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Richness, abundance and ecology of zooplankton in a tropical floodplain lake of majuli river island, Assam, (N. E. India)

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Abstract
Plankton samples collected (September, 2010–August, 2012) from Chela beel of Majuli River Island of Assam, N.E. India, revealed a total of 95 zooplankton species with diverse nature of Rotifera (59 species). This floodplain lake exhibited fairly rich species diversity and indicated a monthly richness between 36 – 56 (44±7) species and 36 – 59 (46±7) species during the first and second year respectively, with nearly identical ranges of community similarities during both the years. Cladocera and Rhizopoda formed the sub-dominant qualitative groups in the sampled floodplain lake. Zooplankton abundance ranged between 123–242 (184 ± 27 n/l) during the study period; it formed the sub-dominant quantitative component of net plankton in the sampled beel both during the first year (36.9±5.0%) as well as during the second year (38.1±3.7%). Rotifera > Rhizopoda mainly influenced zooplankton density variations in the sampled floodplain lake. Richness and abundance of zooplankton registered both insignificant annual as well as monthly variations in the sampling site. Zooplankton communities of the sampled floodplain lake are characterized by higher species diversity, higher equitability and lower dominance. Richness of zooplankton of Chela beel registered a significant negative correlation with rainfall and a significant positive correlation with magnesium while their abundance is significantly inversely correlated with water temperature. The canonical correspondence analysis (CCA) of zooplankton with 17 abiotic parameters recorded 84.4% cumulative variance of zooplankton assemblages.

Keywords: abundance, floodplain lake, richness, zooplankton

Introduction

Water is a precious natural resource which serves as an environment for a diverse array of aquatic organisms. India has been bestowed with a wide diversity of freshwater ecosystems. Among these, the floodplain lakes deserve special mention because of their interesting limnological features. These floodplain lakes are commonly known as '*Beels*' in the state of Assam constituting one of the most significant freshwater environs in the Brahmaputra and Barak valley river basins. Majuli, the largest riverine island of the world, situated in the upper reaches of the river Brahmaputra in the Jorhat district of Upper Assam, is literally dotted with numerous floodplain lakes which serve as valuable bio-diversity hotspots for their both rich flora and fauna and provide ideal breeding grounds for various economically important species of fish and other freshwater organisms.

Zooplanktons comprise an integral component of the aquatic food-webs and contribute significantly to the biological productivity. In spite of several studies, there is still little information on the ecology and role of zooplankton in the aquatic productivity of the Indian floodplain lakes. Such studies from the floodplains of North-eastern India have so far been restricted to the reports of Sharma & Hussain (2001) [33] and Sharma & Sharma (2008) [34]; in addition, Sharma & Sharma (2001) [32] and Sharma (2005, 2009) [25, 35] dealt with Rotifera diversity. Further, our knowledge of zooplankton communities in the floodplains of Majuli River Island is, however, limited to the faunal diversity of Rotifera (Sharma, 2014; Sharma *et al*., 2015) [29, 42] and Cladocera (Sharma and Sharma, 2014; Sharma *et al*., 2015) [29, 42]. On the other hand, the information on diversity and ecology of zooplankton from the floodplain lakes of this river island is limited. This study presents information on zooplankton richness, abundance, community similarities, species diversity, evenness, dominance, the constituent zooplankton groups and the ecology of the sampled floodplain lake.

Materials and Methods

The present study was undertaken during September, 2010–August, 2012 in Chela beel (Longitude: 94° 17′51.9″E, Latitude: 27° 04′58.2″ N; Altitude: 89 m ASL) located in Majuli River Island in the Jorhat district of Upper Assam (N. E. India). The floodplain lake is covered with a wide diversity of macrophytes such as *Eichhornia crassipes*, *Hydrilla verticellata*, *Utricularia flexuosa*, *Trapa bispinosa*, *Lemna major*, *L. minor*, *Salvinia* sp., *Vallisneria spiralis*, *Euryale ferox*, *Xanthium* sp., *Ipomoea fistulosa* and *Sagittaria* sp.

