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NEW SPECIES OF *DEUTERAPHORURA* (COLLEMBOLA: ONYCHIURIDAE) FROM ROMANIA

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ABSTRACT

The description of two new species of the genus *Deuteraphorura* Absolon, 1901 from Doftana Valley, Romania is given. *Deuteraphorura diana* **sp. nov.** has the pseudocellar formula dorsally: 32/033/33353 and ventrally: 3/011/3112. *Deuteraphorura doftana* **sp. nov.** is characterized by its dorsal (33/033/33354) and ventral (3/011/3212) pseudocellar formulae. A proposed key to the all species of *Deuteraphorura* from the world without pseudocelli on the thoracic tergum I is also presented.

Key Words: taxonomy, chaetotaxy, *Deuteraphorura diana* **sp. nov.**, *D. doftana* **sp. nov.**, Doftana Valley

RESUMEN

En el presente trabajo se da la descripción de dos nuevas especies del género *Deuteraphorura* Absolon, 1901 del Valle de Doftana, Rumanía. *Deuteraphorura diana* **sp. nov.** tiene la siguiente fórmula de pseudocelos: dorsalmente 32/033/33353 y ventralmente 3/011/3112. *Deuteraphorura doftana* **sp. nov.** tiene la fórmula de pseudocelos dorsal 33/033/33354 y ventral 3/011/3212. Se presenta la clave de todas las especies de *Deuteraphorura* del mundo sin pseudocelos en el terguito torácico I.

Palabras Clave: taxonomía, chaetotaxia, *Deuteraphorura diana* **sp. nov.**, *D. doftana* **sp. nov.**, Valle de Doftana

The genus *Deuteraphorura* Absolon, 1901 is the second largest after *Protaphorura* within the family Onychiuridae (Bellinger et al. 1996-2013) and includes 78 species in the world (Jordana et al. 2012; Dallai & Fanciulli 2009). The genus is characterized by the shape of the postantennal organ with numerous (11-20), compound vesicles, antennal III sense organ with 5 papillae and 2 ribbed sensory clubs, the presence of the chaeta d0 on head and chaeta p0 on abdominal tergum IV, abdominal tergum VI with 1 medial chaeta, tibiotarsal distal whorl with 9 chaetae, furcal area with 2+2 chaeta in 1 row (Weiner 1996; Pomorski 1998) and usually 2 manubrial rows mm and mp, chaetae from the ma row displaced on the level of dental microchaetae, male ventral organ usually present and anal spines absent. Recently Jordana et al. (2012) provided a key to all species of *Deuteraphorura* of the world, but without *D. banii* Dallai & Fanciulli 2009, which belongs to the unformed group of species without pseudocelli on thoracic tergum I. A key to the species without pseudocelli on thoracic tergum I

is proposed herein based mainly on the key and Table 7 elaborated by Jordana et al. (2012). Some of misunderstandings in the key and in the table were replaced according to the new redescription (Fanciulli et al. 2010) and a proper interpretation (Gruia 1965; Simon & Lucíañez 1994).

The Romanian fauna of *Deuteraphorura* consists of 11 species (Fiera 2007), which were mainly found in caves and described by Gruia (1965, 1971, 1972) and Gruia & Popa (2005). Six of them seem to be endemic for Romanian springtail fauna. In the present paper we describe 2 new species of *Deuteraphorura* from forest soils of Romania. This work is the second contribution on the discovery of new species of Collembola from Doftana Valley (Fiera et al. 2013).

MATERIALS AND METHODS

The specimens were cleared in lactic acid and KOH, and subsequently mounted on slides using Marc Andre II's or Swan's medium. Drawings and

measurements were done using a phase contrast microscope LEICA DM2500 equipped with camera lucida. In the description of the new species we used the nomenclature of morphological features as proposed by Weiner (1996), Pomorski (1998), Fjellberg (1999) and Jordana et al. (2012).

