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A new genus and two new species of Luzarinae cricket from the Atlantic Forest of Northeast Brazil (Orthoptera, Grylloidea)

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Abstract

A new genus and two new species of Luzarinae crickets (Grylloidea, Phalangopsidae) are described from the Atlantic Forest of Northeast Brazil. *Marcgraviella muriciensis* Souza-Dias **n. gen.**, **n. sp.** and *M. christianae* Desutter-Grandcolas & Souza-Dias **n. gen.**, **n. sp.** are described using characters of morphology and male genitalia. The new genus is characterized by male genitalia singularities, presenting elongated and inflatable pseudepiphallic parameres, which lies in vertical or almost vertical position, and long and tubular pseudepiphallic arms associated to phallic glands. We provide a discussion about the morphology of male genitalia and the function of the phallic glands and pseudepiphallic arms in *Marcgraviella* **n. gen.** and related taxa. An identification key for *Marcgraviella* **n. gen.** and related genera is proposed. These genera, which bear phallic glands, are placed in the newly named group, the Aracambiae.

Key words: Atlantic Forest, Grylloidea, Luzarinae, Neotropical region, taxonomy.

Resumo

Um novo gênero e duas novas espécies de grilo da subfamília Luzarinae (Grylloidea, Phalangopsidae) são descritas da Mata Atlântica do nordeste do Brasil. *Marcgraviella muriciensis* Souza-Dias **n. gen.**, **n. sp.** e *M. christianae* Desutter-Grandcolas & Souza-Dias **n. gen.**, **n. sp.**, são descritas baseando-se em caracteres morfológicos e da genitália masculina. O novo gênero é caracterizado por singularidades na genitália masculina, apresentando parâmeros pseudoepifálicos alongados e infláveis, os quais são verticais ou quase verticais, e longos e tubulares braços pseudoepifálicos associados a glândulas fálicas. Nós apresentamos uma discussão sobre a morfologia da genitália masculina e a função das glândulas fálicas e dos braços pseudoepifálicos em *Marcgraviella* **n. gen.** e gêneros próximos. Uma chave de identificação para *Marcgraviella* **n. gen.** e gêneros relacionados é proposta. Estes gêneros, que possuem glândulas fálicas, são agrupados em um novo grupo, Aracambiae

Palavras-chave: Grylloidea, Luzarinae, Mata Atlântica, região Neotropical, taxonomia.

Résumé

Un nouveau genre et deux nouvelles espèces de grillons Luzarinae (Grylloidea, Phalangopsidae) sont décrites de la Forêt atlantique du Nord Est du Brésil. *Marcgraviella muriciensis* Souza-Dias **n. gen.**, **n. sp.** et *M. christianae* Desutter-Grandcolas & Souza-Dias **n. gen.**, **n. sp.**, sont décrits à partir de caractères de la morphologie et des genitalia mâles. Le nouveau genre est caractérisé par des particularités des genitalia mâles, qui présentent des paramères pseudépiphalliques allongés, extensibles, et verticaux ou presque verticaux, et des bras pseudépiphalliques longs et tubulaires assocés à des glandes phalliques. La morphologie des genitalia mâles et la fonction des glandes phalliques et des bras pseudépiphalliques chez *Marcgraviella* **n. gen.** et les taxa proches sont discutées. Une clé d'identification des genres proches de *Marcgraviella* **n. gen.** est proposée; ces genres, qui portent des glandes phalliques, sont regroupés dans le nouveau groupe des Aracambiae.

Mots Clés: Forêt Atlantique, Grylloidea, Luzarinae, région Néotropicale, taxonomie

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Introduction

The systematics of Phalangopsidae is far from being well understood. Several authors have considered this taxon as a separated family (Chopard 1949, 1967 (see foreword), 1968; Desutter 1990; de Mello 1992a, b, 1994; Desutter-Grandcolas 1995; Bolfarini & de Mello 2010; Souza-Dias *et al*. 2014), a subfamily within Gryllidae (Hebard 1928a; Alexander & Otte 1967; Otte & Alexander 1983) or a « subfamily group » within the Gryllidae (Gorochov 2007, 2012; 2014; Eades *et al*. 2014). Whatever its taxonomic level, this cricket group constitutes one of the major divisions among crickets, in terms of phylogenetic, behavioral and ecological diversification. In the Neotropics, Phalangopsidae stand as the major group of Grylloidea.

Available molecular evidence (Chintauan-Marquier *et al*., submit.) confirms this assessment, as Phalangopsidae represents one of the three main clades among true crickets with Trigonidiidae (including Trigonidiinae and Nemobiinae) and Gryllidae (including all other cricket groups). In this study, Phalangopsidae subdivides into five groups, which partly support the subfamilies and tribes currently used in the Orthoptera Species File (http://www.orthoptera.speciesfile.org hereafter OSF). Most of the sampled taxa currently classified in the Luzarinae subfamily on the 2014 OSF are gathered in one clade, which moreover validate the monophyly of the B– and C– groups previously defined according to male genitalia by Desutter (1990). The B–group, which corresponds at least partly to Hebard's 1928 Luzarae, was represented by *Luzara* Walker, 1869, *Niquirana* Hebard, 1928, *Amusodes* Hebard, 1928, *Luzarida* Hebard, 1928, *Acantoluzarida* Desutter-Grandcolas, 1992, and *Luzaridella* Desutter-Grandcolas, 1992 (Chintauan-Marquier *et al*. submit.). To these genera, should be added *Palpigera* Hebard, 1928, *Leptopsis* Desutter-Grandcolas, 1996, *Melanotes* Desutter-Grandcolas, 1993, *Ochraperites* Desutter-Grandcolas, 1993, *Allochrates* Desutter-Grandcolas, 1993, and *Peru* Koçak & Kemal, 2008 (Desutter-Grandcolas 1993a, c), and possibly *Endecous* Saussure, 1878 and *Discophogryllus* Rehn, 1901 (Desutter-Grandcolas 1993a; Mews & Sperber 2008). Most of these genera are classified in the subtribe Luzarina Hebard, 1928 by Gorochov (2014).

The C–group (Desutter, 1990) is more diverse. Initially defined for five described genera, i.e. *Lerneca* Walker, 1869, *Gryllosoma* Hebard, 1928, *Tairona* Hebard, 1928, *Eidmanacris* Chopard, 1956, and *Strinatia* Chopard, 1970 (Desutter 1990), it includes now about 20 genera, added progressively by several authors (de Mello 1990, 1992a, b, 1995; De Mello & Dos Reis 1994; Desutter-Grandcolas 1995; de Mello & de Andrade 2003; Mews *et al*. 2009, 2010; Bolfarini & de Mello 2012; de Mello *et al*. 2013). Only four genera were included in molecular phylogeny, *Aracamby* de Mello, 1992, *Lerneca*, *Microlerneca* de Mello, 1995, and *Prosthacusta* Saussure, 1874, and they are recovered as a monophyletic group. These genera are classified partly in the subtribe Phalangopsina Blanchard, 1845, subtribe Luzarina and subtribe Lernecina Gorochov, 2014 by Gorochov (2014).

Here we describe a new genus and two new species of the Luzarinae C-group of crickets from the Atlantic Forest of Northeast Brazil, close to *Aracamby*, *Marliella* Mews & Mol, 2009, *Izecksohniella* de Mello, 1992, *Cacruzia* de Mello, 1992, and *Vanzoliniella* de Mello & Cezar dos Reis, 1994. As a preliminary work to a morphological phylogeny of this vast and diverse group, we discuss the characters of their male genitalia.

Material and methods

Classifications are best justified when established from a phylogenetic topology. Cricket phylogeny has been very poorly studied up to now. The most extensive study, based on 214 specimens sequenced for up to 7 molecular markers, has just been presented in a congress in 2013 and is presently under publication process. To avoid adding noise in the already confuse classification of crickets, we use the classification adopted by the OSF in 2013 and 2014 as a reference, except for the "Phalangopsinae subfamily group", which we consider a family, as used by previous authors (see above) and supported by molecular evidence (Chintauan-Marquier *et al*. submit.)

Male phallic complexes were removed and treated with an aqueous solution of cold 10% KOH for 24 h to remove muscular tissues.

The specimens were examined, described and compared using a Leica MZ-9.5 stereomicroscope and a Leica MZ12. They were photographed immersed in 85% ethanol using a Leica MZ-16 stereomicroscope attached with a DFC-420 video camera, and drawings were made under a camera lucida attached to a Leica MZ-9.5 or MZ12 stereomicroscope. The software Leica Application Suite LAS v4.0 was used to take the images and the digital

image processing software Helicon Focus 5.3 was used to combine them. Subsequently, the images were edited in GIMP (GNU Image Manipulation Program) 2.8.

Abbreviations

Male genitalia. Arc, ectophallic arc; Arm, pseudepiphallic arm; Ect Ap, ectophallic apodeme; End Ap, endophallic apodeme; End Sc, endophallic sclerite; M L Ps, median lobe of pseudepiphallus; PG, phallic gland; Ps Sc, pseudepiphallic sclerite; Ps P, pseudepiphallic parameres; R, ramus.

