A STUDY OF THE BENTHIC SOFT-BOTTOM AND PELAGIC COMMUNITIES OF SUNGEI BULOH

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ABSTRACT

A survey of the benthic community of Sungei Buloh conducted in April 1988 using trammel nets, an Ekman grab and a naturalist's dredge yielded a total of 1575 specimens, representing 46 families from five phyla. Of the families represented, 18 were polychaetes, 12 bivalves, eight crustaceans, four gastropods, three fishes and one asteroid. This study indicated that the benthic and pelagic communities supported by the river compared favourably with that of other rivers.

INTRODUCTION

The study was carried out at sites along Sungei Buloh Besar and Sungei Buloh Kechil (Figs. 1 and 2). Both rivers drain into the West Johore Strait through a common river

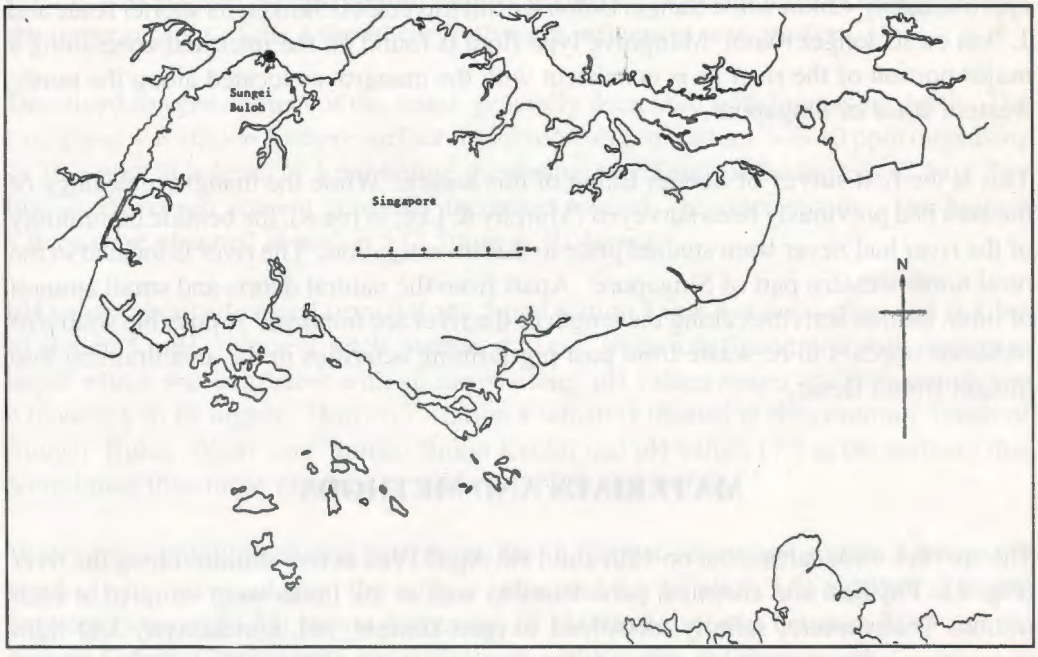

Fig. 1. Map of Singapore showing Sungei Buloh

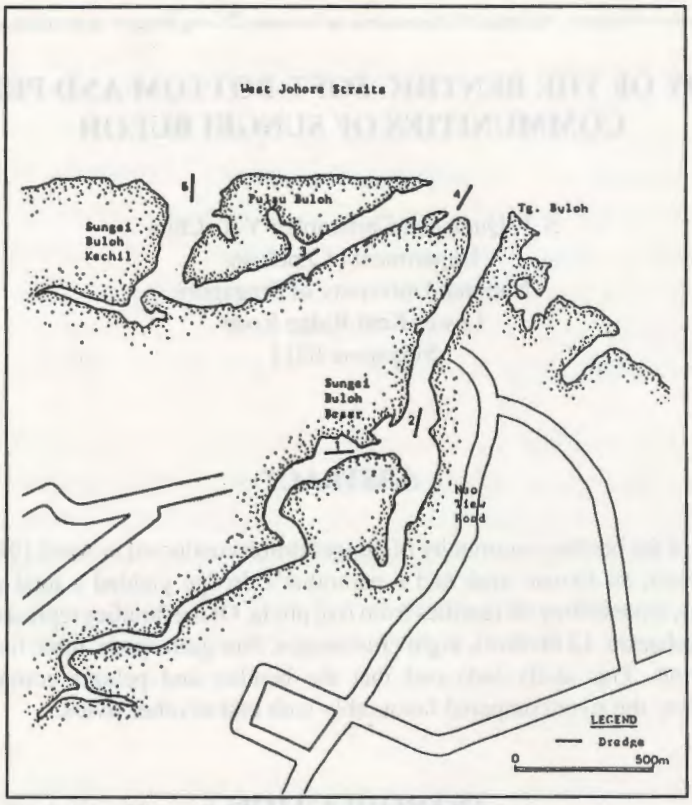

Fig. 2. Map of Sungei Buloh showing sampling stations 1 - 5

mouth between Tanjong Buloh and the eastern tip of Pulau Buloh. In addition, Sungei Buloh Kechil flows through another river mouth bordered by the western edge of Pulau Buloh. Sungei Buloh Besar from source to river mouth traverses a distance of approximately 4.5km while Sungei Buloh Kechil traverses 0.9km on its shorter route and 1.7km on its longer route. Mangrove type flora is found on the intertidal zone along a major portion of the river as is consistent with the mangroves located along the north-western coast of Singapore.

This is the first survey of Sungei Buloh of this nature. While the mangrove ecology of the area had previously been surveyed (Murphy & Lee, in press), the benthic community of the river had never been studied prior to this investigation. The river is located in the rural north-western part of Singapore. Apart from the natural debris and small amount of litter, human activities along the length of the river are minimal. A possible source of pollution appears to be waste from past pig-farming activities in the area draining into Sungei Buloh Besar.

