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Description of the female of *Actinopus balcarce* Ríos-Tamayo & Goloboff, 2018 (Araneae, Actinopodidae), with comments on its natural history

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ABSTRACT. Trapdoor spiders are known for digging deep burrows into the ground closed with a thick trapdoor. *Actinopus balcarce* Ríos-Tamayo & Goloboff was described based on two males from Balcarce, Buenos Aires, Argentina. In a recent survey in the type locality, we found females probably belonging to this species. Morphology of the females found allowed us to attribute them to *Actinopus balcarce*, which are described for the first time. Photographs of the spermathecae are presented along with comments on the natural history of the species. Some morphological insights on the female of this species are also discussed.

Key words: Argentina, La Barrosa hill, Mygalomorphae, taxonomy, trapdoor spider

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INTRODUCTION

Trapdoor spiders (those from the Actinopodidae, Idiopidae and Migidae) are known for digging deep burrows into the ground covered inside by silk and sealed with a thick trapdoor. Usually, this trapdoor is circular and articulated with the burrow by a hinge made of silk (Coyle et al., 1990; Dippenaar-Schoeman, 2002; Ferretti et al., 2014). When closed, the edges of the lid fit into the entrance rim and can be firmly held up by the spider (Coyle et al., 1990; Ferretti et al., 2014). Females are sedentary and specific collection methods are required to find them, such as active search to identify the lids on the soil surface or shaving the surface to expose the burrows (Ríos-Tamayo & Goloboff, 2018). Males have wandering habits and can be collected by casual collectors or using pitfall traps; this behavior could explain their higher presence in scientific collections (Miglio et al., 2012; Ríos-Tamayo & Goloboff, 2018). *Actinopus* Perty, 1833 is the most diverse genus of the family Actinopodidae and includes 96 species exclusively from the Neotropical region (World Spider Catalog, 2023). *Actinopus* was described

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from the state of Piauí, Brazil, to accommodate a newly described species, *A. tarsalis* Perty, 1833. In Argentina, 25 species are known and eight of them exist in the Province of Buenos Aires: *A. balcarce* Ríos-Tamayo & Goloboff, 2018; *A. casuhati* Ríos-Tamayo & Goloboff, 2018; *A. gerschiapelliarum* Ríos-Tamayo & Goloboff, 2018; *A. insignis* Ríos-Tamayo & Goloboff, 2018; *A. laventana* Miglio, Pérez-Miles & Bonaldo, 2020; *A. patagonia* Ríos-Tamayo & Goloboff, 2018; *A. puelche* Ríos-Tamayo & Goloboff, 2018, and *A. szumikae* Ríos-Tamayo & Goloboff, 2018 (Ríos-Tamayo & Goloboff, 2018; Miglio et al., 2020; World Spider Catalog, 2023). *Actinopus balcarce* was described based on two males from Balcarce, Buenos Aires, and its female remains unknown.

During a recent fieldwork in Balcarce, we found some females belonging to the genus *Actinopus* that we could not assign to any known species using the key proposed by Ríos-Tamayo & Goloboff (2018). We consider them conspecific to *A. balcarce* and describe, diagnose and illustrate them for the first time.

MATERIAL AND METHODS

Study area. The Tandilia mountain range is located in the east of Buenos Aires province, in central Argentina. It comprises ancient low-altitude hills of about 50–400 m a.s.l. and 350 km long. 'La Barrosa' hill (37°53'S; 58°15'W; 335 m a.s.l.) presents a northeast–southwest trend and covers 581,25 ha (Alonso et al., 2009). The anthropic impact in this zone is high and can be observed by the invasive alien species, the trekking routes, and its proximity to a racetrack (Figs 1E–1F). Despite these factors, the hillsides include native and endemic plants, some of them are considered endangered (Alonso et al., 2009, Guerrero & Apocada, 2022).

