

DIURNAL VARIATION IN ZOOPLANKTON IN THE ZUARI ESTUARY, WEST COAST OF INDIA

ABSTRACT

Variations in zooplankton biomass and population density in relation to the prevailing hydrographical conditions were studied in Zuari estuary, Goa. The physico-chemical parameters showed limited variations. Zooplankton biomass was relatively more in samples collected during night while it was higher in day collections. Copepods formed the predominant group (30.7 - 69.6%) followed by decapods, brachyuran zoeae, cirripede larvae and chaetognaths. *Lucifer hansenii* formed an appreciable part of the total decapod population. Ten calanoid copepod species such as *Metacalanus aurivilli*, *Pseudodiaptomus bowmani*, *Calanopia minor*, *Acartia bowmani*, *Monstrilla* sp. obtained in day collections and *Pseudodiaptomus sewelli*, *P. Jonesi*, *Calanopia elliptica*, *C. herdmanni* and *Acartia pacifica* in the night collections are the first record from the Zuari estuary. Variations in the incidence of the common zooplankton groups and their species over the diel and tidal cycles are discussed.

DIEL and tidal variations have considerable impact on various environmental and biological properties of an estuary. It is essential to obtain information on these aspects and their influence on the physico-chemical and biological characteristics of the estuary. Studies on the diurnal variation of zooplankton from the west coast of India are limited (Pillai and Pillai, 1973; Madhupratap, 1979; Goswami *et al.*, 1979; Gajbhiye *et al.*, 1984). Preliminary investigations were made on diurnal variations of some physico-chemical factors in Mandovi-Zuari estuarine system (Singbal, 1973 and 1976). The present communication gives further information on diurnal variation of zooplankton and selected physico-chemical parameters of Zuari estuary, west coast of India.

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Observations were made over a complete diel cycle (26-27th January, 1990) at a fixed station located in the lower reaches of the Zuari estuary (Fig. 1). Sampling was done at every 3 hr. interval commencing from 1115 hr. on 26 January and terminating on 27 January at the same time. Temperature and pH were recorded using standard centigrade thermometer and pH meter (Philips Model No. 9046) respectively. Chemical analysis of dissolved

oxygen and salinity were made adopting the methods given by Grasshoff (1976).

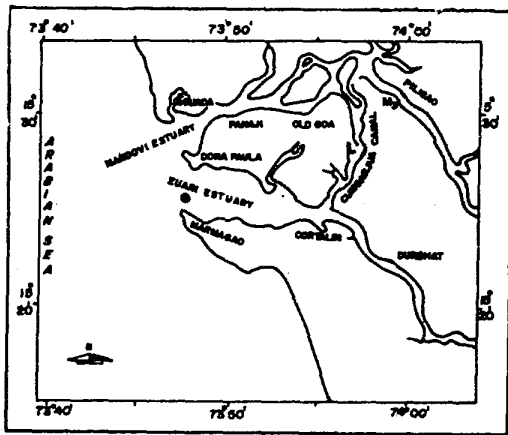


Fig. 1. Location of station

Zooplankton samples were collected by oblique hauls using a Heron - Tranter net (mouth area 0.25 m^2 and mesh size 0.3 mm) fitted with a calibrated TSK flow meter. Biomass was estimated as displacement volume. Occurrence of common zooplankton groups and their genera/species were studied from aliquots of 5 to 10%. Their number was raised to the total and given as per m^3 using flow meter reading. Species diversity indices were computed using the formula given by Shannon and Weaver (1949).

