



Description of *Mitogoniella mucuri* sp. nov. (Opiliones: Gonyleptidae) and considerations on polymorphic traits in the genus and Gonyleptidae

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Abstract

Mitogoniella mucuri sp. nov. is described for some caves in Minas Gerais, Brazil. This species differs from other *Mitogoniella* species by large tubercles on the ocularium that have fused bases and free apices (or almost fully fused tubercles with bifurcated apices), and by a large dry-mark between tubercles on the longitudinal groove of area III. *Mitogoniella* species are hard to recognize: their males lack any armature on leg IV (normally an important diagnostic character among gonyleptid species), and they also present many polymorphisms in coloration (dry-mark), male secondary sex characters, the number of dorsal scutal granules, and the shapes of tubercles on the ocularium. The patterns of these polymorphisms are discussed for the genus and for the family. The present work also presents new occurrences for all the species of the genus, and their biogeography is discussed.

Key words: Goniosomatinae, taxonomy, caves, biogeography

Introduction

Gonyleptidae is the largest family of the opilionid suborder Laniatores, with 16 subfamilies and 829 species (Kury & Pinto-da-Rocha 2007; Kury 2013). The subfamily Goniosomatinae is composed of six genera and 36 species, all of them possessing armed and strong pedipalps, large bodies, varied and conspicuous coloration and, usually, very long legs (some more than 20 centimeters) (DaSilva & Gnaspini 2010). Goniosomatinae represents one of the nine subfamilies of Gonyleptidae that are endemic to Brazilian Atlantic Rain Forest, with the species occurring from Southern Bahia to Santa Catarina States, making these species good models for biogeographic studies (DaSilva & Gnaspini 2010).

Mitogoniella occurs in southeast Bahia and south and east of Minas Gerais State (Serra do Espinhaço and Serra da Mantiqueira mountain ranges and adjacent valleys). The latter region (Serra da Mantiqueira) also harbors *Acutisoma* Roewer, 1913, the sister-genus of *Mitogoniella* (DaSilva & Gnaspini 2010). Four species of *Mitogoniella* are known—*M. modesta* (Perty, 1833); *M. unicornis* DaSilva & Gnaspini, 2010; *M. indistincta* Mello-Leitão, 1936 (type species) and *M. taquara* DaSilva & Gnaspini, 2010—and there is great morphological similarity among them but a great variation on an intraspecific level. *Mitogoniella indistincta* and *M. taquara* occurs in Minas Gerais State, and *M. unicornis* and *M. modesta* are hitherto known only from Bahia State.

In this paper, a new species of *Mitogoniella* is described, new geographical occurrences of all species of the genus are listed, and its biogeography is also discussed; furthermore, polymorphisms in Gonyleptidae are discussed.

Methodology

All specimens were collected in granitic caves in the municipalities of Caraí, Novo Oriente de Minas and Padre

Paraíso, and in Alagoa the single individual collected was from an artificial mine. The habitat surrounding most of the caves is well preserved (Figure 1A).

Animals were manually collected and fixed in 70% ethanol. Type material of the new species was deposited in the following Brazilian collections: Coleção de Invertebrados Subterrâneos de Lavras, Setor de Zoologia/ Departamento de Biologia, Universidade Federal de Lavras, Lavras, Minas Gerais State (ISLA); Coleção de Invertebrados Paulo Young, Universidade Federal da Paraíba, João Pessoa, Paraíba State (UFPB), and Museu de Zoologia da Universidade de São Paulo, São Paulo, São Paulo State (MZSP). New occurrences of other species of *Mitogoniella* were compiled from specimens deposited in MZSP, UFPB, ISLA and in the Museu Nacional da Universidade Federal do Rio de Janeiro, Rio de Janeiro, Rio de Janeiro State (MNRJ).

We adopted the morphological terminology proposed by DaSilva and Gnaspini (2010). Fifteen male and four female specimens were used for granules, tarsi and penis setae counting, and measurement of appendages and dorsal scute length. Morphological structures were measured with an ocular micrometer of a stereomicroscope (Zeiss Stemi 2000-c) and a digital caliper (Messen). The penises from three paratypes were each placed on aluminum support stubs, over a film of aluminum foil with carbon tape, sputter-covered with gold (Baltec SCD 050), and observed in a LEO EVO 40 XVP scanning electron microscope (Leo Electron Microscopy). Drawing and photos were made using a Leica M205A stereomicroscope with the software Leica Application Suite Automontage.

Taxonomy

Mitogoniella mucuri sp. nov.

(Figs. 1 C, 2, 3, 4 A–C, 5 and 6)

Type material. Holotype: male (ISLA 3961) from Loca do Ribeirão Anastácio I, Novo Oriente de Minas, Minas Gerais, 16/VI/2012, *leg.* Ferreira, R.L. Paratypes: 3 females (ISLA 3966), 2 males (MZSP 38154), same data as holotype; 2 males and 1 female (ISLA 1497) from Gruta do Roxo, Novo Oriente de Minas, 20/VII/2002, *leg.* Ferreira, R.L.; 1 male (ISLA 3963) from Loca do Ribeirão Anastácio I, Novo Oriente de Minas, Minas Gerais, 23/X/2012, *leg.* Ferreira, R.L.; 1 male (ISLA 3965) from Loca do Ribeirão Anastácio I, Novo Oriente de Minas, Minas Gerais, 03/X/2012, *leg.* Ferreira, R.L.; 1 female (ISLA 3968) from Loca do Ribeirão Anastácio I, Novo Oriente de Minas, Minas Gerais, 03/X/2012, *leg.* Ferreira, R.L., 1 male (UFPB OP-77) from Loca do Ribeirão do Anastácio I, Novo Oriente de Minas, Minas Gerais, 03/X/2002, *leg.* Ferreira, R.L., 1 male and 1 female (UFPB OP-91) from Loca do Ribeirão do Anastácio I, Novo Oriente de Minas, Minas Gerais, 03/VI/2012, *leg.* Ferreira, R.L.; 1 male and 1 female (ISLA 3969) from Lapa do Córrego Vieira, Padre Paraíso, Minas Gerais, 10/VII/2004, *leg.* Ferreira, R.L.; 1 male and 2 females (ISLA 3970) from Túnel da Fazenda Cilindro I, Carai, Minas Gerais, 21/VII/2012, *leg.* Ferreira, R.L.; 1 male (ISLA 3971) from Gruta do Sumidouro, Carai, Minas Gerais, 25/I/2012, *leg.* Ferreira, R.L.; 1 male (ISLA 3972) from Gruta do Sumidouro, Carai, Minas Gerais, 25/I/2012, *leg.* Ferreira, R.L.; 2 males (ISLA 3973) from Gruta do Sumidouro, Carai, Minas Gerais, 25/I/2012, *leg.* Ferreira, R.L.; 1 male (ISLA 3983) from Túnel do Garrafão, Alagoa, Minas Gerais, 31/I/2008, *leg.* Ferreira, R.L.

