

## CADDISFLIES (INSECTA: TRICHOPTERA) FROM KOŽUF AND BABA MOUNTAINS (REPUBLIC OF NORTH MACEDONIA)

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**Slavevska-Stamenković, V., Ibrahim, H., Hinić, J., Mitić-Kopanja, D., Bilalli, A., Musliu, M., Karouzas, I. & Kučinić, M.: Caddisflies (Insecta: Trichoptera) from Kožuf and Baba mountains (Republic of North Macedonia). *Nat. Croat.*, Vol. 30, No. 1, 145-160, 2021, Zagreb.**

Adult caddisflies were collected during 2018 and 2019 from Kožuf and Baba mountains, located in the southern end of the Republic of North Macedonia. A total of 36 species were recorded, of which 22 and 8 were recorded for the first time for Kožuf and Baba mountains, respectively. *Limnephilus flavicornis* (Fabricius, 1787) is reported for the first time from the country from Kožuf Mountain. In addition, new localities of several rare and endemic caddisfly species were found. The results of this study highlight Kožuf and Baba mountains as refugium for caddisfly species of conservation importance.

**Key words:** rare species, endemic species, diversity, distribution, R. North Macedonia

**Slavevska-Stamenković, V., Ibrahim, H., Hinić, J., Mitić-Kopanja, D., Bilalli, A., Musliu, M., Karouzas, I. & Kučinić, M.: Tulari (Insecta: Trichoptera) planine Kožufa i Babe (Republika Sjeverna Makedonija). *Nat. Croat.*, Vol. 30, No. 1, 145-160, 2021, Zagreb.**

Tijekom 2018 i 2019 prikupljeni su odrasli tulari na planinama Kožuf i Baba, smještenim na južnom dijelu Republike Sjeverne Makedonije. Zabilježeno je 36 vrsta, od kojih su 22, odnosno njih 8, po prvi puta za planine Kožuf, odnosno Baba. *Limnephilus flavicornis* (Fabricius, 1787) zabilježena je prvi puta za Sjevernu Makedoniju, na planini Kožuf. Nađeni su i novi lokaliteti za nekoliko rijetkih i endemičnih vrsta. Rezultati ovog istraživanja ističu planine Kožuf i Baba kao refugije za vrste tulara važnih za zaštitu.

**Ključne riječi:** rijetke vrste, endemi, raznolikost, rasprostranjenost, Republika Sjeverna Makedonija

## INTRODUCTION

Compared to mayflies and stoneflies, the caddisfly fauna of the Republic of North Macedonia has never been in the focus of continuous research and thus the diversity and distribution of this aquatic insect order still remain poorly known (SLAVEVSKA-STAMENKOVIĆ *et al.*, 2016). The first caddisfly data of the R. of North Macedonia were published over eighty years ago, when RADOVANOVIĆ (1935) registered 6 species for the country. In his next paper on the Trichoptera from Ohrid Lake and its surroundings (Jablanica and Pelister) RADOVANOVIĆ (1943) gave information about the presence of 43 species, of which only *Limnephilus rhombicus* (Linnaeus, 1758) and *Mystacides longicornis* (Linnaeus, 1758) had previously been reported. The next investigation into adult caddisflies was conducted by BOTOȘĂNEANU (1960) on Mt Pelister and nearby Ohrid Lake (Shum, St. Naum Springs). Later, PAVLOVSKI (1984, 1991) and ARSOV (1991) made an inventory of caddisfly larvae and adults from the rivers Zrnovska and Babuna, while KUMANSKI (1997) and KUMANSKI & MALICKY (1999) reported new faunistic data on Trichoptera from the country.

Considerable progress has been made in recent year, when some areas became much better explored (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; BILALLI *et al.*, 2018, 2019). However, there are still parts of the country where only scarce data is available, such as Baba (BOTOȘĂNEANU 1960; OLÁH 2010; OLÁH & KOVÁCS 2013; OLÁH *et al.*, 2014, 2017, 2018, 2019; PREVIŠIĆ *et al.*, 2014; RADOVANOVIĆ, 1943; ŠAPKAREV, 1997; WARINGER *et al.*, 2016) and Kožuf (OLÁH *et al.*, 2013; OLÁH & KOVÁCS 2013, 2014; PREVIŠIĆ *et al.*, 2014) mountains. These mountains are very important areas in terms of caddisfly fauna, and recent research resulted in the description of new species, such as *Agaphyalax balcanicus* Olah, Kovacs & Ibrahimi, 2018 from Baba (OLÁH *et al.*, 2018) and *Chaetopterooides tunik* Olah, 2013 from Kožuf mountain (OLÁH *et al.*, 2013).

