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OCCURRENCE OF CILIATES (PROTOZOA) IN PONDS, LUCKNOW CITY, UTTAR PRADESH

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ABSTRACT: Protozoa ciliates are the important components of the "microbial loop". Protozoa are unicellular, phagotrophic organisms. They are found in lake, river and pond. Ciliates and other protoctists are believed to play a remarkable metabolic role in freshwater systems. Ciliates are believed not only to route energy through their consumption of primary producers and subsequent ingestion by predaceous and detritivotrous metazoans but also as photosynthesizers via phytoflagellate symbionts. High rates of reproduction and growth make ciliates major organic matter transformations. Ciliates cover the major portion of living organisms in an aquatic ecosystem. Sunlight has found one of the vital factors which control the ciliates temporal distribution. Food has been one of the important factors which influence the distribution and abundance of a species. There are 106 species of ciliates belonging to 58 genera and 36 families are described from the freshwater ecosystems of India so far.

Keywords: Protozoa, ciliates, aquatic ecosystem, unicellular.

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1.INTRODUCTION

Ciliates are crucial component of the aquatic ecosystem and play an important role in the functioning of the ecosystem. Their composition, abundance species richness and biomass determine by several abiotic factors. After bacteria, ciliates cover the major portion of living organisms in an aquatic ecosystem [3,4,19,20,12,7]. The factors regulate population numbers and biomass of ciliates have been investigated in laboratory and field studies, which include food

limiting factors, but different views have been expressed about the cause of population fluctuations. Sunlight has found one of the vital factors which control the ciliates temporal distribution [24,21,15]. The effect of temperature on the biomass and abundance of ciliates have been studied by Finlay [11], who stated that in a eutrophic loch the temperature was partially responsible for the summer increases in number and biomass of benthic ciliates. The water pH has been found correlated with diversity and abundance of ciliated protozoa [1,2]. This factor forces a limitation on growth of some protozoan species, not only due to the direct effect of the amount of hydrogen or hydroxyl ions in the environment, but it also due to changes in ionic composition of molecules and solubility of inorganic elements which may be essential for their physiology [1]. Salvado and Gracia studied the relationship between biochemical oxygen demand (BOD) and diversity of ciliated protozoa in freshwater [23]. They found increase in the species diversity with increasing value of BOD upto 30 ppm. Food has been one of the important factors which influence the distribution and abundance of a species. It may influence a population's chance to multiply and survive.

2. MATERIALS AND METHODS

Culture Media

The rearing of ciliated protozoa in the laboratory for regular is known as the culture of protozoa. In the laboratory the protozoan are allowed to reproduce in the artificial media with their environment. This media is as same as the natural media which have rich nutrients. What kind of media is required for culturing protozoa is largely depends upon their habits and habitats. The crucial factors are responsible for the successful culture of protozoa (ciliates) is required of inorganic substances suitable amount, they required abundant supply of food, and they required suitable maintenance of chemical and temperature condition for the reproduction. The culture of medium is vary, some protozoa required hey and wheat grain as *Paramecium*, *Vorticella*, *Blepharisma*, and some required other active protozoa as *Stentor* required the medium of active *Euglena*, as *Didinium* required the medium of active *Paramecium*.

Study Area

Study area of pond-I is located in Hasanganj in Lucknow. The area has medium size pond which contain freshwater. This pond was full of lotus flowers which are floating at the surface of water, as protozoa live in freshwater in the bottom of water body and may also found beneath the leaf of lotus. Pond was fishless. Study area of pond-II is located in Balmikinagar in Lucknow. The area has small size pond which contain freshwater. This pond was full of lotus flowers which are floating at the surface of water, as protozoa live in freshwater in the bottom of water body and may also found beneath the leaf of lotus. Pond was fishless.

Protozoa (Ciliates) sampling

Samples were collected from both ponds in 100ml of borosil beaker which is direct dipped into the

pond and pulling it back by scratching the wall of pond, then sample brought to the laboratory for further examination.

