

First records of Aracambiae crickets (Orthoptera: Phalangopsidae) in caves, with description of seven new species

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Abstract

Phalangopsidae crickets usually inhabit humid environments and are commonly found in caves. Genera of the Aracambiae group have not yet been found in subterranean environments. The aim of this study is to present new species of *Izecksohniella*, *Marcgraviella*, and *Marliella* collected in Brazilian caves. The seven new species are primarily distinguished by the shape and position of the pseudepiphallal arms and parameres. This is the first record of phalangopsid crickets of the Aracambiae group in caves. The description of these new species provides a better understanding of the cave communities where they were found.

Resumo

Os grilos ffanglopdeos habitam preferencialmente ambientes úmidos e são comumente achados em cavernas. Gêneros do grupo Aracambiae ainda não foram encontrados em ambientes subterrâneos. O objetivo deste estudo é apresentar novas espécies de *Izecksohniella*, *Marcgraviella* e *Marliella* coletadas em cavernas brasileiras. As sete novas espécies distinguem-se principalmente pela forma e posição dos braços e parâmeros pseudepifállicos. Este é o primeiro registro de grilos ffanglopseidos do grupo Aracambiae em cavernas. A descrição dessas novas espécies permite uma melhor compreensão das comunidades cavernícolas onde foram encontradas.

1. Introduction

Phalangopsid crickets (Orthoptera: Ensifera: Phalangopsidae) exhibit their highest diversity in the Neotropical region, occurring predominantly in humid environments (DESUTTER-GRANDCOLAS 1995, SOUZA-DIAS 2015). These crickets occupy various microhabitats, such as crevices in tree trunks and rocks, burrows, leaf litter, spaces beneath roots, and caves (DESUTTER-GRANDCOLAS 1992, 1995). Within these environments, they contribute significantly to nutrient cycling (LAVOIE et al. 2007), playing crucial roles in ecosystem processes that are essential to the maintenance of subterranean communities. The main genera found in Brazilian caves include *Adelosgryllus* Mesa & Zefa, 2004, *Bambuina* de Mello et al., 2013, *Erebonyx* de Mello, 2021, *Endecous* Saussure, 1878, *Eidmanacris* Chopard, 1956, *Phalangopsis* Serville, 1831, and *Strinatia* Chopard, 1970. Among these, *Endecous* and *Erebonyx* are particularly notable for encompassing strictly cave-dwelling, troglobitic species (CARVALHO et al. 2023, CASTRO-SOUZA et al. 2020, DE MELLO & FERREIRA, 2021).

The Aracambiae group (Phalangopsidae: Phalangopsinae: Phalangop-

sini) comprises 13 species distributed across seven genera: *Aracambys* de Mello, 1992, *Cacruzia* de Mello, 1992, *Desutterella* Souza Dias et al., 2017, *Izecksohniella* de Mello, 1992, *Marcgraviella* Souza-Dias & Desutter-Grandcolas, 2014, *Marliella* Mews & Mól, 2009, and *Vanzoliniella* de Mello & Cezar dos Reis, 1994 (CIGLIANO et al. 2025). This group is characterized by male genitalia with a pair of tubular pseudepiphallal arms associated with glands, and pseudepiphallal parameres composed of both sclerotized structures and inflatable membranes (SOUZA-DIAS & DESUTTER-GRANDCOLAS 2014). Crickets of the Aracambiae group are found in the Amazon Rainforest, Atlantic Forest, and Cerrado biomes (CIGLIANO et al. 2025, DE MELLO 1992, DE MELLO & CEZAR DOS REIS 1994, MEWS & MÓL, 2009, SOUZA-DIAS & DESUTTER-GRANDCOLAS 2014, SOUZA-DIAS et al. 2017). To date, no species from the Aracambiae group have been recorded in caves.

This study provides the first records of Aracambiae crickets in caves and describes a new species of *Izecksohniella*, two new species of *Marcgraviella*, and four new species of *Marliella*, all discovered in Brazilian caves.

