



The species of *Grammostola* (Araneae: Theraphosidae) from Central Argentina: taxonomy, distribution, and surface ultrastructure of coxal setae

N. FERRETTI¹, G. POMPOZZI² & F. PÉREZ-MILES³

¹Centro de estudios parasitológicos y de vectores (CEPAVE) (CCT-CONICET-La Plata), Calle 2 N 584, (1900) La Plata, Argentina.
E-mail: nelsonferretti@hotmail.com

²Universidad Nacional del Sur, Dpto. de Biología, Bioquímica y Farmacia, San Juan 670, (8000) Bahía Blanca, Argentina

³Facultad de Ciencias, Sección Entomología, Iguá 4225, (11400) Montevideo, Uruguay

Abstract

Three species of *Grammostola* (Araneae, Mygalomorphae, Theraphosidae) from central Argentina are redescribed and illustrated and their geographic distributions are reported. A new synonymy between *G. vachoni* Schiapelli & Gerschman 1961 and *G. schulzei* (Schmidt 1994) *n. syn.* is proposed. We did not find zones of co-occurrence with the three species but, in several localities, we found two *Grammostola* species in sympatry. The surface ultrastructure of three types of coxal setae was studied by scanning electron microscopy (SEM). Two morphological types of spiniform setae were found on the coxae. The first type consisted of short and strong piriform setae, with the surface completely covered by ridges, and the second type consisted of long and thinner spiniform setae, with a piriform basal portion. The basal portion of the setae had ridges, the central portion was smooth and the apical zone had numerous short barbs with curved tips. The different types of setae found in these *Grammostola* species are clearly distinguished, and could be new useful character to diagnose at least these species. In combination with other characteristics, these characters could probably help to solve the problems in other species of this difficult genus if not also other genera.

Key words: Neotropical, Argentina, theraphosids, spider taxonomy, new synonymy, setae morphology

Introduction

The family Theraphosidae is comprised of mostly large-sized mygalomorph spiders. The subfamily Theraphosinae is exclusive to the New World and includes almost half of the 900 species described in the family. Spiders of the genus *Grammostola* Simon 1892 inhabit temperate South America and the genus currently includes 21 species described throughout Argentina, Uruguay, Chile, Brazil, Bolivia and Paraguay (Platnick 2009). At this time, there are 13 species cited for Argentina and four of them occur in Buenos Aires province (Central Argentina): *G. vachoni* Schiapelli & Gerschman 1961; *G. schulzei* (Schmidt 1994); *G. doeringi* (Holmberg 1881) and *G. burzaquensis* Ibarra-Grasso 1946.

Grammostola has presented a taxonomic challenge. The color pattern helps to differentiate live specimens of one species from another but coloration is usually lost when preserved. Bücherl (1951) recognized only four species based on morphometric relationships of the appendages, and later Schiapelli & Gerschman (1961) proposed six valid species for Argentina based on genital characters, such as the form of male palpal organs and spermathecae. The differences between *Grammostola* species usually reflect mostly that male palpal organs were observed in different position making the comparison among species difficult. In addition, *G. doeringi* was not included in the analysis of the species from Argentina (Schiapelli & Gerschman 1961). *Grammostola burzaquensis* is present in Buenos Aires province but no data have been published since Ibarra-Grasso (1946; 1961). The taxonomy of this group has not received formal attention since Schiapelli & Gerschman (1961). Recently, more species from Argentina have been described but without information about distribution or even type locality (e.g., Schmidt 2003; Schmidt 2004; Schmidt 2005). Schmidt (1994a) described the genus *Polyspina* and its single species, *Polyspina schulzei* based on a single female from an unknown locality, presumed to be Africa equatorial, Madagascar or

Yemen. Bertani & Fukushima (2004) re-examined the holotype, examined new material from Cordillera de los Andes (Argentina) and Tandil (Buenos Aires, Argentina), and transferred the species to *Grammostola*, establishing the new combination *Grammostola schulzei* (Schmidt 1994). This species is characterized by spike setae on pro- and retrolateral faces of the coxae of the palp and legs as well as plumose, modified paddle setae on coxae I of males and females and spermathecal tubes curved inwards (Schmidt 1994a). Recently, this species was also found in Sierra de la Ventana (Buenos Aires, Argentina) (Ferretti & Ferrero 2008); sharing the area of distribution with *G. vachoni*.

Schiapelli & Gerschman (1961) described *G. vachoni* from Tandil where the type was collected. They diagnosed *G. vachoni* from *G. burzaquensis*, *G. cala* Chamberlin 1917, *G. chalcothrix* Chamberlin 1917, *G. inermis* Mello-Leitão 1941 and *G. pulchripes* (Simon 1891). Schmidt (2003) invalidly considered *G. vachoni* as a *nomen nudum* and described a male from Argentina for the first time.

In this study, we redescribe and illustrate *G. burzaquensis*, *G. doeringi* and *G. vachoni* following an exhaustive review of theraphosid specimens from Argentina and additional field collections in Buenos Aires Province. Their geographic distribution is reported. As a result of our study, a key character was recognised: the surface ultrastructure of three types of coxal setae. These features were studied by scanning electron microscopy (SEM) and are a new and useful character for delimitation of some species of *Grammostola*. Finally, a new synonymy between *G. vachoni* and *G. schulzei* is proposed.

Material and methods

Field work. From 2006 to 2009, field trips were conducted during spring and summer (November – April, Southern Hemisphere) at localities in the southwest of Buenos Aires province. Adults and juveniles were collected by hand mainly by two techniques. In the case of burrowing species in meadows, burrows were excavated until the spider was removed. In species inhabiting hilly zones, careful inspection of the substrate under the stones was made to collect the spiders. Geographic coordinates were registered using a global positioning system (Garmin Etrex Legend Hcx). Individuals were collected in 70% ethanol and deposited in the collection of the Laboratory of Invertebrate Zoology II (LZI), Universidad Nacional del Sur (Buenos Aires, Argentina).

Laboratory methods. Abbreviations: AME = anterior median eyes, ALE = anterior lateral eyes, PME = posterior median eyes, PLE = posterior lateral eyes, OQ = ocular quadrangle (including lateral eyes), D = dorsal, P = prolateral, R = retrolateral, V = ventral. Collection abbreviations as follows: IBSP = Instituto Butantan, São Paulo, Brazil; LZI = Laboratorio de Zoología de Invertebrados II, Universidad Nacional del Sur, Buenos Aires, Argentina; MACN = Museo Argentino de Ciencias Naturales “Bernardino Rivadavia”, Argentina; MLP = Museo de La Plata, Argentina; SMF = Senckenberg Forschungsinstitut und Naturmuseum, Frankfurt-am-Main, Germany. All measurements are given in millimeters and were made with digital dial callipers with an error of 0.01mm, rounded up to one significant decimal where appropriate, and an Olympus stereoscopic microscope equipped with a calibrated ocular micrometer scale.

Morphometric statistics were calculated using SPSS version 14.0 (2005); error factors are given as standard deviations (SD). Photographs of preserved material were taken with a Sony Cyber-Shot DSC –H2. A Jeol 35 Cf scanning electron microscope (SEM) was used for the examination of surface ultrastructure of setae. Geographic coordinates specimens from museums and literature were determined using a gazetteer. Distribution maps for each species were made by using DIVA-GIS (Annapurna) v6.0.3 (CIP 2007, <http://www.diva-gis.com>).

Results

Surface ultrastructure of coxal setae

Setae studied were found on the prolateral and retrolateral faces of coxae I–IV (Fig. 4) of males and females. Numerous and large plumose setae (Fig. 7) were also found in these areas. Three morphological types of spiniform setae were found on the coxae. They were inserted in circular cuticular sockets with the posterior edge more prominent than the anterior (Fig. 7).

The first type consists of short and strong piriform setae with the surface completely covered by ridges. These setae lie prolaterally mostly on the dorsal border of the coxae (Figs. 4, 21). They form two groups on the retrolateral face of the coxae (Fig. 17): one located at the dorsal border with *ca.* 34 about spiniform setae; the second group is at the center of the coxae bearing *ca.* 51 spiniform setae. Short spiniform setae measurements: $149.28\mu \pm 12.28$ long, basally $65.07\mu \pm 6.56$ wide and apical width of $16.44\mu \pm 4.03$ (Fig. 10).

The second type consisted of longer and thinner spiniform setae with a piriform basal portion. They occur over the entire prolateral face and in two groups on the retrolateral face of the coxa as the short spiniform setae. Measurements: $552.35\mu \pm 47.70$ long, basal portion with ridges (Fig. 5) and $41.18\mu \pm 5.57$ wide; central portion of setae smooth and apical zone bearing numerous short barbs with curved tips (Fig. 6). Measurements: $10.22\mu \pm 1.22$ SD (including barbs) wide; barbs were approximately $6.86\mu \pm 0.93$ long and $0.47\mu \pm 0.03$ in diameter (Figs. 11, 14). Long and short spiniform setae are compared (Fig. 12).

A third type of setae consisted of regular smaller setae with a thin basal portion having ridges and a width of 24.65μ (Fig. 8); the apical portion also had short barbs not curved, with a width (including barbs) of 3.94μ (Fig. 9).

Taxonomy

Family Theraphosidae Thorell 1869

Genus *Grammostola* Simon 1892

Grammostola Simon 1892: 163. Type species: *Eurypelma pulchripes* Simon 1891.

Sorata Strand 1907: 554. Type species: *Sorata monticola* Strand 1907. Considered a junior synonym by Raven 1985: 159.

Lasiopelma Simon 1892: 169. Type species: *Lasiopelma grossum* (Ausserer 1871). Considered a junior synonym by Schmidt 1994b: 5, contra Raven 1985.

