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MOUSE SPIDERS IN THE HUMID CHACO: TWO NEW SPECIES OF *ACTINOPUS* PERTY, 1833 FROM PARAGUAY (ARANEAE: ACTINOPODIDAE)

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Abstract: Based on male specimens, two new sympatric species of *Actinopus* Perty, 1833 from Paraguay: *Actinopus tetymapyta* **sp. nov.** and *Actinopus tasneemae* **sp. nov.** are described. The remarkable discovery of two species occurring sympatrically in the humid Chaco ecoregion of Paraguay demonstrates the species richness of the genus.
Key words: Araneae, Actinopodidae, taxonomy, systematics, biodiversity, Paraguay.

Arañas ratonas en el Chaco húmedo: dos especies nuevas de *Actinopus* Perty, 1833 de Paraguay (Araneae: Actinopodidae)
Resumen: A partir de ejemplares machos, se describen dos nuevas especies simpátricas de *Actinopus* Perty, 1833 de Paraguay: *Actinopus tetymapyta* **sp. nov.** y *Actinopus tasneemae* **sp. nov.** El notable descubrimiento de dos especies presentes en simpatría en la ecorregión del Chaco húmedo de Paraguay demuestra la riqueza de especies de este género.
Palabras clave: Araneae, Actinopodidae, taxonomía, sistemática, biodiversidad, Paraguay.

Taxonomy / Taxonomía: *Actinopus tetymapyta* **sp. nov.,** *Actinopus tasneemae* **sp. nov.**

Introduction

The genus *Actinopus* Perty, 1833 is the most diverse of the family Actinopodidae Simon, 1892, with 95 valid species and one invalid junior synonym *A. ceceliae* Mello-Leitão, 1923 (= *A. crassipes* (Keyserling, 1891) per Silva-Moreira *et al*., 2010 but this synonymy is doubtful as mentioned by Miglio *et al*., 2020) (World Spider Catalog, 2022) and can be characterised from other mygalomorphs by the combination of a prominent rastellum, patellae III and IV with crown of apical spines, the spinose retrolateral face of tibia II, and presence of a PA on the male palpal bulb. Of the known species, only *Actinopus crassipes* (Keyserling, 1891) has been recorded from Paraguay. However, this record is based on Simon (1897) and is doubtful, given the lack of illustrations, and considering disjunct distribution (in terms of ecoregions) of *A. crassipes* in Rio Grande de Sul. We therefore reject the distribution of *A. crassipes* in Paraguay but recognise Simon (1897) as the first author to report the genus *Actinopus* from Paraguay.

Actinopus species are often highly localised, with narrow distribution ranges that may owe to a limited dispersal ability (Ríos-Tamayo & Goloboff, 2018). The locality of some recently collected specimens (see below) falls within the humid Chaco ecoregion, a highly biodiverse system in South America, where limited sampling of *Actinopus* has taken place. The department of Ñeembucú, bordered by the Paraná and Paraguay rivers, is dominated by wetlands, with up to 90% of the department flood-prone (Contreras Roqué *et al*., 2007). Ñeembucú is one of the least explored regions of Paraguay (Mereles *et al*., 2005). Few studies have examined the invertebrate fauna of the region in any depth. Dickens *et al*. (2020) found a unique Odonata fauna in a multi- year systematic study, highlighting the conservation potential of the area. In terms of its spider fauna, scarcely little is known, although the recent discovery of numerous new species from limited collection methods and sampling regimes (e.g. Pett, Rubio & Stolar, 2021; Pett, 2021; Pett, Rubio & Perger, 2022), add substantial cause for conservation of the area. Four recently collected male specimens of *Actinopus* from the humid Chaco ecoregion in Paraguay, most of which were co-collected by the second author, revealed two morphospecies. Thus, the recently acquired samples enabled examination of the first known material of this genus from the area and also represented specimens from an area of flooded soils. Ríos Tamayo & Goloboff (2018) previously stated that *Actinopus* species are highly restricted in their microhabitat choice and rarely found in flooded soils.

