



# Diversity and Distribution of Zooplankton in Ropar Wetland (Ramsar Site) Punjab, India

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## ABSTRACT

The present study reveals the diversity, abundance and composition of zooplankton in Ropar wetland. A total of 17 genera of zooplankton population were recorded and categorized into 5 different groups, i.e. Protozoa, Rotifera, Cladocera, Copepoda and Ostracoda at all the sites (S1, S2, S3 and S4) from October 2015 to September 2017. Among these, Protozoa and Rotifera were the dominant groups consisting of 6 genera each. Of all the seasons, summer season depicted the highest density of zooplankton at all the sites and lowest diversity during monsoon season. The diversity indices were observed to be maximum at S2 and S4 sites as compared to S1 and S3 sites indicating that the wetland is moderately polluted as the values of Shannon-Weaver diversity index for zooplankton are above two in different seasons. This signifies that this wetland receives pollution from various sources, but still has low impact. The correlation of zooplankton population has also been studied with different physico-chemical parameters, which showed a negative correlation with dissolved oxygen (DO) and free CO<sub>2</sub> at all the sites and also with total dissolved solids (TDS) at S3 site.

## INTRODUCTION

Zooplankton being heterotrophic organisms and foremost trophic link in food chain play a pivotal role in aquatic ecosystems by cycling of organic materials, energy transfer in the food web and energy transfer from primary producer to secondary consumer (Steinberg & Robert 2009). Apart from this, certain species of zooplankton have the ability of indicating the deterioration in the quality of water caused by pollution or eutrophication (Mahajan 1981). The survival and growth of fishes are directly related to zooplankton due to the fact that they feed on them and also serve as base of food chains and food webs in all aquatic ecosystems (Miah et al. 2013, Shivashankar & Venkataramana 2013). The ability of zooplankton to react rapidly to the changes in environmental conditions as well as physical and chemical conditions of water body makes them a good indicator of changes occurring in water quality, thus helping in understanding the status of water pollution (Contreras et al. 2009). Numerous factors like physico-chemical properties of habitat, biotic factors and climate change affect the occurrence and distribution of plankton fauna (Richardson 2008, Rajagopal et al. 2010, Ahmad et al. 2011, Alexander 2012). Environmental factors like water temperature serve as an essential element, affecting the growth and development of organisms, thus controlling their death rate (Hall & Burns 2001, Andrulewicz et al. 2008, Tunowski 2009). Another environmental factor like salinity, significantly affects the organisms as they have to adjust the saline concen-

tration in their bodies as per the external environment (Lawrence et al. 2004, Ojaveer et al. 2010). In semi-enclosed water bodies, factors like warming of surface waters and freshwater input are very important in the process of stratification (Rabalais et al. 2002). These environmental parameters ultimately affect the composition and density of zooplankton by affecting their breeding (Greenwood et al. 2001). The present study was conducted to assess the diversity and distribution of zooplankton in Ropar wetland (Ramsar site) Punjab, India.

## MATERIALS AND METHODS

**Study area:** Ropar Wetland is a man-made freshwater riverine as well as lacustrine wetland. It came into existence with the impoundment of water by constructing a barrage on the River Sutlej near Ropar town. It was created in 1952 on the Sutlej River in the Punjab State of India, by building a head regulator to store and divert water for beneficial uses of irrigation through canals, drinking and industrial water supply (Fig. 1). It is situated at 30°58'-31°02' N latitude and 76°30'-76°33' E longitude. This important ecological zone is located in the Shivalik foothills of the Lower Himalayas. Shallow water features exist along both the sides of the river located within the wetland area. Climatically this area is sub-moist or humid and comparatively less hot region of Punjab with mean annual rainfall of 1518 mm. The total area covered by the wetland is 1365 ha, which includes 800 ha area of the river and the reservoir, 30 ha of



