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Araştırma Makalesi / Research Paper

Diversity and Species Composition of the Macrobenthic Invertebrates in Sürgü Stream (Malatya, Turkey)

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ABSTRACT

The study was carried out on Sürgü Stream, located in Malatya Province (Turkey), and aimed to determine the diversity and species composition of macrobenthic invertebrates. Six stations were determined on the stream and macrobenthic invertebrates were taken seasonally. As a result, 34 taxa belonging to five classes were detected; one of which belongs to Hirudinea, one of which belong to Arachnida, three to Gastropoda, five to Malacostraca and 24 to Insecta classes. Insecta was the most dominant group among the determined taxa. The Shannon Weaver Diversity Index and the Simpson Index showed that the lowest species diversity was observed at the third station while the highest species diversity was found at the second station. Also, UPGMA algorithm was used to show possible clustering relationships among the seven stations based on organisms. According to UPGMA analysis, the highest similarity value was observed between the first and second stations (87%), while the lowest similarity value was found between the second and fourth stations (13%). To date, there is no study on the determination of macrobenthic invertebrate fauna of Sürgü Stream. Therefore, all the identified taxa have been recorded for the first time for the study area.

Keywords: Macrobenthic invertebrates, Species diversity, Sürgü Stream, Malatya

Sürgü Çayı (Malatya, Türkiye)'nda Makrobentik Omurgasızların Tür Kompozisyonu ve Çeşitliliği

ÖZ

Bu çalışmada Malatya İli'nde (Türkiye) yer alan Sürgü Çayı'nın makrobentik omurgasızlarının tür kompozisyonunun ve çeşitliliğinin belirlenmesi amaçlanmıştır. Altı istasyon belirlenmiş ve örnekler mevsimsel olarak alınmıştır. Sonuç olarak beş sınıfa ait; Hirudinea ve Arachnida sınıflarından bir, Gastropoda'dan üç, Malacostraca'dan beş ve Insecta sınıflarından 24 olmak üzere; 34 takson tespit edilmiştir. Belirlenen taksonlar arasında en baskın grup Insecta olmuştur. Shannon Weaver çeşitlilik indeksi ve Simpson indeksine göre en düşük çeşitlilik üçüncü istasyonda, en yüksek çeşitlilik değeri ikinci istasyonda bulunmuştur. Ayrıca, organizmalara dayalı olarak yedi istasyon arasındaki kümeleme ilişkilerini göstermek için UPGMA algoritması kullanılmış, buna göre, en yüksek benzerlik değeri birinci ve ikinci istasyonlar arasında (%87), en düşük benzerlik değeri ise ikinci ve dördüncü istasyonlar arasında (%13) bulunmuştur. Bugüne kadar Sürgü Çayı'nın makrobentik omurgasız faunasının belirlenmesine yönelik bir çalışma yoktur. Bu nedenle, belirlenen tüm taksonlar çalışma alanı için ilk kez kaydedilmiştir.

Anahtar Kelimeler: Makrobentik omurgasızlar, Tür Çeşitliliği, Sürgü Çayı, Malatya

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INTRODUCTION

Freshwater ecosystems have important multi-usage components, such as sources of drinking water, irrigation, fishery and energy production. Nevertheless, streams and lakes are among the most threatened ecosystems in the world (Malmqvist and Rundle, 2002). It is important to understand the consequences of human perturbations on these ecosystems to maintain restore their integrity (Meybeck, 2003). Macrobenthic invertebrates have an important role in the biomonitoring studies carried out for this purpose (Rosenberg and Resh, 1993).

Biological monitoring of freshwater ecosystems began more than a century ago and the different taxonomic groups assemblages (e.g. bacteria, algae, and fish) have used for determining of water quality (Hellawell, 1986; Metcalfe, 1989; Rosenberg and Resh, 1993; Dolédec and Statzner 2010). Macrobenthic invertebrates are one of the most preferred groups in these studies (Azrina et al., 2006; Johnson and Ringler, 2014; Herman and Nejadhashemi, 2015). Because, the life cycles of this group are long enough to understand what the differences are in their habitats before and after the pollution, they have limited habitat, they are sensitive to pollution by altering their community composition (Rosenberg and Resh 1993; Lunde and Resh, 2012).

