

Seasonal Variations in Zooplankton Species of Lake Gölhisar, a Shallow Lake in Burdur, Turkey

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Abstract.- Seasonal variations of zooplankton species were investigated between Spring 2002 and Winter 2003 in Lake Gölhisar, Burdur, Turkey. A total of 31 species comprising 15 Rotifera (48%), 11 Cladocera (36%), and 5 Copepoda (16%) were recorded. *Keratella quadrata*, *Daphnia longispina* and *Acanthodiptomus denticornis* were the common species during the study period. Maximum number of taxa were observed from Rotifera and Cladocera during summer, while minimum taxa was determined from Copepoda during winter.

Keywords: Rotifera, Cladocera, Copepoda.

INTRODUCTION

In the lake ecosystem, phytoplanktons are important food source of some invertebrate organisms, whereas, zooplanktons provide an important food source for larval fish. The major groups of zooplankton in freshwater ecosystems are Rotifera, Cladocera and Copepoda. Many rotifers play an important role in lacustrine food webs because they have a rapid turnover rate and metabolism (Segers, 2004). Rajashekhar *et al.* (2009) stated that rotifera are sensitive to environmental changes and are therefore useful indicators of water quality. Cladocera are an important group of aquatic ecosystems especially in freshwater, and can survive in quite extreme conditions (Sarma *et al.*, 2005).

Various studies were conducted including some fish fauna research in Lake Gölhisar (Alp, 1997; Alp and Balık, 2000). Previously zooplankton fauna of different lakes in Turkey has been studied *viz.*, lake Karagöl (Ustaoğlu, 1986), lake Karamuk and Hoyran (Gündüz, 1987), lake Çavuşçu and Eber (Emir, 1994), lake Akşehir (Emir Akbulut, 2000), lake Sazlıgöl (Ustaoğlu *et al.*, 2003), lake Terkos (Güher *et al.*, 2004), lake Beyşehir (Altındağ and Yiğit, 2004), lake Yenişehir (Bozkurt, 2006), lake Çernek (Bekleyen and Taş, 2008), lake Eğrigöl (Aygen *et al.*, 2009), lake Gölçük (Özdemir Mis and Ustaoğlu, 2009), lake Burdur (Gülle *et al.*, 2010),

lake Van, (Yildiz *et al.*, 2010), lake Sünnet (Deveci *et al.*, 2011), Beymelek lagoon and lake Kaynak (Yalım *et al.*, 2011), lake İznik (Apaydın Yağcı and Ustaoğlu, 2012). However, the zooplankton fauna of Lake Gölhisar has not been studied so far.

The purpose of the investigation was to determine the zooplankton species and its seasonal variations in lake Gölhisar.

MATERIALS AND METHODS

Study site

Lake Gölhisar which is in the western Taurus Mountains in Turkey is established in drainage basin of Dalaman River in Gölhisar that is the town in the Burdur province. Lake Gölhisar is natural lake at altitude of 931 m. Its approximate surface area and maximum depth are 400 ha and 2 m, respectively. Margins of this shallow lake are covered with dense macrophytes.

Uylupınar and Yamadı located near of this lake. Nutrition basin of this lake is quite narrow. There isn't stream which constantly feeds the lake. The real sources of lake Gölhisar are subterranean water sources on the floor of it and water of Yapraklı Dam. Because of locating in a hole, to prevent increasing of water a channel was built and water drainage was made to Dalaman ÇAY (Uzun, 1998; Alp and Balık, 2000; Bostancı *et al.*, 2007). Depth of lake Gölhisar and area of it show differences in 1993, extra water of Yapraklı Dam was started to drain lake Gölhisar and this situation was removed (Alp, 1997). There are marshes in coast of lake place to place and water sources are

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found in environment lots of wide of marshes. Ermez, Kocapınar, Karapınar and Kargaçlı springs one the most important of them. With drainage studies which were carried out in coast of slew some part of the lake was drained to meadow. Moreover sometimes marshes occur in coast of lake and they were dried that was seen. Sampling localities were showed in Figure 1. Sampling were collected seasonally Spring 2002-Winter 2003 from two stations selected from lake Gölhisar. The zooplankton samples were taken using plankton net Hydrobios Kiel with a mesh size of 55 μm . The samples were preserved with 4% formalin soon after collection. Species were identified according to Dussart (1967), Dussart (1969), Kiefer and Fryer (1978), Koste (1978), Negrea (1983), Korovchinsky (1992), Segers (1995), Smirnov (1996), Nogrady and Segers (2002). The statistical cluster analysis was used according to the MVSP 3.22 demo version (Kovach Computing Services) in this research. Phsico-chemical variables, such as water temperature, pH, dissolved oxygen and conductivity were measured with a WTW 340i.

