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SHORT COMMUNICATION

First record of a phoretic mite (Histiostomatidae) on a cave dwelling cricket (Phalangopsidae) from Brazil

Primeiro registro de ácaros foréticos (Histiostomatidae) em um grilo cavernícola (Phalangopsidae) no Brasil

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Abstract

The first record of a phoretic mite of the genus *Histiostoma* (Sarcoptiformes: Histiostomatidae) associated with an individual of *Endecous* (*Endecous*) *alejomesai* (Orthoptera: Phalangopsidae) is reported from a Brazilian cave. Although deutonymphs of histiostomatid mites are common phoretic on invertebrates, this is the first report of their phoretic association with a cave dwelling cricket.

Keywords: *Histiostoma*, *Endecous*, *simbiosis*, hypogean habitat.

Resumo

O primeiro registro do ácaro forético do gênero *Histiostoma* (Sarcoptiformes: Histiostomatidae) associado a um indivíduo de *Endecous* (*Endecous*) *alejomesai* (Orthoptera: Phalangopsidae) é relatado para uma caverna brasileira. Embora as deutoninfas de ácaros sejam comumente encontradas realizando forese em invertebrados, esse é o primeiro relato de sua associação com um grilo cavernícola.

Palavras-chave: *Histiostoma*, *Endecous*, simbiose, habitat hipógeo.

Phoresis is a common type of symbiosis between live animals representing an interspecific association in which one organism (phoretic) attaches for an unlimited period of time to another (host) strictly with the aim to disperse (Houck and OConnor, 1991; Knülle, 2003; Reynolds *et al.*, 2014). Such type of interaction is common in habitats where the conditions rapidly changes and/or when the resources are ephemeral (e.g. feces and carcasses) (Farish and Axtell, 1971; Houck and OConnor, 1991). Cave organisms are frequently supported by ephemeral resources from the surface imported by biotic (e.g. bats) or abiotic agents (e.g. water courses, wind). In general, these agents are inefficient in this transport, what results in the oligotrophic condition commonly observed in caves (Culver and Pipan, 2009).

Mites of the family Histiostomatidae, such as the species of the genus *Histiostoma* (Acariformes, Astigmatina, Histiostomatoidea) are among the species that use such phoretic strategy of dispersion and represent one of the largest groups within Astigmatina, with more than 500 described species (Schatz *et al.,* 2011). These species are found living free in the soil and in decomposing or-

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ganic matter both in epigean and hypogean environments, generally during the deutonymph phase (hypopus stage), and also may be found phoreticaly associated to other invertebrates (Houck and OConnor, 1991). The exceptions to this lifestyle are a few described species, parasites of fish, leeches, and worm eggs (Fain and Lambrechts 1987; Halliday and Collins 2002; Hughes and Jackson, 1958).

During their life cycle, the Histiostomatidae mites, such as other Astigmatina groups, may turn into hypopus which are deutonymphs specialized on dispersing (Houck and OConnor, 1991; OConnor, 1994). In most species, the hypopus shows morphological adaptations, such as an anal sucker plate, by means of which the mite fastens in its vector (Houck and OConnor, 1991; OConnor, 1994). Although the hypopus usually do not feed, some species may take advantage of the close corporal relationship with the host, parasitizing it, andabsorbing compounds in form of a fluid, such as water (Houck and Cohen, 1995). This phase usually occurs in a given population when the mites are in environmentally unsuitable locations, or when the population grows very sharply. In these cases, individuals migrate for other habitats associated with their hosts, since the mites have little ability to move (Farish and Axtell, 1971).

