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The Seasonal Variations of Planktonic and Epilithic Diatoms in Kalecik Reservoir (Elazig, Turkey)

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Abstract: In the study, the planktonic and epilithic diatoms were studied at four stations selected on Kalecik reservoir between March and October 2010. Sampling was performed monthly. Some physical and chemical characteristics (Water temperature, electrical conductivity, pH and concentrations of dissolved oxygen and total hardness) of the reservoir were measured throughout the duration of the study. Of the 41 diatom taxa identified during the study. The seasonal variations in these diatoms were examined together with their physical and chemical characteristics and the results of this examination were compared with the results of previous studies carried out in reservoirs.

Key words: Kalecik reservoir, diatom, epilithon, plankton, seasonal variation, Elazig

INTRODUCTION

Diatom are the major primary producers in many aquatic systems and an important food source for other organisms. They include planktonic and benthic forms. Diatoms have been especially recognized as useful indicators of environmental conditions. The use of diatoms as water quality indicators has been recognized in a number of articles (King *et al*., 2000; Winter and Duthie, 2000). Phytoplanktonic and benthic diatoms are analyzed and discussed separately with different relationships between these and the environmental variables assumed due to different ecology (Tolotti, 2001).

A considerable amount of information has been gathered over the last 20 years on the ecology and distribution of diatom in freshwater ecosystems in Turkey. Most of these studies were performed on the species composition and biomass of both planktonic and benthic diatom occurring in lakes (Aykulu and ve Obali, 1981; Gonulol and ve Aykulu, 1984; Gonulol, 1985a, b; Yildiz, 1985; Altuner and ve Gurbuz, 1990; Yazici and ve Gonulol, 1994; Cetin and ve Sen, 1997; Gonulol and ve Obali, 1998; Atici, 1999; Cevik, 1999; Cetin and Yildirim, 2000, 2003; Gurbuz and Kivrak, 2003; Baykal *et al*., 2004; Cetin and Sen, 2004, 2006; Atici *et al*., 2005; Pala, 2006).

The present study was carried out to determine the species composition and seasonal variations of planktonic and epilithic diatoms in relation to physical and chemical factors in Kalecik reservoir since species composition and the seasonal variations of benthic forms in freshwaters are known to be dependent on interactions between physical and chemical factors.

MATERIALS AND METHODS

The planktonic and epilithic diatoms and water quality in Kalecik reservoir have been investigated for 8 month from March 2010 to October 2010 using monthly samplings. There is Kalecik reservoir in Karakocan Township Kalecik village.

Kalecik reservoir is located on Kalecik stream and fills in the form of land. Reservoir is located 3 km from the district in 1970s was built and used for irrigation purposes. The volume of water in the reservoir is 12.5 hm^3 and area of the reservoir is 1.16 km^2 (Fig. 1).

Surface water temperature of the Kalecik reservoir was measured using a mercury thermometer with 1°C divisions, pH, electrical conductivity and dissolved O_2 values with Hanna 91410 model pH/O_2 meter in the field while total hardness values were determined using Titrimetric method (APHA, 1985).

Plankton samples were collected by sweeping the entire lake surface with a plankton net and epilithic diatoms were scraped from stones. Epilithic samples were washed in sterile water and put into sterile plastic bags. The samples were watered with pure water on a daily basis and diatoms were made to cling to the gauze using their heliotropic nature.

After several days, the gauze was washed with pure water and placed into an Erlenmeyer flask. While diatom other than the planktonic and epilithic diatoms were examined in transient preparations, continuous preparations were made for diatoms. Nikon brand microscope and relevant identification books were used

