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Zooplankton Fauna of High Mountain Lake: Sarıncof (Çamlıhemşin, Rize, Turkey)

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ABSTRACT

In this study, which carried out on Sarıncof Lake on 13 July 2021, 27 species from Rotifera, 6 from Cladocera, and 3 from Copepoda, belonging to zooplankton groups were identified in a total of 36 species. Among the identified species, Rotifers were the dominant group with a rate of 51 %. This was followed by Copepoda 28.3 % and Cladocera 20.7 %, respectively. The identified species are the first record for Sarıncof Lake, which is the subject of the study.

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ÖZET

13 Temmuz 2021 tarihinde Sarıncof Gölü'nde yapılan bu çalışmada zooplankton gruplarına ait Rotifera'dan 27, Cladocera'dan 6 ve Copepoda'dan 3 olmak üzere toplam 36 tür teşhis edilmiştir. Teşhis edilen türler arasında Rotiferler %51,0 oran ile dominant gruptur. Bunu sırasıyla Copepoda %28,3 ve Cladocera %20,7 takip etmiştir. Teşhis edilen türler çalışmaya konu olan Sarıncof Gölü için ilk kayıttır.

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INTRODUCTION

The current glaciers, which are common in the Polar Belts, are found in very small high mountain areas in Turkey. However, it is known that Turkey was exposed to a much larger area of glaciation in the Pleistocene than today. Glacial erosion and accumulation patterns were formed in the Pleistocene, especially in some mountainous areas above 2000 m. There are troughs formed as a result of glacial erosion. These are known by the name of the cirque. The dimensions of the cirques vary according to the thickness of the glacier mass, the period of their stay, and the structural and lithological features of the underlying formations. Regardless of its dimensions, the lake formed by the filling of the said graben by water is of glacial origin. Today, there are no glaciers around these lakes as in the Pleistocene. Pleistocene glaciers have disappeared in Turkey (Gönençgil, 2016).

Zooplanktonic organisms are the main food source of fish in freshwaters. They constitute the main food of the young periods of demersal-fed creatures with many fish species that provide their food from pelagic. In addition, zooplankton species are also used to determine water quality, trophic status of the lake, and water pollution. Along with the importance of zooplankton organisms, research has been started on

Rotifera, Cladocera, and Copepoda, which make up an important part of zooplankton (Saler et al., 2018).

Turkey has many lowland lakes of various sizes in terms of inland waters, and both monitoring and limnological studies have been carried out on these lakes. However, due to difficulties experienced in transportation, studies on the limnology of glacial and tectonic origin lakes located on high mountains are almost scarce. In Turkey, mostly systematic studies on zooplanktonic organisms found in glacial lakes are aimed at listing species and creating a database (Ustaoğlu et al., 2005, 2008; Aygen et al., 2009, 2012; Yıldız, 2011; Mis & Ustaoğlu, 2017; Gürbüzer, 2018).

The alpine regions and ecosystems belonging to this region are either not affected at all or very little by anthropogenics, especially due to harsh environmental conditions. One of the Alpine regions that can provide reference conditions and are quite suitable for ecological studies is Alpine lakes, known as glacial lakes. These lakes, which are of glacial origin, originate from hydrogeological, hydromorphological, and physical factors such as temperature and sunshine duration. Therefore, the temperature changes in alpine lakes cause phase changes in water. This change in the lake provides both oxygen enrichment and nutrient input by providing the circulation of the lake's water (Sommaruga, 2015). The living groups that succeed in forming colonies despite the harsh environmental conditions have become the focus of research. One of the creatures that make up this colonization is the zooplankton. There are zooplankton eggs in dormancy in the benthic zone of alpine lakes, which spend most of the year under ice cover (Cáceres, 1997; Gyllström & Hansson, 2004).

