

Three new ground living pholcid species (Araneae: Pholcidae) from Parque Estadual da Cantareira, São Paulo, São Paulo, Brazil

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Abstract

Three pholcid species (Araneae: Pholcidae) from Parque Estadual da Cantareira, city of São Paulo, Brazil are newly described: *Mesabolivar cantharus* n. sp., *Mesabolivar camussi* n. sp., and *Tupigea cantareira* n. sp. Collection data suggest a preference of the species for ground level habitats. Preliminary data on *Tupigea cantareira* n. sp. suggest a continuous occurrence of adult individuals throughout the year, with a peak in the rainy season. It also seems that *T. cantareira* n. sp. prefers the natural (“Mata”) environment over the reforested *Pinus* area.

Key words: Pholcidae, *Mesabolivar*, *Tupigea*, Neotropical region, taxonomy

Introduction

The Atlantic Forest in eastern Brazil is highly fragmented, with only 2% of the original forest remaining, dispersed as small patches surrounded by open fields (Ranta *et al.* 1998; Silva & Tabarelli 2000). In addition to causing immediate local extinctions, fragmentation may have long-term effects on populations through changes in ecological processes (Ranta *et al.* 1998), representing a great threat to biodiversity. Different animal groups experience different degrees of threat, and very little is known in this respect for spiders. The first step in developing this kind of study is a better knowledge of the existing biodiversity, requiring more basic taxonomic work. Further important aspects are the distribution, sensitivity to habit changes and responses to fragmentation. Several spider groups show a high but poorly known diversity in the Neotropics. Even the Atlantic Forest fragments near big cities remain largely unexplored, still including many undescribed species (B. A. Huber, unpubl. data; Machado *et al.* 2007). The species described herein apparently have relatively restricted distributions, which emphasizes the importance for conservation politics to consider even small and apparently disturbed fragments.

Very little research has been done on Brazilian pholcid spiders since the promising start by Moenkhaus (1898) and Keyserling (1891) in the late 19th century. In the 20th century, Mello-Leitão produced some significant increments (references in Huber 2000), but only recently the group has been revised at generic level (Huber, 2000) and recent taxonomic contributions have added further species and biological data (Huber 2005; Huber & Brescovit 2003; Huber, Brescovit & Rheims 2005; Huber, Rheims & Brescovit, 2005a, b; Huber, Pérez & Baptista, 2005; Astrin *et al.* 2006).

The Neotropical genus *Mesabolivar* González-Sponga, 1998 currently includes 39 nominal species

(Huber, Brescovit & Rheims 2005; Platnick 2006; Machado *et al.* 2007). Only recently, several new ground-level living species of the genus *Mesabolivar* have been described (Huber, Brescovit, & Rheims 2005; Machado *et al.* 2007) and the genus seems to present even greater diversity than previously assumed. Some species of *Mesabolivar* seem to have restricted distributions, at least those at the ground level.

The genus *Tupigea* Huber, 2000 currently includes eight species (Platnick 2006), distributed from southeastern to southern Brazil (Huber 2000). Nothing is known about the biology of the representatives of this genus.

Here we describe two new species of *Mesabolivar* (*M. cantharus* **n. sp.** and *M. camussi* **n. sp.**) and one of *Tupigea* (*T. cantareira* **n. sp.**), collected with pitfall traps in the Parque Estadual da Cantareira, located in the city of São Paulo, São Paulo, Brazil. With a total area of 7916 ha, this park is considered the largest urban forest of the world (Negreiros *et al.* 1974). These results originate from the subproject “Inventário das aranhas de solo do Parque Estadual da Cantareira” in the project “Biodiversity of the Arachnida and Myriapoda of the state of São Paulo” from the BIOTA/FAPESP program. This subproject targets the spider fauna from vestiges of Atlantic Forest in the municipality of São Paulo. We focus on the temporal variation of the newly described species, but only *Tupigea cantareira* **n. sp.** was collected in significant numbers.

Material and methods

Study area

The Parque Estadual da Cantareira (23° 25' S; 46° 37' W), an urban reserve with approximately 7900 ha, belongs to the city of São Paulo, State of São Paulo, Brazil (Negreiros *et al.* 1974) and is part of the “Serra da Cantareira” formation (Fig. 44). Sampling was done in two different areas, one characterized by a secondary forest of Atlantic Forest in an advanced state of regeneration (23° 25' 17.2" S; 46° 37' 19.5"W), the other formed by a reforestation of exotic *Pinus* sp. (Pinaceae) (23° 25' 18.2" S; 46° 37' 45.4" W).

Sampling was done using pitfall traps (Brennan *et al.* 1999) with 70% alcohol. One hundred pitfall traps were placed in each area and kept open for five days, every three months. This resulted in a total of four sampling periods (winter: 28/VII to 02/VIII/2004, spring: 14 to 19/XI/2004, summer: 02 to 07/II/2005 and autumn: 12 to 17/V/2005), totaling 800 samples. Material collected manually in December 2003 is also included in this study. The latter material is excluded from the quantitative analysis.

