Bulletin of Pure and Applied Sciences
Zoology (Animal Science), Vol.43A, No.1,
January-June 2024: P.99-104

Print version ISSN 0970 0765
Online version ISSN 2320 3188
DOI: https://doi.org/10.52710/bpas-zoo.28

Original Research Article
Content Available online at: https://www.bpasjournals.com/

A Preliminary Study on Testate Amoeba Diversity in Garbhanga Reserve Forest (Proposed Wildlife Sanctuary)

Aradhana Chaudhary*

Author's Affiliation:
Assistant Professor and HOD, Department of Zoology, Raja Peary Mohan College (affiliated to University of Calcutta), 1, Acharya Dhruba Pal Road, Kotrung, Uttarpara, Hooghly, West Bengal, Pin- 712258, India.

***Corresponding author:**
Aradhana Chaudhary,
Assistant Professor and HOD, Department of Zoology, Raja Peary Mohan College (affiliated to University of Calcutta), 1, Acharya Dhruba Pal Road, Kotrung, Uttarpara, Hooghly, West Bengal, Pin- 712258, India.
E-mail: chaudharyaradhana@gmail.com

Received on 27.01.2024
Revised on 07.03.2024
Accepted on 17.04.2024

ABSTRACT:
In this preliminary study, the testate amoeba diversity was assessed in the Garbhanga Reserve Forest (Proposed Wildlife Sanctuary), a protected area on the south bank of the river Brahmaputra, adjacent to Guwahati, in Assam during December 2023. Among the twenty nine species recorded, the phylum Tubulinea comprised 83 percent of the diversity recorded, while the prominent Genus were *Centropyxis* Stein 1857, *Difflugia* Leclerc 1815, *Arcella* Ehrenberg 1830 and *Trinema* Dujardin 1841. This moist deciduous forest has a unique topographical position and hosts remarkable biodiversity (Indo- Myanmar biodiversity hotspot). This forest with numerous elephant corridors has higher occurrence of human-elephant conflict due to habitat destruction (deforestation and encroachment). The high species richness of testate amoeba in this forest signifies its healthy soil dynamics and its high conservation values; moreover all the species are new records to this sanctuary and is a repository to numerous species. This forest has gained attention from the state due to its diversity and is proposed to be the 25th Wildlife Sanctuary to conserve the threatened biodiversity under the IUCN Category IV for habitat management of the species of this forest.

Keywords:
Testate Amoeba, Diversity, Biodiversity, Conservation, New Records.

How to cite this article: Chaudhary A. (2024). A Preliminary Study on Testate Amoeba Diversity in Garbhanga Reserve Forest (Proposed Wildlife Sanctuary). *Bulletin of Pure and Applied Sciences-Zoology*, 43A (1), 99-104.

INTRODUCTION

Testate amoeba are the unicellular eukaryotic protozoans, which commonly inhabitants in moist soils, wetlands, fresh water, marine environment, found from terrestrial to sub-aerial environment (Tolonen 1986, Warner 1990). The test is the unique morphology of testate amoeba, which enables its identification to species level (Ogden and Hedley 1980, Tolonen 1986, Warner 1990). Adl et al., 2019 classified them as an assemblage of three unrelated groups Amoebozoa, Stramenopiles and Cercozoa which are found in size ranging from 5-300 µm. The environmental sensitivity, rapid turnover of testate amoeba, the tolerant nature of test to withstand a wide range of environmental circumstances (Charman et al. 2000, Medioli and

Scott 1983, Smith et al. 2008); and the interesting correlation between quantitative moisture parameters and testate amoeba assemblages in the studies of Charman and Warner 1992, 1997, Woodland et al. 1998 and Mitchell et al. 1999 has raised its importance as a potential bioindicators (Foissner 1987, 1999). They are bacterial consumers in terrestrial ecosystems (Krashevska et al. 2007, 2017) and aids in nutrient recycling. This study is the first attempt to analyze the diversity and distribution of testate amoeba in this protected area which hosts biodiversity of numerous forest types.

