International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Studies on Plankton Diversity of Different Pond Ecosystems of Bathinda, Punjab, India

Lakhwinder Singh[1], Ramandeep Achint[2], Veerpal Kaur[3]

[1]Research scholar, School of Bio Sciences, RIMT University, Mandi Gobindgarh, Punjab, India, 147301
[2]Assistant Professor Department of Bio Sciences, RIMT University, Mandi Gobindgarh, Punjab, India, 147301
[3]Associate Professor, Dolphin PG College, Chunni Kalan, Fatehgarh Sahib, Punjab, India, 140406

Abstract:
A twenty ponds of Bathinda district of Punjab were investigated from Nov 2024-July 2025 to gather preliminary information on the diversity of plankton community. A total of 29 plankton species were recorded during the study of which 20 were phytoplankton and 9 belonged to zooplankton. Phytoplankton community was composed with 55% Chlorophyceae, 6% Bacillariophyceae and 3% Cyanophyceae. Zooplankton community dominance was shown by Insecta (55.5%) followed by Rotifer (22.22%) and Crustacean (22.22%). The present study highlights significance of plankton in ponds of Bathinda. The study demonstrates that ponds ecosystems of Bathinda harbour different plankton which is vital for ecosystem health. Understanding the dynamics of these plankton communities is essential for managing pond ecosystems effectively.

Keywords: Ponds, Bathinda, zooplankton, phytoplankton

1. INTRODUCTION

Ponds are small, shallow water bodies [1]. Ponds are the freshwater biodiversity hotspots that cover more area than lakes and provide habitat to many species including rare and threatened species than other freshwater habitats [2-3].

Ponds play role in providing a variety of ecosystem, helps in aquifer recharge, nutrient retention [4], carbon sequestration, and habitat conservation [5-7]. Ponds provide habitat for variety of flora and fauna and amongst which fishes are most important and inseparable part.

Despite their ecological and social benefits, ponds have been largely overlooked in freshwater ecosystem protection and conservation efforts [8]. Restoration and management initiatives tend to prioritize large, nationally significant water bodies or those within protected area networks. However, ponds provide crucial ecosystem services, serving as sources of food and freshwater, ecological niches, and habitats for diverse species (planktons). Planktons have great value as food and play a crucial role in disposal of sewage and natural purifiers of water and are important ecological parameter in water quality assessment.

Plankton are present in almost all natural waters and play a substantial role in the aquatic ecosystem and consists of aquatic organisms having little or no resistance to current, living free, floating, and suspended in the open or pelagic waters [9]. Plankton are highly sensitive to environmental changes, making them valuable bioindicators for monitoring ecological fluctuations in aquatic ecosystems [10]. They contribute significantly to global biogeochemical cycles and carbon sequestration. Plankton diversity and abundance are influenced by various physicochemical factors, including temperature, dissolved oxygen, and organic matter [11-13].

Understanding plankton dynamics is crucial for assessing water quality and ecosystem health as they constitute a vital link in aquatic food chains. Plankton has been widely used as a bioindicator to monitor aquatic ecosystems and assess water quality [14-15]. Phytoplankton is a polyphyletic group exhibiting immense variation in size, shape, color, metabolic processes, and life history traits. Phytoplankton form food for zooplankton, an important link between the producers and secondary consumers. The abundance and composition is greatly regulated by zooplankton [16]. Phytoplankton means plantlike community of plankton. Phytoplankton diversity and density serve as biological indicators for evaluating water quality and eutrophication status [17-21]. These indicators provide valuable insights into the health of aquatic ecosystems.

Zooplankton plays a vital role in aquatic food chains, converting plant food into animal food and serving as a crucial link between primary producers and higher trophic levels. They are essential for fish survival and growth, and their species composition can indicate water quality. Zooplankton acts as regional bioindicators of eutrophication and acidification. Zooplanktons are valuable bioindicators for detecting dispersal patterns of anthropogenic contamination and understanding the movement of waste nitrogen through aquatic food chains [22].