2. Materials and methods

Collection. Adult males of *Izecksohniella*, *Marcgraviella* and *Marliella* were collected through active searches in caves in the states of Mato Grosso, Mato Grosso do Sul, Goiás, Minas Gerais, Bahia, Sergipe, and Pernambuco. The specimens were preserved in 70% ethanol and stored in the Collection of Subterranean Invertebrates of Lavras (ISLA). All analyses and descriptions were conducted at the Center of Studies on Subterranean Biology (CEBS), at the Federal University of Lavras, Brazil.

Examined material. *Izecksohniella* n. sp. - Adult male, Brazil, Bahia,

municipality of Iuiú, Gruta Toca Valada cave (14°29'27.8"S, 43°39'08.8"W), 13/IX/2016, Cardoso, R.C.; Adult male, same locality, 21/X/2021, Ferreira, R.L. *Marcgraviella* n. sp. 1 - Adult male, Brazil, Sergipe, municipality of Simão Dias, Toca da Raposa cave (10°43'15.7"S, 37°52'23.7"W), 11/I/2010, Ferreira, R.L.; Adult male, Brazil, Bahia, municipality of Paripiranga, Furna do Fim do Morro do Parafuso cave (10°38'25.7"S, 37°52'02.9"W), 11/I/2010, Ferreira, R.L. *Marcgraviella* n. sp. 2 - Adult male, Brazil, Minas Gerais, municipality of Morro do Pilar, SPT-0487 cave (19°12'59.8"S, 43°23'03.4"W), 26/07/2016-

13/X/2016, Carste Team. *Marliella* n. sp. 1 - Adult males, Brazil, Mato Grosso do Sul, municipality of Bodoquena, Gruta Alta Campina cave (20°36'05.0"S, 56°43'01.0"W), 02/X/2022, Ferreira, R.L. *Marliella* n. sp. 2 - Adult male, Brazil, Mato Grosso, municipality of Cuiabá, Gruta Kiogo Brado cave (15°37'04.9"S, 55°30'13.5"W), 27/X/2006, Ferreira, R.L. *Marliella* n. sp. 3 - Adult males, Brazil, Goiás, municipality of Cocalzinho de Goiás, Gruta dos Ecos cave (15°41'24.5"S, 48°24'23.9"W), 12/X/2007. *Marliella* n. sp. 4 - Adult male, Brazil, Minas Gerais, municipality of Coromandel, Gruta do Huguinho cave (18°21'06.3"S, 47°08'26.3"W), 05/X/2000, Ferreira, R.L. (Figure 1)

Analysis and description. Adult males were dissected, and their genitalia subjected to enzymatic treatment for at least 24 hours, following Álvarez-Padilla & Hormiga (2007). Afterward, the genitalia were prepared

by carefully removing muscles and membranes, and then analyzed under a ZEISS Stemi 2000 stereomicroscope. The descriptions were based on the terminology proposed by Desutter-Grandcolas (2003) and modified by Souza-Dias et al. (2015).

Photographs of the male genitalia were obtained using a ZEISS Axiocam 506 camera attached to a ZEISS Axio Zoom V16 stereomicroscope. For the comparative diagnosis, descriptions, photographs, and illustrations available in the literature were reviewed (MEWS & MÓL 2009, SOUZA-DIAS & DESUTTER-GRANDCOLAS 2014).

Additionally, head, thorax, abdomen, and appendages were described based on observations of specimens under a ZEISS Stemi 2000 stereomicroscope.

