

## New genus and species of short-tailed whipscorpion (Schizomida: Hubbardiidae) from the Venezuelan Amazon

PÍO A. COLMENARES<sup>1,2\*</sup>, JAIRO A. MORENO-GONZÁLEZ<sup>1</sup>, OSVALDO VILLARREAL<sup>2,3</sup> & LORENZO PRENDINI<sup>1</sup>

<sup>1</sup>Arachnology Lab, Division of Invertebrate Zoology, American Museum of Natural History, Central Park West at 79<sup>th</sup> Street, New York, NY 10024-5192, U.S.A.

 [jmorenogonzalez@amnh.org](mailto:jmorenogonzalez@amnh.org);  <https://orcid.org/0000-0001-5980-1417>

 [lorenzo@amnh.org](mailto:lorenzo@amnh.org);  <https://orcid.org/0000-0001-8727-7106>

<sup>2</sup>Instituto y Museo del Instituto de Zoología Agrícola, Facultad de Agronomía, Universidad Central de Venezuela, Maracay, Aragua, Venezuela

<sup>3</sup>Centro de Ecología, Instituto Venezolano de Investigaciones Científicas, km 11 carretera Panamericana, Altos de Pipe, Miranda 1204-A, Venezuela

 [osvaldovillarreal@gmail.com](mailto:osvaldovillarreal@gmail.com);  <https://orcid.org/0000-0001-5355-3723>

\*Corresponding author:  [pcolmenares@amnh.org](mailto:pcolmenares@amnh.org);  <https://orcid.org/0000-0002-9568-7217>

### Abstract

A new genus and species of short-tailed whipscorpion (Schizomida: Hubbardiidae Cook, 1899) is described based on specimens collected in the Venezuelan state of Amazonas. The new genus differs from other Neotropical genera in the presence of six setae on opisthosomal tergite II, the absence of seta  $Dm_4$  on the flagellum in both sexes, the female flagellum comprising four segments, and the median lobes of the spermatheca being four times longer than the lateral lobes. *Jipai longevus* gen. et sp. nov. increases the count of South American schizomid genera to fourteen and the count of species to 57. The type locality of the new taxon is situated in the Guiana region of Amazonia s. l., where three other hubbardiid genera have also been recorded. This discovery contributes to the understanding of Amazonian schizomid diversity and highlights the need for further sampling in this diverse, vulnerable and poorly explored area.

**Key words:** Amazonia, Hubbardiinae, Neotropics, South America, morphology, taxonomy

### Introduction

The arachnid order Schizomida Petrunkevitch, 1945 is composed of small (total length less than 30 mm), eyeless whipscorpions characterized by vertically oriented, raptorial pedipalps, a three-segmented prosoma (comprising a propeltidium, mesopeltidium, and metapeltidium), terminal repugnatorial gland openings on the opisthosoma, and a sexually dimorphic pygidial flagellum (Reddell & Cokendolpher 1995). Although circumtropical in distribution, schizomids, also known as short-tailed whipscorpions, are microhabitat specialists with low vagility. Most species are short-range endemics, with an extent of occurrence less than 10,000 km<sup>2</sup>, and many are known only from a single locality (Harvey 2002; Harvey *et al.* 2011).

The order currently comprises two families (Protoschizomidae Rowland, 1975; Hubbardiidae Cook, 1899), 71 extant genera, and 376 extant species (WSC 2024). Thirteen genera and 56 species occur in South America, predominantly in Brazil, Colombia and Venezuela (WSC 2024). The schizomid fauna of Venezuela is the third most diverse in the region, with six genera and ten species recorded (WSC 2024). As in other taxa, recent sampling of South American schizomids focused mostly on the Andean region (Armas & Delgado-Santa 2012, 2013; Moreno-González & Villarreal 2012; Delgado-Santa & Armas 2013; Moreno-González *et al.* 2014; Villarreal *et al.* 2016; Moreno-González & Villarreal 2017). Although the Amazon is the World's largest tropical rainforest and occupies ca. 40% of the South American continent (Rocha & Kaefer 2019), relatively few studies have been conducted on Amazonian schizomids (Pinto-da-Rocha *et al.* 2016; Ruiz & Valente 2017, 2019; Salvatierra 2018). Notwithstanding

