Mar. Life Sci. (2024) 6(2): 47-57 E-ISSN: 2687-5802

Marine and Life Sciences

Journal Homepage: https://dergipark.org.tr/en/pub/marlife

Seasonal analysis of Reyhanlı Dam Lake zooplankton fauna

Ahmet Bozkurt[1]✉

[1] Iskenderun Technical University, Faculty of Marine Sciences and Technology, Department of Marine Sciences, Iskenderun, Hatay, Türkiye

✉ Corresponding Author: ahmet.bozkurt@iste.edu.tr

Please cite this paper as follows:
Bozkurt, A. (2024). Seasonal analysis of Reyhanlı Dam Lake zooplankton fauna. *Marine and Life Sciences*, *6*(2), 47-57. https://doi.org/10.51756/marlife.1487493

Research Article

Article History
Received: 21.05.2024
Accepted: 24.09.2024
Published Online: 05.12.2024

Keywords:

Zooplankton
Rotifer
Copepod
Cladocer
Reyhanlı Dam Lake

A B S T R A C T

This study was conducted seasonally in 2022 and 2023 in Reyhanlı Dam Lake (Hatay, Türkiye), which was established in 2020. Zooplankton fauna and main water quality characteristics were investigated. The average values of the water quality parameters (temperature, dissolved oxygen, conductivity and pH) measured in the dam lake were determined to be of first-class water quality. A total of 67 species were identified, of which fifty-four (54) species were Rotifera (80.60%), 7 species were Copepoda (10.45%) and 6 species were Cladocera (8.95%). Brachionidae was the most abundant with 14 species, Chydoridae represented by two species and Cyclopidae were represented by 3 species. According to the frequency index, 3 species ($F \geq 76\%$) were classified as constant and 11 species ($75\% > F \geq 51\%$) were classified as common. Of the 67 species recorded, only 29 species were very abundant (●) and abundant (○) in the different seasons. The highest species richness was recorded in the summer, with 54 species.

INTRODUCTION

Due to the lack of taxonomic studies, it is not possible to take the necessary measures for sustainable management and especially the protection of ecosystems. In Türkiye, which has a very rich fauna composition, unfortunately, there is still not enough taxonomic information on most living groups (Bozkurt and Genç, 2018). Türkiye, which has a very rich inland water potential, has many rivers, lakes and dams with an area of about one million hectares, which are negatively affected by increasing environmental degradation and colonisation.

Many reservoirs have been built for years for drinking water supply, irrigation, flood control and energy production (Yuksel, 2015), but as a result of population growth and industrialization, reservoirs are at risk of eutrophication, which can lead to a loss of biodiversity and disruption of the balance of the food chain (Brito et al., 2011). Therefore, limnological and biological factors in reservoirs should be studied and assessed, and the results should be used to improve water quality. Biotic and abiotic factors in the reservoirs can influence the diversity, density, biomass and spatio-temporal distribution of zooplankton species (Dorak et al., 2019).

Some aquatic organisms feed on zooplankton only at a certain stage of their life, particularly the larval stage, while many other species feed on zooplankton throughout their lives (Sales, 2011). This explains the close relationship between the diversity and abundance of zooplankton and the productivity of the aquatic environment (Brun et al., 2019). They play an important role in the aquatic environment as most zooplankton organisms such as copepods, cladocerans and rotifers feed on phytoplankton and rapidly convert plants into animal protein (Svanberg et al., 2022).

Although zooplankton is an important component of the food chain, some species are considered good indicators of eutrophication, pollution and water quality due to their

CC BY NC SA

sensitivity to environmental changes (Ismail and Adnan, 2016). Zooplankton abundance and diversity, which are closely linked to water quality characteristics, increase and decrease with the trophic status of inland waters (İpek Alış and Saler, 2016), making studies of inland zooplankton increasingly important. Characterization of the zooplankton fauna of Türkiye, will contribute to a comprehensive understanding of Türkiye's biodiversity. In order to use these inland water resources efficiently, it is important to know the inland waters, aquatic organisms and their distribution in Türkiye.

This study was the first to investigate zooplankton biodiversity and main water quality characteristics in Reyhanlı Dam Lake (Hatay), a new reservoir. It also serves as an example for future studies.

MATERIALS AND METHODS

The study was conducted seasonally between May 2022 and December 2023 in the Reyhanlı Reservoir (36°20'27 "N 36°33'53 "E) in Hatay province (Figure 1). The Reyhanlı Reservoir (Hatay, Türkiye) has a total height of 29 m and a volume of 480 million m^3. It was built in 2020 on the Afrin and Karasu rivers for the purpose of agricultural irrigation. Although 5846.40 ha of agricultural land was created for irrigation purposes, it also creates new habitats for many aquatic animals and birds (Şimşek, 2022).

