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# Two new American species of *Paraxenylla* (Collembola: Hypogastruridae) and ecological notes

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## Abstract

Two new species of *Paraxenylla* are described and illustrated, *Paraxenylla cubana* **sp. nov.** from Cuba and *Paraxenylla peruensis* **sp. nov.** from Peru. The species *Paraxenylla mangle* (Murphy, 1965) **stat. nov.**, **comb. nov**. is revalidated and recombined. *Paraxenylla arenosa* (Uchida & Tamura, 1967) **comb. nov**. and *Paraxenylla oceanica* (Yosii, 1960) **comb. nov**. are transferred from *Xenylla*. A key for the 8 species known in the genus is also given and detailed information about the ecology of *Paraxenylla peruensis* **sp. nov.** is provided.

**Key words:** Collembola, Hypogastruridae, *Paraxenylla*, taxonomy

## Introduction

Murphy (1965) erected the subgenus *Paraxenylla* for the species *Xenylla* (*Paraxenylla*) *mangle* taking in account some of the differences shown by the species in comparison with other congeneric species, such as the chaetotaxy and mouthparts. Actually, the clear differences are the presence of dorsal mesochaetae, absence of the *linea ventralis*, reduction of the setae of ventral tube, elongation of the mucrodens, and a terminal position of the anus.

## History

Stach (1930:280–281) provided a brief description of the species *Xenylla affiniformis* in Latin: "Mucro a dente separatus, ungue longior, gracilis, rectus, acuminatus, lamina

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angusta instructus. Dentes cum mucronibus tibiis paullo longiores. Unguis dente destitutus. Supra unguem pilum clavatum singulum. Papillae et spinae anales desunt. Long. 1 mm. Buccari 14.vi.1894, leg. Biró, det. Stach.", but mentioned on p.271 that he would provide a more detailed description afterwards. In Stach (1949:204), he provided a short differential diagnostic description in the key to the species of *Xenylla*, and he added in Plate XXIII, three detailed figures of *X. affiniformis*: one of the tibiotarsus and two of the mucrodens.

Yosii (1960) described *Xenylla oceanica* from New Caledonia, which actually turns out to be a species of *Paraxenylla*.

Murphy (1965) erected the subgenus *Paraxenylla* for the species *Xenylla* (*Paraxenylla*) *mangle* and already suggested the affinities of *Xenylla (Paraxenylla) mangle* with other species of *Xenylla*, as *X. affinis* Schäffer, 1897 *(*note that *X. affinis* was synonymised with *X. humicola* by Wahlgren (1906:5)), *X. affiniformis* and *X. oceanica* Yosii, 1960, because of the peculiar tenent hairs and the mucro, which have proved to be group specific.

Uchida & Tamura (1967) described *Xenylla arenosa* from Japan, but the description and figures correspond clearly to a species into the genus *Paraxenylla*.

Gama & Deharveng (1984) created the genus *Haloxenylla* based on specimens collected on Mediterranean coasts, in Açores and in Australia, and assumed that this species was synonymous with the one described by Stach (1930) as *Xenylla affiniformis*.

Culik & Deharveng (1986) sunk *Haloxenylla* Gama & Deharveng, 1984 to *Paraxenylla* Murphy, 1965. Palacios-Vargas & Vázquez (1989) described a Mexican species, *Paraxenylla lapazana*. Thibaud & Weiner (1997) described under *Paraxenylla* the species *P. piloua*, also from New Caledonia.

## Results

We describe here two new species, revalidate and recombine the species *Paraxenylla mangle* and make a new combination for *Xenylla arenosa* Uchida & Tamura, 1967 and *Xenylla oceanica* Yosii, 1960.

After describing the new species, and finding some new characters, we modified the diagnosis of the genus. We also have made a comparative table (Table 1) to analyse all the species morphology and we provided a key to identify the 8 species we can consider now into the genus.

