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A NEW SPECIES OF *BOTHRIURUS* PETERS, 1861 (SCORPIONES: BOTHRIURIDAE) FROM THE PARQUE NACIONAL DAS EMAS IN CENTRAL BRAZIL

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Abstract: A new scorpion species, *Bothriurus goiano* **sp. n.**, is described from the savanna-type cerrado formations of the Parque Nacional das Emas, situated at the border between the Brazilian states of Goiás and Mato Grosso do Sul. The new species belongs to the *B. araguayae* Vellard, 1934 species group and has clear affinities with *B. guarani* Maury, 1984, so far known only from the more humid parts of the Paraguayan Chaco (Chaco húmedo). The new species is the third species of *Bothriurus* reported from the cerrado of central Brazil. Some biogeographic hypotheses on the two putatively related species of *Bothriurus* are proposed.
Key words: Scorpiones, Bothriuridae, new species, cerrado, Brazil, Goiás, Mato Grosso do Sul.

Una especie nueva de *Bothriurus* Peters, 1861 (Scorpiones: Bothriuridae) del Parque Nacional das Emas en Brasil central
Resumen: Se describe una especie nueva de escorpión, *Bothriurus goiano* **sp. n.**, a partir de especímenes colectados en formaciones de cerrado del Parque Nacional das Emas, situado en la frontera entre los estados de Goiás y Mato Grosso do Sul, Brasil. La nueva especie pertenece al grupo de especies de *B. araguayae* Vellard, 1934 y presenta afinidades con *B. guarani* Maury, 1984, conocida sólo de las partes más húmedas del Chaco paraguayo (Chaco húmedo). Esta nueva especie es la tercera de *Bothriurus* reportada del cerrado. Se proponen algunas hipótesis biogeográficas sobre las dos especies supuestamente relacionadas de *Bothriurus*.
Palabras clave: Scorpiones, Bothriuridae, especie nueva, cerrado, Brasil, Goiás, Mato Grosso do Sul.

Taxonomy / Taxonomía: *Bothriurus goiano* **sp. n.**

Introduction

As already outlined in previous publications (Lourenço *et al.,* 2004; Lourenço, 2016a), scorpions of the family Bothriuridae Simon, 1880 have always been considered as a taxonomically challenging group. Obviously, this is also true for the type genus of the family, *Bothriurus* Peters, 1861. In Brazil, *Bothriurus* is represented by 13 or 14 species, some of which requiring further studies to confirm their status (Lourenço, 2002, 2016a; Lourenço *et al.,* 2004).

The scorpion fauna of the Cerrado (savanna-type formations) of the central Brazilian states of Goiás and Tocantins remain poorly studied, with new species still being discovered (e.g., Lourenço, 2019). Until relatively recently, only *Bothriurus araguayae* Vellard, 1934 was known from this region, with a second species, *Bothriurus cerradoensis* Lourenço, Motta, Godoi & Sousa Araújo, 2004, described 17 years ago from the state of Tocantins (Lourenço *et al.,* 2004). In the present contribution, a further new species of *Bothriurus* is described from the Cerrado formation of the Parque Nacional das Emas, which is located at the border between the Brazilian states of Goiás and Mato Grosso do Sul.

Material and Methods

All specimens were collected at night using UV (black) lights. All collection sites are situated within the Parque Nacional das Emas, a national park dominated by the Cerrado, situated at the state border between Goiás and Mato Grosso do Sul. GPS coordinates were obtained using iPhone's GPS system and later verified on GoogleEarth. All specimens were collected on the Goiás side of the park, with permission granted by the ICMBio of the Brazilian Government (see Acknowledgements). The abbreviation "fcn" stands for individual field collection number, which sometimes also refers to the photographic voucher of the specimen.

All illustrations and measurements were made with the aid of a Wild M5 stereomicroscope equipped with a drawing tube (camera lucida) and an ocular micrometer. Measurements follow Stahnke (1970) and are given in mm. Trichobothrial and general morphology terminologies follow Vachon (1974) and Hjelle (1990), respectively. The map was prepared in Photoshop based on ecoregions from SimpleMappr (simplemappr.net).

Type material of the new species is deposited in the Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil (MNRJ); Universidade de Brasília, Brasília, Brazil (UnB); Universidade Federal de Goiás, Goiânia, Brazil (UFG); and Muséum National d'Histoire Naturelle, Paris, France (MNHN).

The type material of *Bothriurus guarani* Maury, 1984, deposited in the Naturhistorisches Museum, Vienna, Austria (NHMW) was not examined due to this museum's restrictions concerning loans of type material, although at our request, Christoph Hörweg made available a series of detailed photographs of one of the type specimens. We were also able to examine two specimens collected near the type

locality of *B. guarani*, which were deposited in the Muséum d'Histoire Naturelle, Geneva, Switzerland (MHNG). These specimens, used as comparative material, were sent to one of us (WRL) on loan by Dr. Peter J. Schwendinger.

Comparative material. *Bothriurus guarani* Maury, 1984. MHNG (no number), 2 males (30.0 mm), Paraguay, Concepcion, Estancia Laguna Negra, 23°04'00"S / 57°07'00"W, under log, leg. V. Mahnert, 13 Oct. 1985. *Bothriurus araguayae* Vellard, 1934. UFG (no number), 1 male (28.0 mm), Brazil, Goiás, Alto Paraiso de Goiás, 14°12'20"S / 47°50'55"W, 750 m, forest, leaf litter, leg. M. Lovato, A. Anker, P.C. Silva, 26 May 2019, [fcn GO-133]; UFG (no number), 1 female (33.0 mm), Brazil, Goiás, Alto Paraiso de Goiás, 14°10'78"S / 47°35'75"W, 1105 m, Cerrado *s. str*., leaf litter, leg. M. Lovato, A. Anker, P.C. Silva, 25 May 2019 [fcn GO-124]; MNRJ 7684, 1 male (38.0 mm), Brazil, Goiás, Pirenópolis, 15°51'09"S / 48°54'05"W, 1310 m, Cerrado with large boulders (Campo rupestre), ground/litter, leg. M. Lovato, A. Anker, J.P. Nunes, M.M. da Silva, 12 Oct. 2018 [fcn GO-014].