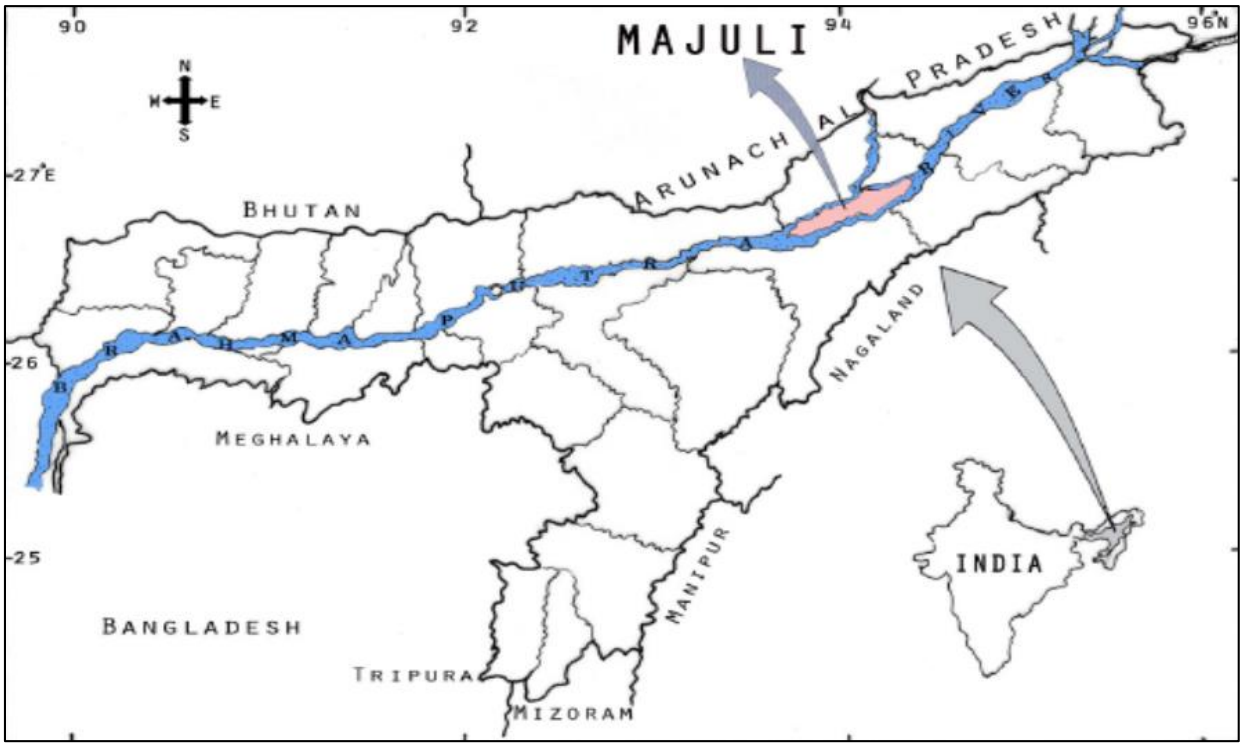

Fig 1: District map of Assam state indicating location of Majuli River Island (insert map of India showing Assam state of northeast India)

Water samples were collected at regular monthly intervals and analyzed for various abiotic factors. Water temperature, specific conductivity and pH were recorded by field probes, dissolved oxygen was estimated by the modified Winkler's method and other parameters were analyzed following A.P.H.A. (1992). Qualitative zooplankton samples were collected from the floodplain lakes by towing a nylobolt plankton net (# 50 µm) and preserved in 5% formalin. These samples were subsequently screened for various zooplankton species and their permanent mounts were made in Polyvinyl alcohol-Lactophenol mixture. Monthly quantitative zooplankton samples were also obtained by filtering 25 litres of the lake water through a nylobolt plankton net (No. 25). Individual collections were then concentrated to 25 ml each and preserved in 5% formalin. The quantitative enumeration (n/l) was done with the help of a Sedgwick-Rafter counting cell. The zooplankton were then identified following Koste (1978) [12], Michael & Sharma (1988) [16], Sharma (1998) [21] and Sharma & Sharma (1999a, 1999b, 2008) [30, 31, 34]. Quantitative samples were analyzed for abundance of zooplankton and zooplankton constituent groups. Community similarities (Sorensen's index), species diversity (Shannon's index), dominance (Berger-Parker's index) and evenness (Pileou's index) were calculated following Ludwig & Reynolds (1988) [13] and Magurran (1988) [15]. ANOVA was used to analyze the significance of temporal variation of the biotic communities. Ecological relationships between the abiotic and biotic parameters of Chela beel were determined by simple correlation co-efficient (r); their P values were calculated vide http://facultysites.vassar.edu/lowry/tabs.html and their significance was ascertained after the use of Bonferroni correction ($P < 0.0033$). The canonical correspondence analysis (XLSTAT 2014) was done to observe cumulative influence of different abiotic parameters (water temperature, rainfall, pH, specific conductivity, dissolved oxygen, free CO_2, total alkalinity, total hardness, calcium, magnesium, chloride, dissolved organic matter, total dissolved solids, phosphate, nitrate, sulphate and silicate) on the zooplankton communities.