The material examined is deposited in the collections of Instituto Butantan, São Paulo (IBSP, A. D. Brescovit), Museu de Zoologia da Universidade de São Paulo, São Paulo (MZSP, R. Pinto da Rocha) and Alexander Koenig Zoological Research Museum, Bonn (ZFMK, B. A. Huber). Descriptions, the terms “vertical hairs”, “curved hairs” and ratio L/d of the tibia I (length/diameter, a measure of the robustness of the legs) follow Huber (2000). Measurements are given in millimeters. The epigynum was dissected and immersed in clove oil for visualization of internal structures following Levi (1965). All illustrations were done with a camera lucida on a Leica MZ12,5 stereo microscope.

Taxonomy

Mesabolivar cantharus **n. sp.**

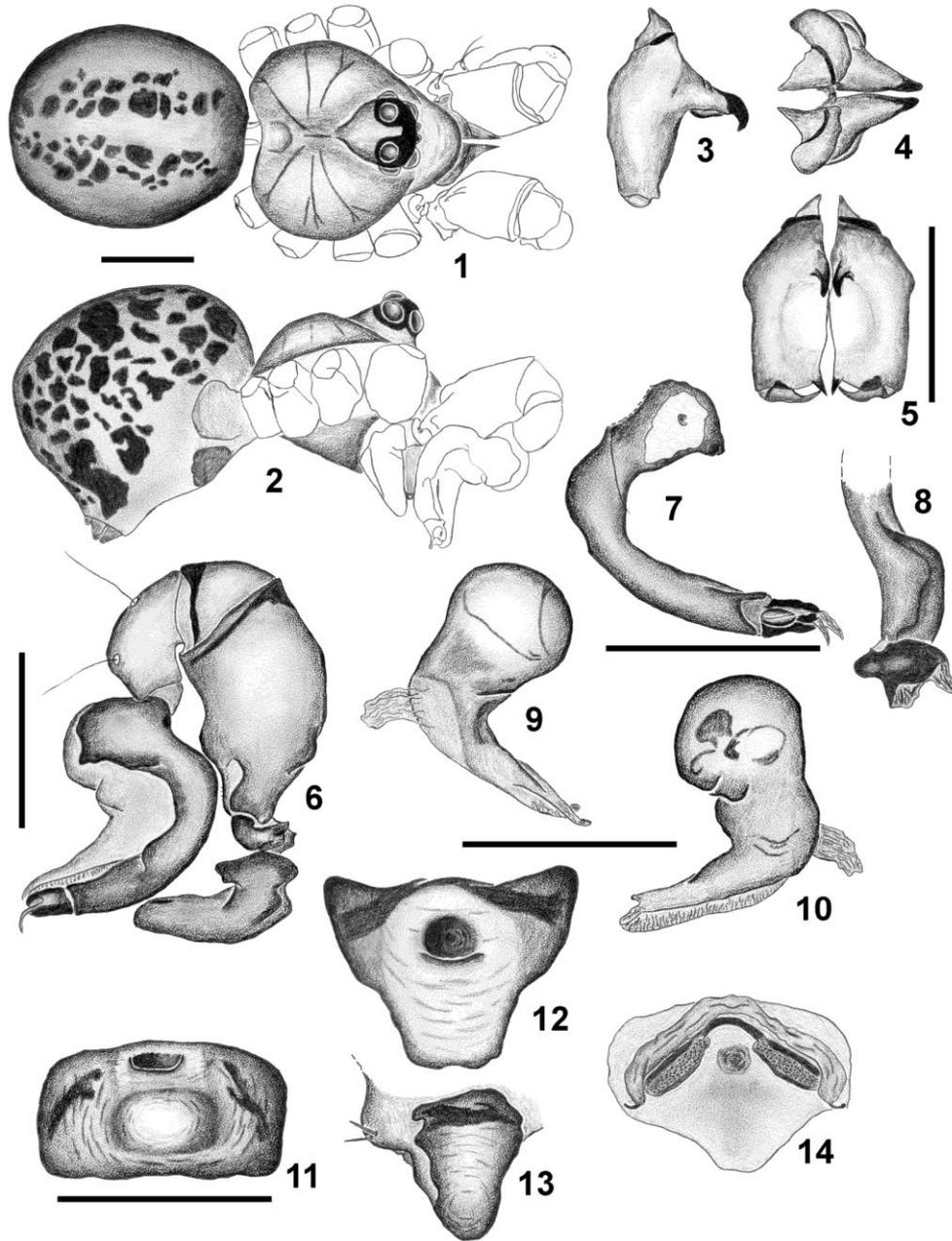
(Figs. 1–14)

Types. Male holotype from Parque Estadual da Cantareira (23° 25' S; 46° 37' W), São Paulo, São Paulo, Brazil, 12–17.V.2005, F. Yamamoto col. with pitfall traps, deposited in IBSP 61393. Paratypes: 1 female (IBSP 62402); 1 male and 1 female (IBSP 62404); same data as holotype, 14–19.XI.2004.