Material and morphology examination. The material examined is deposited in the arachnological collection of Centro de Recursos Naturales Renovables de la Zona Semiárida-Universidad Nacional del Sur, Bahía Blanca, Argentina (UNS). The females were captured by shaving the soil surface to expose the lids of the burrows and preserved in ethanol 70% for further examination. The images were obtained with a MShot digital camera attached to a Leica S APO stereoscopic microscope, and then stacked using Helicon Focus. The measurements were taken according to Coyle (1974) and Ríos-Tamayo & Goloboff (2018), using a caliper, with an error of about 0.01 mm. All measurements are in millimeters. To obtain more precise measurements we used MShot Image Analysis System version 1.1.4. Total length does not include spinnerets nor chelicerae. The description of the spination pattern follows Goloboff & Platnick (1987), describing the legs from anterior to posterior and from proximal to distal. Variation between both sides of one specimen is indicated as two numbers separated by a slash (/). The spermathecae were dissected and cleaned with Naclens® enzymatic pills for photography. The terminology follows Ríos-Tamayo & Goloboff (2018).

Abbreviations. **ALE**: anterior lateral eyes; **AME**: anterior median eyes; **ATA**, apical tegular apophysis; **D**: dorsal; **PLE**: posterior lateral eyes; **PLS**: posterior lateral spinnerets; **PME**: posterior median eyes; **PMS**: posterior median spinnerets; **PL**: prolateral; **RL**: retrolateral; **V**: ventral.

RESULTS

Taxonomic hierarchy

Class Arachnida Lamarck, 1801

Order Araneae Clerck, 1757

Infraorder Mygalomorphae Pocock, 1892

Family Actinopodidae Simon, 1892

Genus *Actinopus* Perty, 1833

Type species: *Actinopus tarsalis* Perty, 1833:198, pl. 39, fig. 6 (male holotype from Piauí, Brazil).

