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Research Article

The Subfamily Pselaphinae (Coleoptera: Staphylinidae) of South-western Bulgaria: Rila and Pirin Mountains

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Abstract: This study adds new data about the species richness of the subfamily Pselaphinae from two of the highest mountains of the Balkan Peninsula: Rila (2,925 m a.s.l.) and Pirin (2,914 m a.s.l.). The list of recorded species was expanded from 26 to 29 for Rila Mts. and from 27 to 36 for Pirin Mts. New localities for the previously reported pselaphines are listed. These two mountains are diversity hotspots of the subfamily Pselaphinae as almost half of the reported species (46%) are either Bulgarian or Balkan endemics. We describe the new species *Bryaxis zubroides* sp. n. from Rila Mts.

Key words: new species, taxonomy, faunistics, zoogeography.

Introduction

Rila Mts. and Pirin Mts. are high-altitude mountains (~2,900 m a.s.l.) in SW Bulgaria, possessing well-defined subalpine and alpine zones. Their flora and fauna are peculiar, including many recorded endemic species (Gruev 1988). Some of the first and most detailed studies on the subfamily Pselaphinae (Staphylinidae) in Bulgaria were from Rila and Pirin Mts. (Rambousek 1909, Karaman 1948, 1952, 1955, 1957, 1967, 1969, Löbl 1969, Besuchet 1999, Lapeva-Gjonova 2004, Bekchiev 2007, 2008, 2016, Bekchiev & Guéorguiev 2015). As a result of the mentioned works (representing an exhaustive literature survey), 26 species were recorded from Rila Mts. and 29 from Pirin Mts. In spite of this, the mountains still remain insufficiently studied, since mainly few popular and easily accessible places (e.g., Rila Monastery, Bansko, etc.) have sporadically been visited in the past and areas outside them remain unexplored.

The present article aims to expand the knowledge about the subfamily Pselaphinae from Rila and Pirin by publishing data gathered during field work during a period of more than 20 years (1997–2020). It includes new information about materials deposited in the collection of the National Museum of Natural History, Sofia (NMNHS) as well as in the private collection of Adam Šíma, Prague, Czech Republic (ASCP).

Materials and Methods

The material from the field was collected using the following methods:

Sifting with a litter reducer with a mesh diameter 6×6 mm. The beetles were sorted manually directly from the sifted leaf litter and rotten wood or were extracted using Winkler/Moczarski eclectors from 2.5–3 kg soil samples;

Light traps – tower with a 160W MBTF lamp and a F8T5-365 nm black light tube;

Sweeping of the vegetation with an entomological net and with a one-hand blower Partner GBV 325;

Table 1. Collection sites in Rila and Pirin Mts.

Mountain	Locality	Coordinates		Altitude (m a.s.l.)	Habitat
		Latitude	Longitude		
Rila	Parangalitsa Reserve	42.0432	23.3635	1463	*Picea abies*
	Kirilova polyana-Tiha polyana	42.1473	23.4317	2020	subalpine zone
	Kirilova polyana	42.1455	23.4284	1600	*Fagus sylvatica*
	above Pastra Village	42.1498	23.2233	1313	*Fagus sylvatica*
	Pastra Village	42.1223	23.2383	840	*Fagus sylvatica*
	Brichebor locality	42.0907	23.3812	1320	*Fagus sylvatica*
	Borovets Resort	42.2566	23.5889	1500	*Picea abies*
	Mussala Hut	42.1977	23.5900	2400	subalpine zone
	Malyovitsa Hut	42.2088	23.3899	1760	*Pinus peuce*
	Malyovitsa Hut 2	42.1832	23.3732	2100	subalpine zone
	Kostenets Town	42.2486	23.8049	880	*Fagus sylvatica*
Pirin	Breznitsa-Gotse Deltshev Hut	41.6192	23.6064	1500	*Fagus sylvatica*
	Breznitsa Village, Kadieva livada	41.6836	23.5994	1320	*
	Popovi livadi	41.5535	23.6259	1640	*Fagus sylvatica*
	Pirin Village	41.5217	23.5787	890	*Fagus sylvatica*
	Orelyak Reserve	41.5824	23.6190	1780	*Fagus sylvatica*
	Yavorov Hut	41.8247	23.3781	1760	*Pinus peuce*
	Vihren Hut	41.7618	23.4171	1960	*Pinus heldreichii*
	Lilyanovo Village	41.6144	23.3127	520	*

Pitfall traps – 500 ml containers filled with propylene glycol as a preservative at selected sites.

