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Three New Records from Euglenozoa In Acarlar Floodplain Lake For Turkish Freshwater Algal Flora

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ABSTRACT: Acarlar Lake is a freshwater floodplain lake that consists of swamps and forests growing up on inorganic soils and exposing to seasonal floods. During the studies carried out in Acarlar Lake Floodplain (Sakarya) between February 2011 and May 2011, three new records were identified for the freshwater algae of Turkey from the samples obtained from *Ceratophyllum demersum* L. and *Typha* sp. L. plants. These species are *Phacus gigas* Cunha, *Phacus undulatus* var. *major* (Prescott) Huber-Pestalozzi, and *Trachelomonas sydneyensis* Playfair belonging to Euglenozoa.

Keywords: Euglenozoa, epiphytic algae, new record, floodplain, Türkiye

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INTRODUCTION

Acarlar Floodplain Lake (AFL) is the second-largest floodplain forest in Turkey, including wooded swamps and seasonally flooded forests formed on inorganic soils (Güngördü, 1999; Ertürk, 2005). Although AFL is protected as a "Wildlife Protection Area", it is exposed to intense agricultural activity, like other wetlands of Turkey, during the dry period. In recent years, the epiphytic algal diversity according to substrate type of AFL was studied by Tunca *et al.* (2014). Moreover, Sevindik and Küçük (2016) contributed to the algal flora of Turkey by evaluating the water quality of AFL by using diatom indices.

A few check-lists containing Turkish algal flora have been revised (Gönülol *et al.*, 1996; Aysel, 2005; Şahin, 2005), and also, the total number of taxa in this flora has increased since many new records have been given on this subject (Taşkın *et al.*, 2019; Maraşlıoğlu and Gönülol, 2021). 1543 Euglenozoa taxa have been reported at the worldwide (Guiry and Guiry, 2021). There are a few taxonomic and floristic studies of the Euglenozoa in Turkey. The number of Euglenozoa taxa has increased significantly in recent years depending on algological studies in Turkish waters. Atıcı (2002) found three new record from Euglenozoa in Sarıyar Dam for Turkish Algal flora. Aysel (2005) reported that there were 159 taxa for Euglenozoa. After this checklist, Maraşlıoğlu *et al.* (2005), Soylu *et al.* (2007), Sevindik *et al.* (2010, 2011, 2015, 2017), Özer *et al.* (2012), Varol and Şen (2016) and Varol et al. (2018) identified 25 Euglenozoa taxa as new records. Taşkın *et al.* (2019) reported that there were 210 taxa in the Euglenozoa section of the algae flora of Turkey. Finally, Maraşlıoğlu et al. (2022) determined 81 Euglenozoa taxa as new records in twenty-five river basins of Turkey. This study aims to contribute to the flora of Turkey by adding 3 new records belonging to the Euglenozoa found in the AFL.

MATERIALS AND METHODS

The study area is located within the borders of Sakarya province being in coordinates between 41° 05' 38" - 41° 08' 08' north latitudes and 30° 32' 44" - 30° 26' 05' east longitudes and a single station was selected in the study area (Figure 1). Epiphytic and metaphytic algae were collected from the surface of *Ceratophyllum demersum* L. and *Typha* sp. L in studies conducted between February 2011 and May 2011. In this process, the washing-stripping method was applied with distilled water. The 50 mL of obtained water sample was left to stand for at least 24 hours for precipitation and the solution containing lugol and 4% formaldehyde was dripped to fix the water samples. When the bottom of the chambers collapsed, the clear water at the top was removed with a bullied pipette. The 5 mL portion at the bottom was stored in opaque, labeled small glass bottles for analysis. The identification of epiphytic algae was conducted under the Olympus BX51 microscope. Identification of algae was carried out according to Huber-Pestalozzi (1955). Status names of taxa were determined from Algaebase (Guiry and Guiry, 2021), new record statuses were determined by scanning Taşkın *et al.* 2019, and Maraşlıoğlu and Gönülol, 2021 database, which also includes current and latest new records.