The studies of freshwater macrobenthic invertebrates as biological monitoring techniques have been widely reported and described by the various researchers in Turkey (Kazancı and Dügel 2000; Duran et al., 2003; Balık et al., 2006; Kalyoncu and Zeybek, 2009; Türkmen and Kazancı 2010; Yıldız et al., 2010; Kalyoncu and Zeybek 2011; Zeybek et al., 2012; Kazancı et al. 2013; Zeybek et al., 2014; Yıldız et al., 2015).

In order to be able to carry out biomonitoring studies using macrobenthic invertebrates, it is important to first determine the macrobenthic fauna of study area. Although the important of they in freshwater ecosystems has been reported, and there has been no research about macrobenthic fauna of Sürgü Stream. It is hoped that the results of this study will provide basic information for biomonitoring studies to be carried out in this stream.

MATERIAL AND METHODS

Malatya is located at the upper parts of Fırat River Basin in Eastern Anatolia. The present study was carried out on Sürgü Stream in Malatya province (Turkey) between April 2014-February 2015. The length of this stream is approximately 30 km. The stream is an important water source for Malatya and is mainly used for irrigation. It is one of the most important tributaries of the Göksu River. Six stations were defined at the stream and samplings were performed seasonally. Totally, 24 samples had been taken per site/single sampling from six stations at four seasons (Figure 1).

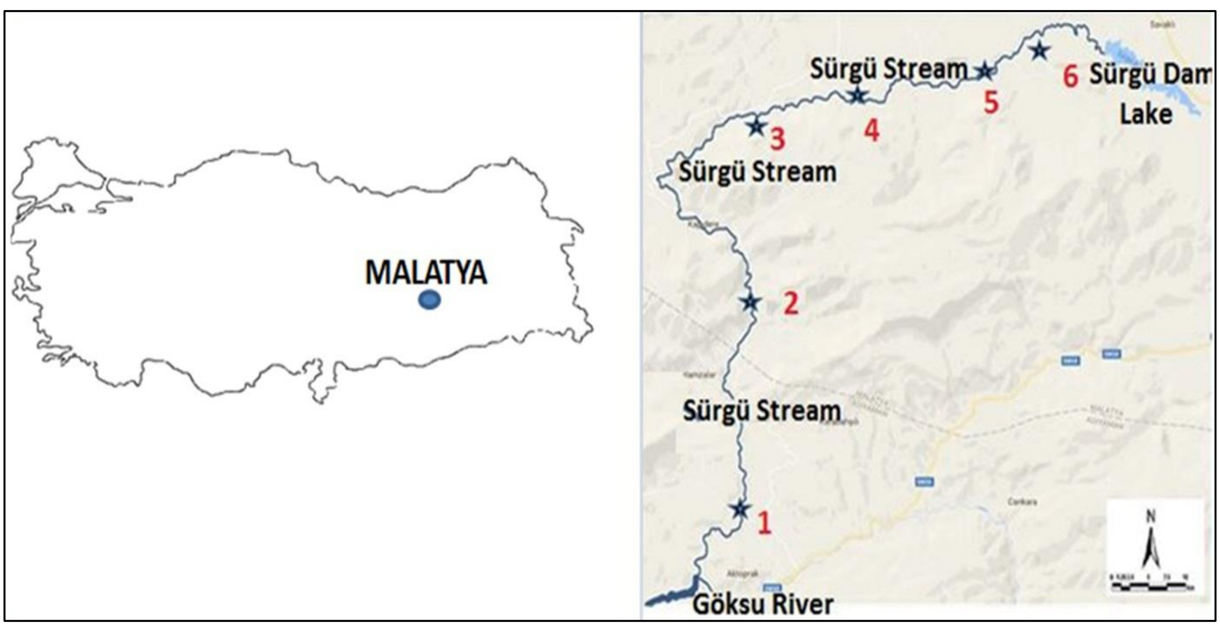

Figure 1. Study area and stations on the Sürgü Stream

Some physical properties of the selected stations are shown in the Table 1.

