



## RESEARCH ARTICLE

# Taxonomic diversity of genus *Trachelomonas* (Ehrenberg, 1835) in wetlands of bhagalpur district, Bihar, India

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## Abstract

While working on algal taxonomy in wetlands of Bhagalpur district, Bihar during December 2020 to June 2022, the authors came across some interesting members of Euglenoids i.e. *Euglena*, *Phacus*, *Lepocinclis*, *Strombomonas*, *Trachelomonas*, *Cyclidiopsis* and *Colacium*. The algal samples were collected seasonally from the wetlands located in the sixteen blocks of Bhagalpur district (Latitude-N 25.253391/ Longitude- E 86.989059). In this study, 19 taxa of *Trachelomonas* were recorded from the various wetlands under investigation. The present study aimed to prepare a subordinate zone based on taxonomical and morphological understanding for freshwater genus *Trachelomonas* which might be helpful in improving the taxonomic system of the genus. *Trachelomonas* community in the present study included the following taxa: *Trachelomonas bernardi*, *T. caudata*, *T. curta*, *T. lacustris*, *T. superba*, *T. vermiculosa*, *T. volvocina*, *T. verrucosa* var. *spirogyra*, *T. volvocinopsis*, *T. lefevrei*, *T. sydneyensis*, *T. pseudocaudata*, *T. verrucosa* f. *sparseornata*, *T. similis*, *T. hispida*, *T. planctonica*, *T. annulifera*, *T. dangeardiana* and *T. flava*.

**Keywords:** Euglenoids, Freshwater, Species diversity, *Trachelomonas*.

## Introduction

Euglenophytes are worldwide microorganisms occurring mainly in freshwater habitats. Their communities are well known in small water bodies rich in organic matter (Skuja 1956, Paczuska *et al.* 2002). Most of them are mixotrophic, i.e. switching between photosynthesis and carbon utilization. Hence these freshwater flagellates are studied mainly for their ecological importance a good indicators of organic pollution. Within phytoplankton communities, the genus *Trachelomonas* Ehrenberg 1835 (Phylum Euglenophytes, Class Euglenophyceae) are often encased in a lorica whose characteristic surface morphology provides significant information for their identification. The pigmented

genus *Trachelomonas* is a large genus within the division Euglenophytes encompassing approximately 250 species that inhabit freshwater environments worldwide (Bourrelly 1970) and includes marine species (Leedale 1967) also. In 1835, Ehrenberg established the genus *Trachelomonas* based on cells surrounded by a lorica. Deflandre (1926) improved the taxonomic system of the genus based on the lorica shape and ornamentation. Since then, the classification of *Trachelomonas* was heavily dependent on the lorica morphology. In India, various taxonomical studies have been carried out on the diversity of euglenoids (Saxena 1955, Philipose 1982, 1984, 1988, Roy and Pal, 2016). However, very few deal with the taxonomical diversity of the genus *Trachelomonas*. The present work aims at highlighting the taxonomical investigation of the genus *Trachelomonas* occurring in abundance in different wetlands of the Bhagalpur district.

## Study area

Bhagalpur district is located in the eastern part of the state and extends between the northern latitudes of 25° 03'40" and 25°30'00" and eastern longitudes of 86°30'00" and 87°29'45". It is one of the oldest districts and divisional headquarter of eastern Bihar. The district forms a part of the mid -Gangetic alluvium plain covering an area of 2570 km<sup>2</sup>. Geomorphologically, the district of Bhagalpur forms

