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ZOOPLANKTON DIVERSITY AND PHYSICOCHEMICAL PROFILE OF AMEENPUR TANK, TELANGANA, INDIA

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ABSTRACT

Zooplankton composition and diversity in Ameenpur tank, Telangana, India were investigated during the year 2010-2012. The study reveals the occurrence of 55 species of zooplankton, of which 38 species rotifers, 14 cladocerans and 03 copepods. The population density varied from 195 to 5500Ind./L. The highest density of zooplankton was due to rotifer population. Diversity (H´) ranged from 0.6 to 2.45, evenness (J´) was 0.21 to 0.80 and species richness was 5 to 27. The population abundance because of *Brachionus angularis, B. calyciflorus, B. caudatus, B. falcatus and B. rubens, Keratella tropica, Ceriodaphnia cornuta, Moina micrura, Bosmina longirostris, Indialona ganapati* and *Mesocyclops leuckarti*. The significant inter and intra relationship between and within physicochemical and zooplankton indices were noted. Zooplankton diversity and physicochemical parameter reveal the change in the trophic status of Ameenpur tank.

Key words: Zooplankton, diversity, physicochemical, Ameenpur tank

INTRODUCTION

Freshwater ecosystem is under increasing threats and pressures throughout the world (Dudgeon *et al.,* 2005; Pattnaik, 2007). This has been overstrained and poisoned in various ways like industrial wastes, sewage, agricultural runoff with chemical wastes and excess nutrients. Discharges of pollutants degrade the quality of water, as well as affecting the health of aquatic ecosystems. Freshwater of the world is collectively experiencing accelerating rates of qualitative and quantitative degradation (Wetzel, 1992). According to Dudgeon *et al.* (2005) threats to global freshwater biodiversity under five categories like over exploitation, water pollution, flow modification, destruction and degradation of habitat and invasion of exotic species. These combined and interacting influences have resulted in the population decline and range reduction of freshwater biodiversity worldwide.

Freshwater environment has much faunal diversity, among them zooplankton plays a significant role in interlinking food web and energy transfer. Nevertheless, many studies recommend that the community size of selected major zooplankton as biological indicators for assessing the trophic status and water quality (Ferdous and Muktadir, 2009; Haberman and Haldna, 2014). Hence, eutrophication is one of the most prevalent environmental problems responsible for water quality degradation worldwide. There are many studies indicating the influence of eutrophication on changes in the abundance and composition of zooplankton (Gliwicz, 1969; Patalas, 1972; Maier, 1998). The present investigation aims to assess the trophic status of an irrigation tank through zooplankton species composition, diversity along with few physicochemical factors.

MATERIALS AND METHODS

The study was conducted at an irrigation tank about $3km^2$, located (17°31´19´´N and 78°19´52´´E) at Ameenpur village, Medak district, Telangana, India. It was carried out at monthly intervals from December 2010 to November 2012. Zooplankton collections were made from the littoral surface of the water column at different stations. Qualitative collections were done by towing surface water column and quantitative samples were made from four different sampling stations. 50L of water was collected in a known volume of a plastic bucket and filtered through zooplankton net made of bolting silk (No 25), 62 µm mesh size. The collected samples were transferred to a clean plastic container which is about 100ml capacity and preserved in 4% neutralized formalin solution. Quantitative collections were estimated by Sedgwick-Rafter cell method. The counting cell is marked glass slide with a rectangular cavity (50mm x 20mm x 1mm) of volume $1cm^3$ (i.e., 1ml capacity). The quantitative zooplankton samples were mixed thoroughly and then transferred to 1ml of sample to Sedgwick-Rafter counting cell with the help of a wide mouth glass dropper. It is then covered with a rectangular glass cover slip avoiding air bubbles. Allow the plankton to settle and then count under a compound light microscope. Good numbers of replicates were taken and average count per milliliter is calculated and the results were expressed in Ind./L (Welch, 1948)

Sedgwick-Rafter cell zooplankton (Ind./L)

$$= \frac{a \times C \times 1000}{L}$$

Where, a = average numbers of zooplankton counted in one small counting cell

C = volume of concentrate in ml

L = Volume of water filtered in liters

Identification of zooplankton species was done by using standard literature (Michael and Sharma, 1988; Sharma, 1992; Ranga Reddy, 1994; Segers, 1995; Dhanapathi, 2000; Sharma and Sharma, 2008) under a light microscope (Carl Zeiss 10×25x).

Physicochemical parameters like ambient and subsurface water temperature, electrical conductivity, pH and total dissolved solids were recorded in the field with digital electronic testers (Orlab). Water samples were collected in a clean plastic container (one liter) to estimate the chemical parameters. Dissolved oxygen content was estimated by Winkler's method. Total hardness, total alkalinity, Calcium, Chloride, Phosphate, Nitrate and Nitrite were analysed by using Orlab water quality kits according to standard method APHA (1985).

Statistical analysis, such as species diversity (Shannon diversity index H'), Species richness and Abundance (Hill Numbers index), Evenness (Pielou index) and Dominance (Berger-Parker dominance index) were analysed according to Hayek and Buzas (1997) and their working equations by using *Biodiversity pro* software. Principle component analysis was made according to Jolliffe (2002) by using *XLSTAT software*.

Shannon Diversity index $H' = -\sum_{i} pi \ln (pi)$

Where Pi = proportion of the number of individuals of species to the total number of individuals (Pi = ni/N).

n = total number of species.

N = total number of individuals

Evenness $J' = H_{max'} / Log^2 S$

Hmax´ = is the Shannon maximum diversity index

S = the total number of species in the sample.

Hill Numbers

H_0 = S (species richness)

H_1 = exp H' exponential of Shannon diversity Indices (abundance)

Berger-Parker Dominance index $d = N_{max} / N$

N_{max} = the number of individuals in the most abundant species

N = the total number of individuals in the sample

RESULTS

In this study, we have recorded 55 species of zooplankton from the Ameenpur tank. Of which 38 were rotifers, 14 were cladoceraus and 03 were copepods (Table 1). Among the

Table 1. List of Zooplankton species recorded in Ameenpur tank

Sl. No.	**Rotifers** Class EUROTATORIA Subclass MONOGONONTA Order PLOIMA	2010-11	2011-12
1	**Asplanchnidae**		
	Asplanchna brightwellii Gosse, 1850	+	+
	Brachionidae		
2	*Anuraeopsis fissa* Gosse, 1851	+	+
3	*Brachionus angularis* Gosse, 1851	+	+
4	*Brachionus budapestinensis* Daday, 1885	+	-
5	*Brachionus bidentata* Anderson, 1889	+	+
6	*Brachionus calyciflorus* Pallas, 1776	+	+
7	*Brachionus caudatus* Barrios and Daday, 1894	+	+
8	*Brachionus diversicornis* Daday, 1883	+	+
9	*Brachionus durgae* Dhanapathi, 1974	+	+
10	*Brachionus falcatus* Zacharias, 1898	+	+
11	*Brachionus quadridentatus quadridentatus* Hermann, 1783	+	+
12	*Brachionus quadridentatus var Melhemi* Barrios and Daday, 1894	+	-
13	*Brachionus rubens* Ehrenberg, 1838	+	+
14	*Brachionus urceolaris* Muller, 1773	+	-
15	*Keratella tropica* (Apstein, 1907)	+	+
	Lepadellidae		
16	*Colurella obtusa* (Gosse, 1886)	+	-
	Epiphanidae		
17	*Epiphanes clavulata* (Ehrenberg, 1832)	-	+
	Euchlanidae		
18	*Euchlanis dilatata* Ehrenberg, 1832	+	-
	Trichotriidae		
19	*Trichotria tetractis* (Ehrenberg, 1830)	+	-
	Lecanidae		
20	*Lecane leontina* (Turner, 1892)	+	-
21	*Lecane papuana* (Murray, 1913)	+	+
22	*Lecane bulla* (Gosse, 1851)	+	+
23	*Lecane luna* (Muller, 1776)	-	+
24	*Lecane closterocerca* (Harring and Myers, 1926)	+	-
25	*Lecane hamata* (Stokes, 1896)	+	-
26	*Lecane lunaris* (Ehrenberg, 1832)	+	-
27	*Lecane stenroosi* (Meissner, 1908)	+	+

Table 1. contd.

