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STUDY OF ZOOPLANKTON DIVERSITY, ABUNDANCE AND SEASONAL VARIATIONS FROM NAKANA LAKE, DHULE (MS) INDIA

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Abstract

One of the vital territories of the world is aquatic ecosystem which covers the much more area where some organisms to be inherent in it. From those zooplanktons are important ecological indicators of freshwater bodies serves as major element of aquatic food chain. The present investigation deals with zooplankton diversity, abundance with some diversity indices in different seasons into two-year study period (Feb, 2013 to Jan, 2015). The zooplankton diversity of Nakana Lake was represented by taxonomic 4 groups i.e., Rotifera, Cladocera, Copepoda and Ostracoda with total density 1512 and 1383 org/l in two years. The Copepods dominated with 9 species followed by Rotifers with 7 species then Cladocera's with 6 species and Ostracods with 3 species. Maximum zooplanktons were identified in summer season, moderate in winter and minimum in monsoon season. At the density point of view ostracods dominated, followed by rotifer, Cladocera then Copepod. The diversity indices show different values in couple of year. Polluted status of lake indicated by few rotifer species which happen due to anthropogenic activities.

Keyword: Territory, Cladocera, Locomotion, *Keratella tropica*

Introduction

Zooplankton diversity is most important ecological parameters in water quality appraisal. The zooplanktons are microscopic animals, length having 100 to 500 um, they show ciliated outgrowths at the anterior end of the body called corona. Corona used for food capturing and locomotion process (Sing and Talpade, 2018). These microscopic invertebrates can attain maturity quickly but they have very short life span. Generally, zooplankton depends to a large extent on various phytoplankton for food. Many of the superior forms feed on minor zooplankton, forming secondary consumer, while some of them are detritivore feeders, browsing and feeding on the organic matter attached to substrate or lying on the bottom sediment. As a primary consumer they link between phytoplankton and fish, some zooplanktonic species indicating the presence or absence of certain fish species. According to Manickam *et. al.* (2017) Assessment of zooplankton biodiversity will be beneficial to screen the healthy status of waterbody and productivity of fishes. They provide food for secondary consumers which is valuable for commercially important aquaculture. These types of primary consumers constitute an important role in energy transfer from first to most advanced level in food chain of floating as well as stagnant aquatic ecosystem (Dhanasekaran *et al.,* 2017), as they are varying from one ecological area to other and even within same geographical locality. Hence qualitative and quantitative analyses of zooplankton are of huge importance in reservoir water body. No systemic analysis has been carried out regarding seasonal fluctuation and diversity indices of zooplanktons from Nakana Lake. In sort to fill up this lacuna, present investigation had undertaken in two successive years.

Material and Methods

For estimation of zooplanktons the sample was collected monthly, between 7.00 am to 9.00 am, by using 25 mm mesh size plankton net during Feb, 2014 to Jan, 2016 from Nakana lake. The two-year study data (Feb., 2014 to Jan., 2016), for seasonal variation was polled for four months and three seasons, with respect to Summer (February, March, April and May) Monsoon (Jun, July, August and September) and winter (October, November, December and January). Mean and Standard Error of Mean (SEM) were calculated for each season and One Way ANOVA with no post test for various parameters for three seasons. 100 l of surface water were sieved, filtrate was taken in another sterilized bottle, labeled and for preservation 4% formalin was added. For further analysis sample were brought to the laboratory. Counting was completed with the help of "Sedgwick–Rafter counting cell". The systemic identification of zooplanktons was made by using slandered keys of Dhanpathi (2000) and Altaff (2004). Diversity indices estimated by (Shannon and Wiener, 1949; Simpson, 1949; Margalef, 1958 and Pielou, 1966) methods.

Data analysis

Methods to measure the diversity are based on the relationship between the different types of species present in an area and their total populations.

1. Shannon – Weiner Index (1963): (H): H= -∑Pi (In Pi),
2. Simpson's Dominance Index (1949) :(D): D= ∑ n(n-1)/N(N-1),
3. Simpson's Index of Diversity = 1-D,
4. Simpson's reciprocal Index = 1/D,
5. Margalef's Index (1958): (MD): MD = R=S-1/Ln(n)
6. Pielou's evenness Index (1966): (J): J = H/Ln*S

Result and Discussion

Mostly zooplankton depends to a large extent on various phytoplanktons for foodstuff. Many of the larger forms feed on minor zooplankton, forming secondary consumer, while some of them are detritivore feeders, browsing and feeding on the organic matter particles attached to substrate or lying on the underneath residue. Communities of freshwater Zooplankton belong to four main taxonomic groups Rotifera, Cladocera, Copepoda and Ostracoda. The recorded values indicate Copepoda > Rotifera > Cladocera > Ostracoda during both years, shown in fig. -1

Zooplanktons from Nakana Lake are represented by 25 species. Total (1512 and 1383) org. /l were recorded two repeated years, during Feb, 2014 to Jan, 2016 shown in table-1.

