A STUDY OF THE HYDROBIOLOGICAL CONDITIONS OF SUNGEI SERANGOON

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ABSTRACT

The physico-chemical conditions, and pelagic and soft-bottom benthic fauna of six stations established along Sungei Serangoon were investigated. Results revealed low dissolved oxygen levels of the water, as well as a low abundance of living benthic fauna. A total of 68 specimens from eight families were recorded, mainly obtained for a single station at the mouth of the river. Trammel nets set overnight yielded 40 specimens of the catfish, *Plotosus anguillaris*, the most abundant species obtained in this study, 11 specimens of another catfish, *Arius* sp. and three *Gerres* sp. (family Gerreidae). Pollution caused by pig farming, refuse dumping and squatter settlements, together with dredging activities in the river are probable reasons for the poor water quality and the paucity of benthic fauna observed.

INTRODUCTION

Sungei (= river) Serangoon is located on the north-eastern coast of Singapore and drains 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 market-gardening and livestock rearing became increasingly important in Singapore and many pig and poultry farms were set up in coastal areas. These farming activities were located near rivers such as Sungei Punggol, Serangoon and Seletar where the rivers served both as a source of water for the farms, as well as dumping grounds for farm wastes (Pang, 1987).

During the late 1970's, pig farms located within water catchment areas and urban river systems were resited to Punggol where provisions had 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 catchment area in 1977 phased out pig farming activities in these southern rivers altogether, relocating them to Punggol (Chia *et al.*, 1988), which led to an increased pollution load in the rivers draining the Punggol area, namely, Sungei Punggol and Sungei Serangoon. Presently, these pig farming activities in the north are also in the process of being eliminated, owing to the move to phase out pig farming altogether.

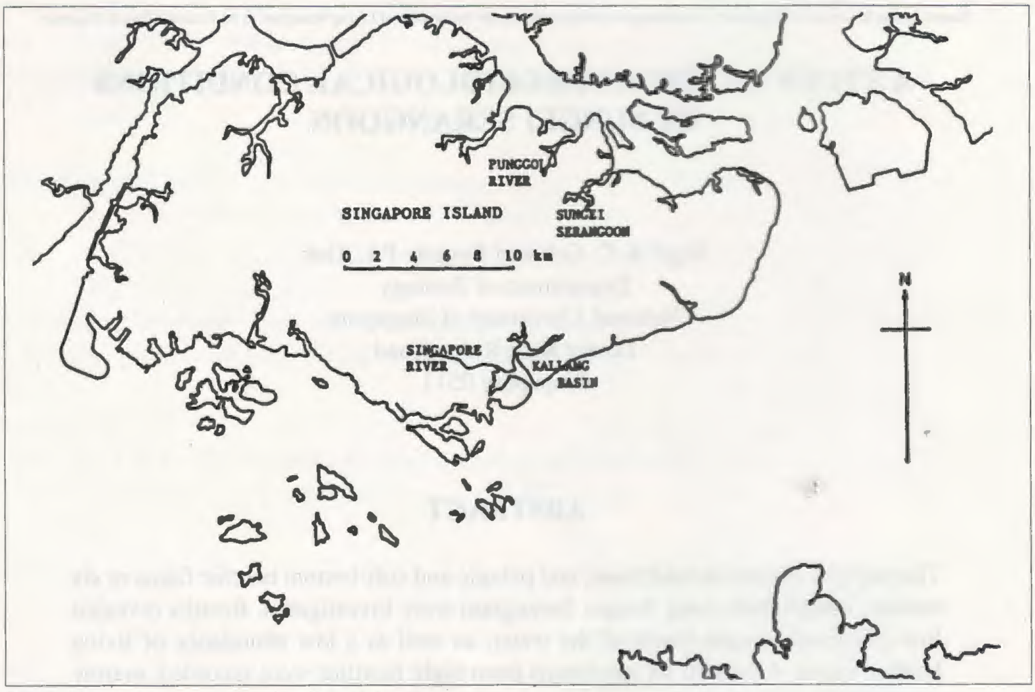

Fig. 1. Map of Singapore showing Sungei Serangoon.

At present, the coastal area of Serangoon houses a sludge treatment works. In addition, reclamation works which began in the 1960's to develop the area for refuse disposal and industrial and recreational purposes are still in progress (Chia *et al.*, 1988).