### *Paraxenylla* Murphy, 1965

Syn. *Haloxenylla* Gama & Deharveng, 1984:131

Diagnosis of the genus

Habitus of *Xenylla*. Body length 0.36–1.50 mm, with blue pigment, PAO absent, with 5 + 5 eyes. Mouthparts modified with tendency to a type for chewing. Labral setae 7/ 5, 5, 4. Antennae of *Xenylla* type, but sensorial organ of antennal segment III with five similar elements, ventral guard setae between the sensorial rods. Antennal segment IV with four thick sensilla, one microsensillum, one subapical organ and a simple apical bulb. Tenent hairs capitate or acuminate. Unguis without empodium, with or without a median teeth. Furcula well developed, mucro completely or partially separate from dens. Tenaculum with 2, 3 or 4 teeth on each ramus. Anus terminal and abdominal segment VI as a truncate cone. Anal spines absent.

Chaetotaxy of Type I, with mesosetae and macrosetae. Dorsally on thoracic segments II and III with m2 (absent in *Xenylla*) as a macroseta. On abdominal segments I–IV, p2 is a macroseta; on abdominal V a1 is a macroseta and ss at p4. Ventral chaetotaxy of the head and abdominal segments I–III reduced. Ventral tube with 1, 2, 3 or 4 setae per side.

The following species, originally described under the genus *Xenylla*, probably belong to *Paraxenylla* and need revision: *littoralis* Womersley, 1933, *longicauda* Folsom, 1898 and *occidentalis* Womersley, 1933.

Type species *Xenylla* (*Paraxenylla*) *mangle* Murphy, 1965

***Paraxenylla cubana* sp. nov.**
(Figs. 1–10)

Body length (n = 3) 450 µm (range 430–465 µm). Body with very short acuminate setae (5 µm). Macrosetae and sensorial setae (8–10 µm) about twice the length of ordinary setae. Color light blue, eye patches dark.

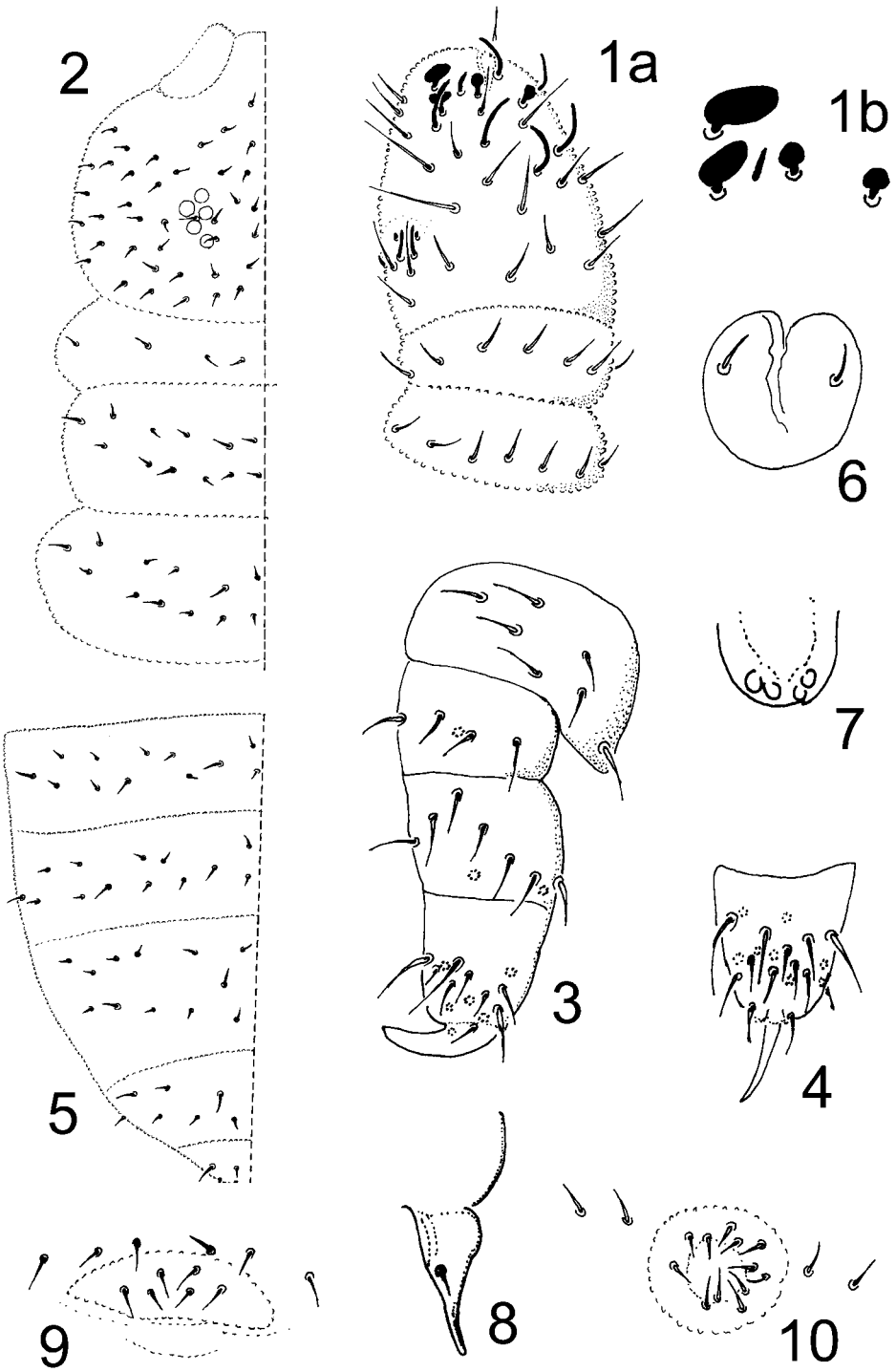
Ratio head:antenna = 1:0.6. Antennal segment I with 7 dorsal setae. Antennal segment II with 11 setae. Antennal segment III sensory organ consists of 2 very small sensory rods, 2 longer guard setae and one external microsensillum. Antennal segment IV with four globular sensorial sensilla, two smaller than others, one microsensillum, one subapical organ and a simple apical bulb. There are also several acuminate setae and several thicker curving setae with apex truncate similar to sensilla (Fig.1).