Pollution harms various organisms in the food chain, which are sensitive to environmental changes. The degree of pollution is determined not only by physical and chemical parameters but also by the response of aquatic organisms [23]. Rotifers, respond more quickly to any change in environment and also indicate change in water [24]. The community size of major zooplankton species can indicate the trophic status of lakes and detect shifts in trophic state [25], form the main sources of natural food for fish which is directly related to their survival and growth and are base of food chains and food webs in all aquatic ecosystems [26]. The major groups of zooplankton include Rotifers, Cladocerans, copepods and ostracods. As a result, current research looked into qualitative study of planktons in different ponds in Bathinda.

2. MATERIAL AND METHODS

2.1 Study Area

The research area is focused on Bathinda, a municipal corporation in Punjab, India. Situated in the Malwa Region of northwestern India, Bathinda lies 227 km west of Chandigarh.

This study has been focused on twenty ponds across four tehsils in Bathinda Punjab's fifth-largest city. Geographically, it is positioned at 30.20°N 74.95°E, with an average elevation of 201 m. The region experiences a semi-arid climate, characterized by significant temperature fluctuations between summer and winter, and receives relatively low annual rainfall (20-40 cm). The city is home to two modern thermal power plants, a fertilizer plant, and two cement factories, leading to industrialization and consequent water pollution. This has drawn researchers to investigate the water quality ofvarious water bodies in the area. Unscientific farming practices, introduced during the Green Revolution, have also been linked to increased cancer cases, reproductive issues, genetic deformities, and various health problems. To mitigate these effects, the government has prohibited the use of groundwater for drinking purposes in the city (Fig. 1.).

In Bathinda, twenty ponds (Table. 1) have been assessed from November 2024 to July 2025 to find out plankton diversity and their qualitative abundance in Bathinda District, Punjab, India .

