Reassessment of the taxonomic position of Hypogastrura monticola Stach, 1946 (Collembola: Hypogastruridae)

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Abstract

New data on the morphology of Hypogastrura monticola Stach, 1946, are provided based on extensive material from the Alps, the Pyrenees, the Sudetes and the Carpathians. The taxonomic position of this species within the genus is discussed. A monticola group consisting of H. monticola, H. papillata Gisin, 1949, H. hispanica (Steiner, 1955), H. dasiensis Selga, 1966, H. subpapillata Babenko, 1994 and H. hatiparae Babenko, 1994, is proposed. A key to Hypogastrura species groups is given.

Keywords: springtails, H. monticola group

1. Introduction

The genus Hypogastrura Bourlet, 1839, consists of 162 species (Bellinger et al. 2009) and is one of the largest within the Collembola. Yosii (1960), Christiansen & Bellinger (1980), Babenko et al. (1994) and Thibaud et al. (2004) distinguished some groups of morphologically similar and probably related species within this genus: H. crassaegranulata, H. christianseni, H. manubrialis, H. nivicola, H. packardi, H. reticulata, H. sahlbergii, H. socialis, H. trybomi and H. viatica. However, numerous species do not belong to any of these groups, for example Hypogastrura monticola Stach, 1946. According to Babenko et al. (1994) it is a morphologically distinct species occupying an isolated position within the Hypogastrura. H. monticola is a species living in European mountains: the Alps, the Pyrenees, the Sudetes and the Carpathians. It inhabits mosses growing on rocks in cold and humid places in the subalpine and alpine zones mainly. Where habitat conditions are close to optimal, it can live at lower altitudes, for example in shaded river valleys and deep rocky ravines. Stach’s original and subsequent descriptions of H. monticola are quite accurate, but lack information on the chaetotaxy and the mouthpart structure (Stach 1946, 1949). Babenko (Babenko et al. 1994) re-described the species based on the Polish specimens from Stach’s collection (Tatra Mts, Zawrat) and supplied the missing data. A comparison of all these data sets shows that Stach and Babenko differed in their assessment of the sensillary chaetotaxy of antennal segment IV. According to the former, H. monticola has only slightly thickened, long 2 lateral and 2 dorsal sensilla (Stach 1946: Plate I, Fig. 1), while the latter drew them as distinctly thick (Babenko et al. 1994: Fig. 36.2). A review of extensive material allows me to improve our knowledge of the morphology of H. monticola and establish its relationships within the genus.
2. Material examined

Stach’s collection: 9 syntypes, Alps, Karinthia, High Tauern, Grossglockner, 1937, leg. Franz; 57 specimens, Tatra Mts, Zawrat, spring, on snow, leg. J. Małachowski; 2 specimens, Tatra Mts, at the base of Giewont Mt., neighbourhood of a snow field, 12 July 1933, leg. J. Stach, (all specimens on slides, formerly in alcohol vials labelled as ‘H. montana Stach’, deposited at the Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, Kraków).

Fig. 1 Chaetotaxy of antennal segments III–IV of Hypogastrura monticola. Abbreviations: *: cylindrical sensilla on antennal segment IV; AOIII: antennal III–organ; av: apical vesicle; ms: microsensillum, or: subapical organite.
3. Results and discussion

A review of the available specimens from Stach’s collection and other collections showed that they fit the original description and the re-description with one remarkable exception. There are consistently 2 lateral and 3 dorsal slightly thickened sensilla on antennal segment IV (Fig. 1). Distinctly inflated sensilla, probably as a result of long-lasting conservation are visible only in specimens analysed by Babenko (Babenko et al. 1994) from Zawrat (Tatra Mts), whereas the sensilla of other individuals from the same mountains have normal shape and size.

Stach (1946, 1949) compared *H. monticola* with *H. sahlbergi* (Reuter, 1895) and *H. strenua* (Brown, 1923) (now a synonym of *H. sahlbergi*); Babenko (Babenko et al. 1994) regarded its position as isolated, whereas Thibaud et al. (2004) included this species (probably erroneously) in the *crassaegranulata* group.

