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Eukoenenia (Palpigradi: Eukoeneniidae) in Brazilian caves with the first troglobiotic palpigrade from South America

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Abstract. Reports of Palpigradi from South American caves are rare, and no troglobiotic species have yet been described. This apparent deficiency, however, reflects merely a lack of reporting. Ten years of biospeleological surveys of 603 caves in 16 of the 26 Brazilian states, in bedrocks including limestone, quartzite, iron ore, granite, and gneiss, have led to the capture of 494 palpigrades, and specimens with troglomorphic characteristics have been found in Minas Gerais, Bahia, and Espirito Santo. Palpigrades have been found to be relatively more common in iron ore caves, and troglomorphic species apparently occupy cave habitats different from those occupied by edaphomorphic species. The description of the first troglobite species from South America is presented here. *Eukoenenia maquinensis*, new species, collected in the Maquiné Cave Minas Gerais, Brazil, has six blades in the lateral organs, seven pairs of setae on the propeltidium, six setae on the basitarsus IV (a single proximal sternal seta) and a singular chaetotaxy of opisthosomal sternites.

Keywords: *Eukoenenia maquinensis*, Neotropics, troglomorphic

The order Palpigradi Thorell 1888 includes small arachnids found in soil, leaf litter, caves, and semi-aquatic interstitial environments (Barranco & Harvey 2008). Since their original discovery in Catania (Grassi and Calundruccio 1885), researchers have found palpigrades in many locations around the world, including northern Africa, Europe, Madagascar, Australia, southeastern Asia, and both North and South America (e.g., Condé 1956, 1974b, 1984a, 1987, 1996; Peyerimhoff 1902; Harvey 2003).

In South America, only nine palpigrade species are known: *Prokoenenia chilensis* (Hansen 1901), *Eukoenenia* cf. *grassii* (Hansen 1901), and a member of the *E. mirabilis-berlesei* complex from Chile; *Eukoenenia florenciae* (Rucker 1903) from Paraguay, Colombia and Argentina; *E. grassii*, from Paraguay; *E. improvisa* Condé 1979, *Allokoenenia afra* Silvestri 1913 and *Koeneniodes notabilis* Silvestri 1913 from French Guiana; *E. janetscheki* Condé 1993 and *E. roquettei* (Mello- Leitão & Arlé 1935) from Brazil (Condé 1979, 1984a, 1986, 1993, 1996; Mello-Leitão & Arlé 1935).

Except for *Leptokoenenia* Condé 1965 (with two marine interstitial species) and *Triadokoenenia* Condé 1991 (monotypic, associated with rain forests of northeastern Madagascar), all genera of the order have species endemic to caves. However, species of the genus *Eukoenenia* Börner 1901 are by far the most highly morphologically modified and most numerous in the underground environment. Of the 66 species of palpigrades included in this genus, 27 are restricted to caves (21 in Europe, one in Cuba, and at least five in tropical Asia) (Condé 1996).

The species *E. orghidani* Condé & Juberthie 1981, found in the Bellamar cave in Cuba, is the only recognized troglobiotic species of the order Palpigradi to have been discovered in the Americas (Condé 1996), and no records of troglobiotic palpigrades have been reported from South America.

In the present paper, a new troglobiotic species of the genus *Eukoenenia*, the first from South America, is described, and various aspects related to the geographical distribution of the genus *Eukoenenia* in Brazilian caves are noted.

METHODS

Various inventories of cave fauna using the methodology proposed by Ferreira (2004) have been compiled in 603 Brazilian caves over the past ten years, including caves in 16 of the 26 Brazilian states (Minas Gerais, Goiás, Espírito Santo, Bahia, Rio de Janeiro, Mato Grosso, São Paulo, Paraná, Santa Catarina, Rio Grande do Sul, Sergipe, Ceará, Rio Grande do Norte, Alagoas, Pernambuco and Tocantins). Caves in various lithologies were included in the inventories: carbonate rocks (limestone, dolomite, calcarenite, marble, and calcoschist), conglomerates, iron ore (hematite and itabirite), siliclastic rocks (quartzite and sandstone), and magmatic rocks (gneiss and granite).

In all the caves we conducted a thorough search for palpigrades in all potential microhabitats: on the floor of the cave, on the speleothems, and under rocks, from regions near the entrance to those deeper inside the cave. They were caught with fine brushes and fixed in 70% alcohol. The area outside the caves was also inspected when the environmental conditions appeared to be favorable for the occurrence of palpigrades. The specimens examined for this study are lodged in the Coleção de Invertebrados Subterrâneos do Laboratório de Ecologia Subterrânea do Departamento de Biologia da Universidade Federal de Lavras (UFLA), Lavras, MG, Brazil, and the Instituto Butantan, São Paulo, SP, Brazil (IBSP).

A chi-square test was used to evaluate the abundance of palpigrades in different lithologies. In order to obtain the local average yield of non-quantitative palpigrade sampling (by municipality), the total number of palpigrades collected in the caves of a municipality was divided by the number of palpigrade-inhabited caves.

The material was examined by clearing in Nesbit's solution and mounted in Hoyer's medium on 7.6 × 2.5 cm glass slides using standard procedures for mites (Krantz & Walter 2009). We made drawings under phase contrast microscopy, with measurements reported in micrometers (μm). Body length was

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Table 1.—Brazilian municipalities with occurrence of underground palpigrades.

