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OBSERVATIONS ON THE ECOLOGY OF NEMATODES INHABITING LITTORAL SANDS OF THE HUGLI ESTUARY

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ABSTRACT

Abundance and species composition of benthic nematodes inhabiting soil substratum composed of silt and medium to fine sand at two stations in the Hugli Estuarine Complex were studied seasonally from February, 1985 to June, 1986. Average population densities (no./400 gm of soil) ranged from 25 to 525 and displayed seasonal changes in their species composition with epigrowth feeders reaching maximum densities in premonsoon and post-monsoon and deposit feeding and predatory/omnivorous species during monsoon. A dependance of a large number of predatory forms having long setae to the medium to fine sands of lower littoral zones have been encountered during premonsoon period.

INTRODUCTION

SOIL, a living system as stated by Bamforth (1985), consists of an interstitial mosaic of microsites and mineral particle aggregates which colonise a variety of water film organisms. Nematodes are considered to be the most dominant water film fauna that inhabit the capillary water in pores between and within soil aggregates (Bamforth, 1985). Their proposed role in the ecology of shallow marine ecosystem ranges from serving as a source of nutrition for larger animals (Tietjen, 1967) playing an important role in benthic nutrient regeneration (Tietjen, 1980). Despite their probable versatility and wide spectrum of ecological sinificance, attempts have not yet been made systematically to work out in detail the structure and dynamics of this important meiofaunal group of the Gangetic Estuary. The present paper provides some information on the faunal assemblage of nematodes, their distribution, species composition in the lower stretch of the Hugli Estuary.

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MATERIALS AND METHODS

The investigation was carried out on two estuarine intertidal sand and mud flats. Station I is at Harinbari area, comprised of fine to clayey soft sediment having particular type of surface vegetation (dominated by *Excoecaria agallocha* L, *Acanthus ilicifolius* L and *Bruguiera gymnorhyza* L) with moderate exposure to wave actions and Ganga Sagar area (Stn. II) having medium to fine sandy substratum characterised by different kind of surface vegetation (*Phoenix peludosa* Roxb, *Suaeda maritima* and *Salicornia* sp.) and more exposed to the pounding waves of the Bay of Bengal. For qualitative and quantitative assessment, samples were collected at three littoral zones, *viz.* upper littoral and lower littoral zones by scrapping

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off the superficial layer (0-5 cm) of the sediment by a hand operated corer. Subsamples were analysed for per cent silt clay and sand analysis and soil texture by following pipetting method. Physico-chemical parameters like temperature, salinity, pH, dissolved oxygen were measured by usual standard methods. Modified Baermann Funnel method was followed for extracting nematodes from the sediment. After extraction, the specimens were fixed in hot 4% formalin, identified upto genera with the help of Tarjan's (1980) and Platt and Warwick's (1983) reference works and grouped into four trophic groups (proposed by Wieser, 1959) based on buccal morphology. Their relative abundances were also been made to investigate any relationship existing between feeding habit and sediment texture.

Results

Summary of the environmental data have been documented in Fig. 1 and 2. Sediment characteristics varies from fine sand to clay at St. I and medium to fine sandy sediment at St. II.

Distribution of nematodes : Intertidal distribution of meiofauna as stated by McIntyre (1969), is determined by temperature and salinity and also by the grian size of the deposit which determines the interstitial space, water content and availability of food and oxygen. Wieser (1959) observed that widely separated areas have a characteristic pattern in distribution of certain species. He found the genus *Chromadorina laeta* to be the dominant species in algal mat subjected to extreme exposure on the coasts of Chile, the Mediterranean Sea and the North Sea. Our data support the observations on the dominance of the composite chromadorid group in algal environments. Moreover species composition and seasonal distribution pattern in different littoral zones suggest that these environments greatly favour epigrowth feeders (Wieser's Group 2A type). They reach significant peak in abundance during premonsoon and postmonsoon, may be correlated with increased abundance of benthic microflora. Although no data on microflora density are available still the guts of nematodes showed the presence of green pigments, presumably the chloroplasts of benthic chlorophytes ingested by them.

Data available from the present study (Table 1 & 2) suggest certain trends in the occurrence of various species in the littoral sediments. Not only some species are either restricted to or clearly most abundant in one sediment type, but also less abundant species displayed regional abundance. The genera *Mesacanthion*, *Rhynchonema*, *Microlaimus*, *Onyx*, *Daptonema* and *Dichromadora geophila*.