Diagnosis. The new species is distinguished from others in the genus by having the ocularium with a pair of strong tubercles, high, with widely fused bases, similar to a single strong tubercle with bifurcated apex. In other species, if fused, tubercles are weak and pointed. It is also distinguished by a large dry-mark between area III tubercles, on the longitudinal groove.

Etymology. Mucuri is the name of the main river in the type locality and also a common tree in the region's ombrophyllous forest. This noun should be treated as a noun in apposition.

Description (male holotype). Measurements in Table 2; dorsum pictures in Fig. 2, A–C. Ocularium with a pair of strong tubercles, high, with widely fused bases, similar to a single strong tubercle with bifurcated apex (Fig. 4 A–C). Carapace smooth, except for ocularium tubercles. Areas I, II and III with 9, 8 and 10 medium-sized granules. Area I with a pair of paramedial, small tubercles. Area III with a pair of thin, large spines. Angles of posterior margin of dorsal scute with medium-sized tubercles; angles of free tergites with small granules. Lateral margin with rows of small, randomly distributed granules.

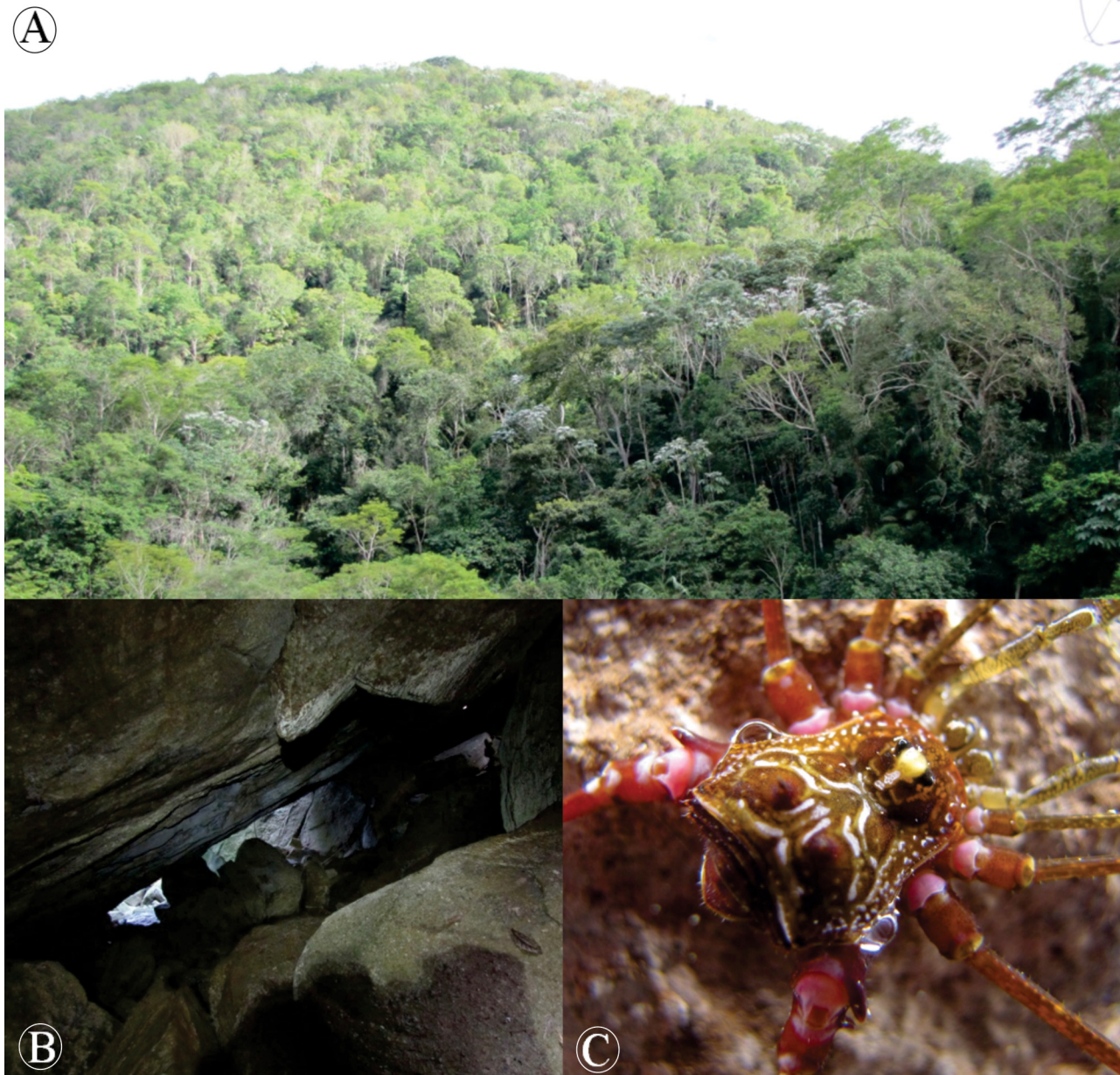


FIGURE 1. A) Atlantic Rainforest in the external area of the Loca do Ribeirão Anastácio cave, Novo Oriente de Minas, Minas Gerais State; B) Entrance of the cave in the main population of the new species was found; C) *Mitogoniella mucuri* sp. nov., living male specimen inside the cave.

Chelicerae. Segment I with a small, basal, dorsal-retrolateral tubercle and two apical, retrolateral and prolateral tubercles; five small ventral granules. Segment II with a medium density of medium-sized granules.

Pedipalps. Trochanter: with a large, ventral, retrolateral tubercle; a small, ventral, prolateral tubercle; and two small, dorsal tubercles. Femur: six setiferous tubercles (elevation pattern IiIiii) and a large, retrolateral, subapical spine. Patella: a medium, retrolateral tubercle. Tibia: with ventral armature iIiIi prolaterally, IiIi retrolaterally and four medium-sized, ventral granules. Tarsus: with ventral armature IiIi prolaterally and Iii retrolaterally.

