Research Article

Chlorophyta algae of Keban Dam Lake Gülüşkür region with aquaculture criteria in Elazıg, Turkey

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Received: May 2021 **Accepted:** August 2021

Abstract

Algae can be used as indicator for water quality, which could be a benefit for fish health. In this study, algae and water samples were taken from three selected stations from Keban Dam Lake Gülüşkür Region were investigated for six months between March 2015 and August 2015. A total of 48 taxa belonging to Chlorophyta were recorded during the study. Members of Chlorophyta showed their best growth in July and August, when light and temperature increased. Species belonging to Scenedesmus, Pediastrum, Ankistrodesmus and Oocystis genera were the most important members of phytoplankton with their frequency of occurrence and the size of the populations they formed.

Keywords: Phytoplankton, Chlorophyta, Aquaculture, Keban Dam Lake, Elazığ, Turkey

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Introduction

Algae, which have become significant in aquaculture or other industries such as hygiene industries providing broader-based resources for the needs of people together with developing technology and increasing population, have gained the importance they deserve in scientific studies by being used in many beneficial industrial branches.

Algae, whose significance was first understood by planktonic studies, have been highly important organisms in aquatic environments. Plant organisms that manufacture their own food through photosynthesis also form the first link of the food chain, and therefore, they are called as primary producers. Algae are the main organic matter builders both in freshwater and seas, and they enable the other creatures to live as well, by maintaining the oxygen balance. In addition to being used as human and animal food as they are high in protein, algae are commonly used in studies on natural fertilizer and natural vitamin making.

[DOR: 20.1001.1.2345315.2021.7.1.3.8]

[DOI: 10.52547/ijaah.7.1.32]

As the importance of algae in standing and running waters has been understood, the numbers of studies on these organisms have also started to increase.

In an algological study, Akbay (1993) analyzed the horizontal and vertical distribution of phytoplankton in Uluova region of Keban Dam Lake.

In Taş and Gönülol's (2007) study, a total of 180 taxa belonging to 8 classes in phytoplankton were identified. Researchers determined that 22 of these belonged to Cyanophyta (Cyanobacteria, 12%), 74 species to Bacillariophyta (41%), 69 to Chlorophyta (38%), 1 to Chrysophyta (1%), 2 to Cryptophyta (1%), 6 to Euglenophyta (3%), 3 to Pyrrophyta (2%), and 3 to Xanthophyta (2%). Gürbüz and Kıvrak (2003) examined the seasonal change of benthic algal flora of Kuzgun Dam Lake (Erzurum). Baykal et al. (2004) analyzed Devegeçidi Dam Lake (Diyarbakır) algae, and identified a total of 112 taxa belonging to Cyanophyta (29), Euglenophyta (5), Chlorophyta (45), Pyrrhophyta (5), and Bacillariophyta (28). Baykal and Açıkgöz (2004) carried out a study on Hirfanlı Dam Lake (Kırşehir) algae. They identified a total of 329 algal species belonging to Bacillariophyta (208), Chlorophyta (65), Cyanophyta (39), Euglenophyta (10), Dinophyta (5), and Chrysophyta (2). Atıcı (2004) studied on planktonic algae of Sarıyar Dam. During the study, the researcher identified 35 Cyanophyta taxa belonging to 15 species, in total. He reported that the mostly observed organisms in the dam lake were the species Anabaena, Oscillatoria, Spirulina, Phormidium and Chroococcus. In this study, Sarıyar Dam Lake's planktonic Cyanophyta species composition was presented.

In another study (Atıcı *et al*., 2005) a total of 76 phytoplankton species was identified so that among them, 13 belonging to Cyanophyta, 17 to Chlorophyta, 2 to Dinophyta, 6 to Euglenophyta and 38 to Bacillariophyta. In the same period, physical and chemical analyses were also carried out, abundance and presence of the species were observed, and it was found out that in the dam, there were algal species tolerant to pollution. Kıvrak and Gürbüz (2005) analyzed the phytoplankton composition of Demirdöven Dam Lake (Erzurum) and the physico-chemical properties of the lake. They identified a total of 174 taxa belonging to Bacillariophyta, Chlorophyta, Cyanophyta, and Euglenophyta. Sömek *et al*. (2005) found the phytoplankton composition in the study, which was carried out in Topçam Dam Lake (Aydın). A total of 63 taxa, 15 belonging to Cyanophyta, 26 to Chlorophyta, 15 to Bacillariophyta, 3 to Dinophyta and 4 to Euglenophyta were identified. The seasonal change and chlorophyll-*a* values of Sarıyar Dam phytoplankton were investigated (Atıcı and Obalı, 2006). It was determined that the divisions of Bacillariophyta and Chlorophyta were the dominant organism. They reported the presence of Cyclotella, Navicula, Nitzchia and Synedra members from Bacillariophyta, and Chlorella and Scenedesmus members from Chlorophyta.

The epilithic diatoms of Keban Dam Lake's İçme Region was examined (Pala and Çağlar, 2006). They identified a total of 53 species.

[DOR: 20.1001.1.2345315.2021.7.1.3.8]
[DOI: 10.52547/ijaah.7.1.32]