Table 1. Some physical characters of the stations

Station	Subsrate	Macrophytes	Depth(m)
1	gizzard	*	0,5
2	stony+muddy	*	0,7
3	gizzard		0,6
4	gizzard+muddy	*	0,65
5	sandy+gizzard	*	0,5
6	stony+muddy	*	0,75

Macrobenthic invertebrates were sampled from each station by using a standart kick net (500 µm mesh sized). The samples were taken from the various substrate types (e.g. silt, gravel, sand) present at the stations. At some stations, where large stones present, stones were firstly picked out from the locality and were washed into the net in order to remove pupae and other attached individuals. Each sampling took 3 minutes. The collected material was fixed in formaldehyde (4%) in the field and then kept in 80% ethyl alcohol. They were sorted in the laboratory and identified to the lowest possibly taxonomic level (genus or species) under a stereomicroscope. The unweighted pair group method with arithmetic mean (UPGMA) algorithm was used to define for possible clustering relationships among the stations in terms of macrobenthic invertebrates. Also, Shannon Weaver Diversity Index (1963) and Simpson (1949) indices were applied to determine the species diversity of the stations. UPGMA and was performed based on macrobenthic invertebrates by using MVSP version 3.1 (Kovach, 1998). The relative percentage of occurrence was calculated for each species by using the simple formula Ni/Nt x 100 (Ni= individuals of species i, Nt= total number of collected species).

RESULTS AND DISCUSSION

As a result of the study, 1539 individuals and 34 taxa belonging to five classes were determined. The maximum number of individuals was observed at the station 3 (548 individuals) while the fewest at the station 6 (59 individuals). The determined species were belong to Hirudinea (1 taxon), Arachnida (1 taxon), Gastropoda (3 taxa), Malacostraca (5 taxa), Insecta (25 taxa). Insecta was the most dominant group among the determined taxa. This class was also found as the dominant taxa in different streams in Turkey several times (Duran, 2006; Zeybek et al., 2014; Yorulmaz et al., 2015; Zeybek, 2017). Distributions and relative percentage of occurrence (%), along with a list of the recorded macrozoobenthic invertebrates, were showed in Table 1. The relative percentages of occurrence (%) of the determined species were differed from each other. For instance, *Ancylus fluviatilis* was the most dominant species (19.30%) at the station 1; *Baetis rhodani* (16.53%) at the station 2; *Agapetus fuscipes* (70.8%) at the station 3; *Gammarus* sp. (32.81 %) at the station 4; *Hydropsyche instabilis* (24.59 %) at the station 5 and *Sericostoma personatum* (28.81 %) at the station 6 (Table 2).

Table 2. Distributions and relative occurrence (%) of macrobenthic invertebrates at the stations

	Sta 1.	Sta 2.	Sta 3.	Sta 4.	Sta 5.	Sta 6.
MOLLUSCA						
Gastropoda						
Acroloxus lacustris (Linnaeus, 1758)	7.51	5.79	-	-	-	-
Ancylus fluviatilis O. F. Müller, 1774	19.30	10.74	-	-	-	-
Theodoxus anatolicus (Récluz,1844)	12.87	21.49	-	-	-	-
Malacostraca						
Gammarus birsteini Karaman & Pinkster, 1977	-	-	3.28	2.34	-	-
G. kischineffensis Schellenberg, 1937	-	-	2.19	10.94	-	-
G. pseudosyriacus Karaman & Pinkster, 1977	-	-	6.93	16.41	-	10.17
G. pulex (Linnaeus, 1758)	-	-	2.92	8.20	-	5.08
Gammarus sp.	-	-	1.09	32.81	-	5.08
ARTHROPODA						
Arachnida						
Atractides walteri (Viets, 1925)	-	-	-	-	6.56	5.08
Insecta						

Table 2. Distributions and relative occurrence (%) of macrobenthic invertebrates at the stations (continued…)

