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Thirty new records for Turkish freshwater algal flora from Danamandıra Ponds (Silivri, İstanbul) and North Mollaköy Lake (Sakarya)

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Abstract

Thirty new records for the freshwater algal flora of Turkey were determined in studies conducted from August 2012 to June 2013 in Danamandıra Ponds, Silivri, İstanbul and from July 2012 to June 2013 in North Mollaköy Lake, Sakarya, Turkey. Among these new records, 13 were Chlorophyta, 2 were Charophyta, 5 were Euglenophyta, 3 were Cryptophyta, 2 were Cyanobacteria, 3 were Dinophyta, and 2 were Ochrophyta.

Key words: Danamandıra Ponds, North Mollaköy Lake, New record, Algae, Turkey

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Danamandıra Göletleri'nden (Silivri, İstanbul) ve Kuzey Mollaköy Gölü'nden (Sakarya) Türkiye tatlı su alg florası için otuz yeni kayıt

Özet

Danamandıra Göletleri'nde (Silivri, İstanbul) ve Kuzey Mollaköy Gölü'nde (Sakarya) Temmuz 2012 ve Haziran 2013 tarihleri arasında yapılan çalışmada Türkiye tatlı su alg florası için 30 yeni kayıt teşhis edilmiştir. Tespit edilen taksonların 13 tanesi Chlorophyta, 2 tanesi Charophyta, 5 tanesi Euglenophyta, 3 tanesi Cryptophyta, 2 tanesi Cyanobacteria, 3 tanesi Dinophyta ve 2 tanesi Ochrophyta gruplarına aittir.

Anahtar kelimeler: Danamandıra Göletleri, Kuzey Mollaköy Gölü, Yeni Kayıt, Alg, Türkiye

1. Introduction

Formerly, check-lists were published about the freshwater algal flora of Turkey at different times (Gönülol et al., 1996; Aysel, 2005; Şahin, 2002, 2005). However, fresh water algal researches have been progressing rapidly in Turkey (Maraşlıoğlu et al., 2011; Yerli et al., 2012; Atıcı and Alaş, 2012) and new records were given for the algal flora in various dates (Atıcı, 2002; Baykal et al., 2009, Sevindik et. al., 2010; Sevindik et al., 2011; Baykal et al., 2012). In addition to these, one review was performed about the investigations on diatoms in Turkish inland waters (Solak et al., 2012). With new records, contributions to the algal flora are increasing with each passing day. However, there are many wetlands which should be studied. For this reason, the total list of the algal flora of Turkey has not yet been completed. It is obvious that with new researches, total number of algal taxa will increase in the future. 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. Danamandıra ponds

Danamandıra ponds (DP) are located Turkey's northwest, in Silivri peninsula, 27 km from the shore of Marmara, 20 km from the shore of Black Sea**.** In this area, there are two ponds which are called as big (DP 1) and little

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ponds (DP 2). Big DP (41°17'53"N and 28°13'9"E) lie at 187 m above the sea level and has a surface area of 0.295 km^2, drainage area of 0.656 km^2, length of 1033 m and a maximum depth of 1.3 m. Little DP (41018'39"N and 28012'46"E) lie at 204 m above the sea level and has a surface area of 0.185 km^2, drainage area of 0.699 km^2, length of 850 m and a maximum depth of 1 m. These ponds are fed by Süpürgetarla stream. Dense macrophyte (*Phragmites sp.)* development was seen on the coasts of ponds. 5 stations were chosen in the ponds. First 4 were selected in big ponds while other one in little pond (Figure 1).

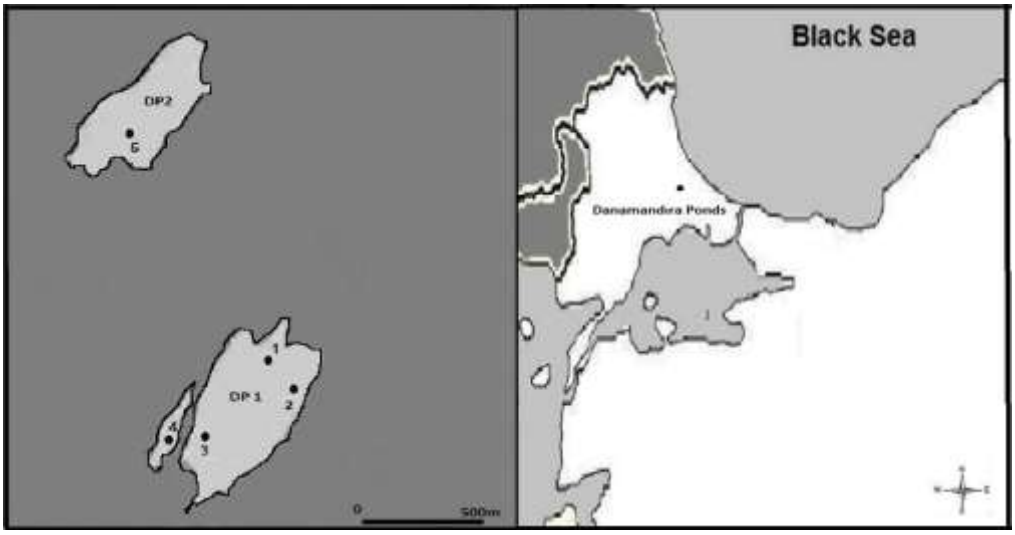

Figure 1. The map of the Danamandıra ponds and the location of sampling stations

2.1.2. North Mollaköy Lake: Mollaköy Lakes (40º 41' N, 30º 24'E) lie 40 m above the sea level and are located on the east bank of lower Sakarya River and consist of 9 small lakes. This study was carried out in North Mollaköy Lake (NML) which has a length of 2.1 km and a surface area of 2.8 km^2. It contains 4 small lakes connected to each other with small channels. 4 stations were chosen, considering the partitioned morphology of the lake. The first and second stations have a minimum depth of 1 m and maximum depth of 3 m. The third station was chosen at the middle part and water level range is between 2 to 5 m. The fourth station was selected at the deepest part and water level range is between 8 to 15 m (Figure 2).

