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Zooplankton Fauna of Abant Lake: Past and Present

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ABSTRACT

Observing the changes of zooplanktonic organisms over the years can give us consistent information about the limnological conditions of the present and future. Our aim in this study was to determine current conditions of zooplankton fauna of Abant Lake, which was studied seasonally, and could provide resources for future studies. The samples of zooplankton were collected horizontally and vertically from Abant Lake seasonally, between 2015 -2016 from seven stations. At the end of the study, a total of forty-nine zooplankton species were identified. Of these, 33 belonged to Rotifera, 14 to Cladocera and 2 to Copepoda. In addition, twelve species of Rotifera, and six species of Cladocera were found as new records for the Abant Lake.

Keywords: Rotifera, Cladocera, Copepoda, Abant Lake

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Abant Gölü Zooplankton Faunası: Geçmiş ve Bugün

Öz: Zooplanktonik organizmaların yıllar içerisindeki değişimlerini izlemek, gölün bugünkü ve gelecekteki limnolojik durumu hakkında tutarlı bilgiler verebilir. Bu çalışmada ki amacımız, Abant Gölü'nün zooplankton faunasının güncel durumunu belirlemek ve gelecekteki çalışmalara katkı sağlamaktır. Zooplankton örnekleri, Abant Gölü'nden 2015-2016 yılları arasında mevsimsel olarak, farklı habitatlarda ki yedi istasyondan yatay ve dikey olarak alınmıştır. Çalışmanın sonunda 33 tür ile Rotifera, 14 tür ile Cladocera ve 2 tür ile Copepoda grubuna ait toplam kırk dokuz zooplankton türü tespit edilmiştir. Bu çalışma ile birlikte, 12 Rotifera türü ile 6 Cladocera türü Abant Gölü zooplankton faunası için yeni kayıt olarak bulunmuştur.

Anahtar kelimeler: Rotifera, Cladocera, Copepoda, Abant Gölü

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Introduction

Lake studies provide a practical and useful structure for community studies because they can give important information to the researchers about climate change and ecosystem structure etc. (Olden et al. 2006). Zooplanktonic organisms include both predator and prey organisms. They are primary consumers in aquatic ecosystems, especially in lakes and constitute a major food source for their predator like macroinvertebrates, fish and birds. Zooplankton considered as indicators in lakes because of their pivotal role in aquatic food webs (Jeppesen et al. 2011).

It is known that zooplankton distribution, richness, and composition are affected by biotic parameters like the presence of predators, trophic structure, habitat differences etc. and abiotic parameters such as temperature, salinity, etc. (Kaya et al. 2010; Gürbüzer et al. 2017). For example, one of the most reliable predictors of eutrophic condition is total phosphorus (Filstrup and Downing 2017). It is known to affect species richness in zooplankton communities where richness decreases with an increasing total phosphate (Jeppesen et al. 2000). Since rotifers are opportunistic species they become dominant taxa when water quality deteriorates

(Gannon and Stremberger 1978). It is also thought that observing the changes of zooplanktonic organisms over the years can give us consistent information about the limnological conditions of the present and future.

Abant Lake is located in the west coast of the Black Sea Region and west of the city Bolu. It has been declared as a National Park in 1988 by The Ministry of Culture and Tourism. The area has warm temperate, fully humid and warm summer according to Köppen-Geiger Climate Classification (Kottek et al. 2006). It is located at 1340 m above sea level, and surface area of lake is 125 ha (Akşıray 1959, Erinç et al 1961) and the maximum depth is 18 m (Çelekli and Külköylüoğlu 2006). Abant Lake gets attention of scientists because the lake and its surroundings have the rich flora and fauna (Dügel et al. 2008, Karakaya et al. 2011, Atıcı and Tokatlı 2014).

There are available several zooplankton studies about Abant Lake and the first one was conducted in 1970 by Margaritora and Cottarelli which was later followed by extensive studies of Altındağ (1999), Altındağ and Yiğit (2000) and Özdemir Mis et al. 2017. Our aim in this study was to determine current conditions of zooplankton fauna of Abant Lake, which was studied seasonally, and could provide resources for future studies.

