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Norman Reef Environmental Monitoring Project

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A REPORT TO THE GREAT BARRIER REEF MARINE PARK AUTHORITY

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NORMAN REEF ENVIRONMENTAL MONITORING PROJECT 1987-88

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SUMMARY

The establishment of a tourist destination pontoon serviced by 300 seat international catamarans on Norman Reef to the NE of Cairns prompted the GBRMPA to require an on-going biological monitoring program to be implemented. The aims of the program were to attempt to establish the effect such intensive tourist operations were having on the reef community; specifically on the percentage cover of encrusting organisms, the height of coral colonies and the density of selected fish species.

Surveys of corals, other encrusting organisms and fishes were made at 4 sites on Norman Reef between March 1987 and June 1988. Sites were: adjacent to the Great Adventures pontoon; in the area of Great Adventures semi-submersible operation; adjacent to the Deep Sea Divers Den main mooring; and at an undisturbed control area. A total of 35 permanent 20m line transects were used to measure the cover of corals and other encrusting organisms. Measures of coral height were also made at each site. Fishes were counted along 5 haphazard 50 x 20m transects at each site.

Corals were only affected directly by the pontoon, either by shading or mooring chain abrasion. This affected an area of about 365 square metres of potential coral habitat (hard substratum beneath the pontoon), and resulted in the loss of 32 square metres of live hard coral (a 4.3% reduction against the 4.6% increase in both control sites). As a result coral height was significantly reduced at this site, but the mean height reduction per coral colony was only 6.4cm.

Diver activities did not have any detectable effect either on coral cover or coral height at any of the potentially affected sites in the time scale of this survey.

This survey indicated that operating semi-submersibles occasionally touch the reef; there was a 2m long gouge in the coral basement across one of the semi-sub transects, and an approximately 50cm high knob of coral missing from the end of another, that were both almost certainly the result of semi-sub bumps. However, both these observed incidents resulted in negligible coral damage and there were no significant reductions either in coral cover or coral heights in the semi-sub transects.

There were no significant effects detected on the abundance of any of the other groups of encrusting organisms, including macroalgae, turfing algae, sponges and soft corals.

Fish were obviously affected by tourist activities with small numbers of several species attracted to the activity sites, especially the pontoon site. In the final survey there were moderately high numbers of 6 species in the immediate vicinity of the pontoon that were either absent or uncommon at the other 2 sites, probably due to the daily fish feeding activities made from the pontoon. There were no detectable reductions in any of the species counted, although there were indications that chaetodontids had decreased in numbers immediately beneath the pontoon, probably as a result of the reduction in coral cover.

With the exception of a few small patches immediately beneath the pontoon there were no deleterious effects on aesthetics in the reef communities of the survey sites during the 12 months of this survey. Norman Reef is aesthetically very spectacular, mainly

as a result of rich coral communities and consistently clear water. Any degradation of the coral communities would have a noticeable effect on aesthetics but this has not occurred to date

It is recommended the the Norman Reef monitoring program be continued and expanded because of increased use of the reef by tourist operators and to establish the longer term effects of such intensive albeit non-exploitative use.

INTRODUCTION

Norman Reef (16° 52'S; 146°E) is a small oval shaped reef that lies approximately 60km north of the city of Cairns on the southern edge of Trinity Opening (figure 1). With a cross-shelf position of 0.85, Norman can be regarded as an outer shelf reef, and is one of the few reefs zoned General Use A. The combination of its small size (1.5 x 2.5km; see figure 2), outer shelf position and isolation (Norman is at least 10km from other large reefs) means that this reef is usually bathed in clear oceanic water with underwater visibility of between 15 and 30m.

This reef is one of the few in the Cairns area that was not subject to extensive coral damage in the crown of thorns outbreak of the early 1980s. The rich coral communities, clear water and proximity to Cairns began to attract the attention of the expanding tourist dive industry in Cairns in the mid 1980s. The Deep Sea Divers Den (DSDD), a diver training school based in Cairns, began running their catamaran 'Tropic Queen' to Norman in March 1986 with up to 26 trainee divers. Since then this boat has made 3 two day trips each week to Norman Reef resulting in approximately 600 dives in the area per week, the majority in the vicinity of the new DSDD mooring.

Late in 1986 the Hayles tourist boat operating company (now called Great Adventures) became interested in establishing a fast catamaran day trip tourist operation to a destination pontoon on Norman Reef. There was some opposition from the DSDD, but after discussions by both parties with the Marine Parks in Cairns it was agreed that DSDD would move to a new site SW of their existing mooring, leaving Hayles to use the more appropriate centre area of the back reef bay. Hayles were given permission for this operation by the GBRMPA in early 1987 and began establishing moorings for the pontoon on 1st April 1987 using heavy chain and large concrete blocks.

The 45 x 15m pontoon was put in position in the vicinity of the old DSDD mooring in May 1987 and operations began using a single 30m International Catamaran immediately afterward, with the capability of transporting up to 300 persons to the reef every day. In addition to the destination pontoon, that acts as a base for swimming and snorkeling activities as well as providing more space for the visitors to move around, Hayles uses 2 glass bottomed boats and 2 semi-submersible coral viewers (semi-subs) to give non-swimmers a view of the reef community. Regular fish feeding is carried out from the pontoon using food scraps to provide a spectacle for the tourists.

The purpose of this survey was to check whether the presence and operation of the pontoon and associated tourist activities including fish feeding, or the diver activity and the associated limited, irregular fish feeding at the DSDD site were having any effect on the reef community. As there has been concern about the effects of semi-submersible operation on corals along the shallow reef edge where these vessels run, the monitoring survey was also designed to check on the extent of this damage.

METHODS

STUDY SITES

Four sites were chosen, all of them on the sheltered back reef region that was and is the focus of tourist activity (see figure 3).

The first was in the immediate vicinity of the Hayles (now Great Adventures) reef destination pontoon (see figure 4). Swimmers and snorkelers at the pontoon are restricted by buoyed lines to the area east and south of the pontoon to avoid conflict with the semi-sub and glass bottomed boat operation. The majority of swimmers and snorkel divers do not venture more than 100m from the pontoon. The deep transects were positioned either immediately beneath the indicated position of the pontoon or within an estimated 20m of the pontoon edge. The shallow transects at this site were set up around the edges of the patches of reef flat closest to the pontoon position; it was reasoned that these would receive the greatest level of snorkeler/swimmer impact. The semi-sub and glass bottom boat moorings at the Pontoon site were in deeper water some distance out from the pontoon over a predominantly sand bottom; no detrimental effects were expected from these moorings.

Site 2 was in the area of the permanent mooring used by the Deep Sea Divers Den boats "Tropic Queen" and "Tropic Princess" for their diver training operations and covered an area approximately 200m square (see figure 5). The permanent transects at this site were set up about a month after the DSDD had shifted their mooring to the new site and were confined to the area that observation and consultation suggested was the most intensively used by the trainee divers.

The third site was a control about 200m wide mid-way between the first two sites that was out of bounds to both operations (see figure 6).

Site 4 incorporated the area to the north of the pontoon that was used by the two semi-submersibles operating from the pontoon (see figure 7). As at the DSDD site the transects at this site were set up about a month after operations had started to ensure that they were immediately adjacent to the semi-sub route that was being used in practice rather than that proposed before operations began.

CORAL TRANSECTS

Encrusting organisms were assessed using permanent 20m line intersect transects. Transects were marked with 100mm masonry nails driven into the coral basement or massive corals at intervals of 2-4m. The length of intersection of all encrusting organisms with the transect line was recorded in cm - the sum of these intersects giving a measure of percentage cover for the various species. Five replicate transects were positioned haphazardly in each of two depth strata at each site. The five shallow transects were between 0-2m below mean low water (MLW), while the deep transects were between 6-10m below MLW. No deep transects were surveyed at the semi-sub site. Differences in the cover of encrusting organisms between sites and depths were tested using a two factor analysis of variance, while changes through time, being non-independent, were tested using a t-test for the comparison of the means of paired samples. As 101 separate t-tests were necessary for this analysis the level of probability taken as significant was 99% rather than the normal 95%.

CORAL HEIGHTS

One of the concerns about heavy tourist use of a coral reef area is that snorkelers and divers may inadvertently break portions off erect and branching corals and eventually cause significant degradation to the area around a regularly used destination. Similarly it has been thought that regular bumping of reef edges by semi-submersibles trying to get as close as possible to the coral may cause additional damage to corals. In an attempt to quantify this type of damage measurements of the maximum height of branching and plate type corals were made along each of the permanent transects. The highest piece or clump of live coral in a square metre centred on each metre of the transect line was measured, giving 20 height measurements for each transect. If there was no erect hard coral within this square metre the piece nearest to the line outside this area was measured. Changes in coral height were tested using a t-test for the comparison of the means of paired samples.

FISH COUNTS

Selected groups of fishes were counted along five haphazard 50 x 20m transects at three of the sites; no fish counts were made at the semi-sub site. Each count was marked using a 50m central fiberglass tape run out at a depth of about 5-8m and fish counted 10m each side of the line. Fish counted were those that experience suggested could be affected by the fish feeding and other tourist activities and included: large non-secretive cods and coral trout (family - Serranidae); jacks and trevallies (Carangidae); snappers or sea-perch (Lutjanidae); fusiliers (Caesionidae); sweetlips (Haemulidae); emperors (Lethrinidae); batfishes (Ephippidae); butterflyfishes (Chaetodontidae); large wrasses (Labridae); parrotfishes (Scaridae); surgeonfishes (Acanthuridae); and rabbitfishes (Siganidae). As both sets of fish counts were made using haphazard and hence independent samples a two factor analysis of variance was used to test for differences among sites and between times.

RESOURCE MAPPING

The area around the tourist destination pontoon was mapped in detail using aerial photographs and the position of all large massive corals, large coral clumps and giant clams plotted. It was anticipated that this map would be of use to the operators as an aid to help tourists understand what they were seeing while investigating the reef community. It would also provide a baseline for looking at the long term effect of tourist activities on the larger coral colonies and giant clams.

SAMPLING DATES

A special trip to the study area was made at the end of March 1987 to survey the Pontoon Site prior to the establishment of the pontoon moorings: the 10 encrusting organism transects were set up and surveyed at this time, along with the first group of fish counts. The remainder of the initial survey of all sites, including the resource map, was made during the period June-July 1987. The final survey at all sites was made in June 1988.

RESULTS

CORAL COVER

Raw data and preliminary analyses for all the groups of encrusting organisms recorded in the permanent transects are included in appendix 1 and summarised in table 1.

Norman Reef has a very rich cover of hard coral compared with most other outer shelf or mid-shelf reefs on the GBR. Coral cover at the start of the survey ranged from 45.1-53.1% for the shallow sites, and from 43.4-61.1% for the deep sites. For comparison, mean coral cover measured on the back reef of 9 Central Section outer shelf reefs measured using ten 10m line intersect transects was 27.7% (range from 21.2-35.2%), while coral cover on 19 mid-shelf reefs unaffected by *Acanthaster* grazing in the same area was 26.7% (range from 15.2-48.8%) (data from Ayling and Ayling, 1985). Similarly, mean coral cover on 38 Capricorn Section reefs was 22.6% (Data from Ayling and Ayling, 1986).

Initially (1987 survey) there was no significant difference in coral cover, either between sites or between depths. However, the composition of the coral community was different between the two depth strata. In the shallow transects plate acroporids (10% cover) and small clumping acroporids (12%) were the major components of the coral community, along with poritids (11%), pocilloporids (2.5%) and faviids (4.8%). In contrast poritids were strongly dominant in deeper water (34% cover), faviids were similar to shallow areas (4.3%), while small clumping acroporids (6%), plate acroporids (0.1%) and pocilloporids (1%) were markedly less abundant than in the shallow transects (see table 2).

In overall hard coral cover there were increases in several groups of counts over the time of the survey but this was only significant at the semi-sub shallow site where the percentage cover of corals increased from 53 to almost 64. A significant increase in plate acroporids was the main component of this change (see table 2). The only real reduction, although non-significant, was recorded at the deep pontoon site where shading killed some corals and damage from moorings and chain abraded others, resulting in a drop from 61 to 57% cover.. This was reflected in non-significant reductions in the cover of poritids, staghorn acroporids and small clumping acroporids.

CORAL HEIGHTS

The measure of coral height indicated a slight but non-significant increase in height at both DSDD sites (see table 3), and a strongly significant decrease at the deep pontoon site. This decrease was caused by the shading death of some large staghorn corals beneath the pontoon and damage to some branching corals by the moorings and chain.

OTHER ENCRUSTING ORGANISMS

There were no significant changes in the cover of soft corals, macroalgae, turfing algae or sponges at any of the sites, although there was a decrease in macroalgae on the shallow pontoon site, and an increase in turfing algae at both DSDD sites and the deep control site (see table 1).

FISHES

Raw data from all fish counts, along with preliminary analyses, are tabulated in appendix 2. Abundance summaries and the results of 2 factor analyses of variance for the totals for the common families are shown in table 4.

Observation showed that some groups and species of fishes gathered at the sites of tourist activity, most of them attracted by the feeding. At the DSDD site fish feeding activities were irregular and involved throwing over of a few food scraps after meals and some feeding of scraps to fish by the divers while underwater. As a result there were usually a few schools of fusiliers present in the vicinity of the moored boat, while 2-10 individuals of the species *Platax orbicularis* (batfish), *Lethrinus nebulosus* (spangled emperor) and *Hipposcarus longiceps* (yellow-tailed parrotfish) were attracted to the site when divers were in the water. Beneath the pontoon there were also schools of fusiliers, as well as large schools of *Lutjanus bohar* (red bass) and *L. gibbus* (paddle-tails). There were also a few spangled emperors, some parrotfishes, and one or two medium sized cod and coral trout at this site at the end of the survey period.

There were strong site effects for scarids, with high numbers at the pontoon site for all surveys compared with the other two sites. This was a result of the features of the site itself rather than the presence of the pontoon; there were high numbers here before the pontoon was installed and no significant time effects. Numbers of fusiliers were very variable with standard deviations mostly considerably greater than the mean, and although there was a numerical increase in density both at the pontoon site and the DSDD site this was not significant. There was a significant site effect for fusiliers: densities at the pontoon site and DSDD site were higher than at the control site in the second survey. Lutjanids showed a dramatic and significant increase in density at the pontoon site with large resting schools of *Lutjanus bohar* and *L. gibbus* beneath the pontoon in the June 1988 survey, along with small numbers of *L. fulvus* (blacktail snapper) This also gave a significant site effect.

DISCUSSION

CORAL COVER

If the tourist activities at the pontoon site and the DSDD site were having any detrimental effect on hard coral communities then a reduction in coral cover at either of these sites in comparison with the control site would be expected. In fact, there was an increase of 5.6 percentage points in coral cover at both control sites that was significant at the 95% probability level but not at the 99% level accepted here. There were similar or larger increases in coral cover at the DSDD deep site, the shallow pontoon site and the semi-sub site - the latter significant at the 99% level. Given the cover of fast growing acroporid corals at these sites, ranging from 20-45% in the shallow sites, this sort of increase in cover is to be expected over a 12 month period as a result of colony growth alone.

There was only a very slight increase in coral cover at the DSDD shallow site, possibly a result of the relatively low cover of fast growing acroporids at this site: 18.8% compared to 27.3%, 27.5% and 44.5% at the other 3 shallow sites. In contrast there was a 4.3 percentage point reduction in coral cover at the deep pontoon site due to the death from shading of most acroporids and some poritids and other species beneath the pontoon. Over the first few months the shaded corals changed colour to a dark brown in an attempt to cope with the reduced light levels. Many corals subsequently died but others have been able to survive under the new low-light regime. Other corals in the vicinity of the pontoon were damaged or destroyed by mooring chain abrasion. There was, however, no reduction in coral cover in the shallow pontoon site, despite being exposed to potential damage from large numbers of inexperienced snorkel divers every day. Such use may be expected to cause coral damage in shallow water from careless swim fin kicking or by snorkelers standing on the reef to rest or clear their mask, but any such effect is not great enough to reduce live coral cover over the period of this study.

The fast growing acroporid corals increased in cover over the period of this study at all sites with the exception of the shaded deep pontoon site where a 17% reduction in total acroporid cover was recorded (from data in table 2). The mean increase in cover of these corals at the other 6 sites was 21.6% (range from +12.7% to +28.4%) The combined cover of all other groups of hard corals, mainly poritids, faviids and pocilloporids, did not show the same consistent change, with a mean increase recorded of only 4.7% (range from -5.1% to +14.1%). Like the acroporids these other corals also showed a reduction at the deep pontoon site where a change of -5.3% was recorded.

Snorkel diver activities and similar scuba diver effects may also be expected to reduce the average height of erect, branching and plate forming corals, even if it does not reduce live coral cover. Similarly if the semi-sub activities along the reef edge to the north of the pontoon were occasionally breaking erect or plate forming corals this might be expected to reduce coral height. The coral height measurements made along each of the permanent coral transects did in fact show up a significant reduction in coral height in the deep pontoon site due to the death from shading of branching acroporids beneath the pontoon and the breakage and destruction of some erect corals in this area by the pontoon mooring chains. Although this demonstrated the sensitivity of this method to overall changes in coral height, no reductions in coral heights were detected at any of the other sites.

OTHER ENCRUSTING ORGANISMS

Soft corals were not abundant in this region of Norman Reef, ranging from 4-10% cover at the majority of sites. These populations were very stable through time with a maximum change of 1% in cover over 12 months.

Any nutrient enrichment resulting from the tourist activities in this area may be expected to lead to an increase in the cover of macro- or turfing algae. In fact, although there was an increase in turf cover at both DSDD sites and the deep control site and a decrease in macroalgal cover at the shallow pontoon site, there were no significant changes at any site. Mean macroalgal cover ranged from 0.2-2.0% at the beginning of the survey period and from 0.2-2.1% 12 months later. Similarly, turfing algae ranged from 0-1.9% initially and from 0-3.3% 12 months later.

It has been postulated that sponges respond to any organic pollution by increasing in abundance (Wilkinson, 1987). Sponges were not common in this region of Norman Reef ranging from 0-2.8% cover - there were no significant changes over the period of the survey.

FISHES

Most of the obvious changes in the reef community around heavily used tourist destinations are in fish populations. Many reef fishes are opportunistic and quickly gather at sites of disturbance or feeding, while others may be repelled by the constant tourist activity. There is anecdotal evidence that chaetodontids (butterflyfishes) decrease in density at areas of heavy diver activity (Wendy Richards, personal communication re Agincourt Reef pontoons), but this may be due to reductions in coral cover and/or quality as many of these fishes are obligate coral feeders.

The initial survey in late March 1987 was not completed prior to all tourist activity. The Deep Sea Divers Den had been using a permanent mooring (a chain wrapped around a small coral knob) at the pontoon site for their boat 'Tropic Queen' for about 12 months prior to this initial survey. The divers had been feeding large fishes, including *Lethrinus nebulosus*, *Platax orbicularis* and *Cheilinus undulatus* (maori wrasse), and relatively small numbers of these species had been attracted to this site. As a result total lutjanids, lethrinids and ephippids were slightly higher at the pontoon site than at the other two sites prior to the establishment of the pontoon.

As has been mentioned, the main fish species attracted to diver activities were *Platax orbicularis*, *Lethrinus nebulosus*, *Cheilinus undulatus*, *Caesio cuning* (fusilier) and *Hipposcarus longiceps*. These species were present at the pontoon and DSDD sites during the final survey, all except *Caesio cuning* in relatively small numbers, but did not increase significantly over the period of the survey. The most obvious fish effect was the large school of about 200 *Lutjanus bohar* and *L. gibbus* adjacent to the pontoon during the final survey. This resulted in a significant time effect on the density of the family Lutjanidae due to an order of magnitude increase from an initial mean of 5.4 per 1000 square metres to a final mean of 51.6.