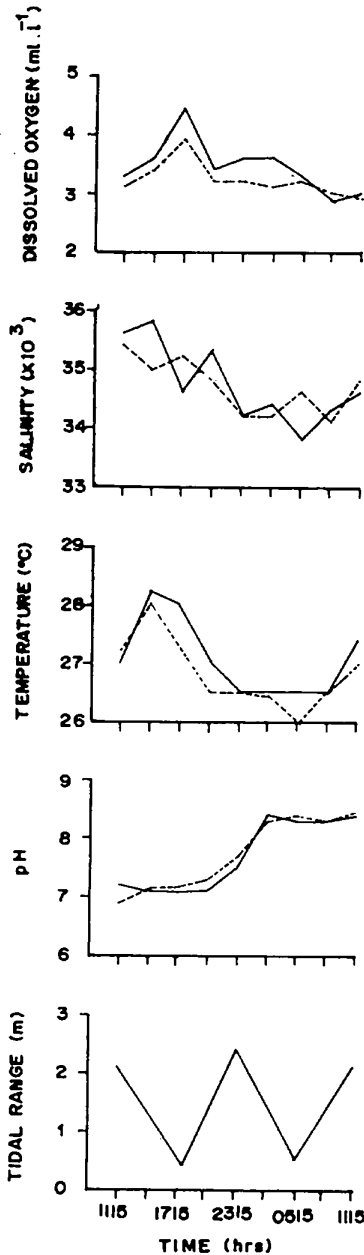


Fig. 2. Variation in physico-chemical parameters at Zuari estuary.

Physico-chemical parameters

A variation of 1.9 m (Fig. 2) was observed between the water levels of lowest low water (0515 hrs.) and highest high water (1115 hr.). The salinity conditions over diel cycle revealed differences ranging from 33.8 to 35.8×10^3 for surface and 34.1 to 35.4×10^3 for bottom waters. Fluctuation in water temperature was not much and maximum difference was 1.7°C for the bottom. Variations in pH were between 6.9 and 8.4. Dissolved oxygen, during the tidal cycle, varied from 2.9 to 4.4 ml.l^{-1} at the surface and from 2.9 to 3.9 ml.l^{-1} near the bottom.

Zooplankton biomass and density

The zooplankton biomass at the station varied from 0.1 to 0.3 ml.m^{-3} (Fig. 3). Maximum

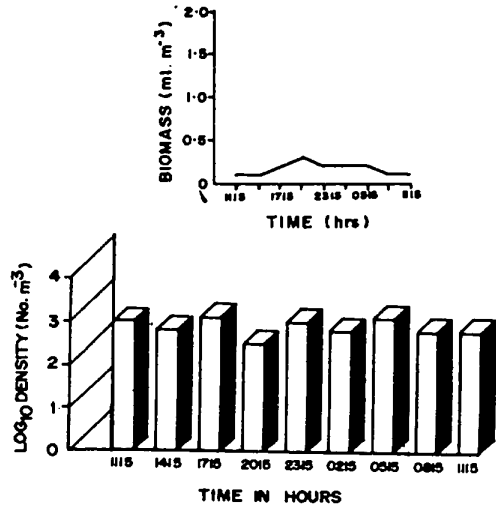


Fig. 3. Variation in total zooplankton biomass and density at Zuari estuary.

density (1315 m^{-3}) was recorded at 0515 hr. and minimum (676 m^{-3}) at 0815 hr. The population density was relatively more during the day (av. 907 m^{-3}) compared to the night (Av. 881 m^{-3}).

