

# Systematic revision and phylogeny of the South American sun-spider genus *Gaucha* Mello-Leitão (Solifugae: Mummuciidae), with description of four new species and two new generic synonymies

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## Abstract

The South American sun-spider genus *Gaucha* Mello-Leitão, 1924 is herein studied from a combined approach of cladistics and traditional taxonomy. This is the first cladistic analysis for a group of mummuciid solifuges, and it is pioneer in integrating traditional morphological characters with landmark data for inferring the phylogeny of any group of Solifugae. As a result, *Gaucha* is redefined and its monophyly demonstrated. *Gaucha fasciata* Mello-Leitão, 1924, type species of this formerly monotypic genus, is redescribed based on specimens from the type locality, in Rio Grande do Sul, Brazil. Three new species are described from Brazil: *Gaucha avexada* **sp.nov.** from Bahia and Tocantins, *Gaucha curupi* **sp.nov.** from Rio Grande do Sul, and *Gaucha eremolembra* **sp.nov.** from Minas Gerais. A fourth new species, *Gaucha casuhati* **sp.nov.**, is described from Buenos Aires province, Argentina. In addition, *Metacleobis* Roewer, 1934 and *Gauchella* Mello-Leitão, 1937 are synonymized with *Gaucha*, following the examination of the type specimens and based upon evidence from the cladistic analysis. *Gaucha fulvipes* (Roewer, 1934) **comb.nov.**, from Mato Grosso (Brazil), is therefore proposed, whereas *Gaucha stoeckeli* Roewer, 1934 **comb.rest.**, from Luribay (Bolivia), is restored into its original name combination. *Gaucha ibirapemussu* (Carvalho et al., 2010) **comb.nov.** and *Gaucha mauryi* (Rocha, 2001) **comb.nov.**, from the Brazilian states of Piauí and Bahia, are also transferred, from *Mummucia* Simon, 1879. *Gaucha* is here defined, among other characters, by the large size of the cheliceral movable finger MP tooth as compared to MM tooth, and by the presence of a pronounced gnathal edge carina on the movable finger mucron of males. Two species-groups are herein defined within the genus: the *fasciata* group, for *G. casuhati* **sp.nov.**, *G. curupi* **sp.nov.**, *G. fasciata*, *G. fulvipes* **comb.nov.** and *G. stoeckeli* **comb.rest.**, and the *ibirapemussu* group, for *G. avexada* **sp.nov.**, *G. eremolembra* **sp.nov.**, *G. ibirapemussu* **comb.nov.** and *G. mauryi* **comb.nov.** A key to the identification of *Gaucha* species is included.

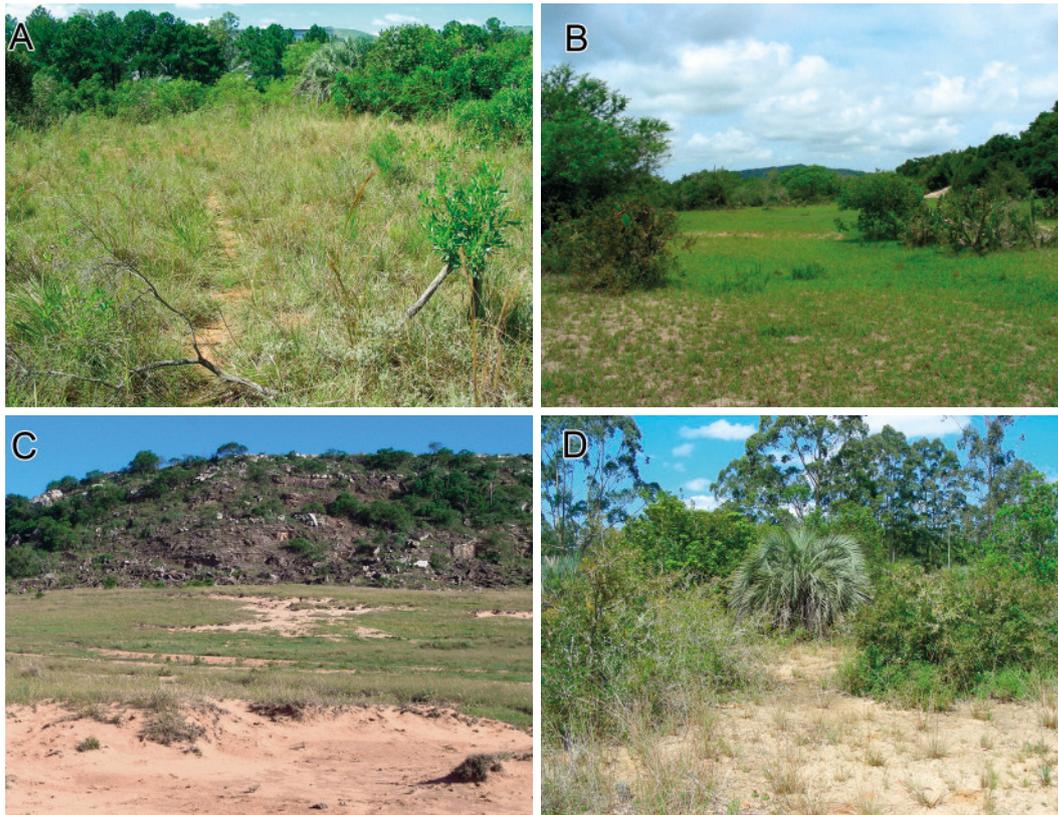
## Key words

Argentina, Bolivia, Brazil, morphometrics, Neotropics, solifuges, systematics, taxonomy, Uruguay.

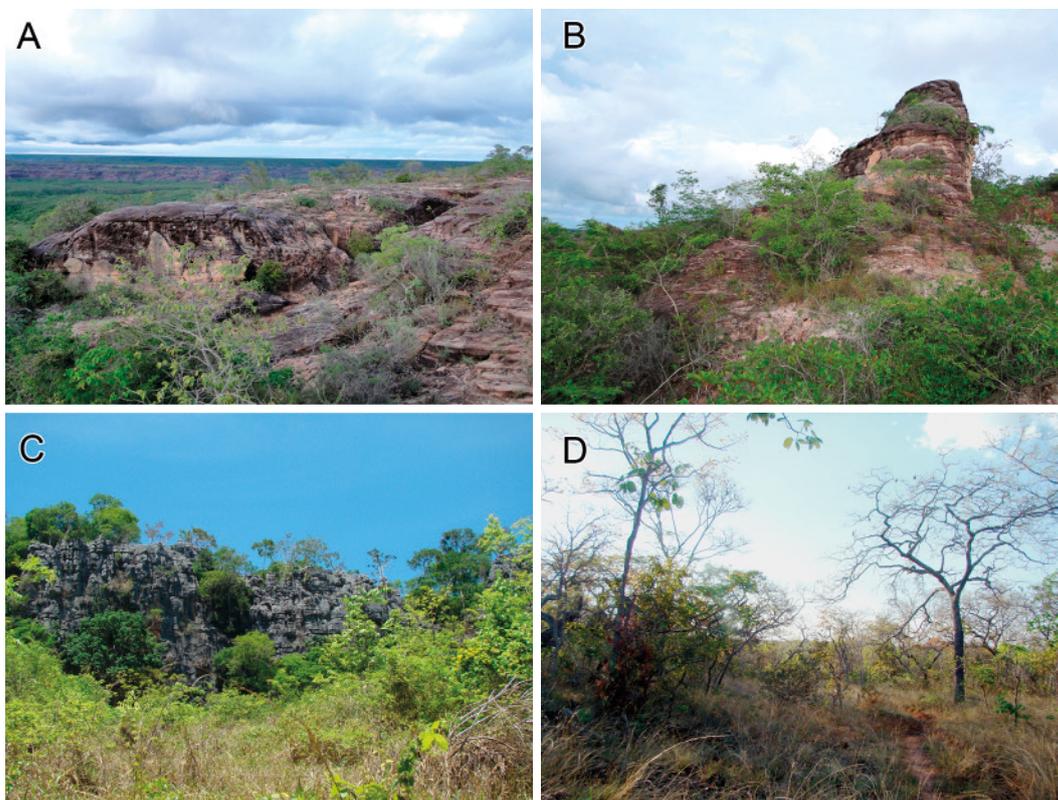
## 1. Introduction

With nearly 1200 extant species and 140 genera comprised in 12 families, Solifugae is one of the meso-diverse arachnid orders (HARVEY 2002, 2003; PRENDINI

2011; BIRD et al. 2015; BIRD & WHARTON 2015; BOTERO-TRUJILLO 2016). They are distributed in the Old and New World, primarily in semi- to hyperarid ecosystems (Figs.



**Fig. 1.** Habitat of some *Gaucha* Mello-Leitão, 1924 species in Rio Grande do Sul, Brazil. **A:** Jardim Botânico de Porto Alegre, habitat of *Gaucha fasciata* Mello-Leitão, 1924. **B:** Reserva Biológica do Lami, habitat of *G. fasciata*. **C:** São Francisco de Assis, habitat of *Gaucha curupi* sp.nov. **D:** Viamão, habitat of *Gaucha* sp.



**Fig. 2.** Habitat of some *Gaucha* Mello-Leitão, 1924 species in Brazil. **A,B:** Parque Nacional Serra das Confusões (Piauí), habitat of *Gaucha ibirapemussu* (Carvalho et al., 2010) **comb.nov.** **C,D:** Parque Nacional Cavernas do Peruaçu (Minas Gerais), habitat of *Gaucha eremolembra* sp.nov.



**Fig. 3.** Live specimens of *Gaucha* Mello-Leitão, 1924. **A:** Female of *Gaucha curupi* **sp.nov.** from São Francisco de Assis. **B:** Female of *Gaucha fasciata* Mello-Leitão, 1924 from Porto Alegre. **C:** Male of *Gaucha* sp. from Santana do Livramento. **D:** Female of *Gaucha* sp. from Santana do Livramento. **E,F:** Egg-laying female of *Gaucha* sp. from Santana do Livramento under laboratory conditions.

1, 2), and are absent from Madagascar and Australia (PUNZO 1998; HARVEY 2003; CODDINGTON et al. 2004). Solifuges are active predators and most species exhibit nocturnal habits, although some are diurnal on account of which they are known as ‘sun spiders’ (CLOUDSLEY-THOMPSON 1977; PUNZO 1998).

Mummuciidae Roewer, 1934 is one of the four solifuge families occurring in the New World, and the only one in the region whose members exhibit diurnal habits (MAURY 1984). The other families in the New World are Eremobatidae Kraepelin, 1901, Ammotrechidae Roewer, 1934 and Daesiidae Kraepelin, 1899. Among these, only the latter is not restricted to the Americas but is also found in the Old World (HARVEY 2003; BIRD et al. 2015). Thus

far, Mummuciidae comprises 19 known species placed in nine genera, i.e., *Mummucia* Simon, 1879 and *Mummucina* Roewer, 1934, respectively with seven and five species, and the monotypic *Gaucha* Mello-Leitão, 1924, *Gauchella* Mello-Leitão, 1937, *Metacleobis* Roewer, 1934, *Mummucipes* Roewer, 1934, *Cordobulgida* Mello-Leitão, 1938, *Uspallata* Mello-Leitão, 1938 and *Vemprioniella* Botero-Trujillo, 2016.

Contributions focussed on mummuciid solifuges are very sparse. All have dealt with taxonomic or distributional aspects and conducted by no more than a handful of solifuge workers (e.g., C.F. Roewer, C. de Mello-Leitão, E.A. Maury). Among those, ROEWER’S (1934) contribution is remarkable, since many mummuciid species were

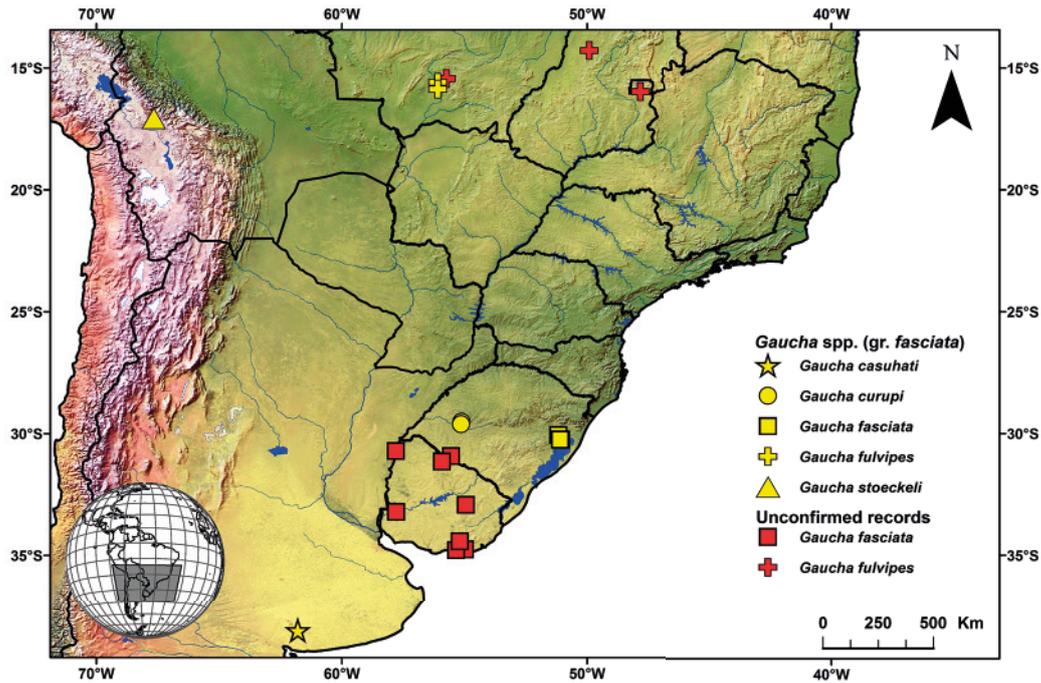


Fig. 4. Confirmed (yellow) and unconfirmed (red) records of species belonging to the *fasciata* species-group of *Gaucha*.

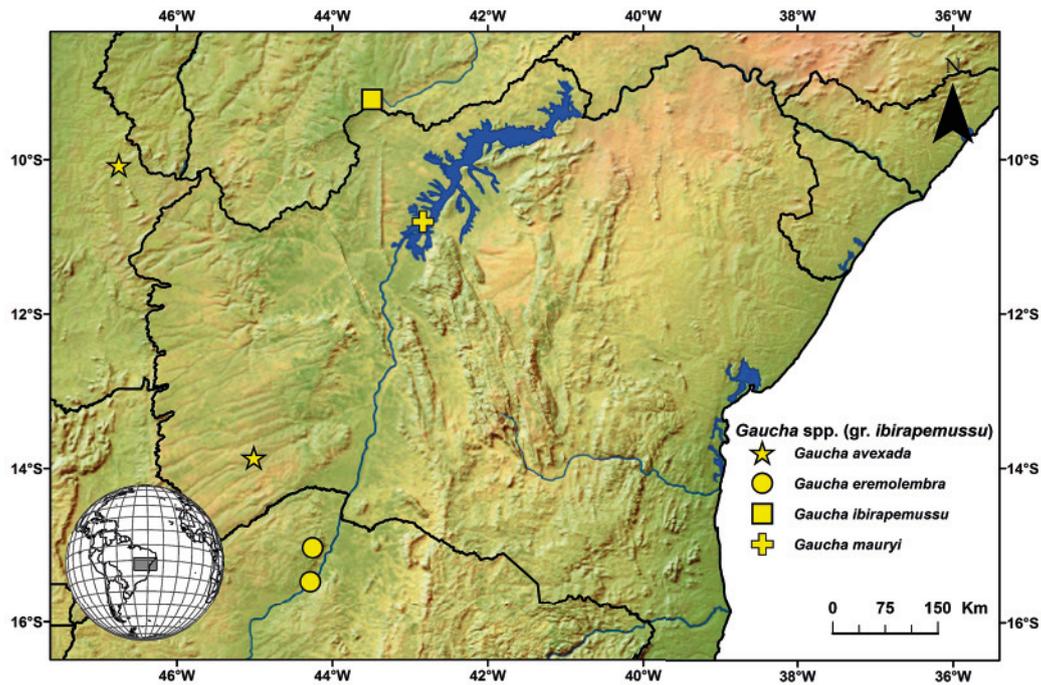
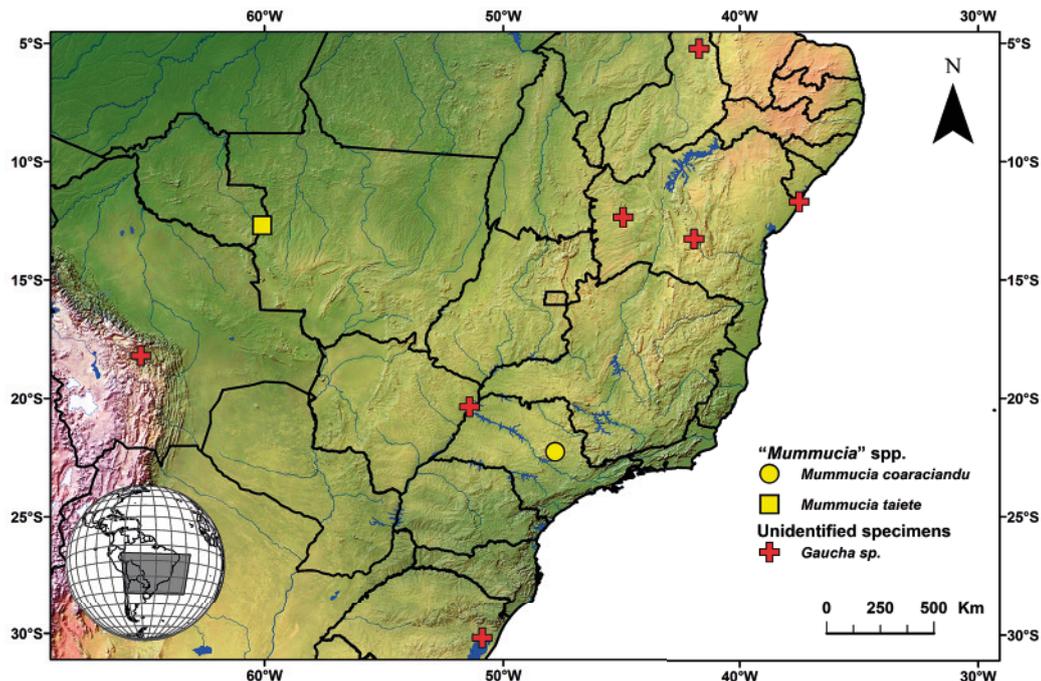


Fig. 5. Confirmed records of species belonging to the *ibirapemussu* species-group of *Gaucha*.

therein described, and the character system used there became the basis for the taxonomy and current classification of the family. ROEWER'S (1934) character system was strongly based on the number of spiniform setae on legs and the number of teeth present on the chelicerae. In last decades, various authors have argued problems with those characters and, consequently, with the internal classification of Mummuciidae upon those based (MAURY

1998; XAVIER & ROCHA 2001; ROCHA & CANCELLO 2002a; MARTINS et al. 2004; ROCHA & CARVALHO 2006; CARVALHO et al. 2010; BOTERO-TRUJILLO 2014).

In the present contribution, we share the results of a cladistic analysis conducted with selected species of Mummuciidae, which allowed us to redefine *Gaucha* (Fig. 3). We revisit the morphology of *Gaucha fasciata* Mello-Leitão, 1924 (Fig. 3B) and redescribe the species



**Fig. 6.** Records of unidentified species of *Gaucha* (red) and other mummuciid solifuges from Brazil not assignable to this genus (yellow, thus far conservatively placed in *Mummucia*).

using specimens from the type locality. Four new species are described: *Gaucha avexada* **sp.nov.**, *G. curupi* **sp.nov.** (Fig. 3A) and *G. eremolembra* **sp.nov.**, from Brazil, and *G. casuhati* **sp.nov.**, from Argentina. Based on evidence here obtained, *Metacleobis* and *Gauchella* are considered subjective junior synonyms of *Gaucha*; therefore, *Gaucha fulvipes* (Roewer, 1934) **comb.nov.** and *Gaucha stoeckeli* Roewer, 1934 **comb.rest.** are proposed. In addition, *Gaucha ibirapemussu* (Carvalho et al., 2010) **comb.nov.** and *Gaucha mauryi* (Rocha, 2001) **comb.nov.** are here transferred from *Mummucia* Simon, 1879. Species of *Gaucha* are assigned to either the *fasciata* or *ibirapemussu* species-groups, herein defined.

The geographic distribution of the species treated herein and of the specimens not assigned to species is shown in Figs. 4 (*fasciata* species-group of *Gaucha*), 5 (*ibirapemussu* species-group of *Gaucha*), and 6 (unidentified species of *Gaucha* and other mummuciid solifuges from Brazil not assignable to this genus).

## 2. Taxonomic scenery

MELLO-LEITÃO (1924) erected the genus *Gaucha* for *Gaucha fasciata* Mello-Leitão, 1924, described from a male holotype and an unspecified number of paratypes (as ‘cotypes’) from Porto Alegre, Brazil. MELLO-LEITÃO’S (1924) description gave some relevant information about the morphology of this species; however, the accompa-

nying images, particularly the illustration of the chelicera (MELLO-LEITÃO 1924: fig. 24a), were uninformative.

ROEWER (1934) recognized *Gaucha* as valid and assigned to it a second species, *Gaucha stoeckeli* Roewer, 1934. He considered that *Gaucha* was unique, among other genera of Mummuciinae (at the time a subfamily of Ammotrechidae), in the number of ventral spiniform setae on telotarsus (‘tarsi’) of leg IV. Such was reported as “2.2.2/2.2.4” (ROEWER 1934: 583, 587), standing for three pairs on the basal pseudosegment of first tarsomere, two pairs on the distal pseudosegment, and an apical row of four spiniform setae on which is nowadays known to be a separate (second) tarsomere (MAURY 1982, 1984). *Gaucha* was also characterized there by having two ‘frontal’ teeth on the cheliceral fixed finger, herein deemed to correspond to the FM and FD teeth (according to BIRD et al.’s 2015 terminology).

MELLO-LEITÃO (1924) did not provide a count of spiniform setae for the telotarsi of leg IV of *G. fasciata*. ROEWER’S (1934: 587) reference to *G. fasciata* followed the text “*Nach Autor*” (‘By Author’), suggesting that he had not studied any specimen of that species. Therefore, the setal count reported by ROEWER (1934) for *Gaucha* was likely based on his observations on *G. stoeckeli* only.

ROEWER’S (1934) setal and tarsomere accounts was shortly afterwards revised by MELLO-LEITÃO (1937). This author reported that the count of spiniform setae on the telotarsus (‘tarsi’) of leg IV of *G. fasciata* was 2.2.2 on the basal segment (pseudosegment) and 2.4 on the distal segment (i.e., distal pseudosegment of first tarsomere plus second tarsomere), and thus different to that alleged by ROEWER (1934) to be diagnostic for *Gaucha*. Based on this, MELLO-LEITÃO (1937) erected the new genus

*Gauchella* for *G. stoeckeli*, without having examined the type material, and distinguished both genera merely on the basis of this difference. MELLO-LEITÃO (1937) also argued that the species *Mummuciella simoni* Roewer, 1934, described from a female specimen from the same locality of *G. fasciata*, corresponded to the same species. The monotypic genus *Mummuciella* had been considered a separate genus by ROEWER (1934) because of having the same spinal count on the telotarsus of leg IV that MELLO-LEITÃO (1937) subsequently reported for *G. fasciata*, as well as the same number of ‘frontal’ teeth on the cheliceral fixed finger. Therefore, MELLO-LEITÃO (1937) placed *Mummuciella* in synonymy with *Gaucha* and its type species in synonymy with *G. fasciata*.

MELLO-LEITÃO (1938) hypothesized the presence of *Gaucha* in Argentina. It was MAURY (1970) who first reported the genus for that country, based on specimens from Sierra de la Ventana, in Buenos Aires province. MAURY (1970) considered that those specimens were conspecific with *G. fasciata*, species that was subsequently reported by the same author for several localities of Uruguay (MAURY 1979). *Gaucha* has lasted as a monotypic genus, until now.

### 3. Material and methods

#### 3.1. Cladistic analysis

A cladistic analysis was carried out to: **(i)** facilitate a morphology-based delimitation of *Gaucha*; **(ii)** determine whether or not *Metacleobis* and *Gauchella* should be recognized as valid genera; **(iii)** determine the relationships that four species originally described within the type genus (as a conservative approach without taxonomic support) have to *Gaucha* and other selected mummuciid genera; **(iv)** evaluate the monophyly of *Gaucha* (as here defined); and, **(v)** study the interrelationships of the species of *Gaucha*.

The list of morphological characters used in the cladistic analysis is presented in the Appendix; the data matrix for all the terminal taxa, containing the distribution of discrete characters only, in Table 3; the complete data matrix (.tnt format), combining numerical and landmark data, is available in the Electronic Supplement file (S1A).

##### 3.1.1. Taxon sample

The analysis is based on 15 species of Mummuciidae as terminal taxa, belonging to seven genera. The ingroup taxon sample consisted of nine species: *Gaucha fasciata*, *Metacleobis fulvipes* and *Gauchella stoeckeli*, type species of three, thus far monotypic genera, all of which ex-

hibit similar morphologies; *Mummucia ibirapemussu* and *M. mauryi*, both thus far placed in *Mummucia* but which share some morphological aspects with *G. fasciata*; and four new species here described. The outgroup consisted of six species: *Mummucia variegata* (Gervais, 1849), type species of *Mummucia* wherein four species from Brazil, all included in this analysis, had been originally placed; *Vempironiella aguilar* Botero-Trujillo, 2016, species in a monotypic genus with unique morphological attributes; *Mummucina titschacki* Roewer, 1934, species of unknown systematic position whose morphology has been studied into detail; *Mummucipes paraguayensis* Roewer, 1934, species which shares some morphological aspects with members of the ingroup; *Mummucia coaraciandu* Pinto-da-Rocha & Rocha, 2004 and *M. taiete* Rocha & Carvalho, 2006, both of which have remained in *Mummucia* and of uncertain systematic position. The tree was rooted on *V. aguilar*, which BOTERO-TRUJILLO (2016) found to be more different to the type species of the other genera in the family than they were to one another.

##### 3.1.2. Character matrix

The character matrix combines standard (discrete) and landmark (shape configuration) data for a total of 22 characters. Discrete characters (chars. 0–19) were recorded in Mesquite, version 3.04 (MADDISON & MADDISON 2015; available at <http://www.mesquiteproject.org/>). Of these, 18 were coded into binary states and 2 into trinary states. The latter (chars. 10 and 17) were treated as ordered / additive considering that, for both characters, the condition defined by state 1 is a clear intermediate between the conditions defined by states 0 and 2.

Landmark data were obtained from two shape configurations of the male chelicerae (chars. 20 and 21), structures which are of paramount importance for solifuge systematics (e.g., BROOKHART & CUSHING 2004; BIRD et al. 2015). Coordinates were generated for five landmarks of each configuration. Landmarks were obtained from photographs of the male chelicerae in retrolateral aspect, generated as explained in section 3.3.

Three Type 1 (*LM1*, *LM3*, *LM4*) and two Type 2 (*LM2*, *LM5*) landmarks were used for Character 20; two Type 1 (*LM2*, *LM3*), two Type 2 (*LM1*, *LM4*), and one Type 3 (*LM5*) landmarks were used for Character 21 (Appendix). One chelicera of each species was used for the landmark-based component of the cladistic analysis. In the methodological grounds, not all the chelicerae in the samples examined were suitable for photographing, e.g., some are entirely or partially closed, whereas dissection of additional chelicerae was not desired: dissection and manipulation of the chelicerae often causes damage to integumentary structures (e.g., setae of the prosoma and the chelicerae) or to cheliceral teeth, and facilitates the subsequent deterioration of the specimen. Bottom line, species identifications are primarily possible thanks to the highly conserved, species-specific morphology of the

male chelicerae, and not any intraspecific variability was evident to us with regard to the two shape configurations herein studied.

For landmark data, tpsUtil, version 1.69 and tpsDig, version 2.26 (ROHLF 2015; available at <http://life.bio.sunysb.edu/morph/>) were used to create the initial .tps file listing and digitalize the landmarks, respectively. To eliminate the effect of translation, rotation and scaling, the configurations were aligned in MorphoJ, version 1.06d (KLINGENBERG 2011; available at [http://www.flywings.org.uk/MorphoJ\\_page.htm](http://www.flywings.org.uk/MorphoJ_page.htm)), from raw coordinates, using the Procrustes method against a specified reference taxon. This is the first time that shape configurations from landmark data of any body region are used to investigate the phylogeny of a group of solifuges.