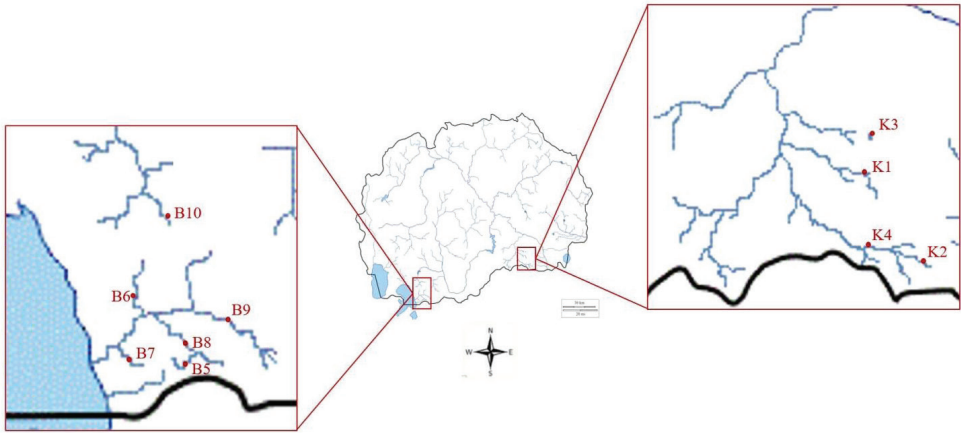
The aim of this study is to contribute to the faunistic list of caddisflies from Kožuf and Baba mountains (Republic of North Macedonia), to summarize literature and recent unpublished faunistic data and to provide information on the distribution of some rare and endemic species.

## MATERIALS AND METHODS

### Study area

Adult caddisflies were collected from ten localities in the Republic of North Macedonia (Fig. 1). The first four sampling sites are located on Kožuf Mountain (protected area within the Emerald network), where K1 (brook) and K4 (stream) are situated in the forest zone, while K2 (open brook) and K3 (small lake and open brooks) are located in the alpine grassland.

The rest of the sampling sites are located on Baba Mountain within Pelister National Park, a potential Natura 2000 site. Among them, sampling sites from B5 to B9 are situated in the forest zone, while B10 (tributary of Caparska Reka River) at the edge of the forest zone. All localities belong to the 6<sup>th</sup> ecoregion (Hellenic Western Balkan) according to ILLIES (1978). Detailed information about the sampling localities of collected adult specimens are presented in Table 1.



**Fig. 1.** Map of the sampling localities of Kožuf (K1 – K4) and Baba mountains (B5 – B10) (R. North Macedonia).



**Fig. 2a-d.** Sampling localities on Kožuf and Baba mountains (R. North Macedonia): a) K1 – Brook in the forest zone, b) K4 – Stream in the forest zone, c) B8 – Rzanska Reka River, d) B9 – Brajcinjska Reka River above the intake of small hydro power plant (SHPP) Brajcin 1.

Kožuf Mountain is situated between the Republic of North Macedonia and Greece. Its highest peak is Zelenbeg at 2171 m asl. Because this area is a natural barrier in the Republic of North Macedonia, directly exposed to the influences of the Mediterranean and the Aegean Sea, it is an important biodiversity hotspot for different groups of organisms in the country (STOJMILOV, 2011).

Baba Mountain, also known by the name of its highest peak, Pelister (2601 m asl.), is the third highest mountain in R. North Macedonia. In areas lower than 1,200 m the climate is basically moderate continental, but also expresses the influences of a mountain climate. The higher areas are characterized by a continental climate, and starting from 1,800 m, one can easily feel the mountain climate. Above 2,400 m the mountain climate gains certain alpine characteristics, with an average temperature of 1.3 to 2.3°C. Pelister National Park, situated on Baba Mountain (STOJMILOV, 2011), is the oldest and second largest national park in the R. North Macedonia after Mavrovo, and is renowned for its many endemic plant and animal species.

**Tab. 1.** Characteristics of the sampling sites from the Kožuf and Baba mountains (Republic of North Macedonia).

Code	River/Locality	Altitude (m)	Longitude (°N)	Latitude (°E)	Ecoregion	Sampling period
Kožuf Mountain						
K1	Brook in the forest zone	1580	41.19572	22.20575	6	June – July 2019
K2	Open brook in alpine grassland	1808	41.17148	22.20595	6	June – July 2019
K3	Small lake and open brooks in alpine grassland	1668	41.20955	22.221941	6	June – July 2019
K4	Stream in the forest zone	1466	41.18328	22.19485	6	June – July 2019
Baba Mountain						
B5	Small brook on Rzanska Reka River	1425	40.9041192	21.2036355	6	June 2019
B6	Stanisar Reka River below the intake of small hydro power plant (SHPP) Brajcino 2	1136	40.9153988	21.1814784	6	June 2019
B7	Baltanska Reka river above v. Brajcino	1124	40.903579	21.169998	6	June 2019
B8	Rzanska Reka River	1388	40.90586	21.20454	6	June 2019
B9	Brajcinska Reka River above the intake of small hydro power plant (SHPP) Brajcino 1	1371	40.9198120	21.2205601	6	June 2019
B10	Brook on the edge of the forest zone	1808	41.01436	21.17423	6	May 2018

