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The biodiverse rotifers (Rotifera: Eurotatoria) of the floodplain wetlands of Barak valley of Assam, Northeast India

B.K. SHARMA*, S. SHARMA

*Bhushan Kumar Sharma & Sumita Sharma Department of Zoology, North-Eastern Hill University, Shillong - 793 022, Meghalaya, India; *profbksharma@gmail.com (corresponding author)*

Abstract. The present analysis of alpha diversity of Rotifera of the floodplain wetlands of Barak valley, south Assam, northeast India (NEI) reveals 170 species, belonging to 39 genera and 19 families, with three species new to the Indian sub-region and two species new to Assam state. The rich and diverse rotifer assemblages comprise ~70%, ~57% and ~39% of total species of the Phylum known till date from Assam, NEI and India, respectively and thus affirm habitat and ecological heterogeneity of the Barak River floodplain wetlands. The elements of global biogeographic importance include one Australasian, eight Oriental, 10 Paleotropical, one Indo-Chinese, one cosmo (sub) tropical and four other species, and ~37% species merit regional distribution interest for India with ~13% exclusively reported from NEI. Lecanidae (~30%) and Brachionidae ≈ Lepadellidae (~32%) largely contribute to the rotifer richness; Trichocercidae > Testudinellidae are notable (~15%), and Notommatidae, Euchlanidae, Mytilinidae, Trichotriidae and Trochosphaeridae collectively form 16.5%. *Lecane* is the most speciose genus; *Lepadella* > *Brachionus* = *Trichocerca* include ~32% species, while *Testudinella* > *Keratella* deserve mention. Rotifera of the Barak floodplains exhibit the littoral-periphytonic nature, several small sized species and tropical character.

Keywords. Barak River, biodiversity, composition, important taxa, richness, south Assam.

INTRODUCTION

Rotifera or Rotatoria, an integral component of aquatic metazoans, have been recorded from distant parts of India since the pioneering work of Anderson (1889). Nevertheless, the Indian literature still lacks attention on regional faunal diversity of these `wheel animalcules' except for NEI - the most rich and Rotifera biodiverse region of India (Sharma & Sharma 2014a, 2017). Importantly, Assam state of NEI, a part of the Indo-Myanmar biodiversity hotspot, merits attention as `the Assam-gateway' which is recognized as a unique phase in the biogeographic evolution of India (Mani 1974, Ranga Reddy 2013). Further, this state is characterized by the fluvial floodplain wetlands of the Brahmaputra and Barak Rivers; the former are hypothesized as globally rich rotifer habitats (Sharma & Sharma 2008, 2014b, Sharma *et al*. 2018).

In light of the salient highlights of Assam, we extend our studies to the floodplains of the Barak river basin of south Assam (known as Barak valley) which is yet practically unexplored with regards to rotifer fauna (Sharma & Sharma 2014a). This lacuna assumes more prominence in spite of several limnological works (Kar & Kar 2013, Gupta & Devi 2014, Narzary *et al.* 2015, Das & Kar 2016, Kar & Kar 2016a, 2016b, Das *et al.* 2018, Kar *et al.* 2018) from Barak valley but loaded with 'ad-hoc' rotifer inventories due to lack of species determinations, incomplete species lists, overlooking identifications of small taxa, inadequate sampling and lack of taxonomic expertise. The present study thus provides the first exhaustive assessment of the rotifer biodiversity from the floodplain wetlands of the Barak River basin. An inventory of the observed species is presented, and various new records and interesting species are illustrated to warrant validations routinely lacking for the rotifer taxa reported from India (Sharma & Sharma 2014a, 2017). Remarks are made on species composition, richness and distribution, and important taxa. The results mark a useful contribution to biodiversity of Rotifera of

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India, the floodplain wetlands of this country as well as that of (sub) tropical floodplains.

MATERIALS AND METHODS

The present observations are based on analysis of plankton and semi-plankton samples collected during August 2005, November 2008, February 2011 and April–May 2014 from all three districts, namely Cachar, Hailakandi and Karimganj of Barak valley (Fig. 1 A–C) of south Assam (24°48′ – 24.80°N; 92°45′ – 92.75°E). The latter region is named after the Barak River which originates from the Barail Range (Assam–Nagaland border), flows through 40–50 km wide Barak valley and finally forms a part of the Surma–Meghna River system of Bangladesh. The study area is characterized by the tropical monsoon climate.

The plankton and semi-plankton samples were collected from scattered perennial floodplain lakes (beels), seasonal floodplain lakes (hoars) and small wetlands (dobas or dubies) by towing a nylobolt plankton net (# size 50 µm) and were preserved in 5% formalin. All the collections were screened with a Wild stereoscopic binocular microscope; the rotifers were isolated and mounted in polyvinyl alcohol–lactophenol, and were observed with Leica DM 1000 stereoscopic phase contrast microscope fitted with an image analyzer. Microphotographs were provided for interesting species and measurements were indicated in micrometers (µm). Various rotifer taxa were identified following the works of Koste (1978), Koste & Shiel (1987, 1989, 1990), Segers (1995), Sharma (1983, 1998), Sharma & Sharma (1999, 2000, 2008, 2013), and Jersabek & Leitner (2013). Segers (2007) and Jersabek & Leitner (2013) were considered for biogeographic comments on various taxa.

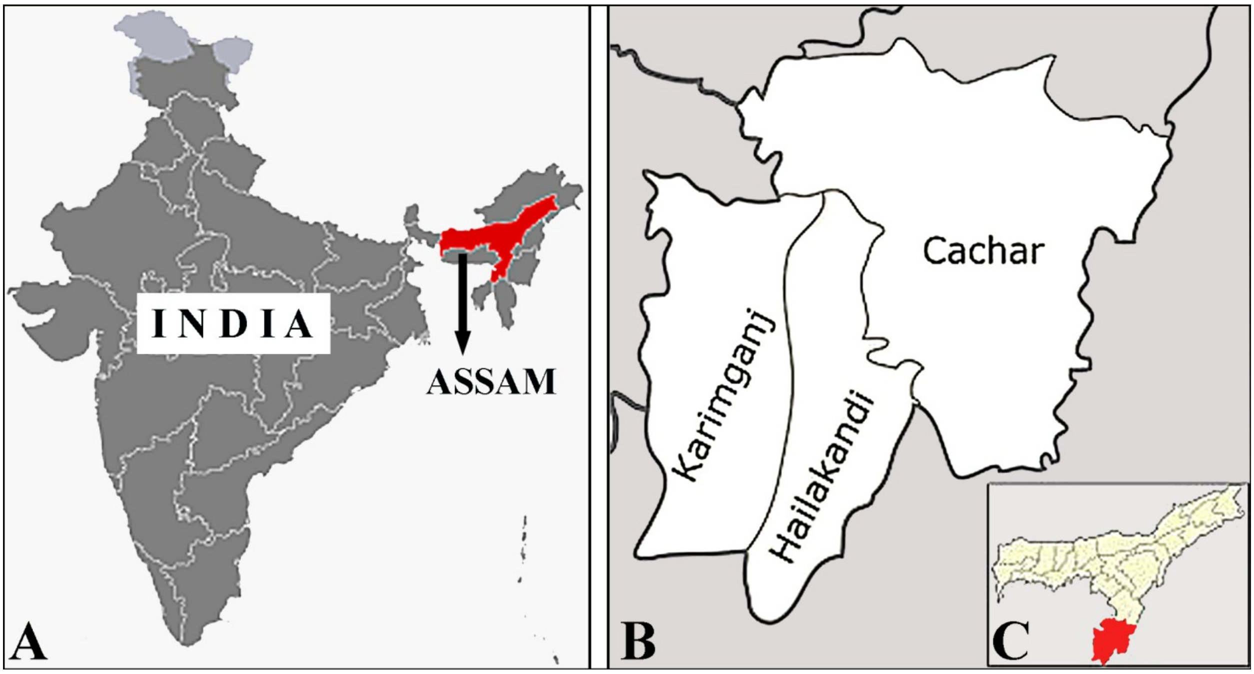

Figure 1. A = map of India indicating northeast India (NEI) and the state of Assam; B = map indicating the sampled districts of Barak valley of south Assam; C = inset map of Assam indicating Barak valley.

RESULTS

Our plankton and semi-plankton collections from floodplains of the Barak valley of south Assam reveal 170 species, belonging to 39 genera and 19 families. The detailed systematic list of the examined species is presented below:

Rotifera recorded from the Barak River floodplain wetlands

Phylum: Rotifera
Class: Eurotatoria
Subclass: Monogononta
Order: Ploima

Family: **Brachionidae**

1. *Anuraeopsis fissa* Gosse, 1851
2. *Brachionus angularis* Gosse, 1851
3. *B. bennini* Leissling, 1924
4. *B. bidentatus* Anderson, 1889
5. *B. budapestinensis* Daday, 1885
6. *B. calyciflorus* Pallas, 1766
7. *Brachionus caudatus* Barrois & Daday, 1894
8. *B. diversicornis* (Daday, 1883)
9. *B. durgae* Dhanapathi, 1974
10. *B. falcatus* Zacharias, 1898
11. *B. forficula* Wierzejski, 1891
12. *B. mirabilis* Daday, 1897
13. *B. murphyi* Sudzuki, 1989**#
14. *B. nilsoni* Ahlstrom, 1940*#
15. *B. quadridentatus* Hermann, 1783
16. *B. rubens* Ehrenberg, 1838
17. *B. srisumonae* Segers, Kotethip & Sanoamuang, 2004*#
18. *Keratella cochlearis* (Gosse, 1851)
19. *K. edmondsoni* Ahlstrom, 1943
20. *K. javana* Hauer, 1937#
21. *K. lenzi* Hauer, 1953
22. *K. tecta* (Gosse, 1851)
23. *K. tropica* (Apstein, 1907)
24. *Platyias leloupi* (Gillard, 1967)
25. *P. quadricornis* (Ehrenberg, 1832)
26. *Plationus patulus* (Muller, 1786)

Family: **Epiphanidae**

27. *Epiphanes brachionus* (Ehrenberg, 1837)

Family: **Euchlanidae**

28. *Beauchampiella eudactylota* (Gosse, 1886)
29. *Dipleuchlanis propatula* (Gosse, 1886)
30. *Euchlanis dilatata* Ehrenberg, 1832
31. *E. incisa* Carlin, 1939
32. *E. triquetra* Ehrenberg, 1838
33. *Tripleuchlanis plicata* (Levander, 1894)

Family: **Mytilinidae**

34. *Lophocharis salpina* (Ehrenberg, 1834)
35. *Mytilina acanthophora* Hauer, 1938
36. *M. bisulcata* (Lucks, 1912)
37. *M. michelangellii* Reid & Turner, 1988
38. *M. ventralis* (Ehrenberg, 1830)

Family: **Trichotriidae**

39. *Macrochaetus collinsi* (Gosse, 1867)
40. *M. longipes* Myers, 1934
41. *M. sericus* (Thorpe, 1893)
42. *T. tetractis* (Ehrenberg, 1830)
43. *Wolga spinifera* (Western, 1894)

Family: **Lepadellidae**

44. *Colurella adriatica* Ehrenberg, 1831
45. *C. colurus* (Ehrenberg, 1830)
46. *C. obtusa* (Gosse, 1886)
47. *C. sulcata* (Stenroos, 1898)
48. *C. uncinata* (Müller, 1773)
49. *Lepadella acuminata* (Ehrenberg, 1834)
50. *L. apsicora* Myers, 1934
51. *L. apsida* Harring, 1916
52. *L. benjamini* Harring, 1916
53. *L. biloba* Hauer,1958
54. *L. costatoides* Segers, 1992
55. *L. dactyliseta* (Stenroos, 1898)
56. *L. discoidea* Segers, 1993
57. *L. ehrenbergi* (Perty, 1850)
58. *L. eurysterna* Myers, 1942
59. *L. heterostyla* (Murray, 1913)
60. *L. minuta* (Weber & Montet, 1918)
61. *L. ovalis* (Müller, 1786)
62. *L. patella* (Müller, 1773)
63. *L. quinquecostata* (Lucks, 1912)
64. *L. rhomboides* (Gosse, 1886)
65. *L. triba* Myers, 1934
66. *L. triptera* (Ehrenberg, 1832)
67. *L. vandenbrandei* Gillard, 1952#
68. *Squatinella lamellaris* (Müller, 1786)

Family: **Lecanidae**

69. *Lecane aculeata* (Jakubski, 1912)
70. *L. arcula* Harring, 1914
71. *L. batillifer* (Murray, 1913)
72. *L. bifastigata* Hauer, 1938
73. *L. bifurca* (Bryce, 1892)
74. *L. blachei* Berzins, 1973
75. *L. bulla* (Gosse, 1851)
76. *L. calcaria* Harring & Myers, 1926*#
77. *L. closterocerca* (Schmarda, 1859)
78. *L. crepida* Harring, 1914
79. *L. curvicornis* (Murray, 1913)
80. *L. decipiens* (Murray, 1913)
81. *L. dorysimilis* Trinh Dang, Segers & Sanoamuang, 2015#
82. *L. doryssa* Harring, 1914
83. *L. elegans* Harring, 1914
84. *L. flexilis* (Gosse, 1886)
85. *L. furcata* (Murray, 1913)
86. *L. haliclysta* Harring & Myers, 1926
87. *L. hamata* (Stokes, 1896)

88. *L. hastata* (Murray, 1913)
89. *L. hornemanni* (Ehrenberg, 1834)
90. *L. inermis* (Bryce, 1892)
91. *L. inopinata* Harring & Myers, 1926
92. *L. lateralis* Sharma, 1978
93. *L. latissima* Yamamoto, 1951#
94. *L. leontina* (Turner, 1892)
95. *L. ludwigii* (Eckstein, 1883)
96. *L. luna* (Müller, 1776)
97. *L. lunaris* (Ehrenberg, 1832)
98. *L. monostyla* (Daday, 1897)
99. *L. nitida* (Murray, 1913)
100. *L. niwati* Segers, Kotethip & Sanoamuang, 2004#
101. *L. obtusa* (Murray, 1913)
102. *L. papuana* (Murray, 1913)
103. *L. paxiana* Hauer, 1940
104. *L. ploenensis* (Voigt, 1902)
105. *L. pusilla* Harring, 1914
106. *L. pyriformis* (Daday, 1905)
107. *L. quadridentata* (Ehrenberg,1830)
108. *L. rhenana* Hauer, 1929#
109. *L. rhytida* Harring & Myers, 1926 #
110. *L. signifera* (Jennings, 1896)
111. *L. simonneae* Segers, 1993
112. *L. stichoclysta* Segers, 1993**#
113. *L. stenroosi* (Meissner, 1908)
114. *L. superaculeata* Sanoamuang & Segers, 1997#
115. *L. tensuiseta* Harring, 1914
116. *L. thienemanni* (Hauer, 1938)
117. *L. undulata* Hauer, 1938
118. *L. unguitata* (Fadeev, 1925)
119. *L. ungulata* (Gosse, 1887)

Family: **Notommatidae**
120. *Cephalodella gibba* (Ehrenberg, 1830)
121. *C. mucronata* Myers, 1924
122. *C. trigona* (Rousselet, 1895) #
123. *Monommata longiseta* (Müller, 1786)
124. *M. maculata* Harring & Myers, 1930
125. *Notommata pachyura* (Gosse, 1886)
126. *N. tripus* Ehrenberg, 1838

Family: Scaridiidae
127. *Scaridium longicaudum* (Müller, 1786)

Family: **Gastropodidae**
128. *Ascomorpha ecaudis* Perty, 1850
129. *A. ovalis* (Bergendal, 1892)

Family: Trichocercidae
130. *Trichocerca bicristata* (Gosse, 1887)
131. *T. bidens* (Lucks, 1912) #
132. *T. capucina* (Wierzejski & Zacharias, 1893)
133. *T. cylindrica* (Imhof, 1891)
134. *T. elongata* (Gosse, 1886)
135. *T. flagellata* Hauer, 1937
136. *T. hollaerti* De Smet, 1990#
137. *T. insignis* (Herrick, 1885) #
138. *T. longiseta* (Schrank, 1802)
139. *T. pusilla* (Jennings, 1903)
140. *T. rattus* (Müller, 1776)
141. *T. similis* (Wierzejski, 1893)
142. *T. tenuior* (Gosse, 1886)
143. *T. tigris* (Muller, 1786)
144. *T. weberi* (Jennings, 1903)

Family: Asplanchnidae
145. *Asplanchna brightwellii* Gosse, 1850
146. *A. priodonta* Gosse, 1850

Family: **Synchaetidae**
147. *Ploesoma lenticulare* Herrick, 1885
148. *Polyarthra vulgaris* Carlin, 1943

Family: **Dicranophoridae**
149. *Dicranophoroides caudatus* (Ehrenberg, 1834)
150. *Dicranophorus forcipatus* (Müller, 1786)

Order: **Flosculariaceae**
Family: **Flosculariidae**
151. *Sinantherina socialis* (Linne, 1758)
152. *S. spinosa* (Thorpe, 1893)

Family: **Conochilidae**
153. *Conochilus unicornis* Rousselet, 1892

Family: Hexarthridae
154. *Hexarthra mira* (Hudson, 1871)

Family: **Testudinellidae**
155. *Testudinella amphora* Hauer, 1938#
156. *T. brevicaudata* Yamamoto, 1951#
157. *T. dendradena* de Beauchamp, 1955#
158. *T. emarginula* (Stenroos, 1898)
159. *T. greeni* Koste, 1981#
160. *T. parva* (Ternetz, 1892)
    T. parva bidentata (Ternetz, 1892)
161. *T. patina* (Hermann, 1783)
162. *T. tridentata* Smirnov, 1931#
163. *Pompholyx sulcata* Hudson,1885

Family: **Trochosphaeridae**
164. *Filinia camasecla* Myers, 1938
165. *F. longiseta* (Ehrenberg, 1834)
166. *F. opoliensis* (Zacharias, 1898)
167. *F. saltator* (Gosse, 1886)
168. *Trochosphaera aequatorialis* Semper, 1872

Sub-class: Bdelloidea
Order: Philodinida
Family: Philodinidae
169. *Dissotrocha aculeata* (Ehrenberg, 1832)
170. *Rotaria neptunia* (Ehrenberg, 1830)

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* New records from the Indian sub-region; ** new records from Assam state; # reported only from NEI

Brachionus srisumonae (Fig. 2), *B. nilsoni* (Fig. 3) and *Lecane calcaria* (Fig. 4) are new records from the Indian sub-region, while *Brachionus murphyi* (Fig. 5) and *Lecane stichoclysta* (Fig. 6) are new records from Assam state. Several other species of biogeographic interest noticed in our collections include *Brachionus bennini* (Fig. 7), *B. durgae* (Fig. 8), *Filinia camasecla* (Fig. 9), *Keratella edmondsoni* (Fig. 10), *Lecane batillifer* (Fig. 11), *L. bifastigata* (Fig. 12), *L. blachei* (Fig. 13), *L. dorysimilis* (Fig.14), *L. latissima* (Fig.15), *L. niwati* (Fig.16), *L. rhenana* (Fig.17), *L. rhytida* (Fig. 18), *L. simonneae* (Fig. 19), *L. superaculeata* (Fig. 20), *Lepadella benjamini* (Fig. 21), *L. discoidea* (Fig. 22), *L quinquecostata* (Fig. 23), *L. vandenbrandei* (Fig. 24), *Testudinella amphora* (Fig. 25), *T. brevicaudata* (Fig. 26), *T. greeni* (Fig. 27), *T. parva bidentata* (Fig. 28), *T. tridentata* (Fig. 29) and *Trichocerca hollaerti* (Fig. 30).

Lecanidae, Brachionidae, Lepadellidae, Trichocercidae and Testudinellidae are represented by 50, 26, 25, 15 and 10 species, respectively; Notommatidae and Euchlanidae include 7 and 6 species respectively; and Mytilinidae, Trichocercidae and Trochosphaeridae include five species each. *Lecane, Lepadella, Brachionus, Trichocerca, Testudinella* and *Keratella* record 50, 19, 16, 16, 9 and 6 species, respectively. Our 2005, 2008, 2011 and 2014 collections indicate 153, 148, 155 and 150 species, respectively.

DISCUSSION

Our collections from the floodplain wetlands of Barak valley of Assam state of NEI reveal rich Rotifera diversity of 170 species belonging to 39 genera and 19 families. The richness forms a notable fraction *i.e.*, ~70%, ~57% and ~39% of the species of the phylum known till date from Assam, NEI and India (Sharma & Sharma 2017, BKS unpublished), respectively; the rich and diverse rotifer assemblages are hypothesized to micro-habitat and ecological heterogeneity of the sampled wetlands. The reports of ~90%, ~87%, ~91% and ~82% of species from our 2005, 2008, 2012 and 2014 surveys from the Barak basin endorse consistently biodiverse rotifers with limited seasonal differences in species composition *vis-a-vis* the sampling intensity. This study marks a significant update over our unpublished report of 90 species from Barak valley (Sharma & Sharma 2014a). Our collections from south Assam even reveal more species-rich rotifers than the reports of 162, 161 and 150 species from the states of Mizoram (Sharma & Sharma 2015), Meghalaya (Sharma *et al.* 2016) and Nagaland (Sharma *et al.* 2017) of NEI, respectively.

The present study indicates higher rotifer richness than certain reports from the floodplains of the Rio Pilcomayo National Park of Argentina (114 species; Jose de Paggi 2001), 124 and 136 species from Oguta and Iyi-Efi lakes of the Niger delta (Segers *et al.* 1993) of Africa, respectively; Lake Guarana (130 species; Bonecker *et al.* 1994), and Rio Tapajos (151 species; Koste 1974) and Lago Camaleao (148 species; Koste & Robertson 1983) of Brazil, respectively; Thale-Noi Lake, Thailand (106 taxa; Segers & Pholpunthin 1997); and Laguana Bufeos of Bolivia (104 species; Segers *et al.* 1998). The richness from the Barak River floodplains, however, compares well with 184 species known from more intensively sampled Upper Paraná floodplains (Bonecker *et al.* 1994, 1998, 2005) of Brazil. Further, our collections highlight more biodiverse rotifer assemblages than the 144 species reported from beels of the Majuli River Island (Sharma *et al.* 2015) and 141 species from three beels of the Dibru-Saikhowa Biosphere Reserve (Sharma *et al.* 2017) of upper Assam; 164 species from 15 beels (Sharma 2005) and 160 species from four beels of lower Assam (Sharma *et al.* 2018); 162 species from Loktak Lake basin of Manipur (Sharma *et al.* 2016); and 110 species from the floodplains of the Yamuna River at Delhi (Arora & Mehra 2003). The stated comparisons affirm the rich faunal diversity of the floodplain wetlands of the Barak River and thus endorse our reports from the floodplains of NEI (Sharma & Sharma 2014a, 2014b, 2017, 2018a, Sharma *et al.* 2018) *vis-a-vis* Rotifera-rich habitats. In contrast, comparisons with reports of 12 (Kar & Kar 2013), 2 (Gupta & Devi 2014), 7 (Narzary *et al*. 2015), 18 (Das & Kar 2016), 20 (Kar & Kar 2016a), 20 (Kar & Kar 2016b), 21 (Das *et al.* 2018) and 10 (Kar *et*

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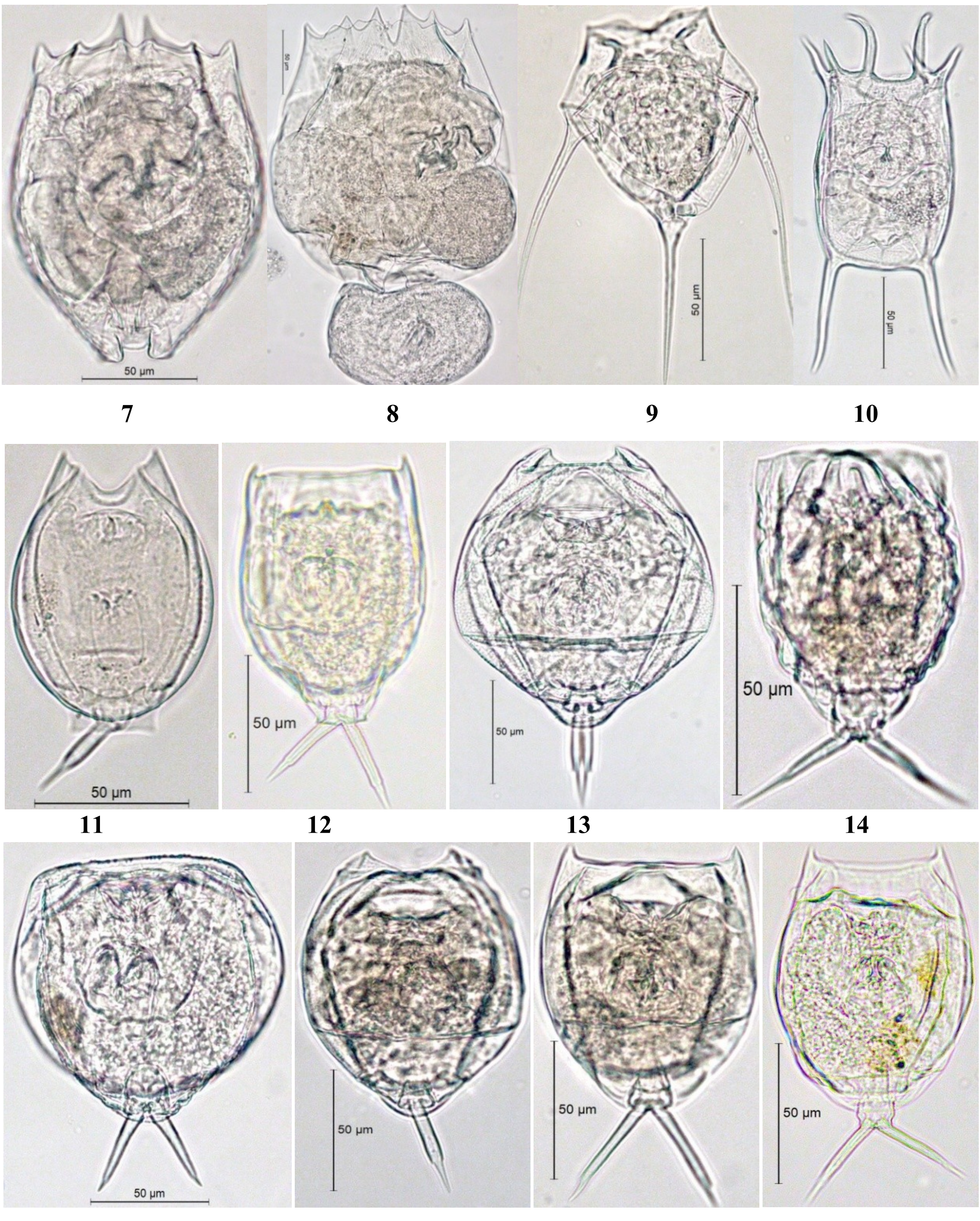
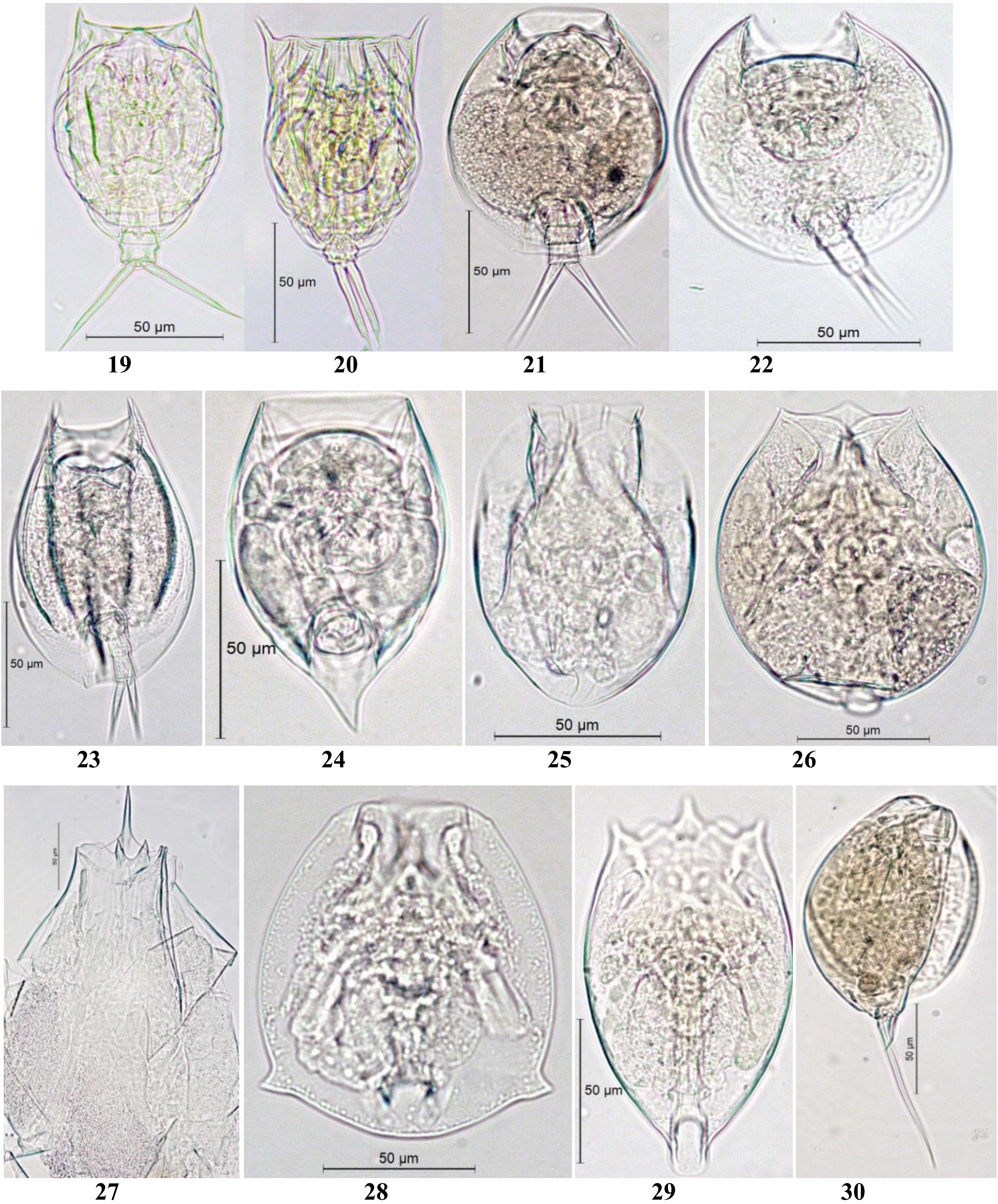
4 5 6

Figures 2-6. New records of Rotifera from Barak valley. 2 = *Brachionus srisumonae* Segers, Kotethip & Sanoamuang (dorsal view); 3 = *Brachionus nilsoni* Ahlstrom (ventral view); 4 = *Lecane calcaria* Harring & Myers (ventral view); 5 = *Brachionus murphyi* Sudzuki (ventral view); 6 = *Lecane stichoclysta* Segers (ventral view).



Figures 7-18. Interesting Rotifera from Barak valley. 7 = *Brachionus bennini* Leissling (ventral view); 8 = *Brachionus durgae* Dhanapathi (dorsal view); 9 = *Filinia camasecla* Myers (ventral view); 10 = *Keratella edmondsoni* Ahlstrom (ventral view); 11 = *Lecane batillifer* (Murray) (dorsal view); 12 = *Lecane bifastigata* Hauer (ventral view); 13 = *Lecane blachei* Berzins (ventral view); 14 = *Lecane dorysimilis* Trinh Dang, Segers & Sanoamuang (dorsal view); 15 = *Lecane latissima* Yammoto (dorsal view); 16 = *Lecane niwati* Segers, Kotethip & Sanoamuang (ventral view); 17 = *Lecane rhenana* Hauer (ventral view); 18 = *Lecane rhytida* Harring & Myers (dorsal view).



Figures 19-30. Interesting Rotifera species from Barak valley. 19 = *Lecane simonneae* Segers (dorsal view); 20 = *Lecane superaculeata* Sanoamuang & Segers (ventral view); 21 = *Lepadella benjamini* Harring (ventral view); 22 = *Lepadella discoidea* Segers (ventral view); 23 = *Lepadella quinquecostata* (Lucks) (dorsal view); 24 = *Lepadella vandenbrandei* Gillard (ventral view) 25 = *Testudinella amphora* Hauer (dorsal view); 26 = *Testudinella brevicaudata* Yamamoto (ventral view); 27 = *Testudinella greeni* (part) (ventral view); 28 = *Testudinella parva bidentata* (Ternetz) (ventral view); 29 = *Testudinella tridentata* Smirnov (ventral view); 30 = *Trichocerca hollaerti* De Smet (lateral view).

al. 2018) rotifer taxa from wetlands of south Assam indicate under-estimation of the richness with lack of species identifications in most of these works.

Brachionus srisumonae, *B. nilsoni* and *Lecane calcaria* are new additions to Rotifera of the Indian sub-region; these species are listed elsewhere from the Oriental region from Thailand (Sa-Ardrit *et al.* 2013). Of these, the rare and interesting brachionid *B. srisumonae* was described from Thailand (Segers *et al.* 2004) and was since listed as 'Thai endemic' (Sa-Ardrit *et al.* 2013), while we now designate it as 'Oriental endemic'. The cosmopolitan *B. nilsoni* is likely to be confused with *B. urceolaris* while *L. calcaria*, known from the Neotropical and Oriental regions (Segers 2007), is characterized by its small-size, soft lorica and distinctive toes. All three new records are notable for rare occurrence in our collections from Barak valley. In addition, *Brachionus murphyi* and *Lecane stichoclysta* are new records from Assam state; the former was reported from India from Nagaland (Sharma *et al.* 2017) state of NEI while this brachionid and *Lecane stichoclysta* are recently observed from Arunachal Pradesh, the eastern Himalayas (Sharma and Sharma, 2019).

Our results highlight both (i) the global and (ii) regional distribution importance of the rotifers from Barak valley. The former feature is endorsed by a notable fraction (~15%) of the reported species including: (a) the Australasian *Lecane batillifer*; (b) the Oriental endemics *Brachionus srisumonae, B. murphyi, Keratella edmondsoni, Lecane blachei, L. latissima, L. niwati, L. superaculeata* and *Filinia camasecla*; (c) the Paleotropical *Keratella javana, Lecane lateralis*, *L. simonneae, L. stichoclysta*, *L. unguitata*, *Lepadella discoidea, L. vandenbrandei, Testudinella brevicaudata, T. greeni* and *Trichocerca hollaerti*; (d) the Indo-Chinese *L. dorysimilis*; (e) the cosmo (sub) tropical *Brachionus durgae*; and (f) other species namely *Cephalodella trigona, L. bifastigata, L. calcaria,* and *Testudinella amphora.* Besides, we report a sizable component (~37%) of species of (ii) regional distribution interest for India with ~13% known exclusively to date from NEI; the latter include *Brachionus murphyi, B. nilsoni, B. srisumonae, Cephalodella trigona, Keratella javana, Lecane calcaria, L. dorysimilis, L. latissima, L. niwati, L. rhenana, L. rhytida,* L. *stichoclysta*, L. *superaculeata, Lepadella vandenbrandei, Testudinella amphora, T. brevicaudata, T. dendradena, T. greeni*, *T. tridentata*, *Trichocerca bidens*, *T. hollaerti* and *T. insignis*.

Lecanidae, represented by the 'tropic-centered' *Lecane,* records distinctly diverse nature (50 species; ~30%). The lecanids along with Eurotatoria families Brachionidae ≈ Lepadellidae (~32%) largely contribute to the rotifer richness of the Barak floodplains; Trichocercidae > Testudinellidae are notable (~15%), while Notommatidae, Euchlanidae, Mytilinidae, Trichotriidae and Trochosphaeridae collectively include 16.5% species. Besides the speciose genus *Lecane*, *Lepadella* > *Brachionus* = *Trichocerca* together include ~32% species, while *Testudinella* > *Keratella* deserve mention (~9 %). The richness of the 'tropic-centered' *Brachionus* (16 species) in the Barak valley floodplains is higher than our reports from other floodplains of NEI *i.e*., the Majuli River Island (Sharma 2014) and the Dibru-Saikhowa Biosphere reserve (Sharma *et al.* 2017) of upper Assam, and the Loktak Lake basin of Manipur (Sharma & Sharma 2018a). The richness importance of *Lecane* and *Brachionus***,** large fraction of cosmopolitan species (~66%) and occurrence of several pantropical and cosmotropical species (~20%) imparts 'tropical character' to the rotifer assemblages of the Barak valley floodplains. This generalization concurs with various global reports on the composition of the tropical rotifer faunas (Fernando 1980; Dussart *et al.* 1984; Segers 1996, 2001, 2008). The lecanid dominance compares well with the reports from the floodplains of Africa (Segers *et al.* 1993, 1998), Thailand (Sa-Ardrit *et al.* 2013) and Argentina (Jose de Paggi 2001). The overall significance of important Eurotatoria families and genera concurs with the reports from the floodplains of Africa (Segers *et al.* 1993, Green 2003), Brazil (Koste 1974, Koste & Robertson 1983, Bonecker *et al.* 1998), Thailand (Segers & Pholpunthin 1997), Bolivia (Segers *et al.* 1998) and Argentina (Jose De

Paggi 2001). This generalization, in turn, assigns the littoral-periphytonic nature to Rotifera of the Barak River floodplains with occurrence of several small-sized species of *Colurella*, *Lecane*, *Lepadella* and *Trichocerca*. The latter attribute is hypothesized to the predation influence of juvenile fish and invertebrates (Baumgartner *et al.* 1997); this feature also endorses our remarks on the rotifers from the floodplains of NEI (Sharma & Sharma 2014a, 2018a; Sharma *et al.* 2016, 2017, 2018) as well as of the Kashmir Himalayas (Sharma & Sharma 2018b).

To sum up, this first comprehensive analysis of zooplankton of the Barak River floodplains of south Assam depicts the species-rich and diverse Rotifera assemblages, and thus affirms microhabitat and environmental heterogeneity of the wetlands of the region. Our study highlights sizeable fractions of species of global as well as regional biogeographic interest, various new records and interesting taxa, the littoral-periphytic nature, several small-sized species, large fraction of cosmopolitan species and occurrence of several pantropical and cosmotropical rotifers. The results merit biodiversity and biogeographic interest for Indian Rotifera as well as that of the floodplains of the Indian sub-region in particular. Analysis of more intensive collections with emphasis on the periphytic, sessile, colonial and benthic taxa is likely to update the rotifer biodiversity of the Barak floodplains, Assam state and NEI.

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New earthworm records from the Ukrainian part of the north-eastern Carpathians (Megadrili: Lumbricidae)

T. SZEDERJESI

*Tímea Szederjesi, Hungarian Natural History Museum, Department of Zoology, H-1088 Budapest,
Baross u.13. E-mail: t.szederjesi@gmail.com*

Abstract. Elaboration of the earthworm material collected from the Ukrainian part of the north-eastern Carpathians resulted in recording 8 species. Revision of the former *E. spelaea* (Rosa, 1901) records revealed that all these specimens are misidentifications of *E. lucens* (Waga, 1857). *D. veneta cognettii* (Černosvitov, 1935), a former synonym of *D. alpina alteclitellata* (Pop, 1938) and junior homonym of *D. cognettii* (Michaelsen, 1903) has been reinstated and a new replacement name *D. cernosvitovi* nom. nov. is proposed.

Keywords. Oligochaeta, Eisenia, Dendrobaena, veneta cognettii, replacement name.

INTRODUCTION

Research on the earthworm fauna of the north-eastern Carpathians started at the beginning of the 20th century however, this area is still insufficiently known.

The recent research are focused mainly on the Maramureş region in Romania and revealed remarkable diversity. Csuzdi & Pop (2006, 2008) recorded presence of altogether 22 species, which is nearly the quarter of the total number of earthworm species known in the Carpathian Basin and among them, two species (*Octodriloides izanus* and *Octodrilus parvivesiculatus*) proved to be new to science (Csuzdi *et al.* 2011).

The Ukrainian part of the north-eastern Carpathians was first studied by Cognetti (1927), Černosvitov (1928, 1932) and then Perel (1979). Altogether, 18 earthworm taxa were reported from this region so far (Černosvitov 1935, Perel 1979).

The aim of this study is to present the results of the earthworm collectings carried out in the early 2000s, in the Zakarpatska province (Kárpátalja) of Ukraine.

MATERIAL AND METHODS

Earthworms were collected by hand-sampling, *i.e.* searching under stones, the bark of fallen logs, etc. The specimens were killed and fixed in 75% ethanol and deposited in the earthworm collection of the Hungarian Natural History Museum (HNHM). Additional material in the earthworm collection of Lev Černosvitov was also used for the study (C/numbers).

RESULTS

Aporrectodea carpathica (Cognetti, 1927)

Allolobophora carpathica Cognetti, 1927: 5; Černosvitov 1928: 26; 1932: 529; 1935: 51.
Aporrectodea carpathica: Csuzdi & Pop 2006: 38; 2008: 146.

Material examined. HNHM/17417 2 ex., Polonyna Krasna (Kraszna-havas), spring section of a forest sidebrook of Luzhanka River, N48° 22.432' E23°45.050', 1195 m, from wood and under stones, leg. D. Murányi, 18.05.2002.

Bimastos rubidus (Savigny, 1826)

Enterion rubidum Savigny, 1826: 182.
Bimastus constrictus: Cognetti 1927: 7. Černosvitov 1928: 26.

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Dendrobaena subrubicunda: Černosvitov 1932: 531.
Dendrobaena subrubicunda f. *typica*: Černosvitov 1935: 43.
Bimastus tenuis: Černosvitov 1935: 63.
Dendrodrilus rubidus rubidus: Csuzdi & Pop 2006: 40; 2008: 148.
Bimastos rubidus: Csuzdi 2012.

Material examined. HNHM/17413 1 ex., Polonyna Krasna (Kraszna-havas), upper section of Luzhanka River, below the ice covered sections, N48°22.759' E23°45.372', 1130 m, from wood and under stones, leg. D. Murányi, 19.05.2002.

Dendrobaena alpina alteclitellata (Pop, 1938)

(Figure 1)

Eisenia alpina alteclitellata Pop, 1938: 136.
Eisenia alpina (part.): Černosvitov 1932: 528.
Eisenia alpina f. *typica* (part.): Černosvitov 1935: 37.
Dendrobaena alpina alteclitellata: Csuzdi & Pop 2006: 39; 2008: 147.

Material examined. HNHM/17402 1 ex., Polonyna Krasna (Kraszna-havas), Luzhanka River catchment basin, beech forest, 1000 m, leg. B. Cser, 04.07.2003. HNHM/17405 1 ex., Polonyna Krasna (Kraszna-havas), Topas hillside on the treeline, beech forest, from wood and under stones, 1300 m, leg. D. Murányi, 19.05.2002. HNHM/17420 9 ex., Polonyna Krasna (Kraszna-havas), valley of Luzhanka River, beech forest, 580 m, leg. B. Cser, 07.08.2003.

Dendrobaena attemsi (Michaelsen, 1902)

Helodrilus (Dendrobaena) attemsi Michaelsen, 1902: 47.
Dendrobaena attemsi: Perel 1979: 236. Csuzdi & Pop 2006: 39; 2008: 147.

Material examined. HNHM/17403 2 ex., Polonyna Krasna (Kraszna-havas), Luzhanka River catchment basin, beech forest, 1000 m, leg. B. Cser, 04.07.2003. HNHM/17406 3 ex., Polonyna Krasna (Kraszna-havas), Topas hillside on the treeline, beech forest, from wood and under stones, 1300 m, leg. D. Murányi, 19.05.2002. HNHM/17407 2 ex., Polonyna Krasna (Kraszna-havas), Kvasovets stream source region, beech forest, gulch, from leaf litter, wood and under stones, leg. D. Murányi, 21.05.2002.

Dendrobaena cernosvitovi nom. nov.

(Figure 2)

Eisenia veneta var. *cognettii* Černosvitov, 1935: 40 = *Dendrobaena cognettii* (Černosvitov, 1935) non *Dendrobaena cognettii* (Michaelsen, 1903).
Eisenia veneta var. *concolor*: Cognetti 1927: 5. Černosvitov 1928: 25; 1932: 528.
Eisenia alpina (part.): Černosvitov 1932: 528.
Eisenia alpina f. *typica* (part.): Černosvitov 1935: 37.
Dendrobaena alpina: Perel 1972: 109.
non *Dendrobaena alpina alteclitellata* (Pop, 1938): Csuzdi & Pop 2006: 39; 2008: 147.

Material examined. C/597 Holotype, Bilky-Sinevir, 12–16.08.1926. C/497 3 ex., Carpathians, Apšinec, leg. L. Černosvitov, 03.07.1932. C/590 4 ex., Carpathians, 1925. C/591 4 ex., Carpathians, Hoverla, leg. S. Hrabě, 02.08.1925. C/601 5 ex., Carpathians, Byčkov, leg. O. Jírovec, 07.1929. C/614 1 ex., Carpathians, Svidovec, leg. V. Vladykov, 07.1925. C/628 1 ex., Tempa-Užčerna, 1200 m, leg. L. Černosvitov, 28.07.1926. HNHM/17411 5 ex., Polonyna Krasna (Kraszna-havas), beech forest in the upper valley of Luzhanka River, N48°22.81' E23°45.29', 1190 m, from wood and soil, leg. D. Murányi, 19.05.2002. HNHM/17414 1 ex., Polonyna Krasna (Kraszna-havas), upper section of Luzhanka River, below the ice covered sections, N48°22.759' E23°45.372', 1130 m, from wood and under stones, leg. D. Murányi, 19.05.2002.

External characters. Length 48–62 mm, diameter 3–4 mm. Number of segments 100–122. Pigmentation red-violet dorsally, darker anteriorly. Prostomium epilobous ½ open. First dorsal pore at the intersegmental furrow 5/6. Setae distantly standing. Setal arrangement behind clitellum: *aa*:*ab*:*bc*:*cd*:*dd* = 1.83:1.07:1.22:1:2.88. Male pores large on segment 15, accompanied by a glandular crescent protruding into the 16th segment. Nephridial pores irregularly alternate between setal line *b* and above *d*. Clitellum on segments 27, ½ 27–33. Tubercula pubertatis on segments 31–32. Glandular tumescences on segments 11, 12, 16 *b*.

Internal characters. Septa 6/7–8/9 slightly thickened. Testes and funnels paired in segments 10–11. Three pairs of seminal vesicles in 9, 11, 12. Two pairs of spermathecae in 9/10, 10/11 with external openings between setal line *d* and the mid-dorsal line (M). Calciferous glands with well-developed diverticula in segment 11–12. Last pair of hearts in segment 10. Nephridial bladders sausage-shaped. Crop in segments 15–16, and gizzard in segments 17–18. Typhlosolis T-shaped. The cross-section of the longitudinal muscle layer of pinnate type.