In this work, we describe two new species of *Actinopus* that occur sympatrically in the humid Chaco ecoregion of Southern Paraguay. We also discuss palpal bulb morphology in *Actinopus*, which has inconsistent application between two recent publications (Ríos-Tamayo & Goloboff, 2018; Miglio *et al*., 2020).

Material and methods

Specimens were examined under a binocular microscope. Photographs of specimens were made by DS using a Leica M125C auto-montage, with images stacked using Helicon Focus software. Description style follows Sherwood *et al*. (2020), originally used for theraphosids, adapted here for actinopodids. Abbreviations, Institutions: CIPLT = Colección Científica Para La Tierra, Pilar, Paraguay. The accession number denotation "-Ar" refers to the arachnology collection of CIPLT. Structures: ALE = anterior lateral eyes, AME =

anterior median eyes, PLE = posterior lateral eyes, PME = posterior median eyes. Other: leg. = legit. Abbreviations for museum collections follow Evenhuis (2007). Leg spine terminology follows Petrunkevitch (1925) with the modifications proposed by Bertani (2001): d = dorsal, v = ventral, r = retrolateral, p = prolateral. Palpal bulb terminology follows Bertani (2000); PA = paraembolic apophysis; PAc = prolateral accessory keel; PI = prolateral inferior keel, PS = prolateral superior keel, R = retrolateral keel; TA = tegular apophysis. Leg formulae start with the longest leg to the shortest in order of decreasing size, e.g. 4,1,2,3. All measurements are in mm and were made using ImageJ. The ecoregion affinities of the species were investigated by visualizing the coordinates and a shapefile of the regionalization of ecoregions by Olson *et al*. (2001), by using the geographic information system QGIS (version 3.16, http://www.qgis.org/en/site/), the resultant map was compiled by BLP.

Palpal bulb morphology

Two previous publications which made major contributions (i.e. description of double-digit new taxa) to the knowledge of *Actinopus* used different terminology for palpal bulb keels (Ríos-Tamayo & Goloboff, 2018; Miglio *et al.,* 2020). In Ríos -Tamayo & Goloboff (2018), the terms "Bk" (basal keel) "Mk" (medial keel), "Ak" (apical keel) and "RMk" (retrolateral medial keel) are used. However, Miglio *et al.* (2020) used the palpal bulb keel terminology system developed by Bertani (2000) for theraphosids. This had indeed been the framework used by two prior works: Miglio, Lucas & Bonaldo (2012) (who correctly label the PI but label the PAc as the PS and vice versa) and Ríos-Tamayo (2014) (who correctly labelled all palpal bulb structures in agreement with Bertani's terminological definitions but considered the denticulate area on the prolatero-ventral face of the embolus to be part of the PI, which is erroneous). The PS and PI keels (*sensu* Bertani, 2000) can be equated to the "Bk" and "Mk" in Ríos-Tamayo & Goloboff (2018). The third keel labelled as by Miglio *et al.* (2020) is the PAc equates to "Ak" in Ríos-Tamayo & Goloboff (2018). In actuality, Miglio *et al.* (2020) thereby misinterpreted Bertani (2000) as his work clearly defines the PAc as being a structure found between the prolateral (i.e. PS and PI) keels. In *Actinopus*, the structure labelled as PAc by Miglio *et al.* (2020) is actually the PI and vice versa. Miglio *et al*. (2020) made no explicit comment on the retrolateral keel (R *sensu* Bertani, 2000; as "RMk" in Ríos-Tamayo & Goloboff, 2018) but it can be clearly seen in many taxa they illustrate (e.g. Miglio *et al*. 2020: 46: fig. 38A; 49: fig. 41A) and is recognised as a structure in several taxa, but erroneously labelled as a PAc (e.g. Miglio *et al*., 2020: 43: fig. 35A; 52: fig. 44A).