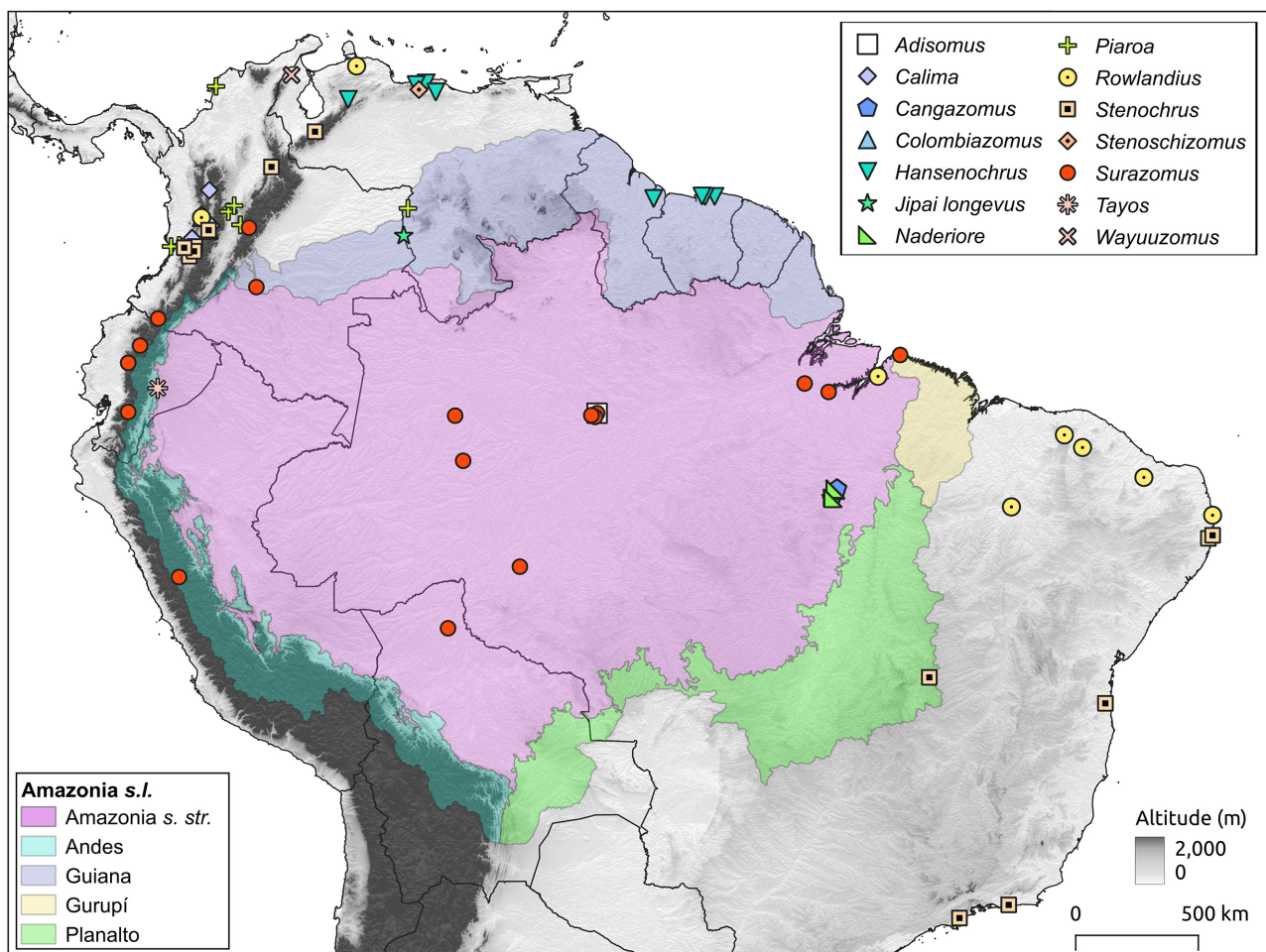
that some of the first studies of schizomid behavior (Kraus & Beck 1967) and phenology (Adis *et al.* 1999, 2001) were conducted in the Amazon, only eight genera and 25 valid species, most of which (14 species) belong to the genus *Surazomus* Reddell & Cokendolpher, 1995, have been recorded from Amazonia *s. l.* (*sensu* Eva *et al.* 2005).

The present contribution describes a new genus and species of hubbardiid, based on specimens collected in the Venezuelan state of Amazonas. The new genus differs from other Neotropical genera in the presence of six setae on opisthosomal tergite II, the absence of seta *Dm*<sub>4</sub> on the flagellum in both sexes, the female flagellum comprising four segments, and the median lobes of the spermatheca being four times longer than the lateral lobes. *Jipai longevus* gen. *et* sp. nov. increases the count of South American schizomid genera to 14 (Fig. 1) and the count of species to 57. The type locality of the new taxon is situated in the Guiana region of Amazonia *s. l.*, where three other hubbardiid genera have also been recorded. This discovery contributes to the understanding of Amazonian schizomid diversity and highlights the need for further sampling in this diverse, vulnerable and poorly explored area.

## Materials and Methods

The material examined is deposited in the Museo del Instituto de Zoología Agrícola (MIZA), Maracay, Venezuela, and the Invertebrate Zoology Collection of the American Museum of Natural History (AMNH), New York, U.S.A.

General morphological nomenclature follows Reddell & Cokendolpher (1995); cheliceral setation follows Lawrence (1969), modified by Villarreal *et al.* (2016); pedipalp setation follows Monjaraz-Ruedas & Francke (2016);



**FIGURE 1.** Known distributions of South American schizomid genera: *Adisomus* Cokendolpher & Reddell, 2000; *Calima* Moreno-González & Villarreal, 2012; *Cangazomus* Pinto-da-Rocha *et al.*, 2016; *Colombiazomus* Armas & Delgado-Santa, 2012; *Hansenochrus* Reddell & Cokendolpher, 1995; *Jipai* gen. nov.; *Naderiore* Pinto-da-Rocha *et al.*, 2016; *Piaroa* Villarreal *et al.*, 2008; *Rowlandius* Reddell & Cokendolpher, 1995; *Stenochrus* Chamberlin, 1922; *Stenoschizomus* Gonzalez-Sponga, 1997; *Surazomus* Reddell & Cokendolpher, 1995; *Tayos* Reddell & Cokendolpher, 1995; *Wayuuzomus* Armas & Colmenares, 2006. Amazonian boundaries after Eva *et al.* (2005).

