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BIOGEOGRAPHICAL DISTRIBUTION OF TINTINNIDS (*PROTOZOA : CILIATA*) FROM PORTO NOVO WATERS

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ABSTRACT

Fortynine species of tintinnids have been identified from aquatic biotopes: neritic, estuarine, backwater and mangrove on the Coromandel coast of India. Depending on the frequency of occurrence, the tintinnids were divided into four groups namely, a) frequent species, b) seasonal species, c) restricted species and d) rare species. The appearance of the autochthonous and allochthonous species mostly during summer and premonsoon seasons is attributed to the prevailing circulation pattern in the Bay of Bengal associated with easterly flowing monsoon current. All the 49 species of tintinnids have been grouped as per their biogeographically known distribution. Porto Novo coastal waters possessed all representative groups such as the temperate-tropical, inter-tropical, Indo-Pacific, Indian Ocean, Atlantic Ocean, Pacific and cold water, thus suggesting the possible influence of the current distributories along the coast line.

Key-words : Tintinnids, distribution, autochthonous species, allochthonous, Species, currents, Porto Novo.

INTRODUCTION

A study of the distrubution of plankton helps to learn the nature of currents prevailing in an area. In order to understand annual fluctuations in their occurrence and abundance, it is useful to know the biogeographical composition of the plankton of the area (Lindley, 1975). Classical biogeography seeks to provide an outline of the spatial distributions of systematic units like species of higher categories.

Eventhough there are several work available on the distribution and seasonal variation of tintinnids from other regions (Marshall, 1969; Zeitzschel, 1966; Lindley, 1975; Balech, 1959), similar studies from Indian waters are very scanty.

Porto Novo (Bay of Bengal), a tropical region, provides refuge for all planktonic organisms. Studying their biogeographical composition, Santhanam (1976) derived several biogeographical groups of diatoms and dinoflagellates Krishnamurthy, Damodara Naidu & Santhanam (1978) attempted a biogeographical classifications of the Bay of Bengal phytoplankters and discussed peculiarities in the distribution like the occurrence of some rare tintinnids.

In the present study the tintinnids are considered in detail to attempt their biogeographical groupings.

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MATERIAL AND METHODS

Plankton samples were collected by using 1 litre polythene bottles from four aquatic biotopes (Viz., neritic, estuarine, backwater and mangrove) of Porto Novo region (Lat. 11°29′ N; Long. 79°46′, India) for a period of three years. Simultaneously, net (Bolting silk cloth No. 32) samples were also collected. The plankton collections were allowed to settle after adding 5% neutral formalin, bringing final concentration to 2%. After 48 hours the tintinnids present in the samples were counted.

OBSERVATIONS

A total number of 49 species has been identified from this region and grouped as per their biogeographically known distribution. A large number of species from the neritic Bay of Bengal, off Porto Novo, are found to share, with their counterparts, world wide as well as restricted distribution as shown in Table I.

Among the tintinnids observed at Porto Novo, 6 species were common with temperate-tropical, 32 species belonged to intertropical divisions; the representation was as follows: 9 species to Indo-Pacific, 4 species to the Indian Ocean, 22 species to the Atlantic, 13 species to the Pacific and 11 species to the Arctic and the Antarctic Oceans. In total, 18 species known from the east coast shared their distribution with the Arabian Sea (West Coast).

Autochtnonon

The tintinnids have been arranged into three convenient groups depending on their distribution pattern. This arrangement is based on the frequency (percentage) of occurrence from each biotope of Porto Novo region. The data from three year period of investigations revealed that some species enjoyed only restricted regional distribution, while some showed seasonal occurrence. Some species were common to all the biotopes. For the sake of convenience, the species which were present in more than 70% and below 10% of the total samples of plankton collections were considered as possible endemic (autochthonous) and visiting (allochthonous) species respectively. The species occurring in frequencies 10–70% in the total samples were considered as 'seasonal' species. This norm of occurrence was successfully employed in the case of phytoplankton by Santhanam (1975).

The allochthonous species were generally found to be insignificant in all the biotopes. They did not show any pattern of distribution. Most of these species were exotic. On the other hand, the autochthonous species were present for the most part of the year and made striking contribution to the tintinnid density of this region.

A list of species (together with their percentage appearance) constituting those groups in various biotopes is given below:

Table I. Biogeographical composition of tintinnids from Porto Novo.

