

NEW DATA ON DISTRIBUTION OF *CALIAESCHNA MICROSTIGMA* (SCHNEIDER, 1845) (ODONATA: AESHNIDAE) IN SERBIA

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Abstract

Caliaeschna microstigma is a species distributed mainly in the eastern Mediterranean, from Croatia in the west to northern Iran and the Caucasus in the east. Until this study, it was reported only from a few localities in Serbia, located in the far south. Here we have summarized all available data and present new data on the distribution of *C. microstigma* in Serbia. The Eastern Spectre was detected at seven new localities (four during field work and three from publicly available databases), extending its current range in Serbia by more than 120 km to the north.

KEY WORDS: Eastern Spectre, dragonfly, distribution, new data

Introduction

The Balkan Peninsula is a major European biodiversity hotspot characterized by high species richness and outstanding levels of endemism (Griffiths *et al.* 2004). This general pattern is also reflected in the distribution of Odonata in Europe, where the Balkan Peninsula is characterized as one of the areas with the highest number of endemic species (Kalkman *et al.* 2018). Dragonflies and damselflies are among the most charismatic and attractive groups of insects for the general public and have enjoyed great popularity among amateur naturalists, especially in the last two decades (Kalkman *et al.* 2018). At the same time, research interest in Odonata is increasing worldwide, including in the Western Balkans, resulting in numerous publications (see Jović 2013 and Vilenica *et al.* 2021). In addition to the previously mentioned, the Odonata fauna of the Western Balkans can be considered poorly studied, especially compared to Western and Central Europe (Vilenica *et al.* 2021). The Serbian fauna counts numbers 67 Odonata species, of which six were collected rarely and are known almost exclusively from historical records (Jović 2013, Đurđević *et al.* 2020). One of these species is the Eastern Spectre – *Caliaeschna microstigma* (Schneider, 1845).

Caliaeschna microstigma is the smallest Aeshnidae species in Europe, with an overall length of 50-60 mm and a hindwing length of 35-41 mm (Askew 2004; Smallshire & Swash 2020). It is distributed mainly in the eastern Mediterranean, from Croatia in the west to northern Iran and the Caucasus in the east (Askew 2004; Dijkstra & Lewington 2006; Boudot *et al.* 2009; Kalkman & Jović 2015, Vilenica *et al.* 2021). Larvae inhabit relatively fast-flowing and mostly unpolluted streams and small rivers with stony, pebbly, or gravelly substrates (Kovács & Murányi 2013). Until recently, *C. microstigma* was reported only twice in Serbia. Karaman (1979) gave a scanty record from a locality near Milanovac without further identification, so the exact locality remained unknown, as there are several Milanovac toponyms in Serbia. Similarly, Askew (2004) reported *C. microstigma* from Belgrade, but without reference to dates or locality. More recently, Vinko *et al.* (2020) reported this species from four localities in Kosovo, while Đukić & Bolesnikov (2020) and Kovács *et al.* (2022) reported it from the far south of Serbia.

This study aimed to summarize all available data, provide new data on the distribution of *C. microstigma* in Serbia, and present localities in which *C. microstigma* potentially occurs.

Materials and Methods

Fieldwork was conducted in eastern and southeastern Serbia as part of the Odonata survey in two periods (06.06.-10.06.2022 and 13.07.-17.07.2022.). More than 70 localities were visited during this research. The localities surveyed included springs, streams, rivers, and ponds in hilly and mountainous landscapes. Adult dragonflies and damselflies were collected using an entomological net. Most specimens were identified, photographed, and released in the field. Voucher specimens of several species were collected and deposited in the collection of the Institute of Zoology, Faculty of Biology, University of Belgrade. Odonata was identified using the following identification keys: Askew 2004; Dijkstra & Lewington 2006; Đurđević *et al.* 2020, and Smallshire & Swash 2020. In order to obtain all available data on *Caliaeschna microstigma* in Serbia, literature and database searches were conducted in addition to fieldwork.

