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Study on Potential Zooplankton Composition and Seasonal Occurrence in Relation to *Physico-Chemical* Properties in Upper Manair Reservoir in Telangana State

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Abstract

This paper deals with the analysis of zooplankton community and assessment of water quality of Upper Manair Reservoir of Telangana State. The studies were carried out on the reservoir water during 2016-2017 and 2017-2018 at different sites. The environmental conditions were varied widely according to season at the site. During the time of investigation 45 species of zooplanktons were recorded out of these 24 species were rotifers 08 were Cladocera, 08 were copepods, 0_2 were ostracods and 03 were protozoans and the total density of zooplanktons ranged from 400 to 403 Number of Organisms/mL the highest densities were noted in the months of December and January. The water quality parameters like temperature, pH, DO, COD, BOD were also analyzed and the correlation studies undertaken zooplankton showed significant relation with Cl^-,DO, NO_3^- ,TA, COD, HCO_3^- BOD and inverse relation the parameters like pH, Ca_{2+} , Mg_2^+ PO_4^3 and TDS. The results were indicated water quality influence on zooplankton abundance and distribution in the reservoir. The impact of seasonal changes on zooplankton biodiversity was carried out for a period from 2016 to 2018. The statistical analysis reveals a significant correlation between the presence of zooplankton species and some environmental parameters. The change in a biotic factors is reflected in the biological activity of reservoir during 2016 to 2018 appears to be strongly negative influenced by calcium ions, magnesium ions, phosphates and total dissolved solids and positive effect by pH, dissolved oxygen, nitrates, total alkalinity, chemical oxygen demand, biological oxygen demand and bicarbonates. In current study, the group wise zooplankton species diversity such as rotifers, Cladocera, copepods, ostracods and protozoan's were ranged 24, 08,08, 02 and 03 respectively during the study period. The minimum species diversity was found during the monsoon (June-September) period while the maximum was observed in post-monsoon (October-January) period.

Keywords: Zooplanktons; Water Quality Parameters; Seasonal Variation; Zooplankton Abundance; Dissolved Oxygen

Introduction

Zooplanktons are crucial entities of freshwater reservoir ecosystems as they present as the centre of the aquatic food web. All the freshwater fish species consume zooplankton as an important food during their life cycle. The potential distribution of zooplankton in the water body mainly depends on the physico-chemical properties of water. The diversity of zooplankton depends on a complex combination of factors and nutrients. The freshwater reservoir plays an important

role in maintaining the biodiversity of plankton. It is a limited resource and is not essential only for the survival of living organisms but also for fulfilling human requirements such as agriculture, industry and domestic needs [1]. Freshwater is crucial for sustaining all terrestrial and aquatic ecosystems and human society [2]. The physico-chemical characteristics of reservoir may significantly change by anthropogenic activities like agricultural practices and irrigation as well as natural dynamics which can consequently affect the water quality, zooplankton species distribution, diversity, production capacity and sometimes leads to disruption in the balance of ecological system operating in the reservoir. The present studies focused on the correlation between physico-chemical properties of water and zooplankton abundance corresponding with monthly values and season wise during the study period 2016-2018.Zooplanktons mediate the transfer of energy from lowers to higher trophic level it represent an important link in aquatic food chain [3]. It acts as major connecting link between producers and secondary consumers. The zooplankton density may use to understand relationship of water quality and aquatic organisms. The present study results indicate the wealth of aquatic ecosystem which would be help for the better aquaculture management practices [4].

Study Area

Upper Manair Reservoir is of Rajanna Sircilla, at Narmala Village near GambhiraopetMandal, which falls under $18^0$16'13''N $78^0$32'40''E longitude. Total catchment area is 5.9 sq. miles, live storage capacity 61,439,000 m^3 and grass storage of the reservoir is 62,387,000 m^3. It is used for drinking water, irrigation purpose and depth of reservoir is 31 meters [5]. The Upper Manair Dam is a reservoir on the Manair River is a tributary to the river Godavari RajannaSircilla is 319 mts above sea level and located at 18.38° N 78.83° E.The district is spread over an area of 2,030.89 square kilometres (784.13 sq mi) (Table 1).

