

Epiphytic and Epilithic Diatoms In Dam Lakes (Euphrates - Turkey)Arzu MORKOYUNLU YUCE^{1*}, Ö. Osman ERTAN², M. Zeki YILDIRIM³^{1*} Hereke Ö.İ. Uzunyol Vocational Schools Kocaeli University, Turkey.² Egirdir Fisheries Faculty, Süleyman Demirel University, Isparta, Turkey.³ Faculty of Education ,Mehmet Akif Ersoy University, Burdur, Turkey.

* Sorumlu yazar: Tel: +90 262 511 56 75

E-posta: arzu.yuce@kocaeli.edu.tr

Geliş Tarihi: 20.04.2015

Kabul Tarihi: 05.06.2015

Abstract

In this study, epiphytic and epilithic diatom compositions in Birecik Dam Lake and Karkamış Dam Lake were identified. The diatom samples chosen from 6 stations were investigated between 2012 and 2013. In the research, 47 taxa belonging to Ochrophyta were identified. *Cocconeis pediculus* Ehr., *Cymbella affinis* Kütz., *Navicula radiosa* Kütz., *Nitzschia sigmaidea* (Ehr.) W. Smith taxa were found widespread. Other species of Ochrophyta were determined in various abundancies and frequencies in different seasons of the year. In the study, diatoms were determined to show their best growth in spring and summer, whilst they showed lower cell numbers in autumn and winter.

Keywords: Diatom, Karkamış Dam Lake, Birecik Dam Lake, Fırat.**Özet**

Bu çalışmada, Birecik ve Karkamış Baraj Göllerinde bulunan epifitik ve epilitik diatom kompozisyonu mevsimsel olarak belirlenmiştir. Seçilen 6 istasyondan örneklemeler 2012 ve 2013 tarihlerinde gerçekleştirilmiştir. Araştırmada, 47 taxon tespit edilmiş, bunlardan *Cocconeis pediculus* Ehr., *Cymbella affinis* Kütz., *Navicula radiosa* Kütz., *Nitzschia sigmaidea* (Ehr.) W. Smith türleri yaygın olarak bulunmuştur. Ochrophyta 'ya ait diğer türler yıl içerisinde değişen boluklarda ve sıklıklarda belirlenmiştir. Çalışmada, diatomların bahar ve yaz dönemlerinde daha iyi geliştiği, sonbahar ve kış dönemlerinde sayısal olarak azalış gösterdikleri tespit edilmiştir.

Anahtar Kelimeler: Diatom, Karkamış Baraj Gölü, Birecik Baraj Gölü, Fırat.**Introduction**

Wetlands, considered the natural wealth sources of the world due to their biological diversity, are the most important ecosystems of the earth with their natural functions and economic values. They have a positive effect on the local climatic elements; particularly rainfall and temperature by increasing the rate of

humidity in the region. They provide a habitat for many species with their rich floral and animal diversity, both ecological and commercial values of which are high, fishes and waterfowls being in the first place (Özuslu and Tel, 2010). In addition, determination of ecological-biological structures of dam lakes,

which have an important place in aquatic systems, is necessary for sustainable water management. Although there are studies carried out in dam lakes in Turkey, new researches are also being carried out. (Aykulu and Obalı, 1981; Gönüloğlu and Aykulu, 1984; Gönüloğlu, 1985; Yıldız, 1985; Altuner and Gürbüz, 1990; Akbay *et al.*, 1999; Sömek *et al.*, 2005; Uğurlu and Polat, 2005; (Toprak) Pala and Çağlar, 2006; Mert *et al.*, 2008; Bulut *et al.*, 2011; Boztuğ *et al.*, 2012).

Diatoms are the most widely identified diatom species in the studies conducted to determine the trophic status of dam lakes. Diatoms are important components of primer productivity and valuable indicators of environmental conditions because they respond directly and sensitively to many physical,

chemical, and biological changes in aquatic ecosystems. Diatoms have proven to be extremely powerful tools with which to explore and interpret many ecological conditions (Koçer and Şen, 2012). The purpose of this study was to determine the epilithic and epiphytic diatom compositions of Dam Lakes and to contribute to the algal flora of Turkey.