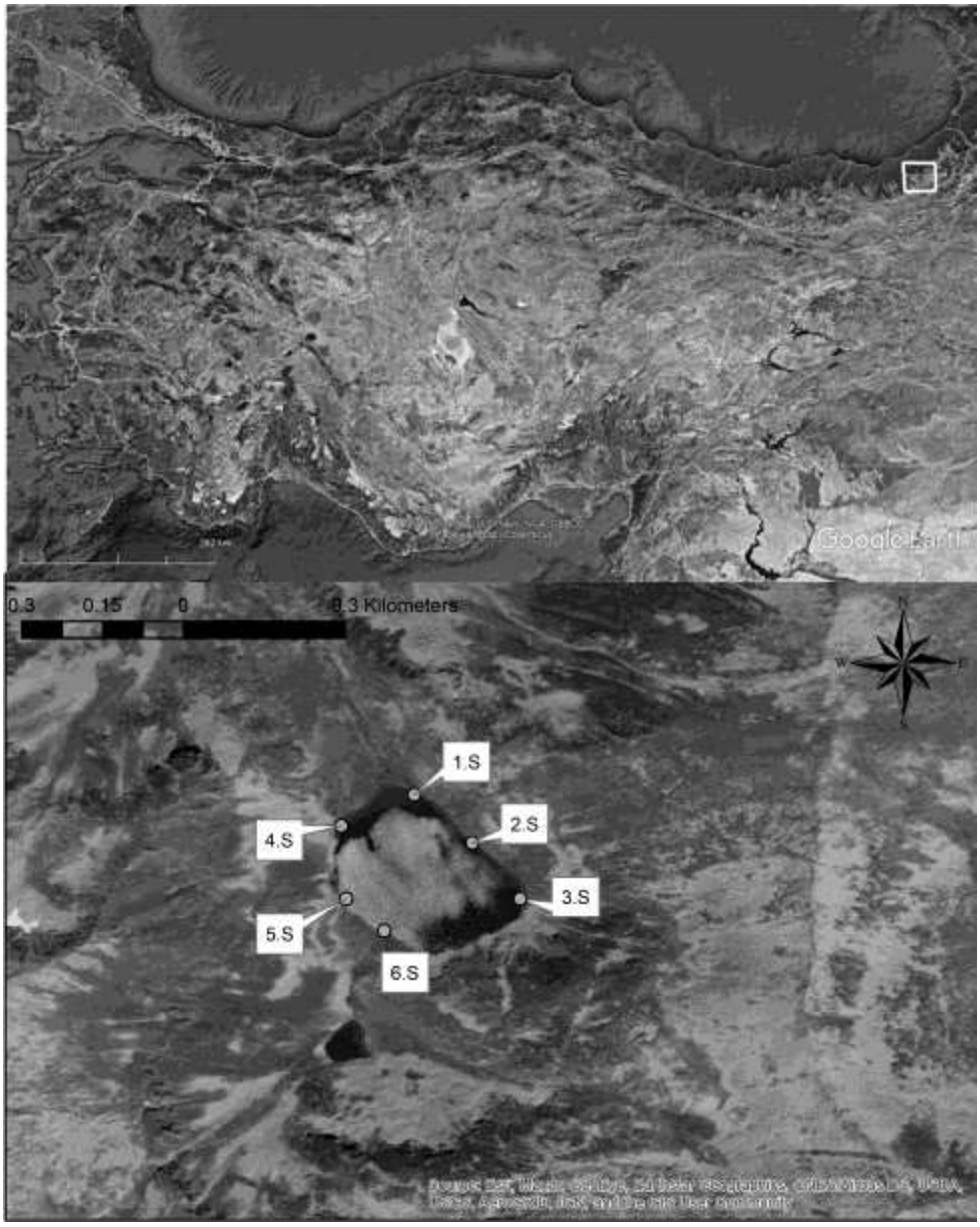
Although the alpine regions are related to altitude, the forest boundary is based on the determination of the alpine zone (Pechlaner, 1971). The forest limit in Southern Norway is 1250 m, while the Austrian Alps is 1500 m. In Turkey, alpine meadows are observed between 1900 m and 2800 m (Anonymous, 2021a). There are 129 alpine zones over 3000 m in many mountains (Kılınç & Karakaya, 1992; Kılınç & Kutbay, 2004). The highest peak of the Doğu Karadeniz Mountains is Kaçkar Mountain (3932 m), and it has 6 glaciers on its slopes. The largest of them reaches up to 2850 m and was named Kaçkar I glacier by Erinç (1949). The study area is located on the provincial border of Rize and the forest border starts between 2000 and 2400 m. The upper part of the forest line consists of subalpine and alpine meadows. The Alpine region is covered with snow between November and March. The highest peak of the Kaçkar Mountains is within the borders of the province, and there are 18 peaks with an altitude of over 3300 m (Abay, 2017). Considering the difficulty of transportation and working conditions to mountain lakes, little attention has been paid to alpine regions in Turkey. The aim of this study, the Sarıncof Lake located on Verçenik mountain in the Kaçkar mountain range, which has not been found in any literature information before, was selected (Figure 1) to eliminate this deficiency for zooplankton research. Also, it is to investigate the zooplankton fauna and community structure in the alpine lakes of Turkey and to provide a resource for the research of inter-population relations.