Polyspinosa Schmidt 1999a: 14. Type species by monotypy: *Polyspinosa schulzei* (Schmidt 1994). Considered a junior synonym and a replacement name for *Polyspina* Schmidt 1994a: 3, type (by monotypy) *P. schulzei* Schmidt 1994, by Bertani & Fukushima 2004: 330.

Grammostola burzaquensis Ibarra-Grasso 1946

(Figs. 20, 24, 1, 15, 23; Tables 1–2)

Grammostola burzaquensis Ibarra-Grasso 1946: 786, fig. 8; Bücherl 1957: 395, fig. 53; Schiapelli & Gerschman 1961: 203, figs. 3–4 (restored to species); Ibarra-Grasso 1961: 7, unnumbered f.; De Carlo 1973: 344, fig. 1.

G. pulchripes b.: Bücherl 1951: 118 (reduced to subspecies).

Types. Holotype male, Buenos Aires, Argentina, 1946 (Ibarra-Grasso), MLP 105. Paratype male, Burzaco, Buenos Aires, Argentina, 1944 (Ibarra-Grasso). Female paratype, Buenos Aires, Argentina, 1946 (Ibarra-Grasso).

Diagnosis. *G. burzaquensis* is the smaller species of the three in this study and can be recognized by the following combination of characters: cephalic area slightly raised; presence of regular smooth setae on pro- and retrolateral coxal faces of legs I–IV and retrolateral palpal maxillae (Fig. 20); males differ by having a tibial apophysis bearing a long strong black thorn noticeably curved at tip, on inner side of primary (smallest) spur, and very long conical process above the secondary (longer) spur; spermathecae with short straight tubes (Fig. 24); coloration (in vivo) black with lines on patellae, less evident than *G. vachoni*, and very short reddish setae, shorter than *G. doeringi* on ventral faces of all legs (Fig. 1).

Description. Male (Holotype) MLP 105: Total length, excluding chelicerae and spinnerets, 31.5. Carapace length 14.8, width 13. Cephalic area slightly raised. Anterior eye row procurved, posterior recurved. Eye sizes and interspaces: AME 0.17, ALE 0.14, PME 0.19, PLE 0.1, AME–AME 0.39, AME–ALE 0.19, PME–PME 0.75, PME–PLE 0.04, ALE–PLE 0.13, OQ length 1.38, width 1.5. Clypeus 0.7. Fovea straight, width 1.5. Labium 1.5 long, 2.7 wide with 91 evident cuspules, although cuticular holes indicate 136 originally, maxillae with 190 cuspules on inner third. Sternum 6.0 long, 5.5 wide. Chelicerae with 8 teeth on promargin and 2 small teeth on retro-margin. Regular smooth setae on pro- and retrolateral coxal faces of legs I–IV and retrolateral palpal maxillae. Stridulatory setae on retrolateral face of maxilla and opposing prolateral face of coxa I are typical and well devel-

oped (Fig. 15). Tarsi I–IV densely scopulated, scopula entire. Metatarsi I entirely scopulated, II 3/4 scopulated, III 1/2 scopulated and IV 1/4 scopulated. Spination: femorae and patellae I–IV and palps, 0. Tibiae: palp 1-2-1 P; I 1-1-1 P, 1 V, 1-1 R; II 1-1-1 P, 1-1 V, 1-1 R; III 1-1-1 P, 1-1-2 V, 1-1-1 R; IV 1-1-1 P, 2-1-2 V, 1-1R. Metatarsi: I 1 P, 1 R, 1 V; II 1-1-1 V, 1 P; III 1-1-2 V, 1-1-1-1 P, 1-1-1 R; IV 1-1-1 V, 1-1-2 P, 1-1 R. Tarsi I–IV and palp 0. Tibia I with paired ventral apophyses, bearing long strong black thorn, noticeably curved at tip, on inner side of primary (smallest) spur, and very long conical process on top of secondary (longer) spur (Fig. 23). Palpal organ piriform. Color (in alcohol): cephalothorax and legs light brown with yellowish hairs, prominent lines on patellae and femorae, abdomen dark brown.



FIGURE 1. Live habitus of adult female *G. burzaquensis*. Scalebar: 9 mm. Photo: J. Barneche.

Female (Paratype): Total length, excluding chelicerae and spinnerets, 39.1. Carapace 14.7 long, 13.8 wide. Cephalic area slightly raised. Anterior eye row procurved, posterior recurved. Eye sizes and interspaces: AME 0.32, ALE 0.12, PME 0.25, PLE 0.1, AME–AME 0.36, AME–ALE 0.33, PME–PME 1.04, PME–PLE 0.04, ALE–PLE 0.13, OQ length 1.57, width 2. Clypeus 1.7. Fovea straight, width 3. Labium 2.0 long, 2.7 wide with 155 evident cuspules, although cuticular holes indicate 158 originally, maxillae with 222 cuspules on inner third. Sternum 7.2 long, 7.0 wide. Chelicerae with 9 big and 2 small teeth on promargin and 3 small teeth on retromargin. Regular smooth setae on pro- and retrolateral coxal faces of legs I–IV and retrolateral palpal maxillae. Stridulatory setae on retrolateral face of maxilla and opposing prolateral face of coxa I are typical and well developed. Tarsi I–IV densely scopulated, I–II entire, III–IV divided by row of three setae. Metatarsi I 2/3 scopulated, II 2/3 scopulated, III 3/4 scopulated and IV 1/4 scopulated. Spination: Femorae and patellae I–IV and palps, 0. Tibiae: palp 1-2 P 1 R; I 1 P, 1-1 V; II 1-1-1 P, 1-1 V; III 1 P, 1 V; IV 1 P, 1 V, 1-1R. Metatarsi: I 1 V; II 1-1 V, 1 P, 1 R; III 1-1 V, 1-1 P, 1 R; IV 1-1 V, 2 P, 2-1-1 R. Tarsi I–IV and palps 0. Color (in alcohol): cephalothorax and legs light brown with yellowish hairs, abdomen dark brown. Spermathecae with short straight tubes.

TABLE 1. Length of leg and palpal segments of male *G. burzaquensis*.

	I	II	III	IV	Palp
Fe	13.20	11.80	10.40	12.10	8.60
Pa	5.90	4.90	5.50	4.10	4.50
Ti	9.60	8.60	5.90	10.30	5.50
Mt	7.40	8.10	8.40	7.70	-
Ta	4.80	5.70	6.20	4.70	2.70
Total	40.90	39.10	36.40	38.90	21.30

TABLE 2. Length of leg and palpal segments of female *G. burzaquensis*.

	I	II	III	IV	Palp
Fe	11.50	10.20	8.50	9.90	8.50
Pa	6.30	6.20	5.20	4.40	3.60
Ti	7.45	7.80	7.10	8.30	5.90
Mt	6.30	4.90	8.40	9.30	-
Ta	4.80	4.50	6.20	5.30	5.50
Total	35.90	33.60	35.40	37.20	23.50

Other examined material. Argentina: Buenos Aires Province: La Plata, Feb.1952, Ringuelet col., 1 female (MACN 362); same locality, 13-19 May 1918, no collector, 3 males (MACN 86,87,88); same locality, Nov 1939, Barrow col., 1 male (MACN LP45); same locality, no date, Juanco col., 1 female (MACN 317); same locality, 26 Nov 1950, Pérez col., 1 male (MACN LP61); same locality, no date, M. Biraben col., 1 female (MACN LP37), 1 male (MACN LP36); La Plata, Campo de los Ingleses, Mar 1940, no collector, 1 immature (MACN 76); Azul, 18 Nov 1961, E. Aguirre col., 1 male (MACN); Buenos Aires, 1956, Riglos col., 1 male (MACN); Burzaco, Nov 1948, Martinez col., 1 male (MACN); Florencio Varela, 22 Nov 1949, De Ferraris col., 3 females (MACN LP33, LP34, LP35); Balcarce, Laguna Brava, Dec 1960, no collector, 2 males (MACN); Luis Guillón, 29 Nov 1964, Martinez col., 1 immature (MACN); Magdalena, Jan 1942, Monrós col., 1 female (MACN 1299); Moreno, 21 Mar 1964, E. Maury col., 1 male (MACN); same locality, 20 Oct 1964, E. Maury col., 1 female (MACN).

Distribution. Most eastern zone of Buenos Aires, Central and southeast of Buenos Aires province (Fig. 29).

Grammostola doeringi (Holmberg 1881)

(Figs. 18, 25, 2; Tables 3–4)

Eurypelma doeringii Holmberg 1881: 147, pl. 3, fig. 8; Mello-Leitão 1933: 6.

Eurypelma minax Thorell 1894: 33; Gerschman & Schiapelli 1978:86.

Grammostola doeringi: Gerschman & Schiapelli 1962: 154, figs 1–2 (Male transferred from *Euthycaelus*=*Holothele*); Schiapelli & Gerschman 1979: 86; Schmidt 1999b: 6, fig. 14.

Types. Types from Holmberg (1881) lost. *Grammostola doeringi* (Holmberg 1881), Neotype male designated by Gerschman & Schiapelli 1962, Nicolas Levalle, Buenos Aires, Argentina, Dec 1960 (Schiapelli & Gerschman), MACN 153. Female, Nicolas Levalle, Buenos Aires, Argentina, Dec 1960 (Schiapelli & Gerschman), MACN 151.