Abbreviations: Th.—thoracic segment, Abd.—abdominal segment, Ant.—antennal segment, AIIIO—sensory organ of antennal segment III, PAO—postantennal sense organ, pso—pseudocellus, psp—pseudopore, psx—parapseudocellus, VT—ventral tube, ma, mm, mp—manubrial rows a, m and p; mvo—male ventral organ, IBB—Institute of Biology Bucharest (Romania); ISEA—Institute of Systematics and Evolution of Animals (Poland).

DEUTERAPHORURA DIANAE SP. NOV.
(FIGS. 1-7; TABLE 1)

Material Examined

HOLOTYPE female, ROMANIA, Teleajen Subcarpathians (included in Curvature Subcarpathians), Șotriile village, Prahova County, Doftana Valley, N 45° 13' 39" E 25° 43' 44", 110-year old forest with *Quercus petraea* Liebl. and *Fagus sylvatica* L., 650 m altitude, low productivity and moder humus, low trophicity, little available water, pH 4.0-5.5 (Paucă-Comănescu et al. 2009), mosses on dead tree, 28-X-2010, C. Fiera (IBB). **PARATYPES** 4 females and 3 males, data same as Holotype (2 females and 2 males in IBB, 2 females and 1 male in ISEA). Other material: 2 males and 2 juveniles, Doftana Valley, near to Voila village, N 45° 09' 58" E 25° 45' 10", *Quercus petraea* (Mattuschka) Liebl. and *Fagus sylvatica* L., 100-yr old mixed forest, 500 m altitude, medium trophicity, water is permanently available, soil with pH 5.8-6.8 (Vasilii-Oromulu et al. 2007-2008), 27-IV-2006, C. Fiera.

Description

Length of holotype 0.98 mm, length of paratypes: 0.81-1.04 mm (females), 0.79-0.88 mm (males). Shape of body typical for the genus: cylindrical without anal spines (Fig. 1). Color in alcohol, white. Granulation more or less uniform, distinct. Usually 10-11 grains around each pseudocellus.

Antennae almost of the same length as head. Ant. I-IV and antennal base well marked. Ant. I with 7 chaetae, Ant. II with 14 chaetae. AIIIO with 5 guard chaetae, 5 papillae, 2 smooth sensory rods, 2 ovoid, curved and ribbed sensory clubs, ventro-lateral microsensillum present. Ant. IV with subapical organite, and latero-external microsensillum, ca. ¼ length from the base (Fig. 3).

PAO with 11 compound vesicles (Fig. 2). Labral formula of chaetae: 4/142. Maxillary outer lobe

with simple palp, basal chaeta and with 2 sublobal hairs. Labial palp of AB-type (Fig. 4).

Pseudocellar formula dorsally: 32/033/33353 (Table 1); ventrally: 3/011/3112. Pseudocelli on Abd. I sternum arranged as in Fig. 6. Subcoxae 1 of I-III legs with 2,2,2 (pso). Parapseudocellar formula ventrally on Abd. IVI sterna: /111001^m (^m—single psx on upper anal valve). Subcoxae 1 of I-III legs without (psx). Pseudopores formula dorsally: 11/1111, ventrally: 011/0??1^m (^m—single psp in medial position at the base of manubrial area) (Fig. 6).

Dorsal chaetotaxy, usually symmetrical, as in Fig. 1, slightly differentiated into macrochaetae and microchaetae. Sensory chaetae s not especially distinct, their formula per half tergum 2/022/222121. Th. I with 7+7 chaetae, chaeta m absent. Th. II and III with lateral microsensilla. Head with seta d0. Abd. IV with medial chaeta p0. Abd. V without medial chaetae. Abd. VI with one medial chaeta m0 as macrochaeta. Th. sterna I-III without chaetae. Subcoxae 1 of I, II and III legs with 4, 4-5,4-5 chaetae, subcoxae 2 with 0,4,3 chaetae, coxae with 3,10,12-13 chaetae, trochanters with 9 chaetae each, femora with 15, 15, 14 chaetae, tibiotarsi with 4 rows of chaetae: distal whorl = A+T rows, and rows B and C with 18(9 + 7 + 2), 18(9 + 8 + 1), 17(9 + 7 + 1) chaetae respectively. Chaeta M present in row B. Claw always without denticle. Empodial appendage shorter than claw (¾ of inner edge of the claw), with small basal lamella (Fig. 7).