opisthosomal setation follows Villarreal *et al.* (2016); flagellar setation follows Monjaraz-Ruedas *et al.* (2016); spermathecal structure follows Moreno-González *et al.* (2014); and male genitalia follows Ruiz & Valente (2023). The following abbreviations are used: chelicera: guard tooth (GT), cheliceral setal groups 1–5 ( $G_{1-5}$ ); pedipalp setae: femur: dorsal (*Fd*), ectal (*Fe*), medial (*Fm*), ventral (*Fv*); patella: ectal (*Pe*), medial (*Pm*); tibia: external row (*Ter*), internal row (*Tir*), medial row (*Tmr*), ventral (*Tv*); male genitalia: medium septum (MS), pterapophysis (Pt); female genitalia: anterior branch (AB), chitinized arch (ChA), duct opening (DO), internal angle (IA), lateral lobe (LL), median lobe (ML), lateral tip (LT), posterior branch (PB); other setae: dorsolateral (*DI*), dorsomedian (*Dm*), microsetae patch (*msP*), ventrolateral (*VI*), ventromedian (*Vm*).

Photographs were taken with a Nikon DS-Qi2 camera, attached to a Nikon SMZ18 stereo microscope. Image stacking was conducted with Nikon NIS-Elements (<https://www.microscope.healthcare.nikon.com/products/software/nis-elements>). Vector illustrations of the chelicera and spermatheca were prepared using Inkscape 1.3.2. (<https://inkscape.org>) from photographs taken using an Amscope MU series 18 mp camera fitted to an Amscope CL-T720 trinocular compound microscope and stacked using ZereneStacker (<https://zerenesystems.com>).

A distribution map was prepared with QGIS 3.30 (<http://www.qgis.org>) using a digital elevation model, the raster Hillshade conversion (with layers on azimuths 45° and 145°) and a single band rendering (i.e., BrBg). The Amazonian boundaries proposed by Eva *et al.* (2005) were applied, using a shapefile from the European Commission (<https://forobs.jrc.ec.europa.eu/amazon>).

## Taxonomy

### Family Hubbardiidae Cook, 1899

#### Subfamily Hubbardiinae Cook, 1899

#### *Jipai* gen. nov.

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**Type species.** *Jipai longevus* sp. nov., by monotypy.

**Diagnosis.** In common with the following eleven Neotropical hubbardiid genera, *Jipai* gen. nov. possesses a female flagellum comprising four flagellomeres and three annuli (Figs. 5D–F, 6D–F): *Adisomus* Cokendolpher & Reddell, 2000; *Calima* Moreno-González & Villarreal, 2012; *Cangazomus* Pinto-da-Rocha *et al.* 2016; *Colombiazomus* Armas & Delgado-Santa, 2012; *Hansenochrus* Reddell & Cokendolpher, 1995; *Mayazomus* Reddell & Cokendolpher, 1995; *Naderiore* Pinto-da-Rocha *et al.* 2016; *Piaroa* Villarreal *et al.* 2008; *Rowlandius* Reddell & Cokendolpher, 1995; *Tayos* Reddell & Cokendolpher, 1995; *Wayuuzomus* Armas & Colmenares, 2006. However, these genera may be separated as follows. The presence of two pairs of lobes, median lobes (ML) and lateral lobes (LL), in the spermatheca (Fig. 4E) separates *Jipai* gen. nov. from *Adisomus*, *Calima*, *Piaroa*, and *Tayos*, each of which possess a single pair (LL), whereas the ML being significantly longer than the LL separates *Jipai* gen. nov. (Fig. 4E) from some species of *Hansenochrus*, *Rowlandius*, and *Wayuuzomus*, in which the ML are similar in length to the LL, and from *Cangazomus*, *Colombiazomus*, *Naderiore* and some species of *Hansenochrus* and *Rowlandius*, in which the ML are shorter than the LL. Additionally, the presence of more than one pair of setae on opisthosomal tergite II separates *Jipai* gen. nov. (Fig. 4A) from all the abovementioned genera, except some species of *Mayazomus*, which only possess a single pair.

*Jipai* gen. nov. most closely resembles *Mayazomus*, from which it can be distinguished by the linear ML of the spermatheca (Fig. 4E), six setae (*Dm*,  $DI_1$ , and  $DI_2$ ) on opisthosomal tergite II (Fig. 4A), and the male pedipalp with a slender femur lacking setiferous tubercles distally, the patella not curved ventrally, and a ventral apophysis absent on the tibia (Fig. 3A). In *Mayazomus*, the ML of the spermatheca are curved, four (rarely five) setae (*Dm* and  $DI_1$ ) are present on tergite II, and the male pedipalp exhibits a robust femur with setiferous tubercles distally, the patella markedly curved ventrally, and a ventral apophysis present on the tibia.

**Etymology.** The generic name, masculine in gender, is a noun for soil or ground in Kurripako, a language of the Arawak linguistic family, spoken in parts of the Amazon in Brazil, Colombia and Venezuela. It refers to the substrate in which schizomids are commonly found.

