

The fish fauna around proposed reef sites in Singapore

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ABSTRACT

Five sites were identified as possible areas for the establishment of artificial reefs. These were Terumbu Bemban, Terumbu Jarat, Terumbu Pandan, Terumbu Pempang Tengah and Pulau Semakau. The fish fauna at these sites was surveyed and a preliminary list of reef species observed at the sites is given. Only three species of indicator butterflyfishes (Chaetodontidae) were recorded during the surveys. Generally, there were few target species (families Caesionidae, Carangidae, Haemulidae, Lethrinidae, Lutjanidae and Serranidae). The most abundant fishes were the pomacentrids and the labrids. The fish fauna was abundant at 3 m depth and generally poor at 10 m depth.

INTRODUCTION

The Artificial Reefs in Living Resources Enrichment in the Singapore component of the ASEAN/US Coastal Resources Management Project is the first project of its kind in Singapore. It aims to increase fish habitats and restore critical habitats for the purpose of increasing fish production, enhancing recreational fishing and preserving genetic diversity in Singapore waters. Studies on Singapore reefs have shown that artificial substrates may prove significant in coral recruitment and growth (Chong 1985; Chou and Lim 1986). Artificial reefs can also serve as fish aggregating devices. The initial activities of the project entailed a site-selection survey for possible artificial reef sites and a documentation of reef substrate. This paper gives a list of visually conspicuous reef fishes surveyed and an estimate of their abundance in each site.

METHODOLOGY

Five reefs south of the Singapore mainland were chosen as potential artificial reef sites (Fig. 1). They are Terumbu Bemban, Terumbu Jarat, Terumbu Pandan, Terumbu Pempang Tengah and Pulau Semakau. The reefs at the first four sites are patch ones, while that at Pulau Semakau is fringing.

The fish surveys were made by visual census, modified from that described by Dartnall and Jones (1986). At each site, a 150-m transect line was laid along the reef slope, parallel to the reef crest, at two depths (3 and 10 m). Two observers swam along the line and recorded the fish observed within 3 m to the left, right and above. The total area covered using this method was 900 m².

Actual counts were made for the indicator species (family Chaetodontidae) and the target species (important food families such as Haemulidae, Lethrinidae, Lutjanidae and Serranidae). The abundance of all other families of fishes was estimated according to log 4 abundance categories (Table 1). The abundance of scads (Carangidae) and fusiliers (Caesionidae), although considered target species, have been estimated according to log 4 categories because of their schooling habit.

All surveys were carried out between 11 A.M. and 3 P.M. within a three-month period from June to August 1988. No data were collected for the 10-m transect at Terumbu Jarat since the reef slope was not beyond 6 m deep.

RESULTS

A total of 57 species of fishes from 17 families was recorded. The results are summarized in Table 1.

Indicator fish (Chaetodontidae)

The butterflyfishes recorded were *Chaetodon octofasciatus*, *Chelmon rostratus* and *Coradion chrysozonus*. *C. rostratus* and *C. octofasciatus* were ubiquitous at all the sites surveyed. However, while *C. rostratus* was observed at both depths, *C. octofasciatus* was observed only at the 3-m depth transect. *C. chrysozonus* was not recorded in any of the transects but was sighted at Terumbu Bemban at 10 m depth.

Target species

The nine species recorded under this category were two species of sweetlips (Haemulidae), two species of groupers (Serranidae), two species of scad/trevallies (Carangidae), two species of fusiliers (Caesionidae) and one species of snappers (Lutjanidae). No emperor bream (Lethrinidae) was observed. The schooling fusiliers (*Caesio teres* and *C. caerulea*) were most abundant and occurred in schools of 10 to 40. Their sizes ranged from 10 to 18 cm. Among the solitary target species, the snapper (*Lutjanus carponotatus*) and the small grouper (*Cephalopholis pachycentron*) were more common. Single large individuals (approximately 30 cm in length) of groupers (*Plectropomus areolatus*) and sweetlips (*Plectorhynchus pictus*) were recorded at Terumbu Jarat and Terumbu Bemban, respectively. The small scad (*Selaroides leptolepis*) was also present in the reefs but was not recorded in the transects.

