

TWO NEW SPECIES OF *BRACHYDESMUS* HELLER, 1858 FROM THE BALKAN PENINSULA (DIPLOPODA: POLYDESMIDA: POLYDESMIDAE)

D. Ž. ANTIĆ¹, B. P. M. ĆURČIĆ¹, V. T. TOMIĆ¹, T. RAĐA², BILJANA RAĐA³,
M. A. MILINČIĆ⁴ and S. E. MAKAROV¹

¹ Institute of Zoology, Faculty of Biology, University of Belgrade, 11000 Belgrade, Serbia

² Speleological Society "Špiljar", 21000 Split, Croatia

³ Faculty of Natural Sciences, Mathematics and Education, Department of Biology, 21000 Split, Croatia

⁴ Faculty of Geography, University of Belgrade, 11000 Belgrade, Serbia

Abstract – Two new polydesmid species are described, illustrated, and diagnosed: a troglobitic, *Brachydesmus mulaomerovi* n. sp., from Bosnia and Herzegovina and epigeal *Brachydesmus verrucosus* n. sp. from Macedonia. The new taxa belong to *inferus*- and *stygivagus*-groups of species, respectively. Relationships with congeners are briefly discussed. The distribution map and key are given for all currently known taxa belonging to these groups of species.

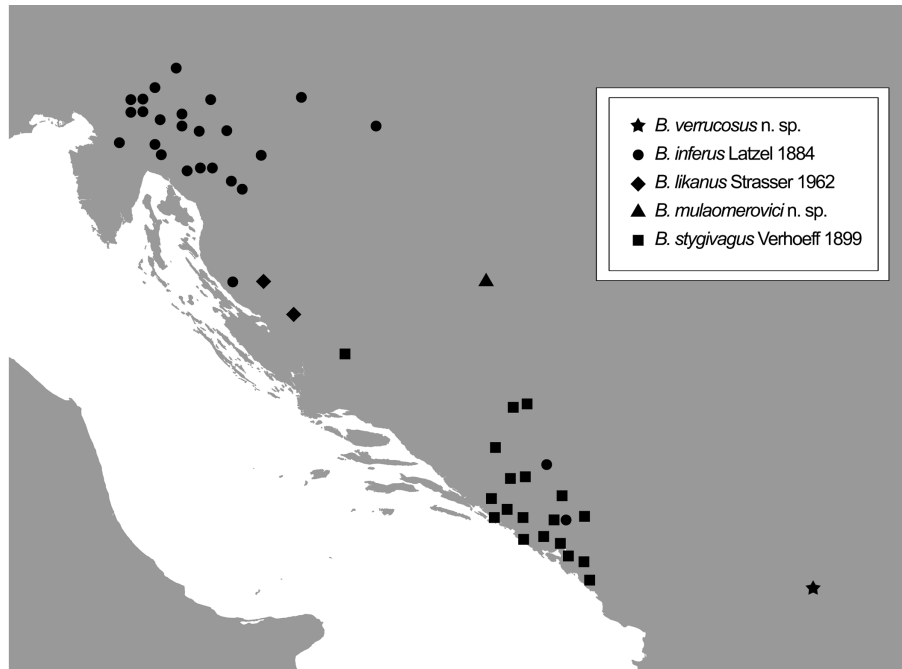
Key words: Balkan Peninsula, Bosnia and Herzegovina, Macedonia, *Brachydesmus*, new species.

INTRODUCTION

Among the three southern European peninsulas – Iberian, Apennine and Balkan, that had a major role as refugial zones during the last glaciation in the Pleistocene (Hewitt, 1999), for both paleo- and neoendemic forms, the Balkan Peninsula shows the highest degree of species richness and endemism (Ćurčić, 1998; Gaston and David, 1994; Savić, 2008). Its geographical position, between the Pannonian Basin in the north and Mediterranean region in the south, geomorphological and climatic events, as well as the historical development of the fauna on the Balkan Peninsula have made this area the center of speciation, diversification and adaptive radiation in many invertebrate groups (Ćurčić, 1998; Ćurčić et al., 2002; Savić, 2008).

Among the rich European millipede fauna, the genus *Brachydesmus* Heller, 1858, is one of the most numerous. According to Enghoff and Kime (2011), about 70 species of this genus inhabit Europe, of which nearly 80% are described from epigeic, endogeic and cave habitats on the Balkan Peninsula. Such species richness confirms the hypothesis that the Balkans (especially the former Yugoslavia) are a center of diversification of this genus.

After careful examination of abundant samples of diplopods from the Balkan Peninsula containing many interesting, rare and topotypic species, we determined that two of them are new to science. Description, illustration and diagnosis of these new taxa, as well as a brief discussion on congeners, and a distributional map are presented in this paper.



Map 1. Distribution of representatives of *inferus*- and *stygivagus*-group of species.

The terminology we have used for the description of polydesmid gonopods was proposed by Djursvoll et al. (2000), and Golovatch and Wytwer (2007).

