

DIURNAL VARIATION OF ZOOPLANKTON OFF VERSOVA (BOMBAY)

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ABSTRACT

Physico-chemical parameters and diurnal variation of zooplankton were studied off Versova on 17/18 February 1981. Salinity and dissolved oxygen showed limited variation during the period of study. Nutrient values followed the tidal rhythm and high values were always associated with ebb tide. Zooplankton biomass varied from 1.20-12.13 ml/100 m³ (av. 4.71 ml/100 m³) with higher population during night than day collection. Relatively higher values of zooplankton biomass and population were associated with flood to ebb tide. Day/night variation observed in the incidence of some species of zooplankton are discussed in detail.

Key words: Diurnal variation, Zooplankton, Versova.

INTRODUCTION

Reports on the diurnal variation of zooplankton from the west coast of India are limited to the studies of Pillai & Pillai (1973), Madhupratap & Rao (1979), Goswami, Selvakumar & Goswami (1979) and Mathew, Gopinathan, Rao, Regunathan & Murthy (1977). A recent study on the diurnal variation of zooplankton at the mouth of a creek located along the coast of Bombay indicated that the variation in physico-chemical parameters coupled with the pollution load influenced the abundance and diversity of zooplankton. (Gajbhiye, Nair and Desai, 1984). In continuation of this study, a 24 hour investigation was carried out off the creek mouth at Versova to evaluate the extent of variability in the distribution of zooplankton and the results are presented in this communication.

MATERIALS AND METHODS

The station selected for the present study is located about 6 km off Versova creek (Fig. 1). The depth of the station varied from 13-16 m during the different tidal condition.

Zooplankton samples were collected on February 17/18, 1981 using a Heron Tranter net (0.25 m² mouth area, mesh size .3 mm) fitted with a flow meter. During day time samples were collected at hourly interval while once in two hours during night. Water samples were collected for estimating salinity, dissolved oxygen, BOD, reactive phosphorus, nitrate, nitrite and ammonia. The chemical estimations were done following standard methods. Biomass and number of zooplankton were calculated and reported in terms of ml/100 m³ and number/100 m³ respectively.

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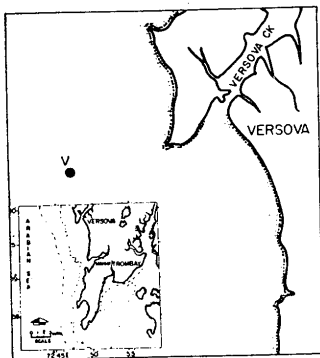


Fig. 1. Location of station.

RESULTS AND DISCUSSION

Physical parameters

The tide was semidiurnal. During observations the high tide was at 1100 and 2400 hrs. The observations were completed at 0700 hrs during low tide. Variation between surface and bottom temperatures were not much at the time of slack and after the slack the maximum difference of 0.75°C was attained (Table I).

Chemical parameters

The surface salinity of water was usually slightly higher than the bottom value. The water column appeared to be well mixed without any stratification. The salinity values were slightly lower during the second ebb tide. pH values did not show much variation. The dissolved oxygen values were almost uniform during the entire period of study and the difference between the two tidal conditions did not exceed more than 1.0 mg/l. The recorded flood tide BOD of surface layer (1.8 mg/l) was lower than the BOD value for the ebb tide (2.14 mg/l). The range of BOD at the bottom was from 0.47 to 6.52 mg/l.

The concentration of phosphate was directly associated with the prevailing tidal conditions. The maximum phosphate value was observed during ebb-tide and the minimum during the flood tide (at 1230 hrs). The nitrate values

Table 1. Variations in different physico-chemical parameters during 24 hours study off Versova.