	Trichocercidae		
28	*Trichocerca pusilla* (Jennings, 1903)	+	+
29	*Trichocerca rattus* (Muller,1776)	+	-
	Synchaetidae		
30	*Polyarthra sp.*	+	+
	Order **Flosculariaceae**		
	Conochilidae		
31	*Conochilus sp.*	+	-
	Hexarthridae		
32	*Hexarthra sp.*	+	-
	Filiniidae		
33	*Filinia sp.*	+	+
34	*Filinia opoliensis* (Zacharias, 1898)	-	+
	Testudinellidae		
35	*Testudinella patina* Hermann, 1783	+	+
36	*Pompholyx sp*	+	+
	Subclass **Bdelloidea**		
	Philodinidae		
37	*Rotaria neptunia* Ehrenberg, 1832	+	+
38	*Rotaria sp.*	+	+
	Subphylum CRUSTACEA Class BRANCHIOPODA Order DIPLOSTRACA Suborder CLADOCERA		
39	**Sididae** *Diaphanosoma sarsi* Richard, 1895	+	+
40	*Diaphanosoma excisum* Sars, 1885	+	+
	Daphniidae		
41	*Ceriodaphnia cornuta* Sars, 1885	+	+
42	*Daphnia (Ctenodaphnia) lumholtzi* Sars, 1885	+	+
43	*Simocephalus vetulus* (O. F. Muller, 1776)	+	-
	Moinidae		
44	*Moina micrura* Kurz, 1874	+	+
	Bosminidae		
45	*Bosmina longirostris* (O. F. Muller, 1776)	+	-
	Macrothricidae		
46	*Macrothrix spinosa* King, 1853	+	+
47	*Ilyocryptus spinifer* Herrick, 1882	+	-

Table 1. contd.

	Chydoridae		
48	*Chydorus sphaericus* (O. F. Muller, 1776)	-	+
49	*Coronatella rectangula* Sars, 1862a	+	+
50	*Leberis davidi davidi* Richard, 1895a	+	-
51	*Leydigia acanthocercoides* (Fischer, 1854)	+	-
52	*Indialona ganapati* Petkovski, 1966	+	+
	Copepoda		
	Calanoida		
	Diaptomidae		
53	*Heliodiaptomus viduus* (Gurney, 1916)	+	+
54	*Sinodiaptomus* (*Rhinediaptomus*) *indicus* Kiefer, 1936	+	+
	Cyclopoidae		
55	*Mesocyclops leuckarti* Claus, 1857	+	+

rotifers, family Brachionidae and Lecanidae contains a high number of species, of which Genus *Brachionus* (12 species) and *Lecane* (08 species) represents the highest number. In cladocera, family Chydoridae has a high number of species. In copepoda, family Diaptomidae has two species and Cyclopoidae one (Table 1). Most commonly occurring species *viz. Brachionus angularis, B. calyciflorus, B. caudatus, B. rubens*, *Keratella tropica*, *Filinia longiseta, Rotatoria neptunia, Rotatoria rotatoria, Polyarthra indica*, *Ceriodaphnia cornuta, Diaphanosoma sarsi, Moina micrura* and *Mesocyclops leuckarti.*

The overall zooplankton density varied between 195 ind./L and 5500 Ind./L throughout the study (Table 2). The highest density was observed in December 2011 (5500 Ind./L) followed by March (3525 Ind./L), April (3854 Ind./L) and May 2012 (2214 Ind./L) were shown in Fig. 1. The highest rotifer population was recorded in December 2011 followed by March, April, and May 2012 (5293, 2209, 2873 and 1095 Ind./L respectively). The cladoceran population was lesser in density than rotifer and copepod. But, cladoceran population was higher than copepod during the summer (April and May 2011, March and May 2012 is about 322, 314, 1200 and 611 Ind./L.) and monsoon (October and November 2011, September and November 2012). Furthermore, copepods were observed more in summer (April, May 2011 and 2012) and are about 401, 614, 682, and 508 Ind./L (Fig. 1). The density of rotifer population was due to the abundance of the following species *Brachionus angularis*, *B. calyciflorus*, *B. caudatus*, *B. falcatus* and *B. rubens* in summer, *Keratella tropica* in monsoon seasons. In cladoceran density was due to the abundance of *Ceriodaphnia cornuta*, *Moina micrura*, *Bosmina longirostris* and *Indialona ganapati*. Similarly, the copepod abundance was due to *Mesocyclops leuckarti*. Chloride contents have significant positive correlation with Total zooplankton (r = 0.541), rotifer (r = 0.458) and cladoceran (r = 0.461) density (Table 4).

Zooplankton diversity (H') varied between 0.6 and 2.45 (Table 2 and Fig. 2). It was higher in March 2011 (H'= 2.45), and less in December 2011 followed by April, August, November 2012 (H'= 0.6, 1.2, 1.04 and 1.24 respectively). The evenness (J) of zooplankton was ranging between 0.212 and 0.80 (Fig. 3), this was high in January 2011 (J = 0.80), less in December 2010 and 2011 (J = 0.48 and J = 0.21 respectively). Species richness (S) was in the range of 5-27, highest in May 2011 and least in August 2012 (Fig. 4). The abundance of zooplankton was ranging between 3.34 and 49.7% (Fig. 5). Similarly Dominance varied between 18.4 and 88.7% in 2010-2012, high in December 2012 and less in March 2011 (Fig. 6). The diversity and evenness were high during

Table 2. Zooplankton density and diversity during 2010-2012

Index	Duration	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Total zooplankton (No/L)	2010-11	1023	872	530	1203	1883	1378	988.46	816.5	511.6	742.6	615.3	1451
	2011-12	5500	881	650	3525	3854	2214	847	354	195.6	1083	931.3	681.9
Rotifera (No/L)	2010-11	91.74	555	197	932.9	1158	450.1	625.89	350.8	194.2	391.2	217.8	1012
	2011-12	5293	636	224	2209	2873	1095	487	115	34.4	408.8	769.9	14.1
Cladocera(No/L)	2010-11	453.2	225	138	95	322.8	314.2	173.01	65	55.3	86.3	197.9	381.8
	2011-12	64.3	62.8	372	1200	299	611	66	63	34.5	316.9	46.1	443.7
Copepoda(No/L)	2010-11	478.4	92.3	195	175	401.7	614	189.56	400.7	262.1	265.1	199.6	57.4
	2011-12	142.5	182	55	115.3	682	508	294	176	126.7	357.3	115.3	224.1
Diversity (H')	2010-11	1.462	2.242	2.116	2.455	2.263	1.923	2.105	1.618	1.73	2.047	2.072	1.947
	2011-12	0.6	1.845	1.748	1.508	1.278	1.699	1.751	1.734	1.045	1.67	1.865	1.249
Evenness (J')	2010-11	0.488	0.809	0.695	0.763	0.732	0.584	0.715	0.571	0.598	0.683	0.692	0.63
	2011-12	0.212	0.666	0.594	0.572	0.555	0.644	0.73	0.723	0.649	0.725	0.689	0.503
Species Richness	2010-11	20	16	21	25	22	27	19	17	18	20	20	22
	2011-12	17	16	19	14	10	14	11	11	5	10	15	12
Abundance (%)	2010-11	11.89	36.65	30.55	49.79	37.764	23.12	30.077	14.88	17.49	27.65	28.65	23.92
	2011-12	3.428	20.66	17.95	12.71	9.122	16.74	18.03	17.59	6.516	16.06	21.28	8.745
Berger-Parker Dominance (d%)	2010-11	46.74	25.1	36.78	18.49	21.34	44.54	24.47	49.07	51.23	34.91	31.93	36.12
	2011-12	88.71	41.94	52.76	33.65	60.28	27.09	34.7	48.85	64.77	32.73	34.97	53.7

Table 3. Physicochemical profile of Ameenpur tank

Parameters	Duration	Ranges	Mean
Atmospheric Temperature °C	2010-2011	25.0-33.0	28.6 ± 2.4
	2011-2012	18.5-32.7	24.3 ± 4.3
Surface water Temperature °C	2010-2011	22.0-28.8	25.9 ± 2.5
	2011-2012	15.5-24.7	21.1 ± 3.0
P^H	2010-2011	7.9-9.4	8.8 ± 0.4
	2011-2012	8.4-10.1	9.0 ± 0.4
Electrical conductivity (mS)	2010-2011	0.8-1.6	1.2 ± 0.3
	2011-2012	1.4-3.4	2.1 ± 0.6
Dissolved Oxygen (mg/L)	2010-2011	6.7-14.2	10.3 ± 2.0
	2011-2012	4.3-19.0	10.5 ± 4.2
Total Dissolved Solids (ppm)	2010-2011	615-1270	937.3 ± 238
	2011-2012	1045-2000	1462.0 ± 391
Total Hardness (mg/L)	2010-2011	130.4-314	199.0 ± 56
	2011-2012	154-320	239.6 ± 45
Total Alkalinity (mg/L)	2010-2011	127.5-261.3	181.7 ± 36.4
	2011-2012	178.5-318.8	216.2 ± 40.6
Chlorides (mg/L)	2010-2011	131.5-475	271.1 ± 102.3
	2011-2012	151.8-688	418.4 ± 202.5
Calcium (mg/L)	2010-2011	22.1-37.9	32.3 ± 5.2
	2011-2012	28.4-47.4	39.3 ± 7.3
Magnesium (mg/L)	2010-2011	23.7-69.1	40.7 ± 13.7
	2011-2012	26-71.1	48.9 ± 12.5
Phosphates (mg/L)	2010-2011	0.2-1.0	0.4 ± 0.3
	2011-2012	0.1-10.7	1.5 ± 2.9
Nitrates (mg/L)	2010-2011	0.8-43.3	15.1 ± 16.5
	2011-2012	5.0-105	22.1 ± 36.7
Nitrites (mg/L)	2010-2011	0.0-0.2	0.1 ± 0.1
	2011-2012	0.0-0.3	0.1 ± 0.1
Ammonia (mg/L)	2010-2011	0.0-12.2	1.4 ± 3.6
	2011-2012	0.1-5.5	1.5 ± 2.1

