

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

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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 magdalenae* sp. nov. is the smaller species (450 μm) with relatively long setae. *Paranura rooensis* sp. nov. is larger (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 Anuridae because of the absence of furcula and a postantennal organ. Cassagnau (1982) transferred this genus in the subfamily Neanurinae giving some new characters to the genus, such as the presence of 3 + 3 well pigmented eyes, the reduction or 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-uenoi* Yosii, 1955.

Cassagnau (1986) 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 Holarctic 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, mesoseta; mi,

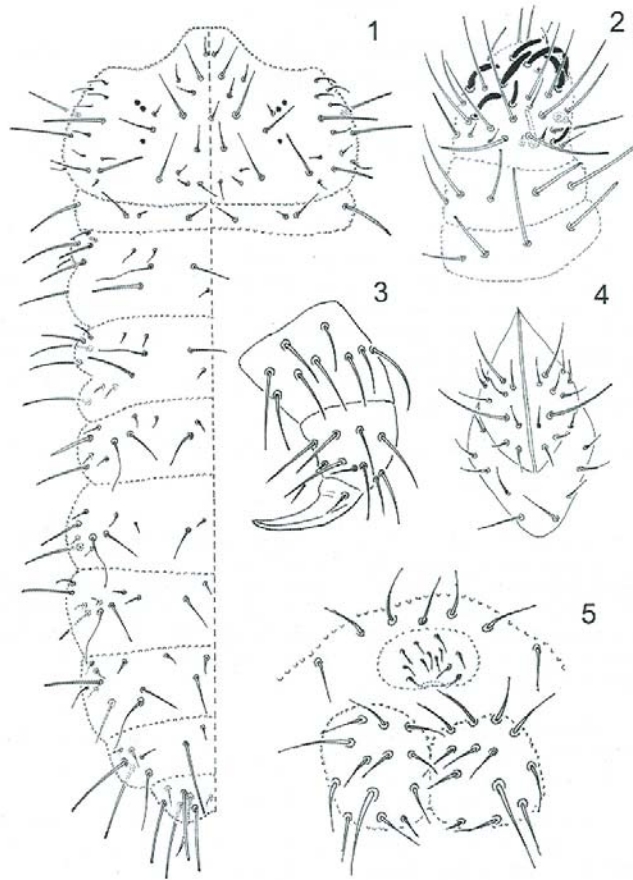
microseta; s, sensorial seta; for others, Ant., antennal article; Th., thoracic segment; Abd., abdominal segment. S.g.v., ventral sensorial guard sensillum; Di, dorso internal; De, dorso external; DL, dorso lateral; and L, lateral. When there are two kinds of setae, their order is indicated in the setation.

Key for Species of *Paranura*

1. With eyes 0.2
Without eyes
 *anops* Christiansen and Bellinger 1980
2. With 3 + 3 eyes 0.21
With 2 + 2 eyes 0.3
3. With 1,3,3 setae on dorso-internal thoracic tubercles 0.6
With 1,2,2 setae on dorso-internal 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
 *nudifera* Yoshii and Suhardjono 1992
With 0,2,2 setae on thoracic lateral tubercles
 *timorensis* Yoshii and Suhardjono 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 dorso-external thoracic tubercles
 *impedita* Palacios-Vargas and Deharveng 1987
With 2,2,2 setae on dorso-external thoracic tubercles 0.9
9. With 1,2,2 setae on dorso-lateral thoracic tubercles *meo* Deharveng 1989
Different chaetotaxy on dorso-lateral thoracic tubercles 10

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Figs. 1-5. *Paramura magdalenae* sp. nov. 1. Total chaetotaxy. 2. Antennal chaetotaxy in dorsal view. 3. Leg III, femur, tibia, tarsus and unguis. 4. Labial chaetotaxy. 5. Female genital area.

