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Qualitative and quantitative analysis of zooplankton along Veraval coast, Gujarat

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Abstract

The present study was conducted on qualitative & quantitative analysis of zooplankton along Veraval coast. At a time of high tide, 100 liter of surface seawater was collected from two different sites in a month. The collected water was filtered two times with zooplankton net of $>0.2 \mu\text{m}$ mesh size. After the sampling, the fixation of samples was carried out. Total 17 groups of marine zooplankton were identified such as Copepod, Decapods, Foraminiferan, Cladocerans, Ostracodes, Amphipods, Isopods, Nematods, Branchiopods, Gastropod, Salps, Rotifer, Chetognata, Appendicularians, Siphonophora, Polychaeta, and Ichthyoplanktons and also other larvae and unknown species. A number of species diversity and abundance was recorded such as copepods followed by Decapods and Ichthyoplanktons at both the stations. Total 76 species of marine zooplankton was obtained from coastal waters at Jhaleshwar and Bhidia. Forty species belonging to 17 orders, were recorded throughout the study period at Jhaleshwar coast whereas thirty six species of zooplankton belonging to 16 orders, were recorded at Bhidia coast. The diversity of zooplankton was generally higher in the month of monsoon and post monsoon season than pre-monsoon season at both the stations. The zooplankton diversity at Jhaleshwar and Bhidia coast was almost similar. There was no significant difference in the availability of species at both the stations expect *M. gracillis* obtained from Bhidia coast which was absent at Jhaleshwar coast.

Keywords: zooplankton, Qualitative & quantitative analysis, veraval coast

Introduction

Zooplanktons are the diverse, delicate and often very beautiful assemblages of animals that drift in the waters of the world oceans. The name zooplankton is derived from the Greek: Zoon, animal; planktons, wandering. They play a key role in the marine food web by transferring the organic energy produced by the unicellular algae to higher trophic levels such as pelagic stocks. Because of their critical role as food source for larval and juvenile fish, the dynamics of zooplankton populations, their reproductive cycles, growth and survival rates are all important factors influencing recruitment of fish stocks and thereby the magnitude of fishery. Fish larvae, absorbed yolk sac depending on the plankton populations for survival. In this case, any kind of changes that may affect the plankton, consequently will also affect the fish populations. Therefore a region which has highest plankton density as fish feed is the richest fishing area as well.

Zooplanktons are classified in four ways based on different criteria. Firstly, they are divided into Holoplankton and Meroplankton based on their developmental stages. Secondly, zooplanktons are divided into Protozoa and Metazoa. Thirdly, zooplanktons are classified according to their size which include Nano plankton (2-20 μm), Micro plankton (20-200 μm), Meso plankton (0.2-2 mm), Macro plankton (2mm-20cm), and Megaplankton (20-200 cm) (Varghese *et al.*, 2015) ^[5]. Fourthly, zooplanktons are classified into Neritic and Oceanic. Neritic plankton inhabits inshore waters upto 200 m depth and beyond that oceanic plankton prevails.

Creatures living in aquatic environment lead their existence in a balance of nature. This balance has been changed during the last decades due to the factors such as overfishing, eutrophication, and lack of oxygen. As a consequence, some zooplankton species are disappearing or available only in small numbers (Caddy 1993; Zaitsev and Alexandrov, 1995) ^[2, 7]. Tidal flushing is one of the main bottom-up factors controlling zooplankton biomass in estuaries besides nutrients (Villate, 1997; Ali *et al.*, 2011) ^[6, 1]. These short/medium-term patterns of zooplankton abundance probably determine the availability of food for their predators and may thus have significant implications for the foraging strategies of juvenile fish preying upon zooplankton.

Materials and Methods

Materials

Forceps, Measuring cylinder, Slide, Cover slip, Plankton net, BOD bottle, Spatula Sedgwick rafter, Pipette, Conical flask, Aspirator pump, Separating funnels, Whatmans glass filter paper, Hot air oven, Microscope.