The present data shed new light on the taxonomic position of *H. monticola*. This species is related to *H. papillata* Gisin, 1949 (Alps, Serra da Lousa Mountains, Pyrénées, Dinaric Mountains), *H. hispanica* (Steiner, 1955) (Sierra de Guadarrama), *H. dasiensis* Selga, 1966 (Pyrénées), *H. subpapillata* Babenko, 1994 (Sayan Mountains) and *H. hatiparae* Babenko, 1994 (Caucasus) (Babenko et al. 1994, Jordana et al. 1997). They constitute a group (the *monticola* group) defined as follows: thin or slightly thickened and long antennal segment IV sensilla arranged in two groups: 3 dorsal and 2–3 lateral, postantennal organ 1.5–2 times larger than the adjacent ocelli, labrum with papillae, basal empodial lamella broad, no more than 1, 1, 1 clavate tenent hairs, quadridentate retinaculum, dens with 7 setae and without tooth-like granules and ventro-apical swelling, mucro without distinct subapical tooth, setae
The *monticola* group fits into the group system proposed by Christiansen & Bellinger (1980) (see key). The system, based on analysis of a large number of various morphological features, is commonly accepted (Babenko et al. 1994, Thibaud et al. 2004), unlike Yosii’s (1960) provisional system, which mainly relies on a small number of chaetotactic characters (Tab. 2). Although the classification used by Christiansen & Bellinger (1980), Babenko et al. (1994) and Thibaud et al. (2004) seems to be a not fully substantiated phylogenetic hypothesis, it has high practical value. It facilitates taxonomic studies on this speciose genus. The system is open, numerous weakly recognised species and species with exceptional characteristics remain unclassified.

Tab. 1  Morphological differences between members of the *monticola* group. Data after: *H. papillata* – Gisin (1949), Babenko et al. (1994), Jordana et al. (1997); *H. hispanica* – Steiner (1955), Jordana et al. (1997); *H. dasiensis* – Selga (1966), Jordana et al. (1997); *H. subpapillata* – Babenko et al. (1994) and Babenko (in litt.); *H. hatiparae* – Babenko et al. (1994).

<table>
<thead>
<tr>
<th>Character</th>
<th><em>H. monticola</em></th>
<th><em>H. papillata</em></th>
<th><em>H. hispanica</em></th>
<th><em>H. dasiensis</em></th>
<th><em>H. subpapillata</em></th>
<th><em>H. hatiparae</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Body granulation</td>
<td>fine</td>
<td>coarse</td>
<td>fine</td>
<td>coarse</td>
<td>coarse</td>
<td>coarse</td>
</tr>
<tr>
<td>Antennal segment IV sensilla</td>
<td>5</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Tibiotarsal tenent hair</td>
<td>pointed</td>
<td>clavate or pointed</td>
<td>clavate</td>
<td>clavate</td>
<td>clavate or pointed</td>
<td>clavate</td>
</tr>
<tr>
<td>Granulation of distal part of dens</td>
<td>fine</td>
<td>moderate</td>
<td>fine</td>
<td>fine or coarse</td>
<td>coarse</td>
<td>fine</td>
</tr>
<tr>
<td>Setae on ventral tubus</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Anal spines as long as papillae</td>
<td>as long as papillae</td>
<td>2 x shorter than (basally joined) papillae</td>
<td>as long as papillae</td>
<td>as long as papillae</td>
<td>slightly smaller than papillae</td>
<td>minute on very low papillae</td>
</tr>
</tbody>
</table>
Among the features defining the *monticola* group, the arrangement of antennal segment IV sensilla deserves special attention. In *Hypogastrura* the basic pattern is 3 dorsal and 3 lateral sensilla; the *manubrialis* group tends to have a larger number of dorsal sensilla; and the *nivicola (= socialis), packardi (= sahlbergi)* and *crassaegranulata* groups a tendency to show a greater number of lateral ones can be seen (Babenko et al. 1994). The *monticola* group shows quite a different tendency: towards a smaller number of lateral sensilla. Another important character defining the newly distinguished group is the large size of the postantennal organ (1.5–2 times larger than the adjacent ocelli). Members of the *manubrialis* group and some representatives of the *trybomi* group share this feature, while the remaining ones have their postantennal organ slightly smaller than the neighbouring ocelli (Christiansen & Bellinger 1980, Babenko et al. 1994).