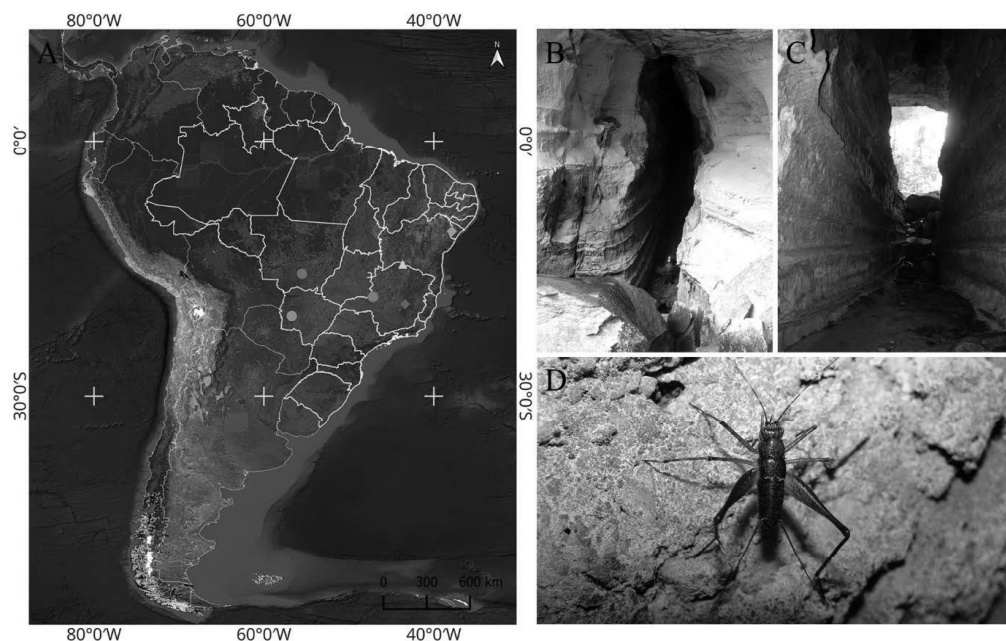


Figure 1: A) Map of the South American continent, countries outlined with thin white lines, Brazilian states outlined with thick white lines, and colored shapes indicating the type locality of the new species of the Aracambiae group (yellow triangle - *Izecksohniella* n. sp., blue diamond - *Marcgraviella* n. sp. 1, red diamond, *Marcgraviella* n. sp. 2, pink circle - *Marliella* n. sp. 1, orange circle - *Marliella* n. sp. 2, purple circle - *Marliella* n. sp. 3, green circle - *Marliella* n. sp. 4); B) Entrance of Gruta Kiogo Brado cave; C) Interior of Kiogo Brado cave; D) Adult male of *Marliella* n. sp. 2.

3. Results

Izecksohniella n. sp. **Type locality:** Brazil, Bahia, Iuiú, Gruta Toca Valada cave (14°29'27.8"S, 43°39'08.8"W). **Partial description of adult male:** General morphology. Head predominantly brown-orange; fastigium and frons dark brown with yellowish-brown stripes; antennae banded; segments IV and V of the maxillary palpi white, with segment V curved and truncated ventrally; pronotum brown-orange with two white spots on the anterolateral portion; metanotum with two pairs of protuberances; forewings covering approximately half of the abdomen; supra-anal plate trapezoidal with a rounded posterior margin; subgenital plate with a median fold on the posterior margin; legs orange-brown; tibia I with a tympanum on the inner face; tibia III with four pairs of subapical spurs on the dorsal face and two sets of apical spurs, three internal and three external; inner apical spurs longer than the outer ones. Genitalia. Pseudepiphallallic arms elongated, crossing each other dorsally, with the apex covered with a row of pointed, sclerotized teeth, the most proximal tooth being the longest, resembling an opposable thumb; pseudepiphallallic ventral parameres small and sclerotized, positioned ventrally; dorsal parameres quadrangular and oblique, dorsal face predominantly membranous, featuring sclerotized distal projections in the shape of a rounded saw; ectophallallic fold sclerotized and L-shaped; endophallallic sclerite short, sclerotized, and bilobed at the apex (Figure 2).