	Sta 1.	Sta 2.	Sta 3.	Sta 4.	Sta 5.	Sta 6.
Ephemeroptera						
Baetis buceratus Eaton, 1870	2.14	2.48	-	-	1.64	-
B. muticus (Linnaeus, 1758)	2.14	4.96	0.73	0.78	-	-
B. rhodani (Pictet, 1845)	18.23	16.53	3.65	-	-	-
B. scambus Eaton, 1870	1.07	2.48	-	-	-	-
B. vernus Curtis, 1834	6.43	4.96	1.09	-	-	-
Nigrobaetis digitatus (Bengtsson, 1912)	3.22	1.65	0.36	-	-	-
Caenis horaria (Linnaeus, 1758)	-	-	0.18	2.34	6.56	-
C. macrura Stephens, 1835	-	-	-	0.78	6.56	-
C. pusilla Navas, 1913	-	-	0.18	-	-	-
Ephemera danica Müller, 1764	-	1.65	0.73	-	-	-
E. vulgata Linnaeus, 1758	0.80	2.89	0.36	-	-	-
Odonata						
Aeshna sp.	1.07	0.83	-	0.39		
Plecoptera						
Leuctra hippopus Kempny, 1899	1.07	0.83	-	-	-	-
Leuctra sp.	0.54	2.48	-	-	-	-
Isoperla sp.	1.07	3.31	-	-	-	-
Trichoptera						
Agapetus fuscipes Curtis, 1834	11.80	-	70.80	15.23	18.03	-
Goera pilosa (Fabricius, 1775)	3.22	-	-	3.91	-	-
Hydropsyche fulvipes Curtis, 1834	3.75	5.79	-	-	-	-
H. instabilis (Curtis, 1834)	-	-	-	4.30	24.59	25.44
Polycentropus irroratus Curtis, 1835	-	-	2.74	-	-	-
Sericostoma personatum (Kirby & Spence, 1826)	3.77	5.79	2.01	-	-	28.81
Coleoptera						
Elmis maugetii Latreille, 1798	-	1.24	0.76			
Diptera						
Chaoborus sp.	-	4.13	-	-	4.92	3.39
Simulium sp.	-	-	-	-	11.48	3.39
ANNELIDA						
Hirudinea						
Helobdella stagnalis	-	-	-	1.57	19.66	13.56
TOTAL	373	242	548	256	61	59

Considered determined species in general, there were species living in slightly or moderately polluted water at the first four stations. There was dominancy of any species that indicates heavily polluted stream. It was found species belong to Hirudinea class in both stations 5 and 6. However, the species belong to Trichoptera and Ephemeroptera orders and *Gammarus* were detected in the same stations too.

Gammarus species are found intensively in slightly polluted sections of the rivers (Meyer, 1987; Kalyoncu and Zeybek, 2009). Members of EPT are considered to be sensitive to environmental stress, thus their presence in high abundance at the upstream signified a relatively clean environment (Armitage et al., 1983). Therefore, EPT were found to be a potential bio-indicator for a clean ecosystem. According to Lenat (1988), EPT taxa are mostly found in clean waters and they give us information about the pollution status of the streams. The members of EPT include intolerant organisms and found in areas protecting its species richness (Armitage et al., 1983; Wahizatul et al., 2011).

The species belong to Ephemeroptera are sensitive to pollution; if the pollution increases, decline in number and diversity of these species is observed. They usually live in unpolluted habitats (Plafkin et al., 1989) and in much polluted habitats (alfa-mesosaprobic) no Ephemeroptera taxa can be observed (Moog et al., 1997; Bauernfeind et al., 1995).

Trichoptera larvae are affected by organic pollution and environmental changes. Therefore, they are important in biomonitoring studies (Dohet, 2002; Woodcock et al., 2007; Zeybek and Koşal Şahin, 2016). In the present study, all the determined species of Gastropoda are commonly live clean water; they cannot survive in heavily polluted waters. Koşal Şahin and Zeybek (2016) reported that *Acroloxus lacustris* was showed positive correlation with DO values in Tunceli streams. *Theodoxus* species commonly lives in running waters of turbulent waters includes taxa living in springs, rivers, lakes and even in low-salinity waters and sometimes on the vegetation (Roth, 1987; Yıldırım, 2004; Yıldırım et al., 2006).

Percent similarities of each sampling station based on macrobenthic invertebrates in the study area were detected using UPGMA analysis. According to this analysis, stations 1 and 2 were the most similar to each other (87%) and stations 2 and 4 showed the lowest similarity (13%). The stations were clustered into two main groups. The first group contains two stations (1 and 2) while the second group consisted of two subgroups; stations 3 and 4 composed of the first subgroup and stations 5-6 the second one (Figure 2). It was observed that stations with similar ecological characteristics were located in the same group.