Total 473 Rotifer recorded during year 2014-15 and 422 in year 2015-16, viz; *Brachionus angularis, Brachionus candatus, Tricocera cylinderica, Tricocera smiles, Lapadella ovalis, Lecane luna* and *Keratella tropica.* The rotifer exhibits very wide range of morphological variations and adoptions, and are a known indicator of water quality, Gannone and Stremberger (1978). *Lapadella ovalis* record maximum density in month of February (16 org/L and 15 org/L) at both years while minimum density *Lecane luna* in month of June and September in 2014-15 and *Keratella tropica* in month of September and December during 2015-16, coincided with (Rao, 2016)

Abundance of Cladocera varies between 283 to 271 in two-year study periods, reported with 6 species like *Alona pulchella, Ceriodaphnia sp., Daphnia carinata, Daphanosoma sp., Monoclaphnia sp.* and *Simocephalus sp.* Ecologically Cladocera can be classified as the most important component of zooplankton community (Panvar and Malik, 2016). In this group *Alona pulchella* found to be dominant in month of November at both years.

Freshwater Copepods represent most important zooplankton communities, they provide as food to numerous fishes and participate a major role in the energy makeover the furthermost tropic levels. They found to be governing by 9 species (373 to 399 org/l) at the whole study period, viz *Cyclops bicuspidatus, Cyclops viridis, Cyclopoid sp., Cyclocypria sp., Clanoid sp., Heliodiaptomus sp., Daptomu sp., Mesocyclops leuckarti* and *Zoaea Larva.* Maximum abundance of *Heliodiaptomus sp.* in month of January in year 2014-15 and *Clanoid sp* had shown maximum number in same month of year 2105-16, correlated with (Singh *et al.,* 2021).

Ostracods represents by 3 species with dominant genera at the density point of view i. e. 305 to 369 org/l. Cypris. *Cypris, Stenocypris* and *Srandesia* had maximum abundance. Maximum population of *Cypris* (25 org/l) in occur month of December and *Srandesia* species absent in month of August during 2013-14, corroborated with (Kar and Kar, 201)

Seasonal Variation

Zooplankton is good indicators of the changes in water quality because they are strongly affected by climatic fluctuations and respond rapidly to changes in water quality, recorded in Table- 2.

Present study observations showed that highest population of total zooplanktons (142.66 ±24.90 and 131.56 ±30.02) in winter season as well as lowest at monsoon (135.5 ±44.15 and 123.25 ± 40.47) in year 2014-15 to 2015-16 respectively. Pick point recorded about Rotifer population in February and Minimum in July during 2013-15. Maximum abundance was recorded during summer (7.07 ± 3.63 and 6.42 ± 3.25) and decline in monsoon season (4.28 ± 1.87 and 3.96 ± 1.87) and moderately recorded in winter (5.53 ± 2.07 and 4.67 ± 2.07), present record corresponding with (Kumar *et al*., 2015). In cladocera maximum occurrence in February (35 org/l and 32 org/l) and minimum at November in both repeated years. About copepoda pick population (39 org/l and 36 org/l) in April and least in December in couple of years. Both groups showed highest values in winter season (4.75 ± 2.78 and 4.87 ± 2.25; 4.41 ± 2.25 and 4.08 ± 2.06) and lowest in Monsoon (3.95 ± 2.09 and 4.12 ± 1.96: 3.61 ± 1.97 and 3.51 ± 1.57). According to Singh *et. al.* (2021) pick residence of Cladocera and Copepoda in winter season due to easy availability of food, favorable abiotic factor and plentiful development of phytoplanktons, reduction in summer due to unavailability of food. Group Ostracoda shoed same result about seasonal variation, uppermost on winter (11.91 ± 6.82 and 11.25 ± 6.10) while buck in monsoon (8.92 ± 5.97 and6.66 ± 3.96) in couple of year. In the present study monsoon season records minimum values because of turbidity due to soil erosion and surface run-off. Our findings related with (Dede and Deshmukh, 2015).

