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Comparative Study on Plankton Diversity in Khandarani Lake & Ketki Lake Water Ecosystem in Belpahari, Jhargram, West Bengal, India

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ABSTRACT

Diversity of plankton is an excellent biological indicator of an environment's health. 2 lake water bodies were selected. The first Lake (Khandarani) and (Ketki Lake) are non-culture fish lake and second is fish culture Two Lakes at Belpahari, Jhargram West Bengal. The water samples were collected during June 2024 between 7:00 to4:00 Pm to 2025, October. Samples collected 1500 ml water in one litter of plastic bottles at selected location and preserved them with 3-4 ml. Lugol's solution. The total no of 70 species belonging to Bacillariophyta, Chlorophyta, Cyan bacteria, Euglenozoa, Myzozoa, Rotifera observed in the present study. The maximum number of the genera of phytoplankton was recorded in Chlorophyta (22 genera) followed by Bacillariophyta (20 genera), Cyanobacteria (15 genera), Euglenoza (8 genera), Cryptophyta (2 genera) and Myzozoa (1genera). Only one group (Rotifera) was recorded under Zooplankton. Culture ponds showed more diversity compared to non-culture ponds in the present study.

Introduction

Plankton communities (Example phytoplankton and zooplankton) are one of the major indicators of biotic communities for fresh water aquatic ecosystems. The stagnant/lentic ecosystem is in land fresh water bodies (examples ponds, lakes, tanks, pools, puddles, swamps) which have a key responsibility in supplying resources and habitats to aquatic and terrestrial animals (Williams *et al.* 2004, Schefferet *al.* 2006, Martins *et al.* 2020, Kumar *et al*. 2022). Plankton is susceptible to water pollution (Zelalem 2015, Kumar *et al*. 2015, 2020). Plankton are classified on the basis of size such as macro plankton (200-2000 µm), micro plankton (20-200 µm), nano plankton (2-20 µm), picoplankton (0.2-2 µm) and femtoplankton (0.02-0.2 µm) (Tucker and Lloyd1984) Planktons form the primary food or basicfood for herbivorous as well as omnivorous fishes with reference of Indian Major carps (IMC) from the river in ecosystem (Alam*et al*2015, Dwivedi*et al.* 2019, Dwivedi & Mishra2023) and also provide the food for zooplankton (Islam *et al.* 2020, 2022). Plankton populations are influenced by factors such as supplement is present, temperature, sunlight, water

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currents. They form an essential component of ecosystems, contributing to global biodiversity, carbon cycling, and the overall health of the oceans. In ponds, similar to the ocean, plankton also exist, although the specific composition and abundance may vary. Ponds typically support a different set of organisms compared to the open ocean due to differences in size, nutrient availability, and environmental conditions. Ponds also provide habitat for the early life stages of many aquatic insects, such as mosquitoes, midges, dragonflies, and damselflies. The larvae of these insects are often considered part of the plankton community. They live in the water column, feeding on smaller organisms and detritus until they mature and undergo metamorphosis (Cottenie*et al.* 2001, Céréghino*et al.* 2008,

Hoverman & Johnson 2012)

Ponds were recently determined to help extra species, in addition to extra remarkable, rare, and threatened species in comparison to streams, rivers, reservoirs and lakes (Mohanty*etal.* 2011, Gebre*et al.* 2016, Dwivedi *et al.* 2004, Jha *et al.* 2015). There are 2 types of Lake Water, natural and artificial. These may be Permanent and temporary (Biggs *et. al.* 2005). The Lakes are formed by a large, standing body of water, primarily fresh water, situated in a basin or depression on Earth's surface that formed naturally without intervention. Commonly the water of rainy season falls into these lakes. Lakes are generally land locked and there is release of water. These ecosystems contain a huge variety of plankton (Sondergaard*et al.* 2005). Pollution, particularly from industrial discharge or chemical contamination, domestic and sewage can alter the species composition of plankton. Some species may be more tolerant of pollution, while others may be more sensitive and decline in abundance. Shifts in the dominance of certain plankton species can signal changes in water quality and pollution levels. To enhance of present research work is to determine the diversity of different planktonic species from rearing and non-rearing fish culture lakesin summer season (lowest water depth in ponds due to higher temperature, low availability of water, maximum seepage, multiple use of water (example agriculture and cattle farming) of Khandarani Lake & Ketki lake at Belpahari, West Bengal India.

Materials and Methods

There were Two water bodies selected for the present study the first one is Khandarani Lake are nonculture fish Lake while second no of Lake is fish culture Lake. All water bodies are situated within at Belpahari, Jhargram, West Bengal.

Lake - 1: The first Lake Khandarani is located nearby Belpahari Gram Panchayet. This Lake is a non-culture fish pond. The source of water in this lake is precipitation water. This lake is mainly used by local people for domestic, commercial and irrigation purposes. This Lake is free from sewage water effluents.