They stated that the diatom genera represented by the highest number of species in the researched region of Keban Dam Lake were Navicula (9), Gomphonema (8) Nitzschia (7), and Fragilaria (6). Baykal and Yıldız (2006) analyzed the algae except for Bacillariophyta in Çamlıdere Dam Lake, and identified a total of 112 species, 48 belonging to Cyanophyta, 57 to Chlorophyta, 3 to Chrysophyta, 13 to Euglenophyta, and 1 to Pyrrophyta. They observed that the members of Chroococcales and Chlorococcales were mostly present in plankton and partly in epipelon while filamentous forms were more common and abundant in epiphyton and epilithon. Baykal *et al*. (2006) analyzed the seasonal changes of Hirfanlı Dam Lake's phytoplankton and zooplankton densities and the relationship between them. They found that the seasonal distribution of organism densities was not in the expected order. Ersanlı (2006) examined Çakmak Dam's (Tekkeköy-Samsun) phytoplankton and its seasonal change. In phytoplankton of Çakmak Dam Lake, she identified a total of 136 taxa belonging to the divisions of Bacillariophyta, Chlorophyta, Chrysophyta, Cryptophyta, Cyanoprokaryota, Dinophyta, Euglenophyta, and Xanthophyta. She noted that although the members of Bacillariophyta division were rich in terms of species in the lake, the members of Chlorophyta division were dominant in terms of population density. Pala (2007) studied planktonic algae (Bacillariophyta) and their seasonal changes in Gülüşkür region of Keban Dam Lake. During the research, he identified a total of 165 taxa belonging to Bacillariophyta. He put that diatoms' species belonging to the genera of Nitzschia, Navicula, Achnanthes and Cymbella were the most important members of phytoplankton. Maraşlıoğlu (2007) researched into Yedikır Dam Lake's (Amasya-Turkey) phytoplankton and its seasonal change. In phytoplankton, he identified a total of 126 taxa belonging to the divisions of Chlorophyta, Bacillariophyta, Cyanophyta, Euglenophyta, Dinophyta, Chrysophyta, Cryptophyta and Xantophyta. Özyalın and Ustaoğlu (2008) analyzed phytoplankton of Kemer Dam Lake (Aydın). In the study, they identified a total of 77 phytoplankton taxa, 33 belonging to Chlorophyta, 22 to Bacillariophyta, 10 to Cyanophyta, 7 to Euglenophyta, 4 to Dinophyta, and 1 to Chrysophyta. Sezen (2008) examined Sarımsaklı Dam Lake's phyotoplankton, its seasonal change, and physical and chemical factors affecting this change. As a result of the sampling, he identified a total of 126 taxa, 58 belonging to Chlorophyta, 44 to Bacillariophyta, 13 to Cyanophyta, 5 to Euglenophyta, 3 to Dinophyta, 1 to Chrysophyta, 1 to Cryptophyta, and 1 to Xantophyta.

Sevindik (2010) analyzed the phytoplankton composition of Çaygören Dam Lake (Balıkesir). In the study, she identified 192 taxa belonging to 8 divisions in total, namely Chlorophyta (75), Bacillariophyta (60), Cyanobacteria (19), Euglenophyta (19), Charophyta (8), Myzozoa (6), Cryptophyta (3), and Heterokontophyta (2). In their planktonic study on Buldan Dam Lake (Denizli), Ustaoğlu et al. (2010) identified a total of 106 taxa. While 76 of these taxa were detected in

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phytoplankton, 18 belonging to Cyanobacteria, 1 to Heterokontophyta, 26 to Ochrophyta, 3 to Dinoflagellata, 7 to Euglenozoa, 17 to Chlorophyta, and 4 to Charophyta), 30 of them were detected in zooplankton (23 belonging to Rotifera, 5 to Cladocera, 1 to Copepoda, and 1 to Argulidea). Hasırcı (2012) examined Dodurga Dam Lake's (Boyabat, Sinop) phytoplankton and its seasonal change. In phytoplankton of Dodurga Dam Lake, she identified 35 taxa belonging to the divisions of Charophyta, Chlorophyta, Cyanophyta, Dinoflagellata, Euglenozoa and Ochrophyta. She reported 5 of these taxa as new records for the Algal Flora of Turkey.

The present study carried out in Gülüşkür region of Keban Dam Lake aims at contributing to the freshwater algal flora of Turkey.

Materials and methods

The Keban Dam with hydroelectric plant, is located 45 km northwest of Elazığ and 65 km northeast of Malatya, and was built 10 km southwest of where the Karasu and Murat rivers meet, in the vicinity of Keban district. The Euphrates and its tributaries (Murat River, Karasu, Peri Suyu, Munzur Suyu and Arapgir Creek) feed the Keban Dam Lake. Three stations from Gülüşkür region of Keban Dam Lake were identified for this study. The distance between the stations is approximately 500 m (Figure 1). Qualitative phytoplankton samples were taken by plankton net. Sterilized glass jars were used to determine the density of phytoplankton members on the water surface. 'Leitz' branded inverted microscope was used for counting phytoplankters. 1 mL of the samples collected for counting was taken, dropped on the counting slide, and counted. During the counting, each colony or filament in colonial forms was accepted as an organism, which was followed the methods of Smith (1950) and Prescot (1973). In this regards, The Sorensen Similarity Index (1948) was used to determine the similarity between species recorded at the stations.

The Sorensen Similarity Index: $Q= 2J/ +B$

A= Total number of species in the first sample

B= Total number of species in the second sample

J= Number of common species in both samples (Sorensen, 1948).

