

Description of anomalies in sand flies of the genus *Sciopemyia* (Diptera, Psychodidae, Phlebotominae)

Descrições de anomalias em flebotomíneos do gênero Sciopemyia (Diptera, Psychodidae, Phlebotominae)

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Abstract

The taxonomy of sand flies (Diptera, Psychodidae, Phlebotominae) is based on morphological and morphometric characters, for which anomalies have already been reported. These can occur in different structures, such as antennae, palps, legs, wings, and the genitalia of both sexes. Therefore, given the importance of this group of insects in public health, it is necessary to describe them, avoiding errors in identification, description of the new species, or reports of distribution of erroneous forms. Thus, the present study describes different types of morphological anomalies detected in species of the genus *Sciopemyia*. Specimens deposited in biological collections and originating from field collections in different Brazilian states were analyzed. In total, 16 specimens of the genus (15 males and 1 female) with some type of anomaly were detected. The researchers in the group should be aware of these morphological variations, document them, and deposit these anomalous specimens in biological collections for consultation and future taxonomic studies.

Keywords: Anomaly, Insects, Morphology, Taxonomy

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Resumo

A taxonomia de flebotomíneos (Diptera, Psychodidae, Phlebotominae) é fundamentada em caracteres morfológicos e morfométricos, para os quais anomalias já foram relatadas. Estas podem ocorrer em diferentes estruturas, como antenas, palpos, pernas, asas e nas genitálias de ambos os sexos. Assim, torna-se necessário descrevê-las, visto a importância em saúde pública desse grupo de insetos, evitando erros de identificação, descrição de novas espécies ou relatos de distribuição de formas equivocadas. Assim, o presente estudo descreve diferentes tipos de anomalias morfológicas detectadas em espécies do gênero *Sciopemyia*. Espécimes depositados em coleções biológicas e procedentes de coletas de campo de diferentes estados brasileiros, foram analisados. Ao todo, foram detectados 16 espécimes do gênero (15 machos e 1 fêmea) com algum tipo de anomalia. Os estudiosos do grupo devem estar atentos a essas variações morfológicas, documentá-las e depositar esses espécimes anômalos em coleções biológicas para consulta e estudos taxonômicos futuros.

Palavras-chave: Anomalia, Insetos, Morfologia, Taxonomia

Introduction

Historically, the taxonomy of sand flies has been based on morphological characters and linear morphometry (Andrade et al., 2020). The identification of some species belonging to certain genera or groups of species has some limitations, such as the inability to identify morphologically identical specimens, the so-called cryptic species, to a specific level (Struck et al., 2018; Souza-Paula et al., 2020). In addition, the laborious processes of clarification and mounting of these insects make identification difficult, as some structures are difficult to visualize and/or may be lost (Rodrigues & Galati, 2023).

Another factor that may influence the taxonomy of the subfamily Phlebotominae is the presence of morphological anomalies (Cutolo et al., 2009), which have already been reported in the literature for different species of sand flies (Andrade Filho et al., 2004; Srinivasan et al., 2012; Chemkhi et al., 2015; Santana et al., 2020). Anomalies occur in different structures, such as antennae, palps, legs, thorax, wings, and genitalia of both sexes and may eventually cause erroneous identifications, leading to the incorrect description of a new species and consequent increase in synonymous lists (Andrade et al. 2013, Miranda et al., 2021). In males, the most common alterations are in the number of gonostyle spines (Léger et al. 1982; Feliciangeli, 1985). In females, the anomalies commonly observed are the reduction in the number of teeth in the cibarium (Parrot & Habibi, 1946; Léger

et al., 1982; Feliciangeli, 1985). Other anomalies can be found in both sexes, such as changes in the legs (Ortiz, 1963) and in the venation of the wings (Marcondes, 1999). Among these, gynandromorphism is a condition in which both sexual characteristics are expressed in the same individual, which has also been observed in sand flies (Chaniots, 1971; Gállego et al., 1991; Souza et al., 2008).

Recently Chaves Júnior et al. (2022a) described four new species of the genus *Sciopemyia* Barretto, 1962, characterized as having four spines on the gonostyles, which is now composed of 12 species. For this genus, morphological anomalies have been documented only in males of the species *S. sordellii* (Young & Morales, 1987, Cutolo et al., 2009). The types and frequencies of these abnormalities are important for correct identification, but their origin and meaning are not yet known (Feliciangeli et al., 1985).