CARVALHO et al. (2010) studied the geometry of the propeltidium of males of *M. ibirapemussu* as compared to that of *M. fulvipes*, and found it to be informative for species recognition. Even though we agree that the propeltidium might assist taxonomic efforts, we did not observe any obvious differences in the shape of the propeltidium of the species here studied, as we did find in the shape of the chelicerae. For this reason, we did not study the propeltidium from a geometric morphometrics perspective; however, we present photographs and provide linear measurements of the propeltidium of males and females (when available) of the different species dealt with in section 5.1.

### 3.1.3. Analysis

Parsimony analyses were conducted with TNT, version 1.5-beta (GOLOBOFF et al. 2008; GOLOBOFF & CATALANO 2016; program and documentation, available from the authors, at <http://www.lillo.org.ar/phylogeny/tnt/>). An initial exhaustive search (implicit enumeration) was performed for the discrete-only character data set (landmark data excluded). The combined discrete-landmark data matrix underwent heuristic (traditional) search method, implemented with the following parameters: system set to store up to 10000 trees in memory, 100 random-addition sequences (Wagner trees), followed by tree bisection reconnection (TBR) branch-swapping algorithm saving up to 10 trees per replication. Different combinations of new technology search strategies were also implemented, which reproduced the results of the traditional searches. To evaluate the sensitivity of the results to analytical regimes, the combined matrix was also analysed under four implied weighting regimes (concavity  $k = 10, 40, 70, 100$ ), using the same search parameters described above.

Given the small number of landmark-based configurations, absolute Bremer supports, standard Bootstrapping and Jackknifing (36% removal probability) were performed with the default TNT option for resampling and support, i.e., “assessing support considering individual landmarks instead of whole configurations,” to meaningfully evaluate conflict between individual landmarks.

## 3.2. Terminologies and descriptions

Terminology used for referring to cheliceral teeth and other cheliceral structures follows BIRD et al. (2015), except for the term *fixed finger retrofondal diastema* (FRFD) first used by BOTERO-TRUJILLO (2016). Likewise, the term *fixed finger median apical diastema* (FMAD) is here introduced to refer to a distinct notch present between the FSD and FD teeth of males of *Mummucia variegata*. Identification of individual teeth used BIRD et al.’s (2015: 83) criteria for primary homology assessment of dentition. Leg segmentation terminology follows SHULTZ (1989). In line with BIRD & WHARTON (2015) and BOTERO-TRUJILLO (2016), we use the terms basi- and telotarsus for the pedipalp segments traditionally referred to as metatarsus and tarsus. The term ‘spiniiform setae’ (equivalent to spine-like setae) refers to rigid, socketed macrosetae and is preferred over ‘spines’ (broadly used before by various authors), following recent works on solifuges (BOTERO-TRUJILLO 2014, 2016; BIRD & WHARTON 2015; BOTERO-TRUJILLO & IURI 2015; DUNLOP et al. 2015). The formula used to describe the pattern of spiniiform setae on telotarsi of legs follows IURI et al. (2014), where a dash (-) stands for incomplete segmentation and a slash (/) for complete segmentation. Pedipalp setae terminology follows CUSHING & CASTO (2012). In line with BOTERO-TRUJILLO (2016), the term ‘ctenidia’ is herein used only for the long, single-tipped (non-bifid) and flexible setiform structures that, in *Gaucha*, are present on 1<sup>st</sup> to 5<sup>th</sup> post-genital sternites. Likewise, the rigid hairs along posterior margin of post-spiracular sternite II (4<sup>th</sup> post-genital sternite) are not considered to be ctenidia and are therefore referred to as a ‘row of rigid hairs’.

The ‘comparisons’ provided in section 5.1. refer only to characters considered in the revised differential diagnosis of *Gaucha*. Its purpose is to readily allow distinguishing *Gaucha* from the other genera in the family. The features listed there do not represent a thorough distinction between the other six genera and that section does not represent any formal attempt to redefine them. Additional features relevant to other genera will be treated in forthcoming contributions, but the information herein presented may facilitate making decisions of placing species into one genus or another. Only the type species of the different genera were used for building the ‘comparisons’ section.

In section 5.1., a single description is provided for the genus which is common to all the species. The description applies to males and females unless otherwise specified in the text when gender names are written in capital letters. The species descriptions refer to aspects of their morphology which we deemed important to treat separately. The ‘variation’ section part of the species descriptions deals with observations on the presence/absence of the cheliceral fixed finger FSD tooth; other variability, if any, is mentioned in the ‘notes’ section of each species.

### 3.3. Examination and pictorial documentation

Specimens were examined with Leica M165 C and Leica S8AP0 stereomicroscopes. Photographs of preserved specimens were taken with a Leica DFC 290 digital camera mounted on the Leica M165 C stereomicroscope and the extended focal range images composed with Helicon Focus 6.2.2 Pro software (available at <http://www.heliconsoft.com/heliconsoft-products/helicon-focus/>). To allow visualization of the dentition and facilitate photographing, some chelicerae were manipulated following the procedure outlined by BOTERO-TRUJILLO (2016). To make sure that the chelicerae of the different species were all in the same position for photographing in retrolateral aspect, these were positioned in a way such that three reference points were all in focus at the same time: apex of the fixed finger mucron (FT tooth), apex of the movable finger mucron (MT tooth), and fixed finger RFA tooth. This was especially important to ensure that the shape configurations used in the cladistic analysis, captured from landmarks placed in the photographs, reflect the specimen's morphology as accurately as possible. Photographs in prolateral aspect were obtained with the chelicerae positioned in a way such that the surface of the stridulatory apparatus, and that of the flagellum (in the case of male), were horizontal, and three reference points were all in focus at the same time (to the best extent possible): apex of the fixed finger mucron (FT tooth), apex of the movable finger mucron (MT tooth), and prolateral interdigital condyle (*pic*). Photographs of the chelicerae were obtained prior to dehydration for scanning electron microscopy (SEM). For SEM preparations of the chelicerae, pieces were dissected, cleaned with a fine-bristle paintbrush, dehydrated via 80% – 87% – 96% – 100% ethanol series, fixed to aluminum stubs, and gold-palladium coated in a VG Scientific SC 7620 mini sputter-coater. SEM micrographs of the chelicerae were taken under high vacuum with a Philips FEI XL30 TMP, except those of *G. ibirapemussu* **comb.nov.** which were obtained with a Zeiss LEO (1450 VP); micrographs of other body regions were obtained with a Jeol-JSM-5200 with attached Pentax SLR digital camera.

Illustrations of the chelicerae were prepared with CorelDRAW 12 by superimposing vectors on previously obtained micrographs. Images were edited with Adobe Photoshop CS3 (10.0). Metric data, in millimeters, were obtained using an ocular micrometer fitted to a Leitz Wetzlar stereomicroscope. The distribution maps were produced using ArcGIS 10.3 (ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE – ESRI 2014, Redlands, California).

### 3.4. Abbreviations

**Collections.** Specimens used in the present work belong to the following collections: **CHNUFPI** – Coleção

de História Natural, Universidade Federal do Piauí, Floriano, Brazil; **FCEyN-UBA** – Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Argentina; **MACN** – Museo Argentino de Ciencias Naturales “Bernardino Rivadavia”, Buenos Aires, Argentina; **MCN** – Museu de Ciências Naturais, Fundação Zoológica do Rio Grande do Sul, Porto Alegre, Brazil; **MCTP-PUCRS** – Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil; **MNRJ** – Museu Nacional do Rio de Janeiro, Rio de Janeiro, Brazil; **MPEG** – Museu Paraense Emílio Goeldi, Belém, Brazil; **MZUFBA** – Museu de Zoologia, Universidade Federal da Bahia, Salvador, Brazil; **MZUSP** – Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil; **SMF** – Senckenberg Forschungsinstitut und Natur-Museum, Frankfurt, Germany; **UFMG** – Coleções Taxonômicas da Universidade Federal de Minas Gerais, Belo Horizonte, Brazil.

### 3.5. Material examined

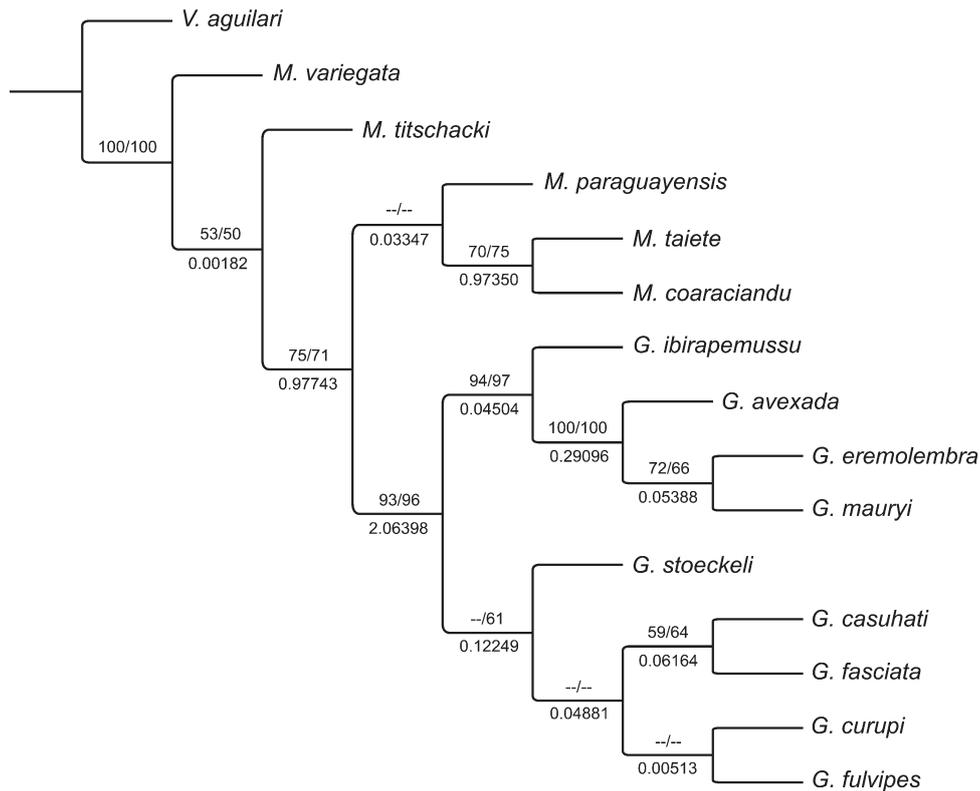
All specimens are preserved in 80% ethanol unless otherwise specified. Apart from specimens of the species herein studied in section 5.1. and all the material listed by BOTERO-TRUJILLO (2016) belonging to other genera, the following specimens were examined for comparative purposes and inclusion into the cladistic analysis.

***Mummucia coaraciandu* Pinto-da-Rocha & Rocha, in Martins et al., 2004: BRAZIL: São Paulo:** Itirapina, 21 males, 2 females (MZUSP 20951, labelled as ‘paratypes’ in the accompanying label), 1 male (MZUSP 20949, labelled as ‘paratype’ in the accompanying label), 1 female (MZUSP 20950, labelled as ‘paratype’ in the accompanying label); São Paulo, Itirapina, Estação Ecológica de Itirapina, 22°15'13"S 47°49'22.80"W, G. Machado, ix.2002, 1 female (UFMG 5899).

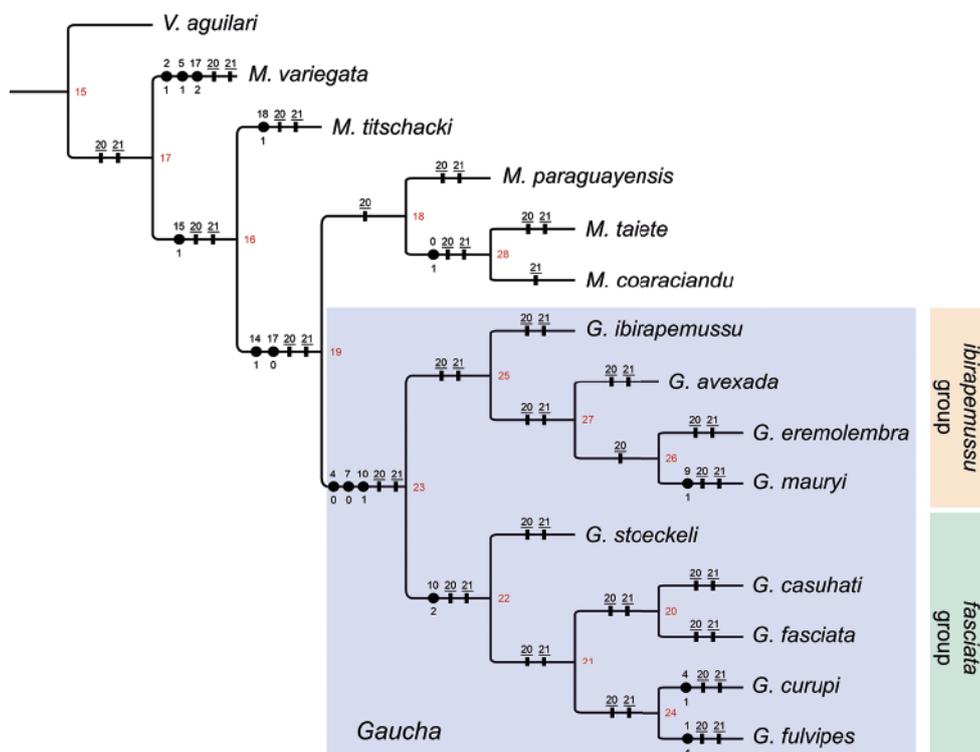
***Mummucia taiete* Rocha & Carvalho, 2006: BRAZIL: Rondônia:** Vilhena, 1999, M. Carvalho, 8 males, 2 females (MZUSP 21440); Rondônia, Vilhena, 19.viii-30.ix.1999, L. Rocha, 1 male, 2 juveniles (MCN-Sol-011).

## 4. Phylogenetic results

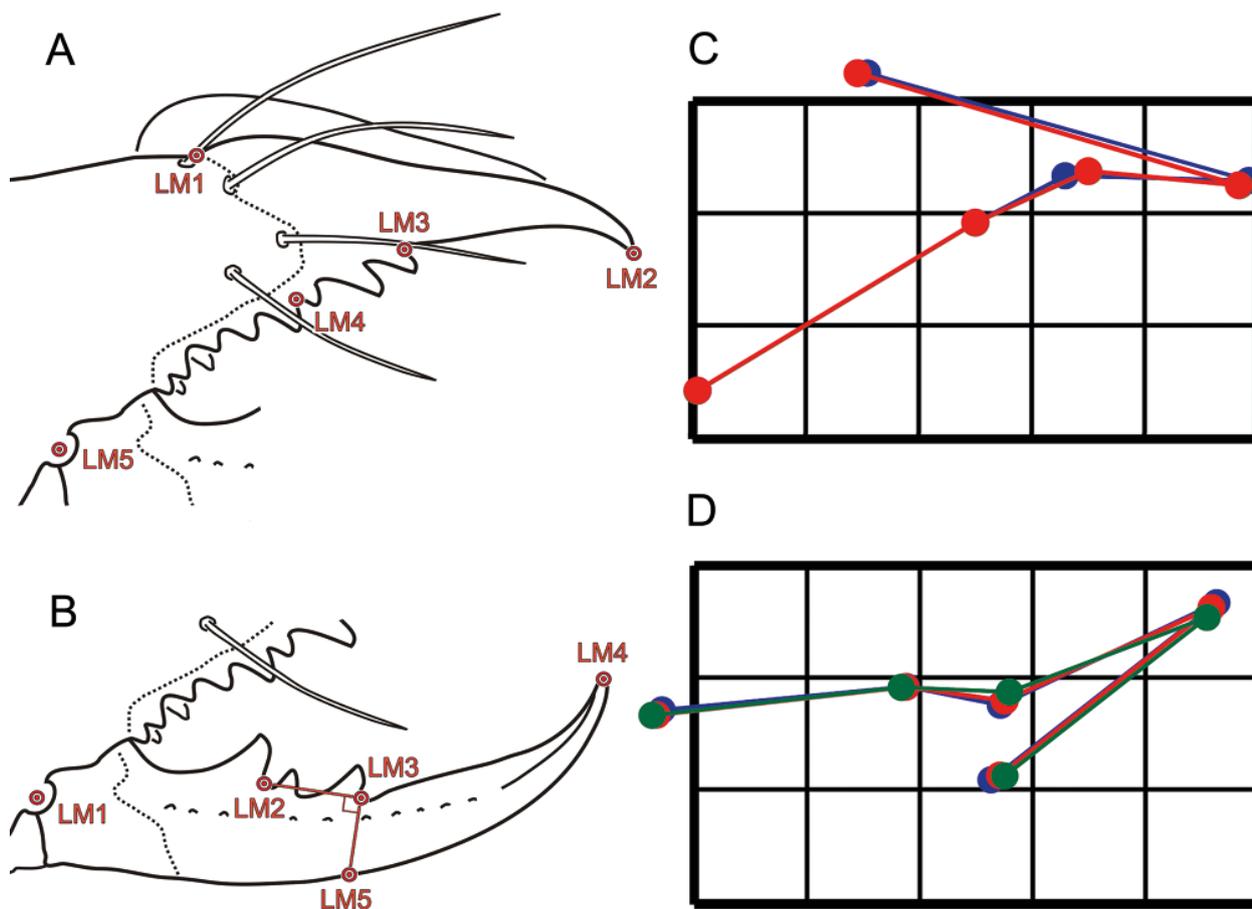
The analysis performed for the discrete characters found 28 most parsimonious trees (score = 24). The strict consensus recovered a monophyletic group formed by *G. fasciata*, *M. fulvipes*, *G. stoeckeli*, *M. ibirapemussu*, *M. mauryi*, and the four new species of *Gaucha*. There was no internal resolution in the strict consensus for any couple of terminals within this clade, which appeared as sister group to either *M. paraguayensis* or a clade formed by *M. coaraciandu* + *M. taiete*. The relationships of this 12-species group to *M. variegata* and *M. titschacki* were not resolved either.



**Fig. 7.** Single most parsimonious tree (score = 29.27195) obtained by the analysis of 22 morphological characters for 15 species of Mum-muciidae, under equal weighting and four implied weighting regimes ( $k = 10, 40, 70, 100$ ). Numbers in branches indicate measures of support obtained with equal weights. Above branches are standard Bootstrapping (left) and Jackknifing (right; 36% removal probability) percentages (50% or greater); below branches are absolute Bremer supports.



**Fig. 8.** Single most parsimonious tree (score = 29.27195) obtained by the analysis of 22 morphological characters for 15 species of Mum-muciidae, under equal weighting and four implied weighting regimes ( $k = 10, 40, 70, 100$ ). Unambiguous character optimization shown for every branch. Filled hashmarks (for discrete characters only) represent non-homoplasious transformations, with characters on top and states below. Underlined characters represent transformations on shape configurations. Numbers (in red) next to internal nodes identify the HTUs. Refer to S1B–S1D in Electronic Supplement file for detailed information on individual landmarks moving in the tree.



**Fig. 9.** Distribution of landmarks. **A:** Schematic representation of the cheliceral morphology (retrolateral aspect) of a male *Gaucha* Mello-Leitão, 1924, showing the position of individual landmarks selected for capturing the shape configuration of the fixed finger (char. 20) used in the cladistic analysis. **B:** Ibid. for movable finger (char. 21). **C:** Landmark boxes showing the reconstruction of the shape configuration of the fixed finger in the ancestors of *Gaucha* (HTU 23, in red), the *ibirapemussu* species-group (HTU 25, in blue), and the *fasciata* species-group (HTU 22, in green); note that the green and red configurations are very similar and overlap almost completely. **D:** Ibid. for movable finger. Refer to S1B–S1D in Electronic Supplement file for landmark boxes of all the terminal taxa and internal nodes.

Analysis of the combined discrete-landmark data matrix under equal weighting produced one most parsimonious tree (score = 29.27195) (Figs. 7, 8). Each of the four implied weighting regimes used ( $k = 10, 40, 70, 100$ ) also yielded a single tree, with the exact same topology as that obtained under equal weights. This demonstrates that weighting against homoplasious characters had no effect on the phylogenetic hypothesis. This topology is one of 96120, fully-resolved optimal solutions (24 steps) obtained by exhaustive search of the discrete-only character matrix without collapsing rules.

As shown in the tree (Figs. 7, 8) all the species of the ingroup formed a monophyletic group, with high support values. Synapomorphies for the group are: movable finger MP distinctly taller than MM, fixed finger FSD tooth absent, movable finger of male gnathal edge carina moderately convex, and shape configuration transformations on fixed and movable fingers of male. Two clades are identified within this group. One of them includes *G. fasciata*, *M. fulvipes*, *G. stoeckeli*, *G. curupi* **sp.nov.** and *G. casuhati* **sp.nov.** This whole group is supported by the gnathal edge carina on the movable finger mucron of

male markedly convex, and by the shape configuration of both fingers. The internal structure of the group was built from the landmark data, the three internal nodes being supported by changes of both configurations. The other clade is formed by *G. eremolembra* **sp.nov.**, *G. avexada* **sp.nov.**, *M. ibirapemussu* and *M. mauryi*. This whole group is supported by transformations in shape configurations; its internal structure is also built upon landmark data only. The distribution of landmarks and reconstruction of the shape configurations of the fixed and movable fingers of male in the ancestors of *Gaucha*, the *fasciata* species-group and the *ibirapemussu* species-group, are shown in Fig. 9.

Based on this analysis, *Gauchella* and *Metacleobis* require to be synonymized with *Gaucha* (as further addressed in section 5.1.), such that clear limits can be established for this genus. In other words, continuing recognizing *Metacleobis* and *Gauchella* as valid would cause that it be not possible to recognize all the three genera based on discrete apomorphic features. The analysis revealed that the placement of *M. ibirapemussu* and *M. mauryi* in *Mummucia* is not justified. Instead, both species belong

into the *Gaucha* clade and are therefore here transferred to this genus (sections 5.1.2.3. and 5.1.2.4.) We propose that the *fasciata* and *ibirapemussu* species-groups, as defined in sections 5.1.1. and 5.1.2., be recognized for the two clades of *Gaucha* (Fig. 8).

Furthermore, the analysis demonstrated that *M. coaraciandu* and *M. taiete* do not belong into either *Gaucha* (as the other species from Brazil) or *Mummucia* (where they are currently placed). The tree topology indicates that these two species constitute a monophyletic group most closely related to *M. paraguayensis*, as inferred from the shape configuration of the fixed finger only. For the moment, we abstain from making taxonomic decisions on this respect, pending more detailed study of *Mummucia* or *Mummucipes*.

## 5. Taxonomy

### Family Mummuciidae Roewer, 1934

#### 5.1. Genus *Gaucha* Mello-Leitão, 1924

*Gaucha* Mello-Leitão, 1924: 140–141 (as *Gaucha* [sic]). **Type species:** *Gaucha fasciata* Mello-Leitão, 1924 (by original designation).

*Gaucha*: ROEWER 1932: 51; ROEWER 1934: 582, 583, 587, fig. 331b,g; MELLO-LEITÃO 1937: 83, 84; MELLO-LEITÃO 1938: 17, 18; ROEWER 1941: 180–181; ZILCH 1946: 150; MUMA 1971: 8, 10; MUMA 1976: 24; MAURY 1998: 568; HARVEY 2003: 289; GONZÁLEZ-REYES & CORRONCA 2013: 538; BOTERO-TRUJILLO 2014: 319; BIRD et al. 2015: 26; BOTERO-TRUJILLO 2016: 218.

*Mummuciella* Roewer, 1934: 583, 587 (synonymized by MELLO-LEITÃO 1937: 84). **Type species:** *Mummuciella simoni* Roewer, 1934.

*Mummucina* [lapsus calami]: MELLO-LEITÃO 1937: 84 [line 7, used by error referring to *Mummuciella*].

*Metacleobis* Roewer, 1934: 589 (**new synonymy**). **Type species:** *Metacleobis fulvipes* Roewer, 1934.

*Gauchella* Mello-Leitão, 1937: 84 (**new synonymy**). **Type species:** *Gaucha stoeckeli* Roewer, 1934.

**Species composition:** *Gaucha avexada* **sp.nov.**; *Gaucha casuhati* **sp.nov.**; *Gaucha curupi* **sp.nov.**; *Gaucha eremolembra* **sp.nov.**; *Gaucha fasciata* Mello-Leitão, 1924; *Gaucha fulvipes* (Roewer, 1934) **comb.nov.**; *Gaucha ibirapemussu* (Carvalho et al., 2010) **comb.nov.**; *Gaucha mauryi* (Rocha, 2001) **comb.nov.**; *Gaucha stoeckeli* Roewer, 1934 **comb.rest.**

**Distribution.** Argentina (Buenos Aires province), Bolivia (Cochabamba and La Paz departments), Brazil (states of Bahia, Distrito Federal, Goiás, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Piauí, Rio Grande do Sul, Tocantins), Uruguay (Lavalleja, Río Negro, Rivera) (Figs. 4–6).

**Revised differential diagnosis.** Members of Mummuciidae because of having a three-dark-band pattern on opisthosomal dorsal surface, a row of rigid hairs along posterior margin of post-spiracular sternite II (4<sup>th</sup> post-genital sternite), lacking spiniform setae on pedipalps, and the male flagellum being of the composite type, retrolaterally compressed with ipsilateral opening, and immovably attached to the cheliceral fixed finger (MAURY 1984; BIRD et al. 2015; BOTERO-TRUJILLO & IURI 2015). Species of this genus form a monophyletic group (Figs. 7, 8) characterized by the following combination of features not present in any other genus: **(i)** Cheliceral movable finger MP tooth noticeably large, taller than MM tooth (mostly evident in males). **(ii)** Cheliceral movable finger mucron of males with gnathal edge carina prominent and convex on lateral aspect. **(iii)** Cheliceral fixed finger FSD tooth absent, otherwise present only in some specimens, often reduced to the size of a minute denticle in males. **(iv)** Cheliceral fixed finger of female curved on lateral aspect; angular dorsal crest absent, at most obsolete. **(v)** Males and females with ctenidia present: sparse on 1<sup>st</sup> and 2<sup>nd</sup> post-genital sternites (spiracular sternites I and II); more abundant on 3<sup>rd</sup> and 4<sup>th</sup> post-genital sternites (post-spiracular sternites I and II); and one or two ctenidia close to posterior margin of 5<sup>th</sup> post-genital sternite (post-spiracular sternite III). **(vi)** Ctenidia filiform, setiform and similar on the five sternites; distinguishable from integumental setae by being longer, single-tipped (non-bifid), and flexible. **(vii)** Sub-ventral whitish bands of the opisthosomal pleural membranes with scattered black marks surrounding the socket of some setae, instead of similar but white marks on the sub-dorsal blackish bands of the membrane.

**NOTE:** Juveniles (especially those with the complete set of malleoli) strongly resemble the morphology of adult females with respect to the features described above. Therefore the juveniles of *Gaucha*, like the adults, can be identified to family and generic levels.

**Comparisons.** The type species of all other genera currently recognized in the family differ substantially from *Gaucha*. In all of them (note that the male of *Uspallata pulchra* Mello-Leitão, 1938 remains unknown), the movable finger gnathal edge carina of males is ordinary, identified by a subtle elevation. Males and females of all have the MP and MM teeth similar in size, whereas the MM tooth was secondarily lost in *Vemprioniella aguilaris*. A distinct and pronounced angular dorsal crest on the cheliceral fixed finger of female is only present in *Mummucia variegata* and *U. pulchra*, whereas it is weak in *Mummucina titschacki*, and is absent in the other species. Ctenidia are present on 3<sup>rd</sup> and 4<sup>th</sup> post-genital sternites of all species. These are also present on 1<sup>st</sup> and 2<sup>nd</sup> post-genital sternites of males and females of *Mummucipes paraguayensis*, on 2<sup>nd</sup> post-genital sternite only in *M. titschacki*, at least on 2<sup>nd</sup> post-genital sternite in *Cordobulgida bruchi* Mello-Leitão, 1938 (a good assessment of the 1<sup>st</sup> has not been possible), and ctenidia are absent from both sternites in *M. variegata*, *U. pulchra* and *V. aguilaris*.

In males of *M. variegata* the ctenidia on 3<sup>rd</sup> post-genital sternite are markedly thick basally, distinctly more robust than those on 4<sup>th</sup> post-genital sternite, whereas the ctenidia are moderately thick on both 3<sup>rd</sup> and 4<sup>th</sup> post-genital sternites of *M. titschacki*, and these are filiform, similar on both sternites in *C. bruchi*, *M. paraguayensis* and *V. aguilari*. Black marks on the whitish bands of the opisthosomal pleural membranes, similar to those of *Gaucha*, are present in the type species of all other genera except for *M. titschacki* and *V. aguilari*, both of which have white marks on the blackish bands.