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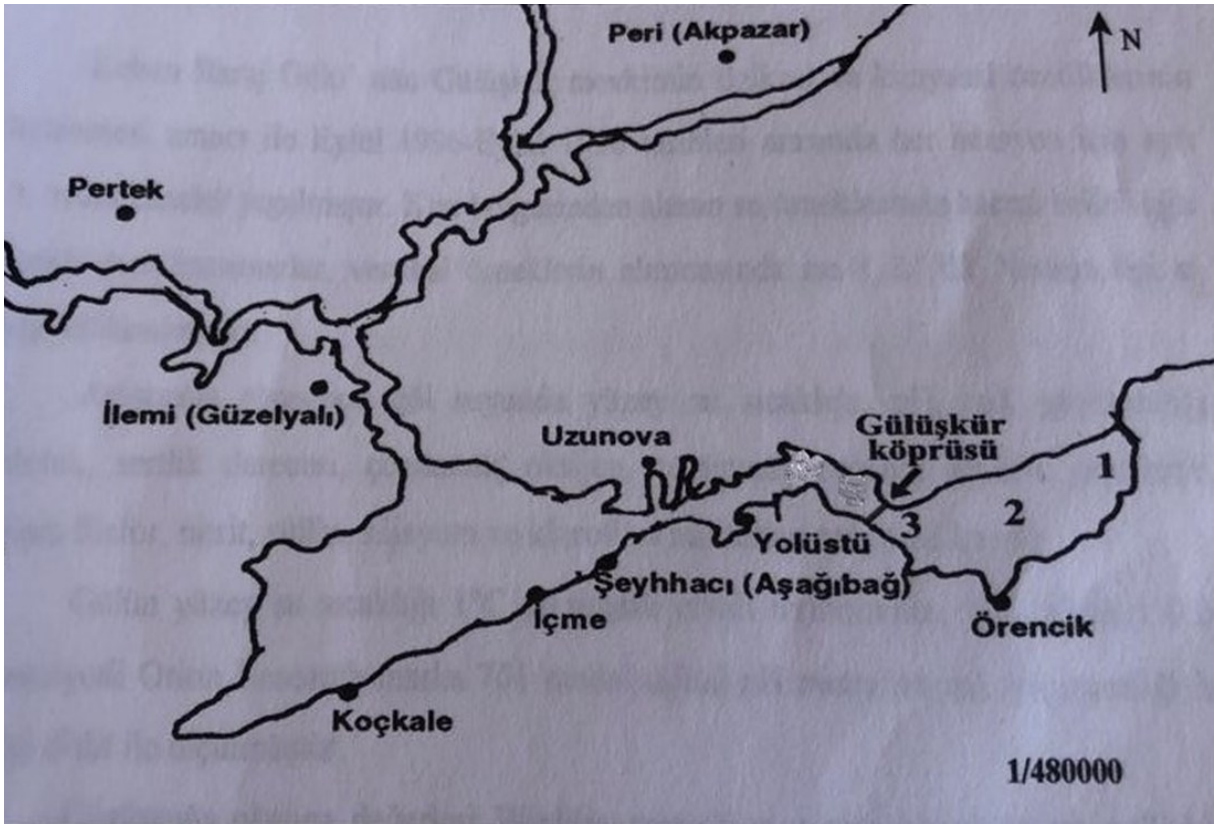

Figure 1. Stations selected in Gülüşkür Region of Keban Dam Lake.

Results

The availability of Chlorophyta (Green Algae) members recorded in Gülüşkür Region of Keban Dam Lake is shown in table 1 on a station-by-station basis.

Table 1. Availability of Chlorophyta (Green Algae) members recorded in Gülüşkür Region of Keban Dam Lake at the selected stations

Taxa	1.Station	2.station	3.station
Actinastrum hantzschii Lagerheim	+	+	+
Ankistrodesmus falcatus (Corda) Ralfs	+	-	+
Ankistrodesmus fractus (West &West) Collins	+	-	+
Ankistrodesmus nivalis Chodat ex Brunnthaler	+	+	+
Ankistrodesmus viretii Chodat	-	+	+
Cerasterias staurasroides West &West	+	+	-
Cladophora glomerata (Linnaeus) Kützing	+	+	+
Closteriopsis acicularis (Chodat) J.H.Belcher & Swale	+	+	+
Crucigenia tetrapedia (Kirchner) Kuntze	-	+	+
Desmodesmus cordatus Wolle	+	+	+
Desmodesmus maximus (West &West) Hegewald	+	+	-
Desmodesmus opoliensis (P.G. Richter) Hegewald	+	+	+
Dimorphococcus lunatus A. Braun	-	+	-
Klebsormidium subtile (Kützing) Mikhailyuk, Glaser, Holzinger & Karsten	-	+	+
Microspora loefgrenii (Nordstedt) Lagerheim	+	+	-
Monactinus simplex (Meyen) Corda	+	-	+
Monaraphidium mirabile (West &West) Pankow	-	+	-
Mougeotia genuflexa (Roth) C. Agardh	+	+	+
Neglectella solitaria (Wittrock) Stenclová & Kastovsky	-	-	+

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Oedogonium giganteum Kütz. ex Hirn	+	-	+
Oocystis borgei J.W. Snow	-	+	+
Oocystis crispum Wittrock ex Hirn	-	+	-
Oocystis mammilata W.B. Turner	+	-	-
Oocystis pusilla Hansgirg	+	+	+
Pediastrum boryanum (Turpin) Meneghini	+	+	+
Pediastrum boryanum var. *longicorne* (Reinsch) Hansgirg	+	+	+
Pediastrum duplex Meyen	+	+	-
Pediastrum integrum Naegeli	-	+	+
Pediastrum simplex Meyen	+	-	+
Pseudopediastrum boryanum (Turpin) Hegewald	+	+	+
Scenedesmus abundans (O. Kirchner) Chodat	+	+	+
Scenedesmus arcuatus (Lemmermann)Lemmermann	-	+	-
Scenedesmus arcuatus var *platydiscus* G.M. Smith	+	+	-
Scenedesmus bijugus (Turpin) Kützing	-	+	+
Scenedesmus obtusus Meyen	+	-	+
Scenedesmus obundans var. *brevicauda* G.M. Smith	-	+	-
Scenedesmus quadriacuda (Chodat) G.M. Smith	+	+	+
Scenedesmus subsalsa Kützing	+	+	-
Spirogyra gracilis Kützing	+	-	+
Stauridium tetras (Ehr.) Hegewald	+	-	-
Stigeoclonium pachydermum Prescott	+	+	+
Tetradesmus dimorphus (Turpin) M.J. Wynne	-	+	+
Tetradesmus incrassatulus (Bohlin) M.J. Wynne	+	-	+
Tetradesmus obliquus (Turpin) M.J. Wynne	+	+	+
Tetraedron minimum (A.Braun) Hansgirg	+	+	+
Tetraedron trigonum (Nageli) Hansgirg	+	-	+
Ulothrix cylindrica Prescott	-	-	+

According to table 1, a total of 33 taxa at the 1st station, and a total of 34 taxa at the 2nd and 3rd stations were recorded. The species *Oocystis mammilata* and *Stauridium tetras* were recorded only at the first station; *Dimorphococcus lunatus, Oocystis crispum, Scenedesmus abundans* var. *brevicauda* and *Scenedesmus arcuatus* were recorded only at the second station; and *Neglectella solitaria* and *Ulothrix cylindrica* were recorded only at the third station.