Diagnosis. *G. doeringi* differs from the other two species by the noticeably raised cephalic area: 6.47 ± 1.05 high, $n = 20$ (non-paired t-test: $t = 3.25$, $p = 0.003$); long spiniform setae on pro- and retrolateral coxal faces of legs I–IV and retrolateral palpal maxillae (Fig. 18); spermathecae with long straight tubes (Fig. 25); coloration (in vivo) dark grey with lines on patellae, less evident than on *G. vachoni*, and short reddish setae on ventral faces of all legs (Fig. 2).

Description. Male (Neotype) MACN 153: Total length, excluding chelicerae and spinnerets, 26.5. Carapace length 14.1, width 13.6. Cephalic area noticeably raised. Anterior eye row procurved, posterior recurved. Eyes sizes and interspaces: AME 0.18, ALE 0.13, PME 0.16, PLE 0.11, AME–AME 0.31, AME–ALE 0.2, PME–PME

0.72, PME–PLE 0.04, ALE–PLE 0.25, OQ length 1.15, width 1.5. Clypeus 0.5. Fovea slightly recurved, width 2.7. Labium length 2.0, width 3.0 with 135 cuspules, maxillae with 172 cuspules on inner third. Sternum length 4.5, width 5. Chelicerae with 8 teeth on promargin and 5 small teeth on retromargin. Long spiniform setae on pro- and retrolateral coxal faces of legs I–IV and retrolateral palpal maxillae. Tarsi I–IV densely scopulated and entire. Metatarsi I 2/3 scopulated, II 1/2 scopulated, III 2/3 scopulated and IV 1/4 scopulated. Spination: femorae and patellae I–IV and palp, 0. Tibiae: palp 1-1 R, 1-2-1 P; I 1-1-1 P, 1-1 V, 2-1 R; II 1-1-1-1 P, 2-1-1 V, 2-1 R; III 1-1 P, 2-2-1 V, 1-1-1 R; IV 1-1 P, 2-1-1 V, 1-1 R. Metatarsi: I 1-1 P, 1-1 R, 1 V; II 2-1 V, 1 P; III 1-1-1-1-1 V, 1-1-1 P, 1-1 R; IV 1-1-1-1-1 V, 1-1-1-2-1-1 P, 1-1-1-1 R. Tarsi I–IV and palps 0. Tibia I with paired ventral apophyses, bearing long, strong and black thorn slightly curved at tip on inner side of primary (smallest) spur, and short conical process on top of secondary (longer) spur. Palpal organ piriform. Color (in alcohol): cephalothorax and legs light brown with yellowish hairs, abdomen dark brown.

TABLE 3. Length of leg and palpal segments of male *G. doeringi*.

	I	II	III	IV	Palp
Fe	15.80	13.65	12.20	14.20	8.85
Pa	6.50	6.25	4.70	5.35	4.30
Ti	12.30	10.70	8.60	11.40	6.55
Mt	11.50	11.20	10.70	14.65	-
Ta	6.60	6.40	7.60	8.98	2.10
Total	52.70	48.20	43.80	54.55	21.80

TABLE 4. Length of leg and palpal segments of female *G. doeringi*.

	I	II	III	IV	Palp
Fe	13.70	10.90	10.30	13.45	9.25
Pa	6.75	6.45	5.80	5.90	5.45
Ti	10.85	8.10	7.45	9.65	6.65
Mt	9.25	8.75	9.20	11.75	-
Ta	6.10	6.25	5.95	7.00	5.75
Total	46.65	40.45	38.70	47.75	27.10

Female MACN 151: Total length, excluding chelicerae and spinnerets, 39. Carapace length 18.5, width 15.2. Cephalic area noticeably raised. Anterior eye row procurved, posterior recurved. Eye sizes and interspaces: AME 0.29, ALE 0.23, PME 0.22, PLE 0.2, AME–AME 0.54, AME–ALE 0.35, PME–PME 1.08, PME–PLE 0.13, ALE–PLE 0.39, OQ length 1.79, width 2.1. Clypeus 1.2. Fovea straight, width 4.0. Labium length 2.5, width 3.0 with 169 extant cuspules, although cuticular holes indicate 176 originally, maxillae with 174 cuspules on inner third. Sternum length 6.9, width 7.5. Chelicerae with 8 big teeth on promargin and 8 small teeth on retromargin. Long spiniform setae on pro- and retrolateral coxal faces of legs I–IV and retrolateral palpal maxillae. Tarsus I–IV densely scopulated and entire. Metatarsi I 3/4 scopulated, II 1/2 scopulated, III 1/3 scopulated and IV 1/4 scopulated. Spination: Femorae and patellae I–IV and palp, 0. Tibiae: palp 2-1-1 V 1-2 P; I 1-1 P, 1-1 V, 1 R; II 1-1 P, 2-1-1 V; III 1-1 P, 1-1 V, 1 R; IV 1-1 P, 2 V, 1 R. Metatarsi: I 1-1 V, 1-1 P, 1 R; II 1-1 V, 1-1 P, 1-1 R; III 1-1 V, 1-1-1-1 P, 1-1-1 R; IV 1-1-1-1-1 V, 1-1-1-1-2-1-1 P, 1-1-1 R. Tarsi I–IV and palps 0. Color (in alcohol): cephalothorax and legs light brown with yellowish hairs, abdomen dark brown. Spermathecae with long straight tubes.

Other examined material. Argentina: Buenos Aires Province: Bahía Blanca, 1919, Del Pino col., 1 male (MACN 253); same locality, no date, Semignan col., 1 male (MACN 6543); same locality, Apr 1939, Schiapelli & Gerschman cols., 1 male (MACN 74); 5 km NW Bahía Blanca (3839' S; 6213' W), 15 Jul 2009, G. Pompozzi, N. Ferretti & S. Copperi cols., 1 female (LZI), 1 immature (LZI); Bahía Blanca, carrindanga (3839' S; 6210' W), no date, no collector, 1 immature (LZI); Bahía Blanca, Seminario (3844' S; 6212' W), 5 Nov 2008, N. Ferretti col., 1 immature (LZI); Bahía Blanca, B Patagonia (3841' S; 6212' W), 16 Oct 2008, no collector, 1 male (LZI); Bahía Blanca, B Palihuen (3842' S; 6213' W), 19 Oct 2008, no collector, 1 male (LZI); Bahía Blanca, B Villa Rosario

(3844' S; 6215' W), 27 May 2009, N. Ferretti col., 1 female (LZI); Bahía Blanca, Shopping (3841' S; 6214' W), no date, G. Trobbiani col., 1 female (LZI); Bahía Blanca, route 33 (3839' S; 6217' W), no date, G. Pompozzi col., 1 immature (LZI); Bajo Hondo (3845' S; 6155' W), 12 Nov 2008, no collector, 1 male (LZI); Castelar, 11 Apr 1952, Pikelin col., 1 female (MACN); Chasicó (3819' S; 6243' W), 18 Oct 2006, S. Copperi col., 2 males (LZI); Cnel. Dorrego, 15 Dec 1950, Cuccioli col., 1 male (MACN 115); Trenque-Lauquen, Colonia Martín Fierro, Nov 1938, J. Ydiart col., 1 female (MACN 27); Florencio Varela, Dec 1973, Adrague col., 2 females (MACN); Gral. Villegas, no date, A. Nicoletti col., 1 male (MACN 7); La Plata, no date, no collector, 4 immatures (MACN); Lobería, Nov 1942, Riglos col., 1 female (MACN 1232); Lomas de Zamora, Dec 1968, Vellard col., 1 male (MACN); Mayor Buratovich, Dec 1966, Soria col., 1 female (MACN 6760); Necochea, INTA, 28 Mar 1963, no collector, 1 female (MACN); Nicolás Levalle, Salinas Las Barrancas, 30 Apr 1951, Schiapelli & Gerschman cols., 1 male (MACN 3293); same locality, Dec 1959, Schiapelli & Gerschman cols., 4 males (MACN 138, 140, 145, 146); same locality, no date, Schiapelli & Gerschman cols., 1 immature (MACN); same locality, Jan 1961, Schiapelli & Gerschman cols., 1 male (MACN); same locality, Oct 1960, Schiapelli & Gerschman cols., 4 males (MACN 172, 180, 183); Pedro Luro, 20 Apr 1942, no collector, 1 female (MACN dg116); Pilar, Nov 1935, Castillo col., 1 male (MACN 2); Puerto Belgrano, 20 Dec 1950, Schiapelli & Gerschman cols., 1 male (MACN 121); Quilmes, 14 Nov 1946, Gricola col., 1 female (MACN 124); Ranelagh, Mar 1949, Borella col., 1 female (MACN); Reta, Tres Arroyos (3853' S; 6020' W), no date, C. Irigoyen col., 1 male (LZI); Sierra de la Ventana, Mar 1939, Gario col., 1 male (MACN); same locality, no date, Wood col., 1 male (MACN 100); same locality (387' S; 6148' W), no date, S. Bork col., 1 female (LZI); Sierras Las Tunas, 29 Sept 1968, Riggi col., 1 female (MACN 68), 4 males (MACN 52, 64, 67, 70); same locality, no date, Riggi col., 1 male (MACN 72); Zelaya, no date, J. Pereyra col., 1 male (MACN 149). **La Pampa Province:** Gral. Pico, no date, Williamson col., 1 male (MACN 66); Parque Nacional Lihué Calel, 20 Oct 1962, Bachman col., 1 male (MACN); same locality, Nov 1969, E. Maury & Gallardo cols., 2 immatures (MACN 6758); Puelches, 1966, De Husso col., 2 males (MACN); Rancul, 29 Nov 1964, Martinez col., 1 male (MACN); Hidalgo, Salinas Grandes, Dec 1948, Scartaiseinig col., 1 female (MACN 4); Santa Rosa, Dec 1966, Aparena col., 2 immatures (MACN); same locality, May 1967, Aparena col., 2 immatures (MACN); same locality, 2 Jan 1964, E. Maury col., 1 male (MACN). **Neuquén Province:** Plaza Huincul, Feb 1950, no collector, 1 female (MACN 43); Zapala, 1 Mar 1960, Capurro col., 1 female (MACN 149). **Río Negro Province:** Benjamín Zorrilla, Oct 1963, Bachman col., 1 male (MACN); Gral. Roca, Oct 1962, no collector, 1 female (MACN), 1 immature (MACN); same locality, no date, Bachman col., 1 female (MACN); Río Colorado, 11 Oct 1957, Rosas col., 1 immature (MACN); Villa Regina, May 1973, Soraka col., 1 male (MACN 6763). **Chubut Province:** Route between Pto. Madryn and Rawson, 19 Mar 1970, Daziuk col., 2 males (MACN).



