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A study on Zooplankton diversity and abundance in mangroves of Kali Estuary, Karwar, West coast of India

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ABSTRACT

The present study conducted at the mangrove ecosystem of Kali estuary. Samples were collected from the three fixed stations for the period of thirteen months from January 2008 to January 2009 at regular monthly interval to identify and quantify the abundance and relative ratio of zooplankton. In the present study of species diversity of zooplankton groups in the mangrove area, composed of twelve groups comprising fifty two species major share comes from the copepods which comprises about seventeen species. Protozoa taxa comprised by five species, coelenterata and cladocera by two species each, ctenophore comprised by single species whereas the larval forms comprised by fourteen species.

KEYWORDS

Zooplankton, Diversity, Abundance, Estuary, Mangrove, Karwar.

INTRODUCTION

Present study was undertaken in the mangrove habitats of Kali estuary, Karwar. The importance of this ecosystem in escalating the productivity, harboring large faunal communities and highly rich fishing zone, so far no attempt has been made on the biotic community of this was undertaken. Keeping all these facts & figures in view, the present study was focused mainly on the zooplankton diversity of this ecosystem.

The River Kali originated in the Kusavali village in Supa taluka and after meandering about 185 km in the Sahyadri plateau and lastly joins the Arabian Sea at Karwar (14°50'21" N and 74°10'05"E). The River Kali flows at the beginning in a southeasterly direction then easterly, south, south easterly and southwest for a length of more than 50km and takes sudden westward turn and flows up to the confluence with Arabian Sea (Fig.1). River Kali exhibits different type of biotopes such as estuary, backwater, fresh water and mangrove, grassland etc. The environmental parameters of aquatic biotope fluctuate periodically dependable on the three conspicuous seasons, pre-monsoon (February-May), southwest monsoon (June-September) and post-monsoon (October-January)

MATERIALS AND METHODS

Totally three study stations were selected and fixed in the mangrove ecosystem of Kali estuary, Karwar on West coast of India. The study stations are Sunkeri, Kadawad & Kinnar (Fig. 1). Samples were collected from the three fixed stations for the period of thirteen months from January 2008 to January 2009 at regular monthly interval.

STUDY SITES:

Station 1: This study station is also located in the mangrove habitat Sunkeri which is about 5.75 km from the estuary point and located at the southern bank of the river is covered with rich mangrove floral stretch with maximum mangrove species. .

Station 2: This study station is around 9 km from the Kali estuary and is located in the Kadwad area. This study point located in the mangrove habitat of the river and this area is also known for good fishery throughout the year.

Station 3: This study station is located in the Kinnar which is around 12.5 km from the estuarine point and is mostly fresh water biotope with more number of freshwater fin fish species.

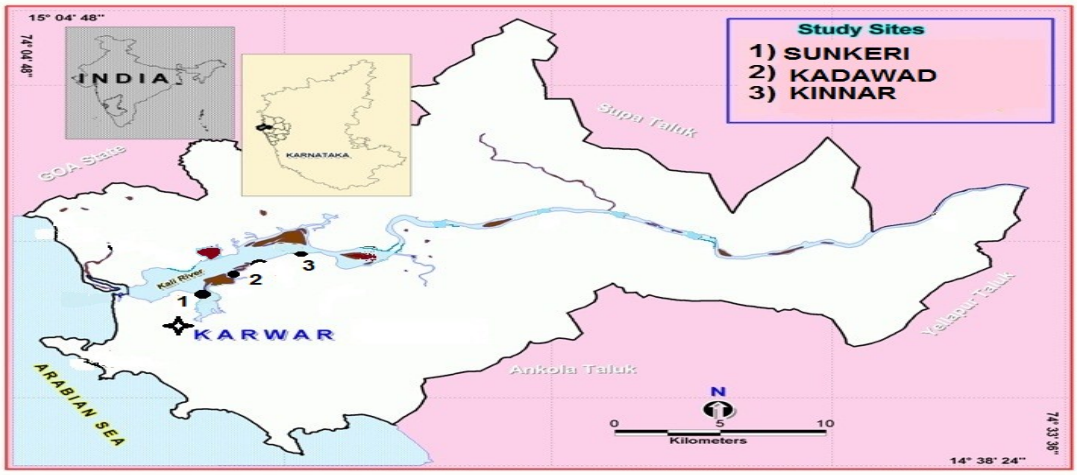

Fig 1: Map of Kali River Showing the position of Study Sites

SAMPLING METHOD

Samplings of zooplankton were carried out from the surface water, by towing the zooplankton net (mouth diameter 0.35 m) made up of bolting silk cloths (Mesh size 158 Fm), for half an hour from three stations located at mangrove ecosystem of Kali estuary (Fig.1), during the present study period. The collected samples were preserved in 5% neutralized formalin for further 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).