Table 2 shows the monthly changes in the number of colonies per mL of Chlorophyta members recorded at the first station.

Table 2. Monthly changes in the number of colonies per mL of Chlorophyta members recorded at the first station

Taxa	March	April	May	June	July	August
Actinastrum hantzschii	1	1	1	3	3	2
Ankistrodesmus falcatus	-	-	-	-	2	3
Ankistrodesmus fractus	2	1	3	3	3	4
Ankistrodesmus nivalis	-	2	1	-	2	2
Cerasterias staurasroides	2	8	5	1	-	-
Cladophora glomerata	-	4	3	9	7	7
Closteriopsis acicularis	-	3	2	1	1	-
Desmodesmus cordatus	2	2	2	3	4	5
Desmodesmus maximus	-	4	4	3	6	6
Desmodesmus opoliensis	1	2	2	4	-	5
Microspora loefgrenii	3	1	5	4	2	8
Monactinus simplex	-	-	-	2	3	3
Mougeotia genuflexa	2	4	2	3	1	2
Oedogonium giganteum	2	1	-	1	1	2
Oocystis mammilata	-	3	-	3	2	-

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Oocystis pusilla					8	11
Pediastrum boryanum	-	2	3	1	-	3
Pediastrum boryanum var. *Longicorne*	-	1	2	-	-	-
Pediastrum duplex	4	1	-	1	2	3
Pediastrum simplex	1	-	-	1	1	1
Pseudopediastrum boryanum	2	1	1	1	1	2
Scenedesmus abundans	-	-	2	1	2	2
Scenedesmus arcuatus var *platydiscus*	-	-	2	2	3	3
Scenedesmus obtusus	3	3	-	1	-	-
Scenedesmus quadriacuda	1	-	1	-	3	4
Scenedesmus subsalsa	-	1	1	1	1	2
Spirogyra gracilis	5	4	4	5	3	5
Stauridium tetras	-	-	2	1	1	2
Stigeoclonium pachydermum	2	2	2	1	1	3
Tetradesmus incrassatulus						
Tetradesmus obliquus	1	-	3	3	2	3
Tetraedron minimum	8	5	4	3	3	4
Tetraedron trigonum	1	-	-	1	2	-

According to table 2, the species appearing at the first station in all months were *Actinastrum hantzschii, Ankistrodesmus fractus, Desmodesmus cordatus, Microspora loefgrenii, Mougeotia genuflexa, Pseudopediastrum boryanum*, *Spirogyra gracilis, Stigeoclonium pachydermum*, and *Tetraedron minimum*. The highest number of colonies recorded at this station was that of *Oocystis pusilla* in August.

Table 3 shows the monthly changes in the number of colonies per mL of Chlorophyta members recorded at the second station.

Table 3. Monthly changes in the number of colonies per mL of Chlorophyta members recorded at the second station

Taxa	March	April	May	June	July	August
Actinastrum hantzschii	-	-	-	1	-	2
Ankistrodesmus nivalis	3	2	3	2	1	4
Ankistrodesmus viretii	-	1	-	1	2	-
Cerasterias staurasroides	4	-	-	-	3	3
Cladophora glomerata	2	1	3	5	5	5
Closteriopsis acicularis	-	-	-	1	-	1
Crucigenia tetrapedia	-	1	1	1	1	1
Desmodesmus cordatus	3	5	7	9	5	8
Desmodesmus maximus	2	2	2	-	2	2
Desmodesmus opoliensis	-	1	1	-	1	-
Dimorphococcus lunatus	-	1	1	3	3	3
Klebsormidium subtile	-	-	1	2	2	3
Microspora loefgrenii	2	1	3	3	5	2
Monaraphidium mirabile	3	1	2	7	8	8
Mougeotia genuflexa	3	4	1	2	5	3
Oocystis borgei	-	-	-	-	3	2
Oocystis crispum	8	5	5	3	-	6
Oocystis pusilla	2	-	-	2	2	3
Pediastrum boryanum	-	3	-	1	-	3
Pediastrum boryanum var. *longicorne*	-	1	-	2	1	1
Pediastrum duplex	1	1	2	-	2	2
Pediastrum integrum	-	1	1	1	1	1
Pseudopediastrum boryanum	-	1	1	1	1	2
Scenedesmus abundans	-	-	1	1	1	2
Scenedesmus arcuatus	1	-	-	-	-	1
Scenedesmus arcuatus var *platydiscus*	2	4	4	3	4	4

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Scenedesmus obundans var. *brevicauda*	-	2	-	2	-	1
Scenedesmus quadriacuda	2	4	3	4	4	2
Scenedesmus subsalsa	-	-	1	2	3	2
Stigeoclonium pachydermum	-	2	1	2	3	3
Tetradesmus dimorphus	-	-	1	2	2	1
Tetradesmus obliquus	-	2	1	2	2	-
Tetraedron minimum	2	3	3	1	1	1

According to table 3, the species appearing at the first station in all months were *Ankistrodesmus nivalis, Cladophora glomerata, Desmodesmus cordatus, Microspora loefgrenii, Monaraphidium mirabile, Mougeotia genuflexa, Scenedesmus arcuatus* var *platydiscus*, *Scenedesmus quadriacuda*, and *Tetraedron minimum*. The highest number of colonies at this station (9 col./mL) was that of *Desmodesmus cordatus* in June.

Table 4 shows the monthly changes in the number of colonies per mL of Chlorophyta members recorded at the third station.

