

THE SOFT-BOTTOM BENTHIC COMMUNITY OF PULAU AYER CHAWAN : A PRELIMINARY SURVEY

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ABSTRACT

As part of a project to determine the extent of Singapore's coastal living resources, the soft bottom benthic community of Pulau Ayer Chawan was surveyed by using the naturalist's rectangular dredge and the Ekman grab. Pulau Ayer Chawan is part of a group of nearshore islands located south of Singapore mainland that house a high concentration of petrochemical industries, thus representing an area prone to petrochemical pollution. A total of 299 specimens from 36 families was collected, belonging to the phyla Annelida, Arthropoda, Echinodermata, Mollusca and Sipuncula. The most abundant family was Eunicidae (Annelida). The number of families is similar to that of West Johore Strait but compares poorly with those of other nearshore sites such as East Johore Strait, Bedok and Pulau Tekong.

INTRODUCTION

In order to determine the extent of the coastal living resources in Singapore, extensive surveys were carried out on coral reefs, mangroves and soft-bottom communities in and around the main island under the Asean-Australia Coastal Living Resources Project. Soft-bottom communities of both riverine and nearshore habitats were surveyed and Pulau Ayer Chawan was one of the three nearshore survey sites identified in the project, the other two being Pulau Tekong and West Johore Strait.

These benthic surveys are of special interest because of the paucity of published material on benthic communities in Singapore. Prior to this, Lee (1973) conducted a preliminary survey of East Johore Strait (to the north of Singapore) and Chou and Khoo (1990) studied the soft-bottom benthic community at Bedok, situated at the southern part of the main island. The results presented in this paper together with those of the other survey sites will serve as a baseline data set for subsequent research.

Pulau Ayer Chawan (103° 42'E and 1° 16'N) was chosen as a site because of the high concentration of petrochemical works in the area. It is part of a group of 10 or so islands off the southwestern coast of the main island (Fig. 1). All these islands have been set aside for the location of petrochemical-related industries and are being developed for this purpose at a rapid pace.