Etymology. The species is named after the renowned Oligochaete taxonomist, Dr. Lev Černosvitov.

Remarks. This species was first reported as *E. veneta* var. *concolor* (Cognetti 1927, Černosvitov 1928, 1932), which was originally described from the Caucasus and Transcaucasus, but based on the differences in the extension of the clitellar organs (cl: 27–32, tb: 30–31 *vs*. cl: 28–33, tb: 31–32) Černosvitov (1935) described it as a new variety; *E. veneta* var. *cognettii*. Perel (1972), highlighting that no *D. veneta* occurrences had yet been reported from the Carpathians, synonymized *D. veneta* v. *cognettii* with *D. alpina* (Rosa, 1884) due to the morphological similarities. Csuzdi & Pop (2006) reinstated *D. alpina alteclitellata* (Pop, 1938) from the synonymy with *D. alpina alpina* on the basis of recent molecular phylogenetic results (Csuzdi *et al.* 2005) and regarded *D. veneta cognettii* as a senior synonym of *D. alpina alteclitellata*. However, as the senior synonym name represents a junior homonym of *D. cognettii* (Michaelsen, 1903) they regarded the junior name *D. alpina alteclitellata* as valid.

The differences in the position of the tubercles (31–32 *vs*. 30–31), the opening of the spermathecae (d–M *vs*. M), the position of the last hearts (10 *vs*. 11 and extraoesophageal vessels in 12) and the presence of calciferous diverticula in 11–12 clearly distinguish *D. veneta cognettii* from *D. veneta* and unequivocally shows its relationship with the *D. alpina* species group, especially with *D. alpina alteclitellata*. However, *cognettii* clearly differs from *alteclitellata* in the position of the tubercles (31–32 *vs*. 30–32) and the opening of the spermathecae (d–M *vs*. M). Besides, their distribution overlaps in the studied region of the north-eastern Carpathians, therefore *D. veneta cognettii* is suggested to be raised to species rank. As this name is a junior homonym of *D. cognettii* (Michaelsen, 1903), a new replacement name is proposed.

Revision of the material of Černosvitov revealed that several specimens previously reported as *D. alpina* from the studied region in fact belong to *D. cernosvitovi*. These and the newly collected specimens showed that the shape of the tubercles are thicker and look more like to that of *D. alpina alteclitellata* and *D. clujensis* instead of the thinner tubercles presented by Černosvitov (1935: 40).

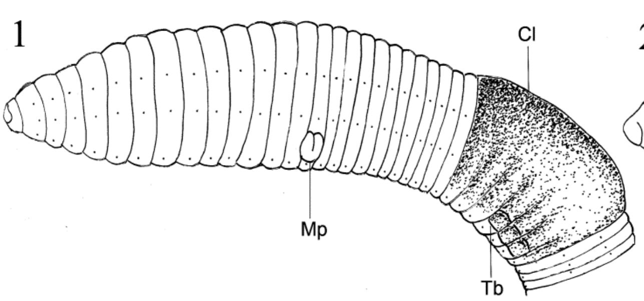

Figure 1. *Dendrobaena alteclitellata* (Pop, 1938).

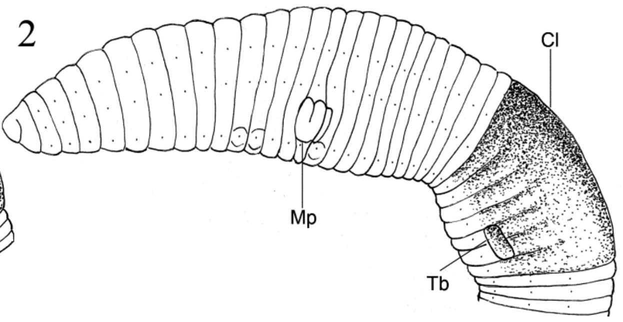

Figure 2. *Dendrobaena cernosvitovi* nom. nov.

Ventrolateral view of the fore body. Cl = clitellum, Mp = male pore, Tb = tubercles.

Dendrobaena octaedra **(Savigny, 1826)**

Enterion octaedrum Savigny, 1826: 183.
Dendrobaena octaedra: Cognetti 1927: 6. Černosvitov 1928: 26; 1932: 530. Csuzdi & Pop 2006: 39; 2008: 148.
Dendrobaena octaedra f. *typica*: Černosvitov 1935: 46.

Material examined. HNHM/17408 1 ex., Polonyna Krasna (Kraszna-havas), Kvasovets stream source region, beech forest, gulch, from leaf litter, wood and under stones, leg. D. Murányi, 21.05.2002. HNHM/17419 3 ex., Polonyna Krasna (Kraszna-havas), valley of Luzhanka River, beech forest, 580 m, leg. B. Cser, 07.08.2003.

Eisenia lucens **(Waga, 1857)**

Lumbricus lucens Waga, 1857: 161.
Eisenia spelaea: Cognetti 1927: 3. (misidentification)
Eisenia spelea: Černosvitov 1928: 25; 1932: 528; 1935: 39. (misidentification)
Eisenia submontana: Černosvitov 1932: 526; 1935: 35.
Eisenia lucens: Csuzdi & Pop 2006: 40; 2008: 149.

Material examined. C/185 3 ex., Carpathians, Apšinec, 1400 m, 20.07.1926. C/188 3 ex., Carpathians, Koroleve (Királyháza), 04.08.1926. C/621 4 ex., Berehove (Beregszász), leg. L. Černosvitov, 7–8.08.1926. C/625 2 ex., Lozeščina (Mezőhát), leg. L. Černosvitov, 25.07.1926. HNHM/17401 1 ex., HNHM/17418 1 ex., Polonyna Krasna (Kraszna-havas), valley of Luzhanka River, beech forest, 580 m, leg. B. Cser, 07.08.2003. HNHM/17409 7 ex., Polonyna Krasna (Kraszna-havas), Kvasovets stream source region, beech forest, gulch, from leaf litter, wood and under stones, leg. D. Murányi, 21.05.2002. HNHM/17410 3 ex., Polonyna Krasna (Kraszna-havas), beech forest in the upper valley of Luzhanka River, N48°22.81' E23°45.29', 1190 m, from wood and soil, leg. D. Murányi, 19.05.2002. HNHM/17412 3 ex., Polonyna Krasna (Kraszna-havas), Kolocava (Alsókalocsa), beech forest above Kvasovets stream, from wood and under stones, 600–900 m, leg. D. Murányi, 16.05.2002. HNHM/17415 4 ex., Polonyna Krasna (Kraszna-havas), upper section of Luzhanka River, below the ice covered sections, N48°22.759' E23°45.372', 1130 m, from wood and under stones, leg. D. Murányi, 19.05.2002. HNHM/17416 1 ex., Polonyna Krasna (Kraszna-havas), spring section of a forest sidebrook of Luzhanka River N48°22.432' E23°45.050', 1195 m, leg. D. Murányi, 18.05.2002.

Remarks. The early literature contains several *E. spelaea* (Rosa, 1901) records from this region (Cognetti 1927, Černosvitov 1928, 1932, 1935). Distinguishing the *E. lucens*/*E. spelaea* species pair is rather difficult due to the high morphological similarity. Besides the ability of bioluminescence in case of *E. lucens*, the only difference is in the position of the spermathecal pores, which are near the mid-dorsal line (M) in *E. lucens* and near setal line *d* in *E. spelaea*. However, in case of this character a certain degree of variance can be observed. Examination of the newly collected specimens and the material of Černosvitov clearly showed that the openings of the spermathecal pores of the *E. lucens* specimens in the north-eastern Carpathians are halfway between M and *d*. A recent molecular study (Szederjesi *et al.* 2018) revealed that the species pair separates well in the Carpathian Basin. *E. spelaea* can only be found in the western edge, while *E. lucens* possesses a wider range and is distributed through the whole Carpathian arch. Consequently, the earlier records of *E. spelaea* from the north-eastern Carpathians are treated here as misidentifications of *E. lucens*.

Lumbricus rubellus **Hoffmeister, 1843**

Lumbricus rubellus Hoffmeister, 1843: 187. Černosvitov 1932: 538; 1935: 75. Csuzdi & Pop 2006: 40; 2008: 150.

Material examined. HNHM/17404 2 ex., Talabor River under Nehrovets (Felsőkalocsa), under stones, leg. D. Murányi, 23.05.2002.

DISCUSSION

The earthworm collectings in the Ukrainian part of the north-eastern Carpathians resulted in recording altogether 8 earthworm species.

Revision of the former *E. spelaea* (Rosa, 1901) records and its comparison with the newly collected material showed that all specimens from this part of the Carpathians are in fact *E. lucens* (Waga, 1857) however, a slight variance in the position of the openings of the spermathecae can be observed.

The new material also revealed that *D. veneta* var. *cognettii* described by Černosvitov (1935) from Bilky-Sinevir shows characteristic differences from *D. alpina alteclitellata* (Pop, 1938), therefore its resurrection from syonymy and a new replacement name *D. cernosvitovi* nom. nov. was proposed.

With the new records and the actualisation of the former data, the number of the known earthworm species in the Ukrainian part of the north-eastern Carpathians is 16. Taking into account the recent results of Csuzdi & Pop (2006, 2008), with thorough researches in the Ukrainian Carpathians the occurrence of several additional species is expected.

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Notes on the identity of the male paralectotype of *Thecla heodes* and description of a new species: *Strymon cryptodes* sp. nov. from northern Peru (Lepidoptera: Lycaenidae)

ZS. BÁLINT[1], J. CERDEÑA GUTIÉRREZ[2], P. BOYER[3], K. FLORCZYK[4] & T.W. PYRCZ[4&5]

[1]*Zsolt Bálint, Hungarian Natural History Museum, Department of Zoology,H-1088 Budapest, Baross utca 13, Hungary. E-mail: balint.zsolt@nhmus.hu*

[2]*José Cerdeña Gutiérrez, Universidad Nacional de San Agustín, Museo de Historia Natural, Av. Alcides Carrión s/n, Escuela de Biología UNSA, Arequipa, Peru. E-mail: cerdenajose@yahoo.es*

[3]*Pierre Boyer, Lotissement l'Horizon, 13610 Le Puy Sainte Réparade, France. E-mail: pierdom@aliceadsl.fr*

[4]*Klaudia Florczyk, Nature Education Centre, Jagiellonian University, Gronostajowa 5, 30–387 Kraków, Poland. E-mail: klaudia.florczyk@uj.edu.pl*

[5]*Tomasz Wilhelm Pyrcz, Nature Eduaction Centre & Entomology Department, Institute of Zoology and Biomedical Research, Jagiellonian University, Gronostajowa 9, 30–387 Kraków, Poland. E–mail: tomasz.pyrcz@uj.edu.pl*

Abstract. A new species, *Strymon cryptodes* sp. nov. is described from puna grasslands of northern Peru. Its phenotype corresponds with the male paralectotype of a congeneric species originally described as *Thecla heodes* Druce, 1909, which, in consequence, turns out to be a mixture of two biological species. Males of *S. heodes* have conspicuous scent patches, absent in *S. cryptodes* sp. nov. The new species is known from four individuals recently collected in the vicinity of the city of Cajamarca and two historical specimens from other localities in the department of Cajamarca. Based on wing colour patterns and other morphological characters *S. cryptodes* sp. nov. is placed in the *Strymon istapa* species-group defined by Robbins & Nicolay (2002), although the presence or absence of male androconial patch and genitalia brush organ are demonstrated not to be a valid diagnostic infrageneric character.

Keywords. Andes, Cajamarca, male androconial patch, new species, Peru, syntype.

INTRODUCTION

Thecla heodes Druce, 1909, was described on the basis of two syntypes, a supposed male from „Uramarca" (=Yuracmarca, Ancash) and a supposed female from „San Marcas" (in all probability San Marcos, 50 km SE of the city of Cajamarca, approximately 2250 m). The „male" of *Thecla heodes* turned out to be a female and was selected as the lectotype of this species (Johnson *et al.* 1992). Accordingly, the second specimen became automatically a paralectotype. The genitalia of both type specimens were also figured (Johnson *et al.*, op. cit., figs. 14a, 14b). The identity of *Thecla heodes* was again recently discussed, its placement in the genus *Strymon* was confirmed, and the type material was briefly reviewed (Bálint & Benyamini, 2017). It was suggested that the labels of these two type specimens have been inadvertently changed (see D'Abrera 1995). Although, the first author (ZB) suspected that the male paralectotype of *Thecla heodes* represents another, by then undescribed species, this was not expressed in the paper, because no evidence could have been presented due to the difficulty in acquiring necessary information on the specimen. During recent sampling in cloud forests and puna habitats of the Andes in northern Peru three males and one female of an unrecognized *Strymon* species were collected. Their phenotype appeared to match perfectly that of the male paralectotype of *Thecla heodes*, thus it

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became obvious that the syntypes of *Thecla heodes* are, actually, a mixture of two biological species, one of them so far unnamed.

MATERIALS AND METHODS

A total of 600+ specimens of *Strymon* were examined in the Hungarian Natural History Museum, Budapest, Hungary (HNHM), ~150 specimens in the Nature Education Centre, Jagiellonian University, Kraków, Poland (CEP-MZUJ), and ~300 specimens in the collection of Pierre Boyer, Le Puy Sainte Réparade, France (PBF) (to be deposited in CEP-MZUJ). Additional material of the genus *Strymon* was examined in the Natural History Museum (UK, London) (NHMUK) by the first author (ZB).

Field work methods consisted in sampling with the use of standard entomological nets, with 1,5–2,5 m extension tubes. Collecting sites coordinates and altitude above sea level were recorded with a GPS.

Laboratory studies included standard entomological techniques (Winter 2000). Terminal parts of the abdomen were removed and soaked in 10% KOH solution for 5–10 minutes. Subsequently, abdomens were preliminarily cleaned out of soft tissue in water in order to expose genital parts. Dissected genitalia were cleaned out of water by using ethanol 90% and 95% solutions. Female abdomen was stained in chlorazole black in order to identify soft genital parts. Nikon digital camera DS–Fi1 and Olympus SZX9 stereomicroscope were used for taking pictures of the dissections, which were then processed in Combine ZP and Corel PHOTO–PAINT X3 programs to enhance focus and improve quality. Genital dissections were kept in glycerol in microvials pinned under corresponding specimens. In the HNHM an Olympus 70SZX12 optical stereo microscope was used to examine specimen anatomy and for digitalisation an Olympus DP70 digital camera attached to the microscope has been used. In CEP-MZUJ Nikon digital camera DS–Fi1 and Olympus SZX9 stereomicroscope were used for taking pictures of the dissections, which were then processed in Combine ZP and Corel PHOTO–PAINT X3 programs to enhance focus and improve quality.

Nomenclature of wing colour patterns and genitalia are compatible with papers dealing with *Strymon* by Robbins & Nicolay (2002), and Nicolay & Robbins (2005).

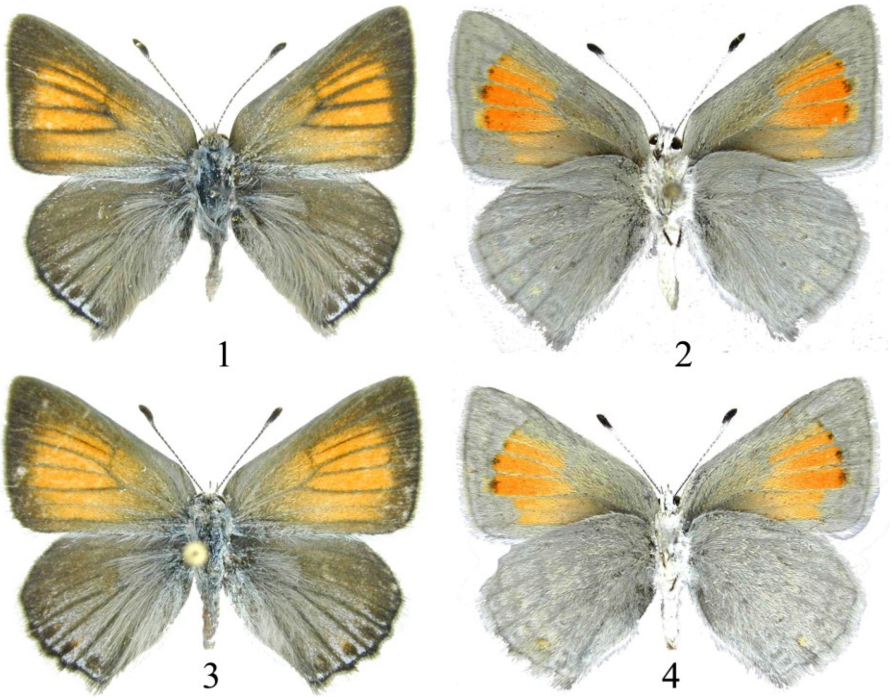
RESULTS

Strymon cryptodes sp. nov. Bálint, Cerdeña Gutierrez, Boyer & Pyrcz

(Figures 1–13)

Type material. Holotype (♂): forewing length 13 mm, Aylambo, au dessus de Cajamarca, 3200 m, S 07°14'25" / W 78°29'20", Cajamarca, Pérou, 17/6/2018 (white label), currently in PBF, to be deposited in Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima (MUSM). *Paratypes* (4 ♂ and 1 ♀): 1 ♂: same data as the holotype, in HMNH, prep. genit. Bálint no. 1645 (paratype no. 1); 1 ♀: same data as the holotype, prep. genit. Bálint no. 1646, in PBF (paraytpe no. 2); 1 ♂: Peru, Depto. Cajamarca, Cajamarca, Aylambo, 3200−3250 m, 17.VI.2018, leg. T. Pyrcz (white label) prep. mol. 391/26.08.2018 (green label); prep. genit. 1375, 31.08.2018/K. Florczyk (white label), Peru, Delegacja CEP-MZUJ 22/2018 (blue label), in CEP-MZUJ (paratype no. 3); 1 ♂: „San Marcas” (= San Marcos, Cajamarca; Lamas, pers. comm.), paralectotype of *Thecla heodes* (see: Fig. 12) (paratype no. 4.), in NHMUK; 1 ♂: „Guarapunga” (= Huayrapongo, Cajamarca; Lamas, pers. comm.), Simons, November 1899 (see Fig. 12), in NHMUK (paratype no. 5).

Classification and generic placement. All the species of Lycaenidae of the tribe Eumaeini possess the following three diagnostic characters: (1) ten forewing veins; (2) „greyhound shaped” male genitalia without a sclerotized juxta; (3) male foretarsus fused, used for walking, and stubby tipped (Eliot, 1973). All the species belonging to the genus *Strymon*, including the new species, have setae on the dorsal valva surface

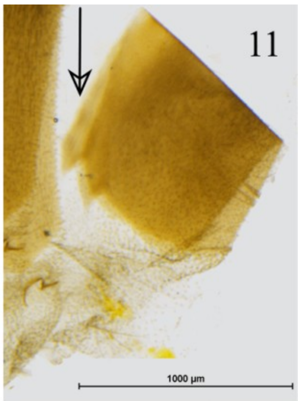


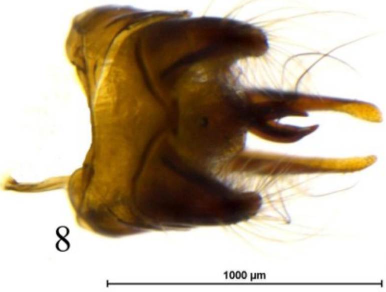
Figures 1–4. *Strymon cryptodes* type material, in dorsal and ventral views. 1–2 = male holotype, 3–4 = female paratype no. 3. (in same magnification; holotype forewing costa length: 13 mm).

modified into anteriorly pointing teeth (*cf.* Fig. 6) and most of them have brush organs on the dorsal vinculum (Robbins & Nicolay 2002). The new species is assigned to the *Strymon istapa* species group because: *(1)* it has no basal patch of white scales on the ventral surface of the hindwing; *(2)* aedeagus tip is down-turned with a single slender cornutus; *(3)* ductus bursae is simple with a sclerotized loop; *(4)* ductus seminalis arises from the unsclerotized posterior end of the ductus bursae; and *(5)* female's 8th tergum is furrowed and with imbedded presumed vestigial spiracles (*cf.* Fig. 11) (Robbins and Nicolay 2002).

Diagnosis. *Strymon cryptodes* sp. nov. is distinguished from other *Strymon istapa* group species by a combination of the following characters: *(1)* no scent patch (*S. nivea* (Johnson, Miller & Herrera, 1990), *S. oribata* (Weymer, 1890), *S. patagoniensis* Johnson, Miller & Herrera, 1992 (regraded as a junior subjective synonym of *S. rana*; see Warren *et al.* 2017), and *S. rana* (Schaus, 1902) have no scent patch, but all these species have all brown wings dorsal surface); *(2)* male with wide forewing orange patches (*S. bicolor* (Philippi, 1859), *S. flavaria* (Ureta, 1956), *S. heodes* and *S. wagenknechti* (Ureta, 1947), are similar in this respect, but they all have a large scent patch); *(3)* an ash-grey, almost patternless hindwing ventral surface.

Description. Male (Figs. 1–2) and female (Figs. 3–4) are externally similar, sexual dimorphism is limited to wingshape: male forewing outer margin is straight, female forewing outer margin is slightly convex. Forewing costa length 13 mm (n=5). *Dorsal wingsurface* (Figs. 1, 3): Forewing postdiscal area orange, no scent patch. Costa, outer and submargin area dark brown or black, veins covered by black scales; fringes white. Basal area and inner margin covered by long hairs. Hindwing ground colour same as the forewing costal and marginal areas with black submarginal spots with dusting of blue scales between veins M3 and 2V. Basal and discal area covered by long hairs. Outer margin without tail-like extensions. Fringes white. *Ventral wingsurface* (Figs 2, 4): Forewing postdiscal area orange with faint intercellular spots between





Figures 5–9. *Strymon cryptodes* male genitalia. 5 = genitalia capsule in lateral view (holotype), in the lower valval edge with anteriorly pointed setae traces well visible, pointed by the arrow (better seen under larger magnification) (scale bar: 2 mm), 6 = genitalia capsule in lateral view (aedeagus removed) (paratype no. 1), 7 = aedeagus in lateral view (paratype no. 1.), 8 = genitalia capsule in dorsal view (aedeagus removed) (paratype no. 1.), 9 = aedeagus in dorsal view (paratype no. 1.) (scales as indicated).

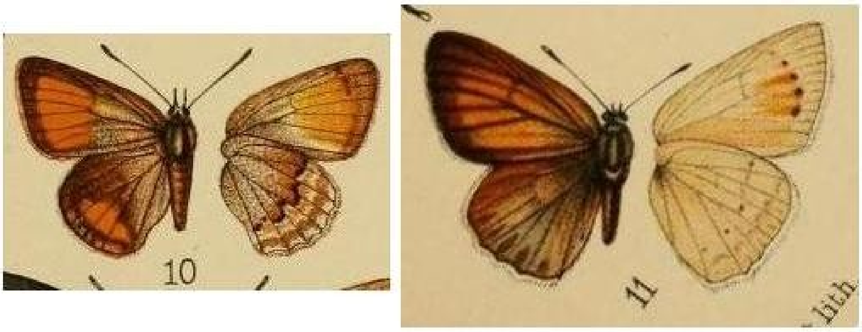
Figures 10–11. *Strymon cryptodes* female genitalia. 10 = ductus and bursa (scale bar: 1 mm), 11 = 8th tergite, the furrowed area pointed by the arrow (better seen under larger magnification) (scale as indicated).

veins M1-Cu1. Costa, outer and inner margin ash grey. Fringes white. Hindwing also ash grey, with pattern hardly visible. Fringes white. *Head*: Frons grey with dark piliform scales intermixed. Antenna black dorsally, ash grey ventrally, with about 18 white-ringed segments and a club with about 15 segments. Nudum confined to club. *Genitalia* (Figs. 5–11): Male genitalia typical of *Strymon istapa* group with a downturned aedeagus bearing a single cornutus, but without a brush organ. Female genitalia also typical of *Strymon istapa* group with no bursal sclerotization at the antrum, with a simple loop of ductus.

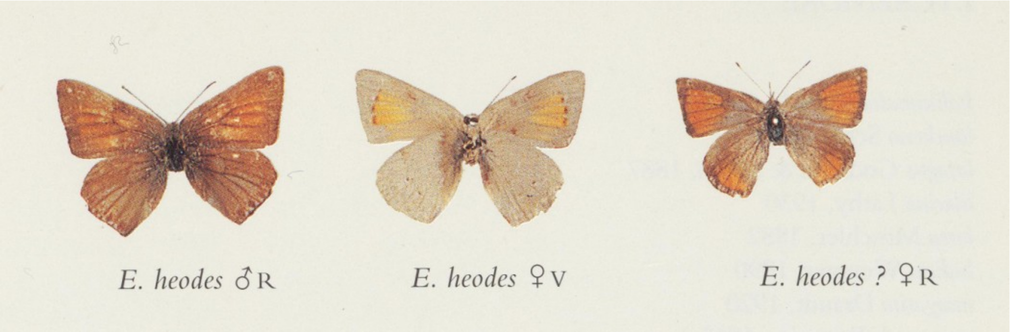
Individual variation. There is no significant variation in wingshape, colouration or pattern, except for the submarginal blue scaling on the hindwing dorsal surface: it is restricted to the antemarginal area, but when it is more extended, black submarginal spots are formed. Another interesting aspect is provided by the hindwing underside pattern, which is almost immaculate in the recently collected type material, but the „female" paralectotype of *Thecla heodes* shows some traces of a postmedial pattern (see: Figs. 12–13).

Distribution. So far this species is known only from three localities in the department of Cajamarca, Aylambo, Huayrapongo and San Marcos. The type locality is situated some 8km SSE from the city of Cajamarca centre (Fig. 14).

Bionomics. The habitat of *Strymon cryptodes* sp. nov. is dry puna sparsely covered with grasses and different kinds of bushes and perennial plants. The type locality is highly threatened by the spreading of crops (mostly potatoes) and the plantations of *Eucalyptus* (Fig. 15). This site was



Figures 12. Images of *Thecla heodes* in the lithographic plate of Druce 1909. Left = type „male" (= lectotype female); right = type „female" (= paralectotype male; *Strymon cryptodes* sp. n., paratype no. 4.).



Figures 13. Documentation of „*Eiseliana heodes* Druce, 1909" in the folio plate of D'Abrera (1995). Left = male, „Guarapunga" (*Strymon cryptodes* paratype no. 5), middle = male, „San Marco" (= *Thecla heodes* paralectotype „female" = *S. cryptodes* paratype no. 4), right = female, „Uramarca" (= *Thecla heodes*, lectotype = *Strymon heodes*).

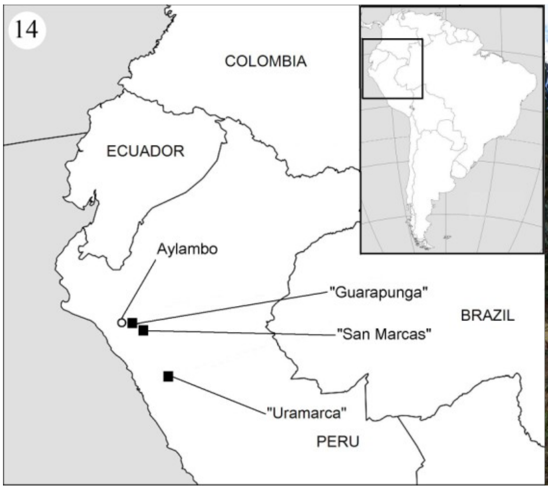


Figure 14. Known localities in department Cajamarca, Peru, where *Strymon cryptodes* has been recorded: Aylambo, type locality; „Guarapunga" = Huayrapongo, collecting site of paratype no. 5, „San Marcas" = San Marcos, collecting site of paratype no. 4 (male paralectotype of *Thecla heodes*). The type locality of *S. heodes* is also indicated as „Uramarca" (= Yuracmarca, Ancash).

Figure 15. The type locality of *Strymon cryptodes* in deparment Cajamarca, Peru: Aylambo, 8km SSE from Cajamarca, 3200 m, S 07°14'25" / W 78°29'20" (photo: Pierre Boyer).

visited 20 years ago by one of the co-authors (TWP) who observed that most of the original puna vegetation of the area was already lost. *Strymon cryptodes* flies quite rapidly, low above the ground. It was seen visiting flowers. Ovipositing was not observed. It is found in company of *Argyrophorus blanchardi blanchardi* Pyrcz & Wojtusiak, 2010 (Satryrinae), which was described from the same spot (Pyrcz & Wojtusiak 2010), and of *Euptoieta sunides* (Hewtison, 1877) (Heliconiinae), among others.

Etymology: The species-group name is used to signify that the identity of the species has been hidden („cryptic" = krɪptoʊ (*kryptós*) in Greek) for more than one century. It is a Latinized masculine noun formed in rhyme with the species-group name of the similar congener *Strymon heodes*.

DISCUSSION

Further historical specimens and identification

Apart from four individuals collected recently, two historical specimens were positively identified as representing the new species. However, Johnson *et al.* (1992) mentions another male of *Strymon heodes* from „Pampa Incas" (= Baños del Inca, Cajamarca; *cf.* Lamas 1976) in NHMUK, not examined, but considering the locality there is a possibility that it represents yet another specimen of *S. cryptodes*.

Strymon cryptodes is easy to identify by three distinguishing characters. The first is the lack of the male scent patch. All the species in the *Strymon istapa* group without scent patch have brown dorsal wingsurface. The other *Strymon* species without scent patch, representing other *Strymon* species groups, can be also easily discriminated on the basis of the orange coloured dorsal wingsurfaces, which was the second important character we pointed out in the diagnosis. All *Strymon* species with orange dorsal wingsurfaces have scent patch in the males and the hindwing ventral surface is patterned. The almost patternless hindwing ventral surface, the third wing character we mentioned, typifies *Strymon ahrenholzi* Nicolay & Robbins, 2005, but that species has scent patch in the male and a dark brown dorsal wingsurface in both sexes. All the other species of neotropical *Strymon* have patterned ventral hindwing surfaces.

Characters

Johnson *et al*. (1992) partly misdiagnosed the genus *Heodes* (type species: *Thecla heodes* Druce, 1909), indicating that „though worn, the original presence of hindwing tails is apparent on all known specimens" (*l.c*., p. 130). However, it became evident now that *Strymon heodes* is not tailed (Bálint & Benyamini 2017). The genus-group name *Heodes* was placed in synonymy by Robbins & Nicolay (2002)

The presence or the absence of the male scent patch is a somewhat discordant character in the systematics of *Strymon*, in particular in its division into putatively monophyletic groups. According to Robbins & Nicolay (2002) the absence of dorsal forewing scent patches is a diagnostic character of the *Strymon melinus* group, which harbours six species. However, in an other group, the *Strymon martialis* group constituted only by two species, one of them have a scent patch, and one has not (Nicolay & Robbins, 2005). Furthermore, in *Strymon istapa* group, *S. oribata* (Weymer, 1890) also lacks this male sexual character, and neither *S. nivea* (Johnson, Miller & Herrera, 1992) nor *S. rana* (Schaus, 1902) possess a scent patch. In the light of the above, further research is needed on this issue.

The male genitalia of *Strymon cryptodes* have no brush organ. Although in the general diagnosis of *Strymon* Nicolay & Robbins (2005) indicated the presence of the organ in general, they pointed out elsewhere (Robbins & Nicolay 2002) that some species of the *S. istapa* group in southern North America and in Mesoamerica may also lack brush organs. They also mentioned that *S. bicolor* was variable in this respect. However, the senior author dissected ten individuals of *S. bicolor* from Chile and Argentina, and found brush organs in none of them. Similarly, no brush organ in the specimens of *S. flavaria* and *S. heodes* were found, but *S. wagenknechti* possessed the organ. Probably, the character state of male brush organ also indicates closer interspecific relationships. Further research is needed also on this topic.

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Revision of European *Wormaldia* species (Trichoptera, Philopotamidae): Chimeric taxa of integrative organisation

J. OLÁH[1], T. ANDERSEN[2], S. BESHKOV[3], G. COPPA[4], A. RUIZ GARCIA[5] & K.A. JOHANSON[6]

[1]*János Oláh, Residence postal address: Tarján u. 28, H-4032 Debrecen, Hungary, profolah@gmail.com*
[2]*Trond Andersen, Department of Natural History, University Museum of Bergen, University of Bergen, P.O. Box 7800, N-5020 Bergen, Norway, trond.andersen@um.uib.no*
[3]*Stoyan Beshkov, National Museum of Natural History, 1 Tsar Osvoboditel Blvd. 1000 Sofia, Bulgaria, beshkov@nmnhs.com*
[4]*Gennaro Coppa, 1, rue du Courlis, F-08350 Villers-sur-Bar, France, gennaro.coppa@wanadoo.fr*
[5]*Antonio Ruiz Garcia, Departamento de Sistemas Físicos, Químicos y Naturales (Zoología), Universidad Pablo de Olavide, A-376, Km 1, 41013 Sevilla, Spain, aruigar@upo.es*
[6]*Kjell Arne Johanson, Swedish Museum of Natural History, Department of Zoology, Box 50007, SE-10405 Stockholm, Sweden. E-mail: kjell.arne.johanson@nrm.se*

Abstract. We have recognised significant incongruences among the most commonly used taxonomic characters in the European species of *Wormaldia* genus of the Philopotamidae caddisfly family. During taxonomical analysis and ranking procedures we have recorded incongruent, discorcordant characters also in the taxa in Rhyacophilidae, Hydropsychidae and Limnephilidae caddisfly families. Based on theoretical background we concluded that taxa of examined caddisflies and probably all living creatures are chimeric entities composed of components of different origin. Genomes and phenomes are tree-like on the surface but more reticulated in the deep. We understand chimerism with universal consequences, expanding well beyond the evolutionary tree-thinking of reductionism and determinism. Taxa are chimeric or at least chimerical in a stochastic universe under the permanent fluxes of the external and internal impacts created by intercourses between entropy and energy gradients. We have surveyed how to create and correct synonymies in the splitter/lumper perspectives along the principles of compositional and specification hierarchies understood as quantitative variability of non-adaptive neutral and qualitative stability of adaptive, non-neutral traits. We outlined how the apophantic (declaratory) hybris creates synonymies and underestimates biodiversity. After redrawing the diverging genitalic structures, particularly the speciation traits we have reinstated species status of eight taxa: *W. trifida* Andersen, 1983 stat.restit, stat. nov., *W. albanica* Oláh, 2010 stat. restit., *W. bulgarica* Novak, 1971 stat. nov., *W. daga* Oláh, 2014 stat. restit., *W. graeca* Oláh, 2014 stat. restit., *W. busa* Oláh, 2014 stat. restit., *W. homora* Oláh, 2014 stat. restit. *W. nielseni* Moretti, 1981 stat. nov. Character selection and lineage sorting procedures established the following species groups, species complexes and species clades in the European species of *Wormaldia*: *W. occipitalis* species group: *W. occipitalis* species complex; *W. charalambi* species group; *W. copiosa* species group; *W. triangulifera* species group: *W. bulgarica* species complex, *W. khourmai* species complex, *W. subnigra* species complex: *W. asterusia* species clade, *W. subnigra* species clade, *W. vercorsica* species clade; *W. triangulifera* species complex, *W. variegate* species complex. Unplaced species: *W. ambigua*, *W. algirica*, *W.* sarda. In this revision we have described fourteen new species: *W. longiseta, W. carpathica, W. kurta, W. parba, W. foslana, W. kumanskii, W. libohova, W. silva, W. gorba, W. kera, W. rona, W. sima, W. granada, W. telva*.

Keywords. Speciation trait, taxonomic incongruence, chimeric taxa, *Wormaldia*, new species.

INTRODUCTION

The European representatives of the *Wormaldia* genus are middle-sized or even smaller species of dull and drab-brown coloured animals, widely populating crenon, hypocrenon and epirithron habitats of headwater streams. They are frequent, therefore important components of the ecological and nature protection studies. But we are unable to identify them reliably to phylogenetic species level that is to the basic autonomous unit producing and consuming energy in the ecosystems.

Early attempts on fine phenomics in caddisfly taxonomy go back to one of the teachers of the first author in trichopterology, to Dr. Lazare Botosaneanu, and to his studies on the European species of the genus *Wormaldia*. We dedicate this paper to him.

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We had several stimuli to start a revision on the European *Wormaldia* species. *(1)* Evidenced by the very limited knowledge of this so distributed and so abundant genus. *(2)* Urged by practical need to identify species in environmental samples. *(3)* Empathized to remember Botosaneanu's first trials in fine phenomics. *(4*) Scholarly supported by the comprehensive studies and achievement on the endothecal spine patterns of the taxa of "*Wormaldia occipitalis*" by Neu (2015). *(5)* Actualised by the outdated atlas of European Trichoptera (Malicky 2004). *(6)* Provoked by apophantic nature of synonymies created recently on some European *Wormaldia* species (Malicky 2018).

Our character selecting and analysis in the genus *Wormaldia* have found significant incongruences among the most commonly used characters. All taxa have mixtures in various rations of ancestral and derived characters (Omland *et al.* 2008). Endless character trees in a single species tree create radical incongruences between classification and cladistic systems (Grant 2003). Which character tree represents the species tree? We have found various kinds of incongruences in several other caddisfly groups as well. In the Limnephilidae family we have found the speciation trait of paramere to have the most reliable species tree function (Oláh *et al*. 2018). In Rhyacophilidae family the tree of epiproct shows dissimilar phylogenetic relations compared to gonopod tree. These discordant character trees obscure lineage sorting (Oláh & Kiss 2018). In a brief survey on character state transformations of the phallic head in the Hydropsychidae family it was confirmed that taxonomic incongruence seems to be a general principle. It is rather a rule, than an exception (Oláh & deVries 2019).

THEORETICAL DISCOURSE

According to the Greek myth the chimeric constructs are entities composed of components of different origin. Chimeric living entities have very disparate parts of different origins, like cells, organs, tissues or any structural units from different species. As adjectives the difference between chimeric and chimerical is that chimeric is like a chimera while chimerical is of or pertaining to a chimera.

Chimerism is supported both by morphological character analysis and by molecular taxonomy. The more we learn about genomes the less tree-like we find their evolutionary history due to mosaic pattern of relationships among taxa. They are more network-like expanding well beyond historic tree-thinking (Bapteste *et al*. 2013). Species are more chimerical than Darwinian, or at least chimeric. Chimerism of incongruences or discordances is created by complex pattern of gene evolution, including incomplete lineage sorting (deep coalescence), gene duplications, gene losses, genom fusion, and lateral gene transfer, admixture of hybridization, introgression and recombination. Incongruence can occur for artefactual reason or for biological reason when gene trees are distinct from each other and from the species tree as well. In prokaryote only a tiny fraction of 1 % of the reconstructed gene trees are congruent with the reconstructed species tree. The same value is roughly 30 % in human genes (Galtier & Daubin 2008). If chimerism is so common and cannot be dismissed then no any hierarchical universal classification can be taken as natural (Doolittle 1999).

Incongruence between taxonomic and cladistic systems. The dream of taxonomic congruence (Mickevich 1978) that is the similarity in groupings between classifications of the same organisms based on different characters is a naïve wishful byproduct of the evolutionary discourse between phenetics and phylogenetics. The practical consequences of the incongruences between taxonomic *versus* cladistic systems are deeply frozen in biological systematics (Grant 2003): *(1)* classification *versus* cladification; *(2)* grouping criteria: similarity and differences of taxa *versus* branching order of clades; *(3)* paraphyletic groups: accepted *versus* banned; *(4)* characters of chromosomal genome *versus* molecular evidences of cytoplasmatic organelles; *(5)* empirical *versus* virtual; *(6)* hermeneutical character weighting *versus* overall similarity without hermeneutical weighting, especially in molecular cladistics; *(7)* character state identities *versus* character state transformations.

Branching versus *reticulation*. Clonal markers (mtDNA, Y chromosomal DNA) have always shown a high degree of robustness when analysed for hierarchical structures. Contrary, recombining genetic element like the X chromosome and the autosomes give conflicting information and incongruences from genome region to genome region or from character to character. As a result there is a tension between classifications in terms of nested hierarchies congruent with branching diagrams *versus* reticulated relations. Genes or characters of organism have different evolutionary history. In bacteria no single gene recovers the same branching pattern. Better to abandon the tree metaphor also in human taxonomy, in reality no such tree exists and theoretically it is useless to strive for one (DeSalle 2016). The tree metaphor of Darwinism, descent with modification, appears only as an apparent virtual tree, the real tree is uprooted, axed, annihilated, trashed or politely buried (Morrison 2014). Incomplete lineage sorting and other 'rogue' data fell the tree of life. There is, however strong belief that reticulation does not invalidate the concept of Tree of Life; in fact it was always reticulate (Mindell 2013). The vertical transfer in combination with speciation creates a tree-like organismal history, while horizontal transfer of hybridization, recombination, introgression, and gene transfer as well as genome fusion create reticulation in that tree. Therefore an emerging alternative metaphor is the network of tree with reticulation (Morrison 2014).

Character trees in species tree. In the persistent evolutionary discourse an inferred phylogeny based on one, more or multitude of characters are taken as given *a priori* and other neutral or adaptive characters were constrained to follow this branching path as confounding asymmetries of mere passengers (Maddison 2006). These inferred or resolved species trees even with high level of discordance (incongruence) among individual gene trees or trait trees ignore variations in the gene trees used to construct them. Resolution is realised by assuming that the most common topology represent the species tree applying concatenation or majority-rule methods. Their topology is discordant with the species topology. In hemiplasy the character mapping incorrectly infers the number of times a character has evolved (Hahn & Nakhleh 2015).

Various internal and external factors affect the vectors and rates of diversification with biases through adaptation and reproductive isolation in the integrative organisation (Oláh *et al*. 2017). Contrary to our clade constructions, the material organisation is not an inherently selective parsimonious process. Any entity from packages of a few quantums to the human body is composed of multitudes of incongruent trees in an apparent tree. Species trees are built under the permanent constructing/ deconstructing/ reconstructing processes by integrating innumerable and dynamic quantum/gene trees. Character evolution might be correlated with another trait due to shared developmental pathway, pleiotropic effects, linkage disequilibrium and the same trait appears many times in different lineages (Ng & Smith 2014). Discordance between incongruent gene trees and their containing species trees leads to the cloud concept of gene histories (Maddison 1997). It is rather a rule than an exception that the gene trees of gene copies sampled from various species disagree with species phylogeny. This is a direct evidence of chimerism. It seems that any phylogenetic tree is a broad-scale, low resolution view of fuzzy distribution, a cloud of gene histories.

MATERIALS AND METHODS

We summarize briefly the taxonomic consequences of the apophanticity in creating and supporting synomymies. We detail our principles and applications of the character selection and lineage sorting applying in this revision of the European species of the *Wormaldia* genus. We have put together our materials and made significant activity to loan type materials available in type depositories listed below. We have organised collecting trips and realised significant sampling field collecting activities to have newly collected specimens available for population studies.

Depositories. Cantonal Museum of Zoology Lausanne, Switzerland (CMZL); Civic Natural Science Museum "E. Caffi", Bergamo, Italy (CNSMB); Gennaro Coppa Private Collection, France (CPC); Hungarian Natural History Museum, Budapest, Hungary (HNHM); National Museum of Natural History, Sofia, Bulgaria (NMNHS); National Museum, Prague, Czech Republic (NMPC); Naturalis Biodiversity Center, Zoological Museum, Amsterdam, Netherlands (NBC-ZMAN); Oláh Private Collection, Debrecen, Hungary, under national protection by the Hungarian Natural History Museum, Budapest (OPC); Swedish Museum of Natural History, Stockholm, Sweden (SMNH); The Manchester Museum, University of Manchester, England (MMUE); University Museum of Bergen, University of Bergen, Norway (ZMBN).

Creating and correcting synonymies

Our new phylogenetic species of incipient caddifly siblings (Oláh *et al.* 2012, 2013a, b; 2014, 2015, 2016, 2017), delineated by subtle but stable adaptive speciation traits, have inspired a number of papers to synonymize them with unjustified declaratory negation (Malicky 2014, 2018, Sipahiler 2017, 2018). Such ungrounded nomenclatural acts have value as particular personal opinions in science history and might be generated and grounded by various motivations. The resource-depleted and armless taxonomy is still unprepared and fails to realise the resolution power of fine phenomics in searching and recognising speciation traits. These failures feed the pathetic debate of lumpers and frequently accompanied by apophantic synonymies.

Apophanticity. Aristotle's apophantic term is a declaratory statement without examining and evaluating the entities in themselves. This scientific over-reduction in creating synonymies is produced by mixing of scalar compositional hierarchy with vectorial specification hierarchy (Salthe 1991). We revisit the fine phenomics of our synonymised *Wormaldia* taxa with more comprehensive approach in order to present comparative evidences in more details, badly awaited in this highly neglected genus with unsettled taxa. However, apophanticity is a favourite method of Heidegger against the comparative methods of judging. Comparison obscures the truth, because of placing something in front of something else. His epistemic position is adequate even in the context of our practical problem in creating synonymies among living creatures. If we compare our *Wormaldia* species in a detailed comparative study to decide about their identity (synonymy) without distinguishing hermeneutically between adaptive and neutral traits we place neutrality in front of adaptability, blinding ourselves in such a way. Therefore, in the present revision we have examined all the available species (mostly types!) of the European *Wormaldia* genus and clearly distinguished the adaptive traits from the neutral traits that are the head of segment ten together with the endothecal spine pattern as adaptive speciation trait from the neutral traits of the body and other genitalic structures.

Vectorial divergence or scalar variance? Lumpers rely upon similarities and neglect incipient divergences while conflating minor variabilities of vectorial speciation hierarchies with stabilities of scalar hierarchies (Salthe 1991). They are unable to differentiate between adaptive speciation trait of vectorial speciation hierarchy and neutral characters of scalar compositional hierarchy. They rely on gross morphology and looking for similarities of scalar origin rather than for vectorial differences. Our lumper colleagues used to treat the well-discernible contemporary divergences of reproductive barrier building, detected by fine phenomics, routinely, as quantitative variability. Their gross-morphology based inferences are frequently misled and confused in contact zones and clines where various stages of reinforcements are detectable with intermediate forms produced by lateral transfer of crossing and enforced by character displacements. In the disease classification of nosology, the lumpers of psychologists find it easier to recognize similarities than differences, but splitter geneticists encounter with genetic heterogeneity behind. Lumpers in taxonomy focus our attention and provoke the science of fine phenomics and genomics to realise more scientific effort. This is one reason why Darwin wrote: "It is good to have hair-splitters and lumpers" (Burkhardt & Secord 2016). In a wider and somehow different context

Sober (2015) exposed the dubious question is the scientific method a myth? Are there principles of scientific reasoning that transcend the boundaries of particular disciplines? Philosophers are mostly normative lumpers with their deductive validity of logical forms. Historians and scientists of various disciplines are more concern about observations, descriptions and conclusions applying different methodologies. Therefore, they are rather splitters, like geneticists as digging deep along particular small topics. But what is the theoretical background behind all of these misunderstandings of complexity?

