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Source: American Museum Novitates, 2008(3633) : 1-9

Published By: American Museum of Natural History

URL: <https://doi.org/10.1206/640.1>

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# AMERICAN MUSEUM *Novitates*

PUBLISHED BY THE AMERICAN MUSEUM OF NATURAL HISTORY  
CENTRAL PARK WEST AT 79TH STREET, NEW YORK, NY 10024  
Number 3633, 9 pp., 5 figures, 1 table December 31, 2008

## Redescription of *Mimoscorpilus pugnator* (Butler, 1872) (Arachnida: Thelyphonida), with first description of the female

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### ABSTRACT

A redescription of the endemic Guatemalan whip scorpion, *Mimoscorpilus pugnator* (Butler, 1872), including the first description of the female, new records, and natural history observations, is provided.

### INTRODUCTION

The whip scorpion (Thelyphonida) fauna of Central America is depauperate compared, for example, to the fauna of Southeast Asia. Prior to 2005, the order was represented in Central America by a single genus, *Mastigoproctus* Pocock, 1894, with three species. Three genera and five species are currently recognized (Armas and Viquez, 2005, 2007; Viquez and Armas, 2005, 2006a, 2006b). *Mimoscorpilus pugnator* (Butler, 1872) is one of the most interesting. Originally described as a species of *Thelyphonus* Latreille, 1802, on the basis of a single adult male allegedly from the Philippines, the monotypic genus *Mimoscorpilus*

Pocock, 1894 was later created to accommodate it. No further specimens were reported until more than 125 years after the original description, when a mature male was collected in southwestern Guatemala, and found to be conspecific with *M. pugnator* upon comparison with high-quality images of the holotype deposited in the Natural History Museum, London (Armas and Viquez, 2005, 2007; Viquez and Armas, 2006a). The type locality of *M. pugnator* was evidently erroneous and the species belongs to the Central American fauna (Armas and Viquez, 2005). This was a significant discovery because *M. pugnator* shares several morphological characters with *Mastigoproctus*, to which it appears closely related (Rowland and Cooke, 1973). This relationship is

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now more plausible based on the close geographical proximity of the two genera.

*Mimoscorpis pugnator* was recently found to be the senior synonym of *Mastigoproctus liochirus* Pocock, 1900, originally described from an immature male (Armas and Viquez, 2007). As a consequence of this synonymy, Central America is left without *Mastigoproctus*, which now have a disjunct distribution in North America, South America, and the Caribbean (Harvey, 2003; Armas and Viquez, 2007). It remains to be seen whether the *Mastigoproctus* species in South America and the Caribbean will remain in that genus.

In July 2006, two of the authors (J.C.H. and C.V.) traveled to Guatemala and collected several specimens of *M. pugnator* at different life stages, including the first adult female specimens of these sexually dimorphic whip scorpions. In the present contribution, we provide the first description of the female of *M. pugnator*, as well as new records and observations on the natural history of the species.

## MATERIAL AND METHODS

The material examined is deposited in the following collections: AMNH (American Museum of Natural History, New York, USA); BMNH (The Natural History Museum, London, UK); IES (Instituto de Ecología y Sistemática, Havana, Cuba); INBio (Instituto Nacional de Biodiversidad, Heredia, Costa Rica); MUSHNAT (Museo de Historia Natural de la Universidad de San Carlos, Guatemala City, Guatemala); UVGC (Universidad del Valle de Guatemala, Guatemala City, Guatemala). Female genitalia were studied following methods described by Viquez and Armas (2005). Morphological terminology follows Millot (1949), except for pedipalp morphology which follows Snodgrass (1948). Measurements, taken with Mitutoyo® digital calipers and an ocular micrometer attached to an Olympus SZ60 dissection microscope, are recorded in millimeters. Digital images were obtained using a video camera attached to the same microscope, and prepared using "Montage Explorer" software (Syncroscopy Co., Cambridge, U.K.). Habitus photographs were taken using a Microoptics ML-1000 digital imaging system.

