http://dergipark.gov.tr/trkjnat
Trakya University Journal of Natural Sciences, 19(1): 21-31, 2018
ISSN 2147-0294, e-ISSN 2528-9691
DOI: 10.23902/trkjnat.356711

Research Article

DAILY VERTICAL VARIATION IN PHYTOPLANKTON COMPOSITION OF A DRINKING WATER RESERVOIR (KADIKÖY RESERVOIR-EDİRNE) DURING SUMMER STRATIFICATION

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Cite this article as:

Öterler B. 2018. Daily vertical variation in phytoplankton composition of a drinking water reservoir (Kadıköy Reservoir-Edirne) during summer stratification, *Trakya Univ J Nat Sci*, 19(1): 21-31, DOI: 10.23902/trkjnat.356711

Received: 21 November 2017, Accepted: 28 December 2017, Online First: 28 December 2017, Published: 15 April 2018

Abstract: This study is performed in August 2012 in Kadıköy Reservoir in Keşan district of Edirne. The deepest point of the reservoir when there is no water drown was chosen as the sampling station. Samples were taken from 6 different depths every three hours during a 24 hour period. 65 phytoplanktonic algae taxa belonging to Chlorophyta (26 taxa), Bacillariphyta (18 taxa), Euglenophyta (8 taxa), Charophyta (5 taxa), Cyanophyta (4 taxa), Miozoa (3 taxa) and Ochrophyta (1 taxa) were identified.

Key words: Phytoplankton, Daily vertical composition, Chlorophyll-a, Kadıköy Reservoir.

Özet: Bu çalışma Ağustos 2012 tarihinde Edirne ili Keşan ilçesinde bulunan Kadıköy barajında yapılmıştır. Barajdan su çekiminin yapılmadığı tarihler içerisinde en derin noktası istasyon olarak seçilmiştir. Çalışma süresince 3'er saat ara ile 24 saatlik bir periyotta ve 6 farklı derinlikten örnekler alınmıştır. Çalışma süresince Chlorophyta (26 taxa), Bacillariphyta (18 taxa), Euglenophyta (8 taxa), Charophyta (5 taxa), Cyanophyta (4 taxa), Miozoa (3 taxa) ve Ochrophyta (1 taxa) divizyolarına ait toplam 65 fitoplanktonik alg taksonu belirlenmiştir.

Introduction

Reservoirs are generally formed with barriers in front of rivers and they are described as hybrid systems between the lakes and the rivers (Thornton *et al.* 1990). Being described as artificial lakes for different purposes like flood control, power generation, irrigation and recreation, reservoirs are separated from natural lakes with some of their characteristics like high water flow velocity, solid matter presence in influent suspend and short term water exchange (Harper *et al.* 1999). Naturally, as a result of changing environmental factors and irrigation activities, there might be some changes on the organisms living in an aquatic ecosystem (Wetzel 2001). The responses of the organisms affected by these changes would be either as disappearing or increasing in a population (Wetzel 2001, Harper *et al.* 1999). Therefore, aquatic systems must be under scientific control and physical, chemical and biological characteristics should be recorded.

As algae live in a wide range, they are the most important oxygen source of their environment and they provide oxygen and food requirements for many organisms, ranging from benthic invertebrates to fishes, in aquatic ecosystems (Round 1984). In addition to their surface distributions on the water body, it is also important how algae distribute vertically in the water column in different depths. Turbidity occuring as a result of excess increase on some water layers depending on some environmental factors (food substances, water temperature, climate condition etc.) will also suppress the community structure of the species in the lower layers (Reynolds *et al.* 2002, Akçaalan *et al.* 2006, Akçaalan *et al.* 2014, Becker *et al.* 2009). To understand the factors regulating the key species in aquatic environments, it might be important to determine daily and vertical distributions of phytoplankton communities (Takamura & Yasuno 1984). Phytoplanktonic organisms have remodelled their morphology and physiology for surviving in different environments (Reynolds 1988), including adaptations to particular daily and vertical dynamics.

This study is performed to determine the daily vertical distributions of phytoplankton in Kadıköy Reservoir which provides tap water to Keşan district of Edirne.

Materials and Methods

Study area

Kadıköy Reservoir is located in Keşan city borders in Edirne province and was constructed in 1973 on Derbent

Stream in order to provide water both for agricultural irrigation and industrial and daily use and to prevent flood. The reservoir is located at an altitude of 74m a.s.l and its surface area is 6.20km^2 at normal water-level. The total agricultural area using irrigation water from the reservoir covers about 4,428 hectares and the average amount of daily water use is 2hm^3 (http://www.dsi.gov.tr) (Fig. 1).

The sampling station was selected near the water intake (40°47'40.04"N, 26°46'24.31"E) in the deepest part of the reservoir. The reservoir shows the characteristics of a mesoeutrophic system and its maximum depth is 18.5m (Öterler *et al.* 2015). The annual mean temperature is 13.5°C. The reservoir was thermally stratified, as clear mixed epilimnion and slightly alkaline conditions. Some physico-chemical parameters were formerly measured in the water column (Öterler *et al.* 2015) (Table 1).

Sampling and analyses

Phytoplankton and water samplings were taken in the reservoir on 16 August 2012. Samplings started at mid-day (13:00) and phytoplankton communities were sampled every 3h during a 24-h period in a vertical profile. Samplings were performed from surface water and from 6 depths of 1, 3, 5, 9, 12 and 15 meters. Samplings were made during the period when the dam covers were closed and there was no water intake.

