

# A new species of *Pseudosinella* Schäffer, 1897 (Collembola, Entomobryidae) from Hungary and Romania, with redescription of the related species *Pseudosinella huetheri* Stomp, 1971

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## Abstract

A new species of the genus *Pseudosinella* Schäffer, 1897 from Hungary and Romania is described and illustrated. *Pseudosinella hartnerae* sp. nov. belongs to the group with 5+5 eyes, and can be identified by its unique labial chaetotaxy ( $M_1m_2rel_1L_2$ ) within this group. *Pseudosinella huetheri* Stomp, 1971, the closest related species sharing the same dorsal macrochaetae formula ( $R_0R_1R_2001/00/0101+2$ ), is also redescribed here based on the holotype. Comparative analysis between the two species and among other related species is provided.

## Keywords

Chaetotaxy, *Pseudosinella hartnerae* sp. nov., springtails, taxonomy

## Introduction

*Pseudosinella* Schäffer, 1897 is the largest collembolan genus, represented by 382 described species worldwide (Bellinger et al. 2021), inhabiting a wide range of habitats from xerophilic areas (e.g., Traser et al. 2006) through caves (e.g., Gisin and Gama 1969; Cipola et al. 2020) to wetlands like alluvial forests (e.g., Buşmachiu et al. 2017; Winkler and Mateos 2018).

As a part of soil biodiversity surveys in Hungary, the Bátorliget Pasture Nature Conservation Area was revisited in 2017. Among the collected Collembola material, a new species of *Pseudosinella* Schäffer, 1897 was discovered and is described in the present paper. Around the same time, Collembola samplings were carried out in Romania Mohoş Nature Reserve, from where the same *Pseudosinella* species was also found. The genus was previously represented by 17 species in Hungary (Dányi and Traser 2008; Winkler and Mateos 2018) and 24 species in Romania (Fiera 2013). However, its richness is probably underestimated and doubtless destined to increase with further taxonomic efforts in both countries.

The new species belongs to the group of species with 5+5 eyes. With the help of the computer assisted Delta identification key using the combination of chaetotaxic and other characters, originally designed by Christiansen et al. (1990) and regularly updated by Jordana et al. (2021), *Pseudosinella huetheri* Stomp, 1971 was found to be its closest related species. Therefore, on this occasion, *Pseudosinella huetheri* was also examined and redescribed from the holotype preserved in the Natural History Museum of Geneva (Switzerland).

## Material and methods

In October 2017, soil samplings were carried out in the Bátorliget Pasture Nature Conservation Area (East Hungary). A month later, soil mesofauna samplings were carried out also in Romania, around St. Ana Lake (Mohoş Nature Reserve). Springtails were extracted from the hand collected litter and soil samples within 14 days using a modified Berlese–Tullgren apparatus (without light or heating devices). The specimens were cleared using Nesbitt fluid and then mounted on permanent slides in Hoyer's medium. The slides were examined under a Leica DM2500 LED microscope with conventional bright light and phase contrast.

Abbreviations used in text and figures are:

|               |   |
|---------------|---|
| <b>Abd</b>    | abdominal tergite;                                |
| <b>accp</b>   | accessorial p–sensilla;                           |
| <b>Ant</b>    | antennal segment;                                 |
| <b>a.s.l.</b> | above sea level;                                  |
| <b>HNHM</b>   | Hungarian Natural History Museum, Budapest;       |
| <b>IBB</b>    | Institute of Biology Bucharest, Romanian Academy; |

|             |                                   |
|-------------|-----------------------------------|
| <b>NHMG</b> | Natural History Museum of Geneva; |
| <b>Mac</b>  | macrochaeta;                      |
| <b>mic</b>  | microchaeta;                      |
| <b>psp</b>  | pseudopore;                       |
| <b>Th</b>   | thoracic tergite.                 |

Symbols used in figures:

|                    |               |
|--------------------|---------------|
| <b>open circle</b> | Mac;          |
| <b>black dots</b>  | mic;          |
| <b>x</b>           | trichobotria. |

## Terminology

Dorsal head chaetotaxy follows Gisin (1967), Jordana and Baquero (2007) and also the “AMS” nomenclature of Soto-Adames (2010). Clypeal chaetotaxy follows Yoshii and Suhardjono (1992). For the labial palp, the notation of Fjellberg (1999) was used. For labial chaetotaxy, Gisin’s nomenclature (1964) was applied, while for postlabial chaetotaxy, the notations of Chen and Christiansen (1993) and Cipola et al. (2018) were used. Dorsal chaetotaxy schemes of thoracic and abdominal segments follow Gisin (1967) and Szeptycki (1972, 1979), except for chaeta  $m_{7a}$  on Abd III (following Wang et al. 2003) and chaeta  $p_{8p}$  on Abd III (following Mateos 2008). The tergal specialized chaetae (S-chaetae) pattern follows Zhang and Deharveng (2015).

## Taxonomy

**Class Collembola** Lubbock, 1873

**Order Entomobryomorpha** Börner, 1913

**Family Entomobryidae** Schäffer, 1896

**Subfamily Lepidocyrtinae** Wahlgren, 1906

**Genus *Pseudosinella*** Schäffer, 1897

***Pseudosinella hartnerae* Winkler & Fiera, sp. nov.**

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Figures 1–5

**Type material. Holotype:** Hungary. ♀ on slide (Nr. HNHM collpr-896), Bátorliget, Szabolcs–Szatmár–Bereg county, 161 m a.s.l., 47°46'11"N, 22°16'19"E, from litter, hand collecting, 8 Oct. 2017, leg. D. Winkler. **Paratypes:** Two ♀ and one ♂ on slide (Nr. HNHM collpr-896); two ♀ and one specimen with sex not visible (Nr.: HNHM collpr-897); two ♀ (Nr. WD-coll-113 and WD-coll-114); same data as holotype. The holotype and four paratypes are deposited in the Hungarian Natural History Mu-



