

Biological Characteristics as Part of
Pollution monitoring Studies

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Ecosystem modifications can be considered as an integral part of any pollution monitoring studies and in such cases community structure/diversity is of prime importance. Considering this advantage of aquatic life, pelagic and benthic communities have been considered to evaluate the intensity of pollution in the nearshore waters of Bombay. Polluted and unpolluted areas were selected for the study. The polluted regions were characterised by wide fluctuations in the standing stock of zooplankton (0.04-54.53 ml/100m³) while the clean area showed comparable rates of production with limited variation (5.14 - 25.38ml/100m³). The clean areas showed higher incidence of siphonophores, lamellibranchiates, appendicularians and fish larvae. Aggregations of medusae, ctenophores, mysids and polychaetes were characteristics of polluted areas. Concentration of Cu and Cd in zooplankton was more at Versova and Mahim than at Thana. Co and Ni concentration in zooplankton were invariably high at Thana creek. Based on the results importance of biological characteristics to identify or classify the nature of pollution has been discussed.

The coastal marine environment close to highly industrialised cities of India is getting polluted due to the disposal of large quantities of waste. This has created an awareness among people to adopt effective measures to control the discharge of waste by proper environmental monitoring measures. In all such evaluations biological monitoring forms an integral part, taking into consideration ecosystem modifications or more precisely change in community, structure or diversity as of prime importance^{1,2}. If systematically studied this provides information on the prevailing environmental conditions over long periods of time which unlike the physico-chemical

parameters are relatively less susceptible to temporary variations in environmental conditions. Considering this advantage of marine organisms detailed surveys were carried out in the nearshore waters of Bombay and the results obtained on zooplankton are presented here as a case study.

Material and Methods

The results presented are based on the studies carried out during 1979-80 and 1983-84. Two types of locations were considered for the evaluation of effect of pollution on zooplankton. Thana creek (Station T₁), Mahim creek (Station M₁) and Versova Creek (Station V₁) are polluted areas of which the first one is mainly polluted by industrial effluents while the other two receive large quantities of sewage. Corresponding to the creek areas three stations were selected at 12-16 m off Thana in the harbour area (Station T₂), off Mahim (Station M₂) and off Versova (Station V₂) which are relatively unpolluted (Fig.1).

Zooplankton samples were collected by oblique hauls using a HT net (mouth area 0.25 m²; mesh size 0.3 mm). The samples were preserved in 5% formalin and later used for biomass and population estimations.

Results and Discussions

Bombay (Lat.18°55'; Long.72°49') having a population of 8.2 million is the largest metropolitan city on the west coast of India. About 20,000 industrial units forming about 30% of the total industries are located within the city and nearby areas. The quantity of sewage and industrial waste generated by the city is about 1500 mld³, while the present treatment capacity available with the treatment plants is only about 350 mld.

The physico-chemical factors observed at the above stations indicated certain characteristic features. The creek stations were unique with low

levels of DO values at V and M often reaching zero level in April-May period. Stations V₁, M₁ and T₁ showed better water quality with relatively high DO content, high salinity and low nutrient values. Due to effective dilution, mixing and circulation processes the intensity of pollution decreased to near normal conditions at the stations towards offshore waters.

In the nearshore waters of Bombay like any other coastal area copepods dominated the zooplankton community except during the period of unusual abundance of polychaetes and mysids⁴. The other common species were decapods, chaetognaths, medusae, polychaetes, gastropods, lamellibranchiates, mysids, fish eggs & larvae, ctenophores and amphipods. Appendicularians, stomatopod larvae, ostracods, siphonophores, isopods and cladocera^a were occasional inhabitants.

