The Benthic Algae of Meke Lake (Karapınar/Konya)

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Abstract

The aim of this study was to determine the physical and chemical properties of the lake water and benthic algae of Lake Meke which is a volcanic lake. Water and algal samples from 5 different stations were obtained monthly between April and May 2011. Totally, 49 taxa were detected, which included 22 of *Ocrophyta*, 13 of *Cyanobacteria*, 11 of *Chlorophyta* and 3 of *Euglenozoa*. The *Ocrophyta* was found dominant in the whole organisms. The variety of species was limited in the lake due to salt. Meke represents characteristic volcanic features, which makes it an important reservoir.

Keywords: Meke, benthic algae, epiphytic, epilithic, epipelic

Meke Gölü (Karapınar/ Konya) Bentik Algleri

Özet

Bu çalışmada volkanik bir göl olan Meke gölü bentik algleri ile göl suyunun fiziksel ve kimyasal özelliklerini belirlemek amacıyla yapılmıştır. Göl de seçilen 5 farklı istasyondan su ve alg örnekleri, Nisan 2011 ile Mayıs 2011 tarihleri arasında her ay periyodik olarak alınmıştır. Gölde toplam 49 takson bulunmuş, bunların 22' si *Ocrophyta*, 13' ü *Cyanobacteria*, 11'i *Chlorophyta* ve 3'ü *Euglenozoa*' ya aittir. *Ocrophyta* dominat organizma olmuştur. Göl suyu tuzlu olduğundan tür çeşitliliği az olmuştur. Meke gölü karakteristik volkanik göl özelliklerin hepsine sahip önemli rezervdir.

Anahtar kelimeler: Meke Gölü, Bentik alg, epipelik, epifitik, epilitik.

INTRODUCTION

Benthic algae are regarded as an important component of lakes, since they make an important contribution to the biological diversity and productivity of the lakes (Moss, 1969). It has been recognized that seasonal changes, composition and production of benthic algae are affected by the chemical features of water and sediment structure (Round, 1984). Some studies have been done on the benthic algae of the lakes, reservoirs and ponds in Turkey (Atıcı et al., 2005; Atıcı and Çalışkan, 2007; Dokcan et al., 2010).

The aim of this study was to investigate the abundance and species composition of benthic algae and to examine the physical and chemical properties of the lake water.

MATERIALS and METHODS

Research Area

Meke Lake is in the 101 km distance of Konya's southeast. In the rainy years, the lake widens whereas it dramatically narrows in the dry years and the alluvial lake bottom comes to the surface. Meke Lake, which is volcanic-based and a salty water source, is an important habitat for birds and other creatures. In this case study, to

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determine the level of pollution and the quality of the water in Meke Lake, during the years of 2011-2012, monthly water samples of the lake were taken. The aim of the current study was to explore the reasons of the disappearance or the deterioration of the natural beings or sources around Meke Lake, and especially to explore thoroughly the reasons for the decrease of the water level of the lake. Thus, through this study, some important precautions would be determined to protect Meke Lake, which is classified to be one of the most important geological legacy and accepted to be the pearl of the region, and the natural balance surrounding it.

The place of the research is nearly 101km far from Konya and it is in the 8 km southeast of the county Karapınar, and last of all, it is 2 km inside the Karapınar-Ereğli road (Figure 1). The Meke Lake, which came into existence as a result of the accumulation of water in an inactive volcano crater, and which includes various islets inside itself, has been added to the RAMSAR pact about the international protection of the watery places issue, on 21 June 2005.

Analysis

The samples of epipelic, epilithic and epiphytic algae were taken periodically once a month between April 2011 and March 2012 from five different stations chosen from Meke Lake. In January 2012, due to the weather conditions no samples were taken from the lake. To take the sediment samples, glass sticks, 0.8 cm in scale and 100 cm in height, were used. The open side of the glass stick is plunged into water over the sediment, and then by drawing back the thumb, the glass is moved on the sediment in the radial direction, and therby the glass stick is made to fill with water and mud (Round, 1953). After the glass stick is totally filled, again by covering one side of the stick with the thumb and taking the stick out of water, the plastic jar in the size of 1 liter is made to fill. It is specifically paid great attention to take the samples in the same amount from each station.

