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Preliminary systematic investigation of the zooplankton fauna in the streams of Gürün District (Sivas, Türkiye)

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A B S T R A C T

A total of 34 species were detected over 5 locations in 4 distinct water bodies within the Gürün (Sivas) and Elbistan (Kahramanmaraş) districts, comprising 21 species of Rotifera, 9 species of Cladocera, and 4 species of Copepoda. Fifteen families were found, comprising ten families of Rotifera, three families of Cladocera, and two families of Copepoda. The Lecanidae and Lepadellidae families are the most diverse, each comprising five species. *Colurella adriatica* was detected at all sampling locations, whereas *Lecane closterocerca*, *Lecane lunaris*, and *Lepadella patella* were discovered at four sampling sites. In addition, in the locality where no zooplankton studies have previously been conducted, four species were classified as constant (F≥50%), six species as common (50%>F≥25%), and twenty-four species as rare (F<25%) according to Soyer's frequency index (%F).

INTRODUCTION

Zooplankton, constituting the second tier in the food chain that conveys energy from producers to consumers, are a crucial component of aquatic ecosystems (Sharma et al., 2010). These creatures are vital for the regulation and operation of aquatic ecosystems and are fundamental elements of the food web in aquatic environments (Lampert and Sommer, 1997; Moss, 1988).

Zooplankton communities purify water in natural ecosystems, enhancing various aquatic conditions and providing a crucial food source for numerous fish larvae and invertebrates (Sharma, 2020; Shurganova, 2007). The abundance and species diversity of these organisms are directly correlated with water quality and act as indicators of pollution, eutrophication, and overall water characteristics, contingent upon the trophic level of the aquatic ecosystem they inhabit (Berzins and Pejler, 1987; Gannon and Stemberger, 1978). Zooplankton are essential in the pelagic food web, facilitating the transport of photosynthetic energy to higher trophic levels. They significantly influence the regulation of yearly catch rates of commercial fish populations, especially during the initial feeding phases of fish larvae and their succeeding instars. Zooplankton play a vital role in shaping the composition and number of particles that reach the benthos, supplying nutrients for benthic species and directly regulating several ecosystem processes.

Although Türkiye is not a water-rich country, it has significant river (estimated at over 8,000 km²) and standing water (approximately 10,000 km²) resources. The zooplankton diversity of these waters has not yet been fully investigated, and further research is needed to

comprehensively assess the country's zooplankton fauna. This study, conducted at a sampling site where no previous zooplankton studies have been carried out, aimed to identify the zooplankton in the Tohma Stream, Sularbaşı Stream, Bahçeiçi Village (Tıhmın) Stream, Şuğul Valley, and Horhor Stream adjacent to Horhor Village in the Elbistan District of Kahramanmaraş Province.

MATERIALS AND METHODS

Sampling Area

The research was performed in aquatic environments located within the Gürün District of Sivas Province and the Elbistan District of Kahramanmaraş Province. Samples were collected from Sularbaşı Village Sazcağız Creek (38° 46' 59.45'' N, 37° 18' 28.53'' E), Bahçeiçi Village (Tıhmın) (38° 42' 02.72'' N, 37° 22' 12.15'' E), Tohma Stream (Bahçeiçi Village and Gürün Şuğul Valley) (38° 42' 47.11'' N, 37° 19' 55.22'' E; 38° 45' 12.19'' N, 37° 14' 07.96'' E), and Horhor Creek (38° 31' 12.06'' N, 37° 14' 32.81'' E) (Figure 1).

