Indian Journal of Marine Sciences
Vol. 6, June 1977, pp. 1-5

Distribution & Seasonal Abundance of Macrobenthos of the Cochin Backwaters

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Received 24 *November* 1976

Macrobenthos was studied at fortnightly intervals during March 1974 to March 1975 at 5 stations spread over a distance of about 12 km in the Cochin Backwaters. Environmental parameters such as temperature, salinity, dissolved oxygen and grain size were also studied and correlated with distribution and abundance of macrofauna. Pattern of distribution and seasonal abundance of important benthic groups were studied. Among the various animal groups studied, polychaetes constituted the bulk of the fauna at all stations throughout the year. Distribution of bottom fauna in different stations from month to month showed maximum benthic population during December to April and minimum during south-west monsoon period (July to September). It was also seen that thick clay supported poor fauna while sand, silt and clay in more or less equal proportions supported dense and varied populations.

STUDIES on benthic animal communities have assumed greater importance concurrent with the increasing realization of the significant role they play in the trophic cycle. A detailed knowledge of the bottom fauna is essential for the determination of the fishery potential of an area. Various studies have been made on the bottom fauna of different regions[1-13].

The present report deals with the studies on macrobenthos of the Cochin Backwaters made during March 1974 to March 1975. The purpose of the investigation is to explore major constituents of the fauna, their pattern of distribution and their seasonal abundance. An attempt has been made to study the hydrography and the nature of the bottom deposit in relation to the distribution and abundance of bottom fauna.

Physiography of Vembanad Lake-cum-backwaters

The Vembanad Lake, the largest on the west coast, comprising a chain of shallow brackish water lagoons and swamps, is situated between lat. 9°28′ and 10°N, and long. 76°13′ and 76°31′E. The length of the lake is about 65 km and the width varies from 0·5 to about 15 km. A channel of about 500 m width at Cochin gut makes a permanent connection with the Arabian Sea. The major source of the fresh water for the backwater is two large rivers — Periyar in the north and Pampa in the south. Four other small rivers, viz. Achankoil, Manimala, Meenachil and Moovatupuzha, also flow into the backwaters. The depth of the backwater varies considerably. It is deeper in the harbour area, close to the sea, the depth being about 12 m and shallower in the upper reaches with a depth of about 1-5 m. The present study is confined to those areas of the backwater system between Aroor and the barmouth (between latitude 9°50′ and 10°N).

Materials and Methods

Fortnightly samples were taken during high tide from 5 selected stations, almost equidistant from one another (Fig. 1). Quantitative samples for the macrofauna were taken, using a van Veen grab with an effective sampling area of 0·1 m². Two grab samples were taken from each station. Hand-sieving was employed for separating the animals from the sediment. The grab contents were screened through 0·5 mm² mesh sieve[14]. The residue from the sieve was preserved in 5% neutral formalin for further study. All the animals in each sample were sorted, identified and used for finding out biomass.

Physico-chemical parameters studied along with benthos were station depth, substratum, surface and bottom temperature, salinity and dissolved oxygen. Surface water samples were collected using a plastic bucket and the bottom samples with the help of a bottom water sampler[15]. Surface and bottom temperatures were noted with a bucket thermometer. The depth was also noted using plummet and string. Chlorinity of the water was estimated using the Mohr method[16] and salinity calculated using Knudsen's table. Winkler technique[17] was used for the estimation of dissolved oxygen. Sediment samples were subjected to combined sieving and pipette method of Krumbein and

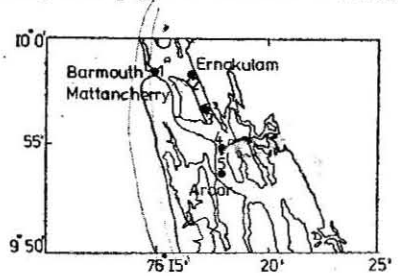

Fig. 1 — Location of stations

Pettijohn[18]. The sand-silt-clay per cent of sediments from different stations were plotted in triangular diagrams[19].

Results

Hydrography — Based on hydrographical parameters of the Cochin Backwaters studied, 3 definite seasons can be recognized, viz. premonsoon period (February to May) of high salinity, monsoon period (June to September) of very low salinity and postmonsoon period (October to January) of rising and fluctuating salinity. Similar findings were also made earlier[20,21].

Temperature — Surface and bottom water temperatures (Fig. 2) were observed at each station. Lowest temperatures of surface and bottom water recorded (25·1° and 25°C respectively) were at station near the barmouth during August and the highest (32·5° and 32·2°C respectively) at station 4 away from the barmouth during April. A steady increase in temperature was observed during the postmonsoon and the highest temperature was during the premonsoon.

