TÜBİTAK

Turkish Journal of Zoology

http://journals.tubitak.gov.tr/zoology/

Short Communication

Turk J Zool
(2017) 41: 1100-1104
© TÜBİTAK
doi:10.3906/zoo-1702-15

Macroinvertebrate composition in the metarhithral zones of the Munzur and Pülümür rivers: a preliminary study

Zuhal GÜLTEKİN[1,*], Rahmi AYDIN[2], Carola WINKELMANN[1]
[1]Institute for Integrated Natural Sciences, University of Koblenz-Landau, Koblenz, Germany
[2]Faculty of Fisheries, Munzur University, Tunceli, Turkey

Received: 09.02.2017 • **Accepted/Published Online:** 17.07.2017 • **Final Version:** 21.11.2017

Abstract: The aim of this work was the determination of the macroinvertebrate community in the metarhithral zones of the Munzur and Pülümür rivers. This is the first documented research on macroinvertebrates in the metarhithral zone of the Munzur and Pülümür rivers in the region of the city of Tunceli. In total, 30 taxa of 9 orders of benthic invertebrates were recorded at the four sampling sites. Larvae of *Taeniopteryx caucasica* (Plecoptera), *Oligoneuriella baskale*, and *Ecdyonurus dispar* (Ephemeroptera) were recorded for the first time in the province of Tunceli.

Key words: Macroinvertebrates, biodiversity, *Taeniopteryx caucasica*, Munzur River, Pülümür River

Macrozoobenthos are invertebrates larger than 0.5 mm that live in or on the different substrates in water bodies. They are bioindicators for water quality, and rivers can be classified according to their occurrence. The biodiversity of aquatic invertebrates in the province of Tunceli has been investigated in very few studies. There are studies in which the adults of invertebrates from this area have been determined (e.g., Salur et al., 2012; Avgın et al., 2015; Salur et al., 2016). Although single groups have been examined before (Ephemeroptera: Kazancı, 2009; Mollusca: Koşal Şahin and Zeybek, 2016; Plecoptera: Zwick, 1971; Kazancı, 2009; Darilmaz et al., 2016; Trichoptera: Zeybek and Kosal Sahin, 2016), a quantitative sampling of the whole benthic invertebrate community has not yet been carried out. Information on community composition of benthic invertebrates is particularly important for the assessment of the ecological quality of running water. However, before it can be used for such an assessment, general information on the faunistic patterns and the biodiversity of the streams and rivers in Turkey is needed. Therefore, a contribution to this much-needed pool of knowledge was targeted in this study by analyzing the species composition of macroinvertebrate communities at four sites of the metarhithral zones of the Munzur and Pülümür rivers.

The Munzur and Pülümür rivers are located in eastern Turkey, in the province of Tunceli. The approximately 80-km-long Munzur River originates in the Munzur Mountains north of Ovacık. In 1971, the Munzur River and part of the catchment area were declared a national park. The Pülümür River, about 70 km long, has its origin near the district of Pülümür in Tunceli. The Munzur River and the Pülümür River join in the city center of Tunceli and create the Uzunçayır Reservoir. Tunceli Province is dominated by extensive, primarily common oak woodlands covering about 80% of the surface and is characterized by a relatively humid climate. Because these two rivers are the most important and largest rivers in this province, we decided to start the collection of data on benthic invertebrate composition there. We studied two different sites for each river, one in March (m1, p1) and one in June (m2, p2). Originally, we planned to collect the two subsequent samples, m2 and p2, at the exact same location. However, due to extraordinary flooding during snowmelt, the water level of the Uzunçayır Reservoir in June 2012 was so high that the sampling location was still in the backwater area and therefore not suitable for analyzing the benthic invertebrate composition of the rivers. Consequently, we relocated the sampling site of the Pülümür River upstream from the original location of p1 and that of the Munzur River downstream from m1. It was important that, for comparability, the March and June sampling sites were as close as possible. The distances between m1 and m2 amount to 3.2 river kilometers and between p1 and p2 to 4 river kilometers. All sites had altitudes between 900 and 950 m (Table 1) and were characterized by fast-flowing water with a substrate of

