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ORIGINAL ARTICLE

AN ASSESSMENT OF TESTATE AMOEBA (PROTOZOA) ASSEMBLAGE BASED ON ATITUDINAL GRADIENT IN PROTECTED AREAS OF WEST BENGAL

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Abstract: *Testate amoeba, the polyphyletic group comprising of amoeboid protozoans are enclosed in a distinctively unique covering called test (shell). They are the abundant, diverse and widely distributed microbial group which is used for ecological studies and acts as ecological health predictor organism. The testate amoeba diversity decreases with increasing latitude: ±300 taxa in Arctic from a total of ±2000, and a decline in nebelid species richness were observed in the high southern latitudes. In this study we assessed the assemblage of the testate amoeba in the fresh water sample collected from the protected areas of West Bengal. Higher species richness was found at lower altitude within the selected protected areas for the study conducted. Altitude has a negative correlation with diversity of testate amoeba.*

Key words*: Testate amoeba, diversity, altitudinal gradient, protected areas, West Bengal.*

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1. INRODUCTION

Testate amoebas are unicellular, single-celled protozoans having an exterior shell (the test). This polyphyletic group consists of amoeboid protozoans contained in a test (shell) that may be found in both freshwater (sediments) and terrestrial settings. The protist community assays a prominent role both in ecological health functioning and structuring [1] of the ecosystem which is reported across the globe, However, significant reporting about this community from West Bengal is scanty. These studies in many biotopes [2-4] across various countries provide the templates to assume the significance of testate amoeba in the past and present condition in those areas. Experimental studies across the globe have revealed its wide habitat spreading from terrestrial, wetlands and freshwater habitats, lake margins and even biofilms of sewage treatment plants [5-9]. Its rapid response to environmental changes makes them an ideal indicator of the health of the ecosystem. Its rate of reproduction depends on the availability of temperature, humidity, food and material to constructing tests [10-11]. Its shell morphology is affected by abiotic and biotic factors such as food source, temperature and insecticides [12-13]. Its sensitivity towards many environmental variables both at lower and higher latitudes were depicted in the studies of [13-17].

According to the 2021 report of the Indian state of Forest, the total geographical area of the West Bengal covered by forests (including the protected areas) is only 18.96%. The forest cover of West Bengal is spread across varying altitude range (from sea level to 4000 meters above sea level).

The altitudinal gradient has significant impact on the diversity and distribution of testate amoeba [5. 18-20]. In this study, an attempt was made to study the assemblage of the testate amoeba in the fresh water sample collected from different altitudes within the protected areas of Birbhum, Nadia and North 24 Parganas district of West Bengal.

2. MATERIALS AND METHODS

A. STUDY AREA

The study was conducted on fresh water samples collected from different water bodies and several regions of protected areas belonging to dry deciduous forest at Birbhum district, tropical moist deciduous forest at Nadia district and tropical dry deciduous forest at North 24 Parganas district of West Bengal during December 2021-January 2023. As all of the three studied forests conserve a specific type of soil, floral and faunal diversity, they were selected for the present survey.

B. SAMPLING

Samples were collected from GPS fixed locations (Garmin GPS 72H) and brought to laboratory. Aqueous drops were drawn from the sample, using micropipette, put on glass slides and examined under the light microscope. Testacids were isolated and then kept for air drying. After two or three washings in absolute alcohol, then the specimen was mounted in DPX [21-23]. The enumeration and identification using published guides and keys including [10-11, 15, 24-25] of these prepared permanent microscopic slides were carried out at 200 X to 400 X magnification with Olympus BX41 and Nikon Eclipse Ni-U microscopes. All the prepared permanent slides were deposited in the National Zoological Collections (NZC) of the Protozoology Section of Zoological Survey of India, Kolkata.

3. RESULTS AND DISCUSSION

A total of 57 species of testate amoeba was recorded during this study which belonged to 12 families, 13 genus and 2 orders. The altitude ranges from 20 to 230 feet in this study area where the highest species richness was recorded at 31.4 feet and 20 feet and least (3 species) at 230 feet. The genus *Arcella* Ehrenberg 1830, *Euglypha* Dujardin 1841, *Centropyxis* Stein 1857, *Trinema* Dujardin 1841 and *Difflugia* Leclerc 1815 are the most prominently found genus among the study areas and the also at the sites (altitude 20, 22, 23 and 31.4 feet) having maxing species diversity. The prominence of this genus at all forest type state there cosmopolitan and resilience nature in all environmental parameters. Most of the sites lying between scale 0 - 75 feet had the expressive number of testate amoeba diversity.