Histiostomatidae are known by using a great diversity of arthopods as hosts in the epigean environment, such as arachnids (Dunlop *et al.*, 2012; Fain, 1991; Vachon, 1940), centipedes (Fain, 1991), coleopterans (Fain and Santiago-Blay, 1993; Wirth *et al.*, 2016; Wirth and Pernek, 2012), dipterans, earwigs, cockroaches (Negm and Alatawi, 2011; Pimsler *et al.,* 2016; Tagami, 2013; Chmielewski, 2009), hymenopterans (Fain and Erteld, 1998; Fain and Pauly, 2001; Uppstrom and Klompen, 2011), springtails (Fain and Johnston, 1974), among others arthropods. However, few cases of Histiostomatidae using orthopterans as disperser hosts are recorded: a single association with crickets (Gryllidae: *Gryllus bimaculatus*) in Saudi Arabia (Negm and Alatawi, 2011) and other with sandgropers (Cylindrachetidae: *Cylindraustralia kochii* and *C. tindalei*) in Australia (Houston, 2007). On the other hand, despite that occurrences of Histiostomatidae in the cave environment are common (Bernardi *et al.*, 2009; Cokendolpher and Polyak, 1996; Palacios-Vargas *et al.*, 2011; Welbourn, 1999), mainly associated to bat guano (Ferreira *et al*., 2000; Pellegrini and Ferreira, 2013), cases of phoresis involving this group have not been recorded. Therefore, the present work reports the first occurrence of histiostomaid mites at hypopus stage associated to genus *Endecous* in a Brazilian cave, a commonly crickets found in subterranean cavities from South America (Cigliano *et al*., 2017).

The association reported in this study was observed during collections performed in Cabeceira D'Água cave (13°52'53.56''S 46°55'44.31''W), municipality of Nova Roma, Goiás, Brazil (Figure 1), on August 8, 2015. This cave presents considerable dimensions, exceeding 4.5 Km of extension, and a stream runs in the main gallery of the cave. Along this main gallery there were discrete piles of guano and vegetal organic matter imported by the stream. Such organic substrates represent ideal places for reproduction and foraging of mites and crickets, among other invertebrates (Ferreira *et al*., 2000; Pellegrini and Ferreira, 2013; Schneider *et al*., 2011).

During the expedition, sampling was carried out using the active search method, where all the potential biotopes that could possibly be used as food and shelter resource for fauna were examined (e.g. soil, remnants of matter organic, under stones). All specimens collected were stored in individual vials containing 70% ethanol. The identification of the crickets was done by analyzing the external morphology and genital sclerites (from both males and females) using a stereomicroscope STEMI 2000 (Zeiss). The identification was based on taxonomic keys and species descriptions (Mello *et al.,* 2013; Zefa *et al.,* 2010). The photographs of the association between the crickets and mites were obtained using an Axion Zoom V16 (Zeiss) stereomicroscope. The identification of mites was given after the removal of individuals from the host, and mounting of specimens on glass slides, with the use of Hoyer's medium. Specimens mounted on slides were kept in heather at 45ºC for 10 days. After that, each individual

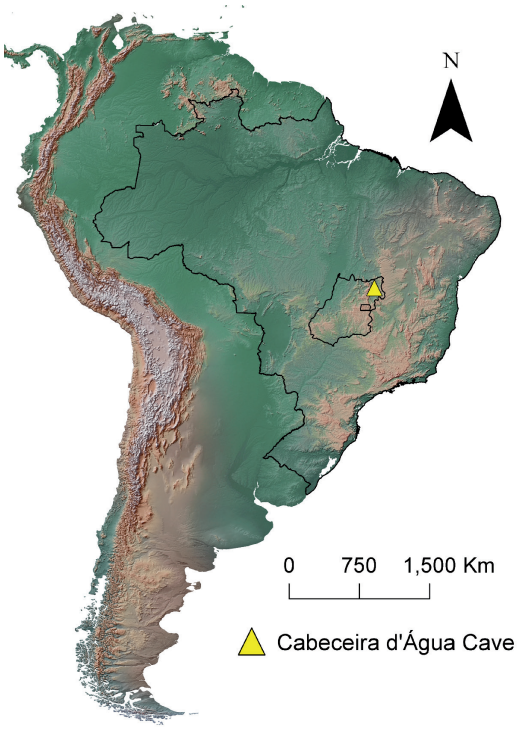

Figure 1. Location of the cave Cabeceira d'Água, state of Goiás, Brazil, in South America.