Materials and Methods

Research Stations

The research was carried out seasonally in 6 stations chosen from the littoral zones of Dam Lakes between October 2012 and August 2013. The Dam Lakes, power and flood control purposes was established on the Euphrates. The locations of the research stations in Dam Lakes are given in Figure 1.



Figure 1. Research area

Sampling and Examination of Samples

This investigation was conducted with seasonal samples. The samples taken in spring, summer, autumn and winter for the study were obtained from the 6 stations chosen in the littoral zone of the dams between October 2012 and August 2013. The epilithic and epiphytic (*Potamogeton* sp, and *Myriophyllum* sp.) samples were taken from the stations chosen to represent the dams using standard methods (Dere and Sıvacı, 1994; Atıcı and Yıldız 1996; Yüce, 1999). Samples were preserved in 4% formaldehyde solutions. Diatoms were studied in permanent preparations, the samples having been digested with acid (APHA, 1985). Taxonomic identifications were made according to Hustedt (1985); Patrick and Reimer (1966, 1975); Gönüloğlu *et al.* (1996); Aysel *et al.* (2005); Gönüloğlu (2014); Anonymous (2014).

Results

The samples taken seasonally from the diatoms showing a contagious distribution in Karkamış and Birecik Dam Lakes were analyzed qualitatively and quantitatively. In the research, 47 taxa belonging to Ochrophyta were determined. *Cocconeis pediculus* Ehr., *Cymbella affinis* Kütz., *Navicula radiosa* Kütz., *Nitzschia sigmoidea* (Ehr.) W. Smith taxa were found widespread. Other species of Ochrophyta were determined in various frequencies in different seasons of the year.

Diatoms showed their best growth in spring and to some extent in summer whilst they occurred in lower cell numbers in autumn and winter. The list of the identified species and their habitats are given in Table 1.

Discussion

In the research conducted seasonally in the six stations chosen among dam lakes, a total of 47 taxa belonging to Ochrophyta were determined. In the research, *Cocconeis pedi-*

culus, *Cymbella affinis*, *Navicula radiosa*, *Nitzschia sigmoidea* taxa were found widespread. Although the selected stations was found to show values close to each other in the distribution of epilithic diatoms, *Cocconeis pediculus* was identified as the most abundant species in the third station.

Epiphytic diatoms were found to show distribution in the 3rd and 6th stations. Besides, *Cocconeis pediculus* was identified as the most abundant species epiphytically in the fourth station. The reason of this is thought to result from the fact that the species of *Potamogeton* sp, and *Myriophyllum* sp. had a more abundant distribution in the 4th station than in the other stations. In the study carried out in Karkamış Dam Lake, the secchi disk depth varied between 3.2 and 6.5 m, chlorophyll-a between 0.21 and 2.41 µg/L, total phosphorus between 10 and 50 µg/L and total nitrogen between 1460 and 2890 µg/L. Karkamış Dam Lake was reported to be classified as mesotrophic in terms of its trophic status according to the mean value of total phosphorus (25.83 µg/L), and oligotrophic according to the mean values of chlorophyll-a (1.14 µg/L) and secchi disk depth (4.46 m) (Tepe *et al.*, 2014). In the study performed in Lower Euphrates Basin of the South East Anatolian Region, *Pinnularia* species identified as oligotrophic and *Epithemia* spp. known to show good growth in nitrogen-limited media recorded significant growths in Karkamış Dam (Açıkgöz Erkaya *et al.*, 2011). Partly oligotrophic and partly mesotrophic diatom species were identified in our study as well. In the studies conducted in the dam lakes in our country, Ochrophyta was also found dominant in Hirfanlı Dam Lake, Sarıyar Dam Lake, Derbent Dam Lake, Bedirkale Dam Lake and belonging to Ochrophyta; *Amphora ovalis*, *Cymbella affinis*, *Cymbella cymbiformis*, *Denticula tenuis*, *Diatoma vulgare*, *Melosira varians*, *Synedra*