Salinity — Among all the hydrographical parameters studied, salinity was found to be the most fluctuating factor (Fig. 2). The south-west monsoon season is characterized by heavy rainfall and there is a decrease in salinity values at all stations. During the period of observation, very low saline conditions (0·13-2·81‰) prevailed at all stations from July to August, when the rainfall was at its maximum. Premonsoon is dry with less rainfall and the maximum salinity was observed at all stations. Maximum salinity of 33·13 and 32·88‰ were recorded during March and April at stations 1 and 2 respectively near the barmouth. In the stations farthest from the barmouth highest salinity recorded was 30·82‰ during April. A steady increase in salinity at all stations was observed during postmonsoon.

Dissolved oxygen — During the south-west monsoon, a high value of dissolved oxygen (6·17 ml/litre at NTP) was recorded in July and August in the surface at station 4 (Fig. 2). Dissolved oxygen came down to a minimum of 3·14 ml/litre at NTP in September in the surface at station 1 near the barmouth. For the bottom water dissolved oxygen content showed a decrease during south-west monsoon and minimum values (2·42 ml/litre at NTP) were recorded in June at station 1. Highest value of dissolved oxygen in the bottom water (5·7 ml/litre at NTP) was recorded in December at station 5. The usual inverse relationship between dissolved oxygen and salinity was also observed.

Substratum — Amongst all the physical environmental factors, the nature of the substratum has the greatest influence on the distribution and abundance of benthic population[22]. The nature of the bottom observed during the course of the present investigation showed that the composition of sediment varies markedly from station to station. Based on the investigation (Fig. 3) the region under study can be differentiated into 4 major sedimentological zones: (i) area covered by clayey silt with very little sand — stations 1 and 2; (ii) area with

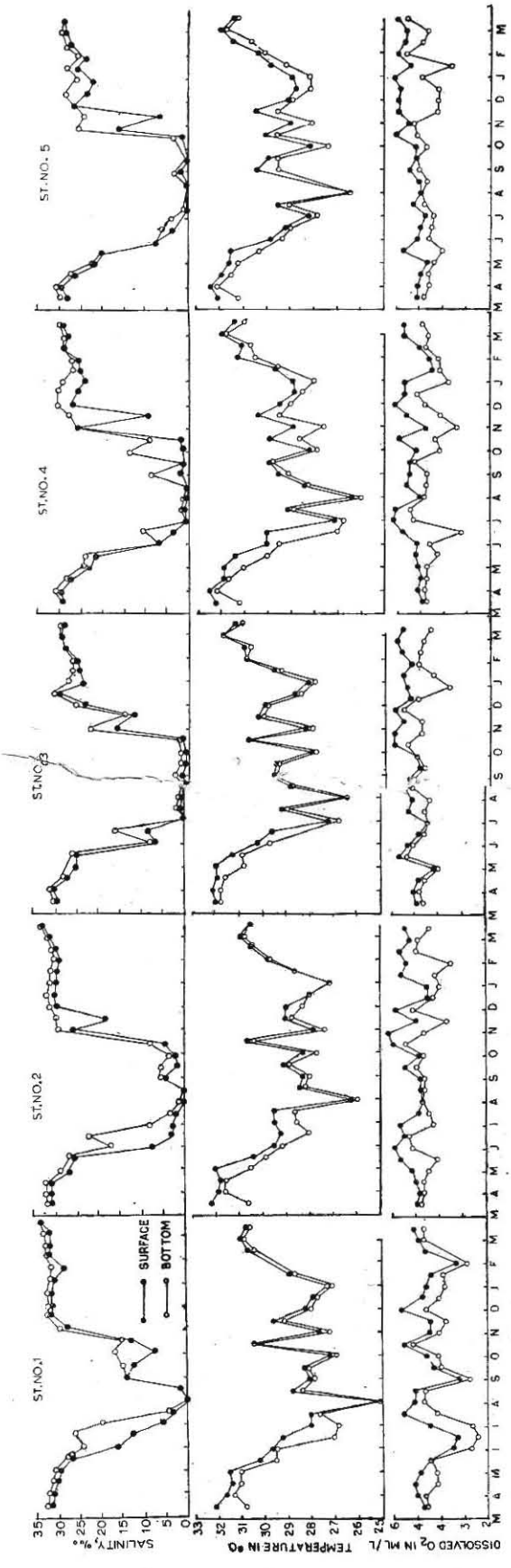

Fig. 2 — Distribution of surface and bottom water temperature, salinity and oxygen

dominance of sand fraction — station 3; (iii) area covered by sand, silt and clay in more or less equal proportions — station 4; and (iv) area covered by sandy mud — station 5.