Lumper/splitter's debate is focused near at the initial splitting point of new emergences. Our new incipient sibling species were delineated mostly by speciation traits of adaptive origin characterized by subtle, but stable divergences enabling us to delineate precise and minute distinctions. Their adaptive shape stability is protected in organised complexes of integrative mechanisms as described in molecular genetics (Oláh & Oláh 2018). They are reliably detectable by applying the high resolution level of fine phenomics. In contrary, these incipient species have been synonymised just *(1)* by statements based on inadequate phenomics of gross morphology; *(2)* by lack of comparative examinations; *(3)* by declarations of personal opinion; *(4)* and without studies on type materials. This ungrounded negation is powered more by human hubris and less balanced by scientific devotion to discern the apparently discernibles even by the "lumpers", who give more importance to similarities than to differences in classification.

Human hubris. "*Abhimana*" (pride, false prestige, selfish conviction) is the function of *ahamkara* (ego) in Sanscrit. In ancient Greece the "*hubris*" was one of the greatest human sins. It was understood somehow between overdosed pride and arrogance with abuse, transgression, and the superman attitude of intruding into someone else's sphere, the loss of contact with reality and an overestimation of one's own competence, accomplishments or capabilities. Just opposite to the scientist's attitudes of devotion and humility towards where to cutoff between reality and fantasy. In everydayness of the taxonomy there are few nomenclatural acts creating synonymies without examination of the holotype and without any comparative trait presentations reflecting only simple opinion of unknown grounding. The nomenclatural acts of empty "ex-cathedra" pronouncements are simply declarations without any factual-interpreted (structures, drawings) or without factical-interpreter (hermeneutics) supports. This apophantic (declaratory) assertion, the apophanticity stands blank without aletheia (disclosure, unclosedness, unconcealedness): however there are no facts that exist independent of how scientists perceiving them.

Underestimating biodiversity. Unfortunately this imbalance of lumpers in recognizing the least inclusive taxa, the lower bound of living hierarchy leads to the underestimation of biodiversity. The lumper's attitude and their gross phenomics are not sensitive enough to recognise the most valuable endemic taxa in their homelands. Moreover, the resulted excuse concept of the "*widely distributed and highly varying taxa*" amplifies a relief background for the wasteful consumption of the biodiversity resources that produces ecosystem services: air, water, soil and food. Humans are accompanied by a biodiversity of over 100 million (Lee 2016), or including prokaryotes one to six billion (Larsen *et al.* 2017) species and so far we have succeeded to describe only less than two million (Oláh *et al.* 2015). In the last half century the taxonomy is immobilised and paralysed by the conundrum still dominating between the resolution-limits of DNA molecules and gross morphology. As a result most taxonomists miss to apply the high-tech and high throughput potential of fine phenomics in species delineation. They do not accept and apply in taxonomy the old principle of Liebniz's identity of indiscernibles. Without applying the principles and practices of fine phenomics, we are unable to recognise phylogenetic incipient species; we neglect Liebniz's principle and as a result we underestimate the biodiversity relying simply upon the outdated and overly lumped alpha taxonomy of "adult, "full" or "good" biological species. (Oláh *et al.* 2015, 2017). We are unable to utilise the adaptive superiority models of the most dynamic and information-rich components of local biodiversity entities.

Character selection and lineage sorting

In the common every-day practice of taxonomy the determination and classification of living organisms are based on principles, procedures and methods of semiotics, semiology, semantics and hermeneutics (Oláh *et al*. 2018). The traditional identification of a single *Wormaldia* specimen is carried out with arsenals of these sciences, although unconsciously and routinely. In the present taxonomic revision of the European species of the *Wormaldia* genus we have followed the traditional analytical procedure of character comparison used to delimit species and to delineate higher taxonomical hierarchies.

(1) *Character analysis* has focused on comparative empirical phenomics of gross and fine structures with simple visual trait matrices, without any statistics, without any modelling algorithms and without any clade computation and construction.

(2) *Character selection*. For the European species of the *Wormaldia* genus we have selected six historically studied structures of male genitalia (see below).

(3) *Character typing* by fixing attributes and recognising its transformational differences.

(4) *Character splitting* to follow early divergences of initial splits and older divergences of the higher hierarchies with adaptive speciation traits and with non-adaptive neutral traits and with their character combinations.

(5) *Character ranking* to establish incipient phylogenetic species, species clades, species complexes and species groups applying the principles of commonality, generality, locality, diversity, hierarchy, complexity and parsimony.

Character selection. McLachlan (1865) used the shape of mesal excision on the apical margin of tergite VIII and the form of gonopods as the distinguishing species characters in the *Wormaldia* genus. Kimmins (1953) has recorded the form of tergite X, cerci and gonopod as well as the armature of the penis as useful characters for the separation of species. In the revision of the *Wormaldia occipitalis* species group Neu (2015) has used the same characters to delimit species: *(1)* excision of tergite VIII, *(2)* form of tergite X, *(3)* form of cerci, *(4)* form of gonopods, *(5)* endothecal spine pattern. In this revision we have selected six characters to distinguish among taxa.

(1) Dorsal view of the mesoapical excision on tergite VIII, non-adaptive neutral traits with moderate variability. In practice it is difficult to draw the exact profile of the apical margin of the intact three-dimensional tergite VIII. A two-dimensional flattening of the entire tergite is difficult to realise.

(2) Lateral view of harpago, the second segment of the gonopod. It is non-adaptive neutral trait with small variability. According to the commonality, generality, diversity, locality, hierarchy and complexity principles the divergences of the gonopods are the oldest among the selected six genital characters. Probably the harpago is the most important ranking criteria to separate the species groups in the European representatives of the *Wormaldia* genus.

(3) Lateral view of cerci, non-adaptive neutral traits with small variability. Basal and apical region exhibit some limited diversity with basal dilatation and variously shaped rounded or truncated apical head.

(4) Dorsal view of cerci, non-adaptive neutral traits with small variability. Its trait, the extent of the ventromesad turning apex of the cerci is visible reliably in dorsal view.

(5) Lateral view of the head of segment X, the “head” is adaptive, non-neutral speciation trait, more diverse and stable than the endothecal spine pattern. The head of segment X is sensitive fine structure and supplied with highly specialised sensory structures of peg and pitted peg sensillae or simply alveoli. The mere presence of these sensory structures indicates the importance of this genital fine structure in sexual integration performing signal function in the development of early stages of reproductive isolation.

(6) Lateral view of the endothecal spine pattern in the phallic organ, adaptive, non-neutral speciation trait, rather stable, but not reliable in routine identification procedure due to the highly variable dispositions of the individual spines. The position of spines is very sensitive to the erection state of the phallic organ.

Lineage sorting. Due to the theoretically chimeric, reticulated nature of all the living entities any sorting trial in taxonomy is artificial. In reality the nature is chimeric with reticulation in the details, and only apparently diverging in taxonomic hierarchies as a result of the power of integrated organisation. The authonomies of living creatures, maintained by integrative organisation, work against the disintegration of incongruent, discordant stochasticity as they are being-in-the world. Every entity is only an ephemeral structural product of the interaction between disintegration and integration in the course of the accelerating universal expansion and the equilibrating entropy. These apparent divergences, with reticulation behind, create the biodiversity. Therefore in our taxonomical practice we have to continue the tree-like thinking both in classification and in cladistics, but bearing in mind that any trials of classification represent only the surface of reality. The practical solution to stochastic chimerisms is to rely upon various procedures of character combinations with probability perspectives applying majority, supermajority, supramajority or qualified majority rules or total evidence in molecular taxonomy and the old hermeneutics in classical taxonomy with phenomics. The growing interest in the inconsistency in science has reached already our understanding of inconsistent mathematics, paraconsistent logic, metaphysics of science and language (Bueno & Vickers 2014).

Lineage sorting of the European species of the *Wormaldia* genus was delineated by character ranking with various character combinations. Applying the selected six characters and their combinations and distinguishing between adaptive and non-adaptive traits, we have found four taxonomical nominal kinds in the the genus.

(1) Incipient phylogenetic species are delimited by the speciation trait that is by the lateral profile of the head of segment X.

(2) Species clades in the *Wormaldia subnigra* species complex of the *W. triangulifera* species group are distinguished by the combination of the lateral shape of the dorsal concavity of the head of segment X and of the endothecal spine pattern.

(3) Species complexes in the *Wormaldia triangulifera* species group are distinguished by the combination of the lateral profile of the head of segment X and by the endothecal spine pattern.

(4) Species groups in the European species of the *Wormaldia* genus are distinguished by the lateral profile of the harpagones.

Established lineages. Based upon the examination of types and freshly collected specimens as well as published drawings we have succeeded to establish the taxonomic position of all European species and included all of them into the linage sorting. However, the placement of some poorly known species without proper drawings is uncertain and, needs future confirmation. Species whose types or freshly collected specimens have been examined directly are indicated by bold letters.

Wormaldia occipitalis SPECIES GROUP

echinata, ***joosti***, *karystia*, ***longiseta* sp. nov.**, *taganana*.

Wormaldia occipitalis species complex: ***bosniaca***, ***carpathica* sp. nov.**, ***cianficconiae***, ***hellenica***, ***juliani***, *meridionalis*, ***morettii***, ***occipitalis***, *serratosioi*, ***subterranea***, ***trifida.***

Wormaldia charalambi SPECIES GROUP

charalambi, gardensis, ***kurta* sp. nov.**, *yavuzi*.

Wormaldia copiosa SPECIES GROUP

artillac, ***botosaneanui, copiosa,*** *corvina, dizkiran, hemsinensis*, ***kakopetros, marlieri, parba* sp. nov., *pulla, vargai.***

Wormaldia triangulifera SPECIES GROUP

Wormaldia bulgarica species complex: ***albanica***, ***bulgarica***, ***daga***, *erzincanica*, ***foslana* sp. nov.** ***graeca***, ***kimminsi***, ***kumanskii* sp. nov.**, ***libohova* sp. nov.**, ***silva* sp. nov.**

Wormaldia khourmai species complex: ***balcanica***, ***busa***, ***gorba* sp. nov.**, ***kera* sp. nov.**, ***khourmai***, *mahiri*, ***rona* sp. nov.**, ***sima* sp. nov.**

Wormaldia subnigra species complex:

Wormaldia asterusia species clade: ***asterusia***, ***homora.***

Wormaldia subnigra species clade: ***granada* sp. nov.**, ***mediana***, ***nielseni***, ***subnigra*.**

Wormaldia vercorsica species clade: ***gattolliati***, *ikizdere*, *malickyi*, *sukranae*, ***telva* sp. nov.**, *vercorsica*.

Wormaldia triangulifera species complex: *beaumonti*, ***cantabrica***, ***langohri***, *laticerca*, ***lusitanica***, ***moselyi***, *saldetica*, *schmidi*, ***triangulifera*.**

Wormaldia variegara species complex: *arriba*, *corsicana*, ***maclachlani***, *mattheyi*, *numidica*, ***variegata*.**

Unplaced (incertae sedis): *ambigua*, *algirica, sarda*

TAXONOMY

Wormaldia McLachlan, 1865

Wormaldia McLachlan, 1865: 140–141: "This genus I have named after Mr. P.C. Wormald, one of the few Entomologists who have paid attention to the *Trichoptera*. It is allied to *Philopotamus*, but differs in the form of palpi and in the neuration of the wings, as was pointed out by Dr. Hagen in the Stettin "Entomologische Zeitung" for 1860, p. 279. The species are small and unicolorous."

The *Wormaldia* genus, a distinctly apomorphic lineage in the ancestral Philopotaminae subfamily has all trace of 2A on hindwing almost disappeared and resulted in the appearance of anal veins as a divergent fork (Ross 1956). Its representatives are widespread both in the Old and the New Worlds. In the present survey we have established the lineage position of all the known European species of the *Wormaldia* genus, except three unplaced species, with brief characterization of the newly established species groups, species complexes and species clades. New drawings were prepared without any further taxonomical evaluation for all the examined species applying identical drawings style and drawing details including *(1)* left lateral profile of the entire genitalia without phallic organ; *(2)* left lateral profile of the head of the segment X for several specimens or several drawings from the single specimen; *(3)* lateral view of the phallic organ with the endothecal spine pattern; *(4)* dorsal view of the segment X and the cerci; *(5)* dorsal view of the apical margin of tergite VIII with the mesal excision. Besides the description of new species and taxonomical treatment of little-known ones we have evaluated and treated all the apophantic and invalid synonymies.

Wormaldia occipitalis species group

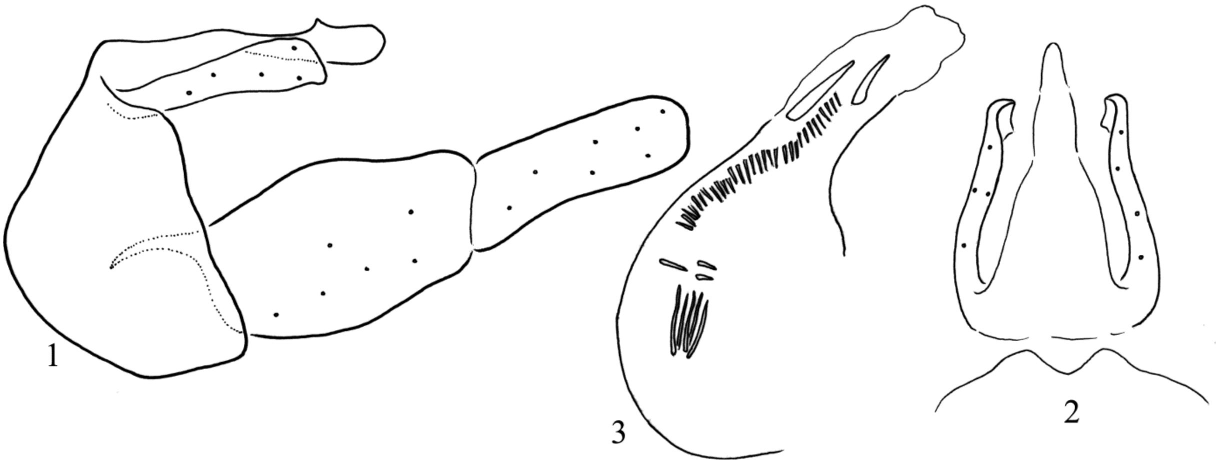
This species group is characterized by the combination *(1)* of the parallel-sided, not tapering harpago with rounded head, *(2)* of the terminal of segment X with capitate "head" and with pronounced dorsal subapical pointed process and *(3)* of the endothecal spine pattern with the presence of various clusters of small spines and with variously shaped and sized spines.

Wormaldia echinata Tobias, 1995

(Figures 1–3)

Material examined. **France**, Alpes-Maritimes, Moulinet, La Bevera, 9.X.2006, leg. G. Coppa (1 male, OPC).

Remarks. Based on the older divergences of gonopod *Wormaldia echinata* having parallel-sided harpago belongs to the *W. occipitalis* species group. However, the "head" is more elongated compared to *W. occipitalis* species complex, almost similar to the *W. subnigra* complex of the *W. triangulifera* group. There is an elongated, very long cluster of small spines, a character present only in the *W. bulgarica* and *W. khourmai* species complexes of the *W. triangulifera* species group. There are three different incongruent, discordant or chimeric character trees of the harpago, the head and the long small spine cluster. The ranking principles of generality, diversity and locality relate *W. echinata* to the *W. occipitalis* species group by the parallel-sided harpago.



Figures 1-3. *Wormaldia echinata* Tobias, 1995. 1 = male genitalia in left lateral view, 2 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 3 = phallic organ with the endothecal spine pattern in left lateral view.

Wormaldia joosti Kumanski, 1980

(Figures 4–6)

Material examined. Holotype: **Russia**, Western Caucasus, northern slopes, basin of Teberda river, spring brooklets, tributaries of the Karakel lake, 17.VI.1976, leg. Mrs. and Mr. Wolfgang Joost (1 male, NMNHS). Allotype: same as holotype (1 female, NMNHS). Paratype: same as holotype (1 female, NMNHS). **Georgia**, Svanetia, brook, left tributary of Mulkhura riv. SE of Mestia, 43°02.5'N 42°45.8'E; 1500 m, 5.VII.2013, leg. P. Chvojka (1 male, NMPC).

Remarks. Based on the older divergences of gonopod *Wormaldia joosti* having parallel-sided harpago belongs to the *W. occipitalis* species group. The "head" is elongated, very long and concave dorsad compared to the *W. occipitalis* species complex. The elongate and concave head is similar to the *W. subnigra* complex of the *W. triangulifera* group. There are two different incongruent, discordant or chimeric character trees of the harpago and the head. The ranking principles of generality, diversity and locality relate *W. joosti* to the *W .occipitalis* species group by the parallel-sided harpago.

Wormaldia longiseta Coppa & Oláh, sp. nov.

(Figures 7–9)

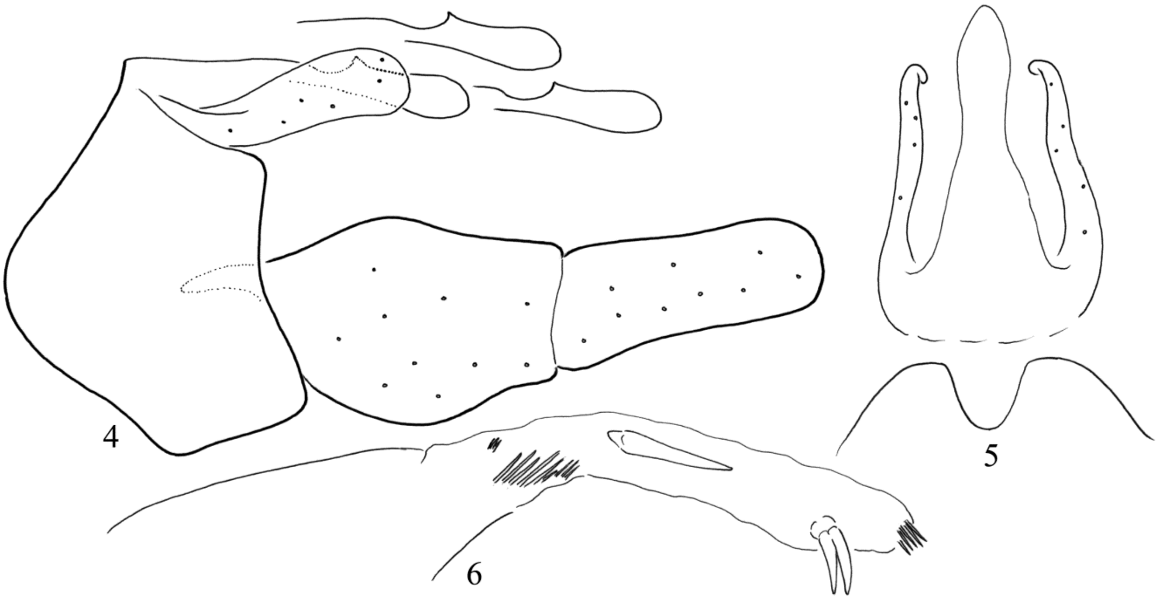
Material examined. Holotype, **France**, Lozère department, Cocures, river le Briançon, 3°36'45"E; 44° 21'28"N, 600 m, 27.V.2017, leg. G. Coppa (1 male, CPC).

Diagnosis. Having parallel-sided harpago *W. longiseta* sp. nov. belongs to the *Wormaldia occipitalis* species group and having no complex endothecal spine system this new species is not a member of the *W. occipitalis* species cluster. It is a unique species characterized by the elaborated network of small spine clusters composed of thin and long setae.

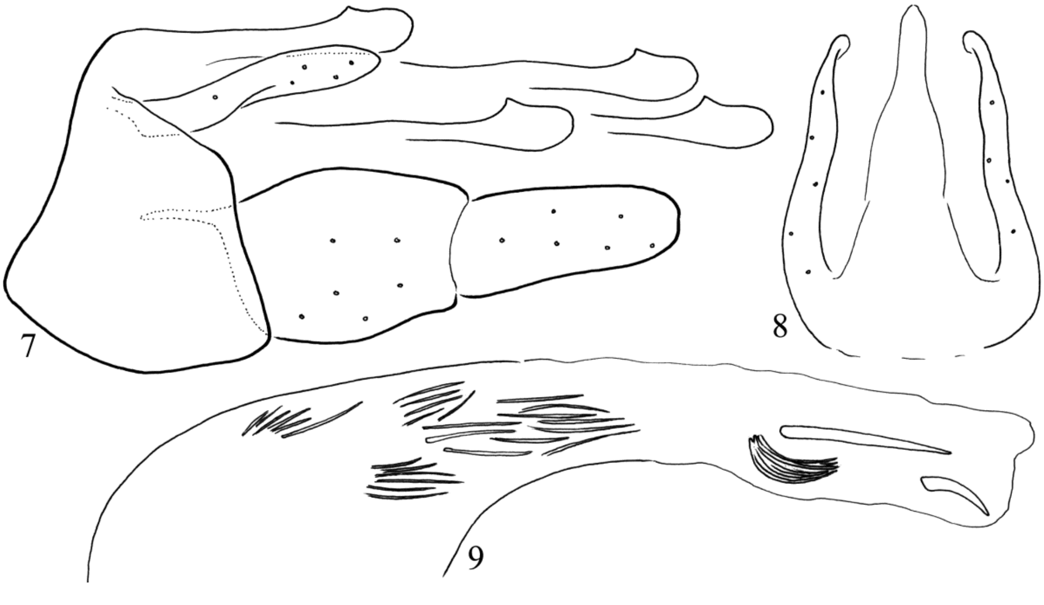
Distinguishing diagnosis. This species is delineated by the character combination detailed below. Easily delimited and recognised by the unique innovation of the dense and extended clusters of slender, elongated setae in the endothecal spine pattern of the phallic organ.

Description. Male (in alcohol). Medium-sized light brown animal. Sclerites medium brown, setal warts both on head and thorax and legs brown. Maxillary palp formula is I-II-IV-III-V. Forewing length 4 mm. Spur formula is 244.

Male genitalia. Segment X characterized by narrow parallel-sided apex in dorsal view, and by a dorsal small pointed subapical process visible in lateral view; apex elongated plum-shaped in lateral view; the ending is armed with sensory structures of *sensilla basiconica* (pegs) or *sensilla coeloconica* (pitted pegs) both on the very dorsal ending of the narrowing apex as well as on the sublateral broadening. Cerci slender with slightly pointed apex. Gonopods very produced, coxopodite and harpago with equal length; harpagones parallel-sided in lateral view. Phallic organ with eversible membranous endotheca containing an elaborated network of clusters composed of very thin and long setae.



Figures 4-6. *Wormaldia joosti* Kumanski, 1980. 4 = male genitalia in left lateral view, 5 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 6 = phallic organ with the endothecal spine pattern in left lateral view.



Figures 7-9. *Wormaldia longiseta* Coppa & Oláh, sp. nov. Holotype: 7 = male genitalia in left lateral view, 8 = segment X with cerci in dorsal view, 9 = phallic organ with the endothecal spine pattern in left lateral view.

Character combination. *(1)* Dorso-subapical point of segment X tiny, visible in lateral profile as the top point formed by the apical right-angle of the dorsal concavity. *(2)* Apex of segment X perfectly horizontal and elongated semicircular, plum-shaped. *(3)* Apex of cerci pointed. *(4)* Ventromesal projection of cerci less developed. *(5)* Harpagones parallel-sided. *(7)* Slender and long basal spines lacking. *(8)* Proximal pair of clusters of small spines lacking. *(9)* Distal pair of clusters lacking. *(10)* Two stout spines present. *(11)* Arching cluster of small spine developed.

Etymology. *longiseta*, with reference to the presence of elongated slender spines composing the elaborated spine clusters in the endotheca of the phallus.

Wormaldia occipitalis **species complex**

In Europe every trichopterologists has treated *Wormaldia occipitalis* as a highly variable and widely distributed species. Most of us have identified this very abundant component of headwaters with some hesitation and put aside them for a more detailed future study in order to find reliable character states for species delineation.

This species complex is characterized with rather complicated pattern of spine system organised in integrative processes on the everted surface of the eversible endotheca as detailed already by Botosaneanu more than half century ago (1960a,b). Recently Neu (2015) has given particular attention to the character state transformations of the endothecal spine pattern participating in species divergences and helping taxonomists in species delineations. Here we follow his grounding discoveries.

Species delineation by endothecal spine pattern. In practice, after clearing and cleaning, the endotheca are visible usually in virgin or various non-virgin stages of reverted, intruded, invaginated, retracted position depending on the individual functional mating and/or copulating histories. The endotheca resting in the retracted position inside the phallotheca is only very seldom visible in a fully everted, extruded, protruded, evaginated position. Most frequently the position of endotheca is unstable varying around reverted condition, partially invaginated or evaginated. The everted tip slender spines are basal spines in reverted position. The everted basal stout spines are tip spines in reverted position. The everted middle clusters of small spines remain middle also in reverted position. Neu (2015) applied the everted position however, in practice usually we face the reverted position; therefore here we apply the reverted position to locate the components of the endothecal spine system. We have to emphasize that the position of spines are very dynamic depending on the actual condition of the endotheca. Every individual specimen has its own arrangement pattern of the same five spine components. The particular locations of the individual spines or the degree of disintegration of spine clusters are highly sensitive to the copulation history as well as to the invaginated-devaginated state of the endotheca. Beside, the location and desintegration instability, the diagnostic application of the endothecal spine pattern is further complicated by the spine losses occurring during functional copulatory processes. Moreover, to locate successfully the particular component of the spine system requires proper clearing and cleaning procedure, high microscope resolution and experienced careful examination with several viewing angles. Bearing in mind all of these shortcomings, the endothecal spine pattern has primary diagnostic value.

Coding the reverted pattern of endothecal spine components. There are four types of spines. *(1)* Slender spines: they are long and basal in the anterior part of the reverted endotheca, located very near to the apical opening of the short tube-like endothecal sclerites; in most species (*bosniaca, carpathica*, *occipitalis, subterranea*) they are represented by a pair or three (only at *hellenica*) of slender long spines, occasionally duplicated, seldom triplicated, but variously adhering basad; in *hellenica* the three slender basal spines (triplet) also prone or liable to dublicate or triplicate; *juliani* and *morettii* lack distinct slender spines; these slender and long basal spines are the most variable components of the spine systems. *(2)* Clusters (bundle, bunch) of small spines located usually in middle position; there are four such clusters: a pair of proximal (anterior) clusters and a pair of distal (posterior) clusters; the number of small spines in the clusters is variable with specific ranges; the clusters are liable to disintegrate, depending on the intensity of copulations; *(3)* Stout spines: there are three spines (triplet), usually one long and two short located middle or apicad or in tip position; the most stable component of the spine system. *(4)* Specialised cluster of small spines; the fifth cluster present in 3 species; discovered by Neu (2015) as appearing during eversion on the tip of a small endothecal side lobe (*occipitalis*) or apical lobe (*juliani*) as well as a single cluster composed of many densely packed very thin black spines (*bosniaca*).

Wormaldia bosniaca **Botosaneanu, 1960**

(Figures 10–12)

Wormaldia occipitalis bosniaca Botosaneanu, 1960a: 273–274, "s'en distingue pourtant par la présence de 5 touffes d'épines (celle apicale, k, composée d'un très grand nombre de très fines épines, manque chez *occipitalis occipitalis*, et, semble-t-il aussi chez *o. subterranea* Rad.), puis par le grand nombre d'épines composant les autres 4 touffes - d,c,f,e - (environ 10-17 pour chaque touffe); quant à l'aspect et à la position des grosses épines (a,b,g,h,i), ils correspondent assez bien à ce que nous savons d'*occipitalis occipitalis* (observer pourtant des trois branches de l'épine a). Gonopodes comme chez *o. occipitalis*, X^{e} segment comme chez *o. subterranean*, mais appendices supérieurs arrondis à l'apex. Je pense qu'il s'agit d'une nouvelle sous-espèce, que je vais dénommer *bosniaca* n. ssp. 1♂ et 1♀ de Trebevic ont été désignés comme holotype et allotype (Fernand Schmid); 1 ♂ parat.: Deutsches Entomologisches Institut, Berlin; 1 ♂ parat.: Lazare Botosaneanu."

Wormaldia bosniaca Botosaneanu, 1960a: Malicky 2005:549, Unclear taxonomic position.

Wormaldia bosniaca Botosaneanu 1960a: Neu 2015: 107, Raised to species rank.

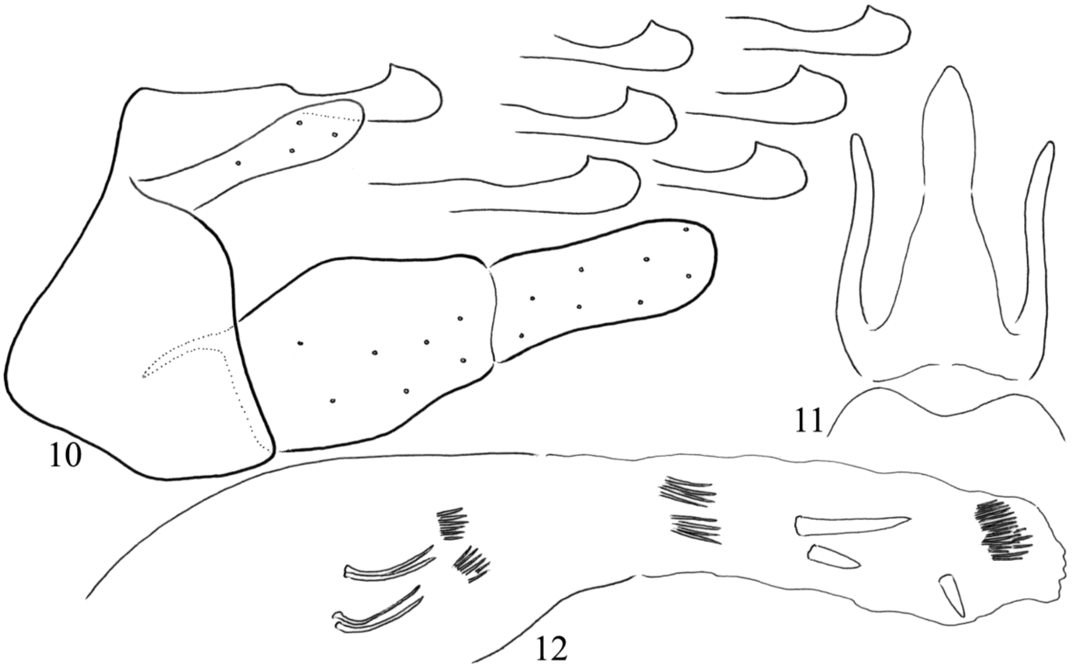
Material examined. **Bosnia-Herzegovina**, Sutjeska National Park, Klobučarica stream, left tributary of Sutjeska River, 2.IX.1988, singled leg. J. Oláh (12 males, OPC). Sutjeska National Park, first spring stream at Sutjeska River, 2.IX.1988, singled leg. J. Oláh (23 males, OPC). Sutjeska National Park, second spring stream at Sutjeska River, 2.IX.1988, singled leg. J. Oláh (41 males, OPC). Sutjeska National Park, small tributary of Sutjeska River, 1.IX.1988, singled leg. J. Oláh (3 males, 3 females; OPC). Jablanica, first spring stream, 4.IX.1988, singled leg. J. Oláh (4 males, OPC). Jablanica, second spring stream, 4.IX.1988, singled leg. J. Oláh (4 males, OPC).

Distinguishing diagnosis. This species is delineated by the character combination detailed below. Easily delimited by the combination of the perfectly horizontal and plum-shaped semicircular slightly elongated apex of segment X and of the pronounced presence of the fifth specialized spine cluster composed of many and densely packed small black spines.

Character combination. *(1)* Excision on tergite VIII deep and wide. *(2)* Dorso-subapical point of segment X tiny, visible in lateral profile as the top point formed by the apical right-angle of the dorsal concavity. *(3)* Apex of segment X semicircular. *(4)* Apex of cerci rounded. (5) Ventromesal projection of cerci lacking. *(6)* Harpagones parallel-sided. *(7)* Slender and long basal spines organized in a pair, each frequently doubled or tripled. *(8)* Proximal pair of clusters of small spines short. *(9)* Distal pair of clusters longer. *(10)* Three stout spines present. *(11)* Specialised fifth cluster of small spines very produced.

Variability. We have examined six populations from the Sutjeska National Park and found the lateral profile of the apex of segment X rather stable. However, we have collected three specimens from near the locus typicus representing a mixed population with highly varying apex of segment X and spine pattern.

Contact zone. As detailed at *Wormaldia subterranea* presentation we have found mixed populations of *W. bosniaca* and *W. subterranea* in Bosnia-Herzegovina along the Neretva Valley with intermediate hybrids having shortening head of segment X and without the fifth dense cluster composed of many thin spines.



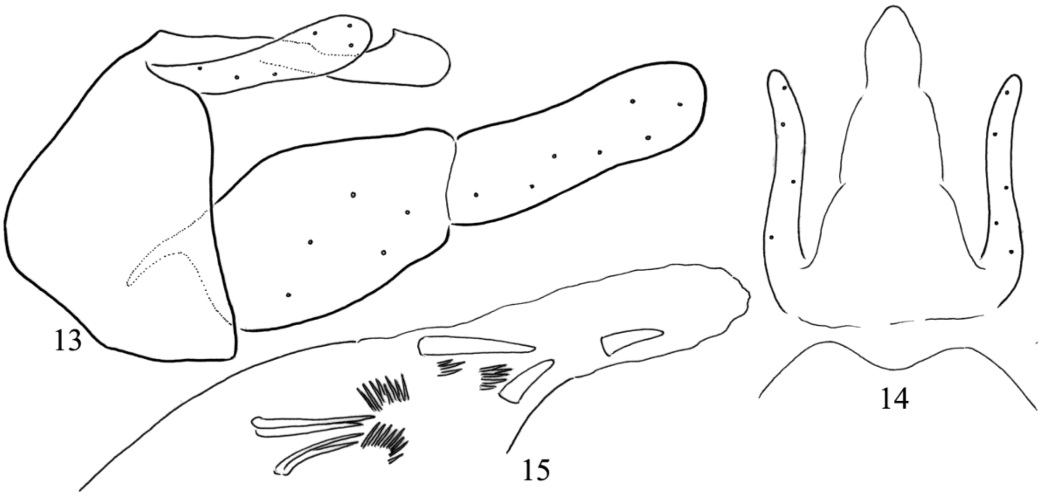
Figures 10-12. *Wormaldia bosniaca* Botosaneanu, 1960. 10 = male genitalia in left lateral view, 11 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 12 = phallic organ with the endothecal spine pattern in left lateral view.

Wormaldia carpathica Oláh, sp. nov.

(Figures 13–15, 16–67)

Material examined. Holotype: **Hungary**, Zemplén Mts., Kemence Valley, small streams, 4–5.IX.1984, singled leg. J. Oláh (1 male, OPC). Pratypes: same as holotype (23 males, 6 females, OPC). **Albania**, Tiranë, SW slopes of Dajti Mt., 22.VI.1994, leg. P. Chvojka (40 males, 17 females, NMPC; 3 males, OPC). Albania, Malësia e Tiranës (Highlands of Tirana), below Maja e Fekenit (=Feken peak), west from Qafa e Selitës pass, N41°22'12", E019°59'11", 1100 m, 12.VIII. 2018, leg. S. Beshkov A. Nahirnic & C. Plant (2 males, OPC). **Bulgaria**, Berkovitsa Province, Stara Planina, Berkovitsa, stream E of Kom settlement, 1590m, N43°10.722' E23°04.922', 14.VIII.2005, leg. T. Deli, Z. Erőss, Z. Fehér, D. Murányi (1 male HNHM). Bulgaria, Ossogovo Mts below Ruen (= Autotransport) chalet, above Kyustendil town 1505m., N42°10'28", E022°37'56.5", 23.IX.2018, at lamps, light traps leg. S. Beshkov & A. Nahirnic (22 males, OPC). **Czech Republic**, SE Moravia, Bílé Karpaty Mts., spring area, Bukový pot. (595 m), 49°01'34"N, 18°00'32"E, 24.V.–23.X.2010, leg. P. Chvojka (25 males, 19 females, NMPC; 6 male, OPC). Czech Republic, SE Moravia, Bílé Karpaty Mts., spring area 2km SE Nová Lhota-Vápenky, 48°51'42"N, 17°39'07"E, 265 m, 7.VI.–27.X.2005, leg. P. Chvojka, mixed population with *W. subterranea* (69 males, NMPC; 12 males, OPC). **Hungary**, Börzsöny, Diósjenő, Kemence patak, 700 m, 3.V.2006, leg. D. Murányi (1 male, HNHM). Mátra Mts., Mátraháza, 30.VII.1938, leg. J. Sátori, identified as *Wormaldia trianulifer* by J. Sátori (14 males, 4 females; OPC). Hungary, Mátra Mts., Parádfürdő, 11.VII.1941, leg. J. Sátori, identified as *Wormaldia trianulifer* by J. Sátori (1 male, OPC). Hungary, Mátra Mts., Galyatető, Lengyendi stream, 15.VII.1983, leg. J. Oláh (3 males, 1 female; OPC). Hungary, Mátra Mts., Szuhai stream, 15.VII.1983, leg. J. Oláh (1 male, OPC). Hungary, Mátra Mts., Csörgő stream, 14.VII. 1983, leg. J. Oláh (1 male, OPC). Hungary, Mátra Mts., Galyatető, Feketetó forrás, 17.IX.1986, leg. Á. Uherkovich & S. Nógrádi (1 male, OPC). Hungary, Bükk Mts., Szentlélek, small stream with lime tuff steps, 7.X.1964, singled leg. J. Oláh (3 males, OPC). Hungary, Bükk Mts., Nagyvisnyó, Bán Valley, 18.IX. 1985, leg. Á. Uherkocich (1 male, OPC). Hungary, Zemplén Mts. Kőkapu, Kemence stream, 7.VIII.1987 leg. J. Oláh (12 males, OPC). Hungary, Zemplén Mts., Ördög Valley, small stream, 10.VIII.1966, singled leg. J. Oláh (2 males, 1 female; OPC). Hungary, Zemplén Mts., Lászlótanya, small stream, 20.VI.1983, light leg. J. Oláh (2 males, 1 female; OPC). Hungary, Zemplén

Mts., Lászlótanya, small stream, 24.VII.1985, singled leg. J. Oláh (6 males, 1 female; OPC). Hungary, Zemplén Mts. Füzér, Nagy stream, 12.VII.2005, leg. Papp & Földváry (4 males, HNHM). **Macedonia**, Southeastern region, Plavuš Hills, Valandovo, forest brook at Motel Izvor, N of the city, N41°19.636', E22°33.327', 260 m, 06.05.2014, T. Kovács, D. Murányi (1 male, 2 females; OPC). Macedonia, Southwestern region, Jablanica Mts, Vevčani, Vevčani Springs and outlet stream at the city, N41°14.371', E20°35.056', 935 m, 26.06.2014, P. Juhász, T. Kovács, D. Murányi (1 male, OPC). **Poland**, Western Carpathians, Silesian Beskids,Biala Wiselka Valley, 26.VIII.1986, singled leg. J. Oláh (6 males, 1 female; OPC). Poland, Gorce Mts., Kamienica stream, 26.VII. 1985, singled leg. J. Oláh (1 male, OPC). **Romania**, Cindrel Mts. Paltinis, stream Daneasa, N45° 41.999' E23°53.527', 726m, 29.V.2013, singled leg. J. Oláh, E. Bajka, Cs. Balogh, & G. Borics (1 female, OPC). Romania, Apuseni Mts. Garda de Sus, tributary of Ariesul Mare, N46°270.493' E22°47.895', 788m, 29.V.2013, singled leg. J. Oláh, E. Bajka, Cs. Balogh, & G. Borics (35 males, 2 females; CNSMB). Romania, Apuseni Mts. Vartop, spring streams, N46°31.045' E22°39.821', 1209m, 29.V.2013, singled leg. J. Oláh, E. Bajka, Cs. Balogh, & G. Borics (4 males, 2 females; OPC). Romania, Apuseni Mts. Garda de Sus, tributary of Ariesul Mare, N46°270.493' E22°47.895', 788m, 20.VI.2013, singled leg. J. Oláh, Cs. Balogh, & S. Fekete (47 males, 39 females; OPC). Romania, Apuseni Mts. Vartop, spring streams, N46°31.045' E22°39.821', 1209m, 20.VI.2013, singled leg. J. Oláh, Cs. Balogh, & S. Fekete (3 males, 2 females; OPC). Romania, Apuseni Mts., Vladeasa Mt., Jada stream, Iedulului triburaty, Saritoarea Iedulului Waterfall, N: 46°42'42.2' E: 22°35'04,9", 950m, 3.VII.2013, leg. Cs. Balogh, (4 males, 1 female, OPC). Romania, Apuseni Mts., Bihor Mt., Crisul Pietros, Valea. Sebiselu, N: 46°36'56,61" E: 22°29'16,68”, 518m, 4.VII.2013, leg. Cs. Balogh, (2 males, 6 females; OPC). Romania, Apuseni Mts., Bihor Mt., Crisul Pietros, Valea. Aleului, N: 46°38'24,3" E: 22°36'27,9", 634m, 4.VII. 2013, leg. Cs. Balogh, (2 males, 1 female; OPC). Romania, Retezat Mts., tributary of Cerna stream, 1208m, N: 45°13'10.39" E: 22°50'24.17", 12.VII.2013, leg. E. Bajka, Cs. Balogh, G. Borics, P. Borics, (3 males, 4 females; OPC). Romania, Apuseni Mts. Garda de Sus, tributary of Ariesul Mare, N46°27'30.23"” E: 22°47"55.15" 788m, 22.VIII.2013, singled leg. Cs. Balogh (6 males, 9 females; OPC). Romania, Apuseni Mts. Bihor Mt. Baita, Baita Plai, tributary Crisul Baita, N: 46°28'52.10" E: 22°36'10.03", 507 m 15.05.2014, leg. Cs. Balogh & B.V. Béres (3 males, 1 female; OPC). Romania, Apuseni Mts. Bihor Mts. Bubesti-Cobles, tributary P. Cobles, N: 46°29'56.08" E: 22°43'48.64" 902 m, 14.05.2014, leg. Cs. Balogh & B.V. Béres (1 males, OPC). Romania, Apuseni Mts. Muntii Gilaului, Statiunea Muntele Baisorii, La Mocirle, spring streams, N46°30.241' E23°15.550', 1552m, 4.IX.2015, singled leg. M. Kiss, J. Oláh & L. Szél (40 males, OPC). Romania, along Transalpina (67C) road, 3 km downstream of Oasa Reservoir, 29.VI.2016, singled leg. J. Oláh & J. Oláh jr. (5 males, 1 female; OPC). Romania, Maramures Mts. Viso stream, tributary, 15.V.1993, leg. J. Oláh (8 males, OPC). Romania, Maramures Mts. Rona stream, 12.VIII. 1993, light leg. J. Oláh (9 males, 4 females; OPC). Romania, Muntii Rodnei, Statiunea Borsa, (Borsabánya) 900m, 6.VIII.1942, leg. J. Sátori (1 male, OPC). Romania, Maramureş county, Muntii Ignis, Deseşti-Staţiunea Izvoare, forest spring at settlement, 920m, N47°45.167’ E23°43.013', 08.X.2010 leg. P. Barcánfalvi, D. Murányi & J. Oláh, (8 males, OPC). Romania, Caras-Severin county, Semenic Mts. Open brook E of Mt. Piatra Goznei, 1340m, N45°10.949' E22°03.967', 11.VI.2011, leg. T. Kovács, D. Murányi & G. Puskás, (6 males, OPC). Romania, Caras-Severin county, Tarcu Mts. Spring and its outlet at Cuntu Meteorological Station, 1465m, N45°18.008' E22° 30.059', 9.VI.2011, leg. T. Kovács, D. Murányi & G. Puskás, (8 male, OPC). Romania, Hargitha Mts., Sincraieni, Valea Mare,, 5. VII.1993, leg. L. Keresztes (4 males, 1 female; OPC). Romania, Muntii Rodnei, Statiunea Borsa, open stream and its sidebrooks, 878-1022m, 28.VI.2005, leg. J. Kontschán, D. Murányi & K. Orci (8 mlaes, HNHM). Romania, Southern Carpathians, Semenic Mts., 28.VII.2006, leg. M. Bálint (31 males, OPC). **Slovakia**, Roznava, Majerska Dolina, 23.VII.1964 singled leg. J. Oláh & Z. Varga (6 males, OPC). Slovakia, Tatranská Lomnica, small spring stream, 20.VII.1966, singled leg. J. Oláh (3 males, OPC). Slovakia, Rejdova (Sajóréde), Mlynna stream, below spring, at bridge, N48°46'16" E20°13'31" 1250 m, 3.X.2013, singled leg. J. Oláh & J. Kecskés J. (38 males, 2 females; OPC). Slovakia Rejdova (Sajóréde), right tributary of Slana (Sajó) stream, lower reach, N48°48'53" E20°15'51" 680 m, 3. X.2013, singled leg. J. Oláh & J. Kecskés J. (41 males, 3 females, OPC). Slovakia, E Slovakia, Vihorlatské hills, Malá Bystrá stream (560–700 m), 48°56'16"N, 22°11'36"E, 9.X.1990, leg. P. Chvojka (24 males, 10 females, NMPC; 6 males, OPC). Slovakia, W Slovakia, Strážovské Mts., Strážovský potok stream (800–1000 m), 48°57'41"N, 18°28'02"E, 19.IX.2009, leg. P. Chvojka (12 males, 10 females, NMPC; 6 males, OPC). Slovakia, Dobsina, Dankova, 12.X.1989, leg. Á. Uherkovich & S. Nógrádi (3 males, 1 female, OPC).



Figures 13-15. *Wormaldia carpathica* Oláh, sp. nov. Holotype: 13 = male genitalia in left lateral view, 14 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 15 = phallic organ with the endothecal spine pattern in left lateral view.

