



## Phytoplankton Composition of Çaygören Reservoir, Balıkesir-Turkey

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Received 23 February 2009  
Accepted 01 March 2010

### Abstract

The phytoplankton of the Çaygören Reservoir was investigated between February 2007 and January 2009. Samples were taken monthly from 3 sampling stations. A total of 192 taxa belonging to 8 divisions have been identified, including Chlorophyta (75 taxa), Bacillariophyta (60 taxa), Cyanobacteria (19 taxa), Euglenophyta (19 taxa), Charophyta (8 taxa), Myzozoa (6 taxa), Cryptophyta (3 taxa) and Heterokontophyta (2 taxa). Most of the species are characterized by their widespread presence, although some taxa are rarely found in Turkey.

*Keywords:* Çaygören Reservoir, phytoplankton, taxonomy.

### Çaygören Baraj Gölünde Fitoplankton Kompozisyonu, Balıkesir-Türkiye

#### Özet

Bu çalışmada Çaygören Barajı fitoplanktonu Şubat 2007 ve Ocak 2009 tarihleri arasında araştırılmıştır. Örnekler aylık olarak 3 istasyondan alınmıştır. Chlorophyta (75 takson), Bacillariophyta (60 takson), Cyanobacteria (19 takson), Euglenophyta (19 takson), Charophyta (8 takson), Myzozoa (6 takson), Cryptophyta (3 takson) ve Heterokontophyta (2 takson) olmak üzere toplam 8 divizyoya dahil 192 takson teşhis edilmiştir. Birçok tür geniş yayılım alanına sahip olmakla beraber bazı taksonlar Türkiye’de nadir olarak bulunmaktadır.

*Anahtar Kelimeler:* Çaygören Barajı, fitoplankton, taksonomi.

#### Introduction

Çaygören Reservoir is located at lat. 39°17'24" N and long. 28°19'16" E in the province of Balıkesir, Turkey (Figure 1). It is 273.5 m above the sea level. It is mainly fed by Simav Stream and is also fed by Demyan Stream. It was constructed in 1971 for the purposes of irrigation, energy production and flood prevention. Reservoir has a surface area of 8,148 km<sup>2</sup> with a maximum depth of 53.5 m, annual mean water capacity of 392 hm<sup>3</sup> and total lake volume of 142,569 hm<sup>3</sup>. The length of the lake from east to west is approximately 658 m (DSI, 1987).

Some taxonomical and ecological studies have been carried out on the phytoplankton of dams in Turkey. Some of them are: Ankara, Kurtboğazı Dam (Aykulu and Obalı, 1981), Ankara, Çubuk-I Dam (Gönüloğlu and Aykulu, 1984), Konya, Altınapa Dam (Yıldız, 1985), Ankara, Bayındır Dam (Gönüloğlu,

1985), Tercan Dam (Altuner and Gürbüz, 1994), Samsun, Suat Uğurlu Dam (Yazıcı and Gönüloğlu, 1994), Manisa, Demirköprü Dam (Şipal *et al.*, 1996a), Samsun, Hasan Uğurlu Dam (Gönüloğlu and Obalı, 1998), Ankara, Eskişehir, Sarıyar Dam (Atıcı, 2003), İstanbul, Ömerli Dam (Albay and Akçaalan, 2003), Erzurum, Demirdöven Dam (Kıvrak and Gürbüz, 2005), Samsun, Derbent Dam (Taş and Gönüloğlu, 2007). There are no algological studies on Çaygören Reservoir in the literature. This study was aimed to determine the planktonic algae of Çaygören Reservoir.

#### Materials and Methods

Three stations were chosen in different areas of reservoir. The samples were taken from these stations each month between February 2007 and January 2009 vertically with 10 m intervals using plankton net with

a pore diameter of 55  $\mu\text{m}$ . In the field, phytoplankton samples were placed in 250 ml dark bottles and fixed with Lugol's solution. In the laboratory, 0.05 ml of water was poured into objective slides for microscopic analysis. Identification of samples was performed on a compound microscope, equipped with water immersion lenses and a phase contrast attachment. Diatoms were also analyzed using permanent preparations where the samples were digested with acid (APHA, 1995). Phytoplankton species were identified according to widely used taxonomic keys (Round *et al.*, 1990; Sims, 1996; Kramer and Lange-Bertalot, 1986, 1991; Huber-Pestalozzi, 1941, 1950, 1961, 1962, 1969, 1982, 1983; John *et al.*, 2003; Komarek and Anagnostidis, 2008). Taxonomy of algae was controlled with <http://www.algaebase.org> (Guiry and Dhoncha, 1996–2009) website. Some of the phytoplankton species were photographed with a Canon Digital Ixus 75 camera attached to an Olympus BX 51 microscope (Figure 2-6).

## Results and Discussion

A total of 192 phytoplanktonic taxa was identified. Chlorophyta comprised 39% (75 taxa) of the total taxa and were dominant in the phytoplankton. The remaining divisions were as follows: Bacillariophyta 31% (60 taxa), Cyanobacteria 10% (19 taxa), Euglenophyta 10% (19 taxa), Charophyta 4% (8 taxa), Myzozoa 3% (6 taxa), Cryptophyta 2% (3 taxa) and Heterokontophyta 1% (2 taxa) (Figure 7). A list of phytoplankton is given in Table 1. Of these, 29 taxa which were determined as new records for Turkish freshwater algae, have been publishing in two separate articles (Sevindik *et al.*, 2010; Sevindik *et al.*, in press) and were marked (\*) on Table 1.

The highest number of species was recorded in summer and fall while the lowest species richness was

found in winter. In 2007 the highest number of taxa (88) was recorded in August. Chlorophyta was the dominant phytoplankton group showing the greatest species richness (75 taxa) with large contribution of Chlorococcales (45 taxa). Species numbers of Chlorophyta were high in spring and summer and reached a maximum in May 2007 with 45 taxa. Chlorococcales were mostly consisted of *Pediastrum*, *Scenedesmus* and *Tetrastrum* species. *Scenedesmus* and *Pediastrum* species were found in oligomesotrophic reservoirs in Turkey (İşbakan *et al.*, 2002; Kıvrak and Gürbüz, 2005). Round (1956) indicated that some Chlorococcales species are more abundant in water bodies turning into oligotrophic phase to eutrophic phase. *Tetraedron* was another important genus with 6 species of order Sphaeropleales in this phylum. It is known that *Chlamydomonas*, *Eudorina* and *Pandorina* (Volvocales) species were mostly found in shallow and nutrient rich waters (Hutchinson, 1967). They were significant (especially the first station) in both years.

The second dominant group was Bacillariophyta with 60 taxa. Species numbers of Bacillariophytes were high in winter and reached a maximum in February 2007 with 37 taxa. Species numbers of Bacillariophyceae and Fragilariophyceae diatoms were more important than Coscinodiscophyceae diatoms in Bacillariophyta. *Navicula* and *Nitzschia* were dominant genus and they were both represented with 9 taxa. *Ulnaria acus*, *Fragilaria capucina*, *Nitzschia palea*, *N. amphibia*, *N. acicularis*, *Gomphonema olivaceum*, *G. parvulum*, *Encyonema minutum*, *Asterionella formosa*, *Navicula capitatoradiata* were widely found especially in winter. *Nitzschia palea*, *N. acicularis*, *Gomphonema olivaceum*, *G. parvulum*, *Ulnaria acus*, *Asterionella formosa* were known to have a broad distribution in Turkey (Gönülol *et al.*, 1996; Aysel, 2005). *Ulnaria*, *Fragilaria* and *Nitzschia* species were known as