Etymology. The species name is a noun in apposition, derived from the Latin word for jar, in reference to

the jar (*cântaro*) commonly used to carry and store water from streams and riverheads in the 16th and 17th centuries at the type locality.

Diagnosis. The male is distinguished from the congeners by the shape of the cheliceral apophyses (large with a curved end: Figs. 3–5) combined with the shape of the procurus, very curved (Figs. 6–7) and the tip with a prolateral projection (Fig. 7) and a retrolateral membranous projection (Fig. 8). The female is distinguished by the projecting epigynum with a rounded, relatively large and shallow epigynal pocket (Fig. 12).



FIGURES 1–14. *Mesabolivar cantharus* n. sp. 1–2. Male, dorsal and lateral views; 3–5. Chelicerae, lateral, dorsal, and frontal views; 6. Left palp, retrolateral; 7. Left procurus, prolateral; 8. Tip of left procurus, dorsal view; 9–10. Left bulb, prolateral and retrolateral views; 11–14. Epigynum, ventral, anterior, lateral, and dorsal views. Scale lines: 0.5 mm.

Description. Male (Holotype). Total length 2.4, carapace width 1.0; leg I: 18.2 (5.0 + 0.4 + 5.2 + 6.3 + 1.3), tibia II: 2.5, tibia III: 2.1, tibia IV: 3.1, tibia I L/d: 40. Habitus as in figs. 1–2. Carapace light brown, very similar in shape to *M. forceps* Machado, Brescovit, Candiani & Huber, 2007; sternum light ochre. Distinct thoracic groove. Eight eyes on slightly elevated ocular area (Fig. 2); distance PME–ALE about 60% of PME diameter. Chelicerae light brown, basal segment with a pair of large parallel frontal apophyses with strongly curved ends (Figs. 3–5). These apophyses are approximately perpendicular to the chelicerae (Fig. 3). Palps as in figs. 6–10. Coxa with prominent and approximately rectangular retrolateral apophysis (Fig. 6). Femur proximally with distinct round retrolateral apophysis and small proximal dorsal hump (Fig. 6). Procurus dark brown, strongly curved proximally, with strong proximal-prolateral hair (Figs. 6–7). Distinct tip of procurus, enlarged laterally and strongly sclerotized, with a prolateral apophysis (Figs. 7–8) and a retrolateral semitransparent membranous projection (Figs. 6–8). Bulb with small transparent projection (Figs. 9–10), embolar division of bulb long and dorsally bent, membranous ventrally. Legs light brown; without spines, vertical or curved hairs. Tarsus I with approximately 24 pseudosegments. Opisthosoma globular, pale green, with several lateral bluish-green spots (Figs. 1–2).

Female (Paratype IBSP 62402). Total length 2.4, carapace width 0.93; leg I: 10.4 (1.4 + 0.4 + 3.1 + 4.4 + 1.1), tibia II: 2.0, tibia III: 1.6, tibia IV: 2.6, tibia I L/d: 28. Habitus as in fig. 1. In general very similar to male. Epigynum dark brown, elevated, ventral region bulging, with rounded and shallow medium-sized median pocket, without apophyses or humps (Figs. 11–13), with two pairs of short and strong hairs on membranous area behind gonopore (Fig. 13). Internal genitalia with two pore plates, longer than wide (Fig. 14).

Variation. Three males: carapace width 0.9–1.0; tibia I: 4.2–5.2. Two females: carapace width 0.93; tibia I: 3.1–3.3.

Other material examined. Brazil, São Paulo: São Paulo (Parque Estadual da Cantareira, 23° 25' S; 46° 37' W), 1♂, 14–19.XI.2004 (IBSP 62405); 1♂, 12–17.V.2005 (IBSP 62406).

Distribution. Known only from type locality.

***Mesabolivar camussi* n. sp.**

(Figs. 15–28, 41–43)

Mesabolivar sp. 2: Astrin, Huber, Misof & Klütsch 2006: 444.

