Zooplankton diversity in river Kali, Karwar, West coast of India

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Abstract: The present study was aimed to investigate the abundance of zooplankton population in Kali Estuary Karwar, Karnataka, India. Water samples were collected monthly at 6 different locations during February 2016 to February 2017 to know abundance of zooplankton in various seasons. A total of 42 species of zooplankton were identified and they belonged to 11 groups. The dominant group being Copepoda with 17 species. Station 6 was found to have highest diversity of zooplanktons as it is a mangrove rich area. The zooplankton community of the mangrove ecosystem was relatively high.

Introduction:

The study was undertaken in river Kali, Karwar to study the biodiversity of zooplanktons. This river is known for rich biotic communities. The river originated in Kusavali village in Supa taluka and after meandering about 185 km in the Sahyadri plateau and lastly joins the Arabian Sea at Karwar (14o50'21" N and 74o10'05"E). Zooplanktons are tiny animals found in all aquatic ecosystems, particularly the pelagic and littoral zones in the ocean. They are one of the primary consumers of the ocean and grazes on the phytoplankton. They themselves are an important food source for large animals [Day et al., 1989] and are important in the remineralisation and transport of nutrients [Haris 1959]. Estuaries are the most productive zone and we will find rich zooplanktons diversity in the estuary [Robertson and blabber, 1992]. Mangroves in the estuary which are very productive help in maintaining a rich diversity of zooplankton, [Lugo AE, and Snedaker]. Zooplankton provides an important food source for larval vertebrates and invertebrates in natural waters and in aquaculture ponds. It has been reported that in many countries the failure of fishing is attributed to the reduced zooplankton [Rajasegar et al 2000]. Zooplankton species distribution shows wide spatio temporal variations due to the different hydrographical factors on individual species. They also serve as good indicators of water quality as per the previous studies on zooplankton of Indian coastal environment [Saraswathi 1983].

Materials and Methods:

The study was carried out along the lower stretch of the river Kali from the bar mouth up to Halga which is about 25 km away from the bar mouth. Six sampling stations were selected along the river in three different zones. Four of the six sampling stations were situated in the estuary which is within 6 km of radius. The six study stations along the river estuary were Kodibag (Stn 1), Kanasgeri (Stn 2), Kinnar (Stn 3), Halga (Stn 4). One in backwaters i,e, Sunkeri backwaters (Stn 5) and another one in Devbag Creek (Stn 6) (Fig 1). The study was carried out during the period February 2016 to February 2017. Samples were collected by horizontal towing of plankton net (0.35m mouth diameter) made of bolting silk (No.10, mesh size 158µm) for fifteen minutes. These samples were preserved in 5% formalin [Parson et al 1984] and used for qualitative analysis. The density was determined by numerical method using Sedgewick's counting chamber under the microscope. Various planktonic groups and their species were enumerated by examining 5-10% of the sub sample and the number of organisms computed per m^3 of water (Wickstead, 1965: NIO Manual, 2000). Zooplanktons were identified using the standard works of Venkataraman&Wafar (2005), Subramanyam.R. (1959).

Fig 1: Map showing location of sampling stations along the river Kali.

Results:

The study was carried for the period of thirteen months from February 2016 to February 2017. Six sampling points were selected for the zooplankton analysis. Totally 42 species of zooplankton belonging to 11 groups were recorded during the study period. Copepoda with 17 species was the dominant group, Protozoa and larva forms consisted of 5 species and Ostracoda with 3 species. Of the six stations, the maximum number of species of zooplankton was found at the stn 6 (38 species), followed by Stn1 with 32 number of zooplankton species and 28 species of zooplankton at station 2 (Table 1). Of the 11 groups of zooplankton recorded it was seen that Copepoda was the major group in the river kali forming around 53.56%, followed by Protozoa with 23.19% and larval forms comprises of 16.84% and rest of the groups was verynegligable (Fig 2). Station wise data showed that copepod formed 62.6% at stn 6 followed by 58.35% at stn 5. Protozoa which was second dominant group was found at stn 4 with 33.14%.(Table 2).

Table 1: Zooplankton recorded along the Kali estuary at different stations.