Water samples were taken from under water surface using a Van Dorn type water sampler in order to determine some environmental values of the reservoir such as water temperature, dissolved oxygen (DO), pH, nitrogen in nitrite and nitrate forms and phosphate values. Water temperature, DO, pH and electrical conductivity were measured on sampling station using field type equipments and chlorophyll-*a* was measured spectrophotometrically according to Nusch (1980). Water transparency was measured once using a 20-cm Secchi disk.

For the phytoplankton samples, 1L of the water samples taken from the reservoir using Whatmann GF/A filter papers were filtered, planktonic samples were condensed and identification of the algae other than diatoms in temporary slides were done on Olympus brand CX41 model microscope. For identifications of diatoms, samples brought to the laboratory were purified from organic matter by boiling in 1:1 volume H_2SO_4+HNO_3 and by rinsing in distilled water for a couple of times. Neutral pH was provided and a drop was taken and dried on lamella, then it was covered by Naphrax and permanent slides were prepared and identified under the microscope. From the water samples, 25-50 and 100ml sub-samples were prepared, precipitated according to Utermöhl (1958) and organism counts and calculations were done under an Olympus brand CK2 model inverted microscope. The taxonomic books (Huber-Pestalozzi 1982, John *et al.* 2003, Krammer & Lange-Bertalot 1986-2004, Round *et al.* 1990, Komarek & Anagnostidis 2005, Hindák 2008, Kristiansen & Preisig 2011) were used for the identification of algal species. All species were checked online on algaebase cite (Guiry & Guiry. 2017).

Table 1. Some environmental variables in the water column (Öterler *et al.* 2015).

Parameters	Values
NO_2^-	0.037mg.L^{-1}
NO_3^-	1.778mg.L^{-1}
SRP	0.009mg.L^{-1}
Hardness	22°F
Salinity	0.083‰
Secchi Disc	98 cm (Midday)

Fig. 1. The map showing the locations of Kadıköy Reservoir and the sampling point. The solid circle in the left figure corresponds to the sampling point.

Results

The sky was open during samplings and the mean wind speed varied from 3 to 8ms^{-1} depending on the sampling time. In morning samplings, generally a relatively gentle breeze occurred while evening and night time samplings were generally characterized by a moderate and a light breeze, respectively.

Air temperature was lower than surface water temperature from 22:00 to 07:00h, but higher from 10:00 to 19:00h. The daily water temperature ranged from 18.5°C to 27°C, but the surface water (0-5m) lost heat throughout the night when the air temperature fell below the surface water but gained heat during the day (Fig. 2).

The highest value of average DO was measured in 1m samples of 04.00pm with 11.86mg.L^{-1} and the descending ranking in terms of DO was as 5m>1m>3m>Subsurface>9m>12m>15. The pH was measured between 7.41 and 8.94 and conductivity average was 0.52µS.cm^{-1} (Table 2). The laboratory analysis showed that there was no significant difference between sampling depths and times in the measured parameters.

Phytoplankton species diversity and chlorophyll-a

Identification of the sampled material showed that a total of 65 taxa were present in the reservoir during the sampling period. Chlorophyta was identified as the group having the maximum number of taxa with 26, followed by Diatoms (Bacillariophyta) with 18 taxa, Euglenophyta with 8 taxa, Carophyta with 5 taxa, Cyanophyta with 4 taxa, Miozoa with 3 taxa and Ochrophyta with 1 taxon (Table 3).

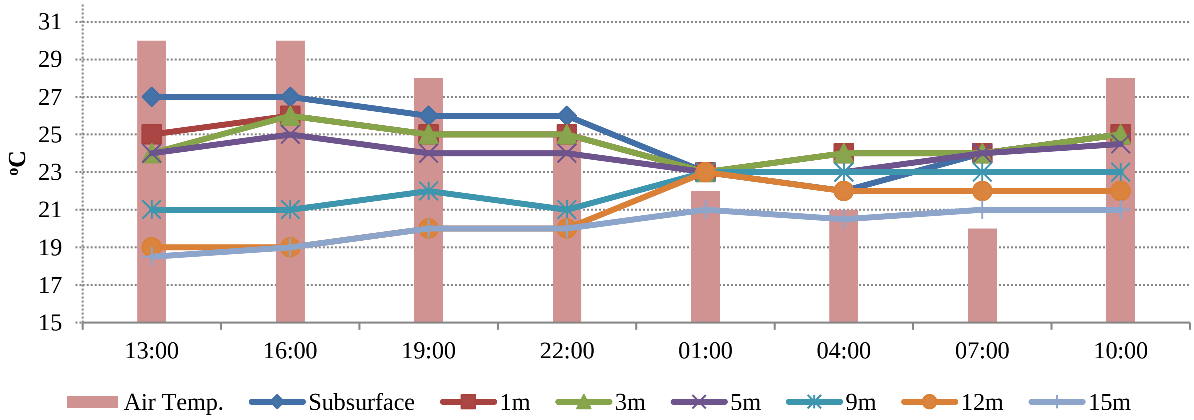

Fig. 2. The relationship between water and air temperature values during a sampling day.

Table 2. Daily variation of Dissolved Oxygen (DO) concentration (mg.L^{-1}), pH and Electric Conductivity (EC) (µS.cm^{-1}) of the water column in the reservoir.

