

Description of two new species of *Hypogastrura* Bourlet, 1839 of the *H. crassaegranulata* group (Collembola: Hypogastruridae) from the Caucasus, with notes on some related species

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A revision of '*Hypogastrura crassaegranulata*' material from the eastern Palaearctic was done as all records before 2006 referred to *H. crassaegranulata* have become unclear after recent redescription of the species. It shown that among four forms mentioned under this name by Babenko *et al.* (1994) none belongs to true *H. crassaegranulata*. Two of these forms are in fact species new to science described and illustrated below as *H. tepi* sp. n. and *H. aushensis* sp. n. (Russia, Northern Caucasus). Two others appear to be *H. franconiana* (Stach, 1949) and *H. szeptyckii* Skarżyński, 2006 firstly recorded from Kazakhstan (Tien Shan) and Ukraine (Carpathians), respectively.

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1. Introduction

Hypogastrura crassaegranulata (Stach, 1949) was originally described as a polytypic species including three distinct subspecies, i.e. *H. crassaegranulata crassaegranulata*, *H. crassaegranulata franconiana*, and *H. crassaegranulata dobsinensis*. Later (Cassagnau 1959, Gisin 1960, Nosek 1962) several additional forms were described within the same species. Recent revision of this complex made by Skarżyński (2006a) not only precisely defined *H. crassaegranulata* s.str., but also raised to species level two subspecies,

H. c. franconiana (Stach, 1949) and *H. c. carpatica* Nosek, 1962, treating other known forms as junior synonyms. As a result all records before 2006 referred to *H. crassaegranulata* have become unclear. Thus, a review of material from the eastern Palaearctic revealed that among four forms mentioned under this name by Babenko *et al.* (1994) none is truly *H. crassaegranulata*. Two of these forms are in fact species new to science whereas two more seems to be *H. franconiana* (Stach, 1949) and *H. szeptyckii* Skarżyński, 2006. Descriptions and taxonomic notes on these species are given below.

2. Material and methods

Terminology for the descriptions follows Fjellberg (1984, 1998, 1999) and Babenko *et al.* (1994). Abbreviations used: ant. I–IV – antennal segments I–IV, AOIII – antennal III–organ, th. I–III – thoracic terga I–III, abd. I–VI – abdominal terga I–VI, VT – ventral tube.

3. Taxonomy

3.1. *Hypogastrura tepli* n. sp. (Fig. 1)

Hypogastrura crassaegranulata: Babenko *et al.* (1994): 88

Type material. Holotype female on slide, Russia, Northern Caucasus, Republic of North Ossetia-Alania, Kurtatinsk ravine (valley of Fiagdon river), *Draba siliquosa* and lichens on cliff, 3,410 m a.s.l., 12. VIII. 1984, leg. I. T. Kuchiev. Paratypes: 3 male, 3 female, 4 juv., same data as above (deposited in the collection of Zoology and Ecology Department, Moscow State Pedagogical University).

Description. Body length up to 1.1 mm. Col-

our dark, appendages and ventral side of body slightly paler. Granulation coarse, 3–5 granules between setae p1 on abd. V (Fig. 1b).

Chaetotaxy of head typical of the genus. Setae short and smooth. Body sensilla fine, smooth and rather short. Dorsal chaetotaxy of th. II–III and abd. III–VI as in Figs 1a, b. Th. I with 3+3 setae. Th. II with 6+6 ordinary m–setae (m_1, m_2, m_3, m_4, m_5 and m_6'), setae m_4 sometimes absent. Th. III with 4+4 ordinary m–setae (m_1, m_3, m_5 and m_6'). Setae p_3 and p_7 on abd. IV present, abd. V without setae p_2 . Subcoxae I, II, III with 1, 3–4, 3–4 setae respectively. Microsensillum on th. II present.

Ant. IV with simple apical vesicle, subapical organite (or), microsensillum (ms), 7–9 short, thick sensilla. AOIII with two long (outer) and two short (internal) curved sensilla. Microsensillum on ant. III present (Fig. 1c). Ant. I with 8 setae.

Ocelli 8+8. Postantennal organ with four lobes typical of the genus, equal to or slightly smaller than neighbour ocellus. Accessory boss present. Labrum with 5, 5, 4 setae and 4 prelabrals. Maxillary head and labium of the *tullbergi* type. Outer lobe of maxilla with 2 sublobal hairs.

