

A NEW SPECIES AND A NEW INTERESTING RECORD OF THE
GENUS *HYPOGASTRURA* BOURLET, 1839 (COLLEMBOLA,
HYPOGASTRURIDAE) FROM UKRAINE

SKARŻYŃSKI, D.¹ and KAPRUS', I. J.²

¹Zoological Institute, Wrocław University, Przybyszewskiego 63/77, 51–148 Wrocław, Poland

E-mail: hypogast@biol.uni.wroc.pl

²State Museum of Natural History, Ukrainian National Academy of Sciences,

Teatral'na St. 18, UA–79008 L'viv, Ukraine; E-mail: i-kaprus@mail.ru

Hypogastrura martiani sp. n. is described from Crimea, Ukraine. The new species belongs to the *H. viatica* group and can be easily distinguished from its two relatives, *H. tullbergii* (SCHÄFFER, 1900) and *H. concolor* (CARPENTER, 1900), by the structure of the antennal III-organ, the shape of dorsal setae, the range of distribution, habitat preferences, and the ability to pass ecomorphosis. *Hypogastrura janetscheki* STEINER, 1959 is removed from synonymy of *Hypogastrura socialis* (UZEL, 1891). This species has been recorded from Ukraine for the first time.

Key words: taxonomy, springtails, *Hypogastrura martiani* sp. n., *Hypogastrura janetscheki*

INTRODUCTION

A cosmopolitan genus *Hypogastrura* BOURLET, 1839 is the largest in the whole family Hypogastruridae. It currently comprises about 161 species (BELLINGER *et al.* 2008), of which 14 are known from Ukraine (KAPRUS' *et al.* 2006). During examination of the material collected in the Crimean Peninsula and in the Prychornomors'ka Lowland, we found specimens representing a species new to science as well as specimens of *Hypogastrura janetscheki* STEINER, 1959, a species new for the Ukrainian fauna. A description of the former species and a note on the taxonomic status of the latter are given below.

MATERIAL AND METHODS

The specimens were cleared in potassium hydroxide and chloral phenol and then mounted on slides in SWAN'S medium (distilled water, chloral hydrate, glacial acetic acid, glucose, gum arabic) and observed using a Nikon Eclipse E 600 phase contrast microscope. All figures were drawn with the camera lucida. The terminology for the description follows that given in BABENKO *et al.* (1994), CHRISTIANSEN & BELLINGER (1998), FJELLBERG (1984, 1999) and THIBAUD *et al.* (2004).

The material studied is deposited at the following two institutions: the State Museum of Natural History, Ukrainian National Academy of Sciences, L'viv, Ukraine (SMNHL), and the Department of Biodiversity and Evolutionary Taxonomy, Wrocław University, Poland (DBET).

Hypogastrura martiani sp. n.
(Figs 1–13)

Type material. Holotype: female on slide, Martian Cape near the town of Yalta (Crimean Peninsula, Ukraine), pine forest, litter and soil, 28.VII.1996, leg. MOSALOV (SMNHL). Paratypes (all on slides): 15 males (including 8 reproductive and 1 ecomorphic), 10 females (including 3 reproductive and 2 ecomorphic), 27 juv. (including 16 ecomorphic, 2 in ecdysis from non-ecomorphic to ecomorphic form), same data as above (48 paratypes SMNHL, 4 paratypes DBET).

Other material examined. 1 male on slide, near the town of Yalta (Crimean Peninsula, Ukraine), pine forest, litter and moss, 14.II.2007, leg. O. HAUSTOV; 3 males, 1 female, 3 juv., Hrestova Mountain near Livadia village (Crimean Peninsula, Ukraine), litter and moss, 10.XII.2006, leg. O. HAUSTOV (SMNHL).

Description. Body length 0.9–1.5 mm. Body colour bluish grey. Granulation fine and uniform, 8–16 granules between setae p_1 on abdominal tergum V (Fig. 2).