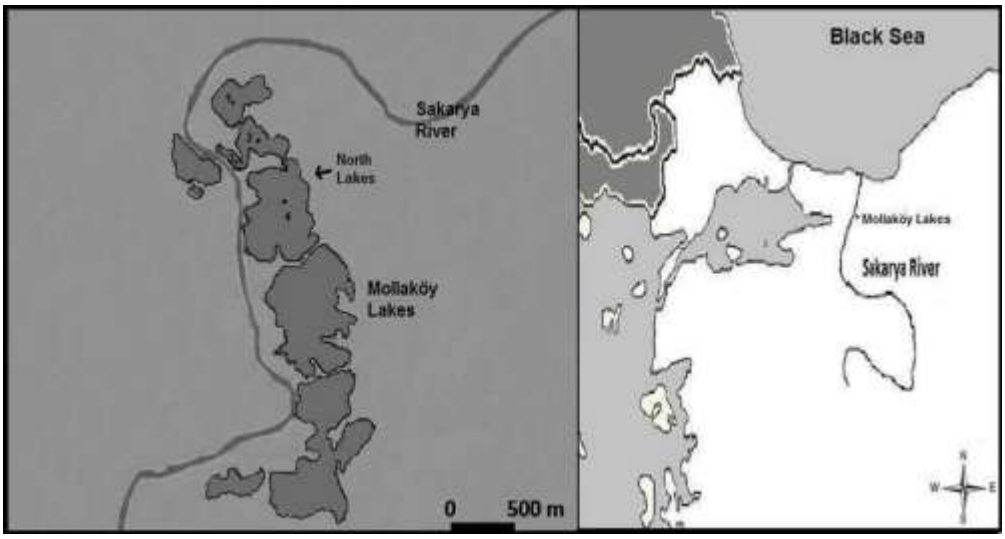

Figure 2. The map of the North Mollaköy Lake and the location of sampling stations

2.2. Sampling and Identification

The samples were taken from five stations of DP and four stations of NML from 10 cm below the surface of the pelagic zone, between August 2012 to June 2013 and July 2012 to June 2013, respectively. 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, 2008); Coesel and Meesters (2007); Peerapornpisal (2005). 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) and Şahin (2002, 2005), determined as new taxa for Turkish algal flora. Taxonomy of algae was controlled for current accepted status of the species from http://www.algaebase.org (Guiry and Guiry, 2015) and http://www.turkiyealgleri. org (Gönülol, 2015) web sites.

2.3. Environmental Variables

Specific conductance, total dissolved solid, pH, dissolved oxygen; salinity and water temperature were measured from 10 cm below the surface using a YSI ProPlus water quality instrument. Water transparency was measured on each sampling date using a Secchi disk. Concentrations of nitrate-nitrogen, nitrite-nitrogen, total phosphorus, orthophosphate and sulfate were determined spectrophotometrically with Shimadzu UV mini – 1240 according to Strickland and Parsons (1972) and Technicon Industrial Methods (1977 a, b). Chlorophyll-a was determined via extraction with 90% methanol spectrophotometrically (Youngman, 1978). Chemical oxygen demand (COD) and biological oxygen demand (BOD) were determined according to APHA (1995).

3. Results

Environmental variables of DP and NML waters are given in Tablo 1 and Table 2. COD and BOD values were measured only in DP.

Table 1. The mean and standard deviation (SD) of environmental variables measured at the sampling sites of the Danamandıra Ponds water during study period.

Variable	Station 1 (Mean±SD)	Station 2 (Mean±SD)	Station 3 (Mean±SD)	Station 4 (Mean±SD)	Station 5 (Mean±SD)
Temperature (ºC)	16.3±4.51	17.6±3.21	17.2±4	18.1±3.71	18.3±3.31
Specific conductance (µScm^{-1})	164.75±5.21	160.75±6.31	163.65±4.51	139.75±61	110.75±5.51
Dissolved oxygen (mgL^{-1})	7.65±0.21	7.56±0.96	7.4±0.21	11.13±1.71	13.03±2.07
Total dissolved solid (mgL^{-1})	105.63±9.41	101.4±6.71	102.1±4.51	86.13±2.31	64.03±4.51
pH	7.77±0.68	7.74±0.24	7.76±0.13	9.94±0.08	7.71±1.86
Secchi Disk Depth (cm)	62.50±3.59	50±5.51	80±9.51	42.50±6.51	32.50±8
Orthophosphate (mgL^{-1})	0.0046±0.002	0.0041±0.0015	0.0027±0.001	0.008±0.006	0.007±0.006
Total phosphorus (mgL^{-1})	0.005±0.002	0.0046±0.002	0.0051±0.0015	0.01±0.005	0.014±0.007
Nitrate-nitrogen (mgL^{-1})	0.086±0.091	0.102±0.031	0.079±0.05	0.147±0.03	0.033±0.02
Nitrite-nitrogen (mgL^{-1})	0.0021±0.001	0.0017±0.001	0.0016±0.001	0.0041±0.003	0.0037±0.004
Sulphate (mgL^{-1})	16.07±0.52	14.72±4.71	13.21±4.59	22.02±4.29	23.5±5.51
Chlorophyll-a (µgL^{-1})	8.51±0.71	8.11±1.51	8.30±0.41	12.11±1.39	14.11±0.69
Salinity (ppt)	0.075±0.02	0.07±0.014	0.07±0.014	0.06±0.01	0.045±0.02
Chemical oxygen demand (mgL^{-1})	151.50±12.50	152.50±11.60	152.50±11.60	162.50±9.40	212.51±8.30
Biological oxygen demand (mgL^{-1})	49±12.71	50±14.0	50±14.0	55±7.01	69±12.70

Table 2. The mean and standard deviation (SD) of environmental variables measured at the sampling sites of the North Mollaköy Lake water during study period.

Variable	Station 1 Mean±SD	Station 2 Mean±SD	Station 3 Mean±SD	Station 4 Mean±SD
Temperature (ºC)	19.37±8.32	18.04±8.09	19.21±8.20	19.41±8.49
Specific conductance (µScm^{-1})	763.66±124.51	773.75±143.54	763.6±99.77	724.5±105.29
Dissolved oxygen (mgL^{-1})	11.88±4.35	9.82±2.26	10.75±4.06	11.33±5.41
Total dissolved solid (mgL^{-1})	567.51±51.19	593.11±104.52	551.81±48.09	528.87±33.14
pH	8.64±0.23	8.58±0.22	8.67±0.22	8.69±0.28
Secchi Disk Depth (cm)	106.66±26.31	96.66±26.31	112.51±47.69	133.31±60.95
Orthophosphate (mgL^{-1})	0.012±0.01	0.013±0.01	0.012±0.01	0.021±0.01
Total phosphorus (mgL^{-1})	0.015±0.01	0.016±0.008	0.014±0.01	0.025±0.008
Nitrate-nitrogen (mgL^{-1})	1.69±1.61	2.21±2.11	1.36±0.93	1.63±1.51
Nitrite-nitrogen (mgL^{-1})	0.0046±0.004	0.0059±0.001	0.0041±0.003	0.0041±0.003
Sulphate (mgL^{-1})	128.11±55.62	171.89±85.22	167.67±62.33	139.25±86.22
Chlorophyll-a (µgL^{-1})	8.49±4.47	5.51±4.45	6.88±5.29	7.86±4.45
Salinity (ppt)	0.39±0.11	0.42±0.034	0.42±0.041	0.41±0.028

A total number of new records for freshwater algal flora of Turkey are 30; Chlorophyta 13, Charophyta 2, Euglenophyta 5, Cryptophyta 3, Cyanobacteria 2, Dinophyta 3, and Ochrophyta 2 taxa are listed below.