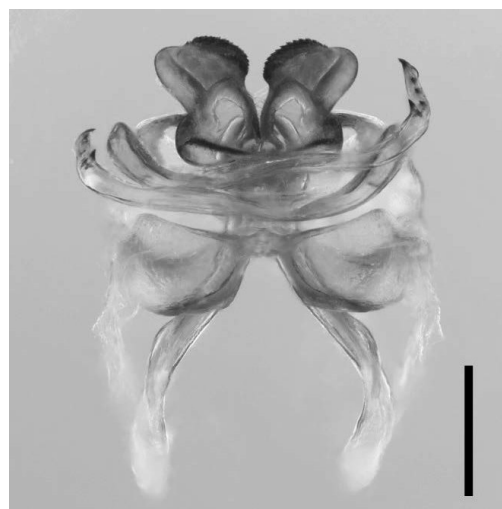


Figure 2: *Izecksohniella* n. sp., male genitalia (dorsal view); scale bar: 0.5 mm.

Marcgraviella n. sp. 1. **Type locality:** Brazil, Bahia, Paripiranga, Furna do Fim do Morro do Parafuso cave (10°38'25.7"S 37°52'02.9"W). **Partial description of adult male:** General morphology. Head predominantly brown-orange; fastigium and frons dark brown with yellowish-brown stripes; antennae banded; maxillary palpus yellowish-brown, with segment V white distally, curved, and truncated ventrally; pronotum brown-orange with brown spots on the anterodorsal and posterolateral portions; metanotum with two pairs of protuberances; forewings covering about two-thirds of the abdomen; supra-anal plate trapezoidal with a rounded posterior margin; subgenital plate with a median fold on the posterior margin; legs orange-brown; tibia I with a tympanum on the inner face; tibia III with four pairs of subapical spurs on the dorsal face and two sets of apical spurs, three internal and three external; inner apical spurs longer than the outer ones. Genitalia. Pseudepiphallic arms elongated, crossing each other dorsally, with a sclerotized apex devoid of teeth, curving ventrally; pseudopiphallic ventral parameres sclerotized, rectangular, positioned centrodorsally; dorsal parameres bilobed, each half droplet-shaped, sclerotized ventrally, with the apex sclerotized and covered with small teeth; ectopiphallic fold membranous; endopiphallic sclerite short, sclerotized, and bilobed at the apex (Figure 3, A).

Marcgraviella n. sp. 2. **Type locality:** Brazil, Minas Gerais, Morro do Pilar, SPT-0487 cave (19°12'59.8"S, 43°23'03.4"W). **Partial description of adult male:** General morphology. Head predominantly brown-orange; fastigium and frons brown-orange with yellowish stripes; ocelli surrounded by dark spots; antennae banded; maxillary palpi yellowish-brown, with segment V white distally, curved, and truncated ventrally; pronotum brown-orange; metanotum with two pairs of protuberances; forewings covering approximately half of the abdomen; supra-anal plate trapezoidal with a rounded posterior margin; subgenital plate with a median fold on the posterior margin; legs orange-brown; tibia I without a tympanum; tibia III with four pairs of subapical spurs on the dorsal face and two sets of apical spurs, three internal and three external; inner apical spurs longer than the outer ones. Genitalia. Pseudepiphallic arms short, crossing each other dorsally, with a sclerotized, pointed apex; pseudopiphallic ventral parameres sclerotized, proximal portion hook-shaped, positioned centrodorsally; dorsal parameres approximately elliptical, posterior margin sclerotized, covered with small teeth, and bearing a smooth, flattened projection with rounded margins; ectopiphallic fold membranous; endopiphallic sclerite short, sclerotized, and bilobed at the apex (Figure 3, B).