In the present study, Versova and Mahim stations behaved identically (Figs. 2-4). The creek stations showed low standing stock/population with higher biomass during flood period while the relatively unpolluted stations were characterised by higher values of zooplankton for the ebb period with increase in faunal/species diversity. The Thana region behaved in a different way with high biomass, very often contributed by gelatinous organisms, which are of little use to the ecosystem. The Thana creek is connected to the Ulhas river-bassein creek system and hence the influx of water through these may enhance the standing stock of zooplankton. However, the limited variation observed at St.T coupled with relatively higher diversity substantiate the decrease in pollution load². A few reports on zooplankton from the nearshore waters of Bombay indicate that the unpolluted regions were characterised by an almost steady population and the fluctuations were within a relatively narrow limit except during the peak seasons^{6,7}. The clean areas showed higher incidence of groups like

siphonophores, lamellibranchiates, stomatopods, appendicularians, fish eggs and larvae. Aggregations of medusae, ctenophores, mysids and polychaetes in the creek areas are indicative of pollution. The disappearance of sensitive species of chaetognaths like S. enflata and the consequent decrease in diversity can be taken as the first indicatin of impending deterioration of the creek areas around Bombay .

Relatively high concentrations of Cu and Mn were obtained from zooplankton from the nearshore area (Table 1). Co and Ni concentrations were invariably high at St. T₁, which receives considerable amount of industrial effluent. Variation in Cd concentration in different groups of zooplankton did not show much variatin. Concentration of metals in different groups of zooplankton indicated that Cu, Mn and Ni were higher in copepods and in gelatinous groups while they were relatively low in mysids and in decapods.

A polluted environment can be differentiated from an unpolluted area by selecting features which show reliable variability. In the nearshore waters variations in zooplankton standing stock/population in relation to the tide or benthic variability in terms of biomass/population serve as an index to pollution induced changes. Eventhough species diversity is a very important criteria to check the health of an ecosystem, faunal diversity can also give the requisite information. High organic content in sediment associated with low benthic biomass can indicate the environmental deterioration. The ratio of dominant species/groups and their relative accumulation of pollutants can very well be considered to classify the type of pollution prevailing in a marine ecosystem.

Acknowledgement

The authors are thankful to the Director, Natinal Institute of Ocea-

nography, Goa and the Scientist-in-Charge, Regional Centre of NIO, Bombay for the facilities provided. They also thank Dr. S.N. Gajbhiye and Dr.P.K. Varshney for providing some valuable data.

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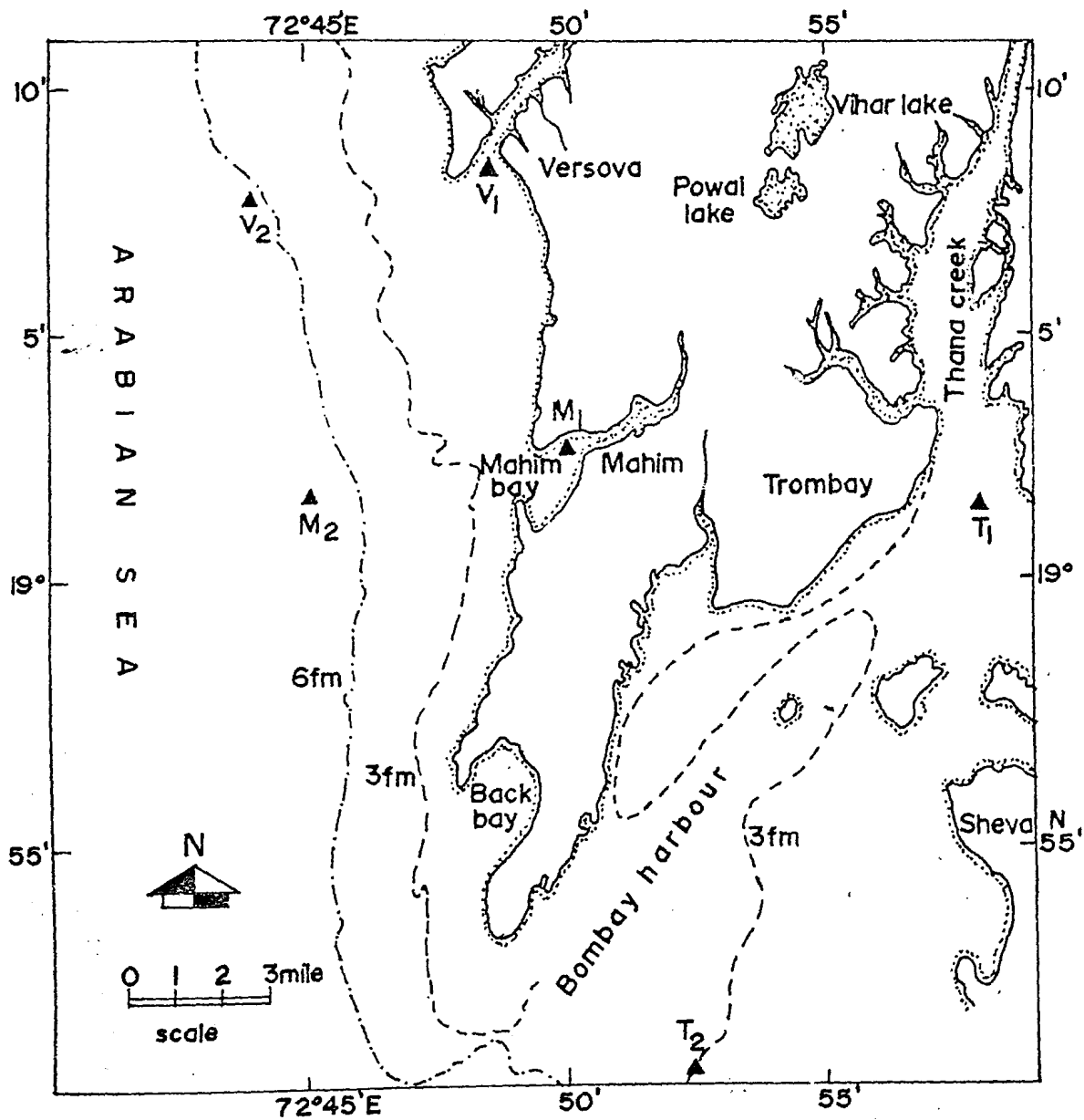