Depth — The depth of the area under investigation varies from 1·5 to 4 m, the deepest area being at station 4.

Distribution and composition of bottom fauna — The estuarine fauna generally consist of marine, brackish water, fresh water and migratory forms. The important macrobenthic groups obtained during the present investigations are polychaeta, crustacea and mollusca. The benthic population based on numerical counts shows wide variation in their distribution in different stations. Quantitative distribution of bottom fauna as determined by numerical abundance in all stations is given in Fig. 4.

Polychaeta: Among various animal groups polychaeta constituted the bulk of the fauna in terms of number at all stations throughout the year. Altogether 32 species of polychaeta belonging to 23 genera were collected. Of these, 7 species, viz. *Ancistrosyllis constricta, Lumbriconereis simplex, Lumbriconereis* sp., *Nephthys oligobranchia, Prionospio pinnata, P. polybranchiata,* and *Paraheteromastus tenuis,* were common and abundant numerically in all stations and among them *Prionospio polybranchiata* was dominant. But only 5 of these species were recorded throughout the year. In the case of *Prionospio pinnata, P. polybranchiata* and *Paraheteromastus tenuis,* seasonal increase in number was noticed due to recruitment. Polychaete fauna as a whole showed seasonal decrease in number during monsoon and maximum numbers were recorded during the premonsoon.

Crustacea: Crustacean fauna consists of mainly Amphipod, Isopod, Tanidacea, Cumacea, Penaeid prawns, Alpheidae and Branchyurans. The amphi-