Labrum with /5,5,4 setae. 5 + 5 eyes well pigmented.

Mandible apparently without apical teeth. Maxillae with six hypertrophied fringed lamellae. Labium with a small internal process.

Prothorax with 4 + 4 setae. Dorsal chaetotaxy of head and thorax in Fig. 2. Trochanters with five setae, femora I, II, III with 11,11, 10 setae respectively. Tibiotarsi I, II, III with 18, 18, 16 very small setae (3–5 µm) respectively, no tenent hairs developed at all. One dorsal seta on tibiotarsus and one on femur are thicker than others (Fig. 3). Unguis about 10 µm long, without teeth, no empodial appendix (Fig. 4).




**FIGURES 1–10.** *Paraxenylla cubana* **sp. nov.** 1, Ant. I to IV with magnification of sensilla; 2, dorsal chaetotaxy of head and thorax: 3, leg III lateral view; 4, tibiotarsus III ventral view; 5, dorsal chaetotaxy of Abd. II–VI; 6, ventral tube; 7, tenaculum; 8, mucrodens; 9, female genital plate; 10 male genital plate.

Dorsal chaetotaxy of abdomen in Fig. 5. Ventral tube with 1 + 1 setae (Fig. 6). Abd. II with 1+1 ventral setae. Tenaculum with 2 teeth on each ramus (Fig. 7). Mucrodens (20 µm) apparently with only one seta (Fig. 8). Female with 3 + 3 pregenital setae, 2–3 genital and 2 eugenital (Fig. 9). Male with 3 + 3 pregenital setae, 4 circumgenital and 8 eugenital (Fig. 10). Anal plate with 11 setae. Anus terminal, no anal spines.

*Derivatio nominis*: from the country where this species was found: Cuba.

Type locality: Cuba: Guanacabibes.

Type Material: Holotype ♀, two paratypes ♂♂. Kept at senior author's collection. 1-XII-1989, M. Díaz Azpiazu col.

Discussion: The most distinctive and easy character to separate *Paraxenylla cubana* **sp. nov.** from the others is the presence of only 2 + 2 teeth on the retinaculum, and only one dental seta. Another important character is the presence of four globular sensilla, while in the other congeneric species they are cylindrical. This is the only species with reduction of the tibiotarsal setation.