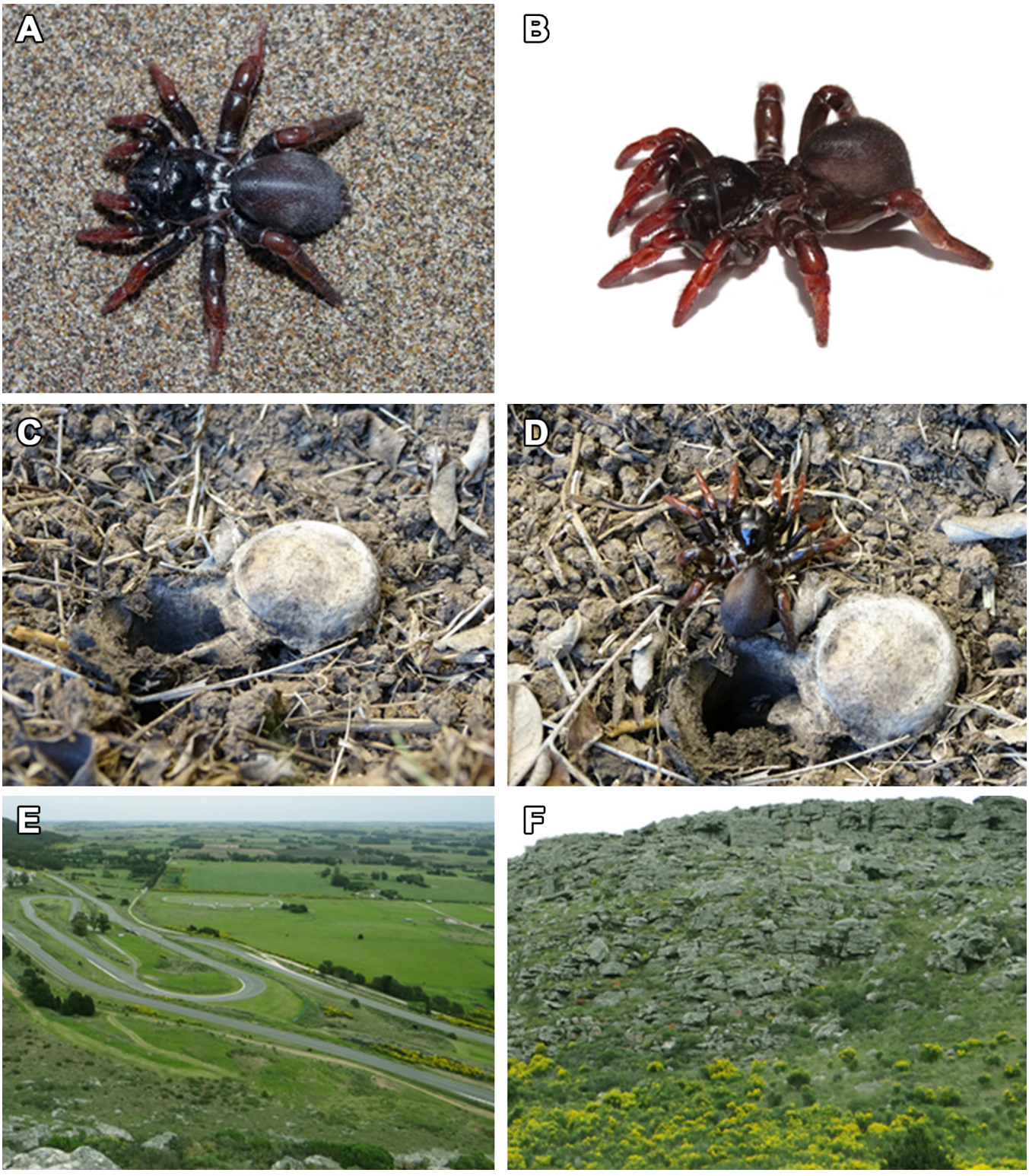

Figure 1. *Actinopus balcarce* Ríos-Tamayo & Goloboff, 2018, female and habitat. **A.** Habitus, dorsal view; **B.** Habitus, lateral view; **C.** Female burrow; **D.** Female outside of her burrow; **E.** Racetrack at the study area; **F.** Habitat of the species with alien shrubs.

Actinopus balcarce Ríos-Tamayo & Goloboff, 2018 (Figs 1–3)

Type material. Holotype ♂ (MACN-Ar2864): Argentina, Buenos Aires: Balcarce [37°51'S, 58°15'W] IV.1950, col. C. de la Serna (not examined).

Additional material examined. 1 ♀ (UNS-M1056): Argentina, Buenos Aires: Balcarce, Sierra 'La Barrosa' [37°52'28.8"S, 58°15'36.2"W] 28.IV.2023, cols. Nicoletta & Schwerdt; 1 ♀ (UNS-M1065): Argentina, Buenos Aires: Balcarce, Sierra 'La Barrosa' [37°52'28.8"S, 58°15'36.2"W] 28.IV.2023, cols. Nicoletta & Schwerdt; 1 juvenile ♀ (UNS-M0571): Argentina, Buenos Aires: Balcarce, Sierra 'La Barrosa', 24.VI.2019, col. Ferretti; 1 ♀ (UNS-M661): Argentina, Buenos Aires: Olavarría, Sierras Bayas, no date, no collector; 1 ♀ (UNS-M1079): Argentina, Buenos Aires: Balcarce, Sierra 'La Barrosa', 21.IX.2023, col. Nicoletta.

Diagnosis. Females of *A. balcarce* can be distinguished from those of the congeners by the following combination of characteristics: sternum with a slight depression (Fig. 2E); continuous thoracic fovea (Fig. 2A); and sub-quadrate spermathecae with two receptacles bearing an external lobe well developed and projected in the same direction of the fundus or slightly twisted inwards (Fig. 3A).