Methodology

Sample was collected from Jaleshwar and Bhidia at the Veraval coast of Gujarat during the year 2016 and 2017. Data was collected at every month. At a time of high tide, 100 liter of surface seawater was collected from two different sites in a month. The collected water was filtered two times with zooplankton net of $>0.2 \mu\text{m}$ mesh size. The netting is made of bolting silk, nylon or other synthetic material. The material should be durable with accurate and fixed pore size. The mesh should be square and aperture uniform. The mesh size of 0.2 mm of monofilament nylon was used for collecting zooplankton for taxonomic and productivity studies. The zooplankton was collected horizontal, oblique and vertical hauls. In the horizontal sampling the net was towed at a slow speed usually for 5 to 10 minutes. After the sampling, the fixation of samples was carried out. The most common fixing and preserving reagent formaldehyde (4-5%) was used. After the sample preservation, samples were put on a slide with a drop of distilled water and examined under the microscope for identifications (Dhargalkar & Verlecar, 2004) [3].

Calculations

The species diversity was calculated by following methods:

Simpson's Index (D)

$$\lambda = \frac{\sum_{i=1}^R n_i(n_i - 1)}{N(N - 1)}$$

Where, λ = Simpson index, n_i = number of individuals in the 'ith' species, N = total number of individuals, S = total number of species.

Shannon- Wiener index

Where, H' = Shannon-Wiener index, p_i = proportion of the individual of the species in the total sample, R = total number of species.

$$H' = - \sum_{i=1}^R p_i \ln p_i$$

Pielou's evenness indices (J')

$$E_1(J') = \frac{H'}{\ln(S)}$$

Where, H' = Shannon-Wiener index, S = Total number of species Source: Shannon (1948) [4]

Statistical Analysis

All the statistical analysis was performed using SPSS 16.0 (SPSS Inc. Illinois). The differences in zooplankton diversity

along the sites and months were compared by using one way analysis of variance.

Results and Discussions

Qualitative and Quantitative Analysis of Zooplankton

Investigations on qualitative and quantitative analysis of zooplankton revealed that total 76 species are dominating from high tide line of Jhaleshwar and Bhidia stations of Veraval. The dominated group identified as Copepods, Ostracods, Amphipods, Foraminiferans, Nematods, Branchiopods, Gastropods, Salps, Cladocerans, Decapods, Rotifers, Chetognata, Appendicularians, Siphonophora, Polychaeta, Isopods, Itchthyoplanktons. The density of zooplankton cells has reached minimum during the month of September and November from Jhaleshwar/Bhidia coast, whereas the maximum were recorded during monsoon and post monsoon season. The zooplankton species are maximum in stations Jhaleshwar as compared to the Bhidia coast of Veraval.

The zooplankton diversity at Jhaleshwar coast and Bhidia coast was almost similar. There was no significant difference in the availability of species at both the stations except *M. gracillis* obtained from Bhidia coast whereas it was absent at Jhaleshwar coast. The diversity of zooplankton was generally higher in the months of monsoon and post monsoon season than the pre-monsoon season at both the stations.

Investigations on zooplankton abundance revealed that forty species belonging to 17 orders, were recorded throughout the study period at Jhaleshwar coast whereas thirty six species of zooplankton belonging to 16 orders, were recorded at Bhidia coast. During the analysis of the numbers of zooplankton and identification of varied zooplankton species it was revealed that Copepods was the most diversified group comprising of 17 different species, followed by decapods 5 species, Foraminiferans 2 species, Cladocerans 2 species, 1 species constitute from each group including Ostracodes, Amphipods, Nematods, Brachiopods, Gastropods, Salps, Rotifer, Chetognata, Appendicularians, Siphonophora, Polychaeta and Isopods and from Itchthyoplanktons fish eggs were recorded in the study period.

The group showing maximum percentage can be considered as dominant group. Whereas, the zooplankton diversity at Jhaleshwar coast comprises Copepods (43%), Decapods (19%), Foraminiferans (3%), Cladocerans (4%), Ostracodes (1%), Amphipods (2%), Isopods (3%), Nematods (5%), Branchiopods (3%), Gastropods (2%), Salps (1%), Rotifer (3%), Chetognata (1%), Appendicularians (3%), Siphonophora (2%), Polychaeta (3%), Itchthyoplanktons (3%), and unknown species (1%), the zooplankton diversity at Bhidia coast comprises of Copepods (39%), Decapods (20%), Foraminiferans (1%), Cladocerans (1%), Ostracodes (1%), Amphipods (2%), Isopods (3%), Nematods (3%), Branchiopods (4%), Gastropods (3%), Rotifer (4%), Chetognata (2%), Appendicularians (1%), Siphonophora (2%), Polychaeta (2%), Itchthyoplanktons (9%), other larvae (3%), except Salp. Variations of zooplankton population between two locations were illustrated in Fig No. 1 & Fig No. 2.

