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Nineteen new records for Turkish freshwater algal flora from Lake Taşkısığı and Lake Little Akgöl

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Abstract

Nineteen new records for the freshwater algal flora of Turkey were determined in studies conducted from January 2013 and December 2013 in Lake Taşkısığı and Lake Little Akgöl, Sakarya, Turkey. Sampling for chemical analyses and measurement of physical variables were carried out monthly in conjunction with algae collection at the two monitoring stations in each lake. Among these new records, 2 were Cyanobacteria, 9 were Chlorophyta, 1 was Charophyta, 1 was Ochrophyta, 3 were Cryptophyta, and 3were Euglenophyta.

Key words: Lake taşkısığı, Lake little Akgöl, new record, algae, Turkey

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Taşkısığı ve Küçük Akgöl gölleri'nden Türkiye tatlı su alg florası için on dokuz yeni kayıt

Özet

Taşkısığı Gölü'nde ve Küçük Akgöl Gölü'nde (Sakarya) Ocak 2013 ve Aralık 2013 tarihleri arasında yapılan çalışmada Türkiye tatlı su alg florası için on dokuz yeni kayıt teşhis edilmiştir. Kimyasal ve fiziksel parametrelerin ölçümü, alg örneklemesiyle eş zamanlı olarak her gölde belirlenen iki istasyondan aylık olarak yapılmıştır. Tespit edilen taksonların 2 tanesi Cyanobacteria, 9 tanesi Chlorophyta, 1 tanesi Charophyta, 1 tanesi Ochrophyta, 3 tanesi Cryptophyta ve 3 tanesi Euglenophyta gruplarına aittir.

Anahtar kelimeler: Taşkısığı gölü, Küçük Akgöl gölü, yeni kayıt, alg, Türkiye

1. Introduction

Inland waters with different morphometry and hydrology may support distinct algal diversity. Moreover, substantial differences were recognizable when considering the effects of altitude and climate on algal composition (Pollingher, 1990). Since Turkey has possessed three different types of climates and exhibited noticeable altitude differences, number of new records was expected to increase in the future. Until now, many studies were done about the new records for the algal flora in Turkey (e.g., Atıcı, 2002; Baykal et al., 2009, 2012; Sevindik et. al., 2010, 2011, 2015; Baytut and Gönülol, 2016). The aim of this study was to contribute algal flora of Turkey with determined new records.

2. Materials and methods

2.1. Study areas

2.1.1. Lake Taşkısığı

Lake Taşkısığı (LT) is located at 40° 52' 18'' N, 30° 24' 14''E, 13 km north of Sakarya, Turkey (Figure 1). It lies at 12 m above the sea level and has a surface area of 0.9 km^2, a length of 1.2 km, a maximum depth of 5 m and a mean depth of 1.5 m. The lake was formed in the old Sakarya River bed. It is mainly fed by underground water sources

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located at various places and rainfalls. 20% of the lake's shore is covered with macrophtes (*Phragmites* sp., *Nymphaea alba* L. and *Ceratophyllum demersum* L.). Lake Taşkısığı is a shallow eutrophic freshwater lake (the mean annual chlorophyll-*a* concentration is 0.005 mgL^{-1}, total phosphorus is 0.036 mgL^{-1} and Secchi disk depth is 68.91 cm) according to Carlson (1977) and OECD (1982) criteria. Formerly, the influence of some physiochemical parameters on phytoplankton abundance and species composition have been reported in Lake Taşkısığı (Aykulu et al., 1999; Temel and Yardımcı, 2004).

2.1.2. Lake Little Akgöl

Lake Little Akgöl (LLA) is located at 40° 52' 38''N, 30° 25' 56''E, 20 km north of Sakarya, Turkey (Figure 1). It lies at 12.3 m above the sea level and has a surface area of 0.16 km^2, a length of 0.58 km, a maximum depth of 1.3 m and a mean depth of 0.5 m. The lake was formed in the old Sakarya River bed. The sole outlet located northern edge that connected with Çark Stream which is formerly connected with Sakarya River. Dense macrophyte (40% mean coverage) (*Phragmites* sp., *Nymphaea alba* L. and *Ceratophyllum demersum* L.) development was seen on the coasts of the lake. Surroundings of the lake are comprised of forest. In 2001, 30 hectares of the area was declared a "Wildlife Protection Area". Lake Little Akgöl is a shallow eutrophic freshwater lake (the mean annual chlorophyll-*a* concentration is 0.011 mgL^{-1}, total phosphorus is 0.167 mgL^{-1} and Secchi disk depth is 55.3 cm) according to Carlson (1977) and OECD (1982) criteria.