The type specimens (holotype male, allotype female, two paratype males and eight paratype juveniles from Bosnia and Herzegovina and holotype male, allotype female and paratype female from Macedonia) are deposited in the collection of the Institute of Zoology, Faculty of Biology, University of Belgrade (Belgrade, Serbia).

RESULTS

TAXONOMY POLYDESMIDAE

BRACHYDESMUS MULAOMEROVICI MAKAROV, ĆURČIĆ & ANTIĆ, NEW SPECIES (Figures 1a; 2a; 3–8)

Material examined – Holotype male from Ukra-sna Pećina Cave, near Kamenica, Municipality of

Zavidovići, Bosnia and Herzegovina; July 19, 2002; collected by T. Rađa. Allotype female, two paratype males and eight paratype juveniles, same data as holotype.

Etymology – After Dr. Jasminko Mulaomerović, the well-known Bosnian speleologist and naturalist, and “*spiritus movens*” of Bosnian speleology.

Diagnosis – The new species clearly differs from *B. inferus* Latzel, 1884 and *B. likanus* Strasser, 1962, by the presence of well-developed paranota that are not curved upward, as well as by the specific structures of the gonopods.

Description – Body with 19 segments (including telson) in adults. Measurements: holotype male 8.36 mm long, width of midbody pro- and metazona (somite nine) 0.63 mm and 0.98 mm; allotype female 8.62 mm long, width of midbody pro- and metazona (somite nine) 0.73 mm and 1.12 mm; paratype male I 8.80 mm long, width of midbody pro- and metazona (somite nine) 0.67 mm and 1.04 mm, paratype male



Fig. 1. Habitus, dorsal view – *Brachydesmus mulaomerovici* n. sp., paratype male from Ukrasna Pečina Cave, village Kamenica, near Zavidovići, Bosnia and Herzegovina (a), *Brachydesmus verrucosus* n. sp., paratype female from Skopska Crna Gora Mountain, northern Macedonia (b).

II 8.85 mm long, width of midbody pro- and metazona (somite nine) 0.68 mm and 1.08 mm, respectively. Pigmentless polydesmids.

Head (holotype male): Broader than collum, covered with numerous minute setae. Occipital suture distinct, cheeks with straight margins. Labrum with eight labral and four supralabral setae. Lingual plates with 4-6 setae arranged in one row. Stipites with four apical, two subapical, three medial and one or two basal setae. Paraproct with three apical and one medial microsetae. Antennae elongated; length 1.80 mm. Length/breadth ratios of antennomeres I–VII: 1.00 (I), 2.53 (II), 3.50 (III), 2.17 (IV), 1.71 (V), 1.58 (VI), 1.15 (VII), respectively. Antennomeres IV–VI with few long sensitive setae; antennomeres VII with one long sensitive seta. Antennomeres V and VI with distodorsal sensillar areas with numerous bacilliform sensillae. Antennomere VII with parbasal sensory knob and distodorsal knob with few setiform sensilla. Apical part of antennae with four large cones.

Collum: Tuberculated. Anterior edge semicircular, posterior gently concave. One caudal inci-

sion present on both lateral sides. Collum with three transverse rows of setae; setal formula: 8+8+8.

Body segments: Due to the broad metazonae and elongated legs, body looks stocky. Segments gently broadening until somite IX, then parallel-sided to somite XVII; after that rapidly tapering toward the body end (Fig. 1a). Paraterga well developed with distinct incisions; caudolateral corners are simple (Fig. 2a). Metazonae II, III, IV, VI, VIII, XI and XIV with three incisions, and metazonae V, VII, IX, X, XII, XIII, XV–XVIII with four incisions. Ozopores present on segments with four incisions (Fig. 2a). Border between pro- and metazona distinct. Surface of prozona and anterior margins of paraterga gently tuberculated. Metazona with three transverse rows of blunt setae (Fig. 2a); setal formula: 6+8+6 (within second row of two medial setae slightly shifted to posterior edge). Posterior margins of metazonae denticulated. Epi-proct subtriangular (in dorsal view), gently flattened dorsoventrally with eight long knob-supporting setae in three rows (1+1 subapical and 3+3 medial). Tip of epi-proct rounded with four (2+2) long setae. Paraproct semicircular, each with two knob-supporting setae. Hypoproct subtrapezoid, with two long paramedian knob-supporting setae at the top.

Walking legs: elongated, without any modification.

Gonopods (Figs. 3-8): Prefemorite wide and short, densely covered with trichoid setae (Fig. 5). Femorite long with caudomesal protuberance, covered by few short setae (Figs. 3-5 and 8). Above caudal part of femoral protuberance, there is setose pulvillus with two small triangular teeth (Figs. 3-5). From pulvillus, gonopods suddenly narrow almost half the width (Figs. 5 and 8). Exomere unipartite; subapically with very long and pointed mesal process and long and apically bifurcated lateral process (Figs. 3-8). One gonopod of holotype male possesses two small spikes at the base of mesal process (Figs 3-7). Apical part of exomere simple.