Very little data comprising soft-bottom benthic communities has been published in Singapore. Some of the previous work include the early study of the biota and environmental conditions of Punggol River by Chua (1966), and the more recent study of the hydrobiological conditions of Singapore River and Kallang Basin (Chiang, 1985; Yip *et al.*, 1987; Loo *et al.*, 1987).

This study is part of the Asean-Australia Coastal Living Resources Project. It is aimed at identifying and quantifying the soft-bottom benthic and pelagic fauna of Sungei Serangoon, and recording the physico-chemical conditions of the river. The results of this study will be indicative of the impacts of intensive agriculture and increasing industrial activity on a riverine system.

MATERIALS AND METHODS

The pelagic and soft-bottom macrobenthic fauna, and physico-chemical parameters of Sungei Serangoon were investigated on 23 and 24 May 1988 at 6 stations along the river (Fig. 2).

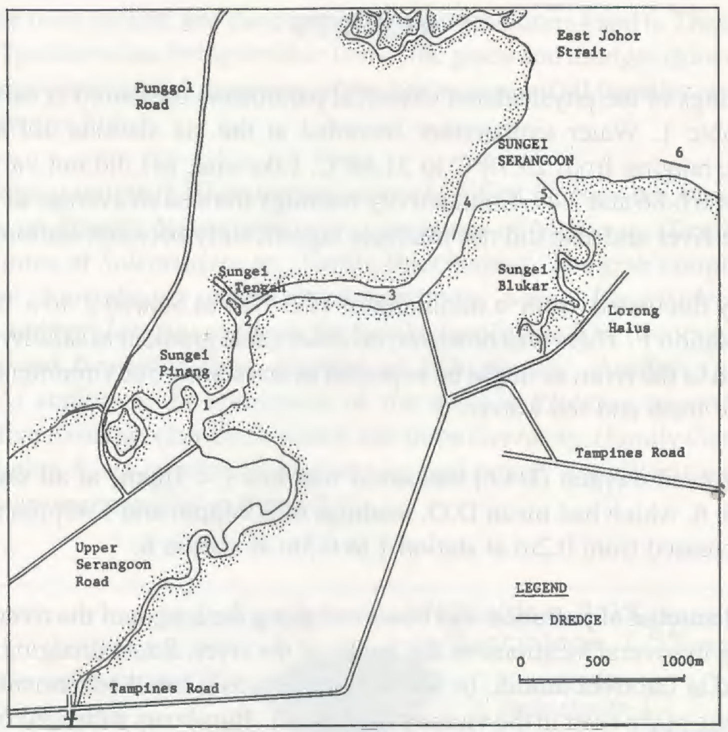

Fig. 2. Map of Sungei Serangoon showing the 6 sampling stations.

An Ekman grab (15cm x 15cm) was used to collect specimens of benthic organisms. Three grab samples were made at each station. Bengal rose in 10% formalin was added to the grab samples before they were sorted. A naturalist's rectangular dredge (with 75cm x 20cm opening, and 50cm long polypropylene net bag with stretched mesh size of 2.5cm) was used to collect samples of benthic macrobiota. A 10 minute dredge tow at one knot was taken at each of the six stations. In addition, one trammel net each (30m x 1.5m , stretched mesh size of 4cm) was laid at two stations (stations 4 and 6) and left for 24 hours to sample pelagic organisms.

The physico-chemical parameters of temperature, pH, salinity, dissolved oxygen, and conductivity were measured at intervals of 0.5m of the water column at each station. Visibility was also measured using a Secchi disc. Salinity and temperature were measured *in situ* with a portable YSI model 33 Salinity-Conductivity-Temperature meter. The conductivity of the water was measured using a portable pHOX 52E Conductivity meter, dissolved oxygen with a YSI Model 57 Oxygen meter and pH with an Orion Research Model SA250 pH meter.

Grab samples were sorted using 1mm and 2mm mesh size seives while dredge specimens were sorted with 5mm and 7mm mesh size seives. The specimens were preserved in 10% formalin buffered with Borax and, with the exception of the polychaetes, were transferred to 70% alcohol after 24 hours. A BENTH1 progamme (Bainbridge, 1988) was used to process and summarize the data obtained.

