CHAPTER 4

ZOOPLANKTON

Introduction

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4.1 Introduction

Zooplankton are the diverse, delicate and often very beautiful, assemblage of animals that drift the waters of the world's ocean. It plays an important role in ecology of oceans by controlling phytoplankton population, shaping food web, a major contributor of the food base for larval fish stocks and some adult fish species (Mavuti & Litterick, 1981). It is an important link between primary production and planktivorous fish and other aquatic fauna (Ekwu *et al.,* 2006, Robin *et al.,* 2009). They play an important role in trophic dynamics of planktonic ecosystems as they transfer energy from primary productivity to higher trophic levels (Davis, 1996) hence they are considered as a chief index of utilization of aquatic biotope at secondary level (Goswami & Padmavati, 1996). In addition, they have a potential importance as indicators of water quality in ecosystems function (Suzanne and Jeffery, 1997). Zooplankton organisms have various behavioral adaptations like utilization of tidal current, vertical migration, high reproductive rate and changes in the larval behaviors by which they have been successfully thriving well in the dynamic systems like estuaries, creeks, and bays (Wooldridge *et al.,* 1980). Study of zooplankton forms an important aspect of biological oceanography (Bhunia and Choudhury, 1998). The rate of zooplankton production can be used to estimate the exploitable fish stock (Tiwari and Nair, 1991). Abundance of zooplankton practically acts as an ideal index to assess the fertility of water mass. Zooplankton may be classified according to their habitats, depth distribution, size and duration of planktonic life. They include a wide variety of passively drifting organisms of different shape, size belonging to various animal phyla viz., Protozoa, Coelenterates, Chaetognatha, Annelids, Arthropoda, Mollusca, etc.

Variability is a characteristic feature of plankton distribution. Hydrographic parameters undergo considerable variation due to the seasonal and climatological changes, which in turn influence the spatial and temporal distribution of planktonic communities (Krishnamurthy and Santhanam, 1975; Damodara Naidu *et al.*, 1997). Some fishes are exclusively zooplankton feeder and therefore their abundance is directly linked to the presence of particular zooplankton in the environment. Furthermore, many zooplankton species are used as the indicators of water quality and pollution (Mishra and Panigrahy, 1999) which include changes in community structure, species diversity, species preference and bioaccumulation of toxicants.

4.2 Methodology

The present investigation was carried out at in the three selected sampling stations for a period of 2 years from June 2007 to May 2009. Collected data were grouped seasonally (winter, summer and Monsoon). Samples were collected at the same sites where samples for phytoplankton and other water quality parameters were collected. Zooplankton samples were collected using standard zooplankton net with a mouth area of 0.25 m^2 (0.5x0.5m) fitted with a flow meter. The net was towed from a boat for 5 minute with a constant boat speed of 2 nautical miles per hour. Initial and final reading in the flow meter was noted down and the soup collected in the plankton bucket was transferred to appropriately labelled container and preserved with 5% neutralized formaldehyde. In order to counter-check the zooplankton density values obtained, water samples of 100 litres was collected and preserved, which was later analyzed for zooplankton density.

One ml of the zooplankton soup was added to a Sedgwick counting chamber and was observed under a compound microscope. The group/taxa were identified using standard identification keys and their number was counted. Random cells in the counting chamber were taken for consideration and the number of zooplankton were noted down along with their binomial name. This was repeated for five 1 ml samples and the average value was considered for final calculation. For greater accuracy, the final density values were counter-checked and compared with the data collected by settlement method.

Different diversity and dominance indices (Shannon H, Evenness e^H/S, Margalef, Pielou evenness) for species diversity, evenness and richness were computed following Magurran (1988) for all the sampled stations. Agglomerative hierarchical cluster analysis and Multi-Dimensional Scaling (MDS) was used to assess level of similarity among different stations in all the 3 seasons in both the years.