Based on the results we can see the dominance of Phylum Tubulinea in the study area considered as a whole (74%) and also in individual forest (dry deciduous 80%, tropical moist deciduous forest 67% and tropical Dry deciduous forest 52.5%). The Phylum Cercozoa in the study area considered has (26%) and also in individual forest has (dry deciduous 20%, tropical moist deciduous forest 33% and tropical Dry deciduous forest 47.5%) the following contribution respectively.

The diversity of testate amoeba in the study area belongs to12 families of which Arcellidae, Difflugidae, Trinematidae, Centropyxidae, Euglyphidae and Netzeliidae are found in descending order of presence in the altitudinal gradient of 20-230 feet (Figure 2).

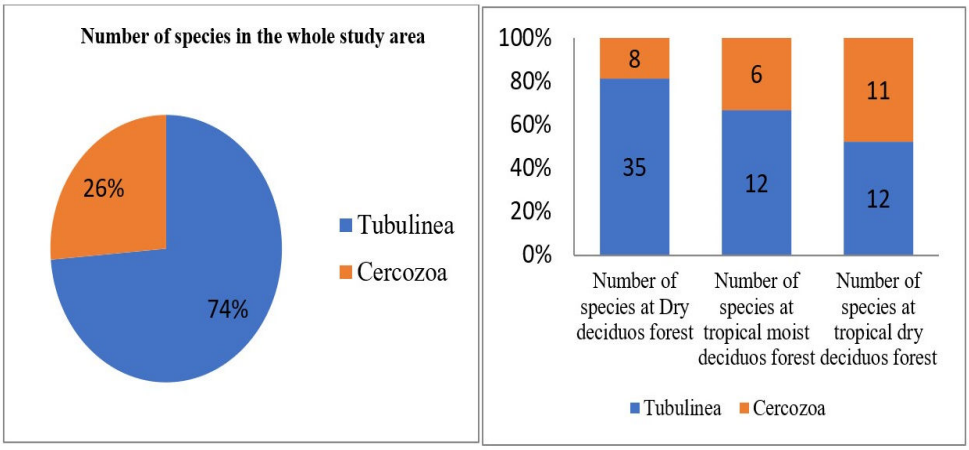

Figure 1. Diversity of testate amoeba (based on phylum) in the whole study area (left) and diversity of testate amoeba (based on phylum) in each of the three forests studied (right).