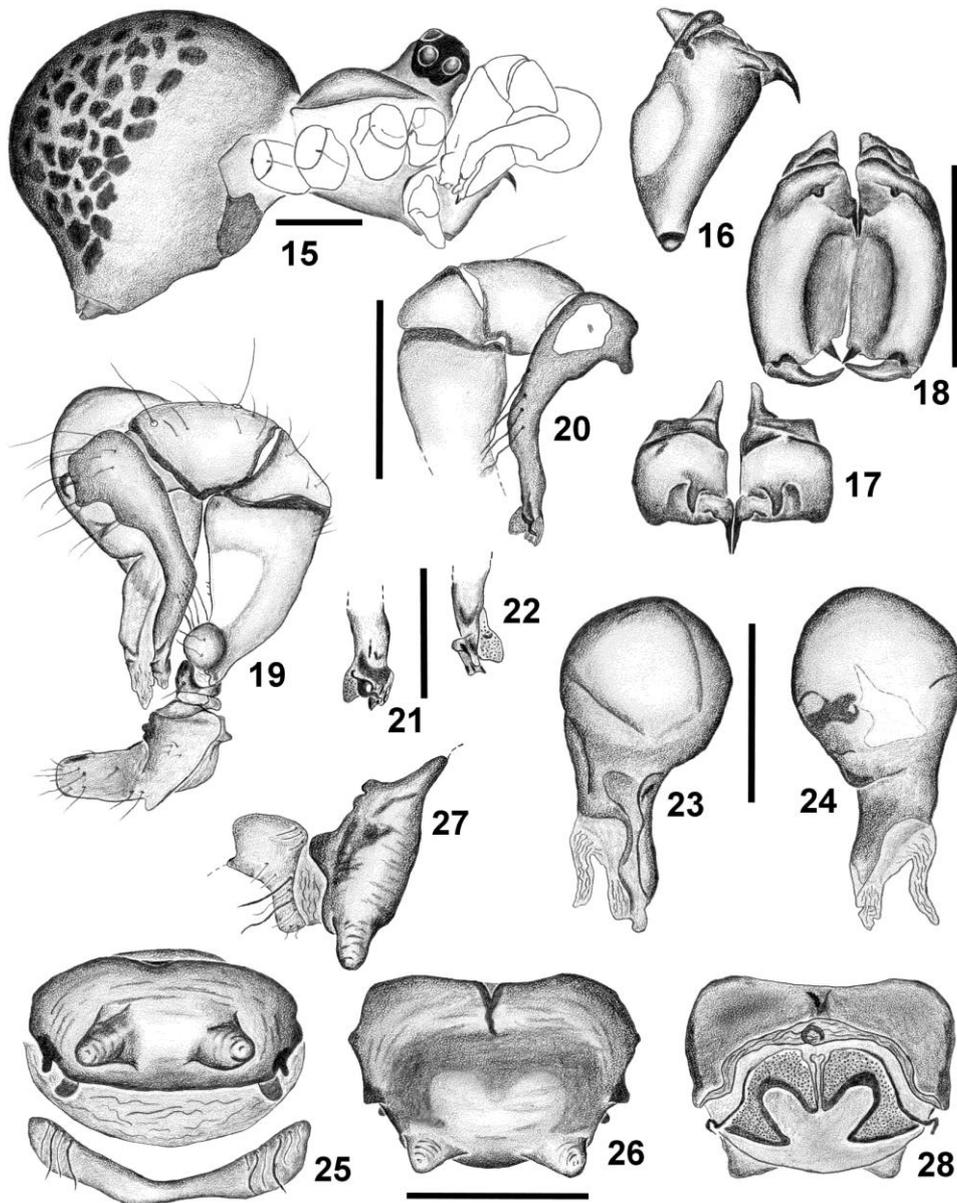
Types. Male holotype from Parque Estadual da Cantareira (23° 25' S; 46° 37' W), São Paulo, São Paulo, Brazil, 14–19.XI.2004, F. Yamamoto col. with pitfall traps, deposited in IBSP 62399. Female paratype, same data as holotype, 28.VII–02.VIII.2004 deposited in IBSP 62398.

Etymology. The specific name is a noun in apposition, derived from the Tupi word for “jar”.

Diagnosis. The male is distinguished from congeners by cheliceral armature, with a pair of long and pointed proximal median apophyses and a pair of proximal small protrusions (Figs. 16–18), by the shape of the procurus (Figs. 19–20), with its unique ventral-prolateral flap-shaped apophysis at the tip (Figs. 21–22, 42) and by the spherical retrolateral femur apophysis (Fig. 19). The female is distinguished by the anterior position of the epigynal pocket combined with the protuberant pair of ventral apophyses in the epigynum (Figs. 25–27) and by the peculiar shape of the pore plates (Fig. 28).

Description. Male (Holotype). Total length 2.5, carapace width 1.1; leg I: 27.1 (6.5 + 0.4 + 6.9 + 11.5 + 1.8), tibia II: 4.2, tibia III: 2.8, tibia IV: 4.3, tibia I L/d: 68. Habitus as in fig. 15. Carapace light brown; sternum light ochre. Distinct thoracic groove. Eight eyes on elevated ocular area (Fig. 15); distance PME–ALE about 83% of PME diameter. Chelicerae light brown, basal segment of chelicerae with a medium-sized median pair and a small lateral pair of apophyses (Figs. 16–18, 41). Palps as in figs. 19–24. Coxa with distinct retrolateral apophysis (Fig. 19). Femur proximally with a distinct spherical retrolateral apophysis (Fig. 19).

Procurus dark brown, with four median prolateral hairs. Distinct tip of procurus, with a ventral-prolateral flap-shaped apophysis at the tip (Figs. 21–22, 42). Bulb with small transparent projection (Figs. 23–24), embolar division of bulb membranous at the end (Figs. 23–24). Legs light brown; without spines, vertical or curved hairs. Tarsus I with approximately 22 pseudosegments. Opisthosoma globular, pale green, with some lateral bluish-spots (Fig. 15).