Morphometric and Hydrological Characteristics of the Upper Manair Reservoir

Dam Name	Upper Manair Dam
State Name	Telangana
Type of dam	Earthen, Gravity, Masonary
Nearest City	KamaReddy
Impounds	Manair River and Kudlair River
District Name	RajannaSircilla (former of Karimnagar)
Catchment Area	15290 (103 m^3)
Lati / Long	18°16′13″N 78°32′40″E
Total Storage Capacity	62,387,000 m^3
Purpose	Irrigation
Construction began	In 1943
Opening date	In 1950
Height	31 meters
Length	9,201 meters
Width	N.A.
Dam Volume Content	1724.00 (103 m^3)
Spillway Gates	3
Spillway Type	Ogee
Type of Spillway Gates	N.A.
Creates	Upper Manair Reservoir
Project	Upper Manair Medium Irrigation Project

Table 1: Morphometric and Hydrological Characteristics of the Upper Manair Reservoir.

Period and Seasonality

The field studies were carried out for 24 months from June 2016 to May 2018 on a bi monthly basis to cover different seasons at four different sites. The seasons defined as Monsoon (June to September), Post-monsoon (October to January) and Pre-monsoon (February to May) [6].

Sampling Sites

Four sampling sites - namely Site-I, Site-II, Site-III and Site-IV(1.2 C in map), were selected for collecting water samples during the study period (2016-2018). Sampling sites were chosen from the reservoir keeping in view the accessible area of the lake. Sampling sites were chosen as 4 corners of the lake and samples were collected for water analysis [7].

Collection of Water Samples: The study area is divided in to four sites, Site I, site II site III and Site IV, and. One litre of surface water samples were collected from four different stations of the reservoir on monthly basis for about 2 years [8].

- The samples were collected in plastic bottles and were brought to laboratory for analysis. The pH, temperature was recorded at sampling sites, separate bottles were used for the estimation of DO (dissolved oxygen).

