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DETERMINATION OF THE ZOOPLANKTON COMMUNITY DISTRIBUTION OF SAVRUN STREAM (KADİRLİ-OSMANİYE) IN AUTUMN AND WINTER

ABSTRACT

A total of 50 zooplankton species, including 41 Rotifera species, 5 Cladocera species and 4 Copepoda species, were identified in Savrun Stream. A total of 12 families were recorded from Rotifera, and Lecanidae was found to be the richest family with 12 species. Four families were recorded from Cladocera, Chydoridae was the richest family with 2 species and Cyclopoidae had 3 species from 2 families of Copepoda. *Rotaria rotatoria* (Rotifera), *Bosmina longirostris*, *Alona costata* (Cladocera) and *Paracyclops fimbriatus* (Copepoda), which were the most common zooplankton species found during the study. The abundance of zooplankton is quite low, and only 16 species were found in abundance (ıı) and low (ı) levels at various sampling times.

Keywords: Rotifer, Cladoceran, Copepod, Zooplankton, Savrun Stream

1. INTRODUCTION

It is well known that flowing water ecosystems such as streams and rivers high levels of biodiversity [1]. Zooplankton abundance is an indicator for eutrophication and pollution levels because zooplankton abundance and composition are closely related to water quality and show an increasing and decreasing pattern depending on the trophic levels of lakes [2]. Various pollutants affect global freshwater ecosystems by causing habitat degradation and loss of biodiversity [1 and 3] as well as greatly compromising the functioning and service of aquatic ecosystems [4 and 5]. Streams offer zooplankton a distinct, complex habitat and can support high numbers of microzooplankton [6]. In contrast to lacustrine zooplankton communities, which are usually dominated by larger cladocerans and copepods, river zooplankton communities may have the structure and function of rivers [7]. Plankton abundance in rivers is primarily influenced by two factors: those that influence the movement of organisms from source areas to the river and those that influence the growth and reproduction of organisms in the river [8]. With stagnant waters in contact with the canal, plankton can reach the river. The growth of zooplankton populations in rivers can also be aided by the incubation of eggs that are resting in river sediments [9].

Although zooplankton of stagnant waters was widely researched in Turkey, studies on running waters are relatively few. Some of these are Rotifer fauna of Gümüldür Stream (İzmir) [10], a taxonomic study on Riva Creek Zooplankton [11], rotifer and cladocer fauna [12] of Seyhan River (in the part of Adana city centre), the first

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observations on the fauna of the rivers in the North Aegean Region [13], the Euphrates Rotifers and their seasonal changes [14], the rotifers and seasonal changes of the Zıkkım Stream pouring into Hazar Lake (Elazığ) [15], Asi River rotifer fauna (Hatay, Turkey) [16], the first observations on the zooplankton (rotifer, cladocer and copepod) fauna of some rivers in Mediterranean Region [17], and Cladocera and Copepoda (Crustacea) Fauna of Asi River (Hatay, Turkey) [18].

2. RESEARCH SIGNIFICANCE

This study was carried out to determine the zooplankton fauna of Savrun Stream located in Kadirli district of Osmaniye province, which has not been studied on zooplankton until now.

The zooplankton and its distribution of Savrun Stream was not studied before. This study is the first research on zooplankton in the Savrun Stream. It is aimed that this study will contribute to future studies on zooplankton.

Highlights:

- Identification of zooplankton species.
- Determination of the variation of zooplankton species.
- Determination of species richness and diversity of species recorded in the stream

3. MATERIALS AND METHODS

Savrun Stream originates from Kahramanmaraş province, Göksun district, Mazgaç Mountain, Akgedik location and its total length is 83 km, and its length within the province is 65km. It passes through Kadirli district and joins the Ceyhan River.