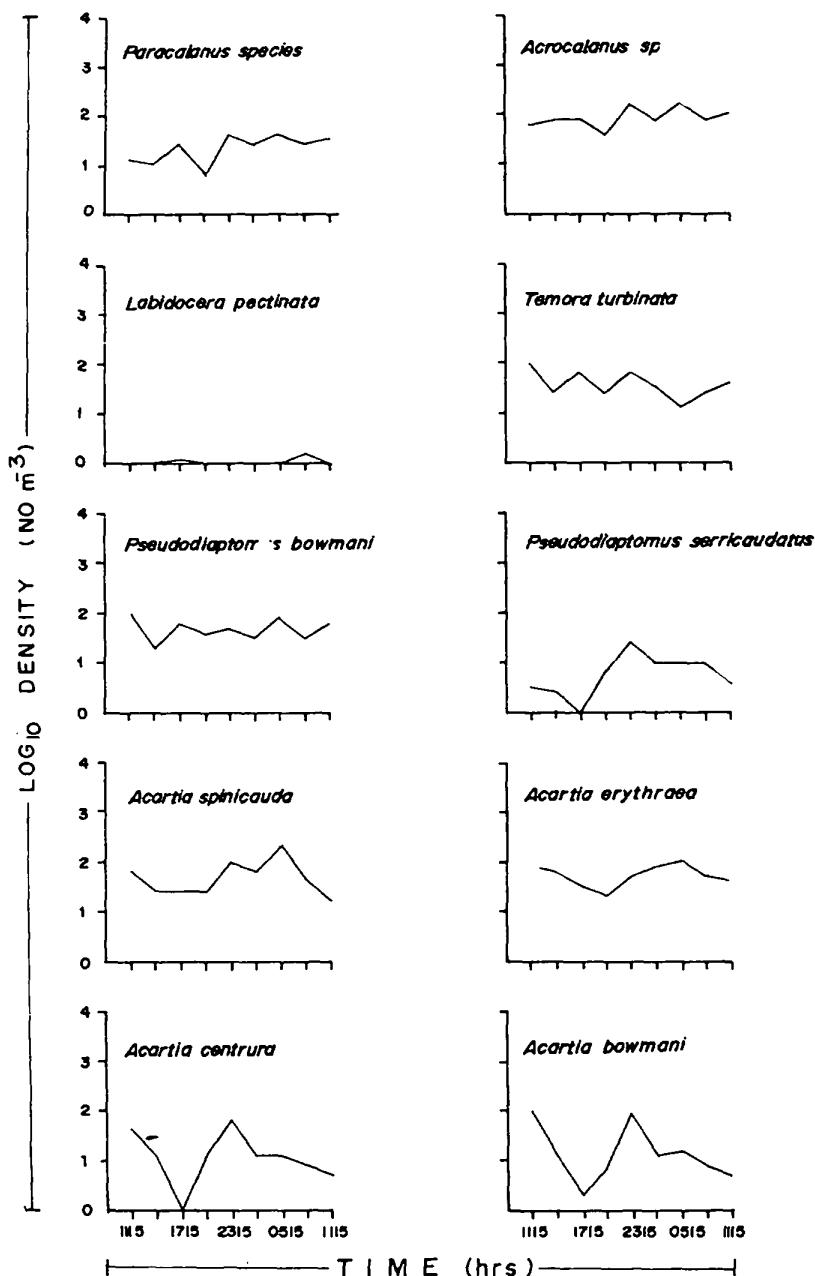


FIG. 4. Variation in abundance of common copepod species at Zuari estuary.

Faunistic composition

Twenty-two zooplankton groups were recorded in the samples. The percentage occurrence of each taxon during day and night in the study area are given in Table 1. Copepoda, Cladocera, Decapoda, Sergestidae, Gastropod larvae, Cirripede larvae, Appendicularia and fish eggs were more in day samples while Polychaeta, Amphipoda, Mysidacea and fish larvae were numerically high in the night collections.

TABLE 1. Percentage occurrence of major zooplankton groups during day and night in the study area.