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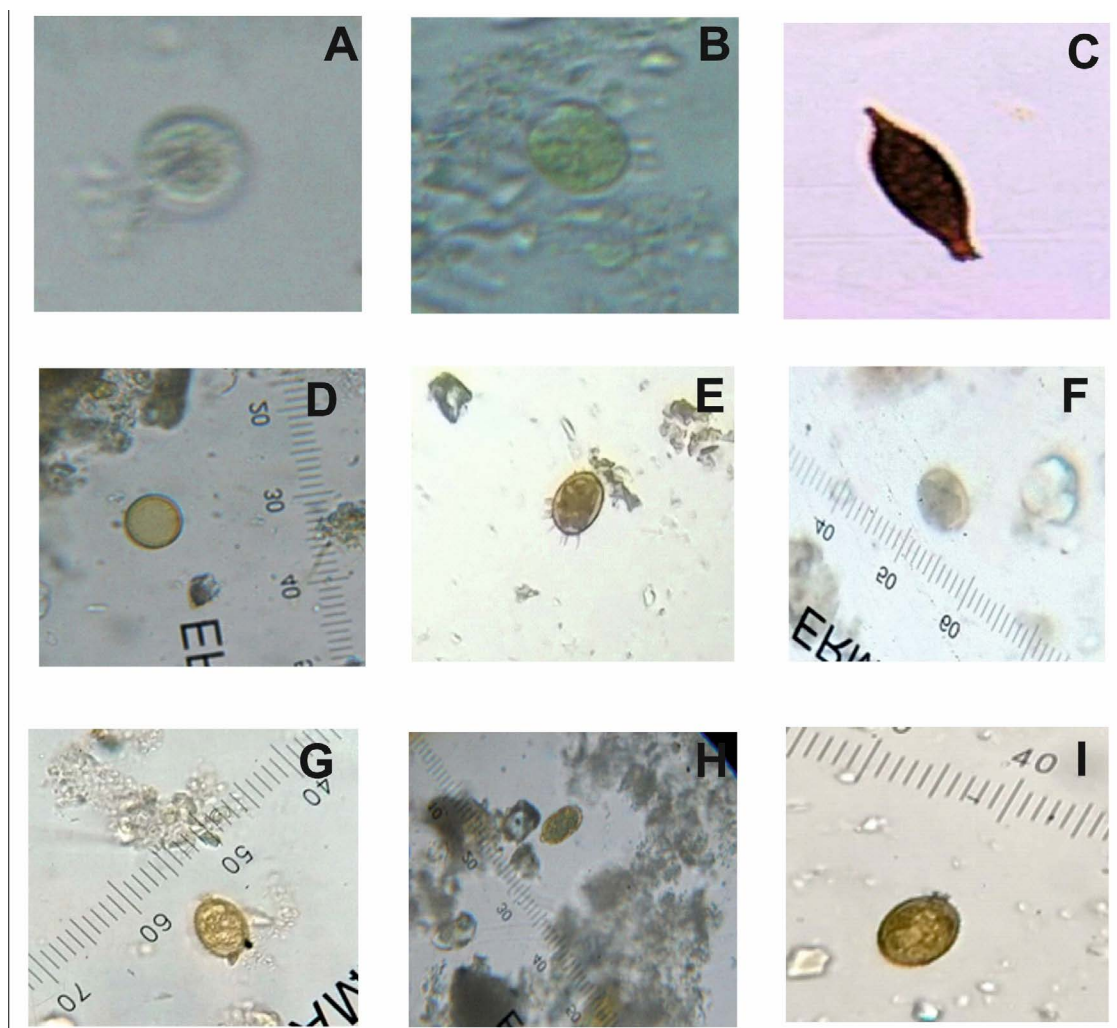
**Conflict of interest:** None.

a part of the Mid-Ganga Foreland Basin. The north and central Bhagalpur towards the north and south of Ganga respectively forms a flat Indo-Gangetic alluvium tract. The southern part of the district forms a marginal alluvial tract. The general elevation of the alluvium tract remains within 45 m above mean sea level (AMSL). Bhagalpur Sadar, Kahalgaon, and Naugachhia are the three sub-divisions of the district with a total of sixteen community development blocks namely Pirpanti, Kahalgaon, Sanhaua, Sabour, Nathnagar, Jagdishpur, Sultanganj, Sakhund, Bihpur, Naugachhia, Gopalpur, Kharik, Narayanpur, Goradih, Ismailpur, and Rangra chowk. The wetlands in these sixteen community development blocks were surveyed for documenting the taxonomic diversity of the genus *Trachelomonas*.

#### Material and Methods

Phytoplankton samples were collected at the surface level seasonally from December 2020 to June 2022 from different wetlands of the Bhagalpur district. A sampling bottle of 125 ml

was used for collecting water through a phytoplankton net of 65 $\mu$ m size. The filtrate was immediately preserved in 4% formaldehyde and was transported to the Environmental Biology Research Laboratory of University Department of Botany, T. M. Bhagalpur University. The transported samples were analyzed following standard method (APHA 2005). The algal taxa were observed under a light microscope with a high magnification of 45X. The illustrations (camera lucida diagram) were made using a drawing apparatus. For current publication of manuscript only photographic images have been used in (Plate – 1 & 2). Cell and organelle dimension was given as a mean of 50 cells. All the recorded species were briefly described based on the morphology of the trachelomonad envelope or external structure. Identification of the algal forms and taxonomical comments were done using relevant literature and monographs on algal taxonomy (Prescott 1962, Philipose 1982, 1984, Cramer 1984, Alves-da-Silva and Hahn 2001, Wehr and Sheath 2003, Roy and Pal 2016, Satpati and Pal, 2017).