3. RESULTS AND DISCUSSION

Protozoa are live in pond, lake and river. The study was carried out from January 2022 to May 2022. The study area of two ponds located in Hasanganj and Balmikinagar respectively of Lucknow city. Total eight species were recorded in the ponds.

Table 1: List of ciliate protozoa found in study areas of pond-I in Hasanganj and pond-II in Balmikinagar and their abundance Lucknow, Uttar Pradesh

Class	Family	Genus	Observed species in pond water	Pond I Hasanganj	Pond II Balmikinagar	Species name
Oligohymenoptera	Paramecidae	*Paramecium*	1	+	+	*Paramecium caudatum* (Ehrenberg, 1833)
	Vorticellidae	*Vorticella*	1	+	+	*Vorticella campanula* (Ehrenberg, 1795)
Spirotrichea	Aspidiscidae	*Aspidisca*	1	+	+	*Aspidisca sp.* (Ehrenberg, 1830)
Heterotrichea	Blepharismidae	*Blepharisma*	1	-	+	*Blepharisma intermedium* (Bhandary, 1962)
	Stentoridae	*Stentor*	1	+	+	*Stentor roeseli* (Ehrenberg, 1835)
Litostomatea	Dileptidae	*Dileptus*	1	-	-	*Dileptus gigas* (Claparede and Lachmann,1859)
Oligotrichea	Halteriidae	*Halteria*	1	+	-	*Halteria grandinella*

						(Muller, 1773)
Karyolectiae	Loxodidae	*Loxodes*	1	+	-	*Loxodes* (Stokes 1887)
	Total	8	8			
+ Present and - Absent						

The species *Paramecium; Stentor* and *Vorticella* is the most commonly seen in study area of both ponds. Table-1 showing that the total number of ciliated protozoa was observed was eight different genera and in pond-I of Hasanganj 6 species were observed whereas in pond-II of Balmikinagar 5 species were observed. Both the pond's community was observed that the surface layer is covered with the leaves of lotus, and have same ecosystem. The ciliates (Table -1) found in both ponds in which the most common species observed in both ponds were *Paramecium sp.; Vorticella sp.; Aspidisca sp.; Blepharisma sp.; Stentor sp.; Dileptus sp.; Halteria sp.* and *Loxodes sp.* Some ciliates which was only present in pond-I viz. *Paramecium sp.; Vorticella sp.; Stentor sp.; Dileptus sp.; Halteria sp.* and *Loxodes sp.* In pond II species were recoded viz. *Paramecium sp.; Vorticella sp.; Aspidisca sp.; Blepharisma sp.; Stentor sp.* Few species of ciliates were present in both ponds viz. *Paramecium sp.; Vorticella sp.;* and *Stentor sp.*

Ciliates species of protozoa observed in study areas

Paramecium sp. (Ehrenberg, 1833), (plate-1, fig-1) is a unicellular protist. Body is slipper shaped and covered with minute hair-like organelles called cilia, cilia use for feeding and locomotion. It is unequal in size. They have two type of nucleolus that is macronucleus and micronucleus. *Paramecium caudatum* are very common in freshwater, marine water and brackish water [6]. *Vorticella sp.* (Ehrenberg 1831), (plate-1, fig-2) is commonly known as bell- shaped organism. It processes ring of cilia around the oral end and has unbranched stalk at the aboral end of organism. Cilia do not found between aboral end and oral end. They live in freshwater and they feed on small protozoan and bacteria. They mainly attached to small aquatic animals, to submerged object and to the scum of surface. Stalk is contractile thread like. It has a long horse-shoe shaped macronucleus, small micronucleus, single contractile vacuole and some food vacuoles are present[6]. *Aspidisca sp.* (Ehrenberg, 1830), body is irregular ovoid shaped. It is small and body is flexible with dorsal ridges. Body length is 200 µm to 400 µm. they feed on bacteria. Undulating membrane, marginal or caudal cirri is absent. Five or more transverse cirri are present which is located in posterior and at the anterior often seven cirri is present. C horse-shaped macronucleus and one and two micronuclei is present [6]. *Blepharisma sp.* (Bhandary, 1962), is found in freshwater and salt water, they vary in shape and size. It may be 50 micrometer small to 1 millimeter large but the normal size of *Blepharisma* is varying from 75 to 300 micrometer. It is tea drop shaped were posterior is round. They feed on flagellates, bacteria and algae. Cilia present at whole body surface

in longitudinal rows. Cilia use for locomotion and sweeping the food into mouth. Contractile vacuole is often large in size and present at the posterior side [8].

