



Two new species of the sun-spider genus *Gaucha* from Argentina and Brazil (Solifugae, Mummuciidae)

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Abstract

Two new species in the South American sun-spider family Mummuciidae are herein described. *Gaucha ramirezi* **sp. nov.** is known from the Chancaní Provincial Park and Forest Reserve, Córdoba province, Argentina, and further reported for a single locality to the northeast, in Santiago del Estero province. The systematic position of this species is uncertain and it is not assigned to any species-group of *Gaucha* Mello-Leitão, 1924. The other species, *Gaucha santana* **sp. nov.**, is only known from the Ibirapuitã Environmental Protection Area, in the southern Brazilian state of Rio Grande do Sul, and is a member of the *fasciata* species-group. With these descriptions, the number of known species of *Gaucha* is raised to eleven.

Key words: Solifuges, Chancaní Park and Reserve, Ibirapuitã Environmental Protection Area, Santana do Livramento, taxonomy, DNA barcode

Introduction

Mummuciidae is one of four solifuge families present in the New World and the only one which is unique to South America. Members of this family have been recorded from Argentina, Bolivia, Brazil, Chile, Ecuador, Paraguay, Peru and Uruguay (Roewer 1934; Mello-Leitão 1938; Harvey 2003; Botero-Trujillo *et al.* 2017). Four of seven genera thus far recognized still remain monotypic: *Cordobulgida* Mello-Leitão, 1938, *Mummucipes* Roewer, 1934, *Uspallata* Mello-Leitão, 1938 and *Vemprioniella* Botero-Trujillo, 2016. Two others, *Mummucia* Simon, 1879 and *Mummucina* Roewer, 1934, comprise five species each; however, the former has been demonstrated to be not monophyletic (Botero-Trujillo *et al.* 2017). One other genus, *Gaucha* Mello-Leitão, 1924, remains as the most speciose thus far, with nine known species.

The known taxonomic diversity of Mummuciidae is far from being an accurate estimation of this family’s generic and specific diversity, as revealed in a comprehensive revisionary study (Botero-Trujillo 2018 [unpublished]). With only one published work having addressed the classification of Mummuciidae in a phylogenetic framework (Botero-Trujillo *et al.* 2017), insights on the phylogenetic structure of this family is in its very early stages.

Botero-Trujillo *et al.* (2017) recovered the monophyly of *Gaucha*, for which they proposed a morphological redefinition and revised its taxonomic composition. The authors further organized its known diversity, nine species

at that time, into two species-groups. The *fasciata* species-group comprises the type species of *Gaucha* and four others, and is present in Brazil (three species), Argentina (one species) and Bolivia (one species). The *ibirapemussu* species-group comprises four species, all from Brazil. Both groups are currently defined upon aspects of the cheliceral morphology; however, whereas each is supported by transformations on the shape configurations of the fixed and movable fingers, only the *fasciata* species-group is supported by a combination of apomorphic discrete- and landmark data.

In this contribution, we describe two new species of *Gaucha* based on several male and female specimens of both. *Gaucha ramirezi* **sp. nov.** is described from the Chancaní Provincial Park and Forest Reserve and additionally reported for Copo National Park, respectively in the Argentine provinces of Córdoba and Santiago del Estero (Fig. 1). This is the second species of *Gaucha* known from Argentina (the other being *G. casuhati* Botero-Trujillo, Ott & Carvalho, 2017 from Sierra de La Ventana, in Buenos Aires province) and the second mummuciid recorded from Córdoba province (the other is *Cordobulgida bruchi* Mello-Leitão, 1938); meanwhile, it also becomes the first record of this family from Santiago del Estero province. The other species, *Gaucha santana* **sp. nov.**, is described from the Ibirapuitã Environmental Protection Area, in Rio Grande do Sul, Brazil (Fig. 1), and becomes the third species of *Gaucha* known from this Brazilian state (others are *G. fasciata* Mello-Leitão, 1924 and *G. curupi* Botero-Trujillo, Ott & Carvalho, 2017). With these descriptions, the number of known species of *Gaucha* is raised to eleven, two of which are from Argentina and eight from Brazil.

The additions herein presented make necessary to amend the morphological diagnosis of *Gaucha*. Botero-Trujillo *et al.* (2017) reported the presence of black marks on the whitish bands of the opisthosomal pleural membranes as one among various diagnostic features of the genus. While this aspect is shared by all species of *Gaucha* known at that time, *G. ramirezi* **sp. nov.** exhibits white marks on the blackish band (i.e., the inverse pattern), something hitherto restricted to *Mummucina* in “stricto sensu” and *Vempironiella* (Botero-Trujillo 2016; Botero-Trujillo *et al.* 2017). For all other aspects, however, this species fits well in *Gaucha* and into no any other genus, prompting us to minimize the importance that this character has in the generic diagnosis in effect. On account of this very characteristic feature of *G. ramirezi* **sp. nov.** and uncertain about this species’ affinities to other members of the genus, we conservatively abstain from assigning it into any of the two species-groups.



FIGURE 1. Map plotting known locality records of *Gaucha ramirezi* **sp. nov.** and *Gaucha santana* **sp. nov.**

Material and methods

Specimens studied and specifically referred in the present work belong to the following collections: Arachnological Collection of the Museo Argentino de Ciencias Naturales “Bernardino Rivadavia”, Buenos Aires,

Argentina (MACN-Ar); Laboratorio de Biología Reproductiva y Evolución, Instituto de Diversidad y Ecología Animal, CONICET—Universidad Nacional de Córdoba, Córdoba, Argentina (LBRE); Museu de Ciências Naturais, Fundação Zoobotânica do Rio Grande do Sul, Porto Alegre, Brazil (MCN). Apart from the two species herein dealt with, specimens belonging to other *Gaucha* species considered by Botero-Trujillo *et al.* (2017) were examined and directly compared to the new species.

Style and terminology used for the species descriptions follow the most recent taxonomic works on Mummuciidae (Botero-Trujillo 2016; Botero-Trujillo *et al.* 2017). Terminology used for identifying teeth and other structures in the chelicerae follows Bird *et al.* (2015). Identification of individual teeth used Bird *et al.*'s (2015: 83) criteria for primary homology assessment of dentition. In line with recent works (e.g., Bird & Wharton 2015; Botero-Trujillo *et al.* 2017) we use the terms basi- and telotarsus for the pedipalp segments traditionally referred to as metatarsus and tarsus. The term 'ctenidia' stands for long, single-tipped (non-bifid) and flexible setiform structures present on some opisthosomal sternites. It is used in a way different to that of Maury (1984, 1998), who applied this term to a different structure that in members of this family is present along posterior margin of 4th post-genital sternite, and which subsequently has come to be known as a 'row of rigid hairs' (Botero-Trujillo 2016; Botero-Trujillo *et al.* 2017).

Specimens were examined with Leica M165 C and Leica S8AP0 stereomicroscopes. Photographs under visible light and scanning electron micrographs were obtained at the MACN following Botero-Trujillo *et al.* (2017: 10). Photographs of the chelicerae were obtained under the same positioning parameters specified by Botero-Trujillo *et al.* (2017: 10); therefore, these can be used along with images of the chelicerae of other *Gaucha* species published by the mentioned authors, in any shape-based morphometric approach to come in the future. Metric data, in millimeters, were obtained using an ocular micrometer fitted to a Leitz Wetzlar stereomicroscope.

