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Assessment of zooplankton diversity of a tropical wetland system

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Abstract
Zooplankton community is cosmopolitan in nature and they inhabit all freshwater habitats of the world. These spices are not only useful as bioindicators, but are also helpful for ameliorating polluted waters. Hence qualitative and quantitative studies of zooplankton diversity are of great importance. In the present study, monthly changes in diversity and density of zooplankton assemblages had been recorded during June 2008-May 2009, at three selected sites of Varasda wetland, situated between 22°29’30.69″ N latitude and 72º 30’ 30.23’’ E longitude of Kheda district, Central Gujarat, India. The population at Varasda wetland consisted of 36 genera of zooplankton. The recorded genera were categorized into 6 different groups – Rhizopoda, Cladocera, Rotifera, Ciliophora, Copepoda and others which included Zooflagellates, Ostracoda, Callanoids and Herpacticoids.

Key-Words: Zooplankton, Tropical wetland, Diversity and Density

Introduction
Tropical wetlands have played an important role for humankind in all continents[1]. These are characterized by a large number of ecological niches and harbour a significant percentage of world’s biological diversity. Wetlands are among the most productive ecosystems in the world comparable to rainforests and coral reefs[2]. Zooplankton community is cosmopolitan in nature and they inhabit all freshwater habitats of the world. Zooplankton diversity and density refers to variety within the community[3]. These are often an important link in the transformation of energy from producers to consumers due to their large density, drifting nature, high group or species diversity and different tolerance to the stress.

Zooplankton diversity is one of the most important ecological parameters as these are the intermediate link between phytoplankton and fish and plays a key role in cycling of organic materials in an aquatic ecosystem.

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Due to their short life span, the zooplankton community often exhibits quick and dramatic changes in response to the changes in the physico- chemical properties of the aquatic environment[4]. They do not only form an integral part of the lentic community but also contribute significantly, the biological productivity of the fresh water ecosystem[5].

In this investigation, the data of zooplankton density and diversity in a tropical wetland system Varasda was studied for one year, June 2008-May 2009, at three selected sites.

Material and Methods
Study Area
Present study has been carried out at Varasda wetland (Figure 1). This tropical wetland lies between 22°29’30.69″ N latitude and 72º 30’ 30.23’’ E longitude of Kheda district, Central Gujarat, India.

Total area of the wetland is approximately 40-50 ha with maximum depth of about 10 ft and the pH of the epilimnion varies from 7.2 to about 8. The water temperature rises up to 35 °C during the month of May and falls below 15 °C in January. The wetland is a one of the principal source of food and fishing for local dependent communities of the peripheral village. Household sewage at little extent and agricultural run-off from surrounding village pockets are being merged into it. Three sampling sites [site I (V1), site II (V2), site III (V3)] were earmarked based on the morphometiric features of the wetland with regard to topography and pollution.

Zooplankton Collection, Preservation, Identification and Density Analysis

The samples of zooplankton were collected from each selected study site of this tropical wetland for a period of one year (June 2008 – May 2009). The nylon nets (20µ mesh- size) were used for collection of zooplankton. Plankton net of conical shape and reducing cone (having filtering area three times larger than the area of the mouth) with the bottle at its end was preferred[6]. For a precise collection of zooplankton, the plankton net was towed in open water area of each site three times (horizontally, vertically and obliquely). After transferring the sample in air tight plastic bottles, it was carefully labelled and preserved immediately on-site using 5% formaldehyde. Later, the collected samples were brought to the laboratory for identification using various monographs, books and other published literature[7-10]. After an accurate identification of each genus, the density of zooplankton was calculated as per the Lackey's drop method[11].

Results and Conclusion

The population at Varasda wetland consisted of 36 genera of zooplankton (Table 1). The recorded genera were categorized into 6 different groups – Rhizopoda, Cladocera, Rotifera, Ciliophora, Copepoda and others which included Zooflagellates, Ostracoda, Callanoids and Herpacticoids. The highest numbers (27 genera) of zooplankton assemblages were present at site V1 whereas lowest population was recorded at V2 (16 genera). The site V3 possessed moderate (20) of zooplankton genera. Diversity analysis revealed that Rhizopoda dominated the zooplankton assemblage of Varasda wetland with 12 genera. Cladocerans (06) were the second dominant group followed by 5 genera of Rotifera and Ciliophora each, 2 genera of Zooflagellates and 1 genera each of Ostracoda, Callanoids and Herpacticoids. The main bulk (86%) of the total zooplankton population was found to be contributed by Rhizopoda, Cladocera, Rotifera, Ciliophora and Copepoda. The minor groups Zooflagellates, Ostracoda Callanoids and Herpacticoids combined formed the rest 14% of the total zooplankton population at Varasda wetland (Figure 2).