MATERIAL AND METHODS

Study area:

Garbhanga Reserve Forest (Proposed Wildlife Sanctuary) is a protected area in Kamrup district, under the East Kamrup Forest Division of Assam, India. This dense forest covers an area of 117 square kilometers which is limited by the Meghalaya hill ranges on the eastern and southern side, Rani Reserve Forest on the western side, Basistha forest in the south-east corner of Guwahati city and Deepor beel wildlife sanctuary on the northern side. The forest is situated at 26° 55′ N to 26° 05′ N latitude and 91° 37′ E to 91° 49′ E Longitude and is located at an altitude of 170–200 m above the mean sea level. The area receives most of its rainfall during June to October, with an average highest monthly rainfall of 373 mm. The mean maximum temperature fluctuates between 31°C to 40°C, with July being the warmest and winter during November to January. The reserve forest is also documented for many rare species of butterflies, reptiles and birds diversity. This study is a first attempt, conducted to record the testate amoeba diversity in this forest.

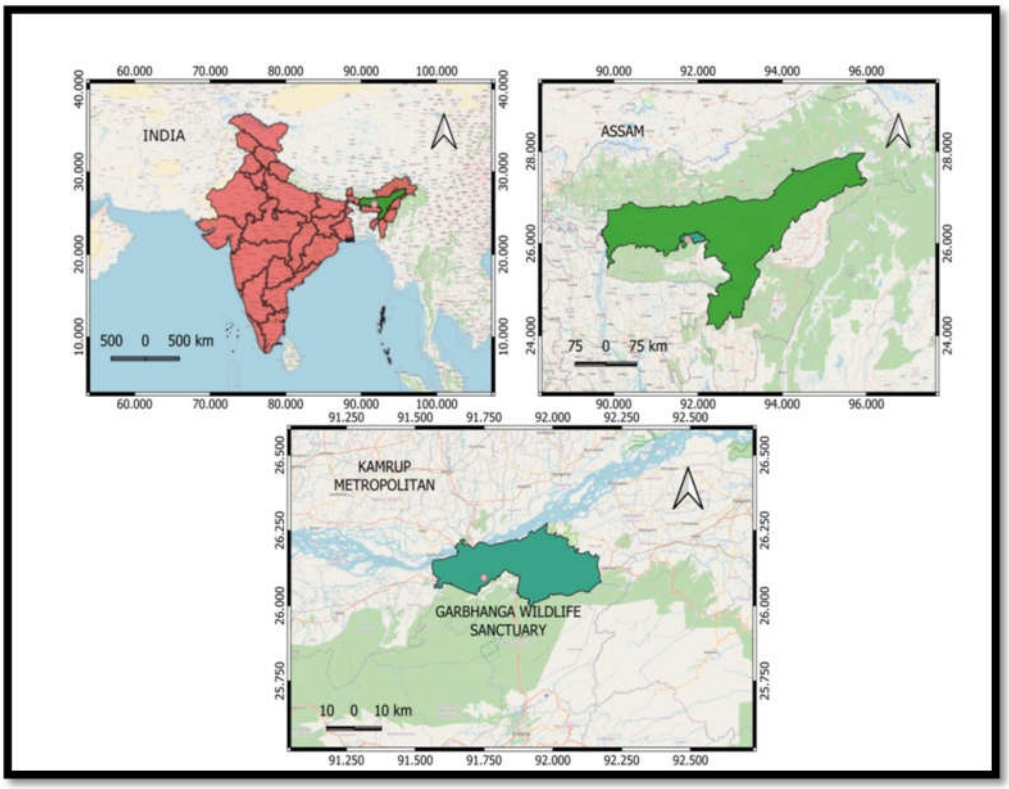

Figure 1: Map of the study area, Garbhanga Reserve Forest (Proposed Wildlife Sanctuary)

Sampling:
Water samples with sediments from water bodies; soil samples from the different vegetation habits and moss sample from tree, wall and termite colony were collected from the GPS fixed locations in the forest during December 2023. The samples were brought to the laboratory, studied thoroughly to record their diversity and abundance. The isolated testate amoebas were air dried, washed in absolute alcohol and mounted in DPX (Das et al. 1993, 1995, Chattopadyay and Das 2003) to prepare permanent slides. Further, their identification was carried using the key and guidelines of Ogden and Hedley 1980, Hoogenraad and de Groot 1942, Charman et al. 2000, Mitchell et al. 2016, Adl et al. 2019.