According to our observations and unlike *Gaucha*, the type species of all other genera have the fixed finger FSD tooth present, regardless of the sex or maturity of the specimen. In some species the FSD is reduced to the size of a small denticle in males (i.e., *Mummucia variegata*). Except for when there is reason to believe that a specimen has an anomalous dentition where this tooth is absent, the FSD series is invariably present in these species.

**Justification for the new synonymies.** ROEWER (1934) defined *Metacleobis* as solifuges with two frontal teeth on the cheliceral fixed finger (i.e., FD + FM), “1.1.2.2.4” (i.e., 1.1.2.2/2.2) ventral spiniform setae on telotarsi of legs II and III, and “2.2.2/2.4” (i.e., 2.2.2-2/2.2) on that of leg IV. According to ROEWER (1934), the spiniform setal count of *Gaucha* was “1.2.2.4” (i.e., 1.2.2/2.2) on telotarsi of legs II and III, and “2.2.2/2.2.4” (i.e., 2.2.2-2.2/2.2) on that of leg IV. *Gaucha* also had two ‘frontal’ teeth on the fixed finger, and therefore a distinction between the two genera could only be made on the basis of the telotarsal spiniform setae.

MELLO-LEITÃO (1937) reported that ROEWER (1934) was mistaken, and that the correct number of spiniform setae on the telotarsus of leg IV of *G. fasciata* was “2.2.2/2.4”, identical to that of *Metacleobis*.

The examination of the holotype of *M. fulvipes* allowed us to confirm that the formula of spiniform setae of *Metacleobis* reported by ROEWER (1934) was correct for leg IV of the specimen. However, that of legs II and left leg III was found to be 1.2.2/2.2. While this is the same formula reported for *Gaucha* by ROEWER (1934), and subsequently confirmed by MELLO-LEITÃO (1937) and by us in *G. fasciata*, the telotarsus of right leg III does indeed have one additional proventral spiniform seta, as reported by ROEWER (1934), but also another retroventral proximal spiniform seta, overlooked by him. Through the examination of several different specimens of *Gaucha*, we observed that telotarsi often bear one or two extra spiniform setae not present in the opposite leg (i.e., variation from left to right on a single individual). Considerable intraspecific variation in the number of telotarsal spiniform setae was also reported for *M. fulvipes* by ROCHA & CANCELLO (2002a) (see ‘remarks’ in section 5.1.1.4.) Based on this and considering the results of the cladistic analysis (section 4.), we propose the synonymy of *Metacleobis* with *Gaucha*.

ROEWER (1934) described *Gaucha stoeckeli* and placed it in *Gaucha* based on it reportedly having 1.2.2.4

(as “1.2.2/2.2”) ventral spiniform setae on the telotarsi of legs II and III, and 2.2.2/2.2.4 (as “2.2.2-2.2/2.2”) on that of leg IV; this is the same as the formulae presumed for *G. fasciata* at the time (see above). When clarifying the correct number of spiniform setae in *G. fasciata*, MELLO-LEITÃO (1937) erected *Gauchella* for *G. stoeckeli* on account of it presumably having such number of spiniform setae unique in the family (without having examined the type specimens).

Through examination of the type specimens of *G. stoeckeli*, we discovered that the correct number of telotarsal spiniform setae is 1.2.2/2.2 for legs II and III, and 2.2.2-2/2.2 for leg IV. Based on this and on the cladistic analysis, we propose the synonymy of *Gauchella* with *Gaucha*. *Gaucha stoeckeli* is therefore herein restored to its original name combination.

**Description. Prosoma:** Propeltidium wider than long; with short, medium and long bifurcated setae, of which at least the latter exhibit a bilaterally symmetrical distribution on propeltidium; anterior margin procurved, with ocular tubercle elevated; complete and shallow median longitudinal furrow present; anterolateral propeltidial lobes separated from the propeltidium principal shield by incomplete lateral groove. Meso- and metapeltidium wider than long, with bifurcated setae of variable size. Coxae densely covered with bifurcated setae; those of pedipalps and legs I–III with some longer bifurcated setae with bilateral symmetrical distribution, and one or two other long single-tipped setae. Sternum glabrous. **Chelicera, dentition and processes:** Fixed finger with median teeth series comprising all primary teeth, i.e., FP, FM, FD; with one (FSM) or two (FSM and FSD) secondary teeth; retrofondaal teeth series uninterrupted, with no more than five well-developed teeth among which RFA and RFP are larger; profondaal teeth series generally with three teeth (PFSP, PFP, PFM). Movable finger with median teeth series comprising two well-developed primary teeth, i.e., MM and moderately-to-markedly larger MP teeth, and one secondary MSM tooth, which is medium-sized and upright, such that MP > MM > MSM (except in male of *G. mauryi* **comb.nov.** where MP > MSM > MM); all teeth close together in median region of the finger. Movable finger without subproximal (MSP) or subterminal (MST) teeth; retrolateral carina consisting of one, at much two, rows of granules. Closure of FP and FM teeth distal to MP and MM, respectively, when fingers are closed. **MALE:** Fixed finger with prodorsal carina complete (along the entire length of the asetose area), starting approximately at level of the attachment point of the flagellum and of RFP tooth (or slightly anterior to it), gently curved to predominantly straight, without angular dorsal crest; proventral carina pronounced and restricted to the mucron area; mucron moderately to very long, ventral margin predominantly straight, subterminal flange (STF) absent or obsolete, apex (FT tooth) gently curved (straight in *G. eremolembra* **sp.nov.**). Movable finger mucron with prominent gnathal edge carina, moderately (*ibirapemussu* group) to markedly (*fasciata*

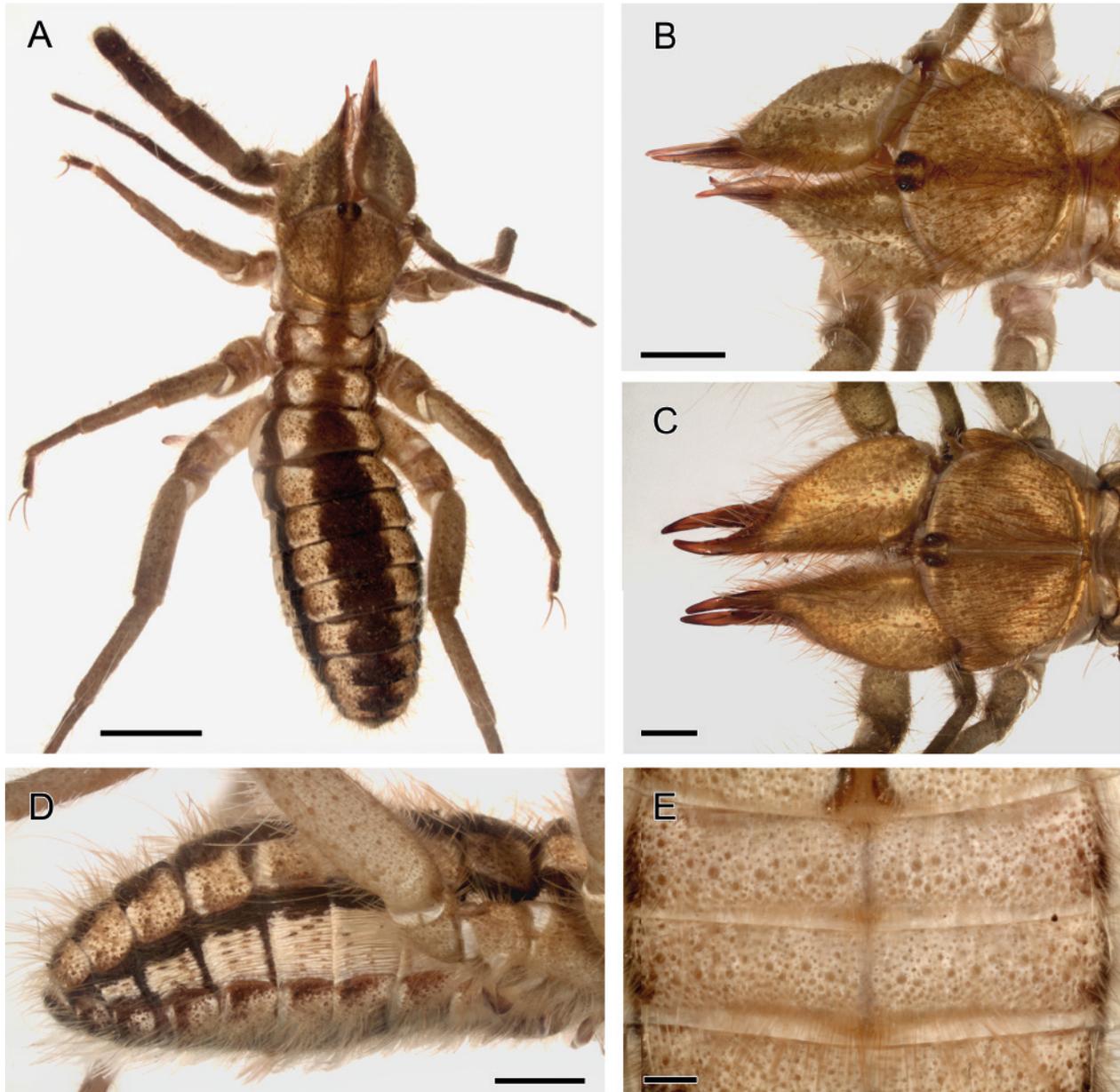
group) convex on lateral aspect. **FEMALE:** Chelicera without the secondary sexual characteristics of males. Fixed finger median teeth series with all primary teeth large. Fixed finger curved on lateral aspect; angular dorsal crest absent, at much obsolete. Fixed finger mucron hook-like, both dorsal and ventral margins curved, without subterminal flange (STF). Movable finger MP and MM primary teeth erected and sharpened; retrolateral carina consisting of abundant granules in one distinct staggered row or two rows; movable finger mucron with gnathal edge carina low, identified by differences in angles between adjacent pro- and retrolateral surfaces. **Chelicera, setose areas and stridulatory plate:** Retrolateral and dorsal surfaces with abundant bifurcated retrolateral manus (*rlm*) and retrolateral finger (*rlf*) setae, of different sizes, more robust in males; some of these setae are arranged in a bilaterally symmetrical pattern, including four evident principal retrolateral finger (*principal rlf*) setae. Prolateral surface with array of setal types, as follows: proventral distal (*pvd*) setae consisting of two rows of plumose setae, the ventral of which reaches the level of the fondal interdigital articular membrane (*fiam*), and the dorsal most reaching the prolateral interdigital condyle (*pic*); proventral subdistal setae made up of few thick and blunt setae (*pvsd* comb) at level of the stridulatory apparatus, and others thinner in more distal position (*pvsd*); carpet-like field of barbed and bristle-like promedial (*pm*) setae, covering the distalmost part of manus. Stridulatory plate approximately as long as high, occupying most of manus, dorso-distally with a 6/7-ridged stridulatory apparatus. Prolateral setose area of movable finger with setal insertions reaching the level of MSM tooth; movable finger prodorsal (*mpd*) setal series consisting of plumose setae arranged in one staggered- or two rows, followed by abundant setae of different length and thickness corresponding to the movable finger promedial (*mpm*) and proventral (*mpv*) setal series, the distalmost setae of each of which is longer. **Male flagellum:** A thin, translucent, membranous structure immovably attached prodorsally to the fixed finger; ipsilateral opening present, extending from near the attachment point to the apex of the flagellum. General aspect inflated, narrowing anteriorly; ventral margin subtly sinuous. Visible (prolateral) surface coated with minute to long spicules, mostly along prodorsal margin and apex, sometimes on proventral margin also; apex fringed, with no, scarce and small, or abundant and long spicules; flagellum extending beyond FD tooth. **Pedipalp:** All segments coated with bifurcated setae (*sensu* CUSHING & CASTO 2012) of different sizes; femur, basitarsus, and especially tibia with ventral set of very long setae, some of them as long as the tibia; clubbed setae (*sensu* CUSHING & CASTO 2012) on basi- and telotarsus; spiniform setae absent. **Leg I:** Similar to pedipalp with respect to the types, density and distribution of setae; with neither claws nor spiniform setae. Telotarsus with a dorsal pore area on distal third (only explored with SEM in *G. fasciata* and *G. curupi* **sp.nov.**; Figs. 28A,B, 29A); each pore is defined by an elevated border and bears a seta inside (i.e., sensilla am-

pullacea *sensu* BAUCHHENS 1983). **Walking legs:** Covered with abundant small- to medium-sized bifurcated setae, and a few longer setae. Legs II and III: tibia with pro- and retroventral rows of three spiniform setae each, retrolateral ones thinner than prolateral, and distal-most pair longer and more robust than others; basitarsus with row of three proventral, row of three retroventral, and one distal subventral spiniform setae, in a 2.2.3 rather staggered pattern; telotarsus bi-segmented with pro- and retroventral rows of five and four spiniform setae respectively, in a 1.2.2/2.2 pattern. Leg IV: Tibia with row of four/five spiniform setae on proventral surface and single distal spiniform seta on retroventral surface, distal pair longer and more robust; basitarsus with row of four/five proventral and one distal retroventral spiniform setae, in a 1.1.1.2 or 1.1.1.1.2 pattern; telotarsus bi-segmented with incomplete (ventral) segmentation on first (basal) tarsomere, with pro- and retroventral rows of six spiniform setae each, in a 2.2.2-2/2.2 pattern. **Opisthosoma:** Tergites with abundant bifurcated setae of variable size, and a pair of much longer, bilaterally symmetrical setae. Sternites with several bifurcated setae. Ctenidia scarcely distributed on 1<sup>st</sup> and 2<sup>nd</sup> post-genital sternites (spiracular sternites), more abundant on 3<sup>rd</sup> and 4<sup>th</sup> post-genital sternites (post-spiracular sternites I and II), and only one or two ctenidia on posterior margin of 5<sup>th</sup> post-genital sternite (post-spiracular sternite III); ctenidia filiform, setiform, similar in thickness to the bifid setae, but distinguishable because ctenidia are longer, single-tipped (non-bifid), and flexible; ctenidia similar in all the sternites where present and in both sexes, except for slightly longer in male, and more conspicuous insertion sockets on post-spiracular sternites I–II. Post-spiracular sternite II with row of rigid hairs along posterior margin.

**Notes on the cheliceral teeth.** Both inter- and intraspecific variability was observed across species / specimens of *Gaucha*, especially regarding the fixed finger FSD tooth. Based on BIRD et al.'s (2015) corollary I of their structural criterion of homology (i.e., “secondary teeth are more likely to be absent than primary teeth”) and in line with their interpretation of the dentition of some *Gaucha* specimens (BIRD et al. 2015: pls. 151a–f) we propose that it is the FSD which is absent in these cases.

### 5.1.1. The *fasciata* species-group

Here defined for *Gaucha* species that exhibit the following combination of features: **i)** Cheliceral movable finger mucron of males short (as compared to that of the *ibirapemussu* group), with gnathal edge carina very prominent and convex on lateral aspect. **ii)** Cheliceral fixed finger FSD tooth present only in some specimens (intraspecifically variable) or invariably absent, often reduced to the size of a minute denticle in males. **iii)** Fixed finger mucron of males short to moderately long and robust. NOTE: The *fasciata* species-group includes the type species of the genus and therefore represents *Gaucha sensu stricto*.



**Fig. 10.** *Gaucha casuhati* sp.nov. **A:** Male paratype, habitus, dorsal aspect (MACN-Ar). **B:** Male paratype, propeltidium and chelicerae, dorsal aspect. **C:** Ibid. for female paratype (MACN-Ar). **D:** Male paratype, opisthosoma, lateral aspect. **E:** Male paratype, opisthosoma, 3<sup>rd</sup> and 4<sup>th</sup> post-genital sternites. Scale bars: 2 mm (A); 1 mm (B–D); 0.3 mm (E).

**Species composition:** *Gaucha casuhati* sp.nov.; *Gaucha curupi* sp.nov.; *Gaucha fasciata* Mello-Leitão, 1924; *Gaucha fulvipes* (Roewer, 1934) comb.nov.; *Gaucha stoeckeli* Roewer, 1934 comb.rest.

#### 5.1.1.1. *Gaucha casuhati* sp.nov.

Figs. 4, 10, 11; Table 1

*Gaucha fasciata* (misidentification): MAURY 1970: 358–362, figs. 1–11; MAURY 1979: 159 [in part], 160 [in part]; MAURY 1998: 568; ROCHA 2002: 440 [in part]; BIRD et al. 2015: pl. 151b.

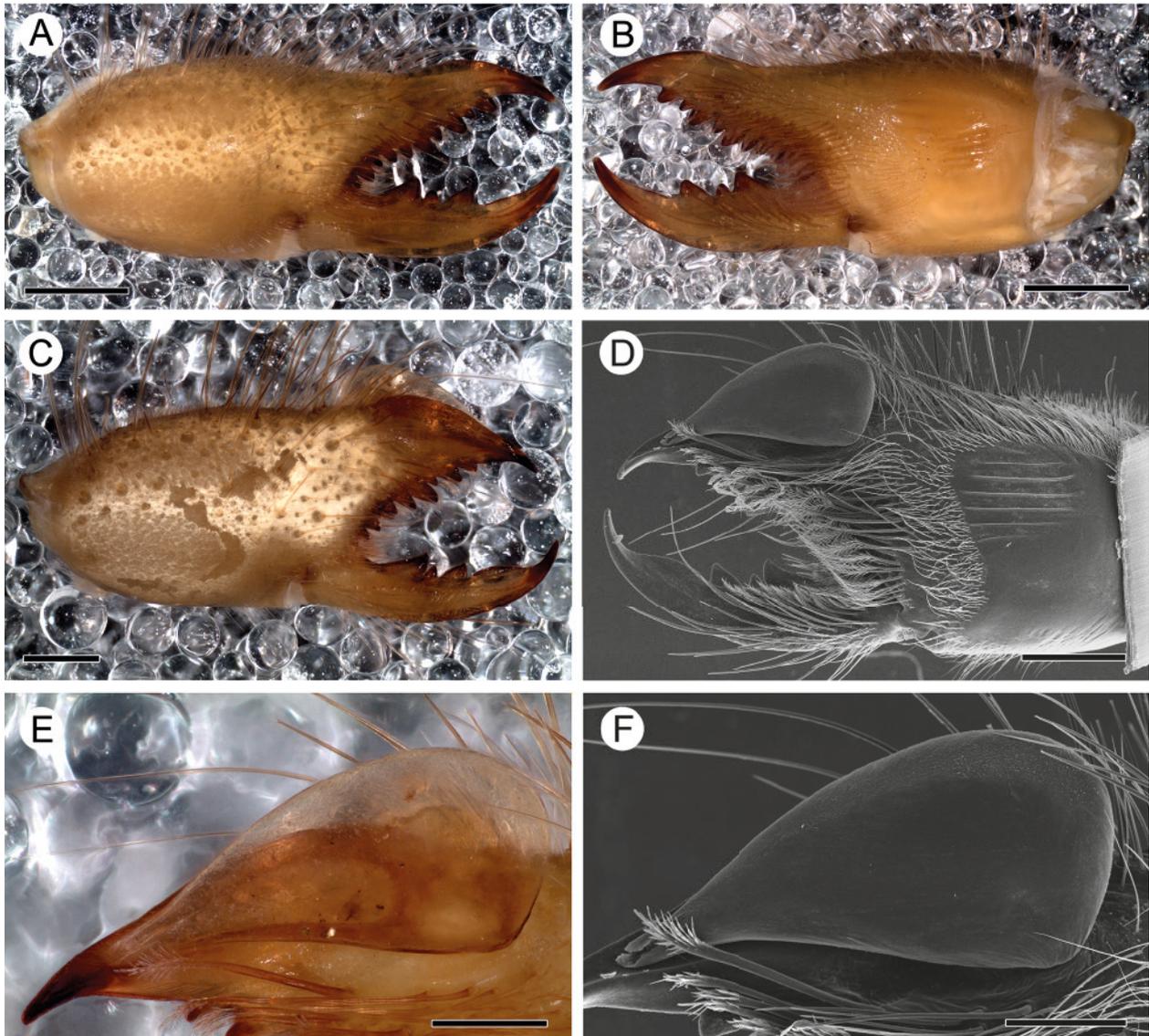
**Type material. Holotype:** male from ARGENTINA: Buenos Aires: Tornquist, Sierra de la Ventana, 28–30.xi.1968, E.A. Maury & F. Malleville (MACN-Ar-6264[a]). **Paratypes:** same data as

holotype, 1 juvenile (MACN-Ar-6264[b]). Tornquist, Sierra de la Ventana, A. E. Riggi, 1 female (MACN-Ar-6265). Tornquist, Sierra de la Ventana, “Las Espadañas”, 03.x.1973, E. A. Maury, 2 juveniles (MACN-Ar-7193). Tornquist, Sierra de la Ventana, 2 males, 5 females, 3 juveniles (MACN-Ar), 1 male, 1 female (FCEyN-UBA).

**Additional material examined. ARGENTINA: Buenos Aires:** Tornquist, Sierra de la Ventana, 29 juveniles (MACN-Ar).

**Derivatio nominis.** The specific epithet, *casuhati*, from *Casu* (= hill) + *Hati* (= high), is the name that the Puelche community gave to the ‘Sierra de la Ventana’. It is herein used as a noun in apposition.

**Differential diagnosis.** Males of *Gaucha casuhati* sp.nov. can be recognized from others in the *fasciata* group by having a much inflated, rounded flagellum with

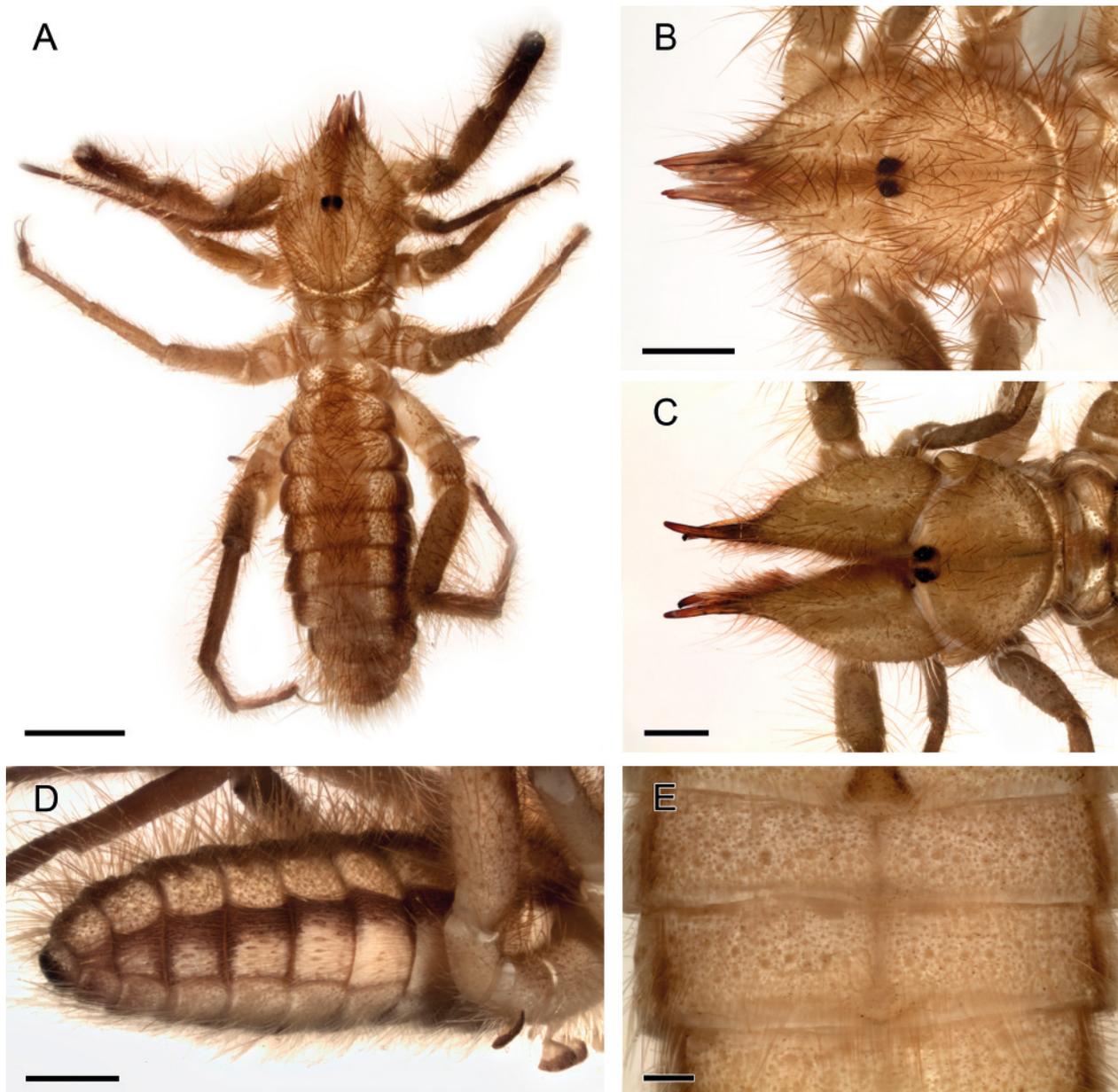


**Fig. 11.** *Gaucha casuhati* sp.nov., chelicerae. **A,B:** Right chelicera of female paratype (MACN-Ar). **A:** Retrolateral aspect. **B:** Proteral aspect. **C–F:** Right chelicera of male paratype (MACN-Ar). **C:** Retrolateral aspect. **D:** Proteral aspect (under SEM). **E:** Flagellum. **F:** Ibid. (under SEM). Scale bars: 1 mm (A,B); 0.5 mm (C,D); 0.3 mm (E); 0.25 mm (F).

conspicuous spicules, though small, on prodorsal margin only (Fig. 11D–F); the principal teeth of the fixed finger median series of average size, graded as  $FP > FM > FD$  (Fig. 11C); the fixed finger prodorsal carina progressively leaning down anteriorly (Fig. 11C); and the fixed finger mucron moderately long, without subterminal flange (STF) (Fig. 11C,E). Although females cannot generally be identified confidently, those of *G. casuhati* sp.nov. have the chelicera manus more robust than that of females of *G. curupi* sp.nov., *G. fasciata* and *G. stoeckeli* comb.rest. (Figs. 11A, 13A, 15A, 19A). In addition, females of *G. casuhati* sp.nov. most frequently have the fixed finger FSD tooth (Fig. 11A), whereas FSD is most frequently absent in females of *G. fasciata* (Fig. 15A).