Table 1. Morphological differences between *H. tepli* sp. n. (tep), *H. aushensis* sp. n. (aus) and related species of the *crassaegranulata* group: *H. hohi* (hoh), *H. ghirkani* (ghi), *H. microspina* (mic), *H. crassaegranulata* (cra), *H. franconiana* (fra) and *H. chouardi* (cho). Data after Cassagnau (1959), Babenko *et al.* (1994) and Skarżyński (2006a, b).

Character	tep	aus ¹⁾	hoh	ghi	mic ²⁾	cra	fra	cho ³⁾
No of thick ant. IV sensilla	7–9	8–11	7	8–10	6	6–9	6–9	6
Maxillary lamella 1 broadened at the tip	–	–	+	+	–	–	–	?
No of VT setae	5–7	5	5	5	5	5–7	5–7	6–8
Mucro with small subapical tooth	+	+	–	+	–	–	–	+
Papillae of anal spines	low	high	low	high	low	low	high	low
No of setae on th. I	3+3	3+3	3+3	3+3	3+3	2+2	3+3	?
m2 th. II	+	+	+/-	+	+/-	–	+	?
m4 th. II	+/-	+	+/-	+	+/-	–	+	?
m2 th. III	–	+/-	?	+/-	–	–	+	?
m3 th. III	+	+/-	?	–	+	–	+	?
m6' th. II–III	+	+	–	–	–	–	+	?
m6 th. II–III	–	–	+	+	–	–	–	?
p3 abd. IV	+	+	+	+	+	–	+	?
p7 abd. IV	+	+	+	+	+	–	+	?
p2 abd. V	–	+	–	+	+	–	+/-	?

1) Trilobed apical vesicle on ant. IV.

2) Long lateral sensilla of AOIII.

3) Postantennal organ 4-lobed with finger-like papilla, pointed tibiotarsal tenent hairs, 6–7 dorsal dental setae and 1 ventral.