* Correspondence: zguel@uni-koblenz.de

Table 1. The table contains UTMS coordinates and mean width [m] of the sampling sites. "m" = Munzur River, "p" = Pülümür River, the measured values of physicochemical parameters of the rivers, which are shown as mean ± standard deviation (May: n = 4; June: n = 6; NO_2-N and NO_3-N [mg L^{-1}], May: n = 2; June: n = 6). Additionally, the water quality classes are given in Roman numerals (according to LAWA, https://www.umweltbundesamt.de/sites/default/files/medien/1968/dokumente/chemische_guteklassifikation.pdf; http://gewaesser-bewertung.de/files/steckbriefe_fliessgewaessertypen_april2008.pdf).

	m1	m2	p1	p2	LAWA
Latitude (N)	39°08′03.72	39°07′18.09	39°06′21.76	39°06′13.94	
Longitude (E)	39°29′33.76	39°30′57.78	39°34′21.14	39°36′25.60	
Elevation [m]	938 m	915 m	905 m	926 m	
May					
Temperature [°C]	11.1 ± 0.9	-	11.8 ± 1.3	-	<18 to <20 [max.]
O_2-saturation [%]	94 ± 5.2	-	84 ± 6	-	
O_2-content [mg L^{-1}]	10.4 ± 0.39	-	9.15 ± 0.6	-	> 9 [I] > 7 [II]
Conductivity [µS cm^{-1}]	214 ± 23	-	319 ± 14	-	170–450
SAL [mg L^{-1}]	0.14 ± 0.01	-	0.20 ± 0.01	-	
pH	8.6 ± 0.51	-	8.4 ± 0.6	-	7.7–8.5
NO_2-N [mg L^{-1}]	0.0045	-	0.012 ± 0.001	-	≤ 0.01 [I] ≤ 0.1 [II]
NO_3-N [mg L^{-1}]	0.8	-	0.800 ± 0.283	-	≤ 1.0 [I] ≤ 2.5 [II]
June					
Temperature [°C]	12.8 ± 1	12.9 ± 0.82	14.6 ± 2.5	13.9 ± 2.0	<18 to <20 [max.]
O_2-saturation [%]	105 ± 11.6	110 ± 10.5	100 ± 11	111 ± 16	
O_2-content [mg L^{-1}]	11.1 ± 1.03	11.6 ± 1.11	10.2 ± 1.02	11.5 ± 1.4	> 9 [I] > 7 [II]
Conductivity [µS cm^{-1}]	194 ± 4	202 ± 4	324 ± 30	308 ± 21	170–450
SAL [mg L^{-1}]	0.12 ± 0	0.13 ± 0	0.19 ± 0	0.19 ± 0.006	
pH	8.2 ± 0.10	8.0 ± 0.13	8.1 ± 0.15	8.2 ± 0.1	7.7–8.5
NO_2-N [mg L^{-1}]	0.006 ± 0.005	0.013 ± 0.006	0.024 ± 0.031	0.012 ± 0.11	≤ 0.01 [I] ≤ 0.1 [II]
NO_3-N [mg L^{-1}]	1.29 ± 0.28	1.275 ± 0.236	0.720 ± 0.507	1.52 ± 1.04	≤ 1.0 [I] ≤ 2.5 [II]

stones, gravel, and sand. Geographical locations (latitude/longitude) of the sampling areas at each river are shown in Table 1.

In the Munzur River, one site (m1) is located in the Munzur National Park, and the other site (m2) is on the border of the park, lacking any great visible anthropogenic disturbances. The Pülümür p2 also similarly reflected almost natural conditions; however, slight structural degradation was observed at p1, most probably caused by the gravel and sand extraction at this site. Such impacts are characteristic for the Pülümür River because there are various mining sites along the river (chrome, marble, gravel, and sand; Tunceli Valiliği Çevre ve Şehircilik İl Müdürlüğü, 2012).

Environmental factors (temperature, O_2-saturation, O_2-content, conductivity, salinity, pH) were measured twice a day at around 0600 and 1800 hours on 17 May, 29 May, 5 June, 12 June, and 19 June 2012 using a multiparameter probe (YSI, Professional Plus, Yellow Springs, OH, USA). In addition, water samples for nitrite (NO_2-N) and nitrate (NO_3-N) were taken around 0600 and around 1800 hours on 29 May, 5 June, 12 June, and 19 June in the middle of the river and kept in a cooler at 4 °C. One day after each sampling, the nitrite and nitrate concentrations were measured using photometric test kits (Hach Lange, Berlin, Germany; nitrite: Cat. No. 21071-69 (NitriVer 3), nitrate: Cat. No. 21061-69 (NitraVer 5)) and the corresponding photometer (DR/890, Hach Lange).