**Figure 1.** *Pseudosinella hartnerae* sp. nov. Habitus. Scale bar: 0.5 mm.

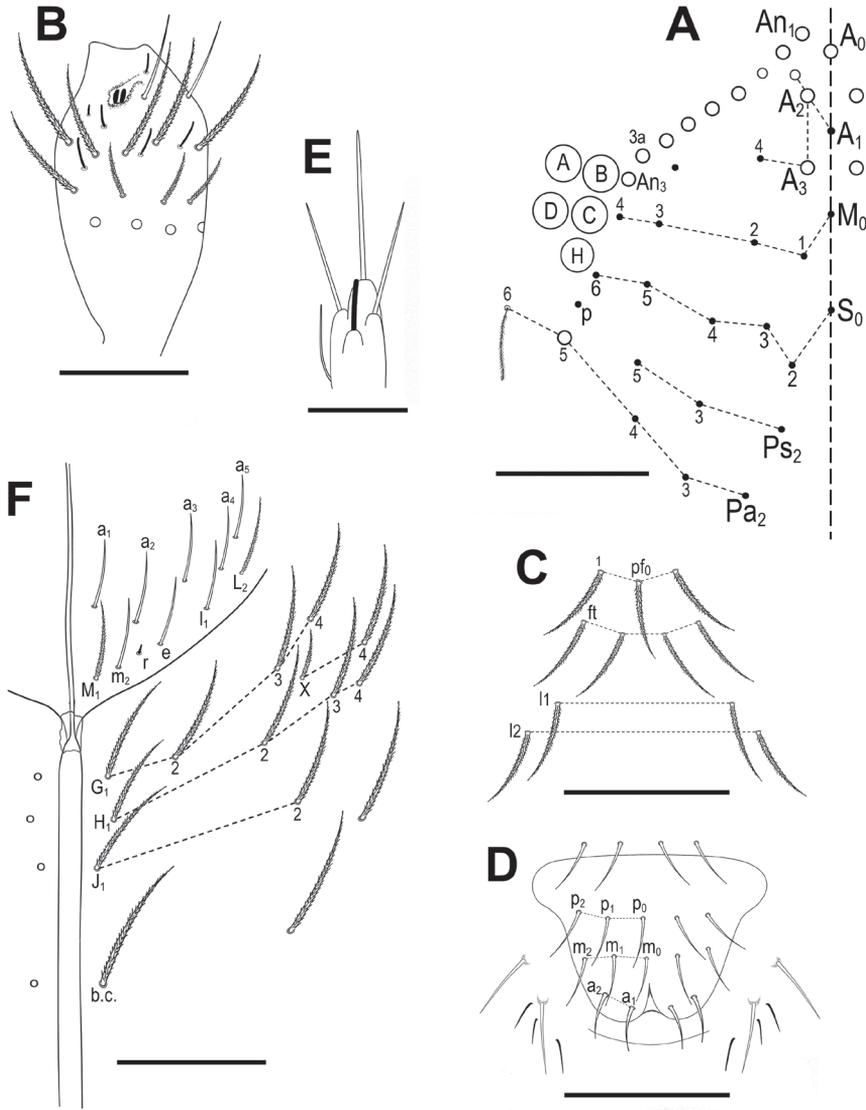
seum (HNHM), Budapest. Two paratypes are preserved in the first author's collection at the University of Sopron, Faculty of Forestry, Sopron, Hungary; one paratype is kept in C. Fiera's collection (IBB).

**Other material.** Romania. Seven specimens (one ♂ on slide, Nr.: IBB Coll-12544; and six specimens of sex not determined in ethyl alcohol, vial Nr. IBB–26), Lake Saint Ana, Harghita County, Romania, 984 m a.s.l., 46°7'33"N, 25°53'28"E, 2 Nov. 2017, mixed forest with beech and fir, from litter, hand collecting, leg. C. Fiera.; 4 specimens (one ♀ on slide, Nr. IBB Coll–12545; and three specimens of sex not determined in ethyl alcohol, vial Nr. IBB–26), Mohoș peat bog, 1050 m a.s.l., 46°8'6"N, 25°53'59"E, 2 Nov. 2017, Scots pine forest, from peat moss *Sphagnum*, hand collecting, leg. C. Fiera. Preserved in the last author's collection (IBB).

**Diagnosis.** 5+5 ocelli. Colour bluish-grey. Labial chaetotaxy  $M_1m_2rel_1L_2$ , r vestigial. Dorsal macrochaetae formula  $R_0R_1R_2001/00/0101+2$ . Abd II chaetotaxy: paBq<sub>1</sub>q<sub>2</sub>. Abd IV accessory chaeta s, anteriorly to trichobothrial complex, absent. Antennae and legs without scales. Unguis inner side with two paired basal teeth and one unpaired tooth. Unguiculus outer lamella smooth.

**Description.** *Habitus* (Fig. 1). Body length (without head and furca) 1.01–1.27 mm (holotype: 1.08 mm). Colour: Head, antennae, trunk and legs bluish-grey, blue shades also on manubrium and ventral tube. Eye patches dark blue.

**Head.** With 5+5 eyes (ABCDH, with H only slightly smaller). Dorsal cephalic main macrochaetae formula  $R_0R_1R_2P$  (according to AMS notation  $A_0$ ,  $A_2$ ,  $A_3$  and  $Pa_5$ ) (Fig. 2A). Maximum number of macrochaetae "An" on head 9+9. Antennal length to head diagonal length (measured from cervical edge to apex of labrum) ratio 1.2–1.4

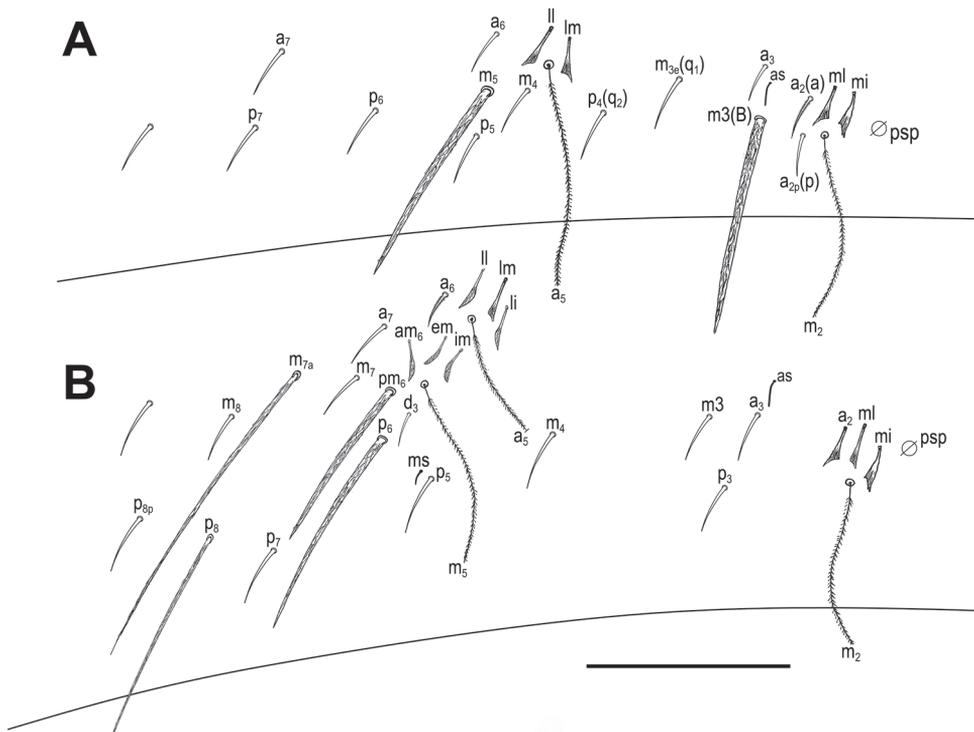


**Figure 2.** *Pseudosinella hartnerae* sp. nov. **A** head, dorsal chaetotaxy (left side) **B** antennae, Ant III with sensillar organ **C** clypeus, clypeal chaetae **D** labrum **E** labial papilla E with lateral process **F** labial triangle (right side) and ventral cephalic groove with labial and postlabial chaetotaxy. Scale bars: 0.05 mm (**A**); 0.03 mm (**B–D, F**); 0.01 mm (**E**).