Taxonomic section

Family **Bothriuridae** Simon, 1880

Genus ***Bothriurus*** Peters, 1861

***Bothriurus goiano* sp. n.**
(Figs. 1–3, 4A, 5, 6)

TYPE MATERIAL. Brazil, Goiás, Mineiros, Parque Nacional das Emas. Holotype: MNRJ 7683, male (29.3 mm), 17°54'44.6"S / 52°59"04.2"W, 860 m, Cerrado *s. str.*, ground, leg. M.L.L. de Souza, V. Moraes, J.W.C. Silva & J.P. Nunes, 8 Sep. 2018. Paratypes: MNHN-RS-9150, 1 juvenile female (18.7 mm), same collection data as for holotype [fcn GO-065]; MNHN-RS-9148, 1 male (29.2 mm), 17°54'44.6"S / 52°59"04.2"W, Cerrado *s. str*., leg. V.S. Moraes, May 2018 [fcn GO-079]; MNHN-RS-9149, 1 female (24.8 mm), same collection data as for previous paratype [GO-076]; UnB 9755, 1 male (23.0 mm), same collection data as for previous paratype [fcn GO-078]; MNRJ 7682, 1 female (22.0 mm), same collection data as for previous paratypes [GO-080]; UnB 9754, 2 males, (28.0 mm, 29.0 mm), 17°55'0.2"S / 53°00'17"W, 860 m, Cerrado *s. str*., ground, leg. W. Moyses, V. Moraes & F. Alves, 8 Jun. 2018 [fcn GO-052]; UFG, 1 female (28.0 mm), 17°54'49.6"S / 52°59'25.7"W, 860 m, Cerrado *s. str*., ground, leg. A. Anker & L. Gaehwiller, 25 Oct. 2019 [GO-145]; UnB 9756, 2 females (25.0 mm, 27.0 mm), same collection data as for previous paratype [GO-143, GO-144]; UFG (no number), 1 female (22.0 mm), 17°55'05.0"S / 53°00'17.9"W, 860 m, Cerrado *s. str*., leaf litter, leg. A. Anker, 27 Oct. 2019 [GO-146].

DIAGNOSIS. Species of *Bothriurus araguayae* species group. Scorpions of moderate size relative to average size of species in the genus; total length (including telson) of adult males, 23.0–29.2 mm, adult females 22.0–29.0 mm. General colouration brownish to brownish-yellow, with strongly marked pale yellow longitudinal line over tergites; ambulatory legs almost completely yellow reddish dorsally, with some brown spots; females paler than males. Tegument of carapace, tergites of prosoma and metasomal segments rather smooth. Almost all metasomal carinae absent, with dorsal and laterodorsal carinae vestigial, represented by few distal granules. Pectines with 16–18 teeth in males and 12–15 teeth in females. Trichobothriotaxy of type C *sensu* Vachon (1974: fig. 209); chela with five trichobothria on ventral side. Hemispermatophore typical for *B. araguayae* species group (Lourenço 2002).

DESCRIPTION. Based on male holotype and female paratype. All measurements provided in Table I.

Table I. Morphometric values (in mm) of a male of *Bothriurus guarani* and male holotype and female paratype of *Bothriurus goiano* **sp. n.**

	Bothriurus		
	guarani ♂	*goiano* ♂	*goiano* ♀
Total length	30.5	29.3	26.6
Carapace:			
- length	3.7	3.7	3.5
- anterior width	2.5	2.4	2.3
- posterior width	4.0	3.8	3.8
Mesosoma length	8.3	8.1	8.3
Metasomal segment I:			
- length	1.8	1.7	1.6
- width	2.3	2.5	2.3
Metasomal segment II:			
- length	2.1	2.0	1.7
- width	2.2	2.3	2.2
Metasomal segment III:			
- length	2.3	2.1	1.9
- width	2.1	2.2	2.1
Metasomal segment IV:			
- length	3.0	2.8	2.4
- width	2.1	2.1	2.0
Metasomal segment V:			
- length	4.7	4.5	3.7
- width	2.0	2.1	2.0
- depth	1.7	1.7	1.5
Telson length	4.6	4.3	3.5
Vesicle:			
- width	1.8	2.1	1.6
- depth	1.3	1.6	1.2
Pedipalp:			
- Femur length	2.7	2.4	2.3
- Femur width	1.1	1.1	1.1
- Patella length	3.0	2.8	2.6
- Patella width	1.2	1.2	1.1
- Chela length	5.2	5.1	4.6
- Chela width	1.7	2.0	1.5
- Chela depth	2.0	2.2	1.6
Movable finger:			
- length	2.4	2.2	2.2

Colouration: Body generally brownish to brownish-yellow, colouration darker in males. Prosoma: carapace brownish with anterior quarter more yellow; eyes surrounded by dark-brown area. Mesosoma: tergites brownish with longitudinal yellow stripe, latter better marked in females; venter and sternites yellow without spots; sternite VII heavily spotted; pectines and genital operculum pale yellow. Metasoma: segments reddish-yellow with brownish spots; telson reddish in males and yellow in females, paler than segment V; aculeus blackish. Chelicerae yellow with variegated reddish-brown spots; fingers reddish-brown. Pedipalps reddish to reddish-yellow, with some dark spots on femur, patella and chela. Legs yellow to reddish-yellow with some minute brownish spots on most-distal articles.