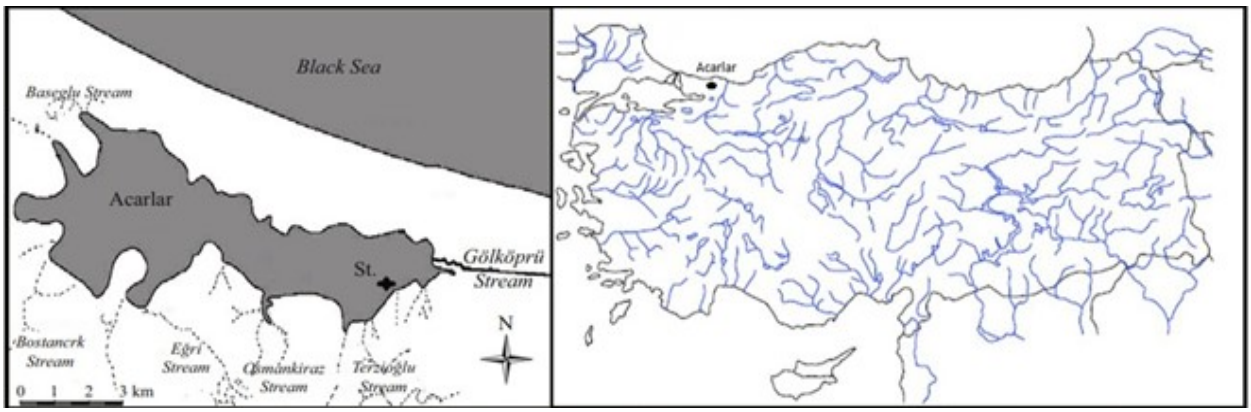

Figure 1. The map of the Acarlar Floodplain Forest and the location of sampling station

RESULTS AND DISCUSSION

Three new records belonging to Euglenozoa were found for the Turkish freshwater algal flora. These taxa are listed as follows (Figure 2).

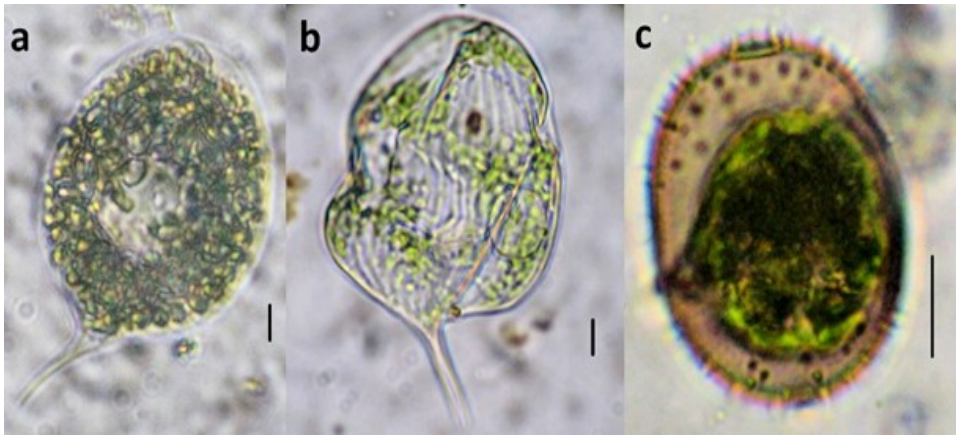

Figure 2. Three new records belonging to Euglenozoa for the Turkish freshwater algal flora. (a) *Phacus gigas* (b) *Phacus undulatus* var. *major* (c) *Trachelomonas sydneyensis* (Scale 10 µm)

Divisio: Euglenozoa

Classis: Euglenophyceae

Ordo: Euglenida

Familia: Phacidae

Genus: *Phacus* Dujardin (1841)

Species: *Phacus gigas* A.M. Cunha (1913)

Synonym: *Phacus pleuronectes* f. *gigas* (A.M.Cuhna) Popova (1947)

Description: Cells segmented, oval, and sections flat. Cells have an unusual size. Posterior end seems to relatively longer, thinner and slightly crooked. Cells differ from other species due to different shape of the paramylon grains. Paramylon in the form of numerous, rather small, ring-shaped ones. Length approximately 100 µ, width 70 µ, spine length 20 µ. It was found as epiphytic in water samples obtained from *Typha* sp. (Figure 2a)

Ecology: *Phacus gigas* is predominantly found in mesosaprobic environments (Pereira and Azeiteiro, 2003)

Distribution in the World: Cosmopolitan.