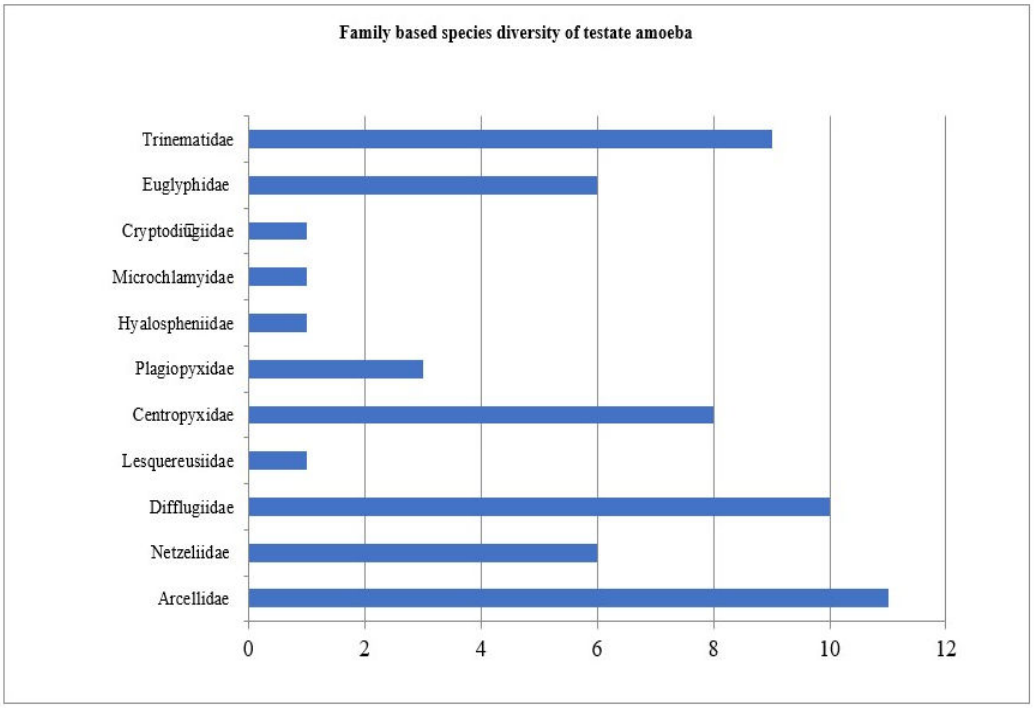

Figure 2: Family based diversity of testate amoeba across the altitude gradient of 20-230 feet.

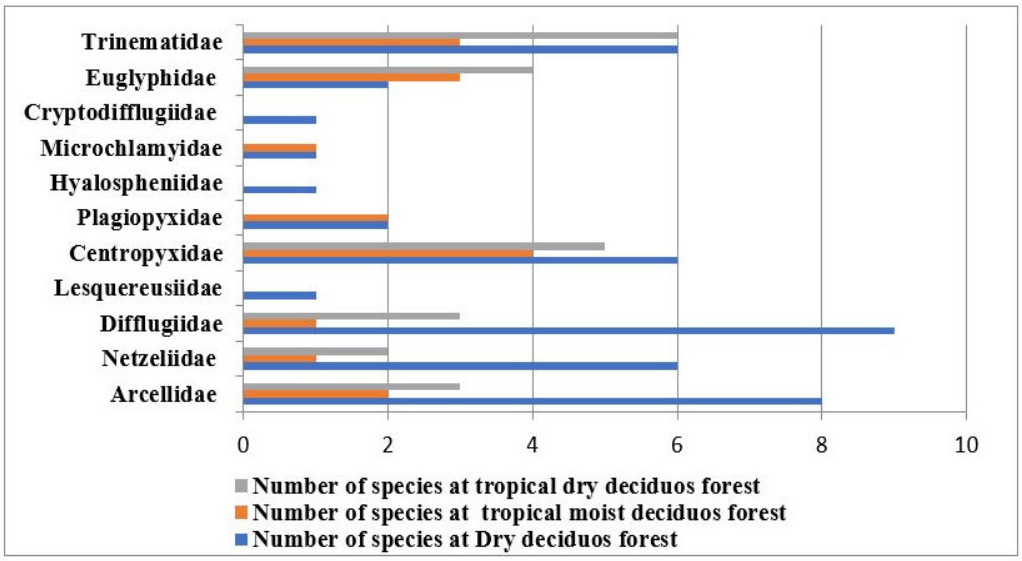

Figure 3: Family based diversity of testate amoeba in the three different forests.

The family Difflugidae (9) has the highest species diversity in the Dry deciduous forest followed by Arcellidae, Trinematidae, Centropyxidae, Difflugidae, Netzeliidae and Euglyphidae. The family Trinematidae (6) has the highest species diversity in the tropical drydeciduous forest followed by Centropyxidae, Euglyphidae, Difflugidae, Arcellidae and Netzeliidae. The family Centropyxidae (4) has the highest species diversity in the tropical moist deciduous forest followed by Trinematidae, Euglyphidae, Arcellidae, Plagiopyxidae, Difflugidae and Netzeliidae. The family Difflugidae has negative correlation with altitudinal gradient; Dry deciduous forest located in range below 250 feet has 9 species >tropical moist deciduous forestlocated in range below 50 feet has 3 species>tropical Dry deciduous forest located in range below 25 feet has 1 species.

