Indian Journal of Marine Sciences
Vol. 28, June 1999, pp. 158-162

Species composition, abundance and distribution of hydromedusae from Dharamtar estuarine system, adjoining Bombay harbour

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Received 28 July 1997, revised 12 November 1998

Species composition, abundance and distribution of hydromedusae from Dharamtar estuarine system, adjoining Bombay harbour were investigated during 1984 - 1985. Twenty six species belonging to 19 genera were obtained from this area. Maximum species diversity was observed at st. 1 (coastal zone). A downward trend in species diversity was discernible towards the upper reaches of the estuary. Highest population density of hydromedusae was observed at st. 4 (inner zone) and it was due to the swarm of *Ostroumovia inkermanica*, 6450/100m^3 during September. The swarms were composed of chiefly juveniles. The more number of species of the outer zone was due to the occurrence of holoplanktonic species. *Ostroumovia inkermanica, Phialidium brunescens, Euphysora bigelowi* and *Blackfordia virginica* were recorded from all stations at least in a few months of the year. A marked species succession was discernible at some stations while species co-existence also was observed at other stations. Postmonsoon season (October-January) and late monsoon season (September) were found to be favourable for the growth and activity of hydromedusae in this estuary.

Hydromedusae are ecologically important since they are exclusively carnivores and form an important link in the food chain. Tropical estuaries experience only limited fluctuations in temperature. Dharamtar estuary is the lower reaches of Amba river, lying in the northern part of this place. With new industries cropping up along here in the Nagothana area, it is imperative to study the status of the ecosystem. This estuary is a fishing ground for sciaenids, clupeids, cat fishes, engraulids, shrimps and prawns[1]. Lele & Gae[2] reported the occurrence of hydromedusae from coastal area of Bombay during 1930's. Detailed studies on this group are available only from limited estuaries in India[3-9]. Within the zooplankton community hydromedusae form a significant part of the carnivores and in an estuarine habitat the group often serves as an index to industrial pollution. The present report on hydromedusae provides the baseline information for future ecological assessment of the Dharamtar estuarine system.

Five locations were selected along a stretch of about 30 km from Bombay Harbour up to Dharamtar between lat. 18°42′ - 18°52′ N and long 72°50′ 29″ - 73°01′ E. Stations 1 and 2 were located towards the open sea of the estuary considered as the outer zone while sts. 3-5 were located within the upper reaches of the estuary representing the inner zone (Fig. 1). The depth of the water column at outer zone was 8-11 m and that of the inner zone was 5-7 m. Surface and bottom water samples were collected using a Niskin Water Sampler. Selected physical and chemical parameters of the water (temperature, salinity, dissolved oxygen, *p*H, BOD, PO_4-P, NO_2-N, NO_3-N and NH_3-N were estimated using standard analytical methods[10-12]. Zooplankton was collected by oblique haul using Herron Tranter net (mesh 0.3 mm, mouth area 0.25 m^2) fitted with a calibrated T.S.K. flow meter. Monthly sampling was done during September 1984 to November 1985. Total zooplankton biomass (ml/100m^3) was measured as volume adopting the displacement method, while hydromedusae were identified by analysing whole samples or aliquots depending upon sample volume.

NIO Contribution No. 2642
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Results

The range of selected physical and chemical parameters are already reported[13] and the salient features are given here. The difference between surface and bottom temperature was generally insignificant indicating lack of vertical stratification due to shallowness of the estuary. The *p*H varied in a range of 7.5 to 8.4 with higher values during premonsoon season (February - May) and low values during monsoon season (June to September). During premonsoon period salinity increased to 38‰ and the entire column was homogeneous due to limited fresh water influx. High level of DO and BOD indicated effective assimilation of organic load. Nutrients indicated seasonal variations with maximum concentration during monsoon period[13]. Nitrate level showed enhanced values at the interior most part of the estuarine system (Fig. 2).

Zooplankton biomass ranged from 1.1 to 135.3 ml/100 m^3 A well defined increase in biomass value was noticed from the outer to the inner zone (Fig. 2) with a maximum value found during monsoon period in September 1985. Earlier studies from south Gujarat[14,15] suggested that the high saline period can accelerate zooplankton abundance. However, in the present study zooplankton abundance was higher during September and October when moderate salinity prevailed over Dharamtar estuary.