MATERIALS AND METHODS

The surveys were carried out on 12th and 13th April 1988 at five stations along the river (Fig. 2). Physical and chemical parameters as well as the fauna were sampled at each station. Temperature, salinity, dissolved oxygen content, pH, conductivity and light penetration were recorded *in situ* at 0.5m depth intervals of the water column at each

station. Temperature and salinity were measured with a portable YSI Model 33 Salinity - Conductivity-Temperature meter while the dissolved oxygen content was measured with a portable YSI Model 57 Oxygen meter. The pH was measured with an Orion portable pH meter model SA250. The conductivity of water was measured with a pHOX 52E Conductivity meter. Light was measured with a Quantum Sensor in conjunction with a LI-COR LI-1000 Data Logger. Water visibility was measured with a Secchi disc. An Ekman grab (15cm x 15cm) was used to collect samples of benthic organisms from the river bed. Three grab samples were taken at every station. A naturalist's rectangular dredge (with 60cm x 22cm opening, 50cm long polypropylene net-bag with stretched mesh size of 2.5cm) was used to collect samples of benthic macro biota from the river bed (Dartnall & Jones, 1986). A 10-minute dredge tow at 1 knot was carried out at every station (Dartnall & Jones, 1986). One trammel net (30m x 1.5m, stretched mesh size 4cm) each was set at stations 4 and 5 to sample for the larger nektonic organisms. The nets were set and left for 24 hours before being collected.

RESULTS

The physical and chemical parameters of the water at the 5 stations are given in Table 1. The list of all specimens and abundance (family level) is given in Table 2. Water temperature recordings showed no definite trends with respect to the depths at which they were taken. Readings at stations 1 and 4 showed the surface temperature to be higher than at the bottom while in all the other stations, the opposite was found to be true. Generally, the temperatures at the intermediate depths were constant. The highest temperature recorded was 30.5°C and the lowest 28.0°C.