Major families

In terms of the number of species and abundance, the dominant families recorded were Pomacentridae and Labridae. A total of 17 species of pomacentrids and 11 species of labrids were recorded during the fish surveys. The smaller pomacentrids of genera *Neopomacentrus* and *Pomacentrus* were most common. *Pomacentrus* was distributed throughout the reef and was abundant at the 10-m depth, while *Neopomacentrus* was confined to shallower depths (3 m). Among the labrids, the most common were *Halichoeres dussumieri* and *H. melanurus*. The soapfish (Grammistidae, *Diploprion bifasciatus*) was also relatively abundant at all sites.

Other families of fishes observed at the sites were Apogonidae, Blenniidae, Gobiidae, Mullidae, Nemipteridae, Ostraciidae, Pomacanthidae and Scaridae.

Eleven species were common at lower depths (10 m). Five of these were pomacentrids: *Pomacentrus alexanderae*, *P. brachialis*, *Chrysiptera unimaculata*, *Hemiglyphidodon plagiometapon* and *Neopomacentrus* sp. 1. The rest were: one chaetodontid (*Chelmon rostratus*); one pomacanthid or angelfish (*Chaetodontoplus mesoleucus*); one labrid (*Halichoeres dussumieri*); one Caesionidae (*Caesio caerulea*); one lutjanid (*Lutjanus carponotatus*); and one Grammistidae or soapfish (*D. bifasciatus*).

Fish species recorded at the sites were generally small. Only a few large species were sighted: *P. areolatus*, *P. pictus*, *P. chaetodontoides*, *Scarus ghobban* and *Chelinus fasciatus*. With the exception of the more pelagic fusiliers (*Caesio teres*, *C. caerulea*) and scad/trevallies (*Selyroides leptolepis*, *Caranx* spp.), all other fishes were observed to be closely associated with the reef.

DISCUSSION

Randall noted that the number of species of reef fish in Singapore was low (Tay and Khoo 1984). Tay and Khoo (1984) recorded 99 species from 28 families. It should be noted that the 57 species recorded in this survey can not be directly compared with the number of species they reported as the methods and time of recording differed greatly. While Tay and Khoo used comprehensive but time-consuming methods, the method used for this study yielded quick but only semiquantitative data. However, this method allowed the identification of the visually conspicuous species of reef fishes and an estimation of their abundance for the assessment of the fish populations (GBRMPA 1978).

The pomacentrids and labrids were the dominant reef fishes at all the sites surveyed. The chaetodontids, with only three species, can be considered poor in terms of variety. This trend was also observed for the target species.

The reef fishes were generally of greater variety and more abundant at the 3-m depth than at the 10-m depth. This can be attributed to the greater live coral cover at the 3-m depth compared to the 10-m depth (Hsu and Chou, this vol.). At greater depths (10 m), the percentage of rubble was greater; this implies a lower availability of food and shelter. Eleven species, however, seem to have adapted to these conditions. Most of these species were generally small; the larger species observed were only a few.

The proposed artificial reefs may enhance the fish population at these sites. Once established, these reefs will be evaluated for their effectiveness.

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Table 1. The distribution and abundance of reef fishes at proposed artificial reef sites.