- | | |
|---|---|
| <p>10. Antennofrontal tubercle without seta 0. Abdominal segment IV with tubercles De and DL fused
 <i>colombiana</i> Palacios-Vargas and Peñaranda-Parada 2005</p> <p>Antennofrontal tubercle with seta 0. Abdominal segment IV with the tubercles De and DL isolate
 <i>tapatia</i> Palacios-Vargas and Peñaranda-Parada 2005</p> <p>11. Antenno-frontal tubercles without seta "C" 12
 Antenno-frontal tubercles with seta "C"
 <i>godovarica</i> Cassagnau 1991</p> <p>12. With 2,2,2 setae on dorso-external thoracic tubercles
 <i>johorensis</i> (Yosii 1976)
 With 2,3,4 setae on dorso-external thoracic tubercles
 <i>garoensis</i> Cassagnau 1991</p> <p>13. Antenno-frontal tubercle with seta "O" 0.14
 Antenno-frontal tubercle without seta "O" 18</p> <p>14. With 2,2,3 setae on dorso-external thoracic tubercles 0.17</p> | <p>With 2,3,4 setae on dorso-external thoracic tubercles 15</p> <p>15. Without tubercles
 <i>quadrilobata</i> Hammer 1953 sensu Fjellberg 1985</p> <p>With tubercles, on last abdominal segments slightly developed 0.16</p> <p>16. Tibiotarsus with seta "M", with 19,19,17 setae
 <i>modesta</i> Deharveng 1989
 Tibiotarsus without seta "M", with 18, 18, 17 setae
 <i>tibiotarsalis</i> Deharveng 1989</p> <p>17. Abdominal segment V with two setae on Di tubercle. Abdominal segment IV with tubercle De with one seta.
 <i>bisetosa</i> Deharveng 1989
 Abdominal segment V with three setae on Di tubercle. Abdominal segment IV with tubercle De with two setae
 <i>dalgeri</i> Deharveng 1989</p> <p>18. Dorso-external thoracic tubercles with 2,3,4 setae 0.19</p> |
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- Dorso-external thoracic tubercles with 2,2,2 setae 0.20
19. Dorso-internal tubercle with two setae
tamul Cassagnau 1988
 Dorso-internal tubercle with three setae
cenobita Cassagnau 1991
20. With 1,2,2 setae on dorso-lateral thoracic tubercles *globulifer* Deharveng 1989
 With 1,3,3 setae on dorso-lateral thoracic tubercles *leclerci* Deharveng 1989
21. Without clavate setae on last abdominal segments, at most with rounded tips 22
 With clear clavate setae on last abdominal segments abdominales *sitchensis* Fjellberg 1985
22. With two ocular setae 0.23
 With three ocular setae 27
23. With two setae on dorso-external prothoracic tubercle 25
 With one seta on dorso-external prothoracic tubercles 24
24. With 2,2,2 setae on dorso-external abdominal segments I-IV
sarukhani Palacios-Vargas et Deharveng 1987
 With 1,1,1,1 setae on dorso-external abdominal segments I-IV
jorgei Palacios-Vargas and Deharveng 1987
25. With three setae on dorso-external mesothoracic tubercle 0.26
 With two setae on dorso-external mesothoracic tubercle
longisensillata Palacios-Vargas and Deharveng 1987
26. With three setae on dorso-external metathoracic tubercle *magdalenae* sp. n.
 With four setae on dorso-external metathoracic tubercle *rooensis* sp. n.
27. Antenno-frontal tubercle with seta "O" . . . 29
 Antenno-frontal tubercle without seta "O" . . . 0.28
28. With 2,2,2 setae on dorso-external thoracic tubercles *tridentata* Lee and Kim 1984
 With 2,4,4 setae on dorso-external thoracic tubercles *rosea* Lee and Kim 1984
29. With 2,4,5 setae on dorso-external thoracic tubercles 0.30
 Different chaetotaxy 0.32
30. Antenno-frontal tubercle with seta "C" . . . 0.31
 Antenno-frontal tubercle without seta "C"
koryoi Deharveng and Weiner 1984
31. Antenno-frontal tubercle with seta "D"
mjhjangensis Deharveng and Weiner 1984
 Antenno-frontal tubercle without seta "D"
ieti (Yosii 1966)
32. Antenno-frontal tubercle without seta "E"
colorata Mills 1934 sensu Fjellberg 1985
 Antenno-frontal tubercle with seta "E" . . . 0.33
33. With 2,2,2 setae on dorso-external thoracic tubercles *chiangdaoensis* Deharveng 1989
 With 2,3,3 setae on dorso-external thoracic tubercles
sexpunctata Axelson 1902 sensu Fjellberg 1998

Table 1. Total chaetotaxy of *Paranura magdalenae* sp. nov.

Setae group	Tubercles	Amount of setae	Kind of setae	Setae
Cl	—	2	M, me	F, G
Af	—	5	M me Mi	B A O, C, D
Oc	—	2	mi, M	Oca, Ocp
Di	—	2	Mi	Di1, Di2
De	—	2	M, mi	De1, De2
DL + L	—	9	M	DL1, DL5, L1, L4 DL3, DL4 DL6, L2, L3
So	—	5	Mi M Mi	So1, So3, So4, So5, So6
Thorax				
I	M	M, mi	M	—
II	M, mi	M, 2mi+s	2M, mi+s+ms?	M, 2mi
III	M, mi	M, 2mi+s	2M, mi+s	M, 2mi
Abdomen				
I	M, mi	M, 2mi+s	M, mi	M, 2mi
II	M, mi	M, 2mi+s	M, mi	M, 2mi
III	M, mi	M, 2mi+s	M, mi	M, 2mi
IV	M, mi	M, 2mi+s	M, mi	M, 3mi
V	M, mi	2M, 3mi+s		
VI	5M, 2me			

The following species are not included in the key for lack of information: *coenotiba* Cassagnau, 1991; *godavarica* Cassagnau, 1991; *nalo* Christiansen & Bellingier, 1992; *s-uenoi* Yosii, 1955; and *schotti* Womersley, 1936.