Legs. Leg I. Coxa with a ventral row of large tubercles, with two basal apophyses on dorsal region and a low density of small granules. Trochanter with low density of minute granules. Femur, patella and tibia with minute granules. Metatarsus smooth. Leg II. Coxa with a ventral row of medium tubercles, with two basal apophyses on dorsal region and a low density of small granules. Trochanter with a low density of minute granules. Femur, patella and tibia with minute granules. Metatarsus smooth. Leg III. Coxa with a ventral row of small tubercles and a low density of small granules. Trochanter with a low density of minute granules. Femur, patella and tibia with small

granules. Metatarsus almost smooth. Leg IV. Coxa with a strong, prolateral, apical apophysis and a small, retrolateral, apical apophysis, as a granule. Trochanter with a low density of small granules. Femur, patella and tibia with minute granules. Metatarsus smooth. Tarsal claws smooth. Tarsal segmentation (the holotype condition in parentheses): 10–12 (10), 19–24 (20), 12–16 (13), 13–16 (15). Distitarsus I–II with 3 segments.

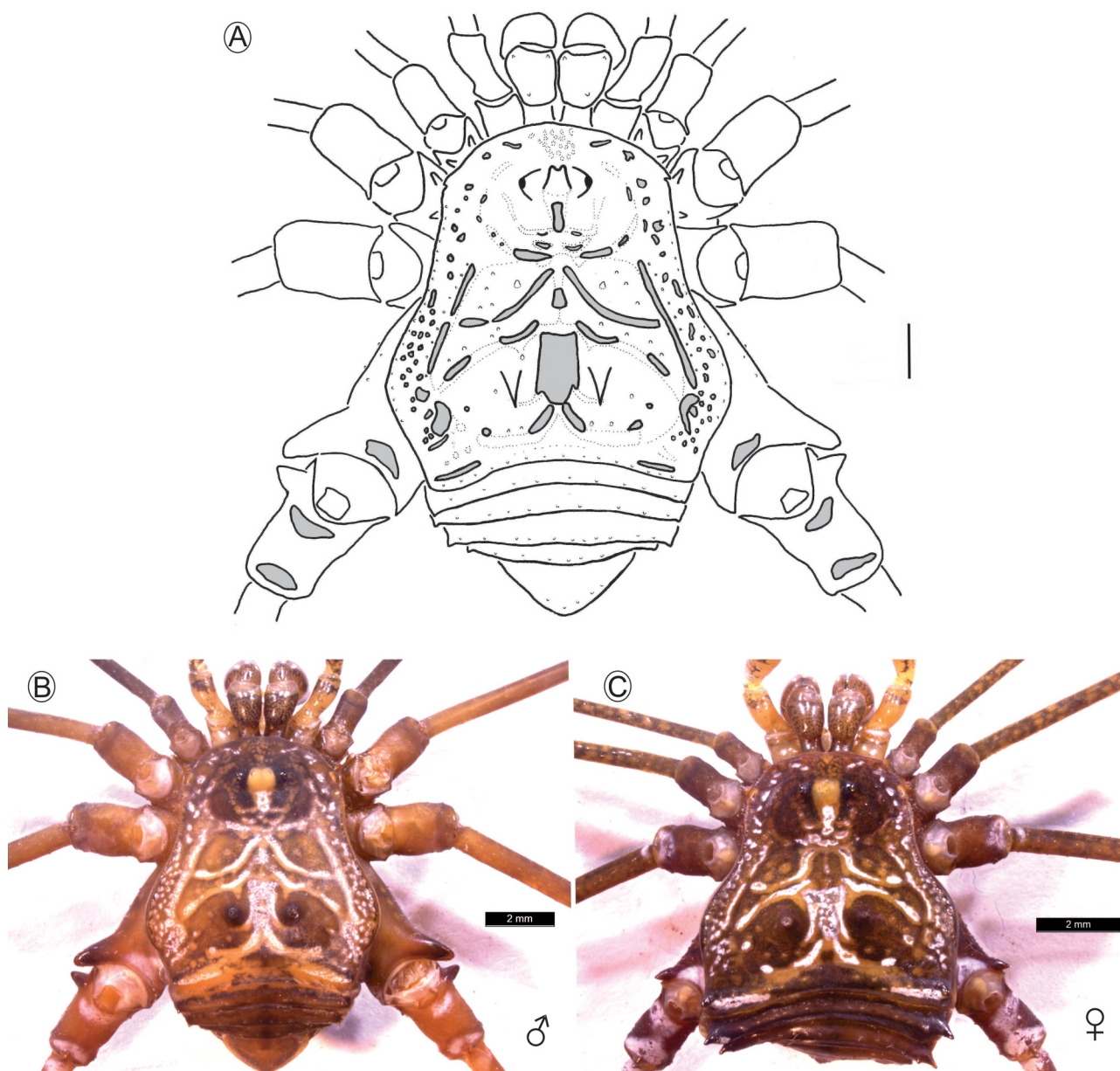


FIGURE 2. A) Dorsal view of *Mitogoniella mucuri* sp. nov. A) *Mitogoniella mucuri* sp. nov., male holotype, with gray patches representing the white dry-marks. Scale bar equals 1 mm. B–C) Photographs of the male holotype (ISLA 3961) and female paratype (ISLA 3968), respectively.

Coloration pattern (Fig. 2 A–C). Dorsal scute varying from dark brown to light brown. Grooves of areas and tubercles of ocularium unpigmented (yellowish), with a slightly unpigmented circle around granules of the dorsal scute. Legs I, II, III and IV light-brown, with patella, tibia and apical portion of femur blackish. Pedipalps and chelicerae dark brown, with a reticulate pattern of dark pigment. Dry-mark (a thicker external serose layer of the cuticle that forms white markings on the animal): following the grooves of areas (described by DaSilva & Gnaspini, 2010) and as a wide stripe between spines of area III, besides of a pair of paramedian, longitudinal stripes; in dots on whole lateral margins of dorsal scute, and as a thin stripe on carapace behind the ocularium; on dorsal portion of trochanter IV and base of femur.