Table 4. Correlation matrix between zooplankton and physicochemical parameters

Variables	AT	ST	PH	EC	DO	TDS	TH	TA	Cl	Ca	Mg	PO_4	NO_2	NO_3	NH4	TZ (Ind./L)	Rotifera (Ind./L)	Cladocera (Ind./L)	Copepoda (Ind./L)	Diversity (H')	Evenness (J')	Species Richness	Abundance (%)
ST	**0.907**																						
PH	-0.093	-0.047																					
EC	-0.352	**-0.504**	0.251																				
DO	0.109	0.218	0.268	-0.224																			
TDS	-0.180	-0.328	0.176	**0.912**	-0.175																		
TH	-0.176	-0.206	0.275	**0.696**	-0.275	**0.776**																	
TA	-0.211	-0.295	**0.462**	**0.725**	-0.287	**0.660**	**0.758**																
Cl	0.111	-0.041	0.037	**0.656**	-0.002	**0.776**	**0.439**	0.370															
Ca	**-0.575**	**-0.584**	0.227	0.027	0.169	-0.086	-0.098	-0.063	-0.256														
Mg	-0.098	-0.126	0.240	**0.678**	-0.291	**0.771**	**0.992**	**0.750**	**0.463**	-0.225													
PO_4	-0.103	-0.191	0.114	**0.605**	**-0.444**	**0.409**	0.399	**0.645**	0.382	-0.177	**0.413**												
NO_2	-0.380	-0.395	-0.271	0.268	-0.267	0.303	0.289	0.042	-0.090	0.131	0.266	0.010											
NO_3	-0.276	-0.329	0.093	0.064	-0.156	-0.020	-0.155	-0.005	-0.229	0.287	-0.190	0.074	**0.595**										
NH_4	-0.134	-0.122	-0.148	0.068	**-0.456**	-0.013	0.022	-0.006	0.031	-0.060	0.029	0.366	0.162	0.206									
TZ (Ind./L)	0.113	0.049	0.061	0.314	-0.151	**0.450**	0.287	0.230	**0.541**	-0.238	0.312	0.141	-0.149	-0.197	0.079								
Rotifera (Ind./L)	0.036	0.011	0.052	0.233	-0.088	0.383	0.263	0.179	**0.458**	-0.173	0.281	0.049	-0.097	-0.112	0.043	**0.967**							
Cladocera (Ind./L)	0.330	0.085	0.086	0.349	-0.018	0.334	0.122	0.097	**0.461**	-0.102	0.133	0.249	-0.222	-0.290	0.120	0.367	0.159						
Copepoda (Ind./L)	0.083	0.150	-0.033	0.199	**-0.477**	0.192	0.132	0.320	0.166	**-0.414**	0.183	0.326	-0.096	-0.251	0.109	0.212	0.058	0.105					
Diversity (H')	**0.438**	**0.420**	-0.305	-0.374	-0.079	-0.397	-0.362	-0.301	-0.319	-0.358	-0.308	-0.019	0.139	0.332	0.174	**-0.509**	**-0.512**	-0.104	-0.095				
Evenness (J')	-0.010	-0.052	-0.224	-0.082	-0.190	-0.239	-0.239	-0.152	-0.362	-0.043	-0.228	0.058	0.288	**0.439**	0.284	**-0.647**	**-0.643**	-0.161	-0.134	**0.812**			
Species Richness	**0.734**	**0.788**	-0.251	**-0.571**	0.166	**-0.440**	-0.363	-0.369	-0.132	**-0.577**	-0.281	-0.160	-0.178	-0.064	-0.147	-0.038	-0.044	-0.014	0.045	**0.579**	0.020		
Abundance (%)	**0.478**	**0.486**	-0.330	**-0.488**	-0.099	**-0.500**	**-0.436**	**-0.422**	-0.390	-0.382	-0.377	-0.087	0.099	0.359	0.189	-0.334	-0.295	-0.184	-0.167	**0.928**	**0.698**	**0.630**	
Dominance (d%)	-0.345	-0.240	0.255	0.124	0.279	0.220	0.184	0.152	0.220	0.270	0.145	-0.206	-0.196	-0.299	-0.250	0.391	**0.461**	-0.192	0.026	**-0.881**	**-0.815**	-0.344	**-0.788**

summer and monsoon seasons. Atmospheric and surface water temperature have positive correlation with diversity (r = 0.438; 0.420), species richness (r = 0.734; 0.788) and abundance (r = 0.478; 0.486). Nitrite content significantly correlates with the evenness (r = 0.439) of the zooplankton. Rotifer density has a significant correlation with total zooplankton density (r = 0.967) and its dominance (r = 0.461). Diversity and abundance were positively correlated with evenness (r = 0.812; 0.698) and species richness (r = 0.579; 0.630). Similarly, diversity and abundance (r = 0.928) have significant positive correlation (Table 4).

Physicochemical features of study shown in Table 3. The atmospheric temperature varied between 19.5 and 33°C and surface water temperature ranged between 18 and 28°C (Fig. 7). Similarly, the pH ranged from 7.9-10.1 (Fig. 8). The electrical conductivity was 0.83-3.4mS, which was high in 2010-11, and less in 2011-12. The maximum value 3.4mS was attained only in May 2012 (Fig. 9). The dissolved oxygen content was 6.6-14.2mg/L in 2010-11 and 4.3-19.0mg/L in 2011-12. The highest amount of dissolved oxygen 19.0mg/L was recorded only in February 2011, which was less (4.3mg/L) in April and May 2011(Fig.8). The total hardness value was 154.05-320mg/L, highest hardness was observed during the summer and monsoon in 2011-12. Total alkalinity was ranging from 127.5-318.8mg/L; high content was in 2011-12. Chloride values were 166.9-688mg/L in 2010-12. The highest values were observed during the summer, but it is low in monsoon (Fig. 10). Calcium and Magnesium contents were 22.1-47.4mg/L, 26.02-71.1mg/L respectively, the highest content of Calcium was observed in 2011-12. Similarly, Magnesium was in 2011-12 (Fig. 11). Nutrients such as Phosphate (0.28-10.7mg/L), Nitrate (0.01-105mg/L), Nitrite (0.001-0.305mg/L) and Ammonia (0.05-12.19mg/L) contents were analyzed (Table 6). The highest content of Phosphate was observed in May (10.7mg/L), during September and October 2012 it was in the range of 1.5-1.07mg/L (Fig. 12). Similarly, the highest content of Nitrate was observed 105mg/L in June 2012 (Fig. 13), whereas Nitrite was high 0.1-0.3mg/L from May to July and October 2012 (Fig. 14). The ammonia content was also high 0.1-5.5mg/L in March- May 2012 (Fig. 15).

The correlation matrix was analysed between the physicochemical parameters shown in Table 4. It reveals that most of the parameters have a significant positive correlation. Atmospheric and surface water temperature (r=0.907); pH and total hardness (r=0.462) have a positive correlation with each other. Electrical conductivity correlates positively with total dissolved solids (r=0.912), total hardness (r=0.696), total alkalinity (r=0.725), Chloride (r=0.656), Magnesium (r=0.678) and Phosphate (r=0.605); Total dissolved solids also coincide in similar way with a total hardness (r=0.776), total alkalinity (r=0.660), Chloride (r=0.776), Magnesium (r=0.771) and Phosphate (r=0.409). Total alkalinity correlation with magnesium (r=0.750) and Phosphate (r=0.645) is also significant. Chloride and Phosphate positively correlate with Magnesium (0.463; 0.413 respectively) and so is the case with Nitrate and nitrite (r=0.595). Principle component analysis of zooplankton indices and physicochemical parameters compliantly shows the variability 30.04% with alpha 0.05% significant. The species richness has more correlation with atmospheric and surface water temperature, whereas total zooplankton density with chloride content (Fig. 16). Physicochemical parameter shows the variability 35.54% with alpha 0.05% significant. Total dissolved solids, total hardness, alkalinity, electrical conductivity, magnesium and chloride had more association with one another (Fig. 16, 17). Zooplankton indices have variability 49.4%, p-value 0.005% significant. Total zooplankton density had more correlation with rotifer density. Diversity, abundance and species richness were more association than evenness, whereas dominance was natively correlated with diversity indices (Fig. 18).