## TAXONOMY

Family Thelyphonidae Lucas, 1835

Subfamily Mastigoproctinae Speijer, 1933

*Mimoscorpis* Pocock, 1894

*Mimoscorpis* Pocock, 1894: 132; Kraepelin, 1897: 10, 1899: 206; Gravely, 1916: 62, 63, 71, 80, 83; Giltay, 1931: 24, 25; Mello-Leitão, 1931: 24; Werner, 1935: 467; Rowland, 1973: 6; Rowland and Cooke, 1973: 68; Harvey, 2003: 68; Armas and Viquez, 2005: 299–301, 2007: 507–509, figs. 1, 3; Viquez and Armas, 2006a: 299, 302–305, figs. 7, 13, 2006b: 37.

TYPE SPECIES: *Thelyphonus pugnator* Butler, 1872, by original designation.

DIAGNOSIS: *Mimoscorpis* differs from all other whip scorpions on the basis of the following combination of characters. Carapace with pair of well-developed anterolateral carinae, extending from lateral ocelli approximately two-thirds towards median ocular tubercle. Median ocelli not separated by superciliary carina. Three pairs of lateral ocelli. Abdominal tergites II and III divided, with median longitudinal suture; IV and often V with partial suture; X divided laterally by pleuron; XII (anal) with pair of large, oval, laterally compressed ommatoids. Flagellar segments each with flagellar organs, situated anteroventrally. Sternite II (♂) with two inflated surfaces posterolaterally and posterior margin lobate medially. Seminal receptacle (♀) tubular, kidney-shaped, posteriorly directed. Pedipalps (♂) with long, cylindrical femur, almost twice length of patella; patellar apophysis long, slender; tibia enlarged proximally, forming ca. 45° angle with longitudinal axis. Leg tibiae IV, each with single ventrodiscal spur.

*Mastigoproctus* may be distinguished from *Mimoscorpis* on the basis of the following characters. The male pedipalp of *Mimoscorpis* is noticeably elongated, the trochanter dentition is not sexually dimorphic, and the tibia is almost as broad as long. The seminal receptacles of *Mastigoproctus giganteus* (Lucas, 1835), the type species of the genus, are short, vertically and posteriorly directed. The median ocelli of *Mastigoproctus* are separated by a well-developed superciliary carina. Leg tibiae II–IV each possess a single ventrodiscal spur in *M. giganteus*.