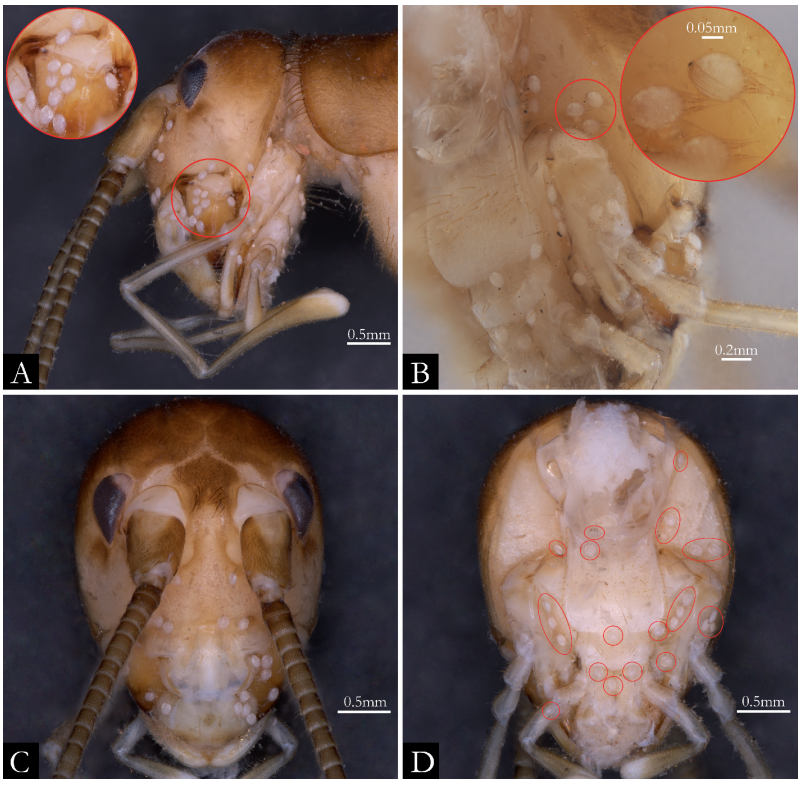

Figure 2. *Endecous* (*Endecous*) *alejomesai* associated with numerous mites of the genus *Histiostoma:* cricket head in lateral (A), diagonal (B), frontal (C) and dorsal (D) views. Red circles indicate histiostomatid mites attached to the head of the cricket.

was identified through a morphological analysis using a microscope Axio Scope. A1 (Zeiss) equipped with Differential Interference Contrast (DIC) and with a coupled camera. Taxonomic keys used for identification are in the publications of Hughes and Jackson (1958), Walter *et al.* (2009), and Wirth (2004).

The mites were observed attached to the head of a single specimen of *Endecous* (*Endecous*) *alejomesai* Zefa 2010. The adult male cricket carried about 50 individuals of the genus *Histiostoma* (Sarcoptiformes: Histiostomatidae), which were strongly adhered to all parts of the cricket head, including the palp, basis of antenna, mandibular pieces and others (Figure 2). Both species were deposited in the Collection of Subterranean Invertebrates of Lavras (ISLA), Federal University of Lavras, Brazil. Unfortunately, it was not possible to make progress in identifying the individuals of *Histiostoma* found in this study. In order to differentiate Histiostomatidae species or to describe a new species accurately, an analysis of both young and adult stages is necessary (Pernek *et al.*, 2012; Wirth, 2004).

The association between histiosmatid mites and *Endecous* is not common in the cave environment (and neither was recorded for epigean habitats). Hundreds of individuals from more than 236 caves from 13 Brazilian states has been analyzed in a taxonomic study on crickets of this genus from Brazilian caves (Castro-Souza, unpublished data) and the here reported association was observed only once.