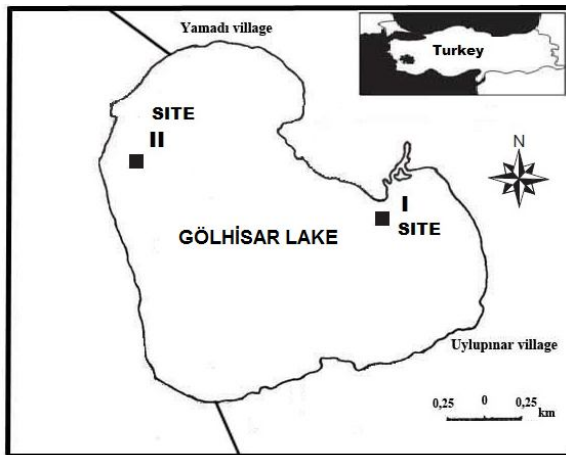


Fig. 1. Sampling site of lake Gölhisar (Ist Station: 37° 06' 54" N, 029° 36' 29" E; IInd Station: 37° 07' 04" N, 029° 35' 27" E)

RESULTS AND DISCUSSION

As a results, a total of 31 zooplankton species were identified. Rotifers were the most abundant of the 3 zooplankton groups comprising 48% of the total number of organisms, followed by the

cladocerans with 36%. The least abundant species belong to the Copepoda with 16%. In this study, seasonal distribution of zooplankton species were listed in the stations (Table I). Moreover, it is found that the greatest number of species is determined in summer and the least number of species is observed in winter (Fig. 2). The highest similarity was observed between winter and autumn seasons with 78.56 % level in lake Gölhisar. According to the other seasons, the lowest similarity was showed in spring as 47.02% level (Fig. 2).

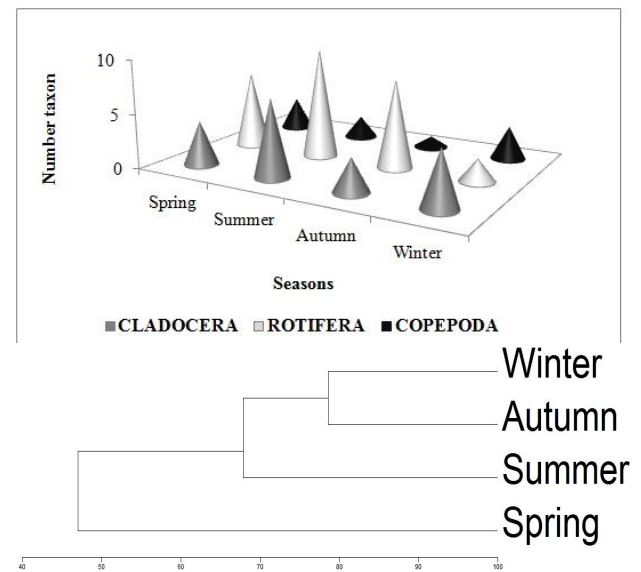


Fig. 2. Seasonally variations and cluster analysis of zooplankton number taxon during all seasons in lake Gölhisar.

The water temperature ranged from 11.3 to 22.3 ° C, pH from 8.31 to 8.65; dissolved oxygen from 3.11 to 6.6 mg/L and conductivity from 647 to 714 $\mu\text{mhos/cm}$ were measured. Secchi disk and depth of the lake are 40 cm and 4 m, respectively.

Of 31 species determined 21 species belonged to 1st station and 24 species belonged to 2nd station in lake Gölhisar. Saksena (1987) reported that rotifera was the dominant group among the groups of zooplanktonic organisms in freshwater ecosystems. In this study, the dominant rotifera species in lake Gölhisar was similar with Saksena (1987).