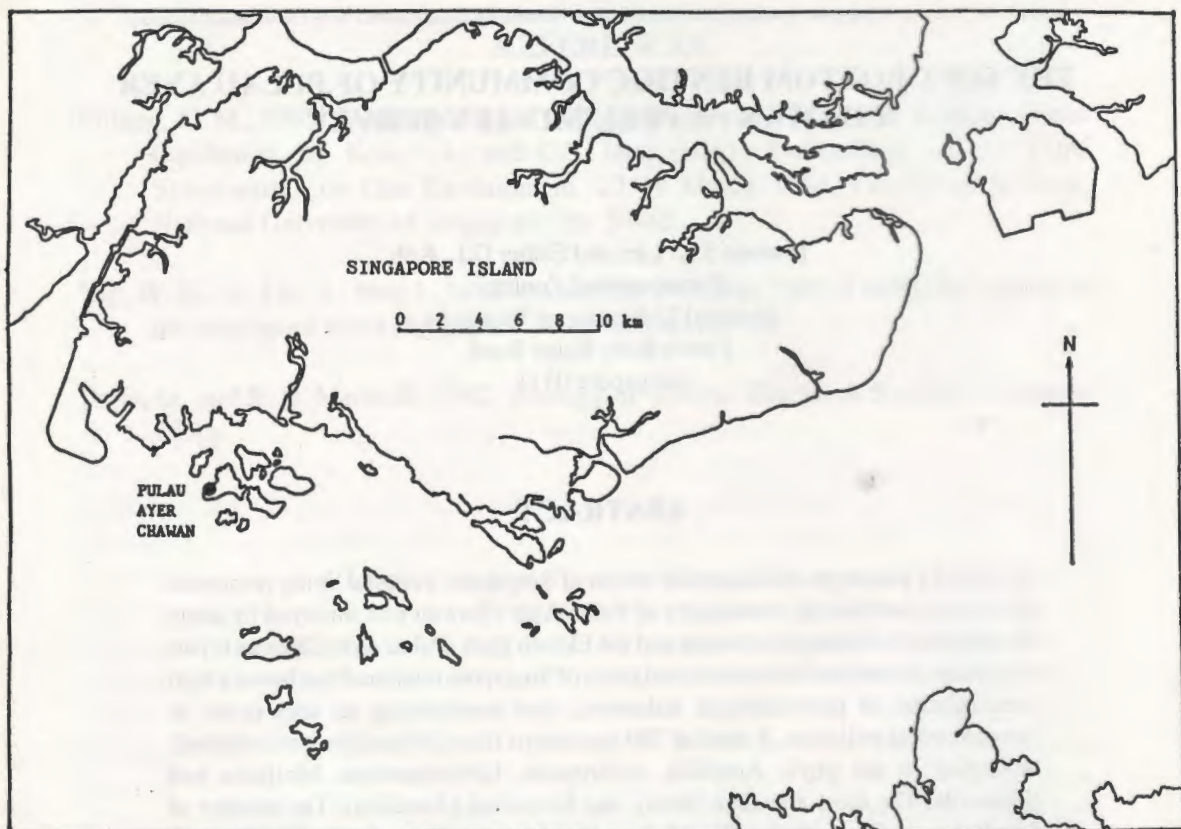


Fig. 1. Map of Singapore showing the survey site (Pulau Ayer Chawan).

MATERIALS AND METHODS

Samples were taken from five stations (Fig. 2) around Pulau Ayer Chawan in November 1986. The materials and method used were based on those described in Dartnall and Jones (1986) with some modifications. Neither the Smith-McIntyre grab nor the Ockelmann sledge were available at the time of the survey, and instead, the Ekman grab (sampling area 15cm by 15cm) and a naturalist's rectangular dredge with a mouth size of 75cm by 20cm were used. A polypropylene net (50cm long) with stretched mesh size of 2.5cm was attached to the dredge.

The attempts at collecting grab samples were unsuccessful because of the sandy or gravelly nature of the substrate around Pulau Ayer Chawan. At each station, a dredge sample was taken by towing the dredge for 10 minutes at the speed of one knot. The contents of each dredge were immediately sieved through 5.0mm and 7.5mm wire-mesh sieves and the live specimens were removed for sorting and preserving in 10% formalin on the day of collection. All the specimens were then transferred into 70% alcohol the next day, except for the polychaetes which were left in formalin.

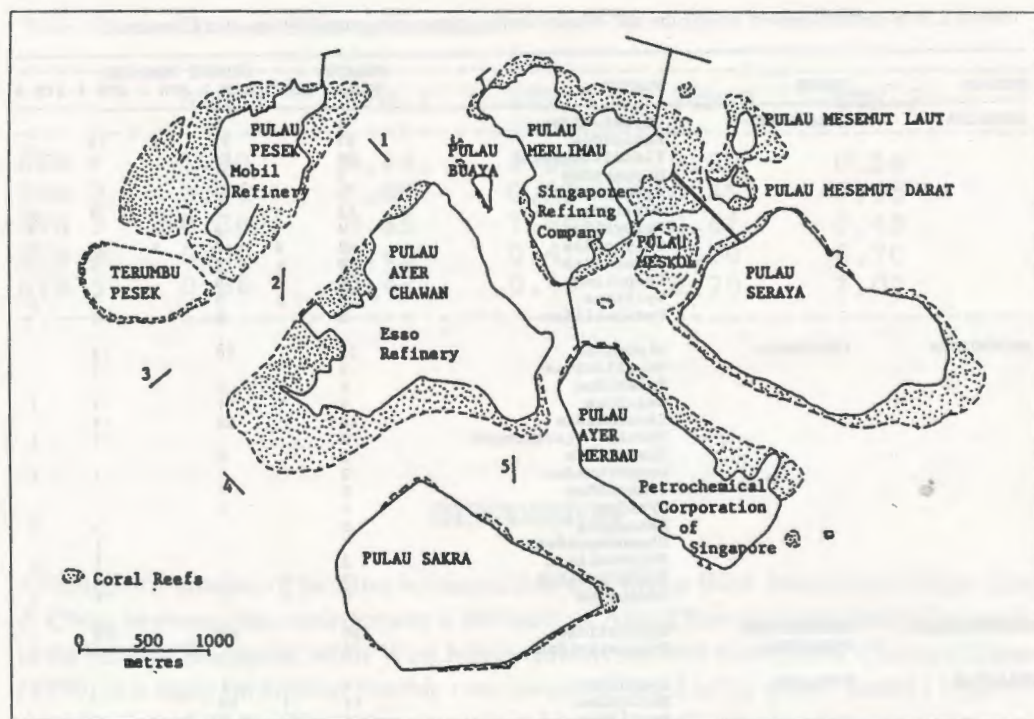


Fig. 2. Ayer Chawan group of islands showing sampling stations 1 to 5.