Species: *Phacus undulatus* (Skvortsov) Pochmann var. *major* (Prescott)

Synonym: *Phacus anacoelus* f. *major* Prescott (1944)

Description: Cells oval, strongly asymmetrical. Length 112, width 63 µm. *P. undulatus* var. *major* differs from *Phacus undulatus* var. *multiundulatus* due to the large size of the cell. (The size of *P. undulatus* var. *multiundulatus* varies between 43-47.2 x 31.3-31 according to Huber-Pestalozzi, 1955b). Posterior end seems to be crooked, relatively longer, thinner, and more pointed shape. Flanks with 2-3 notches that are not very deep. It was found as epiphytic in water samples obtained from the *C. demersum* (Figure 2b)

Ecology: : *Phacus undulatus* (Skvortsov) var. *major* is predominantly found in freshwater ecosystems (Guiry and Guiry, 2021).

Distribution in the World: Rare (Alves-da-Silva and Bicudo, 2009).

Familia: Euglenidae

Genus: *Trachelomonas* Ehrenberg (1834)

Species: *Trachelomonas sydneyensis* Playfair (1915)

Description: Lorica varies from ellipsoidal to elongated oval. Length 36.5 µm, width 23 µm. The cell wall is covered with sparsely dispersed spines and dense dots. The apical end with a small collar, Lorica 1.5-3(4) times longer than the flagellum length. Chloroplasts numerous and each one contains a pyrenoid. It was found as epiphytic in water samples obtained from the *C. demersum*. (Figure 2c)

Ecology: : *Trachelomonas sydneyensis* is predominantly found in ponds, swamps and ditches (John et al. 2011).

Distribution in the World: Cosmopolitan.

Euglenozoa is a division of protists with a high species richness and this divisio includes euglenoid algae with many features with extreme lifestyles. Euglenoides are predominantly free-living, and they display phagotrophy, osmotrophy, or photoautotrophy (Yamaguchi *et al*. 2012). Cosmopolitan euglenoids can be found phagotrophically in sediments and phototrophically in ponds (Kolisko *et al*., 2020; Simon *et al*., 2014; Geisen *et al*., 2019). In temperate regions, euglenoids are abundant in small eutrophic reservoirs having rapid heat alterations (Zimba *et al.*, 2004; 2010). *Phacus* sp. and *Trachelomonas* sp. have been detected in low abundance in coastal environments of shallow areas (Lukešová *et al*., 2020; Grabowska and Wołowski, 2014).

Atıcı (2002) included three Euglenozoa species identified as *Trachelomonas armata* (Ehr.) Stein, *T. lacustris* Drezepolski var. *lacustris* Yamagishi & Akijama, *T. armata* (Ehr.) Stein var. *longispina* (Playf.) Deflandre to the Turkish algal flora. Sevindik et al. (2010) found three species (*Strombomonas praeliaris* (Palmer) Deflandre, *Trachelomonas granulosa* Playfair var. *crenulatocollis* (Szabados) Huber-Pestalozzi, *T. globularis* (Averintsev) Lemmermann var. *crenulatocollis* Szabados) as new Euglenozoa records in Çaygören Reservoir (Balıkesir). Sevindik et al. (2011) recorded *Trachelomonas scabratula* (Playfair) Deflandre in İkizcetepeler Reservoir (Balıkesir). Özer et al. (2012) found *Euglena spirogyra* var. *abrupte-acuminata* Lemmermann in Tigris River Basin. Sevindik et al. (2015) contributed to the flora by identifying *Trachelomonas oblonga* var. *angusta* Huber-Pestalozzi, *T. vas* Deflandre, *T. volzii* Lemmermann var. *cylindracea* Playfair, *Euglena rubra* Hardy, *P. vigueri* Allorge and Lefèvre in Danamandıra Ponds (Silivri, İstanbul) and North Mollaköy Lake (Sakarya). Varol and Şen (2016) recorded *Euglena sociabilis* P.A. Dangeard, *Strombomonas planctonica* (Wołoszyńska) T.G. Popova and *Strombomonas pascheriana* (Skvortsov) Deflandre, *Trachelomonas nigra* Svirenko,