Distribution – Probably endemic species of Bosnia and Herzegovina.

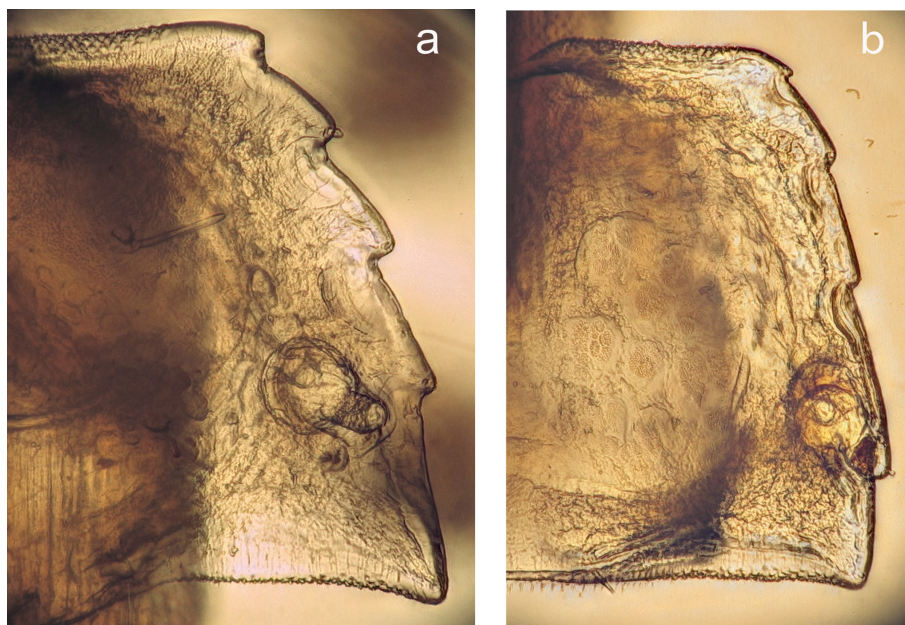


Fig. 2. Paranota of somite XII – *Brachydesmus mulaomerovici* n. sp., holotype male from Ukrasna Pećina Cave, village Kamenica, near Zavidovići, Bosnia and Herzegovina (a), *Brachydesmus verrucosus* n. sp., holotype male from Skopska Crna Gora Mountain, northern Macedonia (b). Without scale.

BRACHYDESMUS VERRUCOSUS
MAKAROV & ANTIĆ, NEW SPECIES
(Figs. 1b; 2b; 9–15)

Material examined – Holotype male from Skopska Crna Gora Mountain, near Saint Ilija Monastery, 600 m elevation, northern Macedonia; April 16, 2006. Allotype female and paratype female, same data as holotype.

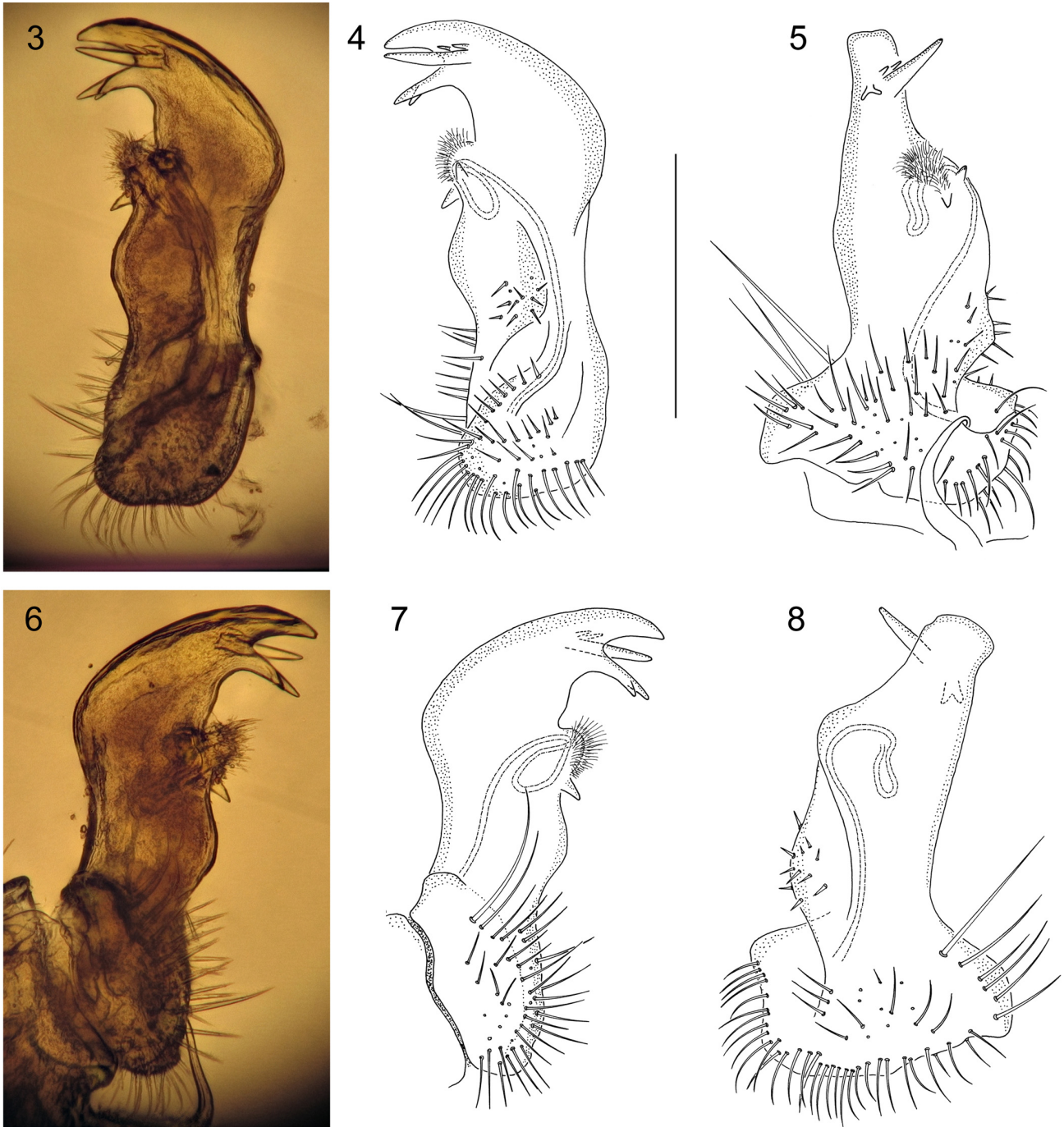
Etymology – After warty dorsomesal side of exomere.