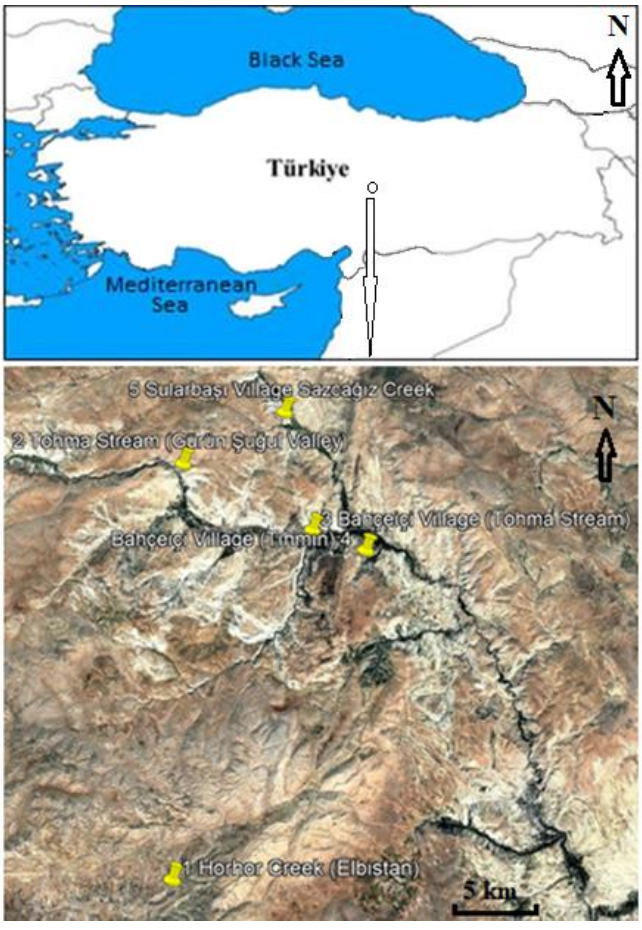

Figure 1. Map of the study and sampling stations

The Tohma Stream is a significant tributary of the Euphrates River, starting in Sivas Province and discharging into the Karakaya Dam in Malatya. The stream is created by the convergence of two principal tributaries: The Kangal Tohma, which emanates from the Dikkulak (Karatonus) Mountains near Şarkışla. The Gürün Tohma, originating in the Tahtalı Mountains, merges with the Sazcağız and Gökpınar streams inside the boundaries of the Gürün district, where both Tohma tributaries confluence near Malatya. The Tohma Stream measures around 52.5 kilometers in length (www.Malatya.gov.tr). The Bahçeiçi Village Reservoir was created by capturing the spring water from the Özdere region, previously referred to as Tıhmın, located 15 km from the Gürün district. Upon exiting the spring, the water promptly traverses a tiny stream around 2 km in length before entering the Tohma Stream. The sample was extracted from a pool created at the spring. Horhor Creek is a little watercourse situated in proximity to Horhor Village along the Gürün road. The Sazcağız Creek begins in Sularbaşı hamlet, located 13 km north of the Gürün district center, traverses the hamlet, and converges with the Tohma Stream around 7 km downstream (Figure 1).

Sampling and Evaluation

Zooplankton sampling occurred once in August 2025 at the specified coordinates. Sampling was conducted utilizing a plankton net including a 60 μm mesh size, a 30 cm mouth diameter, and a length of 1 m. Sampling was performed in the streams by maintaining the plankton net stationary while allowing water to flow through the segment for approximately 25-30 minutes. In still waters, zooplankton samples were collected by throwing the plankton net 15-20 meters away from the shore and pulling it back, and this process was repeated 10 times. Samples were contained in 500 ml plastic bottles and stored with 4% formaldehyde. Zooplankton specimens were analyzed utilizing an inverted microscope and a binocular microscope (Olympus CH40). Approximately 20 cc of subsamples were extracted from each sample, and identifications were conducted in petri dishes. This approach was employed a minimum of three times to ascertain all species present.

Zooplankton abundance was not quantified but was qualitatively assessed based on visual observations, categorized into three levels: low, abundant, and very abundant. Soyer's (1970) frequency index (%F) was employed to quantify the prevalence of zooplankton species categorized as constant (F≥50%), common (50%>F≥25%), and rare (F<25%) (Table 2). Zooplankton was identified utilizing the taxonomic keys of Scourfield and Harding (1966), Dussart (1969), Damian-Georgescu (1970), Smirnov (1974), Ruttner Kolisko (1974), Kiefer and Fryer (1978), Koste (1978), Negrea (1983), Ranga Reddy (1994), Borutsky (1964), Nogrady and Pourriot (1995), Segers (1995), De Smet (1996), and Dussart and Defaye (2001).

RESULTS

A total of 34 species were discovered, comprising 21 from Rotifera (62%), 9 from Cladocera (26%), and 4 from Copepoda (12%) (Table 1). Ten families were identified within Rotifera, with Lecanidae and Lepadellidae each comprising the highest number of species, totaling five species per family. Brachionidae, Mytilinidae, and Notammatidae constituted the second most prevalent families, each comprising 2 species. The remaining five families were represented by a single species each. Three families from Cladocera were identified: Chydoridae, which has the most species; Daphnidae, with three species; and Bosminidae, with one species (Table 1). Copepoda was represented by two families: Cyclopidae, including three species, and Ameiridae, comprising one species. *Colurella adriatica* was detected in all sampling locations, but *Lecane closterocerca*, *Lecane lunaris*, and *Lepadella patella* were identified in four sampling instances. The remaining species were few, identified in two and one samples (Table 1).