RESULTS

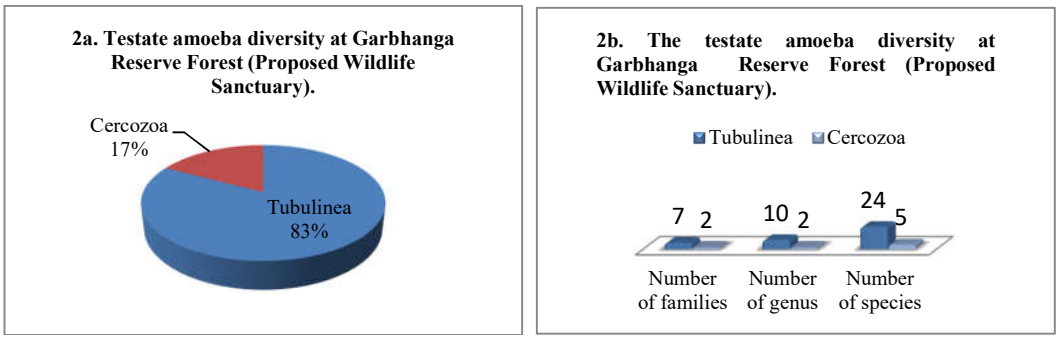

Figure 2: a). Testate amoeba diversity under different Phylums; b). The diversity of testate amoeba under different taxa at Garbhanga Reserve Forest (Proposed Wildlife Sanctuary).

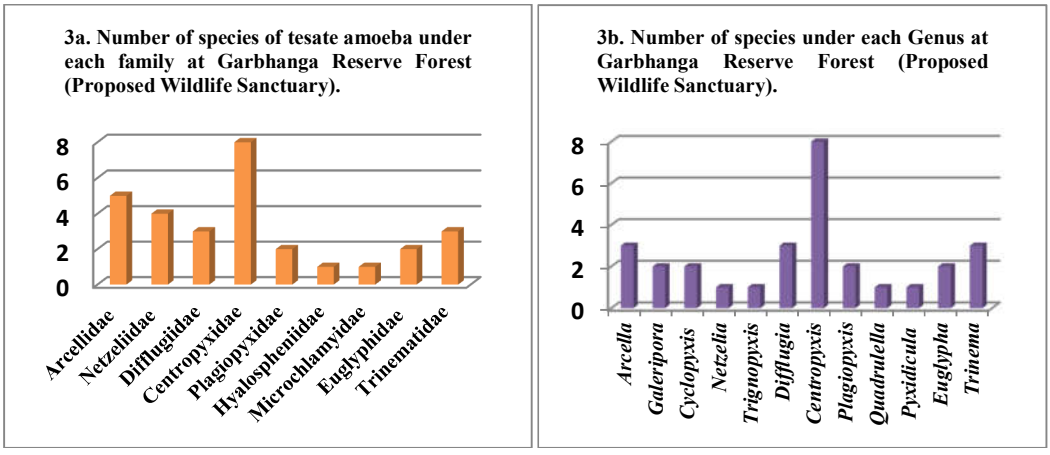

Figure 3: a). Testate amoeba diversity under different Families; b). The number of testate amoeba species under different Genus at Garbhanga Reserve Forest (Proposed Wildlife Sanctuary).

Among the total recorded species, 24 species were described under Phylum Tubulinea and remaining 5 species belonged to the Phylum Cercozoa. Centropyxidae is the dominant family among the 9 Families recorded; Genus *Centropyxis* Stein 1857, *Difflugia* Leclerc 1815, *Arcella* Ehrenberg 1830 and *Trinema* Dujardin 1841 were found to be the dominant genera among 12 Genera recorded and all the 29 species belonged to 2 orders.