Division: Chlorophyta
Class: Chlorophyceae
Order: Sphaeropleales
Family: Scenedesmaceae
Genus: *Desmodesmus* (Chodat) An, Friedl, Hegewald, 1999
D. dispar (Brebisson) Hegawald, 2000 (Figure 3a)
Basionym: *Scenedesmus dispar* Brebisson, 1868
Synonym: *S. dispar* Brebisson, 1868
(Huber-Pestalozzi, 1983; John et al 2003)
Coenobia of 4 slightly alternately arranged and tightly packed cells, cells 17 µm long, 5 µm wide, elongate-ovoid, tapering to rounded or polygonal apices bearing 2 short spines, with spines arising laterally on apices and diagonally opposite on adjacent cells and lying almost perpendicular to long axis of coenobia, spines on adjacent cells often facing in opposite direction. Found at St 4 of DP.

Genus: *Pectinodesmus* Hegewald, Wolf, Keller, Friedl and Krienitz, 2010
P. regularis (Svirenko) Hegewald, Wolf, Keller, Friedl and Krienitz, 2010 (Figure 3b)
Basionym: *Scenedesmus regularis* Svirenko, 1924
Synonym: *S. regularis* Svirenko, 1924
(Huber-Pestalozzi, 1983)
Cells asymmetric, thin, fusiform, includes finger-like spines and terminate conical. The outer ends of the inner cells more curved at the ends. Cells 14 µm long, 4 µm wide. Found at St 1, St 2, St 3, St 4 of NML.

Family: Selenastraceae
Genus: *Quadrigula* Printz, 1916
Q. closterioides (Bohlin) Printz, 1916 (Figure 3c)
Basionym: *Nephrocytium closterioides* Bohlin, 1897
Synonyms: *N. closterioides* Bohlin, 1897; *Ankistrodesmus closterioides* (Bohlin) Printz, 1914
(Huber-Pestalozzi, 1983;John et al 2003)
Coenobia 4 celled, cells in groups of 4 with their long axes, lying paralel to one another. Cells cylindrically spindle-shaped, slightly curved, narrowing abruptly to short and blunt apices. Chloroplasts are small. Cells 20 µm long, 4 µm wide. Found at St 1, St 2, St 3 of DP.

Family: Characiaceae
Genus: *Characium* Kützing,1849
C. conicum Korshikov, 1953 (Figure 3d)
(Huber-Pestalozzi, 1983)
Cells typically oval, 13 µm long, 7 µm wide. Basal portion large and round, upper part conical, cell wall thin, pyrenoid close to the nucleus. Found at St 2, St 3, St 4 of NML.

Family: Hydrodictyaceae
Genus: *Tetraedron* Kützing, 1845
T. proteiforme (Turner) Brunnthaler, 1915 (Figure 3e)
Basionym: *Polyedrium proteiforme* Turner, 1892
Synonym: *P. proteiforme* Turner, 1893
(Philipose, 1967)
Cells 3 cornered, angles drawn out and ending in a long spine; in side view more or less acicular. Three-angled cells

30 µm in diameter with spines. Found at St 1, St 2, St 3, St 4 of DP.

Order: Chlamydomonadales
Family: Chlamydomonadaceae
Genus: *Chlamydomonas* Ehrenberg, 1833
C. lunata Pascher and Jahoda, 1958 (Figure 3f)
(Huber-Pestalozzi, 1974)
Cells long elliptical-oval, slightly curved, 14 µm long, 9 µm wide. Membrane thickened in the papilla. Nucleus at anterior. Found at St 1, St 3 of NML.

C. heterogama Gerloff, 1940 (Figure 3g)
(Huber-Pestalozzi, 1974)
Cells ellipsoidal, 20 µm long, 17 µm wide. Chloroplast cup-shaped, large. Papilla present, broad with flattened apex; a pyrenoid anterio-posteriorly depressed, at posterior half of the cell body; nucleus at anterior. Found at St 4 of NML.

C. muriella Lund, 1947 (Figure 3h)
(Huber-Pestalozzi, 1974;John et al 2003)
Cells oval, 12 µm long, 10 µm wide. Papilla not recognizable. Chloroplast cup-shaped, pyrenoid located at posterior half of the cell body. Found at St 2 of NML.

C. praecox Pascher, 1943 (Figure 3i)
(Huber-Pestalozzi, 1974)
Cells spherical, 19 µm in diameter. Membrane rigorous, sometimes slightly yellowish green. Pyrenoid irregular. Stigma irregular and located at the front end of chloroplast. Chloroplast rough and pot-shaped. Found at St 4 of NML.

C. proboscigera Korshikov, 1927 (Figure 4a)
Synonyms: *C. subglobosa* Pringsheim, 1930; *C. sphaeroides* Gerloff, 1940; *C. iyengarii* Mitra, 1950
(Huber-Pestalozzi, 1974; John 2003)
Cells ellipsoidal, 20 µm long, 18 µm wide. Membrane fragile, conical papilla present, chloroplast cup-shaped, pyrenoid located at posterior half of the cell body, stigma elliptical, anterior. Found at St 3 of NML.

C.proboscigera var. *conferta* (Korshikov) Ettl, 1965 (Figure 4b)
Basionym: *C. conferta* Korshikov
Synonym: *C. conferta* Korshikov
(Huber-Pestalozzi, 1974; Jonh et al 2003)
Cells spherical, 14 µm in diameter. Chloroplast cup-shaped, pyrenoid located at the centre of the cell body. Two contractile vacuole located at anterior. Found at St 1, St 2, St 3, St 4 of NML.

Genus: *Vitreochlamys* Batko, 1970
V. fluviatilis (Stein) Batko, 1970 (Figure 4c)
Basionym: *Chlamydococcus fluviatilis* Stein, 1878
Synonyms: *C. fluviatilis* Stein, 1878; *Sphaerellopsis crassicauda* Korshikov, 1925
(Huber-Pestalozzi, 1974)
Cells ellipsoidal, 16 µm long, 11 µm wide, about 1.5 times as long as wide, envelope broad, about half width of protoplast, hyaline; protoplast usually pear-shaped; chloroplast cup-shaped, with basal pyrenoid and apical eyespot. Found at St 2, St 3, St 4 of NML.

Class: Trebouxiophyceae
Order: Chlorellales
Family: Chlorellaceae
Genus: *Closteriopsis* Lemmermann,1899
C. longissima var. *tropica* West and G.S.West, 1905 (Figure 4d)
(Huber-Pestalozzi, 1983;John et al 2003)
Thalli unicellular, not embedded in mucilage envelope. Cells fusiform, straight, 180 µm long, 4 µm wide, slightly rounded at both ends. Sequential band-shaped chloroplast occurs as straight. Found at St 3 of NML.

