

A SURVEY OF THE FRINGING REEF COMMUNITY OF PULAU SEMAKAU

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ABSTRACT

This paper summarises the benthic lifeform data collected at two sites from depths of 3 and 10 metres on the reef slopes of Pulau Semakau in four surveys. Analysis of the data showed that the hard corals found at both sites were all of the non-*Acropora* type. A significant decrease in live coral cover occurred with increase in depth at both sites, from 42.09% to 2.48% at site 1, and from 59.72% to 0.0% at site 2. Foliose and submassive corals predominated at the two sites studied, concentrated mainly on the upper reef slopes. Thirty-three genera of scleractinian corals were recorded from the study, with *Pectinia* being the most common genus encountered. Submassive corals like *Pterogyra*, *Euphyllia* (Site 1) and *Goniopora* (Site 2) were also found in great abundance. Another notable feature of the sites surveyed was the high percentage of abiotic cover, comprising mainly of sand and rubble, on the lower reef slopes, indicating less favourable conditions for growth at that depth. The percentage covers of algae and other fauna were low at these sites.

INTRODUCTION

Pulau Semakau (1°12'N, 103°45'E) is approximately 10 kilometres south of the Singapore mainland (Fig. 1). It is presently uninhabited, with a jetty on the western side of the island. The island is surrounded by mangroves and by a fringing reef that extends to as much as 500m from the shore in some places. The reefs of Pulau Semakau support a rich community by Singapore standards (Chou & Koh, 1986), but has been subjected to the dumping of earth spoils (about 500 truckloads a day or 2920m³) on the south-eastern side of the island since December 1988 (Quek, 1989). The authorities have also drawn up plans to dump ash from the incineration plants and refuse at this site after the dumping of earth is completed. As a result, the fringing reefs on the eastern and southern sides of the island are steadily being smothered by silt.

A quantitative study of the fringing reefs of Pulau Semakau was carried out between May 1986 and April 1987 using the depth-specific 100m line transect technique. The upper reef slopes were covered in a previous survey (Chou & Koh, 1986) as part of a broader study covering three other reefs.