4.3 RESULTS:

4.3.1 Taxa/Group Composition:

Composition of zooplankton in the three study stations for a period of 2 years was diverse and mainly contributed by copepods, decopods, fishes and polychaete larval forms. A total of 47 groups in eleven broader taxa (Calanoids, Cyclopoids, Harpacticoid, Appendicularians, Chaetognaths, Cladocerans, Decapods, Fishes, Hydrozoans, Molluscs, Polychaetes) was similar in the both the years during different seasons and stations (Table. 4.1, 4.2). Sanghi, Mundra and Mandvi recorded 32, 34 and 35 groups during summer for the first year and whereas in second year, 31, 31 and 35 groups were recorded. For the winter seasons, Sanghi, Mundra and Mandvi recorded 35, 38 and 36 groups for the first year and 35, 33 and 31 during the second year. For the monsoon seasons Sanghi, Mundra and Mandvi recorded 43, 44 and 40 groups during the first year and 39, 36 and 34 during the second year (Table 4.1, 4.2). When compared to both the years the maximum groups/taxa representation was recorded in the monsoon at Sanghi during both the first and the second year (Table. 4.3). In all the seasons and stations, copepods constituted the major group followed by decapods (Table. 4.3). Among copepods, calanoids with 18 groups constituted the major group whereas other two copepod groups (cyclopoids and harpacticoids) were poorly represented in all the stations and seasons with only two taxa each. Zooplankton composition showed that all the taxa were represented by more than one species except cladoceran and ostracod which was represented by only one genus (*Evadne* sp.) and *Pyrocypris* sp respectively.

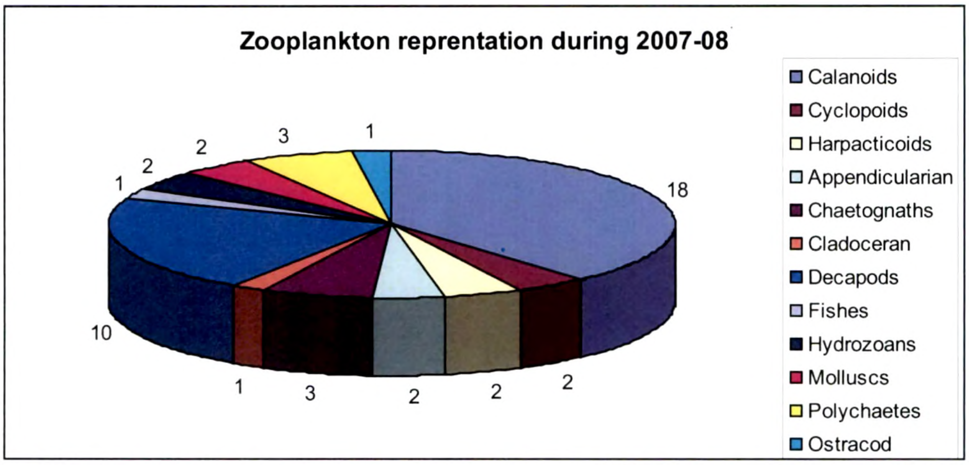

Fig: 4.1 Graphical representation of zooplankton during 2007-08

Calanoid groups had the largest representation with 18 groups though all the groups were not recorded during any season or stations. Following calanoids, decapods were represented by 10 groups and all these 10 groups were recorded at Mundra during Monsoon season. Chaetognaths represent by 3 groups and all three groups found during all three season in Mundra during 1st year. cyclopoids, harpacticoids, appendicularians, and molluscs were represented by two groups each (Fig. 4.1).

While during second year calanoids represents 18 groups followed by cyclopoids by 9 groups and rest of them groups were same number as during first year (Fig 4.2). All these stations had two molluscan groups well represented in all the seasons. The four hydrozoan medusa were conspicuously absent in all stations during winter and the only cladoceran, *Evadne* sp. recorded was absent during summer at Mundra and Mandvi (Table 4.1).

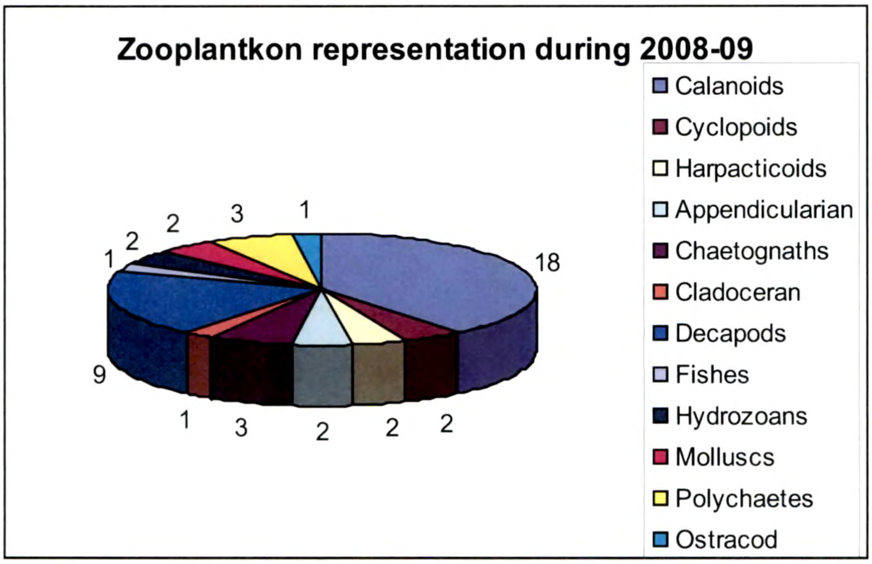

Fig: 4.2 Graphical representation of zooplankton during 2008-09.