Table 1. List and abundance of zooplankton species in the sampling areas

Sampling Stations	1	2	3	4	5	F%
Rotifera						
Brachionidae						
Keratella cochlearis (Gosse, 1851)	-	-	*	-	-	**20**
Keratella tecta (Gosse, 1851)	-	-	-	*	-	**20**
Lecanidae						
Lecane closterocerca (Schmarda, 1859)	*	*	-	*	*	**80**
Lecane flexilis (Gosse, 1886)	*	-	-	*	-	**40**
Lecane lunaris (Ehrenberg, 1832)	*	*	*	*	-	**80**
Lecane stenroosi (Meissner 1908)	-	-	*	-	-	**20**
Lecane stichea Harring 1913	-	-	-	*	-	**20**
Lepadellidae						
Colurella adriatica Ehrenberg, 1831	*	+	*	*	*	**100**
Colurella uncinata (Müller, 1773)	*	-	-	-	-	**20**
Lepadella acuminata (Ehrenberg, 1834)	-	*	-	-	-	**20**
Lepadella ovalis (Müller, 1786)	-	*	-	-	-	**20**
Lepadella patella (Müller, 1773)	*	*	-	*	*	**80**
Synchaetidae						
Polyarthra dolichoptera Idelson, 1925	-	-	o	-	*	**40**
Trichocercidae						
Trichocerca weberi (Jennings, 1903)	-	*	-	-	*	**40**
Mytilinidae						
Mytilina mucronata (Müller, 1773)	-	-	-	*	-	**20**
Mytilina ventralis (Ehrenberg, 1830)	-	-	-	*	*	**40**
Euchlanidae						
Euchlanis dilatata Ehrenberg, 1832	*	-	-	-	-	**20**
Notommatidae						
Cephalodella gibba (Ehrenberg, 1830)	-	*	-	-	-	**20**
Taphrocampa selenura Gosse, 1851	*	-	-	-	-	**20**
Testudinellidae						
Testudinella patina (Hermann, 1783)	-	-	-	*	-	**20**
Asplanchnidae						
Asplanchna priodonta Gosse, 1850	-	-	o	-	-	**20**
Cladocera						
Bosminidae						
Bosmina longirostris (Müller, 1776)	-	-	+	-	*	**40**
Daphniidae						
Ceriodaphnia pulchella Sars, 1862	-	-	+	-	-	**20**
Daphnia galeata Sars, 1864	-	-	o	-	-	**20**
Daphnia longispina (Müller, 1776)	-	-	-	-	+	**20**
Chydoridae						
Biapertura affinis (Leydig, 1860)	-	-	*	-	-	**20**
Chydorus sphaericus (Müller, 1785)	-	-	*	-	-	**20**
Coronatella rectangula (Sars, 1862)	-	-	*	-	-	**20**
Disparalona rostrata (Koch, 1841)	-	-	*	-	-	**20**
Pleuroxus aduncus (Jurine, 1820)	-	-	*	-	-	**20**
Copepoda						
Cyclopidae						
Cyclops vicinus Uljanin, 1875	-	-	o	-	-	**20**
Macrocyclops albidus (Jurine, 1820)	-	-	*	-	-	**20**
Tropocyclops pracinus (Fischer, 1860)	*	-	-	+	-	**40**
Ameiridae						
Nitokra hibernica (Brady, 1880)	-	*	-	-	-	**20**

***1:** Horhor Creek, **2:** Tohma Stream –Gürün Şuğul Valley, **3:** Tohma Stream –Bahçeiçi Village, **4:** Bahçeiçi Village –Tıhmın, **5:** Sazcağız Creek –Sularbaşı Village) **-:** Absent, ***:** few (rare F<25%), **+:** abundant (Common 50%>F≥25%), **o:** very abundant (Constant F≥%50)*

The results were categorized as constant (F≥50%), common (50%>F≥25%), and rare (F<25%) species, based on Soyer's (1970) frequency index (%F). *Colurella adriatica* exhibited the highest prevalence (100%) across all samples among these several species. The prevalent species included *Lecane closterocerca, Lecane lunaris*, and *Lepadella patella* (80%), while other notable species comprised *Lecane flexilis*, *Polyarthra dolichoptera*, *Trichocerca weberi*, *Mytilina ventralis*, *Bosmina longirostris*, and *Tropocyclops pracinus* (40%) (Table 1).

DISCUSSION

This research is the first investigation of zooplankton in the Horhor Creek, Tohma Stream, Bahçeiçi Village-Tıhmın, and Sazcağız Creek, located within the Gürün District of Sivas Province and the Elbistan District of Kahramanmaraş. This research identified 34 species of zooplankton, with Rotifera comprising 62% of the overall count. Numerous studies indicate that rotifers prevail both qualitatively and quantitatively in stationary aquatic environments, including lakes, ponds, reservoirs, and wetlands (Jamila et al., 2014; Ismail and Adnan, 2016; Dorak et al., 2019). Nonetheless, despite the tested waters being flowing, rotifers were discovered to be predominant, similar to certain streams. Segers (2007) observed that rotifers inhabit nearly all varieties of freshwater environments, including big permanent lakes, small temporary ponds, intermediate and capillary waters, acidic mineral lakes, soda lakes, hyperoligotrophic mountain lakes, and sewage ponds.