## Data sampling and processing

Adult caddisfly specimens were collected with entomological nets and handpicking during the day, as well as ultraviolet (UV) pyramid light traps during the night. Samplings were conducted in May 2018 and during the period of June to July 2019 at the localities from Kožuf Mountain, and on Baba Mountain during June 2019. The collected material was preserved in 96% ethanol.

Adult specimens were identified using a Nikon SMZ745 stereomicroscope with appropriate identification keys (KUMANSKI, 1985, 1988; MALICKY, 2004). All specimens collected are deposited in the Macedonian National Collection of Invertebrates (MNCI) Skopje and in the Laboratory of Zoology at the Faculty of Natural and Mathematical Sciences in Prishtina. Systematic presentation was done according to MORSE (2019).

New distributional records are presented in Material examined. Literature records are given only for the species recorded during our investigation and are cited in a shortened form including the respective reference, name of the watercourse or lake and adjacent settlement or mountain. Additional information may be found in original papers. New caddisfly species added to the fauna of Kožuf and Baba mountains, as well as of R. North Macedonia, are given in Notes.

## RESULTS

During our investigation thirty-six taxa were recorded from Kožuf and Baba mountains, belonging to twelve families: Rhyacophilidae, Glossosomatidae, Philopotamidae, Hydropsychidae, Polycentropodidae, Brachycentridae, Limnephilidae, Uenoidae, Odontoceridae, Goeridae, Sericostomatidae and Beraidae. Among the families, the highest number of species was recorded within Limnephilidae (14 taxa) and Rhyacophilidae (9), while Polycentropodidae (3 species) and Glossosomatidae (2 species) were less diverse families. All other caddisfly families are represented with only one species each.

Female specimens of the genus *Hydropsyche* are identified only up to the generic level and thus, they were not taken into consideration for counting of the taxa recorded from Kožuf and Baba mountains.

### Systematic list of caddisflies collected at ten sampling localities of Kožuf and Baba mountains (R. North Macedonia):

**Family: RHYACOPHILIDAE** Stephens, 1836

**Genus: *Rhyacophila*** Pictet, 1834

1. *Rhyacophila armeniaca* Guerin – Meneville, 1834

Material examined:

**Kožuf:** K4. 20. VII. 2019. 1 ♂, 19. VI. 2019. 1 ♂.

Note: new for **Kožuf Mountain**

2. *Rhyacophila balcanica* Radovanović, 1953

Material examined:

**Kožuf:** K2. 20. VII. 2019. 1 ♂; K4. 20. VII. 2019. 8 ♂♂, 19. VI. 2019. 1 ♂.

Note: new for **Kožuf Mountain**

3. *Rhyacophila fischeri* Botosaneanu, 1957  
Material examined:  
**Kožuf:** K4. 20. VII. 2019. 2 ♂♂, 19. VI. 2019. 4 ♂♂.  
Note: new for **Kožuf Mountain**
  4. *Rhyacophila laevis* Pictet, 1834  
Material examined:  
**Baba:** B5. 20. VI. 2019. 12 ♂♂.  
Note: new for **Baba Mountain**
  5. *Rhyacophila loxias* Schmid, 1970  
Material examined:  
**Kožuf:** K1. 20. VII. 2019. 1 ♂; K4. 20. VII. 2019. 15♂♂, 2♀♀.  
**Baba:** B6. 20. VI. 2019. 2 ♂♂; B7. 15. VII. 2019. 3 ♂♂, 1♀.  
Note: new for **Kožuf and Baba mountains**
  6. *Rhyacophila nubila* Zetterstedt, 1840  
Material examined:  
Baba: B6. 20. VI. 2019. 1 ♂.  
Literature records:  
Baba: OLÁH (2010): Noted near Brajcino Stream beneath Brajcino village.
  7. *Rhyacophila obtusa* Klapalek, 1894  
Material examined:  
**Kožuf:** K1. 19. VI. 2019. 8 ♂♂, 2 ♀♀; K4. 19. VI. 2019. 1 ♂.  
Note: new for **Kožuf Mountain**
  8. *Rhyacophila polonica* McLachlan 1879  
Material examined:  
**Kožuf:** K1. 20. VII. 2019. 1 ♂; K4. 20. VII. 2019. 4 ♂♂.  
Note: new for **Kožuf Mountain**
  9. *Rhyacophila tristis* Pictet, 1834  
Material examined:  
**Kožuf:** K2. 20. VII. 2019. 1 ♂.  
**Baba:** B8. 20. VII. 2019. 1 ♂.  
Literature records:  
**Baba:** BOTOȘĂNEANU (1960): Medium sized stream in a valley towards Bitola and river at Capari village.  
Note: new for **Kožuf Mountain**
- Family: GLOSSOSOMATIDAE Wallengren, 1891**  
**Genus: Glossosoma Curtis, 1834**
10. *Glossosoma conformis* Neboiss, 1963  
Material examined:  
**Kožuf:** K4. 20. VII. 2019. 3 ♂♂.  
Note: new for **Kožuf Mountain**

