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SHORT COMMUNICATION

A new troglobitic Eukoenenia (Palpigradi: Eukoeneniidae) from Brazil

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Abstract. A new Brazilian species of the genus Eukoenenia is described from a single male specimen collected within the Archimedes Passini cave, a marble cave located in the municipal district of Vargem Alta, Espírito Santo. Eukoenenia spelunca, sp. nov., has six blades on the prosomal lateral organs and a unique shape of the genital lobes. Some morphometric parameters demonstrate the specialization of this new species to the cave environment.

Keywords: Neotropics, taxonomy, caves, troglomorphomic

Palpigradi is one of the least known of the arachnid orders, and its phylogenetic position is problematic (Pepato et al. 2010). Historically, various authors (Hansen & Sörensen 1897; Petrunkevitch 1955; Weygoldt and Paulus 1979; van der Hammen 1982) have proposed different relationships with other groups of arachnids, but there is no consensus.

Within the Palpigradi, the most distinctive troglomorphisms are found in species of the genus Eukoenenia Börner 1901, which is also the most diverse and widely distributed genus. Representatives of the genera Allokoenienia Silvestri 1913, Koeneioides Silvestri 1913, and Prokoenienia Börner 1901 sometimes have been found in caves, but in none of the cases have the species expressed adaptations related to the subterranean environment (Condé 1996).

Despite being one of the smallest arachnid orders (Harvey 2007), new palpigrade species are being regularly discovered and described (e.g., Moreno 2006; Barranco & Harvey 2008; Christian 2009). In recent years researchers have uncovered a variety of Palpigradi in several Brazilian caves (Souza & Ferreira 2010). Most of these species are new, and many are currently under study to determine their affinities. In the present work, a new Brazilian species of the genus Eukoenenia with troglomorphic traits is described from an adult male found walking on a speleothem in a marble cave in the municipal district of Vargem Alta, Espírito Santo.

METHODS

The specimen was examined by clearing it in Nesbit’s solution and mounting it in Hoyer’s medium on 3 × 1-inch glass slides using standard procedures developed for mites (Krantz & Walter 2009). All measurements are presented in micrometers (μm) and were taken using an ocular micrometer with a phase contrast microscope. Body length was measured from the apex of the propeltidium to the posterior margin of the opisthosoma. The areoles in some drawings represent the insertions of setae.

The following abbreviations were utilized, based on Barranco & Mayoral (2007): L, total body length (without flagellum); B, dorsal shield length; P, pedipalpus; I and IV, legs I and IV; ti, tibia; bta1, basitarsus 1; bta2, basitarsus 2; bta3, basitarsus 3; bta4, basitarsus 4; ta1, tarsus 1; ta2, tarsus 2; ta3, tarsus 3; a, width of basitarsus IV at level of seta r; er, distance between base of basitarsus IV and insertion of seta r; grt, tergal seta length; gla, lateral seta length; r, stiff seta length; tr, ratio between length of basitarsus IV and stiff seta length; tr/er, ratio between basitarsus IV length and distance to insertion of stiff seta; gla/grt, ratio between lengths of lateral and tergal setae; B/bta, ratio between lengths of prosomal shield and basitarsus IV; bta/ti, ratio between lengths of basitarsus IV and tibia IV. Setal nomenclature follows that of Condé (1974a, 1974b, 1981, 1984, 1988, 1989, 1992, 1993, 1994).

The specimen is lodged in the Coleção de Invertebrados Subterrâneos de Lavras, Departamento de Biologia, Universidade Federal de Lavras, Lavras, Minas Gerais (ISLA).

TAXONOMY

Family Eukoeneniidae Petrunkevitch 1955
Genus Eukoenenia Börner 1901
Koeneinia Grassi & Calandruccio 1885:165 [junior primary homonym of Koeneinia Beushausen 1884 (Mollusca: Bivalvia)].
Koeneinia (Eukoenenia) Börner 1901:551.

Type species.—Koeneinia mirabilis Grassi & Calandruccio 1885, by monotypy.

Eukoenenia spelunca new species (Figs. 1–15)

Material examined.—Brazil: Espírito Santo: Holotype adult male, Archimides Passini cave (collected from a speleothem), Vargem Alta (UTM 283168,01; 7711062,66), 15 September 2005, R.L. Ferreira (ISLA 850).

Diagnosis.—Eukoenenia spelunca differs from all other species of the genus by the following combination of characters: prosomal lateral organs with 6 blades; six setae on the basitarsus IV with a single proximal sternal seta; opisthosomal sternites IV–VI with 2 + 2 thickened setae (a1, a2) in middle of the opisthosoma between both normal slender setae (s); and male genitalia with 11 + 11 setae on first

Figures 1, 2.—Eukoenenia spelunca new species, holotype male: 1. Frontal organ, dorsal view; 2. Lateral organ, dorsal view. Scale bars 20 μm (Fig. 1), 20 μm (Fig. 2).
lobe (and 2 + 2 sternal setae), 4 + 4 setae on second lobe, and 4 + 4 setae on third lobe.

**Description.**—*Prosoma*: frontal organ with two branches, blunt apically and each 4.4 times longer than wide (27.5 μm/6.25 μm) (Fig. 1). Lateral organ with 6 pointed parallel blades, each 6.5 times longer than wide (32.5 μm/5 μm) (Fig. 2).

*Propeltidium* with 10 + 10 setae (Fig. 3). *Metapeltidium* with 3 + 3 setae (t₁, t₂, t₃) each of different length, inner seta shortest (65 μm, 75 μm, and 67.5 μm) (Fig. 4). Deutotritosternum with 5 setae in U-shaped arrangement (Fig. 5).