We herein also adopted the palpal bulb keel terminology of Bertani (2000), conventionally used for theraphosids, to label and interpret the keels found in the palpal bulbs of *Actinopus* taxa. Males possess a PS, PAc and PI, an area of denticulation parallel and separate of the PI is also present in some taxa. We adopt Bertani's term PA (paraembolic apophysis) previously used by Miglio, Lucas & Bonaldo (2012), Ríos-Tamayo (2014), and Miglio *et al.* (2020). We also adopt TA (tegular apophysis), also *sensu* Bertani (2000), following two previous works on the genus *Actinopus* which also used Bertani's term unmodified (see Miglio, Lucas & Bonaldo, 2012; Ríos-Tamayo, 2014).

In a true prolateral view the PS, PAc and PI are visible. In retrolateral view the PAc, PI and R are visible. In dorsal view, the PS, PAc and R are the only keels visible. In ventral view all four keels are visible. In prolatero-ventral view the PS, PAc and PI are visible; in this view the area of denticulation on the embolus is most apparent, making this view of the palpal bulb useful for the idiosyncrasies of *Actinopus* morphology. In taxa which possess a TA (the vast majority of species possess this bulb character) this structure can be seen in all views except dorsal. All known males of *Actinopus* have a PA, which is visible in dorsal, ventral, prolatero-ventral and retrolateral views. In taxa which have denticulation on the prolatero-ventral face of the embolus, the denticles can be seen in prolatero-ventral, ventral, dorsal, and prolateral views. Other terms used in Miglio *et al.* (2020) found in other species groups are well-supported but not discussed here as they are absent in the species discussed in the present work.

Taxonomy

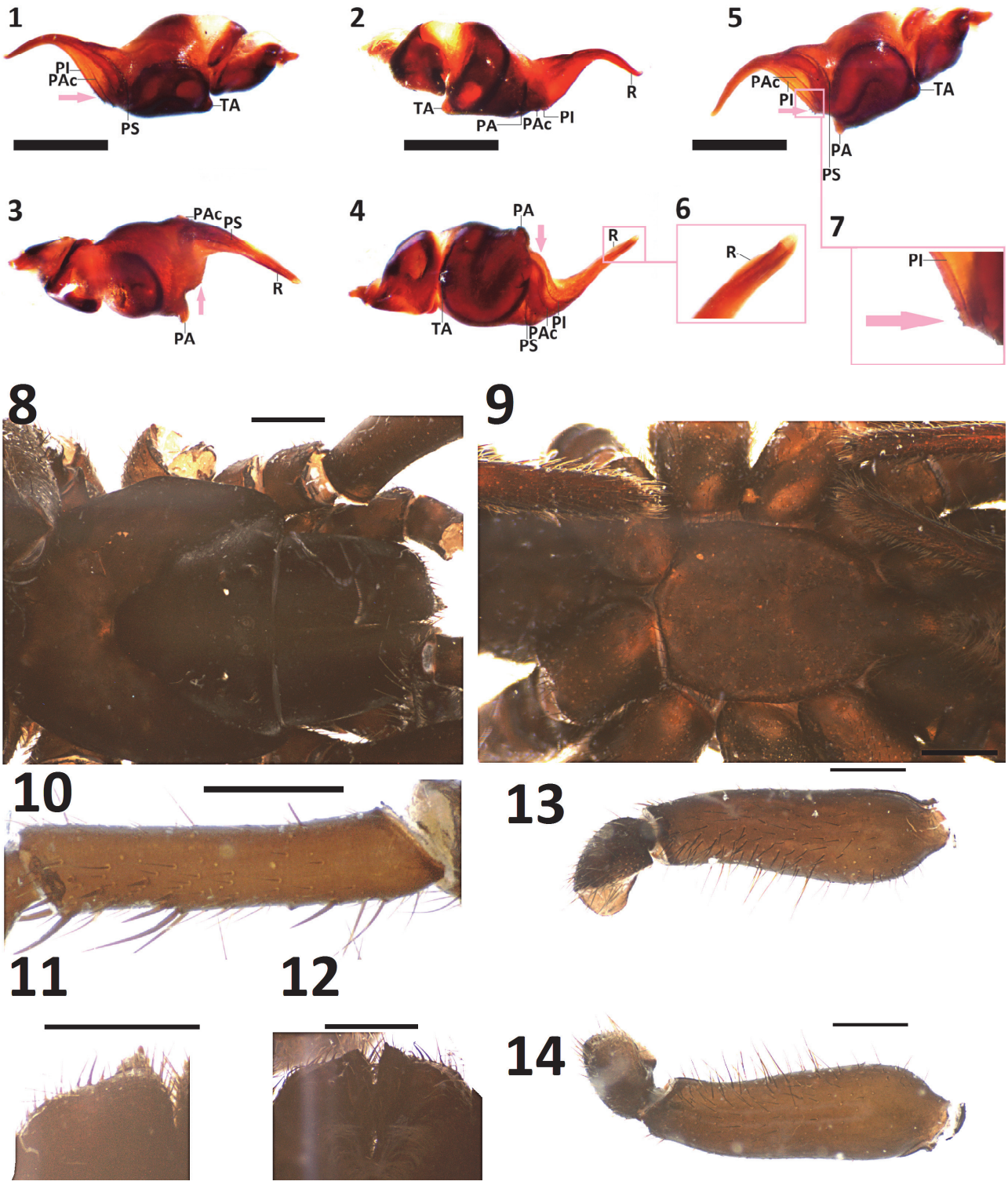
Actinopus tasneemae sp. nov.