Groups	Day	Night
Cirripede larvae	4.2	1.3
Hydromedusae	0.3	0.2
Ctenophora	—	0.1
Polychaeta	0.4	0.7
Chaetognatha	1.3	1.7
Copepoda	50.3	64.2
Ostracoda	—	0.3
Cladocera	0.4	0.8
Mysidacea	0.1	0.8
Cumacea	2.4	0.1
Amphipoda	—	0.3
Isopoda	0.1	0.2
Brachyuran larvae	7.1	1.8
Sergestidae	22.0	19.2
Decapoda	9.6	5.4
Brachiopoda	2.1	0.5
Tanaidacea	—	0.9
Gastropoda	0.8	0.4
Bivalves	0.1	0.2
Appendicularia	0.4	0.5
Fish eggs	0.2	0.1
Fish larvae	0.2	0.3

A total of 35 copepod species belonging to 18 families were recorded of which calanoids dominated. Diurnal variations in the occurrence and abundance of common copepod species are shown in Fig. 4. Maximum number of copepod species (28) was obtained at 1815 hr. Some species of calanoid copepods such as *Canthocalanus pauper*, *Temora turbinata*, *Centropages furcatus*, *Acartia bowmani*, *A. erythraea* and the poecilostomatoid, *Corycaeus* spp. were abundant in the day collections

while *Acartia spinicauda*, *A. centrura*, *Pseudodiaptomus serricaudatus*, *P. jonesi*, *Calanopia elliptica* and the cyclopoid *Oithona* spp. were more in the night collections.

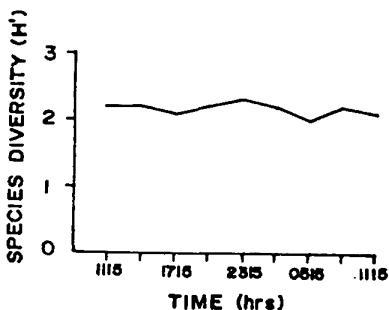
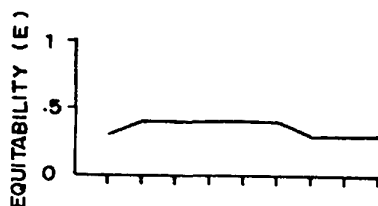
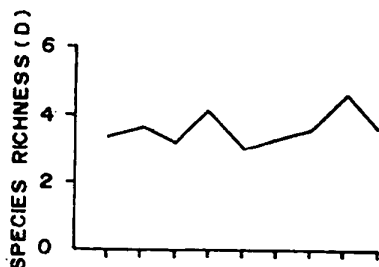


Fig. 5. Trends in diversity of copepod at Zuari estuary.

Species diversity

Mean number of species was high (23) for day collections. The mean diversity values (H') were relatively more for night collections

(2.2) while mean species richness values (D) were high for day samples (3.7). The very low diversity value obtained in night sample (0515 hr) was due to the dominance of a single species viz. *Acartia spinicauda*. The evenness values were quite low for both day and night collections (Fig. 5).

The tides in the Zuari estuary are of the semi-diurnal type with a maximum range of about 2 m. The tides don't appear to influence the various environmental parameters. Mean zooplankton biomass during the period of study was 0.2 ml^{-3} which is low compared to the earlier report from the Zuari estuary (Goswami *et al.*, 1979). It could be due to seasonal variability in the distribution of zooplankton.

Higher concentration of some groups of zooplankton such as Copepods, Cladocera, Decapod larvae, Gastropod larvae, Cirripede larvae, Appendicularia, Sergestidae, Brachyura zoeae and fish eggs were obtained in the day collections. Goswami *et al.*, (1979) reported the nocturnal abundance of decapod larvae from the Zuari Estuary while Madhupratap (1979) reported the abundance of Sergestidae (*Lucifer hansenii*), Brachyuran zoeae and fish larvae in the night samples from Cochin backwaters. This variation in the occurrence of these groups in relation to the diel rhythm in Zuari Estuary and Cochin backwaters may be due to the morphological difference of the ecosystems. Amphipoda and Mysidacea exhibited significant diel variations. They appear to come out from the mud into the water column only during night.