TABLE 1. *Distribution of nematodes at Harinbari station (Station I)*

Species		Trophic group	Distribution trend
Anoplostoma sp. I	..	2B	Loamy clay
Chromadorid III	..	2A	Do.
Cyatholaimid	..	2A	Do.
Daptonema sp.	..	1B	Silty clay
Diplolaimid	..	1B	Do.
Desmodorid II	..	2A	Sandy clay
Enoplid I	..	1A	Silty clay
Comesomatid	..	1B	Sandy clay
Dichromadora sp.	..	2A	Do.
Chromadorid V	..	2A	Do.
Eleutherolaimus sp.		2A	Do.
Halalaimus sp. II	..	1A	Silty clay
Haliplectus sp.		1A	Do.
Oxystomina sp.	..	1A	Silty clay
Oncholaimid I & II	..	2B	Loamy clay
Ptycholaimellus sp.	..	2A	Do.
Parodontophora sp.	..	2A	Do.
Sphaerolaimus sp. I	..	2B	Silty clay
Sphaerolaimus sp. III	..	2B	Sandy clay
Sabatieria sp.	..	1B	Do.
Theristus II	..	1B	Sandy clay
Terschellingia longicaudatum		1A	Silty clay
Trissonchulus sp.	..	2A	Loamy clay
Tripyloides granulatus	..	2A	Do.
Halichoanolaimus sp.	..	2A	Sandy clay

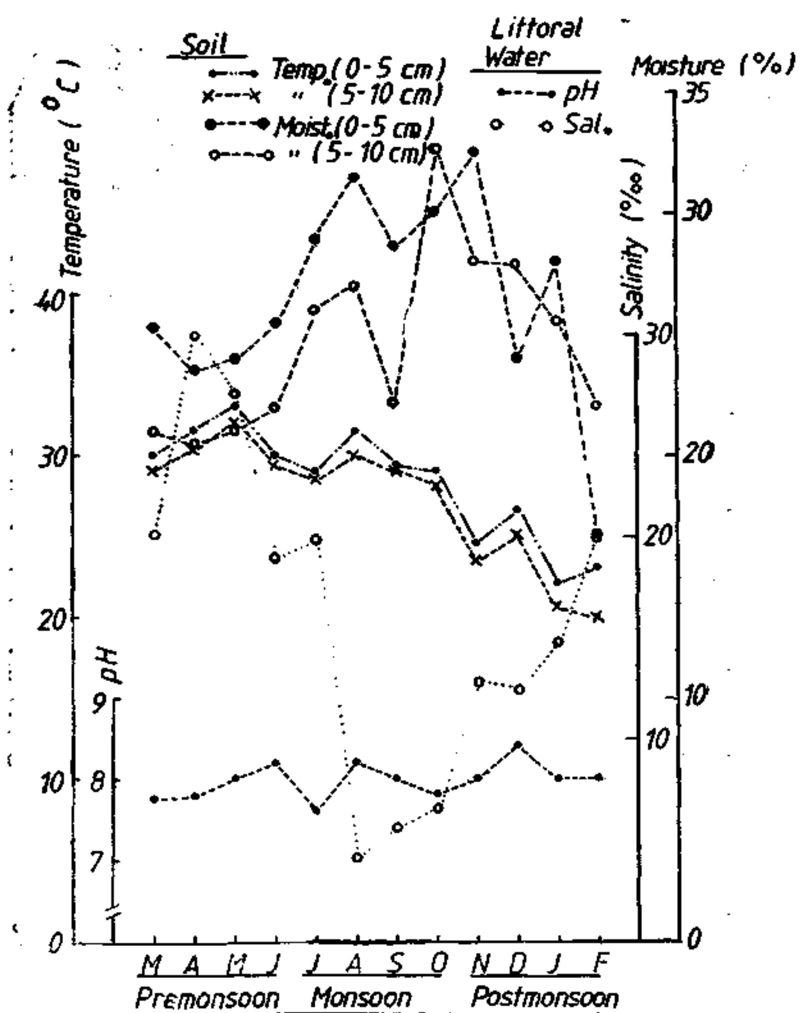

Fig. 1. Seasonal variations in environmental parameters at Station I (Harinbari).

