

## Diversity of Free-Living Protozoans in the Karamana River, Trivandrum, Kerala



### Life Sciences

**KEYWORDS :** Free living Protozoans, Diversity, Karamana River, Kerala

\* **Mini Mohandas**

Ph.D Student, Department of Aquatic Biology & Fisheries, University of Kerala, Thiruvananthapuram, Kerala, India. \* Corresponding Author

**Athira Nagendran**

Ph.D Student, Department of Aquatic Biology & Fisheries, University of Kerala, Thiruvananthapuram, Kerala, India

**Apreshgi K. P**

Ph.D Student, Department of Aquatic Biology & Fisheries, University of Kerala, Thiruvananthapuram, Kerala, India

**Lekshmy S.**

Postdoctoral Fellow, Department of Aquatic Biology & Fisheries, University of Kerala, Thiruvananthapuram, Kerala, India

**Tresa Radhakrishnan**

Professor, Department of Aquatic Biology & Fisheries, University of Kerala, Thiruvananthapuram, Kerala, India

### ABSTRACT

*Karamana River (Kerala) ranks 15th in catchment area and 17th in stream length. It is one of the major rivers flowing through Thiruvananthapuram district, Kerala State. The River originates from Western Ghats falls in to the Lakshadweep Sea. The deterioration of quality, loss of biodiversity and fast depletion of water resources are the main challenges, which need urgent attention. An attempt is made to study the diversity of the free living forms of Sarcocystidophorans and some ciliates in the Karamana River. The entire complex of purification plants can make use of these protozoans in order to reduce the pollutant level in Karamana River. Protozoa literally means 'first animal' which constitute a subkingdom of the Animal Kingdom. It encompasses single celled eukaryotic animalcules of microscopic size, ranging mostly between 5 micrometers to 250 micrometers. This study identified a total of 22 rhizopod species belonging to 8 Genera and 5 Families 3 Orders and 3 Classes and 6 species of ciliates belonging to 6 Genera and 6 Families 6 Orders and 4 Classes. *Phacus* sp., *Arcella conica*, *Arcella catinus*, *Arcella gibbosa*, *Centropyxis minuta*, *Centropyxis discoides*, *Difflugia tuberculata*, *Difflugia urceolata*, *Lesquereusia modesta*, *Porodon* sp., *Lacrymaria* sp., and *Vorticella* sp. were the first reports in Kerala. *Netzelia oviformis* was first reported in India during the study.*

### INTRODUCTION

Protozoa literally means first animal which constitute a subkingdom of the Animal Kingdom (Committee on Systematics and Evolution of the Society of Protozoologists; 1980). These include both free living forms and parasitic forms. Though minute in size and apparently insignificant, they take on a wondrous variety of form and structure. Because of their small size, they are sometimes rated as least important, but they play a useful and important role in the biosphere. The group protozoa have now been raised to the level of subkingdom under the Kingdom Protista (Cavalier-Smith; 1998). Protozoa comprises a highly heterogeneous assemblage of several phyla, viz., Sarcocystidophora, Labyrinthomorpha, Apicomplexa, Microspora, Ascetospora, Myxozoa and Ciliophora, according to the revised classification developed in 1980 by the Society of Protozoologists. This classification is widely accepted even though it was further revised by the Society (Sleigh; 1989). The classical taxonomy of the Protozoa is based on the nature of their locomotory organelles and on the formation of encapsulated resistant stages. The flagellates and ciliates are characterized by the possession of filiform oscillating locomotory organelles. The Rhizopoda shows peripheral areas of cytoplasmic streaming which protrude for a time from the protoplasmic body and can then be reabsorbed. Such locomotory organelles are called pseudopodia or false feet. The Rhizopoda are distinguished on the basis of their pseudopodia formation, as well as on their protective and supportive organelles. Their role in water purification systems is very significant. Several major taxonomic groups of protozoa, viz; flagellates, naked and testate amoebae, actinopods and ciliates occur in biological sewage treatment plants. Protozoa also play a vital role in controlling bacterial population and biomass (Stoecker and Capuzo; 1990).