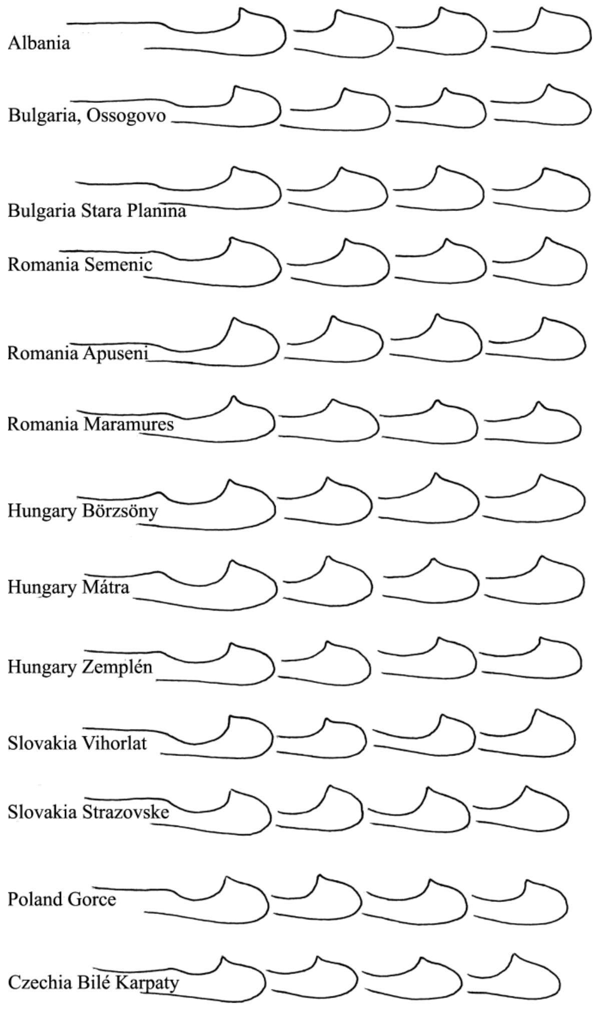
Slovakia, Hrabosice, 26.IX.1984, leg. Á. Uherkovich & S. Nógrádi (20 males, OPC). Slovakia, Hrabosice, 13.X.1989, leg. Á. Uherkovich & S. Nógrádi (1 male, 1 female, OPC). **Ukraine**, Bieszczady Mts (Besszádok), Ung National Park, below Lubnya (Kiesvölgy), N: 49°00' 54.81" E: 22°43'23.82", 478 m, singled, 20. IX.2013, leg. J. Oláh, Cs. Balogh, Cs. Deák & I. Meszesán (2 females; OPC). Ukraine, Bieszczady Mts (Besszádok), Ung National Park, small forested stream between Uzsok Pass and Uzsok, N: 48°59'33.52' E: 22°52'03.40", 642m, singled, 20.IX.2013, leg. J. Oláh, Cs. Balogh, Cs. Deák & I. Meszesán (8 males, 7 females; OPC).

Diagnosis. Having parallel-sided harpago *W. carpathica* sp. nov. belongs to the *Wormaldia occipitalis* species group and having very complex endothecal spine system belongs to the *W. occipitalis* species cluster. It is most close to *W. hellenica*, but differs by having more elongated apex of segment X; having only a pair, not three basal slender spines and the pair of posterior endothecal spine cluster is highly reduced both in number and length. Moreover, *W. carpathica* sp. nov. is larger and lighter species.

Distinguishing diagnosis. This species is delineated by the character combination detailed below. Easily identified by the combination of *(1)* the perfectly horizontal, elongated plum-shaped semicircular apex of segment X, *(2)* the absence of the fifth specialized spine cluster composed of many and densely packed small black spines, *(3)* the absence of the third slender basal endothecal spine, and *(4)* the highly reduced pair of posterior endothecal spine clusters.

Description. Male (in alcohol). Medium-sized ligth brown animal. Sclerites medium brown, setal warts both on head and thorax and legs brown. Maxillary palp formula is I-II-IV-III-V. Forewing length 4 mm. Spur formula is 244.

Male genitalia. Tergit VIII with shallow and wide mesal excision on the apical margin. Segment X characterized by triangular apex in dorsal view, and by a dorsal small pointed subapical process visible in lateral view; the ending is armed with sensory structures of *sensilla basiconica* (pegs) or *sensilla coeloconica* (pitted pegs) both on the very dorsal ending of the narrowing apex as well as on the sublateral broadening. Cerci slender, slightly clavate with blunt apex. Gonopods very produced, coxopodite and harpago with equal length; harpagones parallel-sided in lateral view. Phallic organ with eversible membranous endotheca containing a pair of slender basal spines each frequently doubled or tripled adhering basad; two pairs of spine clusters composed of small spines; posterior spine cluster reduced; one long and two short stout spines present.



Figures 16-67. Lateral profile of the speciation trait that is the head of segment X of the paratypes of *Wormaldia carpathica* Oláh, sp. nov. from various Carpathian regions.

Character combination. *(1)* Excision on tergite VIII shallow and wide. *(2)* Dorso-subapical point of segment X tiny, visible in lateral profile as the top point formed by the apical right-angle of the dorsal concavity. *(3)* Apex of segment X perfectly horizontal and plum-shaped elongated semicircular. *(4)* Apex of cerci rounded. *(5)* Ventromesal projection of cerci lacking. *(6)* Harpagones parallel-sided. *(7)* Slender and long basal spines organized in a pair each frequently doubled or tripled. *(8)* Proximal pair of clusters of small spines short. *(9)* Distal pair of clusters reduced in number and length. *(10)* Three stout spines present. *(11)* Specialised fifth cluster of small spines lacking.

Variability. Examining over six hundred specimens we have found only a single male with a triplet of basal slender spine pattern. It was possibly the result of desintegration due to copulation or during the preparation.

Contact zone. We have found mixed populations of *W. carpathica* and *W. subterranea* Northwest of the distributional area in the White Carpathians of Czech Republic and Southwest in Bulgaria with intermediate hybrids having less elongated head of segment X and/or abbreviated spines of posterior clusters.

Etymology. This new species populates all ranges of the Carpathian Mountains. The specific epithet refers to this distribution.

***Wormaldia cianficconiae* Neu, 2017**

(Figures 68–70)

Wormaldia cianficconiae Neu, 2017:114, „differentiated from *Wormaldia occipitalis* Pictet, 1834 and *Wormaldia subterranea* Radovanovic, 1932 by the combination of the following characters: (1) in lateral view, a distinct hump in the middle of segment X before the saddle-shaped depression in the distal half, (2) aedeagus without long, needle-like spines, but with a diffuse group of about 25 short spines, two groups of 4–8 long spines and three or four strong thorns."

Material examined. Locus typicus: **Italy**, Lazio-Rieti, Cittareale, Sorg. Velino loc. Cupello, N42.619° E13.153°, 980m, 26.VIII.1991, leg. P. Capoccia, det. (2017) P.J. Neu (1 male, 1 female, CNSMB; 1 male, OPC).

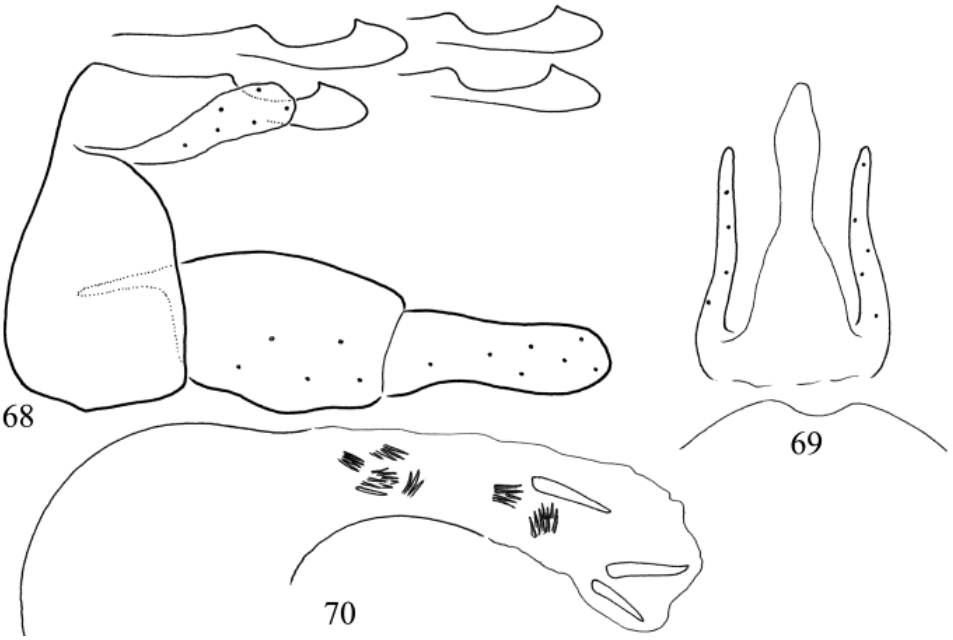
***Wormaldia hellenica* Jacquemart, 1962**

(Figures 71–73)

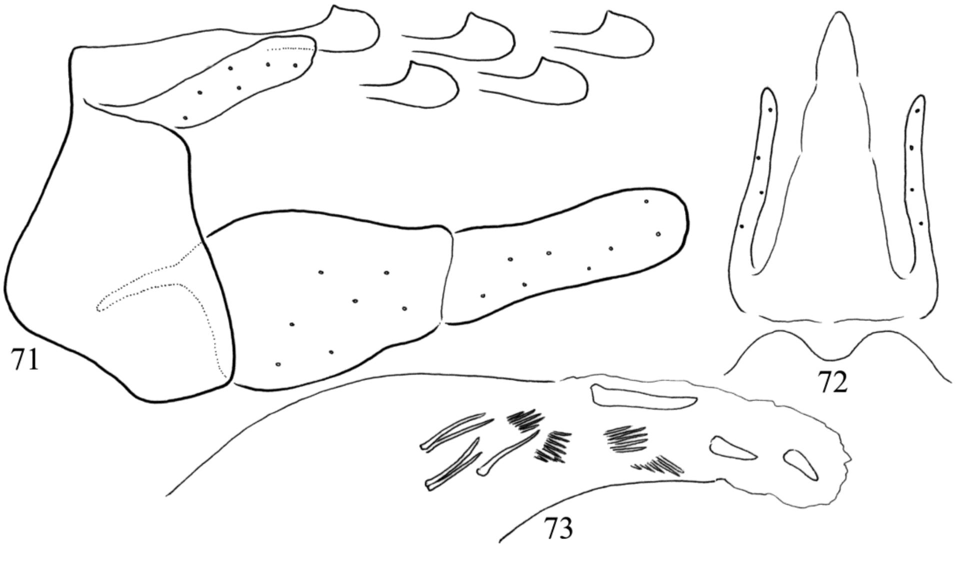
Wormaldia hellenica Jacquemart, 1962:3–4, „Materiel. – Récoltés par la mission E. Janssens-R Tollet, Mont Pélion W. Drakia (Khani Zisi) (1.200 m), 28/30-VII-1953, 5 preparations microscopiques, Mont Alympe E Stavros a Prioni, 1.000 m, 21/23–VII–1953, 1 preparation microscopique."

Wormaldia hellenica Jacquemart, 1962: Malicky 2005:549, Unclear taxonomic position.

Wormaldia hellenica Jacquemart, 1962: Neu 2015:107, Raised to species rank.



Figures 68-70. *Wormaldia cianficconiae* Neu, 2017. 68 = male genitalia in left lateral view, 69 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 70 = phallic organ with the endothecal spine pattern in left lateral view.



Figures 71-73. *Wormaldia hellenica* Jacquemart, 1962. 71 = male genitalia in left lateral view, 72 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 73 = phallic organ with the endothecal spine pattern in left lateral view.

Material examined. **Albania**, Malësia e Tiranës (Highlands of Tirana), below Maja e Fekenit (=Feken peak), west from Qafa e Selitës pass, N41°22'12", E019°59'11", 1100 m, 12.VIII.2018, leg. S. Beshkov A. Nahirnic & C. Plant (2 males, OPC).

Character combination. (1) Excision on tergite VIII deep and narrow. *(2)* Dorso-subapical point of segment X tiny, visible in lateral profile as the top point formed by the apical right-angle of the dorsal concavity. *(3)* Apex of segment X horizon tal almost semicircular. *(4)* Apex of cerci rounded. *(5)* Ventromesal projection of cerci almost lacking. *(6)* Harpagones parallel-sided. (7) Slender and long basal spines organized in a triplet, each could be doubled or tripled. *(8)* Proximal pair of clusters of small spines short. *(9)* Distal pair of clusters short. *(10)* Three stout spines present. *(11)* Specialised fifth cluster of small spines lacking.

Remarks. The two *W. hellenica* specimens were collected by light from the same habitat in the same evening and preserved in alcohol together with two *W. carpathica* sp. nov. specimens. This identical treatment permits a comparative gross visual examination of the two species. The general colour and the size of the two species are strikingly different as visible without any microscope, simply with naked-eye. *Wormaldia hellenica* is smaller and dark greyish brown compared to the larger and yellowish brown *Wormaldia carpathica* sp. nov. specimens. The difference in abdomen and genitalia colours between the greyish brown *hellenica* and the yellowish brown *carpathica* remained even more pronounced after clearing in alkaline solution of NaOH and under the microscope. The colour contrast of the cleared abdomens of the two species is remarkable. However, identically collected, preserved and cleared specimens are seldom available for such a comparative study. We need to apply fine phenomics to distinguish the two sibling species.

Wormaldia juliani Kumanski, 1979

(Figures 74–76)

Wormaldia juliani Kumanski, 1979:58–60, „Material and localities. Bulgaria, Maleshevska Mt., streamlet falling into Struma River, nearly 2 km over railway station Kresna (about 400 m a.s.l.), 9.VI.1975, Holotype ♂ and 4 Paratypes (3♂♂ and 1♀). Strandzha Mts., spring Aidere near the bridge on the road Malko Tarnovo-Zvezdetz, 11.VII.1975, 1♂ Paratype. Holotype and 4 Paratypes deposed in the author's collection in the National Natural History Museum, Sofia; 1♂ Paratype in coll. H. Malicky, Lunz am See, Austria. I am very obliged to Dr. Malicky for reexamining and confirming the new species."

Wormaldia occipitalis vaillantorum Botosaneanu, 1980a:168–169, „Holotype ♂ de l'ile grecque de Kérkira (=Corfou): Or. (=Mt.) Pantokrator, 900 m. alt., Mai („16/30") 1971, coll. B. van Aartsen. J'ai trouvé cet exemplaire dans les collections entomologiques de notre Musée; il y est conservé à sec, abdomen dans un petit tube à glycérine."

Wormaldia juliani vaillantorum Botosaneanu, 1980: Botosaneanu 2004:162, Subspecies.

Wormaldia juliani Kumanski, 1979, *Wormaldia vaillantorum* Botosaneanu, 1980: Malicky 2005:549, Unclear taxonomic position.

Wormaldia juliani Kumanski, 1979: Neu 2015:107, Synonymised *Wormaldia occipitalis vaillantorum* Botosaneanu, 1980, with *Wormaldia juliani* Kumanski, 1979.

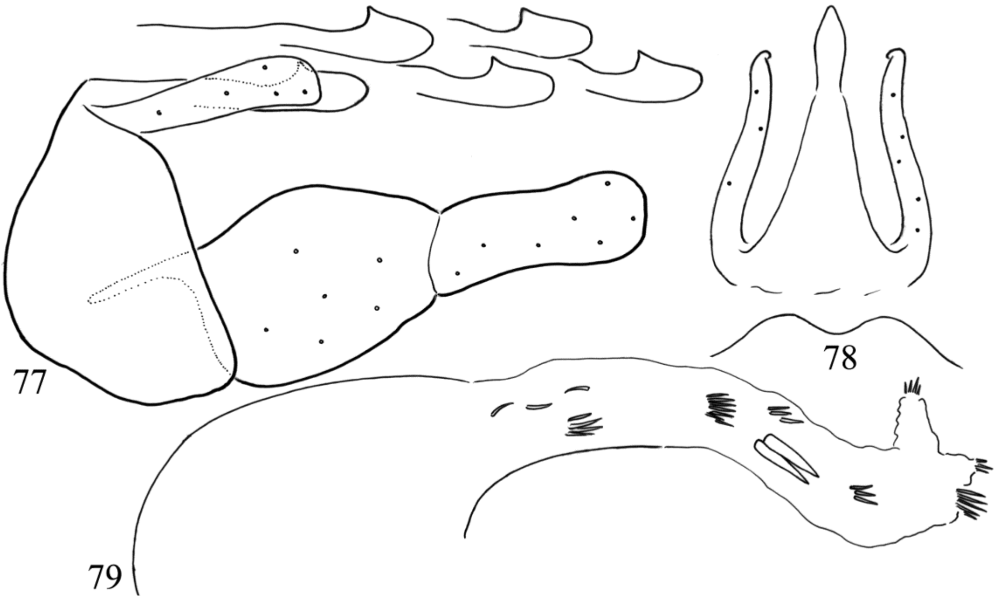
Material examined. Lectotype: **Bulgaria**, Maleshevska Mt., streamlet falling into Struma River, nearly 2 km over railway station Kresna (about 400 m a. s. l.), 9.VI.1975. leg. K.P. Kumanski (1 male, NMNHS). Allotype: same as lectotype (1 female, NMNHS). **Macedonia**, Southeastern region, Plavuš Hills, Valandovo, forest brook at Motel Izvor, N of the city, N41° 19.636', E22°33.327', 260 m, 06.05.2014, leg. T. Kovács, D. Murányi (1 male, 2 females; OPC). Macedonia, Southwestern region, Jablanica Mts, Vevčani, Vevčani Springs and outlet stream at the city, N41°14.371', E20°35.056', 935 m, 26.06.2014, leg. P. Juhász, T. Kovács, D. Murányi (1 male, OPC). **Serbia**, S Serbia, Bujanovac Distr., Starac Mt., Turski Grob near Pcinja River Valley, 821m, N42°20'25"; E21° 52'46" 31.V.2018, leg. S. Beshkov, C. Plant, P. Jaksic & A. Nahirnic (1 male, OPC).

Remarks. No real clusters of small spines, but a number of single and/or twined scattered spines present. Distal margin of tergite VIII straight without any excision. Apices of cerci rounded, not truncate. Harpago parallel-sided as long as coxopodite.

Wormaldia meridionalis Vaillant, 1974 stat. nov.

Wormaldia occipitalis meridionalis Vaillant, 1974:980, „Un seul exemplaire examiné. Petite source se déversant dans la Vésubie, au-dessus de Notre-Dame-de-Fenestre (Var), 1950 m, 30.VIII.1968." Raised hereby to species rank.

Figures 74-76. *Wormaldia juliani* Kumanski, 1979. 74=male genitalia in left lateral view, 75=mesal excision on tergite VIII and segment X with cerci in dorsal view, 76=phallic organ with the endothecal spine pattern in left lateral view.



Figures 77—79. *Wormaldia morettii* Vigano, 1974. 77 = male genitalia in left lateral view, 78 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 79 = phallic organ with the endothecal spine pattern in left lateral view.

Material examined. **Italy**, Piemonte-Torino, Exilles, „Rio del Forte, N45.0977° E6.9377°, 14.VIII. 2000, leg. G. B. Delmastro, det. H. Malicky (2001) as *W. occipitalis*, det. P. J. Neu (02/2016) as *W. occipitalis meridionalis* (4 males, 4 females, CNSMB; 2 males, OPC).

Wormaldia morettii Vigano, 1974

(Figures 77–79)

Material examined. **Italy**, Toscana, Marradi, Monte Bruno, 44.0259°N 11.6786°E, 700 m, 9.VI.2002, leg. A. Usvelli, det. P. Neu (2 males, 2 females; CNSMB).

Italy, Toscana, Pistola dintorni Collina, 44.03°N 10.94°E, 17.VIII.1966, leg. A. Vigano, det. M. Valle as *W. occipitalis* (4 males, 6 females, CNSMB; 2 males, 2 females, OPC).

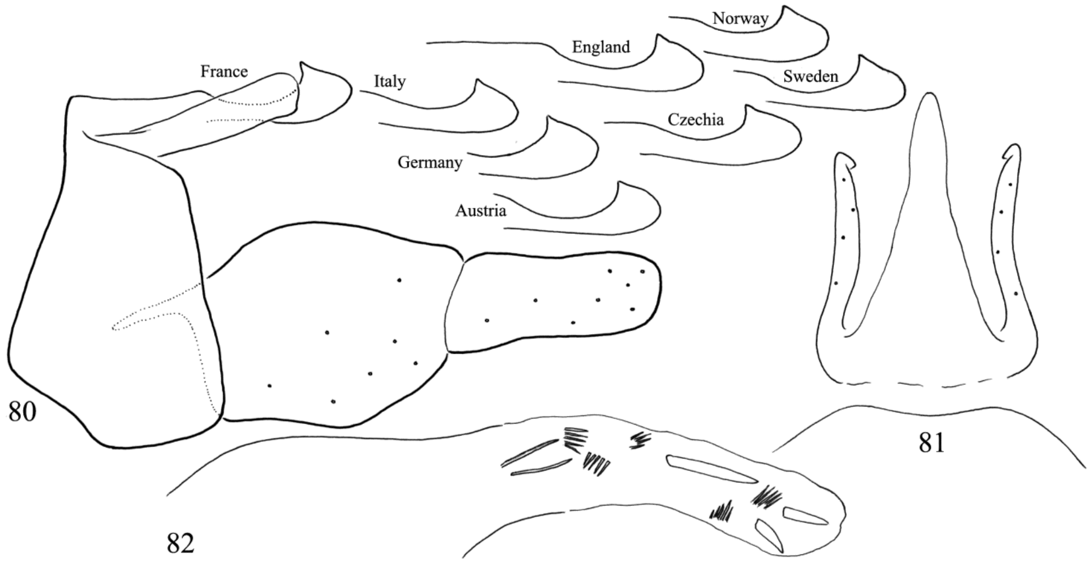
Wormaldia occipitalis (Pictet, 1934)

(Figures 80–82)

Material examined. **Austria**, Tyrol, Galtür, 1600m, 19.IX.1987, leg. G. Uherkovich (1 male, OPC). **Czech Republic**, N Bohemia, Jizerské hory Mts., tributary of Ješkrabec stream below Český Šumburk, 50°43'53"N, 15°20'20"E, 29.IX.2006, leg. P. Chvojka (4 males, 7 females, NMPC; 4 males, OPC). Czech Republic, Central Bohemia, Vůznice Reserve, spring area NE Dřevíč, 50°01'27"N, 13°59'09"E, 14.6.–15.9.2006, leg. P. Chvojka (3 males, OPC). Czech Republic, E Bohemia, Železné hory Mts., Polom Reserve, springs E Malá Střítež, 49°47'38"N, 15°45'02"E, 29.VI.1999, leg. P. Chvojka (4 males, NMPC; 4 males, OPC). Czech Republic, S Bohemia, Šumava Mts., outlet of Černé lake, 49°10'55"N, 13°11'14"E, 29.9.2010, leg. J. Bojková (2 males, NMPC; 2 male, OPC). **England**, Cumbria, NW of Kendal, Rather Heath, woodland stream, 24.VIII. 1978, leg. A. Brindle, SD485963, F3298.2309 (2 male, 2 females, MMUE; 3 males, OPC). England, Lancashire, Whalley, Spring Wood, 26.VIII.1974, leg. A. Brindle 34/742363, F3298.2308 (8 males, MMUE; 3 males OPC). England, Lancashire, Higher Hodder Bridge, 15.VII.1979, leg. A. Brindle, SD696412, F3298.2307 (3 males, 1 female, MMUE; 3 males, OPC). England, Yorkshire, Ilkey, Stubham Wood, SE(44)/119488, 24.VI.1977, leg. A. Brindle (4 males, MMUE). **France**, Pyrenees Mts. Atlantic Pyrenees, Nivelle River System, 12–18.VII.1986, singled leg. J. Oláh (2 males, OPC). France, Alpes-Maritimes, Saorge, torrent Merim résurgence, 3.VII.2016, leg. G. Coppa (1 male, OPC). France, Alpes-Maritimes, Saorge, ru Mairise rive gauche du Cairos, 3.VII.2016, leg. G. Coppa (1 male, OPC). France, Alpes-Maritimes, Entraunes, pra bourres tuf rive droite du Var, 24.VIII.2017, leg. G. Coppa (1 male, OPC). France, Haute-Savoie, Naves Parmelan, zone humide des Caves, 2.IV.2010, leg. G. Coppa (2 males, OPC). France, Herault, Mons, gorges d'Héric suintement rocheux partie en aval, 11.VII.2008, leg. G. Coppa (1 male, OPC). France, Cher, Villegenon, la Nère pont D926, 26.IV.2011, leg. G. Coppa (1 male, OPC). France, Aude, Greffeil, ru de Castillon aval ru de Lauquet greffeil amont, 1.V.2012, leg. G. Coppa (1 male, OPC). France, Aude, Clermont-sur-Lauquet, le Guinet route de Limoux, 2.V.2012, leg. G. Coppa (2 males, OPC). France, Indre, Sainte-Gemmes, fossé près de l'étang Vieux, sortie moine, 28.V.2011, leg. G. Coppa (1 male, OPC). France, Landes, Onesse-et-Laharie, ru d'Hossegen, 9.III.2011, leg. G. Coppa (3 males, OPC). France, Finistère, Camaret, ru Veraych'h, 1.V.2007, leg. G. Coppa (3 males, OPC). **Germany**, Reinland Pfalz, 54319 Mertesdorf, Quelle NE Dömäne Avelsbach, N49.75610 E6.70460, 17.IV.2011, leg. det. P. J. Neu (2 males, OPC). Germany, Saarland, Waldrill, Goth-Bach, NW Waldrill, N49.58948 E6.88400, 17.V. 2015, leg. det. P.J. Neu (3 males, OPC). Germany, Damshausen, Qeullbach am Bauerst, Ohe-Quellgebiet, N50.83340 E8.61671, 16.IX.2015, leg. J. Fischer, det. P. J. Neu (3 males, OPC). **Italy**, Lombardia, Solto Collina, Valle del Ferro, 500m, 9.VII.2007, leg. M. Bálint, O. Lodovici & M. Valle (7 males, 6 females, OPC). Italy, Bergamo Province, S. Giovanni Bianco, Roncaglia, hygropetric habitat, 500 m a.s.l. 4.VIII. 2010, singled leg. O. Lodovici & J. Oláh (1 male, OPC). Bergamo Province, Lenna, Sorgente Fregera, 500 m a.s.l. 4.VIII.2010, singled leg. O. Lodovici & J. Oláh (2 males, 2 females, OPC). **Norway**, Hordaland, Kvinnherad, Rosendal, Vedavika, 60.005103°N 5.987725°E, 2 m, outlet of small shallow stream in area with alder forest, bedrock gneiss, 8.IX.1983, sweepnet, leg. T. Andersen (1 male, ZMBN). Sweden, Halland, Halmstad kommun, Fylleån at Anderstorp, 1.3 km (air) ESE Skedala, 55.6915°N 12.9967°E, 26.VIII.2016, net leg. K.A. Johanson (1 male, SMNH: C409, NHRS-TOBI 000003831).

Character combination. (1) Excision on tergite VIII very shallow and wide. *(2)* Dorso-subapical point of segment X pronounced, very protrusive visible in lateral profile as a triangular process. *(3)* Apex of segment X characterized by a downward sloping oblique dorsum. *(4)* Apex of cerci truncate. *(5)* Ventromesal projection of cerci produced. *(6)* Harpagones parallel-sided. *(7)* Slender and long basal spines organized in a pair. *(8)* Proximal pair of clusters of small spines short. *(9)* Distal pair of clusters of small spines short. *(10)* Three stout spines present. *(11)* Specialised fifth cluster of small spines present.

Variability. Examining specimens from over the entire distribution range we have found rather stable lateral profiles of the head of segment X. Its downward sloping oblique dorsum seems very stable as a speciation trait.



Figures 80-82. *Wormaldia occipitalis* (Pictet, 1934). 80 = male genitalia in left lateral view, with lateral profile of the speciation trait that is the head of segment X from various populations. 81 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 82 = phallic organ with the endothecal spine pattern in left lateral view.

Wormaldia subterranea Radovanovic, 1932

(Figures 83–85)

Wormaldia subterranea Radovanovic, 1932:104, "Appendices praeanales einfach; sie erstrecken sich nach hinten beiderseits des umgewandelten 10. Abdominalsegmentes; Genitalfüβe zweigliedrig, Glieder ungefähr gleich lang."

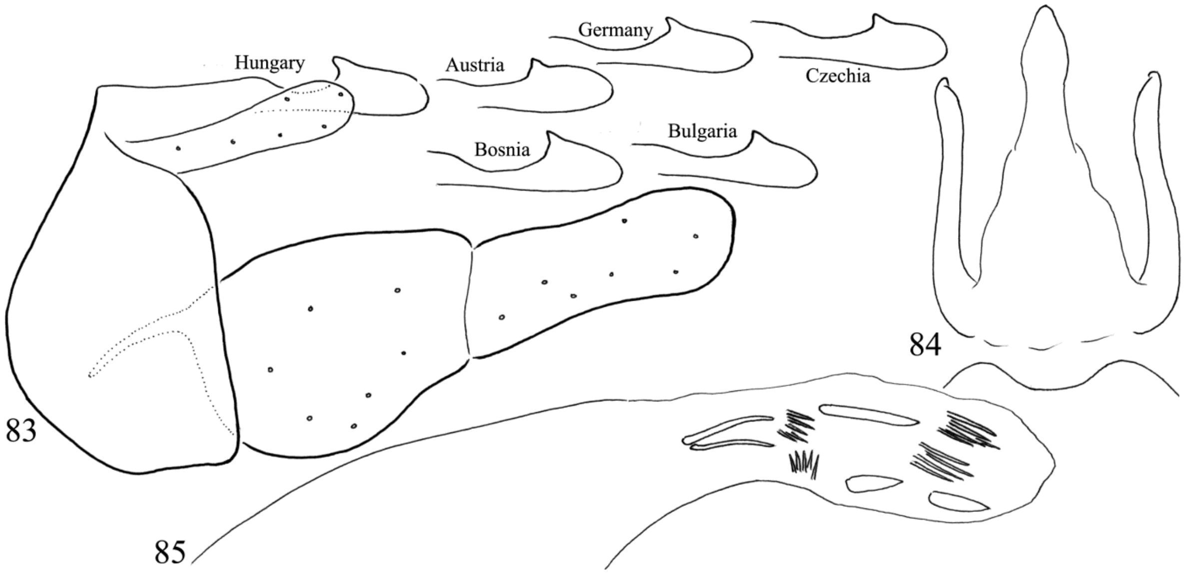
Wormaldia occipitalis subterranea Radovanovic, 1932: Kimmins 1953, reduced to subspecies rank.

Wormaldia subterranea Radovanovic, 1938: Botosaneanu 1989:165–166, *W. subterranea* and *W. occipitalis subterranea* were synonymized with *W. occipitalis occipitalis*.

Wormaldia subterranea Radovanovic, 1932: Neu 2015:107, species rank resurrected.

Wormaldia khourmai bulgarica Novák, 1971:105–106 (part.), "Paratypen: Fundorte: Rila-Gebirge; Zufluss des Malovice Flusses, Rilski Monastir, 14.VII. 1962, 5♂, 3♀." One paratype from this series has been found in the Kumanski's collection (NMNHS) was misidentified and identified here as *Wormaldia subterranea* Radovanovic. Misidentification!

Material examined. **Austria**, Carinthia, Karawanken Mts, Vellach Stream, 25.VII.1989, singled leg. J. Oláh (1 male, OPC). **Bosnia-Herzegovina**, small right tributary of Neretva River before Mostar, 14.IX.1989, singled leg. J. Oláh mixed population with *W. bosniaca* (3 males, OPC). **Bulgaria**: misidenfied paratype of *Wormaldia khourmai bulgarica* Novák: Rila Mts. tributary of Malovice River, at Rila Monastery, 14.VII.1962, leg. K. Novák, probable hybrid with *W. carpathica* (1 male, NMNHS). Bulgaria, without collecting data, with number 870 of the lost catalogue, found in Kumanski's collection as *Wormaldia occiptalis occipitalis* (1 male, 2 females, NMNHS). **Czech Republic**, Central Bohemia, Vůznice Reserve, spring area NE Dřevíč, 50°01'27"N, 13°59'09"E, 14.6.-15.9.2006, leg. P. Chvojka (1 male, OPC). N Bohemia, spring area, Růžovský hill NW Srbská Kamenice, 50°49'52"N 14°20'27"E, 10.VI.-30.VIII.2010, leg. M.Trýzna, (5 males, 14 females, NMPC; 4 males, OPC). **Germany**, Saarland, Bethingen, Waldbach zum Salzbach, 1 km E Bethingen, N49.46170 E6.55039, 260m, 16.VI.2013, leg. det. P.J. Neu (1 male, 1 female; OPC). Reinland Pfalz, 55774 Baumholder, Nebenbach an der L 169 *ca*. 3.5 km SE Baum, N49.60724° E7.38919°, 320 m, 13.VI.2009, leg. det. P. J. Neu (1 male, 1 female; OPC). **Hungary**, Mecsek Mts. Pécs, Bodóhegy, 11.VI.1938, leg. J. Sátori, determined by Sátori as *Wormaldia triangulifera* (1 male, 1 female; OPC). Mecsek Mts., Magyaregregyi Vár Valley, N46° 13.0956' E 18° 21.5538', 466 m, Pásztor spring, 2.VI. 1988, singled leg. J. Oláh (5 males, 5 females; OPC). Mecsek Mts., Vékény, Várvölgy, 4.VI.1984, leg. S. Nógrádi, (3 males, OPC). Mecsek Mts., Kisújbánya, Pásztor-forrás, 3.IX.1984, leg. S. Nógrádi, (3 males, 2 females; OPC). Kőszeg Mts., Stájer Házak, 18.X.1986, leg. Á. Uherkovich (9 males, OPC). Kőszeg Mts.,



Figures 83-85. *Wormaldia subterranea* Radovanovic, 1932. 83 = male genitalia in left lateral view, with lateral profile of the speciation trait that is the head of segment X from various populations. 84 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 85 = phallic organ with the endothecal spine pattern in left lateral view.

Stájer Házak, 5.X.1991, leg. Á. Uherkovich (3 males, 1 female; OPC). Kőszeg Mts., Hármas-patak, 5.X. 1991, leg. Á. Uherkovich (1 male, 2 females; OPC). Szőce, spring at the Research Station, 18.VI. 1984, leg. G. Uherkovics & S. Nógrádi (17 males, OPC). Kám, Jeli Arborétum, 24.V.1984, leg. G. Uherkovics & S. Nógrádi (11 males, 2 females; OPC). **Montenegro**, Kolasin area, Ibristica stream, 8.V. 2007, leg. V. Pesik (1 male HNHM). Sinjajevina Mts. Gornji Lipovo NW 4km, beech forest and forest brook, 1351m, N42°53.829' E19°23.140', 11.X.2008, leg. L. Dányi, Z. Fehér, J. Kontschán & D. Murányi (2 males, HNHM).

Character combination. (1) Excision on tergite VIII medium shallow and wide. *(2)* Dorso-subapical point of segment X most pronounced in the *occipitalis* complex (Kimmins 1953, Botosaneanu 1989), very protrusive visible in lateral profile as turning anterad. *(3)* Apex of segment X horizontal and very elongated ovoid. *(4)* Apex of cerci rounded. *(5)* Ventromesal projection of cerci slightly produced. *(6)* Harpagones parallel-sided. *(7)* Slender and long basal spines organized in a pair each could be doubled or tripled. *(8)* Proximal pair of clusters of small spines short. *(9)* Distal pair of clusters elongated. *(10)* Three stout spines present. *(11)* Specialised fifth cluster of small spines lacking.

Contact zone. We have found mixed populations of *W. subterranea* and *W. carpathica* northwest of the distributional area in the White Carpathians of Czech Republic and Southwest in Bulgaria with intermediate hybrids having less elongated head of segment X and/or abbreviated spines of posterior clusters. In Bosnia-Herzegovina along the Neretva Valley we have found mixed population of *W. subterranea* and *W. bosniaca* with intermediate hybrids having shortening head of segment X and without the fifth characteristic dense cluster composed of many thin spines.

Wormaldia trifida Andersen, 1983 stat. nov.

(Figures 86–88)

Wormaldia occipitalis trifida Andersen, 1983:202–204.

Wormaldia occipitalis trifida Andersen, 1983: Malicky 2005:549, unclear taxonomic position.

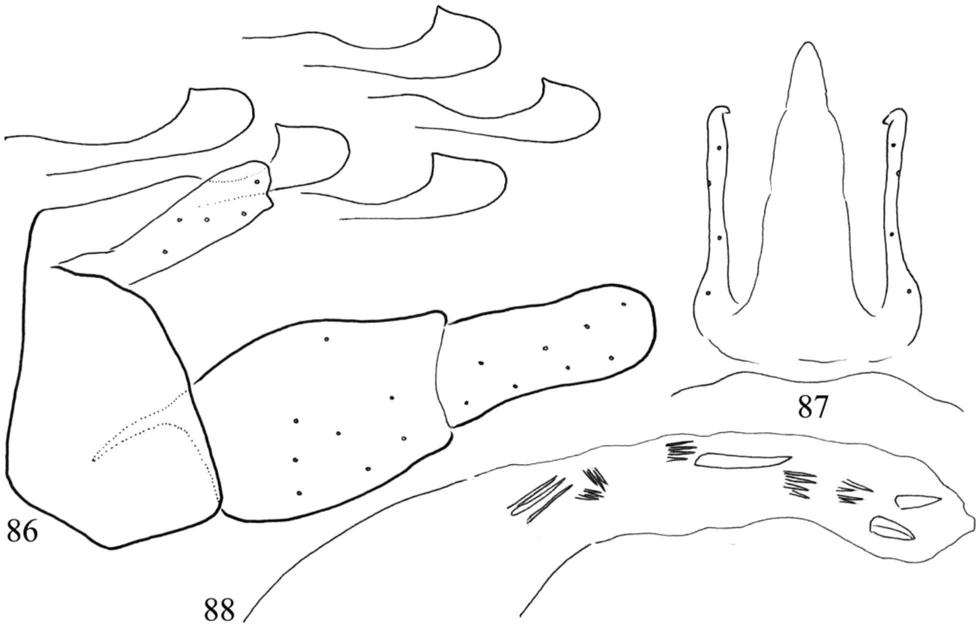
Wormaldia occipitalis trifida Andersen, 1983: Neu 2015: 110, synonymised with *Wormaldia occipitalis occipitalis*.

Material examined. Holotype: **Norway**, inner Hordaland, Ullensvang, Hovland (UTM: 32VLM

684803), 14–30. IX. 1977, leg. T. Andersen In coll. Zool. Mus. Bergen, mounted on four slides (no. A 11805 a–d). Telemark, Porsgrunn, Hitterbekk, 59.073897°N 9.650094°E, 27m, 20.07.1988, sweepnet, leg. G.E.E. Søli (23 males, 1 female, ZMBN). Telemark, Porsgrunn, Hitterbekk, 59.073897°N 9.650094°E, 27 m, small, fast flowing stream in limestone area with bottom substrate stones and gravel, 15.VII–19.X.1988, Malaise trap, leg. G.E.E. Søli (33 males, 188 females, ZMBN). Hordaland, Tysnes, Ånuglo, 59.923709°N 5.730776°E, 5m, small seep over limestone bedrock, 7.VI.1990, sweepnet, leg.T. Andersen (12 males, ZMBN). Hordaland, Ullensvang, Hovland, 60.236179°N 6.619910°E, 20 m, small shallow stream in area with farmland, bedrock gneiss, 14–30.IX.1977, light trap, leg. T. Andersen (1 male, ZMBN). **Sweden**, Skåne, Vitbäckskällan, 55.5888°N, 13.7854°E, spring stream with mix of coarse and fine sand, 30.VI.2016, net leg. K. A. Johanson (2 males, SMNH: C219, NHRS-TOBI 000003742; C257, NHRS-TOBI 000003829). Östergötland län, Ödeshögs kommun, Omberget, stream, 58.3165°N, 14.6282°E, 1.VII.2016, net leg. K. A. Johanson (1 male, SMNH: C512, NHRS-TOBI 000003830). Skåne, Båstad commune, Lyadalen Nature Reserve, stream, 56.4126°N 12.8611°E, 1.VII.2017, net leg. K.A. Johanson (1 male, SMNH: C082, NHRS-TOBI 000003832). Skåne, Ångelholms commun, N shore of Lake Västersjön, 56.3272°N, 13.0430°E, 24.VI.2015, net leg. K.A. Johanson (1 male, SMNH: B467, NHRS-TOBI 000003828).

Character combination. (1) Excision on tergite VIII shallow and wide. *(2)* Dorso-subapical point of segment X pronounced, less protrusive visible in lateral profile as a small triangular process. *(3)* Apex of segment X characterized by semicircular configuration. *(4)* Apex of cerci truncate. *(5)* Ventromesal projection of cerci produced. *(6)* Harpagones parallel-sided. *(7)* Slender and long basal spines organized in a pair. *(8)* Proximal pair of clusters of small spines short. *(9)* Distal pair of clusters of small spines short. *(10)* Three stout spines present. *(11)* Specialised fifth cluster of small spines indistinct.

Remarks. This species is distinguished from its sibling species, *Wormaldia occipitalis* clearly by the speciation trait of the head of segment X. Apex of segment X characterized by a downward sloping oblique dorsum at *W. occipitalis*, but characterized by semicircular configuration at *W. trifida*. Divergence seems subtle, but stable. Here we reinstate its taxon status and elevate it to species rank; **stat. nov**.



Figures 86-88. *Wormaldia trifida* Andersen, 1983. 86 = male genitalia in left lateral view, with lateral profile of the speciation trait that is the head of segment X from various populations of Norway and Sweden. 87 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 88 = phallic organ with the endothecal spine pattern in left lateral view.

Wormaldia charalambi species group

This species group is characterized by the combination *(1)* of the parallel-sided, not tapering harpago with pointed head, *(2)* the terminal of segment X with capitate “head” and with dorsal subapical pointed process and *(3)* the endothecal spine pattern without clusters of small spines and with 3–4 variously shaped and sized spines.

Wormaldia kurta Oláh, sp. nov.

(Figures 89–91)

Wormaldia charalambi Malicky, 1980: Oláh & Kovács 2014:99, a single male and six associated females from Greece, Rhodope peripheral unit, Sapka Mts. Misidentification!

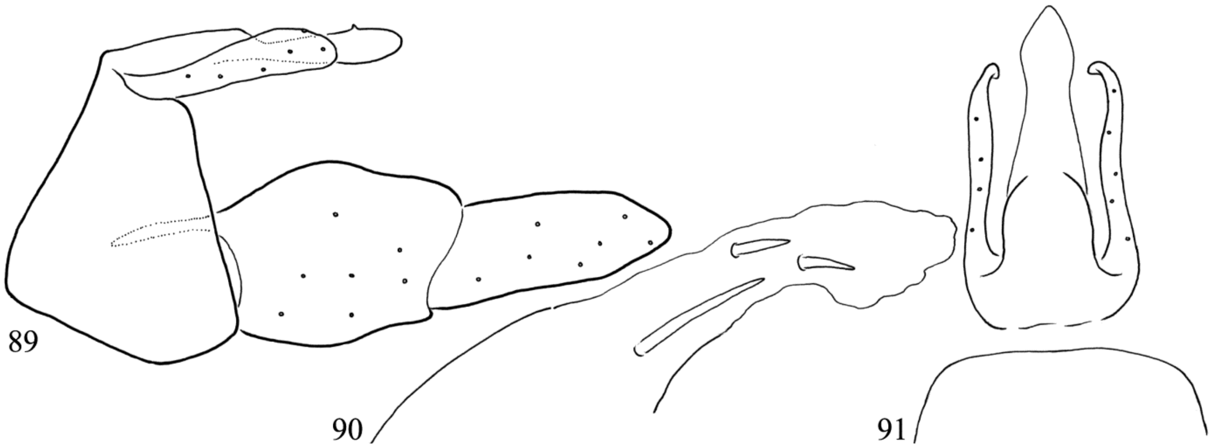
Wormaldia charalambi Malicky, 1980: Oláh & Beshkov 2016:88, a single male from Bulgaria, Pirin Mts. Misidentification!

Material examined. Holotype: **Bulgaria**, S. Pirin, Alibotush Mts., Gradishte between Nova Lovcha and Paril villages, 750 m, N41°26'00" E23°41'52", 23.VI. 2014, leg. S. Beshkov & M. Beshkova (1male, OPC). Pratypes: **Greece**, Thrace, Rhodope peripheral unit, Sapka Mts., Kizario, stream and pasture SW of the village, 140 m, N41°03.492' E25°45.672', 27.V.2012, leg. J. Kontschán, D. Murányi, & T. Sederjesi (1 male, OPC). Thrace, Rhodope peripheral unit, Sapka Mts., Nea Sanda, open brook and pasture NE of the village, 790 m, N41°07.965' E25°54.052', 26.V.2012, leg. J. Kontschán, D. Murányi, & T. Szederjesi (6 associated females, OPC).

Diagnosis. Having harpago with pointed apex *W. kurta* sp. nov. belongs to the *Wormaldia charalambi* species group and is most close to *W. yavuzi* Sipahiler, 1996 described from the middle of South Turkey. But it differs by having very short, abbreviated coxopodite of gonopod, not long; tergite VIII with smooth flat apical margin without any setae in dorsal view, not with two mesal humps armed with bunch of sensory setae; the endothecal spine is stout, not slim slender.

Description. Male (in alcohol). Small castanean brown animal. Sclerites medium brown, setal warts both on head and thorax and legs brown. Maxillary palp formula is I-II-IV-III-V. Forewing length 4 mm. Spur formula is 244.

Male genitalia. Tergite VIII smooth plane without any discernible mesal excision on the apical margin. Segment X characterized by triangular apex in dorsal view, and by a dorsal small pointed subapical process visible in lateral view; the ending is armed with sensory structures of *sensilla basiconica* (pegs) or *sensilla coeloconica* (pitted pegs) both on the very dorsal ending of the narrowing apex as well as on the sublateral broadening. Cerci with blunt apex. Gonopods, both coxopodite and harpago short and high (broad); harpagones with pointed apex as visible in lateral view. Phallic organ with eversible membranous endotheca containing a single long spine as stout as the short two stout spines; short spines are with enlarged rounded basement and slightly arching body.



Figures 89-91. *Wormaldia kurta* Oláh sp. nov. Holotype: 89=male genitalia in left lateral view, 90= mesal excision on tergite VIII and segment X with cerci in dorsal view, 91=phallic organ with the endothecal spine pattern in left lateral view.

Etymology. *kurta*, from “kurta”, short, curt, cutty in Hungarian, refers to the abbreviated coxopodite of the gonopod.

***Wormaldia copiosa* species group**

This species group is characterized by the combination *(1)* of the abbreviated parallel-sided, not tapering harpago, *(2)* the terminal of segment X without formal capitate “head” that is the ending of segment X is not forming an enlarged rounded variously shaped apical head and *(3)* the endothecal spine pattern without clusters of small spines and with 3–4 variously shaped and sized spines in various numbers.