In light of the current interest to inventory biodiversity through DNA barcodes, tissues dissected from selected specimens of *Gaucha* were processed by the International Barcode of Life (iBOL) Argentina (<http://ibol.org/argentina/>) team at the MACN. DNA-quality tissues of *G. ramirezi* **sp. nov.** were not available, and attempts to obtain DNA from 80% ethanol-preserved specimens of this species were unsuccessful. Genomic DNA was extracted, and polymerase chain reaction was performed according to standard procedures summarized by Ramírez & Grismado (2015). Sequencing of the mitochondrial cytochrome c oxidase subunit I (COI) fragment was performed at the Canadian Centre for DNA Barcoding—CCDB (Canada). Sequences were analyzed in the BOLD Systems platform (<http://www.boldsystems.org/>). A Neighbor-Joining clustering of the sequences was generated there, using Kimura 2-parameter distance model and MUSCLE alignment method. BOLD process IDs (i.e., SSA###-##) are specific identifiers within the project "Solifugae of South America," whereby the data and photographic record of voucher specimens are stored.

Data for voucher specimens sequenced for COI marker are as follow:

***Gaucha curupi* Botero-Trujillo, Ott & Carvalho, 2017:** 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, xii.2014, R. Ott & R. Botero Trujillo, 1 juvenile (MCN-Sol-032, tissue sample Sol-M00059, BOLD process ID SSA059-16). São Francisco de Assis, iv–v.2005, R. Ott, 1 juvenile (MCN-Sol-034, tissue sample Sol-M00058, BOLD process ID SSA058-16). 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, 1 juvenile (MCN-Sol-033, tissue sample Sol-M00057, BOLD process ID SSA057-16).

***Gaucha fasciata* Mello-Leitão, 1924:** BRAZIL: Rio Grande do Sul: 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 (MCN-Sol-036, tissue sample Sol-M00060, BOLD process ID SSA060-16); 1 juvenile (MCN-Sol-037, tissue sample Sol-M00061, BOLD process ID SSA061-16). Porto Alegre, Jardim Botânico, granito, 46 m elev., 30°03'13.11" S 51°10'35.18" W, xii.2014, R. Ott & R. Botero Trujillo, 1 male (MCN-Sol-035, tissue sample Sol-M00062, BOLD process ID SSA062-16). 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, 1 juvenile (MCN-Sol-048, tissue sample Sol-M00063, BOLD process ID SSA063-16).

***Gaucha santana* sp. nov.:** See the 'type material' section for this species below.

All COI sequences were deposited in GenBank database (<https://www.ncbi.nlm.nih.gov/genbank/>) with the

following accession numbers, i.e., BOLD process IDs [GenBank accession #]: SSA054-16 [MK246630], SSA055-16 [MK246631], SSA056-16 [MK246632], SSA057-16 [MK246633], SSA058-16 [MK246634], SSA059-16 [MK246635], SSA060-16 [MK246636], SSA061-16 [MK246637], SSA062-16 [MK246638], SSA063-16 [MK246639].

Taxonomy

Family Mummuciidae Roewer, 1934

Genus *Gaucha* Mello-Leitão, 1924

Gaucha Mello-Leitão, 1924: 140–141 (as *Gaucha* [sic]).

Gauchella Mello-Leitão, 1937: 84 (synonymized by Botero-Trujillo *et al.* 2017: 13).

Metacleobis Roewer, 1934: 589 (synonymized by Botero-Trujillo *et al.* 2017: 13).

Mummuciella Roewer, 1934: 583, 587 (synonymized by Mello-Leitão 1937: 84).

Gaucha ramirezi sp. nov.

Figures 1, 2–4; Table 1

Type material. Holotype: male from **ARGENTINA: Córdoba:** Pocho, Parque Natural Provincial y Reserva Forestal Natural Chancaní, forest with livestock, 31°22'21.788" S 65°29'20.706" W, 05–13.xii.2010, M.F. Nime & C.I. Mattoni, pitfall (MACN-Ar 39101). **Paratypes:** same data of holotype, 8 males, 6 females (MACN-Ar); 9 males, 1 female, 2 juveniles (LBRE 401); 7 males, 1 female, 1 juvenile (LBRE 402); 4 males, 1 female, 1 juvenile (LBRE 403); 1 male, 2 females, 1 juvenile (LBRE 404).

Additional material examined. ARGENTINA: Córdoba: Same locality and data of holotype but, 03–09.ii.2011, 1 male, 1 juvenile (LBRE). Parque Natural Provincial y Reserva Forestal Natural Chancaní, mature forest, 31°21'1.192" S 65°28'56.755" W, 12–19.i.2010, M.F. Nime & C.I. Mattoni, pitfall, 7 males, 2 females (MACN-Ar); 5 males, 2 females, 2 juveniles (MACN-Ar); 6 males, 1 female, 1 juvenile (LBRE); 2 males, 1 juvenile (LBRE); 1 female (LBRE); 1 juvenile (LBRE); 1 male (LBRE); 6 males, 8 juveniles (LBRE); 6 males, 1 female, 2 juveniles (LBRE); 1 male, 1 juvenile (LBRE); 2 males, 1 female, 1 juvenile (LBRE); 7 males (LBRE); 2 males (LBRE); 1 male (LBRE). Same locality and data but, 03–11.xi.2010, 2 males (LBRE); 1 male (LBRE). Parque Natural Provincial y Reserva Forestal Natural Chancaní, secondary forest, 31°21'28.847" S 65°29'17.282" W, 04–12.xii.2010, M.F. Nime & C.I. Mattoni, pitfall, 4 males, 1 female, 2 juveniles (LBRE). Parque Natural Provincial y Reserva Forestal Natural Chancaní, Jarillal, 31°23'26.617" S 65°27'17.758" W, 05–13.xii.2010, M.F. Nime & C.I. Mattoni, pitfall, 1 male (LBRE). Parque Natural Provincial y Reserva Forestal Natural Chancaní, 10–14.xi.2010, M.F. Nime & C.I. Mattoni, pitfall, 12 males, 1 juvenile (LBRE). **Santiago del Estero:** Parque Nacional Copo, 26°04' S 61°44' W, 23–25.x.2003, collector unspecified, pitfall, 1 male (MACN-Ar 30501).

Etymology. The species name is dedicated to the arachnologist Martín J. Ramírez, from the Museo Argentino de Ciencias Naturales “Bernardino Rivadavia”—CONICET (Buenos Aires, Argentina). RBT wants to specially thank him for his academic guidance during the former’s stay at the MACN.

Diagnosis. *Gaucha ramirezi* sp. nov. differs from the remaining species in the genus by having white marks on the black band of the opisthosomal pleural membranes (Fig. 3D), whereas species in the *fasciata* and *ibirapemussu* species-groups have black marks on the white band. The flagellum is ovoid in shape (Figs. 4E,F), somewhat similar to that of *G. fulvipes* (Roewer, 1934) and *G. casuhati*; however, in the male of *G. ramirezi* sp. nov. the fixed finger lacks the subterminal flange (STF) that is present in *G. fulvipes*, and the flagellum is considerably less inflated than in *G. casuhati* (Figs. 4C,D). The flagellum of *G. ramirezi* sp. nov. has a very broad apex on dorsal aspect and is densely coated with conspicuous spicules, especially on the dorsal surface and subdistal region of the prolateral surface (Fig. 4F). In this respect, the surface ornamentation of the flagellum resembles that of *G. avexada* Botero-Trujillo, Ott & Carvalho, 2017, although the spicules are notably longer in the latter species.