Type Material:
Holotype ♂ (CIPLT-Ar 728), PARAGUAY: Pilar Military Base, Ñeembucú department, -26.8432, -58.3103, 20/02/2020, leg. Tasneem Ahsanullah, examined.

Diagnosis: *Actinopus tasneemae* **sp. nov.** most closely resembles the male of *Actinopus coylei* Ríos-Tamayo & Goloboff, 2018 but can be distinguished by the presence a single cuspule on the rastellum (cuspules absent on rastellum in *A. coylei*) and by the palpal bulb morphology with presence of an R (R absent in *A. coylei*). This taxon is readily distinguished from the male of its sympatric congener *A. tetymapyta* **sp. nov.** by the absence of light orange colouration to the tibiae, metatarsi, and tarsi of legs I-IV (tibiae, metatarsi, and tarsi light orange in *A. tetymapyta* **sp. nov.**) and by the palpal bulb morphology with a more elongate and not abruptly retrolaterally-curved embolus (embolus shorter and abruptly retrolaterally-curved in *A. tetymapyta* **sp. nov.**) and the wider tegulum (tegulum more compact in *A. tetymapyta* **sp. nov.**).

Etymology: The species epithet is a matronym in honour of Tasneem Ahsanullah, who collected the holotype specimen, among numerous other spiders for the second author during work in Paraguay.

Description of holotype male (CIPLT-Ar 728): Total length including chelicerae: 11.4. Carapace: length 5.1, width 4.8. Caput: highly raised. Eyes: ALE > AME, AME > PLE, PLE > PME. Fovea: deep, procurved. Chelicera: length 2.2, width 1.7, rastellum pointed with single large cuspule at apex (Figs. 11–12). Abdomen: (damaged) length 4.1, width 3.0. Maxilla: maxillary cuspules absent. Labium: length 1.2, width 1.0, labial cuspules absent. Sternum: length 3.4, width 2.5, with three pairs of sigilla (Fig. 9). Lengths of legs and palpal segments: see table I. Tarsi I-IV with pseudoscopula present, sparsely distributed on tarsi I and II, denser on tarsi III and IV. Metatarsi without pseudoscopula. Spination: patella III 0–9–16 (apical, 'crown of thorns'), IV p 4–5–2, tibia I v 1–2–6 (4 apical), II v 0–1–3, r 1–2–7 (Fig. 10), III v 0–0–6, p 2–0–1, r 1–3–4, IV p 1–2–3, metatarsus I v 5–7–8 (4 apical), p 1–1–2, r 3–7–5, II v 10–9–10 (4 apical), p 0–2–0, r