Fig. 1. Location of stations

Table - 1. Concentration of metals in zooplankton
from the nearshore waters of Bombay
(Values are averages in ppm dry weight)

Group	Cu	Co	Mn	Ni	Cd
			T 1		
Copepods	17.19	17.82	39.07	75.00	8.79
Chaetognaths and medusae	16.25	15.63	50.00	90.91	10.28
			V 1		
Copepods	60.00	12.50	98.13	45.45	11.14
Mysids	53.75	7.08	39.17	28.79	9.57
Decapods	57.5	7.5	28.44	42.05	11.57
			V 2		
Copepods	64.37	10.0	102.19	43.82	11.35
Mysids	33.75	6.25	15.63	38.64	9.42
Decapods	50.0	10.0	89.38	45.45	10.28
			M 2		
Copepods	174.38	10.94	100.94	54.55	12.21
Chaetognaths	53.75	10.0	125.50	47.73	10.28

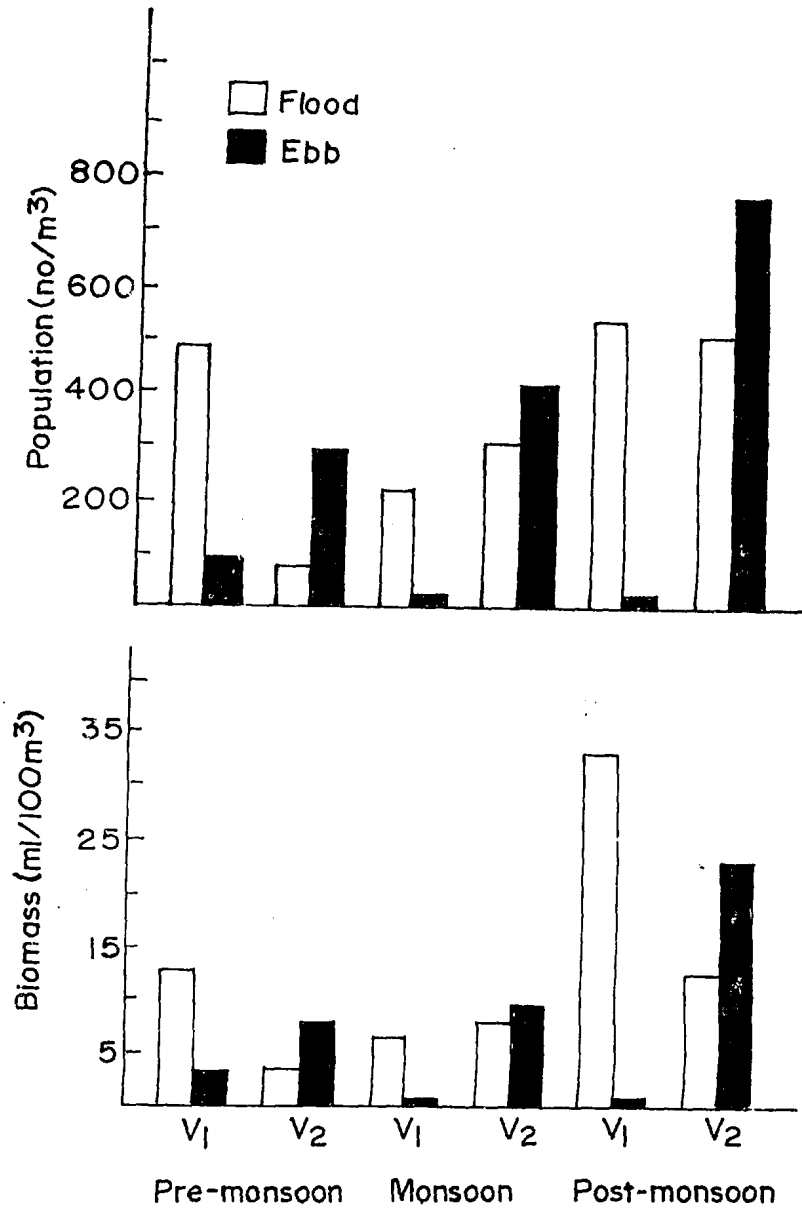


Fig.2. Zooplankton biomass and population for the three seasons at Versova Creek (V₁) and off the Creek (V₂).

