Two New Species of Paranura (Collembola: Neanuridae) from Southeastern Mexico

José Carlos Simón Benito and José G. Palacios-Vargas

Abstract

Two new Mexican species of Paranura from Quintana Roo State are described and illustrated. These Mexican species are easy to distinguish among species with three eyes per side because they have only two ocular setae. Paranura magdalena sp. nov. is the smaller species (450 µm) with relatively long setae. Paranura roosensis sp. nov. is later (950 µm), with relatively short setae. A comparative morphological table for species with three eyes per side is given, and a key for identification of the 34 species in this genus is included.

Key Words: Neanuridae, Paranura, taxonomy, identification key.

The genus Paranura was established by Axelson who designated the type species, Paranura sexpunctata Axelson (1902), from Finnish specimens. Stach (1949) included it in the new family Anuroidea because of the absence of furcula and a postantennal organ. Cassagnau (1982) transferred this genus to the subfamily Neanurinae giving some new characters to the genus, such as the presence of 3 + 3 well pigmented eyes, the reduction of absence of tubercles on the body, and abdominal segment VI without bilobation. He also included within this genus the species Paranura colorata Mills, 1934 and Paranura s.-torvis Yosii, 1955.

Cassagnau (1985) redefined the genus, including the presence of those species with 2 + 2 eyes and their pigmentation. Deharveng (1989) and Deharveng and Weiner (1984) studied the genus in the Far East, and Palacios-Vargas and Deharveng (1987) described four Mexican species. The most recent contribution is by Palacios-Vargas and Peñaranda-Parada (2005) who described two new species, one from Mexico and another from Colombia. More than 30 species have been named and they are distributed widely in biogeographic areas. The first is Asiatic: Nepal, India, Thailand, Japan, Korea, Malaysia and Indonesia, the second is America: Venezuela, Mexico, United States, and Canada. The only Holartic species is P. sexpunctata. Here, we describe two new Mexican species, and we provide an identification key for all the species in the genus. The terminology used is after Deharveng (1983). In the tables half body chaetotaxy is represented. Abbreviations for the kinds of setae are as follows: M, macroseta; me, meso; me, microseta; s, sensorial seta; for others, Ant., antennal article; Th, thoracic segment; Abd., abdominal segment; S.g.s., ventral sensorial guard sensillum; Dv, dorsal internal; De, dorsal external; DL, dorsal lateral, and L, lateral. When there are two kinds of setae, their order is indicated in the setation.

Key for Species of Paranura

1. With eyes .................................. 0.2
   Without eyes .................................. 0.1

2. With 3 + 3 eyes .................................. 0.21
   With 2 + 2 eyes .................................. 0.3

3. With 1,3,3 setae on dorsal internal thoracic tubercles .................................. 0.6
   With 1,2,2 setae on dorsal anterior thoracic tubercles .................................. 4

4. Antennal-frontal tubercle with seta “A” .................................. 0.5
   Antennal-frontal tubercle without seta “A” .................................. squamosa Cassagnau 1991

5. With 0,3,3 setae on thoracic lateral tubercles .................................. madesfana Yoshii and Subahrudai 1992
   With 0,2,2 setae on thoracic lateral tubercles .................................. timorenensis Yoshii and Subahrudai 1992

6. With three setae on ocular tubercle .................................. 0.13
   With two setae on ocular tubercle .................................. 0.7

7. Antennal-frontal tubercle with seta “A” .................................. 0.8
   Antennal-frontal tubercle without seta “A” .................................. 11

8. With 2,3,4 setae on dorsal external thoracic tubercles ..................................
   impudica Palacios-Vargas and Deharveng 1987

9. With 1,2,2 setae on dorsal-lateral thoracic tubercles ..................................
   meo Deharveng 1989

Different chaetotaxy on dorsal-lateral thoracic tubercles .................................. 10

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1 Universidad Autónoma de Madrid, Facultad de Ciencias, Departamento de Biología, Unidad de Zoología, Cantoblanco, 28049, Madrid, Spain.

2 Corresponding author: Laboratorio de Ecología y Sistemática de Microinvertebrados, Dep. Ecología y Recursos Naturales, Fac. Ciencias, UNAM, 04510, México D.F. (e-mail: jgp@hp.ice.unam.mx).
Figs. 1-5. *Parasus magdalenae* sp. nov. 1. Total chaetotaxy. 2. Antennal chaetotaxy in dorsal view. 3. Leg III femur, tibiotarsus and tarsi. 4. Labial chaetotaxy. 5. Female genital area.