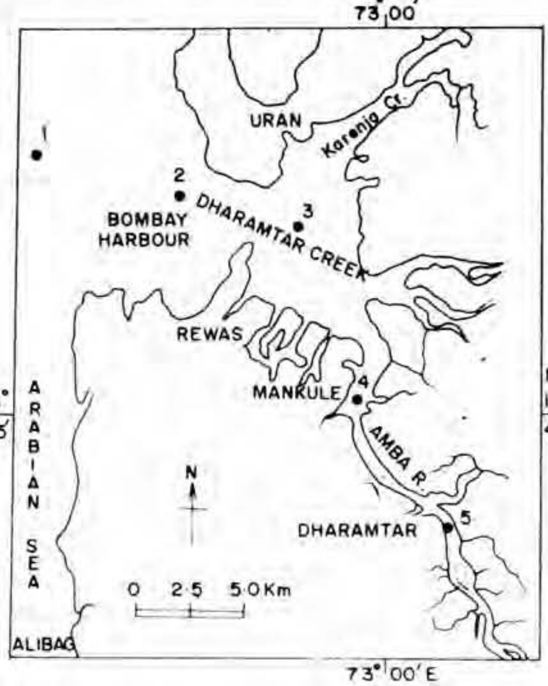

Fig. 1—Location of stations

Monthly variation in zooplankton standing stock and density of hydromedusae at different sts. are shown in Fig. 2. Data from different months were grouped into three distinct seasons viz. premonsoon (February-May) monsoon (June-September) and postmonsoon (October-January). During these seasons zooplankton biomass ranged from 1.4 to 26.6, 1.4 to 135.3 and 1.1 to 81.7 (ml/100^3) and the population density of hydromedusae fluctuated between 10 to 1670, 10 to 500 and 10 to 6660/100m^3 in the premonsoon, monsoon and postmonsoon respectively. It appears that postmonsoon season was found to be favourable for hydromedusae except at st. 5 and their contribution in high density of the total zooplankton biomass was fairly high at st. 4 (Fig. 3).

Twenty six species belonging to twenty one genera were obtained from this estuarine system. Species of hydromedusae recorded from Dharamtar estuary is given below.

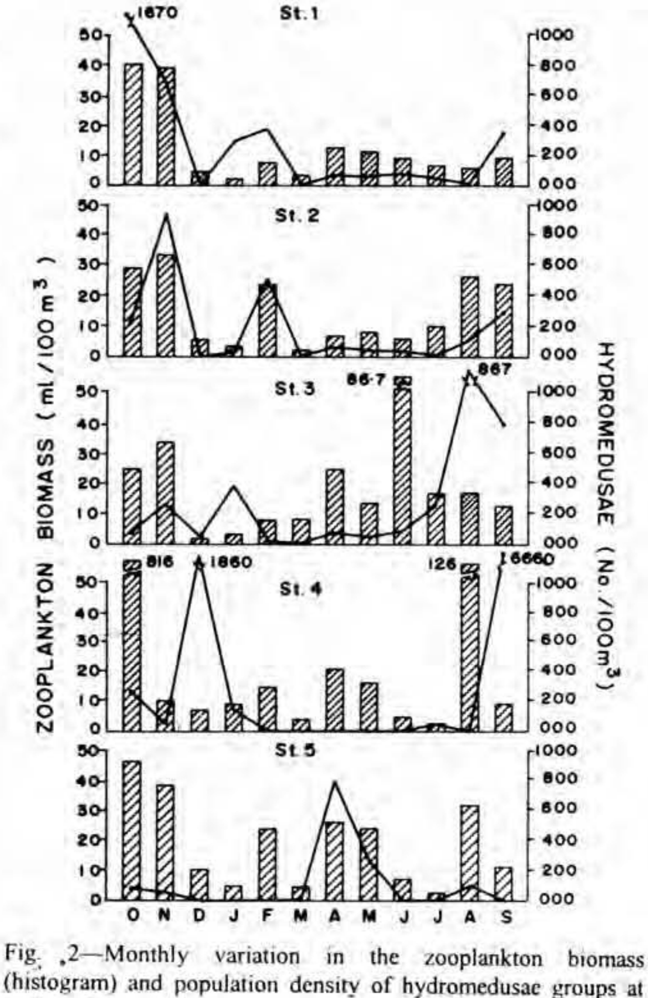

Fig. 2—Monthly variation in the zooplankton biomass (histogram) and population density of hydromedusae groups at stations 1-5