RESULTS & DISCUSSION

In the present study of species diversity of zooplankton groups in the mangrove area, composed of twelve groups comprising fifty two species major share comes from the copepods which comprises about seventeen species. Protozoa taxa comprised by five species, coelenterata and cladocera by two species each, ctenophore comprised by single species whereas the larval forms comprised by fourteen species. The maximum number of genera were found at station 1 (Sunkeri) and mainly contributed by maximum genera from the copepods and larval forms.

Diversity profile of Zooplankton:

Zooplankton reflect the ecological and environmental status and were calculated in terms of number of individuals / specimens (N), number of species (S), total abundance (A), Margalef species richness, (*d'*), Pielou's

Table 1. Check List of Zooplanktons of All Three Study Stations.

Zooplankton species	Zooplankton species
Protozoa	**Ostracoda**
Tintinnopsis sp.	*Labidocera* sp.
Favella sp.	*Oncaea* sp.
Rhabdonella sp.	**Cladocera**
Globigerina sp.	Penillia sp.
Acanthometron sp.	*Evadne* sp.
Coelenterata	**Decapoda**
Obelia sp.	*Lucifera* sp.
Siphonophora sp.	**Annelida**
Ctenophora	Polychaeta:
Pleurobrachia sp.	*Tomopteris* sp.
Chaetognatha	*Spionid* sp.
Sagitta enflata	**Mollusca (Pteropoda)**
S. Bedotii	*Creseis acicula*
Arthropoda	*C.* sp.
Copepoda:	**Protochordata**
Acrocalanus sp.	*Doliolum* sp.
Paracalanus sp.	*Oikopleura* sp.
Rhincalanus sp.	**Larval forms**
Pseudodiaptomus sp.	Copepod nauplius
Eucalanus sp.	Eupahusid nauplius
Copilia sp.	Cirrepede nauplius
Macrosetella sp.	Pontellid nauplius
Miocrosetella sp.	Brachiopod larva
Undinula sp.	Zoea
Acartia sp.	Cyphonautus larva
Temora sp.	Decapod larva
Oithona sp.	Gastropoda
O. plumifera	Bivalvia
Euchaeta sp.	Arachnetcis larva
Euterpina sp.	Fish eggs & larvae
Centropages sp.	
Pontellid	

evenness (*J'*), Shannon index (*H'*) at each sites (Clarke and Gorley, 2001). Bray Curtis similarity for species diversity for all species belonging to zooplankton was determined analytically by PRIMER-V5.

The species richness (d) showed considerable variation in months at station 1 (Sunkeri). The values ranged from 2.540 to 5.915 in August and December months respectively. The Shannon index values varied between 1.455 and 2.076 in August and December (Table 2 & 3). In continuation with this, the species evenness of zooplankton varied between 0.440 (April) and 0.588 (July) respectively.

At station 2 (Kadwad), the zooplankton species richness values ranged from 2.909 to 6.228 in August and December months. Whereas the Shannon index values varied between 1.263 and 2.271 during August and November months respectively (Table 4 & 5). Zooplankton species evenness values ranged from 0.403 (August) to 0.580 (December) with stable values during January to May months.

The species richness of the zooplankton at study station 3 (Kinnar) varied considerably in months and its values ranged from 2.273 to 5.631 in August and November months respectively. Similarly, the Shannon index values varied between 1.121 and 2.018 in August and March months (Table 6 & 7). There is no marked variation in the zooplankton species evenness values between the months and overall it varied between 0.387 (August) and 0.563 (March) respectively.

Based on the numerical abundance, it was found that among zooplankton groups represented in the study areas (mangrove ecosystem), the group larval forms copepods and protozoans were the most dominant groups at station 1st & 2nd. This is further substantiated by the comparatively high diversity index (Shanon index) of larval and copepods at all three study stations.

Similarity Index of Zooplankton

At Sunkeri station, Table 3 and Figure 2 explains the similarity of density between the months. The overall values ranged from 76.87 to 99.45%. Maximum similarity of 99% was observed during June & October, which is followed by and 98% during August & September whereas the third group of cluster of 97% was noticed during in March & December months.

At Kadawad station , the similarity of indices shown great variation (74.86 – 99.14%) among the stations and is given in the Table 5. On the basis of Bray Curtis similarity index it was inferred that, the maximum similarity indices were noticed during July & August; November & December; Janaury'08 & March and June & January'09 respectively at study station 2 and the data has been explained in the Figure 3 respectively. In remaining months they were dissimilar at this level.