	Depth/Hours	13:00	16:00	19:00	22:00	01:00	04:00	07:00	10:00
DO (mg.L^{-1})	Surface	7.71	7.09	6.14	9.92	9.23	11.71	9.4	8.6
	1m	7.57	7.6	6.15	9.65	9.9	**11.86**	10.41	8.4
	3m	7.54	7.48	6.28	9.58	9.64	11.62	10.58	8.36
	5m	7.47	7.91	6.69	9.55	9.59	11.54	11.61	8.41
	9m	7.28	7.35	6.18	8.84	9.51	10.75	11.34	7.32
	12m	6.99	6.88	6.35	8.33	9.54	10.08	10.82	6.92
	15m	6.5	**4.26**	5.24	7.86	9.63	10.13	9.94	6.82
pH	Surface	8.47	**7.41**	**8.94**	8.6	8.56	8.33	8.25	7.88
	1m	8.24	8.8	8.9	8.29	8.6	8.45	8.25	7.86
	3m	8.18	8.71	8.73	8.3	8.41	8.43	8.32	7.78
	5m	8.17	8.58	8.21	8.33	8.63	8.52	8.53	7.76
	9m	8.15	8.21	8.05	8.33	8.57	8.21	8.23	7.58
	12m	8.12	8.11	7.79	8.24	8.27	8.07	8.14	7.52
	15m	8.07	7.71	7.73	8.05	8.14	7.86	7.88	7.46
EC (µmS.cm^{-1})	Surface	0.58	0.54	0.51	0.51	0.5	0.5	0.49	0.52
	1m	0.57	0.54	0.51	0.5	0.5	0.5	0.49	0.52
	3m	0.57	0.55	0.51	0.51	0.52	0.5	0.5	0.52
	5m	0.59	0.55	0.51	0.5	0.5	**0.49**	**0.49**	0.54
	9m	0.6	0.55	0.52	0.51	0.51	0.51	0.5	0.54
	12m	0.62	0.56	0.52	0.51	0.51	0.51	0.5	0.54
	15m	**0.64**	0.58	0.53	0.5	0.51	0.51	0.5	0.55

Table 3. The list of the planktonic algal species determined in the reservoir with respect tothe sampling depths. Represents presence of a taxon in a particular depth sample.

	Surface	1m	3m	5m	9m	12m	15m
BACILLARIOPHYTA							
Bacillariophyceae							
Cocconeis placentula Ehrenberg		X		X		X	
Cymatopleura elliptica (Brébisson) Smith	X	X	X	X		X	
Cymatopleura solea (Brébisson) Smith	X	X		X		X	X
Cymbella cymbiformis Agardh	X						
Cymbella tumida (Brébisson) Van Heurck		X	X		X		
Gyrosigma attenuatum (Kützing) Rabenhorst		X		X			X
Hippodonta capitata (Ehren.) Metzeltin&Witkowski		X	X	X	X	X	X
Navicula sp.	X	X	X	X	X	X	X
Navicula viridula (Kützing) Ehrenberg	X						
Nitzschia acicularis (Kützing) Smith	X	X	X	X	X	X	X
Nitzschia palea (Kützing) Smith	X	X	X	X	X	X	X
Nitzschia sp.	X	X	X	X	X	X	X
Coscinodiscophyceae							
Aulacoseira italica (Ehrenberg) Simonsen	X	X	X	X			
Melosira varians Agardh	X		X		X	X	X
Fragilariophyceae							
Diatoma vulgaris Bory	X						
Fragilaria crotonensis Kitton	X		X				
Ulnaria ulna (Nitzsch) Compère	X	X	X	X	X	X	X
Mediophyceae							
Cyclotella meneghiniana Kützing	X	X	X	X	X	X	X
CHAROPHYTA							
Conjugatophyceae							
Closterium pronum Brébisson	X	X	X	X	X	X	X
Closterium sp.	X	X					
Cosmarium sp.	X	X	X	X		X	X
Staurastrum paradoxum Meyen	X	X	X	X	X	X	X
Staurastrum punctulatum Bréb.	X	X	X	X	X		
CHLOROPHYTA							
Chlorophyceae							
Coelastrum astroideum De Notaris	X	X	X	X	X	X	X
Coelastrum microporum Nägeli		X	X	X		X	X
Desmodesmus abundans (Kirchner) Hegewald		X	X	X	X	X	X
Hariotina reticulata Dangeard		X	X	X	X		
Kirchneriella sp.	X	X	X	X	X	X	
Monactinus simplex (Meyen) Corda	X	X	X	X	X		X
Monoraphidium contortum (Thuret) Komárková-Leg.	X	X	X	X		X	X
Monoraphidium minutum (Nägeli) Komárková-Leg.	X	X	X	X	X	X	
Pediastrum duplex Meyen	X	X	X	X		X	X
Pseudopediastrum boryanum (Turpin) Hegewald		X	X		X		
Scenedesmus bijuga (Turpin) Lag.	X	X		X		X	X
Scenedesmus quadricauda (Turpin) Brébisson	X	X	X	X		X	X
Schroederia sp.	X	X	X	X	X		X
Tetradesmus dimorphus (Turpin) Wynne	X		X	X	X		
Tetradesmus lagerheimii Wynne & Guiry	X	X	X	X	X	X	
Tetradesmus obliquus (Turpin) Wynne	X	X	X	X	X		X

