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ORIGINAL ARTICLE

Rediscovery of *Forcipomyia* (*Trichohelea*) *opilionivora* (Lane, 1947) (Diptera, Ceratopogonidae) in Brazil after 75 years

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Abstract

The species *Forcipomyia* (*Trichohelea*) *opilionivora* (Lane, 1947) (Diptera, Ceratopogonidae) was rediscovered in the state of Rio de Janeiro, Brazil, 75 years after its original description. This study aimed to investigate the ectoparasitic relationship between *F*. (*T*.) *opilionivora* and its host and document its occurrence, which was recorded serendipitously during the collection of Opiliones (harvestmen) specimens in Parque Nacional do Itatiaia in the state of Rio de Janeiro, Brazil. After the collection, both specimens were subjected to photographic documentation and preserved for further examination. This study presents the first photographic record of the ectoparasitic relationship between *F*. (*T*.) *opilionivora* and a harvestman, shedding light on a poorly studied interaction. The host specimen was identified as a female of *Holcobunus nigripalpis* Roewer, 1910 (Opiliones, Sclerosomatidae), a gagrelline commonly found in the Atlantic Forest of southeastern Brazil. Previous records of ectoparasitism between Ceratopogonidae and harvestmen were limited to the family level (Sclerosomatidae species, specifically Gagrellinae or Leiobuninae). However, no specific host species had been identified until now. The rediscovery of *F*. (*T*.) *opilionivora*, along with the identification of its host, addresses a significant gap in our knowledge regarding the biology and distribution of this species and provides valuable insights into the intricate relationships between biting midges and arachnids. This study emphasizes the need for further investigations into the biology of these ectoparasitic species and underscores the importance of documenting and studying lesser-known interactions within ecosystems.

Keywords: Atlantic Forest; Biting-midges; Brazil; Ectoparasitism; Opiliones.

1. Introduction

Ceratopogonidae is a large family of Diptera (Insecta), comprising over 6200 extant species worldwide and highly diverse in the Neotropics (Borkent and Spinelli, 2007; Borkent and Dominiak, 2020). The hematophagous species within this group, which serve as vectors for human diseases, have been a focal point of taxonomic studies (Santarém and Felippe-Bauer, 2021). Despite the attention given to this group, there are still numerous species awaiting description, particularly those found in the Neotropical Region (Borkent, 2009). The genus *Forcipomyia* Meigen, 1818 has approximately 1150 extant species distributed into 36 subgenera (Borkent and Dominiak, 2020), this great diversity is reflected in the morphological variation within each life stage. The genus comprises numerous species that have been documented as ectoparasites of insects across multiple orders (Wirth, 1956; Tokunaga and Murachi, 1959). *Forcipomyia* (*Trichohelea*) Goetghebuer, 1920 has 61 species in total, and 13 species with neotropical distribution (Borkent and Dominiak, 2020). Out of those, only two species have been documented in Brazil (Santarém

and Felippe-Bauer, 2021). The subgenus is an important group of insect ectoparasites, with records of parasitism in Diptera, Coleoptera, Lepidoptera, Megaloptera, Neuroptera, Odonata, and Orthoptera (Wirth and Messersmith, 1971; Debenham, 1987).

The interaction between Ceratopogonidae and arachnids (Arachnida) has been poorly observed and studied, and there are few records of kleptoparasitism documented in spiders (Araneae) (Sivinski *et al.*, 1999; Marshall *et al.*, 2015; Gillung and Borkent, 2017). There are two records of ectoparasitism of *Forcipomyia* in spiders: *Forcipomyia* (*Trichohelea*) *araneivora* Clastrier and Legrand (1991) and *Forcipomyia* sp. (Clastrier and Legrand, 1991). The sole species known to exhibit ectoparasitism in harvestmen (Opiliones) is *Forcipomyia (Trichohelea) opilionivora* (Lane, 1947), although Cokendolpher (1993) recorded 'Forcipomyiinae' specimens biting *Gagrellula ferruginea* Loman, 1902 and *Nelima nigricoxa* Sato & Suzuki, 1939 in Japan. Some photographic records of arachnids with ectoparasitic biting midges can be found on digital platforms such as iNaturalist and Flickr, but these records only allow for the identifications of the biting midges at the family or genus level. Lane (1947) described *F. (T.) opilionivora* based on a solitary specimen that was collected biting the leg of a harvestman belonging to the family 'Phalangidae' [sic] (= Phalangiidae) in the state of São Paulo, Brazil. However, Lane (1947) did not specify the harvestman species that was being parasitized. While Phalangiidae is predominantly found in the Afrotropics and Palearctics, certain species have been documented in North America. Among them, a few exhibit a wide distribution and are also found in Europe. According to Cokendolpher and Holmberg (2018), no members of this family are native to Mexico, Central and South America, or the Caribbean, although there have been records of introduced or misplaced species. Probably, the host classification in the interaction described by Lane (1947) corresponds to Sclerosomatidae (Cokendolpher and Mitov, 2007), specifically in the subfamily Gagrellinae, which is now recognized as the taxonomic placement for the Neotropical species previously assigned to Phalangiidae (Crawford, 1992).