Ventral chaetotaxy of Abd. sterna I-VI as in Fig. 6. VT with 6+6 chaetae, and without chaetae at base. Furcal area with 2+2 chaeta in one row, 2 manubrial rows mm and mp, m-row with 3+3, p-row with 2+2 chaetae – external ones as macrochaetae), chaetae from the ma row displaced on the level of dental microchaetae (Fig. 6). Male ventral organ absent in the preadult specimens.

Etymology

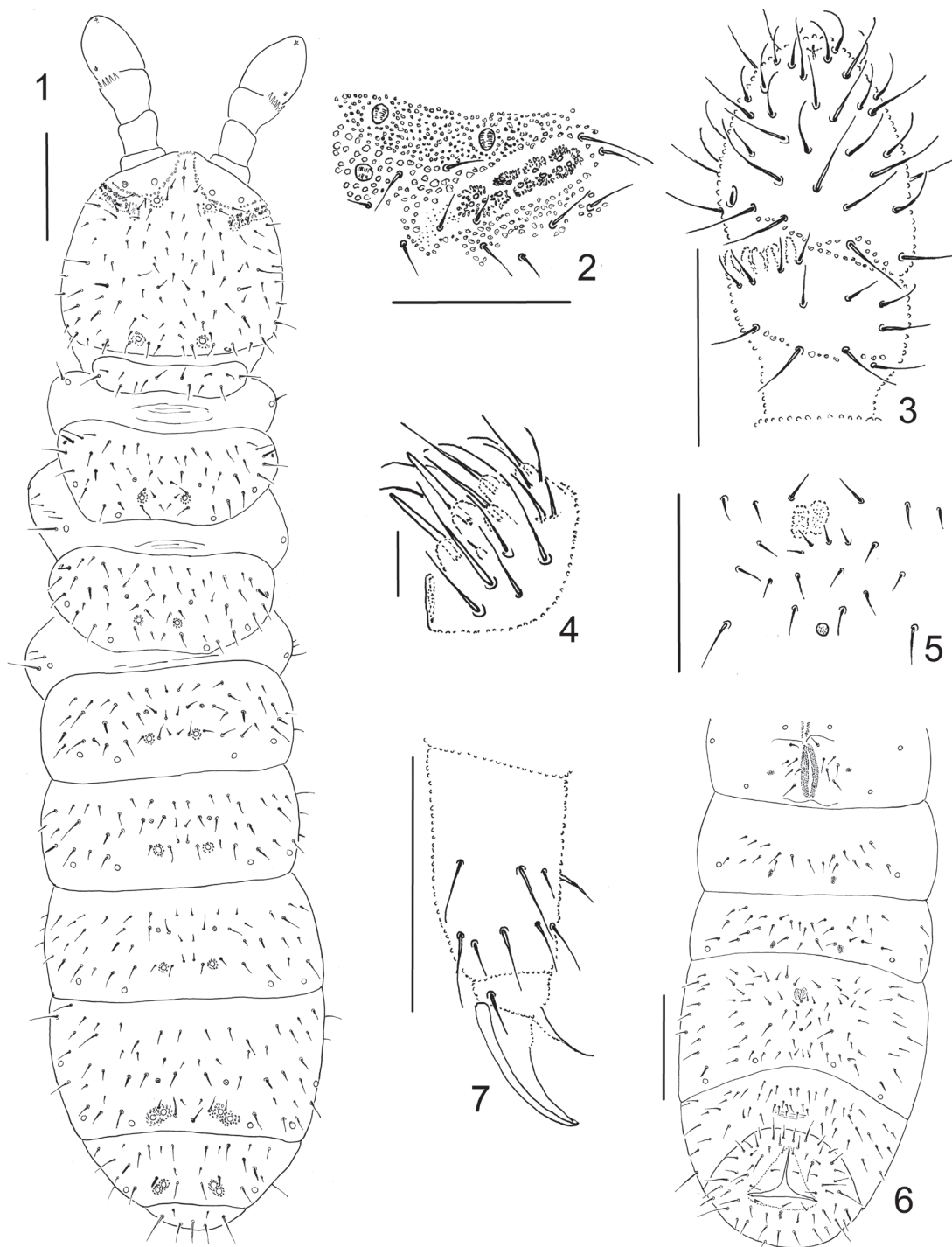
The new species is dedicated to Diana Fiera, daughter of the second author.