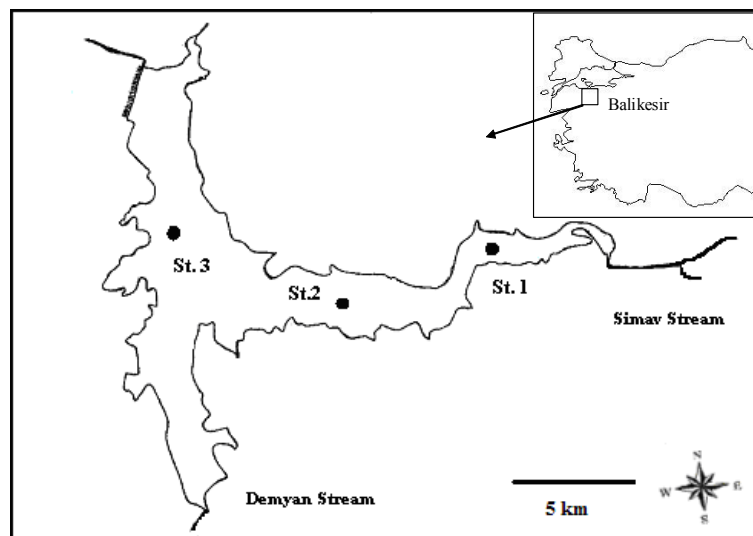
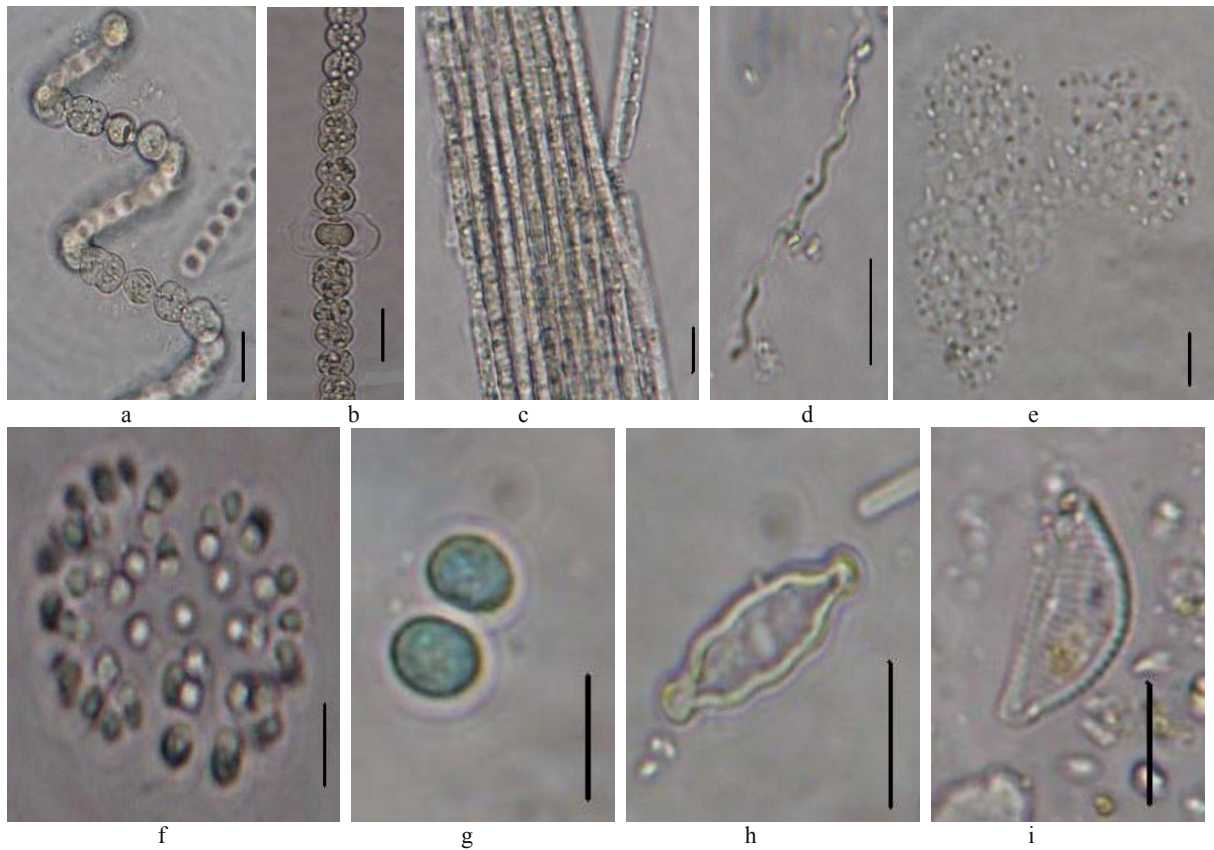
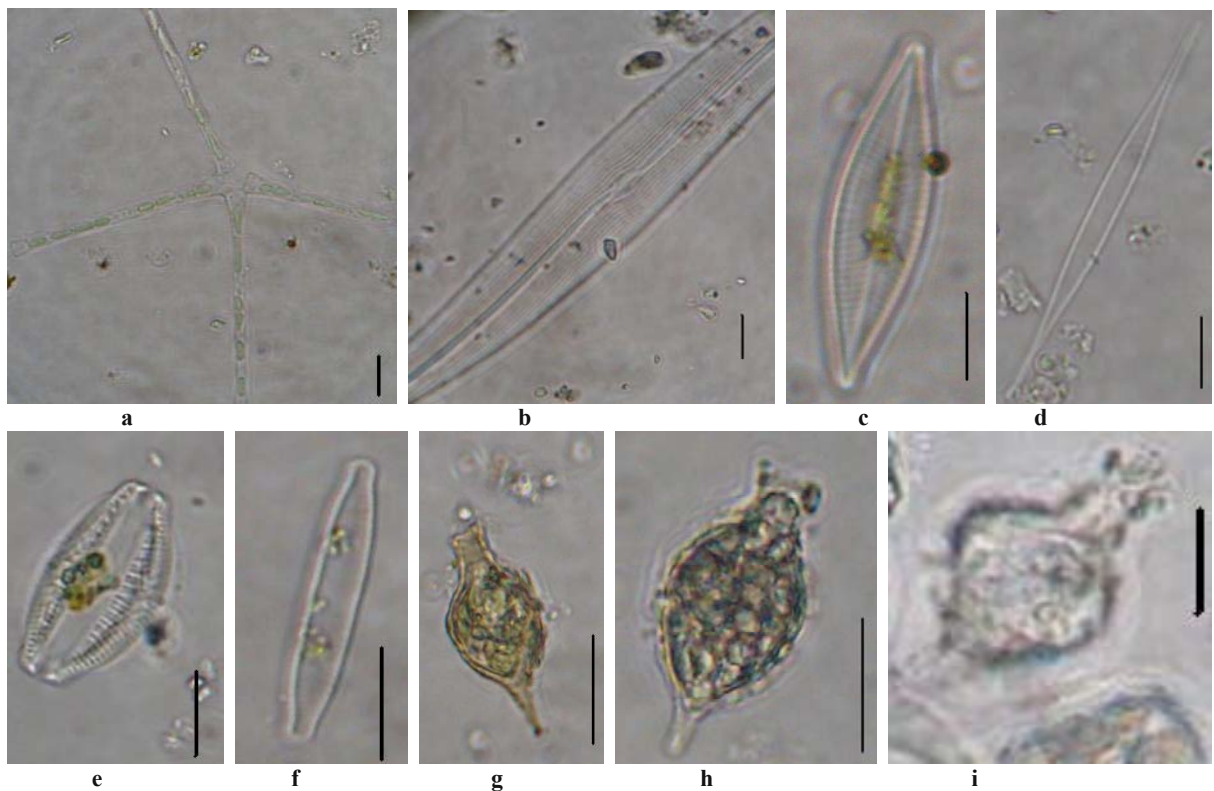