MATERIAL and METHOD

Kaçkar Mountains alpine border stretches from west to east in 3 sections. Verçenik in the west, Kavran in the middle, and Altınparmak mountains in the east (Anonymous, 2021b). The subject of the study, Sarıncof Lake is located on Verçenik Mountain and has an altitude of 2835 m. The lake, which can be reached by a 6-hour walk from Çiçek and Ortayayla, consists of two lakes, one big and the other small. While no snow mass was observed in the sampled lake, snow mass was encountered on the north-facing slope of the other small lake. The lake and the following stream play a pivotal role in the formation of Fırtına Creek by flowing into Hemşin Creek via Hacıncur Creek (Kaçkar Tourism Association, 2013). In this study, which was carried out in Sarıncof Lake in July, 6 stations were selected to represent the zooplankton fauna of the lake, and sampling was carried out. The first of the lake samples was made horizontally and vertically from the middle of the lake to the shores, scanning the lake, and the second was made vertically from the deepest point accessible for the analysis of zooplankton individual numbers. Hydro-Bios Kiel brand (mouth diameter 25 cm and pore opening 55 µ) and Hensen type plankton net with a collector at the tip were used to collecting the zooplankton samples to be diagnosed and counted. The collected samples were placed in 250 ml plastic bottles and fixed by adding 37 % formaldehyde at a concentration of 4 %. After the field studies, Leica brand DMIL model inverted microscope was used for the initial identification of the samples brought to Ankara University Science Faculty Biology Department Algology Laboratory. Afterward, photographs were taken using a Leica DMSL microscope and a Leica DFC320 model camera system, and species were identified.

Species were identified using a key to the world fauna of Zooplankton (Ward & Whipple, 1945; Edmonson, 1959; Flössner, 1972; Kolisko, 1974; Harding & Smith, 1974; Koste, 1978; Dumont & Pansaert, 1983; Nogrady & Pourriot, 1995; Segers, 1995; De Smet, 1996; Smirnov, 1996; Benzie, 2005). Some physicochemical parameters of the lake were measured during the sampling. These parameters; electrical conductivity (EC), dissolved oxygen (DO), water temperature (T), pH, salinity (S), and suspended solids (SS) measurements were performed in situ with a HANNA brand HI 9890 model multiparameter 31 devices. The

coordinates and altitude information of the areas where the field study was carried out were obtained using a Garmin brand 60GSx model GPS device (Table 1).



Şekil 1. Sarıncof Gölü'nün konumu ve örnek alınan istasyonlar
Figure 1. Location of Sarıncof Lake and sampled stations

Çizelge 1. Çalışma alanının koordinat, yükseklik ve alan bilgileri
Table 1. Coordinate, altitude, and area information of the study area

Station No	Coordinates		Altitude (m) - Area (m²)
	X	Y	
1	40°46'26.39"N	40°55'60.00"E	2835 m - 57 m²
2	40°46'24.31"N	40°56'2.06"E	
3	40°46'21.99"N	40°56'4.86"E	
4	40°46'25.16"N	40°55'55.52"E	
5	40°46'22.69"N	40°55'54.86"E	
6	40°46'19.37"N	40°55'55.93"E	

RESULTS

As a result of the study carried out on Sarıncof Lake on 13 July 2021, a total of 36 species, 27 from Rotifera, 6 from Cladocera, and 3 from Copepoda, belonging to the zooplankton group, were identified. The list of identified species is shown in Table 2.