*Jipai longevus* sp. nov.  
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 Figures 1–6, Table 1

**Diagnosis.** As for genus.

**Type material.** Holotype ♂, paratype ♀ (MIZA), ♂, ♀ paratypes (AMNH), **Venezuela:** *Amazonas:* Municipio Atabapo: Comunidad Castillito, 83 m, 16.vii.2022, P.A. Colmenares, Q. Arias, E. Infante & O. Villarreal.

**Etymology.** The specific epithet recognizes the long career of Cuban arachnologist and zoologist Luis F. de Armas, who has worked on the Neotropical arachnid fauna for over five decades, producing numerous taxonomic contributions while mentoring generations of Latin American arachnologists.

**Description.** Based on the holotype ♂ (MIZA) and paratype ♀ (AMNH). Female as for male, except where noted otherwise. Measurements in Table 1.

*Coloration:* Prosoma dark yellowish brown; opisthosomal tergites and legs light yellowish brown; chelicerae and pedipalps medium yellowish brown (Fig. 2A–C).

**TABLE 1.** *Jipai longevus* gen. et sp. nov., measurements (mm) of holotype and paratype, respectively deposited in the in Museo del Instituto de Zoología Agrícola, Maracay, Venezuela, and the American Museum of Natural History, New York, U.S.A.

|                    |              |              | Holotype ♂ | Paratype ♀ |
|--------------------|--------------|--------------|------------|------------|
| Pro- + opisthosoma |              | total length | 3.35       | 3.37       |
| Prosoma            |              | length       | 1.42       | 1.46       |
|                    | propeltidium | length       | 1.06       | 1.11       |
|                    |              | width        | 0.55       | 0.63       |
| Opisthosoma        |              | length       | 1.93       | 1.91       |
| Flagellum          |              | length       | 0.33       | 0.28       |
|                    |              | width        | 0.26       | 0.06       |
|                    |              | height       | 0.33       | 0.05       |
| Pedipalp           |              | total length | 2.61       | 2.01       |
|                    | trochanter   | length       | 0.41       | 0.38       |
|                    | femur        | length       | 0.66       | 0.46       |
|                    | patella      | length       | 0.74       | 0.48       |
|                    | tibia        | length       | 0.48       | 0.40       |
|                    | tarsus       | length       | 0.21       | 0.19       |
|                    | claw         | length       | 0.11       | 0.10       |
| Leg I              |              | total length | 4.11       | 4.01       |
|                    | trochanter   | length       | 0.31       | 0.29       |
|                    | femur        | length       | 1.04       | 1.01       |
|                    | patella      | length       | 1.21       | 1.17       |
|                    | tibia        | length       | 0.88       | 0.86       |
|                    | basitarsus   | length       | 0.27       | 0.27       |
|                    | telotarsus   | length       | 0.40       | 0.40       |
| Leg IV             |              | total length | 3.24       | 3.54       |
|                    | trochanter   | length       | 0.23       | 0.30       |
|                    | femur        | length       | 0.99       | 1.03       |
|                    | patella      | length       | 0.44       | 0.43       |
|                    | tibia        | length       | 0.63       | 0.86       |
|                    | basitarsus   | length       | 0.57       | 0.55       |
|                    | telotarsus   | length       | 0.39       | 0.37       |





**FIGURE 2.** *Jipai longevus* gen. et sp. nov., habitus, dorsal (A, D), lateral (B, E) and ventral (C, F) aspects. A–C. Holotype ♂ (MIZA). D–F. Paratype ♀ (AMNH). Scale bar: 1 mm.



**FIGURE 3.** *Jipai longevus* gen. et sp. nov., pedipalps, retrolateral aspect. **A.** Holotype ♂ (MIZA). **B.** Paratype ♀ (AMNH). Scale bars: 0.1 mm.