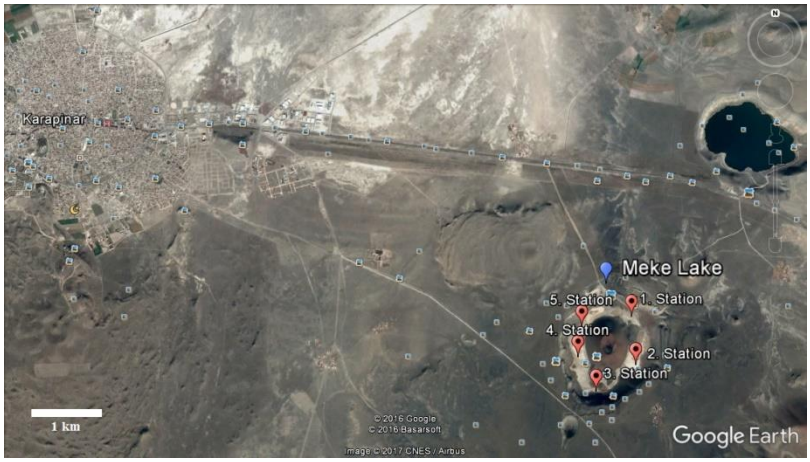

Figure 1. The satellite image of Meke Lake and its schematic map (taken from Google Earth).

RESULTS

Physical and Chemical Features

In order to determine some physical and chemical properties of Meke Lake between April 2011 and May 2011, the surface water temperature, pH and dissolved oxygen values were measured in the field once a month and the results are shown in Table 1-2.

Table 1. The average physical features of Meke Lake (surface water)

Months	Salinity (0%.)	Temperature (°C)	DO2 (mg L^{-1})	pH	Conductivity (µmhos cm^{-1})	Transparancy (cm)
April	17.5	11,52	0,73	7,6	161000	88,3
May	14.0	15,17	0,72	7,3	110000	82
June	11.2	23,09	0,66	7,5	115500	70
July	17.2	26,5		7,4	112000	75
August	17.1	22,82	0,05	7,1	116000	65
September	59.1	21	0,19	7,4	120000	90
October	71.4	18,07	0,21	7,5	118000	95
November	77.5	8,75		7,5	150000	92
February	19.4	9,75	0,21	8,0	73500	15
March	19.3	12	0,22	7,9	85000	134

Table 2. The Chemical features of Meke Lake (surface water)

Months	Ca (mg/l)	Cl (mg/l)	BOD_5 (mg/L)	COD (mg/L)	NO3 (Mg/l)	SO_4 (mg/L)
April	25500	648000		286400	0.53	217903
May	28000	27000	19.14	73600	0.45	11935
June	28000	51000	29.70	80000	0.09	69677
July	20100	85300		4320	0.96	37581
August	29300	174500	14.55	201600	0.69	53548
September	15900	79900	10.60	150400	0.61	8301
October	16800	96700	1.40	44800	0.48	84677
November	10200	137500		92000	0.66	26290
February	28600	105200	6.10	19840	0.31	30645
March	13300	90300	3.80	40960	0.10	17258

Benthic Algae

The benthic algae of the Meke consisted of epipelic, epiphytic and epilithic algal communities. Totally, 49 taxa were recorded in the benthic algal communities. Most species identified in the study period belonged to the Ochrophyta. The aforementioned species have been listed as epipelic, epiphytic and epilithic in the order of their amount. Among the determined habitats, Ochrophyta part with 22 species, Cyanobacteria with 13, Chlorophyta with 11, Euglenozoa with 3 species have been represented (Figure 2). A list of the identified taxa is presented in listed (Table 3).