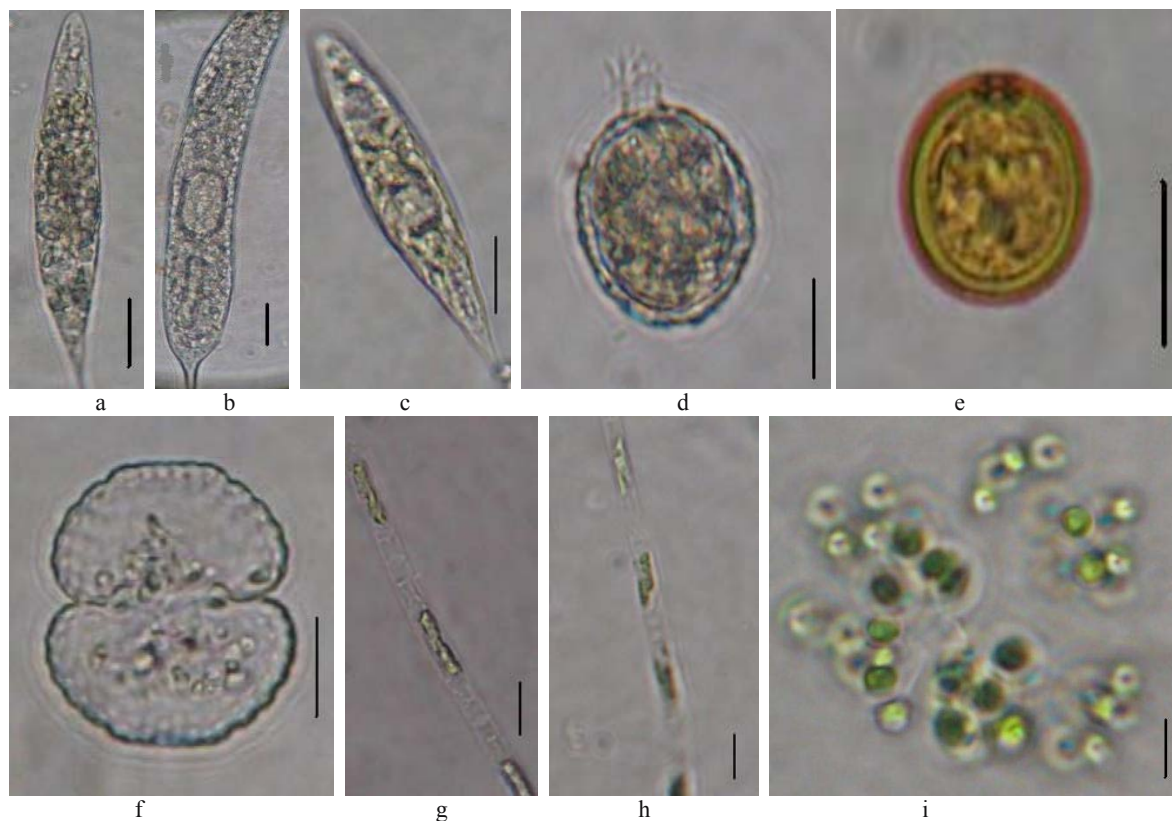
Figure 1. Map of the Çaygören Reservoir showing the position of sampling stations.



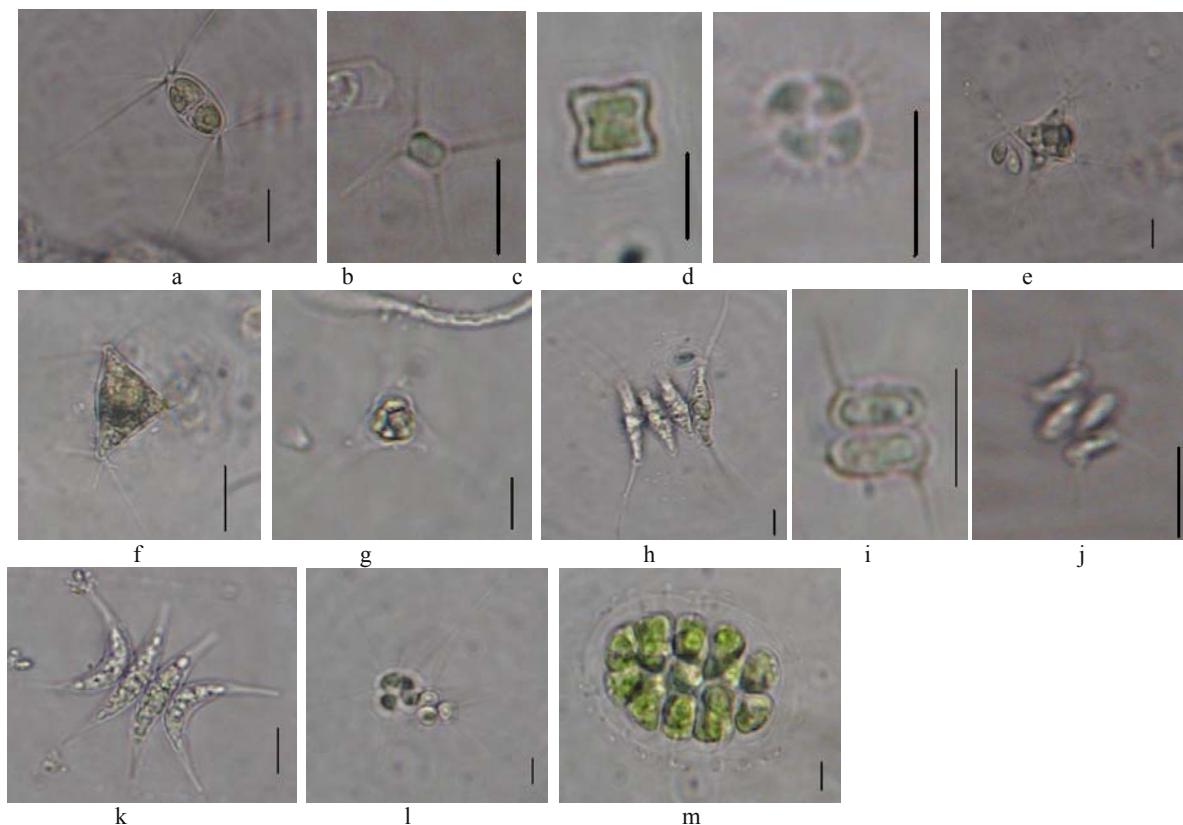
**Figure 2.** a. *Anabaena crassa*, b. *Anabaena planctonica*, c. *Aphanizomenon flos-aquae*, d. *Spirulina meneghiniana*, e. *Aphanothece clathrata*, f. *Gomphosphaeria aponina*, g. *Gloeocapsa decorticans*, h. *Luticola nivalis*, i. *Encyonema minutum* (Scale 10  $\mu$ )



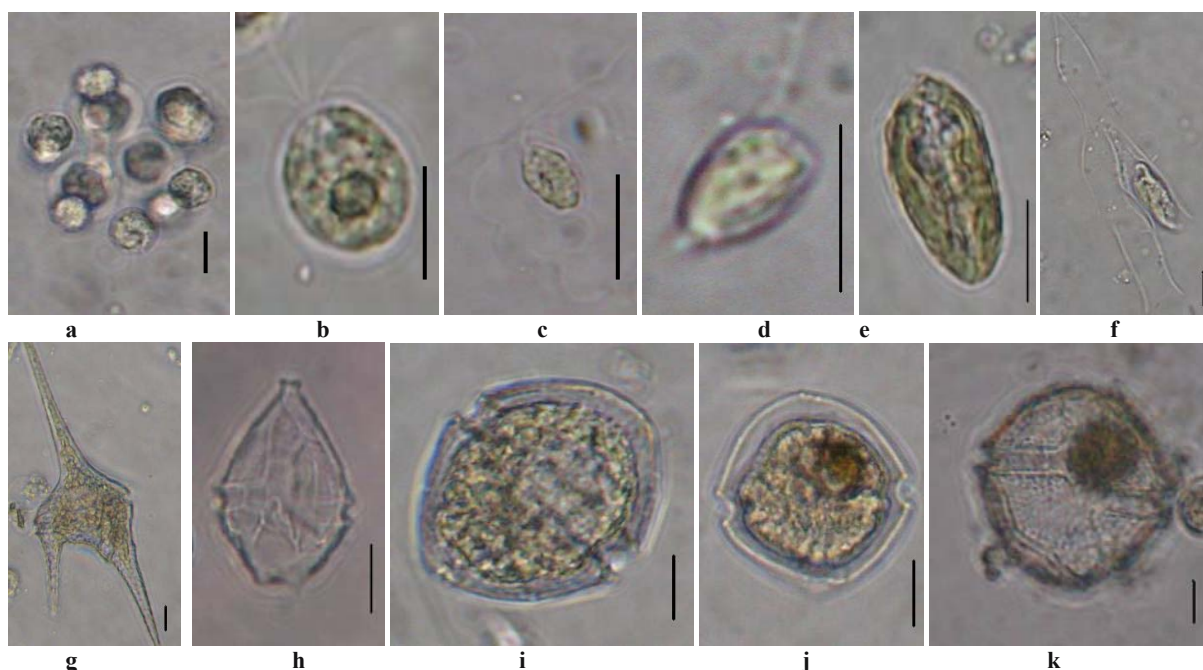
**Figure 3.** a. *Asterionella formosa*, b. *Gyrosigma attenuatum*, c. *Navicula rhyncocephala*, d. *Nitzschia acicularis*, e. *Epithemia sorex*, f. *Fragilaria capucina*, g. *Strombomonas verrucosa* var. *zmiewika*, h. *Strombomonas fluviatilis*, i. *Strombomonas schauinslandii* (Scale 10  $\mu$ ).