Çizelge 2. Çalışma alanındaki zooplankton faunası ve dağılımları
Table 2. The zooplankton fauna and distributions of the study area

Taxa	S.1	S.2	S.3	S.4	S.5	S.6
ROTIFERA						
Cephalodella catellina (Müller, 1786)				**		
Cephalodella gibba (Ehrenberg, 1830)		**	*			
Conochilus hippocrepis (Schrank, 1803)		*	**	*		***
Encentrum uncinatum (Milne, 1886)		*				
Euchlanis dilatata Ehrenberg, 1830		**	*		*	
Filinia longiseta (Ehrenberg, 1834)	*	**	*	*	*	
Keratella cochlearis (Gosse, 1851)				**		
Keratella tecta (Gosse, 1851)				*		
Lecane closterocerca (Schmarda, 1859)			*			
Lecane flexilis (Gosse, 1886)	*	*				
Lecane lunaris (Ehrenberg, 1832)				*		
Lepadella acuminata (Ehrenberg, 1834)		*				
Lepadella ovalis (Müller, 1786)	*					
Lepadella patella (Müller, 1773)	*		*			
Lepadella quadricarinata (Stenroos, 1898)		.				
Monommata grandis Tessin, 1890	*	*				
Notholca squamula (Müller, 1786)		*	*	*	*	*
Philodina megalotrocha Ehrenberg, 1832				.		
Polyarthra vulgaris Carlin, 1943				*		
Synchaeta oblonga Ehrenberg, 1832	*		*			
Synchaeta pectinata Ehrenberg, 1832		*		*	*	*
Trichocerca iernis (Gosse, 1887)		**		*		
Trichocerca longiseta (Schrank, 1802)					**	
Trichocerca relicta Donner, 1950		**	*			
Trichocerca pusilla (Jennings, 1903)				**		
Trichocerca similis (Wierzejski, 1893)				*		
Trichotria tetractis (Ehrenberg, 1830)	*	*	*		*	*
DIPLOSTRACA						
Alona guttata G.O. Sars, 1862			*			
Alona affinis (Leydig, 1860)		*	*			
Ceriodaphnia dubia Richard, 1894	*	***	*	***	***	*
Chydorus sphaericus (O. F. Müller, 1776)		**			*	
Bosmina longirostris (O. F. Müller, 1785)				*		
Moina micrura Kurz, 1875			**			
COPEPODA			*	*		*
Arctodiaptomus aculitobatus acutilobatus (Sars G.O., 1903)	*	*	**	***	*	***
Canthocamptus staphylinus staphylinus (Jurine, 1820)		*				
Mesocyclops leuckarti leuckarti (Claus, 1857)			.			

Barely found, * Sparsely found, ** Mostly found, *** Constantly found

As a result of the study, it was determined dominantly by the Rotifera group (51.0 %), followed by Copepoda (28.3 %) and Cladocera (20.7 %), (Table 3). Conochilus hippocrepis from Rotifera, Ceriodaphnia dubia from Cladocera, and Arctodiaptomus acutilobatus from Copepoda were dominant in the lake. The species are the first records for Sarıncof Lake, which is the subject of the study.

Some physicochemical parameters were also measured during sampling. Measurements were carried out at all stations and the average of the measurements were water temperature: 15.30 °C, EC: 130 (µS/cm), pH: 8.25, salinity: 0.05 ppt, suspended solids (SS), 60 mg/L, and DO: 3.81 mg/L.

Çizelge 3. İstasyonlara göre zooplankton bolluğu (birey/L)
Table 3. Zooplankton abundance (ind/L) by stations

Abundance (%)	S.1	S.2	S.3	S.4	S.5	S.6
Rotifera	3.465	3.3	9.172	116.943	11.974	14.268
Cladocera	-	3.6	6.878	18.344	16.764	6.115
Copepoda	1,732	1.2	9.172	61.911	4.789	22.420

DISCUSSION

The rapid and sensitive response of lakes to climate change and anthropogenic effects makes these structures important for ecological research (Arnott et al. 2006; Adrian et al. 2009). Alpine lakes, on the other hand, have fragile and sensitive structures, therefore, when their structures and compositions are well analyzed, they create a suitable environment for understanding the physical, chemical, and biological changes that occur in the region (Williamson et al. 2008; Sommaruga, 2015). In this study, the zooplankton fauna of Sarinçof Lake, which has not been studied in the region before, has been studied and a total of 36 species were identified. While examining the studies of the other lakes in the region carried out, 5 species of Crustacea, Aygen et al. (2012), according to Özdemir Mis and Ustaoğlu 2017, 18 species from the Rotifera phylum show similarity. When we compare it with the work of Gürbüzer (2018) in the region, 4 species from Rotifera and 1 species from Cladocera are common. In Yıldız (2011)'s study on the Verçenik Mountain Kapılı Lakes, 11 species from Rotifera and 5 species from Crustacea are in common with this study. Due to their structure, the number of species is less in this region compared to the basin lakes. Aygen et al. (2012), this result is not surprising since the physicochemical properties of the lakes in the alpine area are similar at a rate of 88%. With this study, 7 species (Conochilus hippocrepis, Encentrum uncinatum, Monommata grandis, Philodina megalotrocha, Trichocerca iernis, Trichocerca relicta, and Trichocerca pusilla) were added to the zooplankton fauna, which was previously carried out and registered in this location.