Order Anthomedusae

Euphysora bigelowi, Mass, 1905; *Hybocodon forbesi*, Mayer, 1894; *Hybocodon unicus*, Browne, 1902; *Bougainvillia fulva*, Agassiz & Mayer 1899.

Order Leptomedusae

Obelia spp., *Phialidium hemisphaericum*, Leuekart, 1856; *Phialidium brunescens*, Bigelow, 1904; *Phialidium globossum*, Mayer, 1900; *Phialidium simplex*, Browne, 1902; *Blackfordia virginica*, Mayer, 1900; *Eucheilota menoni*, Kramp, 1959; *Helgicirrha malayensis*, Striasny, 1928; *Phialucium condensum* Kramp, 1953; *Octophialucium indicum* Kramp, 1958; *Phialella fragilis* Uchida, 1938; *Eutima mira*, McCrady, 1857; *Eutima commensalis*, Santhakumari, 1970; *Amphinema rugosum*, Mayer, 1900; *Aequorea tenueis*, Agassiz, 1862; *Aequorea conica*, Browne, 1905; *Aequorea pensilis*, Haeckel, 1879.

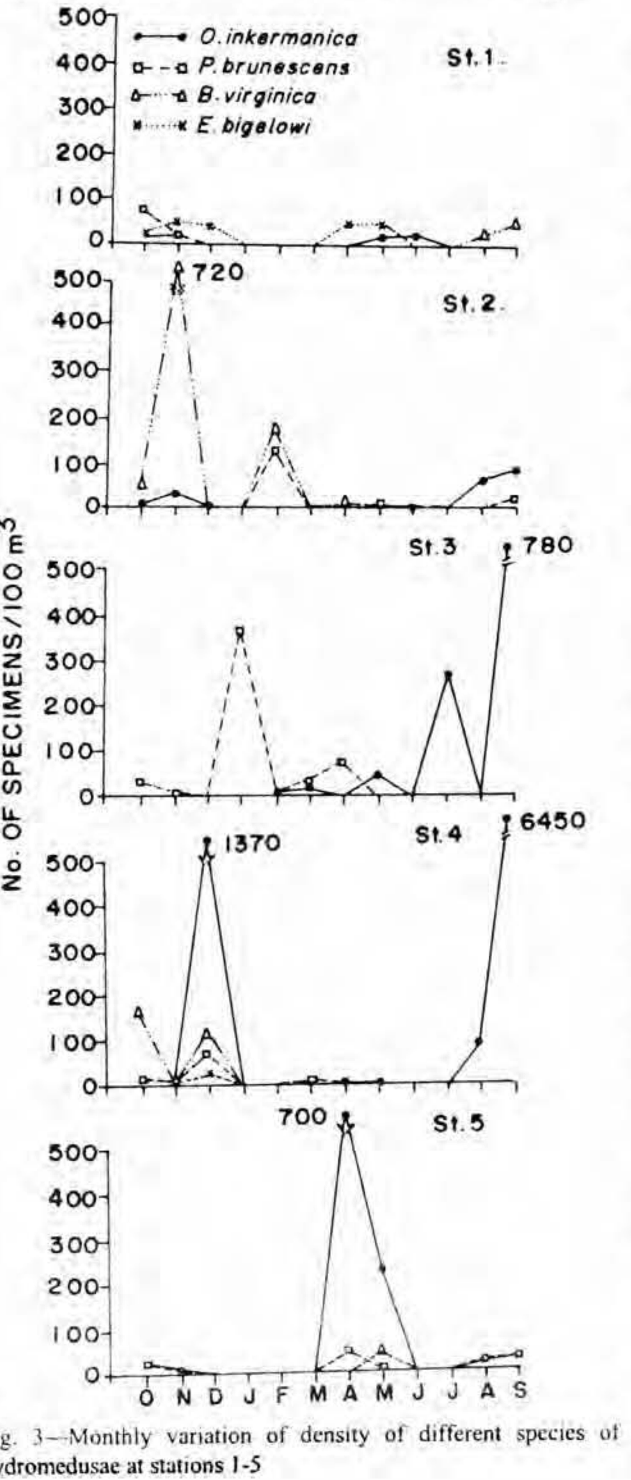

Fig. 3—Monthly variation of density of different species of hydromedusae at stations 1-5

Order Limnomedusae

Ostroumovia inkermanica, Paltsehikowa-Ostroumowa, 1925.

Order Trachymedusae

Aqlaura hemistoma, Peron & Leusuer, 1809; *Liriope tetraphylla*, Chamisso & Eysenhardt, 1921; *Gerionia proboscidalis*, Forskal, 1775.

Order Narcomedusae

Solmundella bitentaculata, Quoy & Gaimard, 1833.

Some of these species are residents of backwaters; others are from coastal and open ocean[14,15]. The high density of hydromedusae at the outer zone was the result of high numbers of holoplanktonic species like *Liriope tetraphylla*, *Solmundella bitentaculata* and *Aglaura hemistoma*. Occurrence of these species in high densities indicate the presence of high saline waters evident at sts. 1-3. Stations 1 and 2 are near to the open sea and thus has the characteristic species. At st. 3 also the influence of high saline water was noticed more during the high tide. *Aglaura hemistoma* was restricted to sts 1 and 2 and the maximum average density, 276, was found at st 1. Its occurrence at st. 2 was with small density and that too during hot saline premonsoon period only. The maximum density of *Solmundella bitentaculata* was 890/100m^3 at st. 1. *Liriope tetraphylla* was observed from sts 1-3 in less numbers. The outer zone especially