J. mar. biol. Ass. India, 1971, **13** (2): 203-210

ZOOPLANKTON DISTRIBUTION ALONG SALINITY GRADIENT IN THE COCHIN BACKWATER BEFORE AND AFTER THE MONSOON

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ABSTRACT

Quantitative studies were made on zooplankton collected along with hydrographic data from ten fixed stations in the backwaters of Cochin during the post and pre-monsoon period and collections were taken both by day and night.

During the post-monsoon period because of the previous heavy monsoonal rainfall and consequent influx of freshwater the estuarine salinity structure showed a steep gradient (0.17‰-31.3‰) and zooplankton biomass was high in those stations towards the mouth of the estuary (upto 562 mg/m^3).

In the pre-monsoon period, because of the lower rainfall and the intrusion of sea water into the estuary, the whole system became highly saline with a weaker gradient (28.0‰-34.4‰) and the biomass and the faunal composition at the different stations showed remarkable variations (92-26782 mg/m^3).

The temperature did not vary as much as salinity in either season, but slightly from day to night.

The overall changes in temperature-salinity and the associated changes in the biomass inside the system are closely associated with the monsoons and the changes effected by the adjacent coastal waters.

INTRODUCTION

To the north and south of Cochin Harbour, the backwaters extend as shallow brackishwater lagoons which receive the waters of several large rivers. The backwaters stretch for the most part, parallel to the coast line and are separated from the sea on the west by low belts of sand. These backwaters are connected with the Arabian Sea at the Cochin Harbour by a bar-mouth of 450 m width and average depth 8-10 m. The depth of the backwaters ranges from 2 m to 8 m and the total area is about 512 square kilometres.

The backwaters receive run off from the south-west monsoon between June and August and also some rain from the north-east monsoon from October to December. The discharge of freshwater from the rivers during the monsoon period reduces the salinity of backwater system considerably. Evaporation and reduced flow of freshwater during the hot pre-monsoon period results in an increased salinity of the whole system.

Our present knowledge on the plankton of Cochin Backwater is mainly based on the pioneering work of George (1958). The hydrography of this estuary has been described by Ramamirtham and Jayaraman (1960), the estimation of plant pigments during monsoon months by Qasim and Reddy (1967), solar-radiation and its penetration with depth by Qasim *et al.* (1968), tidal cycle and environmental features by Qasim and Gopinathan (1969), and nutrients by Sankaranarayanan and Qasim

(1969). Little information is available on the zooplankton biomass and faunal concentration with respect to the salinity gradient and this paper embodies quanti-

