A STUDY OF THE REEF COMMUNITY AT CYRENE REEFS

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ABSTRACT

The reef community at Cyrene Reefs was studied using 100m line transects where the various lifeforms were categorised into broad taxonomic groups. Results indicated that the live coral cover ranged from 0% to 48.06% and the dominant live scleractinia growthforms were encrusting, foliose and massive. The most dominant genera was the family Faviidae. In comparison with the other reefs surveyed in the area, Cyrene Reefs had the highest number (33) of hard coral genera.

INTRODUCTION

Cyrene Reefs collectively refers to 3 patch reefs of which the largest is Terumbu Pandan (Fig. 1), which is located approximately 4 km south of the main island of Singapore at latitude 103° 45'E and longitude 1° 15'N. Apart from being one of the larger patch reefs of the southern islands, it is also the nearest patch reef to the mainland. The other patch reefs that are comparable in size are Terumbu Pempang Laut and Beting Bemban Besar which are located further south. On its longest side, Terumbu Pandan is 1.4km and it has a width of 0.45km. Together with the other two nearby but smaller patch reefs (Pandan Beacon and South Cyrene Beacon), Terumbu Pandan is completely submerged except during low spring tides. This group of reefs is situated right in the middle of a fairway for maritime vessels proceeding to and from the nearby port, petro-chemical and industrial facilities. Even in recent times there have been sightings of vessels going aground on this reef by the researchers. No previous studies on the hard coral community of this reef have been done and this paper is aimed at describing the diversity and variation in the reef community found there.

MATERIALS AND METHODS

Two sites of Terumbu Pandan were selected for survey in this study: Cyrene 1 on the northern side (C1) and Cyrene 2 on the southern side (C2). These two sites were surveyed during the period from April 1986 to April 1989. Figure 2 shows the location of the survey sites. At each site, depth-specific 100m line transects (Dartnall & Jones, 1986) were surveyed at the depths of 3m (C1-3, C2-3) and 10m of the reef slope (C1-3, C1-10).

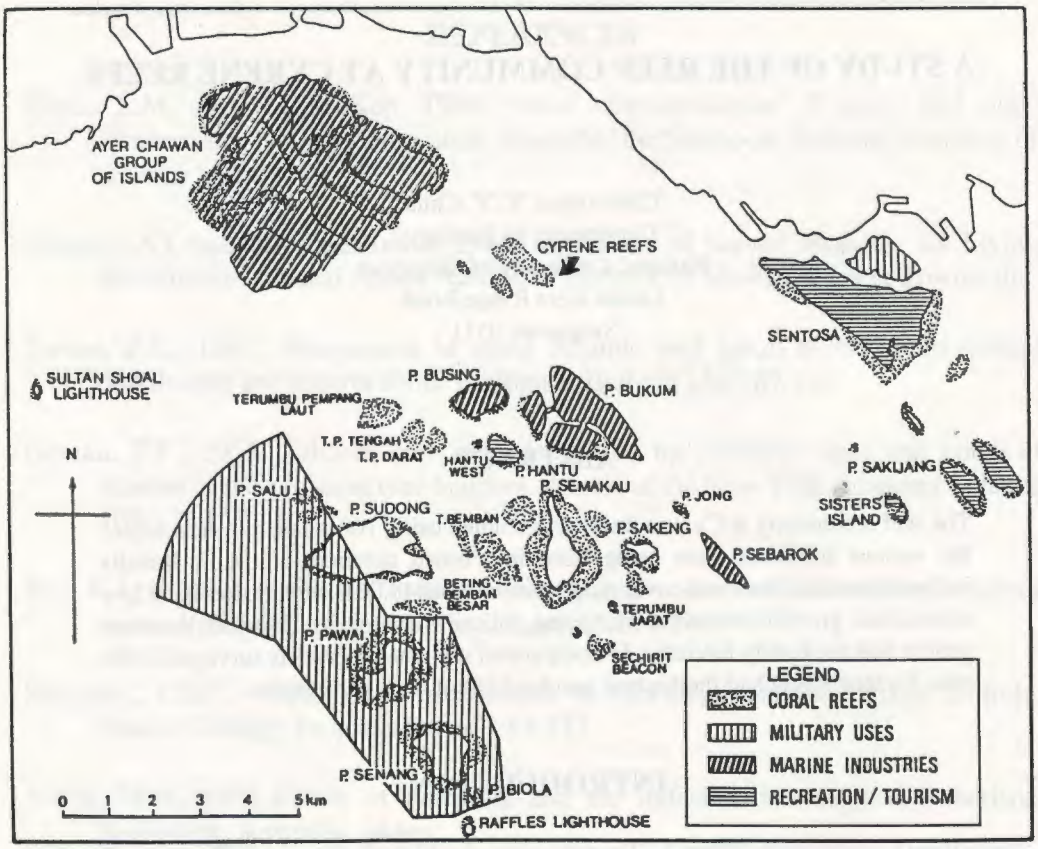

Fig. 1. Map showing the southern islands of Singapore and the location of Cyrene Reefs.