Specimens were identified to the family level with the help of the taxonomic literature of Abbot and Dance (1982), Barnes (1987), Chuang (1961), Clark and Rowe (1971), Fauchald (1977), Gibbs (1977), Grey and Dall (1983) and Sakai (1976). Counts were made of the number of specimens found in each dredge sample. The data was stored and summarised using dBASE III PLUS and the BENTH1 programme.

The similarity (at family level) between stations was compared by using Morisita's Similarity Index (Morisita, 1959), as this index has been found to be most suitable for sample sizes smaller than 20 (Khoo & Lim, 1986).

RESULTS

Two hundred and ninety-nine specimens belonging to 36 families in five phyla were collected in total (Table 1). The annelids made up the highest number of specimens collected from Pulau Ayer Chawan (162 specimens or 54.18%). All of them were polychaetes and could be grouped into 12 families, with Eunicidae being the most abundant family (57 specimens or 19.06%).

The next largest group of animals collected was the crustaceans (phylum Arthropoda) which accounted for 27.42% (82 specimens) of the total, representing 15 different families. The most abundant crustacean family was Cirolanidae, an isopod family, which formed 9.36% (28 specimens) of the total collection.

Table 1. List of families present among the soft-bottom benthic community around Pulau Ayer Chawan.

PHYLUM	CLASS	FAMILY	FAMILY TOTAL	DREDGE SAMPLES						
				STN 1	STN 2	STN 3	STN 4	STN 5		
ANNELIDA	POLYCHAETA	Cirratulidae	1		1					
		Eunicidae	57		31	1	18	7		
		Flabelligeridae	25		24		1			
		Glyceridae	3		3					
		Lysaretidae	1		1					
		Nereidae	13	4	5		3	1		
		Palmyridae	4		3			1		
		Polynoidae	13	4	5	1	2	1		
		Sebellidae	9	1	2		5	1		
		Serpulidae	9		9					
		Syllidae	24	6	5		7	6		
		Terebellidae	3		2		1			
		ARTHROPODA	CRUSTACEA	Alpheidae	23		10		13	
				Ampeliscidae	3				3	
Balanidae	1				1					
Ceinidae	4			1	1		1	1		
Cirolanidae	28				24		4			
Family 1 (arthropod)	2						1	1		
Gammaridae	2				2					
Leucothoidae	2						1	1		
Limnoridae	1				1					
Mysidae	1				1					
Penaeidae	5						3	2		
Pinnotheridae	1						1			
Polychelidae	2						1	1		
Porcellanidae	2			1			1			
Xanthidae	5			1	2		1	1		
ECHINODERMATA	OPHIUROIDEA	Ophiactidae	20		10		10			
	PTEROIDEA	Pterasteridae	1					1		
MOLLUSCA	BIVALVIA	Lucinidae	1		1					
		Malleidae	11	1	10					
		Mytilidae	1				1			
		Nuculidae	1				1			
		Psammobiidae	4		4					
SIPUNCULA	SIPUNCULIDA	Aspidosiphonidae	1		1					
		Golfingiidae	15		15					
TOTAL			299	19	174	2	79	25		

The other three phyla that occurred at Pulau Ayer Chawan were Echinodermata, Mollusca and Sipuncula. Twenty-one specimens from two families of echinoderms were collected, representing 7.02% of the total. The only molluscs found were bivalves (18 specimens or 6.02%) belonging to five different families. The remaining 16 specimens (5.35% of total) belonged to two sipunculid families.

Of the five stations sampled, station 2 yielded the highest number of individuals (174), followed by station 4 (79), station 5 (25), station 1 (19) and last of all station 3 (2).

Table 2 gives the abundance and percentages of the phyla collected per station and the overall abundance and the percentages for the sites. Table 3 shows Morisita's Similarity Indices between the stations. The highest indices computed, were 0.64 between stations 1 and 2, and 0.7 between stations 4 and 5.

Table 2. Percentages and abundances of phyla collected from each station and overall total from Pulau Ayer Chawan (abundance in parentheses).