Protozoan due to their multiple usefulness and unexplored diversity are at the forefront of scientific investigations in most advanced countries. In India, contrarily, very little investigations

have been done until now. There is a dire need in this country to work on these creatures because of their unique structure, numerical dominance in all biomes and terrestrial ecosystems. Karamana River ranks 15<sup>th</sup> in catchment area and 17<sup>th</sup> in stream length among the rivers of Kerala. It is one of the major rivers flowing through Thiruvananthapuram district, Kerala State. The River that originates from Western Ghats falls into the Lakshadweep Sea. In early days, water was primarily used for domestic needs like drinking, washing, bathing and cooking. But due to industrial and urban development, requirement of water for these activities has increased along with domestic purpose. Water of good quality is required for living organisms. The deterioration of quality, loss of biodiversity and fast depletion of water resources are the main challenges, which need urgent attention. Protozoa are rarely included in studies of freshwater zooplankton communities. This is primarily because cladocerans, copepods, and rotifers are considered to be most important in terms of density, biomass, production, grazing, and nutrient regeneration. The Protozoa also require methods of sampling not normally included in zooplankton studies. As a consequence, information about planktonic Protozoa is fragmentary and incomplete. Little is known about the protozoan diversity in Karamana River. The physico-chemical parameters of Karamana River have been studied by various scientists. The quality of water is described by its physical, chemical and microbial characteristics. But if, some correlations were possible among these parameters, then significant ones would be fairly useful to indicate the quality of water (Sujitha *et al.*, 2012). An attempt is made for the first time to study the diversity of the free living forms of Sarcocystidophorans and some ciliates in the Karamana River. These tiny mini protozoans can be made use in order for the purification of plants and to reduce the pollutant level in Karamana River.

### MATERIALS AND METHODS

The collection of the free living protozoans was from two sta-

tions namely, under the Karamana Bridge (purely freshwater) and Thiruvallam (adjacent to Arabian Sea) (Fig. 1). Monthly collection was done for protozoans analysis. The study was conducted for a period of 9 months from October, 2012 to June, 2013



Fig. 1 Location map of study site

The collected samples were examined under a dissection or compound microscope (10X and 40X, Olympus TRM Model BX 50, Olympus, Japan) and identified using standard taxonomic keys. The photograph of each species collected was prepared using a photomicrography unit (Olympus Model PM 20, Olympus, Japan)

The classical taxonomy of the Protozoa is based on the nature of their locomotory organelles and on the formation of encapsulated resistant stages.

**RESULTS AND DISCUSSION**

A total of 22 rhizopods belonging to 8 Genera and 5 Families 3 Orders and 3 Classes were identified. Also a total of 6 ciliates belonging to 6 Genera and 6 Families 6 Orders and 4 Classes were identified and are presented in Table 1.

Sl. No.	Species	Abundance	Locality	Remarks
	Phylum: Sarcomastigophora			
	Class: Phytomastigophora			
	Order: Euglenida			
	Family: Euglenidae			
1	<i>Phacus</i> sp. Dujardin, 1841	30	under the Karamana bridge	First report from Kerala
	Class: Lobosea			
	Order: Arcellinida			
	Family: Arcellidae			
2	<i>Arcella conica</i> Playfair, 1918	30	Thiruvallam	First report from Kerala