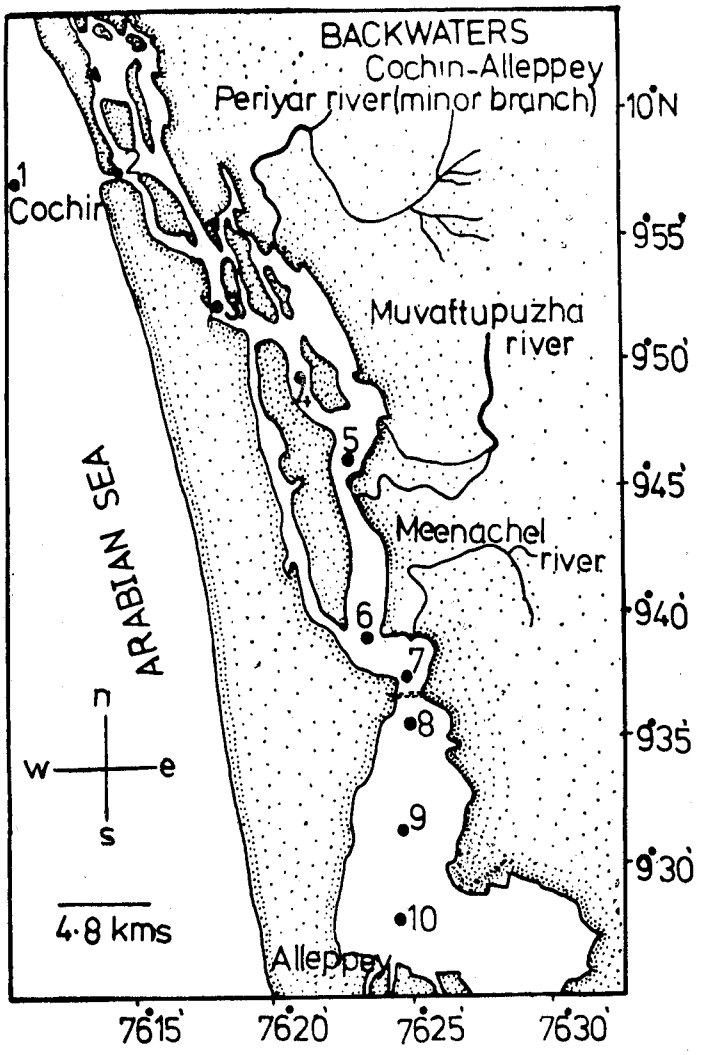

FIG. 1. Showing the station positions in the Cochin Backwater where collections and observations were made.

tative data of zooplankton biomass and faunal composition for the backwaters from Cochin Harbour extending southward to Alleppey.

We are greatly indebted to Dr. N. K. Panikkar, Director, National Institute of Oceanography (India), for providing facilities to carry out this work at the Indian Ocean Biological Centre. Our thanks are due to Dr. T. S. S. Rao, Officer-in-Charge of the Centre for his constant help and guidance.

MATERIAL AND METHODS

Two cruises were made, one in November 1968, during the freshwater regime and the other in April 1969, during the salt water regime. During both cruises, collections were made at ten stations (Fig. 1), working towards the head of the estuary by day and towards the mouth by night.

. Surface samples were collected with a square mouthed net of mouth area 0.25 m^2 and mesh width 0.2 mm. The volume of water filtered was measured by a flow meter at the mouth of the net. Depending on local conditions the duration of the hauls varied between 2-5 minutes during which time 20-60 m^3 of water were filtered. After hauling up the net the samples were concentrated with a nylon gauze and were preserved in 5% formaldehyde using water collected *in situ*. In the laboratory the samples were halved with a Folsom Plankton Splitter for biomass determination (Table 1 and Fig. 2) and faunal studies. Counts of various taxa were made

TABLE 1. *Zooplankton Biomass data of Alleppey Section during the Post-Monsoon Compared with the data during the pre-monsoon period along with hydrography*

	Post-monsoon				Pre-monsoon			
Station	Time of haul (Hrs.)	Temperature (°C)	Salinity (‰)	Biomass (mg/m^3)	Time of haul (Hrs.)	Temperature (°C)	Salinity (‰)	Biomass (mg/m^3)
1	1005	30.0	31.27	142	0932	31.0	33.40	92
2	1100	30.9	27.21	250	1040	33.0	30.7	344
3	1145	32.4	9.70	108	1158	32.8	33.3	936
4	1306	32.6	5.55	268	1251	33.5	33.1	2171
5	1405	32.6	0.72	32	1352	33.3	31.5	5203
6	1512	32.4	0.12	12	1439	33.2	30.2	755
7	1600	32.0	0.58	16	1512	33.6	29.7	850
8	1626	32.0	0.39	8	1529	33.8	29.7	1267
9	—	—	—	—	1633	34.1	27.9	974
10	1840	31.0	0.30	78	1710	33.9	25.4	851
10	1907	30.7	0.30	161	2003	33.8	25.2	4657
9	—	—	—	—	2045	33.2	28.0	1324
8	2243	30.8	0.20	113	2202	33.0	30.0	3400
7	2328	30.6	0.39	80	2202	33.0	30.0	14234
6	0005	30.4	0.20	54	2248	32.3	29.6	26782
5	0113	30.8	0.12	169	2349	33.2	32.2	4070
4	0333	30.2	4.47	562	0119	32.4	33.7	1801
3	0427	29.9	17.54	345	0203	32.3	33.7	1361
2	0545	29.6	29.99	339	0346	31.8	34.4	1217

on a fraction of each sample varying from 1 ml to 20 ml. Salinity was measured *in situ* with a salinity temperature bridge [Type : MC. 5 by Electronic Switchgear (London) Ltd.] and the temperature by laboratory thermometer.

RESULTS

Hydrography

Salinity : The salinity structure of the surface waters during the post-monsoon period of the estuary is given in Table 1 and Fig. 2. The estuary showed a steep

gradient in surface salinities with high values at the mouth of the estuary and a sudden decrease towards the head.