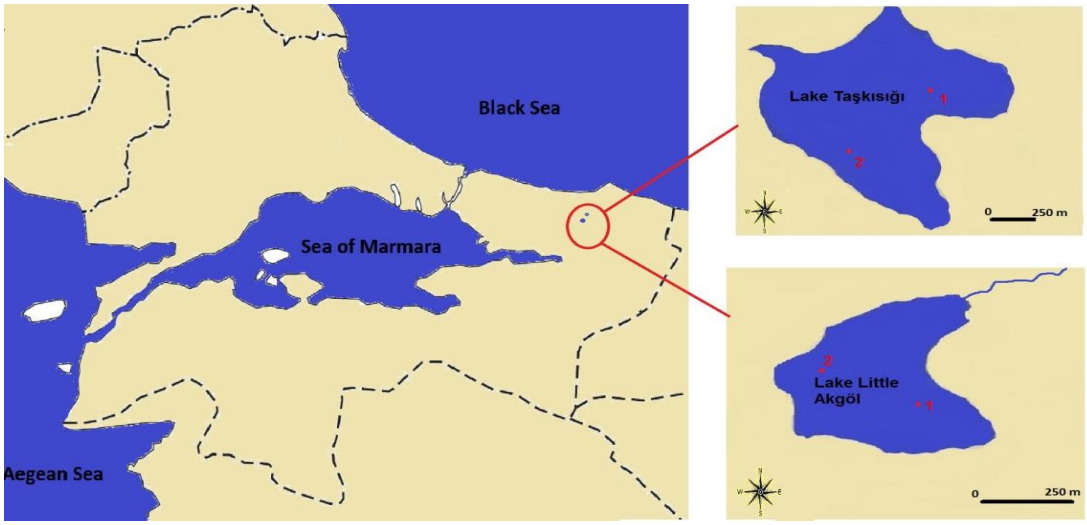

Figure 1. The map of Lake Taşkısığı and Lake Little Akgöl and the location of sampling stations

2.2. Sampling and identification

Sampling was carried out monthly at the two monitoring stations in each lake between January 2013 and December 2013. The whole water column was sampled with integrated sampling tube. In the field, samples were placed in dark bottles. In the laboratory, the samples were first agitated, then poured into 50 mL graduated cylinders and were allowed to settle for 24 hours. At the end of the settling period, 45 mL of water was aspirated from each graduated cylinder and the remaining 5 mL of water was poured into a small glass vial for microscopic analysis. (Utermöhl, 1958). Identification of samples was performed on a compound microscope, equipped with water immersion lenses and a phase contrast attachment. Algal species were identified according to Huber–Pestalozzi (1962, 1969, 1974, 1976, 1983); John et al. (2003); Philipose (1967); Komarek and Anagnostidis (1999). Taxa were photographed with a camera attached to an Olympus BX 51 microscope. Identified taxa were checked with the checklist of Gönülol et al. (1996); Aysel (2005), Şahin (2002, 2005) and Gönülol (2016) web site, determined as new taxa for Turkish algal flora. Taxonomy of algae was controlled for current accepted status of the species from Guiry and Guiry (2017) web site.

2.3. Environmental variables

Sampling for chemical analyses and measurement of physical variables were carried out in conjunction with algae collection. Specific conductance (EC), pH, dissolved oxygen (DO) and water temperature (T) were measured at 10 cm below the surface using a YSI ProPlus water quality instrument. Water transparency was measured on each sampling day using a Secchi disk. For the analysis of chemical variables, samples were collected by a tube sampler, integrating the whole water column. Concentrations of nitrate-nitrogen (NO_3-N), nitrite-nitrogen (NO_2-N), total phosphorus (TP), orthophosphate (PO_4-P), soluble silica (Si) and sulfate (SO_4) were determined spectrophotometrically

according to Strickland and Parsons (1972) and Technicon Industrial Methods (1977 a, b). Chlorophyll-*a* (Chl-*a*) was determined via extraction with 90% methanol spectrophotometrically (Youngman, 1978).

3. Results

Environmental variables of LT and LLA waters are given in Table 1. A total number of new records for freshwater algal flora of Turkey are 19 (Cyanobacteria 2, Chlorophyta 9, Charophyta 1, Ochrophyta 1, Cryptophyta 3, and Euglenozoa 3). These taxa are listed below.