Materials and Methods

The samples of zooplankton were collected from Abant Lake seasonally, between 2015 -2016 from seven stations in different points (Figure 1) and coordinates of the sampling stations were given in Table 1. Samples were collected horizontally and vertically using Hydro-Bios Plankton Net (mesh size 55µ and 25 cm in diameter) and immediately fixed with 4% formalin. To identify zooplankton species, various resources were used which included the studies of Ward and Whipple (1945), Kolisko (1974), Koste (1978), Harding and Smith (1974), Nogrady and Pourriot (1995), Segers (1995), De Smet (1996), and Smirnov (1996). In the present study, all the identified taxa were checked from several checklists from Ustaoğlu 2004, Ustaoğlu et al. 2012, and Ustaoğlu 2015.

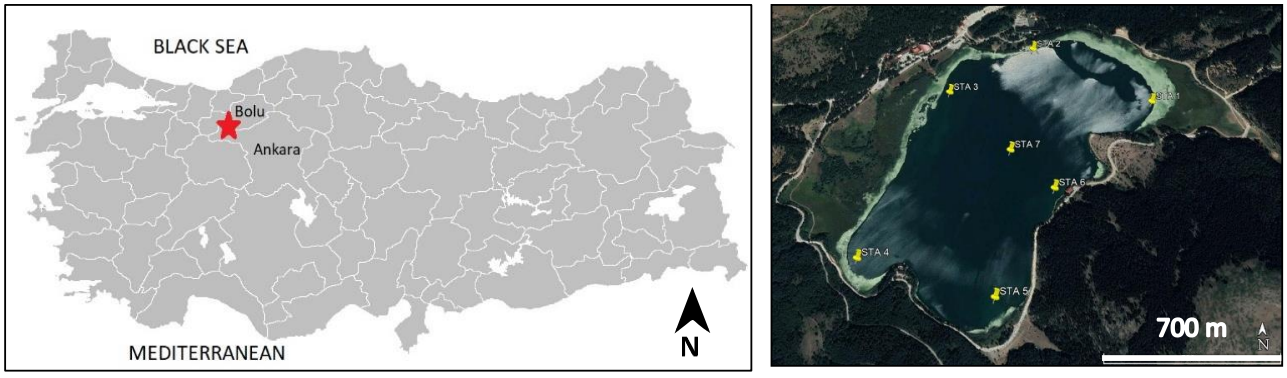

Figure 1. Study area and sampling stations

Table 1. Coordinates of the sampling stations

Station Number	Coordinates
STA 1	40° 36' 31"N / 31° 17' 21"E
STA 2	40° 36' 40"N / 31° 16' 55"E
STA 3	40° 36' 34"N / 31° 16' 39"E
STA 4	40° 36' 6"N / 31° 16' 22"E
STA 5	40° 35' 59"N / 31° 16' 48"E
STA 6	40° 36' 15"N / 31° 17' 00"E
STA 7	40° 36' 24"N / 31° 16' 55"E

Results

In this study, a total of forty-nine zooplankton species were identified. Of these, 33 belonged to Rotifera, 14 to Cladocera and 2 to Copepoda. The species list of Abant Lake was presented in Table 2. 12 species of Rotifera and 6 species of Cladocera are new records for the Abant Lake.

Rotifers *Kellicottia longispina* and *Keratella cochlearis* were found during all seasons, while *Asplanchna priodonta*, *Synchaeta pectinata* were found during three seasons and other taxa were identified only during two seasons or less. Cladocerans were seen during all seasons except winter period, *Alona guttata*, *Bosmina longirostris*, *Chydorus sphaericus* and *Daphnia longispina* were found during three seasons. Copepods were represented by two taxa *Acanthodiaptomus denticornis* and *Megacyclops viridis* and *A. denticornis* was found during all seasons except winter period like cladocerans.

When seasonal zooplankton changes were considered it was seen that, species richness was the highest in autumn (twenty-five taxa), followed by summer and spring (twenty-four and twenty-three taxa, respectively). In the winter season, only six

species were observed all of which belonged to the phylum Rotifera.

When zooplankton taxon frequencies were analyzed, rotifers were found to have the highest taxa percentage with 67%, while copepods had the lowest one with 4%.