***Paraxenylla peruensis* sp. nov.**
(Figs. 11–20)

Body length (n = 5) 1,230 µm (range 1,020–1,480 µm). Body with moderate short acuminate setae (13–15 µm). Macrosetae and sensorial setae long (26–28 µm) almost two times the length of ordinary setae. Color dark blue, eye patches black.

Ratio head:antenna = 1:0.7. Antennal segment I with 7 dorsal setae. Antennal segment II with 11 setae. Antennal segment III sensory organ consists of 2 small sensilla, chop shaped, 2 longer guard setae and one external microsensillum. Antennal segment IV with four cylindrical sensilla, one smaller than others, one microsensillum, one subapical organ and a simple apical bulb. There are also several acuminate setae and some thicker curving setae with apex truncate similar to sensilla (Fig. 11).

Labrum with /5,5,4 setae. 5 + 5 eyes well pigmented.

Mandible with 4–5 teeth. Maxillae with six hypertrophied fringed lamellae. Labium with a well developed internal process.

Prothorax with 5 + 5 setae (sometimes 4 + 4) (Fig. 12). Dorsal chaetotaxy head and thorax in Fig. 12. Trochanters with 5 setae, femora I, II, III with 11, 11, 10 setae respectively; tibiotarsi I, II, III with 19, 19, 18 setae respectively (Fig. 13).

Tibiotarsi with clavate tenent hairs, one dorsal, one ventral-distal, two ventral-proximal. Tibiotarsal setae from 11 to 25 µm, tenent hairs 40 µm. Unguis about 35 µm long, without teeth, no empodial appendix.

Dorsal chaetotaxy of abdomen in Fig. 14, with a hyperthrichosis of the dorsal abdominal segments I to III. Ventral tube with 1 + 1 setae (Fig. 15). Abdominal segment II with three ventral setae on each side (Fig. 16). Tenaculum with 3 teeth on each ramus (Fig. 17). Mucrodens (85 µm) with two setae (Fig. 18). Female with 3 + 3 pregenital setae, 6

genital and 2 eugenital (Fig. 19). Males with 3 + 3 pregenital, 6 circumgenital and 8 eugenital setae (Fig. 20). Anal plate with 11 setae.

*Derivatio nominis*: from the country where this species was found: Peru.

Type locality: Peru: Departamento de Ica: Baha de Paracas, Reserva Nacional de Paracas. Type Material: Holotype ♀, two paratypes ♀♀ will be send to Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima, Peru; two paratypes ♀♀, and one paratype ♂ will kept at senior author's collection; 2 paratypes kept at junior author's collection, 9-V-2003. All specimens collected at the beach on green algae *Ulva* sp. A. Catanazzi col.

Discussion: The most distinctive and easy character to separate *Paraxenylla peruensis* **sp. nov.** from the others is the presence of one smaller sensillum on Ant. IV. The tenent hairs position on tibiotarsi is a differential character, one being dorso-distal, one ventro-distal and two ventro-proximal. Among all the congeneric species this is the only one with this combination. This is the biggest species, almost 1.5 mm. The European *P. affiniformis* (Stach, 1930) *sensu* Gama & Deharveng, 1984 measures between 750–900 µm.

**Remarks**

Based on Stachs illustrations, and comparing the differential morphological characters of the congeneric species of *Paraxenylla* (See Table 1), *P. affiniformis* is clearly distinguished as a valid species of *Paraxenylla.* The validity of *P. affiniformis* has been accepted by Babenko *et al.* (1994:306), Jordana *et al.* (1997:130) and Thibaud *et al.* (2004:158).