Details about the studied localities are presented in Table 1. Here we discuss only the new localities or those for which we have confirmed or provided additional information related to the environmental preferences of a given species (habitat, altitude), which are missing in old sources. The data for the already known localities in Rila and Pirin were previously summarised (Bekchiev 2008, 2016).

Species determination was made by dissection of the male specimens using standard techniques: genitalia and small parts were mounted in Euparal on acetate labels, which were pinned with the specimens. The terminology for species description follows Chandler (2001).

The following abbreviations were used: AL – length of the abdomen along the midline; AW – maximum width of the abdomen; BL – combined length of the body (= HL + PL + EL + AL) measured separately; EL – length of the elytra along the sutural line; EW – maximum width of the elytra; HL – length of the head from the anterior clypeal margin to the occipital constriction; HW – width of the head across the eyes; PL – length of the pronotum along the midline; PW – maximum width of the pronotum.

Previously unpublished localities are emphasised with an asterisk in the list below (*). Coordinates are in datum WGS84 and were obtained with a hand-held GPS unit.

The new type specimen is provided with a red printed label ”HOLOTYPUS” “name of the taxon n. sp.”, “R. Bekchiev det. 2021“.

Results

New data on the subfamily Pselaphinae from Rila and Pirin Mts.

In total, 21 species of the Pselaphinae collected in 20 localities were recorded. Seventeen of those were found in Pirin Mts.; nine species were reported from Rila Mts., one of them was new to science (its description is presented below).

Euplectus kirbii Denny, 1825 – **Pirin**: *Pirin Village, 04.05.2012, 1 ♂, leg. O. Sivilov, B. Zlatkov (NMNHS). Distribution: entire Europe, Asia (Cyprus, Turkey and Russia – West Siberia). European-Siberian species.

Plectophloeus fischeri (Aubé, 1833) – **Pirin**, Lilyanovo Village, 06.06.2013, 2 ex., leg. E. Ezer (ASCP). Distribution: entire Europe. European species.

Trimium puncticeps Reitter, 1880 – **Rila**, *Pastra Village, 13.07.2008, 4 ♂♂, 4 ♀♀, leg. R. Bekchiev (NMNHS). **Pirin**, between Breznitsa Village and Gotse Deltshev Hut, 03–04.08.2012, 1 ♂, leg. R. Bekchiev; Pirin Village, 04.05.2012, 1

♂, leg. O. Sivilov, B. Zlatkov; Popovi Livadi Pass, 22.07.2010, 8 ♂♂, 20 ♀♀, leg. R. Bekchiev (NMNHS); Lilyanovo Village, 06.06.2013, 1 ♂, leg. E. Ezer (ASCP). Distribution: Albania, Bosnia & Herzegovina, Bulgaria, Croatia, Hungary, North Macedonia, Moldavia and Romania. Carpathian-Balkan species.

Trimium carpathicum Saulcy, 1875 – **Pirin**, Lilyanovo Village, 06.06.2013, 1 ♂, leg. E. Ezer (ASCP). Distribution: South-east and Central Europe. South-east European species.

Batrisodes venustus (Reichenbach, 1816) – **Pirin**, Pirin Village, 04.05.2012, 1 ♂, leg. O. Sivilov, B. Zlatkov (NMNHS). Distribution: entire Europe. European species.

Batrisus formicarius Aubé, 1833 – **Pirin**, Lilyanovo Village, 06.06.2013, 1 ex., leg. E. Ezer (ASCP). Distribution: entire Europe. European species.

Bryaxis curtisii orientalis Karaman, 1952 – **Rila**, *Kostenets Village, 21.08.2020, 5 ♂♂, 3 ♀♀, leg. R. Bekchiev, R. Kostova (NMNHS). **Pirin**, Pirin Village, 04.05.2012, 1 ♂, leg. O. Sivilov, B. Zlatkov (NMNHS). Distribution: South-east and Central Europe. South-east European species.

Bryaxis nodicornis Aubé, 1833 – **Rila**, *Brichebor locality, 14.07.2018, 1 ♂, leg. R. Bekchiev (NMNHS). Distribution: entire Europe. European species.