Table 3. The Alphabetical list of the present species (a:Epipelic, b: epilithic, c:epiphytic)

Divisio	**Bacillariophyta**
Ordo	**Centrales**
	Cyclotella Kütz.
	C. ocellata Pantocksek. (a)
Ordo	**Pennales**
	Achnanthes Bory.
	Achnanthes minutissima Kütz. (a,b)
	Amphora ovalis Kütz. (a,b)
	Cymbella C. A. Agardh.
	C. cistula (Ehrenberg) Kirchner (a,b,c)
	C. helvetica Kütz (a,c)
	Diatoma Bory.
	*D. elangatum (*Lygb.) Ag. (a,b)
	D. vulgare Bory (a)
	Diatoma sp. (a,b)
	Fragillaria Lygb.
	F. intermedia Grun. (a,b,c)
	F. vaucheria (Kütz.) J.B. Petersen (b)
	Mastogloia Thwaites ex W. Smith (a)
	M. smithii Thwaites in W. Smith (a)
	Navicula Bory.
	N. lanceolata (Agardh) Ehrenberg (a,c)
	Navicula radiosa.Kütz. (b)
	Nitzschia Hassal
	N. acuta Clev (b,c)
	N. lanceolata W. Smith (a,b,c)
	N. linearis W. Smith (a,b)
	N. sigma (Kützing) W. Smith (a,b,c)
	N. sigmoidea (Ehr) W.Smith. (a,b,c)
	Pinnularia Ehr.
	Pinnularia biceps W.Gregory (b)
	Pinnularia viridis (Nitzsch) Ehrenb (a,b)
	Synedra Ehr.
	S. acus Kützing (a,b)
	S. ulna (Nitzsch.) Ehr. (a,b,c)
Divisio	***Chlorophyta***
Ordo	***Volvocales***
	Chlamydomonas sp. Reinhardtii (b)
	Dunaliella salina (Dunal) Teodoresco (a,b)
Ordo	***Chlorococcales***
	Chlorella vulgaris Beijerinck (b)
	Dictyosphaerium pulchellum H.C. Wood
	Coelastrum microporum Nägeli in A. Braun
	Scenedesmus Meyen
	S. quadricauda (Turp) Bréb. (a, b)
	Selenastrum Reinsch (a)
	Selenastrum sp. (a)
Ordo	**Cladophorales**
	Cladophora Kützing.
	C. fracta (O.F.Müller ex Vahl) Kützing
Ordo	**Desmidales**
	Cosmarium Corda ex Ralfs.
	Cosmarium sp. (a)
	Closterium Nitzsch (a)
	Closterium littorale f. crassior O.F.Borge
Ordo	**Zygnematales**
	Spirogyra Link.
	Spirogyra gratiana Transeau (a, c)
Divisio	***Cyanobacteria***
Ordo	***Chroococcales***
	Chroococcus Naegeli.
	C. limneticus Lemm. (a,b)
	Microcystis aeuroginosa Kütz.
Ordo	**Hormogonales**
	Lyngbya C. Agardh.
	Lyngbya sp. (b,c)
	L. lagerheimii (Moebius) Gom.
	Oscillatoria Vaucher
	Oscillatoria sp. (a)
	O. bornetii (Zukal) Forti (a,b)
	O. curviceps C.Agardh (a,c)
	O. formosa Bory de Saint-Vincent ex Gomont (a,b)
	Oscillatoria limosa C.agardh. (a)
	O. subbrevis Schmidle (a,b)
	O. princeps Vaucher (a)
	Phormidium Kützing ex Gomont
	Phormidium sp.
	Phormidium tenue (Meneghini) Gomont.(a,b)
Divisio	***Euglenophyta***
Ordo	***Euglenales***
	Euglena Ehr.
	E. acus Ehr. (b,c)
	Euglena polymorpha P.A.Dangeard
	Trachelomonas Ehr.
	Trachelomonas sp. (c)