There was also an order of magnitude significant increase in the surgeon fishes *Acanthurus xanthopterus* and *Naso brevirostris* in the immediate vicinity of the pontoon, but this was due to the presence of schools containing only 23 and 16 individuals respectively. There was a slight decrease in the density of butterfly fishes (chaetodontids) at the pontoon site over the 12 month survey period, especially immediately beneath the pontoon where only 3 individuals were recorded during the final survey. However, there were similar slight falls in the other 2 sites; these decreases were not significant overall.

MANAGEMENT IMPLICATIONS

All evidence to date suggests that the level of use of Norman Reef by tourist and dive operators between April 1987 and July 1988 was not having any significant widespread detrimental effect on the reef community. The only effects on encrusting communities detected during this survey have been due to the hardware installation at the pontoon site. There was a non-significant reduction in coral cover and a significant decrease in coral height at the deep pontoon site attributable to shading induced coral death and mooring chain abrasion. No effects on encrusting communities or coral heights that can be directly attributable to the activities of swimmers, snorkel divers or scuba divers have been observed.

Some fish species have been attracted to the vicinity of the pontoon installation by fish feeding activities, causing a significant increase in the density of lutjanids (snappers and sea perch) and 2 species of surgeonfishes at this site. However, these are fishes that normally occur in resting or feeding schools on the reef and no unusual effects can be expected from the gathering generated by the pontoon. There were naturally occurring larger schools of these and a number of other similar species observed on several dives during both surveys on the large bommie 450m to the NNE of the pontoon site where one of the semi-sub transects was located (see map figure 7).

Since this survey was initiated, the use of Norman Reef by dive charter boats has increased markedly. The Deep Sea Divers Den now have a second boat and mooring SW of the DSDD site that was part of this survey. In addition about 5 other boats occasionally anchor or moor along the face of the reef between the pontoon and the northern end of the reef.

In view of the increasing use of the 2.5 km long back edge of this reef it is suggested that a further 3 monitoring sites be established to cover these new centres of activity, and provide additional control sites. This would include an expansion of the semi-sub site to include both a deep coral site and fish counts, and bring the total number of sites to 6. The position of additional sites would be determined by means of a user survey carried out in conjunction with Marine Parks: one site would be in the area most heavily used by transient boats and the other in the least used back reef area as an additional control.

Survey methods used would be basically the same as those used for this survey but would be expanded in some areas. Broken but still living coral would be scored at all sites, probably during a 30 minute haphazard search of the entire site area. This would give another measure of the coral damage caused by diver activity that may in the long term lead to aesthetic degradation while not causing any significant decrease in coral cover. A number of photos taken annually from fixed points of a fixed scene will also be set up to look at aesthetic changes in the long term. Estimates of the area in square metres showing damage caused by anchoring activities would be recorded in the 50 x 20m transects used for fish counts to get a more widespread picture of the effect on the coral community of boat anchoring. Surveys at 12 month intervals of the new and previously established sites should be sufficient in view of the results from this study.

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TABLE 1. ABUNDANCE OF ENCRUSTING ORGANISMS IN THE NORMAN REEF MONITORING SITES

Mean percentage cover is shown from the five 20m line transects at each site and depth along with the significance of paired t tests looking at the changes during the time of the survey. Note: - = not present; ns = not significant ($p > 0.01$); ** = $0.001 < p < 0.01$; *** = $p < 0.001$.

SHALLOW TRANSECTS

	Pontoon			DSDD			Control		
	1987	1988	test	1987	1988	test	1987	1988	test
Macroalgae	1.1	0.2	ns	1.1	0.8	ns	1.8	0.7	ns
Turfing Algae	0.2	-	ns	0.4	1.9	ns	-	0.5	ns
Sponges	0.2	0.7	ns	0.8	1.1	ns	0.8	1.3	ns
Hard Corals	52.8	62.0	ns	46.4	48.5	ns	45.3	50.9	ns
Dead Standing Coral	0.4	1.5	ns	4.4	0.8	ns	2.0	0.1	**
Millepora Corals	-	-		2.1	1.8	ns	-	0.1	ns
Soft Corals	4.3	4.5	ns	10.6	10.7	ns	5.4	5.6	ns
Ascidians	-	-		0.1	-		-	-	

SHALLOW TRANSECTS

	Semi-Sub		
	1987	1988	test
Macroalgae	0.8	0.7	ns
Turfing Algae	-	-	
Sponges	-	-	
Hard Corals	53.2	63.9	***
Dead Standing Coral	1.6	0.2	ns
Millepora Corals	-	0.5	
Soft Corals	4.0	3.1	ns
Ascidians	-	-	

DEEP TRANSECTS

	Pontoon			DSDD			Control		
	1987	1988	test	1987	1988	test	1987	1988	test
Macroalgae	2.0	2.1	ns	0.2	0.5	ns	0.9	0.7	ns
Turfing Algae	0.4	0.3	ns	0.3	2.5	ns	1.9	3.3	ns
Sponges	0.6	1.1	ns	2.6	1.5	ns	2.8	2.1	ns
Hard Corals	61.2	56.9	ns	56.0	61.2	ns	43.5	49.2	ns
Dead Standing Coral	0.5	2.9	ns	2.2	0.8	ns	3.9	0.5	ns
Millepora Corals	1.9	0.5	ns	-	0.4	ns	2.9	3.9	ns
Soft Corals	2.2	2.2	ns	4.0	4.1	ns	3.8	4.8	ns
Ascidians	-	-		0.1	-		0.1	0.1	

TABLE 2. ABUNDANCE OF THE MAJOR GROUPS OF HARD CORALS IN THE NORMAN REEF MONITORING SITES

Mean percentage cover is shown from the five 20m line transects at each site and depth along with the significance of paired t tests looking at the changes during the time of the survey. Note: - = not present; ns = not significant ($p > 0.01$); ** = $0.001 < p < 0.01$; *** = $p < 0.001$.

SHALLOW TRANSECTS

	Pontoon			DSDD			Control		
	1987	1988	test	1987	1988	test	1987	1988	test
Pocilloporidae	1.4	1.2	ns	3.6	4.1	ns	1.3	1.9	ns
Acroporidae - small clumps	11.1	10.7	ns	9.7	9.5	ns	9.4	10.7	ns
Acroporidae - staghorn	1.8	5.5	ns	1.5	2.7	ns	4.0	4.9	ns
Acroporidae - plate	8.0	9.5	ns	2.4	3.3	ns	11.8	12.4	ns
Acroporidae - Montipora	6.4	7.2	ns	5.2	6.8	ns	2.3	3.0	ns
Poritidae	16.1	16.4	ns	13.4	12.4	ns	12.0	13.2	ns
Faviidae	6.2	9.2	ns	6.7	6.0	ns	3.7	4.0	ns
Other Scleractinian Corals	1.9	2.4	ns	4.0	3.8	ns	0.8	0.9	ns

SHALLOW TRANSECTS

	Semi-Sub		
	1987	1988	test
Pocilloporidae	3.5	3.4	ns
Acroporidae - small clumps	17.8	19.7	ns
Acroporidae - staghorn	6.3	8.7	ns
Acroporidae - plate	19.5	25.5	**
Acroporidae - Montipora	0.9	1.6	ns
Poritidae	1.9	2.0	ns
Faviidae	2.7	2.4	ns
Other Scleractinian Corals	0.7	0.6	ns

DEEP TRANSECTS

	Pontoon			DSDD			Control		
	1987	1988	test	1987	1988	test	1987	1988	test
Pocilloporidae	-	0.8	ns	2.4	3.3	ns	0.8	1.3	ns
Acroporidae - small clumps	2.4	1.4	ns	10.0	13.3	ns	5.5	6.2	ns
Acroporidae - staghorn	5.0	3.1	ns	1.3	2.0	ns	0.3	1.0	ns
Acroporidae - plate	-	-	ns	0.3	0.4	ns	-	0.1	ns
Acroporidae - Montipora	1.4	2.8	ns	5.9	6.1	ns	1.6	2.2	ns
Poritidae	48.1	45.0	ns	24.7	24.0	ns	29.7	30.9	ns
Faviidae	2.1	1.6	ns	6.9	6.6	ns	4.0	4.9	ns
Other Scleractinian Corals	2.2	2.2	ns	4.5	5.4	ns	1.8	2.6	ns

TABLE 3. SUMMARY OF HARD CORAL HEIGHTS IN THE NORMAN REEF MONITORING SITES

Summation of heights in cm of 20 coral colonies along each of five 20m transects is shown, along with the mean total for each group of transects and the significance of paired t tests looking at the changes from the beginning to the end of the survey. Note: ns = not significant ($p>0.01$); ** = $0.001<p<0.01$; *** = $p<0.001$.

SHALLOW TRANSECTS

Transect #	Pontoon			DSDD			Control		
	1987	1988	test	1987	1988	test	1987	1988	test
1	638	643		465	482		461	360	
2	787	791		429	422		571	542	
3	597	504		343	413		553	526	
4	510	471		513	535		876	875	
5	550	631		614	681		661	702	
Mean	616	608	ns	473	507	ns	624	601	ns

SHALLOW TRANSECTS

Transect #	Semi-Sub		
	1987	1988	test
1	991	927	
2	555	600	
3	520	624	
4	779	738	
5	832	887	
Mean	735	755	ns

DEEP TRANSECTS

Transect #	Pontoon			DSDD			Control		
	1987	1988	test	1987	1988	test	1987	1988	test
1	580	467		433	493		395	375	
2	487	410		491	487		461	458	
3	518	373		496	565		422	413	
4	486	337		457	517		299	278	
5	562	407		561	602		333	355	
Mean	527	399	***	488	533	ns	382	376	ns

TABLE 4. ABUNDANCE OF THE MAJOR FISH FAMILIES IN THE NORMAN REEF MONITORING SITES

Mean density per 1000 square metres is shown from the five 50 x 20m line transects at each site along with the significance of 2 factor analyses of variance looking at differences between sites and changes during the time of the survey. Note: - = not present; ns = not significant ($p > 0.05$); * = $0.01 < p < 0.05$; ** = $0.001 < p < 0.01$; *** = $p < 0.001$; - (anova results) indicates not sufficient numbers for meaningful analyses.

	Pontoon		DSDD		Control		Anova Results		
	1987	1988	1987	1988	1987	1988	Site	Time	SxT
Serranidae	1.4	0.8	0.4	0.6	-	0.8	-		
Carangidae	1.0	0.6	0.6	0.4	0.8	0.2	-		
Lutjanidae	5.4	51.6	1.4	2.2	0.6	2.0	**	*	ns
Caesionidae	15.6	96.8	10.0	67.0	13.0	10.8	*	ns	ns
Haemulidae	1.8	0.6	-	-	0.2	2.4	-		
Lethrinidae	12.6	23.2	7.0	8.0	6.6	17.2	ns	ns	ns
Ephippidae	2.0	0.8	0.6	1.8	0.2	-	-		
Chaetodontidae	18.2	15.0	25.0	21.2	22.0	20.8	ns	ns	ns
Labridae	0.4	0.8	0.4	1.6	0.4	1.0	-		
Scaridae	53.4	56.6	13.8	23.8	24.8	23.6	***	ns	ns
Acanthuridae	1.0	10.8	-	0.8	-	0.4	**	**	ns
Siganidae	1.2	1.6	3.0	2.6	1.8	2.8	-		