Morphology: Carapace punctate to smooth, weakly granular on posterior edge; anterior margin broadly rounded; carinae absent; all furrows weakly pronounced. Median ocular tubercle situated distinctly in carapace centre. Three pairs of moderate to small lateral eyes, posterior being reduced. Sternum slit-like. Mesosomal tergites I–VI punctate without granules. Tergite VII with four indistinct carinae and thin granulation.

Venter: genital operculum divided longitudinally, each half roughly triangular in shape. Pectinal teeth count: 17–17 teeth in male holotype (see diagnosis for variation). Sternites smooth, with weakly elongate spiracles; VII without carinae. Metasomal segments I–IV with almost all carinae absent, only dorsal and latero-dorsal carinae represented by some granules; ventral carinae present on segment V, arc-shaped, arc incomplete, especially in males; intercarinal spaces smooth, with scattered granules on ventral face of segment V. Telson smooth; aculeus short, moderately curved. Cheliceral dentition characteristic of Bothriuridae (Vachon, 1963). Pedipalps weakly to moderately granular; granules better marked on femur; femur with four moderately marked carinae and some granules on dorsal and internal faces; patella with dorso-internal and ventro-internal carinae, both weakly marked; patella and chela smooth and punctate; fixed and movable fingers with one line of granules not clearly divided into rows; internal and external granules present. Strong apophysis present on inner side of male chela near base of movable finger. Trichobothriotaxy of type C (Vachon, 1974). Chela with five trichobothria on ventral side. Legs: tarsi of legs III and IV with two rows of spines and several very thin setae on ventral surface. Hemispermatophore (length: 5.0 mm) typical for *B. araguayae* species group, however, with basal portion noticeably slenderer.

ETYMOLOGY. The specific name refers to the inhabitants of the Brazilian state of Goiás (*goiano* – Portuguese adjective or noun for "from Goiás"), where the type locality of the new species is situated (see below); used as a noun in apposition to generic name.

TAXONOMIC REMARKS. In its general morphological characteristics, *B. goiano* **sp. n.** is most similar to *B. guarani* (Fig. 7), a species currently only known from the humid Chaco of Paraguay (Maury, 1984; Lourenço, 1994). However, *B. goiano* **sp. n.** can be distinguished from *B. guarani* by several, albeit relatively subtle characters. Although the two species are similar in size, they present different morphometric values for some parts of the body and appendages (see Table I). In *B. goiano* sp. n., the carinae and granules on the dorsal surface of the metasomal segments I and II, are vestigial (Fig. 1A), compared to the much more marked carinae and better developed and more numerous granules in *B. guarani* (Fig. 7A). In males of *B. goiano* sp. n., the chela is noticeably more robust (Fig. 1A), compared to that of males of *B. guarani* (Fig. 7A). The same is true for the patella, which is stouter in the new species (cf. Figs. 1A, 7A). Furthermore, in *B. goiano* **sp. n.**, the pectines are smaller and have shorter teeth; in addition, their number is slighted inferior to that of *B. guarani* (18–19 teeth in the holotype and topotypic males). Finally, the basal portion of the hemispermatophore is more slender in the new species than in *B. guarani* (cf. Fig. 4A, B).

The overall colour of *B. goiano* **sp. n.** seems to be paler than in *B. guarani*, whereas the longitudinal yellow stripe running over the tergites is broader compared to that of *B. guarani* (cf. Figs. 1, 7). The femora of the walking legs in *B. goiano* **sp. n.** are uniform reddish brown, whereas in *B. guarani*, they are mostly dark-brown and the tibia with diffuse brown patches proximally (cf. Figs. 1, 7). In addition, the new species has large, rounded, brown-orange patches on the prosoma, in front of the eyes; these patches seem to be more diffuse and therefore less conspicuous in *B. guarani* (cf. Figs. 1, 7).

Moreover, the two species appear to be allopatrically isolated (Fig. 10), with the vast Pantanal flood plain perhaps acting as a natural barrier in the very recent past (see biogeographic section below).

Bothriurus araguayae was originally described from the Araguaya area of western Goiás (Vellard, 1934) and is also widely distributed in the central and eastern parts of this state. *Bothriurus goiano* **sp. n.** can be easily distinguished from *B. araguayae* by the much paler, brown-yellowish colour, the presence of a narrow, pale yellow longitudinal band running along the tergites and the brown-reddish legs and pedipalps (Fig. 5). In contrast, *B. araguayae* is almost entirely dark brown to black, except for the much paler distal articles of the legs and red-brown telson (Fig. 8). In addition, the basal portion of the hemispermatophore of *B. goiano* **sp. n.** is much more slender compared to that of *B. araguayae* (cf. Fig. 4A, C). Importantly, *B. araguayae* was not found at the type locality of *B. goiano* **sp. n.**, within the limits of the Parque Nacional das Emas.

ECOLOGICAL CONSIDERATIONS. The Cerrado is among the most important South American biomes, historically covering about 23% of the Brazilian territory and being surpassed only by the Amazon rainforest. Its vegetation may have some physiognomic similarities with other savanna-like formations, such as those found in Africa and Australia, but its floristic composition is very peculiar (Ribeiro & Walter 2008). The typical climate of the Cerrado is a tropical dry winter season followed by a marked rainy season, which lasts during the spring and summer months (October to March). The temperatures can range from over 43°C by day during the summer to almost 0°C at night, during the winter (May to July), with frosts in some regions (Coutinho, 2002).

