

## Zooplankton Studies in Visakhapatnam Harbour & Nearshore Waters, East Coast of India

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Distribution of zooplankton biomass in the waters studied showed remarkable variations. The faunal composition was very diverse and the number of species present was more especially during late pre and postmonsoon seasons with conspicuous decrease during the peak of southwest monsoon season. Copepoda, Decapoda, Chaetognatha and fish eggs and larvae constituted the bulk in the collections. Copepods were the dominant component in all the samples except during postmonsoon when chaetognaths were dominant.

Plankton off Visakhapatnam coast<sup>1</sup> and off lawson's Bay (Waltair)<sup>2</sup> and the relation of planktonic abundance to hydrographic conditions of the Waltair coast<sup>3</sup> were reported. In the present investigation quantitative distribution of zooplankton in Visakhapatnam harbour and nearshore waters was studied to know the relationship between the zooplankton abundance and temperature and salinity.

Station locations are shown in Fig. 1 Plankton samples were collected monthly from the polluted (sts 1 and 2) and unpolluted (sts 3 and 4) waters during June 1980 to May 1981 representing monsoon (June-September), postmonsoon (October-January) and premonsoon (February-May) seasons. Horizontal hauls were made using H T net (mouth area 0.25 m<sup>2</sup>, mesh size 0.3 mm) with a modified calibrated flow meter attached. The biomass was determined by displacement method. The density was calculated in terms of numbers (100 m<sup>3</sup>)<sup>-1</sup> of water filtered. Temperature and salinity were measured using T-S Bridge.

Surface water temperature varied at sts 3 and 4 (nearshore water) from 24.5° to 30.5°C (Fig. 2A). The lowest temperature was observed in January coinciding with winter and highest during October. Surface temperature in the harbour region fluctuated between 28° and 31.5°C. The surface salinity varied from 24 to 35.8 × 10<sup>-3</sup> in the nearshore water and 18.5 to 34.5 × 10<sup>-3</sup> inside the harbour (Fig. 2B) Lowest salinity was observed during October while in May highest salinity was recorded at all stations.

**Zooplankton biomass**—In general, biomass values were high during premonsoon season when

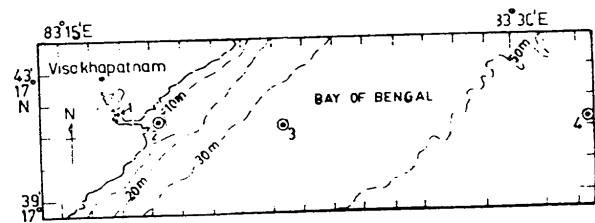


Fig. 1—Station locations

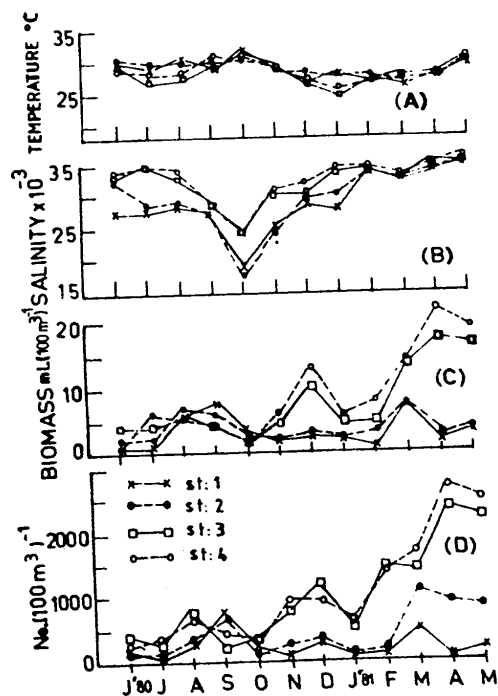


Fig. 2—Variations in (A) temperature (B) salinity (C) biomass and (D) total counts

salinity values were also high (Fig. 2C). Mean biomass values ( $\text{ml. (100 m}^3\text{)}^{-1}$ ) for the entire period at sts 1 and 2 were 3.21 and 3.98 while at sts 3 and 4 were 8.86 and 9.13 respectively. The biomass values in the nearshore water showed 2 peaks, one in November-January and other in March-April. Considerable decrease in biomass was observed during July-August.