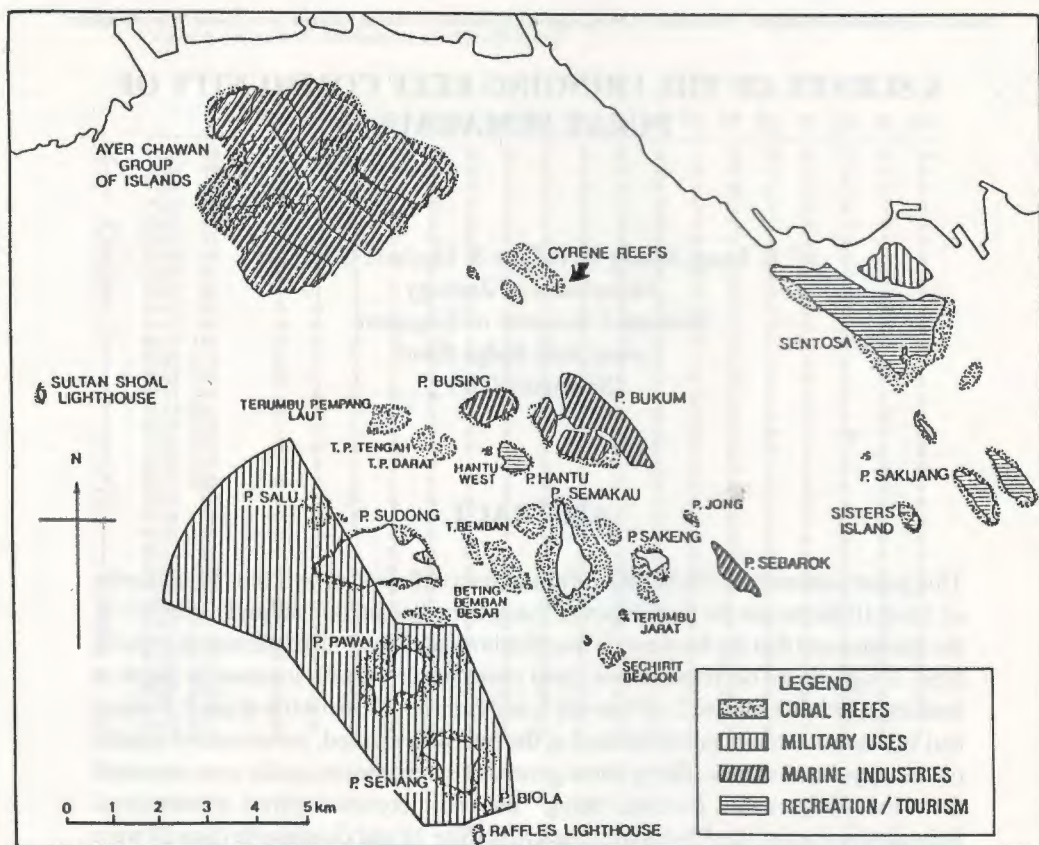


Fig. 1. Map showing the southern islands of Singapore and the location of Pulau Semakau

MATERIALS AND METHODS

The 100-metre line transect survey technique employed is a relatively quick and simple method for determining the benthic cover of a reef (Dartnall & Jones, 1986). The method essentially involves laying a graduated 100-metre tape at a specific depth along the contours of the reef slope. The reef components transected were grouped into different categories based on their structure and physiognomy. Data gathered from the transects were stored in dBASE III Plus and analysed using the LIFEFORM.EXE Programme (Matammu, 1988) to obtain the percentage cover of the various reef components at each transect. Scleractinian corals were identified to generic level using coral taxonomic guides by Veron (1986) and Wood (1983).

A total of four transects was carried out at two sites, on the northeastern (S1) and southwestern (S2) parts of the island (Fig. 2). The two transects established at each site were at different depths, 3m and 10m. These depths were measured with respect to the reef crest.



Fig. 2. Map of Pulau Semakau showing survey sites

RESULTS

Table 1 summarises the results obtained from the surveys. The results are shown as the percentage cover of the 100m transects. Fig. 3 is a bar chart showing the relative abundances of the different categories of benthic cover from the four transects.

Live coral cover was high on the upper reef slopes (3m depth) at both sites, with 59.72% at S2 and 42.09% at S1. At the 10m depth, live corals only covered 2.48% of S1 while none was found at S2. No corals of the family Acroporidae were encountered. Most of the dead corals found had been long dead and were covered with algae. This ranged from 17.32% at S2 at the 3m depth to 0.16% at S2 at the 10m depth where only one such occurrence was recorded.

Table 1. Relative cover of benthic lifeforms on the upper and lower reef slopes of sites surveyed at Pulau Semakau.
<Figures indicate percentage cover with number of occurrences in parentheses>