During the review of specimens from collections and from the field, several variations were observed in different species, which will be described in the present study, since these morphological changes have important taxonomic implications.

Material and methods

The specimens were deposited in two biological collections of phlebotomine “Coleção de Flebotomíneos do Instituto René Rachou (FIOCRUZ/COLFLEB)” and; “Coleção Entomológica

do Laboratório de Entomologia em Saúde Pública da Universidade de São Paulo (LESP-USP-Phlebotominae)". Specimens from field collections in various locations in Brazil were included in the analyses and were deposited in the Parasitology Collection of the Department of Basic Pathology (ColPar/DPAT/UFPR).

For specimens in which some type of morphological anomaly was detected, drawings were made with the aid of a camera lucida coupled to a Leitz Dialux 22 optical microscope. The specific identification of the specimens was confirmed following the classification for the subfamily Phlebotominae proposed by Galati (2024). In addition, descriptions and redescriptions of the anomalous specimens were also consulted (Shannon & Del Ponte,

1927; Young & Morales, 1987; Chaves Júnior et al., 2022). Finally, a map was constructed in the QGIS program version 3.8.27 (QGIS, Development Team, Open Source Geospatial Foundation OSGeo), based on geographic data obtained from slides deposited in the biological collections visited and insects from field collections.

Results

In total, 15 anomalous male and one female specimen were found, belonging to two species of the genus *Sciopemyia*, *S. sordellii*, and *S. shimabukuroae*, from different locations in six states of Brazil (Fig.1).