General morphology. I, II, III, anterior, median, posterior (leg, tarsomere); DD, LL, dorsal disc, lateral lobe of pronotum; FW, forewing.

Venation. Named after Desutter-Grandcolas (2003). CuA, CuP, anterior, and posterior cubital vein; MA, MP, anterior, and posterior media vein.

Repositories. MNHN, Muséum national d'Histoire naturelle, Paris, France; MZSP, Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil.

Measurements (in mm). awpron, anterior width of pronotum; BL, body length; Hw, head width; iod, intra-ocular distance; LFIII, length of hind femur; LFW, forewing length; Lpron, pronotum length; Ltars1-III, length of basitarsomere III; LTIII, length of hind tibia; OL, ovipositor length; pwpron, posterior width of pronotum; wFIII, width of hind femur; wFW, median forewing width; wpron, pronotum width; wTIII, width of hind tibia.

Results

Marcgraviella, n. gen.

Etymology. Taxon dedicated to the German naturalist Georg Marcgrave, the first naturalist to study the fauna of Northeast Brazil in 17th century.

Type species. *Marcgraviella muriciensis* Souza-Dias, **n. sp.**

Species included. *Marcgraviella muriciensis* Souza-Dias **n. sp.**, *Marcgraviella christianae* Desutter-Grandcolas & Souza-Dias **n. sp.**

Distribution. Northeastern Brazil, in Alagoas and Pernambuco States.

Diagnosis. Coloration light yellow brown, with a distinctive ivory band between the eyes on head dorsum; legs not annulated and very elongated in relation to body length (more than 2x larger). Fastigium about as wide as the scape, slightly narrowed distally; not separated from the vertex by a transverse furrow. Joint 4 of maxillary palpi the longest. TI inner tympanum, obliterate; outer tympanum lacking. TIII with 4 pairs of subapical spurs. **Male.** Short, narrow but not vestigial FWs, slightly coriaceous; stridulatory file in a deep FW depression; stridulum more or less complete. Metanotum with a pair of « ball-shaped », median structures, in addition to muscular insertions. Supra anal plate with two bunches of strong setae on distal margin. **Male genitalia.** Pseudepiphallic sclerite with phallic glands and a pair of tubular pseudepiphallic arms dorsally crossing each other in the median part of the pseudepiphallic sclerite; each arm with an opening duct on its apex; pseudepiphallic parameres well developed, with at least two elongated and membranous lobes, inflatable, and partially sclerotized. **Female**. Larger than male; general coloration medium to dark brown; FWs vestigial, reduced to a small scale. **Female genitalia**. Copulatory papilla drop-shaped, sclerotized.

Description. Body small, slender; legs, thin and elongated, the hind femora with a distinctly thinner apical part of about 1/3 of their whole length (Fig. 1N). General coloration light brown. Head small. Fastigium a bit narrowed toward the apex (Figs 1C, 4A); very slightly furrowed longitudinally; slightly lower than the vertex, from which it is not separated by a transverse furrow (Figs 1C, F, 4B); 3 ocelli present, the distance between the median and one lateral ocelli about three fourth that between the lateral ocelli (Figs 1C, 4A). Eyes large and moderately prominent (Figs 1C, 4A); separated from subgenual suture by a distance about one third eye length (Figs 1E, 4A). Scapes longer than wide (Figs 1C, 4A). Maxillary palpi very long and thin (Fig. 1E, F); joint 4 the longest; joint 5 slightly longer than joint 3, only slightly widened; distal portion of joint 5 curved (Fig. 1E, F). Pronotum transverse; DD cephalic margin slightly convex; DD caudal margin well concave (Figs 1C, 4A); LL ventro-cephalic angle curved, with ventral margin ascending arcuate into the caudal margin and ventro-caudal angle not distinct (Figs 1D, 4B). TI

bearing only the internal tympanum, small and oblitered (Fig. 1F); with 2, ventral, apical spurs. TII with 4 apical spurs, the ventrals twice as long as the dorsals. TIII longer than FIII, with 4 pairs of alternate subapical spurs (Fig. 1O); strong serrulation between and above subapical spurs, except between inner subapical spurs 1 and 2; 3 inner and 3 outer apical spurs, the median the longest on both sides; median inner spur the longest, less than half basitarsomere III length. Basitarsomeres III very elongate; with two rows of spines (Fig. 1O). Serrulation of TIII and basitarsomeres III made of long, thin dorsal spines (Fig. 1O).

Male. Metanotum with two broad humps on its antero-lateral borders (muscular insertions) and two small, median rounded projections, without setae and apparent pores, but with irregular surfaces (problably glandular); metanotal distal margin raised and thick (Figs 1G, 4C). FWs covering part of the abdomen, up to tergite 5 (*M. muriciensis* Souza-Dias, **n. sp.**) or covering almost the whole abdomen (*M. christianae* Desutter-Grandcolas & Souza-Dias, **n. sp.** (Fig. 4D), not truncated distally; slightly coriaceous; stridulatory vein present, located in a deep depression of right FW (Figs 2D, 4D, 5E), with few, widely set teeth; left forewing partly thin dorsally, with a file made of very few teeth on the outer part of the stridulatory vein; harp and mirror present, but not clearly separated from surrounding venation (Figs. 2D, 4D, 5E); chords 1 and 2 fused very distally, at about one third of chord 3 length (Figs. 2D, 5E); CuP absent, but FW inflated along CuP normal location; MP and CuA widely separated over their whole length; separation between dorsal and lateral fields made by MP (Figs. 2D, 5E). Lateral field: MA and MP very strong, parallel over their whole length; R weaker than the media veins, with 5-6 irregular, faint bifurcations, and fused with MA distally (Fig. 5F). Hindwings absent. Supra anal plate without extended angles distally, but with two bunches of long and thick setae on distal margin (Figs 1H, 4E). Subgenital plate short, wider than long; deeply furrowed longitudinally, and indented apically (Figs 1J, 4F).

Male genitalia. Pseudepiphallic sclerite with phallic glands and two dorsal tubular pseudepiphallic arms dorsally crossing each other in the median part of the pseudepiphallic sclerite; each arm with an opening duct on its apex. Pseudepiphallic parameres well developed, with membranous inflatable areas, and otherwise partially sclerotized; the sclerotization concentrated on its ventral part. Endophallic sclerite located in the deep of a median ventral slit, with low sclerotization and extending until the basis of the pseudepiphallic parameres; endophallic apodeme present.

Female. Larger than male (Fig. 1B); general coloration darker than male (Fig. 1B). Tegmina very reduced, vestigial, not reaching the half of metanotum and not overlapping. Supra anal plate same as male (Fig. 1I). Subgenital plate small, deeply indented apically (Fig. 1K). Ovipositor as in Figs. 1L, M.

Female genitalia. Copulatory papilla drop-shaped, sclerotized, as in Figs. 3C–E.

Phylogenetic relationships. *Marcgraviella*, **n. gen.** belongs to a group of genera including *Aracamby*, *Cacruzia*, *Izecksohniella*, *Marliella,* and *Vanzoliniella*, based on the structure of male genitalia. This cluster of genera is characterized by the phallic glands within the pseudepiphallic sclerite, the development of a pair of tubular pseudepiphallic arms associated to these glands and the partly membranous and sclerotized pseudepiphallic parameres. Using wide scale observations of male genitalia, one of us (PSD) proposed to name this group of genera, the Aracambiae Souza-Dias. Phylogenetic studies, based on morphological and molecular characters, are presently undertaken to define a wide evolutionary frame to study the evolution of genitalia in this clade.

The occurrence of distal projections arising from the pseudepiphallic sclerite, the pseudepiphallic arms (referred as pseudepiphallic spines by de Mello & de Andrade 2003; Bolfarini & de Mello 2012; de Mello *et al.* 2013), is widespread within the group C of Luzarinae. While in the Aracambiae group they are tubular and connected to phallic glands, in more distant related genera as *Eidmanacris*, *Strinatia*, *Endophallusia* de Mello, 1990, *Ottedana* de Mello & de Andrade, 2003, *Adenopygus* Bolfarini & de Mello, 2012, and *Bambuina* de Mello, Horta & Bolfarini, 2013, they have different patterns, usually being enlarged toward the apex, laminar or rod-shaped, and not linked to phallic glands (de Mello & de Andrade 2003; de Mello *et al.* 2013).

