

**Reviews of the genera *Schaefferia* Absolon, 1900, *Deuteraphorura* Absolon, 1901, *Plutomurus* Yosii, 1956 and the *Anurida* Laboulbène, 1865 species group without eyes, with the description of four new species of cave springtails (Collembola) from Krubera-Voronya cave, Arabika Massif, Abkhazia**

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### Summary

Krubera-Voronya cave and other deep systems in Arabika Massif are being explored during many speleological expeditions. A recent Ibero-Russian exploration expedition (summer of 2010) took place in this cave with the aim of providing a study of the biocenosis of the deepest known cave in the world. Four new species of Collembola were found at different depths: *Schaefferia profundissima* n. sp., *Anurida stereoodorata* n. sp., *Deuteraphorura kruberaensis* n. sp., and *Plutomurus ortobalaganensis* n. sp., the last one at -1980 m deep. The identification and description of the new species have required the careful study of all congeneric species, implying a revision of each genus. As a result of this work tables and keys to all significant characters for each species are presented.

### Keywords

Key; cavernicolous fauna; biospeleology; deepest cave of the world; *Schaefferia profundissima* n. sp.; *Anurida stereoodorata* n. sp.; *Deuteraphorura kruberaensis* n. sp.; *Plutomurus ortobalaganensis* n. sp.

### Introduction

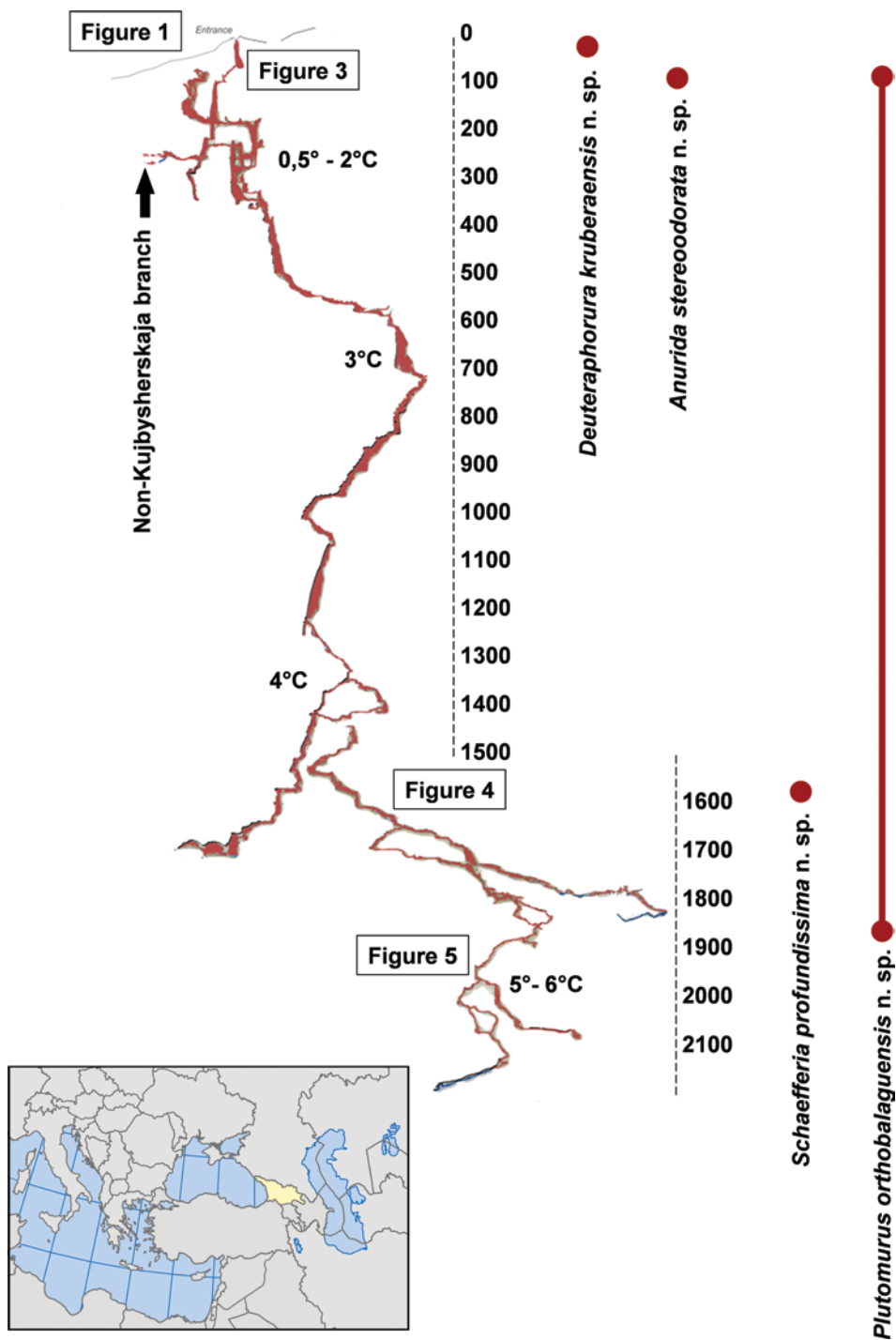
Collembola (springtails) are common inhabitants of caves and more than 240 species are considered troglobionts in the Euro-Mediterranean region (Deharveng and Thibaud

1989; Thibaud and Massoud 1986; Thibaud and Dehanverg 1994), but they also are found in cold caves at high elevations. Collembola play an important role in the terrestrial environments of many subterranean communities, frequently consisting of stable and large populations of tiny arthropods feeding on fungi and decomposing organic matter. Until now the deepest-dwelling springtails were *Ongulonychiurus colpus* Thibaud and Massoud, 1986 and *Tritomurus veles* Lukić, Houssin and Deharveng, 2010, found in caves in Spain (-550 m below ground level, bgl) and Croatia (-430 m bgl) respectively (Thibaud and Massoud 1986; Lukić et al. 2010). But a new discovery of a new species of *Plutomurus* (Tomoceridae) at -1980 m deep in Krubera-Voronya cave (also called Voronya Cave or Voronja Cave), the deepest cave of the world reaching the -2191 m bgl (Figure 1, entrance; Figure 2, cave profile), located in the Arabika massif (Western Caucasus), one of the largest karstic massifs in the World. This massif, well-developed at elevations ranging between 1900 and 2500 m above sea level, asl, is composed of Lower Cretaceous and Upper Jurassic limestone's (Klimchouk 2005). Although Krubera-Voronya cave and other deep systems in Arabika Massif, have been explored during many speleological expeditions, especially in the last decade, but their biological components have received little interest.

During the summer of 2010, an Ibero-Russian exploration expedition in the Krubera-Voronya cave took place including a biospeleological study of the biocenosis of the deepest cave on Earth. The objective was to understand the vertical distribution



**Figure 1.** Krubera-Voronya cave entrance. Photo by Sofia Reboleira.



**Figure 2.** Kruber-Voronya cave profile, location of Figures 1, 3–5, and locations at which new species were found (red dots and red line). Adapted from Ukrainian Speleological Association 2010, compiled by A. Klimchouk.

of the invertebrate fauna in the deepest underground natural place known on Earth (Sendra and Reboleira, unpublished). This led to the discovery of the species described in the present work which are now the deepest invertebrates ever found below the surface of the Earth. Three other new species have been found at different depths in the same cave.

Despite Krubera-Voronya cave is also inhabited by other hypogean arthropods possessing different degrees of troglomorphy (Sendra and Reboleira, unpublished), but still Collembola play a very important role in the decomposition and consumer of organic matter. The described new species were found to be the most abundant secondary decomposers in the terrestrial environment of the cave.

In this environment, and at different depths, have appeared, in addition to the new species of *Plutomurus*, new species of *Schaefferia* (Hypogastruridae), *Anurida* (Pseudachorutinae) and *Deuteraphorura* (Onychiurinae).

## Materials and methods

Field work was conducted in the Krubera-Voronya cave (UTM: 43° 24' 35" N, 40° 21' 44" E) to a depth of -2140 m bgl by the Ibero-Russian CaveX Team. The cave is located in a disputed political entity on the eastern shore of the Black Sea, southwest of the Caucasus. The cave was monitored for almost one month (from 27.VII.2010 to 24.VIII.2010), from the base of the first shaft, in total darkness at -15 m bgl, to the deepest part of the cave, at the last siphon at -2140 m bgl. Sets of pitfall traps (6 cm diameter and 7 cm deep, with 1 cm diameter tube fixed inside at the centre) were used in the base of the first series of shafts (Figure 3) and in each bivouac (-700 m, -1400 m and -1690 m bgl) (Figures 4 and 5). Traps were partially filled with 1,2-propanediol, and cheese was used as a lure. The traps were supported and covered by small stones in order to prevent flooding. The monitoring of pitfalls was supplemented by several hours of active searching during the visit to the cave.

Specimens were cleared in Nesbitt's fluid and, after washing for one hour in 70% alcohol, were mounted in Hoyer's medium for optical microscope observation. Some specimens were observed with a scanning electron microscope, SEM. Specimens from 70% ethyl alcohol, were slowly rehydrated in a decreasing series of ethyl alcohol. Once in distilled water they were fixed in 4% glutaraldehyde in cacodylate buffer for 24 h, and then transferred to sucrose 0.25 M for 24 h. After this time the specimens are dehydrated up to 100% ethyl alcohol. Complete desiccation was achieved by the CO<sub>2</sub> critical point technique. Samples then were covered by a 16 nm thin layer of molecular gold using an Emitech K550 sputter coater. Observations were done with a Zeiss Digital Scanning Microscope 940 A.

### *Cave description*

The entrance of Krubera-Voronya cave is located at 2240 m asl at 15 km from the Black Sea, through an open air pit of -60 m bgl depth in the slope of the valley.



**Figure 3.** Location of two or the pitfall traps at -70 m bgl. Photo by Sofia Reboleira.



**Figure 4.** Bivouac at -1600 m bgl. Photo by Sergio Garcia-Dils.



**Figure 5.** The cave at -1980 m bgl, the deepest habitat of *Plutomurus ortobalaganensis* n. sp. Photo by Denis Provalov.

The cave (Figure 2) has two main branches of strictly vertical pits separated by short meanders. At -1400 m bgl, in the main branch of the cave, requires cave-diving techniques are required to pass several siphons to the current end of the dry cave, in a last siphon at a depth of -2140 m bgl.

The cave atmosphere has a very constant temperature throughout the year. During the sampling period was possible to record a vertical gradient, increasing from the 0.5 °C in the upper part of the cave, to 5–6 °C at -2000 m bgl (García Dils, pers. comm.). The water flow that goes down by gravity is constant along the cave, which allows deposition of organic matter to the deepest parts of the cave in a short period of time.

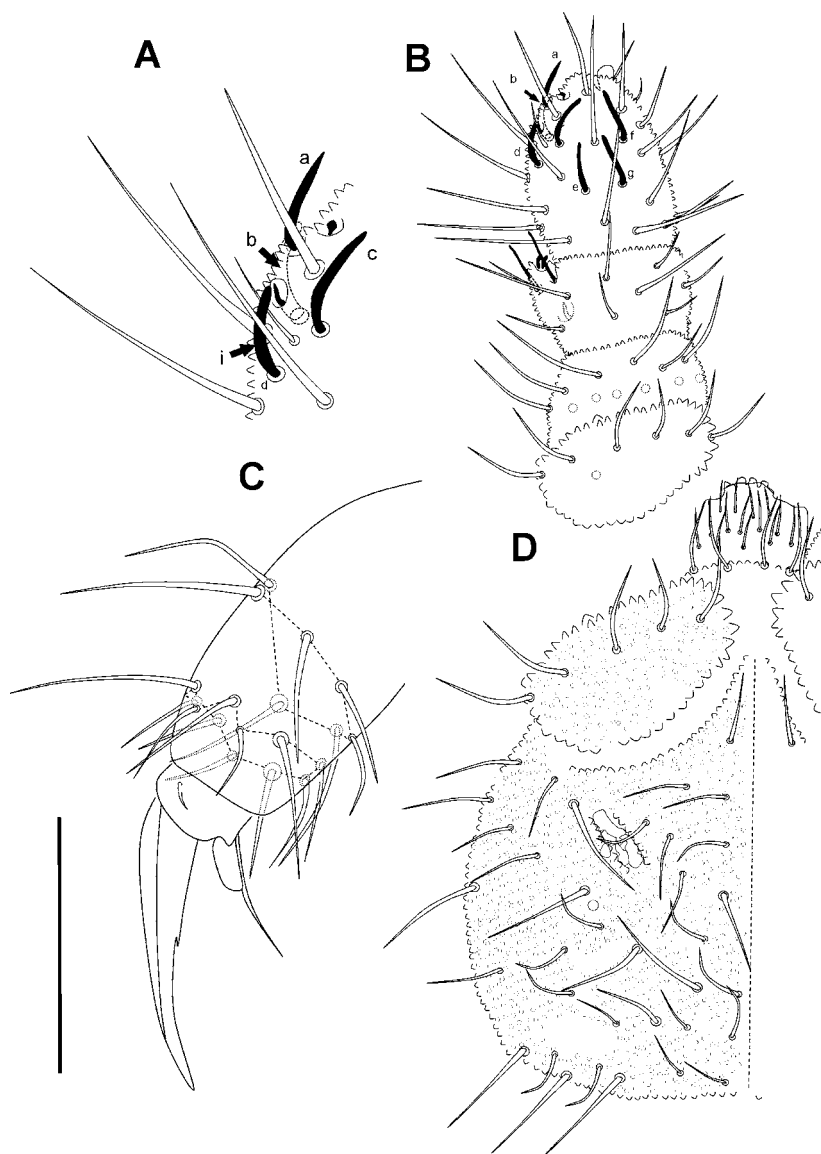
### Systematic entomology

The following abbreviations are used in this section: Abd I–VI, abdominal segment I–VI; Ant I–IV, Antennal segments I–IV; asl, above sea level; bgl, below ground level; ms, microsensillum/a; PAO, postantennal organ; s, sensillum; Th I–III, thoracic segment I–III.

***Schaefferia profundissima* Jordana and Baquero n. sp.**  
(Figures 6–8)

*Type locality*

Kruber Cave, Arabika Massif, Gagrinsky Range of the Western Caucasus, Gagra district of Abkhazia (Ortobalagan).



**Figure 6.** *Schaefferia profundissima* n. sp. (A) Detail of antennal tip (some cylindrical blunt chaetae are named using the nomenclature of Jordana et al. 1997). (B) Antennae. (C) Leg III. (D) Dorsal head.

### *Type material*

Holotype (male) on slide, -1600 m from entrance (that it is at 2420 m asl), shelter 1, from pitfall trap, between 26.VII.2010 to 24.VIII.2010. Coordinates: lat 43.409722°, long 40.362222° (43°24'35.00"N, 40°21'44.00"E). CaveX Team leg. Paratypes (5) on slides (2 males, 2 females and 1 juvenile), same data as holotype. Deposited in Museu de Valencia (Holotype and 4 Paratypes) and MZNA (1 Paratypes).

### *Description*

Body length: holotype 1.11 mm (mean of 6 specimens = 0.93 mm). Habitus typical of Hypogastruridae with reduced eyes and furca, fusiform body and differentiated macro and mesochaetae. Yellowish ground colour without any spot of dark pigmentation. Ant I with 6 dorsal cylindrical blunt chaetae. Ant II with 6 dorsal and 6 ventral chaetae in a single row, Ant III sensory organ with 2 central short rods flanked by 2 longer guard sensilla and a small sensillum in a ventral pit, Ant IV with a simple apical vesicle, 7 sensilla or cylindrical blunt chaetae (a, b, c, d, e, f and g) (after Jordana et al. 1997), sub-apical ms and apical sensory peg (Figures 6A–B). 0 to 1 eyes on each side of the head (1 specimen with 0 + 0, 3 specimens with 0 + 1, and 2 specimens with 1 + 1), each eye similar in size to the PAO accessory tubercle, PAO with 4 vesicles (Figure 6D, 8C). Labrum with 4 prelabral chaetae and 5, 5, 4 labral chaetae. Tibiotarsi I–III with 19, 19, 18 chaetae respectively, without capitate tenent hair. Unguis with tooth at the middle of the internal edge. Unguiculus with basal lamella and an apical filament reaching the middle of the unguis edge (Fig 6C). Unguis 50 µm long. Ventral tube with 3 + 3 apical chaetae. Retinaculum with 4 + 4 teeth. Dens length 92 µm, with 5 chaetae. Mucro (34 µm) near 1/3 as dens length (Figure 7A). Anal spines on papillae not fused, of same length as the unguis of leg III (Figure 7B).

