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THE ECOLOGY OF COPEPODS FROM HOOGHLY ESTUARY, WEST BENGAL, INDIA

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ABSTRACT

Spatial and temporal variations in the abundance and distribution of copepods in the lower stretch of Hoogly estuary were studied from March 1980 February 1981 in relation to hydrological parameters. Most of the copepod species showed higher diversity and abundance during high saline premonsoon period (March-June). Monsoonal cycle induced seasonal rhythm on salinity and copepods. Postmonsoon period (November-February) was characterized with copepod repopulation and proliferation with a gradual salinity recovery. Neritic and limnetic species were stragglers in the environment and showed fortuitous distribution. Seven major families of copepods exhibited varying degrees of coexistence among themselves in the environment.

Key;words : Ecology, copepods, Hooghly Estuary, West Bengal.

INTRODUCTION

Copepods form one of the major components of the zooplankton community in different ecosystem. Their occurrence and abundance are influenced mostly by the physico-chemical conditions, availability of food and seasons (Goswami, 1982). Studies on the seasonal distribution of copepods have been reported by several authors from different places. Studies on copepods of the Hooghly estuary have been mostly erratic either in space or in time or restricted to some groups (Dutta, Malhotra and Bose, 1954; Saha, Ghosh and Gopalkrishnan 1975; Bhunia and Choudhury 1982; Baidya and Choudhury, 1984). The present communication deals with the abundance and occurrence of copepods in relation to hydrographic parameters at two stations in the lower stretch of Hooghly estuary.

MATERIAL AND METHODS

Surface zooplankton samples were collected from two selected stations around Sagar Island (lat 21°30'N and 21°50'N and meridians 88°04' to 88°08'E) during high tide in the forenoon in the lower stretch of Hooghly estuary (Fig. 1) from March 1980 to February 1981. Mandirtala (stn 1; depth 4 m) was situated on the north-western part of Sagar Island. Mooriganga creek (stn 2; depth 3 m) is 6 km. long originating from the river Mooriganga and extending from east to northwest direction in the northern sector of the island.

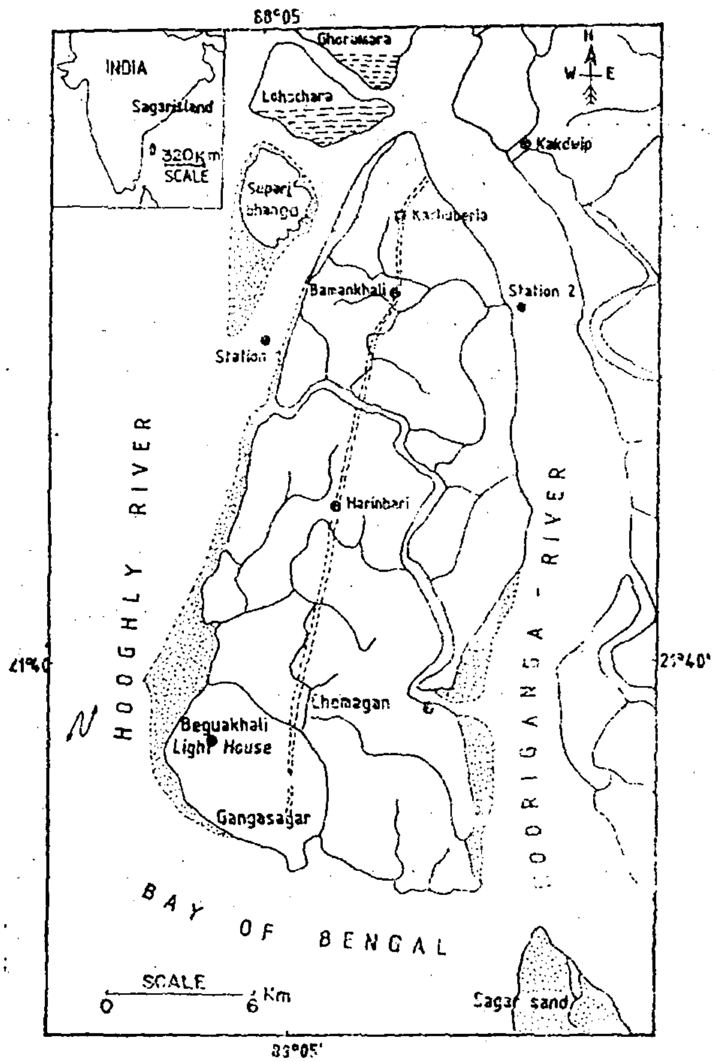

Fig. 1. Station location map.

