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THE FIRST RECORD OF *CARABUS* (*PROCERUS*) *SCABROSUS* OLIVIER, 1790 (COLEOPTERA: CARABIDAE) IN SERBIA: PRESENT IN THE COUNTRY FOR OVER A DECADE

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Abstract

Here we report the first verified record of the huge violet ground beetle *Carabus* (*Procerus*) *scabrosus* Olivier, 1790, one of Europe's largest insects, from Serbia. A single adult male was collected in 2015 along the Nišava River near the village of Gradinje, close to the Bulgarian border. This finding represents an important faunistic contribution to the knowledge of Serbian entomofauna and provides evidence of a notable westward range expansion within the Balkans, where the species had previously been recorded only in Bulgaria, Greece, and Turkey. Recent observations on citizen science platforms from areas (Dimitrovgrad and Pirot) west of the confirmed site suggest that the species is already more widely distributed across southeastern Serbia. Potential pathways for the arrival of this new Serbian faunal element are also discussed. Finally, the study highlights the need for targeted field surveys to assess the species' population status in Serbia and to consider its conservation under national legislation.

KEYWORDS: Carabinae, carabids, faunistics, biogeography, Balkans, Rhodopes

Introduction

In recent years, faunistic research and citizen science platforms have contributed significantly to documenting previously unreported, expanding, or alien insect species in Serbia (Žikić *et al*., 2025). Such new findings have been reported in several groups, including Mantodea, Hemiptera, and Coleoptera (Ilić *et al*., 2025; Nadaždin & Šeat, 2022; Petrović-Obradović *et al*., 2020; Vujić *et al*., 2021).

Ground beetles are a well-studied group of coleopterans, known for their high species richness and ecological importance (Lövei & Sunderland, 1996). Despite a long tradition of ground beetle research in the Balkans, significant faunistic gaps persist, indicating that even basic knowledge remains incomplete in some regions. Mountainous border regions and adjacent valleys are particularly promising for faunistic research, as significant discoveries of previously unrecorded species are more likely in these areas. Such regions may serve as dispersal corridors for numerous insect species, whether through anthropogenically mediated spread or natural range expansion, or they may simply remain underexplored. A recent example is provided by Vesović *et al*. (2025), who reported two ground beetles species, *Ditomus calydonius* (Rossi, 1790) and *Parophonus* (*Ophonomimus*) *hirsutulus* (Dejean, 1829), as new for Serbia from the Đerdap National Park.

The genus *Carabus* Linnaeus, 1758 represents one of the most speciose genera of beetles, with 970 species distributed almost exclusively in the Holarctic (Deuve, 2021). The Balkans hosts a highly diverse *Carabus* fauna comprising 44 species, approximately one-fifth of which are endemic (Turin *et al*., 2003). The subgenus *Procerus* Dejean, 1821 constitutes a clearly defined monophyletic group of large-bodied, apterous, and robust species (Cavazzuti, 1989). These species are characterised by long, acute, strongly curved mandibles, a bilobate labrum, a coarsely wrinkled dorsal surface of the head and pronotum, and tuberculate elytra, making them particularly visually distinctive among ground beetles (Turin *et al*., 2003). The subgenus includes species distributed from northern Italy to northern Iran (Deuve, 2021). As all *Procerus* beetles are flightless, they exhibit active speciation and typically develop highly localised distributions (Cavazzuti, 1989). The systematics of the subgenus *Procerus* is complex and has been repeatedly revised. In the first comprehensive study, based on approximately 5,000 examined specimens, Cavazzuti (1989) recognized seven species within *Procerus* (treated as a genus): *P. caucasicus* (Adams, 1817) (six subspecies), *P. duponcheli* Dejean, 1831, *P. gigas* (Creutzer, 1799) (two subspecies), *P. scabrosus* (Olivier, 1790) (six subspecies), *P. sommeri* Mannerheim, 1844 (nine subspecies), *P. syriacus* Kollar, 1843 (three subspecies), and *P. transversalis* Csiki, 1927 (three subspecies).

Almost three decades later, Březina *et al*. (2017) recognized six *Carabus* species within the subgenus *Procerus*: *C*. (*P*.) *bulgharmaadensis* (Bodemeyer, 1915) (two subspecies), *C*. (*P*.) *caucasicus* (three subspecies), *C*. (*P*.) *elbursianus* Mandl, 1958 (no subspecies), *C*. (*P*.) *gigas* (four subspecies), *C*. (*P*.) *scabrosus* (32 subspecies), and *C*. (*P*.) *syriacus* (two subspecies).

The most recent comprehensive world catalogue of *Carabus* lists five species and several dozen subspecies within the subgenus *Procerus* (Deuve, 2021) (Table I), with subspecies classified as either ‘strong’ or ‘weak’. Two ‘strong’ subspecies are recognized only within *C*. (*P*.) *gigas*, whereas all remaining species contain only ‘weak’ subspecies (Table I). Following this classification, the ‘strong’ subspecies *C*. (*P*.) *gigas gigas* Creutzer, 1799 is subdivided into three ‘weak’ subspecies, *C*. (*P*.) *scabrosus* into 33 ‘weak’ subspecies, *C*. (*P*.) *syriacus* into nine ‘weak’ subspecies, while *C*. (*P*.) *farnazae* Deuve, 2006 and *C*. (*P*.) *elbursianus* have no recognized infraspecific taxa (Deuve, 2021).