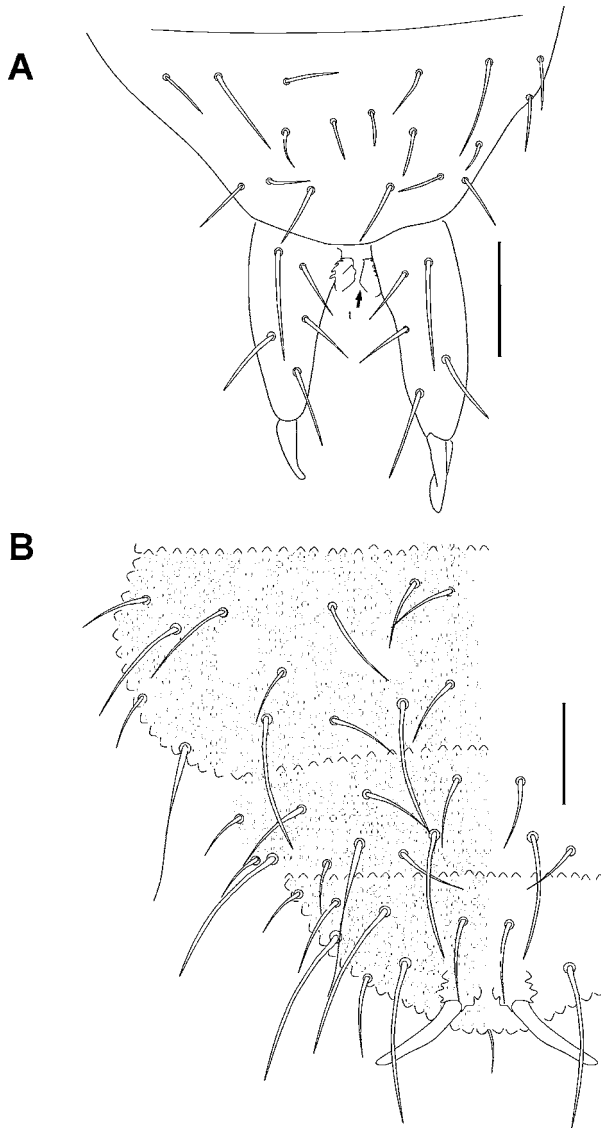
### *Chaetotaxy (Figures 8A–D)*

Head:  $d_2$ – $d_5$  ( $a_0$ ,  $d_0$  and  $d_1$  absent),  $sd_1$ – $sd_5$ ,  $v_1$ – $v_2$ ,  $c_1$ – $c_5$ ,  $p_1$ – $p_5$ ,  $d_2$ ,  $v_2$ ,  $oc_1$ ,  $oc_3$ ,  $g_5$ ,  $p_3$  and  $p_4$  are macrochaetae. Th I with 3 + 3 chaetae. Th II–III with  $a_1$ – $a_6$ ,  $m_1$ ,  $m_4$ – $m_6$  (with ms),  $p_1$ – $p_4$ (s),  $p_5$ – $p_6$ . Abd I with 5 + 5 chaetae between  $p_5$  s in rows “a” and “m”. Abd II–III with 5–7 + 5–7 chaetae between  $p_5$ (s) in rows “a” and “m”. Abd IV with 7 + 7 chaetae between  $p_5$ (s) in rows “a” and “m”, and chaeta  $p_1$  shorter than  $p_2$ . Abd V with 2 + 2 chaetae between  $p_3$ (s) on row “a”. Abd VI with  $a_1$ – $a_3$ ,  $p_1$  (anal spine),  $p_2$ – $p_3$  and  $p_0$  present (chaetotaxy follows Jordana et al. 1997).

### *Discussion*

Thirty-four species of *Schaefferia* have been described around the world, mostly in the Palearctic Region with only four species on the Nearctic Region. Thibaud et al. (2004) considered only 28 of them as valid species, synonymising some species. We have revalidated some of these species as due to differences in chaetotaxy. The specimens found by Babenko et al. (1994) from Caucasus identified as *S. vandalica* have differences in chaetotaxy on Abd II–IV compared with the original description for the

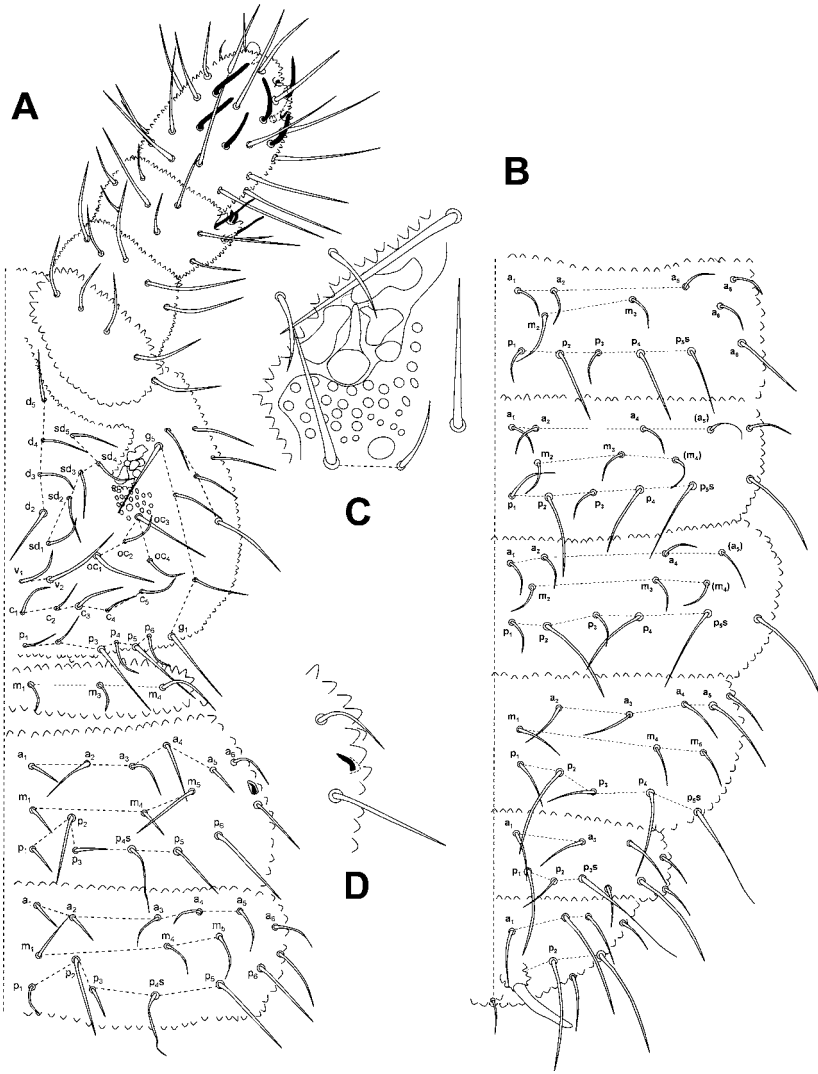




**Figure 7.** *Schaefferia profundissima* n. sp. (A) Furca (t, tenaculum). (B) Dorsal view of Abd IV–VI, showing small areas without granulation.

species. Again, the specimens identified as *S. duodecimocellata* from Alaska (2700 m asl) by Fjellberg (1985), differs in Abd IV chaetotaxy from the original description of *S. duodecimocellata*.

In the key given below all these species can be separated. The new species has been compared with those with 0–1 eyes: *S. coeca* Cassagnau, 1959, *S. guerrerense* (Bonet, 1945), *S. oaxacana* Palacios-Vargas and Thibaud, 1985, and *S. subcoeca* Deharveng and Thibaud, 1980. The new species shares with *S. oaxacana* the presence of mucron, but



**Figure 8.** *Schaefferia profundissima* n. sp. chaetotaxy. (A) Dorsal head (with antenna) and Th. (B) Dorsal Abd. (C) Detail of PAO and granulation beside it. (D) Detail of the ms of Th II.

differs from it by the number of chaetae on dens and sensilla on Ant IV. For the preparation of the characters' tables, the original papers and some reviews for the genus has been consulted (see Table 1).

**Table 1.** World species of *Schaefferia* with its diagnostic characters. Abbreviations: ten, tenaculum; unguis IT, unguis internal teeth; Ant, antennal; Abd, abdominal; a, row a; m, row m; p, row p. The brackets mean that these chaetae occasionally can be missing asymmetrically. Refs., papers used as source of information: 1, Cassagnau, 1959a; 2, Jordana et al., 1997; 3, Thibaud, 1972; 4, Thibaud et al., 2004; 5, Babenko et al., 1994; 6, Cassagnau, 1954; 7, Deharveng and Thibaud, 1980; 8, Wray, 1963; 9, Martynova, 1978; 10, Stach, 1939; 11, Jordana and Arbea, 1990; 12, Fjellberg, 1985; 13, Bonet, 1945; 14, Steiner, 1955; 15, Yosii, 1956; 16, Thibaud, 1995; 17, Yoshii, 1991; 18, Gama, 1963; 19, Palacios-Vargas and Thibaud, 1985; 20, Babenko, 1999; 21, Delamare Debouteville, 1945; 22, Palacios-Vargas and Castaño-Meneses, 2008; 23, Dallai and Sabatini, 1981; 24, Bonet, 1930; 25, Cassagnau, 1959b. “-” denotes: no data available.

species	eyes	dens	mucro	ten	unguis IT	PAO	Ant IV s	emp lam	Abd II–III a	Abd II–III m	Abd I–III p	Abd IV a	Abd IV m	Abd IV p	Abd V a	Abd V p	Refs.
<i>S. ariegica</i>	2	3	no	3	-	4	7	-	1 2 4	2 4	1–5(s)	1 3 4 5	1 3 5	1–5(s)	1 3	1–3(s)	1, 2, 3, 4
<i>S. baschkirica</i>	4	5(6)	yes	3–4	1	4–6 (7–8)	7–8	yes	1 2 4	2 4	1–5(s)	1 2 4 5	4	1–5(s)	1 3	1–3(s)	4, 5
<i>S. bidentata</i>	5	3	yes	3	0	4	5	-	1 2 4 5	2 3 5	1–5(s)	1 2 4 5	1 4 5	1–5(s)	1 3	1–3(s)	4, 6, 25
<i>S. canigouensis</i>	5	3–4	no	3(4)	-	4	6(7)	-	1 2 4	2 4	1–5(s)	1 3 5	1 5	1–5(s)	1 3	1–3(s)	4, 7
<i>S. cheoha</i>	6	3	yes	4	1	4	7	yes	-	-	1–5(s)	-	-	1–5(s)	1 3	1–3(s)	3, 8
<i>S. coeca</i>	0–1	3–5	red.	3	-	4(6)	8–12	-	1 2 4	2 4	1–5(s)	1 3 5	1 4	1–5(s)	1 3	1–3(s)	1, 3, 4
<i>S. czernovi</i>	5	5–6	yes	3(4)	1	4	7(6)	yes	1 2 4	2 4	1–5(s)	1 3 5	1 4 5	1–5(s)	1 3	1–3(s)	9
<i>S. decemoculata</i>	5	3–4	red.	3(4)	-	4(5)	7(6–8)	-	1 2 4	2 3 4	1–5(s)	1 3 5	1 4	1–5(s)	1 3	1–3(s)	3, 4, 10
<i>S. deharvengi</i>	6	4	yes	3	1	4	6	yes	1 2 4	2 4	1–5(s)	1 3 5	1 3	1–5(s)	1 3	1–3(s)	2, 11
<i>S. duodecimoculata</i> (sensu Fjellberg)	6	5	yes	3(4)	-	-	-	-	1 2 4 5	2 3 5	1–5(s)	1 2 3 4	1 4 5	1–5(s)	1 3	1–3(s)	12
<i>S. duodecimoculata</i>	6	5–6	yes	3+4	1	4	7	yes	-	-	1–5(s)	1 2 3 4	m? m?	1–5(s)	1 3	1–3(s)	13
<i>S. duodecimoculata</i>	6	4	yes	4	1	4	6	yes	1 2 4	2 4	1–5(s)	1 3 5	1 3	1–5(s)	1 3	1–3(s)	2, 4, 14
<i>S. elegans</i>	6	5	yes	4	-	4	6(7)	-	1 2 4 5	2 3 5	1–5(s)	1 3 5	1 4	1–5(s)	1 3	1–3(s)	1, 2, 4

(Continued)

Table 1. (Cont.)

species	eyes	dens	mucro	ten	unguis	PAO	Ant	emp	Abd	Abd	Abd	Abd	Abd	Abd	Abd	Abd	Abd	Refs.
					IT		IV s	lam	II–III a	II–III m	IV a	IV m	IV p	V a	V p			
<i>S. emucronata</i>	3	4	no	3	-	4(5)	7(6–8)	-	1 2 4	2 3 4	1–5(s)	1 3 5	1 4 5	1–5(s)	1 3	1–3(s)	3, 4	
<i>S. fukugakuchiana</i>	4	6	yes	4	-	4	6–7	-	-	2(3)(4)	1–5(s)	1 3 4 5	1 3 4 5	1–5(s)	1 3	1–3(s)	4, 15	
<i>S. guerrense</i>	0	4(5)	no	3	1	4	6–7	yes	1 2 4	2 3 5	1–5(s)	1 3 4 5	1 2 4 5	1–5(s)	1 3	1–3(s)	3, 13	
<i>S. hubbardi</i>	3	5	yes	3	1	4	6–7	yes	1 2 4 5	2 3 5	1–5(s)	1 4 5	1 4 5	1–5(s)	1 3	1–3(s)	16	
<i>S. jarac</i>	6	5	yes	4	1	4	6	yes	1 2 4 5	(2)(3) 4	1–5(s)	1	1	1–5(s)	1 3	1–3(s)	2, 11	
<i>S. kitakamiana</i>	2	3–4	yes	3	-	4	6	-	1 2 4 (2)	0	1–5(s)	3	3	1–5(s)	1 3	1–3(s)	17	
<i>S. lindbergi</i>	3	3	no	3	-	4(5)	7(5–8)	-	1 2 4	2 4	1–5(s)	1 4 5	1 4 5	1–5(s)	1 3	1–3(s)	2, 18	
<i>S. maxima</i>	5	5	red.	3	-	4	7(6)	-	1 2 4	2 4	1–5(s)	1 5	1 5	1–5(s)	1 3	1–3(s)	4, 7	
<i>S. oaxacana</i>	0	4	yes	3–4	1	4–5	8	yes	1 2 4 5	2 3 5	1–5(s)	1 4 5	1 4 5	1–5(s)	1 3	1–3(s)	19	
<i>S. oculoa</i>	7	6	no	3	-	4	7	-	1 2 4 5	3 5	1–5(s)	1 3 4 5	1 3 4 5	1–5(s)	1 3	1–3(s)	20	
<i>S. pouadensis</i>	3	3	red.	3	-	4	7(8–10)	-	1 2 3 4	0	1–5(s)	1 5	1 5	1–5(s)	1 3	1–3(s)	3, 21	
<i>S. profundissima</i>	0–1	5	yes	4	1	4	7	-	1 2 4 (5)	2 3 (4)	1–5(s)	2 3 4 5	1 4 5	1–5(s)	1 3	1–3(s)		
n. sp.																		
<i>S. quadrioculata</i>	2	4	no	3	-	4(3–5)	8(9)	-	1 2 4	0	1–5(s)	1 3	1 3	1–5(s)	1 3	1–3(s)	3, 4, 10	
<i>S. quinqueoculata</i>	5	5–6	yes	3(4)	-	4	7(6)	-	1 2 4 5	(2) 3 4	1–5(s)	1 3 5	1 (4)	1–5(s)	1 3	1–3(s)	4, 15, 17	
<i>S. raubmugnizi</i>	5	6	yes	4	1	5	6	yes	1 2 4 5	2 5	1–5(s)	1 2 3 4 4	4	1–5(s)	1 3	2–3(s)	22	
<i>S. scosiroli</i>	3	6(5)	red.	3	-	6–8	7(8)	-	1 2 4 5	2 4	1–5(s)	1 3 4 5	1 4 5	1–5(s)	1 2 3	1–3(s)	4, 23	
<i>S. sexoculata</i>	3	4	yes	3	-	4	9(7–8)	-	1 2 3 4	0	1–5(s)	1 3 5	1 5	1–5(s)	1 3	1–3(s)	3, 4	
<i>S. subcoeca</i>	0	3	no	3	-	4(5)	7	-	1 2 4 5	2 4	1–5(s)	1 3 5	1 3 5	1–5(s)	1 3	1–3(s)	4, 7	
<i>S. vandatica</i>	6	5	yes	3	1	4	7	yes	1 2 4 5	2 4 5	1–5(s)	1 3 4 5	1 4 5	1–5(s)	1 3	1–3(s)	5	
<i>S. vandatica</i> (sensu Babenko)	6(7)	5	yes	4	1	4	7	yes	1 2 4 5	2 3	1–5(s)	1 2 3 4 1(3)	1(3)	1–5(s)	1 3	1–3(s)	2, 11	
<i>S. willemi</i>	4	3–2	red.	3(2–4)	-	4	6–7	-	1 2 4	2 3 4	1–5(s)	1 2 3 5	1 2 3 5	1–5(s)	1 3	1–3(s)	3, 4, 24	

Key to the world species of *Schaefferia*

- 1 With 7 eyes on each side ..... 2  
 - Fewer than 7 eyes on each side ..... 3
- 2 Without mucro ..... *S. oculea* Babenko, 1999 (Russia, soil)  
 - With mucro ..... *S. vandalica* (Jordana and Arbea, 1990) (Sierra Morena, soil)
- 3 With 6 eyes on each side ..... 4  
 - With fewer than 6 eyes ..... 12
- 4 Dens with 3–4 chaetae ..... 5  
 - Dens with more than 4 chaetae ..... 7
- 5 Tenaculum with 3 teeth.....  
 ..... *S. dehanvergi* (Jordana and Arbea, 1990) (Pyrenees, soil)  
 - Tenaculum with 4 teeth..... 6
- 6 6 sensilla on Ant IV .....  
 ..... *S. duodecimoculata* (Steiner, 1955) sensu Thibaud et al., 2004 (Spain, soil)  
 - 7 sensilla on Ant IV ..... *S. cheoha* Wray, 1963 (USA, cave)
- 7 Abd II–III with 5 a-chaetae ..... 8  
 - Abd II–III with 3–4 a-chaetae ..... 9
- 8 Abd II–III with 2 m-chaetae.....  
 ..... *S. vandalica* Jordana and Arbea, 1990 (Sierra Morena, soil)  
 - Abd II–III with 3 m-chaetae.....  
 ..... *S. duodecimocellata* Bonet, 1945 sensu Fjellberg, 1984 (Alaska)
- 9 Abd II–III with 3 a-chaetae ..... *S. duodecimocellata* Bonet, 1945 (Mexico, soil)  
 - Abd II–III with 4 a-chaetae ..... 10
- 10 Tenaculum with 3 teeth; Abd IV with 3 m-chaetae .....  
 ..... *S. vandalica* sensu Babenko nec Jordana and Arbea, 1990 (Caucasus, soil)  
 - Tenaculum with 4 teeth; Abd IV with fewer than 3 m-chaetae ..... 11
- 11 Abd IV with 1 m-chaeta ..... *S. jarae* (Jordana and Arbea, 1990) (Pyrenees, soil)  
 - Abd IV with 2 m-chaetae ..... *S. elegans* (Cassagnau, 1959) (Pyrenees, soil)
- 12 With 5 eyes ..... 13  
 - With fewer than 5 eyes ..... 19
- 13 Unguis without inner tooth..... *S. bidentata* (Cassagnau, 1954) (Pyrenees, soil)  
 - Unguis with inner tooth ..... 14
- 14 Dens with 3–4 chaetae ..... 15  
 - Dens with more than 3–4 chaetae ..... 16
- 15 Abd II with 2 m-chaetae.....  
 ..... *S. canigouensis* Deharveng and Thibaud, 1980 (Pyrenees, soil)  
 - Abd II with 3 m-chaetae..... *S. decemoculata* (Stach, 1939) (Germany, cave)