Distribution

Known only from Doftana Valley, Romania. *Deuteraphorura dianae* sp. nov. was collected from 2 deciduous forests, located close to each other on the mountainside above the Doftana River.

Remarks

The new species belonging to the *Deuteraphorura*-group of species without pso on Th. I tergum, forms part of species with 2+2 pso on the posterior part of head and 3+3 on Th. terga



Figs. 1-7. *Deuteraphorura dianae* sp. nov. 1. Habitus and dorsal chaetotaxy; 2. Postantennal sensory organ (PAO) and anterior cephalic pseudocelli (pso); 3. Antennal sensory organ (AIIIO); 4. Labium; 5. furcal rudiment; 6. Abdominal sterna I-VI; 7. Tibiotarsal chaetotaxy and claw of leg III. Scale bars: 0.1 mm in Figs. 1 and 6, 0.05 mm in Figs. 2, 3, 5 and 7, 0.01 mm in Fig. 4.

TABLE 1. VENTRAL PSEUDOCCELLUS (PSO FORMULA) AND NUMBER OF VESICLES IN POSTANTENNAL SENSE ORGAN (PAO) FOR SPECIES OF *DEUTERAPHORURA* GROUP WITH DORSAL (PSO) FORMULA AS 32/033/33353.

Taxa	Ventral pso formula:	PAO
<i>D. scotaria</i> (Gisin, 1954)	2/022/2212	20
<i>D. ossaria</i> (Gisin, 1964)	3/022/3222	25
<i>D. bosnaria</i> (Gisin, 1964)	3/022/3212	15
<i>D. silesiaca</i> Dunger, 1977	2/022/2222	14-16
<i>D. frassarii</i> Fanciulli, 1999	3/011/3212	16-17
<i>D. banii</i> Dallai & Fanciulli, 2009	3/011/2212	18-20
<i>D. dianae</i> sp.n.	3/011/3112	11

II-III (Gisin 1954, 1964; Dunger 1977; Fanciulli 1999; Dallai & Fanciulli, 2009). The new species has the same formula of dorsal pso (32/033/33353; Table 1) as *D. scotaria* (Gisin, 1954), *D. ossaria* (Gisin, 1964), *D. bosnaria* (Gisin, 1964), *D. silesiaca* (Dunger, 1977), *D. frassarii* Fanciulli, 1999 and *D. banii* Dallai & Fanciulli, 2009. The species differs from other ones by the different formula of the ventral pso, which is 2/022/2212 in *D. scotaria*, 3/022/3222 in *D. ossaria*, 3/022/3212 in *D. bosnaria*, 2/022/2222 in *D. silesiaca* (after Dunger, 1977; Jordana et al. 2012), 3/011/3212 in *D. frassarii* and 3/011/2212 in *D. banii* (Table 1).

DEUTERAPHORURA DOFTANA **SP. NOV.**

(FIGS. 8-13)

Material Examined

HOLOTYPE female, ROMANIA, Teleajen Subcarpathians (included in Curvature Subcarpathians), Șotriile village, Prahova County, Doftana Valley, 45° 13' 39" E 25° 43' 44", 110 year-old forest with *Quercus petraea* Liebl. and *Fagus sylvatica* L., 650 m altitude, soil, 28-X-2010, C. Fiera (IBB). **PARATYPES**: 1 female, data same as holotype (ISEA).

Description

Length of holotype: 1.42 mm, length of paratype: 1.2 mm. Shape of body typical for the genus: cylindrical without anal spines (Fig. 8). Color in alcohol, white. Granulation more or less uniform, distinct. Usually 11 grains around each pseudocellus.