The localities presented as those where *C. microstigma* potentially occurs were identified based on the species' preferred breeding habitats: forested, cold, fast-flowing, well-oxygenated streams and small rivers that flow year-round (Kovács & Murányi 2013; Smallshire & Swash 2020). These streams and rivers are generally shaded and have a rocky, pebbly, or gravelly substrate with many exposed roots or submerged moss (Kovács & Murányi 2013; Smallshire & Swash 2020).

Results

During field research in 2022, seven males of *Caliaeschna microstigma* were found at four localities in eastern and southeastern Serbia. All specimens exhibited distinct species-specific morphological characteristics and were easily identified (Fig. 1). The following characteristics were used for identification: the presence of cross-veins in median space between R+M and Cu veins before the arculus (Fig. 1B); distinctive hooked antehumeral stripes (Fig. 1C); partially fused blue markings on S9-10 forming a 'taillight' (Fig. 1D), and short dark pterostigma.

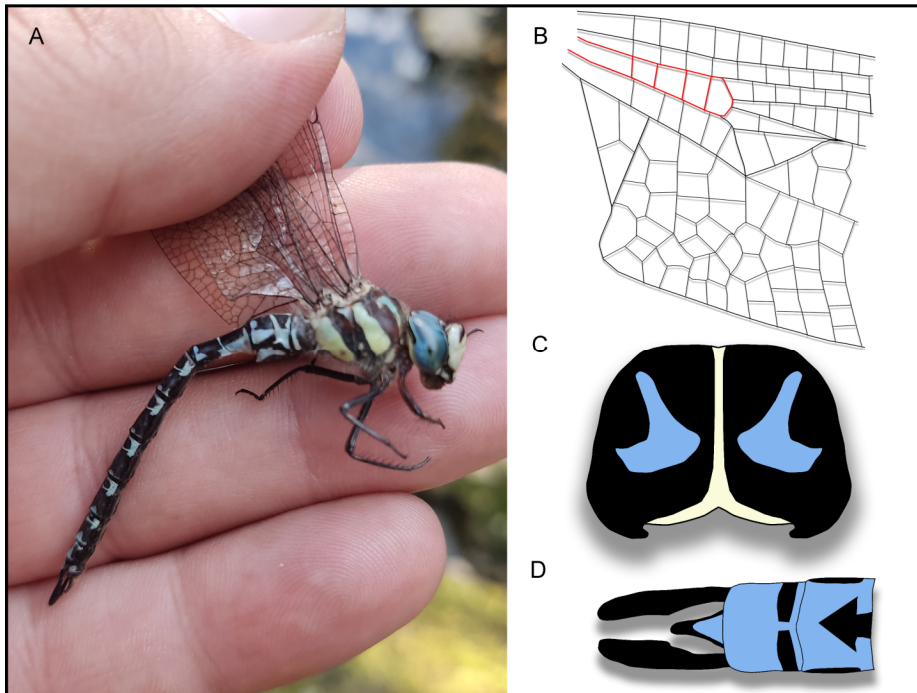


Figure 1. *Callaeschna microstigma*: A – male collected at spring of Moravica river; B – base of the hind wing with cross-veins in median space (red veins); C – hooked antehumeral stripes; D – partially fused blue markings on S9-10 (B-D are redrawn by the author after Dijkstra & Lewington 2006).

Of the 70 sites surveyed, 16 (apart from those where species were recorded) were found to be suitable for *C. microstigma* development and are most likely inhabited, but we failed to record species, so these sites are marked as localities with a potential presence of *C. microstigma* (Table I). The localities where *C. microstigma* was recorded are shown in Figs 2-5.



Figure 2. Spring of Koritnička Reka river – locality where *C. microstigma* was recorded.



Figure 3. Prekonoga – locality where *C. microstigma* was recorded.



Figure 4. Manojlička Reka river canyon – locality where *C. microstigma* was recorded.

Three other localities where *C. microstigma* was detected were found during the database survey. They are taken from the Alciphron database (Rajkov & Veverica 2023) and listed in Table I.