Municipality	Caves	State	Lithology	Total abundance	Relative abundance
Iuiú	2	BA	Limestone	2	1
São Desidério	1	BA	Limestone	3	3
Itaetê	1	BA	Limestone	2	2
Afonso Cláudio	1	ES	Gneiss	2	2
Arcos	11	MG	Limestone	13	1.18
Bambuí	1	MG	Limestone	1	1
Brejo da Madre de Deus	1	PE	Granite	1	1
Corsdisburgo	1	MG	Limestone	7	7
Doresópolis	10	MG	Limestone	10	1
Felipe Guerra	2	RN	Limestone	7	3.5
Iguatama	2	MG	Limestone	6	3
Itabirito	5	MG	Iron ore	17	3.4
Itumirim	1	MG	Limestone	1	1
Lagoa da Prata	7	MG	Limestone	20	2.85
Lagoa Santa	1	MG	Limestone	7	7
Lima Duarte	3	MG	Quartzite	7	2.33
Mambaí	1	GO	Limestone	1	1
Moeda	4	MG	Iron ore	140	35
Nova Lima	10	MG	Iron ore	77	7.7
Padre Paraíso	1	MG	Granite	2	2
Pains	36	MG	Limestone	65	1.8
Paracatu	1	MG	Limestone	1	1
Prudente de Morais	3	MG	Limestone	3	1
Santa Tereza	1	ES	Granite	3	3
Sete Lagoas	1	MG	Limestone	3	3
Vargem Alta	1	ES	Marble	1	1
Varre e Sai	1	RJ	Granite	5	5
Curvelo	1	MG	Limestone	1	1
Januária/Itacarambi	1	MG	Limestone	1	1
Vazante	3	MG	Dolomite	21	7

measured from the apex of the propeltidium to the posterior margin of the opisthosoma.

The following abbreviations were used, based on Barranco & Mayoral (2007): L, total length of body (without flagellum); B, length of dorsal shield; 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, length of tergal seta; gla, length of lateral seta; r, length of stiff seta; t/r, ratio between length of basitarsus IV and stiff seta length; t/er, ratio between length of basitarsus IV and distance to insertion of stiff seta; gla/grt, ratio between lengths of lateral and tergal setae; B/bta, relation between lengths of prosomal shield and basitarsus IV; bta/ti, ratio between lengths of basitarsus IV and tibia IV; F, flagellar segments. Setal nomenclature follows that of Condé (1974a, 1974b, 1981, 1984a, 1988, 1989, 1992, 1993, 1994).

RESULTS

Distribution of species of genus *Eukoenenia* in Brazilian caves.—Individuals of the order Palpigradi were found in 131 of the 603 caves surveyed (21.7% of the total). We discovered these palpigrades in various municipalities in the states of Minas Gerais, Goiás, Espírito Santo, Rio de Janeiro, Pernambuco, Rio Grande do Norte, and Bahia. The lithologies of the caves in which palpigrades were found included carbonate rocks (limestone), iron ore, magmatic rocks (granite and gneiss), and siliclastic rocks (quartzite) (Table 1). Palpigrades were especially prevalent in iron ore caves, and a chi-square test showed that the abundance of palpigrades varied as a function of host rock type, with the number found in iron ore caves double the number that would have been expected.

A total of 494 individuals was found in the various habitats inside the different caves, normally under rocks or in the soil on the floor of the cave; rarely, they were discovered crawling along the walls or on speleothems. The average number of palpigrades per cave per municipality shows that these invertebrates are most abundant in the state of Minas Gerais, especially in caves in iron ore, although many are also found in limestone caves (Fig. 1).

In the epigean environment in the vicinity of the caves, we only found palpigrades in the state of Minas Gerais (municipalities of Iguatama, Lavras, Pedro Leopoldo, Novo Oriente de Minas, Arcos, and Pains). They were especially prevalent in the latter two municipalities, where dozens of individuals were found under the rocks in the forest; however, all sightings were made during rainy periods. It seems probable that during the dry seasons they penetrate the interstices of the soil to protect themselves from the dry conditions of the surface.

All exemplars collected in Brazilian caves were identified as *Eukoenenia*. In addition to the troglobiotic species found in the Maquiné cave, described in this study, individuals collected in six other caves in the states of Espírito Santo, Minas