Table 1. Epilithic and Epiphytic taxa in Dam Lakes

Ochrophyta (Taxa)	Epilithic	Epiphytic
<i>Melosira varians</i> C.A. Ag.	+	+
<i>Planothidium conspicuum</i> (A.Mayer) M.Aboal	-	+
<i>Achnanthes lanceolata</i> var. <i>tenuis</i> Gonzalves & Gandhi	+	-
<i>Amphora ovalis</i> (Kützing) Kützing	-	+
<i>Caloneis silicula</i> (Ehrenberg) Cleve	-	+
<i>Cocconeis pediculus</i> Ehrenberg	+	+
<i>Cocconeis placentula</i> Ehrenberg	-	+
<i>Cocconeis placentula</i> var. <i>euglypta</i> (Ehrenberg) Grunow	+	+
<i>Cymatopleura solea</i> (Brébisson) W.Smith	-	+
<i>Cymbella affinis</i> Kützing	+	+
<i>Cymbella cymbiformis</i> C.Agardh	+	+
<i>Cymbella lanceolata</i> (Ehr.) v. Heurck	-	+
<i>Brebissonia lanceolata</i> (C.Agardh) Mahoney & Reimer	-	+
<i>Encyonema ventricosum</i> (C.Agardh) Grunow	+	+
<i>Cymbella tumida</i> (Brébisson) van Heurck	-	+
<i>Denticula tenuis</i> Kützing	+	+
<i>Denticula elegans</i> Kütz.	+	+
<i>Diatoma vulgare</i> var. <i>brevis</i> Grunow	-	+
<i>Epithemia argus</i> (Ehrenberg) Kützing	+	+
<i>Epithemia muelleri</i> Fricke	+	+
<i>Encyonema minutum</i> (Hilse) D.G.Mann	+	-
<i>Fragilaria crotonensis</i> Kitton	+	-
<i>Ulnaria delicatissima</i> (W.Smith) M.Aboal & P.C.Silva	+	-
<i>Gomphonema truncatum</i> Ehrenberg	+	+
<i>Gomphonema truncatum</i> var. <i>turgidum</i> (Ehrenberg) R.M.Patrick	+	+
<i>Gomphonema olivaceum</i> (Hornemann) Brébisson	+	+
<i>Gomphonema intricatum</i> Kützing	-	+
<i>Gomphonema parvulum</i> (Kützing) Kützing	+	+
<i>Gomphonema ventricosum</i> Gregory	-	+

<i>Gomphonema tergestinum</i> (Grunow) Fricke	-	+
<i>Hantzschia amphioxys</i> (Ehrenberg) Grunow	-	+
<i>Navicula cryptocephala</i> Kützing	+	+
<i>Craticula cuspidata</i> (Kütz.)D.Mann var.	-	+
<i>cuspidata</i>		
<i>Navicula lanceolata</i> Ehrenberg	+	+
<i>Navicula radiosa</i> Kützing	+	+
<i>Navicula rhynchocephala</i> var. <i>constricta</i> Hust.	+	+
<i>Nitzschia linearis</i> W.Smith	+	-
<i>Nitzschia paleacea</i> Grunow	-	+
<i>Nitzschia recta</i> Hantzsch ex Rabenhorst	+	+
<i>Nitzschia sigmoidea</i> (Nitzsch) W.Smith	+	+
<i>Nitzschia sublinearis</i> Husted	+	-
<i>Pinnularia major</i> (Kützing) Rabenhorst	+	+
<i>Rhoicosphenia abbreviata</i> (C.Ag.) Lan-Bertalot	+	+
<i>Surirella angustata</i> Kützing	+	+
<i>Surirella ovalis</i> Brébisson	+	-
<i>Surirella minuta</i> Brébisson	+	-
<i>Synedra ulna</i> (Nitzsch) Ehrenberg	+	+