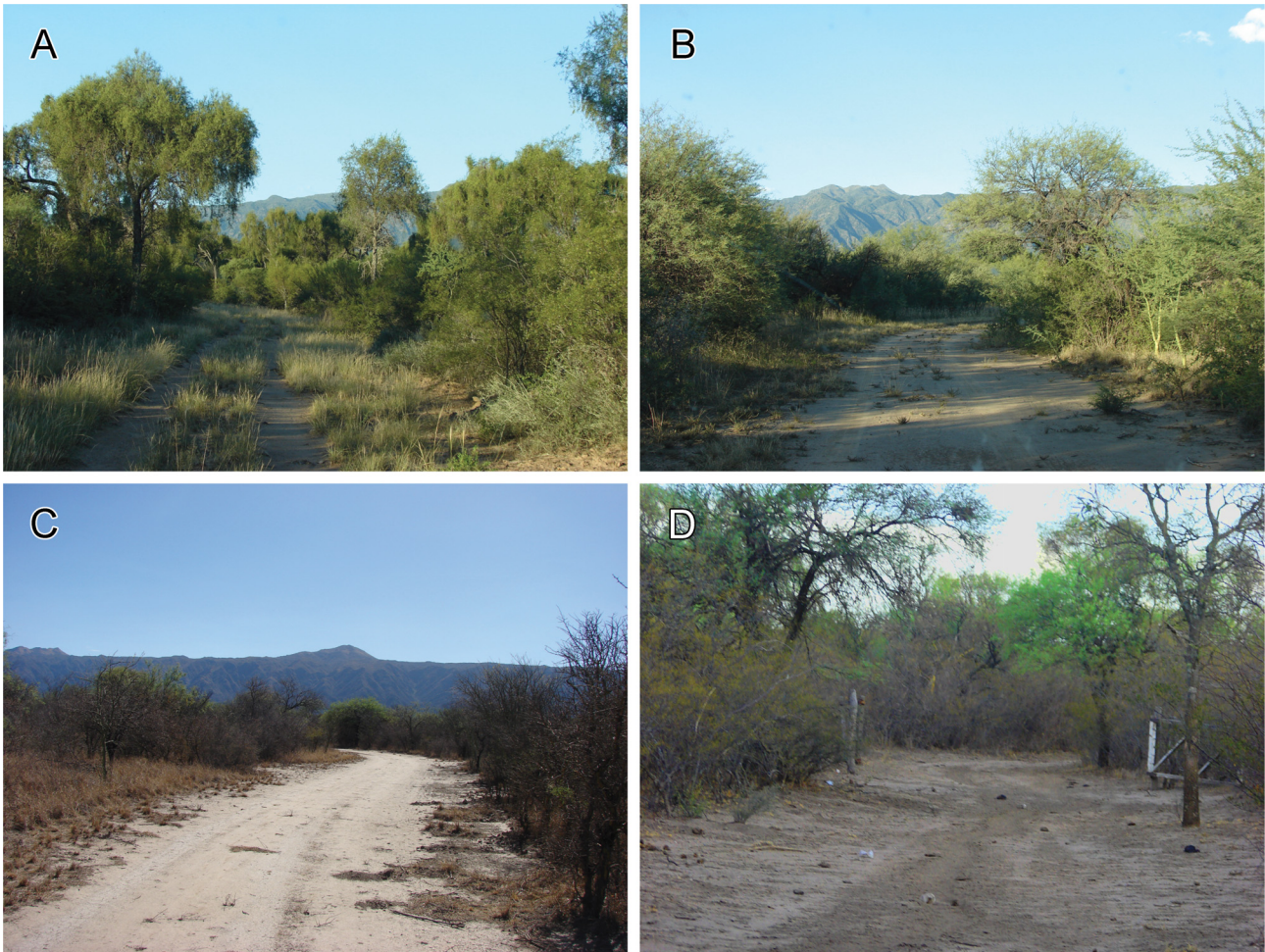


FIGURE 2. Habitat of *Gaucha ramirezi* sp. nov. in Parque Natural Provincial y Reserva Forestal Natural Chancaní and surroundings, Córdoba, Argentina. **A.** Mature forest. **B, C.** Secondary forest. **D.** Forest with livestock.

Systematic position. The presence of white marks on the opisthosomal pleura of *G. ramirezi* sp. nov., prevents us from confidently placing this species into any of the species-groups of *Gaucha* thus far defined. Currently, only the *fasciata* species-group is supported by a combination of apomorphic discrete-character states and shape configurations of the chelicera of males, whereas the monophyly of the *ibirapemussu* group is supported by landmark data only (Botero-Trujillo *et al.*'s 2017: fig. 8). The internal classification of Mummuciidae is on its early stages, and we find premature to place *G. ramirezi* sp. nov. into one or the other species-groups of *Gaucha*. While this species may belong to either of the species groups, having developed the characteristic white marks, it is also possible that it may represent a basal lineage in the *Gaucha* clade (e.g., with these marks being plesiomorphic).

Description. For most aspects the general morphology fits that described for the genus by Botero-Trujillo *et al.* (2017). **Color:** Propeltidium color predominantly whitish, with yellowish-to-brown median area without well-defined borders; ocular tubercle dark except for a median longitudinal light band. Chelicerae with manus predominantly yellowish to brown, with some white areas; limits between the setose and asetose areas often darkened; fingers reddish, especially on the teeth. Meso-, metapeltidium and dorsal surface of opisthosoma with a three-dark-band design typical of the family: tergites with median, longitudinal brown band, and a pair of lateral whitish bands; pleural membranes with sub-dorsal black and sub-ventral white bands; black band of opisthosomal pleural membrane with white marks surrounding the socket of most setae, especially on posterior half; sternites yellowish, immaculate except for posterior margin of one–three posteriormost sternites which is darkened. Ventral surface of prosoma uniformly yellowish; sternum lighter than coxae. Pedipalps and legs yellow to brown; pedipalps progressively becoming darker towards the apex, such that the telotarsus is nearly black. Malleoli whitish, often with distal margin darkened. **Morphology:** Opisthosoma with ctenidia present, at least on 2nd to 4th post-genital sternites (spiracular sternite II and post-spiracular sternites I–II), scarce in spiracular II but more

abundant in the others; ctenidia filiform and setiform, similar in thickness to the bifid setae (in male and female); although ctenidia are apparently absent from spiracular sternite I, this is not clear due to the current state of preservation of the material, e.g., ctenidia, if any, may have fallen off. Chelicerae, fixed finger with median teeth series comprising all primary teeth, i.e., FP, FM, FD; with one (FSM) secondary teeth series and without FSD teeth. Legs II and III: 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: basitarsus with row of four proventral and one distal retroventral spiniform setae, in a 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. **Male:** Metric data as in Table 1. Cheliceral fixed finger with primary teeth of normal size for the genus, graded as $FP \approx FM > FD$ or $FP > FM > FD$; mucron moderately long, without subterminal flange (STF). Movable finger MP tooth pronounced, markedly taller than MM; mucron short (as compared to that of the *ibirapemussu* species-group described by Botero-Trujillo *et al.* 2017), with gnathal edge carina very prominent and convex on lateral aspect. Flagellum inflated and narrowing anteriorly, conspicuously covered with abundant spicules on dorsal and prolateral surfaces. **Female:** Metric data as in Table 1. Similar to male but without male-specific secondary sexual characters. Chelicera on lateral aspect, fixed finger dorsal margin strongly curved and without angular dorsal crest, with highest elevation near the level of FM tooth. Fixed finger robust, with mucron distinctly curved towards the venter. Movable finger MP tooth moderately taller than MM tooth.