Four different types of morphological anomalies

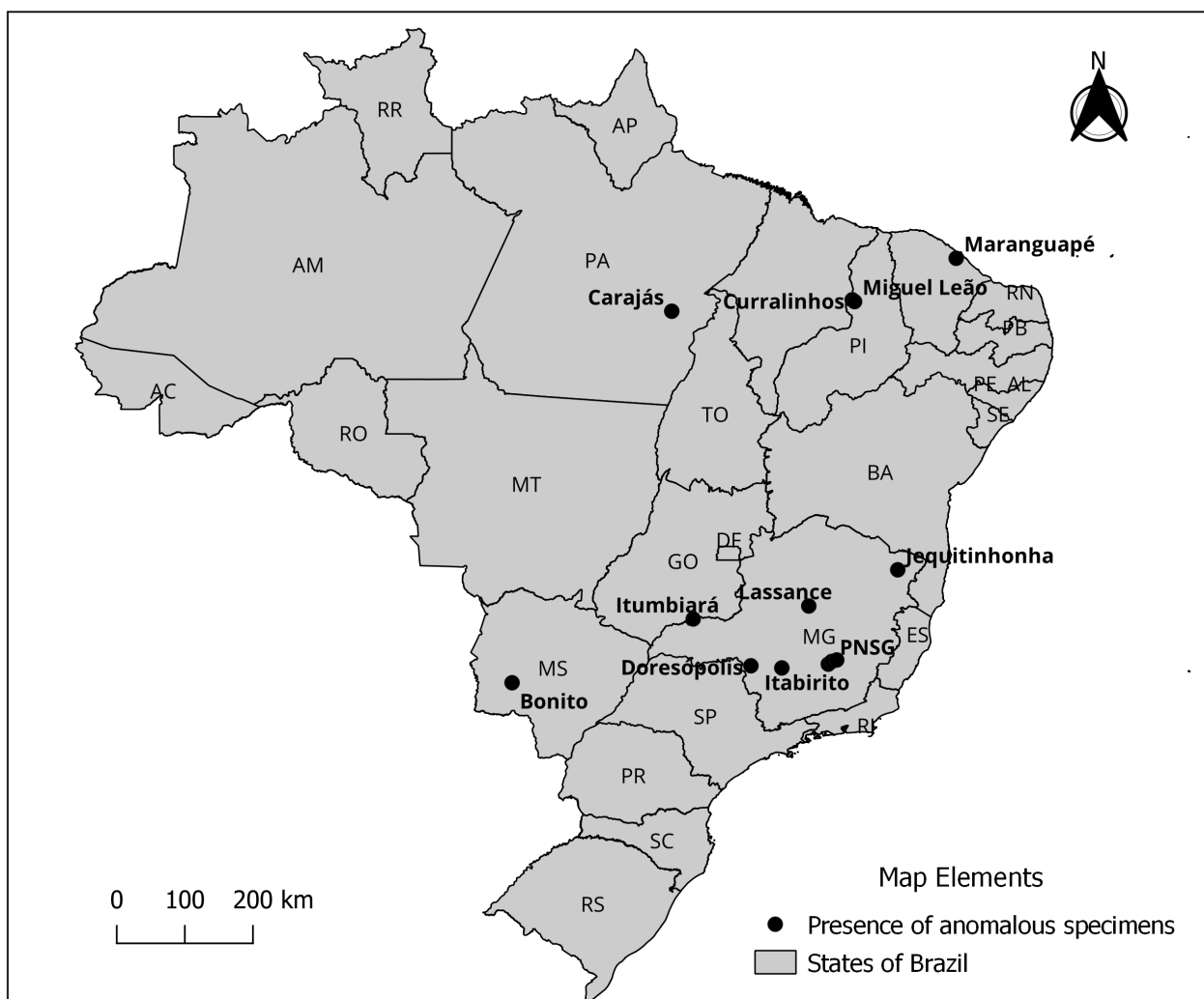


Figure 1. Geographical distribution of specimens of the genus *Sciopemyia* that present some type of anomaly.

in the genitalia of male specimens were observed, all of them present in the gonostyle: (i) a unilateral supernumerary spine in *Sciopemyia shimabukuroae* (Fig.2A) – one specimen from Doresópolis-Minas Gerais (MG); one specimen from Pains-MG and one specimen from Santa Bárbara-MG; the same anomaly was found in males of *S. sordellii* (Fig.2B) – one specimen from Itumbiara-Goiás (GO); one specimen from Maranguapé-Ceará (CE); one specimen from Curralinho-CE; one specimen from Itabirito-MG; one specimen from Jequitinhonha-MG; two specimens from Lassance-MG; two specimens from Carajás-Pará (PA). (ii) atrophied lower external spine, with a cerdiform appearance, in a male *S. sordellii* (Fig.2C) from Miguel Leão-Piauí (PI). (iii) absence of the lower external spine in both gonostyles in a male *S. sordellii* from Bonito-Mato Grosso do Sul (MS) (Fig.2D). (iv) bilateral supernumerary spine in a specimen of *S. shimabukuroae* captured in Serra do Gandarela National Park (PNSG) located in Minas Gerais (Fig.3A). In relation to females, a morphological anomaly was detected in the right wing of a specimen of *S. shimabukuroae* from the PNSG, in which the M2 and M3 veins are intercrossed (Fig.3B).

Discussion

There are several reports of morphological anomalies in species of different genera of New World (Pinto et al., 2010; Costa et al., 2012; Daboín et al., 2015) and Old World sand flies (Léger et al., 1982; Guernaoui et al., 2010; Chemkhi et al., 2015). According to Andrade-Filho et al. (2004), these may be caused by genetic or environmental factors, but their biological significance is still unknown. On the other hand, they may influence the taxonomic status of the group. For example, until the observation of the anomaly represented by five spines on one the gonostyle of *S. sordellii* by Young & Morales (1987) this species was included in the subgenus *Helcocyrtomyia* Barretto, 1962 (Barretto, 1962; Martins et al. 1978). The description of *Phlebotomus breviductus* was based in a male type specimen with the gonostyles with four spines and the other with five, the latter being an extra anomalous spine. The species was later invalidated because it was an assembly artifact (head of *Trichopygomyia* and

thorax+genitalia of *Nyssomyia*) (Andrade et al. 2013). The selective advantage, adaptation, and neutrality of a morphological anomaly are difficult to discern (Ximenes et al. 2002; Andrade-Filho et al. 2004).