Lifeform	Location Depth (m)	S1	S1	S2	S2
		3	10	3	10
Hard corals					
Branching		0.50 <1>	0.00	1.50 <2>	0.00
Massive		6.05 <25>	0.43 <2>	5.18 <10>	0.00
Encrusting		1.28 <4>	0.00	10.05 <21>	0.00
Submassive		12.92 <27>	0.00	15.97 <26>	0.00
Foliose		20.82 <63>	1.55 <6>	26.63 <67>	0.00
Mushroom		0.52 <3>	0.50 <3>	0.39 <3>	0.00
Millipora		0.00	0.00	0.00	0.00
Heliopora		0.00	0.00	0.00	0.00
subtotal		42.09	2.48	59.72	0.00
Dead scleractinia					
Dead coral		0.00	0.90 <1>	0.32	0.00
(with algal covering)		9.82 <19>	11.42 <18>	17.32	0.16 <1>
subtotal		9.82	12.32	17.64	0.16
Algae					
Macro		1.21 <6>	0.00	0.00	0.00
Turf		0.00	0.00	0.00	0.60 <1>
Coralline		1.14 <2>	0.00	0.00	0.00
Halimeda		0.60 <2>	0.00	0.00	0.00
Algal assemblage		5.30 <13>	0.00	0.00	3.47 <10>
subtotal		8.25	0.00	0.00	4.07
Other fauna					
Soft corals		0.17 <1>	0.00	0.00	0.00
Sponge		0.49 <3>	0.37 <4>	0.47 <4>	0.79 <5>
Zoanthids		0.00	0.00	0.00	0.00
Others		5.16 <13>	0.12 <2>	1.90 <5>	0.82 <16>
subtotal		5.82	0.39	2.37	1.61
Abiotic					
Sand		9.47 <16>	78.40 <26>	5.75 <15>	92.59 <19>
Rubble		20.29 <33>	6.31 <9>	9.80 <14>	1.07 <4>
Silt		0.00	0.00	2.48 <8>	0.50 <1>
Water		4.26 <10>	0.00	2.24 <10>	0.00
Rock		0.00	0.00	0.00	0.00
subtotal		34.02	84.71	20.27	94.16
Total		100.00 <241>	100.00 <71>	100.00 <214>	100.00 <57>

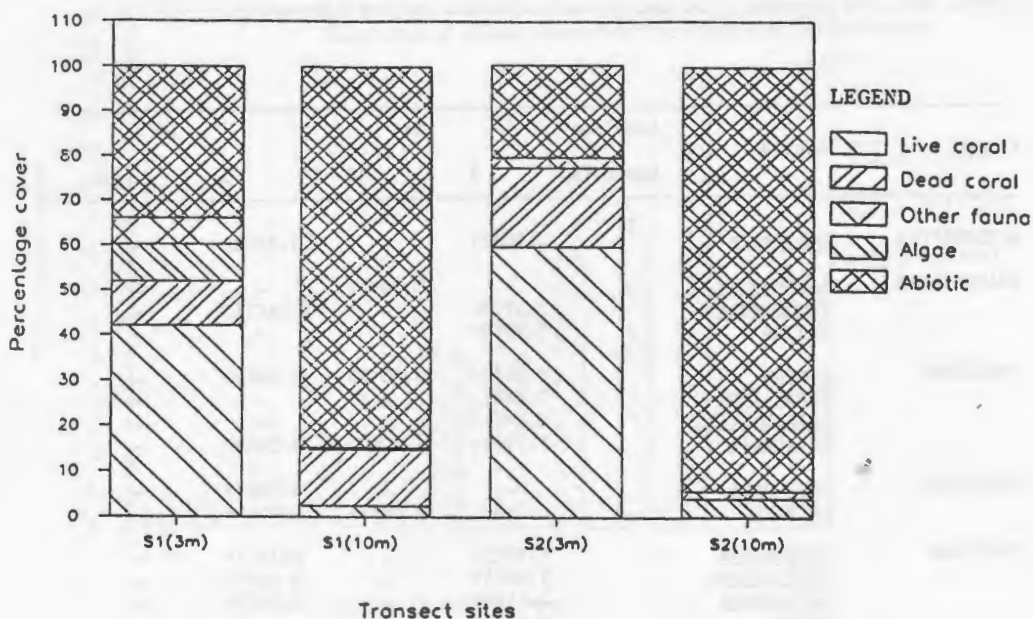


Fig. 3. Bar chart showing the relative abundances of the different categories of benthic cover for the 4 transects.

A large extent of the lower reef slopes at both sites were covered by abiotic substratum, comprising mostly sand and rubble, with the highest at the 10m depth of S2 (94.16%). Algae was only encountered on 2 transects; S1, 3m depth where it covered 8.25% of the transect, and S2, 10m depth where the cover was 4.07%. The algal components at both transects consisted of algal assemblages. Other fauna represented a minor fraction of the lifeforms encountered at all the transects, amounting to not more than 6.00% (S1, 3m depth).