FIGURE 1. MAP OF THE CAIRNS AREA SHOWING THE POSITION OF NORMAN REEF

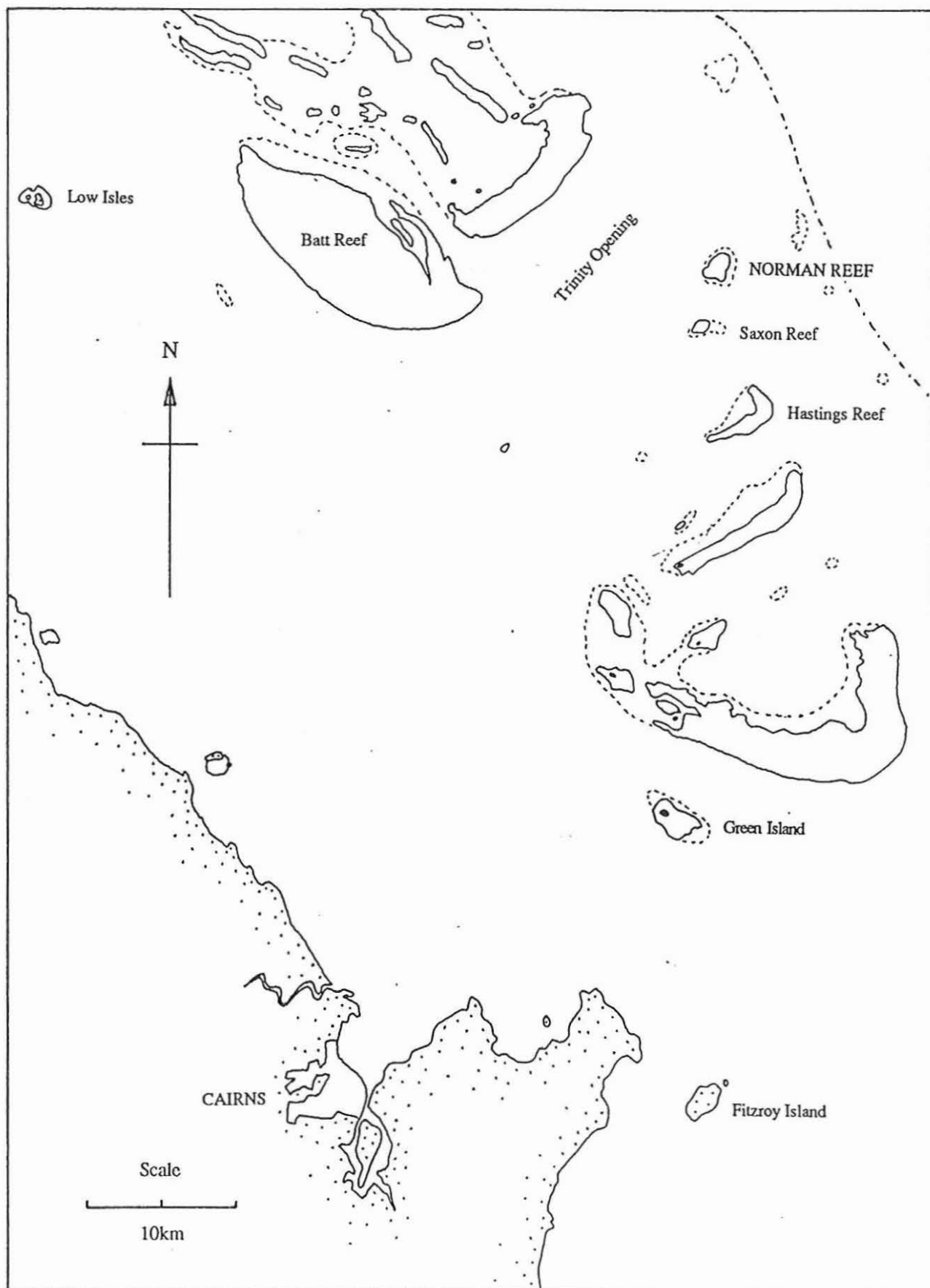


FIGURE 2. MAP OF NORMAN REEF SHOWING THE POSITION OF THE STUDY AREA

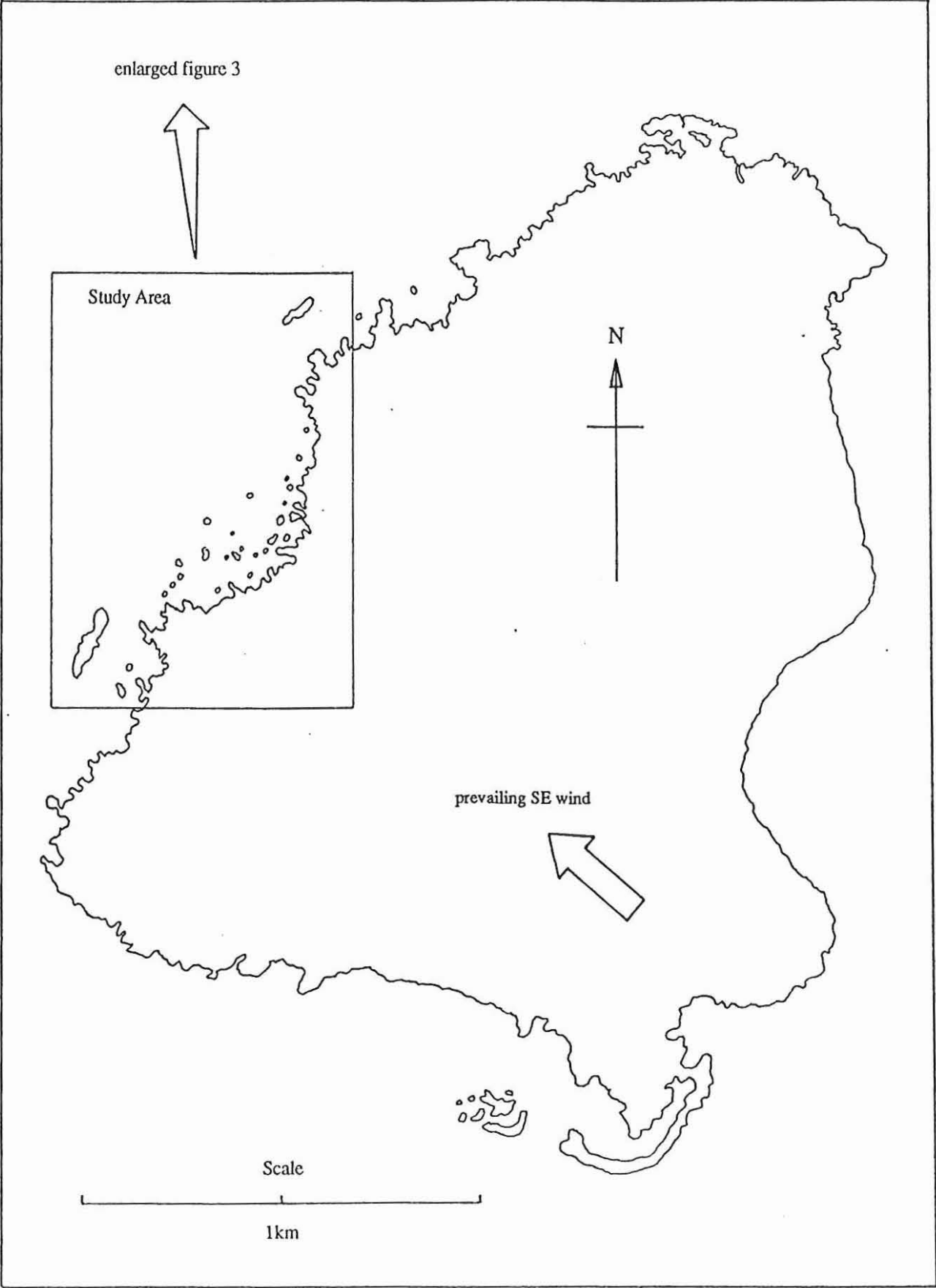


FIGURE 3. NORMAN REEF STUDY AREA SHOWING THE POSITION OF THE 4 STUDY SITES

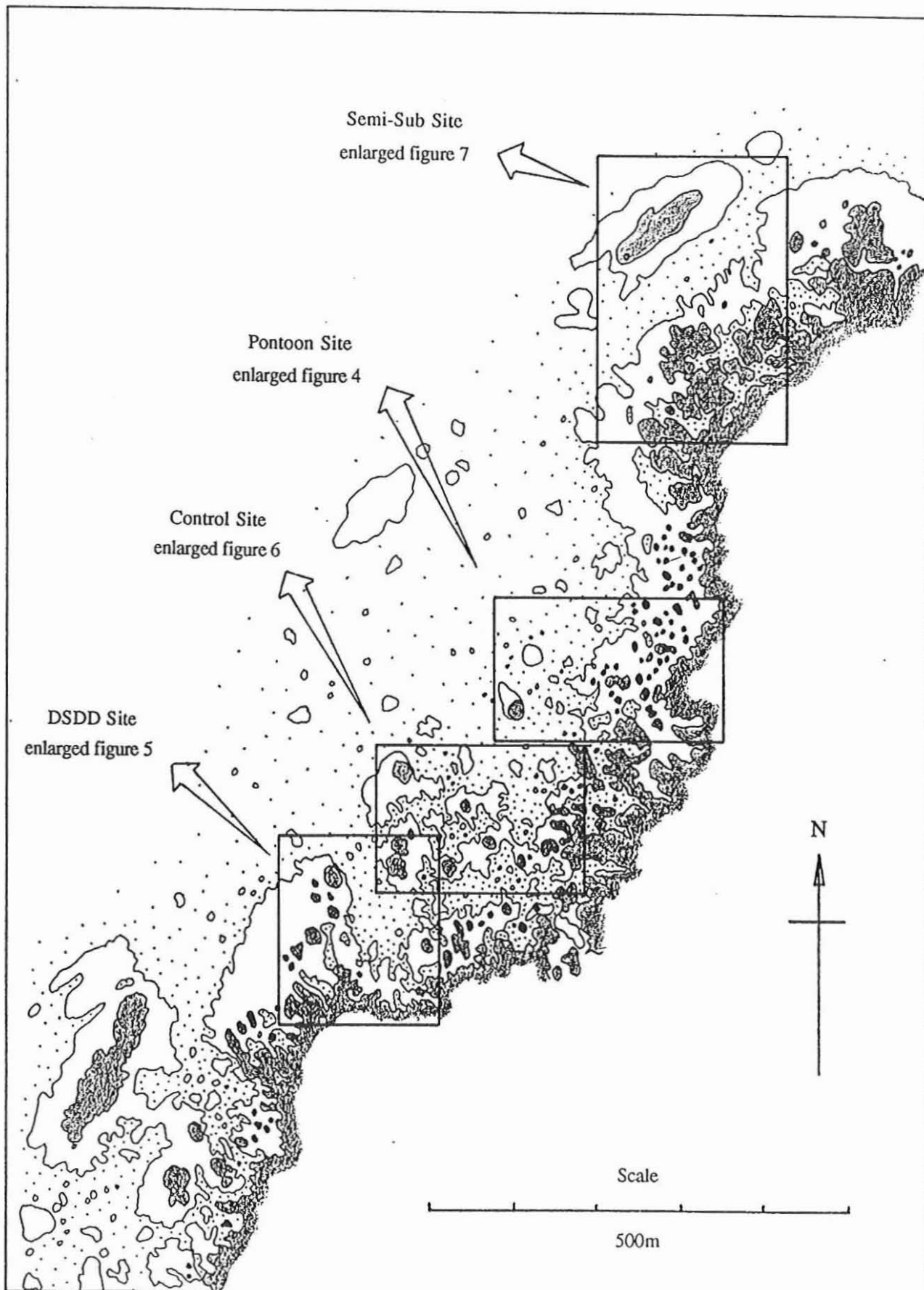





FIGURE 4. PONTOON SITE

Dashed line encloses area within which fish counts were made; short dashed lines mark position of deep coral transects; short dotted lines mark position of shallow coral transects

Key:  sand  reef slope  reef flat

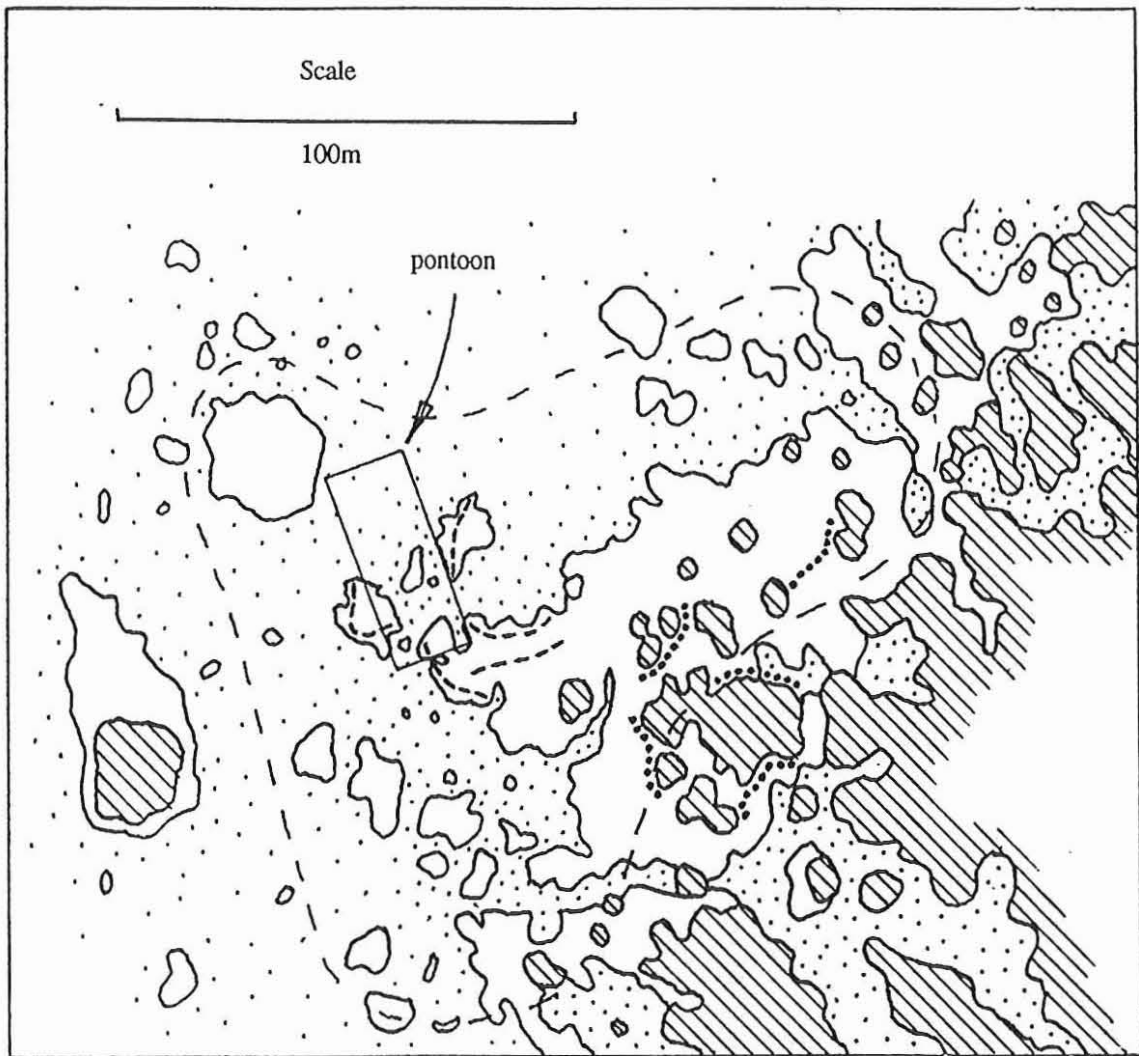





FIGURE 5. DEEP SEA DIVERS DEN (DSDD) SITE

Dashed line encloses area within which fish counts were made; short dashed lines mark position of deep coral transects; short dotted lines mark position of shallow coral transects

Key:  sand  reef slope  reef flat

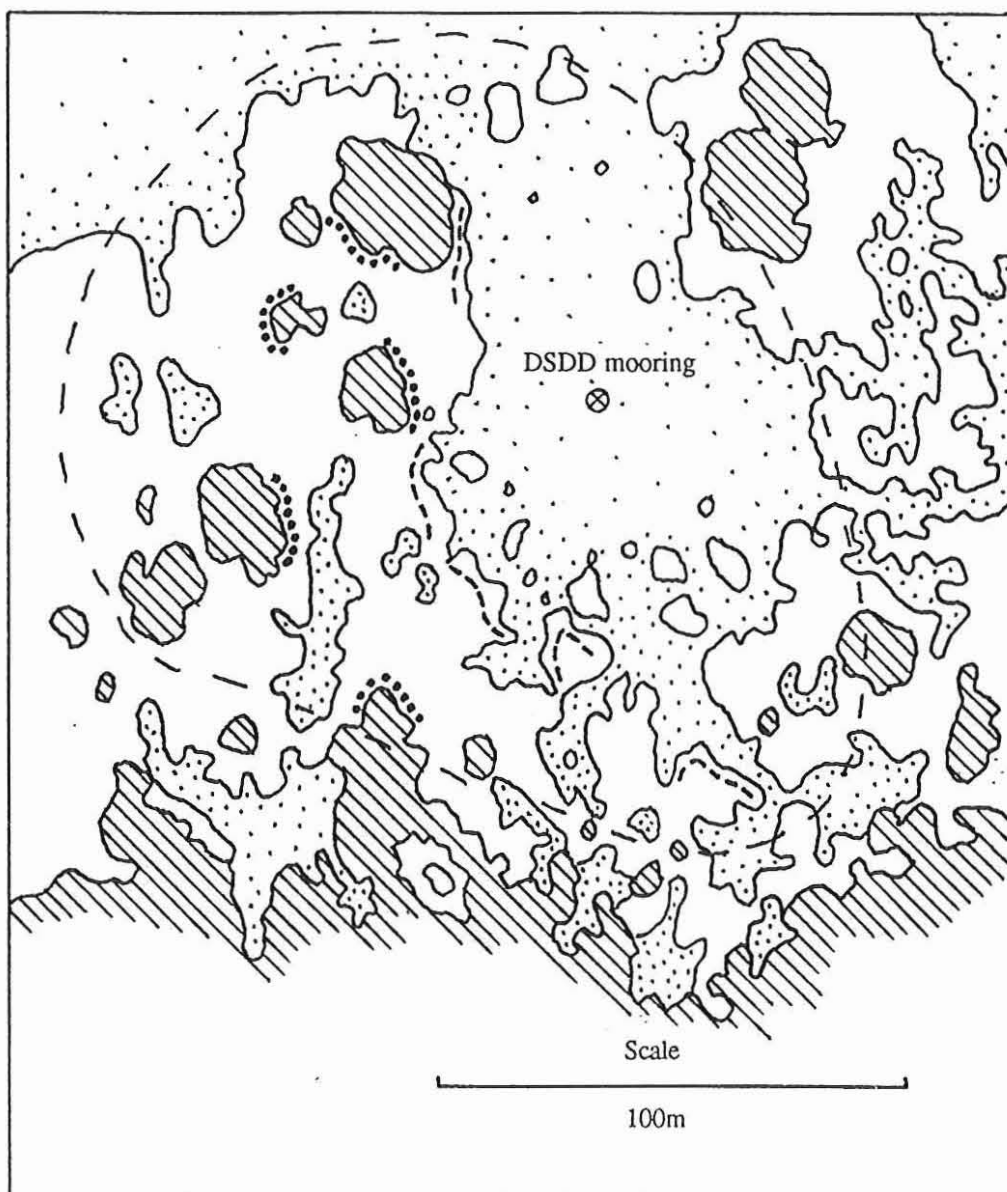





FIGURE 6. CONTROL SITE

Dashed line encloses area within which fish counts were made; short dashed lines mark position of deep coral transects; short dotted lines mark position of shallow coral transects