Table 7 and Figure 4 shows the variation in the similarity indices of this community at station 3 ranging from 65.05 to 99.24% during the months. In Figure 4, the maximum similarity group of cluster was formed during the months of July & September (99%) followed by August & November; and June & December registering the percentile of 98% forming the second group of cluster. In remaining months they were dissimilar at this level.

Table 2: Monthly variation in the species diversity and richness of Zooplankton fauna at Study Station 1

	S	N	d	J'	Brillouin	Fisher	H'(loge)	1-Lambda'
Jan.08	39	3484	4.6591	0.4787	1.7301	6.1502	1.7540	0.6124
Feb.	35	3771	4.1286	0.4768	1.6745	5.3333	1.6952	0.5931
Mar.	33	3213	3.9628	0.5507	1.9019	5.1218	1.9256	0.6740
Apr.	46	4459	5.3554	0.4404	1.6647	7.1452	1.6862	0.5820
May	49	5030	5.6317	0.4869	1.8729	7.5320	1.8949	0.6297
Jun.	34	2705	4.1757	0.5783	2.0101	5.4806	2.0395	0.6853
Jul.	24	2308	2.9699	0.5882	1.8447	3.7334	1.8696	0.6807
Aug.	21	2624	2.5405	0.4782	1.4371	3.1172	1.4558	0.5492
Sept.	22	2554	2.6767	0.5199	1.5874	3.3081	1.6071	0.6164
Oct.	35	2734	4.2964	0.5370	1.8821	5.6617	1.9092	0.6668
Nov.	48	3009	5.8681	0.5071	1.9391	8.1094	1.9630	0.6601
Dec.	49	3341	5.9156	0.5335	2.0466	8.1399	2.0764	0.6900

Table 3: Monthly variation in the similarity indices of Zooplankton fauna at Station 1

	Jan. 08	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Jan.08	0	0	0	0	0	0	0	0	0	0	0	0
Feb.	96.0251	0	0	0	0	0	0	0	0	0	0	0
Mar.	95.8932	92.0764	0	0	0	0	0	0	0	0	0	0
Apr.	87.7932	91.5832	83.7690	0	0	0	0	0	0	0	0	0
May	81.9503	85.6773	78.0159	94.0203	0	0	0	0	0	0	0	0
Jun.	87.5103	83.7528	91.5227	75.6758	70.1448	0	0	0	0	0	0	0
Jul.	79.6752	76.0317	83.6444	68.2559	62.9920	91.9511	0	0	0	0	0	0
Aug.	85.7288	82.0012	89.7618	73.9791	68.4908	98.1623	93.5756	0	0	0	0	0
Sept.	84.4537	80.7418	88.4747	72.7668	67.3216	96.8605	94.9417	98.6312	0	0	0	0
Oct.	88.0539	84.2811	92.0264	76.1948	70.6469	99.4470	91.4113	97.6214	96.3197	0	0	0
Nov.	92.6274	88.6869	96.4644	80.8609	75.2481	94.4670	86.4835	92.6454	91.3507	95.0143	0	0
Dec.	97.7400	93.7822	97.7614	85.8342	80.1285	89.3642	81.4738	87.5523	86.2721	89.9011	94.8598	0

Table 4: Monthly variation in the species diversity and richness of Zooplankton fauna at Study Station 2

	S	N	d	J'	Brillouin	Fisher	H'(loge)	1-Lambda'
Jan.08	46	2942	5.6342	0.5056	1.9047	7.7401	1.9360	0.6562
Feb.	43	3201	5.2036	0.4916	1.8217	7.0209	1.8490	0.6365
Mar.	44	3011	5.3682	0.5203	1.9389	7.3040	1.9690	0.6697
Apr.	48	3870	5.6893	0.4725	1.8035	7.7176	1.8291	0.6204
May	49	4817	5.6604	0.5004	1.9247	7.5916	1.9477	0.6407
Jun.	38	2844	4.6523	0.5507	1.9737	6.1981	2.0034	0.6766
Jul.	24	1815	3.0650	0.5206	1.6251	3.9066	1.6546	0.5999
Aug.	23	1921	2.9098	0.4027	1.2369	3.6732	1.2626	0.4393
Sept.	27	1657	3.5074	0.4641	1.4972	4.5812	1.5297	0.5354
Oct.	45	2070	5.7627	0.4865	1.8129	8.1146	1.8522	0.6270
Nov.	48	2654	5.9615	0.4945	1.8792	8.3216	1.9145	0.6333
Dec.	50	2611	6.2281	0.4804	2.2317	8.7732	2.2708	0.7299
Jan.09	50	2773	6.1808	0.5649	2.1728	8.6628	2.2099	0.7121