DISCUSSION

Zooplankton community structure is shaped primarily by the physical and chemical environment. However, these communities are also modified by biological interactions (Blancher, 1984). This study recorded 61species of various zooplankton, of which rotifera has more number of species composition and density than cladocera and copepoda. The genus *Brachionus* and *Lecane* have more species among the rotifers. Sampaio *et al.* (2002); Kudari *et al.,* (2004) and Kudari *et al.* (2006) were also found similar observations. The population density of zooplankton of this tank showed a wide fluctuation and high population during winter and summer seasons. This is because of the high population of rotifers, especially the numerical abundance of *Keratella tropica* with unusual bloom in winter and *Brachionus angularis, B. calyciflorus, B. caudatus, B. rubens* in summer. Joti and Sehgal (1979); Chattopadhyay and Barik (2009) also noted the similar findings. Kiran *et al.,* (2007) revealed that the numeric variables in rotifers may apparently be influenced by the water quality. Negi and Pant (1983) reported that the dominance of rotifer by *Keratella tropica* is a conspicuous feature of the tropical plankton assemblage, whereas genus *Brachionus* and particularly *B. calyciflorus* is considered to be a good indicator of eutrophication (Sladecek, 1983; Nogueira, 2001; Sampaio *et al.,* 2002). The abundance of rotifers among the zooplankton is taken as an index of eutrophy (Michael, 1966; Schinler and Noven, 1971). Hence, Sharma (1996) reported that the abundance of *Brachionus* species and *Keratella tropica* are characterized as alkaline hard water in different parts of tropical India. Zooplankton abundance built by rotifer indicates the eutrophic (Haberman and Haldna, 2014).

The present study found the numerical dominance of few species was noticed such as *B. angularis, B. calyciflorus, B. caudatus,* and *B. rubens* in rotifer and *Moina micrura* in cladocera. Community dominance by relatively few species indicates environmental stress (Plafkin *et al.,* 1989). Diversity index obtained between H´= 1.5±0.3 and 2±0.3 during this study. It indicates that the tank could be polluted (Staub *et al.,* 1970; Mirsha *et al.,* 2010). According to Haberman and Haldna (2014), the Shannon diversity index for zooplankton between 1 and 2 as a result of eutrophication. The predominance of the rotifer among the zooplankton of a water body might be due to the less specialized feeding, parthenogenetic reproduction and high fecundity (Sampaio *et al.,* 2002). The abundance of cladocera corresponds with the onset of rain as evidenced by Kannan and Job (1980); Negi and Pant (1983). Perhaps the addition of allochthonus nutrients through surface runoff triggers the production of cladocerans because it prefers to live in the clear waters (Uttangi, 2001). Copepoda is more in the monsoon, mainly due to the abundance of *Mesocyclops leuckarti*. Cyclopids formed the dominant component of copepoda. A similar study was made at different places of India by Khan (1987); Sanjer and Sharma (1995); Sharma and Sharma (2011).

Physicochemical profile of the tank shows the tropical climate and alkaline in nature. Wide fluctuations in electrical conductivity, total dissolved solid and dissolved oxygen were due to the high ionic content and low temperature. On the other hand, as the water level recedes, the concentration of pollutants also increases proportionately. High electrical conductivity and total dissolved solids might be due to pollution and accumulation of the anthropogenic activity which hampered the water quality (Kadam, 1990; Manickam *et al.,* 2014). The low value of dissolved oxygen may be because of biological oxygen demands. Patil and Gouder (1985) reported that considerable reduction in dissolved oxygen concomitant with a rise in conductivity and the drop in pH strongly suggesting the higher levels of dissolved salts and less photosynthetic activity. The total hardness shows that hard water nature and increased alkalinity may be due to the increased pollutants. Calcium and Magnesium would have increased the hardness of the water body. Chloride concentration was high due to the anthropogenic pressure and animal wastes. According to Sharma and Dudani (1992) the

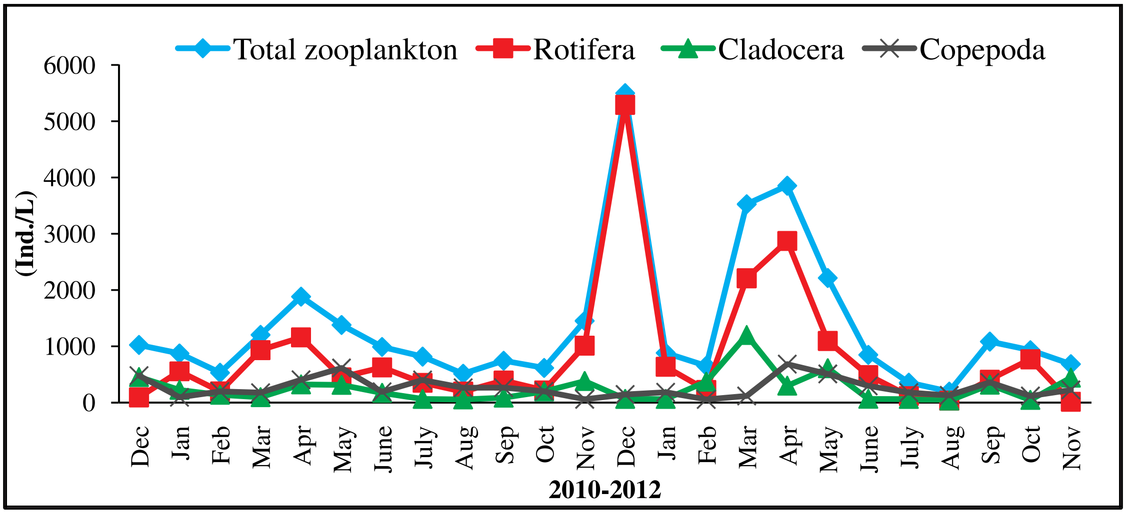

Fig. 1. Monthly variation of zoolplankton density from December 2010 to November 2012

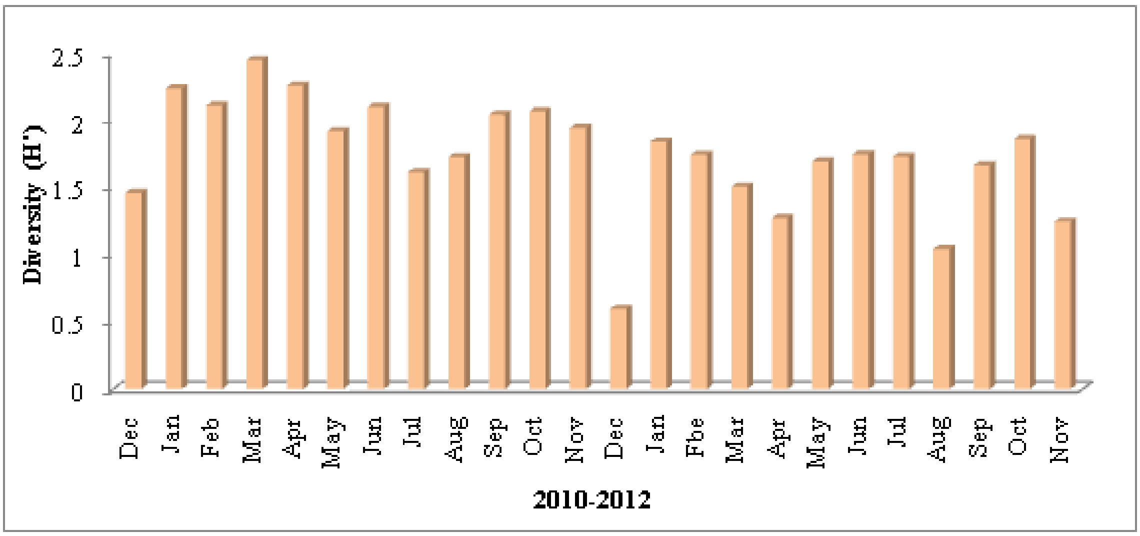

Fig. 2. Monthly variation of zooplankton diversity from December 2010 to November 2012

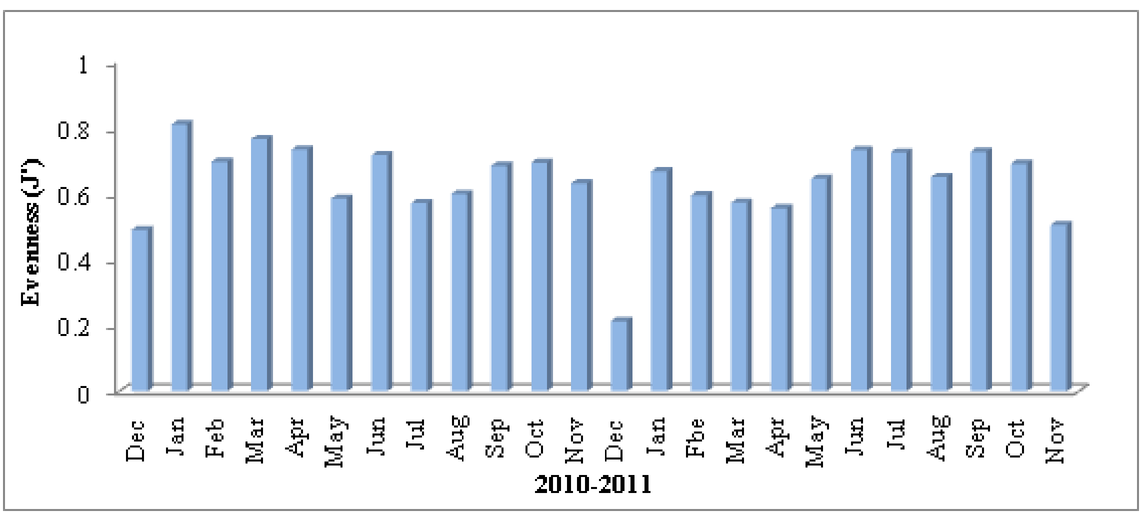

Fig. 3. Monthly variation of zooplankton evenness from December 2010 to November 2012