PLATE-1

Fig 1- *Paramecium sp.*

Fig 2- *Vorticella sp.*

Fig 3- *Halteria sp.*

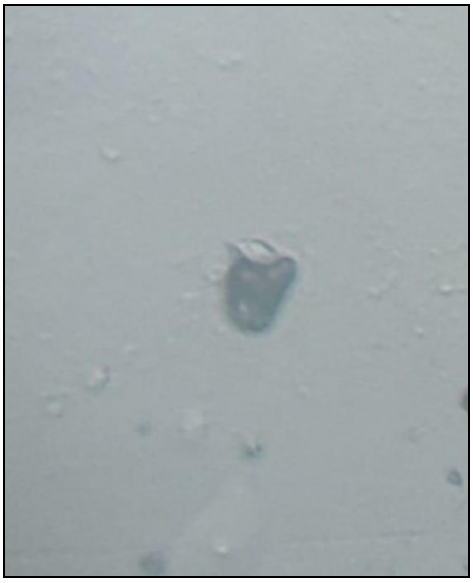

Fig 4- *Stentor sp.*

Dileptus sp. (Claparede and Lachmann, 1859), they feed on rotifer; they first paralyzed their prey then eat slowly. Their body is elongated, rounded with long neck region. Oral aperture is present at the base of neck which is hold up by cytopharyngeal basket of trichites. The basket of trichites is not easily visible. Macronucleus can vary from species to species. Two or many macronucleus is distributed in the cytoplasm or in some species it is rarely single and elongated form [8]. *Halteria*

sp. (Muller, 1773), (plate-1, fig-3) is found in freshwater and brackish water. They feed on bacteria. Their body is spherical shaped and its apical is slightly proturbance. Anterior membranelles in circle and near the anterior end of organism's cytostome is present at the end of membranelles zone. Seven groups of long cilia is lie on lateral body surface. It has two type of locomotion, their movement is either swift drafts or slow rotatory. Macronucleus is spherical and centrally placed. Contractile vacuole is present [8]. *Stentor sp.* (Ehrenberg, 1835), (plate-1, fig-4) is trumpet shaped or horn shaped. The body is often free itself to swim but sometime it attached by the base. The whole body is covered with cilia. Cytoplasm of *Stentor* contains a chain of beaded macronucleus, several micronucleus are present. It has contractile vacuole at anterior region of the body [6]. *Loxodes sp.* Ehrenberg (1830), the outline of body is elongated and oval. Anterior is quarter pointed and ventrally bent which form a concavity were oral aperture is slit like present. Basket of trichites is lies at the base of slit. Body is laterally compressed at the region of anterior but less compressed at the posterior. On upper right surface mostly cilia is restricted and on left lower surface cilia is reduced. In the cell several vesicle bodies (spherical bodies with unknown function) may be found. Single contractile vacuole is found at posterior region. One or two or more macronucleus is found [6]. Research conducted in the favale pond which is located in Italy, during two year of study [14] investigated 58 ciliated species in the small pond of Italy. The predominant ciliate, *Spirostomum teres* was observed to be an important component of the ciliate community of favale pond by many authors [13,10,12,5,16,17]. In the favale pond *Prorodon species, Spirostomum teres, Paramecium caudatum, Halteria grandinella* was the most common investigated species. Few species were living at the water sediment *Caenomorpha medusula, Braclonella spiralis, Metopus species* and *Saprodinium dentatum.* This show the component characteristic of the sulfureta means it is anaerobic organisms which are efficient of feeding on sulfure bacteria. The study was carried out from January 2022 to May 2022. Pond-I is located in Hasanganj and pond-II is located in Balmikinagar. 8 species in which 6 species found in pond-I and 5 species found in pond-II. In this the common species which is investigated in both ponds was normally considered as common in the freshwater system. Important species like *Vorticella* was found associated to submerged macrophytes in shallow water body. In favale ponds and pond-I and pond-II have some common ciliates like *Paramecium* and *Halteria.* Pond-I and pond-II both were have *Paramecium caudatum* as a predominant ciliates, favale pond have *Spirostomum teres.* Research conducted in the two vandorf ponds which are located in Canada [18]. They found that some genera were common with those which founded in permanent ponds of European. For example- *Paramecium, Epistyles, Halteria, Spirostomum, Euplotes* and *Prorodon* and in Japanese ponds common genera were *Spirostomum, Frontonia* and *Halteria*. In his two temporary ponds were dissimilar in species composition and species richness. In his initial study of area pond-I observed 50 species and in pond-II observed 70 species both pond were have 24 common species