Figs. 1–7: *Actinopus tasneemae* **sp. nov.** holotype male (CIPLT-Ar 728), palpal bulb (right hand side), **1** prolateral view, **2** retrolateral view, **3** dorsal view, **4** ventral view, **5** prolatero-ventral view, **6** embolus close up in ventral view, **7** area of embolic denticulation close up in prolatero-ventral view. Scale bars = 1mm. Pink arrows show area of denticulation on prolatero-ventral face of embolus. Photo credits: Danniella Sherwood.
Figs. 8–14: *Actinopus tasneemae* **sp. nov.** holotype male (CIPLT-Ar 728), **8** carapace dorsal view, **9** coxa, labium, and sternum ventral view, **10** tibia II retrolateral view, **11** rastellum (left hand chelicera) dorsal view, **12** rastellum (entire chelicerae) ventral view, **13** palpal tibia prolateral view, **14** palpal tibia retrolateral view. Scale bars = 1mm. Photo credits: Danniella Sherwood.

Table I: *Actinopus tasneemae* **sp. nov.** holotype male (CIPLT-Ar 728), leg and palp lengths.

	I	II	III	IV	Palp
Femur	5.3	4.0	3.2	4.3	3.4
Patella	2.3	2.5	2.3	2.9	2.3
Tibia	3.6	3.2	2.6	4.3	4.2
Metatarsus	4.1	4.1	4.6	4.4	–
Tarsus	2.3	2.6	2.7	2.5	1.5
Total	17.6	12.3	15.4	18.4	11.4

0–0–1, III v 1–2–6 (4 apical), p 1–2–2, r 5–6–5, IV v 4–1–5 (4 apical), p 0–2–1, r 0–0–1, tarsus I v 5–5–7, II v 8–10–5, III v 2–4–7, IV v 2–9–6. Femur III: incrassate. Palpal tibia: slightly incrassate, elongate (Figs. 13–14). Posterior lateral spinnerets with three segments. Lateral median spinnerets with one segment. Palpal bulb with TA; embolus relatively elongate and not abruptly retrolaterally-curved, denticles present on prolatero-ventral face of embolus; PS, PAc, PI and R weakly developed, PA developed, constricted, elongate, TA developed (Figs. 1–7). Colour: carapace brown, caput black, darker than rest of carapace (Fig. 8) and opisthosoma black, sternum and labium brown (Fig. 9), legs (coxae to tarsus) brown.

Distribution: Known only from the type locality Pilar Military Base, Paraguay (Figs. 29–32).

Remarks: The holotype was found to have several legs detached and fragmented, the opisthosoma is also damaged; the left-hand side palpal femur and patella are not present with the specimen but the detached palpal tibia and cymbium are.

Actinopus tetymapyta sp. nov.

Type Material: Holotype ♂ (CIPLT-Ar 727), PARAGUAY: Pilar Military Base, Ñeembucú department, Forest/ Grassland edge pitfall trap, -26.8437, -58.3066, 28/01/2020–16/02/2020, leg. Brogan L. Pett and Rufus Wyer, examined; paratype ♂ (CIPLT-Ar 725), PARAGUAY: Pilar Military Base, Ñeembucú department, Forest interior pitfall trap, -26.8443, -58.3116, 16/02/2020, leg. Brogan L. Pett and Rufus Wyer, examined; paratype ♂ (CIPLT-Ar 726), PARAGUAY: Pilar Military Base, Ñeembucú department, Forest/ Grassland edge pitfall trap, -26.8432, -58.3101, 16/02/2020, leg. Brogan L. Pett & Rufus Wyer, examined.