Table 1. The mean and standard deviation (SD) of environmental variables measured at the sampling sites in Lake Taşkısığı and Lake Little Akgöl. (T: water temperature, EC: specific conductance, DO: dissolved oxygen, NO_3-N: nitrate-nitrogen, NO_2-N: nitrite-nitrogen, PO_4-P: orthophosphate, TP: total phosphorus, SO_4: sulphate, Si: soluble silica, Chl-*a*: chlorophyll-*a*)

	Lake Taşkısığı		**Lake Little Akgöl**	
Variable	**Station 1**	**Station 2**	**Station 1**	**Station 2**
	Mean±SD	**Mean±SD**	**Mean±SD**	**Mean±SD**
T(ºC)	18.33±7.62	18.05±7.47	18.73±8.32	19.1±8.39
pH	8.52±0.97	8.55±0.17	8.42±0.28	8.35±0.29
EC (µScm^{-1})	534.10±28.61	537.82±28.11	567.9±152.03	547.02±167.81
DO (mgL^{-1})	7.10±4.18	8.91±7.20	5.58±2.15	5.24±1.87
Secchi disk (cm)	69.91±13.31	68.37±16.61	56.25±9.79	53.83±13.78
NO_3–N (mgL^{-1})	0.27±0.18	0.35±0.24	0.17±0.13	0.18±0.22
NO_2–N (mgL^{-1})	0.009±0.005	0.009±0.004	0.017±0.09	0.018±0.02
PO_4–P (mgL^{-1})	0.020±0.033	0.019±0.021	0.15±0.01	0.17±0.14
TP (mgL^{-1})	0.040±0.024	0.034±0.022	0.17±0.08	0.18±0.10
SO_4 (mgL^{-1})	20.55±33.45	19.89±25.69	5.89±7.83	5.68±7.93
Si (mgL^{-1})	8.80±6.07	10.55±9.39	6.86±3.56	6.73±3.41
Chl-*a* (mgL^{-1})	0.002±0.001	0.006±0.005	0.011±0.01	0.011±0.01

Division: Cyanobacteria
Class: Cyanophyceae
Order: Chroococcales
Family: Microcystaceae
Genus: *Microcystis* Lemmermann, 1907
Microcystis firma (Kützing) Schmidle, 1902 (Figure 2a)
Basionym: *Micraloa firma* Kützing, 1846
Synonyms: *Micraloa firma* Kützing, 1846; *Polycystis firma* (Kützing) Rabenhorst, 1865; *Anacystis firma* (Kützing) Drouet and Daily, 1948
Reference: (Komarek and Anagnostidis, 1999; information pg. 226, figure 296)
Remarks: Colonies spherical, with densely packed cells, with distinct mucilaginous envelopes. Cells spherical, with gas vesicles, 6 µm in diameter. Found in LT.

Family: Chroococcaceae
Genus: *Chroococcus* Nageli, 1849
Chroococcus aphanocapsoides Skuja, 1964 (Figure 2b)
Reference: (Komarek and Anagnostidis, 1999; information pg. 284, figure 368 a-b)
Remarks: Colonies gelatinous, in outline spherical, 30 µm in diameter. Cells usually arranged in small aggregates (with 4-8 cells) within homogeneous, colorless, hyaline, structureless and diffluent mucilage, forming wide margin around cells. Cells spherical, 3 µm in diameter, without individual mucilaginous envelopes, with homogeneous, pale blue green content, without aerotopes. Found in LLA.

Division: Chlorophyta
Class: Chlorophyceae
Order: Sphaeropleales
Family: Selenastraceae
Genus: *Ankistrodesmus* Corda, 1838
Ankistrodesmus bernardii Komárek, 1983 (Figure 2c)
Reference: (Huber-Pestalozzi, 1983; information pg. 687, figure 193/3 a-d)
Remarks: Colonies form like bundle, with 8 cells, curled and connected together on middle. Cells long and very narrow, 45 µm long, 2 µm wide. Found in LT.

Genus: *Monoraphidium* Komárková-Legnerová, 1969
Monoraphidium subclavatum Nygaard, 1977 (Figure 2d)
Reference: (Huber- Pestalozzi, 1983; information pg. 640, figure 179/3 a-b)
Remarks: Cells fusiform, sickle-shaped, 28 µm long, 8 µm wide. The ends gradually tapered. Chloroplast parietal almost all the cell wall, without significant turning point in the middle, without pyrenoid. Found in LT.