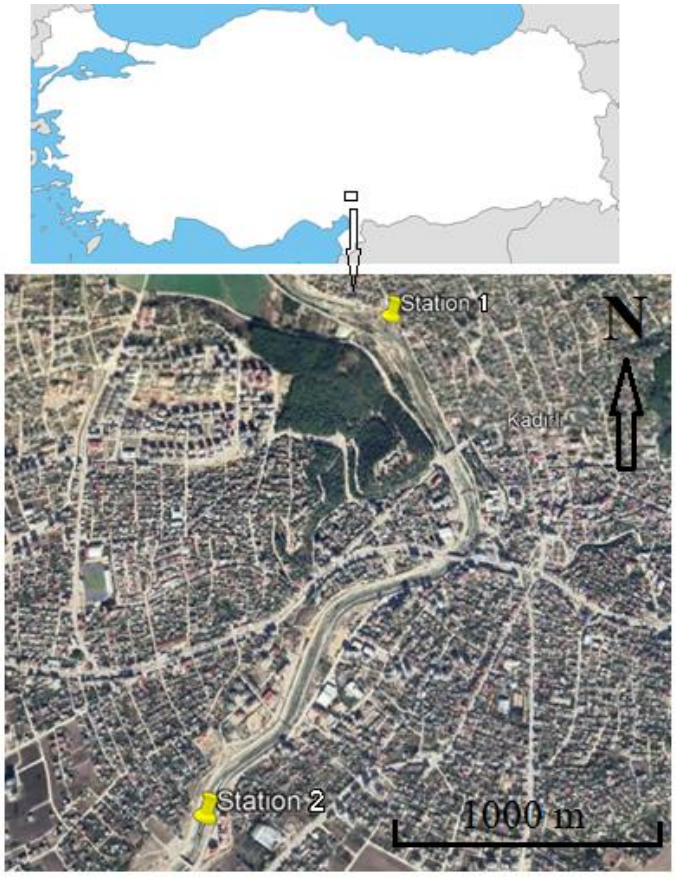

Figure 1. Savrun stream and sampling stations

Zooplankton samples were collected weekly between 03 October 2022 and 19 December 2022 from two stations located on Savrun Stream in Kadirli district of Osmaniye province (Figure 1). Samples were taken with a plankton net of 60µm mesh size, 30cm mouth diameter and 1 m length. Sampling was carried out from the flowing part of the water for approximately 25-30 minutes by keeping the plankton net constant. Samples were placed in 500 cc plastic containers and preserved in 4% formaldehyde. Zooplankton species were examined and identified using an inverted microscope and a binocular microscope (Olympus CH40). The specimens were identified using [19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31 and 32] and the relevant literature.

4. RESULTS AND DISCUSSION

Fourty one (41) species of Rotifera (82%), 5 species of Cladocera (10%), and 4 species of Copepoda (8%) were recorded in Savrun Stream (Table 1).

Table 1. List of zooplankton species in the stream

Rotifera	
Lecanidae *Lecane bulla* (Gosse, 1886) *Lecane closterocerca* (Schmarda,1859) *Lecane flexilis* (Gosse, 1886) *Lecane hamata* (Stokes, 1896) *Lecane luna* (Müller, 1776) *Lecane lunaris* (Ehrenberg, 1832) *Lecane inermis* (Bryce, 1892) *Lecane papuana* (Murray, 1913) *Lecane pyriformis* (Daday, 1905) *Lecane signifera* (Jennings, 1896) *Lecane scutata* (Harring & Myers, 1926) *Lecane stenroosi* (Meissner, 1908)	Testudinellidae *Testudinella patina* (Hermann, 1783) *Pompholyx sulcata* Hudson, 1885
	Trichotriidae *Trichotria tetractis* (Ehrenberg, 1830) *Macrochaetus sericus* (Thorpe, 1893)
	Mytilinidae *Lophocharis salpina* (Ehrenberg, 1834) *Mytilina bisulcata* (Lucks, 1912)
	Dicranophoridae *Dicranophorus epicharis* Harring & Myers, 1928
Lepadellidae *Colurella adriatica* Ehrenberg, 1831 *Colurella obtusa* (Gosse, 1886) *Colurella uncinata* (Müller, 1773) *Lepadella ehrenbergi* (Petry, 1850) *Lepadella ovalis* (Müller, 1786) *Lepadella patella* (Müller, 1773) *Lepadella triptera* (Ehrenberg, 1830) *Squatinella mutica* (Ehrenberg, 1832)	Scaridiidae *Scaridium longicaudum* (Müller, 1786)
	Notommatidae *Cephalodella gibba* (Ehrenberg, 1830)
	Philodinidae *Rotaria rotatoria* (Pallas, 1766)
	Cladocera
	Bosminidae *Bosmina longirostris* (Müller, 1776)
Brachionidae *Brachionus angularis* Gosse, 1851 *Kellicottia longispina* (Kellicott, 1879) *Keratella cochlearis* (Gosse, 1851) *Keratella tecta* (Gosse, 1851) *Keratella quadrata* (Müller, 1786)	Chydoridae *Alona costata* Sars, 1862 *Chydorus sphaericus* (Müller, 1776)
	Ilyocryptidae *Ilyocryptus sordidus* (Liévin, 1848)
	Macrothricidae *Macrothrix laticornis* (Jurine, 1820)
Euchlanidae *Euchlanis dilatata* Ehrenberg, 1832 *Euchlanis triquetra* Ehrenberg, 1838 *Dipleuchlanis propatula* (Gosse, 1886)	Copepoda
Trichocercidae *Trichocerca elongata* (Gosse, 1886) *Trichocerca longiseta* (Schrank, 1802) *Trichocerca tigris* (Müller, 1786)	Cyclopidae *Eucyclops serrulatus* (Fischer, 1851) *Mesocyclops leuckarti* (Claus, 1857) *Paracyclops fimbriatus* (Fischer, 1853)
	Parastenocarididae *Kinnecaris xanthi* Bruno & Cottarelli, 2015