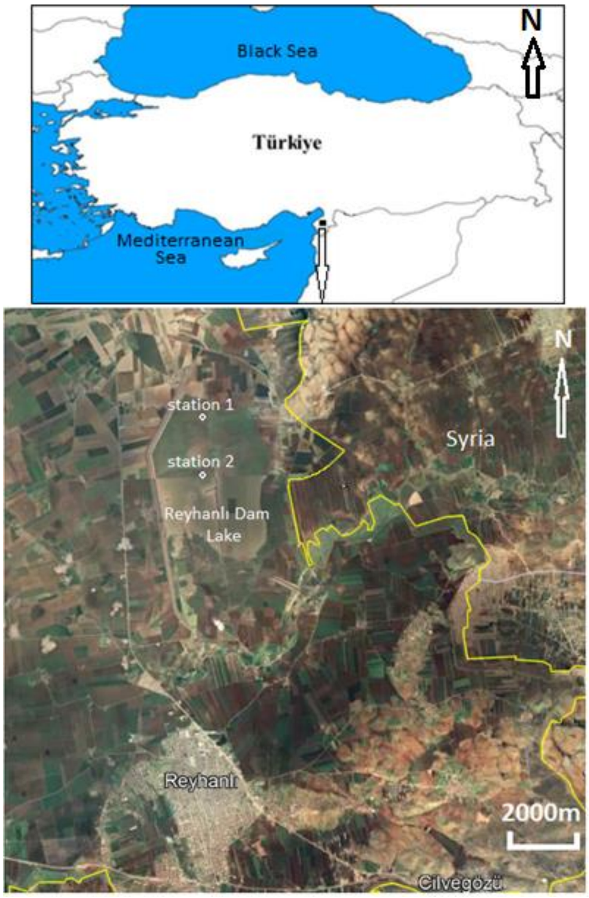

Figure 1. Reyhanlı Dam Lake and sampling stations

Zooplankton samples were collected seasonally at two different stations using a plankton net with a diameter of 0.30 m and a mesh size of 60 μm with horizontal and vertical hauls. Vertical hauls were performed ten times from the bottom to the surface, while horizontal hauls were performed from the water surface for 20 minutes at about 2 km/h with a motorboat. Macrophytes (*Elodea* sp. and *Ceratophyllum* sp.) collected from the northern and southern shores of the reservoir were brought to the laboratory in bags, washed in containers and filtered through the plankton net. All zooplankton samples were fixed in 4% formalin in the laboratory. Dissolved oxygen, water temperature, pH and conductivity were determined in situ using digital meters (oxygen and temperature: YSI Model 52 oxygen meter; pH: YSI 600 pH meter; conductivity: YSI Model 30 salinometer). The first sampling station is closer to the dam lake shore and at a depth of approximately 4-5 m, while the second station is closer to the dam midpoint and at a depth of 12-15 m, and its distance to the crest is around 500 m. Zooplankton species were examined and identified using an inverted microscope and a binocular microscope (Olympus CH40). Approximately 20 cc of each sample was sub-sampled to identify species and examined in a petri. This process was done at least 3 times in order to identify all species present. Soyer's (1970) frequency index (F %) was used to express the frequency of zooplankton species identified from plankton and plant samples in the study area. The results were determined as constant ($F \geq 76\%$), common ($76\% > F \geq 51\%$), occasionally ($51\% > F \geq 26\%$) and rare ($F < 25\%$). Individuals belonging to the species were not counted, but their abundance was determined visually from their density in the petri dish. This was expressed as rare, few, abundant and most abundant, regardless of the Soyer index (Table 2). The specimens were identified according to Rylov (1963), Borutsky (1964), Scourfield and Harding (1966), Dussart (1967), Dussart (1969), Damian Georgescu (1970), Smirnov (1974), Negrea (1983), Apostolov and Marinov (1988), Reddy (1994), Segers (1995), Karaytug (1999) and Holynska et al. (2003).

RESULTS

Water temperature varied between 11.05±0.21°C (winter) and 25.00±0.28°C (summer), with a mean value of 19.89±5.80°C (Table 1). Dissolved oxygen ranged from 8.05±0.07 mg L^{-1} (summer) to 9.55±0.21 mg L^{-1} (winter), with a mean value of 8.75±0.59 mg L^{-1} (Table 1). The conductivity value ranged from 139±1.41 μS cm^{-1} (winter) to 235±7.07 μS cm^{-1} (fall), with a mean value of 187±43.23 μS cm^{-1} (Table 1). The minimum, maximum and mean pH values were 7.40±0.14 (summer), 8.65±0.07 (spring) and 8.18±0.51 (Table 1), respectively.

BY NC SA

Table 1. Main water quality parameters (mean±SD)

Parameters	Spring	Summer	Fall	Winter	Annual Mean
Temperature (°C)	23.55±0.49	25.00±0.28	19.95±0.21	11.05±0.21	19.89±5.80
DO (mg L^{-1})	8.60±0.14	8.05±0.07	8.80±0.14	9.55±0.21	8.75±0.59
EC (µS cm^{-1})	156±5.66	218±3.54	235±7.07	139±1.41	187±43.23
pH	8.65±0.07	8.25±0.07	7.40±0.14	8.40±0.14	8.18±0.51

A total of 67 species were identified, of which fifty-four (54) species were Rotifera (80.60 %), 7 species were Copepoda (10.45 %) and 6 species were Cladocera (8.95 %) (Table 2). Among the rotifers, in which a total of 17 families were identified, the family Brachionidae was the most abundant with 14 species, followed by Lecanidae with 13 species. On the other hand, Trichocercidae, Mytilinidae, Asplanchnidae, Gastropodidae, Conochilidae, Dicranophoridae, Hexarthridae and Epiphanidae were represented with one species each. Of the Cladocera, five families were recorded, with the Chydoridae represented by two species, while the other families (Bosminidae, Moinidae, Macrothricidae and Ilyocryptidae) were represented by one species each (Table 2). Among the 5 families of Copepoda, the Cyclopidae were represented by 3 species and the other families (Ameiridae, Laophontidae, Ergasilidae and Lernaeidae) by one species each (Table 2).

The most common rotifers recorded in all seasons were, *Brachionus angularis*, *B. bidentatus*, *B. calyciflorus*, *B. caudatus*, *B. falcatus*, *B. quadridentatus*, *Keratella cochlearis*, *K. tecta*, *K. tropica*, *Platyias quadricornis*, *Lecane bulla*, *L. closterocerca*, *L. hamata*, *L. scutata*, *Polyarthra dolichoptera*, *P. vulgaris*, *Synchaeta stylata*, *Trichocerca pusilla*, *Asplanchna sieboldi*, *Collotheca pelagica*, *Pompholyx sulcata* and *Dichranophorus epicharis* followed by *Anuraeopsis coelata*, *B. budapestinensis*, *B. urceolaris*, *L. aculeate*, *L. flexilis*, *L. inermis*, *L. stenroosi*, *C. adriatica*, *C. colurus*, *L. patella*, *C. forficula*, *C. gibba*, *R. neptunia*, *D. hertzogi*, *C. mutabilis*, *A. ovalis* and *F. longiseta* (found in 3 seasons) (Table 2).

Among the Cladocera, *M. micrura*, which was recorded in 4 seasons, had the largest distribution habitat, followed by *B. longirostris*, *M. laticornis* and *I. sordidus* (recorded in 3 seasons). On the other hand, *A. robustus* and *O. mohammed* had the largest distribution area among copepods (found in 4 seasons) (Table 2). Some zooplankton species had a limited distribution and were only detected in one season: *L. furcata*, *L. hornemanni*, *L. luna*, *L. pyriformis*, *Lepadella rhomboids*, *T. ruttneri*, *Testudinella patina*, *C. unicornis* (Rotifera) and *M. rubellus* (Copepoda) (Table 2). The amount of zooplankton was generally not very abundant, with only some species occasionally reaching high densities. Of the 66 species recorded, only 29 species were very abundant (●) and abundant (○) in the different seasons, while the other species were fewer in number.