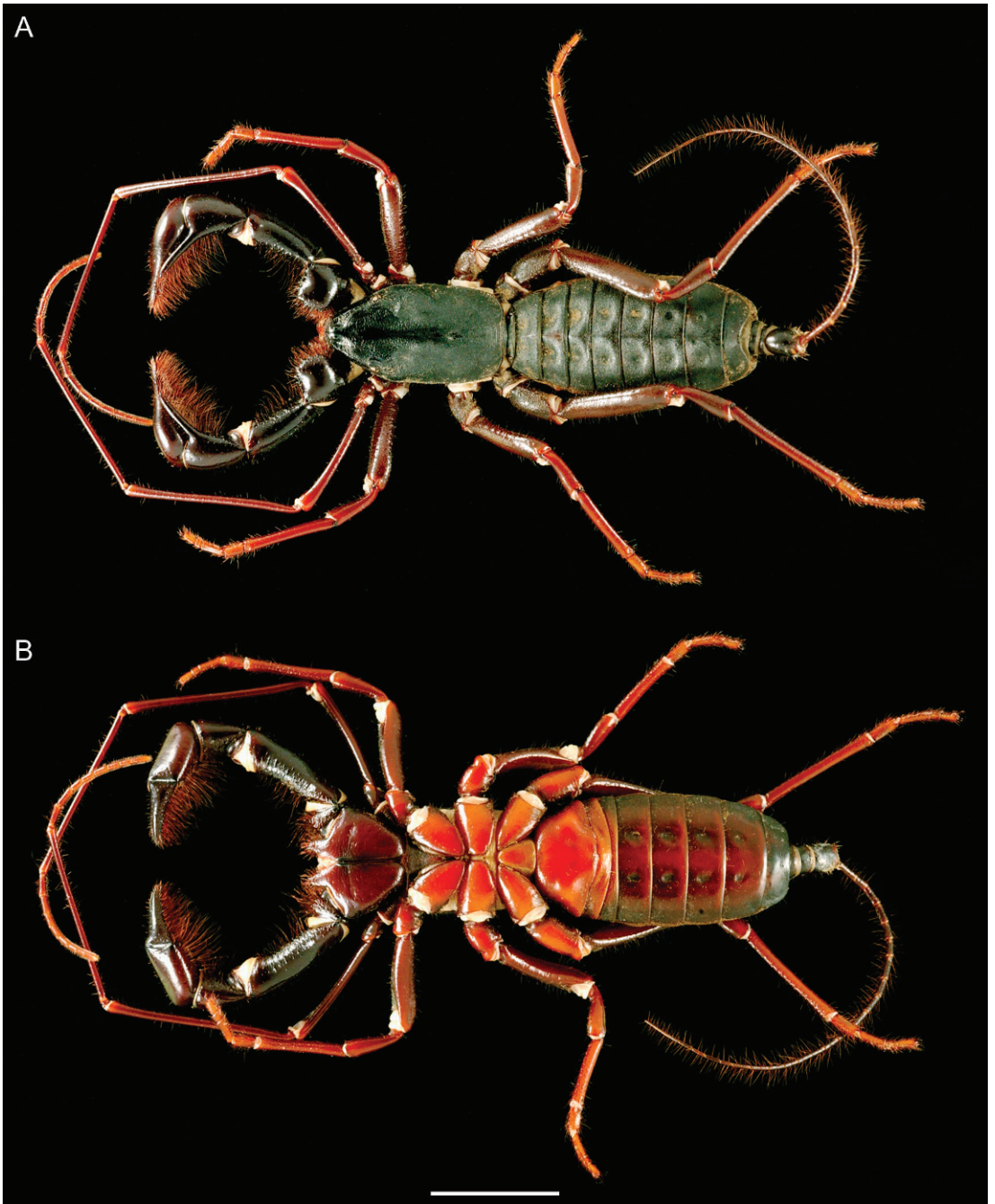


Fig. 1. *Mimoscorpius pugnator* (Butler, 1872), habitus, ♂ (AMNH). **A.** Dorsal aspect. **B.** Ventral aspect. Scale = 10 mm.