Table 4. Monthly changes in the number of colonies per mL of Chlorophyta members recorded at the third station

Taxa	March	April	May	June	July	August
Actinastrum hantzschii	-	2	4	3	8	13
Ankistrodesmus falcatus	2	-	2	8	7	12
Ankistrodesmus fractus	-	3	3	-	3	5
Ankistrodesmus nivalis	3	2	5	7	13	9
Ankistrodesmus viretii	-	-	3	2	5	5
Cladophora glomerata	8	11	6	8	10	9
Closteriopsis acicularis	-	-	2	-	2	4
Crucigenia tetrapedia	-	2	4	5	6	6
Desmodesmus cordatus	8	8	-	-	-	8
Desmodesmus opoliensis	2	2	3	-	12	11
Klebsormidium subtile	2	1	3	1	6	6
Monactinus simplex	8	-	-	-	5	1
Mougeotia genuflexa	2	2	3	5	-	5
Neglectella solitaria	-	-	2	-	2	-
Oedogonium giganteum	-	5	3	2	4	3
Oocystis borgei	1	2	7	1	3	5
Oocystis pusilla	8	5	-	-	8	10
Pediastrum boryanum	2	1	2	3	3	3
Pediastrum boryanum var. *longicorne*	1	-	1	1	2	1
Pediastrum integrum	-	-	-	1	1	1
Pediastrum simplex	1	1	2	1	1	2
Pseudopediastrum boryanum	-	-	1	1	1	1
Scenedesmus abundans	-	-	4	3	-	3
Scenedesmus bijugus	4	1	5	3	5	5
Scenedesmus obtusus	-	-	-	2	1	-
Scenedesmus quadriacuda	3	3	2	-	1	2
Spirogyra gracilis	-	6	5	3	5	8
Stigeoclonium pachydermum	-	1	2	2	4	4
Tetradesmus dimorphus	1	1	1	-	-	-
Tetradesmus incrassatulus	3	4	2	3	6	5
Tetradesmus obliquus	-	-	3	1	1	3
Tetraedron minimum	3	5	6	3	8	7
Tetraedron trigonum	-	-	2	6	2	6
Ulothrix cylindrica	-	-	-	2	4	3

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According to table 4, the species appearing at the third station in all months were *Ankistrodesmus nivalis, Cladophora glomerata, Oocystis borgei, Pediastrum boryanum, Pediastrum simplex, Scenedesmus bijugus, Tetraedron minimum*, and *Tetradesmus incrassatulus*. The highest number of colonies at this station (13 col./mL) was that of *Actinastrum hantzschii* in August.

The Sorensen Similarity Index was found as 66.66% between the first and second stations; 74.62% between the first and third stations; and 65.67% between the second and third stations.

Discussion

The ecological conditions of aquatic environments can be determined by analyzing the organism communities living there. Because each aquatic organism has its own habitat preferences and they choose the best conditions to live (Wetzel, 1983; Rosenberg and Resh, 1993; Kazancı *et al*., 1997). Benthic and planktonic algae are used as observation tools for determining environmental variables and water quality (Prygiel *et al*., 2002). Therefore, these kinds of living beings are called bioindicators. In brief, bioindicator is defined as the species making the identification of the characteristics of an environment easier with its presence in a biotope. Organisms that can be used as biological indicators are bacteria, protozoa, algae, macrophytes and fish (Kazancı *et al*., 1997). Since benthic and planktonic algae are guiding as indicators in determination of water pollution levels, ecological conditions such as the composition of algae, which form the first link of the aquatic food chain, their density and seasonal changes, as well as physical and chemical factors affecting these changes, should be identified. This study, in which Chlorophyta members from phytoplankton of Gülüşkür Region of Keban Dam Lake were identified, aims to contribute to the quality of the dam lake and to the Turkish algal database.

Light and temperature as physical factors have had influence on phytoplankton of the coastal region of Keban Dam Lake. In general, it has been observed that algae started to grow together with the increase of light as of spring and green algae grew well in summer. Light, which is a critical factor, affects phytoplankton production and species composition in lakes. While the abundance of most species is highest in epilimnion where light is ample, other species including algal flagella adapt to deeper waters (Lund and Reynolds, 1982). Light and temperature are two important physical factors complementing each other for the development of photosynthesis and phytoplankton. Generally, diatom species prefer low light and low temperature. Chlorophyta members, on the other hand, like high temperatures while Volvocales members like cold waters (Hutchinson, 1967). According to Reynolds (1993), the optimum temperature for the growth of algae is 25ºC. However, some algae species prefer lower or higher temperatures. Algae generally tolerate temperatures between 10 and 30º C. Temperature affects biological, chemical and physical activities in water and changes the

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[DOI: 10.52547/ijaah.7.1.32]

concentration of many variables. The metabolic rate and respiratory rate of the organisms in the environment increase with the temperature, which leads to an increase also in oxygen consumption. In winter months, algae grow less and their biomasses decrease due to low temperature and sunlight. Together with the increase in temperature and sunlight in spring months, the nutrients that are decomposed due to bacterial activity turn into inorganic substances, so, phytoplanktonic organisms start to reproduce (Reynolds, 1993).

Fogg and Thake (1987) stated that phytoplankton of temperate lakes is generally low during the winter months and that even if nutrient elements are sufficient, low temperature and low light intensity are restrictive. The fact that Chlorophyta grew in Keban Dam Lake during the summer months supports this statement. Similar results were obtained in the studies carried out in Keban Dam Lake (Çetin and Sen, 1997), Sarıyar Dam Lake (Atıcı, 2004), Derbent Dam Lake (Taş, 2003), Yedikır Dam Lake (Maraşlıoğlu, 2007), Tatlı Lake (Soylu *et al*., 2007), Kaz Lake (Zaim, 2007), Sarımsaklı Dam Lake (Sezen, 2008), and Çambaşı Pond (Topkara, 2011) in our country. Transparency and colour of Keban Dam Lake's water during the period of the study was observed to be green, especially in the summer months, depending on the biomass.