16	PAO with 5 lobes .....	16
	..... <i>S. raulmugnizi</i> Palacios-Vargas and Castaño-Meneses, 2008 (Mexico, soil)	
-	PAO with 4 lobes .....	17
17	Abd II–III with 3 a-chaetae .....	18
-	Abd II–III with 4 a-chaetae .....	<i>S. quinqueoculata</i> Yosii, 1956 (Japan, cave)
18	Abd IV with 2 m-chaetae .....	
	..... <i>S. maxima</i> Deharveng and Thibaud, 1980 (Pyrenees, soil)	
-	Abd IV with 3 m-chaetae .....	<i>S. czernovi</i> Martynova, 1978 (Siberia, soil)
19	With 4 eyes .....	20
-	With fewer than 4 eyes .....	22
20	Dens with 3–4 chaetae; mucro reduced .....	
	..... <i>S. willemi</i> (Bonet, 1930) (Belgium, cave)	
-	Dens with more than 4 chaetae .....	21
21	PAO with 4 multi-branched lobes; Abd IV with 1 m-chaeta ( $m_4$ ) .....	
	..... <i>S. baschkirica</i> Kniss, 1985 (Russia, cave)	
-	PAO with 4 simple lobes; Abd IV with 4 m-chaetae .....	
	..... <i>S. fukugakuchiana</i> (Yosii, 1956) (Japan, cave)	
22	With 3 eyes .....	23
-	With fewer than 3 eyes .....	28
23	PAO with 6–8 lobes .....	<i>S. scossirolii</i> Dallai and Sabatini, 1981 (Italy, soil)
-	PAO with fewer than 6 lobes .....	24
24	Mucro totally developed .....	25
-	Mucro reduced or absent .....	26
25	Dens with 5 chaetae .....	<i>S. hubbardi</i> Thibaud, 1995 (USA, cave)
-	Dens with 4 chaetae .....	<i>S. sexoculata</i> (Gisin, 1947) (Switzerland, soil)
26	Mucro reduced; Abd II–III with 4 chaetae in rows “a” and “m” together .....	
	..... <i>S. pouadensis</i> Delamare Deboutteville, 1945 (France, cave)	
-	Mucro absent; Abd II–III with 5 or 6 chaetae in rows “a” and “m” together .....	27
27	Dens with 4 chaetae; Abd II–III with 6 chaetae in rows “a” and “m” together .....	
	..... <i>S. emucronata</i> Absolon, 1900 (Czechia, cave)	
-	Dens with 3 chaetae; Abd II–III with 5 chaetae in rows “a” and “m” together .....	
	..... <i>S. lindbergi</i> Gama, 1963 (Portugal, cave)	
28	With 2 eyes .....	29
-	With 0–1 eyes .....	31
29	With mucro; Ant IV with 6 sensilla .....	
	..... <i>S. kitakamiana</i> Yosii, 1991 (Japan, cave)	
-	Without mucro; Ant IV with 7–9 sensilla .....	30

- 30 Dens with 4 chaetae; Abd II–III with 3 chaetae in rows “a” and “m” together.....  
 .....*S. quadrioculata* (Stach, 1939) (Germany, cave)  
 - Dens with 3 chaetae; Abd II–III with 5 chaetae in rows “a” and “m” together.....  
 .....*S. ariegica* Cassagnau, 1959 (France, soil)
- 31 Ant IV with 8 or more sensilla..... 32  
 - Ant IV with fewer than 8 sensilla..... 33
- 32 Mucro well developed; Abd II–III with 7 chaetae in rows “a” and “m” together ...  
 .....*S. oaxacana* Palacios-Vargas and Thibaud, 1985 (Mexico, cave)  
 - Mucro reduced; Abd II–III with 5 chaetae in rows “a” and “m” together.....  
 .....*S. coeca* Cassagnau, 1959 (France, soil)
- 33 Mucro well developed; 0–1 eyes .....*S. profundissima* n. sp. (Caucaso, cave)  
 - Without mucro; eyes absent ..... 34
- 34 Dens with 4–5 chaetae; Abd IV with 8 chaetae in rows “a” and “m” together.....  
 .....*S. guerrerense* (Bonet, 1945) (Mexico, cave)  
 - Dens with 3 chaetae; Abd IV with 6 chaetae in rows “a” and “m” together.....  
 .....*S. subcoeca* Deharveng and Thibaud, 1980 (France, soil)

***Anurida stereodorata* Jordana and Baquero n. sp.**

(Figures 9–11)

*Type locality*

Krubera Cave (called too Voronya Cave or Voronja Cave), Arabika Massif, Gagrinsky Range of the Western Caucasus, Gagra district of Abkhazia (Ortobalagan).

*Type material*

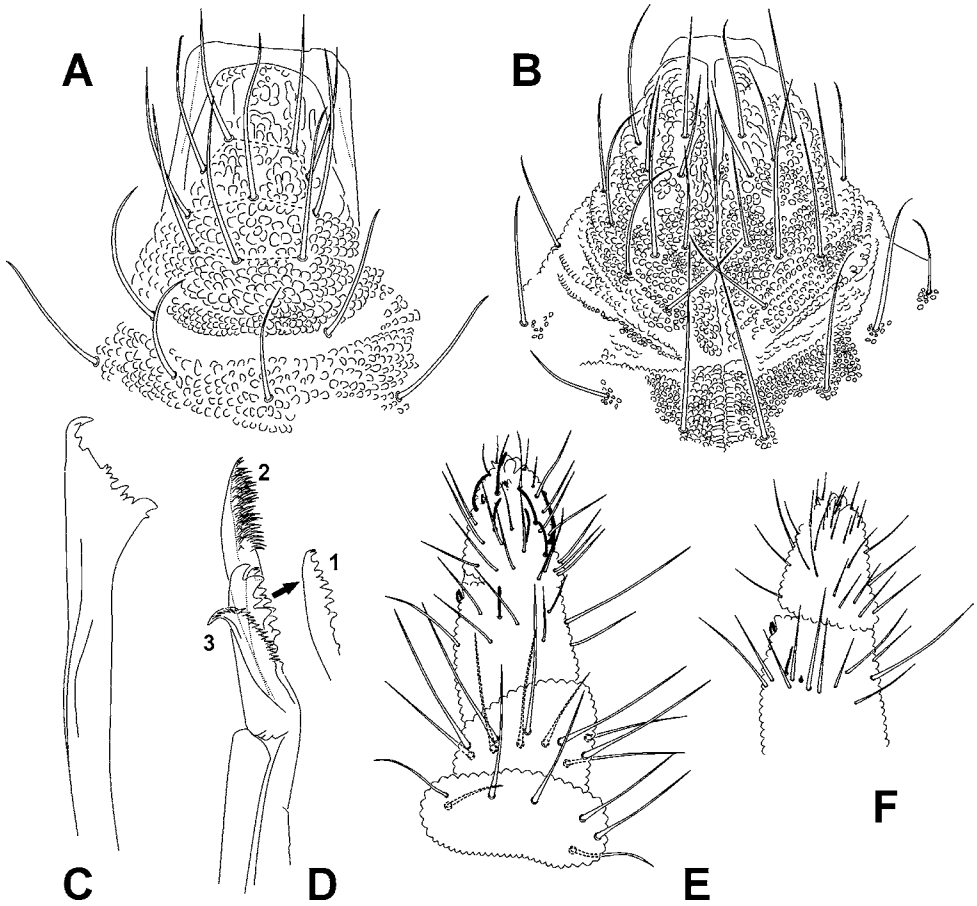
Holotype (female) on slide, -70 m from entrance (2420 m above sea level), pitfall trap, between 26.VII.2010 to 24.VIII.2010. Coordinates: lat 43.409722°, long 40.362222° (43°24'35.00"N, 40°21'44.00"E). CaveX Team leg. 4 paratypes (female) on two slides, 2 paratypes on SEM stub and 104 paratypes in ethyl alcohol. Deposited in Museu de Valencia (Holotype and 90 Paratypes) and MZNA (19 Paratypes).

*Etymology*

The name “*stereodorata*” derives from the orientation forward of the two chemoreceptors (PAO).

*Description*

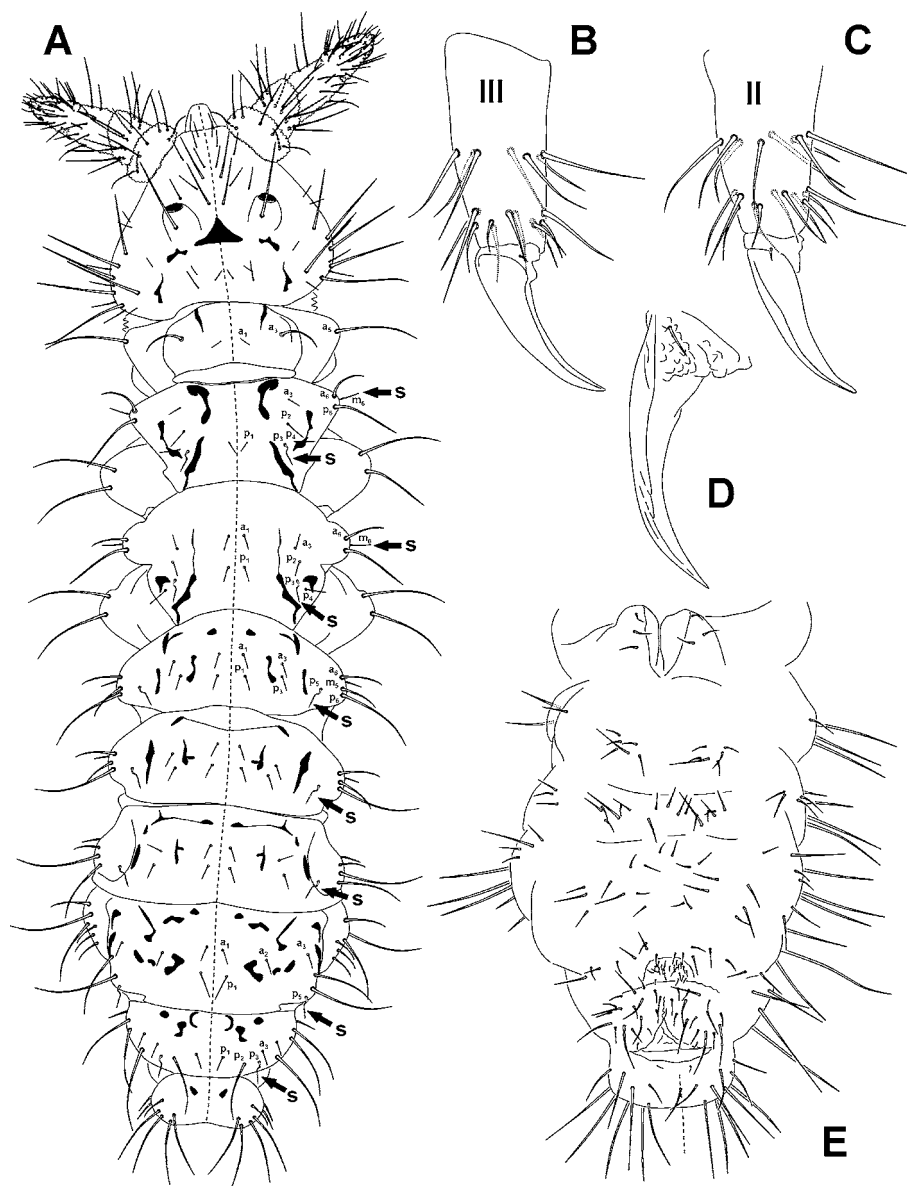
Paratergites on Th and Abd lobed laterally, Abd VI bilobed (Figures 10A, 11A). Holotype (female) length 3.90 mm; paratypes up to 4.5 mm. Colour in alcohol



**Figure 9.** *Anurida stereodorata* n. sp. (A) Labrum. (B) Labium. (C) Mandible. (D) Maxillar lamellae (after Fjellberg 1985). (E) Antenna. (F) detail of antenna, ventral view.

whitish. Eyes absent. Labral formula interpreted as 4/2334 (Figure 9A). Antennae/head ratio 0.65. Antennal segment IV with 7 blunt sensilla and trilobed apical bulb (Figures 9E–F). External ms and subapical organite present. Antennal segments III and IV fused dorsally. Sensory organ of antennal segment III consisting of two long, widely separated outer sensilla, a small ventral ms and two straight and pointed sensory pegs (Figure 11B). Antennal segment II with 11 chaetae, antennal segment I with 7 chaetae. PAO (Figures 11C–D), dome shaped, with about 60 vesicles with chemoreceptor aspect in its frontal part (Figure 11C–E), directed forward, and probably with stereolfactory ability given their position and the environment in which this species lives, in darkness. Mandible with 3 teeth and dentate plate, 10–13 teeth in total (Figure 9C). Maxillary capitulum with a four teeth unguis and three dentate or fringed lamellae (Figure 9D). Labium with 10 chaetae on each side, without papillate L chaeta (Figure 9B). Th I–III and Abd I–IV with lobed laterally paratergites. Female genital plate with 20–26 microchaetae; male genital plate with about 80 microchaetae. Unguis without inner teeth (Figure 10D). Furca completely absent.

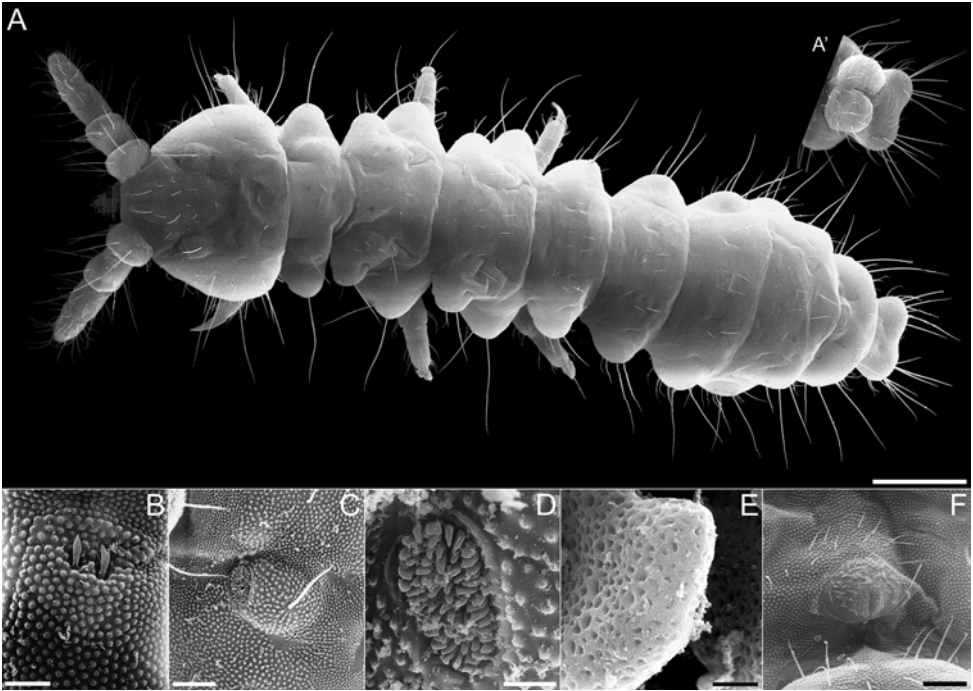




**Figure 10.** *Anurida stereodorata* n. sp. (A) Habitus, dorsal view. The black spots means crevices and depressions (see Figure 11A) (the arrows point to the 'sensory' chaetae) (B–C) Legs III and II respectively. (D) Unguis, lateral view. (E) Ventral view of Abd.

#### *Chaetotaxy* (Figures 10A, 10E)

Macro and microchaetae on body well differentiated; lateral macrochaetae well developed. Th I with 3 + 3 chaetae; Th II with 8 chaetae, 'sensory' chaetae  $s = m_6$  and  $p_3$  (the term 'sensory' not implying that they have any special sensory function); thoracic terga III with 9 chaetae, 'sensory' chaetae  $s = m_6$  and  $p_3$ ; Abd I–III with 9 chaetae.



**Figure 11.** *Anurida stereodorata* n. sp. SEM microphotographs. (A) Dorsal habitus (A', ventral Abd tip). (B) Sensory pegs of sensory organ of antennal segment III (scale bar: 20  $\mu\text{m}$ ). (C–D) PAO (bars: 70 and 20  $\mu\text{m}$  respectively). (E) Detail of a PAO vesicle, showing perforations (scale bar: 1  $\mu\text{m}$ ). (F) Male genital plate (scale bar: 60  $\mu\text{m}$ ).

Formula of 'sensory' chaetae **s** per half tergum: 022/11111. Ms on Th II present, absent on Th III. Ventral chaetotaxy as in a Figure 10E. Ventral tube with 3 + 3 chaetae (Figure 10E). Male genital plate in Figure 11F. Tibiotarsi I, II and III with 19, 19 and 18 chaetae, respectively (Figure 10B–C).

### Discussion

Bellinger et al. (1996-2011) defined Pseudachorutinae as Collembola Neanuridae with: 1) mandible present without molar plate; 2) with or without furca (if present could be reduced to one or two knobs with chaetae); 3) sensillar chaetotaxy of Ant IV with fewer or more than 8 sensilla, never with 8; 4) without ms; 5) Abd VI usually not bilobed or truncated (nevertheless some species have this segment more or less truncate); 6) body without finger-like projections; 7) head and first thoracic segment dorsally separated. The triangular head of the maxilla separates it from Friesinae.

Deharveng (2004) hypothesized that Pseudachorutinae was para- or polyphyletic.