Bryaxis roumaniae Raffray, 1904 – **Rila**, *Kostenets Village, 21.08.2020, 1 ♂, 1 ♀, leg. R. Bekchiev, R. Kostova (NMNHS). **Pirin**, Popovi Livadi Pass, 21.07.2010, 1 ♂, 2 ♀♀, leg. R. Bekchiev; between Sandanski Town and Lilyanovo Village, 12.06.1988, 1 ♂, 2 ♀♀, leg. P. Beron (NMNHS). Distribution: Bulgaria, Greece, Montenegro, Romania and Serbia. Balkan species.

Bryaxis simoni (Reitter, 1880) – **Rila Mts.**, Parangalitsa Reserve, 24.06.2007, 3 ♂♂, 4 ♀♀, leg. R. Bekchiev; * Kirilova Polyana and Tiha Polyana, 16.07.2010, 6 ♂♂, leg. R. Bekchiev; Borovets, 16.06.2019, 1 ♂, 6 ♀♀, leg. R. Bekchiev; Musala Hut, 08.09.1997, 1 ♂, leg. P. Beron; Malyovitsa Hut 2, 15.06.2019, 8 ♂♂, leg. R. Bekchiev; Malyovitsa Hut, 14.06.2019, 6 ♂♂, 1 ♀, leg. R. Bekchiev; *Brichebor locality, 14.07.2018, 15 ex., leg. R. Bekchiev; Kirilova polyana, 15.07.2018, 15 ex., leg. R. Bekchiev (NMNHS). **Pirin Mts.**, * between Breznitsa Village and Gotse Deltshev Hut, 03–04.08.2012, 1 ♂, 2 ♀♀, leg. R. Bekchiev; *Yavorov Hut, 17–18.07.2010, 3 ♂♂, 3 ♀♀, leg. R. Bekchiev; Vihren Hut, 31.08.2020, 1 ♂, leg. R. Bekchiev, R. Kostova (NMNHS). Distribution: Bulgaria, Greece, Montenegro, Romania and Serbia. Balkan species.

Bythinus acutangulus lunifer Karaman, 1948 – **Pirin**, *Popovi Livadi Pass, 28.07.2010, 3 ♂♂, leg. R. Bekchiev (NMNHS). Distribution: Bulgaria, Greece, Montenegro, Romania and Serbia. Balkan subspecies.

Bythinus leonhardinus Reitter, 1882 – **Pirin**, *Pirin Village, 04.05.2012, 1 ♂, leg. O. Sivilov, B. Zlatkov; *Popovi Livadi Pass, 22.07.2010, 1 ♂, leg. R. Bekchiev (NMNHS). Distribution: Bulgaria, Greece, North Macedonia, Serbia, Turkey. Balkan species.

Bythinus lunicornis Reitter, 1884 – **Pirin**, *Popovi Livadi Pass, 28.07.2010, 1 ♂, leg. R. Bekchiev (NMNHS). **Rila**, *Pastra Village, 27.06.2012, 1 ♂, 2 ♀♀, leg. R. Bekchiev; *Brichebor locality, 14.07.2018, 2 ♂♂, leg. R. Bekchiev (NMNHS). Distribution: Bulgaria, Greece, Montenegro, Romania and Serbia. Balkan species.

Bythinus seidli Karaman, 1952 – **Pirin**, *between Breznitsa Village and Gotse Deltshev Hut, 03–04.08.2012, 1 ♂, leg. R. Bekchiev (NMNHS). Distribution: Bulgaria, Greece, Montenegro, Romania and Serbia. Balkan species.

Reichenbachia juncorum (Leach, 1817) – **Pirin**, Breznitsa Village, Kadieva livada, 13.08.2011, 1 ♂, 2 ♀♀, leg. A. Gjonova (NMNHS). Distribution: Europe and North Africa (Algeria, Morocco, Tunisia). European-Mediterranean species.

Dicentrius balcanicus pirinensis Besuchet, 1999 – **Pirin**, *Orelyak Reserve, 15.08.2014, 3 ♂♂, 3 ♀♀, leg. R. Bekchiev (NMNHS). Distribution: The subspecies is so far known only from Bulgaria. Bulgarian endemic subspecies.

Dicentrius discrepans Besuchet, 1999 – **Pirin**, *Yavorov Hut, 17–18.07.2010, 1 ♂, leg. R. Bekchiev (NMNHS). Distribution: The species is known from Bulgaria only. Bulgarian endemic species.