Figure 5. Moravica River spring – locality where *C. microstigma* was recorded.

Table I. Localities in Serbia where the presence of *Callaeschna microstigma* is recorded or could be expected (m – male, f – female).

Date	Locality	Latitude	Longitude	Altitude	Record	Reference
07.07.2014.	Berivojce	42,567737	21,582498	496	1m	Alciphron (Bogoljub Milošević)
10.05.2016.	Buštranje, Rujan stream	42,33522	21,77044	545	1 larva	Kovács <i>et al.</i> 2022
25.06.2016.	Berivojce	42,558202	21,569631	529	1f	Alciphron (Bogoljub Milošević)
25.06.2018.	Miruša river at Miruša waterfalls	42,523889	20,58	395	2f2m	Vinko <i>et al.</i> 2020
30.04.2018.	Grejkovačka Reka river	42,262778	20,779444	420	1 larva	Vinko <i>et al.</i> 2020
25.05.2018.	Vrbnica lake	42,160833	20,557222	305	1m	Vinko <i>et al.</i> 2020
25.05.2018.	Stream E from Vrbnica lake	42,159167	20,558889	310	1 larva	Vinko <i>et al.</i> 2020
21.07.2018. / 09.07.2021.	Šaprance (stream)	42,386389	21,981944	561	3m	Đukić & Bolesnikov 2020/ Alciphron (Filip Vukajlović)
09.07.2021.	Šaprance	42,382344	21,970562	574	1m	Alciphron (Milan Đurić)
13.07.2022.	Spring of Moravica river	43,629971	21,992463	394	1m	Herein
14.07.2022.	Canyon of Manojlička Reka river	43,406908	22,310277	531	1m	Herein
14.07.2022.	Prekonoga	43,398192	22,076464	511	4m	Herein
15.07.2022.	Spring of Koritnička Reka river	43,143205	22,324874	387	1m	Herein
08.06.2022.	Dukat Mt.	42,43435	22,314837	1001	potential presence	Herein
14.07.2022.	Gornja glama	43,279387	22,370211	722	potential presence	Herein
14.07.2022.	Miranovačka Kula	43,367954	22,337894	593	potential presence	Herein
14.07.2022.	Gulijan	43,356853	22,245111	580	potential presence	Herein
14.07.2022.	Malčanska Reka river	43,373087	22,050994	472	potential presence	Herein
15.07.2022.	Vranašnica river, Crnoklište	43,233815	22,452956	366	potential presence	Herein
16.07.2022.	Krupačko Vrelo spring	43,297274	22,222876	316	potential presence	Herein
24.07.2022.	Gornjane	44,190557	22,08379	519	potential presence	Herein
07.06.2022.	Donja Ljubata	42,50484	22,326345	1028	potential presence	Herein
07.06.2022.	Musulj	42,511433	22,2716	1063	potential presence	Herein
08.06.2022.	Dukat Mt. - Smiljanici	42,457785	22,343095	1108	potential presence	Herein
08.06.2022.	Dukat village – Selska Reka river	42,449476	22,333305	992	potential presence	Herein

Table I – continued

Date	Locality	Latitude	Longitude	Altitude	Record	Reference
08.06.2022.	Dukat Mt. – Crna Reka river – stream	42,408831	22,291522	1346	potential presence	Herein
09.06.2022.	Milevci village	42,53688	22,456055	1230	potential presence	Herein
14.07.2022.	Svrjiški Timok river – Pandiralo	43,36947	22,311429	543	potential presence	Herein
15.07.2022.	Kosturska Reka river	43,141774	22,504356	470	potential presence	Herein

Currently, *C. microstigma* has been detected at 13 different localities in Serbia, extending over 150 km in the southeastern part of the country (Table I, Fig. 6).

