

TWO NEW RECORDS FOR THE GENUS *LIMNEPHILUS* LEACH, 1815 (TRICHOPTERA: LIMNEPHILIDAE) FROM NORTH MACEDONIA

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We collected adult caddisflies during the period October 2016 - October 2017 in Brodec village in the Karadak Mountains in North Macedonia. We found 26 species in total, two of which are recorded for the first time from North Macedonia: *Limnephilus auricula* Curtis, 1834, and *Limnephilus griseus* (Linnaeus, 1758). The finding of these two species contributes to the knowledge of their distribution patterns and shows that Balkan Peninsula has still poorly investigated areas.

Keywords: Trichoptera, *Limnephilus auricula*, *L. griseus*, North Macedonia

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Prikupljali smo odrasle tulare od listopada 2016. do listopada 2017., u selu Brodec u planinama Karadak u Sjevernoj Makedoniji. Pronašli smo ukupno 26 vrsta, od čega su dvije zabilježene prvi put za Sjevernu Makedoniju: *Limnephilus auricula* Curtis, 1834 i *Limnephilus griseus* (Linnaeus, 1758). Nalaz ovih dviju vrsta doprinosi poznavanju njihove rasprostranjenosti, i pokazuje da je Balkanski poluotok još uvijek slabo istraživeno područje.

Ključne riječi: Trichoptera, *Limnephilus auricula*, *L. griseus*, Sjeverna Makedonija

INTRODUCTION

Limnephilus Leach, 1815 is one of the most species-rich genera of caddisflies, with nearly 200 described species (HOLZENTHAL *et al.*, 2007; SCHMID, 1988). In Europe, this genus is represented by 59 species (MALICKY, 2004). These species are found in freshwater habitats such as streams, rivers, and lakes, and their larvae build protective cases out of debris or stones. *Limnephilus* caddisflies play an important role in freshwater ecosystems as they are a food source for many aquatic and terrestrial predators, and

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their larvae play an important role in nutrient cycling. The species of *Limnephilus* are considered important indicators of water quality, as their presence or absence can be used to determine the health of freshwater ecosystems.

The first record of caddisflies in North Macedonia in RADOVANOVIĆ (1935) registered 6 species for the country. However, in his subsequent study of the Trichoptera in Ohrid Lake and surrounding areas (Jablanica and Pelister), this author reported the presence of 43 species, of which only *Limnephilus rhombicus* (Linnaeus, 1758) and *Mystacides longicornis* (Linnaeus, 1758) had been previously documented. Later investigations by BOTOȘANEANU (1960) on Mt. Pelister and at Ohrid Lake (Shum, St. Naum Springs), and by PAVLOVSKI (1984, 1991) and ARSOV (1991) on caddisfly larvae and adults in the rivers Zrnovska and Babuna respectively, revealed further insights into the diversity of caddisflies in the country. KUMANSKI (1997) and KUMANSKI & MALICKY (1999) also contributed new faunistic data on Trichoptera in North Macedonia.

There have been significant advances in the knowledge about caddisflies from the Republic of North Macedonia during the recent years as certain areas have been more extensively researched (OLÁH 2010, 2011; OLÁH *et al.*, 2013a, 2013b, 2014, 2015, 2018, 2019; OLÁH & KOVÁCS 2013, 2014; KUČINIĆ *et al.*, 2016; VITECEK *et al.*, 2015a, 2015b, 2015c; WARINGER *et al.*, 2015; RIMCHESKA *et al.*, 2015; SLAVEVSKA-STAMENKOVIĆ *et al.*, 2016; 2020, 2021; BILALLI *et al.*, 2018, 2019; MUSLIU *et al.* 2020; HINIĆ *et al.*, 2020; VALLADOLID *et al.*, 2022; HINIĆ-JORDANOVSKA *et al.*, 2024).

The aim of this study is to contribute to the faunistic list of caddisflies from the Karadak Mountains (Republic of North Macedonia), to summarize literature and recent unpublished faunistic data and to provide information on the distribution of some rare and endemic species.

MATERIAL AND METHODS

Adult caddisflies were collected in one locality in the village of Brodec in the Karadak Mountains in the Republic of North Macedonia at an altitude of 1362 m (exact location: 42.150596 °N 21.455415 °E). The Karadak Mountains are a mountain range located mainly in the Republic of North Macedonia and Kosovo, while a smaller part is in Serbia. The highest peak is Ramno at 1,650 meters above sea level. The mountain range is also an important source of water, with several rivers and streams flowing from its slopes.