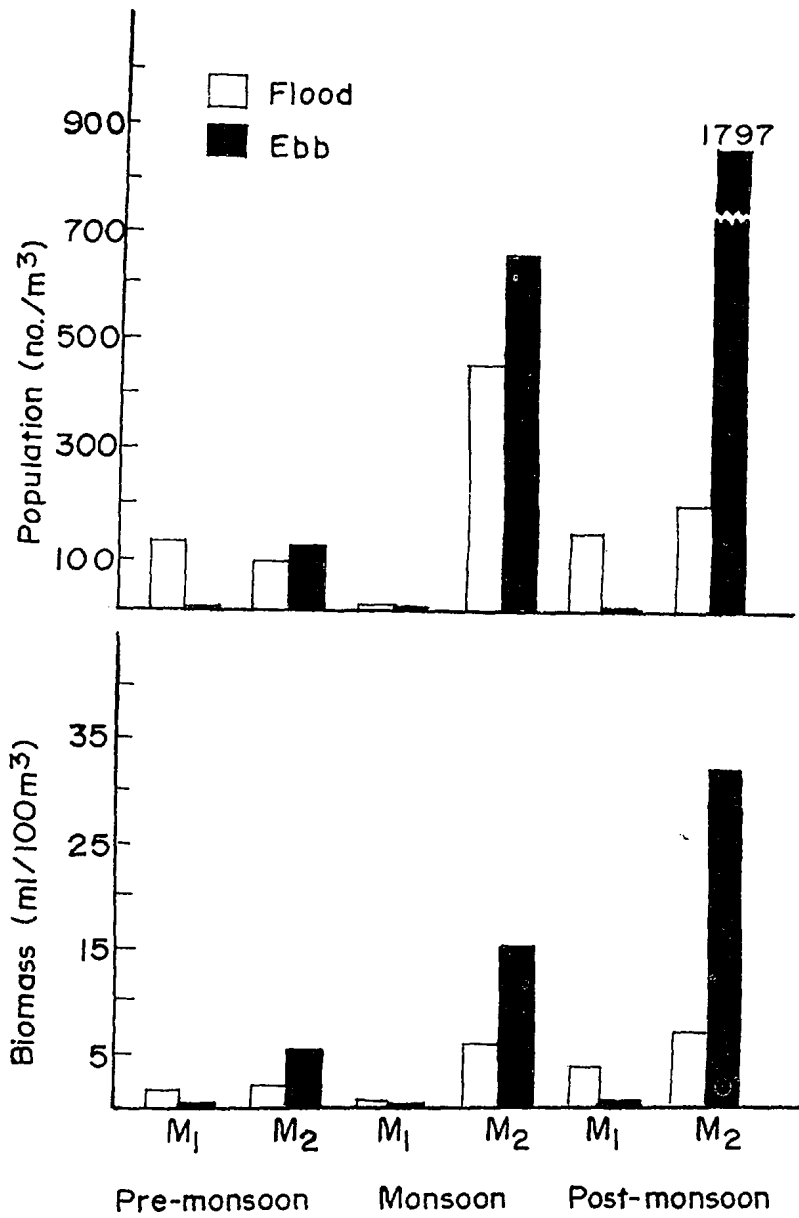


Fig.3. Zooplankton biomass and population for the three seasons at Mahim creek (M) and off the creek (M).