RESULTS

Mean recordings of the physical and chemical parameters measured at each station are shown in Table 1. Water temperature recorded at the six stations did not fluctuate substantially, ranging from 29.78°C to 31.88°C. Likewise, pH did not vary much, and ranged between 6.86 and 7.47. Conductivity readings showed an average of 3.7 X 10^4 µS for the whole river and also did not fluctuate significantly between stations.

Mean salinity fluctuated from a minimum of 12.5 °/oo at Station 2 to a maximum of 18.0 °/oo at station 1 . There was however, no observable gradient in salinity from station 1 to the mouth of the river, as might be expected in an estaurine environment where there is a mixing of fresh and sea water.

Average dissolved oxygen (D.O.) measured was low (< 1ppm) at all stations except stations 1 and 6, which had mean D.O. readings of 3.94ppm and 1.49ppm respectively. Visibility increased from 0.2m at station 1 to 0.5m at station 6.

A substantial amount of pollution was observed along the length of the river, with refuse accumulating in several locations on the banks of the river. Some dredging activity was also observed at the river mouth. In addition, there was a small settlement of squatters along the banks of the river in the vicinity of station 1. Bumboats were also moored along the river bank at station 1.

The stench of hydrogen sulphide was apparent throughout the length of the river and gas bubbles could be seen rising to the surface of the water. This was especially pronounced in the middle reaches of the river but improved nearer the mouth of the river.

Very few living benthic organisms were collected in this study. Although numerous shells of the bivalve, *Perna,* were dredged up at stations 1 and 4, only a total of 68 live specimens from eight families were found, all obtained from one grab and one dredge at

Table 1. Mean readings of physico-chemical parameters recorded at the six stations along Sungei Serangoon.

PARAMETER	STN 1	STN 2	STN 3	STN 4	STN 5	STN 6
Temperature (°C)	31.88	30.50	31.00	30.17	30.17	29.78
pH	7.13	6.98	7.06	7.51	6.86	7.47
Salinity (°/oo)	18.00	12.50	14.93	16.50	12.92	13.00
Dissolved Oxygen (ppm)	3.94	0.23	0.10	0.37	0.16	1.49
Conductivity (X 10000 µS)	3.67	3.34	3.78	2.97	3.74	4.74
Visibility (m)	0.20	1.25	0.30	0.30	0.40	0.50

station 6, at the river-mouth, and the trammel nets set at stations 4 and 6. The other stations (1, 2, 3 and 5) produced no living benthic fauna, the grabs and dredges drawn up yielding only highly anaerobic mud. A summary of the percentages of all families recorded in this survey is shown in Fig. 3.

From the dredge at station 6, 10 gastropods were identified. These were, seven specimens of *Nassarius* sp. (family Nassariidae), two specimens of *Natica* sp. (family Naticidae) and one specimen of *Solenosteira* sp. (family Buccinidae). The grab sample at station 6 produced four annelids of which three specimens were *Paraonides* sp. (family Paraonidae), and one *Iospilus* sp. from the family Iospilidae. The two trammel nets laid at stations 4 and 6 yielded three families of fish, namely, Ariidae, Gerreidae and Plotosidae. At station 6, 39 specimens of the species *Plotosus anguillaris* (family Plotosidae), five *Arius* sp. (family Ariidae), and three *Gerres* sp. (family Gerreidae) were caught. At station 4, six specimens of *Arius* sp. and one *P. anguillaris* were obtained. These results are summarized in Table 2.