***Wormaldia botosaneanui* Moretti, 1981**

(Figures 92–94)

Wormaldia copiosa botosaneanui Moretti, 1981:172–173: „Wide-based superior appendages which tape abruptly after the outer medial angle. In *W. copiosa copiosa* these appendages are cylindrical-conical and do not form a medial angle. The phallus endotheca has a comb of a dozen short spines. In *W. copiosa copiosa* the proximal spines are longer, more supple and closer packed than the apical ones.”

Material examined. **Italy**, Toscana-Lucca, Minucciano Pesciola, torrente, affluente destro torrente Acquabianca, in bosco, N44.141429° E10.254128°, 680m, 28.VI.2011, light trap, leg. O. Lodovico, P. Pantini & M. Valle (2 males, 7 females, CNSMB; 1 male, OPC).

***Wormaldia copiosa* (McLachlan, 1868)**

(Figures 95–97)

Material examined. **Austria**, Lienz an der Drau, Tristachersee, 16.VI.1938, leg. J. Sátori (1 male, OPC). **Italy**, Lombardia-Beergamo, Villa d’Almè, affluente torrente Giongo, N45.7644° E9.6364°, 400m, 23.VII.1 998, light trap, leg. E. Ferrario & P. Pantini (3 males, 1 female, CNSMB; 1 male, OPC).

***Wormaldia kakopetros* Malicky, 1972**

(Figures 98–100)

Material examined. Paratype: **Greece**, Crete, Kakopetros, 3.V.1971, leg. H. Malicky (1 male, NMNHS).

***Wormaldia marlieri* Moretti, 1981**

(Figures 101–103)

Wormaldia pulla marlieri Moretti, 1981:174, „Wide-based cerci with squat apical upturned hook, which is absent in *W. pulla pulla* (a). Phallus endotheca terminates in a large curved spine and a fine dorsal sclerite.”

Material examined. **France**, Alpes-Maritimes, Saorge, Bendola au pont de Baoussoun, 7.VII.2016, leg. G. Coppa (2 males, OPC).

***Wormaldia parba* Oláh, sp. nov.**

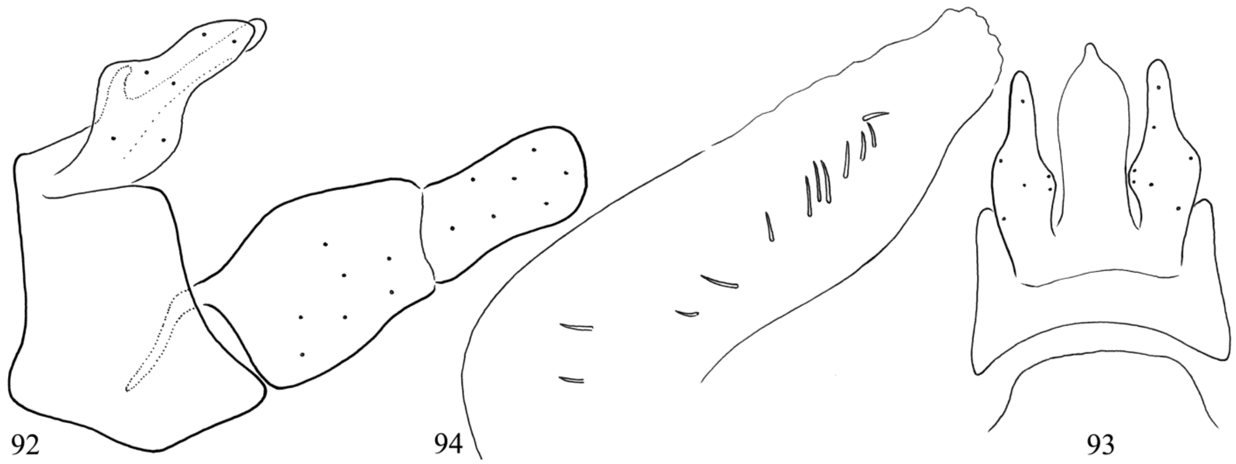
(Figures 104–106)

Material examined. Holotype: **Albania**, Elbasan County, Librazhd municipality, forest brook SW of Fushë Studë 1030m, N41°17.453' E20°22.103' leg. P. Juhász, T. Kovács, D. Murányi, 30.VI.2018 (1 male, OPC).

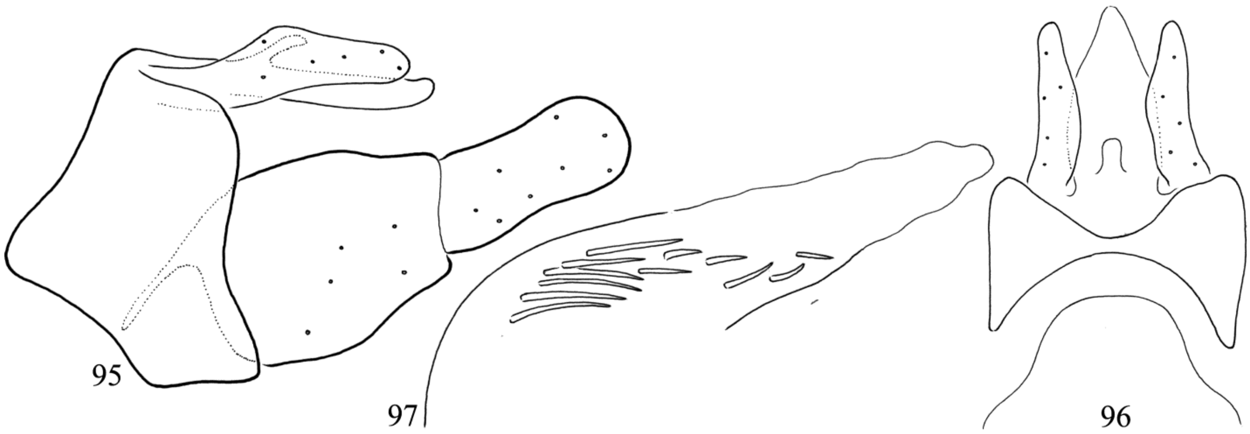
Diagnosis. This new species belongs to the *Wormaldia copiosa* species group with short and high harpagones. *Wormaldia parba* sp. nov. is most close to *W. kakopetros*, but differs by having tergite VIII without mesal excision, harpagones without middle constriction; the dorsal triangular hump is very pronounced; apex of cerci are blunt, not pointed; there are only two equally shaped large spine present in the endotheca, not one long and two small spines.

Description. Male (in alcohol). Small castanean brown animal. Sclerites medium brown, setal warts both on head and thorax and legs brown. Maxillary palp formula is I-II-IV-III-V. Forewing length 4 mm. Spur formula is 244.

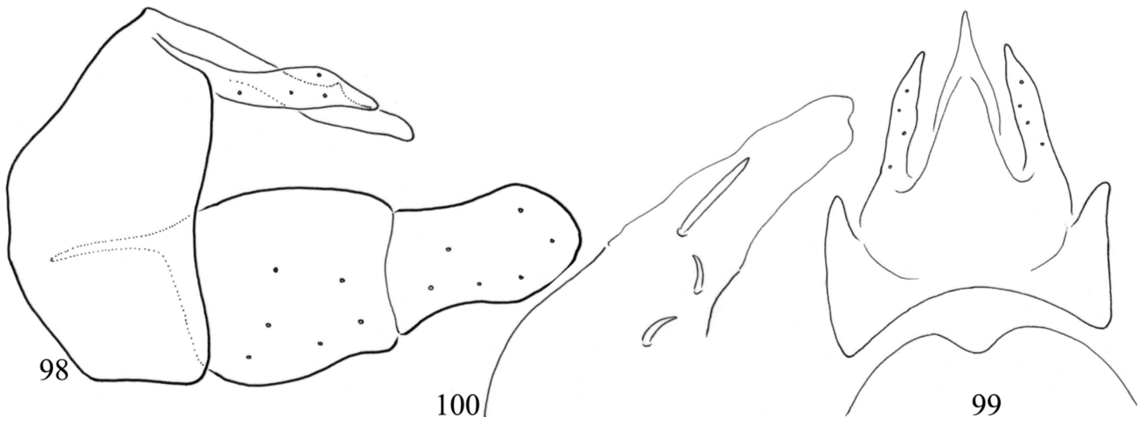
Male genitalia. Tergite VIII smooth flat without rounded triangular mesal excision on the apical margin. Segment X characterized by narrowing apex in dorsal view, and by a middle dorsal pronounced triangular hump visible in lateral view; the ending is armed with sensory structures of *sensilla basiconica* (pegs) or *sensilla coeloconica* (pitted pegs) both on the very dorsal ending of the narrowing apex as well as on the sublateral broadening. Cerci with blunt apex.



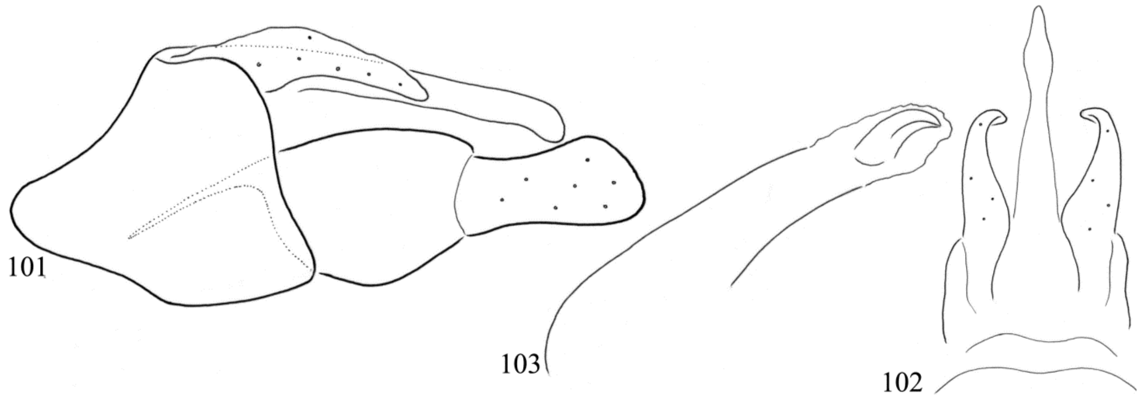
Figurers 92-94. *Wormaldia botosaneanui* Moretti, 1981. 92 = male genitalia in left lateral view, 93 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 94 = phallic organ with the endothecal spine pattern in left lateral view.



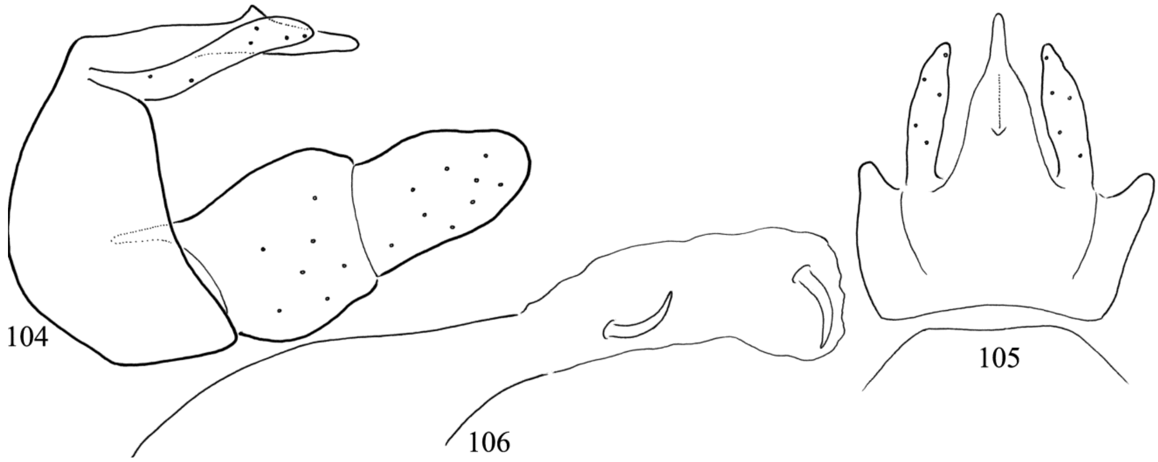
Figures 95-97. *Wormaldia copiosa* (McLachlan 1868). 95=male genitalia in left lateral view, 96= mesal excision on tergite VIII and segment X with cerci in dorsal view, 97=phallic organ with the endothecal spine pattern in left lateral view.



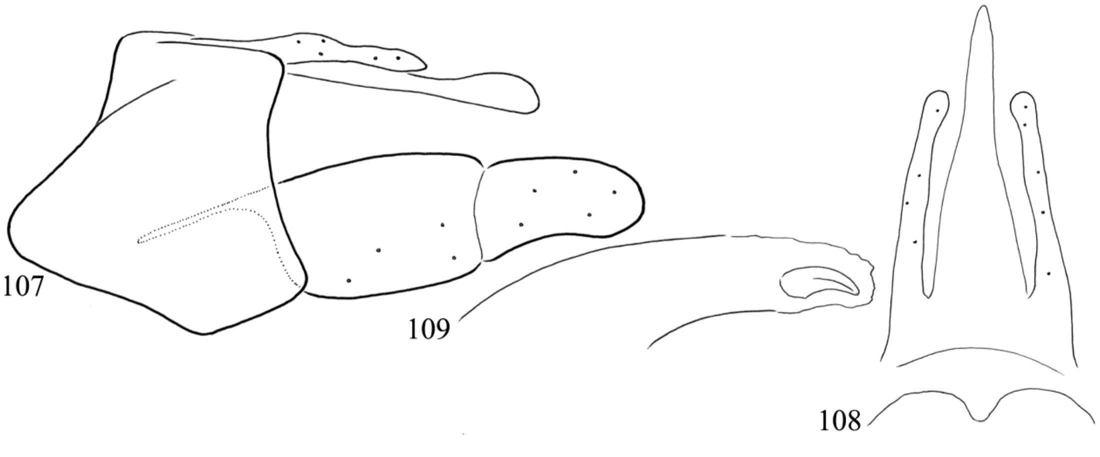
Figures 98-100. *Wormaldia kakopetros* Malicky, 1972. 98 = male genitalia in left lateral view, 99 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 100 = phallic organ with the endothecal spine pattern in left lateral view.



Figures 101-103. *Wormaldia marlieri* Moretti ,1981. 101 = male genitalia in left lateral view, 102 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 103 = phallic organ with the endothecal spine pattern in left lateral view.



Figures 104-106. *Wormaldia parba* Oláh, sp. nov. Holotype: 104 = male genitalia in left lateral view, 105 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 106 = phallic organ with the endothecal spine pattern in left lateral view.



Figures 107-109. *Wormaldia pulla* (McLachlan, 1878). 107 = male genitalia in left lateral view, 108 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 109 = phallic organ with the endothecal spine pattern in left lateral view.

Gonopods, both coxopodite and harpago short and high (broad); harpagones without middle constriction as visible in lateral view. Phallic organ with eversible membranous endotheca containing two stout spines only; these spines are with enlarged rounded basement and arching body.

Etymology. *parba*, from "párban", in couple in Hungarian, refers to the two identically shaped large spine present in the endotheca of the phallus.

Wormaldia pulla (McLachlan, 1878)

(Figures 107–109)

Material examined. **Slovakia**, Belianske Tatry, Zdiar, Riglany stream, 23.VII.1966, singled leg. J. Oláh (2 males, OPC). **Romania**, Muntii Lezerului, 1050 m, 45.45 25.02, 4.VIII.2006, leg. M. Bálint (1 male, OPC).

Wormaldia vargai Malicky, 1981

(Figures 110–112)

Material examined. **Slovenia**, Julian Alp, side stream of Sava Bohinja, 24.VI.1988, sweeping leg. J. Oláh (4 males).

Wormaldia triangulifera species group

This species group is characterized by the combination *(1)* of the tapering harpago, *(2)* of the terminal of segment X with capitate "head" and with dorsal subapical pointed process and *(3)* of the endothecal spine pattern with clusters of small spines and with variously shaped and sized spines.

Wormaldia bulgarica species complex

This species complex is characterized by the combination *(1)* of the tapering harpago, *(2)* of the terminal of segment X with capitate "head" and with dorsal subapical pointed process and *(3)* of the endothecal spine pattern with clusters of small spines and with a single spine.

Wormaldia albanica Oláh, 2010 stat. restit.

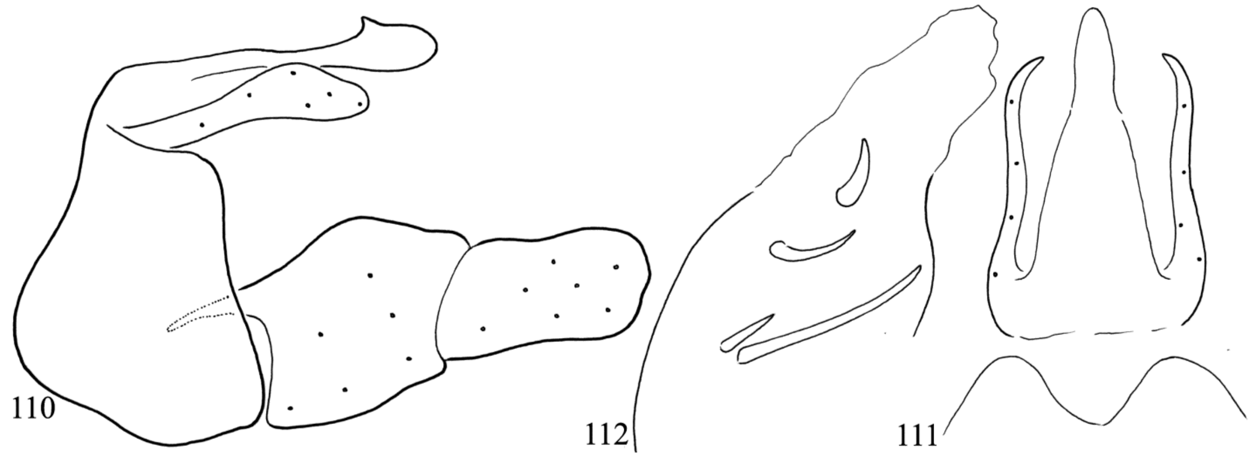
(Figures 113–115)

Wormaldia albanica Oláh, 2010:68–69, "It is closest to *W. bulgarica* described from Bulgaria, but differs by having (1) conspicuous basolateral flange of sclerites present on Xth segment and well visible both in lateral and dorsal view; (2) In lateral view Xth segment has no dorsal excision and no any dorsal subapical hook, tooth or elevation, both present and very conspicuous on *W. bulgarica*; (3) cerci slightly S-forming tapering in dorsal view, not straight and clavate; (4) harpagones longer than coxopodite, not shorter; (5) harpagones slender, tapering and down-curving apically; (6) endotheca with a large spine and a group of four smaller spines besides the long microspine cluster, not only with a single large spine."

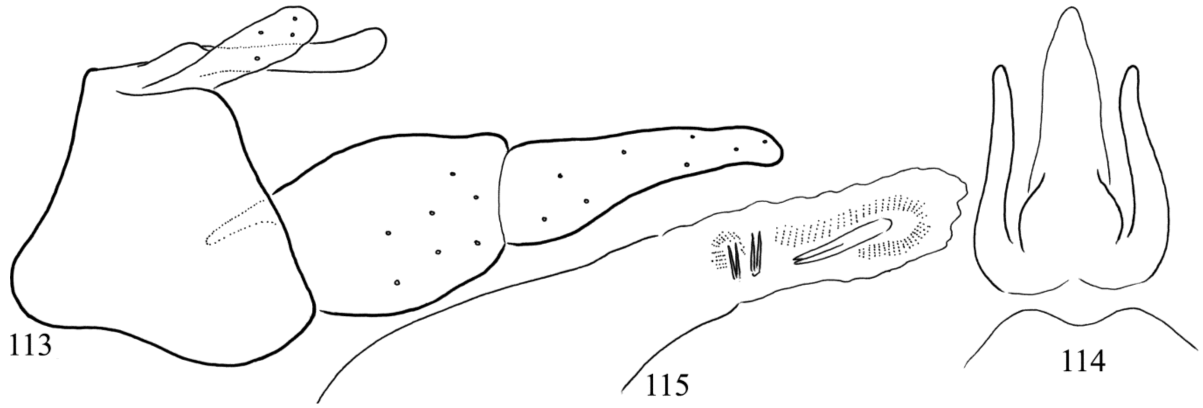
Wormaldia bulgarica Novák, 1971: Malicky 2018:43, "*Wormaldia albanica* Oláh, 2010 was described from one male from Albania and has the typical single spine, but a slightly variable end of segment 10. The type locality is close to the records in the Greek Pindos Mountains: *Wormaldia albanica* Oláh, 2010 = *Wormaldia bulgarica* Novák, 1971, nov. syn."

Material examined. Holotype male. **Albania**, Tepelene county, Tepelene, Uji i Ftohte (Cold Water), 165 m N40°15.011' E20°03.548', 13.III.2008, leg. Sz. Czigány & D. Murányi (1 male HNHM).

Remarks. Malicky has synonymised *Wormaldia albanica* with *W. bulgarica* based on the presence of a single spine in the endothecal spine pattern. However, the single-spined pattern is a character for the entire species complex of *W. bulgarica*. This complex is rather large with eight know and probably many more unknown species. The speciation trait of the head of segment X is completely different: *W. albanica* has no head at all with subapical dorsal pointed process so pronounced and specifically abbreviated at *W. subnigra*. There are divergences in the endothecal spine pattern as well: the single spines split apically, there are two small spines with split apex differentiated from the long small-spine cluster at *W. bulgarica*. Moreover, there are several neutral traits diverged: very pronounced basolateral flanges are present on segment X at *W. albanica* and completely lacking at *W. bulgarica*; harpago longer than coxopodite at *W. albanica*, not shorter; harpago downward curving apicad. Actually *W. albanica* diverged rather far from *W. bulgarica*. Here we reinstate the species status of *Wormaldia albanica*. **stat. restit**.



Figures 110-112. *Wormaldia vargai* Malicky, 1981. 110 = male genitalia in left lateral view, 111 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 112 = phallic organ with the endothecal spine pattern in left lateral view.



Figures 113-115. *Wormaldia albanica* Oláh, 2010. 113 = male genitalia in left lateral view, 114 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 115 = phallic organ with the endothecal spine pattern in left lateral view.

Wormaldia bulgarica **Novak ,1971 stat. nov.**

(Figures 116–118)

Wormaldia khourmai bulgarica Novák, 1971:105–106, "Von der Art *W. khourmai* unterscheidet sich die neue Subspecies besonders in der Chitinarmatur des Penis und durch das Fehlen der zwei dreieckigen Fortsätze am Apicalrande des VIII. Tergites." "Holotypus: Fundort: Bach bei Rilski Monastir, 14.VII. 1962, 1 ♂, in der Sammlung des Autors."

Remarks. According to the Institute of Entomology, Czech Academy of Sciences, České Budějovice, Czech Republic, the holotype of *W. bulgarica* is damaged and incomplete. The four parts are in one tube: head, pronotum, mesonotum, metanotum with proximal abdominal segments. Terminalia are missing. Regarding terminalia there is a letter from Karel Novák wrote to Pavel Chvojka dated November 1992: "I have only the holotype of *W. bulgarica*, unfortunately I have found out now, that it is incomplete - terminalia are missing. But the phallus is mounted on a microscopic slide. ... All paratypes are in the collections of Botosaneanu and Kumanski."

However, repeated search for the slide with the phallus of *W. bulgarica* in the Institute of Entomology was unsuccessful. There is only very small probability that the slide could be discovered in Novák's estate (among documents, papers etc.) in the future.

Unfortunately after repeated search the paratypes of *W. bulgarica* have not been found neither in the Kumanski's collection of the National Museum of Natural History, Sofia, Bulgaria, nor in the Botosaneanu's collection of Naturalis Biodiversity Center, Zoological Museum, Amsterdam, Netherland. It means, there is only an incomplete holotype of *W. bulgarica* labeled "*Wormaldia khourmai* / *bulgarica* Novák / TYPUS / Bach bei Rilki (sic!) Monastir / Rila - Bulgaria leg. Novák / 14.7.1962" remained exist from the entire type material, all collected in the Rila Mountains at around the Rilski Monastir (18 males, 5 females!). The incomplete holotype without genitalia is deposited in the National Museum in Prague henceforward (it was transferred from the Institute of Entomology). Terminalia was lost (Novák 1992 in litt.) and a slide with mounted phallus is missing at present.

Rediagnosis. Fortunately the original drawing prepared from the holotype and redrawn here is detailed enough to distinguish *W. bulgarica* clearly from *W. silva* sp. nov. reported originally as *W. bulgarica* by Kumanski (1979). The speciation trait that is the lateral profile of the head of segment X is much abbreviated (most abbreviated in the species complex!). It is apple-shaped or even a half-cut apple-shaped, not elongated plum-shaped like at *W. silva* sp. nov.

Notes. Kumanski (1979) has raised *Wormaldia khourmai bulgarica* ssp. to species rank, but his nomenclatural act was based on misidentified specimens, on those specimens that we describe here as a new species *Wormaldia silva* sp. nov.

***Wormaldia daga* Oláh, 2014 stat. restit.**

(Figures 119–121)

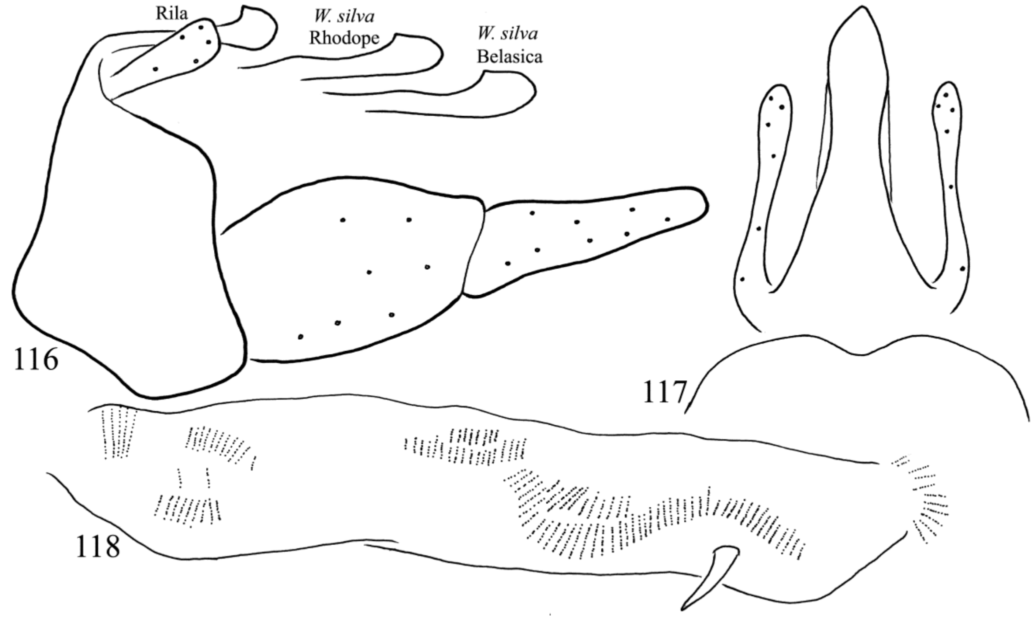
Wormaldia daga Oláh, 2014:99–100, "This species with characteristic endothecal spine clusters and narrowing harpagones belongs to the *W. khourmai*, *W. bulgarica*, *W. balcanica*, *W. mahiri* and *W. erzincanica* group of species and most close to *W. khourmai*, but differs by having more swollen apex of segment X, rounded, not truncate apex of cerci and only a single endothecal spine, not three spines."

Wormaldia cf. *khourmai* Schmid, 1959 (subsp.?): Kumanski 1985:167–168. A single male was described from Bulgaria, Strandzha Mts. as a possible subspecies of *W. khourmai*. According to Kumanski this male from Strandzha is very similar to the single male from Ardesen, Esatern Anatolia.

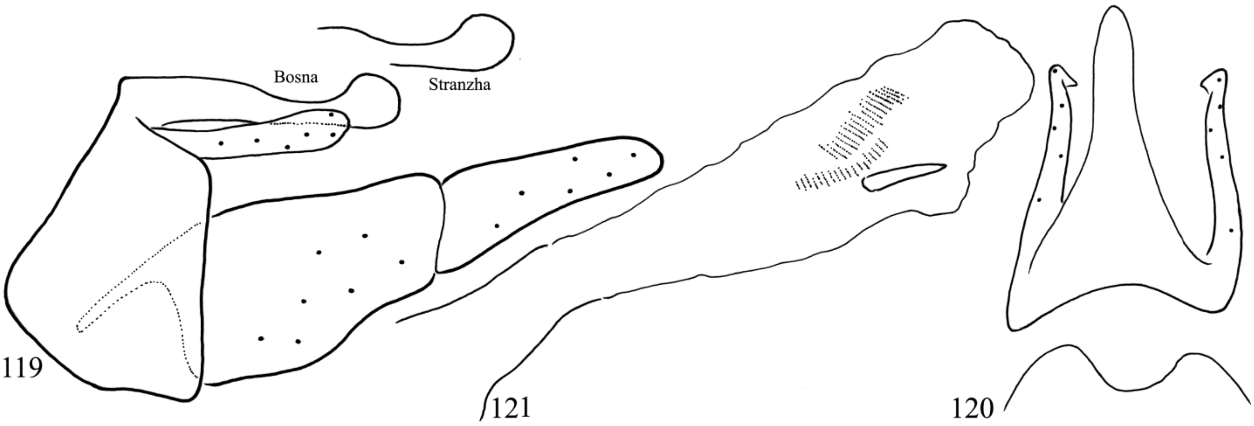
Wormaldia daga Oláh, 2014: Malicky 2018:43, synonymised *W. daga* with *W. bulgarica*: "*Wormaldia daga* Oláh, 2014 has the typical distal spine in the phallus. The end of segment 10 is rounded similar to *W. khourmai*, but the area of *khourmai* is far away, and the individual variation is to be expected. *W. daga* was described from Bulgarian mountains where *bulgarica* is well known. *Wormaldia daga* Oláh 2014 = *Wormaldia bulgarica* Novák 1971, nov. syn.

Material examined. Holotype: **Bulgaria**, Bosna Mts. Dudenovo, Dudenska Reka, between Vizitza and Novo Panicharevo, 249m, N42°10'25" E27°34'07", 26.VII.2012 at light leg. S. Beshkov & M. Beshkova (1male, NMNHS). Bulgaria, Strandzha Mts. Malko Tuinovo, 30.VII.1983, leg. K. Kumanski (1 male, NMNHS).

Remarks. Malicky has synonymised *Wormaldia daga* with *W. bulgarica* based on the presence of a single spine in the endothecal spine pattern. However, the single-spined pattern is a character for the entire species complex of *W. bulgarica*. This complex is rather large with ten known and probably many more unknown species. The speciation trait of the head of segment X is completely different: *W. daga* has very large rounded head without subapical dorsal pointed process so pronounced and specifically abbreviated at *W. subnigra*. There are divergences in the endothecal spine pattern as well: small-spine cluster is very much reduced, not so long elaborated. Moreover, there are several neutral traits diverged: apicomesal excision on tergite VIII very deep, not shallow, cerci with ventromesal turning apex, lacking at *W. bulgarica*. *W. daga* is most close to *W. kumanskii* sp. nov., but differs by the lateral profile of the head of segment X rounded at *W. daga* and hook-forming at *W. kumanskii*. Here we reinstate the species status of *Wormaldia daga*. **stat. restit**.



Figures 116-118. *Wormaldia bulgarica* Novak, 1971. 116 = male genitalia in left lateral view, 117 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 118 = phallic organ with the endothecal spine pattern in left lateral view.



Figures 119-121. *Wormaldia daga* Oláh, 2014. 119 = male genitalia in left lateral view, 120 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 121 = phallic organ with the endothecal spine pattern in left lateral view.

Wormaldia foslana Chvojka & Oláh, sp. nov.

(Figures 122–124)

Material examined. Holotype: **Georgia**, Imereti district, Kutaisi, motel, spring area, 42°15'27"N, 42° 42'35"'E, 158 m, 15.ix.2018, J. Oboňa leg. (1 male, NMPC).

*Diagnosis.*This new species having tapering harpago belongs to the *Wormaldia triangulifera* species group and its elaborated small-spine cluster without even a single individual spine relates it to the *W. bulgarica* species cluster, but more characterized and unique by the disintegration of individual spine into spine clusters.

Description. Male (in alcohol). Small castanean brown animal. Sclerites medium brown, setal warts both on head and thorax and legs brown. Maxillary palp formula is I-II-IV-III-V. Forewing length 4 mm. Spur formula is 244.

Male genitalia. Tergite VIII with narrow and deep triangular mesal excision on the apical margin. Segment X characterized by narrowing apex in dorsal view, and by lateral profile of rather elongated head, pronounced dorso subapical pointed process; supplied with shallow and short subapical excision; the ending is armed with probably specific pattern of sensory structures of *sensilla basiconica* (pegs) or *sensilla coeloconica* (pitted pegs). Cerci with rounded apex in lateral view; in dorsal view without mesad turning apices. Gonopods with coxopodite equal of harpago tapering gradually. Phallic organ with eversible membranous endotheca containing only clusters of spines, one larger basal, one middle with four spines and two small apical clusters.

Etymology. *foslana*, from "foszló", disintegrated in Hungarian, refers to the disintegrated state of individual spines in the endotheca.

Wormaldia graeca Oláh, 2014 stat. restit.

(Figures 125–127)

Wormaldia graeca Oláh, 2014:100–102, „This new species differs from *Wormaldia kimminsi* by having completely different segment X: (1) the dorsal subapical tooth is large rounded, not just visible small and pointed; (2) the middle depression is present and significant, not absent; (3) basolateral pair of flange sclerites well developed, not lacking. Moreover as emphasized by Botosaneanu in his original description the apicomesal excision on tergite VIII is shallow trapezoid. The same excision is deep triangular in *W. graeca* sp. nov. There are significant divergences between the two species also in the endothecal spine systems. The primary large spine is longer, not doubled; there are two cluster of secondary spines, not only a single."

Wormaldia kimminsi Botosaeanu, 1960: Malicky 1977: 68. Greece, Pendayi. Misidentification.

Wormaldia kimminsi Botosaeanu, 1960: Oláh 2010:70. Greece, Phocis prefecture, Vargiani. Misidentification.

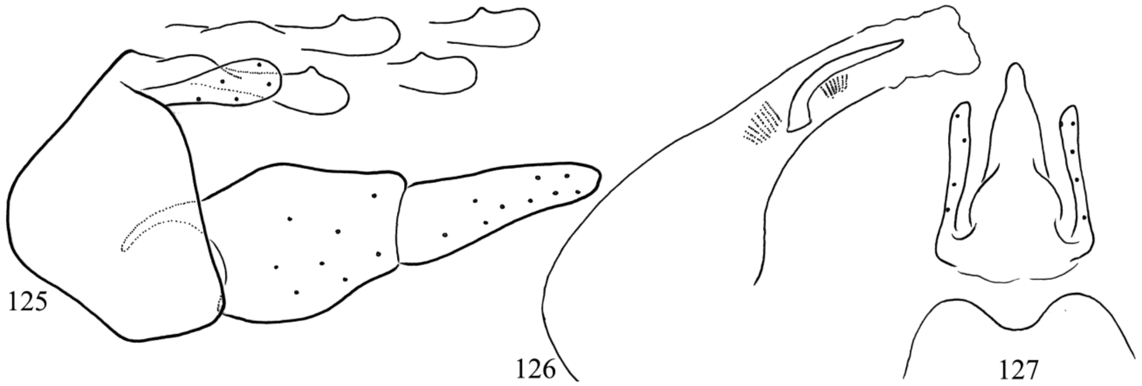
Wormaldia kimminsi Botosaneanu, 1960: Malicky 2018:43, "The figure of *Wormaldia graeca* by Oláh (2014) corresponds well with those of *W. kimminsi*" (Malicky 2004:83), except Segment 10 which is broader in his figure. This may be caused by a different position of the preparation under the microscope, or by individual variability. The phallus includes the typical large, slightly bent sclerite which is accompanied by two bunches of fine spines. I see no reason to make a separate species from this variation. *Wormaldia graeca* Oláh, 2014 = *Wormaldia kimminsi* Botosaneanu, 1960, nov. syn.

Material examined. Holotype: **Greece**, Phocis county, Vargiani, springs and torrent in the village, 970 m, N38°38.499' E22°25.515', 8.IV.2009, leg. L. Dányi, J. Kontschán & D. Murányi (1male, HNHM). Greece, Pendayi, N 38°35' E22°5', 900 m, 3.VI.1975 leg. and det. H. Malicky as *Wormaldia kimminsi* Botosaneanu 1950 (1 male, NBC-ZMAN).

Remarks. In his European Trichoptera Atlas Malicky (2004) has replaced Botosaneanu's original precise drawings of *Wormaldia kimminsi* of Perister Mts. in Macedonia with his own drawings prepared from *W. graeca* of Pendayi in Greece. Beside the complete drawings from *W. graeca* (Fig. 14–17) he has redrawn the cerci, segment X and the large endothecal spine of *W. kimminsi* holotype (Fig. 18–20). Even on his own drawings both the segment X and the endothecal spine of *W. kimminsi* differ very clearly from the same structures of *W. graeca* (Malicky 1977).

Our new diagrammatic drawings indicate the divergences between the two species: the speciation trait of the head of segment X is clearly diverged, its dorsum is concave at *Wormaldia graeca* and convex at *W. kimminsi*; the dorsal subapical tooth is large rounded at *W. graeca*, not just visible small and pointed as at *W. kimminsi*; the middle depression is present at *W. graeca*, absent at *W. kimminsi*. There is shape divergence between the two species in the enlarged single spine. Moreover, there are several neutral traits diverged: apicomesal excision on tergite VIII is rounded deep and wide at *W. graeca*, but very shallow and subquadrangular at *W. kimminsi*; very pronounced basolateral flanges are present on segment X at *W. graeca* and completely lacking at *W. kimminsi*. Here we reinstate the species status of *Wormaldia graeca*. **stat. restit**.

Figures 122-124. *Wormaldia foslana* Chvojka & Oláh, sp. nov. Holotype: 122 = male genitalia in left lateral view, 123 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 124 = phallic organ with the endothecal spine pattern in left lateral view.



Figures 125-127. *Wormaldia graeca* Oláh, 2014. 125 = male genitalia in left lateral view, 126 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 127 = phallic organ with the endothecal spine pattern in left lateral view.

Wormaldia kimminsi Botosaneanu, 1960

(Figures 128–130)

Wormaldia triangulifera kimminsi Botosaneanu, 1960: 271, "J'ai eu à ma disposition 4♂ et 5♀ de Perister 12–16 VIII 1955, que j'ai désigné comme holotype ♂, allotype ♀, paratypes ♂ et ♀; holot. ♂ + allot. ♀: collection Fernand Schmid; 1♂ parat. + 1♀ parat.: Deutsches Entomologisches Institute, Berlin; 2♂ + 2 ♀ parat..: Collection L. Botosaneanu, Bucarest." "En dépit de sa simplicité, l'armature génitale ♂ de cette sous-espèce offre d'excellents caractères qui permettront de la distinguer des trois autres sous-espèces de *triangulifera* (t. *triangulifera* McL., t. *beaumonti* Schmid, t. *mosely* Kimm.). Par l'armature de l'endothèque de son phallus, notre sous-espèce se rapproche le plus de *moselyi* Kimm."

Wormaldia kimminsi Botosaneanu, 1960: Malicky 1977:68. Elevated to species.

Material examined. **Macedonia**, Pelagonia region, Pelister Mts, Nižepole, forest brook below the ski station, N40°58.889', E21°15.246', 1370 m, 7.05.2014, leg. T. Kovács, D. Murányi (1 male, OPC).

Wormaldia kumanskii Oláh & Chvojka, sp. nov.

(Figures 131–133)

Wormaldia khourmai Schmid, 1959 (subsp.?): Kumanski 1979:62–63. A single male from Ardesen, Eastern Anatolia was described and drawn as a possible subspecies of *W. khourmai*. Misidentification

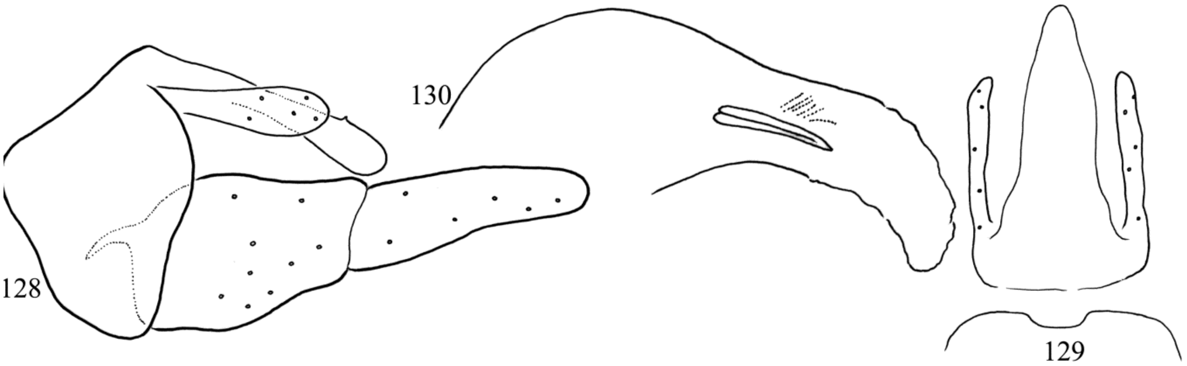
Material examined. Holotype, **Georgia**, Adjaria, Mtirala NP, Chakvistavi *ca*. 20 km NE of Batumi, left tributaries of Chakvistskali riv., 41°40.7'N 41°51.8'E; 280 m, 30.vi.2013, leg. P. Chvojka (1 male, NMPC). Paratypes: same as holotype (20 males, NMPC; 6 males OPC). **Turkey**, Trabzon province, Sumela, brooks and springs, 5.vii.1993, leg. P. Chvojka 15 males, 3 females, NMPC, 4 males, OPC). Artvin province, tributary of Murgul Deresi between Borçka and Murgul, 6.vii.1993, leg. P. Chvojka (10 males, NMPC; 2 males, OPC)

Diagnosis. W. kumanskii sp. nov. is most close to *W. daga*, but differs by the lateral profile of the head of segment X; it is hook-forming at *W. kumanskii* and rounded at *W. daga*.

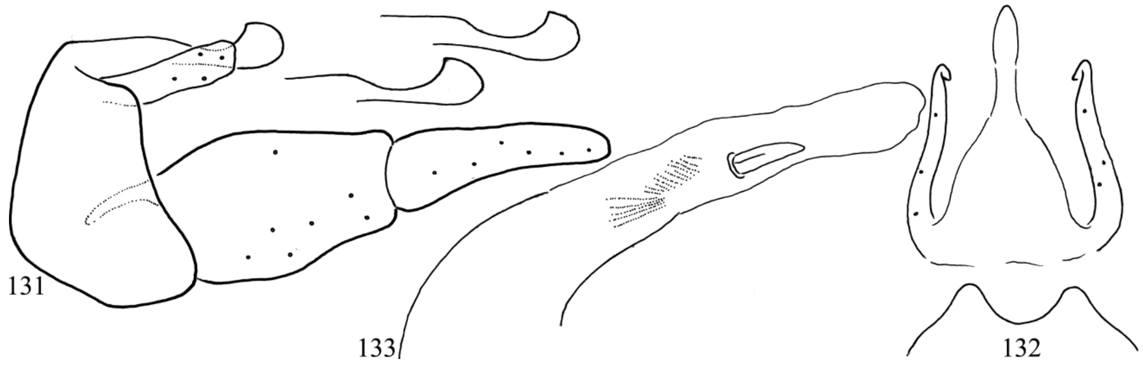
Description. Male (in alcohol). Small castanean brown animal. Sclerites medium brown, setal warts both on head and thorax and legs brown. Maxillary palp formula is I-II-IV-III-V. Forewing length 4 mm. Spur formula is 244.

Male genitalia. Tergite VIII with deep semicircular mesal excision on the apical margin. Segment X characterized by short hook-forming lateral profile of the head; supplied with deep and short subapical excision; the ending is armed with probably specific pattern of sensory structures of *sensilla basiconica* (pegs) or *sensilla coeloconica* (pitted pegs). Cerci with truncate apex in lateral view; in dorsal view pronounced mesad turning apices well visible. Gonopods, with coxopodite having equal length with harpago. Phallic organ with eversible membranous endotheca containing two short small-spine clusters and a single short stout spine; spine is with enlarged rounded basement and slightly arching body.

Etymology. We dedicate this new taxon to the Bulgarian trichopterologist K. P. Kumanski who has first recognised and identified it as *Wormaldia khourmai* Schmid ssp.



Figures 128-130. *Wormaldia kimminsi* Botosaneanu, 1960. 128 = male genitalia in left lateral view, 129=mesal excision on tergite VIII and segment X with cerci in dorsal view, 130 = phallic organ with the endothecal spine pattern in left lateral view.



Figures 131-133. *Wormaldia kumanskii* Oláh & Chvojka, sp. nov. Holotype: 131 = male genitalia in left lateral view, 132 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 133 = phallic organ with the endothecal spine pattern in left lateral view.

Wormaldia libohova Chvojka & Oláh, sp. nov.

(Figures 134–136)

Material examined. Holotype: **Albania**, Gjirokastër distr., springs near Libohovë, 6.x.1992, leg. P. Chvojka (1male, NMPC).

Diagnosis. This new species having tapering harpago belongs to the *Wormaldia triangulifera* species group and related to the *W. bulgarica* species complex with single large stout spine and long small-spine cluster. The concave dorsum of the head of segment X is an incongruent, discordant, chimeric character of the *W. subnigra* species complex. Having elongated head of segment X this new species is most close to *W. foslana* sp. nov. of the *W. bulgarica* species complex, but the endothecal spine pattern is completely different.

Description. Male (in alcohol). Small castanean brown animal. Sclerites medium brown, setal warts both on head and thorax and legs brown. Maxillary palp formula is I-II-IV-III-V. Forewing length 4 mm. Spur formula is 244.

Male genitalia. Tergite VIII with shallow and wide mesal excision on the apical margin. Segment X characterized by narrowing apex in dorsal view, and by an elongated plum-shaped lateral profile of the head exhibiting some dorsal concavity; dorsal subapical pointed process pronounced; the ending is armed with probably specific pattern of sensory structures of *sensilla basiconica* (pegs) or *sensilla coeloconica* (pitted pegs). Cerci with rounded truncate apex in lateral view; in dorsal view without mesad turning apices. Gonopods, with coxopodite equal with harpago tapering. Phallic organ with eversible membranous endotheca containing long small-spine cluster and a single short stout spine accompanied with a tiny additional stout spine.