Despite the presence of species recognized as effective indicators of eutrophic conditions and pollution in the study (*A. priodonta, Euchlanis dilatata, L. lunaris, K. cochlearis, K. tecta, P. dolichoptera, L. patella, T. patina, Taphrocampa selenura,* hypereutrophic *Lecane stichaea, B. longirostris, Ceriodaphnia pulchella, Coronatella rectangula, Chydorus sphaericus, D. longispina, D. galeata, P. aduncus, C. vicinus,* and *T. prasinus*) (Dussart, 1969; Voigt and Koste, 1978; Pesce and Maggi, 1983; Hansen and Jeppesen, 1992; Shah and Pandit, 2013; Heneash and Alprol, 2020; Timms, 1976; Vadadi-Fülöp et al., 2008), their minimal abundance (1-2 individuals per petri dish) indicates that the examined running waters are currently significantly distant from the risk of eutrophication. Oligotrophic lakes often display low biomass with a diverse array of species, whereas lakes in a "bloom" state, indicative of advanced eutrophy, demonstrate high biomass with reduced species diversity (Gliwicz, 1969; Odum, 1969). Moreover, Sladecek (1983) indicates that the genus *Brachionus* is predominantly located in eutrophic waters, whereas the genus *Trichocerca* demonstrates exclusively oligotrophic characteristics or resides in freshwater environments. In this study, *Lecane flexis, L. lunaris, L. clostrocerca, Lepadella ovalis, Polyarhra dolichoptera, Euchlanis dilatata, Asplanchna priodonta, Bosmina longirostris, Coronatella rectangula, Daphnia longispina, Pleuroxus aduncus, Cyclops vicinus* and *Nitokra hibernica* species were also found in Sevsak stream (Saler 2022). The study did not identify any species belonging to the genus *Brachionus. Brachionus quadridentatus* was also recorded in a survey conducted in the Mancınık Stream in the Sivas region. Besides, *L. clostrocerca* and *Biapertura affinis*, identified at stations 2 and 3 in this study, were also encountered in a survey conducted in the Mancınık Stream in the Sivas region (Apaydın Yağcı et al., 2017). The diversity of zooplankton species at stations 2 and 3 on the Tohma Stream exhibited a substantial disparity, favoring station 3. The prevalence of eutrophication indicator species and the species variation between the second and third stations is attributed to the existence of aquaculture operations in the studied streams, the streams traversing residential zones, and the confluence of smaller water bodies with the main stream.

Biapertura affinis, located in hypogean waters (Brancelj and Sket 1990), is a eurybiotic species that resides in both benthic sediments and vegetation in the peripheries of ponds, reservoirs, river floodplains, and both lowland and alpine lakes (Bledzki and Rybak 2016). *Disparalona rostrata* is prevalent in lakes and linked to rocky substrates, although it is infrequent in acidic, electrolyte-deficient waters (Shapiera et al., 2011). *M. albidus* and *T. prasinus* (Fischer, 1860) inhabit aquatic settings of varying dimensions, such as roadside ditches, pools, springs, seeps, marshes, leaf litter in rivers, streams, ponds, and other locales where an adequate food supply exists (Lee and Chang, 2007).

The majority of species examined in the study are recognized for their widespread distribution, cosmopolitan nature, and considerable tolerance to variations in water quality parameters, constituting common taxa within Türkiye's zooplankton fauna (Keppeler, 2003; Keppeler and Hardy, 2004; Segers, 2007; Ustaoğlu et al., 2012; Ustaoğlu, 2015; Koste and Shiel, 1989; De Manuel Barrabin, 2000; De Smet, 1996).

CONCLUSION

The zooplankton species in the examined streams comprise cosmopolitan, ubiquitous species that tolerate changes in environmental conditions. Rotifera constitutes the predominant group, succeeded by Cladocera and Copepoda. The predominant families are Lecanidae and Lepadellidae (Rotifera), Chydoridae (Cladocera), and Cyclopoidae (Copepoda). The limited diversity of organisms observed in the study hampers further commentary on the overall condition of the waters, except from their proximity to an oligotrophic nature. On the other hand, the data obtained from the study can guide future research.

COMPLIANCE WITH ETHICAL STANDARDS

Authors' Contributions

AB: Conception and Supervision, Data analysis and interpretation, Manuscript writing

MA: Field studies;

All authors approved the final draft.

Conflict of Interest

The authors declare that there is no conflict of interest.

Ethical Approval

The authors declare that formal consent is not required for this type of study.

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Data Availability

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

AI Disclosure

The authors confirm that no generative AI was used in writing this manuscript or creating images, tables, or graphics.

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