

**PROTAPHORURA ZLATIBORENSIS, A NEW CAVE-DWELLING SPECIES
(ONYCHIURIDAE, COLLEMBOLA) FROM THE BALKAN PENINSULA (SERBIA)**

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Abstract — A cave collembolan, new to science, *Protaphorura zlatiborensis* sp. n., is described from Serbia, thoroughly illustrated, and diagnosed. Its interrelationships with other species, geographic distribution, and origin are briefly discussed.

Key words: Collembola, Onychiuridae, *Protaphorura zlatiborensis*, new species, caves, evolution, Serbia

UDC 595.71(292.464)
591.9(292.464)

INTRODUCTION

In Serbia, only eight species of the genus *Protaphorura* Absolon, 1901 were known until recently (Pomorski, 1998). These are *Protaphorura armata* (Tullberg, 1869), *P. cancellata* (Gisin, 1956), *P. fimata* (Gisin, 1952), *P. glebata* (Gisin, 1952), *P. meriditata* (Gisin, 1952), *P. quadriocellata* (Gisin, 1943), *P. subcancellata* (Gisin, 1963), and *P. serbica* (Loksa & Bogojević, 1967). Of these, only *P. armata* was previously collected in caves (Denis, 1933; Ćurčić and Lučić, 1998). Other species inhabit different epigeal habitats (and ecological niches) and have been found both throughout Serbia and in many other European countries or regions.

Analysis of a sample of onychiurids from a cave on Mt. Zlatibor, Western Serbia, has yielded a species new to science, *Protaphorura zlatiborensis* sp. n. This taxon is thoroughly described, illustrated, and diagnosed in the present paper.

SYSTEMATIC PART

PROTAPHORURA ABSOLON, 1901
PROTAPHORURA ZLATIBORENSIS ĆURČIĆ & LUČIĆ,
NEW SPECIES
(Figs. 1-6)

Etymology. — After Mt. Zlatibor, its type locality.

Material examined. — Holotype female and five

paratype females from the Markova Pećina Cave, village of Gornji Ljubiš, near Užice, Mt. Zlatibor, Western Serbia; Serbia; collected on 29 May 2004 by S. E. Makarov, B. M. Mitić, and S. B. Ćurčić.

The type specimens are preserved on permanent slides in Swan's fluid (gum chloral medium) and housed in the collection of the Institute of Zoology, University of Belgrade (IZB, 1041-6).

A number of minute morphological structures were analyzed using a Zeiss 3D laser scanning confocal microscope of the LSM 510 type.

Description. — Body length 2.00-2.18 mm (holotype 2.18 mm). Body color white. Body cylindrical, with strong anal spines on distinct papillae (Fig. 1). Antennae almost as long as head (Fig. 1). Furca reduced to a cuticular «pocket» with 1+1 setulae. Body granulation uniform and fine; antennal base well-marked. Antennomere IV with subapical organite (Fig. 2). Antennal sense organ III consists of five guard setae, two sensory rods, two granulated sensory clubs and five papillae.

Postantennal organ (PAO) typical of the genus, consisting of 40 simple vesicles (Figs. 1, 3). Pseudocellar formula (pso): 32/022/22223 (dorsally) and 0/000/00000 (ventrally); subcoxae I each with a single pseudocellus. Parapseudocelli (psx) absent (Fig. 1).