Diagnosis: *Actinopus tetymapyta* **sp. nov.** most closely resembles the male of *Actinopus gerschiapelliarum* Ríos-Tamayo & Goloboff, 2018 but can be differentiated by the absence of cuspules and rounded point of the rastellum (rastellum with cuspules and not rounded to a point in *A. gerschiapelliarum*) and the more triangular PA in dorsal view (PA more rounded in *A. gerschiapelliarum*). This taxon is readily distinguished from the male of its sympatric congener *A. tasneemae* **sp. nov.** by the presence of light orange colouration to the tibiae, metatarsi, and tarsi of legs I-IV (tibiae, metatarsi, and tarsi homogeneously brown in *A. tasneemae* **sp. nov.**) and palpal bulb morphology with a shorter and abruptly retrolateraly-curved embolus (embolus more elongate and not abruptly retrolaterally-curved in *A. tasneemae* **sp. nov.**) and a comparatively more compact tegulum (tegulum wider in *A. tasneemae* **sp. nov.**).

Etymology: The species epithet is a noun in apposition, formed from the Paraguayan Guarani words tetyma (leg) and pytã (red) (the reverse word order is correct grammatically for Paraguayan Guarani) in reference to the colouration of the type specimens.

Description of holotype male (CIPLT-Ar 727): Total length including chelicerae: 12.2. Carapace: length 4.8, width 4.5. Caput: highly raised.: ALE > AME, AME > PLE, PLE > PME. Fovea: deep, procurved. Chelicera: length 1.9, width 1.2, rastellum pointed, without cuspules (Fig. 25). Abdomen: length 5.5, width 4.0. Maxilla: maxillary cuspules absent. Labium: length 1.1, width 0.8, labial cuspules absent. Sternum: length 2.8, width 2.6, with three pairs of sigilla. Lengths of legs and palpal segments: see table II. Tarsi I-IV with pseudoscopula present, sparsely distributed on tarsi I and II, denser on tarsi III and IV. Metatarsi without pseudoscopula. Spination: patella III 1–3–20 (apical, 'crown of thorns'), IV p 19–10–3, tibia I v 2–0–3, p 0–0–1, r 2–0–3, II v 3–2–0, p 0–0–1 (Fig. 24), r 1–3–6, III v 1–1–4, IV v 1–3–4, r 0–1–1, metatarsus I v 4–6–4, p 1–2–1, r 2–2–3, II v 4–3–6, p 2–2–2, r 1–4–4, III v 1–4–4, r 0–0–1, IV v 3–3–6, r 0–1–0, tarsus I v 1–5–5, II v 2–7–9, III v 0–8–9, IV v 1–4–8. Femur III: slightly incrassate. Palpal tibia: slightly incrassate, elongate (Figs. 26–27). Posterior lateral spinnerets with three segments. Lateral median spinnerets with one segment. Palpal bulb with TA; embolus short and abruptly retrolaterally-curved, denticles present on prolatero-ventral face of embolus; PS, PAc, PI and R weakly developed, PA developed, triangular-shaped, TA developed (Figs. 15–21). Colour: carapace brown, caput black, darker than rest of carapace, and opisthosoma black (Fig. 22), sternum and labium brown (Fig. 23), coxae, trochanters, and patellae dark brown, tibiae, metatarsi, and tarsi light orange (Fig. 28).

Table II: *Actinopus tetymapyta* **sp. nov.** holotype male (CIPLT-Ar 727), leg and palp lengths.

	I	II	III	IV	Palp
Femur	4.5	4.0	4.3	4.4	4.4
Patella	2.3	2.2	2.2	2.4	2.0
Tibia	3.5	3.7	2.4	4.2	4.2
Metatarsus	4.2	3.8	4.6	4.9	–
Tarsus	3.0	3.0	2.5	3.5	1.1
Total	17.5	16.7	16.0	19.4	11.7

