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The Benthic Macroinvertebrate Fauna of Sarıkum Lake and Spring Waters (Sinop)

Sarıkum Gölü ve Kaynak Sularının (Sinop) Bentik Makroomurgasız Faunası

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Abstract
In this study, the community composition of benthic macroinvertebrate fauna from Sarıkum Lake and spring waters were investigated monthly between June 1995 and May 1996. Physico-chemical parameters of the sampling stations were measured. The fauna were represented with 26 species belonging to 6 systematic groups (Gastropoda, Bivalvia, Insecta (larvae), Crustacea, Polychaete and Turbellaria classis). Insecta was found as predominant in respect to species diversity. The species belonging to Mollusca and Crustacea classis were in minority. In general, most of the species in Sarıkum Lake were eurythopic organisms of eutrophic lakes.

Keywords: Sarıkum Lake (Sinop), spring water, benthic macroinvertebrate fauna

Introduction

Benthic invertebrate fauna are important at the food web of aquatic ecosystems. Their abundance causes the growth of fish population such as Cyprinidae, Anguillidae and Mugillidae. They play important role on the biological productivity of lakes

and rivers. Moreover, freshwaters are being polluted and facing to various limnological problems. They are used in determining and observing eutrophication, pollution, water quality and many of them are accepted as biomonitor species. Thus, studies on benthic invertebrates have become very important in the world.

There are more than 20 lagoons of different types with a total area of 37000 hectares along the coasts of Turkey. They were considered important areas ecologically and economically, because they have high primer productivity. Thus, first of all sea bass, gilt head bream, gray mullet and young specimens of invertebrates like shrimps enter into for nourishing and maturing (Kocataş, 1997).

There were many studies were available about benthic invertebrates of freshwaters particularly in the South, West and Inner Anatolia (Geldiay,1949; Geldiay and Tareen, 1972; Kırgız, 1988; Kırgız and Soylu, 1975; Şahin, 1984; Tanatmış, 1989; Bilgin, 1967; Bildiren, 1991; Şeşen 1992; Kırgız, 1989; Ustaoğlu, 1980; Tanyolaç and Karabatak, 1974), whereas, no data were available on Sarıkum Lake except macroscopic and microscopic algae (Öztürk, 1994).

The present study was carried out at Sarıkum Lake and around 2 spring waters (Sinop).

Material and Method

Study Area

Sarıkum Lake, an alluvium lagoon lake, is located in the western part of Black Sea Region (Turkey) in the province border of Sinop. It is located 35° 54' 30" E, 42°01'35" N at the West Black Sea Region of Turkey. It has an area of 184 hectares consisting of 102 hectare lake and 82 hectare of marsh. Five streams flow into the lake (Fig. 1). The lake is connected to the Black Sea with a 300 m. stream. This stream is covered by sands coming from the Black Sea and Sarıkum Lake from time to time.

There are many fish such as grey mullet (*Liza aurata*), flounder (*Platichthys flesus*) and Aphanius (*Aphanius* sp.) and seconder aquatic plant such as *Mryophylum* sp., *Ceratophylum* sp., *Ranunculus* sp., *Carex* sp. and *Chara* sp. in the littoral region of the Lake. Flattend aquatic turtles and water snails were observed in the lake (personal observation). Sarıkum Lake is a sheltering, feeding area for fish larvae and migratory birds.
Five sampling stations were chosen at the investigation area:

Station 1: Keçideresi basin spring located 2 km. away, south-east of Sarıkum Lake and of The village of Sarıkum, crossroad of Sinop - Ayancık road.

Station 2: Located south-east of the lake. Its mean depth was 60 cm, bottom covered with black mud and putrified plant root. There were plenty of rushy area at the littoral region.

Station 3: Located near the village of Sarıkum. Its mean depth was 50 cm, bottom sandy, but black mud was observed from place to place.

Station 4: Located at the stream that connects the lake to the The Black Sea. The mouth of the stream was blocked with sand. The depth of the sampling station point was 80 cm, bottom covered with putrified plant deposits and dead mollusc shells. Black mud could be found from place to place.

Station 5: A basin of spring located between the second station and the Sarıkum Village.