Histiostomatidae mites are frequently observed in Brazilian caves, which are mainly found in guano piles and decomposing organic matter (Bernardi *et al.*, 2009; Ferreira and Martins, 2009; Pellegrini and Ferreira, 2013). Such organic resources are commonly used by *Endecous* in their diet. Considering the fixation site of *Histiostoma* on the body of *Endecous,* as well as the habit of these two organisms, it is possible to infer that the mites probably migrated to the host while it was feeding. Given the great amount of individuals observed on the cricket head (Figure 3), the organic substrate was probably full of hypopus. Phoresy behavior presumably results in the dispersal of individuals from areas unsuited for further development, either of the individual or its progeny, to suitable environments (Farish and Axtell, 1971). In the case of some mites, such as the histiostomatid, the unfavorable environmental conditions (such as drying out, overcrowding, lack of food, and accumulation of waste products) favor the interposition of the hypopus stage, which is adapted to dispersion by a host (Binns, 1982; Knülle, 2003; Reynolds *et al.*, 2014). However, it is important to highlight that even considering caves as suitable habitats for mites and crickets, it is possible that this is a sporadic and rare interaction given the number of crickets

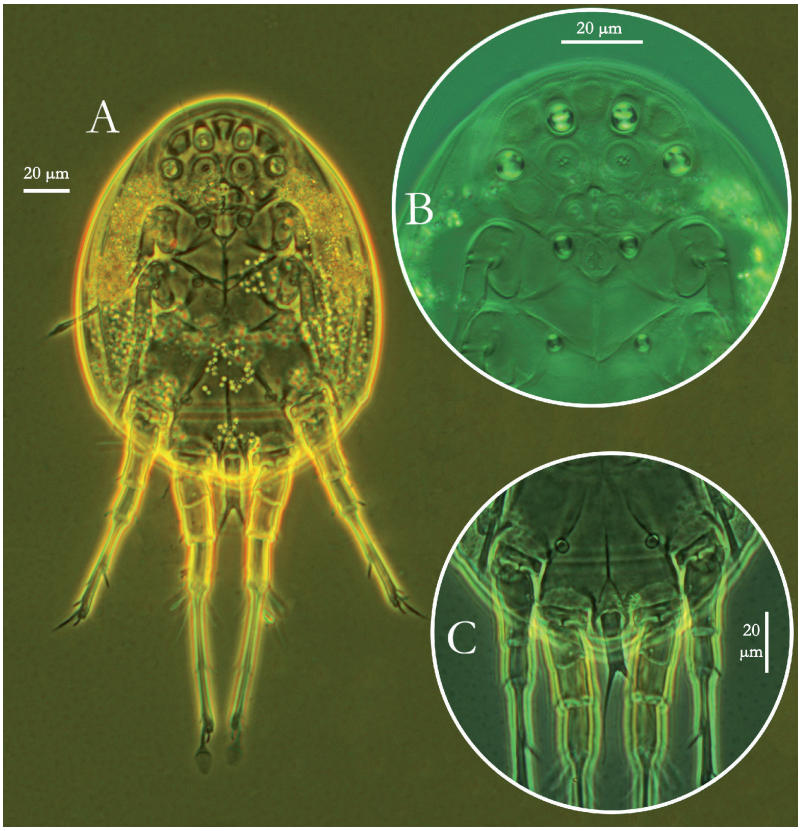

Figure 3. Mites of the genus *Histiostoma*. A: General morphology; B: Anal suckerplate; C: Ventral regions of the legs I, II and gnathossoma.

observed without mites during the studies regarding Brazilian cave fauna in the last years (Cajaiba, 2012; Souza-Dias *et al*., 2014; Bolfarini and Bichuette, 2015; Castro-Souza *et al*., 2017; Cigliano *et al*., 2017).

The interaction between mites and their hosts is still poorly known regarding cave species. However, some associations may constitute an interesting study object since caves are environments where the resources are in general scarce and ephemeral. Therefore, the phoretic dispersion may represent an essential habit for the survival and perpetuation of populations of organisms with reduced motility, such as histiostomatid mites.

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