According to the data obtained, the most dominant zooplankton group was Rotifera followed by Cladocera and Copepoda. A total of 12 families were recorded among Rotifera. Lecanidae were the richest family with 12 species, followed by Lepadellidae with 8 species, Brachionidae with 5 species. Other families, Euchlanidae, Trichocercidae 3 species each, Testudinellidae, Trichotriidae,

Mytilinidae 2 species each, Dicranophoridae, Scaridiidae, Notommatidae and Philodinidae were each represented with 1 species. Four families were recorded from Cladocera. Chydoridae was the richest family with 2 species, followed by Bosminidae, Ilyocryptidae and Macrothricidae were represented by one species each (Table 1). Among the 2 families of Copepoda, Cyclopoidae had 3 species, and the other family Parastenocarididae was represented by one species (Table 1).

According to Table 2, the most widely distributed rotifers found in all sampling time during the study *Rotaria rotatoria*. In the study, *Colurella adriatica* was found in ten samplings, *Lecane hamata* in nine samplings, *Lepadella patella*, *Euchlanis dilatata* and *Trichotria tetractis* in eight samplings. Other species found in most sampling were *Lecane bulla*, *Colurella uncinata* (7 times), *Lecane closterocerca*, *Lecane stenroosi*, *Trichocerca tigris*, *Keratella tecta*, and *Cephalodella gibba* (6 times). For the Cladocera, *Bosmina longirostris* and *Alona costata* recorded at 7 sampling, had the largest distribution range. On the other hand, *Paracyclops fimbriatus* had the largest distribution range (found in 4 sampling times) among the copopods.

Some species, *Lecane pyriformis*, *L. signifera*, *Squatinella mutica*, *Brachionus angularis*, *Kellicottia longispina*, *Keratella quadrata*, *Euchlanis triquetra*, *Dipleuchlanis propatula*, *Trichocerca elongata*, *Trichocerca longiseta*, *Testudinella patina*, *Mytilina bisulcata*, *Dicranophorus epicharis*, *Scaridium longicaudum* (Rotifera), *Macrothrix laticornis* (Cladocera), *Kinnecaris xanthi* (Copepoda) were found at only one sampling (Table 2). As a result of the quantitative analysis, it was observed that the abundance of zooplankton was quite low. In the study in which a total of 50 species were recorded, only 16 species were abundant (11) and few (1) levels in various sampling time, while other species were fewer amounts. *Trichocerca tigris* (4th sampling time) and *Rotaria rotatoria* (6th sampling time) were abundant (11) (Table 3). The species that were few (1) at various sampling times *Lecane bulla*, *Lecane hamata*, *Lecane luna*, *Lecane papuana*, *Lecane stenroosi*, *Colurella adriatica*, *Colurella uncinata*, *Lepadella patella*, *Euchlanis dilatata*, *Trichocerca tigris*, *Pompholyx sulcata*, *Trichotria tetractis*, *Scaridium longicaudum*, *Cephalodella gibba*, *Rotaria rotatoria* and *Alona costata* (Table 2).

Zooplankton are the secondary producer group of the food chain in the aquatic environment, converting vegetable products into animal protein and providing energy flow through the food chain. Zooplankters are excellent indicators of changes in water quality because they are highly impacted by environmental change and react to those changes more quickly than other aquatic organisms [33 and 34].

Rotifers are used as indicators of water quality because they are more susceptible to environmental changes than other zooplankton groups [35]. Because of their rapid reproduction rates and common occurrence in eutrophic freshwater ecosystems, they outnumber other zooplankton groups [36]. Additionally, Cladocerans and Cyclopoid Copepods have a good tolerance for eutrophic environments [35].