Measured quantities of surface water was filtered through a conical net (0.25 m diameter and 0.0695 mm aperture) and the samples were fixed and preserved in 4% formaldehyde in seawater, buffered with 1% hexamine. Depending on the abundance of samples, a subsample of 5-25% was examined in a Sedgewick Rafter counting cell under a compound microscope for the enumeration of copepods and their common species. From each plankton collection, three estimations of subsample were made and the mean was recorded. Water samples were collected simultaneously for the determination of various environmental parameters by standard methods outlined by Strickland and Parsons (1968). Water transparency was estimated with the help of a secchi disc and rainfall data were collected from the Alipure Meteorological Observatory. Zooplankton biomass was determined by displacement method.

RESULTS AND DISCUSSION

Average fortnightly values of the hydrological parameters are presented in Figs. 2, 3 and 4. Hooghly estuary is highly dynamic and presents a cyclic pattern, characterized by large amount of precipitation and tidal interplay (Sarkar, Singh and Choudhury, 1985). Air and water temperatures and salinity values at both

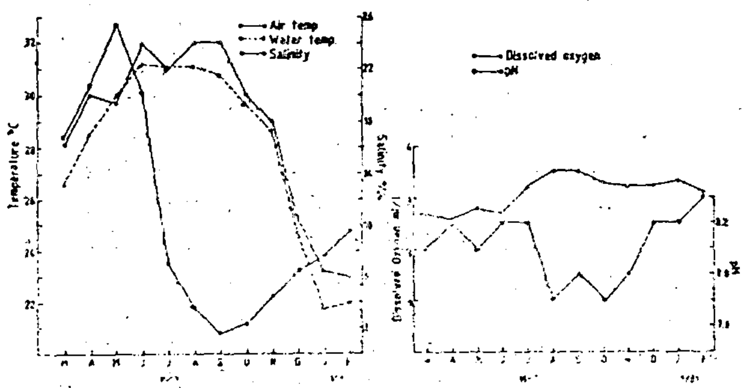

Fig. 2. Temperature, salinity, dissolved oxygen and pH at station 1.

the stations showed a similar trend of distinct seasonal variations. A bimodal temperature oscillation was a distinguished feature. Variations in surface water temperature were normal for a tropical estuary with maximum in June (31.2°C at stn. 1) and minimum in February (21.5°C at stn 2). Salinity was maximum in the premonsoon months (March-June) which account no precipitation but higher

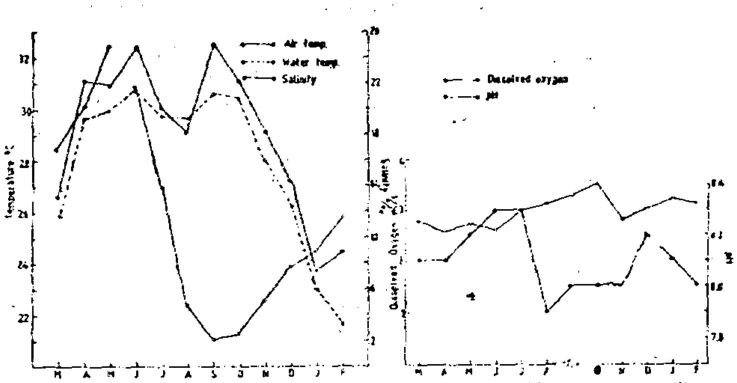

Fig. 3. Temperature, salinity, dissolved oxygen and pH at station 2.

temperatures, and may be classified as the "season of increasing salinity" while June-July is the "season of peak salinity". Salinity was minimum in the monsoon

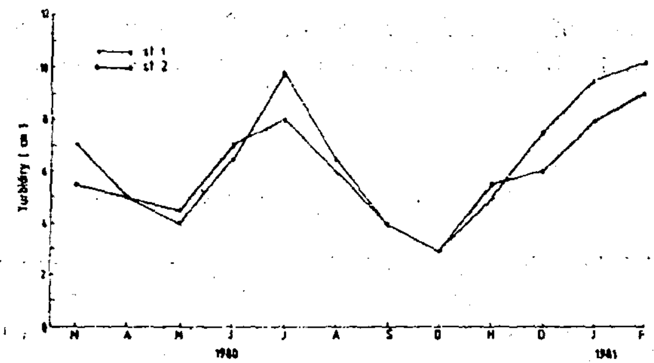

Fig. 4. Secchi disc transparency at station 1 and station 2.