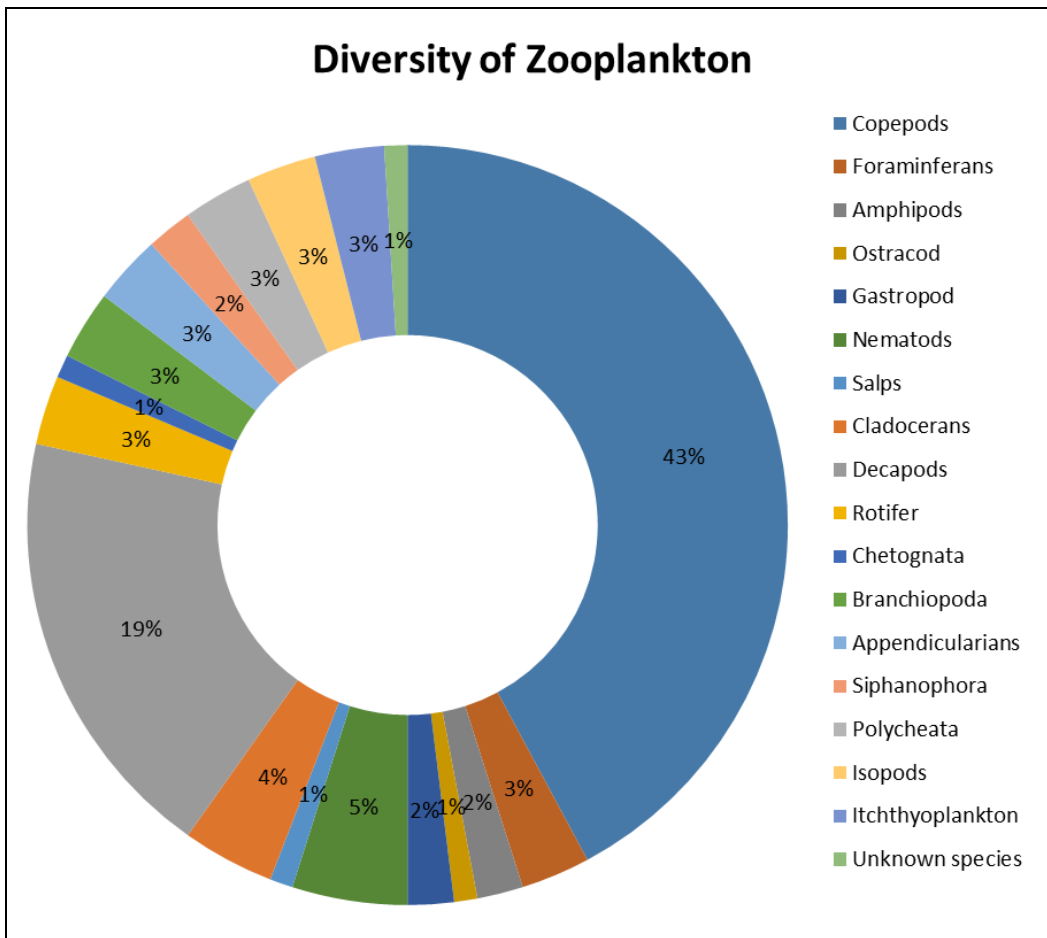


Fig 1: Diversity of zooplankton along Jhaleswar coast

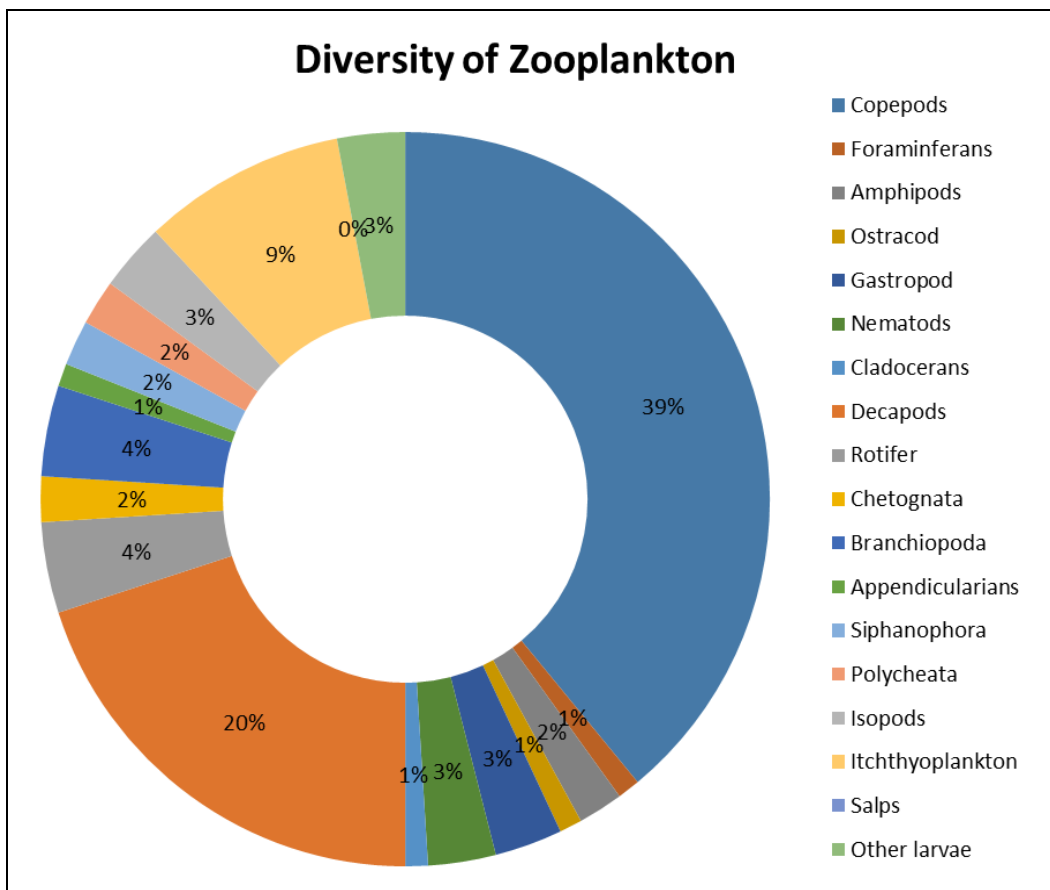


Fig 2: Diversity of zooplankton along Bhidia coast

Diversity Index
Species diversity at Jhaleshwar coast

Table 1: Zooplankton diversity for different taxa & individuals at Jhaleshwar coast

	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17
Taxa_S	24	24	23	19	25	21	19	13	17
Individuals	33	39	39	39	44	26	33	15	21
Dominance_D	0.05418	0.05062	0.05325	0.07955	0.05785	0.05917	0.06887	0.08444	0.06576
Simpson_1-D	0.9458	0.9494	0.9467	0.9204	0.9421	0.9408	0.9311	0.9156	0.9342
Shannon_H	3.061	3.077	3.028	2.741	3.043	2.951	2.803	2.523	2.78
Evenness_e^H/S	0.8891	0.9036	0.8979	0.8158	0.8391	0.9109	0.8681	0.9591	0.9486