Copepods like *Acrocalanus* are euryhaline in nature and tolerate salinity fluctuations during summer showing wider temporal distribution. Representation of Chaetognaths throughout the year has been well documented by several workers. Especially, *Sagitta* sp, being a carnivorous copepod with resistance to higher salinity has been recorded round the year (Mishra and Panigrahy, 1999). As most of the crustaceans (including brachyuran groups) are prolific breeders with short intervals, their larval forms were reported in all seasons. Similarly, in the present study meroplanktonic forms of fishes like fish eggs and larvae were well represented in all the seasons and stations.

Higher zooplanktonic composition recorded at Mundra and Sanghi could be due to presence of mangrove ecosystem in the vicinity which provide suitable feeding place to these larval forms. The occurrence of larval forms throughout the year in different marine environments has been well documented by several earlier studies. (Singh and Chaudhry, 1986; Mishra and Panigrahy, 1999).

4.3.2 Zooplankton distribution

Comparison of seasonal distribution pattern in the three study stations (Sanghi, Mundra, Mandvi) revealed that the number of taxa and groups were higher in all stations during monsoon months than winter and summer. (Table 4.1). Station-wise, Mundra and Sanghi recorded more number of groups and taxa in all seasons than Mandvi. In Sanghi, all the groups were represented during monsoon whereas during summer and winter cladocerans (*Evadne* sp) and hydrozoans (medusa) were not represented. Molluscan larvae represented by two groups were equally well represented in all the three seasons and stations showing that these groups are perennial breeders though the intensity of breeding is more pronounced during monsoon as shown by higher densities recorded during monsoon months. Irrespective of the different study stations, temporal distribution of the genera/groups showed that out of the 47 taxa recorded during the entire study, 17 taxa had wider temporal distribution with 100% occurrence during all the three seasons (Table 4.1, 4.2).

These groups were mostly euryhaline forms with perennial breeding habits like brachyurans, fish egg and larvae, Lucifer, cirripedes and gastropods. Copepods like *Oithona brevicornis* and *Acrocalanus* registered their occurrence throughout the year with 100% frequency. Forms like *Acartia* sp, Acrocalanus *gracilis, Macrosetella sp, Rhincalanuscornatus,* Sabellaria larvae and polychaete larvae also had wider distribution registering 89% of frequency in all stations and seasons. Other groups like Caridean larvae (22%), spionid larvae and the Calanoid, *Temora discaudata* (44%) had very much restricted temporal distribution and were recorded only during very few months and seasons.

Spatial distribution of the different taxa showed that Sanghi had the maximum of 91% of taxa (43 out of 47) during monsoon followed by 74% taxa (35 out of 47) and 68% (32 out of 47) of the taxa recorded during winter and summer respectively during the first·year and in the second year the maximum of 85% taxa (39 out of 46) was recorded during monsoon followed by 76% taxa (35 out 46) and 67% taxa (31 out of 46) during summer and. winter

In Mundra the maximum of 94% taxa (44 out of 47) during monsoon followed by 81% (38 out of 47) and 72% (34 out of 47) during winter and summer in the first year and second year it recorded 78% of taxa (36 out of 46) in the monsoon followed by 67% (31 out of 46) and 72% (33 out of 46) during summer and winter.

In Mandvi the maximum taxa of 87% (40 out of 46) during monsoon followed by 78% (36 out of 46) and 76% (35 out of 46) during winter and summer (2007-2008). In the second year the maximum of 76% taxa (35 out of 46) was recorded in summer followed by 67% (31 out of 46) and 76% (35 out of 46) during winter and monsoon (Table 4.3).

4.3.3 Graphical or distributional techniques:

4.3.3.1. K- Dominance curve:

Multiple K-dominance plots were constructed for all the samples, seasons and stations as implemented in PRIMER. Fig 4.3 shows the observed findings for all samples collected during entire collection period. It can be seen that the maximum faunal population was 44 species in Mundra during monsoon 2008 contributing 93% of the total faunal numbers. The minimum species count (35) was recorded at Mandvi during winter, 2009.