months July-October) affected by southwest monsoon winds accompanied by heavy rain. During postmonsoon period (November-February) the salinity gradient kept a gradual rising trend and attained a maximum value through the premonsoon months. Evaluation of the accumulated data during the present study period reveals that the salinity fluctuations at Mandirtala water was more conspicuous than the Mooriganga creek because of the strategic location of the former station right on the bank of Hooghly funnel and its occasional exposure to the fresh-water freshets from the Hooghly river. Seasonal variations in dissolved oxygen was not conspicuous as was in salinity. pH of the surface water was found to be in the alkaline range throughout the year (7.9-8.3). Secchi disc readings showed progressively increasing transparency of estuarine waters during late monsoon months.

Biomass

Biomass values were high during premonoon period with maximum displacement volume (0.70 ml/m^3) and corresponding wet weight of 640 mg/m^3 in June 1980 at stn 1 (Fig. 5). Due to large number of megalopa population during

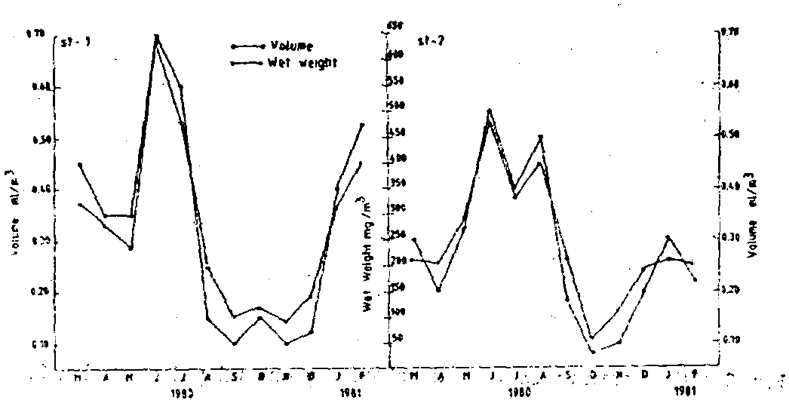

Fig. 5. Average displacement volume (ml m^3) and the corresponding wet weight (mg/m^3) of zooplankton at stations 1 and 2.

January-February at stn. 1 and in August at stn. 2, the corresponding biomass showed a higher value in comparison with the numerical value of the total population.

Community and abundance of copepods

Copepods, by their sheer abundance and diversity, formed the most important group in the zooplankton community throughout the year, constituting 67.8 to 97.0% of the total zooplankton. The copepod abundance followed almost the same pattern as that of zooplankton biomass. Copepod showed a bimodal type of distribution — the primary major peak was encountered in June|July and the secondary peak during February|March (Table I). A gradual trend of decrease

Table I : Copepod density (no./m³) and relative percentage on total zooplankton counts with respective rainfall data (1980-81).

Months	St. 1 Density (%)	St. 2 (Density (%)	Rainfall (mm)
March, 1980	5890 (88.3)	4834 (85.7)	75.3
Apr.	5625 (91.6)	3577 (86.6)	9.7
May	6145 (85.1)	5303 (85.6)	34.9
June	11422 (84.7)	10116 (88.9	313.5
July	8773 (82.8)	11326 (92.1)	391.8
Aug.	4275 (87.6)	2060 (86.3)	224.0
Sept.	3615 (95.5)	2350 (97.4)	191.6
Oct.	1745 (96.3)	1530 (95.6)	193.4
Nov.	2235 (79.4)	1678 (89.1)	000.0
Dec.	4010 (74.5)	3872 (89.2)	002.1
Jan. 1981	4660 (68.9)	3815 (78.6)	019.5
Feb.	5948 (67.8)	5437 (79.5)	49.1
Annual mean	5361.9 (83.5)	4658.2 (87.9)	

was discernible from August to November with a sharp fall in October. Seasonal fluctuations of major copepod species has been represented in Fig. 6.