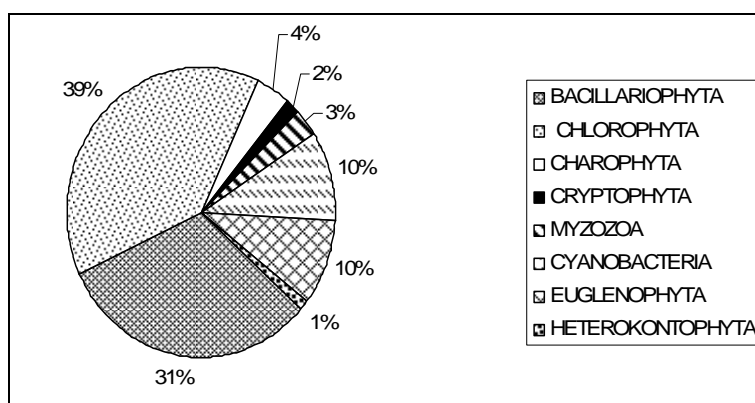
**Figure 4.** a. *Euglena hemichromata*, b. *Euglena oxyuris* var. *skvortzovii*, c. *Euglena geniculata*, d. *Trachelomonas hispida*, e. *Trachelomonas volvocina*, f. *Cosmarium vexatum*, g. *Mougeotia* sp., h. *Gloeotila subconstricta*, i. *Dictyosphaerium pulchellum* (Scale 10  $\mu$ ).



**Figure 5.** a. *Lagerheimia ciliata*, b. *Lagerheimia genevensis*, c. *Tetraedron minimum*, d. *Tetrastrum staurogeniaeforme*, e-f. *Polyedriopsis spinulosa*, g. *Treubaria triappendiculata*, h. *Scenedesmus protuberans*, i. *Scenedesmus bicaudatus*, j. *Scenedesmus intermedius*, k. *Scenedesmus acuminatus*, l. *Micractinium pusillum*, m. *Pandorina morum* (Scale 10  $\mu$ ).



**Figure 6.** a. *Eudorina elegans*, b. *Carteria multifilis*, c. *Lobomonas ampla*, d. *Plagioselmis nannoplanctica*, e. *Cryptomonas pyrenoidifera*, f. *Dinobryon sociale* var. *americanum*, g. *Ceratium hirundinella*, h. *Peridiniopsis cunningtonii*, i. *Glenodinium* sp., j. *Glenodinium* sp., k. *Peridinium willei* (Scale 10 $\mu$ ).



**Figure 7.** The phytoplankton composition of Çaygören Reservoir.

indicators of the eutrophic lakes (Reynolds, 1984; Moss, 2001). Reynolds (1984) remarked that *Asterionella formosa* is the characteristic species of mesotrophic lakes. *Cyclotella meneghiniana* and *Stephanodiscus neoastraea* were the widespread taxa during the study in Coscinodiscophyceae diatoms. *Cyclotella* species were densely recorded in Kurtboğazi (Aykulu and Obalı, 1981), Çubuk-I (Gönülol and Aykulu, 1984) and Keban (Çetin and Şen, 1998) reservoirs, Beytepe and Alap ponds (Ünal, 1984), Hafik (Kılınc, 1998) and Simenit (Ersanlı and Gönülol, 2003) lakes. Round (1956) stated that *Cyclotella* species are biointicators of transient phase from oligotrophic to eutrophic conditions. *Stephanodiscus* species were accepted as members of eutrophic conditions (Rawson, 1956). Diatom species

were found in plankton was generally benthic algae and was densely observed the first station which is shallower. This may be attributed to the movement of cells away from bottom due to strong wind-driven water turbulence.

Species richness of Cyanobacteria increased in summer in both years and reached a maximum in June 2007 with 16 taxa. *Anabaena* and *Merismopedia* were both represented with 3 species. *Anabaena* species were common in Turkey (Gönülol *et al.*, 1996; Aysel, 2005). *Planktothrix* sp. and *Aphanocapsa holsatica* were significant at summer and autumn months. *Aphanocapsa holsatica* was a planktonic species shown in mesotrophic lakes (Sheath and Steinman, 1982). *Planktothrix* sp. has been previously reported mainly from northern lakes and reservoirs in Europe