ulna species were dominant in Ataköy Dam Lake (Bayer, 2013). In the research conducted in Keban Dam Lake, a total of 53 diatom species were identified. *Navicula* spp., *Gomphonema* spp. and *Synedra* spp. were the most important diatoms in terms of their occurrence frequencies in the epilithic diatom community and magnitude of the populations they created ((Toprak) Pala and Çağlar, 2006). The species identified in the Dam Lake were also determined in our study, but not as dominant. In a study conducted in Keban Dam Lake, diatoms were reported to exist in all seasons, but to have more increase in spring (Çetin and Şen, 1998). A similar situation was also determined in our study. The species belonging to *Synedra* and *Cymbella* genera live in clean waters (Bayer, 2013). Individuals belonging to these two genera were identified in our stations. *Nitzschia palea*, *Navicula cryptocephala* were reported to be widespread diatoms living in dirty waters in

different regions of the world and *Fragilaria* species to be generally found widespread in mesotrophic and eutrophic waters (Kıvrak and Gürbüz, 2006). In our research, these species were mostly encountered in the littoral zone of Karkamış Dam. The diatoms in the littoral zone of Karkamış Dam Lake and Birecik Dam Lake are composed of species which are oligotrophic, rich in nutrients and widespread in eutrophic lakes.

In this study, diatoms showed their best growth in spring and to some extent in summer whilst they occurred in lower cell numbers in autumn and winter. Ochrophyta species are generally widespread and dominant in Turkey (Gönülol *et al.*, 1996; Aysel, 2005; Yıldırım and Tanrıku, 2011). In our research, diatom species having distribution in inland waters of our country were identified, which is thought to contribute to the situation assessment of the study area.

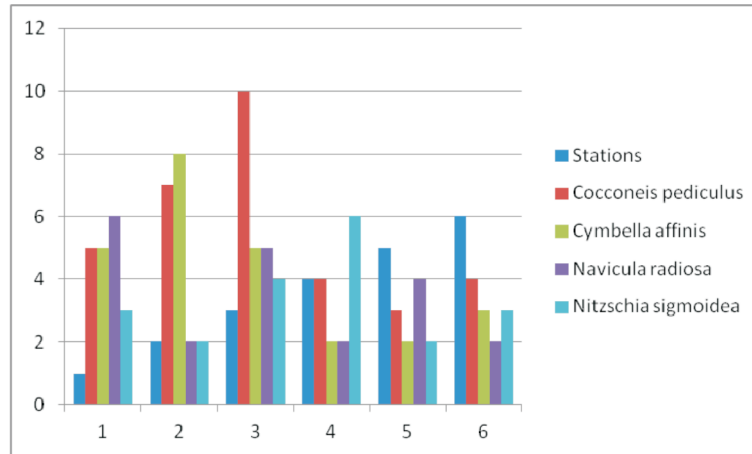


Figure 2. Epilithic diatoms in Lake Birecik (1-3) and Lake Karkamış (4-6).

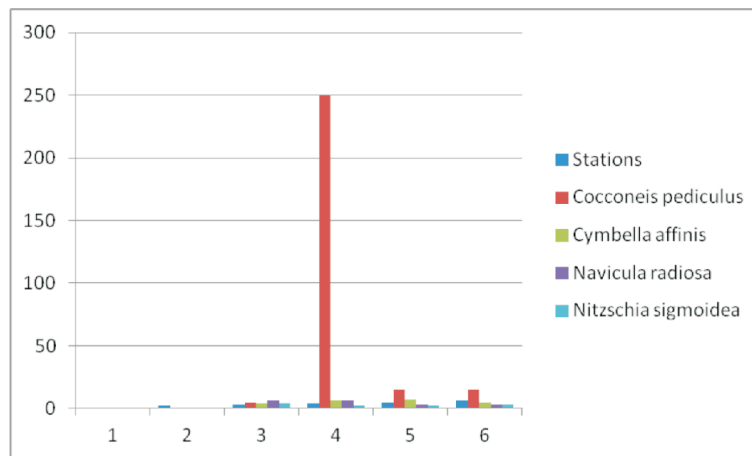


Figure 3. Epiphytic diatoms in Lake Birecik (1-3) and Lake Karkamış (4-6)

