Marine Science 2012, 2(6): 120-124
DOI: 10.5923/j.ms.20120206.02

# Zooplankton Abundance and Composition in Surf Zone of Gopalpur Port, East Coast of India-A Case Study

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**Abstract** Zooplankton abundance, biomass and composition were studied by quantitative approach in coastal water of Gopalpur Port in two selected stations. From the study we recorded a total of 28 zooplankton groups/taxa of which the copepods formed the dominant group in both the stations. The other dominant groups were chaetognaths, decapod larvae, gastropods, bivalve larvae, cladocera, amphipod etc. In the study area, the maximum biomass at 11.9 ml/100m$^3$ and the minimum at 8.6 ml/100m$^3$ were recorded. The maximum and minimum densities of zooplankton were at 17389 Nos./100m$^3$ and 13425 Nos./100m$^3$ respectively. There was not any significant difference in zooplankton abundance between stations ($p > 0.05$) and within sampling months ($p > 0.05$).

**Keywords** Zooplankton, Biomass, Abundance, Gopalpur Port

## 1. Introduction

Zooplankton plays a major role in functioning and productivity of aquatic ecosystems through its impact on the nutrient dynamics and its unique position in the food web. In reverse, they can also act as an important disease reservoir. Many species of zooplankton can be used as biological indicators for water pollution, water quality and eutrophication[1-4]. Zooplankton communities are highly influenced by spatio-temporal variations in hydrochemical parameters and physical forces[5-7]. Species composition and seasonal variation in plankton densities are important in determining the trophic level of an ecosystem.

Information dealing with the plankton of the coastal waters Orissa, that is of zooplankton are meager and mostly limited to Chilika lake[8-10], Rushikulya estuary[11], Bahuda estuary[12-13], Burhabalanga estuary[14] and coastal waters of Bay of Bengal. As the study area is under the influence of anthropogenic pressure by means of receiving pollutants from Gopalpur Port and nearby industries, the output of this study will act as a reference for coastal researchers and environmental planners for environmental impact assessment purpose.

## 2. Materials and Methods

The present study region, coastal water of Gopalpur Port (Figure 1) is in the south of Odisha coast between latitudes 19.300° N - 19.308° N and longitudes 84.962° E - 84.972° E. Here beach material is purely sandy. Rainfall in this area though concentrated in monsoon seasons with peaks in July, rain due to tropical cyclones, storm surges and deep depressions are common. Activities of Gopalpur Port for all weather capability, regular heavy mineral exploration by Indian Rare Earths Limited, agricultural runoff, oil spills due to regular mechanized fishing boat movements and future anthropogenic influence draw attention to document the inventory and status of zooplankton of this dynamic area.

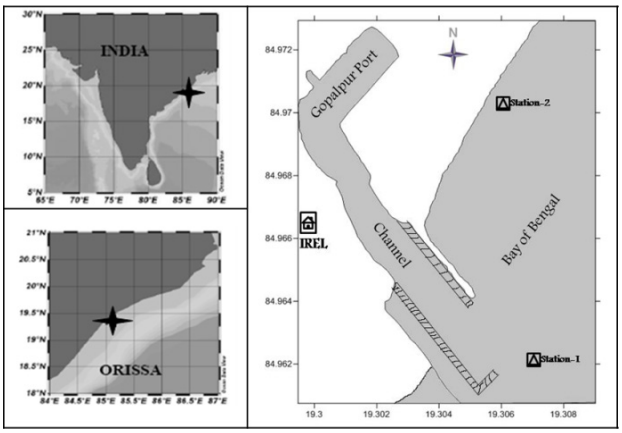


**Figure 1.** Map showing sampling locations in numerical figures (1 and 2)

Zooplankton samples were collected from two selected stations (Figure 1) of the study area. Three sampling surveys were made from October to December of 2010. The zooplankton samples were collected using a plankton net (300µm mesh size) by surface hauling and preserved in 5% formalin. Zooplankton biomass was determined by volume displacement method and expressed in ml/m$^3$. Then an aliquot of zooplankton sample was analyzed for diversity,

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Published online at http://journal.sapub.org/ms

density and relative abundance of different zooplankton groups using a stereo microscope. Standard literatures[15-17] were referred for taxonomy.

