of zooxanthellae to provide enough nutrients to its host from photosynthesis. The shallower depths have a greater light intensity, therefore this is where*T.crocea* is most abundant. The larger clams have a proportionately higher number of zooxanthellae. They can therefore still photosynthesise sufficiently at deeper depths with reduced light intensity.

Fortunately the difficulties encountered were few. The main problems to start with were the logistics of getting all of our equipment and all of the people to this remote atoll. We started our work at the atoll 10 days behind schedule. We were somtimes delayed in our work by freak storms that hit us. Overall the work went extremely smoothly.

## Acknowledgements:

I would like to thank the following sponsors for making this expedition possible:

- The Swann Travel Fund.
- Weir Fund for Field Studies.
- James Rennie Bequest Fund.

Thanks also to Dr CJ Inchley for his personal support of my applications for sponsorship.

## Appendices:

Itinerary:

- 23rd June - 7th July. Initiation Phase. Kudat, Sabah.

Training of techniques for underwater research using SCUBA.

- 8th July - 3rd August. Education Phase. Sabah.

Education about conservation of coral reefs in local schools around Sabah.

- 4th August - 4th September. Research Phase, Pulau Layang Layang.

Individual research project on the endangered species of giant clams.

Financial support was definitely adequate. With a personal contribution and sponsor support the project was a great success. Thank you everyone!