**Description. Male:** Metric data in Table 1. **Color:** On 80% ethanol-preserved specimens. Propeltidium base color brown, with blackish median area without well-

defined borders, and posterior half with a pair of small to medium-sized, whitish lateral areas; ocular tubercle brownish. Chelicerae with manus predominantly brownish with a few lighter areas; fingers reddish. Meso-, metapeltidium, and dorsal surface of opisthosoma with a three-dark-band design typical of the family: tergites with broad, median, longitudinal brown band, and paired, thinner lateral whitish bands, the latter with some brown pigment interspersed; pleural membranes with sub-dorsal black and sub-ventral white bands; white band of opisthosomal pleural membrane with black marks surrounding the socket of most setae, and black pigment along the inter-segmental transversal vertices especially on posterior half; sternites base color yellowish brown, with lateral margins conspicuously darkened as well as posterior margin of the two/three posteriormost sternites; anal plate dark except for dorsal whitish region. Ventral aspect of prosoma uniformly yellowish; sternum lighter

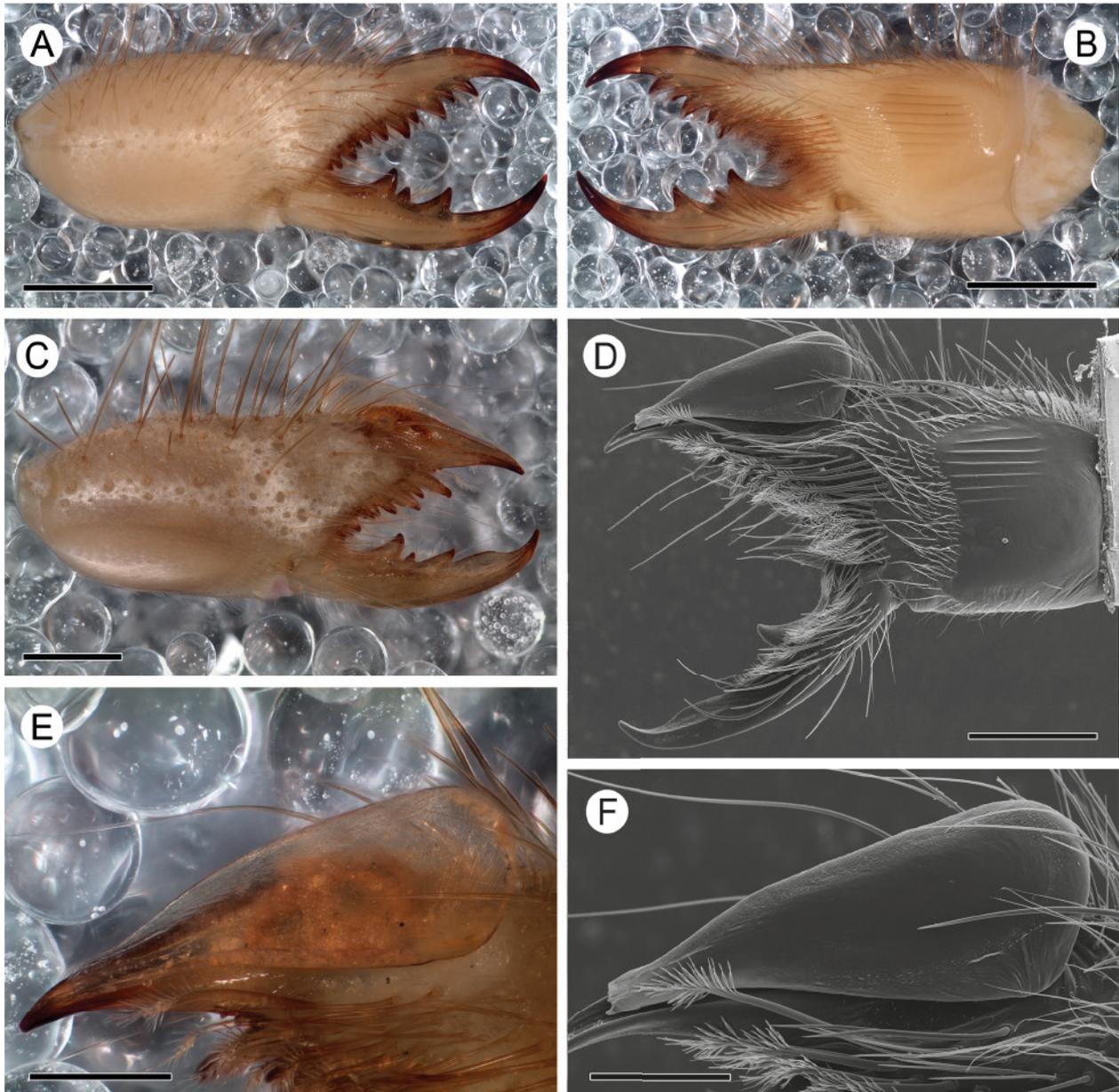


**Fig. 12.** *Gaucha curupi* sp.nov. **A:** Male holotype, habitus, dorsal aspect (MCN-Sol-038). **B:** Male holotype, propeltidium and chelicerae, dorsal aspect. **C:** Ibid. for female paratype (MACN-Ar). **D:** Male paratype, opisthosoma, lateral aspect (MCN-Sol-022). **E:** Male paratype, opisthosoma, 3<sup>rd</sup> and 4<sup>th</sup> post-genital sternites (MACN-Ar). Scale bars: 2 mm (A); 1 mm (B–D); 0.3 mm (E).

than coxae. Pedipalps and legs dark brown especially on dorsal and prolateral surfaces, lighter on ventral and retrolateral surfaces; pedipalp with telotarsus and distal half of basitarsus often darker than the rest of pedipalp. Malleoli predominantly whitish, often with distal margin darkened. **Chelicera:** Fixed finger with FP, FM and FD primary teeth, none noticeably elongated, decreasing in size anteriorly such that  $FP > FM > FD$ . Fixed finger FSD secondary tooth, when present, of the size of a minute denticle. Fixed finger prodorsal carina gently sinuous; mucron moderately long and sharpened. Movable finger MP tooth pronounced, moderately higher than MM; MM tooth approximately as broad as high, rather blunt. Chelicera, prolateral surface with carpet-like field of promedial (*pm*) setae covering the distalmost third of manus.

Flagellum much inflated posteriorly and medially, such that the flagellum dorsal margin is markedly curved on lateral aspect; ventral margin predominantly straight, except for the apex of the flagellum which curved towards the venter. Flagellum with minute spicules along prodorsal margin only; apex of the flagellum reaching about midway between the apex of the mucron and FD tooth; apex very narrow, without evident spicules.

**Female:** Metric data in Table 1. Similar to males but larger in size. Chelicera on lateral aspect, fixed finger highest elevation at level of FSD tooth, when FSD is present, otherwise at level of junction between FM and FD. Fixed finger robust, markedly curved towards the venter. Movable finger MP tooth moderately higher than MM tooth; movable finger retrolateral carina more distinct than in male.



**Fig. 13.** *Gaucha curupi* sp.nov., chelicerae. **A,B:** Right chelicera of female paratype (MCN-Sol-023). **A:** Retrolateral aspect. **B:** Prolateral aspect. **C–F:** Right chelicera of male paratype (MCN-Sol-030). **C:** Retrolateral aspect. **D:** Prolateral aspect (under SEM). **E:** Flagellum. **F:** Ibid. (under SEM). Scale bars: 1 mm (A,B); 0.5 mm (C,D); 0.3 mm (E); 0.25 mm (F).

**Variation.** FSD generally present, sometimes absent, in males and females. FSD was found to be most commonly absent in juveniles, especially in the youngest (i.e., with only three malleoli on leg IV). Males:  $n$  (chelicerae) = 8; 7 with FSD, 1 without. Females:  $n$  = 14; 9 with FSD, 5 without. Juveniles:  $n$  = 68; 22 with FSD, 46 without.

**Distribution.** *Gaucha casuhati* sp.nov. is known only from the type locality, Sierra de la Ventana, Buenos Aires, Argentina (Fig. 4).

**Notes.** Descriptions and illustrations of type specimens of *G. casuhati* sp.nov. were provided by MAURY (1970) (as ‘*Gaucha fasciata*’).

#### 5.1.1.2. *Gaucha curupi* sp.nov.

Figs. 1C, 3A, 4, 12, 13, 29; Table 1

**Type material. Holotype:** male from BRAZIL: Rio Grande do Sul: São Francisco de Assis, Cerro Sul, sandy soil derived from the Arenito Botucatu, 160–170 m elev., 29°30′48.99″S 55°07′15.79″W, pitfall trap, 26.xi.2009, R. Ott (MCN-Sol-038).

**Paratypes:** same data as holotype, 1 male, 1 female (MACN-Ar), 5 males (MCN-Sol-022), 4 females, 3 juveniles (MCN-Sol-023); same data as holotype, 23–28.xi.2009, 2 females (MCN-Sol-031, MCN-Sol-025). São Francisco de Assis, Cerro Norte, sandy soil derived from the Arenito Botucatu, 160–170 m elev., 29°30′48.99″S 55°07′15.79″W, pitfall trap, 23–28.xi.2009, R. Ott, 2 males (MCN-Sol-026, MCN-Sol-030), 2 females (MCN-Sol-027, MCN-Sol-029), 1 juvenile (MCN-Sol-028).

**Additional material examined.** **BRAZIL:** Rio Grande do Sul: São Francisco de Assis, Cerro Sul, sandy soil derived from the Arenito Botucatu, 160–170 m elev., 29°30'48.99"S 55°07'15.79"W, pitfall trap, xii.2014, R. Ott & R. Botero Trujillo, 1 juvenile (96% ethanol, MCN-Sol-032). São Francisco de Assis, Jacaquá, sandy soil derived from the Arenito Botucatu, 210–220 m elev., 29°36'40.98"S 55°08'09.15"W, 27.xi.2009, R. Ott, 2 males, 1 female, 4 juveniles (MCN-Sol-024), 1 juvenile (96% ethanol, MCN-Sol-033). São Francisco de Assis, iv–v.2005, R. Ott, 1 juvenile (96% ethanol, MCN-Sol-034).

**Derivatio nominis.** The noun in apposition is the popular name of a tree (*Sapium haermatospermum* Müll. Arg.; Euphorbiaceae) which is common in the type locality.

**Differential diagnosis.** Males of *Gaucha curupi* **sp.nov.** can be recognized from others in the *fasciata* group by having a moderately inflated flagellum, with conspicuous spicules, though small, on prodorsal and proventral margins (Fig. 13D–F); the FP and FM principal teeth of the fixed finger median series noticeably elongated, and FD tooth greatly reduced, graded as  $FP \approx FM \gg FD$  (Fig. 13C); the fixed finger prodorsal carina progressively leaning down anteriorly (Fig. 13C); and the fixed finger mucron markedly long, without subterminal flange (STF) (Fig. 13C,E). Although females cannot generally be identified confidently, those of *G. curupi* **sp.nov.** have the chelicera manus more slender than that of females of *G. casuhati* **sp.nov.** (Figs. 11A, 13A). In addition, females of *G. curupi* **sp.nov.** appear to have the fixed finger FSD tooth invariably present (Fig. 13A), whereas FSD is most frequently absent in females of *G. fasciata* (Fig. 15A).

**Description. Male:** Metric data in Table 1. **Color:** On 80% ethanol-preserved specimens. Propeltidium base color brown, with blackish median area without well-defined borders, and posterior half with a pair of small to medium-sized, whitish lateral areas; ocular tubercle brownish. Chelicerae with manus predominantly brownish with a few lighter areas; fingers reddish. Meso-, metapeltidium, and dorsal surface of opisthosoma with a three-dark-band design typical of the family: tergites with broad, median, longitudinal brown band, and paired, thinner lateral whitish bands, the latter with sparse brown pigment; pleural membranes with sub-dorsal black and sub-ventral white bands; white band of opisthosomal pleural membrane with black marks surrounding the socket of most setae, and black pigment along the inter-segmental transversal vertices especially on posterior half; sternites base color yellowish brown, with lateral margins conspicuously darkened as well as posterior margin of the two/three posteriormost sternites; anal plate dark except for dorsal whitish region. Ventral aspect of prosoma uniformly yellowish; sternum lighter than coxae. Pedipalps and legs dark brown especially on dorsal and pro-lateral surfaces, lighter on ventral and retrolateral surfaces; pedipalp with telotarsus and distal third of basitarsus darker than the rest of pedipalp. Malleoli predominantly whitish, often with distal margin darkened. **Chelicera:** Fixed finger with FP, FM and FD primary teeth; FP and FM noticeably elongated, either subequal in length or FM longer;

FD much reduced to the size of a minute denticle, such that  $FP \approx FM \gg FD$ . Fixed finger FSD secondary tooth, when present, of the size of a minute denticle, similar to FD or smaller. Fixed finger prodorsal carina predominantly straight; mucron markedly long and sharpened. Movable finger MP tooth pronounced, markedly higher than MM; MM tooth broader than high, strongly pointed. Chelicera, pro-lateral surface with carpet-like field of pro-medial (*pm*) setae covering the distalmost third of manus. Flagellum inflated, especially on posterior extreme, such that the flagellum dorsal margin is approximately straight on lateral aspect; ventral margin sinuous. Flagellum with minute spicules along prodorsal margin and in basal and median thirds of proventral margin; apex of the flagellum almost reaching the apex of the mucron; apex abruptly narrowing, without evident spicules.

**Female:** Metric data in Table 1. Similar to males but larger in size. Chelicera on lateral aspect, fixed finger highest elevation at level of FSD tooth. Fixed finger robust, markedly curved towards the venter. Movable finger MP tooth moderately higher than MM tooth; movable finger retrolateral carina more distinct than in male.

**Variation.** FSD tooth present in females, absent or much reduced in males. All the juveniles examined had the FSD tooth. Males: n (chelicerae) = 22; 14 with FSD, 8 without. Females: n = 20; 20 with FSD. Juveniles: n = 21; 21 with FSD.

**Distribution.** *Gaucha curupi* **sp.nov.** is known only from the type locality, São Francisco de Assis, Rio Grande do Sul, Brazil (Fig. 4). The region is characterized by natural (but anthropomorphically enhanced) geological phenomenon known as arenization (SUERTEGARAY 1998; SUERTEGARAY et al. 2001) (Fig. 1C). Arenization is the conversion of fragile grasslands over sandy soil in desert-like looking landscapes, due to erosion and subsequent covering of grassland vegetation with sand due to the action of the wind. Specimens were observed and collected while actively running, from noon to dusk, mainly in the grassland locations. Some specimens were found hibernating in May, in the ecotone between grassland and sand, and some females were collected, while digging, in November (R. Ott unpubl. observations).

### 5.1.1.3. *Gaucha fasciata* Mello-Leitão, 1924

Figs. 1A,B, 3B, 4, 14, 15, 28; Table 1

*Gaucha fasciata* Mello-Leitão, 1924: 141–143, figs. 24a–c, 25 (as *Gaucha fasciata* [sic]).

*Gaucha fasciata*: ROEWER 1934: 587–588; MELLO-LEITÃO 1937: 83, 84, figs. 1–3; MELLO-LEITÃO 1938: 7, figs. 1–3; ROEWER 1941: 180, 181, figs. 16–18; MAURY 1970: 358 [lines 10–11 only]; MUMA 1976: 24; MAURY 1979: 159 [in part], 160 [in part] KURY & NOGUEIRA 1999: 12; XAVIER & ROCHA 2001: 127; ROCHA 2002: 440 [in part]; HARVEY 2003: 289–290; MARTINS et al. 2004: 2362; ROCHA & CARVALHO 2006: 166; BOTERO-TRUJILLO 2014: 330; BIRD et al. 2015: 74, 83, pls. 19k, l, 23y,z, 24n, 25n, 34g, 35h, 149e,f, 151a,c–f; BOTERO-TRUJILLO 2016: 219.

*Gaucha fasciata* [sic]: ZILCH 1946: 150.

*Mummuciella simoni* Roewer, 1934: 587, fig. 334f (synonymized by MELLO-LEITÃO 1937: 84).

Not *Gaucha fasciata* Mello-Leitão, 1924: MAURY 1970: 358–362, figs. 1–11; MAURY 1979: 159 [in part], 160 [in part]; MAURY 1998: 568; ROCHA 2002: 440 [in part]; BIRD et al. 2015: pl. 151b. (Misidentifications, see section 5.1.1.1.)

DUBIOUS: *Gaucha fasciata*: MAURY 1979: 159 [in part], 160 [records from Rivera, Lavallega and Rio Negro].

**Type material.** Of *fasciata*: male **holotype** (examined) (MNRJ, currently at MCN): Label verbatim: “*Gaucha fasciata* M. L. / Porto Alegre / Gliesch / 42682”. “Laboratorio de Zoologia / Solifugos/Solpugidae / *Gaucha fasciata* / M. Leitão”. 1 male, 2 female **paratypes** (examined) (MNRJ; currently at MCN): Label verbatim: “Laboratorio de Zoologia / Solifugos/Solpugidae / *Gaucha fasciata* / M. Leitão”. Of *simoni*: female **holotype** (not examined) from Porto Alegre, Brazil.

**Additional material examined.** BRAZIL: Rio Grande do Sul: Porto Alegre, Jardim Botânico, granito, 46 m elev., 30°03'13.11"S 51°10'35.18"W, 19.xi.2012, 3 males, 1 female (MCN-Sol-020); 03.xii.2012, 2 males, 2 juveniles (MCN-Sol-021); 04.v.1990, A. D. Brescovit, 1 juvenile (MCN-Sol-002); xii.2014, R. Ott & R. Botero Trujillo, 1 male (96% ethanol, MCN-Sol-035). Porto Alegre, Reserva Biológica do Lami, Banhadinho, 23.iii–11.iv.2006, R. Moraes, 1 female, 2 juveniles (MACN-Ar). Porto Alegre, Reserva Biológica do Lami, sandy field, restinga, 30°14'53"S 51°03'46"W, 16.xii.2009, R. Ott, 1 female (MCN-Sol-014). Porto Alegre, Reserva Biológica do Lami, sandy restinga, 8 m elev., 30°14'08.77"S 51°06'12.29"W, 20.x–08.xi.2005, R. Moraes, 2 males, 1 juvenile (MCN-Sol-008), 3 males (MCN-Sol-009), 1 male (MCN-Sol-010). Porto Alegre, Reserva Biológica do Lami, sandy restinga, 8 m elev., 30°14'08.77"S 51°06'12.29"W, 16.xii.2009, R. Ott, 1 juvenile (96% ethanol, MCN-Sol-036), 1 juvenile (96% ethanol, MCN-Sol-037).

**Remarks.** KURY & NOGUEIRA (1999: 12) reported that the type specimens of *G. fasciata* (holotype and two paratypes), supposedly deposited in the MNRJ, could not be located. MAURY (1979: 160) mentioned that, in addition to the holotype (as MNJR [sic] 42582), he had examined one male and two females of *G. fasciata* belonging to the MNRJ, suggesting that the types comprised four specimens. One of us (R. Ott) managed to locate all the type specimens in the collection of the MCN. The holotype is poorly preserved, with indications of previous dessication. The color of the specimen has faded, although the three-dark-band pattern is evident. Legs and pedipalps are lost. The left chelicera is weakly attached to the propeltidium, while the right chelicera is detached and stored in the same vial. Both chelicerae have the fixed finger mucron broken (not in vial), and the left flagellum is destroyed. The paratypes, one male and two small females (presumably sub-adult) are not as badly preserved as the holotype.

**Revised differential diagnosis.** Males of *Gaucha fasciata* can be recognized from others in the *fasciata* group by having a moderately inflated flagellum, with conspicuous spicules along prodorsal and proventral margins (Fig. 15D–F); the principal teeth of the fixed finger median series of average size, graded as  $FP \approx FM > FD$  (Fig. 15C); the fixed finger prodorsal carina progressively leaning down anteriorly (Fig. 15C); and the fixed finger mucron moderately long, without subterminal flange (STF) (Fig. 15C,E). Although females cannot generally be identified confidently, those of *G. fasciata* have the chelicera

manus more slim than that of females of *G. casuhati* **sp.nov.** (Figs. 11A, 15A). In addition, females of *G. fasciata* most frequently lack the fixed finger FSD tooth (Fig. 15A), whereas FSD appears to be invariably present in females of *G. curupi* **sp.nov.** (Fig. 13A).

**Redescription. Male:** Metric data in Table 1. **Color:** On a recently collected, 96% ethanol-preserved specimen (MCN-Sol-035). Propeltidium base color dark brown, with blackish median area without well-defined borders, and posterior half with a pair of small to medium-sized, whitish lateral areas; ocular tubercle blackish. Chelicerae with manus predominantly brownish with a few lighter areas; fingers reddish. Meso-, metapeltidium, and dorsal surface of opisthosoma with a three-dark-band design typical of the family: tergites with broad, median, longitudinal brown band, and paired, thinner lateral whitish bands, the latter with some brown pigment interspersed; pleural membranes with sub-dorsal black and sub-ventral white bands; white band of opisthosomal pleural membrane with black marks surrounding the socket of most setae, and black pigment along the inter-segmental transversal vertices especially on posterior half; sternites base color yellowish brown, with lateral margins conspicuously darkened as well as posterior margin of the two/three posteriormost sternites; anal plate dark except for dorsal whitish region. Ventral aspect of prosoma uniformly yellowish; sternum lighter than coxae. Pedipalps and legs dark brown especially on dorsal and prolateral surfaces, lighter on ventral and retrolateral surfaces. Malleoli predominantly whitish, often with distal margin darkened. **Chelicera:** Fixed finger with FP, FM and FD primary teeth, none noticeably elongated, the latter smaller such that  $FP \approx FM > FD$ . Fixed finger FSD secondary tooth, when present, very small. Fixed finger prodorsal carina gently curved; mucron moderately long. Movable finger MP tooth pronounced, markedly higher than MM; MM tooth broader than high, sharpened. Chelicera, prolateral surface with carpet-like field of promedial (*pm*) setae covering the distalmost quarter of manus. Flagellum inflated, especially on posterior extreme, such that the flagellum dorsal margin is approximately straight / subtly curved on lateral aspect; ventral margin sinuous. Flagellum with moderate-sized spicules, mostly along prodorsal and proventral margins; apex of the flagellum reaching about midway between the apex of the mucron and FD tooth; apex moderately narrow, with very scarce spicules.

**Female:** Metric data in Table 1. Similar to males but larger in size. Chelicera on lateral aspect, fixed finger highest elevation at level of junction between FM and FD teeth, when FSD is absent, otherwise at level of FSD. Fixed finger robust, markedly curved towards the venter. Movable finger MP tooth moderately higher than MM tooth; movable finger retrolateral carina more distinct than in male.

**Variation.** FSD generally absent, rarely present, in males and females. All the juveniles examined lacked the FSD tooth. Males: n (chelicerae) = 24; 2 with FSD, 22 with-



**Fig. 14.** *Gaucha fasciata* Mello-Leitão, 1924. **A:** Male, habitus, dorsal aspect (MCN-Sol-021). **B:** Male, propeltidium and chelicerae, dorsal aspect (MCN-Sol-021). **C:** Ibid. for female (MCN-Sol-020). **D:** Juvenile, opisthosoma, lateral aspect (MCN-Sol-021). **E:** Male, opisthosoma, 3<sup>rd</sup> and 4<sup>th</sup> post-genital sternites (MCN-Sol-020). Scale bars: 2 mm (A); 1 mm (B–D); 0.2 mm (E).

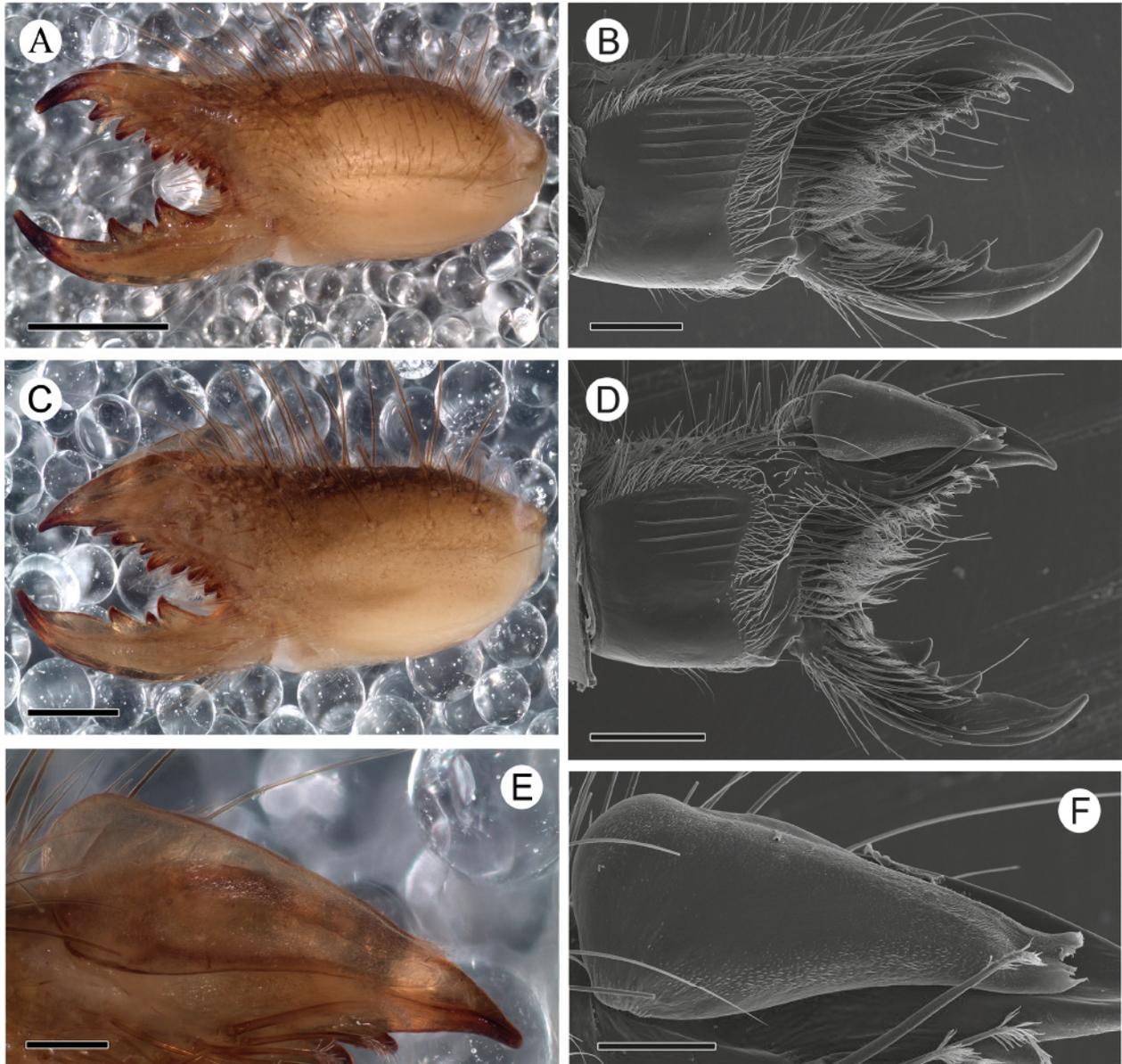
out. Females:  $n = 6$ ; 1 with FSD, 5 without. Juveniles:  $n = 16$ ; 16 without FSD.

**Distribution.** *Gaucha fasciata* is known from the urban area of Porto Alegre and a vicinity area (Reserva Biológica do Lami) in Rio Grande do Sul, Brazil (Fig. 4). The sample area in the Jardim Botânico is characterized by darker and reddish lateritic soil, typical of the top of the granite hills of the Porto Alegre metropolitan region (Fig. 1A). In contrast, in Reserva Biológica do Lami the soil consists of dunes formed by light quartz sand stones (Fig. 1B).

MAURY (1970, 1979) reported *G. fasciata* for a few localities in Uruguay and for Sierra de la Ventana, Argentina. Some of the specimens from Uruguay referred by MAURY (1979) were available to us for study: two males from Rio Negro, one male from Lavalleja, and one juve-

nile from Rivera. Unfortunately, these are few and some are not well-preserved. Males from Lavalleja and Rivera appear to not be conspecific to *G. fasciata*. The specimen from Lavalleja is most similar to *G. casuhati* **sp.nov.**, while the others most probably correspond to an undescribed species. Additional specimens from these localities are necessary to accurately determine the taxonomic identity of these populations, the same being true for that of Rivera whose male remains unknown.

**Notes.** BIRD et al. (2015: 74) reported intraspecific variability in the shape of the male FD tooth for *G. fasciata*, based in part on illustrations provided by MAURY (1970). Although slight differences in the size of FD and FM teeth among specimens of *G. fasciata* were confirmed during the present study, these are very subtle and not



**Fig. 15.** *Gaucha fasciata* Mello-Leitão, 1924, chelicerae. **A,B:** Left chelicera of female (MCN-Sol-020). **A:** Retrolateral aspect. **B:** Prolateral aspect (under SEM). **C–F:** Left chelicera of male (MCN-Sol-020). **C:** Retrolateral aspect. **D:** Prolateral aspect (under SEM). **E:** Flagellum. **F:** Ibid. (under SEM). Scale bars: 1 mm (A); 0.5 mm (B–D); 0.2 mm (E–F).

as marked as depicted by BIRD et al. (2015: pl. 151a,b), which corresponds indeed to interspecific variability (i.e., MAURY'S 1970 specimens from Argentina are here described as *Gaucha casuhati* **sp.nov.**) Even though both populations of *G. fasciata* are very close to each other, the coloration pattern of the specimens from Reserva Biológica do Lami is considerably lighter than that of those from Jardim Botânico. No significant differences between specimens from these two localities were observed thus far in other aspects of their morphology (e.g., chelicerae of males); therefore, the differences in coloration are presumed to be inter-populational variability.