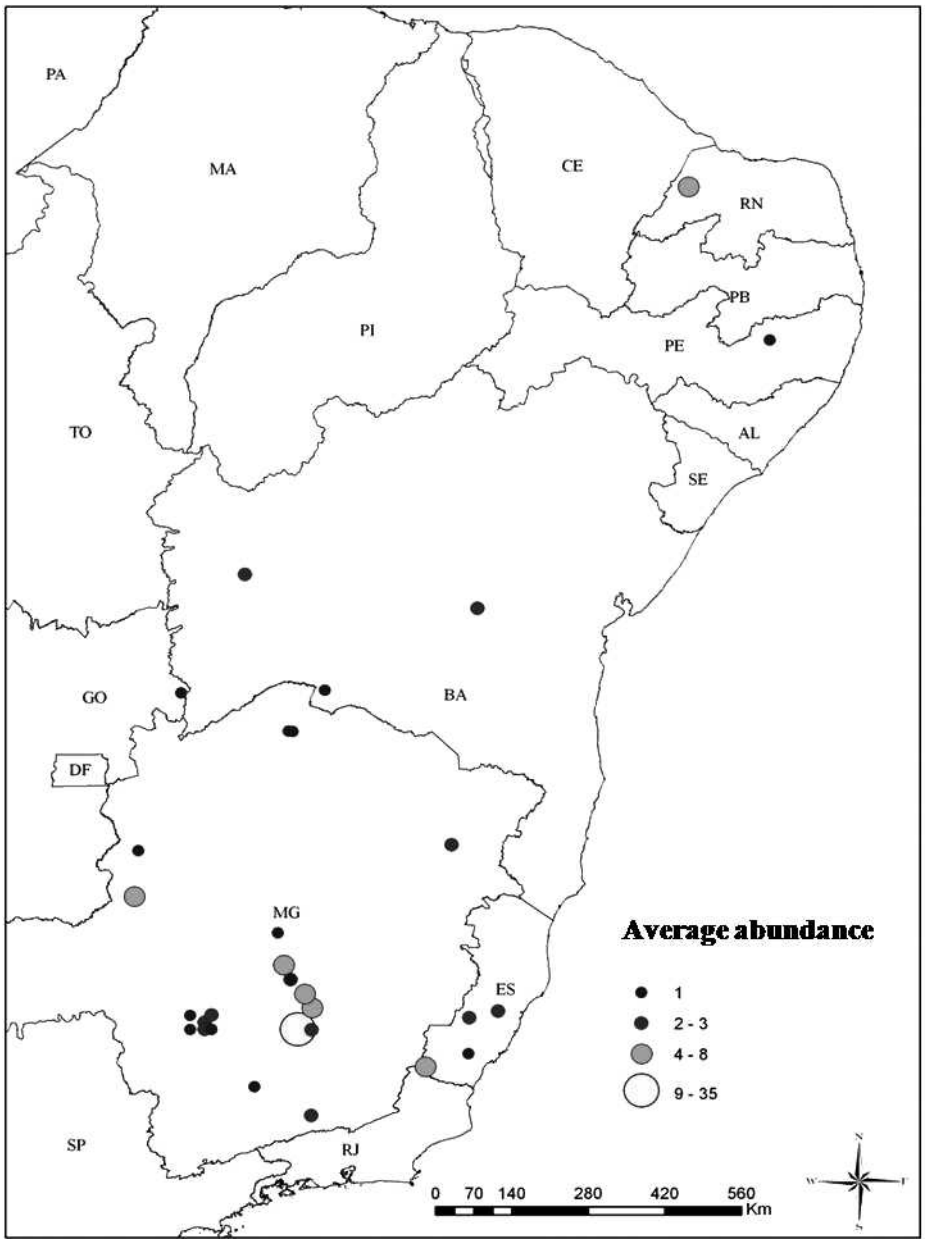
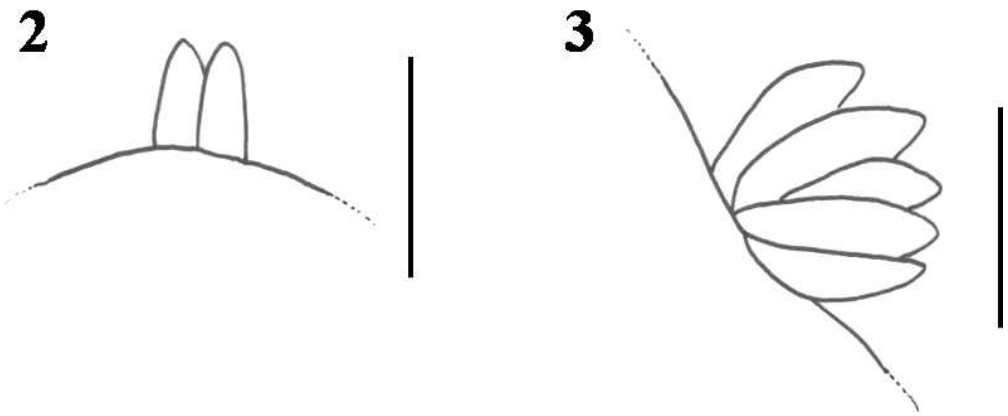


Figure 1.—Distribution of the municipalities with occurrence of subterranean palpigrades in Brazil and its respective average abundances.