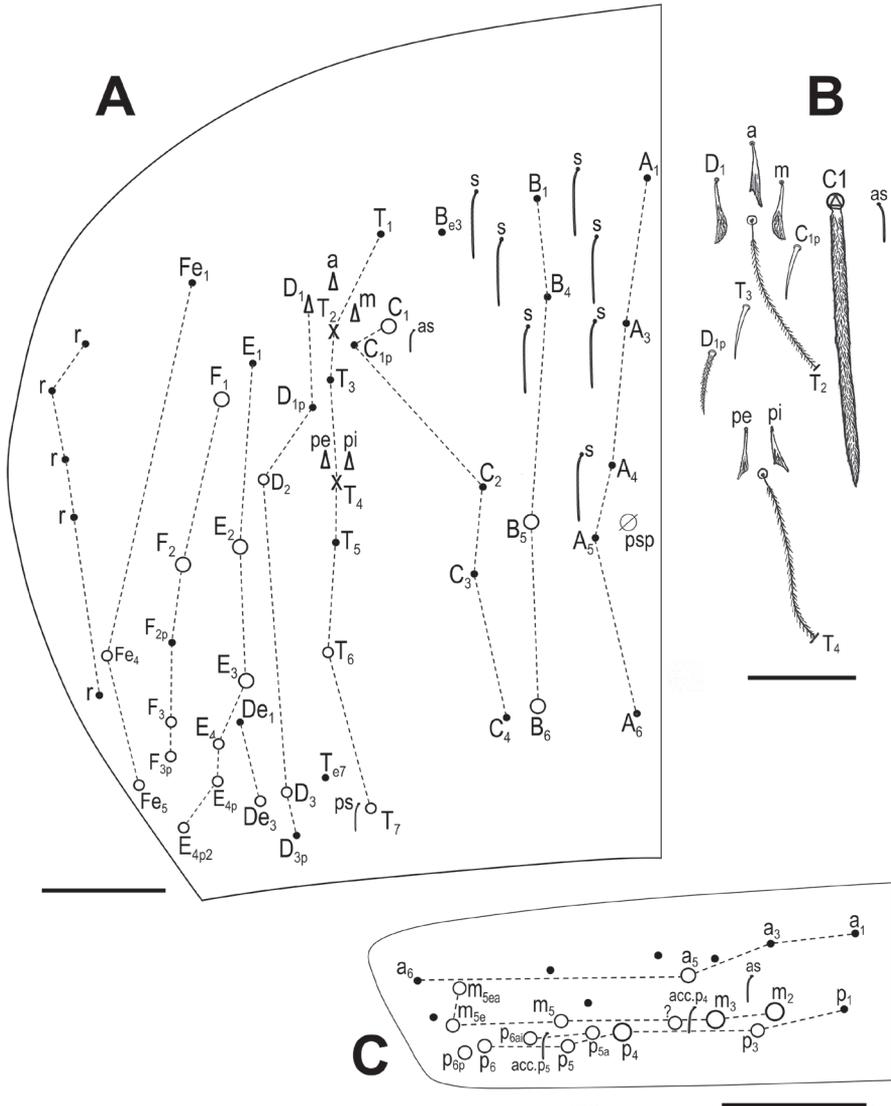
(holotype: 1.3). Relation of antennal segments I–IV as 1 : 1.7 : 1.5 : 2.9 (holotype). Ant III sensillary organ composed of two rod-like sensilla partially behind a cuticular fold, guarded by three sensilla, one of them short, with spiny morphology (Fig. 2B). Ant IV without apical bulb. Clypeus with eleven subequal ciliated chaetae (three in row pf, four in row ft, two in row l1 and two in row l2) (Fig. 2C). Arrangement of chaetae on labrum 4/554, prelabral chaetae smooth; first (p), second (m) and apical (a) rows of labral chae-

tae also smooth, chaetae of p and m series about the same in size, not enlarged,  $a_1$ – $a_2$  thicker but not enlarged; labral edge with no differentiated papillae (Fig. 2D). Outer maxillary palp with two smooth chaetae and three smooth main sublobal hairs. Lateral process (*sensu* Fjellberg 1999) on papilla E finger-shaped, barely reaching the top of papilla (Fig. 2E). Labial anterior row with five smooth chaetae ( $a_1$ – $a_3$ ); formula of basal row  $M_1m_2rel_1L_2$  with  $M_1$  and  $L_2$  ciliated and all other chaetae smooth (Fig. 2F). Chaeta r short (ratio of  $r/m_2$  0.2–0.3). Ventral chaetotaxy with about 15 ciliate chaetae, postlabial formula 4 (G1–4), 2 (X, X4), 4 (H1–4), and 2 (J1–2) chaetae; b.c. present (Fig. 2F).

**Body.** Body dorsal macrochaetae from Th II to Abd IV 00/0101+2. Mesothorax without macrochaetae. Two anterolateral S-chaetae (al and ms) present. Th III without Mac, anterolateral sensillum al present. Abd I with lateral S-microchaeta (ms). Chaetotaxy of Abd II–III as in Fig. 3A, B. Abd II chaetotaxy between two dorso-medial trichobothria  $paBq_1q_2$  using Gisin's symbols (Gisin 1967); following Szeptycki's (1979) notation  $p=a_2p$ ,  $a=a_2$ ,  $B=m_3$ ,  $q_1=m_3e$  and  $q_2=p_4$ . Chaeta a as ciliated mic. Abd III chaeta  $d_3$  present. Chaetotaxy and trichobothrial complex on Abd IV as in Fig. 4A, B. Mac  $B_5$ ,  $B_6$ ,  $C_1$ ,  $E_2$ ,  $E_3$ ,  $F_1$  and  $F_2$  broader with broad sockets,  $D_2$ ,  $D_3$ ,  $De_3$ ,  $E_4$ ,  $E_4p$ ,  $E_4p_2$ ,  $F_3$ ,  $F_3p$ ,  $Fe_4$ ,  $Fe_5$ ,  $T_6$  and  $T_7$  thinner with smaller sockets. Abd IV with five fan-shaped chaetae ( $D_1$ , a, m,  $p_e$  and  $p_i$ ) associated with two trichobothria. Accessory chaeta s, associated with trichobothrium  $T_2$ , absent. Nine S-chaetae (as, ps,

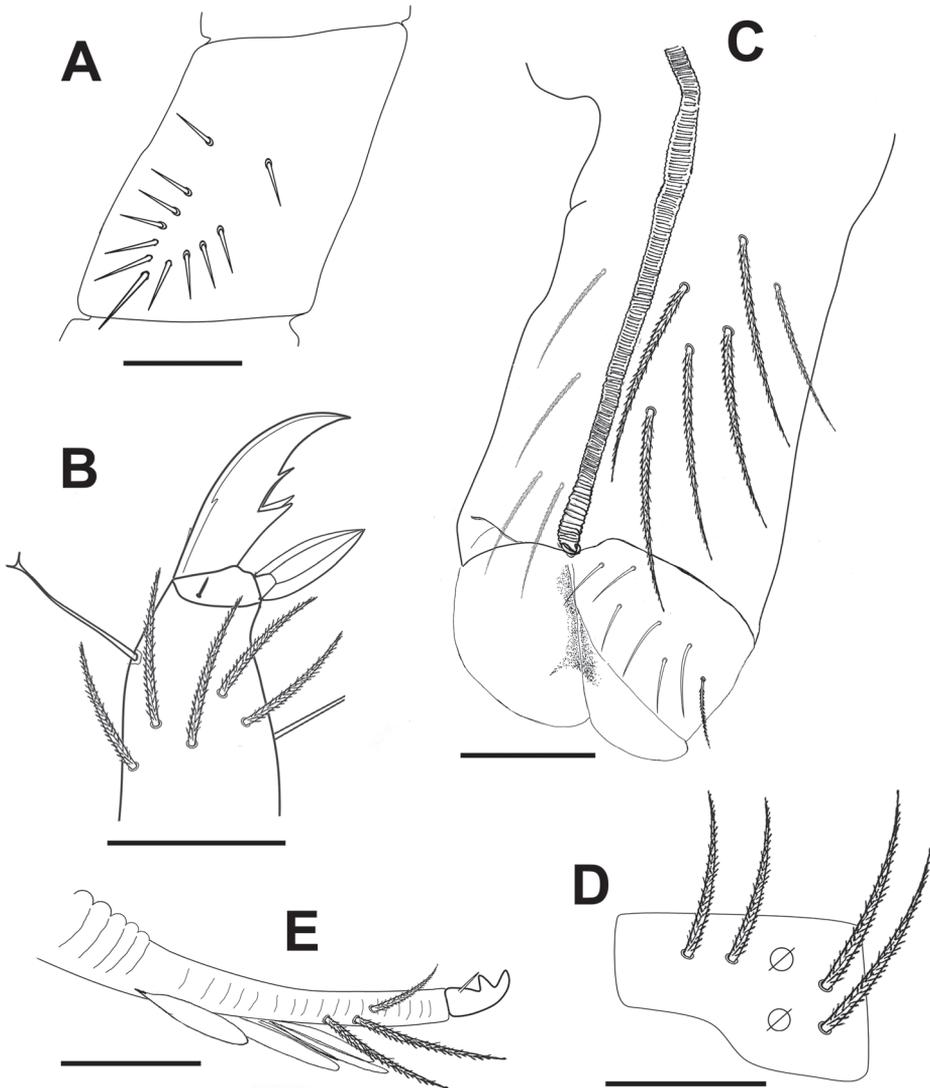


**Figure 3.** *Pseudosinella hartnerae* sp. nov. Abdomen dorsal chaetotaxy: **A** Abd II (left side) **B** Abd III (left side). Scale bar: 0.03 mm (**A**, **B**).



