Description of a cave-dwelling species *Duvalius karaormanicus* sp. n. (Coleoptera: Carabidae: Trechinae) from the south-western part of the Republic of Macedonia

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A new species, *Duvalius karaormanicus* **sp. n.**, in the subgenus *Euduvalius*, is described from the type locality: Mlečnik cave in the Karaorman Mountain in the south-western part of the Republic of Macedonia. This is the second cave-dwelling *Duvalius* and the sixth representative of the genus so far recorded from the Republic of Macedonia. Based on its diagnostic characters, the new species is found to be related to the species in the "*gogalai*" and "*petrochilosi*" groups. *D. karaormanicus* **sp. n.** occupies an intermediate position between the species from these two groups and is therefore placed in a separate "*karaormanicus*" species group.

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1. Introduction

The genus *Duvalius* Delarouzee 1859 was previously represented by five species in the Republic of Macedonia: *Duvalius* (*Duvaliotes*) *peristericus* (J. Müller, 1914), *Duvalius* (*Platyduvalius*) *macedonicus* (J. Müller, 1917), *Duvalius* (*Euduvalius*) *gogalai* Pretner, 1963, *Duvalius* (*Duvalius*) *fodori* Scheibel, 1937 and *Duvalius* (*Duvalius*) *vignai* Casale, 1983 (Drovenik and Peks 1994, 1999). Only one of them (*D. gogalai*) is a cave-dwelling species and has been recorded from the Kalina Dupka and Alilica caves in the Bistra Mountain (Pretner 1963, Hristovski *et al.* 2003, Guéorguiev 2005). All the other species were described from high-altitude zones of mountains in the western parts of the Republic of Macedonia.

In the period from 1998 to 2007 three *Duvalius* specimens were collected from the Mlečnik Cave in the south-western part of the Republic of Macedonia. On examination, the specimens were found to be of an undescribed species. The new species, *Duvalius* (*Euduvalius*) *karaormanicus* **sp. n.**, is described and its systematic position is discussed.

2. Study area

The Mlečnik Cave is located in the south-west of the Republic of Macedonia. The entrance to Mlečnik cave is in an Italian and Turkey oak forest (Quercetum frainetto-cerris macedonicum Oberd. 48 em. H-t 58) at an elevation of 980 m a.s.l. on Mlečnik hill; which is part of Karaorman

Mountain, near the village of Tašmaruništa. The cave is situated 1 km east of the river Drim valley. It is designated for protection as a 'Monument of Nature' due to its important geomorphologic characteristics (Zikov & Anastasovski 1993).

3. Materials and methods

All three specimens of *Duvalius* (*Euduvalius*) *karaormanicus* **sp. n.** were collected in Mlečnik Cave. The two female paratypes were collected in pitfall traps (plastic cans filled with vinegar and formalin) during the period 1998–2002; on 26.II.2007, a male specimen was collected from under loose rocks (by Marjan Komnenov, an arachnologist from Skopje, Republic of Macedonia).

The aedeagus of the holotype ♂ was extracted and cleaned in 5% KOH. The copulatory piece was detached from the penis and examined. Female genital parts were removed from the abdomen of paratype 1. All three specimens were mounted, together with their genital organs, and placed in the entomological collection of the Macedonian Natural History Museum in Skopje.

The specimens were examined through a LOMO MBS10 binocular stereomicroscope; the measurements of the length of the specimens and their body parts were carried out with the aid of an ocular micrometer with an accuracy of 0.02 mm. Microphotography was performed with a USB microscope camera attached to a computer.

Besides the type series of the new species, specimens of other two *Duvalius* species were examined:

- Two female specimens and one male specimen of *Duvalius gogalai* from Kalina Dupka Cave, the Bistra Mt. (leg. S. Hristovski; leg. Axel Schönhoffer; leg. Marjan Komnenov)
- Two male specimens (Holotype ♂ and one Paratype ♂) of *Duvalius zhalovi* from the collection of National Museum of Natural History in Sofia, Bulgaria (NMNHS).

The following abbreviations are used in the text: HT=holotype, PT=paratypes (PT1=paratype 1; PT2=paratype 2), SP=setiferous punture(s).

4. Description of *Duvalius* (*Euduvalius*) *karaormanicus* sp. n. (Figs. 1–5)

Type material. 1♂ (holotype) from Mlečnik cave, 26.II.2007 (leg. M. Komnenov); 2 ♀♀ (paratypes) from Mlečnik cave, traps, IV.1998–17.VIII. 1999 (leg. S. Hristovski and I. Karaman).