	Surface	1m	3m	5m	9m	12m	15m
Tetraedron caudatum (Corda) Hans.	X	X	X	X	X	X	X
Tetraedron trigonum (Nägeli) Hans.			X	X			
Tetrastrum staurogeniiforme (Schröder) Lemm.	X	X	X	X	X		X
Eustigmatophyceae							
Tetraëdriella regularis (Kützing) Fott	X	X	X	X	X	X	X
Trebouxiophyceae							
Botryococcus braunii Kützing	X	X	X	X			
Chlorella sp.	X	X	X	X	X	X	X
Crucigenia tetrapedia (Kirchner) Kuntze	X	X	X	X	X	X	X
Dictyosphaerium sp.	X	X	X	X	X		
Oocystis sp.	X	X	X	X	X	X	X
Willea rectangularis (Braun) Wynne & Tsarenko	X	X	X	X	X	X	X
CYANOBACTERIA (Cyanophyta)							
Cyanophyceae							
Microcystis aeruginosa (Kützing) Kützing	X	X	X	X	X	X	X
Chroococcus sp.	X	X	X	X	X	X	X
Merismopedia sp.	X	X	X	X	X		X
Oscillatoria limosa Agardh						X	X
EUGLENOPHYTA							
Euglenophyceae							
Euglena granulata (Klebs) Schmitz	X	X		X	X	X	X
Euglena texta (Duj.) Hüb.	X	X	X	X	X	X	X
Lepocinclis acus (Müller) Marin & Melkonian	X	X	X	X	X	X	X
Phacus acuminatus Stokes	X	X	X	X	X	X	X
Phacus longicauda (Ehrenberg) Dujardin	X	X	X	X		X	
Strombomonas sp.	X	X	X	X	X	X	X
Trachelomonas hispida (Perty) Stein	X	X	X	X	X	X	X
Trachelomonas volvocina (Ehrenberg) Ehrenberg	X	X		X	X	X	
MIOZOA							
Dinophyceae							
Ceratium hirundinella (Müller) Duj.		X	X	X			
Peridiniopsis cunningtonii Lem.	X	X	X	X	X	X	X
Peridinium cinctum (Müller) Ehrenberg	X	X	X	X	X	X	X
OCHROPHYTA							
Chrysophyceae							
Dinobryon divergens Imhof	X	X	X	X	X		

A total of 53 taxa were determined in the samples taken from subsurface while the taxa determined in 1, 3, 5, 9 12 and 15m depths were 56, 53, 55, 44, 43 and 42, respectively (Fig. 3). The hourly samplings showed that the minimum and maximum taxa numbers were obtained at 19:00 (31 taxa) and at 01:00 (19 taxa) for subsurface samplings, at 10:00 (29 taxa) and at 19:00 (22 taxa) for 1m samplings, at 07:00 (31 taxa) and at 22:00 (21 taxa) for 5m samplings and at 01:00 (26 taxa) and at 13:00 (12 taxa) for 15m samplings (Fig. 4).

During the study, phytoplankton numbers in liter were calculated from all depths and for chosen sampling hours. The highest cell number (80790ind.L^{-1}) was calculated in the sampling at 01:00 on the surface and the lowest (19540ind.L^{-1}) was calculated at 07:00 in 15m (Fig. 5). Average cell number and percentage distributions according to the groups in the reservoir are given in Table 4. Spectrophotometric measurements showed that the highest average chlorophyll-*a* was measured at 22:00 for the surface sampling (12.57µg.L^{-1}) and the lowest was measured at 16:00 for 15m sampling (3.1µg.L^{-1}) (Fig. 6).

Crucigenia tetrapedia, *Monactinus simplex*, *Scenedesmus quadricauda* and *Coelastrum astroideum* from the green algae, *Peridiniopsis cunningtonii* and *Peridinium cinctum* from Miozoa, *Staurastrum paradoxum* from Charophyta and *Microcystis aeruginosa* from Cyanobacteria were identified as the dominant organisms of Kadıköy Reservoir during the study.