showed 17 species of zooplankton. These included 6 species of rotifers, 4 species of copepods, 6 species of cladocerans and 1 species of ostracods (Kamble & Mudkhede 2013). Our results are also parallel to Brraich & Kaur (2015) who recorded 17 genera of zooplankton in Nangal wetland, classified into 5 different groups, Protozoa (6 genera), Rotifera (6 genera), Cladocera (2 genera), Copepoda (2 genera) and Ostracoda (1 genera). Protozoa and Rotifera were the dominant groups among zooplankton community, both having 6 genera, constituting 70.59% of the total zooplankton population. One more study on Bhimtal Lake situated in Uttarakhand, India showed the presence of 29 species of zooplankton including 16 species of Rotifera, 8 species of Cladocera and 5 species of Copepoda. Rotifera group was the most dominant among all the three groups (Panwar & Malik 2016). An assessment of diversity status of zooplankton in Jal Ghar Bhiwani, Haryana India recorded a total of 13 species of zooplankton belonging to 13 genera, 9 families, 5 orders and 4 classes and Rotifers were the dominant group (Kumar & Kumari 2017). The present study is also in accordance with Sharma & Kumari (2018) who assessed the zooplankton diversity of sacred Lake Prashar, Himachal Pradesh, India and divided it into five groups which constituted Rotifera (38%) followed by Cladocera (26%), Protozoa (25%), Copepoda (6%) and Ostracoda (5%) and among these, particularly Rotifera and Cladocera were the dominant groups throughout the study period. The reason behind these quantitative and qualitative variations in zooplankton is the quality of water (Zafar & Sultana 2005).

During the present study, it has been revealed that density of zooplankton population varied in different seasons and is maximum during summer season and least abundant in monsoon season. The highest abundance of zooplankton population during the summer seasons could be due to the water quality, decaying vegetation and increased levels of organic matter in the sediment. It may also be due to the high phytoplankton density during this period as they are the major food for zooplankton. During the monsoon season, the reason behind the least abundance of zooplankton population was due to the dilution of water with rain water and high level of turbidity. Hence, zooplanktons are important indicators of pollution status, water quality, climate change and productivity of aquatic ecosystems. The S2 and S4 sites were observed to have maximum diversity of zooplankton, while S1 and S3 sites had minimum diversity of zooplankton (Tables 1, 2, 3, 4). Our results are in agreement with Kar & Kar (2016) who found that zooplankton diversity of a freshwater pond in a Cachar district of Assam, India have higher population density of zooplankton during winter season and lower during the summer season. The minimum density of zooplankton was observed in the

monsoon season, whereas maximum peak density was recorded in pre and post monsoon seasons but the former peak was higher than pre monsoon in some lentic water bodies of Karwar (Vasanthkumar et al. 2015). The low population density of zooplankton during monsoon season may be attributed to the dilution factor by rain and high water level (Akbulut 2004, Mulani et al. 2009, Rogozin 2000, Tasevska et al. 2010). The present study recorded the higher population of rotifers and is further affirmed by number of workers, which might be due to hypereutrophical conditions of the water body at high temperature and low water level (Abbas & Talib 2018, Jayabhaye & Madlapur 2006, Tyor et al. 2014, Manickam et al. 2018).