Before the construction of the Savrun Dam Lake, the flora and fauna of the Savrun Stream were investigated for the environmental impact assessment report. Of the zooplankton fauna in the report, *Ascomorpha saltans* Bartsch, 1870, *Asplanchna priodonta* Gosse, 1850, *Asplanchna sieboldi* (Leydig, 1854), *Brachionus angularis*, *Brachionus calyciflorus* Pallas, 1766, *Brachionus urceolaris*, *Cephalodella gibba*, *Filinia longiseta* (Ehrenberg, 1834), *Hexarthra fennica*, *Hexarthra intermedia*, *Kellicottia longispina*, *Keratella cochlearis*, *Keratella quadrata*, *Lecane bulla*, *Lecane luna*, *Lepadella quinquecostata* (Lucks, 1912), *Synchaeta pectinata* Ehrenberg, 1832 (Rotifera), *Diaphanosoma*

lacustris Korinek, 1981 (Cladocera), and *Cyclops vicinus* Uljanin, 1875 and *Eucyclops serrulatus* (Copepoda) species have been reported [37].

Table 2. Weekly abundance of species (-: Absent, *: very few -1/10 individuals in each petri, ı: few -10/30 individuals in each petri, ıı: abundant -30/60 individuals in each petri)

Rotifera	03.10 2022	10.10	17.10	25.10	01.11	11.11	15.11	27.11	29.11	05.12	12.12	19.12 2022
Lecane bulla	*	ı	-	ı	ı	ı	*	-	-	*	-	-
Lecane closterocerca	*	*	-	*	*	*	*	-	-	-	-	-
Lecane flexilis	-	*	-	*	-	-	-	-	-	-	-	-
Lecane hamata	*	ı	*	ı	ı	ı	*	-	*	-	-	-
Lecane luna	ı	-	-	-	*	ı	*	-	*	-	-	-
Lecane lunaris		*	*	*	-	*	-	-	-	-	-	-
Lecane inermis	*	-	-	-	-	*	-	-	-	-	-	-
Lecane papuana	-	-	-	*	-	ı	-	-	-	-	-	-
Lecane pyriformis	-	-	-	-	-	*	-	-	-	-	-	-
Lecane signifera	-	-	-	-	-	*	-	-	-	-	-	-
Lecane scutata	-	-	-	-	-	-	-	-	-	-	-	*
Lecane stenroosi	-	*	-	*	*	ı	*	-	-	*	-	-
Colurella adriatica	*	ı	*	ı	*	ı	*	*	-	*		*
Colurella obtusa	-	-	-	*	*	-	-	-	-	-	-	-
Colurella uncinata		ı	*	ı	ı	ı	-	-	-	ı	-	ı
Lepadella ehrenbergi	*	-	*	*	*	*	-	-	-		-	
Lepadella ovalis	-	-	-	*	*	-	-	-	-	*	-	
Lepadella patella	*	-	*	*	*	ı	-	-	*	*	-	*
Lepadella triptera	-	-	-	-	-	*	*	-	-	-	-	-
Squatinella mutica	-	-	-	-	*	-	-	-	-	-	-	-
Brachionus angularis	-	-	*	-	-	-	-	-	-	-	-	-
Kellicottia longispina	-	-	-	*	-	-	-	-	-	-	-	-
Keratella cochlearis	-	-	*	*	-	*	-	-	-	-	-	-
Keratella tecta	-	-	*	*	*	*	-	-	*	*	-	-
Keratella quadrata	-	-	-	-	*	-	-	-	-	-	-	-
Euchlanis dilatata	-	*	-	*	*	*	-	ı	*	*	ı	I
Euchlanis triquetra	-	-	-	-	*	-	-	-	-	-	-	-
Dipleuchlanis propatula	-	-	-	*	-	-	-	-	-	-	-	-
Trichocerca elongata	-	-	*	-	-	-	-	-	-	-	-	-
Trichocerca longiseta	-	-	-	-	-	-	-	-	*	-	-	-
Trichocerca tigris	*	-	-	ıı	ı	*	*	-	*	-	-	-
Testudinella patina	-	-	-	*	-	-	-	-	-	-	-	-
Pompholyx sulcata		-	ı	*		*	-	-	-	-	-	-
Trichotria tetractis	*	-	*	*	*	*	-	-	*	ı	*	-
Macrochaetus sericus	-	-	-	*	*	*	-	-	-	-	-	-
Lophocharis salpina	-	-	-	-	*	*	-	-	-	-	*	-
Mytilina bisulcata	-	-	-	-	*	-	-	-	-	-	-	-
Dicranophorus epicharis	-	-	-	-	-	*	-	-	-	-	-	-
Scaridium longicaudum	-	-	-	-	-	ı	-	-	-	-	-	-
Cephalodella gibba	-	-	-	*	-	*	*	*	*	ı	-	-
Rotaria rotatoria	ı	ı	ı	ı	ı	ıı	ı	ı	ı	*	ı	ı
Cladocera												
Bosmina longirostris	*	-	*	*	*	*	*	-	-	*	-	-
Alona costata	-	*	ı	*	*	*	*	-	*	-	-	-
Chydorus sphaericus	-	-	*	-	-	*	-	-	-	-	-	-
Ilyocryptus sordidus	-	-	*	*	*	-	*	-	-	-	-	-
Macrothrix laticornis	-	-	*	-	-	-	-	-	-	-	-	-
Copepoda												
Eucyclops serrulatus	-	-	-	-	*	-	-	*	-	-	-	-
Mesocyclops leuckarti	-	*	*	-	-	-	-	-	-	-	-	-
Paracyclops fimbriatus	*	-	-	*	-	-	-	-	*	*	-	-
Kinnecaris xanthi	-	-	-	-	-	*	-	-	-	-	-	-