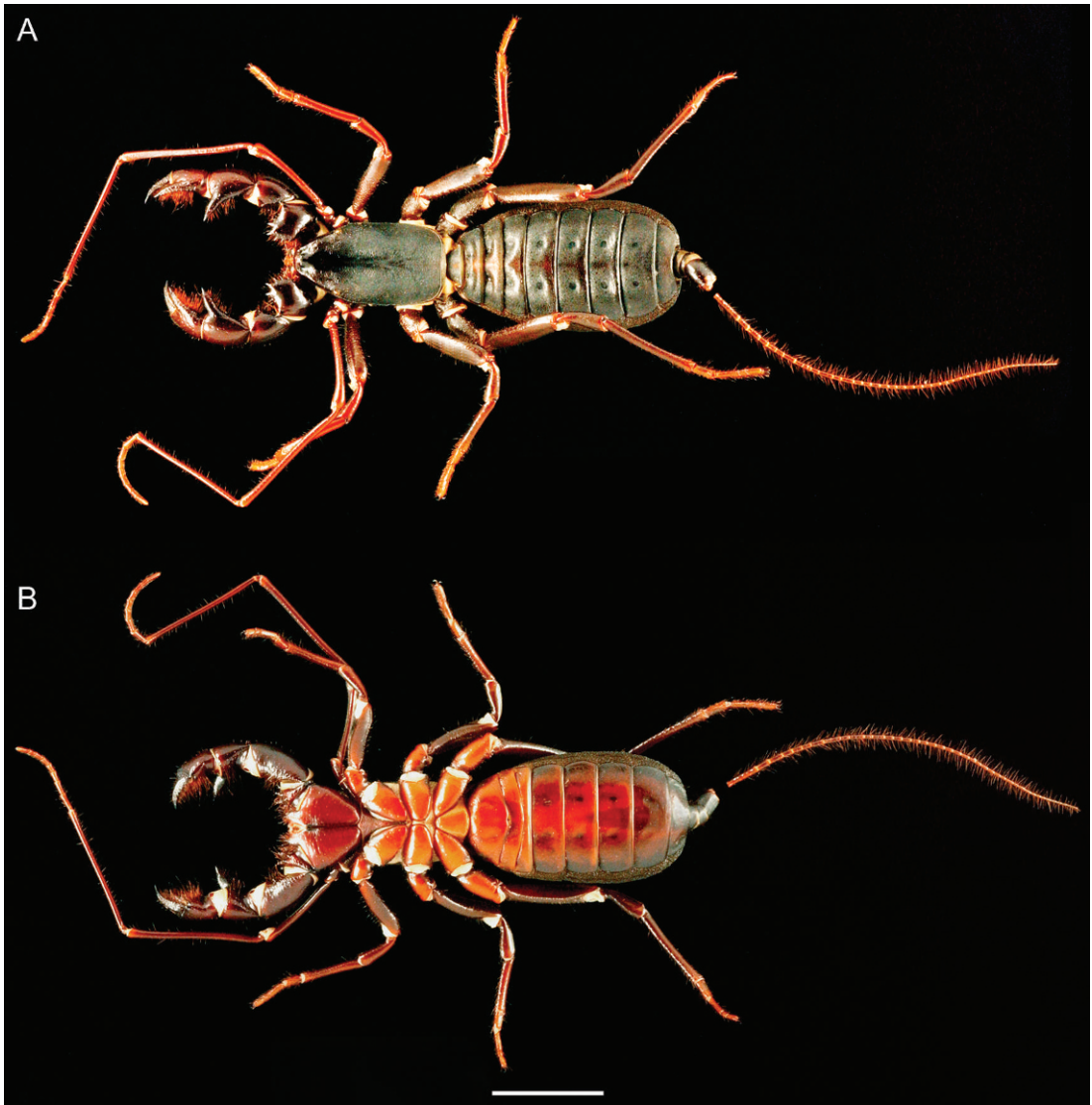


Fig. 2. *Mimoscorpilus pugnator* (Butler, 1872), habitus, ♀ (AMNH). A. Dorsal aspect. B. Ventral aspect. Scale = 10 mm.

*Valeriophonus* Viquez and Armas, 2005, a monotypic genus endemic to Costa Rica, differs from *Mimoscorpilus* based on the presence of a stridulatory organ, situated on opposing surfaces of the pedipalp coxa and the basal cheliceral segment, and the presence, on leg tibiae III and IV, of a single ventrodistal spur in each case. *Valeriophonus* is further distinguished from *Mimoscorpilus* on the basis of its relatively short, robust pedipalp with a well-developed lobe on the external surface of

the fixed finger, and the short, vertically- and anteriorly-directed seminal receptacles.

**DISTRIBUTION:** This genus appears to be endemic to the Central American country of Guatemala.

*Mimoscorpilus pugnator* (Butler, 1872)

Figures 1–11, table 1

*Thelyphonus pugnator* Butler, 1872: 204, pl. XIII, fig. 5.



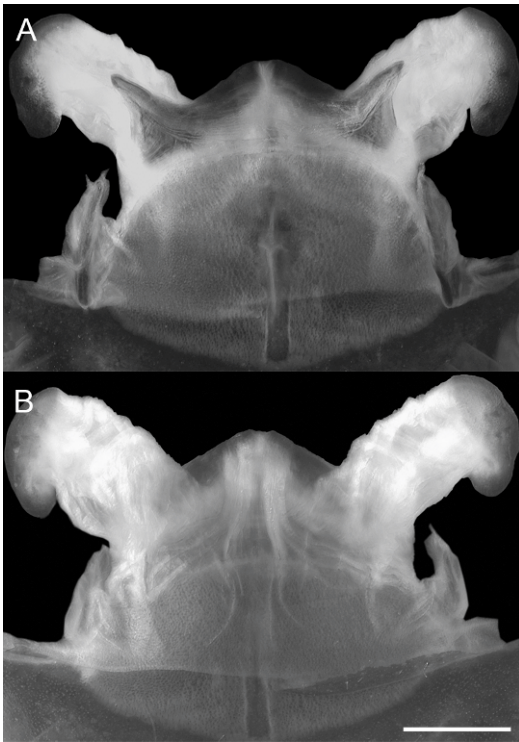


Fig. 3. *Mimoscorpius pugnator* (Butler, 1872), genitalia, ♀ (AMNH). **A.** Dorsal aspect. **B.** Ventral aspect. Scale = 3 mm.