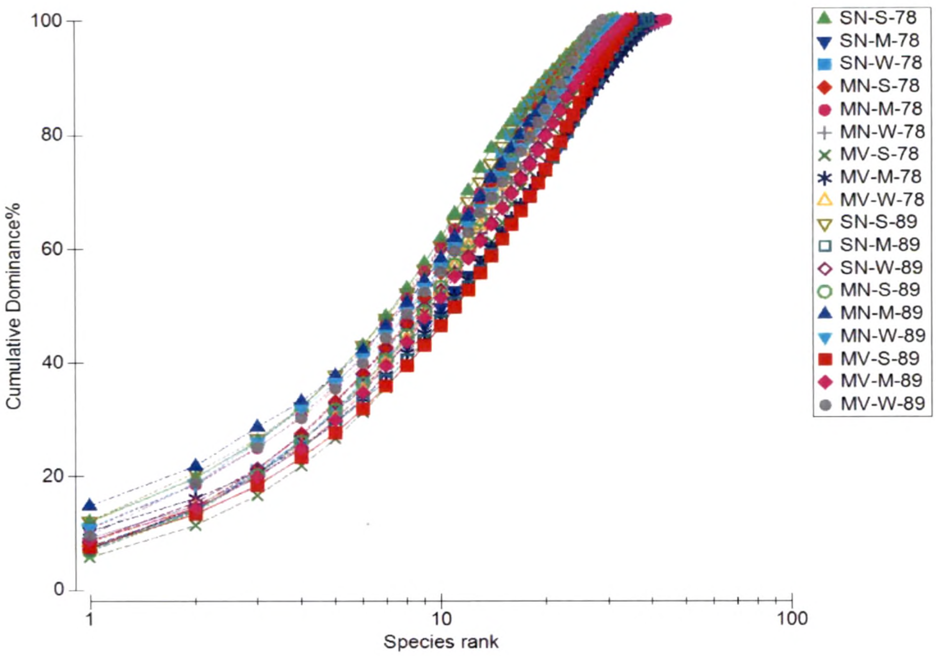

Fig 4.3 Cumulative dominance of zooplankton during all seasons in 2007-09

4.3.4. Multivariate methods:

4.3.4.1. Cluster analysis (Bray-Curtis similarity)

Cluster analysis is a technique in which entities are sequentially linked together according to their similarity (or dissimilarity) producing a two dimensional hierarchical structure (dendrogram). The results of hierarchical clustering is represented by a tree diagram or dendrogram, with the X - axis representing the full set of samples and the Y- axis defining a similarity level at which two samples or groups are considered to have fused. Fig. 4.4. display the results of the hierarchical clustering, using the group average linking on the zooplankton species abundance data for the 3 stations during six seasonal collections in three stations. Bray-Curtis similarities were calculated on the 4th root transformed data (as implemented in PRIMER). From the overall cluster analysis (Winter 2008 to Monsoon 2009), it was observed that maximum similarity (78.72%) was between Sanghi monsoon 2008 and monsoon 2009. Next similarity (77.45%) was in between Mundra monsoon 2008 and monsoon 2009. Next 68.75% showed Mundra summer 2008 and summer 2009. Sanghi winter 2009 and Mandvi summer 2009 joined with 69.07% and Sanghi summer 2008 and summer 2009 joined with 66.75%. This same trend was confirmed in MDS ordination (Fig 4.5).