Dorsal chaetotaxy of thorax and abdomen as in Figs 1–2. Dorsal chaetotaxy of head typical of the genus. Dorsal setae short, thin, tapered, and smooth (Fig. 5). Body sensilla (s) two to three times longer than surrounding setae, smooth. Thoracic tergum I with 3 + 3 setae. Thoracic tergum II with setae m_{2-4} present and setae m_6 absent. Thoracic tergum III with setae m_3 present and setae m_2 , m_4 , and m_6 absent. Setae p_3 on abdominal tergum IV usually present; setae m_2 always absent. 6–8 setae between sensilla p_3 on abdominal tergum V. Macrochaetae near anal spines tapered. Subcoxa I–III with 1, 2, 3 setae respectively. Polychaetosis absent.

Antennal segment IV with simple apical vesicle, subapical organite (or), microsensillum (ms), 4 (3 lateral, 1 dorsal) thin, cylindrical, curved sensilla (Fig. 3) and up to 10 short erect sensilla in the ventral file. Antennal III-organ with two long (lateral) and two short (internal) curved sensilla (Fig. 3). Microsensillum on antennal segment III present. Antennal segment I with 7 setae.

Ocelli 8 + 8. Post antennal organ slightly smaller than neighbour ocelli, with 4 subequal lobes (Fig. 4). Accessory boss invisible.

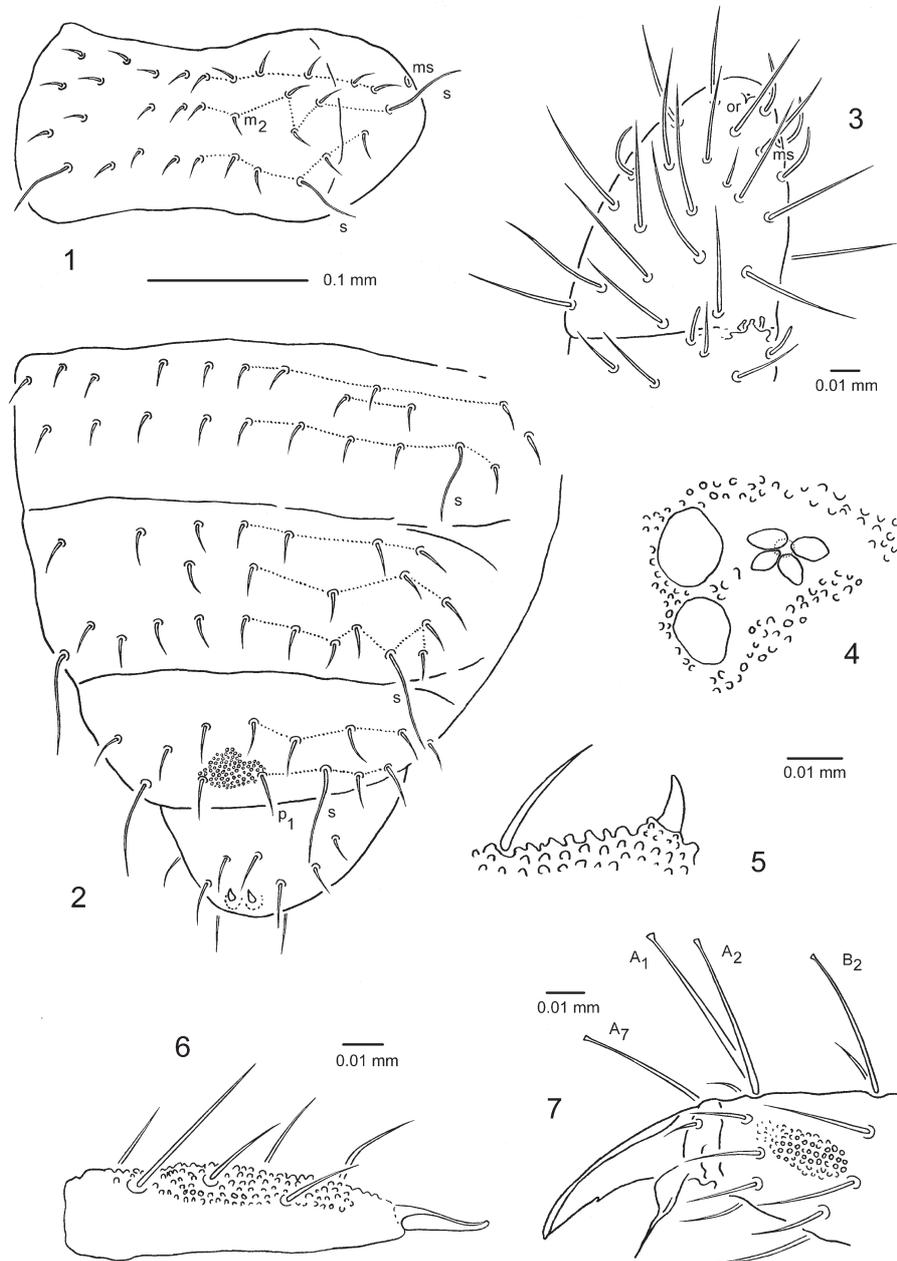
Labrum with 5, 5, 4 setae, 4 prelabrals, and 4–6 distal papillae. Head of maxilla of the *tullbergi* type, outer lobe with 2 sublobal hairs. Labium of the *tullbergi* type.