According to the Froneman and Vorwerk (2013), results of the hierarchical cluster analysis

Table I.- Seasonal distribution of zooplankton community in lake Gölhisar.

Species	Spring		Summer		Autumn		Winter	
	I	II	I	II	I	II	I	II
Rotifera								
<i>Brachionus angularis</i> Gosse, 1851	-	√	√	-	-	√	-	-
<i>Keratella cochlearis</i> (Gosse, 1851)	-	-	√	√	√	√	√	√
<i>Keratella quadrata</i> (Müller, 1786)	√	√	√	√	√	√	√	√
<i>Notholca acuminata</i> (Ehrenberg, 1832)	√	√	-	-	-	-	-	-
<i>Notholca squamula</i> (Müller, 1786)	-	√	-	-	-	-	-	-
<i>Trichotria tetractis</i> (Ehrenberg, 1830)	√	-	-	-	-	-	-	-
<i>Lepadella patella</i> (Müller, 1773)	-	-	√	-	-	-	-	-
<i>Lecane luna</i> (Müller, 1776)	-	-	√	-	-	-	-	-
<i>Lecane lunaris</i> ((Ehrenberg, 1832)	-	-	√	-	√	√	-	-
<i>Lecane</i> sp.	-	-	√	-	-	-	-	-
<i>Synchaeta pectinata</i> Ehrenberg, 1832	√	√	-	-	-	-	-	-
<i>Polyarthra dolichoptera</i> Idelson, 1925	-	-	√	-	-	√	-	-
<i>Asplanchna girodi</i> de Guerne, 1888	-	-	√	-	√	√	-	-
<i>Testudinella patina</i> (Hermann, 1783)	-	√	-	-	-	√	-	-
<i>Filinia longiseta</i> (Ehrenberg, 1834)	-	-	√	√	√	√	-	-
Cladocera								
<i>Diaphanosoma lacustris</i> Korinek, 1981	-	-	-	√	-	-	-	-
<i>Daphnia longispina</i> Müller, 1875	√	√	√	√	√	√	√	√
<i>Ceriodaphnia quadrangula</i> (Müller, 1785)	-	-	√	√	-	√	-	-
<i>Macrothrix laticornis</i> (Fischer, 1851)	-	√	-	-	-	-	-	-
<i>Bosmina longirostris</i> (Müller, 1785)	-	-	√	√	-	-	-	-
<i>Pleuroxus aduncus</i> (Jurine, 1820)	√	-	√	-	-	-	-	√
<i>Alonella exiqua</i> (Lilljeborg, 1853)	-	-	-	-	-	-	-	√
<i>Chydorus sphaericus</i> (Müller, 1776)	-	-	-	√	-	-	√	√
<i>Dunhevedia crassa</i> King, 1853	-	-	-	-	-	-	√	-
<i>Coronatella rectangula</i> (Sars, 1861)	√	√	√	-	-	-	-	-
<i>Acroperus harpae</i> (Baird, 1835)	-	-	-	-	-	√	-	-
Copepoda								
<i>Acanthodiptomus denticornis</i> (Wierzejski, 1887)	√	√	√	√	√	√	-	√
<i>Paracyclops fimbriatus</i> (Fischer, 1853)	-	-	√	-	-	-	-	-
<i>Metacyclops minutus</i> (Claus, 1863)	√	-	-	-	-	-	√	-
<i>Mesocyclops leuckarti</i> (Claus, 1857)	-	√	-	-	-	-	-	-
<i>Canthocamptus staphylinus</i> (Jurine, 1820)	-	-	-	-	-	-	-	√

indicated that the wet and dry seasons were characterised by distinct zooplankton communities. In this study, the stations which demonstrated the greatest increase in similarity between autumn and winter were the Rotifera, *K. cochlearis* and *K. quadrata*, which contributed density of the zooplankton during in the both seasons. During the study, Rotifera: *N. acuminata*, *N. squamula*, *T. tetractis* and *S. pectinata*; Cladocera: *M. laticornis*; Copepoda: *M. leuckarti* were determined only in

spring. Rotifera species observed only in summer were: *L. patella* and *L. luna*; Cladocera species were: *D. lacustris* and *B. longirostris*; Copepoda species was *P. fimbriatus*. *A. exiqua*, *D. crassa* and *A. harpae* from Cladocera were observed only in winter and autumn, respectively. *C. staphylinus* from Copepoda was found only in winter.