Alpine lakes are ultraoligotrophic, therefore their zooplankton community proportion per litre is very low according to lowland lakes. Research carried out in Mogan Lake (Altindag et al. 2007), the lowland lake in Ankara Province, their finding about zooplankton proportion is one million individuals per cubic meter. Similar results were also seen in Halvorsen et al. 2004, Baykal et al., 2006; Bozkurt, 2006; Bozkurt and Sagat, 2008; and Yuan and Pollard, 2018. Indeed, results showed that zooplankton proportion is a maximum of approximately 200.000 and a minimum of 5200 individuals per cubic meter.

In Turkey, mostly systematic studies have focused on zooplanktonic organisms found in glacial lakes. Most of the studies are focused on giving a species list and creating a database. Ustaoglu et al. (2005) studied the zooplankton fauna in the lakes at altitudes varying between 1500 m and 2600 m in the Taurus Mountains and recorded 116 zooplankton species. Among the identified species, rotifers were determined as the dominant group, as in this study. This result was obtained by Aygen et al. (2009) and is also supported in this study.

As expected, high mountain lakes have much less abundance and diversity of zooplankton fauna than basin lakes (Green, 1995). However, it has been observed that the ratio of Rotifera/Cladocera/Copepoda in some lakes are as similar as the basin lakes, while the ratio of Cladocera and Copepoda is much higher than Rotifera (Samraoui et al., 1998).

By creating quite strong pressure, zooplankton groups can be effected by not only fish biomass but also other planktonic groups and on prey and predator populations (Vanni, 2002). In alpine lakes, which are naturally fishless, prey pressure forces zooplankton communities to become larger (Dodson, 1972). The presence of a fish population in the lake puts pressure on zooplankton groups, leading to a decrease in the mass of the creature; its absence allows zooplankton species to become larger in size (Gürbüzer, 2018). In this study, the large bodied Cladocera group with melanin pigmentation, found in other lakes in that area, was expected to be encountered in Sarıncof Lake but more small-sized zooplankton species were detected since the Red Spotted Trout population was observed in the lake.

The fact that the alpine lakes can only be reached on certain days of the year due to the harsh environmental conditions has caused very limited research. It will be a reference source for studies on zooplankton groups belonging to alpine lakes located at the upper forest border in Turkey.

Contribution Rate Statement Summary of Researchers

The authors contributed equally to the article.

Disclosure statement

No potential conflict of interest was reported by the author(s).

REFERENCES

Abay, G. (2017). A Preliminary List of Subalpine and Alpine Bryophytes of Rize, North-East Turkey. *Anatolian Bryology 3* (2), 75-80.

Adrian, R., O'Reilly, CM., Zagarese, H., Baines, SB., Hessen, DO., Keller, W., Livingstone, D.M., Sommaruga, R., Straile, D., Van-Donk, E., Weyhenmeyer G.A. & Winder, M. (2009). Lakes as sentinels of climate change. *Limnology and Oceanography 54* (6), 2283-2297.

Altındağ, A., Yiğit, S. & Ergönül, M., (2007). The Zooplankton Community of Lake Mogan, Turkey. *Journal of Freshwater Ecology, 22*(4), 709-711. https://doi.org/10.1080/02705060.2007.9664832.

Arnott, S.E., Magnuson, J.J., Dodson, SI. & Colby, A.C.C. (2006). Lake as islands: biodiversity, invasion, and extinction. In Long-terms Dynamics

of lakes in the landscape. Magnuson, J.J., Krtaz. T.K., and Benson, B.J. (eds.), Oxford Press, 67-88, Oxford, UK.

Anonymous, (2021a). Alpin Çayırlar. https://tr.wikipedia.org/wiki/Alpin_%C3%A7ay%C4%B1rlar (Alınma Tarihi: 20.01.2022).