Diagnosis – From *B. stygivagus* Verhoeff, 1899 (Fig. 16), new species clearly differs by many characteristics of the gonopods. Above all, there is a distinct difference in the general shape of the gonopods, as well as a difference in the structures of the prefemorate, femorite and exomere.

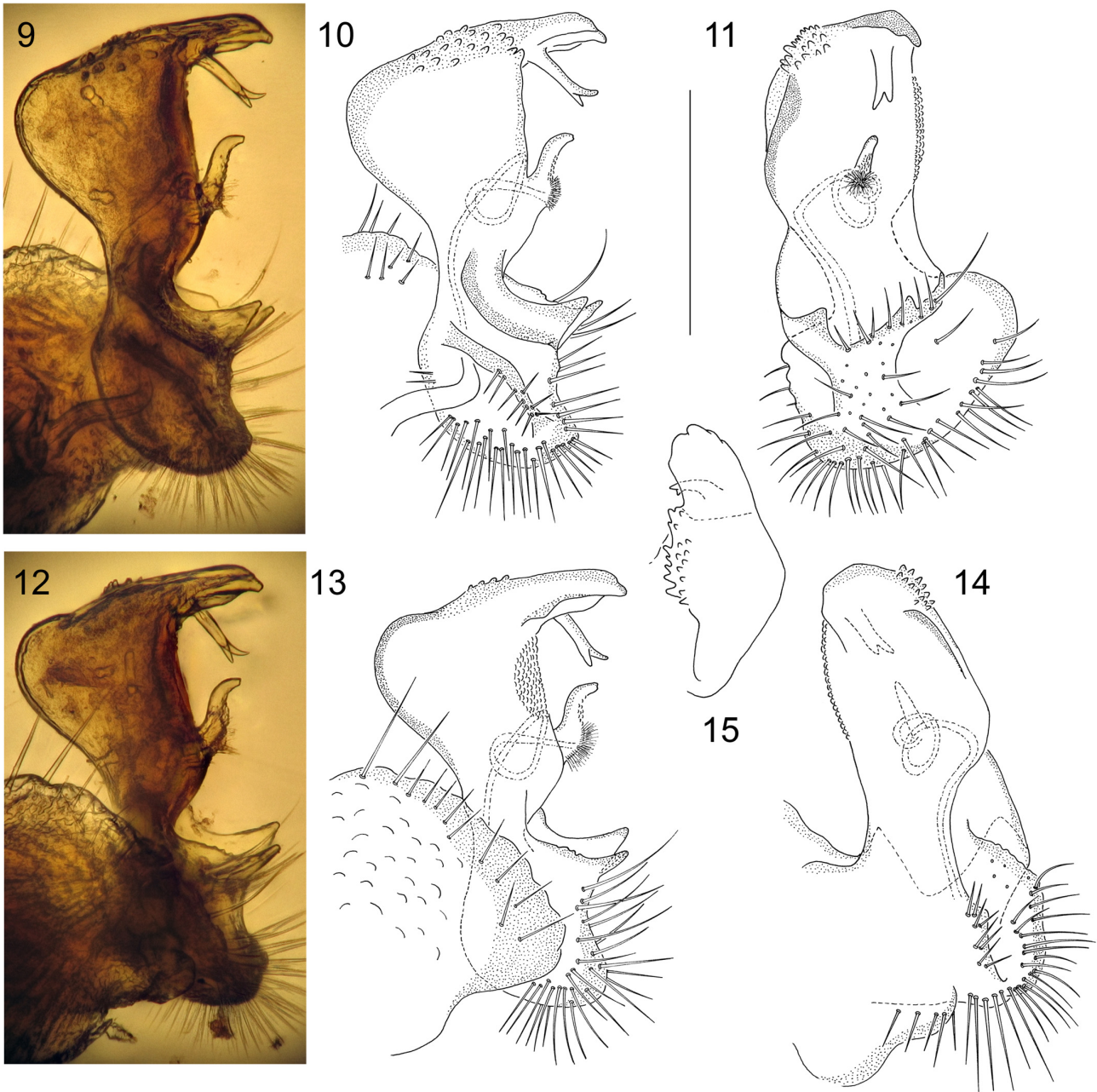
Description – Body with 19 segments (including telson) in adults. Measurements: holotype male 8.03 mm long, width of midbody pro- and metazona