Compared to Cavazzuti (1989), several major changes are evident in Deuve (2021): *P. duponcheli* has been downgraded to a ‘strong’ subspecies of *C*. (*P*.) *gigas*; *P. syriacus* and *P. transversalis* have been merged into a single species [*C*. (*P*.) *syriacus*]; *P. caucasicus*, *P. scabrosus*, and *P. sommeri* have also been consolidated into a single species [*C*. (*P*.) *scabrosus*]; and *P. caucasicus elbursianus* and *P. scabrosus farnazae* have been elevated to species rank as *C*. (*P*.) *elbursianus* and *C*. (*P*.) *farnazae*.

Table I. Species of the subgenus *Procerus* with 'strong' (subsp.) and 'weak' (ssp.) subspecies and their distribution, arranged chronologically by date of description (after Deuve, 2021). Abbreviations: C – central, N – northern, NE – northeastern, NW – northwestern, S – southern, SE – southeastern, SW – southwestern.

Species	Subspecies	Distribution
Carabus scabrosus Olivier, 1790	ssp. *scabrosus* Olivier, 1790	NW Turkey, S and SE Bulgaria
	ssp. *tauricus* Bonelli, 1811	Crimean Peninsula
	ssp. *caucasicus* Adams, 1817	SW Russia, N Georgia
	ssp. *audouini* (Brullé, 1835)	NE Turkey
	ssp. *colchicus* (Motschulsky, 1844)	Georgia, NE Turkey, NE Armenia
	ssp. *sommeri* (Mannerheim, 1844)	NW Turkey
	ssp. *dardanellicus* (Kraatz-Koschlau, 1886)	NW Turkey
	ssp. *sterilis* (Bodemeyer, 1915)	NW Turkey
	ssp. *amasicus* Csiki, 1927	N Turkey
	ssp. *propinquus* Csiki, 1927	NW Turkey
	ssp. *bureschianus* Breuning, 1928	S Bulgaria, NE Greece
	ssp. *armenius* Zaitzew, 1930	NE Turkey
	ssp. *mentor* Blumenthal & Breuning, 1967	NW Turkey
	ssp. *schuberti* Breuning, 1968	N Turkey
	ssp. *callipygius* Cavazzuti, 1986	N Turkey
	ssp. *cerkes* Basquin & Darge, 1986	N Turkey
	ssp. *ispiratus* Cavazzuti, 1986	NE Turkey
	ssp. *munzurensis* Cavazzuti & Lassalle, 1987	C Turkey
	ssp. *culminicola* (Cavazzuti, 1989)	NW Turkey
	ssp. *estegeicus* (Cavazzuti, 1989)	SW Turkey
	ssp. *montisabanti* (Cavazzuti, 1989)	NW Turkey
	ssp. *weidneri* (Lassalle, 1990)	S Turkey
	ssp. *fallettianus* (Cavazzuti, 1997)	S Armenia
	ssp. *boulbenarlettae* Cavazzuti & Myska, 2004	NE Azerbaijan
	ssp. *kahramanicus* Cavazzuti & Myska, 2004	S Turkey
	ssp. *myskai* Cavazzuti, 2004	SE Armenia
	ssp. *crimeanus* Mazzi & Cavazzuti, 2014	Ukraine, Crimean Peninsula
	ssp. *tatianagorokhovae* Cavazzuti & Kozlov, 2014	N Armenia
	ssp. *cavazzutiorum* Deuve & Kozlov, 2015	SW Azerbaijan
	ssp. *nakagomei* Cavazzuti & Kozlov, 2015	S Armenia
	ssp. *vardziaensis* Deuve, 2017	Georgia
	ssp. *bakurianicola* Rataj, 2018	Georgia
	ssp. *demiddelaerae* Rataj, 2018	Georgia
Carabus gigas Creutzer, 1799	subsp. *gigas* Creutzer, 1799	Italy, Austria, Balkans
	ssp. *gigas* Creutzer, 1799	Italy, Austria, Balkans
	ssp. *parnassicus* Kraatz-Koschlau, 1884	C Greece, North Macedonia, Albania
	ssp. *latitudinis* Cavazzuti, Myska & Puchner, 2008	SW Romania
	subsp. *duponcheli* (Dejean, 1831)	S Greece
Carabus syriacus (Kollar, 1843)	ssp. *syriacus* (Kollar, 1843)	S Turkey
	ssp. *bulgharmaadensis* (Bodemeyer, 1915)	S Turkey
	ssp. *galilaeus* Schweiger, 1970	NW Israel, Lebanon, Syria
	ssp. *akbesiensis* Toulgoët, 1987	S Turkey
	ssp. *limitaneus* (Korell, 1988)	S Turkey
	ssp. *toulgoetianus* Deuve, 2002	S Turkey
	ssp. *muruvvetae* (Avgin & Prunier, 2007)	S Turkey
	ssp. *kozloviorum* Cavazzuti, 2014	S Turkey
	ssp. *ludademae* Cavazzuti & Kozlov, 2014	S Turkey
Carabus elbursianus Mandl, 1958	-	N Iran
Carabus farnazae Deuve, 2006	-	NW Iran

To date, only *C.* (*P.*) *gigas*, with its nominotypical subspecies, has been recorded in Serbia within the subgenus *Procerus*, occurring from Mt. Fruška Gora in the north to forested areas throughout the rest of the country (Ćurčić *et al*., 2007).

Commonly known as the huge violet ground beetle, *C.* (*P.*) *scabrosus* is among the largest European insects, with adult body length exceeding 50 mm (Turin *et al*., 2003). The species is characterized by strongly convex, coarsely tuberculate elytra and a metallic bluish, purplish to violet dorsal coloration (Cavazzuti, 1989).