2. Material and Methods

The harvestman specimen was collected through active collecting in Parque Nacional do Itatiaia, Travessia Ruy Braga, Itatiaia, Rio de Janeiro, Brazil, at the coordinates S22°26′7.1″ W44°37′32.6″, altitude, 1207 m, on April 9th, 2019, by CCD Corrêa. The ceratopogonid specimen was observed in laboratory and later removed. It was preserved in 96 % ethanol, subsequently cleared, dissected, and mounted on microscope slides using Euparal. The specimen was deposited in the Coleção Entomológica do Museu Nacional / Universidade Federal do Rio de Janeiro (MNRJ #50014). The harvestman was fixed in 96 % alcohol and deposited in the Coleção de Artrópodes Terrestres / Universidade do Estado do Rio de Janeiro (UERJ A0285). The images were captured using a Leica M205C stereoscopic microscope with FusionOptics digital camera and edited using Adobe Photoshop®.

3. Results

The interaction between the ectoparasite and its host was photographed in the field (Fig. 1). The ceratopogonid specimen, *F. (T.) opilionivora*, was identified among the Neotropical species of the subgenus based on the following characteristics: costal vein length approximately two-thirds of total wing length, and tarsal claws simple (Fig. 2A-C) (Marino and Spinelli, 2004). The specimen was biting the femur I of the harvestman, and its removal from the host proved to be challenging. In addition to the type locality in São Paulo, a new locality record for *F. (T.) opilionivora* was reported

in the state of Rio de Janeiro. The host specimen, a female of *Holcobunus nigripalpis* Roewer, 1910, was identified by its eye mound with low spines, femur I longer than body, background body color yellow with rounded black spots on posterolateral borders of the opisthosoma (typical of females; Fig. 2D), and a considerably faint median stripe (usually present in males; Tourinho and Kury (2001); Tourinho *et al.* (2015)). The host is a gagrelline (Sclerosomatidae) commonly found in the Atlantic Forest of southeast Brazil, with documented records in several states; Minas Gerais (Rio Preto), Rio de Janeiro (Guapimirim, Nova Friburgo, Petrópolis, Resende, Silva Jardim and Teresópolis), and São Paulo (Santos and Salesópolis) (Tourinho and Kury, 2001; Tourinho *et al.*, 2015). This is the first record of *H. nigripalpis* in Itatiaia, located in the state of Rio de Janeiro.

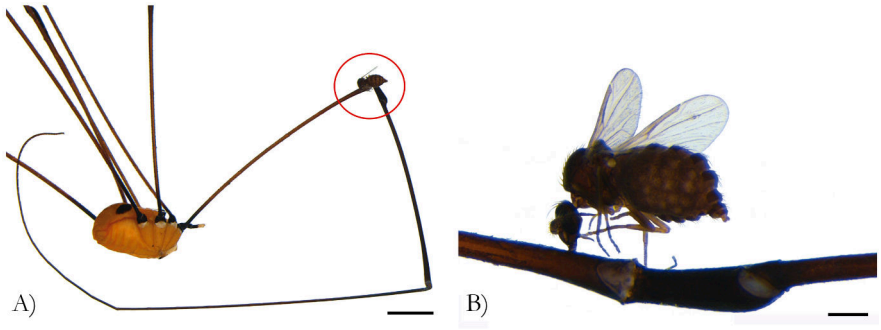

Figure 1. *Forcipomyia* (*Trichohelea*) *opilionivora* (Lane, 1947) biting *Holcobunus nigripalpis* Roewer, 1910. A – Habitus view with a red circle highlighting the ceratopogonid; B – Enlarged view of *Forcipomyia* (*Trichohelea*) *opilionivora* biting the leg of *Holcobunus nigripalpis*. Scale bars: (A) 1 mm, (B) 0.3 mm.

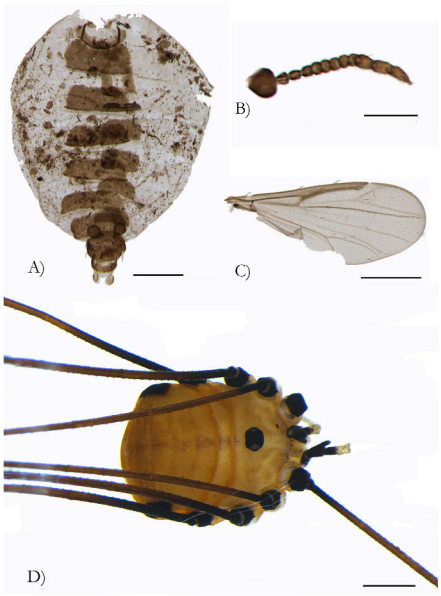

Figure 2. *Forcipomyia* (*Trichohelea*) *opilionivora* (Lane, 1947): A – Abdomen and terminalia, ventral view; B – Antenna; C – Wing. *Holcobunus nigripalpis* Roewer, 1910: D – Habitus, dorsal view. Scale bars: (A, B) 0.2 mm, (C) 0.3 mm, (D) 1 mm.