Family	Species	Survey site/depth									
		Terumbu Pandan		Terumbu Pempang Tengah		Terumbu Bemban		Terumbu Jarat	Pulau Semakau		
		3 m	10 m	3 m	10 m	3 m	10 m	3 m	3 m	10 m	
		Actual counts									
Chaetodontidae	<i>Coradion chrysozonus</i>						+				
	<i>Chaetodon octofasciatus</i>	1		11		5	-	5	4		
	<i>Chelmon rostratus</i>	14	1	5	5	5	11	6	11	2	
		Log 4 abundance									
Apogonidae	<i>Apogon compressus</i>			1			1				
	<i>A. sealei</i>		3								
	<i>Cheilodipterus macrodon</i>	+		+					+		
Blenniidae	<i>Meiacanthus grammistes</i>								1		
	<i>Blenny</i> sp.									2	
Caesionidae	<i>Caesio teres</i>	2		3		4	4	2			
	<i>C. caerulea</i> *										
Carangidae	<i>Selaroides leptolepis</i>			+	+	+		+			
	<i>Caranx</i> sp.							1			
Grammistidae	<i>Diploprion bifasciatus</i>	4	+	3	3	4	4	4	4	3	
Gobiidae	<i>Goby</i> sp. 1			1				1	2		
Haemulidae	<i>Plectorhynchus pictus</i>					1					
	<i>P. chaetodontoides</i>							+		+	
Labridae	<i>Choerodon anchorago</i>	1	1	1	1	2		1	3		
	<i>Cheilinus fasciatus</i>				1				1		
	<i>Halichoeres chloropterus</i>	1		1		2					
	<i>H. melanurus</i>	3	1	1		3					
	<i>H. melanocheir</i>	1									
	<i>H. scapularis</i>			1							
	<i>H. dussumieri</i>	4	3	4	4	4	3	+	4	4	
	<i>H. hartsfeldii</i>				3						
	<i>Hemigymnus melapterus</i>						1				
	<i>Labroides dimidiatus</i>					1					
	<i>Thalassoma lunare</i>					2					
Lutjanidae	<i>Lutjanus carponotatus</i>			3		1	3	1			
Mullidae	<i>Upeneus tragula</i>							1			
Nemipteridae	<i>Pentapus caninus</i>		1								
	<i>Scolopsis bilineatus</i>										
	<i>S. trilineatus</i>					1					
	<i>S. vosmeri</i>						1				

Continued

Table 1 (continued)

Family	Species	Survey site/depth								
		Terumbu Pandan		Terumbu Pempang Tengah		Terumbu Bemban		Terumbu Jarat	Pulau Semakau	
		3 m	10 m	3 m	10 m	3 m	10 m	3 m	3 m	10 m
Ostraciidae	<i>Ostracion</i> sp.	1								
Pomacanthidae	<i>Pomacanthus sexstriatus</i>	1			1	1		1	1	
	<i>Chaetodontoplus mesoleucus</i>	3	1	3	3	4	2	3	3	2
Pomacentridae	<i>Abudefduf bengalensis</i>							1		
	<i>A. coelestinus</i>							1		
	<i>A. saxatilis</i>		1							
	<i>A. vaigiensis</i>		1							
	<i>Amblyglyphidodon leucogaster</i>				1	1	3			
	<i>Amphiprion frenatus</i>				1					
	<i>A. ocellaris</i>	+							+	1
	<i>Chrysiptera unimaculata</i>	1			3				3	
	<i>Hemiglyphidodon plagiometapon</i>			3	2	3		4		
	<i>Neopomacentrus taeniurus</i>	4				2				
	<i>Neopomacentrus</i> sp. 1	4	2	4	2	4	3		4	2
	<i>Neopomacentrus</i> sp. 2						1			
	<i>Paraglyphidodon nigrosis</i>			1	4		3		3	
	<i>Pomacentrus alexanderae</i>	4	3	4	3	5	5	1	4	4
	<i>P. brachialis</i>	4	2	3		4	2	3	4	1
	<i>P. moluccensis</i>				2					
	<i>Pomachromis richardsoni</i>				4		4		4	2
Scaridae	<i>Scarus ghobban</i>			1						
	<i>Scarus</i> sp.								4	
Serranidae	<i>Cephalopholis pachycentron</i>		1	2						
	<i>Plectropomus areolatus</i>							1		

Log 4 Categories	No. of individuals	
1	1	+ indicates presence
2	2 - 4	
3	5 - 16	
4	17 - 64	
5	65 - 256	
6	257 - 1,024	

*No data on distribution and abundance but present at 10-m depth.

