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Short Communication

First record of *Anopheles konderi* Galvão & Damasceno (Diptera: Culicidae) carrying eggs of *Dermatobia hominis* (Linnaeus Jr.) (Diptera: Oestridae), from Oriximiná municipality, Pará, Brazil

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Abstract

Introduction: The muscoid fly *Dermatobia hominis* causes cutaneous myiases in mammals. Females of this species use a vector to carry their eggs to the host. This note describes *Anopheles konderi* acting as phoretic vector for *D. hominis*. **Methods:** A female *A. konderi* carrying *D. hominis* was collected using light traps in Oriximiná, Pará, Brazil. The *A. konderi* specimen was identified at morphological and molecular levels. **Results:** Eight eggs of *D. hominis* were observed on the *Anopheles konderi* female. **Conclusions:** *Anopheles konderi*, only the third *Anopheles* species recorded as a phoretic vector, may be a potential vector of *D. hominis*.

Keywords: Phoretic vector. Dermatobiasis. *Reserva Estadual do Trombetas*. Myiasis.

Dermatobia hominis is a muscoid fly endemic to the Neotropical region. In Brazil, it is popularly known as *mosca do berne*. The larvae of this species cause cutaneous myiasis, also known as dermatobiasis, in a wide range of mammalian hosts, including humans. It is particularly important as a parasite of domestic animals, such as cattle and birds. Several wild animals are also infected[1]. Dermatobiasis is of considerable economic importance, since affected cattle produce poor quality leather, as well as less meat and milk[2]. In humans, the infections are painful but generally benign, even if the larvae reach maturity, but can be lethal in infants if the larvae penetrate the brain via the fontanelle[3].

The females of *D. hominis* exhibit a characteristic reproductive behavior, namely, the use phoretic vectors to transmit their eggs to the host. This reproductive behavior was first recorded by Raphael Morales in Guatemala in 1911, and has subsequently been reported in several publications[1,4]. In general, these vectors are zoophilous Diptera, particularly calyptrate flies of the families Calliphoridae, Muscidae, Tabanidae, Fanniidae, Anthomyiidae, Sarcophagidae, Tipulidae, Syrphidae, Asilidae, Dolichopodidae, Drosophilidae, Ephydridae, Tachinidae, Otitidae, Stratiomyidae, and Trupaneidae. Among non-calyptrate flies, species of Simuliidae and Culicidae have been recorded as vectors[1]. In the latter, the genera *Psorophora, Aedes, Mansonia, Haemagogus, Limatus, Onirion, Wyeomyia, Culex, Trichoprosopon*, *Johnbelkinia*, and *Anopheles* have been recorded as phoretic vectors[1,4-6].

Recent studies have reported new phoretic vectors of *D. hominis*[2,7,8], which are generally calyptrate flies. In this note, we report for the first time the exploitation of *Anopheles konderi*, a dipterous non-calyptrate fly, as a phoretic vector of *D. hominis*.

During sorting of the specimens collected using CDC (Center for Disease Control) miniature light traps in July 2011 in *Floresta Estadual do Trombetas* [*Sistema de Autorização e Informação em Biodiversidade* (SISBIO) License Number 14054-3], Oriximiná municipality, Pará, Brazil (1°28′S; 56°22′W), a single female specimen of *A. konderi*, among several examined, was observed carrying eggs of *D. hominis*. The material was preserved in 80% ethanol and then carefully examined under a stereomicroscope (SV11; Zeiss) at ×66 magnification. As females of *A. konderi* are morphologically similar to those within the *Anopheles oswaldoi* complex[9], the identification was molecularly confirmed by deoxyribonucleic acid (DNA) barcode analysis, using a 663-base pair region of the mitochondrial cytochrome oxidase subunit I (COI) gene. The specimen was photographed using a Celestron® model 44330 imaging system. The processes of sorting, microscopic

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analysis, taxonomic and molecular identification, and photography were conducted in the *Laboratório de Genética de Populações e Evolução de Mosquitos Vetores de Malária e Dengue* of *Instituto Nacional de Pesquisas da Amazônia* (INPA).

Eight eggs of *D. hominis* were found adhered to the ventral abdomen of the female *A. konderi* (**Figure 1A, Figure 1B** and **Figure 1C**), some of which had already hatched and were empty, whereas others were intact and contained visible larvae or were partially hatched. During handling of the material, some of the larvae became detached from their eggs (**Figure 1D**).

Generally, a *D. hominis* female selects a phoretic vector that is of similar size to itself or smaller[4,7], and the number of eggs deposited is directly proportional to the body size of the vector[10]. For example, in Fanniidae, a family of dipterous muscoids, an average of 16.4 eggs of *D. hominis* has been reported per vector specimen[7]. In our study, the number of eggs found on *A. konderi* corroborates this information. Compared with other dipterous muscoids with bulkier bodies, which are the main disseminators of *D. hominis* eggs, the anopheline mosquitoes are smaller and thinner[6].