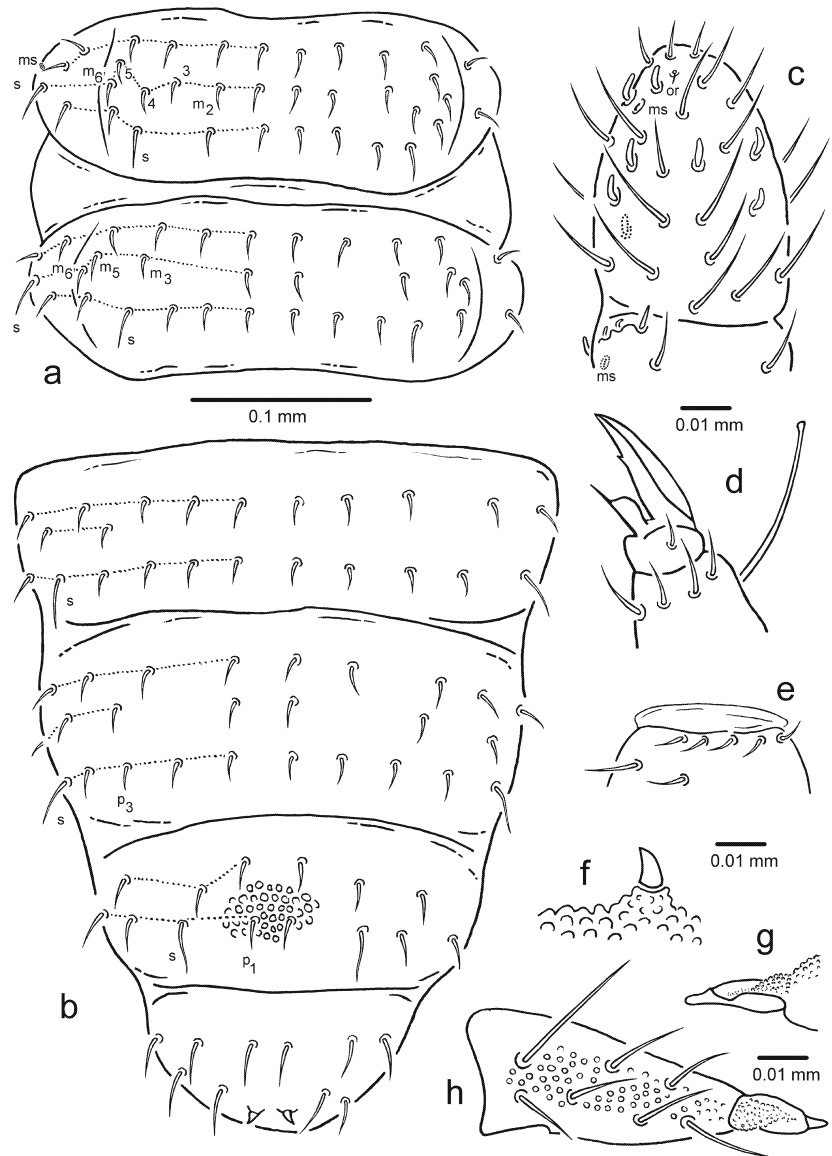


Fig. 1. *Hypogastrura tepli* sp. n. – a. Chaetotaxy of th. II–III. – b. Chaetotaxy of abd. III–VI. – c. Chaetotaxy of ant. III–IV. – d. Claw II. – e. VT chaetotaxy. – f. Anal spine of holotype. – g. Mucro. – h. Dens and mucro of holotype. Abbreviations in the text.

Tibiotarsi I, II, III with 19, 19, 18 setae respectively. Apical seta A_1 clavate. Claws with inner tooth. Empodial appendage with broad basal lamella and apical filament reaching middle of inner lamella of unguis (Fig. 1d).

VT with 5–7 + 5–7 setae (3–5 in upper and 2 in lower row) (Fig. 1e). Retinaculum with 4 + 4 teeth.

Furca well developed. Dorsal side of dens with fine granulation and 7 setae. Mucro with low lateral lamellae (outer higher than inner) which fuse before apex forming a small subapical tooth.

Ratio dens/mucro 3.0–3.5 (Figs 1g, h).

Anal spines small, situated on low basal papillae (Figs 1b, f).

Etymology. The new species is named after Tepli peak of the Fiagdon river valley.

Discussion. *Hypogastrura tepli* sp. n. obviously is a member of the *H. crassaegranulata* group defined as follows: distinctly thickened ant. IV sensilla arranged in two groups: 3 dorsal and 3 or usually more lateral, coarse skin granulation (3–6 granules between setae p1 on abd. V), labrum with papillae, broad basal empodial

lamella, no more than 1, 1, 1 clavate tenent hairs, more than 4 + 4 VT setae, quadridentate retinaculum, dens with 7 setae and fine granulation, ventro-apical swelling absent (Babenko *et al.* 1994). Main differences between *H. tepli* sp. n. and other known species of the complex are summarized in Table 1. Among species characterized by unmodified maxillary head, the new species is the most similar to *H. franconiana* and *H. aushensis* sp. n. described below. All these three species have similar dorsal chaetotaxy with unusual arrangement of m-setae on th. III (*H. tepli* sp. n. – setae m_2 absent and m_3 present, *H. aushensis* sp. n. – setae m_2 and m_3 present or absent, *H. franconiana* – both setae present). Additionally *H. tepli* sp. n. differs from both *H. franconiana* and *H. aushensis* sp. n. having low anal papillae, from *H. franconiana* by different shape of the mucro which has a subapical tooth, and from *H. aushensis* sp. n. by a simple apical vesicle on ant. IV.

3.2. *Hypogastrura aushensis* n. sp.

Hypogastrura crassaegranulata: Babenko *et al.* (1994): 88 (Fig. 2)

Type material. Holotype male on slide, Russia, Northern Caucasus, Karachai-Cherkess Republic, Teberda State Nature reserve, Kyshkager Pass, 3,200 m a.s.l., slide rocks, 13. VIII. 1986, leg. T. V. Dobrolyubova. Paratypes: 6 males, 8 females, same data as above (deposited in the collection of Zoology and Ecology Department, Moscow State Pedagogical University).

Description. Body length up to 1.1 mm. Body colour dark, legs, antennae, and ventral side of body slightly paler. Granulation coarse, 3–4 granules between setae p_1 on abd. V (Fig. 2b).

Chaetotaxy of head typical of the genus. Setae short and smooth. Body sensilla (s) fine, smooth and rather short. Dorsal chaetotaxy of th. II–III and abd. III–VI as in Figs 2a, b. Th. I with 3+3 setae. Th. II with 6+6 ordinary m-setae (m_1 , m_2 , m_3 , m_4 , m_5 and m_6). Th. III with seate m_1 , m_5 and m_6 present and setae m_2 and m_3 present or absent. Setae p_3 and p_7 on abd. IV present, abd. V with setae p_2 . Subcoxae I, II, III with 1, 3–4, 3–4 setae respectively. Microsensillum on th. II present.

Ant. IV with trilobed apical vesicle (Fig. 2d),

subapical organite (or), microsensillum (ms), 8–11 short, thick sensilla. AOIII with two long (lateral) and two short (internal) curved sensilla. Microsensillum on ant. III present (Fig. 2c). Ant. I with 8 setae.