Among the Aracambiae group, other general morphology characters are shared as the small and slender body, elongation of legs, mainly the posterior, and the reduction of male FWs. The stridulatory vein is present in *Aracamby*, *Cacruzia*, *Vanzoliniella*, and *Marcgraviella* **n. gen.** and absent in *Izecksohniella* and *Marliella*. *Marcgraviella* **n. gen.** shares with *Cacruzia* and *Vanzoliniella* the shape and aspect of the FWs, being thin, hard, and not strongly coriaceous; also, tympanum is present on the inner side of foretibia only. The presence of rounded projections in the metanotum is shared by *Marcgraviella* **n. gen.**, *Cacruzia*, and *Marliella*, and the presence of vestigial tegmina in adult females is shared by all genera except *Cacruzia.*

Regarding the general morphology, the genera of the Aracambiae group are very similar. These genera can

only be separated using a combination of general morphology and male genitalia characters, with the latter being the main character to define and separate the genera (see key below).

The monophyly of *Marcgraviella* **n. gen.** can be ascertained by the pattern of the pseudepiphallic parameres, with at least two well developed and partially sclerotized lobes, with membranous, inflatable areas.

***Marcgraviella muriciensis* Souza-Dias, n. sp.**
Figures 1–3

Type locality. Brazil, Alagoas State, Murici municipality. Estação Ecológica de Murici.

Type material: Holotype: Brazil, Alagoas, Murici, Estação Ecológica de Murici, Mata das Bananeiras, 1 male, 26–29.vii.2012, Souza-Dias, P.G.B., Costa, C.S., Alcantara, D.M. and Nihei, S.S. *coll*. (MZSP) **Allotype**: same data as the holotype (MZSP). **Paratypes. 4 females.** Brazil, Alagoas, Murici, Estação Ecológica de Murici, Mata da UFAL – Estação Serra do Ouro, 2 females, 26–29.vii.2012, Souza-Dias, P.G.B., Costa, C.S., Alcantara, D.M. and Nihei, S.S. *coll*.; same collectors as the holotype, Brazil, Alagoas, Satuba. Área de Proteção Ambiental do Catolé, 1 female, 25.vii.2012; same data as the holotype, 1 female (MZSP).

Other specimens examined: Same collectors and dates as the holotype: Brazil, Alagoas, Murici, Estação Ecológica de Murici, Mata da UFAL – Estação Serra do Ouro, 2 females; same data as the holotype, 4 juveniles; same collectors as the holotype, Brazil, Alagoas, Satuba, Área de Proteção Ambiental do Catolé, 2 juveniles, 25.vii.2012 (MZSP).

Etymology. Specific epithet refers to Murici, type locality of this species.

Diagnosis. Within the genus, *M. muriciensis* Souza-Dias, **n. sp.** can be recognized by the following characters: male FWs reaching the fifth tergite, dorsal venation inconspicuous, stridulatory file with 17 teeth; male genitalia: pseudepiphallic parameres well developed, almost vertical, formed by two membranous lobes and partially scletorized. Female with short, not overlapping FWs; copulatory papilla as on Fig. 3C–E; ovipositor shorter than FIII.

Description. In addition to the characters of the genus:

Head: Occiput medium brown, with bristles (Fig. 1C). Vertex and fastigium light brown with thick bristles, mainly on its median part (Figs. 1A, C). Eyes with unpigmented area on supero-internal margin (Fig. 1C, F). Antennal scape medium brown (Figs. 1A–C). Antenomeres medium to dark brown, with interspersed light brown antenomeres; generally few lighter and several darker ones. Fastigium longer than wide, below vertex level (Figs. 1C, D, E). Head dorsum with a wide ivory band between the eyes, surrounding the lateral ocellus, circling the eyes, and reaching the mandible from the distal part of the lower angle of the eyes (Figs, 1 D–F). Mandible dark brown with medium brown spots (Figs, 1D, E). In frontal view, frons with a light brown stripe between two dark brown bands; presence of a light brown band going from the basis of each antennal scape to the clypeus. Clypeus light brown on a dark brown background. Labrum light brown. Maxillary palpi light brown; distal portion of fifth joint light brown, its apex whitish (Figs. 1E, F).

Thorax: Disk of pronotum with several sparse, small dark spots on a medium brown background, darkening towards lateral borders; presence of hard bristles, mainly on cephalic margin (Figs. 1A, C). Cephalic margin almost straight; caudal margin slightly convex (Figs. 1A, C). Lateral lobes dark brown.

Legs: Legs I and II light brown. Femur II light brown on its proximal part to medium brown on distal part; tibia II medium brown. Proximal part of inner face of posterior femur whitish to brown towards the distal part. Posterior legs very elongated, twice longer than the body length. Posterior femur thin and elongated, the ventral portion whitish and the dorsum light brown on outer face (Fig. 1N). Posterior tibia medium brown, serrulated (Fig. 1O). Subapical spurs: four subapical spurs on each face, the distal one smaller on both faces; on inner face, distal spur located near the upper apical spur. Apical spurs more developed on inner face; inner and outer apical spurs: median one longer, dorsal sub-equal in length, ventral one smaller (2>3>1) on both faces (Fig.1O). Basitarsus elongated, bearing a double file of spines and two apical spurs, same color as tibia.

Abdomen: Abdomen medium brown, whitish in the area below tegmina (Fig. 1A). Sternites dark brown. Cerci medium brown. Supra anal plate shield-shaped; anterior margin slightly concave, lateral ones constricted on median portion and posterior one rounded (Fig. 1H). Subgenital plate wider than long, medium to dark brown; anterior margin concave and posterior one rounded with a bilobate apex (Fig. 1J).

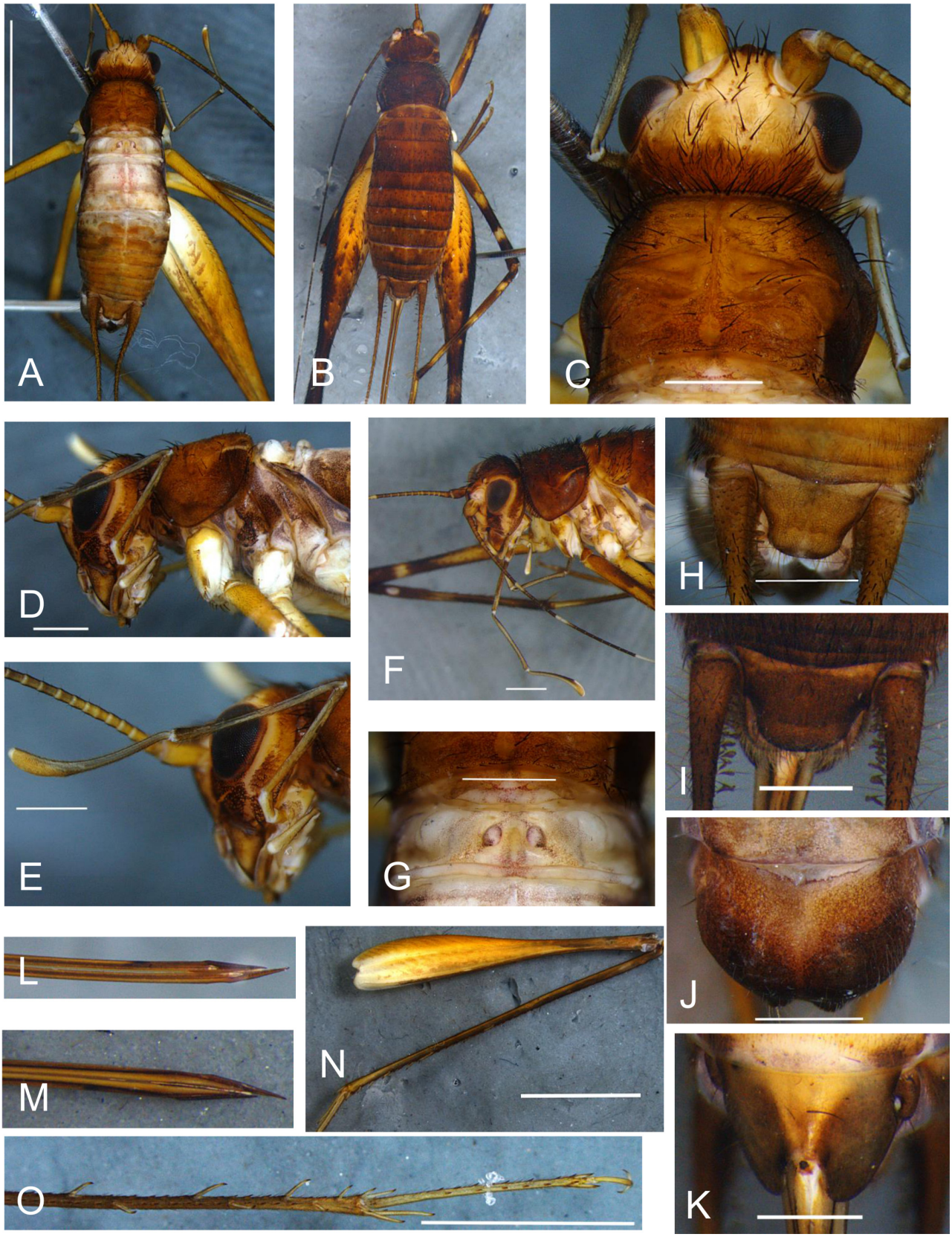

FIGURE 1. *Marcgraviella muriciensis* Souza-Dias, **n. sp.** Holotype and allotype. A, male habitus, dorsal; B, female habitus, dorsal; C, male head and pronotum, dorsal; D, male head, pronotum and metanotum, lateral; E, maxillary palpus, lateral; F, female head, pronotum, maxillary palpus, lateral; G, male metanotum, dorsal; H, male supra anal plate; I, female supra anal plate; J, male subgenital plate; K, female subgenital plate; L–M, ovipositor, dorsal, ventral; N, male hind femur; O, male hind tibia and basitarsus. Scale bar: 5mm (A, N, O), 1mm (C–K).