Family: Hydrodictyaceae
Genus: *Tetraëdron* Kutzing, 1845
Tetraëdron pusillum (Wallich) West and G.S.West, 1897 (Figure 2e)
Basionym: *Micrasterias pusilla* G.C.Wallich
Synonym: *Micrasterias pusilla* G.C.Wallich
Reference: (Philipose, 1967; information pg. 159, figure 74 a-c)
Remarks: Cells cruciform with four processes, each ending in two recurved spines. In side view, elongate- ellipsoid with attenuate ends. Cells 20 µm long, 15 µm wide. Found in LT.

Family: Scenedesmaceae
Genus: *Desmodesmus* (Chodat) An, Friedl and Hegewald, 1999
Desmodesmus microspina (Chodat) Tsarenko, 2000 (Figure 2f)
Basionym: *Scenedesmus microspina* Chodat, 1926
Synonyms: *Scenedesmus microspina* Chodat, 1926; *Scenedesmus quadricauda* var. *microspina* (Chodat) Philipose 1967
Reference: (Huber-Pestalozzi, 1983; information pg. 930, figure 249/7. John et al., 2003; information pg. 395, figure 391/P)
Remarks: Coenobia of 2 linearly arranged cells; cells 8 µm long, 4 µm wide, ellipsoidal with rounded apices, cells whose outermost wall is convex, bear short and oblique spines, cell walls smooth, lacking a mucilaginous envelope. Found in LT.

Genus: *Scenedesmus* Meyen, 1829
Scenedesmus heteracanthus González, 1940 (Figure 2g)
Reference: (Huber- Pestalozzi, 1983; information pg. 890, figure 240/9)
Remarks: Coenobia of 4 linearly arranged cells; cells 10 µm long, 5 µm wide, elongate ellipsoid and outer side are slightly convex. 2 long, straight spines obliquely set in 2 diagonal corners of the coenobia. Accessory teeth often present at the poles of all cells. Found in LT.

Order: Chlamydomonadales
Family: Scotiellocystoidaceae
Genus: *Diplochloris* Korschikov, 1939
Diplochloris lunata (Fott) Fott, 1979 (Figure 2h)
Basionym: *Dichotomococcus lunatus* Fott, 1948
Synonym: *Dichotomococcus lunatus* Fott, 1948
Reference: (Huber- Pestalozzi, 1983; information pg. 675, figure 189/2)
Remarks: Colonies with two cells, cells touching with their convex longitudinal sides. Cells sickle-shaped, not twisted, rounded at the ends, 8 µm long, 3 µm wide. Found in LT.

Family: Chlamydomonadaceae
Genus: *Chlamydomonas* Ehrenberg, 1833
Chlamydomonas ampulla Skvortzov (Figure 2i)
Reference: (Huber- Pestalozzi, 1974; information pg. 432, figure 577)
Remarks: Cells spherical, 15 µm in diameter. Membrane without papilla. Chloroplast cup-shaped; pyrenoid narrow kidney-shaped, basal; stigma anterior. Found in LLA.

Chlamydomonas convexa Pascher, 1932 (Figure 2j)
Reference: (Huber- Pestalozzi, 1974; information pg. 256, figure 292)
Remarks: Cells ellipsoidal, 12.5 µm long, 10 µm wide. Membrane delicate, without particular papilla. Chloroplast cup-shaped; pyrenoid irregular; no stigma; two contractile vacuoles anterior. Found in LLA.

Class: Trebouxiophyceae
Order: Chlorellales
Family: Oocystaceae
Genus: *Scotiella* Fritsch, 1912
Scotiella tatrae Kol, 1965 (Figure 2k)
Reference: (Huber- Pestalozzi, 1983; information pg. 717, figure 200/1)
Remarks: Cells broad oval, 13 µm long, 9 µm wide. Anterior and posterior end sharply narrowing, cell wall spirally coiled. Found in LLA.

Division: Charophyta
Class: Conjugatophyceae

Order: Desmidiales
Family: Desmidiaceae
Genus: *Staurastrum* Meyen ex Ralfs, 1848
Staurastrum anatinum Cooke and Wills, 1881 (Figure 2l)
Reference: (John et al., 2003; information pg. 565, figure 139/J)
Remarks: Cells (2-)3(-4) radiate, 35 µm wide excluding processes, 65 µm wide with processes, 45 µm long excluding processes, 55 µm long with processes, deeply constricted with a wide open internally acute sinus, isthmus 15 µm wide, semicells mostly broadly cup-shaped; lateral margins moderately convex, apex slightly convex; angles usually considerably extended to form long, hollow, gradually attenuating, subparallel to divergent process terminating in 3 short, stout, divergent spines; processes with concentric rings of denticulations of variable prominence along length, continuing onto semicell body; denticulations on apex and each side of body often much enlarged, becoming short emarginate spines. Found in LT.