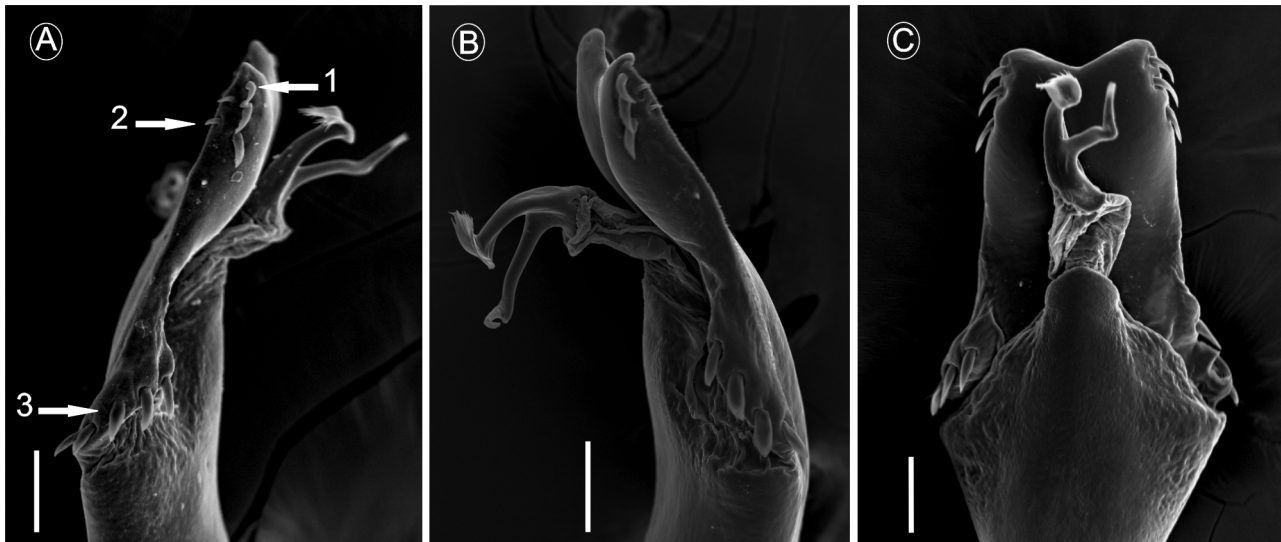


FIGURE 3. Penis of *Mitogoniella mucuri* sp. nov. A) Lateral view (left) (ISLA 3969), 1 – dorsal row of setae of apical group, 2 – ventral row of setae of apical group, 3 – basal group of setae; B) Lateral view (right) (ISLA 3965), showing polymorphism of number of setae of basal group; C) Dorsal view (ISLA 1497). Scale: 100 μ m.

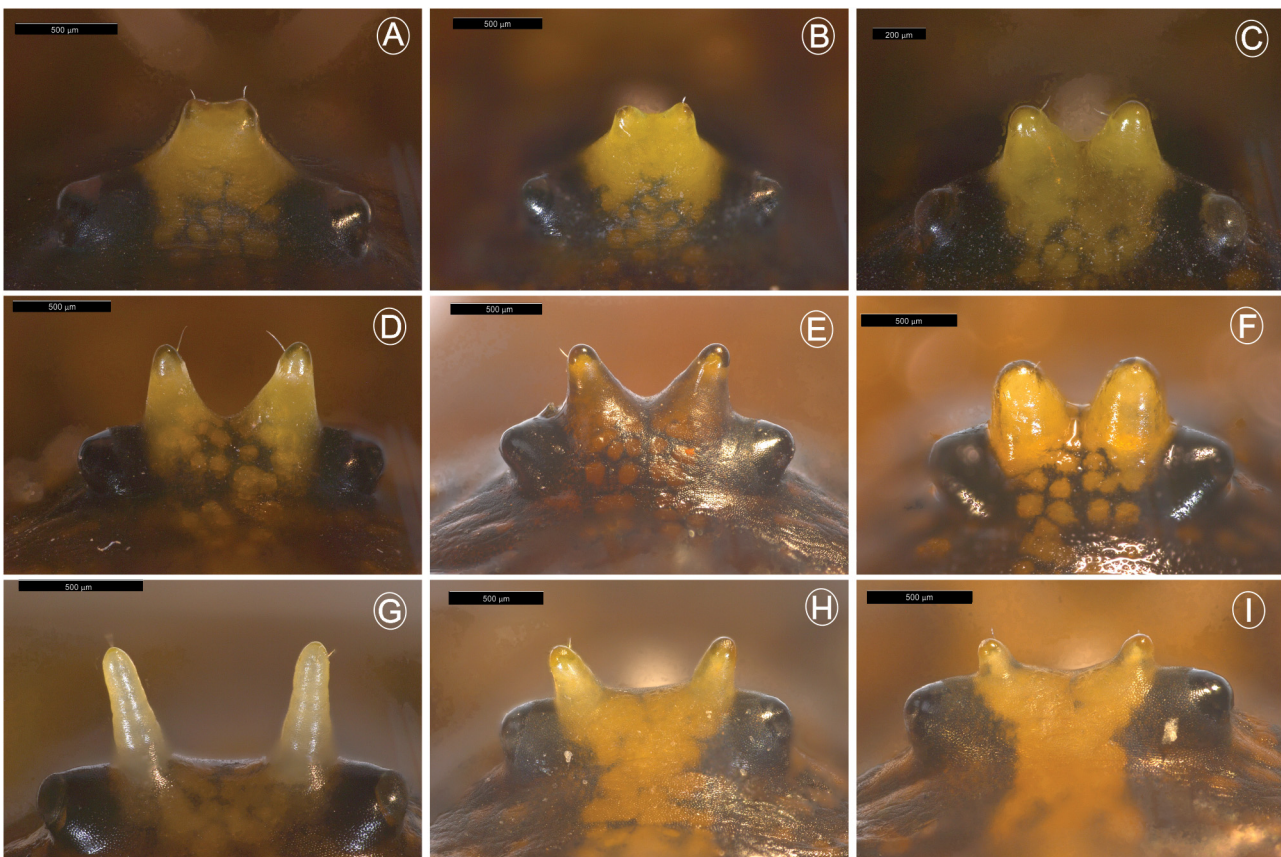


FIGURE 4. Ocularium showing the polymorphism pattern of tubercles in three species of *Mitogoniella* (Goniosomatinae): A–C) *M. mucuri* sp. nov., (ISLA 3963, ISLA 3965, ISLA 3971, respectively); D–F) *M. indistincta*, (ISLA 3461, ISLA 3462, ISLA 3463), respectively; G–I) *M. taquara*, (ISLA 3464, ISLA 3465, ISLA 3466, respectively).

Penis (Fig. 3 A–C). Ventral plate with apical margin concave, lateral margin straight, and basal portion a little wider than the apical portion. Apical group with 4–5 setae in the dorsal row (the basalmost smaller and distant from others) and 3 setae in the ventral row; basal group with 4–5 spatulate setae organized in an oblique row. Ventral

process of glans with a wide apical lamina that has many projections; stylus with rounded apex and 90° angle on third part, with few scales apically.