Dicentrius fodori Besuchet, 1999 – **Rila**, Parangalitsa Reserve, 24.06.2007, 1 ♂, leg. R. Bekchiev; Malyovitsa Hut, 14.06.2019, 6 ♂♂, 1 ♀, leg. R. Bekchiev; Malyovitsa Hut, 02–08.09.2020, 7 ♂♂, 6 ♀♀, leg. R. Bekchiev, R. Kostova; *Kirilova Polyana, 15.7.2018, 2 ♂♂, 3 ♀♀, leg. R. Bekchiev (NMNHS). Distribution: Bosnia Herzegovina and Bulgaria. Balkan endemic species.

Dicentrius zerchei Besuchet, 1999 – **Rila**, Borovets Resort, 16.06.2019, 1 ♂, 1 ♀, leg. R. Bekchiev (NMNHS). Distribution: The species is known only from Bulgaria so far. Bulgarian endemic species.

Pselaphogenius bulgaricus Löbl, 1969 – **Pirin**, Popovi Livadi Pass, 28.07.2010, 1 ♀, leg. R. Bekchiev; Pirin Village, 04.05.2012, 1 ♂, leg. O. Sivilov, B. Zlatkov (NMNHS); Lilyanovo Village, 06.06.2013, 1 ex., leg. E. Ezer (ASCP). Distribution: The species is known from Bulgaria, Greece and North Macedonia so far. Balkan endemic species.

Taxonomy

Bryaxis zubroides Bekchiev sp. n.

Material examined. Holotype: Bulgaria: 1 ♂: Rila Mts., above Pastra Village, N42.14985 E23.22331, 27.06.2012, in leaf litter of *Fagus sylvatica*, leg. R. Bekchiev (NMHNS).

Description. Body reddish-brown; antennae, maxillary palpi and legs also reddish-brown, slightly lighter than body; BL = 1.45 mm (Fig. 1a). Pubescence on head, pronotum and elytra gold, short, dense and recumbent. Head wider than long, HL = 0.25 mm, HW = 0.30 mm. Frons narrower (0.14 mm) than half of head, with shallow, triangular impression between antennal tubercles; rostrum triangular anteriorly. Vertex flat, with small median longitudinal carina, not reaching frontal triangular impression; frontal fovea absent, vertexal foveae small. Eyes big, with 25–30 ommatidia each. Maxillary palpi normally developed, with small, sparse tubercles on external part of apex of palpomeres II–III and the external part of the base of IV; last palpomere 0.20 mm long. Gular region with deep depression; anterior board simple, posterior board with large plate in the middle. Antennae about 0.57 mm long, scape longer than wide, with small tubercle in apical internal part; pedicel longer than wide, securiform (Fig. 1b); antennomeres III–V elongate, subequal in length, VI–VII as long as wide, all shorter than antennomeres III–V; last antennomere large and