Division: Ochrophyta
Class: Chrysophyceae
Order: Chromulinales
Family: Dinobryaceae
Genus: *Pseudokephyrion* Pascher, 1913
Pseudokephyrion conicum Schiller, 1929 (Figure 3a, 3b)
Reference: (Huber- Pestalozzi, 1962; information pg. 200, figure 267)
Remarks: Lorica conical, yellow-brown in colour, 13 µm long, 12 µm wide. Posterior end slightly rounded. Flagella 2, unequal, the shorter one just over the edge of the lorica. Found in LT.

Division: Cryptophyta
Class: Cryptophyceae
Order: Pyrenomonadales
Family: Chroomonadaceae
Genus: *Chroomonas* Hansgirg, 1885
Chroomonas reflexa Kisselev, 1931 (Figure 3c)
Reference: (Huber- Pestalozzi, 1976; information pg. 34, figure 21)
Remarks: Cells ovate, sharpened and curved back of the posterior end, 23 µm long, 12 µm wide. Chloroplast, 2; inner part of the cell possessed starch grains. Found in LT.

Order: Cryptomonadales
Family: Cryptomonadaceae
Genus: *Cryptomonas* Ehrenberg, 1831
Cryptomonas tetrapyrenoidosa Skuja, 1948 (Figure 3d)
Reference: (Huber- Pestalozzi, 1976; information pg. 62, figure 45)
Remarks: Cells oval, 25 µm long, 15 µm wide. Anterior end obliquely rounded with a mostly shallow constriction on the ventral side. Posterior end wide, rounded. Periplast thin, colorless, smooth; flagella slightly unequal. Cytopharynx deep; trichocysts organized in longitudinal row; pyrenoid 4; nucleus posterior; chloroplast 2, brownish-olive, bowl-shaped. Found in LLA.

Cryptomonas paramaecium (Ehrenberg) Hoef-Emden and Melkonian, 2003 (Figure 3e)
Basionym: *Chilomonas paramaecium* Ehrenberg, 1831
Synonym: *Chilomonas paramaecium* Ehrenberg, 1831; *Trichoda paramaecium* Ehrenberg, 1830
Reference: (Huber-Pestalozzi, 1976; information pg. 70, figure 54)
Remarks: Cells elongated cylindrical, 35 µm long, 16 µm wide. Posterior end slightly narrowed and rounded; trichocysts organized as 8 long row in cytopharynx; flagella equal, about one-half cell length; nucleus slightly posterior. Found in LT.

Division: Euglenophyta
Class: Euglenophyceae
Order: Euglenales
Family: Phacaceae
Genus: *Phacus* Dujardin, 1841
Phacus polytrophos Pochmann, 1942 (Figure 3f)
Reference: (Huber-Pestalozzi, 1969; information pg. 186, figure 208)
Remarks: Cells elongated ovoid, 22 µm long, 10 µm wide. Anterior end slightly narrowing, posterior end narrowing to a sharp, straight tail-piece. Stigma large and mostly clear. Chloroplasts numerous, elliptical; paramylon bodies 2, elongated, large and thick. Found in LT.