The Parque Nacional das Emas (hereafter PNE) is located in the southwestern part of the state of Goiás, at the border with Mato Grosso do Sul. In fact, a small section of the PNE, including the park headquarters, lies in the latter state. The PNE is limited by the latitudes 17°51'S – 18°21'S and longitudes 52°43'W –53°01'W. Most of the PNE is covered by a dry vegetation of the classic Cerrado type (Fig. 9A), mainly composed by the more open "campos limpos" and the denser "campos sujos", which occupy almost 80% of the total park area. In higher altitude areas, one species of grass predominates, the "capim-flecha" (*Tristachya leiostachya* Nees). In transitional areas, which represent about 15% of the total park area, the so-called Cerrado *sensu stricto* prevails, characterised by the denser, sometimes almost impenetrable vegetation. The lower areas, which represent only 5% of the total park surface, are covered by floodplain or wetland-type vegetation, such as "veredas de buritis" (palm tree, *Mauritia flexuosa* L.) and "campos de murundum". Seasonal forests and gallery forests associated with fertile soils and watercourses are also present (França *et al.,* 2007).

Most individuals of *B. goiano* **sp. n.** were found in open and mixed Cerrado vegetation (Fig. 9A), both on whitish and reddish soils, usually walking on the ground or in shallow self-dug burrows, although some specimens climbed up to the top of dried fallen leaves or low-growing plants (Figs. 5, 6). The scorpions make their burrows on sandy slopes, such as roadside slopes and ditches (Fig. 9B). They are would typically retreat into their burrows at sensing either the UV light or the approach of the collector. One individual was kept in captivity for some time and was offered various potential prey items, including juvenile cockroaches, ants,

flies, small moths, but only accepted termites (ML, pers. obs), suggesting that temrites may also be the only or at least the primary prey of *B. goiano* **sp. n.** in the wild. However, more studies on its diet in the natural habitat, combined with statistics-based predation experiments, will be needed to confirm this hypothesis.

DISTRIBUTION. Presently known only from the Parque Nacional das Emas in the southwestern part of the state of Goiás, central Brazil (Figs. 9A, 10); in all likelihood also present in the Mato Grosso do Sul section of the park, based on the presence of specimens in a small visitor exhibit at the museum headquarters (AA, pers, obs.).

Biogeographic patterns of bothriurid scorpions in central Brazil

The analysis of the general distribution patterns of several groups (families, genera and species) of South American scorpions draws attention to the possible correlation between the patterns of scorpion distribution and major vegetation formations (Ab'Saber, 1977a; Lourenço, 2016b). This correlation can be interpreted as corridors or passages in the sense proposed by Goodnight & Goodnight (1953). Among these, Corridor B of Lourenço (2016b) is represented by open vegetation formations that occupy the Brazilian diagonal from the Argentine Monte to the Brazilian Caatinga. Typical scorpion elements of this corridor belong to the families Bothriuridae and Buthidae. Bothriurids, although only the elements belonging to the genus *Bothriurus*, may be found as far as the Brazilian Caatinga and the transition zones between the Caatinga and Amazon rainforests (Lourenço, 2016a).

The presence of possible vicariant species, such as *B. guarani* in the humid Chaco of Paraguay and *B. goiano* **sp. n.** in the Cerrado of the state of Goiás in Brazil (and possibly the adjacent northern-most Mato Grosso do Sul, see above), is plausible taking into account the climatic vicissitude, which took place in the South American biomes mainly during the Pleistocene (Ab'Saber, 1977b). During this period, most regions of South America underwent continuous climate changes from wet to dry and dry to wet. During dry periods, dry forests and savannas probably experienced major extensions, whilst during major wet periods, large areas of open vegetation formations may have suffered significant losses or at least experienced significant regressions. During the extension of dry vegetation formations, the populations of *B. guarani* and *B. goiano* **sp. n**. most certainly were continuous. During the Lower Pleistocene, climatic vicissitudes proved to be more severe and lasted longer. In wet periods, the vast humid areas of the Pantanal and nearby regions may have acted as a natural barrier between the Chaco and Cerrado populations (Ab'Saber, 1967; Souza *et at.,* 2006; Barbosa, 2016), including those of *Bothriurus*, eventually leading to allopatric speciation (*B. guarani vs*. *B. goiano* **sp. n**.). Even in present days, the natural formations such as the Cerrados in Brazil and the humid Chaco in Paraguay are still partially isolated by the southern-most range of the Pantanal and some transitional areas between these two quite different biomes (see below). However, since the Holocene, the regions south of the Pantanal have lower humidity conditions, leading to amplification of the Cerrado- and Campos-type formations (Ab'Saber, 2006).

The region of the Pantanal comprises an alluvial area of 150 000 km^2 located in the Paraguay basin of central-western Brazil, representing one of the largest tropical wetland ecosystems in the world. The region has a seasonal climate with three to four dry months, whereas, during the rainy season from November to April, the precipitation is typically 1000–1400 mm. The average annual temperature is 25°C with a maxima near to 40°C during the dry season. According to Eiten (1982), the Pantanal region is a complex of many vegetation types, a large proportion of which are inundated each year. Consequently, the Pantanal region may still have act as a natural barrier between populations distributed in the Paraguayan Chaco and those distributed in the Brazilian Cerrados. The only bothriurid scorpion that occurs in the Pantanal region, most certainly representing an endemic element of this particular biome, is *Brazilobothriurus pantanalensis* Lourenço & Monod, 2000 (Lourenço & Monod, 2000). The hemispermatophore of this species is illustrated in Fig. 4D, for comparison with three species of *Bothriurus*, including the herein described new species.

In summary, our hypothesis of the vicariant speciation between *B. guarani* and *B. goiano* **sp. n**. will need to be tested by a comprehensive phylogenetic analysis (morphology + DNA) of the entire *B. araguayae* species group, with inclusion of representatives of other groups of *Bothriurus* and the monotypic *Brazilobothriurus*.