		Stn 1	Stn 2	Stn 3	Stn 4	Stn 5	Stn 6
Protozoa	*Tintinnopsis sp*	+	+	+	+	+	+
	Favella sp.	+	+	+	+	+	-
	Rhabdonella sp.	+	+	+	+	+	+
	Globigerina sp.	+	+	+	+	+	+
	Acanthometron sp.	+	+	+	+	-	+
Coelenterata	*Obelia sp.*	+	-	-	-	-	+
	Siphonophora sp.	-	-	-	-	-	+
Ctenophora	*Pleurobrachia sp.*	-	-	-	-	-	+
Chaetognatha	*Sagitta enflata*	+	+	+	+	+	+
	Evadne sp.	+	+	+	+	-	+
Decapoda	*Lucifera sp.*	+	+	-	+	+	+
Polycheata	*Tomopteris sp.*	-	-	-	-	-	+
	Spionid sp.	-	-	-	-	-	+
Protochordata	*Doliolum sp.*	+	+	+	+	-	+
	Oikopleura sp.	+	+	+	+	-	+
Copepoda	*Acrocalanus sp.*	+	+	+	+	+	+
	Paracalanus sp.	+	+	+	+	+	+
	Rhincalanus sp.	+	+	+	+	+	+
	Pseudodiaptomus sp.	+	+	+	+	+	+

	Eucalanus sp.	+	+	+	+	+	+
	Copilia sp.	-	-	-	-	+	+
	Macrosetella sp.	-	-	-	-	+	+
	Miocrosetella sp.	-	-	-	-	+	+
	Undinula sp.	+	-	-	-	+	+
	Acartia sp.	+	+	+	+	+	+
	Temora sp.	+	+	+	+	+	+
	Oithona sp.	+	+	+	+	-	+
	Oithona plumifera	+	+	+	-	-	+
	Euchaeta sp.	+	+	+	+	-	+
	Euterpina sp.	+	+	+	+	-	+
	Centropages sp.	+	+	+	+	-	+
	Pontellid	+	+	+	-	-	+
Ostracoda	*Labidocera*	+	+	+	+	-	+
	Oncaea	+	-	-	-	-	+
Cladocera	*Penillia*	-	-	-	-	-	+
Larval forms	*Copepod nauplius*	+	+	+	+	+	+
	Decapod larva	+	+	+	+	+	+
	Gastropoda	+	+	+	+	+	+
	Bivalvia	+	-	-	-	+	+
	Fish eggs & larvae	+	+	+	+	+	+
	Eupahusid nauplius	-	+	+	+	-	+
	Brachiopod larva	-	-	-	+	+	+
	Zoea	+	+	+	+	+	+

Table 2: Percentage composition of Zooplankton at different stations.

	Stn 1	Stn 2	Stn 3	Stn 4	Stn 5	Stn 6
Protozoa	25.65	25.87	26.20	33.14	21.21	7.07
Coelenterata	1.62	0.00	0.00	0.00	0.00	0.82
Ctenophora	0.00	0.00	0.00	0.00	0.00	1.13
Chaetognatha	3.96	2.44	1.58	1.57	0.53	1.95
Decapoda	1.49	0.66	0.00	0.47	0.35	1.01
Polycheata	0.00	0.00	0.00	0.00	0.00	0.64
Protochordata	2.08	3.35	1.40	1.28	0.00	0.94
Copepoda	50.91	49.06	55.19	45.25	58.35	62.60
Ostracoda	1.52	1.39	1.63	2.06	0.00	1.46
Cladocera	0.00	0.00	0.00	0.00	0.00	1.13
Larval forms	12.79	17.22	14.00	16.23	19.55	21.26