11. *Glossosoma klotho* Malicky, 2003

Material examined:

**Kožuf:** K4. 20. VII. 2019. 1 ♂.Note: new for **Kožuf Mountain****Family: PHILOPOTAMIDAE Stephens, 1829****Genus: *Philopotamus* Stephens, 1829**12. *Philopotamus montanus* (Donovan, 1813)

Material examined:

**Kožuf:** K3. 20. VII. 2019. 8 ♂♂, 4 ♀♀; K4. 20. VII. 2019. 2 ♂♂, 1 ♀, 19. VI. 2019. 1 ♂.**Baba:** B5. 20. VI. 2019. 6 ♂♂, 2 ♀♀; B6. 20. VI. 2019. 3 ♂♂, 2 ♀♀; B7. 15. VII. 2019. 1 ♂, 2 ♀♀; B8. 20. VII. 2019. 1 ♂, 4 ♀♀; B9. 19. VI. 2019. 2 ♂♂, 2 ♀♀.

Literature records:

**Baba:** BOTOȘĂNEANU (1960): River in Capari village.Note: new for **Kožuf Mountain****Family: HYDROPSYCHIDAE Curtis, 1835****Genus: *Hydropsyche* Picret, 1834**13. *Hydropsyche incognita* Pitsch, 1993

Material examined:

**Baba:** B6. 20. VI. 2019. 1 ♂.Note: new for **Baba Mountain***Hydropsyche* sp. females**Kožuf:** K4. 20. VII. 2019. 1 ♀.**Baba:** B6. 20. VI. 2019. 1 ♂.**Family: POLYCENTROPODIDAE Ulmer, 1903****Genus: *Plectrocnemia* Stephens, 1836**14. *Plectrocnemia brevis* McLachlan, 1871

Material examined:

**Kožuf:** K4. 20. VII. 2019. 3 ♂♂.Note: new for **Kožuf Mountain**15. *Plectrocnemia conspersa* (Curtis, 1834)

Material examined:

**Kožuf:** K3. 20. VII. 2019. 7 ♂♂; K4. 20. VII. 2019. 1 ♂.Note: new for **Kožuf Mountain****Genus: *Polycentropus* Curtis, 1835**16. *Polycentropus flavomaculatus* (Pictet, 1834)

Material examined:

**Baba:** B6. 20. VI. 2019. 4 ♂♂.

Literature records:

**Baba:** RADOVANOVIĆ (1943): Registered in the upper part of Trnovska Reka river; RADOVANOVIĆ (1953): Collected from Pelister, without mention of the precise sampling site.

**Family: BRACHYCENTRIDAE Ulmer, 1903****Genus: *Brachycentrus* Curtis, 1834**17. *Brachycentrus montanus* Klapalek, 1892

Material examined:

**Baba:** B9. 19. VI. 2019. 12 ♂♂, 1 ♀.Note: new for **Baba Mountain****Family: LIMNEPHILIDAE Kolenati, 1848****Genus: *Drusus* Stephens, 1837**18. *Drusus biguttatus* (Pictet, 1834)

Material examined:

**Kožuf:** K4. 19. VI. 2019. 1 ♂.Note: new for **Kožuf Mountain**19. *Drusus botosaneanui* Kumanski, 1968

Material examined:

**Kožuf:** K2. 20. VII. 2019. 4 ♂♂; K4. 20. VII. 2019. 3 ♀♀; K3. 20. VII. 2019. 5 ♂♂, 7 ♀♀.Note: new for **Kožuf Mountain**20. *Drusus discolor* (Rambur, 1842)

Material examined:

**Kožuf:** K2. 20. VII. 2019. 2 ♂♂; K4. 20. VII. 2019. 15 ♂♂, 2 ♀♀, 19. VI. 2019. 3 ♂♂.**Baba:** B5. 20. VI. 2019. 3 ♂♂; B8. 20. VI. 2019. 12 ♂♂.

