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The first record of the rare hangingfly *Bittacus hageni* in Bosnia and Herzegovina (Mecoptera: Bittacidae)

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Abstract
The first record of *Bittacus hageni* Brauer, 1860 for Bosnia and Herzegovina is reported. This is the second record of the species for the Balkan Peninsula and extends the known range of this rare bittacid in Europe considerably.

Key words: Balkan Peninsula, *Bittacus hageni, Bittacus italicus*, distribution, Mecoptera, threatened species.

Introduction

The hangingflies (Bittacidae) are a cosmopolitan family of Mecoptera with over 200 species distributed worldwide (Penny & Byers 1979; Bicha 2018; Machado et al. 2018). Among them, *Bittacus* Latreille, 1805 is the most diverse genus with more than 150 species (Bicha 2018), of which only two, *Bittacus italicus* (Müller, 1766) and *Bittacus hageni* Brauer, 1860, are known from Europe. Although data on both species are poor, *B. hageni* is much scarcer with only a small number of records from most countries, many of them being very old (Tillier 2008; Devetak et al. 2022). Distribution maps were given by Willmann (2013) and Tillier (2008), but they are mostly based on older records. Only recently more detailed data for central Europe (Dobosz & Pacuk 2018) and the Balkan countries (Devetak et al. 2022) were published.

The current range of *B. hageni* includes Austria, Belgium, Croatia, Czech Republic, France, Germany, Hungary, Italy, Kazakhstan, Poland, Romania, Russia, Slovakia and Slovenia, but in most of them the species is very rare and regarded as threatened (Tillier 2008; Willmann 2013; Savitsky & Timokhov 2021; Devetak et al. 2022). In the Balkan countries *B. hageni* is reported only from Croatia, Romania and Slovenia until now, and only a few of the records from Slovenia are recent (Devetak et al. 2022). However, most of the data from the Balkan countries actually originate from areas north of the border of the Balkan Peninsula (there are several interpretations of where the northern border runs, but it is mostly agreed that the natural border follows the rivers Šoča, Sora, Sava and Danube (Popov 1992)). The recent observation from Nova Gorica (Slovenia), an area at the extreme NW corner of Balkan Peninsula, was until now the only record of the species within the peninsula (Devetak et al. 2022).

This paper presents the first record of *Bittacus hageni* for Bosnia and Herzegovina and the second for the Balkan Peninsula.

Material and methods

The largest part of Bosnia and Herzegovina, the country situated in the north-western part of the Balkan Peninsula, is occupied by the Dinaric mountains. The finding site is

located in the hilly area at the northern edge of these mountains where they gradually decrease towards the lowlands along the Sava River. This is a rural agricultural area with meadows, orchards and forest fragments on the hills above stream and river valleys. The species was found along the path overgrown with trees and bushes that descends from the dirt road to the meadow along the Poljanska River. Above the road hornbeam (*Carpinus betulus* L.) forest is developed, while along the path there are different bushes and rich undergrowth.

The observed specimen was caught by hand net, photographed, and stored in 70% ethanol. It is deposited in the entomological collections of the National Museum of Bosnia and Herzegovina in Sarajevo (NMBiH). The identification is based on the details of wing venation and the structure of male genitalia (Brauer 1860; Savitsky & Timokhov 2021; Devetak et al. 2022).

Results and Discussion

Material examined:
Bittacus hageni Brauer, 1860
Bosnia and Herzegovina: Gradačac, south of Omić Village along the Poljanska River, 44.802595N, 18.437552E, 145 m, 10 Jul 2023, leg. D.Kulijer, 1♂, coll. NMBiH.

