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ORIGINAL ARTICLE

First record of *Forcipomyia* (*Microhelea*) *eriophora* (Williston, 1896) ectoparasitic midges occurrence on *Heraclides anchisiades capys* (Hübner, 1809) butterfly caterpillar hosts in Brazil

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Abstract

In this work we report for the first time the occurrence of female adults of the biting midge *Forcipomyia (Microhelea) eriophora* feeding on butterfly *Heraclides anchisiades capys* caterpillars. We collected the caterpillars and Ceratopogonidae specimens on *Citrus limon* (L.) (Rutaceae) tree leaves from the campus of the Universidade Estadual de Feira de Santana (UEFS), Feira de Santana, Bahia, Brazil. In Brazil, host records of *Forcipomyia* (*Microhelea) eriophora* on caterpillars remain scarce due to significant gaps in our understanding of ectoparasitic habits within Ceratopogonidae.

Keywords: Biting-midges; Brazil; Ectoparasitism.

1. Introduction

The *Forcipomyia Meigen*, 1818 (Diptera, Ceratopogonidae) is a diverse genus, entailing approximately 1150 known biting midge species distributed worldwide, except in Antarctica [1]. Species within some *Forcipomyia* subgenera have ectoparasitic habits on insects [2, 3]. *Forcipomyia* ectoparasites in lepidopteran larvae have been addressed in various studies, as summarized by [4].

The subgenus *Microhelea* Kieffer, 1917 entails about 50 species in the Neotropical Region [1, 5], most of which are known insect ectoparasites [2, 4, 6, 7]. These species are commonly grouped into two major groups, mainly distinguished by their habits and female mouthpart morphology [8]. The *ixodoides* species group is characterized by short mouthparts and consists of Phasmida and Orthoptera ectoparasites. In contrast, the *fuliginosa* species group features elongated mouthparts and includes Lepidoptera and Hymenoptera larvae ectoparasites [4, 8]. In Brazil, eight species within the *fuliginosa* species group have been recorded, with disjointed and punctual distributions [4].

The butterfly family, Papilionidae comprises about 600 known species [9], exhibiting a global distribution, predominantly in the Neotropical Region. In Brazil, 67 Papilionidae species have been recorded [10]. A relatively common subspecies of this family is *Heraclides anchisiades capys* (Hübner, 1809), found exclusively in South America [11]. Immature stages of these butterflies

are commonly observed in forests and citrus (Rutaceae: *Citrus* spp.) tree orchards [12, 13]. The larvae of this subspecies are considered citrus pests in the Northeast Region of Brazil [12]. They are commonly found until 4th instar in groups of at least 20 individuals [12, 13].

The objective of this study is to report for the first time the ectoparasitic behavior of *Forcipomyia (Microhelea) eriophora* (Williston, 1896.) with the caterpillar of *H. anchisiades capys* serving as host.

2. Material and Methods

Caterpillar searches were carried out periodically between August 8-16, 2022, through the Universidade Estadual de Feira de Santana (UEFS) campus, located in the municipality of Feira de Santana, state of Bahia, Brazil. The site consists of an area of 1.096.741,67 m^2, with plant covers of mixed elements including, remnants of Deciduous Forest, Semideciduous Forest, and Caatinga, dense vegetation of herbaceous-shrub-like structure, along with gardens, lawns, and parts of the native vegetation in different successional stages [14].

Caterpillars and Ceratopogonidae specimens were collected on *Citrus limon* (L.) (Rutaceae) leaves and taken to the Laboratório de Sistemática de Insetos (LASIS) at UEFS. The caterpillar was fixed, following the protocol of [15], and identified through specialized taxonomic bibliography *i.e*., [16]. The Ceratopogonidae were fixed in 80 % ethanol and subsequently slide-mounted in Canada balsam and Euparal [17]. Identified *H. anchisiades capys* larvae and adult F. *(M.) eriophora* specimens were deposited in the Coleção Entomológica Prof. Johann Becker of the Museu de Zoologia at UEFS (MZFS) and the Coleção Entomológica do Museu Nacional / Universidade Federal do Rio de Janeiro (MNRJ), respectively.

H. anchisiades capys with F. *(M.) eriophora* images were taken with a Canon T6 camera, 55-250 mm. The microphotographs of the fixed material of F. (*M.) eriophora* were captured using a Leica M205C stereoscopic microscope with a FusionOptics digital camera. All images were edited using Adobe Photoshop®.

3. Results

We observed the occurrence of *H. anchisiades capys* caterpillars feeding on lemon tree (*Citrus limon* (L.)) leaves (**Fig. 1**). The observed larvae were 2nd and 3rd instars, forming groups of several caterpillars. The defense mechanism exhibited by the caterpillars involved moving their heads in repetitive motions against the ectoparasite, consequently the ectoparasites flew away from the caterpillars but returned to feed on them again (Fig. 1). Adult ectoparasite specimens were identified as *F. (M.) eriophora*, characterized by a dark brown coloration, thorax with yellow setae, banded legs, and the following ratios: antennal (1.41), palpal (1.8) and costal (0.54). [4] (**Fig. 2**). Three adult females were observed piercing these caterpillars on different days.