PHYLUM	STN 1	STN 2	STN 3	STN 4	STN 5	TOTAL
Polychaeta	78.95 (15)	52.30 (91)	100 (2)	46.83 (37)	68.0 (17)	54.18 (162)
Arthropoda	15.79 (3)	24.14 (42)	-	37.97 (30)	28.0 (7)	28.42 (82)
Echinodermata	-	5.75 (10)	-	12.66 (10)	4.0 (1)	7.02 (21)
Mollusca	5.26 (1)	8.62 (15)	-	2.53 (2)	-	6.02 (18)
Sipunculida	-	9.20 (16)	-	-	-	5.35 (18)

Table 3. Morisita's Similarity Indices between stations.

	STN 1	STN 2	STN 3	STN 4	STN 5
STN 1	1.00	0.64	0.30	0.30	0.56
STN 2	0.64	1.00	0.35	0.45	0.48
STN 3	0.30	0.35	1.00	0.41	0.49
STN 4	0.30	0.45	0.41	1.00	0.70
STN 5	0.56	0.48	0.49	0.70	1.00

DISCUSSION

Although the number of families is comparable with that at West Johore Strait (Koh, Lim & Chou, in press), the environment is different as Ayer Chawan is situated to the south, in the Strait of Singapore, while West Johore Strait is situated to the north. Chou and Khoo (1990) in a study on another benthic community situated in the south (Bedok) reported the presence of 48 families. This was much higher than the number (36) found at Ayer Chawan. However, family diversity of the benthic community here compares poorly with those of other nearshore sites such as East Johore Strait (Lee, 1973), and Pulau Tekong (Koh, Lim & Chou, in press). Pulau Ayer Chawan was reclaimed in the late sixties (Chia *et al.*, 1988) for the purpose of siting petrochemical industries. Chan (1980) mentioned the possibility of oil pollution and excessive suspended sediment (from erosion of fill in material) as causes of the poor state of coral reef development in Sentosa. Conclusive investigations of the possibility of these two factors on the Ayer Chawan benthic fauna have not been performed as yet.

The relatively high Morisita's Similarity Indices between stations 1 and 2 and stations 4 and 5 give an indication that the benthic faunal composition between these sites are similar. Stations 1 and 2 are situated between Pulau Persek and Pulau Ayer Chawan; stations 4 and 5 are situated south of Pulau Ayer Chawan. The high similarity indices between these sites may be due to similarities in the environment and future investigations on the hydrology of this area are required.

The lack of trained personnel limited identification of specimens to family level. This made explanations of the significance of dominant families at each station difficult. However, the results of this survey provide an initial characterisation of the soft bottom benthic communities in Ayer Chawan. The families found here are mostly adapted for rocky and sandy benthos. More comprehensive investigations of this site as well as other sites in the vicinity of oil refineries may also provide insight on the effects of petrochemical processing on soft bottom benthic communities. This would aid management of coastal resources under similar conditions of stress.

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ABSTRACT

The physical and chemical characteristics of the soft-bottom benthic communities in near-shore habitats of Singapore were investigated. Results revealed the distribution of various species of macrobenthos, as well as a low abundance of living benthic fauna. A total of 46 species, 15 genera and 10 families were recorded, mostly obtained from a single station in the mouth of the river. The most abundant species collected were *Alpheidae*, *Decapoda*, *Polychaeta*, *Amphipoda*, *Isopoda*, *Hydroids* and *Chaetognaths*. It was observed that the abundance of *Amphipoda* and *Hydroids* was directly related to the presence of pig farming activities and the abundance of *Chaetognaths* was related to the presence of pig farming activities. The results of the study will be used to assess the quality of the soft-bottom benthic communities in near-shore habitats of Singapore.

INTRODUCTION

Sungai Serapiang is located in the north-western coast of Singapore and flows into the East Johore Strait. The river mouth opens into the sea directly opposite the offshore island of Pulau Ubin (Fig. 1).

In the late 1940's, agriculture in the form of rubber planting was introduced, starting to become increasingly important in Singapore and much pig and poultry farms were set up in coastal areas. These farming activities were located near rivers such as Sungai Punggol, Serapiang and Selat. With the advent of modern methods of waste disposal, as well as dumping grounds for these wastes (Pong, 1977).

During the late 1970's, pig farms located within some residential areas and urban areas were shifted to Punggol where provision has been made for the large-scale rearing of pigs. In addition, an intensive programme by the government to clean up the Singapore River and Kallang Basin combined with the 1977 phase-out pig farming activities in these locations, resulted in the shifting of pig farming to Punggol (Chen et al., 1987), which had a low population density and low level of pollution. Presently, these pig farming activities are the main source of pig waste in the process of being eliminated through the phase-out of pig farming altogether.