Adult caddisfly specimens were collected with entomological net, sweeping net, handpicking and ultraviolet light trap in Brodec village in Macedonia. The sampling was carried out between October 2016 and October 2017. Collected samples were preserved in 80 % ethanol. Results were visualized in R (4.2.1) using the package "ggplot2" (WICKHAM, 2016).

The specimens were identified under a stereomicroscope with the determination keys of KUMANSKI (1985, 1988) and MALICKY (2004). The collection is deposited at the Laboratory of Zoology of the Faculty of Natural and Mathematical Sciences, University of Prishtina, Republic of Kosovo. Systematic follows MORSE (2023).



Fig. 1. a) Map of the sampling station; b) Photo of the sampling station

RESULTS

During this investigation, we found 26 species and 13 genera belonging to 8 families. The distribution of species within families is as follows: Limnephilidae (14), Rhyacophilidae (4), Philopotamidae (2), Polycentropodidae (2), Glossosomatidae (1), Uenoidae (1), Sericostomatidae (1) and Beraeidae (1).

The highest number of specimens belongs to the families: Limnephilidae (72 specimens), Philopotamidae (53 specimens), Rhyacophilidae (15 specimens), Sericostomatidae (11 specimens), Polycentropodidae (4 specimens), Uenoidae (2 specimens) while with only one specimen are families Glossosomatidae and Beraeidae.

The highest numbers of individuals were observed in August (59 specimens), followed by July (36 specimens), and June (26 specimens). Additionally, a moderate number of individuals were found in October (19 specimens) and September (17 specimens). However, the lowest number of individuals were observed in March, with only two specimens recorded. The caddisfly species that exhibited the longest flight duration was *Philopotamus montanus* (Donovan, 1813), which was found over 5 months, followed by *Wormaldia subterranea* Radovanovic, 1932 over 4 months, and *Micropterana sequax* McLachlan, 1875 over 3 months. Several species including *Rhyacophila fischeri* Botosaneanu, 1957, *Rhyacophila laevis* Pictet, 1834, *Plectrocnemia conspersa* (Curtis, 1834), *Potamophylax pallidus* (Klapalek, 1899), and *Thremma anomalum* McLachlan, 1876 were found over 2 months. Additionally, 15 species were found only during one month. During the observed period, one species had flight activity limited to spring, while 20 species were only active during the summer months. Two species were observed to have a flight period exclusively in autumn, while one species had flight activity from spring until autumn. Additionally, two other species had flight activity from summer until autumn (Tab. 1).

Tab. 1. Systematic list of caddisflies collected in the Karadak Mountains (Brodec) during the period October 2016 - October 2017. Species new to the fauna of North Macedonia are indicated by an asterisk*.

Species/Months	III		VI		VII		VIII		IX		X		Total		
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	Σ
<i>Rhyacophila fischeri</i> Botosaneanu, 1957			3		2	2							5	2	7
<i>Rhyacophila laevis</i> Pictet, 1834			3		1								4		4
<i>Rhyacophila obtusa</i> Klapalek, 1894			1										1		1
<i>Rhyacophila tristis</i> Pictet, 1834					3								3		3
<i>Glossosoma conformis</i> Neboiss, 1963					1								1		1
<i>Philopotamus montanus</i> (Donovan, 1813)	1	1	3		4	2	1		5	1			14	4	18
<i>Wormaldia subterranea</i> Radovanovic, 1932			14	1	7	2	2		3	1	5		31	4	35
<i>Plectrocnemia brevis</i> McLachlan, 1871							2						2		2
<i>Plectrocnemia conspersa</i> (Curtis, 1834)					1		1						2		2
<i>Limnephilus affinis</i> Curtis, 1834							1	1					1	1	2
<i>Limnephilus auricula</i> Curtis, 1834 *							1	2					1	2	3
<i>Limnephilus flavicornis</i> (Fabricius, 1787)							1	1					1	1	2
<i>Limnephilus griseus</i> (Linnaeus, 1758) *							1						1		1
<i>Limnephilus hirsutus</i> (Pictet, 1834)							2						2		2
<i>Limnephilus lunatus</i> Curtis, 1834							11	6			1		12	6	18
<i>Limnephilus sparsus</i> Curtis, 1834							2						2		2
<i>Limnephilus vittatus</i> (Fabricius, 1798)							4	7					4	7	11
<i>Potamophylax pallidus</i> (Klapalek, 1899)									2	3	11		13	3	16
<i>Micropterna caesareica</i> Schmid, 1959					2								2		2
<i>Micropterna sequax</i> McLachlan, 1875					2	1	1		1		1		5	1	6
<i>Grammotaulius nigropunctatus</i> (Retzius, 1873)							1						1		1
<i>Stenophylax meridionalis</i> Malicky, 1980					2	3							2	3	5
<i>Stenophylax mitis</i> McLachlan, 1875					1								1		1
<i>Thremma anomalum</i> McLachlan, 1876									1		1		2		2
<i>Oecimus monedula</i> (Hagen, 1859)							5	6					5	6	11
<i>Beraea pullata</i> (Curtis, 1834)			1										1		1
Σ	1	1	25	1	26	10	36	23	12	5	19		119	40	159