Distribution and habitat. *Gaucha ramirezi* **sp. nov.** is primarily known from the Chancaní Provincial Park and Forest Reserve, located in the southernmost portion of the Arid Chaco ecoregion (NT0701 in Olson *et al.* 2001) in Córdoba province, Argentina. A specimen from the Copo National Park, in Santiago del Estero province, northern Argentina, was also available for this study. Both localities share a similar xerophytic environment and belong to the same biome: Tropical and Subtropical Grasslands, Savannas, and Shrublands (Olson *et al.* 2001). Although the latter specimen is herein presumed to be conspecific to those from the type locality, additional scrutiny, when other specimens become available, may be necessary to clarify the specific identity of that population.

The Chancaní Park and Reserve was created and fenced in 1986, and since, its vegetation has been protected from human disturbance (Cabido & Pacha 2002). Vegetation in the reserve is dry xerophilous woodland. The canopy is discontinuous and ~15 m high, whereas the shrub stratum (~4 m high) is thorny, dense, and almost continuous (Carranza *et al.* 1992). The climate in the reserve is highly seasonal, with a pronounced dry season.

In the Arid Chaco ecoregion, the fire season usually coincides with the frost season, from May to September (Kunst & Bravo 2003). Wildfire affected the Chancaní Reserve in December 1994. It was an out of season, high-intensity fire that started under extremely dry conditions due to a long delay in the onset of the rainy season. The fire covered 32,000 ha of Arid Chaco forest, affecting 230 ha within the western boundaries of the Chancaní Reserve. This fire generated a secondary forest area next to the main forest area.

There are four different ecological-type sites within the study site. (1) The mature forest site shows forest formations that are close to climax conditions, mainly with trees such as *Aspidosperma quebracho-blanco* and *Prosopis flexuosa*. The shrub layer is dominated by *Larrea divaricata*, *Mymozyanthus carinatus* and *Acacia furcatispina* (Carranza *et al.* 1992). (2) The secondary forest site shows dense and homogeneous vegetation, dominated by high grasses (about 1 m tall) and shrubs of about 2.5 m in height. In this area, young trees are common and dead trees are still standing (Pelegrin & Bucher 2010). (3) The Jarillal site is located in the central area of the reserve. In the past, this area was used for the logging of large trees for fuel and charcoal. Currently, it is dominated by shrubs of the genus *Larrea* (“jarilla”); the area is not used for any activities and is recovering. (4) The forest with livestock is a private area facing the reserve that has been used for years for raising livestock, hence the site is much degraded with low, scattered shrubs.

Gaucha ramirezi **sp. nov.** appears to be much more abundant in the mature forest (49 males, 8 females, 17 juveniles) and in the forest with livestock (31 males, 11 females, 6 juvs.), compared to the secondary forest (4 males, 1 female, 2 juvs.) and Jarillal (1 male).

Notes. *Gaucha ramirezi* **sp. nov.** was found in sympatry with *Cordobulgida bruchi*, the latter being much less abundant in the sample studied at a ratio of 18:1 specimens, respectively.

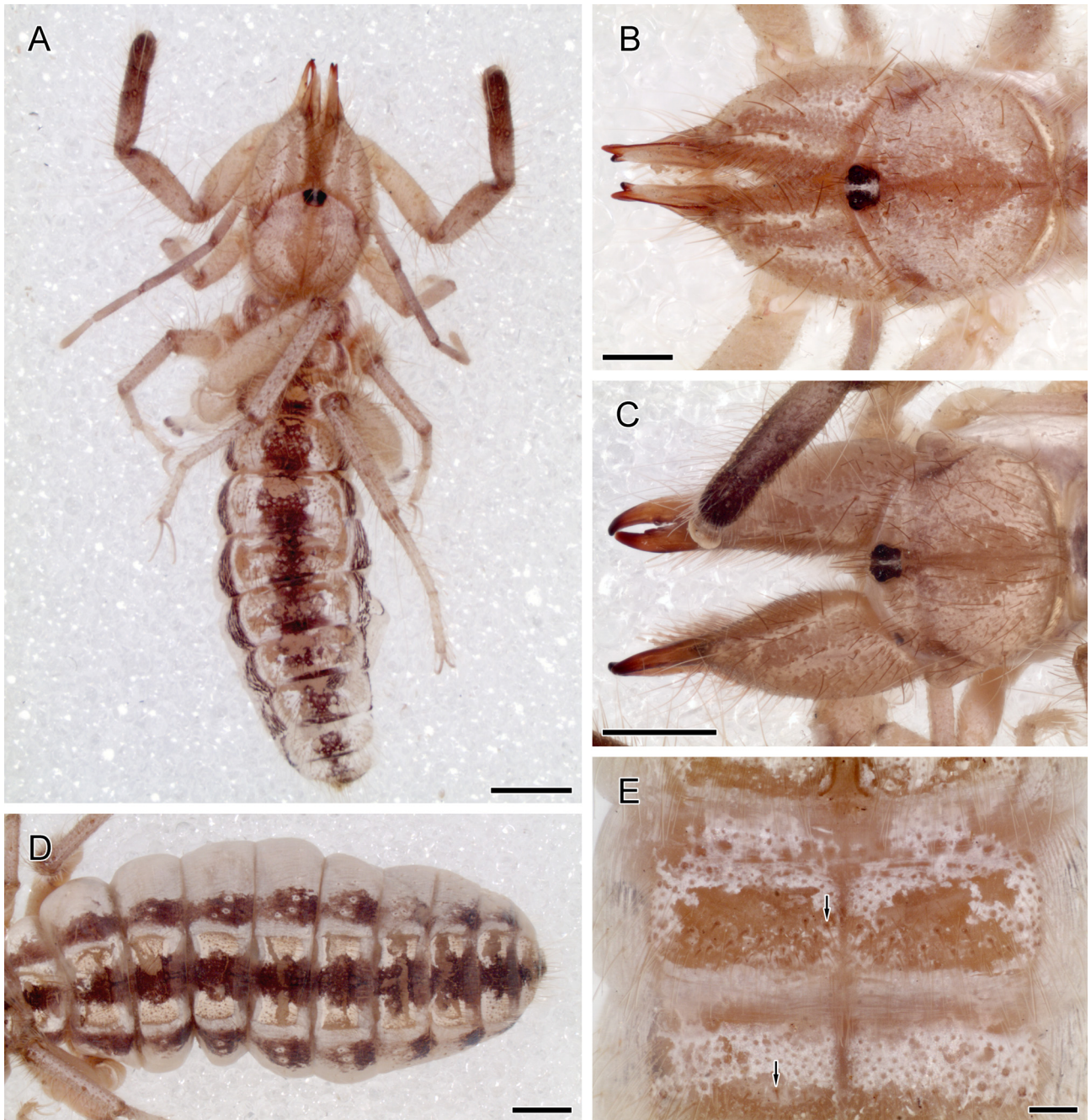


FIGURE 3. *Gaucha ramirezi* sp. nov. **A.** Male holotype, habitus, dorsal aspect (MACN-Ar 39101). **B.** Male paratype, propeltidium and chelicerae, dorsal aspect (LBRE 402). **C.** Ibid. for female paratype (LBRE 402). **D.** Female paratype, opisthosoma, dorsal aspect (LBRE 402). **E.** Male, opisthosoma, 3rd and 4th post-genital sternites (LBRE); selected ctenidia are indicated by arrows (zooming-in is recommended for proper visualization). Scale bars: 1 mm (A, C, D); 0.5 mm (B); 0.2 mm (E).

***Gaucha santana* sp. nov.**

Figures 1, 5–9; Table 1

Gaucha sp.: Botero-Trujillo *et al.* 2017: 39 [in part, records from Santana do Livramento only], figs. 3c–f.