3	<i>Arcella catinus</i> Penard, 1890	10	under the Karamana bridge	First report from Kerala
4	<i>Arcella gibbosa</i> Penard, 1890	20	under the Karamana bridge	First report from Kerala
5	<i>Arcella hemispherica</i> (Perty, 1852)	350	under the Karamana bridge	First report from Karamana River
6	<i>Arcella megastoma</i> Penard, 1902	300, 250	under the Karamana bridge, Thiruvallam	First report from Karamana River
7	<i>Arcella discoides</i> Ehrenberg, 1843	300, 250	under the Karamana bridge, Thiruvallam	First report from Karamana River
	Family: Centropoxyidae			
8	<i>Centropoxya aculeata</i> (Ehrenberg, 1832) Stein, 1857	250	under the Karamana bridge	First report from Karamana River
9	<i>Centropoxya minuta</i> Defflandre 1929	30	under the Karamana bridge	First report from Kerala
10	<i>Centropoxya discoides</i> Penard, 1902	60	under the Karamana bridge	First report from Kerala
11	<i>Centropoxya eornis</i> (Ehrenberg, 1841) Leidy, 1879	150, 100	under the Karamana bridge, Thiruvallam	First report from Karamana River
12	<i>Centropoxya spinosa</i> (Cash & Hopkins, 1905) Defflandre, 1929	60	Thiruvallam	First report from Karamana River
13	<i>Plagiopyxis declivis</i> Bonnet & Thomas, 1956	130	under the Karamana bridge	First report from Karamana River
	Family: Diffugiidae			
14	<i>Diffugia corona</i> Wallich, 1864	100, 200	under the Karamana bridge, Thiruvallam	First report from Karamana River
15	<i>Diffugia lithophila</i> (Penard, 1902)	50	under the Karamana bridge	First report from Karamana River
16	<i>Diffugia lucida</i> Penard, 1890	50	under the Karamana bridge	First report from Karamana River
17	<i>Diffugia tuberculata</i> (Wallich, 1864)	100	Thiruvallam	First report from Kerala
18	<i>Diffugia urceolata</i> Carter, 1864	20	under the Karamana bridge	First report from Kerala
19	<i>Lesquerencia modesta</i> Rumbler, 1895	50, 100	under the Karamana bridge, Thiruvallam	First report from Kerala
20	<i>Netzelia oviformis</i> (Cash, 1909)	50	under the Karamana bridge	First report from India
	Class: Filosea			
	Order: Gromiida			
	Family: Euglyphidae			
21	<i>Euglypha acanthophora</i> (Ehrenberg, 1841)	40	under the Karamana bridge	First report from Karamana River
22	<i>Euglypha</i> sp.	50	under the Karamana bridge	First report from Kerala
	Phylum: Ciliophora			
	Class: Spirotrichea			
	Order: Euplotida			
	Family: Euplotidae			
23	<i>Euplotes</i> sp.	50, 50	under the Karamana bridge, Thiruvallam	First report from Karamana River
	Order: Sporodotrichida			
	Family: Oxytrichida			
24	<i>Tachysoma</i> sp.	150, 50	under the Karamana bridge, Thiruvallam	First report from Karamana River
	Class: Kinetophoragaminophora			
	Order: Prostomatida			
	Family: Proodontidae			
25	<i>Porodon</i> sp.	50	under the Karamana bridge	First report from Kerala
	Order: Holotricha			
	Family: Colpidae			
26	<i>Coleps hirtus</i> Muller, 1786	100, 150	under the Karamana bridge, Thiruvallam	First report from Karamana River
	Class: Lixostomata			
	Order: Haptichia			
	Family: Lacrymaridae			
27	<i>Lacrymaria</i> sp.	60	under the Karamana bridge	First report from Kerala
	Class: Oligohymenophorea			
	Order: Sessilida			
	Family: Vorticellidae			
28	<i>Vorticella</i> sp.	150, 50	under the Karamana bridge, Thiruvallam	First report from Kerala

A total of 28 species were identified of which 12 species are the first reports from Kerala, and they are *Phacus* sp., *Arcella conica*, *Arcella catinus*, *Arcella gibbosa*, *Centropoxya minuta*, *Centropoxya discoides*, *Diffugia tuberculata*, *Diffugia urceolata*, *Lesquerencia modesta*, *Porodon* sp., *Lacrymaria* sp., and *Vorticella* sp. and 15 of them are first reported from Karamana River viz; *Arcella discoides*, *Arcella megastoma*, *Arcella hemispherica*, *Centropoxya aculeata*, *Centropoxya eornis*, *Centropoxya spinosa*, *Plagiopyxis declivis*, *Diffugia corona*, *Diffugia lithophila*, *Diffugia lucida*, *Euglypha acanthophora*, *Euplotes* sp., *Tachysoma* sp. and *Coleps hirtus* (Figs. 2- 29). The Rhizopods were represented by two classes namely Lobosea and Filosea in the examined species. There were 21 species of Rhizopods belonging to 3 orders, 3 classes and 5 families and 7 ciliates belonging to 7 orders, 4 classes and 7 families. Most of the rhizopods were obtained from Station 1.

A total of 2250 protozoan in Station 1 and 1400 protozoan in sta-



Figs 2- 29 Free living Protozoans of Karamana River

tion 2 representing 28 species were reported during the study period. *Arcella megastoma* and *Arcella discoidea* showed the highest occurrence followed by *Centropyxis aculeata*. The maximum species of protozoa were obtained during postmonsoon for Station 1 and for Station 2, it was during pre-monsoon. Least species were seen during the monsoon for both the stations.