***Description* — Female (UNS-M1056).** Color (live specimen): Carapace and chelicerae dorsally black, abdomen dorsally dark grey; legs and palps with black femora and red patellae, tibiae, metatarsi and tarsi (Figs 1A–1B, 1D). Color (in ethanol): Carapace black. Abdomen dark grey, booklungs with dark markings. Spinnerets yellowish. Sternum light brown, labium and maxillae dark brown. Coxae and femora black, patellae, tibia, metatarsi and tarsi reddish brown (Figs 2A–2E). Total length: 23.38. Carapace: length 8.97, width 7.92, anterior part square and posterior part triangular (Fig. 2A). Clypeus: length 0.67. Ocular group: length 2.27, width 4.14, anterior margin procurved and posterior margin recurved (Fig. 2B). Eyes sizes and interdistances: AME 0.15, ALE 0.37, PME 0.23, PLE 0.34, AME–AME 0.42, AME–ALE 1.57, PME–PME 2.49, PME–PLE 0.23. Fovea: length 4.35. Chelicerae: length 5.39, width 2.99, with a total of 13 teeth. Rastellum: length 1.59; cuspules 44/41 (Fig. 2C). Maxillae: cuspules 139/119 (Fig. 2D). Labium: length 2.23, width 1.69, with 25 cuspules (Fig. 2D). Sternum: length 6.30, width 5.34, with a slight central depression (Fig. 2E). Sigillae: shallow, postlabial pair merged, subtriangular, first and second pair elongated, converging into the central depression; diameter: first pair 0.89, second pair 1.17, and third pair diameter 1.66; distances from the sternum edge: first pair 0.95, second pair 0.78, third pair 1.03 (Fig. 2E). Abdomen: dorsal length 13.28, width 8.29; ventral length 11.15, width 8.08. Spinnerets: PMS length 0.96; PLS basal segment length 0.95, median 1.25, and apical 0.31. Spermathecae: length 1.09, width 0.59. Lengths of legs and palp: I: 4.54, 2.91, 2.65, 2.14, 1.5; II: 4.74, 2.87, 2.79, 2.78, 1.75; III: 5.09, 3.17, 1.91, 2.21, 1.84; IV: 5.61, 3.25, 3.71, 3.25, 2.19; palp: 4.08, 3.21, 3.65, 3.31; total lengths: I: 13.51, II: 13.61, III: 13.8, IV: 19.7, palp: 12.98. Chaetotaxy: All femora aspinose. Patellae: I, II 0; III 18p, 15d, 30r; IV 17p, 39r; palp 3p, 1v. Tibiae: I 5p, 21r, 3v; II 1p, 84r, 14v; III 19p, 12d, 45r; IV 37p, 37v; palp 11p, 38r, 1v. Metatarsi: I 13p, 21r, 5v; II 18p, 19r, 4v; III 38d, 45r, 3v; IV 22p, 1d, 1v. Tarsi: I 19p, 16r, 6v; II 15p, 4r, 10v; III 30p, 8d, 13r, 57v; IV 37p, 1d, 37v; palp 31p, 33r, 1v; claws 1p, 1r. Total number of retrolateral spines on tibiae I and II (Fig. 2F): 21 and 84, respectively. Spermathecae: sub-quadrate, with two asymmetrical receptacles bearing an external constriction of the fundus that can be more or less prominent. The apical lobe is well developed and directed straight or slightly curved inwards; the inner and outer lobes are less developed and are projected perpendicular to the fundus axis (Fig. 3A). Spermathecae variation: additional females examined (M1065, M661, M1079) have subtle differences in the spermathecae, such as a variation in the development of the internal lobe and the grade of inclination of the external lobe (Fig. 3B).

Distribution. Argentina. Buenos Aires province: Sierra 'La Barrosa', Balcarce; **New record**: Sierras Bayas, Olavarría (Fig. 1F).

Natural history. The burrows were found in the northern area of 'La Barrosa' hill, on a slope facing the northeast. The burrows were in bare ground and trap-doors were covered with dirt and small pieces of plants (Figs 1C–1D). The female (UNS-M1056) was inside a burrow of 20.8 mm of entrance diameter, with a lid of 25.5 mm in diameter and 3.86 mm in thickness. 'La Barrosa' hill is covered mainly with native plants representing the families Asteraceae (e.g., *Bacharis* and *Senecio*) and Poaceae (e.g., *Piptochaetium* and *Poa*); although, some alien plants were also found, e.g, *Carduus*, *Senecio*, *Briza* and *Poa*, among others (Alonso et al., 2009).