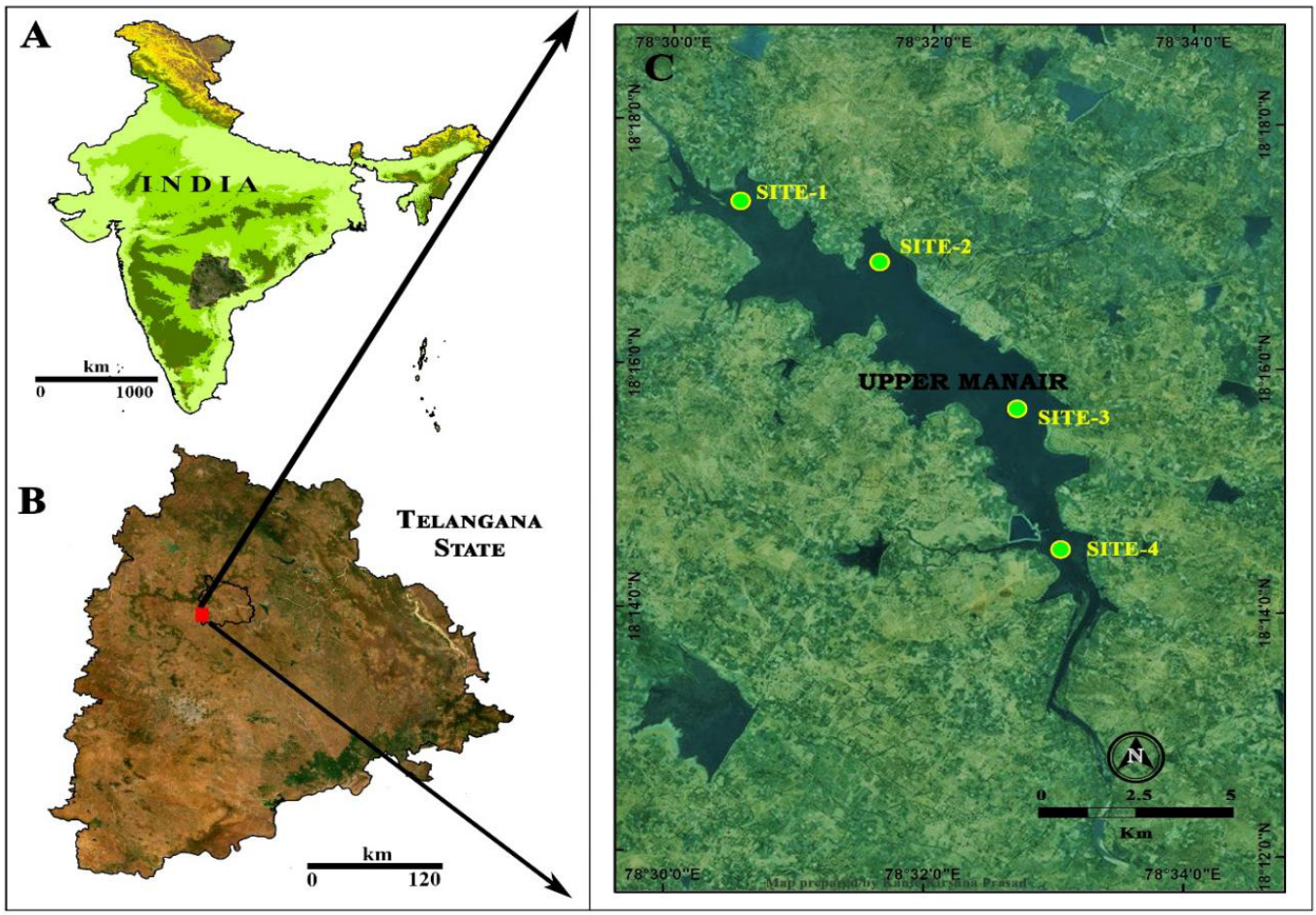

Figure 1: Maps showing: (A) India with Telangana, (B) Telangana with RajannaSircilla district(C) Upper Manair Reservoir with sites.

Collection Zooplankton Samples: Zooplanktons were collected monthly from four different stations of the Upper Manair reservoir from June 2016 to May 2018. Samplings were made between 8.00 am to 9.30 am. Each sample was collected by filtering 20 liters of water through plankton net (size 25 micron). Filtrate was stored in 20 ml plastic bottles and 4% formalin was added for sample preservation. These samples were then brought to laboratory for further studies. One ml of sample was transferred to Sedgwick-Rafter cell with a pipette; identification and enumeration were done by a Compound microscope (10X, 40X magnificent).All the zooplankton present in cell were counted the mean of five estimates was then calculated for each component occurring in the total count [9]. Quantitative studies were made by

using Sedgwick Rafter cell. Sample was properly agitated to distribute the organisms evenly. By using a pipette, one ml of sample was transferred onto the cell. The cover slip was placed properly, avoiding any air bubble. The planktons were allowed to settle for some time and counting was made under microscope. All the planktons, present in the cell were counted by moving the cell, vertically and horizontally covering the whole area. Planktons are very sensitive to the environment they live in and any the alteration in environment leads to the changes in the plankton communities in terms of tolerance abundance, diversity and dominance in the habit.

Correlation

Correlation studies the relationship between two variables in which change in the value of one variable, are associated with changes in the value of the other variable. Correlation is a statistical tool that helps to measure and analyses the degree of relationship between two variables. Correlation analysis deals with the association between two or more variables [10].

Correlation analysis: The Pearson Correlation matrix(r) between physico-chemical parameters and zooplankton availability has been done using Microsoft Excel (2013) to correlate among them [11].

Results

Water quality index analysis showed that the water of reservoir is in good condition for drinking purpose. The Physico-chemical data analysed in the Upper Manair reservoir during the period of 2016 -2018 indicates that the reservoir is at present free from pollution and the quality of water is good. The results analysed were absolutely within the drinking water standards and permissible limits. This water can be used for drinking after proper filtration, also used for irrigation and other domestic purposes. The Various chemical and biological reactions in water depend to a great extent on temperature. The water quality index levels of the reservoir and all the four stations were clearly showed that the status of the water body is oligotrophic in nature and it is suitable for the human consumption. The reservoir is moderate and physico-chemical parameters such as pH, temp, and DO, alkalinity and some others showed favourable range to execute the fish cultivation practices [12].