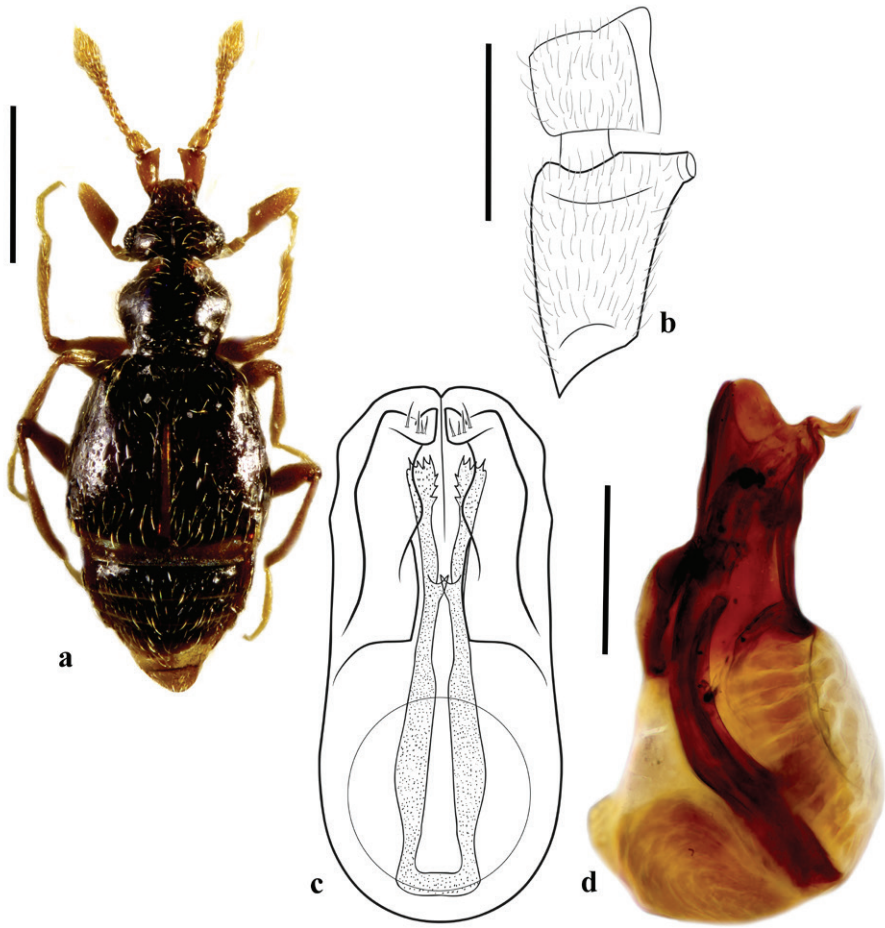

Fig. 1. *Bryaxis zubroides* sp. n.: a. habitus, male; scale-bar 0.5 mm; b. scape and pedicel, dorsal view; scale-bar 0.05 mm; c, d. aedeagus, ventral (c) and lateral (d) view; scale-bar 0.1 mm.

fusiform. Pronotum smooth, wider than long, PW = 0.32 mm, PL = 0.27 mm, widest in the anterior third, with well-defined antebasal sulcus connecting large lateral foveae; median fovea absent. Elytra slightly wider than long, EW = 0.57 mm, EL = 0.57 mm, slightly convex, with two basal foveae and sutural entire striae, discal striae absent, punctuation evanescent. Legs slender; a depression on the inner side of the femurs I present; tibia I with shallow preapical indentation on inner margin; tibiae II and III simple. Aedeagus 0.34 mm long, large and curved to apex of apical lobe (horn like), with three short preapical setae, endophallus complex (Fig. 1c–d).

Sexual dimorphism. Female unknown.

Differential diagnosis. Currently, *Bryaxis zubroides* sp. n. could be placed in the *Bryaxis khnzoriani*-species group defined by Besuchet & Kurbatov (2007). Compared to the other Balkan species, it shares most similarities (e.g. the shape of the scape and pedicel) with *B. islamitus* (Reitter, 1885), *B. muscorum* Kiesenwetter, 1849, and *B. stolzi* Machulka, 1932. However, the new species differs from the other *Bryaxis* by the shape of the aedeagus.

Biology. The only specimen was found in leaf litter of *Fagus sylvatica* L.

Etymology. The name is derived from the Slavic word for the wisent (*Bison bonasus* L.) – zubr. It refers to the habitus (brown, hairy) of the species as well as the horn-like apical lobe of the aedeagus.

Distribution. Bulgaria.

Discussion

Including the new species recorded, the total number of the known Pselaphinae species in Rila Mts. raised to 29 and in Pirin Mts. to 36 species (Fig. 2). Several new localities for the already known species were recorded (six from Pirin and eight from Rila). The higher number of species found in Pirin Mts. than in Rila Mts. is probably due to the higher search effort at its lower parts, where the diversity of pselaphines is expected to be higher.

One species new to science and one new for the region (*Bryaxis nodicornis*) were identified in Rila Mts. The species *Bryaxis puncticollis* (Denny, 1825) was published by Rambousek (1909) from Rila Mts