Table 5: Monthly variation in the similarity indices of Zooplankton fauna at Station 2

	Jan. 08	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan. 09
Jan. 08	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb.	95.7980	0	0	0	0	0	0	0	0	0	0	0	0
Mar.	98.8189	96.9726	0	0	0	0	0	0	0	0	0	0	0
Apr.	86.5991	90.6177	87.6712	0	0	0	0	0	0	0	0	0	0
May	76.1967	80.0714	77.2319	89.2471	0	0	0	0	0	0	0	0	0
Jun.	98.1585	94.0936	97.0702	84.7965	74.4730	0	0	0	0	0	0	0	0
Jul.	76.1973	72.4007	75.1703	63.9530	54.9503	77.9362	0	0	0	0	0	0	0
Aug.	78.7825	74.9355	77.7419	66.3465	57.1474	80.5413	97.1493	0	0	0	0	0	0
Sept.	72.1368	68.4312	71.1325	60.2287	51.5506	73.8377	95.4182	92.5976	0	0	0	0	0
Oct.	83.0015	78.9667	81.8777	70.2868	60.7881	84.4098	92.88	95.6029	88.5752	0	0	0	0
Nov.	94.9195	90.7361	93.7385	81.7183	71.5320	96.3746	80.9500	83.5880	76.7938	87.8977	0	0	0
Dec.	94.0677	89.8905	92.8918	80.9052	70.7966	95.5239	81.6547	84.2983	77.4848	88.6167	99.1373	0	0
Jan. 09	97.0063	92.8171	95.8295	83.7547	73.5080	98.4769	78.8419	81.4717	74.7250	85.7379	97.8022	97.0624	0

Table 6: Monthly variation in the species diversity and richness of Zooplankton fauna at Study Station 3

	S	N	d	J'	Brillouin	Fisher	H'(loge)	1-Lambda'
Jan.08	44	2362	5.5360	0.4289	1.5895	7.6755	1.6231	0.5670
Feb.	39	2041	4.9860	0.5291	1.9013	6.8400	1.9387	0.6787
Mar.	36	1918	4.6302	0.5633	1.9808	6.2900	2.0186	0.7096
Apr.	45	3145	5.4634	0.4108	1.5359	7.4390	1.5639	0.5382
May	46	4627	5.3319	0.4670	1.7670	7.0971	1.7879	0.6855
Jun.	26	1851	3.3229	0.4571	1.4599	4.2824	1.4893	0.5384
Jul.	20	1470	2.6052	0.4714	1.3826	3.2736	1.4122	0.5168
Aug.	18	1765	2.2739	0.3877	1.0978	2.7900	1.1206	0.3987
Sept.	23	1489	3.0112	0.4504	1.3812	3.8605	1.4122	0.5182
Oct.	32	1448	4.2594	0.5275	1.7866	5.7912	1.8282	0.6630
Nov.	43	1735	5.6309	0.5306	1.9515	7.9837	1.9958	0.7005
Dec.	40	1814	5.1977	0.5389	1.9451	7.2355	1.9880	0.6740
Jan.09	43	2185	5.4620	0.4861	1.7899	7.5889	1.8285	0.6061

Table 7: Monthly variation in the similarity indices of Zooplankton fauna at Station 3

	Jan. 08	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan. 09
Jan. 08	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb.	92.7388	0	0	0	0	0	0	0	0	0	0	0	0
Mar.	89.6359	96.8741	0	0	0	0	0	0	0	0	0	0	0
Apr.	86.0671	79.0325	76.0639	0	0	0	0	0	0	0	0	0	0
May	68.1132	61.7805	59.1450	81.2065	0	0	0	0	0	0	0	0	0
Jun.	87.5943	94.7728	97.8841	74.1243	57.4141	0	0	0	0	0	0	0	0
Jul.	76.4510	83.3948	86.4394	63.7231	48.4557	88.5215	0	0	0	0	0	0	0
Aug.	84.9957	92.1345	95.2376	71.6711	55.2696	97.3508	90.9262	0	0	0	0	0	0
Sept.	77.1713	84.1348	87.1863	64.3859	49.0162	89.2730	99.2384	914426	0	0	0	0	0
Oct.	76.2712	83.2387	86.2819	63.5542	48.3342	87.8138	98.6911	89.7201	98.2030	0	0	0	0
Nov.	85.0867	91.9890	94.8821	71.7443	55.3462	96.1945	90.9863	98.1681	91.7407	90.8271	0	0	0
Dec.	87.1079	94.2366	97.1461	73.662	57.0274	98.4832	88.9679	97.8018	89.7194	88.8094	97.7311	0	0
Jan. 09	96.1735	96.5559	93.4370	82.3425	64.7373	91.3598	80.0797	88.7363	80.8107	79.9203	88.8429	90.8908	0

