



Statistical Analysis of Zooplankton Diversity in Hasanparthy Lake of Hanumakonda District of Telangana State

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Authors' contributions

This work was carried out in collaboration among all authors. Author BD designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SRV and AM managed the analyses of the study and literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The present attempt is made to assess the various diversity indices of zooplankton in Hasanparthy Lake during the year 2022-23. A Heron-transter plankton collecting net was used to collect the zooplankton from the selected lake. The collected plankton were preserved at 4% formalin for further quantitative estimation. A total of sixteen species of zooplankton were observed in this study. The highest number of species are Rotifera group and the lowest number are Ostracoda group. The Shannon _H and Simpson-1_D and Evenness diversity indices were calculated in the present study and the highest values of Shannon _H values were noticed in the Rotifera group

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(1.821) and followed by Copepoda (1.750), Cladocera (1.093), and the Ostracoda (0.683). The Simpson-1_D values were highest in Ostracoda group (0.803) and followed by Copepoda (0.778), Cladocera (0.337) and Rotifera (0.274). The abundance of zooplankton in the selected lake that in a non-polluted state and supports to trophic level.

Keywords: Diversity; zooplankton; simpson; shannon; indices.

1. INTRODUCTION

Water on the earth is in moves through the hydrological cycle. The endless circulation of water from the atmosphere to the earth and its return to the atmosphere through condensation, precipitation, evaporation and transpiration is called the hydrological cycle. The hydrological cycle depicted in illustrates the movement of water through the atmosphere to lithosphere and back into the atmosphere. As water is heated by the sun, its surface molecules become sufficiently energized to break free of the attractive force binding them together, and then evaporate and rise as invisible vapor in the atmosphere. Various factors influence the distribution of water on earth, leading to issues of water shortages and distribution for human consumption.

Animal species are considerably more diverse and numerous in inland waters than plants. Most of the major groups include terrestrial or marine species as well as freshwater forms. The zooplankton occupy a central position between the autotrophs and other heterotrophs and or an important link in food web of a freshwater ecosystem. The occurrence and abundance of zooplankton depends on its productivity. Which in turn, is influenced by physico-chemical parameters and the level of nutrients in the water the zooplankton, in general belong to four main taxonomic groups- Rotifera, Cladocera, Ostracoda and Copepoda [1].

Among zooplankton, Rotifers are apparently the most sensitive indicators of water properties [2]. So that the presence of certain species may be used as a reference of the physico-chemical characteristics of their habitat [3]. Rotifers are the other important components of zooplankton and are one of the principle links in the food chain. They have been widely used in assessment of aquatic pollution because of their sensitivity to small changes in environment, short generation time, parthenogenic mode of reproduction etc [4]. Use of different diversity indices continue to elevate disagreement among the naturalists,

whether there is exist a biological relationship between them or not [5]. The diversity of the zooplankton are cannot be estimated with one diversity index, therefore various diversity indices were attempted in this present study. In the present study the seasonal abundance of zooplankton were analysed in the selected lake.

2. METHODOLOGY

The collection of zooplankton was made on monthly basis of every month during the morning time (06:00 -8:00 am) of a specific date of every month. Zooplankton collections was done by a plankton collecting net. The filtering cone was made up of nylon bolting silk plankton net (No. 25 mesh size 50μ) was used for collection of zooplankton from water. The net was hauled for a distance of ten meters. Collected samples were transferred to labeled vial bottles containing 4% formalin. The qualitative estimation of zooplankton communities was carried out in the laboratory. The identification of zooplankton species was done by the Zoological Survey of India, Kolkata and the same was confirmed by [6],[7], [8].

During the present study the Hasanparthy lake was selected to analyze the abundance of zooplankton and the selected lake located 79°30' 50" E Longitude and 18°4' 27" N Latitude.

2.1 Simpson's Diversity Index [9]

The Simpson's diversity index (D) is calculated using the following equation:

$$D = 1 - \sum_{i=1}^s (p_i)^2$$

Where 'p_i' is the proportion of individuals of the ith taxon in the community. Simpson's index gives relatively little weight to the rare species and more weight to the common species. It ranges in value from 0 (low diversity) to a maximum of (1-1/s), where s is the number of taxa.

2.2 Shannon-Wiener Index [10]

This is a widely used method of calculating biotic diversity in aquatic and terrestrial ecosystems and is expressed as:

$$H = - \sum_i^s (p_i) (\log_2 p_i)$$

Where

H= index of species diversity

s= number of species

p_i= proportion of total sample belonging to the 'i'th species.

A large H value indicates greater diversity, as influenced by a greater number and/or a more equitable distribution of species.