Most zooplankton species were recorded in summer with 54 species. This was followed by spring with 53 species, fall with 52 species and spring with 37 species. In terms of abundance, 7 species were very abundant (●) in spring, 7 species in summer and 3 species in fall. The seasonally very abundant (●) species were *B. angularis* (spring, summer and fall), *K. tecta*, *P. vulgaris* (spring, summer), *K. cochlearis*, *P. dolichoptera*, *P. sulcata*, *B. longirostris* (spring), *B. caudatus*, *K. tropica*, *S. stylata*, *N. hibernica* (summer), *C. pelagica* and *M. micrura* (fall) (Table 2). However, zooplankton was abundant (○) with 12 species in each season in spring, summer and fall and 5 species in winter (Table 2). The most abundant (○) species were *R. neptunia* (spring, summer, fall); *B. bidentatus*, *S. stylata*, *A. robustus* (spring, fall); *B. budapestinensis*, *P. dolichoptera* (summer, fall); *B. falcatus* (summer, winter); *B. quadridentatus*, *C. forficula*, *A. sieboldi*, *C. pelagica*, *C. vicinus* (spring, summer); *K. cochlearis*, *C. gibba*, *D. epicharis* (summer); *K. quadrata*, *N. hibernica*, *F. longiseta* (spring); *K. tropica*, *B. caudatus*, *B. longirostris*, *M. micrura* (winter); *P. vulgaris*, *D. hertzogi*, *M. ventralis*, *P. sulcata*, *A. costata*, *M. laticornis* (fall).

Species not found in aquatic plant samples but only in plankton samples; *A. coelata*, *B. angularis*, *B. budapestinensis*, *B. calyciflorus*, *B. falcatus*, *K. cochlearis*, *K. quadrata*, *K. tecta*, *P. vulgaris*, *S. stylata*, *A. sieboldin*, *P. sulcate*, *F. opoliensis*, *P. tentaculatus*, *M. micrura*, *C. vicinus*, *E. sieboldi*, *L. cyprinacea*. In contrast, some zooplankton species (*L. aculeate*, *L. flexilis*, *L. hamata*, *L. inermis*, *L. stenroosi*, *C. colurus*, *L. patella*, *C. forficula*, *E. najas*, *D. hertzogi*, *C. pelagica*, *C. mutabilis*, *D. epicharis*, *M. laticornis* and *I. sordidus*) were only found in aquatic plant samples. Some species (*L. furcate*, *L. hornemanni*, *L. pyriformis*, *T. ruttneri*, *T. patina*, *C. unicornis*, *M. rubellus*) were not assessed because they were found only once during the study, and others were found in both plants and plankton samples.

Table 2. List and abundance of zooplankton species in the dam lake (pl: plankton, op: on the plant. -: Absent, *: very few (rare 25-0.0%), +: few (occasionally 50-26%), ○: abundant (Common 75-51%), ●: very abundant (Constant 100-76%)

Species	Sampling Time								F%
	18.05.2022		10.06.2023		03.09.2023		17.12.2023		
	pl	*op*	*pl*	*op*	*pl*	*op*	*pl*	*op*	
Rotifera									
Brachionidae									
Anuraeopsis coelata de Beauchamp, 1932	*	–	–	–	*	–	*	–	38
Brachionus angularis Gosse, 1851	●	–	●	–	●	–	*	–	50
Brachionus bidentatus Anderson, 1889		○	–	+	*	○	*	+	75
Brachionus budapestinensis Daday, 1885	–	–	○	–	○	–	*	–	38
Brachionus calyciflorus Pallas, 1766	*	–	+	–	*	–	+	–	50
Brachionus caudatus Barrois & Daday, 1894	–	*	●	*	+	–	○	–	63
Brachionus falcatus Zacharias, 1898	*	–	○	–	+	–	○	–	50
Brachionus quadridentatus Hermann, 1783	+	○	○	○	*	+	+	*	100
Brachionus urceolaris Müller, 1773	–	–	+	–	+	–	–	+	38
Keratella cochlearis (Gosse, 1851)	●	–	○	–	+	–	+	–	50
Keratella quadrata (Müller, 1786)	○	–	+	–	–	–	–	–	25
Keratella tecta (Gosse, 1851)	●	–	●	–	+	–	*	–	50
Keratella tropica (Apstein, 1907)	+	+	●	*	*	*	○	+	100
Platyias quadricornis (Ehrenberg, 1832)	–	+	+	–	–	*	*	–	50
Lecanidae									
Lecane aculeata (Jabuski, 1912)	–	*	–	*	–	–	–	+	38
Lecane bulla (Gosse, 1886)	–	*	–	*	*	+	–	*	63
Lecane closterocerca (Schmarda, 1859)	–	+	–	+	*	–	*	*	63
Lecane flexilis (Gosse, 1886)	–	*	–	*	–	*	–	–	38
Lecane furcata (Murray, 1913)	–	–	–	*	–	–	–	–	13
Lecane hamata (Stokes, 1896)	–	+	–	+	–	+	–	+	50
Lecane hastata (Murray, 1913)	–	–	–	–	*	–	*	–	25
Lecane hornemanni (Ehrenberg, 1834)	–	–	–	*	–	–	–	–	13
Lecane inermis (Bryce, 1892)	–	+	–	+	–	–	–	+	38
Lecane luna (Müller, 1776)	–	–	–	–	*	*	–	–	25
Lecane pyriformis (Daday, 1905)	–	–	–	–	*	–	–	–	13
Lecane scutata (Harring & Myers, 1926)	*	*	*	*	–	*	*	–	75
Lecane stenroosi (Meissner, 1908)	–	*	–	*	–	–	–	*	38
Lepadellidae									
Colurella adriatica Ehrenberg, 1831	*	*	–	*	*	*	–	–	63
Colurella colurus (Ehrenberg, 1830)	–	*	–	*	–	*	–	–	38
Lepadella patella (Müller, 1773)	–	*	–	+	–	–	–	+	38
Lepadella rhomboides Gosse, 1886)	–	–	–	–	*	+	–	–	25
Synchaetidae									
Polyarthra dolichoptera Idelson,1925	●	*	○	+	○	+	*	–	88
Polyarthra vulgaris Carlin, 1943	●	–	●	–	○	–	*	–	50
Synchaeta stylata Wierzejski, 1893	○	–	●	–	○	–	*	–	50
Trichocercidae									
Trichocerca pusilla (Jennings, 1903)	+	*	+	*	*	–	*	–	75
Trichocerca ruttneri	–	–	+	–	–	–	–	–	13
Notommatidae									
Cephalodella forficula (Ehrenberg, 1830)	–	○	–	○	–	*	–	–	38
Cephalodella gibba (Ehrenberg, 1830)	–	+	–	○	*	–	–	–	38
Eosphora najas Ehrenberg, 1830	–	–	–	*	–	+	–	–	25
Philodinidae									
Rotaria neptunia (Ehrenberg, 1830)	+	○	○	○	*	○	–	–	75
Dissotrocha hertzogi Hauer, 1939	–	*	–	+	–	○	–	–	38
Mytilinidae									
Mytilina ventralis (Ehrenberg, 1830)	–	+	–	–	*	○	–	–	38