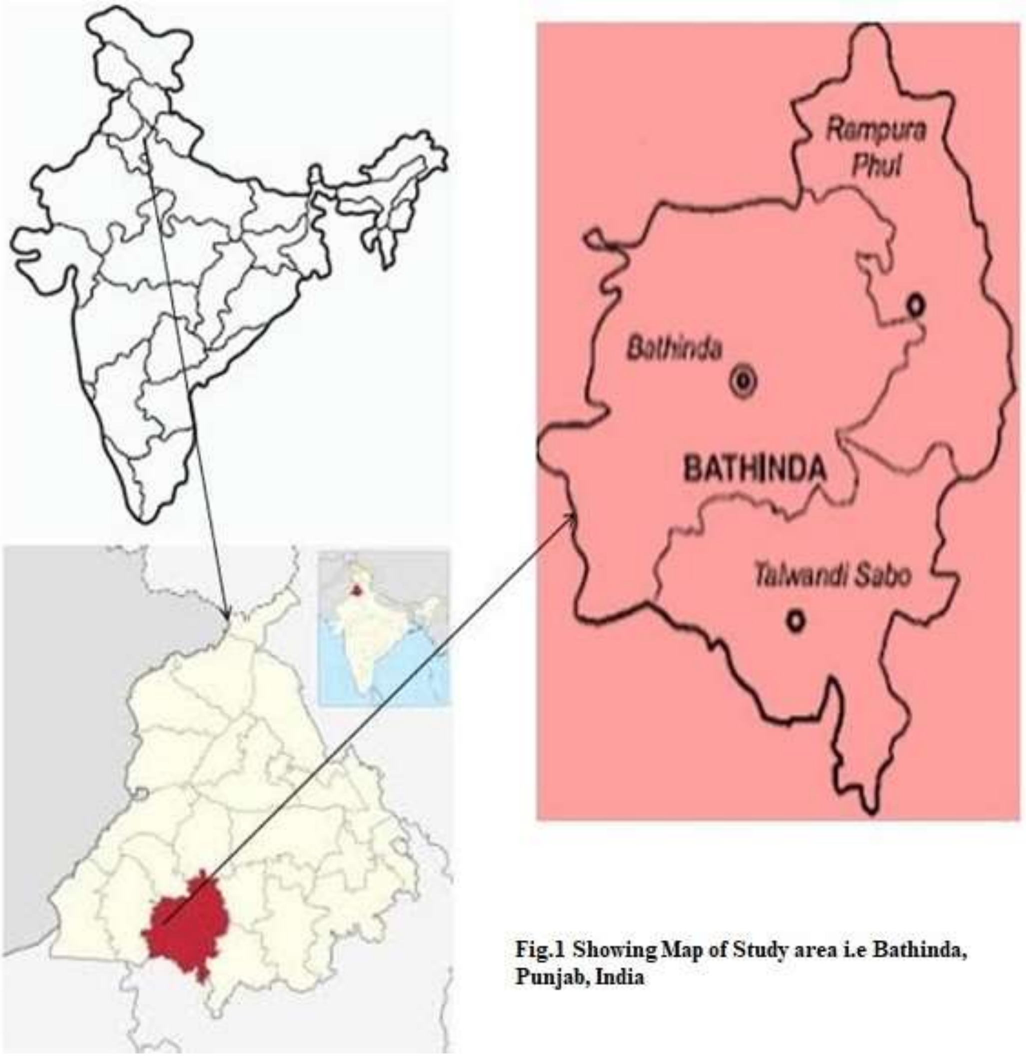

Fig.1 Showing Map of Study area i.e Bathinda, Punjab, India

Ring-type terracotta net with a mesh size of 24 meshes/mm² has been utilized for plankton collection. The net fitted with a wide-mouthed plastic bottle, and 50 L water samples have been filtered through it to obtain the plankton sample. For identification purposes, standard references from [27-29], were consulted. A qualitative assessment of the plankton sample was conducted.

Furthermore, after identification, photography of water samples for planktons was done. For this purpose, two or three drops of sample was put on the slide and covered with a cover slip. After wards, the slide was kept to rest for ten to fifteen minutes so that planktons can settle down. Then the slide was observed under phase contrast microscope and photographs were taken using Leica camera attached to microscope.

Table 1: Identified 20 Sites (ponds from different villages) for sample collection from District Bathinda, Punjab, India

S.No	Village name	Latitude	Longitude
1.	Teona Pujarian (P1)	29.918	75.111
2.	Behman Kaur Singh (P2)	29.906	75.127
3.	Jajal (P3)	30.477	75.164

4.	Lehri (P4)	29.886	75.159
5.	Behman Jassa Singh (P5)	29.922	75.113
6.	Jassi Pau Wali (P6)	30.108	75.091
7.	Katar Singhwala (P7)	30.166	75.0167
8.	Kot Shamir (P8)	30.108	75.091
9.	Jodhpur Romana (P9)	30.150	74.915
10.	Jhumba (P10)	30.108	75.091
11.	Gill Kalan (P11)	30.149	75.185
12.	Dhade (P12)	30.266	75.253
13.	Balianwali (P13)	30.210	74.945
14.	Balloh (P14)	30.145	75.423
15.	Kararwala (P15)	30.266	75.253
16.	Mari (P16)	30.052	75.178
17.	Sandoha (P17)	30.210	74.945
18.	Maisar Khana (P18)	30.207	74.938
19.	Ramgarh Bhunder (P19)	30.318	75.235
20.	Kutiwal Kalan (P20)	30.131	75.249

2.2.Methodology: Collection and Identification of planktons

3. RESULTS

Total 29 planktons have been observed as shown in Table 2. Out of which 20 genera belongs to Phytoplankton and 9 belongs to Zooplankton. In phytoplankton dominance has been by Chlorophyceace followed by Bacillariophyceae and then Cyanophyceae (Figure 2 & Table2). In case of zooplanktons, dominance has been shown by arthropoda followed by rotifer (Figure 3 and Table 2). Different types of planktons from the sampling sites were recorded in the Table 3-4. The observation of different members of planktons under microscope have been shown in Fig. 4- 21.