To describe the benthic community, quantitative samples were collected with a multihabitat sampling method (net area: 0.0625 m^2, 1-mm mesh; Hering et al., 2004) in March and June 2012. Twenty subsamples were taken from each stream site with a total sampling area of 1.25 m^2, sampling all types of mesohabitats proportional to their area at the sampling site. Samples were preserved with 96% ethanol. Subsequently, macroinvertebrates were identified in the laboratory to the lowest feasible taxonomic level using a stereomicroscope (Nikon SMZ 645, Tokyo, Japan) and counted.

The physical and chemical environmental conditions were mostly similar between the two rivers. All sites were characterized by high oxygen concentrations and alkaline

pH values (Table 1). The concentrations of nitrite and nitrate were relatively low (Table 1), indicating very good water quality according to the German working group on water issues of the Federal States and the Federal Government (https://www.umweltbundesamt.de/sites/default/files/medien/1968/dokumente/chemische_guteklassifikation.pdf). The macrozoobenthos found in the metarhithral zone of the Munzur and Pülümür rivers included the first-ever larval record for *Taeniopteryx caucasica* (Plecoptera: Zhiltzova, 1981) in the province of Tunceli. The presence of this species is still to be confirmed by collecting and identifying adult animals. It is known as a Caucasian taxon (Zhiltzova, 1981, 2006) and is only known to be present in Rize in Turkey so far (Darilmaz et al., 2016). This larval record indicates the occurrence of this species in the northeast of Turkey. Since we found *T. caucasica* larvae in both rivers, but only in March and not in June, we assume that this species emerges from the water in early summer. Consequently, to be able to detect early emerging taxa such as *T. caucasica*, it is particularly important in this region to take samples of macrozoobenthos in early spring, before the snow melts. No sampling is possible in April and May during and after snowmelt due to the high discharge.

This study also presents the first larval recordings of some Ephemeroptera such as *Oligoneuriella baskale* (Soldan and Landa, 1977) and *Ecdyonurus dispar* (Curtis, 1834) in Tunceli Province. Other species of the genus *Oligoneuriella* (*O. baskale*, *O. tskhomelidzei*, and/or *O. zanga*) were reported in the provinces of Van, Kars, Artvin, and Erzincan (Tanatmış, 1999; Kazancı, 2001, 2009; Kazancı and Türkmen, 2012). However, it is presently unclear whether these different names indicate different species or represent synonyms for *O. baskale*. Here we have followed the view of Soldan and Landa (1977), who described *O. baskale* and *O. zanga* as two different species. In addition to the morphological characteristics of these taxa, genetic analyses could help to resolve this problem. *O. baskale* is abundant in the Munzur River, so there are good conditions for further detailed analyses.

E. dispar represents a holo-Mediterranean faunistic element of the expansive type, which is represented in Europe, including Great Britain (Bauernfeind and Soldan, 2012). The occurrence of this taxon in several provinces of Turkey, including the northeast, has already been documented (Salur et al., 2016).

Regarding the benthic community as a whole, the number of taxa, the proportion of sensitive taxa, and the occurrence of specific taxa in both rivers indicate a good to very good ecological quality. In Munzur National Park, the mean abundance of EPT taxa amounted to 87% of the total benthic abundance, and in the Pülümür River it amounted to 50% (Figure). Ephemeroptera larvae are especially abundant in both rivers: 65% in the Munzur and 35% in the Pülümür (Figure). This is another indication of good ecological quality in the two rivers because most of the Ephemeroptera are indicators for high ecological water quality (Bauernfeind and Soldan, 2012). Although many Ephemeroptera were represented in the Pülümür, the proportion of Diptera was highest. Diptera, a special Chironomidae, are well-known indicators for disturbed habitats because they do not make high demands on environmental factors such as oxygen or salinity (Pinder, 1986). The highest Chironomidae density of this study was found in p1, near the gravel and sand extraction site on the Pülümür River. The fact that the proportion of EPT taxa and the proportion of Ephemeroptera are higher in the Munzur than in the Pülümür River (Figure; Table 2) might be the result of the river being protected by the National Park Act. Indeed, an EPT abundance of less than