**Plate 1:** (A) *Trachelomonas annulifera*, (B) *Trachelomonas bernardi*, (C) *Trachelomonas caudata*, (D) *Trachelomonas curta* var. *minima*, (E) *Trachelomonas dangeardiana* var. *glabra*, (F) *Trachelomonas flava*, (G) *Trachelomonas hispida* var. *crenulato-collis*, (H) *Trachelomonas lacustris*, (I) *Trachelomonas lefevrei*, (Scale 45 $\mu$ m)

## Results

In the present study, 19 taxa of the genus *Trachelomonas*, freshwater free-swimming euglenophyte, was recorded and described. The following are the taxonomical comments on the recorded taxa of *Trachelomonas*.

### List of taxa with taxonomical comments

*Trachelomonas annulifera* Huber-Pestalozzi 1955 (Plate 1 A)  
Lorica spherical, surface thick, light brown in color, diameter 18.5  $\mu\text{m}$ , Maraslioglu *et al.* (2022).

*Trachelomonas bernardi* Wolosz. 1912 (Plate 1 B)  
Spherical, wall smooth, anterior end truncate, posterior hemispherical, length 6  $\mu\text{m}$ , width 10  $\mu\text{m}$ , Khondker *et al.* (2008).

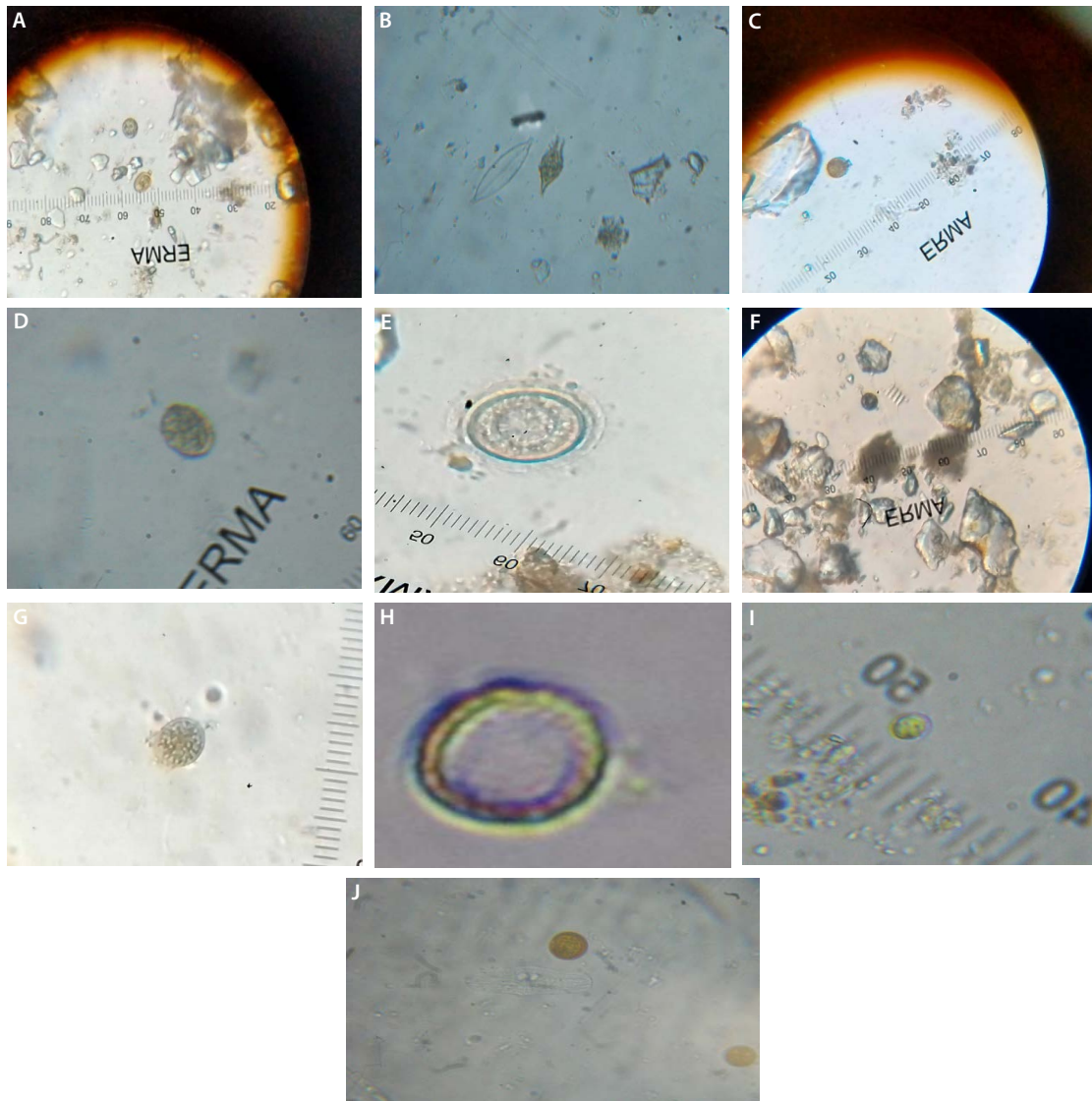
*Trachelomonas caudata* (Ehrenberg) F. Stein 1878 (Plate 1 C)  
Ellipsoid, nearly fusiform, collar cylindrical, lorica with spine, wall dark brown, length 33.3  $\mu\text{m}$ , width 14.8  $\mu\text{m}$ , tail 3.7  $\mu\text{m}$ , collar diameter 3.7  $\mu\text{m}$ , Wolowski *et al.* (2016).

