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Eukoenenia virgemdalapa (Palpigradi: Eukoeneniidae): a new troglobitic palpigrade from Brazil

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Introduction

The order Palpigradi is currently represented by 13 species in South America. Among these, six species of the genus *Eukoenenia* Börner 1901 are found in Brazil: *E. roquetti* (Mello-Leitão & Arlé 1935), *E. janetscheki* Condé 1993, *E. maquinensis* Souza & Ferreira 2010, *E. ferratilis* Souza & Ferreira 2011 *E. spelunca* Souza & Ferreira 2011 and *E. potiguar* Ferreira, Souza, Machado & Brescovit, 2011. The number of described species in Brazil has increased from two to six in the last two years. Furthermore, Brazil is the richest South American country in terms of native described species. Despite the apparent advance in knowledge concerning Brazilian palpigrades, many species remain undescribed, and several areas were not even sampled in the country. Souza & Ferreira (2010) showed that palpigrades are widely distributed in some regions of the country and new species have been found. In this study, *E. virgemdalapa*, the third species of troglobitic Palpigradi from Brazil is described.

The specimen described here was found by visual searching on the ground near an old guano pile in Lapa Nova cave (Vazante, Minas Gerais). It was captured with a fine brush and placed in a vial containing 70% ethanol. It was cleared in Nesbit's fluid and then mounted on a glass slide in Hoyer's medium. Measurements and drawings were made with a phase contrast microscope and are given in micrometers (µm); the body length was measured from the apex of the propeltidium to posterior margin of the opisthosoma. Setal nomenclature follows Condé (1979, 1998).

Eukoenenia virgemdalapa sp. n.

(Figs 1–15)

Material examined. Holotype: adult female (ISLA 1536) from Lapa Nova cave (UTM 23 299811 8010693), Vazante, Minas Gerais, Brazil, 18 Sept. 2009, *leg.* L. F. O. Bernardi. The specimen is deposited in the Coleção de Invertebrados Subterrâneos do Laboratório de Ecologia Subterrânea do Departamento de Biologia da Universidade Federal de Lavras (UFLA), Lavras, MG, Brazil.

Etymology. The specific name *virgemdalapa* refers to the festival in honor of the Virgem da Lapa (the virgin of the cave, in allusion to the Virgin Mary, mother of Jesus), which occurs in Vazante since the 19th century and attracts thousands of visitors every year to the Lapa Nova cave.

Diagnosis. This species differs from all others of the genus *Eukoenenia* by the following combination of characteristics: presence of 7–8 blades in the prosomal lateral organs, frontal organs distally expanded, basitarsus IV with five setae, opisthosomal sternites IV–VI with a_1, a_2 and *s*, genital region of female with 10–11 pairs of setae on first lobe and 3+3 on second lobe.

Description. *Prosoma.* Frontal organ with two branches distally expanded, each 3.1 times longer than wide (35 µm/11 µm) (Fig. 1). Lateral organ with 7–8, distally pointed blades, each 3.9–5.7 times longer than wide (39/10–40/7 µm) (Fig. 2). Propeltidium with 10 + 10 setae in five rows (Fig. 3). Metapeltidium with 3 + 3 setae: t_1 (47.5 µm), t_2 (100 µm), t_3 (70 µm) (Fig. 4). Deuto-tritosternum with at least four setae, but the full number could not be observed (obscured by leg II).

Chelicerae with four dorsal setae, two middle setae and one seta inserted near the tooth of the fixed finger (Fig. 5). The number of teeth on the fingers of the chelicerae could not be precisely determined.