*Mimoscorpius pugnator*: Pocock, 1894: 132; Kraepelin, 1897: 40, 1899: 207; Gravely, 1916: 71; Giltay, 1931: 24, 25; Mello-Leitão, 1931: 24; Werner, 1935: 467, fig. 171; Rowland and Cooke, 1973: 64, 68; Rowland, 1973: 6, 7, 9; Harvey, 2003: 68; Armas and Viquez, 2005: 299–301, 2007: 507–509, figs. 1, 3; Viquez and Armas, 2006a: 302–305, figs. 7, 13, 2006b: 37.

*Mastigoproctus liochirus* Pocock, 1900: 299 (synonymized by Armas and Viquez, 2007: 507–509, fig. 2). Pocock, 1902: 46, 48, pl. X, fig. 5; Mello-Leitão, 1931: 26, 27, 29, fig. 13; Rowland and Cooke, 1973: 68; Valerio, 1981: 15–17, fig. 3; Vásquez Rojas, 1996: 69; Lazell, 2000: 306, 309; Armas and Maes, 2000: 14, 15; Rowland, 2002: 192; Harvey, 2003: 67; Viquez, 2003: 84, 85, map 1, fig. 1; Armas, 2004: 53; Viquez and Armas, 2006a: 299, 301–304, figs. 5, 13.

**HOLOTYPE**: 1 ♂ (BMNH), “Philippine Islands” (digital photomicrographs examined). For discussion on the type locality, see Armas and Viquez (2005).

**DIAGNOSIS**: As for genus.

**DESCRIPTION**: The following description is based on 2 ♂ and 10 ♀ (figs. 1, 2).

**Total length**: Maximum adult length measured from anterior margin of carapace to

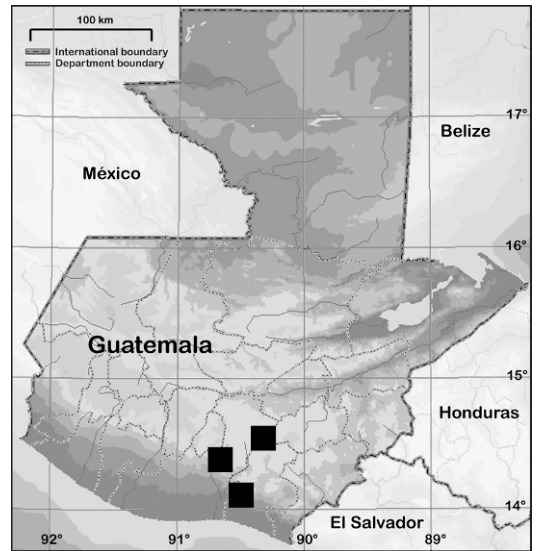


Fig. 4. Map of Guatemala, plotting the known locality records of *Mimoscorpius pugnator* (Butler, 1872).

posterior edge of pygidium (segment XII), 35.73 mm (♂), 38.03 mm (♀) (table 1).

**Color**: Carapace, black. Opisthosoma, dorsal surface, black. Tergites II–IV, region of longitudinal suture, reddish-brown. Sternites I–VII, ventral surfaces, reddish-brown to light brown, lateral edges, dark brown; VIII, dark brown to black. Pygidium, dorsal and ventral surfaces, dark brown. Flagellum, dorsal, lateral and ventral surfaces, reddish-brown, covered with reddish setae. Pedipalp trochanter, dorsal and ventral surfaces, dark reddish-brown. Pedipalp femur, dorsal and ventral surfaces, dark brown. Pedipalp patella, tibia and basitarsus, dorsal and ventral surfaces, dark reddish-brown. Internal surface with numerous long, red setae. Leg I, all segments, reddish-brown; II–IV, coxa, ventral surface, light reddish-brown to orange-brown, trochanter and femur, dark reddish-brown, patella and tibia, reddish-brown, basitarsus and tarsus, light reddish-brown to orange-brown.

**Carapace**: Carapace with pair of well-developed anterolateral carinae, extending from lateral ocelli approximately two-thirds towards median ocular tubercle. Anterior surface and median ocular tubercle, smooth; remainder of carapace wrinkled, becoming densely and finely granular posteriorly, with



Fig. 5. Subtropical forest habitat of *Mimoscorpis pugnator* (Butler, 1872) near El Papayo, Guatemala.

sparse granules on lateral surfaces. Median ocular tubercle situated 0.74 mm from anterior margin of carapace (table 1); distance between ocelli 1.4 times ocular diameter. Posterior fovea obsolete; epistoma present, small. Three pairs of lateral ocelli: anterior ocellus nearly twice the diameter of median ocellus; posterior ocellus only slightly smaller than anterior ocellus; distance between posterior and median ocelli twice the distance between anterior and median ocelli.