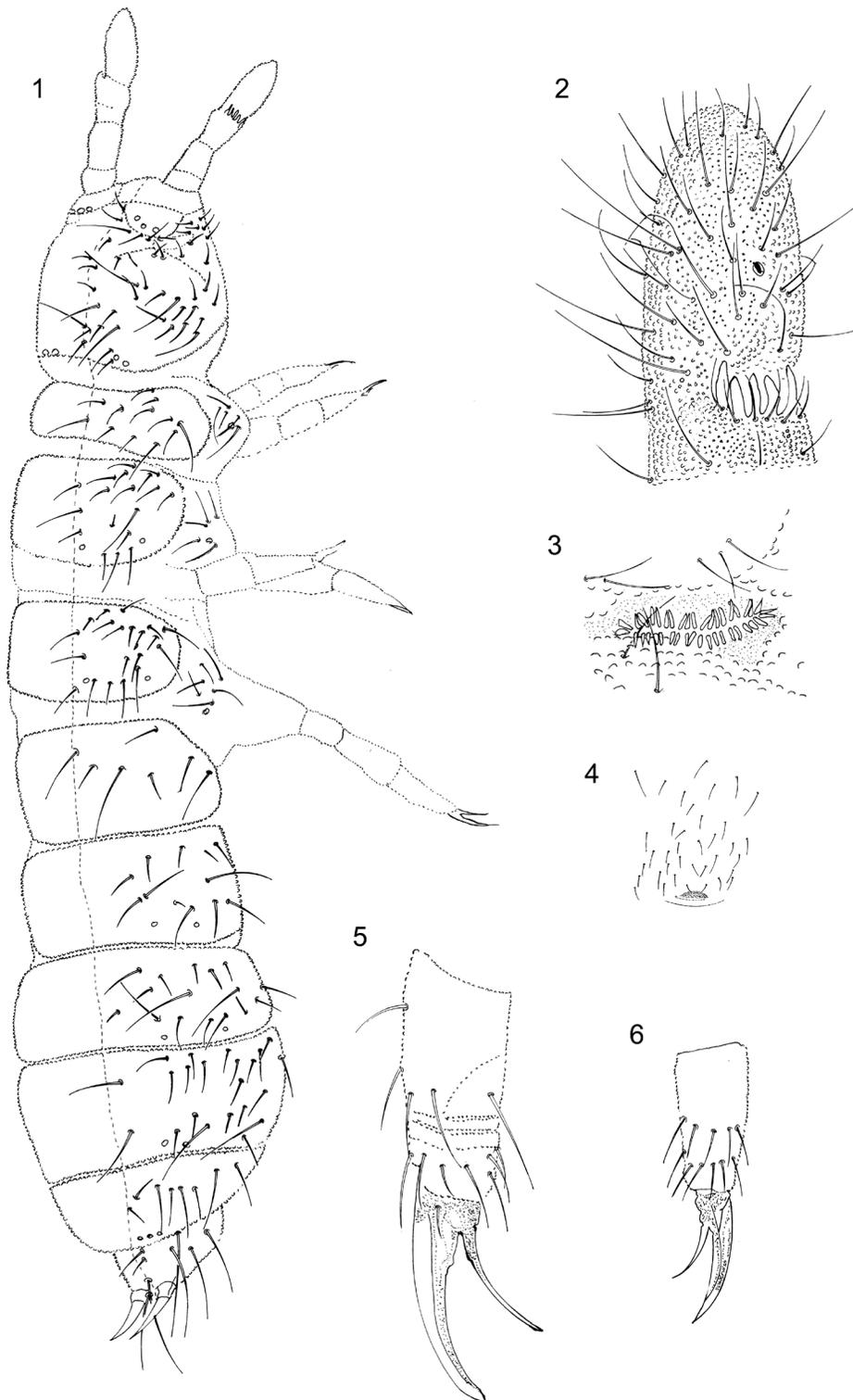


Fig. 1-6. *Protaphorura zlatiborensis* sp. n., holotype female, from Serbia: 1 – chaetotaxy and localization of pseudocelli on dorsal side of body; 2 – antennae III and IV; 3 – postantennal organ (PAO); 4 – genital plate; 5 – tibia-tarsus I; 6 – tibia-tarsus III.

Head with p_2 , but with no d_0 . Thoracic terga II and III each with lateral microsensillae (Fig. 1). Dorsal chaetotaxy: almost symmetrical and well-differentiated into macro-, meso-, and microchaetae (Fig. 1).

Abdominal tergum V with p_0 , VI with a single median seta (Fig. 1). Some short and subparallel setae arranged anterior to anal spines (Fig. 1). Between legs I-III, thorax with 1+1, 2+2, and 2+2 setae, respectively (Fig. 1). Ventral tube with 2+2 basal setae and 9+9 setae on the shaft.

Claws I-III with no teeth; claw length: 0.09 mm. Gonopodial appendage length: 0.06 mm; without basal lamella. Tibiotarsi I and III with a distal verticil of two setae each (Figs. 5, 6).

A small furcal rudiment (in form of an integument fold) with 1+1 setae; base with no setae. Anal spines on distinct papillae, approximately as long as the claws (Fig. 1).

Biology and distribution. — All specimens of *P. zlatiborensis* sp. n. were collected by hand searching, usually under small and wet stones on the cave floor. The type locality of the new taxon is also inhabited by an endemic carabid – *Rascioduvalius zlatiborensis* S. Ćurčić, Brajković & B. Ćurčić, 2005 (Ćurčić et al., 2005).

Protaphorura zlatiborensis is a typical troglote and probably an endemo-relict form of early Tertiary origin.

RESULTS AND DISCUSSION

The new onychiurid from Serbia belongs to a group of species which includes the epigean *Protaphorura ajudagi* Pomorski, Skorzynski & Kaprus, 1998 (from the Crimea), *P. fimata* (Gisin, 1952) (from the Palearctic), and *P. kopetdagi* Pomorski, 1994 (from Turkmenia).

From its phenetically close epigean congener *P. fimata*, *P. zlatiborensis* sp. n. differs clearly in the number and position of pso on the antennal base and hind head margin (3+3 and 3+3 vs. 3+3 and 2+2); the number of pso dorsally (33/022/33333

vs. 32/022/22223); the number of pso ventrally (4/000/00000 vs. absent); the number of subcoxal psx (111 vs. absent); PAO structure (25-27 vesicles vs. 40 vesicles); setation of the tubus ventralis (8+8 setae and 2+2 setae on the base vs. 9+9 setae and 2+2 setae on the base); and furcal setation (2+2 setae vs. 1+1 setae). However, similarities between the two taxa occur in regard to body size, number of subcoxal pso on subcoxa, absence of seta d_0 , presence of seta p_0 on abdominal tergum V, setation between the legs on thoraces I-III, absence of teeth on claws, and form of the empodial appendage.