In the present study, Rotifers were the most abundant throughout the study period however Ostracoda group dominated over the other groups in density point of view.

Diversity Indices

Biological diversity can be measured by many different ways i.e. Richness and Evenness. Different kinds of animals are present in an exacting area is called richness while evenness compares the resemblance of inhabitants of each species. Diversity depends on those, both things are increases, diversity involuntarily increases. Shannon and Wiener index is also significant contrivance for analysis diversity of particular territory. By using different formulae, we calculated values of six types of indices given in Table- 3 and graphical representation in fig.- 2.

The present estimation paid attention' at richness, abundance and different diversity indices of freshwater body, Nakana Lake. The lake represents more affluent value about zooplankton species i. e. 25 and abundance is 1512 and 1383 during 2014-15 and 2015-16 respectively. The value of the Shannon-Weiner index was (60.999 and 49.1047) shows greater diversity in couple of the year. The index of dominance is useful for shaping meticulous zooplankton species ruled by that territory. In Simpson's Dominance Index quantify the possibility that two individuals indiscriminatingly selected from a sample will belongs to the same species. The value of this index was (0.053 and 0.049) in both years. This varies between 0 and 1. If a value of this index was 0 stands for infinite diversity and 1 indicates no diversity (Patil *et al.,* 2016). When value of lake is low, the allegation is that "Dominance is shared by all the species of that community" Cummins (2002). To get over this problem 'D' is subtracted from 1 to give the Simpson's index of diversity (1-D) which was (0.9469 and 0.9509) and Simpson's reciprocal Index (1/D) was (18.8556 and 20.3729). These three are the closely related indices shows the same diversity. The species richness is calculated by Margalef's Index (MD) was (3.2781 and 3.3185) Pielou's evenness index (J) was (18.9504 and 15.2564) in year 2014-15 and 2015-16 respectively. Our observations are correlated with studies like Sharma and Sharma, (2011); Panwar and Malik (2016) is calculated the values of diversity of Loktak lake, Manipur, India and Bhimtal lake of Kumaun region, Uttarakhand respectively.

Conclusion

In nutshell, diversity of zooplanktons of Nakana Lake maintains in both the years but density decreases in next year as compare to earlier. They show higher level abundance in summer season because of high temperature water evaporates and water body enriches with nutrients whereas falls in monsoon due to dilution of water by rainfall and turbid by agricultural runoff. This manmade lake suitable for fishery hence zooplanktons is the better food for the larval form of the fishes. But some anthropogenic activates disturbs this natural food chain. Hereafter the steps should be taken for the protection of this territories.

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Table:-1, Species wise percentage of Zooplankton from Nakana Lake.

Sr. No.	Name of Species	% of org./l	
		2013-14	2014-15
Rotifera (7)			
1	*Brachionus angularis*	16.5	14.9
2	*Brachionus candatus*	12.9	11.1
3	*Tricocera cylinderica*	16	15.4
4	*Tricocera smiles*	13.5	14
5	*Lapadella ovalis*	15.6	15.8
6	*Lecane luna*	11.8	13.3
7	*Keratella tropica*	13.5	13.5
Cladocera (6)			

8	*Alona pulchella*	24	21.2
9	*Ceriodaphnia sp.*	17.3	16.2
10	*Daphnia carinata*	16.2	16.6
11	*Daphanosoma sp.*	10.7	11
12	*Monoclaphnia sp.*	14.3	17.7
13	*Simocephalus sp.*	17.3	16.6
Copepoda (9)			
14	*Cyclops bicuspidatus*	12.2	12.9
15	*Cyclops viridis*	11.2	10.5
16	*Cyclopoid sp.*	11	13.4
17	*Cyclocypria sp.*	10.2	10.4
18	*Clanoid sp.*	14.5	13.4
19	*Heliodiaptomus sp.*	14.5	14.2
20	*Daptomu sp.*	10.3	9.1
21	*Mesocyclops leuckarti*	8.8	8.3
22	*Zoaea Larva*	7	7.2
Ostracoda (3)			
23	*Cypris*	56.3	45.4
24	*Stenocypris*	31.7	26.8
25	*Srandesia*	11.9	10.2

Table- 2, Seasonal variation of zooplankton from Nakana Lake.