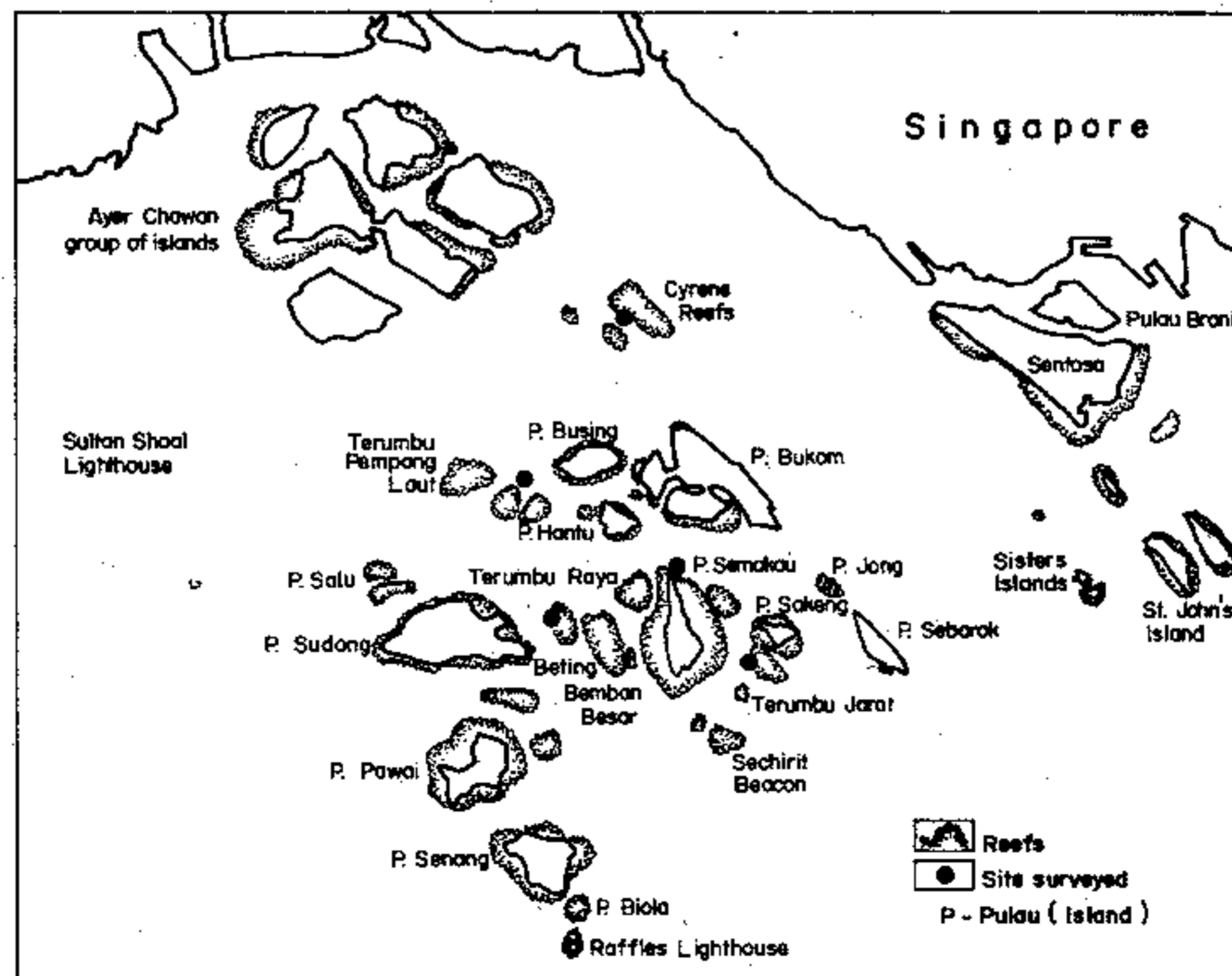


Fig. 1. Map of coral reefs in Singapore showing sites surveyed.