CC BY NC SA

Table 2. (continued)

Species	Sampling Time								F%
	18.05.2022		10.06.2023		03.09.2023		17.12.2023		
	pl	*op*	*pl*	*op*	*pl*	*op*	*pl*	*op*	
Asplanchnidae									
Asplanchna sieboldi (Leydig, 1854)	○	–	○	–	+	–	+	–	50
Collothecidae									
Collotheca pelagica (Rousselet, 1893)	–	○	–	○	–	●	–	+	50
Collotheca mutabilis (Hudson, 1885)	–	*	–	+	–	+	–	–	38
Testudinellidae									
Testudinella patina (Hermann, 1783)	*	–	–	–	–	–	–	–	13
Pompholyx sulcata Hudson, 1885	●	–	+	–	○	–	+	–	50
Gastropodidae									
Ascomorpha ovalis (Bergendahl, 1892)	–	*	+	*	+	–	–	–	50
Trochosphaeridae									
Filinia longiseta (Ehrenberg, 1834)	○	*	+	*	+	–	–	–	63
Filinia opoliensis (Zacharias, 1898)	–	–	–	–	*	–	*	–	25
Conochilidae									
Conochilus unicornis Rousselet, 1892	+	–	–	–	–	–	–	–	13
Dicranophoridae									
Dichranophorus epicharis Harring & Myers, 1928	–	+	–	○	–	+	–	+	50
Hexarthridae									
Hexarthra intermedia (Wiszniewski, 1929)	*	–	+	*	–	–	–	–	38
Epiphanidae									
Proalides tentaculatus de Beauchamp, 1907	+	–	–	–	*	–	–	–	25
Cladocera									
Bosminidae									
Bosmina longirostris Müller, 1785	●	*	+	*	–	–	○	–	63
Moinidae									
Moina micrura Kurz, 1875	*	–	+	–	●	–	○	–	50
Chydoridae									
Alona costata Sars, 1862	–	+	–	–	*	○	–	–	38
Disparalona rostrata (Koch, 1841)	–	*	*	–	–	–	–	–	25
Macrothricidae									
Macrothrix laticornis (Jurine, 1820)	–	*	–	*	–	○	–	–	38
Ilyocryptidae									
Ilyocryptus sordidus (Liévin, 1848)	–	*	–	+	–	*	–	–	38
Copepoda									
Cyclopidae									
Cyclops vicinus Uljanin, 1875	○	–	○	–	+	–	–	–	38
Acanthocyclops robustus (Sars G.O., 1863)	○	–	*	–	○	*	+	–	63
Microcyclops rubellus (Lilljeborg 1901)	–	–	–	–	–	+	–	–	13
Ameiridae									
Nitokra hibernica (Brady, 1880)	–	○	–	●	–	–	*	–	38
Laophontidae									
Onychocamptus mohammed (Blanchard & Richard, 1891)	–	*	*	*	*	–	*	–	63
Ergasilidae									
Ergasilus sieboldi von Nordmann, 1832	–	–	*	–	*	–	–	–	25
Lernaeidae									
Lernaea cyprinacea Linnaeus, 1758	–	–	–	–	*	–	*	–	25
Seasonal species numbers	**53**		**54**		**52**		**37**		

CC BY NC SA

When evaluated according to the frequency index, 3 species (F ≥ 76%) were classified as constant, 11 species (75% > F ≥ 51%) were classified as common, 35 species (50% > F ≥ 26%) were classified as occasionally and 17 species (F < 26%) were classified as rare. Among these dense species, *Brachionus quadridentatus* and *Keratella tropica* were determined with the highest frequency (100%) in all seasons. *Polyarthra dolichoptera* (88%), *Brachionus bidentatus, Trichocerca pusilla, Lecane scutata* and *Rotaria neptunia* (75%), *Brachionus caudatus*, *Lecane bulla*, *Lecane closterocerca*, *Colurella adriatica*, *Filinia longiseta*, *Bosmina longirostris*, *Acanthocyclops robustus*, *Onychocamptus mohammed* (63%), *Brachionus angularis*, *Brachionus calyciflorus*, *Brachionus falcatus*, *Keratella cochlearis*, *Keratella tecta*, *Platyias quadricornis*, *Lecane hamata*, *Polyarthra vulgaris*, *Synchaeta stylata*, *Asplanchna sieboldin*, *Collotheca pelagica*, *Pompholyx sulcate*, *Ascomorpha ovalis*, *Dichranophorus epicharis* and *Moina micrura* (50%) are other zooplanktonic organisms that are frequently seen (Table 2).

DISCUSSION

Temperature increases biological activity in water and accelerates biochemical reactions, which affects the reproduction, feeding and metabolic activities of aquatic organisms. Temperature is one of the most important environmental parameters affecting biodiversity and zooplankton density in aquatic ecosystems (Herzig, 1987; Sharma et al., 2007). Environmental conditions, particularly water temperature, have been reported to have a significant and positive effect on zooplankton diversity and abundance (Rossetti et al., 2009; Dorak, 2013). In this study, where similar results were found, the highest number of species (54 species) was found in the summer season when the average temperature is highest (25.00±0.28).

The amount of dissolved oxygen varies depending on the trophic state of the lakes and the water temperature (Viet et al., 2016). Studies have shown that low oxygen conditions can affect the growth, reproduction and distribution of zooplankton, and it has been reported that dissolved oxygen levels below 5 mg L^{-1} in freshwater can limit the growth of zooplankton (Karpowicz et al., 2020). In the study, the lowest dissolved oxygen was measured in summer and the highest in winter, as high temperature reduces dissolved oxygen in water and increases it at low temperature. The dissolved oxygen values found (8.05–9.55 mg L^{-1}) were above 5 mg L^{-1}. Looking at the dissolved oxygen content in the lake, it appears to be suitable for zooplankton life.

Conductivity, an important water quality parameter, is significantly related to zooplankton diversity, abundance and distribution, and an inverse relationship between conductivity and zooplankton species diversity has been found (Estlander et al., 2009; Tavsanoglu et al., 2015). In general, conductivity increases in places where there is insufficient water inflow due to evaporation when the water temperature rises. Pollution can increase the conductivity of lakes and rivers, as industrial and anthropogenic effluents often have high conductivity (Wetzel, 1983). While the electrical conductivity in the reservoir was found to be high in summer and fall and low in winter and spring, the conductivity values were found to be at a very low level between 139 and 215 µS cm^{-1} and suitable for zooplankton life (Estlander et al., 2009).

pH, which is important for the life cycle of zooplankton, can affect the abundance of zooplankton. Alkaline conditions strongly correlate with primary production and promote zooplankton growth and abundance (Bednarz et al., 2002; Mustapha, 2009), while low pH leads to a decrease in zooplankton abundance, species diversity and extinction of some species (Ivanova and Kazantseva, 2006). In the Surface Water Resources Quality Criteria Regulation (OSİB, 2015), published by the Ministry of Forestry and Water Affairs of the Republic of Türkiye, it is stated that the freshwater pH value, at which many aquatic creatures can sustain their normal life without harming their physiology, should be between 6.00 and 9.00. The pH of the reservoir is between 7.40 and 8.65 and is slightly alkaline and suitable for the survival of zooplankton species (Tessier and Horwitz, 2011).