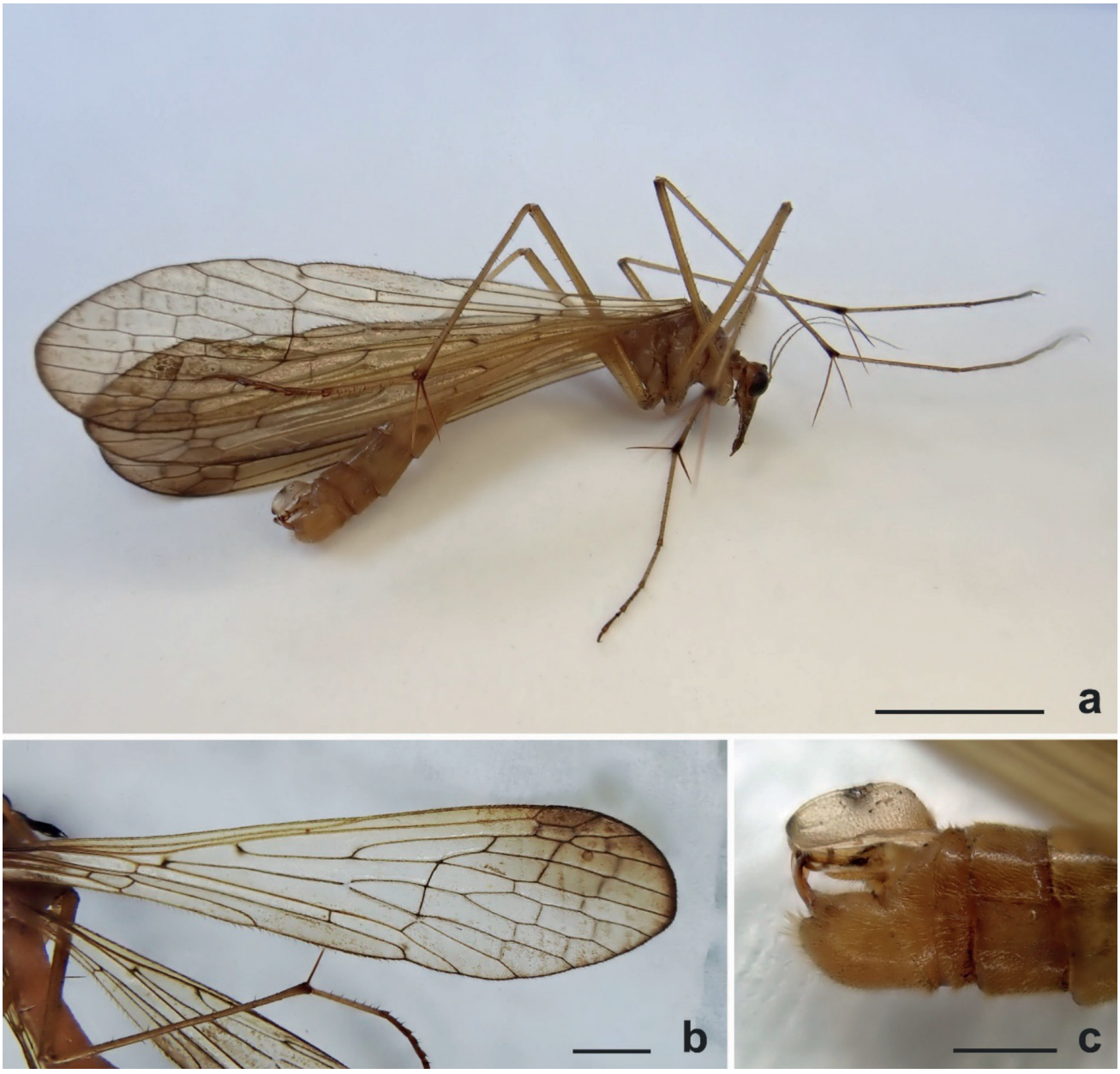

Fig. 1. – a, habitus; **b**, right forewing; and **c**, genitalia of the ♂ specimen of *Bittacus hageni* Brauer, 1860 from Gradačac in Bosnia and Herzegovina. Scale bar: 5 mm (Fig. a); 2 mm (Fig. b); 1 mm (Fig. c). (Photo: D. Kulijer).