**Figure 4.** *Pseudosinella hartnerae* sp. nov. Abdomen dorsal chaetotaxy: **A** Abd IV (left side) **B** Abd IV trichobothrial complex (left side) **C** Abd V. Scale bars: 0.05 mm (**A**); 0.02 mm (**B**); 0.03 mm (**C**).

and seven long dorsal S-chaetae) present. Dorsal chaetotaxy of Abd V as in Fig. 4C. Three S-chaetae (as, acc.p4 and acc.p5) typical for *Pseudosinella* present. Legs without scales. Trochanteral organ with up to 12 smooth spiny chaetae forming a V-shaped pattern (Fig. 5A). Unguis and unguiculus as in Fig. 5B. Unguis with subequal paired basal teeth at 35% from inner edge, and with a median unpaired inner tooth at 60% from inner edge, apical tooth absent. Outer side with paired lateral teeth and a short external tooth. Unguiculus lanceolate, external lamella smooth. Tibiotarsal tenent hair clavate, supraempodial chaeta on tibiotarsus III smooth and acuminate. Ratio



**Figure 5.** *Pseudosinella hartnerae* sp. nov. **A** trochanteral organ **B** leg III unguis and unguiculus **C** ventral tube anterior view (right side) and posterior view (left side) **D** manubrial plate **E** mucro and apical part of dens. Scale bars: 0.02 mm (**A**, **B**, **D**, **E**); 0.03 mm (**C**).

of supraempodial chaeta / unguiculus around 0.9. Ventral tube without scales; with 6+6 subequal ciliated chaetae on anterior side and 4+4 subequal ciliated chaetae on posterior side; lateral flap with 1 ciliated and a maximum of 6 smooth chaetae (Fig. 5C). Manubrium ventrally with scales and 2+2 terminal ciliated chaetae. Manubrial plate with 2 larger inner chaetae and 2 chaetae external to the 2 pseudopores (Fig. 5D). Length of not ringed terminal dens about 4 times the length of mucro. Mucro with distal tooth equal to anteapical one; basal spine reaching tip of anteapical tooth (Fig. 5E). Ratio manubrium/dens/mucro as 16:15:1.

**Ecology and distribution.** The type locality (Bátorliget Pasture Nature Conservation Area, Szabolcs–Szatmár–Bereg county, Hungary) of *Pseudosinella hartnerae* sp. nov. is a special relict mire and forest area with high biodiversity. The new species was collected from the upper layer and litter of a forest clearing with pioneer vegetation including silver birch (*Betula pendula*) trees. Specimens in Romania were collected from litter in the surrounding forest of the volcanic lake Saint Ana, and from peat mosses in the nearby Mohoš bog. Both Romanian sites are located in the Mohoš Nature Reserve, Harghita County. This new *Pseudosinella* is a phytodetriticolous, bryophilous and hygrophilous species.

**Etymology.** The name of the new species is dedicated to former zoologist colleague and friend Dr. Anna Fenyősiné Hartner (1965–2006), an excellent specialist in myrmecology.

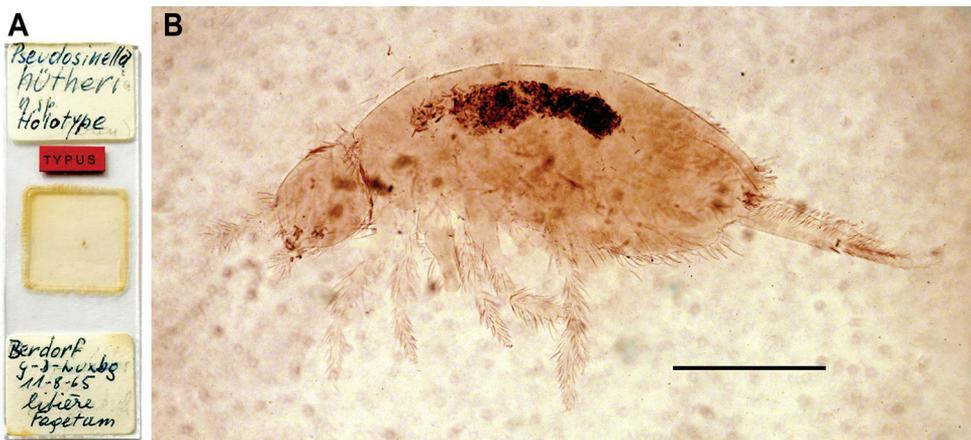
### *Pseudosinella huetheri* Stomp, 1971

Figures 6–10

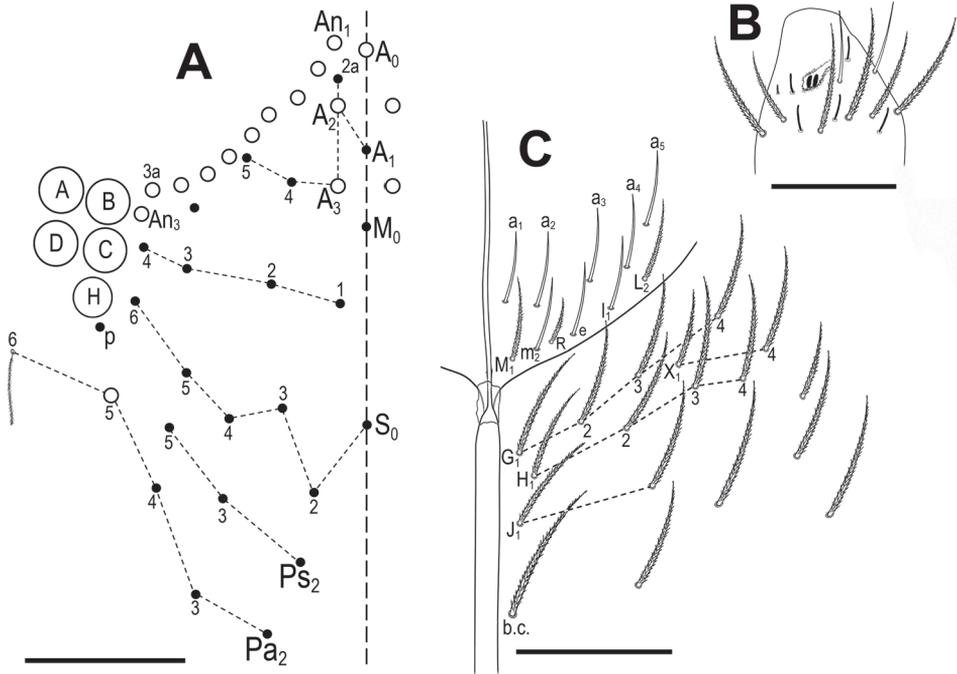
**Material examined. Holotype:** Luxembourg, sex not visible, on slide, preserved in NHMG (Fig. 6A), Berdorf, “Zigzagschloeff” rocks, 357 m a.s.l., 49°49'33"N, 6°20'21"E, beech forest (*Fagetum*), from litter, 11.Aug.1965, leg. N. Stomp.