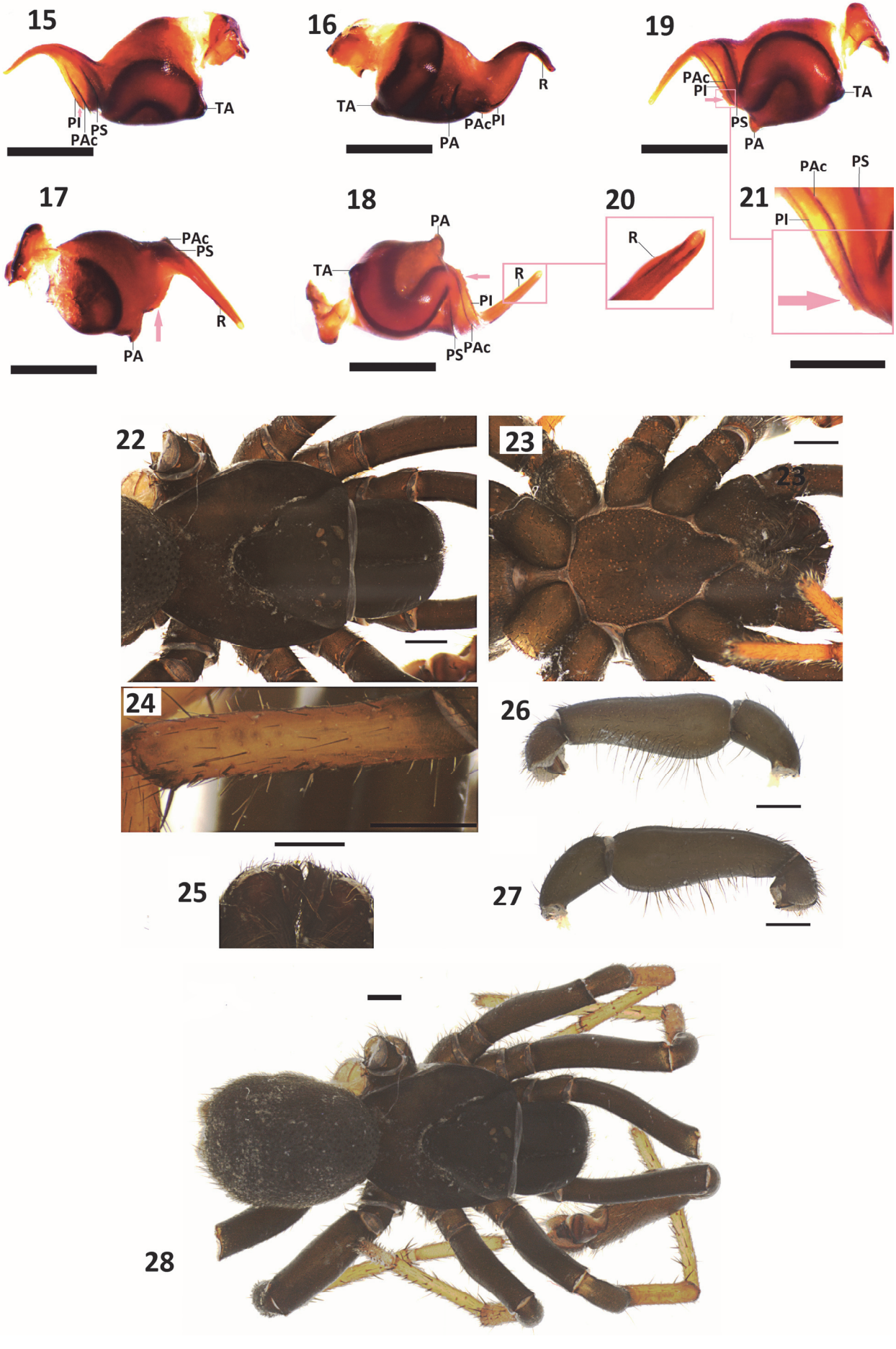
Variation (n = 2): Total length: 14.4–16.8. Carapace: length 5.6–5.9. Chelicera: length 2.1–3.3. Abdomen: length 6.7–7.6.

Distribution: Known only from the type locality Pilar Military Base, Paraguay (Figs. 29–32).