The seasonal mean values of turbidity are recorded in summer, moderate in monsoon and lowest throughout the study period. Turbidity is closely positively associated with sulphates, total hardness. However, it is negatively associated with atmospheric temperature, pH and EC (Table 2).

Seasonal Wise Mean and SD Values of Water Parameters During 2016-2017

Water Parameters	Monsoon	Post-Monsoon	Pre-Monsoon
1.Temp°C	29.25 ± 2.27	23.5 ± 1.5	30.75 ± 4.14
2.Turbidity	4.2 ± 0	8.65 ± 0.55	8.2 ± 0.46
3.pH	8 ± 0.4	7.4 ± 0	8.05 ± 0.33
4.TDS	92.5 ± 0	93.72 ± 0.77	85.4 ± 0.2
5.HCO_3^-	102.46 ± 3.30	98.8 ± 2.62	94.83 ± 1.83
6.TH	96.67 ± 2.82	104.27 ± 4.09	102.92 ± 5.07
7.NO_3^-	8.925 ± 3.79	13 ± 3	14.65 ± 2.10
8.PO_4^{3-}	1.35 ± 0	2.05 ±0	2.75 ±0
9.DO	6.50 ± 1.02	6.30 ± 0.86	5.40 ± 0.556
10.BOD	4.56 ± 0.26	5.1 ± 0.76	6.35 ± 0.05
11.COD	5.63 ± 0.16	6.6 ± 0.2	8.6 ± 0.1
12.TA	90.87 ± 1.08	98.65 ± 3.24	98.57 ± 1.35
13.Cl^-	53.42 ± 1.26	52.85 ± 0.15	63 ± 3
14.Ca^{+2}	26 ± 0	29 ± 1	33 ± 0
15.Mg^{+2}	17 ± 0	19 ± 0	22 ± 0

Table 2: represents seasonal wise Mean and Standard deviation values of water parameters in 2016-2017 year.

Seasonal Wise Mean and SD Values of Water Parameters during 2017-2018 (Table 3)

Water Parameters	Monsoon	Post-Monsoon	Pre-Monsoon
1.Temp°C	25 ± 3.53	29 ± 2.16	31.25 ± 4.14
2.Turbidity	5.8 ± 1.15	5.97 ± 0.71	6.4 ± 1.54
3.pH	7.87 ± 0.34	7.57 ± 0.17	8.3 ± 0.49
4.TDS	91.1 ± 1.10	94.25 ± 2.48	96.62 ± 3.02
5.HCO_3^-	99.2 ± 3.14	106.37 ± 1.08	94.75 ± 3.88
6.TH	93.05 ± 6.62	103.65 ± 4.28	97 ± 6.77
7.NO_3^-	11.07 ± 1.58	12.62 ± 1.08	11.275 ± 1.03
8.PO_4^{3-}	2.92 ± 0	2.12 ± 0	2.92 ± 0
9.DO	6.92 ±0.54	6.6 ± 1.14	5.50 ± 0.50
10.BOD	4.06 ± 1.06	5.8 ± 1.4	4.65± 1.39
11.COD	5.8 ± 0.64	6.975 ± 0.96	7.87 ± 2.11
12.TA	94.75 ± 4.31	95.95 ± 2.49	101.12 ± 7.35
13.Cl^-	49.17 ± 6.72	48.12 ± 4.53	53.37 ± 4.54
14.Ca^{+2}	28 ± 2.35	32 ± 0.55	29 ± 4.47
15.Mg^{+2}	18 ± 1.43	19 ± 1.92	17 ± 2.07

Table 3: represents seasonal wise Mean and Standard deviation values of water parameters in 2017-2018 year.

The pH indicates the acidic and alkaline nature of the water. It is generally affected by temperature and salinity. Biological conditions of the water markedly dependable on Hydrogen ion concentration of the water. The mean values were ranged between 7.4 ± 0.46 to 8.05± 0.33 during 2016-2017 and 7.57 ± 0.17 to 8.3 ± 0.49 during 2017-2018. The pH values are high 8.3 in pre-monsoon season during the year 2017-2018 [13].