During the present study, maximum species diversity and species evenness were recorded during summer season and minimum species diversity during monsoon season at all the sites (Tables 5, 6, 7, 8). Shannon-Weaver index, Simpson's index and species evenness index for zooplankton population in different seasons ranges from 2.822 to 2.83, 0.9398 to 0.9408 and 0.9884 to 0.997 respectively at S1 site; from 2.827 to 2.831, 0.9404 to 0.9409 and 0.9939 to 0.9978 respectively at S2 site; from 2.823 to 2.831, 0.94 to 0.9409 and 0.9903 to 0.9976 respectively at S3 site; and from 2.826 to 2.832, 0.9403 to 0.9411 and 0.9925 to 0.999 respectively at S4 site. The results of the present study of diversity indices indicate that the wetland is moderately polluted as the values of Shannon-Weaver diversity index for zooplankton are above two in different seasons, which shows that there is a meagre impact of pollution in Ropar wetland. In the present work, maximum species diversity indices were observed at S2 and S4 sites, and minimum at S1 and S3 sites. The minimum diversity at S1 site is due to the fact that it receives pollution from the adjoining areas like ash from thermal plant and silt from cement plant. It also receives industrial effluents from National Fertilizer Ltd. (NFL), Nangal. Further, the minimum diversity at S3 site was due to discharge of loads of silt from fragile nature of banks and adjoining agricultural fields. It also receives pollution in the form of pesticides and weedicides from adjoining agricultural fields. The erosion causes loss of habitat in this area every year. The turbid water due to suspended soil particles and loss of habitat are the main causes of minimum occurrence of zooplankton diversity. The maximum diversity at S2 site is due to existence of large organic material because it is surrounded by thick forest area, which is the main source of organic matter. The littoral zone of this site is strewn with small boulders, cobbles, pebbles, gravels and sand which supports large diversity. The site S4 is also very productive due to existence of variety of habitats supported by small boulders, cobbles, pebbles, gravels and sand. The simplest measure of

Table 1: Mean, standard deviation (S.D.), range and seasonal variations of zooplankton population (ind/L) at S1 site of Ropar Wetland from October 2015 to September 2017.

Zooplankton/Months	Winter season	Summer season	Monsoon season	Autumn season	October 2015 to September 2017	
	Mean±S.D.	Mean±S.D.	Mean±S.D.	Mean±S.D.	Mean±S.D.	Range
<b>Protozoa</b>						
<i>Nebella</i> spp.	262.5±125.24	470.83±53.42	145.83±36.79	316.66±78.52	298.95±141.12	100-550
<i>Vorticella</i> spp.	300±111.80	458.33±84.65	183.33±64.54	383.33±64.54	331.25±130.26	100-575
<i>Diffugia</i> spp.	241.66±110.30	525±59.16	200±85.14	366.66±54.00	333.33±149.39	100-600
<i>Arcella</i> spp.	291.66±131.02	500±59.16	191.66±64.54	358.33±64.54	335.41±139.27	100-575
<i>Stylonychia</i> spp.	250±111.80	450±59.16	195.83±65.98	300±59.16	298.95±120.56	100-525
<i>Thecamoeba</i> spp.	225±111.80	483.33±64.54	183.33±54.00	320.83±36.79	303.12±135.79	100-575
<b>Rotifera</b>						
<i>Asplanchna</i> spp.	266.66±114.74	545.83±104.18	187.5±68.46	370.83±73.17	342.70±161.76	100-675
<i>Filinia</i> spp.	212.5±95.85	475±59.16	208.33±54.00	341.66±54.00	309.37±128.70	100-550
<i>Keretella</i> spp.	241.66±110.30	425±59.16	166.66±58.45	358.33±71.87	297.91±125.52	100-500
<i>Hexarthra</i> spp.	208.33±46.54	450±59.16	212.5±77.05	345.83±87.20	304.16±121.50	100-525
<i>Brachionus</i> spp.	258.33±95.74	441.66±71.87	241.66±116.90	408.33±81.64	337.5±125.32	100-550
<i>Tripleuchlanis</i> spp.	191.66±64.54	541.66±64.54	233.33±70.11	400±65.19	341.66±155.10	100-625
<b>Cladocerans</b>						
<i>Daphnia</i> spp.	291.66±60.55	466.66±71.87	183.33±64.54	425±70.71	341.66±130.35	100-575
<i>Monia</i> spp.	216.66±78.52	495.83±48.51	237.5±95.85	470.83±62.08	355.20±148.17	100-575
<b>Copepods</b>						
<i>Cyclops</i> spp.	258.33±64.54	529.16±73.17	258.33±64.54	425±59.16	367.70±132.79	175-650
<i>Eucyclops</i> spp.	233.33±70.11	533.33±78.52	262.5±72.02	362.5±72.02	347.91±137.90	150-625
<b>Ostracods</b>						
<i>Cypris</i> spp.	204.16±57.91	537.5±110.39	229.16±85.75	329.16±85.75	325±156.73	100-675
Total	24925	49975	21125	37700		

Table 2: Mean, standard deviation (S.D.), range and seasonal variations of zooplankton population (ind/L) at S2 site of Ropar Wetland from October 2015 to September 2017.