Division: Charophyta
Class: Conjugatophyceae
Order: Desmidiales
Family: Desmidiaceae
Genus: *Octacanthium* (Hansgirg) Compère, 1996
O. bifidum (Brébisson) Compère, 1996 (Figure 4e)
Basionym: *Arthrodesmus bifidus* Brébisson 1856
Synonyms: *A. bifidus* Brébisson 1856; *Xanthidium bifidum* (Brébisson) Deflandre 1929
(John et al., 2003)
Cells 12 µm long, 10 µm wide. Isthmus 4 µm wide. Apices slightly concave and angles of semicells diverging upwards, with each lateral angle widely emarginate and bifid. Found at St 1, St 2, St 3, St 4 of DP.

Genus: *Cosmarium* Corda ex Ralfs, 1848
C. polygonatum Halász, 1940 (Figure 4f)
(Coesel and Meesters, 2007)
Cells are very small, 13 µm long, 11 µm wide, isthmus 7 µm wide. Sinus moderately deep, narrow, linear; semicells subkidney shaped with flat base; lateral margins convex. Found at St 1, St 2, St 3, St 4 of NML.

Division: Euglenophyta
Class: Euglenophyceae
Order: Euglenales
Family: Euglenaceae
Genus: *Trachelomonas* Ehrenberg, 1835
T. oblonga var. *angusta* Huber-Pestalozzi, 1955 (Figure 4g)
(Huber-Pestalozzi, 1969)
Lorica 14 µm long, 7 µm wide, narrowly ovoid. Wall smooth and yellow in color, porus with circular thickening. Found at St 1 of DP.

T. vas Deflandre, 1927 (Figure 4h)
(Huber-Pestalozzi, 1969)
Lorica 26 µm long, 15 µm wide; ovoid, anterior end with a cylindrical collar (3 × 3 µm). Wall smooth, dark brown. Found at St 5 of DP.

T. volzii Lemmermann var. *cylindracea* Playfair, 1915 (Figure 4i)
Synonyms: *T. paludosa* Skvortzov, 1927
(Huber-Pestalozzi, 1969)
Lorica 35 µm long, 15 µm wide; cylindrical, anterior end with a cylindrical collar (5 × 3 µm). Wall smooth. Found at St 2, St 3 of DP.

Genus: *Euglena* Ehrenberg, 1830
E. rubra Hardy, 1911 (Figure 5a)
(Huber-Pestalozzi, 1969; John et al 2003)
Lorica 85 µm long, 27 µm wide; cylindrical. Posterior end rapidly tapering to a conical pointed cauda (10 × 5 µm). Nucleus posterior; paramylum bodies ovoid. Found at St 5 of DP.

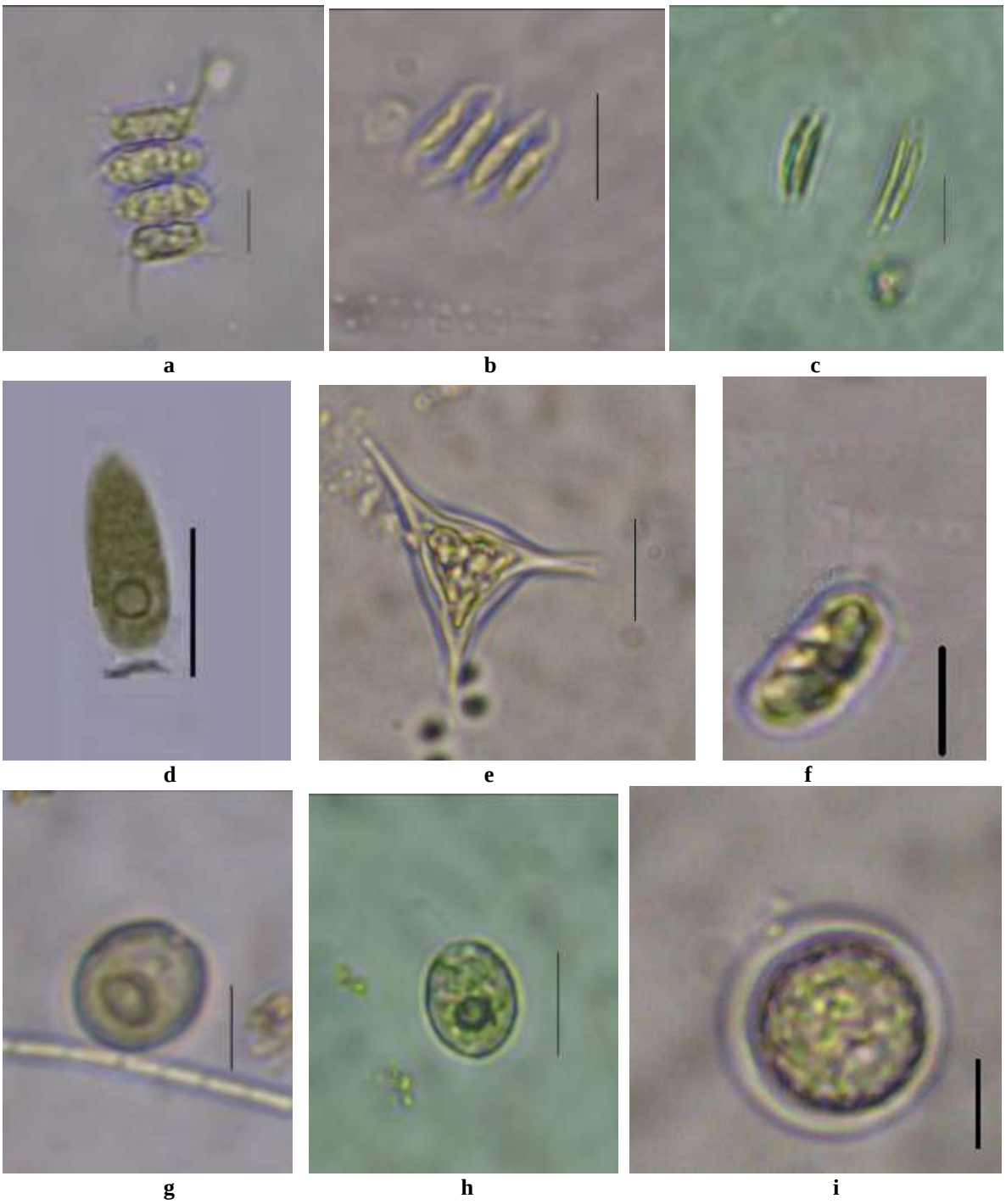

Figure 3. **a.** *Desmodesmus dispar*, **b.** *Pectinodesmus regularis*, **c.** *Quadrigula closterioides*, **d.** *Characium conicum*, **e.** *Tetraedron proteiforme*, **f.** *Chlamydomonas lunata*, **g.** *Chlamydomonas heterogama*, **h.** *Chlamydomonas muriella*, **i.** *Chlamydomonas praecox* (Scale 10 μm)