Females. Similar to males, except for the following: apophyses of coxa IV and trochanter reduced as tubercles; shorter legs; angles of posterior margin of dorsal scute with large spines, angles of free tergites with medium tubercles, and angles of free sternites with small tubercles; dorsal scute with darker coloration (Fig. 2C).

TABLE 1. Comparison among main diagnostic characters of *Mitogoniella* species.

	<i>M. indistincta</i>	<i>M. unicornis</i>	<i>M. modesta</i>	<i>M. taquara</i>	<i>M. mucuri</i> sp. nov.
Height between the ocularium main elevation	Same as the eyes	Inapplicable, single spine	Above the eyes	Same as the eyes	Above the eyes
Ocularium main elevations	Small and weak tubercles far from each other or strong and close to each other	Single spine large and thin	With fused bases and apexes free and divergent	Weak tubercles, small or large, far from each other	Strong and rounded tubercles, with widely fused bases, which can be similar to a single strong tubercle with bifurcated apex.
Granulation of areas I–III	30–65 medium granules	24–26 small granules	Less than 20 small granules	15–30 medium or small granules	13–28 medium granules
Dry-mark on areas of dorsal scute	Punctuate, around all granules; slight fragmented stripes following the grooves of areas.	Following the grooves of areas	Following the grooves of areas	Following the grooves of areas	Following the grooves of areas and a wide stripe between spines of area III
Number of penis setae *	6–4; 2–3; 4	4; 3; 4	4; 2; 4	4; 2; 4	4–5; 3; 4–5

*Dorsal row of apical group; ventral row of apical group; basal group; respectively.

TABLE 2. Variation in appendages and dorsal scute measures (in mm) in *Mitogoniella mucuri* sp. nov. *LDS: length of dorsal scute; WDS: width of dorsal scute.

	Leg I	Leg II	Leg III	Leg IV	Pedipalp	LDS	WDS
Males	50.14–76.7	125.75–225.03	74.71–110.57	93.18–127.92	9.46–11.33	6.4–8.16	6.24–7.68
Females	38.46–44.32	88.93–113.79	61.24–91.01	78.6–111.51	9.58–10.49	6.4–6.88	6.56–7.04

Key for identification of species of *Mitogoniella* (modified from DaSilva & Gnaspini, 2010)

- 1 Ocularium with a single medial spine *M. unicornis*
- Ocularium with a pair of free tubercles or fused bases (at least free apex) 2
- 2 Dorsal scute entirely punctuate with white dry-mark around granules yellowish *M. indistincta*
- White dry-mark on dorsal scute following the grooves of areas (punctuate only on lateral margins) 3
- 3 Space between tubercles of ocularium smaller than height of eyes; tubercles of ocularium weak, low or high *M. taquara*
- Space between tubercles of eye-mound much larger than height of eyes; tubercles of ocularium small or large, with fused bases and free apexes divergent or similar to a single tubercle with bifurcated apex 4
4. Ocularium with weak and divergent tubercles; dry-mark between spines of area III as a pair of paramedian stripes and a thin stripe on longitudinal groove *M. modesta*
- Ocularium with strong and rounded tubercles, with widely fused bases, which can be similar to a single strong tubercle with bifurcated apex; dry-mark between spines of area III as a wide median rounded stripe and one pair of thin paramedian stripes *M. mucuri* sp. nov.

Discussion

Taxonomy. We analysed many specimens of all *Mitogoniella* species and observed that the main differences among them are related to the shape and degree of fusion of tubercles of ocularium (Figure 4) and dry-marks of

dorsal scute (Table 1). *Mitogoniella mucuri* **sp. nov.** is very similar to *M. modesta*, but presents the tubercles of ocularium with fused bases and strong apices, otherwise they can be completely fused with a bifurcated apex (Figure 4 A–C). The remaining characters, such as granulation or other continuous or meristic ones, are not useful to distinguish the species, since their variations overlap (Tab. 1).

Polymorphism in *Mitogoniella* and in Gonyleptidae. Recognizing *Mitogoniella* species is challenging due to their polymorphic traits. The variation mainly occurs in coloration (especially in the dry-mark), in male secondary sex characters (especially in the length of legs II and IV), the number of granules of dorsal scute, and the shape of tubercles of the ocularium. Moreover, the species of *Mitogoniella* present a high morphological homogeneity when compared to species of other Goniosomatinae genera. This occurs because males of *Mitogoniella* lack armatures on leg IV, an important diagnostic character to distinguish species in Gonyleptidae (e.g., Pinto-da-Rocha 2002; DaSilva & Pinto-da-Rocha 2010; Hara & Pinto-da-Rocha 2010; Pinto-da-Rocha & Bragagnolo 2010; Mendes 2011). The basis of Neotropical harvestmen taxonomy (the “Roewerian system”) was established in the early XXth century mainly in works by Roewer (e.g., 1923) and Mello-Leitão (e.g., 1932). In this system, which was extremely typological, many polymorphic characters were used as diagnoses for species, genera and even families (Kury 1989; Pinto-da-Rocha 2002; DaSilva & Gnaspini 2010).

Polymorphisms in Gonyleptidae seem to have different patterns: 1) sexual dimorphism; 2) male polymorphism related to different reproductive strategies; 3) non-fixed characters. Sexual dimorphism in Gonyleptidae occurs in most families and it could be one of its synapomorphies (DaSilva & Pinto-da-Rocha 2012). It is characterized by the fourth legs of males being more armed than those of females, which are completely smooth in many taxa. It has been shown that these armatures are used as weapons in territorial fights with conspecific males (Willemart *et al.* 2009). In some taxa, as in Mitobatinae and *Mitogoniella*, an interesting evolutionary change has occurred with this trait: the lengths of all legs in males are much longer than females, and males use leg IV to fight with other males (Zatz *et al.* 2011; not yet shown for *Mitogoniella* spp.). Males of *Mitogoniella* have lost most of the plesiomorphic strong armature presented by other genera in Goniosomatinae. Moreover, another dimorphic trait of Goniosomatinae is the more armed free tergites of females than those of males (DaSilva & Gnaspini 2010). These sexual dimorphisms caused great taxonomic confusion along the first half of XX century—for example, the two main genera of Goniosomatinae, *Acutisoma* and *Goniosoma* Perty, 1833, were mistakenly distinguished by their free tergite armatures (DaSilva & Gnaspini 2010).