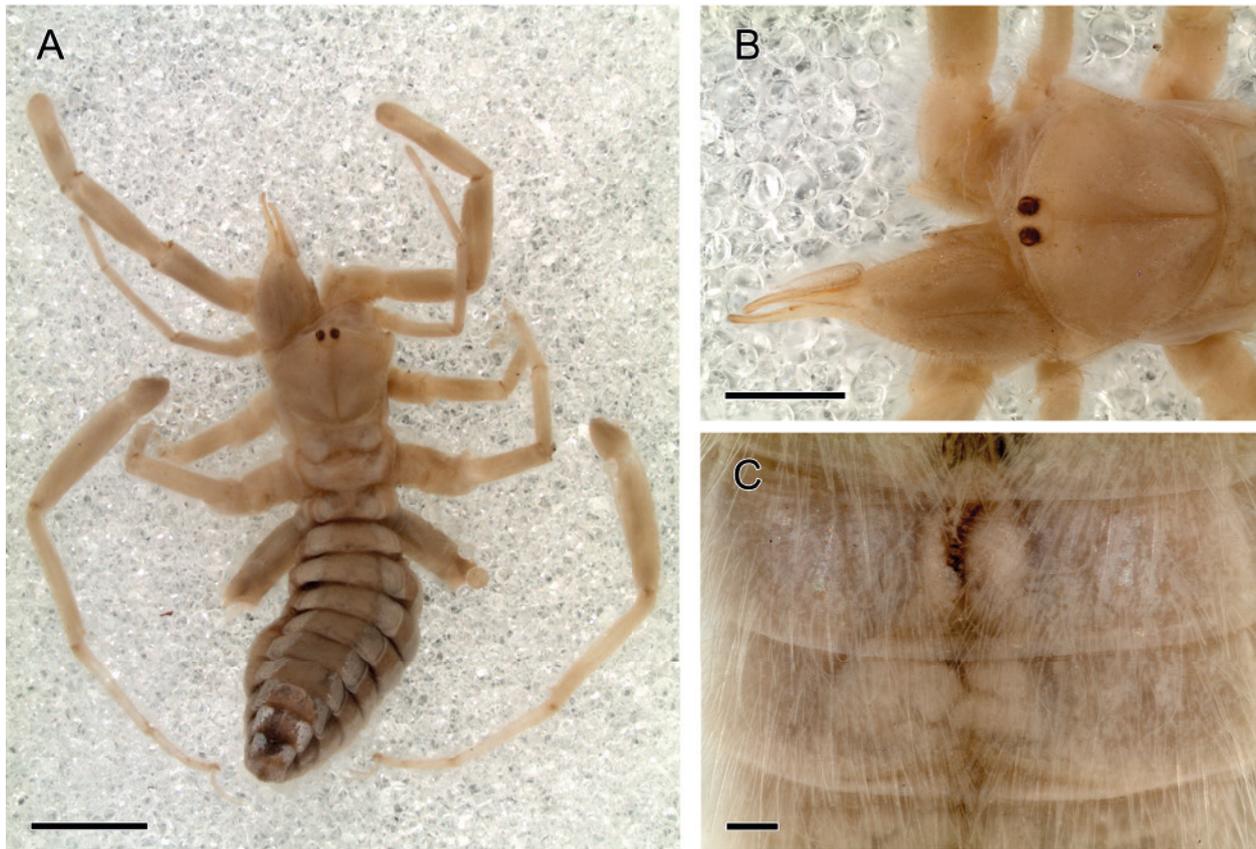
#### 5.1.1.4. *Gaucha fulvipes* (Roewer, 1934) **comb.nov.**

Figs. 4, 16, 17; Table 1

*Metacleobis fulvipes* Roewer, 1934: 589–590, fig. 333c.

*Metacleobis fulvipes*: ZILCH 1946: 150; MUMA 1976: 24; MAURY 1984: figs. 4, 5; ROCHA 2002: 447 [in part], figs. 4, 5; ROCHA & CANCELLO 2002a: 104–107 [in part], fig. 4, ROCHA & CANCELLO 2002b: 2 [in part]; HARVEY 2003: 290; MARTINS et al. 2004: 2362; ROCHA & CARVALHO 2006: 166; RODRIGUES et al. 2007: 803 (unconfirmed record); BOTERO-TRUJILLO 2014: 330; BOTERO-TRUJILLO 2016: 219.

DUBIOUS: *Gaucha fulvipes* (as *Metacleobis fulvipes*): ROCHA 2002: 447 [record from Chapada dos Guimarães]; ROCHA & CANCELLO 2002a: 104–107 [records from Serra da Mesa and Chapada dos Guimarães], figs. 1–3, 5, 7, 10, 12; ROCHA & CANCELLO 2002b: 2 [record from Chapada dos Guimarães]; ROCHA & CANCELLO 2002c: 4.



**Fig. 16.** *Gaucha fulvipes* (Roewer, 1934) **comb.nov.**, male holotype (SMF). **A:** Habitus, dorsal aspect. **B:** Propeltidium and chelicerae, dorsal aspect. **C:** Opisthosoma, 3<sup>rd</sup> and 4<sup>th</sup> post-genital sternites. Scale bars: 2 mm (A); 1 mm (B); 0.2 mm (C).

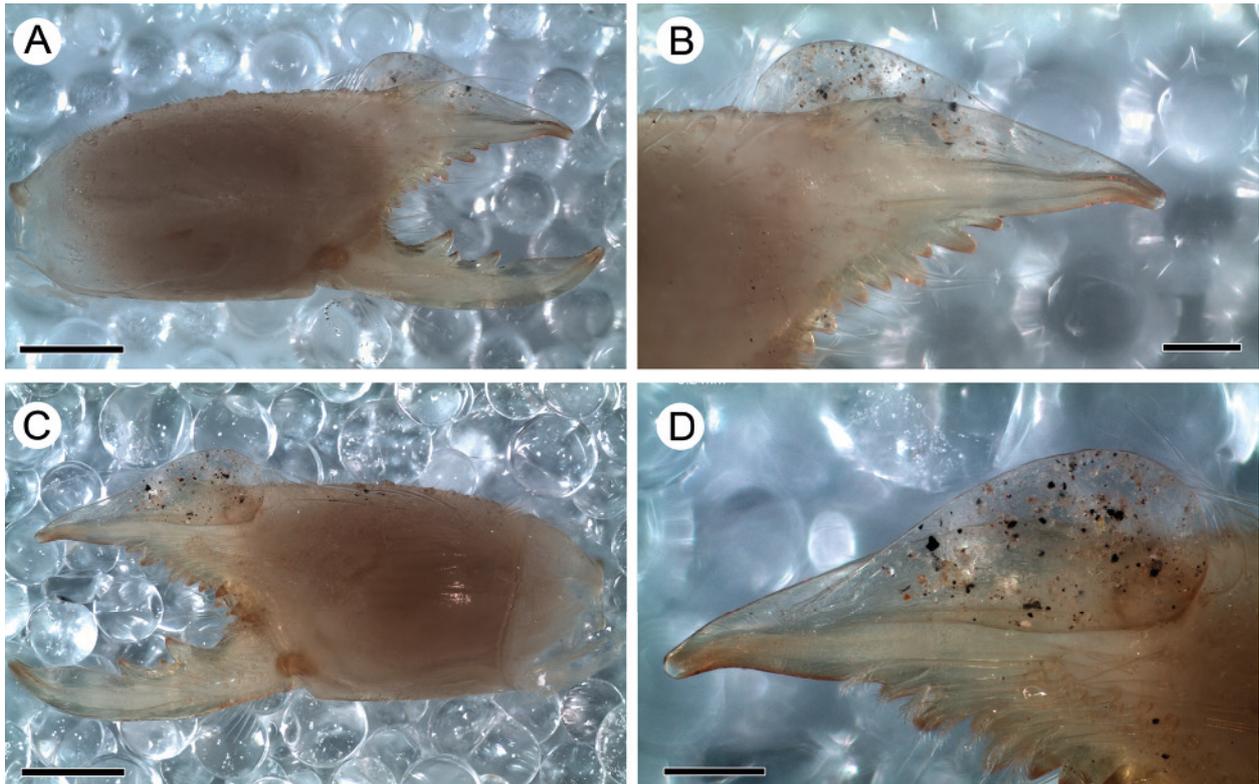
**Type material.** Male **holotype** (examined) (SMF): Label verbatim: “*Arachn. Coll. Roewer – Lfd. No. 4556 / Solifuga: / No. 365 / Metacleobis fulvipes / 1♂ / n. g. n. sp. / Brasil: Matto Grosso, Cuiabá / Typus / Roewer det. 1933*”. “4756”.

**Remarks.** ROCHA & CANCELLO (2002a) presented a re-description of *G. fulvipes comb.nov.* (as ‘*Metacleobis fulvipes*’) based on the examination of the holotype and other male and female specimens from two localities in Brazil. One of those, Chapada dos Guimarães, is only some 30 km to the northeast of Cuiabá (type locality of *G. fulvipes comb.nov.*), whereas the other, Serra da Mesa, is separated some 800 km to the east (Fig. 4). During the present study, one of us (RBT) examined nine males, four females and one juvenile from the former locality, belonging to the MCTP-PUCRS (part of the material currently loaned to the MCN). Those specimens are members of *Gaucha* as herein defined; however, although males share with the holotype of *G. fulvipes comb.nov.* the presence of an obsolete subterminal flange (STF) on the fixed finger mucron, some differences in the male cheliceral morphology were noticed. The manus is less robust than that of the holotype of *G. fulvipes comb.nov.* Likewise, the prodorsal carina proximal end and the flagellar insertion are both at level of the RFA tooth, in males from Chapada dos Guimarães, whereas these are at level of RFP-RFSP teeth in the holotype. In addition, the flagellum is less inflated and less rounded proximally, with broad apex in the former speci-

mens, but it is distinctly inflated and rounded basally, with rather narrow apex in the holotype.

Unfortunately, the holotype is the sole specimen of *G. fulvipes comb.nov.* from Cuiabá that we could examine. ROCHA & CANCELLO’s (2002a: figs. 1, 2) illustrations of the chelicerae of *G. fulvipes comb.nov.* did not specify the specimens on whose basis these were performed (or where they were from), the same being true for the illustration of the female chelicera (ROCHA & CANCELLO 2002a: fig. 3). The shape of the flagellum there depicted does not closely resemble that of the holotype; instead, it appears more similar to that of *G. casuhati sp.nov.* Similar differences in male cheliceral morphology were not observed in any of the other species here studied, but the chelicerae are remarkably invariable across conspecific specimens. Based on this, until new material from Cuiabá is examined, we consider dubious that the populations from Chapada dos Guimarães and Serra da Mesa belong to *G. fulvipes comb.nov.*

ROCHA & CANCELLO (1999) considered that specimens from Serra da Mesa belong to an undescribed species. However, the same material (i.e., MZUSP 15153) was subsequently referred by ROCHA & CANCELLO (2002c) as belonging to *G. fulvipes comb.nov.* (as ‘*Metacleobis fulvipes*’), and was used in the re-description of that species (ROCHA & CANCELLO 2002a). Even though we did not examine material from that population, this raises doubts regarding its conspecificity with *G. fulvipes comb.nov.*



**Fig. 17.** *Gaucha fulvipes* (Roewer, 1934) **comb.nov.**, right chelicera of male holotype (SMF). **A:** Retrolateral aspect. **B:** Ibid., detail of fixed finger. **C:** Retrolateral aspect. **D:** Flagellum. Scale bars: 0.5 mm (A,C); 0.2 mm (B,D).

**Revised differential diagnosis (male-based only).** Males of *Gaucha fulvipes* **comb.nov.** can be recognized from others in the *fasciata* group by having a moderately inflated, proximally and dorsally rounded flagellum (Fig. 17D); the principal teeth of the fixed finger median series of average size, graded as  $FP \approx FM > FD$  (Fig. 17B); the fixed finger prodorsal carina progressively leaning down anteriorly (Fig. 17B); and the fixed finger mucron markedly long, with obsolete but evident subterminal flange (STF) (Fig. 17B,D).

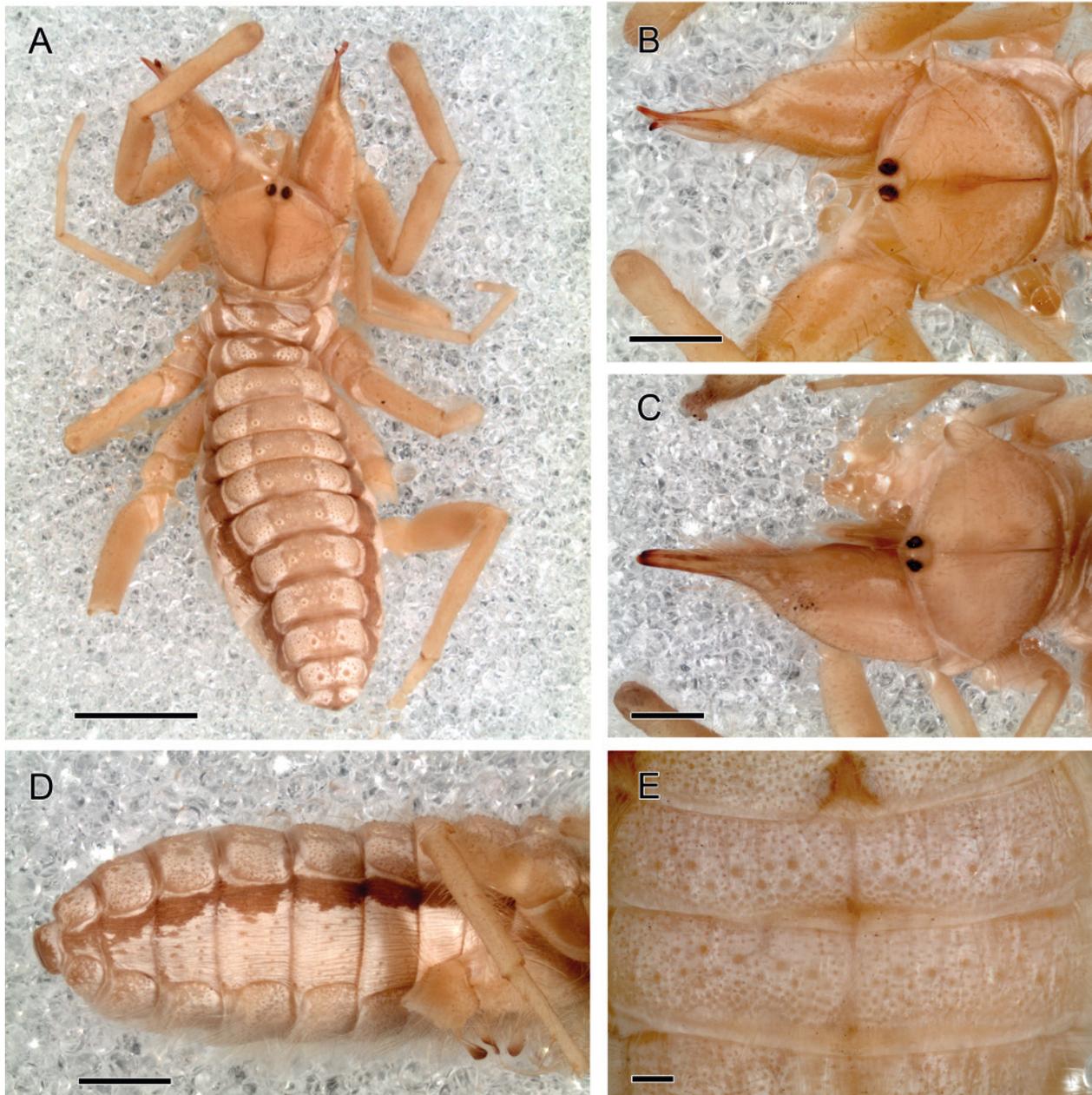
**Redescription. Male holotype:** Metric data in Table 1. **Color:** On 80% ethanol-preserved specimen. The propeltidium has lost any trace of pigmentation, being currently uniformly whitish yellow as are the ventral aspect of prosoma, sternites, pedipalps, legs and malleoli. Chelicerae with faded color, but manus with some dark and light areas similar to those in other congeneric species. Meso-, metapeltidium, and dorsal surface of opisthosoma with a three-dark-band design, faded but evident, typical of the family: tergites with broad, median, longitudinal brown band, and paired, thinner lateral whitish bands; pleural membranes with sub-dorsal dark and sub-ventral white bands; white band of opisthosomal pleural membranes with black marks surrounding the socket of some setae (these have faded slightly, but traces can be recognized especially in the left side membrane). **Chelicera:** Fixed finger with FP, FM and FD primary teeth, none noticeably elongated, the latter smaller such that  $FP \approx FM > FD$ . Fixed finger FSD secondary tooth ab-

sent. Fixed finger prodorsal carina gently curved; mucron long, with obsolete but evident subterminal flange (STF). Movable finger MP tooth pronounced, markedly higher than MM; MM tooth approximately as broad as high. Chelicera, prolateral surface with carpet-like field of promedial (*pm*) setae covering the distalmost third of manus. Flagellum inflated, proximally and dorsally rounded on lateral aspect; ventral margin sinuous. Apex of the flagellum reaching about midway between the apex of the mucron and FD tooth; apex moderately narrow.

**Female:** See ‘remarks’ above.

**Distribution.** *Gaucha fulvipes* **comb.nov.** has been reported for various localities in Brazil (Fig. 4): Cuiabá, Chapada dos Guimarães, Santo Antônio do Leverger (Mato Grosso), Serra da Mesa (Goiás) and São Sebastião (Distrito Federal) (ROEWER 1934; ROCHA 2002; ROCHA & CANCELLO 2002a,b,c; RODRIGUES et al. 2007). The actual range of distribution of this species remains to be determined (see ‘remarks’ above).

**Notes.** Since no other specimens confidently assignable to *G. fulvipes* **comb.nov.** were available (other than the holotype), SEM imaging of the chelicera of this species could not be conducted. Whether or not spicules are present in the flagellum of the holotype could not be determined by traditional stereomicroscopy, since the flagellum has turned translucent and several pieces of dirt inside of it obscure its external details.



**Fig. 18.** *Gaucha stoeckeli* Roewer, 1934 **comb.rest.** **A:** Male syntype, habitus, dorsal aspect (SMF). **B:** Male syntype, propeltidium and chelicerae, dorsal aspect. **C:** Ibid. for female syntype (SMF). **D:** Male syntype, opisthosoma, lateral aspect. **E:** Male syntype, opisthosoma, 3<sup>rd</sup> and 4<sup>th</sup> post-genital sternites. Scale bars: 2 mm (A); 1 mm (B–D); 0.2 mm (E).

Ctenidia could be identified in 2<sup>nd</sup> (spiracular II) through 4<sup>th</sup> (post-spiracular II) post-genital sternites of the holotype. Several setae have evidently broken off in many regions of the body, including the opisthosoma, and it is possible that the ctenidia have broken from 1<sup>st</sup> and 5<sup>th</sup> post-genital sternites.

#### 5.1.1.5. *Gaucha stoeckeli* Roewer, 1934 **comb.rest.**

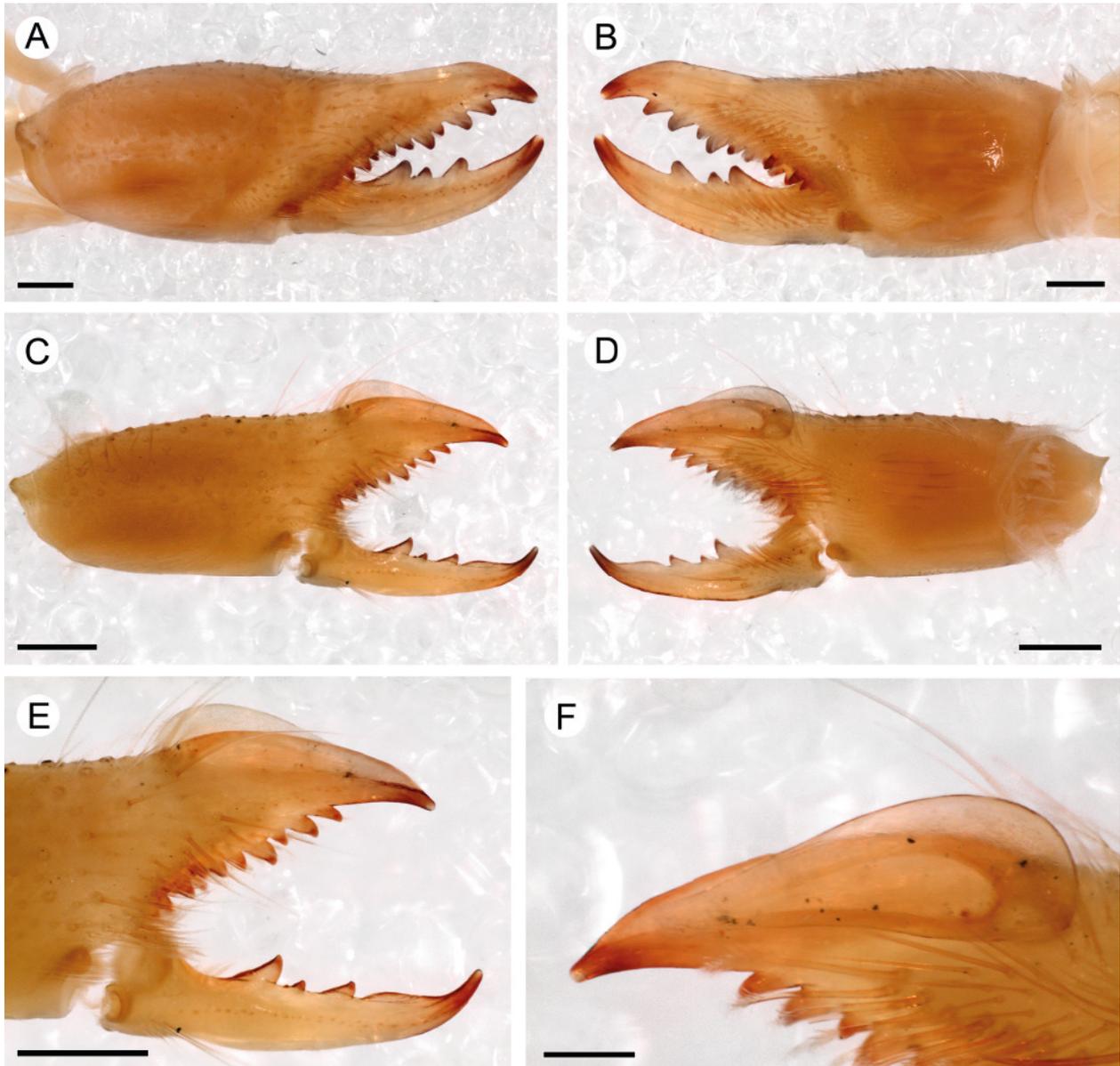
Figs. 4, 18, 19; Table 1

*Gaucha stoeckeli* Roewer, 1934: 588–589, figs. 333b, 334d.  
*Gauchella stoeckeli*: MELLO-LEITÃO 1937: 83, 84–85; ROEWER 1941: 182; ZILCH 1946: 150; MUMA 1976: 24; MORITZ & FISCHER 1980: 148; HARVEY 2003: 290; BOTERO-TRUJILLO 2016: 219.

**Type material.** 2 males, 1 female **syntypes** (examined) (SMF): Label verbatim: “*Arachn. Coll. Roewer – Lfd. No. 2984 / Solifuga: / No. 73 / Gaucha stoeckeli n. sp. / 2♂, 1♀ / Bolivia, La Paz / Typus / Roewer det. 1933*”. “2984”.

**Remarks.** According to ROEWER (1934: 589) the type material of this species consisted of four males and one female. We do not have information about where two males are deposited, and these are probably lost.

**Revised differential diagnosis.** Males of *Gaucha stoeckeli* **comb.rest.** can be recognized from others in the *fasciata* group by having a moderately inflated, proximally and dorsally rounded flagellum (Fig. 19F); the principal teeth of the fixed finger median series of average size,



**Fig. 19.** *Gaucha stoeckeli* Roewer, 1934 **comb.rest.**, chelicerae. **A,B:** Right chelicera of female syntype (SMF). **A:** Retrolateral aspect. **B:** Prolateral aspect. **C–F:** Right chelicera of male syntype (SMF). **C:** Retrolateral aspect. **D:** Prolateral aspect. **E:** Detail of fingers, retrolateral aspect. **F:** Flagellum. Scale bars: 0.5 mm (A–E); 0.2 mm (F).

graded as  $FP \approx FM > FD$  or  $FP > FM > FD$  (Fig. 19E); the fixed finger prodorsal carina semicircular (Fig. 19E); and the fixed finger mucron moderately long, without subterminal flange (STF) (Fig. 19E,F). Although females cannot generally be identified confidently, those of *G. stoeckeli* **comb.rest.** have the chelicera manus more slim than that of females of *G. casuhati* **sp.nov.** (Figs. 11A, 19A).

**Redescription. Male syntypes:** Metric data in Table 1. **Color:** On 80% ethanol-preserved specimen. The propeltidium has lost any trace of pigmentation, being currently uniformly whitish yellow as are the ventral aspect of prosoma, sternites, pedipalps, legs and malleoli. Several setae have broken off the tegument. Chelicerae with faded color, but manus with some dark and light

areas similar to those in other congeneric species. Meso-, metapeltidium, and dorsal surface of opisthosoma with a three-dark-band design, faded but evident, typical of the family: tergites with broad, median, longitudinal brown band, and paired, thinner lateral whitish bands; pleural membranes with sub-dorsal dark and sub-ventral white bands; white band of opisthosomal pleural membranes with black marks surrounding the socket of some setae (these have faded slightly, but traces can be recognized especially in 4<sup>th</sup> to 7<sup>th</sup> post-genital segments). **Chelicera:** Fixed finger with FP, FM and FD primary teeth, none noticeably elongated, the latter smaller such that  $FP \approx FM > FD$ , or FP slightly larger than others such that  $FP > FM > FD$ . Fixed finger FSD secondary tooth absent. Fixed finger prodorsal carina curved, semicircular; mucron moderately long. Movable finger MP tooth pro-

**Table 1.** Metric data for species of the *fasciata* species-group of *Gaucha* Mello-Leitão, 1924. Measurements in millimeters for one male and one female (when known). L = length; W = width; H = height. <sup>1</sup> Measured along medial axis, from the propeltidium anterior margin to the opisthosoma posterior margin. <sup>2</sup> Measured in dorsal view at widest point. <sup>3</sup> Measured in retrolateral view parallel to longitudinal axis of chelicera, from the fixed finger apex to anterolateral propeltidial lobe anterior margin. <sup>4</sup> Measured in retrolateral view, along vertical axis at widest part of manus. <sup>5</sup> Sum of individual segment lengths. <sup>6</sup> Maximum height. <sup>7</sup> Measurement excludes claws.

Species		<i>Gaucha casuhati</i> sp.nov.	<i>Gaucha curupi</i> sp.nov.	<i>Gaucha fasciata</i>	<i>Gaucha fulvipes</i> comb.nov.	<i>Gaucha stoeckeli</i> comb.rest.
Voucher		Male holotype MACN-Ar-6264(a) [Female paratype MACN-Ar]	Male holotype MCN-Sol-038 [Female paratype MACN-Ar]	Male MCN-Sol-021 [Female MCN-Sol-020]	Male holotype (SMF)	Male [and female] syntypes (SMF)
Total body L (w/o chelicerae) <sup>1</sup>		9.18 [17.56]	10.64 [12.24]	7.58 [13.17]	9.71	9.58 [14.63]
Propeltidium	L	2.13 [3.06]	2.00 [2.27]	1.60 [2.00]	1.87	1.83 [2.43]
	W <sup>2</sup>	2.33 [4.52]	2.37 [3.17]	2.03 [2.87]	2.33	2.33 [3.59]
Chelicera	L <sup>3</sup>	3.03 [4.79]	2.53 [3.99]	2.23 [3.52]	2.50	2.97 [4.52]
	W <sup>2</sup>	1.20 [1.87]	1.07 [1.50]	0.87 [1.33]	1.00	1.03 [1.67]
	H <sup>4</sup>	1.30 [2.00]	1.00 [1.50]	0.87 [2.53]	1.00	1.00 [1.63]
Pedipalp total L <sup>5</sup>		7.20 [9.09]	7.67 [7.93]	5.84 [6.26]	7.07	7.00 [8.33]
	Femur L	2.60 [3.46]	3.00 [2.80]	2.17 [2.00]	2.67	2.53 [3.00]
	Tibia L	2.20 [2.50]	2.17 [2.33]	1.67 [1.93]	2.07	2.07 [2.50]
	Tibia W <sup>2</sup>	0.67 [0.80]	0.63 [0.67]	0.47 [0.57]	0.57	0.50 [0.67]
	Basitarsus + telotarsus L	2.40 [3.13]	2.50 [2.80]	2.00 [2.33]	2.33	2.40 [2.83]
Leg I total L <sup>5</sup>		5.81 [7.16]	5.96 [6.39]	4.70 [5.23]	5.54	5.87 [6.47]
	Patella L	1.77 [2.10]	1.83 [2.03]	1.43 [1.37]	1.67	1.73 [1.83]
	Tibia L	1.87 [2.33]	1.97 [2.03]	1.50 [1.73]	1.77	1.87 [2.10]
	Basitarsus L	1.20 [1.50]	1.23 [1.33]	1.00 [1.20]	1.17	1.27 [1.37]
	Telotarsus L	0.97 [1.23]	0.93 [1.00]	0.77 [0.97]	0.93	1.00 [1.17]
Leg IV total L (w/o claws) <sup>5</sup>		9.97 [11.02]	10.23 [9.77]	7.43 [8.23]	8.94	9.43 [10.04]
	Patella L	3.17 [3.86]	3.33 [3.17]	2.33 [2.63]	2.77	3.00 [3.17]
	Patella H <sup>6</sup>	0.87 [1.03]	0.83 [0.93]	0.67 [0.80]	0.67	0.73 [0.93]
	Tibia L	3.03 [3.33]	3.03 [3.07]	2.30 [2.50]	2.70	2.83 [3.07]
	Basitarsus L	2.37 [2.40]	2.47 [2.33]	1.80 [2.00]	2.07	2.13 [2.30]
	Telotarsus L <sup>7</sup>	1.40 [1.43]	1.40 [1.20]	1.00 [1.10]	1.40	1.47 [1.50]

nounced, markedly higher than MM; MM tooth approximately as broad as high. Chelicera, prolateral surface with carpet-like field of promedial (*pm*) setae covering the distalmost third of manus. Flagellum inflated, proximally and dorsally rounded on lateral aspect; ventral margin sinuous. Apex of the flagellum reaching closer to the apex of the mucron than to the FD tooth; apex moderately narrow.