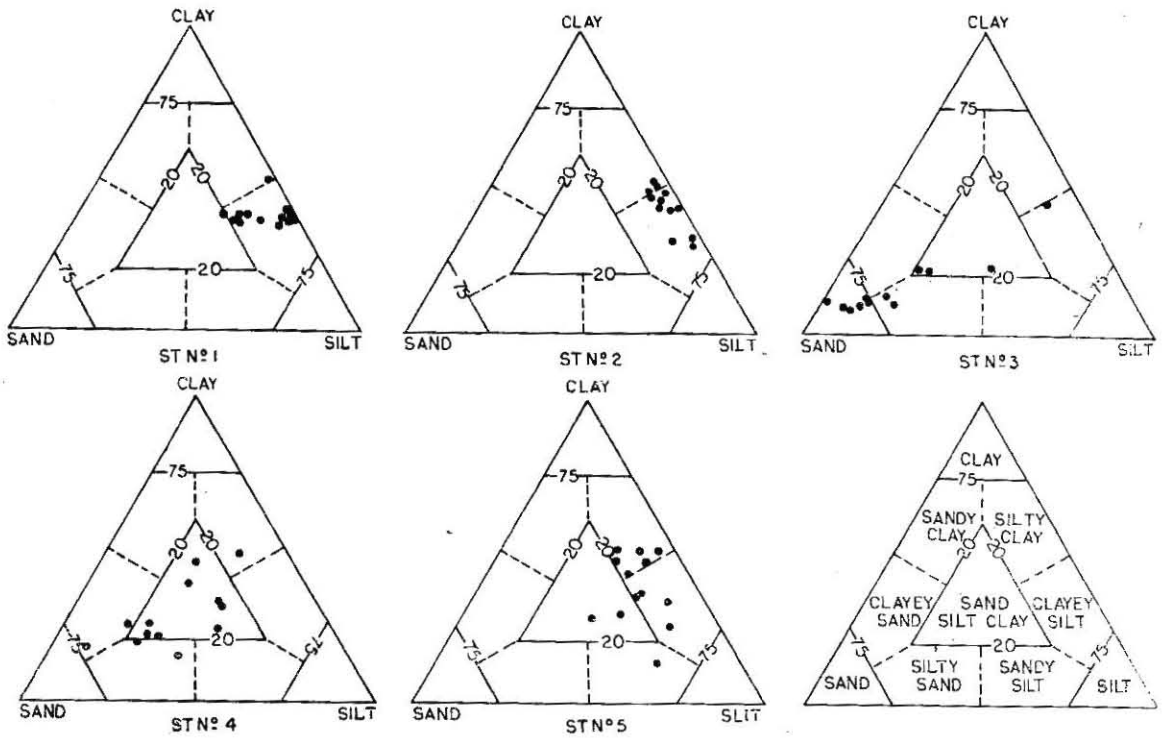

Fig. 3 — Triangular diagrams representing sediment zones

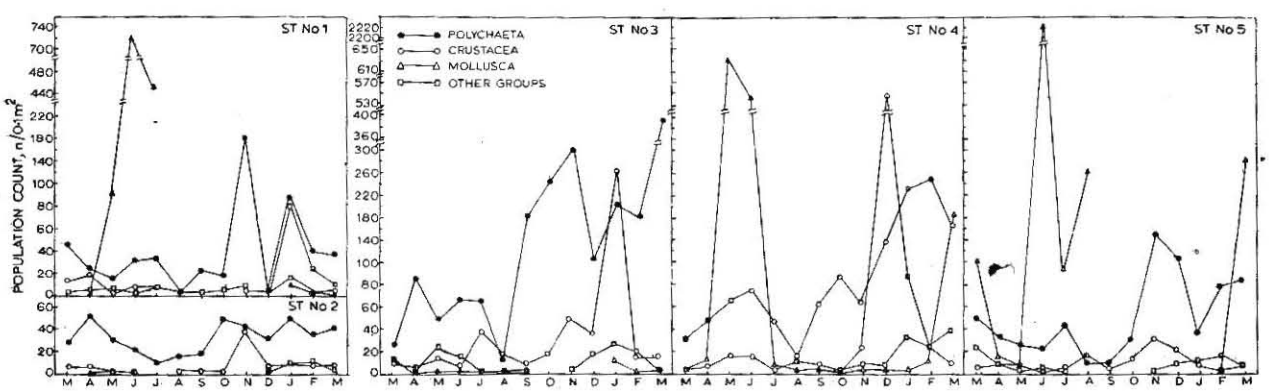

Fig. 4 — Monthly variations in mean number of major macrobenthic groups

pod fauna were rich and they were abundant in stations 3 and 4. Maximum number of 6850/m² was recorded from station 4 in December and the dominant form was *Grandidierella megnae*. Tanidacea was second only to Amphipoda in abundance. Tanids present mostly *Apseudes gymnophobia*. The cumacea though present in small numbers were recorded at all stations and in the case of *Iphinoe* sp., seasonal increase in number was noticed, the maximum being in station 3 (2110/m² during January). Branchyuran fauna were comparatively rich at stations 3 to 5. Among Branchyuran crabs, *Litocheira* sp., *Viaderiana* sp., *Rhynchoplax* sp., *Macrophthalmus* sp., *Ebalia malefactrise*, *Eriphia smithia* were most common.

Mollusca: Of the total 15 species of mollusca collected, only 2, *Modiolus undulatus* and *Nuculana mauritiana*, were abundant in terms of number. *M. undulatus* appeared in large numbers at stations 1 and 4 during May, June and July, and the largest recorded number being 13720/m². *N. mauritiana* was collected from station 5 and the largest number of 44340/m² was recorded during June.

Other groups: The rest of the fauna consist of 2 species of sea anemones, 1 Cirianthus, 1 Sipunculoidea, 1 Echiuroidea, 1 Echinodermata and 5 Pisces.

Discussion

Jones[23] stated that the significant factors which may influence the distribution of bottom fauna are temperature, salinity and the nature of the bottom deposit. Of the 3 hydrographical parameters of the estuary studied, salinity is the most fluctuating factor, which influences the distribution and abundance of the bottom fauna. A marked difference in the salinity values of both surface and bottom water between premonsoon and postmonsoon was recorded in all the stations. During the south-west monsoon period salinity of the water at all stations decreased to such a level that it became almost fresh. Therefore, the poor faunal composition during south-west monsoon (July to September) in all stations, particularly at stations 1 and 2, may be due to the wide fluctuation in salinity.

The nature of the substratum (Fig. 3) was found to be another important factor influencing the distribution and abundance of bottom fauna. If the total number of animals are taken into account, stations 1 and 3 to 5 recorded maximum and station 2 recorded minimum number of animals. Station 2 with a substratum of thick clay supported a poor fauna in comparison to the other stations. But station 3 which shows dominance of sand fraction and station 4, where the substratum consists of sand, silt and clay in more or less equal proportions, supported dense and varied benthic population dominated by polychaeta. Similar findings were reported from Cochin Backwaters[8,24]. Panikkar and Aiyar[3] observed absence of animals on substrate of thick clay and their greater abundance on loose substrate.