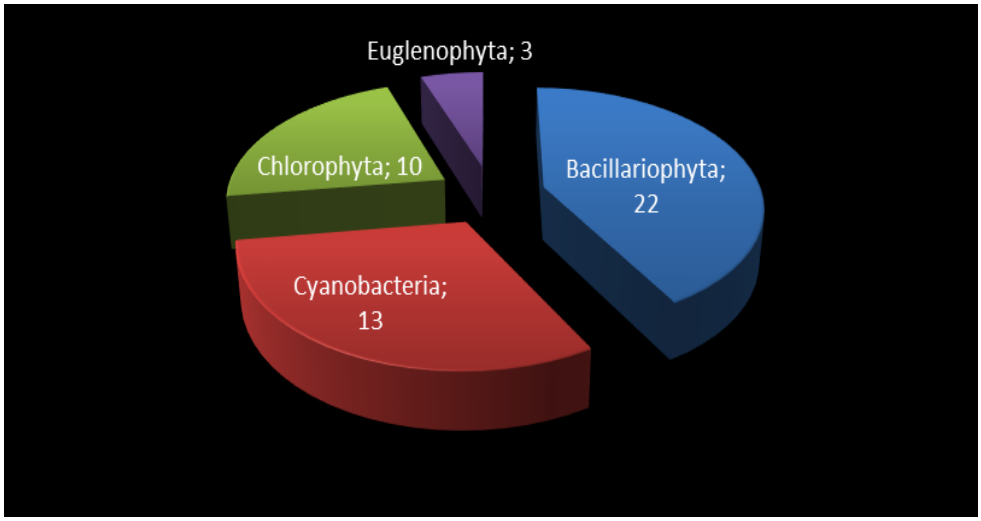

Figure 2. The percentages of the species found

DISCUSSIONS

Studies on the littoral region algae of lakes and ponds have shown that a rich algal flora develops on the sediments. This flora has been studied in detail in the lakes of England, Ireland and Finland (Round, 1964).

Various physical, chemical and biological factors are known to influence the density of algae. Especially light, temperature, water current and wave motion from physical factors control the epipelic community. Benthic food chain in the oxygen conditions under ice cover in winter and epipelic algae in food dynamics are of great importance. Biological and chemical analyses conducted in the lake can be regarded as weak in terms of species number and variety because of the very modest and special conditions when the lake is evaluated from a floristic point of view. Because of the ecological conditions, the lake has an extreme value which is very restrictive in terms of flora.

Waters are evaluated under 4 main categories as high quality, less polluted, polluted and much polluted with respect to their qualities. As a result of the measurements done above, Meke Lake was also evaluated with respect to these criteria. Given the analyses results of Meke Lake, with respect to muddiness, total solid material, sulphate and chloride values and solidity condition, the lake is not suitable for use. Besides, dense salinity of the water, sulphate, and excessive evaporation come atop among the elements increasing the salt density. The lake is only a natural habitat for flora and fauna, which like salt and has a deep tolerance for salt. It is an important reservoir including all the characteristics of the volcanic lake in its body.

Contamination and highest salt levels were observed in the lake water. It may be stated that lake water is not suitable for human consumption. Higher evaporation may cause higher salt and sulphate concentrations in the lake. Higher levels of soluble minerals, salts and ions in the lake water may be depend on geologic characteristic of geographic area. In addition, organic materials contribute the lake dirtiness. Soluble oxygen levels were determined as <0.8 mg/L all sampling time. This situation effects water quality and causes anoxic conditions. Low soluble oxygen levels and higher organic material concentrations

confirm the existence of organic dirtiness. Low BOI level was determined than KOI level. BOI/KOI rate was very different from normal water (WPCR, 2008). This result indicates that organic materials different from biologic fissionable materials. The salty lake was limited the variety of species in the lake.

There is a flora above the sediment with a richer appearance in terms of the number of species of benthic algae in the Meke coastal shoreline. Epipelic algae meets a significant portion of underwater production. According to Round and Hickman, benthic algae describe living organisms in a closed area between solid and liquid surfaces. The epipelic algae biomass and research on population dynamics have often shown that they exceed their total benthic production and thus will not be neglected when determining the total primary production of aquatic ecosystems. Despite biomass abatement in most of the year, epipelic algae are second-rate among the algal communities and have a great proposition for an entire ecosystem.

The *Cyclotella ocellata* from centric diatoms in the Meke Lake has always been available species. *C. ocellata* species, which are continuously available, are also found in Bayındır Dam Lake (Gönülol, 1987), Beytepe and Alap Ponds (Ünal, 1985), Çubuk-I Dam Lake (Gönülol, 1985), Altın Apa Damlake (Yildiz, 1986), Mogan Lake (Obalı, 1989), Beyşehir Lake (Akköz, 1998), Hafik Lake (Kılınç, 1998), Lake Beşgöz (Akköz, 1998), The Palandöken Pond was found in the Lake Tortum (Gürbüz, 2000), an oligotrophic lake. Among the true epiphytic and epilithic diatom species, *Cymbella* species were found to be an important organism with a high rate of benthic flora recurrence, whereas *Gyrosigma acuminatum* cell count and recurrence rate were found to be low. Similar studies have been done on benthic algae in other lakes in the region (Akköz and Yılmaz, 2009; Akköz et al., 2014).