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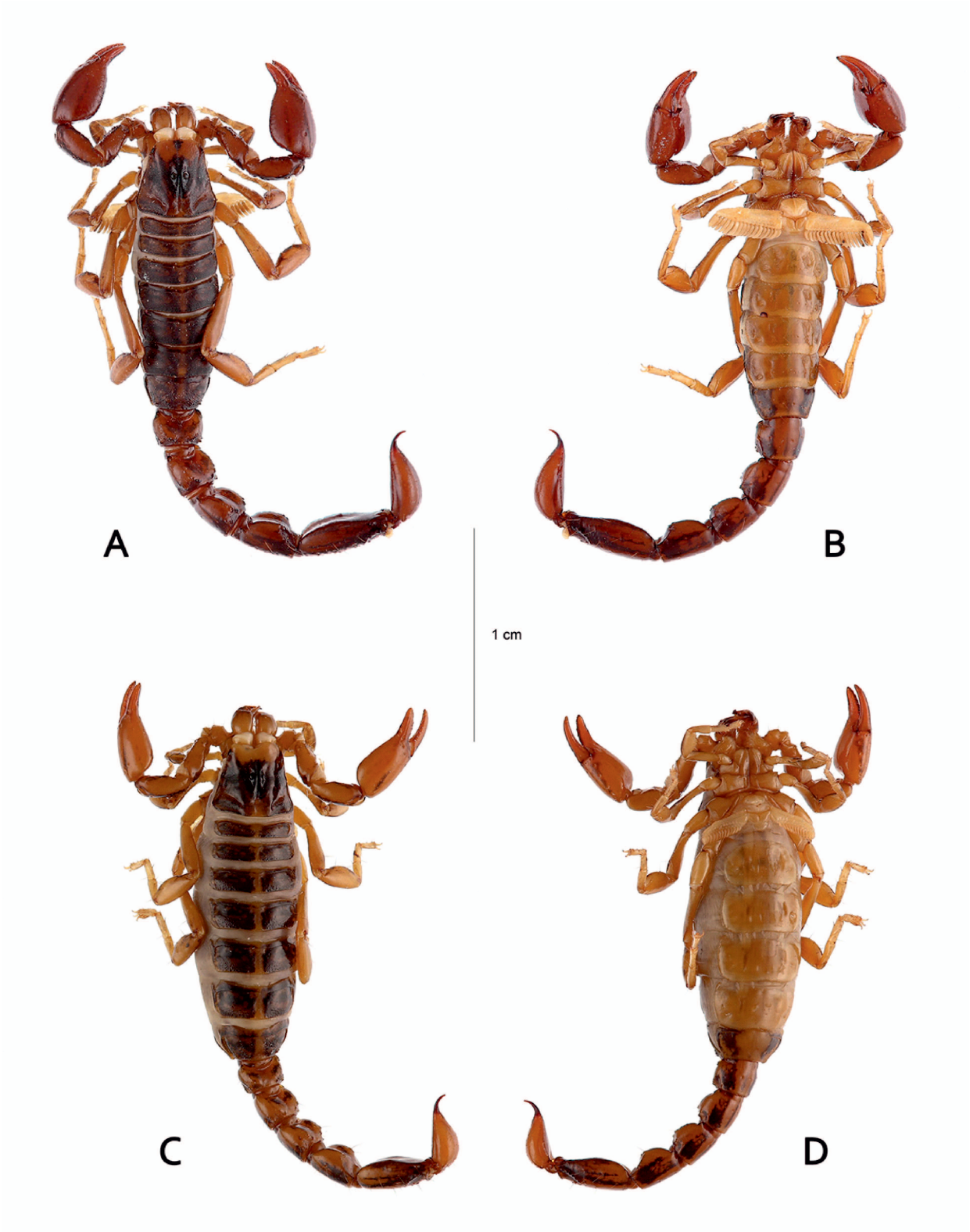


Fig. 1. *Bothriurus goiano* **sp. n.** Male holotype from Parque Nacional das Emas, Goiás, Brazil [MNRJ 7683] (**A, B**); female paratype from the same locality [MNHN-RS-9149] (**C**, **D**). Habitus (preserved specimen), dorsal (A. C) and ventral (B, D) views.