Lake - 2: The second Lake is Ketki Lake L-2) is located nearby Kakrajhore jungal, Belpahari. This Lake is also a non-cultural fish Lake. The source of water in this Lake is precipitation water. Pond mainly used by local people for domestic, commercial and irrigation purposes. This pond is also free from sewage water.

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Sample Collection

We collected 1500ml water samples in one litter of plastic bottles at selected location during 7:00 am to 4:00 pm. and preserved them with 2-3 ml Lugol's. The preserved samples were transporting the laboratory. The samples were stored where in dim light at room temperature for 24-48 hours. A Siphoning procedure was followed to obtain 60 to 100 ml concentrates.

Sample Analysis

The concentrated sample of 4
microliters (v1) was examined under a trinocular
microscope and counted all the plankton species
(n).

Density (unit/litre) = (n/v1) x concentrated volume.

Diversity Indices

During the study period, diversity indices were used to determine species composition and abundance.

Simpson's Index (D)

A measure of biodiversity that accounts for both species richness (number of species) and evenness (relative abundance). It calculates the probability that two individuals randomly selected from a sample belong to the same species. Values range from to 1, where higher values (closer to 1) indicate lower diversity and lower values (closer to 0) indicate higher diversity.

The index is calculated as

$$D = 1 - \left(\frac{\Sigma\, n(n-1)}{N(N-1)} \right)$$

Where, n is the total number of organisms of a particular species, and N is the total number of organisms of all species.

Interpretation: A low D values suggests high diversity, while a high D value suggests low diversity (dominance by one species).

Index of Diversity (1-D): - To make the index more intuitive, 1-D is often used, where values closer to 1 indicate high diversity.

Reciprocal Index: - This measure the number of equally common species that values indicating greater diversity

n = total number of organisms of a particular species
N = the total number of organisms of all species
The value of D ranges between 0 and 1. With
this index, 1 represents infinite diversity and 0, no diversity.

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Shannon Index or Shannon-Weiner Index

(H′)

A statistical measure of biodiversity within an ecosystem. The Shannon-Weaver Index, also known as the Shannon Index or the Shannon-Wiener Index, measures the likelihood that the next observed individual will be the same as the previously observed individual by combining two quantifiable measures, species richness (the number of species in a community) and species equitability (how the number of an individual species compares to the number of other species in the community). It is defines as: H= SUM (pi (In (pi))), where H= diversity index, pi= proportion of total sample represented by species I, and in = natural log.

Result and Discussion

A total of 80 species belonging to Bacillariophyta, Cryptophyta, Cyanobacteria, Euglenozoa, Myzozoa, and Rotifera are recorded in the present study under phytoplankton and zooplankton communities (Table 1). The maximum number of genera recorded in Chlorophyta (22 genera) followed by Bacillariophyta (20 genera), Cyanobacteria (15 genera), Euglenoza (8 genera), Cryptophyta (2 genera) and Myzozoa (1genera) (Fig. 1). Only one group (Rotifera) and 1 genera was recorded under zooplankton communities (Fig. 1).

Plankton Density (U/l)

Density of plankton groups varied from one sampling station to another (Table2). The highest density was recorded under Cyanobacteria (144000 to 10850000 unit/l) followed by Bacillariophyta (36000 to1000000 unit/l), Chlorophyta (18000 to435000 unit/l), Cryptophyta (0 to 750000unit/l), Euglenozoa (0 to 750000 unit/l), Myzozoa (0 to 50000 unit/l). One group of zooplankton Rotifera was recorded lowest density (0 to 50000 unit/l).

Species Richness from CIFRI Pond

A total of 39 plankton species belonging to Chlorophyta (17 genera), Bacillariophyta (9 genera), Cryptophyta (1genera), Cyanobacteria (10 genera), Euglenozoa (1genera) and Myzozoa(1genera) were recorded in CIFRI pond (Fig. 2). The different groups are present in this Lake. The dominant genera were belonged to Chlorophyta followed by Bacillariophyta and Cyanobacteria.

Plankton Density (unit/l)

Plankton density ranged from (0 to 8000000 unit/1). The highest density recorded under Cyanobacteria (557000 unit/l) followed by Chlorophyta (2487000 unit/l) and Bacillariophyta (536000 unit/l). Euglenozoa (125000 unit/l) Myzozoa (67000 unit/l) and Cryptophyta (125000 unit/l) were present in lower abundabundance **Species richness from Khandarani Lake-1.**

A total of 14 plankton genera belonging to Bacillariophyta (8 genera), Chlorophyta (3 genera), Myzozoa (1 genera), Cynobacteria (2 genera) were recorded in Andawa Pond-1 (Fig. 3). The dominant genera were belonged to Bacillariophyta followed by Chlorophyta and Cyanobacteria.