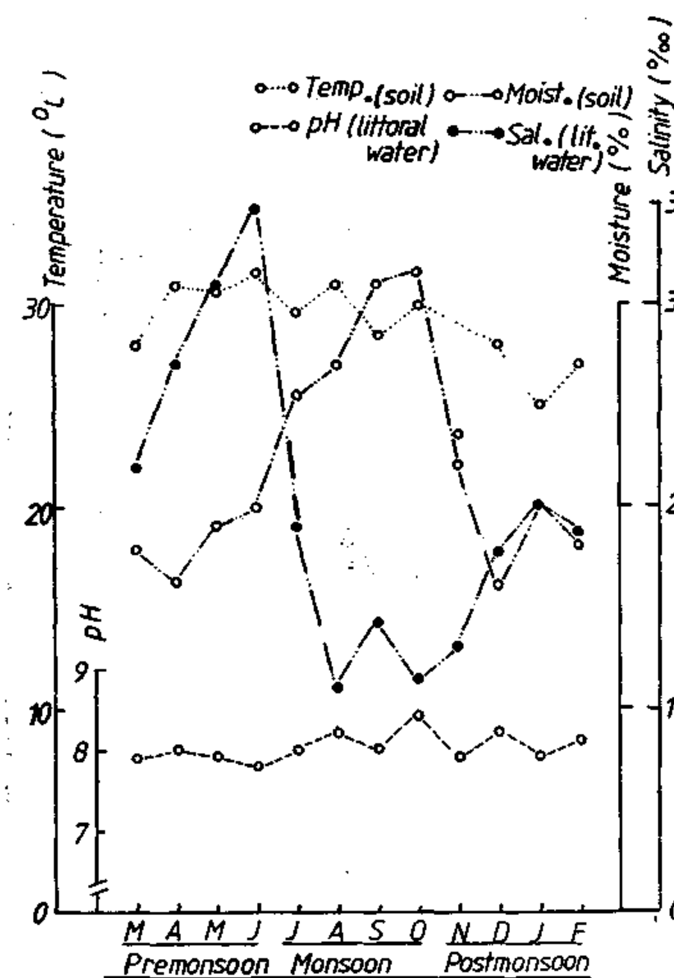

Fig. 2. Seasonal variations in environmental parameters at Station II (Ganga Sagar).

Parironus are found to be restricted in lower littoral sediments of Ganga Sagar station (St. II) and the genera *Comesoma*, *Eleutherolaimus*, *Sphaerolaimus* sp. III. *Dichromadora* and *Theristus* sp. II are found strictly in the lower littoral sediments of Harinbari station (St. I).

TABLE 2. *Species composition of benthic nematodes in littoral zones of Ganga Sagar Station (II) of the Hugli Estuary*

Species	Upper Litt.	Mid Litt.	Lower Litt.	Trophic group
Anoplostoma sp. I ..	+	+	—	2B
Anoplostoma macrospiculum ..	—	—	—	2B
Araeolaimid ..	—	+	—	2A
Cyatholamid sp. I ..	+	—	—	2A
Desmodorid II ..	—	+	—	2A
Dichromadora geophila ..	—	—	+	2A
Diplolaimid ..	+	—	—	2A
Enoplid I ..	+	+	—	1A
Ethmolaimus sp. ..	—	+	—	2A
Halalaimus I. n. sp. ..	+	+	—	1A
Halalaimus II. ..	+	+	—	1A
Halalaimus III. ..	+	—	—	1A
Haliplectus sp. ..	+	+	—	1A
Hopperia sp. ..	+	—	—	2A
Mesacanthion sp. ..	—	—	+	2B
Mesotheristus sp. ..	—	+	—	1B
Metachromadora remanei ..	+	—	—	2A
Oxystomina sp. I ..	+	—	—	2A
Oxystomina sp. II ..	—	—	+	1A
Onyx sp. ..	—	—	+	2A
Parironus sp. ..	—	—	+	2A
Ptycholaimellus sp. ..	+	+	—	2A
Paradesmodora sp. ..	+	—	—	2A
Pseudochromadora sp. ..	—	+	—	2A
Rhynchonema sp. ..	—	—	+	2A
Sabatieria sp. ..	+	—	—	1A
Sphaerolaimus sp. II ..	—	+	—	2B
Steineria sp. ..	—	+	—	1B
Syrinqulaimus striaticaudatus ..	+	+	+	2A
Terschellingia longicaudatum ..	+	+	—	1A
Theristus sp. I ..	—	—	+	1B
Tripyloides granulatus ..	+	+	—	1B
Oncholaimid sp. I & II ..	+	+	—	2B
Oncholaimid sp. III ..	—	—	+	2B
Polygastrophora sp. ..	—	—	+	2B