4. Discussion

Previous records of Ceratopogonidae acting as ectoparasites of harvestmen were associated with species belonging to the Gagrellinae or Leiobuninae subfamilies, within the family Sclerosomatidae (Lane, 1947; Cokendolpher, 1993). These species are distinguished by their long and very delicate legs. Some of these ectoparasitic species have only been described based on a single specimen and record, highlighting the limited number of specialists in Ceratopogonidae compared to the vast species diversity within the family. We rediscovered and provided a photographic record of the ectoparasitic relationship between *F.* (*T.*) *opilionivora* and a harvestman, 75 years after its original description. We also provided a new distribution record for the species.

5. Acknowledgments

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6. Conflict of interest

The authors declare that they have no conflict of interest.

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Redescubrimiento de *Forcipomyia (Trichohelea) opilionivora* (Lane, 1947) (Diptera, Ceratopogonidae) en Brasil después de 75 años

Resumen: La especie *Forcipomyia (Trichohelea) opilionivora* (Lane, 1947) (Diptera, Ceratopogonidae) fue redescubierta en el estado de Río de Janeiro, Brasil, 75 años después de su descripción original. Este estudio tuvo como objetivo investigar la relación ectoparasitaria entre *F. (T.) opilionivora* y su hospedero, y documentar su presencia, la cual fue registrada de manera fortuita durante la recolección de especímenes de opiliones en el Parque Nacional do Itatiaia en el estado de Río de Janeiro, Brasil. Después de la recolección, ambos especímenes fueron sometidos a documentación fotográfica y preservados para su posterior examen. Este estudio presenta el primer registro fotográfico de la relación ectoparasitaria entre *F. (T.) opilionivora* y un opilión, arrojando luz sobre una interacción poco estudiada. El espécimen hospedero fue identificado como una hembra de *Holcobunus nigripalpis* Roewer, 1910 (Opiliones, Sclerosomatidae), una gagrellina comúnmente encontrada en la Mata Atlántica del sureste de Brasil. Los registros previos de ectoparasitismo entre Ceratopogonidae y opiliones se limitaban al nivel de familia (específicamente especies de Sclerosomatidae, en particular Gagrellinae o Leiobuninae). Sin embargo, hasta ahora no se había identificado ninguna especie de hospedero específica. El redescubrimiento de *F. (T.) opilionivora*, junto con la identificación de su hospedero, aborda una brecha significativa en nuestro conocimiento sobre la biología y distribución de esta especie y proporciona información valiosa sobre las complejas relaciones entre las beatillas y los arácnidos. Este estudio enfatiza la necesidad de seguir investigando la biología de estas especies ectoparasíticas y subraya la importancia de documentar y estudiar interacciones menos conocidas dentro de los ecosistemas.

Palabras Clave: Mata Atlántica; Beatillas; Brasil; Ectoparasitismo; Opiliones.

Redescoberta de *Forcipomyia (Trichohelea) opilionivora* (Lane, 1947) (Diptera, Ceratopogonidae) no Brasil após 75 anos

Resumo: A espécie *Forcipomyia (Trichohelea) opilionivora* (Lane, 1947) (Diptera, Ceratopogonidae) foi redescoberta no estado do Rio de Janeiro, Brasil, 75 anos após sua descrição original. Este estudo teve como objetivo investigar a relação ectoparasítica entre *F. (T.) opilionivora* e seu hospedeiro, e documentar sua ocorrência, que foi registrada de forma fortuita durante a coleta de espécimes de opiliões no Parque Nacional do Itatiaia, no estado do Rio de Janeiro, Brasil. Após a coleta, ambos os espécimes foram submetidos à documentação fotográfica e preservados para posterior exame. Este estudo apresenta o primeiro registro fotográfico da relação ectoparasitária entre *F. (T.) opilionivora* e um opilião, lançando luz sobre uma interação pouco estudada. O espécime hospedeiro foi identificado como uma fêmea de *Holcobunus nigripalpis* Roewer, 1910 (Opiliones, Sclerosomatidae), uma gagrellina comumente encontrada na Mata Atlântica do sudeste do Brasil. Registros anteriores de ectoparasitismo entre Ceratopogonidae e opiliões estavam limitados ao nível de família (espécies de Sclerosomatidae, especificamente Gagrellinae ou Leiobuninae). No entanto, nenhuma espécie hospedeira específica havia sido identificada até agora. A redescoberta de *F. (T.) opilionivora*, juntamente com a identificação de seu hospedeiro, aborda uma lacuna significativa em nosso conhecimento sobre a biologia e distribuição dessa espécie e fornece informação valiosa sobre as intricadas relações entre mosquitos-pólvora e aracnídeos. Este estudo enfatiza a necessidade de investigações adicionais sobre a biologia dessas espécies ectoparasitas e destaca a importância de documentar e estudar interações pouco conhecidas dentro dos ecossistemas.

Palavras-chave: Mata Atlântica; Mosquitos-pólvora; Brasil; Ectoparasitismo; Opiliões.

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