Zooplankton/Months	Winter season	Summer season	Monsoon season	Autumn season	October 2015 to September 2017	
	Mean±S.D.	Mean±S.D.	Mean±S.D.	Mean±S.D.	Mean±S.D.	Range
<b>Protozoa</b>						
<i>Nebella</i> spp.	362.5±125.24	570.83±53.42	300±59.16	400±59.16	408.33±126.76	225-650
<i>Vorticella</i> spp.	400±111.80	558.33±84.65	366.66±46.54	450±38.72	443.75±102.74	275-675
<i>Diffugia</i> spp.	341.66±110.30	625±59.16	333.33±54.00	433.33±88.97	433.33±141.93	225-700
<i>Arcella</i> spp.	391.66±131.02	600±59.16	325±59.16	441.66±84.65	439.58±132.47	250-675
<i>Stylonychia</i> spp.	350±111.80	550±59.16	300±59.16	400±59.16	400±118.87	225-625
<i>Thecamoeba</i> spp.	325±111.80	583.33±64.54	320.83±36.79	387.5±75.41	404.16±130.56	200-675
<b>Rotifera</b>						
<i>Asplanchna</i> spp.	366.66±114.74	645.83±104.18	337.5±46.77	412.5±60.72	440.62±147.95	225-775
<i>Filinia</i> spp.	312.5±95.85	575±59.16	341.66±54.00	408.33±76.91	409.37±124.41	200-650
<i>Keretella</i> spp.	341.66±110.30	525±59.16	308.33±78.52	458.33±71.87	408.33±117.64	200-600
<i>Hexarthra</i> spp.	308.33±46.54	550±59.16	312.5±77.05	429.16±64.06	400±117.02	200-625
<i>Brachionus</i> spp.	358.33±95.74	541.66±71.87	375±100	450±79.05	431.25±110.15	250-650
<i>Tripleuchlanis</i> spp.	291.66±64.54	658.33±46.54	283.33±54.00	466.66±88.97	425±168.10	200-725
<b>Cladocerans</b>						
<i>Daphnia</i> spp.	391.66±60.55	566.66±71.87	316.66±64.54	491.66±60.55	441.66±114.36	225-675
<i>Monia</i> spp.	316.66±78.52	595.83±48.51	404.16±62.08	487.5±60.72	451.04±120.79	225-650
<b>Copepods</b>						
<i>Cyclops</i> spp.	358.33±64.54	629.16±73.17	425±59.16	525±59.16	484.37±120.64	275-750
<i>Eucyclops</i> spp.	333.33±70.11	633.33±78.52	362.5±72.02	412.5±60.72	435.41±137.11	250-725
<b>Ostracods</b>						
<i>Cypris</i> spp.	304.16±57.91	637.5±110.39	304.16±62.08	395.83±65.98	410.41±156.71	200-775
Total	35125	60275	34300	44700		

Table 3: Mean, standard deviation (S.D.), range and seasonal variations of zooplankton population (ind/L) at S3 site of Ropar Wetland from October 2015 to September 2017.