Ocelli 8+8. Postantennal organ typical of the genus, equal or slightly smaller than neighbour ocellus. Accessory boss present. Labrum with 5, 5, 4 setae and 4 prelabrals. Labium and head of maxilla of the *tullbergi* type. Outer lobe with 2 sublobal hairs.

Tibiotarsi I, II, III with 19, 19, 18 setae respectively. Apical seta A_1 clavate. Claws with inner tooth. Empodial appendage with broad basal lamella and apical filament reaching middle of inner lamella of unguis (Fig. 2e).

VT with 5 + 5 setae (3 in upper and 2 in lower row). Retinaculum with 4 + 4 teeth.

Furca well developed. Dens with fine granulation and 7 setae. Mucro with low lateral lamellae (outer higher than inner) which fuse before apex forming small subapical tooth. (Figs 2f, g). Ratio: dens/mucro 3.0–3.5.

Anal spines relatively large, situated on high basal papillae (Figs 2b, h).

Etymology. From “aush” that is a mountain pass in Karachai language.

Discussion. The main diagnostic feature of *H. aushensis* sp. n. which identifies it from all other known members of the *H. crassaegranulata* group, is the three-lobed shape of the apical vesicle on ant. IV. Otherwise the new species is similar to *H. franconiana* in having the same complete chaetotaxy (the only difference is variable presence of m_2 and m_3 setae on th. III in *H. aushensis* sp. n.) and many other common morphological characters (see Table 1). Nevertheless these species can be distinguished due to different mucro shape (with or without subapical tooth). *H. tepli* sp.n., which is described from a nearby region, differs from *H. aushensis* sp. n. by lower anal papillae and slightly reduced chaetotaxy.

The shape of the apical vesicle on ant. IV is similar to that of *H. tatrca* (Stach, 1949) from the Carpathians and *H. madera* Christiansen & Bellinger, 1980 from North America which are members of related species groups, the *sahlbergii* group sensu Babenko *et al.* (1994) and the *packardi* group sensu Christiansen & Bellinger (1998). They clearly differ in body granulation