Key:  sand  reef slope  reef flat

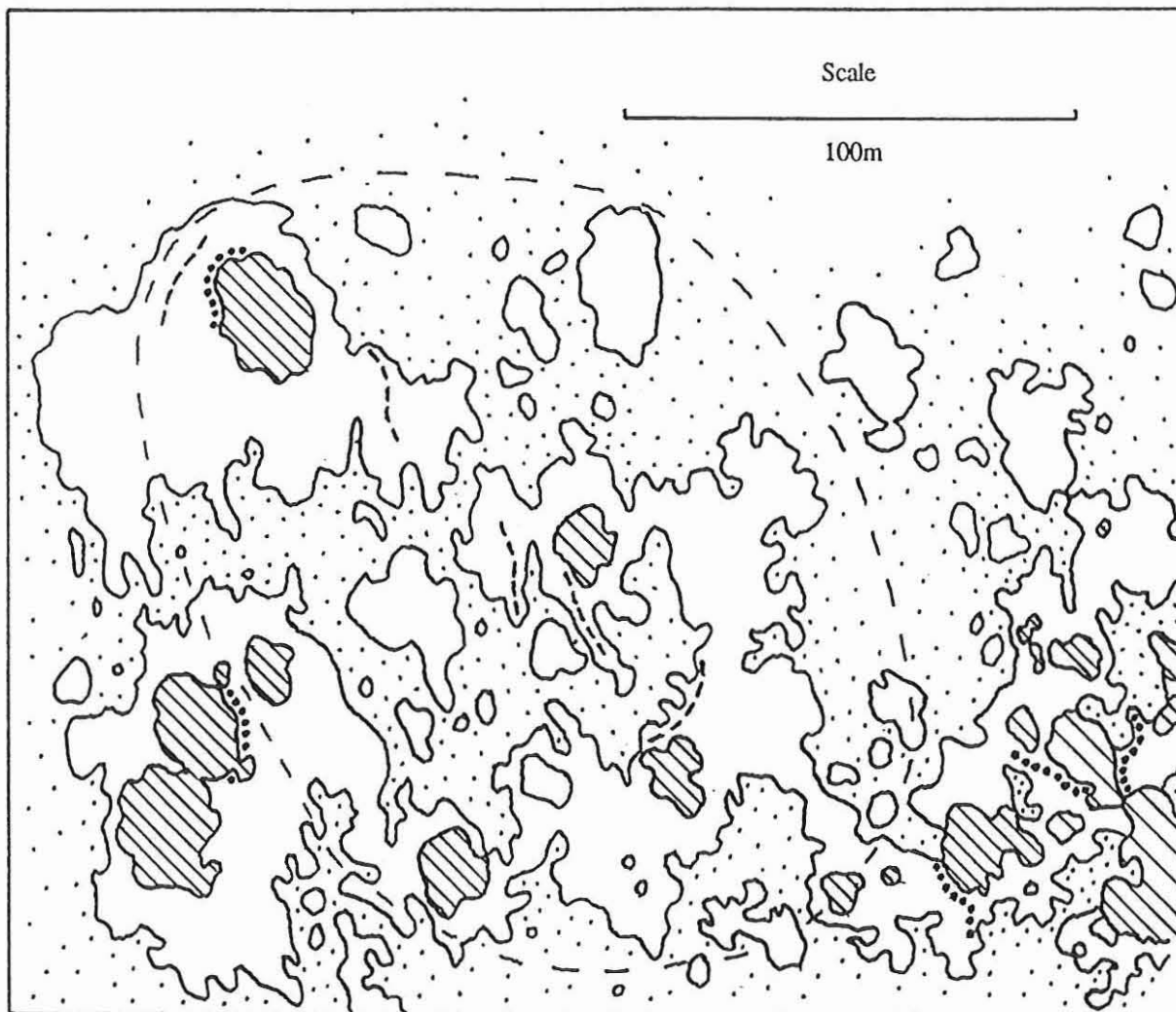



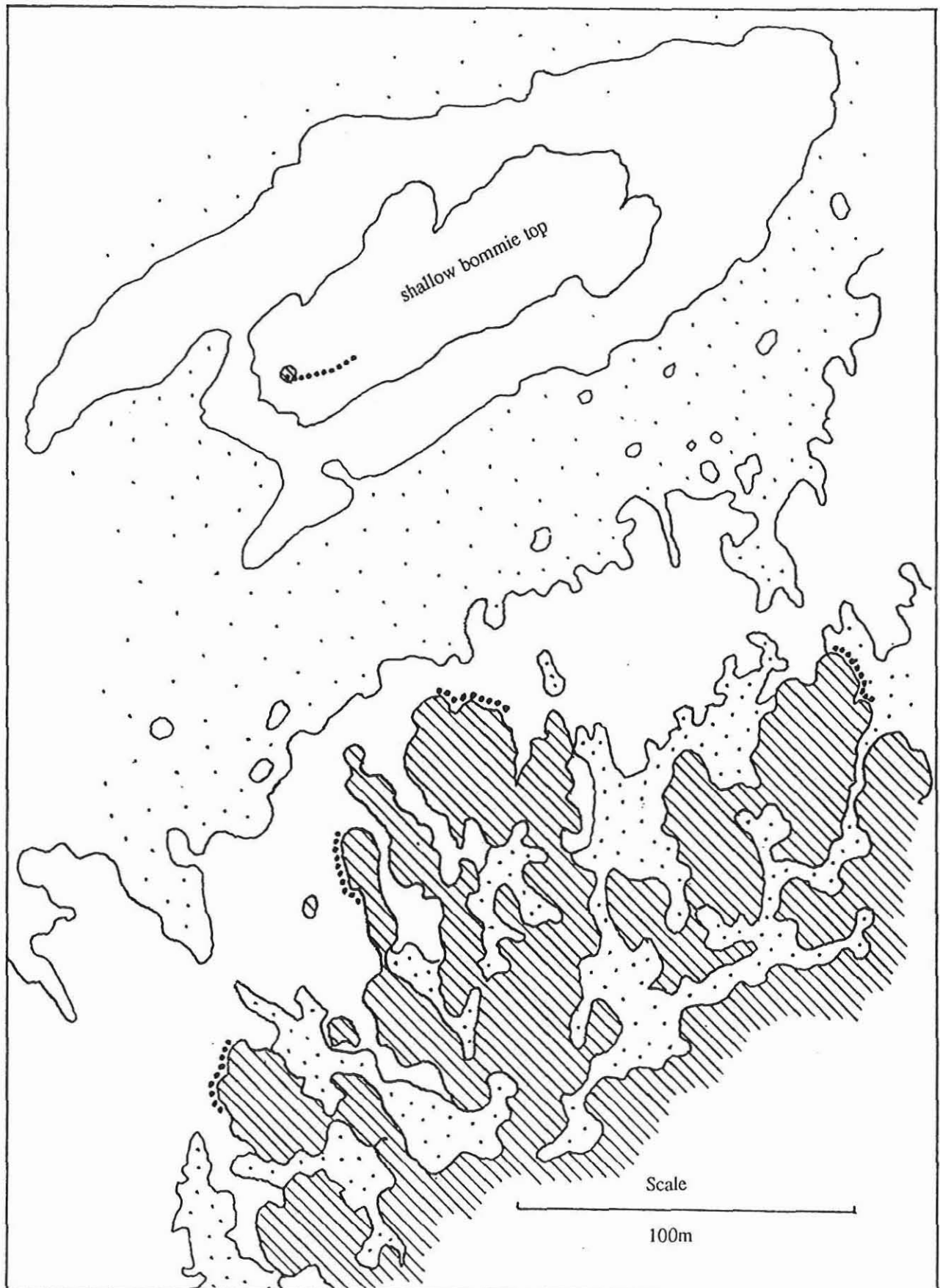


FIGURE 7. SEMI-SUB SITE

Short dotted lines mark position of shallow coral transects

Key:  sand  reef slope  reef flat



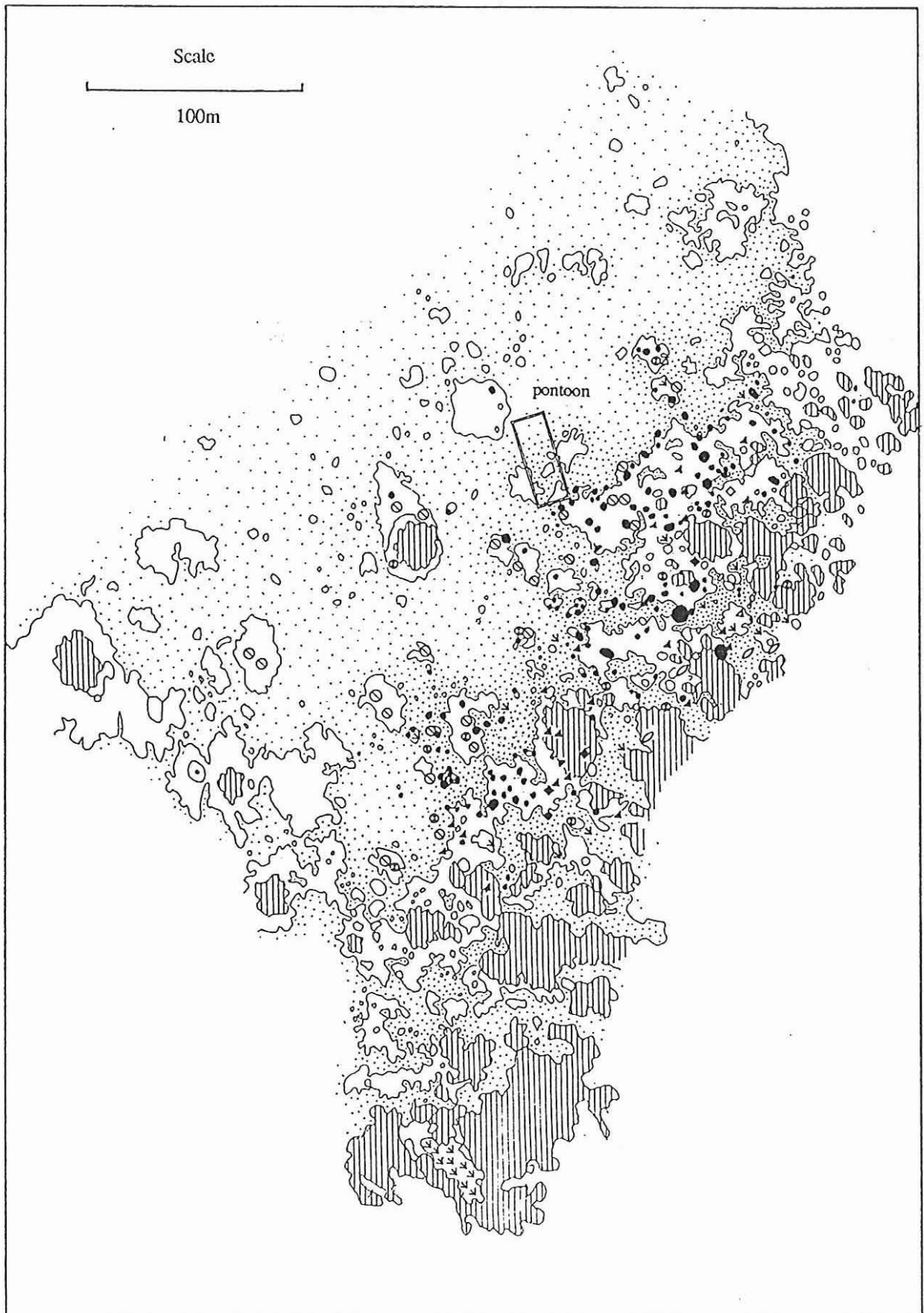
KEY TO NORMAN REEF RESOURCE MAP - FIGURE 8:

- Massive *Porites* heads
- ⊖ Finger *Porites* colonies
- ▼ Plate forming *Acropora* corals
- ▽ Clumping *Acropora* corals
- ∨ Staghorn *Acropora* corals
- ⊕ Massive brown dome corals (*Diploastrea*)
- ⊖ Yellow whorl coral (*Turbinaria*)
- ⊖ Encrusting blue coral (*Montipora*)
- Soft corals
- ◌ Giant clams

- ▤ Reef top - with scattered small clumping corals
- Reef slope
- ▤ Sand floor
- ▣ Hayles pontoon

FIGURE 8. RESOURCE MAP OF PONTOON SITE

See separate Key



APPENDIX 1

RAW DATA FROM THE SURVEYS OF HARD CORALS AND OTHER ENCrustING ORGANISMS MADE IN THE FOUR MONITORING SITES ON NORMAN REEF

Raw data from the 5 replicate permanent transects is shown as total intercepts in cm for each species or group of species, along with the mean and standard deviation for each group of transects (bold type). See figures 4-7 for the position of the transects.

ENCRUSTING ORGANISMS and SUBSTRATUM TYPE: NORMAN REEF; pontoon, shallow; 1st Apr.1987

Transect #	1 (cm)	2 (cm)	3 (cm)	4 (cm)	5 (cm)	mean (% cover)	std.dev. (% cover)
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SUBSTRATUM TYPE:

Coral basemnt	739	542	1160	879	790	41.1	11.3
Coral rubble	0	0	0	0	0	0.0	0.0
Sand	0	0	0	0	0	0.0	0.0

HARD CORALS:

POCILLOPORIDAE							
<i>Seriatopora hystrix</i>	0	0	0	0	0	0.0	0.0
<i>Pocillopora spp.</i>	5	0	6	0	0	0.1	0.2
<i>Stylophora pistillata</i>	30	37	28	34	3	1.3	0.7
ACROPORIDAE							
<i>Acropora palifera</i>	61	26	52	35	0	1.7	1.2
<i>Acropora humilis</i>	0	58	0	39	82	1.8	1.8
Acropora staghorn	70	20	25	5	55	1.8	1.3
Acropora small clumps	172	305	21	81	177	7.6	5.4
Acropora plate	100	416	218	10	57	8.0	8.1
Montipora explanate	202	10	35	235	154	6.4	5.0
PORITIDAE							
<i>Goniopora/Alveopora spp.</i>	0	0	0	0	0	0.0	0.0
Porites massive	299	334	215	365	361	15.7	3.1
Porites finger	0	0	0	10	22	0.3	0.5
<i>Porites lichen</i>	0	0	0	0	0	0.0	0.0
OCULINIDAE							
<i>Galaxea spp.</i>	0	0	0	0	0	0.0	0.0
MUSSIDAE							
<i>Lobophyllia/Symphyllia spp.</i>	0	0	0	0	0	0.0	0.0
MERULINIDAE							
<i>Hydnophora/Merulina spp.</i>	12	0	0	0	0	0.1	0.3
FAVIIDAE							
<i>Favial/Favites spp.</i>	44	63	57	75	62	3.0	0.6
<i>Goniastrea spp.</i>	45	63	20	23	21	1.7	1.0
<i>Platygyra spp.</i>	0	35	0	0	0	0.4	0.8
<i>Echinopora spp.</i>	0	0	0	0	0	0.0	0.0
DENDOPHYLLIIDAE							
<i>Turbinaria spp.</i>	0	0	0	0	0	0.0	0.0
OTHER HARD CORALS	70	7	17	89	106	2.9	2.2

SOFT CORALS:

<i>Sinularia spp.</i>	0	0	0	0	45	0.5	1.0
<i>Sarcophyton spp.</i>	77	0	0	0	0	0.8	1.7
Tufted low fawn	0	7	0	40	5	0.5	0.8
<i>Rumphella aggregata</i>	57	10	93	26	5	1.9	1.8
Other soft corals	0	0	0	20	42	0.6	0.9

TOTAL COVER OF ENCRUSTING ORGANISMS:

Macroalgae	10	36	42	8	13	1.1	0.8
Turfing Algae	0	15	0	0	0	0.2	0.3
Sponges	2	3	11	0	0	0.2	0.2
Hard Corals	1110	1374	694	1001	1100	52.8	12.2
Dead Standing Coral	5	13	0	26	0	0.4	0.5
Millepora Corals	0	0	0	0	0	0.0	0.0
Soft Corals	134	17	93	86	97	4.3	2.1
Ascidians	0	0	0	0	0	0.0	0.0

Data from five 20m intersect line transects as total cm intersects with mean % cover

ENCrustING ORGANISMS and SUBSTRATUM TYPE: NORMAN REEF; pontoon, shallow; 20th June 1988

Transect #	1 (cm)	2 (cm)	3 (cm)	4 (cm)	5 (cm)	mean (% cover)	std.dev. (% cover)
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SUBSTRATUM TYPE:

Coral basemnt	638	586	729	604	549	31.1	3.4
Coral rubble	0	0	0	0	0	0.0	0.0
Sand	0	0	0	0	0	0.0	0.0

HARD CORALS:

POCILLOPORIDAE							
<i>Seriatopora hystrix</i>	0	0	26	0	0	0.3	0.6
<i>Pocillopora spp.</i>	0	0	13	26	0	0.4	0.6
<i>Stylophora pistillata</i>	13	23	0	13	8	0.6	0.4
ACROPORIDAE							
<i>Acropora palifera</i>	39	21	44	44	6	1.5	0.8
<i>Acropora humilis</i>	0	88	0	63	94	2.5	2.3
Acropora staghorn	63	102	28	72	285	5.5	5.1
Acropora small clumps	128	165	125	119	133	6.7	0.9
Acropora plate	281	338	200	52	80	9.5	6.2
Montipora explanate	168	28	74	372	28	6.7	7.2
PORITIDAE							
<i>Goniopora/Alveopora spp.</i>	0	0	0	27	0	0.3	0.6
Porites massive	325	339	303	187	407	15.6	4.0
Porites finger	0	13	0	0	34	0.5	0.7
<i>Porites lichen</i>	0	0	0	0	0	0.0	0.0
OCULINIDAE							
<i>Galaxea spp.</i>	0	0	0	0	0	0.0	0.0
MUSSIDAE							
<i>Lobophyllia/Symphyllia spp.</i>	26	10	18	35	0	0.9	0.7
MERULINIDAE							
<i>Hydnophora/Merulina spp.</i>	0	0	0	0	0	0.0	0.0
FAVIIDAE							
<i>Favia/Favites spp.</i>	30	16	72	124	51	2.9	2.1
<i>Goniastrea spp.</i>	29	83	62	25	44	2.4	1.2
<i>Platygyra spp.</i>	79	86	53	36	10	2.6	1.6
<i>Echinopora spp.</i>	0	0	8	0	9	0.2	0.2
DENDOPHYLLIIDAE							
<i>Turbinaria spp.</i>	0	0	0	0	0	0.0	0.0
OTHER HARD CORALS	82	49	19	65	85	3.0	1.4

SOFT CORALS:

<i>Sinularia spp.</i>	24	0	21	13	38	1.0	0.7
<i>Sarcophyton spp.</i>	51	0	0	25	0	0.8	1.1
Tufty low fawn	0	0	0	9	0	0.1	0.2
<i>Rumphella aggregata</i>	19	0	98	61	5	1.8	2.1
Other soft corals	0	14	0	13	63	0.9	1.3

TOTAL COVER OF ENCRUSTING ORGANISMS:

Macroalgae	5	5	12	0	0	0.2	0.2
Turfing Algae	0	0	0	0	0	0.0	0.0
Sponges	0	26	30	0	13	0.7	0.7
Hard Corals	1263	1361	1045	1260	1274	62.0	5.8
Dead Standing Coral	0	8	65	15	58	1.5	1.5
Millepora Corals	0	0	0	0	0	0.0	0.0
Soft Corals	94	14	119	121	106	4.5	2.2
Ascidians	0	0	0	0	0	0.0	0.0

Data from five 20m intersect line transects as total cm intersects with mean % cover

ENCRUSTING ORGANISMS and SUBSTRATUM TYPE: NORMAN REEF; pontoon, deep; 31st Mar. 1987

Transect #	1 (cm)	2 (cm)	3 (cm)	4 (cm)	5 (cm)	mean (% cover)	std.dev. (% cover)
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SUBSTRATUM TYPE:

Coral basement	318	318	526	831	1137	31.3	17.7
Coral rubble	0	0	0	0	0	0.0	0.0
Sand	0	0	0	0	0	0.0	0.0

HARD CORALS:

POCILLOPORIDAE							
<i>Seriatopora hystrix</i>	0	0	0	0	0	0.0	0.0
<i>Pocillopora spp.</i>	0	0	0	0	0	0.0	0.0
<i>Stylophora pistillata</i>	0	0	0	0	0	0.0	0.0
ACROPORIDAE							
<i>Acropora palifera</i>	0	0	0	14	0	0.1	0.3
<i>Acropora humilis</i>	0	0	0	32	0	0.3	0.7
Acropora staghorn	270	115	0	100	13	5.0	5.4
Acropora small clumps	37	8	66	25	55	1.9	1.2
Acropora plate	0	0	0	0	0	0.0	0.0
Montipora explanate	19	35	0	14	22	0.9	0.6
PORITIDAE							
<i>Goniopora/Alveopora spp.</i>	0	0	0	0	0	0.0	0.0
Porites massive	701	94	1027	703	482	30.1	17.2
Porites finger	320	1022	226	95	139	18.0	19.0
<i>Porites lichen</i>	0	0	0	0	0	0.0	0.0
OCULINIDAE							
<i>Galaxea spp.</i>	0	0	0	0	0	0.0	0.0
MUSSIDAE							
<i>Lobophyllia/Symphyllia spp.</i>	0	0	0	0	0	0.0	0.0
MERULINIDAE							
<i>Hydnophora/Merulina spp.</i>	0	0	0	0	0	0.0	0.0
FAVIIDAE							
<i>Favial/Favites spp.</i>	49	27	0	3	0	0.8	1.1
<i>Goniastrea spp.</i>	12	0	0	0	32	0.4	0.7
<i>Platygyra spp.</i>	15	20	0	0	0	0.4	0.5
<i>Echinopora spp.</i>	0	0	0	0	0	0.0	0.0
DENDOPHYLLIIDAE							
<i>Turbinaria spp.</i>	0	0	0	0	0	0.0	0.0
OTHER HARD CORALS	43	52	93	97	43	3.3	1.4

SOFT CORALS:

<i>Sinularia spp.</i>	22	24	0	0	13	0.6	0.6
<i>Sarcophyton spp.</i>	0	0	15	0	0	0.2	0.3
Tufty low fawn	0	25	26	0	0	0.5	0.7
<i>Rumphella aggregata</i>	5	47	4	3	30	0.9	1.0
Other soft corals	5	0	0	0	0	0.1	0.1

TOTAL COVER OF ENCRUSTING ORGANISMS:

Macroalgae	5	158	9	26	0	2.0	3.3
Turfing Algae	0	38	0	0	0	0.4	0.8
Sponges	15	3	0	12	34	0.6	0.7
Hard Corals	1466	1373	1412	1083	786	61.2	14.3
Dead Standing Coral	0	12	8	26	0	0.5	0.5
Millepora Corals	164	2	0	19	0	1.9	3.6
Soft Corals	32	96	45	3	43	2.2	1.7
Ascidians	0	0	0	0	0	0.0	0.0

Data from five 20m intersect line transects as total cm intersects with mean % cover

ENCrustING ORGANISMS and SUBSTRATUM TYPE: NORMAN REEF; pontoon, deep; 20th June 1988

Transect #	1 (cm)	2 (cm)	3 (cm)	4 (cm)	5 (cm)	mean (% cover)	std.dev. (% cover)
------------	-----------	-----------	-----------	-----------	-----------	-------------------	-----------------------

SUBSTRATUM TYPE:

Coral basement	499	318	614	992	969	33.9	14.8
Coral rubble	0	0	0	0	0	0.0	0.0
Sand	0	0	0	0	0	0.0	0.0

HARD CORALS:

POCILLOPORIDAE							
<i>Seriatopora hystrix</i>	41	0	0	0	0	0.4	0.9
<i>Pocillopora spp.</i>	21	6	0	0	8	0.4	0.4
<i>Stylophora pistillata</i>	0	0	0	0	3	0.0	0.1
ACROPORIDAE							
<i>Acropora palifera</i>	0	0	0	0	0	0.0	0.0
<i>Acropora humilis</i>	0	0	0	0	0	0.0	0.0
Acropora staghorn	234	61	0	18	0	3.1	5.0
Acropora small clumps	40	0	46	15	39	1.4	1.0
Acropora plate	0	0	0	0	0	0.0	0.0
Montipora explanate	30	49	4	29	57	1.7	1.0
PORITIDAE							
<i>Goniopora/Alveopora spp.</i>	8	0	0	4	0	0.1	0.2
Porites massive	435	44	699	534	529	22.4	12.3
Porites finger	458	1105	438	90	152	22.4	20.1
<i>Porites lichen</i>	0	0	0	0	0	0.0	0.0
OCULINIDAE							
<i>Galaxea spp.</i>	0	0	0	0	0	0.0	0.0
MUSSIDAE							
<i>Lobophyllia/Symphyllia spp.</i>	0	0	0	0	0	0.0	0.0
MERULINIDAE							
<i>Hydnophora/Merulina spp.</i>	0	0	0	14	0	0.1	0.3
FAVIIDAE							
<i>Favial/Favites spp.</i>	39	21	0	0	9	0.7	0.8
<i>Goniastrea spp.</i>	6	0	0	0	23	0.3	0.5
<i>Platygyra spp.</i>	11	23	0	0	8	0.4	0.5
<i>Echinopora spp.</i>	0	0	0	0	12	0.1	0.3
DENDOPHYLLIIDAE							
<i>Turbinaria spp.</i>	0	0	0	0	0	0.0	0.0
OTHER HARD CORALS	81	69	85	61	31	3.3	1.1

SOFT CORALS:

<i>Sinularia spp.</i>	18	49	0	21	13	1.0	0.9
<i>Sarcophyton spp.</i>	0	0	19	0	0	0.2	0.4
Tufty low fawn	0	0	0	6	0	0.1	0.1
<i>Rumphella aggregata</i>	0	29	6	5	43	0.8	0.9
Other soft corals	0	0	0	13	0	0.1	0.3

TOTAL COVER OF ENCRUSTING ORGANISMS:

Macroalgae	0	206	0	8	0	2.1	4.6
Turfing Algae	0	8	26	0	0	0.3	0.6
Sponges	31	0	11	16	56	1.1	1.1
Hard Corals	1404	1378	1272	765	871	56.9	14.9
Dead Standing Coral	26	12	52	148	48	2.9	2.7
Millepora Corals	22	0	0	26	0	0.5	0.7
Soft Corals	18	78	25	45	56	2.2	1.2
Ascidians	0	0	0	0	0	0.0	0.0

Data from five 20m intersect line transects as total cm intersects with mean % cover

ENCrustING ORGANISMS and SUBSTRATUM TYPE: NORMAN REEF; DSDD, shallow; 2nd July 1987

Transect #	1 (cm)	2 (cm)	3 (cm)	4 (cm)	5 (cm)	mean (% cover)	std.dev. (% cover)
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SUBSTRATUM TYPE:

Coral basement	888	758	707	621	445	34.2	8.2
Coral rubble	0	0	0	0	0	0.0	0.0
Sand	0	0	0	0	0	0.0	0.0

HARD CORALS:

POCILLOPORIDAE							
<i>Seriatopora hystrix</i>	32	0	0	0	23	0.6	0.8
<i>Pocillopora spp.</i>	63	69	15	59	21	2.3	1.3
<i>Stylophora pistillata</i>	25	0	9	7	39	0.8	0.8
ACROPORIDAE							
<i>Acropora palifera</i>	8	8	0	0	0	0.2	0.2
<i>Acropora humilis</i>	0	8	0	0	17	0.3	0.4
Acropora staghorn	32	0	0	0	122	1.5	2.6
Acropora small clumps	102	186	153	97	387	9.3	5.9
Acropora plate	14	0	0	58	166	2.4	3.5
Montipora explanate	67	200	22	125	93	5.1	3.3
PORITIDAE							
<i>Goniopora/Alveopora spp.</i>	55	63	14	17	0	1.5	1.4
Porites massive	187	388	302	210	76	11.6	5.9
Porites finger	0	0	16	12	0	0.3	0.4
<i>Porites lichen</i>	0	0	0	0	0	0.0	0.0
OCULINIDAE							
<i>Galaxea spp.</i>	0	0	8	0	0	0.1	0.2
MUSSIDAE							
<i>Lobophyllia/Symphyllia spp.</i>	12	0	8	0	0	0.2	0.3
MERULINIDAE							
<i>Hydnophora/Merulina spp.</i>	0	0	8	7	0	0.2	0.2
FAVIIDAE							
<i>Favia/Favites spp.</i>	37	37	52	27	48	2.0	0.5
<i>Goniastrea spp.</i>	0	6	36	81	46	1.7	1.6
<i>Platygyra spp.</i>	38	24	0	61	50	1.7	1.2
<i>Echinopora spp.</i>	13	0	0	0	0	0.1	0.3
DENDOPHYLLIIDAE							
<i>Turbinaria spp.</i>	0	0	176	101	0	5.5	8.0
OTHER HARD CORALS	1	48	131	4	11	2.0	2.7

SOFT CORALS:

<i>Sinularia spp.</i>	0	28	0	75	59	1.6	1.7
<i>Sarcophyton spp.</i>	73	31	52	98	7	2.6	1.8
Tufty low fawn	35	45	47	57	21	2.1	0.7
<i>Rumphella aggregata</i>	90	8	12	0	10	1.2	1.9
Other soft corals	75	8	112	24	93	3.1	2.2

TOTAL COVER OF ENCRUSTING ORGANISMS:

Macroalgae	61	5	22	3	20	1.1	1.2
Turfing Algae	0	0	0	0	35	0.4	0.8
Sponges	46	8	23	0	0	0.8	1.0
Hard Corals	686	1037	950	866	1099	46.4	8.1
Dead Standing Coral	0	72	75	107	184	4.4	3.3
Millepora Corals	46	0	0	141	27	2.1	2.9
Soft Corals	273	120	223	254	190	10.6	3.0
Ascidians	0	0	0	8	0	0.1	0.2

Data from five 20m intersect line transects as total cm intersects with mean % cover

Transect #	1 (cm)	2 (cm)	3 (cm)	4 (cm)	5 (cm)	mean (% cover)	std.dev. (% cover)
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SUBSTRATUM TYPE:

Coral basement	847	686	881	695	340	34.5	10.7
Coral rubble	0	0	0	0	0	0.0	0.0
Sand	0	0	0	0	0	0.0	0.0

HARD CORALS:

POCILLOPORIDAE							
<i>Seriatopora hystrix</i>	11	11	0	16	16	0.5	0.3
<i>Pocillopora spp.</i>	15	78	62	72	20	2.5	1.5
<i>Stylophora pistillata</i>	55	0	7	30	20	1.1	1.1
ACROPORIDAE							
<i>Acropora palifera</i>	7	20	0	0	0	0.3	0.4
<i>Acropora humilis</i>	23	7	0	0	6	0.4	0.5
Acropora staghorn	22	8	0	53	182	2.7	3.7
Acropora small clumps	90	162	83	150	401	8.9	6.5
Acropora plate	0	16	26	21	271	3.3	5.7
Montipora explanate	114	256	17	152	137	6.8	4.3
PORITIDAE							
<i>Goniopora/Alveopora spp.</i>	51	92	15	16	0	1.7	1.9
Porites massive	218	260	351	127	73	10.3	5.5
Porites finger	0	0	21	9	7	0.4	0.4
<i>Porites lichen</i>	0	0	0	0	0	0.0	0.0
OCULINIDAE							
<i>Galaxea spp.</i>	0	0	0	0	0	0.0	0.0
MUSSIDAE							
<i>Lobophyllia/Symphylia spp.</i>	0	0	0	0	0	0.0	0.0
MERULINIDAE							
<i>Hydnophora/Merulina spp.</i>	0	0	11	0	0	0.1	0.2
FAVIIDAE							
<i>Favia/Favites spp.</i>	29	42	40	15	59	1.9	0.8
<i>Goniastrea spp.</i>	8	8	34	46	42	1.4	0.9
<i>Platygyra spp.</i>	12	4	0	67	46	1.3	1.5
<i>Echinopora spp.</i>	24	0	0	0	0	0.2	0.5
DENDOPHYLLIIDAE							
<i>Turbinaria spp.</i>	0	0	179	79	0	5.2	7.9
OTHER HARD CORALS	123	71	28	4	5	2.3	2.5

SOFT CORALS:

<i>Sinularia spp.</i>	64	85	56	114	126	4.5	1.5
<i>Sarcophyton spp.</i>	52	22	53	78	39	2.4	1.0
Tufty low fawn	37	69	30	55	11	2.0	1.1
<i>Rumphella aggregata</i>	58	19	12	12	22	1.2	1.0
Other soft corals	7	37	0	0	8	0.5	0.8

TOTAL COVER OF ENCRUSTING ORGANISMS:

Macroalgae	8	7	20	6	35	0.8	0.6
Turfing Algae	57	0	50	14	69	1.9	1.5
Sponges	51	0	11	36	13	1.1	1.0
Hard Corals	802	1035	874	857	1285	48.5	9.8
Dead Standing Coral	0	40	13	0	26	0.8	0.9
Millepora Corals	17	0	0	133	26	1.8	2.8
Soft Corals	218	232	151	259	206	10.7	2.0
Ascidians	0	0	0	0	0	0.0	0.0

ENCrustING ORGANISMS and SUBSTRATUM TYPE: NORMAN REEF; DSDD, deep; 25th June 1987

Transect #	1 (cm)	2 (cm)	3 (cm)	4 (cm)	5 (cm)	mean (% cover)	std.dev. (% cover)
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SUBSTRATUM TYPE:

Coral basement	589	729	582	681	888	34.7	6.3
Coral rubble	0	0	0	0	0	0.0	0.0
Sand	0	0	0	0	0	0.0	0.0

HARD CORALS:

POCILLOPORIDAE							
<i>Seriatopora hystrix</i>	19	0	35	37	16	1.1	0.8
<i>Pocillopora spp.</i>	0	0	0	0	0	0.0	0.0
<i>Stylophora pistillata</i>	17	15	53	20	30	1.4	0.8
ACROPORIDAE							
<i>Acropora palifera</i>	0	8	0	36	0	0.4	0.8
<i>Acropora humilis</i>	0	0	0	15	0	0.2	0.3
Acropora staghorn	0	13	0	0	115	1.3	2.5
Acropora small clumps	264	187	216	159	118	9.4	2.8
Acropora plate	0	0	0	26	0	0.3	0.6
Montipora explanate	56	75	204	137	100	5.7	2.9
PORITIDAE							
<i>Goniopora/Alveopora spp.</i>	0	0	0	0	26	0.3	0.6
Porites massive	111	216	195	268	52	8.4	4.3
Porites finger	528	324	260	132	351	16.0	7.2
<i>Porites lichen</i>	0	0	0	0	7	0.1	0.2
OCULINIDAE							
<i>Galaxea spp.</i>	0	0	4	0	12	0.2	0.3
MUSSIDAE							
<i>Lobophyllia/Symphyllia spp.</i>	0	37	0	0	0	0.4	0.8
MERULINIDAE							
<i>Hydnophora/Merulina spp.</i>	0	0	0	13	0	0.1	0.3
FAVIIDAE							
<i>Favial/Favites spp.</i>	53	29	61	69	40	2.5	0.8
<i>Goniastrea spp.</i>	52	8	40	8	51	1.6	1.1
<i>Platygyra spp.</i>	36	24	51	41	3	1.6	0.9
<i>Echinopora spp.</i>	0	0	8	97	0	1.1	2.1
DENDOPHYLLIIDAE							
<i>Turbinaria spp.</i>	0	0	0	0	0	0.0	0.0
OTHER HARD CORALS	37	67	100	141	78	4.2	1.9

SOFT CORALS:

<i>Sinularia spp.</i>	22	6	11	11	0	0.5	0.4
<i>Sarcophyton spp.</i>	22	0	10	43	0	0.8	0.9
Tufty low fawn	0	61	13	0	6	0.8	1.3
<i>Runphella aggregata</i>	0	5	0	0	0	0.1	0.1
Other soft corals	42	63	35	11	35	1.9	0.9

TOTAL COVER OF ENCRUSTING ORGANISMS:

Macroalgae	12	0	7	4	0	0.2	0.3
Turfing Algae	0	26	0	0	0	0.3	0.6
Sponges	75	58	57	28	42	2.6	0.9
Hard Corals	1173	1003	1227	1199	999	56.0	5.5
Dead Standing Coral	61	49	56	23	30	2.2	0.8
Millepora Corals	0	0	0	0	0	0.0	0.0
Soft Corals	86	135	69	65	41	4.0	1.8
Ascidians	4	0	2	0	0	0.1	0.1

Data from five 20m intersect line transects as total cm intersects with mean % cover

ENCrustING ORGANISMS and SUBSTRATUM TYPE: NORMAN REEF; DSDD, deep; 17th June 1988

Transect #	1 (cm)	2 (cm)	3 (cm)	4 (cm)	5 (cm)	mean (% cover)	std.dev. (% cover)
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SUBSTRATUM TYPE:

Coral basement	525	556	643	513	611	28.5	2.8
Coral rubble	30	0	0	30	0	0.6	0.8
Sand	0	0	0	0	0	0.0	0.0

HARD CORALS:

POCILLOPORIDAE							
<i>Seriatopora hystrix</i>	9	60	22	25	39	1.6	1.0
<i>Pocillopora spp.</i>	0	0	0	0	0	0.0	0.0
<i>Stylophora pistillata</i>	27	6	44	55	46	1.8	1.0
ACROPORIDAE							
<i>Acropora palifera</i>	0	8	0	0	0	0.1	0.2
<i>Acropora humilis</i>	0	0	0	14	0	0.1	0.3
Acropora staghorn	3	8	0	12	181	2.0	3.9
Acropora small clumps	374	299	228	230	177	13.1	3.8
Acropora plate	0	0	0	37	0	0.4	0.8
Montipora explanate	82	73	229	169	60	6.1	3.7
PORITIDAE							
<i>Goniopora/Alveopora spp.</i>	0	0	0	0	24	0.2	0.5
Porites massive	104	160	162	252	81	7.6	3.3
Porites finger	522	368	250	119	352	16.1	7.5
<i>Porites lichen</i>	0	0	0	0	8	0.1	0.2
OCULINIDAE							
<i>Galaxea spp.</i>	0	12	5	0	20	0.4	0.4
MUSSIDAE							
<i>Lobophyllia/Symphyllia spp.</i>	14	32	0	4	0	0.5	0.7
MERULINIDAE							
<i>Hydnophora/Merulina spp.</i>	0	0	0	0	0	0.0	0.0
FAVIIDAE							
<i>Favia/Favites spp.</i>	45	13	64	64	45	2.3	1.0
<i>Goniastrea spp.</i>	43	31	39	38	66	2.2	0.7
<i>Platygyra spp.</i>	23	28	16	11	0	0.8	0.5
<i>Echinopora spp.</i>	0	0	10	99	0	1.1	2.2
DENDOPHYLLIIDAE							
<i>Turbinaria spp.</i>	0	0	0	8	0	0.2	0.4
OTHER HARD CORALS	44	70	79	135	140	4.7	2.1

SOFT CORALS:

<i>Sinularia spp.</i>	63	69	37	41	96	3.1	1.2
<i>Sarcophyton spp.</i>	24	0	12	10	0	0.5	0.5
Tufty low fawn	0	20	12	0	0	0.3	0.5
<i>Rumphella aggregata</i>	7	0	6	0	0	0.1	0.2
Other soft corals	0	6	8	0	0	0.1	0.2

TOTAL COVER OF ENCRUSTING ORGANISMS:

Macroalgae	6	8	16	8	10	0.5	0.2
Turfing Algae	18	133	15	71	12	2.5	2.6
Sponges	37	28	47	35	7	1.5	0.7
Hard Corals	1290	1168	1148	1272	1239	61.2	3.1
Dead Standing Coral	0	0	30	20	25	0.8	0.7
Millepora Corals	0	12	26	0	0	0.4	0.6
Soft Corals	94	95	75	51	96	4.1	1.0
Ascidians	0	0	0	0	0	0.0	0.0

Data from five 20m intersect line transects as total cm intersects with mean % cover

ENCRUSTING ORGANISMS and SUBSTRATUM TYPE: NORMAN REEF; control, shallow; 16th July 1987

Transect #	1 (cm)	2 (cm)	3 (cm)	4 (cm)	5 (cm)	mean (% cover)	std.dev. (% cover)
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SUBSTRATUM TYPE:

Coral basement	1451	1078	602	482	863	44.8	19.4
Coral rubble	0	0	0	0	0	0.0	0.0
Sand	0	0	0	0	0	0.0	0.0

HARD CORALS:

POCILLOPORIDAE							
<i>Seriatopora hystrix</i>	0	0	13	0	0	0.1	0.3
<i>Pocillopora spp.</i>	29	12	0	0	7	0.5	0.6
<i>Stylophora pistillata</i>	19	0	35	0	15	0.7	0.7
ACROPORIDAE							
<i>Acropora palifera</i>	0	0	0	0	0	0.0	0.0
<i>Acropora humilis</i>	53	110	31	205	0	4.0	4.0
Acropora staghorn	26	97	0	237	40	4.0	4.7
Acropora small clumps	44	98	63	125	212	5.4	3.3
Acropora plate	56	244	227	517	140	11.8	8.7
Montipora explanate	35	93	53	18	28	2.3	1.5
PORITIDAE							
<i>Goniopora/Alveopora spp.</i>	8	0	0	0	0	0.1	0.2
Porites massive	40	22	141	139	434	7.8	8.3
Porites finger	0	0	386	0	30	4.2	8.5
<i>Porites lichen</i>	0	0	0	0	0	0.0	0.0
OCULINIDAE							
<i>Galaxea spp.</i>	0	3	4	0	0	0.1	0.1
MUSSIDAE							
<i>Lobophyllia/Symphylia spp.</i>	6	0	7	12	0	0.3	0.3
MERULINIDAE							
<i>Hydnophora/Merulina spp.</i>	0	0	0	0	0	0.0	0.0
FAVIIDAE							
<i>Favia/Favites spp.</i>	12	0	43	56	28	1.4	1.1
<i>Goniastrea spp.</i>	16	13	72	7	6	1.1	1.4
<i>Platygyra spp.</i>	7	0	54	22	12	1.0	1.1
<i>Echinopora spp.</i>	0	0	0	0	0	0.0	0.0
DENDOPHYLLIIDAE							
<i>Turbinaria spp.</i>	0	0	0	0	0	0.0	0.0
OTHER HARD CORALS	29	2	20	4	11	0.7	0.6

SOFT CORALS:

<i>Sinularia spp.</i>	37	81	64	40	8	2.3	1.4
<i>Sarcophyton spp.</i>	28	8	45	51	0	1.3	1.1
Tufted low fawn	0	13	21	42	6	0.8	0.8
<i>Rumphella aggregata</i>	0	12	22	0	12	0.5	0.5
Other soft corals	5	0	0	0	46	0.5	1.0

TOTAL COVER OF ENCRUSTING ORGANISMS:

Macroalgae	34	87	27	11	17	1.8	1.5
Turfing Algae	0	0	0	0	0	0.0	0.0
Sponges	0	0	34	0	48	0.8	1.1
Hard Corals	380	694	1149	1342	963	45.3	18.9
Dead Standing Coral	65	27	36	32	37	2.0	0.7
Millepora Corals	0	0	0	0	0	0.0	0.0
Soft Corals	70	114	152	133	72	5.4	1.8
Ascidians	0	0	0	0	0	0.0	0.0

Data from five 20m intersect line transects as total cm intersects with mean % cover

ENCrustING ORGANISMS and SUBSTRATUM TYPE: NORMAN REEF; control, shallow; 19th June 1988

Transect #	1 (cm)	2 (cm)	3 (cm)	4 (cm)	5 (cm)	mean (% cover)	std.dev. (% cover)
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SUBSTRATUM TYPE:

Coral basement	1522	1089	465	382	626	40.8	24.0
Coral rubble	0	0	0	0	0	0.0	0.0
Sand	0	0	0	0	0	0.0	0.0

HARD CORALS:

POCILLOPORIDAE							
<i>Seriatopora hystrix</i>	0	0	40	0	0	0.4	0.9
<i>Pocillopora spp.</i>	49	29	7	0	0	0.9	1.1
<i>Stylophora pistillata</i>	21	0	28	0	13	0.6	0.6
ACROPORIDAE							
<i>Acropora palifera</i>	0	0	12	0	0	0.1	0.3
<i>Acropora humilis</i>	40	141	27	132	0	3.4	3.2
Acropora staghorn	17	192	0	181	98	4.9	4.5
Acropora small clumps	64	76	115	195	270	7.2	4.4
Acropora plate	6	220	274	579	156	12.4	10.5
Montipora explanate	72	91	51	54	28	3.0	1.2
PORITIDAE							
<i>Goniopora/Alveopora spp.</i>	17	0	0	0	0	0.2	0.4
Porites massive	53	33	152	172	468	8.8	8.7
Porites finger	0	0	381	10	34	4.3	8.3
<i>Porites lichen</i>	0	0	0	0	0	0.0	0.0
OCULINIDAE							
<i>Galaxea spp.</i>	0	0	0	0	0	0.0	0.0
MUSSIDAE							
<i>Lobophyllia/Symphylia spp.</i>	7	0	0	13	0	0.2	0.3
MERULINIDAE							
<i>Hydnophora/Merulina spp.</i>	0	14	0	0	0	0.1	0.3
FAVIIDAE							
<i>Favia/Favites spp.</i>	11	0	66	57	21	1.6	1.4
<i>Goniastrea spp.</i>	23	0	62	12	32	1.3	1.2
<i>Platygyra spp.</i>	0	0	73	10	15	1.0	1.5
<i>Echinopora spp.</i>	0	0	13	0	0	0.1	0.3
DENDOPHYLLIIDAE							
<i>Turbinaria spp.</i>	0	0	0	0	0	0.0	0.0
OTHER HARD CORALS	32	2	19	4	5	0.6	0.6

SOFT CORALS:

<i>Sinularia spp.</i>	0	28	70	44	70	2.1	1.5
<i>Sarcophyton spp.</i>	32	17	71	58	0	1.8	1.5
Tufty low fawn	0	14	13	27	24	0.8	0.5
<i>Rumphella aggregata</i>	0	0	22	0	13	0.4	0.5
Other soft corals	0	0	0	47	13	0.6	1.0

TOTAL COVER OF ENCRUSTING ORGANISMS:

Macroalgae	18	22	20	6	4	0.7	0.4
Turfing Algae	16	12	0	17	0	0.5	0.4
Sponges	0	0	19	0	110	1.3	2.4
Hard Corals	412	798	1320	1419	1140	50.9	20.7
Dead Standing Coral	0	12	0	0	0	0.1	0.3
Millepora Corals	0	8	0	0	0	0.1	0.2
Soft Corals	32	59	176	176	120	5.6	3.3
Ascidians	0	0	0	0	0	0.0	0.0

Data from five 20m intersect line transects as total cm intersects with mean % cover

ENCrustING ORGANISMS and SUBSTRATUM TYPE: NORMAN REEF; control, deep; 3rd July 1987

Transect #	1 (cm)	2 (cm)	3 (cm)	4 (cm)	5 (cm)	mean (% cover)	std.dev. (% cover)
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SUBSTRATUM TYPE:

Coral basement	500	851	731	1025	917	40.2	10.0
Coral rubble	0	0	0	0	0	0.0	0.0
Sand	0	0	0	0	0	0.0	0.0

HARD CORALS:

POCILLOPORIDAE							
<i>Seriatopora hystrix</i>	12	5	7	6	31	0.6	0.5
<i>Pocillopora spp.</i>	12	0	0	0	7	0.2	0.3
<i>Stylophora pistillata</i>	0	0	0	0	0	0.0	0.0
ACROPORIDAE							
<i>Acropora palifera</i>	0	0	0	0	0	0.0	0.0
<i>Acropora humilis</i>	0	0	0	0	0	0.0	0.0
Acropora staghorn	10	18	0	0	0	0.3	0.4
Acropora small clumps	155	99	220	57	14	5.5	4.1
Acropora plate	0	0	0	0	0	0.0	0.0
Montipora explanate	35	82	15	0	25	1.6	1.6
PORITIDAE							
<i>Goniopora/Alveopora spp.</i>	0	0	0	20	0	0.2	0.4
Porites massive	178	123	154	484	338	12.8	7.6
Porites finger	564	342	482	11	274	16.7	10.7
<i>Porites lichen</i>	0	0	0	0	0	0.0	0.0
OCULINIDAE							
<i>Galaxea spp.</i>	6	0	0	0	4	0.1	0.1
MUSSIDAE							
<i>Lobophyllia/Symphyllia spp.</i>	0	0	0	0	0	0.0	0.0
MERULINIDAE							
<i>Hydnophora/Merulina spp.</i>	12	8	0	0	5	0.3	0.3
FAVIIDAE							
<i>Favia/Favites spp.</i>	25	10	11	0	40	0.9	0.8
<i>Goniastrea spp.</i>	71	26	0	7	5	1.1	1.5
<i>Platygyra spp.</i>	8	12	7	0	0	0.3	0.3
<i>Echinopora spp.</i>	33	11	0	13	36	0.9	0.8
DENDOPHYLLIIDAE							
<i>Turbinaria spp.</i>	0	0	0	0	0	0.0	0.0
OTHER HARD CORALS	69	40	9	55	48	2.2	1.1

SOFT CORALS:

<i>Sinularia spp.</i>	36	6	0	0	0	0.4	0.8
<i>Sarcophyton spp.</i>	0	0	8	0	8	0.2	0.2
Tufty low fawn	0	44	6	0	0	0.5	1.0
<i>Rumphella aggregata</i>	0	0	4	0	0	0.0	0.1
Other soft corals	60	148	28	18	18	2.7	2.8

TOTAL COVER OF ENCRUSTING ORGANISMS:

Macroalgae	0	27	51	5	11	0.9	1.0
Turfing Algae	0	100	50	35	0	1.9	2.1
Sponges	55	13	29	119	59	2.8	2.0
Hard Corals	1190	776	905	653	827	43.5	10.0
Dead Standing Coral	123	7	62	97	98	3.9	2.2
Millepora Corals	36	28	126	48	49	2.9	2.0
Soft Corals	96	198	46	18	26	3.8	3.7
Ascidians	0	0	0	0	13	0.1	0.3

Data from five 20m intersect line transects as total cm intersects with mean % cover

ENCrustING ORGANISMS and SUBSTRATUM TYPE: NORMAN REEF; control, deep; 19th June 1988

Transect #	1 (cm)	2 (cm)	3 (cm)	4 (cm)	5 (cm)	mean (% cover)	std.dev. (% cover)
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SUBSTRATUM TYPE:

Coral basement	375	684	574	963	956	35.5	12.6
Coral rubble	0	0	0	0	0	0.0	0.0
Sand	0	0	0	0	0	0.0	0.0

HARD CORALS:

POCILLOPORIDAE							
<i>Seriatopora hystrix</i>	0	16	33	0	0	0.5	0.7
<i>Pocillopora spp.</i>	9	0	8	0	13	0.3	0.3
<i>Stylophora pistillata</i>	0	39	10	5	0	0.5	0.8
ACROPORIDAE							
<i>Acropora palifera</i>	0	0	0	0	0	0.0	0.0
<i>Acropora humilis</i>	0	0	0	0	0	0.0	0.0
Acropora staghorn	33	63	0	0	0	1.0	1.4
Acropora small clumps	188	108	230	62	34	6.2	4.1
Acropora plate	0	0	0	0	13	0.1	0.3
Montipora explanate	80	85	44	6	0	2.2	2.0
PORITIDAE							
<i>Goniopora/Alveopora spp.</i>	0	0	0	23	0	0.2	0.5
Porites massive	137	140	167	457	333	12.3	7.1
Porites finger	594	353	513	33	337	18.3	10.8
<i>Porites lichen</i>	0	0	0	0	0	0.0	0.0
OCULINIDAE							
<i>Galaxea spp.</i>	0	0	9	0	4	0.1	0.2
MUSSIDAE							
<i>Lobophyllia/Symphylia spp.</i>	0	18	0	0	0	0.2	0.4
MERULINIDAE							
<i>Hydnophora/Merulina spp.</i>	0	8	0	0	0	0.1	0.2
FAVIIDAE							
<i>Favia/Favites spp.</i>	40	7	6	0	14	0.7	0.8
<i>Goniastrea spp.</i>	98	23	5	0	6	1.3	2.0
<i>Platygyra spp.</i>	8	20	19	8	0	0.6	0.4
<i>Echinopora spp.</i>	32	21	0	42	29	1.2	0.8
DENDOPHYLLIIDAE							
<i>Turbinaria spp.</i>	0	0	0	0	0	0.0	0.0
OTHER HARD CORALS	130	53	40	62	51	3.4	1.8

SOFT CORALS:

<i>Sinularia spp.</i>	176	193	27	8	8	4.1	4.7
<i>Sarcophyton spp.</i>	0	0	8	0	13	0.2	0.3
Tufty low fawn	0	27	0	7	0	0.3	0.6
<i>Rumphella aggregata</i>	0	8	0	0	0	0.1	0.2
Other soft corals	0	0	0	0	0	0.0	0.0

TOTAL COVER OF ENCRUSTING ORGANISMS:

Macroalgae	14	22	18	4	11	0.7	0.3
Turfing Algae	0	36	61	231	6	3.3	4.8
Sponges	50	29	40	61	33	2.1	0.7
Hard Corals	1349	954	1084	698	834	49.2	12.5
Dead Standing Coral	0	0	12	0	34	0.5	0.7
Millepora Corals	36	47	174	24	105	3.9	3.1
Soft Corals	176	228	35	15	21	4.8	5.0
Ascidians	0	0	2	4	0	0.1	0.1

Data from five 20m intersect line transects as total cm intersects with mean % cover

Transect #	1 (cm)	2 (cm)	3 (cm)	4 (cm)	5 (cm)	mean (% cover)	std.dev. (% cover)
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SUBSTRATUM TYPE:

Coral basement	926	948	906	725	541	40.5	8.7
Coral rubble	0	0	0	0	0	0.0	0.0
Sand	0	0	0	0	0	0.0	0.0

HARD CORALS:

POCILLOPORIDAE							
<i>Seriatopora hystrix</i>	0	0	0	0	0	0.0	0.0
<i>Pocillopora spp.</i>	78	93	61	55	13	3.0	1.5
<i>Stylophora pistillata</i>	0	16	20	0	9	0.5	0.5
ACROPORIDAE							
<i>Acropora palifera</i>	0	24	13	14	35	0.9	0.7
<i>Acropora humilis</i>	69	158	220	302	316	10.7	5.1
Acropora staghorn	171	157	14	127	161	6.3	3.2
Acropora small clumps	111	208	142	98	66	6.3	2.7
Acropora plate	637	164	118	479	556	19.5	11.8
Montipora explanate	0	47	18	0	28	0.9	1.0
PORITIDAE							
<i>Goniopora/Alveopora spp.</i>	0	0	0	0	0	0.0	0.0
Porites massive	0	11	102	68	7	1.9	2.3
Porites finger	0	0	0	0	0	0.0	0.0
<i>Porites lichen</i>	0	0	0	0	0	0.0	0.0
OCULINIDAE							
<i>Galaxea spp.</i>	0	0	5	0	0	0.1	0.1
MUSSIDAE							
<i>Lobophyllia/Symphylia spp.</i>	0	8	16	0	0	0.2	0.4
MERULINIDAE							
<i>Hydnophora/Merulina spp.</i>	0	0	0	0	0	0.0	0.0
FAVIIDAE							
<i>Favia/Favites spp.</i>	0	32	11	19	40	1.0	0.8
<i>Goniastrea spp.</i>	0	16	0	15	34	0.7	0.7
<i>Platygyra spp.</i>	0	14	15	10	0	0.4	0.4
<i>Echinopora spp.</i>	0	31	0	0	8	0.4	0.7
DENDOPHYLLIIDAE							
<i>Turbinaria spp.</i>	0	0	0	0	0	0.0	0.0
OTHER HARD CORALS	1	2	23	29	5	0.6	0.7

SOFT CORALS:

<i>Sinularia spp.</i>	0	40	143	0	28	2.1	3.0
<i>Sarcophyton spp.</i>	0	15	36	0	0	0.5	0.8
Tufty low fawn	0	0	0	8	0	0.1	0.2
<i>Rumphella aggregata</i>	0	0	112	14	8	1.3	2.4
Other soft corals	0	0	0	0	0	0.0	0.0

TOTAL COVER OF ENCRUSTING ORGANISMS:

Macroalgae	7	8	25	6	29	0.8	0.6
Turfing Algae	0	0	0	0	0	0.0	0.0
Sponges	0	0	0	0	0	0.0	0.0
Hard Corals	1067	981	778	1216	1278	53.2	9.9
Dead Standing Coral	0	8	0	31	116	1.6	2.5
Millepora Corals	0	0	0	0	0	0.0	0.0
Soft Corals	0	55	291	22	36	4.0	6.0
Ascidians	0	0	0	0	0	0.0	0.0

ENCrustING ORGANISMS and SUBSTRATUM TYPE: NORMAN REEF; semi-sub, shallow; 19th June 1988

Transect #	1 (cm)	2 (cm)	3 (cm)	4 (cm)	5 (cm)	mean (% cover)	std.dev. (% cover)
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SUBSTRATUM TYPE:

Coral basement	634	743	717	538	527	31.6	5.0
Coral rubble	0	0	0	0	0	0.0	0.0
Sand	0	0	0	0	0	0.0	0.0

HARD CORALS:

POCILLOPORIDAE							
<i>Seriatopora hystrix</i>	0	0	0	0	6	0.1	0.1
<i>Pocillopora spp.</i>	53	139	66	41	7	3.1	2.4
<i>Stylophora pistillata</i>	0	16	8	0	0	0.2	0.4
ACROPORIDAE							
<i>Acropora palifera</i>	0	46	50	14	21	1.3	1.1
<i>Acropora humilis</i>	140	195	304	310	235	11.8	3.6
<i>Acropora staghorn</i>	286	179	15	102	287	8.7	5.9
<i>Acropora small clumps</i>	59	183	220	113	79	6.5	3.4
<i>Acropora plate</i>	827	237	164	658	667	25.5	14.6
<i>Montipora explanate</i>	0	37	26	54	47	1.6	1.1
PORITIDAE							
<i>Goniopora/Alveopora spp.</i>	0	0	0	0	0	0.0	0.0
<i>Porites massive</i>	0	40	91	61	6	2.0	1.9
<i>Porites finger</i>	0	0	0	0	0	0.0	0.0
<i>Porites lichen</i>	0	0	0	0	0	0.0	0.0
OCULINIDAE							
<i>Galaxea spp.</i>	0	0	0	0	0	0.0	0.0
MUSSIDAE							
<i>Lobophyllia/Symphyllia spp.</i>	0	0	8	0	0	0.1	0.2
MERULINIDAE							
<i>Hydnophora/Merulina spp.</i>	0	0	0	0	0	0.0	0.0
FAVIIDAE							
<i>Favial/Favites spp.</i>	0	33	12	28	23	1.0	0.7
<i>Goniastrea spp.</i>	0	17	7	24	18	0.7	0.5
<i>Platygyra spp.</i>	0	13	6	0	31	0.5	0.6
<i>Echinopora spp.</i>	0	27	0	0	0	0.3	0.6
DENDOPHYLLIIDAE							
<i>Turbinaria spp.</i>	0	0	0	0	0	0.0	0.0
OTHER HARD CORALS	1	14	11	20	5	0.5	0.4

SOFT CORALS:

<i>Sinularia spp.</i>	0	17	61	0	17	1.0	1.2
<i>Sarcophyton spp.</i>	0	0	40	0	0	0.4	0.9
Tufty low fawn	0	0	56	3	0	0.6	1.2
<i>Rumphella aggregata</i>	0	14	85	13	0	1.1	1.8
Other soft corals	0	0	0	0	0	0.0	0.0

TOTAL COVER OF ENCRUSTING ORGANISMS:

Macroalgae	0	32	18	0	24	0.7	0.7
Turfing Algae	0	0	0	0	0	0.0	0.0
Sponges	0	0	0	3	0	0.0	0.1
Hard Corals	1366	1176	988	1425	1432	63.9	9.6
Dead Standing Coral	0	0	0	18	0	0.2	0.4
Millepora Corals	0	18	35	0	0	0.5	0.8
Soft Corals	0	31	242	16	17	3.1	5.1
Ascidians	0	0	0	0	0	0.0	0.0

Data from five 20m intersect line transects as total cm intersects with mean % cover

APPENDIX 2

RAW DATA FROM THE SURVEYS OF SELECTED FISHES MADE IN THREE OF THE MONITORING SITES ON NORMAN REEF

Raw data from the 5 replicate transects is shown along with the mean and standard deviation for each group of transects (bold type). See figures 4-6 for the areas within which the transects were haphazardly surveyed.

FISH COUNTS; NORMAN REEF; pontoon site; 1st April 1987

SUMMARY:

Transect #	1	2	3	4	5	mean	std.dev.
Serranidae	2	1	4	0	0	1.4	1.7
Carangidae	0	0	1	0	4	1.0	1.7
Lutjanidae	11	6	10	0	0	5.4	5.3
Caesionidae	16	8	35	12	7	15.6	11.4
Haemulidae	2	5	2	0	0	1.8	2.0
Lethrinidae	26	11	11	9	6	12.6	7.8
Ephippidae	2	0	0	1	7	2.0	2.9
Chaetodontidae	16	32	17	17	9	18.2	8.4
Labridae	2	0	0	0	0	0.4	0.9
Scaridae	16	36	76	83	56	53.4	27.8
Acanthuridae	2	3	0	0	0	1.0	1.4
Siganidae	0	0	0	0	0	0.0	0.0

Transect #	1	2	3	4	5	mean	std.dev.
SERRANIDAE - Groupers and Coral Trout							
<i>Plectropomus laevis</i>	0	1	1	0	0	0.4	0.5
<i>Plectropomus leopardus</i>	1	0	0	0	0	0.2	0.4
<i>Epinephelus fuscoguttatus</i>	0	0	0	0	0	0.0	0.0
<i>Epinephelus microdon</i>	0	0	0	0	0	0.0	0.0
<i>Epinephelus suillus</i>	0	0	1	0	0	0.2	0.4
<i>Cromileptes altivelis</i>	1	0	1	0	0	0.4	0.5
<i>Cephalopholis argus</i>	0	0	1	0	0	0.2	0.4
CARANGIDAE - Jacks and Trevallys							
<i>Carangoides plagiotaenia</i>	0	0	1	0	0	0.2	0.4
<i>Caranx speciosus</i>	0	0	0	0	4	0.8	1.8
LUTJANIDAE - Snappers							
<i>Lutjanus bohar</i>	0	4	1	0	0	1.0	1.7
<i>Lutjanus carponotatus</i>	0	0	0	0	0	0.0	0.0
<i>Lutjanus fulvus</i>	2	0	4	0	0	1.2	1.8
<i>Lutjanus gibbus</i>	0	0	3	0	0	0.6	1.3
<i>Lutjanus quinquilineatus</i>	0	0	0	0	0	0.0	0.0
<i>Lutjanus russelli</i>	9	1	2	0	0	2.4	3.8
<i>Macolor spp.</i>	0	1	0	0	0	0.2	0.4
CAESIONIDAE - Fusiliers							
<i>Caesio cuning</i>	16	8	35	12	7	15.6	11.4
<i>Caesio caerulea</i>	0	0	0	0	0	0.0	0.0
<i>Pterocaesio chrysozona</i>	0	0	0	0	0	0.0	0.0
HAEMULIDAE - Sweetlips							
<i>Plectorhynchus chaetodontoides</i>	0	1	2	0	0	0.6	0.9
<i>Plectorhynchus goldmanni</i>	2	4	0	0	0	1.2	1.8
LETHRINIDAE - Emperors							
<i>Gymnocranius spp.</i>	0	0	0	0	1	0.2	0.4
<i>Lethrinus elongatus</i>	0	3	0	0	1	0.8	1.3
<i>Lethrinus kallopterus</i>	0	0	0	0	0	0.0	0.0
<i>Lethrinus mahsena</i>	5	1	1	2	0	1.8	1.9
<i>Lethrinus nebulosus</i>	13	2	7	2	1	5.0	5.0
<i>Lethrinus ramak</i>	1	0	1	1	2	1.0	0.7
<i>Lethrinus xanthochilus</i>	0	0	0	0	0	0.0	0.0
<i>Monotaxis grandoculis</i>	7	5	2	4	1	3.8	2.4
EPHIPPIDAE - Batfishes							
<i>Platax spp.</i>	2	0	0	1	7	2.0	2.9

Data from five 50 x 20m visual transect counts

FISH COUNTS; NORMAN REEF; pontoon site; 1st April 1987

Transect #	1	2	3	4	5	mean	std.dev.
CHAETODONTIDAE - Butterflyfishes							
<i>Chaetodon auriga</i>	0	1	0	3	0	0.8	1.3
<i>Chaetodon aureofasciatus</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon baronessa</i>	0	5	0	4	2	2.2	2.3
<i>Chaetodon citrinellus</i>	3	8	4	4	2	4.2	2.3
<i>Chaetodon ephippium</i>	0	2	0	0	0	0.4	0.9
<i>Chaetodon lineolatus</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon melannotus</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon plebeius</i>	4	2	0	2	2	2.0	1.4
<i>Chaetodon pelewensis</i>	2	2	2	0	0	1.2	1.1
<i>Chaetodon rainfordi</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon trifascialis</i>	0	2	1	0	1	0.8	0.8
<i>Chaetodon trifasciatus</i>	6	6	8	4	2	5.2	2.3
<i>Chaetodon ulietensis</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon unimaculatus</i>	0	2	0	0	0	0.4	0.9
<i>Chaetodon vagabundus</i>	0	0	0	0	0	0.0	0.0
<i>Forcipiger flavissimus</i>	1	2	2	0	0	1.0	1.0
LABRIDAE - Wrasses							
<i>Cheilinus undulatus</i>	2	0	0	0	0	0.4	0.9
<i>Choerodon anchorago</i>	0	0	0	0	0	0.0	0.0
<i>Hemigymnus melapturus</i>	0	0	0	0	0	0.0	0.0
SCARIDAE - Parrotfishes							
<i>Bulbometopon muricatum</i>	0	0	0	0	0	0.0	0.0
<i>Cetoscarus bicolor</i>	2	1	3	1	0	1.4	1.1
<i>Hipposcarus longiceps</i>	2	1	8	4	4	3.8	2.7
<i>Scarus altipinnis</i>	0	5	2	6	0	2.6	2.8
<i>Scarus bleekeri</i>	0	0	0	0	0	0.0	0.0
<i>Scarus chameleon</i>	0	0	0	0	0	0.0	0.0
<i>Scarus dimidiatus</i>	0	2	1	0	0	0.6	0.9
<i>Scarus flavipectoralis</i>	0	0	0	0	0	0.0	0.0
<i>Scarus frenatus</i>	0	0	0	3	0	0.6	1.3
<i>Scarus ghobban</i>	0	2	0	1	0	0.6	0.9
<i>Scarus gibbus</i>	0	1	1	2	2	1.2	0.8
<i>Scarus globiceps</i>	0	0	7	6	10	4.6	4.4
<i>Scarus niger</i>	5	9	5	6	4	5.8	1.9
<i>Scarus oviceps</i>	0	0	0	0	0	0.0	0.0
<i>Scarus psittacus</i>	2	4	12	9	9	7.2	4.1
<i>Scarus rivulatus</i>	0	0	12	18	4	6.8	7.9
<i>Scarus schlegeli</i>	3	1	12	5	5	5.2	4.1
<i>Scarus sordidus</i>	2	10	13	22	18	13.0	7.7
ACANTHURIDAE - Surgeonfishes							
<i>Acanthurus mata</i>	0	0	0	0	0	0.0	0.0
<i>Acanthurus xanthopterus</i>	0	2	0	0	0	0.4	0.9
<i>Naso brevirostris</i>	2	1	0	0	0	0.6	0.9
SIGANIDAE - Rabbitfishes							
<i>Siganus doliatus</i>	0	0	0	0	0	0.0	0.0
<i>Siganus punctatus</i>	0	0	0	0	0	0.0	0.0
<i>Siganus virgatus</i>	0	0	0	0	0	0.0	0.0
<i>Siganus vulpinus</i>	0	0	0	0	0	0.0	0.0