Among the species of the *monticola* group, three – *H. monticola, H. hispanica* and *H. dasiensis* – have so far not been classified within any species group; two others – *H. papillata* and *H. hatiparae* – have been located within the *crassaegranulata* group; and *H. subpapillata* has been placed within the *socialis* group (Babenko et al. 1994). Although *H. papillata* and *H. hatiparae* share coarse body granulation with members of the *crassaegranulata* group, they strongly differ from the latter in having weakly differentiated sensilla on antennal segment IV (versus well differentiated), a smaller number of lateral

<table>
<thead>
<tr>
<th>Group</th>
<th>Members of the group</th>
<th>Characteristics</th>
</tr>
</thead>
</table>
| nivicola | *H. nivicola* (Fitch, 1846)  
*H. copiosa* (Folsom, 1916) | Head with 1+1 v-setae, tibiotarsi with 1 tenent hair, sensilla on antennal segment IV rod-like. |
| christianseni | *H. christianseni* Yosii, 1960  
*H. itaya* Kinoshita, 1916 | Head with 2+2 v-setae, m–setae on abdominal tergum V present. |
| reticulata | *H. reticulata* (Börner, 1909) | Head with 2+2 v-setae, m-setae on abdominal tergum V absent, body sensilla on abdominal terga I–IV and V p<sub>4</sub> and p<sub>5</sub> respectively. |
| manubrialis | *H. manubrialis* (Tullberg, 1869)  
*H. nemoralis* Yosii, 1960  
*H. oregonensis* Yosii, 1960  
*H. iwamurae* Yosii, 1960 | Head with 2+2 v-setae, m-setae on abdominal tergum V absent, body sensilla on abdominal terga I–IV and V p<sub>5</sub> and p<sub>3</sub> respectively, tibiotarsi with 1 tenent hair. |
| viatica | *H. viatica* (Tullberg, 1872)  
*H. gracilis* (Folsom, 1899) | Head with 2+2 v-setae, m-setae on abdominal tergum V absent, body sensilla on abdominal terga I–IV and V p<sub>4</sub> and p<sub>3</sub> respectively, tibiotarsi with more than 1 tenent hair. |
sensilla on antennal segment IV (3, versus 3–7), a larger postantennal organ (1.5–2 times larger than the adjacent ocelli, versus slightly smaller than the neighbouring ocelli) and the presence of m-setae on abdominal tergum V (versus absence of m-setae on abdominal tergum V). Re-examination of the types by Babenko (Babenko in litt.) showed that *H. subpapillata* is devoid of the typical features of the *socialis* group: it has a dens without tooth-like granules and a prominent ventroapical swelling and a mucro without a distinct subapical tooth. In consequence this species has been transferred to the newly created *monticola* group as it shares its characteristics.

**Key to Hypogastrura species groups (after Christiansen & Bellinger 1980, Babenko et al. 1994)**

1. More than 1 clavate tenent hair on tibiotarsi, retinaculum tridentate ........... *viatica* group
   – 1 clavate or pointed tenent hair on tibiotarsi, retinaculum quadridentate or rarely tridentate
      ........................................................................................................ 2

2. Labrum without distal papillae ..................................................................................... 3
   – Labrum with 4–6 distal papillae .............................................................................. 4

3. Empodial appendage with narrow basal lamella, setae m₆ on thoracic terga II–III absent ......................................................................................................................................................... 1
   – Empodial appendage with broad basal lamella, setae m₆ on thoracic terga II–III present
      ........................................................................................................................................ *manubrialis* group

4. Antennal segment IV with 3 dorsal and 2–3 lateral weakly differentiated sensilla, postantennal organ 1.5–2 times larger than the adjacent ocelli, m-setae on abdominal tergum V present ................................................................................................................................. *monticola* group
   – Antennal segment IV with 3 dorsal and 3–14 lateral well differentiated sensilla, postantennal organ slightly smaller than adjacent ocelli, m-setae on abdominal tergum V absent ................................................................................................................................. 5

5. Dens with tooth-like granules in distal part and prominent ventro-apical swelling, mucro with distinct subapical tooth ........ *nivicola* group (Nearctic), *socialis* group (Palaearctic)
   – Dens without tooth-like granules and prominent ventro-apical swelling, mucro without distinct subapical tooth ................................................................................................................................. 6

6. Body granulation fine (more than 6 granules between setae p₁ on abdominal tergum V) ................................................................................................................................. *packardi* group (Nearctic), *sahlbergii* group (Palaearctic)
   – Body granulation coarse (3–6 granules between setae p₁ on abdominal tergum V) ................................................................................................................................. *crassaegranulata* group

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5. References


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