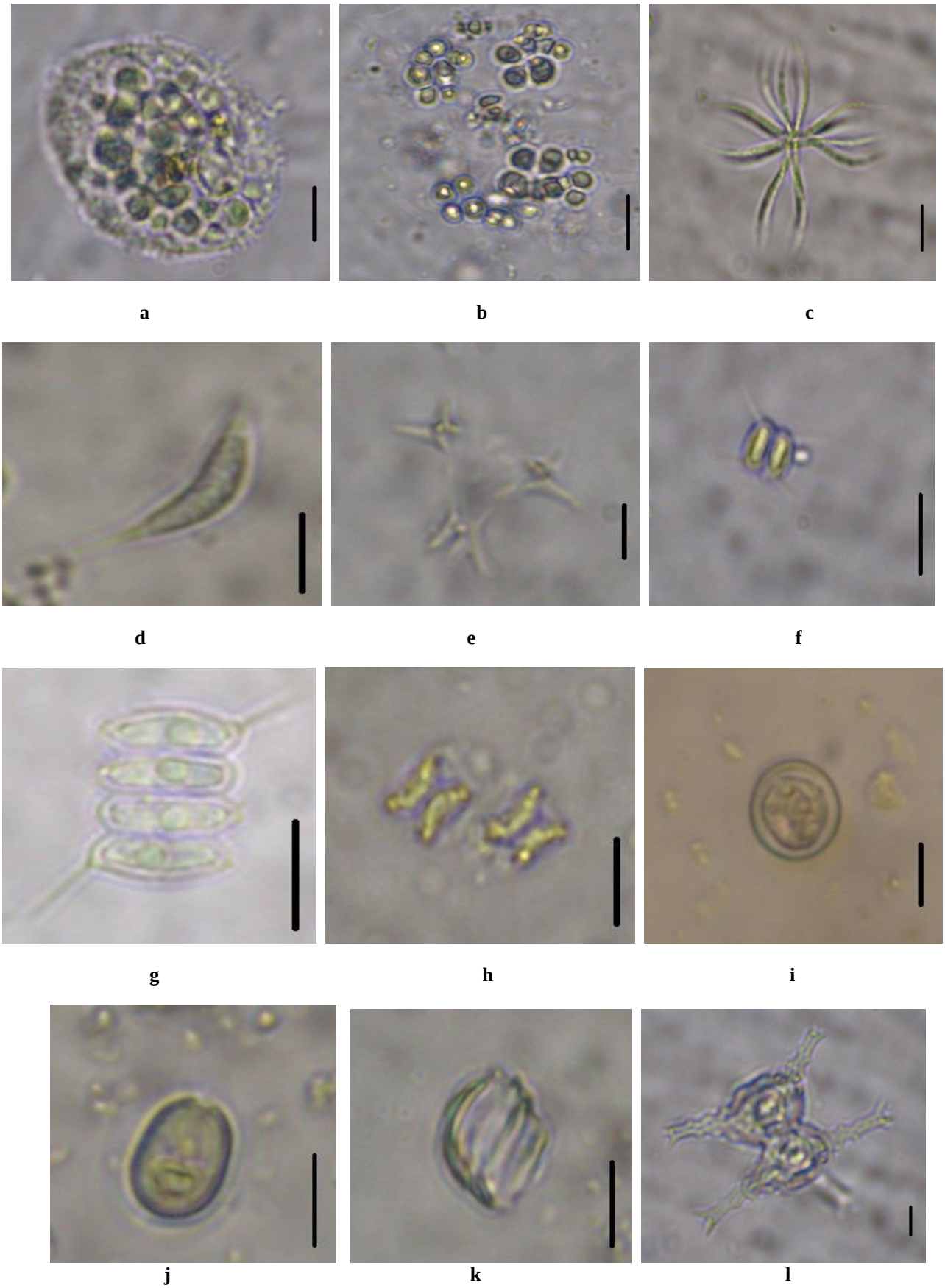

Figure 2. a. *Microcystis firma*, **b.** *Chroococcus aphanocapsoides*, **c.** *Ankistrodesmus bernardii*, **d.** *Monoraphidium subclavatum*, **e.** *Tetraëdron pusillum*, **f.** *Desmodesmus microspina*, **g.** *Scenedesmus heteracanthus*, **h.** *Diplochloris lunata*, **i.** *Chlamydomonas ampulla*, **j.** *Chlamydomonas convexa*, **k.** *Scotiella tatrae*, **l.** *Staurastrum anatinum* (Scale 10 μm)