FIGURES 15–28. *Mesabolivar camussi* n. sp. 15. Male, lateral view; 16–18. Chelicerae, lateral, dorsal, and frontal views. 19–20. Left male palp, retrolateral and prolateral views; 21–22. Tip of left procurus, prolateral and retrolateral (slightly dorsal) views; 23–24. Left bulb, prolateral and retrolateral views. 25–28. Epigynum, ventral, anterior, lateral, and dorsal views. Scale lines: 0.5 mm; except in figs. 21–22: 0.25 mm.

Female (Paratype IBSP). Total length 1.38, carapace width 0.8; leg I: 20.2 (5.1 + 0.4 + 5.2 + 7.8 + 1.8), tibia II: 3.4, tibia III: 2.3, tibia IV: 3.4, tibia I L/d: 40. Habitus as in fig. 15. In general very similar to male. Tarsus I with approximately 22 pseudosegments. Epigynum brown, elevated, with a small, very anterior,

medium-sized median pocket, with a pair of prominent ventral apophyses, with several spines on the post-epigynal plate (Figs. 25, 27, 43). Internal genitalia with two large and strongly sclerotized curved pore plates with median indentation (Fig. 28). The two sclerites visible in ventral view in the post-epigynal membranous area are part of the internal arc (Figs. 25; 28).

Variation. Two males: carapace width 1.1–1.3; tibia I: 6.9–7.8. Eight females: carapace width 0.8–1.1; tibia I: 4.1–5.2.

Other material examined. Brazil, São Paulo: São Paulo (Parque Estadual da Cantareira, 23° 25' S; 46° 37' W), 1♀, 14–19.XI.2004 (IBSP 62400); 1♂, 4♀ (IBSP 62393–62397), 1♀ (MZSP), 02–07.II.2005; 1♂ (IBSP 62406), 1♀ (ZFMK), 12–17.V.2005. Parque Estadual da Cantareira, unspecified location near park entrance, 20.XII.2003 (B.A.Huber), 1♂ in 80% ethanol, 3♂, 7♀ in 100% ethanol (ZFMK).

Distribution. Known only from type locality.

Note. This species (*Mesabolivar* sp. 2 in Astrin *et al.* 2006) is also genetically clearly different from *M. mairyara* Machado, Brescovit, Candiani & Huber, 2007 (*M.* sp. 3; p-distance: 19,2–19,5% for 16S rRNA, 16,0–16,7% for CO1, Astrin *et al.* 2006).

***Tupigea cantareira* n. sp.**

(Figs. 29–40)

Tupigea sp.2: Astrin, Huber, Misof & Klütsch 2006: 444.

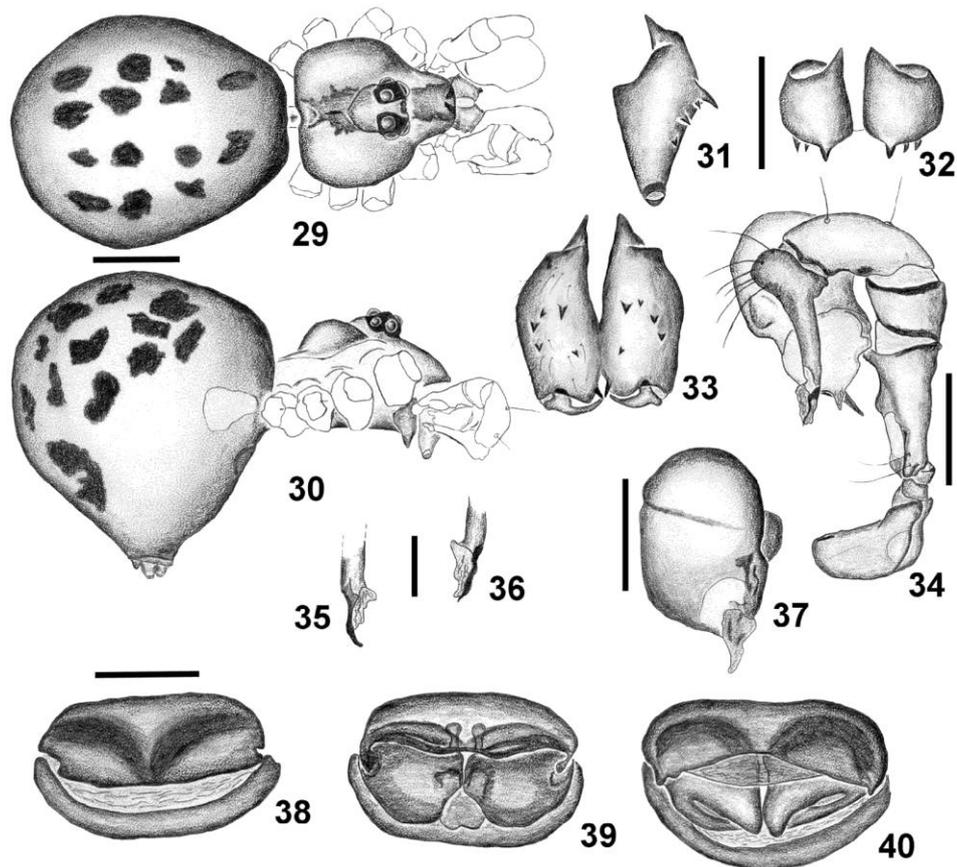
Types. Male holotype from Parque Estadual da Cantareira (23° 25' S; 46° 37' W), São Paulo, São Paulo, Brazil, 02–07.II.2005, F. Yamamoto col. with pitfall traps, deposited in IBSP 60680. Female paratype, same data as holotype.