*Arcella megastoma*, *Arcella discoidea*, *Centropyxis cornis* and *Diffugia corona* showed monthly occurrence in both the stations. *Arcella conica*, *Arcella hemispherica*, *Centropyxis spinosa* and *Diffugia tuberculata* in Station 1 and *Phacus* sp., *Arcella gibbosa*, *Arcella catinus*, *Centropyxis aculeata*, *Centropyxis minuta*, *Centropyxis discoidea*, *Plagiopyxis declivis*, *Diffugia urceolata*, *Netzelia oviformis*, *Euglypha* sp., *Porodon* sp. and *Lacrymaria* sp. in station 2 were absent during the study period. The maximum species of protozoa were obtained during postmonsoon for Station 1 and for Station 2 it was during premonsoon. Least species were seen during the monsoon for both the stations.

*Arcella megastoma*, *Arcella discoidea*, *Centropyxis ecornis* and *Diffugia corona* showed monthly occurrence in both the stations. *Arcella conica*, *Arcella hemispherica*, *Centropyxis spinosa* and *Diffugia tuberculata* in station 1 and *Phacus* sp., *Arcella gibbosa*, *Arcella catinus*, *Centropyxis aculeata*, *Centropyxis minuta*, *Centropyxis discoidea*, *Plagiopyxis declivis*, *Diffugia urceolata*, *Netzelia oviformis*, *Euglypha* sp., *Porodon* sp. and *Lacrymaria* sp. in station 2 were absent during the study period. *Arcella catinus*, *Lesquereusia modesta* and *Porodon* sp. was present only during the month of October, whereas, *Netzelia oviformis* was present only in April. *Diffugia lucida*, *Phacus* sp., *Euglypha* sp. were present during postmonsoon whereas, ciliates like *Euplotes* sp., *Tachysoma* sp., *Coleps hirtus*, *Lacrymaria* sp. and *Vorticella* sp. were seen during pre-monsoon period. *Diffugia tuberculata* and *Arcella conica* occurred only in Station 2 in the month of November and the results are included in Tables 2 and 3.

Table 2: Diversity of Protozoa at Station 1

Sl.No	Species	Months									
		Oct-12	Nov	Dec	Jan-13	Feb	Mar	Apr	May	Jun	
1.	<i>Phacus</i> sp.	+	+	+	-	-	-	-	-	-	
2.	<i>Arcella conica</i>	-	-	-	-	-	-	-	-	-	
3.	<i>Arcella catinus</i>	+	-	-	-	-	-	-	-	-	
4.	<i>Arcella gibbosa</i>	-	-	-	-	-	-	+	-	-	
5.	<i>Arcella hemispherica</i>	-	-	-	-	-	-	-	-	-	
6.	<i>Arcella megastoma</i>	+	+	+	+	+	+	+	+	+	
7.	<i>Arcella discoidea</i>	+	+	+	+	+	+	+	+	+	
8.	<i>Centropyxis aculeata</i>	+	+	+	+	+	+	+	+	+	
9.	<i>Centropyxis minuta</i>	+	+	+	-	-	-	-	-	-	
10.	<i>Centropyxis discoidea</i>	-	-	+	-	-	-	-	-	-	
11.	<i>Centropyxis ecornis</i>	+	+	+	+	+	+	+	+	+	
12.	<i>Centropyxis spinosa</i>	-	-	-	-	-	-	-	-	-	
13.	<i>Plagiopyxis declivis</i>	+	+	+	+	+	+	+	-	-	
14.	<i>Diffugia corona</i>	+	+	+	+	+	+	+	+	+	
15.	<i>Diffugia lithophila</i>	+	+	+	+	-	-	-	-	-	
16.	<i>Diffugia lucida</i>	+	+	+	+	-	-	-	-	-	
17.	<i>Diffugia tuberculata</i>	-	-	-	-	-	-	-	-	-	
18.	<i>Diffugia urceolata</i>	-	+	-	-	-	-	-	-	-	
19.	<i>Lesquereusia modesta</i>	+	-	-	-	-	-	-	-	-	
20.	<i>Netzelia oviformis</i>	-	-	-	-	-	-	+	-	-	
21.	<i>Euglypha acanthophora</i>	-	+	+	-	-	-	-	-	-	
22.	<i>Euglypha</i> sp.	+	+	+	+	+	+	-	-	-	
23.	<i>Euplotes</i> sp.	-	-	-	-	+	+	+	+	-	
24.	<i>Tachysoma</i> sp.	-	-	-	-	+	+	+	+	-	
25.	<i>Porodon</i> sp.	+	-	-	-	-	-	-	-	-	
26.	<i>Coleps hirtus</i>	-	-	-	-	+	+	+	+	-	
27.	<i>Lacrymaria</i> sp.	-	-	-	-	+	+	+	+	-	
28.	<i>Vorticella</i> sp.	-	-	-	-	+	+	+	+	-	
Total species		14	13	13	9	12	11	13	10	5	