In this study period, the values of water temperature were ranged between 11.3°C and 22.3°C in spring and summer, respectively. The

values of dissolved oxygen were ranged between 3.11 and , 6.6 mg/L in summer and spring, respectively. It's the fact that temperature and oxygen are limited factors on living and distribution of zooplanktonic organisms. Berzins and Pejler (1989a) reported that *P. dolichoptera*, *S. pectinata*, *K. quadrata*, *L. lunaris*, *T. patina*, *F. longiseta* and *K. cochlearis* were related with temperature, and these species showed distribution above 20 °C. In our study, these species that were observed the value of water temperature showed coherence (22.3°C) in summer in lake Gölhisar.

Berzins and Pejler (1989b) reported that the dissolved oxygen represented from 2 mg/L to 6 mg/L of the low value in the water. In this study, when the oxygen was in low level (3.11 mg/L) species mentioned above were observed that is similar with the literature. The values of pH ranged between 8.65 and 8.31 in spring and summer, respectively. Whereas water pH < 7 was oligotrophic, pH > 7 water was eutrophic water that was informed (Berzins and Pejler, 1987). Besides, *S. pectinata*, *L. lunaris* and *K. cochlearis* were found in water pH > 8 (Berzins and Pejler, 1987). In our study, this value of pH was measured as 8.31. The highest conductivity value (714 µS/cm) was recorded in summer while the lowest value (647 µS/cm) was determined in spring in lake Gölhisar. The reason of increasing of conductivity value is that organic and inorganic materials which can be dissolve in water with the effects of temperature and decrease of the volume of water in the lake in summer. In a report which is about fisheries was informed in this lake (Alp, 1997); conductivity changed between 600-1000 µS/cm and the highest conductivity was in August that were stated by Alp in 1997. Moreover, water budget of the lake and quality of water, and vegetation structure of this lake were effective for that the highest conductivity was stated by Alp. *K. quadrata*, *K. cochlearis*, *B. angularis*, *N. squamula*, *N. acuminata*, *L. luna*, *P. dolichoptera*, *T. patina*, *F. longiseta*, *C. sphaericus*, *B. longirostris*, *D. longispina* and *C. rectangula* which determined in this study are common species in lakes of Turkey. These species are same species that found in lake Karagöl (Ustaoğlu, 1986), in lake Eber and Çavuşçu (Emir, 1994), in lake Yenişehir (Bozkurt, 2006), in lake Çerneke (Bekleyen and Taş, 2008), in lake

Eğrigöl (Aygen *et al.*, 2009), in lake Van (Yildiz *et al.*, 2010), in lake Sünnet (Deveci *et al.*, 2011).

M. laticornis was observed in lake Yenişehir by Bozkurt (2006); *P. aduncus* was determined in lake Çerneke by Bekleyen and Taş (2008); *A. harpae* was determined in lake Gölçük by Özdemir Mis and Ustaoğlu (2009); *C. quadrangula* and *L. lunaris* were found in lake Eğrigöl by Aygen *et al.* (2009) which are uncommon species. *G. testudinaria*, *Ceriodaphnia* sp., *Diaphanosoma* sp., *Daphnia* sp., and *B. angularis* are characteristic species for eutrophic lakes, whereas *A. harpae* were found in the less productive lakes (Sládeček, 1983; Bos and Cumming, 2003; Kamaladasa and Jayatunga, 2007). Abundance of Rotifera species was observed during the study and from the point of this situation, trophic level of Lake Gölhisar is high that can be said. On point of freshwater ecosystem, Turkey has got a rich potential but, in freshwater ecosystem research of zooplankton is really in restricted number. In conclusion, zooplankton species lake Gölhisar was carried out for the first time in this study. The present study will be usefull contributions to the knowledge of Turkey's biological diversity and a baseline for detailed studies in future in Lake Gölhisar.

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