T. aspera A.M. Cunha, *T. borodiniana* Svirenko and *T. scabra* var. *labiata* (Teiling) Huber-Pestalozzi, *Phacus inflexus* (Kisselev) Pochmann and *P. ovalis* Skvortsov in Tigris River Basin. Sevindik et al. (2017) found *Phacus polytrophos* Pochmann, *Trachelomonas eurystoma* Stein var. *minuta* Van Oye, *T. hispida* var. *acuminata* Deflandre in Lake Taşkısığı (Sakarya). Varol et al. (2018) detected *Trachelomonas volvocinopsis* Svirenko in Tatar Dam Reservoir (Elazığ). Finally, Maraşlıoğlu (2022) identified 187 Euglenozoa species belonging to 25 basins of Turkey.

In this study, the samples were obtained from *Ceratophyllum demersum* and *Typha* sp. Epiphytic algae are generally collected from the surface of aquatic plants as attached organisms. However, planktonic species that do not belong to this flora can also be found in the collection for sampling epiphytic algae. Round (1984) used the term of metaphyton to describe the flora, which is loosely located on the substrate (such as stone, plant surface), and not being completely attached. For this reason, these identified species are thought to be metaphytic.

Phacus includes 158 taxa of which are accepted taxonomically. The number of species has been changing with taxonomic studies (Guiry and Guiry, 2021). It has been reported that *Phacus gigas* is predominantly found in mesosaprobic environments. The species is rarely found in Poland, but it has a cosmopolitan distribution in Brazil (Cunha, 1913; Drežepolski, 1922; Dunck *et al*., 2018). It has also been recorded from many rivers such as the Cértima River, Vagua River, Levira River, Segadães, and Frossos channels in Portugal (Pereira and Azeiteiro, 2003). Also, It is identified in the Netherlands, North America, Iraq, India, Tajikistan, Bulgaria. (Guiry and Guiry, 2021). *Phacus undulatus* var. *major* has been described in southern Brazil in autumn and winter (Alves-da-Silva and Bicudo, 2009).

Trachelomonas includes 374 taxa of which are accepted taxonomically (Guiry and Guiry, 2021). *Trachelomonas sydneyensis* has been reported in European countries such as England, Netherlands, Romania, Slovakia, Spain; in North America; Argentina and Brazil; Ivory Coast; Southwest Asian countries such as Bangladesh and India, China, Russia, Australia, and New Zealand (Prescott, 1962; John *et al*., 2011; Guiry and Guiry, 2021).

Although *Phacus* and *Trachelomonas* have been cosmopolitan for Turkish algal flora, some members of these genus have with rare distribution (Varol and Sen, 2016; Maraşlıoğlu et al., 2022).

CONCLUSION

Euglenoids are indicators of organic pollution and the domestic wastes in the aquatic ecosystem (Fjerdingstad, 1964; Sladeček and Perman, 1978; Starmach, 1983; Wołowski, 2011). *Phacus gigas* is found with rare distribution in mesosaprobic environments and *Phacus undulatus* (Skvortsov) var. *major* is predominantly found with rare distribution areas. On the other hand, *Trachelomonas sydneyensis* is predominantly found in ponds, swamps and ditches with cosmopolitan distribution. In this study, three new records belonging to the Euglenozoa contributed to the algal flora of Turkey.

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Conflict of Interest

The article authors declare that there is no conflict of interest between them.

Decleration of Author Contribution

The authors declare that they have contributed equally to the article.

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