Thirty-three genera of scleractinian corals were recorded in this study with the majority of them distributed on the upper reef slopes; 28 at S1 and 21 at S2 (Table 2). Only 7 genera were found at S1 10m depth and none at S2 10m depth. In terms of cover, *Pectinia* dominated the coral communities on the upper reef slopes of both sites. *Plerogyra* and *Euphyllia* were also abundant at S1 while at S2 high incidences of *Goniopora* and *Merulina* were recorded.

The coral growth form with the highest percentage cover was the foliose type followed by the submassive type (Fig. 4). These growth forms dominated the upper reef slope communities at both sites. At S1 10m depth, the sparse coral cover was mostly made up of foliose corals, represented mainly by *Podabacia* and mushroom corals.

Table 2. Hard coral community of the upper and lower reef slopes analysed at generic level.
(Figures indicate percentage cover with colony number in parentheses)

FAMILY	Genera	Location Depth (m)	S1		S2	
			3	10	3	10
ACROPORIDAE	<u>Montipora</u>	2.90<6>	-	1.25<3>	-	-
AGARICIIDAE	<u>Leptoseris</u>	-	0.10<1>	-	-	-
	<u>Pachyseris</u>	3.47<5>	-	7.34<15>	-	-
	<u>Pavona</u>	0.87<3>	-	-	-	-
FUNGIIDAE	<u>Fungia</u>	0.30<2>	0.50<3>	0.39<3>	-	-
	<u>Herpolitha</u>	0.22<1>	-	-	-	-
	<u>Lithophyllon</u>	0.27<1>	-	-	-	-
	<u>Podabacia</u>	1.19<3>	1.10<2>	0.30<2>	-	-
PORITIDAE	<u>Goniopora</u>	-	-	8.60<7>	-	-
	<u>Porites</u>	-	0.30<1>	2.81<6>	-	-
FAVIIDAE	<u>Cyphastrea</u>	1.18<3>	-	0.33<1>	-	-
	<u>Diploastrea</u>	3.65<3>	-	2.50<1>	-	-
	<u>Echinopora</u>	2.71<8>	-	0.94<2>	-	-
	<u>Favia</u>	0.68<5>	-	-	-	-
	<u>Favites</u>	0.72<2>	-	0.45<1>	-	-
	<u>Goniastrea</u>	0.40<1>	-	-	-	-
	<u>Hydnophora</u>	0.50<1>	-	-	-	-
	<u>Leptoria</u>	-	-	0.76<2>	-	-
	<u>Montastrea</u>	0.76<4>	-	-	-	-
	<u>Platygyra</u>	3.07<11>	-	2.68<11>	-	-
TRACHYPHYLLIIDAE	<u>Trachyphyllia</u>	0.05<1>	-	-	-	-
OCULINIDAE	<u>Galaxea</u>	-	-	0.15<1>	-	-
MERULINIDAE	<u>Merulina</u>	1.72<8>	0.15<1>	7.95<15>	-	-
MUSSIDAE	<u>Lobophyllia</u>	0.76<3>	-	0.80<2>	-	-
	<u>Symphyllia</u>	0.37<1>	-	-	-	-
PECTINIIDAE	<u>Echinophyllia</u>	-	-	1.45<2>	-	-
	<u>Mycedium</u>	0.40<2>	-	1.70<1>	-	-
	<u>Oxypora</u>	-	-	0.70<3>	-	-
	<u>Pectinia</u>	7.29<27>	0.20<2>	13.13<38>	-	-
CARYOPHYLLIIDAE	<u>Euphyllia</u>	4.01<11>	-	2.75<3>	-	-
	<u>Plerogyra</u>	4.22<9>	0.13<1>	1.78<8>	-	-
DENDROPHYLLIIDAE	<u>Tabastraea</u>	0.06<1>	-	-	-	-
	<u>Turbinaria</u>	0.32<1>	-	-	-	-