Table 3: Diversity of Protozoa at Station 2

Sl.No	Species	Months									
		Oct-12	Nov	Dec	Jan-13	Feb	Mar	Apr	May	Jun	
1.	<i>Phacus</i> sp.	-	-	-	-	-	-	-	-	-	
2.	<i>Arcella conica</i>	-	+	-	-	-	-	-	-	-	
3.	<i>Arcella catinus</i>	-	-	-	-	-	-	-	-	-	
4.	<i>Arcella gibbosa</i>	-	-	-	-	-	-	-	-	-	

5.	<i>Arcella hemispherica</i>	+	+	+	+	+	+	+	+	+
6.	<i>Arcella megastoma</i>	+	+	+	+	+	+	+	+	+
7.	<i>Arcella discoidea</i>	+	+	+	+	+	+	+	+	+
8.	<i>Centropyxis aculeata</i>	-	-	-	-	-	-	-	-	-
9.	<i>Centropyxis minuta</i>	-	-	-	-	-	-	-	-	-
10.	<i>Centropyxis discoidea</i>	-	-	-	-	-	-	-	-	-
11.	<i>Centropyxis ecornis</i>	+	+	+	+	+	+	+	+	+
12.	<i>Centropyxis spinosa</i>	+	+	+	+	+	+	+	+	+
13.	<i>Plagiopyxis declivis</i>	-	-	-	-	-	-	-	-	-
14.	<i>Diffugia corona</i>	+	+	+	+	+	+	+	+	+
15.	<i>Diffugia lithophila</i>	+	+	+	+	+	+	+	+	+
16.	<i>Diffugia lucida</i>	-	-	-	-	-	-	-	-	-
17.	<i>Diffugia tuberculata</i>	-	+	-	-	-	-	-	-	-
18.	<i>Diffugia urceolata</i>	-	-	-	-	-	-	-	-	-
19.	<i>Lesquereusia modesta</i>	+	-	-	-	-	-	-	-	-
20.	<i>Netzelia oviformis</i>	-	-	-	-	-	-	-	-	-
21.	<i>Euglypha acanthophora</i>	-	-	-	-	-	-	-	-	-
22.	<i>Euglypha</i> sp.	-	-	-	-	-	-	-	-	-
23.	<i>Euplotes</i> sp.	-	-	-	-	-	-	+	+	-
24.	<i>Tachysoma</i> sp.	-	-	-	-	-	-	+	+	-
25.	<i>Porodon</i> sp.	-	-	-	-	-	-	-	-	-
26.	<i>Coleps hirtus</i>	-	-	-	-	-	-	+	+	-
27.	<i>Lacrymaria</i> sp.	-	-	-	-	-	-	-	-	-
28.	<i>Vorticella</i> sp.	-	-	-	-	-	-	+	+	-
Total species		8	9	7	7	7	7	11	10	6