Etymology. Named after the type locality. The specific name is a noun in apposition.

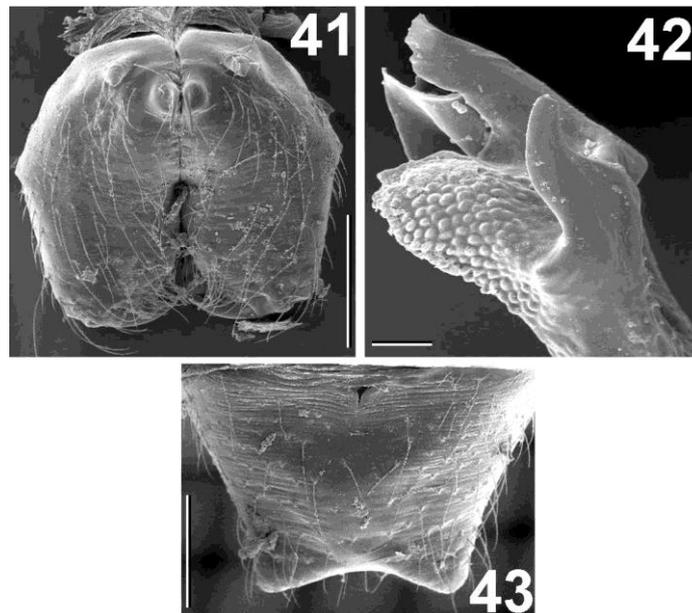
Diagnosis. Males are distinguished from congeners by the shape of procurus (Figs. 34–36), the round ventral apophysis on the palpal femur (Fig. 34) and five pointed apophyses on the chelicerae (Figs. 31–33). Females are distinguished by two large piriform internal structures, visible by transparency in ventral view, with the shape of two half-moons (Figs. 38; 40).

Description. Male (Holotype). Total length 1.9, carapace width 0.8; leg I: 10.7 (2.7 + 0.1 + 2.9 + 3.6 + 1.4), tibia II: 1.8, tibia III: 1.5, tibia IV: 1.9, tibia I L/d: 29. Habitus as in figs. 29–30. Carapace with a darker stripe in the thoracic groove; sternum light ochre. Distinct thoracic groove. Eight eyes, AME very small (Fig. 29); distance PME–ALE about 57% of PME diameter. Chelicerae light brown with five pairs of small pointed apophyses (Figs. 31–33). Palps as in figs. 34–37. Coxa without retrolateral apophysis (Fig. 34). Femur proximally with a rather rounded retrolateral apophysis (Fig. 34) and a rounded ventral projection. Procurus straight and very simple, with a dorsal membranous portion at the tip (Figs. 35–36). Bulb with sclerotized distal apophysis and prolateral membranous semitransparent small projection (Fig. 37). Legs light brown; without spines or vertical hairs. Tarsus I with approximately 24 pseudosegments. Opisthosoma globular, pale green with some lateral dark spots (Figs. 29–30).

Female (Paratype). Total length 1.8, carapace width 0.6; leg I: 6.4 (1.6 + 0.2 + 1.7 + 2.1 + 0.8), tibia II: 1.0, tibia III: 0.8, tibia IV: 1.1, tibia I L/d: 21. Habitus as in figs. 29–30. In general very similar to male. Tarsus I with approximately 14 pseudosegments. Epigynum dark brown, very simple, slightly elevated, with a relatively large membranous area between epigynum and post-epigynal plates (Fig. 38). Two large internal structures are visible in dorsal view (Fig. 39) and in ventral view by transparency, appearing like two half-moons (Fig. 38). In some specimens these internal structures are visible through the membranous area (Fig. 40), showing the piriform shape.



FIGURES 29–40. *Tupigea cantareira* n. sp. 29–30. Male, dorsal and lateral views; 31–33. Male chelicerae, lateral, dorsal, and frontal views; 34. Left male palp, retrolateral; 35–36. Left procurus tip, prolateral and retrolateral (slightly ventral) views; 37. Left bulb, prolateral; 38–40. Epigynum, ventral and dorsal views, variation (ventral view). Scale lines: 0.25 mm, except figs. 29–30: 0.5 mm, figs. 35–36: 0.1 mm.