## 3. Results and Discussion

The term biomass symbolizes the live weight of living matter present in the zooplankton sample. The value obtained is used to evaluate the secondary productivity and fishery potential of the study area. Amongst three months of data, the maximum biomass was obtained in December with magnitude of 11.9 ml/100 $m^3$ (Figure 2). The minimum was obtained in the month of October with 8.6 ml/100 $m^3$. Highest biomass of 12.2 ml/100$m^3$ was found in Station 1 during December. It was found that higher biomass was found in Station 1 as compared to Station 2 (Figure 2). In three months study, the maximum average density of zooplankton was obtained in December with the value 17389 Nos./100 $m^3$ and lowest density in October with the value 13425 Nos./100 $m^3$. Highest zooplankton density of 18712 Nos./100 $m^3$ was found in Station 2 in December (Table-1). A total number of 28 diverse groups / taxa were identified from the zooplankton samples of the study area. The groups contain foraminifera, siphonophore, medusae, ctenophore, chaetognatha, polychate, copepoda, cladocera, ostracoda, amphipoda, isopoda, cyprid larvae, decapod larva (zoea and megalopa larvae), *Lucifer* spp, mysids, prawn larvae, stomatopoda, brachiopoda larvae, gastropods, bivalve larvae, heteropoda, pteropoda, ophiopluteus larvae, doliolum, salp, appendicularia, fish larva, fish egg etc (Table-1). The highest number of groups i.e. 22 was found in November followed by 21 in December. Normally, higher number of groups was found in Station 1 as compared to Station 2.

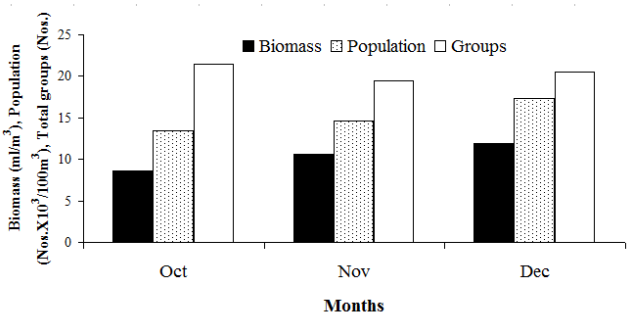


**Figure 2.** Zooplankton biomass, population density and groups in the study area

During the inventory of the samples; group Copepoda formed the major component with the various stages of life cycles like nauplii larvae, copepod eggs. Copepoda comprised 78.07% to 86.59% of the total groups found in the sample and many authors[18-19] have got similar results. The distribution of copepods density and zooplankton biomass shows almost identical patterns. The copepod population ranged from 9379 to 16203 Nos./100 $m^3$ in all three months (Table-1).