Table 1. List of phytoplankton of Çaygören Reservoir

<b>BACILLARIOPHYTA</b>	<i>Meridion circulare</i> (Greville) C. Agardh
<b>COSCINODISCOPHYCEAE</b>	<i>Staurosirella pinnata</i> (Ehrenberg) D.M. Williams & Round
<b>Aulacoseirales</b>	<i>Ulnaria acus</i> (Kützing) M. Aboal
<i>Aulacoseira granulata</i> (Ehrenberg) Simonsen	<i>Ulnaria ulna</i> (Nitzsch) P. Compère
<b>Meloseirales</b>	<i>Ulnaria biceps</i> (Kützing) P. Compère
<i>Melosira italica</i> (Ehrenberg) Kützing subsp. <i>subarctica</i> O.F. Müller	<b>CHLOROPHYTA</b>
<i>Melosira lineata</i> (Dillwyn) Agardh	<b>CHLOROPHYCEAE</b>
<i>Melosira varians</i> C. Agardh	<b>Chlorococcales</b>
<b>Thalassiosirales</b>	<i>Actinastrum hantzschii</i> Lagerheim var. <i>subtile</i> J. Woloszynska**
<i>Cyclotella meneghiniana</i> Kützing	<i>Ankyra judai</i> (G.M. Smith) Fott
<i>Cyclotella ocellata</i> Pantocsek	<i>Coelastrum astroideum</i> De Notaris
<i>Stephanodiscus neoastraea</i> Håkansson & Hickel**	<i>Coelastrum microporum</i> Nägeli
<b>BACILLARIOPHYCEAE</b>	<i>Dictyosphaerium pulchellum</i> H.C. Wood
<b>Achnanthes</b>	<i>Dictyosphaerium tetrachotomum</i> Printz
<i>Cocconeis placentula</i> Ehrenberg	<i>Franceia ovalis</i> (Francé) Lemmermann
<i>Cocconeis placentula</i> Ehrenberg var. <i>lineata</i> (Ehrenberg) van Heurck	<i>Golenkiniopsis parvula</i> (Woronichin) Korshikov**
<b>Bacillariales</b>	<i>Golenkiniopsis solitaria</i> (Korshikov) Korshikov
<i>Amphora ovalis</i> (Kützing) Kützing	<i>Komarekia appendiculata</i> (Chodat) Fott**
<i>Amphora veneta</i> Kützing	<i>Lagerheimia ciliata</i> (Lagerheim) Chodat
<i>Hantzschia amphioxys</i> (Ehrenberg) Grunow	<i>Lagerheimia genevensis</i> (Chodat) Chodat
<i>Nitzschia acicularis</i> (Kützing) W. Smith	<i>Lagerheimia subsalsa</i> Lemmermann
<i>Nitzschia amphibia</i> Grunow	<i>Lagerheimia marssonii</i> Lemmermann**
<i>Nitzschia capitellata</i> Husted	<i>Micractinium pusillum</i> Fresenius
<i>Nitzschia fonticola</i> (Grunow) Grunow	<i>Nephrocitium limneticum</i> (G.M. Smith) G.M. Smith
<i>Nitzschia linearis</i> (Agardh) W. Smith	<i>Oocystis borgei</i> J. Snow
<i>Nitzschia palea</i> (Kützing) W. Smith	<i>Oocystis parva</i> W. West & G.S. West
<i>Nitzschia paleacea</i> Grunow	<i>Pediastrum boryanum</i> (Turpin) Meneghini
<i>Nitzschia recta</i> Hantzsch	<i>Pediastrum duplex</i> Meyen
<i>Nitzschia sigmoidea</i> (Nitzsch) W. Smith	<i>Pediastrum duplex</i> var. <i>gracillimum</i> W. West & G.S. West**
<b>Cymbellales</b>	<i>Pediastrum simplex</i> Meyen
<i>Cymbella affinis</i> Kützing	<i>Pediastrum simplex</i> var. <i>echinulatum</i> Wittrock**
<i>Encyonema minutum</i> (Hilse in Rabenhorst) D.G. Mann	<i>Polydriopsis spinulosa</i> (Schmidle) Schmidle
<i>Gomphonema affine</i> Kützing	<i>Pseudoschroederia robusta</i> (O. Korshikov) E. Hegewald & E. Schnepf
<i>Gomphonema exiguum</i> Kützing var. <i>minutissimum</i> Grunow**	<i>Quadricoccus ellipticus</i> Hortobágyi**
<i>Gomphonema minutum</i> (C. Agardh) C. Agardh	<i>Scenedesmus acuminatus</i> (Lagerheim) Chodat
<i>Gomphonema olivaceum</i> (Hornemann) Brébisson	<i>Scenedesmus bicaudatus</i> Dudesenko
<i>Gomphonema parvulum</i> (Kützing) Kützing	<i>Scenedesmus communis</i> E.H. Hegewald
<b>Naviculales</b>	<i>Scenedesmus disciformis</i> (Chodat) Fott & Komárek
<i>Gyrosigma attenuatum</i> (Kützing) Rabenhorst	<i>Scenedesmus intermedius</i> Chodat
<i>Luticola nivalis</i> (Ehrenberg) D.G. Mann	<i>Scenedesmus protuberans</i> F.E. Fritsch & M.F. Rich
<i>Navicula capitatoradiata</i> Germain	<i>Scenedesmus pseudodenticulatus</i> E. Hegewald**
<i>Navicula cryptocephala</i> Kützing	<i>Scenedesmus pseudohelveticus</i> Kütj.**
<i>Navicula expecta</i> S. L. VanLandingham	<i>Scenedesmus obliquus</i> (Turpin) Kützing
<i>Navicula pusilla</i> W. Smith var. <i>capitata</i> (Husted) Lange-Bertalot	<i>Scenedesmus opoliensis</i> P.G. Richter var. <i>mononensis</i> Chodat
<i>Navicula radiosa</i> Kützing	<i>Scenedesmus ovalternus</i> Chodat var. <i>graevenitzii</i> (Bernard) Chodat
<i>Navicula rhynchocephala</i> Kützing	<i>Scenedesmus verrucosus</i> Y.V. Roll
<i>Navicula veneta</i> Kützing	<i>Sorastrum americanum</i> (Bohlin) Schmidle
<i>Navicula viridula</i> (Kützing) Kützing	<i>Stauridium tetras</i> (Ehrenberg) E. Hegewald
<i>Navicula trivialis</i> Lange-Bertalot	<i>Tetrastrum elegans</i> Playfair**
<i>Pinnularia microstauron</i> (Ehrenberg) Cleve	<i>Tetrastrum glabrum</i> (Y.V. Roll) Ahlstrom & Tiffany
<i>Sellaphora pupula</i> (Kützing) Mereschkovsky	<i>Tetrastrum komarekii</i> Hindák
<b>Rhopalodiales</b>	<i>Tetrastrum staurogeniaeforme</i> (Schröder) Lemmermann
<i>Epithemia frickei</i> Krammer	<i>Treubaria triappendiculata</i> C. Bernard
<i>Epithemia sores</i> Kützing	<b>Sphaeropleales</b>
<b>Suriellales</b>	<i>Ankistrodesmus fusiformis</i> Corda ex Korshikov
<i>Cymatopleura solea</i> (Brébisson) W. Smith	<i>Closteriopsis longissima</i> (Lemmermann) Lemmermann
<i>Surirella brebissonii</i> Krammer & Lange-Bertalot var. <i>kuetzingii</i>	<i>Kirchneriella contorta</i> (Schmidle) Bohlin var. <i>elegans</i> (Playfair)
Krammer & Lange-Bertalot	Komárek**
<b>FRAGILARIOPHYCEAE</b>	<i>Kirchneriella diana</i> (Bohlin) Comas Gonzalez**
<b>Fragilariales</b>	<i>Monoraphidium circinale</i> (Nygaard) Nygaard
<i>Asterionella formosa</i> Hassall	<i>Monoraphidium contortum</i> (Thuret) Komárková-Legnerová
<i>Diatoma moniliformis</i> Kützing	<i>Monoraphidium griffithii</i> (Berkeley) Komárková-Legnerová
<i>Diatoma tenue</i> C. Agardh	<i>Tetraedron incus</i> (Teiling) G.M. Smith
<i>Diatoma vulgare</i> Bory de Saint-Vincent	<i>Tetraedron minimum</i> (A. Braun) Hansgirg
<i>Diatoma vulgare</i> Bory de Saint-Vincent var. <i>grande</i> (W. Smith)	<i>Tetraedron muticum</i> (A. Br.) Hansgirg
Grunow	<i>Tetraedron pentaedricum</i> West & West
<i>Fragilaria arcus</i> (Ehrenberg) Cleve	<i>Tetraedron regulare</i> Kützing var. <i>torsum</i> Brunthaler
<i>Fragilaria berolinensis</i> (Lemmermann) Lange-Bertalot	<i>Tetraedron trigonum</i> (Nägeli) Hansgirg
<i>Fragilaria capucina</i> Desmazières	<b>Tetrasporales</b>
<i>Fragilaria nanana</i> Lange-Bertalot	<i>Sphaerocystis planctonica</i> (Korshikov) Bourelly
<i>Fragilaria tenera</i> (W. Smith) Lange-Bertalot	

\*\* New records for Turkish freshwater algae

Table 1. (Continued)