Zooplankton/Months	Winter season	Summer season	Monsoon season	Autumn season	October 2015 to September 2017	
	Mean±S.D.	Mean±S.D.	Mean±S.D.	Mean±S.D.	Mean±S.D.	Range
<b>Protozoa</b>						
<i>Nebella</i> spp.	262.5±125.24	404.16±144.40	170.83±57.91	333.33±80.10	292.70±133.61	100-575
<i>Vorticella</i> spp.	300±111.80	462.5±125.24	183.33±64.54	354.16±85.75	325±138.50	100-600
<i>Diffugia</i> spp.	241.66±110.30	408.33±148.88	179.16±65.98	304.16±79.71	283.33±131.39	100-575
<i>Arcella</i> spp.	291.66±131.02	437.5±125.24	162.5±46.77	312.5±78.66	301.04±137.42	100-575
<i>Stylonychia</i> spp.	250±111.80	391.66±120.06	200±72.45	304.16±64.06	286.45±114.67	100-525
<i>Thecamoeba</i> spp.	225±111.80	358.33±122.13	216.66±54.00	316.66±94.42	279.16±110.99	100-500
<b>Rotifera</b>						
<i>Asplanchna</i> spp.	266.66±114.74	425±79.05	220.83±104.18	341.66±78.52	313.54±119.09	100-550
<i>Filinia</i> spp.	212.5±95.85	441.66±105.67	208.33±54.00	345.83±65.98	302.08±126.38	100-550
<i>Keretella</i> spp.	241.66±110.30	391.66±95.74	191.66±56.27	308.33±51.63	283.33±108.51	125-500
<i>Hexarthra</i> spp.	208.33±46.54	433.33±78.52	195.83±71.44	375±59.16	303.12±121.65	100-525
<i>Brachionus</i> spp.	258.33±95.74	425±97.46	175±70.71	283.33±54.00	285.41±119.30	100-550
<i>Tripleuchlanis</i> spp.	191.66±64.54	454.16±88.62	233.33±70.11	333.33±64.54	303.12±123.64	100-550
<b>Cladocerans</b>						
<i>Daphnia</i> spp.	291.66±60.55	466.66±95.74	191.66±60.55	291.66±64.54	310.41±121.34	125-575
<i>Monia</i> spp.	216.66±78.52	450±97.46	237.5±95.85	300±59.16	301.04±121.91	100-550
<b>Copepods</b>						
<i>Cyclops</i> spp.	258.33±64.54	466.66±105.67	258.33±64.54	283.33±70.11	316.66±115.07	175-575
<i>Eucyclops</i> spp.	233.33±70.11	416.66±131.02	262.5±72.02	291.66±75.27	301.04±110.69	150-575
<b>Ostracods</b>						
<i>Cypris</i> spp.	204.16±57.91	445.83±108.87	229.16±85.75	295.83±65.98	293.75±122.75	100-575
Total	24925	43675	21100	32250		

Table 4: Mean, standard deviation (S.D.), range and seasonal variations of Zooplankton population (ind/L) at S4 site of Ropar Wetland from October 2015 to September 2017.