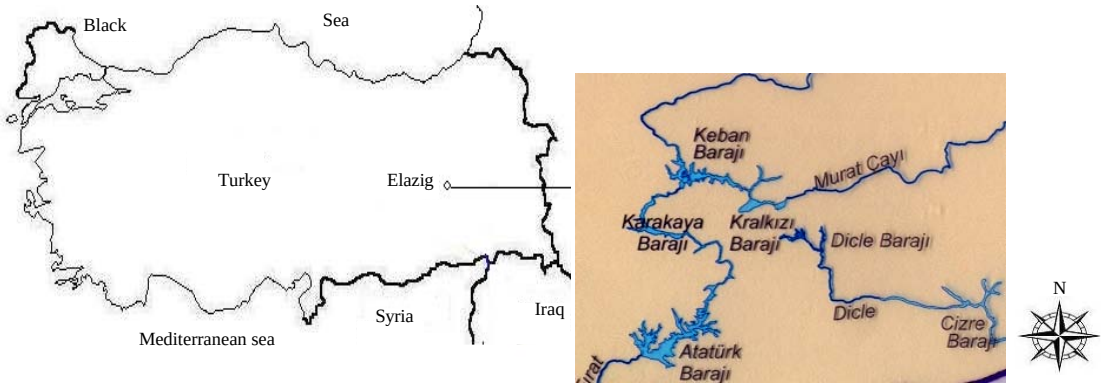

Fig. 1: The map of Kalecik Dam lake

in the species identification and counts of diatoms whose continuous preparations have been made. In addition, the species identification was checked at AlgaeBase data base (www.algaebase.org) (Guiry and Guiry, 2009). The counts in continuous preparations were based on relative density and the results were expressed as organism (%) (Sladeckova, 1962).

RESULTS AND DISCUSSION

In order to determine some physical and chemical properties of the Kalecik reservoir some physical measurements have been carried out in the field and chemical analyses were conducted in the laboratory between March 2010 to October 2010 and the results have been shown in Table 1 and 2.

The highest surface water temperature in the pond throughout the study period (29.2°C) was recorded in September and the lowest surface water temperature (12.0°C) was recorded in March. The highest pH values in the Pond (8.6) were found in June and the lowest (7.0) in April.

The highest dissolved oxygen values in Kalecik reservoir (9.3 mgO_2 L^{-1}) were established in March and the lowest values (7.0 mgO_2 L^{-1}) in July and October (Table 1). The highest electrical conductivity (810 µS cm^{-1}) was recorded in March and the lowest electrical conductivity (455 µS cm^{-1}) in July (Table 1).

Total hardness values of the pond water over the study period were the highest in March and June (115 mg $CaCO_3$ L^{-1}) and the lowest in August (78 mg $CaCO_3$ L^{-1}) (Table 1). Of the 41 diatom taxa identified throughout the study. The list of the alga species identified in Kalecik reservoir is shown in Table 3. Among the diatoms,pennate diatoms were recorded to have a higher number of taxa than centric diatoms and the genera with the highest number of taxa were found to be Nitzschia and Navicula with 5 taxa in each diatoma and with Cymbella 3 taxa in each.

Table 1: Variations in values of physical and chemical parameters of first station in Kalecik Dam lake

	Parameters				
Date	Water temperature (°C)	pH	Dissolved oxygen (mg L^{-1})	Electrical conductivity (µS cm^{-1})	Total hardness (mg$CaCO_3$ L^{-1})
Mar 2010	12.0	7.7	9.3	810	115
Apr 2010	12.8	7.0	8.9	790	111
May 2010	13.8	8.3	8.0	780	110
Jun 2010	17.7	8.6	7.8	789	115
Jul 2010	26.3	8.0	7.0	455	89
Aug 2010	28.0	7.9	7.3	522	78
Sept 2010	29.2	8.3	7.5	536	90
Oct 2010	20.0	7.9	7.0	560	98

Table 2: Variations in values of physical and chemical parameters of second station in Kalecik Dam lake

	Parameters				
Date	Water temperature (°C)	pH	Dissolved oxygen (mg L^{-1})	Electrical conductivity (µS cm^{-1})	Total hardness (mgCaCO L^{-3})
Mar 2010	11.5	7.9	8.6	800	110
Apr 2010	13.0	7.3	8.8	795	100
May 2010	16.5	8.1	8.0	776	99
Jun 2010	18.5	8.0	7.5	780	98
Jul 2010	28.2	8.2	7.6	500	90
Aug 2010	28.2	7.6	7.9	514	99
Sept 2010	28.0	8.1	7.1	521	110
Oct 2010	19.8	8.0	7.9	553	96

Among the planktonic diatoms identified in Kalecik reservoir, the most marked ones in terms of their relative density were *Cocconeis pediculus* (Max. 24% March-Min. 10% October), *Gomphonema truncatum* var. *capitatum* (Max. 22% March-Min. 10% October) and *Ulnaria acus* (Max. 18% March-Min. 6% October) (Fig. 2). Of the planktonic diatoms established in the reservoir over the study period, *Cocconeis pediculus*, Gomphonema