<b>Volvocales</b>	<b>Chroococcales</b>
<i>Carteria multifilis</i> (Fresenius) O. Dill	<i>Gomphosphaeria aponina</i> Kützing
<i>Chlamydomonas debaryana</i> Gor. var. <i>atactogama</i> (Kors.) Ger.**	<i>Microcystis aeruginosa</i> (Kützing) Kützing
<i>Chlamydomonas microsphaera</i> Pasc.&Jahd. var. <i>acuta</i> Bourr.**	<i>Microcystis flos-aquae</i> (Wittrock) Kirchner
<i>Chlamydomonas rodhei</i> Skuja**	<b>Pseudanabaenales</b>
<i>Chlamydomonas umbonata</i> Pascher**	<i>Pseudanabaena catenata</i> Lauterborn
<i>Gloeotila subconstricta</i> (G.S. West) Printz	<i>Spirulina subtilissima</i> (Kützing) Gomont
<i>Eudorina cylindrica</i> Korshikov**	<i>Spirulina meneghiniana</i> (Zanardini) Zanardini ex Gomont
<i>Eudorina elegans</i> Ehrenberg	<b>Synechococcales</b>
<i>Gonium pectorale</i> O.F. Müller	<i>Aphanocapsa holsatica</i> (Lemmermann) G. Cronberg & J. Komárek**
<i>Lobomonas ampla</i> Pascher	<i>Merismopedia minima</i> Beck**
<i>Lobomonas rostrata</i> Hazen	<i>Merismopedia punctata</i> Meyen
<i>Pandorina minodii</i> R. Chodat	<i>Merismopedia tenuissima</i> Lemmermann
<i>Pandorina morum</i> (O.F. Müller) Bory de Saint-Vincent	<b>Oscillatoriales</b>
<i>Sphaerellopsis gloeosphaera</i> (Pasc. & Jahd.) H. Ettl & O. Ettl**	<i>Planktothrix</i> sp.
<i>Tetrabaena socialis</i> (Dujardin) H. Nozaki & M. Itoh	<b>Nostocales</b>
<b>PRASINOPHYCEAE</b>	<i>Anabaena crassa</i> (Lemmermann) Komark.-Legn. & Cronberg
<b>Chlorodendrales</b>	<i>Anabaena planctonica</i> Brunnthaler
<i>Tetraselmis cordiformis</i> (N. Carter) Stein	<i>Anabaena spiroides</i> Klebahn
<b>CHAROPHYTA</b>	<i>Anabaenopsis magna</i> Evans**
<b>ZYGNEMATOPHYCEAE</b>	<i>Aphanizomenon flos-aquae</i> (Linnaeus) Ralfs ex Bornet & Flahault
<b>Zygnematales</b>	<i>Raphidiopsis mediterranea</i> Skuja
<i>Closterium limneticum</i> Lemmermann	<b>EUGLENOPHYTA</b>
<i>Cosmarium contractum</i> O. Kirchner var. <i>minutum</i> (Delponte) Coesel**	<b>EUGLENOPHYCEAE</b>
<i>Cosmarium trilobulatum</i> Reinsch	<b>Euglenales</b>
<i>Cosmarium variolatum</i> P. Lundell var. <i>rotundatum</i> (Willi Krieger)	<i>Euglena clavata</i> Skuja
Messikommer	<i>Euglena geniculata</i> Dujardin
<i>Cosmarium</i> sp.	<i>Euglena hemichromata</i> Skuja
<i>Cosmarium vexatum</i> (Schmidle) Migula	<i>Euglena oxyuris</i> Schamarda f. <i>skvortzovii</i> (Popowa) Popowa
<i>Mougeotia</i> sp.	<i>Euglena tuberculata</i> Swirenko
<i>Staurastrum cingulum</i> (West & G.S. West) G.M. Smith	<i>Lepocinclis ovum</i> (Ehrenberg) Lemermann
<b>CRYPTOPHYTA</b>	<i>Monomorphina pyrum</i> (Ehrenberg) Mereschkowski
<b>CRYPTOPHYCEAE</b>	<i>Phacus caudatus</i> Hübner
<b>Cryptomonadales</b>	<i>Phacus curvicauda</i> Svirenko
<i>Cryptomonas ovata</i> Ehrenberg	<i>Strombomonas fluviatilis</i> (Lemmermann) Deflandre
<i>Cryptomonas pyrenoidifera</i> Geitler	<i>Strombomonas praeliariis</i> (Palmer) Deflandre**
<i>Plagioselmis nannoplantica</i> (H. Skuja) Novarino, Lucas & Morrall	<i>Strombomonas schauinslandii</i> (Lemmermann) Deflandre
<b>MYZOOZOA</b>	<i>Strombomonas verrucosa</i> (Daday) Deflan. var. <i>zmiewika</i> (Svire.) Deflan.
<b>DINOPHYCEAE</b>	<i>Trachelomonas</i> sp.
<b>Peridinales</b>	<i>Trachelomonas granulosa</i> Playf. var. <i>crenulatocollis</i> (Szabad.) Hub.-Pest.**
<i>Ceratium hirundinella</i> (O.F. Müller) Dujardin	<i>Trachelomonas globularis</i> Playfair var. <i>crenulatocollis</i> M. Szabados**
<i>Glenodinium</i> sp.	<i>Trachelomonas hispida</i> (Perty) F. Stein
<i>Peridiniopsis cunningtonii</i> Lemmermann	<i>Trachelomonas volvocina</i> Ehrenberg
<i>Peridinium lomnickii</i> Woloszynska	<i>Trachelomonas volzii</i> Lemmermann var. <i>intermedia</i> Playfair
<i>Peridiniopsis penardii</i> (Lemmermann) Bourrelly**	<b>HETEROKONTOPHYTA</b>
<i>Peridinium willei</i> Huitfeldt-Kaas	<b>CHRYSOPHYCEAE</b>
<b>CYANOBACTERIA</b>	<b>Chromulinales</b>
<b>CYANOPHYCEAE</b>	<i>Dinobryon sociale</i> Ehrenberg var. <i>americanum</i> (Brunnth.) Bachmann
<b>Chroococcales</b>	<i>Volvochrysis polyochla</i> Schiller**
<i>Aphanothece clathrata</i> W. West & G.S. West	
<i>Gloeocapsa decorticans</i> (A. Braun) Richter	

\*\* New records for Turkish freshwater algae

(Skulberg *et al.*, 1984; Berg *et al.*, 1986; Lindholm *et al.*, 1989) and was also observed in Manyas (Ongun, 2004), İznik and Sapanca (Akçaaalan *et al.*, 2006) lakes in Turkey. *Aphanothece clathrata*, *Aphanizomenon flos-aquae*, *Anabaena planctonica*, *Pseudanabaena catenata*, *Gomphosphaeria aponina* were also widespread in summer months in both years. *Pseudanabaena catenata* and *Gomphosphaeria aponina* species were widespread in Turkey (Gönülol *et al.*, 1996; Aysel, 2005). It is reported that Cyanobacteria species are important component of plankton in summer and early autumn at eutrophic and mesotrophic lakes (Trifonova, 1998).

Species numbers of Euglenophyta were high at

both years in summer and autumn. *Trachelomonas* was the most dominant genus with 6 species of this phylum. Especially *Trachelomonas volvocina*, *T. hispida* and *T. volzii* var. *intermedia* were the most common taxa found throughout the sampling period at all sites. Hutchinson (1967) pointed out that *T. volvocina* is widespread in the open water of lakes. *T. volvocina* was recorded in Yedigöller, Abant (Atıcı and Obalı, 2002), Gököy (Çelekli *et al.*, 2007) and Uluabat (Karacaoğlu *et al.*, 2004) lakes. *T. hispida* was recorded in İkizgöl (Şipal *et al.*, 1996b) Gököy (Çelekli *et al.*, 2007), Gölcük (Çirik and Çirik, 1989) lakes and Tahtalı Reservoir Basin (Balık and Şipal, 1995). *Trachelomonas* was generally found in nutrient

rich water (Yamagishi, 1987). *Euglena* species were also important the first station. *Euglena* species usually grow rapidly in warm and rich organic media (Round, 1984).

Charophyta was represented with 8 taxa of the order Zygnematales and species richness of this phylum increased in summer in both years. *Cosmarium* was the most dominant genus with 5 species of this phylum. Zygnematales species were accepted as characteristic species of oligotrophic lakes (Hutchinson, 1967). However, it is known that Zygnematales members are common in eutrophic and mesotrophic lakes rather than oligotrophic lakes in Turkey (Gönülol and Çomak, 1993).

Myzozoa, Cryptophyta, and Heterokontophyta were represented by 6, 3, and 2 taxa, respectively. Myzozoa was mostly found in late summer and autumn in both years. *Ceratium hirundinella*, *Peridinium willei*, *Peridiniopsis cunningtonii* and *Glenodinium* sp. were widespread taxa during those periods. Rawson (1956) stated that *Ceratium hirundinella* prefers mesotrophic conditions. *Ceratium hirundinella* was known to have a broad distribution in Turkey (Gönülol *et al.*, 1996; Aysel, 2005). *Peridinium willei* was reported in Gököy Lake (Çelekli *et al.*, 2007), Tahtalı Reservoir Basin (Balık and Şipal, 1995) and Hirfanlı (Baykal and Açıkgöz, 2004) Reservoir. Cryptophyta was represented with 3 species. In this phylum *Plagioselmis nannoplanctica* and *Cryptomonas pyrenoidifera* were widespread in winter. *P. nannoplanctica* was also recorded in Gököy (Çelekli *et al.*, 2007). Heterokontophyta was represented with 2 species (*Dinobryon sociale* var. *americanum* and *Volvochrysis polyochla*) which were found July-August and September in 2007, respectively. *D. sociale* var. *americanum* was recorded in Gököy (Çelekli *et al.*, 2007). *Dinobryon* species were observed as members of summer plankton in almost all types of lakes which were distributed broadly (Heinonen, 1980).