10. Antennal frontal tubercle without seta 0. Abdominal segment IV with tubercles De and DL fused. 
   . *colombiana* Palacios-Vargas and Peñaranda-Parada 2005
   Antennal frontal tubercle with seta 0. Abdominal segment IV with the tubercles De and DL isolate. 
   . *toputta* Palacios-Vargas and Peñaranda-Parada 2005
   11. Antennal-frontal tubercles without seta “C” 12
   Antennal-frontal tubercles with seta “C” 
   12. With 2,2.2 setae on dorso-external thoracic tubercles 
      *groecata* Cassagnau 1981
      With 2,3,4 setae on dorso-external thoracic tubercles 
      *heterorhini* (Yosi 1976)
      With 2,3,3 setae on dorso-external thoracic tubercles 
      *groecata* Cassagnau 1981
   13. Antennal-frontal tubercle without seta “O” 0.14
   14. With 2,3,3 setae on dorso-external thoracic tubercles 0.17
   15. Without tubercles 
      . *quadrilobata* Hammer 1983 sensu Fjellberg 1985
      With tubercles, on last abdominal segments slightly developed 0.16
      . *modesta* Deharveng 1989
      Tibiotarsus without seta “M”, with 18, 18, 17 setae 
      . *tibiotaralis* Deharveng 1989
   17. Abdominal segment V with two setae on Di tubercle. Abdominal segment IV with tubercle De with one seta. 
      . *bisetum* Deharveng 1989
      Abdominal segment V with three setae on Di tubercle. Abdominal segment IV with tubercle De with two setae. 
   18. Dorso-external thoracic tubercles with 2,3,4 setae 0.19
Dorsal-external thoracic tubercles with 2.2.2 setae ........................................ 0.20
19. Dorsal-internal tubercle with two setae ........................................ 0.30
Dorsal-internal tubercle with three setae ........................................ 0.30
........................................ cerinotis Cassagnau 1986
20. With 1.2.2 setae on dorsal-lateral thoracic tubercles .................. 0.30
With 1.3.3 setae on dorsal-lateral thoracic tubercles .................. 0.30
........................................ ghaliifer Deharveng 1983
........................................ lederer Deharveng 1989
21. Without clavate setae on last abdominal segments .................. 0.20
With clear clavate setae on last abdominal segments .................. 0.20
........................................ stetuncius Fjellberg 1985
22. With two ocellar setae ........................................ 0.20
23. With three ocellar setae ........................................ 0.20
24. With two setae on dorsal-external prothoracic tubercle .......... 0.20
With one seta on dorsal-external prothoracic tubercle .......... 0.20
25. With 2.3.3 setae on dorsal-external abdominal segments I-IV 0.20
........................................ sotarikani Palacios-Vargas et Deharveng 1987
With 1.1.1 setae on dorsal-external abdominal segments I-IV 0.20
........................................ nigropal Palacios-Vargas and Deharveng 1987
With three setae on dorsal-external mesothoracic tubercle .......... 0.20
26. With two setae on dorsal-external mesothoracic tubercle .......... 0.20
........................................ longisinuata Palacios-Vargas and Deharveng 1987
27. With three setae on dorsal-external metathoracic tubercle .......... 0.20
........................................ magdalenae sp. n.
With four setae on dorsal-external metathoracic tubercle .......... 0.20
........................................ roeninli sp. n.
28. Antenna-frontal tubercle with seta "O" ........................................ 0.20
Antenna-frontal tubercle without seta "O" .......................... 0.20
29. With 2.2.2 setae on dorsal-external thoracic tubercles ........ 0.20
With 2.4.4 setae on dorsal-external thoracic tubercles ........ 0.20
30. With 2.4.5 setae on dorsal-external thoracic tubercles ........ 0.20
Different chaetotaxy ........................................ 0.20
31. Antenna-frontal tubercle with seta "C" ........................................ 0.20
Antenna-frontal tubercle without seta "C" .......................... 0.20
........................................ karppi Deharveng and Weiner 1984
........................................ myojyungensis Deharveng and Weiner 1984
Antenna-frontal tubercle without seta "D" .......................... 0.20
........................................ lek (Yoshi 1966)
32. Antenna-frontal tubercle without seta "E" .............. 0.20
........................................ colorata Milli 1934 sensu Fjellberg 1985
........................................ axelsoni Deharveng and Weiner 1984
33. With 2.3.3 setae on dorsal-external thoracic tubercles ........ 0.20
........................................ shanghaisiensis Deharveng 1989
........................................ saxpunata Axelsson 1932 sensu Fjellberg 1986