Literature records:

**Kožuf:** PREVIŠIĆ *et al.* (2014): Reported as larval stage without precise locality data.**Baba:** BOTOȘĂNEANU (1960): Medium sized stream on a valley towards Bitola; PREVIŠIĆ *et al.* (2014): Reported as larval stage without precise locality data; OLAH *et al.* (2017): Широка Hiking Lodge and on the way towards it.21. *Drusus* sp.

Material examined:

**Kožuf:** K1. 19. VII. 2019. 1 ♂, 1 ♀; K2. 20. VII. 2019. 1 ♂.22. *Drusus vernonensis* Malicky, 1989

Material examined:

**Baba:** B10. 21. V. 2018. 10 ♂♂, 2 ♀♀.

Literature records:

**Baba:** WARINGER *et al.* (2016): Reported from a tributary of Caparska Reka River in larval and adult stage.**Genus: *Limnephilus* Leach, 1815**23. *Limnephilus affinis* Curtis, 1834

Material examined:

**Kožuf:** K1. 19. VI. 2019. 1 ♂, 1 ♀; K3. 20. VII. 2019. 1 ♂; K4. 20. VII. 2019. 1 ♂.Note: new for **Kožuf Mountain**



24. *Limnephilus flavicornis* (Fabricius, 1787)

Material examined:

**Kožuf:** K1. 20. VII. 2019. 1 ♂.

Note: New to the fauna of R. North Macedonia

25. *Limnephilus lunatus* Curtis, 1834

Material examined:

**Kožuf:** K1. 19. VI. 2019. 2 ♂♂, 1 ♀; K4. 20. VII. 2019. 1 ♂.Note: new for **Kožuf Mountain**26. *Limnephilus bipunctatus* Curtis, 1834

Material examined:

**Baba:** B10. 21. V. 2018. 1 ♂♂.Note: new for **Baba Mountain****Genus: *Potamophylax* Wallengren, 1891**27. *Potamophylax pallidus* (Klapalek, 1899)

Material examined:

**Kožuf:** K3. 20. VII. 2019. 1 ♂.

Literature records:

**Kožuf:** OLÁH & KOVÁCS (2013): Lake and open brook in alpine grassland towards Ski Kožuf.28. *Potamophylax lemezes* Olah & Graf, 2013

Material examined:

**Kožuf:** K1. 19. VI. 2019. 1 ♀.**Baba:** B5. 20. VI. 2019. 2 ♂♂.Note: new for **Kožuf and Baba mountains****Genus: *Micropterna* Stein, 1873**29. *Micropterna caesareica* Schmid, 1959

Material examined:

**Kožuf:** K1. 19. VI. 2019. 2 ♂♂.**Baba:** B8. 19. 06. 2019. 2 ♂♂.Note: new for **Kožuf and Baba mountains**30. *Micropterna sequax* McLachlan, 1875

Material examined:

**Kožuf:** K1. 20. VII. 2019. 1 ♂, 19. VI. 2019. 2 ♂♂, 2 ♀♀; K3. 20. VII. 2019. 13 ♂♂; K4. 20. VII. 2019. 2 ♂♂.**Baba:** B9. 19. 06. 2019. 1 ♂.Note: new for **Kožuf and Baba mountains****Genus: *Stenophylax* Kolenati, 1848**31. *Stenophylax meridionalis* Malicky, 1982

Material examined:

**Kožuf:** K1. 19. VI. 2019. 2 ♂♂; K4. 19. VI. 2019. 1 ♂, 3 ♀♀.**Baba:** B5. 20. VI. 2019. 1 ♂, 2 ♀♀; B8. 19. 06. 2019. 3 ♂♂; B9. 19. 06. 2019. 2 ♂♂.

Literature records:

**Baba:** OLÁH & KOVÁCS (2013): Open brook at ski station in Nižepole.Note: new for **Kožuf Mountain**

**Family: UENOIDAE Iwata, 1927****Genus: *Thremma* McLachlan, 1876**32. *Thremma anomalum* McLachlan, 1876

Material examined:

**Kožuf:** K4. 19. VI. 2019. 4 ♂♂.**Baba:** B5. 20. VI. 2019. 4 ♂♂.

Literature records:

**Baba:** BOTOȘĂNEANU (1960): Springs in the alpine area and by the river in Capari village; Radovanović (1943): Upper part of Trnovska Reka river.Note: new for **Kožuf Mountain****Family: ODONTOCERIDAE Wallengren, 1891****Genus: *Odontocerum* Leach, 1815**33. *Odontocerum albicorne* (Scopoli, 1763)