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Plankton Density (unit/l)

Plankton density ranged from (0 to10980009 unit/l) in Khandarani Lake 1). The highest density recorded under, Bacillariophyta (54000 unit/l) followed by Chlorophyta (36000 unit/l) and Cyanobacteria (126000 unit/l) in Khandarni Lake 1. Myzozoa (72000 unit/l) were present in lower abundance in khandarni lake 1.

Species Richness from Ketki Lake-2

A total of 15 species to Cyanobacteria (5 genera), Chlorophyta (4 genera), Bacillariophyta (3 genera) were recorded in Ketki Lake -2 (Fig. 4). The different groups are present in this pond. Myzozoa (1genera), Euglenozoa (1 genera) and Cryptophyta (1 genera) were recorded Andawa pond 2. The dominant genera belonged to Cyanobacteria followed by Euglenozoa and Myzozoa.

Plankton Density (unit/l)

Plankton density ranged from (0 to 681000 unit/l) in Andawa pond 2). The highest density recorded under Cyanobacteria (4395000 unit/l) followed by Bacillariophyta (123000 unit/l) and Chlorophyta (51000 unit/l), Euglenozoa (31500 unit/l), Cryptophyta (18000 unit/l) and Myzozoa (18000 unit/l) in Ketki Lake-2.

Lankton Density (unit/l)

Plankton density ranged from (0 to 4799000 unit/l) in Khandarani Lake the highest density recorded under Cyanobacteria (3094000 unit/l) followed by Euglenozoa (456000 unit/l) and Cryptophyta (429000 unit/l) in Jhutitali Kotwa pond. Chlorophyta (401000 unit/l), Bacillariophyta (376000 unit/l) in JhutiTali Kotwa pond. Myzozoa (18000 unit/l) and Rotifera (25000 unit/l) were present in lower abundance in Ketki Lake. **Diversity indices Simpson's index** Simpson's index ranged from 0.6014 to 0.9309 during the present study period. The minimum and maximum values were recorded in CIFRI pond due to sampling days (Table 3).

Shanon Index or Shanon-Weiner Index (H′)

Shanon index H was varied from1.594 to 2.932 in which minimum value recorded in Andawa pond 2 while maximum value observed in CIFRI pond (Table 3).

A total of 69 species recorded during the study period revealed rich diversity of plankton. However, study sites were dominated by different groups of plankton in different sites. Overall Bacillariophyta was the dominant species recorded. Regarding abundance, Cyanobacteria was highly abundant followed by Bacillariophyta, Chlorophyta, Cryptophyta, Euglenozoa indicating organic pollution (Paramasivam & Srinivasan 1981).

Pollution, particularly from industrial discharge or chemical contamination, domestic and sewage can alter the species composition of plankton (Rajgopal*et al.*2010). Followed by Cyanobacteria and Bacillariophyta. However, Cyanobacteria were found to be in high abundance followed by Chlorophyta and Bacillariophyta indicating deterioration of water quality (Paramasivam and the water of this sampling site may be considered to be safe for aquatic life based on the presence of

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Bacillariophyta as a dominant species. Cyanobacteria were the dominant species in Andawa 2 pond. Cyanobacteria were highly abundant followed by Chlorophyta and Bacillariophyta. The dominance of Cyanobacteria is considered to be high organic pollution in aquatic environments (Paramasivam & Srinivasan 1981). Chlorophyta was the dominant species in the Jhutitalikotwa pond followed by Bacillariophyta, Euglenozoa and Cyanobacteria, however, Cyanobacteria was highly abundant followed by Euglenozoa. The presence of Cyanobacteria and Euglenozoa indicates high organic pollution in this pond (Alekesandar*et al.* 2007). The highest diversity in the CIFRI pond indicates a well-managed water body among others, However, diversity was found to be good in other water bodies also. Cyanobacteria, Euglenozoa, and Cryptophyta were tolerated in high organic pollution water bodies. High temperature during summer is favourable for the growth of Cyanobacteria and it was also supported by Bomchul*et al.* (2001) and Aleksandar*etal.* (2007).

Conclusion

It may be concluded that the culture ponds showed more diversity compared to nonculture Lake in the present study.