Male. Tegmina not coriaceous, thin, reaching the fifth tergite; dorsal venation inconspicuous (Fig. 2D); stridulatory file with 17 teeth; no other specialized areas are present in the right wing; left wing membranous, semi-transparent.

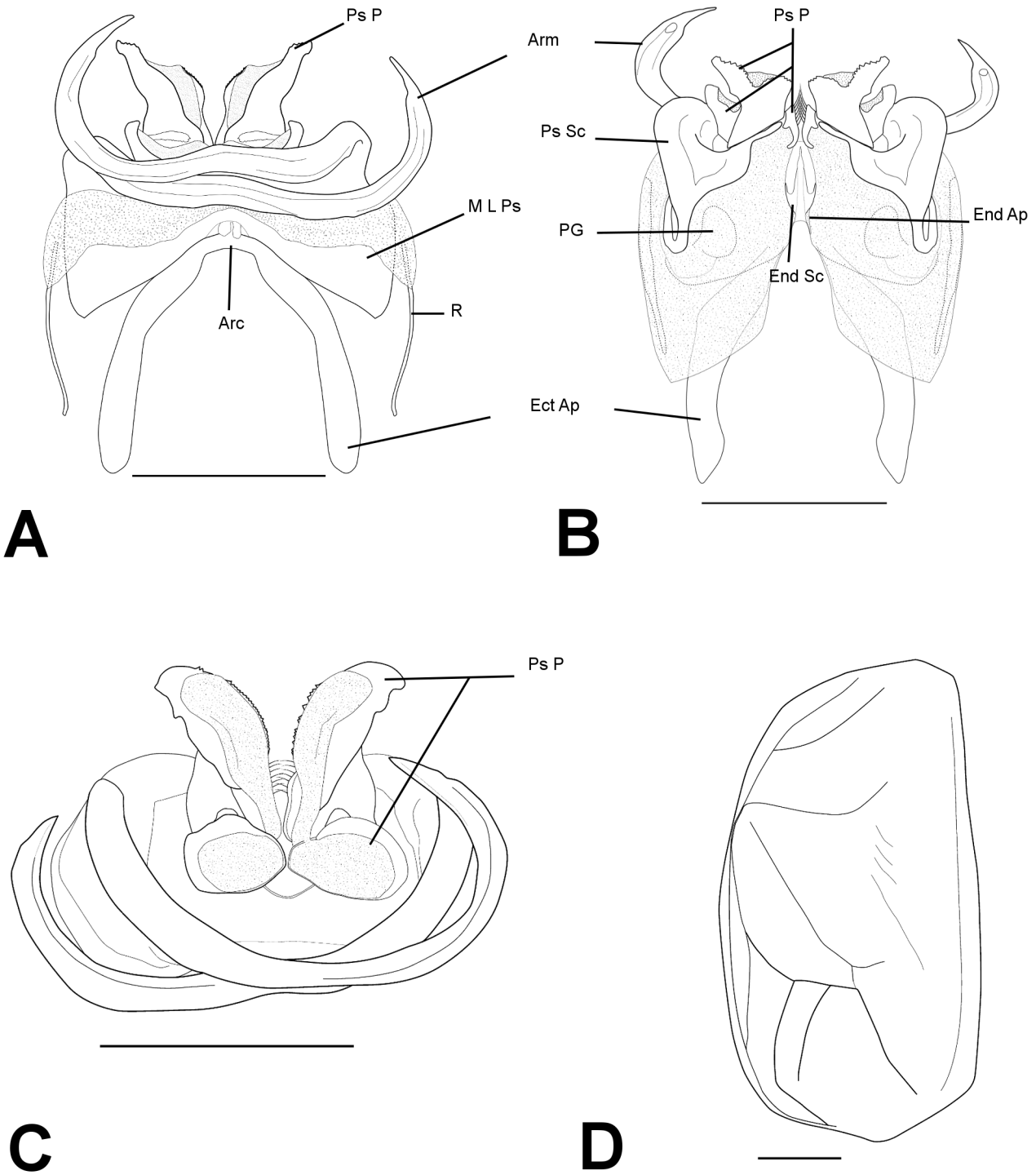

FIGURE 2. *Marcgraviella muriciensis* Souza-Dias, **n. sp.** Male holotype. A–C, male genitalia in dorsal (A), ventral (B), and apical view (C); D, dorsal field of male FW. Abbreviations, see page 500. Scale bar: 1mm.

Male genitalia. Bearing phallic glands within the pseudepiphallic sclerite (Figs. 2B, 3B). Pseudepiphallic sclerite garnished with two dorsal tubular pseudepiphallic arms, with an apical opening duct; its distal half curving towards the apical part of the phallic complex and its apex pointed, without teeth (Figs. 2A–C, 3A–B). Pseudepiphallic arms opposite, crossing each other in the median part of the pseudepiphallic sclerite (Figs. 2A, 3A). Pseudepiphallic parameres well developed, almost vertical, developing two membranous lobes (basal concave

and apical elongated) and partially sclerotized: the sclerotization limited to borders (in dorsal view) and ventral part of the parameres (Figs. 2A–C, 3A–B). Endophallic sclerite located deep in a median ventral slit, with low sclerotization and extending until the basis of the pseudepiphallic parameres (Fig. 2B). Endophallic sclerite with a wide sclerotized lateral projection, forming the wall of the slit and separating the endophallic sclerite from the membranous and glandular area of the phallic complex (Fig. 3B).

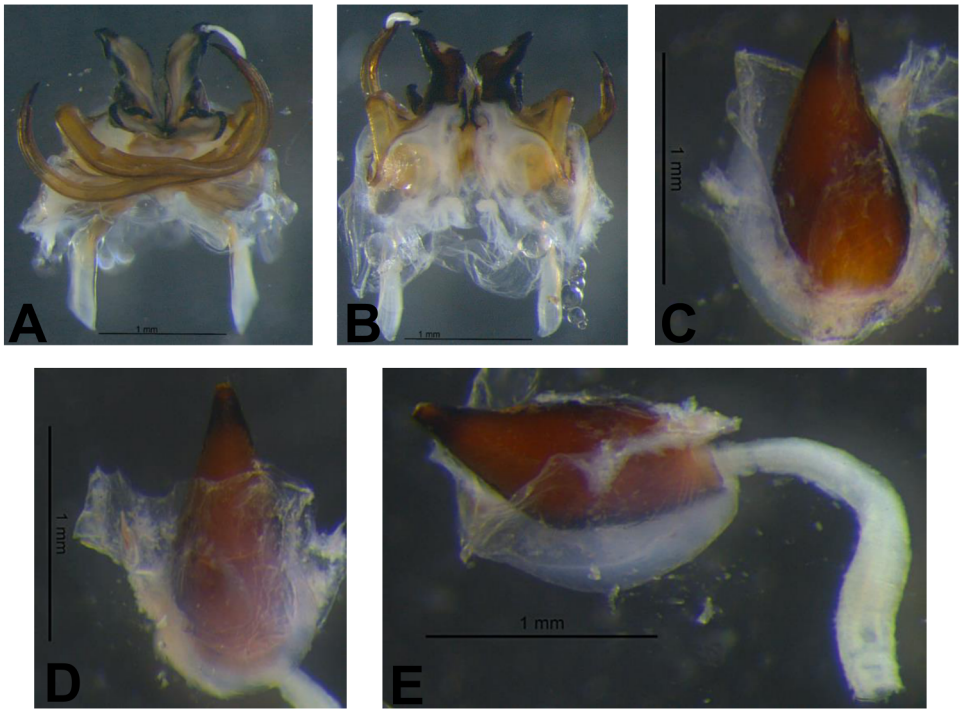

FIGURE 3. *Marcgraviella muriciensis* Souza-Dias, **n. sp.** Holotype and allotype. A, B, male genitalia in dorsal and ventral view; C–E, female copulatory papilla in dorsal (C), ventral (D), and lateral view (E). Scale bar: 1mm.

Female: Larger than male (Fig. 1B). Dorsum of the head and disk of pronotum covered by pilosity and bristles (Figs. 1B, F). General coloration darker than male, mainly the head and disk of pronotum (Figs. 1B, F); all legs darker than male's legs, banded with light brown and medium brown stripes (Fig. 1B). Abdomen pilose, medium to dark brown (Fig. 1B). Tegmina very reduced, vestigial. Supra anal plate same as male (Fig. 1I). Subgenital plate small, posterior margin bilobate (Fig. 1K). Ovipositor as in Figs. L, M.