This study is the first zooplankton study in the young Reyhanlı Reservoir, the construction of which was completed in 2020. 67 species were identified in this study, with the Rotifera being the dominant group with 80.30%.

Various studies have shown that rotifers dominate both qualitatively and quantitatively in stagnant waters, such as most lakes, ponds, reservoirs and wetlands (Jamila et al., 2014; Ismail and Adnan, 2016; Dorak et al., 2019; Saler et al., 2019). In addition, Segers (2007) reported that rotifers occur in almost all types of freshwater habitats, e.g., large permanent lakes, small temporary ponds, intermediate and capillary waters, acidic mineral lakes, fizzy drink lakes, hyperoligotrophic alpine lakes and sewage ponds.

Species reported by various researchers to be good indicators of eutrophic conditions and pollution are *A. coelata*, *B. angularis*, *B. calyciflorus*, *B. quadridentatus*, *B. urceolaris*, *K. cochlearis*, *K. tecta*, *K. tropica*, *L. patella*, *T. pusilla*, *C. forficula*, *R. neptunia*, *C. mutabilis*, *P. sulcata*, *A. ovalis*, *F. longiseta*, *B. longirostris* (Dussart, 1969; Voigt and Koste, 1978; Pesce and Maggi, 1981; Berzins and Bertilsson, 1990; Hansen and Jeppesen, 1992; De Manuel Barrabin, 2000; Petrusek, 2002; Shah and Pandit, 2013; Apaydın Yağcı, 2016; Heneash and Alprol, 2020) was also detected in this study. They also proposed that genus *Brachionus*, *Lecane*, *Trichocerca* and

Keratella can be considered a target taxon for more intensive monitoring of water quality and conservation planning on aquatic environment (Ceirans, 2007). Additionally, *M. micrura*, *C. vicinus* and *A. robustus* are species that are not indicators of eutrophication but are commonly found in eutrophic waters (Jana and Pal, 1985; Crosetti and Margaritora, 1987; Hart, 1990). Unlike these, four species (*P. stylata*, *Collatheca pelagica*, *C. mutabilis*, *F. opoliensis*) reported to be oligotrophy indicators by Sládeček (1983) were also found in this study.

The presence of a large number of eutrophication indicator species (17) and a smaller number of oligotrophication indicator species (4) in the dam lake suggests that the dam lake is under the threat of eutrophication, despite being newly established. However, the low abundance of eutrophication indicator species suggests that the dam lake is not currently under the risk of eutrophication. The majority of the species detected are widespread, cosmopolitan species (Keppeler 2003; Keppeler and Hardy 2004; Segers 2007; Melo Júnior et al. 2007; Santos et al., 2013) that have been detected in previous studies in this region (Eastern Mediterranean inland waters).

Some of the species in the study; *A. sieboldii*, *B. angularis*, *B. quadridentatus*, *C. gibba*, *C. pelagica*, *C. adriatica*, *C. colurus*, *F. longiseta*, *K. cochlearis*, *K. quadrata*, *K. tecta*, *L. bulla*, *L. closterocerca*, *L. flexilis*, *L. luna*, *L. pyriformis*, *L. patella*, *P. quadricornis*, *P. dolichoptera*, and *T. pusilla* have been reported to tolerate a wide range of conductivity (Arcifa et al., 1994; De Ridder and Segers, 1997; Baribwegure and Segers, 2001; Pattnaik, 2014). Some others; *B. calyciflorus*, *P. quadricornis*, *L. luna*, *C. adriatica*, *C. colurus*, *C. mutabilis*, *L. patella*, *T. patina*, *Nitokra hibernica* and acidic *K. cochlearis* and *C. gibba* have been reported to be euryhaline (De Smet 1996; De Ridder and Segers 1997; Fontaneto et al. 2006; Jersabek and Bolortsetseg, 2010; Defaye and Dussart 2011). The fewer species in the study are; *B. quadridentatus*, *B. urceolaris*. *L. bulla, L. flexilis*, *L. rhomboides* and *R. neptunia* have high tolerance to alkaline waters (De Smet, 1996; Ramdani et al., 2001; Rybak and Bledzki, 2010; De Smet, 1996; Rybak and Bledzki, 2010).

In this study, some species (*L. aculeate*, *L. flexilis*, *L. hamata*, benthic *L. inermis*, *L. stenroosi*, *C. colurus*, *L. patella*, *C. forficula*, *E. najas*, *D. hertzogi*, *C. pelagica*, *C. mutabilis*, *D. epicharis*, benthic *M. laticornis* and *I. sordidus*) was found only on plants. It has been reported by various researchers that the same species are commonly found on littoral plants and to a lesser extent on plankton (Koste, 1978; De Smet, 1993; Hingley, 1993; Segers, 1995; De Manuel Barrabin, 2000; Kuczynska-Kippen, 2000). Therefore, it is thought that the fact that it was found only on plants in the study is due to its general ecological characteristics.

Some species in the study (*A. coelata*, *B. angularis*, *B. budapestinensis*, *B. calyciflorus*, *B. falcatus*, *K. cochlearis*, *K. quadrata*, *K. tecta*, *P. vulgaris*, *S. stylata*, *A. sieboldi*, *P. sulcata*, *F. opoliensis*, *P. tentaculatus*, *M. micrura*, *C. vicinus*, *E. sieboldi*, *L. cyprinacea*) were never found on plants and were only found in plankton. Researchers have reported that these species are widely distributed, mostly found in pelagic, but less commonly on plants and benthic (Hutchinson, 1967; Ruttner-Kolisko, 1974; Margalef et al., 1976; Braioni and Gelmini, 1983; Koste and Shiel, 1986, 1987; Ramdani et al., 2001; Santos et al., 2013).

The crustacean parasitic copepods, *Lernaea cyprinacea* and *Ergasilus sieboldi*, have a life cycle in which males are free-living and adult females go through a free-living stage before becoming parasitic and feed on algae (Molnar and Szekely, 1997; Hossain et al., 2018). Therefore, due to the life cycle of these species, not all stages are parasitic and it is quite normal for them to be found in plankton.