Type material. Holotype: male from **BRAZIL: Rio Grande do Sul:** Santana do Livramento—Área de Proteção Ambiental do Rio Ibirapuitã, Fazenda Rincão dos Moraes, 185 m elev., 30°29'08.99" S 55°34'35.51" W, 30.xi.2013, R. Ott (MCN-Sol-018). **Paratypes:** same data of holotype, 1 male (MCN-Sol-016); 1 female (MCN-

Sol-017); 2 males, 1 female, 3 juveniles (MCN-Sol-041). Same locality and data but, xii.2014, R. Ott & R. Botero Trujillo, 1 male, 1 female, 10 juveniles (MCN-Sol-047); 1 male (MCN-Sol-046, tissue sample Sol-M00054, BOLD process ID SSA054-16); 1 male (MCN-Sol-044, tissue sample Sol-M00055, BOLD process ID SSA055-16); 1 subadult female (MCN-Sol-043, tissue sample Sol-M00056, BOLD process ID SSA056-16). Same locality and data but, Fazenda Sr. Caio, 185 m elev., 29.xi.2013, R. Ott, 4 males, 2 females, 4 juveniles (MCN-Sol-015).

Additional material examined. BRAZIL: Rio Grande do Sul: Santana do Livramento—Área de Proteção Ambiental do Rio Ibirapuitã, “Cerrito Reserva”, 263 m elev., 30°36'33.87" S 55°38'30.18" W, xii.2014, R. Ott & R. Botero Trujillo, 1 male (MCN-Sol-045); unknown date, R. Ott, 1 female (MCN-Sol-042). Área de Proteção Ambiental do Rio Ibirapuitã, “Afloramento Passo do Ferrão”, 174 m elev., 30°27'15.97" S 55°43'25.71" W, 14.xi.2011, 2 males, 2 females, 2 juveniles (MCN-Sol-019). Área de Proteção Ambiental do Rio Ibirapuitã, 01.xi.2013, R. Ott, 1 male, 1 female (MACN-Ar).

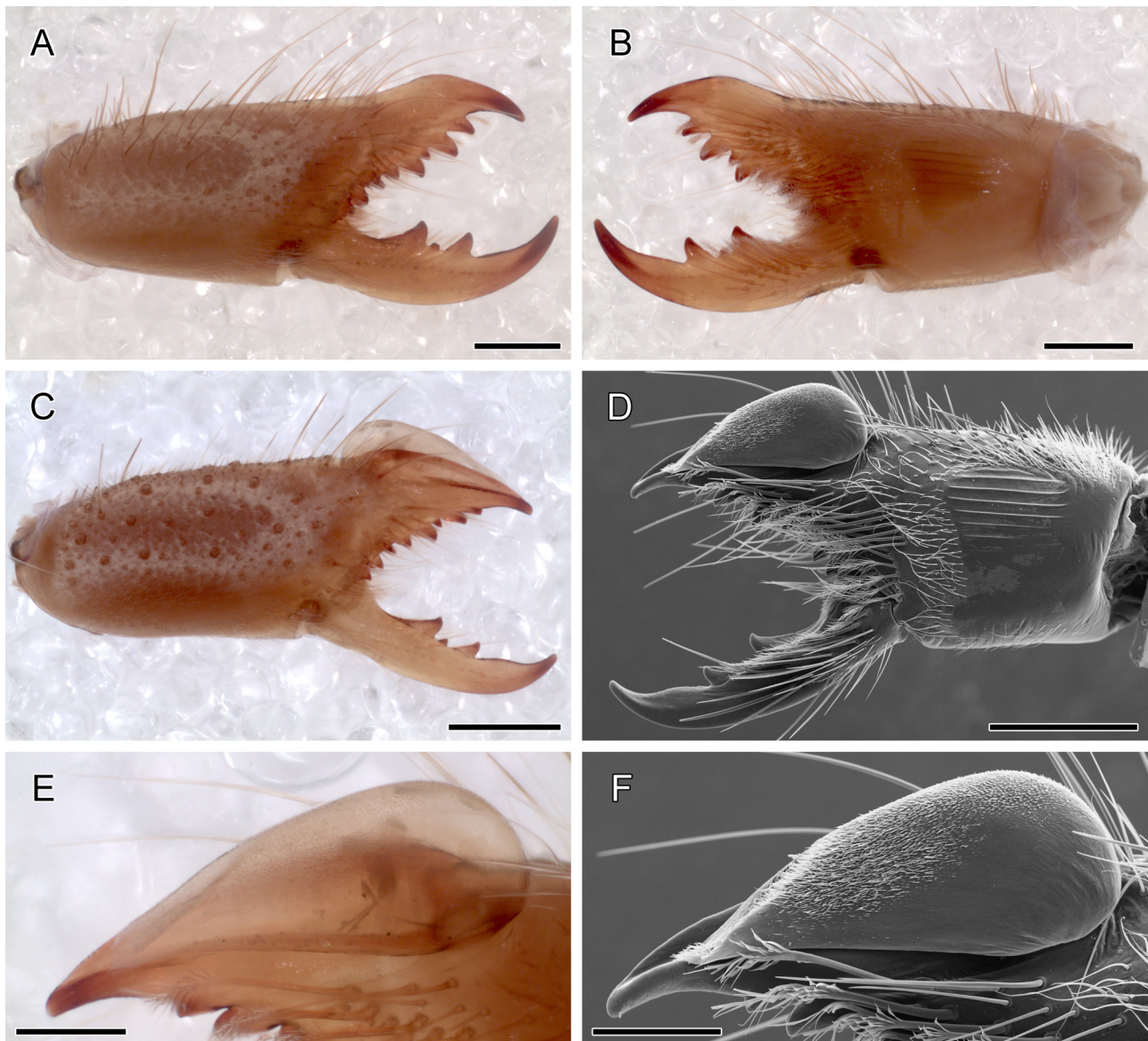


FIGURE 4. *Gaucha ramirezi* sp. nov., chelicerae. **A, B.** Right chelicera of female paratype (MACN-Ar). **A.** Retrolateral aspect. **B.** Prolateral aspect. **C–F.** Right chelicera of male paratype (MACN-Ar). **C.** Retrolateral aspect. **D.** Prolateral aspect (under SEM). **E.** Flagellum. **F.** Ibid. (under SEM). Scale bars: 0.5 mm (A–D); 0.2 mm (E, F).

Etymology. Noun in apposition taken from the municipality ‘Santana do Livramento’, part of whose territory forms the Ibirapuitã Environmental Protection Area where this species was collected.

Diagnosis. *Gaucha santana* sp. nov. belongs to the *fasciata* species-group of *Gaucha*, as defined by Botero-

Trujillo *et al.* (2017: 15). In various respects, males of *G. santana* **sp. nov.** most closely resemble those of *G. curupi* among species in this group. These include that the fixed finger FP and FM teeth are elongated, whereas the FD tooth is much smaller, such that primary teeth are graded as $FP \approx FM \gg FD$ (Fig. 8C). Likewise, the fixed finger mucron is markedly long, similarly shaped in males of both species, and a subterminal flange (STF) is not present in either (Figs. 8C,E), besides both have the flagellum moderately inflated (Figs. 8E,F) (e.g., unlike that of *G. casuhati*). *Gaucha santana* **sp. nov.** can be recognized by the absence of the fixed finger FSD tooth (regardless of sex or maturity of the specimens) (Figs. 8A,C); in contrast, females of *G. curupi* always bear the FSD tooth, while FSD is most often present (though reduced) in males. Furthermore, the FD tooth, which is reduced in males of the two species, is comparatively larger in those of *G. santana* **sp. nov.** (Fig. 8C).