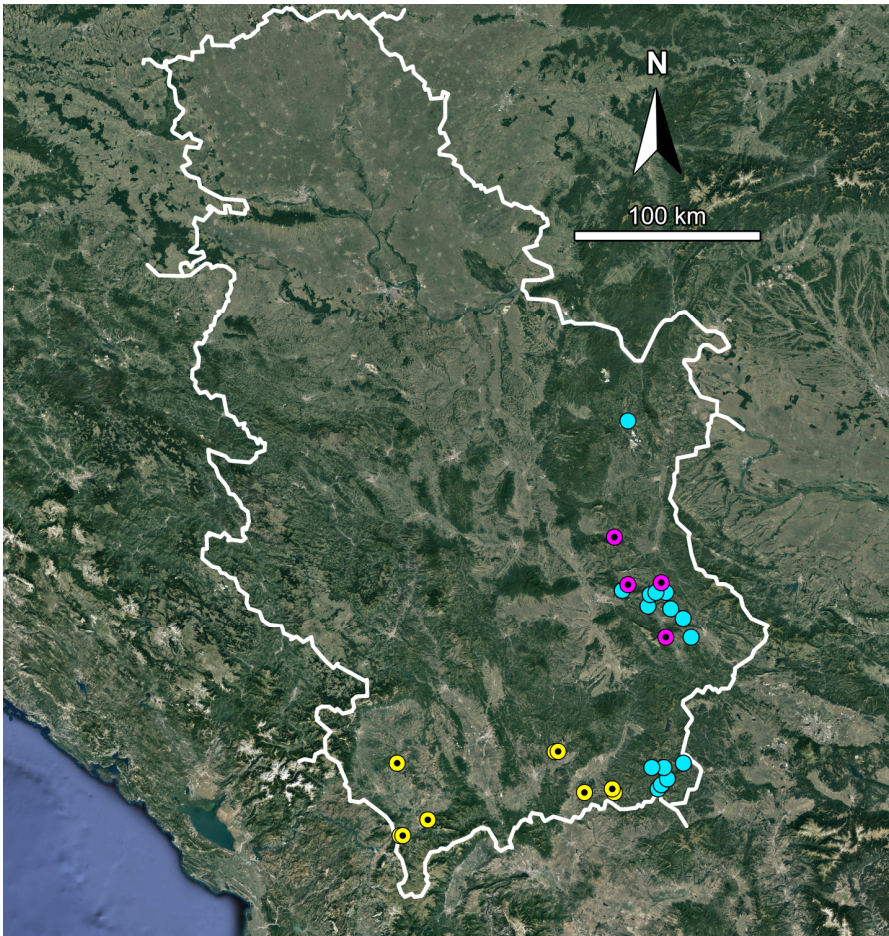


Figure 6. Distribution of *Caliaeschna microstigma* in Serbia. Pink circles – new records; yellow circles – literature data and data from Alciphron database; cyan circles – potential presence.

During the present study, the following Odonata species were recorded as syntopic with *C. microstigma* at all four localities: *Calopteryx virgo* (Linnaeus, 1758), *Cordulegaster heros* Theischinger, 1979, *Platycnemis pennipes* (Pallas, 1771), and *Onychogomphus forcipatus* (Linnaeus, 1758). In addition, the species *Cordulegaster bidentata* (Selys 1843) was found at Koritnička Reka river spring and Moravica river spring, while *Somatochlora meridionalis* Nielsen, 1935 and *Orthetrum brunneum* (Fonscolombe, 1837) were recorded at Prekonoga.