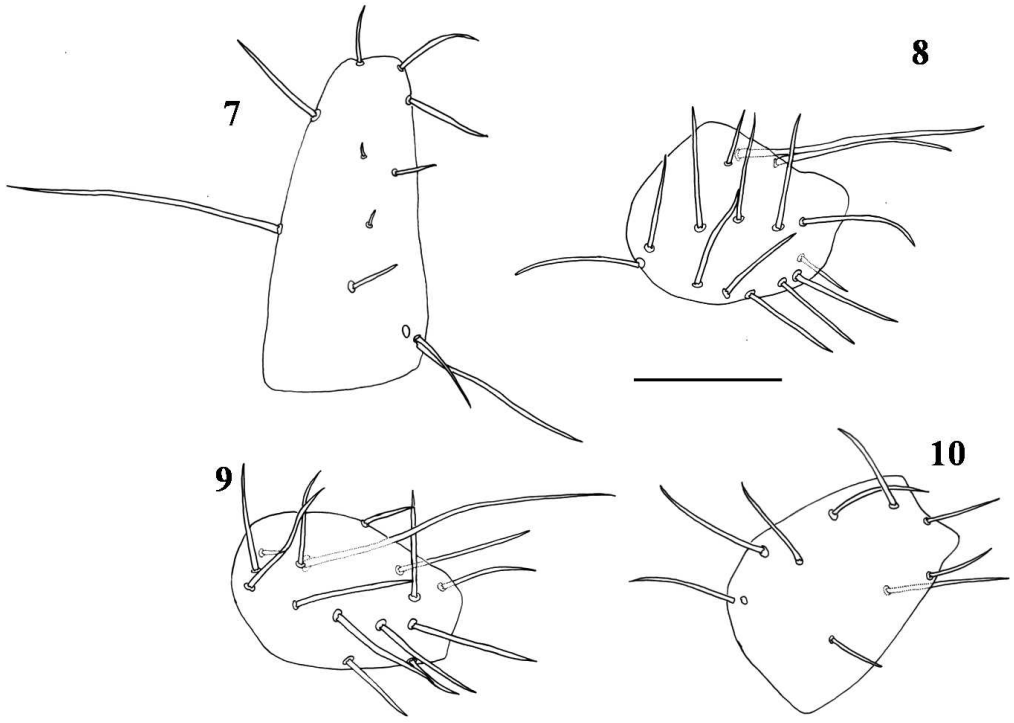


Figures 2, 3.—*Eukoenenia maquinensis* new species (holotype): 2. Frontal organ, dorsal view; 3. Lateral organ, dorsal view. Scale bars: 32.5 μm.

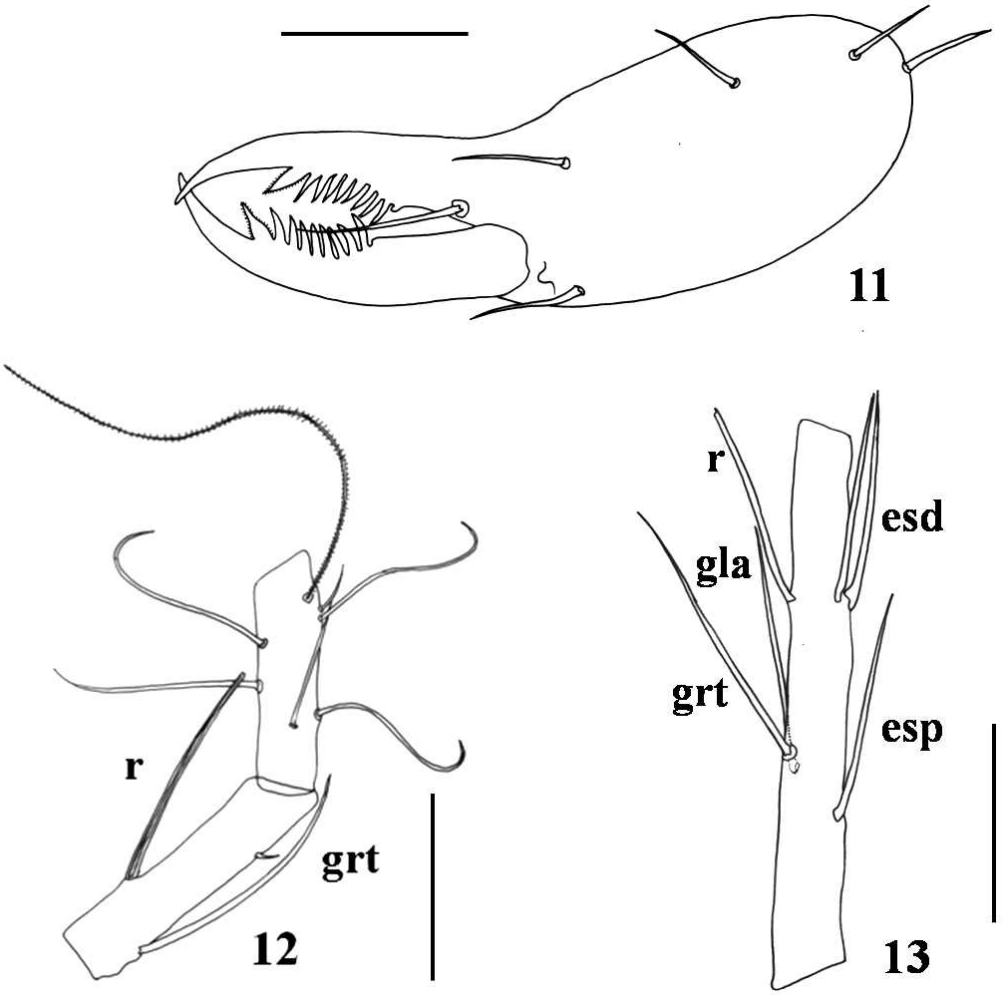
Figures 4–6.—*Eukoenenia maquinensis* new species (holotype): 4. Propeltidial chaetotaxy; 5. Metapeltidial setae; 6. Deuto-tritosternal setae. Scale bars: 150 μm (Fig. 4), 100 μm (Fig. 5), 50 μm (Fig. 6).

Gerais and Bahia presented troglomorphic traits, such as lengthening of appendices and the flagellar segments and an increase in body size. These other troglomorphic species are under description. The study of the edaphomorphic species captured has revealed the presence of at least four undescribed species.

We observed these troglomorphic species moving along the walls and speleothems, whereas the edaphomorphic species were generally hidden under rocks in the soil on the cave floor, although two were found walking on top of water accumulated in travertine dams in the Lapa Nova cave in Vazante and



Figures 7–10.—*Eukoenenia maquinensis* new species (paratype): 7. Coxa I; 8. Coxa II; 9. Coxa III; 10. Coxa IV. Scale bar: 100 μm.



Figures 11–13.—*Eukoenenia maquinensis* new species (holotype): 11. Chelicerae; 12. Basitarsus 3–4 of leg I; 13. Basitarsus IV. Scale bar: 100 μm.

another in the cave of Santuário in Pains, all in the state of Minas Gerais.