Antennae almost the same length as head. Ant. I-IV and base of antennae well marked. Ant. I with 8 chaetae, Ant. II with 14 chaetae. AIII with 5 guard chaetae, 5 papillae, 2 smooth sensory rods, 2 ovoid, curved and ribbed sensory clubs and ventro-lateral microsensillum. Ant. IV with subapical organite, i.e. narrow ampullaceous

vesicle in subapical deep and latero-external microsensillum, c. ¼ length from the base (Figs. 8 and 10).

PAO with 11 vesicles (Fig. 9). Labral formula of chaetae: 4/142. Maxillary outer lobe with simple palp, basal chaeta and with 2 sublobal hairs. Labial palp of type AB (Fig. 11).

Pseudocellar formula dorsally: 33/033/33354; ventrally: 3/011/3212. Pso on Abd. sternum I as in Fig. 13. Subcoxae 1 of I-III legs with 2-2-2 pso. Abd. parapseudocellar formula ventrally: /001001^m (^m-single psx on upper anal valve). Subcoxae 1 of I-III legs without psx. Pseudopores formula dorsally: 11/111? , ventrally: 011/0??1^m (^m-single psp in medial position at the base of manubrial area) (Fig. 6). Dorsal chaetotaxy, usually symmetrical, as in Fig. 8, slightly differentiated into macrochaetae and microchaetae. Sensory chaetae s well visible only on head and Abd. V. Th. tergum I with 7-9 chaetae, chaeta m absent. Th. terga II-III with lateral microsensilla. Head with seta d0. Abd. tergum IV with medial chaeta p0. Abd. tergum V without medial chaetae. Abd. tergum VI with 2 medial chaeta: microchaeta a0 and macrochaeta m0. Th. sterna I-III without chaetae. Subcoxae 1 of I, II and III legs with 4, 5, 5 chaetae, subcoxae 2 with 0, 4, 4, coxae with 3, 10, 13, trochanters with 9 chaetae each, femora with 15,15,14, tibiotarsi with four rows of chaetae: distal whorl = A+T rows and rows B and C with 18(9+7+2), 18(9+8+1), 17(9+7+1) chaetae respectively, chaeta M present in row B. Claw always without denticle. Empodial appendage shorter than claw (¾ of inner edge of the claw), with small basal lamella. (Fig. 14). Ventral tube with 6+6 chaetae and without basal chaetae. Ventral chaetotaxy of Abd. sterna I-VI as in Fig. 13.

Furcal area with 2+2 chaeta in one row, two manubrial rows mm and mp m-row with 3+3, p-row with 2+2 chaetae – external ones as macrochaetae), chaetae from the ma row displaced on the level of dental microchaetae (Fig. 13). Male unknown.