Calanoid copepod species such as *Canthocalanus pauper*, *Temora turbinata*, *Centropages furcatus*, *Acartia bowmani*, *A.*

erythraea, and the poecilostomatoid *Corycaeus* spp. were recorded more in the day collections. This is probably due to the avoidance of intense light by zooplankters and their migration towards the bottom layers of the water column during the day time. *Acartia spinicauda*, *A. centrura*, *Pseudodiaptomus serricaudatus*, *P. jonesi*, *Calanopia elliptica* and the cyclopoid *Oithona* spp. were abundant in the night collections. Madhupratap (1979) reported the occurrence of *Acartia centrura* and *A. spinicauda* in the night samples from the Cochin backwaters and Gajbiye *et al.*, (1984) reported the occurrence of *Acrocalanus* spp., *Paracalanus* spp. and *Oithona* spp. in the night zooplankton collection from Malad creek. However, Goswami *et al.*, (1979) reported the abundance of the genus *Acartia* in the day collections in the Zuari estuary.

The calanoid copepod species namely *Metacalanus aurivilli*, *Pseudodiaptomus bowmani*, *Calanopia minor*, *Acartia bowmani*, *Monstrilla* sp. obtained in day collections and *Pseudodiaptomus sewelli*, *P. jonesi*, *Calanopia elliptica*, *C. herdmanni* and *Acartia pacifica* in the night collections are recorded for the first time from the Zuari estuary.

The overall pattern of zooplankton in the lower reaches of the Zuari Estuary showed no significant effect of tides as reported earlier by Madhupratap (1979) in Cochin backwaters. The distribution of most of the species of zooplankton is chiefly associated with the phenomenon of vertical migration which is probably due to the response of zooplankton to variation in light intensities, irrespective of the prevailing environmental factors and the state of tides.

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STUDIES ON THE ASSOCIATES AND PARASITES OF ZOOPLANKTON FROM SOUTHWEST AND SOUTHEAST COASTS OF INDIA

ABSTRACT

Associates and parasites of zooplankton from southwest and southeast coasts of India were studied. Among the epizoic forms two species of ciliates infesting copepods were new records from Indian waters. Eight species of suctorians were found epizoic on copepods, ostracods and crab larvae. Two ectoparasitic flagellates were recorded from copepods, one from euphausiids and another from decapod larvae. One species of ciliate and a few trematod larvae were noticed in the body cavity of chaetognaths. Some cysts were also observed on copepods. Three suctorians were new species. The nature of association, host associate-parasite relationship and the rate of infestation are discussed. The intensity and percentage of infestation of the associates were more when the hosts occurred in abundance.

SEVERAL authors have studied epizoic and ectoparasitic protozoans from copepods (Santhakumari and Saraswathy 1970). However, very few studies are made on these forms from the Indian Ocean (Sewell, 1954; Santhakumari, 1985, 1986 a & b). The epizoites and ectoparasites are important as they injure the host. The copepod hosts are not only the major group both volumetrically and numerically among zooplankton, but also are economically important as they directly form food of pelagic fishes especially anchovies, sardines, and mackerels. Endoparasitic trematods and ciliates were found inside the body of chaetognaths which are exclusively carnivores and hence play important role in the food web of the sea. The euphausiids were infected with the flagellate parasite.

The zooplankton samples were collected with a Bongo net of 0.5 mm mesh width, 60 cm ring diameter and fitted with a calibrated flow meter. Collections were taken from

southwest and southeast coasts of India and samples were preserved in 4% formalin. Observations were made on living specimens on board also.

List of associates and parasites, hosts, nature of attachment and intensity of infection are given in Table - 1.

EPIZOIC FORMS

Trochilioides trivialis Fenchel : this holotrichous ciliate was noticed from the ventral side of *Eucalanus* sp. from Cape Comorin region.

Zoothamnium adamsi Stokes : up to five colonies were noticed from a single host specimen. The largest colony carried a maximum of 14 individuals. Sewell (1951) described *Zoothamnium* sp. from *Euchaeta marina*.

Ephelota gemmipara Hertwing : was recorded from copepod in the Indian Ocean for the first time. Santhakumari (1985) observed