A total of 36 copepod species belonging to 19 families and 21 genera were encountered in the surface collections, calanoids were represented by 12 genera & 25 species, cyclopoids by 5 genera & 5 species and harpacticoids by 6 genera each having single species.

The copepods have been divided into the following three distinct categories depending on the period of existence in the environment.

Category I : Perennial copepods (Euryhaline)

Paracalanus spp., *Acrocalanus* spp., *Acartia* spp., *A. spinicauda. Acartiella sewelli, Labidocera euchaeta, Pseudodiaptomus annandalei, P. hickmani, P. aurivilli, Oithona* spp. & *Laophonte* spp.,

Table II. Correlation matrix for the copepods belonging to 7 major. copepod families at station 1.

	Paracala-nidae	Acartii-dae	Pontelli-dae	Eucala-nidae	Pseudodiap-tomidae	Oithoni-dae
Paracalanidae	—	—	—	—	—	—
Acartiidae	—0.4729	—	—	—	—	—
Pontellidae	0.9249**	—0.3838	—	—	—	—
Eucalanidae	0.3116	—0.5850	0.1638	—	—	—
Pseudodiaptomidae	—0.6254**	0.6164**	—0.4827	—0.0791	—	—
Oithonidae	0.8542**	—0.5751*	0.8651**	0.3719	—0.5313	—
Laophontidae	0.6959**	—0.1575	0.7834**	0.1995	—0.1409	0.6563

Table III : Correlation matrix for the copepods belonging to 7 major copepod families at station 2.

	Paracalanidae	Acartiidae	Pontellidae	Eucalanidae	Pseudodiap-tomidae	Oithonidae
Paracalanidae	—	—	—	—	—	—
Acartiidae	- 0.4850	—	—	—	—	—
Pontellidae	0.6353*	-0.6934**	—	—	—	—
Eucalanidae	0.5801*	-0.6415*	0.4751	—	—	—
Pseudodiaptomidae	- 0.0265	0.7014**	-0.3951	- 0.0622	—	—
Oithonidae	0.8846**	- 0.2914	0.4687	0.4951	0.0916	—
Laophontidae	0.6894**	- 0.4691	0.7963**	0.5463*	0.0880	0.6462*

* significant at 5% level; ** signlicant at 1% level;