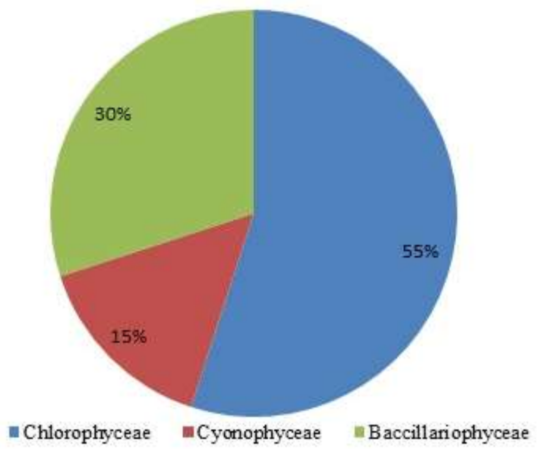

Figure 2. Percentage occurrence of phytoplanktons in ponds of Bathinda, Punjab.

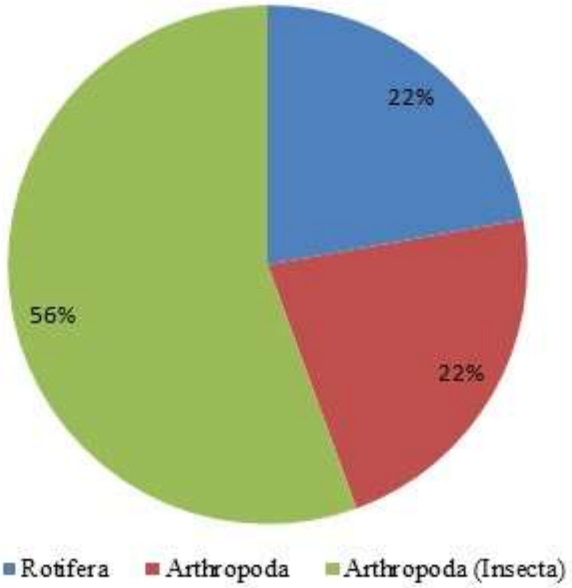

Figure 3. Percentage occurrence of zooplanktons in ponds of Bathinda, Punjab.

Fig. 4. ***Scenedesmus*** **sp.**

Fig. 5. ***Scenedesmus*** **sp.**

Fig. 6. ***Spirogyra*** **sp.**

Fig. 7. ***Spirogyra*** **sp.**

Fig. 8. ***Cosmarium*** **sp.**

Fig. 9. ***Chlamydomonas*** **sp.**


Fig 10. Zygnemopsis sp.


Fig 11. Chlorella sp.


Fig 12. Nitzschia sp


Fig 13. Pinnularia sp.


Fig 14. Synedra sp.


Fig 15. Diatoma sp.


Fig 16. Diatoma sp.


Fig 17. Meridion sp.


Fig 18. Gomphonema sp.


Fig 19. Fragilaria sp.


Fig 20. Navicula sp.


Fig 21. Amphora sp.

Table 2. Planktons recorded from the different ponds during the study period November 2024- July 2025 from different ponds of Bathinda, Punjab, India	
Phytoplankton (20)	Genera
Chlorophyceae	11 (55%)
Cyonophyceae	3 (15%)
Baccillariophyceae	6 (30%)
Zooplankton (9)	

Rotifera	2 (22.2%)
Arthropoda	2 (22.2%)
Arthropoda (Insecta)	5 (55.5%)

Table. 3 Showing abundance of phytoplanktons and zooplanktons collected from ponds in Bathinda