Etymology

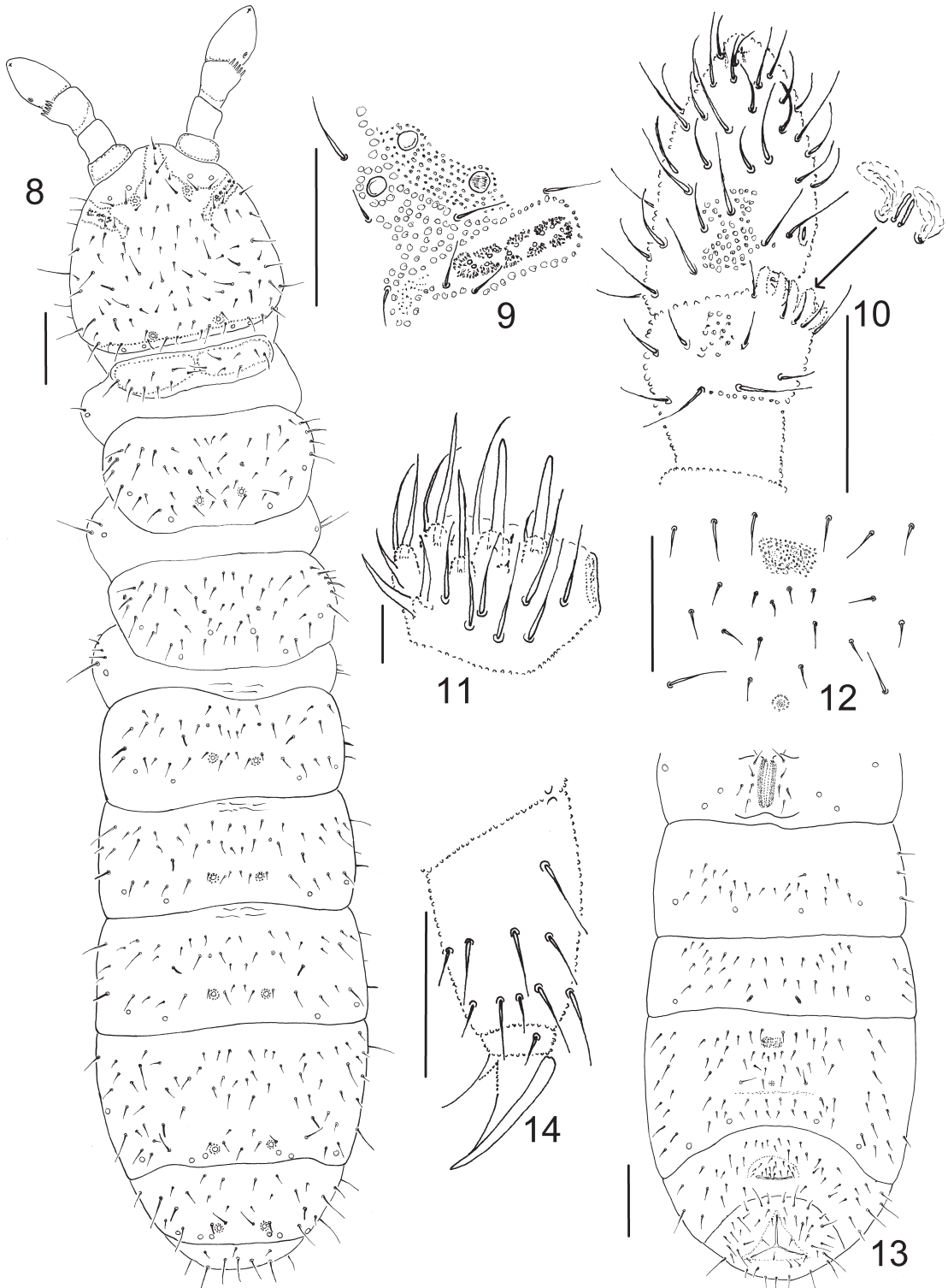
The new species is named after Doftana River, Romania.

Distribution

Known only from type locality. *Deuteraphorura doftana* **sp. nov.** was collected together with *D. dianae* **sp. nov.** from 1 of the 2 studied forests, located in Doftana Valley, Romania.

Remarks

Four *Deuteraphorura* species characterized by the absence of pso on Th. I and the pres-



Figs. 8-14. *Deuteraphorura doftana* sp. nov. 8. Habitus and dorsal chaetotaxy; 9. Postantennal sensory organ (PAO) and anterior cephalic pseudocelli (pcso); 10. Antennal sensory organ (AIII) with internal sensory rods; 11. Labium; 12. Furcal rudiment; 13. Abdominal sterna I-VI; 14. Tibiotarsal chaetotaxy and claw of leg III. Scale bars: 0.1 mm for Figs. 8 and 13, 0.05 mm for Figs. 9, 10, 12 and 14, 0.01 mm in Fig. 11.

ence of 3+3 pso on posterior part of a head and on Th. terga II-III were previously known: *D. pseudofimetaria* Folsom 1917, *D. rendsinae* (Haybach 1962), *D. pseudobosnaria* (Dallai 1970), *D. apuanica* Dallai 1970. Among these species only *D. rendsinae* has the same dorsal pseudocellar formula (33/033/33354) but differs in ventral pso formula (2/000/1112 in *D. rendsinae* and 3/011/3212 in the new species). *D. pseudobosnaria* and *D. apuanica* have only 3+3 dorsal pso on Abd. tergum V (4+4 in

the new species) and other ventral pseudocellar formula (3/011/3212 in *D. pseudobosnaria*, 2/011/1212 in *D. apuanica*). The last two species also possess more vesicles in PAO: 16 in *D. pseudobosnaria* and *D. apuanica*, whereas *D. rendsinae* and the new species have lower numbers of vesicles (8-10 and 11 respectively). *D. pseudofimetaria* with 16 vesicles in PAO has different dorsal abdominal and whole ventral pseudocellar formula than all other species (4435-63-4 and 2/011/1111).