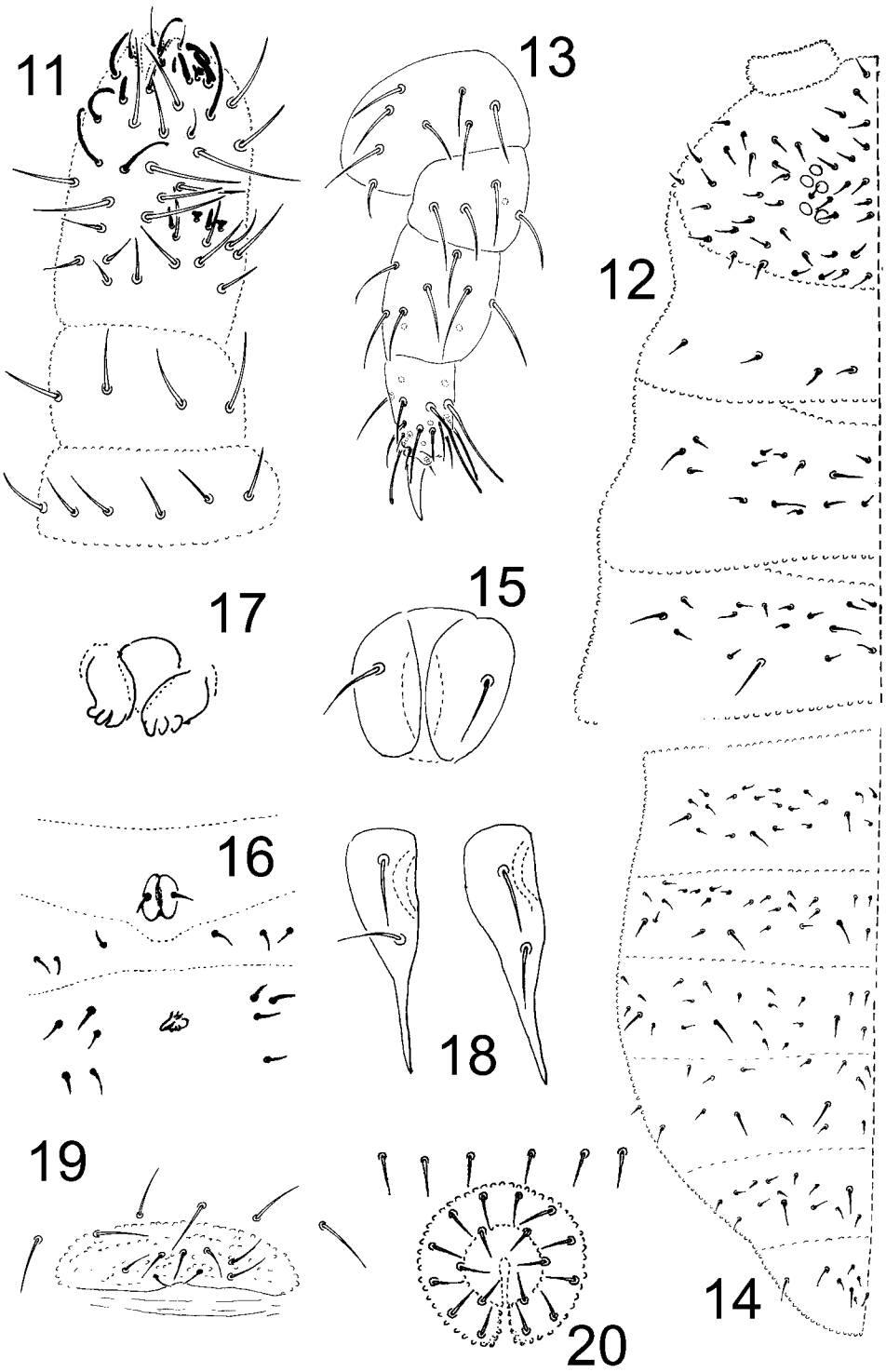
When Gama & Deharveng (1984) studied the type material of *Xenylla affiniformis*, they were not able to confirm their hypothesis of synonymy with *Xenylla (Paraxenylla) mangle*, as they clearly say: "L'état de conservation des types de cette espéce, NE NOUS A PAS permis la confirmation de notre hypothése" (The conservation state of types of this species, HAS NOT allowed us to confirm our hypothesis).