Hutchinson (1967) reported that green algae showed increase during the summer months, and Scenedesmus, Monoraphidium, Tetraedron species, which also showed increase during these months, were common organisms of eutrophic lakes. These species were found also in Keban Dam Lake, especially at the second and third stations; and while Scenedesmus and Monoraphidium reached high numbers, Tetraedron genus had much smaller numbers. The same species were found to be rare in Uzungöl (Şahin, 1993) and Gıcı Lake (Soylu and Gönülol, 2006) while they were found to be abundant in Balık Lake-Uzun Göl (Gönülol and Çomak, 1992a, b; 1993), Karaboğaz (Baytut *et al*., 2006), Akgöl (Şehirli, 1998) and Ladik Lake (Maraşlıoğlu *et al*., 2005). Pediastrum, reported to be the characteristic of mesotrophic lakes (Cirik and Cirik, 1995), was represented by four species in Hasan Uğurlu (Gönülol and Obalı, 1998a), bu twelve species in Keban (Pala, 2007), by five species in Çakmak (Ersanlı, 2006), by two species in Kemer (Özyalın and Ustaoğlu, 2008), by five species in Çaygören (Sevindik, 2010), and by five species (*Pediastrum boryanum*, *Pediastrum boryanum* var. *longicorne*, *Pediastrum duplex*, *Pediastrum integrum*, *Pediastrum simplex*) in our research area. In the research area, Monoraphidium was represented by one species (*Monoraphidium mirabile*), and Oocystis was represented by four species (*Ocystis borgei*, *Oocystis crispum*, *Oocystis mammilata*, *Oocystis pusilla*). It was stated that Monoraphidium species were spread in oligotrophic and mesotrophic lakes, and Oocystis species had oligotrophic properties (Hutchinson, 1967).

In Bektaşağa and Taşmanlı Ponds (Ersoy, 1996) and in Simenit Lake (Ersanlı, 2001), *Oocystis* species were not found. *Oocystis* species were the dominant organisms in Çubuk-

[DOR: 20.1001.1.2345315.2021.7.1.3.8]
[DOI: 10.52547/ijaah.7.1.32]

I (Gönülol and Aykulu, 1984) and Kurtboğazı (Aykulu and Obalı, 1981) dam lakes, and in Porsuk (Gürbüz *et al*., 2002) and Palandöken ponds (Gürbüz and Altuner, 2000).

Palmer (1969) stated that Scenedesmus, Pediastrum, Selenastrum, Chlorococcum and Cladophora species are tolerant to organic pollution. *Scenedesmus bijugus* and *S. abundans* species belonging to Scenedesmus found in the algal flora of Keban Dam Lake are pollution-tolerant species. Hutchinson (1967), considered the presence of Chlorococcales members as transition from oligotrophic period to eutrophic period. Sorensen Similarity Index was used for the diversity and similarities of the species at the stations. The highest similarity (74.62%) was found between the first and third stations.

Continuous flow of water in dam lakes may cause low phytoplankton biomass from time to time. Reynolds et al. (2002) state that dam lakes are rarely highly eutrophic due to their structure. Furthermore, most of the algal species detected in phytoplankton and coastal region of the lake are organisms that develop well in eutrophic lakes. The results of this study show that there is no significant pollution in the lake for now.

Conflict of interest

Authors have no conflict of interest on this work.

References

Akbay, N., 1993. Keban Baraj gölü'nün ova kısmında fito ve zooplanktonun horizontal ve vertikal dağılımı. *F.Ü. Fen Bilimleri Enstitüsü, Y.L. Tezi,* Elazığ, Turkey.

Atıcı, T. and Obalı, O., 2005. Control of Water Pollution and Phytoplanktonic Algal Flora in Bayındır Dam Reservoir (Ankara*)*. *E.U. Journal of Fisheries & Aquatic Sciences*, 22 (1-2), 79–82.

Atıcı, T. and Obalı, O., 2006. Seasonal variation of phytoplankton and value of chlorophylla in the Sarıyar Dam Reservoir. *Turk J Bot*, 30, 349-357.

Atıcı, T., 2004. Sarıyar Barajı Planktonik Algleri Kısım: I – Cyanophyta, *Eğirdir Su Ürünleri Fakültesi Dergisi*, II (XII), 88-98.

Aykulu, G. and Obalı, O., 1981. Phytoplankton Biyomas in the Kurtboğazı Dam Lake. *Commun. Fac. Sci. Univ.* Ank., Ser. C, 24, 29-44.

Baykal, T. and Açıkgöz, İ., 2004. Hirfanlı Baraj Gölü algleri. *Gazi Üniversitesi KırşehirEğitim Fakültesi*, 5 (2), 115-136.

Baykal, T. and Yıldız K., 2006. Çamlıdere Baraj Gölü Bacillariophyta dışı algleri. *İstanbul Üniversitesi Su Ürünleri Dergisi,* 20, 63-77.

Baykal, T., Açıkgöz, İ., Yıldız, K. and Bekleyen, A., 2004. A study on algae in Devegeçidi Dam Lake. *Turkish Journal of Botany*, 28 (5), 457-472.

Baykal, T., Salman, S. and Açıkgöz, İ., 2006. The relationship between seasonal variation inphytoplankton and zooplankton densities in Hirfanlı Dam Lake (Kırşehir, Turkey). *Turkish Journal of Biology*, 30 (4), 217-226.

[DOR: 20.1001.1.2345315.2021.7.1.3.8]

[DOI: 10.52547/ijaah.7.1.32]

Baytut, Ö., Gönülol, A., Arslan, N. and Ersanlı, E., 2006. The Phytoplankton of Karaboğaz Lake in Samsun, Turkey. *Journal of Freshwater Ecology*, 21(2), 359 – 361. https://doi.org/10.1080/02705060.2006.9665008

Cirik, S. and Cirik, Ş., 1995. Limnoloji. *Ege Üniversitesi Su Ürünleri Fakültesi Yayınları* No: 21, 166 p. Ege Üniversitesi Basımevi Bornova-İzmir, Turkey.

Çetin, A.K. and Şen, B., 1997. Keban Baraj Gölü'nün Bacillariophyta dışındaki algleri ve mevsimsel değişimleri. *F. Ü. Fen* ve *Mühendislik Bilimleri Dergisi*, 9(2), 45-49.