<table>
<thead>
<tr>
<th>Setae group</th>
<th>Tubercles</th>
<th>Amount of setae</th>
<th>Kind of setae</th>
<th>Setae</th>
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<tr>
<td>CI</td>
<td>2</td>
<td>M, m, n</td>
<td>F, G</td>
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</tr>
<tr>
<td>AI</td>
<td>5</td>
<td>M</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>AL</td>
<td>2</td>
<td>M</td>
<td>O, C, D</td>
<td></td>
</tr>
<tr>
<td>Oc</td>
<td>2</td>
<td>M, m, M</td>
<td>Ocr, Opc</td>
<td></td>
</tr>
<tr>
<td>De</td>
<td>2</td>
<td>M, m, M</td>
<td>Del, Del</td>
<td></td>
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<tr>
<td>DL = 3</td>
<td>8</td>
<td>M</td>
<td>Del.1, Del.1.1,1.4</td>
<td></td>
</tr>
<tr>
<td>Di</td>
<td>1</td>
<td>M</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>De</td>
<td>1</td>
<td>M</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>DL</td>
<td>1</td>
<td>M</td>
<td>M</td>
<td></td>
</tr>
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<td>Thorax</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>M</td>
<td>M, m, M</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>M, m</td>
<td>M, M + M</td>
<td>M, m + m + m</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>M, m, M</td>
<td>M, m + m + m</td>
<td>M, m + m + m</td>
<td></td>
</tr>
<tr>
<td>Abdomens</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>M, m, M</td>
<td>M, M + M</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>M, m, M</td>
<td>M, M + M</td>
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</tr>
<tr>
<td>III</td>
<td>M, m, M</td>
<td>M, M + M</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>M, m, M</td>
<td>M, M + M</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>M, m, M</td>
<td>M, M + M</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>M, m, M</td>
<td>M, M + M</td>
<td>M</td>
<td></td>
</tr>
</tbody>
</table>

Note that because the description of P. tenui Yoshi, 1955 states that it has a blue color, reticulations on the lateral parts of Abd. V, and a complete Abd. VI, it cannot be included in the genus Parauna.

Results

Parauna Axelsson, 1902

Habitat of Pseudochorontinae. No reticulations on skin. Color white or slightly stained in blue pigment. Black pigment always present on eyes; zero to two or three eyes per side. Ocellar setae two or three. No postantenial organ. Tubercles poorly developed on the body. Ant. III and IV fused dorsally and with eight similar sensilla. When apical bulb present simple or trilobulated. Maxilla styliform and mandible with small number of teeth. Tibiotarsus without tenuous hairs, no empodial appendix. Without anal spines.

Parauna magdalenae sp. nov. (Figs. 1–5)

Description. Length: 450 μm. Color white under cover. Abd. VI slightly bilobulate. Tubercles not developed in the middle part of head or body segments but better developed laterally in the last abdominal segments. Segmentary grain strong on the head, half the diameter of one eye. There are three kinds of setae, fine acuminate microsetae (5 μm), meso setae (15 μm), and cylindrical macrosetae (27–39 μm) the
tip of which can be acuminate or blunt. These setae are mainly on the last abdominal segments. Sensorial setae are longer than closest macrosetae.

Ant. I with seven setae, Ant. II with 11. Ant. III and IV fused, dorsally with eight sensilla, and one microsensillum, apical bulb not observed. Sensorial organ of Ant. III with two small sensilla and two guard sensilla (Fig. 2). Length ratio of antennal articles IV+III:III is 2:1.1. 3 + 3 pigmented eyes, two anterior and one posterior. Maxillae styliform, mandible as typical for the genus with three teeth. Labium without setae B (Fig. 4). Labral sclerite oval.

Body chaetotaxy as illustrated in Fig. 1 and Table 1.

Legs: Tibiotarsi with 19, 19, 18 setae, without tenent hairs. Claw without inner tooth (Fig. 5). No emecdial appendix. Ratio of tibiotarsus: urogomphus = 2.0:97. Ventral tube with 4 + 4 setae.