*Arcella megastoma*, *Arcella discoidea*, *Centropyxis ecornis* and *Diffugia corona* showed monthly occurrence in both the stations. *Arcella conica*, *Arcella hemispherica*, *Centropyxis spinosa* and *Diffugia tuberculata* in Station 1 and *Phacus* sp., *Arcella gibbosa*, *Arcella catinus*, *Centropyxis aculeata*, *Centropyxis minuta*, *Centropyxis discoidea*, *Plagiopyxis declivis*, *Diffugia urceolata*, *Netzelia oviformis*, *Euglypha* sp., *Porodon* sp. and *Lacrymaria* sp. in station 2 were absent during the study period. *Arcella catinus*, *Lesquereusia modesta* and *Porodon* sp. was present only during the month of October. *Netzelia oviformis* was present only in April. *Diffugia lucida*, *Phacus* sp., *Euglypha* sp. were present during the postmonsoon whereas, ciliates like *Euplotes* sp., *Tachysoma* sp., *Coleps hirtus*, *Lacrymaria* sp. and *Vorticella* sp. were seen during premonsoon period. *Diffugia tuberculata* and *Arcella conica* occurred only in Station 2 in the month of November (Table 2, 3).

The high diversity of protozoans in two stations of a riverine ecosystem of Kerala (Karamana River) is the reflection of prevailing high diversity of protozoans in the water bodies of India. In the present study very few protozoans were obtained during monsoon from Station 1, the heavy water current during the monsoon may have drifted away the minute protozoans. Schonborn (1977) says that rainfall played an important role in the dynamics of protozoa among the mosses, contributing to dislocation and modifying production. Many of the protozoa were testate amoebae that carry sand houses around with them. Heavy rains easily knock these loose and carry them to deeper layers in the soil.

A constant number of protozoans were obtained from Station 2 throughout the collection period showing more or less stagnant nature of the water in the site and the presence of pollution tolerant taxa in the area. Protozoa are important consumers in many aquatic ecosystems including some of economic importance, such as waste water treatment plants. The biology of such habitats cannot be properly described unless the protozoa are taken into account. Protozoan communities respond rapidly to changing physical and chemical characteristics, and can be useful indicators of changes in natural communities. In spite of these facts, the inclusion of a protozoan perspective in studies of the biology of aquatic habitats, especially by non-protozoologists, is relatively rare. Some protozoans are harmful to man as they cause serious diseases. Others are helpful because they eat harmful bacteria and are food for fish and other animals. Protozoa are common predators on bacteria and fungi (Hausmann *et al.*; 2003), having the role of nutrient cyclers (Mitchell *et al.*; 2000). Protozoa also have a long history of use as indicators of water quality. Kolkwitz and Marsson (1909) showed that protozoan communities could be useful when monitoring levels of organic pollution in fresh waters.

**ACKNOWLEDGEMENTS**

The first author acknowledges with thanks the financial support for this study from the INSPIRE, DST, India.

**REFERENCE**

- Cavalier-Smith, T. (1998). A revised six-kingdom system of life. *Biol. Rev.* 77: 203-266. | Committee on Systematics and Evolution of the Society of Protozoologists. (1980). A newly revised classification of the Protozoa. *Journal of Protozoology*. 27: 37-58 | Sleigh, M. A. (1989). Protozoa and other protists. Edward Arnold, London. | Stoecke, D. K. & Capuzzo, J. M. (1990). Predation on protozoa: its importance to zooplankton. *J. plankton Res.* 12: 891-908. | Sujitha, P. C, Mitra Dev, D., Sowmya, P. K. & Mini Priya, R. (2012). PhysicoChemical parameters of Karamana River Water in Trivandrum District, Kerala, India. *International Journal of Environmental Sciences*. 2 (3): 1417- 1434. | Schonborn, W. (1977). Production studies on protozoa. *Oecologia* 27: 171-84. | Hausmann, K., Hülsmann, N. & Radek, R. (2003). *Protistology*, 3rd completely revised edition edn. E. Schweizerbart'scheVerlagsbuchhandlung, Berlin, Stuttgart. | Mitchell, E. A. D., Borcard, D., Buttler, A. J., Grosvernier, P., Gilbert D., & Gobat J. M. (2000). Horizontal distribution patterns of testate amoebae (Protozoa) in a Sphagnum magellanicum carpet. *Microbial Ecology* 39, 290-300. | Kolkwitz, R. and Marsson, M. (1909). *Okologie der tierischen Saprobien*. *Internationale Revue der Gesamten Hydrobiologie*, 2: 1-126. | Mini Mohandas. (2013). Diversity of the Free Living Protozoans in the Karamana River and Their Role as Indicator Species. MSc. Dessert., Univ. of Kerala, Trivandrum, Kerala, India. |