Note that because the description of *P. s-uenoi* Yosii, 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 *Paranura*.

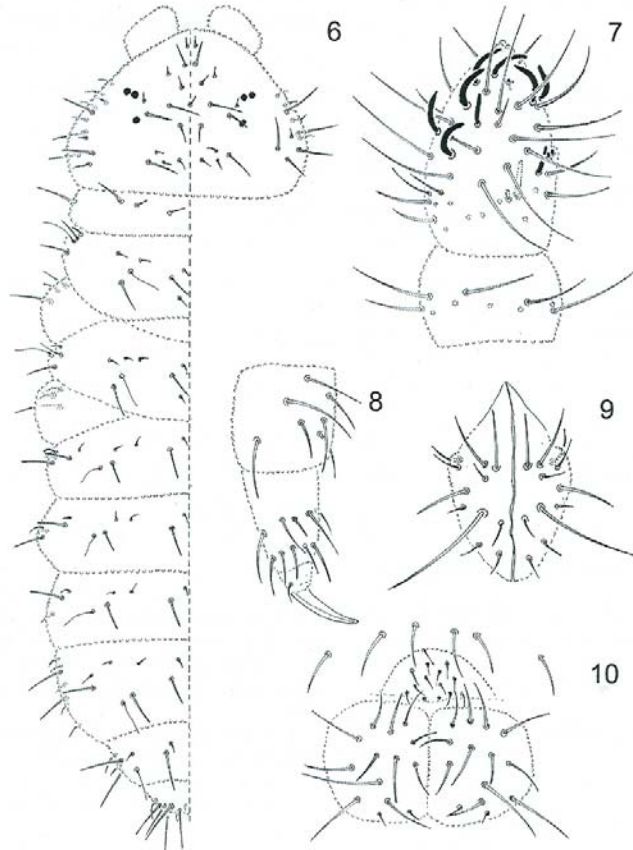
Results

Paranura Axelson, 1902

Habitus of Pseudachorutinae. 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. Ocular setae two or three. No postantennal 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 tenent hairs, no empodial appendix. Without anal spines.

Paranura magdalenae sp. nov.
 (Figs. 1-5)

Description. Length: 450 μ m. Color white under cover. Abd. VI slightly bilobulate. Tubercles not developed in the middle part of head or body segments but better developed laterally and in the last abdominal segments. Tegumentary grain strong on the head, half the diameter of one eye. There are three kinds of setae, fine acuminate microsetae (8 μ m), mesosetae (15 μ m), and cylindrical macrosetae (27-39 μ m) the



Figs. 6-10. *Paranura roensis* sp. nov. 6. Total chaetotaxy. 7. Antennal chaetotaxy from Ant. II to IV. 8. Leg III, femur, tibiotsarsus and unguis. 9. Labial chaetotaxy. 10. Female genital area.

tip of which can be acuminate or blunt. These setae are mainly on the last abdominal segments. Sensorial setae are longer than closest macroseta.

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:II:I 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. 3). No empodial appendix. Ratio of tibiotsarsus: unguis = 2:0.97. Ventral tube with 4 + 4 setae.

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

Types. Holotype female (#2989). MEXICO: Quintana Roo, Sian Ka'an. Two paratype females. 7-VII-1995. From floodable jungle, M. M. Vázquez leg.

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

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

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

Paranura roensis sp. nov.

(Figs. 6-10)

Description. Length: 950 μ m. 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. Tegumentary grain strong on the head, one quarter the diameter of one eye. There are three kinds of setae, fine acuminate microsetae (11-15 μ m), mesosetae (20 μ m) and cy-