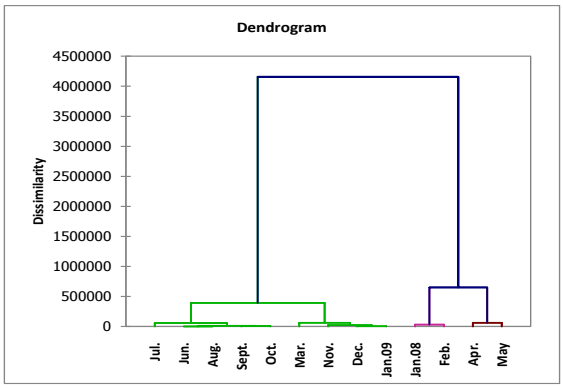

Figure 2: Dendrogram showing similarity of Zooplankton density at station 1.

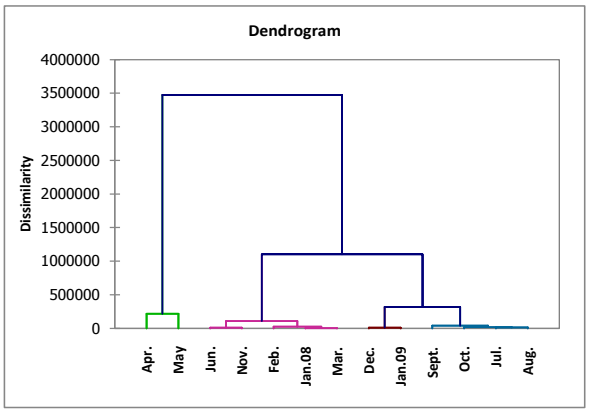

Figure 3: Dendrogram showing similarity of Zooplankton density at station2.

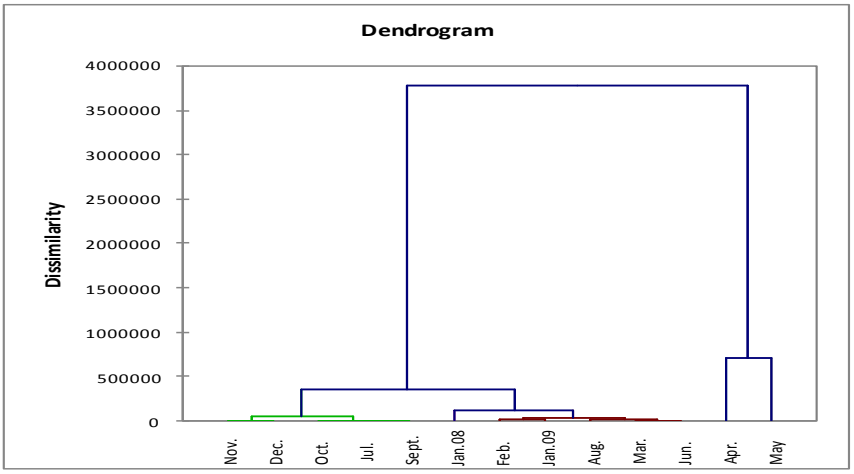

Figure 4: Dendrogram showing similarity of Zooplankton density at station 3.

CONCLUSION:

The study of zooplankton community of Mangrove ecosystem of Kali estuary showed that it was composed of twelve groups namely protozoa, coelenterate, ctenophore, chaetognatha, copepods, ostracoda, cladocera, decapoda, polychaeta, pteropoda, protochordata and larval forms. Among these, the larval forms, copepod and protozoa were the three major groups. The larval forms and copepods have exhibited dominance over the other groups in all the three seasons like pre, southwest and post monsoon respectively. The abundance of copepods and larval forms reached their peak during April-May and October-December which coincided with the peaks of phytoplankton in these months, clearly indicating the dependence of this group on phytoplankton. Similar findings were reported in other mangrove water bodies also.

In conclusion the present study of the zooplankton community of the mangrove ecosystem showed that, although nutrient levels were not appreciable, relatively high densities of zooplankton were found in the study area. The abundance and species composition of the same resembled that of other mangrove area of the tropical area. The magnitude of abundance was interrelated and cumulative effects of various physico-chemical parameters. The onset and prolonged southwest monsoon played an important role in bringing about the drastic changes in the hydrographical conditions of the estuary/mangrove ecosystem resulting in great variations in their abundance and distribution pattern.

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