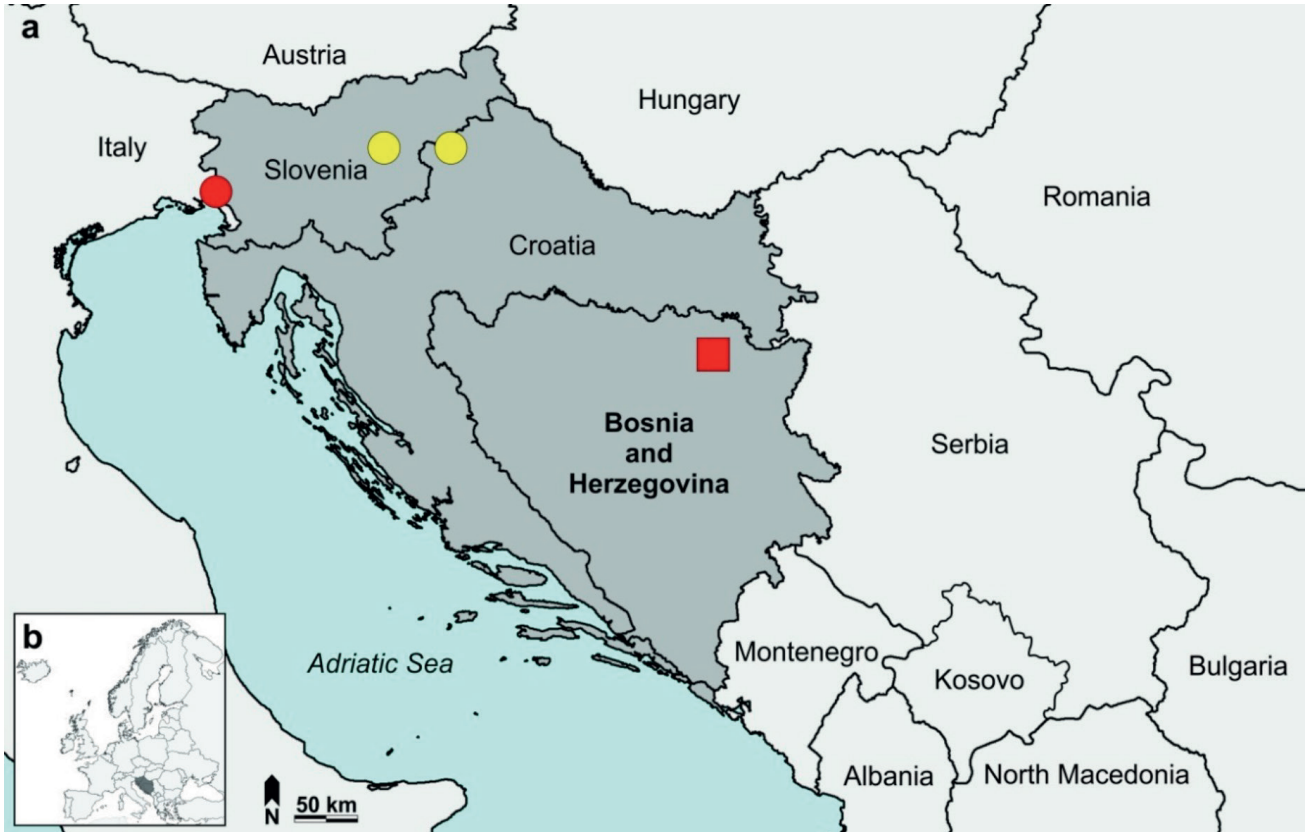

Fig. 2. – a, Distribution of *Bittacus hageni* Brauer, 1860 in the Balkan Peninsula with the new record from Bosnia and Herzegovina (red color – records within the borders of the Peninsula; yellow color – historical records in the western Balkan countries located outside the borders of the Peninsula; square – new record from Bosnia and Herzegovina; circles – published data); **b**, Location of the study area within Europe.

During an odonatological field survey of the Poljanska River a single male of *B. hageni* (Fig. 1 a) was found along the short path, several meters above the river. The specimen was observed after it made a short flight when it was disturbed from its resting/perching position in herbaceous vegetation along the path, app. 1 m above ground. Short inspection of vegetation in the vicinity did not yield any additional specimens. It was found during sunny and warm day at app. 14 PM.