Table 2. Comparison among the species of *Paranura* with 3 + 3 eyes

Species	Cephalic central area	Eyes	Ocular setae	Di	De	DL	L	Distribution
<i>Ieti</i>	ABCEFGO	3	3	133/22223	245/44435	144/2223	-33/33353-4	Nepal
<i>Sexpunctata</i>	ABCEFGO	3	3	133/2222	233/3332	133/2222	-33/333	Holarctic
<i>Koryoi</i>	ABCEFGO	3	3	133/22222-2	245/44435	144/2223	-33/33356-3	Korea
<i>Mjohjangensis</i>	ABCEFGO	3	3	133/22222-2	245/44535	144/2223	-33/3348	Korea
<i>Chiangdaoensis</i>	ABCEFGO	3	3	133/22222-2	222/22223	122/2222	-33/3335	Thailand
<i>Bisetosa</i>	ABCEFGO	2-3	3	133/22222	223/33314	133/2222	-33/33363	Thailand
<i>Leclerci</i>	ABCEFGO	3	3	133/22222-2	222/22224	133/2223	-33/33363	Thailand
<i>Colorata</i>	ABCEFGO	3	3	133/22223-3	233/33324	133/2224	-	USA, Mexico
<i>Longisensillata</i>	ABCEFGO	3	2	133/22223	222/11103-4	133/2222	-33/33-4470-1	Mexico
<i>Sarukhani</i>	ABCEFGO	3	2	133/22222	122/33335-6	122/2222	-33/222-35	Mexico
<i>Jorgei</i>	ABCEFGO	3	2	111/11101	111/22224	122/1111	-33/2-32371	Mexico
<i>Magdalenae</i> sp. nov.	ABCEFGO	3	2	122/22222-2	233/33335	133/2222	-33/3334	Mexico
<i>Rooensis</i> sp. nov.	ABCEFGO	3	2	133/22222	234/33332	133/2222	-33/3337/4	Mexico

lindrical macrosetae (35–51 μm) the tip of which can be acuminate or blunt. These latter are mainly on the last abdominal segments. Sensorial setae are longer than closest macroseta.

Ant. I with seven setae, Ant. II with 11. Ant. III and IV fused, dorsally with eight sensilla, and one microsensillum, apical bulb trilobulate. Sensorial organ of Ant III with two small sensilla and two guard sensilla (Fig. 7). Length ratio of antennal articles IV+III:III:I is 2.5:1.2:1. 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. 9). Labral sclerite oval.

Body chaetotaxy as illustrated in Fig. 6 and Table 3. Legs: Tibiotarsi with 19,19,18 setae, without tenent hairs. Claw without inner tooth (Fig. 8). No empodial appendix. Ratio of tibiotarsus: unguis = 2.5:1.3. Ventral tube with 4 + 4 setae. Male genital opening with six pregenital, 12 circumgenital and eight eugenital.

Table 3. Total chaetotaxy of *Paranura rooensis* sp. nov.

Setae group	Tubercles	Amount of setae	Kind of setae	Setae
Cl	—	2	M, mi	F, C
Al	—	5	M me Mi	B A O, C, D
Oc	—	2	mi, M	Ocm, Ocp
Di	—	2	mi	Di1, Di2
De	—	2	M mi	De1 De2
DL+L	—	7	4M me mi	DL1, DL5, L1 DL6 DL3, L2, L3
So	—	3	M 2mi	So1 So4, So5
	Di	De	DL	L
Thorax				
I	mi	M, mi	M	—
II	M, 2mi	M, 2mi+s	2M, mi+s+ms?	M, 2mi
III	M, 2mi	M, 3mi+s	2M, mi+s	M, 2mi
Abdomen				
I	M, mi	M, 2mi+s	M, mi	M, 2mi
II	M, mi	M, 2mi+s	M, mi	M, 2mi
III	M, mi	M, 2mi+s	M, mi	M, 2mi
IV	M, mi	M, 2mi+s	M, mi, 3mi	
V	M, mi	M, mi+s		
VI	5M, 2mi			

Female with six pregenital, 12 circumgenital and two eugenital setae (Fig. 10).

Type Material. Holotype female (#2990). MEXICO: Quintana Roo: Cueva de la Unión. 19-XI-1997. Three paratypes females. From surrounding vegetation of Cueva de la Unión, ex bark of trees, J. G. Palacios Vargas, col. Specimens will be deposited in the collection of Microarthropods of the Faculty of Sciences, UNAM, México.

Etymology. The name is for the state of Quintana Roo.

Discussion

The species with 3 + 3 eyes in the genus *Paranura* are as follows: *sexpunctata* Axelson, 1902; *colorata* Mills, 1934; *ieti* (Yosii 1966); *koryoi* Deharveng et Weiner, 1984; *mjohjangensis* Deharveng et Weiner, 1984; *bisetosa* Deharveng, 1989; *chiangdaoensis* Deharveng, 1989; *leclerci* Deharveng, 1989; *longisensillata* Palacios-Vargas & Deharveng, 1987; *sarukhani* Palacios-Vargas and Deharveng, 1987 and *jorgei* Palacios-Vargas & Deharveng, 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. longisensillata* the presence of setae "O." Abd. VI of *P. magdalenae* is slightly bilobulate, whereas in *P. rooensis* 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. rooensis* it is a microsetae. The dorsoexternal tubercle of Th. III in *P. rooensis* has three microseta, 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. rooensis*, which is larger (950 μm), it is only 0.6

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