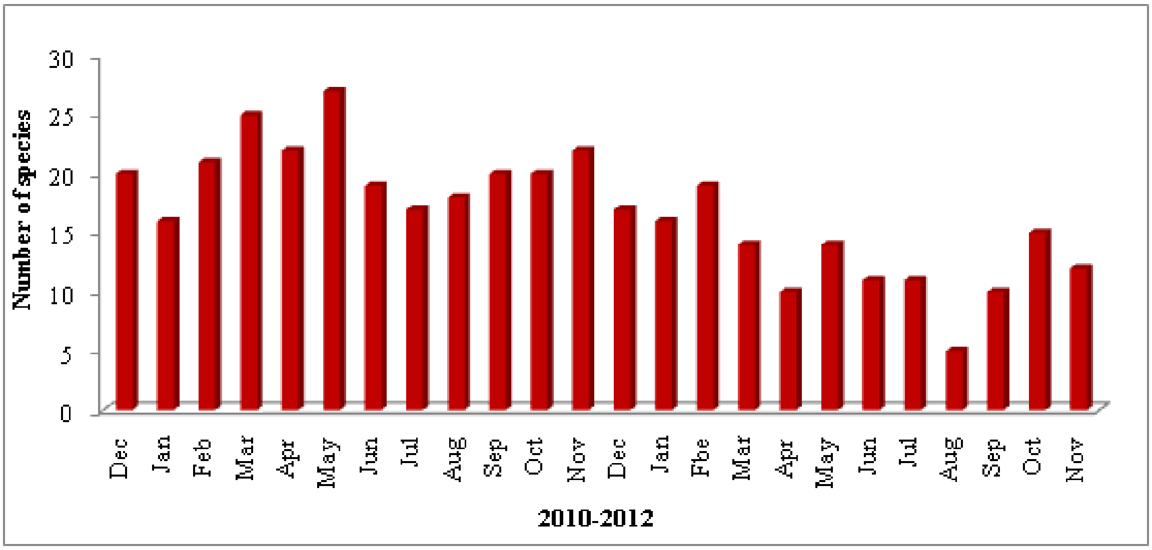

Fig. 4. Monthly variation of zooplankton species richness from December 2010 to November 2012

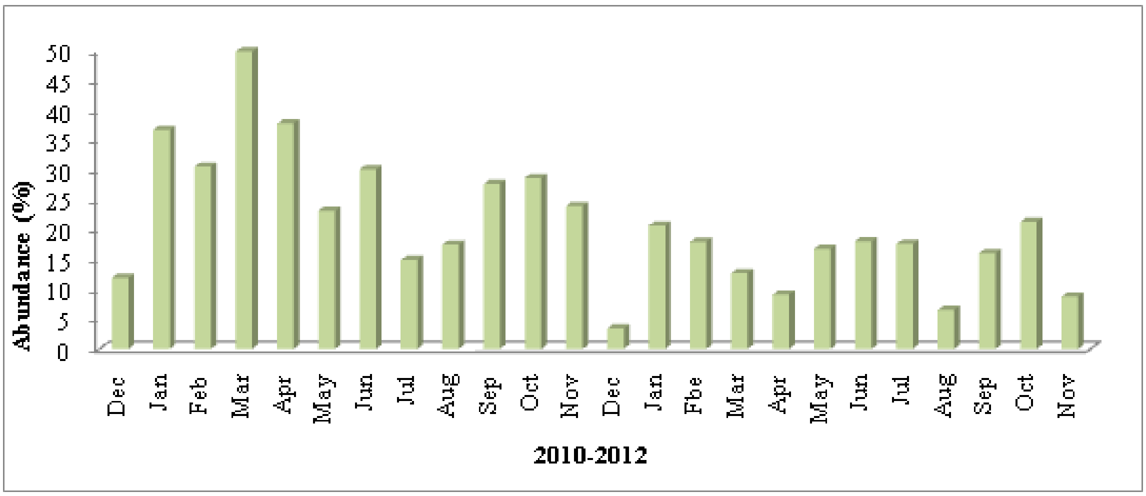

Fig. 5. Monthly variation of zooplankton abundance from December 2010 to November 2012

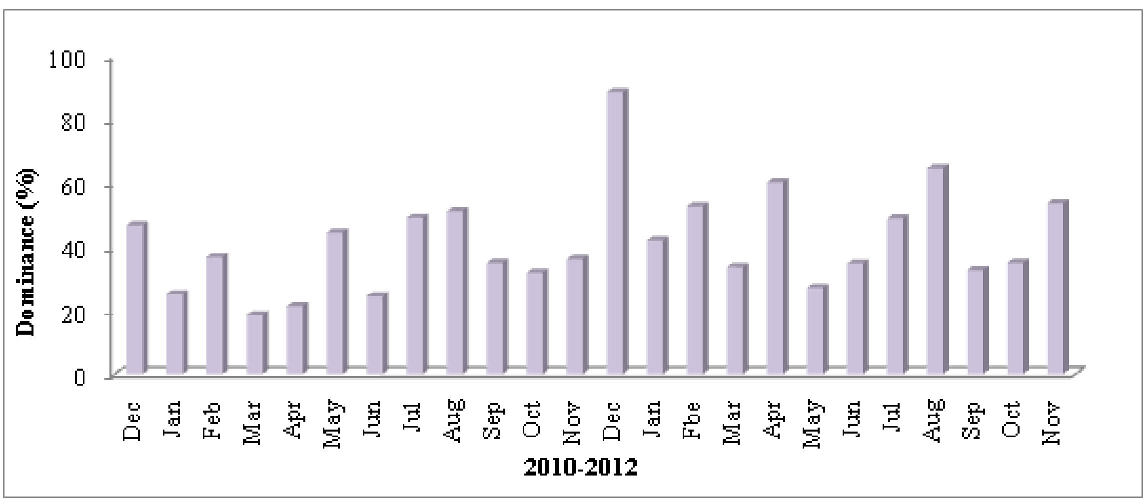

Fig. 6. Monthly variation of zooplankton dominance from December 2010 to November 2012