Material examined:

**Kožuf:** K3. 20. VII. 2019. 1 ♂.Note: new for **Kožuf Mountain****Family: GOERIDAE Ulmer, 1903****Genus: *Silo* Curtis, 1830**34. *Silo pallipes* Fabricius, 1781

Material examined:

**Baba:** B6. 20. VI. 2019. 2 ♂♂, 1 ♀.

Literature records:

**Baba:** RADOVANOVIĆ (1943): Upper part of Trnovska Reka river and Rotinska Reka river; Slavevska-Stamenković and Hinić (unpublished data): Collected in larval stage from Brajchinska Reka river above the turbine room of SHPP Brajčinska 1.**Family: SERICOSTOMATIDAE Stephens, 1876****Genus: *Oecismus* McLachlan, 1876**35. *Oecismus mucidus* McLachlan, 1876

Material examined:

**Baba:** B6. 20. VI. 2019. 2 ♂♂, 1 ♀; B7. 15. VII. 2019. 2 ♂♂; B9. 19. 06. 2019. 6 ♂♂, 1 ♀.

Literature records:

**Baba:** BOTOȘĂNEANU (1960): Main brook towards Bitola (1800 – 2500 m asl); RADOVANOVIĆ (1943): Rotinska Reka river.**Family: BERAIDAE Wallengren, 1891****Genus: *Beraea* Stephens, 1836**36. *Beraea pullata* (Curtis, 1834)

Material examined:

**Kožuf:** K2. 20. VII. 2019. 1 ♂.

Literature records:

**Kožuf:** OLÁH & KOVÁCS (2013): Pond and open brook in alpine grassland towards Ski Kožuf.

## DISCUSSION

Literature data about caddisfly fauna from Kožuf Mountain are scarce, with only eight species reported in the last decade (OLÁH *et al.*, 2013; OLÁH & KOVÁCS 2013, 2014; PREVIŠIĆ *et al.*, 2014). Our investigation significantly contributes to the inventory of the caddisfly fauna as we found 27 taxa, of which 22 are recorded for the first time for Kožuf Mountain. Three of the previously known species (OLÁH & KOVÁCS 2013, 2014; PREVIŠIĆ *et al.*, 2014) were confirmed during our study, while the following five were not found: *Chaetopteroidea tunik*, *Hydropsyche peristerica* Botosaneanu & Marinković-Gospodnetić, 1968, *Notidobia nekibe* Klapálek, 1903, *Oecismus monedula* (Hagen, 1859) and *Tinodes unidentatus* Klapálek, 1894. According to literature and our new faunistic data, 31 taxa in total are currently known from Kožuf Mountain, including one *Drusus* Stephens, 1837, a species currently identified only to generic level. This species is closely related to *Drusus vernonensis* according to the initial morphological comparison and the description is underway following collection of more specimens.

*Limnephilus flavicornis* (Fabricius, 1787) collected near the brook in the forest zone (K1) on Kožuf Mountain is recorded for the first time in R. North Macedonia and thus is a new species for Macedonian fauna. It has been recently reported from Kosovo and the rest of the Balkan Peninsula apart from Albania (IBRAHIMI *et al.*, 2019). In other neighboring and nearby countries, it is a rare species and is only known from few localities (NEU *et al.*, 2018). According to GRAF *et al.*, (2008) the preferred stream zonation for this species are littoral zones and then to a lesser degree the epipotamal and metapotamal zones. The altitude preference for *L. flavicornis* according to the same source was reported not to exceed 1000 meters and is exclusively related to submontane, collin and planar areas. However, as it was found recently in Kosovo (IBRAHIMI *et al.*, 2019) at 1598 m asl and during our investigation in Kožuf Mountain at 1580 m asl, we can conclude that this species inhabits much higher altitudes in Balkans than in Central and Western Europe.

The results of our investigation revealed the presence of a considerable number of rare species on Kožuf Mountain which are currently known only from one or few localities in the Republic of North Macedonia: *Beraea pullata*, *Drusus biggutatus*, *Glossosoma klotho*, *Limnephilus affinis*, *Limnephilus flavicornis*, *Limnephilus lunatus*, *Micropterna caesareica*, *Micropterna sequax*, *Odontocerum albicorne*, *Plectrocnemia brevis*, *Potamophylax lemezes*, *Rhyacophila balcanica*, *Rhyacophila fischeri*, *Rhyacophila obtusa*, *Rhyacophila loxias*, *Rhyacophila polonica* and *Stenophylax meridionalis* (NEU *et al.*, 2018).