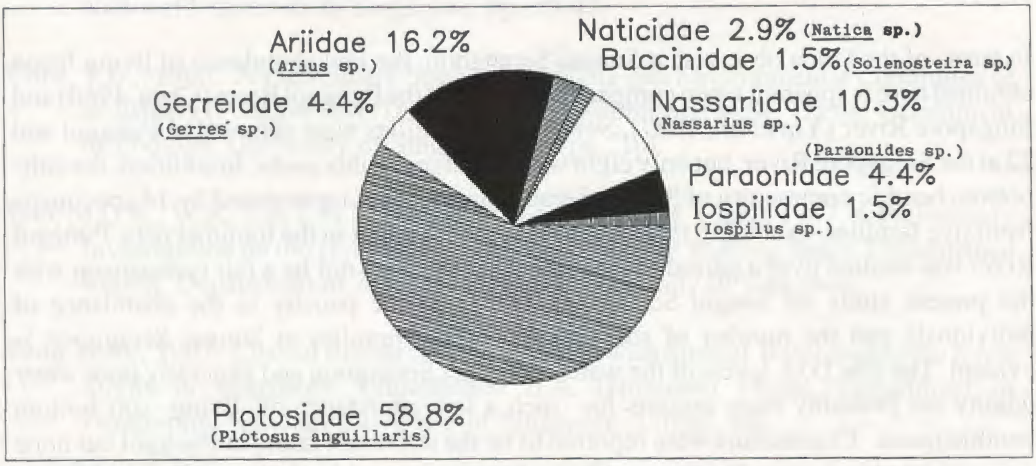

Fig. 3. Percentage family abundance at Sungei Serangoon.

Table 2. Abundance of the various families found in Sungei Serangoon.

		DREDGE		GRAB		NET		TOTAL
PHYLUM	**FAMILY**	**STN 4**	**STN 6**	**STN 4**	**STN 6**	**STN 4**	**STN 6**	**ABUNDANCE**
Annelida	**Iospilidae**				**1**			**1**
	Paraonidae				**3**			**3**
Chordata	**Ariidae**					**6**	**5**	**11**
	Gerreidae						**3**	**3**
	Plotosidae					**1**	**39**	**40**
Mollusca	**Buccinidae**		**1**					**1**
	Nassariidae		**7**					**7**
	Naticidae		**2**					**2**

Note: No specimens were found at stations 1,2,3 and 5.

DISCUSSION

The relatively high D.O. and salinity readings obtained at station 1 that deviated from the mean levels of the other stations could be due to the depth of the river at that site being only 1.5m. This may have caused higher than normal localised readings owing to the poor circulation of water at the time of recording. Generally, the bottom substrate of Sungei Serangoon was highly anaerobic, as indicated by the relatively low level of dissolved oxygen measured in the water column.

One important physico-chemical parameter indicative of the state of pollution of Sungei Serangoon is the D.O. level of the water column. A study carried out by Chua (1966) at Punggol River when pollutive agricultural activities were on the rise reported D.O. levels of the river ranging from 1.40ppm to 5.40ppm. A more recent study of Singapore River carried out after the clean up programme gave D.O. values between 3.10ppm and 4.80ppm (Yip *et al.*, 1987). In comparison, this study revealed Sungei Serangoon to have a D.O. range of between 0.05ppm and 4.01ppm with an extremely low average of 1.05ppm.

In terms of the fauna observed at Sungei Serangoon, the low abundance of living fauna obtained here is apparent when compared with that of the Punggol River (Chua, 1966) and Singapore River (Yip *et al.*, 1987). Seventy five families were sampled at Punggol and 22 at the Singapore River, but only eight were observed in this study. In addition, the soft-bottom benthic community of Sungei Serangoon was only represented by 14 specimens from five families, excluding the pelagic specimens caught in the trammel nets. Punggol River was studied over a period of two years and this may not be a fair comparison with the present study on Sungei Serangoon. However, the paucity in the abundance of individuals and the number of soft-bottom benthic families at Sungei Serangoon is evident. The low D.O. levels of the water at Sungei Serangoon and generally poor water quality are probably main reasons for such a low abundance of living soft-bottom benthic fauna. Crustaceans were reported to be the dominant fauna in Punggol but none were sampled in Sungei Serangoon. The only common species between Punggol River, Singapore River and Sungei Serangoon is the catfish *Plotosus anguillaris* (family Plotosidae). Catfishes have been documented to be well adapted to poorly aerated, stagnant waters with muddy-bottom substrata (Bone & Marshall, 1982). The 40 specimens of *P. anguillaris* and 11 specimens of *Arius* sp. caught in Sungei Serangoon, all from the catfish group, may be indicative of the anaerobic nature of the bottom substrate.

Clearly, pollutive pig farming activities in the past and pollution presently caused by refuse dumping along the banks of the river, pollution by sewage wastes from squatter settlements and boats, coupled with dredging activities that churn up highly anaerobic sediments have led to the present state of the water at Sungei Serangoon. This study indicates that Sungei Serangoon is a highly polluted river, able to sustain life only at the river mouth where conditions are ameliorated by the flushing and diluting effect of seawater.

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