Table 1: Plankton Species Recorded During Study Period from The Different Lakes (Culture and Nonculture) at Belpahari, West Bengal India

Lake	**Khandarani Lake**	**Ketki Lake**
Date & Time	9.06.2024	9.10.24
Plankton species		
Bacillariophyta		
*Achnanthidium*sp.	0	0
Anomoconeis spaeraphora	0	0
Aulacoseira granulate	0	0
*Cocconeis*sp.	1200	126000
*Cyclotella*sp.	6000	3200
*Cymbella*sp.	3000	180000
*Diadesmis*sp.	5000	8900
*Diatoma*sp.	2700	54000
Diatoma vulgaris	16500	2300
*Fragilaria*sp.	3200	7600
*Navicula*sp.	1200	90000
*Neidium*sp.	1200	4300
*Nitzschia*sp.	1200	5600
*Pinnularia*sp.	1200	54000
Stauroneis sp.	1200	1200
Ulnariaacus	1500	18000
Ulnariaacus	1700	7800

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	Khandarani Lake	Ketki Lake
*Trybilionella*sp.	12000	0
*Diploneis*sp.	0	12000
*Gomphonema*sp.	0	45000
Chlorophyta	Khandarani Lake	Ketki Lake
*Akistrodesmus*sp.	13000	0
*Chlamydomonas*sp.	45000	0
*Chorella*sp.	168000	143000
*Coelastrum*sp.	0	23000
Cracigeniafenestrata	0	0
*Crucigenia*sp.	0	0
*Desmodesmus*sp.	12000	0
*Golenkinia*sp.	0	23000
*Kirchneriella*sp.	0	36000
Monoraphidium contortum	36000	12000
Monoraphidium irregulare	45000	479000
*Oocystis*sp.	567700	0
Pediastrum tetras	43000	0
Desmodesmusarmatus	0	12000
Desmodesmus communis	236000	10000
Scenedesmus quadricauda	45000	9000
*Scenedesmus*sp.	10000	1000
Desmodesmusopoliensis	13000	0
*Selenastrum*sp.	40000	0
Tetradesmus obliquus	0	12000
*Tetraedron*sp.	12000	45000
Cryptophyta		
*Cryptomonas*sp.	0	10000
*Rhodomonas*sp.	12000	0
Cyanobacteria		
Anabaena sp.	60000	0
*Aphanothece*sp.	0	120000
Lyngbya sp.	12000	36000
*Merismopedia*sp.	36000	0
Nostoc sp.	48000	56900
*Phormidium*sp.	0	0
*Pseudanabaena*sp.	0	20000

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Euglenozoa	Khandarani Lake	Ketki Lake
Euglena sp.	1400	1100
Euglena gracilis	2300	1090
E. tubacarter	1500	3400
Euglena sp.	2300	4300
Lepocinclis ovum	1200	2200
*Phacus*sp	1700	4400
Myzozoa		5500
*Peridinium*sp.	90000	12000
Rotifera		
Brachinonusplicatilis	0	0

Table 2: Density of Plankton Groups Recorded During Study Period

Plankton Groups	Minimum Density (unit/l)	Maximum Density (unit/l)
Bacillariophyta	36000	1000000
Chlorophyta	18000	4350000
Cryptophyta	0	750000
Cyanobacteria	144000	10850000
Euglenozoa	0	750000
Myzozoa	0	50000
Rotifera	0	50000

Table 3: Diversity Indices Recorded During Study Period

	Khandarani Lake	Ketki Lake
Simpson_1- D	0.9309	0.9049
Shannon_H	0.9049	2.5

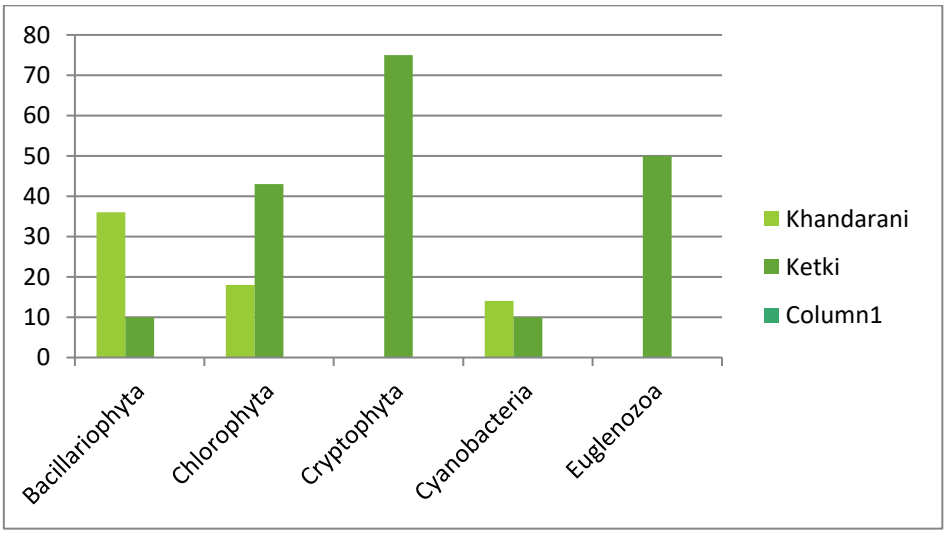

Fig 1: Plankton Groups Were Recorded in The Sampling Period in Two Lake

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