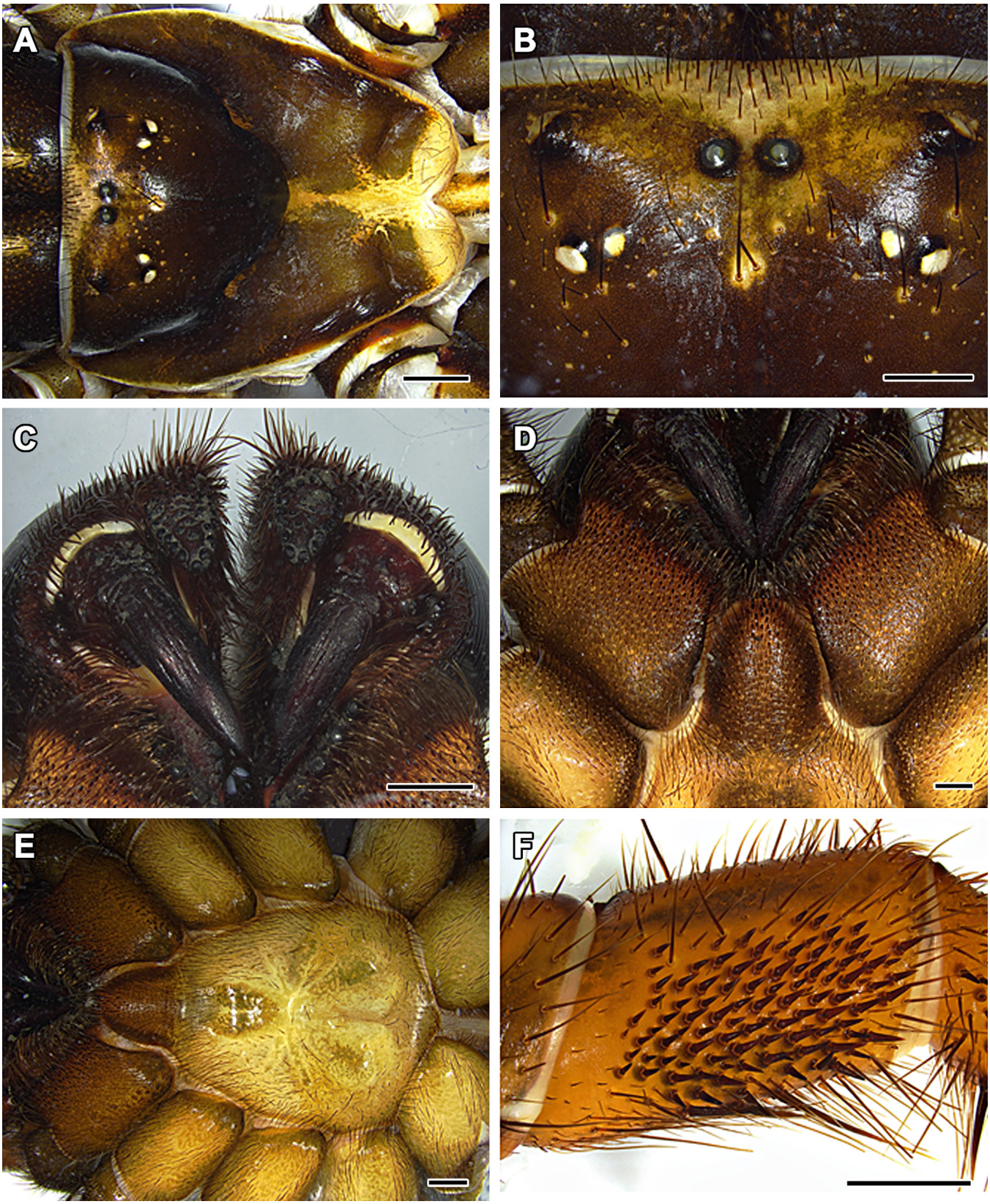

Figure 2. *Actinopus balcarce* Ríos-Tamayo & Goloboff, 2018, female (UNS-M1056). **A.** Carapace, dorsal view; **B.** Ocular group, dorsal view; **C.** Chelicerae, ventral view; **D.** Labium and maxillae, ventral view; **E.** Sternum, ventral view; **F.** Tibia II, retrolateral view. Scale bars: 1 mm.