Anonymous, (2021b). Rize-Kaçkar Sıradağları. https://yigm.ktb.gov.tr/TR-9905/rize-kackar-sira daglari.html (Alınma Tarihi: 20.01.2022).

Aygen, C., Mis-Özdemir, D., Ustaoğlu, M.R. & Balık, S. (2009). Zooplankton Composition and Abundance in Lake Eğrigöl, A High Mountain Lake (Gündoğmuş, Antalya). *Turkish Journal of Zoology*, *33*, 83-88.

Aygen, C., Özdemir-Mis, D. & Ustaoğlu, M.R. (2012). Discovering The Hidden Biodiversity of Crustacea (Branchiopoda, Maxillopoda and Ostracoda) Assemblages in The High Mountain Lakes of Kaçkar Mountains (Turkey). *Journal of Animal and Veterinary Advences, 11*(1), 67-73.

Baykal, T., Salman, S. & Açıkgöz, İ. (2006). The Relationship between Seasonal Variation in Phytoplankton and Zooplankton Densities in Hirfanlı Dam Lake (Kırşehir, Turkey). *Turkish Journal of Biology, 30*(4), 217-226.

Benzie, J.A.H. (2005). The Genus Daphnia (Including Daphniopsis) (Anomopoda: Daphniidae). Guides to The Identification of The Microinvertebrates of The Continental Waters of The World 21. Kenobi Productions, Ghent & Backhuys Publishers, 376.

Bozkurt, A. (2006). Yenişehir Gölü (Reyhanlı, Hatay) Zooplanktonu. *Ege Üniversitesi Su Ürünleri Dergisi, 23*(1/1), 39-43

Bozkurt, A. & Sagat, Y. (2008). Birecik Baraj Gölü zooplanktonunun vertikal dağılımı. *Journal of FisheriesSciences.com, 2*(3), 332-342

Cáceres, C. (1997). Dormancy in Invertebrates. *Invertebrate Biology, 116*(4), 371-383.

De-Smet, W.H. (1996). Prolidae (Monogononta). Vol. 4. *State Universty of Gent*, Belgium.

Dodson, S.I. (1972). Mortality in a Population of *Daphnia rosea*. *Ecology, 53*, 1011-1023.

Dumont, H.J. & Pensaert, J. (1983). A Revision of The Scapholeberinae (Crustacea: Cladocera). *Hydrobiologia, 100*, 3-45.

Edmonson, W.T. (1959). Freshwater Biology 2nd Edition John Wiley& Sons Inc. *London- Champman and Hall Limited, 1284*, New York, USA.

Erinç, S. (1949). Eiszeitliche Formen und gegenwärtige Vergletscherung im nordostanatolischen Randgebirge. *Geologische Rundschau, 37,* 75-83

Flössner, D. (1972). Krebstiere, Crustacea; Kiemen- Und Blattfüsser, Branchiopoda; Fischlause, Branchiura. *Die Tierwelt Deutschlands 60*. G. Fisher Verlag, Jena, Germany.

Green, J. (1995). Altitudinal Distribution of Tropical Planktonic Cladocera. *Hydrobiologia, 307*, 75-84.

Gönençgil, B. (2016). Türkiye Fiziki Coğrafyası. Coğrafya Lisans Programı. İ*stanbul Üniversitesi Açık ve Uzaktan Eğitim Fakültesi*, 423 sy.

Gürbüzer, P. (2018). *Kaçkar ve Aladağlar'da Bulunan Bazı Alpin Göllerde Zooplankton Faunasının ve Daphnia sp. Türlerinin Filogenetik Açıdan Araştırılması. (Tez No:542143)* [Doktora Tezi, Ankara Üniversitesi Fen Bilimleri Enstitüsü Biyoloji Anabilim Dalı] Yükseköğretim Kurulu Ulusal Tez Merkezi.

Gyllström, M. & Hansson, L.A. (2004). Dormancy in Freshwater Zooplankton: Induction, Termination and The Importance of Benthic-Pelagic Coupling. *Aquatic Sciences, 66,* (3), 274-295.