3. RESULTS AND DISCUSSION

In the present study the diversity zooplankton were depicted in table 1 and the diversity indices were placed in table 2, 3 and graph number 1 and 2 respectively.

In the present study period, a total of sixteen various zooplankton belonging to four major groups were observed. Among all, seven species such are *Brachionus angularis*, *Brachionus caudatus*, *Brachionus fulcatus*, *Keratella tropica*, *Keratella cochlearies*, *Cephadella gibba* and *Lecana luna* from Rotifera group, the group of Rotifera is most common when compare to other groups is because of Rotiferan has high adaptability conditions, due to this they occupies their niches rapidly. Three species, *Paracyclops fimbriatus*, *Mesocyclops hyalinus* and *Mesocyclops leukarti* from Copepoda group, *Ceriodaphnia corunata*, *Moina macrocopa*, *Moina barnchiata* and *Bosmina longirostris* species from Ostracoda and *Cypris* sp. and *Heterocypris* from Ostracoda group. The monthly variation of zooplankton species in the selected lake was exposed in table 1.

The diversity indices of four major groups of zooplankton in Hasanparthy lake were depicted in table 2. The Simpson-1_D diversity index values of Rotifera group is varied from 0.179 to 0.247. The highest diversity values were noticed in May 2022 and the lowest values were recorded in August 2022. The Shannon_ H values are ranged from 1.450 to 1.821. The

highest values of Shannon wiener diversity are noticed in August 2022 and lowest values are recorded in October 2022. The values of species evenness are varied from 0.827 to 0.936. The highest values of species evenness were noticed in August 2022 and lowest values are recorded in May 2022. The Simpson-1_D diversity index values of Copepoda group is varied from 0.338 to 0.778. The highest diversity values were noticed in July 2022 and the lowest values were recorded in December 2022. The Shannon_ H values are ranged from 0.320 to 1.091. The highest values of Shannon wiener diversity are noticed in July 2022 and lowest values are recorded in March 2022. The values of species Evenness is varied from 0.406 to 0.986 The highest values of species evenness were noticed in February 2022 and January 2023, lowest values are recorded in July 2022.

In the same lake and year, the Simpson-1_D diversity index values of Cladocera group is varied from 0.337 to 0.781. The highest diversity values were noticed in February 2022 and the lowest values were recorded in December 2022. The Shannon_D values are ranged from 0.066 to 1.093. The highest values of Shannon wiener diversity are noticed in October 2022 and lowest values are recorded in January 2023. The values of species evenness are varied from 0.544 to 0.995. The highest values of species evenness were noticed in October 2022 and lowest values are recorded in February 2022. The Simpson-1_D diversity index values of Ostracoda group is varied from 0.510 to 0.803. The highest diversity values were noticed in September 2022 and the lowest values were recorded in January 2023. The Shannon_D values are ranged from 0.410 to 0.683. The highest values of Shannon wiener diversity are noticed in January 2023 and lowest values are recorded in November 2022. The values of species evenness are varied from 0.503 to 0.985. The highest values of species evenness were noticed in January 2023, lowest values are recorded in November 2022.

In the present study the highest average seasonal values of Simpson-1_D diversity is recorded in summer season in Rotifera (0.220) and Cladocera (0.632) groups, southwest monsoon season in Copepoda (0.518) group and Ostracoda (0.653) groups. The lowest values were noticed in southwest monsoon season in Rotifera (0.198), summer season in Copepoda (0.346) and Ostracoda (0.537) groups, northeast monsoon season in Cladocera (0.385) group respectively. The seasonal values of Shannon_H