 1 2

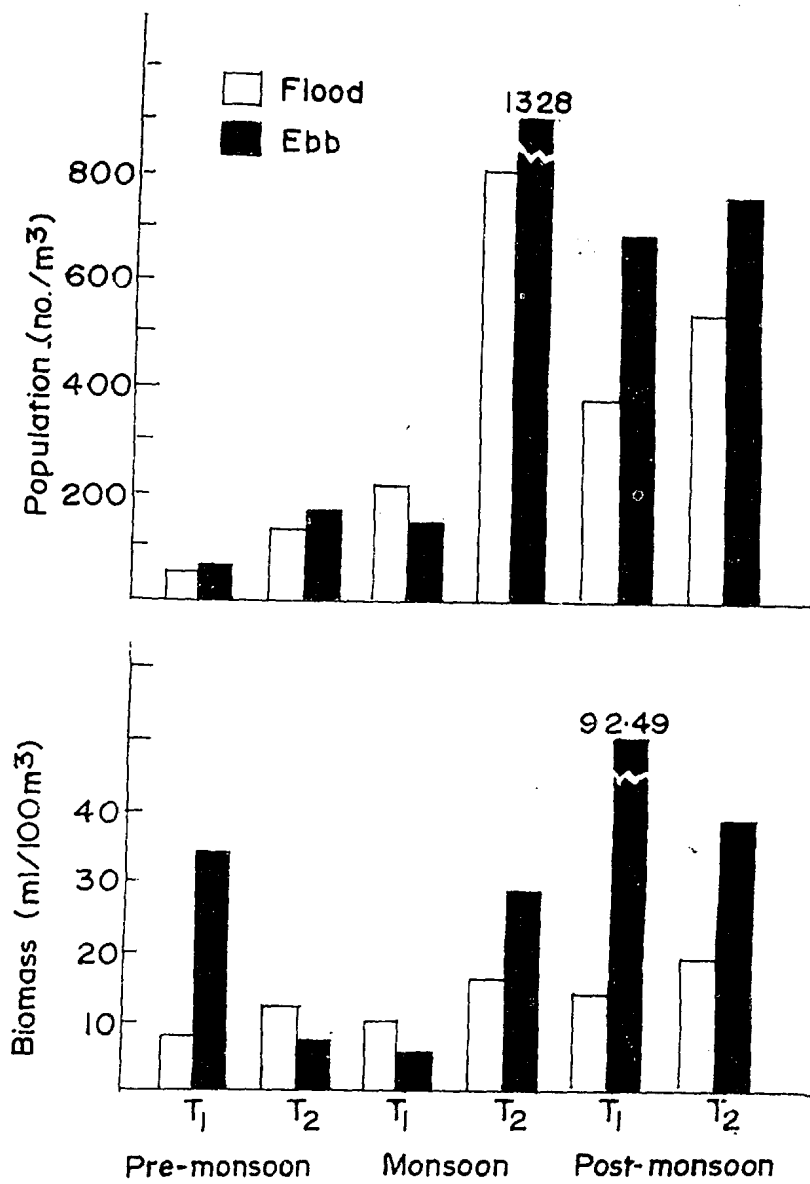


Fig.4. Zooplankton biomass and populatin for the three seasons at Thana creek (T₁) and off the creek (T₂).