Anomalies involving extranumerary spines in the gonostyle are the most common type of anomaly in males (Feliciangeli et al., 1985; Marcondes et al., 1999; Florin et al., 2010). For the genus *Sciopemyia*, two cases of anomalies in males of *S. sordellii* have already been reported in the literature. The first was by Young and Morales (1987), who, when examining the lectotype of the species, observed that the specimen had five spines on one of the gonostyles and only four on the other, arranged in an identical way to those depicted for another species, *Phlebotomus nordestinus* (Mangabeira, 1942). Since it was a previously undetected unilateral anomaly, it was considered a junior synonym of *S. sordellii* by Young and Morales (1987). The second was reported by Cutolo et al. (2009), when they captured a male of *S. sordellii* with a bilateral anomaly in the gonostyle, as it had five spines in one of the gonostyles and eight in the other, whereas males of the genus *Sciopemyia* are characterized by having only four spines in the gonostyle (Chaves Júnior et al., 2022a; Galati, 2024).

In the present study, in addition to the anomalous males of *S. sordellii* with extra numerary spines (Fig. 2B), two other types of morphological anomalies are reported for the species: a male with an atrophied lower external spine, with a cerdiform appearance (Fig. 2C) and another specimen with the absence of this same spine, in both gonostyles (Fig. 2D). No anomalies were found in the female specimens of *S. sordellii* examined. *Sciopemyia sordellii* is a species of neotropical sand fly with a wide geographic distribution, present in 12 Latin American countries, including Brazil, where it has been collected in 22 states, in different Brazilian biomes (Chaves Júnior et al., 2022b). Reporting anomalies in this species is extremely important, as they can lead to erroneous identifications, which in turn can result in mistaken conclusions about species geographic (Andrade Filho et al., 2004).

In addition to the anomalous specimens of *S. sordellii*, this article describes for the first time morphological anomalies in specimens of *S. shimabukuroae*, and is the first report of a female