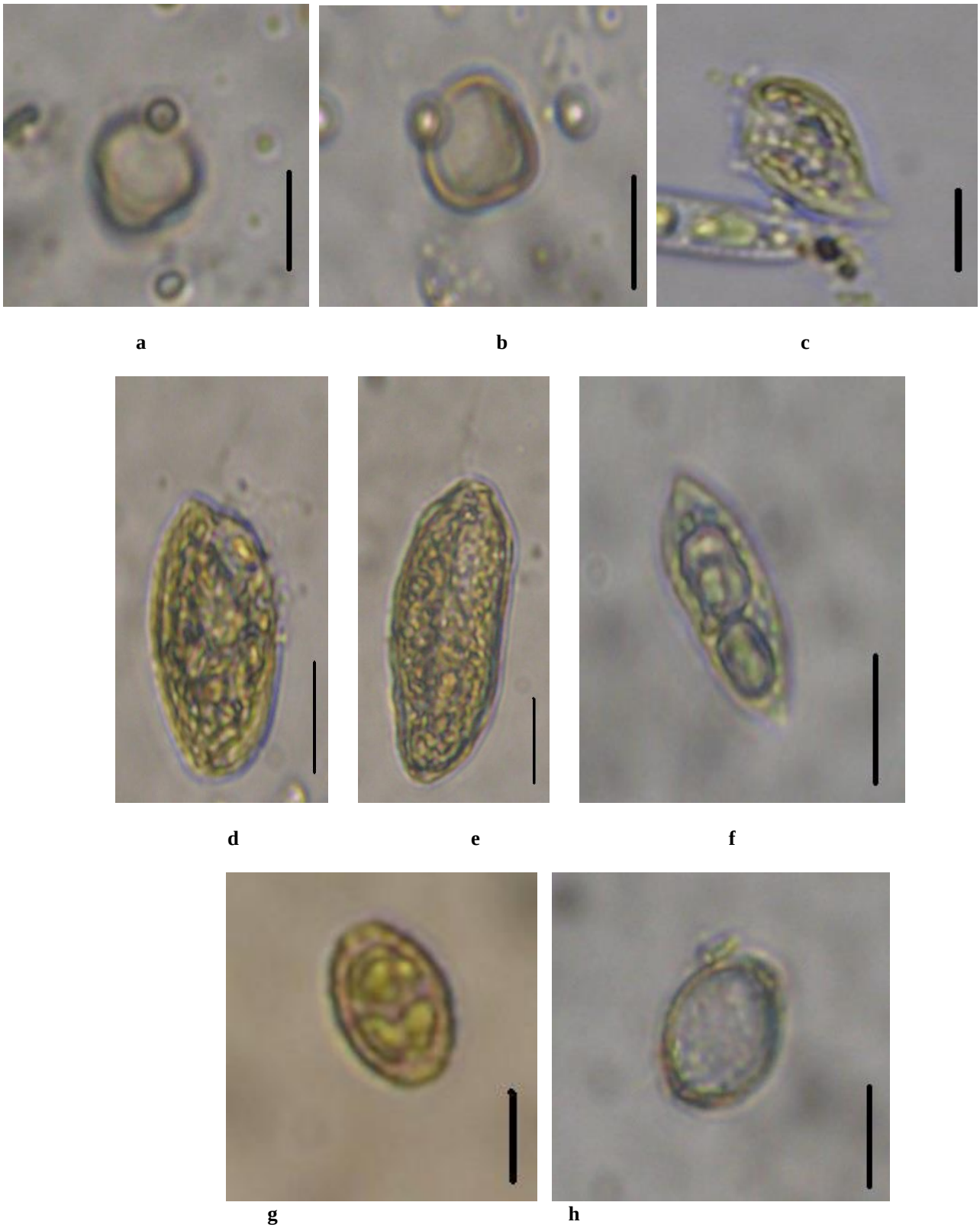

Figure 3. a.-b. *Pseudokephyrion conicum*, **c.** *Chroomonas reflexa*, **d.** *Cryptomonas tetrapyrenoidosa*, **e.** *Cryptomonas paramaecium*, **f.** *Phacus polytrophos*, **g.** *Trachelomonas eurystoma* var. *minuta*, **h.** *Trachelomonas hispida* var. *acuminata* (Scale 10 μm)

Family: Euglenaceae
Genus: *Trachelomonas*, Ehrenberg, 1835
Trachelomonas eurystoma Stein var. *minuta* Van Oye, 1927 (Figure 3g)
Reference: (Huber-Pestalozzi, 1969; information pg. 316, figure 614)

Remarks: Lorica 17 µm long, 10 µm wide, ellipsoidal. Wall serrate, yellowish brown. Anterior end with very short collar. Found in LT.

Trachelomonas hispida var. *acuminata* Deflandre, 1926 (Figure 3h)
Reference: (Huber-Pestalozzi, 1969; information pg. 296, figure 523)
Remarks: Lorica 15 µm long, 10 µm wide, ovoid, posterior end with conical bumps. Wall serrate, orange-brown. Found in LT.