TAXONOMY

Family Eukoeneniidae Petrunkevitch 1955
Genus *Eukoenenia* Börner 1901

Koenenia Grassi & Calandruccio 1885:165 [junior primary homonym of *Koenenia* Beushausen 1884 (Mollusca: Bivalvia)].

Koenenia (*Eukoenenia*) Börner 1901:551.

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

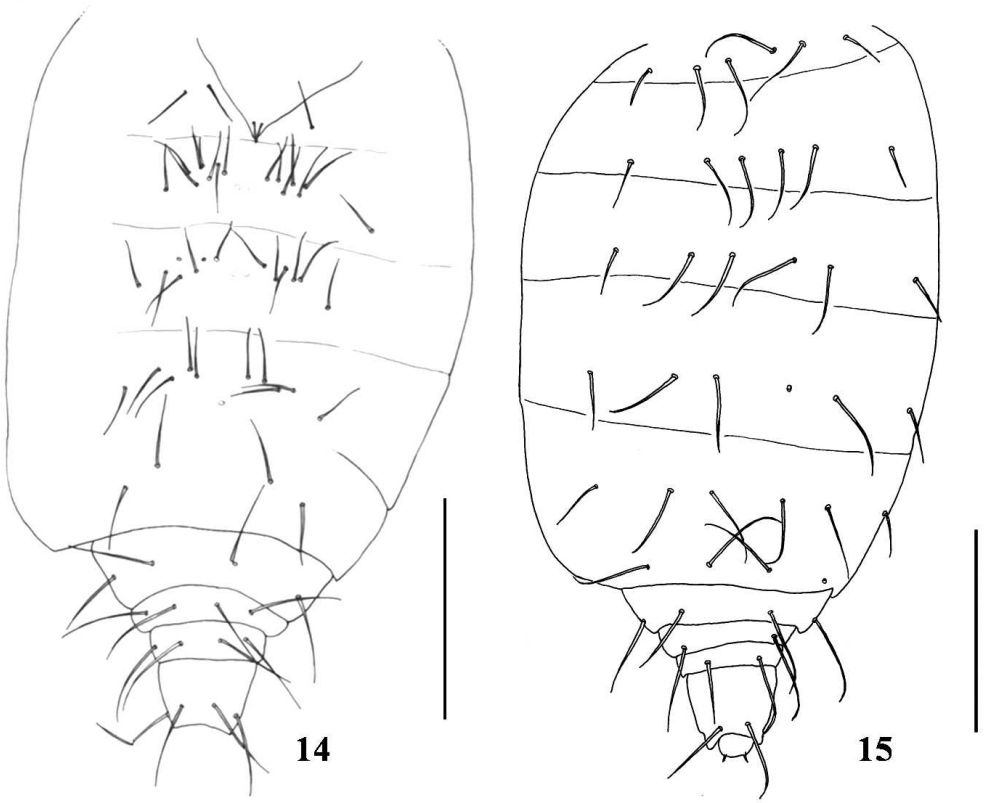
Eukoenenia maquinensis new species
(Figs. 2–20)

Material examined.—**Brazil:** *Minas Gerais*: Holotype adult female, Maquiné cave (collected from a speleothem), Cordisburgo (19°11′15″S, 44°18′45″W), 16 December 2007, R.L. Ferreira (IBSP, IBSP05). Paratype: 1 adult female, Maquiné cave, Cordisburgo (19°11′15″S, 44°18′45″W), 16 December 2007, R. L. Ferreira (UFLA, ISLA 502).

Diagnosis.—*Eukoenenia maquinensis* differs from all other species of the genus by the following combination of characters: presence of 6 blades on prosomal lateral organs; propeltidium with 7 + 7 setae; six setae on basitarsus IV with a single proximal sternal seta; opisthosomal sternites IV–VI with 14, 13, and 11 setae, respectively, in an irregular row.

Description.—*Prosoma*. Frontal organ with two branches, blunt apically, each 5.5 times longer than wide (55 μm/10 μm) (Fig. 2). Lateral organ with six pointed blades, each 6.7 times longer than wide (33.75 μm/5 μm) (Fig. 3); Fig. 3 only shows five blades due to the hidden position of the sixth blade. Propeltidium with 7 + 7 short setae, first pair on either side of frontal organ longer than others (Fig. 4). Metapeltidium with 3 + 3 setae (t_1, t_2, t_3), each of a different length; outer setae shortest (157.5 μm, 125 μm and 115 μm) (Fig. 5). Deutotritosternum with nine or eight setae in U-shaped arrangement (Fig. 6). Chaetotaxy of coxae I–IV: 11, 15, 15 and 9 (Figs. 7–10). The holes in Figures 7 and 10 represent the insertions of each of the respective setae, which are positioned just near each hole.

Chelicerae with 9 teeth on each finger; 4 dorsal setae and 1 ventral seta inserted near the third segment, and 1 seta inserted near the row of teeth of the second segment (Fig. 11).



Figures 14, 15.—*Eukoenenia maquinensis* new species (holotype): 14. Opisthosoma, dorsal view; 15. Opisthosoma, ventral view. Scale bar: 300 μm.