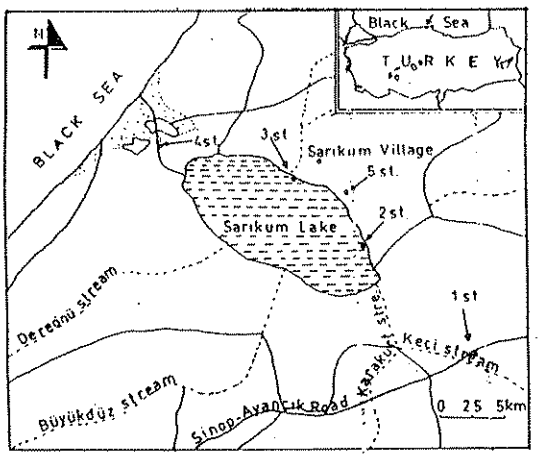

Fig. 1. Sampling stations of Sarıkum Lake and spring waters

The benthic macroinvertebrates were collected from the bottom of Sarıkum Lake and two spring ponds around Sinop, by hand net sieving sediment through a 0,5 mm. mesh between June 1995 and May 1996, monthly. All materials were stored into the vials filled with a 4 % neutralized formaldehyte solution.

Physico-chemical parameters as temperature, pH, conductivity, turbidity were measured with U-10 Horiba in situ. Dissolved oxygen was measured with the Winkler method in vitro.

Concerned publications used in determining the species of macrobenthic fauna were (Şahin, 1991; Ruffo 1982; Fittkau and Roback, 1983; Gledhill et al., 1976; Fauel, 1969; Fauehold, 1977; Elliott et al., 1988; Edmenson, 1959; Demirsoy, 1982; Demirsoy 1998; Zhadin, 1952; Demir 1954; Barnes, 1954; Ahıska ve Karabatak, 1994; Demirsoy, 1996).

Results and Discussion

Physico-chemical parameters of the stations were similar to those of the first and fifth stations. Same can be seen at the second, third and fourth stations.When comparing pH levels of all sampling stations, figure 2 shows that first and fifth stations are similar, and second, third and fourth stations look alike. The pH value of 9 which was measured at the second station in July-1995 is a critical top level for organisms. In spite of this, the species (*I. elegans, G. aequicauda, T. deshayesii and H. diversicolor*) encountered at the second station in July-1995 could live tolerating to 9 of pH value.

Comparing conductivity levels of all sampling stations, while the first and fifth stations are similar due to their freshwater features, the second, third and fourth stations are also similar each other brackish water trait (fig. 3). Conductivity levels of the fourth station was measured more than those of the second and third stations due to sea water entering into the mouth of the lake.

With respect to turbidity levels of the sampling stations, the second, third and fourth stations also look alike while the first and fifth stations are similar due to their being spring water,

(Fig. 4). Turbidity levels of all the stations in summer and autumn are less than those of winter and spring. It can be said that winds and rains mix up shallow lake in winter and spring easily.
Figure 5 shows that dissolved oxygen levels of the first and fifth stations are more than those of the second, third and fifth stations due to spring water. Dissolved oxygen levels of all stations in winter months are more than those of summer months.

Comparing temperature levels of the sampling stations, while the second, third and fourth stations are similar, the first and fifth stations are not (Fig. 6). The first station is in the forest area which is not exposed to sun directly, but the fifth station is at an uncovered area and exposed to sun. Minimum and maximum temperatures of the second, third, and fourth stations are measured 31 °C in June 1995 and 4 °C in January due to shallow lake. It can be said that the euriterm species encountered at these stations in all the years are *H. diversicolor, G. aequicauda, C. thummi, I. elegans* (Table 2 and 3).

In salinity levels of all stations, as the first and fifth stations being fresh water, their salinity was measured ‰ 0 in all the year (Fig. 7). In monthly variation of salinity, the second and third stations are similar. Monthly variation of salinity of the fourth station is very much and higher for being placed at the mouth of the Sarıkum Lake and so mixing with sea water. In this study, the taxa encountered only in fresh water are *P. casertanum, P. milium, P. amnicum, G. pulex pulex, A. aquaticus, and Planaria* sp. The taxa encountered only in brackish water (‰ 4-11) are *T. fluviatilis, H. ventrosa, P. planorbis, D. cornea, E.tendens, Procladius* sp., *D. nervosus, C. pinguis, D. tritomus, V. arduensis, P. aberrans, I. elegans, S.fonscolombei, O. c. colombei, G. aequicauda, T. desshayesii, H. diversicolor*. The taxa encountered in both freshwater and brachishwater are *C. thummi, Eukiefferiella* sp. (Table 3).