FIGURES 41–43. *Mesabolivar camussi* n. sp. scanning electron micrographs. 41. Male chelicerae, frontal view; 42. Tip of procurus, retrolateral view, 43. Epigynum, anterior view. Scale lines: figs. 41–42: 0.25 mm; fig. 43: 20 μ m

Variation. Seven males: carapace width 0.7–0.9; tibia I: 2.6–2.9. Male cheliceral apophyses vary slightly in size and position. Ten females: carapace width 0.6–0.7; tibia I: 1.7–1.9. The two large internal epigynal structures are exposed in some specimens.

Other material examined. Brazil, São Paulo: São Paulo (Parque Estadual da Cantareira, 23° 25' S; 46° 37' W), 2♀, 14–19.XI.2004 (IBSP 60699); 5♂, 14♀ (IBSP 60681–60696), 1♂, 1♀ (MZSP), 1♂, 1♀ (ZFMK), 02–07.II.2005; 2♀, 12–17.V.2005 (IBSP 60697–60698); Parque Estadual da Cantareira, unspecified location near park entrance, leaf litter, 20.XII.2003 (B.A.Huber), 10♂, 3♀ in 80% ethanol, 10♂, 10♀ in 100% ethanol (ZFMK).

Distribution. Known only from type locality.

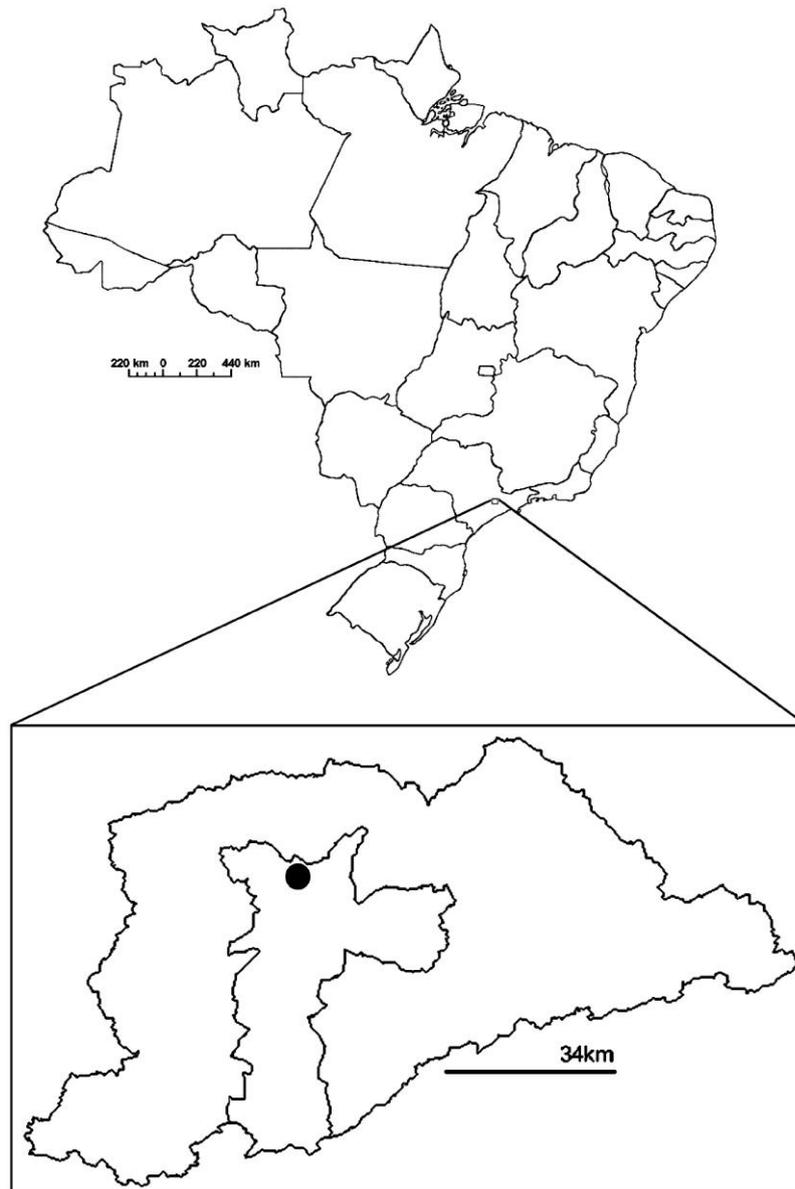


FIGURE 44. Location of the study site. The enlarged area represents the municipality of São Paulo, the inner limits represent the metropolitan region of the city. Spot marks “Parque Estadual da Cantareira”.