These depths were measured with respect to the reef crest. Besides recording the benthic lifeforms transected by the survey lines into broad taxonomic categories, all live scleractinia were identified to generic level using the taxonomic guides of Veron, (1982 & 1986). Data were stored into dBASE III Plus and analysed using the LIFEFORM.EXE programme (Matammu, 1988).

RESULTS

Table 1 summarises the results of the surveys in terms of percentage cover of lifeforms and abiotic components. Live coral cover ranged from 0% to 48.06%. The highest cover was recorded at C2-3 while the lowest at C2-10. Dead coral ranged from 2% to 40.82% with the lowest value at C2-3 and the highest at C1-10. Dead coral cover was mostly coral skeleton covered with filamentous algae. These ranged from 2% at C2-10 to 40.82% at C1-10. No recent dead coral with skeletons not covered by algae was recorded from any of the transects.

The algal component ranged from 0% at C1-10 to 3.08% at C2-10. This formed only a small portion of the lifeforms recorded at each survey site. At Cyrene 1, none was

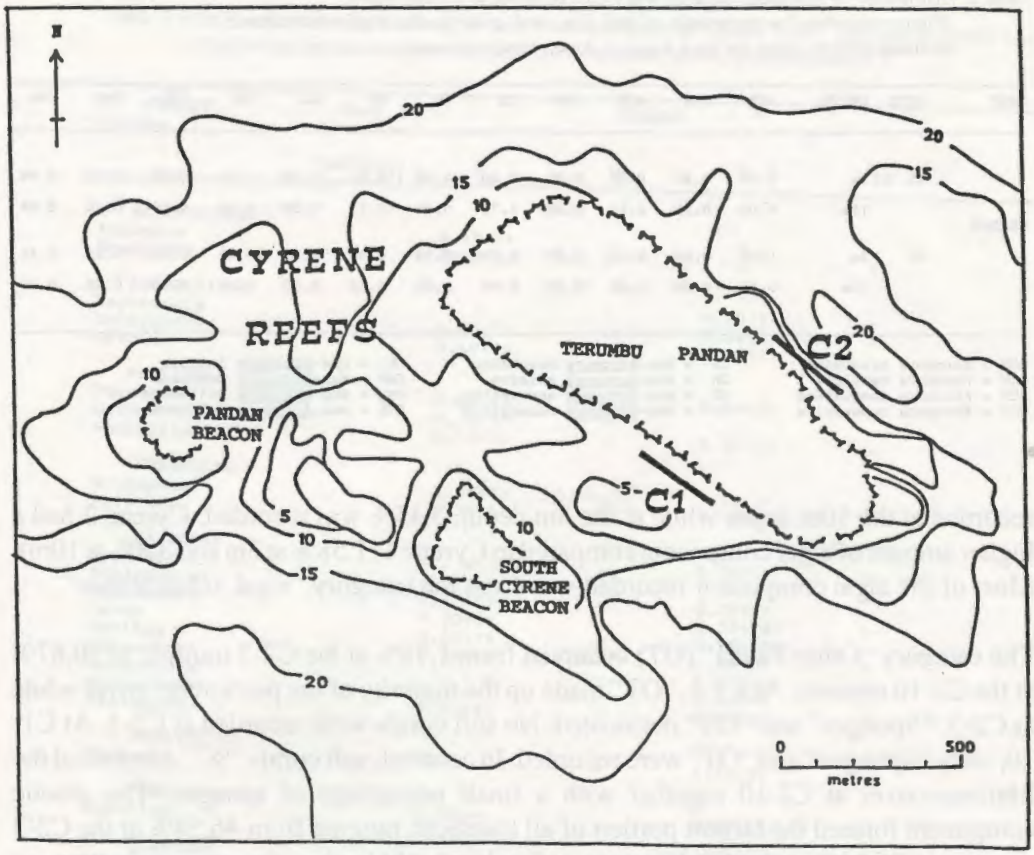

Fig. 2. Map of Cyrene Reefs consisting of Terumbu Pandan, Pandan Beacon and South Cyrene Beacon. C1 and C2 are survey sites on Terumbu Pandan. (numbers and contours indicate depth in metres).

Table 1 : Percentage cover of lifeforms and abiotic components at the 3m & 10m depths of the reef slope at Cyrene Reefs (sites 1 & 2).