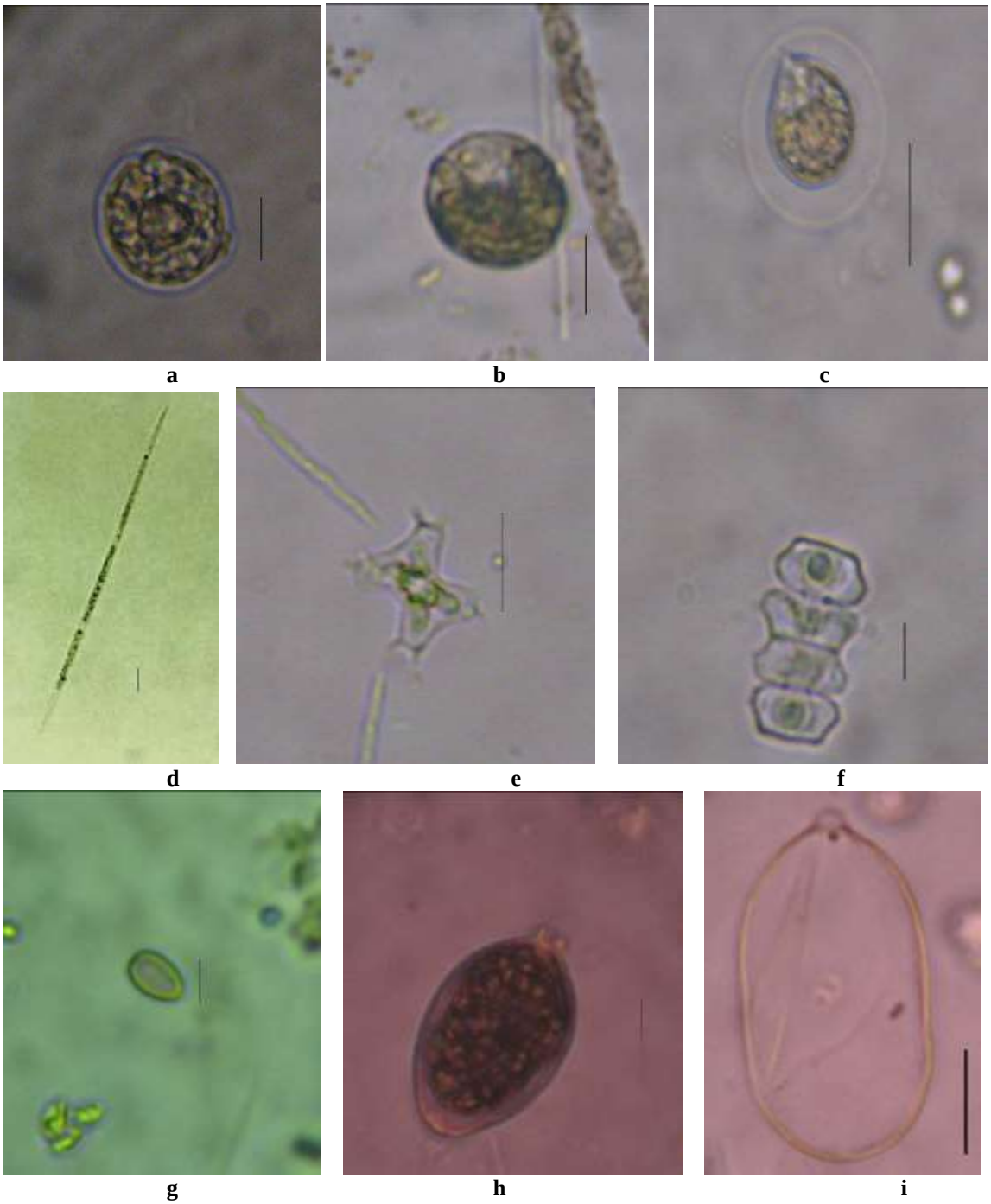

Figure 4. **a.** *Chlamydomonas proboscigera*, **b.** *Chlamydomonas proboscigera* var. *conferta*, **c**. *Vitreochlamys fluviatilis*, **d.** *Closteriopsis longissima* var. *tropica*, **e.** *Octacanthium bifidum*, **f.** *Cosmarium polygonatum*, **g.** *Trachelomonas oblonga* var. *angutsa*, **h.** *Trachelomonas vas*, **i.** *Trachelomonas volzii* var. *cylindracea* (Scale 10 µm)

Family: Phacaceae
Genus: *Phacus* Dujardin, 1841
P. vigueri Allorge and Lefèvre, 1925 (Figure 5b)
(Huber-Pestalozzi, 1969)
Cells broadly ovate, thick cross section, biconvex, 24 µm long, 20 µm wide; posterior spine very short and wide; periplast with longitudinal line; has 2 large paramylon. Found at St 3 of NML.

Division: Cryptophyta
Class: Cryptophyceae
Order: Cryptomonadales
Family: Cryptomonadaceae
Genus: *Cryptomonas* Ehrenberg, 1831
C. parapyrenoidifera Skuja (Figure 5c)
(Huber-Pestalozzi, 1976)
Cells 17 µm long, 8 µm wide; thick, often with a moderate degree of lateral compression, anterior end with a slight, acute, dorsal protuberance and 2 refringent bodies, posterior end rounded; flagella equal, as long as the cell, chloroplasts 2 per cell, olive green in color. Found at St 1, St 2, St 3 of DP.

Order: Pyrenomonadales
Family: Chroomonadaceae
Genus: *Chroomonas* Hansgirg, 1885
C. pochmannii Huber-Pestalozzi, 1950 (Figure 5d)

(Huber-Pestalozzi, 1976)
Cells 13 µm long, 10 µm wide, oval, anterior end curved and wide, posterior end rounded. Contractile vacuole anterior, pyrenoid thick, located below the center of the cell, nucleous posterior. Found at St 1, St 4 of NML.

Genus: *Komma* Hill,1991
K. caudata (Geitler) Hill 1991 (Figure 5 e)
Basionym: *Chroomonas caudata* Geitler, 1924
Synonyms: *C. caudata* Geitler, 1924; *C. acuta* Utermöhl, 1925
(Huber-Pestalozzi, 1976;John 2003)
Cells 11 µm long, 3.5 µm wide, anterior end rounded and acute, posterior end forming a ventrally bent tail. Flagella slightly uniequal, the longer one roughly as long as cell. Pyrenoid in a dorsal position, roughly mid-way between centre and anterior end, nucleous posterior. Found at St 2 of NML.