It is distributed in southern and southeastern Bulgaria, northeastern Greece, across Turkey, the Caucasus, and the northern coast of the Black Sea, including the Crimean Peninsula (Deuve, 2021). Despite its wide distribution, the biology of *C.* (*P.*) *scabrosus* has never been the subject of a dedicated study. Two subspecies occur in the Balkans. *Carabus* (*P.*) *scabrosus bureschianus* Breuning, 1928 inhabits the southern Rhodopes of northeastern Greece and both the central (type locality Bachkovo) and western Rhodopes of southern Bulgaria (Guéorguiev & Guéorguiev, 1995; Guéorguiev & Lobo, 2006; Teofilova, 2019a, 2019b, 2021, 2022a, 2025; Teofilova & Boetzl, 2024). The other Balkan subspecies, *C.* (*P.*) *scabrosus scabrosus* Olivier, 1790, occurs in south-central Bulgaria around Stara Zagora, in the eastern Rhodopes of southern Bulgaria, and on the Strandzha Mts. of southeastern Bulgaria and European Turkey (Guéorguiev & Guéorguiev, 1995; Kostova & Guéorguiev, 2016; Teofilova, 2017, 2021, 2022b; Teofilova & Kodzhabashev, 2020a, 2020b).

Although established populations of *C.* (*P.*) *scabrosus* have also been observed in various ecotone habitats (Teofilova, 2021), its primary habitats are deciduous forests with deep leaf litter on rocky mountain slopes (Volovnik & Suchkov, 2018), particularly beech and oak woodlands (Cavazzuti, 1989), typically from lowlands to approximately 1,500 m a.s.l. (Cavazzuti, 1989; Teofilova, 2021). Both adults and larvae are malacophagous, preying on terrestrial snails (Bartenev & Bartenev, 1997; Turin *et al*., 2003).

Within the Balkans, *C.* (*P.*) *scabrosus* has previously been recorded only from Greece, Bulgaria, and European Turkey, with no confirmed records from Serbia. Here we present the first confirmed Serbian record, based on a specimen collected near Dimitrovgrad in autumn 2015, and a brief discussion of potential pathways by which the species may have expanded its range into the country.

Materials and Methods

Material examined. *Carabus* (*P.*) *gigas* (Figs. 1D-F and 2D-F): 1 ♂, Serbia, Pirot District, Municipality of Pirot, village of Jelovica, near the Jelovička Reka River; geographical coordinates: 43°12'38.2" N, 22°49'59.0" E; 842 m a.s.l.; June 30, 2021; leg. D. Stojanović. The specimen was photographed alongside the newly recorded species, enabling a direct, parallel comparison of external body morphology and aedeagus shape between the two *Procerus* species recorded in Serbia.

The specimens of *C.* (*P.*) *scabrosus* and *C.* (*P.*) *gigas* (one of each), along with their extracted aedeagi, are preserved and kept in 70% ethanol in the private entomological collection of the first author.

Photographs of *Procerus* specimens and their aedeagi were taken with a Nikon D5300 digital camera equipped with a Tamron SP Di AF 90 mm F/2.8 macro lens and a Sigma EM-140 DG ring flash, using a homemade light diffuser.

The authors used the species identification key provided by Cavazzuti (1989). In this study, the systematics proposed by Deuve (2021) is followed.

Habitat description. The habitat surrounding the collection site is a mosaic of shrubs, scattered deciduous trees (*Salix* spp., *Populus* spp.), herbaceous vegetation, and patches of neglected agricultural land transitioning into

semi-natural woodland. An embankment borders the relatively narrow riverbed, and the entire area receives substantial moisture, supporting a relatively dense vegetation cover.

Results

Collection data. *Carabus* (*P.*) *scabrosus* (Figs. 1A-C and 2A-C): 1 ♂, Serbia, Pirot District, Municipality of Dimitrovgrad, near the village of Gradinje, close to the Nišava River; geographical coordinates: 43°00'27.00" N, 22°49'01.00" E; 465 m a.s.l.; October 27, 2015; leg. B. Novaković.

During routine annual water-quality monitoring of the Nišava River near Dimitrovgrad, a male specimen of *C.* (*P.*) *scabrosus* was observed (Figs. 1 and 2) in riparian grass at the river's edge, close to the water, and was collected alive by hand.

The collection site of *C.* (*P.*) *scabrosus* is on the left bank of the Nišava River (Fig. 3A, B), approximately 2.7 km downstream from where the river enters Serbia from Bulgaria and 1.5 km from the Bulgarian border.

Measurements. The specimen measures 43.15 mm in total length (from the anterior margin of the labrum to the apex of the elytra along the midline). The maximum width of the head at eye level is 6.65 mm. The pronotum is 10.22 mm long (along the midline) and 12.05 mm wide at its broadest point. The elytra are 27.89 mm long and 17.23 mm at their maximum width.

Description. The body exhibits a dark metallic blue colouration, with the elytra displaying a faint violet sheen under certain light conditions, while the tips of the wrinkles on the head and pronotum, as well as the tubercles on the elytra, are black (Figs. 1 and 2). The head is narrower than the pronotum, strongly wrinkled and punctate, with moderately convex eyes (Figs. 1A and 2A). The pronotum is cordiform, widest slightly before the middle, with lateral margins subtly thickened towards the posterior angles (Fig. 2B). The elytra are elongated, with well-developed tubercles creating a prominently sculptured appearance, widest around the middle (Figs. 1 and 2). The legs and antennae are black, lacking any metallic sheen, whereas the epipleura of the elytra and pronotum, as well as the entire ventral surface of the body, have a bluish metallic hue (Fig. 1B). Compared to *C.* (*P.*) *gigas*, the elytra are slightly less convex in lateral view, appearing more flattened (Fig. 1B, E).