Among the rare species recorded on Kožuf Mountain especially interesting are the findings of *Beraea pullata* and *Glossosoma klotho*. *Beraea pullata* was recently recorded for the first time by an open brook in alpine grassland at 1660 m asl on Kožuf Mountain by OLÁH & KOVÁCS (2014). Taking it into consideration that the species was also found during our investigation on an open brook in alpine grassland on 1808 m asl (K2), we can speculate that Kožuf Mountain still represents the only locality in the country where the species occurs. Although in some European countries such as Slovenia, *B. pullata* is widespread (IBRAHIMI & KUČINIĆ, 2018), in most of the countries neighboring on R. North Macedonia it is considered very rare (e.g. IBRAHIMI *et al.*, 2016; IBRAHIMI & KUČINIĆ, 2018). We presume that the sparse findings of this species in some of the Balkan countries are a consequence of the lack of inventories and it is probably to be expected from more localities in high altitudes. *B. pullata* is listed in the Polish Red List of Trichoptera (Data Deficient category; Buczynska 2008), is classi-

fied as rare in France (SANTOUL *et al.*, 2005) and in the second category of endangerment of the Red List of Caddisflies of Berlin (MEY, 2005). It is also present in the Red List of Fauna of the Republic of Kosovo (IBRAHIMI *et al.*, 2018) in the category Data Deficient.

During our investigation on Kožuf Mountain we found *Glossosoma klotho* for the second time in R. North Macedonia. The species was described by MALICKY (2003) based on material from Greece, Macedonia and Montenegro. It is one of the rarest species of this genus in the Balkan Peninsula and besides its type locality in Greece (Peloponnese) and few other localities (Central Greece; KARAOUZAS & MALICKY, 2015), it is also known from single localities in Kosovo (Shar Mountains) (IBRAHIMI *et al.*, 2016), Albania (Delvinë district) (OLAH, 2010), R. North Macedonia (Radika River, Mavrovo) and Montenegro (Durdevica Tara) (MALICKY, 2003; IBRAHIMI *et al.*, 2016). As the species was previously known only from Mavrovo, our finding in Kožuf Mountain expands its distribution in R. North Macedonia and the Balkans as well. The altitude where it was found during our research is the preferred altitude for this species from where most of the records derive, although in Albania it was found by OLAH (2010) in much lower altitudes (155 m asl).

Faunistical information from published data and our research on Kožuf Mountain reveal that ten species (*Drusus botosaneanui*, *Glossosoma klotho*, *Potamophylax lemezes*, *Rhyacophila balcanica*, *Rhyacophila fischeri*, *Rhyacophila obtusa*, *Rhyacophila loxias*, *Notidobia nekibe*, *Hydropsyche peristerica* Botosaneanu & Marinkovic-Gospodnetic, 1968 and *Tinodes unidentatus*) are narrow range endemics of the Balkan Peninsula and of narrow adjacent areas. As for *C. tunik* described by OLÁH *et al.*, (2013) from Kožuf Mountain and most probably the newly found *Drusus* species, collected during our investigation, they are endemics of Kožuf Mountain. Furthermore, in the stream where sampling stations K2 and K4 are located, over a distance of only few hundred meters we noted the interesting phenomenon of four *Drusus* species living in sympatry: *Drusus botosaneanui*, *Drusus biggutatus*, *Drusus discolor* and *Drusus* sp. This suggests that favorable and diverse habitats of this area have served as glacial refugia for caddisflies in general and especially for microhabitat specialist species such as those belonging to the subfamily Drusinae (VITECEK *et al.*, 2015a).

The review of literature data shows that 41 caddisfly species inhabit Baba Mountain (RADOVANOVIĆ, 1943; BOTOȘĂNEANU, 1960; BOTOSANEANU & MARINKOVIĆ-GOSPODNETIĆ 1966; ŠAPKAREV, 1997; OLÁH, 2010; OLÁH & KOVÁCS, 2013; PREVIŠIĆ *et al.*, 2014; OLÁH *et al.*, 2014, 2017, 2018, 2019; WARINGER *et al.*, 2016). In the frame of our research on Baba Mountain we found 18 species, of which 8 are recorded for the first time from Baba Mountain and the presence of ten previously known species was confirmed: *Drusus vernonensis* Malicky, 1989, *Drusus discolor* (Rambur, 1842), *Oecismus mucidus* McLachlan, 1876, *Philopotamus montanus* (Donovan, 1813), *Rhyacophila tristis* Pictet, 1834, *Rhyacophila nubila* Zetterstedt, 1840, *Stenophylax meridionalis* Malicky, 1982, *Silo pallipes* Fabricius, 1781, *Polycentropus flavomaculatus* Pictet, 1834, and *Thremma anomalum* McLachlan, 1876. In total, 49 species are currently known from Baba Mountain based on literature records and our current research data.