S.NO.	PHYTOPLANKTON	SITES											
		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
PHYTOPLANKTONS													
Chlorophyceae													
	kistrodesmus sp.	+++	+	++	+	-	-	+	-	-	-	-	-
	lorella sp.	+	++	++	+++	++	-	++	++	-	-	-	++
	lorococcum sp.	-	+	+	++	+	-	-	-	+	-	-	-
	lorotrichum sp.	-	-	-	-	-	+	+	-	-	-	-	-
	adophora sp.	+	+++	++	+	-	-	-	-	-	-	++	++
	osteridium sp.	-	++	+	-	-	-	-	-	-	-	+	-
	enedesmus sp.	+	-	++	++	++	-	+	+	-	++	+	+++
	irogyra sp.	+++	+	+	-	+++	+	-	+	-	-	++	+++
	geoclonium sp.	-	-	+		++	-	-	-	-	-	+	-
	lorella sp	+++	+++	+	+	++	+	+	+	+	+	+	+
	lvox sp.	+++	-	+	+	-	+	+	+	+	+	+	+
Cyanophyceae													
	irulina sp.	+++	+++	-	+	+	+	+	+	+	+	+	+
	abaena sp	+++	+++	-	++	-	+	+	+	++	+	+	+
	cillatoria sp	+++	+++	-	++	-	+	+	+	++	+	+	+
Bacillariophyceae													
	atoma sp.	-	-	-	-	-	-	-	-	+	-	++	-
	eridion sp.	++	+	-	+	+	-	-	-	-	-	-	+
	vicula sp.	+++	++	+	-	-	-	+	+	+	++	+++	++
	tzchia sp.	+	-	-	-	-	-	-	-	-	-	++	+

	nnularia sp.	-	+	+	-	-	-	-	-	-	-	+	_
	nedra sp.	+++	++	+	-	+	-	+	-	+	++	+++	++
ZOOPLANKTONS													
Rotifera													
	achionus spp.	+	+	+	+	+	+	+	+	+	+	+	+
	ratella spp.	+	+	+	+	+	+	+	+	+	+	+	+
Arthropoda (Crustacea)													
	phnia sp.	+	+	+	+	+	-	++	+++	++	+	+	-
	clops sp.	+	+	+	++	++	+++	++	++	+	+	+	+
Arthropoda (Insecta)													
25.	*Ranatra* spp.	+	+	+	-	-	-	+	+++	++	+	-	-
26.	*hnura* sp. ragon fly)	+	+	+	+	++	++	-	+	+	+	+	-
27.	*bellula* sp. amsel fly)	+	+	+++	+	+++	+	+++	+	+++	+	+	-
28	*Culex* sp	+	+	+++	+	+++	+	+++	+	+++	+	+	+
29	*Chrionomous* sp.	+	+	+	+	+	+	+	+	+	+	+	+
+ - Low dominant; ++ - Moderately dominant; +++- Highly dominant													

Table. 4 Showing abundance of phytoplanktons and zooplanktons collected from ponds in Bathinda

		P13	P14	P15	P16	P17	P18	P19	P20
PHYTOPLANKTONS									
Chlorophyceae									
1.	*kistrodesmus* sp.	+	+	+	++	-	-	+	-
2.	*lorella* sp.	++	+	++	+	-	-	-	+
3.	*lorococcum* sp.	-	-	+	+	-	-	-	-
4.	*lorotrichum* sp.	-	+	-	+	-	+	-	-
5.	*adophora* sp.	++	+	+	++	-	-	-	-
6.	*osteridium* sp.	+	+++	++	+	-	-	-	-
7.	*enedesmus* sp.	++	+++	-	++	++	-	+	+
8.	*irogyra* sp.	++	++	++	+	-	+	-	+
9.	*geoclonium* sp.	-	+	+	-	-	-	-	-
10.	*lorella* sp	+	+	+	+	+	-	++	+++
11.	*lvox* sp.	+	+	+	++	++	+++	++	++
Cyanophyceae									