Results

Abiotic parameters: The variations in abiotic parameters of Chela beel observed during the study period (ranges, average ± SD) have been indicated in Table 1.

Table 1: Temporal Variations in Abiotic Factors

Factors	Sept. 2010-August 2011		Sept. 2011-August 2012	
	Range	Mean ± SD	Range	Mean ± SD
Water temperature (°C)	21.0 – 26.5	23.7 ± 1.7	21.0 – 26.5	23.2 ± 2.1
Rainfall (mm)	0.0 – 353.8	108.28 ± 109.95	0.0 – 413.8	176.87 ± 153.94
pH	6.72 – 7.32	6.99 ± 0.17	6.73 – 7.34	7.10 ± 0.19
Conductivity(µS/cm)	110.5 – 250.0	208.3 ± 41.8	108.0 – 250.0	212.5 ± 42.6
Dissolved Oxygen (mg/l)	6.4 – 8.8	7.5 ± 0.6	7.2 – 8.8	8.1 ± 0.7
Free Carbon-dioxide (mg/l)	6.0 – 16.0	10.0 ± 3.0	8.0 – 14.0	10.0 ± 2.0
Alkalinity (mg/l)	60.0 – 140.0	111.0 ± 23.0	60.0 – 156.0	116.0 ± 27.0
Hardness (mg/l)	74.0 – 148.0	116.0 ± 21.0	56.0 – 148.0	111.0 ± 27.0
Calcium (mg/l)	52.5 – 94.5	77.4 ± 12.9	46.2 – 86.1	73.7 ± 11.5

Magnesium (mg/l)	5.22 – 13.05	9.27 ± 2.29	2.38 – 15.11	8.95 ± 4.41
Chloride (mg/l)	5.99 – 10.99	8.32 ± 1.56	5.99 – 13.99	9.40 ± 2.32
Dissolved Organic Matter (mg/l)	0.049 – 0.135	0.098 ± 0.027	0.071 – 0.191	0.106 ± 0.036
Total Dissolved Solids (mg/l)	0.076 – 0.152	0.104 ± 0.024	0.088 – 0.140	0.110 ± 0.015
Phosphate (mg/l)	0.455 – 1.127	0.910 ± 0.248	0.599 – 1.530	1.105 ± 0.273
Nitrate (mg/l)	0.433 – 1.311	0.747 ± 0.270	1.689 – 2.700	2.228 ± 0.279
Sulphate (mg/l)	2.511 – 6.344	4.554 ±1.040	5.617 – 10.310	7.775 ±1.370
Silicate (mg/l)	0.140 – 0.907	0.486 ± 0.290	0.454 – 1.047	0.724 ± 0.184

Biotic parameters: This study revealed a total of 95 species of zooplankton, belonging to five groups (Table 2). Monthly zooplankton richness followed almost similar ranges in Chela beel both during the first year (36 – 56 n/l) and the second year (36 – 59 n/l) of the study period.