Division: Cyanobacteria
Class: Cyanophyceae
Order: Synechococcophycideae
Family: Merismopediaceae
Genus: *Merismopedia* Meyen, 1839 (Figure 5 f)
M. warmingiana Lagerheim, 1883
(Komarek and Anagnostidis, 1999)
Colonies small, regular, flat, in 12 µm dimensions, with more or less densely arranged (16 cells). Grouped in tetrads within colony. Cell spherical, pale blue-green, 1 µm in diameter. Found at St 1, St 2, St 3, St 4, St 5 of DP.

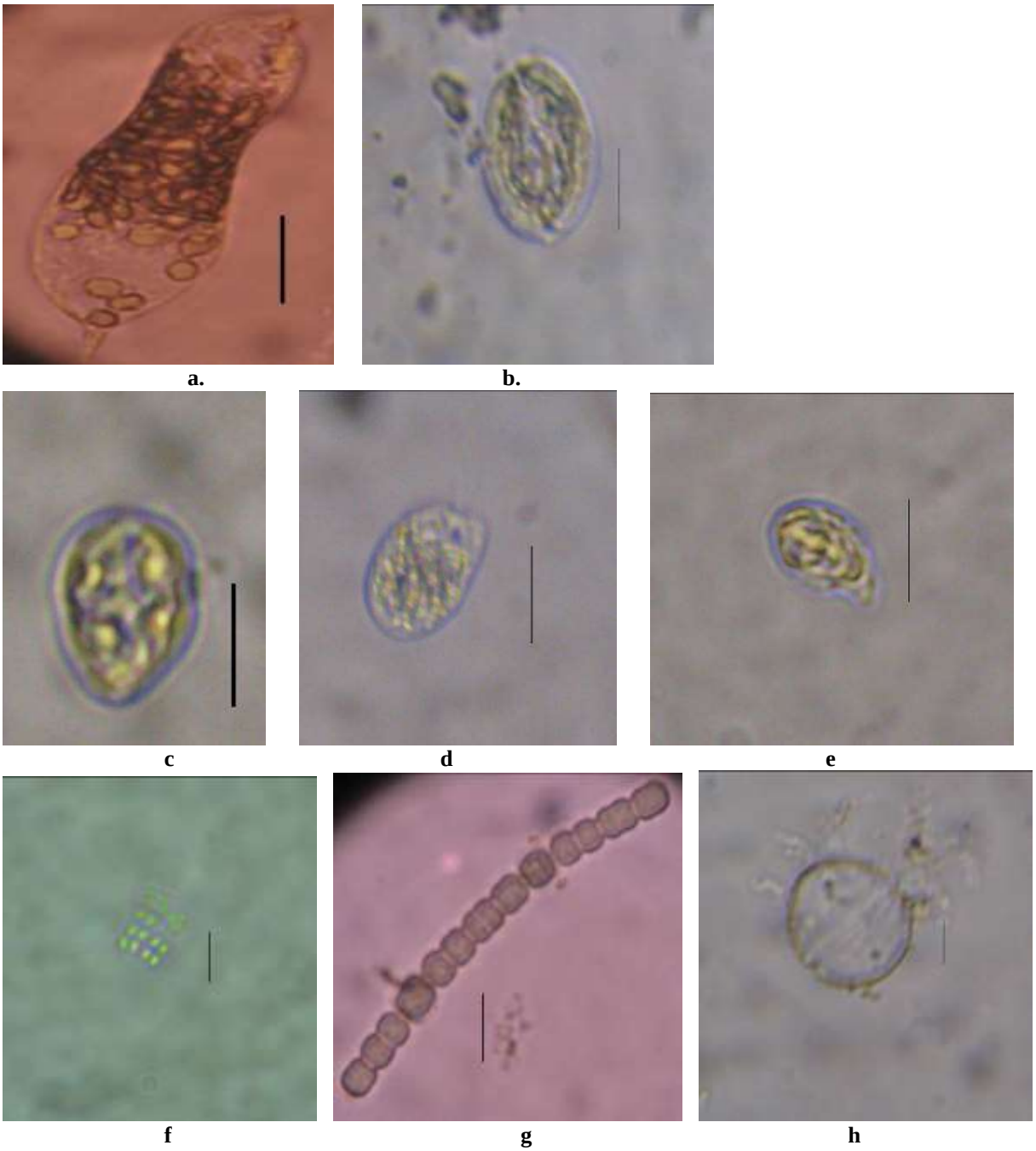

Figure 5 . **a.** *Euglena rubra*, **b.** *Phacus vigueri*, **c.** *Cryptomonas parapyrenoidifera*, **d.** *Chroomonas pochmannii*, **e.** *Komma caudata*, **f.** *Merismopedia warmingiana*, **g.** *Komvophoron crassum*, **h.** *Tovellia coronata* (Scale 10 µm)

Order: Oscillatoriales
Family: Borziaceae
Genus: *Komvophoron* Anagnostidis and Komárek, 1988
K. crassum (Vozzhennikova) Anagnostidis and Komárek, 1988 (Figure 5g)
Basionym: *Pseudanabaena crassa* Vozzhennikova, 1953
Synonym: *P. crassa* Vozzhennikova, 1953
(Komarek and Anagnostidis, 2008)
The trichomes short, generally 20 to 30 celled rarely with more cells. Slightly curved, distinctly constricted at the thick, hyaline cross-walls. Apical cells rounded. Cells short-cylindrical, 5 µm long, 4 µm wide. Found at St 1 of NML.

Division: Dinophyta
Class: Dinophyceae
Order: Gymnodiniales
Family: Tovelliaceae
Genus: *Tovellia* Moestrup, Lindberg and Daugbjerg, 2005
T. coronata (Woloszynska) Moestrup, Lindberg and Daugbjerg, 2005 (Figure 5h)
Basionym: *Gymnodinium coronatum* Woloszynska, 1917
Synonyms: *G. coronatum* Woloszynska, 1917; *Woloszynskia coronata* (Woloszynska) Thompson, 1951
(Huber-Pestalozzi, 1976)
Cells spherical, behind and front sides equal, 28 µm long, 26 µm wide. Small, hexagonal plates thin and perpendicular. Epivalva and hipovalva rounded, separated by a shallow, smooth cingulum. Sulcus not reaching antapex of hypotheca. Found at St 1, St 2, St 3, St 4 of NML.