Female genitalia. Copulatory papilla drop-shaped, sclerotized, as in Fig. 3C–E.

Measurements (in mm). Male (n=1)**:** BL, 10.15; Hw, 2.9; iod, 1.5; Lpron, 1.2; awpron, 2.4; pwpron, 2.8; LFW, 5.9; wFW, 3.4; LFIII, 13.8; wFIII, 2.38; LTIII, 17.3; wTIII, 0.4; LtarsI-III, 5.39.

Females (n=6): BL, 16.97 (16.34 – 18.41); Hw, 3.69 (3.35 – 4.15); iod, 1.71 (1.3 – 1.9); Lpron, 2.28 (1.9 – 2.6); awpron, 3.16 (2.4 – 3.6); pwpron, 4.14 (3.5 – 4.8); LFIII, 17.5 (13.96 – 19.84); wFIII, 3.57 (2.3 – 4.36); LTIII, 18.79 (15.39 – 22.85); LtarsI-III, 5.42 (4.44 – 6.66); OL, 15.71 (13.17 – 17.4).

Acoustic behaviour. Not documented.

Habitat. *Marcgraviella muriciensis* Souza-Dias, **n. sp.** has been collected at night in leaf litter and the specimens were observed next to small cavities at ground level.

Marcgraviella christianae **Desutter-Grandcolas & Souza-Dias, n. sp.**
Figures 4–5

Type locality. Brazil, Pernambuco State, São Lourenço da Mata municipality, Estação Ecológica Tapacura.

Type material: Holotype: Brazil, Pernambuco, São Lourenço da Mata, Estação Ecológica Tapacura, 1 male, 05-07.vii.1990, C. Amedegnato & S. Poulain, rec. (MNHN-EO-ENSIFXXXX). Molecular sample LDG 471.

Etymology. Species named after the French Orthopterist Christiane Amedegnato, for her work on Neotropical Orthoptera.

Diagnosis. Morphology and coloration very similar to *M. muriciensis* Souza-Dias, **n. sp.** The main differences are the longer FWs in male, almost reaching the anterior margin of supra anal plate (Fig. 4D), their more complete and clear venation (Fig. 5E), the stridulatory file (26 teeth), the subgenital plate of the male (Fig. 4F), the median structure on tergite 3 (glandular ?, Fig. 4C) and the phallic complex (pseudepiphallic parameres vertical, and not dorsal as in *M. muriciensis* Souza-Dias, **n. sp.**, and with an additional inflatable lobe; Fig. 5D). Female unknown.

Description. In addition to the character of the genus: Palpi lacking in the holotype. TIII inner serrulation: no spine between the apical and the first subapical spur and between subapical spurs 1 and 2; 3 spines between spurs 2 and 3; 7 spines between subapical spurs 3 and 4; 15-17 (mean 16) spines above subapical spur 4. TIII outer serrulation: no spine between apical and subapical spurs; 2-3 (mean 2.5) spines between subapical spurs 1 and 2; 4 spines between subapical spurs 2 and 3; 8-10 (mean 9) spines between subapical spurs 3 and 4; 12-14 (mean 13) spines above subapical spur 4. Tarsomeres III: 7-8 (male, mean 6.5) outer and 4-5 (mean 4.5) inner spines, in addition to apical spines.

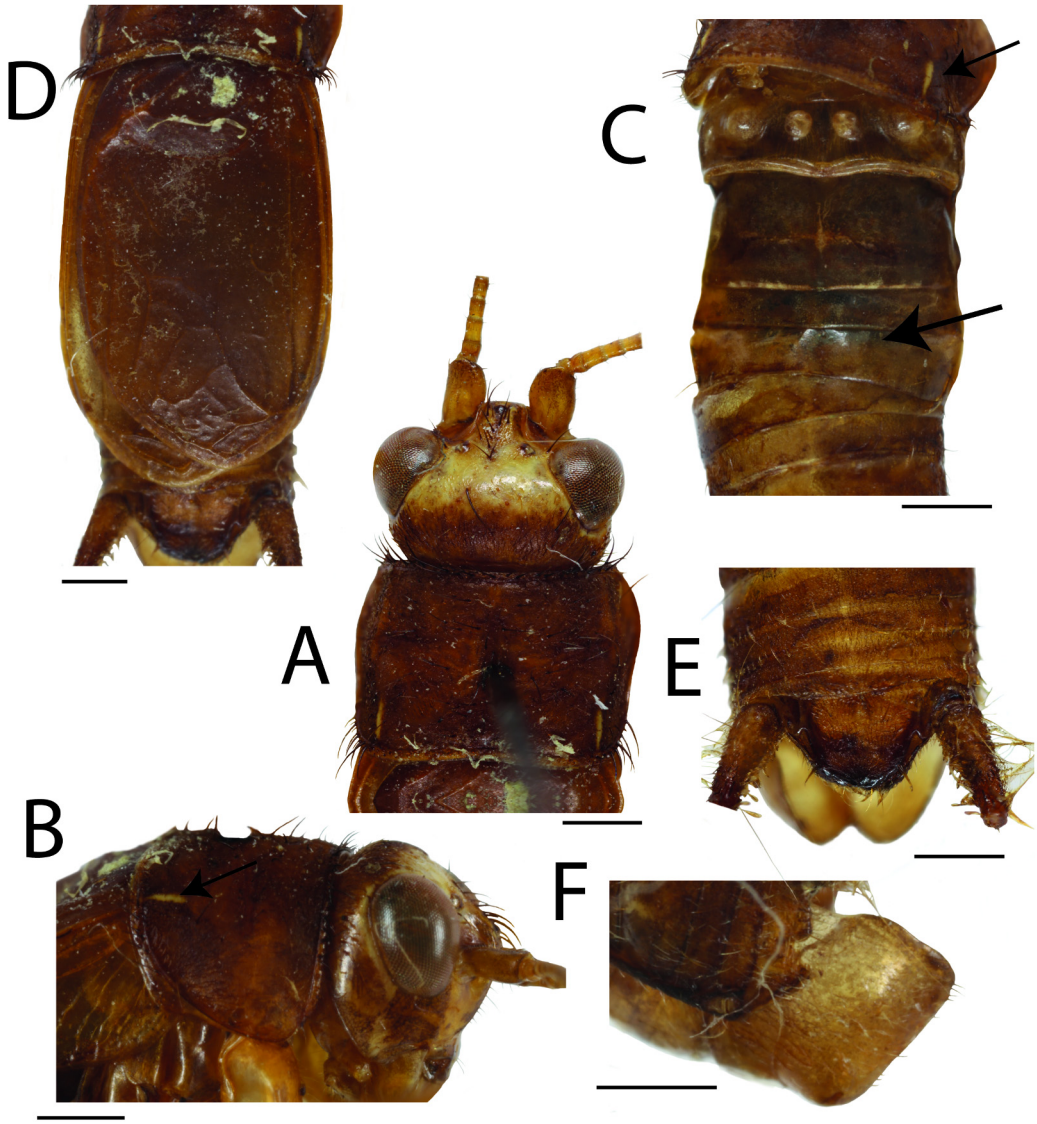

FIGURE 4. *Marcgraviella christianae* Desutter-Grandcolas & Souza-Dias, **n. sp.** Male holotype. A–B, head and pronotum, dorsal (A) and lateral (B); C, particular structures of tergite 3 (wide arrow) and metanotum, and color pattern of pronotum DD (simple arrow); D, forewings, dorsal; E, supra anal plate, dorsal; F, subgenital plate, lateral. Scale bar: 1mm.