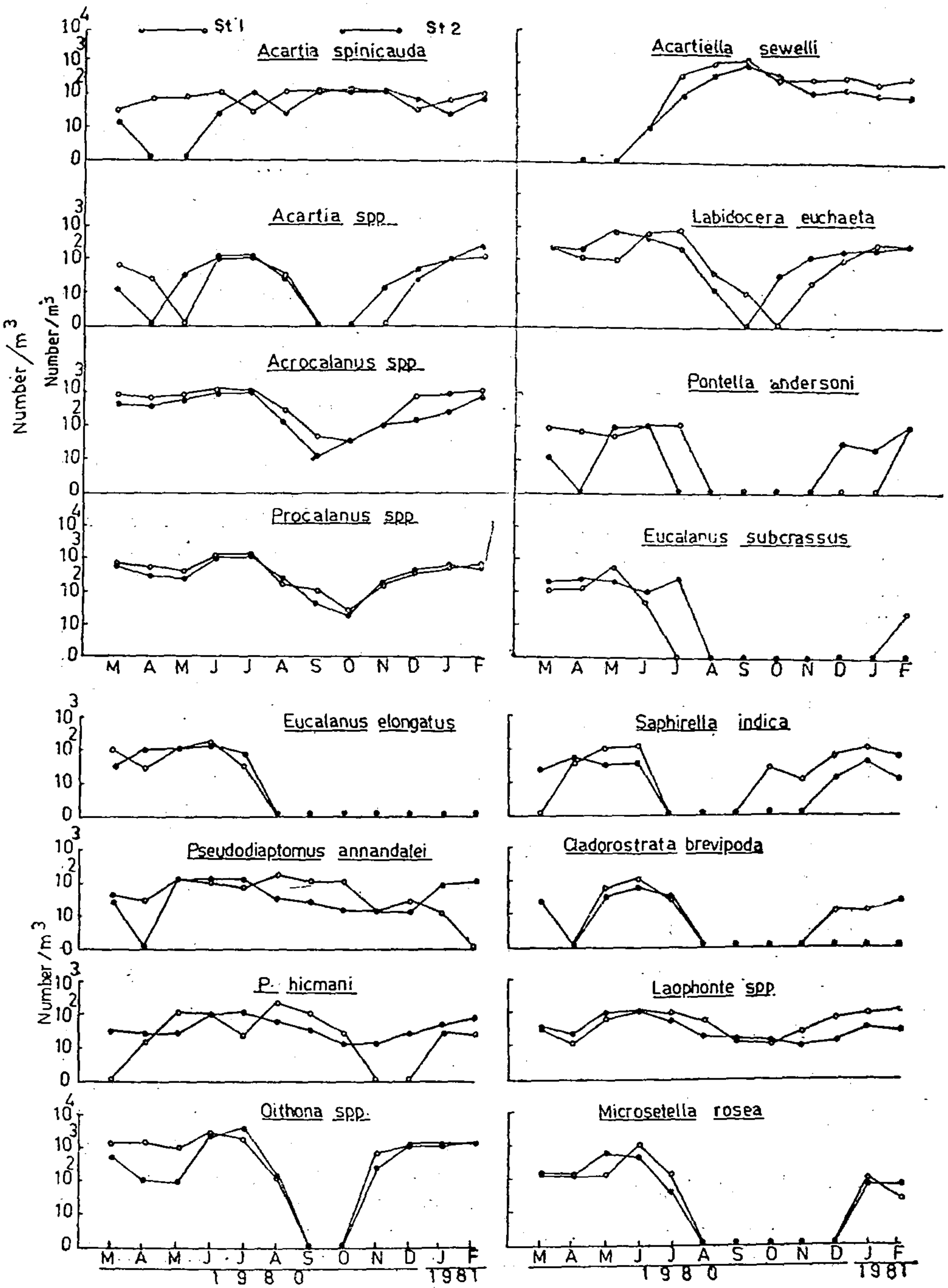

Fig. 6. Distribution of common species of copepods at stations 1 and 2.

Category II : Seasonal copepods (Stenohaline)

Pontella andersoni, Eucalanus subcrassus, E. elongatus, Pseudodiaptomus spp., *P. tollingeri, P. daughlishi, Centropages dorsispinatus. Saphirella* of *indica, Corycaeus danae, Microsetella rosea, Macrosetella gracilis, Cladorostrata brevipoda* & *Euterpina acutifrons.*

Category III : Casual migrants (Oligohaline and Stenohaline)

Pseudodiaptomus masoni, Neodiaptomus strigilipes, Euchaeta spp., *E. marina, E. wolfendeni, E. tenuis, E. concinna, Temora turbinata, T. discaudata, Halicyclops tenuispina, Mesocyclops* spp. & *Harpacticus* spp.,

The correlation matrix in between seven major copepod families at two stations have been shown in Tables II and III. The positive correlation coefficient between any two pairs among the families Paracalanidae, Pontellidae, Eucalanidae, Oithonidae and Laophontidae provides evidence that these families combine to form a group by themselves. The family Acartiidae and Pseudodiaptomidae showed negative correlations with other families implying that they form another group by themselves and occurred abundantly when the members of the other families were either absent or were poorly represented. Pillai, Qasim and Nair (1973) reported the coexistence of six major families i.e., Acartiidae, Centropagidae, Pseudodiaptomidae, Pontellidae, Temoridae and Diaptomidae, out of which the first four families occur commonly in the environment. Members of six families of copepods coexisted in the Mandovi-Zuari estuarine complex (Goswami and Selvakumar, 1977).

In the Hooghly estuary, *Accartiella sewelli* and *Acartia* spp., were the dominant species that successfully flourished during the monsoon months along with the other oligohaline species like *Neodiaptomus strigilipes, Halicyclops tenuispina Mesocyclops* spp., In Cochin backwaters (Madhupratap, 1979; Rao, Nair and Madhupratap, 1981) and in the Mandovi and Zuari estuaries (Goswami, 1982), *Acartiella gravelyi* was the only common monsoonal species. During southwest monsoons, Pati (1980) recorded estuarine and brackishwater copepods like *Pseudodiaptomus annandalei Paracalanus crassirostria, Acartia chilkaensis,* & *A. sewelli.*

The highest (26 at stn. 1 during May/June, 1980) and the lowest (11 at stns. 1 and 2 during October 1980) number of copepod species in this estuarine system were obtained during premonsoon and monsoon seasons respectively. The presence of only a few copepod species during the monsoon months has also been reported from the other Indian estuaries (Pillai, Qasim and Nair, 1973; Rao, Madhupratap and Haridas, 1975; Chandramohan, 1977; Goswami, 1982). The stress associated with salinity change place heavy demands on the tolerance of species which inhabit estuarine environments (Tranter and Abraham, 1971).