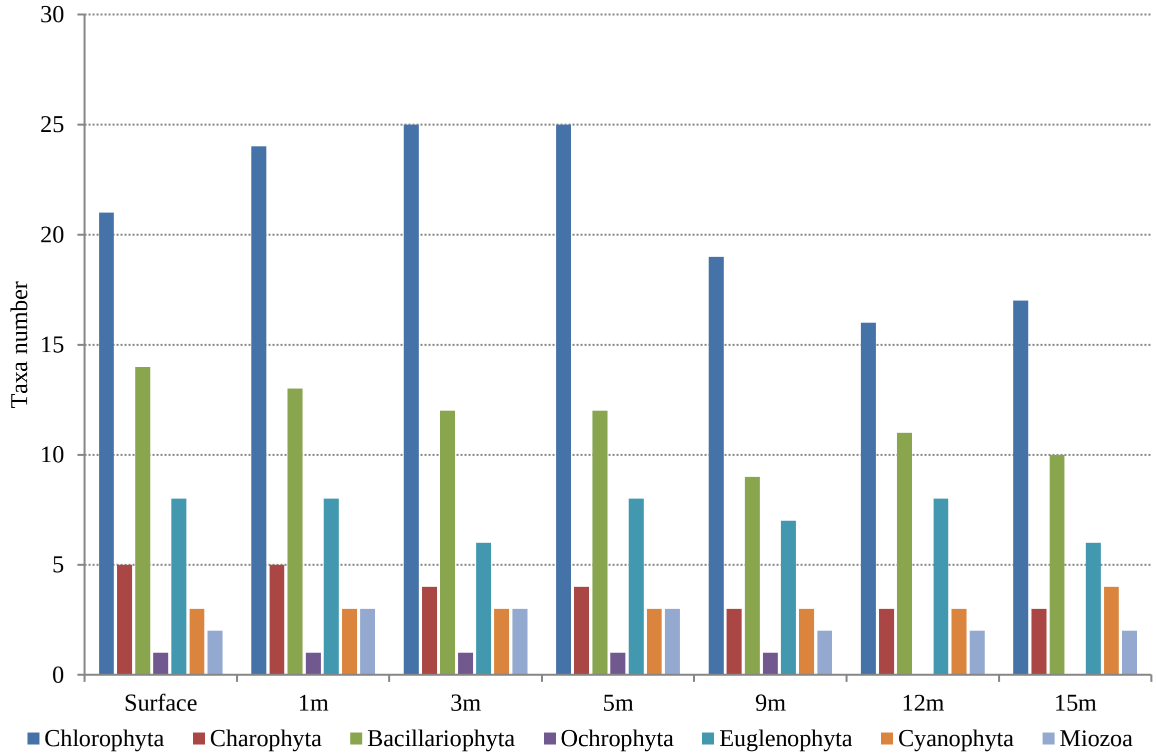

Fig. 3. The spatial distribution of phytoplankton taxa identified in the reservoir with respect to depths.

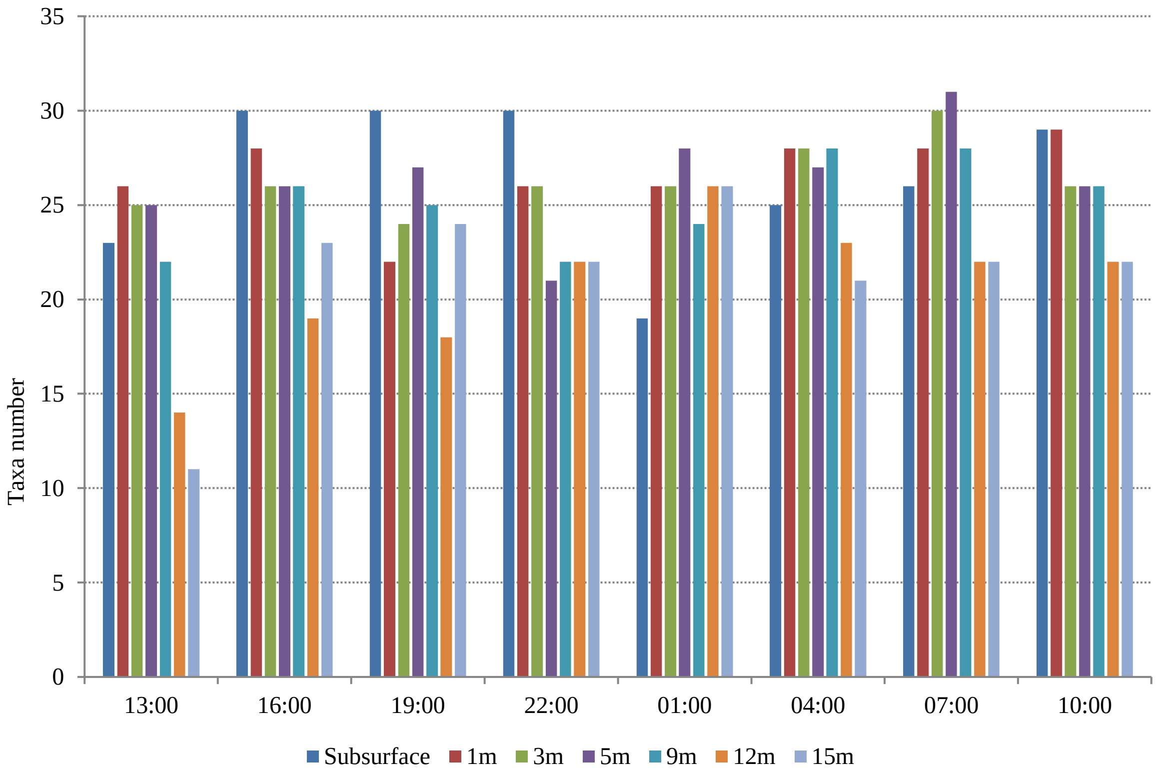

Fig. 4. The spatial distribution of phytoplankton taxa identified in the reservoir with respect to sampling hours.