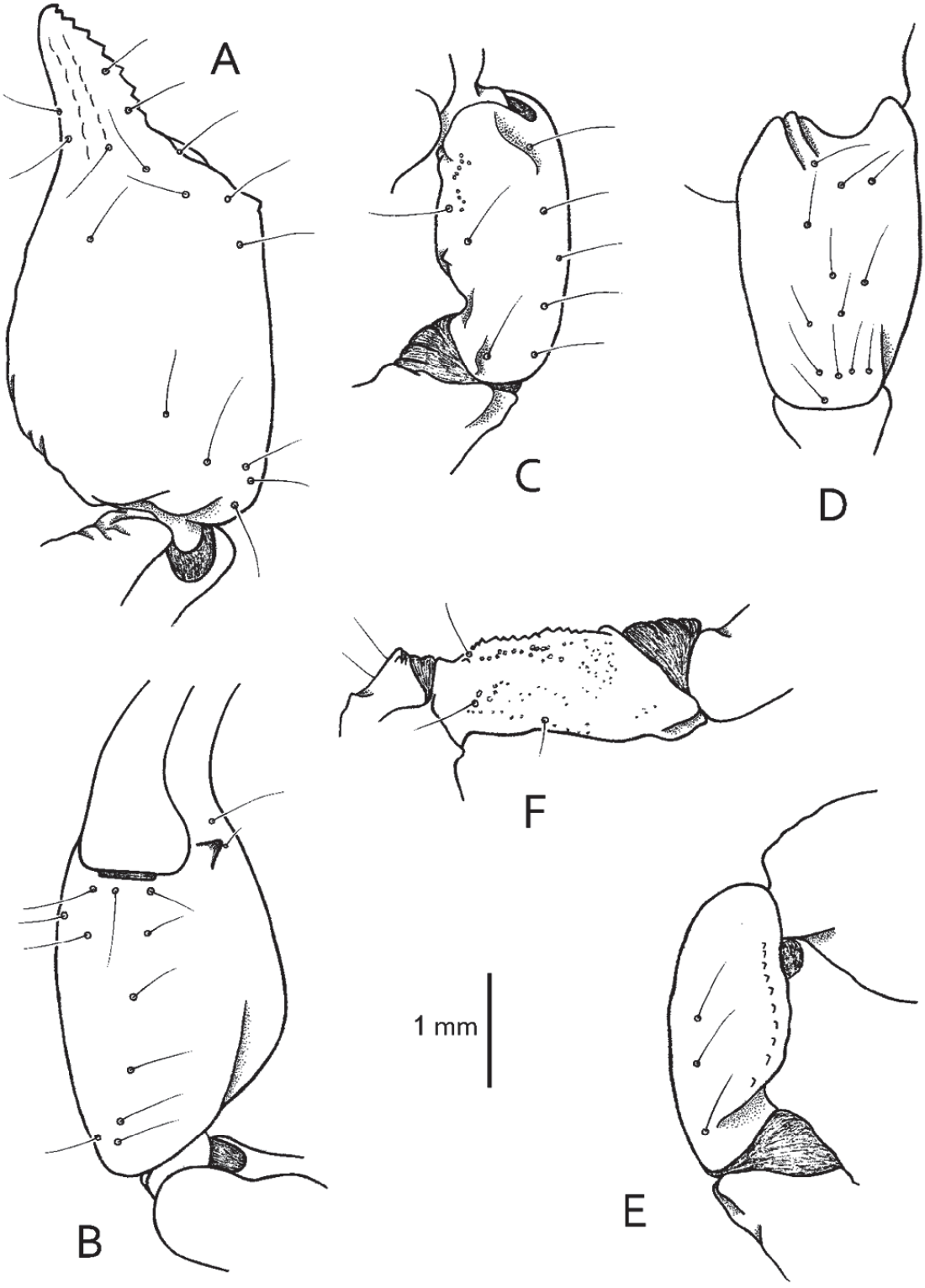


Fig. 2. *Bothriurus goiano* **sp. n.** Male holotype from Parque Nacional das Emas, Goiás, Brazil [MNRJ 7683]. Trichobothrial pattern of pedipalp: **A**, **B** – chela dorso-external and ventral views; **C**, **D**, **E** – patella, dorsal, external and ventral views; **F** – femur, dorsal view.

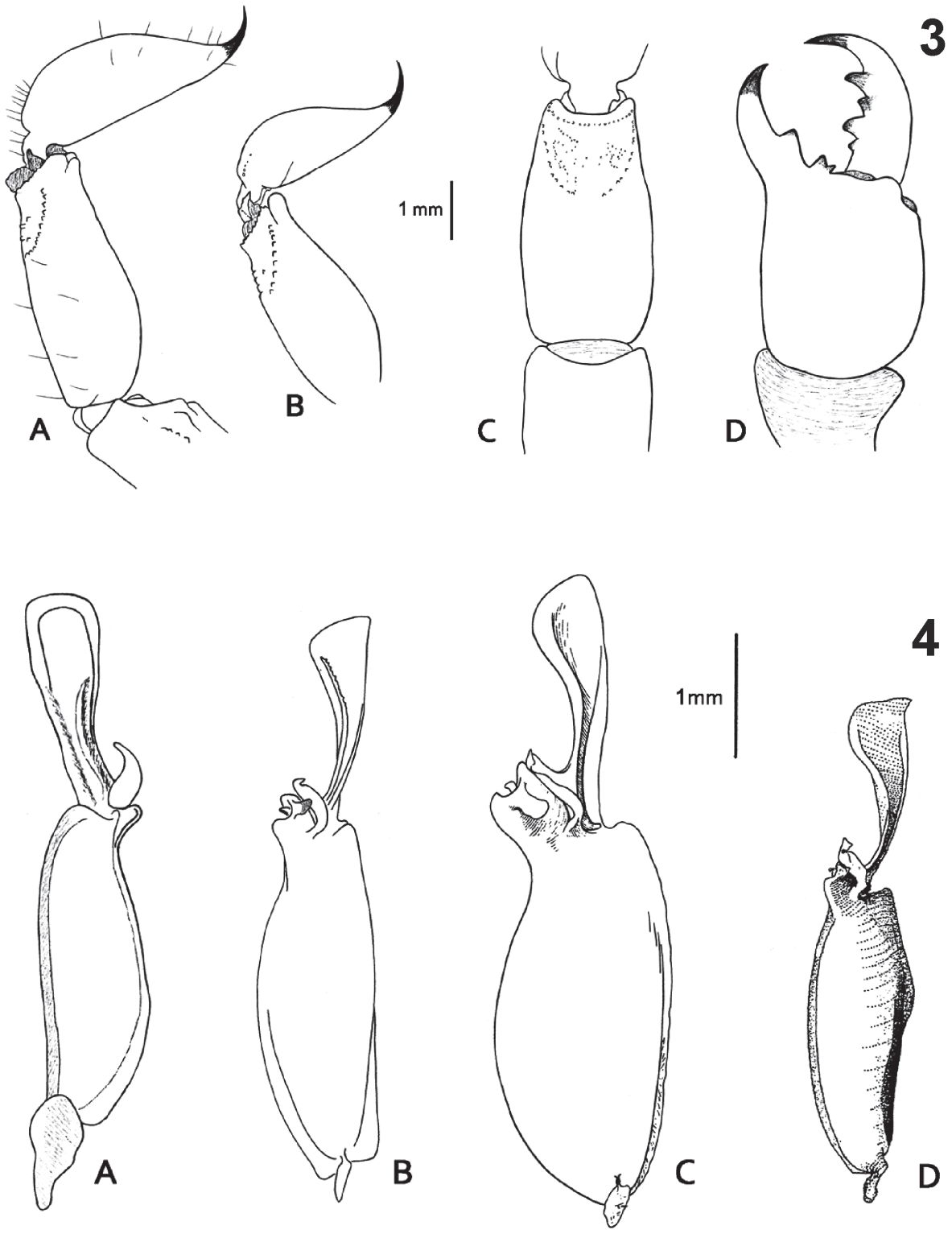


Fig. 3. *Bothriurus goiano* **sp. n.** Male holotype from Parque Nacional das Emas, Goiás, Brazil [MNRJ 7683] (**A**, **C**, **D**); female paratype from the same locality [MNHN-RS-9149] (B). **A**, **B** – Metasomal segment V and telson, lateral view; **C** – Metasomal segment V, ventral view; **D** – chelicera, dorsal view.