The appearance of *Syringolaimus striaticaudatus* predominantly during the late premonsoon to early monsoon, mainly during May to August, does not corroborate with that of previous observation made by Wieser (1967) from Florida Bay. Their data represent that this species appears to be limited during the warmer months. Although the occurrence of lower littoral genera at the Ganga Sagar station agrees well with the observation made by Tietjen (1976) in the North Carolina Coast, but trophic composition of lower littoral at Harinbari station exhibit somewhat more preference towards epigrowth and deposit feeders (Wieser's Group 2A and Group 1 B). It may be due to the fact that since the sediment texture is more silty in the case of Harinbari (St. I) perhaps this environment allows more deposit feeders to colonise preferentially during monsoon and postmonsoon season coinciding with the increasing amount of detritus in the sediment.

Most of the deposit feeders (Wieser's Group 1A & 1B) tended toward increased abundance in the clayey silts such as the genera *Steineria*, *Halalaimus sagarensis* n. sp. (Sinha *et al.*, 1987) *Anoplostoma macrospiculum* n. sp. (Sinha *et al.*, 1987), *Haliplectus*, *Oxystomina*, Diplolaimids, *Sabatieria*, *Terschellingia longicaudatum*, etc. are restricted to upper and mid littoral zones at both the stations. These species probably occurs where detritus is present, independent of the underlying sediment *i.e.*, protected areas where detritus accumulates. Such microhabitat makes dispersal through the free water possible, caused by currents and tidal effects (Jensen, 1984). An interesting observation encountered during the course of study that all the members of the chromadorid types (Wieser's Group 2A) like the genera *Hopperia*, *Pseudochromadora*, *Ptycholaimellus*, *Halichonolaimus*, *Ethmolaimus* and *Metachromadora remanei* share sandy as well as clayey sediments. So the dominance of the fauna by epigrowth feeders at all the stations illustrates that these environments prefer epigrowth feeders through out the seasons (Fig. 3 and 4). Predatory nematodes (Wieser's Group 2B), mainly Oncholaimids are equally represented in medium and fine sandy sediments, whereas the only genus *Sphaerolaimus* being a predatory form, lower littoral zone also corroborates with the previous observation (Tietjen, 1976). Changes in the patterns of distribution of the common nematode species are given in Figs. 5 to 7. Abundance of taxa are expressed as a percentage of the total population.