DISCUSSION

The family Limnephilidae is one of the most diverse families of caddisflies in Europe and in the Balkan Peninsula as well. During the past years, several new species of this family have been described from this area, including from North Macedonia, mostly belonging to the genera *Drusus*, *Annitella*, *Potamophylax* and *Ecclisopteryx* (IBRAHIMI et al., 2015a, 2016, 2021, 2022, 2023; PREVISIC et al., 2014; OLÁH et al., 2013a, 2013b; OLÁH & KOVÁCS, 2014; OLÁH, 2010; VITECEK et al., 2015). The genus *Limnephilus* is however less diverse in the area, but there are species with narrow distributions too (IBRAHIMI et al., 2012, 2014a, b, 2019). One species is known as endemic to the Balkan Peninsula, *Limnephilus petri* (IBRAHIMI et al., 2015b).

The results presented in this paper are the continuation of the initial large-scale investigation of caddisflies of the Karadak Mountains. Several first records of rare caddisfly species were presented in this area (Kosovo and North Macedonia) during

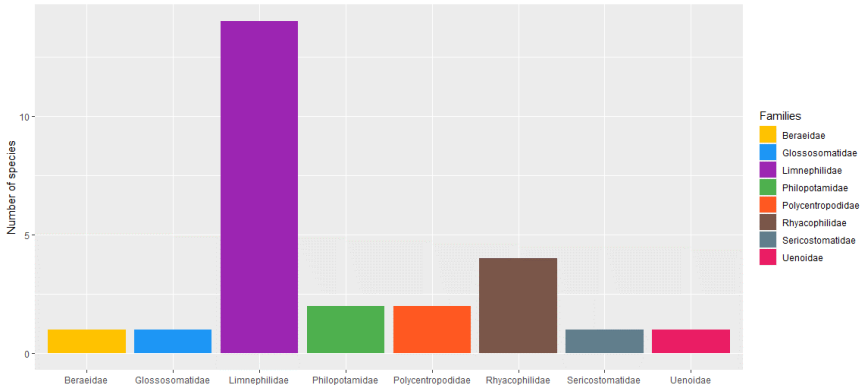


Fig. 2. Number of caddisfly species recorded per family.

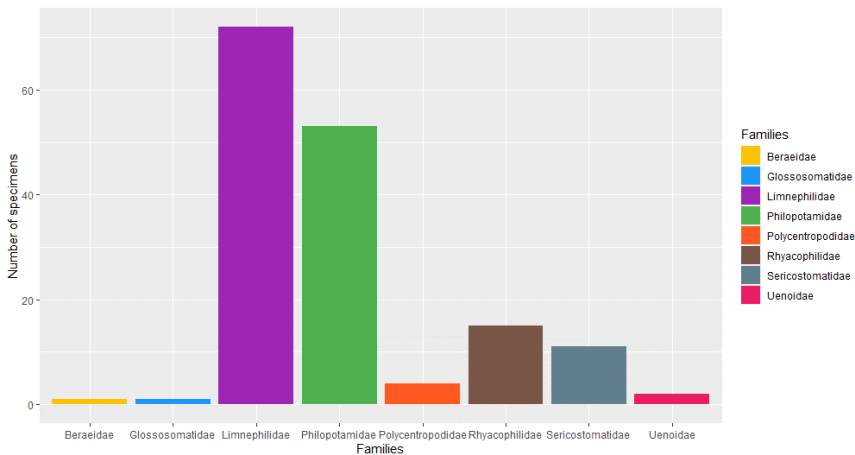


Fig. 3. Number of specimens per family

the past period, the present findings representing a continuation of the ongoing investigation of caddisflies in this area.

The finding of two first records during this investigation in the Karadak Mountains shows that despite recent intensified investigations of caddisfly fauna in Macedonia (BILALI *et al.*, 2018, 2019, 2024; HINIĆ *et al.*, 2020; MUSLIU *et al.*, 2020; OLÁH *et al.*, 2013b; OLÁH & KOVÁCS 2013, 2014; PREVIŠIĆ *et al.*, 2014 SLAVEVSKA-STAMENKOVIĆ *et al.*, 2016 2020, 2021; VALLADOLID *et al.*, 2022) there are still areas that are still insufficiently sampled.