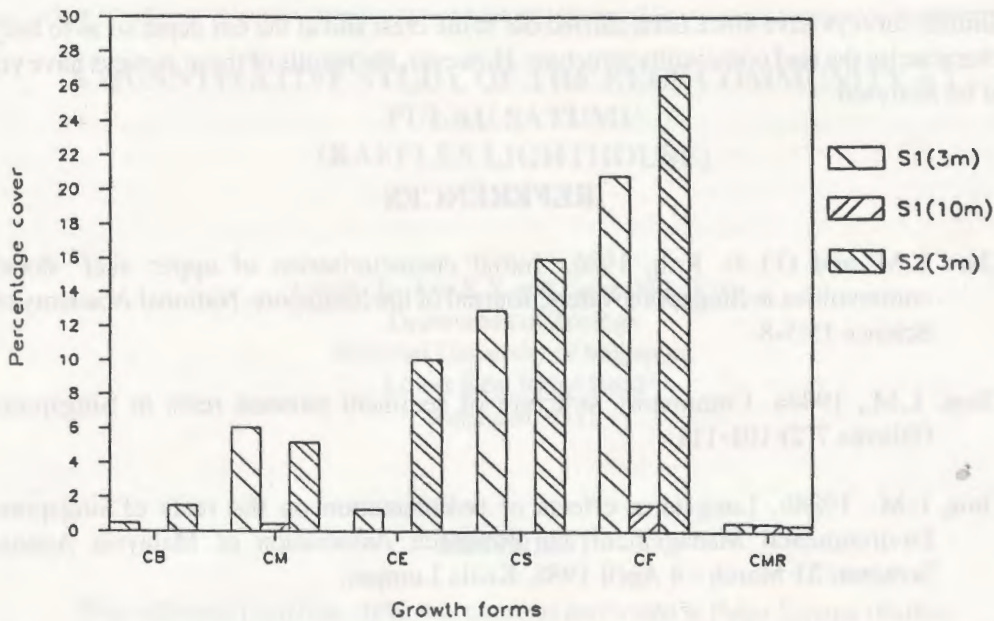


Fig. 4. Bar chart showing the relative abundances of each different scleractinian growth forms for the 4 transects (CB = Coral Branching, CM = Coral Massive, CE = Coral Encrusting, CS = Coral Submassive, CF = Coral Foliose, CMR = Mushroom Coral)

DISCUSSION

Both sites show relatively high coral cover, despite speculations by early authors such as Hill (1973) that the reefs were dead or dying. However, the site further away from the mainland (S2) has greater cover at the upper reef slope because of the decreased sedimentation load (Chou, 1988a). It would seem that the corals found in the reefs of Pulau Semakau have adapted to the high sedimentation rates in the area. This is also supported by the data, which shows that the percentage of recently dead corals is low (less than 1%) as compared to corals that have been dead for a longer time, represented by algae-covered dead coral.

The drastic reduction of live coral cover at the lower depth at both sites can be accounted for by the high turbidity of the waters caused by land reclamation on the mainland and neighbouring islands (eg. Pulau Hantu) and the dumping of earth spoils in the waters southeast of Pulau Semakau (Chou, 1988b). The increase in sediment load from these activities would have killed off many corals on the light-deficient lower slopes.

The predominance of foliose type corals at both sites may be related to the water conditions and the nature of the substratum. Chua and Chou (in press) suggested that the soft substrate and the turbidity of the water favours the growth of foliose or encrusting forms because they are better able at anchoring themselves on the reef slope, and are more effective at absorbing sunlight for the growth of symbiotic zooxanthellae, which is essential to the healthy growth of corals.

Similar surveys have since been carried out at the crest and at the 6m depth so as to fully characterise the reef community structure. However, the results of these surveys have yet to be analysed.

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