By contrast during the pre-monsoon period uniformly high salinity was present throughout the estuary (Table 1 and Fig. 2).

Temperature : The temperature during the period of investigation are shown in Table 1, Fig. 2. The average temperature varied between 29.6°C and 36.6°C in November and between 31°C and 33.9°C in April. Minimum temperature was observed before the day break irrespective of seasons.

Zooplankton Biomass : The zooplankton biomass for the periods, November 1968 and April 1969 is listed in Table 1 and Fig. 3a and 3b.

A general appraisal of the biomass values for both seasons shows that pre-monsoon was a distinctly rich season, though gelatenous organisms particularly in night hauls made up the very high values obtained at some stations (Fig. 3b). A marked decrease in zooplankton biomass was observed towards the head of the estuary during November.

Faunistic composition : Eighteen major taxa were represented in the collections obtained during the periods. Only those groups which contributed to more than 2% of the total are shown in the figure (Fig. 3a and b).

1. *Coelenterata*
   a. *Hydromedusae* were common at almost all stations before the monsoon and rare after the monsoon.
   b. *Scyphomedusae : Achrometes* species were common throughout the estuary before the monsoon.

2. *Ctenophora*

Except for a few species in the lower half of the estuary during the post-monsoon period, this group was absent at most stations. It was abundant in pre-monsoon especially in the lower reaches of the estuary.

3. *Chaetognatha*

Species of the genus *Sagitta* were recorded most commonly. During the post-monsoon they were present only in the vicinity of the bar-mouth, whereas they entered the upper reaches of the estuary during the pre-monsoon period (Fig. 3 a and b).

4. *Annelida*

Annelid larvae were present during both seasons and formed a common component of the community (upto 7%) during the pre-monsoon period notably towards the mouth of the estuary (Fig. 3 a and b).

5. *Crustacea*

a. *Cladocera :* occurred towards the mouth of the estuary, and were conspicuous by their absence towards the head during the pre-monsoon period. Maximum number of organisms of this group (4%) was recorded from station 3 during the post-monsoon.