The aedeagus is elongated, gradually tapering towards the blunt apex (Fig. 1C).

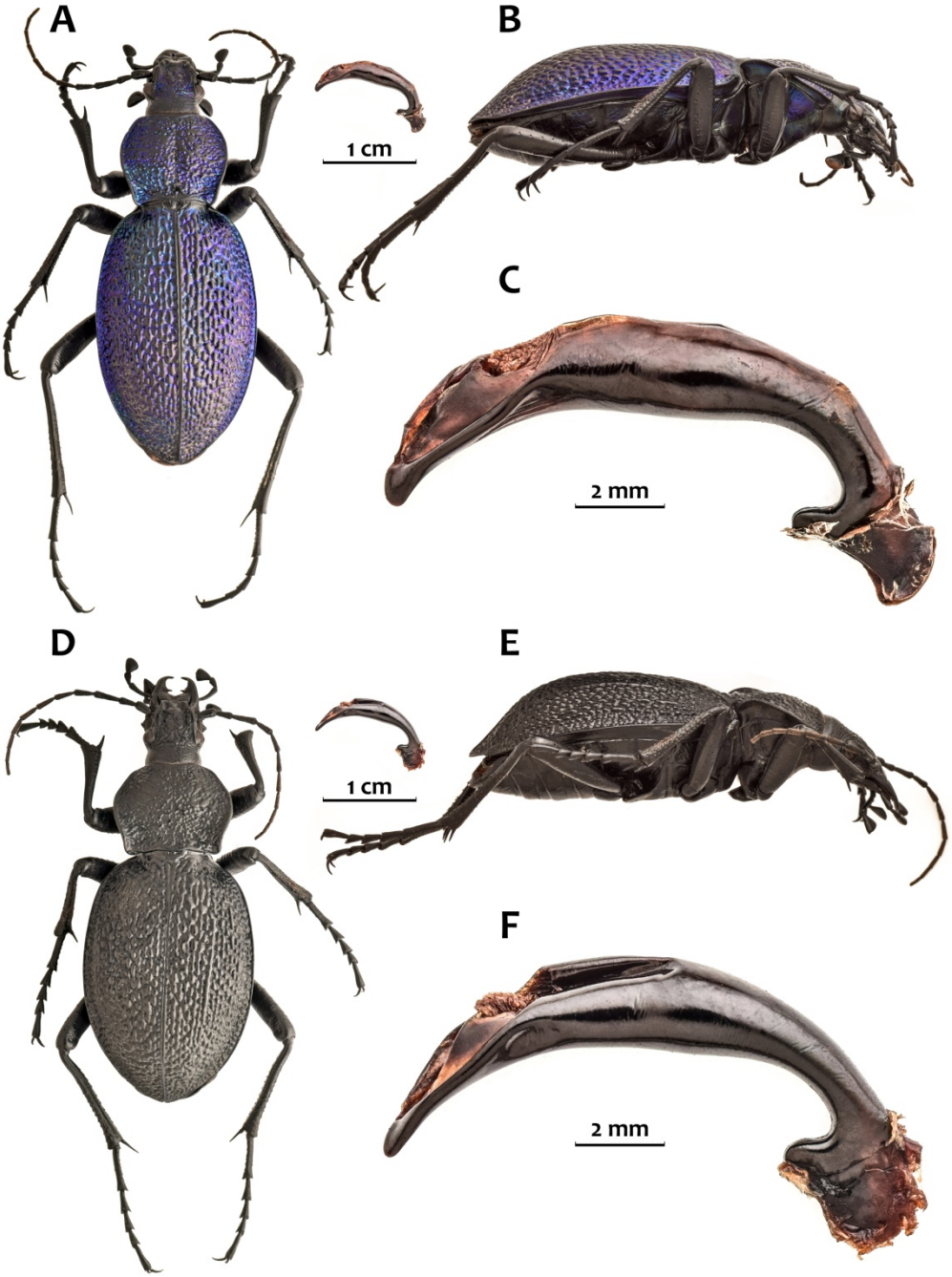


Figure 1. *Carabus* (*Procerus*) species occurring in Serbia – *C.* (*P.*) *scabrosus* (A-C) and *C.* (*P.*) *gigas* (D-F): habitus, dorsal view (A, D); habitus, right lateral view (B, E); aedeagus, left lateral view (C, F). Photos: N. Vesović.