Distinct peaks of Rhizopoda, Cladocera, Rotifera, Ciliophora, Copepoda and Zooflagellates were observed during summers (March to June). However, the minimum population of these groups was registered during monsoons (July to October). During winters (November to February) their moderate growth was recorded. The presence of Ostracods and Callanoids was documented during summers and winters on the other hand absence of these two groups was noted during monsoons. The growth of Herpacticoids was evident only during summers at this tropical wetland (Figures 3 a,b,c).

Density of zooplankton at Varasda wetland was 55.30 x 10^5 u L^{-1} (Table 2). Site wise variation in density of recorded taxonomic groups followed the same pattern with that of spatial variation in diversity of zooplankton except cladocerans and rotifers. Overall, lower zooplankton density was enumerated at site V2 as compared to the other two sites. The highest density of zooplankton was observed at V1 (25.1 x 10^5 u L^{-1}), followed by V3 (16.5 x 10^5 u L^{-1}) and the poor density of zooplankton was noticed at V2 (13.7x 10^5 u L^{-1}) (Figures 4 a,b,c).

Zooplankton peak was observed during summers and least abundance of these microscopic animals was recorded in monsoons. This substantiates with the findings of Sadguru et al.[12] and Pandey et al.[13]. The net zooplankton abundance increased during summers, probably corresponding to the water quality, decaying vegetation, increased levels of organic matter in the sediment and higher abundance of bacteria in the wetlands during this time [14,15]. Sudden reduction in the zooplankton population during the rainy season as noticed in the present findings could be due to sudden fall of temperature and dilution in concentration of minerals and salts in wetland water [16,17].

Qualitative dominance of Rhizopoda over other zooplankton assemblages has been observed at Varasda wetland. Similar observations of qualitative dominance of Rhizopoda have been obtained by Dutta et al.[17]. Summer peak obtained for Rotifera members at the tropical wetland may be due to optimal nutrient and temperature conditions and lower DO contents in this season [18]. Low rotifer density during the rainy season can be attributed to turbulence generated by the excess water flow during this season[19]. Dominance of cladocera among zooplankton peak was found during summer might be due to optimal thermal and nutritional conditions and lower concentration of oxygen [20]. Effect of rains may explain low records of cladocerans from July to September. Copepods developed better in warm periods as noticed in the present study [4]. Lesser abundance of copepods during monsoons as recorded in the present study had also been observed by Majagi and Vijaykumar[21] for Karanja reservoir in Karnataka. The low abundances of copepods in Varasda wetland appear to be due to mainly predation pressure from fishes[22]. Lesser abundance of groups such as Ciliates, Zooflagellates, Ostracods, Callanoids and Herpacticoids in comparison to other zooplanktonic groups had also been reported by [15, 23 and 24]. Higher population of these minor groups was observed during summers in the wetland [21]. Ostracodas and Callanoids were recorded only during summers and winters, and were not observed during monsoons; whereas Herpacticoids flourished only during summers and were absent in monsoons and winter [25, 26].