The following species found during our investigation at Baba Mountain are quite rare in R. North Macedonia and are known currently only from one or few localities: *Brachycentrus montanus*, *Drusus vernonensis*, *Limnephilus bipunctatus*, *Micropterna caesareica*, *Micropterna sequax*, *Oecismus mucidus*, *Polycentropus flavomaculatus*, *Potamophylax*

lemez, *Rhyacophila laevis*, *Rhyacophila nubila*, *Silo pallipes* and *Stenophylax meridionalis*. Three species amongst them are found in Republic of North Macedonia only on Baba Mountain: *Drusus vernonensis*, *Oecismus mucidus* and *Silo pallipes*.

*Drusus vernonensis* was found during our investigation in a brook on the edge of the forest zone (B10) on Baba Mountain, near the tributary of Caparska Reka River where a few years ago it was collected by WARINGER *et al.* (2016). Beside this locality it is only known from the type locality in Mount Vernon in Greece, near the border area with Republic of North Macedonia (MALICKY, 1989). It belongs to the *discophorus* species complex (OLÁH *et al.*, 2017), which comprises microendemic species in the Balkan Peninsula and like other species of this complex it usually inhabits spring areas of higher altitudes.

*Oecismus mucidus* was reported previously from Baba Mountain nearby Bitola (BOTOȘĂNEANU, 1960) and has not been reported again until now. We found it in three sampling stations on Baba Mountain (B6, B7, B9) which shows that it is quite widespread in this mountain, with stable populations. *O. mucidus* is an endemic species of the Balkan Peninsula currently known only from Greece, Macedonia, and Kosovo (MALICKY, 2004; IBRAHIMI & VEHAJI, 2017) associated with the upper reaches of unpolluted streams and rivers (e.g., GRAF *et al.*, 2008).

The first data for the presence of *Silo pallipes* in the R. North Macedonia were published about seventy years ago, when RADOVANOVIĆ (1943) found this species in the rivers Rotinska and Trnovska on Baba Mountain. Recently, Slavevska-Stamenković and Hinić (unpublished data) collected the species in the larval stage from Brajchinska Reka River above the turbine room of SHPP Brajchinska 1. During our research on Baba Mountain the adults of *S. pallipes* were collected on Stanisar Reka River below the intake of SHPP Brajcino 2. Thus, the finding of the species nowadays suggests steady populations of the species in this area. Additionally, results of this study contribute to knowledge about distribution of the species on Baba Mountain. Among the rare species registered on Baba Mountain, *Rhyacophila laevis* was found at a small brook on Rzanska Reka River (B5) which represents the second finding for Republic of North Macedonia. Recently, it was recorded for the first time in the country in the spring of Strezimirska Reka River in Mavrovo (KUČINIĆ *et al.*, 2016). *R. laevis* is known from most part of Europe but is not widespread in the Balkan Peninsula, from where it is known only from few localities (IBRAHIMI *et al.*, 2012).

The following 14 species found during our investigation or known from previous literature records in Baba Mountain are narrow range endemics of the Balkan Peninsula and of narrow adjacent areas: *Chaetopteryx stankovici* Marinkovic-Gospodnetic, 1966, *Crunoecia monospina* Botosaneanu, 1960, *Drusus botosaneanui* Kumanski, 1968, *Drusus macedonicus* Schmid, 1956, *Drusus vernonensis*, *Drusus tenellus* (Klapalek, 1898), *Hydropsyche peristerica*, *Micrasema sericeum* Klapalek, 1902, *Oecismus mucidus*, *Potamophylax goulandrionum* Malicky, 1974, *Psilopteryx montanus* Kumanski, 1968, *Rhyacophila loxias* Schmid, 1970, *Rhyacophila balcanica* Radovanović, 1953, *Wormaldia kimminsi* Botosaneanu, 1960. Recent research by OLÁH *et al.* (2018) resulted in the description of a new caddisfly species *Agaphyalax balcanicus*, from the spring area of Caparska Reka at 1952 m asl. The species is an endemic of Baba Mountain.

In conclusion, this paper summarizes faunistical information from both published and unpublished data concerning the caddisfly fauna of the Kožuf and Baba mountains and reports the first record of *Limnephilus flavicornis* from the country. Overall,

the findings of still undescribed species and new species for the country, as well as endemic and rare species, indicate that Kožuf and Baba mountains are very important habitat areas for caddisfly fauna. Our results highlight the necessity of new surveys in the area in order to assess the overall biodiversity of this aquatic insect group and to evaluate the population status or extinction rates of Trichoptera species according to IUCN criteria. The data obtained could be useful for selection of the regions of Kožuf and Baba mountains that are of high conservation values, in which effective protection measures should be applied.

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