KEY TO THE WORLD SPECIES OF DEUTERAPHORURA WITHOUT PSEUDOCELLI ON THE THORACIC TERGUM I

(This key is based mainly on the key of Jordana et al. 2012.)

1. Dorsal posterior part of head with 2+2 pso 2
- Dorsal posterior part of head with 3+3 pso 29
2. Th. terga II and III with 1+1 or 2+2 pso 3
- Th. terga II with 3+3 pso 10
3. Th. terga II and III with 1+1 pso, dorsal abdominal formula of pso = 33323, PAO with 16 vesicles *D. acicindelia* (Salmon, 1958)
- Th. terga II and III with 2+2 pso 4
4. Abd. tergum IV with 3+3 pso 5
- Abd. tergum IV with 4+4 pso or 5+5 6
5. Abd. tergum V with 2+2 pso, ventral side of head with 1+1 pso *gangjinensis* (Lee & Kim, 1995)
- Abd. tergum V with 3+3, Th. and Abd. sterna without pso, PAO with 8–12 vesicles *D. gridellii* Denis, 1938
6. Abd. tergum IV with 4+4 pso 7
- Abd. tergum IV with 5+5 p 9
7. Abd. tergum V with with 2+2 pso, ventral pso only on Abd. sternum V (1+1), PAO with 10 vesicles *D. nervosa* (Stach, 1954)
- Abd. tergum V with 3+3 pso 8
8. Ventral pseudocellar formula 3/011/42(1)2(1)1, PAO with 19–21 vesicles, mvo with 35–40 modified chaetae on Abd. sternum III *D. hategana* (Gruia, 1971)
- Ventral pseudocellar formula 2/011/2112, PAO with 15–17 vesicles, mvo with 4 modified chaetae on Abd. sternum II and about 21 modified chaetae on Abd. sternum III *D. meziadica* (Gruia, 1972)
9. Abd. tergum V with 2+2 pso, PAO with 16 vesicles, ventral pso formula 2/000/0112, mvo absent *D. lusa* (Christiansen & Bellinger, 1980)
- Abd. tergum V with 3+3 pso, ventral pso formula 3/011/4212, mvo present *D. romanica* (Gruia, 1965)
10. Th. tergum II with 3+3, Th. tergum III with 4+4 pso, Abd. terga I and II with 5+5 pso, PAO with 19 vesicles *spipolae* (Massera, 1949)
- Th. terga II and III with 3+3 pso 11