*Pedipalps:* Cuticle very smooth, shiny, and sparsely punctate. Coxa, external and ventral surfaces smooth; apophysis with one tooth distally. Trochanter smooth, as wide as ( $\delta$ ) or wider than ( $\varphi$ ) long; dorsointernal surface with six teeth, all similar in size, relatively small, proximal three pointed, distal three blunt, rounded ( $\delta$ ) or with teeth larger, increasing in size medially, all sharply pointed ( $\varphi$ ); ventrointernal surface with two teeth.

Femur ( $\delta$ ) almost cylindrical, twice length of trochanter; ventroexternal surface without teeth; ventrointernal surface with one small, blunt tooth medially. Femur ( $\varphi$ ) not cylindrical, only slightly longer than trochanter; ventroexternal surface with one small tooth medially; ventrointernal surface with one larger, more pronounced tooth medially. Patella relatively short, smooth; dorsointernal surface with one short tooth ( $\varphi$ ) or with vestigial tooth ( $\delta$ ), situated proximal to apophysis. Patellar apophysis very elongated, smooth and slender ( $\delta$ ) or unmodified ( $\varphi$ ); internal edge with serrate row of denticles; external edge smooth. Tibia, external edge flattened ( $\delta$ ) or rounded ( $\varphi$ ); internal surface with numerous long, red macrosetae ( $\delta$ ) or with fewer, shorter macrosetae ( $\varphi$ ); ventrointernal surface with one tooth distally. Fixed finger, dorsal edge smooth ( $\delta$ ) or with serrate row of denticles ( $\varphi$ ); ventral edge with serrate



TABLE 1  
*Mimoscorpius pugnator* (Butler, 1872), selected measurements (mm)

Sex		♂	♂	♀	♀	♀	♀
Locality		EP	EP	EP	EP	EP	PB
Collection		AMNH	InBio	AMNH	AMNH	AMNH	AMNH
Carapace	Length	13.53	15.20	12.94	13.29	13.68	12.91
	Width at lateral ocelli	6.66	7.33	5.91	6.16	5.79	6.05
	Width at fovea	7.34	9.01	7.07	7.24	7.12	7.73
	Median ocular tubercle distance <sup>1</sup>	0.75	0.92	0.68	0.69	0.68	0.69
	Ocular width	0.47	0.50	0.36	0.39	0.39	0.30
Leg I	Distance between median ocelli	0.63	0.70	0.54	0.55	0.45	0.49
	Coxa length	2.59	3.48	2.75	2.62	2.67	2.58
	Trochanter length	2.29	2.84	2.23	2.22	2.24	2.24
	Femur length	9.57	11.46	8.51	8.37	8.40	8.60
	Patella length	14.19	16.67	12.32	11.85	12.07	11.80
Leg IV	Tibia length	13.13	15.86	11.56	11.50	11.20	11.58
	Basitarsus-tarsus length	9.30	11.52	8.08	8.28	8.01	7.31
	Coxa length	4.12	5.12	4.19	3.82	3.93	4.18
	Trochanter length	4.32	5.46	4.87	4.67	4.39	4.81
	Femur length	10.47	11.69	9.10	8.63	9.68	10.20
Total length <sup>2</sup>	Patella length	4.75	5.60	4.58	4.04	4.26	4.50
	Tibia length	9.41	11.45	8.93	8.38	8.38	8.67
	Basitarsus length	3.01	2.60	2.12	1.91	2.00	2.37
	Tarsus length	4.62	5.10	4.61	4.34	4.02	3.95
		36.69	46.00	36.82	38.53	38.19	34.15

<sup>1</sup>Measured from anterior carapace margin.

<sup>2</sup>Measured from anterior carapace margin to posterior edge of pygidium.

Abbreviations: AMNH (American Museum of Natural History, New York); EP (El Papayo, Guatemala); PB (Peña Blanca, Guatemala); InBio (Instituto Nacional de Biodiversidad, Santo Domingo, Costa Rica).

row of denticles; strongly curved downwards, overlapping basitarsus (♂) or straight, not overlapping basitarsus (♀). Basitarsus, dorsal edge with serrate row of denticles; ventral edge smooth (♂) or with serrate row of denticles (♀); apex bifid (♂).