*Trachelomonas curta* var. *minima* Tell & Zalocar de Domitrovic 1985 (Plate 1 D)

Lorica spherical, smooth, anterior and posterior slightly flattened, apical portion pore like structure, brown in color, length 7.4  $\mu\text{m}$ , width 5.5  $\mu\text{m}$ , Maraslioglu *et al.* (2022).

*Trachelomonas dangeardiana* (Deflandre) Huber-Pestalozzi 1955 var. *glabra* (Playfair) Defl. 1926 (Plate 1 E)

Ovoid, rod like spine in posterior sides, yellowish brown in color, length 33  $\mu\text{m}$ , width 27  $\mu\text{m}$ , M.T. Philipose (1988).



**Plate 2:** (A) *Trachelomonas planctonica*, (B) *Trachelomonas pseudocaudata* var. *elongata*, (C) *Trachelomonas similis*, (D) *Trachelomonas superba*, (E) *Trachelomonas sydneyensis* var. *obesa*, (F) *Trachelomonas vermiculosa*, (G) *Trachelomonas verrucosa* f. *sparseornata*, (H) *Trachelomonas verrucosa* var. *spirogyra*, (I) *Trachelomonas volvocina* var. *derephora*, (J) *Trachelomonas volvocinopsis*, (Scale 45  $\mu\text{m}$ )

*Trachelomonas flava* Palmer 1925 (Plate 1 F)

Compressed globose, circular in apical, blunt papillae like spine on lorica, diameter 25.9 µm, Kim *et al.* (2000).

*Trachelomonas hispida* (Perty) Stein emend. 1833 Deflandre 1926 var. *crenulato-collis* (Muskell) Lemm. 1910 (Plate 1 G)

Ovoid, narrow anterior, short spine present on body surface, cylindrical collar, brown in color, length 25.9µm, width 18.5 µm, collar length and width 3.7 µm, M. T. Philipose (1988).

*Trachelomonas lacustris* Drezepolski 1925 (Plate 1 H)

Cylindrical, broadly rounded both posterior anterior, golden yellow brown in color, length 33.3 µm, width 18.5 µm, G.W. Prescott (1962).

*Trachelomonas lefevrei* Deflandre 1926 (Plate 1 I)

Ovoid, slightly swelled at mid region, dark brown in color, length 25 µm, width 18 µm, collar 3.7 µm in diameter, Kouassi *et al.*, (2013).

*Trachelomonas planctonica* Swirenko 1914 (Plate 2 A)

Ellipsoidal lorica, cylindrical collar, anterior pole with curved collar, yellow brown in color length 18.5 µm, width 14.8 µm, Wolowski and Walne (2007).