11. Abd. terga I–III with 4+4 pso, ventral side of head with 2+2 pso, PAO with 12–14 vesicles *D. boneti* (Gisin, 1953)
- Abd. terga I–III with 3+3 pso 12
12. Abd. tergum IV with 4+4 pso 13
- Abd. tergum IV with 5+5 pso 16
13. Abd. tergum V with 2+2 or 3+3 pso 14
- Abd. tergum V with more pso 15
14. Abd. tergum V with 2+2 pso, ventral pseudocellar formula: 3/011/1111, PAO with 16 vesicles *D. oregonensis* (Denis, 1929)
- Abd. tergum V with 3+3 pso, ventral pseudocellar formula: 2–3/011/1–2??? *D. inermis* (Tullberg, 1869)
15. Abd. tergum V with 4+4 pso, ventral pseudocellar formula: 1/111/2220, PAO with 14 vesicles, mvo present *D. kratochvili* (Nosek, 1963)
- Abd. tergum V with 5+5 pso, ventral pseudocellar formula: 2/011/2111, mvo absent *D. handschini strinati* (Gisin, 1963)
16. Abd. tergum V with 2+2 pso 17
- Abd. tergum V with more pso 18
17. Ventral pseudocellar formula: 2/022/2222, PAO with 14–16 compound vesicles, mvo present *D. silesiaca* (Dunger, 1977)
- Ventral pseudocellar formula: 3/011/?1?1, PAO with 13–14 compound vesicles, mvo absent *D. vinuensis* (Simon & Lucíañez, 1994)
18. Abd. tergum V with 4+4 pso 19
- Abd. tergum V with 3+3 pso 22
19. Th. sterna II and III without pso, pseudocellar formula of Abd. sterna I–IV: 2111, PAO with 15 vesicles, mvo present *D. hussoni* (Denis, 1935)
- Th. sterna II and III with pso 20
20. Th. sterna II and III with 2+2 pso 21
- Th. sterna II and III with 1+1 23
21. Head ventrally with 2+2 pso, PAO with 20 vesicles, mvo present *D. scotaria* (Gisin, 1954)
- Head ventrally with 3+3 pso 22
22. Abd. tergum V with 4+4 pso, pseudocellar formula of Abd. sterna I–IV with 3212. *D. bosnaria* (Gisin, 1964)
- Abd. tergum V with 3+3 pso, pseudocellar formula of Abd. sterna I–IV with 3222 *D. ossaria* (Gisin, 1964)
23. Head ventrally with 2+2 pso 24
- Head ventrally with 3+3 pso 25
24. Pseudocellar formula of Abd. sterna I–IV with 2212, mvo present *D. ghidinii* (Denis 1938)
- Pseudocellar formula of Abd. sterna I–IV with 2-3111, mvo absent *D. handschini* (Denis, 1924)

25. Abd. tergum V with 4+4 pso 26
 —. Abd. tergum V with 3+3 pso 27
26. Pseudocellar formula of Abd. sterna I–IV: 3212, PAO with 19–21 vesicles, mvo absent
 *D. caprelleana* Fanciulli, Loreti & Dallai, 2010
- . Pseudocellar formula of Abd. sterna I–IV: 2212, PAO with 14–16 vesicles, mvo present
 *D. pseudoghidinii* (Dallai, 1969)
27. Abd. sternum I with 2+2 pso, pseudocellar formula of Abd. sterna II–IV: 212, PAO with 18–20
 compound vesicles *D. banii* Dallai & Fanciulli, 2009
- . Abd. sternum I with 3+3 pso 28
28. Pseudocellar formula of Abd. sterna II–IV: 212, PAO with 16–17 compound vesicles, base of
 ventral tube with 2 pso, without pso above ventral tube (Fanciulli pers. comm.)
 *D. frassassii* Fanciulli, 1999
- . Pseudocellar formula of Abd. sterna II–IV: 112, PAO with 11 compound vesicles, base of ventral
 tube with 1 pso and 1psx, with 1 pso above ventral tube *D. diana* **sp. nov.**
29. Dorsal pseudocellar formula of Abd. I–IV: 4435-63-4, ventral pseudocellar formula of Abd. I–IV:
 2/011/1111, mvo present *D. pseudofimetaria* (Folsom, 1917)
- . Dorsal pseudocellar formula of Abd. I–IV: 33353 or 33354 30
30. Pseudocellar formula of Abd. terga I–IV: 33353 31
- . Pseudocellar formula of Abd. terga I–IV: 33354 32
31. Ventral pseudocellar formula: 2/011/1212, PAO with 14–16 vesicles
 *D. apuanica* (Dallai, 1970)
- . Ventral pseudocellar formula: 3/011/3212, PAO with 16 vesicles
 *D. pseudobosnaria* (Dallai, 1970)
32. Ventral pseudocellar formula: 2/000/1112, PAO with 8–10 vesicles, mvo present
 *D. rendsinae* (Haybach, 1962)
- . Ventral pseudocellar formula: 3/011/3212, PAO with 11 vesicles, mvo absent
 *D. doftana* **sp. nov.**

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