Table 1. Zooplankton diversity of Hasanparthy Lake Durng The Year 2022-23

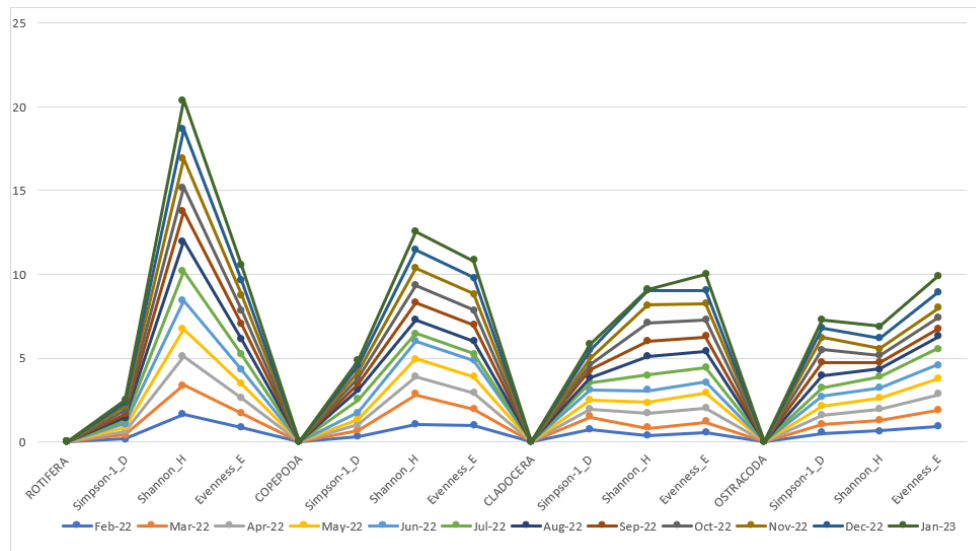
	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23
Rotifera												
<i>Brachionus angularis</i>	54	64	60	50	32	36	22	22	26	21	36	52
<i>Brachionus caudatus</i>	6	40	44	20	4	4	12	22	20	22	22	24
<i>Brachionus fulcatus</i>	184	188	150	98	92	20	20	34	102	100	100	126
<i>Keratella tropica</i>	164	210	210	220	40	52	36	42	112	98	100	104
<i>Keratella cochlearies</i>	102	120	120	124	42	22	22	12	135	60	98	90
<i>Cephadella gibba</i>	40	42	40	20	14	12	8	8	20	40	22	40
<i>Lecana luna</i>	42	40	40	28	10	10	8	6	12	10	24	20
Total	592	704	664	560	234	156	128	146	427	351	402	456
Copepoda												
<i>Paracyclops fimbriatus</i>	184	200	154	156	86	100	60	22	24	38	78	118
<i>Mesocyclops hyalinus</i>	144	154	128	100	42	10	14	36	42	82	100	148
<i>Mesocyclops leukarti</i>	120	116	98	100	48	4	10	16	16	50	80	96
Total	448	470	380	356	176	114	84	74	82	170	258	362
Cladocera												
<i>Ceriodaphnia corunata</i>	4	10	10	4	20	34	32	10	10	10	12	20
<i>Moina macrocopa</i>	-	-	4	2	2	10	42	28	10	16	10	32
<i>Moina barnchiata</i>	28	2	2	-	50	56	36	8	8	20	42	38
Total	32	12	16	6	72	100	110	46	28	46	64	90
Ostracoda												
<i>Cypris sps.</i>	126	120	100	98	36	68	88	80	66	72	64	112
<i>Heterocypris</i>	80	60	60	56	86	42	20	10	12	12	36	84
Total	206	180	160	154	122	110	108	90	78	84	100	196

Table 2. Zooplankton diversity indices of Hasanparthy Lake Durng the Year 2022-23