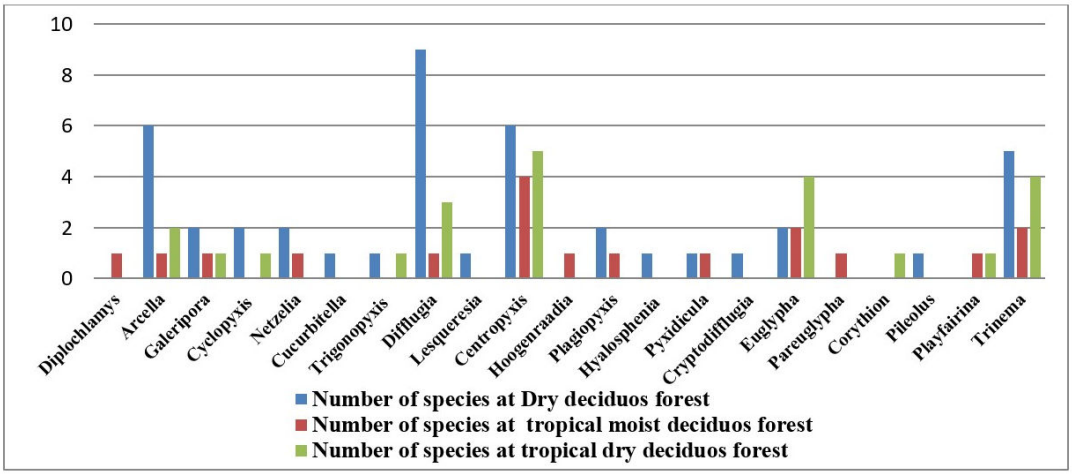

Figure 5: Genus based diversity of testate amoeba in the three different forests.

The family Trinematidae is cosmopolitan in nature and found in all forests across the whole altitudinal gradient. It has negative correlation with altitudinal gradient;Dry deciduous forest located in range below 250 feet has 5 species > tropical moist deciduous forest located in range below 50

feet has 4 species > tropical Dry deciduous forest located in range below 25 feet has 2 species. The family Centropyxidaehas negative correlation with altitudinal gradient;Dry deciduous forest located in range below 250 feet has 6 species > tropical moist deciduous forest located in range below 50 feet has 5 species > tropical Dry deciduous forest located in range below 25 feet has 4 species (Figure 4-6).

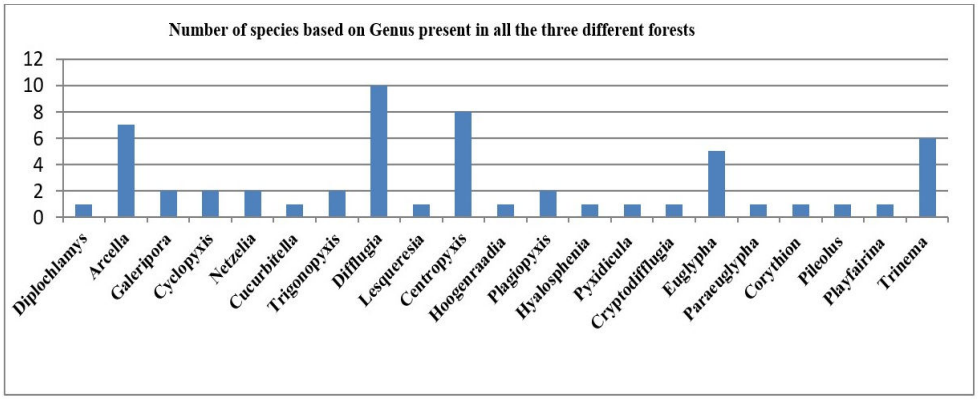

Figure 4: Genus based diversity of testate amoeba across the altitude gradient of 20-230 feet.