At least seven families of Laniatores present intraspecific male polymorphisms (Cosmetidae, Cranidae, Epedanidae, Gonyleptidae, Manaosbiidae, Stygnidae, and Triaenonychidae; DaSilva & Kury 2007), supposedly caused by alternate reproductive strategies (Tsurusaky & Fujikawa 2004; Machado & Macías-Ordóñez 2007). The two male morphs, often called alpha and beta, or major and minor, differ in the armature, length and curvature of legs IV, the length of leg II (in Gonyleptidae), and the size of the chelicerae (see Forster 1954; Pérez González & Vasconcelos 2003; Gnaspini *et al.* 2004; DaSilva & Kury 2007; Kury 2008; Mendes 2011; Zatz *et al.* 2011). Two male morphs were found in many of Goniosomatinae species studied here, distinguished by the above cited characters (e.g., DaSilva & Gnaspini 2010; Buzatto *et al.* 2011). Thus, our taxonomy was influenced by this morphological variation between male morphs. As males of *Mitogoniella* have the leg IV with a reduced armature, its length could be useful as a diagnostic character.

Morphometry presented in Table 2 shows great variation in all body measurements of *M. mucuri* **sp. nov.** Legs IV of males vary in a similar ratio as other characters (Tab. 2 and Fig. 5). We could expect a wider range in legs IV lengths, caused by two male morphs, if they were used for male fighting, as in Mitobatinae (Zatz *et al.* 2011). On the other hand, it is interesting to note a wider range in length of male leg II than other legs of *M. mucuri* **sp. nov.** (Fig. 5). Buzatto and Machado (2009) demonstrated that males of *Serracutisoma proximum* (Mello-Leitão, 1922) (Goniosomatinae) use leg II to fight, and their lengths are related to two morphs. DaSilva and Gnaspini (2010) demonstrated that *S. proximum*, *M. indistincta* and *M. unicornis* males present small spines on the tibia of leg II, as does a single male of *M. mucuri* **sp. nov.** (ISLA 3969). Thus, we might hypothesize that leg II is a secondary sexual character used as a weapon in territorial fighting among males of *Mitogoniella* species and would be a morphofunctional convergence with *S. proximum*.

We did not find differences among measurements of *Mitogoniella* species (DaSilva & Gnaspini 2010). Nonetheless, the use of measurement ranges for taxonomic studies of Gonyleptidae should not be discarded, since those characters are diagnostic for some Goniosomatinae species (Gnaspini 1999) or useful in phylogenetic analyses (DaSilva and Gnaspini 2010). Furthermore, such measurements are certainly useful for population studies in *Mitogoniella*, as shown by Machado *et al.* (2003).

The third type of polymorphism is related to non-sexual morphological features among populations and, less frequently, between sister-species. In *Mitogoniella* this occurs with the number of granules, the shape and size of ocularium tubercles (the only characters used by DaSilva and Gnaspini (2010) to distinguish *M. taquara* and *M. modesta*) dry-marks on dorsal scute (autapomorphic only in *M. indistincta* and *M. mucuri* **sp. nov.**), and the setation of the ventral plate of the penis (with similar variation among species (Fig. 2–4, Tab. 1)). We used the unique shape of the ocularium tubercle and a different dry-mark stripe of the dorsal scute for recognizing the new species: the former is thicker and has a higher degree of fusion than other species (Fig. 4), and the latter presents a particular condition in the new species, discussed below. Presently we have no hypotheses for ecological causes of these character differences.

The dry-mark disappears in alcohol, but when dry (in life or preserved) it is distinct (DaSilva & Gnaspini 2010). It is an important diagnostic character for the subfamily, but its polymorphism hinders its use in taxonomy. Species of Goniosomatinae seem to have a unique, general, dry-mark pattern, but each individual lacks parts of that “complete mark”. These individual variations in the pattern could be caused by environmental factors during development. Usually, females seem to have more complete markings than males within the same population (pers. obs.). *Mitogoniella mucuri* **sp. nov.** can be distinguished by the presence of a wide stripe of dry-mark between area III spines (Fig. 2), although, as usually for this feature in the subfamily, some individuals do not present it. Therefore, the dry-mark can be used in the taxonomy of these animals, but only if we consider a there to be a general species-specific pattern that each individual present with varying degrees of completeness.

Individual variation was found in the number of setae on the penis of *Mitogoniella*, even in a single penis on each side of the ventral plate. For example, *M. indistincta* presents the apical group with four to six setae in the dorsal row and two or three on the ventral row (Tab. 1). Thus, this character does not seem reliable for the species diagnoses. This variation was found in other Goniosomatine species (DaSilva & Gnaspini, 2010), but it is not common for Laniatores, and characters of penis are widely used in opilionid species recognition.

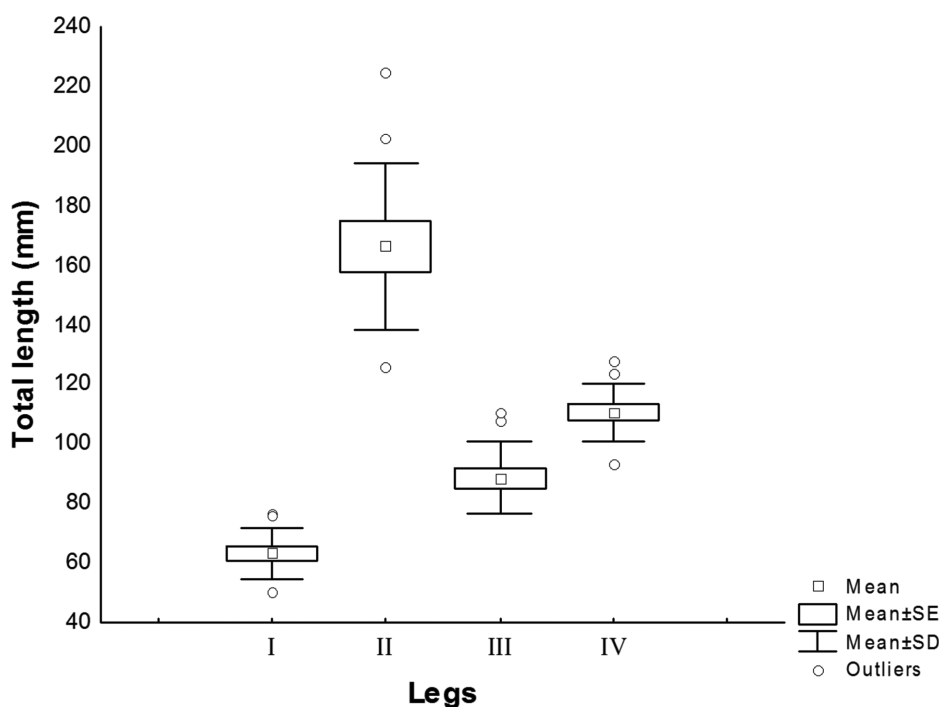


FIGURE 5. Variance of leg lengths in examined male specimens of *Mitogoniella mucuri* **sp. nov.**