Basitarsus 3 of leg I slender, 4.23 times longer than wide, with 3 setae (*grt* 140 μm; *r* 125 μm). Seta r shorter than segment (137.5 μm/125 μm, *t*/*r* = 1.1), inserted in proximal half and surpassing hind edge (42.5 μm/125 μm, *s*/*er* = 0.34) (Fig. 12). Basitarsus of leg IV long, 9.1 times longer than wide, with 6 setae (2 *esd*, *esp*, *gla*, *grt* and *r*) (Fig. 13), bta/ti 1.07. Stiff seta r 2.75 times shorter than tergal edge of article (275 μm/100 μm, *t*/*r* = 2.75) and inserted in distal third (275/185, *t*/*er* = 1.48). Seta *esp* proximally inserted, followed by *grt* and *gla*, more or less at the same level, all of them in proximal half.

Opisthosoma: Tergites II–VI with 3 + 3 setae each, 2 pairs of tergal setae (t) (t_1, t_3) between both slender setae (s). Tergites VII–VIII with 2 + 2 setae, only t setae present and without s (Fig. 14). Sternite III with 2 + 2 setae. One seta on left side of this structure was not represented in the drawing, but was visible unattached near the sternite. Its insertion was not represented due to the difficulty in finding it precisely. Sternites IV–VI with 14, 13 and 11 setae in slightly irregular transverse row, all of them of similar shape and with length varying between 65–75 μm, 52.5–77.5 μm and 72.5–82.5 μm respectively. Sternites IV–V each with two glandular pores. Sternites VII–VIII with 2 + 2 setae. Segments IX–XI each with 6 setae (Fig. 15).

Genitalia: With 2 lobes, first lobe (Fig. 16) with 11 + 12 setae in 5 transverse rows, 4 sternal 2 + 2, 2 + 3 (asymmetry caused by dislocations due to the lack of regular and/or the presence of additional setae), 2 + 2, 1 + 1 and distal 4 + 4, of which a_1, a_2, a_3, a_4 measure 35 μm, 30 μm, 37,5 μm and 50 μm, respectively. Second lobe (Fig. 17) with 3 + 3 setae (seta y was possibly lost during the collection or the specimen presents an asymmetry) (x, y, z), measuring 32.5 μm, 40 μm, and 30 μm, respectively; six glandular orifices. Spermathecae triangular, with the base measuring 15 μm and the height measuring 10 μm.

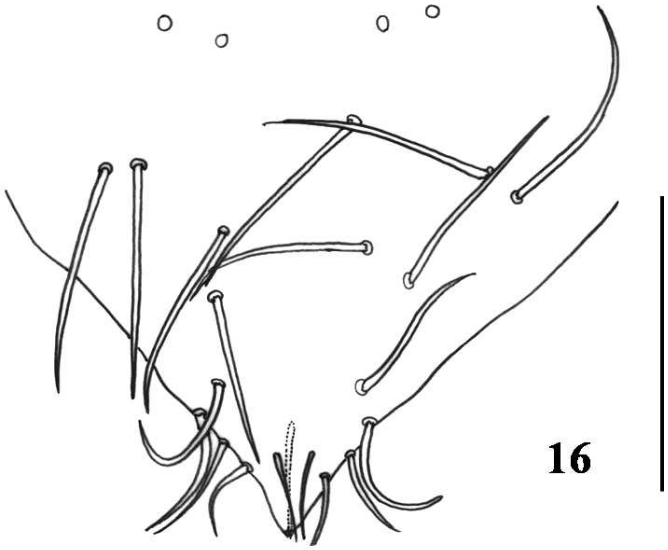
Flagellum: Longer than opisthosoma, with 14 long, slender articles (Fig. 18). First, thirteenth and fourteenth segments considerably shorter than others. First 3 segments have structures similar to a crown of spines around the extremity, with 11 long setae inserted in the distal half. Fourth, sixth and eighth segments without the crown of spines and with 9 long setae inserted in distal third. Fifth, seventh and ninth segments also with spines on their extremities and with 8 long setae inserted in distal half (Fig. 19). In the other segments, the crown of spines is lacking. Tenth segment with 9 long setae inserted in the distal half. Eleventh segment with 8 long setae in proximal half. Twelfth and thirteenth segments with 8 long setae inserted in proximal third. Last segment with 6 long setae inserted in middle of segment and 4 setae inserted apically (Fig. 20).

Dimensions (μm): See Table 2.

Habitus: See Fig. 21

Etymology.—The specific name refers to the cave, Maquiné, where the specimens were found.

Habitat.—Maquiné cave is the only known habitat of *E. maquinensis*. This cave is the oldest tourist cave in Brazil and has been exploited for this purpose since 1908. In 1967, the infrastructure was modernized to include not only stairs and



Figures 16, 17.—*Eukoenenia maquinensis* new species (holotype): 16. Female genitalia, first lobe; 17. Female genitalia, second lobe. Scale bars: 100 μm (Fig. 16), 50 μm (Fig. 17).

topographical alterations to the floor of the cave, but also electric lights. At the far end of the cave, the relative humidity is approximately 91%, and the average temperature is about 24° C. The trophic resources consist of organic material left during the installation of the tourist infrastructure, such as wood scraps, as well as scraps of food left by tourists during their visit to the cave and small plants growing near the lights. The specimens described here were collected in an area not subjected to visitation by tourists.

DISCUSSION

The environments suitable for populations of palpigrades include caves and other subterranean environments, and these invertebrates have been reported from such systems in many locations around the world, including Europe, Asia, Central America and Africa (e.g., Condé 1984a, 1987, 1996; Barranco & Harvey 2008).