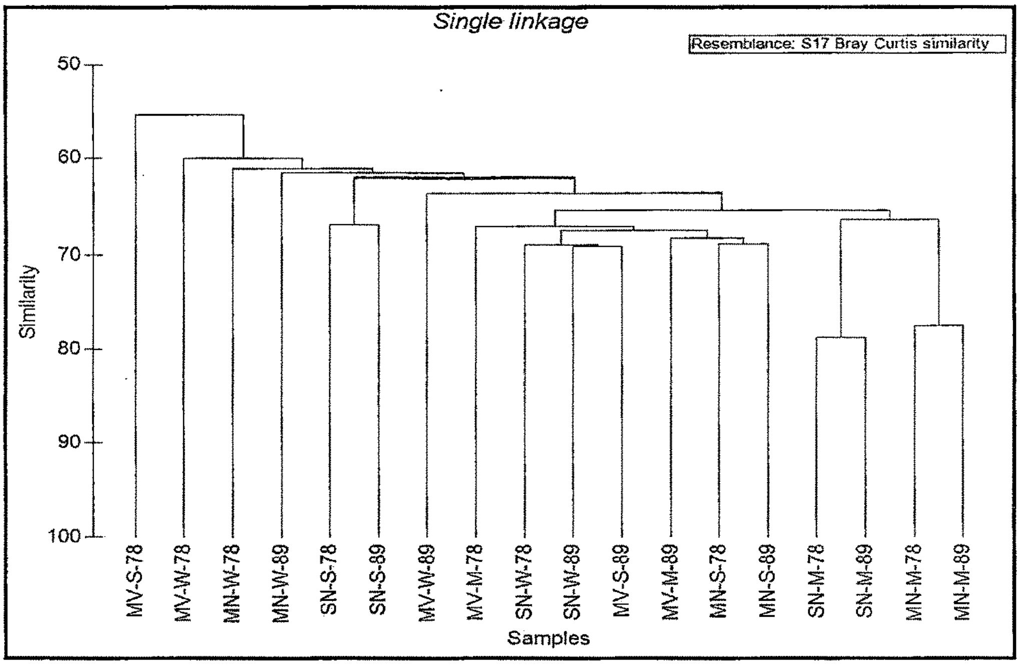

Fig. 4.4 Dendrograph of cluster analysis of zooplankton

4.2.4.2 MDS (non-metric Multi Dimensional Scaling):

Six seasonal samples collected in three stations over a period of 24 months were treated with MDS (Non-Metric Multi-Dimensional Scaling (Shepard 1962; Kruskal, 1964). MDS is a simple concept based on relevant sample information.

In MDS a map of samples through ordination is created in which the placement of samples, rather than representing their simple geographical location, reflects the similarity of their biological communities. Distances between samples on the ordination attempt to match the corresponding dissimilarities in community structure; nearby points have very similar communities, samples which are far apart have few species in common or the same species at very different levels of abundance (or biomass). To confirm the pattern of grouping obtained in cluster dendrogram, ordination (MDS) was done for all the seasons. The trend observed in cluster analysis was quiet evident here (Fig. 4.4.). The stress values found in MDS configurations were low (<0.2) suggesting good representation of interrelationship between the fauna of stations sampled.

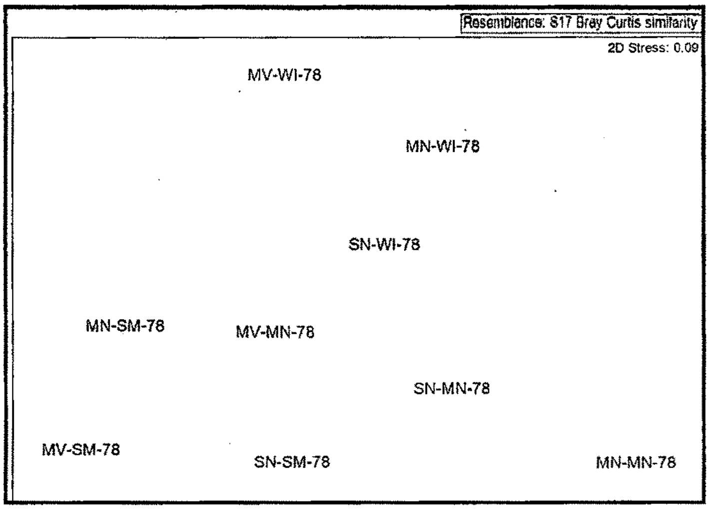

Fig. 4.5 Multi dimensional scaling of zooplankton

4.3.5 Density:

Average density of zooplankton was highest during monsoon followed by winter (Table 4.3). Summer recorded the lower density in all the three stations with a value of 379, 309 and 212 cells/m^3 at Sanghi, Mundra and Mandvi in the first year and 402, 306 and 368/m^3 in the second year, whereas winter recorded density of 474, 626 and 327 cells/m^3 in the first year and in the second year it recorded 408, 584 and 334/m^3 during the three seasons and stations (Table 4.3). Generally, calanoid copepods contributed predominantly to the faunal density whereas density of other two recorded copepods (harpacticoids and cyclopoids) was least (Table 4.4, 4.5).