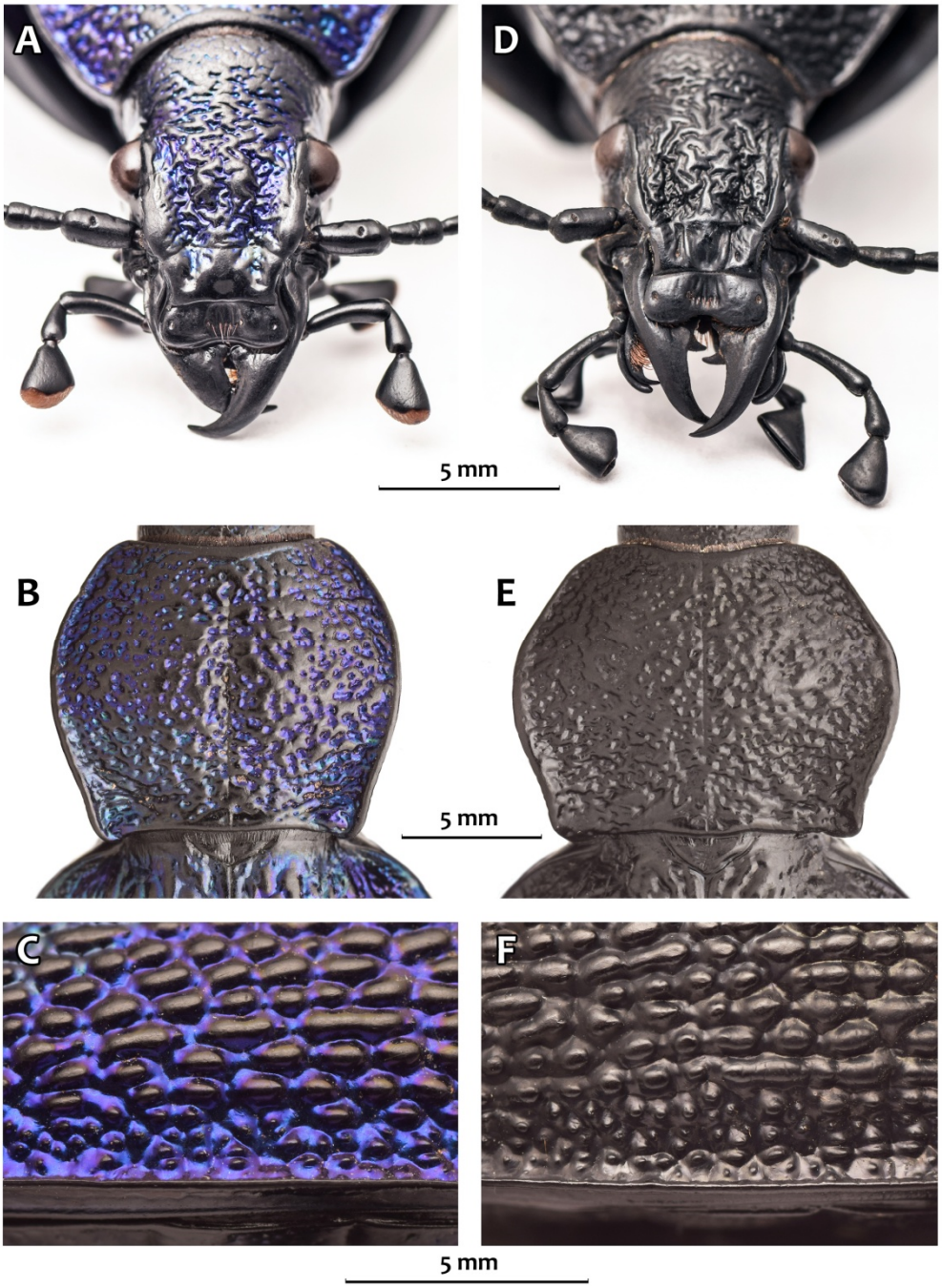


Figure 2. Morphological details of *Carabus* (*Procerus*) species occurring in Serbia – *C.* (*P.*) *scabrosus* (A-C) and *C.* (*P.*) *gigas* (D-F): head, frontal view (A, D); pronotum, dorsal view (B, E); elytral tuberculate surface, lateral view (C, F). Photos: N. Vesović.



Figure 3. Localities of *Carabus* (*Procerus*) *scabrosus* in southeastern Serbia and its potential prey: collection site along the Nišava River near the village of Gradinje (A, B); panorama of the city of Pirot (C); Nišava River in Pirot, near the site of the most recent photographic record in 2020 (D); *Helix lucorum*, a potential prey species common in the area (E). Photos: N. Vesović.

Discussion

The 2015 finding represents the earliest documented and first verifiable record of *C.* (*P.*) *scabrosus* in Serbia. Despite the species' distinctive size and morphology, which reduce the likelihood of misidentification, no previous faunistic surveys or entomological catalogues for Serbia have reported its presence, including Carabidae checklists (Ćurčić *et al*., 2007; Guéorguiev, 2008) and broader taxonomic syntheses on the genus *Carabus* (Cavazzuti, 1989; Turin *et al*., 2003; Deuve, 2021).

Despite numerous targeted efforts over the past decade, including manual searching and pitfall trapping along the Nišava River Valley from Dimitrovgrad to Pirot, no additional individuals were captured, precluding assessment of intraspecific variability within the Serbian population.

Two subsequent observations of *C.* (*P.*) *scabrosus* from Dimitrovgrad in 2018 (https://biologer.rs/sr/groups/33/species/23881) and Pirot in 2020 (https://www.inaturalist.org/observations/44917359) are documented only by photographs published on citizen science platforms. Both online observations were carefully examined by the authors, and the photographs were checked to confirm that the depicted individuals are indeed *C.* (*P.*) *scabrosus*, providing independent verification of the identification.

Biogeographical and taxonomic considerations. This finding extends the known distribution of *C.* (*P.*) *scabrosus* westward from Bulgaria into the Nišava River Valley in southeastern Serbia, marking the westernmost limit not only of its distribution range, but also of any *Procerus* species other than *C.* (*P.*) *gigas*. The discovery highlights the importance of river valleys as dispersal corridors facilitating faunal migrations and underscores the need for further monitoring to assess the establishment and potential spread of *C.* (*P.*) *scabrosus* in Serbia.