SUMMARY:

Transect #	1	2	3	4	5	mean	std.dev.
Serranidae	1	2	0	0	1	0.8	0.8
Carangidae	2	1	0	0	0	0.6	0.9
Lutjanidae	48	169	27	3	11	51.6	67.8
Caesionidae	222	111	18	89	44	96.8	79.0
Haemulidae	0	3	0	0	0	0.6	1.3
Lethrinidae	10	16	5	55	30	23.2	20.1
Ephippidae	3	1	0	0	0	0.8	1.3
Chaetodontidae	3	10	21	23	18	15.0	8.3
Labridae	0	2	1	0	1	0.8	0.8
Scaridae	65	72	67	30	49	56.6	17.2
Acanthuridae	42	6	0	6	0	10.8	17.7
Siganidae	2	2	2	0	2	1.6	0.9

Transect #	1	2	3	4	5	mean	std.dev.
SERRANIDAE - Groupers and Coral Trout							
<i>Plectropomus laevis</i>	0	0	0	0	0	0.0	0.0
<i>Plectropomus leopardus</i>	1	0	0	0	0	0.2	0.4
<i>Epinephelus fuscoguttatus</i>	0	0	0	0	1	0.2	0.4
<i>Epinephelus microdon</i>	0	1	0	0	0	0.2	0.4
<i>Epinephelus suillus</i>	0	0	0	0	0	0.0	0.0
<i>Cromileptes altivelis</i>	0	0	0	0	0	0.0	0.0
<i>Cephalopholis argus</i>	0	1	0	0	0	0.2	0.4
CARANGIDAE - Jacks and Trevallys							
<i>Carangoides plagiotaenia</i>	2	1	0	0	0	0.6	0.9
<i>Caranx speciosus</i>	0	0	0	0	0	0.0	0.0
LUTJANIDAE - Snappers							
<i>Lutjanus bohar</i>	43	65	13	2	8	26.2	26.8
<i>Lutjanus carponotatus</i>	0	0	0	0	0	0.0	0.0
<i>Lutjanus fulvus</i>	0	6	1	0	0	1.4	2.6
<i>Lutjanus gibbus</i>	5	96	12	0	1	22.8	41.2
<i>Lutjanus quinquilineatus</i>	0	0	0	0	0	0.0	0.0
<i>Lutjanus russelli</i>	0	2	1	0	0	0.6	0.9
<i>Macolor spp.</i>	0	0	0	1	2	0.6	0.9
CAESIONIDAE - Fusiliers							
<i>Caesio cuning</i>	141	47	12	64	0	52.8	55.7
<i>Caesio caerulaurea</i>	44	18	6	25	44	27.4	16.6
<i>Pterocaesio chrysozona</i>	37	46	0	0	0	16.6	23.0
HAEMULIDAE - Sweetlips							
<i>Plectorhynchus chaetodontoides</i>	0	3	0	0	0	0.6	1.3
<i>Plectorhynchus goldmanni</i>	0	0	0	0	0	0.0	0.0
LETHRINIDAE - Emperors							
<i>Gymnocranius spp.</i>	0	0	0	0	0	0.0	0.0
<i>Lethrinus elongatus</i>	0	0	0	0	0	0.0	0.0
<i>Lethrinus kallopterus</i>	0	0	0	0	0	0.0	0.0
<i>Lethrinus mahsena</i>	0	1	0	5	4	2.0	2.3
<i>Lethrinus nebulosus</i>	1	5	0	6	3	3.0	2.5
<i>Lethrinus ramak</i>	2	4	1	5	2	2.8	1.6
<i>Lethrinus xanthochilus</i>	0	0	0	0	2	0.4	0.9
<i>Monotaxis grandoculis</i>	7	6	4	39	19	15.0	14.6
EPHIPPIDAE - Batfishes							
<i>Platax spp.</i>	3	1	0	0	0	0.8	1.3

FISH COUNTS; NORMAN REEF; pontoon site; 17th June 1988

Transect #	1	2	3	4	5	mean	std.dev.
CHAETODONTIDAE - Butterflyfishes							
<i>Chaetodon auriga</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon aureofasciatus</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon baronessa</i>	1	1	5	4	5	3.2	2.0
<i>Chaetodon citrinellus</i>	0	3	4	4	6	3.4	2.2
<i>Chaetodon ephippium</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon lineolatus</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon melannotus</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon plebeius</i>	2	0	4	2	3	2.2	1.5
<i>Chaetodon pelewensis</i>	0	0	0	2	0	0.4	0.9
<i>Chaetodon rainfordi</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon trifascialis</i>	0	0	2	1	2	1.0	1.0
<i>Chaetodon trifasciatus</i>	0	4	6	4	2	3.2	2.3
<i>Chaetodon ulietensis</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon unimaculatus</i>	0	2	0	0	0	0.4	0.9
<i>Chaetodon vagabundus</i>	0	0	0	4	0	0.8	1.8
<i>Forcipiger flavissimus</i>	0	0	0	2	0	0.4	0.9
LABRIDAE - Wrasses							
<i>Cheilinus undulatus</i>	0	0	0	0	0	0.0	0.0
<i>Choerodon anchorago</i>	0	0	0	0	0	0.0	0.0
<i>Hemigymnus melapturus</i>	0	2	1	0	1	0.8	0.8
SCARIDAE - Parrotfishes							
<i>Bulbometopon muricatum</i>	0	6	0	0	0	1.2	2.7
<i>Cetoscarus bicolor</i>	0	0	5	0	2	1.4	2.2
<i>Hipposcarus longiceps</i>	3	1	4	1	3	2.4	1.3
<i>Scarus altipinnis</i>	0	0	3	0	2	1.0	1.4
<i>Scarus bleekeri</i>	0	0	0	0	0	0.0	0.0
<i>Scarus chameleon</i>	0	0	0	0	2	0.4	0.9
<i>Scarus dimidiatus</i>	0	1	1	0	0	0.4	0.5
<i>Scarus flavipectoralis</i>	1	0	0	0	0	0.2	0.4
<i>Scarus frenatus</i>	0	0	4	0	3	1.4	1.9
<i>Scarus ghobban</i>	0	3	0	0	1	0.8	1.3
<i>Scarus gibbus</i>	0	3	4	0	1	1.6	1.8
<i>Scarus globiceps</i>	4	1	0	0	1	1.2	1.6
<i>Scarus niger</i>	5	16	13	9	6	9.8	4.7
<i>Scarus oviceps</i>	0	1	2	0	0	0.6	0.9
<i>Scarus psittacus</i>	28	19	17	6	12	16.4	8.2
<i>Scarus rivulatus</i>	3	1	2	3	0	1.8	1.3
<i>Scarus schlegeli</i>	10	6	3	3	4	5.2	2.9
<i>Scarus sordidus</i>	11	14	9	8	12	10.8	2.4
ACANTHURIDAE - Surgeonfishes							
<i>Acanthurus mata</i>	3	1	0	0	0	0.8	1.3
<i>Acanthurus xanthopterus</i>	23	3	0	1	0	5.4	9.9
<i>Naso brevirostris</i>	16	2	0	5	0	4.6	6.7
SIGANIDAE - Rabbitfishes							
<i>Siganus doliatus</i>	2	2	0	0	2	1.2	1.1
<i>Siganus punctatus</i>	0	0	2	0	0	0.4	0.9
<i>Siganus virgatus</i>	0	0	0	0	0	0.0	0.0
<i>Siganus vulpinus</i>	0	0	0	0	0	0.0	0.0

SUMMARY:

Transect #	1	2	3	4	5	mean	std.dev.
Serranidae	0	0	0	1	1	0.4	0.5
Carangidae	0	2	0	0	1	0.6	0.9
Lutjanidae	3	0	2	2	0	1.4	1.3
Caesionidae	44	0	3	3	0	10.0	19.1
Haemulidae	0	0	0	0	0	0.0	0.0
Lethrinidae	8	2	6	12	7	7.0	3.6
Ephippidae	3	0	0	0	0	0.6	1.3
Chaetodontidae	18	25	38	25	19	25.0	8.0
Labridae	1	1	0	0	0	0.4	0.5
Scaridae	14	11	13	14	17	13.8	2.2
Acanthuridae	0	0	0	0	0	0.0	0.0
Siganidae	0	0	0	0	0	0.0	0.0

Transect #	1	2	3	4	5	mean	std.dev.
SERRANIDAE - Groupers and Coral Trout							
<i>Plectropomus laevis</i>	0	0	0	1	0	0.2	0.4
<i>Plectropomus leopardus</i>	0	0	0	0	1	0.2	0.4
<i>Epinephelus fuscoguttatus</i>	0	0	0	0	0	0.0	0.0
<i>Epinephelus microdon</i>	0	0	0	0	0	0.0	0.0
<i>Epinephelus suillus</i>	0	0	0	0	0	0.0	0.0
<i>Cromileptes altivelis</i>	0	0	0	0	0	0.0	0.0
<i>Cephalopholis argus</i>	0	0	0	0	0	0.0	0.0
CARANGIDAE - Jacks and Trevallys							
<i>Carangoides plagiotaenia</i>	0	2	0	0	1	0.6	0.9
<i>Caranx speciosus</i>	0	0	0	0	0	0.0	0.0
LUTJANIDAE - Snappers							
<i>Lutjanus bohar</i>	0	0	0	0	0	0.0	0.0
<i>Lutjanus carponotatus</i>	0	0	0	0	0	0.0	0.0
<i>Lutjanus fulvus</i>	0	0	0	0	0	0.0	0.0
<i>Lutjanus gibbus</i>	0	0	0	0	0	0.0	0.0
<i>Lutjanus quinquilineatus</i>	1	0	1	0	0	0.4	0.5
<i>Lutjanus russelli</i>	2	0	0	0	0	0.4	0.9
<i>Macolor spp.</i>	0	0	1	2	0	0.6	0.9
CAESIONIDAE - Fusiliers							
<i>Caesio cuning</i>	32	0	3	3	0	7.6	13.7
<i>Caesio caerulea</i>	12	0	0	0	0	2.4	5.4
<i>Pterocaesio chrysozona</i>	0	0	0	0	0	0.0	0.0
HAEMULIDAE - Sweetlips							
<i>Plectorhynchus chaetodontoides</i>	0	0	0	0	0	0.0	0.0
<i>Plectorhynchus goldmanni</i>	0	0	0	0	0	0.0	0.0
LETHRINIDAE - Emperors							
<i>Gymnocranius spp.</i>	0	0	0	0	0	0.0	0.0
<i>Lethrinus elongatus</i>	0	0	0	0	0	0.0	0.0
<i>Lethrinus kallopterus</i>	0	0	0	0	0	0.0	0.0
<i>Lethrinus mahsena</i>	0	0	1	2	0	0.6	0.9
<i>Lethrinus nebulosus</i>	4	1	0	0	1	1.2	1.6
<i>Lethrinus ramak</i>	2	0	1	2	2	1.4	0.9
<i>Lethrinus xanthochilus</i>	0	0	0	0	0	0.0	0.0
<i>Monotaxis grandoculis</i>	2	1	4	8	4	3.8	2.7
EPHIPPIDAE - Batfishes							
<i>Platax spp.</i>	3	0	0	0	0	0.6	1.3

FISH COUNTS; NORMAN REEF; DSDD site; 22nd June 1987

Transect #	1	2	3	4	5	mean	std.dev.
CHAETODONTIDAE - Butterflyfishes							
<i>Chaetodon auriga</i>	1	0	0	0	1	0.4	0.5
<i>Chaetodon aureofasciatus</i>	0	0	1	0	0	0.2	0.4
<i>Chaetodon baronessa</i>	3	2	7	6	2	4.0	2.3
<i>Chaetodon citrinellus</i>	0	1	6	3	3	2.6	2.3
<i>Chaetodon ephippium</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon lineolatus</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon melannotus</i>	0	1	4	0	0	1.0	1.7
<i>Chaetodon plebeius</i>	1	2	2	6	2	2.6	1.9
<i>Chaetodon pelewensis</i>	4	10	4	2	2	4.4	3.3
<i>Chaetodon rainfordi</i>	0	0	1	0	0	0.2	0.4
<i>Chaetodon trifascialis</i>	1	0	3	2	0	1.2	1.3
<i>Chaetodon trifasciatus</i>	7	6	7	4	5	5.8	1.3
<i>Chaetodon ulietensis</i>	0	0	0	2	0	0.4	0.9
<i>Chaetodon unimaculatus</i>	0	2	0	0	0	0.4	0.9
<i>Chaetodon vagabundus</i>	0	1	3	0	4	1.6	1.8
<i>Forcipiger flavissimus</i>	1	0	0	0	0	0.2	0.4
LABRIDAE - Wrasses							
<i>Cheilinus undulatus</i>	1	1	0	0	0	0.4	0.5
<i>Choerodon anchorago</i>	0	0	0	0	0	0.0	0.0
<i>Hemigymnus melapturus</i>	0	0	0	0	0	0.0	0.0
SCARIDAE - Parrotfishes							
<i>Bulbometopon muricatum</i>	0	0	0	0	0	0.0	0.0
<i>Cetoscarus bicolor</i>	0	1	0	1	0	0.4	0.5
<i>Hipposcarus longiceps</i>	3	0	0	0	0	0.6	1.3
<i>Scarus altipinnis</i>	0	1	0	1	3	1.0	1.2
<i>Scarus bleekeri</i>	0	1	1	1	0	0.6	0.5
<i>Scarus chameleon</i>	0	0	0	0	0	0.0	0.0
<i>Scarus dimidiatus</i>	0	0	0	0	0	0.0	0.0
<i>Scarus flavipectoralis</i>	0	0	0	0	0	0.0	0.0
<i>Scarus frenatus</i>	0	0	1	0	0	0.2	0.4
<i>Scarus ghobban</i>	2	1	0	0	0	0.6	0.9
<i>Scarus gibbus</i>	2	1	2	3	1	1.8	0.8
<i>Scarus globiceps</i>	0	0	0	0	0	0.0	0.0
<i>Scarus niger</i>	4	2	4	4	2	3.2	1.1
<i>Scarus oviceps</i>	0	0	0	0	0	0.0	0.0
<i>Scarus psittacus</i>	0	0	0	0	0	0.0	0.0
<i>Scarus rivulatus</i>	0	1	2	0	9	2.4	3.8
<i>Scarus schlegeli</i>	0	0	0	1	1	0.4	0.5
<i>Scarus sordidus</i>	3	3	3	3	1	2.6	0.9
ACANTHURIDAE - Surgeonfishes							
<i>Acanthurus mata</i>	0	0	0	0	0	0.0	0.0
<i>Acanthurus xanthopterus</i>	0	0	0	0	0	0.0	0.0
<i>Naso brevirostris</i>	0	0	0	0	0	0.0	0.0
SIGANIDAE - Rabbitfishes							
<i>Siganus doliatus</i>	0	0	0	0	0	0.0	0.0
<i>Siganus punctatus</i>	0	0	0	0	0	0.0	0.0
<i>Siganus virgatus</i>	0	0	0	0	0	0.0	0.0
<i>Siganus vulpinus</i>	0	0	0	0	0	0.0	0.0

SUMMARY:

Transect #	1	2	3	4	5	mean	std.dev.
Serranidae	0	0	0	2	1	0.6	0.9
Carangidae	0	0	0	2	0	0.4	0.9
Lutjanidae	3	5	3	0	0	2.2	2.2
Caesionidae	117	0	200	18	0	67.0	88.8
Haemulidae	0	0	0	0	0	0.0	0.0
Lethrinidae	7	11	10	8	4	8.0	2.7
Ephippidae	0	1	4	3	1	1.8	1.6
Chaetodontidae	26	25	17	15	23	21.2	4.9
Labridae	1	4	2	0	1	1.6	1.5
Scaridae	42	25	30	9	13	23.8	13.3
Acanthuridae	0	1	2	1	0	0.8	0.8
Siganidae	2	4	1	2	4	2.6	1.3

Transect #	1	2	3	4	5	mean	std.dev.
SERRANIDAE - Groupers and Coral Trout							
<i>Plectropomus laevis</i>	0	0	0	1	0	0.2	0.4
<i>Plectropomus leopardus</i>	0	0	0	1	0	0.2	0.4
<i>Epinephelus fuscoguttatus</i>	0	0	0	0	1	0.2	0.4
<i>Epinephelus microdon</i>	0	0	0	0	0	0.0	0.0
<i>Epinephelus suillus</i>	0	0	0	0	0	0.0	0.0
<i>Cromileptes altivelis</i>	0	0	0	0	0	0.0	0.0
<i>Cephalopholis argus</i>	0	0	0	0	0	0.0	0.0
CARANGIDAE - Jacks and Trevallys							
<i>Carangoides plagiotaenia</i>	0	0	0	2	0	0.4	0.9
<i>Caranx speciosus</i>	0	0	0	0	0	0.0	0.0
LUTJANIDAE - Snappers							
<i>Lutjanus bohar</i>	0	2	0	0	0	0.4	0.9
<i>Lutjanus carponotatus</i>	0	0	0	0	0	0.0	0.0
<i>Lutjanus fulvus</i>	0	0	0	0	0	0.0	0.0
<i>Lutjanus gibbus</i>	0	0	0	0	0	0.0	0.0
<i>Lutjanus quinquilineatus</i>	2	0	3	0	0	1.0	1.4
<i>Lutjanus russelli</i>	1	0	0	0	0	0.2	0.4
<i>Macolor spp.</i>	0	3	0	0	0	0.6	1.3
CAESIONIDAE - Fusiliers							
<i>Caesio cuning</i>	78	0	89	0	0	33.4	45.9
<i>Caesio caerulea</i>	39	0	111	18	0	33.6	46.2
<i>Pterocaesio chrysozona</i>	0	0	0	0	0	0.0	0.0
HAEMULIDAE - Sweetlips							
<i>Plectorhynchus chaetodontoides</i>	0	0	0	0	0	0.0	0.0
<i>Plectorhynchus goldmani</i>	0	0	0	0	0	0.0	0.0
LETHRINIDAE - Emperors							
<i>Gymnocranius spp.</i>	0	0	0	0	0	0.0	0.0
<i>Lethrinus elongatus</i>	0	0	0	0	0	0.0	0.0
<i>Lethrinus kallopterus</i>	0	0	1	0	0	0.2	0.4
<i>Lethrinus mahsena</i>	1	2	0	1	0	0.8	0.8
<i>Lethrinus nebulosus</i>	0	1	6	1	0	1.6	2.5
<i>Lethrinus ramak</i>	1	2	0	2	0	1.0	1.0
<i>Lethrinus xanthochilus</i>	0	0	0	0	0	0.0	0.0
<i>Monotaxis grandoculis</i>	5	6	3	4	4	4.4	1.1
EPHIPPIDAE - Batfishes							
<i>Platax spp.</i>	0	1	4	3	1	1.8	1.6