Reef Site	Depth (m)	Live Coral	Dead Coral	Algae	Other Fauna	Abiotic Component
Cyrene 1	3	23.50	22.84	3.45	2.20	48.01
	10	4.53	40.82	0.00	3.94	50.71
Cyrene 2	3	48.06	2.00	1.58	1.78	46.58
	10	0.00	29.29	3.80	10.67	56.24

Table 2. Distribution of dominant coral growth forms recorded at Cyrene Reefs
(Figures expressed as percentage of total live coral cover for that particular transect; dominant growth forms for each transect shown in parentheses).

REEF	SITE	DEPTH	ACB	ACT	ACE	ACS	CB	CM	CE	CS	CF	CMR	CME	CHL
CYRENE	C1	3m	0.45	0.00	0.00	0.00	0.00	2.00	(13.5)	0.40	6.25	0.90	0.00	0.00
		10m	0.00	0.00	0.00	0.60	1.73	0.00	(2.3)	0.50	0.00	0.00	0.00	0.00
	C2	3m	0.00	0.00	0.00	0.00	0.60	18.52	5.43	2.86	(19.5)	0.30	0.00	0.85
		10m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ACB = Acropora branching
ACT = Acropora tabulate
ACE = Acropora encrusting
ACS = Acropora submassive
CB = Non-Acropora branching
CM = Non-Acropora massive
CE = Non-Acropora encrusting
CS = Non-Acropora submassive
CF = Non-Acropora foliose
CMR = Non-Acropora mushroom
CME = Non-Acropora Millepora
CHL = Non-Acropora Heliopora

recorded at the 10m depth while at the 3m depth, 3.45% was recorded. Cyrene 2 had a higher amount of algal component compared to Cyrene 1 (1.58% at 3m and 3.8% at 10m). Most of the algal component recorded was from the category "algal assemblages".

The category "Other Fauna" (OT) occupied from 1.78% at the C2-3 transect to 10.67% at the C2-10 transect. At C1-3, "OT" made up the majority of the percentage cover while at C2-3, "Sponges" and "OT" dominated. No soft corals were recorded at C2-3. At C1-10, only "Sponges" and "OT" were recorded. In contrast, soft corals "SC" dominated the lifeform cover at C2-10 together with a small percentage of sponges. The abiotic component formed the largest portion of all transects, ranging from 46.58% at the C2-3 transect to 56.24% at the C2-10 transect. Sand and rubble were the major substrata.

Table 2 shows the results of the live scleractinian growthforms recorded at Cyrene Reefs. At Cyrene 1 (C1), live scleractinia was dominated by encrusting non-acropora which occupied 13.5% of the transect at the 3m depth and 2.3% at the 10m depth. Foliose non-acroporid corals were the next highest (6.5%) and it was at this site where the only incidence of *Acropora* (branching) was recorded. At Cyrene 2 (C2), foliose and massive growthforms were dominant. In all the surveys, acroporid corals did not contribute significantly to the live coral cover and these were recorded only at Cyrene 1. *Millepora* was not recorded from any of the transects.

Table 3 shows the generic distribution and the number of occurrences of the hard corals on Cyrene Reefs. The dominant genera at Cyrene 1 was *Diploastrea* at the 3m depth and *Goniastrea* at the 10m depth. *Fungia* had the highest number of occurrences (5) at 3m depth while *Dendrophyllia* was most frequent at 10m depth. *Merulina* was dominant at the 3m depth of Cyrene 2 and it was also the most frequently recorded genus at this site. No live corals were recorded at the 10m depth. A total of 33 genera from 12 families was recorded. The most widespread genera were *Goniopora* and *Goniastrea* which were distributed at 3 of the 4 sites. Frequency occurrences of live coral ranged from 0 to 107 colonies per 100m. The highest was recorded at C2-3 transect. The occurrences per genera ranged from 1 to 13 colonies along each transect, the highest being *Merulina* (13) at Cyrene 2.

Table 3. Hard coral community of the upper and lower reef slopes of Cyrene Reefs, analysed at generic level. (Figures indicate percentage cover with colony number shown in parentheses)