FIGURE 2. Live habitus of adult female *G. doeringi* from Bahía Blanca, Buenos Aires, Argentina. Scalebar: 12 mm. Photo: Pompozzi, G.

Distribution. Eastern zone, north, Southwest and south of Buenos Aires province; northeast and south of La Pampa; north of Río Negro; Central Neuquén and northeast of Chubut (Fig. 30).

***Grammostola vachoni* Schiapelli & Gerschman 1961**

(Figs. 21, 27, 13, 16, 26, 3, 28; Tables 5–6)

Grammostola vachoni Schiapelli & Gerschman 1961: 204, figs 5–6; Schmidt 2003: 12, figs 1–3.

Polyspina schulzei Schmidt 1994a: 4, fig. 1. **New synonymy.**

Polyspinosa schulzei: Schmidt 1999d: 14.

Grammostola schulzei: Bertani & Fukushima 2004: 330, fig. 1

Types. *Grammostola vachoni* Schiapelli & Gerschman 1961, holotype male, Tandil, Buenos Aires, Argentina, 26 Apr 1950 (St. B. Andrae), MACN 7152. Female, Sierra de la Ventana, Buenos Aires, Argentina, Feb 2007 (Ferretti, Pompozzi, Copperi), LZI 15.

Grammostola schulzei (Schmidt 1994), holotype female (SMF37537), unknown locality, originally presumed to be from Africa equatorial, Madagascar or Yemen.

Diagnosis. *G. vachoni* can be recognized by the following combination of characters: cephalic area slightly raised: 5.11 ± 1.46 high, $n = 20$ (non-paired t-test: $t = 3.25$, $p = 0.003$); presence of short and long spiniform setae on pro- and retrolateral coxal faces of legs I–III, prolateral coxae IV and retrolateral palpal maxillae (Fig. 21); spermathecae with bent tubes and bowls pointing inwards (Fig. 27); coloration (in vivo) black with prominent lines on patella and numerous long yellowish setae on ventral faces of all legs (Fig. 3).



FIGURE 3. Live habitus of adult female *G. vachoni* from Sierra de la Ventana, Buenos Aires, Argentina. Scalebar: 12 mm. Photo: Pompozzi, G.

Description. Male (Holotype) MACN 7152: Total length, excluding chelicerae and spinnerets, 34.9. Carapace length 15.3, width 14.4. Cephalic area slightly raised. Anterior eye row procurved, posterior recurved. Eye sizes and interspaces: AME 0.33, ALE 0.28, PME 0.25, PLE 0.31, AME–AME 0.43, AME–ALE 0.2, PME–PME 0.92, PME–PLE 0.06, ALE–PLE 0.33, OQ length 1.75, width 2. Clypeus 0.7. Fovea straight, width 3.3. Labium length 1.7, width 2.5 with 141 cuspules, maxillae with 144 cuspules on inner third. Sternum length 6.9, width 5.5. Chelic-

erae with 8 teeth on promargin and 9 small teeth on retromargin. Short and long spiniform setae on pro- and retrolateral coxal faces of legs I–III, prolateral coxae IV and retrolateral palpal maxilla. Stridulatory setae present on retrolateral face of maxilla and prolateral in coxa I are typical and well developed (Figs 28, 13, 16). Tarsi I–IV densely scopulated and entire. Metatarsi I entire scopulated, II 3/4 scopulated, III 1/2 scopulated and IV 1/4 scopulated. Spination: Femorae and patellae I–IV and palps, 0. Tibiae: palp 1-2 R; I 2-1-1 P, 1-2 V, 1-1-1 R; II 1-1 P, 1-2-2 V; III 1-2-2 P, 2-2-2 V, 1-1 R; IV 1-1-1 P, 2-2 V, 1-1-1 R. Metatarsi: I 1 P, 1 R; II 1-1-2 V, 1-1 P; III 1-1-1 V, 1-1-2-2 P, 1-1 R; IV 1-1-1-1 V, 1-2-1 P, 2-1-1 R. Tarsi I–IV and palps 0. Tibia I with paired ventral apophyses, bearing long strong black thorn, slightly curved at tip, on inner side of primary (smallest) spur, and short conical process above secondary (longer) spur (Fig. 26). Palpal organ piriform. Color (in alcohol): cephalothorax and legs light brown with yellowish hairs, abdomen dark brown.

Female LZI 15: Total length, excluding chelicerae and spinnerets, 37.10. Carapace length 15, width 12. Cephalic area slightly raised. Anterior eye row procurved, posterior recurved. Eye sizes and interspaces: AME 0.33, ALE 0.22, PME 0.34, PLE 0.2, AME–AME 0.60, AME–ALE 0.28, PME–PME 1.26, PME–PLE 0.05, ALE–PLE 0.38, OQ length 2.15, width 2.50. Clypeus 1.00. Fovea straight, width 1.7. Labium length 1.80, width 2.20 with 178 cuspules, maxillae with 141 cuspules on inner third. Sternum length 5.50, width 5.10. Chelicerae with 8 big teeth and 2 small on promargin and 12 small teeth on retromargin. Short and long spiniform setae on pro- and retrolateral coxal faces of legs I–III, prolateral coxae IV and retrolateral palpal maxilla. Tarsi I–IV densely scopulated and entire. Metatarsi I 3/4 scopulated, II 2/3 scopulated, III 1/2 scopulated and IV 1/4 scopulated. Spination: femorae and patellae I–IV and palps, 0. Tibiae: palp 2 V, 1 R, 1-1-1 P; I 1 V; II 1 P, 1 V; III 1-1-1 P, 2 V, 1-1 R; IV 2 V, 1-1 R. Metatarsi: I 1-1 V, 1 P; II 1-1-1 V, 1 P; III 6-2-1-2 V, 2-1-2-1-1 P, 2-1-1 R; IV 1-1-1-1-1 V, 2-1-1-1 P, 2-1-1 R. Tarsi I–IV and palps 0. Color (in alcohol): cephalothorax and legs light brown with yellowish hairs, abdomen dark brown. Spermathecae with long bent tubes pointing inward.

TABLE 5. Length of leg and palpal segments of male *G. vachoni*.

	I	II	III	IV	Palp
Fe	14.60	13.15	12.90	14.20	8.35
Pa	7.25	6.95	6.30	5.95	4.60
Ti	10.70	9.45	8.65	10.35	6.50
Mt	9.55	9.60	12.20	14.20	-
Ta	7.30	6.60	6.90	7.25	2.60
Total	49.40	45.75	46.95	51.95	22.05

TABLE 6. Length of leg and palpal segments of female *G. vachoni*.

	I	II	III	IV	Palp
Fe	10.15	10.10	8.00	9.85	8.00
Pa	4.95	4.40	4.25	4.05	3.95
Ti	6.40	4.95	5.45	8.05	4.40
Mt	4.65	4.65	5.50	9.40	-
Ta	3.80	3.55	4.20	5.00	5.00
Total	29.95	27.65	27.40	36.35	21.35