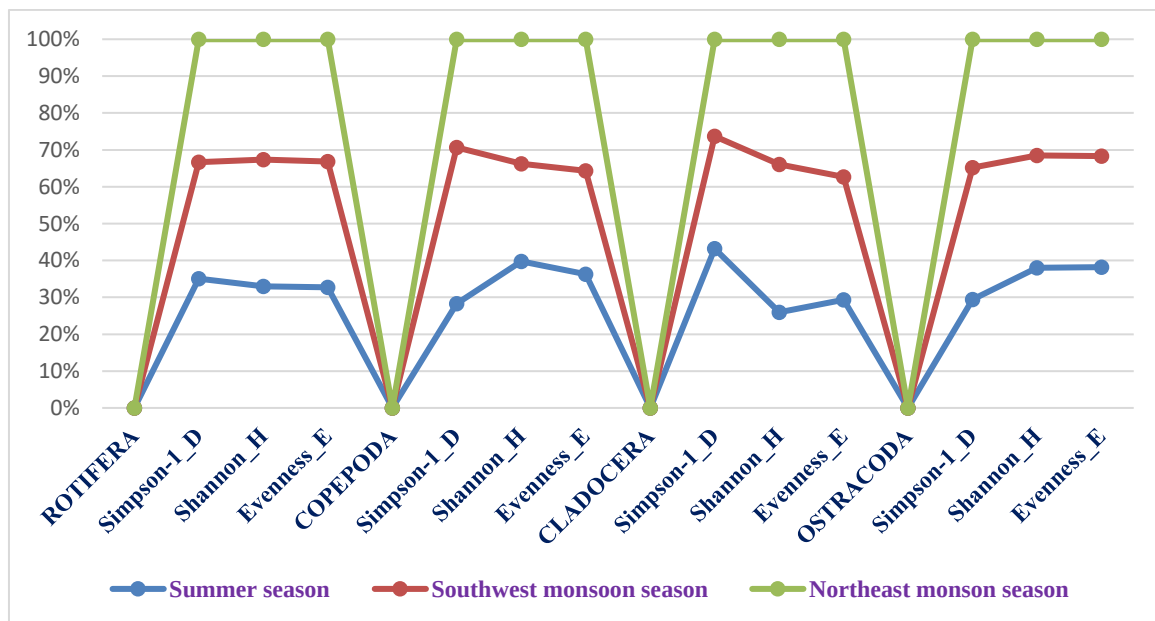
	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23
Rotifera												
Simpson-1_D	0.221	0.208	0.204	0.247	0.211	0.211	0.179	0.194	0.235	0.21	0.201	0.193
Shannon_H	1.657	1.727	1.745	1.609	1.717	1.712	1.821	1.764	1.45	1.707	1.739	1.766
Evenness_E	0.851	0.888	0.897	0.827	0.882	0.88	0.936	0.906	0.83	0.877	0.894	0.908
Copepoda												
Simpson-1_D	0.344	0.349	0.344	0.35	0.37	0.778	0.552	0.372	0.386	0.369	0.338	0.344
Shannon_H	1.083	1.75	1.082	1.075	1.046	0.446	0.792	1.042	1.021	1.047	1.092	1.083
Evenness_E	0.986	0.978	0.985	0.978	0.952	0.406	0.721	0.949	0.93	0.953	0.994	0.986
Cladocera												
Simpson-1_D	0.781	0.722	0.469	0.556	0.56	0.439	0.338	0.448	0.337	0.357	0.49	0.354
Shannon_H	0.377	0.451	0.9	0.637	0.709	0.922	1.092	0.938	1.093	1.061	0.88	0.066
Evenness_E	0.544	0.65	0.819	0.918	0.645	0.839	0.994	0.854	0.995	0.966	0.801	0.97
Ostracoda												
Simpson-1_D	0.525	0.556	0.531	0.537	0.584	0.528	0.698	0.803	0.74	0.755	0.539	0.51
Shannon_H	0.668	0.637	0.662	0.656	0.607	0.665	0.479	0.349	0.429	0.41	0.653	0.683
Evenness_E	0.964	0.918	0.954	0.946	0.835	0.959	0.691	0.503	0.619	0.592	0.943	0.985

Table 3. Seasonal diversity indices values of Hasanparthy lake during the year 2022-23

	Summer season	Southwest monsoon season	Northeast monsoon season
	February, March, April and May	June, July, August, September	October, November, December, January
Rotifera			
Simpson-1_D	0.22	0.198	0.209
Shannon_H	1.684	1.753	1.665
Evenness_E	0.865	0.901	0.877
Copepoda			
Simpson-1_D	0.346	0.518	0.359
Shannon_H	1.247	0.831	1.06
Evenness_E	0.981	0.757	0.965
Cladocera			
Simpson-1_D	0.632	0.446	0.385
Shannon_H	0.591	0.915	0.775
Evenness_E	0.732	0.833	0.933
ostracoda			
Simpson-1_D	0.537	0.653	0.636
Shannon_H	0.655	0.525	0.543
Evenness_E	0.945	0.747	0.784



Graph 1. Zooplankton diversity indices of hasanparthy lake during the year 2022-23



Graph 2. Seasonal diversity indices values of hasanparthy lake during the year 2022-23

are recorded highest in southwest monsoon season in Rotifera (1.753) and Cladocera (0.915) groups, while in Copepoda (1.247) and Ostracoda (0.655) summer season and lowest values in Rotifera (1.665) group in northeast monsoon season, southwest monsoon season in Copepoda (0.831) and Ostracoda (0.525) groups, while in summer season Cladocera (0.591) group. The highest Evenness_E values were noticed in southwest monsoon season in Rotifera (0.901), in summer season in Copepoda (0.981) and Ostracoda (0.945) groups, while in northeast monsoon season in Cladocera (0.933) group, the lower values of Rotifera (0.865) and

Cladocera (0.732) groups and in southwest monsoon season in Copepoda (0.757) and Ostracoda (0.747) groups respectively. The climate of Hanumakonda is in semi-arid conditions and the maximum rain fall is recorded in July and August months of southwest monsoon season. While in the northeast monsoon season the surface water had low temperature. Due to this the diversity of zooplankton is observed less abundance in monsoon seasons and more abundance in summer months [11]. The similar type of results were made by [12].

4. CONCLUSION

The present results clearly indicates that the zooplankton shows most abundance in summer season and less abundance was observed in northeast monsoons season. This may be due to the normal level of water in summer season and optimum temperature for the survive of zooplankton species.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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