Table 2. Species list of Abant Lake, past and present studies

Species	Present Study							
ROTIFERA	Winter	Spring	Summer	Fall	MC1970	A1999	AY2000	ÖM2017
Ascomorpha ecuadis (Petry, 1850)						+	+	
Asplanchna girodi Guerne, 1888			+		+	+	+	
Asplanchna priodonta Gosse, 1850		+	+	+		+		
Cephalodella gibba (Ehrenberg, 1830)*				+				
Collotheca mutabilis (Hudson, 1885)*			+					
Collotheca ornata (Ehrenberg, 1830)			+	+		+	+	
Collotheca pelagica (Rousselet, 1893)			+			+	+	
Collotheca sp.								+
Colurella adriatica Ehrenberg, 1831						+	+	
Conochilus hippocrepis (Schrank, 1803)			+	+		+	+	+
Conochilus unicornis (Rousselet, 1892)			+	+	+			+
Euchlanis dilatata (Ehrenberg, 1830)				+		+	+	
Filinia longiseta (Ehrenberg, 1834)	+					+	+	
Filinia terminalis (Plate, 1886)	+				+			
Gastropus stylifer Imhof, 1891				+		+	+	+
Kellicottia longispina (Kellicott, 1879)	+	+	+	+	+	+	+	+
Keratella cochlearis (Gosse, 1851)	+	+	+	+	+	+	+	+
Keratella quadrata (Müller, 1786)	+	+			+	+	+	+
Keratella tropica (Apstein, 1907)*			+					
Lecane bulla (Gosse, 1851)			+					+
Lecane closteracerca (Schmarda, 1859)*		+		+				
Lecane hamata (Stokes, 1896)						+	+	
Lecane luna (Müller, 1776)								+
Lecane lunaris (Ehrenberg, 1832)		+				+	+	+
Lecane stenroosi (Meissner, 1908)*		+						
Lepadella acuminata (Ehrenberg, 1834)*				+				
Lepadella ovalis (Müller, 1786)*		+						
Lepadella patella (Müller, 1773)*				+				
Lophocharis salpina (Ehrenberg, 1834)	+					+	+	
Mytilina ventralis (Ehrenberg, 1830)*		+		+				
Notholca squamula (Müller, 1786)		+					+	
Philodina megalotrocha Ehrenberg, 1832*		+						
Platyias quadricornis (Ehrenberg, 1832)								+
Polyarthra dolicoptera Idelson, 1925		+				+	+	
Polyarthra vulgaris Carlin, 1943		+		+		+	+	
Squatinella mutica (Ehrenberg, 1832)*				+				
Synchaeta litoralis Rousselet, 1902						+	+	
Synchaeta pectinata Ehrenberg, 1832		+	+	+		+	+	+
Trichotria pocillum (Müller, 1776)		+				+	+	
Trichotria tetractis (Ehrenberg, 1830)*		+						

Table 2. Continued

Species	Present Study							
CLADOCERA	Winter	Spring	Summer	Fall	MC1970	A1999	AY2000	ÖM2017
Acroperus harpae (Baird, 1843)					+			
Alona affinis (Leydig, 1860)					+			
Alona costata Sars, 1862					+			
Alona guttata Sars, 1862*		+	+	+				
Alonella excisa (Fischer, 1854)							+	
Alonella exigua (Lilljeborg, 1853)								+
Alonella nana (Bairs, 1850)		+					+	
Bosmina longirostris (Müller, 1785)		+	+	+			+	+
Ceriodaphnia quadrangula (Müller, 1785)			+	+				+
Ceriodaphnia reticulata (Jurine, 1820)*				+				
Coronatella rectangula Sars, 1862*			+					
Chydorus sphaericus (O.F. Müller, 1776)		+	+	+			+	
Daphnia hyalina Leydig 1860					+			
Daphnia longispina (O.F. Müller)		+	+	+			+	+
Diaphanosoma brachyurum (Lievin, 1848)			+				+	+
Macrothrix hirsuticornis Norman & Brady, 1867*			+	+				
Macrothrix laticornis (Jurine, 1820)*			+					
Pleuroxus truncatus (O.F. Müller, 1785)				+	+			
Polyphemus pediculus (Linnaeus, 1758)			+				+	+
Scapholeberis mucronata (O.F. Müller, 1758)					+			
Sida crystallina (O. F. Müller, 1776)							+	
Simocephalus serrulatus (Koch, 1841)*		+						
COPEPODA								
Acanthodiaptomus denticornis (Wierzejski, 1887)		+	+	+	+		+	+
Megacyclops viridis (Jurine, 1820)			+		+			+
Thermocyclops dybowskii (Lande, 1890)								+