**Diagnosis.** 5+5 ocelli. Colour yellowish white. Labial chaetotaxy  $M_1m_2Rel_1L_2$ ,  $R \sim 0.5$  of  $M$ . Dorsal macrochaetae formula  $R_0R_1R_2001/00/0101+2$ . Abdominal tergite II chaetotaxy:  $-aBq_1q_2$ . Abd IV accessory chaeta  $s$ , anteriorly to trichobothrial complex, absent. Antennae and legs without scales. Unguis inner side with two paired basal teeth and one unpaired tooth, unguiculus outer lamella smooth.

**Redescription. Habitus** (Fig. 6B). Body length (without head and furca) 1.2–1.5 mm (Stomp 1971), holotype length 1.46 mm. Colour (after Stomp 1971): yellowish white, without any trace of pigment, neither on tergites and coxae nor on antennae. A few spots of blue pigment distributed in small dots around eyes. Eye patches blue.

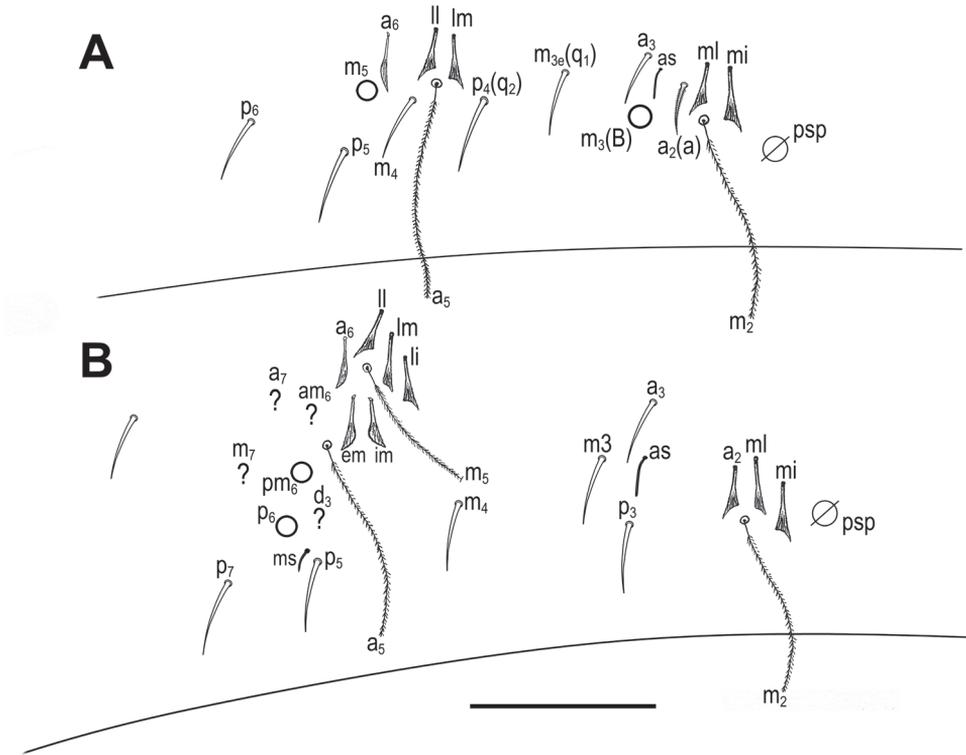


**Figure 6.** *Pseudosinella huetheri* Stomp, 1971. **A** Photograph of the slide of the holotype from the NHMG Switzerland) **B** Habitus, holotype. Scale bar: 0.05 mm (**B**).



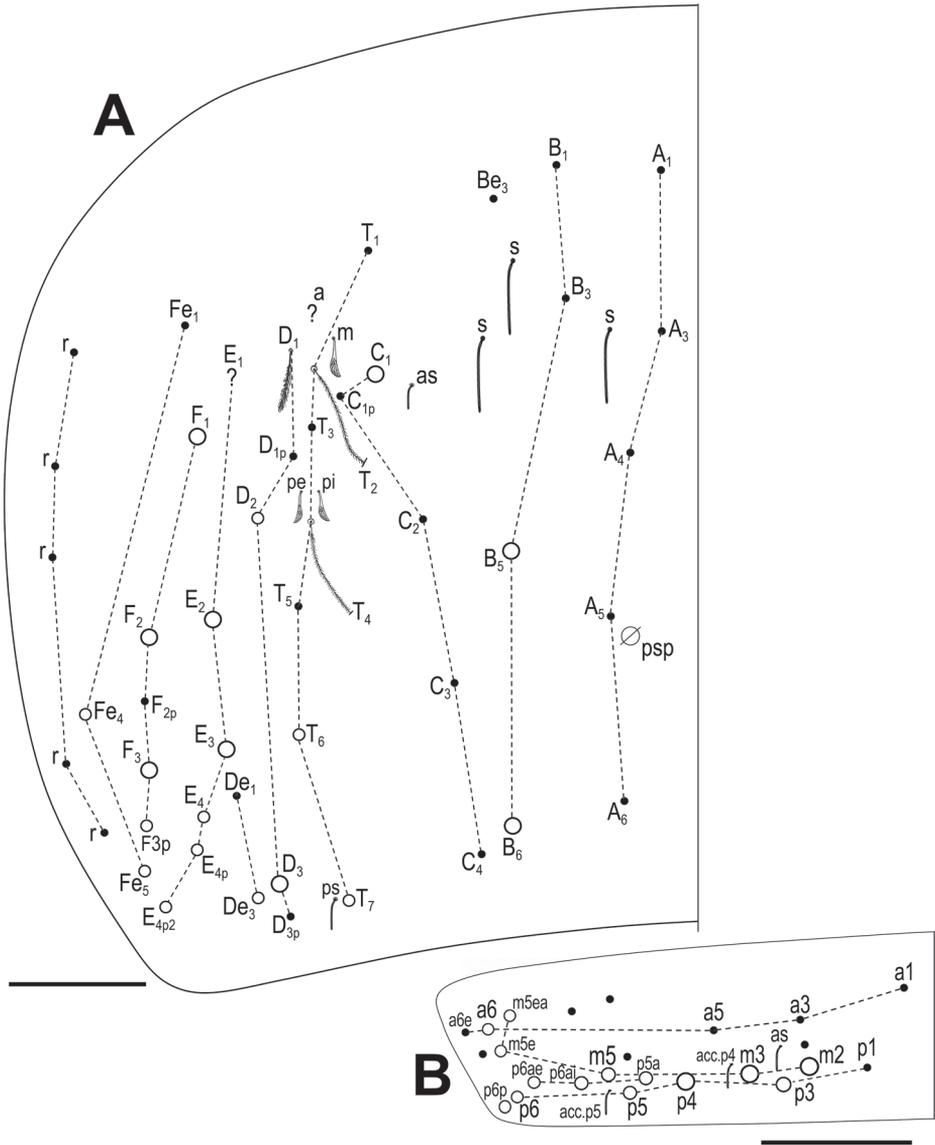
**Figure 7.** *Pseudosinella huetheri* Stomp, 1971 **A** head, dorsal chaetotaxy (left side) **B** antennae, apex of Ant III with sensillary organ **C** labial triangle (right side) and ventral cephalic groove with labial and postlabial chaetotaxy. Scale bars: 0.05 mm (**A**); 0.03 mm (**B, C**).