The most important factors controlling the algal density are light and temperature due to their role in photosynthesis. Decreasing light and sunbathing in winter creates the most unfavourable conditions for the growth of algae together with low temperature. Swale (1964) and Lund (1965) noted that the increase in day length was the most effective factor in the initiation of early dairy growth. Whitford and Schumacher (1963) reported that the diathermy's light intensity requirement is generally good to good, while temperature demand is low. Algae community is proliferating twice a year as it is in the temperate zone of inland waters of Lake Meke. Higher increases were observed compared to summer and winter months, although more in the spring and a little lower in the autumn. Higher increases were observed compared to summer and winter months, although more in the spring and a little lower in the autumn. The most important reason for this is understood to be the fact that the physical properties such as light, flow rate and heat are more important in the development of epipelic algae. The effect of falling rains in the spring prevented the well-being of the algae flora due to low light and low temperature in winter.

High evaporation-sweat and the decrease of the fall as a result of the hydraulic circle developing in the basin, decrease the water potential in the area. Along with this, as there is no afforestation around Meke Lake, this contributes to the restriction of the nourishment of the lake water. The stowing in Meke Lake and around it, provide the flow from the lake basin to the groundwater. The sediments belonging to the lake on the base of the lake give way to the wide flows both through the lava flows and also under them in the direction of the centre of the Karapınar. These units include rocks which have a partial pervious

characteristic makes the water circulation possible. It is possible that there might be some water leak from these units which constitute one part of the base of the lake.

Especially due to the uncontrolled watering pits all around Karapınar and due to the seasonal draws there have been a decrease at the level of the underground water. That the level of the water of Meke Lake is 991 m and the decrease of the level of the underground water in the direction of the centre of Karapınar to 970 m provide underground flows outside. Besides, immense draw might also lead to the opening of the underground canals and contribute to their widening.

There is no superficial water drainage canals to nourish Meke Lake, in which the potential for evaporation (692.02 mm) is more than fall (291.08 mm), and all around it. Therefore, there must be afforestation all around the lake to prevent evaporation there. And, for afforestation, the trees which have low water needs and are resistant to drought should be preferred. Especially, creeping brushes are of great significance to this end, as they have twofold benefits; as they cover the earth, they both decrease evaporation and also prevent erosion. Biological characteristic of the lake is also is under threat. What gives life to the lake and what feeds the living creatures inside the lake by nourishing them is nothing more than water. At this present condition, the water reservoir of the lake is under the minimum code and it is about to come to an end. Both to save the lake and also to rehabilitate it by protecting the living reservoir there, the amount of the water must be taken above the minimum code by increasing the water amount there. This is of great significance both for the biodiversity and also for the continuation of the ecological characteristics. To this end, to increase the level of the water, it is of importance to restrict the water outlay. As it is not possible to prevent the natural evaporation around the lake recently, there must be a plan to restrict the water use. More than half of the present watering pits must be chosen as the pilot practice and their activity should be brought to an end. Yet, to put this into action, the reaction of the people should be taken into consideration and it must be done alternately with a beforehand schedule.

If the agricultural facilities are done in accordance with a plan done by the professionals with respect to the needs of the soil and with the suitable production pattern, this situation might be controlled, as with this program mostly the plants which are resistant to drought or which have very little requirement of water would be planted. With such use-based precautions, there might be some conservation.

When the basin code of the lake is taken into consideration, the basin of the lake is higher while the level of the water is at a lower position; this inevitably shows a flow from the lake to the basin. The level of the water might also be increased, if the direction of the outer flow from the lake is closed. To bring water from the outside to increase the level of the water there seems not possible right now.

The afforestation at that part will not only control the erosion there, but also provide shelter, reproduction and nourishment possibilities to the members of that particular area's fauna. Thus, quickly, suitable brushes, small trees and trees must be planted there.

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