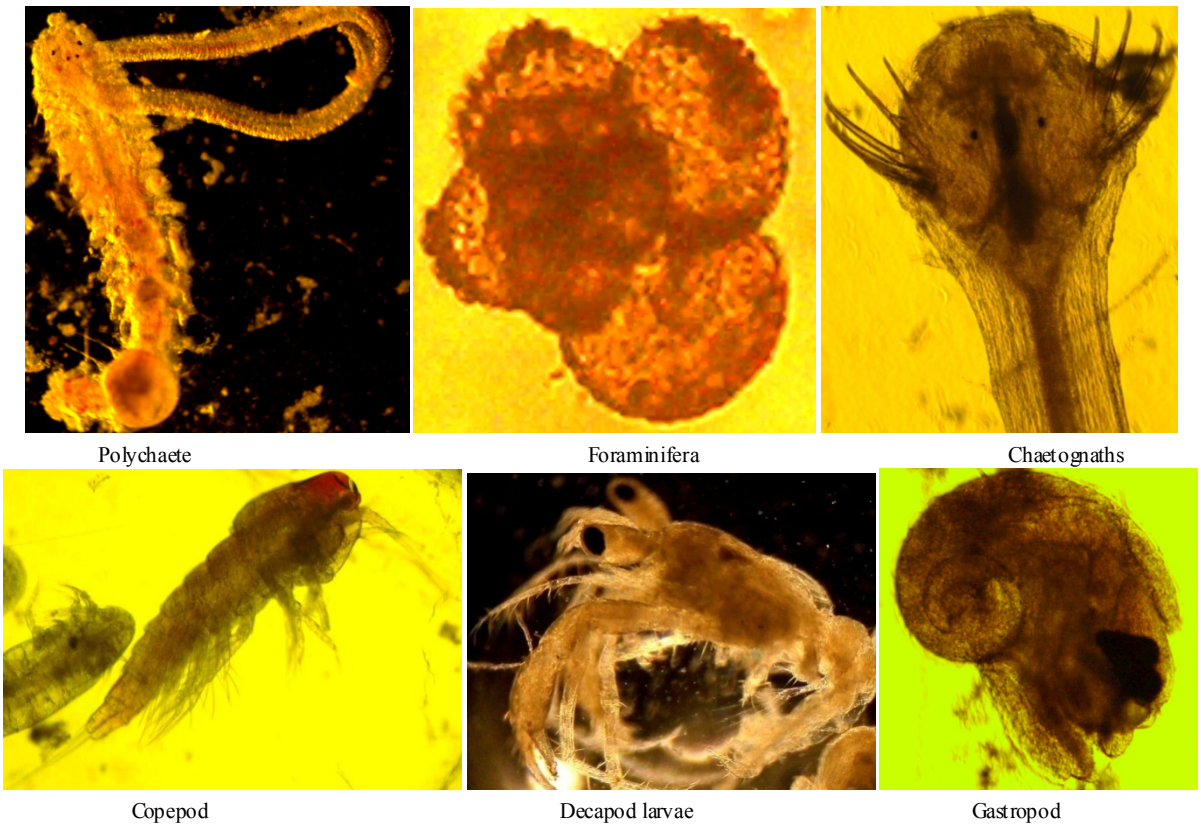


**Figure 3.** Under microscope photographs of some important dominant zooplankton groups

**Table 1.** Zooplankton composition and relative abundance of two stations

| | Station 1 | | Station 2 | |
|---|---|---|---|---|
| | Nos./100m$^3$ | % Composition | Nos./100m$^3$ | % Composition |
| Foraminifera | 23 | 0.15 | 8 | 0.06 |
| Siphonophore | 2 | 0.01 | 5 | 0.03 |
| Medusae | 15 | 0.10 | 14 | 0.09 |
| Ctenophore | 2 | 0.01 | 4 | 0.03 |
| Chaetognath | 1533 | 9.94 | 1571 | 10.51 |
| Polychaete | 5 | 0.03 | 3 | 0.02 |
| Copepod | 12798 | 82.97 | 12414 | 83.11 |
| Cladocera | 22 | 0.14 | 16 | 0.11 |
| Ostracod | 9 | 0.06 | 8 | 0.05 |
| Cumacea | 2 | 0.01 | - | - |
| Amphipod | 19 | 0.12 | 16 | 0.11 |
| Isopod | 9 | 0.06 | 3 | 0.02 |
| Mysid | 3 | 0.02 | 2 | 0.02 |
| *Lucifer* spp. | 29 | 0.19 | 26 | 0.17 |
| Decapod larvae | 787 | 5.10 | 672 | 4.50 |
| Prawn larvae | 11 | 0.07 | 7 | 0.05 |
| Stomatopod | 3 | 0.02 | 2 | 0.02 |
| Pycnogonida | - | - | 1 | 0.01 |
| Cyprid larvae | 16 | 0.10 | 20 | 0.13 |
| Gastropod | 41 | 0.27 | 46 | 0.31 |
| Bivalve larvae | 38 | 0.24 | 43 | 0.29 |
| Brachiopoda larvae | - | - | 1 | 0.01 |
| Pteropod | 12 | 0.08 | 15 | 0.10 |
| Heteropod | 2 | 0.01 | 5 | 0.03 |
| Ophiopluteus larvae | 3 | 0.02 | - | - |
| Doliolum | 3 | 0.02 | 5 | 0.03 |
| Salps | - | - | - | - |
| Appendicularlae | 12 | 0.08 | 14 | 0.09 |
| Fish Egg | 4 | 0.03 | 5 | 0.03 |
| Fish Larvae | 6 | 0.04 | 5 | 0.04 |
| Others | 14 | 0.09 | 6 | 0.04 |
| **Total** | **15425** | **100** | **14937** | **100** |