Sr. No.	Group	Year	Average ± SD		
			Summer	Monsson	Winter
1	Total Zooplanktons	2013-14	135.5 ±44.15	99.75 ±25.77	142.66 ±24.90
		2014-15	123.25±40.47	90.00 ±20.11	131.56 ±30.02
2	Rotifera	2013-14	7.07 ± 3.63	4.28 ± 1.87	5.53 ± 2.07
		2014-15	6.42 ± 3.25	3.96 ± 1.87	4.67 ± 2.07
3	Cladocera	2013-14	3.95 ± 2.09	2.58 ± 1.74	4.75 ± 2.78
		2014-15	4.12 ± 1.96	2.79 ± 1.35	4.87 ± 2.25
4	Copepoda	2013-14	3.61 ± 1.97	3.05 ± 1.62	4.41 ± 2.23
		2014-15	3.51 ± 1.57	2.83 ± 1.59	4.08 ± 2.06
5	Ostracoda	2013-14	9.91 ± 5.91	8.92 ± 5.97	11.91 ± 6.82
		2014-15	8.07 ± 4.88	6.66 ± 3.96	11.25 ± 6.10

Table- 3, Zooplanktonic species richness, abundance, dominance and diversity indices of Nakana Lake.

Sr. No.	**Zooplankton**	**2013-14**	**2014-15**
1	Species Richness (S)	25	25
2	Species abundance (N)	1512	1383
3	Shannon-Weiner Index (H)	60.999	49.147
4	Simpson's Dominance Index (D)	0.053	0.049
5	Simpson's Index of Diversity (1-D)	0.9469	0.9509
6	Simpson's Reciprocal Index (1/D)	18.8556	20.3729
7	Margalef's Index (R)	3.2781	3.3185
8	Pielou's Evenness Index (J)	18.9504	15.2564

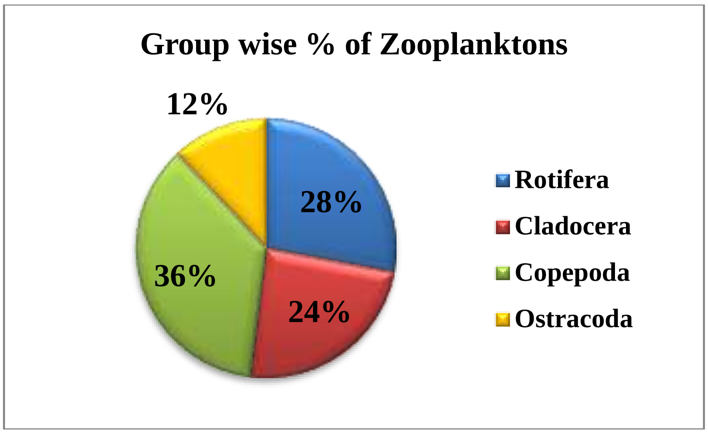

Fig. -1, Total percentage occurrence of Groups of Zooplankton from Nakana Lake, during Feb, 2014 to Jan, 2016.

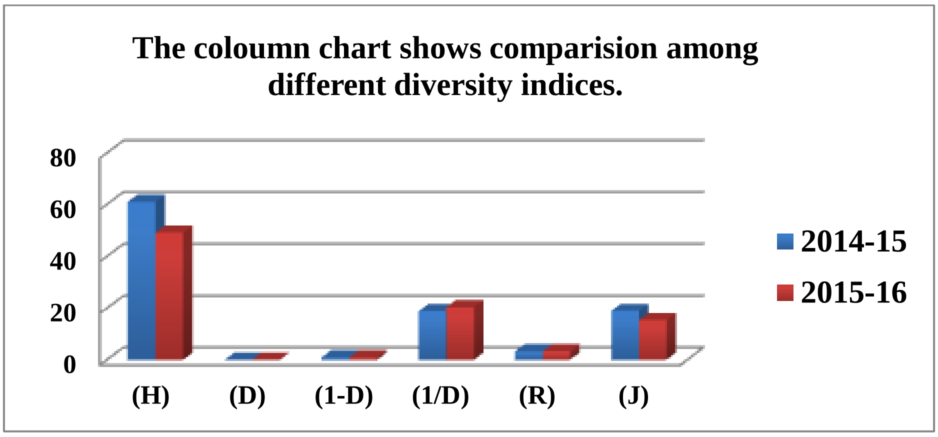

Fig.- 2 Graphical Representation of Diversity indices of Zooplanktons from Nakana Lake, during Feb, 2014 to Jan, 2016.