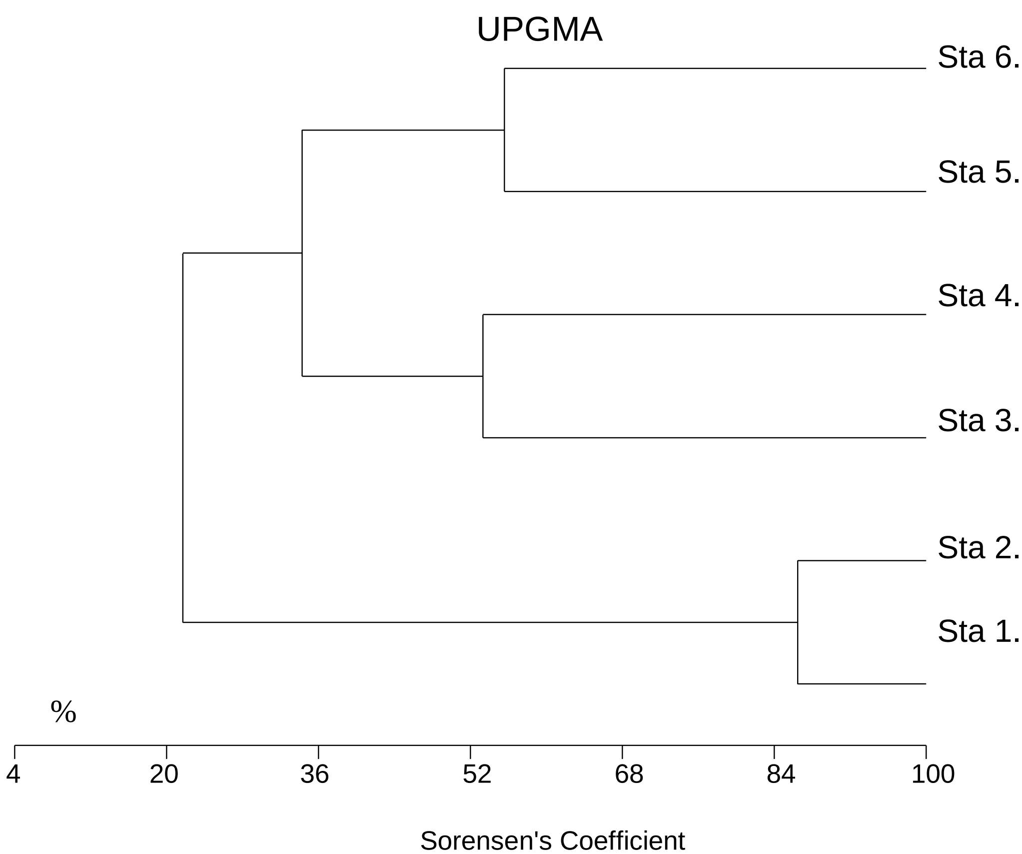

Figure 2. Cluster analysis dendrogram (UPGMA method) for stations based on macrobenthic invertebrates

Shannon Weaver, Simpson and Evenness indices were performed to detect the species diversity of the stations. According to these indices, the highest species diversity value was found at the second station while the lowest value at the third one (Table 3). In term of diversity, 5th and 6th stations had the lowest species diversity among the stations. On the other hand, evenness values of the mentioned stations were detected to be high. Though the 3rd station represented 17 species, the diversity value was found to be low because of low value of evenness (Table 3).

Table 3. The values of Shannon Weaver and Simpson species diversity indices, and Evenness

Stations	Shannon Weaver		Simpson	
	Diversity value	Evenness	Diversity value	Evenness
Sta 1.	3.475	0.833	0.883	0.935
Sta 2.	3.681	0.866	0.894	0.943
Sta 3.	1.871	0.458	0.489	0.519
Sta 4.	2.88	0.778	0.819	0.887
Sta 5.	2.847	0.898	0.84	0.945
Sta 6.	2.732	0.862	0.814	0.915

Species diversity consists of two components: species richness and species evenness. Species richness is a simple count of species, whereas species evenness quantifies how equal the abundances of the species are (Hill, 1973; Tuomisto, 2010 a, b). The low evenness value indicated that there was no balance for distribution of their numbers of species and community was dominated by a taxon or some taxa (Magurran, 2004). Hence, it was also observed in 3rd station that *Agapetus fuscipes* was reached 70% of dominancy and the species diversity value of this station was determined to be low. According to Mason (2002), if Shannon- Weaver index value is between 1 and 3, the stream is moderately polluted. In this case, the pollution load of the first two stations is less than the other stations and the diversity values are higher than last four stations. They are moderately polluted.

CONCLUSION

Considering both the ecological characteristics and species diversity indices, it can be suggested that there is no heavy organic pollution in the stream.

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