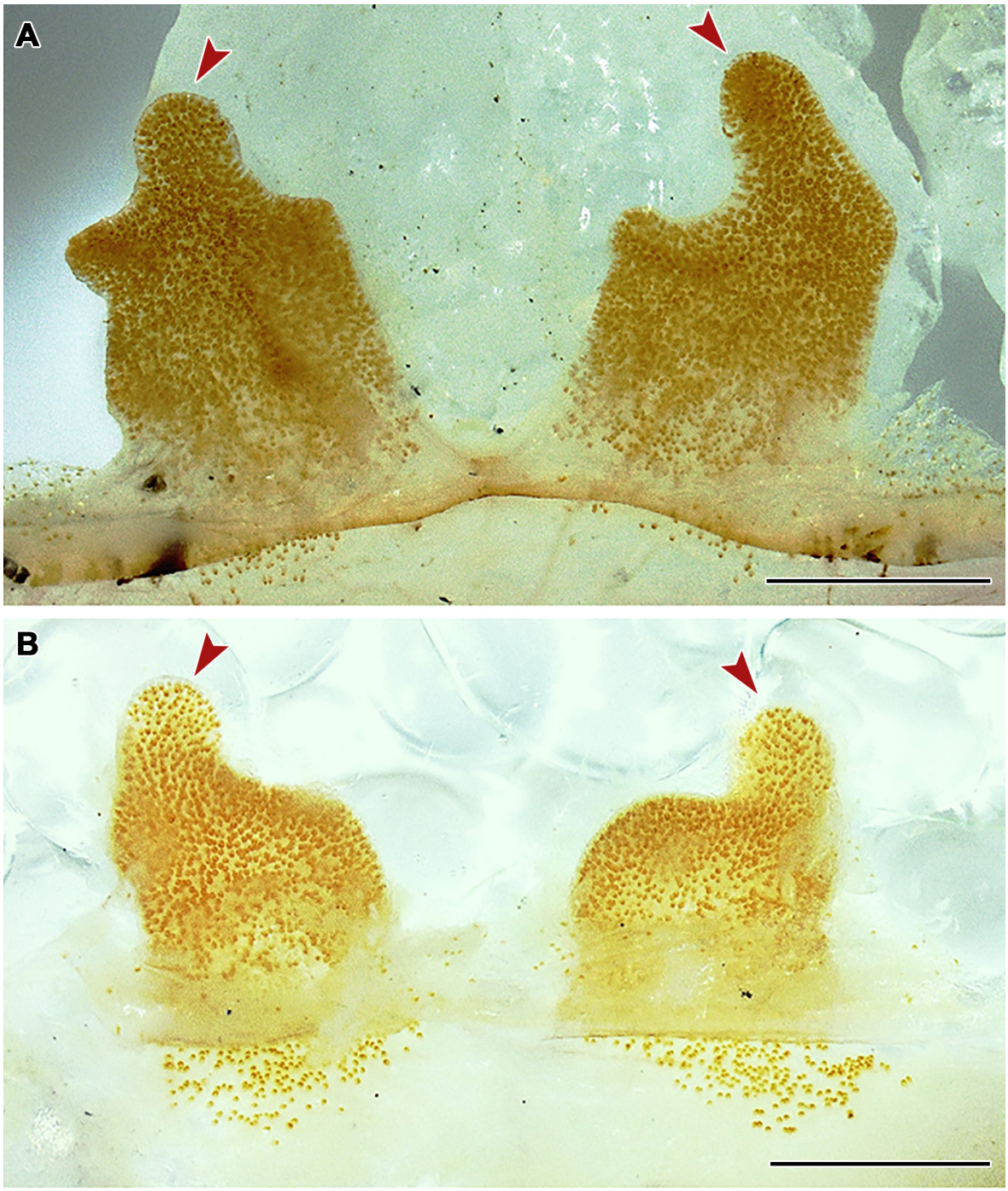

Figure 3. *Actinopus balcarce* Ríos-Tamayo & Goloboff, 2018, spermathecae of females. **A.** Spermathecae from described female (UNS-M1056), dorsal view, **B.** Spermathecae from additional female examined (UNS-M1079), dorsal view. Scale bars: 1 mm.

DISCUSSION

We described the female of *Actinopus balcarce* for the first time, based on the material collected in the type locality. Although it is challenging to match conspecific specimens when dealing with species that usually live in sympatry, in our work, the locality of the females discovered plus the morphological features present in them —such as the size and the coloration of legs—together with the sampling effort conducted at the area resulted in no other species presumably living in sympatry with specimens attributable to *A. balcarce*, which led us to be confident of those females actually belonging to this species.