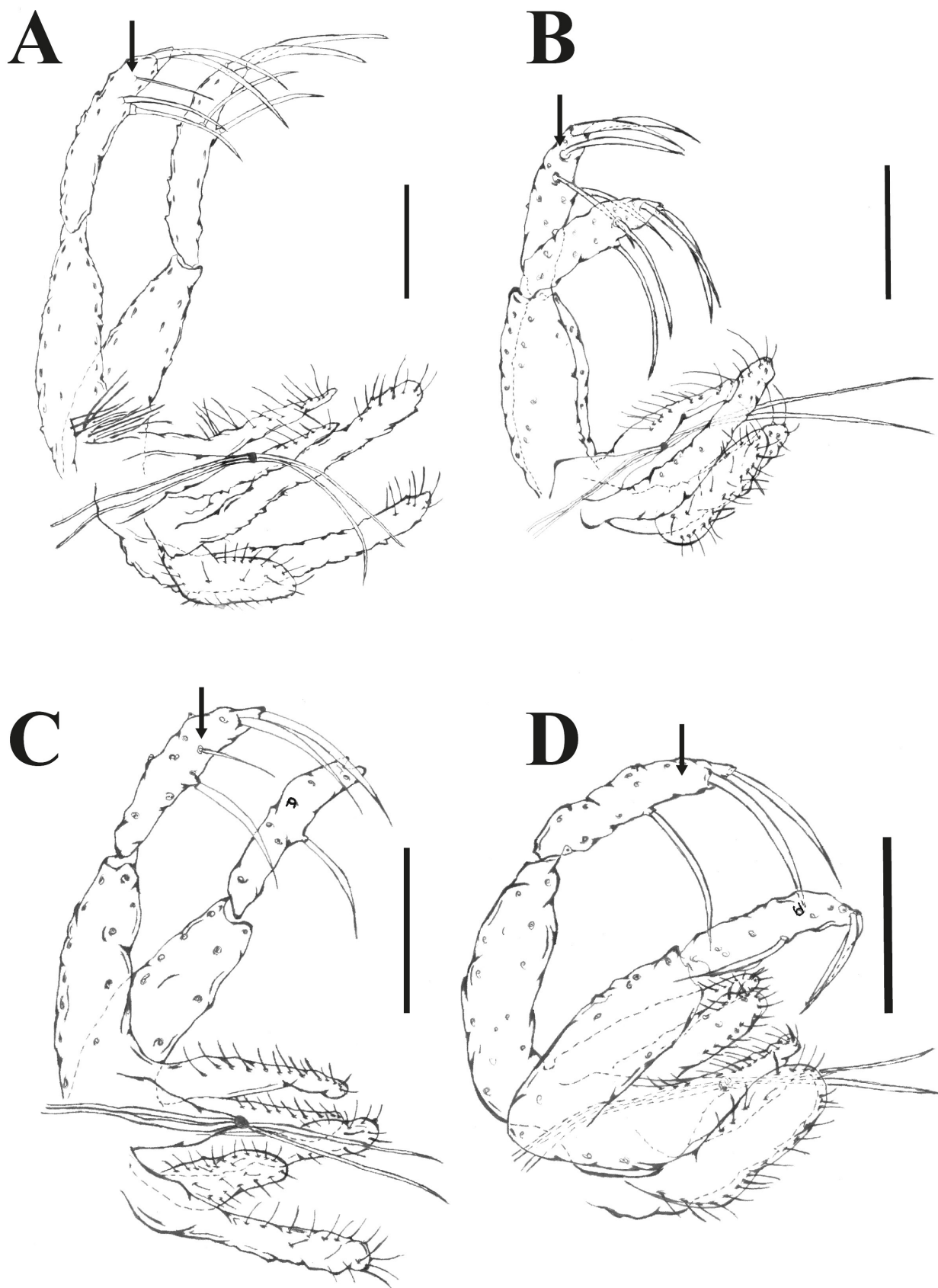


Figure 2. Anomalous genitalia of male sand flies of the genus *Sciopemyia*. Unilateral extranumerary spine in A) *Sciopemyia shimabukuroae*; B) *Sciopemyia sordellii*; C) Lower external spine cordiform in *Sciopemyia sordellii*; D) Absence of lower external spine in *Sciopemyia sordellii* (the arrow points to the anomaly described) (Bar: 100µm).