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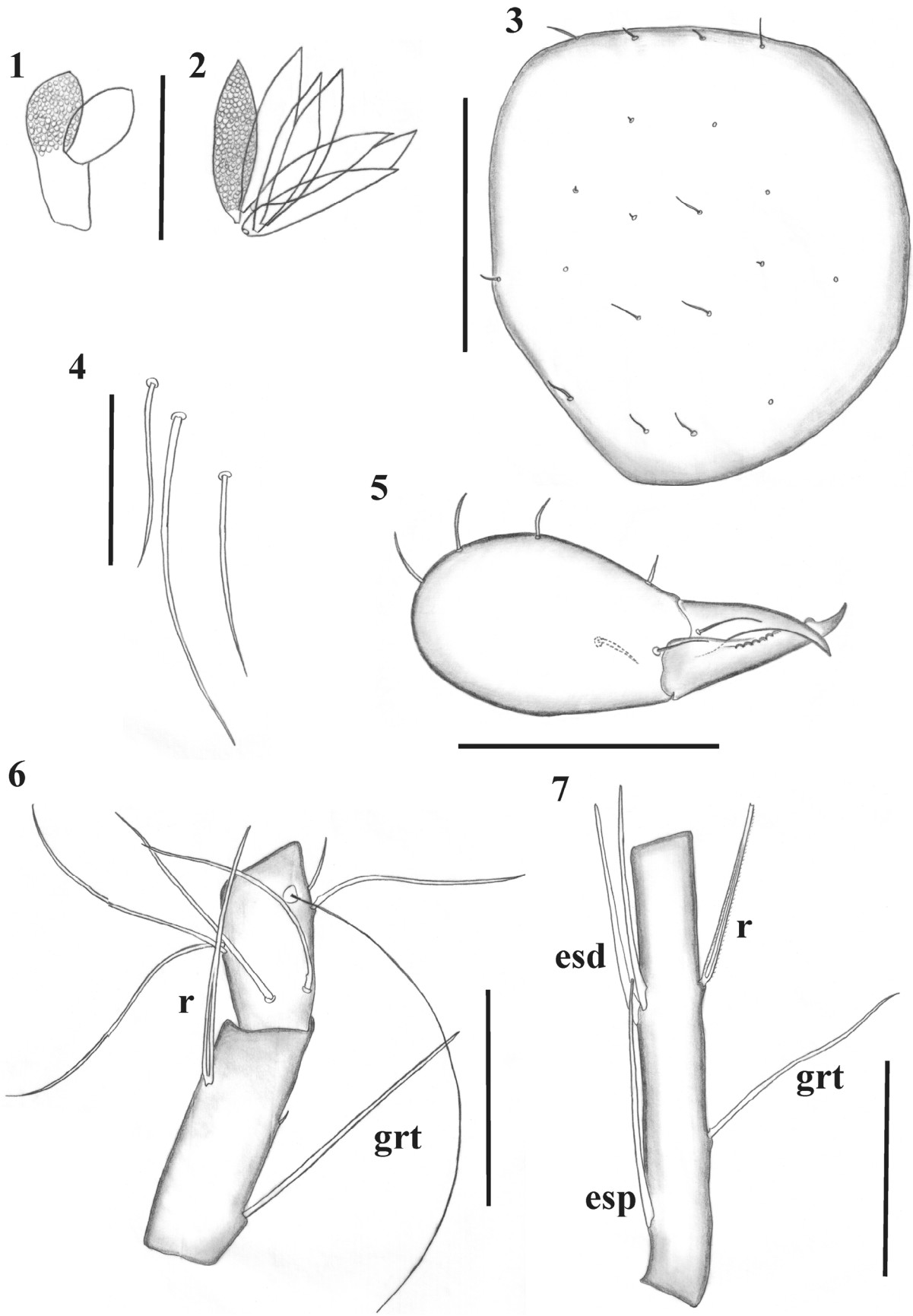


FIGURES 1–7. *Eukoenenia virgemdalapa* **sp. n.** 1, frontal organ; 2, lateral organ, dorsal view; 3, propeltidial chaetotaxy; 4, metapeltidial setae; 5, left chelicera; 6, basitarsus 3–4 of leg I; 7, basitarsus IV. Scale bars: 40 µm (Figs 1–2), 60 µm (Fig. 4), 80 µm (Figs 6–7), 200 µm (Figs 3, 5).