In total 26 taxa were determined by taxonomical examination of benthic macroinvertebrate fauna in Sarıkum Lake's littoral zone

and around spring waters. They belonged to Gastropoda (3 species), Bivalvia (4 species), Insecta (larvae-13 species), Crustacea (4 species), Polychaeta (1 species) and Turbellaria (1 species) and were determined among the benthic fauna (Table 1, 2). The rates of frequency of macrobenthic invertebrate fauna were also estimated (Table 2).

The taxa belonging to Bivalvia classis and Ephemeroptera ordo were predominant in the fifth station while the taxa belonging to Bivalvia, Crustacea and Insecta classis were predominant in the first station. The predominant groups at the second, third and fourth stations were taxa belonging to Crustacea, Gastropoda, Insecta and Bivalvia, respectively.

The diversity of taxa were found 7, 13, 16, 16, 6 in the first, second, third, fourth and fifth stations, respectively (Table 1). Besides, the shells *of Heliopsis derbentia, Cernuella virgata variabilis* and *Cochliella acuta* belonging to land mollusc were encountered at the second, third and fourth stations. It was assumed that they were removed of the lake by wind and rain water. However alive species were observed at the sandy and grassy area around the Lake (Schütt, 1993).

The richest stations were the third and fourth stations (Table 1, 2). The constant common species (80-100 %) at the first station were *Pisidium amnicum, P. casertanum, Chironomus thummi, Gammarus pulex pulex* and *Asellus aquaticus,* the mostly common species (60-40 %) was *P. milium*; the less common species (20-40 %) were *Procladius* sp., *Planaria* sp. The species belonging to Crustacea, Bivalvia, and Insecta classises at the first station were predominant. Except for *C. thummi*, it can be concluded that the others at the first station were stenohalin species living only in fresh water. *C. thummi* is an eurihalin species to have been encountered at the other stations (Table 2). As it can be observed in the tables 1 and 2, except for *Planaria* sp. encountered at the first station, the other species at the first station have got euriterm qualify for encountering during the all year.