Remarks: The holotype male is the smallest of the three adult males in the type series. The entire left-hand side leg IV was found to be missing. One of the paratypes (CIPLT-Ar 725) was found to have an extremely damaged left-hand side palpal bulb which was dissected prior to receipt of the specimen by DS. The opisthosoma of the other paratype (CIPLT-Ar 726) was found detached from the opisthosoma and damaged.

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Figs. 15–21: *Actinopus tetymapyta* **sp. nov.** holotype male (CIPLT-Ar 727), palpal bulb (right hand side), **15** prolateral view, **16** retrolateral view, **17** dorsal view, **18** ventral view, **19** prolatero-ventral view, **20** embolus close up in ventral view, **21** area of embolic denticulation close up in prolatero-ventral view. Scale bars = 1mm. Pink arrows show area of denticulation on prolatero-ventral face of embolus. Photo credits: Danniella Sherwood. **Figs. 22–28:** *Actinopus tetymapyta* **sp. nov.** holotype male (CIPLT-Ar 727), **22** carapace dorsal view, **23** coxa, labium, and sternum ventral view, **24** tibia II retrolateral view, **25** rastellum (entire chelicerae) ventral view, **26** palpal tibia prolateral view, **27** palpal tibia retrolateral view, **28** dorsal habitus. Scale bars = 1mm. Photo credits: Danniella Sherwood.


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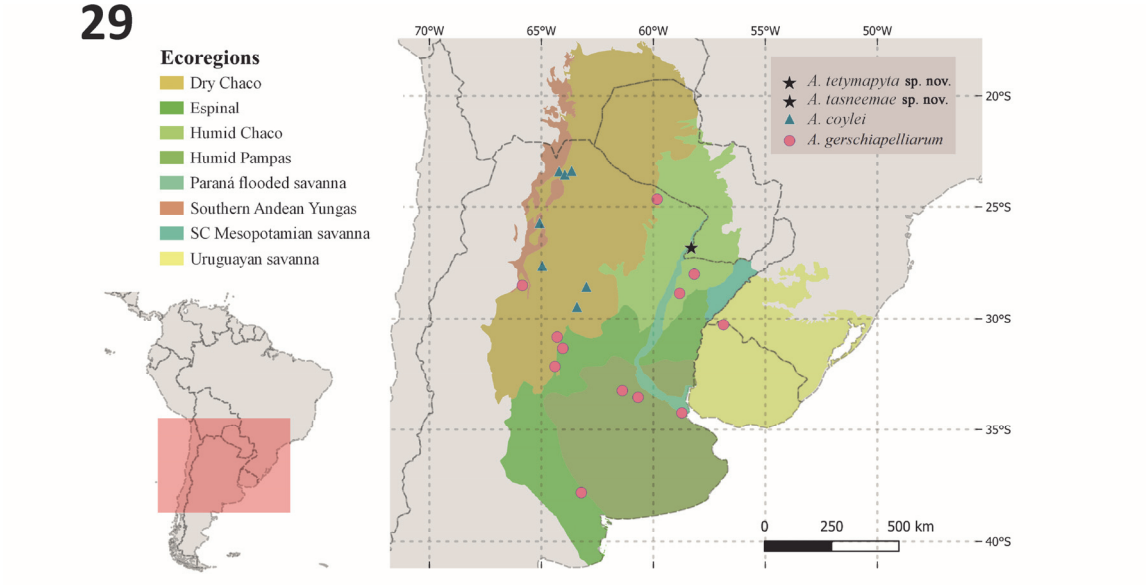








Fig. 29: Map showing the distribution of *Actinopus tasneemae* **sp. nov.** and *Actinopus tetymapyta* **sp. nov.** (known only from the same locality) in comparison to closely morphologically-related Argentinian congeners, overlaid with ecoregions (per Olson *et al.* 2001). **Figs. 30–32:** Pilar Military Base, habitat at the type locality of *Actinopus tasneemae* **sp. nov.** and *Actinopus tetymapyta* **sp. nov.** Photo credits: Lillie Hoffart.

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