Legs. Basitarsus 3 of leg I 2.9 times longer than wide, with three setae (*grt*: 100 µm; *r*: 95 µm). Seta *r* as long as the segment (95 µm /95 µm, *t/r* = 1), inserted in distal half and reaching distal margin of basitarsus 4 (82.5 µm/ 60 µm, *s/er* = 1.3) (Fig. 6). Leg I with 7 trichobothria in usual arrangement.

Leg IV: basitarsus 7.7 times longer than wide, with five setae (2 *esd*, 1 *esp*, *grt* and *r*), *bta/ti* 0.91. Stiff seta *r* 2.5 times shorter than the tergal edge of segment (174 µm/69 µm, *t/r* = 2.5) and inserted in its distal half (174 µm/ 117.5 µm, *t/er* = 1.4); *esp* and *grt* inserted in proximal half (Fig. 7).

Coxal chaetotaxy: coxa I with 14 setae, coxa II with 3 thick and 10 normal setae, coxa III with 3 thick and 9 normal setae and coxa IV with 1 thick and 8 normal setae (Figs. 8–11).

Opisthosoma. Tergite II–VI with 3 + 3 setae, two pairs of setae (t_1, t_3) between a pair of slender setae (*s*) (Fig. 12). Sternite III with 2 + 2 setae. Sternites IV–VI each with 2 + 2 thickened setae in middle of opisthosoma (a_1 and a_2) between one normal slender seta (*s*) on each side (1+2 *s* setae on sternite VI, asymmetry caused by the presence of an additional *s* seta) (Fig. 13); a pair of glandular pores can be observed between the a_1 setae on these segments. Segments VII with 7 setae and segments VIII–XI with 8 setae each.

Only two flagellar segments were found with the specimen in the tube. The first has two short setae and eight long setae and the second has nine long setae. In addition, each segment has setae similar to spikes at the apex (Fig. 14).

Female genitalia. First lobe with 10 + 11 setae (asymmetry caused by dislocations due to lack of regular seta or presence of additional seta) in 5 transverse rows: 4 sternal 2 + 2, 2 + 2, 1 + 2, 1 + 1 and distal 4 + 4, of which a_1, a_2, a_3 and a_4 measure 17, 18–20, 22–27 and 40 µm respectively. Second lobe with 3 + 3 setae (*x*, *y*, *z*), measuring 27, 38 and 32 µm respectively; 5 glandular orifices (Fig. 15). The mouth of the spermatheca illustrated in figure 15 (other parts of spermatheca could not be observed).

Measurements (in µm). *Body.* Total length 1670; dorsal shield length 340.

Pedipalp. Tibia 172.5; basitarsus 1, 70; basitarsus 2, 77.5; tarsus 1, 45; tarsus 2, 62.5; tarsus 3, 75.

Leg I. Tibia 177.5; basitarsus 1 + 2, 142.5; basitarsus 3, 95; basitarsus 4, 67.5; tarsus 1, 50; tarsus 2, 50; tarsus 3, 172,5.