Table 2: Temporal variations (range, mean ± SD) of zooplankton

	First Year	**Second Year**	**Study Period**	
	Range	**Range**	**Range**	
Qualitative	Rotifera (59) > Cladocera (16) > Rhizopoda (13) > Copepoda (5) > Ostracoda (2)			
Zooplankton Total 95 species				
% Similarity	36.5 – 69.8	41.3 – 70.4		
Zooplankton	36 – 56	36 – 59	36 – 59	45 ± 7
Rotifera	13 – 37	15 – 37	13 – 37	24 ± 7
Cladocera	6 – 11	5 – 12	5 – 12	9 ± 2
Rhizopoda	4 – 10	6 – 10	4 – 10	8 ± 2
Copepoda	2 – 4	3 – 5	2 – 5	3 ± 1
Ostracoda	0 – 2	0 – 2	0 – 2	1 ± 1
Quantitative				
Zooplankton	123 – 209	149 – 242	123 – 242	184 ± 27
% composition	28.6 – 45.7	34.0 – 47.5	28.6 – 47.5	37.5 ± 4.3
Diversity	3.189 – 3.884	3.223 – 3.973	3.189 – 3.973	3.582 ± 0.228
Dominance	0.054 – 0.162	0.037 – 0.128	0.037 – 0.162	0.096 ± 0.037
Evenness	0.883 – 0.978	0.893 – 0.978	0.883 – 0.978	0.945 ± 0.029
Rotifera	41 – 144	50 – 168	41 – 168	85 ± 35
% composition	22.8 – 71.3	27.0 – 69.4	22.8 – 71.3	45.8 ± 15.9
Cladocera	14 – 43	14 – 45	14 – 45	29 ± 8
% composition	8.3 – 24.6	8.4 – 21.3	8.3 – 24.6	16.1 ± 4.4
Rhizopoda	8 – 88	19 – 78	8 – 88	41 ± 24
% composition	5.3 – 48.9	7.9 – 39.0	5.3 – 48.9	22.5 ± 13.0
Copepoda	4 – 68	10 – 49	4 – 68	27 ± 17
% composition	2.5 – 32.7	5.5 – 24.5	2.5 – 32.7	14.5 ± 8.6
Ostracoda	0 – 4	0 – 5	0 – 5	2 ± 1
% composition	0.0 – 2.2	0.0 – 2.2	0.0 – 2.2	1.1 ± 0.7
Important Families (n/l)				
Lecanidae	11 – 61	13 – 62	11 – 62	32 ± 15
Lepadellidae	5 – 23	5 – 21	5 – 23	13 ± 5
Brachionidae	5 – 24	4 – 31	4 – 31	13 ± 7
Chydoridae	7 – 24	8 – 25	7 – 25	17 ± 5
Daphniidae	2 – 13	3 – 11	2 – 13	7 ± 3
Macrothricidae	0 – 9	0 – 6	0 – 9	4 ± 2
Arcellidae	2 – 19	2 – 25	2 – 25	11 ± 6
Centropyxidae	3 – 49	2 – 18	2 – 49	14 ± 11
Difflugidae	0 – 12	0 – 6	0 – 12	3 ± 3
Euglyphidae	0 – 28	2 – 10	0 – 28	6 ± 6

Rotifera (59 species) was the most speciose group in Chela beel with qualitative importance of Lecanidae > Lepadellidae > Brachionidae. Zooplankton recorded 36.5 – 69.8% and 41.3 – 70.4% community similarities (*vide* Sørensen's index) in Chela beel during the two years, respectively.

The zooplankton (179 ± 27 n/l, 189 ± 28 n/l) comprised 36.9 ± 5.0% and 38.1 ± 3.7% of net plankton of Chela beel during the first and second year respectively (Table 2); zooplankton formed a sub-dominant quantitative component of net plankton in Chela beel during the entire study period. Rotifera (80 ± 32 n/l, 90 ± 39 n/l) formed the dominant quantitative group of zooplankton while Rhizopoda (42 ± 30 n/l, 40 ± 17 n/l) formed the sub-dominant group in Chela beel both during the first year and second year of the study period. Cladocera and copepod also played a sub-dominant role in the sampled floodplain lake. Other group of zooplankton namely Ostracoda is characterized by low densities. The species diversity of zooplankton of Chela beel varied between 3.539 ± 0.238 and 3.625 ± 0.220 during the first and

second year of the study period respectively (Figure 4). The zooplankton dominance ranged between 0.108 ± 0.041 and 0.084 ± 0.029 while their evenness varied between 0.939 ± 0.034 during the first year and between 0.952 ± 0.023 during the second year respectively (Table 2).

The canonical correspondence analysis (CCA) with 17 abiotic factors recorded 66.03% and 18.39% cumulative variance of zooplankton along axis 1 and axis 2, with importance of different factors (Figure 5).

Discussion

Abiotic parameters: Water temperature affirms sub-tropical nature of the sampled beel which concurred with its geographical location. Chela beel depicted a typical acidic to circum-neutral nature. The floodplain lake is characterized by moderately hard water, moderate dissolved oxygen content, low free CO_2 and low concentration of micro-nutrients. Specific conductivity exhibits low ionic concentration of the sampled lake; this interesting feature warrants their inclusion under 'Class I' category of trophic classification *vide* Talling & Talling (1965) [47]. The sampled floodplain lake is also characterized by low chloride content resulting from lack of organic pollution and relatively low concentrations of dissolved organic matter, total dissolved solid and the nutrients. In general, the ranges of most abiotic factors broadly agree with earlier reports from other floodplain lakes of Assam (Sharma & Sharma 2008, 2012a; Sharma 2004, 2005; Hazarika, 2010) [34, 38, 24, 25, 7].

Biotic parameters: 95 zooplankton species recorded in this study indicate habitat diversity and environmental heterogeneity of the sampled floodplain and a qualitative importance of Rotifera (24 ± 7 species) > Cladocera (9 ± 2 species). Zooplankton formed the dominant qualitative component of net plankton which concurred with the reports of Sharma and Sharma (2012a) [38]. The recorded richness is lower than the report of 102–118 species from various beels of Assam (Sharma and Sharma, 2008) [34]. The diversity is, however, higher than the reports of 76 species from two wetlands (Datta, 2011) [5] of Barak river basin of Assam; 71 species from Beri Gopalpur and Sosadanga (Khan, 2003) [11] of southwest Bengal and 51 species from Trigamasar and Naranbagh lakes (Khan, 1987) [9].