Marliella n. sp. 1. **Type locality:** Brazil, Mato Grosso do Sul, Bodoquena, Gruta Alta Campina cave (20°36'05.0"S, 56°43'01.0"W). **Partial description of adult male:** General morphology. Head predominantly brown; fastigium and frons dark brown with incomplete yellowish-brown stripes; antennae banded; segments IV and V of the maxillary palpi white, with segment V curved ventrally; pronotum brown, with dark brown lateral lobes; metanotum with two pairs of protuberances; forewings short, partially covering the first tergite, and lacking distinct veins; supra-anal plate trapezoidal with a rounded posterior margin; subgenital plate with a median fold on the posterior margin; legs yellowish-brown, covered with brown spots; tibia I without a tympanum; tibia III with four pairs of subapical spurs on the dorsal face and two sets of apical spurs, three internal and three external; inner apical spurs longer than the outer ones. Genitalia. Pseudepiphallic arms elongated, crossing each other dorsally, with the distal half covered with multiple rows of teeth, apex sclerotized and pointed; pseudopiphallic ventral parameres sclerotized, proximal portion hook-shaped, positioned centrodorsally; dorsal parameres bilobed, distal halves bean-shaped, proximal halves concave and bowl-shaped, with sclerotized margins covered with teeth; ectopiphallic fold membranous; endopiphallic sclerite short, sclerotized, and bilobed at the apex (Figure 4, A).

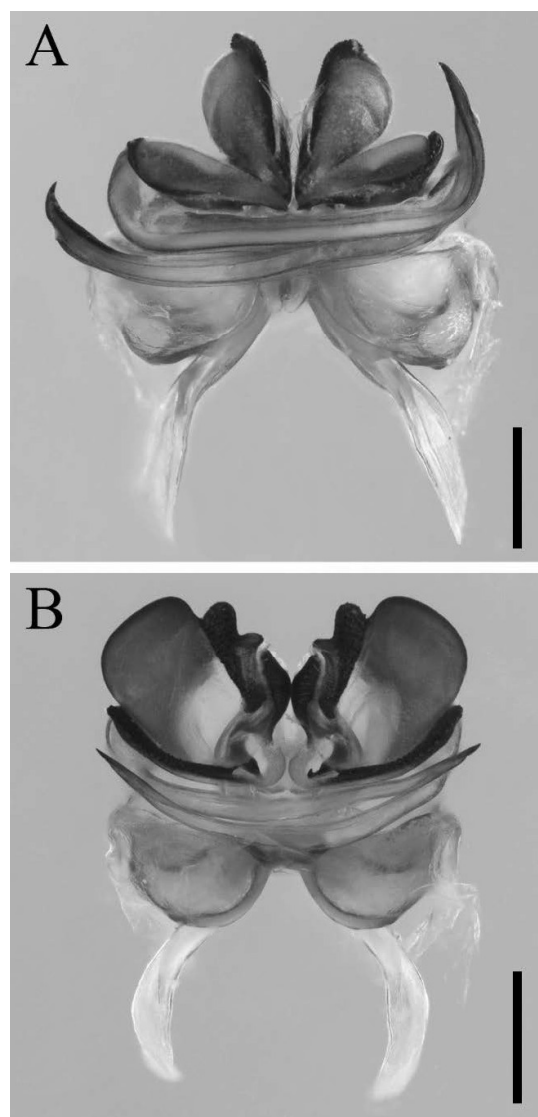


Figure 3: A) *Marcgraviella* n. sp. 1, male genitalia (dorsal view); B) *Marcgraviella* n. sp. 2, male genitalia (dorsal view); scale bar: 0.5 mm.