S.N. Time	Air Temp (°C)		Wat. Temp		pH		DO (mg/l)		Salinity (‰)		RP (µg str/l)		NO ₂ (µg str/l)		NO ₃ (µg str/l)		
	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	
1 0730	24.0	23.30	23.80		7.96	8.09	6.7	7.2	36.05	35.91	7.97	0.89	0.22	0.08	6.04	6.18	
2 0830	27.0	24.05	24.75		8.02	8.09	6.9	8.1	36.14	35.80	0.44	0.72	0.0	0.4	3.75	4.29	
3 0930	25.0	24.75	25.5		8.02	8.12	7.6	6.8	35.71	35.22	2.16	0.50	0.0	0.54	2.29	1.44	
4 1030	27.0	25.25	24.75		8.08	8.11	7.1	7.0	35.73	35.73	0.33	0.66	0.1	0.24	2.61	3.51	
5 1130	25.75	25.0	24.75		8.07	8.11	7.4	6.8	35.64	35.38	0.00	0.83	0.0	0.6	2.4	1.69	
6 1230	25.75	25.25	24.75		8.11	8.11	6.7	7.1	35.56	35.67	0.22	1.0	0.0	0.28	2.61	2.85	
7 1330	26.30	25.0	25.0		8.07	8.11	7.1	7.0	35.94	35.53	0.33	0.55	0.0	0.16	2.50	3.07	
8 1430	25.75	25.0	25.25		8.08	8.11	7.3	7.7	35.47	35.69	0.5	0.77	0.0	0.2	3.96	4.28	
9 1530	25.75	25.2	25.0		8.07	8.10	7.1	7.1	35.80	35.65	0.44	1.49	0.04	0.5	7.03	6.17	
10 1630	26.0	25.0	25.0		8.07	8.10	6.8	—	36.07	35.73	0.72	1.22	0.64	0.64	5.20	6.03	
11 1730	26.0	24.75	24.75		8.08	8.10	6.7	6.9	36.00	35.69	2.16	0.66	0.1	0.58	5.95	6.30	
12 1830	EF	25.0	25.0		8.08	8.10	6.8	7.0	36.32	35.31	0.77	0.77	0.16	0.22	4.85	5.83	
13 1930	25.25	24.5	24.5		8.03	8.10	6.7	6.8	35.96	35.76	0.17	1.0	0.02	0.26	3.63	4.12	
14 2130	24.25	24.75	24.5		8.10	8.12	6.8	6.7	35.87	35.35	0.5	0.5	0.0	0.0	3.02	3.34	
15 2330	24.75	24.75	24.75		8.12	8.13	6.7	6.7	35.75	35.40	0.22	1.05	0.14	0.1	2.05	2.38	
16 0130	FF	24.75	24.5	24.75		8.12	8.13	6.7	6.7	35.85	35.73	0.77	2.71	0.3	0.36	2.2	4.96
17 0330	24.75	24.3	24.75		8.10	8.12	6.7	6.7	35.94	35.28	3.15	1.43	0.22	0.0	5.72	4.07	
18 0530	24.7	24.2	24.7		8.11	8.10	6.6	6.7	35.96	35.44	1.05	0.77	0.06	1.23	5.36	2.94	
19 0700	24.0	24.0	24.75		8.09	8.10	6.8	6.7	36.12	35.53	6.69	2.60	0.02	0.04	6.76	4.97	

were higher than nitrite. Relatively high concentration of nitrite and nitrate were recorded during ebb tide. On many occasions zero values of the nitrite were observed. The estimated values of ammonia in the area of study were negligible.

Zooplankton biomass

Zooplankton volume varied from 1.20 (at 1030 hrs) to 12.13 (at 1530 hrs) ml/100 m³. Eventhough peak values were obtained during day time, generally, zooplankton biomass was higher during night than day (Fig. 2). Relatively higher values were attained during flood to ebb tide.

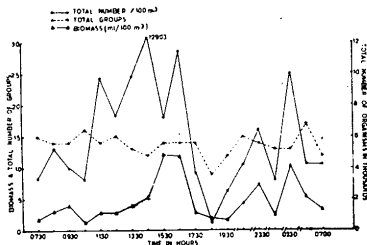


Fig. 2. Variation in biomass, population and total faunal groups of zooplankton

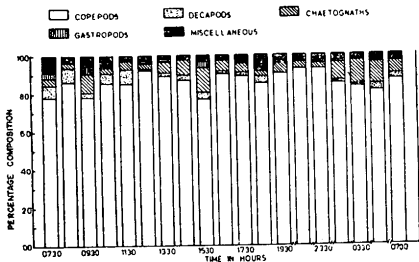


Fig. 3. Variation in percentage composition of zooplankton

Total population and composition (Figs 2 & 3)

The population density of zooplankton varied from 556-12903/100 m³, with minimum and maximum recorded at 1830 and 1430 hrs respectively. Lowest population was recorded during the ebb tide. The major peak in zooplankton was represented by 12 groups. They are: copepods (87.26%), chaetognaths (8.18%), decapods (2.82%), medusae (0.28%), siphonophores (0.19%), lamellibranchiates (0.19%), gastropods (0.38%), stomatopods (0.37%) and other groups (0.33%). The minimum population density was contributed by 9 groups. Of these, copepods represented 85.61% of total zooplankton count. The other groups were decapods (3.78%), chaetognaths (2.88%), medusae (0.93%), fish eggs (1.80%), salps (2.34%), siphonophores (0.9%), gastropods (0.9%) and ostracods (0.86%). The maximum group diversity (17) was found at 0530 hrs.