Diagnosis. The new species inhabits an area close to the known localities of *Duvalius* (*Euduvalius*) *gogalai* Pretner, 1963 and *Duvalius* (*Euduvalius*) *zhalovi* Guéorguiev, 2005. *D. karaormanicus* is morphologically similar to these two species. However, it differs from *D. gogalai* in having a smaller body size and in the form of the median lobe; *D. gogalai* has an asymmetrical median lobe in dorsal view while *D. karaor-*

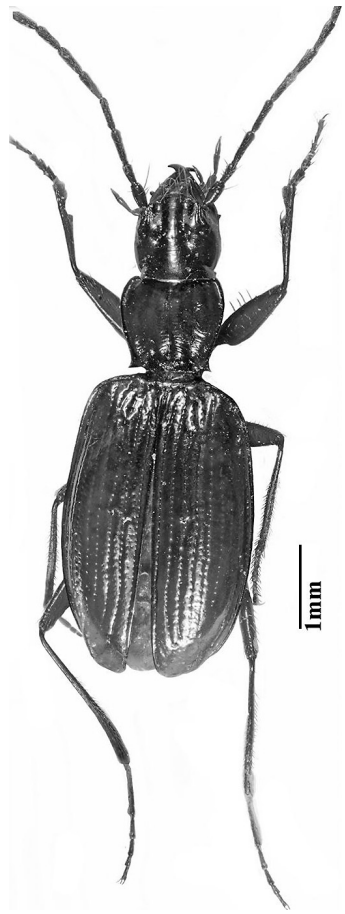

Fig. 1. Habitus of *Duvalius karaormanicus* **sp. n.** (paratype female).

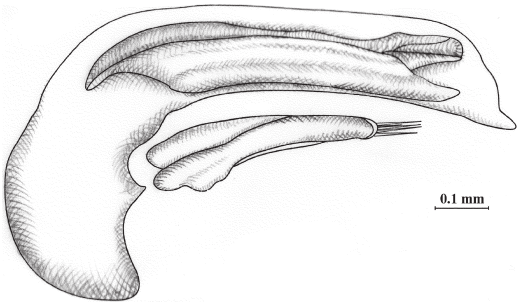

Fig. 2. Aedeagus of *Duvalius karaormanicus* **sp. n.** with copulatory piece, right lateral view (holotype).

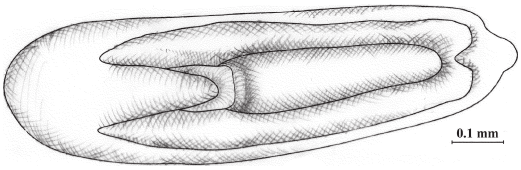

Fig. 3. Aedeagus of *Duvalius karaormanicus* **sp. n.** with copulatory piece, dorsal view (holotype).

manicus **sp. n.** and *D. zhalovi* both have a straight apex to the median lobe. *D. karaormanicus* differs from *D. zhalovi* in the smaller body size, the different shape of the copulatory piece (lamella copulatrix) and the more protruded apex of the penis (dorsal view). In fact, the penis in both *D. gogalai* (2.15 mm in topotype male) and *D. zhalovi* (2.3 mm in holotype male) is significantly longer than that of *D. karaormanicus* **sp. n.** (1.18 mm).

Description. Average length (from apex of mandibles to apex of elytra) 6.04 mm, 5.96 mm in HT (Fig. 1). Average maximum width of elytra 2.32 mm (2.36 mm in HT). Color of body rusty red. Legs, antennae and palpi reddish-yellow. Body glabrous, with indistinct microsculpture. Microsculpture consists of transverse mashes on elytra and pronotum (disc of pronotum almost glabrous); only neck of head with clearly visible microsculpture consisting of large isodiametric mashes. Legs and antennae (excluding first antenomere and first third of second antenomere) distinctly pubescent.

Head longer than pronotum (ratio 1.25), with protruding mandibles. Frontal furrows deep and complete. Clypeus distinctly separated from rest of head by complete transversal furrow. Antennae long (4 mm) and exceeding half of elytra. Eyes strongly reduced, represented by small and narrow lines without facets.

Pronotum subconvex and subcordate with long concave sinuation towards hind angles. Maximum width at anterior third, at level of anterior marginal setiferous puncture. Midline clearly visible. Anterior margin slightly concave. Anterior angles rounded, not protruding forwards. Hind angles sharp, extruded backwards, outwards and upwards. Posterior margin straight, deepened near hind angles. Posterior setiferous puncture located slightly forwards from tip of hind angles. Basal foveae deep, impunctate. Ratio between width and length of the pronotum: 1.19. Width of base of pronotum almost equal to width of anterior margin.

Elytra 1.54 times longer than wide, sinuated before apex, each elytron separately rounded at tip. Basal margin of elytra shortened, reaches forth elytral stria. Scutellar striae and scutellar puncture prominent. First and second striae reach apex of elytra; other striae obliterated shortly before apex. All striae distinctly and coarsely punctate as punctuation less prominent towards the apex of elytra. Recurrent stria adjoining fifth elytral stria.