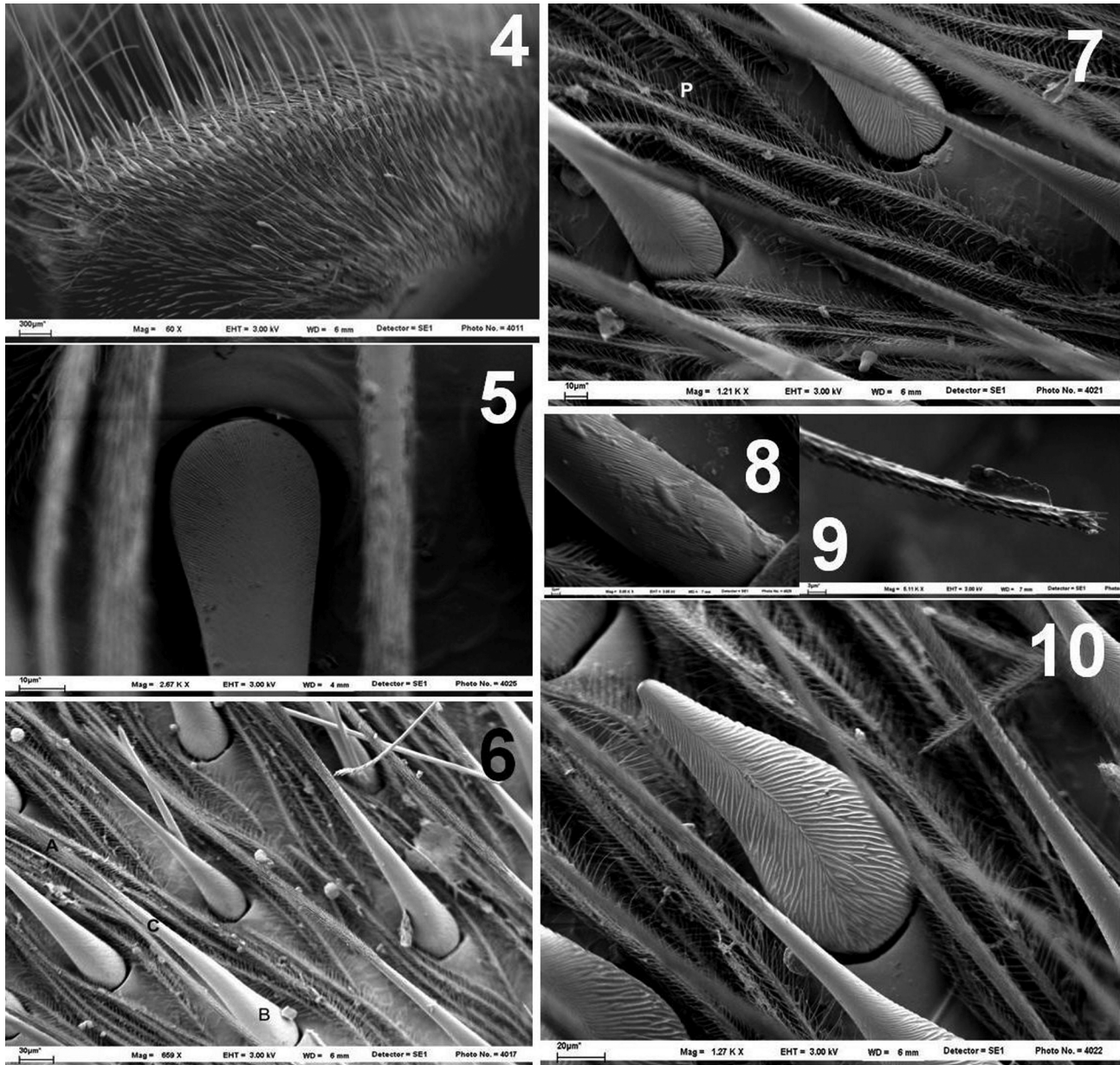
Other examined material. Argentina: Cordillera de los Andes, 20 Aug 88, L. Colonel col., 1 female (IBSP 10391). **Córdoba Province:** Bialeto Massé, Jan 1960, C. Paolini & C. Nera cols., 1 female (MACN), 1 male (MACN); Gral. Deheza, 7 Feb 1961, no collector, 1 male (MACN); Gral. Roca, Balsa de Paso, 22 Mar 1959, R. N. col., 1 male (MACN 110); Ing. Malmen, Gral. San Martín, 8 May 1962, Gallardo col., 1 female (MACN); La Cumbre, 13 Sep 1952, V. Nuñez col., 1 female (MACN LP28); La Falda, Apr 1975, Cesari col., 1 immature (MACN); Mina Clavero, 16 Feb 1940, Birula col., 1 female (MACN), 1 immature (MACN); Santa Rosa de Calamuchita, 13 Jan 1961, no collector, 2 immatures (MACN); South of Córdoba, Oct 1944, no collector, 1 female (MACN). **Buenos Aires Province:** Azul, Dec 1948, Barros col., 1 male (MACN T125); Bahía Blanca, Apr 1939, Schiapelli &

Gerschman cols., 1 male (MACN 73); same locality (3842' S; 6218' W), 27 Oct 2008, no collector, 1 male (LZI); Carmen de Patagones, 2 Mar 1970, no collector, 1 female (MACN 1042); same locality (4048' S; 6258' W), no date, no collector, 1 female (LZI); Curamalal, 30 Jan 1979, no collector, 1 immature (MACN); Curamalal, Abra del Xinojo, no date, Soraka col., 1 female (MACN); Estancia El Tropezón, road between Púan and Pigué, Nov 1969, Gallardo col., 2 females (MACN 6757), 3 males (MACN 6757), 1 immature (MACN 6757); Nicolás Levalle, Salinas Las Barrancas, Villarino, Oct 1960, Schiapelli & Gerschman cols., 1 male (MACN 185); same locality, Jan 1961, Schiapelli & Gerschman cols., 4 males (MACN); Olavarría, Estancia La China, 6 Dec 1969, Galiano col., 1 male (MACN); same locality, Nov 1972, E. Maury col., 1 female (MACN); Olavarría, Sierra de la China, 19 Nov 1969, E. Maury & Gallardo cols., 1 female (MACN 6761); Sierra de la Ventana, Dec 1971, Galiano col., 1 female (MACN 6436); same locality, Feb 1974, Toth col., 1 male (MACN); same locality, Jan 1967, Galiano col., 1 male (MACN); same locality, 5 May 1951, Viccetti col., 1 female (MACN); same locality, 22 Dec 1953, Viccetti col., 2 males (MACN); same locality, 12 Apr 1954, Viccetti col., 1 male (MACN); same locality, 15 Jul 1954, Viccetti col., 1 male (MACN); same locality, 18 Dec 1956, Viccetti col., 1 male (MACN); same locality, Dec 1941, no collector, 1 female (MACN); same locality, Mar 1939, Gario col., 1 immature (MACN); same locality, 14 Sept 1953, Kagen col., 1 female (MACN 55); same locality, 18 Sept 1952, E. Maury col., 1 male (MACN); same locality, 1959, Gario col., 1 male (MACN 46); same locality, Nov 1972, Echechuren col., 1 female (MACN 6766); same locality, Jul 1972, no collector, 1 male (MACN); same locality, 30 Jun 1978, no collector, 1 immature (MACN 2); same locality (3807' S; 6147' W), 21 Jan 2009, S. Copperi col., 1 female (LZI); same locality (3807' S; 6147' W), 21 Jan 2009, N. Ferretti, G. Pompozzi & S. Copperi cols., 1 male (LZI); Sierra de la Ventana, Abra de la Ventana, Oct 1969, H. Castello col., 1 immature (MACN); same locality, 4 Nov 1969, Gallardo col., 1 female (MACN), 1 male (MACN), 3 immatures (MACN); same locality, 25 Nov 1972, E. Maury col., 2 females (MACN); Sierra de la Ventana, Cerro Negro, Feb 1972, Aguilera col., 1 male (MACN); same locality, 2 Mar 1972, Aguilera col., 1 male (MACN); same locality, 12 Apr 1974, Cesari col., 1 immature (MACN 101); same locality, 12 Jun 1974, Cesari col., 2 immatures (MACN); Sierra de la Ventana, Estancia Funke (3804' S; 6202' W), 26 Apr 2008, N. Ferretti & G. Pompozzi cols., 1 female (LZI), 2 immatures (LZI); same locality, 26 Apr 2008, G. Pompozzi col., 1 male (LZI); Sierra de la Ventana, Tornquist, 1 Jan 1947, Bachman & Rossi cols., 1 female (MACN 856); Sierra Las Tunas, 29 Sept 1968, Riggi col., 1 female (MACN 52); Sierra Las Tunas, cerro La Tigra "San Carlos, 21 Jan 1968, Gallardo col., 1 immature (MACN); Tandil, 26 Apr 1950, Andrae col., 1 female (MACN); same locality, 14 Nov 90, L. Colonel col., 1 female (ISBP 8277); same locality, no date, no collector, 1 male (SMF 57834); same locality, no date, no collector, 1 female (MACN 39); same locality, 5 Sept 1958, Amelane col., 3 females (MACN M3, M4, M5), 3 immatures (MACN); same locality, Jul 1950, Orfila col., 1 female (MACN); same locality, Ago 1950, Orfila col., 1 female (MACN); same locality, 6 Nov 1950, Foesstei col., 1 female (MACN); same locality, 12 Apr 1951, Amelane col., 1 female (MACN M2); same locality, 22 May 1955, Amelane col., 1 female (MACN M1); same locality, May 1950, Orfila col., 1 female (MACN); same locality, Dec 1950, Orfila col., 1 male (MACN); same locality, Jun 1968, E. Maury col., 2 females (MACN), 1 male (MACN); same locality, Dec 1943, no collector, 1 male (MACN), 1 immature (MACN); same locality, Apr 1985, C. Scioscia col., 1 male (MACN); Tornquist, Cerro Colorado, Oct 1962, Soraka col., 1 female (MACN 6768); Tornquist, Cerro Esmeralda, Oct 1972, Soraka col., 1 female (MACN); same locality, Nov 1972, Soraka col., 4 females (MACN 6769); Villa Ventana (3804' S; 6155' W), 2005, N. Ferretti col., 1 female (LZI). **La Pampa Province:** Parque Nacional Lihué Calel, Ago 1967, E. Maury col., 1 male (MACN 6759), 3 immatures (MACN 6759); same locality, Nov 1969, E. Maury & Gallardo cols., 1 female (MACN 6758), 12 immatures (MACN 6758); same locality, Nov 1969, E. Maury & Posadas cols., 2 females (MACN 6764), 1 male (MACN 6764). **Mendoza Province:** Chacras de Coria, Nov 1957, Fegni col., 1 male (MACN 4886). **Río Negro Province:** Viedma (4048' S; 6301' W), no date, no collector, 1 female (LZI); Villa Regina, May 1973, Soraka col., 1 female (MACN 6763). **Chubut Province:** Puerto Madryn, Feb 1972, Stickel col., 1 male (MACN 6762).

Distribution. Throughout the mountains and southeast of Córdoba. Hilly zones of Mendoza near Cordillera de Los Andes. Mainly found in mountainous systems of Ventania and Tandilia in southwestern and central Buenos Aires; and meadows in southern Buenos Aires province. South of La Pampa, Sierras de Lihué Calel, which comprises lower mountain ranges. North of Río Negro. Northeast of Chubut (Fig. 31).