The discontinuous thoracic fovea and sternum with deep central depression are characters shared within males of *A. goloboffi* Ríos-Tamayo, 2014, *A. excavatus* Ríos-Tamayo & Goloboff, 2018 and *A. balcarce*. These three species were grouped by Ríos-Tamayo & Goloboff (2018) in their 'type III morphology' while Miglio et al. (2020) grouped them in the '*goloboffi*' group. The females of *A. goloboffi* also have these two morphological features present in males, but curiously females of *A. excavatus* have a continuous thoracic fovea (Ríos-Tamayo & Goloboff, 2018). Miglio et al. (2020) mentioned that males of *A. gerschiapelliarum* also have a discontinuous thoracic fovea, but she did not include this species inside the '*goloboffi*' group. Moreover, according to Ríos-Tamayo & Goloboff (2018), the females of *A. gerschiapelliarum* have a continuous thoracic fovea. In *Actinopus balcarce*, a similar situation could occur since females have a continuous thoracic fovea, unlike males. Thus, this could indicate that these morphological characters are prone to show some intraspecific variation among males and females, justified due to the enormous sexual dimorphism. Another explanation is that, if these characters are intraspecifically conserved, perhaps more species that we know are living in an extreme degree of sympatry and the diversity of the genus *Actinopus* is still poorly known.

The Tandilia mountain range is a 350 km long northwestern belt with ranges and hills that rise about 50–250 meters above the Pampean plain (Demoulin et al., 2005). This mountain range is characterized by having representative fauna and vegetation from the Neotropical and Pampean biogeographic provinces (Arana, 2021; Guerrero & Apodaca, 2022). Due to its topology, this hilly environment acts as a biodiversity refuge by limiting the expansion of agricultural activities, and therefore providing natural shelters for native, endemic and threatened species (Kristensen et al., 2014). However, 'La Barrosa' hill, where *A. balcarce* was discovered, is highly disturbed not only because a car race track is located on a hillside but also because of a woody plant invasion and a high touristic activity. Despite these disturbances, the environment harbors 204 plant species belonging to 51 families, of which Asteraceae is the most abundant and diverse (Alonso et al., 2009). Four species of *Actinopus* had been recorded for the Tandilia mountain range: *A. balcarce*, *A. casuhati*, *A. puelche* and *A. szumikae* Ríos-Tamayo & Goloboff, 2018 (Ríos-Tamayo & Goloboff, 2018). Although *A. casuhati, A. puelche* and *A. szumikae* have wide distributional ranges in Buenos Aires province, *Actinopus balcarce* comprises the easternmost species and so far the only one restricted to the Tandilia system. This highlights the relevance in conducting samplings in areas that could be acting as a refuge of species in order to unveil the endemic degree of taxa, the threats from disturbed environments and the conservation status for these poorly known and highly habitat-specialist mygalomorph spiders.

AUTHOR'S CONTRIBUTION

The authors confirm their contribution in the paper as follows: M. Millenpeier prepared the figures and described the specimens; M. Nicoletta and N. Ferretti collected and identified the material. All authors contributed equally to write the paper. All authors read and approved the final version of the manuscript.

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AVAILABILITY OF DATA AND MATERIAL

The specimens listed in this study are deposited in the arachnological collection of Centro de Recursos Naturales Renovables de la Zona Semiárida-Universidad Nacional del Sur, Bahía Blanca, Argentina (UNS) and are available from the curator, upon request.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this paper.

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توصیف جنس ماده عنکبوت *Actinopus balcarce* Ríos-Tamayo & Goloboff, 2018 (Araneae, Actinopodidae)، و نکاتی از تاریخ طبیعی آن

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چکیده: عنکبوت‌های دریچه‌ساز بر اساس ویژگی حفر دالان‌های عمیق در زمین که با درپوش مستحکمی بسته می‌شود، شناخته شده‌اند. گونهٔ *Actinopus balcarce* Ríos-Tamayo & Goloboff بر اساس دو نمونهٔ نر جمع‌آوری شده از باکارسه واقع در استان بوئنوس آیرس آرژانتین توصیف شده است. طی مطالعه اخیر در منطقه توصیف شده برای نمونه مرجع (Type locality)، نمونه‌های ماده‌ای که احتمالاً به این گونه تعلق دارند، یافت شد. این نمونه‌ها بر اساس ریخت‌شناسی جانور ماده به گونهٔ *Actinopus balcarce* نسبت داده شده و برای اولین بار توصیف شدند. تصاویر اسپرماتکا همراه با نکاتی از دوره زیستی این گونه ارایه شد. برخی اطلاعات ریخت‌شناسی جانور ماده نیز مورد بحث قرار گرفت.

واژگان کلیدی: آرژانتین، تپهٔ لاباروزا، رتیل‌ریختان، تاکسونومی، عنکبوت دریچه‌ساز