In Çaygören Reservoir, most phytoplankton species are cosmopolitan (Gönülol *et al.*, 1996; Aysel, 2005); however 29 species are new records for Turkish freshwater algae (Sevindik *et al.*, 2010; Sevindik *et al.*, in press). One of the widely used methods for the classification of trophic state of lake is phytoplankton indexes, but it is pointed out that these indexes are not reliable because of the short period of water retention time in reservoir systems (Lind *et al.*, 1993). Although it is difficult to understand the trophic status of the lake using only species composition results, Hutchinson stated that *Staurastrum*, *Closterium* and *Cosmarium* in desmids, *Anabaena* or *Oscillatoria* in cyanophytes are found; *Peridinium* and *Ceratium* in dinoflagellats, *Cyclotella*, *Stephanodiscus* and *Asterionella formosa* in diatoms are dominant in eutrophic and mesotrophic water (Moss, 1988). Based on the findings, Çaygören Reservoir is a productive eutrophic reservoir.

## Acknowledgements

I would like thank to Associate Prof.Dr. Kemal Çelik (Balıkesir University) for advising me during the preparation of the manuscript. I also thank Prof. Dr. Şükran Dere, Assist. Prof.Dr. Nurhayat Dalkıran, Research Assist. Dr. Didem Karacaoğlu (Uludağ University) for their help for some species identification. Special thanks to my father, Osman Ongun for helping the fieldwork. The support for this research came from Balıkesir University Research Foundation.

## References

- Akçaalan, R., Young, F.M., Metcalf, J.S., Morrison, L.F., Albay, M. and Codd, G.A. 2006. Microcystin analysis in single filaments of *Planktothrix* spp. in laboratory cultures and environmental blooms. *Water Research*, 40: 1583-1590.
- Albay, M. and Akçaalan, R. 2003. Factors influencing the phytoplankton steady state assemblages in a drinking-water reservoir (Ömerli Reservoir, Istanbul). *Hydrobiologia*, 502: 85-95.
- Altuner, Z. and Gürbüz, H. 1994. A Study on the Phytoplankton of the Tercan Dam Lake, Turkey. *Tr. J. of Botany*, 18: 443-450.
- APHA (American Public Health Association), 1995. Standard methods for the examination of water and wastewater. 19<sup>th</sup> Edition, Washington, D.C.
- Atıcı, T. 2003. Sarıyar Barajı Planktonik Algleri Kısım II – Chlorophyta. S.D.Ü. Eğirdir Su Ürünleri Fakültesi Dergisi, 8: 128-151.
- Atıcı, T. and Obalı, O. 2002. Yedigöller ve Abant Gölü (Bolu) Fitoplankton'unun Mevsimsel Değişimi ve Klorofil-a Değerlerinin Karşılaştırılması. E.Ü. Su Ürünleri Dergisi, 19(3-4): 381-389.
- Aykulu, G. and Obalı, O. 1981. Phytoplankton Biomass in Kurtboğazi Dam Lake. *Commun. de la Fac. Sci. d'Ank*, 24: 29-45.
- Aysel, V. 2005. Check-List of the Freshwater Algae of Turkey. *Journal of the Black Sea/Mediterranean Environment*, 11(1): 1-124.
- Balık, S. and Şipal (Gezerler), U. 1995. Tahtalı Baraj Havzasının (Gümüldür-İzmir) Makro ve Mikro Alg Florası. II. Ulusal Ekoloji ve Çevre Kongr. Bildirileri, Ankara: 483-492.
- Baykal, T. and Açıkgöz, İ. 2004. Hirfanlı Baraj Gölü Algleri. *Gazi Üniv. Kırşehir Eğitim Fak.*, 5(2): 115-136.
- Berg, K., Skulberg, O.M., Skulberg, R., Underdal, B. and Willen, T. 1986. Observations of toxic blue-green algae (cyanobacteria) in some Scandinavian lakes. *Acta Vet. Scand.*, 27: 440-452.
- Cirik, S. and Cirik, Ş. 1989. Gölçük'ün (Bozdağ/İzmir) planktonik algleri. *İstanbul Üniv., Su Ürünleri Dergisi*, 3(1-2): 131-150.
- Çelekli, A., Albay, M. and Dügel, M. 2007. Phytoplankton (except Bacillariophyceae) Flora of Lake Gököy (Bolu). *Turkish Journal of Botany*, 31: 49-65.
- Çetin, K. and Şen, B. 1998. Diatoms (Bacillariophyta) in the Phytoplankton of Keban Reservoir and their Seasonal Variations. *Turk. J. Bot.*, 22: 25-34.
- DSİ. 1987. İkizcetepeler ve Çaygören II. Aşama Projesi Planlama Revizyon Raporu. Ankara.