Caves in sixteen of the Brazilian states were surveyed, and palpigrades were found in seven of these states. Moreover, since relatively few surveys of cave fauna have been conducted in the country, the geographical distribution of the palpigrades in Brazilian caves is probably much greater than that described here. Furthermore, some regions had been poorly studied, as the Central Amazon, where studies revealed a high abundance of a single species, *E. janetscheki* (Condé 1993; Adis et al. 1997).

Biological surveys of some 350 caves in Brazil have been previously reported in the literature (Pinto-da- Rocha 1995; Trajano 1996, 2000; Gomes et al. 2000; Zeppelini Filho et al. 2003; Prous et al. 2004; Ferreira 2005; Silva 2006). In these papers, few palpigrades have been reported, except for iron ore caves (Ferreira 2005). The reports of Trajano (1996, 2007) for the caves of Olhos DÁgua (MG) and the System of Areias (SP) include no taxonomic identification. Moreover, this author gave little emphasis to these arachnids, failing to include information about abundance and microhabitat, as well as the behavior of individuals prior to collection. This

Table 2.—Measurements (μm) of selected body parts of the two type specimens of *Eukoenenia maquinensis*.

Body part	Female (Holotype)	Female (Paratype)
L	1490	2140
B	435	462.5
Pti	235	252.5
PBta1	90	95
PBta2	105	112.5
Pta1	55	60
Pta2	75	75
Pta3	80	112.5
Iti	320	320
IBta1+2	245	260
IBta3	137.5	147.5
IBta4	115	112.5
Ita1	70	70
Ita2	80	72.5
Ita3	215	220
IVTi	255	252.5
IVBta	275	270
IVTa1	102.5	100
IVTa2	125	130
A	30	25
Er	185	187.5
Grt	137.5	130
Gla	127.5	135
R	100	100
t/r	2.75	2.7
t/er	1.48	1.44
Gla/grt	0.92	1.03
B/bta	1.58	1.7
Bta/ti	1.078	1.07
Flagelo	3865	-
FI	197.5	-
FII	240	-
FIII	275	300
FIV	290	325
FV	250	-
FVI	320	305
FVII	265	275
FVIII	332.5	325
FIX	260	260
FX	377.5	385
FXI	372.5	375
FXII	352.5	320
FXIII	170	330
FXIV	162.5	175

Figures 18–20.—*Eukoenenia maquinensis* new species (holotype): 18. First six flagellar segments; 19. Fifth flagellar segment; 20. Fourteenth flagellar segment. Scale bars: 600 μm (Fig. 18), 100 μm (Fig. 19), 150 μm (Fig. 20).

lack of information, in conjunction with the limited number of records of palpigrades, has limited our understanding of their behavior and ecology. Moreover, inadequate collection methods in caves may have led to the misconception that palpigrades are rare in underground Brazilian systems. As shown in this paper, more than 20% of the caves surveyed have palpigrades, which shows that these organisms are not rare in Brazilian caves.

Palpigrades have been discovered in epigean environments near cave entrances, as well as in their disphotic hypogean interiors, a fact that probably reflects the high humidity prevailing when collections were made. These populations can stay inside and outside of caves in the same territory.

Condé (1996) affirms that the most likely places to find palpigrades inside caves are spaces under rocks, in the soil on the floor of the cave, or moving around on the ground or walls. He explains that the occupation of these different habitats is determined by factors such as the hygrometry and the movement of air in the cave. During the collecting process, we observed that the troglomorphic palpigrades were frequently found walking along the walls and on speleothems, whereas the edaphomorphic species were found only under rocks or in the soil. Similar information is reported for troglomorphic individuals of *E. orghidani* (in Cuba) and *E. spelaea* (in the Alps of Provence) found walking around exposed on stalagmites (Condé 1984b). The adoption of this exposed habitat may reflect behavioral modifications that have accompanied the morphological adaptations linked to the underground environment. Therefore, the occupation of habitats unlike those inhabited by palpigrades under other circumstances seems to be related both to environmental aspects of the cave in which they are found and to the degree of specialization of the species in the underground environment.

The greater frequency of palpigrades in iron ore caves may be explained by the structural and functional characteristics of this type of underground system. These rock systems, especially the weathered mantle (''canga'') covering the mother rock, include numerous minute conduits forming a network of interstitial spaces (meso- and microcaves) which are linked to the larger caverns, thus facilitating colonization of regions far from the entrance (Ferreira 2005). Furthermore, the epigean vegetation associated with iron ore is relatively sparse and provides rather limited leaf litter (Ferreira 2005), making the epigean environment unfavorable for the survival of soil fauna.

The troglomorphic species described here as *Eukoenenia maquinensis* displays various troglomorphic characteristics. These include reduction of the length and number of setae of the propeltidium (7 + 7) as in *E. naxos* Condé 1989, a reduction in the number of setae of the basitarsus of leg IV, with six setae instead of seven (absence of an esp seta), and a flagellum composed of 14 narrow and much elongated segments. The presence of tiny setae in the propeltidium is shared with other troglomorphic species as *E. gasparoi* Condé 1988 (10 + 10 setae), *E. thais* Condé 1988 (10 + 10) and *E. maros* Condé 1992 (10 + 9).