Etymology. Named after the type locality.

Wormaldia silva Oláh, sp. nov.

(Figure 116)

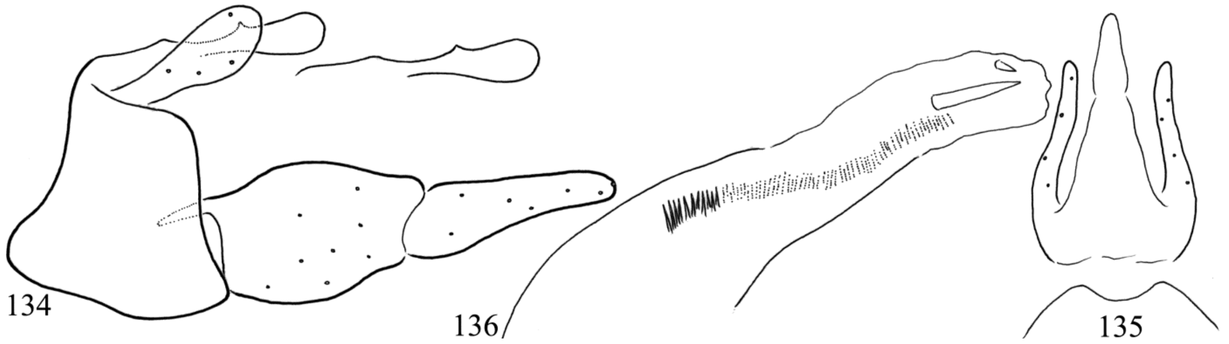
Wormaldia bulgarica Novák, 1971: Kumanski 1979: 61–62, "The following differences separate these two species: *bulgarica* is evidently smaller (length of fore wing 5 mm) than *khourmai* (7–8 mm); its dorsal margin of 8th tergite almost without the characteristic for *khourmai* lateral "epaulets"; no medial dent at the terminal end of the App. superiors; only a single spine in the apex of penis instead of three in *khourmai*; two groups of spines in the basal part of the penis (indistinctly separated from each other) in addition to the simple (*khourmai*) range of spines; 10th segment triangular (viewed dorsally), with a rather broad base and feeble lateral enlargements before the apex." Misidentification!

Material examined. Holotype: **Bulgaria**, Blagoevgrad province, Belasica Mts, Petrič, sping of Lesniska Stream SW of the city, N41°21.021', E23° 10.767', 1025 m, 05.05.2014, T. Kovács, D. Murányi (1 male, OPC). Paratypes: same as holotype (2 females, OPC). Bulgaria, Rhodope Mts. streamlet with hydropetric zone, confluent of the Cherna River above Smolyan, 17.VII.1971, leg. and det. K. Kumanski (1 male genitalia in permanent slide, NMNHS).

Diagnosis. The new species is close to *Wormaldia bulgarica*, but differs by the pronounced divergence of the speciation trait that is the lateral profile of the head of segment X. The head of the segment X has elongated plum-shaped lateral profile, not abbreviated and not apple-shaped profile of *W. bulgarica*. The plum-shaped lateral profile seems rather stable on the Kumanski's drawings and on the examined and drawn specimens from the Rhodope and Belasica Mountains. *W. bulgarica* is described and known only from the Rila Mountains. We have found similar divergences between the Rila and Belasica populations in the genera of *Chaetopteroides* (Oláh *et al.* 2013a) and *Drusus* (Oláh *et. al.* 2017a).

Description. Male (in alcohol). Small castanean brown animal. Sclerites medium brown, setal warts both on head and thorax and legs brown. Maxillary palp formula is I-II-IV-III-V. Forewing length 4 mm. Spur formula is 244.

Male genitalia. Tergite VIII with shallow and narrow triangular mesal excision on the apical margin. Segment X characterized by narrowing apex in dorsal view, and by an elongated plum shaped lateral profile of the head; the ending is armed with probably specific pattern of sensory



Figures 134-136. *Wormaldia libohova* Chvojka & Oláh, sp. nov. Holotype: 134 = male genitalia in left lateral view, 135 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 136 = phallic organ with the endotheca spine pattern in left lateral view.

structures of *sensilla basiconica* (pegs) or *sensilla coeloconica* (pitted pegs). Cerci with rounded truncate apex in lateral view; in dorsal view without mesad turning apices. Gonopods, with coxopodite equal with harpago tapering. Phallic organ with eversible membranous endotheca containing long microspine cluster and a single short stout spine.

Etymology. *silva*, from "szilva", plum in Hungarian, refers to the elongated plum-shaped lateral profile of segment X.

Wormaldia khourmai species complex

This species complex is characterized by the combination *(1)* of the tapering harpago, *(2)* the terminal of segment X with capitate "head" and with less pronounced dorsal subapical pointed process and *(3)* the endothecal spine pattern with clusters of small spines and with three spines.

Wormaldia balcanica Kumanski, 1979

(Figures 137–139)

Wormaldia khourmai balcanica Kumanski, 1979:63–65: *partim*, specimens from Bulgaria, Strandzha Mts., hygropetric biotope near Katun-dere stream, not far from the bridge on the road Malko Tarnovo-Zvezdetz (about 100 m a.s.l.) 11.VII.1976, 16♂ and 12 ♀ (leg. Kumanski). Other paratypes represent diverged species: 4 paratypes from Lesbos Island, Greece: *W. gorba* sp. nov., 5 paratypes from Chios Island, Grece: *W. rona* sp. nov., 2 paratypes from Rhodos Island, Greece: *W. busa* Oláh, 2014, one paratype from Turkey was not available, probably represents a new species.

Wormaldia balcanica Kumanski, 1979: Kumanski 1985:167, stat. nov. Raised to species rank.

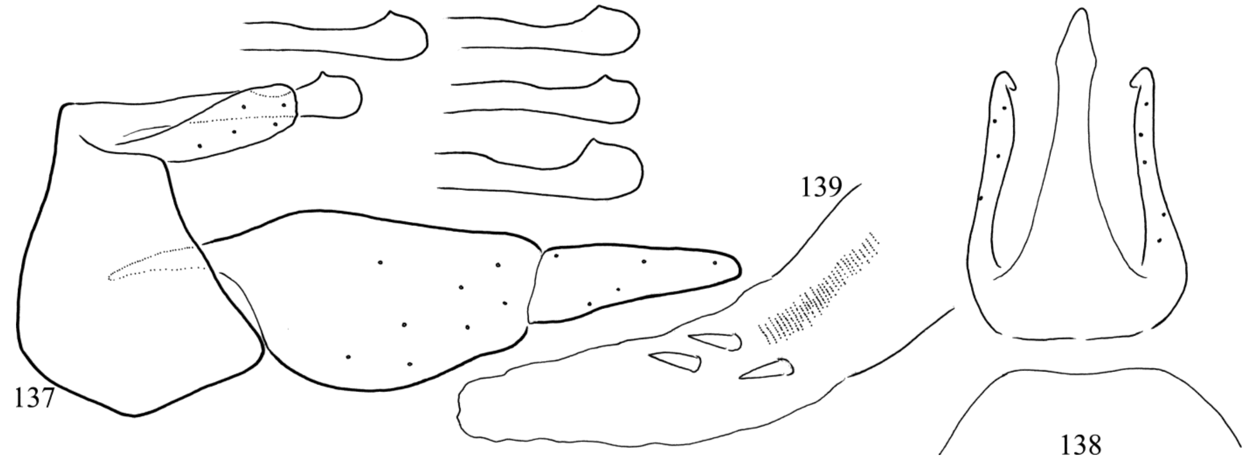
Material examined. Paratypes from **Bulgaria**, Strandzha Mts., hygropetric biotope near Katun-dere stream, not far from the bridge on the road Malko Tarnovo-Zvezdetz (about 100 m a.s.l.) 11.VII.1976, 16♂ and 12♀ (leg. Kumanski). There were only 9 males and 8 females among the paratypes deposited in NMNHS.

Lectotype designation and deposition. Holotype male was selected from "among the Bulgarian specimens" however without designating any particular specimen. Here we have designated a syntype as the single name-bearing type specimen subsequent to the establishment of the species. *Lectotype*: Bulgaria, Strandzha Mts., hygropetric biotope near Katun-dere stream, not far from the bridge on the road Malko Tarnovo-Zvezdetz (about 100 m a.s.l.) 11.VII.1976, leg. Kumanski (1 male, NMNHS). Paralectotypes: same as lectotype (4 males, 8 females, NMNHS; 4 males, OPC).

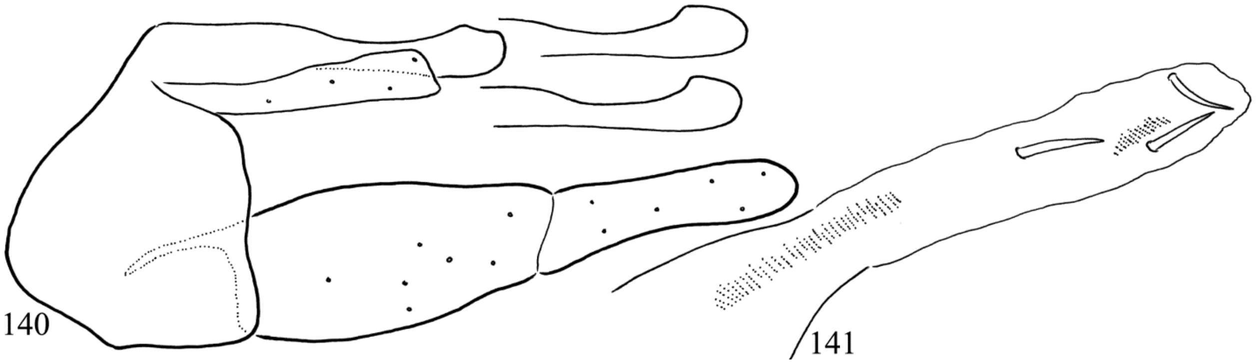
Wormaldia busa Oláh, 2014 stat. restit.

(Figures 140–141)

Wormaldia busa Oláh, 2014:98–99, "closest to *W. balcanica*, but differs by having more slender gonopod, harpagones clavate not narrowing, apical head of segment X without subapical pointed process, but with dorsoapical projection in lateral view;



Figures 137-139. *Wormaldia balcanica* Kumanski, 1979. 137 = male genitalia in left lateral view with lateral profile of the speciation trait that is the head of segment X of six paralectotypes, 138 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 139 = phallic organ with the endothecal spine pattern in left lateral view.



Figures 140-141. *Wormaldia busa* Oláh, 2014. 140 = male genitalia in left lateral view with lateral profile of the speciation trait that is the head of segment X of two more specimens from another population, 141 = phallic organ with the endothecal spine pattern in left lateral view.

cerci with ventromesal pointed tooth just visible, not produced.”

Wormaldia balcanica Kumanski, 1979: Malicky 2018: 43, “*Wormaldia busa* Oláh, 2014 has the three typical straight and sturdy spines in the phallus. The end of segment 10 falls within the variation for *W. balcanica*. *W. busa* was described from the island of Rhodos where *W. balcanica* was already known (Malicky 2005:74) *Wormaldia busa* Oláh, 2014 = *Wormaldia balcanica* Kumanski, 1979, nov. syn.” Misidentification!

Material examined. Holotype: **Greece**, South Aegean, Rhodes regional unit, Apollona, Triana, stream in a gorge with plane trees, 315m, N36°15.261' E27°55.157', 09.11.2012 leg. J. Kontschán, D. Murányi (1male, HNHM). Greece, Rhodos Island, Epta Piges, 28°7'E, 36°15'N, 60 m, 9.V.1975, leg. H. Malicky (2 males, NMNHS).

Remarks. Malicky has synonymised *Wormaldia busa* with *W. balcanica* based on the presence of three spines in the endothecal spine pattern. However, the three-spined pattern is a character for the entire species complex of *W. khourmai*. This complex is rather large with eight known and probably many more unknown species. The speciation trait of the head of segment X is completely different: *W. busa* has the head without subapical dorsal pointed process. There are divergences in the endothecal spine pattern as well: the tree spines are more slender, not stout as redrawn here from the holotype and from the two males collected and identified by Malicky as *W. balcanica*. Moreover, there are neutral traits diverged: the ventromesad turning apex of cerci is tiny pointed, almost lacking; the harpago almost parallel-sided, not tapering. Here we reinstate the species status of *Wormaldia busa*. **stat. restit**.

Wormaldia gorba Oláh, sp. nov.

(Figures 142–144)

Wormaldia khourmai balcanica Kumanski 1979:63–65: partim, 4 paratypes from Lesbos Island, Greece. Misidentification!

Wormaldia balcanica Kumanski 1985:167: partim, specimens from Lesbos Island, Greece. Misidentification!

Wormaldia balcanica Kumanski 1985. Malicky 2005: 74: partim, specimens from Lesbos Island, Greece. Misidentification!

Material examined. Examined 4 male paratypes of *Wormaldia balcanica* from Lesbos Island, Greece deposited in NMNHS. Holotype. **Greece**, Lesbos Island, Plomari, Lesbos, 7 km E. 26°26'E, 38°59'N, 110 m, 31.V.1975, leg. H. Malicky 11♂ (1 male, NMNHS). Paratypes: same as holotype (1 male, NMNHS; 2 males, OPC).

Diagnosis. This new species having tapering harpago belongs to the *Wormaldia triangulifera* species group and having long small-spine cluster with three stout spines belongs to the *Wormaldia khourmai* species group. *Wormaldia gorba* sp. nov., an allopatric species known only from Lesbos Island, Greece was listed by Kumanski as paratypes of *Wormaldia khourmai balcanica* subspecies, a subspecies described with holotype from Stransha Mts., Bulgaria. *Wormaldia gorba* sp. nov. is most close to *W. rona* sp. nov. but differs by having shallow, rounded excision on tergite VIII, not deep triangular; lateral profile of segment X is upward curving, with slight and long subapical dorsal excision, not simply flat with short subapical dorsal excision; cerci pointed ventrad, not truncate; harpago tapering, not parallel-sided.

Description. Male (in alcohol). Small castanean brown animal. Sclerites medium brown, setal warts both on head and thorax and legs brown. Maxillary palp formula is I-II-IV-III-V. Forewing length 4 mm. Spur formula is 244.

Male genitalia. Tergite VIII with very shallow rounded mesal excision on the apical margin. Segment X characterized by narrowing apex in dorsal view, and by a rather upward curving configuration in lateral view; supplied with shallow and long subapical excision; rounded apex upward arching; the ending is armed with probably specific pattern of sensory structures of *sensilla basiconica* (pegs) or *sensilla coeloconica* (pitted pegs). Cerci with ventrad pointed apex in lateral view; in dorsal view small mesad turning apices visible. Gonopods, with coxopodite slightly longer than harpago that is tapering, not parallel-sided. Phallic organ with eversible membranous endotheca containing long microspine cluster and three short stout and almost equal spines; these spines are with enlarged rounded basement and arching body.

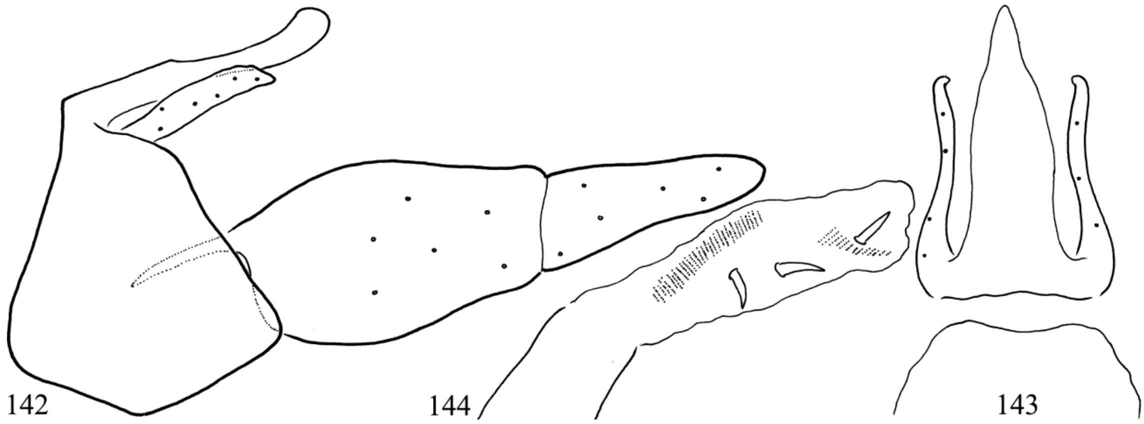
Etymology. gorba, from “görbe”, curved, crooked in Hungarian, refers to the shape of segment X with upward arching apical region.

Wormaldia kera Oláh, sp. nov.

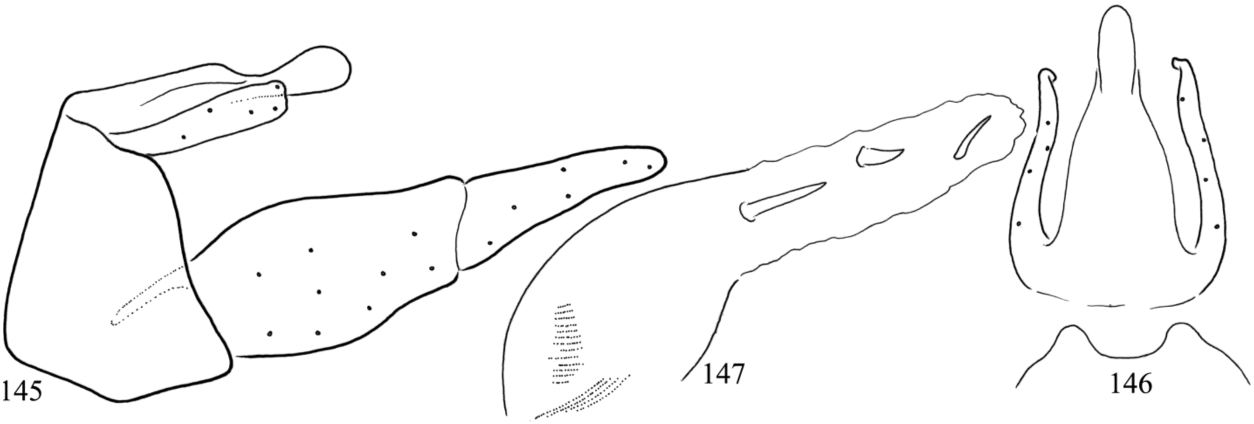
(Figures 145–147)

Material examined. Holotype, **Georgia**, Racha-Lechkhumi & Kvemo Svaneti region, Svaneti range, Benieri, spring outlet and open brook, N42°48.638' E43°06.654', 1335m, leg. D. Murányi *et al.*, 16.IX. 2018 (1 male, OPC).

Diagnosis. This new species having tapering harpago belongs to the *Wormaldia triangulifera* species group and having long small-spine cluster with three stout spines belongs to the *Wormaldia khourmai* species complex. Most close to *W. sima*, but the speciation trait that is the head of segment X is almost regularly rounded at *W. kera*, not with triangular dorsal subapical pointed process of *W. sima*. The spine shapes of the endotheca are different. The apicomesal excision on tergite VIII is deep and wide subquadrangular with pronounced lateral lobes, not triangular without lateral lobes.



Figures 142-144. *Wormaldia gorba* Oláh, sp. nov. Holotype: 142 = male genitalia in left lateral view, 143 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 144 = phallic organ with the endothecal spine pattern in left lateral view.



Figures 145-147. *Wormaldia kera* Oláh, sp. nov. Holotype: 145 = male genitalia in left lateral view, 146 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 147 = phallic organ with the endothecal spine pattern in left lateral view.

Description. Male (in alcohol). Small castanean brown animal. Sclerites medium brown, setal warts both on head and thorax and legs brown. Maxillary palp formula is I-II-IV-III-V. Forewing length 4 mm. Spur formula is 244.

Male genitalia. Tergite VIII with deep and wide mesal excision on the apical margin. Segment X characterized by narrowing apex in dorsal view, and by a rather rounded head configuration in lateral view; supplied with deep and short subapical excision; the ending is armed with probably specific pattern of sensory structures of *sensilla basiconica* (pegs) or *sensilla coeloconica* (pitted pegs). Cerci with truncate apex in lateral view; in dorsal view pronounced mesad turning apices well visible. Gonopods, with coxopodite longer than harpago that is tapering and slightly downward curving. Phallic organ with eversible membranous endotheca containing two short small-spine clusters and three spines; these spines are differently shaped.

Etymology. *kera*, from "kerek", circular in Hungarian, refers to the shape of the head of segment X.

Wormaldia khourmai **Schmid, 1959**

(Figures 148–150)

Material examined. **Iran**, Gilan Province, Elburz Mts. Talysh Mt. Masula River, small left side tributary, 12.VIII.1990, singled leg. J. Oláh (3 males, OPC). Iran, North Iran, Mazandaran province, stream 10 km S of

Galugah, 36°41.1'N, 53°46.3'E; 550 m, 30.v.2006, leg. P. Chvojka (1 male, NMPC; 1 male, OPC). Iran, North Iran, Golestan province, stream 2 km E Tunel-e-Golestan, 37°22.2′N 55°59.5′E; 850 m, 26.v.2006, leg. P. Chvojka, (11 males, 36 females, NMPC; 4 males, OPC). Iran, North Iran, Golestan province, streamlet 8 km SE Galikash, 37°12.9'N, 55°29.1'E; 880 m, 28.v. 2006, leg. P. Chvojka, (12 males, 7 females, NMPC; 4 males, OPC). Iran, North Iran, Gilan province, stream, 5 km from Kakrud S of Rudsar, 36°51.2'N 50°13,9'E; 670 m, 2.vi.2006, leg. P. Chvojka, (2 males, 4 females, NMPC; 1 male, OPC).

Wormaldia rona Oláh, sp. nov.

(Figures 151–153)

Wormaldia khourmai balcanica Kumanski, 1979:63–65, 5 paratypes from Chios Island, Greece. Misidentification!

Wormaldia balcanica Kumanski, 1979: Kumanski 1985:167, Malicky 2005:74, partim: specimens from Chios Island, Greece. Misidentification!

Material examined. 5 male paratypes of *Wormaldia balcanica* from Chios Island, Greece deposited in NMNHS. Holotype. **Greece**, Chios Island, Kaminia, W. Chios, 25°56'E, 38°33'N, 410 m, 18.V.1975, leg. H. Malicky 20♂, 15♀, (1 male, NMNHS). Paratypes: same as holotype (2 males, NMNHS; 2 males, OPC).

Diagnosis. This new species having tapering harpago belongs to the *Wormaldia triangulifera* species group and having long small-spine cluster with three stout spines belongs to the *Wormaldia khourmai* species complex. *Wormaldia rona* sp. nov., an allopatric species known only from Chios Island, Greece was listed as paratypes of *Wormaldia khourmai balcanica* subspecies, a subspecies described with holotype from Strandzha Mts., Bulgaria. *Wormaldia rona* sp. nov. differs from *W. balcanica* by having deep triangular excision on tergite VIII, not just discernible shallow; lateral profile of segment X simply flat with slight and short subapical dorsal excision, without pronounced capitate ending, not without subapical dorsal excision and not with pronounced capitate head; cerci more truncate, not rounded; harpago almost parallel-sided, not tapering.

Description. Male (in alcohol). Small castanean brown animal. Sclerites medium brown, setal warts both on head and thorax and legs brown. Maxillary palp formula is I-II-IV-III-V. Forewing length 4 mm. Spur formula is 244.

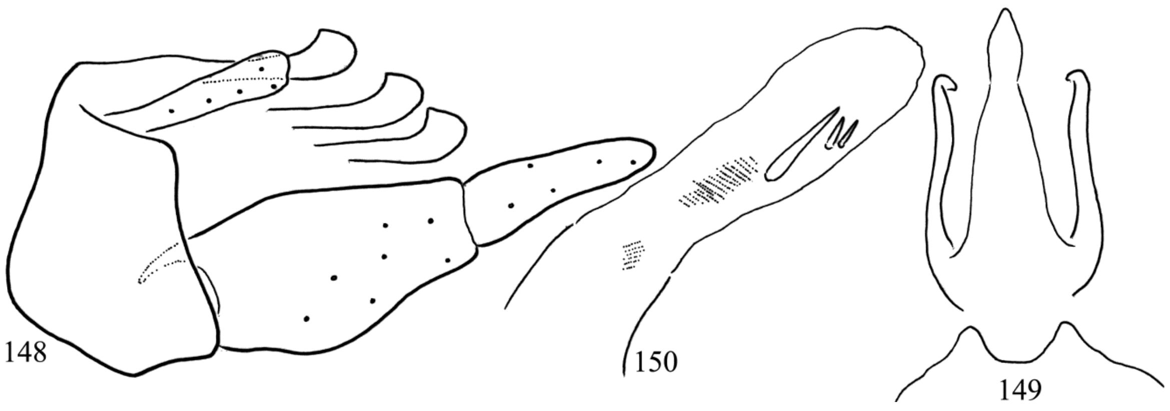
Male genitalia. Tergite VIII with deep triangular mesal excision on the apical margin. Segment X characterized by narrowing apex in dorsal view, and by a rather flat configuration in lateral view; supplied with shallow and short subapical excision; the ending is armed with probably specific pattern of sensory structures of *sensilla basiconica* (pegs) or *sensilla coeloconica* (pitted pegs). Cerci with truncate apex in lateral view; in dorsal view pronounced mesad turning apices well visible. Gonopods, with coxopodite longer than harpago tapering only slightly, almost parallel-sided. Phallic organ with eversible membranous endotheca containing long microspine cluster and three short stout and almost equal spines; these spines are with enlarged rounded basement and arching body.

Etymology. rona, from "róna", flat in Hungarian, refers to the flat lateral profile of segment X without upward arching apical region.

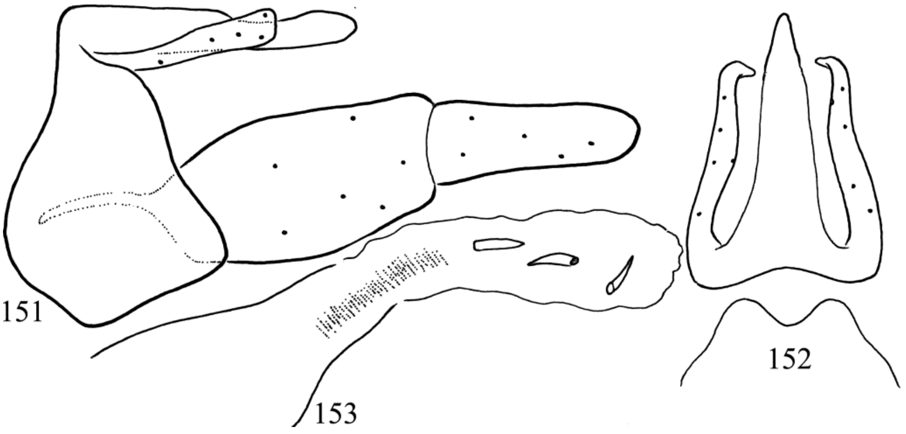
Wormaldia sima Oláh & Chvojka, sp. nov.

(Figures 154–156)

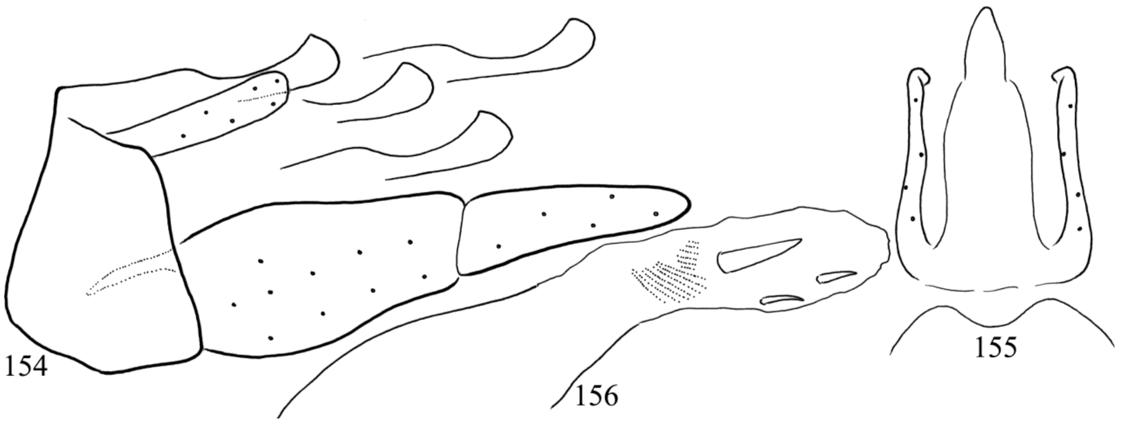
Material examined. Holotype, **Georgia**, Imereti region, Racha range, Tkibuli, karst spring in forest below Nakerala Pass, N42°22.928', E43°01.070', 995 m, 18.IX.2018, leg. D. Murányi *et al.* (1 male, OPC). Paratype: Georgia, Imereti district, Pereval Nakeral'skii pass, tributary of Tkibula River, 42°22'55"N, 43°01' 07"E, 1016 m, 18.IX.2018, J. Oboňa leg. (1 male, NM PC). Georgia, Svanetia, stream N of Mestia, 43°03'N, 42°43.1'E, 1510–1700 m, 5.VII.2013, leg. P. Chvojka (3 males, NMPC; 2 males, OPC). Georgia, Svanetia, brook, left tributary of Mulkhura riv. SE of Mestia, 43°02.4'N, 42°45.5'E, 1490 m, 5.VII.2013, leg. P. Chvojka (3 males, NMPC; 2 males, OPC). Georgia, Svanetia, brook, left tributary of Mulkhura riv. SE of Mestia, 43°02.5'N 42°45.8'E; 1500 m, 5.VII.2013, leg. P. Chvojka (4 males, NMPC). Georgia, Svanetia, brook, left tributary of Mulkhura riv. SE of Mestia, 43°02.5'N, 42°46.3'E, 1510 m, 5.VII.2013, leg. P. Chvojka (4 males, NMPC; 3 males, OPC)



Figures 148-150. *Wormaldia khourmai* Schmid, 1959. 148 = male genitalia in left lateral view, 149 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 150 = phallic organ with the endothecal spine pattern in left lateral view.



Figures 151-153. *Wormaldia rona* Oláh, sp. nov. Holotype: 151 = male genitalia in left lateral view, 152 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 153 = phallic organ with the endothecal spine pattern in left lateral view.



Figures 154-156. *Wormaldia sima* Oláh & Chvojka, sp. nov. Holotype: 154 = male genitalia in left lateral view, 155 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 156 = phallic organ with the endothecal spine pattern in left lateral view.

Diagnosis. This new species having tapering harpago belongs to the *Wormaldia triangulifera* species group and having long microspine cluster with three stout spines belongs to the *Wormaldia khourmai* species complex. *W. sima* sp. nov. Most close to *W. kera*, but the speciation trait that is the head of segment X is arching not regular rounded. The spine shapes of the endotheca are different. The apicomesal excision on tergite VIII triangular without lateral lobes, not deep and wide subquadrangular with pronounced lateral lobes.

Description. Male (in alcohol). Small castanean brown animal. Sclerites medium brown, setal warts both on head and thorax and legs brown. Maxillary palp formula is I-II-IV-III-V. Forewing length 4 mm. Spur formula is 244.

Male genitalia. Tergite VIII with triangular mesal excision on the apical margin. Segment X characterized by narrowing apex in dorsal view, and by a smoothly arching dorsum of the head in lateral view; this arching is a continuation of the subapical excision; the ending is armed with probably specific pattern of sensory structures of *sensilla basiconica* (pegs) or *sensilla coeloconica* (pitted pegs). Cerci with rounded apex in lateral view; in dorsal view pronounced mesad turning apices well visible. Gonopods, with coxopodite longer than the tapering harpago. Phallic organ with eversible membranous endotheca containing short small-spine cluster and three spines; one spine is large robust, other two spines are small.

Etymology. *sima*, from "sima", in Hungarian refers to smooth arching dorsum of the lateral profile of the head on segment X.

Wormaldia subnigra species complex

According to our ranking criteria *Wormaldia subnigra* species complex having narrowing harpagones belongs to the *Wormaldia triangulifera* species group. This species complex is characterized by the combination *(1)* of the tapering harpago, *(2)* the terminal of segment X with dorsally concave capitate "head", with pronounced dorsal subapical pointed process.

Wormaldia asterusia clade

This species clade is characterized by the combination *(1)* of the tapering harpago, *(2)* the terminal of segment X with elongated and dorsally concave capitate "head", with pronounced dorsal subapical pointed process and *(3)* the endothecal spine pattern with just discernible cluster of small spines and with 2–4 individual spines.

Wormaldia asterusia Malicky, 1972

(Figures 157–159)

Wormaldia triangulifera asterusia Malicky, 1972:31–32, "Holotypus ♂: Kreta, Asterusia-Gebirge südlich von Pigaidakia, 29.4.1971, leg. Malicky. Allotypoid ♀ und zahlreiche Paratypoide beider Geschlechter mit gleihen Daten; viele weitere Paratypoide von 13 anderen Fundorten aus ganz Kreta. Alle in meiner Sammlung." "die kretischen Exemplare unterschiden sich deutlich von den Vertretern der vier bisher bekannten Unterarten (*triangulifera* MCL.: Frankreich, *beaumonti* Schmid: Spanien, *kimminsi* Bots.: Mazedonien, *moselyi* Kimmins: Pyrenäen; Botosaneanu 1960, 1960a, Kimmins 1953), weshalb sie beschreiben und benannt wärden müssen."

Wormaldia thasica Malicky, 1983 in Çakin & Malicky 1983. Malicky 2005a:549: "der Unterschied ist minimal", synonymised with *W. asterusia* Malicky, 1972.

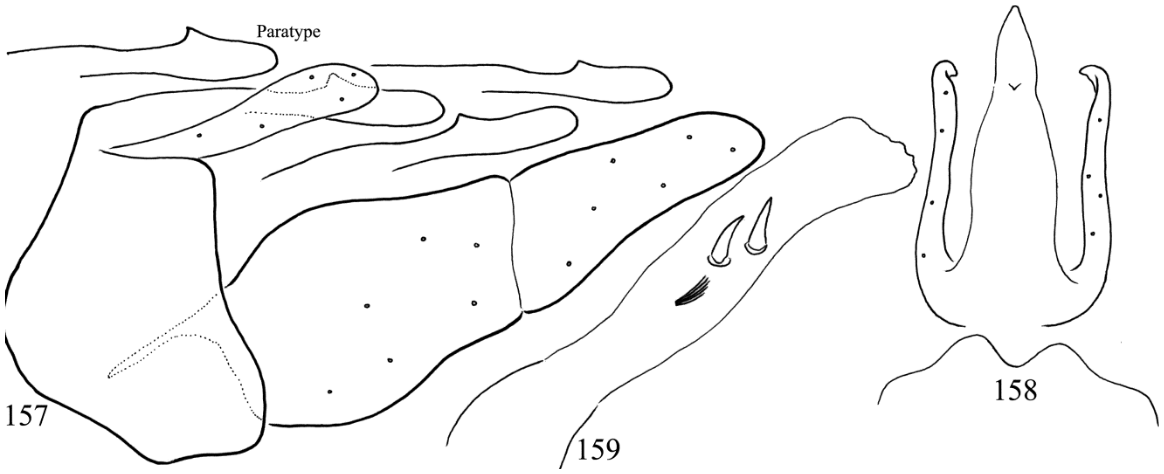
Wormaldia asterusia Malicky, 1972: Malicky 2005b: 73–74, recorded from Greece: Chalkidiki, Thrakien, Crete, Thasos, Samothraki, Lesbos, Chios, Naxos, Ikaria, Samos, Kos, Rhodos, Karpathos. "Der Unterschied zwischen den nördlichen Populationen (*thasica* Malicky, 1983) und denen aus Kreta ist gering und rechtfertigt wohl doch kleinen eigenen Name."

Material examined. Paratype: **Greece**, Crete, Pigaidakia, 24°50'E, 34°57'E, 400 m, 29.IV.1971, leg. H. Malicky (1 male, NMNHS). Crete, Hania nomos Prases, 18.V.1995, leg Á. Uherkovich & S. Nógrádi (1 male, OPC). Crete, Rethymno regional unit, Axos, spring S of the village, N35°17.934' E24°50.485', 590 m, 2.IV.2013 leg. J. Kontschán, D. Murányi, T. Szederjesi, (3 males, HNHM).

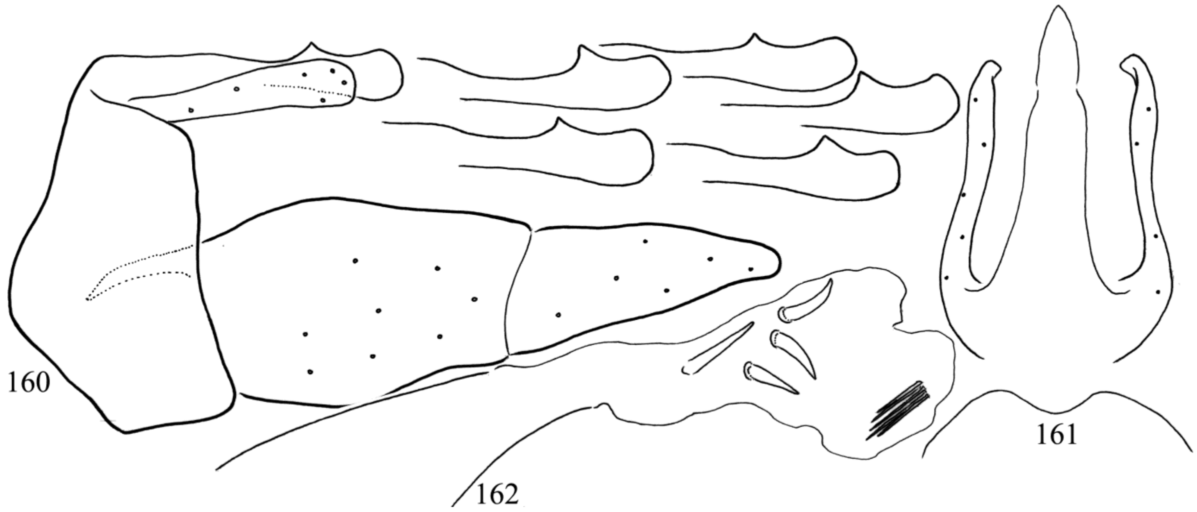
Wormaldia homora Oláh, 2014 stat. restit.

(Figures 160–162)

Wormaldia homora Oláh, 2014:102–103: "most close to *W. asterusia*, but differs by having apex of seg-



Figures 157-159. *Wormaldia asterusia* Malicky, 1972. 157 = male genitalia in left lateral view, 158 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 159 = phallic organ with the endothecal spine pattern in left lateral view.



Figures 160-162. *Wormaldia homora* Oláh, 2014. 160 = male genitalia in left lateral view, 161 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 162 = phallic organ with the endothecal spine pattern in left lateral view.

ment X high, not low, apical portion of cerci truncate, not rounded in lateral view and the subapical mesal projection triangular, not rounded lobe in dorsal view; apices of harpago narrowing and downward curving, not broad; endothecal spine structure different."

Wormaldia triangulifera McLachlan, 1878: Kumanski 1969:177, Bulgaria, Pirin, below Vichren, 21.XI. 1967, (1 male, NMNHS). Having only a single male it was not possible to determine the subspecies. Misidentification!

Wormaldia triangulifera asterusia Malicky, 1972: Kumanski 1975:59, Bulgaria, Stara Planina, Belogradchik, 26.VI.1973, leg. A.C. (1 male, NMNHS). Bulgaria, Burgas, VII.1949, leg. A. P. (1 male, NMNHS). Bulgaria, Micsurin (Tsarevo), 13.VII. 1974, light leg. C.Z. (1 male, NMNHS). Misidentification!

Wormaldia triangulifera asterusia Malicky, 1972: Kumanski & Malicky 1976:103, "Material aus Bulgarien: Stara Planina, Umgebung von Belogradtschik, 26.VI.1973: 1♂; Pirin-Gebirge, oberhalb der Hütte Wichren, 2300 m, 21.IX.1967: 1♂; Küste des Schwarzen Meeres, Burgas, Juli 1949: 1♂, leg. A. Popov; Strandscha-Gebirge, Katschul, 13.VII.1974, 1♂, leg. Zagortschinov. Misidentification!

Wormaldia asterusia Malicky, 1972. Malicky 2018:43, "According to the description and the figures *Wormaldia homora* (Oláh, 2014) is without doubt

W. asterusia, a species which lives from Crete in the south to the Bulgarian mountains (Malicky 2005:179), and is common in many sites. Its variability is well known. *Wormaldia homora* Oláh, 2014 = *Wormaldia asterusia* Malicky 1972, nov. syn.

Material examined. Holotype: **Bulgaria**: Eastern Rodopi, near Strazhetz, above the crossroad Gugutka-Krumovgrad, 575m, N41°21'11" E25°50'35", 24.VII. 2012, at lights leg. S. Beshkov & M. Beshkova, (1 male, NMNHS). Bulgaria, Pirin Mts. below Vichren, 21.XI.1967, leg. K. Kumanski (1 male, NMNHS). Bulgaria, Stara Planina, Belogradchik, 26.VI.1973, leg. A.C. (1 male, NMNHS). Bulgaria: Strandzha Mts., Katschul, 13.VII.1974, leg. Zagortschinov (1 male, NMNHS). Bulgaria: Central Stara Planina Mts. Tchamdzha Reserve near Hristo Danovo Village, 570 m, N42°43'59" E24°35'37", 31.VII.2014, leg. S. Beshkov (1male, NMNHBAS). Bulgaria, SW Bulgaria, Paril Pass between Alibotush (=Slavyanka) Mts. and S. Pirin Mts. between Paril and Nova Loccha Villages, 756 m, N41°25'57" E23°42'02", 17.VI.2013, leg. at lamps and light traps, S. Beshkov & B. Zlatkov (1male, NMNHS).

Remarks. We have examined the type material of *Wormaldia asterusia* Malicky, 1972 together with newly collected material from two other regions of Crete and and compared again with the holotype of *W. homora* Oláh, 2014 and with other specimens collected from various mountains in Bulgaria: Pirin, Stara Planina, Strandzha, Alibotush Mountains.

The speciation trait that is the head of segment X is very stable in all the populations examined from various regions in Crete and from various mountains in Bulgaria. The head of segment X is short, high with very concave dorsum at *W. homora* and long, low and flat at *W. asterusia.* The endothecal spine pattern is composed of four stout spines in *W. homora* and composed only of two stout spines in *W. asterusia*. There are divergences in neutral traits as well: the apicomesal excision is wide without lateral lobes in *W. homora* and triangular with lateral lobes in *W. asterusia*; apices of harpago narrowing and downward curving in *W. homora* and broad in *W. asterusia*. Here we reinstate the species status of *Wormaldia homora* Oláh, 2014. **Stat. Restit**.

***Wormaldia subnigra* clade**

This species clade is characterized by the combination *(1)* of the tapering harpago; *(2)* the terminal of segment X with elongated and dorsally concave capitate "head", with pronounced dorsal subapical pointed process and *(3)* of the endothecal spine pattern with just discernible cluster of small spines and with doubled and variously sized spines.

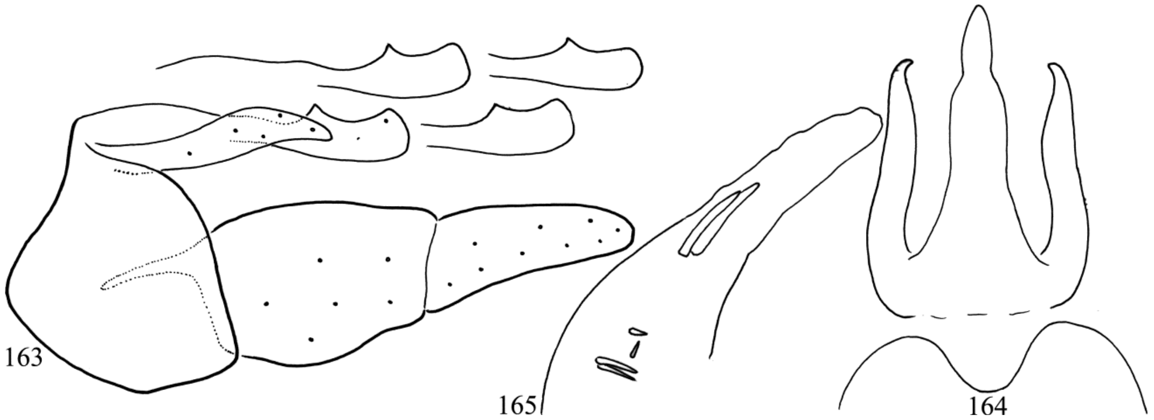
***Wormaldia granada* Oláh & Zamora-Muñoz, sp. nov.**

(Figures 163–165)

Material examined. Holotype, Spain, Granada, Monachil village, Cortijo de Diéchar, Rio Monachil, spindle: 30S, X-UTM: 459643, Y-UTM:4106471, 1416m, 6.X.2008, leg. C. Zamora-Muñoz (1 male, OPC). Paratypes. Spain, Malaga, Canillas de Albaida village, Fabrica de la Luz, Rio de la Llanada de Turvilla, spindle: 30S, X-UTM: 413487, Y-UTM:408230, 720m, 2-3.V.2017, leg. A. Tinaut (1 male, OPC). Spain, Malaga, Canillas de Albaida village, Fabrica de la Luz, Rio de la Llanada de Turvilla, spindle: 30S, X-UTM: 413487, Y-UTM:408230, 720m, 15.V.2017, leg. A. Tinaut (1 male, OPC).

Diagnosis. This new species having tapering harpago belongs to the *Wormaldia triangulifera* species group and having the terminal of segment X with elongated and dorsally concave capitate "head" with pronounced dorsal subapical pointed process belongs to *W. subnigra* species complex, and having of rather specialised spine pattern of doubled spines belongs to *W. subnigra* species clade. Close to *W. subnigra*, but differs by having the speciation trait that is the head of segment X elongated very much, especially its dorsal concavity. This concavity is highly stable in all the examined populations both of *W. granada* and of *W. subnigra*.

Description. Male (in alcohol). Small castanean brown animal. Sclerites medium brown, setal warts both on head and thorax and legs brown. Maxillary palp formula is I-II-IV-III-V. Forewing length 4 mm. Spur formula is 244.



Figures 163-165. *Wormaldia granada* Oláh & Zamora-Muñoz, sp. nov. Holotype: 163 = male genitalia in left lateral view with lateral profile of the speciation trait that is the head of segment X of three more paratypes from another populations, 164 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 165 = phallic organ with the endothecal spine pattern in left lateral view.