(somite nine) 0.60 mm and 0.86 mm; allotype female 9.20 mm long, width of midbody pro- and metazona (somite nine) 0.81 mm and 1.10 mm, paratype female 8.71 mm long, width of midbody pro- and metazona (somite nine) 0.81 mm and 1.09 mm, respectively. Color yellowish-brown.

Head: Broader than collum, covered with numerous minute setae; as broad as somite II. Occipital suture distinct; cheeks with straight margins. Three labral teeth; labrum with eight labral and 10 supra-labral setae. Lingual plates (holotype male) with 4–6 setae; stipites with 17+17 setae. Antennal length 1.54 mm (holotype male). Length/breadth ratios of antennomeres I–VII: 1.23 (I), 2 (II), 2.54 (III), 1.75 (IV), 1.27 (V), 1.50 (VI), 1.18 (VII), respectively. Antennomeres IV–VI with few long sensitive setae, antennomere VII with one long sensitive seta. Antennomeres V and VI with distodorsal sensillar areas, with numerous bacilliform sensillae. Antennomere VII with parabasal sensory knob and distodorsal knob with few setiform sensilla. Apical part of antennae with four large cones.



Figs. 3-8. *Brachydesmus mulaomerovici* n. sp., from Ukrasna Pećina Cave, village Kamenica, near Zavidovići, Bosnia and Herzegovina. 3 – holotype male, gonopod, mesal view; 4 – holotype male, gonopod, mesal view; 5 – holotype male, gonopod, caudal view; 6 – holotype male, gonopod, lateral view; 7 – holotype male, gonopod, lateral view; 8 – paratype male, gonopod, oral view. Scale line = 0.2 mm.



Figs. 9-15. *Brachydesmus verrucosus* n. sp., holotype male from Skopska Crna Gora Mountain, northern Macedonia. 9 – gonopod, mesal view; 10 – gonopod, mesal view; 11 – gonopod, caudal view; 12 – gonopod, lateral view; 13 – gonopod, lateral view; 14 – gonopod, oral view; 15 – gonopod, exomere, dorsal view. Scale line = 0.2 mm.



Fig. 16. *Brachydesmus stygivagus* Verhoeff, 1899, gonopods, mesal view – from Jama Bezdán Pit, Vignje, southern Croatia (new record) (a), from Dabarsko polje, Municipality of Berkovići, Bosnia and Herzegovina (new record) (b). Without scale.

Collum: With semicircular anterior edge and gently concave posterior edge. One medial incision present on both lateral sides; with three transverse rows of setae; setal formula (holotype male): 8+8+8.

Body segments: Gently broadening until segment VII or VIII, then parallel-sided to segment XVI and from segment XVII, rapidly tapering toward the body end (Fig. 1b). Paraterga well developed with distinct incisions; caudolateral corners bilobed; caudal corner overlapping subcaudal one on somites with four incisions (Fig. 2b). Metazona II, III, IV, VI, VIII, XI and XIV with three incisions, while metazona V, VII, IX, X, XII, XIII, XV–XVIII with four incisions. Ozopores present on segments with four incisions (Fig. 2b). Border between pro- and metazona distinct. Surface of prozona and anterior margins of paraterga gently tuberculated. Metazona with three transverse rows of trichoid setae (Fig. 2b); setal formula: 6+8+6. Posterior mar-

gins of metazonae denticulated (Fig. 2b). Epiproct subtriangular (in dorsal view), flattened dorsoventrally. Tip of epiproct rounded with four (2+2) long setae; dorsal side with 5+5 knob-supporting setae (3+3 medial, 1+1 subapical and 1+1 apical). Paraproct semicircular, each with two knob-supporting setae. Hypoproct subtriangular, with two long paramedian knob-supporting setae.