**Head.** With 5+5 eyes (ABCDH, with H only slightly smaller) (Fig. 7A; see also fig. 2 in Stomp 1971). Dorsal cephalic main macrochaetae formula  $R_0R_1R_2P$  (according to AMS notation  $A_0, A_2, A_3$  and  $Pa_3$ ). Number of macrochaetae “An” on head 10+10 (Fig. 7A). Antennal length to head diagonal length ratio 1.4 (head diagonal measured from cervical edge to apex of labrum). Relation of antennal segments I–IV as 1 : 1.7 : 1.5 : 3.0. Ant III sensillary organ composed of two rod-like sensilla partially behind a cuticular fold, guarded by three sensilla, one of them shorter, spine-like (Fig. B). Ant IV without apical bulb. Arrangement of chaetae on labrum 4/554; prelabral chaetae smooth, first (p), second (m) and apical (a) rows of labral chaetae also smooth, chaetae of p and m series about the same in size, not enlarged,  $a_1$ – $a_2$  thicker but not enlarged; labral edge with no differentiated papillae (as in Fig. 2D). Outer maxillary palp with two smooth chaetae and three smooth main sublobal hairs. Lateral process (*sensu* Fjellberg 1999) on papilla E finger-shaped, barely reaching the top of papilla (see Fig. 2E). Labial anterior row formed by 5 smooth chaetae ( $a_1$ – $a_5$ ); formula of basal row  $M_1m_2Rel_1L_2$  with  $M_1$ , R and  $L_2$  ciliated and all other chaetae smooth (Fig. 7C). Chaeta R reduced (ratio of R/ $m_2$  0.5). Ventral postlabial chaetotaxy with about 18 ciliate chaetae, postlabial formula 4 (G1–4), 2 (X, X4), 4 (H1–4), and 2 (J1–2) chaetae; b.c. present (Fig. 7C).



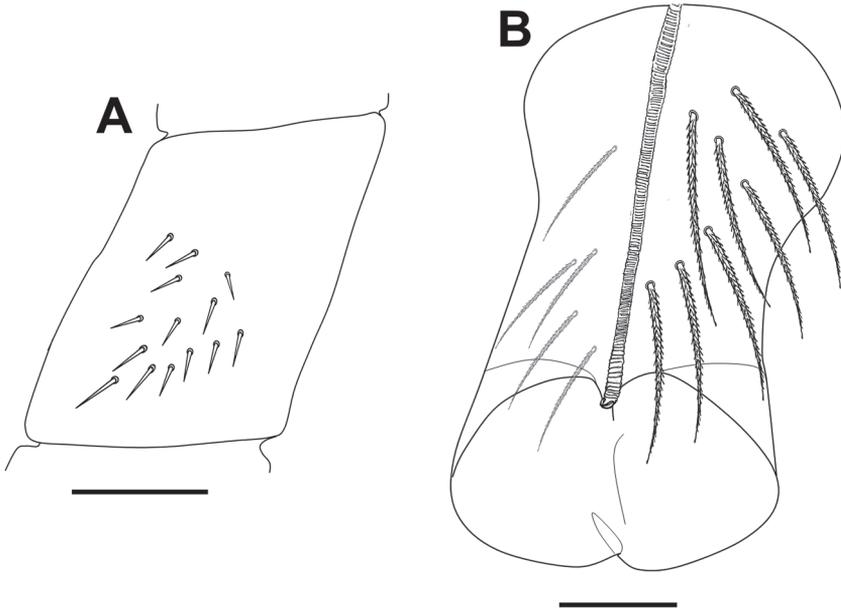
**Figure 8.** *Pseudosinella huetheri* Stomp, 1971. Abdomen dorsal chaetotaxy: **A** Abd II (left side) **B** Abd III (left side). ? indicates the estimated position of chaetae that were not observed in the holotype due to the condition of the slide, but their presence is assumed. Scale bar: 0.05 mm (**A**, **B**).

**Body.** Body dorsal macrochaetae from Th II to Abd IV 00/0101+2. Mesothorax without Mac. Two anterolateral S-chaetae (al and ms) present. Th III without Mac, anterolateral sensillum al present. Abd I with lateral S-microchaeta (ms). Chaetotaxy of Abd II–III as in Fig. 8A, B. Abd II chaetotaxy between two dorso-medial trichobotria –aBq<sub>1</sub>q<sub>2</sub> using Gisin’s symbols (Gisin 1967); following Szeptycki’s (1979) notation a=a<sub>2</sub>, B=m<sub>3</sub>, q<sub>1</sub>=m<sub>3</sub>e and q<sub>2</sub>=p<sub>4</sub>. Chaeta a as ciliated mic. Abd IV chaetotaxy as in Fig. 9A. Mac B<sub>5</sub>, B<sub>6</sub>, C<sub>1</sub>, D<sub>3</sub>, E<sub>2</sub>, E<sub>3</sub>, F<sub>1</sub>, F<sub>2</sub> and F<sub>3</sub> broader with broad sockets, D<sub>2</sub>, De<sub>3</sub>, E<sub>4</sub>, E<sub>4</sub>p, E<sub>4</sub>p<sub>2</sub>, F<sub>3</sub>p, Fe<sub>4</sub>, Fe<sub>5</sub>, T<sub>6</sub> and T<sub>7</sub> thinner with smaller sockets. Chaeta E<sub>1</sub> not visible, its morphology unknown. Abd IV chaetae associated with the two trichobotria (m, p<sub>e</sub> and p<sub>i</sub>) fan-shaped (chaeta a not visible, but with great certainty also fan-shaped) (see also Hüther 1969). Accessory chaeta s, associated with trichobotrium T<sub>2</sub>, absent. Five S-chaetae (as, ps, and three long dorsal S-chaetae) present. Dorsal chaetotaxy of Abd V as in Fig. 9B. Three S-chaetae (as, acc.p<sub>4</sub> and acc.p<sub>5</sub>) typical for the genus present. Legs without scales. Trochanteral organ with 14 smooth spiny chaetae forming a V-shaped pattern (Fig. 10A). Unguis and unguiculus as in fig. 3 in Stomp (1971). Unguis with subequal paired basal teeth at 45% from inner edge, and with a median



**Figure 9.** *Pseudosinella huetheri* Stomp, 1971. Abdomen dorsal chaetotaxy: **A** Abd IV (left side) **B** Abd V. ? indicates the estimated position of chaetae that were not observed in the holotype due to the condition of the slide, but their presence is assumed. Scale bars: 0.05 mm (**A**, **B**).

unpaired inner tooth at 65% from inner edge, apical tooth absent. A short external tooth also present. Unguiculus lanceolate, external lamella smooth. Tibiotarsal tenent hair spatulate, supraempodial chaeta on tibiotarsus III smooth and acuminate. Ratio of supraempodial chaeta / unguiculus ~0.9. Ventral tube without scales; with 8+8 subequal ciliated chaetae on anterior side and 5+5 subequal ciliated chaetae on posterior



**Figure 10.** *Pseudosinella huetheri* Stomp, 1971. **A** trochanteral organ **B** ventral tube anterior view (right side) and posterior view (left side). Scale bars: 0.03 mm (**A**, **B**).

side (Fig. 10B); lateral flap with 4 ciliated and 7 smooth chaetae. Manubrium ventrally with scales and 2+2 terminal ciliated chaetae. Manubrial plate with 2 inner chaetae and 2 chaetae external to the 2 pseudopores (as in Fig. 5D). Length of not ringed terminal dens about 4 times the length of mucro. Mucro with distal tooth equal to anteapical one; basal spine reaching tip of anteapical tooth (as in Fig. 5E). Ratio manubrium/dens/mucro as 12:13:1.