*Anurida stereodorata* n. sp. could be considered as belonging to a new genus on the basis of the unique PAO and bilobed Abd VI. All other *Anurida* spp. have the PAO tubercles arranged in a circle or ellipse, and none has a bilobed Abd VI.

**Table 2.** World genera of Pseudochorutinae (Neanuridae) with its principal diagnostic characters. Abbreviations: spp. n°, number of described species for the genus; PAO, post antennal organ; Ten., tenaculum. “-” denotes: no data available.

Genera	Author	spp. n°	eyes	PAO	Mandible	Maxillae	Furca	Ten.	muco
<i>Aethiopella</i>	Handschin, 1942	24	8	yes	multidentate	needle like	yes	yes	yes
<i>Aethiopellina</i>	Delamare, 1951	4	8	yes	absent	needle like	yes	yes	yes
<i>Anurachorutes</i>	Kuznetsova and Potapov, 1988	1	6	yes	dentate	yes/mple lamelas	yes	yes	no
<i>Anurida</i>	Laboulbene, 1865	71	0–5	yes	dentate	dentate lamela	absent/rudiment	no	no
<i>Anuridella</i>	Willem, 1906	5	0	yes	special	dentate lamela	absent/rudiment	no	no
<i>Anuridelsa</i>	Womersley, 1939	1	8	no	multidentate	needle like	yes	yes	yes
<i>Arleyesa</i>	Handschin, 1942	9	5–7	no	dentate	needle like	yes	yes	-
<i>Arleyesella</i>	Delamare, 1951	6	8	no	multidentate	needle like	yes	yes	yes
<i>Brayesimeria</i>	Stach, 1949	2	6	no	dentate	needle like	absent	no	no
<i>Cassagnaudina</i>	Massoud, 1967	4	8	yes	dentate	dentate lamela	reduced	yes	no
<i>Cassagnaurida</i>	Salmon, 1964	1	8	yes	dentate	dentate lamela	yes	yes	yes
<i>Cephalachorutes</i>	Bedos and Deharveng, 1991	13	0–8	no	6–14	needle like	yes	yes	1/2 of dens
<i>Cenutrimeria</i>	Börner, 1906	11	8	yes	dentate	needle like	yes	yes	present
<i>Delamarrellina</i>	Rapoport and Rubio, 1963	3	5	no	dentate	dentate lamela	reduced	yes	-
<i>Forsteramea</i>	Salmon, 1965	1	8	yes	dentate	dentate lamela	yes	yes	yes
<i>Furculanurida</i>	Massoud, 1967	15	yes-no	yes	multidentate	needle like	yes/reduced	yes	reduced
<i>Gamachorutes</i>	Cassagnau, 1978	1	8	yes	dentate	needle like	yes	yes	present
<i>Gastranurida</i>	Bagnall, 1949	1	3	yes	special	dentate lamela	absent	no	no
<i>Granaurida</i>	Yossi, 1954	5	0	yes	bidentate	needle like	reduced	no	no
<i>Halachorutes</i>	Arlé, 1967	1	8	yes	-	needle like	yes	-	-
<i>Hylaeauru</i>	Arlé, 1966	3	0	no	unidentate	needle like	reduced	yes	no
<i>Intermediurida</i>	Najt, Thibaud and Weiner, 1990	1	0	yes	dentate	needle like	yes	yes	present
<i>Israelimeria</i>	Weiner and Kaprus, 2005	1	4	no	dentate	needle like	absent	no	no
<i>Kenyura</i>	Salmon, 1954	7	0–2	no	dentate	needle like	reduced	no	no
<i>Koreanurina</i>	Najt and Weiner, 1992	2	3	yes	dentate	needle like	reduced	no	no
<i>Lanzhotia</i>	Rusek, 1985	1	0	yes	dentate	needle like	reduced	no	no
<i>Linnaemima</i>	Philipschenko, 1926	2	8	no	dentate	needle like	reduced	yes	fused

(Continued)

Table 2. (Cont.)

Genera	Author	spp. n°	eyes	PAO	Mandible	Maxillae	Furca	Ten.	micro
<i>Meganurida</i>	Carpenter, 1935	1			-	-	-	-	-
<i>Micranurida</i>	Börner, 1901	28	0–5	yes	dentate	needle like	absent/rudiment	-	-
<i>Minotaurella</i>	Weiner, 1999	3	0	yes	dentate	dentate lamella	rudiment	no	no
<i>Najtafrica</i>	Barra, 2002	1	2	yes	dentate	needle like	yes	yes	yes
<i>Neotropiella</i>	Handschin, 1942	15	5–6	yes	dentate	needle like	yes	yes	present
<i>Notachorudina</i>	Cassagnau and Rapoport, 1962	1	8	no	dentate	dentate lamella	yes	yes	yes
<i>Oudemanyesa</i>	Schött, 1901	7	8	no	multidentate	needle like	yes	yes	yes
<i>Paranurida</i>	Skarzynski and Pomorski, 1994	1	2	no	absent	needle like	absent	no	no
<i>Philorella</i>	Najt and Weiner, 1985	6	5	yes	multidentate	needle like	absent	no	no
<i>Platanurida</i>	Carpenter, 1925	3	5	yes	dentate	needle like	yes/reduced	-	yes o no
<i>Pongea</i>	Najt and Weiner, 2002	1	0	yes	absent	dentate lamella	absent	no	no
<i>Protanurida</i>	Rusek, 1973	8	8	yes	reducida	needle like	yes	-	reduced/absent
<i>Protachorutes</i>	Cassagnau, 1955	2	8	yes	reducida	needle like	reduced	yes	no
<i>Pseudachorudina</i>	Stach, 1949	14	8	yes	dentate	dentate lamella	yes	yes	yes
<i>Pseudachorutella</i>	Stach, 1949	13	8	no	dentate	needle like	yes	yes	present
<i>Pseudachorutes</i>	Stach, 1949	112	8	yes	dentate	needle like	yes	yes	present
<i>Pseudanurida</i>	Schött, 1901	6	8	no	multidentate	needle like	yes	yes	present
<i>Quatacanthella</i>	Salmon, 1945	1	5	no	dentate	dentate lamella	yes	-	-
<i>Rusekella</i>	Deharveng, 1983	7	5–8	yes	dentate	dentate lamella	absent	no	no
<i>Stachorutes</i>	Dallai, 1973	17	2–5	yes	dentate	needle like	reduced	yes	yes
<i>Tasmanura</i>	Womersley, 1937	1	8	yes	dentate	needle like	reduced	-	no
<i>Tijucameria</i>	Mendonça and Fernandes, 2005	1	6	yes	multidentate	needle like	reduced	no	present
<i>Venezuelida</i>	Diaz and Najt, 1995	1	4	yes	dentate	needle like	reduced	no	no

**Table 3.** World species of *Anurida* without eyes. Abbreviations: PAO, post antennal organ; M/m, presence of macrochaetae and microchaetae differentiated; Abd, abdominal; parat., paratergites; Md/n° t, teeth number on mandibula; Max., number of maxillar lamellae; Ant IV n° s, sensilla number on antennal IV; mam., mammelons; References, papers used as source of information: 1, Tshelnokov, 1988; 2, Harsia and Gruia, 1992; 3, Yosii, 1956; 4, Rusek, 1970; 5, Cassagnau, 1955; 6, Dallai and Martinozzi, 1980; 7, Dallai, 1969; 8, Jordana et al., 1997; 9, Fjellberg, 1985; 10, Fjellberg, 1998; 11, Yosii, 1970; 12, Tamura and Zhao, 1997; 13, Babenko, 1998; 14, Dunger, 1974; 15, Tshelnokov, 1988; 16, Yosii, 1966; 17, Babenko, 1997 (key to the northern Holarctic species of the genus *Anurida*); 18, Yosii, 1954; 19, Yue and Yin, 1999; 20, Gisin, 1953; 21, Fjellberg, 1973. “-” denotes: no data available.

Species	PAO	more-like PAO	M/m	Abd VI bilobate	parat.	Md/n° t	furca	Max.	Unguis tooth	Ant IV n° s	References
<i>A. annatsbagi</i>	16–17	no	yes	no	no	3–4	-	2 + 1	0	5s	1, 17
<i>A. ariesi</i>	7–8	no	no	-	Th	3	-	3 + 1	0	6s	2
<i>A. assimilis</i>	45	yes	yes	no	Th	10–12	-	-	0	9–10s	3
<i>A. balatovae</i>	9	no	no	no	no	5	-	2 + 1	0	6s	4
<i>A. bonneti</i>	7–9	no	no	-	-	6	-	2 + 1	0	6s	5
<i>A. callanii</i>	11–15	no	no	no	-	6	-	2 + 1	0	6s	6
<i>A. caprariensis</i>	15–17	no	yes	no	-	6	-	2 + 1	0	8s	7, 8
<i>A. desnuda</i>	18	yes	yes	no	no	4–6	-	2 + 1	0	9–10s	3
<i>A. diabolica</i>	20	no	yes	no	Th	10–15	-	2 + 1	0	-	3
<i>A. frigida</i>	15	yes-no	yes	no	Th	6	-	3 + 1	0	7s	21
<i>A. granaria</i>	10–20	no	yes	no	Th	6	2 mam.	3 + 1	0	6s	8, 17
<i>A. iriei</i>	60	yes	yes	no	Th	6 +	2 mam.	3 + 1	1	7s	11
<i>A. kazukoae</i>	16–17	no	no	no	no	5	1 mam.	2 + 1	0	6s	12
<i>A. komi</i>	16–18	no	yes	no	Th	5	2 mam.	3 + 1	0	6s	13
<i>A. latosensillata</i>	9–12	no	no	no	no	4	-	-	-	5s	14
<i>A. livska</i>	14–16	no	no	no	Th	5	2 mam.	3 + 1	0	6s	13
<i>A. mandibulata</i>	16–17	yes	yes	-	-	6	-	2 + 1	1	8s	15
<i>A. martynovae</i>	12–16	no	no	no	no	4–5	-	3 + 1	0	6s	10, 17
<i>A. nadezhdae</i>	9	no	no	no	no	5	2 mam.	3 + 1	0	5s	13
<i>A. nuda</i>	20–25	no	-	no	no	5	-	3 + 1	1	5s	3
<i>A. okamotoi</i>	30	yes	yes	no	Th	4–5 +	swelling	3 + 1	1	20s	11
<i>A. plurichaetotica</i>	48	yes	yes	no	Th	3–5	2 mam.	3 + 1	1	12s	16

(Continued)

Table 3. (Cont.)

Species	PAO	more-like PAO	M/m	Abd VI bilobate	parat.	Md/n <sup>o</sup> t	furca	Max.	Unguis tooth	Ant IV n <sup>o</sup> s	References
<i>A. polaris</i>	10–15	no	no	no	no	6	-	3+1	0	7s	9, 10, 17
<i>A. reducta</i>	13–18	no	no	no	no	5	-	3+1	1	6s	10
<i>A. sabkensis</i>	10–15	no	no	no	Th	5	-	3+1	0	6s	17
<i>A. setosa</i>	30	yes	yes	no	Th	6–8	-	2+1	1	9–10s	3
<i>A. similis</i>	15–22	no	no	no	-	5	-	3+1	0	6–8s	10
<i>A. speobia</i>	25–37	yes	yes-no	no	Th	4–5	2 mam.	3+1	1	5–9s	3, 18
<i>A. subarctica</i>	11–17	no	no	no	no	5+	-	3+1	0	5–6s	10, 17
<i>A. tamurae</i>	19–21	no	no	no	no	4	2 mam.	?	0	6s	19
<i>A. thalassophila</i>	12–18	no	yes	-	Th, Abd	6	-	3+1	0	6–8s	8, 9
<i>A. uniformis</i>	12–15	no	yes	no	no	4	-	3+1	0	7s	9, 20
<i>A. vicaria</i>	38–40	yes	yes	no	Th	6+	-	-	1	numerous	3
<i>A. wangelensis</i>	12–14	yes-no	no	no	Th	5	-	2+1	0	6s	15
<i>A. stereodonata</i> n. sp.	60	yes	yes	yes	Th, Abd	12–13	no	3+1	0	7s	This paper

Thirty-three genera of Pseudachorutinae have the PAO present, but only 9 have some species without eyes (Table 2): *Furculanurida* Massoud, 1967, *Granaturida* Yosii, 1954, *Intermediurida* Najt, Thibaud and Weiner, 1990, *Lanzhotia* Rusek, 1985 and *Micranurida* Börner, 1901 have needle-like maxilla; *Anurida* Laboulbene, 1865 (71 spp.), *Anuridella* Willem, 1906 (5 spp.), *Minotaurella* Weiner, 1999 (1 sp.) and *Pongeia* Najt and Weiner, 2002 (1 sp.) have dentate or fringed maxillary lamellae. *Anuridella* has a unique form of mandible not present in the new species, *Pongeia* lacks mandibles, and *Minotaurella* has a tuberculate body.

Of the 71 described species of *Anurida*, 35 species lack eyes (Table 3). The PAO is roundish or oval, with vesicles in a single line, and occasionally with some vesicles in the interior part of the external line (morel-like form). Ten species share this characteristic of the PAO (not its dome shaped), and between them, only two species share with the new species the absence of tooth on the inner edge of the unguis: *A. assimilis* Yosii, 1956 and *A. desnuda* Yosii, 1956. *Anurida assimilis* has 45 vesicles in the PAO and *A. desnuda* has 18, while the new species has about 60. In the new species Abd VI is clearly bilobed and Ant IV has 7 sensilla, while the other two species have a rounded Abd VI and 9–10 sensilla on Ant IV. The other species with internal vesicles on an elliptic PAO are: *A. wrangelensis* Tshelnokov, 1988 and *A. frigida* Fjellberg, 1973; each of these species has 12–15 vesicles in PAO and Abd VI is entire.

#### Key to the world species of *Anurida* without eyes

- |   |   |   |
|---|---|---|
| 1 | PAO moruliform.....                                     | 2   |
| - | PAO not moruliform.....                                 | 14  |
| 2 | Macrochaeta and microchaeta differentiated.....         | 4   |
| - | Macrochaeta and microchaeta not differentiated.....     | 3   |
| 3 | PAO with 25–37 vesicles.....                            | <i>A. speobia</i> Yosii, 1954 (Japan, cave)                                 |
| - | PAO with 12–14 vesicles.....                            | <i>A. wrangelensis</i> Tshelnokov, 1988 (Wrangel Isl. Arctic, Russia, soil) |
| 4 | More than 10 teeth on the mandible.....                 | 5   |
| - | Fewer than 10 teeth on the mandible.....                | 6   |
| 5 | Abd VI bilobed, PAO with 60 vesicles.....               | <i>A. stereodorata</i> n. sp. (Abkhazia, cave)                              |
| - | Abd VI not bilobed, PAO with 45 vesicles.....           | <i>A. assimilis</i> Yoshii, 1956 (Japan, cave)                              |
| 6 | Unguis without internal tooth.....                      | 7   |
| - | Unguis with internal tooth.....                         | 8   |
| 7 | Th with paratergites, Ant IV with 7 sensilla.....       | <i>A. frigida</i> Fjellberg, 1973 (Sweden, under moss)                      |
| - | Th without paratergites, Ant IV with 9–10 sensilla..... | <i>A. desnuda</i> Yosii, 1956 (Japan, cave)                                 |
| 8 | PAO with more than 45 vesicles.....                     | 9   |
| - | PAO with fewer than 45 vesicles.....                    | 10  |

9	Ant IV with 7 sensilla, PAO with 60 vesicles .....	
	..... <i>A. iriei</i> Yosii, 1970 (Japan, cave)	
-	Ant IV with 12 sensilla, PAO with 48 vesicles .....	
	..... <i>A. plurichaetotica</i> Yosii, 1966 (South Korea, cave)	
10	PAO with fewer than 20 vesicles.....	
	..... <i>A. mandibulata</i> Tshelnokov, 1988 (Magadan, Russia, tundra)	
-	PAO with more than 20 vesicles .....	11
11	PAO with 38–40 vesicles, Ant IV with numerous sensilla.....	
	..... <i>A. vicaria</i> Yosii, 1956 (Japan, cave)	
-	PAO with fewer than 38 vesicles.....	12
12	Maxilla with 2 + 1 lamellae, Ant IV with 9–10 sensilla.....	
	..... <i>A. setosa</i> Yosii, 1956 (Japan, cave?)	
-	Maxilla with 3 + 1 lamellae.....	13
13	Ant IV with 5–9 sensilla.....	<i>A. speobia</i> Yosii, 1954 (Japan, cave)
-	Ant IV with 20 sensilla.....	<i>A. okamotoi</i> Yosii, 1970 (Japan, cave)
14	Mandible with 10–15 teeth.....	<i>A. diabolica</i> Yosii, 1956 (Japan, cave)
-	Mandible with fewer than 10 teeth.....	15
15	Mandible with 6 teeth.....	16
-	Mandible with fewer than 6 teeth.....	22
16	With macrocheatae and microchaetae differentiated.....	17
-	Macrocheatae and microchaetae not differentiated .....	20
17	Maxilla with 2 + 1 lamellae.....	<i>A. caprariensis</i> Dallai, 1969 (Europe, soil)
-	Maxilla with 3 + 1 lamellae.....	18
18	Paratergites on Th and Abd .....	
	..... <i>A. thalassophila</i> (Bagnall, 1939) Stach, 1949 (Europe, soil near sea shore)	
-	Paratergites only on Th.....	19
19	Ant IV with 6 sensilla.....	
	..... <i>A. granaria</i> (Nicolet, 1847) Tullberg, 1869 (Holarctica and Australia)	
-	Ant IV with 7 sensilla.....	<i>A. frigida</i> Fjellberg, 1973 (Sweden, under moss)
20	PAO with 7–9 vesicles.....	<i>A. bonneti</i> Cassagnau, 1955 (France, soil)
-	PAO with 10 or more vesicles.....	21
21	Maxilla with 2 + 1 lamellae, Ant IV with 6 sensilla.....	
	..... <i>A. callainii</i> Dallai and Martinuzzi, 1980 (Italy, soil)	
-	Maxilla with 3 + 1 lamellae, Ant IV with 7 sensilla.....	
	..... <i>A. polaris</i> (Hammer, 1954) (Arctic)	
22	Th with paratergites.....	23
-	Th without paratergites.....	27