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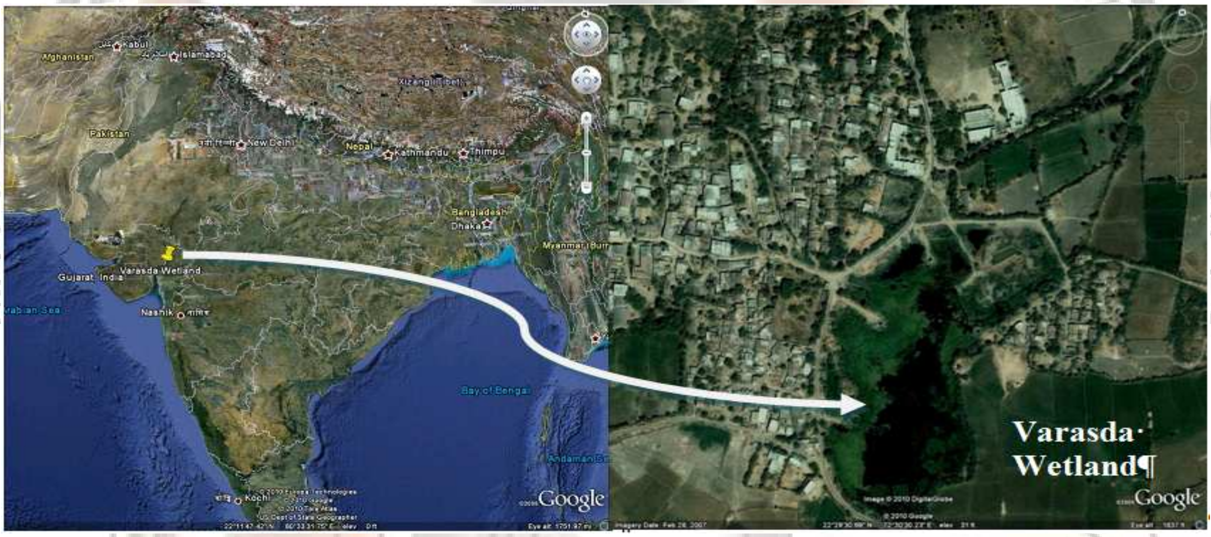


Fig. 1: Showing the study Area (Courtesy Google Earth)

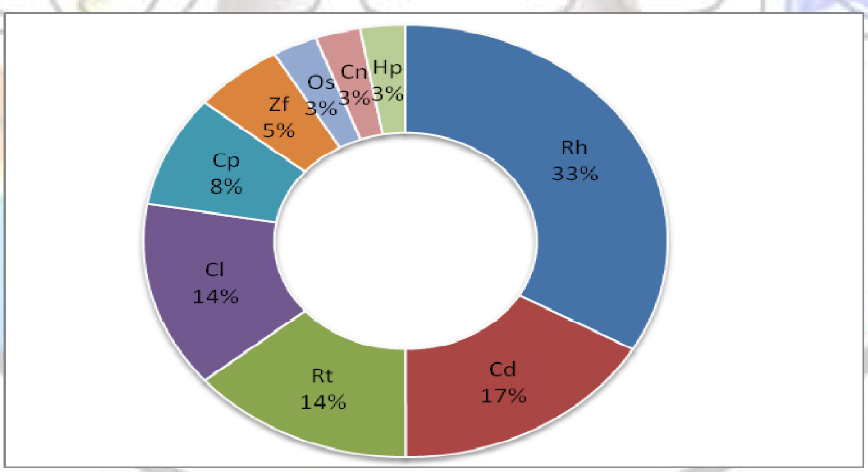
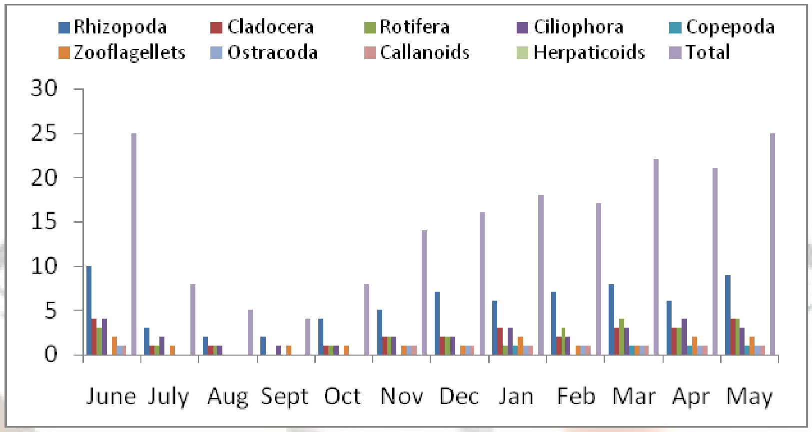
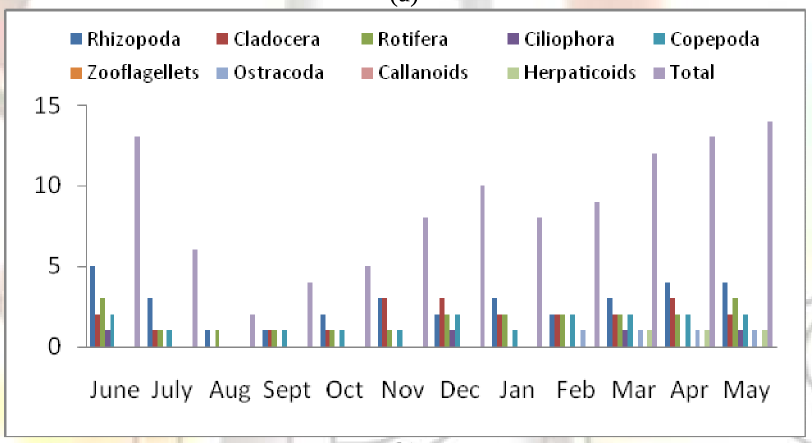