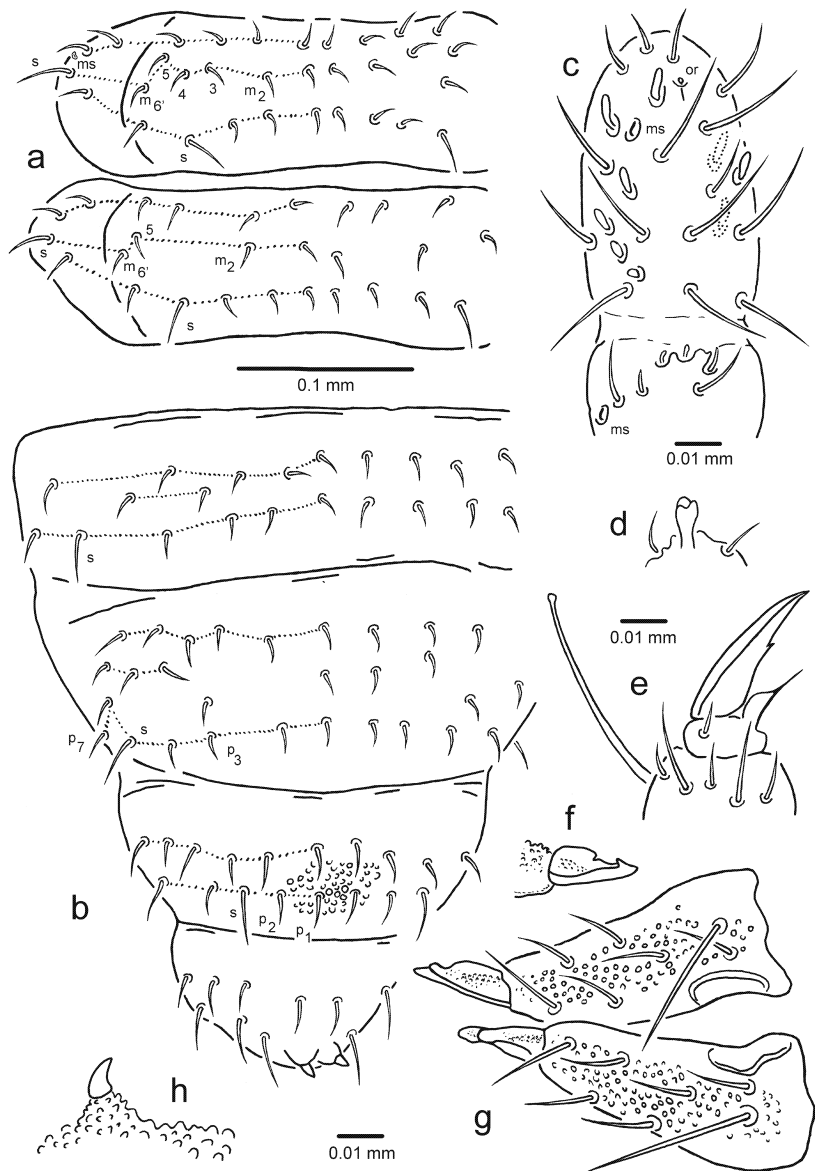


Fig. 2. *Hypogastrura aushensis* sp. n. – a. Chaetotaxy of th. II–III of holotype. – b. Chaetotaxy of abd. III–VI of holotype. – c. Chaetotaxy of ant. III–IV. – d. Everted apical vesicle. – e. Claw II. – f. Mucro. – g. Dens and mucro. – h. Anal spine. Abbreviations in the text.

(*H. aushensis* sp. n. – coarse, *H. tatrlica* and *H. madera* – fine), number of thick ant. IV sensilla (*H. aushensis* sp. n. – 8–11, *H. tatrlica* – usually 7, *H. madera* – 10), number of VT setae (*H. aushensis* sp. n. – 5, *H. tatrlica* – 7, *H. madera* – 4), number of v-setae on head (*H. aushensis* sp. n. and *H. tatrlica* – 2, *H. madera* – 1), presence of large granules on distal part of dens and ventroapical swelling on dens (*H. aushensis* sp. n. and *H. tatrlica* – absent, *H. madera* – present) (Stach 1949, Christiansen & Bellinger 1998, Babenko *et al.* 1994).

3.3. *Hypogastrura franconiana* (Stach, 1949)

Hypogastrura crassaegranulata: Babenko *et al.* (1994): 88

Material examined. 9 adult specimens, Kazakhstan, Tien Shan, Zailiiski Alatau Mt. Range, Chinturgen ravine, 2,100–2,300 m a.s.l., alpine zone, mosses on cliffs, 21–22.VIII.1991, leg. N. Smetana (deposited in the collection of Zoology and Ecology Department, Moscow State Pedagogical University).

Note. These specimens are in a full agreement

with the recent redescriptions of *H. franconiana* by Skarżyński (2006a, b). All of them are characterized by 7 short and thick ant. IV sensilla, 5 + 5(6) VT setae, narrow mucro without subapical tooth and identical dorsal chaetotaxy. Before this record the species was known only from mountainous areas of Europe (France: Côte d'Or, Saone-et-Loire, Pyrenees, Germany: Bavaria, Poland: Sudetes).

3.4. *Hypogastrura szeptyckii* Skarżyński, 2006

Hypogastrura crassaegranulata: Babenko *et al.* (1994): 88

Material examined. 6 adult and 21 juvenile specimens, Ukraine, Carpathians, Chornohora, subalpine belt, under pine tree, 29.X.1982, leg. N. A. Kuznetsova (deposited in the collection of Zoology and Ecology Department, Moscow State Pedagogical University).

Note. As a whole these specimens fit well the original description of *H. szeptyckii*. Nevertheless some differences exist, namely coarser tegument granulation (5–6 granules between setae p_1 on abd. V in Ukrainian specimens, versus 6–10 in adults from Polish populations), consequently long ant. IV sensilla, and mucro with low lateral lamellae which fuse before apex forming small, but distinct subapical tooth (Babenko *et al.* 1994: Fig. 31). Tegument granulation in the species seems to be highly age-dependent with juveniles having coarser granulation (3–5 granules between p_1 setae on abd. V). That is why this difference in granulation cannot be used to separate these forms because of small size of the studied specimens (the largest ones are 0.9 mm, versus 1.6 mm in the original description). Two other characteristics are also variable in the Polish material. Ant. IV sensilla are moderately long (frequent condition) to long (rare condition) in Polish adults. Mucro of Polish specimens is of the same type as in Ukrainian specimens, but subapical tooth is more or less distinct. Consequently we

consider the observed morphological differentiation as intraspecific variability and treat these forms as conspecific. Additional argument for such decision is that all known populations of the species are closely distributed (Krakowsko-Wieluńska Upland and Pieniny Mountains and Chornohora in the Carpathians).

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