(+: present, *: new records for region, MC1970: Margaritora and Cottarelli 1970; A1999: Altındağ 1999; AY2000: Altındağ and Yiğit 2000, ÖM2017: Özdemir Mis et al. 2017)

Discussion

In freshwater ecosystems, zooplankton community have an important role in water quality (Moss et al. 2003), and rotifers can also be used for this purpose (Gutkowska et al. 2013; Apaydın Yağcı et al. 2017). Rotifers are thought to become the dominant taxa in many lakes over time (Wen et al. 2011) and they can adapt to the degraded situation better than other similar taxa. According to Saksena (1987), rotifers are the dominant group in freshwater ecosystems and as being compatible with this result, in our study, rotifer percentages (67%) were found to be much higher than cladocerans (29%) and copepods (4%), a situation similar to other Mediterranean freshwater lakes (Saler 2017). *K. longispina*, *K, cochlearis* and *K. quadrata* known as cosmopolitan (Segers 2007) and they were observed by all researchers.

The first study on zooplankton community in Abant Lake was carried out in 1970 (Margaritora and Cottarelli) and six Rotifera, (Dumont and De Ridder 1987), six Cladocera and two Copoepoda taxa were described. All rotifer species were also found in this study (Table 2). The most important difference between these two studies is the number of species found. The low number of zooplankton species, especially rotifers, maybe resulting from the sampling procedures like using a broader mesh size, taking one sample, etc. The cladoceran species, *Scapholeberis mucronata* (O.F. Müller, 1758), *Daphnia hyalina* Leydig 1860, *Alona costata* Sars, 1862, *Acroperus harpae* (Baird, 1843) and *Alona affinis* (Leydig, 1860) were not found except *P. truncatus*.

Other detailed studies were carried out by Altındağ (1999) and Altındağ and Yiğit (2000). In these studies, rotifera phylum and zooplankton composition of Abant Lake were revealed. However, in our study *Lecane hamata* (Stokes 1896), *Colurella adriatica* Ehrenberg, 1831, *Synchaeta littoralis*

Rousselet, 1902 and *Ascomorpha ecuadis* were not observed despite being present in Altındağ (1999) and also *Alonella excisa* (Fischer, 1854) and *Sida crystallina* (O. F. Müller, 1776) were not observed despite being present in Altındağ and Yiğit (2000). Altındağ (1999) also pointed out that *Asplanchna girodi* is synonymous with *A. brightwellii* and we also described this taxon as *A. girodi*.

The most recent work regarding Abant Lake is of a field study of Özdemir Mis et al., which were conducted in between 2002-2003 yet published in 2017. In this study, twenty-one taxa were determined and among them, 12 belonged to Rotifera, 6 to Cladocera and 3 to Copepoda. Of these 21 taxa, 16 were mutual with our result (Table 2). *A. denticornis* has been found since 1970 in Abant Lake. Zooplankton differences between ours and this study were *Lecane luna* and *Platiyas quadricornis* from Rotifera, *Alonella exigua* from Cladocers and *Thermocyclops dybowskii* from Copepoda fauna.

Diversity of observed planktonic organisms can be affected by the sampling method (for example plankton net size and shape, etc.) therefore zooplankton density and composition differences can be due to the differences in sampling procedures (Gutkowska et al. 2012). Considering previous studies, it is easy to conclude, species richness is increased in the past decades especially for rotifers and cladoceran taxa. However, it is not clear whether there is an increase in species richness, because the methods used were not compatible with each other. In this study, we believe high numbers of identified separate species compared to past stem from vertical and horizontal sampling in different habitats. We think that using standardized and commonly accepted sampling methods will allow our predictions regarding future community compositions to be more accurate.

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