Order: Peridiniales
Family: Peridiniaceae
Genus: *Peridinium* Ehrenberg, 1830
P. lomnickii var. *splendidum* Woloszynska, 1916 (Figure 6a)
(Huber-Pestalozzi, 1976)
Cells ovate, slightly dorsiventrally flattened, 38 µm long, 30 µm wide. Epivalva conical, slightly longer than rounded hypotheca, separated by a wide, shallow, smooth cingulum ofset by up to one-half cingulum width. Sulcus hardly penetrates epitheca and not reaching antapex of hypotheca. Cell wall densely covered with spines on the apical plate. Found at St 1, St 2, St 3, St 4 of NML.

Order: Thoracosphaerales
Family: Glenodiniaceae
Genus: *Peridiniopsis* Lemmermann, 1904
P. elpatiewskyi (Ostenfeld) Bourrelly, 1968 (Figure 6b)
Basionym: *Peridinium umbonatum* var. *elpatiewskyi* Ostenfeld 1907
Synonyms: *P. umbonatum var. elpatiewskyi* Ostenfeld, 1907; *Peridinium elpatiewskyi* (Ostenfeld) Lemmermann, 1910; *Glenodinium elpatiewskyii* (Ostenfeld) Schiller, 1937; *P. marchicum* var. *simplex* Woloszynska, 1916; *P. elpatiewskyi* var. *pseudopenardii* Lindemann, 1918; *P. pygmaeum* Lindemann, 1920; *P. pygmaeum f. brigantinum* Lindemann, 1923; *G. pygmaeum* (Lindemann) Schiller, 1937; *Peridiniopsis pygmaeum* (Lindemann) Bourrelly, 1968
(Huber-Pestalozzi, 1976)
Cells are oval and dorsiventrally flattened, 32 µm long, 26 µm wide. Apex available. Epivalva expanded to the back, wider than hipovalva. Sulcus wide and not reaching antapex of hypotheca. Found at St 2, St 3, St 4 of NML.

Division: Ochrophyta
Class: Xanthophyceae
Order: Mischococcales
Family: Ophiocytiaceae
Genus: *Ophiocytium* Nägeli, 1849
O. bicuspidatum (Borge) Lemmermann, 1899 (Figure 6c)
Basionym: *O. majus* var. *bicuspidatum* Borge
Synonym: *O. majus* var. *bicuspidatum* Borge
(Huber-Pestalozzi, 1962;John et al 2003)
Robust free-floating cells, cylindrical, arcuate, twisted, 35 µm long, 6 µm wide, with a 5 µm long spine at each end. Found at St 3 of NML.

Family: Pleurochloridaceae
Genus: *Isthmochloron* Skuja, 1948
I. lobulatum (Nägeli) Skuja, 1948 (Figure 6d-e)
Basionym: *Polyedrium lobulatum* Nägeli, 1849
Synonym: *P. lobulatum* Nägeli, 1849
(Peerapornpisal, 2005;John et al 2003)
Cells solitary, deeply lobed so as to appear quadraradiate, with all four arms in one plane. Plastids range from a few to many, without pyrenoids. Cells 22 µm long. Found at St 3 of NML and St 1, St 2 of DP.

4. Conclusions

DP and NML are eutrophic systems with annual mean chlorophyll concentrations of 8.3 μgL^{-1} and 7.19 μgL^{-1}, total phosphorus concentrations of 0.008 mgL^{-1} and 0.012 mgL^{-1}, Secchi disk depths of 65 cm and 112 cm, respectively (Carlson, 1977; Karadži´c et al., 2010). Low water level, dense macrophyte vegetation and high organic matter concentrations, due to the high biological activity in water (Öztürk and Akköz, 2014), of DP show that this area changes gradually from pond to swamp. A total of 30 taxa belonging to 23 genera are new records for Turkish freshwater algae in the divisions of Chlorophyta, Charophyta, Euglenophyta Cryptophyta, Cyanobacteria, Dinophyta, and Ochrophyta. The division Chlorophyta contains the highest records with 13 taxa. These taxa are dispersed into genus *Chlamydomonas* (7), *Vitreochlamys*, *Desmodesmus*, *Pectinodesmus*, *Quadrigula*, *Characium*, *Tetraedron*, *Closteriopsis* which are widespread worldwide (John et al., 2003; Wehr and Sheath, 2003). It is reported that the species belonging to these genera are cosmopolitan in lakes, ponds, reservoirs, and stagnant and slow flowing running waters in Turkey (Gonulol et al., 1996; Aysel, 2005; Celekli et al., 2007a, 2007b; Celik and Ongun, 2008; Sevindik, 2010; Sevindik and Çelik, 2012). All new records of genus *Chlamydomonas* were found in NML. *Chlamydomonas* species are abundant in small, very or extremely nutrient rich waters, particularly in the spring and early summer (John et al., 2003). *D. dispar* are reported as planktonic and periphytic. It is cosmopolite and widely distributed in Europe; also found in Brazil and Singapore (Huber-Pestalozzi, 1983; Guiry and Guiry, 2015). *P. regularis* is known as planktonic in lakes and ponds with increasing salinity and reported in France, Chad, Cuba, Ukraine, Hungary and Brazil (Huber-Pestalozzi, 1983; Guiry and Guiry, 2015). This species was found in NML where salinity levels were high (around 0.41 ppt). *Q. closterioides* is known as planktonic and periphytic and found in swamps and peat swamps of Europe and America (Arkansas, Argentina, Brazil and Cuba) (Huber-Pestalozzi, 1983; Guiry and Guiry, 2015). This species was found in DP. *C. conicum* is found as periphytic on the microscopic particles in this study. This genus is known as periphytic on algae, aquatic macrophytes, animals and sometimes on other surfaces (John et al., 2003) and reported in Ukraine and Sweden (Huber-Pestalozzi, 1983). *T. proteiforme* is found in stagnant waters and reported in India, Burma, Japan and

Sweden (Philipose, 1967), while, *C. longissima* var. *tropica* is planktonic in lakes and small ponds, probably cosmopolitan or very dispersed (Huber-Pestalozzi, 1983).

The genus *Octacanthium* and its species *O. bifidum* are both reported as a new record for the first time for Algal Flora of Turkey. *O. bifidum* is reported as most frequent in small pools and bogs in Scotland and Ireland and in similar habitats in England (John et al., 2003). It is known that members of Desmidales are common in eutrophic and mesotrophic alkaline lakes in Turkey (Gonulol and Comak, 1993).