Remarks. The male type of *G. vachoni* and female type of *G. schulzei* possess a field of short spiniform setae on the pro- and retrolateral coxal faces of legs I–III, prolateral coxae IV and retrolateral palpal maxillae (Fig. 19). These structures were interpreted as apomorphic for *G. schulzei* (Schmidt 1994). When Schmidt (2003) described a

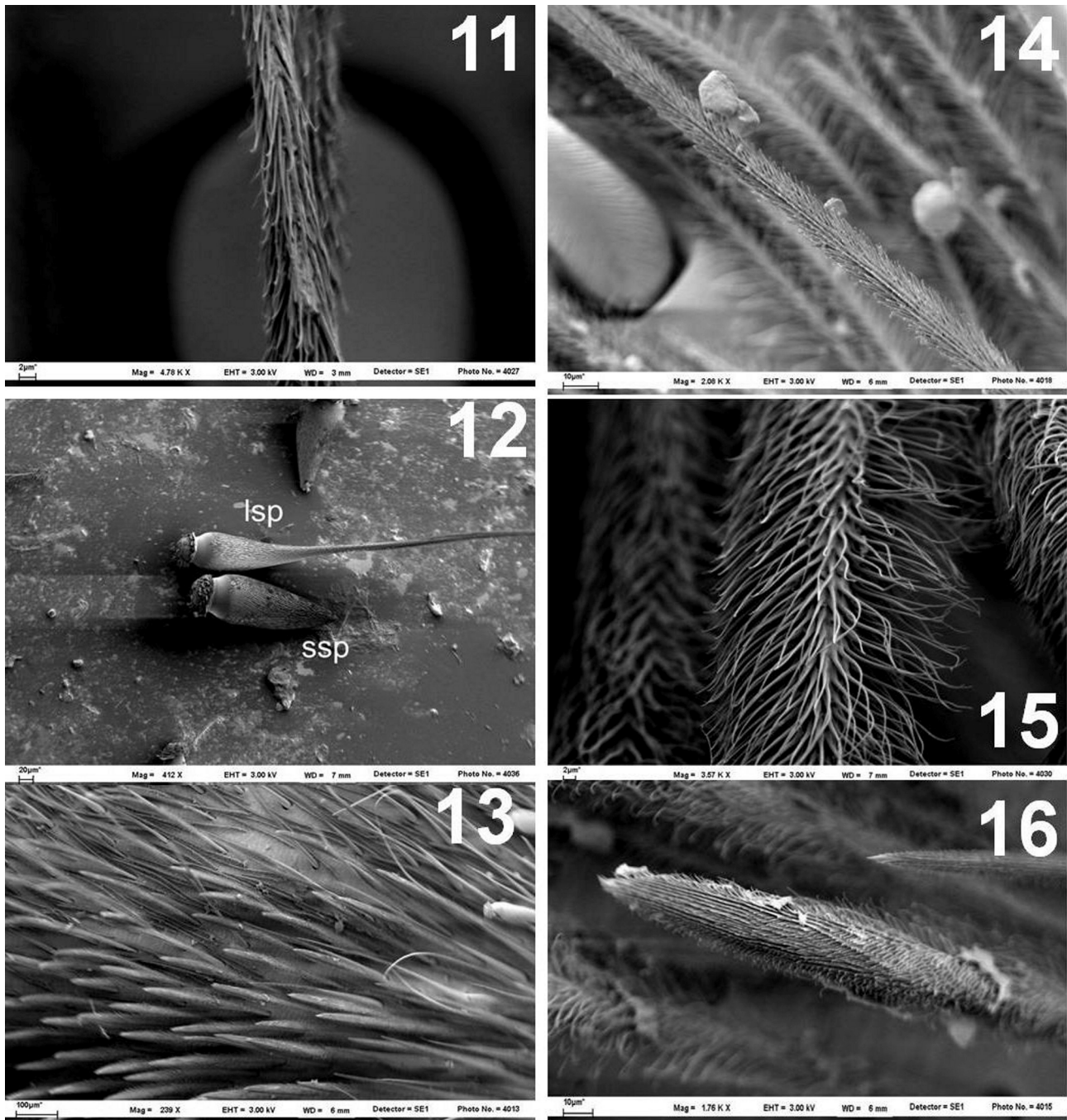
male of *G. vachoni*, he did not note that this specimen had the same short spiniform setae as *G. schulzei*. Moreover, this individual has feathered setae on proteral coxa I. The tibial apophysis of males of *G. vachoni* and *G. schulzei* did not differ. No differences were found in the morphology of the spermathecae. Both types have stridulatory setae on the retrolateral face of the maxillae (Fig. 22). The weak hair-like stridulating bristles, indicated by Schmidt (2003) for *G. vachoni* are not consistent with the stridulatory setae observed in the types. For these reasons, *G. schulzei* is considered a junior synonym of *G. vachoni*.



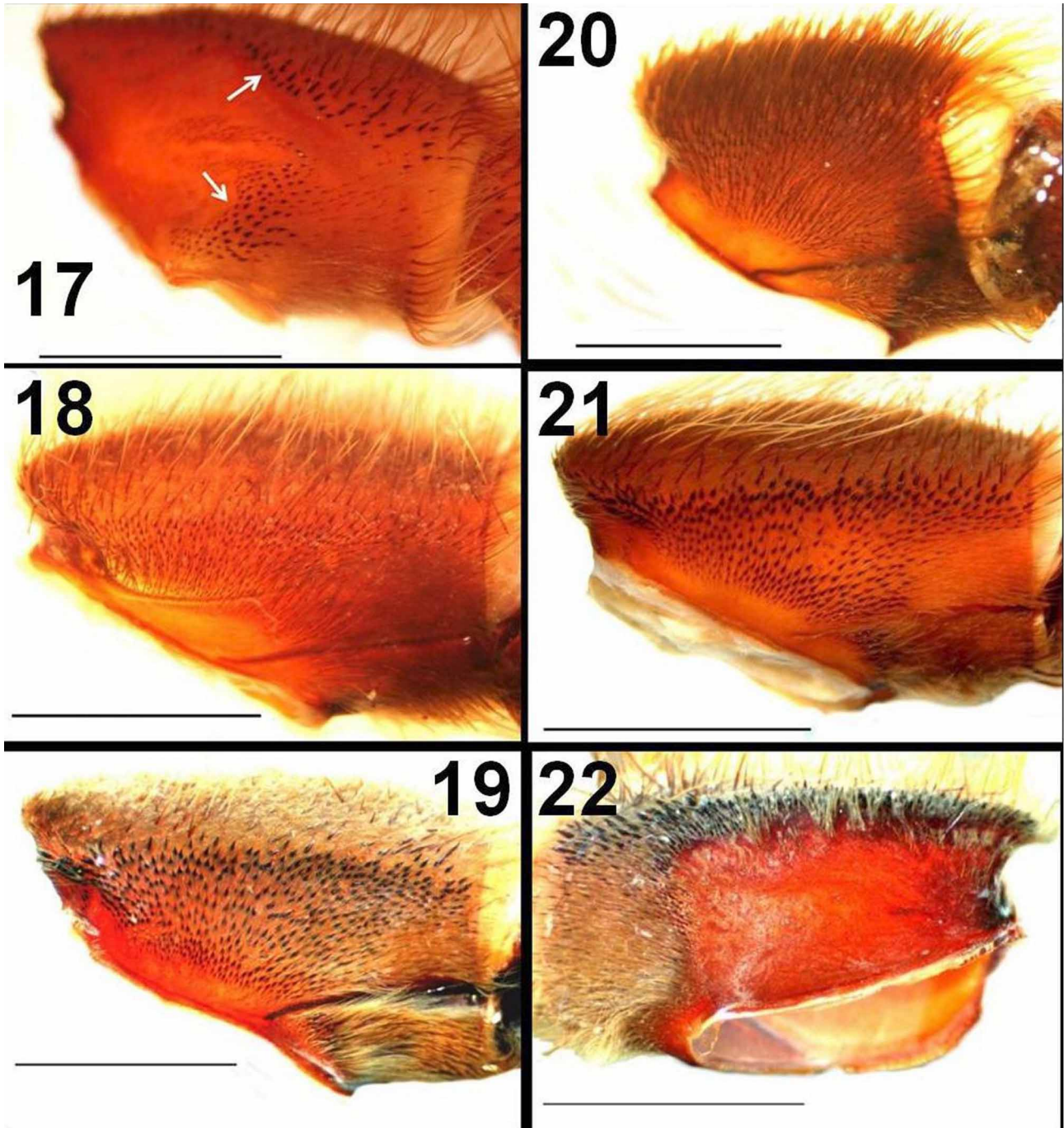
FIGURES 4–10. *Grammostola vachoni* (4–7, 10), *Grammostola burzaquensis* (8, 9). 4. Prolateral face of coxa I. 5. Basal portion of long spiniform setae. 6. General morphology of long spiniform setae. A = Apical, C = Central, B = Basal. 7. Detail of plumose setae (P). 8. Detail of basal portion of regular setae. 9. Detail of apical portion of regular setae. Note: short barbs.