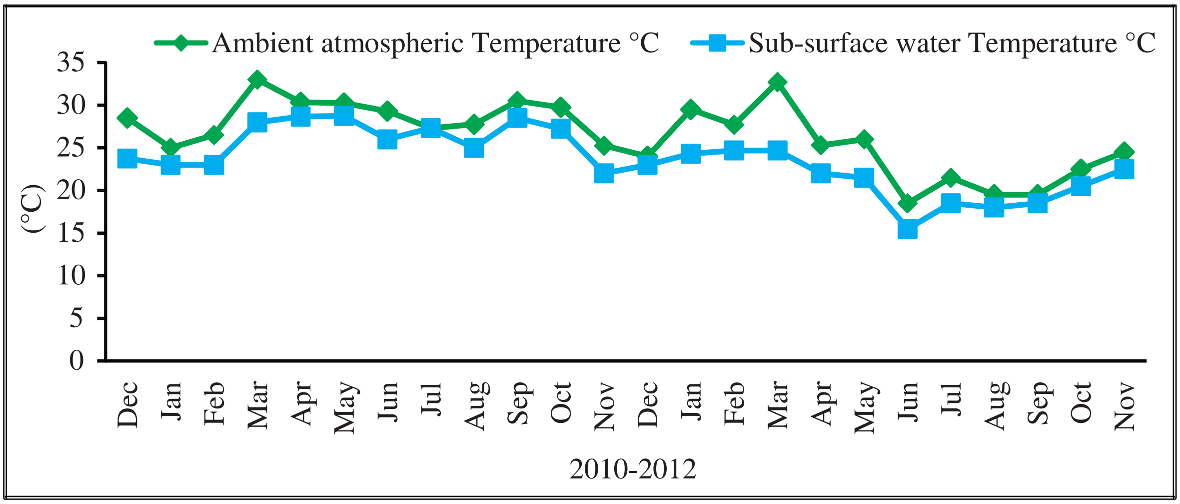

Fig. 7. Monthly variation of temperature from December 2010 to November 2012

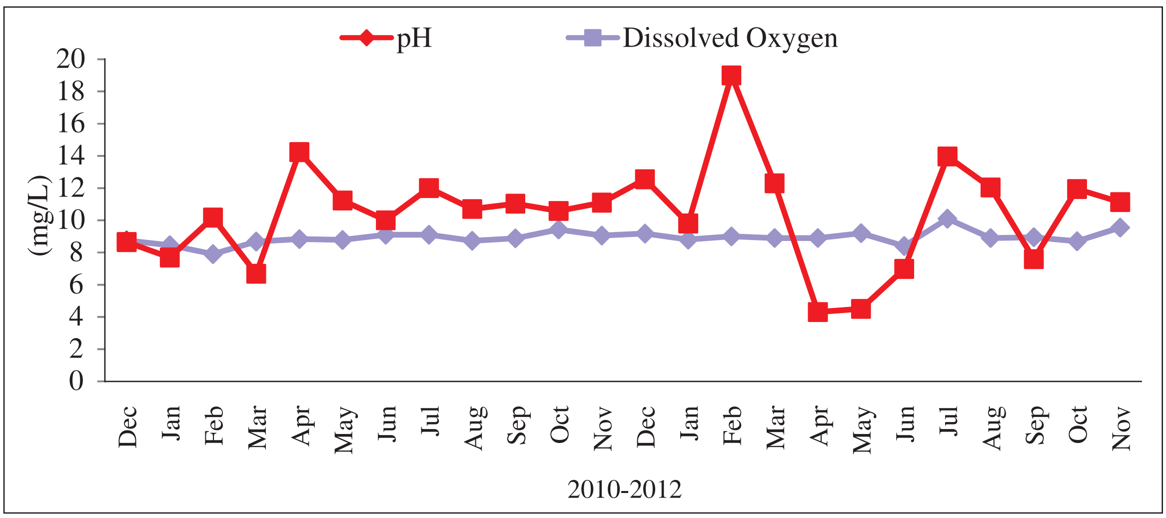

Fig. 8. Monthly variation of pH and dissolved Oxygen from December 2010 to November 2012

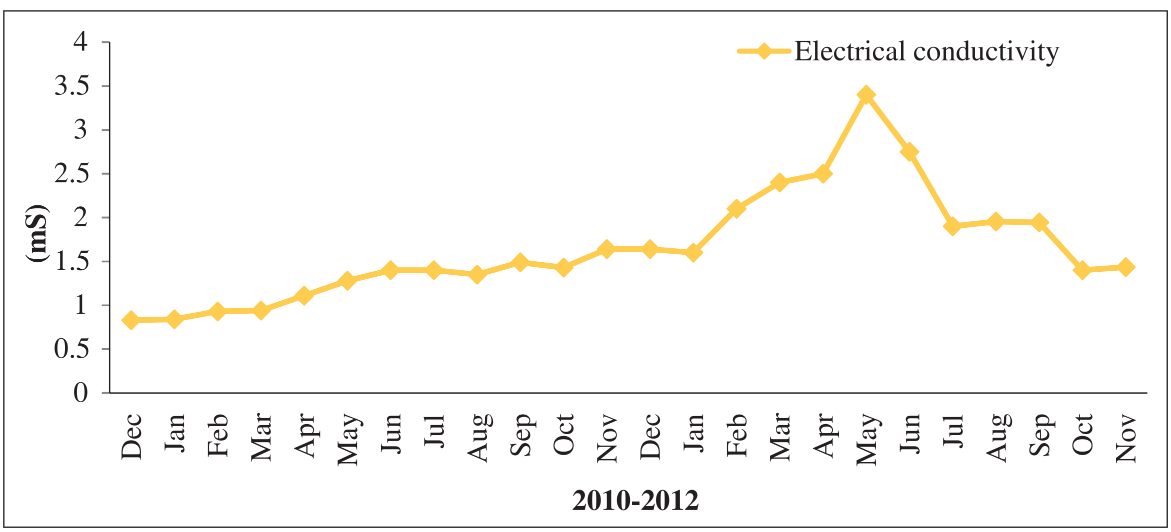

Fig. 9. Monthly variation of Electrical conductivity from December 2010 to November 2012

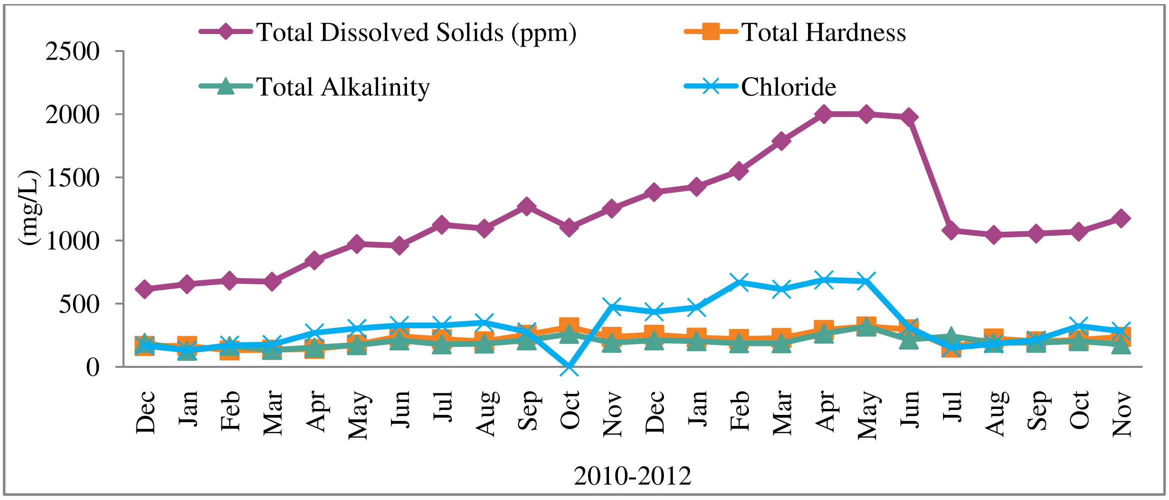

Fig. 10. Monthly variation of Total dissolved solids, hardness, alkalinity and chloride from December 2010-November 2012

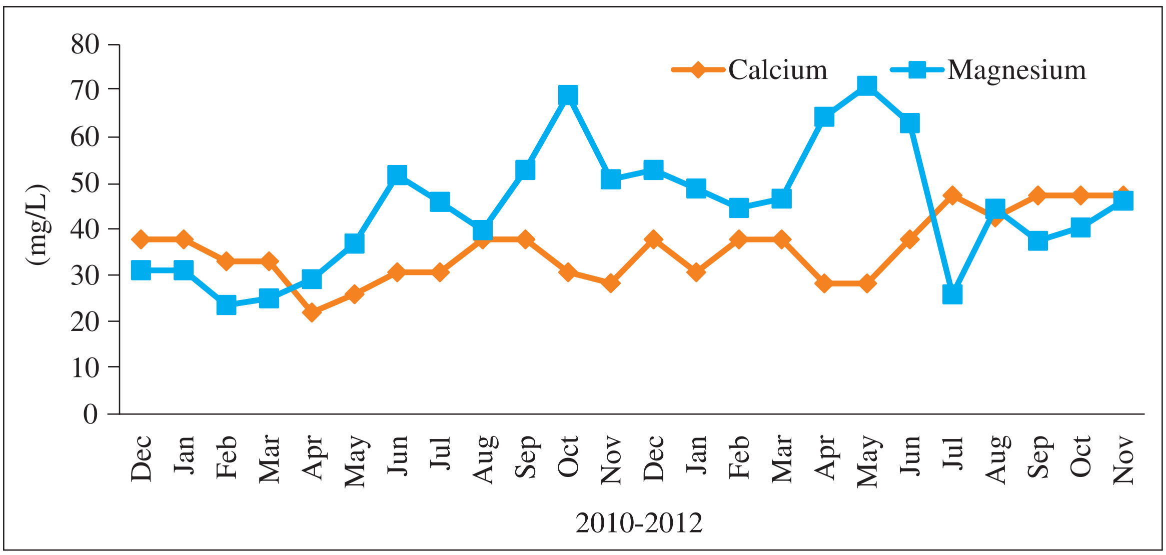

Fig. 11. Monthly variation of Calcium and Magnesium from December 2010 to November 2012