As a result, for the sustainable management of the reservoir, nitrogen and phosphorus entering the reservoir through various transports being taken under control, regular performance of environmental auditing, implementation of necessary sanctions and creating social responsibility projects in order to raise the awareness of the local people on the issue are important considerations.

Acknowledgement

We would like to thank Aquaculture Engineer (M.Sc) Murat Yuçe and Aquaculture Engineer (M.Sc) Uğur Yavuz and Aquaculture Engineer (M.Sc) Uğur Asan, who gave support

in field works of our study, very much.

References

- Açıkgöz Erkaya, I., Baykal Özer, T., Akbulut, A., Udoh, A., U. and Yıldız, K. 2011. The Abundant and Wide-Spread Species of Algae in the Algal Flora of the Lower Euphrates Basin Wetlands, Turkish Journal of Fisheries and Aquatic Sciences 11: 55-62.
- Akbay, N., Anul, N., Yerli, S., Soyupak, S. and Yurteri, C. 1999. Seasonal Distribution of Large Phytoplankton in the Keban Dam Reservoir, Journal of Plankton Research vol,21, no.4, 771-787.
- Altuner, Z. and Gürbüz, H. 1990. A Research on Phytoplankton Community of Tercan Dam Lake. X. National Biology Congress, 18-20 July, 131-140.