Also Babenko *et al.* (1994:306) doubt the synonymy of *P. mangle* with *P. affiniformis*. Therefore, after the analysis of the morphological characters of the new species, in comparison with other species, we consider *P. mangle* as a valid species of *Paraxenylla*, different from *P. affiniformis*. (See table 1). *P. affiniformis* has 1 + 1 setae on ventral tube and *P. mangle* has 2 + 2 setae. Tenent hairs on *P. affiniformis* there are 1 dorsal and six ventral, 2 (distal) + 4 (proximal), while in *P. mangle* there are only 1 dorsal and two ventral (proximal).

*P. oceanica* (Yosii, 1960) **comb. nov**., because of the peculiar tenent hairs and the mucro, which have proved to be group specific, is transferred from *Xenylla* to *Paraxenylla*.

We also consider *Paraxenylla arenosa* (Uchida & Tamura, 1967) as new combination. This Japanese species is clearly separate from the other species of *Paraxenylla* because it has 3 + 3 setae on the ventral tube and 4 + 4 teeth on the tenaculum.




**FIGURES 11–20.** *Paraxenylla peruensis* **sp. nov.** 11, Ant. I to IV; 12, dorsal chaetotaxy of head and thorax; 13, leg III; 14, Abd. chaetotaxy; 15, ventral tube; 16, ventral chaetotaxy of Abd. I to III; 17, tenaculum; 18, two different mucrodens; 19, female genital plate; 20, male genital plate.

The comparative table (Table 1) of the species of *Paraxenylla* on which we support our conclusions is given bellow.

The genus seems to have a cosmopolitan distribution, on the shores, littoral rocks, sands and many biotopes in the mangroves, and they have been found on green algae. They feed on algae and also on diatoms.

**TABLE 1.** Morphological characters and distribution.

| Spp\ Character | Kind of sensilla | Similarity of sensilla shape | Th. I setae | Ventral tube setae | Clavate tenent hairs | Tenent hairs (dorsal/ ventral) | Abd. II, ventral setae | Tenaculum teeth |
|---|---|---|---|---|---|---|---|---|
| *affiniformis* | Cylindric | = | 5 + 5 | 1 + 1 | + | 1/2,4 | 2 + 2 | 3 + 3 |
| *arenosa* | Cylindric | = | ? | 3 + 3 | ? | 1/0,2 | ? | 4 + 4 |
| *cubana* **sp. nov.** | Globular | ≠ | 4 + 4 | 1 + 1 | - | 0/0,0 | 1 + 1 | 2 + 2 |
| *lapazana* | Cylindric | = | 4 + 4 | 1 + 1 | + | 1/0,2 | 1 + 1 | 3 + 3 |
| *mangle* | Cylindric | = | 5 + 5 | 2 + 2 | + | 1/0,2 | 2 + 2 | 3 + 3 |
| *oceanica* | Cylindric | ? | ? | 4 + 4 | + | 1/0,2 | ? | 3 + 3 |
| *peruensis* **sp. nov.** | Cylindric | ≠ | 5 + 5 | 1 + 1 | + | 1/1,2 | 3 + 3 | 3 + 3 |
| *piloua* | Cylindric | ≠ | 4 + 4 | 1 + 1 | - | 1/0,2 | 1 + 1 | 3 +3 |

continued.

| Spp\ Character | Dental setae | Unguis teeth | Tita III | Mucro/ dens | Color | Length µm | Distribution |
|---|---|---|---|---|---|---|---|
| *affiniformis* | 2 | + | 18 | 1:1.1 | blue | 750-900 | Europa |
| *arenosa* | 2 | ? | | | | | Japan |
| *cubana* **sp. nov.** | 1 | - | 16 | | | 450 | Cuba |
| *lapazana* | 2 | - | 18 | 1:1.2 | blue | 980-1020 | Mexico |
| *mangle* | 2 | | ? | 1:1.3 | | | Gambia |
| *oceanica* | 2 | - | ? | | gray | 700 | New Caledonia |
| *peruensis* **sp. nov.** | 2 | - | 18 | | blue | 1020-1480 | Peru |
| *piloua* | 2 | - | 18 | 1:1.5 | blue | 360-400 | New Caledonia |