Salinity increased with increasing depth at all stations except station 5 where the surface salinity was 16 °/oo and the bottom salinity (2.5m) 15 °/oo. Salinity decreased towards the upper reaches of the river where freshwater influences was greater.

Dissolved oxygen content of the water generally decreased with increasing depth. The exception was station 5 where surface dissolved oxygen content was 10 ppm increasing to 10.4 ppm at a depth of 1.5m before decreasing to 7.5ppm at the bottom (2.5m). The dissolved oxygen content generally increased towards the river mouth. The highest values were obtained at station 5 (7.5ppm to 10.4ppm).

pH values obtained ranged from 6.8 at 1.5m of station 1 to 8.4 at the surface and at 1.5m of station 5. pH values at each station did not show a definite trend with respect to depth which was consistent with all the stations. pH values nearer the river mouth had a tendency to be higher. However, station 4 which is located at the common mouth of Sungei Buloh Besar and Sungei Buloh Kechil had pH values (7.5 at the surface) that were lower than those obtained at stations 2 (7.6) and 3 (7.6).

Water conductivity increased with depth for all the stations except station 5 where the conductivity increased from the surface value of $3.8 \times 10^4 \mu S$ to $3.85 \times 10^4 \mu S$ at depths between 0.5m and 1.5m before decreasing to 35500uS at depths between 2.0m and the bottom (2.5m). Conductivity generally increased towards the river mouth.

Table 1. Physico-chemical parameters of Sungei Buloh

PARAMETERS	DEPTH (m)	1	2	3	4	5
TEMPERATURE	0.0	30.5	29.0	29.0	29.5	29.0
(°C)	0.5	30.5	28.0	29.5	29.0	29.0
	1.0	30.0	28.0	29.5	29.0	30.0
	1.5	30.0	28.0	29.0	29.5	30.0
	2.0	-	29.5	29.5	29.0	30.0
	2.5	-	-	29.5	29.0	30.0
	3.0	-	-	-	29.0	-
SALINITY	0.0	12.00	14.00	14.50	15.50	16.00
(°/oo)	0.5	12.50	16.00	15.50	15.50	15.75
	1.0	13.00	16.00	17.00	16.50	15.50
	1.5	13.00	16.50	17.50	18.00	15.50
	2.0	-	17.00	17.50	18.50	14.75
	2.5	-	-	17.00	18.50	15.00
	3.0	-	-	-	18.50	-
DISSOLVED OXYGEN	0.0	2.00	3.90	4.80	3.90	10.00
(ppm)	0.5	1.80	3.55	5.20	3.85	10.20
	1.0	1.90	3.70	4.50	4.75	10.30
	1.5	1.75	3.85	1.50	3.10	10.40
	2.0	-	4.30	1.45	0.70	8.90
	2.5	-	-	1.85	0.68	7.50
	3.0	-	-	-	0.50	-
pH	0.0	7.2	7.6	7.6	7.5	8.4
	0.5	7.1	7.6	7.9	7.5	8.3
	1.0	7.1	7.8	7.9	7.5	8.3
	1.5	6.8	7.8	7.8	8.1	8.3
	2.0	-	7.7	7.7	7.6	8.3
	2.5	-	7.8	7.6	7.5	8.4
	3.0	-	-	-	7.7	-
CONDUCTIVITY	0.0	3.60	3.35	3.60	3.70	3.80
($x10^4$ µS)	0.5	3.70	3.55	4.00	3.80	3.85
	1.0	3.75	3.85	4.20	3.90	3.85
	1.5	3.75	4.00	4.30	4.30	3.85
	2.0	-	4.15	4.30	4.40	3.55
	2.5	-	-	4.30	4.40	3.55
	3.0	-	-	-	4.40	-
LIGHT INTENSITY	AIR	2196.0	2189.0	2413.0	2738.0	2730.0
(µmoles/sec/m^2)	0.0	2093.0	1692.0	2058.0	1775.0	2104.0
	0.5	1096.0	988.5	1505.0	704.6	1167.0
	1.0	531.7	590.4	945.7	481.4	564.0
	1.5	-	341.0	673.1	464.4	267.1
	2.0	-	186.5	449.3	113.6	203.2
	2.5	-	114.8	-	66.1	-
	3.0	-	-	-	50.4	-
LIGHT PENETRATION (m)		0.70	1.35	1.10	1.50	0.90