Average Values of Rainfall, Temperature, Humidity During the Work Period 2016-2018 in Karimnagar (Table 4)

Months	Temperature	Rainfall m	Humidity%
January	21.5	0 mm	61.5%
February	25.5	7.3	57.5
March	29	11.2	53
April	33	15.05	49.5
May	36	13.55	46.5
June	32	195.28	67.5
July	29	255.74	78
August	29	233.57	80
September	28	219.33	80.5
October	26.5	124.99	74.5
November	23.5	1.7	66
December	21.5	**0**	64

Source: Indian meteorological department (Sircilla District).
Table 4: Average Values of Rainfall, Temperature, Humidity During the Work Period 2016-2018 in Karimnagar.

Total Dissolved solids sites wise variations and seasonal averages of Upper Manair Reservoir in different stations during the study period (Tables 4 & 5). The TDS values were ranged between 85.4 ± 0.2 to 93.72 ± 0.77 during 2016-2017, 91.1 ± 1.10 to 96.62 ±3.02 during 2017-2018.The highest TDS values were recorded in the month of April 2016 and 2017. The lowest values were recorded in the month of September 2016 and 2017 in all the four stations. Total Hardness (TH) average values ranged between 93.82 ± 5.03 to 101.2 ± 6.02 during 2016-2017 and 96.54 ± 7.76 to 99.35 ± 8.45. Maximum values were recorded during June and July 2016, whereas low values recorded during September and October 2016. High range value of TH obviously due to high loading of organic substances [14]. The TH showed significant positive correlation with zooplankton production.

Estimation of biological oxygen demand is an important measure of the oxygen needed for the degradation of organic matter. The BOD values ranged from 4.36 ± 1.13 to 4.48 ± 1.05 as the year 2016-2017, 4.88 ± 2.20 to 5.01 ± 1.90 during the year 2017-2018. BOD showed positive/negative correlation with respect to zooplankton production. DO is a significant aquatic parameter and plays as vital role in the context of culture of all aquatic organisms. High concentration of dissolved oxygen was recorded during monsoon, this may be attributed to low solubility at high temperature and high degradation of organic substances. In the present study DO values showed positive correlation with zooplankton population [15]. It has been observed that though BOD not showed a definite correlation with phosphate and nitrate content of the reservoir. The mean values of DO find high during monsoon, followed by post-monsoon and pre-monsoon (Table 4).

During the study period maximum values of chloride 63 ± 3 and 53 ± 4.54 mg/Lt were recorded in pre-monsoon due to higher rate of evaporation, organic waste of aquatic organisms' origin. The minimum values of chloride content 52.85 ± 0.15 and 48.12 ± 4.53 were recorded in monsoon season due to dilution of reservoir water by rain an inflow. In the present investigation the mean values of chloride content not exceed the maximum permissible limits as prescribed by BIS and WHO. Rotifers are commonly called as animal wheel and having distinct mouth called as a corona .it is used for both locomotion and filter feeding.

These are simply drift along with water and efficient reproducers and can multiply in good conditions. Rotifers eat bacteria, detritus, other rotifers, algae and protozoa. Cladocera are small crustaceans by two-valve bolded carapace which covers the thorax and abdomen or outer shell, most of their body, commonly called as water fleas. ϖ Copepod; meaning is a group of small crustaceans found in nearly every freshwater and saltwater habitat [16].

Some species are planktonic (drifting in sea waters), benthic (living on the ocean floor) and continental species may live in limno- terrestrial habitats and other wet terrestrial places, such as swamps, under leaf fall in wet forests, bogs, springs, ephemeral ponds, and puddles, damp moss, or water-filled recesses. These are strong swimmers and also exhibit diurnal migration, to connect food webs between small, algal cells and all the way up to large fish and whales. Ostracods are a class of the Crustacea (class Ostracoda), sometimes known as seed shrimp. The percentage of different zooplanktons classes noted during June-2016 to May-2017 were Rotifers 30, Cladocera 24, copepods 21, ostracods 14 and protozoa 11 percent respectively during this period.