and in mid-May and earlier June pond-I had 88 species and pond-II had 104 species were 47 species are common. Pond-I were dominated with smaller ciliates and pond-II were had mid- sized ciliates. Several of the ciliate species were observed algivorous because of more phytoplankton inside the ponds. Previous studies of beaver and crisman, 1989 have found ciliate abundance and biomass to be strongly related to chlorophyll a and algivorous ciliates in benthos have been shown to peak in summer when production rate of benthic algae were high [22,9]. The study was carried out from January 2022 to May 2022 and ponds selected in different location of Lucknow area show different abundance species of ciliates (Table-1). Total 8 species observed in which 6 species found in pond-I and 5 species found in pond-II. Vandorf ponds have algivorous ciliates and pond-I and pond-II both were dominated by carnivorous species. In vandorf pond-I densely covered with lemna and pond-II did not covered with lemna and both study ponds were covered with lotus and carnivorous were high.

4. CONCLUSION

Protozoa can be found in almost everywhere in aquatic habitat. It found from cesspool to mountain stream and from birdbath garden to the Amazon. The natural aquatic communities typically contain dozens of protozoan species and protozoan diversity is retained when they are collected in jars and returned to the laboratory. The richness of protozoa is expressed as an amazing array of body forms, occupied the wide range of niches. In the recent years, protozoa has become clear that despite of their small size, it can be very substantial that the contribution of protozoa to the metabolism of aquatic and terrestrial ecosystem. Protozoa occupy some significant that they are dominant, within a community the position of protozoa among the consumer. Their important is to use of bacteria as a source of food. Communities of protozoa are very dynamic in structure, their number of cells change rapidly by cell division, excystment and encystment. The protozoan community of the structure is quick responds to change in chemical and physical characteristics of environment, recommend a potential use of the diversity of protozoa and the occurrence of species as an indicators of changes in ecosystem but such recommendation must be followed with the proper care as it has major difficulties which involved in finding the right way to sample the habitat which is occupied by protozoa and in species identification.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

No Animals/Humans were used for studies that are base of this research.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

The author confirms that the data supporting the findings of this research are available within the

article.

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CONFLICT OF INTEREST

The authors have no conflict of interest.

