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Short Communication

NEW FINDING OF *Cordulegaster insignis* Schneider, 1845 (ODONATA: CORDULEGASTRIDAE) IN SERBIA

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ABSTRACT. During a field survey in 2021 in Southern Serbia, near the village of Strezovac, two specimens of *Cordulegaster insignis* Schneider, 1845 were found. This species is extremely rare in Serbia. The findings are located on the western border of its areal.

Keywords: Blue-eyed Goldenring, dragonflies, Anisoptera, distribution.

Knowledge about the species of the genus *Cordulegaster* Leach, 1815 is under significant changes in the last few decades (KULIJER and BOUDOT, 2013). SMALLSHIRE and SWASH (2020) divided European species of this genus into two groups, based on the structures of the secondary genitalia and yellow marks on the side of the first abdominal segment (S1): the group *boltonii* (*C. boltoni*, *C. trinacriae*, *C. heros,* and *C. picta*) and the group *bidentata* (*C. bidentata*, *C. helladica,* and *C. insignis*).

The blue-eyed Goldenring *Cordulegaster insignis* Schneider, 1845 is distributed in southeastern Europe and southwestern Asia. European populations of *C. insignis* have been registered in the southern parts of Romania, in Bulgaria, North Macedonia, Serbia, Greece with the islands of Samothraki and Thassos, as well as the European part of Turkey (Thracian Turkey and Göckçeada island) (BOUDOT *et al*., 2009; BOUDOT, 2014).

Although *C. insignis* is classified as Least Concern (LC) at the global level (BOUDOT, 2014), it is considered Endangered (EN) in Europe with an unknown population trend (BOUDOT, 2010). In 2018, this species is proposed to be included within the Directive on the conservation of natural habitats and of wild fauna and flora (Council Directive 92/43/EEC) (KALKMAN *et al*., 2018). Currently, it is not on the list of protected or strictly protected species in the Republic of Serbia (ANONIMOUS, 2010-2016), i.e. it is not protected by the national law. According to BOUDOT (2010), direct destruction of its habitat, especially by forest fires or water extraction, is the main threat to this species at the global and European levels. Droughts and drying out of habitat due to climate change have already contributed to the extinction of this species in critical locations (BOUDOT, 2010).

Two males of *C. insignis* were found in 2021 during the field survey in Southern Serbia, near the village of Strezovac, Preševo Municipality (42.257487°E, 21.711014°N) (Signe 3 on Fig. 3). Observations are made on June 26th, exactly in the middle of the flight season of the species (from May to mid-August). The specimens were discovered at an altitude of 448 meters near a small stream. This is consistent with the existing literature data, which suggest that this species prefers smaller streams, but occasionally could be found in the larger and deeper waters (DIJKSTRA and SCHRÖTER, 2020). One specimen is preserved in the private collection of the first author. The preserved specimen had characteristic blue eyes (Fig. 1a) that could clearly distinguish it from other species of the genus (DIJKSTRA and SCHRÖTER, 2020). However, we must note that this character is not present in all individuals within the population and a form with green eyes could also be common (DIJKSTRA and SCHRÖTER, 2020). Additionally, we considered the shape of the yellow pattern on the abdomen, the yellow occipital triangle (Fig. 1b), the characteristic yellow markings on the flank of the S1 (Fig. 1c), and the structure of the male appendages (Fig. 2) (SMALLSHIRE and SWASH, 2020). This finding of *C. insignis* (signe 3 on Fig. 3) represents only the fourth record for Serbia in more than 125 years.