CONCLUSION

The zooplankton species in the dam lake consist of cosmopolitan, widely distributed species that tolerate a wide range of conductivity, salinity and alkalinity. Rotifera was the dominant group, followed by Copepoda and Cladocera. The dominant families were Brachionidae and Lecanidae (Rotifera), Chydoridae (Cladocera) and Cyclopoidae (Copepoda). Although the dam lake is newly established, considering the high number of eutrophication indicator species (17 species).

COMPLIANCE WITH ETHICAL STANDARDS

Conflict of Interest

The author declares that there is no conflict of interest.

Ethical Approval

For this type of study, formal consent is not required. Permission to take water samples was obtained from the Ministry of Agriculture and Forestry with the official letter number E-67852565-140.03.03-5292356.

Funding

Not applicable.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon request.

REFERENCES

Apaydın Yağcı, M. (2016). Variations in the zooplankton species structure of eutrophic lakes in Turkey. In M. N. Rashed (Ed.), *Lake Sciences and Climate Change* (Chapter 5, pp. 1-24). InTech Open. http://doi.org/10.5772/63749

Apostolov, A., & Marinov, T. M. (1988). Copepoda Harpacticoida (morski kharpaktikoidi). Copepoda, Harpacticoida (marine harpacticoids). *Fauna Bulgarica*, *18*, 1–384. [in Bulgarian]

Arcifa, M. S., Castilho, M. S. M., & Carmouze, J. P. (1994). Composition et évolution du zooplancton dans unelagune tropicale (Brésil) au cours d´une période marquée par une mortalité de poissons. *Revue D'hydrobiologie Tropicale*, *27*, 251-263

Baribwegure, D., & Segers, H. (2001). Rotifera from Burundi: The Lepadellidae (Rotifera: Monogononta). *Hydrobiologia*, *446/447*, 247-254. https://doi.org/10.1051/limn/2000022

Bednarz, T., Starzecka, A., & Mazurkiewicz-Boroń, G. (2002). Microbiological processes accompanying the blooming of algae and cyanobacteria. *Wiadomości Botaniczne*, *46*(1-2), 45-55 (in Polish).

Berzins, B., & Bertilsson, J. (1990). Occurrence of limnic microcrustaceans in relation to pH and humic content in Swedish water bodies. *Hydrobiologia*, *199*, 65-71. https://doi.org/10.1007/BF00007834

Borutsky, E. V. (1964). Freshwater Harpacticoida. Fauna of U.S.S.R. (Crustacea), Vol. 3. Israel Program for Scientific Translations 607.

Bozkurt, A., & Genç, M. A. (2018). Zooplankton fauna of some temporary volcanic lakes in Gaziantep. *Journal of Limnology and Freshwater Fisheries Research*, *4*(2), 118- 121. https://doi.org/10.17216/LimnoFish.354205

Braioni, M. G., & Gelmini, D. (1983). Rotiferi Monogononti. Guida per il Riconoscimento Delle Specie Animali Delle Acque Interne Italiane. Consiglio Nazionale Delle Ricerche (in Italian).

Brito, S. L., Maia-Barbosa, P. M., & Pinto-Coelho, R. M. (2011). Zooplankton as an indicator of trophic conditions in two large reservoirs in Brazil. *Lakes & Reservoirs: Research and Management*, *16*(4), 253-264. https://doi.org/10.1111/j.1440-1770.2011.00484.x

Brun, P., Zimmermann, N. E., Graham, C. H., Lavergne, S., Pellissier, L., Münkemüller, T., & Thuiller, W. (2019). The productivity-biodiversity relationship varies across diversity dimensions. *Natural Communation*, *10*, 5691. https://doi.org/10.1038/s41467-019- 13678-1

Ceirans, A. (2007). Zooplankton indicators of trophy in Latvian lakes. *Acta Universitatis Latviensis*, *723*, 61-69.

Crosetti, D., & Margaritora, F. G. (1987). Distribution and life cycles of cladocerans in temporary pools from central Italy. *Freshwater Biology*, *18*, 165-175.

Damian-Georgescu, A. (1970). *Fauna Republicii Socialiste Romania, Crustacea. Vol. IV. Fasc. 11. Copepoda, Harpacticoida.* Ed. Acad. R.P.R.

De Manuel Barrabin, J. (2000). The rotifers of Spanish reservoirs: Ecological, systematical and zoogeographical remarks. *Limnetica*, *19*, 91-167. https://doi.org/10.23818/limn.19.08

De Ridder, M., & Segers, H. (1997). Rotifera Monogononta in six zoogeographical regions after publications between 1960-1992. Van Goethem, J. (Ed.), *Studiedocumenten van het Koninklijk Belgisch Instituut voor Natuurwetenschappen*, 481.

De Smet, W. H. (1993). Report on rotifers from Barentsoya, Svalbard (78°30'N). *Fauna Norvegica Series*, *A 14*, 1-26.

De Smet, W. H. (1996). *The Prolidae (Monogononta). Vol. 4*. SPB Academic Publishing.

Defaye, D., & Dussart, B. (2011). World directory of Crustacea: Copepoda of inland waters. Backhuys & Margraf, Weikersheim.

Dorak, Z. (2013). Zooplankton abundance in the lower Sakarya river basin (Turkey): Impact of environmental variables. *Journal of Black Sea/Mediterranean Environment*, *19*(1), 1- 22.

Dorak, Z., Köker, L., Gaygusuz, Ö., Gürevin, C., Akçaalan, R. & Albay, M. (2019). Zooplankton biodiversity in reservoirs of different geographical regions of Türkiye: Composition and distribution related with some environmental conditions. Aquatic Sciences and Engineering, 34(1): 29-38. https://doi.org/10.26650/ASE2019522326

Dussart, B. (1967). Les Copepodes des eaux continentales d'europe occidentale, tomeı, calanoides et harpacticoides. Editions N. Boubee, et cie, Paris, 500 pp.

Dussart, B. H. (1969). *Les Copepodes de eaux continentales d'Europe occidentale. Tome 2, Cyclopoides et biologie*. Boubée et Cie.