ANOVA indicated both insignificant annual as well as monthly variations of zooplankton richness in the sampled floodplain lake. Zooplankton richness recorded peaks during winter both during the first year (January, 2011) and second year (December, 2011) of the study period (Figure 2), which concurred with the winter maxima reported from Loktak lake, Manipur (Sharma and Sharma, 2011) [28]. Rotifera (59 species), the most species-rich group of zooplankton, contributed significantly to temporal variations of the latter ($r = 0.931$, $p < 0.0001$) in Chela beel. The qualitative importance of Rotifera concurred with the reports from various floodplain lakes of West Bengal (Khan, 2002, 2003) [10, 11] and northeast India (Sharma, 2000, 2005, 2009; Sharma and Sharma, 2010) [35, 25]. In addition, Cladocera, the sub-dominant qualitative group, also contributed significantly to zooplankton richness ($r = 0.686$, $p = 0.0002$) in the sampled floodplain lake. Zooplankton, in Chela beel, recorded nearly identical ranges of community similarities (*vide* Sørensen's index) during the study period and the ranges suggested heterogeneity in their species composition.

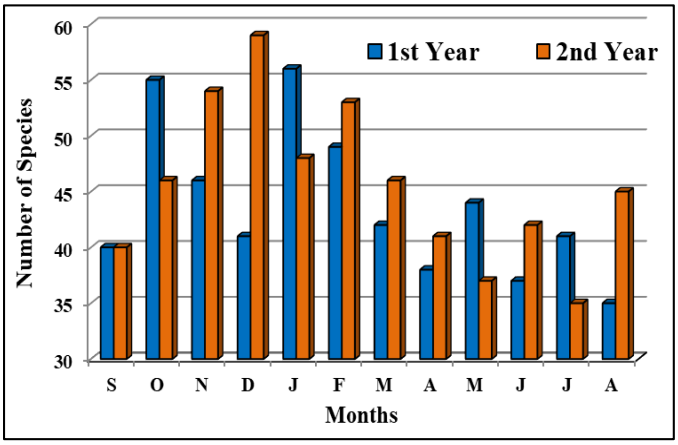

Fig 2: Monthly variations in species richness of zooplankton

Zooplankton abundance in Chela beel was relatively higher during the second year (149 – 242, 189±28 n/l) as compared to the first year (123 – 209, 179±27 n/l) of the study period (Figure 3) and registered both insignificant annual as well as monthly zooplankton density variations. The recorded zooplankton abundance is lower than the reports from Ghorajan beel (Sharma and Sharma, 2012a) [38] of Assam. Further, the recorded densities are lower than the reports from Deepor Beel – a Ramsar site (Sharma, 2011) [28] and from a lake (Bhagabati and Borkotoki, 2014) of upper Assam. Zooplankton monthly density variations recorded peaks during winter, both in the first year (January, 2011) as well as in the second year (December, 2011) during the study period which concurred with the winter maxima reported by Sharma (2011) [28]. Zooplankton formed the sub-dominant quantitative component (36.9±5.0% and 38.1±3.7%) of net plankton in Chela beel both during the first and second year respectively. Zooplankton sub-dominance in this sampled lake concurred with the results from certain floodplain lakes of Kashmir (Kaul and Pandit, 1982) [8], Bihar (Rai and Dutta-Munshi, 1988; Baruah *et al.*, 1993; Sinha *et al.*, 1994; Sanjer and Sharma, 1995) [17, 3, 45, 18], West Bengal (Sugunan, 1989) [46] and Assam (Yadava *et al.*, 1987; Goswami and Goswami, 2001) [49, 6].