23	Maxilla with 2 + 1 lamellae.....	
	..... <i>A. wrangelensis</i> Tshelnokov, 1988 (Wrangel Isl. Arctic, Russia, Soil)	
	Maxilla with 3 + 1 lamellae.....	24
24	PAO with 7–8 vesicles.....	<i>A. ariesi</i> Harsia and Gruia, 1992 (Romania)
-	PAO with more than 10 vesicles.....	25
25	Furca reduced to 2 mamelons.....	26
-	Without furca.....	<i>A. sakhensis</i> Babenko, 1997 (Yakutia, Russia, soil)
26	With macrochaetae and microchaetae differentiated.....	
	..... <i>A. komi</i> Babenko, 1998 (Russia, soil)	
-	Macrochaetae and microchaetae not differentiated.....	
	..... <i>A. lvivska</i> Babenko, 1998 (Ukraine, mossy soil)	
27	Ant IV with 5 sensilla.....	28
-	Ant IV with more than 5 sensilla.....	30
28	Mandible with 3–4 teeth.....	29
-	Mandible with 5 or more teeth.....	32
29	With macrochaetae and microchaetae differentiated.....	
	..... <i>A. annatshagi</i> Tshelnokov, 1988 (Russia, soil tundra)	
-	Macrochaetae and microchaetae not differentiated.....	
	..... <i>A. latosensillata</i> Dunger, 1974 (Germany, soil)	
30	PAO with 9 vesicles.....	<i>A. nadezhdae</i> Babenko, 1998 (Taymir, Russia, soil)
-	PAO with more than 9 vesicles.....	31
31	PAO with 11–17 vesicles.....	<i>A. subarctica</i> Fjellberg, 1985 (Alaska, U.S.A)
-	PAO with 20–25 vesicles.....	<i>A. nuda</i> Yosii, 1956 (Japan, cave)
32	Mandible with 4 teeth.....	33
-	Mandible with 5 or more teeth.....	35
33	PAO with 12–16 vesicles.....	34
-	PAO with 19–21 vesicles.....	<i>A. tamurae</i> Yue and Yin, 1999 (China, soil)
34	Ant IV with 6 sensilla.....	<i>A. martynovae</i> Fjellberg, 1985 (Alaska and Canada)
-	Ant IV with more than 5 sensilla.....	<i>A. uniformis</i> Gisin, 1953 (Europe, soil)
35	PAO with 9 vesicles.....	<i>A. balatovae</i> Rusek, 1970 (Czechia and Poland, soil)
-	PAO with more than 9 vesicles.....	36
36	Unguis with internal tooth.....	<i>A. reducta</i> Fjellberg, 1985 (Arctic)
-	Unguis without internal tooth.....	37
37	Maxilla with 2 + 1 lamellae.....	<i>A. kazukoae</i> Tamura and Zhao, 1997 (China, soil)
	Maxilla with 3 + 1 lamellae.....	38

- 38 With asymmetric vesicles.....*A. subarctica* Fjellberg, 1985 (Alaska, U.S.A)  
 - PAO rounded or oval, with symmetric vesicles ..... 39
- 39 Vesicles of PAO narrow or compressed .....  
 ..... *A. similis* Fjellberg, 1985 (Alaska and USA, soil)  
 - PAO rounded and without compressed vesicles .....  
 .....*A. martynovae* Fjellberg, 1985 (Alaska and Canada)

***Deuteraphorura kruberaensis* Jordana and Baquero n. sp.**

(Figures 12–14)

*Type locality*

Krubera Cave (called too Voronya Cave or Voronja Cave), Arabika Massif, Gagrinsky Range of the Western Caucasus, Gagra district of Abkhazia (Ortobalagan).

*Type material*

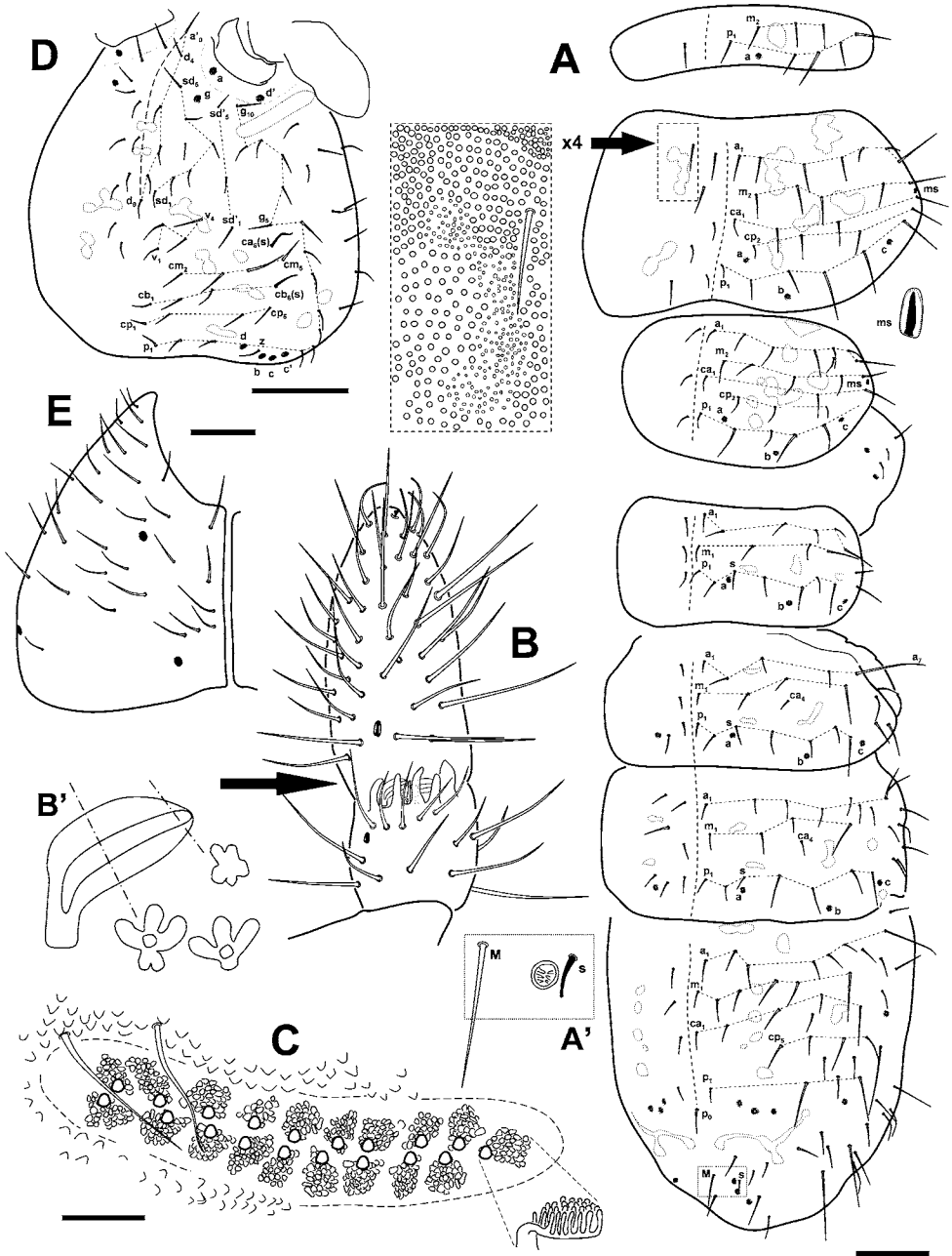
Holotype (female) on slide, -15 m from entrance (2420 m above sea level), pitfall trap, between 26.VII.2010 to 24.VIII.2010. Coordinates: lat 43.409722°, long 40.362222° (43°24'35.00"N, 40°21'44.00"E). CaveX Team leg. 2 paratypes (male and subadult) on slide, 2 paratypes on SEM stub and 16 paratypes in ethyl alcohol. Deposited in Museu de Valencia (Holotype and 10 Paratypes) and MZNA (10 Paratypes).

*Etymology*

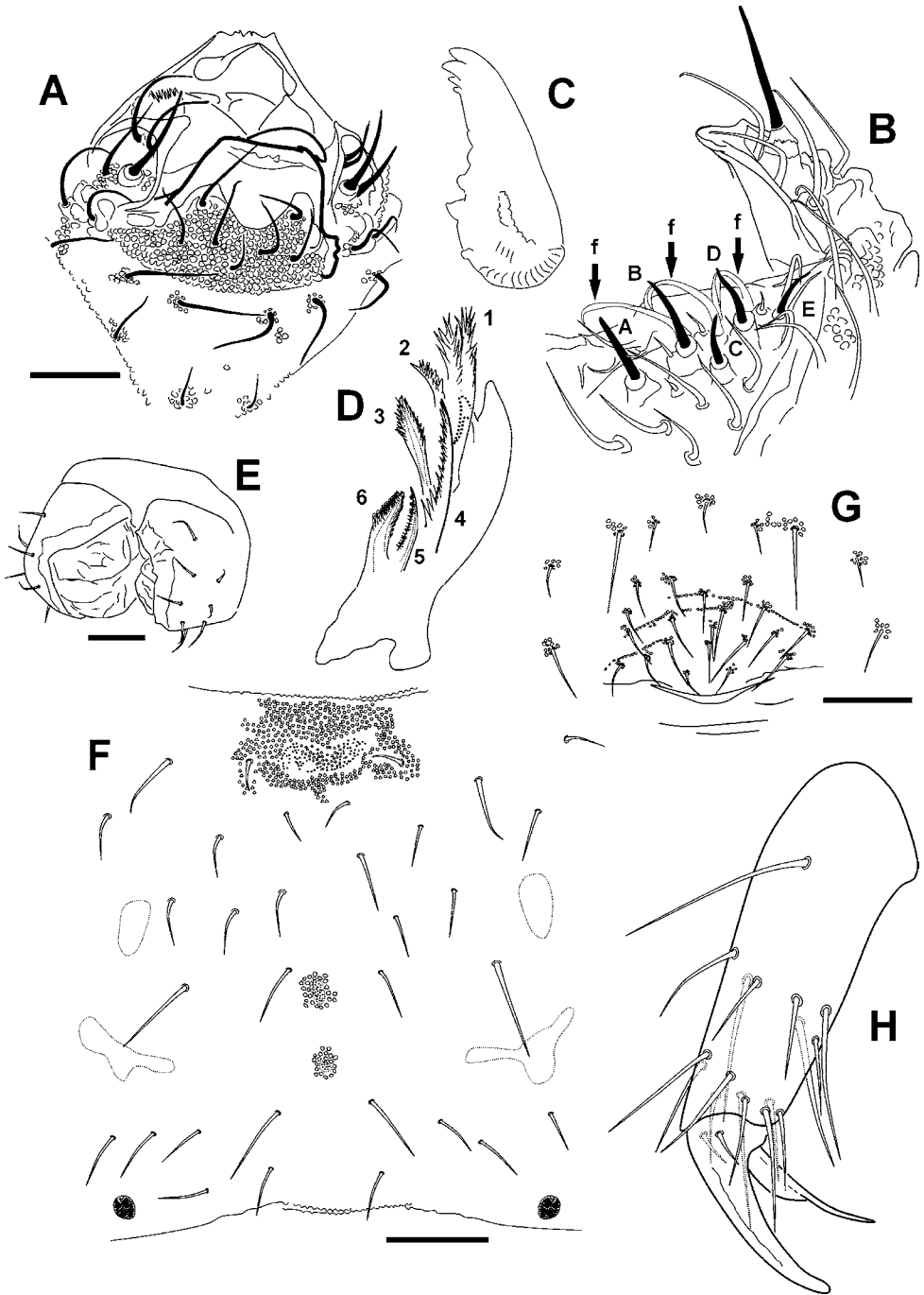
The species name is derived from the name of the cave (Krubera) where the specimens were collected.

*Description*

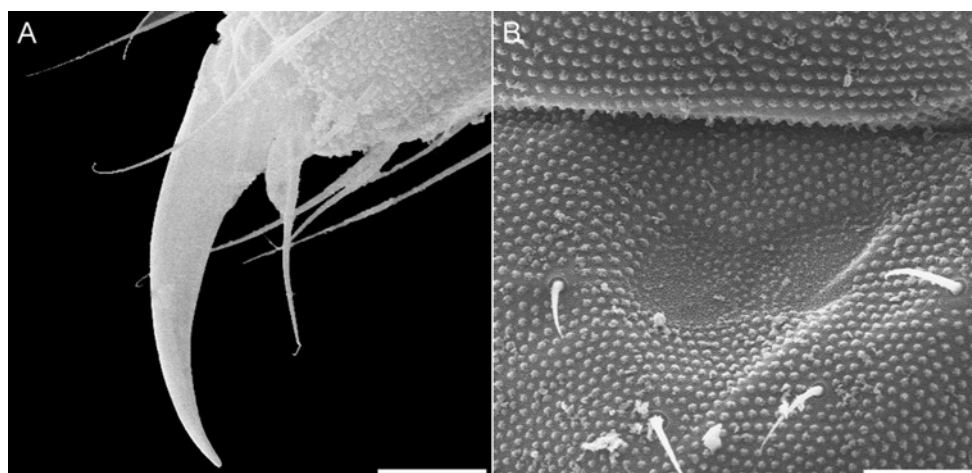
Body length up to 2.2 mm (average 1.6, n = 17), cylindrical, with uniform cuticular granulation except for small areas on all tergites (Figure 12A, dotted line). Colour white in alcohol. Length of Ant I, II, III and IV as 50, 80, 70 and 150 µm. Ratio antennae/head diagonal = 0.72. Antennal base well marked. Ant IV (Figure 12D) with subapical organite and ms at its base, in latero-external position; 30-40 thin chaetae like sensilla, not well distinguishable from chaetae, on the distal two third of Ant IV, in the opposite side of the antennal III sense organ. Antennal III sense organ with two sensory rods, two sensory ribbed clubs (Figure 12B') protected by five papillae and its respective five guard chaetae, and a ventral ms (Figure 12B). PAO consisting of 19–21 compound vesicles disposed in two parallel rows (Figure 12C). Labrum with 4/142 chaetae (Figure 13A). Submentum with 4 + 4 chaetae, basolateral field (mentum) with 5 chaetae; outer maxillary lobe with one basal chaeta and two sublobal hairs. Labial papillae of A type (according to Fjellberg 1999), with six proximal chaetae; labial papillae A, B, C, D, E with 1, 4, 0, 3, 3 guard chaetae respectively (Figure 13B). Mandible with four apical teeth, only the basal slightly different in both mandibles (Figure 13C);



**Figure 12.** *Deuteraphorura kruberaensis* n. sp. (A) Dorsal chaetotaxy of the thoracic and abdominal tergites (A', detail of chaeta M and chaeta s of the tergite V) (scale bar: 100 µm). (B) Ant III–IV (B', detail of the sensory clubs with two sections). (C) PAO (postantennal organ) (scale bar: 20 µm). (D) Dorsal head chaetotaxy (scale bar: 90 µm). (E) Ventral head chaetotaxy (scale bar: 60 µm).



**Figure 13.** *Deuteraphorura kruberaensis* n. sp. (A) Labrum chaetotaxy (scale bar: 40  $\mu$ m). (B) Labial palp chaetotaxy (labial papillae A, B, C, D and E) and outer maxillary lobe (f: flattened chaetae). (C) Mandible. (D) Maxilla. (E) Ventral tube (scale bar: 40  $\mu$ m) (F) Ventral view of Abd IV, with the vestigial furca at the top (scale bar: 50  $\mu$ m). (G) Detail of the female genital aperture (scale bar: 40  $\mu$ m). (H) Tibiotarsus, unguis and unguiculus of leg III.



**Figure 14.** *Deuteraphorura kruberaensis* n. sp. SEM microphotographs. (A) Unguis and unguiculus of leg III. (B) Area of vestigial furca (bar, A and B: 20  $\mu$ m).

**Table 4.** *Deuteraphorura kruberaensis* n. sp. head chaetotaxy. Abbreviations: m, microchaeta; M, macrochaeta; s, sensilla; z, chaeta z. “-” denotes: absence of chaeta.

Chaeta number/serie	0	1	2	3	4	5	6	7
d	m	m	m	m	m	-	-	-
sd	-	m	m	m	m	M	-	-
sd'	-	m	m	-	-	m	-	-
v	-	m	M	m	M	-	-	-
ca	-	-	-	-	-	-	s	-
cm	-	-	m	m	M	m	-	-
cb	-	m	m	m	-	-	s	-
cp	-	m	m	-	m	m	-	-
p	-	m	m	m	z	m	m	-
g	11 chaetae, g <sub>5</sub> as macrochaetae							

maxillary head as in Figure 13D. Unguis without inner or outer teeth; unguiculus with basal lamella (Figures 13H, 14A). Ventral tube with 8 + 8 apical chaetae, without basal chaetae (Figure 13E). Furca reduced to a finely granulated area with 1 + 1 small chaetae backward (Figures 13F and 14B). Typical dorsal pseudocellar formula 34/133/33353, but frequently variable, specially on Abd IV (3–5 pseudocelli), common disposition on Abd IV 3 + 1 + 1 from dorsal axis to lateral, sometimes 1 + 0 + 2. Ventral pseudocellar formula 3/0111/31110. Subcoxae 1 of all legs each with 2 pseudocelli.

**Table 5.** *Deutenaphorura kruberaensis* n. sp. dorsal thoracic chaetotaxy. Abbreviations: m, microchaeta; M, macrochaeta; s, sensilla; ms, microsensilla. “-” denotes: absence of chaeta.