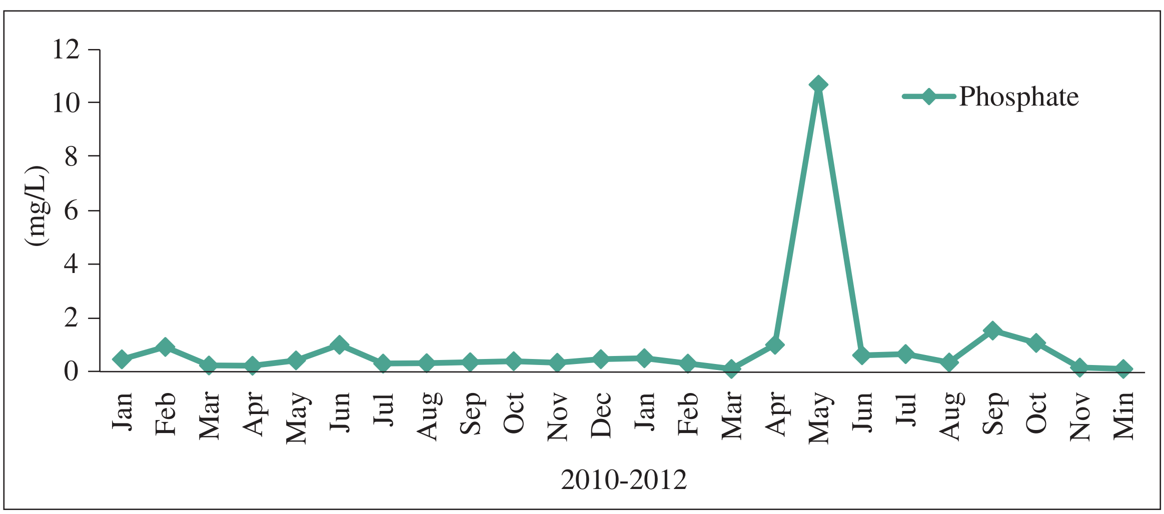

Fig. 12. Monthly variation of Phosphate from December 2010 to November 2012

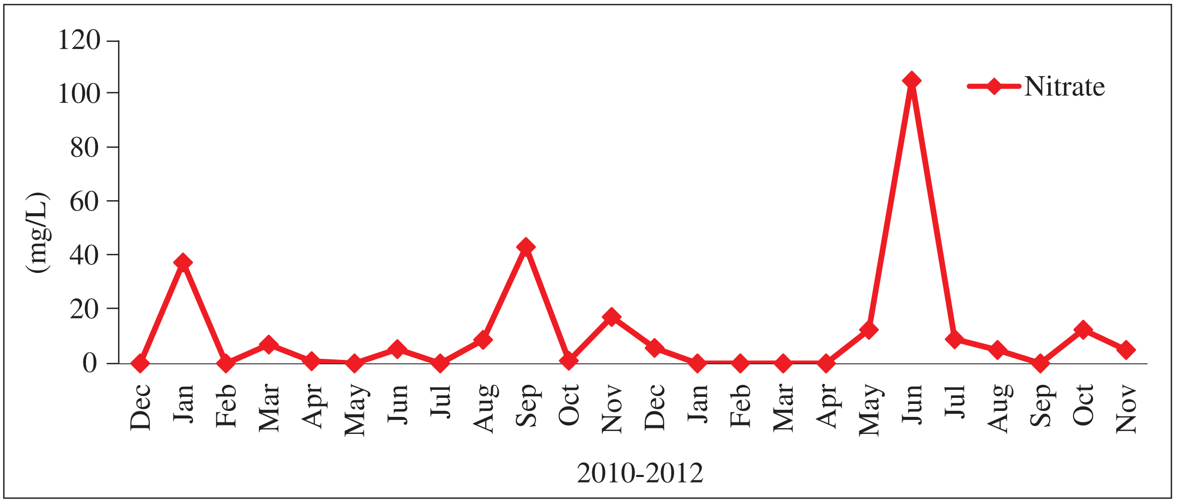

Fig. 13. Monthly variation of Nitrate from December 2010 to November 2012

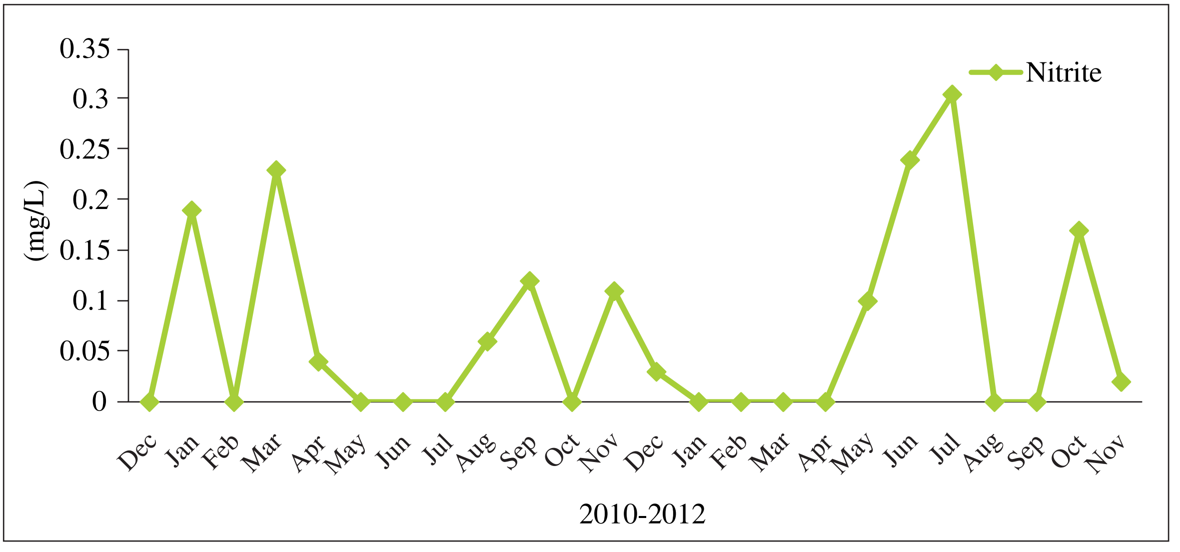

Fig. 14. Monthly variation of Nitrite from December 2010 to November 2012

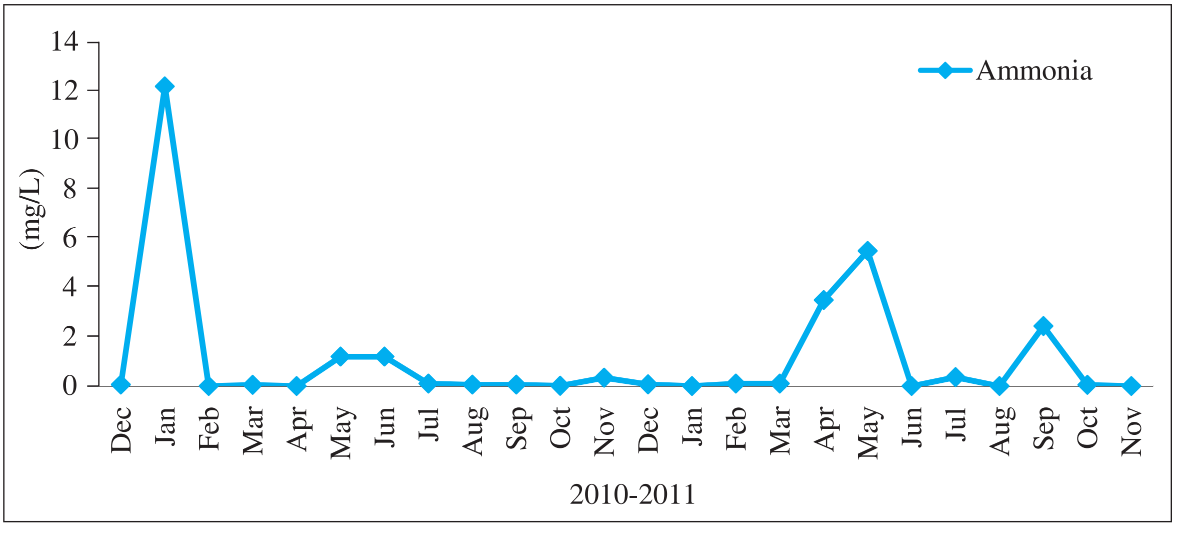

Fig. 15. Monthly variation of Ammonia from December 2010 to November 2012

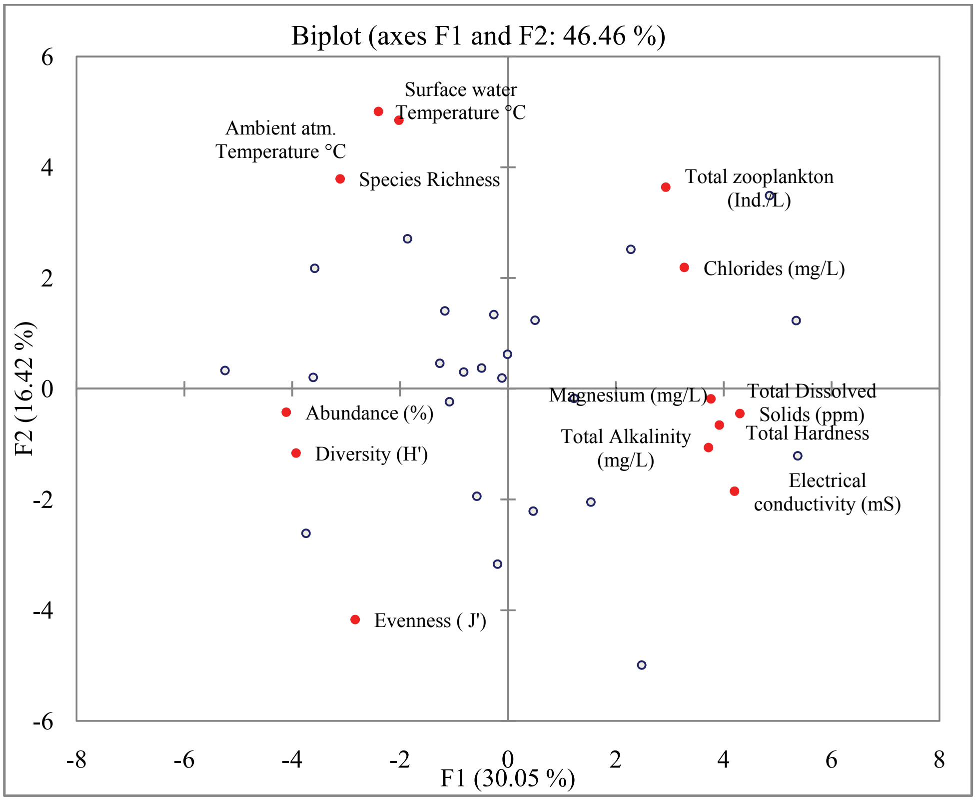

Fig. 16. PAC analysis of zooplankton and physicochemical values of Ameenpur tank

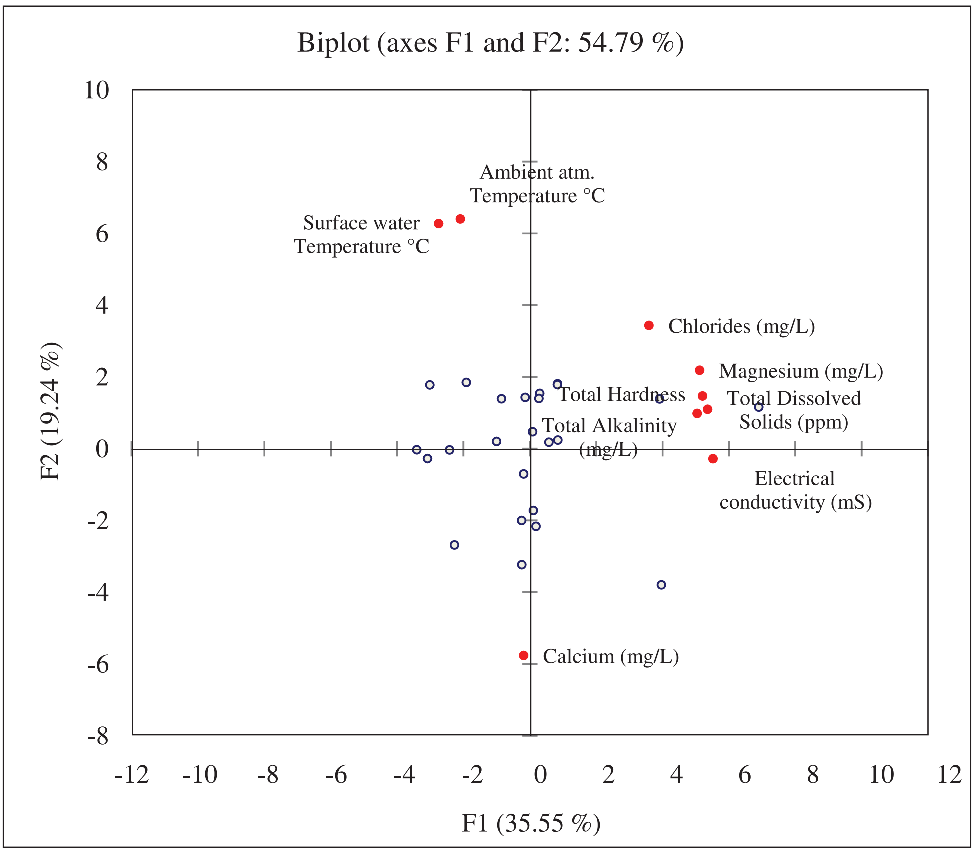

Fig. 17. PAC analysis between physicochemical values of Ameenpur tank

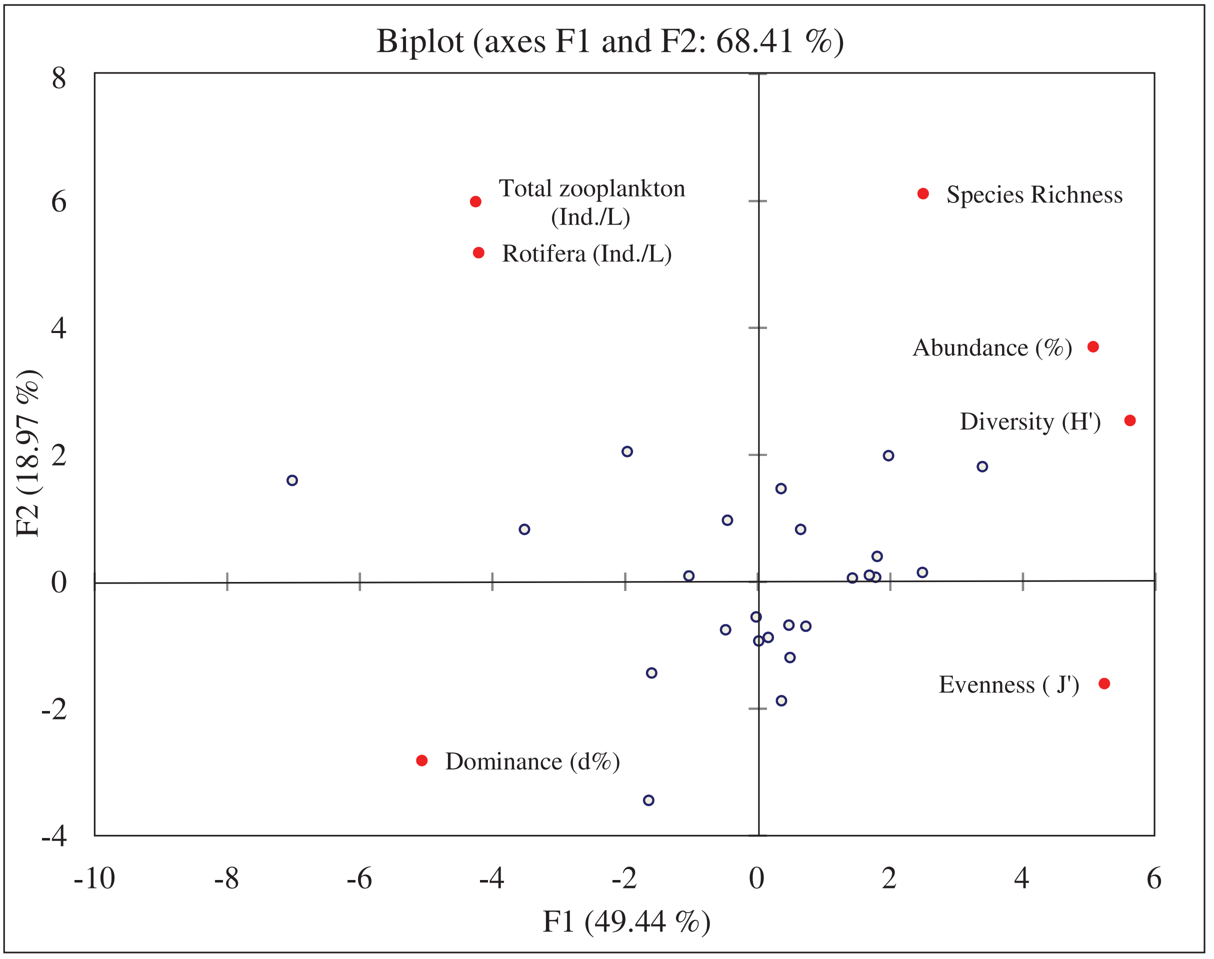

Fig. 18. PAC analysis among zooplankton indices of Ameenpur tank

high concentration of total hardness, alkalinity and chloride could be attributed to the influx of sewage waters and pollutants. Phosphate concentration is the key factor eutrophication of a water body (Shapiro, 1970). Phosphate content is high due to high a nutrient content which was also evidenced with a high concentration of Nitrate, Nitrite and Ammonia. The present tank has high Phosphate content, might be due to pollution. Nitrate, Nitrite and Ammonia contents were high in the initial period of study could be due to run off from heavy rain. Similarly, these contents were higher in summer seasons of the second year due to lack of rain, influx of sewage and receding of water level was more during this summer. The correlation coefficient and PAC analysis clearly reveal that the temperature significant correlation with diversity, abundance and species richness. Zooplankton density correlates with rotifer population, Chloride and total dissolved solids. Electrical conductivity, total dissolved solids, total hardness and Magnesium are more association one another within the physicochemical features. These factors are could be the determiner of the zooplankton productivity and diversity of the tank. Species richness, diversity, abundance negatively correlates with dominance. Zooplankton production and the predominance of rotifer population indicates the process of eutrophication (Ostoli, 2002). Hence, Zooplankton diversity of this tank moderately high in the initial period of the study, whereas it decreased later, may be due to shifts in the trophic status from mesotrophic to eutrophic condition. We conclude that the zooplankton community as a potential tool for assessing trophic status and water quality. It could provide a meaningful biological indicator for regional specific for better management and conservation of the freshwater ecosystem.

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