st.1, is populated by 20 species, st. 2 by 18 species, st. 3 by 13 species, st. 4 by 9 species and st. 5 by only 4 species. Thus in general a downward trend in species richness was discernible towards the upper reaches of the estuary. The highest population density, 6660/100m^3 was observed at st.4 during September 1984 (Fig. 2, st. 4) when the salinity value and NO_3 values were medium.

The maximum density of *Ostroumovia inkermanica*, 6450/100m^3 was observed in September from st. 4 (Fig. 3) when the salinity was 16.4‰ This species was obtained from all stations atleast during certain periods of the year. When it occurred in swarms the population was dominated by juveniles. It was reported from Visakhapatnam, Bay of Bengal[16].

Phialidium brunescens was reported[4] earlier from Cochin backwaters (lat. 9°58′ N, long. 76°17′ E). Vannucci[17] recorded *Phialidium brunescens* at all station from the Gulf of Naples. In the present study this species was noticed at all stations but not throughout the year. The highest density encountered was 360/100m^3 at st. 3 in January (Fig. 3) during the postmonsoon period.

Euphysora bigelowi was the next most abundant species noticed at all stations, however, its occurrence was irregular. Its abundance was greatest at st. 1 during pre and postmonsoon periods. Earlier this species was reported from Bombay Harbour-Thana-Bassein estuarine complex[9].

Blackfordia virginica is a euryhaline species common in backwaters and swamps of west coast of India[6]. Its maximum representation was observed at st. 2 during November (Fig. 3).

Phialidium hemisphaericum, Hybocodon forbesi, Hybocodon unicus, Bougainvillia fulva, Eutima mira, Aequorea tenueis, Aequorea pensilis, Phialidium globossum, Phialidium simplex, Eucheilota menoni, Amphinema rugosum and *Obelia* spp. were obtained in small numbers from the outer zone. *Eutima commensalis*, a backwater species was found at all station except at st. 5. Earlier this species was known only from the Cochin backwater system [4,5,18] and it was considered this species endemic to Cochin area. Santhakumari[9] reported this species for the first time from Bombay waters.