REFERENCES

1. Anderson, O. R. Comparative Protozoology. Springer-Verlag, New York, 1988; 482 pp.
2. Al-Rashid, K. A. S. and Sleigh, M. A. Distribution and abundance of interstitial ciliates in Southampton water in relation to physicochemical conditions, metal pollution and availability of food organisms. Estuarine, Coastal Shelf Sci., 1995;41, 61–80.
3. Buechler, D. G. and Dillon, R. D. Phosphorus regeneration in freshwater Paramecia. J. Protozool., 197; 21, 343–393.
4. Berk, S. G., Brownlee, D. C., Heinle, D. R., Kling, H. S. and Colwell,R. R. Ciliates as a food sources for the marine planktonic copepods. Micro. Ecol., 1977; 4, 27–40.
5. Bark A.W., Watts J.M., A comparison of the growth characteristic and spatial distribution of hypolimnetic ciliates in a small lake and an artificial lake ecosystem. J. Gen. Microbial., 1984; 130: 3113-3122
6. Bick, Hartmut and World Health Organization. Ciliated protozoa: an illustrated guide to the species used as biological indicators in freshwater biological / Hartmut bick. World Health Organization; 1972
7. Caron, D. A., Gollmen, G. C. and Dennett, M. Experimental demonstration of the roles of bacteria and bacterivorous protozoa in plankton nutrient cycles. Hydrobiologia, 1988; 159, 27–40.
8. Chandra Kailash, Gopi, K.C., Rao, D.V., Valarmathi, K. and Alfred, J.R.B., Current Status of Freshwater Faunal Diversity in India (chapter-3): 2017; 1-624 (Published by the Director, Zool. Surv. India, Kolkata).
9. Fenchel T. The quantitative importance of the benthic microfauna of an Arctic tundra pond. Hydrobiologia, 1975; 46, 445-464.
10. Finlay B.J., Bannister P., stewart J., Temporal variation in benthic ciliates and the application of associated analysis. Freshw. Biol., 1979; 9: 45-53
11. Finlay, B. J. Temporal and vertical distribution of ciliophora communities in the benthos of a small eutrophic loch with particular reference to the redox profile. Freshwater Biol., 1980; 10, 15–34.

12. Finlay, B. J., Clarke, K. J., Cowling, A. J., Hidle, R. M., Rogerson, A. and Berringer, U. G. On the abundance and distribution of protozoa and their food in a productive freshwater pond. Eur. J. Protistol., 1988; 23, 205–217.
13. Goulder, R. The seasonal and spatial distribution of some benthic ciliated protozoan in Esthwaite water. Freshwater Biol., 1974; 4, 127–147.
14. Hatano H. and Watanabe Y. Seasonal change of protozoa and micrometazoa in a small pond with leaf litter supply. Hydrobiologia, 1981; 85, 161-174.
15. Lackey, J. B. A study of some ecologic factors affecting the distribution of protozoa. Ecol. Monogr., 1938; 8, 501–527.
16. Laybourn-Parry, J., Olver, J. and Rees, S. The hypolimnetic protozoan plankton of a eutrophic lake. Hydrobiologia, 1990a; 203: 111–119.
17. Laybourn-Parry, J., Olver, J., Rogerson, A. and Duverge, P. L. The temporal and spatial patterns of protozooplankton abundance in a eutrophic temperate lake. Hydrobiologia, 1990b; 203: 99–110.
18. Okasana Andrushchyshyn, A. Katarina Magnusson, and D. Dudley Williams. Ciliate Population in Temporary Freshwater Ponds: Seasonal Dynamics and Influential factors, Freshwater Biology; 2003; 48(3), 548-564
19. Porter, K. G., Pace, M. L. and Battey, I. F. Ciliate protozoans as link in freshwater planktonic food chains. Nature, 1979; 227, 563–565.
20. Pratt, J. R. and Cairns, J. Jr. Functional groups in the Protozoa: Roles in differing ecosystems. J. Protozool., 1985; 32, 415–423.
21. Richards, O. W. The correlation of the amount of light with the division of ciliates. Biol. Bull. Mar. Biol. Lab. Woods Hole, 1929; 56, 298–305.
22. Stanley D.W. Benthic algae productivity in Tundra ponds and lakes. In: Proceedings of the 1972 Tundra Biome Symposium U.S. Tundra biome IBP, 1972; 174- 177.
23. Salvado, H. and Gracia, M. P. Response of ciliate population to changing environmental conditions along a fresh water reservoir. Arch. Hydrobiol., 1991; 123, 239–255.
24. Wang, C. C. Ecological studies on the seasonal distribution of protozoa in a freshwater pond. J. Morph., 1928; 46, 431–478.