**Ecology and distribution.** *Pseudosinella huetheri* was described from Luxembourg, from a beech forest near Berdorf (Stomp 1971). The original description reported the species also from Germany and Switzerland. Later, the species was found in Austria (Bretschko and Christian 1989), France (Ponge 2004) and Slovakia (Raschmanová et al. 2008). Dányi et al. (2006) collected a species close to *P. huetheri* in Romania, listed as “*Pseudosinella* cf. *huetheri*”, but without any differential character being mentioned.

## Discussion

Considering the number of eyes (5+5) and the similar dorsal main macrochaetae distribution (R000/00/0101+2 or R001/00/0101+2), *Pseudosinella hartnerae* sp. nov. is close to *P. altamirensis* Baquero, Jordana, Labrada & Luque, 2020; *P. horaki* Rusek, 1985; *P. huetheri*; *P. mauli* Stomp, 1972; *P. mucronata* Gouze & Deharveng, 1987; and *P. sandelsorum* Gruia, 1977 (Table 1). The new species is, however, characterized by a

**Table 1.** Comparison of *P. hartnerae* sp. nov. with related species with 5+5 eyes and similar dorsal macrochaetae distribution.

| Species                      | Ch1                               | Ch2  | Ch3            | Ch4     | Ch5 | Ch6 | Ch7 | Ch8  | Ch9 | Ch10 | Ch11   | Ch12 |
|------------------------------|-----------------------------------|--|----------------|---------|-----|-----|-----|------|-----|------|--------|------|
| <i>P. altamirensis</i>       | pale with blue pigmentation       | M <sub>1</sub> m <sub>2</sub> Rel <sub>1</sub> L <sub>2</sub>                      | R000/00/0101+2 | 1.6–2.2 | –   | +   | 3   | 35%  | 40% | 1    | 2+7–12 | 2    |
| <i>P. horaki</i>             | pale greyish blue                 | M <sub>1</sub> M <sub>2</sub> REL <sub>1</sub> L <sub>2</sub>                      | R001/00/0101+2 | 1.6     | +   | –   | 3   | 50%  | 75% | 2    | U      | 1    |
| <i>P. huetheri</i>           | yellowish white                   | M <sub>1</sub> m <sub>2</sub> Rel <sub>1</sub> L <sub>2</sub>                      | R001/00/0101+2 | 1.4     | –   | –   | 3   | 45%  | 65% | 2    | 2+2    | 1    |
| <i>P. maui</i>               | bluish black                      | M <sub>1</sub> M <sub>2</sub> rEL <sub>1</sub> L <sub>2</sub>                      | R001/00/0101+2 | 1.3     | +   | +   | 3   | –45% | 65% | 2    | 2+3    | 1    |
| <i>P. mucronata</i>          | diffuse pigmentation              | m <sub>1</sub> (M <sub>1</sub> )<br>m <sub>2</sub> Rel <sub>1</sub> L <sub>2</sub> | R000/00/0101+2 | 1.8–2.0 | –   | –   | 3   | –45% | 60% | 1    | U      | 2    |
| <i>P. sandelsorum</i>        | dark blue pigment on Ant and legs | M <sub>1</sub> M <sub>2</sub> REL <sub>1</sub> L <sub>2</sub>                      | R001/00/0101+2 | 1.3     | +   | –   | 4   | –50% | 70% | 2    | 2+4–10 | 1    |
| <i>P. hartnerae</i> sp. nov. | bluish-grey                       | M <sub>1</sub> m <sub>2</sub> rel <sub>1</sub> L <sub>2</sub>                      | R001/00/0101+2 | 1.2–1.4 | +   | –   | 3   | 35%  | 60% | 2    | 2+2    | 1    |

Legend. **Ch1**: body colour. **Ch2**: basal labial chaetotaxy formula. **Ch3**: body dorsal macrochaetae formula. **Ch4**: antennal length to head diagonal length ratio. **Ch5**: Abd II chaeta p: (+) present or (–) absent. **Ch6**: Abd IV supplementary chaeta s: (+) present or (–) absent. **Ch7**: number of teeth of inner unguis. **Ch8**: distance of distal paired claw tooth from the base as a % of total claw length. **Ch9**: distance of distal unpaired claw tooth from the base as a % of total claw length. **Ch10**: tenent hair shape: (1) acuminate, (2) clavate. **Ch11**: number of inner and outer chaetae on manubrial plate. **Ch12**: habitat: (1) surface, (2) cave. “U”, unknown.

unique basal labial chaetotaxy. While *P. horaki*, *P. maui* and *P. sandelsorum* have M<sub>1</sub>, M<sub>2</sub>, E, L<sub>1</sub> and L<sub>2</sub> as ciliated chaetae, in *P. hartnerae* sp. nov. only M<sub>1</sub> and L<sub>2</sub> are ciliated, and m<sub>2</sub>, r, e, and l<sub>1</sub> are smooth. *Pseudosinella altamirensis* bears two ciliated labial chaetae (M<sub>1</sub> and R), and *P. mucronata* has R and occasionally also M<sub>1</sub> as ciliated chaetae, while all other chaetae are smooth. Only *P. huetheri* shows a similar morphology of labial chaetae, with the exception of chaeta R present as a fairly developed ciliated chaeta (r smooth and reduced in *P. hartnerae* sp. nov.). The new species differs from *P. huetheri* also by the colour pattern and by the presence of Abd II chaeta p (a<sub>2p</sub>). The new species differs from *P. altamirensis* and *P. mucronata* also by the presence of subocular cephalic macrochaeta Pa<sub>5</sub>. The new species differs from *P. altamirensis* and *P. maui* by the absence of accessory chaeta s on Abd IV. Besides, the new species differs from *P. sandelsorum* by the number of teeth of the inner unguis. *Pseudosinella hartnerae* sp. nov. and *P. huetheri* share the number of chaetae (2) external to the pseudopores on the manubrial plate, which is greater for *P. altamirensis* (7–12), *P. maui* (3) and *P. sandelsorum* (4–10).