Tibiotarsi I–III with 19, 19, 18 setae, clavate tenent hairs 2 (A_1 , A_7), 3 (A_1 , A_2 , A_7), 3–4 (A_1 , A_2 , A_7 , B_2) respectively. Tenent hairs slightly longer than claws. Setae A_1 thicker and longer than others; setae B_2 on tibiotarsi III more or less clavate, rarely pointed. Claws with small inner tooth above middle of inner edge; lateral teeth weakly visible. Empodial appendage with broad basal lamella and apical filament reaching 1/2 of claw inner edge (Fig. 7).

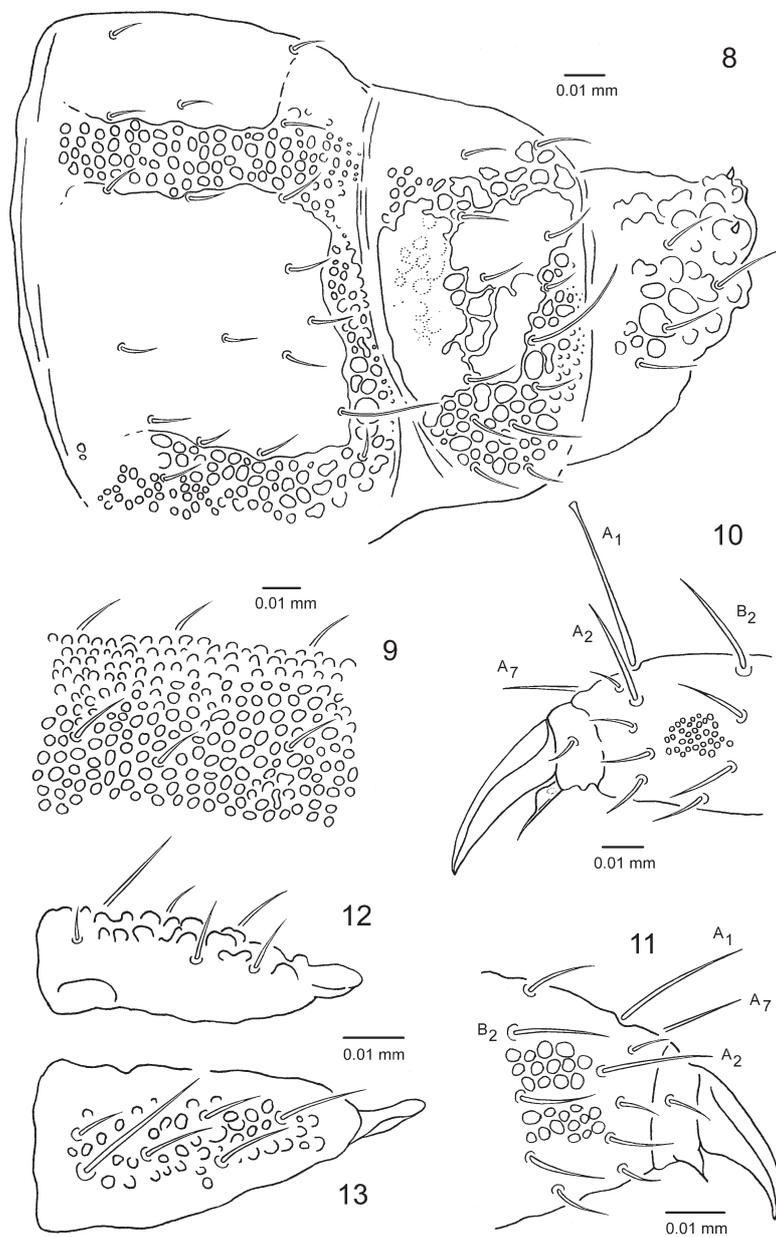
Ventral tube with 4 + 4 setae. Retinaculum with 3 + 3 teeth.