Estlander, S., Nurminen, L., Olin, M., Vinni, M., & Horppila, J. (2009). Seasonal fluctuations in macrophyte cover and water transparency of four brown-water lakes: implications for crustacean zooplankton in littoral and pelagic habitats. *Hydrobiologia*, *620*, 109-120. https://doi.org/10.1007/s10750-008-9621-8

Fontaneto, D., De Smet, W. H., & Ricci, C. (2006). Rotifers in thalassic environments: Re-evaluation of an inconspicuous taxon. *Journal of the Marine Biological Association of the United Kingdom* *86*(4), 623-656. https://doi.org/10.1017/S0025315406013531

Hansen, A. M. & Jeppesen, E. (1992). Life cycle of *Cyclops vicinus* in relation to food availability, predation, diapause and temperature. *Journal of Plankton Research*, *14*(4), 591-605. https://doi.org/10.1093/plankt/14.4.591

Hart, R. C. (1990). Copepod post-embryonic durations: pattern, conformity, and predictability. The realities of isochronal and equiproportional development, and trends in the copepodids–naupliar duration ratio. *Hydrobiologia*, *206*, 175-206. https://doi.org/10.1007/BF00014085

Heneash, A. M. M., & Alprol, A. E. (2020). Monitoring of water quality and zooplankton community in presence of different dietary levels of commercial wood charcoal of red tilapia. *Journal of Aquaculture Research and Development*, *11*(6), 592. https://doi.org/10.35248/2155-9546.20.11.592

Herzig, A. (1987). The analysis of planktonic rotifer populations: Plea for long-term investigations. *Hydrobiologia*, *147*, 163-180.

Hingley, M. (1993). *Microscopic Life in Sphagnum*. Richmond Publishing Co. Ltd.

Holynska, M., Reid, J. W., & Ueda, H. (2003). Genus *Mesocyclops* Sars, 1914. In H. Ueda & J. W. Reid (Eds.), *Copepoda: Cyclopoida Genera Mesocyclops and Thermocyclops* (pp. 12-214). Backhuys Publishers.

Hossain, M. M. M., Ferdoushi, J., & Rupom, A. (2018). Biology of anchor worms (*Lernaea cyprinacea*). *Journal of Entomology and Zoology Studies*, *6*(1), 910-917. https://doi.org/10.22271/j.ento.2018.v6.i1m.3047

Hutchinson, G. E. (1967). *A treatise on limnology. Vol. 2. Introduction to lake biology and the limnoplankton*. Wiley.

İpek Alış, N., & Saler, S. (2016). Zooplankton Fauna of Özlüce Dam Lake (Bingöl - Turkey). *BEU Journal of Science*, *5*(1), 86-90. https://doi.org/10.17798/beufen.11633

Ismail, A. H., & Adnan, M. A. A. (2016). Zooplankton composition and abundance as indicators of eutrophication in two small man-made lakes. *Tropical Life Sciences Research*, *27*(Supp. 1), 31-38. https://doi.org/10.21315/tlsr2016.27.3.5

Ivanova, M. B., & Kazantseva, T. I. (2006). Effect of water pH and total dissolved solids on the species diversity of pelagic zooplankton in lakes: A statistical analysis. *Russian Journal of Ecology*, *37*(4), 264-270. https://doi.org/10.1134/S1067413606040084

Jamila, I., Yousuf, A. R., & Parveen, M. (2014). Rotifer community of Manasbal Lake of Kashmir. *International Journal of Fisheries and Aquatic Studies*, *1*(6), 190-198.

Jana, B. B. & Pal, G. P. (1985). Life history parameters of *Moina micrura* (Kurz.) grown in different culturing media. *Water Research*, *19*, 863-867.

Jersabek, C. D., & Bolortsetseg, E. (2010). Mongolian rotifers (Rotifera, Monogononta): A checklist with annotations on global distribution and autecology. *Proceedings of the Academy of Natural Sciences of Philadelphia*. *159*, 119-168. https://doi.org/10.1635/053.159.0108

Karaytug, S. (1999). Genera Paracyclops, Ochridacyclops and Key to the Eucyclopinae. *Guides to the Identification of the Microinvertebrates of the Continental Waters of the World*. Backhuys.

Karpowicz, M., Ejsmont-Karabin, J., Kozłowska, J., Feniova, I., & Dzialowski, A. R. (2020). Zooplankton community responses to oxygen stress. *Water*, *12*, 706. https://doi.org/10.3390/w12030706

Keppeler, E. C. (2003). Comparative study of the zooplankton composition of two lacustrine ecosystems of southwestern Amazonia. *Acta Scientiarum*, *25*, 467–477.

Keppeler, E. C., & Hardy, E. R. (2004). Vertical distribution of zooplankton in the water column of Lago Amapá, Rio Branco, Acre, Brazil. *Revista Brasileira de Zoologia*, *21*(2), 169-177. https://doi.org/10.1590/S0101-81752004000200002

Koste, W. & Shiel, R. J. (1986). Rotifera from Australian inland waters. I. Bdelloidea (Rotifera: Digononta). *Marine and Freshwater Research*, *37*, 765-792

Koste, W., & Shiel, R. J. (1987). Rotifera from Australian inland waters II. Epiphanidae and Brachionidae (Rotifera: Monogonta). *Invertebrate Taxonomy*, *7*, 949-1021. https://doi.org/10.1071/IT9870949

Koste, W. (1978). *Die Radertiere Mitteleuropas Ein Bestim-mungswerk, Begründet Von Max Voigt. Überordnung Mono-gononta*. 2 Auflage Neubearbeitet Von II. Tefelband.

Kuczynska-Kippen, N. (2000). Seasonal changes of the rotifer community in the littoral zone of a polymictic lake. Verhandlungen des Internationalen *Verein Limnologie*, *27*, 2964-2967. https://doi.org/10.1080/03680770.1998.11898216

Margalef, R., Planas, D., Armengol, J., Vidal, A., Prat, N., Guiset, A.., Toja, J., & Estrada, M. (1976). *Limnología de los Embalses Españoles*. Dirección General de Obras Hidráulicas Ministerio de Obras Públicas (in Spanish).

Melo Junior, M. D., Paranagua, M. N., Schwamborn, R., Leitao, S. N., & Ekau, W. (2007). Fluxes of zooplankton biomass between a tidal estuary and the sea in Northeastern Brazil. *Brazilian Journal of Oceanography*, *55*, 239–249. https://doi.org/10.1590/S1679-87592007000400001

Molnár, K., & Székely, C. S. (1997). An unusual location for *Ergasilus sieboldi* Nordmann (Copepoda, Ergasilidae)) on the operculum and base of pectoral fins of the pikeperch (*Stizostedion lucioperca* L.). *Acta Veterinaria Hungarica*, *45*(2), 165–175.

Mustapha, M. K. (2009). Zooplankton assemblage of Oyun Reservoir, Offa, Nigeria. *Revista de Biología Tropical*, *57*(4), 1027-1047. https://doi.org/10.15517/rbt.v57i4.5444

Negrea, S. T. (1983). *Fauna Republici Socialiste Romania: Crustacea Cladocera*. Academia Republici Socialiste Romania.