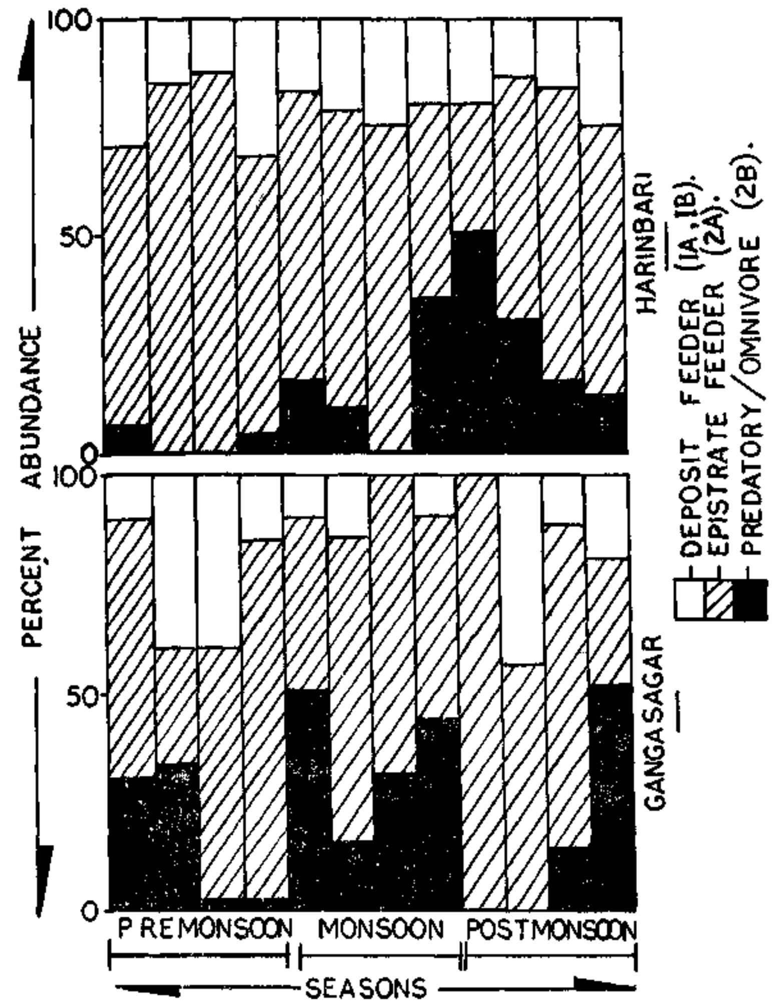

Fig. 3. Seasonal distribution of nematode feeding types.

but exclusively restricted to clayey soft sediments of both the stations. The distribution of this genus in the present study is in agreement with the data given by Tietjen (1976). The distribution of the genus *Mesacanthion* in the

Discussion

The organisms inhabiting the estuary can be expected to react and adapt to physical, chemical and biological changes of the environment. Being a tropical estuary, temperature fluctuations are not significant enough to inhibit the recruitment of these organisms. Moreover, food supply seldom acts as a limiting factor in a tropical estuary and does not seem to govern the seasonal abundances (Qasim, 1970). The substratum of the intertidal zone which supports a characteristic assemblage of organisms (Newell, 1979). But the influence of substratum on the distribution of nematodes is difficult to define (Tietjen, 1976). While relationships

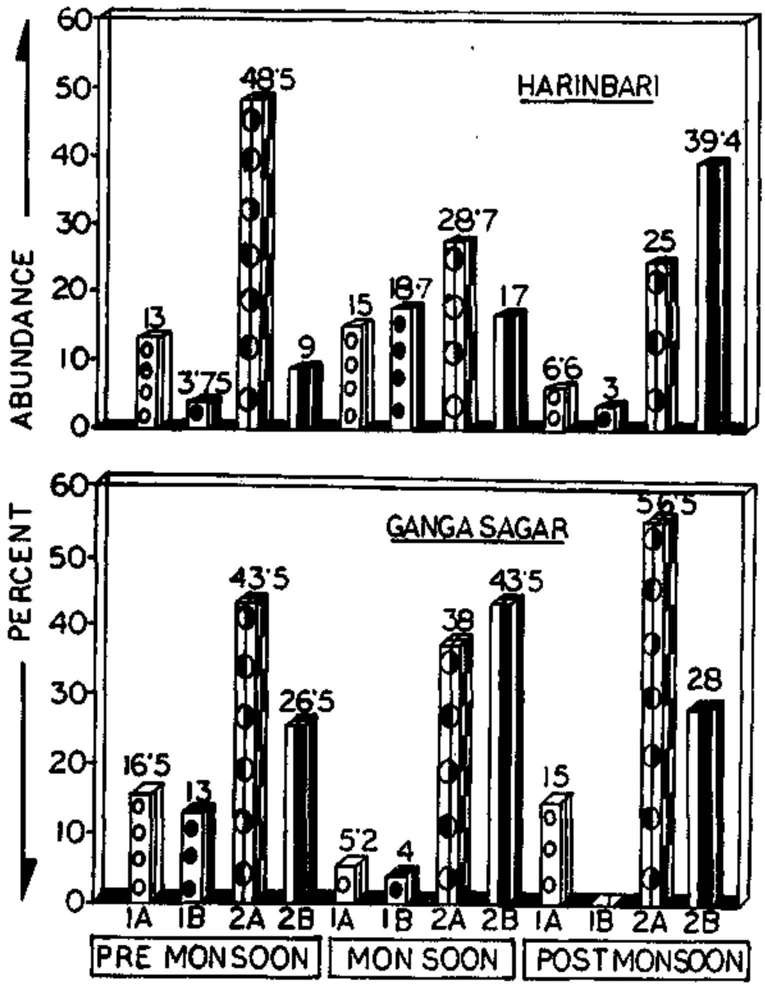

Fig. 4. Seasonal abundance of nematode feeding groups at midlittoral zones of Hugli Estuary.