*Trachelomonas pseudocaudata* Deflandre 1926 var. *elongata* M. T. Philipose (Plate 2 B)

Cylindrical collar, slightly widened towards aperture and denticulate, posterior part obtuse tail, color dark yellow brown, total length 29.6µm, width 11.1µm, collar length and width 3.7µm. M. T. Philipose (1988).

*Trachelomonas similis* Stokes 1890 (Plate 2 C)

Ellipsoid or ovoid, pore with collar which is bent membrane, yellowish brown in color, length 24.05 µm, width 14.8 µm, collar length and width 3.7 µm, M. T. Philipose 1988, Proc. Indian Acad. Sci. (Plant Sci.) Vol. 98, No. 5, pp 317- 394, G. W. Prescott (1962).

*Trachelomonas superba* (Swirenko) Deflandre 1926 var. *spinosa* Prescott 1944 (Plate 2 D)

Ovoid, porous, wall with short spine, length 28.5 µm, width 10.5 µm, spine 3.7 µm, G. W. Prescott (1962).

*Trachelomonas sydneyensis* var. *obesa* Playfair 1915 (Plate 2 E)

Ovalis, denticulos, color brown, diameter 14.8 µm, G. I. Playfair (1915).

*Trachelomonas vermiculosa* Palmer 1902 (Plate 2 F)

Lorica nearly spherical, wall thin, purple in color, diameter 12 µm, T.C. Palmer (1902).

*Trachelomonas verrucosa* f. *sparseornata* Deflandre 1926 (Plate 2 G)

Spherical, semicircular thick, granulations present on body, diameter 11.1 µm, Maraslioglu *et al.* (2022).

*Trachelomonas verrucosa* Stokes var. *spirogyra* (Balech) Huber – Pestalozzi 1955 (Plate 2 H)

Lorica spherical, thick, reddish brown in color, diameter 11.1µm, Maraslioglu *et al.* (2022).

*Trachelomonas volvocina* Ehrenberg 1833 var. *derephora* Conrad 1916 (Plate 2 I)

Lorica spherical, pore surrounded by depressed collar, membrane smooth, reddish brown in color, diameter 15 µm, collar 3.7 µm, G. W. Prescott (1962).

*Trachelomonas volvocinopsis* Swirenko 1914 (Plate 2 J)

Lorica spherical, smooth, reddish brown in color, diameter 25.9 µm, M.T. Philipose (1988).

## Discussion

This study of *Trachelomonas* adds 19 taxa to the record for the Bhagalpur district. Most of the taxa have a worldwide distribution and are commonly reported, with *T. volvocina*, *T. volvocinopsis* and *T. hispida* being the most frequently recorded. The other *Trachelomonas* species were less abundant, not consistently recorded at all the sampling sites, and were rare like *Trachelomonas dangeardiana*. Species showed marked seasonal variation having maximum number of count during the summer season while minimum number of count was reported during the rainy season. The high number of euglenoids in the water bodies indicates organic pollution (Starmach 1983, Wolowski 1998, 2011). The abundant development of euglenoids is also known to indicate high water temperature (Wolowski *et al.* 2013, Duangjan and Wolowski 2013). Therefore, knowledge of the euglenophyte flora can be useful in the assessment of water quality. Several taxa are very tolerant to organic pollution, although they cannot be used as bio – indicators of saprobity, e.g. *T. hispida*, *T. volvocina* var. *volvocina*, *T. volvocinopsis* and *T. planctonica*. Some are good indicator of moderate polluted waters, e.g., *T. similis* var. *similis* and *T. verrucosa* var. *verrucosa*. The members of genera *Trachelomonas* have been observed in permanent ponds mostly used for domestic purposes in rural localities. After monsoon season water recedes from the wetlands and there is gradual decrease in volume of water which is responsible for accumulation of organic matter that leads to their occurrence. *Trachelomonas* is invariably associated with eutrophic conditions (Solórzano *et al.* 2011). Based on Palmer's (1969) pollution intolerant genera and species pollution index, *Trachelomonas volvocinopsis* suggested that wetlands were advancing towards organic pollution.

## Conclusions

A total of 19 taxa of the genus *Trachelomonas* are described and illustrated here which are important components of Euglenophytes communities. *Trachelomonas* species are abundant and diverse in the natural wetlands of

the Bhagalpur district. From the perusal of the available literature, it appears that this is probably the first report on the diversity of freshwater euglenoids, particularly on the taxa of *Trachelomonas*, from the Bhagalpur district of Bihar.

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