Sympatry. In several localities, we found two species in sympatry but we did not find all three species co-occurring. In the Oriental zone of Buenos Aires Province, we found *G. doeringi* and *G. burzaquensis* living in sympatry at La Plata and Florencio Varela. In the center of the province, *G. vachoni* and *G. burzaquensis* are found together at Azul. In the southwest, there is a large overlap in the distributions of *G. vachoni* and *G. doeringi*. *G. vachoni* occurs mainly on hilly zones, such as Sierra de la Ventana, but some individuals collected in Bahía Blanca, Nicolas Levalle and Carmen de Patagones confirm that they also occupy in meadows. *G. doeringi* seems to occur strictly in meadows; in Sierra de la Ventana this species was noted only in meadows, beside roads. In La Pampa

province, *G. vachoni* and *G. doeringi* occurred in sympatry at Lihué Calel, in central south of the province. In Río Negro province, *G. vachoni* and *G. doeringi* occur together at Villa Regina in the north center of the province, a zone characterized by extended meadows. Chubut province is the southernmost occurrence for the species of *Grammostola* treated here. The shared occurrence of *G. vachoni* and *G. doeringi* was noted in Puerto Madryn, northeast of Chubut province.



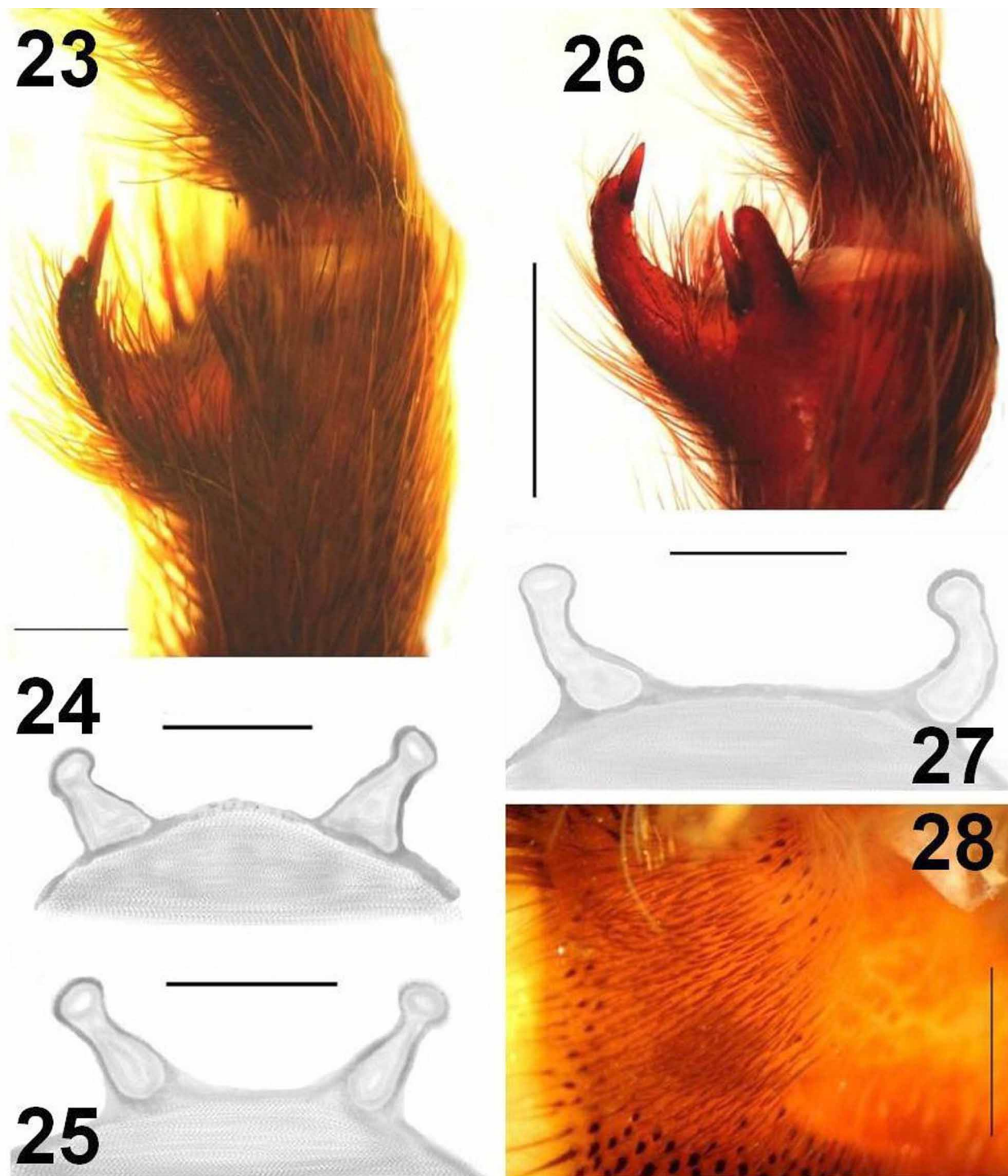
FIGURES 11–16. *Grammostola vachoni* (11–14, 16), *Grammostola burzaquensis* (15). 11. Detail of apical zone of long spini-form setae. 12. Short and long spiniform setae. lsp = long spiniform setae, ssp = short spiniform setae. 13. Stridulatory setae on retrolateral face of maxilla. 14. Detail of short barbs with curved tips. 15. Stridulatory setae on retrolateral face of maxilla. 16. Detail of one stridulatory setae.



FIGURES 17–22. *Grammostola vachoni*, holotype male (MACN 7152) (17, 21), *G. doeringi*, neotype male (MACN 153) (18), *G. schulzei*, holotype female (SMF 37537) (19, 22), *G. burzaquensis*, holotype male (MLP 105) (20). 17. Retrolateral face of coxa I, arrows indicate the groups of spiniform setae. 18. Prolateral face of coxa I. 19. Prolateral face of coxa I. 20. Prolateral face of coxa I. 21. Prolateral face of coxa I. 22. Retrolateral face of maxilla. Scale bars = 3.5mm for 17, 18, 21; 3mm for 20, 22; 3.8mm for 19.

Discussion

Surface ultrastructure of setae. The different types of setae found in these species of *Grammostola* are clearly differentiable and are a new and useful character, at least to diagnose these species. In combination with other characteristics, they will contribute to solving problems in other species of this taxonomically difficult genus. The ornamentation found in the short spiniform setae and in the basal portion of the long spiniform setae resemble that



FIGURES 23–28. *Grammostola burzaquensis*, holotype male (MLP 105) (23), female paratype (24), *G. doeringi*, allotype female (MACN 151) (25), *G. vachoni*, holotype male (MACN 7152) (26, 28), female (LZI 15) (27). 23. Tibial apophyses of males. 24. Spermathecae of females. 25. Spermathecae of females. 26. Tibial apophyses of males. 27. Spermathecae of females. 28. Retrolateral face of maxilla. Scale bars = 1.25mm for 23; 3.25mm for 26; 2mm for 28; all others 1mm. Illustrations of 24, 25, 27 by Ferretti ,N.

of the cuspules found in the labium and maxillae of the mygalomorph spiders (Griswold 1985; Pérez-Miles and Montes de Oca 2005; Raven 1994). The cuspules show differences in ornamentation between the anterior and the posterior faces (Pérez-Miles and Montes de Oca 2005). However, we did not find differences of ornamentation between the anterior and the posterior faces of the setae. We cannot be sure of the function of these different types of setae. Bertani *et al.* (2008) found spiniform setae on the faces of coxae and trochantera of two species of

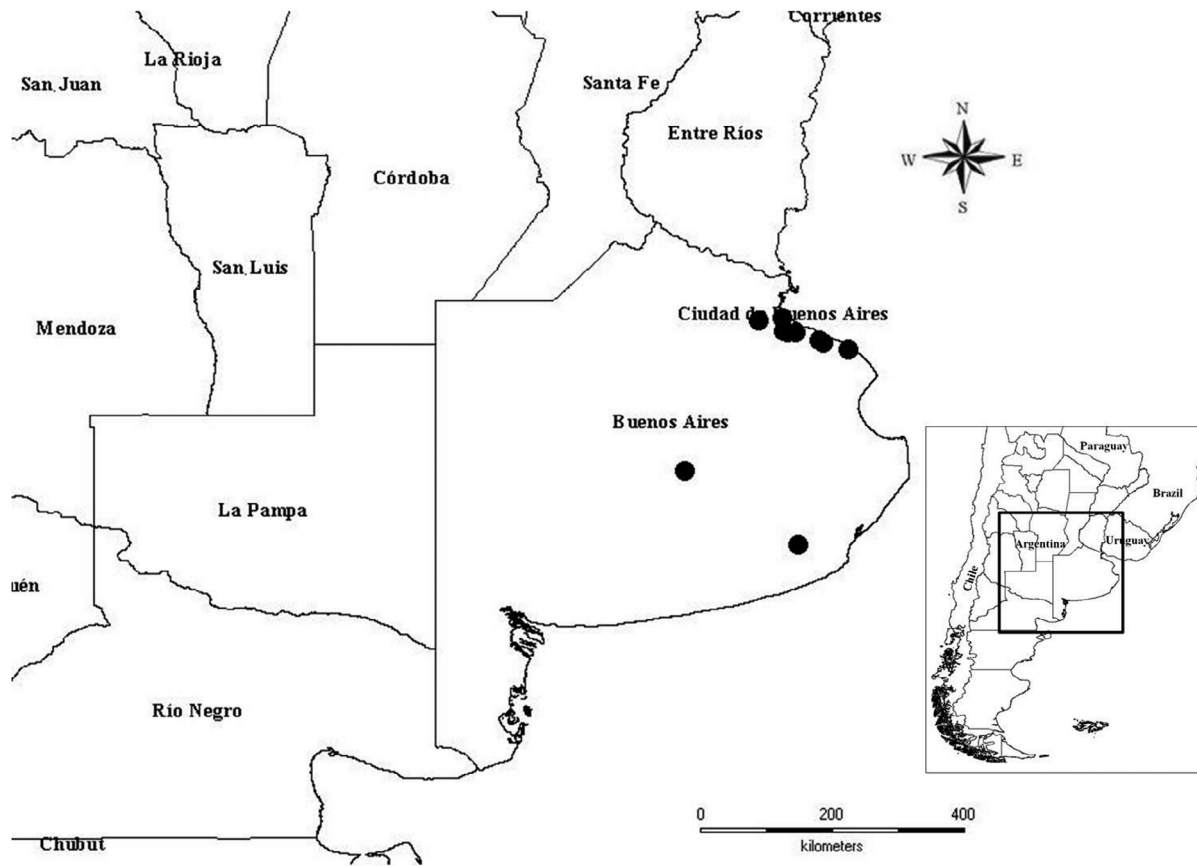


FIGURE 29. Distribution of *Grammostola burzaquensis*.