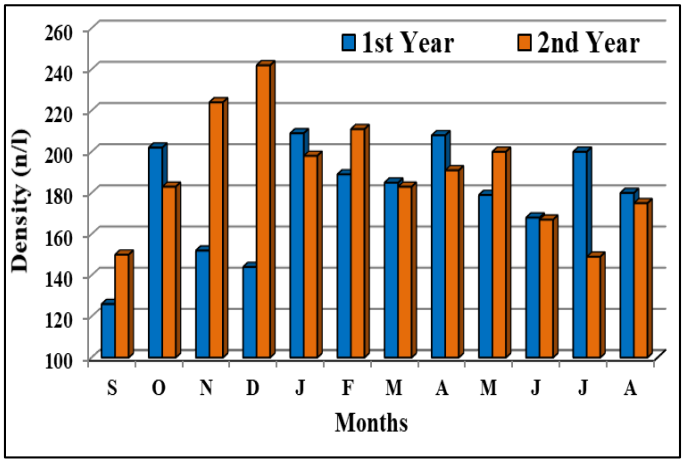

Fig 3: Monthly variations in abundance of zooplankton

Rotifera formed the dominant quantitative component of zooplankton during the entire study period; their abundance ranged between 80±32 n/l and 90±39 n/l during the first and second year respectively. ANOVA registered insignificant variations both between the years as well as between the months in the sampled floodplain lake. The quantitative importance of Rotifera in Chela beel agreed with the reports of Khan (1987) [9], Sanjer and Sharma (1995) [18], Sharma (2005, 2011) [25, 28] and, Sharma and Sharma (2011, 2012, 2014a) [28, 38, 41]. The abundance of Rotifera in Chela beel followed indefinite pattern of monthly variations with peaks in post-monsoon (October, 2010), during the first year and in winter (December, 2011), during the second year of the study period respectively. Their post-monsoon peak concurred with the reports from the floodplains of the Kashmir valley (Khan, 1987) [9], while the winter peak concurred with the results from certain floodplain lakes of northeast India (Sharma and Hussain, 2001 and Sharma, 2009, 2011) [33, 35, 28]. Lecanidae > Lepadellidae > Brachionidae contributed notably to Rotifera abundance in Chela beel during the period of study. The importance of littoral periphytonic taxa of these three Eurotatorien families is attributed to lack of true limnetic conditions in the sampled floodplain lake. This salient feature concurred with the reports from the floodplain lakes of northeast India (Sharma and Hussain 2001 and, Sharma and Sharma 2008, 2014a) [33, 34, 41]. Further, the results obtained indicated the lack of quantitative dominance of any individual rotifer species which, in turn, suggested that the rotifers are generalists in terms of general environment.

Rhizopoda formed the sub-dominant quantitative component of zooplankton in Chela beel both during the first year (23.4±16.0%) and second year (21.6±9.8%) of the study period. ANOVA registered insignificant rhizopoda density variations in the sampled beel both between the years as well as between the months. This group followed no definite pattern of quantitative variations during the study period and recorded peaks in autumn (August, 2011) during the first year, and in summer (May, 2012) during the second year of the study period. The summer peak observed during the second year concurred with the reports of summer periodicity of these testaceans reported by Yadava *et al.* (1987) [49], Sinha *et al.* (1994) [45] and Sharma and Hussain (2001) [33]. Centropyxidae > Arcellidae > Euglephidae contributed to the Rhizopoda abundance Chela beel during the study period.

Cladocera formed another sub-dominant quantitative group of zooplankton in Chela beel, and registered both insignificant annual as well as monthly density variations. The Cladoceran abundance followed definite pattern of monthly density variations in the sampled lake and registered peak values during winter, both in the first year (January, 2011) and in the second year (February, 2012) of the study period. The winter peaks concurred with the reports of Sharma (2011) [28] and, Sharma and Sharma (2009) [35]. The Cladocera was characterized by the quantitative importance of Chydoridae observed during the entire study period which, in turn, concurred with the results of Sharma (2011) [28] and, Sharma and Sharma (2008, 2011, 2012b) [34, 28, 39] but differed from lack of any such feature as reported by Khan (1987) [9], Sanjer and Sharma (1995) [18], Sharma and Hussain (2001) [33] and Khan (2003) [11]. Daphniidae and Macrothricidae were two other important families in the sampled beel.

Copepoda, another sub-dominant quantitative group of zooplankton of Chela beel, indicated insignificant annual but significant monthly ($F_{11, 23}$ = 3.48385, P = 0.0247) density variations in the sampled lake. The sub-dominant role observed in Chela beel was in contrast to their dominance reported by Yadava *et al.* (1987) [49], Baruah *et al.* (1993) [3], Sharma and Hussain (2001) [33] and Khan (2003) [11]. This group registered peak values during early summer in the first year (April, 2011) as well as in the second year (May, 2012) of the study period. Cyclopoid copepods mainly influenced quantitative variations of this group; the calanoid, however, indicated insignificant role. The former feature concurred with the reports of Sharma and Hussain (2001) [33] and, Sharma and Sharma (2011, 2012b) [28, 39]. The quantitative significance of the copepods reflected the prevalence of stable environmental conditions for these 'k-strategists' as suggested by Allen (1976) and Schmidt-Araya & Zuniga (1992) [19]. The occurrence of nauplii throughout the study period showed an active continuous reproductive phase of the cyclopoids. Ostracoda, another group of zooplankton, indicated very poor abundance in the sampled floodplain lakes.

