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Comparative study of Diversity of Cladoceran fauna from two Subtropical lakes of Yavatmal District

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Abstract

Prior knowledge of the spatial arrangement of the organisms in various types of aquatic environments is necessary for the development of management and protection strategies for aquatic biodiversity in water bodies. The cladoceran fauna of two subtropical freshwater lakes (Mama Lake & Singhada Lake) that are located in Yavatmal district was examined in the current study. A total of 19 species of cladoceran were recorded from the two ponds during the study period March, 2021- Feb, 2023. The various diversity indices such as Shannon-Wiener Index, Richness index and evenness were calculated. Three separate cladoceran families were found to predominate in both lakes, which showed completely diverse cladoceran faunal components. Family Daphnidae showed high species richness followed by family Alonae and Chydoridae. The overall populace of Cladoceran fauna is more in Mama Lake than that of Singhada Lake.

Key words : Diversity, Zooplankton, Mama Lake, Singhada Lake.

Smaller aquatic ecosystems like ponds, pools, and ditches, which frequently make up the majority of freshwater habitats anywhere, have received much less attention than their larger counterparts, although being equally significant. Due to growing eutrophication from both natural and human-caused sources, these tiny ecosystems are extremely fragile and constantly under stress[4]. Anthropogenically induced conditions lead to an increase in the quantifiable abundance with a deterioration in the overall biodiversity and the overall quality of an ecosystem in particular. It is crucial to evaluate the diversity and community makeup of aquatic creatures in such environments.

The rotifers, cladoceran, copepods, ostracods and protozoa that make up the freshwater zooplankton are particularly important for biological monitoring studies[23]. Most freshwater lakes include Cladocerans which

are also referred to as water fleas. They are valuable source of food for aquatic invertebrates and plankton feeding fishes also it play a significant role as feeders of debris and algae[3]. Due to their place at the bottom of the food chain, they often aid in the movement of energy through the aquatic food chains, and they also help regulate the movement of pollutants and contaminants to the higher levels of the food chain[11]. The composition of the Cladoceran species can vary a lot between lakes, even if they're close together, especially if they're isolated from each other, have a very different trophic level, or are in different stages of their ecological evolution[9]. This study is aimed at how communities and the population of Cladocera are affected in two different kinds of lakes in Yavatmal district.

Water samples for study were collected from two different lakes (Singhada and Mama) of Yavatmal district of Maharashtra between March 2021 and February -2023. Singhada Lake (20°02' North latitude and 78°57' East longitude) is located in Wani Taluka of Yavatmal District. And is at 215 meter above sea level. Mama Lake (19°48' North latitude and 78°51' East longitude) is present near Mukutban and is at 249 meter above sea level. The water parameters such as temperature, pH, DO, free CO_2, and BOD were calculated by standard methods[2]. The analysis of Cladoceran fauna was carried out using the following standard keys of Edmondson[7], Meisch,[18] and Altaff[1]. The various diversity indices such as Shannon-Wiener Index, Richness index and evenness were calculated.

a) Shannon-Wiener's Index calculated using the formula[22] (Ludwig and Reynolds,[15]):

$H2 = (\Sigma\ pi\ ln\ pi)$

Where,

Pi = n/N n= No. of individual species, N = total density of all organisms.

b) Margalef's richness index (d) was calculated by the formula (Margalef, 1958):

$d = S-1 / \log N$

c) Evenness was calculated using the formula: $e = H2 / \ln S$

The variations in the water parameter values of Singhada Lake and Mama Lake from Yavatmal district in the year 2021-2023 are presented in table-1. Water temperature play an important role in regulating nearby all other water parameters and also the biological productivity of water body[26]. The temperature of water not only affects the growth of aquatic species but also affects the biological and chemical activities[9].

In general, pH explains significant abiotic and biotic characters of the ecosystem[5]. The mean values of the pH in Singhada Lake was observed 7.22 ±0.09 and that of the Mama Lake was found to be 7.17 ±0.12 (table-1). The productive nature of the water body can be indicated by pH range 6.0 to 8.5. The pH values of the Lake studies are in between the range of 6.0 to 8.5, this indicates that the Singhada Lake and Mama Lake are well buffered.

The amount of dissolved oxygen in lakes varies depending on their trophic levels, and its decrease is arguably the most common consequence of water contamination[25]. The most important factor in determining the trophic status and degree of eutrophication is the

amount of dissolved oxygen because it is essential to the existence of most aquatic life forms[8,9]. in the present study, the average high values of dissolved oxygen are found in Mama Lake (5.9 ±1.08 mg/L) while the Singhada Lake showed low values of dissolved oxygen (3.2 ±0.97 mg/L) as presented in table-1. This indicates that the Singhada Lake is more contaminated than the Mama Lake.

In the present study it is found that the Singhada lake shows higher values of free CO_2 (6.2 ±1.18 mg/L) as compared to that at Mama Lake (4.2 ±2.05 mg/L) as indicated in table-1. The increased values of the free CO_2 indicates the high degree of contamination in the Lakes[6,9]. In this investigation, it is seen that

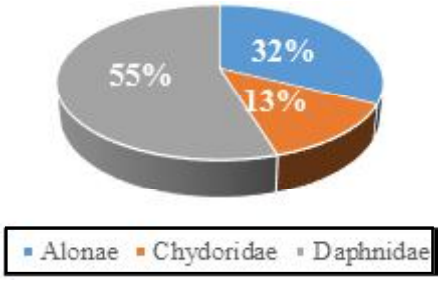

Fig. 1. Average Percent contribution of Cladoceran families at Singhada Lake (March 2021 – Feb. 2023).