Furca well developed (Fig. 6). Dens with fine and uniform granulation and 6 setae. Mucro narrow with low outer lamella and about 1/3–1/4 as long as dens.

Anal spines short, set on small basal papillae (Figs 2, 5).



Figs 1-7. *Hypogastrura martiani* sp. n.: 1 = chaetotaxy of thoracic tergum II; 2 = chaetotaxy of abdominal terga III-VI; 3 = chaetotaxy of antennal segments III-IV, dorsal view; 4 = post antennal organ and neighbour ocelli; 5 = anal spine and neighbour seta, lateral view; 6 = dens and mucro; 7 = tibiotarsus III, claws and empodial appendage



Figs 8–13. *Hypogastrura martiani* sp. n. (ecomorphic forms): 8 = tegumentary granulation and chaetotaxy of abdominal terga IV–VI of form B; 9 = tegumentary granulation and chaetotaxy of axial area of abdominal tergum IV of form C; 10 = tibiotarsus III, claws and empodial appendage of form B; 11 = tibiotarsus III, claws and empodial appendage of form C; 12 = mucrodens of form C; 13 = dens and mucro of form B.

Description of ecomorphic specimens. Numerous specimens collected in July exhibit features typical of ecomorphic forms of *Hypogastrura boldorii* DENIS, 1931 (CASSAGNAU 1956) and *Hypogastrura conflictiva* JORDANA et ARBEA, 1992 (ARBEA 2007). 1 male, 1 female, and 18 juveniles comparable with form B of *H. boldorii* (CASSAGNAU 1956) have reduced mouthparts (head of maxillae small with indistinct lamellae; mandibles small with some indistinct apical teeth and without molar plates), small ocelli, claws (without inner tooth), empodial appendages (Fig. 10), mucro (Fig. 13), anal spines and short body setae (Fig. 8). Of the tibiotarsal tenent hairs, only A_1 are clavate, while the remaining ones are shortened and pointed (Fig. 10). Tegumentary granulation is coarse and irregular, especially on the last abdominal terga. On abdominal tergum IV and V, smooth plates made of joined granules are visible (Fig. 8). 1 female of *H. martiani* sp. n. refers to the ecomorphic form C of *H. boldorii* (CASSAGNAU 1956). This specimen differs from form B in having more shortened and thickened claws, smaller empodial appendages with indistinct basal lamellae, all tibiotarsal tenent hairs pointed (Fig. 11), mucrodens (Fig. 12), and a coarse and regular tegumentary granulation (Fig. 9). Moreover, mandibles are invisible in form C.

Although morphological signs of ecomorphosis in *H. martiani* sp. n. and *H. boldorii* sensu CASSAGNAU (1956) are similar, their life cycles are different. This former species reproduces in the summer (July), whereas the latter in the autumn (October). The occurrence of the reproductive form and the ecomorphic forms of *H. boldorii* sensu CASSAGNAU (1956) in the field is separated temporally due to ecoclimatic conditions. The coexistence of all forms of *H. martiani* sp. n. (non-reproductive/non-ecomorphic, ecomorphic B, ecomorphic C, and reproductive) at the same time and place is an interesting phenomenon in this context. Further studies are needed to explain the peculiar characteristics of this life cycle.

Etymology. Named after its terra typica, Cape Martian near the town of Yalta (Crimea, Ukraine).