Limnephilus auricula is widespread in Europe and the Balkan Peninsula (NEU *et al.*, 2018). It is a species whose larvae can be found in temporary pools, ponds and ditches. Its substratum preference includes plant material, particulate organic matter, mud and sand, in mainly standing water. The feeding ecology of the larvae of *L. auricula* is predominantly shredding, with some predation and grazing. The larvae of this species

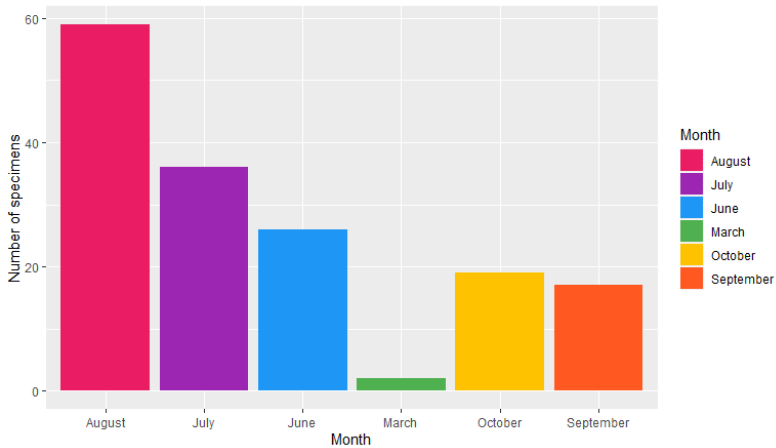


Fig. 4. Number of specimens per month

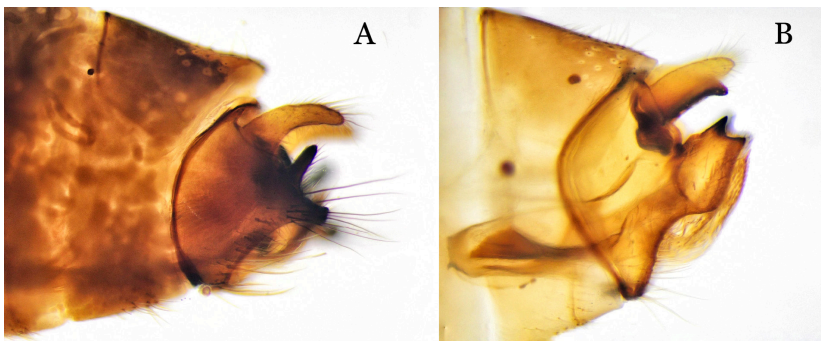


Fig. 5. Male genitalia; A. *Limnephilus auricula* B. *Limnephilus griseus*.

construct protective cases made of plant materials, and they use these cases to camouflage themselves from predators. The adults are short-lived, and are mainly active at night.

Limnephilus griseus is currently known from only a few localities in the Balkans (NEU et al., 2018). The flight time is from May to November. The females presumably have a rest period to bridge the dry summer before the eggs are laid in the autumn (HILEY, 1978). *L. griseus* can be found in slow-flowing streams as well as in vegetation-rich pools and fens. The species can be dominant in periodically drying out pools (GÍSLASON, 1993; CZACHOROWSKI & SZCZEPANSKA 1991).

Both species are associated with pristine undisturbed freshwater habitats in upstream segments of streams and rivers and are thus under continuous threat from anthropogenic activities such as forest degradation, alternation of freshwater ecosystems, and disturbances in the water flow regime.

This investigation contributes to a better knowledge of the faunistics, ecology, distribution, and diversity of caddisflies in North Macedonia.

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SUMMARY

Two new records for the genus *Limnephilus* Leach, 1815 (Trichoptera: Limnephilidae) from North Macedonia

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The paper presents two new records of the genus *Limnephilus* Leach, 1815 (Trichoptera: Limnephilidae) from North Macedonia, based on caddisfly material collected in the Karadak Mountains from October 2016 until October 2017. In total, we found 26 species and 13 genera belonging to 8 families. Adult caddisfly specimens were collected with entomological net, sweeping net, handpicking and ultraviolet light trap. Collected samples were preserved in 80 % ethanol.

The new records (*Limnephilus auricula* and *L. griseus*) represent the first records of these species in North Macedonia and expand the known distribution of the genus in the Balkans.

The paper highlights the importance of continued research and monitoring of caddisflies in the region the better to understand their biodiversity and distribution.