The intact forest landscape shows high diversity and abundance of testate amoeba; with hydrophilic species of genera *Arcella* and *Difflugia* being dominant in the aquatic communities while Genera *Centropyxis*, *Euglypha* and *Trinema* were dominant in terrestrial communities. The regions on the outskirts of the forest has constant interference that causes change in vegetation and habitat leading to change in community structure of testate amoeba. Presence of *Difflugia globulosa* signifies high water level in the habitat and hydromorphic character of the soil. The high species diversity and abundance of testate amoeba indicates habitat heterogeneity and high nutrient presence in the soil; thereby indicating a healthy microbial diversity in the forest.

DISCUSSION

India is one among the twelve mega biodiversity centers of the world, with North- East being one among the twenty seven hot spots of the world. Among the eight states of North Eastern India, Assam houses 18 types of forests and the biodiversity richness is conserved under the recognition of various National Parks, reserve forests, wildlife sanctuaries and protected areas. Garbhanga Reserve Forest (Proposed Wildlife Sanctuary) is unique forest of Assam which lies at the Assam Meghalaya state border. This forest is remarkable corridor for elephants which helps in their smooth commutation in the forest and the surrounding forests around it. Due to increased anthropogenic activities and blooming population in the Guwahati city, the destructive impact is propagated to the nearby forest areas of Garbhanga WLS, Deepor Beel, and Basistha Forest. Landslides due to deforestation are not only leading to habitat destruction, but also lead to loss of Biodiversity. Increased human animal conflict is accompanied with destruction and misuse of natural resources inducing loss of both faunal and floral diversity. The ethnic inhabitants in these forests are mostly the tribal communities; with traditional knowledge and Ethno medicinal wisdom. They rely on the biodiversity resources for their sustenance; so loss of biodiversity will lead to loss of this knowledge as well as handicap their survival.

This forest was formerly known as Garbhanga and Rani Reserve forest and later proposed as Wildlife sanctuary due to its rich biodiversity, and to prevent, protect and control damage inflicted by encroachers and deforestation. This is a first attempt to study the testate amoeba diversity at this ecological significant forest and the result shows very high abundance and species diversity of testate amoeba here. A healthy microbial loop indicates a sustainable ecosystem; as they help in nutrient cycling, primary production in biomass and thereby influencing the large scale ecological functions. Testate amoeba is one of the important components of microbial loop which constitutes as a major consumer and provide nutrients for organisms at higher trophic levels. Moreover their ability to respond to the changes in the habitat makes them a potential bioindicators. Thus the community structure of testate amoeba is a huge reservoir which can reveal many ecological parameters of the ecosystem. This forest houses numerous species of ecological significance which are at the threat of extinction due to their habitat loss; proper conservation strategies will mitigate the potential threats and reduce their habitat loss rate. The present study indicates a healthy ecosystem with resilience to do away the damage done by anthropogenic activities. Further study of testate amoeba diversity in this forest will enable to monitor the health of this forest at a very ecologically sustainable method and help in formulating conservation guidelines to enhance the habitat restoration.

CONCLUSION

The enormous vast vegetation diversity leads to occurrence of numerous faunal varieties in this forest. The increasing population in the city has enhanced the interference of humans in these areas which has lead to habitat destruction. Testate amoeba is one of most cosmopolitan group of protozoans, widely distributed and constitutes a major hold in the microbial ecosystem. There responsiveness as hydrological proxy can easily figure out the changing pattern in the moisture content in the study area. The morphological changes in test shape and structure helps to identify the impact of changing parameters. The study of testate

amoeba in monitoring the health of the study area will enable a sustainable approach to mitigate many ecologically driven problems. The Garbhanga Reserve Forest (Proposed Wildlife Sanctuary) should be well conserved in order to protect the hotspot biodiversity facing the threat of endemism. The seasonal study of testate amoeba diversity will help to assess the forests microbial health and in turn the health of the whole ecosystem there. The present study indicates high species richness and abundance in areas undisturbed and away from human interference whiles the diversity and the abundance is lower in areas having deforestation and habitat destruction due to encroachments. Conservation strategies should be more stringent in these vulnerable areas facing the dearth of shrinkage and destruction in order to maintain a resilient ecosystem in this forest and protect the biodiversity.

Conflict of Interest:
No Conflict of Interest is declared.

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