**Female syntype:** Metric data in Table 1. Similar to males but larger in size. Chelicera on lateral aspect, fixed finger highest elevation at level of junction between FM and FD teeth. Fixed finger robust, curved towards the venter. Movable finger MP tooth moderately higher than MM tooth (but both, as other teeth, are visibly worn); movable finger retrolateral carina more distinct than in male.

**Variation.** All the chelicerae of males ( $n = 4$  chelicerae) and those of the female ( $n = 2$ ) lack the fixed finger FSD tooth. *Gaucha stoeckeli* **comb.rest.** is the only species in the *fasciata* species-group in which there is no evidence that the FSD could be present.

**Distribution.** *Gaucha stoeckeli* **comb.rest.** is known only from the type locality, which ROEWER (1934: 589) reported as “Bolivien (La Paz, Lusibay)”. Roewer’s hand-written label accompanying the specimens does not

mention “Lusibay” or anything similar. While we could not identify a locality with this exact name, we found one named ‘Luribay’, some 80 km to the southeast of La Paz city, but in La Paz department. We therefore consider that the type locality of *G. stoeckeli* **comb.rest.** is Luribay (Loayza Province, La Paz department, Bolivia), with approximate geographic coordinates 17°03’43.31”S 67°39’39.73”W (Fig. 4).

**Notes.** Since no other specimens of *G. stoeckeli* **comb.rest.** were available (other than the syntypes), SEM imaging of the chelicera of this species could not be conducted. The extent to which the surface of the flagellum bears spicules could not be determined in detail by traditional stereomicroscopy; minute spicules seem to be present along its prodorsal margin and on the apex, however.

Ctenidia could be identified in 2<sup>nd</sup> (spiracular II) through 5<sup>th</sup> (post-spiracular III) post-genital sternites of this species. Several setae have evidently broken off in many regions of the body and it is possible that the ctenidia have broken from the 1<sup>st</sup> post-genital sternite.

One chelicera of a male and both chelicerae of the female have an extra minute denticle immediately distal to MP. That tooth belongs to the MSM teeth series and is absent from the chelicerae of the other male.

**Table 2.** Metric data for species of the *ibirapemussu* species-group of *Gaucha* Mello-Leitão, 1924. Measurements in millimeters for one male and one female. L = length; W = width; H = height. <sup>1</sup> Measured along medial axis, from the propeltidium anterior margin to the opisthosoma posterior margin. <sup>2</sup> Measured in dorsal view at widest point. <sup>3</sup> Measured in retrolateral view parallel to longitudinal axis of chelicera, from the fixed finger apex to anterolateral propeltidial lobe anterior margin. <sup>4</sup> Measured in retrolateral view, along vertical axis at widest part of manus. <sup>5</sup> Sum of individual segment lengths. <sup>6</sup> Maximum height. <sup>7</sup> Measurement excludes claws. \*\* Measurement unavailable (segment missing).

Species		<i>Gaucha avexada</i> sp.nov.	<i>Gaucha eremolembra</i> sp.nov.	<i>Gaucha ibirapemussu</i> comb.nov.	<i>Gaucha mauryi</i> comb.nov.
Voucher		Male holotype MZUFBA(ARC)0082 [Female paratype MZUFBA(ARC)0044]	Male holotype UFMG 15923 [Female paratype UFMG 19271]	Male paratype MPEG(Sol)11 [Female paratype MPEG(Sol)12]	Male holotype MZUSP 16470 [Female MZUFBA(ARC)14]
Total body L (w/o chelicerae) <sup>1</sup>		6.00 [11.31]	8.78 [12.50]	7.18 [8.38]	6.25 [9.00]
Propeltidium	L	1.30 [1.73]	1.67 [2.00]	1.53 [1.57]	1.17 [1.38]
	W <sup>2</sup>	1.42 [2.33]	2.03 [2.80]	1.80 [2.33]	1.27 [1.80]
Chelicera	L <sup>3</sup>	2.18 [3.00]	2.67 [13.97]	2.17 [2.67]	1.70 [2.28]
	W <sup>2</sup>	0.65 [1.10]	1.00 [1.33]	0.83 [1.13]	0.60 [0.88]
	H <sup>4</sup>	0.70 [1.00]	0.87 [1.27]	0.77 [1.00]	0.50 [0.70]
Pedipalp total L <sup>5</sup>		5.92 [6.70]	6.50 [7.50]	5.64 [5.64]	4.60 [4.68]
	Femur L	2.00 [2.40]	2.03 [2.67]	2.00 [1.97]	1.60 [1.62]
	Tibia L	1.80 [1.93]	2.00 [2.33]	1.67 [1.67]	1.33 [1.38]
	Tibia W <sup>2</sup>	0.38 [0.47]	0.43 [0.53]	0.40 [0.50]	0.33 [0.20]
	Basitarsus + telotarsus L	2.12 [2.37]	2.47 [2.50]	1.97 [2.00]	1.67 [1.68]
Leg I total L <sup>5</sup>		4.52 [6.04]	5.33 [5.80]	4.64 [n.a.]	3.61 [3.76]
	Patella L	1.68 [2.50]	1.67 [1.80]	1.5 [**]	1.07 [1.18]
	Tibia L	1.30 [1.70]	1.73 [1.83]	1.5 [**]	1.17 [1.18]
	Basitarsus L	0.92 [1.07]	1.13 [1.27]	0.97 [**]	0.80 [0.78]
	Telotarsus L	0.62 [0.77]	0.80 [0.90]	0.67 [**]	0.57 [0.62]
Leg IV total L (w/o claws) <sup>5</sup>		7.61 [8.00]	8.80 [8.53]	n.a. [6.54]	6.64 [5.84]
	Patella L	2.38 [2.50]	2.83 [2.83]	2.33 [2.10]	1.87 [1.90]
	Patella H <sup>6</sup>	0.40 [0.57]	0.60 [0.77]	0.60 [0.57]	0.42 [0.30]
	Tibia L	2.35 [2.33]	2.67 [2.53]	2.07 [1.97]	1.87 [1.82]
	Basitarsus L	1.78 [2.00]	2.07 [2.00]	1.77 [1.50]	2.07 [1.32]
	Telotarsus L <sup>7</sup>	1.10 [1.17]	1.23 [1.17]	** [0.97]	0.83 [0.80]

### 5.1.2. The *ibirapemussu* species-group

Here defined for *Gaucha* species that exhibit the following combination of features: **i**) Cheliceral movable finger mucron of males long (as compared to that of the *fasciata* group), with gnathal edge carina moderately prominent and convex on lateral aspect. **ii**) Cheliceral fixed finger FSD tooth invariably absent in males and females. **iii**) Fixed finger mucron of males moderately to very long and slender.

**Species composition:** *Gaucha avexada* sp.nov.; *Gaucha eremolembra* sp.nov.; *Gaucha ibirapemussu* (Carvalho et al., 2010) comb.nov.; *Gaucha mauryi* (Rocha, 2001) comb.nov.

#### 5.1.2.1. *Gaucha avexada* sp.nov.

Figs. 5, 20, 21; Table 2

**Type material. Holotype:** male from BRAZIL: Bahia: Jaborandi, Fazenda Mombim, 13°51'31"S 45°00'38"W, 15.vii.2008 [MZUFBA(ARC)0082]. **Paratypes:** same data as holotype, 1 male, 1 female [MZUFBA(ARC)0044], 1 male (CHNUFPI 1195), 1 male (CHNUFPI 1196), 2 females [MZUFBA(ARC)0083].

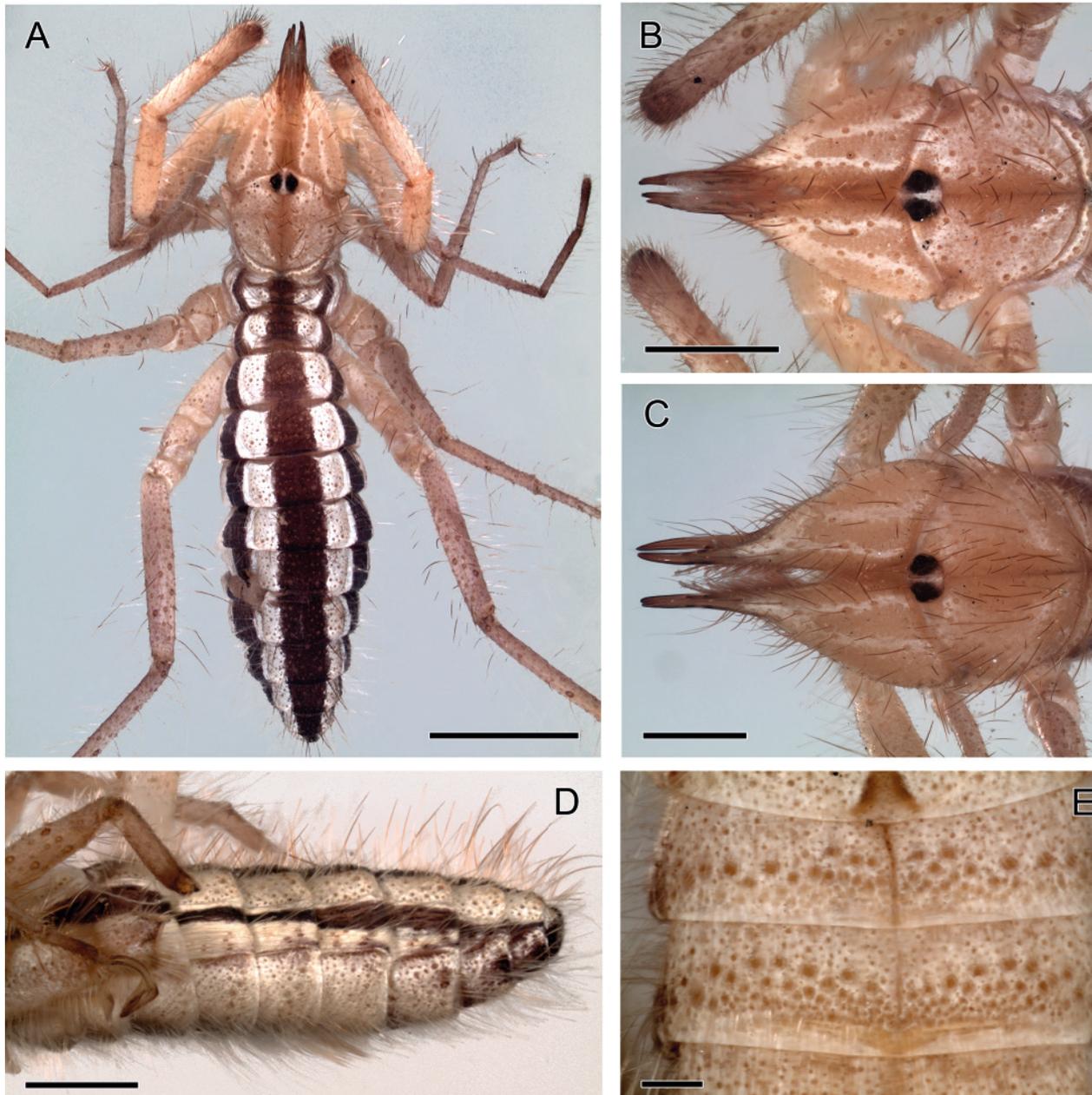
**Additional material examined. BRAZIL. Tocantins:** São Félix do Tocantins, Cerrado, 10°04'14.7"S 46°44'42.3"W, 22.ix– 05.x.

2006, P.R. Silva & R.S.M. Feitosa, 3 males, 6 juveniles (MZUSP 27861).

**Derivatio nominis.** The specific epithet is an adjective in Brazilian Portuguese, commonly used as a regional expression in northeastern Brazil for referring to someone that is hurrying. It is inspired in the fast running-speed of these solifuges.

**Differential diagnosis.** Males of *Gaucha avexada* sp.nov. can be recognized from other species in the *ibirapemussu* group by having the fixed finger mucron remarkably long, with apex (FT tooth) directed towards the apex of movable finger (MT tooth) (Fig. 21C,E); FM and FD teeth moderately elongated (Fig. 21C); medial part of the fixed finger prodorsal carina bent towards the retrolateral surface, such that the apex of the flagellum is placed sub-dorsally on the finger; MM tooth larger than MSM (Fig. 21C,D); flagellum with apex very broad (in both dorsal and prolateral aspect), densely coated with long spicules which continue along the prodorsal margin, and smaller spicules on proventral margin (Fig. 21E,F).

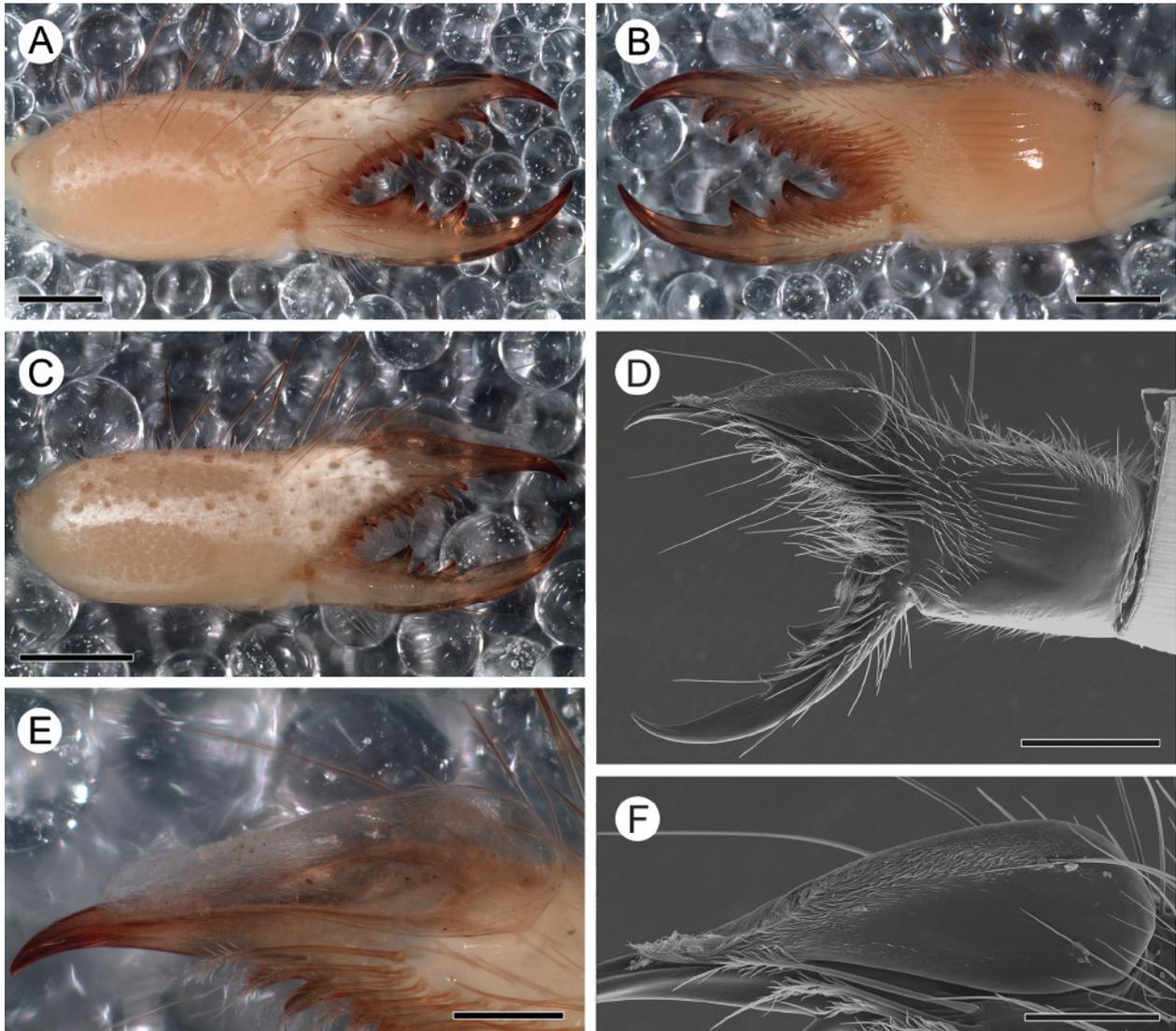
**Description. Male:** Metric data in Table 2. **Color:** On 80% ethanol-preserved specimens. Propeltidium base color yellow, with yellowish median area without well-



**Fig. 20.** *Gaucha avexada* sp.nov. **A:** Male paratype, habitus, dorsal aspect [MZUFBA(ARC)0044]. **B:** Male paratype, propeltidium and chelicerae, dorsal aspect [MZUFBA(ARC)0044]. **C:** Ibid. for female paratype [MZUFBA(ARC)0044]. **D:** Male paratype, opisthosoma, lateral aspect (CHNUFPI 1195). **E:** Male paratype, opisthosoma, 3<sup>rd</sup> and 4<sup>th</sup> post-genital sternites (CHNUFPI 1195). Scale bars: 2 mm (A); 1 mm (B–D); 0.2 mm (E).

defined borders which is surrounded by conspicuous white pigment; ocular tubercle whitish, dark around the eyes. Chelicerae with manus predominantly yellowish with some white areas; fingers reddish yellow. Meso-, metapeltidium, and dorsal surface of opisthosoma with a three-dark-band design typical of the family: tergites with median, longitudinal brown band, and paired, thinner lateral whitish bands; pleural membranes with sub-dorsal black and sub-ventral white bands; white band of opisthosomal pleural membrane with black marks surrounding the socket of most setae, and black pigment along the inter-segmental transversal vertices especially on posterior half; sternites base color whitish yellow,

with lateral margins conspicuously darkened especially on two/three posteriormost sternites, and preanal sternite almost entirely dark; anal plate dark except for dorsal white regions. Ventral aspect of prosoma uniformly yellowish; sternum lighter than coxae. Pedipalps and legs yellow; pedipalp with telotarsus darker than the rest of pedipalp. Malleoli predominantly whitish, often with distal margin darkened. **Chelicera:** Fixed finger with FP, FM and FD primary teeth; FM and FD columnar; FM slightly longer than the others such that  $FM > FP \approx FD$ . Fixed finger FSD secondary tooth absent. Fixed finger prodorsal carina straight along most of its length; mucron remarkably long and straight, not markedly thin,



**Fig. 21.** *Gaucha avexada* sp.nov., chelicerae. **A,B:** Right chelicera of female paratype [MZUFBA(ARC)0044]. **A:** Retrolateral aspect. **B:** Prolateral aspect. **C–F:** Right chelicera of male paratype [MZUFBA(ARC)0044]. **C:** Retrolateral aspect. **D:** Prolateral aspect (under SEM). **E:** Flagellum. **F:** Ibid. (under SEM). Scale bars: 0.5 mm (A–D); 0.2 mm (E–F).

and with the apex (FT tooth) strongly curved towards the venter. Movable finger MP tooth pronounced, markedly higher than MM; MM tooth approximately as broad as high, triangular. Chelicera, prolateral surface with carpet-like field of promedial (*pm*) setae covering the distalmost third of manus. Flagellum drop-like, moderately inflated posteriorly and medially, with dorsal margin straight on lateral aspect; ventral margin slightly sinuous. Flagellum with conspicuous spicules along prodorsal margin, increasing in length anteriorly such that the apex is coated with long spicules; apex of the flagellum reaching two thirds of the mucron from the base; apex very broad.

**Female:** Metric data in Table 2. Similar to males but larger in size. Chelicera on lateral aspect, fixed finger highest elevation at level of FD tooth. Fixed finger robust, markedly curved towards the venter. Movable finger MP tooth moderately higher than MM tooth; movable finger retrolateral carina similarly developed to that of male.

**Variation.** All the chelicerae of males ( $n = 14$  chelicerae), females ( $n = 6$ ) and juveniles ( $n = 12$ ) were confirmed to lack the fixed finger FSD tooth.

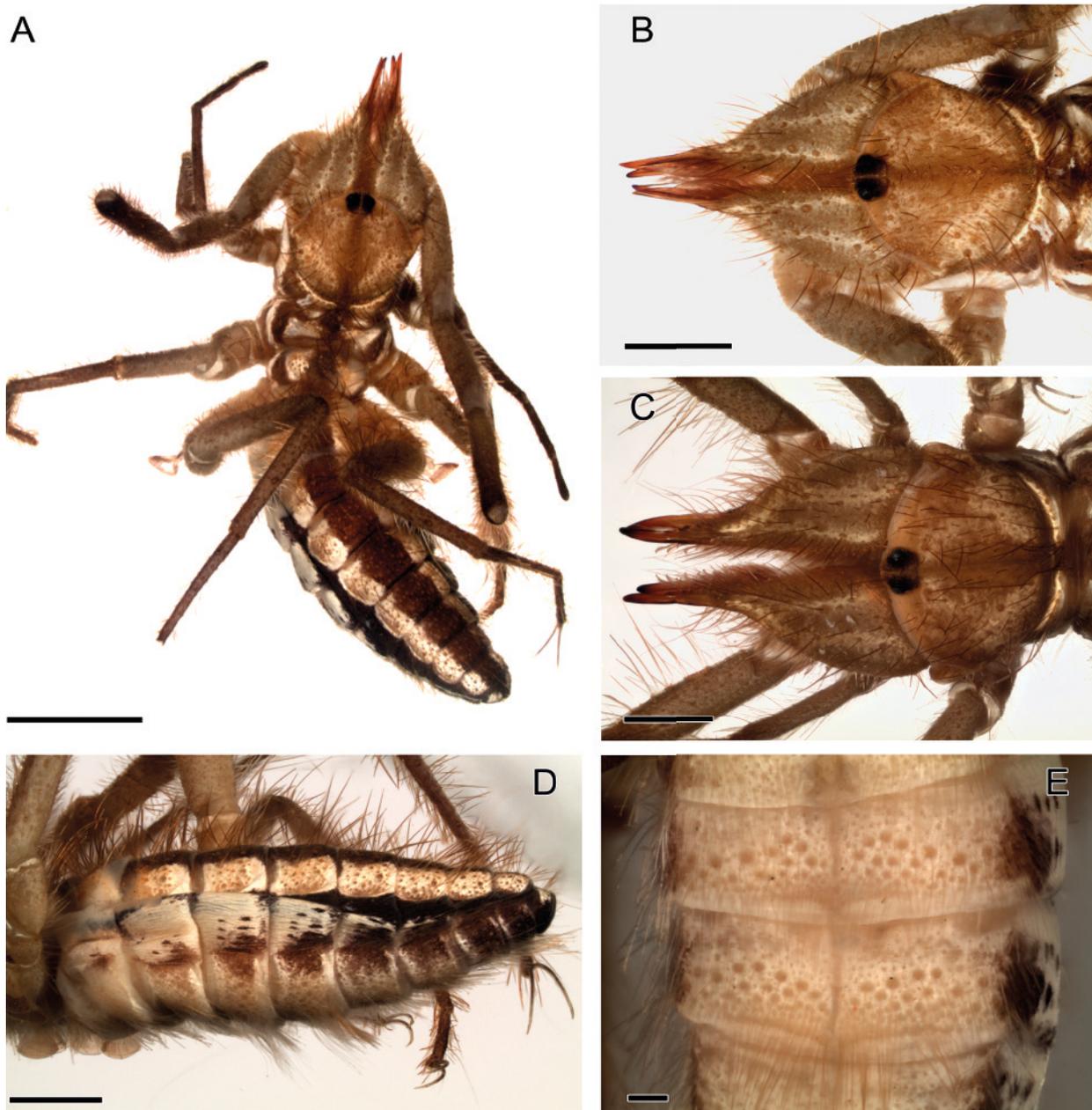
**Distribution.** *Gaucha avexada* sp.nov. is known from Jaborandi and São Félix do Tocantins, respectively in the states of Bahia and Tocantins, Brazil (Fig. 5).

#### 5.1.2.2. *Gaucha eremolembra* sp.nov.

Figs. 2C,D, 5, 22, 23; Table 2

**Type material. Holotype:** male from BRAZIL: Minas Gerais: Januária, Parque Nacional Cavernas do Peruaçu, 15°01'40"S 44°15'11"W, vii.2009, R.S. Recoder & M. Teixeira Jr. (UFMG 15923). **Paratypes:** same data as holotype, 4 males, 2 females (UFMG 15924), 3 males, 2 females (UFMG 19271).

**Additional material examined. BRAZIL: Minas Gerais:** Januária, Rio Pandeiros, 15°28'01.42"S 44°16'57.54"W, v.2002, F. Leite, 1 male (UFMG 5900).



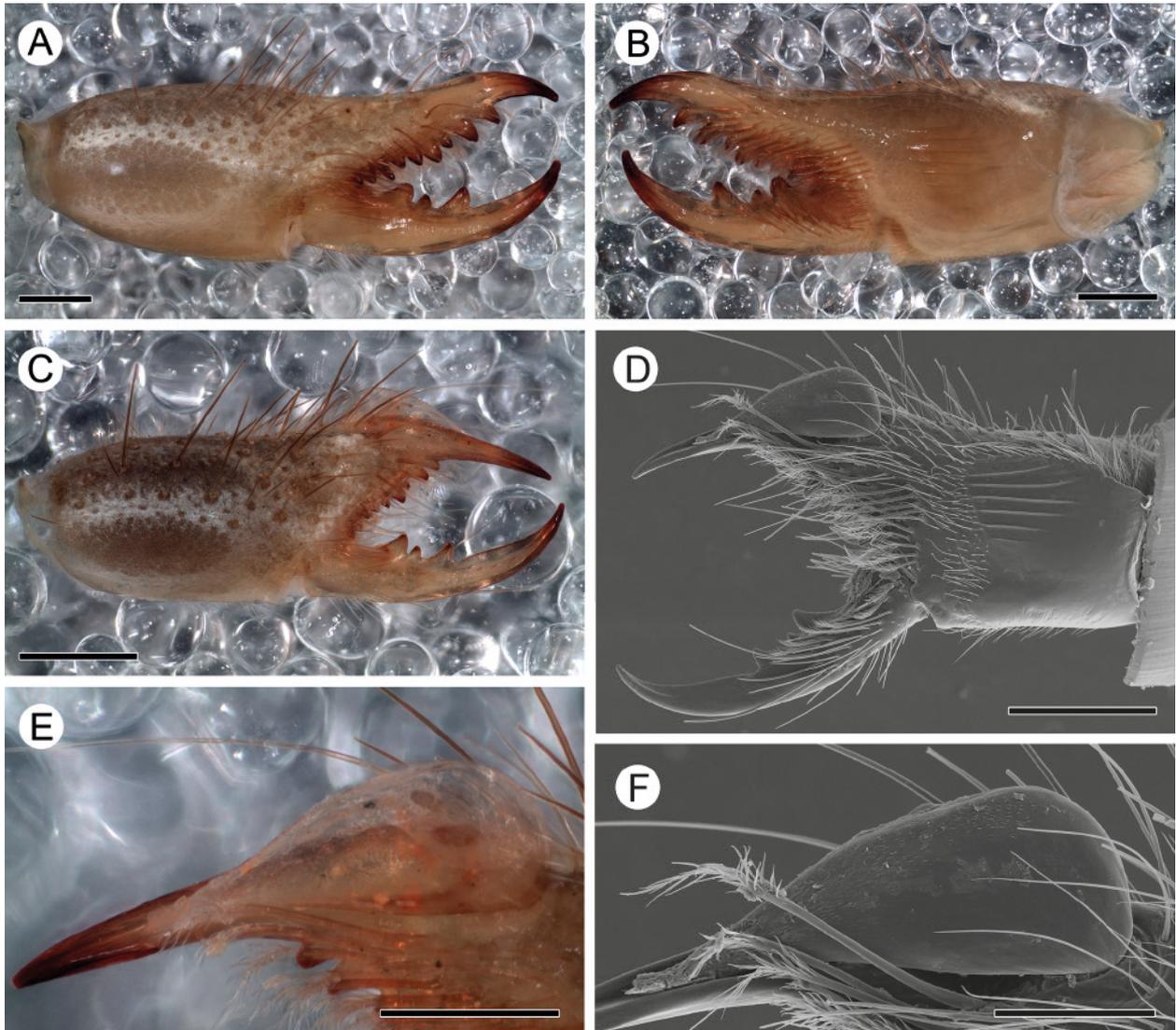
**Fig. 22.** *Gaucha eremolembra* sp.nov. **A:** Male holotype, habitus, dorsal aspect (UFMG 15923). **B:** Male holotype, propeltidium and chelicerae, dorsal aspect. **C:** Ibid. for female paratype (UFMG 19271). **D:** Male holotype, opisthosoma, lateral aspect. **E:** Male holotype, opisthosoma, 3<sup>rd</sup> and 4<sup>th</sup> post-genital sternites. Scale bars: 2 mm (A); 1 mm (B–D); 0.2 mm (E).