FISH COUNTS; NORMAN REEF; DSDD site; 16th June 1988

Transect #	1	2	3	4	5	mean	std.dev.
CHAETODONTIDAE - Butterflyfishes							
<i>Chaetodon auriga</i>	1	0	0	2	0	0.6	0.9
<i>Chaetodon aureofasciatus</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon baronessa</i>	2	8	0	5	1	3.2	3.3
<i>Chaetodon citrinellus</i>	2	4	8	2	4	4.0	2.4
<i>Chaetodon ephippium</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon lineolatus</i>	0	0	2	0	0	0.4	0.9
<i>Chaetodon melannotus</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon plebeius</i>	3	7	1	0	2	2.6	2.7
<i>Chaetodon pelewensis</i>	5	2	2	0	6	3.0	2.4
<i>Chaetodon rainfordi</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon trifascialis</i>	0	1	0	0	0	0.2	0.4
<i>Chaetodon trifasciatus</i>	5	2	2	6	6	4.2	2.0
<i>Chaetodon ulietensis</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon unimaculatus</i>	2	1	0	0	0	0.6	0.9
<i>Chaetodon vagabundus</i>	4	0	2	0	4	2.0	2.0
<i>Forcipiger flavissimus</i>	2	0	0	0	0	0.4	0.9
LABRIDAE - Wrasses							
<i>Cheilinus undulatus</i>	0	1	1	0	0	0.4	0.5
<i>Choerodon anchorago</i>	0	0	0	0	0	0.0	0.0
<i>Hemigymnus melapturus</i>	1	3	1	0	1	1.2	1.1
SCARIDAE - Parrotfishes							
<i>Bulbometopon muricatum</i>	0	0	0	0	0	0.0	0.0
<i>Cetoscarus bicolor</i>	2	2	2	0	0	1.2	1.1
<i>Hipposcarus longiceps</i>	8	0	10	0	0	3.6	5.0
<i>Scarus altipinnis</i>	2	0	2	0	0	0.8	1.1
<i>Scarus bleekeri</i>	1	0	1	0	0	0.4	0.5
<i>Scarus chameleon</i>	0	2	1	0	0	0.6	0.9
<i>Scarus dimidiatus</i>	0	0	0	0	0	0.0	0.0
<i>Scarus flavipectoralis</i>	2	2	0	1	0	1.0	1.0
<i>Scarus frenatus</i>	0	0	0	0	0	0.0	0.0
<i>Scarus ghobban</i>	2	0	0	0	0	0.4	0.9
<i>Scarus gibbus</i>	1	0	0	2	0	0.6	0.9
<i>Scarus globiceps</i>	0	0	0	0	0	0.0	0.0
<i>Scarus niger</i>	12	8	6	4	7	7.4	3.0
<i>Scarus oviceps</i>	0	0	0	0	0	0.0	0.0
<i>Scarus psittacus</i>	0	0	0	1	1	0.4	0.5
<i>Scarus rivulatus</i>	0	0	0	0	0	0.0	0.0
<i>Scarus schlegeli</i>	4	1	0	0	1	1.2	1.6
<i>Scarus sordidus</i>	8	10	8	1	4	6.2	3.6
ACANTHURIDAE - Surgeonfishes							
<i>Acanthurus mata</i>	0	0	0	0	0	0.0	0.0
<i>Acanthurus xanthopterus</i>	0	0	2	1	0	0.6	0.9
<i>Naso brevirostris</i>	0	1	0	0	0	0.2	0.4
SIGANIDAE - Rabbitfishes							
<i>Siganus doliatus</i>	2	2	0	2	2	1.6	0.9
<i>Siganus punctatus</i>	0	0	0	0	0	0.0	0.0
<i>Siganus virgatus</i>	0	2	0	0	2	0.8	1.1
<i>Siganus vulpinus</i>	0	0	1	0	0	0.2	0.4

SUMMARY:

Transect #	1	2	3	4	5	mean	std.dev.
Serranidae	0	0	0	0	0	0.0	0.0
Carangidae	1	1	0	2	0	0.8	0.8
Lutjanidae	0	0	1	1	1	0.6	0.5
Caesionidae	0	58	4	3	0	13.0	25.2
Haemulidae	0	1	0	0	0	0.2	0.4
Lethrinidae	6	15	3	4	5	6.6	4.8
Ephippidae	0	1	0	0	0	0.2	0.4
Chaetodontidae	11	22	29	23	25	22.0	6.7
Labridae	0	0	0	0	2	0.4	0.9
Scaridae	21	18	30	25	30	24.8	5.4
Acanthuridae	0	0	0	0	0	0.0	0.0
Siganidae	0	0	0	0	0	0.0	0.0

Transect #	1	2	3	4	5	mean	std.dev.
SERRANIDAE - Groupers and Coral Trout							
<i>Plectropomus laevis</i>	0	0	0	0	0	0.0	0.0
<i>Plectropomus leopardus</i>	0	0	0	0	0	0.0	0.0
<i>Epinephelus fuscoguttatus</i>	0	0	0	0	0	0.0	0.0
<i>Epinephelus microdon</i>	0	0	0	0	0	0.0	0.0
<i>Epinephelus suillus</i>	0	0	0	0	0	0.0	0.0
<i>Cromileptes altivelis</i>	0	0	0	0	0	0.0	0.0
<i>Cephalopholis argus</i>	0	0	0	0	0	0.0	0.0
CARANGIDAE - Jacks and Trevallys							
<i>Carangoides plagiotaenia</i>	1	1	0	2	0	0.8	0.8
<i>Caranx speciosus</i>	0	0	0	0	0	0.0	0.0
LUTJANIDAE - Snappers							
<i>Lutjanus bohar</i>	0	0	0	0	1	0.2	0.4
<i>Lutjanus carponotatus</i>	0	0	0	0	0	0.0	0.0
<i>Lutjanus fulvus</i>	0	0	0	0	0	0.0	0.0
<i>Lutjanus gibbus</i>	0	0	0	0	0	0.0	0.0
<i>Lutjanus quinquilineatus</i>	0	0	1	0	0	0.2	0.4
<i>Lutjanus russelli</i>	0	0	0	0	0	0.0	0.0
<i>Macolor spp.</i>	0	0	0	1	0	0.2	0.4
CAESIONIDAE - Fusiliers							
<i>Caesio cuning</i>	0	0	4	3	0	1.4	1.9
<i>Caesio caerulea</i>	0	32	0	0	0	6.4	14.3
<i>Pterocaesio chrysozona</i>	0	26	0	0	0	5.2	11.6
HAEMULIDAE - Sweetlips							
<i>Plectorhynchus chaetodontoides</i>	0	1	0	0	0	0.2	0.4
<i>Plectorhynchus goldmanni</i>	0	0	0	0	0	0.0	0.0
LETHRINIDAE - Emperors							
<i>Gymnocranius spp.</i>	0	0	0	0	1	0.2	0.4
<i>Lethrinus elongatus</i>	0	0	0	0	1	0.2	0.4
<i>Lethrinus kallopterus</i>	0	0	0	0	0	0.0	0.0
<i>Lethrinus mahsena</i>	0	1	0	1	1	0.6	0.5
<i>Lethrinus nebulosus</i>	2	1	0	0	0	0.6	0.9
<i>Lethrinus ramak</i>	1	2	0	0	0	0.6	0.9
<i>Lethrinus xanthochilus</i>	0	0	0	0	0	0.0	0.0
<i>Monotaxis grandoculis</i>	3	11	3	3	2	4.4	3.7
EPHIPPIDAE - Batfishes							
<i>Platax spp.</i>	0	1	0	0	0	0.2	0.4

FISH COUNTS; NORMAN REEF; control site; 22nd June 1987

Transect #	1	2	3	4	5	mean	std.dev.
CHAETODONTIDAE - Butterflyfishes							
<i>Chaetodon auriga</i>	1	2	1	0	0	0.8	0.8
<i>Chaetodon aureofasciatus</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon baronessa</i>	0	3	5	1	3	2.4	1.9
<i>Chaetodon citrinellus</i>	2	0	3	4	4	2.6	1.7
<i>Chaetodon ephippium</i>	0	0	0	2	0	0.4	0.9
<i>Chaetodon lineolatus</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon melannotus</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon plebeius</i>	2	1	2	2	6	2.6	1.9
<i>Chaetodon pelewensis</i>	2	7	4	0	2	3.0	2.6
<i>Chaetodon rainfordi</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon trifascialis</i>	0	1	0	4	3	1.6	1.8
<i>Chaetodon trifasciatus</i>	4	4	10	6	4	5.6	2.6
<i>Chaetodon ulietensis</i>	0	2	0	0	0	0.4	0.9
<i>Chaetodon unimaculatus</i>	0	0	2	0	0	0.4	0.9
<i>Chaetodon vagabundus</i>	0	2	2	4	3	2.2	1.5
<i>Forcipiger flavissimus</i>	0	0	0	0	0	0.0	0.0
LABRIDAE - Wrasses							
<i>Cheilinus undulatus</i>	0	0	0	0	1	0.2	0.4
<i>Choerodon anchorago</i>	0	0	0	0	1	0.2	0.4
<i>Hemigymnus melapturus</i>	0	0	0	0	0	0.0	0.0
SCARIDAE - Parrotfishes							
<i>Bulbometopon muricatum</i>	0	0	0	0	0	0.0	0.0
<i>Cetoscarus bicolor</i>	0	0	0	2	1	0.6	0.9
<i>Hipposcarus longiceps</i>	1	0	0	2	0	0.6	0.9
<i>Scarus altipinnis</i>	0	0	0	1	2	0.6	0.9
<i>Scarus bleekeri</i>	2	1	0	0	0	0.6	0.9
<i>Scarus chameleon</i>	0	0	0	0	0	0.0	0.0
<i>Scarus dimidiatus</i>	0	0	0	0	0	0.0	0.0
<i>Scarus flavipectoralis</i>	1	0	0	0	0	0.2	0.4
<i>Scarus frenatus</i>	1	0	0	3	0	0.8	1.3
<i>Scarus ghobban</i>	0	0	1	1	0	0.4	0.5
<i>Scarus gibbus</i>	0	0	1	1	4	1.2	1.6
<i>Scarus globiceps</i>	0	0	0	0	0	0.0	0.0
<i>Scarus niger</i>	7	5	8	7	11	7.6	2.2
<i>Scarus oviceps</i>	0	0	0	0	0	0.0	0.0
<i>Scarus psittacus</i>	0	1	1	0	2	0.8	0.8
<i>Scarus rivulatus</i>	0	0	0	2	0	0.4	0.9
<i>Scarus schlegeli</i>	1	1	3	2	1	1.6	0.9
<i>Scarus sordidus</i>	8	10	16	4	9	9.4	4.3
ACANTHURIDAE - Surgeonfishes							
<i>Acanthurus mata</i>	0	0	0	0	0	0.0	0.0
<i>Acanthurus xanthopterus</i>	0	0	0	0	0	0.0	0.0
<i>Naso brevirostris</i>	0	0	0	0	0	0.0	0.0
SIGANIDAE - Rabbitfishes							
<i>Siganus doliatus</i>	0	0	0	0	0	0.0	0.0
<i>Siganus punctatus</i>	0	0	0	0	0	0.0	0.0
<i>Siganus virgatus</i>	0	0	0	0	0	0.0	0.0
<i>Siganus vulpinus</i>	0	0	0	0	0	0.0	0.0

SUMMARY:

Transect #	1	2	3	4	5	mean	std.dev.
Serranidae	0	0	3	0	1	0.8	1.3
Carangidae	0	1	0	0	0	0.2	0.4
Lutjanidae	1	6	0	3	0	2.0	2.5
Caesionidae	0	0	12	0	42	10.8	18.2
Haemulidae	1	0	11	0	0	2.4	4.8
Lethrinidae	2	39	21	7	17	17.2	14.4
Ephippidae	0	0	0	0	0	0.0	0.0
Chaetodontidae	16	21	19	20	28	20.8	4.4
Labridae	1	0	3	1	0	1.0	1.2
Scaridae	18	19	26	38	17	23.6	8.8
Acanthuridae	2	0	0	0	0	0.4	0.9
Siganidae	4	4	4	0	2	2.8	1.8

Transect #	1	2	3	4	5	mean	std.dev.
SERRANIDAE - Groupers and Coral Trout							
<i>Plectropomus laevis</i>	0	0	1	0	0	0.2	0.4
<i>Plectropomus leopardus</i>	0	0	1	0	0	0.2	0.4
<i>Epinephelus fuscoguttatus</i>	0	0	1	0	1	0.4	0.5
<i>Epinephelus microdon</i>	0	0	0	0	0	0.0	0.0
<i>Epinephelus suillus</i>	0	0	0	0	0	0.0	0.0
<i>Cromileptes altivelis</i>	0	0	0	0	0	0.0	0.0
<i>Cephalopholis argus</i>	0	0	0	0	0	0.0	0.0
CARANGIDAE - Jacks and Trevallies							
<i>Carangoides plagiotaenia</i>	0	1	0	0	0	0.2	0.4
<i>Caranx speciosus</i>	0	0	0	0	0	0.0	0.0
LUTJANIDAE - Snappers							
<i>Lutjanus bohar</i>	1	0	0	0	0	0.2	0.4
<i>Lutjanus carponotatus</i>	0	1	0	0	0	0.2	0.4
<i>Lutjanus fulvus</i>	0	3	0	0	0	0.6	1.3
<i>Lutjanus gibbus</i>	0	0	0	0	0	0.0	0.0
<i>Lutjanus quinquilineatus</i>	0	0	0	0	0	0.0	0.0
<i>Lutjanus russelli</i>	0	0	0	0	0	0.0	0.0
<i>Macolor spp.</i>	0	2	0	3	0	1.0	1.4
CAESIONIDAE - Fusiliers							
<i>Caesio cuning</i>	0	0	12	0	0	2.4	5.4
<i>Caesio caerulea</i>	0	0	0	0	6	1.2	2.7
<i>Pterocaesio chrysozona</i>	0	0	0	0	36	7.2	16.1
HAEMULIDAE - Sweetlips							
<i>Plectorhynchus chaetodontoides</i>	0	0	0	0	0	0.0	0.0
<i>Plectorhynchus goldmanni</i>	1	0	11	0	0	2.4	4.8
LETHRINIDAE - Emperors							
<i>Gymnocranius spp.</i>	0	0	0	0	0	0.0	0.0
<i>Lethrinus elongatus</i>	0	0	0	0	0	0.0	0.0
<i>Lethrinus kallopterus</i>	0	0	0	0	0	0.0	0.0
<i>Lethrinus mahsena</i>	1	6	4	1	7	3.8	2.8
<i>Lethrinus nebulosus</i>	0	0	1	1	1	0.6	0.5
<i>Lethrinus ramak</i>	0	2	1	0	0	0.6	0.9
<i>Lethrinus xanthochilus</i>	0	0	0	0	0	0.0	0.0
<i>Monotaxis grandoculis</i>	1	31	15	5	9	12.2	11.7
EPHIPPIDAE - Batfishes							
<i>Platax spp.</i>	0	0	0	0	0	0.0	0.0

FISH COUNTS; NORMAN REEF; control site; 17th June 1988

Transect #	1	2	3	4	5	mean	std.dev.
CHAETODONTIDAE - Butterflyfishes							
<i>Chaetodon auriga</i>	0	2	0	0	0	0.4	0.9
<i>Chaetodon aureofasciatus</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon baronessa</i>	2	5	3	4	6	4.0	1.6
<i>Chaetodon citrinellus</i>	2	4	2	4	6	3.6	1.7
<i>Chaetodon ephippium</i>	0	0	0	2	2	0.8	1.1
<i>Chaetodon lineolatus</i>	0	0	2	0	2	0.8	1.1
<i>Chaetodon melannotus</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon plebeius</i>	3	3	4	2	2	2.8	0.8
<i>Chaetodon pelewensis</i>	0	0	0	4	0	0.8	1.8
<i>Chaetodon rainfordi</i>	0	0	0	0	0	0.0	0.0
<i>Chaetodon trifascialis</i>	3	1	1	0	4	1.8	1.6
<i>Chaetodon trifasciatus</i>	2	4	3	2	4	3.0	1.0
<i>Chaetodon ulietensis</i>	2	0	0	0	2	0.8	1.1
<i>Chaetodon unimaculatus</i>	0	0	2	0	0	0.4	0.9
<i>Chaetodon vagabundus</i>	2	2	2	0	0	1.2	1.1
<i>Forcipiger flavissimus</i>	0	0	0	2	0	0.4	0.9
LABRIDAE - Wrasses							
<i>Cheilinus undulatus</i>	0	0	1	0	0	0.2	0.4
<i>Choerodon anchorago</i>	0	0	1	0	0	0.2	0.4
<i>Hemigymnus melapturus</i>	1	0	1	1	0	0.6	0.5
SCARIDAE - Parrotfishes							
<i>Bulbometopon muricatum</i>	0	0	0	0	0	0.0	0.0
<i>Cetoscarus bicolor</i>	0	0	1	2	0	0.6	0.9
<i>Hipposcarus longiceps</i>	1	1	0	8	2	2.4	3.2
<i>Scarus altipinnis</i>	0	0	0	0	0	0.0	0.0
<i>Scarus bleekeri</i>	1	0	0	0	0	0.2	0.4
<i>Scarus chameleon</i>	0	0	1	1	0	0.4	0.5
<i>Scarus dimidiatus</i>	0	0	0	0	0	0.0	0.0
<i>Scarus flavipectoralis</i>	1	0	0	0	0	0.2	0.4
<i>Scarus frenatus</i>	0	0	2	0	0	0.4	0.9
<i>Scarus ghobban</i>	0	0	0	0	0	0.0	0.0
<i>Scarus gibbus</i>	0	0	0	1	1	0.4	0.5
<i>Scarus globiceps</i>	0	0	0	0	0	0.0	0.0
<i>Scarus niger</i>	7	7	2	8	5	5.8	2.4
<i>Scarus oviceps</i>	0	0	0	0	0	0.0	0.0
<i>Scarus psittacus</i>	0	1	4	3	0	1.6	1.8
<i>Scarus rivulatus</i>	0	0	0	0	0	0.0	0.0
<i>Scarus schlegeli</i>	2	1	2	2	0	1.4	0.9
<i>Scarus sordidus</i>	6	9	14	13	9	10.2	3.3
ACANTHURIDAE - Surgeonfishes							
<i>Acanthurus mata</i>	0	0	0	0	0	0.0	0.0
<i>Acanthurus xanthopterus</i>	2	0	0	0	0	0.4	0.9
<i>Naso brevirostris</i>	0	0	0	0	0	0.0	0.0
SIGANIDAE - Rabbitfishes							
<i>Siganus doliatus</i>	2	2	4	0	2	2.0	1.4
<i>Siganus punctatus</i>	2	0	0	0	0	0.4	0.9
<i>Siganus virgatus</i>	0	2	0	0	0	0.4	0.9
<i>Siganus vulpinus</i>	0	0	0	0	0	0.0	0.0