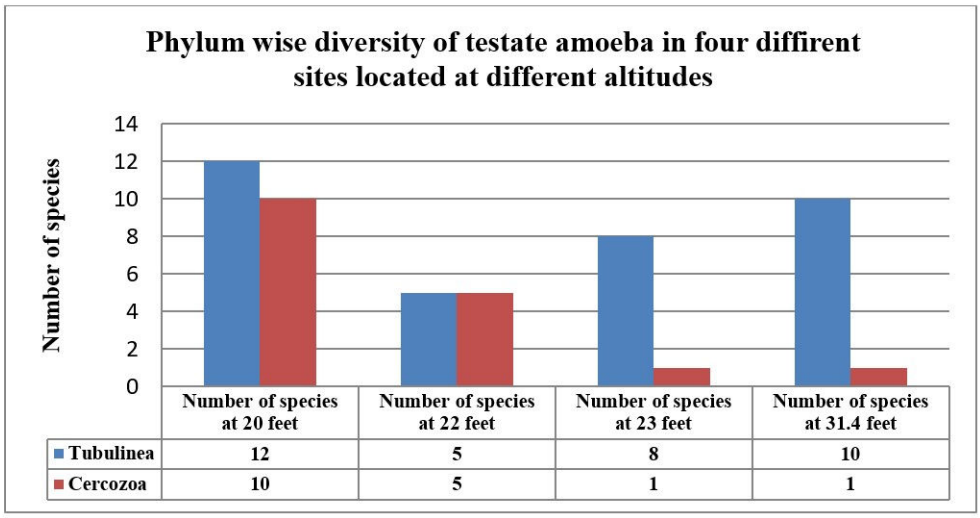

Figure 6: Phylum based diversity of testate amoeba situated at 20 ft, 22 ft, 23 ft and 31.4 feet altitude among the study areas situated in three different forests having maximum diversity.

All the study sites located at lower altitude, the Phylum Tubulinea has major number of species. The results show Phylum Tubulinea: Phylum Cercozoa found in the ratio of 3:1 in dry deciduous, 2:1 in tropical moist deciduous forest and 1:1 in tropical Dry deciduous forest. Among the 12 families found across the study areas, Arcellidae excels followed by Difflugidae, Trinematidae, Centropyxidae, Euglyphidae and Netzeliidae. The diversity of testate amoeba has negative correlation with altitudinal gradient which is shown in Figure 7.

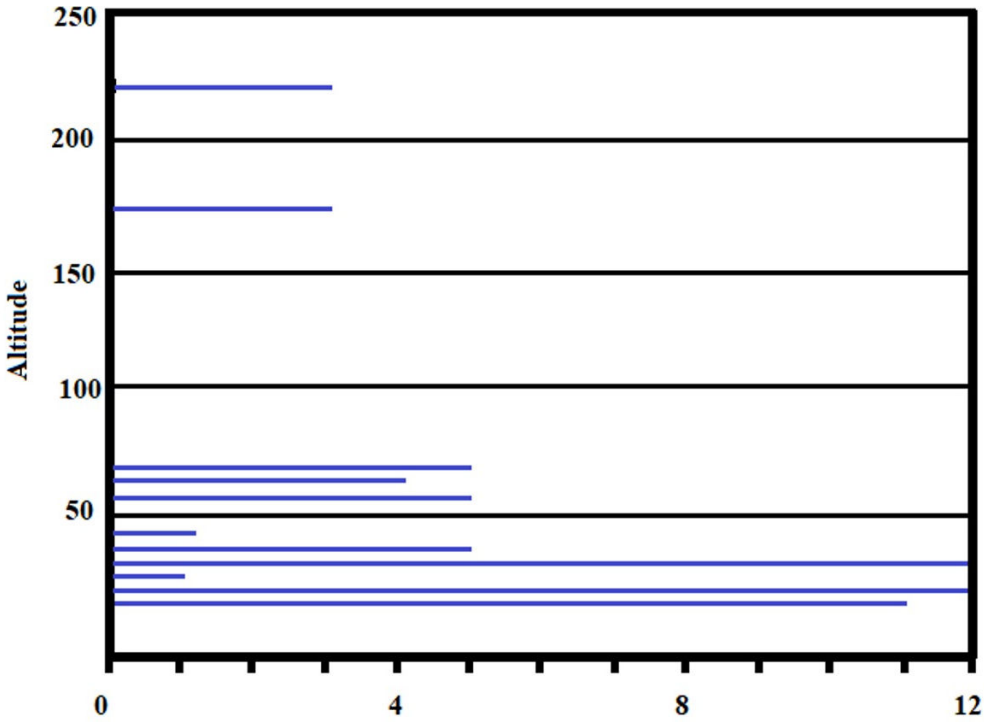

Figure 7: Diversity of testate amoeba across the Altitudinal gradient of three forests

The four sites having the highest diversity of testate amoeba show Tubulinea as the dominant phylum (Figure 5 and 6). The four sites have diversity of testate amoeba belonging to 8 families (Figure 8) and 21 Genus (Figure 9). Along with altitudinal gradient the pH, temperature and moisture content in the forest areas impact the diversity of testate amoeba (Figure 9).