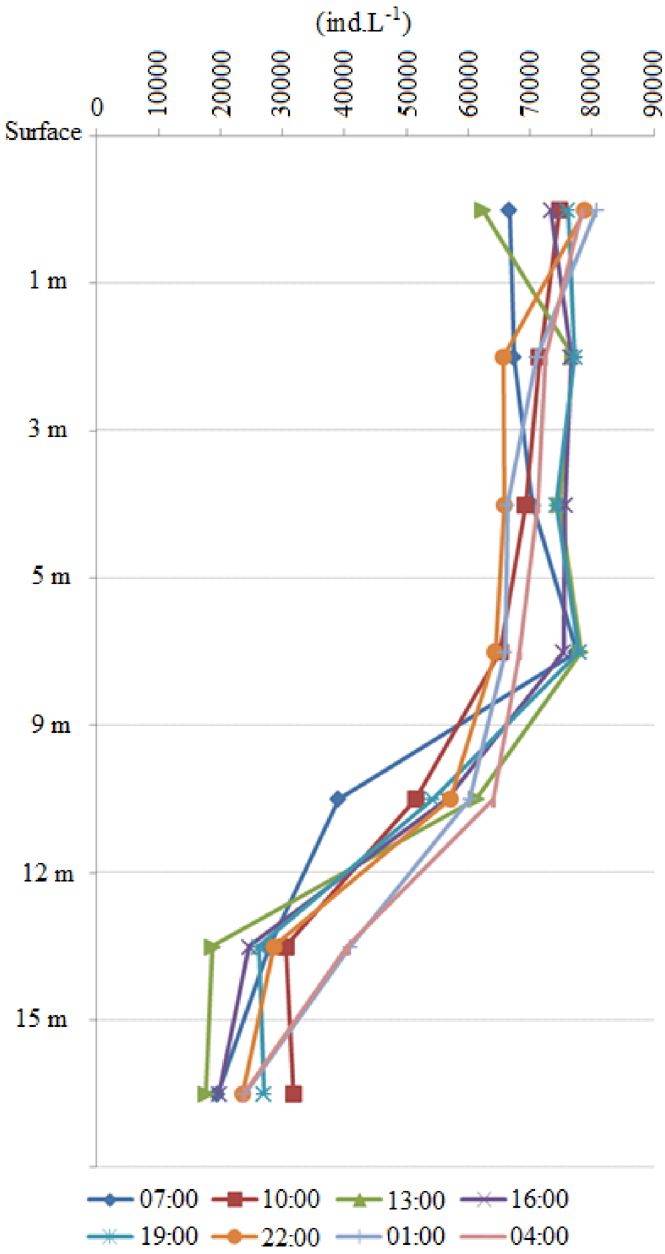

Fig. 5. Organism numbers (in total) determined with respect to depths (ind.L^{-1}).

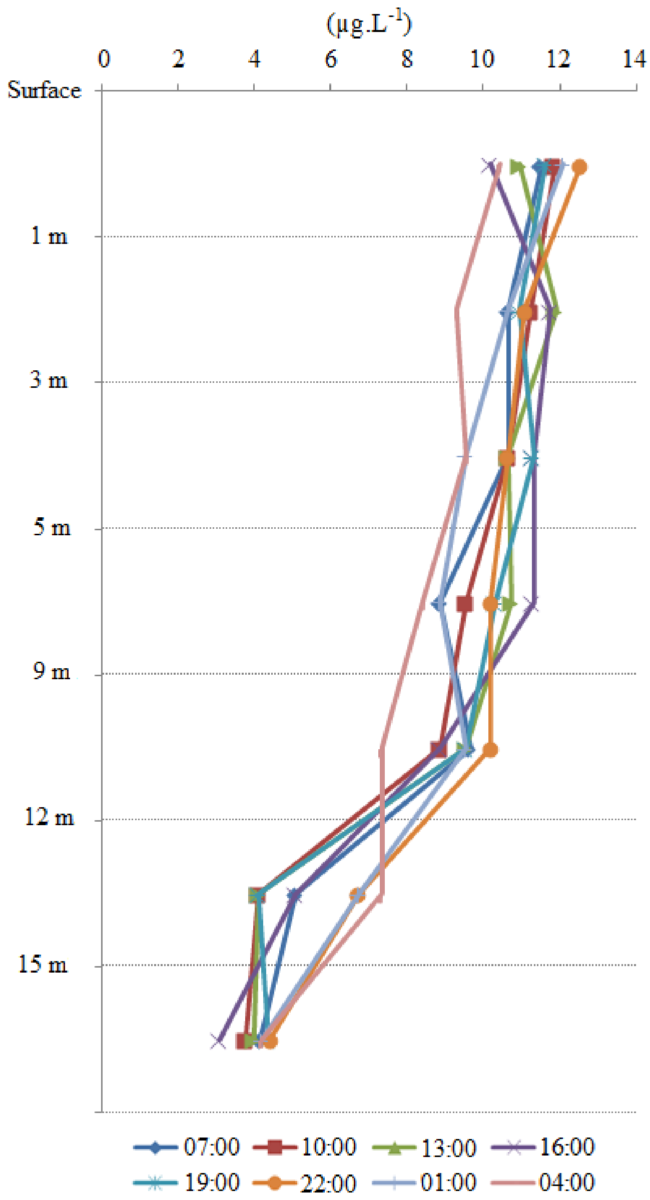

Fig. 6. Chlorophyll-a quantities identified with respect to depths (µg.L^{-1}).

Table 4. Abundance of taxonomic groups of phytoplankton and their contributions to total phytoplankton abundance in the reservoir (ind.L^{-1}).

	Subsurface	1m	3m	5m	9m	12m	15m
Bacillariophyta	2453	2051	2476	2406	2389	1806	1871
Charophyta	5963	6096	7012	6798	7096	2227	1745
Chlorophyta	44121	40662	40195	40368	28287	16912	13020
Cyanophyta	6461	6519	5526	6149	4994	2068	1068
Euglenophyta	3225	3792	4651	5103	2954	3417	3619
Miozoa	11733	13263	11144	10795	9825	3388	2075
Ochrophyta	6157	7214	7200	7886	8243	7909	7460
Total	80113	79597	78203	79505	63789	37726	30857