**Faunal composition**—Copepoda showed highest numerical abundance and contributed to the bulk of the biomass. For the entire period the average population density values [ $\text{no. (100 m}^3\text{)}^{-1}$ ] of this group in the nearshore and harbour waters were  $47907 \pm 3381$  and  $11680 \pm 1153$  respectively. The average percentage abundance of this group in nearshore and harbour water was 57.94 and 53.35 respectively. However, the minimum copepod population values of 1046 and 168 occur at sts 4 and 1 during July. Major peaks in the distribution of copepods were observed in March-May and November-December.

The average population density of decapod larvae for sts 3 and 4 was  $3388 \pm 266$  for sts 1 and 2 was  $1493 \pm 173$ . Average abundance being 6.94 and 5.59% in nearshore and harbour waters respectively with a maximum abundance (19.04%) in February at st 3. While chaetognaths density was  $25446 \pm 2262$  in nearshore water and  $4145 \pm 361$  in harbour waters the density of fish eggs and larvae was  $2509 \pm 287$  and  $1307 \pm 128$  in nearshore and harbour waters respectively. However, the lowest values of 53 and 43 were also noticed in case of chaetognaths and fish eggs and larvae respectively in the nearshore waters during period of observation. Apart from these, other groups such as Hydromedusae, Siphonophora, Pteropoda, Salpa, Gastropod larvae, Doliolids, Bivalve larvae, Ctenophora and polychaete larvae were sporadically represented in the plankton samples and contributed only a small percentage of total counts.

The zooplankton distribution (Fig. 2D) indicates that the nearshore (sts 3 and 4) water is more productive compared to harbour water (sts 1 and 2). Total population density of zooplankton was relatively higher in the nearshore water than in the inner harbour, as reported earlier<sup>4-6</sup>. In all the 4 stations copepods dominated the total plankton population as recorded earlier from the nearshore waters off Visakhapatnam<sup>1-3</sup>. The primary peak of copepods observed during premonsoon season may be attributed to the large scale upwelling as earlier reported<sup>7</sup>. The second peak is coinciding with the period when there is large scale mixing of low saline surface water and the

nutrient rich bottom water during the period of increased turbulence<sup>8</sup>.

Abundance of decapods in general was greater in the inshore waters and agree with the earlier findings<sup>9</sup>. Chaetognaths abound the marine environment around Visakhapatnam in appreciable numbers and are dominant at sts 3 and 4 during postmonsoon season. Chaetognaths are typically oceanic forms but have the capacity to withstand low salinities also<sup>10</sup>.

The observed peak in the number of fish eggs and larvae during August is coinciding with the breeding period as observed in the Cape Comorin area along the Tamilnadu coast<sup>11</sup>.

The present results indicate a rise in biomass value as one proceeds from the inner harbour water to inshore water corresponding to an increase in salinity gradient. In August, the marked variations in salinity are not reflected in biomass whereas in April, marginal variations are seen in salinity while biomass varied widely. An attempt has been made to establish the relationship between salinity and biomass through statistical treatment of the data. The lack of correlation ( $r=0.0152$ ) between biomass and salinity in the harbour waters may be due to the impact of the pollutants discharged into Visakhapatnam harbour<sup>12,13</sup>. Sarma *et al.*<sup>14</sup> have reported very high concentrations of nitrate and phosphate in the Visakhapatnam harbour during the same period of observations (January to December 1980) due to the discharge of industrial effluents through northwestern arm and domestic sewage through south lighter canal. These high concentrations of nutrients may be having an adverse effect on zooplankton. Desai and Gajbhiye<sup>15</sup> have found a marked decrease of zooplankton populations near the outfall in the polluted environment of Thana creek (Bombay) due to pronounced effect of discharge of effluents and domestic sewage. A good correlation ( $r=0.5149$ , 99% significant) observed with the present data in the nearshore waters confirms the close relation between seasonal variations in salinity and the abundance and distribution of zooplankton. However, noticeable relationship was not found between temperature and biomass.

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