Fig. 2: Mean (%) composition of zooplankton groups at Varasda wetland during 2008-09 (Rt: Rotifera; Cd: Cladocera; Cp: Copepoda; Rh: Rhizopoda; Cl: Ciliophora; Zf: Zooflagellates; Os: Ostracoda; Cn : Callanoids; Hp: Herpacticoids)



(a)



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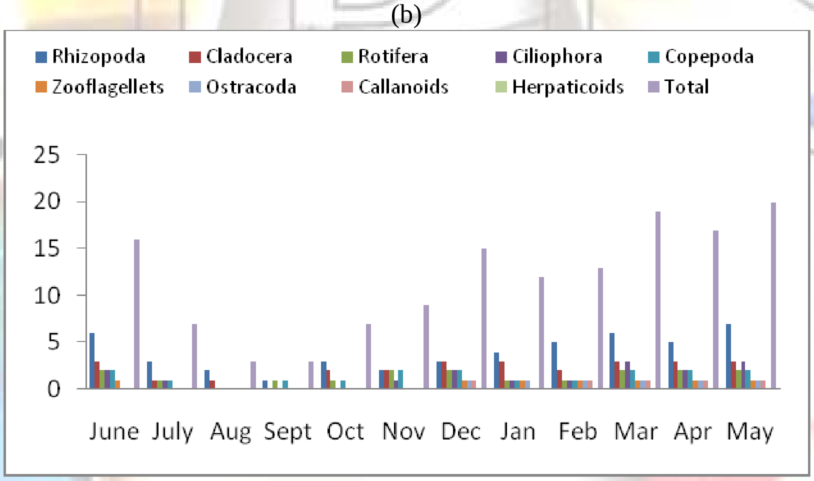