Ersanlı, E., 2001. Simenit Gölü (Terme-Samsun-Türkiye) algleri üzerine bir araştırma. Yüksek Lisans Tezi, *Ondokuz Mayıs Üniversitesi Fen Bilimleri Enstitüsü*, Samsun, Turkey.

Ersanlı, E., 2006. Çakmak Barajı (Tekkeköy–Samsun) fitoplanktonu ve mevsimseldeğişimi üzerinde bir araştırma. Doktora Tezi, *Ondokuz Mayıs Üniversitesi FenBilimleri Enstitüsü*, Samsun, Turkey.

Ersoy, H. N., 1996. Sinop İli bektaşağa ve taşmanlı göletleri alg florası üzerine biraraştırma. Yüksek Lisans Tezi, *Ondokuz Mayıs Üniversitesi Fen Bilimleri Enstitüsü,* Samsun, Turkey.

Fogg, G. E. and Thake, B., 1987. Algal cultures and phytoplankton ecology, 3rdEdition, 269 p. *The University of Wisconsin Press*.

Gönülol, A. and Aykulu, G., 1984. Çubuk-I Baraj Gölü algleri üzerinde araştırmalar I. fitoplanktonun kompozisyonu ve yoğunluğunun mevsimsel değişimi. *Doğa Bilim Dergisi*, Az. 8(3), 330-342.

Gönülol, A. and Çomak, Ö., 1992a. Bafra Balık Gölleri (Balık Gölü, Uzun Göl) Fitoplanktonu üzerinde floristik araştırmalar I- Cyanophyta. *Doğa, Turkish Journal of Botany*, 16, 223-245.

Gönülol, A. and Çomak, Ö., 1992b. Bafra Balık Gölleri (Balık Gölü, Uzun Göl) Fitoplanktonu üzerinde floristik araştırmalar IV-Bacillorophyta, Dinophyta, Xanhtophyta. *Ondokuz Mayıs Üniversitesi Fen Bilimleri Enstitüsü, Fen Dergisi*, 4(1), 1-19.

Gönülol, A. and Çomak, Ö., 1993. Bafra Balık Gölleri (Balık Gölü, Uzun Göl) Fitoplanktonu üzerinde floristik araştırmalar II. *Euglenophyta*. *Doğa*, *Turkish Journal of Botany*, 17, 163-169.

Gönülol, A. and Obalı, O., 1998a. A study on the phytoplankton of Hasan Uğurlu Dam Lake (Samsun-Turkey). *Turkish Journal of Biology*, 22, 447-461.

Gürbüz, H. and Altuner, Z., 2000. Palandöken (Tekederesi) Göleti fitoplankton topluluğu üzerinde üzerinde kalitatif ve kantitatif bir araştırma. *Turkish Journal of Biology*, 24, 13-30.

Gürbüz, H. and Kıvrak, E., 2003. Seasonal variations of benthic algae of Kuzgun Dam Reservoir and their relationship to environmental factors. *Fresenius Environmental Bulletin*, 12(9), 1025-1032.

[DOR: 20.1001.1.2345315.2021.7.1.3.8]

[DOI: 10.52547/ijaah.7.1.32]

Gürbüz, H., Kıvrak, E. and Sülün, A., 2002. Porsuk Göleti (Erzurum, Türkiye) bentik alg florası üzerinde kalitatif ve kantitatif bir araştırma. *E.U. Journal of Fisheries andAquatic Sciences*, 19(1-2), 53 – 61.

Hasırcı, S., 2012. Dodurga Baraj Gölü (Boyabat, Sinop) fitoplanktonu ve mevsimsel değişimi üzerine bir araştırma. Yüksek Lisans Tezi, *Sinop Üniversitesi FenBilimleri Enstitüsü*, Sinop, Turkey.

Hutchinson, G. E., 1967. A treatise on limnology, Introduction to lake biology and the limnoplankton. 115p. *John Wiley and Sons*. *Inc*, Newyork.

Kazancı, N., Girgin, S., Dügel, M. and Oğuzkurt, D., 1997. Türkiye iç suları araştırmalarıdizisi ıı (ed. n. kazancı): akarsuların çevre kalitesi yönünden değerlendirilmesindeve izlenmesinde biyotik indeks yöntemi. *İmaj Yayınevi*, Ankara, Turkey.

Kıvrak, E. and Gürbüz, H., 2005. Seasonal variations in phytoplankton composition andphysical-chemical features of Demirdöven Dam Reservoir, Erzurum, Turkey. *Biologia*, *Bratislava*, 60(1), 1- 8.

Lund, J. W. G. and Reynolds, C. S., 1982. The Development and Operation of LargeLimnetic Enclosures in Blelham Tarn, English Lake District, and Their Contribution to Phytoplankton Ecology. *Progress in phycological research*, 1, 1-65.

Maraşlıoğlu, F., 2007. Yedikır Baraj Gölü (Amasya-Türkiye) fitoplanktonu vemevsimsel değişimi üzerine bir araştırma. Doktora Tezi, *Ondokuz MayısÜniversitesi Fen Bilimleri Enstitüsü*, Samsun, Turkey.

Maraşlıoğlu, F., Soylu, E. N. and Gönülol, A., 2005. Seasonal variation of thephytoplankton of Lake Ladik, Samsun, Turkey. *Journal of Freshwater Ecology*, 20 (3), 549-554. https://doi.org/10.1080/02705060.2005.9664770

Özyalın, S. and Ustaoğlu, R., 2008. Kemer Baraj Gölü (Aydın) net fitoplankton komposizyonunun incelenmesi. *E.U. Journal of Fisheries and Aquatic Sciens*. 4, 275-282.

Pala, T.G. and Caglar, M., 2006. Keban Baraj Gölü Epilitik Diyatomelerive Mevsimsel Değişimleri. Fırat Üniversitesi Fen ve Mühendislik Bilimleri Dergisi, 18(3), 323-329.