Another epigean species – *P. ajudagi* (from the Crimea) – and *P. zlatiborensis* sp. n. differ sharply in body size (1.50-1.70 mm vs. 2.00-2.18 mm); the number of pso dorsally (32/022/33232 vs. 32/022/22223); the number of pso ventrally [2/000/0001(0) vs. absent]; the number of psx ventrally (0/000/110001 vs. absent); the number of subcoxal pso (absent vs. 1/1/1); the number of subcoxal psx (1/1/1 vs. absent); PAO structure (30-36 vs. 40 vesicles); abdominal tergum V setation (with p_0 and p_1 vs. with p_0 only); setation between the legs on thoraces I-III (absent vs. 1+1, 2+2 and 2+2); setation of the tubus ventralis (8+8 setae and 2+2 setae on the base vs. 9+9 setae and 2+2 setae on the base); presence/absence of claw teeth (present vs. absent); and furcal setation (2+2 vs. 1+1 setae). The two species share some common features, such as the number of pseudoocelli on thorax II, presence of seta d_0 , setation of abdominal tergum VI, absence of a basal lamella on the empodial appendage, and the number of the setae of tibiotarsal dorsal vesicle.

Protaphorura zlatiborensis sp. n. and *P. kopetdagi* (from Turkmenia) also differ in many important respects, such as body size (2.00-2.18 mm vs. 1.00-1.60 mm); the number of pso dorsally (32/022/22223 vs. 32/022/33322); the number of pso ventrally (absent vs. 11/000/0001); the number of psx ventrally (absent vs. 0/000/111); the number of subcoxal pso (1/1/1 vs. absent); in the number of subcoxal psx (absent vs. 1/1/1); PAO structure (40 vs. 26-36 vesicles); setation between the legs on thoraces I-III (1+1, 2+2, 2+2 vs. absent); claw dentition (without teeth vs. with teeth); and habitat preference (cavernicolous vs. epigean). However, these two

taxa also exhibit similarities in some characters, for example the number of pso on thorax II, setation of the antennal base and hind margin of head, and furcal setation.

At the present time, *P. zlatiborensis* sp. n. is the only typical cave inhabitant among all *Protaphorura* species inhabiting Serbia; all other representatives of the genus from this region are epigeic forms.

IN LIEU OF A CONCLUSION

Study of the evolution of more than 120 recent species of *Protaphorura* (<http://www.collembola.org/taxa/onicinae.htm>) distributed on all continents leads us to reconsider origin of the cave-living species of this genus inhabiting the Dinaric karst (to which Mt. Zlatibor belongs). In the beginning of the Peninsula's existence of the Balkan Peninsula, these animals lived on floors of some ancient tropical or subtropical forests, which were present before the origin of caves. Contemporary cave-dwelling protaphorurans must have gone through a long evolutionary history, which resulted in the present-day composition of the Dinaric collembolan fauna. During that time, certain species disappeared, others evolved in different geological periods, and some species underwent evolution underground, giving birth to new autochthonous species and genera. In order to understand the way in which present-day cave fauna has evolved, it is not enough merely to seek the origin and age of relicts or those of the ancestors of autochthonous species (Vandel, 1964; Čurčić, 1974). The epoch of formation of each Serbian (i.e., Dinaric and Carpatho-Balkan) collembolan species is difficult to ascertain with precision. One can only speculate in that respect for taxa with more primitive traits and disjunctive ranges. Related species of these collembolans are distributed elsewhere (Pomorski, 1998). Moreover, relicts

whose relatives occur in Eurasia (like *P. zlatiborensis* sp. n.) represent the remnants of some ancient faunal complex(es). The geographical distributions of these animals are much more reduced than those of aforementioned related collembolans, being confined either to Dinaric or Carpatho-Balkan caves, which represent their last refuge.

Study of the *Protaphorura* inhabiting caves of the Dinaric Karst has offered further proofs of their great age and probably different origin. Such species and genera represent the last vestiges of an old fauna, which found their in the underground domain of the Balkans and elsewhere (Čurčić and Lučić; Pomorski, 1998).

Acknowledgment — This work was financially supported by the Serbian Ministry of Science and Environmental Protection (Grant # ON 143053).

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**PROTAPHORURA ZLATIBORENSIS, НОВА ПЕЋИНСКА ВРСТА (ONYCHIURIDAE,
COLLEMBOLA) СА БАЛКАНСКОГ ПОЛУОСТРВА (СРБИЈА)**

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У раду је описана, илустрована и дијагно-
стификована за науку нова пећинска врста
колембола, *Protaphorura zlatiborensis* sp. n. из

Србије. Разматран је однос нове врсте са дру-
гим врстама, њена географска дистрибуција и
порекло.