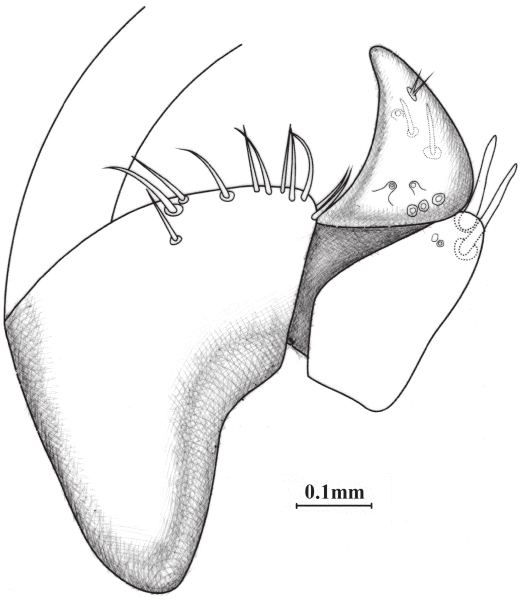

Fig. 4. Female genitalia of *Duvalius karaormanicus* **sp. n.**, ventral view (paratype 1).

Table 1. Measurements (mm) and ratios of characters of type specimens of *Duvalius karaormanicus* **sp. n.** Abbreviations: HT = holotype, PT1 = paratype 1, PT2 = paratype 2.

Characters	HT	PT1	PT2	Average
Total length (tip of mandibles–tip of elytra)	5.96	6.11	–	6.04
Length of elytra	3.51	3.58	3.61	3.57
Maximal width of elytra	2.36	2.18	2.43	2.32
Width/length ratio of elytra	1.49	1.65	1.48	1.54
Length of pronotum	1.09	1.07	1.19	1.12
Maximal width of pronotum	1.30	1.30	1.40	1.33
Width/length ratio of pronotum	1.19	1.21	1.18	1.19
Length of protarsus	0.82	0.85	–	0.83
Length of 1. protarsomere	0.27	0.21	–	0.24
Maximal width of 1. protarsomere	0.11	0.11	–	0.11
Length/witdh ratio of 1. protarsomere	2.57	2.00	–	2.29
Length of antennae	3.94	4.02	–	3.98
Length of median lobe	1.18	–	–	1.18
Length of left paramere	0.57	–	–	0.57
Length of right paramere	0.66	–	–	0.66
Length of copulatory piece	0.98	–	–	0.98

Legs long and slender. Length of first article of male protarsi 2.57 times longer than wide and 1.5 times longer than second article. Third article shorter than second, fourth very short. Onychium much longer than first article. Metatibia long and slightly S-shaped in male.

Median lobe relatively small – 1.18 mm (Figs. 2, 3). Apical part 1.5 times longer than basal bulb. Apical part straight and slightly bent downwards at apical third (lateral view, Fig. 2). Largest width of apical part at basal third (dorsal view); its sides symmetrically tapering to apex (Fig. 3). Apex constricted with protruded tip at end. Internal sac occupies most of apical part as well as portion of basal bulb.

Copulatory piece (piéce copulatrice) 0.98 mm in length (4/5 of the length of the median lobe), consisting of two lamellae. The ventral one is clearly bifid, wider and ca. 5 times longer than the dorsal one; it consists of two parallel, rolled segments which are connected to each other by a wide flat segment; each of them pointedly protruding in the basal part; the apical ends of the two segments are rounded.

The female genitalia are presented in Fig. 4.

Measurements and ratios of characters among the type specimens are presented in Table 1.

Chaetotaxy. Labrum has 6 (3+3) SP, equally distant from each other. Clypeus has 2+2 SP (closer to anterior margin) – the distance between the internal SP is twice as long as the distance between internal and external SP of one group. Head has two pairs of supraorbicular punctures – the anterior one situated slightly behind the level of reduced eyes; posterior situated slightly inwardly.

There are two pairs of SP near the tantennal grooves. Lateral margin of pronotum has two SP: one in hind angles, but moved slightly forward and one at anterior third of the pronotum, at its widest point.

Scutellar punctures on elytra present and distinctly elevated. There are small apical SP at the end of the second and fifth elytral striae. Third elytral interval has three SP. First and second ones are positioned in the third elytral stria; third one (preapical) positioned in third elytral interval, closer to second stria. First SP situated at first sixth of length of elytra (slightly closer to anterior margin than to suture); second one at first third; preapical one at last seventh of elytra.

Umbilicate series consists of 8 SP (4 humeral, 2 medial and 2 apical); half of SP situated close to marginal suture (1, 2, 6 and 8); rest of umbilical SP (3, 4, 5, and 7) moved inwards suture (Fig. 5). Distance between humeral and medial series almost twice as long as length of humeral series. Fifth SP situated in middle of elytral length.