The maximum number of rotifers was recorded in (140) January-2017 and minimum in (54) September2016. Similarly, the Cladocera was maximum number(117) in Janary-2017, minimum number(39) in Septmber-2016 ;copepods were maximum number(105) in May-2017, minimum(34) in Septmber-2016, Ostracods was maximum 67 in May-2017, minimum 21 in septmber-2016 and protozoans were maximum 45 January2017, minimum 24 in June and August-2016. The percentage of zooplankton groups in seasonal wise during June-2016 to May-2017 was highest percentage during Winter (post-monsoon) 42%, next 37% in summer (pre-monsoon) and low in rainy (monsoon) was 21%. Due to the presence of higher population of bacteria and dead and decayed organisms, Vegetation and shallowness and low level of the reservoir water have a supported the increases the zooplankton population [17]. The low number of zooplankton in monsoon due to the fall in temperature, low light penetration and heavy water flow wash off the surface.

The percentage of different zooplanktons classes noted during June-2017 to May-2018 were Rotifers 29, Cladocera 24, copepods 21, ostracods 15 and protozoa 11 percent respectively during this period. The maximum number of rotifers was recorded in (141) december-2017 and minimum in (52) September-2017. Similarly, the Cladocera was maximum number (121) in Janary-2018, minimum number (41) in Septmber-2016; copepods were maximum number (110) in May-2018, minimum (37) in july-2017, Ostracods was maximum 70 in May-2018, minimum 24 in Septmber-2017 and protozoans were maximum 47 Jan-2017, minimum 25 in August-2017. The percentage of zooplankton groups in seasonal wise during June-2017 to May-2018 was highest percentage during Winter (post-monsoon) 42%, next 37% in summer (pre-monsoon) and low in rainy(monsoon) was 21%.Ostracods were maximum in summer(pre-monsoon),lower in Monsoon(rainy) and similar observations found in the case of protozoans. Seasonal wise population of zooplanktons were Rotifers, Cladocera were high in post-monsoon and lower in monsoon

period. Copepods, ostracods were high number in pre-monsoon period, lower in monsoon season and protozoans' highest number during post-monsoon season, lowest in monsoon period [18].

Seasonal Wise Population of Zooplankton from June-2016 to May-2017 (Number of Organisms/Ml.) (Table 5)

Zooplanktons	Monsoon	Post-Monsoon	Pre-monsoon	Total
Rotifers	214	511	340	1065
Cladocera	171	431	256	858
Copepods	144	242	378	764
Ostracods	108	157	241	506
Protozoa	99	163	125	387
Total	**736**	1504	1340	3580

Table 5: represents seasonal wise zooplankton number in all three seasons in 2016-2017 year.

Seasonal Wise Zooplankton Population during 2016-2017

Overall population of Rotifers during 2016-2017 were,1065 organisms/mL, cladocera858 organisms/ mL, Copepods 764 organisms/mL, Ostracods 506 organisms/mL and protozoans were 387 organisms/ mL. During 2017-2018 Rotifers were 1092 organisms/mL, Cladocera 897 organisms/mL, copepods 791 organisms /mL, Ostracods 542 organisms /mL and protozoans 407 organisms/ mL.

Seasonal Wise Population of Zooplankton from June-2017 to May-2018 (Number of Organisms/Ml.) (Table 6)

Zooplanktons	Monsoon	Post-Monsoon	Pre-monsoon	Total
Rotifers	221	522	349	1092
Cladocera	180	450	267	897
Copepods	152	247	392	791
Ostracods	119	170	253	542
Protozoa	106	172	129	407
Total	**778**	**1561**	**1390**	**3729**

Monsoon=June-September, Post-monsoon = October-January and Pre-monsoon = February-May

Table 6: represents seasonal wise zooplankton number in all three seasons in 2017-2018 year.