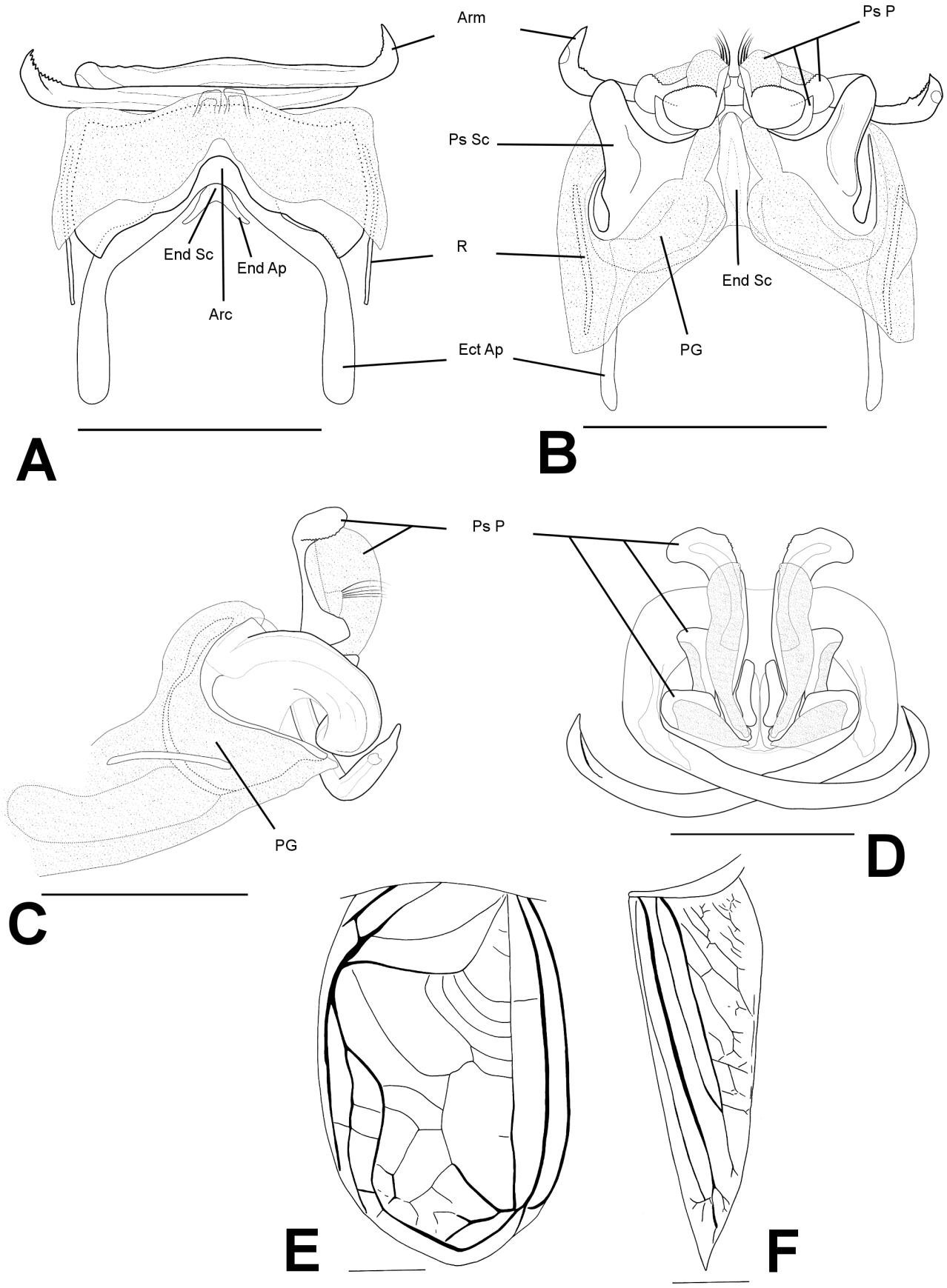

FIGURE 5. *Marcgraviella christianae* Desutter-Grandcolas & Souza-Dias, **n. sp.** Male holotype. A–D, male genitalia in dorsal (A), ventral (B), lateral (C), and apical view (D); E–F, forewing, dorsal field (E), lateral field (F). Abbreviations, see page 500. Scale bar: 1 mm.

Coloration. Very similar to that of *M. muriciensis* Souza-Dias, **n. sp.**, especially for the head dorsum (Fig. 4A) and clypeus; face light yellow with a slightly darker line from each side of median ocellus down to epistemal suture, along a light yellow line, and a light brown band from the lower margin of each eye to the epistemal suture; cheeks light brown, with an indistinct yellow spot (Fig. 4B). Scapes light yellow brown (Fig. 4A). Antennae light brown basally; with 3 distantly set, small yellow rings, before a wider yellow part covering about 10 articles. Pronotum light brown, with a small yellow line between LL and DD close to anterior margin (Fig. 4C, arrows). Tergites and sternites yellow brown, the distal margin of supra anal plate darker. Legs all light yellow brown, the knees somewhat darker; TIII spurs yellowish at base and near the brown apex.

Male. Metanotum with 2 high, ball-shaped structures with irregular surface (probably glandular), between the muscular insertions; distal margin inflated and raised (Fig. 4C). FW venation (Figs 5E, 4D): stridulum complete, with a harp and mirror, in addition to the deep set file; harp crossed by four oblique, parallel veins; apical field very reduced; area between the chords and the diagonal wide and crossed by one (or two) row(s) of cells, according to the hypothesized location of the mirror anterior angle. Stridulatory file with 26 small and high teeth, located on the horizontal part of the vein only. Lateral field (Fig. 5F): R and MA parallel along most of their length, fused distally; MA and MP broadly parallel over their whole length, connected distally by a faint, transverse vein. Tergite 3 with a median structure (Fig. 4C wide arrow, glandular ?). Supra anal plate without elongate posterior angles, but with two bunches of long setae (Fig. 4E). Subgenital plate short and high; with a deep longitudinal furrow over 3/4 of its length; surface of the plate on each side of the furrow bulged, with a pair of highly convex hill-shaped structures on each side of the anterior end of the furrow (Fig. 4F).

Male genitalia: Pseudepiphallic parameres vertical (Fig. 5B, C); lobes completely visible only in posterior view (Fig. 5D); each paramere formed by an elongated inflatable lobe and two concaves smaller ones, also inflatable (Fig. 5B, D), with an additional small inflatable lobe

Female. Unknown.

Measurements (in mm). Male holotype: BL, 9.7; Hw, 2.5; ioD, 1.2; Lpron, 2; awpron, 3.2; pwpron, 2.6; LFW, 4.9; wFW, 3.1; LFIII, 11.9; wFIII, 2.4; LTIII, 12.9; LtarsI-III, 4.5.

Remarks. The alteration in the pseudepiphallic parameres, with its consequent vertical position, is only known to this moment in this species.

Acoustic behaviour. Not documented.

Habitat. Not documented.

Key to genera of the Aracambiae group

1 Male forewings: stridulatory vein present 3
- Male forewings: stridulatory vein absent 2
2 Male forewings: distal margin whitish; dorsal venation inconspicuous. Tympanum present on inner side of foretibia. Metanotum with two broad humps on its antero-lateral borders and two small rounded projections between them, probably not glandular. Phallic complex: distal half of pseudepiphallic arms curved towards the apical part of the phallic complex and its apex pointed, bearing small denticles . . . . . ***Marliella*** Mews & Mól
- Male forewings: distal margin not differentiated; dorsal venation conspicuous. Foretibia without tympanum. Metanotal glands present (*I. almeidai* Mews & Mól and *I. puri* Sperber *et al*.) or absent (*I. aimore* de Mello). Phallic complex: pseudepiphallic arms bearing a row of teeth on its apex. . . . . ***Izecksohniella*** de Mello
3 Presence of inter-segmental glands on male abdomen (visible in distended specimens). Male paraprocts with a spine (accessory clasper). Apex of male supra anal plate whitish. In addition to morphological characters: Phallic complex: pseudepiphallic arms lateral, with bifurcate apex and visible glandular opening duct; pseudepiphallic parameres medial, highly sclerotized, without inflatable areas . . . . . ***Aracamby*** de Mello
- Inter-segmental glands on male abdomen absent. Male paraprocts without spine. Apex of male supra anal plate with same color as median and anterior part. In addition to morphological characters: Phallic complex: pseudepiphallic arms opposite, crossing each other on the median part of pseudepiphallic sclerite; pseudepiphallic parameres distal, partially sclerotized and membranous, with inflatable areas 4
4 Hind femur with distinctive dark stripes. Phallic complex: pseudepiphallic glands small, reduced; pseudepiphallic arms very thin. . . . . ***Cacruzia*** de Mello
- Dark stripes of hind femur weakly pronounced or absent. Phallic complex: pseudepiphallic glands and pseudepiphallic arms well developed. 5
5 Head dorsum ivory, contrasting with the dark brown occiput. Maxillary palpi: joint 4 the longest; joint 4 and 5 brownish, only the apex of joint 5 whitish. Phallic complex: distal half of pseudepiphallic arms curved towards the apical part of the phallic complex and its apex pointed, without denticles. Pseudepiphallic parameres partially sclerotized and membranous, forming

two dorsal lobes, with well-developed inflatable areas; the sclerotization concentrated on its ventral part; pseudepiphallic parameres in a vertical or almost vertical position . . . . . ***Marcgraviella*** **n. gen.**

- Head dorsum brownish, not contrasting with the occiput. Maxillary palpi: joint 3, 4 and 5 same-sized and not particularly elongated; joint 4 and 5 whitish. Metanotal glands conspicuous and well developed, composed by two elevated protuberances. Phallic complex: apex of pseudepiphallic arms bifurcate; pseudepiphallic parameres distal but smaller than in the remaining genera, partially sclerotized and membranous, with smaller inflatable areas . . . . . ***Vanzoliniella*** de Mello

Discussion

Phallic glands are common in Luzarinae, but they occur according to different structural and probably functional patterns, which increase their evolutionary interest and significance.