Fig. 4. Hemispermatophores of four species of Bothriuridae. **A** – right hemispermatophore of *Bothriurus goiano* **sp. n.**, male paratype from Parque Nacional das Emas, Goiás, Brazil [MNHN-RS-9150]; **B** – left hemispermatophore of *Bothriurus guarani* Maury, 1984, topotypic male from Concepcion, Estancia Laguna Negra, Paraguay [MHNG no number]; **C** – hemispermatophore of *Bothriurus araguayae* Vellard, 1934 (adapted from Lourenço 2002). **D** – hemispermatophore of *Brazilobothriurus pantanalensis* Lourenço & Monod, 2000 (adapted from Lourenço 2002).



Fig. 5. *Bothriurus goiano* **sp. n.** Female paratype from Parque Nacional das Emas, Goiás, Brazil [UnB 9756] (**A**); female paratype from the same locality [UnB 9756] (**B**). Scorpions photographed *in situ* shortly before collection. Both photographs by AA.

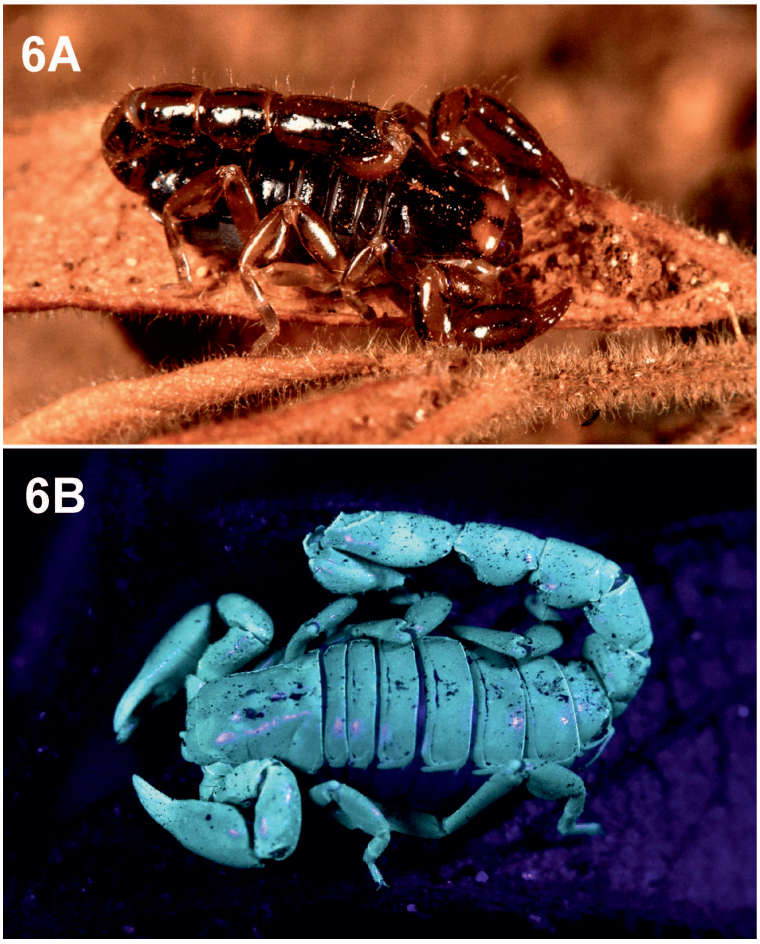


Fig. 6. *Bothriurus goiano* **sp. n.** Female paratype from Parque Nacional das Emas, Goiás, Brazil [UFG (no number)], same individual photographed *in situ*, with camera flashlights (**A**) and under UV light (**B**), prior to collection. Both photographs by AA.