- Ersanlı, E. and Gönüloğlu, A. 2003. Study on the Phytoplankton and Seasonal Variation of Lake Simentit (Terme-Samsun, Turkey). *Turkish Journal of Fisheries and Aquatic Sciences*, 3: 29-39.
- Gönüloğlu, A. and Aykulu, G. 1984. Çubuk-I Baraj Gölü algleri üzerine arařtırmalar, I-Fitoplankton kompozisyonu ve yoğunluğunun mevsimsel deęiřimi. *Doęa Bilim Dergisi*, 8(3): 330-342.
- Gönüloğlu, A. 1985. Studies on the Phytoplankton of Bayındır Dam Lake. *Commun. de la Fac. Sci. d'Ank, serie C Biologie*, Tome, 3: 21-38.
- Gönüloğlu, A. and Obalı, O. 1998. A Study on the Phytoplankton of Hasan Uęurlu Dam Lake (Samsun – Turkey). *Tr. J. of Biology*, 22: 447-461.
- Gönüloğlu, A. and Çomak, Ö. 1993. Bafra Balık Gölleri (Balık Gölü, Uzungöl) fitoplanktonu üzerinde floristic arařtırmalar III-Chlorophyta. *Doęa, Tr. J. Botany*, 17: 227-236.
- Gönüloğlu, A., Öztürk, M. and Öztürk, M. 1996. A check-list of the freshwater algae of Turkey. *Ondokuz Mayıs Üniv. Fen Edb. Fak. Fen Dergisi*, 7(1): 8-46.
- Guiry, M.D. and Dhoncha, E.N. 1996-2009. *AlgaeBase* version 2.0 world-wide electronic publication, National University of Ireland, Galway, <http://www.algaebase.org>
- Heinonen, P. 1980. Quantity and composition of phytoplankton in Finnish inland waters. *Public Water Resources Institute, National Board of Waters*, 37: 1-91.
- Huber-Pestalozzi, G. 1941. *Das Phytoplankton des Süßwassers. (Die Binnengewässer, Band XVI). Teil 2. (i) Chrysophyceen, Farblose Flagellaten Heterokonten.* E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart.
- Huber-Pestalozzi, G. 1950. *Das Phytoplankton des Süßwassers, 3 Teil. Cryptophyceen, Chloromonadien, Peridineen.* In: A. Thienemann (Ed.), *Die Binnengewässer*, E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart.
- Huber-Pestalozzi, G. 1961. *Das Phytoplankton des Süßwassers. (Die Binnengewässer, Band XVI). Teil 5. Chlorophyceae, Ordnung: Volvocales.* E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart.
- Huber-Pestalozzi, G. 1962. *Das phytoplankton des süßwassers systematik und biologie, 1. Teil, Blaualgen,* E. Schweizerbarth'sche Verlagsbuchhandlung (Nagele u. Obermiller), Stuttgart.
- Huber-Pestalozzi, G. 1969. *Das phytoplankton des süßwassers systematik und biologie, 4. Teil, Euglenophyceen,* E. Schweizerbarth'sche Verlagsbuchhandlung (Nagele u. Obermiller), Stuttgart.
- Huber-Pestalozzi, G. 1982. *Das phytoplankton des süßwassers systematik und biologie, 8. Teil, 1.Halffe Conjugatophyceae Zygnematales und Desmidiaceae (excl. Zygnemataceae),* E. Schweizerbarth'sche Verlagsbuchhandlung (Nagele u. Obermiller), Stuttgart.
- Huber-Pestalozzi, G. 1983. *Das phytoplankton des süßwassers systematik und biologie, 7. Teil, 1.Halffe Chlorophyceae (Grünalgen) Ordnung: Chlorococcales,* E. Schweizerbarth'sche Verlagsbuchhandlung (Nagele u. Obermiller), Stuttgart.
- Hutchinson, G.E. 1967. *A treatise on limnology, vol: II, introduction to lake biology and the limnoplankton,* John Wiley and sons. inc., Newyork, London, Sydney, 115 pp.
- İřbakan (Tař), B., Gönüloğlu, A. and Tař, E. 2002. A study on the seasonal variation of the phytoplankton of Lake Cernek (Samsun-Turkey). *Turkish Journal of Fisheries and Aquatic Sciences*, 2: 121-128.
- John, D.M., Whitton, B.A. and Brook, A.J. 2003. *The Freshwater Algal Flora of the British Isles: an identification guide to freshwater and terrestrial algae.* The Natural History Museum and The British Phycological Society. Cambridge University Press, Cambridge, 702 pp.
- Karacaoęlu, D., Dere, ř. and Dalkıran, N. 2004. A Taxonomic Study on the Phytoplankton of Lake Ulubat (Bursa). *Tr. J. of Botany*, 28: 473-485.
- Kılınç, S. 1998. A Study in the Seasonal Variation of Phytoplankton in Hafik Lake (Sivas, Turkey). *Tr. J. of Botany*, 22: 35-41.
- Kıvrak, E. and Gürbüz, H. 2005. Seasonal variations in phytoplankton composition and physical-chemical features of Demirdöven Dam Reservoir, Erzurum, Turkey. *Biologia, Bratislava*, 60(1): 1-8.
- Komarek, J. and Anagnostidis, K. 2008. *Cyanoprokaryota, 2. Teil/Part 2: Oscillatoriales, Süßwasser Flora von Mitteleuropa (Freshwater Flora of Central Europe),* 759 pp.
- Kramer, K. and Lange-Bertalot, H. 1986. *Bacillariophyceae. 1. Naviculaceae.* In: *Süßwasserflora von Mitteleuropa.* Gustav Fischer Verlag, 2/1, Stuttgart, New York, 876 pp.
- Kramer, K. and Lange-Bertalot, H. 1991. *Bacillariophyceae. 3. Centrales, Fragilariaceae, Eunoticeae.* In: *Süßwasserflora von Mitteleuropa.* Gustav Fischer Verlag, 2/3, Stuttgart, New York, 577 pp.
- Lind, O.T., Terrell, T.T. and Kimmel, B.G. 1993. Problems in reservoir trophic state classification and implications for reservoir management. In: M. Straskraba, J.G. Tundisi and A. Duncan (Ed.), *Comparative Reservoir Limnology and Water Quality Management*, Kluwer Ac. Publ., the Netherlands: 57-67.
- Lindholm, T., Eriksson, J.E. and Meriluoto, J.A.O. 1989. Toxic cyanobacteria and water quality problems-examples from a eutrophic lake on Åland, south west Finland. *Wat. Res.*, 23: 481-486.
- Moss, B. 1988. *Ecology of Fresh Waters, Man and Medium.* 2<sup>nd</sup> Ed., Blackwell Sci. Publ., Oxford, 417 pp.
- Moss, B. 2001. *Ecology of freshwaters.* Third edition, Blackwell Science, Oxford.
- Ongun, T. 2004. *Manyas Kuř Gölü Fitoplankton Komunité Yapısı,* MSc thesis. Balıkesir: Balıkesir University.
- Rawson, D.S. 1956. *Algal Indicators of Trophic Lake Types.* *Limnology and Oceanography*, 4: 386-398
- Reynolds, C.S. 1984. *The ecology of freshwater phytoplankton.* Cambridge Univ. Press, Cambridge, New York, 384 pp.
- Round, F.E. 1956. *The phytoplankton of there water supply rezervuar note Central Wales.* *Arch. F. Hydrobiol.*, 220-232.
- Round, F.E. 1984. *The ecology of the algae.* Cambridge Uiversity Press, Cambridge, 653 pp.
- Round, F.E., Crawford, R.M. and Mann, D.G. 1990. *The Diatoms: Morphology and biology of the genera.* Cambridge University Press, Cambridge, 747 pp.
- Sevindik (Ongun), T., Çelik, K. and Gönüloğlu, A. 2010. Twentyfour new records for the freshwater algae of Turkey. *Turkish Journal of Botany*, 34: 249-259.

- Sevindik (Ongun), T., Çelik, K. and Gönüloğlu, A. (in press). Twenty new records for Turkish freshwater algal flora from Çaygören and İkizcetepeler Reservoirs (Balıkesir, Turkey). Turkish Journal of Fisheries and Aquatic Sciences.
- Sheath, R. and Steinman, G. 1982. A checklist of freshwater algae of the Northwest Territories, Canada. Canadian Journal of Botany, 60: 1964-1997.
- Sims, P.A. 1996. An Atlas of British Diatoms. Biopress Ltd., London, 601 pp.
- Skulberg, O.M., Codd, G.A. and Carmichael, W.W. 1984. Toxic blue-green algal blooms in Europe, a growing problem. *Ambio*, 13: 244-247.
- Şipal (Gezerler), U., Balık, S. and Ustaoglu, M.R. 1996a. Demirköprü Baraj Gölü'nün (Salihli-Manisa) Fitoplanktonu, II. Uluslar arası Su Ürünleri Sempozyumu, İstanbul Üniv., Su Ürünleri Fak., İstanbul.
- Şipal (Gezerler), U., Balık, S. and Ustaoglu, M.R. 1996b. İkizgöl'ün (Bornova, İzmir) Mikro ve Makro Alg Florası. *Su Ürünleri Dergisi*, 13(1-2): 183-190.
- Taş, B. and Gönüloğlu, A. 2007. Derbent Baraj Gölü (Samsun, Türkiye)'nün Planktonik Algleri. *Journal of Fisheries Sciences*, 1(3): 111-123.
- Trifonova, I.S. 1998. Phytoplankton composition and biomass structure in relation to trophic gradient in some temperate and subarctic lakes of north-western Russia and the Prebaltic. *Hydrobiologia*, 370: 99-108.
- Ünal, Ş. 1984. Beytepe ve Alap göletlerinde fitoplanktonun mevsimsel değişimi. *Doğa Bilim Der.*, 8(1): 121-137.
- Yamagishi, T. 1987. The Euglenophyceae from Brophet in the Central Plain of Thailand. *Gen. Educ. Rev. Coll Apr. and Vet. Med. Nihon. Univ.*, 23: 39-51.
- Yazıcı, N. and Gönüloğlu, A. 1994. Suat Uğurlu Baraj Gölü (Çarşamba, Samsun-Türkiye) Fitoplanktonu Üzerinde Floristik ve Ekolojik Bir Araştırma. *E.Ü. Su Ürünleri Dergisi*, 11(42-43): 71-93.
- Yıldız, K. 1985. Altınapa Baraj Gölü Alg Toplulukları Üzerinde Araştırmalar Kısım I: Fitoplankton topluluğu, *Doğa Bilim Dergisi*, 9(2): 419-426.