Discussion. The *Hypogastrura viatica* group is one of the largest within the genus and comprises about 30 species and forms characterized by weakly differentiated sensilla on antennal segment IV, the retinaculum with 3+3 teeth, the ventral tubus with 4+4 setae, broad basal empodial lamella, and tibiotarsi with more than one clavate setae (NAJT *et al.* 1984, FJELLBERG 1985, BABENKO *et al.* 1994, CHRISTIANSEN & BELLINGER 1998, THIBAUD *et al.* 2004). Some of them, e.g. *H. viatica* (TULLBERG, 1872), *H. distincta* (AXELSON, 1902), and *H. purpurescens* (LUBBOCK, 1867), are morphologically well defined and widely distributed; others are distinguished based on subtle morphological features, distributional patterns, and habitat preferences.

H. martiani sp. n. belongs to a group of species and forms that have 2, 3, 3–4 clavate tenent hairs on tibiotarsi I–III, 5–6 setae on dens, and no signs of polychaetosis. It is similar to two strictly Arctic species: *H. tullbergii* (SCHÄFFER, 1900) and *H. concolor* (CARPENTER, 1900), from which it differs in the structure of the antennal III-organ (*H. tullbergii* – additional sensilla present, *H. martiani* sp. n. and *H. concolor* – additional sensilla absent) and the shape of dorsal setae (*H. concolor* – thick and serrated, *H. martiani* sp. n. and *H. tullbergii* – thin and smooth) (NAJT *et al.* 1984, FJELLBERG 1985, BABENKO *et al.* 1994). Both of the

Arctic species, which live in cold, open habitats, do not pass ecomorphosis in their life cycles, whereas two ecomorphic forms were discovered in *H. martiani* sp. n., which lives in forests of the temperate climatic zone. The new species relates also to some undescribed forms, such as "*H. tullbergii*" from Thuringia (Germany) (see GISIN 1961), "*H. sp. Delieux*" from Toulouse (France) (see NAJT *et al.* 1984) and "*H. cf. subboldorii*" from Bashkiria, the Caucasus Mountains, and the Altai Mountains (see BABENKO *et al.* 1994). However, further studies are needed to establish their actual taxonomic status and affinities. *H. boldorii* DENIS, 1931 from the Italian Alps, and *H. browni* (BAGNALL, 1940) from Great Britain are possible relatives of the new species; however, their poor diagnoses (DENIS 1931*a, b*, BAGNALL 1940, LAWRENCE 1962) make comparison with the new species difficult. *H. boldorii* is commonly regarded as a species characterized by well-developed polychaetosis and therefore related to *H. affinis* (LUCAS, 1846) sensu JORDANA *et al.* (1997) (NW Africa, SW Europe), *H. aequipilosa* (STACH, 1949) (Central Europe), *H. conflictiva* (SW Europe), *H. elegantula* (BUTSCHEK, 1948) (Austrian Alps), *H. litoralis* (AXELSON, 1907) (N Europe), and *H. subboldorii* DELAMARE DEBOUTTEVILLE *et* JACQUEMART, 1962 (French Pyrenees) (GISIN 1961, NAJT *et al.* 1984, FJELLBERG 1998). Due to its morphology, geographic range, and ecological preferences, *H. browni* is considered to be a synonym of *H. litoralis*, which inhabits bogs and seashores in Finland, Sweden, Denmark, and Russian Karelia (FJELLBERG 1998, HOPKIN 2007).

Hypogastrura janetscheki STEINER, 1959, **bona species**

Hypogastrura janetscheki STEINER, 1959: 455

Hypogastrura socialis (UZEL, 1891) summer form: JORDANA *et al.* (1997: 91)

Hypogastrura janetscheki STEINER, 1959 (as syn. n. of *Hypogastrura socialis* (UZEL, 1891): JORDANA *et al.* (1997: 759)

Hypogastrura janetscheki STEINER, 1959 (as cyclomorphic form of *Hypogastrura socialis* (UZEL, 1891): ARBEA (2007: 120)

Material examined. 21 specimens on slides, soil and litter in birch forest, Solenozerna locality, Chornomors'ky Biosphere Reserve, Kherson district, Ukraine, 30. IV. 2006, leg. I. KAPRUS'; 1 specimen, soil and turf, steppe, Jagorlyts'ky Kut locality, Chornomors'ky Biosphere Reserve, Kherson district, Ukraine, 2. V. 2006, leg. I. KAPRUS'; 1 specimen, soil and turf, steppe, Kamiani Mohyly Reserve, Donets'k district, Ukraine, 23. X. 1996, leg. O. STAROSTENKO (18 specimens SMNHL, 5 specimens DBET).