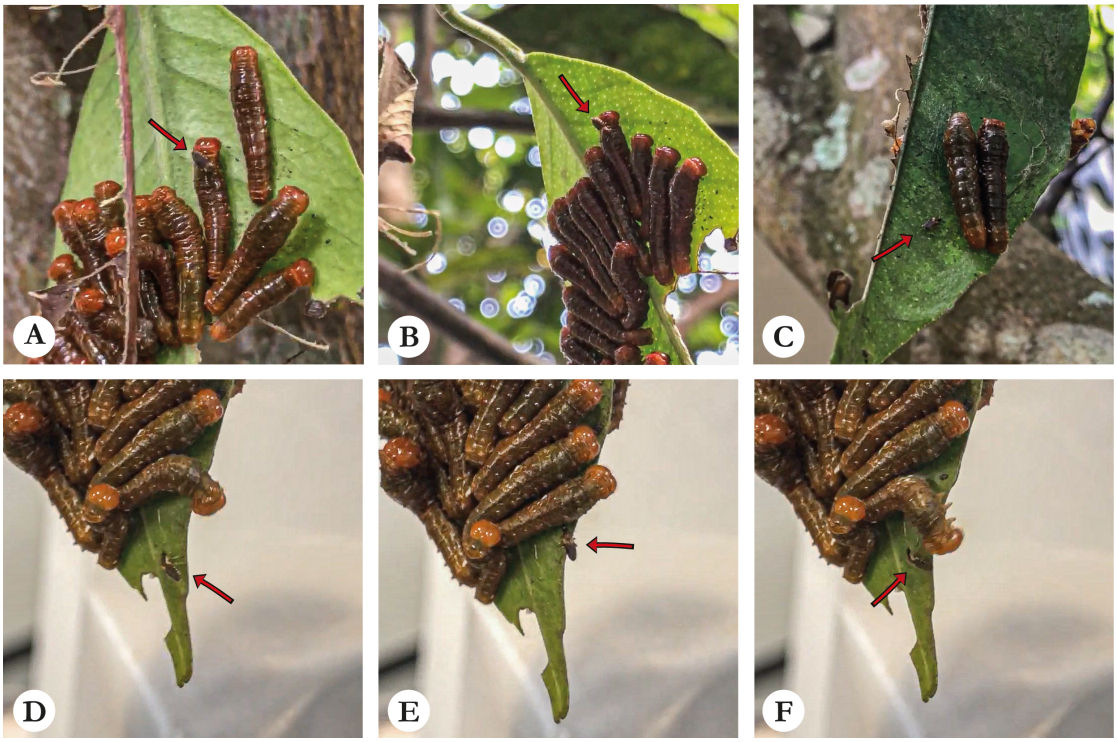

Figure 1. A–F) *Heraclides anchisiades capys* caterpillars feeding on leaves of *Citrus limon* (L.) (Rutaceae). **D–F**) The host' defense mechanism is exhibited by the caterpillars moving their heads in repetitive motions against the ectoparasite.

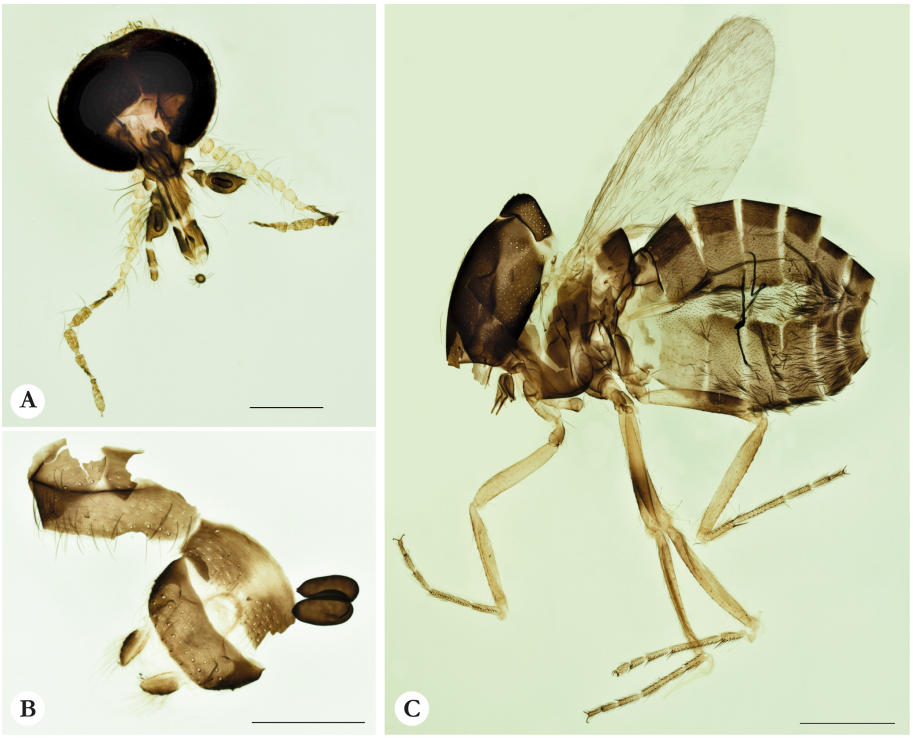

Figure 2. *Forcipomyia (Microhelea) eriophora*, female. **A)** Head; **B)** Terminalia; **C**) Thorax and abdomen. Scale bar: A-B: 0.2 mm, C: 0.5 mm.