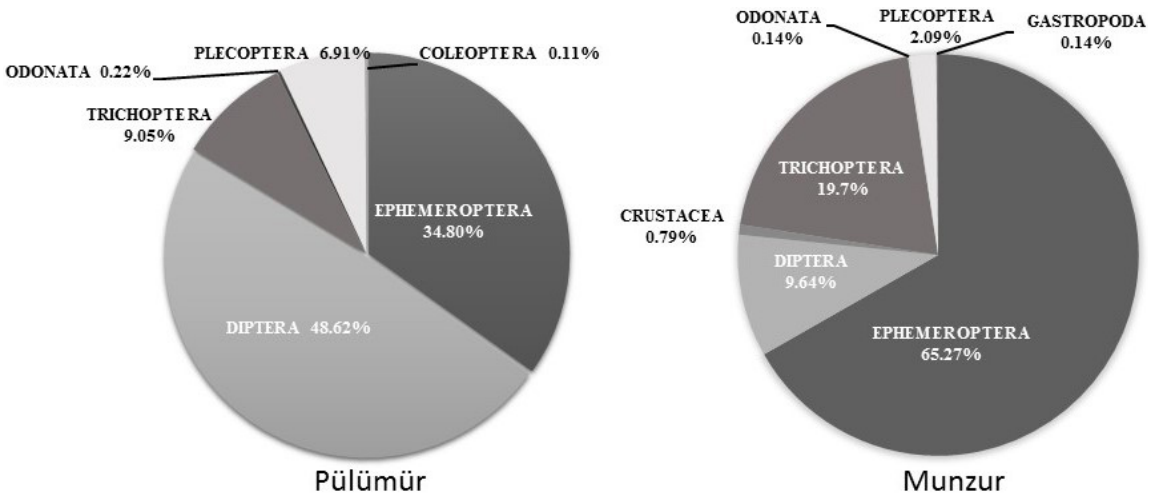

Figure. The proportion of benthic abundance for different invertebrate orders relative to the total benthic abundance [%] of the Munzur and Pülümür rivers, representing the mean value of the 2 sites per river.

Table 2. Abundance [ind./m^2] of the benthic individuals in the Munzur and Pülümür rivers in March [m1 and p1] and June [m2 and p2] 2012.

	Munzur River		Pülümür River	
Taxon	March (m1)	June (m2)	March (p1)	June (p2)
COLEOPTERA				
Coleoptera larvae	4	24	2	2
Elmis sp.	-	-	1	-
CRUSTACEA				
Gammarus sp.	5	6	-	-
DIPTERA				
Atherix ibis	2	1	-	-
Chironomidae	60	14	300	146
Empididae	2	-	1	-
Limoniidae	6	-	1	2
Simulium sp.	43	6	21	4
EPHEMEROPTERA				
Baetis sp. 1	-	60	33	46
Baetis lutheri-Gr.	-	-	-	10
Baetis cf. *gemellus*	-	-	-	144
Ecdyonurus dispar	-	-	17	-
Epeorus (*Iron*) *caucasicus*	30	-	-	1
Epeorus zaitzevi	-	11	-	38
Ephemerella ignita	-	20	-	33
Heptagenia coerulans	-	-	2	6
Oligoneuriella baskale	328	394	-	40
Rhithrogena znojkoi	57	8	4	-
GASTROPODA				
Ancylus fluviatilis	2	-	-	-
HIRUDINEA	1	2	-	-
ODONATA				
Caliaeschna microstigma	2	-	-	-
Gomphus sp.	-	-	2	-
PLECOPTERA				
Leuctra sp.	6	-	18	-
Perla sp.	13	-	-	-
Perlodes sp.	-	9	45	-
Taeniopteryx caucasica	1	-	1	-
TRICOPTERA				
Halesus sp.	-	5	-	-
Hydropsyche instabilis-Gr.	116	126	15	81
Rhyacophila sp.	1	-	1	-
Sericostoma sp.	16	10	-	-
Total	695	696	463	553

43% is regarded as an indicator of disturbance in Central European streams and rivers because it indicates a potential reduction of sensitive species, as well as shifted species and abundance ratios (http://www.fliessgewaesserbewertung.de/kurzdarstellungen/bewertung/typ9_2/). From this perspective, station p1 with an EPT abundance of 29% might be disturbed, although this is not apparent at station p2 of the Pülümür (more than 43% EPT abundance). We conclude from these results that gravel and sand extraction can have negative effects on the macrozoobenthos community, although the effects seem to be spatially limited. Consequently, further disturbances might be expected in this river if more sand and gravel extraction takes place.