Light measurements showed a decreasing amount of light quanta with increasing depth. There appeared to be no pattern with respect to the station's proximity to the river mouth. Water visibility showed a tendency to improve as the river mouth was approached. The lowest value was 0.7m at station 1 while the highest was 1.5m at station 4.

A total of 1575 specimens from 46 families belonging to six classes and five phyla were collected from the dredge, grab and net samples. The dominant class in terms of abundance was Crustacea with an abundance of 980 individuals, representing eight families. In terms of diversity, the polychaetes were dominant with 18 families and an abundance of 69 individuals. The most poorly represented class in terms of diversity and abundance was Asteroidea (Echinodermata), represented by one family with an abundance of two. Crustaceans belonging to the family Balanidae were dominant in terms of abundance with 945 specimens.

The station 1 dredge sample yielded 297 specimens representing 13 families. Most

Table 2. Summary of families found in Sungei Buloh

Class	Family	Dredge STN 1	STN 2	STN 3	STN 4	STN 5	Grab STN 1	STN 2	STN 3	STN 4	STN 5	Net STN 4	STN 5	Total
Crustacea	Balanidae	215	678	52										945
	Portunidae		1									3	17	21
	Family 3	3										2		5
	Penaeidae	2	2											4
	Gammaridae						2							2
	Paguridae						1							1
	Ocypodidae	1												1
	Family 2									1				1
Bivalvia	Solenidae		2	149	7	1		1	1					161
	Veneridae	45	76			1		1						123
	Tellinidae	3	4	44	41	3		1	1	1				98
	Mactridae			5	9	3		1			29			47
	Lucinidae	2			16	1								19
	Dreissenidae	3	1											4
	Semelidae			2										2
	Corbiculidae		1											1
	Donacidae	1												1
	Pholadidae		1											1
	Mytilidae	5	9	9										23
	Arcidae		1											1
Gastropoda	Epitonidae						2							2
	Nassariidae	1	25					2						28
	Bithyniidae						1							1
	Family 1		1											1
Polychaeta	Nereidae	11	5	2			1	2						21
	Lacydoniidae			3										3
	Syllidae				3									3
	Phyllodocidae		1						1					2
	Hesionidae								2					2
	Aphroditidae		1											1
	Goniadidae			1										1
	Glyceridae				1									1
	Eunicidae	5	2	1	2									10
	Onuphidae			1		1	1							3
	Spionidae		1		2				5					8
	Heterospionidae						1		2					3
	Capitellidae				2			2						4
	Cirratulidae								1					1
	Opheliidae			1			1							2
	Ctenodrilidae										2			2
	Sabellidae									1				1
	Pauveliopsidae						1							1
Osteichthyses	Plotosidae											3	4	7
	Family 4											1	1	2
	Family 5											1	1	2
Asteroidea	Astropectinidae				1	1								2
	Total taxa	13	18	12	10	7	8	8	7	2	3	5	4	
	Total abundance	297	812	270	84	11	10	11	13	2	32	10	23	1575

dominant was Balanidae (Crustacea) with 215 specimens. The most dominant class was Crustacea with 221 specimens representing five families. The grab sample from this station yielded eight families represented by 10 specimens.

The station 2 dredge yielded the most specimens, representing the greatest number of families among all stations. There were 18 families with an abundance of 812 individuals. Balanidae was again dominant with 678 specimens and contributed significantly towards raising Crustacea as the dominant class with 681 specimens. The bivalves were also well represented with 95 specimens from eight families. The grab sample yielded 11 specimens from eight families.