Chaeta number/serie	1	2	3	4	5	6	7
Th I				m	m	-	-
m	-	m	-	m	m	-	-
p	m	-	-	m	M	m	M
Th II							
a	m	m	m	m	m	m	M
m	-	m	m	-	m	m	M (+ ms)
ca	m	-	m	-	m	-	M
cp	-	m	-	m	-	m	M
p	m	-	M	m	M	M	M
Th III							
a	m	m	m	m	m	m	M
m	-	m	m	-	m	m	M
ca	m	-	-	-	m	-	M
cp	-	m	-	m	-	m	-
p	m	-	m	m	M	M	-

**Table 6.** *Deutenaphorura kruberaensis* n. sp. dorsal abdominal chaetotaxy. Abbreviations: m, microchaeta; M, macrochaeta; s, sensilla; z, chaeta z. “-” denotes: absence of chaeta.

Chaeta number/serie	1	2	3	4	5	5'	6	7
Abd I-III								
a	m	mm-	-	m	m-m	-	m	M
m	m	-	-	m	m	-	-	M
ca	-	-	-	-mm	-	-	-	-
p	m	m	s	m	m	-	m	M
Abd IV								
a	m	m	m	-	m	-	m	-
m	m	m	m	m	m	-	-	M
ca	m	m	-	-	m	-	m	M
cp	-	-	-	-	m	m	M	M
p	m	-	-	-	-	-	m	M

### Chaetotaxy

Lateral ms on Th II and III. Distribution of dorsal chaetae as in Figure 12A, 12D and Tables 4-6; asymmetries are common. Chaeta p<sub>0</sub> present on Abd IV and VI. Ratio chaetae M/s = 2.7 on Abd V; longest macrochaetae on Abd VI: 110 µm. Without chaetae on ventral thoracic sternites; ventral chaetotaxy of head as in Figures 12D (dorsal) and 12E (ventral). Female genital area with 20 chaetae (Figure 13G).

Tibiotarsi I, II, and III with 18, 18 and 17 chaetae respectively; distal whorl with 9 chaetae.

**Table 7.** World species of *Deuteraphorura* with its diagnostic characters. Occasional number of pseudocelli between brackets. Abbreviations: PAO, Post Antennal Organ; Ant O III, Antennal Organ III; ves n°, vesicles number; c, composed; s, simple; pap n°, number of guard papillae; s, smooth; r, rough; ant, anterior; post, posterior; Th, thorax; Abd, abdomen. “-” denotes: no data available.

Species	ves n°	PAO	Dorsal pseudocelli				Ventral pseudocelli																	
			shape	pap n°	Ant O III	Head	Th	Abd	Head	Th	Abd													
<i>D. acindeliella</i>	16	c	9	s	3	2	0	1	1	3	3	2	3	-	-	-	-	-	-					
<i>D. akelaris</i>	12–14	s	5	s	3	3	1	3	3	4	5	4	5	4	3	0	1	1	2	2	1	1		
<i>D. ameskoana</i>	12–14	c	5	s	3	4	1	3	3	4	4	4	6	4	3	0	1	1	3	1	1	1	1	
<i>D. angelieri</i>	16–17	c	5	s	3	2	1	3	3	3	3	3	4	2	3	0	1	1	1	2	1	2	2	
<i>D. antheuili</i>	11–16	c	5	-	3	2	1	3	3	3	3	3	5	4	2	0	0	0	0	0	0	0	0	0
<i>D. apuanica</i>	16	c	5	s	3	3	0	3	3	3	3	3	5	3	2	0	1	1	1	2	1	2	2	
<i>D. aralarensis</i>	12–14	c	5	s	3	4	1	3	3	3–4	4	3–4	5	3–4	3	0	1	1	3	2	1	1	1	1
<i>D. arminiaris</i>	12	c	5	s	3	3	1	3	3	3	3	5	4	3	3	0	1	1	2	1	1	2	2	
<i>D. austriaria</i>	15	c	5	s	3	2	1	3	3	3	3	3	5	4	3	0	1	1	3	2	2	2	2	
<i>D. banatica</i>	16	c	5	s	3	2	1	3	3	3	3	3	5	4	3	0	-	-	3	2	2	2	2	
<i>D. bergamaria</i>	20	c	5	s	3	2	1	3	3	3	3	4	5	4	2	0	0	0	2	2	1	2	2	
<i>D. boneti</i>	12–14	c	5	s	3	4	1	3	3	3–4	4–5	3–4	5	4	3	0	1	1	4	1–2	1–2	2	2	
<i>D. boneti</i>	-	c	5	s	3	2	0	3	3	4	4	4	3	3	2	-	-	-	3	2	1	2	1	
<i>D. bosnaria</i>	15	c	5	s	3	2	0	3	3	3	3	3	5	4	3	0	2	2	3	2	1	2	2	
<i>D. caprelleana</i>	-	-	-	-	3	2	0	3	3	3	3	3	5	4	3	0	1	1	3	2	1	2	2	
<i>D. cebennaria</i>	15	c	5	s	3	2	1	3	3	3	3	3	5	4	3	0	1	1	3	2	1	2	2	
<i>D. clossanica</i>	12	c	5	r	3	3	4	1	3	3	3	3	5	3	3	0	1	1	4	1–2	1–2	2	2	
<i>D. defensaria</i>	15	c	5	s	3	2	1	3	3	3	3	3	5	4	2	0	1	1	1	2	1	2	2	
<i>D. diaelleni</i>	20–24	c	5	r	3	4	1	3	3	3	4	4	6	3–4	1	0	0	0	0	0	0	0	1	1
<i>D. difficilis</i>	-	-	-	-	3	2	1	3	3	3	3	3	5	4	3	0	1	1	3	2	1	2	2	

(Continued)

Table 7. (Cont.)

Species	ves n°	PAO	shape	pap n°	Ant O III	Head			Dorsal pseudocelli					Ventral pseudocelli											
						ant	post	I	II	III	Th	I	II	III	IV	V	Head	I	II	III	IV	Abd			
<i>D. donezezbensis</i>	12–14	c	5	s	3	4	1	3	3	4	4	4	4	5–6	4	3	0	1	1	1	3	1	1	1	1
<i>D. dunaria</i>	15	c	5	s	3	2	1	3	3	3	3	3	3	5	4	3	0	1	1	2	2	1	2	1	2
<i>D. eduardi</i>	10–20	c	5	s	3	2	1	3	3	3	3	3	3	3	3	2	0	0	0	1	2	1	2	1	2
<i>D. fazi</i>	16	c	4	s	3	2	1	2	3	3	3	3	3	3	3	0	0	0	0	1	1	1	1	1	1
<i>D. inermis</i>	?	c	?	s	3	2	0	3	3	3	3	3	3	4	3	2–3	0	1	1	1–2	-	-	-	-	-
<i>D. frasassii</i>	-	-	-	-	3	2	0	3	3	3	3	3	3	5	3	3	0	1	1	3	2	1	2	1	2
<i>D. galani</i>	12–14	c	5	s	3	3	1	3	3	3–4	4	3–4	5	4	3	3	0	1	1	4	2	1	2	1	2
<i>D. ganginensis</i>	-	-	-	-	3	2	0	2	2	3	3	3	3	2	1	1	1	1	1	0	1	0	1	0	1
<i>D. gemae</i>	12	c	5	s	3	2	1	3	3	3	3	3	3	5	3	3	0	1	1	3	2	1	2	1	2
<i>D. ghidimii</i>	10–18	c	5	s	3	2	0	3	3	3	3	3	3	5	4	2	0	1	1	2	2	1	2	1	2
<i>D. gizoni</i>	15	c	5	s	3	2	1	3	3	3	3	3	3	5	4	3	0	1	1	0	1	1	1	1	1
<i>D. gridellii</i>	08–12	c	4	s	3	2	0	2	2	3	3	3	3	3	3	2	0	0	0	0	0	0	0	0	0
<i>D. handschimi</i>	15	c	5	s	3	2	0	3	3	3	3	3	3	5	4	2	1	1	3	1	1	1	1	1	1
<i>D. handschimi strinatii</i>	-	c	5	s	3	2	0	3	3	3	3	3	3	4	5	2	0	1	1	2	1	1	1	1	1
<i>D. barrobiensis</i>	12–15	c	5	s	3	3	1	3	3	3–4	4	4	6	4	4	3	0	1	1	4	1	1	1	1	1
<i>D. batagana</i>	19–21	c	5	s	3	2	0	2	2	3	3	3	4	3	3–2	-	-	-	4	2–1	2–1	1	1	1	1
<i>D. haybachae</i>	15	c	5	s	3	2	1	3	3	3	3	3	5	4	3	0	1	1	3	2	2	2	2	2	2
<i>D. hussoni</i>	15	c	5	s	3	2	0	3	3	3	3	3	5	4	2	0	0	0	2	1	1	1	1	1	1
<i>D. imperfecta</i>	14–19	c	5	s	3	2	1	3	3	3	3	3	5	4	3	0	1	1	2	2	1	1	1	1	1
<i>D. inferni</i>	17	c	5	s	5	6	2	3	3	5	6	6	9	5	1	0	1	1	2	2	2	2	2	1	1
<i>D. insubriaria</i>	15–16	c	5	s	3	2	1	3	3	3	3	3	5	3	3	0	1	1	2	2	1	2	1	2	1
<i>D. jana</i>	12	c	4	s	3	2	1	3	3	2	3	3	3	2–3	2	0	0	0	1	1	1	1	0	1–2	
<i>D. jittkae</i>	21	c	5	s	3	3	1	3	3	3	3	3	4	2	1	-	-	-	2–3	2	1	1	1	1	1

(Continued)





Table 7. (Cont.)

Species	ves n°	PAO	shape	pap n°	Ant O III shape	Dorsal pseudocelli			Ventral pseudocelli													
						Head	Th	Abd	Head	Th	Abd											
<i>D. sexpunctata</i>	-	-	-	-	-	I	II	III	I	II	III	I	II	III	IV							
<i>D. silesiaca</i>	14–16	c	5	s	3	2	0	3	3	3	5	2	2	0	2	2	2	2				
<i>D. silvaria</i>	12	c	5	s	3	2	1	3	3	3	3	3	3	0	1	1	3	2	2			
<i>D. sipolae</i>	19	c	5	s	3	2	0	3	4	5	3	5	3–4	-	-	-	2	2	0	2		
<i>D. trauti</i>	26–28	c	5	s	3	2	1	3	3	3	3	4	3	3	0	0	0	1	1	2		
<i>D. trisilvaria</i>	18	c	5	s	3	3	1	3	3	3	3	5	4	3	0	1	1	3	2	1	1	
<i>D. troglocarpathica</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>D. variabilis</i>	10	c	?	s	3	2	1	3	3	3	3	4	3	2	-	-	-	1	1	1	2	
<i>D. verconaria</i>	15	c	5	s	3	2	1	3	3	3	3	5	4	3	0	1	1	3	2	2	2	
<i>D. vinuensis</i>	-	-	-	-	3	2	0	3	3	3	3	3	5	2	3	0	1	1	-	1	-	1
<i>D. zalbidensis</i>	14–17	c	5	s	3	4	1	3	3	4	4	6	4	3	0	1	1	4	2	2	2	

## Discussion

The characters used by Weiner (1996) and Pomorski (1998) in the diagnosis of the genus *Deuteraphorura* are: PAO with compound vesicles, sensory clubs in Ant III organ ovoid, curved (or bent), smooth with one or two ribs in the middle, sensilla on Ant IV slightly marked, two stout sensilla present, and microsensillum (ms) at  $\frac{1}{4}$  the length of the segment, base of antenna well marked, posterior pseudocelli on the head present, Th I with 1 + 1 or 0 + 0 pseudocelli, tergites from Th II to Abd III with few pseudocelli, Abd IV and V with 4–5 + 4–5 and 3 + 3 pseudocelli respectively, sensilla(s) on the body differentiated, rather well marked on the head (2 + 2) and Abd V and VI, chaeta  $d_0$  on the head present, Abd VI with two rows of chaetae,  $a_0$  present, anal spines absent, furcal rudiment with finely granulated area and four small chaetae posteriorly, two manubrial row of chaetae present. The new species has all these characters except the last two: furcal rudiment with finely granulated area and two small chaetae posteriorly, relatively backward, and more than two manubrial row of chaetae.

To ascertain the nature of the latter two characters, we studied the type series of *D. ameskoana* (Beruete et al., 2001), *D. aralarensis* (Beruete et al., 2001), *D. boneti* Gisin, 1953 (Beruete et al., 2001), *D. doneztebensis* (Beruete et al., 2001), *D. labainensis* (Beruete et al., 2001), *D. leitzaensis* (Beruete et al., 2001) and *D. zalbidensis* (Beruete et al., 2001). In those, we observed considerable intraspecific variation, including four small chaetae in a row, four small chaetae in an asymmetric row, four small chaetae in a trapezoidal disposition (with the lesser wide backward), two (in some cases three) small chaetae. In all these species, there are three or four manubrial rows of chaetae. Therefore, we consider that these small differences do not justify erecting a new genus. Also, we have avoided those characters in the key to the species of *Deuteraphorura*.

*Deuteraphorura* contains 77 described species (Table 7). This new species belongs to a group of 10 species with four posterior dorsal cephalic pseudocelli; these species occur in European caves, mostly in Spain (Gisin, 1953, 1962; Gruia, 1965; Neuertz and Nosek, 1976 and Beruete et al, 2001): *D. ameskoana*, *D. aralarensis*, *D. boneti*, *D. closanica* (Gruia, 1965), *D. diaelleni* (Neuhertz and Nosek, 1976), *D. doneztebensis*, *D. labainensis*, *D. leitzaensis*, *D. quadrisilvaria* (Gisin, 1962) and *D. zalbidensis*. They can be distinguished from *D. kruberaensis* n. sp. by the following characteristics: *D. leitzaensis* has two pseudocelli on dorsal Th I; *D. closanica* and *D. diaelleni* has more-like (after Weiner, 1996) sensory clubs in antennal III sense organ; *D. ameskoana*, *D. boneti*, *D. doneztebensis* and *D. zalbidensis* have four pseudocelli on ventral abdominal tergite I, and *D. aralarensis*, *D. labainensis* and *D. quadrisilvaria* have two ventral pseudocelli on abdominal sternite II.

### Key to the world species of *Deuteraphorura*

- |   |  |    |
|---|--|----|
| 1 | Two posterior dorsal cephalic pseudocelli .....            | 2  |
| - | More than 2 posterior dorsal cephalic pseudocelli.....     | 52 |
| 2 | 2 pseudocelli on dorsal anterior part of the head.....     |    |
|   | ..... <i>D. mildneri</i> (Christian, 1985) (Austria, cave) |    |

-	3 pseudocelli on dorsal anterior part of the head.....	3
3	Without pseudocelli on dorsal Th I .....	4
-	Th I with 1 dorsal pseudocellus .....	28
4	Th II–III with 1 dorsal pseudocellus.....	
	..... <i>D. acicindelia</i> (Salmon, 1958) (New Zealand, cave)	
-	Th II–III with more than 1 dorsal pseudocellus.....	5
5	Abd IV with 3 dorsal pseudocelli on.....	6
-	Abd IV with more than 3 dorsal pseudocelli.....	8
6	Abd I–III with 4 dorsal pseudocelli .....	<i>D. boneti</i> (Gisin, 1953) (Spain, cave)
-	Abd I–III with 3 dorsal pseudocelli .....	7
7	Formula of ventral pseudocelli 1/111/0101 .....	
	..... <i>D. gangjinensis</i> (Lee and Kim, 1995) (South Korea, soil)	
-	Formula of ventral pseudocelli 2/000/0000 .....	
	..... <i>D. gridelli</i> (Denis, 1938) (Italy, soil)	
8	Abd IV with 4 dorsal pseudocelli.....	9
-	Abd IV with 5 dorsal pseudocelli.....	15
9	Th II–III with 2 dorsal pseudocelli .....	10
-	Th II–III with 3 dorsal pseudocelli .....	12
10	Ant III sensory organ with 4 papillae.....	
	..... <i>D. nervosa</i> (Stach, 1954) (Europe, cave & surface)	
-	Ant III sensory organ with 5 papillae.....	11
11	PAO with 19–21 compound tubercles.....	
	..... <i>D. hategana</i> (Gruia, 1971) (Romania, cave)	
-	PAO with 15–17 compound tubercles.....	
	..... <i>D. meziadica</i> (Gruia, 1972) (Romania, cave)	
12	Abd V with 2 dorsal pseudocelli .....	
	..... <i>D. oregonensis</i> (Denis, 1929) (USA, cave)	
-	Abd V with more than 2 dorsal pseudocelli .....	13
13	Abd V with 3 dorsal pseudocelli .....	
	..... <i>D. inermis</i> (Tullberg, 1869) Absolon, 1901 (Holarctic and Australia)	
-	Abd V with more than 3 dorsal pseudocelli .....	14
14	Abd V with 4 dorsal pseudocelli.....	<i>D. kratochvili</i> (Nosek, 1963) (Europe, cave)
-	Abd V with 5 dorsal pseudocelli .....	
	..... <i>D. handschini strinatii</i> Gisin, 1963 (Switzerland, cave)	
15	Th II–III with 2 dorsal pseudocelli .....	16
-	Th II–III with 3–3 or 3–4 dorsal pseudocelli .....	17