Zooplankton/Months	Winter season	Summer season	Monsoon season	Autumn season	October 2015 to September 2017	
	Mean±S.D.	Mean±S.D.	Mean±S.D.	Mean±S.D.	Mean±S.D.	Range
<b>Protozoa</b>						
<i>Nebella</i> spp.	412.5±72.02	683.33±64.54	375±59.16	575±59.16	511.45±140.45	300-775
<i>Vorticella</i> spp.	450±74.16	725±59.16	400±59.16	583.33±100.82	539.58±146.87	325-800
<i>Diffugia</i> spp.	358.33±95.74	691.66±64.54	387.5±46.77	566.66±90.36	501.04±156.29	250-775
<i>Arcella</i> spp.	408.33±119.02	700±59.16	275±59.16	479.16±53.42	465.62±173.01	200-775
<i>Stylonychia</i> spp.	366.66±100.82	650±59.16	375±59.16	591.66±64.54	495.83±146.27	225-725
<i>Thecamoeba</i> spp.	341.66±95.74	616.66±64.54	383.33±60.55	608.33±78.52	487.5±146.88	225-700
<b>Rotifera</b>						
<i>Asplanchna</i> spp.	383.33±105.67	633.33±78.52	433.33±70.11	541.66±95.74	497.91±128.94	225-750
<i>Filinia</i> spp.	329.16±79.71	658.33±78.52	275±59.16	550±97.46	453.12±176.82	200-750
<i>Keretella</i> spp.	358.33±100.82	625±59.16	375±59.16	570.83±48.51	482.29±136.42	225-700
<i>Hexarthra</i> spp.	325±59.16	650±59.16	295.83±65.98	525±111.80	448.95±165.41	200-725
<i>Brachionus</i> spp.	375±80.62	658.33±64.54	333.33±73.59	558.33±78.52	481.25±152.38	225-750
<i>Tripleuchlanis</i> spp.	341.66±46.54	658.33±84.65	329.16±73.17	520.83±82.78	462.5±154.98	200-750
<b>Cladocerans</b>						
<i>Daphnia</i> spp.	387.5±66.61	700±67.08	354.16±53.42	508.33±95.74	487.5±153.93	300-775
<i>Monia</i> spp.	333.33±64.54	683.33±56.27	375±59.16	491.66±54.00	470.83±149.03	250-750
<b>Copepods</b>						
<i>Cyclops</i> spp.	358.33±64.54	700±59.16	370.83±62.08	491.66±64.54	480.20±151.79	275-775
<i>Eucyclops</i> spp.	350±65.19	683.33±64.54	408.33±54.00	604.16±62.08	511.45±151.07	250-775
<b>Ostracods</b>						
<i>Cypris</i> spp.	312.5±46.77	691.66±64.54	345.83±76.51	579.16±82.78	482.29±174.37	250-775
Total	37150	68450	36550	56075		

Table 5: Seasonal variations in zooplankton diversity indices at S1 site of Ropar Wetland.

Indices	Winter season	Summer season	Monsoon season	Autumn season
Taxa_S	17	17	17	17
Individuals	4147	8323	3513	6276
Simpson_1-D	0.9402	0.9408	0.9398	0.9404
Shannon_H	2.825	2.83	2.822	2.826
Evenness_e^H/S	0.9918	0.997	0.9884	0.9932

Table 6: Seasonal variations in zooplankton diversity indices at S2 site of Ropar Wetland.

Indices	Winter season	Summer season	Monsoon season	Autumn season
Taxa_S	17	17	17	17
Individuals	5847	10040	5711	7444
Simpson_1-D	0.9407	0.9409	0.9404	0.9407
Shannon_H	2.829	2.831	2.827	2.83
Evenness_e^H/S	0.9959	0.9978	0.9939	0.9964

Table 7: Seasonal variations in zooplankton diversity indices at S3 site of Ropar Wetland.

Indices	Winter season	Summer season	Monsoon season	Autumn season
Taxa_S	17	17	17	17
Individuals	4147	7272	3509	5368
Simpson_1-D	0.9402	0.9409	0.94	0.9408
Shannon_H	2.825	2.831	2.823	2.83
Evenness_e^H/S	0.9918	0.9976	0.9903	0.9967

Table 8: Seasonal variations in zooplankton diversity indices at S4 site of Ropar Wetland.

Indices	Winter season	Summer season	Monsoon season	Autumn season
Taxa_S	17	17	17	17
Individuals	6186	11404	6087	9339
Simpson_1-D	0.9406	0.9411	0.9403	0.9409
Shannon_H	2.829	2.832	2.826	2.831
Evenness_e^H/S	0.9956	0.999	0.9925	0.9974

biodiversity in an area is species diversity which accounts for the number of different species in a particular area and is determined by Shannon-Weaver Index. It is the most preferred index among the other diversity indices. The values above 3.0 indicate that the structure of habitat is stable and balanced and the values under 1.0 indicate that there is pollution and degradation of habitat structure. The Shannon-Weaver Diversity Index, commonly used to assess the impact of pollution is based upon the plankton diversity. Our results are in conformity with Ansari & Khan (2014), Pradhan (2014) and Tyor et al. (2014). The values of Shannon-Weaver diversity index for zooplankton were found to be below three and our results are as per Braich & Kaur (2015) thus, indicating that the water body was moderately polluted.