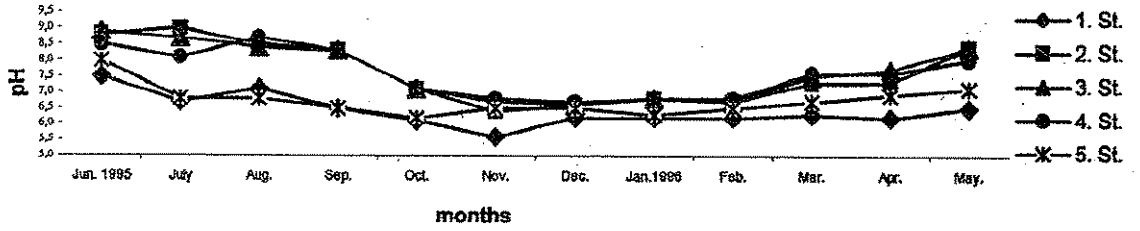

Fig. 2. Monthly variations of pH of the sampling stations monthly

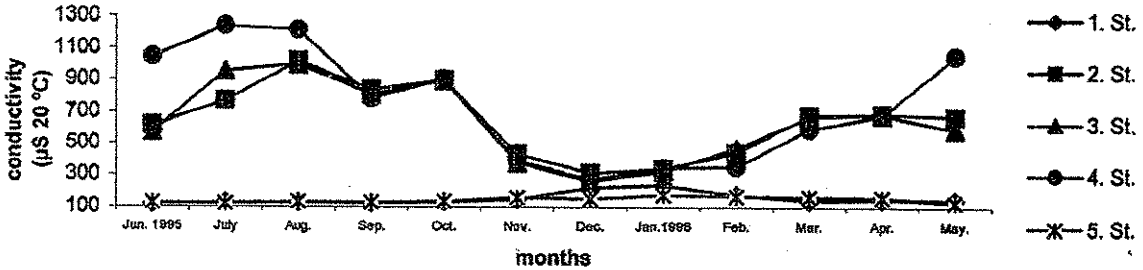

Fig. 3. Monthly variations of conductivity of the sampling stations

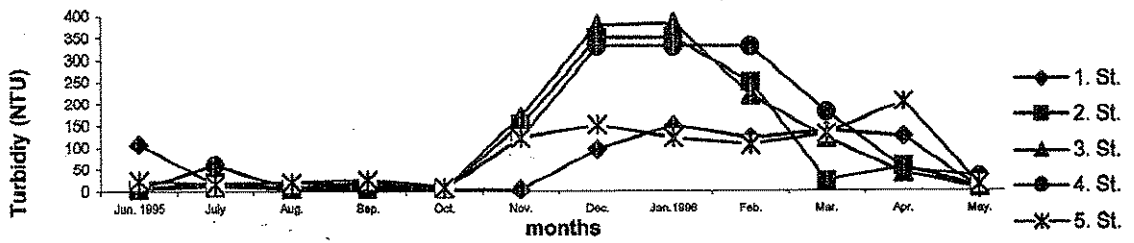

Fig. 4. Monthly variations of turbidity of the sampling stations

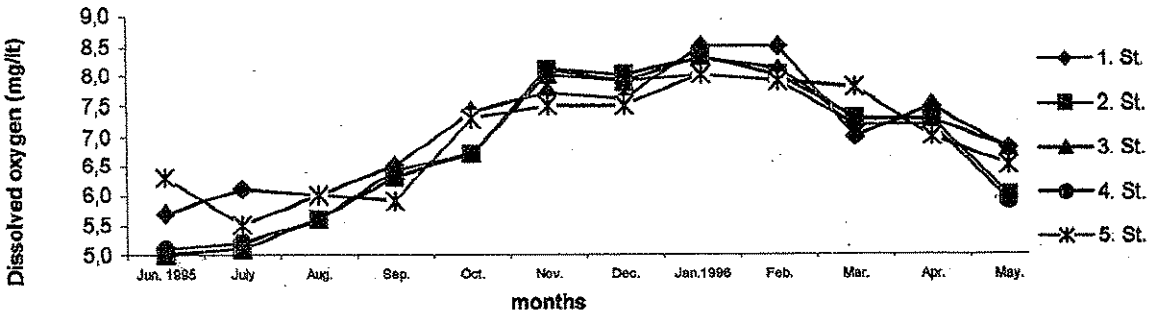

Fig. 5. Monthly variations of dissolved oxygen of the sampling stations

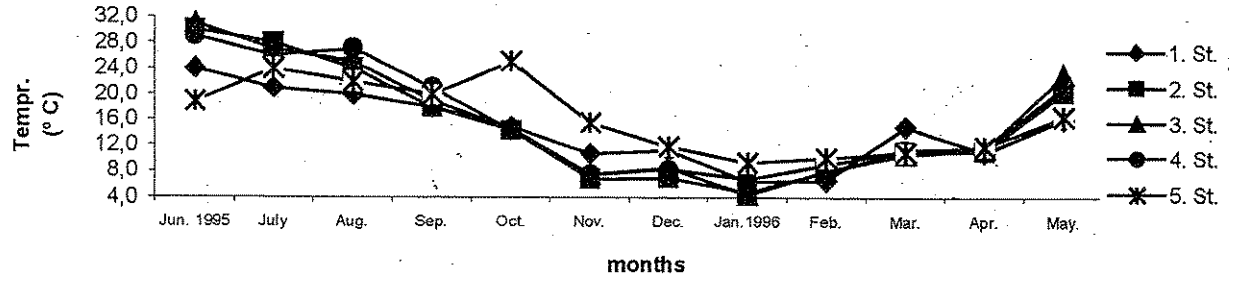

Fig. 6. Monthly variations of temperature of the sampling stations

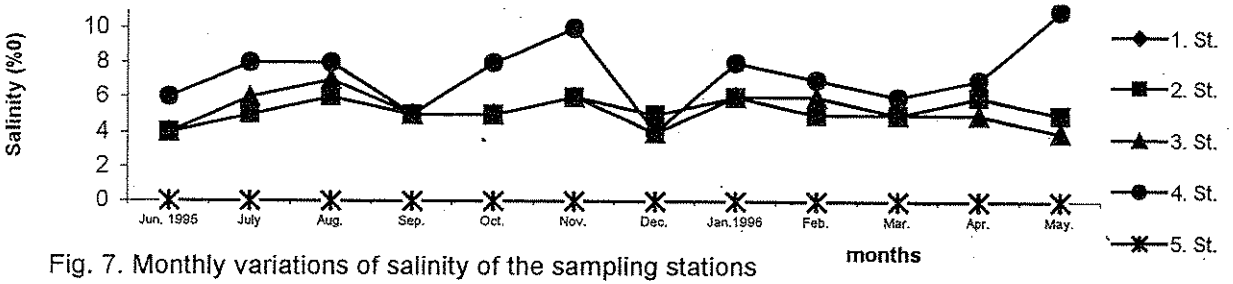

Fig. 7. Monthly variations of salinity of the sampling stations

The constant common species at the second station were *Hediste diversicolor, Gammarus aequicauda,* the majority common species is *Hydrobia ventrosa,* the mostly common species were *Theodoxus fluviatilis, Procladius* sp., *Ischnura elegans, Talorchestia deshayesii, Chironomus thummi* the less common species were *Sympetrum fonscolombei, O. cancellatum cancellatum,* the rarely common species were *Planorbis planorbis, Virgotanytarsus arduensis.* At the second station, six species were predominant, seven species were emerging temporarily only in certain seasons.

The constant common species at the third station was *G.aequicauda;* the majority common species were *H. diversicolor, T.fluviatilis;* the mostly common species were *Hydrobia ventrosa, Ischnura elegans, Donacilla cornea, Sympetrum fonscolombei, C.thummi, Procladius* sp, the less common species were *P. planorbis, D. nervosus and Clinotanypus pinguis.* The mollusc species were predominant because this station's bottom was sandy. Besides, Amphipoda and Polychaete species were also predominant.

The constant common species at the fourth station were *G. aequicauda, H. ventrosa, H. diversicolor,* the majority common species were *D. cornea, C. thummi, Procladius* sp., *I. elegans, S. fonscolombei;* the less common species were *P. planorbis, D. nervosus, V. arduensis, P. aberrans.*