- Anonymous, 2014. <http://www.algaebase.org>. (entry april 15,2014).
- APHA, 1985. Standard Methods for the Examination of Water and Wastewater. Washington: American Public Health Association.
- Atıcı, T. and Yıldız, K. 1996. Diatoms of Sakarya River, Tr. J. of Botany, 20, 119-134.
- Aysel, V. 2005. Checklist of Freshwater Algae of Turkey, Journal of The Black Sea/Mediterranean Environment, Vol.,11, Number 1.
- Aykulu, G. and Obalı, O. 1981. Phytoplankton Biomass in the Kurtbogazi Dam Lake. Comun. Fac. Sci. Univ. Ank., Tome 24, Serie C2, 29-45.
- Bayer, D. 2013. Algal Flora Of Ataköy Dam Lake (Tokat) And The Isolation Of Some Species Of Algae, M. Sc. Thesis, Gaziosmanpaşa University Graduate School Of Natural And applied Sciences Department Of Biology.
- Boztuğ, D., Dere, T., Tayhan, N., Yıldırım, N., Danabaş, D., Cıkıcıoğlu Yıldırım, N., Öztüfekçi Önal, A., Danabaş, S., Ergin, C., Uslu, G. and Ünlü, E. 2012. Physico-Chemical Characteristics of Uzuncayir Dam Lake (Tunceli) and Water Quality, Adiyaman University, Journal of Science, 2 (2) 93-106.
- Bulut, S., Mert, R., Solak, K. and Konuk, M. 2011. Some Limonological Properties of Selevir Dam Lake, Ecology 20, 80, 13-22 doi: 10.5053/ekoloji.2011.803.
- Çetin, A. K. and Şen, B. 1998. Diatoms (Bacillariophyta) in the Phytoplankton of Keban Reservoir and Their Seasonal Variations, Tr. J. of Botany 22 (1998) 25-33.
- Dere, Ş. and Sivacı, E. R. 1994. Epipellic, Epiphytic and Epilithic Algal Flora of Kızılırmak (Entry and exit of Sivas), XII. National Congress of Biology, Section of Hydrobiology, Volume IV, pp. 180-188.
- Gönüloğlu, A., Öztürk, M. and Öztürk, M. 1996. The List of Freshwater Algae of Turkey, Ondokuz Mayıs University, Faculty of Science and Literature, Journal of Science, Volume 7, Issue 1, 46pp.
- Gönüloğlu, A. and Aykulu, G. 1984. Researches on the Algae of Çubuk-I Dam Lake, Seasonal Change of the Phytoplankton Composition and Density, Journal of Natural Sciences. A2, 8, 2, 330-342.
- Gönüloğlu, A. 1985. Studies on the phytoplankton of the Bayındır Dam Lake. Commun. Fac. Bci. Univ ANK., ISSN 0256-7865, Serie C, Tome 3, 21-38.
- Gönüloğlu, A. 2014. <http://www.turkiyealgleri.org>., Turkish algae electronic publication, Samsun, Turkey (entry May 18, 2014).
- Husted, F. 1985. The Pennate Diatoms, a translation of Husted 'Die Kieselalgen ,2.Teil' with supplement by Norman G. Jensen, Koeltz Scientific Books, Koenigstein, 918pp.
- Kıvrak, E. and Gürbüz, H. 2006. Seasonal Change of the Benthic Algal Flora of Tortum Lake (Erzurum). E.U. Journal of Aquaculture, 23(3-4), 307-313.
- Koçer, M. A. T. and Şen, B. 2012. The seasonal succession of diatoms in phytoplankton of a soda lake (Lake Hazar, Turkey), Turk J Bot 36 738-746 , TÜBİTAK doi:10.3906/bot-1106-9.
- Mert, R., Bulut, S. and Solak, K. 2008. Investigation of Some Physical And Chemical Properties of Apa Dam Lake (Konya), Mert, Bulut and Solak/ AKÜ Journal of Science-02 1-10.
- Özuslu, E. and Tel, A. Z. 2010. Biological Diversity of Karkamış Wetland (Gaziantep-Turkey), Turkish Journal of Scientific Reviews 3(2): 11-32, ISSN:1308-0040, www.nobel.gen.tr.
- Patrick, R. and Reimer, C. W. 1966. The Diatoms of The United States I, Acad. Sci, Philadelphia, p. 687pp.
- Patrick, R. and Reimer, C. W. 1975. The Diatoms of The United States, II Acad. Sci, Philadelphia, p. 213pp.
- Sömek, H., Balık, M. S. and Ustaoglu, R. 2005. Phytoplankton of Topçam Dam Lake (Çine-Aydın) and Their Seasonal Variations, Süleyman Demirel University, Journal of the Faculty of Aquaculture, Volume I, Issue, 26-32.
- Uğurlu, S. and Polat, N. 2005. The Fishes Inhabiting in Suat Uğurlu Dam Lake, Terice and Göksu Stream (Ayvacık-SAMSUN), Süleyman Demirel University, Journal of Eğirdir Aquaculture Faculty, Volume: 1, Issue: 2, 27-37.
- Tepe, R., Sesli, A., Karakaya, G. and Özbey, N. 2014. Evaluation of the Trophic Status of Karkamış Dam Lake, 5th Aquaculture symposium of Eastern Anatolia Region, 46-47.
- (Toprak) Pala, G. and Çağlar, M. 2006. Epilithic Diatoms in Keban Dam Lake and Their Seasonal Variations, Science and Eng. J of Fırat Univ. (3), 323-329.
- Yıldız, K. 1985. Researches on the Algal Communities of Altınapa Dam Lake, Part I: Phytoplankton Community. Journal of Natural Sciences. A2, 9, 2, 419-427.
- Yıldırım, V. and Tanrıku, A. 2011. Dicle River (Diyarbakır) Physico-Chemical Proparties And Epipellic Algae, e-Journal of New World Sciences Academy Volume: 6, Number: 2, Article Number: 5A0064.
- Yüce, A. 1999. Taxonomical and Ecological Analysis of Kovada Lake and Channel Algae, Phd Thesis, S. D.U. Institute of Science.