12.	*irulina* sp.	+	+	+	+	+	+	+	+
13.	*abaena* sp	+	+	+	+	+	+	+	+
14.	*cillatoria* sp	+	+	+	+	+	+	+	+
Bacillariophyceae									
15.	*atoma* sp.	++	+	+	-	-	-	-	-
16.	*eridion* sp.	+	-	-	-	-	-	-	-
17.	*vicula* sp.	+++	+++	++	-	-	+	-	++
18.	*tzchia* sp.	-	+	+	-	-	-	-	-
19.	*nnularia* sp.	++	+	+	-	-	-	-	-
20.	*nedra* sp.	+++	+++	++	-	+	-	+	-
ZOOPLANKTONS									
Rotifera									
21.	*achionus* spp.	++	++	++	++	+	++	++	++
22.	*ratella* spp.	+++	+++	+++	+++	+	++	+++	++
Arthropoda (Crustacea)									
23.	*iphnia* sp.	++	++	++	++	++	++	++	++
24.	*clops* sp.	+++	+++	+++	+++	+++	+++	+++	+++
Arthropoda (Insecta)									
25.	*Ranatra* spp.	+++	+++	+++	+++	+++	+++	+++	+++
26.	*hnura* sp. (Dragon fly)	+++	+++	+	+	+++	++	-	+
27.	*bellula* sp. (Damsel fly)	+++	+++	+	+	+	+++	+++	-
28.	*lex* sp	+	+	+	+	+	+	+	+
29.	*rionomous* sp.	+	+	+	+	+	+	+	+
+ - Low dominant; ++ - Moderately dominant; +++- Highly dominant									

4. DISCUSSION

The plankton community in pond is crucial, as it provides a fundamental food source for various aquatic organisms. Phytoplankton, comprising algae, cyanobacteria, forms the foundation of aquatic food web. Zooplankton such as rotifers, crustaceans etc feed on phytoplankton thereby regulating their population and impacting water quality. Both phytoplankton and zooplankton plays pivotal role in aquatic ecosystem.

In present study, different ponds have been studied to find out the diversity of aquatic organisms (phytoplanktons and zooplanktons in Bathinda Punjab. In phytoplankton, dominance has been shown by chlorophyceae and in zooplanktons; arthropods (insecta) have been found to be dominant. Amongst the phytoplanktons, the prominence groups were Chlorophyceae, Cynaphyceae and Bacillarophyceae and similar results have been observed by many other workers [30-32].

Baruah and Kakati [33] reported 45 species of phytoplankton from a pond of Gopeswar temple freshwater comprising 16 species of Chlorophyceae (35.56%). Similarly, Bakalial [34] analysed plankton in freshwater perennial pond of Jorhat, Assam and found a total of 58 phytoplankton and phytoplankton community was dominated with 41.38% Chlorophyceae.

In present study, *Brachionus* sp, *Daphnia* sp, *Cyclops* sp, *Cypris* sp were recorded throughout the study period. Similar results were observed by [35]. The present study highlights significance of plankton in ponds of Bathinda. Understanding the dynamics of these plankton communities is essential for managing pond ecosystems effectively.

CONCLUSION

The study demonstrates that ponds ecosystems of Bathinda harbor different plankton which is vital for ecosystem health. Further research can provide valuable insights into these ecosystems. Ecological balance of ponds depends on plankton interactions.