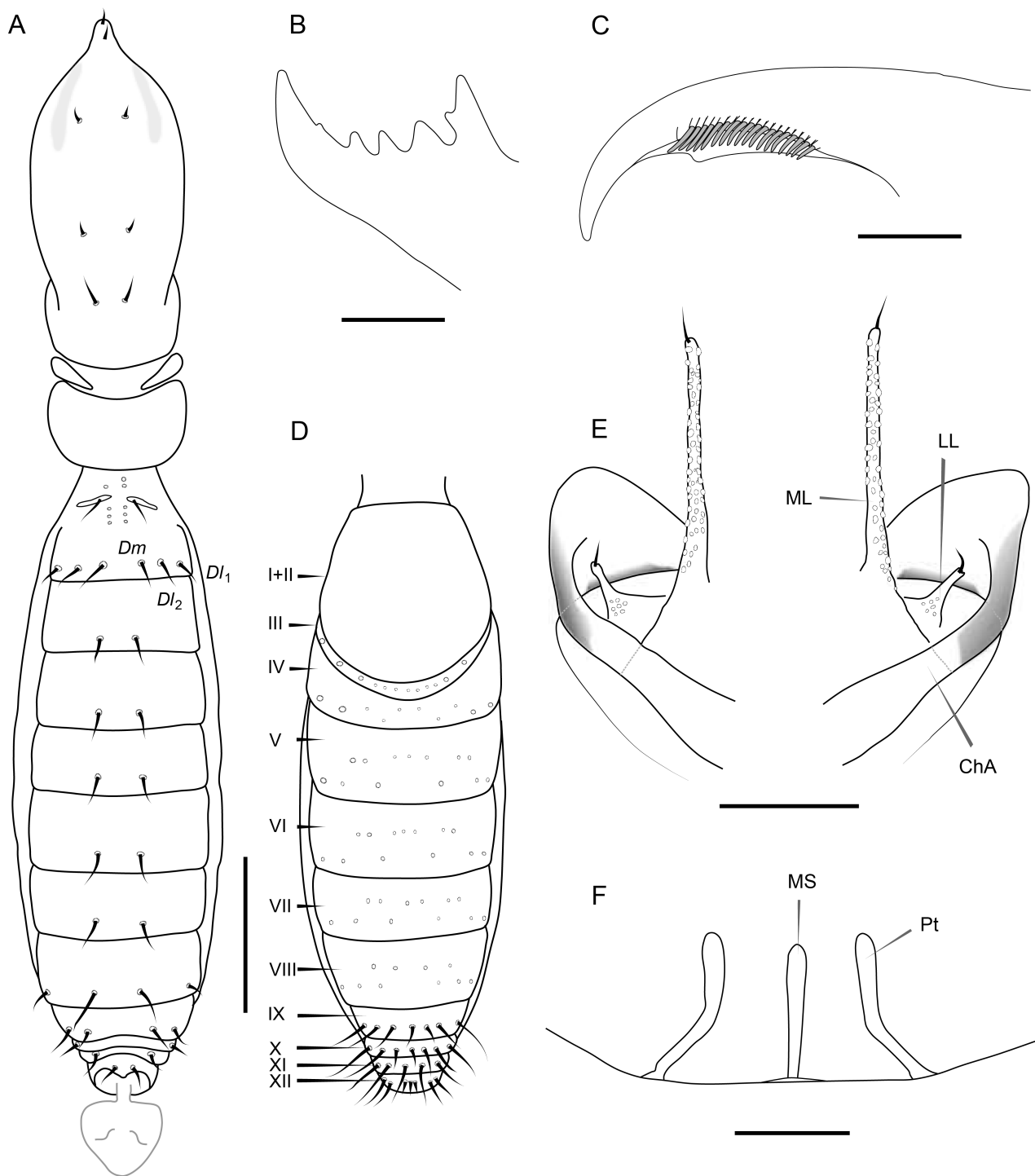
*Prosoma*: Propeltidium anterior process with two setae, one posterior to the other, and three pairs of dorsosubmedian setae, posterior pair larger (Fig. 2A–C). Eyespot slender, elongated. Metapeltidium undivided. Anterior sternum with nine setae, plus three sternophysal setae; posterior sternum with six setae.

*Chelicerae*: Movable finger sharp and curved distally; serrula, composed of seventeen hyaline teeth, increasing in length distally; guard tooth and lamella present (Fig. 4B, C); rounded accessory teeth present on lamella, posterior to guard tooth. Fixed finger with three teeth of similar length between two larger teeth; distal tooth simple with basal tooth vestigial and proximal tooth bifid.  $G_1$  (setal group 1) comprising three spatulate setae, one (dorsalmost) with basal surface almost smooth, other two with basal surface covered by four longitudinal rows of spicules;  $G_2$  comprising five plumose setae, subequal and longer than movable finger;  $G_3$  comprising four subequal setae, each with dorsal surfaces plumose and ventral surfaces serrate;  $G_4$  comprising two short, stout, acuminate setae with smooth surfaces;  $G_{5A}$  comprising seven subequal setae, longer than fixed finger and plumose apically;  $G_{5B}$  comprising nine setae, longer than  $G_{5A}$  setae and plumose apically;  $G_6$  comprising one smooth seta, more than half the length of movable finger;  $G_7$  comprising six setae, plumose medially to apically, and decreasing in length distally. Setal group formula ( $G_1$ – $G_2$ – $G_3$ – $G_4$ – $G_{5A}$ – $G_{5B}$ – $G_6$ – $G_7$ ): 3–5–4–2–7–9–1–6.

*Pedipalps*: Sexually dimorphic, pedipalp of male longer than female, without armature (Figs. 2B, F, 3A, B); 2.5 x (♂) or 1.8 x (♀) longer than propeltidium. Trochanter with apical process subconical; prolateral spur present. Femur slender, slightly swollen distally, 3.2 x (♂) or 1.4 x (♀) longer than high; retroventral surface with  $Fe_1$ ,  $Fev_1$  and  $Fev_2$  setae acuminate; prolateral surface with  $Fmv_1$  seta basal and  $Fmy_{2-3}$  setae more distal. Patella slender, 4.2 x (♂) or 2.7 x (♀) longer than high; ventral surface with acuminate  $Pe_1$  setae basal, and  $Pe_{2-5}$  and  $Pm_{1-5}$  setae in distal half. Tibia cylindrical, 3.5 x (♂) or 2.9 (♀) longer than high; ventral surface with  $Ter$  comprising four acuminate setae, and  $Tmr$  and  $Tir$  each comprising four apically plumose setae. Tarsus slightly conical, about one third the length of tibia; ventroapical spurs similar in length; tarsal claw sharp, curved.

*Legs*: Leg IV femur 2.1 x (♂) or 2.4 x (♀) longer than high (Fig. 2B, E).