Halvorsen, G., Dervo, B.K. & Papinska, K. (2004). Zooplankton in Lake Atnsjøen 1985–1997. In: Sandlund, O.T., Aagaard, K. (eds) The Atna River: Studies in an Alpine—Boreal Watershed. *Developments in Hydrobiology, vol 177*. Springer, Dordrecht. https://doi.org/10.1007/978-1-4020-2254-8_12

Harding, J.P. & Smith, W.A. (1974). A Key to The British Freshwater Cyclopoid and Calanoid Copepods. 2nd Edition, Sci. Publ. Vol. 218, *Freshwater Biological Association, 54,* The Ferry House, Ambleside, Westmorland.

Kaçkar Turizm Birliği, (2013). Buzul Gölleri Kenti Rize ISBN: 978-605-149-492-0

Kılınç, M. & Karakaya, M. (1992). Çambaşı Yaylası (Ordu)'nın Subalpin ve Alp Vejetasyonu Üzerinde Fitososyolojik Bir Araştırma. *Doğa Türk Botanik Dergisi, 16*,(1), 195-206.

Kılınç, M. & Kutbay, G. (2004). *Bitki Ekolojisi, Plame Yayıncılık,* Ankara.

Kolisko, R. (1974). Plankton Rotifers Biology and Taxonomy, E. Schweizerbart'sche Verlagsbuchhandlung (Nagele U. Obermiller) Stuttgart, 974.

Koste, W. (1978). Radertiere Mitteleuropas. 2. Tafelband, 235, Berlin and Stuttgart.

Nogrady, T. & Pourriot, R. (1995). The Notommatidae. Queen's Universty, Kingston, *Ont. Canada and Université 6,* Paris, France.

Özdemir-Mis, D. & Ustaoğlu, M.R. (2017). Distribution of Rotifers of High Mountain Lakes in The Eastern Black Sea Range of Turkey. *Turkish Journal of Zoology, 41*(4), 674-685.

Pechlaner, R. (1971). Factors That Control The Production Rate and Biomass of Phytoplankton in High-Mountain Lakes. *Verhandlungen Internationale Vereinigung Für Theoretische und Angewandte Limnologie, 19,* 125-145.

Saler, S., Yüce, S., Çelik, B. & Bulut, H. (2018). Hoşrük Çayı (Elazığ-Türkiye) Zooplanktonu. *Türk Tarım-Gıda Bilim ve Teknoloji Dergisi, 6*(5), 607-612.

Samraoui, B., Segers, H.H., Maas, S., Baribwegure, D. & Dumont, H.J. (1998). Rotifera, Cladocera, Copepoda, and Ostracoda From Coastal Wetlands

in Northeast Algeria. Hydrobiologia 386, 183.

Segers, H. (1995). The Lecanidae (Monogononta), Universty of Gent, Belgium.

Simirnov, N.N. (1996). The Chorinae and Sayciinae (Chydoridae) of The World, SPB Academic Publishing, Amsterdam, The Netherlands.

Sommaruga, R. (2015). When Glaciers and Ice Sheets Melt: Consequences for Planktonic Organisms. *Journal of Plankton Research, 37* (3), 509-518.

Ustaoğlu, M.R., Balık, S., Özdemir-Mis, D. & Aygen, C. (2005). The Zooplankton of Some Mountain Lakes in The Taurus Range (Turkey). *Zoology in The Middle East, 34*, 101-108.

Ward, H.B. & Whipple, G.C. (1945). Freshwater Biology, 2nd Edition, John Wiley&Sons, 1111. New York, USA.

Williamson, C.E., Dodds, W., Kratz, T.K. & Palmer, M.A. (2008). Lakes and streams as sentinels of environmental change in terrestrial and atmospheric processes. *Frontiers in Ecology and the Environment, 6,* 247-254.

Vanni, M.J. (2002). Nutrient Cycling by Animals in Freshwater Ecosystems Annu. *Rev. Ecol. Syst., 33*,(1), 341-370.

Yıldız, P. (2011). *Verçenik Dağı (Rize, Türkiye)'nın Kuzey ve Güney Göllerinin Zooplankton Faunası Açısından Karşılaştırılması. (Tez No:300835)* [Yüksek Lisans Tezi, Ankara Üniversitesi Fen Bilimleri Enstitüsü Biyoloji Anabilim Dalı], Yükseköğretim Kurulu Ulusal Tez Merkezi.

Yuan, L.L. & Pollard, A.I. (2018). Changes in the relationship between zooplankton and phytoplankton biomasses across a eutrophication gradient. *Limnology and Oceanography, 63*(6), 2493-2507.