fluctuation range of dissolved oxygen and pH at the littoral waters in the Hugli Estuary are little to moderate. Hence, salinity with wide range of fluctuations appears to be major hydrological factor controlling the incidence of these organisms along with the nature of between certain species and sediment type have been noted by various workers (Wieser, 1959 a ; 1960 ; Tietjen, 1969 ; Warwick and Buchanan, 1970 ; Warwick, 1971 ; Tietjen, 1976), all these workers have found that the apparent preference by certain species and a particular sub-

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stratum is not always the same in different localities. The influence of joint sediment type (availability of food) and salinityof interstitial water complex on the meiofauna is thought to be a reasonably good indicator to explain the apparent relationship between nematode trophic composition and their seasonal abundance (Wieser, 1959).

epigrowth feeders and predatory/omnivorous, or to be more equally represented by all feeding types.

Both Wieser (1960) and Hopper and Meyers (1967 b) have stated that similarities of animal communities can be obtained by an analysis and comparison of samples collected within and between various sites. Homogeneity or

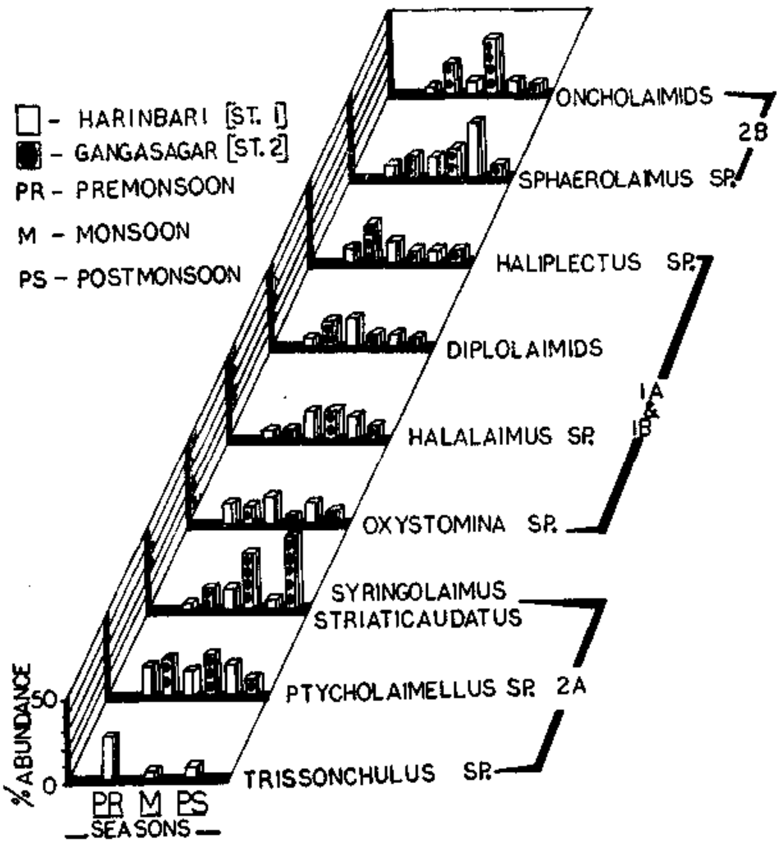

Fig. 5. Abundance in percentage of common species of nematodes at midlittoral regions of the Hugl Estuary.

The normal pattern is for sandy substrata tended to be inhabited by longer nematodes possessing somewhat longer setae than the nematodes inhabiting finer sediments. Conversely, finer sediments to be dominated by deposit feeding types and for medium to fine sediments either to be dominated by epistrate/

affinity is indicated by a high percentage of commonness while conversely, heterogeneity, or diversity, is expressed by a low figure.

Distribution of the feeding types from the present study between and within sites shows a dissimilarity in the species of a group with