Marliella n. sp. 2. **Type locality:** Brazil, Mato Grosso, Cuia-bá, Gruta Kiogo Brado cave (15°37'04.9"S, 55°30'13.5"W). **Partial description of adult male:** General morphology. Head predominantly brown; fastigium dark brown anteriorly; frons dark brown with yellowish-brown stripes; antennae banded; maxillary palpi brown, with segment V white distally and curved ventrally; pronotum brown; metanotum with two pairs of protuberances; forewings short, with white posterior margins, partially covering the first tergite, and lacking distinct veins; supra-anal plate trapezoidal with a rounded posterior margin; subgenital plate with a median fold on the posterior margin; legs yellowish-brown, covered with brown spots; tibia I with a tympanum on the inner face; tibia III with four pairs of subapical spurs on the dorsal face and two sets of apical spurs, three internal and three external; inner apical spurs longer than the outer ones. Genitalia. Pseudepiphallic arms elongated, crossing each other dorsally, with the external distal face covered with teeth, apex sclerotized and pointed; pseudopiphallic ventral parameres sclerotized, positioned centrodorsally, proximal portion hook-shaped and covered with small teeth; dorsal parameres bean-shaped, with sclerotized distal and lateral margins covered with teeth; ectopiphallic fold membranous; endopiphallic sclerite short, sclerotized, and bilobed at the apex (Figure 4, B).

Marliella n. sp. 3. **Type locality:** Brazil, Goiás, Cocalzinho de Goiás, Gruta dos Ecos cave (15°41'24.5"S, 48°24'23.9"W). **Partial description of adult male:** General morphology. Head predominantly brown; fastigium and frons dark brown with yellowish-brown stripes; antennae banded; maxillary palpi brown, with segment V white distally and curved ventrally; pronotum brown; metanotum with two pairs of protuberances; forewings short, with white posterior margins, covering the second tergite, and lacking distinct veins; supra-anal plate trapezoidal with a rounded posterior margin; subgenital plate with a median fold on the posterior margin; legs yellowish-brown, covered with brown spots; tibia I without a tympanum; tibia III with four pairs of subapical spurs on the dorsal face and two sets of apical spurs, three internal and three external; inner apical spurs longer than the outer ones. Genitalia. Pseudepiphallic arms elongated, crossing each other dorsally, with the external face covered with teeth, apex sclerotized and pointed, bearing ventral teeth; pseudopiphallic ventral parameres sclerotized, positioned centrodorsally, proximal portion hook-shaped and smooth; dorsal parameres bilobed, with proximal halves concave and bowl-shaped, sclerotized margins covered with teeth; posterior margin of the distal halves sclerotized, covered with teeth, and projecting over the membranous area; ectopiphallic fold membranous; endopiphallic sclerite short, sclerotized, and bilobed at the apex (Figure 4, C).

Marliella n. sp. 4. **Type locality:** Brazil, Minas Gerais, Coromandel, Gruta do Huguinho cave (18°21'06.3"S, 47°08'26.3"W). **Partial description of adult male:** General morphology. Head predominantly brown; fastigium dark brown anteriorly; frons dark brown with yellowish-brown stripes; antennae banded; maxillary palpi brown, with segment V white distally and curved ventrally; pronotum brown; metanotum with two pairs of protuberances; forewings short, with white posterior margins, partially covering the first tergite, and lacking distinct veins; supra-anal plate trapezoidal with a rounded posterior margin; subgenital plate with a median fold on the posterior margin; legs yellowish-brown, covered with brown spots; tibia I without a tympanum; tibia III with four pairs of subapical spurs on the dorsal face and two sets of apical spurs, three internal and three external; inner apical spurs longer than the outer ones. Genitalia. Pseudepiphallic arms elongated, crossing each other dorsally, bifurcated into short and long branches; external face of the short branch apex covered with teeth, long branch projecting perpendicularly, with apex curved ventrally and bearing a small tooth at the base; dorsal parameres bilobed and almost entirely sclerotized, distal halves rounded at the apex and covered with small teeth; ectopiphallic fold membranous; endopiphallic sclerite short, sclerotized, and bilobed at the apex (Figure 4, D).