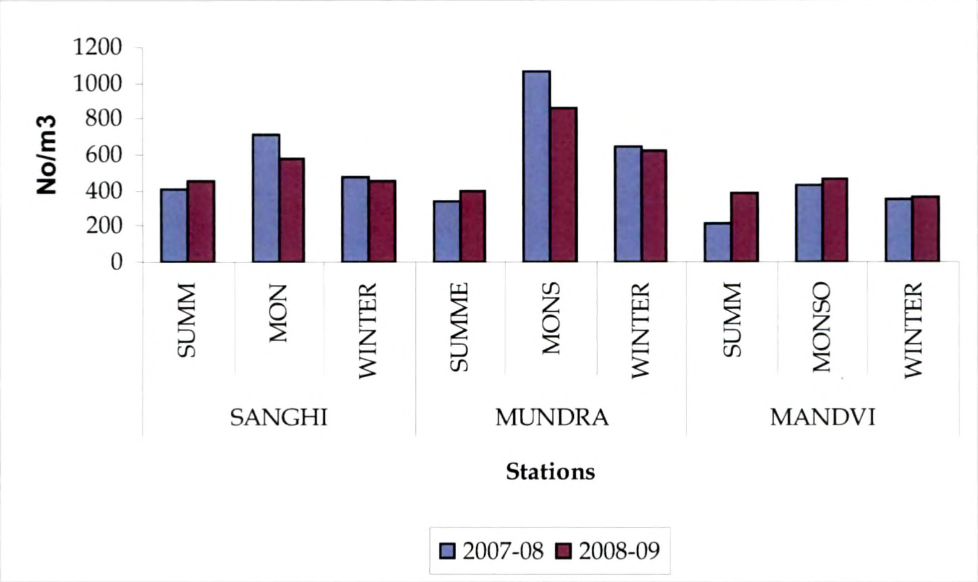

Fig 4.6. Zooplankton Density during different Seasons and Stations

Mundra during monsoon recorded the highest copepod density of 500 cells/m^3 in the first year and 316cells/m^3 in the second year. Next to copepods, decapods' contribution was higher in all the seasons with the highest density of 256 cells/m^3 during monsoon at Mundra in the first year and 219 cells/m^3 in the second year (Fig. 4.6). Other faunal groups like polychaetes, mollusks and fishes contributed moderately in the range of 2 to 114 cells/m^3 in the first year and 1 to

114 cells/m^3 in the second year across seasons and stations. With the single representation of *Evadne* sp, cladocerans contributed the lowest density of 2 to 5 cells/ m^3 in many stations and seasons.

4.3.6. Species Diversity, Evenness and Richness

Temptation Shannon diversity indices (H′) values for zooplankton for entire study period of two years ranged from 3.15 to 3.50 (Table 4.3). Diversity values during the second year were almost similar to the first year values. Similarly, among stations, average diversity values did not vary much. Mundra and Sanghi recorded an average diversity value of 3.29 and 3.31 while Mandvi recorded an average diversity value of 3.37.

Season wise, Monsoon 2008 and monsoon 2009 recorded highest diversity value of 3.43 and 3.36 whereas in other seasons values were lower (Table 4.3). Recorded diversity values indicate even distribution of zooplankton species in the study stations.

Pielou's Evenness values ranged from 0.6282 to 0.89 (Table 4.3). Evenness values were generally higher in all the stations during summer and lower during monsoon. Summer 2009 recorded higher evenness values of 0.83 whereas other seasons recorded values of 0.82 and 0.79. Second year recorded marginally higher evenness values than the first year. Station-wise, Mandvi recorded comparatively higher average evenness values of 0.84 than Mundra (0.75) and Sanghi (0.77). Higher evenness values at Mandvi showed that species distribution was more uniform and evenly distributed in these stations.

Mergalef's richness values ranged for the entire study period 4.82 to 6.48 (Table 4.3). Average Mergalef's values were marginally higher (5.97) during first year than the second year (5.34). Station-wise, highest Mergalef values were recorded during Mandvi 2007-08 and lowest during Mundra 2008-09 while year wise first year recorded higher Margalef values than second year. Season-wise lowest everness value of 5.11 was recorded during winter 2009. Station-wise average Mergalef's richness was higher at Mandvi (5.81) and lower at Mundra (5.53).

Table: 4.1 Number of Zooplankton Genera/Species under different Groups in three Stations 2007-08

		Sanghi			Mundra			Mandvi		
Groups	**Taxa**	**S**	**M**	**W**	**S**	**M**	**W**	**S**	**M**	**W**
Calanoids	18	12	16	13	15	16	14	13	17	16
Cyclopoids	2	1	2	2	1	1	2	1	2	2
Harpacticoids	2	1	2	1	1	2	2	2	2	2
Appendicularian	2	2	2	1	0	2	2	1	2	0
Chaetognaths	3	1	2	3	3	3	3	2	1	2
Cladoceran	1	0	1	1	1	1	0	1	0	0
Decapods	10	8	9	9	7	10	8	7	8	9
Fishes	1	1	1	1	1	1	1	1	1	1
Hydrozoans	2	2	2	0	2	2	0	2	2	0
Molluscs	2	2	2	2	2	2	2	2	2	2
Polychaetes	3	2	3	1	1	3	3	3	2	2
Ostracod	1	0	1	1	0	1	1	0	1	0
Total	**47**	**32**	**43**	**35**	**34**	**44**	**38**	**35**	**40**	**36**