Gonopods (Figs. 9–15): Prefemur massive, densely covered with numerous long and trichoid setae. Border between prefemur and femur laterally and mesally very slender (Figs. 9, 10, 12 and 13), with mesal and lateral triangular processes on caudal side (Figs. 9–14). Rift between these processes U-shaped (Fig. 11). Mesal process forming a spoon-shaped structure (Figs. 9–11) which makes border between prefemur and femur very wide (Figs. 11 and 14). Femur short with marked excavation (Figs. 9–13). Acropodite sigmoid; with numerous

knobs, mainly on the caudal side; broadened at the base with pulvillus. (Figs. 9-13). Exomere unipartite; densely granulated on lateral side (Figs. 11-14). Oral side of exomere is very convex, giving the impression of massive gonopod part (Figs. 9, 10, 12 and 13). Dorsomesal side of exomere is warty (Figs. 9-14); apically, wide and simple, only with one small lobe at the end (Fig. 15). Exomere possess a long and thin, apically bifurcated, process which is almost perpendicular to the acropodite (Figs. 9-14).

Distribution – Probably endemic species of Macedonia.

DISCUSSION

The genus *Brachydesmus* includes small- to medium-sized polydesmids, with poorly pigmented or depigmented body, living cryptic or underground life. The vast majority of species of this genus inhabit Europe, while a small number are native to Caucasus, Anatolia, Hyrcania and Levant (Golovatch and Wytwer, 2007); introduced to other parts of the world (Engelhoff and Kime, 2011).

Within the genus *Brachydesmus*, numerous closely related taxa exist and 13 subgenera were included. After synonymization of all subgenera under the nominal genus *Brachydesmus* (Engelhoff and Kime, 2011), the need for separation of the groups of species arose. Recently, Antić et al. (2013) recognized at least three groups of species: *vermosanus*-, *ljubetensis*- and *jubatus*-group. In this paper, we differentiated an additional two groups of species.

1. The *inferus*-group includes three species: *Brachydesmus inferus* Latzel, 1884 (for synonyms see Attems, 1940; Strasser, 1971; Mršić, 1988), *B. likanus* Strasser, 1962, and *B. mulaomerovici* n. sp. Strasser (1962) and Mršić (1988) pointed out the similarities between *B. inferus* and *B. likanus*. According to Strasser (1962), these similarities are reflected in some structures of the gonopods, especially the exomere, as well as in the shape of the paraterga, which is in both species with upward curved wings. Similarities in the gonopod struc-

tures are reflected by the presence of an inner long and thin process and two external ones on the exomere, as well as the presence of an inner femoral lobe. Differences between these two species are: the presence of two caudal processes on the prefemorite in *B. inferus* vs. absence of these structures in *B. likanus*; a triangular and prominent femoral lobe in *B. inferus* vs. smaller and not triangular femoral lobe of *B. likanus*; an inner process of the exomere without any denticles in *B. inferus* vs. an inner process with one or two denticles in *B. likanus*, and a basally curved-down inner tooth on the pulvillus of *B. inferus* vs. an inner pulvillus tooth not curved downwards in *B. likanus*. We have assigned *B. mulaomerovici* n. sp. a preliminary designation to this group of species based on the similarities in gonopod structures with *B. likanus*. These similarities are related primarily to the structure of prefemorite and femorite. In both species, the prefemorite is simple, without any of the teeth, processes or extensions present in *B. inferus*. In addition, the femorite is very similar between *B. likanus* and new species. Caudally on the femorite, both species possess an embossment, above which is the pulvillus with two similar triangular teeth. In general, the shape and structure of the gonopods to the exomere are very similar between *B. likanus* and *B. mulaomerovici* n. sp. Differences between these two taxa are reflected in the shape and structure of the exomere. Both species possess a mesal process, but in the new taxa, this process is very long, thin, pointed and not extended at the base, while *B. likanus* possesses a shorter and very extended mesal process at the base, which looks more like a separated branch. In addition, the new species possess a long and apically bifurcated process which is absent in *B. likanus*. Furthermore, the new taxon differs from *B. likanus* and *B. inferus* in the presence of very well developed paranota without upward curved wings. We supposed that, according to Djursvoll et al. (2000), the new species possess some plesiomorphic features, such as a depigmented body, relatively long femorite and short prefemorite, an absence of any kind of teeth, processes or extensions on the prefemo-

rite, absence of marked excavation on femorite, a relatively short and unipartite exomere as well as the absence of a solenomere. However, some apomorphic characters appear in the new species: blunt setae on the somites, an absence of acropodite as well as presence of well-developed processes on the exomere (Djursvoll et al., 2000). The depigmented body with elongated antennae and walking legs in the new species indicates its clear troglomorphism.