The closest known locality of *C.* (*P.*) *scabrosus* to the Serbian collection site is approximately 175 km to the southeast as the crow flies, in the village of Ravnogor, Pazardzhik Province, Bulgaria, where the population of *C.* (*P.*) *scabrosus bureschianus* occurs (Teofilova, 2017, 2019a, 2019b). A comparable straight-line distance of approximately 190 km separates the first Serbian locality from the nearest population of *C.* (*P.*) *scabrosus scabrosus*, recorded in the village of Svezhen in the Sredna Gora mountain range, Plovdiv Province, Bulgaria (Teofilova & Kodzhabashev, 2020b). This is not the first instance of *C.* (*P.*) *scabrosus* being recorded outside its previously known range. A similar case involves *C.* (*P.*) *scabrosus crimeanus* Mazzi & Cavazzuti, 2014, documented in the city of Melitopol (Zaporizhzhia Oblast, Ukraine), approximately 140 km north of other known localities, representing its first record beyond the Crimean Peninsula (Volovnik & Suchkov, 2018).

Although the pronotum shape of the Serbian specimen is identical to that of *C.* (*P.*) *scabrosus bureschianus*, a detailed comparison of aedeagus illustrations of all Balkan representatives of *C.* (*P.*) *scabrosus* revealed that the Serbian specimen resembles, but is not identical to *C.* (*P.*) *scabrosus scabrosus*, *C.* (*P.*) *scabrosus bureschianus*, or any other conspecific subspecies (Fig. 4) (Cavazzuti, 1989). However, these illustrations do not indicate consistent differences among individuals from different populations, even within the same subspecies.

For now, we provisionally assign the Serbian specimen to the subspecies *C.* (*P.*) *scabrosus bureschianus*, noting that additional specimens, particularly males, are needed to assess morphological variability, especially of the aedeagus, and to confirm its taxonomical status.

Similarly, Cavazzuti (1989) noted that specimens of *C.* (*P.*) *scabrosus bureschianus* from the Xanthi area in northeastern Greece differ from those from Bulgarian populations, suggesting that a potential new subspecies from Greece might be described in the future if these differences prove consistent. However, we argue that the casual establishment of new subspecies does little to resolve taxonomic issues and may instead introduce further confusion into an already poorly understood subspecific categories within the subgenus.

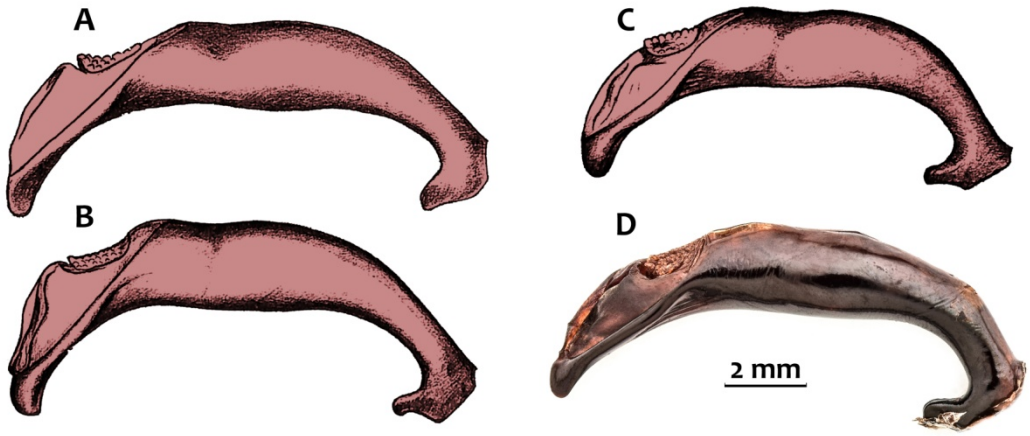


Figure 4. Aedeagus of Balkan representatives of *Carabus* (*Procerus*) *scabrosus*, left lateral view: *C.* (*P.*) *scabrosus scabrosus* from Demirköy, Kırklareli Province, Turkey (A); *C.* (*P.*) *scabrosus bureschianus* from Xanthi, Western Thrace, Greece (B), Bachkovo, Plovdiv Province, Bulgaria (C), and near Gradinje, Pirot District, Serbia (D) (modified after Cavazzuti, 1989).

At this stage, we fully endorse the classification recognizing 'strong' and 'weak' subspecies within the subgenus *Procerus* as proposed by Deuve (2021). Based on the morphological variability among specimens from different populations across the distribution range of *C.* (*P.*) *scabrosus*, we support the view that these differences may not be sufficient or consistent enough to justify the recognition of any 'strong' subspecies within this species.

Ecological implications. As one of the largest ground beetles in the region alongside *C.* (*P.*) *gigas*, *C.* (*P.*) *scabrosus* may play an important ecological role in local ecosystems. Its presence in southeastern Serbia indicates that suitable microhabitats and adequate prey resources exist there to sustain populations of these large predatory beetles. *Helix lucorum* Linnaeus, 1758 (Fig. 3E), a likely prey species, was recorded at the same locality, with both live individuals and numerous empty shells observed.

The discovery of a live adult male in autumn 2015 indicates that *C.* (*P.*) *scabrosus* has been present in Serbia for at least a decade. Given that adults can survive for more than 1.5 years in captivity (Berlov & Berlov, 1997), and that observations in southeastern Serbia span more than three times that period, it is reasonable to assume that several generations have already developed *in situ*. We therefore consider the *C.* (*P.*) *scabrosus* population to be established in Serbia, though its size cannot currently be estimated and is likely small.