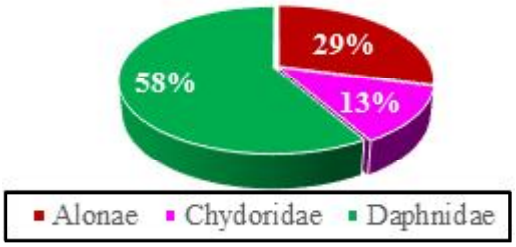

Fig. 2. Average Percent contribution of Cladoceran families at Mam Lake (March 2021 – Feb. 2023).

the behaviour of dissolved oxygen and free CO_2 is reciprocal. Similar results were also shown by Mohapatra[19].

The BOD values of Singhada lake were found higher (6.8 ±1.08 ml/L) than that of Mama Lake (6.2 ±0.97 mg/L) as represented in table-1. Biological oxygen demand is an indirect indicator of biodegradable organic matter and a direct indicator of oxygen used[14]. The increased BOD values may be due to the strong bacterial activity and substantial organic matter intake into the water.

In all 19 species of Cladocera were observed in Mama Lake while Singhada Lake represented 18 species (table-2). The low number of species observed in Singhada Lake may be attributed to the lake's more eutrophic nature than that of Mama Lake while, the more species number observed in Mama Lake may be attributed to its low population density than Singhada Lake. As the water body is more eutrophic, diversity of the Cladoceran fauna is found low in that water body[12]. In the present study, family Daphnidae was observed to be more species rich than family Alonae followed by family Chydoridae (table-2). The average percent of number of individuals observed high for family Daphnidae at Singhada Lake (55%) followed family Alonae (32%) and family Chydoridae (13%) (fig.-1). At Mama Lake, family Daphnidae contributes (58%) followed family Alonae (29%) and family Chydoridae (13%) (fig.-2). Out of all the species observed, *Ceriodaphnia pulchella* was found dominant species in both lakes (table-2). Patel and Laharia[21] observed presence of 9 species of Cladocera from fresh water perennial pond in Wani city and found

Table-1. Mean values of Water parameters from two study lakes in Yavatmal district (March 2021 – Feb. 2023).

Parameters	Singhada Lake	Mama Lake
Water temperature (°C)	22.7 ± 0.54	21.9 ± 0.77
pH	7.22 ± 0.09	7.17 ± 0.12
DO (mg/L)	3.2 ± 0.97	5.9 ± 1.08
FCO_2 (mg/L)	6.2 ± 1.18	4.2 ± 2.05
BOD (mg/L)	6.8 ± 1.08	6.2 ± 0.97

Table-2. Average number of Cladoceran fauna observed in Singhada Lake and Mama Lake of Yavatmal district (March 2021 – Feb. 2023).

Family	Genus / Species	Average number of Individuals observed in Singhada Lake	Average number of Individuals observed in Mama Lake
Alonae	*Alona affinis*	15	30
	Alona karau	13	23
	Alona monacantha	15	30
	Alona quadrangularis	15	28
	Alona rectangula	13	29
	Alona rustica	14	30
Chydoridae	*Bryospilus repens*	0	24
	Chydorus ovalis	18	23
	Leydigia acanthocercoides	16	26
Daphnidae	*Ceriodaphnia bicuspidata*	13	32
	Ceriodaphnia carolinansis	18	40
	Ceriodaphnia dubia	10	37
	Ceriodaphnia minor	13	38
	Ceriodaphnia quadrangula	16	35
	Ceriodaphnia pulchella	20	42
	Daphnia Catawba	17	38
	Moinodaphnia macleayii	12	25
	Scapholeberis mucronata	13	30
	Simocephalus vetulus	12	24
	Total	263	584

Table-3. Average indices of Cladocera fauna in Singhada Lake and Mama Lake of Yavatmal district (March 2021 – Feb. 2023).

Lakes	Margalef Richness index	Shanon-Weiner index	Evenness
Singhada	2.825	2.88	0.995
Mama	3.05	2.93	0.994

the family Daphnidae as dominant. Mukherjee[20] stated that higher species richness is indicated by a wider food chain.

The diversity index is frequently employed as a biological criterion to interpret the state of the environment and to determine the average level of insecurity within the population. As per Mason[17], if the diversity index is <1, it means the water is much polluted, if it is 1-3, it means it is moderately polluted, and if it's >3, it means there's no pollution in water body. In the present investigation, the data values of Shanon-Weiner index were higher for Mama Lake (2.93) while lower for Singhada Lake (2.88) (table-3). The lower diversity index of Singhada Lake is an indication of more stressed and contaminated environment and high trophic level of the water body. The observations of Latha and Thanga[13] showed that the high diversity index was found in non-retting zones and the lower index was fond in retting zones.

The Margalef Richness index was calculated maximum at Mama Lake (3.05) and minimum at Singhada Lake (2.825). Somasheker and Ramaswamy[24] reported that higher values of richness index indicates the healthy nature of water body. The Evenness index of Mama Lake was calculated as (0.994) and that of the Singhada Lake as (0.995) (table-3).

After comparing the data of diversity indices of both the lakes, it is clear that the values of Margalef Richness index and Shanon-Weiner index are found higher than that of Singhada Lake while Evenness index is somewhat more in Singhada Lake than that of Mama Lake.

There was a significant difference in the number of species and individuals of Cladoceran in both ponds. The higher calculated values of the diversity indices for Mama Lake denotes its healthy ecological status while the lower calculated values of the diversity indices for Singhada Lake indicates its more contaminated and less healthy ecological status. In addition to this, the indices of diversity, richness and evenness are found in accordance with the findings of water parameters.

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