FIGURE 5. Live specimens of *Gaucha santana* **sp. nov.**, photographed in the field. **A.** Male. **B, C.** Two different females.

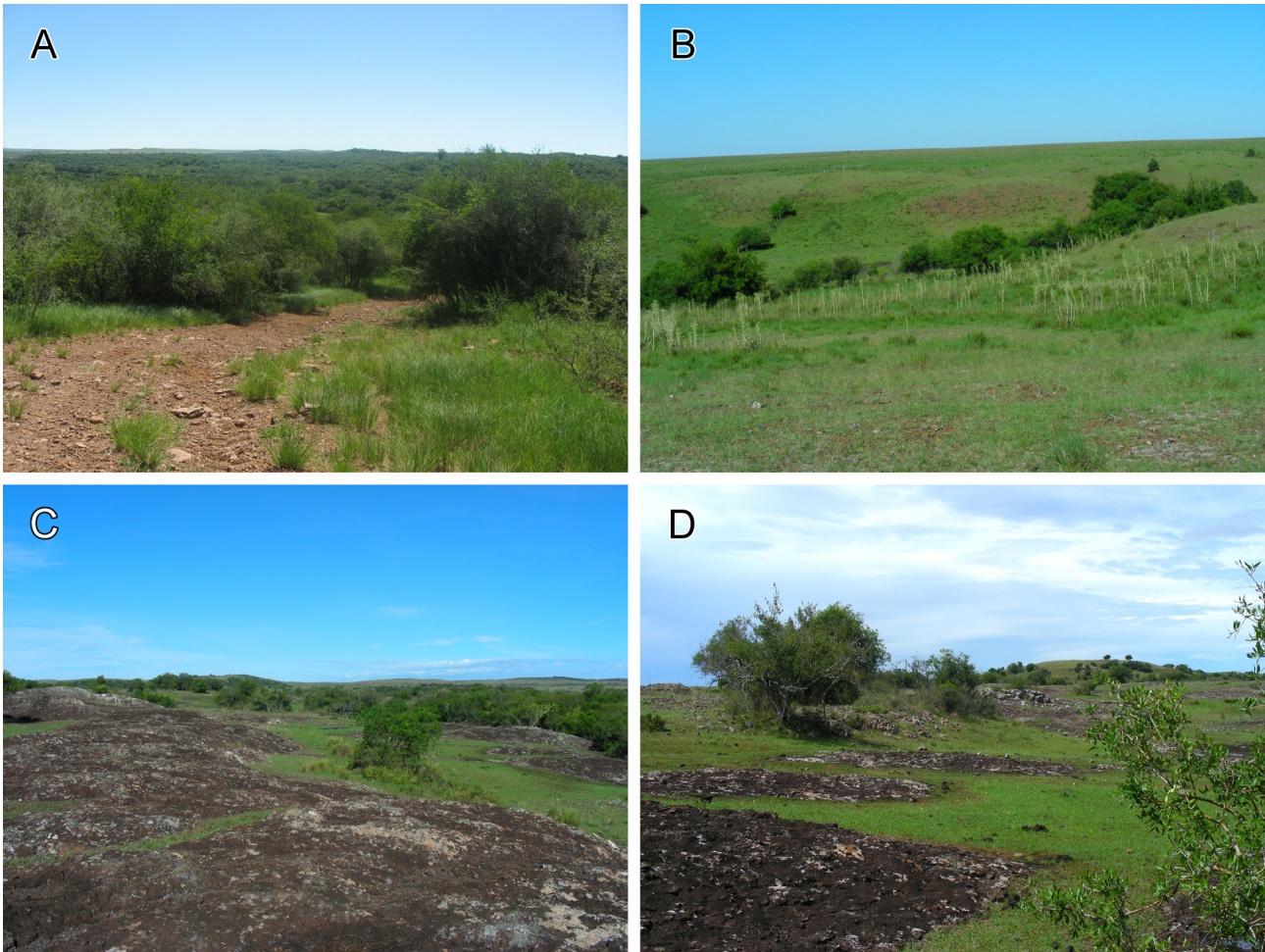


FIGURE 6. Habitat of *Gaucha santana* sp. nov. in Santana do Livramento—Área de Proteção Ambiental do Rio Ibirapuitã, Rio Grande do Sul, Brazil. **A, B.** Fazenda Rincão dos Moraes, showing typical sandy and stony soils. **C, D.** Large basalt outcrops, “Afloramento Passo do Ferrão”.

Description. For most aspects the general morphology fits that described for the genus and the *fasciata* species-group by Botero-Trujillo *et al.* (2017). **Color:** Propeltidium brown, with some slightly lighter areas; ocular tubercle brown to black. Chelicerae with manus predominantly brown and 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; 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 yellowish brown, with lateral margins conspicuously darkened, especially on two/three posteriormost sternites. Ventral surface 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; pedipalp with telotarsus darker than the rest of pedipalp. Malleoli whitish, often with distal margin darkened. **Morphology:** Opisthosoma with scarce ctenidia on 1st and 2nd post-genital sternites (spiracular sternites), more abundant on 3rd and 4th post-genital sternites (post-spiracular sternites I–II); ctenidia filiform and setiform, similar in thickness to the bifid setae (in male and female). Chelicerae, fixed finger with median teeth series comprising all primary teeth, i.e., FP, FM, FD; with one (FSM) secondary teeth series and without FSD teeth. Legs II and III: 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: basitarsus with row of four proventral and one distal retroventral spiniform setae, in a 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. **Male:** Metric data as in Table 1. Cheliceral

fixed finger with well-developed FP and FM primary teeth, FD tooth much smaller, graded as $FP \approx FM \gg FD$; mucron markedly long, without subterminal flange (STF). Movable finger MP tooth pronounced, markedly taller than MM; mucron short, typical of the *fasciata* species-group, with gnathal edge carina very prominent and convex on lateral aspect. Flagellum inflated and narrowing anteriorly, with minute spicules along prodorsal and proventral margins. **Female:** Metric data as in Table 1. Similar to male but without male-specific secondary sexual characters. Chelicera on lateral aspect, fixed finger dorsal margin moderately curved and without angular dorsal crest, with highest elevation at level between FM and FD teeth. Fixed finger robust, with mucron distinctly curved towards the venter. Movable finger MP tooth moderately taller than MM tooth.