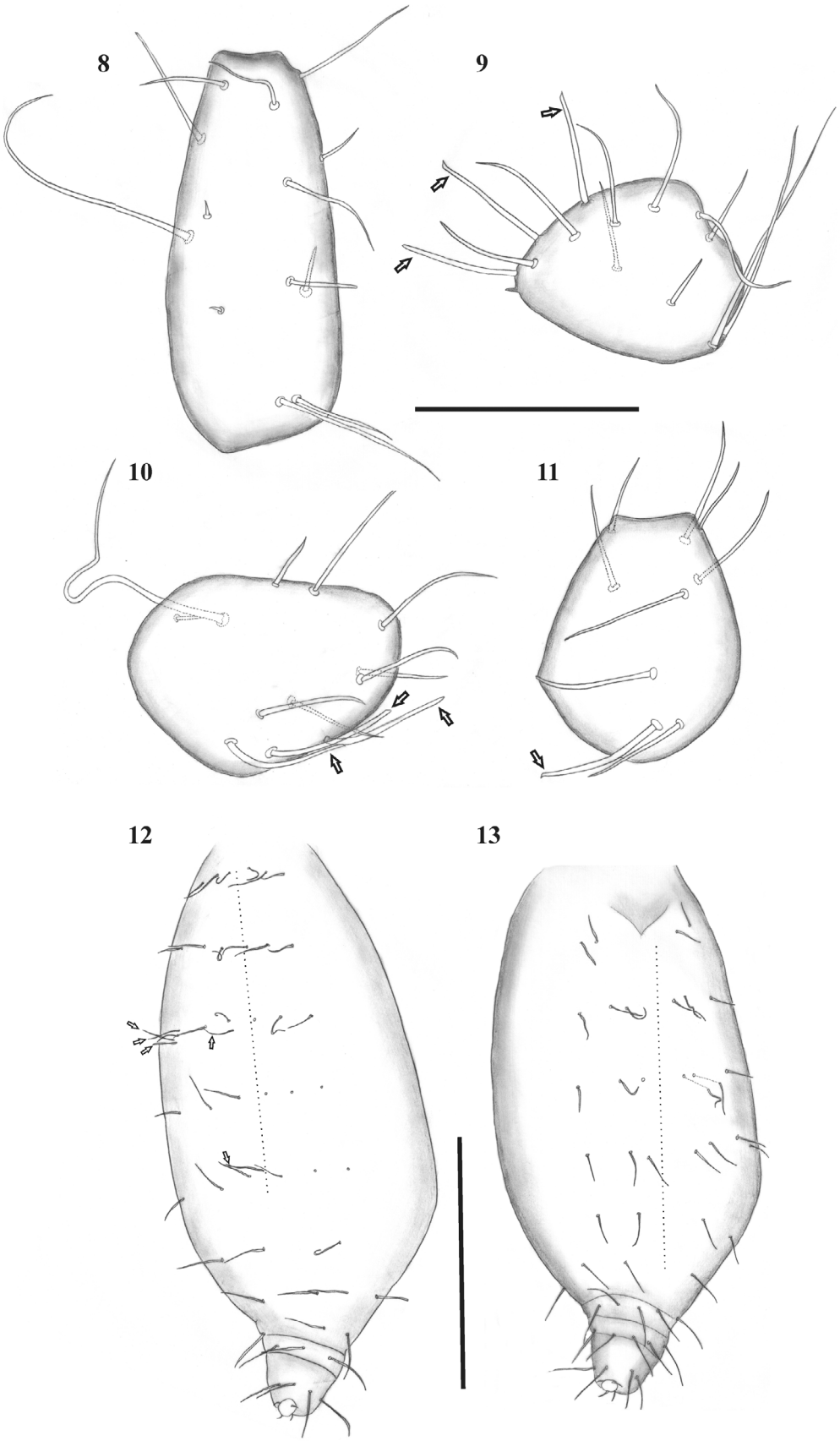
Leg. IV. Tibia 190; basitarsus 1, 174; tarsus 1, 167.5; tarsus 2, 92.5; width of basitarsus IV at level of seta *r* 22.5; distance between base of basitarsus IV and insertion of seta *r* 117.5; length of tergal seta (*grt*) 87.5; length of stiff seta (*r*) 69; ratio between length of basitarsus IV and stiff seta length (*t*/*r*) 2.5; ratio between length of basitarsus IV and distance to insertion of stiff seta (*t*/*er*) 1.48; ratio between lengths of prosomal shield and basitarsus IV (B/bta) 1.9; ratio between lengths of basitarsus IV and tibia IV (bta/ti) 0.91.

Habitat. Lapa Nova is a dolomitic cave located in the municipal district of Vazante, Minas Gerais, Brazil. This cave has approximately 4.5 km of linear development and receives a large number of tourists during a religious festival in honor of the Virgem da Lapa (virgin of the cave), which occurs early in the month of May. The specimen described here was collected in an area not subject to visits by tourists. Several biospeleological surveys were conducted in the cave during the past years, and only one specimen was found. This clearly shows the rarity of the species.