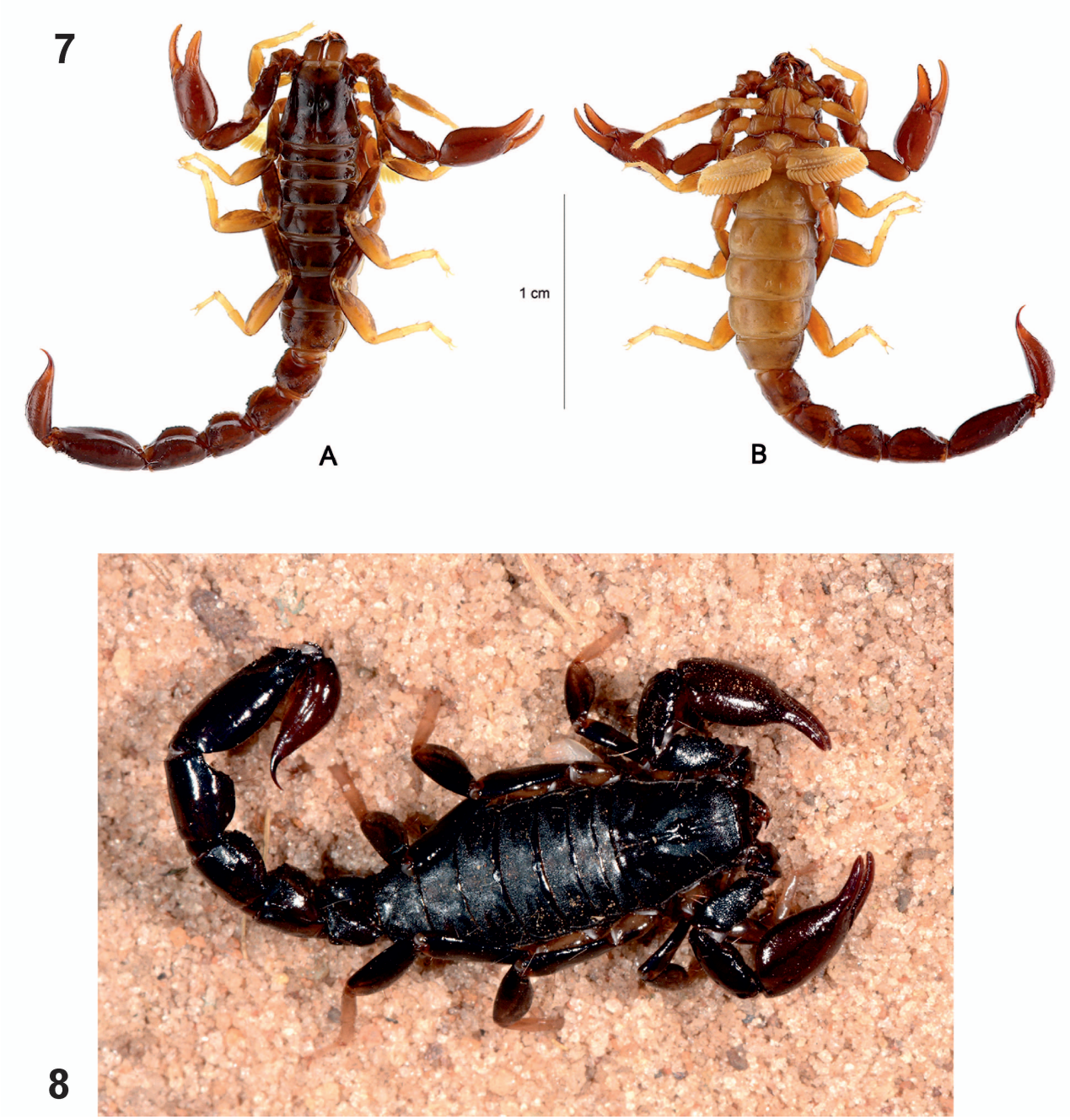


Fig. 7. *Bothriurus guarani* Maury, 1984. Topotypic male from Concepcion, Estancia Laguna Negra, Paraguay [MHNG no number]. Habitus, dorsal (**A**) and ventral (**B**) aspects.

Fig. 8. *Bothriurus araguayae* Vellard, 1934. Male from Pirenópolis, Goiás, Brazil [MNRJ 7684], photographed *in situ* shortly before collection. Photographs by AA.



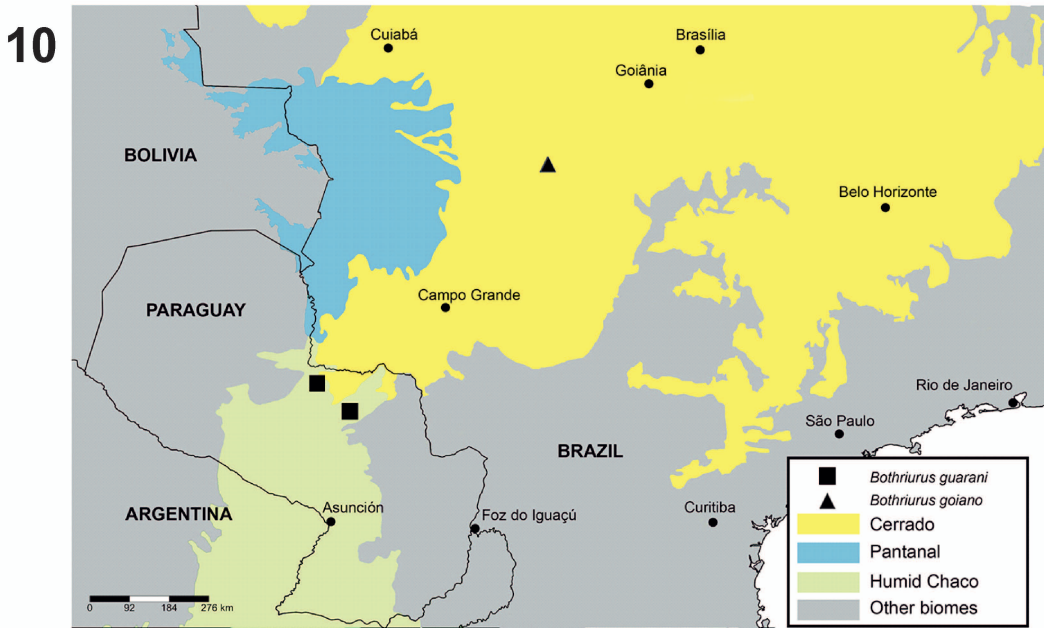


Fig. 9. Habitat of *Bothriurus goiano* **sp. n.** Dirt road through a typical Cerrado formation in the Parque Nacional de Emas, Goiás, Brazil (A) and details of roadside slopes, with small burrow holes (some possibly made by scorpions). Both photographs by AA.

Fig. 10. Map of south-central Brazil and Paraguay, showing the three main formations discussed in the text (Cerrado, Pantanal and Humid Chaco), as well as the presently known distribution of *B. guarani* Maury 1984 (solid squares) and *B. goiano* **sp. n.** (solid triangle).