REFERENCES

1. Richardson D.D., Holgerson M.A., Farragher M.J., Hofman, K.K., King, K.B.S., Alfonso, M.B., et al. A functional defnition to distinguish ponds from lakes and wetlands. Sci. Rep, 2022, 12, 1-13.
2. Indermuehle N., Oertli B., Biggs J., editors. Pond conservation in Europe: The European Pond Conservation Network (EPCN). SIL Proceedings, 1922-2010, 2022.
3. Oertli B., Parris, K.M., Review toward management of urban ponds for freshwater biodiversity, Ecosphere, 2019, 10.
4. Riley W.D., Potter E.C.E., Biggs J., Small Water Bodies in Great Britain and Ireland: Ecosystem function, human-generated degradation, and options for restorative action. Sci. Total Environ, 2019, 645, 1598–1616.
5. Cereghino R., Boix D., Cauchie H.M., The ecological role of ponds in a changing world, Hydrobiol, 2014, 723:1-6.
6. Bhattacharya S., Traditional water harvesting structures and sustainable water management in India: A socio-hydrological review, Int. Lett. Nat. Sci, 2014, 37, 30-38.
7. Oertli B., Parris K.M., Review: toward management of urban ponds for freshwater biodiversity, Ecosphere, 2019, 10.
8. Hill M.J., Hassall C., Oertli B., New policy directions for global pond conservation, Conserv. Lett, 2018, 11, 1–8.
9. Raymond E.G., Plankton and Productivity in the Oceans 2nd ed. Vol. 1, Perganmon Press, 502, 1983
10. Paul S., Wooldridge T., Perissinotto R., Evaluation of abiotic stresses of temperate estuaries by using resident zooplankton: A community vs. population approach, ECSS, 2016, 170,102-111.
11. Nanazato T., Yasuno M., Population dynamics and production of cladocerans zooplankton in the highly eutrophic lake kasumigaura, Hydrobiol, 1985, 124,13-22.
12. Bhati D.P.S, Rana K.S., Zooplankton in relation to abiotic components in the Fort moat of Bharatpur, Proc. Nat. Acad. Sci. India, 1987, 57 (B), 237-242.
13. Takamura K., Sugaya Y., Tamamura N., Hanazato T., Yasuno M., Iwakunna T., Primary production in phytoplantkton and standing crops of zooplankton and zoo-benthos in hypertrophic lake Teganuma, Hydrobiol, 1989, 173,171-184.
14. Beaugrand G.F., Ibanez, Reid P.C., Spatial, seasonal and long-term fluctuations of plankton in relation to hydroclimatic features in the English channel, Celtic Sea and Bay of Biscay, Mar. Ecol. Prog. Ser, 2000, 93-102.
15. Li M., Gargett A., Denman K., What determines seasonal and interannual variability of phytoplankton and zooplankton in strongly estuarine systems? Application to the semienclosed estuary of Strait of Georgia and Juan de Fuca Strait, ECSS, 2000, 50: 467-488.
16. Gulati R.D., A study on the role of herbivorous zooplankton communities as primary consumers of