The estuarine belts to the eastern side is less productive at secondary level when compared to its western counterpart. The shallowness of the area, the associated turbidity and possible differences in flow patterns perhaps render the environment 'severe' at stn. 2.

The present study has indicated that the seasonal distributional pattern of different copepod species are dependent upon the prevailing hydrographic conditions and the salinity acts as the limiting factor controlling the abundance of most of them. However, location of sampling station, turbidity, currents and availability of food may be the other controlling factors.

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REFERENCES

Baidya, A. and A. Choudhury, 1984. Copepod components of zooplankton in a tidal creek (Chemagari) of Hooghly estuary, Sagar Island, Sunderbans, West Bengal. *Environment and Ecology*, **2** : 162-167.

Bhunia, A. B. and A. Choudhury, 1982. Some ecological considerations for zooplankton production in Chemagari creek, Sagar Island (South), Sunderbans. *Mahasagar — Bulletin of the National Institute of Oceanography*, **15** : 247-252.

Chandramohan, P., 1977. Seasonal distribution of copepods in the Godavari estuary. *Proceedings of the symposium on Warm Water zoolankton*, Special publication, NIO|UNESCO, 330-336.

Dutta, N., J. C. Malhotra and B. B. Bose, 1954. Hydrology and seasonal fluctuation of the plankton in the Hooghly estuary. Indo Pacific Fisheries Council Symposium on plankton : 35-47.

Goswami, S. C. and R. A. Selvakumar, 1977. Plankton studies in the estuarine system of Goa. *Proceedings of the symposium on warm water zooplankton*, Special publication, NIO|UNESCO, 226-241.

Goswami, S. C., 1982. Distribution and diversity of copepods in the Mandovi-Zuari estuarine system, Goa. *Indian Journal of Marine Sciences*, **11** : 292-295.

Goswami, S. C., 1983. Coexistence and succession of copepod species in the Mandovi and Zuari estuaries, Goa, *Mahasagar — Bulletin of the National Institute of Oceanography*, **16** : 251-258.

Madhupratap, M., 1979. Distribution, community structure and species succession of copepods from Cochin backwaters. *Indian Journal of Marine Sciences*, **8** : 1-8.

Patel, M. I., 1975. Pelagic copepods from the inshore waters off Saurashtra coast. *Journal of Marine Biological Association of India,* **17** : 658-663.

Pati, S., 1980. Observations on the hydrography and inshore plankton of the Bay of Bengal off Balasore. *Hydrobiologia,* **70** : 123-132.

Pillai, P. P., S. Z. Qasim and A. K. K. Nair, 1973. Copepod component of zooplankton in a tropical estuary. *Indian Journal of Marine Sciences,* **2** : 38-46.

Rao, T.S.S., M. Madhupratap and P. Haridas, 1975 Distribution of zooplankton in space and time in a tropical estuary. *Bulletin, Department of Marine Science,* Cochin University, **7** : 695-704.

Rao, T.S.S., V.R. Nair and M. Madhupratap, 1981. Ecological considerations on tropical zooplankton. *Proceedings of the symposium on Ecology of Animal Population,* Zoological Survey of India, Part 1 : Part **1** : 15-39.

Saha, B. S., B. B. Ghosh and V. Gopalkrishnan, 1975. Plankton of the Hooghly estuary with special reference to salinity and temperature. *Journal of Marine Biological Association of India,* **17**: 107-120.

Sarkar, S. K., B. N. Singh and A. Choudhury, 1985. Ecology of chaetognaths in Hooghly estuary, Bay of Bengal, *Indian Journal of Marine Sciences,* **14**: 98-101.

Strickland, J. D. H. and T. R. Parsons, 1968. A practical handbook of seawater analysis. *Bulletin — Fisheries Research Board of Canada,* No. **167** : 311.

Tranter, D. J. and S. Abraham, 1971. Coexistence of species of Acartiidae (Copepoda) in the Cochin backwaters, a monsoonal estuarine lagoon. *Marine Biology,* **11**: 222-241.