After copepods the other dominant groups were chaetognaths, decapod larvae, gastropods, bivalve larvae, cladocera, amphipod etc. Copepoda are the most versatile group and abundant in marine waters. They are dominant as they can tolerate a wide range of fluctuations in different physico-chemical parameters. Copepods are among the most important secondary producers in coastal and marine ecosystems, representing an important link between phytoplankton, microzooplankton and higher tropic levels such as fish[20]. One of the largest contributions to marine zooplankton are the crustacean of the class copepoda which are mainly herbivorous, although some species are omnivorous and carnivorous. Copepods are widely distributed throughout the world Ocean and this consumers of the marine environment usually contribute 80% of the biomass[21].

The copepod forming the bulk of abundance followed by chaetognaths, was reported by many authors earlier[22-23]. Meroplankton constitute a major fraction of zooplankton community in tropical seas. Different meroplankton were recorded in the entire study.

The distribution and abundance of these organisms in polluted and unpolluted water can provide useful information on the health of the sea where they found[24]. The study area showed rich diversity of zooplankton. Study on zooplankton provides clue for ecological studies of vicinity of marine environment of Gopalpur area. No significant changes in the diversity were observed during the study. Distribution of zooplankton was normal in unpolluted areas but in polluted area although the diversity was high, only pollution tolerating species were large in number, but during the study period no such observation was recorded as compared to the creeks and bays of Mumbai[25].

**Table 2.** Results of ANOVA test applied on zooplankton data

| Source | df | Mean Square | F | Sig. |
|---|---|---|---|---|
| Months | 2 | 266886.697 | .050 | .951 |
| Stations | 1 | 11107.834 | .002 | .964 |

Zooplankton abundance data were subject to Analysis of

Variance (ANOVA) to understand any significant difference between stations and within months (Table-2). During the study, it was not noticed any significant difference in zooplankton abundance between stations ($p>0.05$) and within months ($p>0.05$). Copepods formed the major catch among all the zooplankton communities. It was the most prevailing group of zooplankton communities throughout the investigation. This group mainly consists of a large number of herbivores and a few carnivores. So, the copepods can limit the phytoplankton growth in the study region[26].

# 4. Conclusions

In the present piece of study, 28 zooplankton groups/taxa have been documented of which the copepods formed the dominant group in both the stations. Zooplankton play an important role in forming a main link between primary producers (phytoplankton) and higher trophic levels[27-28]. During the study period, it is further established that there was no significant difference in zooplankton composition in between stations and within the sampling months. Previously it has been reported that zooplankton diversity weakens due to domestic sewages and industrial wastes[29]. In recent days, the ongoing industrial activities by TATA steel and construction of Gopalpur all weather port since are gaining their momentum, zooplankton fauna will appear to be more prone towards anthropogenic threats. It is a fact that zooplankton diversity in an area regulates the fishery, an important sector of the livelihood for many coastal inhabitants. Their community composition therefore should be studied on regular basis and appropriate measures should be taken for eco-restoration in case of any environmental threat caused to these tiny denizens.

The present study revealed the faunal composition of zooplankter only for post-monsoon months. But environmental drivers responsible for the season-wise fluctuation in zooplankton abundance and species composition should further be studied in relation to environmental and anthropogenic factors.

# ACKNOWLEDGEMENTS

The present work was carried out as a part of INCOIS (Indian National Centre for Ocean Information Services) funded SATCORE (Satellite Coastal and Oceanographic Research) project awarded to Berhampur University. All the authors are highly indebted to Dr. T.S Kumar and Dr. A. A Lotliker of INCOIS for their suggestions during the course of study.

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