Discussion

In the present study, we determined the occurrence of *Callaeschna microstigma* in southern and southeastern Serbia. Our data showed that the Eastern Spectre is more widespread in Serbia than previously thought. The current range of this species in Serbia extends more than 120 km to the north. All studied localities are located in non-protected areas and are affected by varying degrees of habitat degradation. The localities of the Koritnička Reka river spring and Prekonoga are located near settlements, and the predominant anthropogenic threat factors are agriculture (pollution from agricultural activities), traffic (pollution from traffic and road construction), and waste disposal (household and agricultural waste) (Figs 2 and 3). The Manojlička Reka river canyon and Moravica river spring are both threatened by waste disposal and the construction of water intakes (Figs 4 and 5). In addition, the Manojlička Reka river canyon is threatened by logging, and uncontrolled tourist activities threaten the Moravica river spring. According to our field data, we can assume that the distribution of *C. microstigma* is much greater in Serbia, as there are numerous localities with suitable habitats (suitable substrates and water flow). Apart from localities in southeastern Serbia (we propose 16, Table I, Fig. 6), numerous localities in eastern, central, and western Serbia should be investigated to determine the actual distribution of *C. microstigma* in Serbia. We conducted several Odonata surveys in western Serbia in 2021 but without success. These surveys were not focused on *C. microstigma* and were conducted later in the season, which may be the reason they were no records. Recently, Vilenica *et al.* (2021) published a study on the distribution, habitat requirements, and threats to *C. microstigma* in Croatia, Montenegro, and Bosnia and Herzegovina, reporting 107 previously unknown localities. They also hypothesized that a limiting factor for distribution could be cold, harsh winters, but in the same study, they reported the reproduction of *C. microstigma* in northern Montenegro, where an alpine climate prevails (Vilenica *et al.* 2021). Apparently, there is still a lack of knowledge about the habitat requirements and preferences of *C. microstigma* (Vilenica *et al.* 2021), as well as detailed monitoring at the northwestern edge of its distribution.

The Balkan Peninsula is the only part of Europe where *C. microstigma* (largely southwest Asian species) occurs (Boudot *et al.* 2009), but there is no conservation management for this species in most Balkan countries. Croatia is the only Western Balkan country where the conservation status of *C. microstigma* has been assessed, and the species is Critically Endangered (CR) (Belančić *et al.* 2008; Vilenica *et al.* 2021), in contrast to the global assessment by IUCN, where it is considered of Least Concern (LC) (Boudot 2014), and the assessment in Europe and the Mediterranean, where it is considered as Near Threatened (NT) (Riservato *et al.* 2009, Kalkman *et al.* 2010). Due to the apparent lack of data, there is currently no conservation management or protection of *C. microstigma* in Serbia. Of all the places where *C. microstigma* has been detected in Serbia, only Šaprance is located in a protected area (Outstanding Natural Landscape "Dolina Pčinje" (Pčinja River Valley)) (Đukić & Bolesnikov 2020; Rajkov & Veverica 2023). Although the data collected so far on the distribution of *C. microstigma* in Serbia are still sparse, there is an urgent need to protect this species in Serbia for several reasons: 1) Serbian populations are on the edge of the species' range; 2) the species is still rare and localized in southeastern Serbia; 3) the known localities are threatened with destruction, as mining activities are planned in this part of Serbia. Revision of the legal protection status

of Odonata in general is needed not only in Serbia and the Balkans but throughout Europe (Kalkman *et al.* 2018; Tang & Visconti, 2021). To justify a proposal to change legal protection, adequate data are lacking for most species in Serbia and the Western Balkans, and therefore there is an urgent need for targeted field surveys to map the distribution of species and assess their conservation status.

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НОВИ ПОДАЦИ О РАСПРОСТРАЊЕЊУ ВРСТЕ *CALIAESCHNA MICROSTIGMA* (SCHNEIDER, 1845) (ODONATA: AESHNIDAE) У СРБИЈИ

АНЂЕЉКО ПЕТРОВИЋ

Извод

Caliaeschna microstigma је врста распрострањена углавном у источном Медитерану, од Хрватске на западу до северног Ирана и Кавказа на истоку. До ове студије је регистрована само на неколико локалитета у Србији, који се налазе на крајњем југу. У овом раду су обједињени сви доступни подаци о распрострањењу врсте *C. microstigma* у Србији. Врста је забележена са седам нових локалитета (четири приликом теренског истраживања и три из доступних база података), чиме је њен садашњи ареал у Србији проширен за више од 120 км ка северу.

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