Table 3: The epilithic and planktonic diatoms of Kalecik Dam lake

Taxa of alga	Plankton	Epilithon
Bacillariophyta		
Centrales		
Aulacoseira granulata Ehrenberg (Simonsen)	+	+
Cyclotella meneghiniana Kutzing	-	+
Pennales		
Achnanthidium minutissimum (Kutzing) Czarnecki	+	+
Amphora ovalis (Kutzing) Kutzing	+	-
Anomoeneis sphaerophora E. Pfitzer	-	+
Cocconeis pediculus Ehrenberg	+	+
Cocconeis placentula Ehrenberg	+	+
Craticula ambigua (Ehrenberg) D.G. Mann	+	+
Craticula cuspidata (Kutzing) D.G. Mann	+	+
Ctenophora pulchella (Ralfs ex Kutzing) D.M. Williams and Round	-	+
Cymatopleura solea (Brebisson) W. Smith	-	+
Cymbella affinis Kutzing	+	+
Cymbella cuspidata Kutzing	+	+
Cymbella helvetica Kutzing	+	+
Cymbella tumida (Brebisson) Van Heurck	+	+
Diatoma elongatum (Lyngbye) C. Agardh	+	+
Diatoma vulgaris Bory	+	+
Diploneis elliptica Kutzing (Cleve)	+	+
Gomphonema intricatum Kutzing	+	+
Gomphonema productum (Grunow) Lange-Bertalot and Reichardt	+	+
Gomphonema truncatum var. *capitatum* (Ehr.) Patr. nom. nov.	+	+
Gyrosigma acuminatum (Kutzing) Rabenhorst	+	+
Halamphora veneta (Kutzing) Levkov	+	+
Navicula cincta (Ehrenberg) Ralfs	+	+
Navicula cryptocephala Kutzing	+	+
Navicula rhynchocephala Kutzing	+	+
Navicula salinarum Grunow	+	+
Navicula viridula (Kutzing) Ehrenberg	+	+
Nitzschia amphibia Grunow	+	+
Nitzschia gracilis Hantzsch	+	+
Nitzschia intermedia Hantzsch ex Cleve and Grunow	+	+
Nitzschia linearis (C. Agardh) W. Smith	+	+
Nitzschia palea (Kutzing) W. Smith	+	+
Nitzschia sigmoidea (Nitzsch) W. Smith	+	+
Sellaphora pupula (Kutzing) Mereschkovsky	+	+
Stauroneis anceps Ehrenberg	+	+
Surirella moelleriana Grunow	+	+
Surirella ovalis Brebisson D.M. Williams and Round	+	+
Tabellaria fasciculata (C. Agardh)	+	+
Ulnaria acus (Kutzing) M. Aboal	+	+
Ulnaria ulna (Nitzsch) P. Compere	+	+

remarkable due to their common occurrence (Fig. 2). *Cocconeis pediculus*, *Gomphonema truncatum* var. *capitatum* and *Ulnaria acus* were the most common epilithic diatoms of the Kalecik reservoir and had relative densities greater than other diatoms (Fig. 3).

Diatom in Kalecik reservoir were examined between September 2008 and August 2009 and the results were compared with the results of previous diatom studies carried out in ponds in Turkey. Of the 41 diatom taxa identified over the study period.

The fact that some diatom taxa are found only in a single community demonstrates that these diatoms enjoy specific occurrence characteristics. Since, the majority of alga taxa showed specific characteristics by occurring in

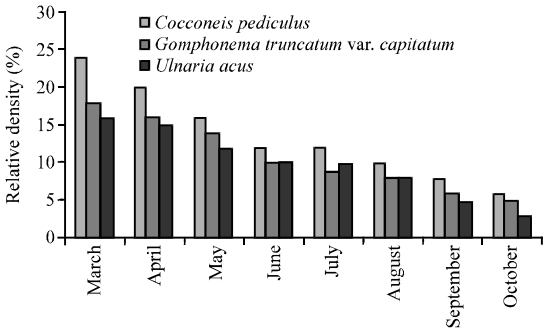

Fig. 2: Seasonal variations in the relative density of planktonic diatoms in the Kalecik Dam lake