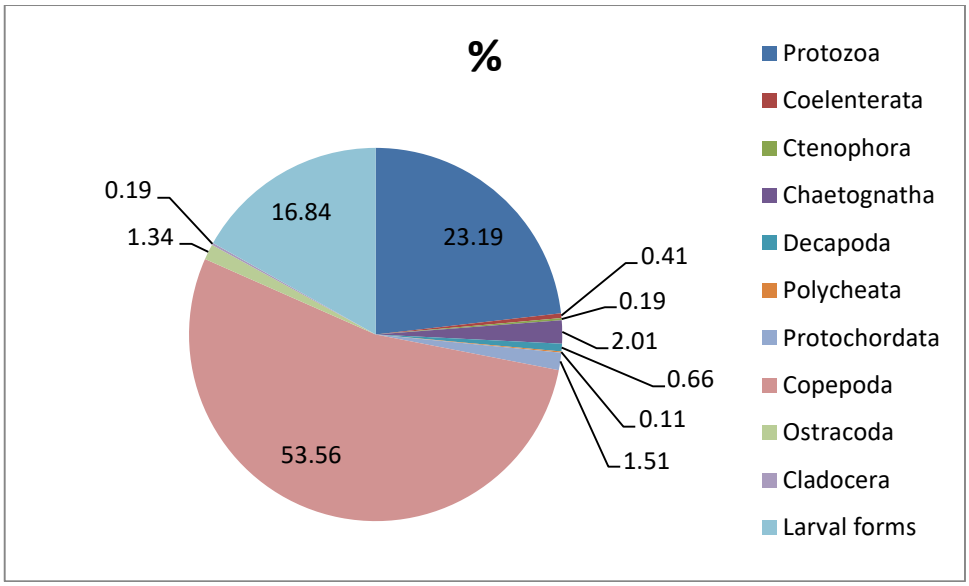

Fig 2: Percentage of zooplankton recorded in Kali river.

The data analysis in Margalef's species richness (*d'*), Shannon- Weiner diversity function (*H'*) and Pielou's evenness (*J'*) was used to reflect the underlying changes in zooplankton species. The species richness and diversity of zooplankton at six sampling stations were determined using Pielous evenness which was highest at the station 1,2 and 4 (0.86) and lowest at the station 5 (0.84). Margalef 's diversity was highest at the stations 6 (5.57) and lowest at the station 4 (4.03). Shanon indices was highest at the stations 6 (3.09) and lowest at the station 5 (2.57) (Table 3). The dendrogram revealed that the species similarity were between the stations 1,2,3 and 4 and was linked to station 6 (Fig 3). Same was seen and revealed in MDS plot with station 1-4 clustering together and 5 and 6 away from the rest (Fig 4).

Table 3. Variation in Zooplankton diversity and species richness of zooplankton.

	S	N	d	J'	H'(loge)
Stn 1	32	807.92	4.63	0.86	2.98
Stn 2	28	728.10	4.10	0.86	2.88
Stn 3	27	620.75	4.04	0.85	2.80
Stn 4	26	491.02	4.03	0.86	2.79
Stn 5	21	338.05	3.43	0.84	2.57
Stn 6	38	769.62	5.57	0.85	3.09

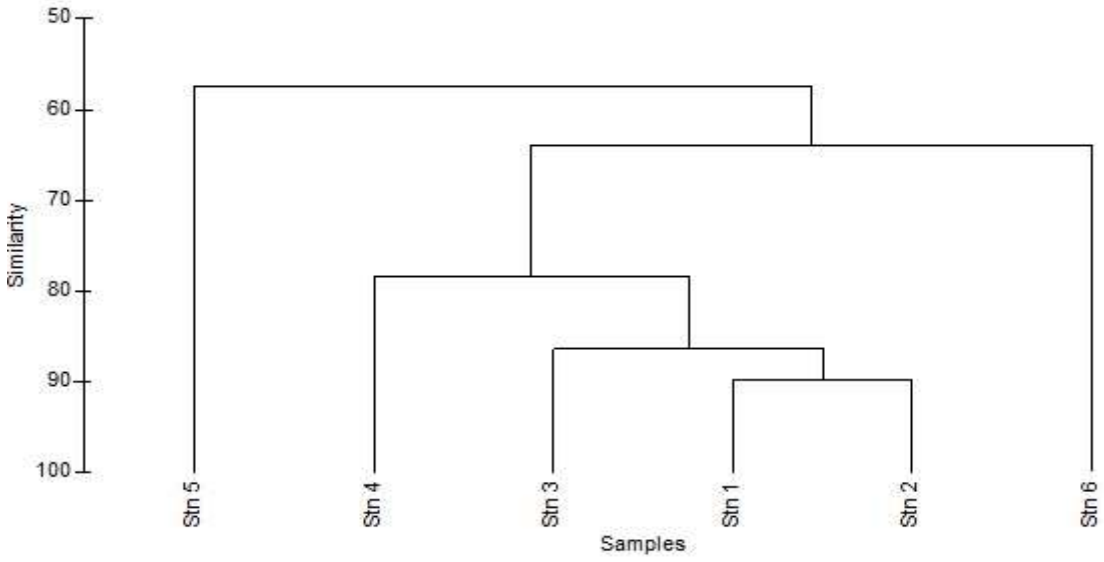

Fig 3. Dendrogram showing cluster analysis of Zooplankton at different stations.