Zooplankton communities of Chela beel are characterized by consistently high species diversity throughout the study period (Figure 4). The species diversity is higher than the reports of Sharma and Hussain (2001) [33] but is lower than the results of Sharma and Sharma (2010, 2012b) [36, 39]. The characteristic feature of high diversity with lower density of majority of species observed in Chela beel is attributed to fine niche portioning amongst the zooplankton species in combination with micro- and macro-scale habitat heterogeneity as hypothesized by Segers (2008) [20] and affirmed by Sharma (2011) [28] and, Sharma and Sharma (2011, 2012b) [28, 39]. Rotifera > Cladocera contributed to higher zooplankton diversity in the sampled floodplain lake.

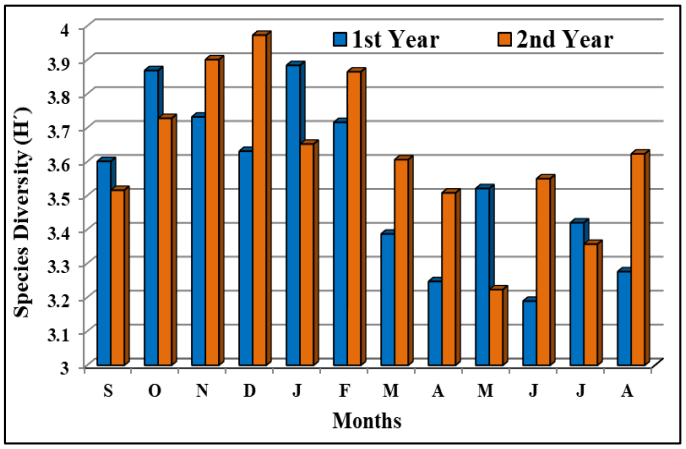

Fig 4: Monthly variations of species diversity of zooplankton

Lower dominance and higher evenness, two other interesting features of Chela beel, were attributed to lack of quantitative importance of any individual species coupled with low density of majority of species. The lack of distinct quantitative importance of different species noticed in this study is hypothesized (Mac Arthur, 1965) [14] to the fact that the habitat of the sampled lake has resources for utilization by majority of species and thus providing high amount of niche overlap. High evenness recorded in this study affirmed low densities and equitable abundance of various species and reiterated that the majority of zooplankton are 'generalists' vis-à-vis their general environment; the latter feature supported the hypothesis (Sharma and Sharma, 2014) [29] on high

evenness of Rotifer communities in the floodplain lakes of northeast India.

The present study indicated limited influence of individual abiotic parameters on the richness of zooplankton in Chela beel. It registered a significant negative correlation with rainfall (r = -0.666, p = 0.0004) and a positive correlation with magnesium (r = 0.585, p = 0.0027); this salient feature concurred with the report of limited influence from Loktak lake (Sharma and Sharma, 2011) [28] in Manipur. Rotifera richness is inversely correlated with only rainfall (r = -0.588, p = 0.0025) while Cladocera richness is directly correlated with magnesium (r = 0.617, p = 0.0007). The limited significance of individual abiotic parameters on the richness of Rotifera concurred with the results of Sharma (2005, 2009b) [25]. Zooplankton abundance is inversely correlated only with rainfall (r = -0.626, p = 0.0011); limited influence of individual abiotic factors corroborated with the reports of Yadava and Dey (1990) [48], Sharma and Hussain (2001) [33], Sharma (2011) [28] and, Sharma and Sharma (2011) [28]. Individual abiotic parameters exhibited no influence on the abundance of Rotifera. On the other hand, Cladocera is positively correlated only with magnesium (r = 0.580, p = 0.0030) while Ostracoda is directly correlated only with total alkalinity (r = 0.611, p = 0.0015). Abundance of Copepoda exhibited no significant correlation with any abiotic parameter in Chela beel.