Species	Geographical areas							
	1	2	3	4	5	6	7	8
Amphorellopsis acuta	x	x	—	—	x	x	—	x
Codonellopsis orthoceros	x	x	—	—	—	—	x	x
C. ostenfeldii	—	—	x	—	x	x	x	x
C. schabi	x	x	—	—	—	—	—	x
C. tessellata	x	—	—	—	—	—	—	—
Codonellopsis sp. nov.	—	—	—	—	—	—	—	—
Coxliella ampla	x	—	—	x	—	—	—	—
C. annulata	—	—	—	—	—	—	—	x
Dadayiella bulbosa	x	—	—	—	—	—	x	x
D. ganymedes	x	x	x	x	—	x	x	x
Dictyocysta seshaiyai	—	—	—	—	—	—	—	—
Dictyocysta sp. nov.	—	—	—	—	—	—	—	—
Epiplocylis undella	x	—	—	—	—	—	—	—
Eutintinusm lusus-undee	x	—	—	—	x	—	x	x
E. tenuis	—	x	—	—	—	x	—	x
Favella bravis	—	—	—	—	—	—	—	x
F. ehrenbergii	—	—	—	x	x	—	—	x
F. philippinensis	—	—	—	—	—	—	—	x
Favella sp. nov.	—	—	—	—	—	—	—	—
Helicostomella longa	x	x	—	—	x	—	—	x
Leprotintinnus nordquisti	—	x	—	—	x	x	—	x
L. simplex	—	x	—	—	x	x	—	x
Metacylis corbula	—	—	—	x	—	—	—	x
M. jorgensenei	—	—	—	—	—	—	—	x
Rhabdonella spiralis	x	—	—	—	x	—	—	x
Stenosemella parvicollis	—	x	—	—	—	—	—	—
S. stenei	—	—	—	—	—	—	—	x
S. ventricosa	x	—	—	x	x	—	—	x
Tintinnidium incertum	—	—	—	—	x	—	—	x
T. primitivum	—	—	x	—	x	—	—	—
Tintinnopsis amphora	—	—	—	—	—	—	—	—
T. bermudensis	—	—	—	—	x	—	—	—
T. beroidea	x	—	—	x	x	x	x	x
T. butchlii	x	—	—	—	—	—	—	x
T. cylindrica	—	x	x	—	—	x	—	x
T. directa	—	x	—	—	x	x	—	x
T. glans	x	—	—	x	—	—	—	x
T. gracilis	x	—	—	—	—	—	—	x
T. karajacensis	—	—	—	x	—	—	—	—
T. kofoidii	x	—	—	—	—	—	—	—
T. lohmanni	—	—	—	—	x	—	—	x
T. minuta	—	x	—	—	—	—	—	—
T. mortensenei	x	—	—	—	—	—	—	x
T. mucula	x	x	—	—	—	—	—	—
T. parvula	—	—	—	x	—	—	—	x
T. radix	—	—	—	x	x	—	—	—
T. tocantinensis	x	—	—	—	x	—	—	x
T. tubulosa	x	—	—	x	x	—	—	x
T. uruguayensis	x	—	—	—	—	—	—	—

X — present, — not recorded, 1. — Atlantic Ocean 2. — Pacific Ocean 3. — Indian Ocean 4. — Arctic and Antarctic Seas 5. — Arabian Sea 6. — Indo-Pacific 7. — Tropical — Temperate 8. Intertropical.

A. Autochthonous species:

Neritic biotope: *F. Philippinensis* (97.22) *L. nordquisti* (72.22), *S. parvicollis* (72.22), *T. beroidea* (86.11), *T. minuta* (77.78), *T. nucula* (72.22), *T. tocantinensis* (86.11), *T. tubulosa* (85.33), *T. uruguayensis* (74.23), *T. directa* (72.22), *D. seshaiyai* (77.78).

Estuarine biotope: *E. philippinensis* (97.22), *L. nordquisti* (70 00), *S. parvicollis* (72.22), *T beroidea* (75.00), *T. directa* (83.33), *T. nucula* (91.67), *T. tocantinensis* (97.22), *T. tubulosa* (91.67), *T. uruguayensis* (97.22).

Backwater: *T. beroidea* (75.00), *T. directa* (75.00), *T. nucula* (70.00) *T. tocantinensis* (77.78), *T. tubulosa* (83.33), *T. uruguayensis* (75.00).

Mangrove biotope: *T. beroidea* (70.00), *T. tocantinensis* (72.22) *T. tubulosa* (70.00), *T. uruguayensis* (80 00).

B. Allochthonous species:

Neritic biotope: *C. schabi* (8.33), *C. orthoceros* (7.78), *C. ampla* (8.33) *C. annulata* (5.56), *D. bulbosa* (2.78), *D. ganymedes* (2.78), *E. brevis* (8.33) *F. ehrenbergii* (2.78), *S. steinei* (8.33), *E. undella* (5.56), *R. spiralis* (8.33).

Estuarine biotope: *C. schabi* (8.33), *C. ampla* (8.33), *M. corbula* (5.66), *M. jorgensenei* (8.33).

Backwater biotope: *A. acuta* (8.33), *C. ostenfeldii* (8.33), *C. ampla* (5.55) *F. brevis* (8.33), *M. jorgensenei* (8.33), *T. radix* (2.78).

Mangrove Biotope: *D. seshaiyai* (8.33), *T. radix* (2.78).