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## References

- Baquero E, Jordana R, Labrada L, Luque CG (2020) A new species of *Pseudosinella* Schäffer, 1897 (Collembola, Entomobryidae) from Altamira Caves (Cantabria, Spain). *ZooKeys* 989: 39–54. <https://doi.org/10.3897/zookeys.989.52361>
- Bellinger PF, Christiansen KA, Janssens F (2021) Checklist of the Collembola of the World. <http://www.collembola.org> [Accessed on: 11.09.2021]
- Börner C (1913) Die Familien der Collembolen. *Zoologischer Anzeiger* 41: 315–322.
- Bretschko G, Christian E (1989) Collembola in the bed sediments of an Alpine gravel stream (RITRODAT-Lunz Study Area, Austria). *Internationale Revue der gesamten Hydrobiologie und Hydrographie* 74(5): 491–498. <https://doi.org/10.1002/iroh.19890740504>
- Buşmachi G, Kováč L, Miklisová D, Weiner WM (2017) Riparian Collembola (Hexapoda) communities of northern Moldova, Eastern Europe. *ZooKeys* 724: 119–134. <https://doi.org/10.3897/zookeys.724.12478>
- Chen J-X, Christiansen KA (1993) The genus *Sinella* with special reference to *Sinella* s. s. (Collembola: Entomobryidae) of China. *Oriental Insects* 1993, 27(1): 1–54. <https://doi.org/10.1080/00305316.1993.10432236>
- Christiansen K, Bellinger P, Gama MM da (1990) Computer Assisted Identification of Specimens of *Pseudosinella* (Collembola: Entomobryidae). *Revue d'Écologie et de Biologie du Sol* 27(2): 231–246.
- Cipola NG, Arbea J, Baquero E, Jordana R, Morais JW, Bellini BC (2018) The survey *Seira* Lubbock, 1870 (Collembola, Entomobryidae, Seirinae) from Iberian Peninsula and Canary Islands, including three new species. *Zootaxa* 4458: 1–66. <https://doi.org/10.11646/zootaxa.4458.1.1>
- Cipola NG, Oliveira JVL, Bellini BC, Ferreira AS, Lima ECA, Brito RA, Stievano LC, Souza PGC, Zeppelini D (2020) Review of Eyeless *Pseudosinella* Schäffer (Collembola, Entomobryidae, and Lepidocyrtinae) from Brazilian Caves. *Insects* 11(3): e194. [141 pp.] <https://doi.org/10.3390/insects11030194>
- Dányi L, Traser G (2008) An annotated checklist of the springtail fauna of Hungary (Hexapoda: Collembola). *Opuscula Zoologica* 38: 3–82.
- Dányi L, Traser G, Fiera C, Radwanski JM (2006) Preliminary data on the Collembola fauna of the Maramureş (Romania). *Studia Universitatis Vasile Goldis Arad, Seria Stiintele Vietii* 17: 47–51.
- Fiera C (2013) Species of the genus *Pseudosinella* (Collembola: Entomobryidae) in Romanian fauna. *Acta Oecologica Carpatica* 6: 53–66.
- Fjellberg A (1999) The labial palp in Collembola. *Zoologischer Anzeiger* 237: 309–330.
- Gisin H (1964) Collemboles d'Europe VII. *Revue Suisse de Zoologie* 71(4): 649–678. <https://doi.org/10.5962/bhl.part.75615>
- Gisin H (1967) Espèces nouvelles et lignées évolutives de *Pseudosinella* endogés (Collembola). *Memórias e Estudos do Museu Zoologico da Universidade de Coimbra* 301: 1–25.
- Gisin H, Gama MM da (1969) Espèces nouvelles de *Pseudosinella* cavernicoles (Insecta, Collembola). *Revue suisse de Zoologie* 76(6): 143–181. <https://doi.org/10.5962/bhl.part.146030>
- Gouze A, Deharveng L (1987) Deux espèces nouvelles de *Pseudosinella* cavernicoles du Var (Coll.). *Bulletin de la Société Entomologique de France* 91(3–4): 65–68.

- Gruia M (1977) Collemboles euédaphiques de la Vallé Motru Sec. Travaux de l'Institut de Spéologie "Émile Racovitza" 16: 77–84.
- Hüther W (1969) Über einige bemerkenswerte Ur-Insekten aus der Pfalz und benachbarter Gebiete (Protura, Diplura, Collembola). Mitteilungen der Pollichia des Pfälzischen Vereins für Naturkunde und Naturschutz 16: 135–148.
- Jordana R, Baquero E (2007) New species of *Pseudosinella* Schäffer, 1897 (Collembola, Entomobryidae) from Spain. Zootaxa 1465: 1–14. <https://doi.org/10.11646/zootaxa.1465.1.1>
- Jordana R, Baquero E, Ariño AH (2021) Continuously updated: Collembola DELTA database. University of Navarra. <http://www.unav.es/unzyec/collembola/> [Accessed on 14.02.2021]
- Lubbock J (1873) Monograph of the Collembola and Thysanura. Ray Society, London, 276 pp. <https://doi.org/10.5962/bhl.title.11583>
- Mateos E (2008) The European *Lepidocyrtus* Bourlet, 1839 (Collembola: Entomobryidae). Zootaxa 1769: 35–59. <https://doi.org/10.11646/zootaxa.1769.1.2>
- Ponge JF (2004) Effets des composés organiques sur la faune du sol: perturbation des communautés et recolonisation des substrats pollués. Technial report. Muséum National d'Histoire Naturelle, CNRS UMR 7179, 42 pp.
- Raschmanová N, Kováč L, Miklisova D (2008) The effect of mesoclimate on Collembola diversity in the Zádiel Valley, Slovak Karst (Slovakia). European Journal of Soil Biology 44: 463–472. <https://doi.org/10.1016/j.ejsobi.2008.07.005>
- Rusek J (1985) New Palearctic *Lepidocyrtus* and *Pseudosinella* species (Collembola: Entomobryidae). Vestník Československe Spolecnosti Zoologicke 49: 132–146.
- Schäffer C (1896) Die Collembolen der Umgebung von Hamburg und benachbarter Gebiete. Mitteilungen aus dem Naturhistorischen Museum Hamburg 13: 149–216.
- Schäffer C (1897) Apterygoten. Hamburger Magalhaensische Sammelreise Apterygoten 8: 1–48.
- Soto-Adames FN (2010) Two new species and descriptive notes for five *Pseudosinella* species (Hexapoda: Collembola: Entomobryidae) from West Virginian (USA) Caves. Zootaxa 2331: 1–34.
- Stomp N (1971) Contribution à l'étude des *Pseudosinella* endogés. Espèces européennes de *Pseudosinella* à 5+5 yeux. Revue d'écologie et de biologie du sol 8: 173–184.
- Stomp N (1972) Deux nouvelles espèces de *Pseudosinella* endogés d'Europe (Collemboles, Entomobryides). Revue Suisse de Zoologie 79: 279–286. <https://doi.org/10.5962/bhl.part.97128>
- Szeptycki A (1972) Morpho-systematic studies on Collembola III. Body chaetotaxy in the first instars of several genera of the Entomobryomorpha. Acta Zoologica Cracoviensia 17: 341–372.
- Szeptycki A (1979) Morpho-systematic studies of Collembola. IV. Chaetotaxy of the Entomobryidae and its phylogenetical significance. Polska Akademia Nauk, Zakład Zoologii Systematycznej i Doświadczalnej, Państwowe Wydawnictwo Naukowe, Warszawa and Kraków, 218 pp.
- Traser G, Szűcs P, Winkler D (2006): Collembola diversity of moss habitats in the Sopron Region, NW-Hungary. Acta Silvatica et Lignaria Hungarica 2: 69–80.
- Wahlgren E (1906) Apterygoten aus Ägypten und dem Sudan nebst Bemerkungen zur Verbreitung und Systematik der Collembolen. Results of the Swedish Zoological Expedition to Egypt and the White Nile 1901 under the Direction of L.A. Jägerskiöld, Uppsala, 72 pp.

- Wang F, Chen J-X, Christiansen K (2003) Taxonomy of the genus *Lepidocyrtus* s.l. (Collembola: Entomobryidae) in East and Southeast Asia and Malaysia, with description of a new species from the People's Republic of China. *The Canadian Entomologist* 135: 823–837. <https://doi.org/10.4039/n02-106>
- Winkler D, Mateos E (2018) New species of *Pseudosinella* Schäffer, 1897 (Collembola, Entomobryidae) from Hungary. *Zootaxa* 4382(2): 347–366. <https://doi.org/10.11646/zootaxa.4382.2.7>
- Yoshii R, Suhardjono YR (1992) Collembolan fauna of Indonesia and its affinities III: Collembola of Timor Island. *AZAO* 1992, 2: 75–96.
- Zhang F, Deharveng L (2015) Systematic revision of Entomobryidae (Collembola) by integrating molecular and new morphological evidence. *Zoologica Scripta* 44(3): 298–311. <https://doi.org/10.1111/zsc.12100>