Male not seen, female with six pregenital, 10 circumgenital and two egigenital setae (Fig. 5).


Specimen will be deposited in the collection of Micronorphoidea of the Faculty of Sciences, UNAM, México.

Etymology. The name is after Dr. María Magdalena Vázquez, for her contributions to the knowledge of collemboles from Sian Ka'an.

Note: In the holotype specimen of *P. magnusiae* the dorso-internal tubercle of Th. II has two microsetae, but Th. III has only one.

*Paramura roseana* sp. nov. (Figs. 6–10)

Description. Length 950 μm. Color white under cover. Abd. VI truncate, not bilobulate. Tubercles not developed in middle part of head or body segments, but better developed laterally and in the last abdominal segments. Segments strong on the head, one quarter the diameter of one eye. There are three kinds of setae, fine acuminate microsetae (11–15 μm), mesosetae (30 μm) and cye-
lindrical macrosetae (35–51 μm) the tip of which can be acuminate or blunt. These latter are mainly on the last abdominal segments. Sensory setae are longer than closest macrosetae.

Ant I with seven setae, Ant II with 11, Ant. III and IV fused, dorsally with eight sensilla, and one microsensillum, apical bulb trilobulate. Sensory organ of Ant III with two small sensilla and two guard sensilla (Fig. 7). Length ratio of antennal articles IV : III : II I is 2.5:2.1.3, 3 + 3 pigmented eyes, two anterior and one posterior. Maxillae styletiform, mandible as typical for the genus with three teeth. Labium without setae B (Fig. 9). Labral solerite oval.

Body chaetotaxy as illustrated in Fig. 6 and Table 3. Leg I: Tibiotarsi with 19,19,18 setae, without tibial hairs. Claw without inner tooth (Fig. 8). No empodial appendix. Ratio of tibiotarsus:ungues = 2.5:1.3. Ventrail tube with 4 + 4 setae. Male genital opening with six prosternal, 12 cirrigranual and eight eugential setae.

**Table 3. Total chaetotaxy of Paramura rosacea sp. nov.**

<table>
<thead>
<tr>
<th>Setae group</th>
<th>Tubercles</th>
<th>Amount of setae</th>
<th>Kind of setae</th>
<th>Setae</th>
</tr>
</thead>
<tbody>
<tr>
<td>CI</td>
<td>2</td>
<td>M, mi</td>
<td>B, C</td>
<td></td>
</tr>
<tr>
<td>Af</td>
<td>5</td>
<td>M</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Dl</td>
<td>2</td>
<td>Mi, O, C, D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>De</td>
<td>2</td>
<td>Mi, D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DL+1</td>
<td>7</td>
<td>Mi, DL, DLS, L1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>So</td>
<td>3</td>
<td>M</td>
<td>Sol, Sol</td>
<td></td>
</tr>
<tr>
<td>Thors</td>
<td></td>
<td>Dl</td>
<td>Dl, L</td>
<td></td>
</tr>
<tr>
<td>Abdomen</td>
<td></td>
<td></td>
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</tbody>
</table>

**Discussion**

The species with 3 + 3 eyes in the genus Parauna are as follows: sequanceta Axelson, 1962; colonius Mills, 1934; iteti (Yosi 1966); kurogii Deharvarg et Weinerg, 1984; mohyanganensis Deharvarg et Weinerg, 1984; bisetosa Deharvarg, 1989; chiangiaensis Deharvarg, 1989; keferer Deharvarg, 1989; longiserialata Palacios-Vargas & Deharvarg, 1987, sorokaii Palacios-Vargas & Deharvarg, 1987 and jorgiei Palacios-Vargas & Deharvarg, 1987, the last four from Mexico, as well as the two species described here.

All the Mexican species differ from the Asian species, in having only two ocular setae. Other differences can be seen in Table 2. Both new species share with P. longiserialata the presence of setae “O” Abd. VI of P. magdalenae is slightly trilobulate, whereas in P. rosensis it is truncate. The most evident differences in dorsal chaetotaxy are that cephalic seta DL six is a mesoseta in P. magdalenae, whereas in P. rosensis it is a microsetae. The dorsocentral tubercle of Th. III in P. rosensis has three microsetae, and in P. magdalenae only two. Even though P. magdalenae is very small (450 μm), its longest abdominal setae is 1.3 times the length of abdominal segment V, whereas in P. rosensis, which is larger (980 μm), it is only 0.8

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