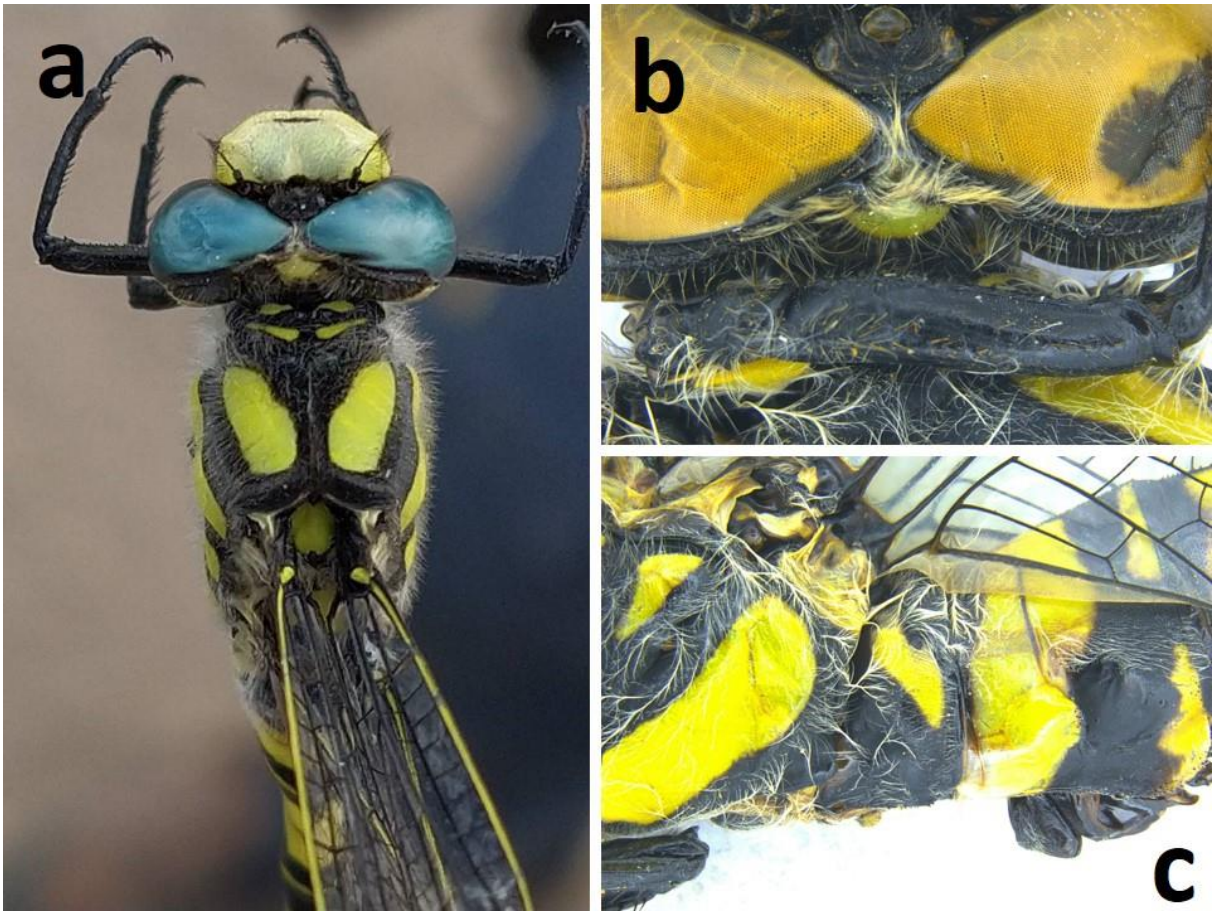

Figure 1. *Cordulegaster insignis* Schneider, 1845: a – bluish eyes of live specimen; b – yellow occipital triangle; c – club-shaped yellow patch on S1. (Photos by M. Popović, 2021 and A. Đurđević, 2023)

Historically, the first specimens of *C. insignis* in Serbia were collected in 1894 by Moricz Hilf (Austro-Hungarian military officer and amateur entomologist) who sent his specimens to Viktor Apfelbeck, an entomologist in the National Museum of Bosnia and Herzegovina (KULIJER and BOUDOT, 2013). Analyzing these material, ADAMOVIĆ (1948) reported the presence of two specimens (male and female) of the species *Cordulegaster annulatus*, collected in Požarevac (Serbia) (signe 1 on Fig. 3). However, due to the lack of

adequate literature, the author remains unsatisfied with this identification and states that examined museum specimens identified as *Cordulegaster annulatus* do not fully match the description of the Central European specimens. Finally, these two specimens, deposited in National Museum of Bosnia and Herzegovina in Sarajevo, were re-examined in 2013 (KULIJER and BOUDOT, 2013) and identified as *C. insignis* (inventory numbers APF12869 and APF12870).

Figure 2. *Cordulegaster insignis* Schneider, 1845: male appendages a – dorsal view; b – ventral view; c – lateral view (photo by A. Đurđević, 2023).