4. Discussion

The species *F. (M.) eriophora* belongs in the *fuliginosa* species group [8], it specializes in lepidopteran larvae and occurs from the east coast of the United States of America to Brazil, with records for the municipality of Ilhéus, state of Bahia [18, 19]. Literature records indicate a wide diversity of Lepidopteran caterpillars attacked by *F. (M.) eriophora*, including families Geometridae, Nymphalidae, Papilionidae, Pieridae, and Sphingidae [2, 4, 19, 20, 21, 22] (**Table 1**). Some of the butterfly species targeted by dipteran ectoparasites are of phytosanitary importance, being pests in various crop types (e.g., tobacco, *Nicotiana tabacum* Linnaeus, 1753) [23]. The observation in this study is the first report of *F. (M.) eriophora* as an ectoparasite of *H. anchisiades capys*.

Previous studies [4, 19, 22, 24] revealed that ceratopogonidae may act as pathogen vectors to their hosts during feeding. [4] proposed that the presence of *F. (M.) eriophora* is likely widespread, contrasting with the limited available data due to subsampling and evident knowledge gaps in the literature, especially in the Neotropical Region. We emphasize the importance of future studies to determine the impact of *F. (M.) eriophora* on *H. anchisiades capys* populations as a possible biological control tool for this pest. We also call to expand the study of the distribution of ectoparasitic ceratopogonidae, which will contribute to filling gaps in our understanding of the biology between parasites and their hosts.

Table 1. List of caterpillar species attacked by *Forcipomyia (Microhelea) eriophora*.

Butterfly host	Reference
Geometridae	
Melanchroia geometroides Walker, 1854	Baker (1907)
Nymphalidae	
Anaea troglodyta floridalis F. Johnson & W. Comstock, 1941	Salvato *et al*. (2012)
Papilionidae	
Heraclides anchisiades capys (Hübner, 1809)	Present study
Papilio demoleus Linnaeus, 1758	Abreu-Rodríguez *et al*. (2011)
Pieridae	
Phoebis sennae (Linnaeus, 1758)	Koptur *et al*. (2013)
Sphingidae	
Manduca sexta (Linnaeus, 1763)	Wolcott (1948)

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6. Conflict of interest

The authors declare that they have no conflict of interest.

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Primer registro de jejenes *Forcipomyia (Microhelea) eriophora* (Williston, 1896) como ectoparásitos en orugas de la mariposa *Heraclides anchisiades capys* (Hübner, 1809) en Brasil

Resumen: En este trabajo, reportamos por primera vez la ocurrencia de hembras adultas del jején *Forcipomyia (Microhelea) eriophora* alimentándose de orugas de la mariposa *Heraclides anchisiades capys*. Colectamos las orugas y los especímenes de Ceratopogonidae en hojas del árbol *Citrus limon* (L.) (Rutaceae) en el campus de la Universidade Estadual de Feira de Santana (UEFS), Feira de Santana, Bahía, Brasil. En Brasil, los registros de *Forcipomyia (Microhelea) eriophora* en orugas hospedadoras son escasos debido a las deficiencias significativas en la comprensión de los hábitos ectoparásitos de los Ceratopogonidae.

Palabras Clave: Brasil; Ectoparasitismo; Jejenes

Primeiro registro de maruins *Forcipomyia (Microhelea) eriophora* (Williston, 1896) como ectoparasitas em lagartas da borboleta *Heraclides anchisiades capys* (Hübner, 1809) no Brasil

Resumo: Neste trabalho, relatamos pela primeira vez a ocorrência de fêmeas adultas do maruim *Forcipomyia (Microhelea) eriophora* alimentando-se de lagartas da borboleta *Heraclides anchisiades capys*. Coletamos as lagartas e os espécimes de Ceratopogonidae em folhas de árvores de *Citrus limon* (L.) (Rutaceae) no campus da Universidade Estadual de Feira de Santana (UEFS), Feira de Santana, Bahia, Brasil. No Brasil, os registros de *Forcipomyia (Microhelea) eriophora* em lagartas hospedeiras são escassos devido a deficiências significativas na compreensão dos hábitos ectoparasitas dentro dos Ceratopogonidae.

Palavras-chave: Brasil; Ectoparasitismo; Maruins.

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