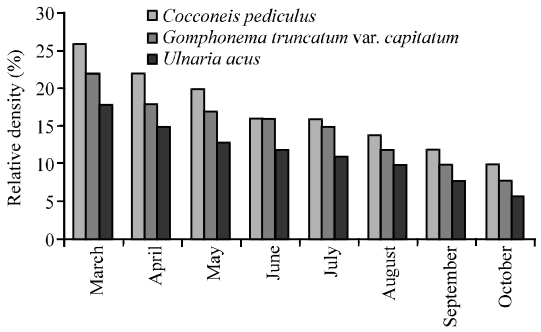

Fig. 3: Seasonal variations in the relative density of epilithic diatoms in the Kalecik Dam lake

one or two samples throughout the study, it may be misleading to generalize the selective properties that diatom display when they occur. It is a well known fact that the determination of the specific characteristics that diatom display when they emerge requires long and laborious research efforts.

Lund (1965) and Hutchinson (1967), stated that *Navicula* and *Nitzschia* species were cosmopolite. It has been reported in various studies (Aykulu and ve Obali, 1981; Gonulol and ve Aykulu, 1984; Gonulol, 1985a, b; Yildiz, 1985; Altuner and Gurbuz, 1990; Yazici and ve Gonulol, 1994; Cetin and ve Sen, 1997; Gonulol and ve Obali, 1998; Atici, 1999; Cevik, 1999; Cetin and Yildirim, 2000; Gurbuz and Kivrak, 2003; Cetin and Yildirim, 2003; Baykal *et al*., 2004; Cetin and Sen 2004, 2006; Atici *et al*., 2005; Pala, 2006) carried out in the country that *Navicula* and *Nitzschia* species are commonly found. The fact that the species *Navicula* and *Nitzschia* were established in all habitats in the study supports the idea that the species belonging to these genera are cosmopolite. Odum (1971) and Round (1981) argued that light was the major factor in the seasonal distribution of diatom while Moss (1998) and Reynolds (1993) noted that diatom grew better in the phytoplankton in spring and early summer and less

in the period between July and October. Besides, Wetzel (2001) highlighted temperature and light as the major factors that affected the development of diatom. The richness and the number of individual members of diatom species were seen to vary seasonally in the present study. Spring was the season in which species composition of diatom in the reservoir was the richest and autumn was when the composition was the poorest.

This suggests that the water temperature and intensity of light affect the composition and reproduction of diatom.

The species composition and numbers of individuals of diatoms are related to a variety of environmental factors in the aquatic environment. Water temperature and transparency are among the most important physical factors affecting the species composition and numbers of individuals of diatoms in aquatic environments (Lund, 1965; Hutchinson, 1967; Odum, 1971; Round, 1981; Moss, 1998; Reynolds, 1993; Wetzel, 2001). In general, species composition of epilithic and planktonic diatoms was found to be rich in spring. However, in the present study, the richest numbers of species coincided both with summer and autumn at all stations.

CONCLUSION

The study shows that although, several diatoms registered in Kalecik reservoir were insignificant in terms of their frequency of occurrence among epilithic and planktonic diatom communities, they were noteworthy due to their high relative density in certain months. This finding suggests that there may be a succession among diatoms, as long as conditions permit.

When the continuous presence of diatoms in the epilithic and planktonic diatom communities is considered, it appears that diatoms are cosmopolitan, can be among the most commonly encountered diatom in all types of substrata and may be used as biological monitors (Round, 1981; Reynolds, 1993).

REFERENCES

APHA, 1985. Standart Methods for the Examination of Water and Wasatewater. 16th Edn., APHA, Washington DC, pp: 1268.

Altuner, Z. and H. ve Gurbuz, 1990. An investigation on algae of Tercan Dam Lake. X. National Biology Congress, S. 131-140.

Atici, T., 1999. An investigation of floristic and ecological of Sariyar Dam Lake. Gazi University. Enstitu of Science.

Atici, T., O. Obali and H. Caliskan, 2005. Control of water pollution and phytoplanktonic algal flora in bayindir dam reservoir (Ankara). E.U. J. Fish. Aquat. Sci., 22: 79-82.

Aykulu, G. and O. ve Obali, 1981. Phytoplankton Biomass in the Kurtbogazi Dam Lake. Ankara Univ., 24: 29-44.

Baykal, T., I. Acikgoz, K. Yildiz and A. Bekleyen, 2004. A study on algae in Devegecidi Dam Lake. Turk. J. Bot., 28: 457-472.