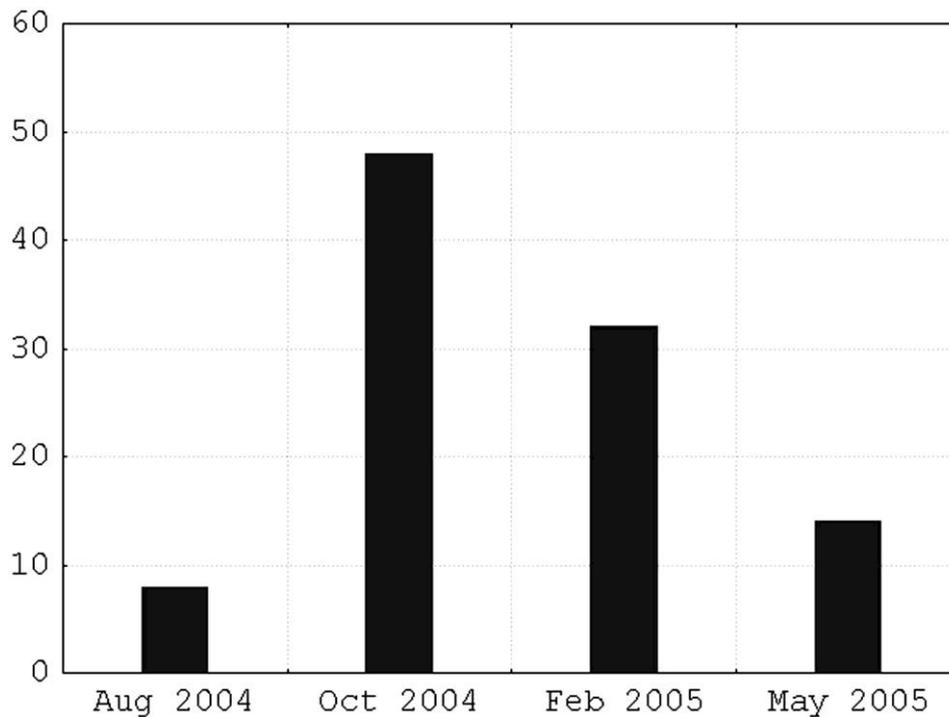


FIGURE 45. Temporal variation of *Tupigea cantareira n. sp.* The bars represent the number of specimens per sampling period.

Ecological data

Four species of pholcid spiders were collected in one year with pitfall-trap sampling in two types of environments in the “Parque Estadual da Cantareira”. Three of these species belong to the genus *Mesabolivar* González-Sponga, 1998, *M. cantharus n. sp.* and *M. camussi n. sp.*, both described here, and *M. cavicelatus*, described recently in Machado *et al.* (2007). These species were represented by a total of 25 adult specimens. The fourth species, *Tupigea cantareira n. sp.*, described here, was collected in large numbers, and is represented by 102 adult specimens. Immature individuals accounted for 145 individuals, with a continuous occurrence all over the year, but greater number in the rainy seasons (table 2).

Tupigea cantareira n. sp. accounts for 80,3 % of the total pholcid spiders collected, which allows us to evaluate some aspects of the temporal variation in this species. It has a continuous distribution throughout the year, with a peak of individuals collected in the rainy seasons (Fig. 45). 47% of the specimens of *T. cantareira n. sp.* were collected in spring and 31% in summer (table 2). It also seems that *T. cantareira n. sp.* prefers the natural environment over the *Pinus* area, with 80% of specimens collected in the “Mata” area. (tables 1, 2).

The other three *Mesabolivar* species were collected in low numbers: four specimens of *M. cantharus n. sp.*, eleven of *M. camussi n. sp.*, and eight of *M. cavicelatus* Machado, Brescovit, Candiani & Huber, 2007 (table 1). This makes it difficult to evaluate aspects of temporal variation. All the species of *Mesabolivar* were collected in higher numbers of adult individuals in the *Pinus* area (table 2), in contrast to *Tupigea cantareira n. sp.*

Current evidence suggests that *M. cantharus n. sp.* and *M. camussi n. sp.* have a distribution restricted to the Atlantic Forest of the “Serra do Mar” formation, possibly not surpassing the “Serra da Cantareira” region.

TABLE 1. Number of specimens per area.

	<i>Mesabolivar cantharus</i>			<i>Mesabolivar camussi</i>			<i>Mesabolivar cavicelatus</i>			<i>Tupigea cantareira</i>			Juveniles	
	♂	♀	Total	♂	♀	Total	♂	♀	Total	♂	♀	Total		
Native	1	1	2	1	1	2	2	0	2	34	47	81	85	
<i>Pinus</i>	3	1	4	2	7	9	1	5	6	14	7	21	60	
Total	4	2	6	3	8	11	3	5	8	48	54	102	145	

TABLE 2. Number of specimens per sampling period

	<i>M. cantharus</i>		<i>M. camussi</i>		<i>M. cavicelatus</i>		<i>Tupigea cantareira</i>		Juveniles	
	Native	<i>Pinus</i>	Native	<i>Pinus</i>	Native	<i>Pinus</i>	Native	<i>Pinus</i>	Native	<i>Pinus</i>
Jul-Aug 2004	0	1	0	1	0	1	8	0	9	6
Nov 2004	1	2	0	3	0	0	27	21	12	41
Feb 2005	0	0	0	5	2	0	32	0	45	2
May 2005	1	1	2	0	0	5	14	0	19	11
Total	2	4	2	9	2	6	81	21	85	60

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