New occurrences and biogeography of the genus

Mitogoniella indistincta Mello-Leitão, 1936

New records: Brazil. Minas Gerais; Baependi (Serra do Papagaio), (MZSP 32610); Barão de Cocais (Mina de Brucutu), (ISLA 3698); Caeté (Serra da Gandarela), (MNRJ 2237); Itabirito (Gruta da Mina do Pico), (ISLA

3691); Itambé do Mato Dentro (Gruta Baixada dos Criolos), (ISLA 1502); Lima Duarte (Gruta do Martiniano), (3692); Mariana (Gruta do Meio do Mato), (ISLA 3693); Minduri (Chapada Do Abanador), (ISLA 3695); Prados (RESV Libélulas da Serra de São José), (MZSP 32623); Rio Preto (MNRJ 8937); São José da Safira (Mina do Milto Godinho), (ISLA 3690); Ouro Branco (Serra de Ouro Branco), (MZSP 30067); Ouro Preto (Lavras Novas), (MZSP 30066).

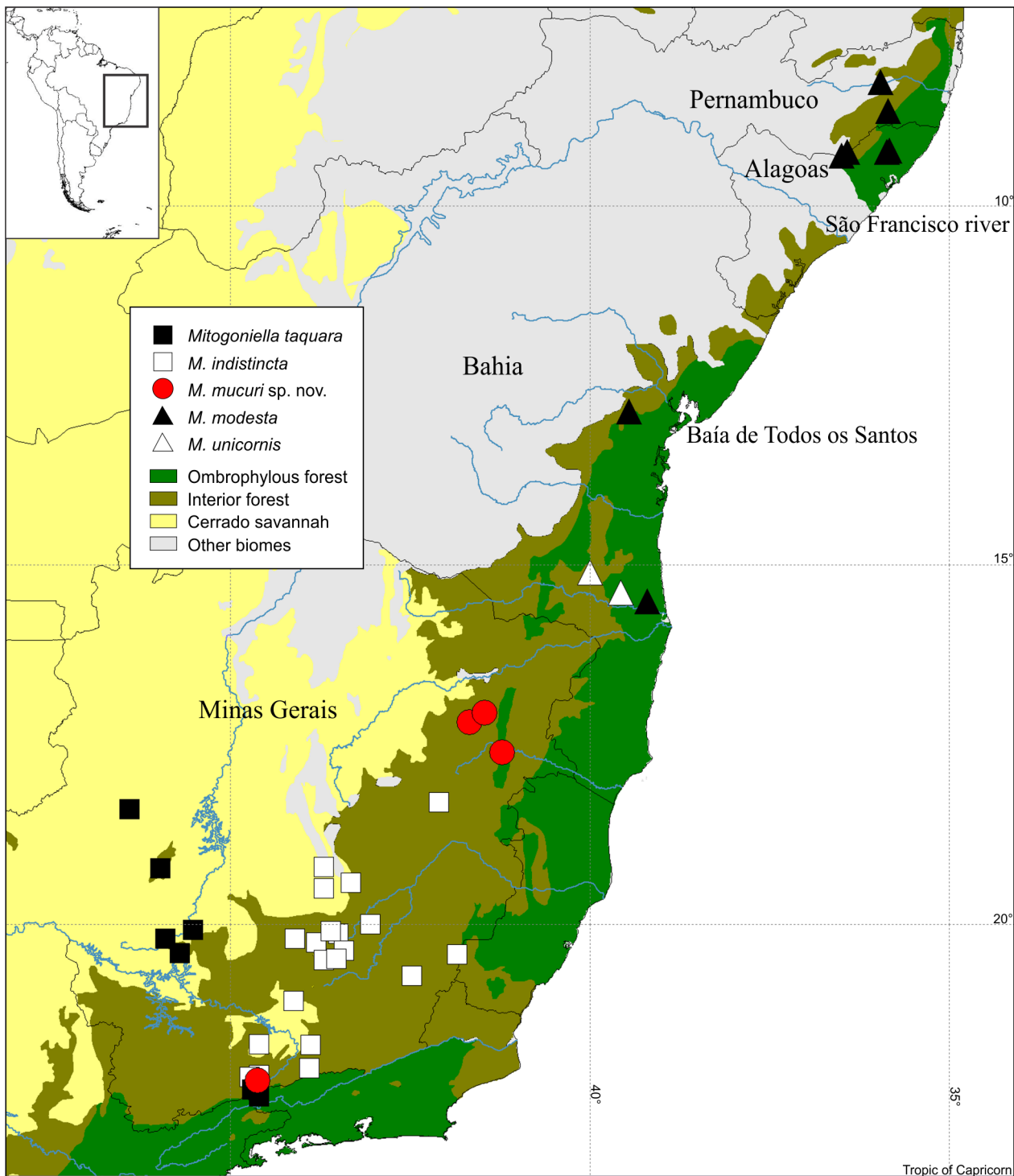


FIGURE 6. Geographic distribution of *Mitogoniella* species.

***Mitogoniella taquara* DaSilva & Gnaspini, 2010**

New records: Brazil. Minas Gerais: Lagoa da Prata (Gruta Bicho que Foi), (ISLA 1531); Matutina (Lapa do Campo de Fubebol), (ISLA 3696); Presidente Olegário (Gruta da Corujá), (ISLA 1490).

***Mitogoniella unicornis* DaSilva & Gnaspini, 2010**

New records: Brazil. Bahia: Camacan (RPPN Serra Bonita), (MZSP 31238).

***Mitogoniella modesta* (Perty, 1836)**

New Records: Brazil. Alagoas: Murici (MZSP 31237); Quebrangulo (REBIO Pedra Talhada), (MNRJ 31239). Bahia: Elísio Medrado (RPPN Jequitibá), (MNRJ 07701). Pernambuco: Caruaru (P.N.M. João Casconcelos Sobrinho), (MZSP 31310); Jaqueira (RPPN Frei Caneca), (MZSP 56036).