16	Ventral formula 2/000/0112.....	.....
	..... <i>D. lusa</i> (Christiansen and Bellinger, 1980) (USA and Canada, surface)	
-	Ventral formula 3/011/4212.....	<i>D. romanica</i> (Gruia, 1965) (Romania, cave)
17	Th II–III with 3–3 dorsal pseudocelli .....	18
-	Th II–III with 3–4 dorsal pseudocelli.....	.....
	..... <i>D. spipolae</i> Massera, 1949 (Italy, cave)	
18	Abd V with 2 dorsal pseudocelli .....	19
-	Abd V with more than 2 dorsal pseudocelli .....	20
19	Ventral formula of pseudocelli 2/022/2222 .....	.....
	..... <i>D. silesiaca</i> (Dunger, 1977) (Czechia, Poland and Hungary)	
-	Ventral formula of pseudocelli 3/011/?1?1 .....	.....
	..... <i>D. vinuensis</i> (Simón-Benito and Lucíañez, 1994) (Spain, surface)	
20	Abd V with 3 dorsal pseudocelli .....	21
-	Abd V with 4 dorsal pseudocelli .....	23
21	2 ventral head pseudocelli.....	<i>D. scotaria</i> (Gisin, 1954) (Europe, surface)
-	3 ventral head pseudocelli.....	22
22	Ventral formula of pseudocelli 3/011/3212 .....	.....
	..... <i>D. frasassi</i> (Fanciulli, 1999) (Italy, cave)	
-	Ventral formula of pseudocelli 3/022/3222 .....	.....
	..... <i>D. ossaria</i> (Gisin, 1964) (Italy, cave)	
23	2 ventral head pseudocelli.....	24
-	3 ventral head pseudocelli.....	26
24	Without ventral pseudocelli on Th II–III.....	.....
	..... <i>D. hussoni</i> (Denis, 1935) (Europe, caves)	
-	With ventral pseudocelli on Th II–III.....	25
25	Ventral formula of pseudocelli 2/011/2212 .....	.....
	..... <i>D. ghidinii</i> (Denis, 1938) (Europe, surface)	
-	Ventral formula of pseudocelli 2/-11/3111 .....	.....
	..... <i>D. handschini</i> (Denis, 1925) (Europe, cave)	
26	Th II–III with 2 ventral pseudocelli.....	<i>D. bosnaria</i> (Gisin, 1964) (Bosnia, soil)
-	Th II–III with 1 ventral pseudocellus.....	27
27	Ventral formula of pseudocelli 3/011/2212. ....	.....
	..... <i>D. pseudoghidinii</i> (Dallai, 1969) (Italy, soil and cave)	
-	Ventral formula of pseudocelli 3/011/3212 .....	.....
	..... <i>D. caprelleana</i> Fanciulli, Loreti and Dallai, 2010 (Italy, cave)	
28	Th II with 2 dorsal pseudocelli .....	29
-	Th II with 3 dorsal pseudocelli .....	30

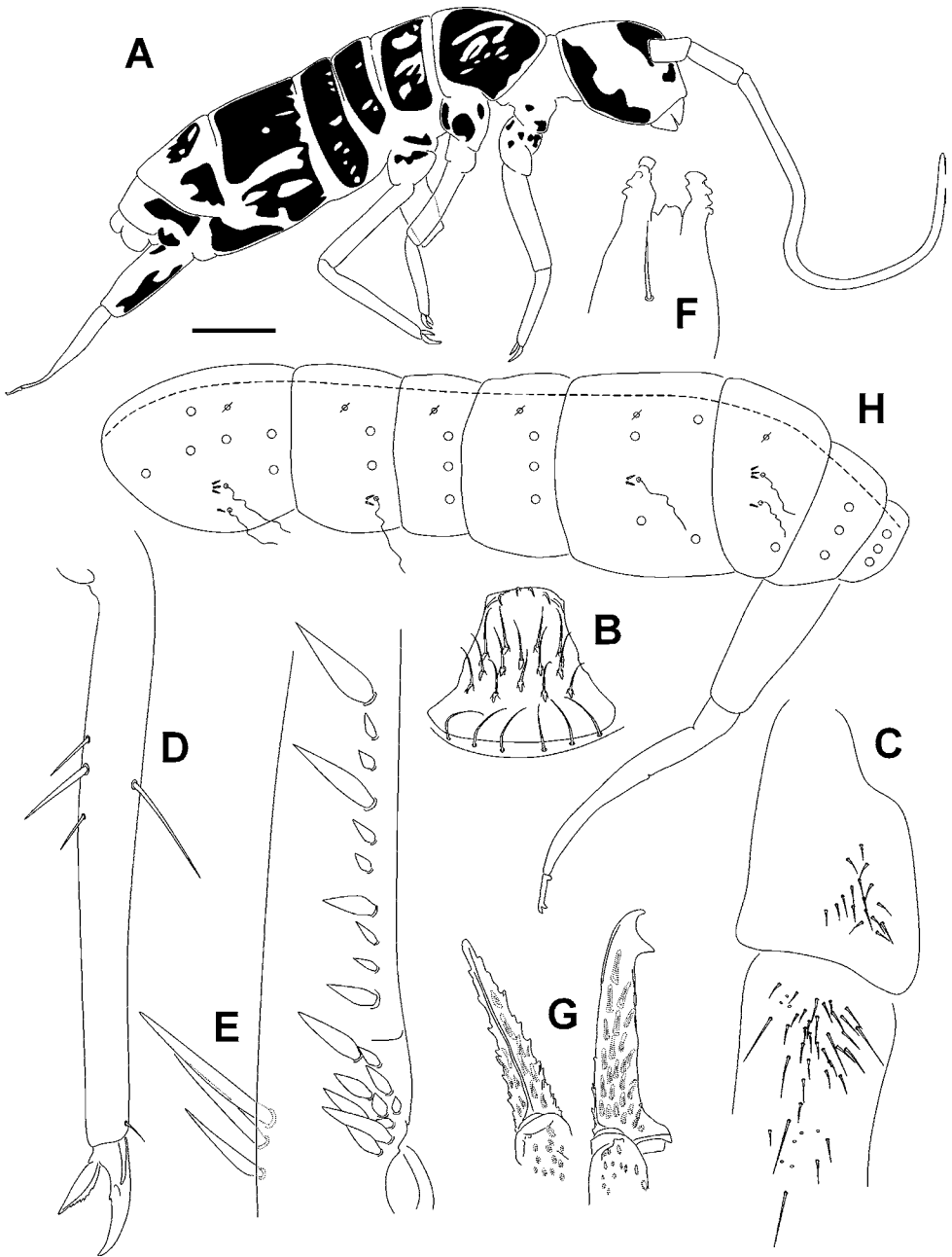
29	Th III with 2 dorsal pseudocelli and Abd IV with 4 dorsal pseudocelli .....	
	..... <i>D. nevoi</i> (Gruia, Poliakov and Broza, 2000) (Israel, soil)	
-	Th III and Abd IV with 3 dorsal pseudocelli.....	
	..... <i>D. fazii</i> (Christiansen, 1956) (Lebanon, soil)	
30	Abd II–III with 4 dorsal pseudocelli .....	
	..... <i>D. bergamaria</i> (Gisin, 1956) (Italy, cave)	
-	Abd II–III with 3 dorsal pseudocelli .....	31
31	Abd IV with 3 dorsal pseudocelli.....	32
-	Abd IV with more than 3 dorsal pseudocelli.....	33
32	Ant III sensory organ with 4 papillae.....	
	..... <i>D. jana</i> (Christiansen and Bellinger 1980) (U.S.A and Mexico, cave?)	
-	Ant III sensory organ with 5 papillae.....	
	..... <i>D. paro</i> (Christiansen and Bellinger 1980) (USA and Canada, cave & soil)	
33	Abd IV with 4 dorsal pseudocelli.....	34
-	Abd IV with 5 dorsal pseudocelli.....	38
34	Abd V with 2 dorsal pseudocelli .....	35
-	Abd V with more than 2 dorsal pseudocelli .....	36
35	Ventral formula of pseudocelli 2/000/2111 .....	
	..... <i>D. paro</i> (Christiansen and Bellinger 1980) (USA and Canada, cave & soil)	
-	Ventral formula of pseudocelli 3/011/1212 .....	
	..... <i>D. angelieri</i> (Izarra, 1968) (France, soil)	
36	With more than 25 vesicles in PAO.....	
	..... <i>D. traiani</i> Gruia and Popa, 2005 (Romania, cave)	
-	With fewer than 21 vesicles in PAO .....	37
37	PAO with 10 vesicles.....	
	..... <i>D. variabilis</i> (Stach, 1954) (Europe, surface)	
-	PAO with 12–20 vesicles.....	
	..... <i>D. opa</i> (Christiansen and Bellinger, 1980) (USA and Mexico, surface & cave)	
38	Abd V with 3 dorsal pseudocelli .....	39
-	Abd V with 4 dorsal pseudocelli .....	44
39	Th I–III without ventral pseudocelli .....	
	..... <i>D. eduardi</i> (Denis, 1937) (Italy and France, surface & cave)	
-	Th I–III with 011 ventral pseudocelli .....	40
40	Abd I–IV with 1212 ventral pseudocelli .....	
	..... <i>D. pseudoinsubraria</i> (Dallai, 1970) (Italy, soil)	
-	With different formula .....	41
41	Abd I–IV with 2212 ventral pseudocelli .....	
	..... <i>D. insubraria</i> (Gisin, 1952) (Europe, surface & cave)	

- With different formula .....	42
42 Abd I–IV with 3212 ventral pseudocelli .....	43
- Abd I–IV with 3222 ventral pseudocelli .....	
..... <i>D. silvaria</i> (Gisin, 1952) (Europe, surface & cave)	
43 Unguiculus with basal lamella, 18–18–17 chaetae on tibiotarsus I, II, III .....	
..... <i>D. mangazeya</i> Babenko, 2007 (Russia, Siberia, soil)	
- Unguiculus without basal lamella, 18–18(20)–18(19) chaetae on tibiotarsus I, II, III.....	
..... <i>D. gemae</i> (Simón-Benito et al., 1994) (Spain, soil)	
44 Head with 2 ventral pseudocelli.....	45
- Head with 3 ventral pseudocelli.....	47
45 Th and Abd without ventral pseudocelli (2/000/0000) .....	
..... <i>D. antheuili</i> (Denis, 1936) (Europe, surface & cave)	
- Th and Abd with ventral pseudocelli.....	46
46 Ventral pseudocelli formula 2/011/1212.....	
..... <i>D. defensaria</i> (Gisin, 1964) (Italy, cave)	
- Ventral pseudocelli formula 2/011/2212.....	
..... <i>D. imperfecta</i> sensu Denis, 1938 nec Gisin 1952 (Europe, surface & cave)	
47 Abd I with fewer than 3 ventral pseudocelli.....	48
- Abd I with 3 ventral pseudocelli .....	49
48 Ventral pseudocelli formula 3/011/0111.....	
..... <i>D. gigoni</i> (Gisin, 1962) (Europe, cave)	
- Ventral pseudocelli formula 3/011/2212.....	
..... <i>D. dunaria</i> Gisin, 1956 (Europe, cave)	
49 Ventral pseudocelli formula 3/011/3212.....	
..... <i>D. cebennaria</i> (Gisin, 1956) (Europe, cave)	
- Ventral Abd I–IV pseudocelli formula 3222 .....	50
50 Unguiculus with basal lamella and subcoxa with 1 pseudocellus .....	
..... <i>D. banatica</i> (Gruia, 1965) (Romania, cave)	
- Unguiculus without basal lamella .....	51
51 Subcoxa with 2 pseudocelli.....	
..... <i>D. haybachae</i> (Gisin, 1962) ( <i>D. austriaria</i> possible synonym) (Austria, cave)	
- Subcoxa with 3 pseudocelli..... <i>D. vercoraria</i> (Gisin, 1963) (Europe, surface)	
52 Head with 3 posterodorsal pseudocelli.....	53
- Head with more than 3 posterodorsal pseudocelli.....	65
53 Th I without dorsal pseudocelli.....	54
- Th I with 1 pseudocellus.....	58
54 Abd V with 3 dorsal pseudocelli .....	56
- Abd V with 4 dorsal pseudocelli .....	55

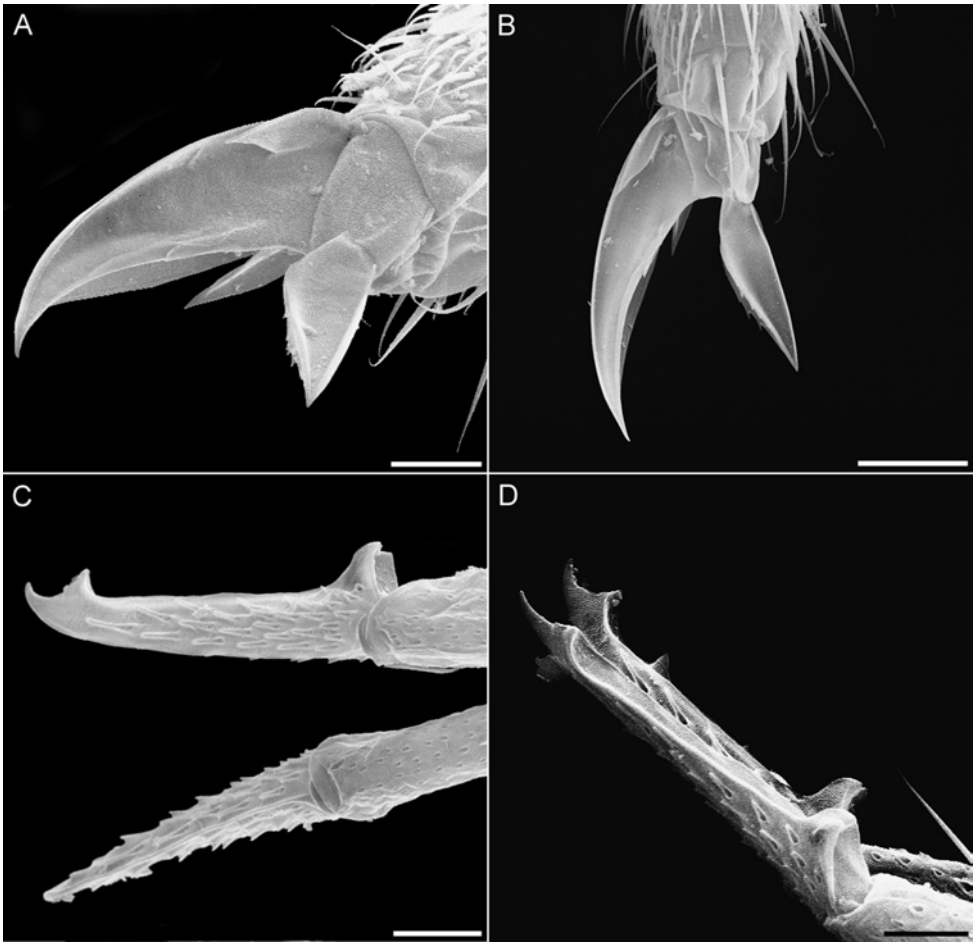
55	Abd I–II with 4 dorsal pseudocelli.....	.....
	.....	<i>D. pseudofimetaria</i> (Folsom, 1917) (USA, cave & surface)
-	Abd I–II with 3 dorsal pseudocelli.....	.....
	.....	<i>D. rendsinae</i> (Haybach, 1962) (Austria, soil)
56	Head with 2 ventral pseudocelli (ventral formula 2/0111/.....)	57
-	Head with 3 ventral pseudocelli (ventral formula 3/022/3212).....	.....
	.....	<i>D. pseudobosnaria</i> (Dallai, 1970) (Italy, soil)
57	Abd I–IV with 1212 ventral pseudocelli.....	.....
	.....	<i>D. apuanica</i> (Dallai, 1970) (Italy, soil)
-	Abd I–IV with 1111 ventral pseudocelli.....	.....
	.....	<i>D. pseudofimetaria</i> (Folsom, 1917) (USA, cave & surface)
58	Abd IV with 4 dorsal pseudocelli.....	<i>D. jitkae</i> (Rusek, 1964) (Slovakia, soil)
-	Abd IV with more than 4 dorsal pseudocelli.....	59
59	Abd IV with 5 dorsal pseudocelli.....	60
-	Abd IV with 6 dorsal pseudocelli.....	.....
	.....	<i>D. harrobiensis</i> (Beruete et al., 2001) (Spain, cave)
60	Abd II with 3 dorsal pseudocelli.....	62
-	Abd II with more than 3 dorsal pseudocelli.....	61
61	Abd II with 4 dorsal pseudocelli.....	.....
	.....	<i>D. galani</i> (Beruete et al., 2001) (Spain, cave)
-	Abd II with 5 dorsal pseudocelli.....	<i>D. boneti</i> (Gisin, 1953) (Spain, cave)
62	Abd V with 3 dorsal pseudocelli.....	.....
	.....	<i>D. closanica</i> (Gruia, 1965) (Romania, cave)
-	Abd V with 4 dorsal pseudocelli.....	63
63	Ventral pseudoceli formula 3/011/2112.....	.....
	.....	<i>D. arminiaria</i> (Gisin, 1961) (Austria, cave)
-	With different formula.....	64
64	Ventral pseudocelli formula 3/011/3211.....	.....
	.....	<i>D. trisilvaria</i> (Gisin, 1962) (Austria, cave)
-	Ventral pseudocelli formula 3/011/4222.....	.....
	.....	<i>D. kosarovi</i> (Zonev, 1973) (Bulgaria, soil)
65	Head with 4 posterodorsal pseudocelli.....	66
-	Head with 6 posterodorsal pseudocelli.....	.....
	.....	<i>D. inferni</i> Gisin, 1956 (Switzerland, cave)
66	Th I with 1 dorsal pseudocellus.....	67
-	Th I with 2 dorsal pseudocelli.....	.....
	.....	<i>D. leitzaensis</i> (Beruete et al., 2001) (Spain, cave)



67	Abd V with 3 dorsal pseudocelli .....	68
-	Abd V with 4 dorsal pseudocelli .....	70
68	Abd II–III with 3–3 dorsal pseudocelli .....	69
-	Abd II–III with 4–4 dorsal pseudocelli .....	
	..... <i>D. diaelleni</i> (Neuherz and Nosek, 1976) (Austria, cave)	
69	PAO with 12 compound tubercles, ventral formula as 3/011/3212 .....	
	..... <i>D. closanica</i> (Gruia, 1965) (Romania, cave)	
-	PAO with 19–24 compound tubercles, ventral pseudocelli formula 3/011/3111 .....	
	..... <i>D. kruberaensis</i> n. sp.	
70	Abd II with 2 dorsal pseudocelli .....	
	..... <i>D. quadrisilvaria</i> (Gisin, 1962) (Austria, cave)	
-	Abd II with more than 2 pseudocelli .....	71
71	Abd II with 4 dorsal pseudocelli .....	72
-	Abd II with 5 dorsal pseudocelli .....	<i>D. boneti</i> (Gisin, 1953) ) (Spain, cave)
72	Abd IV with 3 dorsal pseudocelli .....	
	..... <i>D. aralarensis</i> (Beruete et al., 2001) (Spain, cave)	
-	Abd IV with 5–6 dorsal pseudocelli .....	73
73	Abd IV with 5 dorsal pseudocelli .....	74
-	Abd IV with 6 dorsal pseudocelli .....	75
74	Abd IV with 1 ventral pseudocellus (3/011/2 + 1111) .....	
	..... <i>D. doneztebensis</i> (Beruete et al., 2001) (Spain, cave)	
-	Abd IV with 2 ventral pseudocelli (3/011/3 + 11–21–22) .....	
	..... <i>D. boneti</i> (Gisin, 1953) (Spain, cave)	
75	PAO with 20–24 compound vesicles .....	
	..... <i>D. diaelleni</i> (Neuherz and Nosek, 1976) (Austria, cave)	
-	PAO with fewer than 18 compound vesicles .....	76
76	Abd II with 1 ventral pseudocellus .....	77
-	Abd II with 2 ventral pseudocelli .....	78
77	Ventral pseudocelli formula 3/011/2 + 1211 .....	
	..... <i>D. labainensis</i> (Beruete et al., 2001) (Spain, cave)	
-	Ventral pseudocelli formula 3/011/3 + 1222 .....	
	..... <i>D. zalbidensis</i> (Beruete et al., 2001) (Spain, cave)	
78	Chaeta $m_7$ present on Th II–III .....	
	..... <i>D. doneztebensis</i> (Beruete et al., 2001) (Spain, cave)	
-	Chaeta $m_7$ absent on Th II–III .....	
	..... <i>D. ameskoanus</i> (Beruete et al., 2001) (Spain, cave)	



**Figure 15.** *Plutomurus ortobalaganensis* n. sp. (A) Lateral habitus showing colour pattern (scale bar: 500  $\mu\text{m}$ ). (B) Labrum and prelabral chaetae. (C) Trochanter and basal femur, showing the trochanteral organ. (D) Leg III tibiotarsus, showing the shape of chaetae and spine-like chaeta. (E) Basal dental spines. (F) Tenaculum. (G) Detail of the mucro. (H) Body macrochaetotaxy ( $\emptyset$ , pseudopore; O, macrochaetae).