Note. *H. janetscheki* has been recorded from Ukraine for the first time. This species described from Sierra Nevada (S Spain) (STEINER 1959) was recognized as summer form of *H. socialis* and synonymized by JORDANA *et al.* (1997). However,

judging from the description and figures, *H. socialis* sensu JORDANA *et al.* (1997) in fact represents two distinct species different from *H. socialis* sensu STACH (1949), BABENKO *et al.* (1994), and FJELLBERG (1998). The summer form of *H. socialis* sensu JORDANA *et al.* (1997), characterized by 8 cylindrical sensilla on antennal segment IV, m_2 setae on thoracic tergum II absent, setae m_1 on abdominal tergum IV present, mucro with subapical tooth, and dens with fine tegumentary granulation (JORDANA *et al.* 1997: fig. 38), is *H. janetscheki*, and the winter form from Quinto Real (West Pyrenees), with 8 cylindrical sensilla on antennal segment IV, m_2 setae on thoracic tergum II and setae m_1 on abdominal tergum IV absent, mucro with subapical tooth, and dens with some spine-like granules (JORDANA *et al.* 1997: fig. 39), is *H. kelmendica* PEJA, 1985 or a related species (see SKARŻYŃSKI & SMOLIS 2003). True *H. socialis* can be easily distinguished from them by the larger number (10–12) of sensilla on antennal segment IV and the presence of setae m_2 on thoracic tergum II. In the light of these facts *H. janetscheki* should be considered a valid species.

Unfortunately our knowledge of the morphology of *H. janetscheki* is incomplete. All specimens mentioned by STEINER (1959) were collected in July; therefore, the morphology of winter (cyclomorphic) specimens remains unknown. The Ukrainian material is also imperfect in this respect, as there is only one specimen collected in the autumn. It has fine granules at the basal part of the dens and some larger (but not spine-like) ones near its distal end. Further studies are needed to establish whether *H. janetscheki* is a cyclomorphic species.

Although the Ukrainian population fits the description of *H. janetscheki* (STEINER 1959, JORDANA *et al.* 1997), it can also be related to *Hypogastrura spei* BABENKO, 1994 from Taymir, the Urals, Chukotka, and Armenia, which is a possible synonym of the former species. They differ in the character of dens granulation only. *H. spei* is a cyclomorphic species with the summer and the winter forms typical of the *H. socialis* group (BABENKO *et al.* 1994). Until the morphology of winter specimens of *H. janetscheki* becomes known, *H. spei* should be considered as a valid species.

REFERENCES

- ARBEA, J. I. (2007) Descripción de un nuevo caso de ecomorfosis en *Hypogastrura conflictiva* Jordana & Arbea, 1992 y claves para la identificación de las especies iberobaleares del género *Hypogastrura* Bourlet, 1839 (Collembola, Hypogastruridae). *Boletín de la Asociación Española de Entomología* **31**: 115–125.
- BABENKO, A. B., CHERNOVA, N. M., POTAPOV, M. B. & STEBAEVA, S. K. (1994) *Collembola of Russia and adjacent countries: Family Hypogastruridae*. Moscow, Nauka, 336 pp.
- BAGNALL, R. S. (1940) Notes on British Collembola. *Entomologist's Monthly Magazine* **76**: 163–174.