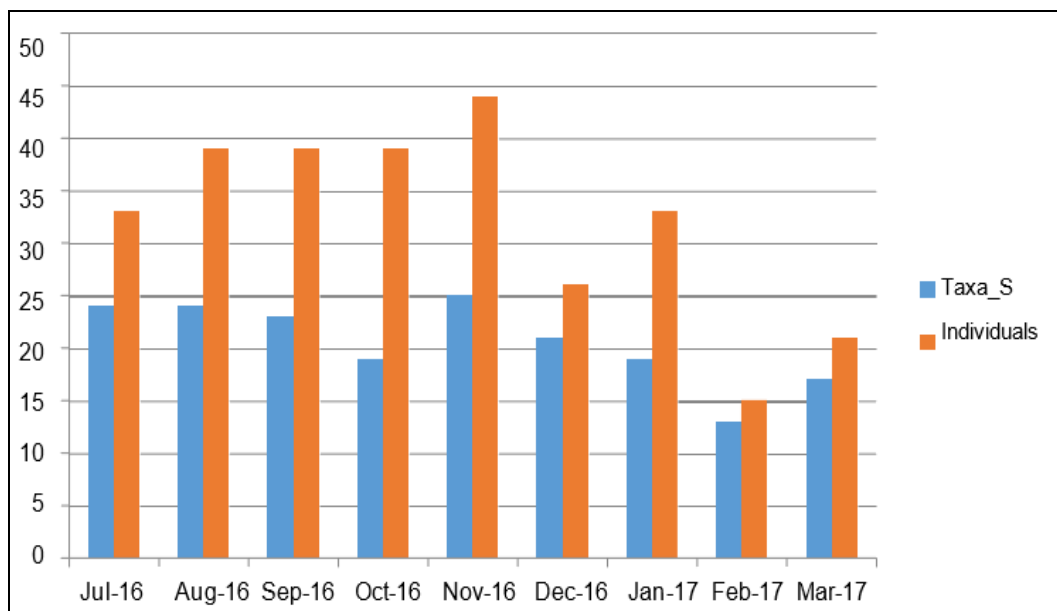


Fig 3: Zooplankton diversity for different taxa & individuals at Jhaleshwar coast Species diversity at Bhidia coast

Table 2: Zooplankton diversity for different taxa & individuals at Bhidia coast

	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17
Taxa_S	20	27	24	19	25	22	22	16	19
Individuals	32	41	50	35	42	33	36	24	24
Dominance_D	0.07	0.05	0.06	0.06	0.06	0.06	0.06	0.07	0.06
Simpson_1-D	0.92	0.94	0.93	0.93	0.93	0.93	0.93	0.92	0.93
Shannon_H	2.81	3.13	2.97	2.81	3.01	2.92	2.90	2.65	2.83
Evenness_e^H/S	0.83	0.84	0.81	0.87	0.81	0.84	0.83	0.8919	0.89