Maximum density of hydromedusae and especially the swarm of *Ostroumovia inkermanica* was observed at st. 4 in October and a second peak was noticed in December, the postmonsoon period when the salinity of the ambient water was medium.

Discussion

A striking feature with regard to the hydromedusae species composition was a general lack of species richness towards the interior stations. Another noteworthy feature was the maintenance of high density of population at the interior stations except st. 5.

The density of an organism depends upon the availability of the suitable food material. Here in the present study other zooplankters viz. copepods, decapods, chaetognaths etc. were also more during the postmonsoon period[13] at stations other than st. 4[13]. At st.4 zooplankton was dominated by medusae and they might have fed zooplankton in plenty. At st. 5 number of species as well as the density of the population was very little and perhaps one or more or the combined action of the physical and chemical parameters which inhibits the growth and activity of these animals.

In general, the zooplankton fauna of the backwaters, including the hydromedusae, is greatly influenced by the salinity fluctuations. At the interior stations medusae were found in good numbers during the very low saline period (Fig. 2, St. 4). The hydromedusae population decreased during the very low saline period (Fig. 2). Here in Dharamtar estuary a very low saline period exists during the monsoon season at st. 5 and hence at this station the hydromedusae population occurred in good numbers only during the high saline premonsoon period (Fig. 3). But *Ostroumovia inkermanica* is usually found in brackish waters and is euryhaline. Species succession is observable in some of the stations (Fig. 3). During the monsoon months medusae were practically absent in Cochin backwaters, south west cost of India, where the fresh water condition prevails for longer duration and medusae were totally absent towards the head of the estuary when the salinity was too low[4,6]. All the findings so far indicate that some of the endemic species that are metagenical, i.e. that have a benthic stage of hydroid in their life cycle, probably ensure survival of population during an unfavourable low salinity period by developing an endurance stage; "capsules" or "cysts" are known for a few species[6,17]. Kinne[19] reported the effect of salinity changes on the sexual and asexual reproduction of the hydroid *Cordylophora caspia*. Santhakumari[20] also showed that low salinity was not suitable for the growth and reproduction of hydroid of *Eutima commensalis* which live inside the mantle cavity of wood boring molluscs[3].

The present study indicates that the water quality of the outer zone of Dharamtar estuary is comparable to other nearshore coastal marine environments except for the relatively higher values of salinity. Drastic differences in salinity between seasons with an increase in nutrient levels during the monsoon period was an interesting feature of the interior zone of Dharamtar estuary. The average population density of different groups also indicated that the interior part of the estuary is richer than the outer area during the high saline period (Fig. 2).

A more diversified faunal community of oceanic and neritic species of hydromedusae characterized the lower reaches of the estuary. The zooplankton species which occur during the high saline period tolerate wide salinity fluctuations; however, the estuarine species rarely occur in the inshore waters. Some of the high saline species like *Liriope tetraphylla, Aequorea conica* are opportunistic showing rapid population increase and utilizing their adaptability to the environmental variations. Species diversity in estuarine zooplankton is generally low[4]. There is usually a progressive gradient in zooplankton diversity from estuaries and lagoons to nearshore and coastal environments; oceanic regions maintain still higher diversity. However, the number of estuarine species of tropics is higher compared to that of higher latitude[21,22]. Naturally, higher species richness occurs near the mouth and lower reaches because of the presence of holoplanktonic forms. Rigours of the environment contribute to the low diversity of estuarine fauna. Among the several arguments advanced to explain low species diversities encountered in nature, the more cogent reasoning with respect to the tropical estuaries pertains to the lack of stability[23]. The inter-monsoon period allows some time for diversification, and even during this period, the environment is influenced by tidal flushings, turbulance and salinity gradient. The low saline and medium saline species show considerable overlap in their co-occurrences indicating co-existence (Fig. 3).

Acknowledgement

The authors are grateful to the Director, National Institute of Oceanography, Goa, Scientist-in-Charge, R.C., N.I.O., Bombay and Scientist-in-charge, R.C., N.I.O., Cochin for providing facilities.

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