The constant common species at the fifth station station was *Cloeon dipterum;* the mostly common species were *P. casertanum, P. amnicum;* the less common species were *P. milium* and the rarely common species was *Procladius* sp. They were extremely present species and living in spring ponds and need much dissolved oxygen.

The common species between the first and fifth station were *P. casertanum, P. amnicum, P. milium, C. thummi, Procladius* sp. However *Cloeon dipterum* was only encountered at the fifth

station and *Planaria* sp. was found at the first station. The common species among the second, third and fourth station only chosen of Sarıkum Lake were *T. fluviatilis, H. ventrosa, C. thummi, Procladius* sp., G. *aequicauda, T. deshayesii* and *H. diversicolor.* Whereas *Chironomus thummi and Procladius* sp. were encountered at all the stations. The common species between the second and third stations were *P. planorbis, D. nervosus.* The common species between third and fourth stations were *D. cornea, P. aberrans* (Table 2).

Table 1. Distributions of macrobenthic specimens at the stations with respect to systematic groups.

	Stations				
Groups	1	2	3	4	5
Gastropoda	-	3	3	2	-
Bivalvia	3	-	1	1	3
Insecta (larvae)	1	7	9	10	3
Crustacae	2	2	2	2	-
Polychaeta	-	1	1	1	-
Turbellaria	1	-	-	-	-
Total	7	13	16	16	6

In a study on distribution of benthic organisms in Güllük Lagoon like this study, 68 species belonging to 7 systematic groups were found in the lagoon (Önen et al., 1998). Sarıkum lake is also a lagoon, 26 species belonging to 6 systematic group were found in this study.

The 9 Chironomidae larvae species that have been defined in the present study were determined at the earlier studies in Turkey. They are cosmopolite species and occur in Turkish freshwater (Şahin 1991).