During the present study, zooplankton population showed negative correlation with dissolved oxygen (DO) and free CO<sub>2</sub> at all the sites and also with total dissolved solids (TDS) at S3 site. DO at S1, S2, S3 and S4 ( $r = -0.33002$ ,

$r = -0.684$ ,  $r = -0.17531$  and  $r = -0.62494$ ). Free CO<sub>2</sub> at S1, S2, S3 and S4 ( $r = -0.235$ ,  $r = -0.3084$ ,  $r = -0.5107$  and  $r = -0.26793$ ) and at S3 with TDS ( $r = -0.03564$ ). The rest of the parameters showed positive correlation with zooplankton population at all the sites (Table 9). Similar studies have been conducted by several workers and reported that zooplankton abundance has an inverse relationship with DO (Miah et al. 1981, Alam et al. 1987, Suresh et al. 2011, Bera et al. 2014). However, our results are contradictory to Ansari & Khan (2014) who showed a negative correlation of zooplankton with water temperature and positive correlation with pH and DO. However, further studies revealed that different environmental factors like climate change, habitat physico-chemical properties and biotic factors play important roles in the occurrence, distribution, development and abundance of zooplankton, and their variations in the physico-chemical properties of water bring about changes in the composition and abundance of aquatic organisms (Hall & Burns

Table 9: Correlation matrix among physico-chemical parameters and density of zooplankton at all the sites.

Physico-chemical Parameters	Density of zooplankton			
	S1-site	S2-site	S3-site	S4-site
Air Temperature (°C)	0.32139	0.47767	0.13467	0.31051
Water temperature (°C)	0.13944	0.50215	0.16149	0.23612
Conductivity (µS/cm)	0.54117	0.60358	0.46579	0.56201
TDS (mg/L)	0.55906	0.85231	-0.03564	0.57948
Turbidity (NTU)	0.78616	0.64882	0.5614	0.7009
Dissolved oxygen (mg/L)	-0.33002	-0.684	-0.17531	-0.62494
Free CO <sub>2</sub> (mg/L)	-0.235	-0.3084	-0.5107	-0.26793
pH	0.50768	0.60392	0.38935	0.67607
Alkalinity (mg/L)	0.51355	0.66829	0.35124	0.59257
Salinity (mg/L)	0.54417	0.65382	0.38439	0.57532
Chlorides (mg/L)	0.68387	0.79165	0.51393	0.78912
Total Hardness (mg/L)	0.56048	0.82348	0.39572	0.68937
Ca <sup>++</sup> Hardness (mg/L)	0.70172	0.62715	0.38127	0.61665
Mg <sup>++</sup> Hardness (mg/L)	0.45966	0.41192	0.30845	0.35883
Phosphates (mg/L)	0.86951	0.78828	0.70707	0.75843
Sulphates (mg/L)	0.80351	0.73436	0.7629	0.85512
Nitrates (mg/L)	0.91333	0.88527	0.83771	0.83966
Nitrites (mg/L)	0.90517	0.76091	0.76733	0.90097
Silicates (mg/L)	0.87276	0.57294	0.61416	0.88984

2001, Andrulowicz et al. 2008, Richardson 2008, Perumal et al. 2009, Tunowski 2009, Rajagopal et al. 2010, Ojaveer et al. 2010, Suresh et al. 2011, Ahmad et al. 2011, Alexander 2012).

## CONCLUSIONS

It was concluded from the present investigation that zooplanktons are very important for monitoring the pollution level in this water body. Further this study revealed a significant variation in zooplankton population due to variable macrophytes, quality of water and several other physico-chemical factors. Zooplankton populations become one of the necessities to evaluate freshwater wetlands with respect to their ecological and fisheries status. It would also give a preliminary knowledge of the diversity and productivity of the wetland. This, in turn, helps in planning, exploitation, antipollution or conservation strategies.

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