The occurrence of internal spherical formations on male genitalia, probably glandular, is reported for several genera of Neotropical Luzarinae, e.g. *Amusodes* Hebard, 1928, *Arachnopsita* Desutter-Grandcolas & Hubbell, 1993, *Cophella* Hebard, 1928, *Joadis* Mews & Sperber, 2009, *Lerneca* Walker, 1869, *Longuripes* Desutter-Grandcolas & Hubbell, 1993, *Mayagryllus* Desutter-Grandcolas & Hubbell, 1993, *Prolonguripes* Desutter-Grandcolas & Hubbell, 1993, and *Grandcolasia* Koçak & Kemal, 2010 (Desutter-Grandcolas 1991(1992), 1992, 1993b, 1995, Mews *et al*. 2009, Desutter-Grandcolas 2014). These genera occur in Central America including Caribbean islands, and Amazonia.

Marcgraviella **n. gen.** belongs to a distinct cluster of Luzarinae genera, characterized by the occurrence of phallic glands within the pseudepiphallic sclerite and the development of a pair of tubular arms associated to these glands. This cluster includes *Aracamby*, *Cacruzia*, *Izecksohniella*, *Marliella* and *Vanzoliniella*, and composes the Aracambiae group (see the above key). These genera occur in the Brazilian Atlantic Forest, Cerrado and Caatinga and are not reported for the Amazon.

Among Luzarinae, the male genitalia of the Aracambiae group share a unique modification in its structure, which can be considered a putative synapomorphy of the group: the occurrence of a pair of tubular pseudepiphallic arms associated to phallic glands. The pseudepiphallic arms are curved and cross each other on the median part of the pseudepiphallic sclerite, except in *Aracamby*, where the pseudepiphallic arms are lateral and straight. The apex of the pseudepiphallic arms can be bifurcate as in *Aracamby* and *Vanzoliniella,* acting as claspers during copulation, or pointed, as in remaining genera.

In *Aracamby*, the arms hold the female papilla and release a secretion through an opening duct which is located on their apex; the secretion seals the female copulatory papilla, acting as a mating plug (for more details see de Mello 1992, 2007).

In *Cacruzia, Izecksohniella* and *Vanzoliniella*, the pseudepiphallic arms are dorsal and opposite, and so they cannot be connected to the female copulatory papilla and act as claspers (de Mello, 2007). Thus, the function of the secretions produced by the phallic glands of these genera remains unknown. Although this secretion may solidify in contact with liquids as ethanol (in preserved specimens), it cannot act as mating plugs, because there is no contact between the pseudepiphallic arms and the female copulatory papilla. These glands could rather produce pheromones and other stimulating substances directed to females (de Mello, 2007).

Marcgraviella **n. gen.** and *Marliella* present similar, curved pseudepiphallic arms, with pointed apex, directed towards the distal part of the genitalia; the apex of the pseudepiphallic arms is slightly toothed in *Marliella*, while it is smooth in *Marcgraviella* **n. gen.** The duct of the phallic gland opens in the apex of the arms and although the secretion can solidify in contact with liquids (ethanol, in this case), it apparently does not act as a mating plug. In these genera, it is hypothesized that the phallic gland also acts in the production of pheromones and/or stimulant substances for females.

Another remarkable feature of the male genitalia of the Aracambiae group is the pseudepiphallic parameres. These structures are typically clasping devices in crickets and are widely variable in Phalangopsidae. In the Aracambiae group, the pseudepiphallic parameres share a significant modification: the occurrence of both sclerotized parts and hollow, membranous parts. While in *Aracamby* they are completely sclerotized and medial in relation to the apex of the pseudepiphallic arms, in *Cacruzia, Izecksohniella, Marliella* and *Marcgraviella* **n. gen.** they are apical, well developed, and partly membranous. Dorsally, a sclerotized part is visible, which can be jagged, and another one with variable size, membranous and hollow. Ventrally, the pseudepiphallic parameres are

connected to the membranous cavity that houses the gland, and they are able to expand during copulation, probably by hydraulic pressure (de Mello & de Andrade 2003; de Mello 2007). Thus, it is possible that during copulation, the expanded portion of the pseudepiphallic parameres can increase their attachment to the female's copulatory papilla, acting like claspers.

Vanzoliniella presents smaller pseudepiphallic parameres, with the inflatable area less developed than in the other genera. The occurrence of membranous and hollow parts of pseudepiphallic parameres, probably inflatable, is also reported in more distant Luzarinae genera as *Eidmanacris* and *Ottedana* (de Mello & de Andrade, 2003).

The phallic gland is well developed in all genera, except *Cacruzia*, where it is very reduced. In this genus the pseudepiphallic arms are thin, reduced and the opening duct is not visible.

By contrast, in *Joadis*, a genus described in the Brazilian Amazon that bears phallic glands, the pseudepiphallic arms are straight, lateral and with bifurcate apex, as in *Aracamby*. *Joadis,* however, does not share the morphological features observed in the Aracambiae, mainly in the pseudepiphallic parameres, and is probably close to Amazonian genera that bear phallic glands, as *Grandcolasia*.

The function of the probably glandular internal spherical structures of other Neotropical Luzarinae taxa is unknown.

The male genitalia pattern of *Aracamby*, *Cacruzia*, *Izecksohniella*, *Marcgraviella* **n. gen.**, *Marliella* and *Vanzoliniella* has great importance in the Luzarinae systematics by the possibility of providing relevant characters to phylogenetic hypothesis. It has also a great importance in Luzarinae evolutionary biology, because several cases of convergent and parallel evolution are already documented. The occurrence of phallic glands associated to the opposite pseudepiphallic arms and inflatable pseudepiphallic parameres raises relevant questions regarding the reproductive behavior of this group of crickets, since the role of these structures in mating is unknown. Therefore, the Aracambiae brings new interesting questions and promising perspectives on systematics, reproductive biology, behavioral ecology, and natural history studies.

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References

Alexander, R.D. & Otte, D. (1967) The evolution of genitalia and mating behavior in crickets (Gryllidae) and other Orthoptera. *Museum of Zoology of the University of Michigan Miscellaneous Publications*, 133, 1–62.

Bolfarini, M.P. & De Mello, F.A.G. (2010) *Anomaloterga mantiqueirae*: a new genus and species of Strogulomorphini from the Mantiqueira fault scarpment, Brazil (Orthoptera, Phalangopsidae, Strogulomorphini). *Journal of Orthoptera Research*, 19 (1), 19–24.
http://dx.doi.org/10.1665/034.019.0104

Bolfarini, M.P. & De Mello, F.A.G. (2012) *Adenopygus*: a new genus and two new species of Luzarinae cricket of Brazilian Atlantic Forest (Orthoptera: Grylloidea). *Zootaxa*, 3303, 37–49.

Chintauan-Marquier, I., Legendre, F., Hugel, S., Robillard, T., Grandcolas, P., Nel, A., Zuccon, D. & Desutter-Grandcolas, L. (2014) Laying the foundations of evolutionary and systematic studies in crickets (Insecta, Orthoptera): a multilocus phylogenetic analysis. [submitted]

Chopard, L. (1949) Ordre des Orthoptères. *In*: Grasse, P.P. (Ed.), *Traté de Zoologie, Vol. 9*. Masson, Paris, pp. 617–722.

Chopard, L. (1956) Some crickets from South America (Grylloidea and Tridactyloidea). *Proceedings of the United States National Museum*, 106 (3366), 241–293.
http://dx.doi.org/10.5479/si.00963801.106-3366.241

Chopard, L. (1967) Pars 10: Gryllides: Fam. Gryllidae: Subfam. Gryllinae (Trib. Gymnogryllini, Gryllini, Gryllomorphini, Nemobiini). *In:* Beier, M. (Ed.), *Orthopterorum Catalogus.* Dr. W. Junk, Gravenhage, pp. 1–211.

Chopard, L. (1968) Pars 12: Gryllides: Fam Gryllidae: Subfam. Mogoplistinae, Myrmecophilinae, Scleropterinae, Cachoplistinae, Pteroplistinae, Pentacentrinae, Phalangopsinae, Trigonidiinae, Eneopterinae. Fam. Oecanthidae, Gryllotalpidae *In:* Beier, M. (Ed.), *Orthopterorum Catalogus.* W. Junk, Gravenhage, pp. 213–500.