Table 2. Replicate rates of macrobenthic fauna (occuring number of organisms / total number of sampling*100). % 100-80: Constant common species, % 80-60: Majority common species, % 60-40: Mostly common species, % 40-20: Occasionally species, % 20-1: Rarely species. Number of sampling: 12

Sampling stations		1. st	2.st.	3.st.	4.st.	5.st.
Gastropoda	*Theodoxus fluviatilis*	...	58.3	66.6	75	...
	Hydrobia ventrosa	...	66.6	58.3	83.3	...
	Planorbis planorbis	...	8.3	8.3	...	...
Bivalvia	*Pisidium casertanum*	100	...	...	...	50
	Pisidium milium	41.6	...	...	...	50
	Pisidium amnicum	83.3	...	...	...	83.3
	Donacilla cornea	...	...	41.6	41.6	...
Insecta (Larvae)	*Endochironomus tendens*	...	...	...	16.6	...
	Chironomus thummi	100	50	41.6	41.6	33.3
	Procladius (Holotanypus) sp.	...	41.6	41.6	8.3	...
	Dicrodentipes nervosus	...	16.6	8.3	...	...
	Clinotanypus pinguis	...	...	16.6	...	...
	Dicrodentipes tritomus	...	...	...	25	...
	Virgotanytarsus arduensis	...	16.6	8.3	16.6	...
	Eukiefferiella sp.	...	...	...	16.6	16.6
	Polypedilum aberrans	...	...	8.3	16.6	...
	Ischnura elegans	...	58.3	58.3	50	...
	Sympetrum fonscolombei	...	25	41.6	50	...
	O. c. cancellatum	...	25	25	33.3	...
	Cloeon dipterum	...	...	...	...	66.6
Crustacea	*Gammarus pulex pulex*	100	...	...	...	...
	Gammarus aequicauda	...	100	100	100	...
	Talorchesia deshayesii	...	41.6	25	33.3	...
	Asellus aquaticus	100	...	...	...	...
Polychaeta	*Hediste diversicolor*	...	91.6	75	83.3	...
Turbellaria	*Planaria* sp.	33.3	...	....	...	....

Table 3. Monthly distribution of the species at the sampling stations.

Date	June 1995	July 1995	August 1995	September 1995	October 1995	November 1995
Station No	I II III IV V	I II III IV V	I II III IV V	I II III IV V	I II III IV V	I II III IV V
Species						
T. fluviatilis	- + + - -	- - - - -	- - - - -	- - + + -	- - - + -	- - - + -
H. ventrosa	- + - - -	- - - - -	- - + + -	- - - + -	- - - + -	- + - + -
P. planorbis	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -
P. casertanum	+ - - - +	+ - - - +	+ - - - +	+ - - - -	+ - - - -	+ - - - -
P.milium	+ - - - +	+ - - - +	- - - - -	+ - - - +	- - - - +	- - - - -
P. amnicum	+ - - - +	+ - - - +	+ - - - +	+ - - - +	- - - - -	+ - - - +
D. cornea	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -
E. tendens	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -
C.thummi	+ - - - -	+ - + - -	+ - - - -	+ - - + -	+ - - - +	+ + - - -
Procladius sp.	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -
D. nervosus	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- + - - -
C. pinguis	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -
D. tritomus	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - + -
V. arduensis	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - + -
Eukieferiella sp.	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -
P. aberrans	- - - - -	- - + - -	- - - - -	- - - - -	- - - - -	- - - - -
I.. elegans	- - - - -	- + - - -	- - + - -	- - + - -	- - + + -	- + - + -
S. fonscolombei	- + - - -	- - - - -	- - - - -	- - - + -	- - - + -	- - + + -
O. cancellatum cancellatum	- + + - -	- - - - -	- + - - -	- - - - -	- - - + -	- - - + -
C. dipterum	- - - - -	- - - - -	- - - - -	- - - - -	- - - - +	- - - - +
G. pulex pulex	+ - - - -	+ - - - -	+ - - - -	+ - - - -	+ - - - -	+ - - - -
G. aequicauda	- + + + -	- + + + -	- + + + -	- + + + -	- + + + -	- + + + -
T. deshayesii	- + + + -	- + + + -	- + - - -	- + - - -	- - + + -	- - - + -
A. aquaticus	+ - - - -	+ - - - -	+ - - - -	+ - - - -	+ - - - -	+ - - - -
H. diversicolor	- + + + -	- + + + -	- + - + -	- + + + -	- + + + -	- + + + -
Planaria sp	- - - - -	+ - - - -	- - - - -	- - - - -	- - - - -	- - - - -