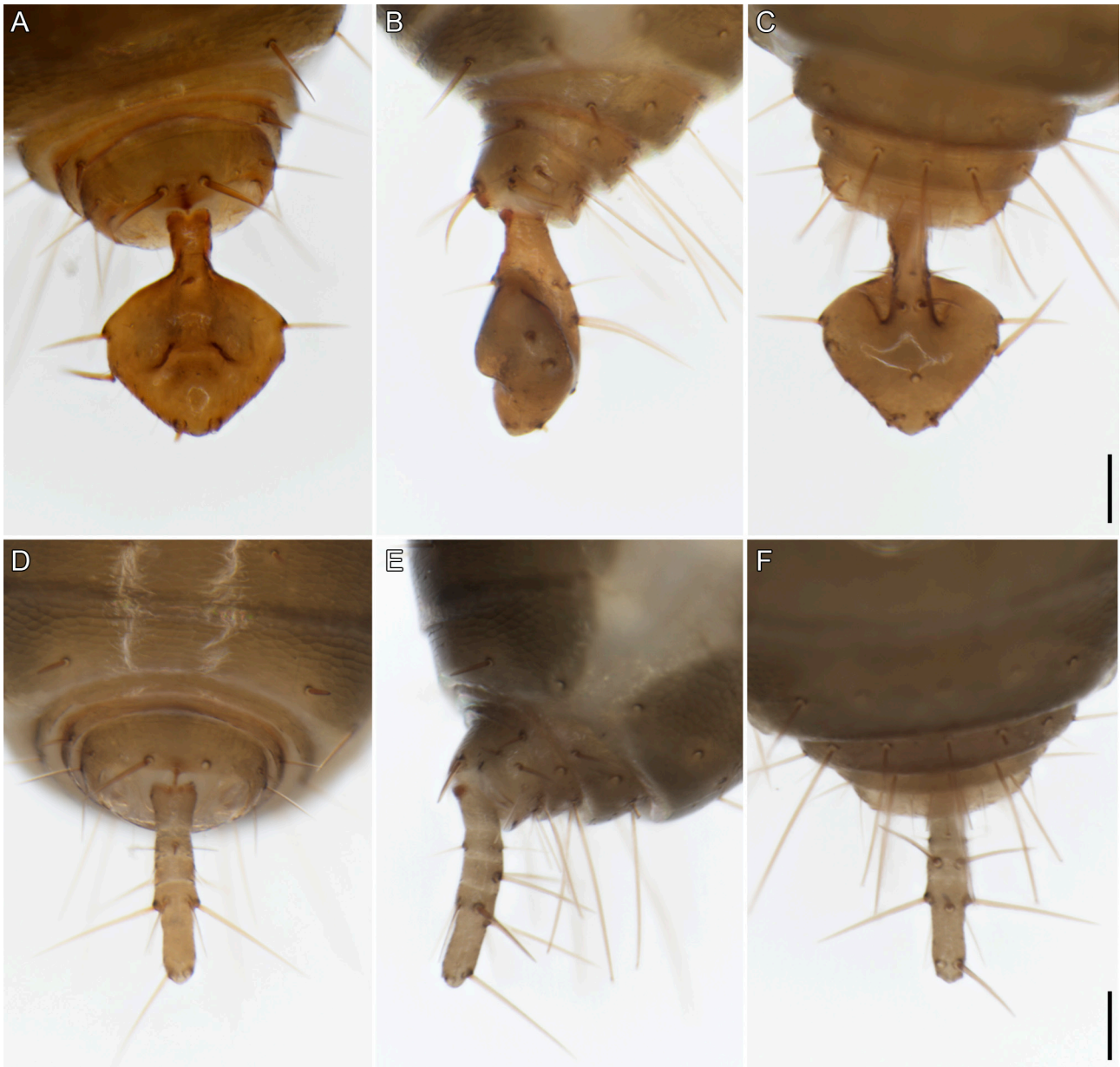
*Tergites*: Tergite I divided, with two anterior pairs of microsetae and one posterior pair of  $Dm$  setae (Fig. 4A); II with three anterior pairs of microsetae and three posterior pairs of  $Dm$ ,  $Dl_1$  and  $Dl_2$  setae; III–VII each with one pair of  $Dm$  setae; VIII with one pair of  $Dm$  setae; IX with  $Dl_1$  and  $Dl_2$  setae.



**FIGURE 4.** *Jipai longevus* gen. et sp. nov., holotype ♂ (MIZA) (A–D, F) and paratype ♀ (AMNH) (E). **A.** Prosomal and opisthosomal setation, dorsal aspect. **B.** Cheliceral fixed finger, retrolateral aspect. **C.** Cheliceral movable finger, ventral aspect illustrating serrula. **D.** Opisthosomal setation, ventral aspect. **E.** Spermatheca, dorsal aspect. **F.** Male genitalia, ventral aspect. Abbreviations: ChA, chitinated arch; Dm, dorsomedian setae; Dl, dorsolateral setae; LL, lateral lobe; ML, median lobe; MS, median septum; Pt, pterapophysis. Scale bars: 0.5 mm (A, D); 0.1 mm (B, C, F); 0.05 mm (E).