The quality and quantity of zooplankton population shows much influence on production of potential of an aquatic ecosystem. Zooplankton is very important biotic component in food chain and contribute significant biological productivity of an aquatic ecosytem. The interactions and directly or indirectly subjected to the comples influences. All the metabolic, physiological processes and life activities such as distribution, movements, feeding and temperature, rise in temperature leads to the fast chemical and biochemical reactions. Rotifers are opportunistic organisms, densities are changed with temp in a short time. The ciliates are considered as biological indicator and predict the organic pollution. The ciliates reached maximum population density in winter. The salinity of water regulates distribution, metabolic and survival of zooplanktons in fresh water ecosystem and salinity exhert different physiological and ecological effects with the interaction of other factors like temp, oxygen and ionic substances [19].

Many water quality parameters showed a positive effect on zooplankton growth as well as their abundance in the reservoir, some negative effect their abundance during the study period of study area. The positive correlation between the groups of zooplankton including BOD ,DO, NO_3^-,TA ,Cl^-, COD, $HCO_3^-$and some of the zooplankton groups revealed a negative correlation with pH ,TDS ,Ca^{+2} ,Mg^{+2} and $PO_4^{3-}$of the water. The rotifer abundance in turbid water became of negative effects of competition and predation [20].

Zooplanktons Shannon–Weiner Diversity Index (H)

Seasonal wise like such as monsoon period highest diversity in protozoa (0.592), low diversity in copepods (0.724), post-

monsoon period highest diversity Cladocera (0.299), low diversity was in ostracods (0.5080) and pre monsoon season highest diversity in copepods (0.305), low in Cladocera (0.525). During the total period highest diversity was in rotifers is 0.526 and low in protozoa is 0.966.

Simpson Index (D)

During Monsoon period high diversity in protozoa(0.065), low in copepods (0.035), post-monsoon high in Cladocera (0.252) low in ostracods (0.096) and pre-monsoon period high in copepods (0.244), low in Cladocera (0.089). The total period high values in rotifers (0.880), low index in protozoa (0.011). Simpson index diversity (1-D): high diversity in copepods (0.965), low in rotifers (0.96) during rainy season, in winter high diversity ostracods (0.904), low in copepods (0.9) and summer high in Cladocera (0.911), low in copepods (0.774). The total period high diversity in protozoa (0.989), low in rotifers (0.912).

Evenness Index (J)

Rainy season high values in copepods (0.329), low in protozoa (0.296), winter period high in ostracods (0.231), low in Cladocera (0.113) and summer high in protozoa (0.233), low in copepods (0.118). Over all period high evenness in protozoa (0.373), low evenness in rotifers (0.173). Species richness (d): during rainy season high in rotifers (70.36), low in protozoa (37.88), winter high in rotifers (168.48), low richness in ostracods (57.69), summer high richness in copepods (130.76), low in protozoa (47.93). Total period the high species richness in rotifers (299.460, low richness in protozoa (108.64).

Total Zooplankton Correlation Values During Study Period (2016-2018) (Table 7)

S.NO.	Parameters	Rotifers		Cladocerans		Copepods		Ostracods		Protozoans	
1.	Water Temperature	0.191	0.662	-0.862	0.023	-.435	-0.310	-0.319	-0.159	0.894	-0.015
2.	pH	-0.133	-0.050	-0.661	-0.537	-0.971	-0.844	0.550	-0.499	0.342	-0.425
3.	Turbidity	-0.432	-0.247	-0.491	-0.489	-0.912	-0.753	0.736	-0.340	0.085	-0.316
4.	Dissolved oxygen	0.868	-0.902	0.364	-0.669	-0.365	-0.545	0.392	-0.438	-0.357	-0.534
5.	Total Alkalinity	-0.064	0.347	-0.372	0.690	0.632	0.906	-0.979	0.585	0.694	0.553
6.	Chlorides	-0.694	0.372	0.137	0.883	0.696	0.930	-0.394	0.949	-0.053	0.897
7.	Phosphates	-0.577	-0.050	0.151	-0.537	0.798	-0.844	-0.536	-0.499	0.004	-0.425
8.	Total Hardness	-0.254	0.662	-0.655	0.023	0.364	-0.310	-0.856	-0.159	0.867	-0.015
9.	Calcium	0.797	-0.560	0.750	-0.846	0.550	-0.654	-0.255	-0.940	-0.450	-0.939
10.	Nitrates	0.163	-0.247	0.415	-0.489	0.986	-0.753	-0.784	-0.340	-0.035	-0.316
11.	Magnesium	-0.431	-0.027	0.375	-0.612	0.878	-0.882	-0.486	-0.642	-0.191	-0.553
12.	TDS	-0.210	-0.902	0.427	-0.669	-0.476	-0.545	0.954	-0.438	-0.756	-0.534
13	COD	-0.062	0.993	-0.306	0.833	-0.981	0.580	0.835	0.694	-0.067	0.787
14.	BOD	0.131	0.251	-0.624	0.817	-0.944	0.931	0.457	0.887	0.379	0.819
15.	HCO_3-	-0.494	0.251	0.305	0.817	0.848	0.931	-0.491	0.887	-0.136	0.819