Acknowledgments

For the financial support of this work, we thank the University of Koblenz-Landau, Department of International Cooperation. We are grateful to the staff of Munzur University for their logistical support, especially Deniz Demirbilek, Ercan Şahin, Nilgün Tayhan, and Osman Serdar. We also thank Alexandra Bohnet and Wolfram Remmers (University of Koblenz-Landau) for proofreading the manuscript. We appreciate the assistance in taxonomy from several experts, especially Dr Caner Aydınlı (Anadolu University), Dr Claudia Hellmann (University Koblenz-Landau), Gilles Vinçon, and Prof Wolfram Graf (University of Natural Resources and Life Sciences, Vienna).

References

Avgın SS, Antonini G, Lason A, Jansson N, Öncül Abacıgil T, Varlı SV, De Biase A, Audisio P (2015). New data on distribution, ecology, and taxonomy of Turkish Nitidulidae (Coleoptera). Turk J Zool 39: 314-322.

Bauernfeind E, Soldan T (2012). The Mayflies of Europe (Ephemeroptera). Ollerup, Denmark: Apollo Books.

Darilmaz MC, Salur A, Muranyi D, Vincon G (2016). Contribution to the knowledge of Turkish stoneflies with annotated catalogue (Insecta: Plecoptera). Zootaxa 4074: 1-74.

Hering D, Moog O, Sandin L, Verdonschot PFM (2004). Overview and application of the AQEM assessment system. Hydrobiologia 516: 1-20.

Kazancı N (2001). Türkiye Ephemeroptera (Insecta) faunası. In: Kazancı N, editor. Türkiye İç Suları Araştırmaları Dizisi, Vol. 4. Ankara, Turkey: İmaj Yayınevi, pp. 43-44 (in Turkish).

Kazancı N (2009). Ephemeroptera (Insecta) fauna of Turkey: records from eastern Anatolia (Turkey). Review of Hydrobiology 2: 187-195.

Kazancı N, Türkmen G (2012). The checklist of Ephemeroptera (Insecta) species of Turkey. Review of Hydrobiology 5: 143-156.

Koşal Şahin S, Zeybek M (2016). Distribution of Mollusca fauna in the streams of Tunceli Province (East Anatolia, Turkey) and its relationship with some physicochemical parameters. Turk J Fish Aquat Sc 16: 187-195.

LAWA (1998). Beurteilung der Wasserbeschaffenheit von Fließgewässern in der Bundesrepublik Deutschland – Chemische Gewässergüteklassifikation. Berlin, Germany: LAWA (in German).

Pinder LCV (1986). Biology of freshwater Chironomidae. Ann Rev Entomol 31: 1-23.

Salur A, Doğan Ö, Yağız Y (2012). Odonata fauna of Pülümür (Turkey: Tunceli Prov.). Mun Ent Zool Vol. 7: 359-362.

Salur A, Darilmaz MC, Bauernfeind E (2016). An annotated catalogue of the mayfly fauna of Turkey (Insecta, Ephemeroptera). ZooKeys 620: 67-118.

Soldan T, Landa V (1977). Three new species of the genus Oligoneuriella (Ephemeroptera, Oligoneuriidae). Acta Entomologica Musei Nationalis Pragae 74: 10-15.

Tanatmış M (1999). Türkiye Ephemeroptera türleri ve yayılışları. In: Demirsoy A, editor. Genel Zoocoğrafya ve Türkiye Zoocoğrafyası "Hayvan Coğrafyası". Ankara, Turkey: Meteksan, pp. 739-747 (in Turkish).

Tunceli Valiliği Çevre ve Şehircilik İl Müdürlüğü (2012). Tunceli İl Çevre Durum Raporu. Tunceli, Turkey: Tunceli Valiliği Çevre ve Şehircilik İl Müdürlüğü (in Turkish).

Zeybek M, Kosal Sahin S (2016). The distribution of Trichoptera assemblages in relation to environmental variables in the streams of Tunceli (Turkey). Fresen Environ Bull 25: 4972-4981.

Zhiltzova LA (1981). New and poorly-known species of stoneflies (Plecoptera) from Caucasia. Entomol Rev 60: 607-611.

Zhiltzova LA (2006). A review of stoneflies of the family Taeniopterygidae (Plecoptera) in Russia and adjacent countries. Entomol Rev 86: 632-634.

Zwick P (1971). Plecoptera aus Anatolien und benachbarten Gebieten. Mitteilungen der Schweizerischen Entomologischen Gesellschaft 44: 233-264 (in German).