From the station 3 dredge, 270 specimens from 12 families were collected. The bivalve family, Solenidae, was dominant with 149 specimens. The bivalves were the dominant class with 209 specimens. The grab samples had 13 specimens from seven families. The polychaetes were dominant with five families represented by 11 specimens. Spionidae was the dominant polychaete family.

The station 4 dredge sample yielded 84 specimens from 10 families. Tellinidae (bivalve)

was dominant with 41 specimens. The bivalves were the dominant class with 73 of the 84 specimens collected. The grab sample yielded one specimen each of Sabellidae (polychaete) and Tellinidae. The trammel net sample yielded 10 specimens from five families. The catfish (Plotosidae) and the edible flower crab, Portunidae *(Portunus pelagicus)* were represented by three specimens each. One crustacean and two fishes remain unidentified from this net sample.

The station 5 dredge yielded 11 specimens representing seven families. There was no dominant family. However the dominant class was Bivalvia, accounting for nine of the 11 specimens. The grab sample gave 32 specimens from three families. Bivalves from the family Mactridae were dominant with 29 specimens. The trammel net yielded 23 specimens from four families. Dominant was Portunidae *(Portunus pelagicus)* with 17 specimens.

Of all the dredge samples, the dredge at station 2 yielded the most specimens and highest number of families. The grab at station 5 yielded the most specimens, numbering 32, while those at stations 1 and 2 yielded the least families, each with eight.

DISCUSSION

As this is the first study of this nature, it is not possible to ascertain how much, if at all, the pollution from the pig farms have affected the benthic lifeforms. However, the records of the dissolved oxygen levels show that the water of Sungei Buloh Besar have a lower content of dissolved oxygen. Stations 1 and 2, located in Sungei Buloh Besar, had surface dissolved oxygen contents of 2ppm and 3.9ppm respectively while station 3, located on Sungei Buloh Kechil at approximately the same distance from the river mouth as station 2 on Sungei Buloh Besar, had an oxygen content of 4.8ppm. Station 5, where waters only from Sungei Buloh Kechil flowed into the sea, had a dissolved oxygen content of 10ppm at the surface, while station 4 where both rivers drain into the sea had a dissolved oxygen content of only 3.9ppm at the surface. This difference in the oxygen contents of both rivers could possibly be attributed to the waste from past pig-farming activities that flowed directly into Sungei Buloh Besar.

The results obtained from the water conductivity measurements show corresponding trends to that of salinity. Salinity is an indication of the amount of dissolved salts in the water, which being electrolytes, influence the conductivity of water. This may explain the decreasing salinity with increasing depth found at station 5 in contrast to the reverse trend in the other stations. The other physico-chemical parameters showed no significant trends.

It is interesting to note that Balanidae, being the most dominant family was found only in station 1 (215) and station 2 (678). On the other hand, Solenidae, the next most abundant family was found in 4 of the 5 stations while Tellinidae was found in all stations. The polychaetes were represented in all stations with the family Eunicidae occurring in 4 of the 5 stations.

Of the 5 rivers that were surveyed in the whole project, Sungei Buloh appears to support one of the healthiest benthic and pelagic communities. In abundance, it is second only to Singapore River (Goh & Loo, 1990) with 6249 specimens from 42 families and Sungei Punggol (Chong & Loo, 1990) with 5356 specimens coming from 23 families and second in diversity to Kallang Basin (Chua & Loo, 1990) with 51 families represented by 208 specimens.

It can be concluded from these preliminary quantitative results that Sungei Buloh, while exposed to some pollution in the past, compares favourably with the other sites like Sungei Punggol, Singapore River and Kallang Basin in terms of the abundance and diversity of lifeforms that the river supports. The pollution levels also compare well with the other sites, with the highest dissolved oxygen content of 10.4ppm recorded at any site.

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