C. Seasonal species:

Neritic biotope: *A. acuta* (44.44), *C. schabi* (30.56), *C. Orthoceras* (16.67), *C. ampla* (47.22), *C. annulata* (19.44), *E. tenuis* (30.56), *F. brevis* (30.56), *L. simplex* (27.28), *M. jorgenseneii* (44.44), *S. nivalis* (22.22), *S. stenini* (22.22), *S. ventricosa* (27.78), *T. cylindrica* (38.69), *T. karajacensis* (16.67), *T. mortensenei* (36.11), *T. radin* (22.22).

Estuarine biotope: *A. acuta* (47.22), *C. ostenfeldii* (38.89), *C. annulata* (22.22), *C. ampla* (16.67), *D. ganymedes* (13.89), *D. seshaiyai* (44.44), *E. tenuis* (27.78), *F. erhenbergii* (41.67), *L. simplex* (36.11), *F. brevis* (27.78), *M jorgensenei* (36.11), *S. nevalis* (25.00), *S. steinei* (16.67), *T. bermudensis* (22.22), *T. cylindrica* (41.67), *T. karajacensis* (13.89), *T. minuta* (33.33), *T. mortensenei* (16.67), *T. radix* (27.78), *T. glans* (16.76).

Backwater biotope: *A. acuta* (30.89), *D. seshaiyai* (16.67), *F. brevis* (11.11), *F. ehrenbergii* (19.44), *L. nordquisti* (22.22), *L. simplex* (27.78), *S. parvicollis* (19.44), *S. steinei* (16.67), *T. bermudensis* (43.67), *T. beroidea* (11.67), *T. minuta* (52.78), *T. nucula* (11.11).

Mangrove biotope: *F. philippinensis* (20.00), *T. directa* (20.00), *T. glans* (20.00), *T. minuta* (30.00), *T. nucula* (30.00).

It is interesting to note that as many as 11 species known from cold waters are found in Porto Novo neritic biotope. They are *C. ampla, D. ganymedes, F. ehrenbergii, L. nordquisti, S. nivalis, S. ventricosa, T. beroidea, T. glans T. karajacensis, T. radix* and *T. parvula.* Among the 11 species, 6 are known mainly from the Arctic and 5 species principally from the Antarctic seas.

Except for *D. seshaiyai, T. incertum* and *T. primitivum* all other tintinnid species recorded from Porto Novo have been collected from temperate waters also. The presence of principally Atlantic Ocean inhabiting species such as *C. tessellata, E. undella* and *T. uruguayensis* is rather intriguing. It emphasizes that our knowledge of tintinnid distribution is very insufficient and inadequate. Most of these species could also be used as indicator species of currents. All the Red Sea tintinnids reported by Halim, (1969) also occur at Porto Novo.

The biogeographical distribution of tinntinnids of Porto Novo showed interesting features. Porto Novo coastal waters possessed all representive groups such as the temperate-tropical, inter-tropical, Indo-Pacific, Indian Ocean, Atlantic Ocean, Pacific and cold waters, thus suggesting the possible influence of the current distributories along the coast line. Presence of rare species like *F. brevi s T. amphora, R. spiralis* and *C. tessellata* is a notable feature. However, further investigations are necessary to get elaborate knowledge of the biogeographical nature of tintinnids of Indian waters.

The Genus *Tintinnosis* ranked first in all the biotopes occurring consistently. The most common species *T beroidea, T. directa, T. tocantinensis* and *T. tubulosa* were also the 'frequent species' and totally dominated the tintinnid scene of microzooplankton panorama. Even though they occurred throughout the year, they are still affected by the seasonal fluctuations, which is reflected in their rise and fall in numbers in an year. The intensity is maximum in premonsoon season. The maximum numbers, encountered during this study, are of *F. philippinesis* and *S. parvicollis.* They are also included in the list of 'frequent species'.

The other Tintinnopsis species with imprints of 'seasonal occurrence' are *T. butchlii, T. cylindrica, T. mortensenei, T. nucula, T. gracilis T. raix.*

Interestingly *C. ostenfeldii, C. ampla, C. annulata, A. acuta* and *E. tenuis* could be called examples of 'restricted distribution'. The 'rare species' viz *C. orthoceras. C. tesselltaa, M. corbula, D. bulbosa, E. undella* were found once or twice in neritic or esturine biotope. Their contribution to tintinnid biomass was about 1%.

The appearance of the allochthonous species mostly during summer and premonsoon seasons in the various biotopes might be due to the prevailing circulation pattern in the Bay of Bengal associated with the easterly flowing monsoon current. It would also be ascribed to the upwelling (LaFond, 1957; Ganapati and Subbarao, 1957) during this period. The occurrence of the dino-

flagellates *Ceratocorys horrida* and the tintinnid *Rhabdonella spiralis* reported by Krishnamurthy, Damodara Naidu and Santhanam (1978) further supported the influence and the presence of different current system and upwelling in our Bay. *Favella brevis* now recorded, holds promise as an indicator species of current.

The size distribution of endemic tintinnids in this survey was interesting. It formed the primordial nucleus of tintinnid biomass in all the biotopes. The variations during seasons were due to the migration of seasonal species and the 'visiting species'.

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