The main question, therefore, is how this population arrived and became established, given that the nearest known localities of *C.* (*P.*) *scabrosus* are approximately 175 km east of Dimitrovgrad. How could these large, apterous beetles have travelled such a considerable distance, or did they travel at all? Three potential scenarios may be considered: natural westward range expansion, accidental anthropogenic transport, and the existence of a previously undetected autochthonous local population in the border area.

In the first scenario, gradual westward expansion from Bulgaria would likely be slow and result in intermediate occurrences between southern Bulgaria (western Rhodopes) and southeastern Serbia. However, no such records exist there to date, though this may reflect limited exploration of the area rather than true absence.

Prey (e.g., terrestrial gastropods) availability may also facilitate the natural dispersal of ground beetles, as observed in Ukraine, where the range expansion of *Helix albescens* Rossmässler, 1839 is thought to have aided the spread of *C.* (*P.*) *scabrosus crimeanus* (Volovnik & Suchkov, 2018). However, in southeastern Serbia, this mechanism is unlikely, as suitable prey snails (*H. lucorum*) are abundant. Climatic shifts may also have contributed to the occurrence of the ground beetle species in the country. Meteorological data from Serbia indicate a rise in mean annual temperature in recent decades (Đurđević *et al*., 2018), while current climatic conditions in southern Bulgaria and southeastern Serbia remain broadly comparable and suitable for the survival of the species. Prey availability and suitable climate likely facilitated the establishment of a local population of *C.* (*P.*) *scabrosus* in Serbia.

The second scenario considers the possibility of accidental anthropogenic transport via the railway and road connections running through the Nišava River Valley between Bulgaria and Serbia, although this is probably less likely. It is possible that one or more gravid females, or several adults of both sexes, were introduced via cargo traffic. A comparable case has been reported from Ukraine, where a single specimen of *C.* (*P.*) *scabrosus tauricus* Bonelli, 1811 was discovered at a railway station 500 km north of its native range (Brigadirenko, 2003).

According to the third scenario, a population of *C.* (*P.*) *scabrosus* may have been present in the area for a prolonged period. In this case, the record would not necessarily indicate a recent westward range expansion, but rather the persistence of a local, isolated population in southeastern Serbia.

Later observations on citizen science platforms. Although our 2015 record represents the earliest confirmed evidence of *C.* (*P.*) *scabrosus* in Serbia, subsequent observations on citizen science platforms indicate that the species is already more widely distributed in southeastern Serbia (Fig. 5). These include a record from Dimitrovgrad on July 6, 2018 (43°00'44.5" N, 22°46'36.8" E; 480 m a.s.l.; about 3.3 km from the locality of the first record) on the website Biologer (Popović *et al*., 2020) (https://biologer.rs/sr/groups/33/species/23881), and a record from the Senjak settlement of the city of Pirot (Fig. 3C, D) on May 4, 2020 (43°09'06.7" N, 22°35'28.5" E; 369 m a.s.l.; about 24.3 km from the locality of the first record) on the website iNaturalist (Penić, 2020) (https://www.inaturalist.org/observations/44917359).

Given their geographic position and timing, these records support the scenario of a gradual westward expansion of the species' range.

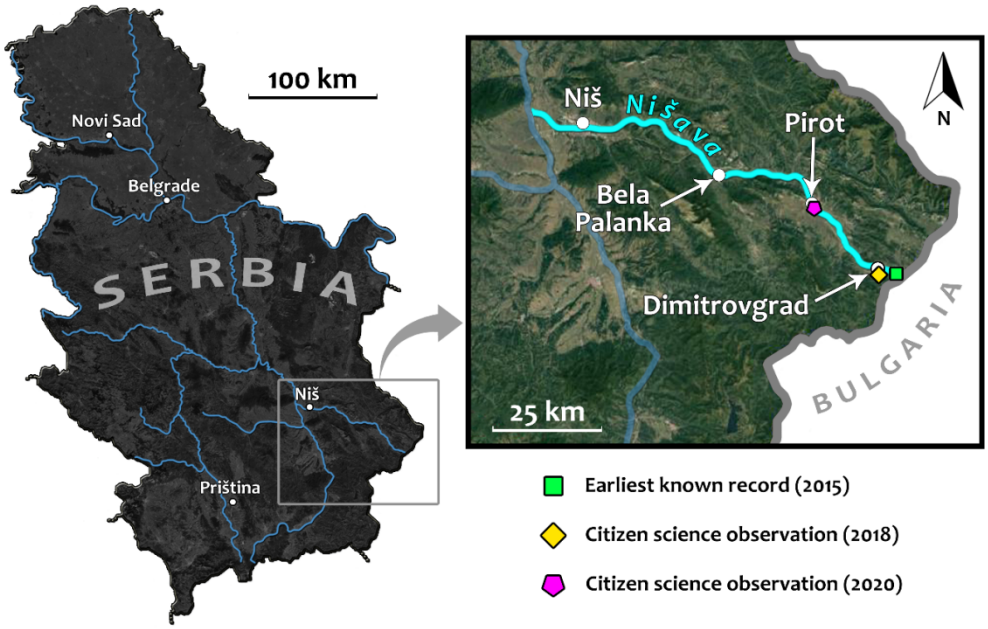


Figure 5. Distribution of *Carabus* (*Procerus*) *scabrosus* in Serbia.