Table 3 (Continued)

Date	Dec. 1995	Janu. 1996	Febr.1996	March 1996	April 1996	May 1996
Station No	I II III IV V	I II III IV V	I II III IV V	I II III IV V	I II III IV V	I II III IV V
Species						
T. fluviatilis	- + + + -	- + + + -	- + + +	- + + + -	- + + + -	- + + + -
H.ventrosa	- + - + -	- + + + -	-	- + + + -	- + + + -	- + + + -
P. planorbis	- - - - -	- - - - -	- + + + - - + - - -	- - - - -	- - - - -	- - - - -
P.casertanum	+ - - - -	+ - - - -	+ - - - +	+ - - - +	+ - - - -	+ - - - +
P.milium	- - - - -	- - - - -	- - - - -	+ - - - +	- - - - +	+ - - - -
P. amnicum	+ - - - -	- - - - +	+ - - - +	+ - - - +	+ - - - +	+ - - - +
D. cornea	- - + - -	- - + + -	- - - + -	- - + + -	- - + + -	- - + + -
E. tendens	- - - - -	- - - - -	- - - - -	- - - + -	- - - + -	- - - - -
C. thummi	+ - + - -	+ + + + +	+ + + + +	+ + + - +	+ + - + -	+ + - + -
Procladius sp.	- + - - -	+ + + - -	+ + + - -	+ + + - -	- - + + -	- + + - -
D. nervosus	- - - - -	- - - - -	- - - - -	- - + - -	- + - - -	- - - - -
C. pinguis	- - - - -	- - + - -	- - - - -	- - + - -	- - - - -	- - - - -
D. tritomus	- - - - -	- - - - -	- - - + -	- - - + -	- - - - -	- - - - -
V. arduensis	- - - - -	- + + - -	- + - - -	- - - - -	- - - - -	- - - - -
Eukieferiella sp.						
P. aberrans	- - - - -	- - - - -	- - - - +	- - - - +	- - - - -	- - - - -
I. elegans	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - + -
S .fonscolombei	- + - - -	- + + + -	- - + + -	- + + - -	- + - + -	- + + + -
O. c. cancellatum	- - + - -	- - - + -	- - + + -	- - - - -	- + + + -	- + + - -
C. dipterum	- - + - -	- - - - -	- - + + -	- - a - -	- - - + -	- + - - -
	- - - - +	- - - - +	- - - - +	- - - - +	- - - - +	- - - - +
G. pulex pulex	+ - - - -	+ - - - -	+ - - - -	+ - - - -	+ - - - -	+ - - - -
G. aequicauda	- + + + -	- + + + -	- + + + -	- + + + -	- + + + -	- + + + -
T. deshayesii	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- + - - -
A. aquaticus	+ - - - -	+ - - - -	+ - - - -	+ - - - -	+ - - - -	+ - - - -
H. diversicolor	- + - + -	- + + + -	- + + + -	- + - - -	- - + + -	- + + - -
Planaria sp	- - - - -	+ - - - -	+ - - - -	+ - - - -	- - - - -	- - - - -

In the present study, the 3 species belonging to Odonata ordo have been determined. They were also found in the previous study and have got large distribution area (20).
Consequently, it can be said that the lake has got eutrophic state regarding to the defined species and physico-chemical parameters and natural eutrafication has begun in Sarıkum Lake. However, more detailed studies needed on the lake.

Özet

Bu araştırmada, Haziran 1995-Mayıs 1996 tarihleri Sarıkum Gölü ve çevresindeki kaynak sularının bentik makroomurgasız faunasının kommunite yapısı aylık olarak incelenmiştir. Örnekleme istasyonlarının fiziko-kimyasal parametreleri ölçülmüştür. Fauna 6 sistematik gruba ait (Gastropoda, Bivalvia, İnsekta (larva), Krustase, Poliket ve Turbellaria sınıfları) toplam 26 türden oluşmuştur. İnsekta sınıfı tür çeşitliliği bakımından dominant olmuştur. Bunu Molluks ve Krustase sınıflarına ait türler izlemiştir. Genel olarak Sarıkum Gölü' nde tanımlanan türlerin çoğunluğu ötrofik göllere özel euryök organizmalardır.

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