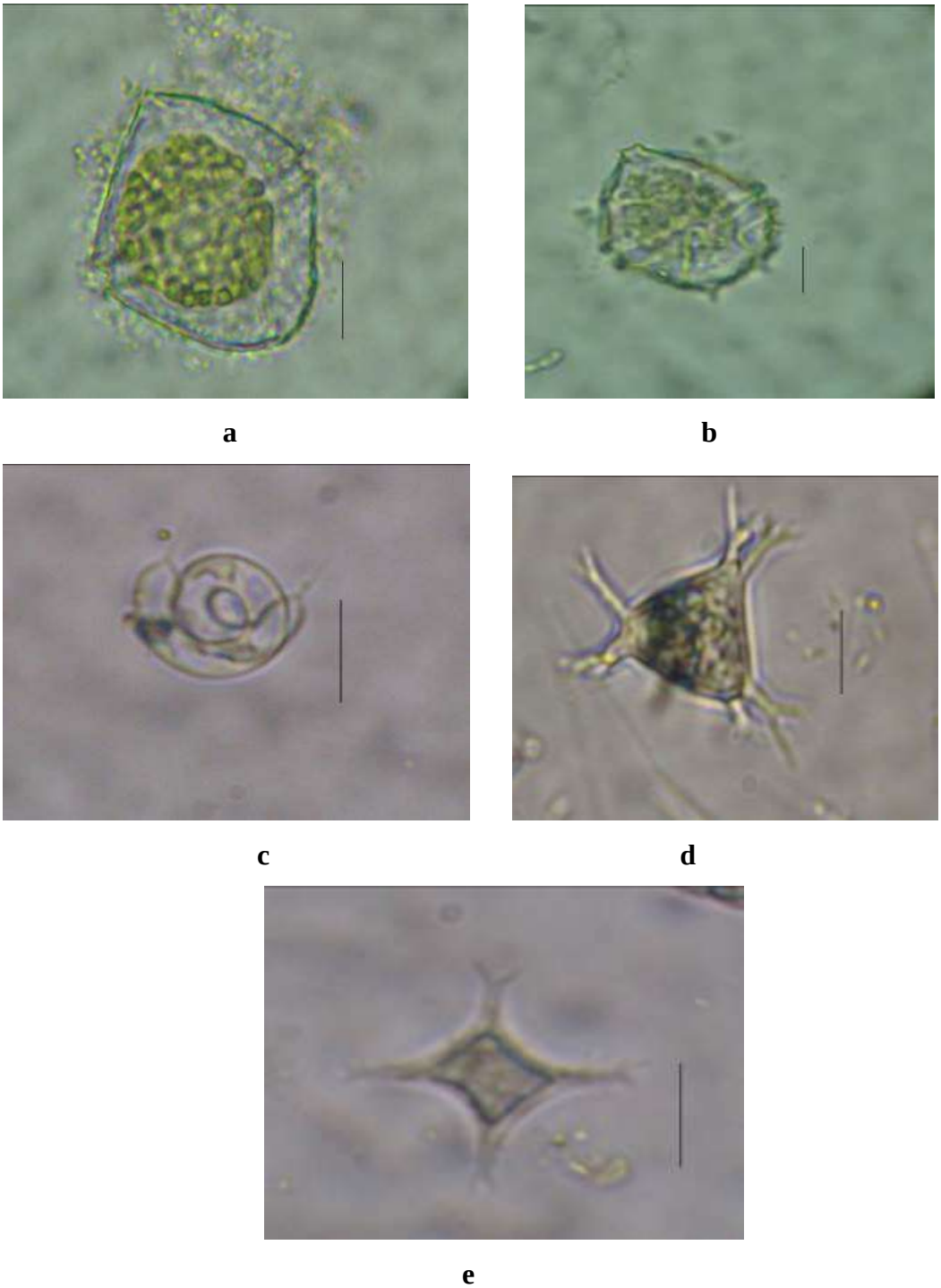

Figure 6. **a.** *Peridinium lomnickii* var. *splendidum*, **b.** *Peridiniopsis elpatiewskyi*, **c.** *Ophiocytium bicuspidatum*, **d.** *Isthmochloron lobulatum*, (at DP), **e.** *Isthmochloron lobulatum* (at NML) (Scale 10 μm)

The division Euglenophyta contains five new records in the genus of *Trachelomonas*, *Euglena* and *Phacus*; and 4 species of them were found in DP where organic matter content is high. *Euglena*, *Phacus* and *Trachelomonas* mostly occur in stil 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). *T. vas* distributed in Europe and Africa while, *T. volzii* var. *cylindracea* is reported in Europe, Asia and Australia and, *T. oblonga* var. *angusta* in swamps of Switzerland and South America (Huber-Pestalozzi, 1969). *Trachelomonas* species are 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, 2007b).

M. warmingiana is reported as planktonic in eutrophic water bodies of Europe and Australia; and not commonly distributed (Komarek and Anagnostidis, 1999; Guiry and Guiry, 2015). *K. crassum* was described firstly in mountain creeks of Tajikistan and also reported from Carpathian region, Romenia and Queensland (Australia) (Komarek and Anagnostidis, 2008; Guiry and Guiry, 2015).

P. elpatiewskyi is planktonic in lakes of Europe, Asia, Australia and New Zealand, preferred alkaline waters and pH 7.5-7.8 (Huber-Pestalozzi, 1976; Guiry and Guiry, 2015). Few *Peridiniopsis* species is reported in Turkey (Ersanlı and Gonulol, 2003; Celekli et al., 2007a, 2007b). *P. lomnickii* var. *splendidum* dispersed in ponds of Europe and maximum abundance was observed in winter (Huber-Pestalozzi, 1976). This species was found abundantly in winter plankton of NML. *T. coronata* distributed in Europe and is founded in mud ponds, swamps, and rarely in ponds (Huber-Pestalozzi, 1976; Guiry and Guiry, 2015).

Members of Cryptophyta occur in very different kinds of freshwater environments, some are favored by waters rich in organic substances and several are more common during the colder months of the year (John et al., 2003). Cryptophytes are reported in Çaygören and İkizcetepeler reservoirs, Ladik, Akgöl lakes (Maraşlıoğlu et al., 2005; Ersanlı et al., 2006; Sevindik, 2010; Sevindik et al., 2011). *K. caudata* widely distributed in Europe, Asia, North America, Austria and New Zealand while, *C. parapyrenoidifera* is reported in Brazil and Sweden, and *C. pochmannii* in Germany and Czech Rebublic (Huber-Pestalozzi, 1976; Guiry and Guiry, 2015).

The genus *Isthmochloron* (Ochrophyta) and its species I. *lobulatum* are both reported as a new record for the first time for Algal Flora of Turkey. This species was both found in NML and DP. 2 species of this genus are reported in North America where they are metaphytic in dystrophic ponds and pools (Wehr and Sheath, 2003). *O. bicuspidatum* was other species as new record in Ochrophyta. This species is uncommonly found in North America and Europe and preferred acidic waters (John et al., 2003). However, it was found in alkaline waters of NML.

It was seen that, generally these new records preferred similar environmental conditions like other wetlands, which they were previously reported in the word. Studies on wetlands with different limnological characters, lead to increasing numbers of new records. Turkey, due to its geographical and climatological structure, has different types of wetlands and different limnoecological conditions. As a result of this, number of new records is expected to increase in the future.

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