Taking the whole area under investigation, largest benthic population occurred between December and April and minimum during south-west monsoon (July to September). Polychaeta were most dominant numerically, followed by Mollusca and Amphipoda. Seven species of polychaeta were recorded from all stations and some of which were present throughout the year. As far as species composition was concerned, station 4 was the richest. Molluscan fauna consisted mainly of *Modiolus undulatus* and *Nuculana mauritiana* and were abundant at stations 1, 4 and 5. Amphipods were recorded from all stations and they were abundant at stations 3 and 4.

Studies on the seasonal distribution of macrobenthic components revealed that with the onset of south-west monsoon a quick and marked change in the composition of the macrofauna took place in all stations. This was most obvious at stations 1 and 2. A fairly rich fauna was present at stations 1 and 2 during pre- and postmonsoon periods and it nearly disappeared during the heavy monsoon period (August). This could be due to the lowering of salinity during the active south-west monsoon. Desai and Krishnankutty[8] also reported a marked decline of macrofauna during the south-west monsoon in Cochin Backwaters. Recolonization by macrofauna started during the beginning of the postmonsoon and steadily increased; the maximum was recorded during December to March.

Acknowledgement

Thanks are due to Dr R. Damodaran for his valuable guidance and help and to Dr C. V. Kurian for his encouragements. Thanks are also due to the CSIR, New Delhi, for the Junior Research Fellowship, during the tenure of which this work was carried out, and also to the University of Cochin for the facilities provided.

References

1. ANNANDALE, N., *Rec. Indian Mus.*, (1907), 1.
2. ANNANDALE, N. & KEMP, S., *Mem. Indian Mus.*, **5** (1915), 1.
3. PANIKKAR, N. K. & AIYAR, R. G., *Proc. Indian Acad. Sci.*, **6** (1937), 284.
4. SESHAPPA, G., *Proc. Natn. Inst. Sci. India*, **19** (1953), 257.
5. KURIAN, C. V., *Proc. Natn. Inst. Sci. India*, **19** (1953), 746.
6. RAMASARMA *et al.*, *Final report, Department of Zoology, Andhra University, Waltair*, 1964, 54.
7. KRISHNAMURTHY, K. N., *Proc. Indian Acad. Sci.*, **53B** (1960), 96.
8. DESAI, B. N. & KRISHNANKUTTY, M., *Proc. Indian Acad. Sci.*, **66** (1967), 123.
9. RAJAN, S., *Indian J. Fish.*, **12** (1965), 492.
10. PATNAIK, S., *J. mar. Biol. Ass. India*, **13** (1971), 106.
11. PARULEKAR, A. H. & DWIVEDI, S. N., *Indian J. mar. Sci.*, **3** (1974), 41.
12. PARULEKAR, A. H. & DWIVEDI, S. N., *Recent researches in estuarine biology*, edited by R. Natarajan (Hindustan Publishing Corp., Delhi), 1975, 21.
13. AJMALKHAN, S., VIVEKANANDAN, E. & BALASUBRAHMANYAN, K., *Recent researches in estuarine biology*, edited by R. Natarajan (Hindustan Publishing Corp., Delhi), 1975, 255.
14. BIRKETT, L. & MCINTYRE, A. D., *Methods for the study of marine benthos*, edited by N. A. Holme & A. D. McIntyre — I.B.P. Hand Book No. 16 (Blackwell Scientific Publications, Oxford and Edinburgh), 1971, 156.
15. CHERIAN, P. V., *Bull. Dept. mar. Biol. and Oceanogr. Univ. Kerala*, **3** (1967), 9.

16. BARNES, H., *Apparatus and methods of oceanography*: Part I (George Allen & Unwin, London), 1959.
17. STICKLAND, J. D. H. & PARSONS, T. R., *A manual of sea water analysis* (Fisheries Research Board of Canada, Ottawa), 1965.
18. KRUMBEIN, W. C. & PETTIJOHN, E. J., *Manual of sedimentary petrography* (Appleton-Century-Crofts, New York), 1938, 549.
19. SHEPARD, F. P., *J. sedimen. Petrol.*, **24** (1954), 151.
20. GEORGE, M. J. & KARTHA, K. N. K., *J. mar. biol. Ass. India*, **5** (1963) 128 x 178
21. NAIR, N. B., *Int. Revueges Hydrobiol.*, **50** (1965), 411.
22. SANDERS, H. L., *International oceanographic congress*, reprints edited by Mary Sears (American Association for the Advancement of Science, Washington DC), 1959, 583.
23. JONES, N. S., *Biol. Rev.*, **25** (1950), 283.
24. KURIAN, C. V., *Bull. natn. Inst. Sci. India*, **38** (1967), 649.