**Chelicerae:** with 9 teeth on each finger; 4 dorsal setae, 1 lateral seta and 1 seta inserted near the row of teeth of the second segment (Fig. 6).

**Legs:** chaetotaxy of coxae I–IV: 11, 8, 12 and 8 (Figs. 7–10). Basitarsus 3 of leg I 2.3 times longer than wide, with 2 setae (grt 67.5 μm; r 77.5 μm). Seta r longer than segment (65 μm/77.5 μm, tr = 0.8), inserted in proximal half and surpassing hind edge (27.5 μm/60 μm, s/er = 0.45) (Fig. 11). Basitarsus of leg IV 5.6 times longer than wide, with 6 setae (2 esd, esp, gla, grt and r), b/alti 0.91. Stiff seta...
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Figure 15.—Eukoenenia spelunca new species, holotype male: 15. Male genitalia. Scale bar 60 μm.

Discussion

Among the species of Palpigradi found in South America, Eukoenenia improvisa Conde 1979 from French Guiana (Conde 1979a) has characteristics most in common with E. spelunca. Such characteristics include the presence of 6 setae on the basitarsus of leg IV (presence of only a seta esp), the chaetotaxy of the opisthosomal sternites IV–VI (2 + 2 thickened setae between both slender setae) and of the opisthosomal tergites II–VI (3 + 3 setae, two pairs of seta t between both seta s), presence of 5 setae in the deutotritosternum, and seta r inserted in the distal half of the basitarsus IV. However, some characteristics distinguish E. improvisa from E. spelunca such as the lateral organs formed by 4 elements, the disposition of the setae of the deutotritos sternum, and the body dimension values. Although E. improvisa has a larger body size, E. spelunca has longer segments that form the pedipalp and legs I and IV, the former characteristic of edaphomorphic species and the latter with troglobitic species. Unfortunately, the characteristics of the genitalia cannot be compared, since the male of E. improvisa is not known (Conde 1979a). Despite these similarities with E. improvisa, a better knowledge of the intertropical species is necessary, based on males and females, so that it is possible to group them or to phylogenetically associate them.

The chaetotaxy of the opisthosomal sternites IV–VI of E. spelunca is also similar to that of E. thais Conde 1988 and E. lyrifer Conde 1992 (Conde 1988, 1992). In addition, the occurrence of 6 setae of the IV bta due to the presence of only one seta esp is also observed in E. pauli Conde 1979 (Conde 1979c).

The presence of 6 elements forming the lateral organs in E. spelunca is shared with other species found in caves such as E. spelaea (Peyerimhoff 1902) (5–6), E. reyny Conde 1974 (4–6), E. maroccana (6) and E. maquinensis Souza & Ferreira 2010 (6) (Peyerimhoff 1902; Conde 1974; Souza & Ferreira 2010).

Table 1.—Measurements (μm) of selected body parts of the two type specimens of Eukoenenia spelunca.

| Body part | Holotype |
|-----------|----------|
| L         | 720      |
| B         | 245      |
| Pti       | 115      |
| Ptba1     | 52.5     |
| Ptba2     | 62.5     |
| Pt1       | 32.5     |
| Pt2       | 40       |
| Pt3       | 50       |
| Iti       | 117.5    |
| Ibta1+2   | 100      |
| Ibta3     | 65       |
| Ibta4     | 62.5     |
| Ita1      | 15       |
| Ita2      | 32.5     |
| Ita3      | 120      |
| IVt1      | 140      |
| IVt2      | 57.5     |
| A         | 22.5     |
| Er        | 72.5     |
| Grt       | 75       |
| Gla       | 77.5     |
| R         | 575      |
| tlr       | 2.21     |
| tler      | 1.75     |
| glalgrt   | 1.03     |
| B/btaIV   | 1.92     |
| btaIV/ti  | 0.91     |

DISCUSSION

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The male genitalia of *E. spelunca* has 38 setae (11 + 11 on the first lobe, 4 + 4 on the second, 4 + 4 on the third), this being a characteristic also found in *E. bonadonai* Condé 1979 and *E. pretneri* Condé 1977 (Condé 1977, 1979b). However, in spite of having the same number of setae, the lobes of the genitalia of these three species have a completely different shape and distribution of the setae. *Eukoenenia spelunca* has fusules on moderately dilated processes, as in *E. pauli*, *E. lawrencei* Rémy 1957 from South Africa and Papua New Guinea, *E. grassii* (Hansen 1901) from South America, and *Eukoenenia vestris* from Morocco. Furthermore, the bta IV/ti ratio (1.92) suggests prolongation of the appendages, being similar to that of troglobitic species, which is always less than 2 (Condé 1998). Finally, the bta IV is 5.6 times longer than at the level of the seta r, being in the range found for cave species, which varies between 3.22 in *E. pretneri* and 10.22 in *E. grassii* (Condé 1998).

The description of a new species of troglobitic *Palpigradi* for Brazil is very important, keeping in mind the fact that few described species exist not only in the country, but also in the Neotropics region as a whole (Harvey 2003).

Furthermore, in Brazil, the presence of an endemic troglobitic species assures the preservation of the cave in which it was found. Until 2009, all Brazilian caves were protected by law. However, unfortunately, the legislation was altered, and the Brazilian caves now exist not only in the country, but also in the Neotropics region as a whole (Harvey 2003).}

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