Table 7: represents correlation values between water parameters and zooplankton population in work period 2016-2018.

Discussion

The zooplankton was recorded rotifers hold the top rank in percentage composition during study period in Upper Manair reservoir. Rotifera were found to be predominant with 29.49% followed by Cladocera 24.02%Copepods 21.28%Ostracoda 14.33% and protozoa 10.86%. Zooplankton population was recorded in the range between 3580 to 3729.The minimum population was recorded during the monsoon period (September to November), while the maximum during summer season (March to May), Rotifera group was more significant in taxonomic richness, similar results reported by several Indian researcher studies. The results of seasonal variation in environmental parameters and plankton population reveals that, the favourable period for primary production in upper manair reservoir noticed in October to November due to nutrients accumulated from fresh water run-off.

The presence of different types of plankton and its availability throughout the year assumes to good ecological condition and the reservoir ecology is balance during the study period

2016 to2018.The zooplankton population indicated strong correlation with the parameters like Water temperature, DO, alkalinity, phosphates and nitrates. The high correlation between BOD and DO reveals that, the reservoir water was less polluted. Interspecific and intraspecific factors also influenced the distribution and abundance. Zooplankton community dynamics is also altered with environmental degradation and presence of higher densities indicates their tolerance of higher salinity of water, which then affects the other biotic components of the ecosystem.During the monsoon season, the fresh water inflow played a key role in altering the physico-chemical characteristic of the reservoir.

The zooplankton aggregation largely depends on various factors including water quality and their ability to counter dispersion predator and prey relationship and also grazing rate. The correlation studies revealed that all most all of the water quality parameters exhibit either positive or negative correlation with zooplankton abundance and distribution in the reservoir during the study period. Most of the results are also indicative of the potential problem likely to affect the aquatic ecosystem. The species richness index of zooplankton showed positive correlation with BOD and Cl^- during the study period. The positive correlation with pH, Cl^- and NO_3^- and negative correlation with dissolved oxygen. The uneven distribution of zooplankton species density during various seasons revealed by the evenness index was notice due to the lowering of salinity and increased turbidity in the reservoir. Zooplankton responds more quickly to the changes in water quality. The water temperature and pH values were suggested that the positively support the high zooplankton densities. The minimum species diversity was recorded in monsoon, the maximum was observed in post-monsoon season. The low species evenness found in monsoon and maximum during post-monsoon.

Conclusion

The present investigation confirms that the Upper Manair Reservoir is not polluted according to BIS and WHO. In conclusion, our study showed although nutrient levels were moderate, relatively high densities of zooplankton were found in the reservoir. The nutrient levels increase beyond the normal limits, due to the entering of agricultural drain which is always the possibility for the initiation of harmful algal blooms. Distribution of nutrients is mainly based on season, tidal condition, freshwater inflow, land runoff and flashing of fertilizer used in paddy fields. Regular pollution monitoring has been undertaken to note down environmental status of the reservoir.

Proper chemical and biological treatments of domestic sewage need to be taken care before discharging water to the system for long run sustainable of water resource. The reservoir should be protected and effective conservation strategies by raising the awareness with public enlighten programs to the local people. So as to change their personal behaviors and attitude.

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