When first seen the humeral SP appears to be situated equidistantly; however, precise measure-

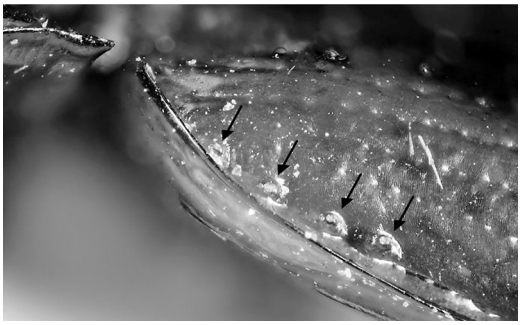

Fig. 5. Microphotograph of the four humeral umibilical setae (arrows) of left elytron of *Duvalius karaormanicus* **sp. n.** (paratype female).

ments show that the distance between the first and second humeral SP is longer than the distance between second and third SP. The distance between third and forth SP is the shortest.

Bionomy. The new species was named after the Karaorman Mountain where the Mlečnik Cave (type locality) is situated.

5. Discussion

The classification system of the genus *Duvalius* proposed by Jeannel (1928) has been followed in the majority of recent monographical works and catalogues (Casale & Laneyrie 1983, Moravec *et al.* 2003, Vigna Taglianti 2010). This system, although needing revision and corrections, is still the most accepted and widely used arrangement of tribe Trechini (Moravec *et al.* 2003) while descriptions of new genera (*Serboduvalius*, *Rascioduvalius*, *Javorella*, *Curcicia*), based on existing groups of species or individual species, has been criticized by Janak & Moravec (2008), because the differences between those genera and *Duvalius* are negligible.

The discovery of *D. karaormanicus* **sp. n.** from the limestone massif of the Karaorman Mountain improves knowledge of the distribution of the subgenus *Euduvalius*. The species of this subgenus are distributed in Dalmatia, Bosnia and Herzegovina, Montenegro, west parts of the Republic of Macedonia, East Albania and Greece (Jeannel 1928, Casale *et al.* 1996, Gučorguiev 2005). This is a typical Dinaric-Scardo-Pindic distribution, suggesting the Illyrian origin of *Euduvalius*.

According to Guéorguiev (2005) the representatives of *Euduvalius* have two synapomorphies: the first tarsomere of the male protarsi is noticably longer than wide and some of the umbilical setae are removed inwardly from the marginal suture of the elytron. *D. karaormanicus* **sp. n.** has both of these characteristics. Examination of topotype material of *D. gogalai* showed that this species has the same positioning of umbilical setae.

The nine known *Euduvalius* species have been arranged in three groups: "*erichsoni*" with five species from Dalmatia, Bosnia and Herzegovina and Montenegro; "*gogalai*" with two species from the western parts of the Republic of Macedonia and East Albania and "*petrochilosi*" from Greece, with two species. The new species seems most related to the species of the "*gogalai*" species group (Guéorguiev 2005) which contains two species: *D. gogalai* and *D. zhalovi*. *D. karaormanicus* **sp. n.** has a copulatory piece consisting of dorsal and ventral plates, similar external morphology, similar chaetotaxy and close geographic distribution to the species of the "*gogalai*" group. However, *D. karaormanicus* **sp. n.** is smaller in size and its aedeagus is also proportionally much smaller. The most distinguishing feature in the new species is the copulatory piece, which is excavated from below, while the species of "*gogalai*" group do not have such an excavation (Guéorguiev 2005). Furthermore, both *D. gogalai* and *D. zhalovi* have a remarkably long apical part of the aedeagus, while this part in *D. karaormanicus* **sp. n.** is proportionally shorter.

The excavated copulatory piece is also characteristic for the taxa of the "*petrochilosi*" group of *Euduvalius*. The length of the bulb in the species of "*gogalai*" group is two times shorter than the length of the apical part. *D. ruffoanus* ("*petrochilosi*" group) has a much longer and slenderer bulb.

D. karaormanicus **sp. n.** has the shortest apical part and a slenderer bulb than the species of the "*gogalai*" group, but wider than in the species of "*petrochilosi*" group. In addition, the body size in *D. karaormanicus* **sp. n.** is intermediate between the "*gogalai*" and the "*petrochilosi*" groups in terms of the species so far described. All the above data suggest that the new species occupies an intermediate position between the

species of the "*gogalai*" group and the species from the "*petrochilosi*" group. For this reason and based on the unique combination of characters, a new species group: "*karaormanicus*" has been assigned for the new species.

The regions of western Macedonia and eastern Albania are still poorly investigated in relation to their subterranean fauna. This region can be expected to support a highly diverse cave and hypogean fauna; it is therefore expected that further investigations may reveal additonal *Duvalius* species, which will assist in establishing the phylogenetic relationships between the species groups.

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