**Derivatio nominis.** The specific epithet is inspired in the shape of the chelicerae of males, particularly of the fixed finger mucron, which reminds us of the stilet-like distal shape of the fixed finger of some North American male eremobatid solifuges. The name is formed by part of the family-group name stem, ‘*Eremo*,’ and the Portuguese word for ‘remind,’ ‘*lembra*’.

**Differential diagnosis.** Males of *Gaucha eremolembra* sp.nov. can be recognized from other species in the *ibirapemussu* group by having the fixed finger mucron remarkably long, thin and straight (stilet-like) (Fig. 23C–E); FM and FD teeth of small size (Fig. 23C); fixed finger prodorsal carina straight on dorsal view, not bent

laterally; MM tooth larger than MSM (Fig. 23C,D); flagellum with apex very narrow and conspicuous spicules along prodorsal margin (Fig. 23E,F).

**Description. Male:** Metric data in Table 2. **Color:** On 80% ethanol-preserved specimens. Propeltidium base color yellowish brown, with brownish median area without well-defined borders which is surrounded by white pigment interspersed; ocular tubercle brownish, darker around the eyes. Chelicerae with manus predominantly brownish with a few lighter areas; fingers reddish. Meso-, metapeltidium, and dorsal surface of opisthosoma with a three-dark-band design typical of the family: tergites with median, longitudinal brown band, and paired, thinner lat-



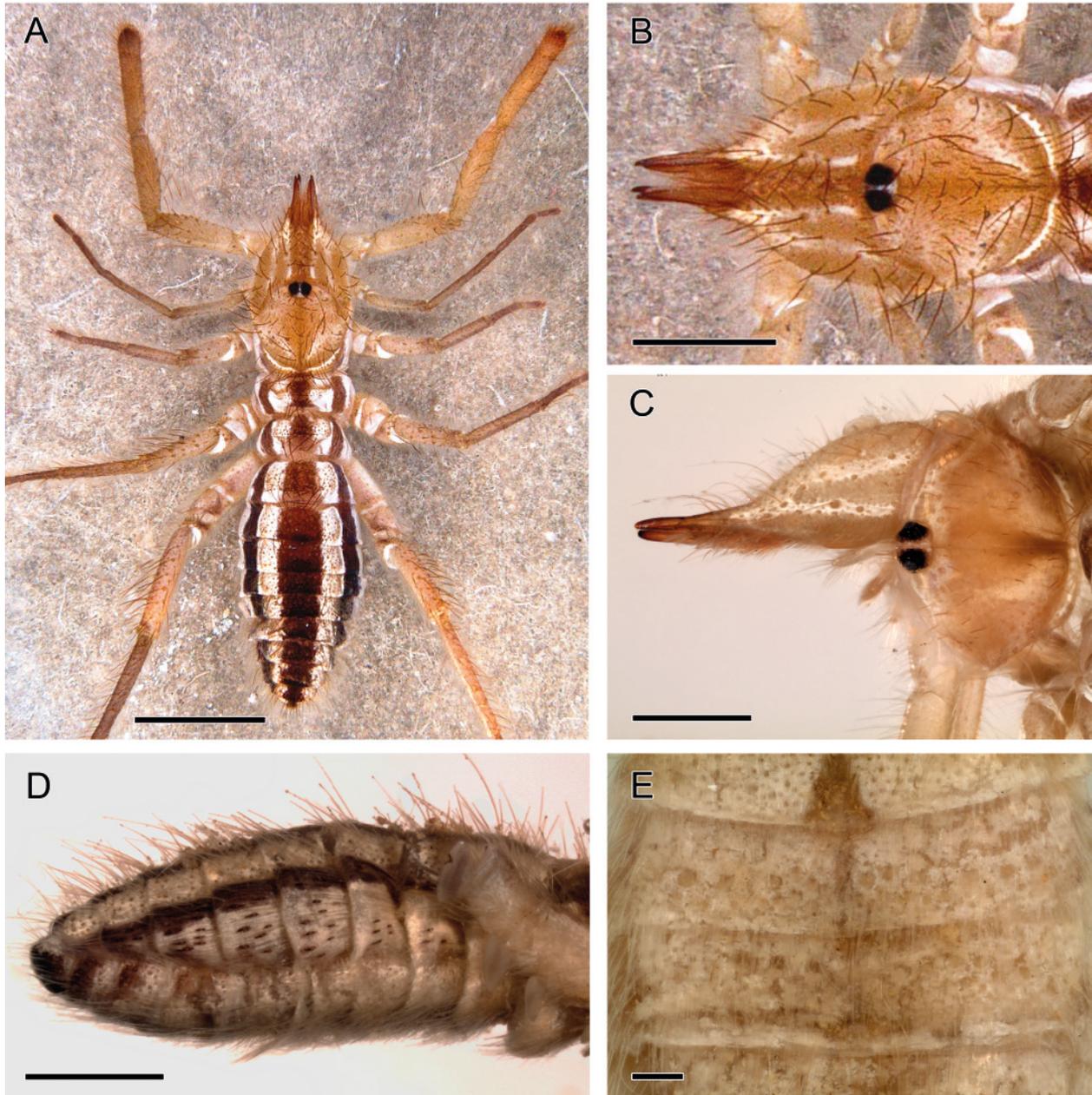
**Fig. 23.** *Gaucha eremolembra* sp.nov., chelicerae. **A,B:** Right chelicera of female paratype (UFGM 19271). **A:** Retrolateral aspect. **B:** Prolateral aspect. **C–F:** Right chelicera of male paratype (UFGM 19271). **C:** Retrolateral aspect. **D:** Prolateral aspect (under SEM). **E:** Flagellum. **F:** Ibid. (under SEM). Scale bars: 0.5 mm (A–D); 0.3 mm (E); 0.2 mm (F).

eral whitish bands, the latter with some brown pigment interspersed; pleural membranes with sub-dorsal black and sub-ventral white bands; white band of opisthosomal pleural membrane with black marks surrounding the socket of most setae, and black pigment along the inter-segmental transversal vertices especially on posterior half; sternites base color yellowish, with lateral margins conspicuously darkened especially on two/three posteriormost sternites, and preanal sternite entirely dark; anal plate dark except for dorsal white regions. Ventral aspect of prosoma uniformly yellowish; sternum lighter than coxae. Pedipalps and legs brownish especially on dorsal and prolateral surfaces, lighter on ventral and retrolateral surfaces; pedipalp with telotarsus and distal half of basitarsus darker than the rest of pedipalp. Malleoli predominantly whitish, often with distal margin darkened. **Chelicerae:** Fixed finger with FP, FM and FD primary teeth, none noticeably elongated, the latter smaller such that  $FP \approx FM > FD$ . Fixed finger FSD secondary tooth absent. Fixed finger prodorsal carina predominantly straight; mucron remark-

ably long, thin and straight (stilet-like). Movable finger MP tooth pronounced, moderately higher than MM; MM tooth approximately as broad as high, sharpened. Chelicera, prolateral surface with carpet-like field of promedial (*pm*) setae covering the distalmost quarter of manus. Flagellum moderately inflated posteriorly and medially, with dorsal margin curved on lateral aspect; ventral margin slightly sinuous. Flagellum with moderate-sized spicules along prodorsal margin only; apex of the flagellum reaching about midway between the apex of the mucron and FD tooth; apex very narrow and with evident spicules.

**Female:** Metric data in Table 2. Similar to males but larger in size. Chelicera on lateral aspect, fixed finger highest elevation at level of FD tooth. Fixed finger robust, markedly curved towards the venter. Movable finger MP tooth moderately higher than MM tooth; movable finger retrolateral carina more distinct than in male.

**Variation.** All the chelicerae of males ( $n = 18$  chelicerae) and females ( $n = 8$ ) were confirmed to lack the fixed fin-



**Fig. 24.** *Gaucha ibirapemussu* (Carvalho et al., 2010) **comb.nov.** **A:** Male, habitus, dorsal aspect. **B:** Male, propeltidium and chelicerae, dorsal aspect. **C:** Ibid. for female paratype [MPEG(Sol)000012]. **D:** Male paratype, opisthosoma, lateral aspect [MPEG(Sol)000014]. **E:** Male paratype, opisthosoma, 3<sup>rd</sup> and 4<sup>th</sup> post-genital sternites [MPEG(Sol)000014]. Scale bars: 2 mm (A); 1 mm (B–D); 0.2 mm (E).

ger FSD tooth. One female chelicerae had a small process resembling the FSD tooth; however, it is placed right on the trunk of FD (and not between FM and FD) so it is considered an abnormality of such tooth in that specimen.

**Teratology.** In one male specimen (UFMG 15924), the fixed finger of the right chelicera is markedly shorter than the movable finger, and the flagellum and some teeth are lacking (including FP). The specimen's left chelicera is normal.

**Distribution.** *Gaucha eremolembra* **sp.nov.** is known from Parque Nacional Cavernas do Peruaçu and Rio Pandeiros, Januária, Minas Gerais, Brazil (Fig. 5).

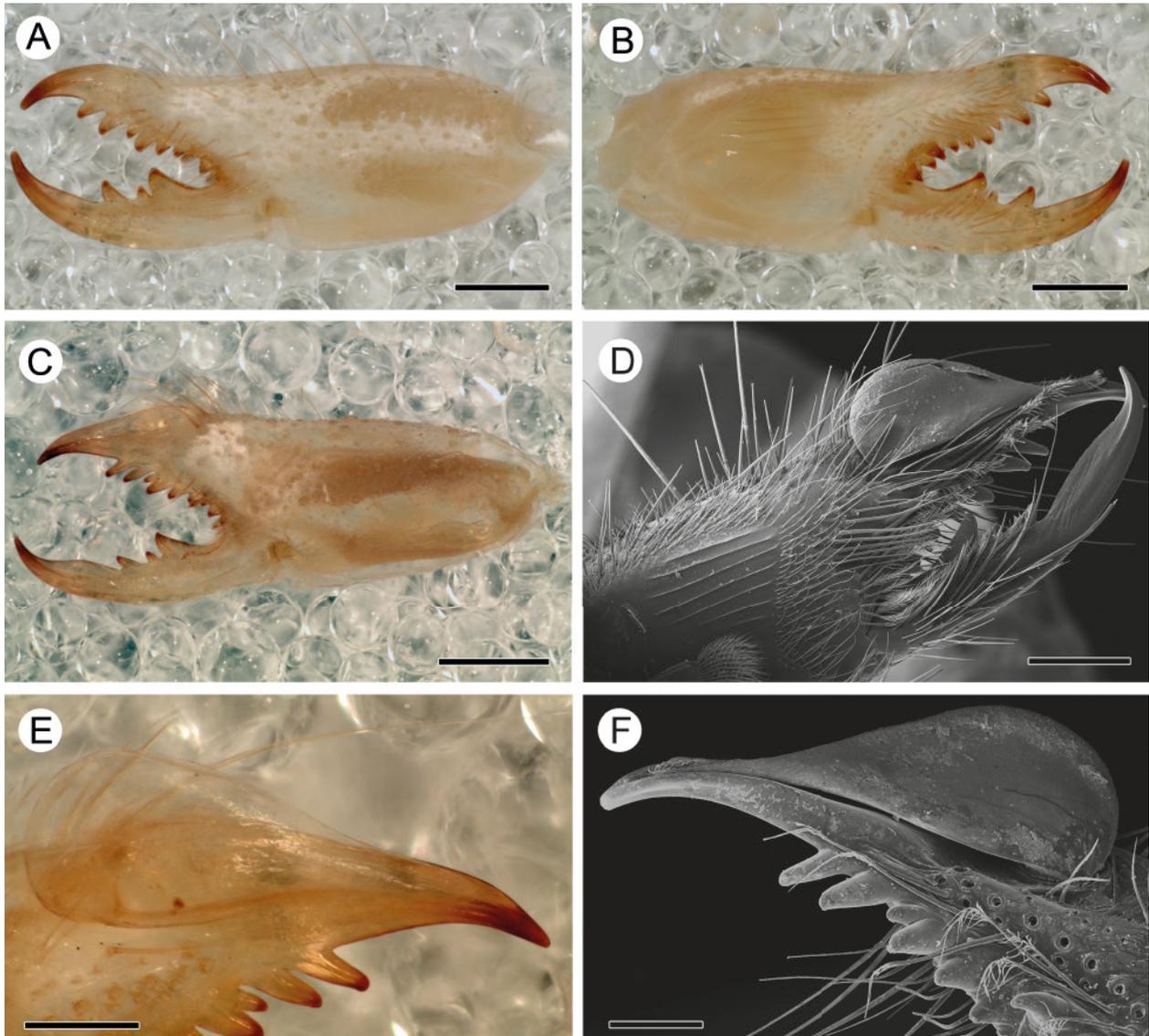
**Notes.** The specimen from Rio Pandeiros is lighter than the specimens from the type locality. No other morphological differences were identified and both populations are considered to belong to the same species.

**5.1.2.3. *Gaucha ibirapemussu* (Carvalho et al., 2010) **comb.nov.****

Figs. 2A,B, 5, 24, 25; Table 2

*Mummucia ibirapemussu* Carvalho, Candiani, Bonaldo, Suesdek & Silva, 2010: 21–30, figs. 2–27.

*Mummucia ibirapemussu*: BOTERO-TRUJILLO 2014: 330; BIRD et al. 2015: 76.



**Fig. 25.** *Gaucha ibirapemussu* (Carvalho et al., 2010) **comb.nov.**, chelicerae. **A,B:** Left chelicera of female paratype [MPEG(Sol)000012]. **A:** Retrolateral aspect. **B:** Prolateral aspect. **C:** Left chelicera of male paratype, retrolateral aspect [MPEG(Sol)000011]. **D:** Left chelicera of another specimen, prolateral aspect (under SEM). **E:** Left flagellum of male paratype [MPEG(Sol)000011]. **F:** Right flagellum in another specimen (under SEM; from CARVALHO et al. 2010). Scale bars: 0.5 mm (A–C); 0.3 mm (D); 0.2 mm (E); 0.15 mm (F).

*Mummucia anaityaia*: Used by CARVALHO et al. (2010: fig. 29) (as *M. anaityaia*) (**nomen nudum**).

*Mummucia tyaiassu*: Used by CARVALHO et al. (2010: fig. 29 [legend]) (**nomen nudum**).

**Type material. Holotype** (not examined): male from BRAZIL: Piauí: Guaribas/Caracol, Parque Nacional Serra das Confusões, 09°03'55"S 43°46'31"W, vi–vii.2007, P.R.R. Silva et al. [MPEG-(Sol)05]. **Paratypes** (examined): same data as holotype, 1 male [MPEG(Sol)09], 1 female [MPEG(Sol)10], 1 male [MPEG(Sol)11], 1 female [MPEG(Sol)12], 1 female [MPEG(Sol)13], 1 male [MPEG(Sol)14], 2 males [MPEG(Sol)15].

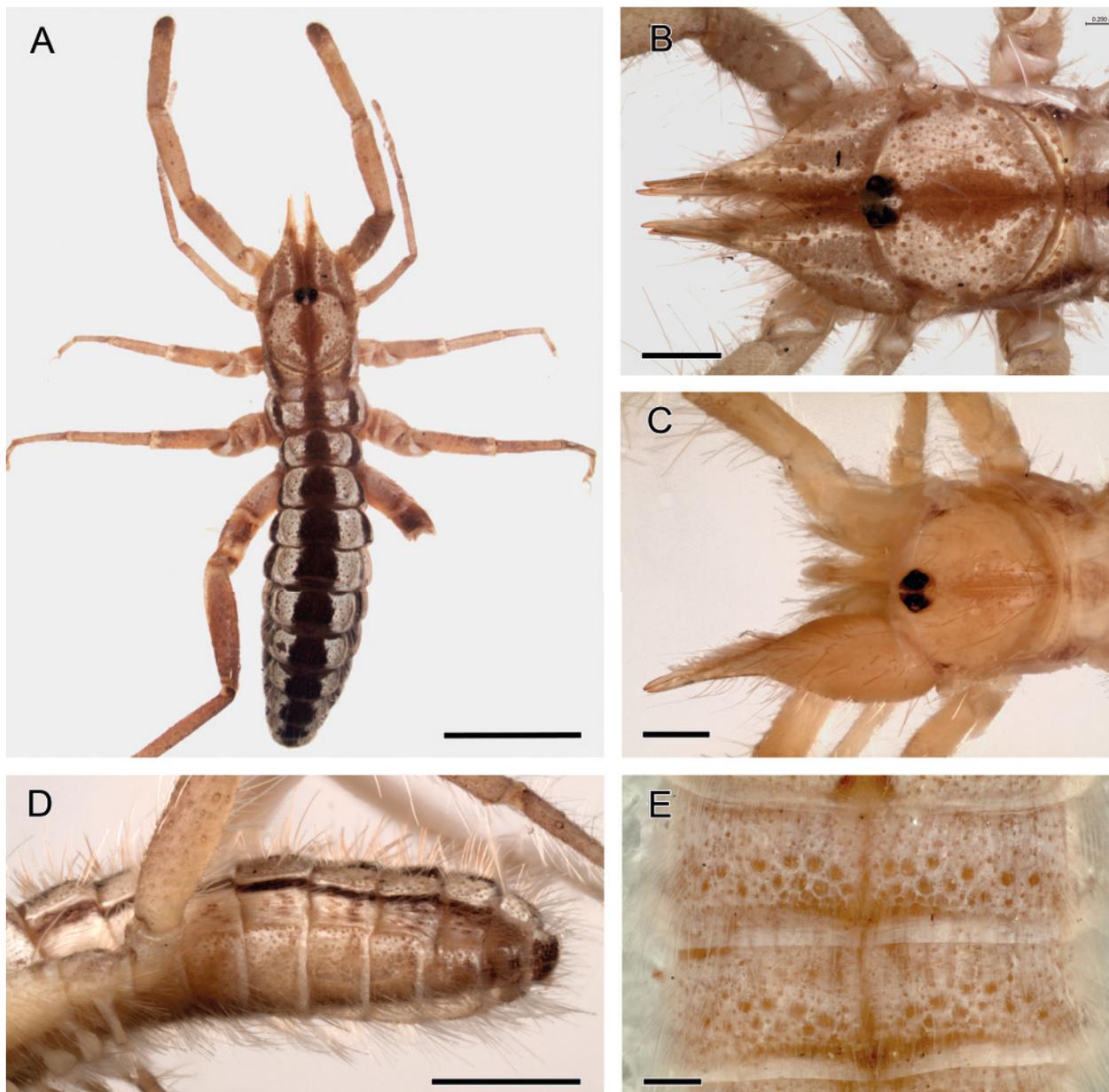
**Additional material examined. BRAZIL:** same data as holotype, 3 males (CHNUFPI 0994), 1 male (CHNUFPI 1192), 1 male (CHNUFPI 2053).

**Revised differential diagnosis.** Males of *Gaucha ibirapemussu* **comb.nov.** can be recognized from other spe-

cies in the *ibirapemussu* group by having the fixed finger mucron moderately long, with apex (FT tooth) directed towards the apex of movable finger (MT tooth) (Fig. 25C,E); FM and FD teeth moderately elongated (Fig. 25C,E); fixed finger prodorsal carina straight on dorsal view, not bent laterally; MM tooth larger than MSM (Fig. 25C); flagellum with distal part very narrow and tubular in appearance, predominantly spicule-less on prolateral aspect except for moderate spicules along prodorsal margin and on apex (Fig. 25E,F).

**Description.** Refer to CARVALHO et al. (2010). Metric data in Table 2.

**Variation.** All the chelicerae of males ( $n = 19$  chelicerae) and females ( $n = 3$ ) were confirmed to lack the fixed finger FSD tooth.



**Fig. 26.** *Gaucha mauryi* (Rocha, 2001) **comb.nov.** **A:** Male, habitus, dorsal aspect [MZUFBA(ARC)12]. **B:** Male, propeltidium and chelicerae, dorsal aspect [MZUFBA(ARC)12]. **C:** Ibid. for juvenile (female) [MZUFBA(ARC)16]. **D:** Male, opisthosoma, lateral aspect [MZUFBA(ARC)13]. **E:** Male, opisthosoma, 3<sup>rd</sup> and 4<sup>th</sup> post-genital sternites [MZUFBA(ARC)12]. Scale bars: 2 mm (A); 0.5 mm (B–C); 1 mm (D); 0.2 mm (E).

**Distribution.** *Gaucha ibirapemussu* **comb.nov.** is known only from the type locality, Parque Nacional Serra das Confusões, Piauí, Brazil (Fig. 5).

**5.1.2.4. *Gaucha mauryi* (Rocha, 2001) comb.nov.**

Figs. 5, 26, 27; Table 2

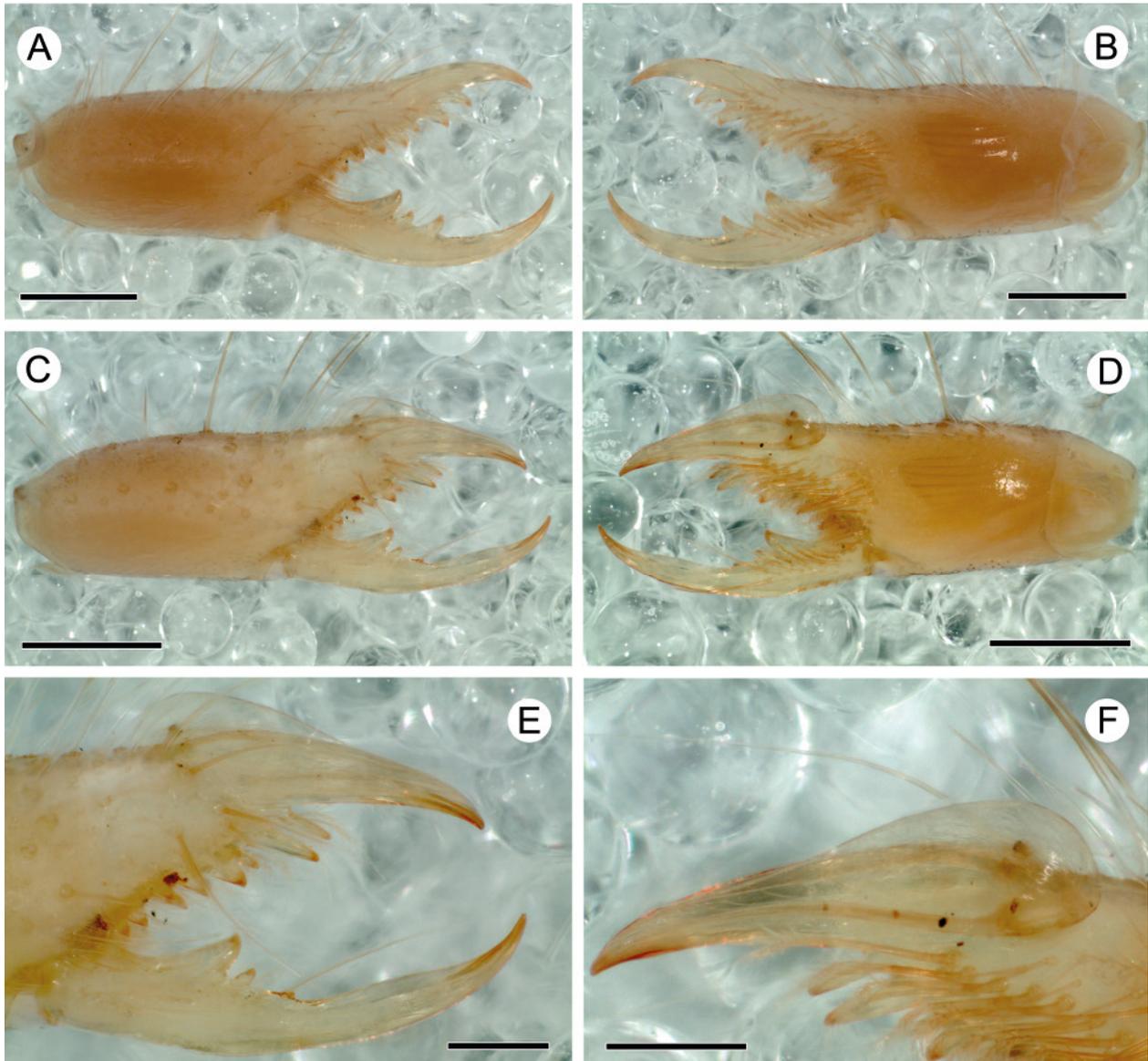
*Mummucia mauryi* Rocha, in Xavier & Rocha, 2001: 129–131, figs. 1–10.

*Mummucia mauryi*: ROCHA & CANCELLO 2002c: 4; HARVEY 2003: 290; MARTINS et al. 2004: 2362, 2372, 2373, 2374; ROCHA & CARVALHO 2006: 166; RODRIGUES et al. 2007: 803; CATENAZZI et al. 2009: 157; CARVALHO et al. 2010: 19, 21, 24, 25; BOTERO-TRUJILLO 2014: 330; BIRD et al. 2015: 103; BOTERO-TRUJILLO 2016: 225.

*Mummucia* sp.: ROCHA & CANCELLO 1999: 88 (as “*Mummucia* sp.n.2”).

**Type material. Holotype** (examined): male from BRAZIL: Bahia: Ibiraba, western side of São Francisco River, 10°48’S 42°50’W, ii.1996, P. Rocha (MZUSP 16470). **Paratypes** (not examined): same locality as holotype, E. Xavier, ii.1996, 1 male, 1 female (MZUSP 15784), 2 females (MZUSP 15932); same data as holotype, P. Rocha, 25.ii.1996, 1 male (MZUSP 16471), 2 males (MZUSP 16472); same data as holotype, E. Xavier, 11.xii.1996, 1 male (MZUSP 16473); same data as holotype, E. Xavier, 12.xii.1996, 1 male (MZUSP 16474).

**Additional material examined. BRAZIL: Bahia:** Barra, Vila de Ibiraba, Dunas do Médio São Francisco, 10°48’00”S 42°50’00”W, 05.xii.1996, 1 female [MZUFBA(ARC)04], 1 male [MZUFBA(ARC)05], 1 male [MZUFBA(ARC)12], 1 male



**Fig. 27.** *Gaucha mauryi* (Rocha, 2001) **comb.nov.**, chelicerae. **A,B:** Right chelicera of juvenile (female) [MZUFBA(ARC)16]. **A:** Retrolateral aspect. **B:** Prolateral aspect. **C–F:** Right chelicera of male [MZUFBA(ARC)13]. **C:** Retrolateral aspect. **D:** Prolateral aspect. **E:** Detail of fingers, retrolateral aspect. **F:** Flagellum. Scale bars: 0.5 mm (A–D); 0.2 mm (E,F).

[MZUFBA(ARC)13], 1 female [MZUFBA(ARC)14], 1 juvenile (female) [MZUFBA(ARC)16].

**Revised differential diagnosis.** Males of *Gaucha mauryi* **comb.nov.** can be recognized from other species in the *ibirapemussu* group by having the fixed finger mucron remarkably long, with apex (FT tooth) gently curved towards the apex of movable finger (MT tooth) (Fig. 27C,E); FM and FD teeth exceptionally elongated (Fig. 27E); fixed finger prodorsal carina straight on dorsal view, not bent laterally; MM tooth much reduced, smaller than MSM (Fig. 27E); flagellum with apex very narrow and tubular in appearance (Fig. 27F).