Male genitalia. Tergite VIII with deep rounded mesal excision on the apical margin. Segment X characterized by narrowing apex in dorsal view, and by elongated head with long and deep dorsal concavity; the ending is armed with probably specific pattern of sensory structures of *sensilla basiconica* (pegs) or *sensilla coeloconica* (pitted pegs). Cerci with downward tapering apex in lateral view; in dorsal view apices slightly mesad directed. Gonopods, with coxopodite equal length to tapering harpago. Phallic organ with eversible membranous endotheca containing adhering doubled stout spines and two pairs of smaller spines.

Etymology. Named after the type locality.

Wormaldia mediana McLachlan, 1878

(Figures 166–168)

Material examined. **France**, Ardennes, Fleigneux, près de l'étang amont, sur la Hatrelle, 6.VIII.1999, sweeping leg. G. Coppa (1 male without phallic organ, OPC). France, Nièvre, Glux-en-Glenne, Yonne, 22. VII.2007, sweeping leg. G. Coppa (2 males, OPC). France, Var, La Martre, torrent Artuby pont romain, 14.VIII.2009, sweeping leg. G. Coppa (2 males, OPC).

Wormaldia nielseni Moretti, 1981 stat. nov.

(Figures 169–171)

Wormaldia mediana nielseni Moretti, 1981:173–174, „Differs from *W. mediana* in its longer harpago which is less curved at the lower margin and more densely spiney in the inner apical surface (a). The phallus endotheca has ten apical spines arranged in the form of a hair-pin, the last four being longer and irregularly oriented (b). The other spines and the basal indented sclerites as in *W. mediana mediana* (c).“

Material examined. **Italy,** Basilicata-Potenca, Maratea, Fiume Noce, N39.9574° E15.7709°, 30 m, 22. VI.1998, light trap, leg. E. Bertuetti, P. Pantini & M. Valle, det. *Wormaldia mediana* E. Bertuetti (4 males, 9 females, CNSMB; 2 males, OPC). Italy, Calabria-Cosenca, Spezzano Piccolo Fallistro, Fiume Neto, N39.323° E16.475°, 1370 m, 21.VIII.2017, light trap, leg. S. Scalercio & M. Infusino, det. M. Valle (2017) as *Wormaldia mediana nielseni* (5 males, 1 female, CNSMB; 1 male, OPC). Italy, Sicilia-Messina, Roccella Valdemone, Torrente Licopeti-Contrada Revocato, N37.95° E15.015°, 800 m, 7.VII.2016, light trap, leg. R. Leotta, det. O. Lodovici (2016) as *Wormaldia mediana nielseni* (4 males, 2 females, CNSMB; 1 male, OPC).

Wormaldia subnigra McLachlan, 1865

(Figures 172–174)

Wormaldia triangulifera thasica Malicky, in Çakin & Malicky, 1983: 270.

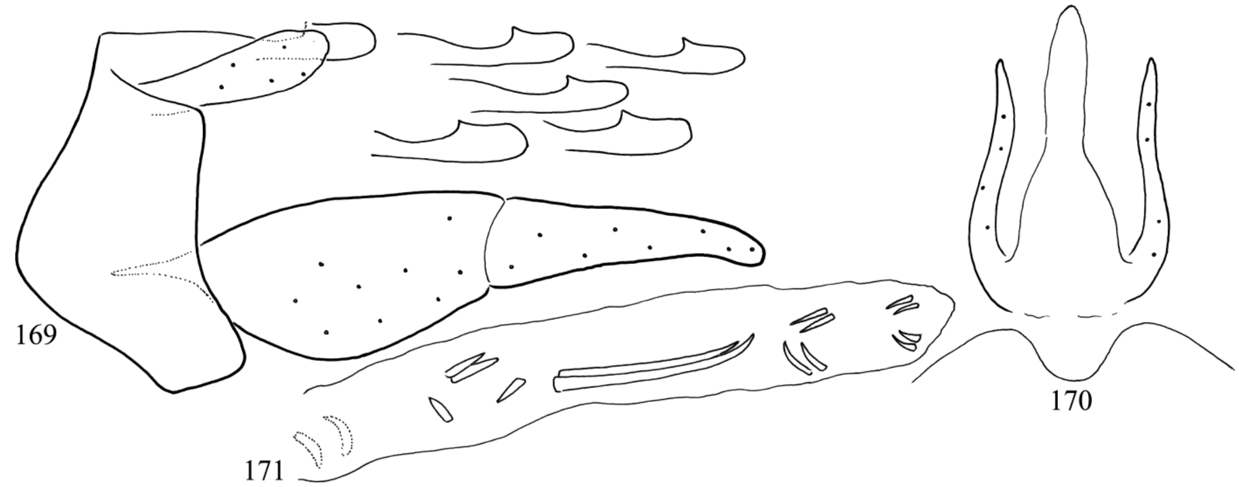
Wormaldia triangulifera thasica Malicky, 1983: Malicky 2005: 549, synonym of *Wormaldia asterusia*.

Wormaldia triangulifera thasica Malicky, 1983. *Wormaldia asterusia* is a sibling in the *W. asterusia* clade. This clade differs from the *W. subnigra* clade by having elongated concave apex of segment X and endothecal spine pattern without the twin of large spines. Moreover, the shape of the lateral profile of segment X and the endothecal spine pattern are identical with those of *Wormaldia subnigra*. *Wormaldia triangulifera thasica* is a synonym of *W. subnigra*. **New Synonym**.

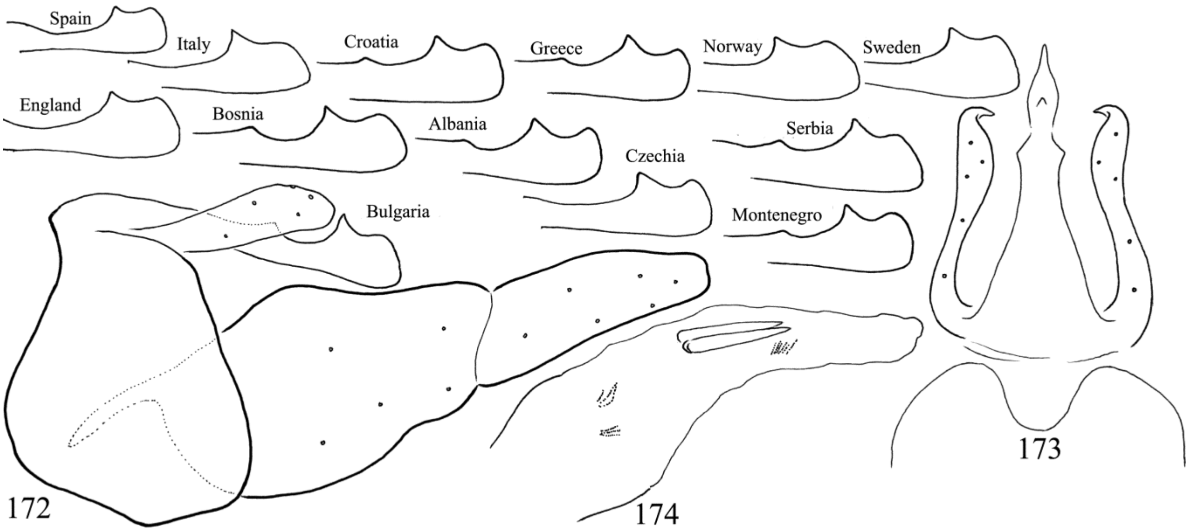
Material examined. **Albania**, Vlore county, Dhermi, Dhermi stream in the village, 139 m, N40°09.330' E19°38.374', 11.III.2008, leg. Sz. Czigány & D. Murányi (2 males, HNHM). Gjirokastër county, Finiq municipality, Syri i Kaltër spring, N39°55'23", E020°11'30", 155 m, 3.XI.2018, leg. S. Beshkov & A. Nahirnic (2 males, OPC). **Bosnia & Herzegovina**, Sutjeska stream, Klobucarika tributary, 21–23.IX.1988, light/singled leg. J. Oláh (45 males, 2 females; OPC). **Bulgaria**, Eastern Rhodopi, Byala Reka River, Zhultichalskoto dere near Meden Buk Village, Ivaylovgrad District, 121m, N41°22'48" E26°01'40", 25.VII.2012, at lamps, light traps leg. S. Beshkov & M. Beshkova, (2 males, OPC). Easterm Rhodopi Mts, Borovitza Valley, between Duzhdovnitza and Pudartzi, 359m, N41.68591°, E25.282159° 13.VI.2018, leg. S. Beshkov, B. Zlatkov, R. Bekchiev (1 male, OPC). **Croatia**, Plitvicka Jezera N.P. Great Waterfall, 9.VII.2006, leg. L. Dányi (1 male HNHM). **Czech Republic**, Central Bohemia, Vůznice Reserve, Vůznice stream NW of Nižbor, 15.IX.2006, leg. P. Chvojka (4 males, NMPC; 1 male, OPC). **England**, Lancashire, Holme, 30.VIII. 1937, leg. W.G. Bainbridge (1 male, MMUE). England, Downham, Lancashire, 17.VII.1960, leg. A. Brindle (1 male, MMUE). Downham, Lancashire, 28.VIII.1932, leg. W. Britten (1 male, MMUE). **Greece**, Lamia, Sperchias, N38.878°, E22.163°, 185 m, 29.VII.2007, leg. M. Bálint (9 males, OPC). 3 km NE Loutro, N38.97°, E21.2, 40° m, 30.VII.2007, leg. M. Bálint (23 males, OPC). **Italy**, Friuli-Venezia, Giulia-Trieste, San Dorligo della Valle, torrente Rosandra, N45.6183°, E13.8737°, 170 m, 18.VII.1996, light trap, leg. P. Pantini & M. Valle (2 males, CNSMB). **Montenegro**, Sinjajevina Mts. Boan E 7km, brook and its gorge, 1184m, N42°55.616' E19°16.333', 10.X.2008, leg. L. Dányi, Z. Fehér, J. Kontschán & D. Murányi (1 male HNHM). **Norway**, Vestfold Sandefjord: Andebu, Sukke, 59.363538°N 10.134272°E, 13–25.VIII.1974, leg. Arild Fjeldså (12 males, OPC). **Serbia**, Gamizigrad, Crni Timok River and its gallery, 183 m, N43°55'30.6" E22°0.7'46.2", 14.X. 2006, leg. L. Dányi, J. Kontschán & D. Murányi (14 males, 3 females, HNHM). **Spain**, Cádiz province, Guadalete river basin, Arroyo Gaidóvar. 702m, Grazalema, 27. VI.1995, leg. A. Ruiz Garcia (4 males, OPC). **Sweden**, Dalarna, Malung-Sälans kommun, Österdalsälven, along road 70, 9 km (air) WSW Idre, 61.8257°N, 121.8789°E, 7.VIII.2016, net, leg. K.A. Johanson (1 male, SNHM, C563, NHRS-TOBI 000003740).

Remarks. It is remarkable to recognise how stable is the lateral profile of the head of segment X that is the speciation trait on the entire distributional area sampled here in thirteen countries: Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, England, Greece, Italy, Montenegro, Norway, Serbia, Spain, and Sweden. Of course every population or even every specimen has its own individual shape, but in a strictly integrated specific range of the species. In *Wormaldia subnigra* the dorsum of the head is short concave!

Figures 166-168. *Wormaldia mediana* McLachlan, 1878. 166 = male genitalia in left lateral view with lateral profile of the speciation trait that is the head of segment X of two more specimens from another populations, 167 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 168=phallic organ with the endothecal spine pattern in left lateral view.



Figures 169-171. *Wormaldia nielseni* Moretti, 1981. 169 = male genitalia in left lateral view with lateral profile of the speciation trait that is the head of segment X of five more specimens from another populations, 170 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 171 = phallic organ with the endothecal spine pattern in left lateral view.



Figures 172-174. *Wormaldia subnigra* McLachlan, 1865. 172 = male genitalia in left lateral view with lateral profile of the speciation trait that is the head of segment X of populations from the entire distributional area, 173 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 174=phallic organ with the endothecal spine pattern in left lateral view.

Wormaldia vercorsica clade

This species clade is characterized by the combination *(1)* of the tapering harpago, *(2)* the terminal of segment X with abbreviated, but dorsally concave capitate "head", with dorsal subapical pointed process and *(3)* the endothecal spine pattern without any cluster of small spines and with 4–6 individual stout spines. This clade is rather incongruent, discordant, chimeric, therefore uncertain to classify. Even the combination of tapering harpago and the concave dorsum of the head of segment X is not stable. *Wormaldia ikizdere*, *W. malickyi*, *W. sucranae* and the nominal species *W. vercorsica* are with concave dorsum of the head of segment X. The other two species *W. gattolliati* and *W. telva* sp. nov. are almost without any concavity, but has the combination of tapering harpago and four individual spines in the endotheca without any cluster of small spines.

Wormaldia gattolliati Malicky & Graf, 2017

(Figures 175–177)

Material examined. **France**, Alpes-Maritimes, Saorge, ru de Mairise, 44°0'46.6N ; 7°27'16.12 E, 1099 m, in Mercantour National Park, 3.VII.2016, leg. G. Coppa (1 male, CPC; 1 male, OPC). **Italy**, Piemonte-Cuneo, Ormea, Rio Armella, N44.1639 E7.8821, 1000 m, 29.V.1998, leg. Museo Caffi BG, det. Bianchi as *Wormaldia mediana* (1 male, CNSMB).

Wormaldia telva Oláh & Johanson, sp. nov.

(Figures 178–180)

Material examined. Holotype: **Georgia**, Marelisi southeast of Surami, N41°56'22.7" E043°16'37.3", 693 m, 20.V.2012, sweeping leg. O. Kurina (1 male, SMNH, NHRS-TOBI 000003744).

Diagnosis. This new species having tapering harpago belongs to the *Wormaldia triangulifera* species group. The combination of tapering harpago and four individual spines in the endotheca without any cluster of small spines relates this new species to *W. vercorsica* species clade. It is very close to *W. gattolliati* but distinguished by the higher lateral profile of the head of segment X, the different shape pattern of the four spines as well as the shape of cerci.

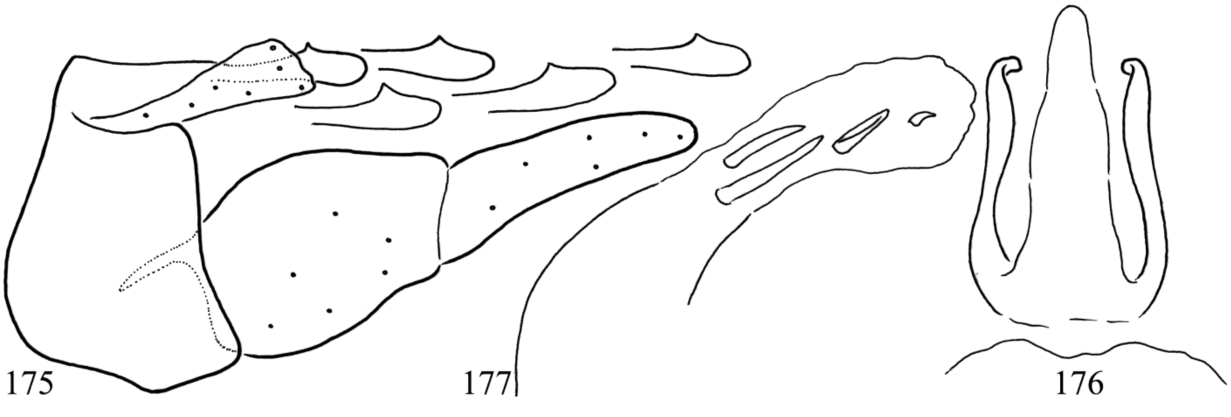
Description. Male (in alcohol). Small castanean brown animal. Sclerites medium brown, setal warts both on head and thorax and legs brown. Maxillary palp formula is I-II-IV-III-V. Forewing length 4 mm. Spur formula is 244.

Male genitalia. Tergite VIII with very shallow mesal excision on the apical margin. Segment X characterized by narrowing apex in dorsal view, and by the rounded elongated head rather high and with pronounced subapical dorsal pointed process; the ending is armed with probably specific pattern of sensory structures of *sensilla basiconica* (pegs) or *sensilla coeloconica* (pitted pegs). Cerci with downward tapering apex in lateral view; in dorsal view apices mesad directed. Gonopods, with coxopodite equal length to tapering harpago. Phallic organ with eversible membranous endotheca containing one stout, longer, simple spine and three stout and shorter spines with longitudinal edge.

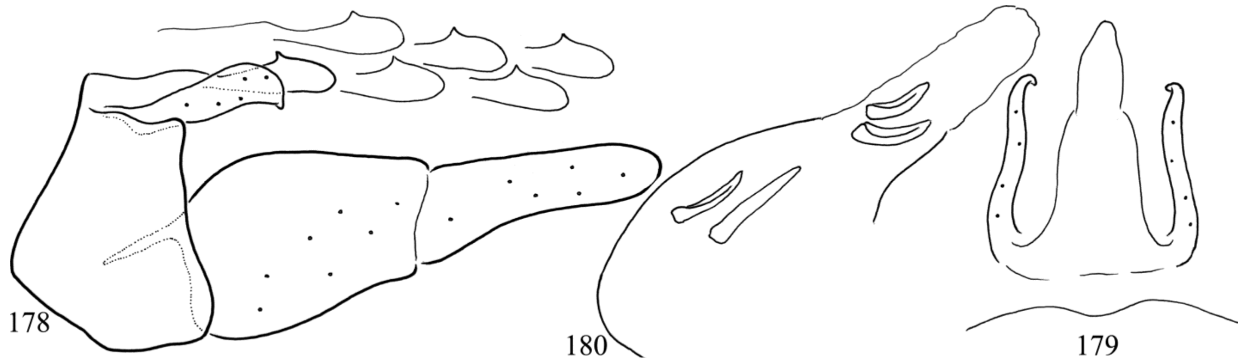
Etymology. *telva*, from "telve", full of in Hungarian, refers to the convex dorsum of the apex of segment X.

Wormaldia triangulifera species complex

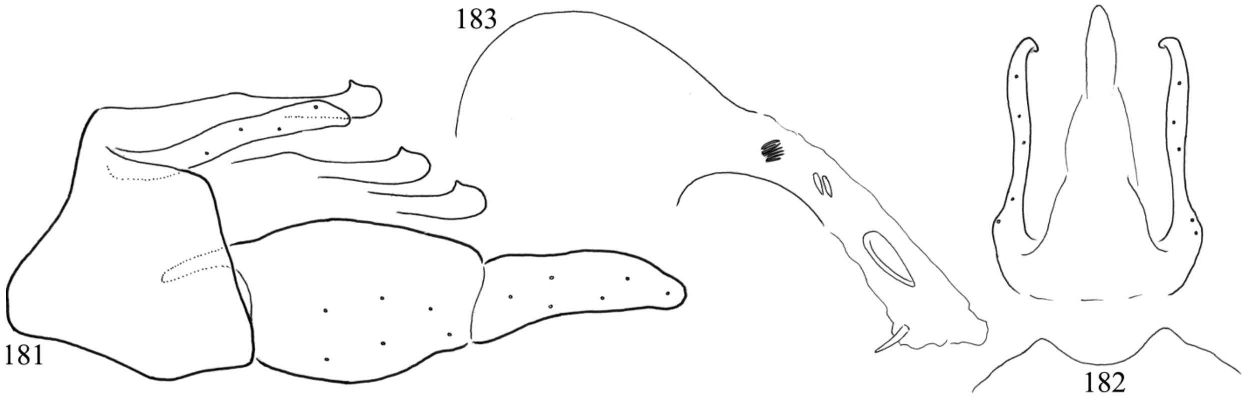
This species complex is characterized by the combination *(1)* of the tapering harpago, *(2)* of the terminal of segment X with abbreviated capitate "head", with dorsal subapical pointed process and *(3)* of the endothecal spine pattern with a pronounced basal spine cluster accompanied by some individual variously sized spines.



Figures 175-177. *Wormaldia gattolliati* Malicky & Graf, 2017. 175 = male genitalia in left lateral view with lateral profile of the speciation trait that is the head of segment X of populations from France and Italy, 176 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 177 = phallic organ with the endothecal spine pattern in left lateral view.



Figures 178-180. *Wormaldia telva* Oláh & Johanson, sp. nov. Holotype: 163 = male genitalia in left lateral view with lateral profile of the speciation trait that is the head of segment X redrawn five times, 164 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 165=phallic organ with the endothecal spine pattern in left lateral view.



Figures 181-183. *Wormaldia cantabrica* Gonzalez & Botosaneanu, 1983. 181 = male genitalia in left lateral view with lateral profile of the speciation trait that is the head of segment X of two more specimens from another populations, 182 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 183 = phallic organ with the endothecal spine pattern in left lateral view.

Wormaldia cantabrica Gonzalez & Botosaneanu, 1983

(Figures 181–183)

Material examined. Paratypes: **Spain**, Sierra Segundera, Porto (Zamora), 1200 m, 18.VII.1982, leg. M. Gonzalez (2 males, NBC-ZMAN). Spain, Sierra de Ancares, Lugo, Fuente del Barcal, 14.VIII.1984, leg. and det. M.A. Gonzalez (2 males, OPC).

Wormaldia langohri Botosaneanu & Giudicelli, 2001

(Figures 184–186)

Material examined. **France**, Lozère, Le Pont-de-Montvert, le Mazel route vers l'Hopital suintement, 26.V.2017, leg. G. Coppa (1 male, OPC).

Wormaldia lusitanica Gonzalez & Botosaneanu, 1983

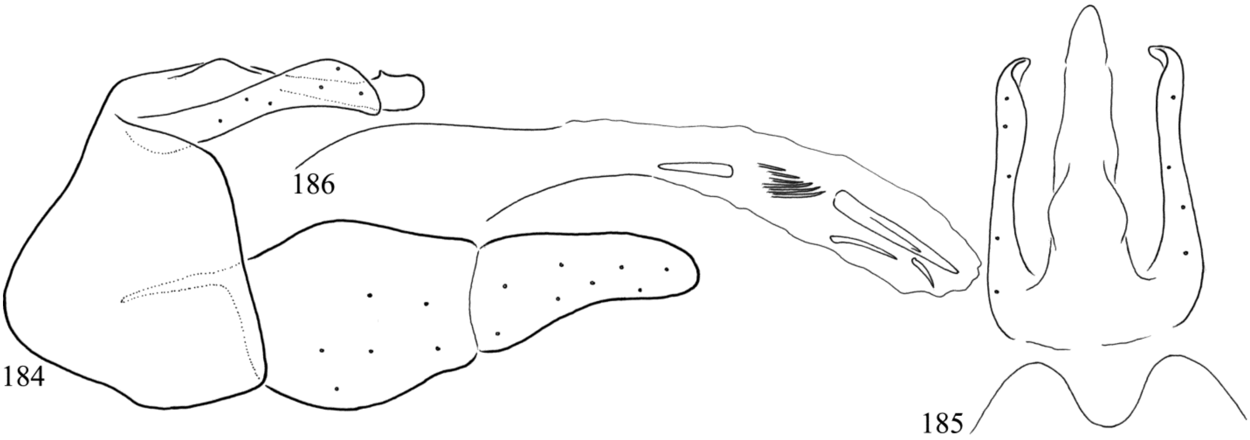
(Figures 187–189)

Material examined. Paratypes: **Spain**, El Rio (Orense), Rio Barbantiño, 480 m, 18.V.1974, leg. M. Gonzalez (5 males, NBC-ZMAN). Spain, NW Spain, Galicia, Orense, Queguas, 14.VII.1988, leg. and det. M.A. Gonzalez (3 males, OPC). **Portugal**, Boticas Park-Nature e Biodiversity, Relva, 4. VI. 1980, leg. L. Terra, det. M. A. Gonzalez (2 males, OPC).

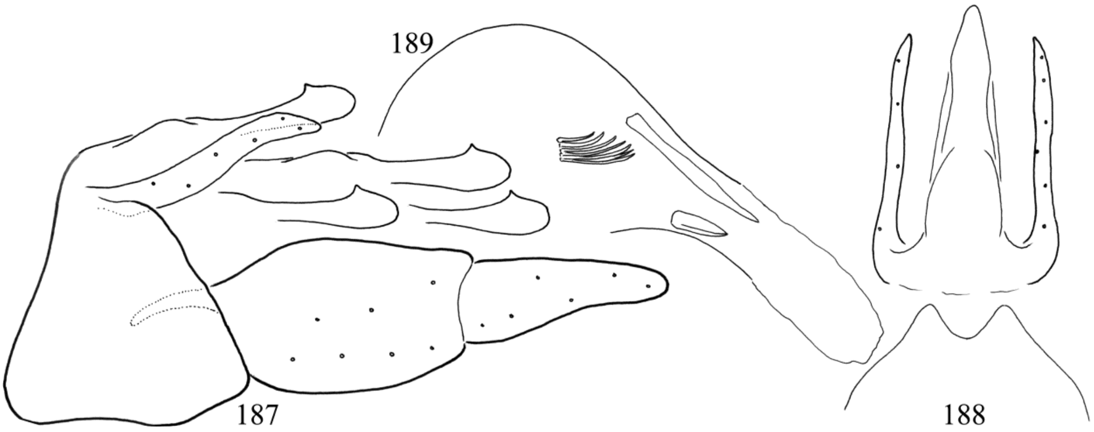
Wormaldia moselyi Kimmins, 1953

(Figures 190–192)

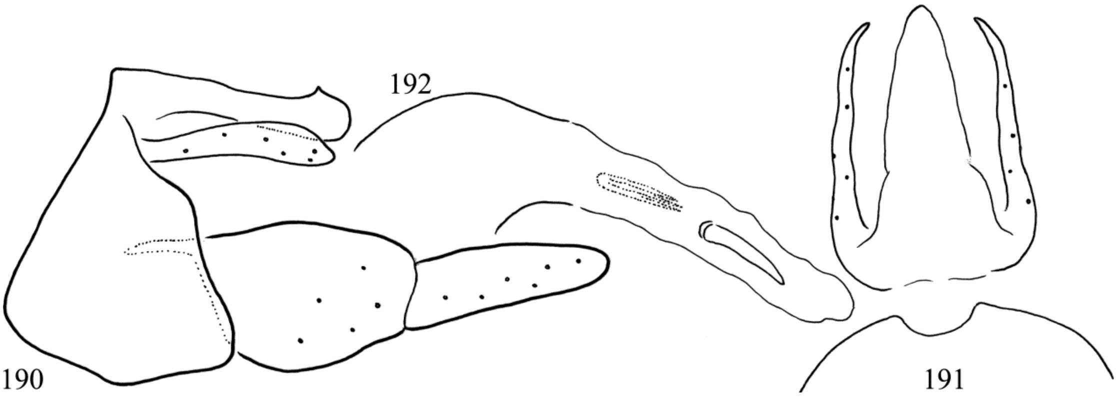
Material examined. France, Pyrenees Mts., Atlantic Pyrenees, Nivelle River system, 12-18.VII.1986, singled and light leg. J. Oláh (35 males, OPC).



Figures 184-186. *Wormaldia langohri* Botosaneanu & Giudicelli, 2001. 184 = male genitalia in left lateral view, 185 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 186 =phallic organ with the endothecal spine pattern in left lateral view.



Figures 187-189. *Wormaldia lusitanica* Gonzalez & Botosaneanu, 1983. 187 = male genitalia in left lateral view with lateral profile of the speciation trait that is the head of segment X of specimens from Spain and Portugal, 182 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 183 = phallic organ with the endothecal spine pattern in left lateral view.



Figures 190-192. *Wormaldia moselyi* Kimmins, 1953. 190 = male genitalia in left lateral view, 191=mesal excision on tergite VIII and segment X with cerci in dorsal view, 192 = phallic organ with the endothecal spine pattern in left lateral view.

Wormaldia triangulifera McLachlan, 1878

(Figures 193–195)

Material examined. **France**, Citou, Aude, N43.408° E2.591°, 906 m, 14.VII.2007, leg. M. Bálint (12 males OPC). France, Lespinassiére, N43.402° E2.532°, 450m, 14.VII.2007, leg. M. Bálint (5 males, 2 females, OPC). **Spain**, Lerida, Valle de Arán, Font de Savantan, 20. IX. 1986, leg. and det. M. A. Gonzalez (1 male, OPC).

Wormaldia variegata species complex

This species complex is characterized by the combination *(1)* of the tapering harpago, *(2)* of the terminal of segment X with less capitate, more hook-shaped head, with long or deep subapical depression without pronounced subapical pointed process and *(3)* of the endothecal spine pattern without spine cluster with some individual variously sized spines.

Wormaldia maclachlani Kimmins, 1953

(Figures 196–198)

Wormaldia mediana viganoi Moretti & Taticchi, 1992: 254–256.

Wormaldia viganoi Moretti & Taticchi, 1992: Malicky 2002:5, removed from *W. mediana* and raised to species rank with stat. nov.

Wormaldia viganoi Moretti & Taticchi, 1992: Malicky 2005:550, synonymised with *W. machlachlani*.

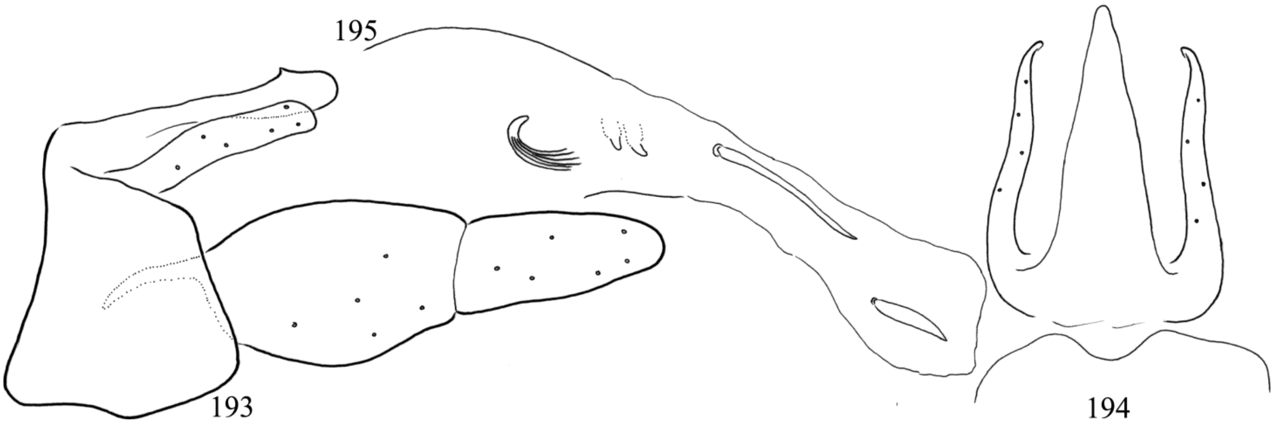
Material examined. **Italy**, Piemonte-Biella, Quittengo, Rio Vait, N45.656° E8.0363°, 1230 m, 8.VIII. 2012, light trap, leg. O. Lodocici, P. Pantini, M. Valle, det. O. Lodovici (2012) as *W. variegata maclachlani* (3 males, 6 females, CNSMB; 2 males, OPC). Italy, Lombardia-Bergamo, Valgoglio, Valsanguigno, sorgente con igropetrico, N45.9694°, E9.8897°, 1250 m, 25.VII. 2009, light trap, leg. S. Cerea, det. S. Cerea (2009) as *W. variegata maclachlani* (1 male, 1 female, CNSMB; 1 male, OPC).

Wormaldia variegata Mosely, 1930

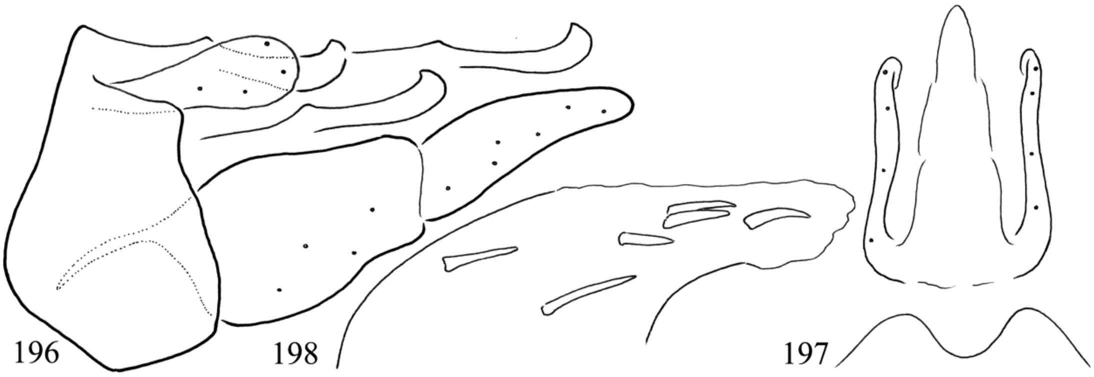
(Figures 199–201)

Wormaldia variegate denisi Moretti, 1981:174–175. "This subspecies is similar to *W. variegate corsicana* Vaillant, 1974." **New Synonym**!

Material examined. **France**, Corse du Sud, Quensa, ru de tijeda pont D268, 16.VII.2011, leg. G. Coppa (1 male, OPC). **Italy**, Sardegne-Cagliari, Maracalagonis, Rio Dominugheddu sopra Geremea, N39.2516° E9.4266°, 380 m, 6.XII.2004, leg. O. Lodovici & P. Pantini (1 male, CNSMB; 1 male, OPC).



Figures 193-195. *Wormaldia triangulifera* McLachlan 1878. 193 = male genitalia in left lateral view, 194=mesal excision on tergite VIII and segment X with cerci in dorsal view, 195 = phallic organ with the endothecal pine pattern in left lateral view.



Figures 196-198. *Wormaldia maclachlani* Kimmins, 1953. 196 = male genitalia in left lateral view with lateral profile of the speciation trait that is the head of segment X of specimens from two populations, 197 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 198 = phallic organ with the endothecal spine pattern in left lateral view.

Figures 199-201. *Wormaldia variegata* Mosely, 1930. 199 = male genitalia in left lateral view with lateral profile of the speciation trait that is the head of segment X of specimens from France and Italy with redrawing, 200 = mesal excision on tergite VIII and segment X with cerci in dorsal view, 201 = phallic organ with the endothecal spine pattern in left lateral view.

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Contributions to the taxonomy, identification, and biogeography of *Eriborus* Förster, 1869 and *Nepiesta* Förster, 1869 (Hymenoptera: Ichneumonidae: Campopleginae)

Z. VAS

Zoltán Vas, Hungarian Natural History Museum, Department of Zoology, Hymenoptera Collection,
H-1088 Budapest, Baross u. 13., Hungary. E-mail: vas.zoltan@nhmus.hu

Abstract. *Eriborus mirabilis* sp. nov. is described from Papua New Guinea, and the first identification key to the Australasian species of *Eriborus* Förster, 1869 is provided. *Nepiesta cruella* sp. nov. is described from Jordan, the female of *Nepiesta tibialis* Horstmann, 1977 is described for the first time, and an updated identification key to all known *Nepiesta* Förster, 1869 species is given. Additionally, the first records of *Eriborus obscuripes* Horstmann, 1987 from Romania, *Eriborus terebrator* Aubert, 1960 from Hungary and Spain, *Nepiesta mandibularis* (Holmgren, 1860) from Hungary and Romania, *Nepiesta rufocincta* Strobl, 1904 from Romania, and *Nepiesta tibialis* Horstmann, 1977 from Turkmenistan are reported.

Keywords. *Eriborus mirabilis* sp. nov., *Nepiesta cruella* sp. nov., *Nepiesta tibialis*, species description, identification key, new records, Australian realm, Palaearctic realm, Imre Loksa.

INTRODUCTION

Eriborus Förster, 1869 is a moderately species rich genus of the family Ichneumonidae, subfamily Campopleginae with 56 valid species worldwide, including the presently described new species; it is most diverse in the Oriental and Eastern Palaearctic regions (Yu *et al*. 2012). Regarding *Eriborus*, the biogeographical scope of this work is the Australian (Australasian) realm, including Australia, New Guinea, New Zealand and the surrounding islands (such as New Caledonia or Vanuatu) eastwards from Wallace's line; Fiji and Samoa Islands are also considered here (Rueda *et al*. 2013), though sometimes these are assigned to the Oceanic realm (see *e.g*. Olson *et al*. 2001, Yu *et al*. 2012). There are eight *Eriborus* species known from the Australasian region, including the presently described *Eriborus mirabilis* sp. nov.; one of these, *Eriborus molestae* (Uchida, 1933), is an Eastern Palaearctic (Japan, Korea) and Nearctic (USA) species, introduced to Australia (Yu *et al*. 2012). *Eriborus loculosus* (Vachal, 1907) and *Eriborus cryptoides* (Vachal, 1907) are known from New Caledonia, *Eriborus epiphyas* Paull & Austin, 2006 from Australia, *Eriborus iavilai* (Cheesman, 1936) from Australia, New Caledonia and Vanuatu, and *Eriborus tutuilensis* (Fullaway, 1940) from Fiji and American Samoa (Yu *et al*. 2012). Besides *Eriborus mirabilis* sp. nov. only one species, *Eriborus anomalus* (Tosquinet, 1903) is known from Papua New Guinea, as well as from the whole island of New Guinea (Yu *et al*. 2012). Since the majority of known species of the genus is tropical and/or subtropical, most probably several yet undescribed species occur in Australasia as well.

Nepiesta Förster, 1869 is small genus of the family Ichneumonidae, subfamily Campopleginae, with 12 valid species worldwide, including the presently described *Nepiesta cruella* sp. nov. All known *Nepiesta* species occur in the Palaearctic realm; most species are known only from the Western Palaearctic region, while *Nepiesta rasnitsyni* Kasparyan, 2011 is known only from the Eastern Palaearctic region, and *Nepiesta mandibularis* (Holmgren, 1860) from both regions

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(Yu *et al*. 2012). *Nepiesta tibialis* Horstmann, 1977 was described and still known only by a male specimen from the material of the Hungarian Natural History Museum (HNHM, Budapest) (Horstmann, 1977). In the material of HNHM, recently a female specimen of *Nepiesta tibialis* Horstmann, 1977 was found, collected in the same location, at the same date, and by the same collector as the holotype male (this female specimen missed Horstmann's attention, most probably because it was in a different drawer among the unsorted, unidentified material). As Horstmann's (1977) original description is rather short, a more detailed re-description of the species is given in this work, representing also the first description of the female.

MATERIAL AND METHODS

The taxonomical and faunistical results of this paper were yielded during the ongoing identification process of Ichneumonidae material housed in the HNHM. Type specimens of the presently described *Eriborus mirabilis* sp. nov. were collected by Imre Loksa (1923–1992), a pedozoologist and former head of the Department of Systematic Zoology and Ecology at Eötvös Loránd University (Budapest, Hungary) during his expedition to Papua New Guinea in 1968.

Taxonomy and nomenclature follow Yu & Horstmann (1997), and Yu *et al*. (2012); complete nomenclatural history and list of synonym taxa are not repeated here, since they were given in detail in these works. The morphological terminology applied in this paper is primarily based on Gauld (1991) and Gauld *et al*. (1997); however, in some cases, especially about of wing veins, the corresponding terminology of Townes (1969) is also indicated. The identifications and the provided key are based on Tosquinet (1903), Cameron (1907), Vachal (1907), Cheesman (1936), Fullaway (1940), Townes *et al*. (1961), Šedivý (1963), Momoi (1970), Townes (1970), Horstmann (1973, 1977, 1987), Aubert (1977), Kasparyan (1981, 2011), Jonathan (1999), Paull & Andrew (2006), Khalaim & Kasparyan (2007), Choi & Lee (2010), and on checking the relevant type material. Distributional records of species were checked and traced through the database of Yu *et al.* (2012). The specimens were identified and examined by the author using a Nikon SMZ 645 stereoscopic microscope, and are deposited in the Hymenoptera Collection of HNHM. Photos were taken with Nikon D5200 and Nikon AF Micro Nikkor 60mm lens and MitutoyoM Plan Apo 5X microscope lens. Exposures were stacked in ZereneStacker 1.04, post image work was done with ImageJ 1.52c and Photoshop CS5.

RESULTS

Taxonomy

Subfamily: Campopleginae Förster, 1869

Genus: *Eriborus* Förster, 1869

Type species. *Campoplex perfidus* Gravenhorst, 1829; designation by Morley (1913).

Eriborus mirabilis sp. nov.

(Figure 1)

Material examined. Holotype: female, Papua New Guinea [on label: New Guinea /NE/], Mt. Wilhelm, Field Station, 20.IX.1968, leg. I. Loksa, No. NG-M.R. 32; specimen card-mounted, right antenna damaged; Id. No. HNHM-HYM 153086. *Paratype*: female, same locality, date, collector; specimen card-mounted; Id. No. HNHM-HYM 153087. [The Mt. Wilhelm Field Station mentioned on the label was established in Chimbu Province, Mt. Wilhelm, Pindaunde Valley, near Lake Aunde, 5°47'26.9"S 145°03'29.2"E, *ca*. 3500 m a.s.l.]. The holotype and the paratype are deposited in the Hymenoptera Collection of HNHM (Budapest, Hungary).

Diagnosis. The new species can easily be distinguished from all other Australasian species of the genus by its elongated metasomal tergites (second tergite 2.3× as long as its apical width), which, from third tergite onwards, are distinctly excised medioapically, and by its unique coloration: ivory yellow pterostigma, mainly orange legs, more or less distinct faint bluish reflection on lateral parts of head and mesosoma.

Figure 1. Holotype of *Eriborus mirabilis* sp. nov., female, lateral habitus (photo: Z. Soltész, HNHM).

Description. Female (Fig. 1). Body length *ca.* 5.5 mm, fore wing length *ca.* 4 mm.

Head. Antenna with 27 flagellomeres; first flagellomere long and slender, *ca.* 4.5× as long as apically wide; preapical flagellomeres slightly longer than wide. Head transverse, granulate to finely granulate with relatively long and scattered whitish hairs. Ocelli small, ocular-ocellar distance 1.8–1.9× as long as ocellus diameter, posterior ocellar distance as long as or slightly shorter than ocellus diameter. Inner eye orbits weakly indented, parallel. Gena (temple) shinier than other parts of head, wide, weakly narrowed behind eye, in dorsal view about as long as eye width; in lateral view, at the level of ventral margin of eye, gena longer than basal width of mandible. Occipital carina complete, almost straight, reaching hypostomal carina before mandibular base; hypostomal carina normal, not elevated. Malar space relatively long, 0.8–0.9× as long as basal width of mandible. Face and clypeus almost flat in profile, granulate; face matt, clypeus slightly shinier. Clypeus very weakly separated from face, apical margin weakly convex. Lower margin of mandible with moderately wide flange from teeth toward base, mandibular teeth of equal length.

Mesosoma. Mesosoma with short, greyish hairs; hairs denser on dorsal parts, sparser on lateral parts; lateral parts shinier than dorsal parts. Pronotum almost entirely granulate, lower corner with few, weak transverse wrinkles. Mesoscutum granulate, convex in profile, 1.1× as long as wide; notaulus not developed. Scuto-scutellar groove wide, deep, very finely granulate to smooth. Scutellum granulate, convex in profile, without lateral carina. Mesopleuron finely granulate; speculum very finely sculptured to almost smooth. Pleural and ventral part of epicnemial carina complete, strong; transverse part (*i.e.* part at the level of sternaulus running through the epicnemium to the ventral edge of pronotum) absent; pleural part obliquely bent to anterior margin of mesopleuron reaching it below its middle height; ventral part of epicnemial carina slightly elevated. Sternaulus indistinct. Posterior transverse carina of mesosternum complete. Metanotum finely granulate. Metapleuron very finely granulate; juxtacoxal carina absent; submetapleural carina complete. Pleural carina of propodeum strong; propodeal spiracle small, short oval, separated from pleural carina by about its length. Propodeum granulate, long, its apex lengthened above hind coxa, reaching about one third of length of hind coxa; propodeal carinae distinct. Area basalis small, triangular, its basal width subequal to its length, its apical tip connected to the base of area superomedia by a single median carina about as long as area basalis. Area superomedia longer than wide, lateral carinae very weakly constricted apically, almost parallel; area superomedia apically opened, confluent with area petiolaris. Costula (section of anterior transverse carina between lateromedian and lateral longitudinal carinae) strong, complete, connecting to lateral margin of area superomedia before its middle.

Fore wing without areolet, intercubitus (2*rs-m*) *ca.* 0.5× as long as abscissa of *M* between intercubitus and second recurrent vein (2*m-cu*); distal abscissa of *Rs* straight, apically weakly curved toward *R*; distal abscissa of *M* weakly pigmented; nervulus (*cu-a*) almost interstitial to very weakly postfurcal, inclivous; postnervulus (abscissa of *Cu*1 between 1*m-cu* and *Cu*1a + *Cu*1b) intercepted above its middle by *Cu*1a; lower external angle of second discal cell acute (*ca.* 70°). Hind wing with nervellus (*cu-a* + abscissa of *Cu*1 between *M* and *cu-a*) weakly reclivous, not intercepted; discoidella (distal abscissa of *Cu*1) not connected to nervellus, very weak, not pigmented, spectral.

Legs rather long and slender. Coxae finely granulate. Hind femur long, slender, *ca*. 6× as long as high. Inner spur of hind tibia longer than outer spur, inner spur *ca*. 0.45–0.50× as long as hind basitarsus. Hind basitarsus with a midventral row of closely spaced, short hairs (appearing as a darker, more or less scaly, inconspicuous line). Tarsal claws relatively long, slightly to distinctly longer than arolium, with few weak and small basal pecten.

Metasoma. Metasoma (not including ovipositor) *ca*. 1.3–1.4× as long as combined length of head and mesosoma, compressed, very finely granulate to finely shagreened, rather shiny, with scattered, short, whitish hairs. First tergite long, narrow, *ca*. 3× as long as its apical width, with distinct, deep glymma; dorsomedian carina of first tergite indistinct; petiolus smooth, postpetiolus very finely granulate. Second tergite long, narrow, about as long as first tergite, 2.3× as long as its apical width; thyridium oval, its distance from basal margin of tergite 1.5× as long as its length. Third tergite 1.3–1.4× as long as its apical width. Epipleurum of second and third tergites separated by a crease. Posterior margin of third and following tergites medially concave, distinctly roundly excised, seventh tergite strongly excised. Ovipositor sheath 1.0–1.1× as long as hind tibia (2× as long as first tergite, 3× as long as apical depth of metasoma, *ca*. 0.5× as long as metasoma, *ca*. 0.3× as long as body length), ovipositor upcurved, dorsal preapical notch distinct, tip narrowed, acute.