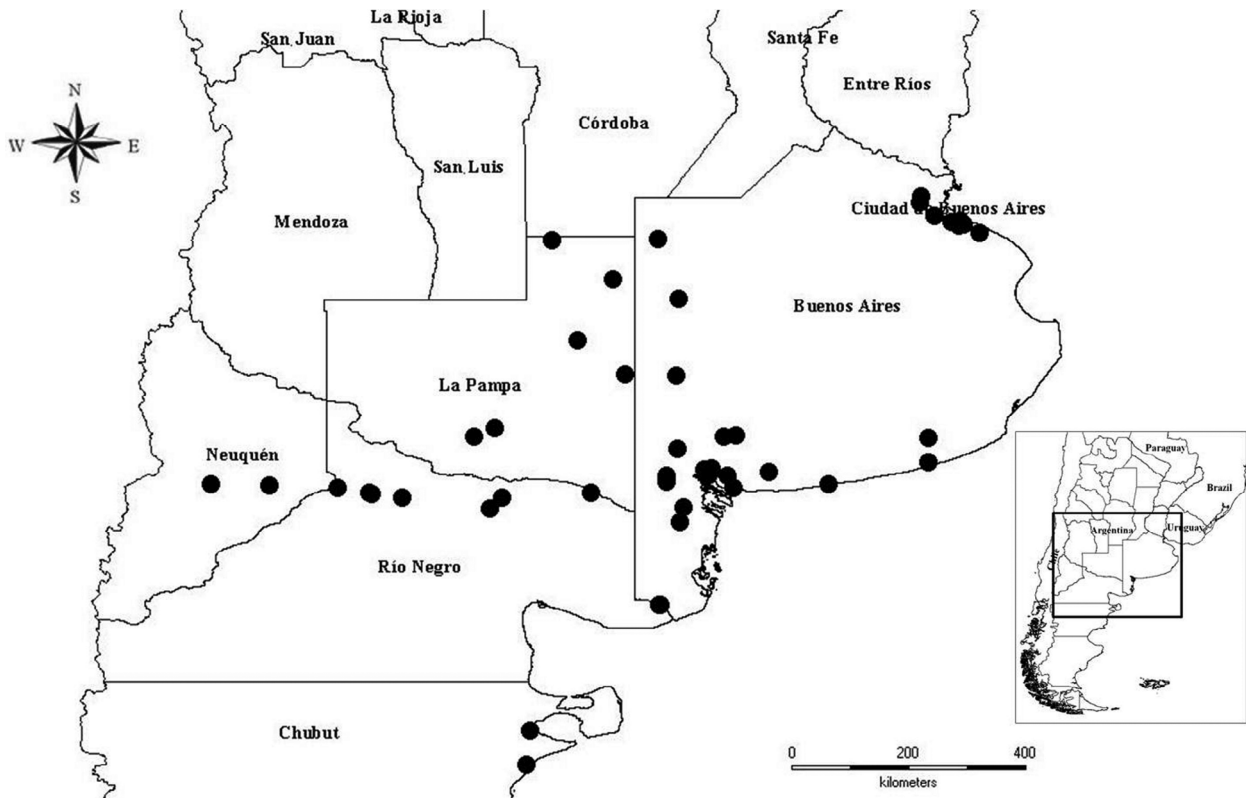


FIGURE 30. Distribution of *Grammostola doeringi*.

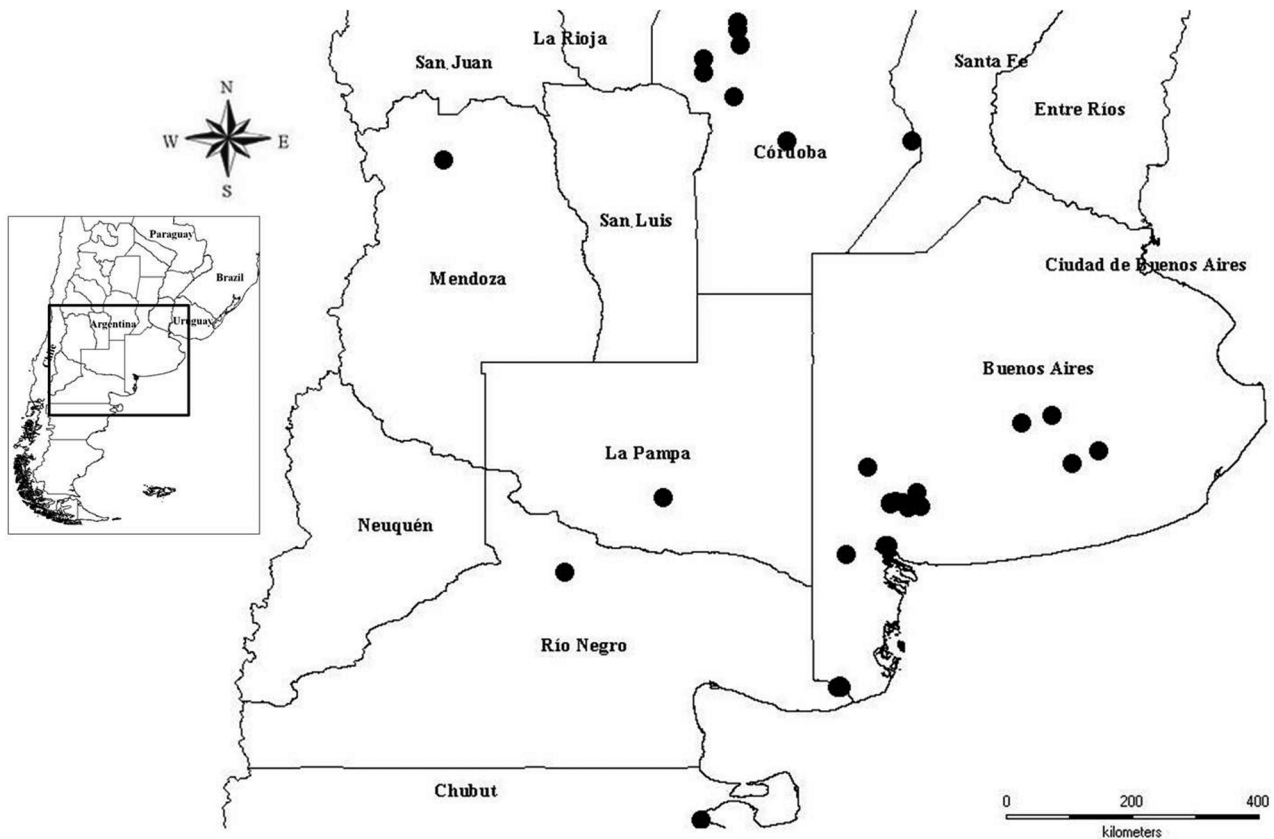


FIGURE 31. Distribution of *Grammostola vachoni*.

Pamphobeteus that were stridulatory in function. However, those setae seemed to be larger than the setae found in these species of *Grammostola* and also in other Theraphosinae, such as *Eupalaestrus spinosissimus* Mello-Leitão 1923 and *Eupalaestrus campestratus* (Simon 1891) (Bertani 2001). Moreover, the spiniform setae on these *Grammostola* species are restricted to the coxae. The long spiniform setae, with the apical portion bearing numerous barbs, could be acting like stridulatory setae as was found on trochantera of *Acanthoscurria suina* (Pérez-Miles *et al.* 2005). The stridulatory apparatus reported for *Grammostola* spp. consist of plumose hairs found between the coxae of the palps and the first pair of legs. Further data are needed to clarify the function of these types of setae on *Grammostola* species.

Sympatry. In some localities, two *Grammostola* species occur in sympatry. More studies on the habitat in central and South Argentina are needed in order to determine the overlapping zones for establishing the sympatric occurrence of these *Grammostola* species. In the southwest of Buenos Aires province, studies are being carrying out in order to determine if *G. vachoni* and *G. doeringi* are sympatric species living in meadows and in hilly zones (Ferretti *et al.* 2009).

Acknowledgments

We would like to thank the following individuals for the loan of specimens used in this study: Dr. Peter Jäger, Dr. Antonio Brescovit, Dr. Cristina Scioscia and Dr. Luis Pereira. Dr. Martín Ramírez and Mr. Cristian Grismado for their help on stage at the Museo Argentino de Ciencias Naturales. Mr. Jorge Barneche for photos and Mrs. Sofía Copperi for collecting some specimens are thanked. Thanks to Dr. Pablo Martín and the Ecology Laboratory for the use of digital calipers. The Laboratory of Invertebrate Zoology II, provided collection facilities, Dr. Adriana Ferrero, Mrs. Mercedes Gutierrez, Dr. Natalia Stefanazzi, Dr. Carolina Sanchez Chopa, Mrs. Veronica Benzi and Mr. Jorge Werdin are also thanked. This work was partially funded by the American Arachnological Society and the Vincent Roth Foundation. The author is a fellowship of CONICET (Comisión Nacional de Investigaciones Científicas y Técnicas).

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