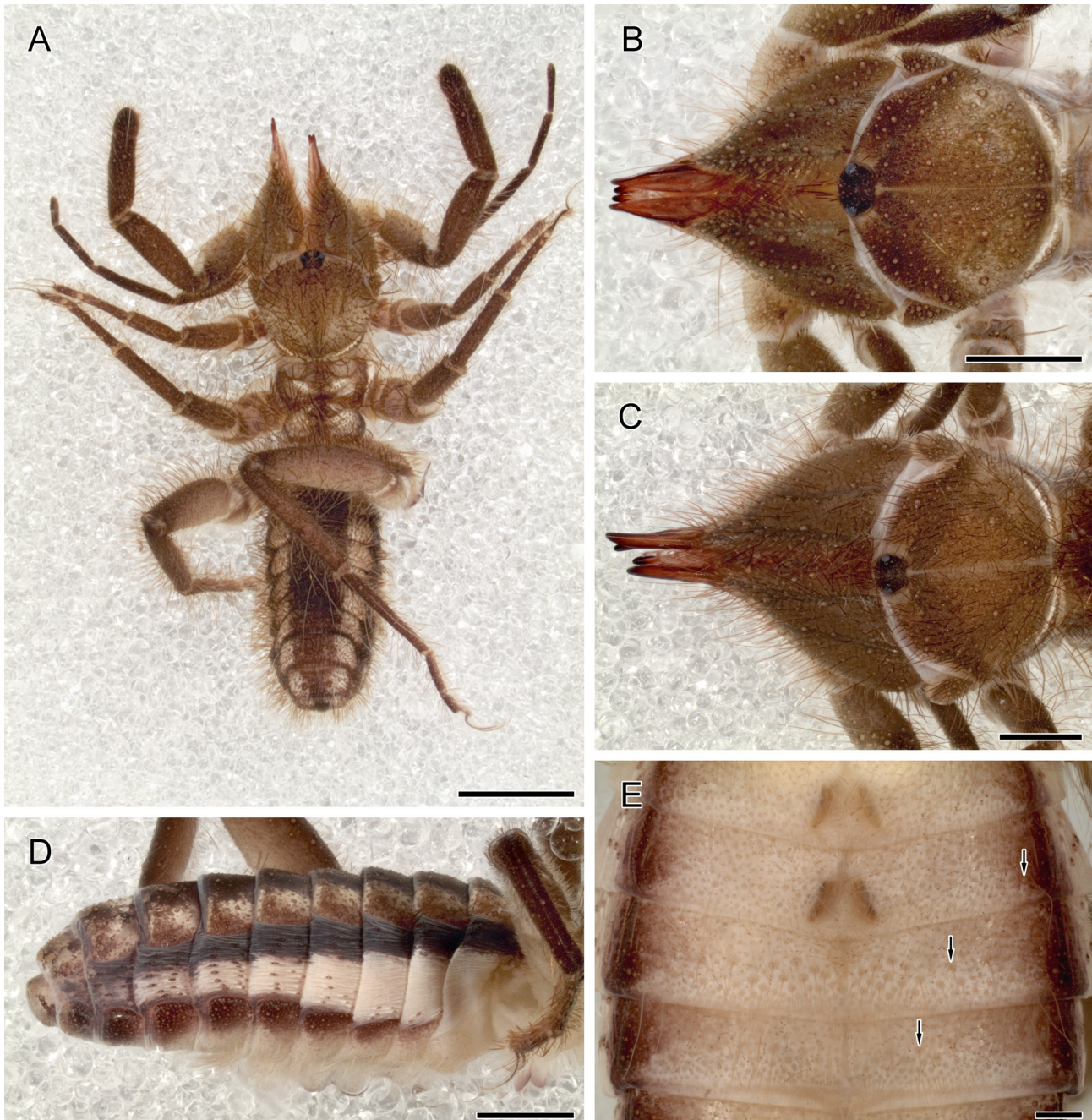


FIGURE 7. *Gaucha santana* sp. nov. **A.** Male holotype, habitus, dorsal aspect (MCN-Sol-018). **B.** Male paratype, propeltidium and chelicerae, dorsal aspect (MCN-Sol-044). **C.** Ibid. for female paratype (MCN-Sol-047). **D.** Male paratype, opisthosoma, lateral aspect (MCN-Sol-044). **E.** Male paratype, opisthosoma, 1st to 4th post-genital sternites (MCN-Sol-044); selected ctenidia are indicated by arrows (zooming-in is recommended for proper visualization). Scale bars: 2 mm (A); 1 mm (B–D); 0.25 mm (E).

TABLE 1. Metric data for *Gaucha ramirezi* **sp. nov.** and *Gaucha santana* **sp. nov.** Measurements in millimeters for one male and one female. L = length; W = width; H = height. ¹ Measured along medial axis, from the propeltidium anterior margin to the opisthosoma posterior margin. ² Measured in dorsal view at widest point. ³ Measured in retrolateral view parallel to longitudinal axis of chelicera, from the fixed finger apex to anterolateral propeltidial lobe anterior margin. ⁴ Measured in retrolateral view, along vertical axis at highest part of manus. ⁵ Sum of individual segment lengths. ⁶ Maximum height. ⁷ Measurement excludes claws.

Species		<i>Gaucha ramirezi</i> sp. nov.	<i>Gaucha santana</i> sp. nov.
Voucher		Male holotype MACN-Ar 39101 [Female paratype MACN-Ar]	Male holotype MCN-Sol-018 [Female paratype MCN-Sol-041]
Total body L (w/o chelicerae) ¹		8.11[9.58]	8.51[15.16]
Propeltidium	L	1.57[1.77]	1.97[2.50]
	W ²	1.67[2.17]	2.37[3.59]
Chelicera	L ³	2.10[2.80]	2.50[4.52]
	W ²	0.75[1.00]	1.13[1.63]
	H ⁴	0.77[1.00]	1.17[1.67]
Pedipalp total L ⁵		4.90[5.33]	6.59[7.87]
	Femur L	1.80[1.83]	2.53[2.87]
	Tibia L	1.43[1.57]	1.93[2.33]
	Tibia W ²	0.42[0.48]	0.55[0.67]
	Basitarsus + telotarsus L	1.67[1.93]	2.13[2.67]
Leg I total L ⁵		3.73[4.00]	5.31[5.93]
	Patella L	1.10[1.17]	1.67[1.60]
	Tibia L	1.23[1.33]	1.67[2.10]
	Basitarsus L	0.77[0.87]	1.07[1.33]
	Telotarsus L	0.63[0.63]	0.90[0.90]
Leg IV total L (w/o claws) ⁵		6.24[5.90]	8.67[9.84]
	Patella L	2.07[1.97]	2.87[3.10]
	Patella H ⁶	0.57[0.65]	0.80[0.97]
	Tibia L	1.83[1.83]	2.63[3.07]
	Basitarsus L	1.47[1.37]	2.00[2.30]
	Telotarsus L ⁷	0.87[0.73]	1.17[1.37]

Distribution, habitat and biological observations. *Gaucha santana* **sp. nov.** is known only from the type locality, Santana do Livramento—Área de Proteção Ambiental do Rio Ibirapuitã, in the state of Rio Grande do Sul, southern Brazil. The Ibirapuitã Environmental Protection Area is a conservation unit located in the northernmost portion of the Uruguayan Savanna ecoregion (NT0710 in Olson *et al.* 2001), into the biome of Tropical and Subtropical Grasslands, Savannas, and Shrublands. Grasslands dominate the area, and local geology is characterized by shallow, sandy or stony soils with low capacity for water retention (Overbeck *et al.* 2015). Rocky outcrops of basalt are notable formations; in the easternmost part of the protected area there is a place where sandstone emerges below the basalt cover, in a formation known as "Costa do Haedo". Specimens of *G. santana* **sp. nov.** have been observed in open fields of stony soils with little grassy vegetation, often resembling small rocky islands, or running on large basalt outcrops.

No specimens of *G. santana* **sp. nov.** were found in morning hours. The peak of activity of this species seemingly starts at noon, and activity can be noticed until right before twilight begins. With respect to seasonality, the species exhibits the greatest activity in spring and summer, especially from November to January, and this presumably coincides with the breeding season.

In the field, adult females were sometimes observed digging burrows in the late afternoon. In early December 2012, one of these specimens was taken to the laboratory where shortly afterwards, in its new place over a litter

layer, laid 73 eggs, but none hatched. A year later, in December 2013, another female was captured in digging behavior and taken to the laboratory; there she laid 25 eggs, 23 from which larvae emerged after 37 days. All larvae died and no other observations could be performed. Images of the cited egg-laying females are available in Botero-Trujillo *et al.* (2017: figs. 3E,F).