**Sternites:** Sternites I–III each with rows of scattered microsetae (Fig. 4D); IV–VIII each with  $Vm_2$ ,  $Vl_1$ , and  $Vl_2$  setae; IX and X each with  $Vm_1$ ,  $Vm_2$ ,  $Vl_1$ , and  $Vl_2$  setae; XI with  $Vm_1$ ,  $Dl_1$ ,  $Vm_2$ , and  $Vl_1$  setae; XII with  $Dm$ ,  $Dl_1$ ,  $Dl_2$ ,  $Vm_2$ ,  $Vl_{1A}$ ,  $Vl_{1B}$ , and  $Vl_2$  setae, and without posterodorsal abdominal process. Respiratory spiracles large, oval, and slightly sclerotized.





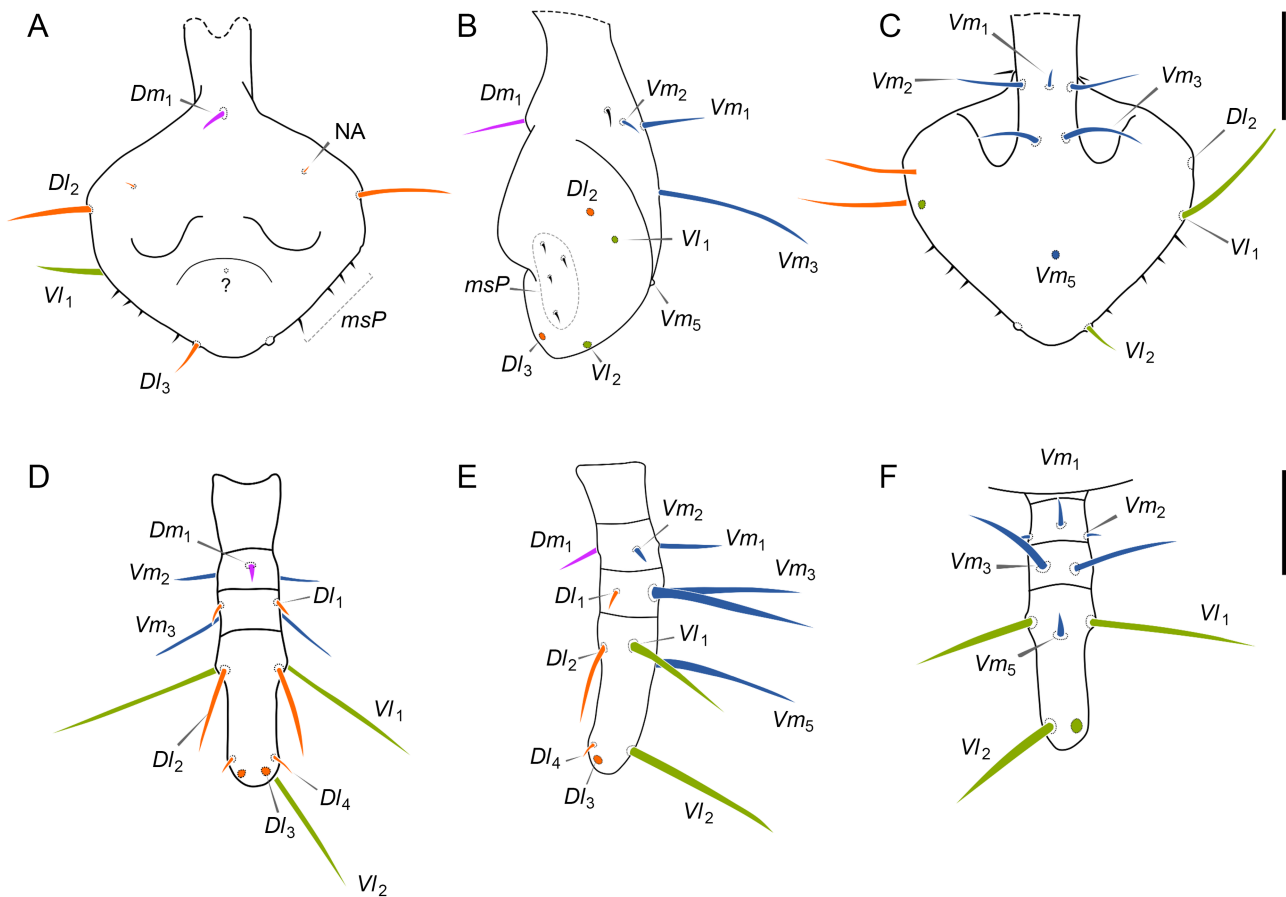
**FIGURE 5.** *Jipai longevus* gen. et sp. nov., flagellum, dorsal (A, D), lateral (B, E) and ventral (C, F) aspects. A–C. Holotype ♂ (MIZA). D–F. Paratype ♀ (AMNH). Scale bars: 0.1 mm.

**Male genitalia:** Gonosternite ca. 0.3 x opisthosomal length, with rows of anterior macrosetae and scattered posterior microsetae (Fig. 4F). Pterapophysis (Pt) angular, concave, bent at angle of ca. 40° medially, and slightly wider apically. Median septum slightly shorter than Pt, also wider apically.

**Spermathecae:** Two pairs of lobes, LL stalk short, narrow, and straight with some basal DOs and apical opening where microtubule inserted (Fig. 4E); ML stalk long, 4 x longer than LL, and linear, covered with sclerotized DOs, and with apical opening where microtubule inserted; all lobe stalks wider basally, terminal circular receptacula absent. Chitinized arch with AB and PB open medially, PB sclerotized anteriorly, narrowing posteriorly; LT wide, projected, with rounded IA. Gonopod absent.