OSİB. (2015). *Surface water quality regulation*. Republic of Turkey Ministry of Forestry and Water Affairs. (in Turkish).

Pattnaik, B. S. (2014). Determination of rotifer distribution to trophic nature of ponds. *Indian Journal of Applied Research*, *4*(4), 25-26. https://doi.org/10.15373/2249555X/APR2014/5

Pesce, G. L., & Maggi, D. (1981). Cyclopoides et calanoïdes des eaux phréatiques de la Grèce méridionale et insulaire (Crustacea: Copepoda). *Ecologia Mediterranea, 7*(1), 163-182.

Petrusek, A. (2002). Moina (Crustacea: Anomopoda, Moinidae) in the Czech Republic: A review. *Acta Societatis Zoologicae Bohemicae, 66*, 213-220.

Ramdani, M., Elkhiati, N., Flower, R. J., Birks, H. H., Kraïem, M. M., Fathi, A. A., & Patrick, S. T. (2001). Open water zooplankton communities in North African wetland lakes: The CASSARINA Project. *Aquatic Ecology, 35*, 319-333. https://doi.org/10.1023/a:1011926310469

Reddy, R. (1994). *Phyllodiaptomus praedictus* n. sp. (Copepoda, Calanoida) from Thailand. *Hydrobiologia, 273*, 101-110. https://doi.org/10.1007/BF00006852

Rossetti, G., Viaroli, P., & Ferrari, I. (2009). Role of abiotic and biotic factors in structuring the metazoan plankton community in a lowland river. *River Research and Applications*, *25*(7), 814-835. https://doi.org/10.1002/rra.1170

Ruttner-Kolisko, A. (1974). *Plankton Rotifers: Biology and Taxonomy.* E. Schweizerbart'sche Verlagsbuchhandlung.

Rybak, J. I., & Błędzki, L. A. (2010). *Freshwater planktonic crustaceans.* Warsaw: Warsaw University Press.

Rylov, V. M. (1963). *Fauna of The U.S.S.R. Crustacea, Vol. III, No. 3, Freshwater Cyclopoida.* I.P.S.T.

Saler, S., Bulut, H., Güneş, S., Alpaslan, K., & Karakaya, G. (2019). Seasonal variations of zooplankton in Nazik Lake (Turkey). *Turkish Journal of Science & Technology, 14*(2), 79-84.

Sales, J. (2011). First feeding of freshwater fish larvae with live feed versus compound diets: A meta-analysis. *Aquaculture International, 19*, 1217–1228. https://doi.org/10.1007/s10499-011-9424-1

Santos, M. J. A., dos Keppeler, E. C., Vieira, L. J. S., Serra, A. J., & Ferraudo, A. S. (2013). Zooplankton composition in five oxbow lakes from the Upper Juruá River, Acre State, Brazil. *Revista Peruana de Biología, 20*(2), 137-144.

Scourfield, D. J., & Harding, J. P. (1966). A key to British species of freshwater Cladocera with notes on their ecology (3rd ed.). *Freshwater Biological Association Scientific Publication* 5.

Segers, H. (1995). Rotifera. Vol. 2, the Lecanidae (Monogononta). In H. J. F. Dumont & T. Nogrady (Eds.), *Guides to the Identification of the Microinvertebrates of the Continental Waters of the World* (Vol. 6, pp. 142-167). SPB Academic Publishing.

Segers, H. (2007). Annotated checklist of the rotifers (Phylum Rotifera) with notes on nomenclature, taxonomy and distribution. *Zootaxa, 1564,* 1-104. https://doi.org/10.11646/zootaxa.1564.1.1

Shah, J. A., & Pandit, A. K. (2013). Relation between physicochemical limnology and crustacean community in Wular Lake of Kashmir Himalaya. *Pakistan Journal of Biological Sciences, 16*(19), 976–983. https://doi.org/10.3923/pjbs.2013.976.983

Sharma, P., Pandey, S., Meena, B. S., & Singh, N. P. (2007). Knowledge and adoption of livestock feeding practices in Jhansi district of Bundelkhand. *Indian Journal of Dairy Sciences, 60*(1), 63-67.

Sládeček, V. (1983). Rotifers as indicators of water quality. *Hydrobiologia, 100*, 169-201. https://doi.org/10.1007/BF00027429

Smirnov, N. N. (1974). *Fauna of U.S.S.R. Crustacea. Vol I, No: 2, Chydoridae.* I.P.S.T.

Soyer, J. (1970). Bionomie benthique du plateau continental de la côte catalane française. III. Les peuplements de Copépodes Harpacticoides. *Vie et Milieu, 21*, 337–511.

Svanberg, J., Ardeshiri, T., Samsten, I., Ohman, P., Rana, T., & Danielson, M. (2022). Prediction of environmental controversies and development of a corporate environmental performance rating methodology. *Journal of Cleaner Production, 344,* Article 130979. https://doi.org/10.1016/j.jclepro.2022.130979

Şimşek, E. (2022). First record of economically important big-scale sand smelt (*Atherina boyeri* Risso, 1810, Pisces: Atherinidae) with some biological parameters from Reyhanlı Dam Lake, Türkiye. *Oceanological and Hydrobiological Studies, 51*(4), 337–343. https://doi.org/10.26881/oahs-2022.4.03

Tavşanoğlu, U. N., Maleki, R., & Akbulut, N. (2015). Effects of salinity on the zooplankton community structure in two maar lakes and one freshwater lake in the Konya Closed Basin, Turkey. *Ekoloji, 24*(94), 25-32. https://doi.org/10.5053/ekoloji.2015.944

Tessier, A. J., & Horwitz, R. J. (2011). Influence of water chemistry on size structure of zooplankton assemblages. *Canadian Journal of Fisheries and Aquatic Sciences, 47*(10), 1937-1943. https://doi.org/10.1139/f90-218

Viet, N. D., Bac, N. A., & Huong, H. T. T. (2016). Dissolved oxygen as an indicator for eutrophication in freshwater lakes. In *Proceedings of International Conference on Environmental Engineering and Management for Sustainable Development* (p. 690).

Voigt, M., & Koste, W. (1978). *Rotatoria. Überordnung Monogonanta.* I. Textband, 650 pp., II. Tafelband, 234 pp., Gebrüder Borntraeger.

Wetzel, R. G. (1983). *Limnology* (2nd ed.). Saunders College Publishing.

Yuksel, I. (2015). Water management for sustainable and clean energy in Turkey. *Energy Reports*, *1*, 129-133. https://doi.org/10.1016/j.egyr.2015.05.001