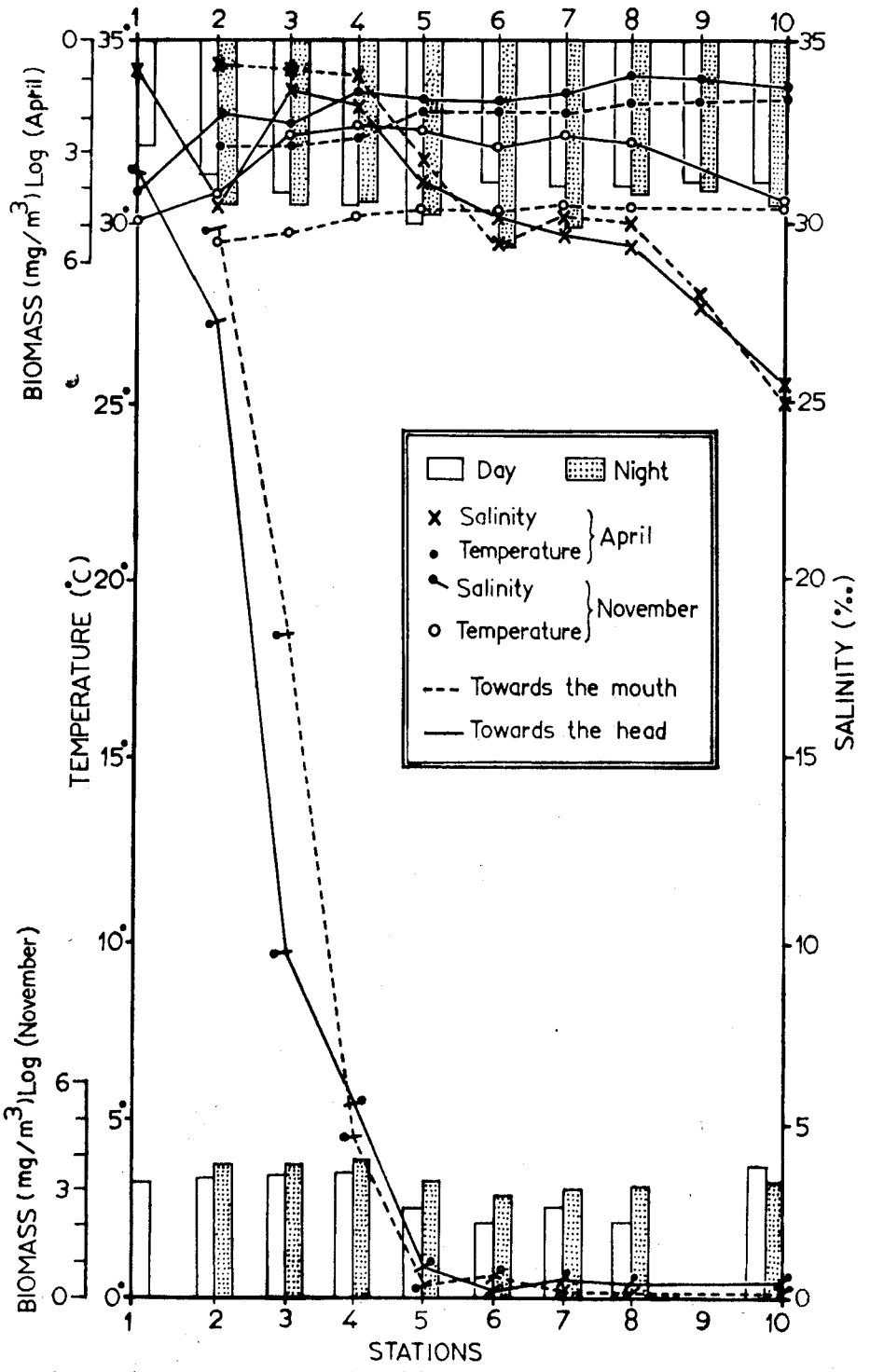

FIG. 2. Surface temperature (°C), salinity (‰) and biomass (mg/m³) at stations between Fairway buoy and Alleppey during November and April.