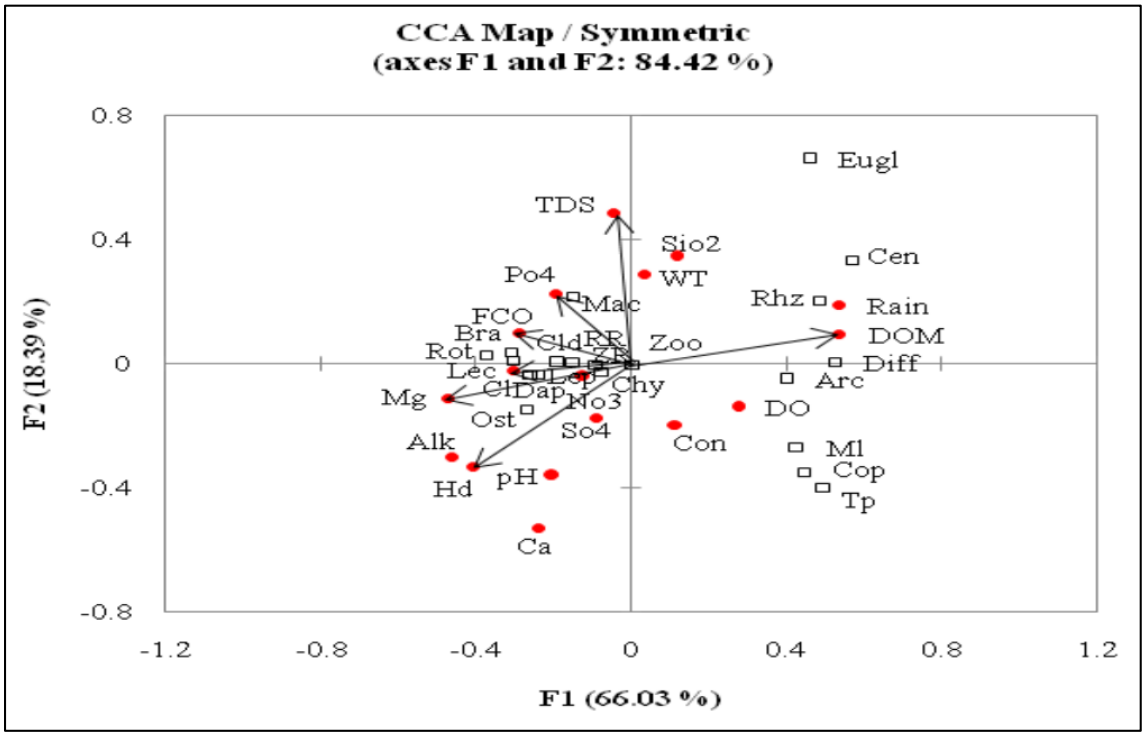

Fig 5: CCA ordination biplot of zooplankton assemblages and environmental variables

Abbreviations

Abiotic: Alk (alkalinity), Ca (Calcium), Cl (Chloride), Con (conductivity), DO (dissolved oxygen), DOM (dissolved oxygen matter), FCO (free carbon dioxide), Hd (Hardness), Mg (Magnesium), pH (hydrogen-ion concentration), No3 (nitrate), Po4(phosphate), Rain (rainfall), Sio2 (silicate), So4 (sulphate), TDS (Total dissolved solids), Wt (water temperature). Biotic: Arc (Arcellidae), Bra (Brachionidae), Cen (Centropyxidae), Chy (Chydoridae), Cld (Cladocera), Cop (Copepoda), Dap (Daphniidae), Diff (Difflugidae), Eugl (Euglephidae), Lec (Lecanidae), Lep (Lepadellidae), Mac (Macrothricidae), Ml (*Mesocyclops leuckarti*), Ost (Ostracoda), Rhz (Rhizopoda), Rot (Rotifera), RR (Rotifera richness), Tp (*Tropocyclops prasinus*), ZP (Zooplankton), ZR (Zooplankton richness). Canonical correspondence analysis (CCA) with 17 abiotic parameters recorded a cumulative variance of 84.42% along F1 and F2 axes. The present study reflected the importance of carbon-dioxide, hardness, calcium, magnesium, dissolved organic matter, total dissolved solids and phosphate; clustering of various biotic parameters in the centre of the plots; thus depicting certain micro-environmental differences within the sampled floodplain lake.

Conclusion

The species rich and diverse zooplankton of Chela beel formed the dominant qualitative, but sub-dominant quantitative component of net plankton, and exhibited rich diversity and quantitative importance of Rotifera > Rhizopoda during the entire study period.

The richness, abundance and species diversity of zooplankton and of its constituent groups followed no definite pattern of monthly variations.

The results affirmed higher species diversity, higher evenness and lower dominance of zooplankton and main constituent groups, and exhibited lower densities of majority of species. Individual abiotic parameters exerted limited influence on the richness and abundance of zooplankton and its constituent groups.

CCA explained high cumulative variance of zooplankton assemblages along axes F1 and F2 in the sampled floodplain lake.

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