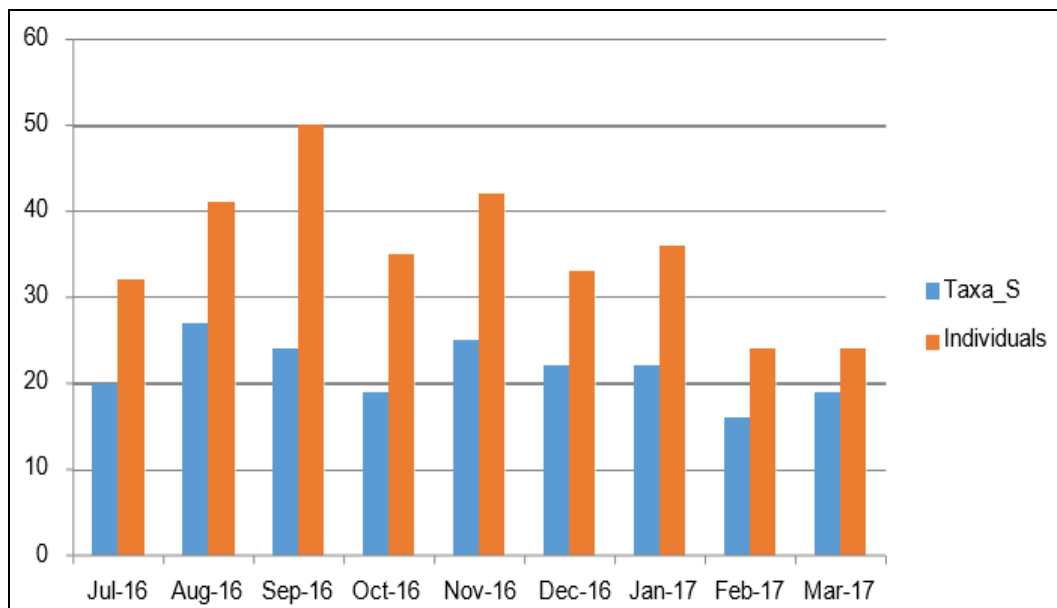


Fig 4: Zooplankton diversity for different taxa & individuals at Bhidia coast

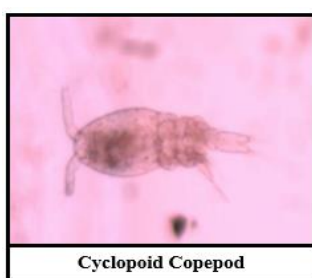
Simpson diversity index is measure of diversity into an ecosystem is use to quantifying biodiversity in particular habitat. Simpson index take into account the no. of the species present as well as abundant of each species. It measures the probability that two individuals, randomly selected from the sample, which belongs to the same species. D indicates the Simpson index, D ranges from 0-1, with this index, 0 represents infinite diversity whereas, 1 indicates no diversity. Bigger the value of D lowers the diversity in the present Jhaleshwar coast study. D value is close to 0.05 in the Bhidia coast, D value is close to 0.07, which also resembles highest diversity of zooplankton in the coast.

Simpson index of diversity $1-D$, in the present index of diversity value of index ranges from 0-1, but in this case greater the value, greater the sample diversity. In this case, the index represents the probability that two individuals randomly selected from sample will belong to differences in the Jhaleshwar coast and Bhidia coast. Simpson $1-D$ index shows both values near to 0.9 to which is close to 1, which indicates highest diversity in both stations of Veraval coast.

The Shannon index is an information statistic index, which means it assumes all species are represented in a sample and that they are randomly sampled. In Shannon index, the value estimated between 2.523-3.077 at Jhaleshwar coast. The highest value recorded in the month of August, and lowest value obtained in the month of February, it means monsoon season and post monsoon season (Table no. 1) highly than pre-monsoon season and at Bhidia coast value estimated at in between 2.658-3.133. The highest value recorded in the month of August and lowest value recorded in the month of February, it means monsoon season and post monsoon season (Table no. 2) highly diverse than pre-monsoon season.

Evenness is a measure of the relative abundance of the different species making up the richness of an area. The value ranges in between 0-1, shows both the value near to 0.9 to which is close to 1, which indicates high evenness in both stations of Veraval coast.

Zooplankton species



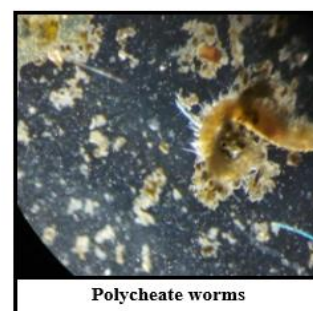
Cyclopoid Copepod



Amphipod



Crustacean larva



Polycheate worms

Conclusions

The qualitative and quantitative analysis of zooplankton from Veraval coastal body between two locations i.e Jhaleshwar and Bhidia coast revealed the presence of Seventeen

taxonomic groups: Copepod, Decapods, Foraminiferan, Cladocerans, Ostracodes, Amphipods, Isopods, Nematods, Branchiopods, Gastropod, Salps, Rotifer, chetognata, Appendicularians, Siphonophora, Polychaeta, and Itchthyoplanktons and also other larvae and unknown species. A number of species diversity and abundance was recorded such as Copepods followed by Decapods and Itchthyoplanktons at both the stations. Total 76 species of marine zooplankton obtained from coastal waters of Jhaleshwar and Bhidia, Fourty species belonging to 17 orders, were recorded throughout the study period at Jhaleshwar coast whereas thirty six species of zooplankton belonging to 16 orders, were recorded at Bhidia coast. The diversity of zooplankton was generally higher in the month of monsoon and post monsoon season than pre- monsoon season at both the stations. The zooplankton diversity at Jhaleshwar coast and Bhidia coast was almost similar. There was no significant difference in the availability of species at both the stations except *M. gracillis* obtained from Bhidia coast whereas it was absent at Jhaleshwar coast.

This confirms that the Veraval coastal body is very productive in nature and nutritionally rich for fish production and for other marine biodiversity.

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