Further research. Continued targeted surveys in the Nišava River Valley and surrounding forested areas are required to obtain an initial estimate of population size and to assess the presence of a stable, reproducing population in Serbia. Research efforts should also extend further west downstream along the Nišava River, first towards the town of Bela Palanka and then towards the city of Niš, as further range expansion in that direction is expected. Special attention should be given to the bimodal activity pattern, with peak occurrences in spring and autumn.

Detailed surveys of the mountainous forested areas south of the town of Dimitrovgrad, such as the Lukavička Reka River Valley towards Mt. Ruj, are recommended to investigate and potentially confirm natural population expansion from the Bulgarian Rhodopes towards the Serbo-Macedonian Massif. Conversely, the area north of Dimitrovgrad towards the Stara Planina Mts. is also of interest to determine whether *C.* (*P.*) *scabrosus* occurs there.

Conservation. *Carabus* (*P.*) *scabrosus* and some of its subspecies are recognized as taxa of conservation concern in several countries. The species is listed as Vulnerable (VU) in the Red Data Book of Bulgaria (Golemanski *et al.*, 2015). *Carabus* (*Procerus*) *scabrosus fallettianus* (Cavazzuti, 1997) is listed as Vulnerable (VU) in the Red Book of the Republic of Armenia in accordance with IUCN Red List guidelines (Aghasyan & Kalashyan, 2010). Additionally, *C.* (*P.*) *scabrosus tauricus* is classified as Vulnerable (VU) in the Red Data Book of Ukraine (Puchkov, 2009). In the Russian Federation, *C.* (*P.*) *scabrosus caucasicus* is included in the regional Red Data Book of Krasnodar Krai, with a conservation status of Vulnerable (VU) (Governor of Krasnodar Krai, 2025).

Given its conservation status in these countries, a formal evaluation and assessment of *C.* (*P.*) *scabrosus* population(s) in Serbia is warranted and should be incorporated into future national legislative documents, as is the case in Bulgaria (Teofilova, 2022a, 2022b). According to Guéorguiev (2004), this ground beetle is of

particular conservation concern and requires protection beyond the current national framework, as its populations appear to be declining throughout Bulgaria.

Continued monitoring of the population in Serbia and its potential further expansion is strongly recommended. Additional citizen science records would be valuable for tracking the occurrences of this new member of the Serbian ground beetle fauna.

Conclusions

In conclusion, the presence of *C*. (*P*.) *scabrosus* in Serbia represents both a faunistic novelty and an indicator of dynamic biogeographical processes in the Balkans. This finding also highlights the importance of systematic faunistic surveys in border regions. Parts of southeastern Serbia, such as the Nišava River Valley, form a natural biogeographical corridor that may facilitate the dispersal of taxa between the eastern Balkans and central Serbia, and Pontic or Anatolian species may expand their ranges within this area in the future.

The presence of the species in the Dimitrovgrad and Pirot areas may tentatively be explained by dispersal from the eastern Balkans, potentially via the continuous mountain systems of southwestern Bulgaria and the Serbo-Macedonian Massif. Although the exact colonization pathway remains unclear, geographical connectivity between these regions cannot be excluded. Given the species' flightlessness and therefore limited dispersal capacity, natural colonization was likely gradual.

There is still no reliable evidence about when or by which routes the species expanded into Serbia, or whether it had already been present there.

Due to its complex geological history, pronounced topographical heterogeneity, and refugial role during Pleistocene climatic oscillations, the Balkans is recognized as a hotspot of ground beetle diversity and endemism (Guéorguiev, 2007). Many species and subspecies of *Carabus* have narrow or fragmented distributions shaped by mountain ranges that act as effective dispersal barriers (Cavazzuti, 1989; Turin *et al*., 2003; Calatayud *et al*., 2019). However, no firm taxonomic conclusions can be drawn at this stage, and the issue may only be clarified in the future, particularly once a larger number of specimens becomes available for examination. This would allow definitive determination of the infraspecific status and, through potential haplotype comparisons, the precise origin of this previously unknown *C*. (*P*.) *scabrosus* population in Serbia.

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ПРВИ НАЛАЗ *CARABUS* (*PROCERUS*) *SCABROSUS* OLIVIER, 1790 (COLEOPTERA: CARABIDAE) У СРБИЈИ: ПРИСУТАН У ЗЕМЉИ ВИШЕ ОД ДЕЦЕНИЈЕ

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Извод

У раду представљамо први за територију Србије потврђени налаз великог љубичастог трчуљка *Carabus* (*Procerus*) *scabrosus* Olivier, 1790, једног од најкрупнијих европских инсеката. Један адултни мужјак сакупљен је током 2015. године на обали реке Нишаве, код села Градиње, недалеко од бугарске границе. Ово откриће представља важан фаунистички допринос познавању ентомофауне Србије, а уједно и сведочи о значајном проширењу познатог ареала врсте на запад, која је до сада на Балкану била бележена једино у Бугарској, Грчкој и Турској. Недавна запажања на платформама за грађанску науку из подручја (Димитровград и Пирот) која се налазе западније од горе поменутог локалитета указују на то да је врста већ шире распрострањена у југоисточној Србији. У раду се такође разматрају потенцијални путеви доласка овог новог члана фауне Србије у земљу. На крају, студија наглашава потребу за циљаним теренским истраживањима ради процене стања популације ове врсте у Србији и разматрања њене заштите у оквиру националне легислативе.

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