**Flagellum:** Male flagellum kite-shaped (rhomboidal) in dorsal view, approximately as wide as long (Figs. 5A–C, 6A–C); pair of rounded, dorsosubmedian eminences and ventromedian eminence distally, all separated by depression;  $Dm_1$  seta and  $Vm_1$  seta subaligned where pedicel connects flagellar bulb;  $Vm_1$  and  $Vm_2$  setae aligned;  $Vm_3$  setae large, distal to  $Vm_1$  and  $Vm_2$  setae and proximal to  $Vl_1$  setae;  $Dl_2$  setae proximal to  $Vl_1$  setae;  $Vm_5$  seta closer to  $Vl_1$  setae than to  $Vl_2$  setae in lateral aspect;  $Dl_3$  setae subapical, aligned with  $Vl_2$  setae;  $Dm_4$  seta absent; one pair





**FIGURE 6.** *Jipai longevus* gen. et sp. nov., flagellum, dorsal (A, D), lateral (B, E) and ventral (C, F) aspects with setal terminology. A–C. Holotype ♂ (MIZA). D–F. Paratype ♀ (AMNH). Abbreviations: *Dl*, dorsolateral; *Dm*, dorsomedian; *msP*, microsetae patch; *NA*, not assigned; *Vl*, ventrolateral; *Vm*, ventromedian. Scale bars: 0.1 mm.

of dorsal microsetae situated proximally on eminences, between *Dm*<sub>1</sub> and *Dl*<sub>2</sub> setae, and another pair of microsetae dorsal to *Vm*<sub>2</sub> setae; *msP* comprising four setae, second seta situated more ventrally than others, between *Dl*<sub>2</sub> and *Dl*<sub>3</sub> setae. Female flagellum comprising four flagellomeres and three annuli (Figs. 5D–F, 6D–F); flagellomere I asetose; II with *Dm*<sub>1</sub>, *Vm*<sub>1</sub> and *Vm*<sub>2</sub> setae; III with pair of *Dl*<sub>1</sub> setae and pair of large *Vm*<sub>3</sub> setae; IV with *Dl*<sub>2</sub> and *Vl*<sub>1</sub> setae aligned; *Vm*<sub>5</sub> seta distal to *Vl*<sub>1</sub> setae; *Dl*<sub>4</sub> setae proximal to *Dl*<sub>3</sub> setae; *Vl*<sub>2</sub> and *Dl*<sub>4</sub> setae aligned; *Dm*<sub>4</sub> seta absent.

**Distribution.** Known only from the type locality in the state of Amazonas, Venezuela (Fig. 1).

**Natural History.** All specimens of the type series were taken from a single tree stump next to a group of rural houses atop a hill on the banks of the Orinoco River. The surrounding area was flooded as it was during the rainy season.

**Remarks.** Multiple pairs of setae on the dorsal surface of opisthosomal tergite II have only been reported in five hubbardiine genera, in addition to *Jipai* gen. nov. (Venezuela), which has six setae: *Antillostenochrus* Armas & Teruel, 2002 (Cuba, Dominican Republic, Haiti, and Puerto Rico), which has four to eight setae; *Clavizomus* Reddell & Cokendolpher, 1995 (Malaysia and Singapore), which has four to seven posterior setae; *Mayazomus* (Mexico), which has two to five setae; *Pinero* Teruel, 2018 (Cuba), which has four setae; and *Draculoides* Harvey, 1992 (Australia), which has two or three setae. Although the presence of multiple pairs of setae was considered synapomorphic for *Mayazomus* by Monjaraz-Ruedas & Francke (2016), this hypothesis remains to be tested by a phylogenetic analysis in which the other genera are included.

The absence of seta *Dm*<sub>4</sub> is rare among Hubbardiinae, having only been reported in *Jipai longevus* gen. nov. et sp. nov., *Reddellzomus cubensis* Armas, 2002, and *Bamazomus siamensis* Zheng et al., 2024, and is assumed to be autapomorphic for each of these species.

## Discussion

Significant Linnean (species) and Wallacean (geographical distribution) shortfalls (Hortal *et al.* 2015) limit current understanding of the global diversity and distribution of schizomids. Whereas some progress has been made in addressing these shortfalls in the Andes, many other areas, such as Amazonia, remain largely unexplored. These global shortfalls may explain why more than 40% of the extant genera (28 out of 69) of Hubbardiidae are monotypic (WSC 2024). Another possible explanation may be associated with the low vagility, specialized microhabitat preferences, and short generation times of schizomids. These characteristics suggest that, following colonization events, schizomid populations may become restricted to small areas of suitable habitat and rapidly differentiate genetically from other populations separated by just a few kilometers (Clouse *et al.* 2017). Given their low vagility and short generation times, localized schizomid populations could rapidly diverge by drift or selection, speciating regardless of whether environmental pressures differ from one location to the next.

Although the distinctive morphology of *Jipai* gen. nov. sets it apart from all other known Neotropical genera, suggesting it could represent a relictual lineage, the new genus appears to be most closely related to the Mexican genus, *Mayazomus*. A phylogenetic relationship between these genera is plausible, considering what is known about the origins and dispersal patterns of schizomids in the Americas (Clouse *et al.* 2017; Monjaraz-Ruedas *et al.* 2020), but this hypothesis awaits further testing.

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