4. Conclusions and discussion

A total of 19 taxa were determined as new records for Turkish freshwater algae in the divisions of Cyanobacteria, Chlorophyta, Charophyta, Ochrophyta, Cryptophyta and Euglenophyta. The division Chlorophyta contained the highest records with 9 taxa. These taxa are dispersed into genus *Ankistrodesmus*, *Monoraphidium*, *Tetraëdron*, *Desmodesmus*, *Scenedesmus*, *Diplochloris*, *Chlamydomonas* (2), which were widespread worldwide (John et al., 2003; Wehr and Sheath, 2003). It has been reported that the species belonging to these genera were cosmopolitan in lakes, ponds, reservoirs, and stagnant and slow flowing running waters in Turkey (Gonulol et al., 1996; Aysel, 2005; Celekli et al., 2007a, b; Celik and Ongun, 2008; Sevindik, 2010; Sevindik and Çelik, 2012; Sevindik et al., 2015). Only one species in genus *Scotiella* was rare in distribution (Huber- Pestalozzi, 1983). All new records of genus *Chlamydomonas* were found in LLA which were more eutrophic. *Chlamydomonas* species are abundant in small, very or extremely nutrient rich waters, particularly in the spring and early summer (John et al., 2003). It was reported that *Ankistrodesmus bernardii* was in association with aquatic macrophytes, however we found it in plankton. It was reported in Romania, Spain, Brazil, Cuba, and Southeast Asia (Huber- Pestalozzi, 1983; Guiry and Guiry, 2017). *Monoraphidium subclavatum* was reported as planktonic and found in Germany, Romania, Brazil and Denmark (Huber-Pestalozzi, 1983; Guiry and Guiry, 2017). *Tetraëdron pusillum* was reported in North America, Pakistan, China and India (Philipose, 1967; Guiry and Guiry, 2017). *D. microspina* was probably cosmopolitan and widely distributed in Europe and also reported in Iceland, Cuba, Argentina (John et al., 2003; Guiry and Guiry, 2017). *Diplochloris lunata* distributed in Britain, Germany, Spain, Taiwan, while, *Scenedesmus heteracanthus* in Europe, South America, Africa and India (Huber- Pestalozzi, 1983; Guiry and Guiry, 2017).

Microcystis firma was reported as planktic in stagnant waters of Europe and Australia; and widespread especially in North Europe (Komarek and Anagnostidis, 1999; Guiry and Guiry, 2017). *Chroococcus aphanocapsoides* was found in oligo - mesotrophic lakes and distributed in Baltic Sea, Lithuania, Spain, Australia (Komarek and Anagnostidis, 1999; Guiry and Guiry, 2017).

Staurastrum anatinum was reported as cosmopolitan, and distributed in the plankton of poor to nutrient-enriched lakes in Europe, America, Asia and Australia. It preferred alkaline waters (John et al., 2003; Guiry and Guiry, 2017). We found this species in LT, and pH ranged between 8.27 and 9.17. It was known that members of Desmidiales were common in eutrophic and mesotrophic alkaline lakes in Turkey (Gonulol and Comak, 1993).

The genus *Pseudokephyrion* (Ochrophyta) and its species *Pseudokephyrion conicum* were both reported as a new record for the first time for algal flora of Turkey. *Pseudokephyrion conicum* was recorded in Germany, Spain, Austria and New Zealand (Guiry and Guiry, 2017). It observed only during the flood in various fresh waters (Huber-Pestalozzi, 1962) especially in spring (John et al., 2003). We found this species in early spring (March).

Members of Cryptophyta occurred in very different kinds of freshwater environments, some were favored by waters rich in organic substances and several were more common during the colder months of the year (John et al., 2003). Cryptophytes were reported in Çaygören and İkizcetepeler reservoirs, Ladik, Akgöl and Mollaköy lakes and Danamandıra Ponds (Maraşlıoğlu et al., 2005; Ersanlı et al., 2006; Sevindik, 2010; Sevindik et al., 2011, 2015). *Chroomonas reflexa* was described as characteristic species of some typical ponds in Central Asia (Huber- Pestalozzi, 1976). *Cryptomonas tetrapyrenoidosa* was recorded in Europe, North America and Japan, while, *C. paramaecium* in Europe, America, Asia, Australia (Guiry and Guiry, 2017).

The division Euglenophyta contains three new records in the genus of *Trachelomonas* and *Phacus*; and all of them were found in LT. *Phacus* and *Trachelomonas* mostly occur in stagnant waters of puddles, ponds, swamps, ditches and lakes, especially in waters with high levels of organic nutrients (Prescott, 1962; Say and Whitton 1980; John et al., 2003). *Phacus polytrophos* was found in Europe, America, Africa, Asia while, *Trachelomonas eurystoma* var. *minuta* was reported in Belgium and Congo. *Trachelomonas hispida* var. *acuminata* was recorded in Brazil and France (Huber-Pestalozzi, 1969; Guiry and Guiry, 2017). *Trachelomonas* species were found widespread in both shallow lakes and reservoirs of Turkey (Gonulol et al., 1996; Aysel, 2005; Ersanlı et al., 2006; Soylu et al., 2007; Celekli et al., 2007a, b; Sevindik et al., 2015).

In conclusion, 19 new records were added to freshwater algal flora of Turkey with this study. It was observed that these taxa were distributed different regions in the world. Number of new records for algal flora of Turkey is expected to increase in the future.

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