While *Lecane bulla, Lecane luna, Brachionus angularis, Kellicottia longispina, Keratella cochlearis, Keratella quadrata, Cephalodella gibba, Eucyclops serrulatus* were found in both studies, *Synchaeta pectinata, Hexarthra intermedia* Wiszniewski, 1929, *Hexarthra fennica* (Levander, 1892, *Brachionus calyciflorus, Lepadella*

quinquecostata, *Asplanchna sieboldi*, *Filinia longiseta*, *Asplanchna priodonta*, *Ascomorpha saltans*, *Brachionus urceolaris*, *Diaphanosoma lacustris*, *Cyclops vicinus* were not found in the present study. No other species (*L. closterocerca*, *L. flexilis*, *L. hamata*, *L. lunaris*, *L. inermiş*, *L. papuana*, *L.pyriformis*, *L. signifera*, *K. tecta*, *E. dilatata*, *E. triquetra*, *D. propatula*, *T. elongata*, *T. longiseta*, *T. tigris*, *T. patina*, *P. sulcata*, *T. tetractis*, *M. sericu*, *L. salpina*, *M. bisulcata*, *D. epicharis*, *S. longicaudum*, *R. rotatoria*, *B. longirostris*, *A. costata*, *C. sphaericus*, *I. sordidus*, *M. laticornis*, *M. leuckarti*, *P. fimbriatus*, *K. xanthi*) were mentioned in the report. The reason for this difference may be related to the sampling time and duration, the sensitivity of the samples, as well as the fact that the previous study was conducted in 2013.

Most of the taxa described are cosmopolitan, and some species belonging to the genera *Keratella*, *Brachionus* and *Trichocerca* are generally reported as the dominant zooplankton taxa of the lotic areas [38, 39, 40, 41 and 42]. Unlike lake ecosystems, as in our study, lotic freshwater systems typically contain less cladocerans and copepods and are more controlled by rotifers [43]. The physical environment of lotic systems is unfavorable for zooplankton growth in comparison to lentic waters, so individual zooplankton struggle to retain their position and are carried downstream [44, 45, 46 and 47].

Among the zooplankton species identified in the study area: *B. angularis*, *E. dilatata*, *K. cochlearis*, *K. quadrata*, *K. tecta*, *Trichotria tetractis*, *L. bulla*, *L. luna*, *P. sulcata*, *Trichocerca* species, *L. patella* (Rotifera), *B. longirostris*, *C. sphaericus* (Cladocera) and *E. serrulatus* (Copepoda) are reported to be common indicator species in eutrophic waters [25, 48, 49, 50, 51, 52, 53, 54, 55 and 56]. However, the small amount of these species means that eutrophication has not occurred completely. It can be said that the region is under the pressure of various pollution factors due to the intense agricultural production and the Savrun Stream passing through the city. In addition, it is reported that the species identified in this study are common in the inland waters of Turkey and especially in the inland waters of the Mediterranean Region [57, 52 and 58].

In the study, in which 50 species were determined in total, it can be said that Savrun Stream has a character that can be considered rich in terms of species diversity. According to several studies [59, 60 and 61], the volume and species variety of zooplankton in flowing water varies depending on the discharge regime, turbidity, water quality, and river upstream and downstream.

5. CONCLUSION AND RECOMMENDATIONS

While the zooplankton structure of Savrun Stream, which consists of cosmopolitan species, can be considered rich in quality, it is seen that it is quite weak in terms of quantity. In terms of species content, it was determined that it generally consisted of eutrophication indicator species. In order to prevent further progress of eutrophication, it is important to carry out agricultural practices carefully and to take measures to prevent organic and inorganic inputs into the stream.

CONFLICT OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

FINANCIAL DISCLOSURE

The authors did not receive any financial support in conducting this study.

DECLARATION OF ETHICAL STANDARDS

The authors of this article declare that the materials and methods used in this study do not require ethical committee permission and/or legal-special permission.

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