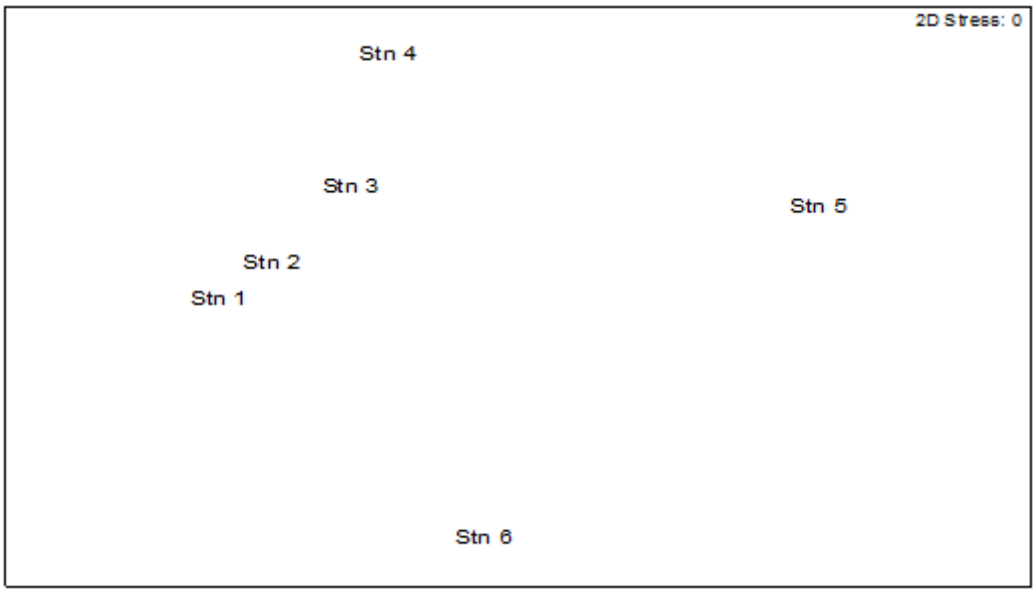

Fig 4. The MDS plot of zooplankton at different station in river Kali.

Discussion:

The high rate of zooplankton production influences enrichment of organic matter and plays a vital role in secondary and tertiary productions, represented by young instars of fishes. The survival of the young of herbivorous finfish and shellfishes such as tilapia, Sardinella, mud crabs and shrimps may depend on the availability of abundant littoral zooplankton and benthos aided by omnivore and high ecological efficiencies. Planktonic fish larvae prey on zooplankton and occasionally phytoplankton. Several families of finfish and shellfishes consume zooplankton wholly or partly in various stages of their life histories. These are crucial in achieving high finfish and shellfish yields in the tropics even if their role seems to be mainly through the young stages of fishes [Robertson and blabber, 1992].Saldeek (1983) reported that among zooplanktons crustaceans, cladocerans and copepods can used as the indicator of aquatic environment. In present study also Copepoda with 17 species was the dominant group, Protozoa and larva forms consisted of 5 species and Ostracoda with 3 species. In present survey a total of 11 group of zooplankton were observed which comprise of 42 species. The most common copepods were *Paracalanus sp., Rhincalanus sp., Pseudodiaptomus sp. and Eucalanus sp*. Such types of numerical abundance of copepods in various waters were studied by (Gowsami, 1985a, b and Vijayalakshmi*et al.*, 1983). The high zooplankton density at river Kali might be due to relatively stable environmental conditions like optimal salinity, temperature, and good standing crop of phytoplankton prevailing in that region. During the present study it was seen thatthe backwater of the river (stn 6)was very rich in zooplankton. Various studies conducted on zooplankton diversity also have the same opinion about the richness of zooplankton in Mangrove areas of the estuary. The different types of larval forms found, depicts the effectiveness of estuary, this indicates that the breeding and spawning of shell fishes and crustaceans in the estuary is throughout the year. Similar observations were also made by Perumal *et al.* (2009) and Tiwari and Nair (1993). Larvae of crustaceans were found throughout the year and this type of observation was also reported from the estuarine ecosystem of Odisha (Gouda and Panigrahy, 1995; Mishra and Panigrahy, 1999). During the present study, zooplankton population is positively related with zooplankton biomass. Further intensive and long term studies are required to evaluate the secondary productivity of the estuary on a seasonal, annual basis and also elucidate the plankton biodiversity in the estuary.

Conclusion:

The study of zooplankton community of River kali showed that it consist of 11 groups with Copepoda being the dominant group followed by Protozoa and Larval forms of zooplanktons. The trend of the zooplankton population was noticed in all the stations of the river Kali, especially station 6 was found to have highest diversity of zooplanktons as it is a mangrove rich area. In the present study relatively high density of zooplanktons were found along the mangrove ecosystem.

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