*Legs:* Leg I, basitarsus and telotarsus, tarsomeres I–VII gradually decreasing in size, with I largest; tarsomere VIII almost as long as I. Legs II–IV, basitarsus with two ventrodistal spurs. Leg IV, tibia with one ventrodistal spur.

*Trichobothria:* Leg I with two trichobothria; other legs with one trichobothrium; present at distal end of leg tibiae only.

*Opisthosoma:* Abdominal tergites finely granular; II and III divided by median longitudinal suture; IV and often V, suture reaching approximately to anterior third of segment; X divided laterally by suture (pleuron); XII with pair of large, laterally compressed oval ommatoids. Sternite II (genital)

(♂) with pair of inflated surfaces posterolaterally; posterior margin with conspicuous, subrectangular median lobe; III and IV undivided, III three times longer than IV; remaining sternites smooth medially, finely punctate laterally. Sternite II (genital) (♀) unmodified; posterior margin with small median notch, small circular sclerotized structure below surface of cuticle posterior to median notch. Seminal receptacles tubular, kidney-shaped, convex dorsally, concave ventrally; posteriorly directed (fig. 3).

*Sexual dimorphism:* The adult male exhibits several secondary sexual characters not observed in the adult female. The pedipalps of the male are elongated, with a modified tibia, compared to the female in which the pedipalps are relatively short and robust, with an unmodified tibia. Sternite II presents two inflated surfaces posterolaterally, and its posterior margin is lobate medially, in the male, but is unmodified in the female.



**MATERIAL EXAMINED:** **GUATEMALA:** *Departamento Escuintla:* San Vicente, Pacaya, Los Almendros farm (14°24'58"N 90°38'21"W), 3.v.2001, F. Alvarado, 1 ♀ (UVGC). *Departamento Guatemala:* Peña Blanca (14°32'0"N 90°20'0"W), 3.vii.1980, T. Okazawa, 1 ♀ (AMNH). *Departamento Santa Rosa:* Taxisco, El Papayo village (14°08'03"N 90°33'52"W), 270 m, 13.vi.2002, C. Ávila Ramos, 1 ♂ (INBio); same locality, 3–4.vii.2006, C. Viquez, J. Huff, D. Ortiz, C. Ávila, and R. Estrada, 1 ♂, 3 ♀, 9 juv. (AMNH), 2 ♀, 1 juv. ♂, 1 juv. ♀ (INBio), 2 ♀, 1 juv. ♂ (MUSHNAT), 1 ♀, 1 juv. ♂, 1 juv. ♀ (IES).

**DISTRIBUTION:** Recorded from the Escuintla, Guatemala and Santa Rosa departments of Guatemala (fig. 4).

**NATURAL HISTORY:** *Mimoscorpilus pugnator* inhabits humid subtropical forests at an elevation of 270 m, with a temperature of 18–24°C, and mean annual precipitation of 1000–2000 mm (fig. 5). This species was collected in small mammal (agouti or armadillo) burrows, holes at the base of large trees, and from inside and under rotten logs. Six *M. pugnator* specimens were taken, together with several schizomids, from an agouti burrow which contained many dead leaves. These whip scorpions appear to tolerate each other when in close proximity and no aggression was observed among individuals of various sizes. The defensive spray of this species smells strongly of acetic acid.

#### ACKNOWLEDGMENTS

We are indebted to Sergio Pérez (MUSHNAT) and Enio Cano (UVGC) for helping J.H. and C.V. during the expedition to Guatemala (2006) and for the initial loan of *Mimoscorpilus* to C.V. We thank Emmanuel Agreda, David Ortiz, and Carlos Ávila for invaluable assistance in the field and in obtaining collecting and export permits for the expedition. Ricardo Estrada assisted as guide and collector in El Papayo. We thank Janet and George Beccaloni (BMNH) for providing photos of the holotype of *M. pugnator*, Steve Thurston for assistance with preparing the plates, and James Cokendolpher and Mark Harvey for critical review of the manuscript. The expedition to Guatemala was

funded by U.S. National Science Foundation grant EAR 0228699 to L.P.

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