Bittacus hageni differs from *B. italicus* in wing morphology. The wings in *B. hageni* are shorter and wider than in *B. italicus*. In *B. hageni* the first cell of the radial sector (Rs1) is slightly longer to slightly shorter than the common stem of the radial sector (Rs), while in *B. italicus* it is considerably longer. In the fore wing, A1 in *B. hageni* meets the hind margin halfway between the ends of Cu2 and A2 or slightly closer to A2 in forewing. In *B. italicus* it terminates much closer to the end of the second cubital vein (Cu2) than to that of the second anal vein (A2). Additionally, in *B. hageni* the cross vein of the first medial fork (m) is inclined to the longitudinal wing axis (Fig. 2 b). However, significant variability in wing morphology and size exists (Willmann 1989). For example, fore wing length in *B. hageni* ranges from 16.9 to 18.45 mm in specimens available to us. Thus, there is considerable overlap with *italicus* (16.7-20.0 mm in our specimens). The best way to distinguish the species is by using the male genitalia. The males of *B. hageni* can be easily be distinguished from *B. italicus* by the following genital structures: prominent, broad and flat branches of the epiandrium, a spirally coiled penisfilum, prominent penuncus and well-developed appendix dorsalis and appendix ventralis (Fig. 2 c) (Brauer 1860; Przybyłowicz 2006; Savitsky & Timokhov 2021; Devetak et al. 2022). For comparison, see pictures of the male genitalia of *B. italicus* given in Klapálek (1910), Mickoleit & Mickoleit (1978), Willmann (1981) and Petschenka (2006).

Until now only *B. italicus* was known from Bosnia and Herzegovina and this was based only on historical findings (Devetak et al. 2022). The record of *B. hageni* from Bosnia and Herzegovina is only the second record of the species for the Balkan Peninsula that further extends the species range in the region and in Europe (Fig. 2). The closest known location of *B. hageni* is an old record from Krapina (Croatia) (Devetak et al. 2022), some 250 km to the NW. Along with another historical record from Comana (Romania), app. 620 km to the east (Esben-Petersen 1910), this is also the southernmost record of the species in South-eastern Europe. Details of the species distribution in the Balkan countries were given by Devetak et al. (2022).

Fig. 3. – The habitat of *Bittacus hageni* Brauer, 1860 in Bosnia and Herzegovina, 10 Jul 2023 (photo: D. Kulijer).

The data on the habitat preferences of *B. hageni* are still scarce. It is reported from a variety of biotopes, from waterlogged meadows to xerothermic habitats (e.g. Tillier 2008; Vidlička 2010; Dobosz & Pacuk 2018). According to Savitsky & Timokhov (2021) *Bittacus hageni* prefers dense and shady vegetation and humid undergrowth, often along river banks. In Poland it was reported from similar habitats that were surrounded by the typical rural and anthropogenically modified landscape with fields, meadows and fragments of forests and shrubs (Przybyłowicz 2006). In the countries of Balkan Peninsula both European bittacids were mostly found in riparian vegetation near waterbodies (Devetak et al. 2022). The habitat of the species in Bosnia and Herzegovina, a shaded humid path margin with rich undergrowth close to the small rivers in hilly forested area (Fig. 3), fits well into the known habitat characteristics of the species in other parts of Europe (e.g. Petschenka 2006; Przybyłowicz 2006).

Bittacus hageni is a rare species in Europe whose discovery in many areas was mainly accidental (e.g. Jacquemin 2005; Hahn et al. 2021). Besides the species rarity, the superficial resemblance of *Bittacus* spp. with much more common Tipulidae (Diptera) may have been a reason that the species has been overlooked in the past as targeted research in Germany by the second author has yielded some unexpected finds during the last few years. Lack of experts and neglected research in bittacids and tipulids are other main reasons for poor knowledge of their distribution (Przybyłowicz 2006). This is especially true for Bosnia and Herzegovina and some other parts of the Balkans where the lack of experts and entomological research is much more pronounced than in Central and Western Europe. We hope that this discovery and the recently published overview on the distribution of Bittacids in the Balkan countries (Devetak et al. 2022) will motivate further research on these interesting insects in the country and region.

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