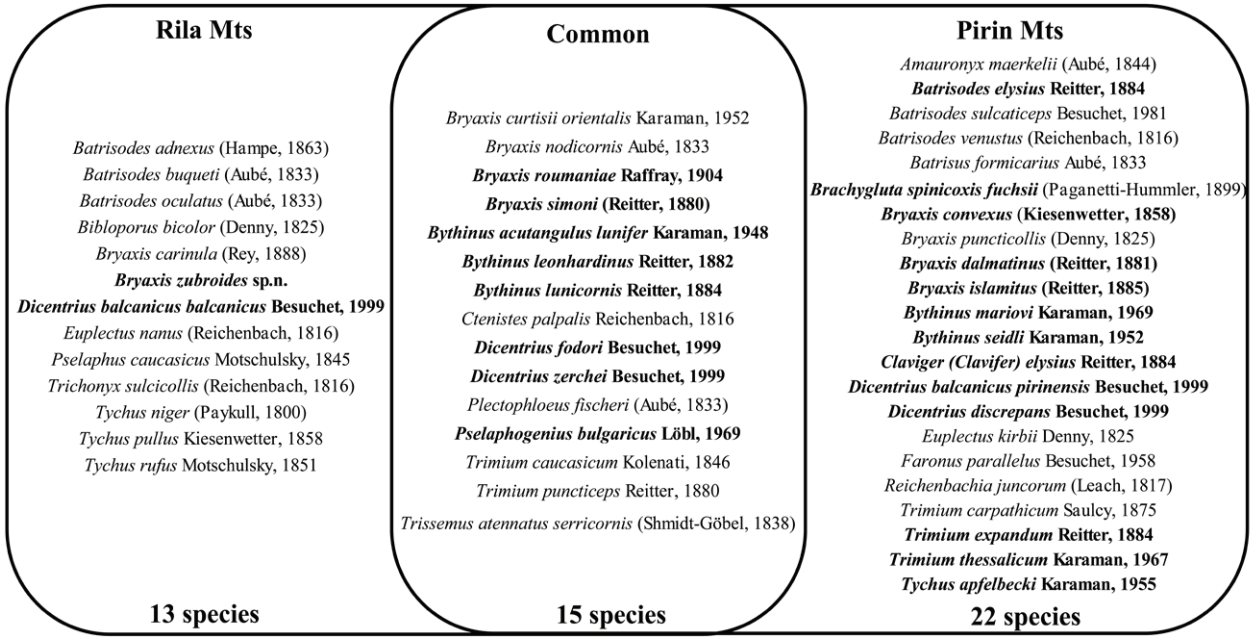

Fig. 2. Full list of the Pselaphinae species recorded from both Rila and Pirin mountains based on literature and new data. The species are arranged in alphabetical order. Names in bold are those of Balkan and Bulgarian endemics.

(Chamkoriya = Borovets) and was treated as uncertain for the fauna of Bulgaria (Bekchiev 2008). However, a recent discovery of this species in Stara Planina Mts. by one of the authors (RB, unpublished data) suggests that this treatment should be dropped and the species should be reconsidered as a possible species for Rila Mts., also.

Nine species were reported as new for the fauna of Pirin Mts (*Batrisodes venustus*, *Batrisus formicarius*, *Bryaxis curtisii orientalis*, *Bythinus seidli*, *Bythinus lunicornis*, *Plectophloeus fischeri*, *Reichenbachia juncorum*, *Trimium carpathicum* and *Trimium puncticeps*). Our finding of *Reichenbachia juncorum* in Pirin is only the third known locality for the species in Bulgaria. The first two were Vitosha and Stara Planina Mts. (Bekchiev 2008, Kostova et al. 2016). Thus, its known range in the country was considerably expanded.

Among the 50 species recorded from Rila and Pirin, only 15 co-occur in both mountains (Fig. 2). The Balkan endemics and Bulgarian endemics (17 and 6 species, respectively) represent almost half of the recorded species, i.e. 46% (Fig. 2). It is difficult to assess and discuss the local endemism of the Pselaphinae on the Balkans because the knowledge about the geographical ranges of most species is limited. Given our current knowledge, some species look like local endemics but are probably with broader ranges yet to be identified. However, with some level of confidence, we could consider them at least as Balkan endemics.

The low dispersal ability of the endemic pselaphines, most of which are wingless soil dwellers, makes them very vulnerable to habitat destruction and fragmentation (Bekchiev 2007). Moreover, none of the Balkan and Bulgarian endemic beetle species is protected by Bulgarian legislation. It calling for urgent measures to be taken for their protection and conservation. The high number of endemic Pselaphinae spp. in Rila and even more in Pirin once again demonstrates that both mountains are very important areas for biodiversity and especially for beetle conservation. Although some areas in these mountains were proclaimed as national parks (or other type of protected territories), this alone may not be sufficient enough to provide protection and additional measures should be taken.

Although we provide further data about Pselaphinae from Rila and Pirin, some parts of these mountains still remained unstudied. Therefore, new pselaphine species are expected to be found as a result of further more extensive examinations.

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