Chopard, L. (1970) Description de Gryllides cavernicoles nouveaux. *Bulletin de la Société entomologique de France*, 75, 117–123.
De Mello, F.A.G. (1990) A new genus of phalangopsid crickets from South America (Orthoptera: Grylloidea: Phalangopsidae). *Revista de Agricultura*, 65 (2), 145–150.
http://dx.doi.org/10.2307/3503560
De Mello, F.A.G. (1992a) *Aracamby*, *Cacruzia* and *Izecksohniella*: Three new Genera of Phalangopsid Crickets from the Brazilian Coastal Forests (Orthoptera: Grylloidea). *Journal of Orthoptera Research*, 1, 50–58.
http://dx.doi.org/10.2307/3503560
De Mello, F.A.G. (1992b) A new genus of long-legged crickets from the forests of eastern Brazil (Orthoptera: Grylloidea: Phalangopsidae). *Revista de Agricultura,* 67 (2), 125–131.
De Mello, F.A.G. & Dos Reis, J.C. (1994) Substrate Drumming and Wing Stridulation Performed During Courtship by a New Brazilian Cricket (Orthoptera: Grylloidea: Phalangopsidae). *Journal of Orthoptera Research*, 2, 21–24.
http://dx.doi.org/10.2307/3503603
De Mello, F.A.G. (1995) *Microlerneca* and *Lernecopsis*: two new Brazilian genera of phalangopsid crickets related to *Lerneca* Walker, 1969 (Orthoptera, Grylloidea, Phalangopsidae). *Revista Brasileira de Entomologia*, 39 (3), 646–646.
De Mello, F.A.G. & De Andrade, M.A.B.S. (2003) *Ottedana cercalis*: a new genus and species of phalangopsid cricket from the Mantiqueira Range of southeastern Brazil (Orthoptera: Grylloidea). *Journal of Orthoptera Research*, 12 (2), 141–148.
http://dx.doi.org/10.1665/1082-6467(2003)012[0141:ocanga]2.0.co;2
De Mello, F.A.G. (2007) Female monopolization and paternity assurance in South American crickets (Orthoptera, Grylloidea): mating plugs, extra claspers and forced copulation. *Papéis Avulsos de Zoologia*, 47 (20), 245–257
De Mello, F.A.G., Horta, L.S. & Bolfarini, M.P. (2013) *Bambuina bambui*: a new genus and species of cave cricket from Brazil (Orhoptera: Grylloidea: Phalangopsidae: Luzarinae). *Zootaxa*, 3599 (1), 87–93.
http://dx.doi.org/10.11646/zootaxa.3599.1.8
Desutter, L. (1987) Structure et Évolution du Complexe Phallique des Gryllidea (Orthoptères) et Classification des Genres Néotropicaux de Grylloidea – Première Partie. *Annales de la Societé entomologique de France* (n.s), 23 (3), 189–206.
Desutter, L. (1988) Structure et Évolution du Complexe Phallique des Gryllidea (Orthoptères) et Classification des Genres Néotropicaux de Grylloidea – Deuxième Partie. *Annales de la Societé entomologique de France* (n.s), 24 (3), 343–373.
Desutter, L. (1990) *Etude phylogénétique, biogéographique et écologique des Grylloidea néotropicaux (Insectes, Orthoptères). Thèse de doctorat*. Orsay: Université Paris XI-Orsay, 347 pp.
Desutter-Grandcolas, L. (1991-1992) Nouvelles données sur les Phalangopsidae néotropicaux (Orthoptères, Grylloidea). *Bulletin de la Société entomologique de France*, 96 (5), 451–461.
Desutter-Grandcolas, L. (1992) Les Phalangopsidae de Guyane française (Orthoptères, Grylloidea): systématique, elements de phylogénie et de biologie. *Bulletin du Muséum national d'Histoire naturelle,* 14, 93–177. [4 series., section A, n1]
Desutter-Grandcolas, L. (1993a) *Luzarida* Hebard, 1928 et genres affines: genres nouveaux, phylogénie et scénarios (Orthoptera, Grylloidea, Phalangopsidae, Luzarinae). *Revue Française D'Entomologie* (n.s.), 15 (4), 169–182.
Desutter-Grandcolas, L. (1993b) The cricket fauna of Chiapanecan caves (Mexico): systematics, phylogeny and the evolution of troglobitic life (Orthoptera, Grylloidea, Phalangopsidae, Luzarinae). *International Journal of Speleology*, 22, 1–82.
http://dx.doi.org/10.5038/1827-806x.22.1.1
Desutter-Grandcolas, L. (1993c) *Melanotes*, n. gen., et *Koilenoma* n. gen., deux genres de Luzarinae à écologie nouvelle pour la sous-famille (Orthoptera, Grylloidea, Phalangopsidae). *Bulletin de la Société entomologique de France*, 98 (3), 275–286.
Desutter-Grandcolas, L. (1995) Toward the Knowledge of the Evolutionary Biology of Phalangopsid Crickets (Orthoptera: Grylloidea: Phalangopsidae): Data, Questions and Evolutionary Scenarios. *Journal of Orthoptera Research*, 4, 163–175.
http://dx.doi.org/10.2307/3503472
Desutter-Grandcolas, L. (1996) *Leptopsis* nouveau nom pour *Stenotes* Desutter-Grandcolas (Orth., Grylloidea). *Bulletin de la Société entomologique de France*, 101 (5), 507–507.
Desutter-Grandcolas, L. (2003) Phylogeny and the evolution of acoustic communication in extant Ensifera (Insecta, Orthoptera). *Zoologica Scripta*, 32, 525–561.
http://dx.doi.org/10.1046/j.1463-6409.2003.00142.x
Desutter-Grandcolas, L. (2014) New taxa and data for Neotropical Phalangopsidae (Orthoptera, Grylloidea). *Zootaxa*, 3866 (3): 398–420.
Eades, D.C., Otte, D., Cigliano, M.M. & Braun, H. (2014) Orthoptera Species File. Version 5.0/5.0. Available from: http://orthoptera.speciesfile.org/ (accessed 29 June 2014)
Gorochov, A.V. (2007) Taxonomic study of Mexican Phalangopsinae (Orthoptera: Gryllidae). *Zoosystema rossica*, 16, 177–200.
Gorochov, A.V. (2012) New and Little Known Phalangopsinae (Orthoptera, Gryllidae): 7. Neotropical Taxa of the Tribes Paragryllini and Luzarini. *Entomological Review*, 92 (1), 68–82.
http://dx.doi.org/10.1134/s0013873812010071
Gorochov, A.V. (2014) Classification of the Phalangopsinae subfamily group, and new taxa from the subfamilies Phalangopsinae and Phaloriinae (Orthoptera: Gryllidae). *Zoosystematica Rossica*, 23 (1), 7–88.
Hebard, M. (1928a) The Group Luzarae (Orthoptera: Gryllidae). *Transactions of the American Entomological Society*, 54, 1–56.

Hebard, M. (1928b) Studies in the Dermaptera and Orthoptera of Colombia. Orthopterous Family Gryllidae. *Transactions of the American Entomological Society*, 54, 79–124.

Koçak, A.O. & Kemal, M. (2008) Replacement names among the genus and family group taxa in Orthoptera. *Miscellaneous Papers*, 141, 1–5.

Koçak, A.O. & Kemal, M. (2010) Nomenclatural notes on the genus group names of some families (Orthoptera). *Priamus*, 12 (6), 155–156.

Mews, C.M. & Sperber, C.F. (2008) A new species of *Endecous* Saussure, 1878 and redescription of *Endecous cavernicolus* Costa-Lima, 1940 (Orthoptera: Grylloidea: Phalangopsidae). *Studies on Neotropical Fauna and Environment*, 43 (2), 159–167.
http://dx.doi.org/10.1080/01650520701492389

Mews, C.M., Mól, A.B. & Sperber, C.F. (2009) Crickets with phallic glands: two new genera and one new species of Brazilian Luzarinae (Grylloidea: Phalangopsidae). *Zootaxa* 2292, 34–48.
http://dx.doi.org/10.1080/01650521.2010.524535

Mews, C.M., Szinwelski, N. & Sperber, C.F. (2010) A new genus and new species of Brazilian Luzarinae crickets (Grylloidea: Phalangopsidae). *Studies on Neotropical Fauna and Environment*, 45 (3), 159–174.
http://dx.doi.org/10.1080/01650521.2010.524535

Otte, D. & Alexander, R.D. (1983) *The Australian Crickets (Orthoptera: Gryllidae).* Academy of Natural Sciences of Philadelphia, Monograph 22, 477 pp.

Rehn, J.A.G. (1901) Some necessary changes and corrections in names of Orthoptera. *The Canadian Entomologist*, XXXIII (10), 271–272.
http://dx.doi.org/10.4039/ent33271-10

Saussure, H. (1877-1878) *Mélanges Orthoptérologiques*. *Mémoires de la Société de Physique et D'Histoire Naturelle de Geneve*, VIme fascicule, Tome XXV, seconde partie, 705 pp.

Souza-Dias, P.G.B., Bolfarini, M.P., Nihei, S.S. & De Mello, F.A.G. (2014) *Endecous apterus*: a new species of cave cricket from northeast Brazil, with comments on the use of subterranean habitats by Luzarinae crickets (Orthoptera: Grylloidea: Phalangopsidae: Luzarinae). *Zootaxa*, 3784 (2), 120–130.
http://dx.doi.org/10.11646/zootaxa.3784.2.2

Walker, F. (1869) *Catalogue of the specimens of Dermaptera Saltatoria and supplement to the Blattariae in the collection of the British Museum*. British Museum (Natural History), London, 224 pp.
http://dx.doi.org/10.5962/bhl.title.28190