**Key for the separation of the species of *Paraxenylla***

1 Ventral tube (v.t.) with 1 + 1 setae ..... 4
- v.t. with more than 1 + 1 setae..... 2
2 v.t. with 2 + 2 setae..... *.P. mangle*
- v.t. with more than 2 + 2 setae..... 3
3 v.t. with 3 + 3 setae ..... *P. arenosa*

- v.t. with 4 + 4 setae ..... *P. oceanica*
4 Tenaculum with 3 teeth on each ramus; tibiotarsi with tenent hairs ..... 5
- Tenaculum with 2 teeth on each ramus; tibiotarsi without tenent hairs ..... ..... *P. cubana* **sp. nov.**
5 With 1 + 1 ventral setae on abdominal segment II ..... 6
- With more than 1 + 1 ventral setae on abdominal segment II ..... 7
6 Very small species, less than 0.5 mm; two antennal sensilla bigger than others ..... ..... *P. piloua*
- About 1 mm long; only one sensillum smaller than others ..... *P. lapazana*
7 With a total of 7 tenent hairs; unguis with one teeth; 1 + 1 ventral setae on abdominal segment II; about 0.9 mm long ..... *P. affiniformis* (*sensu* Gama & Deharveng, 1984)
With only 4 tenent hairs; unguis with no teeth; 3 + 3 ventral setae on abdominal segment II; about 1.5 mm long ..... *P. peruensis* **sp. nov.**

## Ecological notes

*Paraxenylla peruensis* **sp. nov.** is an epigean littoral species that is found in high density on top of stranded green algae in the intertidal zone of Paracas Bay, Peru.

*Paraxenylla peruensis* **sp. nov.** was collected along a 2-km stretch of beach in Paracas Bay, located at the end of a gentle slope of arid land. Most of this beach is composed of empty shells, pebbles, and decaying algal material. The zone of shell beach is narrow (1–3 m wide) and subject to a semi-diurnal tidal cycle. Waters enclosed within Paracas Bay are calm, because they are protected from marine currents by the northern edge of the Paracas Peninsula. Drift inputs of *Ulva* in this system are conspicuous along the shoreline throughout the year and this alga was often the only macroalga that could be found along the beach of Paracas Bay. Springtails were extracted by washing 22 samples of 100 g of wet *Ulva* with a solution of water and soap and by filtering the washout on a 150 µm mesh size filter. Springtails were also collected in pitfall traps placed at regular intervals along a perpendicular transect from the shoreline. Some springtails were collected in traps located in the desert few meters away from the intertidal zone, suggesting that these springtails could migrate to the supratidal zone during high-tide periods. *Paraxenylla* were observed and/or collected throughout the year.

Springtails were by far the most common arthropod in decomposing *Ulva* mats. Average density across 22 algal samples of 100 g of wet *Ulva* was 615.95 springtails ± 129.72 (SE), ranging from 0 to 1904 springtails/100 g of *Ulva*. The second most common arthropod group, mites, averaged only 41.90 mites/100 g of *Ulva*. A litter-bag experiment, where macroarthropods and springtails were excluded from the *Ulva* mats by using bags of different mesh sizes, did not reveal any significant effect of these invertebrate groups on the decomposition rate of *Ulva*.

Springtails may play an important role in the intertidal food web of Paracas Bay. Data

from carbon and nitrogen stable isotope analyses suggest that these arthropods may not feed directly on *Ulva*, but rather on phycophile diatoms that live on the surface of *Ulva*. Diatoms have also been found in the stomachs of preserved specimens. Potential predators in Paracas Bay include two unidentified species of mites (Mesostigmata), a centipede (*Thindyla litoralis*), two species of rove beetles (Staphylinidae), a jumping spider (*Sitticus* sp.), a solifuge (*Chinchippus peruvianus*), and a few species of dipterans. A few springtails have also been found in the stomach contents of the gecko *Phyllodactylus angustidigitus* (possibly unintentionally ingested). Springtails may play an important role in recycling nutrients, and making them available to other consumers in the intertidal and supratidal food web. Because of the extreme aridity of the desert, several terrestrial arthropods and vertebrates depend upon the availability of marine-derived energy and nutrients for their survival.

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