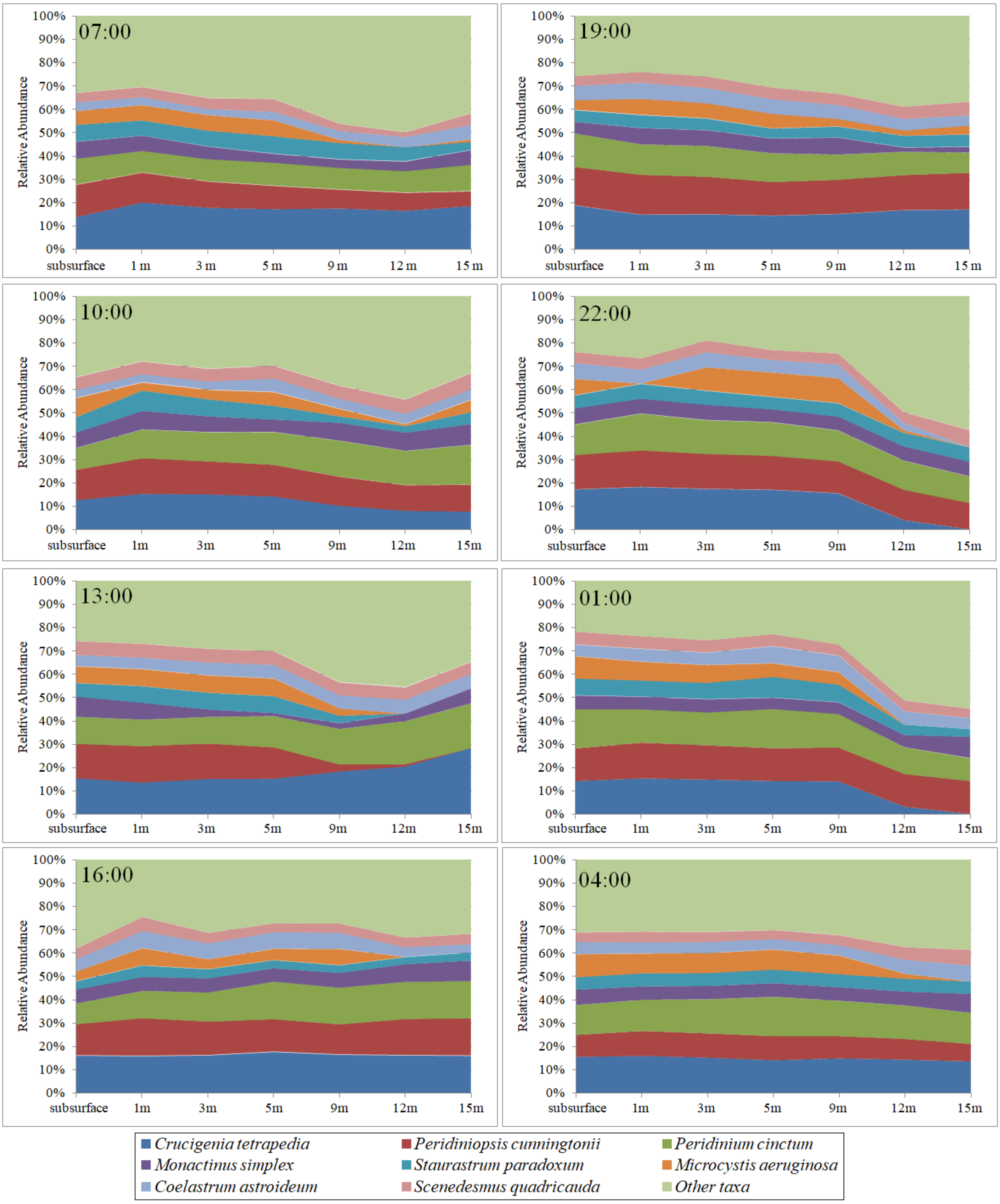

Fig. 7. Relative abundance changes of the dominant species found in Kadıköy reservoir phytoplankton with respect to the months (% abundance).

Especially, *C. tetrapedia* being in the first place, *P. cunningtonii* and *P. cinctum* were identified having the highest relative abundance in every sampling hour and in almost all depths. Although *M. aeruginosa* was identified in the first 5m, it was not found below 5m or identified hardly. In the samplings done at 10:00, 19:00, 22:00 and 04:00, *S. quadricauda* was found in 12 and 15m depths in higher numbers. *C. astroideum* was found in high numbers close to the bottom in early morning. *S. paradoxum* was positioned between 1-5m while *M. simplex* was found to be vertically distributed almost homogeneously. Hourly identified dominant species and their relative abundances in Kadıköy reservoir are given in Fig. 7.

Discussion

Weather and water temperatures measured during the study period were in seasonal normal, but when water temperatures of the surface water and in 1, 3, 5, 9, 12 and 15 m depths were evaluated according to YSKYY (Surface Water Quality Management Framework), it appeared that they do not exceed I. class water quality values (YSKYY 2015). A pH value between 6.5 and 8.5 is needed to provide a suitable environment for aquatic organisms and to not to pose endangering risks on the life of organisms (Küçükyılmaz *et al.* 2010). High pH values in particular lead to increase of detrimental effects of ammoniac and nitrogen compounds and therefore it is stated that pH changes in water is very important in aquatic environments to provide chemical balance thus making sure that aquatic life continues (Küçükyılmaz *et al.* 2010, Boztuğ *et al.* 2012). When data taken from the measurements are considered from the perspective of YSKYY, it is found that it does not significantly exceed the I. class quality values in terms of pH value of the reservoir. Besides being directly related with photosynthesis and respiration and decomposition, dissolved oxygen is also related with light density and temperature (Cunha-Santino *et al.* 2013). In our study, dissolved oxygen levels were found to be I. class water quality according to YSKYY criteria (YSKYY 2015). In fresh water ecosystems, 250-500µS.cm^{-1} conductivity level is suitable for fresh water organisms (Tanyolaç 2011). In Kadıköy reservoir, conductivity levels were measured daily and were found to be suitable for fresh water ecosystems and for the organisms living there. Salinity value is important for drinking water and in our study the values showing the salinity indicate that Kadıköy reservoir is suitable as a freshwater reserve (Tanyolaç 2011).