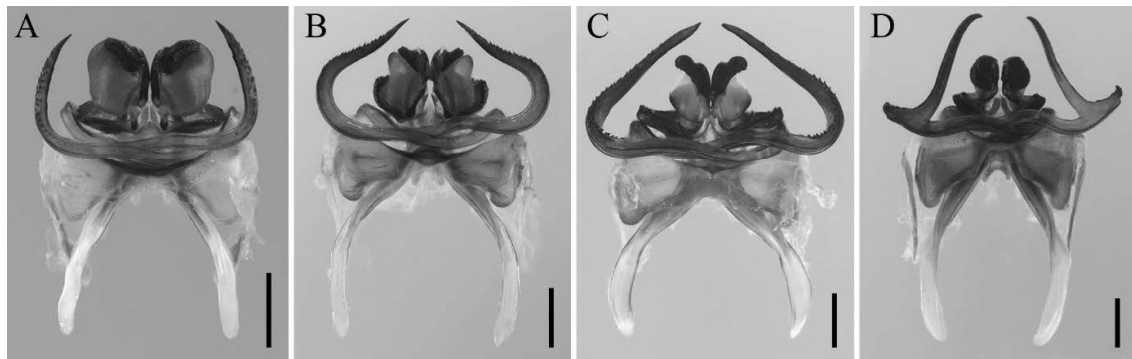


Figure 4: A) *Marliella* n. sp. 1, male genitalia (dorsal view); B) *Marliella* n. sp. 2, male genitalia (dorsal view); C) *Marliella* n. sp. 3, male genitalia (dorsal view); D) *Marliella* n. sp. 4, male genitalia (dorsal view); scale bar: 0.5 mm.

4. Discussion

Izecksohniella n. sp. differs from other species of the genus mainly by the quadrangular and oblique shape of the pseudopiphallic dorsal parameres, and the position and number of teeth at the apex of the pseudopiphallic arms.

Marcgraviella n. sp. 1 differs from *M. christiana* Souza-Dias & Desutter-Grandcolas, 2014, and *M. muriciensis* Souza-Dias & Desutter-Grandcolas, 2014, mainly through the inclination of the pseudopiphallic dorsal parameres and the shape of their apical margins. *Marcgraviella* n. sp. 2 distinguishes itself from these three species mainly by the length of the pseudopiphallic arms and the shape of the pseudopiphallic dorsal parameres.

The four new species of *Marliella* differ from *M. titai* Mews & Mól, 2009, through the shape of the pseudopiphallic dorsal and ventral parameres, the curvature and ramifications of the pseudopiphallic arms, and the presence or absence of tympana. In the case of *Marliella* n. sp. 1, the forewings lack whitish margins.

5. Conclusion

Seven new Aracambiae species were described from crickets collected in Brazilian caves, marking the first record of the group in subterranean environments. The description of these new species provides a

All seven species described herein have caves as type localities, making them the first records of the Aracambiae group in subterranean environments. Phalangopsid crickets are commonly found in caves (CASTRO-SOUZA et al. 2020, DESUTTER-GRANDCOLAS 1992, 1995) and may be accidental, troglomorphic, or troglitic. None of the Aracambiae group species described herein show typical troglomorphic traits, such as tegument depigmentation, elongation of appendages, or reduction of ocular structures (CARVALHO et al. 2023, CASTRO-SOUZA et al. 2020, CHRISTIANSEN 2012, DE MELLO & FERREIRA 2021). Thus, there is no evidence that *Izecksohniella* n. sp. 1, *Marcgraviella* n. sp. 1, *Marcgraviella* n. sp. 2, *Marliella* n. sp. 1, *Marliella* n. sp. 2, *Marliella* n. sp. 3, and *Marliella* n. sp. 4 are troglitic species. Nymphs, adult males, and females of *Izecksohniella* n. sp. 1, *Marcgraviella* n. sp. 1, *Marliella* n. sp. 1, and *Marliella* n. sp. 3 were found inside the cave, suggesting that these species are capable of completing their life cycles in subterranean environments and can, therefore, be classified as troglitic.

better understanding of cave-dwelling communities. Further studies on the habits and population dynamics of these crickets are necessary to better understand their association with the subterranean environment.

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