Table II. Incidence of different species of copepods during 24 hours study off Versova.

Species	Total Population (no/100 m ³)	Frequency occurrence
<i>Canthocalanus pauper</i>	5789	0730, 0930 to 1530, 1830 hrs
<i>Eucalanus crassus</i>	1445	0830, 2130 and 0130 hrs
<i>E. monachus</i>	655	0830 & 2130 hrs
<i>E. subcrassus</i>	13409	All time except at 1130, 0330 & 0700 hrs.
<i>E. crassirostris</i>	469	0700 hrs.
<i>Paracalanus crassirostris</i>	18902	All time except 1530 & 1930 hrs.
<i>P. aculeatus</i>	1669	1830, 2130, 0130 to 0700 hrs.
<i>P. parvus</i>	7340	1730, 1930, 2330, 0330 & 0700 hrs.
<i>Aerocalanus similis</i>	19630	All time except 1830, 0330 & 0700 hrs.
<i>A. gracilis</i>	375	0730, 0830, 1030, 1230, 1430 & 1830 hrs.
<i>A. monachus</i>	384	0730 & 0930 hrs.
<i>Euchaeta concinna</i>	14443	All time except 0730, 0700 hrs.
<i>E. marina</i>	136	1230 hrs.
<i>E. wolfendeni</i>	5541	1430, 1630, 1830, 2130, 0130 & 0530 hrs.
<i>Euchaeta</i> sp.	7117	0930, 1130, 1330, 1530, 1930, 2330, & 0700 hrs.
<i>Acartia spinicauda</i>	84	1030 hrs.
<i>A. centrura</i>	2	0530 hrs.
<i>Acartia</i> sp.	229	0830 hrs.
<i>Tortanus barbatus</i>	223	1530 hrs.
<i>Oithona plumifera</i>	39	2130 hrs.
<i>Oithona</i> sp.	181	1200 & 1430 hrs.

Copepoda: Copepods formed the dominant group in all the samples and varied from 77.56–93.09% of the total zooplankton. The maximum number of copepods (11259/100 m³) was recorded at 1230 hrs, whereas the minimum (476/100 m³) was obtained at 1830 hrs. A total of 21 species of copepods were recorded from this area (Table II). The maximum (9) and minimum (4) species diversity was recorded at 2130 and 0330 hrs respectively.

Among the twenty one species recorded, eight species viz., *Paracalanus crassirostris*, *Acrocalanus similis*, *Euchaeta concinna*, *Eucalanus crassus*, *E. monachus*, *E. subcrassus*, *Euchaeta* sp. and *E. wolfendeni* were observed during day and night collections, five species, viz., *Acartia centrura*, *Oithona plumifera*, *Paracalanus aculeatus*, *Eucalanus crassirostris* and *Paracalanus parvus* during night while the remaining eight, *Acartia spinicauda*, *Acrocalanus gracilis*, *Tortanus barbatus*, *Euchaeta marina*, *Oithona* sp., *Acartia* sp., *Acrocalanus monachus* and *Canthocalanus pauper* were observed only during day time. *Paracalanus aculeatus*, *Canthocalanus pauper*, *Euchaeta concinna*, *Euchaeta* sp. and *Eucalanus subcrassus* were found more during high tide.

Chaetognaths: Chaetognaths constituted 2.30–12.92% of the total zooplankton and the population density varied from 16 (1830 hrs) to 1280/100 m³ (0330 hrs). The chaetognath species represented in the collections were *Sagitta enflata*, *S. hedoti* and *S. pulchra*. The maximum population density was contributed by *S. hedoti* (90%), *S. enflata* (5%) and *S. pulchra* (5%), whereas the lowest population density was represented exclusively by *S. hedoti*. Incidence of *S. pulchra* was more during night time. *S. enflata* was caught in higher numbers during flood tide.

Hydromedusae: The total population of medusae varied from 5/100 m³ at 1830 hrs to 119/100 m³ during 1630 & 0130 hrs. and the percentage composition varied from 0.1 to 1.6. The total population attained minimum values during ebb tide. Thirteen species of medusae were encountered of which *Solmundella bitenaculata*, *Streentrupia bigelowi* and *Euphysora* sp. were the most dominant species. *Sarsia* sp., *Liriope tetraphylla*, *Aglantha* sp. and *Aglaura hemistoma* were the other common forms.