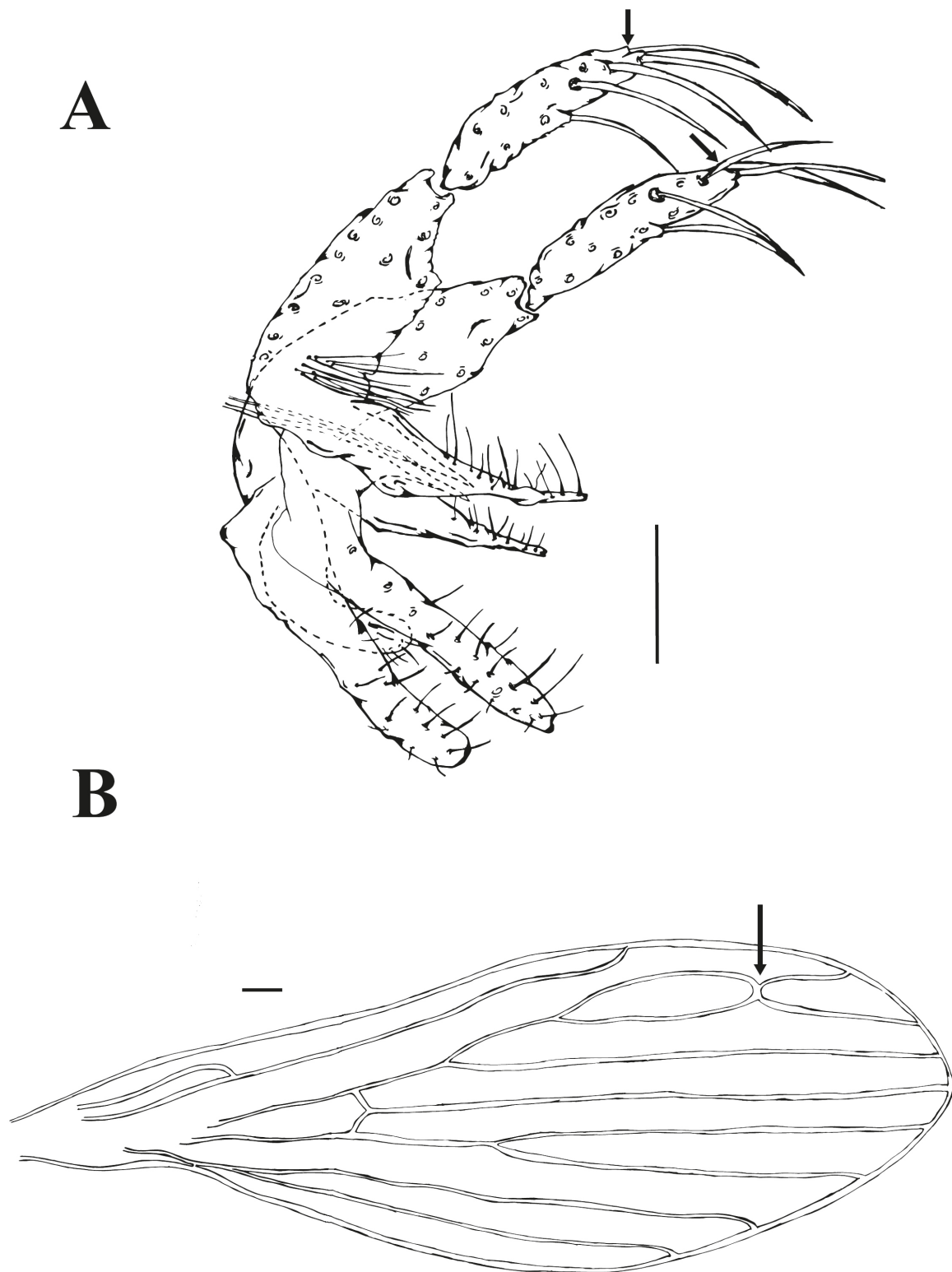


Figure 3. A) Bilateral supernumerary spines in *Sciopemyia shimabukuroae*; B) Fused wing veins in female *Sciopemyia shimabukuroae* (the arrow points to the anomaly described) (Bar: 100 μm).

of the genus *Sciopemyia* with some type of alteration in its morphology. *Sciopemyia shimabukuroae* was recently described by Chaves Júnior et al. (2022a) from specimens captured in caves in the state of Minas Gerais, Brazil. Like *S. sordellii*, little is known about the bioecology of this species, however, it has been recorded in two Brazilian states, Minas Gerais and Espírito Santo. Furthermore, Costa et al. (2021) demonstrated through molecular biology that females of *S. shimabukuroae* feed on cold-blooded vertebrates, such as the amphibian species *Bokermannohyla* (Bokerman, 1964) and *Scinax fuscovarius* (Lutz, 1925).

In males of *S. shimabukuroae*, specimens with extranumerary spines on the gonostyle were detected, unilaterally (Fig. 2A) or bilaterally (Fig. 3A). The female presented an anomaly in its wing, where the M2 and M3 veins are intercrossed (Fig. 3B). Anomalies in females are less commonly reported than in males and are generally found in the cibarium, with a reduction or increase in the number of posterior teeth (Parrot & Habibi, 1946; Leger et al., 1982, Feliciangeli et al., 1985; Daboín et al., 2015). Another morphological anomaly frequently described for female sand flies is the presence of an additional spermatheca in the specimens, which have three instead of two (Oliveira et al., 2016; Chemkhi et al., 2015).

Conclusion

This study reports different types of morphological anomalies in species of the genus *Sciopemyia*, both in males and females. Furthermore, it is observed that the occurrence of these morphological variations is independent of region or biome. However, researchers must be aware of morphological variations and document them, since failure to identify these changes as mutations may influence the geographic distribution of species and the taxonomic status of the group, leading to the erroneous description of new species or even the erroneous registration of species. Furthermore, it is important to deposit these anomalous specimens in scientific collections for consultation and future taxonomic studies.

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Contribution of the authors: Chaves Júnior, S.P.: identification, conceived and designed the analysis; collected the data; wrote the paper. Nogueira, V. L. S.: identification, description and illustration of the anomalous specimens; collected the data; wrote the paper. Shimabukuro, P. H. F.: contributed data; revised the manuscript. Andrade, A. J.: identification; conceived and designed the analysis; contributed data or analysis; wrote the paper.

Conflicts of interest

The authors declare no conflicts of interest.

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