**Figure 16.** *Plutomurus ortobalaganensis* n. sp. SEM microphotographs. (A–B) Unguis and unguiculus of leg III. (C–D) Mucro in different views (bars, A, C and D: 20  $\mu$ m; B: 40  $\mu$ m).

***Plutomurus ortobalaganensis* Jordana and Baquero n. sp.**

(Figures 15–16)

*Type locality*

Krubera Cave (called too Voronya Cave or Voronja Cave), Arabika Massif, Gagrinsky Range of the Western Caucasus, Gagra district of Abkhazia (Ortobalagan).

*Type material*

Holotype (female) on slide, -70 m from entrance (2420 m above sea level), pitfall trap, between 26.VII.2010 to 24.VIII.2010. Coordinates: lat 43.409722°, long 40.362222° (43°24'35.00"N, 40°21'44.00"E). CaveX Team leg. Paratypes: 9 from -70 m (one female on slide, one on SEM stub and 7 in ethyl alcohol); 4 from -1980 m (ethyl

**Table 8.** World species of *Plutomurus* with its principal diagnostic characters. Abbreviations: ten, tenent hair; spin. tib., spine-like chaetae on tibiotarsus; ung. teeth, number of teeth on inner unguis; ung., number of teeth on unguiculus; prelab., number of prelabral chaetae; troch/fem, trochanteral organ, number of chaetae on trochanter and femur, respectively; mucro (b/s/a), number of teeth or denticles on basal, subapical and apical mucro; Refs., references used: 1, Kniss and Thibaud, 1999; 2, Djanashevili and Barjadze, 2010; 3, Suma, 1981; 4, Christiansen and Bellingier, 1998; 5, Yosii, 1967; 6, Folsom, 1913; 7, Rusek and Weiner, 1978; 8, Christiansen, 1980; 9, Yosii, 1966; 10, Lee, 1975; 11, Yoshii, 1991; 12, Börner, 1901; 13, Denis, 1932; 14, Yosii, 1956. 1\*: following Denis, 1932. “-” denotes: no data available.

species	cave (c) soil (s)	dental spines ("I" denotes "big spine")	ten.	spin. tib.	ung. teeth	ung.	eyes	prelab.	troch/fem	mucro (b/s/a)	Refs.
<i>P. abebasicus</i>	s	7-8 III/5 I 3 I	p	002	3	1	6	2+2	30/24	2/0/2	1
<i>P. baskirkiricus</i>	c	6-9/9-13 I (6-8 I/9-13 I)	c	002	3-4	3-4	6	2+2	17/20	2/0/2	1, 2
<i>P. belozerovi</i>	s	4-6 I-II/12 I	c	012	3-4	1	6	2+2	-	1/0/2	1
<i>P. birsteini</i>	c	5-15 I-III/2-9 I 0-3 0-I 0-3 0-I 0-3 0-I 0-2 0-I 0-2 0-I	c	001	2-4	0	6	2+2	40	2/0/2	2
<i>P. borealis</i>	s	6-10/10-15 I	c	011	3-4	1	6	2+2	30-36/ 26-30	?/0/2	3
<i>P. brevimacronatus</i>	s	4-7 I-II/3-4 I 3-6 I	p-c	-	1-2	0	6	2+2	12/16	1/1/2	4, 5
<i>P. californicus</i>	c; s	7-9 I/2-3 I 1-3 I 2 I	p	002	2-3	0	0	2+2	28/17	1-2/4/2	5, 6
<i>P. carpaticus</i>	s	4 I/0-2 I 1-2 I 1-4 I	c	001	2	0	6	2+2	15-18/7-9	2/0-1/2	7
<i>P. diversispinus</i>	c	10-12/2-4 I 3-4 I 2 I 2-3 I	p	-	3	0	2	2+2	35/25	2/2-4/2	5, 9
<i>P. edaphicus</i>	s	5-8/5 I 2 I	c	001	3	0	6	2+2	10/15	1/1/2	3, 5, 7
<i>P. ebimensis</i>	c	8/3 I 1-2 I 2 I	p	002	1-2	0	0	3+3	-	1/1/2	5
<i>P. grabami</i>	s	2-4 I-II 1-2 I 1-3 I 2 I	c	000	3-4	2-3	0	3+3	14-23/ 25-49	2/2/2	4, 8
<i>P. gul</i>	c	8-12/1-5 I 1 I 1 I 1-2 I	p	-	1	0-3	0	3+3	20-35/ 20-35	2/1/2	5, 9, 10
<i>P. iwatensis</i>	c	9 3 I 1 I 1 I 2 I	p	-	1	5-6	0	3+3	10/15	2/0/2	11
<i>P. jeleznowodski</i>	c	4-5 I/6 I 3 I	c	001	3	1	6	2+2	17/25	2/0/2	1

(Continued)

Table 8. (Cont.)

species	cave (c) soil (s)	dental spines ("I" denotes "big spine")	ten.	spin. tib.	ung. teeth	ung.	eyes	prelab.	troch/ fem	muco (b/s/a)	Refs.
<i>P. kawasawai</i>	c	8/2-3 I 2 I 2 I	p	002	1-2	0	0	3+3	20/20	2/0/2	5
<i>P. kelasuricus</i>	c	11-13 I-III/4-6 I 1 I 1 I 1 I 2 I 2 I 3	p	001	1	1-2	6	3+3	30/43	2/0/2	1
<i>P. leei</i>	c	8-10/8-10 I	p	-	3	0	3	2+2	35/25	2/2-4/2	5, 9
<i>P. marmorarius</i>	c	10/3 I 2-3 I 1 I	p	-	1	0	0	4+4	30/25	1/1/2	5
<i>P. ortobalaganensis</i> n. sp.	c	7-9 I/I 2-3 I 2-3 I 2 I	p	001	1	5-6	0	3+3	17/35	2/0/2	
<i>P. riugadoensis</i>	c	8-10/4-5 I 2 I 2 I	p	002	4-5	1	5	2+2	40/40	2/3-4/2	5
<i>P. sorosi</i>	c	7-8 I-II/5 I 3 I 3 I	p	001	2-3	2-4	4-5	2+2	-	2/0/5	1
<i>P. suzukenensis</i>	c	10/3 I 2 I 2 I	p	002	3	0	0	2+2	35/40	1/1/2	5
<i>P. unidentatus</i>	c	5 I/9 I	c	-	2(1*)	1	6	-	-	2/0/2-3	12, 13
<i>P. viginiferispina</i>	c	6 I/5 I 1 1 1 2 I	c	-	5	0	6	2+2	30/40	2/2-4/2	10
<i>P. wilkeyi</i>	c; s	3-8 II-III/0-3 I 1-3 I 2-4 I	c	002	3-4	1	6	2+2	25/22	2/2-4/2	4, 5
<i>P. yamatensis</i>	c	8-14/4-6 I 2-3 I 2-3 I	p	002	1	0	0	2+2	20/35	1/0/2	5, 14

alcohol). Deposited in Museu de Valencia (Holotype and 3 Paratypes) and MZNA (2 Paratypes).

### *Etymology*

From Ortobalagan, meaning “nearby settlement”.

### *Description*

Body length up to 3.8 mm excluding antennae (mean 3.0 with  $n = 16$ ). Body background greyish, with patches of darker pigmentation over the whole body except on antennae, legs (trochanter to tibiotarsi) and dentes; colour pattern as in Figure 15A.

*Head.* Eye patch small, divided into two subpatches but without exterior corneoles (as seen with SEM). Ratio body/antennae length 0.8 ( $n = 2$ ). Prelabral chaetae: 3 + 3, labrum 5, 5, 4 and 4 curved chaetae on distal part of labrum (Figure 15B).

*Body.* Trochanteral organ well developed on trochanter and femur, with 17/40 chaetae respectively, a few chaetae longer than the rest (Figure 15C). Ventral tube with 35–40 chaetae. Spine-like chaetae absent on tibiotarsus I and II, 1 such chaeta on tibiotarsus (formula 001) (Figure 15D). Unguis with 1 or 2 internal teeth (if 2, paired), at 40% of the unguis length from the base of unguis; unguiculus blade-like, with serrate external edge after middle point, and almost to its tip (Figure 16A–B); tenent hair very short, pointed (0.27 times length of unguis). Ratio of unguis, unguiculus and tenent hair 17:10:5. Unguis with a thin pseudonychia, 0.42 times length of inner edge of unguis. Tenaculum with 4 + 4 teeth and 1 chaeta on corpus (Figure 15F). Ratio of manubrium, dens and mucro 5.4 : 8.6 : 1. Outer margin of dens with 3 thick spine-like chaetae. Dental formula: 7–9 **I** / **I** 2–3 **I** 2–3 **I** 2 **I** (dental big spines in Roman and bold) (Figure 15E). Mucro with 2 basal, fused denticles, without subapical denticles, and 2 distal teeth (Figures 15G, 16C–D).

### *Chaetotaxy*

Macrochaetotaxy and trichobothrial patterns in Figure 15H. Dorsal macrochaetae: Th II–III with 6–2 macrochaetae respectively; Abd I–VI with 3–3–4–1–3–3 macrochaetae respectively. Trichobothrial formula 0/2–1/0–0–1–2–0. Trichobothrium with 1–3 small anterior chaetae.

### *Discussion*

Of the 26 known *Plutomurus* spp. (Table 8) 9 lack eyes altogether. *Plutomurus ortobalaganensis* n. sp. differs from these 9 species by the following combination of characters: 3 + 3 prelabral chaetae; subapical denticles lacking on mucro; unguiculus with internal teeth, and dental spine formula 7–9 **I** / **I** 2–3 **I** 2–3 **I** 2 **I**. Five of the 9 species have 3 + 3 prelabral chaetae, but only 2 of the 5 have a similar mucronal denticles formula: 2/0/2 (basal/subapical/apical); *P. kawasawai* has no denticles on unguiculus. The remaining species, *P. iwaiensis*, can be distinguished by its dental spine formula (9 3/**I** 1 **I** 1 **I** 2 **I**) and the trochanteral organ (10/15 chaetae on trochanter and femur

respectively). Three *Plutomurus* spp. have been described from Georgia (*P. abchasicus*, *P. birsteini* and *P. kelasuricus*), but all have six eyes on each side.

### Key to the world species of *Plutomurus*

(In the dental spine formula “I” denotes “large spine”).

- |    |  |  |
|----|--|--|
| 1  | With 6 eyes on each side of the head .....   | 2  |
| -  | With fewer than 6 eyes .....   | 14   |
| 2  | With subapical denticles on mucro.....   | 3  |
| -  | Without subapical denticles on mucro.....  | 7  |
| 3  | Two to four subapical denticles on mucro.....  | 4  |
| -  | One subapical denticle on mucro .....  | 5  |
| 4  | Unguiculus without tooth .....   | <i>P. vigintiferispina</i> Lee, 1974 (South Korea, cave) |
| -  | Unguiculus with 1 tooth .....  | <i>P. wilkeyi</i> Christiansen, 1964 (USA, cave)         |
| 5  | Mucro with 1 basal tooth .....   | 6  |
| -  | Mucro with 2 basal teeth .....   |  |
|    | ..... <i>P. carpaticus</i> Rusek and Weiner, 1978 (Carpatian, mts., cave & soil)   |  |
| 6  | Unguis with 1–2 internal teeth; dental spine formula 4–7 I–II/3–4 I 3–6 I .....  |  |
|    | ..... <i>P. brevimumcronatus</i> Denis, 1928 (USA, soil and cave)  |  |
| -  | Unguis with 3 internal teeth; dental spine formula 5–8/5 I 2 I.....  |  |
|    | ..... <i>P. edaphicus</i> Yosii, 1967 (Japan, soil)  |  |
| 7  | Tenent hair clavate.....   | 8  |
| -  | Tenen hair pointed .....   | 13   |
| 8  | Unguiculus without internal tooth .....  |  |
|    | ..... <i>P. birsteini</i> Djanashvili and Barjadze, 2011 (Georgia, cave)   |  |
| -  | Unguiculus with internal tooth.....  | 9  |
| 9  | Dental spine formula 5 I/9 I.....  | <i>P. unidentatus</i> (Börner, 1901) (Europe, cave)      |
| -  | Different dental spine formula.....  | 10   |
| 10 | Spine-like chaetae on tibiotarsus I, II and III: 011 .....   |  |
|    | ..... <i>P. borealis</i> Suma, 1981 (Japan, soil)  |  |
| -  | Spine-like chaetae on tibiotarsus I, II and III: 001, 012 or 002.....  | 11   |
| 11 | Mucro with 1 basal tooth; dental spine formula 4–6 I –2/12 I; one spine-like chaeta on tibiotarsi II and two on tibiotarsi III ..... |  |
|    | ..... <i>P. belozeroovi</i> Martynova, 1977 (Sakhalin Isl. Russia, soil)   |  |
| -  | Mucro with 2 basal teeth. ....   | 12   |
| 12 | One spine-like chaeta on tibiotarsus III; dental spine formula 4–5 I /6 I 3 I.....   |  |
|    | ..... <i>P. jeleznovodski</i> Kniss and Thibaud, 1999 (Caucasus, Russia, cave)   |  |

- Two spine-like chaetae on tibiotarsus III; dental spines formula 6–9/9–13 I.....  
..... *P. baschkiricus* (Skorikov, 1900) (Europe, cave)
- 13 One spine-like chaetae on tibiotarsus III; prelabral chaetae 3 + 3.....  
..... *P. kelasuricus* Martynova, 1969 (Georgia, cave)
- Two spine-like chaetae on tibiotarsus III; prelabral chaetae 2 + 2.....  
..... *P. abchasicus* Martynova, 1969 (Abkhazia, cave)
- 14 With 4–5 eyes ..... 15
- With fewer than 4 eyes ..... 16
- 15 With 3 or 4 subapical denticles on mucro .....  
..... *P. riugadoensis* (Yosii, 1939) Yosii, 1956 (Japan, cave)
- Without subapical denticles on mucro.....  
..... *P. sorosi* Kniss and Thibaud, 1999 (Russia, cave)
- 16 With 3 eyes ..... *P. leei* Yosii, 1966 (South Korea, cave)
- Without or with 2 eyes ..... 17
- 17 With 2 eyes ..... *P. diversispinus* Yosii, 1966 (South Korea, cave)
- Without eyes ..... 18
- 18 Prelabral chaetae 4 + 4..... *P. marmorarius* Yosii, 1967 (Japan, cave)
- Prelabral chaetae 2 + 2 or 3 + 3..... 19
- 19 Prelabral chaetae 3 + 3..... 20
- Prelabral chaetae 2 + 2..... 25
- 20 Without subapical denticles on mucro..... 21
- With subapical denticles on mucro..... 23
- 21 Unguiculus without internal tooth ..... *P. kawasawai* Yosii, 1956 (Japan, cave)
- Unguiculus with internal tooth..... 22
- 22 Dental spine formula 9 3/ I 1 I 1 I 2 I..... *P. iwatensis* Yosii, 1991 (Japan, cave)
- Dental spine formula 7–9 I / I 2–3 I 2–3 I 2 I..... *P. ortobalaganensis* n. sp.
- 23 Unguis with 3 or 4 internal teeth.....  
..... *P. grahami* Christiansen, 1980 (USA, cave & soil)
- Unguis with 1 or 2 internal teeth..... 24
- 24 Dental spine formula 8/3 I 1–2 I 2 I ..... *P. ehimensis* Yosii, 1956 (Japan, cave)
- Dental spine formula 8–12/1–5 I 1 I 1 I 1–2 I.....  
..... *P. gul* Yosii, 1956 (South Korea, cave)
- 25 Without subapical denticles on mucro..... *P. yamatensis* Yosii, 1956 (Japan, cave)
- With subapical denticles on mucro..... 26
- 26 With 1 subapical denticle on mucro..... *P. suzukaensis* Yosii, 1956 (Japan, cave)
- With 4 subapical denticles on mucro.....  
..... *P. californicus* (Folsom, 1913) (California, cave).



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