Table 4.2 Number of Zooplankton Genera/Species under different Groups in three Stations 2008-09

Groups	Taxa	Sanghi			Mundra			Mandvi		
		S	M	W	S	M	W	S	M	W
Calanoids	18	11	14	14	11	13	11	15	13	11
Cyclopoids	2	1	2	1	1	1	1	2	1	2
Harpacticoids	2	2	2	2	1	2	1	1	1	1
Appendicularian	2	1	2	1	1	1	1	1	1	0
Chaetognaths	3	1	2	2	2	1	2	1	1	2
Cladoceran	1	1		1		1	1	1	1	1
Decapods	9	7	8	6	7	9	8	6	7	7
Fishes	1	1	1	1	1	1	1	1	1	1
Hydrozoans	2	2	2	1	2	2	2	2	2	0
Molluscs	2	2	2	2	2	2	2	2	2	2
Polychaetes	3	2	3	2	2	3	2	3	2	2
Ostracod	1	0	1	0	0	0	0	0	0	0
Total	**46**	**31**	**39**	**33**	**30**	**36**	**32**	**35**	**32**	**29**

Table 4.3 Zooplankton Diversity, Evenness and Richness Indices for the Seasons and Stations- 2007-2009

Season	Station	Species Richness	Abundance	Mergalef Richness	Pielou's Evenness	Shannon Diversity
Winter 2008	Sanghi	35	474	5.511	0.7372	3.251
	Mundra	38	626	5.737	0.7719	3.379
	Mandvi	36	327	6.032	0.7717	3.324
Summer 2008	Sanghi	32	373	5.233	0.7266	3.146
	Mundra	34	303	5.779	0.7653	3.259
	Mandvi	35	209	6.353	0.866	3.411
Monsoon 2008	Sanghi	43	683	6.428	0.7708	3.501
	Mundra	44	1048	6.175	0.6282	3.319
	Mandvi	40	406	6.475	0.8102	3.478
Winter 2009	Sanghi	34	408	5.49	0.828	3.338
	Mundra	33	584	5.024	0.7883	3.259
	Mandvi	29	334	4.818	0.8572	3.213
Summer 2009	Sanghi	31	402	5.003	0.7609	3.161
	Mundra	31	306	5.241	0.8505	3.272
	Mandvi	35	368	5.755	0.8931	3.442
Monsoon 2009	Sanghi	39	529	6.06	0.8256	3.472
	Mundra	36	806	5.226	0.7047	3.234
	Mandvi	34	436	5.43	0.8485	3.362

Table 4.4. Zooplankton Density in Different Stations and Seasons during 2007-08

Species/Genus	Sanghi			Mundra			Mandvi		
	S	M	W	S	M	W	S	M	W
Acartia danae	1	8	16	9	2	25		5	18
Acartia erythraea		23	3	1	60		4	11	
Acartia sp	22	19	2	9	3	34	3	4	17
Acetes sp		7	1		2			3	12
Acrocalanus sp	24	34	18	17	57	14	9	18	16
Acrocalanus gracilis	1		6	6	19	21	1	16	3
Balanus amphiprite	18	40	26	14	68	26	11	3	5
Bivalve larvae	5	18	2	15	44	5	12	24	1
Brachyuran larvae	29	30	25	22	55	36	8	14	14
Calanus sp	45	44	33	22	56	8	12	19	6
Centrapages sp	2	15	25	12	15	58	4	8	28
Caridean			4		7				
Centropagus forcatus	8	3	9			35	6	12	17
Balanus	3	16	7	13	32	26	7	9	2
Eucalanus	7	44	22	13	82	6	2	5	1
Euchaeta sp		2		13		14		10	14
Euchaeta concinna	2	3		19	6		6		
Euphausiid	13	27	5	12	35	5	5	17	3
Evadne sp		2	2	1	5		5		
Fish egg and larvae	17	53	24	7	114	34	10	43	5
Gastropod larvae	16	21	34	5	29	4	4	9	16
Lucifer sp	20	14	21	12	17	25	11	7	2
Lucifer hanseni	4	2	7	1	5	5			4
Macrosettala sp		9	21	20	7	31	1	14	1
Macrosettala gracilis	15	7			5	4	7	12	7
Medusae	9	5		11	7		7	6	
Medusae-pleurobranchia	5	9		9	11		7	8	
Metacalanus			14	4	7	15		8	14
Mysis larvae of shrimp	6	20			34	6	3	11	2
Oikopleura sp	4	13	11		1	5	4	4	
Oithona bravicornis	16	17	5	1	25	16	3	18	12
Oithona rigida		6	22			10		4	20