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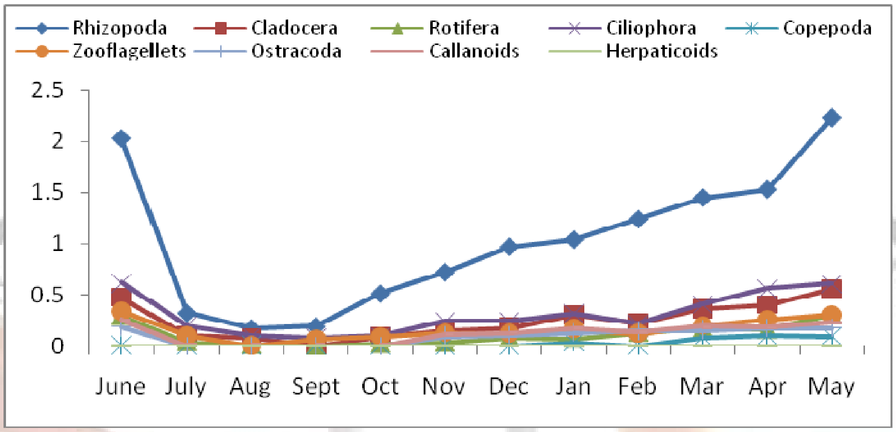
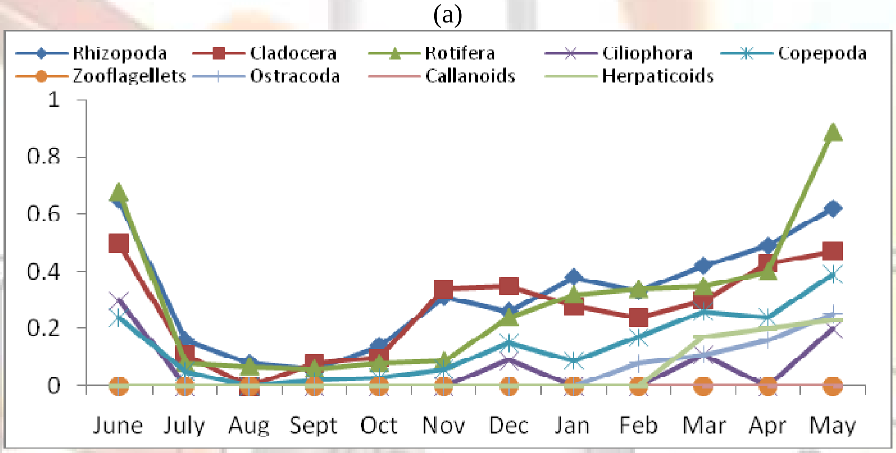
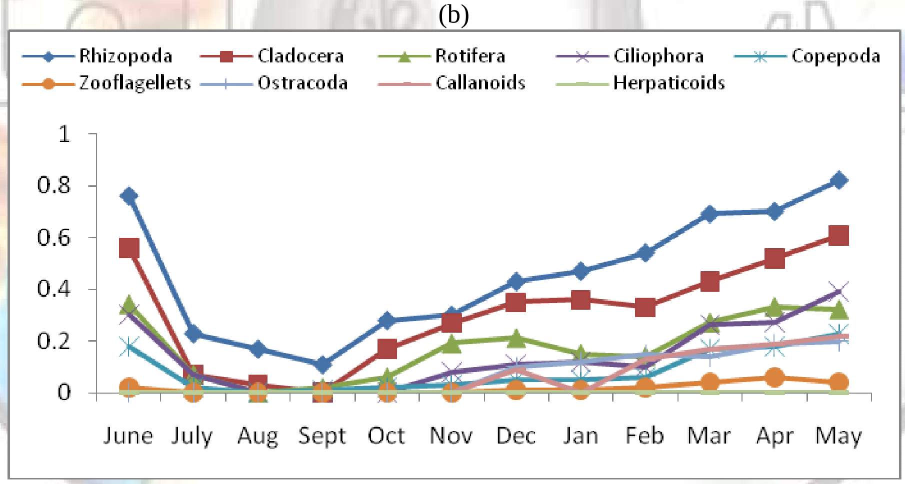
Fig. 3: Monthly variation of number of different groups of zooplankton at study sites V1 (a) , V2 (b) and V3 (c) at Varasda wetland during 2008-09



(a)



(b)



(c)

Fig. 4: Monthly variation in densities ($x10^5$ u L^{-1}) of different zooplankton groups at study sites V1 (a), V2 (b) and V3 (c) at Varasda wetland during 2008-09

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Table 1: Diversity of zooplankton at three study sites of Varasda wetland (year 2008-09)

Sites	Rh	Cd	Rt	Cl	Cp	Zf	Os	Cn	Hp	Total Genera
V1	10	4	4	4	1	2	1	1	0	27
Relative %	37.05	14.81	14.81	14.81	3.7	7.42	3.7	3.7	0	100.00
V2	5	3	3	1	2	0	1	0	1	16
Relative %	31.25	18.75	18.75	6.25	12.5	0	6.25	0	6.25	100.00
V3	7	3	2	3	2	1	1	1	0	20
Relative %	35	15	10	15	10	5	5	5	0	100.00
Total Genera	12	6	5	5	3	2	1	1	1	36

Table 2: Composition of zooplankton at Varasda wetland (year 2008-09)