Cetin, A.K. and B. Sen, 2004. Seasonal distribution of phytoplankton in Orduzu Dam Lake (Malatya, Turkey). Turk. J. Bot., 28: 279-285.

Cetin, A.K. and B. Sen, 2006. Benthic diatom flora (*Bacillariophyta*) of keban reservoir (Elazig, Turkey). Int. J. Algae., 8: 162-173.

Cetin, A.K. and B. ve Sen, 1997. Seasonal variations and algae of exception Bacillariophyta of Keban reservoir. Firat Univ. J. Sci., 9: 45-49.

Cetin, A.K. and V. Yildirim, 2000. Species composition and seasonal variations of the phytoplankton in Surgu Reservoir (Malatya, Turkey). Acta Hydrobiol., 42: 21-28.

Cetin, A.K. and V. Yildirim, 2003. Epilithic and epiphytic diatoms of surgu reservoir (Malatya, Turkey). Int. J. Algae, 5: 37-45.

Cevik, F., 1999. The Water Quality Parameters and Algae of Seyhan Dam Lake. Canakkale University, Institute of Science, Turky.

Gonulol, A., 1985a. Studies on the phytoplankton of the bayYndYr dam lake. Communications, 3: 21-38.

Gonulol, A. and G. ve Aykulu, 1984. An investigation on algae of Cubuk I Dam lake. I. a seasonal variation of density and composition of phytoplankton. J. Sci. Doga, 8: 330-342.

Gonulol, A. and O. ve Obali, 1998. A study on the phytoplankton of Hasan Ugurlu Dam Lake (Samsun-Turkey). Turk. J. Biol., 22: 447-461.

Gonulol, A., 1985b. An investigation on Cubuk I Dam lake, a seasonal variation of density and composition of littoral algae. J. Sci. Doga, 9: 253-268.

Guiry, M.D. and G.M. Guiry, 2009. AlgaeBase. World-wide electronic publication. National University of Ireland, Galway.

Gurbuz, H. and E. Kivrak, 2003. Seasonal variations of benthic algae of kuzgun reservoir and their relationship to environmental factors. Fresen. Environ. Bull., 12: 1025-1032.

Hutchinson, G.E., 1967. A Treatise on Limnology. I. Introduction to lake Biology and Limnoplankton. Vol. 2, John Wiley and Sons, New York, pp: 1115.

King, L., P. Barker and R.I. Jones, 2000. Epilithic algal communities and their relationship to environmental variables in lakes of the English Lake District. Freshwater Biol., 45: 425-442.

Lund, J.W.G., 1965. The ecology of the freshwater phytoplankton. Biol. Rev., 40: 231-293.

Moss, B., 1998. Ecology of Freshwaters, Man and Medium, Past to Future. Blackwell Science Ltd., Oxford, UK.

Odum, E.P., 1971. Fundamentals of Ecology. 3rd Edn., W.B. Saunders Company, Philadelphia, pp: 574.

Pala, G., 2006. The Seasonal variations and planktonic algae on guluskur region of keban reservoir. II. *Bacillariophyta*. Firat Univ. J. Sci., 19: 23-32.

Reynolds, C.S., 1993. The Ecology of Freshwater Phytoplankton. Cambridge University Press, Cambridge.

Round, F.E., 1981. The Ecology of Algae. Cambridge University Press, New York, USA., ISBN-13: 9780521225830, Pages: 653.

Sladeckova, A., 1962. Limnological investigation methods for the periphyton (Aufwuchs) community. Bot. Rev., 28: 286-350.

Tolotti, M., 2001. Phytoplankton and littoral epilithic diatoms in high mountain values in lakes of the Adamello-Brenta regional park (Trentino, Italy) and their relation to trophic status and acidification risk. J. Limnol., 60: 171-188.

Wetzel, R.G., 2001. Limnology: Lake and River Ecosystems. 3rd Edn., Academic Press, San Diego, USA..

Winter, J.G. and H.C. Duthie, 2000. Epilithic diatoms as indicators of stream total N and total P concentration. J. N. Am. Benthol. Soc., 19: 32-49.

Yazici, N. and A. ve Gonulol, 1994. An investigation on phyoplankton of suat ugurlu dam lake. Ege Univ. J. Aqua. Fisch., 11: 71-93.

Yildiz, K., 1985. An investigation on algae of altinapa dam lake. I. phytoplankton. J. Sci. Doga, 9: 419-427.