phytoplankton in Dutch Lakes, Verch. Int. Verein Limnol, 1975, 19:1202-1210.
17. Vareethiah K., Haniffa M.A., Phytoplankton pollution indicators of coir retting. J. Environ. Pollut, 1998, 3, 117-122.
18. Bianchi F., Acri F., Aubry F.B., Burton A., Boldrin A., Camatti E., et al., Can plankton communities be considered as bioindicators of water quality in the lagoon of Venice? Mar. Pollut. Bull, 2003, 46, 964-971.
19. Hoch M.P., Dillon K.S., Coffin R.B., Cifuentes L.A., Sensitivity of bacterioplankton nitrogen metabolism to eutrophication in sub-tropical coastal water of Key West Florida. Mar. Pollut. Bull, 2008, 56, 913-926.
20. Adoni A., Joshi D.G., Gosh K., Chourasia S.K., Vaishya A.K., Yadav M., et al., Work book on limnology, Pratibha Publisher, Sagar, 1985, 1-122.
    1. (Fisher et al., 1943), in phytoplankton ecology,
    2. (i.e., the number of items and their
    3. ‘phytoplankton’, span a gradient in trophic modes that
    4. 2013). Phagotrophy is now known from all cl
21. Ponmanickam P., Rajagopal T., Rajan M.K., Achiraman S., Palanivelu K., Assessment of drinking water of Vembakottai reservoir, Virudhunagar, Tamilnadu, J. Exp. Zool. Ind, 2007, 10, 485-488.
22. Xu J., Zhang M., Primary consumers as bioindicator of nitrogen pollution in lake planktonic and benthic food webs, Ecol. Indicators, 2012, 14, 189-196.
23. Dirican S., Musul H., Cilek S., Some physico-chemical characteristics and Rotifers of Camligoze Dam lake, Susehri, Sivas, Turkey, J. Ani. Vet. Adv, 2009, 8(4).
24. Gannon J.E., Stemberger R.S., Zooplankton (especially crustacean and rotifers) as indicators of water quality, Trans Amer. Micros. Soc, 1978, 97(1), 16-35.
25. Ferdous Z., Muktadir A.K.M., A Review: Potentiality of Zooplankton as Bioindicator, Amer. J. Appl. Sci, 2009, 6(10), 1815-1819.
26. Miah, M.F., Roy S., Jinnat E., Khan Z.K., Assessment of Daphnia, Moina and Cylops in Freshwater Ecosystems and the Evaluation of Mixed Culture in Laboratory, Amer. Int. J. Res., 2013, 4(1), 1-7
27. Pennek, R.W., Freshwater Invertebrates of United States, John Wiley and Sons : New York, 1953
28. Kudo R.R., Protozoology (1st Indian ed.). Books and Periodical Corporation, New-Delhi, India, 1986.
29. Ward G.P., Whipple G.C., Fresh Water Biology. John Wiley and Sons, New York, 1992.
30. Shastri Y., Pendse D.S., Hydrobiological study of Dehikhuta Reservoir, J. Environ. Biol, 2001, 22: 67-70.
31. Harsha T.S., Malammanavar S.G., Assessment of phytoplankton density in relation to environmental variables in Gopalswamy Pond in Chitradurga, Karnataka, J. Environ. Biol, 2004, 25(1), 113-116.
32. Tiwari A., Chauhan S.V.S., Seasonal phytoplankton diversity of Kitham Lake, J. Environ. Biol, 2006, 27(1), 35-38.
33. Baruah P.P., Kakati B., Water quality and phytoplankton-diversity of Gopeswar temple freshwater pond in Assam (India), Bangl. J Bot, 2012, 41(2),181-185.
34. Bakalial B., Plankton diversity of a freshwater perennial pond of northeast India with an additional report of freshwater tardigrade for India, Int. J. Entomol. Res, 2021, 6(4), 225-230.
35. Singh S., Kumari V., Usmani E., Dutta R., Kumari R., Kumari J., et al. Study on Zooplankton

Diversity in A Fresh Water Pond (Raja Bandh) of Jamtara, Jharkhand, India, Int. J. Adv. Life Sci. Res, 2021, 4(2), 5-13.

36. variation in size, shape, colour, type of metabolism, and life history traits. Due to the emerging knowledge in nutritional capabilities of microorganisms, our view of phytoplankton has drastically changed (Flynn et al., 2013). Phagotrophy is now known from all clades except diatoms and cyanobacteria. At the same time, ciliates, which have not been considered as part of 'phytoplankton', span a gradient in trophic modes that render the distinction between phototrophic phyto-plankton and heterotrophic protozoa meaningless.
37. This complexity has been expressed in the high diversity of natural phytoplankton assemblages.
38. Diversity can be defined in many different ways and levels. Although the first diversity measure that encompassed the two basic components of diversity (i.e., the number of items and their relative frequen- cies) appeared in the early forties of the last century (Fisher et al., 1943), in phytoplankton ecology, taxonomic richness has been used the most often as diversity estimates. Until the widespread use of the inverted microscopes, phytoplankton ecologists did not have accurate abundance estimation methods and the net plankton served as a basis for the analyses.
39. Richness of taxonomic groups of net samples, and their ratios were used for quality assessment (Thun- mark, 1945, Nygaard, 1949).