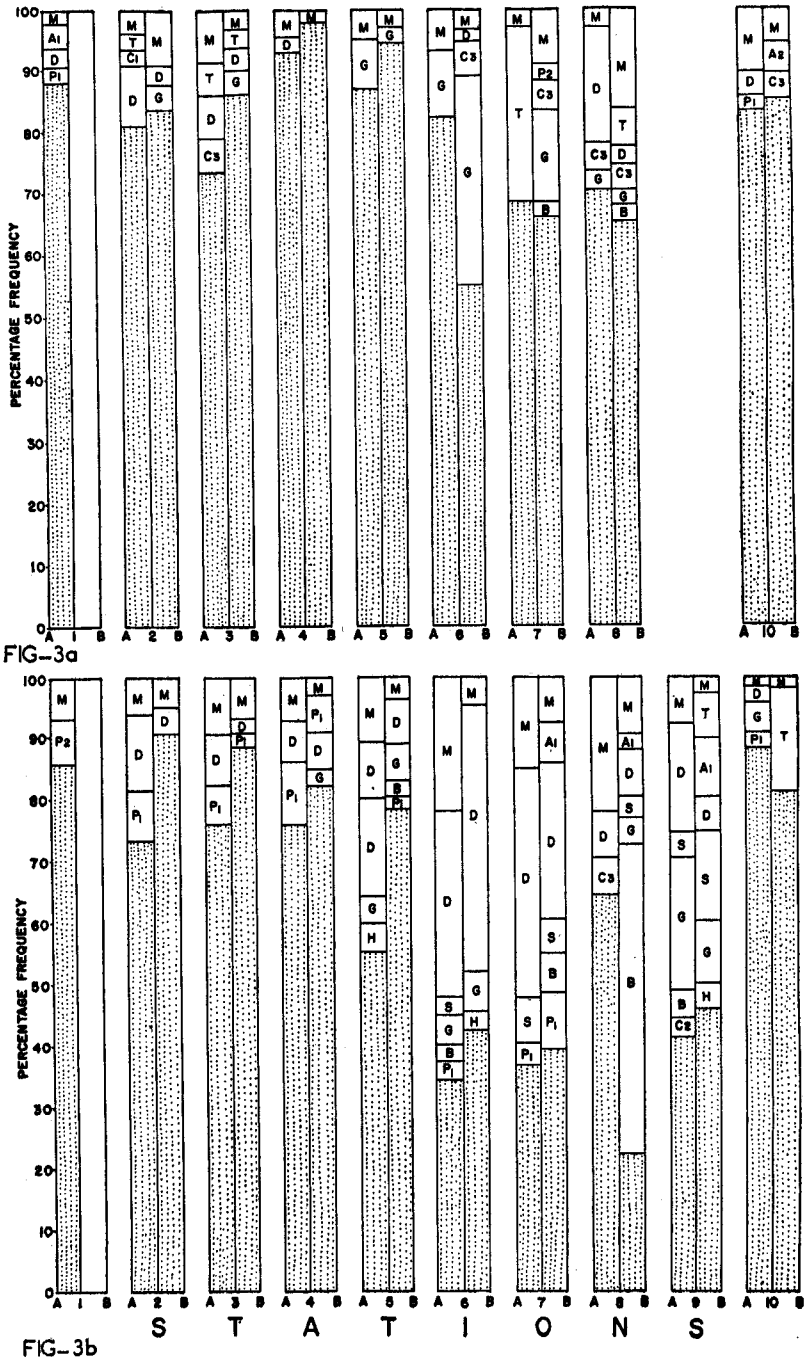

FIG. 3 a & b. Histograms showing the percentage frequency of the zooplankton at stations between Cochin and Alleppey Backwaters in November and in April respectively. A—Day ; B—Night. Stippled portion indicates copepods ; A1—Appendicularia ; A2—Amphipoda ; B—Bivalve larvae ; C1—Chaetognatha ; C2—Cirriped larvae ; C3—Cladocera ; D—Decapod larvae ; G—Gastropod larvae ; H—Hydromedusae ; M—Miscellaneous ; P1—Polychaeta ; P2—Penaeid larvae ; S—Sergestids ; T—Teleostei.

b. *Copepoda :* This group dominated the community during both the seasons. Though abundant (99% St. 4) during the post-monsoon periods, during the pre-monsoon the percentage was low (22% St. 8) for the central portion of the estuary.

c. *Amphipoda :* Though few in number gammarid amphipods were represented at almost all stations during both seasons. A conspicuous number was observed at station 10 (Fig. 3 a) where the water was almost fresh (0.3‰).

d. *Decapoda :* Post-larvae of penaeids formed the major component of this group and were most common at station 6 and 7 during November. Brachyuran zoea were abundant in both seasons with high values during pre-monsoon.

e. *Sergestidae :* Pre-monsoon proved to be a period for Sergestids evidenced by their increased number in occurrence in the collection, especially at the interior of the estuary (St. 6, 7, 8 & 9).

f. *Stomatopoda :* Alima larvae occurred only in the night collections, taken during the pre-monsoon period (St. 4, 5 & 6).

6. *Mollusca*

Gastropod larvae were present during both periods, but were always more common (6%) towards the head of the estuary (Fig. 3 a and b).

Although larvae of bivalves were few during November they were abundant during April, and were a major component in the collections taken during night at Station 8.

7. *Fish eggs and larvae*

Eggs and larvae of clupeidae were present throughout the estuary during both the seasons.

8. *Miscellaneous groups*

Many other groups such as cirriped larvae, mysids and cumaceans were present during both periods. Larvae of insects and freshwater oligochaets occurred at the head of the estuary during post-monsoon period, where the environment was oligohaline in character.

Discussion

In Cochin Backwater the surface water of the estuary becomes almost fresh (0.3‰) during September and nearly marine during April (34.4‰—Menon and Nair, 1967). It is evident from our study that salinity plays a major role in controlling the faunistic composition of the area.

A comparative study of the biomass obtained during the different seasons show the following striking features.

1. Both diversity and abundance of the fauna were high during April particularly in the central part of the estuary.

2. Both diversity and abundance were lowest in November towards the head of the estuary.

3. The present data indicates that conditions during the pre-monsoon are more favourable for zooplankton than those during the post-monsoon period.

Faunistic composition reveals that during post-monsoon the dominant taxa were copepoda and molluscan larvae. Decapod larvae and fish larvae also were common at some stations.

On the other hand during pre-monsoon the major taxa present were, copepoda, decapod larvae, molluscan larvae, hydromedusae, sergestidae, and polychaete larvae.

Studies on primary production by Qasim and Reddy (1967) show that it is at its peak towards the latter half of the post-monsoon. The zooplankton maximum which we observed a few months later in April appear to be derived from the post-monsoon maximum of primary production by the re-establishment of a more uniform high salinity throughout the estuary from January-April.

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