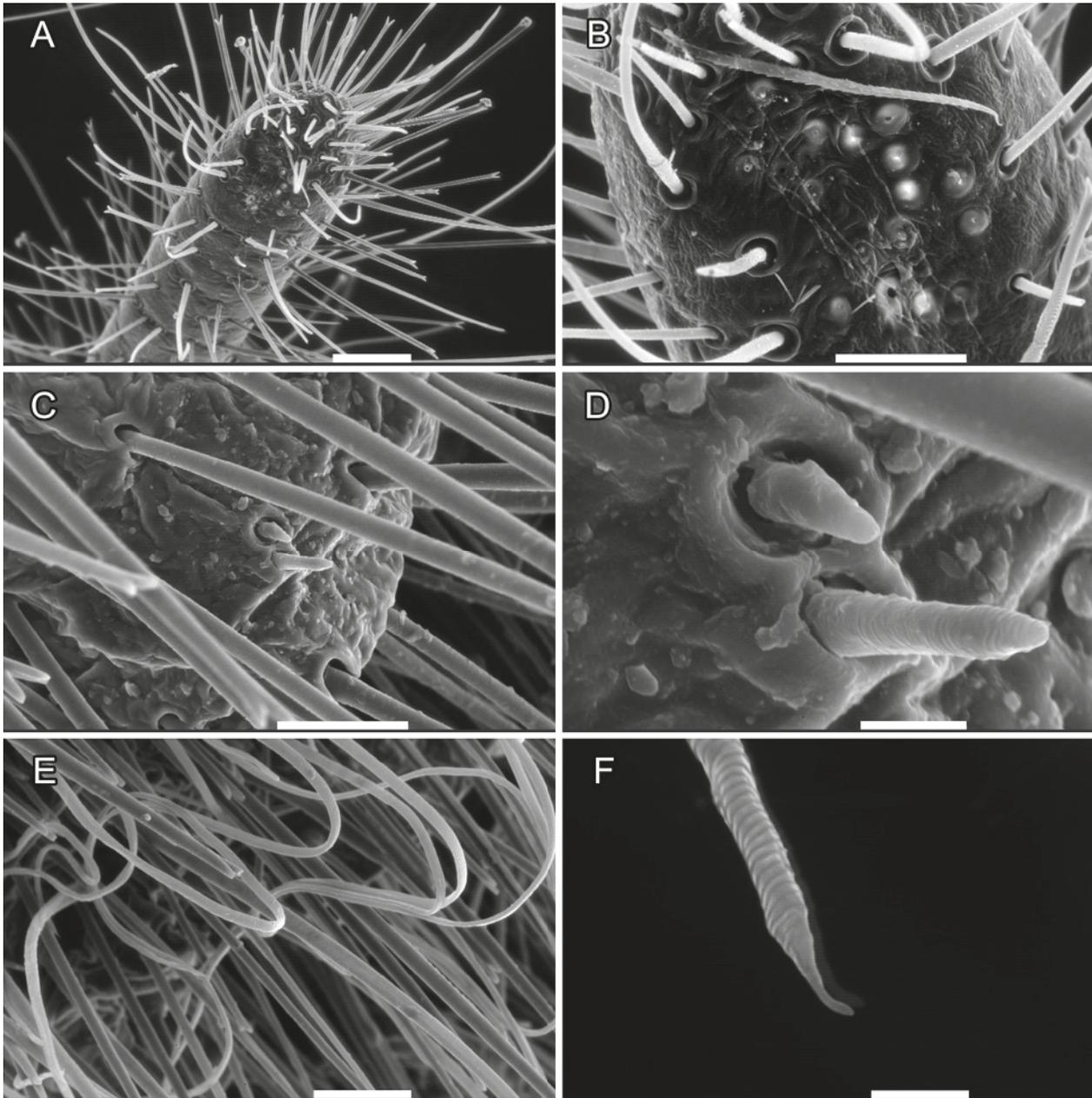
**Description.** Refer to XAVIER & ROCHA (2001). Metric data in Table 2.

**Variation.** All the chelicerae of males ( $n = 8$  chelicerae), females ( $n = 3$ ) and juveniles ( $n = 1$ ) were confirmed to lack the fixed finger FSD tooth.

**Distribution.** *Gaucha mauryi* **comb.nov.** is known only from the type locality, Ibiraba, Bahia, Brazil (Fig. 5).

**Notes.** In none of the specimens of *M. mauryi* **comb.nov.** that we examined were there any ctenidia identified in 1<sup>st</sup> post-genital (spiracular I) or 5<sup>th</sup> post-genital (post-spiracular III) sternites. Several setae are broken off the sternites and it is possible that the ctenidia have fallen from these sternites.

Due to the few specimens available for study, SEM imaging of the chelicera of *G. mauryi* **comb.nov.** was not conducted. Whether spicules are present or absent



**Fig. 28.** *Gaucha fasciata* Mello-Leitão, 1924, SEM images of males (MCN). **A:** Leg I telotarsus. **B:** Ibid., detail of pore area. **C:** Sternal microsetae. **D:** Ibid. zoomed in. **E:** Ctenidia (only the curled setae-like structures, the straight ones correspond to bifid setae). **F:** Ibid., apical portion. Scale bars: 0.1 mm (A); 50  $\mu$ m (B–C); 10  $\mu$ m (D–E); 5  $\mu$ m (F).

in the flagellum could not be determined by traditional stereomicroscopy.

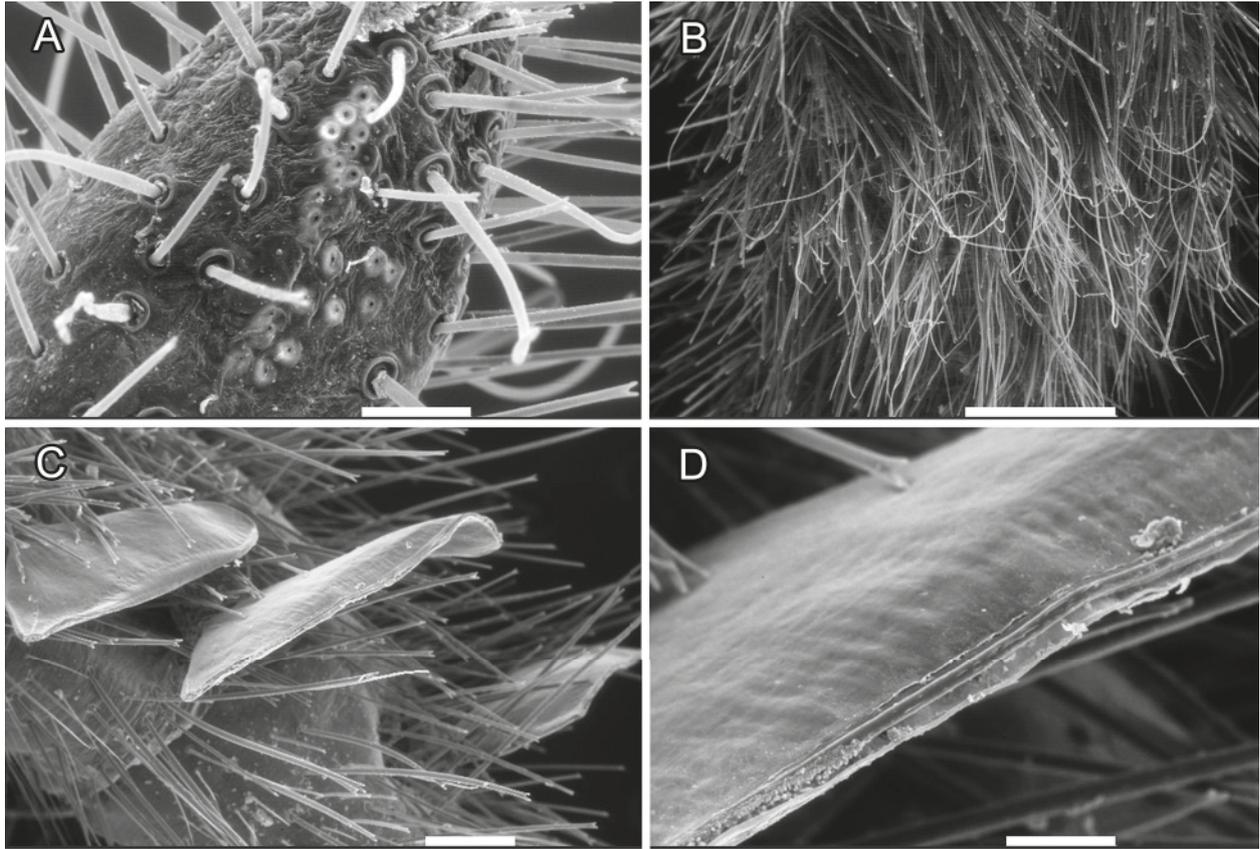
### 5.1.3. Other material examined of unidentified *Gaucha* species

Figs. 4, 6

The list below includes all other materials of *Gaucha* that we examined but of which the specific identity remains to be determined. Most of these samples consist of female or juvenile specimens only, and therefore cannot be studied in the context of the male-based species identification system used in this contribution. The identity of the

*Gaucha* cf. *fulvipes* specimens is pending clarification, as explained above (section 5.1.1.4.) Few males are available from Uruguay, all of which belong to the *fasciata* species-group. Given the scarce number of specimens from that country and that some are not in good condition, we abstain from making taxonomic decisions for those until more material becomes available. Specimens from Santana do Livramento also belong to the *fasciata* species-group; these are currently undergoing additional studies to clarify their specific identity.

***Gaucha* cf. *fulvipes*:** BRAZIL: Mato Grosso: Chapada dos Guimarães, 17.vii.2001, Rafael Carlo Francisco, 1 female (MCTP-PU-CRS 00009 [in part]). Chapada dos Guimarães, 6 males, 2 females



**Fig. 29.** *Gaucha curupi* sp.nov., SEM images of males (MCN). **A:** Leg I telotarsus, pore area. **B:** Opisthosoma, ventral aspect showing ctenidia. **C:** Malleoli on leg IV. **D:** Ibid. with apical border zoomed in. Scale bars: 50 µm (A,D); 0.1 mm (B); 0.2 mm (C).

(MCTP-PUCRS); 3 males, 1 female, 1 juvenile (MCTP-PUCRS 00009 [in part]).

**Gaucha** sp.: **BOLIVIA: Cochabamba:** between Tocota and Aiquile, 22.x.1983, A Roig, 1 juvenile (MACN-Ar). **BRAZIL: Bahia:** São Desidério, Sítio do Rio Grande, x.2009, M.A. Freitas, 1 female (CHNUFPI 1194). Abaíra, Mata da Tijuquinha, Serra do Barbado, Distrito de Catolés, 1678 m elev., 13°16'8.4"S 41°54'39.8"W, 01.xi.2013, L.S. Carvalho & M.B. da Silva, 1 juvenile (CHNUFPI 1193). **Mato Grosso do Sul:** Selviria, Cerrado, 15.iv.1989, J.L.M. Diniz, 1 female (MZUSP 20362). **Piauí:** Castelo do Piauí, ECB Rochas Ornamentais, 05°13'50.8"S 41°42'01.1"W, 03.xii.2005, F.M. Oliveira-Neto, 1 female [MPEG(SOL)03]. **Rio Grande do Sul:** Santana do Livramento, Área de Proteção Ambiental do Rio Ibirapuitã, Fazenda Sr. Caio, basalto, 185 m elev., 30°29'08.99"S 55°34'35.51"W, 29.xi.2013, R. Ott, 4 males, 2 females, 4 juveniles (MCN-Sol-015). Viamão, Águas Claras, between Estrada da Pimenta and Estrada da Faxina, 1.5 km SW of the Brahma brewery factory (Itapuã Formation, paleodune), 63 m elev., 30°11'05.74"S 50°52'52.60"W, xii.2014, R. Ott & R. Botero Trujillo, 2 juveniles (96% ethanol, MCN). **URUGUAY: Lavalleja:** Cerro El Penitente, in rocky soil, 26.x.1958, L.C. de Zolessi, 1 male (MACN-Ar). **Rio Negro:** xii.1944, 2 males (MACN-Ar). **Rivera:** surroundings of the city, 25.iii.1963, C.S. Carbonell, 1 juvenile (MACN-Ar).

5.1.4. Key to *Gaucha* species

1 Movable finger mucron of male short, with gnathal edge carina very prominent (Figs. 11C, 13C, 15C, 17A, 19E); male and female cheliceral fixed finger with or without FSD tooth (e.g., Figs. 13A, 15A),

if present, often the size of a minute denticle (Fig. 13C) ..... 2 (*fasciata* species-group)

1' Movable finger mucron of male long, with gnathal edge carina moderately prominent (Figs. 21C, 23C, 25C, 27E); male and female cheliceral fixed finger without FSD tooth (e.g., Figs. 21A, 23A, 25A)

..... 6 (*ibirapemussu* species-group)

2 Fixed finger mucron of male with evident subterminal flange (Fig. 17B,D)

..... *Gaucha fulvipes* comb.nov.

2' Fixed finger mucron of male without subterminal flange (Figs. 11C, 13C, 15C, 19E) ..... 3

3 Fixed finger of male with FP and FM teeth noticeably elongated, FD tooth greatly reduced (Fig. 13C)

..... *Gaucha curupi* sp.nov.

3' Fixed finger of male with FP, FM and FD teeth of average size, none noticeably elongated (Figs. 11C, 15C, 19E) ..... 4

4 Flagellum rounded and much inflated (Fig. 11E,F)

..... *Gaucha casuhati* sp.nov.

4' Flagellum moderately inflated (Figs. 15E,F, 19F) ..... 5

5 Flagellum sub-triangular in appearance, with basal portion pronounced dorsally and noticeably elevated (Fig. 15E,F) ..... *Gaucha fasciata*

5' Flagellum drop-like, with basal portion moderately elevated and gently curved dorsally (Fig. 19F) ..... *Gaucha stoeckeli* comb.rest.

- 6 Fixed finger FM and FD teeth of male exceptionally long and narrow; movable finger MM tooth of male greatly reduced, smaller than MSM (Fig. 27E) ..... *Gaucha mauryi* **comb.nov.**
- 6' Fixed finger FM and FD teeth of male small or moderately long; movable finger MM tooth of male larger than MSM (Figs. 21C, 23C, 25C) ..... 7
- 7 Fixed finger mucron of male remarkably thin and straight (stilet-like); FM and FD teeth of male small (Fig. 23C–E) ..... *Gaucha eremolembra* **sp.nov.**
- 7' Fixed finger mucron of male moderately thin, with apex directed towards the apex of movable finger; FM and FD teeth of male moderately elongated (Figs. 21C,E, 25C,E) ..... 8
- 8 Flagellum with apex very broad, densely coated with long spicules (Fig. 21E,F); fixed finger prodorsal carina bent towards the retrolateral surface, such that the apex of the flagellum is placed subdorsally on the finger ..... *Gaucha avexada* **sp.nov.**
- 8' Flagellum with apex very narrow and tubular in appearance, predominantly spicule-less (Fig. 25E,F); fixed finger prodorsal carina straight on dorsal view, not bent laterally ..... *Gaucha ibirapemussu* **comb.nov.**

## 6. Discussion

The count of telotarsal spiniform setae was pivotal for ROEWER'S (1932–1934) classification, and many genera (besides *Gaucha* and its synonyms) were defined based upon these setae. Mummuciid genera have also been traditionally delimited based on the number of 'anterior' (or 'frontal') teeth on the cheliceral fixed finger (i.e., presence or absence of the FSD tooth). Even though the latter character is indeed useful in the taxonomy of the family, it does not suffice to distinguish between the seven genera.

ROCHA & CANCELLO (2002a) reported considerable intraspecific variability in a species of *Gaucha*, and suggested that the telotarsal spination patterns are poor taxonomic discriminators in Mummuciidae. Even though these authors might have made the statement based on examination of specimens that were not conspecific, our observations on *G. fasciata*, *G. fulvipes* **comb.nov.** and *G. stoeckeli* **comb.rest.** also support these authors' observation. In addition, direct examination performed by us of specimens belonging to the type species of all the genera currently recognized in the family, including type specimens of all but *Mummucina*, revealed that the number of spiniform setae on the telotarsi of legs is unreliable to distinguish between genera. The presence of 1.2.2/2.2 spiniform setae on telotarsi of legs II and III and 2.2.2-2/2.2 on that of leg IV is widespread in the family and does not provide resolution to its internal classification (i.e., considering its current composition). BOTERO-TRUJILLO (2016: 223) reported a different count of spiniform

setae for legs II and III of *V. aguilar* (i.e., 1.1.2/2.2); this genus, however, was not defined based on the different setal counts, but was rather defined based on more reliable diagnostic characters (i.e., mostly from the cheliceral morphology). It is clear that, although within-species and within-specimen variations were found to be relatively common in Mummuciidae, deviations from standard setal counts often correspond to morphological anomalies in individual specimens (see 'justification for the new synonymies' in section 5.1.), or are due to setae that are broken off.

MAURY (1982: 125) reported intraspecific variability in the number of spiniform setae present on the telotarsi of the walking legs, in species belonging to four ammotrechid genera (both among conspecific specimens and within a single animal). This author recommended that the counts of spiniform setae should not be given high priority in generic differentiation. MAURY'S (1982) recommendation might have been premature, however; different solifuge taxa can vary widely in level of variation for a given trait. We consider that the extent to which the number of spiniform setae facilitates the definition of supraspecific solifuge taxa requires careful observations (e.g., thorough assessments of intra- and interspecific variability) in sufficiently closely-related and sufficiently distant taxa.

With some exceptions, solifuge species generally exhibit a much conserved morphology on generic, or even familial level, in several body regions (e.g., legs, opisthosoma, propeltidium). Conversely, in many (if not most) males, the chelicerae carry a tremendous amount of information which is of fundamental significance for the taxonomic identification of solifuges (e.g., MUMA 1976; BROOKHART & CUSHING 2004; BIRD et al. 2015). Even though some aspects from the cheliceral morphology of males and females can be captured as discrete characters in a data matrix for phylogenetic analyses (for example, chars. 0–13 in Appendix), it is often difficult to code continuous (metric) traits. This drastically limits the number of morphological characters available for taxonomic and phylogenetic studies. In addition, discrete (meristic) traits often do not suffice to capture all the taxonomically revealing information in solifuges. Adding metric data would therefore greatly benefit solifuge systematics. Geometric morphometrics, as a tool for the study of species-level solifuge taxonomy, has previously been explored and demonstrated useful (CARVALHO et al. 2010). Based on the results obtained from the cladistic analysis here presented, we suggest that the implementation of shape configurations (e.g., in the form of landmark data as in this study) in conjunction with traditional characters, may help to untangle the taxonomy and phylogenetic relationships of these animals. To date, the use of landmark data in solifuge taxonomy remains largely unexplored.

Brazil has a vast territory and mummuciid solifuges have only been recorded from very few localities. The southernmost known records of *Gaucha* are from Buenos Aires province (Argentina) and Rio Grande do Sul (Brazil), whereas other records are from far more northern

localities to the east and west (Figs. 4–6). The inventory of arachnids in Brazil (as in other countries) is heterogeneous and large regions remain without a single record of any arachnid specimen. This is true even for groups that have been traditionally studied in more detail, such as spiders (BRESCOVIT et al. 2011; CARVALHO et al. 2014), scorpions (PORTO et al. 2014) or harvestmen (SOUZA et al. 2014). With this in mind, it is reasonable to assume that several more species of Mummuciidae remain to be discovered across the Brazilian territory.

## 7. Acknowledgements

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**Table 3.** Distribution of states of 20 discrete morphological characters (described in Appendix) among six outgroup and nine ingroup taxa of Mummuciidae included in the cladistic analysis of *Gaucha* Mello-Leitão, 1924.

Taxa	Characters																			
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
<i>Vempironiella aguilarí</i>	0	0	0	1	1	0	0	—	1	—	0	0	0	0	0	—	[0 1]	[0 1]	0	
<i>Mummucia coaraciandu</i>	1	0	0	0	1	0	1	1	0	0	0	1	1	1	?	1	0	0	0	1
<i>Mummucia taiete</i>	1	0	0	0	1	0	1	1	0	0	0	1	1	1	?	1	0	0	0	1
<i>Mummucia variegata</i>	0	0	1	0	1	1	1	1	0	0	0	1	1	1	0	0	—	2	0	1
<i>Mummucina titschacki</i>	0	0	0	0	1	0	1	1	0	0	0	1	1	1	0	1	1	1	1	0
<i>Mummucipes paraguayensis</i>	0	0	0	0	1	0	1	1	0	0	0	1	1	1	1	1	0	0	0	1
<i>Gaucha avexada</i> sp.nov.	0	0	0	0	0	0	1	0	0	0	1	1	1	1	1	1	0	0	0	1
<i>Gaucha casuhati</i> sp.nov.	0	0	0	0	[0 1]	0	1	0	0	0	2	1	1	1	1	1	0	0	0	1
<i>Gaucha curupi</i> sp.nov.	0	0	0	0	1	0	1	0	0	0	2	1	1	1	1	1	0	0	0	1
<i>Gaucha eremolembra</i> sp.nov.	0	0	0	0	0	0	1	0	0	0	1	1	1	1	1	1	0	0	0	1
<i>Gaucha fasciata</i>	0	0	0	0	[0 1]	0	1	0	0	0	2	1	1	1	1	1	0	0	0	1
<i>Gaucha fulvipes</i> comb.nov.	0	1	0	0	0	?	1	0	0	0	2	1	?	?	?	1	0	0	0	1
<i>Gaucha ibirapemussu</i> comb.nov.	0	0	0	0	0	0	1	0	0	0	1	1	1	1	1	1	0	0	0	1
<i>Gaucha mauryi</i> comb.nov.	0	0	0	0	0	0	1	0	0	1	1	1	1	1	?	1	0	0	0	1
<i>Gaucha stoeckeli</i> comb.rest.	0	0	0	0	0	0	1	0	0	0	2	1	1	1	?	1	0	0	0	1

## 9. Appendix

List of 22 morphological characters used for the cladistic analysis of *Gaucha* Mello-Leitão, 1924. Standard (discrete) characters (chars. 0–19) are unordered / non-additive, and measurable on / applicable to male and female unless otherwise specified. Landmark characters (chars. 20, 21) describe the position of individual landmarks for estimating shape configurations on fixed (char. 20) and movable (char. 21) fingers of male (see Fig. 9A,B).

- Male chelicerae, fixed finger, position of FM, FSD (when present) and FD teeth: positioned at same level of other teeth, mound absent = 0; positioned in an elevated mound = 1.
- Male chelicerae, fixed finger, mucron, ventral subterminal flange: absent = 0; present = 1.
- Male chelicerae, fixed finger median apical diastema (FMAD): absent = 0; present = 1.
- Chelicerae, fixed finger retrofondal diastema (FRFD): absent = 0; present = 1.
- Chelicerae, fixed finger, FSD tooth: absent = 0; present = 1.
- Female chelicerae, fixed finger, shape of dorsal surface: curved, without or with obsolete angular dorsal crest = 0; with pronounced angular dorsal crest = 1.
- Chelicerae, movable finger, MM tooth: absent = 0; present = 1.
- Chelicerae, movable finger, relative size of MP and MM teeth: MP distinctly taller than MM (sometimes mostly evident in male, but also in female) = 0; MP and MM subequal in size (in male and female) = 1.
- Chelicerae, movable finger, development of MSM tooth: moderately pronounced and upright (subtriangular) = 0; markedly pronounced and columnar = 1.
- Male chelicerae, movable finger, size of MM tooth relative to MSM: MM larger than MSM = 0; MM much reduced, smaller than MSM = 1.
- Male chelicerae, movable finger, mucron, development of gnathal edge carina (ordered / additive): obsolete = 0; moderately convex = 1; markedly convex = 2.
- Chelicerae, movable finger, retrolateral carina: obsolete, represented by shallow granules on base of finger and edge carina on apex = 0; evident, without interruption between basal granules and apical edge carina (mostly evident in female but also in male) = 1.
- Female chelicerae, movable finger, mucron, development of gnathal edge carina: obsolete, identified only by a sclerotized line such that the mucron is cylindrical = 0; evident, identified by pronounced angle formed by adjacent surfaces = 1.
- Female chelicerae, movable finger, position of teeth: all teeth in basal third of finger = 0; all teeth in median third of finger = 1.
- Opisthosoma, spiracular sternite I (1<sup>st</sup> post-genital sternite), ctenidia: absent = 0; present = 1.
- Opisthosoma, spiracular sternite II (2<sup>nd</sup> post-genital sternite), ctenidia: absent = 0; present = 1.
- Male opisthosoma, spiracular sternite II (2<sup>nd</sup> post-genital sternite), ctenidia: filiform throughout (barely recognizable from other setae) = 0; moderately thickened on basal portion = 1.
- Male opisthosoma, post-spiracular sternite I (3<sup>rd</sup> post-genital sternite), ctenidia (ordered/additive): filiform

and flexible throughout (barely recognizable from other setae) = 0; moderately thickened on basal portion and flexible = 1; markedly thickened on basal portion, flexible in distal portion = 2.

18. Male opisthosoma, post-spiracular sternite II (4<sup>th</sup> post-genital sternite), ctenidia: filiform throughout (barely recognizable from other setae) = 0; moderately thickened on basal portion = 1.
19. Opisthosoma, pleural membranes, insertion sockets of setae, surrounding color: insertions surrounded by white pigment (visible in the blackish bands) = 0; insertions surrounded by black pigment (visible in the whitish bands) = 1.
20. Shape configuration estimated on fixed finger of male. *LM1*, *LM3*, *LM4* = Type 1 landmarks; *LM2*, *LM5* = Type 2 landmarks. *LM1*: basal starting point of the prodorsal carina; *LM2*: apex of the fixed finger mucron (FT tooth); *LM3*: basal starting point of the fixed finger mucron (identified by the intersection of the mucron and the anterior slope of FD tooth); *LM4*: intersection point between FP and FSM teeth; *LM5*: center of the retrolateral interdigital condyle (*ric*).

21. Shape configuration estimated on movable finger of male. *LM2*, *LM3* = Type 1 landmarks; *LM1*, *LM4* = Type 2 landmarks; *LM5* = Type 3 landmark. *LM1*: center of the retrolateral interdigital condyle (*ric*); *LM2*: base of the anterior slope of the MP tooth; *LM3*: basal starting point of the movable finger mucron (identified by the intersection of the mucron and the anterior slope of MM tooth, or MSM in *V. aguilari*); *LM4*: apex of the movable finger mucron (MT tooth); *LM5*: placed on ventral surface opposite to *LM3*, corresponds to the point at which a straight line connecting it with *LM3* forms a 90° angle with a line connecting *LM3* with *LM2*.

## Electronic Supplement File

at <http://www.senckenberg.de/arthropod-systematics>

**File 1:** botero&al-solifugae-gaucha-asp2017-electronicssupplement.zip – Zipped file containing **S1A**) Complete data matrix (.tnt format) used in the cladistic analysis. **S1B**) TNT-generated trees, screen-printed, showing individual landmarks for the two shape configurations (chars. 20, 21) that change on each branch, i.e., apomorphies (command *apo!20*; *apo!21*); note that landmarks are numbered 0–4 in the file, instead of 1–5 as in text and figures (i.e., landmark 0 = *LM1*, and so on). **S1C–S1D**) TNT-generated .svg files (commands *lmbbox filename.svg 0 20 line +gpl*; and *lmbbox filename.svg 0 21 line +gpl*;) containing landmark boxes showing the shape configurations of fixed (**S1C**) and movable (**S1D**) fingers of males of terminal taxa, and reconstructions for the internal nodes (HTUs, identified in Fig. 8); blue lines represent apomorphic displacements of landmarks.

## Zoobank registrations

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***Gaucha curupi* Botero-Trujillo, Ott & Carvalho, 2017:** <http://zoobank.org/urn:lsid:zoobank.org:act:3282D6B9-D70B-4896-A7A4-259EEE5A858E>

***Gaucha avexada* Botero-Trujillo, Ott & Carvalho, 2017:** <http://zoobank.org/urn:lsid:zoobank.org:act:C4E87E06-1AB6-4BA5-BA0D-F5A05DD78A0B>

***Gaucha eremolembra* Botero-Trujillo, Ott & Carvalho, 2017:** <http://zoobank.org/urn:lsid:zoobank.org:act:CDC32F6A-77A6-48E0-BA3D-796A68A6AB62>