Moreover, this species has elongated appendages, such as the elongation of the basitarsus IV of *E. maquinensis*, which is longer than the tibia, with a bta/ti ratio of 1.07. This value is close to that found for *E. naxos* (bta/ti = 1.10), considered to be the species that has reached the highest level of underground evolution, with the exception of the lateral organs of the prosoma (Condé 1996). The mean value of *B*/*bta*

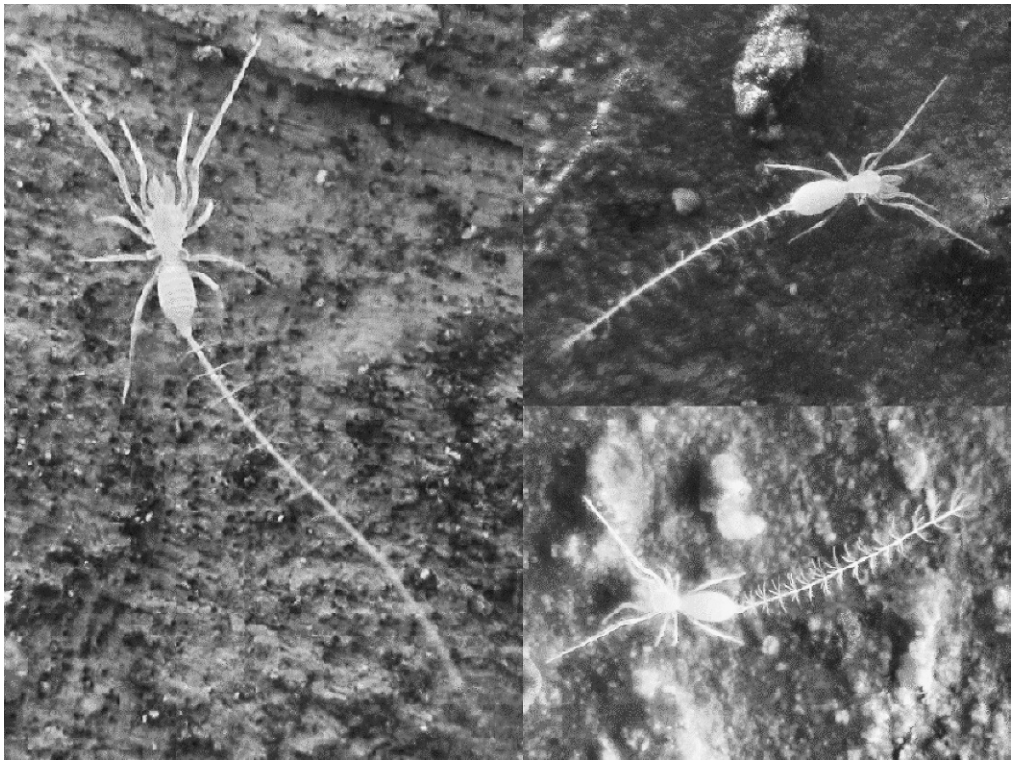


Figure 21.—Habitus of *Eukoenenia maquinensis* new species.

IV in the two specimens is 1.64, close to that of other cave species such as *E. naxos* (1.71), *E. thais* Condé 1988 (1.61), and *E. grafittii* Condé & Heurtault 1994 (1.59) (Condé 1998).

Condé (1996) considers body length to be a very arbitrary criterion for determining troglomorphism, since it is related to how stretched out an individual is in the preserving solution when measurements are taken. The holotype of *Eukoenenia maquinensis* measured only 1.49 mm, but this would correspond to approximately 2 mm, since the specimen shrank upon contact with the 70% alcohol used for preservation. The paratype preserved in 60% alcohol measured 2.14 mm, which is a more realistic representation of the adults' real size.

Furthermore, the flagellum is extremely fragile and is rarely preserved. If it survives the original capture, it seldom survives subsequent manipulation. Few specimens have been described with an intact flagellum, although Condé (1996) suggests that this length varies from 1.36 to 3.25 mm for a body length of 0.97 to 2.20 mm for adult cave species. If this is accurate, *E. maquinensis* has the longest flagellum reported for a species of *Eukoenenia*, with a length of 3.865 mm.

The lateral organs of *Eukoenenia maquinensis* are composed of six elements, similar to that of *E. spelaea* (Peyerimhoff 1902) (5–6), *E. depilata* Rémy 1960 (6), *E. remyi* Condé 1974 (4–6), *E. maroccana* Barranco & Mayoral 2007 (6) and *E. guzikae* Barranco & Harvey 2008 (6).

It was not possible to establish the deutotritosternal chaetotaxy because one of the specimens had nine setae while the other had only eight setae. The number of specimens collected was inadequate to determine if this variation in the setae represented a population characteristic or if one of the specimens served as an exception.

The holotype genitalia suggest asymmetry caused by dislocations due to the lack of regular and/or the presence of additional setae, not unusual in *Eukoenenia*. Unfortunately, the genital lobes of the paratype were damaged during slide mounting. It is impossible to determine if this asymmetry is an exclusive trait of the holotype female; in that case, the actual number of setae would be 11+11 or 12+12. In the opisthosomal sternites IV–VI the tip of the lateral setae is similar to the tip of the paramedian setae, hence, it is very difficult to distinguish the thickened setae (a) from normal setae (s).

Eukoenenia maquinensis is certainly one of the most modified palpigrades adapted to the underground environmental conditions. Many models concerning the evolution of subterranean lineages state that isolation (due to climatic changes) was more pronounced in temperate regions than in tropical areas. This would be the reason why there are so many modified troglobiotic species in temperate areas. However, the strongly modified species described here suggests that the effects of climatic changes in Neotropics (leading to isolation in subterranean habitats) could have led to the same effects observed in the temperate areas, at least for some groups such as the palpigrades.

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