2. The *stygivagus*-group includes two species, *B. stygivagus* Verhoeff, 1899 (for synonyms see Attems, 1959; Strasser, 1971; Makarov, 1997) and *B. verrucosus* n. sp., whose main and probably plesiomorphic character is the well-developed acropodite with a pulvillus on an extended base. In *B. stygivagus*, the gonopods show some variability. This variability is reflected by the presence of long or short thorn with or without hairs on the border between the prefemorite and femorite; the presence of a bifurcated or simple acropodite; the presence or absence of a subapical process, as well as the presence of a divided or undivided lobular process. Regardless of which characteristics are concerned, the new species clearly differ from those previously mentioned in the general shape of the gonopods. Instead of long or short thorn on the border between the prefemorite and femorite, the new species possess two well-developed triangular processes, with a U-shaped rift between. In some forms of *B. stygivagus*, denticles are present on the oral side of the exomere, while the new species possess a warty dorsomesal side of the exomere. Also, the difference is reflected in the construction of the exomere, which is simple at the top and possesses only one apically bifurcated process in the new species, while the same structure in *B. stygivagus* is denticulated apically with, mainly, two processes: subapical and lobular. In the new species, many apomorphic characteristics are present. These are a pigmented body, excavation on the femorite, a relatively long exomere with strong bifurcated process (see Djursvoll et al., 2000), triangular processes between prefemorite and femorite as well as a warty

dorsomesal side of the exomere. The absence of a solenomere, presence of a well-developed acropodite and trichoid setae on the somites can be considered as plesiomorphic according Djursvoll et al. (2000). It is of interest to note that the new species possess bilobed caudolateral corners of the paranota. This is characteristic only for *B. langhofferi* Verhoeff, 1929, *B. granulatus* Makarov et al., 2003 and for the genus *Brembosoma* Verhoeff, 1931 (Djursvoll et al., 2000; Makarov et al., 2003). The status of the former *B. zawalanus* Attems 1912, with three subspecies, which are synonymized under *B. stygivagus*, is questionable. There are some differences in gonopod structure, as well as differences in the general shape and size of the gonopods between these forms, possibly indicating their independent status (Fig. 16). This remains an open question for future research.

Representatives of the *inferus*-group inhabit caves and forests of the Dinaric Karst in Slovenia, Croatia, Bosnia and Herzegovina and Montenegro (Map 1) (Attems, 1940, 1959; Mršić, 1988). The most common species of this group is *B. inferus*, known from many cave and forest habitats in Slovenia and Croatia. According to Attems (1959), this species was recorded from one cave in Herzegovina (Bukovica Ponor at Gacko, northeastern Herzegovina) and one in Montenegro (Krivošije, Careve-Pećine in Elešov dô). *B. likanus* is known only from three sites in Lika, a geographic region in mountainous Croatia, while *B. mulaomerovici* n. sp. is known only from the type locality in the central part of Bosnia and Herzegovina. A more southern distribution shows representatives of the *stygivagus*-group of species (Map 1). *B. stygivagus* is known from numerous caves, mainly in the coastal parts of southern and central Croatia, southern Bosnia and Herzegovina and Montenegro (Attems 1940, 1959; Mršić 1988; Makarov et al., 2004), while *B. verrucosus* n. sp. is known only from one site on the Skopska Crna Gora Mountain in northern Macedonia, and probably represents an endemic species of this mountain.

The discovery of two new species of the genus *Brachydesmus* from the Balkan Peninsula confirms

the hypothesis mentioned at the beginning, that this part of southern Europe, especially the Dinaric Karst of former Yugoslavia, represents a center of diversification of this millipede genus.

A key to the *inferus*- and *stygivagus*-groups of species

This key is based on the structure of gonopods in adult males:

(a) *inferus*-group

1. Prefemurite with caudal processes. Femurite with distinct triangular mesal lobe. Inner pulvillus tooth basally curved downwards.....
.....*B. inferus* Latzel, 1884
- Prefemurite without any processes, teeth or extensions. Femurite with mesal lobe, but not triangular. Inner pulvillus tooth not curved basally2
2. Exomere with mesal process that is very extend at the base, and looks more like a separated branch. With two lateral extensions on exomere.....
.....*B. likanus* Strasser, 1962
- Mesal process on exomere very long, thin and pointed, without extended base. Lateral extensions on exomere absent, only one apically bifurcated process is present near mesal one.....
.....*B. mulaomerovici* n. sp.

(b) *stygivagus*-group:

1. Border between prefemurite and femurite with long or short thorn with or without hairs. Exomere mainly with two processes (subapical and lobular) and with denticulated apical part. Exomere without warty dorso-mesal side.....
.....*B. stygivagus* Verhoeff, 1899
- Border between prefemurite and femurite with two triangular processes, with U-shaped rift between. Exomere only with one apically bifurcated process

and with one small apical lobe. Dorso-mesal side of exomere warty.....*B. verrucosus* n. sp.

Acknowledgments - This work was supported by the Serbian Ministry of Education, Science and Technology (Grant 173038).