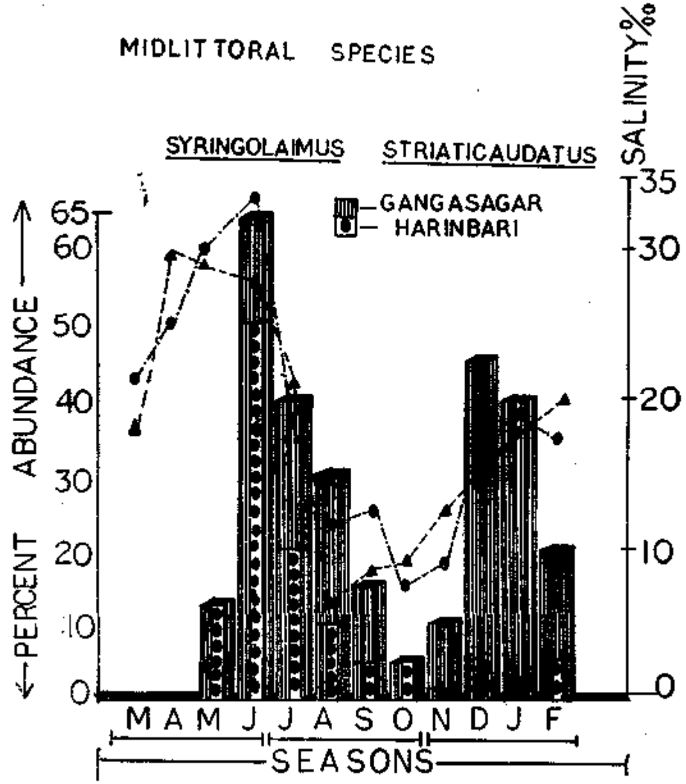

Fig. 6. Seasonal abundance in relation to salinity.

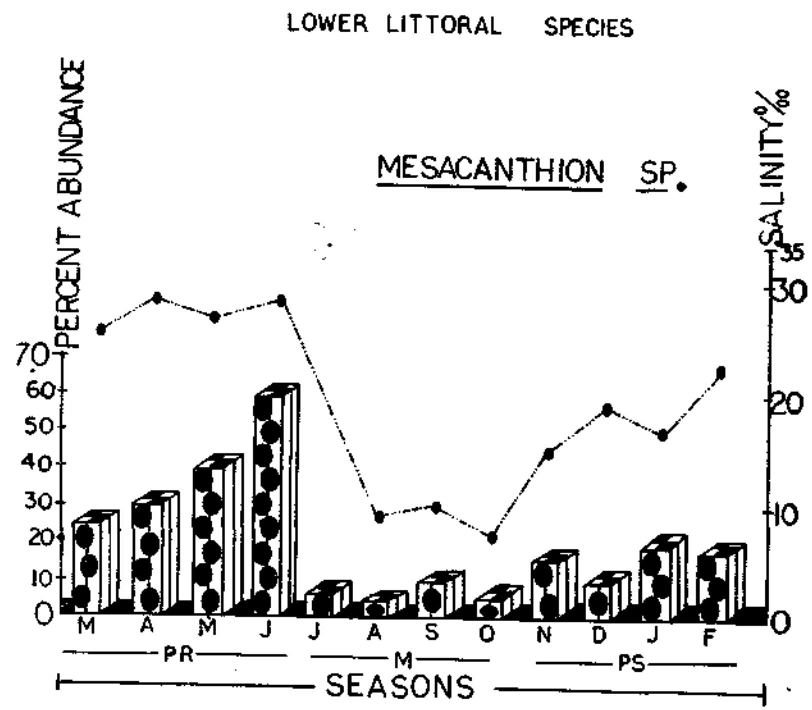

Fig. 7. Seasonal abundance in relation to salinity (Bay water).

comparable feeding habits. These variabilities may be due in part to the peculiar characteristics of sites ranging from very fine sedimentary layer with extremely shallow water and mangrove runoff to fine to medium sedimentary layer with strong tidal exposure. The averages of feeding types noted in our study when compared, it exhibits equal sharing of epistrate and deposit feeders at mid littoral zones comprising deposit feeders : 7 ; epistrate feeders : 9 at Ganga Sagar station and deposit feeders : 9 ; epistrate feeder : 8 at Harinbari station.

The observational results thus presented demonstrate that the major difference in substratum texture played little role in the pattern of nematode species distribution, particularly in the midlittoral zone of both the stations.

There has been considerable discussion on the feeding habits of benthos (Dayton and Hessler, 1972 ; Deutsch, 1978), particularly regarding the specific or non-specific nature of feeding by benthic animals (Tietjen and Le, 1977 ; Deutsch *et al.*, 1977). Experiments carried out by them suggest that some marine nematodes may be selective feeders and if this is taken to be true, then the distribution of nematodes along the intertidal substratum of the Hugli estuarine mud and sand flats with special reference to some epistrate feeder and the abundance of deposit and omnivorous types, might be explained by their feeding habit and food preference.

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