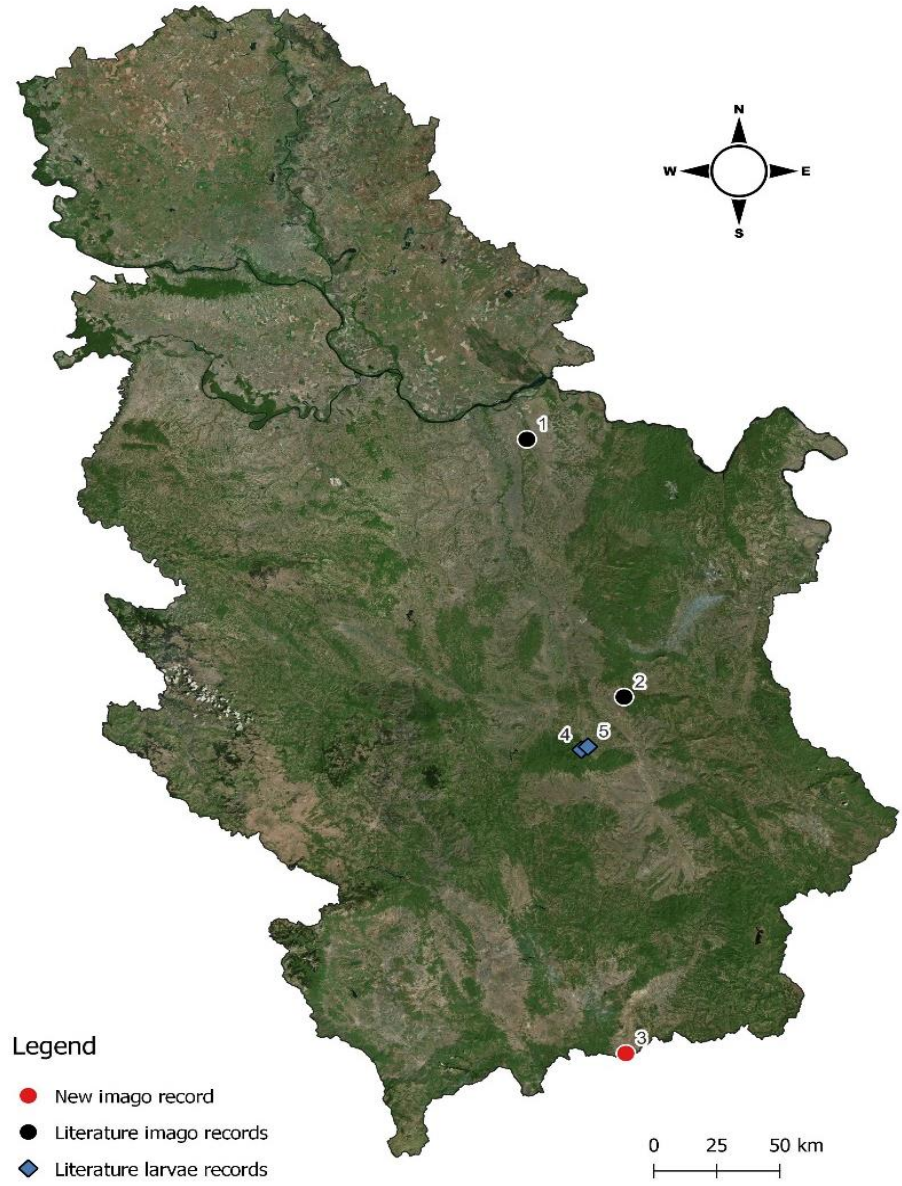

Figure 3. Distribution of *Cordulegaster insignis* Schneider, 1845 in Serbia. (Map by I. Medenica, 2023)

More than 109 years after the original discovery, the species was found in 2003 (in the larval stage) in Ribarska Reka river (Central Serbia) (ŽIVIĆ, 2005) (signes 4 and 5 on Fig. 3). After this record, again an imago of the species was found in 2011 in Eastern Serbia (Signe 2 on Fig. 3) – one female specimen was caught in the central part of the Sokobanjska Moravica stream (5th June 2011) and deposited in the collection of the Natural History Museum in Belgrade after laboratory identification (KULIĆ *et al.*, 2013). The authors could not find any specimens during the revisiting of the locality in 2012 and 2013.

Based on these data *C. insignis* may be treated as an "extremely rare" species in Serbia (ĐURĐEVIĆ *et al*. 2020) and proposed for inclusion in the Annex II of the Rulebook on the Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals, and Fungi with the status of a protected species (ŽIVIĆ, personal communication, 2023).

Our findings of *C. insignis* in Serbia (Fig. 3) are on the western border of the species areal (KULIĆ *et al.*, 2013), while the one from Požarevac lies on the northern (northwestern) (KULIJER and BOUDOT, 2013). It can be assumed that the species is expanding its range to the west due to climate change. The *C. insignis* could be more abundant in the eastern and southeastern regions of Serbia. However, the green-eyed specimens may be missidentified as *C. bidentata*, so it is necessary to carry out more detailed research in these regions in order to accurately delimit their distribution.

This study represents significant evidence of the presence of *C. insignis* in Serbia and a valuable contribution to knowledge about its distribution. It could help guide further studies to shed more light on the *C. insignis* distribution, ecology, and threats and suggest adequate conservation measures.

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