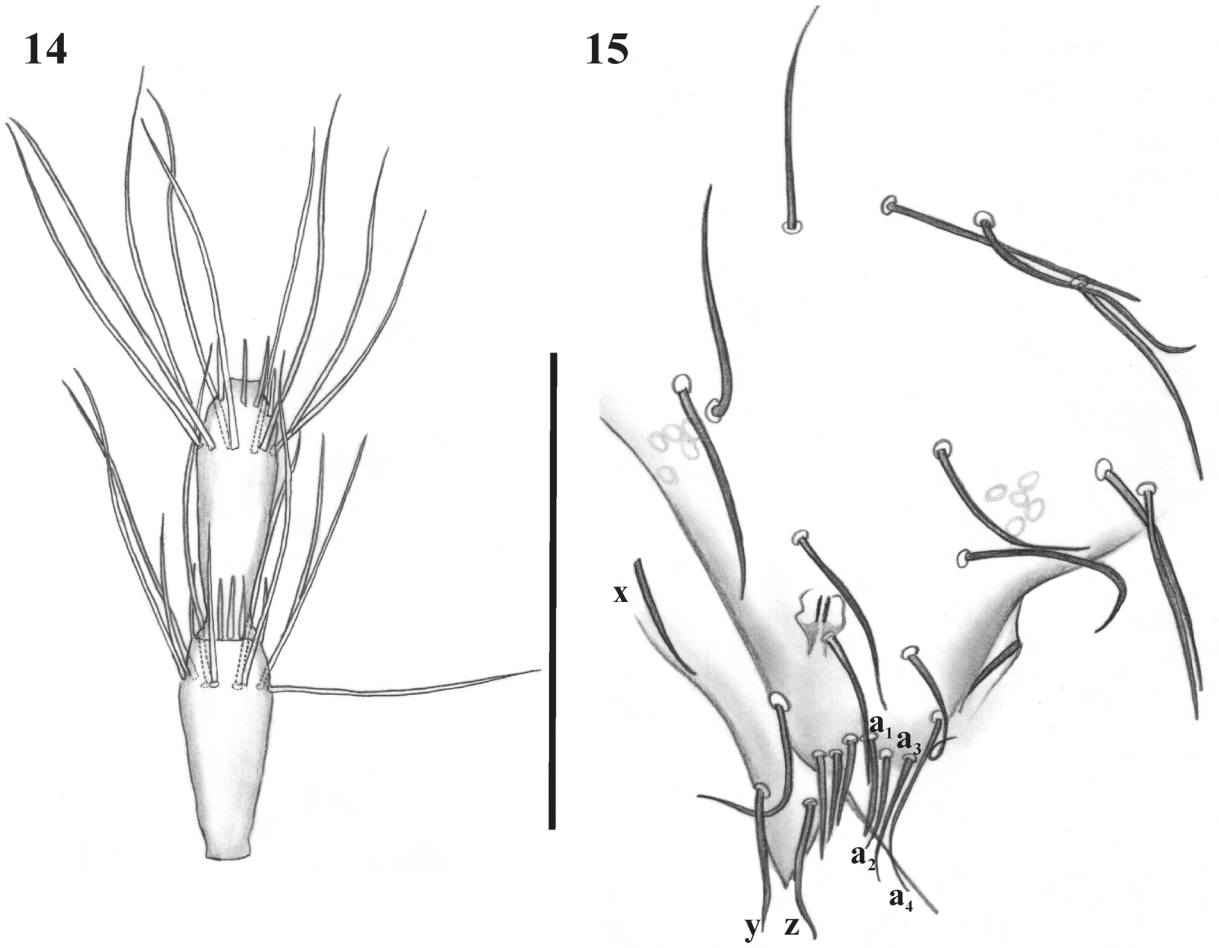
Discussion

The holotype of *Eukoenenia virgemdalapa* presents an asymmetry in the lateral organs, since it has seven blades on the left side and eight on the right side. The presence of 8 elements forming the lateral organs is shared with other species of the same genus: *Eukoenenia draco* (Peyerimhoff, 1906) (8), *Eukoenenia hispanica* (Peyerimhoff, 1908) (8), *Eukoenenia patrizii* (Condé 1956) (8–10), *Eukoenenia lyrifer* Condé 1992 (8) and *Eukoenenia grafittii* Condé & Heurtault 1993 (8). However, the presence of seven elements forming the lateral organs has never been registered in any other Palpigradi species. Unfortunately, since there is only one specimen, it is not possible to determine whether the normal number of lateral organs is 7 or 8 pairs, or even if such asymmetry is common in the species.

The blades that form the frontal organ in *E. virgemdalapa* have an unusual shape. They are distally expanded, not showing the typical lanceolate form observed in most *Eukoenenia* species. However, a similar shape can be observed in the two *Leptokoenenia* species (Condé 1965; Monniot 1966).



FIGURES 8–13. *Eukoenenia virgemdalapa* sp. n. 8, coxa I; 9, coxa II; 10, coxa III; 11, coxa IV; 12, opisthosoma, dorsal view; 13, opisthosoma, ventral view. Arrows in figures 9–11 indicate thick setae; those in figure 12 indicate setae displaced from original positions. Dotted line in figures 12–13 indicates plane of symmetry. Scale bars: 100 μm (Figs 8–11), 500 μm (Fig. 12–13).



FIGURES 14–15. *Eukoenenia virgemdalapa* **sp. n.** 14, flagellar segments; 15, female genitalia. Scale bars 250 μm (Fig. 14) 100 μm (Fig. 15).

Another unusual characteristic of *E. virgemdalapa* is the presence of five setae (2 *esd*, *esp*, *grt*, *r*) on basitarsus IV. Within the genus *Eukoenenia*, this characteristic is shared only with *E. brignolii* Condé 1979 from Italy.