Colour. Head and mesosoma predominantly black with a more or less distinct faint bluish reflection on lateral parts; antenna brown to light brown, scapus and pedicellus ventrally yellowish brown; head black except yellow palpi and mandibles, mandibular teeth reddish brown; mesosoma black except pale yellow tegula. Metasoma: first tergite black; second tergite black, apical margin narrowly brownish; third tergite basally blackish, apically brown; from third tergite onwards, tergites brown to reddish brown; ovipositor sheath brown. Wings hyaline, wing veins light brown, pterostigma ivory yellow. Fore leg: coxa dull yellow; trochanter and trochantellus yellow; femur, tibia, and tarsus light orange. Middle leg: coxa reddish to yellowish brown; trochanter and trochantellus yellow; femur, tibia, and tarsus orange. Hind leg: coxa black to dark brown; trochanter brown; trochantellus yellow; femur orange, narrowly and faintly more or less darkened basally; tibia orange, basally very narrowly darkened; tarsus orange, last tarsomere brownish.

Male. Unknown.

Distribution. Currently known from Papua New Guinea (Mount Wilhelm).

Ecology. No host is known. The new species might be a koinobiont endoparasitoid of lepidopterous hosts, similarly to other *Eriborus* species with known hosts.

Etymology. The specific epithet "mirabilis" is a Latin adjective (masculine gender, nominative case) meaning marvellous, wonderful, admirable, remarkable; it refers to the extraordinary colouration of the new species.

Genus: *Nepiesta* Förster, 1869

Type species. *Nepiesta subclavata* Tomson, 1887.

Nepiesta cruella sp. nov.

(Figure 2)

Material examined. Holotype: female, Jordan, 6.IV.1956, leg. J. Klapperich; specimen card-mounted, left antenna damaged, right middle leg missing; Id. No. HNHM-HYM 153101. The holotype is deposited in the Hymenoptera Collection of HNHM (Budapest, Hungary).

Diagnosis. The new species belongs to the morphological group of *Nepiesta* species characterised by ventrally flattened hind trochantellus and distinctly shortened hind basitarsus [this morphological group consists of the species previously included in the genus *Eripternus* Förster, 1869 in Šedivý (1963) and Kasparyan (1981), now considered a junior synonym of *Nepiesta* (Yu & Horstmann 1997)]. *Nepiesta cruella* sp. nov.

can easily be distinguished from all other species of this morphological group – namely *Nepiesta tarsalis* (Szépligeti, 1911) and *Nepiesta atrator* (Aubert, 1977) – by its entirely reddish middle and hind femora and tibiae (at least middle and hind femora are almost entirely black in both other species). Additionally, the new species differs from *Nepiesta tarsalis* (Szépligeti, 1911) by its black tegula and having the lower mandibular tooth longer than the upper, and from *Nepiesta atrator* (Aubert, 1977) by its stouter second tergite and having the nervellus intercepted below middle.

Figure 2. Holotype of *Nepiesta cruella* sp. nov., female, lateral habitus (photo: T. Németh, HNHM).

Description. Female (Fig. 2). Body length ca 5 mm, fore wing length ca 4 mm.

Head. Antenna with 26 flagellomeres; first flagellomere long and slender, *ca*. 4× as long as wide apically; preapical flagellomeres slightly longer than wide. Head with short and scattered, greyish hairs, transverse, granulate, distinctly and densely punctate, punctures separated from each other by usually less than a puncture diameter. Ocelli small, ocular-ocellar distance 1.6–1.7× as long as ocellus diameter, posterior ocellar distance 1.7× as long as ocellus diameter. Inner eye orbits slightly indented, parallel. Gena (temple) wide, not narrowed behind eye, in dorsal view about as long as eye width. Occipital carina bent outward ventrally, reaching hypostomal carina at mandible base, extreme ventral part obsolescent; hypostomal carina slightly elevated. Malar space 0.6× as long as basal width of mandible. Face and clypeus weakly convex in profile, and strongly, densely punctate. Face coarsely granulate, matt. Clypeus wide, shinier than face, dorsal part finely granulate, ventral part almost smooth, punctures stronger than on face, apical margin convex. Mandible rather strong and long, basal half strongly, densely punctate, lower margin without flange, lower tooth distinctly longer than upper tooth.

Mesosoma. Mesosoma with short, greyish hairs; hairs denser on dorsal parts, sparser on lateral parts. Dorsal part of pronotum densely punctate on finely granulate surface, punctures separated from each other by usually less than a puncture diameter, ventral part of pronotum with strong transverse wrinkles on smoother, shinier surface. Mesoscutum finely granulate, and densely, coarsely punctate, punctures separated from each other by usually less than a puncture diameter; mesoscutum convex in profile, about as long as wide; notaulus not developed. Scuto-scutellar groove wide, deep. Scutellum densely punctate on granulate surface, punctures separated from each other by usually less than a puncture diameter; scutellum convex in profile, without lateral carina. Mesopleuron densely punctate on granulate to finely granulate surface, punctures separated from each other by usually less than a puncture diameter; anterior two-third of speculum shagreened, posterior third smooth. Pleural and ventral part of epicnemial carina complete, strong; transverse part (*i.e.* part at the level of sternaulus running through the epicnemium to the ventral edge of pronotum) absent; pleural part obliquely bent to anterior margin of mesopleuron reaching it below its middle height; ventral part of epicnemial carina slightly elevated. Sternaulus indistinct. Posterior transverse carina of mesosternum complete. Metanotum granulate. Metapleuron densely punctate on granulate surface, punctures separated from each other by usually less than a puncture diameter; juxtacoxal carina indistinct; submetapleural carina complete. Pleural carina of propodeum strong; propodeal spiracle small, circular, separated from pleural carina by about 2× its length. Anterior third of propodeum densely punctate on granulate surface, punctures separated from each other by usually less than a puncture diameter; posterior two-third of propodeum granulate with strong, dense irregular wrinkles; propodeal carinae only partly developed. Area basalis very small, trapezoidal. Area superomedia narrow, longer than wide, its lateral carinae weakly divergent apically; area superomedia apically opened, confluent with area petiolaris. Costula (section of anterior transverse carina between lateromedian and lateral longitudinal carinae) indistinct.

Fore wing with relatively large, tetragonal areolet, posterior half of 3*rs-m* weakly pigmented, 2*rs-m* about as long as abscissa of *M* between 2*rs-m* and second recurrent vein (2*m-cu*); distal abscissa of *Rs* straight, apically weakly curved toward *R*; distal abscissa of *M* weakly pigmented; nervulus (*cu-a*) postfurcal by about its width, slightly inclivous; postnervulus (abscissa of *Cu*1 between 1*m-cu* and *Cu*1a + *Cu*1b) intercepted below its middle by *Cu*1a; lower external angle of second discal cell almost right-angle. Hind wing with nervellus (*cu-a* + abscissa of *Cu*1 between *M* and *cu-a*) intercepted little below middle by discoidella (distal abscissa of *Cu*1), discoidella very weakly pigmented to spectral.

Coxae finely granulate with weak, dense punctures. Hind trochantellus distinctly flattened from below. Hind femur rather stout, *ca.* 4× as long as high. Inner spur of hind tibia longer than outer spur, inner spur *ca*. 0.6× as long as hind basitarsus. Hind basitarsus shortened, distinctly shorter than middle basitarsus. Tarsal claws small, thin, about as long as arolium, without basal pecten.

Metasoma. Metasoma finely to very finely granulate with short, dense, greyish hairs. First tergite long, narrow, *ca*. 3× as long as its apical width, without glymma; dorsomedian carina of first tergite not developed; petiolus smooth, postpetiolus very finely granulate. Second tergite 1.3× as long as its apical width; thyridium absent. Third tergite about as long as its apical width. Epipleurum of second and third tergites separated by a crease. Ovipositor sheath short, about as long as apical depth of metasoma; ovipositor straight, dorsal preapical notch distinct, tip acute.

Colour. Antenna black to dark brown. Head black except brownish middle of mandibles and light brown palpi. Mesosoma, including tegula, black. Metasoma black. Wings hyaline, wing veins brown, pterostigma brown. Fore leg: coxa blackish; trochanter dark brown, trochantellus brown; femur light reddish, basal one-sixth brown; tibia light reddish; tarsus light reddish, apical tarsomeres brownish. Middle leg: coxa blackish; trochanter dark brown, trochantellus brown; femur reddish, basal one-sixth brown; tibia reddish; tarsus brownish. Hind leg: coxa black; trochanter dark brown, trochantellus dark brown to brown; femur entirely reddish; tibia reddish, apically slightly darkened; tarsus brownish, extreme basal parts of tarsomeres yellowish.

Male. Unknown.

Distribution. Currently known from Jordan.

Ecology. No host is known. The only other *Nepiesta* species with known hosts, *Nepiesta tarsalis* (Szépligeti, 1911), is a koinobiont endoparasitoid of the leaf beetle *Colaphellus sophiae* (Schaller, 1783) (Coleoptera: Chrysomelidae) (Müller 1950).

Etymology. The specific epithet "cruella" is derived from the name Cruella de Vil, a fictional antagonist character created by the English author Dorothy Gladys Smith in her novel, The Hundred and One Dalmatians, in 1956. The new species shows a superficial resemblance in colouration (black body with reddish legs) to Cruella de Vil's usual clothing in her animated and live-action adaptations (black dress with red gloves and shoes). Another reason of this choice was to dignify Dorothy Gladys Smith's creative pun in naming this villain character, which name, I believe, fits very well to an ichneumon wasp, too. The specific epithet is a proper noun in apposition, its ending not to be changed.

Nepiesta tibialis Horstmann, 1977

(Figure 3)

Material examined. Male (holotype), Jordan [on label: O. Jordan], Jordan Valley [on label: Jordantal], Arda Road, 600 m, 8.III.1958, leg. J.

Klapperich, specimen pinned, Id. No. HNHM-HYM 100288. – Female, same location, date, and collector, specimen pinned, Id. No. HNHM-HYM 153102. – The holotype male specimen and the below described female specimen are deposited in the Hymenoptera Collection of HNHM (Budapest, Hungary). [Note that in the original description of the species, the year of the collection of the holotype specimen is erroneously indicated as 1959 (Horstmann 1977); the correct date from the label is the one given here.]

Diagnosis. Nepiesta tibialis Horstmann, 1977 is characterised by normal (not flattened from below) hind trochantellus and not shortened hind basitarsus (hind basitarsus not shorter than middle basitarsus). *Nepiesta tibialis* Horstmann, 1977 is most similar in colouration to *Nepiesta mandibularis* (Holmgren, 1860), as both species have yellow tegula, yellowish pterostigma, and entirely to predominantly dark metasoma and hind femur. *Nepiesta tibialis* Horstmann, 1977 can be easily distinguished from *Nepiesta mandibularis* (Holmgren, 1860) by the colouration of the hind tibia: externo-medially it is distinctly creamy yellowish in *Nepiesta tibialis* Horstmann, 1977, while reddish brown in *Nepiesta mandibularis* (Holmgren, 1860).

Description. Female (Fig. 3). Body length *ca*. 5 mm, fore wing length ca 4 mm.

Head. Antenna with 23 flagellomeres; first flagellomere *ca*. 3.5× as long as wide apically; preapical flagellomeres longer than wide. Head with dense, greyish hairs, transverse, granulate and distinctly, densely punctate, punctures separated from each other by usually less than a puncture diameter. Ocelli small, ocular-ocellar distance 1.6× as long as ocellus diameter, posterior ocellar distance about 2× as long as ocellus diameter. Inner eye orbits slightly indented, parallel. Gena (temple) wide, weakly narrowed behind eye, in dorsal view about 0.8× as long as eye width. Occipital carina reaches hypostomal carina before mandible base; hypostomal carina slightly elevated. Malar space only slightly shorter than basal width of mandible. Face and clypeus weakly convex in profile, and strongly, densely punctate. Face coarsely granulate, matt. Clypeus wide, shinier than face, dorsal part finely granulate, ventral part almost smooth, punctures stronger than on face, apical margin convex. Mandible rather long, upper tooth slightly longer than lower tooth.

Figure 3. Female of *Nepiesta tibialis* Horstmann, 1977, Id. No. HNHM-HYM 153102, lateral habitus (photo: T. Németh, HNHM).

Mesosoma. Mesosoma with short, dense, greyish hairs. Dorsal part of pronotum densely punctate on finely granulate surface, punctures separated from each other by usually less than a puncture diameter, ventral part of pronotum with strong transverse wrinkles on smoother, shinier surface. Mesoscutum finely granulate, and densely, coarsely punctate, punctures separated from each other by usually less than a puncture diameter; mesoscutum convex in profile, about as long as wide; notaulus not developed. Scuto-scutellar groove wide, deep. Scutellum densely punctate on granulate surface, punctures separated from each other by usually less than a puncture diameter; scutellum convex in profile, without lateral carina. Mesopleuron densely punctate on granulate to finely granulate surface, punctures separated from each other by usually less than a puncture diameter; speculum very finely granulate to smooth. Pleural and ventral part of epicnemial carina complete, strong; transverse part (i.e. part at the level of sternaulus running through the epicnemium to the ventral edge of pronotum) absent; pleural part obliquely bent to anterior margin of mesopleuron reaching it below its middle height; ventral part of epicnemial carina slightly elevated. Sternaulus indistinct. Posterior transverse carina of mesosternum complete. Metanotum granulate. Metapleuron densely punctate on granulate surface, punctures separated from each other by usually less than a puncture diameter; juxtacoxal carina indistinct; submetapleural carina complete. Pleural carina of propodeum basally strong, apically weak; propodeal spiracle small, circular, separated from pleural carina by about its length. Anterior half of propodeum densely punctate on granulate surface, punctures separated from each other by usually less than a puncture diameter; posterior half granulate with mostly transverse wrinkles; propodeal carinae only partly developed, rather weak. Area basalis very small, trapezoidal. Area superomedia finely granulate, longer than wide, its lateral carinae weakly convergent posteriorly, apically weakly closed. Costula (section of anterior transverse carina between lateromedian and lateral longitudinal carinae) short, indistinct, connecting to lateral margin of area superomedia before its middle. Apical part of area superomedia and area petiolaris with transverse wrinkles.

Fore wing without areolet, 2*rs-m* longer than abscissa of *M* between 2*rs-m* and second recurrent vein (2*m-cu*); distal abscissa of *Rs* straight, apically weakly curved toward *R*; distal abscissa of *M* weakly pigmented; nervulus (*cu-a*) interstitial, straight; postnervulus (abscissa of *Cu*1 between 1*m-cu* and *Cu*1a + *Cu*1b) intercepted at its middle by *Cu*1a; lower external angle of second discal cell almost right-angle. Hind wing with nervellus (*cu-a* + abscissa of *Cu*1 between *M* and *cu-a*) intercepted distinctly below middle by discoidella (distal abscissa of *Cu*1), discoidella very weakly pigmented to spectral.

Coxae finely granulate with weak, dense punctures. Hind trochantellus normal, not flattened from below. Hind femur rather stout, *ca*. 4× as long as high. Inner spur of hind tibia longer than outer spur, inner spur ca 0.6× as long as hind basitarsus. Hind basitarsus as long as middle basitarsus. Tarsal claws small, thin, about as long as arolium, without basal pecten.

Metasoma. Metasoma granulate to finely granulate with short, dense, greyish hairs. First tergite finely granulate, narrow, *ca*. 2.5× as long as its apical width, without glymma, dorsomedian carina not developed. Second tergite about as long as its apical width; thyridium absent. Third and following tergites shorter than apical width. Epipleurum of second and third tergites separated by a crease. Ovipositor sheath short, about as long as apical depth of metasoma; ovipositor straight, dorsal preapical notch distinct, tip acute.

Colour. Antenna black to dark brown. Head black; mandibles mainly yellow, basally black, teeth brownish, palpi light brown. Mesosoma black except yellow tegula. Metasoma black, except very narrow yellowish patches at apical edges of first and second tergites. Wings hyaline, wing veins brown, pterostigma yellowish. All coxae, trochanters and trochantelli black, with narrow yellowish patches on trochantelli. Fore femur yellowish, basal half predominantly black; middle and hind femur black, apically narrowly yellowish. Fore tibia yellowish; middle tibia yellowish brown; hind tibia basally and externomedially creamy yellow, subbasally, interno-medially and apically dark brown. All tarsi yellowish brown to brown.

Male. Similar to female in all characters described above, except whole speculum very finely granulate, and metasoma slightly slenderer, first tergite 3× as long as its apical width, second tergite 1.2× as long as its apical width; antennae of the holotype male are broken, number of flagellomeres unknown; see also the original description (Horstmann 1977).

Distribution. Currently known from Jordan and from Turkmenistan (see below in Biogeography section).

Identification

An identification key to the Australasian species of *Eriborus* is provided below. Since four out of the eight Australasian species are known only by females, this key works for females; hence, *Eriborus cryptoides* (Vachal, 1907), a New Caledonian species described and known by male only, is not considered here. Distributional information is given in brackets.

1. Pterostigma ivory yellow .... *Eriborus mirabilis* sp. nov. [Papua New Guinea]
– Pterostigma entirely or predominantly brown **2**

2. Hind coxa yellowish to light yellowish or reddish brown ... **3**
– Hind coxa black or very dark brown **4**

3. Petiolus entirely reddish . *Eriborus iavilai* (Cheesman, 1936) [Australia, New Caledonia, Vanuatu]
– Petiolus almost entirely black................*Eriborus tutuilensis* (Fullaway, 1940) [Fiji, American Samoa]

4. Metasoma entirely black, hind femur almost entirely blackish...........................*Eriborus loculosus* (Vachal, 1907) [New Caledonia]
– Metasoma not entirely black, hind femur not blackish...... **5**

5. Metasoma basally black, dark brownish in the middle, apically black .... *Eriborus molestae* (Uchida, 1933) [Australia, introduced]
– Metasoma apically reddish brown, not black **6**

6. Second tergite slightly shorter than its apical width ....
.............*Eriborus epiphyas* Paull et Austin, 2006 [Australia]
– Second tergite 1.5× as long as its apical width ....
Eriborus anomalus (Tosquinet, 1903) [Papua New Guinea]

An identification key to all known species of *Nepiesta* is provided below. This key is largely based on Horstmann (1973); however, updated and completed with the subsequently described species in Horstmann (1977), Kasparyan (2011), and in present study, and with *Nepiesta tarsalis* (Szépligeti, 1911) and *Nepiesta atrator* (Aubert, 1977), which species were previously included in the genus *Eripternus*, now considered a junior synonym of *Nepiesta* (Yu & Horstmann 1997).

1. Hind basitarsus distinctly shorter than middle basitarsus, hind trochantellus distinctly flattened from below............... **2**
– Hind basitarsus not shorter than middle basitarsus, hind trochantellus normal, not flattened from below **4**

2. Tegula yellow, upper mandibular tooth longer than lower tooth..............................*Nepiesta tarsalis* (Szépligeti, 1911)
– Tegula black, upper mandibular tooth shorter than lower tooth... **3**

3. Hind femur entirely to almost entirely black ....
....*Nepiesta atrator* (Aubert, 1977)
– Hind femur entirely reddish...........*Nepiesta cruella* sp. nov.

4. Tegula black or dark brown... **5**
– Tegula yellow.. **7**

5. Metasoma basally and apically black, middle tergites of metasoma widely reddish, second tergite distinctly longer than its apical width ....*Nepiesta rufocincta* Strobl, 1904
– Metasoma entirely or predominantly dark **6**

6. Area superomedia about as long as area petiolaris, second tergite about as long as its apical width in females, longer than its apical width in males ....
.... *Nepiesta jugicola* Strobl, 1904
– Area superomedia distinctly shorter than area petiolaris, second tergite longer than its apical width in both sexes........
...............................*Nepiesta robusta* Schmiedeknecht, 1909

7. Hind femur predominantly reddish, middle tergites of metasoma widely reddish.. **8**
– Hind femur predominantly black, metasoma entirely dark or dark with brownish bands **9**

8. Antenna with 21 flagellomeres, area superomedia 1.5× as long as long as wide, anterior part of nervellus strongly inclivous.......................*Nepiesta hungarica* Szépligeti, 1916
– Antenna with 26–28 flagellomeres, area superomedia 2× as long as long as wide, anterior part of nervellus vertical ....
.... *Nepiesta rasnitsyni* Kasparyan, 2011

9. Pterostigma yellowish, metasoma entirely to predominantly dark **10**
– Pterostigma brown, metasoma dark with brownish bands .. **11**

10. Hind tibia externo-medially creamy yellowish ....
.... *Nepiesta tibialis* Horstmann, 1977
– Hind tibia externo-medially reddish brown ....
.... *Nepiesta mandibularis* (Holmgren, 1860)

11. Malar space shorter than basal with of mandible, mesoscutum and mesopleuron rather sparsely punctate, punctures separated from each other by usually more than a puncture diameter, dark apical band of hind tibia longer than wide......................*Nepiesta subclavata* Thomson, 1887
– Malar space as long as basal with of mandible, mesoscutum and mesopleuron rather densely punctate, punctures separated from each other by usually less than a puncture diameter, dark apical band of hind tibia very narrow ....
.................................*Nepiesta tricingulata* Horstmann, 1973

Biogeography

The first records of *Eriborus obscuripes* Horstmann, 1987 from Romania, *Eriborus terebrator* Aubert, 1960 from Hungary and Spain, *Nepiesta mandibularis* (Holmgren, 1860) from Hungary and Romania, *Nepiesta rufocincta* Strobl, 1904 from Romania, and *Nepiesta tibialis* Horstmann, 1977 from Turkmenistan are reported below.

Eriborus obscuripes Horstmann, 1987

Material. Romania, Arad County, Ineu [on label: Borosjenő], 13.VI.1927, collector unknown, 1♂. – Romania, Cluj County, Ocna Dejului [on label: Désakna], date unknown, leg. E. Zilahi-Kiss, 1♂.

Remarks. First records for Romania. This species was previously known from several Western and Middle European countries; these Romanian records represent its easternmost occurrence (Yu *et al*. 2012).

Eriborus terebrator Aubert, 1960

Material. Hungary, Budapest, 18th District, Kossuth Street, IX.2014, leg. V. Szőke, 1♀. – Spain, Catalonia, Province of Lleida, 6 km E of Bassella Ogern, 13–14.V.2003, leg Gy. & I. Rozner, 1♀.

Remarks. First records for Hungary and Spain. This species was known from France, Bulgaria and Italy so far (Yu *et al*. 2012, Di Giovanni & Reshchikov 2016).

Nepiesta mandibularis (Holmgren, 1860)

Material. Hungary, Budapest, Csepel, date 11. IV.1895, leg. Gy. Szépligeti, 3♀. – Hungary, Budapest, Svábhegy, IV.1895, leg. Gy. Szépligeti, 1♀. – Hungary, Somogy County, Babócsa, 7.IV.2001, leg. unknown, 1♀. – Romania, Mureș County, Saschiz [on label: Kaisd-Saschiz], date unknown, leg. Silbernagel, 1♂.

Remarks. First records for Hungary and Romania. This species has been known from several countries of the Palaearctic region (Yu *et al*. 2012).

Nepiesta rufocincta Strobl, 1904

Material. Romania, Bistrița-Năsăud County, Rodna Mts, Vârful Ineu (= Ineu Peak) [on label: Radnai-havasok, Ünőkő], 17.VII.1908, leg. E. Csiki, 1♀.

Remarks. First record for Romania. This species has been known from Austria, France, Germany, and Poland so far; this Romanian record represents its easternmost occurrence (Yu *et al.* 2012).

Nepiesta tibialis Horstmann, 1977

Material. Turkmenistan, Kopet Dagh Mts, 6 km W of Germob, Kurkulab, 850 m, 19.IV.1993, leg. M. Hreblay, Gy. László & A. Podlussány, No. L89, 1♀.

Remarks. First record for Turkmenistan (and, hence, for the Eastern Palaearctic region). This species has been known only from Jordan so far (Yu *et al*. 2012).

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First record of the exotic earthworm *Metaphire bahli* (Gates, 1945) (Oligochaeta: Megascolecidae) from India

S.P. NARAYANAN[1*], S. SATHRUMITHRA[1], R. ANUJA[2], G. CHRISTOPHER[1],
A.P. THOMAS[1]& J.M. JULKA[3]

[1]*Sasankan Prasanth Narayanan, Somanadhan Sathrumithra, Guna Christopher & Ambattu Paili Thomas, Advanced Centre of Environmental Studies and Sustainable Development, Mahatma Gandhi University, Priyadarsini Hills, Kottayam – 686560, Kerala, India. Email: narayanankc@gmail.com *Corresponding author*

[2]*Rajagopal Anuja, School of Environmental Sciences, Mahatma Gandhi University, Priyadarsini Hills, Kottayam – 686560, Kerala, India.*

[3]*Jatinder Mohan Julka, School of Biological and Environmental Sciences, Faculty of Basic Sciences, Shoolini University, Solan –173 212, Himachal Pradesh, India.*

Abstract. The occurrence of the exotic earthworm species *Metaphire bahli* (Gates, 1945) of the family Megascolecidae is recorded for the first time from India. Specimens were collected from the Alappuzha District of Kerala State. Its detailed description along with geographical distribution is provided.

Keywords. Annelida, Peregrine, Kerala, New record, Western Ghats.

INTRODUCTION

India is one of the mega earthworm biodiversity countries, about 71% of genera and 89% of earthworm species are endemic here (Julka & Paliwal 2005). Currently 425 earthworm species and subspecies belonging to 10 families and 67 genera are recorded from India (Julka 2014, Ahmed & Julka 2017, Mandal *et al.* 2017, Narayanan *et al.* 2017, Kharkongor 2018). Within the country, the Western Ghats biodiversity hotspot along with the western coastal plains stand out as the regions with the highest level of earthworm species richness, consisting of *ca*. 53% of the country's earthworm diversity (Julka & Paliwal 2005). Kerala State is a narrow strip of land spreading over an area of 38,863 km^2 along the southwest corner of the Indian subcontinent (between 8°17'–12°47'N and 74°52'–77°24'E). It is an important biodiversity region as 48% of its area belongs to the Western Ghats. Various workers have contributed to the taxonomical studies of the earthworm fauna of the state but most of the earthworm species of Kerala were recorded more than 80–90 years ago and many are known only from the original description (Narayanan *et al.* 2016*a*). At present 98 species/subspecies belonging to 27 genera and 9 families are reported from the state, of which 17 are exotic (Narayanan *et al.* 2016*a*, *b*, *c*, 2017). However, the diversity and distribution pattern of alien earthworm species of Kerala State are still not fully understood (Narayanan *et al*. 2016*d*). As part of our study to assess the earthworm diversity of Kerala State, we have sampled various regions of the Alappuzha District, which revealed the presence of the exotic *Metaphire bahli* (Gates, 1945). Survey of relevant literature affirmed that this species has not been previously reported from India (Stephenson 1923, Gates 1972, Blakemore 2012).

MATERIALS AND METHODS

Earthworms were collected by digging and hand sorting method as proposed by Julka (1990). Collected specimens were preserved in 5% for-

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malin. All anatomical observations were made by dorsal dissection under a binocular stereomicroscope (Nikon SMZ800N). Specimens were identified following Gates (1945), Blakemore (2012, 2016) and Nguyen *et al.* (2017). Collected specimens were deposited in the earthworm laboratory of the Advanced Centre of Environmental Studies and Sustainable Development, Mahatma Gandhi University, Kerala, India.

RESULTS

Family Megascolecidae Rosa, 1891

Metahire bahli (Gates, 1945)

(Figures 1A−D, 2)

Pheretima bahli Gates, 1945: 85, 1972: 209.
Metaphire bahli: Sims & Easton 1972: 239, Blakemore 2012: 426, 2016: 22, Nguyen *et al.* 2017: 894.

Type locality. Colombo in Sri Lanka (Gates 1945).

Type material. Unknown (Nguyen *et al.* 2016).

Material examined. 12 clitellate and 3 aclitellate specimens, Reg. No. ACESSD/EW/880, Chennithala, 9.273746°N, 76.529845°E), Alappzuha District, Kerala State, India, 27 August 2018, leg. S.P. Narayanan (Fig. 2).

Description. Medium size, color reddish brown in life. Length 76–121 mm, diameter 4–5 mm, segments 79–119. Setae perichaetine, 73+ in preclitellar segment and 91+ in post-clitellar segment. Prostomium epilobous open. Dorsal pores from intersegmental furrow 12/13. Clitellum annular, in segments 14–16. Spermathecal pore three pairs, in furrows 6/7/8/9. Female pore on 14. Male field concave to form an ellipsoidal shape. Male pores embedded in copulatory pouches in segment 18. Genital markings two pairs, invaginate, in 17/18 and 18/19, in line with secondary male apertures. Holandric. Gizzard in segment 8. Intestinal caeca simple, in 27 to 24. Typhlosole present, simple. Meronephric. Prostate racemose, in 17–20, prostatic duct long, thick at the ectal end and sinuous towards the ental portion; Spermathecae three pairs, duct shorter than ampulla, diverticulum slender, coiled and with a bulb like seminal chamber at the ental end, diverticulum starts from the ectal portion of the duct. Genital marking glands slightly sausage shaped, spheroidal in dorsal view.

Ingesta. Mainly sand and major portion of it is tiny quartz, also a few pieces of rootlets, bark and colloids.

Remarks. At the collection site this species coexisted with a number of native (*Megascolex konkanensis konkanenis* Fedarb, 1898 and *Megascolex* sp.) and exotic species (*Pontoscolex corethrurus* (Müller, 1857) and *Metaphire houlleti* (Perrier, 1872)). Once collected out from the soil, it remained motionless for a bit of time. When disturbed, it moved away with serpentine motion with great agility through sand and even through grasses.

DISCUSSION

Metaphire bahli morphologically belongs to the *peguana* species group consisting of *M. peguana peguana* (Rosa, 1890), *M. peguana laisonensis* Nguyen & Nguyen, 2017 and *M. doiphamon* Bantaowong & Panha, 2016. Members of this group have similar number and position of spermathecal pores, genital markings and morphology of male region (Bantaowong *et al.* 2016, Blakemore 2016, Nguyen *et al.* 2017). However, they are distinguished from each other by size, shape of genital markings in male region, origin of spermathecal diverticula and shape of the prostate (Bantaowong *et al.* 2016, Nguyen *et al.* 2017). *M. bahli* was described from Sri Lanka (Gates 1945), but the original home is supposed to be the region of Thailand/Laos (Blakemore 2012). Present record from Chennithala, Kerala State represents the first record of this species from India. So far, this species is known mainly from Asia (Cambodia, Laos, Myanmar, Philippines, Sri Lanka, Thailand and Vietnam) and Australia (Gates 1945, 1972, Blakemore 2012, Nguyen *et al.* 2016, 2017). Apart from *M. bahli,* two other species of *Metaphire* are known from Kerala State; they are

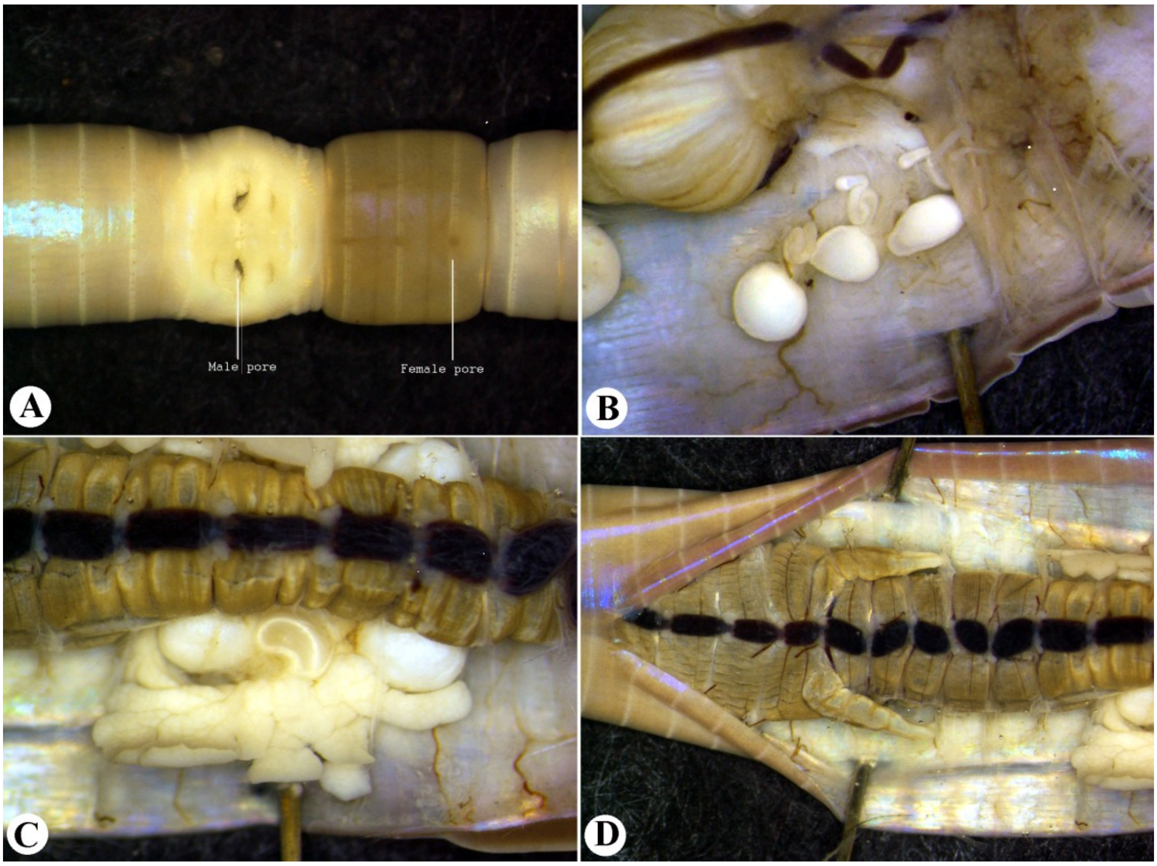

Figure 1. *Metaphire bahli* (Gates, 1945), A = Clitellum, female pore, male field and genital markings, B = Spermathecae, C = Prostate, D = Caeca.

Table 1. Character comparison among the *Metaphire* species found in Kerala Sate, India
Based on: § Blakemore (2012); Nguyen *et al.* (2017); # present study

Character	***M. houlleti* §**	***M. peguana* §**	***M. bahli* #**
Length (mm)	40–240	115–240	76–121
Diameter (mm)	2.6–7	4.2–8	4–5
Segments	73–200	97–125	79–119
Prostomium	Epilobous open	Epilobous open	Epilobous open
First dorsal pore	Often in 9/10 or11/12, sometimes in 7/8–12/13	12/13	12/13
Spermathecal pore	6/7/8/9	6/7/8/9	6/7/8/9
Genital markings	Usually absent, when present near spermathecal pores	17/18 and 18/19, nearly elliptical pads with slit-like central apertures	17/18 and 18/19, invaginate
Morphology of male region	Not concave	Not concave	Strongly concave
Spermathecal diverticula origin	Entally	Ectally	Ectally
Intestinal caeca	27–22	27–22	27-24
Prostate	Racemose in 16,17–20, 21,	Racemose in 16–21	Racemose in 17–20

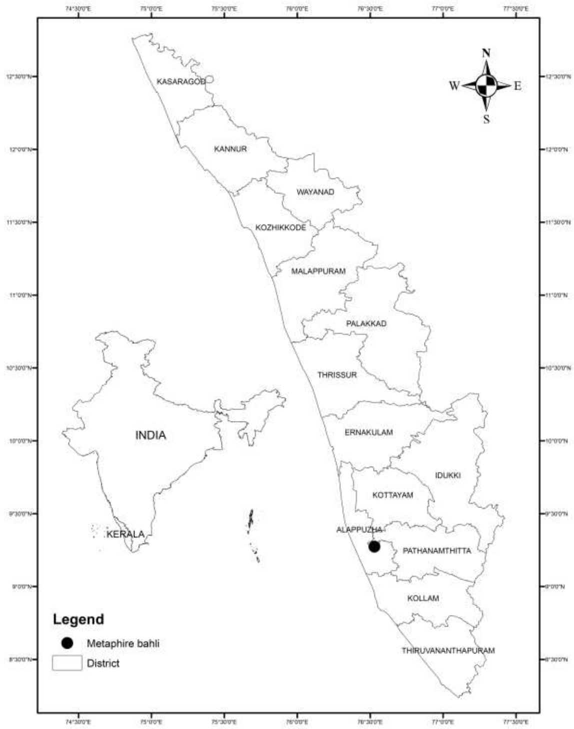

Figure 2. Location of the *Metaphire bahli* (Gates, 1945) collection site in India.

M. houlleti (Perrier, 1872) and *M. peguana* (Rosa, 1890). Key characters to distinguish these species are provided in table 1. The former is now widely distributed in the state (Narayanan *et al.* 2015) and the latter is known only from a single location (Narayanan *et al.* 2016*b*).

Occurrence of the exotic invasive species such as *Pontoscolex corethrurus* (Müller, 1857) and *M. houlleti* in Kerala State was reported around a century back (Fedarb 1898, Michaelsen 1910, Stephenson 1916), and now they are found widely colonized here (Narayanan *et al.* 2015, 2016*d*). Being a cosmopolitan invasive species *M. bahli* could establish itself in different regions of the country with time. Further collections in the surrounding areas should be carried out to determine whether this species has been colonized in other similar areas of the region. Hitherto, existence of 51 exotic earthworm species has been documented from India (Julka 2014, Ahmed & Julka 2017). With the addition of *M. bahli*, the number rose to 52 species. Many regions of India remain unexplored regarding the earthworm fauna and the country has been a trade center since millennia. Hence, further intensive surveys may unearth the presence of many new exotic species from the country.

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A new species of *Orthosia* (Lepidoptera: Noctuidae) from Vietnam

P. GYULAI

Péter Gyulai, H–3530 Miskolc, Mélyvölgy 13/A, Hungary. E–mail: gyulainegarai.adrienne@upcmail.hu

Abstract. The description and diagnosis of *Orthosia franzhoferi* sp. nov. are given. The new species and three closely related taxa are illustrated with 4 imagines in colour and 4 female genitalia figures.

Keywords. Lepidoptera, Noctuidae, *Orthosia*, new species, Vietnam.

INTRODUCTION

The most recent survey on the Asiatic *Orthosia* species was published by Ronkay *et al.* (2010) providing descriptions of 11 new species and 3 new subspecies from China, Indochina and Taiwan. The subsequent investigations on the winter fauna of northern Indochina revealed the existence of another *Orthosia* (s.l.) species in North Vietnam which is described here as new to science.

Abbreviations for personal and institutional collections used are as follows: HNHM = Hungarian Natural History Museum (Budapest, Hungary); PGM = collection of Péter Gyulai (Miskolc, Hungary); PGY= genitalia slide of Péter Gyulai.

TAXONOMY

Orthosia franzhoferi sp. nov.

(Figures 1–6)

Material examined. *Holotype*: female (Fig. 1) "N. Vietnam, Fan-si-pan Mts., N-seite Cha-pa (=Sapa), 1000m, 22.17ºN 103.44ºE, prim. Urwald, 28.X.–3.XI. 1994, leg. Sinjaev & einh. Sammler, ex coll. A. Schintlmeister, ex coll. F. Hofer", "coll. Dr. P. Gyulai, Miskolc, Hungary", slide No. PGY2092♀ (coll. PGM, later to be deposited in the HNHM).

Description. The main external features of the new species are the brown head and thoracic vesture, the pale brown, unicolorous ground colour of wings with slight red-brown shade in the forewings, sparsely with tiny black dots; the reduced (obsolete) wing pattern with conjectural, poorly defined, ghost–like stigmata; the poorly visible transversal lines from which the arcuate postmedial line is somewhat better indicated by blackish dots; the subterminal line is thin and yellow, slightly defined by red scales at the inner side; the hindwing median fascia is represented by a few blurred brown signs on the main veins; and the indistinct, brown hindwing discal spot. The wingspan of the single known female is 35 mm; the antennae are thin, filiform.

Female genitalia. The main characters of *O. franzhoferi* (Fig. 4) are the large, broad, setose papillae anales and long apophyses anteriores and posteriores; the sclerotized, rather tubular antrum with somewhat oval ostium bursae; the long ductus bursae, belt-like appendix bursae and plum-like corpus bursae.

Diagnosis. The new species (Figs. 1, 4) is the sister species of the Vietnamese *Orthosia huberti huberti* Hreblay & Ronkay, 1999 (Figs. 2, 5) (the type locality of the two is almost the same) and its Chinese subspecies, *Orthosia huberti marci* Ronkay, Ronkay, Gyulai & Hacker, 2010 (Figs 3, 6) and of the Chinese *Orthosia yelai* Ronkay, Ronkay, Gyulai & Hacker, 2010 (Figs. 7, 8).

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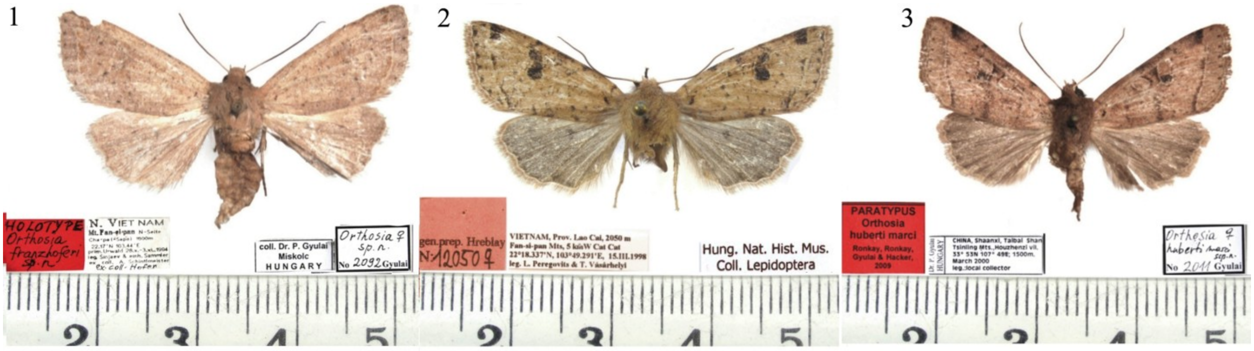
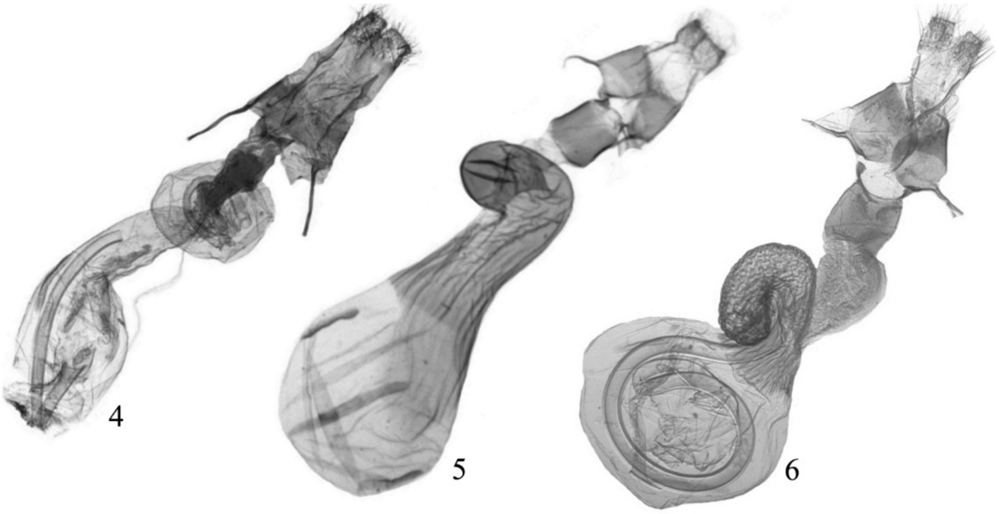


Figures 1–3. Adults. 1 = *Orthosia franzhoferi* sp. nov., holotype, Vietnam, Fan-si-pan Mts. (coll. PGM); 2 = *Orthosia huberti huberti* Hreblay & Ronkay, 1999, Vietnam, Fan-si-pan Mts, (coll. HNHM); 3 = *Orthosia huberti marci* Ronkay, Ronkay, Gyulai & Hacker 2010, paratype, China, Shaanxi, (coll. PGM).



Figures 4–6. Female genitalia. 4 = *Orthosia franzhoferi* sp. nov., holotype, Vietnam, Fan-si-pan Mts, slide no. GYP 2092 (coll. PGM); 5 = *Orthosia huberti huberti* Hreblay & Ronkay, 1999, Vietnam, Fan-si-pan Mts, slide no. Hreblay 12050 (coll. HNHM); 6 = *Orthosia huberti marci* Ronkay, Ronkay, Gyulai & Hacker 2010, paratype, China, Shaanxi, GYP 2011 (coll. PGM)

Although *O. franzhoferi* is most similar externally to *O. huberti*, according to the female genitalia structure, its closest known relative is *Orthosia yelai*. The four taxa are apparently similar in the ground colour and wing pattern elements. The distinctive external features for the separation of the four taxa are as follows: *O. franzhoferi* sp. nov. has lighter wings and much regressed wing pattern than in *O. huberti huberti*, *O. huberti marci* and *O. yelai* with the absence of the basal, antemedial and medial crosslines and the orbicular and reniform stigmata (including the black spot in the latter stigma which is more or less conspicuous in the related species). Additionally, the brown definition of the subapical triangular spot is diffuse, ghost-like, and the subterminal line is also paler whereas it is much stronger, more or less brown or brown edged in *O. huberti* and O. *huberti marci*; in comparison to *O. yelai*, the conspicuous, completely encircled orbicular and reniform stigmata of this species support the very easy distinction.

Female genitalia. The female genitalia of the three species are easily separable as the shape and size of all major parts show distinctive features. The new species has (Fig. 4), in comparison with

O. huberti huberti and *O. huberti marci* (Figs 5, 6), remarkably longer apophyses anteriores and posteriores, considerably weaker ostium-antrum complex, longer ductus bursae, differently shaped, belt-like appendix bursae (it is globular in *O. huberti huberti*, horseshoe-like and ribbed in *O. huberti marci*) and plum-shaped corpus bursae which is larger and sacculiform in *O. huberti huberti* and globular in *O. huberti marci*. *O. franzhoferi* sp. nov. is more resemble *O. yelai* (Fig. 8) in the structure of the ostium-antrum-ductus bursae complex, which is slenderer and differently sclerotized in the new species; furthermore it has considerably longer ductus bursae, differently shaped, belt-like appendix bursae and less spacious corpus bursae.

Biology and distribution. The new species is known only from the type locality in Vietnam.

Etymology. The name of the new species is dedicated to Mr. Franz Hofer, who donated the holotype specimen of the new species to the author years ago.

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Figures 7–8. Color imagine of adult and female genitalia of *Orthosia yelai* Ronkay, Ronkay, Gyulai & Hacker, 2010, paratype, China, Shaanxi, GYP 1988 (coll. PGM)