Notes. No any other mummuciid species was found in the area inhabited by *G. santana* **sp. nov.**

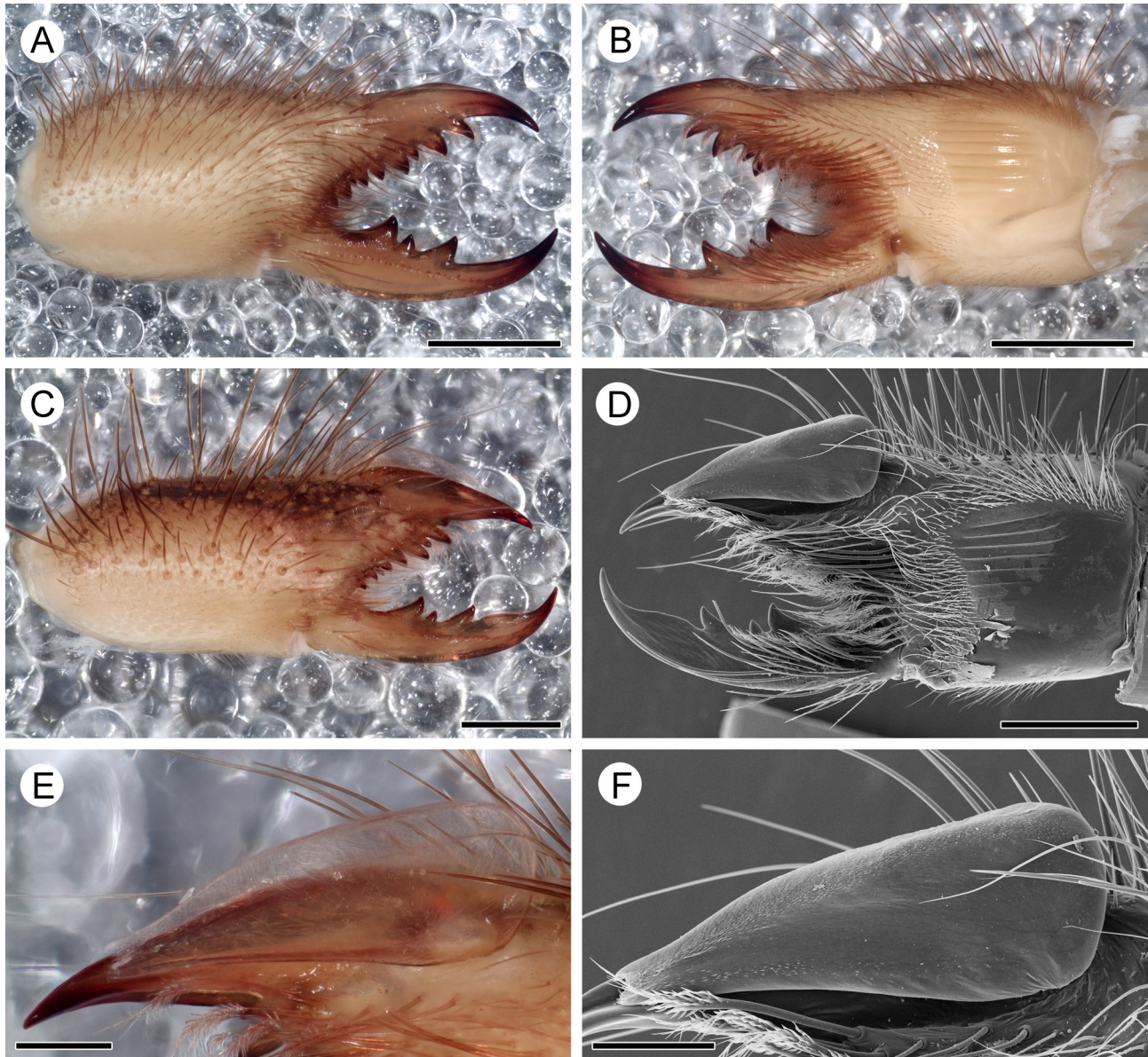


FIGURE 8. *Gaucha santana* **sp. nov.**, chelicerae. **A, B.** Right chelicera of female paratype (MCN-Sol-015). **A.** Retrolateral aspect. **B.** Prolateral aspect. **C–F.** Right chelicera of male paratype (MCN-Sol-041). **C.** Retrolateral aspect. **D.** Prolateral aspect (under SEM). **E.** Flagellum. **F.** Ibid. (under SEM). Scale bars: 1 mm (A,B); 0.5 mm (C,D); 0.2 mm (E,F).

Barcode. Three COI sequences (657 bp) obtained from different specimens of *G. santana* **sp. nov.** had identical nucleotide composition (0% intra-specific divergence). An identification search in BOLD Systems for this sequence (Barcode Index Number: BOLD:ADD5797) indicated closer match with *Gaucha fasciata* (BIN:BOLD:ADD5134) followed by *Gaucha curupi* (BIN:BOLD:ADD8503), with 90.66–90.67% and 89.76–90.21% similarity range values, respectively. Figure 9 shows the clustering pattern of sequences of the three species.

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Neighbor-Joining

Colourization = Barcode cluster (BIN) / species
Model = Kimura 2 Parameter

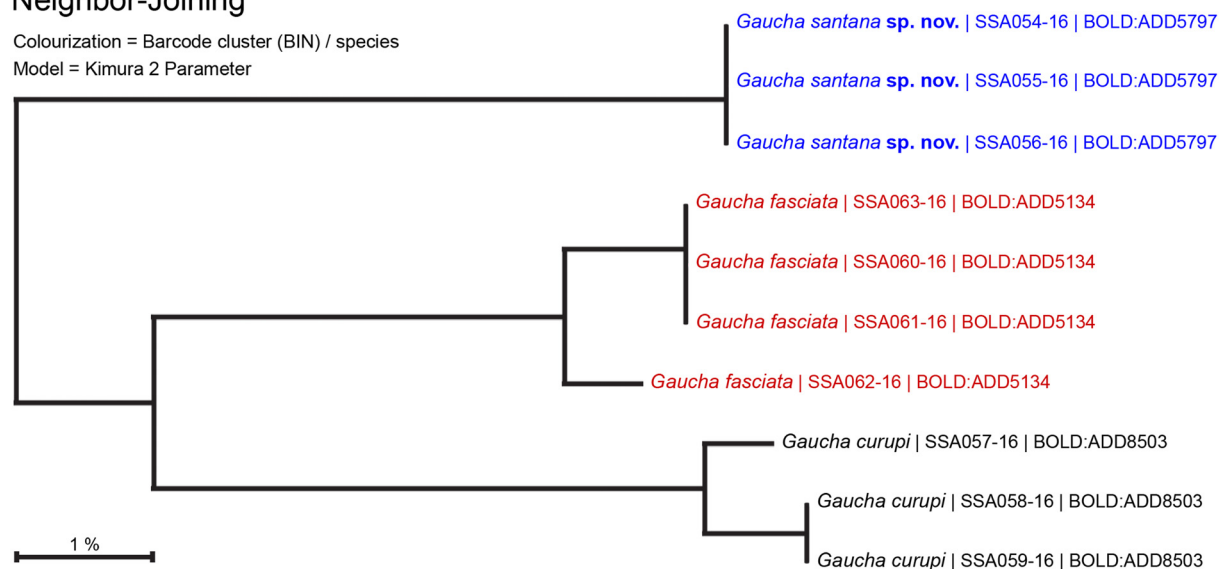


FIGURE 9. Neighbor-Joining clustering for selected species of the *fasciata* species-group of *Gaucha* Mello-Leitão, 1924.

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