In this study, 65 taxa have been identified, the highest abundance was determined in the sampling done at 01:00 as 80790ind.L^{-1} on the subsurface. In the lake phytoplankton, Chlorophyta (56.21%) was found to be dominant followed by Miozoa (15.64%), Charophyta (9.29%), Cyanophyta (8.24%), Euglenophyta (6.73%) and Bacillariophyta (3.89%). Diatoms are represented in low numbers in every sampling hour while Euglonids were higher in number in evening hours under 5m depth. *Microcystis aeruginosa*, which is an eutrophic indicator species, is among the dominant organisms at around 5m in the lake phytoplankton. This situation is similar to the results of the study in Ömerli Reservoir performed by Albay and Akçalan (2003). Besides, *M. aeruginosa* is identified in many reservoir studies like Hasan Uğurlu, Kemer, Çamlıdere, Derbent, Hirfanlı, Ömerli and Kadıköy Reservoir (Fakıoğlu *et al.* 2011). This species is also identified in the studies performed in the lakes and rivers of Trakya (Öterler 2013, Öterler *et al.* 2014, Öterler *et al.* 2015). Other Cyanophyta group members were not dominant in the reservoir.

In our study area, Chlorophyta is the phytoplankton group that is represented by the highest taxa and organism number. This situation resembles many mesotrophic and eutrophic lakes' phytoplankton compositions (Gönülol & Obalı 1998b, İşbakan-Taş *et al.* 2002; Ongun-Sevindik 2010). Among the dominant organisms of the reservoir, *C. tetrapedia* is a planktonic, cosmopolitan and eutrophic species that is highly seen in lakes and rivers (John *et al.* 2003). Other Chlorococcales members we came across in our study, *Scenedesmus*, *Monactinus* and *Pediastrum* species, are highly seen in oligomesotrophic reservoirs and eutrophic lakes in our country (Aykulu & Obalı 1981, Aykulu *et al.* 1983, Obalı 1984, Gönülol & Obalı 1998a, 1998b, Atıcı 2001-2002, İşbakan-Taş *et al.* 2002, Albay & Akçaalan 2003, Atıcı 2003, Baykal *et al.* 2004, Kıvrak & Gürbüz 2005, Özyalın & Ustaoğlu 2008, Ongun-Sevindik, 2010, Çelekli & Öztürk 2014).

Among Charophyta, 5 taxa have been identified and most of them are *Staurastrum,* known as the characteristic of oligotrophic lakes (Rawson 1956, Hutchinson 1967, Wetzel 2001). These species can be seen in many of the oligotrophic and mesotrophic lakes in our country (Baykal *et al.* 2004, Karacaoğlu *et al.* 2004, Atıcı *et al.* 2005, Şahin & Akar 2007, Ustaoğlu *et al.* 2010, Ongun-Sevindik 2010, Atıcı & Alaş 2012).

Miozoa, the 2nd dominant organism group of the reservoir after Chlorophyta was identified as determinant of mesotrophic waters by Rawson (1956): *Ceratium hirundinella* is common in oligotrophic and mesotrophic waters and *Peridinium cinctum* and *Peridiniopsis cunningtonii* are found in high numbers (Rawson 1956, Eloranta 1995, Reynolds *et al.* 2002). Being identified in water poor in phosphorus, *Dinobryon divergens* is found in the reservoir in the first 9m depth (Hutchinson 1944, Lee 1980, Sandgren 1988).

There is a strong relation between the physical and chemical features of water bodies and the phytoplankton distribution and structure. The abiotic water conditions show variations naturally throughout the day and over the seasons of the year. These variations which may be related to stratification and mixing of the water column can be either vertical or horizontal. As a result, the availability of light and nutrients for the development of the phytoplankton community result in changes. Stratification, buoyancy, capacity for vertical regulation, light regime and grazing are the factors which have the potential of controlling phytoplankton biomass and species composition (Lopes et al., 2005). It can be said that temperature and especially light are effective in daily vertical changes of phytoplankton in Kadıköy dam. Phytoplanktonic organisms, which are concentrated in 1-3 meters depending on the amount of light during the day, approach the surface water in order to make more efficient use of light in the evening hours. During the study period, the sunset time in Edirne province was around 21:30. This may explain the detection of high chlorophyll_*a* and high cell counts in the sample taken at 22:00, which appears to be a paradox. Phytoplanktonic organisms sink deep into the night with a decrease in the amount of light and temperature.

In conclusion, the present study provided evidence for a relation with the 24-h cycle phytoplankton distribution and environmental conditions. The highest values of phytoplankton densities and biomass were found during the second half of a day and for the first 9m depth. Phytoplankton taxa without self-regulating capacity and those able to regulate their vertical position were differentially distributed in the segregated layers during the 24-h cycle. The results are regarded as evidence to conclude that temperature and light have effect on daily vertical movements of phytoplankton in Kadıköy reservoir.

Editor-in-Chief note: Burak Öterler is a member of Editorial Board of Trakya University Journal of Natural Sciences. However, he was't involved in the decision process during manucript evaluation.

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