The chaetotaxy of the first lobe of the female genitalia shows an asymmetry, making it impossible to determine if it normally has 10 +10 or 11 + 11 setae. Asymmetries in such structures are relatively common, being observed, for instance, in females of the Brazilian species *E. maquinensis* and *E. ferratilis*. The presence of 7–8 elements forming the lateral organs and the elongation of the appendages are troglomorphisms of *E. virgemdalapa*. The value of the bta IV/ti ratio (0.91) is closer to the average for troglobitic species (0.95) than to that of endogeic species (0.79) (Condé 1996). The value of the propeltidium/bta IV ratio (1.9) is also consistent with that of troglobitic species, which is less than 2 (Condé 1998).

Some characteristics could not be observed, such as the number of deuto-tritosternal setae and number of teeth on chelicerae, because the slide preparation was inadequate to show such characters. Unfortunately, troglobitic species usually have very small populations, thus the capture of many individuals is often unfeasible. Furthermore, small organisms like palpigrades can inhabit interstitial spaces that are not accessible to humans. As previously mentioned, in different biological surveys conducted in Lapa Nova cave, only a single specimen was found. This is also the case for several troglobitic species, such as *E. spelunca*, recently described from Brazil, and *E. naxos* Condé 1989, which is one of the most troglomorphic species described to date. Thus, the low probability of finding other specimens of this species, combined with the low richness of palpigrades in South America, justify the description of another species from a unique specimen.

In Brazil, the presence of an endemic troglobitic species assures the preservation of the cave in which it was found. In 2008, the Brazilian legislation concerning cave protection was altered, such that caves can be destroyed by various human activities. To assure the preservation of a cave in Brazil, it is necessary to show that it possesses

at least one endemic troglobitic or rare species. Therefore, the description of *E. virgemdalapa*, besides contributing to the knowledge of Palpigradi diversity in the country, ensures the preservation of an important cave and its surroundings.

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