Species/Genus	Sanghi			Mundra			Mandvi		
	S	M	W	S	M	W	S	M	W
Okiopleura parva	15	17			8	2		5	
Paracalanus parvus	5	4	18	1	49	24	9	4	14
Paracalanus sp	9	8	33	4	50	19	2	4	7
Parvocalanus sp.		16			14		2	5	12
Penaeid nauplius	7	25	20	4	2	14	6	9	9
Polychaet larvae	19	12	2		3	21	4	10	11
Pyrocypris		12	3		14	1		4	
Rhincalanus cornatus		15	24	7	16	12	10	17	10
Rhincalanus sp	2	13		7	17	11		2	3
Sagitta hispida	21		3	2	4	4	3		10
Sabellaria sp	4	8		3	28	16	8	10	4
Sagita sp		13	5	3	11	8		8	2
Setiger larvae		5	5	3	13	11	7		
Spionid larvae		14			4	21	8		
Temora discaudata		15			14			13	9

Table 4.5. Zooplankton Density in Different Stations and Seasons during 2008-09

	Sanghi			Mundra			Mandvi		
Species/Genus	**S**	**M**	**W**	**S**	**M**	**W**	**S**	**M**	**W**
Acartia danae	4	7	9		3		6		
Acartia erythraea	2	19			21			14	14
Acartia sp		18	5	13	6	24	8	8	21
Acetes sp		9		5	8	34	5	4	
Acrocalanus sp	18	31	12	12	19		12	13	
Acrocalanus gracilis	3	4	11	8	31		9	21	9
Balanus amphiprite larvae									
Bivalve larvae	6	8	8	13	34	4	9	25	4
Brachyuran larvae	19	19	23	17	57	27	15	21	11
Calanus sp	49	15	35	20	26	43	18	22	31
Centrapages sp	4	15	28	13	14	11	11	10	15
Caridean					9		3		
Centropagus forcatus		1	17			25	9		
Balanus larvae	23	14	12	21	34	45	16	11	9
Eucalanus	15	38	24	18	55	16	28	18	17
Euchaeta sp	5			12		21	9	16	15
Euchaeta concinna								11	
Euphausiid	12	21	8		37	7			7
Evadne sp	12		4		7	9	11	13	12
Fish egg and larvae	24	37	24	14	120	64	15	38	12
Gastropod larvae	7	26	11	8	31	2	7	7	7
Lucifer sp	22	10	10	9	28	15	11	16	32
Lucifer hanseni	6	4	4	3	7	8		7	3
Macrosettala sp	12	12	9	21	9	12	8	18	3
Macrosettala gracilis	16	9	5		7				
Medusae	8	1	0	5	12	3	5	3	0
Medusae-pleurobranchia	3	3	2	8	5	10	5	5	0
Metacalanus			11	7	9	21	13		9
Mysis	4	23		12	36	12		21	8
Oikopleura sp	5	5	7	6		8	11	11	
Oithona bravicornis		15	9		31	7	9	11	8
Oithona rigida	14	11		12			7		13

	Sanghi			Mundra			Mandvi		
Species/Genus	**S**	**M**	**W**	**S**	**M**	**W**	**S**	**M**	**W**
Okiopleura parva		13			11				
Paracalanus parvus	13	12	18	3	21			5	17
Paracalanus sp	17	5	12		36	14	9	3	11
Parvocalanus sp.		12	12	3	9		9		
Penaeid nauplius	5	17	9	11	4	24	4	24	7
Polychaet larvae	21	14	6	3	5	9	6	4	8
Pyrocypris		9							
Rhincalanus cornatus		12	13			24	21	12	
Rhincalanus sp	16	13	21	13	19	21	19	10	9
Sagitta hispida	34	7	11	3		17		7	
Sabellaria sp	3	11		3	30	11	9	6	6
Sagita sp		11	5	4	13	18	13	11	7
Setiger larvae			12	6		7		10	9
Spionid larvae		18	1		6		5		
Temora discaudata						11	13		

Plate 4.1 Zooplankton recorded during study

	
Acartia sp.	*Medusae*
	
Paracalanus sp.	*Sagita sp.*
	
Bivalve larvae	*Gastropod larvae*