Mitogoniella indistincta was hitherto known to occur in six localities of the east-central region of Minas Gerais State (DaSilva & Gnaspini 2010). The present work adds 13 localities to the species distribution (Fig. 6). These new occurrences expand its range widely northward and southward, onto high altitudes of the leeward side of Serra da Mantiqueira mountain range (up to 2200m). *Mitogoniella taquara* was known to Itatiaia, in Rio de Janeiro State, and to three localities of Minas Gerais (DaSilva & Gnaspini 2010). Currently, new occurrences expand the species range widely northward, beyond the limits of Atlantic Rain Forest biome, in the Cerrado biome (Fig. 6). However, it is unlikely that those populations live in the open savannah vegetation, since Goniosomatinae is restricted to forestal physiognomies. Actually, these specimens were collected in caves that are common shelters for most species of Goniosomatinae (DaSilva & Gnaspini 2010). *M. unicornis* was hitherto known only from its type locality, Itororó, in Bahia State (DaSilva & Gnaspini 2010), now expanding to one nearby locality, Camacan (Fig. 6). *Mitogoniella modesta* was hitherto known only from one locality, Santa Luzia municipality, in Bahia State (type locality unknown; DaSilva & Gnaspini 2010). Five new occurrences expand the species range widely northward to Alagoas and Pernambuco States (Fig. 6). The new occurrences are farther north from those of Bahia and actually widely expand the distribution of the subfamily (now occurring from Pernambuco to Santa Catarina States).

Mitogoniella mucuri **sp. nov.** occurs in a gap for harvestmen distributions (Pinto-da-Rocha *et al.* 2005; DaSilva & Pinto-da-Rocha 2011), in northeastern Minas Gerais State around the upper Mucuri River, between *M. indistincta* occurrences in Minas Gerais and *M. unicornis* occurrences, in Bahia, besides a single record in southern Minas Gerais (Fig. 6).

Recent works have presented a historical biogeographical scenarios for the Atlantic Rain Forest using harvestmen distributions, including Goniosomatinae (Pinto-da-Rocha *et al.* 2005; DaSilva & Pinto-da-Rocha 2011). Harvestmen living in this biome have very restricted ranges and about 97% of endemism in Atlantic Rain Forest (especially Goniosomatinae, whose all species are endemic). From 36 species of the subfamily, 32 are restricted to one of the areas of endemism proposed by Pinto-da-Rocha *et al.* (2005) and DaSilva and Gnaspini (2010). Those areas probably originated by the uplift of mountain ranges and the resulting Pleistocene refuges of forest and marine transgressions in large river valleys (DaSilva & Pinto-da-Rocha 2011). Goniosomatinae speciated with those events, especially due to their association with humidity, high phylopatry and low vagility (DaSilva & Gnaspini 2010).

New occurrences of *Mitogoniella* species do not corroborate previous delimitation of areas of endemism, except for *M. unicornis*, restricted to Bahia area. This species was one of those used by DaSilva and Pinto-da-Rocha (2011) to form the Congruence Core of this area of endemism. *Mitogoniella indistincta* lives in south Serra do Espinhaço area of endemism (DaSilva & Pinto-da-Rocha 2011), the only one totally composed of Semideciduous Seasonal Forest, but with a range much wider than other endemic harvestmen species living there (Fig. 6). *Mitogoniella modesta* lives in the Bahia and Pernambuco areas of endemism, *i.e.*, a widespread species in northeastern Brazil, with a range spreading throughout important barriers for animal and plant forest species, such as the São Francisco River and Baía de Todos os Santos (*e.g.*, Prance 1982; Silva & Casteleti 2005; Carnaval & Moritz 2008; DaSilva & Pinto-da-Rocha 2011). *Mitogoniella taquara* is restricted to Serra da Mantiqueira mountain range and the adjacent interior plateau, but the mountain range is not demonstrated as an area of endemism, since there is not enough congruence among endemic species ranges (unpublished data). Thus, *Mitogoniella taquara* lives in Itatiaia, the core of Serra da Mantiqueira, but much northward into the Cerrado biome. Other harvestmen species restricted to this region also live in Itatiaia, but with unique ranges in the interior of Minas Gerais State (DaSilva & Pinto-da-Rocha 2011 and unpublished data). We can infer from this pattern a scenario that contradicts the hypothesis of a common geographical origin of these species ranges, as in the area of endemism hypothesis, but isolated biological expansions from the more humid coastal areas of Atlantic Rain Forest or Serra do Espinhaço area of endemism. In glacial periods, marked by colder and drier weather, the Atlantic Forest

reduced to mountain range slopes and coastal areas and probably its biota followed it (e.g., Ab'Saber 1982; Ledru *et al.*, 2005). However, some works have shown asymmetry and asynchrony in these changes, as evidence of moist and cold periods in some areas, as in northeastern region (Oliveira *et al.* 1999). Thus, the present Semideciduous forest was probably substituted by Cerrado savannah in drier periods. With moist periods, species could spread over this “new” interior forest, and could speciate, as would have happened with *M. taquara* and other endemic species of Serra da Mantiqueira area.

Mitogoniella mucuri **sp. nov.** was recorded in a region poorly known for harvestmen, the northeast region of Minas Gerais State, plus in southern Minas Gerais. This distribution is unexpected, since this southern occurrence is disjunct from others, overlaps two other species of the genus, and a complete allopatry among sister-species is by far the most common pattern in Goniosomatinae (DaSilva & Gnaspini 2010). This unexpected sympatry with *M. taquara* and *M. indistincta* strengthen the hypothesis of unique biogeographical histories of species living in interior forests or other non-allopatric speciation modes.

Taxonomic studies on Opiliones contribute to ecological and behavioral studies, including those in caves, as shown by intensive work in recent years, especially with Goniosomatinae species (e.g., Gnaspini & Cavalheiro 1998; Machado & Oliveira 1998; Machado *et al.* 2000; Machado 2002; Willemart & Gnaspini 2004; Ferreira *et al.* 2005; Buzatto *et al.* 2007; Buzatto & Machado 2009). Harvestmen use caves as refuges during the day, form large aggregates on cave walls and leave them at night to forage in the epigeal environment (Gnaspini 1995; Gnaspini *et al.* 2003; Machado *et al.* 2003; Willemart & Gnaspini 2004; Ferreira *et al.* 2005; Chelini *et al.* 2011). Therefore, Goniosomatine harvestmen are important in subterranean ecosystems, and a new species makes an immense contribution to the justification for conserving the caves in its type locality and, in general, eastern Minas Gerais State.

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