FAMILY / Genera	Reef	CYRENE			
	Location	1		2	
	Depth(m)	3	10	3	10
ACROPORIDAE					
Acropora		0.45<1>	-	-	-
Montipora		0.98<3>	-	-	-
AGARICIIDAE					
Leptoseris		-	-	0.60<1>	-
Pachyseris		0.60<1>	-	1.94<2>	-
Pavona		0.40<1>	-	0.20<1>	-
FUNGIIDAE					
Fungia		0.80<5>	-	0.38<2>	-
Herpolitha		0.10<1>	-	-	-
Podabacia		0.10<1>	-	1.24<3>	-
PORITIDAE					
Goniopora		2.30<1>	0.50<1>	1.19<3>	-
Porites		0.30<1>	-	2.15<5>	-
FAVIIDAE					
Cyphastrea		-	-	0.08<1>	-
Diploastrea		10.65<1>	-	-	-
Echinopora		1.60<2>	-	2.25<5>	-
Favia		0.30<1>	-	2.59<10>	-
Favites		0.25<1>	-	5.28<10>	-
Goniastrea		0.20<1>	2.30<2>	2.19<6>	-
Hydnophora		-	-	1.31<2>	-
Montastrea		-	-	2.46<6>	-
Platygyra		1.30<4>	-	2.93<10>	-
OCULINIDAE					
Galaxea		-	-	1.46<8>	-
MERULINIDAE					
Merulina		0.75<3>	-	5.87<13>	-
MUSSIDAE					
Lobophyllia		0.20<1>	-	0.68<2>	-
Symphyllia		-	-	1.00<3>	-
PECTINIIDAE					
Echinophyllia		0.98<2>	-	2.70<3>	-
Oxypora		0.52<2>	-	1.28<2>	-
Pectinia		0.30<4>	-	5.54<1>	-
CARYOPHYLLIIDAE					
Euphyllia		0.10<1>	-	1.10<2>	-
Physogyra		-	-	0.10<1>	-
Plerogyra		0.32<1>	-	0.50<1>	-
DENDROPHYLLIIDAE					
Tubastraea		-	0.25<3>	-	-
Dendrophyllia		-	1.48<6>	-	-
Turbinaria		-	-	0.09<1>	-
HELIOPORIDAE					
Heliopora		-	-	0.85<3>	-
12 Families 33 Genera	TOTAL	23.50(39)	4.53(12)	48.06(107)	0.00(0)

DISCUSSION

The results indicate that site 2 of the reef supports a higher live coral cover than site 1. The turbidity of the water has decreased light penetration to the lower depths resulting in low live coral cover at the 10m depth. Compared with the other reefs which were surveyed during the same period, the percentage of live coral cover at the 3m depth was the lowest (Chua & Chou, in press). Between the two sites surveyed, site 2 has more than twice the

percentage of live coral and one-eleventh the amount of dead coral than site 1. Selective pressures may have contributed to this condition as was the case seen in Eilat (Loya, 1972).

Corals of the family Faviidae were dominant at site 1. This is not surprising since this family is the largest in terms of number of genera throughout the Indo-Pacific (Veron, 1982). The single largest coral colony recorded was the faviid *Diploastrea* (10.65%) at site 1. Such large colonies are usually found in protected or semi-protected localities (Veron, 1982) and as Cyrene Reefs are situated close to the mainland to the north and offshore islands to the south, it is sheltered from strong wave action (Bradbury & Young, 1981). The dense skeleton of *Diploastrea* prevents penetration by boring organisms and grazing by fishes. At the 10m depth, the highest coral cover for any single genus belonged to *Goniastrea* colonies. Veron (1986) had documented the resilience of this coral and found it to be one of the toughest of all corals. They are able to tolerate long exposure to sunlight and are found frequently in places where no other coral might be expected to live. The most frequently recorded genus was *Dendrophyllia* (6) and since it is ahermatypic and thus not dependent on light, the dim-light conditions experienced at the 10m depth makes it ideal for this genus to colonise the reef slope at this depth and face less competition from other more vigorous-growing hermatypic corals. At site 2, the foliaceous coral *Merulina* with 13 colonies had the highest percentage cover though the faviids were still largely represented. The large surface area to volume ratio of such growth forms may be a contributory factor to the fast growth rates exhibited by this genus. Prevailing conditions at these two sites appear to favour the survival of massive and foliaceous coral growth forms. At the 10m depth, live coral cover was only recorded at site 1 (4.53%). The high percentage of dead coral recorded at the two sites is indicative of the devastating effects of reduced light penetration on the survival of live corals at the deeper depths.

The dominant growthforms, encrusting and foliose non-acroporid corals, appear to have adapted to the recent environmental stresses from high sedimentation as a result of massive land reclamation (Chou, 1988). This characteristic was also observed in the results obtained from surveys carried out in the surrounding reefs during the same period.

These results demonstrate only some trends in the benthic community structure, particularly in the reduction of live scleractinian cover at increased depths. Although Cyrene Reefs have been subjected to some pressures (closeness to fairway and mainland) which has reduced the lifeform cover, these have not affected the generic richness of the hard corals in the shallower waters. The total of 33 hard coral genera representing 12 families is the highest number recorded compared to the other reefs surveyed at Raffles Light, Pulau Semakau, Pulau Hantu and Hantu West (Chua & Chou, in press).

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