Pala, G., 2007. Keban Baraj Gölü gülüşkür kesimindeki planktonik algler ve mevsimseldeğişimleri II-Bacillariophyta. *Fırat Üniversitesi Fen ve Mühendislik Bilimleri Dergisi*, 19(1), 23-32.

Palmer, C. M., 1969. A composite rating of algae tolerating organic pollution. *Journal of Phycology and International Journal of Algal Research*, 5 (1), 76-82. https://doi.org/10.1111/j.1529-8817.1969.tb02581.x

Prescott, G. W., 1973. Algae of the western great lake area m.c. brown comp., *Dubuque*, Lowa, 997p.

[DOR: 20.1001.1.2345315.2021.7.1.3.8]

[DOI: 10.52547/ijaah.7.1.32]

Prygiel, J., Carpentier, P., Almeida, S., Coste, M., Druart, J.C., Ector, L., Guillard, D., Honoré, M.A., Iserentant, R., Ledeganck, P., Lalanne-Cassou, C., Lesniak, C.,Mercier, I., Moncaut. P., Nazart, M., Nouchet, N., Peres, F., Peeters, V., Rimet,F., Rumeau, A., Sabater, S., Straub, F., Torrisi, M., Tudesque, L., Van der Vijver,B., Vidal, H., Vizinet, J. and Zydek, N., 2002. Determination of the diatom index(IBD NF T 90-354): results of an intercalibration exercise. *Journal of Applied Phycology*, 14, 27-39. https://doi.org/10.1023/A:1015277207328

Reynolds C. S., Huszar V. L., Nasellı-Flores L. and Melo S., 2002. Towards a functionalclassification of the freshwater phytoplankton. *Journal of Phytoplankton Research*, 24, 417-428. https://doi.org/10.1093/plankt/24.5.417

Reynolds, C.S., 1993. The Ecology of freshwater phytoplankton. *Chambridge Univ*. 384p.

Rosenberg, D. M. and Resh, V. H., 1993. Introduction to freshwater biomonitoring andbenthic macroinvertebrates. p. 1-9. in: d.m. rosenberg and v.h. resh (eds.) freshwater biomonitoring and benthic macroinvertebrates, *Chapman and Hall*, New York.

Şahin, B., 1993. Trabzon - Uzungöl'ün algleri üzerinde bir araştırma. Doktora Tezi, *Karadeniz Teknik Üniversitesi Fen bilimleri Enstitüsü*, Trabzon, Turkey.

Şehirli, H., 1998. Akgöl (Terme-Samsun) fitoplanktonunun kompozisyonu vemevsimsel değişimi üzerinde bir araştırma. Yüksek Lisans Tezi, *Ondokuz MayısÜniversitesi Fen Bilimleri Enstitüsü*, Samsun, Turkey.

Sevindik, O, T., 2010. Phytoplankton composition of Çaygören Reservoir, Balıkesir, Turkey. *Turkish Journal of Fischeries and Aquatic Sciences*, 10, 295-304.

Sezen, G., 2008. Sarımsaklı Baraj Gölü (Kayseri) fitoplanktonu ve su kalitesi özellikleri. *Ankara Üniversitesi Fen Bilimleri Enstitüsü*, Doktota Tezi, Ankara, Turkey.

Sömek, H., Balık, S. and Ustaoğlu, M.R., 2005. Topçam Baraj Gölü (Çine-Aydın) fitoplanktonu ve mevsimsel değişimleri. Süleyman Demirel Üniversitesi, *Eğirdir Su Ürünleri Fakültesi Dergisi*, 1(1), 26-32.

Sorensen, T., 1948. A method of establishing groups of equal amplitude in plantsociology based on similarity of species and its application to analyses of the vegetation on Danishcommon. *Kongelige Danske Videnskabernes Selskab* 5 (4), 1–34.

Soylu, E. N. and Gönülol, A., 2006. Seasonal variation in the diversity, species richness andcomposition of the phytoplankton assemblages in a shallow lake. *Cryptogamie Algologie*, 27 (1), 85-101.

Soylu, E. N., Maraşlıoğlu, F. and Gönülol, A., 2007. Phytoplankton seasonality of ashallow turbid lak. *Algologial Studies*, 123, 95-110. https://doi.org/10.1127/1864-1318/2007/0123-0095

Taş, B. and Gönülol A., 2007. Derbent Baraj Gölü (Samsun, Türkiye)'nün planktonic algleri.

[DOR: 20.1001.1.2345315.2021.7.1.3.8]

[DOI: 10.52547/ijaah.7.1.32]

Journal of Fisheries Sciences, 1 (3), 111-123. https://doi.org/10.3153/jfscom.2007014

Taş, B., 2003. Derbent Baraj Gölü (Bafra Samsun-Türkiye) fitoplanktonu ve mevsimsel değişimi üzerine bir araştırma. Doktora Tezi, *Ondokuz Mayıs Üniversitesi*, *Fen Bilimleri Enstitüsü*, Samsun, Turkey.

Topkara, S., 2011. Çambaşı Göleti (Kabadüz, Ordu) fitoplanktonu ve trofik yapısı. Yüksek Lisans Tezi, *Ordu Üniversitesi Fen Bilimleri Enstitüsü*, Ordu, Turkey.

Ustaoğlu, M. R., Balık, S., Şipal, U.G., Mis, Ö, D. and Aygen, C., 2010. Buldan Baraj Gölü (Denizli) planktonu ve mevsimsel değişimi. *E.U. Journal of Fisheries & AquaticSciences*, 27(3), 113-120.

Wetzel, R.G., 1983. Limnology, 2nd ed., SCP.

Zaim, E., 2007. Planktonic diatom (*Bacillariophyta*) composition of Lake Kaz (Pazar, Tokat). *Turkish Journal Biology*, 31, 203-224.

[DOR: 20.1001.1.2345315.2021.7.1.3.8]

[DOI: 10.52547/ijaah.7.1.32]