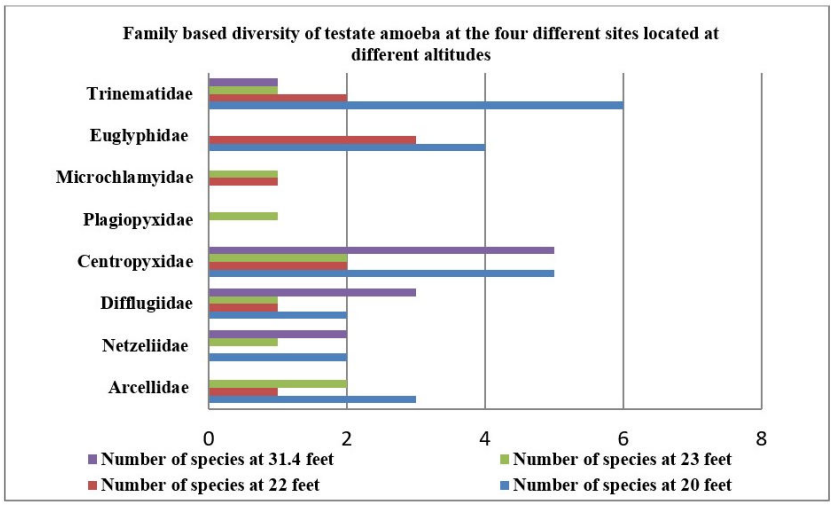

Figure 8: Family based diversity of testate amoeba situated at 20 ft, 22 ft, 23 ft and 31.4 ft altitude among the study areas situated in three different forests having maximum diversity.

The Genus Centropyxis (5), Euglypha (4), Trinema (4), Difflugia (3) and Arcella (2) have the highest number of species at the altitude of 20 feet in the decreasing order respectively. The species abundance is high for *Centropyxis discoides, Euglypha laevis* and *Trinema lineare* at this site. The Genus *Centropyxis, Euglypha* and *Trinema* have the highest number of species at the altitude of 22

feet. *Trinema lineare* and *Euglypha laevis* have species abundance at this site. Difflugia pulex has the highest species abundance at altitude of 23 feet. The genus *Centropyxis* has highest number of species at the altitude of 31.4 feet.

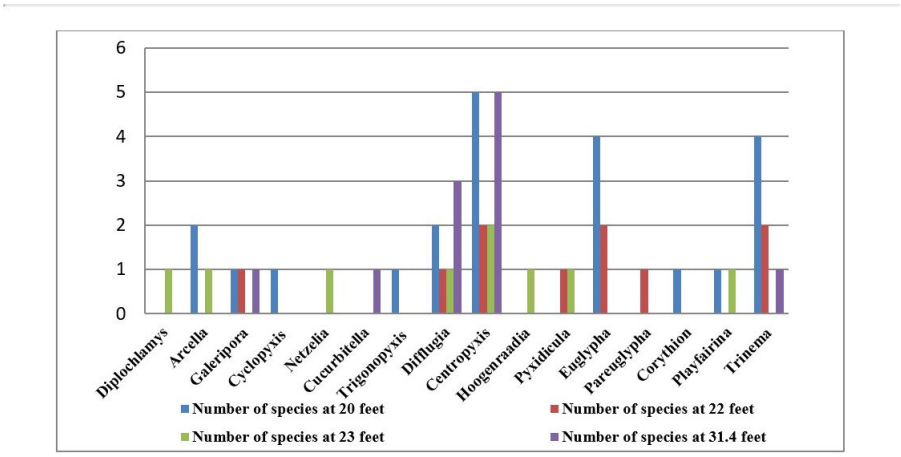

Figure 9: Genus based diversity of testate amoeba situated at 20 ft, 22 ft, 23 ft and 31.4 ft altitude among the study areas situated in three different forests having maximum diversity.

The testate amoeba diversity decreases with increasing latitude: ±300 taxa in Arctic [5] from a total of ±2000, and a decline in nebelid species richness were observed in the high southern latitudes [18-20]. A significant difference was found in the diversity and species abundance of testate amoeba at these study areas which were also located at various altitudes. Along with altitude gradient, other environmental parameters also play role in their diversity.

Testate amoeba, a highly important element of the microbial community plays several roles in soil and other freshwater habitats. A comprehensive survey of such a crucial living component in the soil, water, and moss habitats of West Bengal's protected areas is quite limited, allowing for a broad breadth of study to be done now and in the future.

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