Siphonophora: The group was represented in all the samples with higher incidence during flood tide. The percentage varied from 0.08 to 1.74 of the total zooplankton. The highest population density (92/100 m³) and lowest population density 2/100 m³ were recorded at 0830 and 1930 hrs. respectively.

Decapoda: Their contribution to total population varied from 0.28 to 7.28%. The decapod larvae represented in the samples belonged to groups Alpheidae, Porcellanidae, Palaemonidae, Sergestidae and Penaeidae.

Lucifers were represented by the single species *Lucifer hanseni*. The frequency of occurrence was 26.32% and the percentage composition varied from 0.02 to 0.08. The highest population density of lucifers (3/100 m³) was re-

corded between 0830-0930 hrs. The genus *Acetes* was represented mainly by *Acetes indicus*. The frequency of occurrence was 52.62% with the percentage composition varying from 0.03 to 0.47.

Mysids: The frequency of occurrence of mysids was 26.32% and the populations varied from 2 to 4/100 m³. Mysids were dominated by *Mesopodopsis zeylanica*.

Stomatopod larvae: The stomatopods were represented by alima larvae of squilla and were recorded in large numbers during day collections with a percentage prevalence of 57.89. The highest population density (93/100 m³) was recorded at 1130 hrs.

Ostracods: The ostracods were represented by the single species *Cypridna dentata* and higher density was recorded during night collection (maximum of 34/100 m³ at 2330 hrs). The frequency of occurrence was 89.47% with the percentage composition varying from 0.05 to 0.52.

Molluscs: The maximum density of gastropods (243/100 m³) was noticed at 1530 hrs. The lamellibranchiates were also common in the area and the frequency of occurrence was 84.21%. Their contribution to the total zooplankton varied from 0.05 to 5.40%.

Fish eggs and larvae: Fish eggs and larvae were abundant in the collection and their frequency of incidence were 100% and 89.47% respectively. The percentage composition varied from 0.02 to 1.80 and 0.02 to 0.74 respectively for eggs and larvae. The highest population density of eggs (47/100 m³) and larvae (29/100 m³) were recorded at 1630 and 0920 hrs respectively.

Groups like amphipods, polychaetes, appendicularia, salps, isopods and cladocerans were occasionally recorded in the collection with very low percentage composition. The frequency of occurrence of isopods, amphipods and polychaetes were respectively 10.53, 42.11 and 78.95%.

DISCUSSION

The creek receives about 200 mld of effluent and this affects the water quality of the creek area (Gajbhiye, Nair & Desai, 1984). However, the pollution load towards the offshore area is being considerably reduced due to effective mixing. The environmental parameters like salinity, dissolved oxygen, BOD and nutrients directly influence the abundance and diversity of zooplankton.

The various environmental parameters did not show much variation during the period of study. High values of DO and low levels of BOD indicate the prevailing healthy environmental conditions. Relatively higher concentration of DO found during day (av. 7.02 mg/l) than night (av. 6.71 mg/l) was probably because of the lack of photosynthetic activity during night.

The mean zooplankton biomass recorded off Versova was comparatively higher than that recorded for the Versova Creek (av. 3.4 ml/100 m³). Biomass

values were relatively higher during flood to ebb period especially during the night time. Siphonophores, hydromedusae, ostracods, stomatopods and lucifers were recorded in higher numbers during the flood period.

Day/night variability in the incidence of some species was observed. Among the twenty one species of copepods recorded from the area eight species were found exclusively during day while five were limited to the night. Relatively high abundance of *Cypidina centata* and *S. pulchra* were observed during night.

Compared to the study made at Versova creek (Gajbhiye, Nair and Desai, 1984) the present investigation indicated differences in the incidence of some groups/species of zooplankton. Population of chaetognaths was more in the present area of study (6.29%) than the Versova creek (1.09%). Ostracods and stomatopods were restricted to the offshore area. The record of siphonophores was ten times more in the offshore than the creek mouth. Oceanic species of copepods viz., *Canthocalanus pauper*, *Eucalanus crassus*, *Paracalanus crassirostris*, *Euchaeta concinna*, *Euchaeta* sp., *Oithona plumifera* and *Oithona* sp., and medusae — *Strenstrupia bigelowi*, *Liriope tetraphylla* and *Euphysora* dominated the offshore area. In general, the relatively higher species diversity and limited variation in the zooplankton biomass over the 24 hrs. study off Versova indicate a congenial environment for population maintenance.

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