Sr No	Groups/Genera	O	V1	V2	V3	TD	MD
	Rhizopoda						
1	*Arcella* sp.	2	0.90		0.40	1.30	0.65
2	*Astramoeba* sp.	1	1.20			1.20	1.20
3	*Balantidium* sp.	3	0.30	0.70	0.60	1.60	0.53
4	*Bullinularia* sp.	2	2.40		1.10	3.50	1.75
5	*Colpoda* sp.	2		0.90	0.30	1.20	0.60
6	*Difflugia* sp.	3	0.40	0.80	0.50	1.70	0.57
7	*Entamoeba* sp.	1		0.40		0.40	0.40
8	*Parmulina* sp.	2	1.20		0.70	1.90	0.95
9	*Plagiopyxis* sp.	1	0.90			0.90	0.90
10	*Pyxidicula* sp.	3	2.80	1.10	1.90	5.80	1.93
11	*Thecamoeba* sp.	1	0.80			0.80	0.80
12	*Trigonopyxis* sp.	1	1.50			1.50	1.50
	Genera		**10**	**5**	**7**		
	Density		**12.40**	**3.90**	**5.50**	**21.80**	**7.27**
	Relative %		**56.88**	**17.89**	**25.23**		
	Cladocera						
13	*Alona* sp.	1			1.10	1.10	1.10
14	*Bosmina* sp.	1	0.60			0.60	0.60
15	*Chydorus* sp.	1		1.20		1.20	1.20
16	*Macrothrix* sp.	2	0.80		1.20	2.00	1.00
17	*Moina* sp.	2	0.20	1.20		1.40	0.70
18	*Sida* sp.	3	1.30	0.80	1.40	3.50	1.17
	Genera		**4**	**3**	**3**		
	Density		**2.90**	**3.20**	**3.70**	**9.80**	**3.27**
	Relative %		**29.59**	**32.65**	**37.76**		
	Rotifera						
19	*Asplanchna* sp.	3	0.20	1.00	0.90	2.10	0.70
20	*Filinia* sp.	1	0.30			0.30	0.30
21	*Rotaria* sp.	2	0.20	1.20		1.40	0.70
22	*Notommata* sp.	1	0.60			0.60	0.60
23	*Polyartha* sp.	2		1.40	1.20	2.60	1.30
	Genera		**4**	**3**	**2**		

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	Density		**1.30**	**3.60**	**2.10**	**7.00**	**2.33**
	Relative %		**18.57**	**51.43**	**30**		
	Ciliophora						
24	*Chilodontopsis* sp.	1	0.50			0.50	0.50
25	*Enchelys* sp.	1	0.70			0.70	0.70
26	*Nassula* sp.	1			0.30	0.30	0.30
27	*Paramecium* sp.	2	1.40		0.50	1.90	0.95
28	*Vorticella* sp.	3	1.10	0.70	0.90	2.70	0.90
	Genera		**4**	**1**	**3**		
	Density		**3.70**	**0.70**	**1.70**	**6.10**	**2.03**
	Relative %		**60.66**	**11.48**	**27.86**		
	Copepoda						
29	*Cyclops* sp.	2		0.90	0.40	1.30	0.65
30	*Mesocyclops* sp.	1		0.80		0.80	0.80
31	*Nauplis* sp.	2	0.30		0.60	0.90	0.45
	Genera		**1**	**2**	**2**		
	Density		**0.30**	**1.70**	**1.00**	**3.00**	**1.00**
	Relative %		**10**	**56.67**	**33.33**		
Others							
	Zooflagellets						
32	*Actinomonas* sp.	2	0.80		0.20	1.00	0.50
33	*Bodo* sp.	1	1.10			1.10	1.10
	Genera		**2**		**1**		
	Density		**1.90**	**0.00**	**0.20**	**2.10**	**1.05**
	Relative %		**90.48**	**0.00**	**9.52**		
	Ostracoda						
34	*Stenocypris* sp.	3	1.20	0.60	0.90	2.70	0.90
	Genera		**1**	**1**	**1**		
	Density		**1.20**	**0.60**	**0.90**	**2.70**	**0.90**
	Relative %		**44.44**	**22.22**	**33.34**		
	Callanoids						
35	*Acartiella* sp.	2	1.40		0.80	2.20	1.10
	Genera		**1**		**1**		
	Density		**1.40**	**0.00**	**0.80**	**2.20**	**1.10**
	Relative %		**63.64**	**0.00**	**36.36**		
	Herpaticoids						
36	*Euterpina* sp.	1		0.60		0.60	0.60
	Genera			**1**			
	Density		**0.00**	**0.60**	**0.00**	**0.60**	**0.60**
	Relative %		**0.00**	**100**	**0.00**		
	Total Genera (36)		**27**	**16**	**20**		
	TD		**25.1**	**13.7**	**16.5**	**55.3**	**18.43**
	Total Relative %		**72.22**	**44.44**	**55.56**		
	MD		**8.37**	**4.57**	**5.5**	**18.44**	