- BELLINGER, P., CHRISTIANSEN, K. A. & JANSSENS, F. (2008) Checklist of the Collembola of the World. Available from: <http://www.collembola.org> (accessed 27.03.2008).
- CASSAGNAU, P. (1956) Modifications morphologiques expérimentales chez *Hypogastrura boldorii* Denis (Collembole). *Compte Rendu Hebdomadaire des Séances de l'Académie des Sciences, Paris* **243**: 603–605.
- CHRISTIANSEN, K. & BELLINGER, P. (1998) *The Collembola of North America north of the Rio Grande. A taxonomic analysis*. Grinnell College, Grinnell, Iowa, 1520 pp.
- DENIS, J. R. (1931a) Sur la faune Italienne des Collemboles, IV. *Memorie della Societa Entomologica Italiana* **10**: 80–85.
- DENIS J. R. (1931b) Collemboli di caverne Italiane. *Memorie dell' Instituto Italiano di Speleologia, Ser. Biologica* **2**: 5–15.
- FJELLBERG, A. (1984) Maxillary structures in Hypogastruridae (Collembola). *Annales de la Société Royale Zoologique de Belgique* **114**: 89–99.
- FJELLBERG, A. (1985) Arctic Collembola. 1. The collembolan fauna of Alaska: Families Poduridae, Hypogastruridae, Odontellidae, Brachystomellidae and Neanuridae. *Entomologica Scandinavica Suppl.* **21**: 1–126.
- FJELLBERG, A. (1998) *The Collembola of Fennoscandia and Denmark. Part 1 Poduromorpha*. Fauna Entomologica Scandinavica. Leiden, Boston, Köln (Brill) Vol. 35, 184 pp.
- FJELLBERG, A. (1999) The labial palp in Collembola. *Zoologischer Anzeiger* **237**: 309–330.
- GISIN, H. (1961) Collembolen aus der Sammlung C. Börner des Deutschen Entomologischen Institutes. *Beiträge zur Entomologie* **11**: 329–354.
- HOPKIN, S. P. (2007) *A key to the Collembola (Springtails) of Britain and Ireland*. Field Studies Council, Shropshire, 245 pp.
- JORDANA, R., ARBEA, J. I., SIMÓN, C. & LUCIÁÑEZ, M. J. (1997) *Collembola, Poduromorpha*. In: RAMOS, M. A., TERCEDOR, J. A., ROS, X. B., NOGUERA, J. G., SIERRA, A. G., MAYOL, E. M., PIERA, F. M., MARINO, J. S. & GONZÁLES, J. T. (eds). *Fauna Ibérica, vol. 8*. Museo Nacional de Ciencias Naturales, CSIC, Madrid, 807 pp.
- KAPRUS', I. J., SHRUBOVYCH, J. J. & TARASHCHUK, M. V. (2006) *Catalogue of the Collembola and Protura of Ukraine*. State Museum of Natural History, Ukrainian National Academy of Sciences, L'viv, 164 pp.
- LAWRENCE, P. N. (1962) A review of Bagnall's *Hypogastrura* types (Collembola). *Entomologist's Gazette* **13**: 132–151.
- NAJT, J., DALENS, H. & DEHARVENG, L. (1984) Note sur la biologie, le polymorphisme et le statut taxonomique de quelques populations d'*Hypogastrura* du sous-groupe tullbergi. *Revue d'Écologie et de Biologie du Sol* **21**: 395–413.
- SKARŻYŃSKI, D. & SMOLIS, A. (2003) Notes on *Hypogastrura kelmendica* Peja, 1985 (Collembola, Hypogastruridae), a springtail species new for the Polish fauna. *Polskie Pismo Entomologiczne* **72**: 105–109.
- STACH, J. (1949) *The apterygotan fauna of Poland in relation to the world fauna of this group of insects. Families Neogastruridae and Brachystomellidae*. Acta Monographica Musei Historiae Naturalis, Polish Academy of Sciences and Letters, Kraków, 341 pp.
- THIBAUD, J.-M., SCHULZ, H.-J. & GAMA, M. M. da (2004) Hypogastruridae. In: DUNGER, W. (ed.) *Synopses on Palaearctic Collembola*. Vol. 4. *Abhandlungen und Berichte des Naturkundemuseums Görlitz* **75**: 1–287.

Revised version received July 12, 2007, accepted January 10, 2008, published March 31, 2009