REFERENCES

- Antić, D. Ž., Ćurčić, B. P. M., Mitić, B. M., Tomić, V. T., Lučić, L. R., Dudić, B. D., Stojanović, D. Z., and S. E. Makarov (2013). A new cave diplopod species of the genus *Brachydesmus* Heller, 1858 from Southwest Serbia (Diplopoda: Polydesmida: Polydesmidae). *Arch. Biol. Sci.*, Belgrade, **65** (2), 745-750.
- Attems, C. (1940). *Tierreich: eine Zusammenstellung und Kennzeichnung der rezenten Tierformen*. Myriapoda. Polydesmoides, 3: fam. Polydesmidae, Vanhoeffenidae, Cryptodesmidae, Oniscodesmidae, Sphaerotrichopidae, Peridontodesmidae, Rhachidesmidae, Macellopholidae, Pandirodesmidae. W. de Gruyter und Co, Berlin und Leipzig, 578 pp.
- Attems, C. (1959). Die Myriapoden der Höder Balkanhalbinsel; nach dem Material der "Biospeleologica balcanica". *Ann. Mus.*, Wien, **63**, 281-406.
- Ćurčić, B. P. M. (1998). The cave fauna in Serbia: Origin, historical development, and diversification. In: *Speleološki Atlas Srbije* (Ed. P. Đurović), 17-45. Geografski Institut "Jovan Cvijić", SANU; Faculty of Biology; Belgrade.
- Ćurčić, B. P. M., Makarov, S. E., and S. V. Stanković-Jovanović (2002). Taksonomske implikacije endemične diferencijacije Diplopoda (Myriapoda) u Jugoslaviji i Makedoniji. *Zbornik radova Odbora za kras i speleologiju*, **7**, 103-112.
- Djursvoll, P., Golovatch, S. I., Johanson, K. A., and B. Meidell (2000). Phylogenetic relationships within *Polydesmus sensu lato* (Diplopoda: Polydesmidae). *Fragm. faun.*, Warszawa, **43**, 37-59.
- Enghoff, H., and R. D. Kime (ed.). (2011) Fauna Europaea. Myriapoda. *Fauna Europaea*, version 1.2. Available from <http://www.faunaeur.org>
- Gaston, K. J., and David, R. (1994) Hotspots across Europe. *Biodiversity Letters*, **2**, 108-116.
- Golovatch S. I., and J. Wytwer (2007). *Brachydesmus nevoi*, a new millipede from Israel (Diplopoda: Polydesmida). *Ann. Zool. (Warszawa)*, **57** (2), 205-210.
- Hewitt, G. M. (1999). Post-glacial re-colonization of European biota. *Biol. J. Linn. Soc.* **68**, 87-112.
- Hoffman, R. L. (1980). *Classification of the Diplopoda*. Muséum d'Historie Naturelle, Genève. 273 pp.

- Kime, R. D., and Enghoff, H. (2011). Atlas of European Millipedes (Class Diplopoda). Volume 1. Orders Polyxenida, Glomerida, Platydesmida, Siphonocryptida, Polyzoniida, Callipodida, Polydesmida. – Co-published by Pensoft Publishers, Sofia – Moscow & European Invertebrate Survey, Leiden: 282 pp.
- Makarov, S. E. (1997). On two little-known millipedes (Polydesmidae: Diplopoda), from Yugoslavia. *Arch. Biol. Sci.*, Belgrade, **49** (1-2), 9P-10P.
- Makarov, S. E., Lučić, L. R., Mitić, B. M., and T. Rađa (2003). On two new species of millipedes (Diplopoda, Myriapoda) from Croatia. *Period. biol.* **105** (4), 461-464.
- Makarov, S. E., Ćurčić, B. P. M., Tomić, V. T., and A. Legakis (2004). *The Diplopods of Serbia, Montenegro, and the Republic of Macedonia*. Institute of Zoology, Faculty of Biology, University of Belgrade; Hellenic Zoological Society; Committee for Karst and Speleology, Serbian Academy of Science and Arts; Belgrade, Athens.
- Mršić, N. (1988). Polydesmida (Diplopoda) of Yugoslavia. *Razprave SAZU, IV. razr.* **29** (3), 69-112.
- Savić, I. R. (2008) Diversification of the Balkan fauna: its origin, historical development and present status. In: *Advances in Arachnology and Developmental Biology, Papers Dedicated to Prof. Dr. Božidar P. M. Ćurčić*, eds. S.E. Makarov and R.N. Dimitrijević, pp. 39–57. *Belgrade–Vienna–Sofia: Institute of Zoology, Faculty of Biology, University of Belgrade – Committee for karst and speleology, Serbian Academy of Sciences and Arts – UNESCO MAB Committee Serbia – Faculty of Life Sciences, University of Vienna – Institute of Zoology, Bulgarian Academy of Sciences.*
- Shear, W. A. (1969). A synopsis of the cave milliped genera of the United States with an illustrated key to genera. *Pysche*. 76, 123-146.
- Strasser, K. (1962). Diplopoden aus Bulgarien und Jugoslawien. *Senck. biol.*, **43** (6), 437-470.
- Strasser, K. (1966). Neue Diplopoden aus Höhlen Jugoslawiens. *Senck. biol.*, **47** (5), 379-398.
- Strasser, K. (1971) Diplopoda. Catalogue Faunae Jugoslaviae. *Cons. Acad. Sci. Rei Publ. Soc. Fed. Jugosl., Acad. Sci. Art. Slov., Ljubljana*, **3**, 1-50.