Understanding the epidemiology of dermatobiasis in the Neotropics depends on knowledge of the biological, ecological, and ethological parameters of phoretic vectors implicated in the transmission of the *D. hominis* ectoparasite. To date, *Anopheles konderi* is the third species of *Anopheles* that has been reported as a phoretic vector of *D. hominis*, only preceded by *A. boliviensis* and *A. intermedius*[1,4]. Little is known about these parameters regarding *A. konderi*. This is mainly due to problems associated with the taxonomic status of this species. *Anopheles konderi* is morphologically similar to *A. oswaldoi*, with which it was synonymized in the past, although the males of these two species can be distinguished based on subtle differences in their genitalia. Subsequently, studies have reported that these two species differ in terms of their behavioral patterns and ITS2 (Internal Transcribed Spacer) and COI molecular markers, and also possibly as malaria vectors[11,12]. Currently,

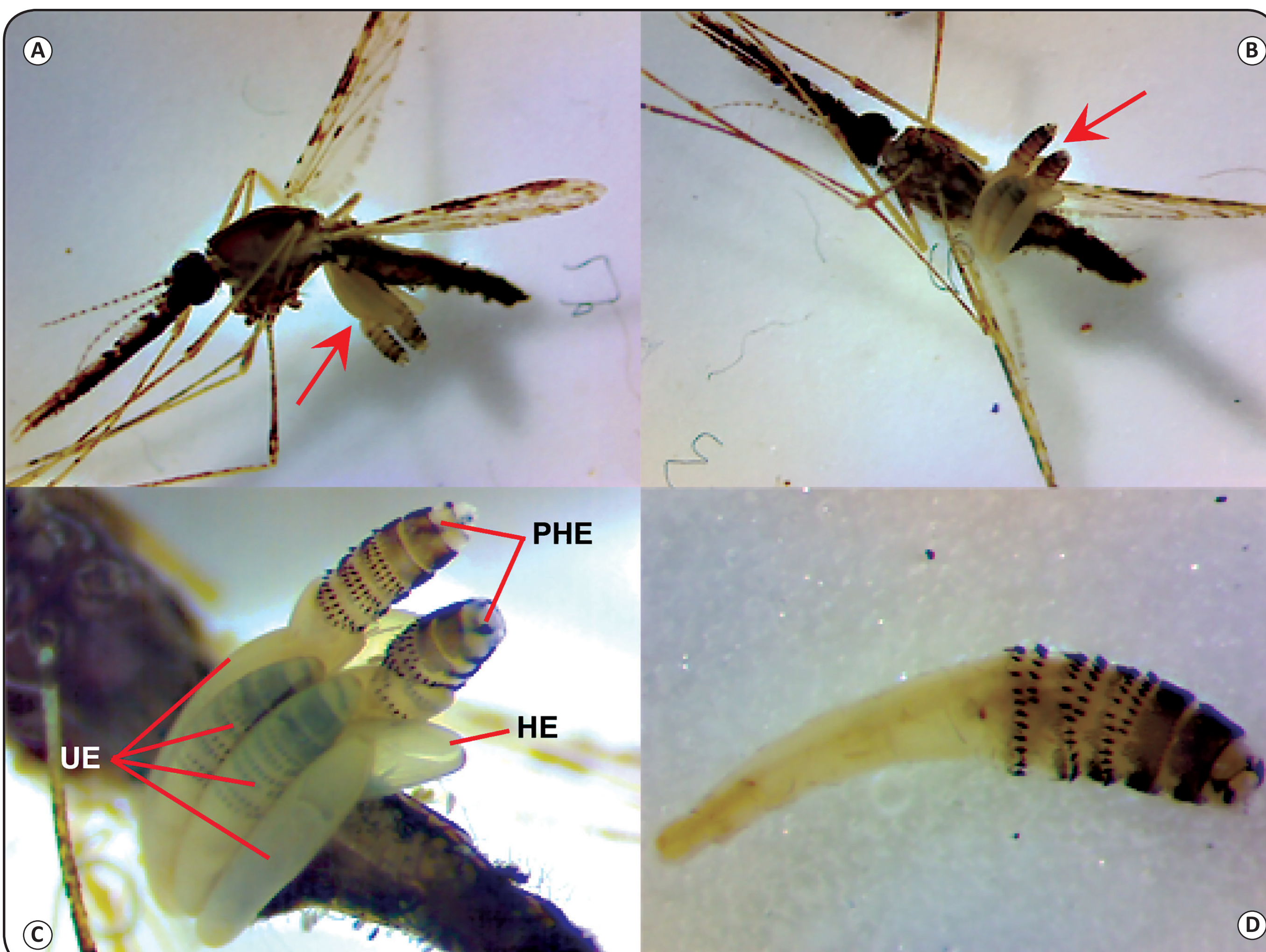

FIGURE 1 - *Anopheles konderi* carrying the eggs and larvae of *Dermatobia hominis*: (A): and (B):. Dorsal and ventral views, respectively, of a female *A. konderi* with eggs and partially hatched larvae attached to its abdomen (see arrows). (C): Eggs of *D. hominis* attached to the abdomen of *A. konderi*. (D): Newly hatched larva of *D. hominis*. PHE: partially hatched eggs; **UE:** unhatched eggs; **HE:** hatched egg; ***A.***: *Anopheles*; ***D.:*** *Dermatobia*.

A. konderi is recognized as a distinct species from *A. oswaldoi* s.l., although it is a member of a group of cryptic species within the *A. oswaldoi* complex[11-13].

Dermatobia hominis occurs primarily in forests, thereby avoiding dehydration and excessive heat[14]. Their phoretic vectors are predicted to have, among other characteristics, diurnal and zoophilic habits[4,7]. Specimens belonging to the *A. oswaldoi* complex have zoophilic behavior, generally inhabiting forests, but also show exophilic behavior[9]. Others have been observed to exhibit vespertine crepuscular and nocturnal activities, including biting humans, and it has been collected in human habitations[15]. As diurnal habit is one of the characteristics of *D. hominis* vectors, it is possible that the typically nocturnal *A. konderi* also has diurnal and/or crepuscular activities.

Although in the current study, we did not demonstrate that *A. konderi* routinely acts as a phoretic vector for the eggs of *D. hominis*, our observations indicate that this anopheline can potentially play this role, being one among the various dipteran species responsible for maintaining the incidence of dermatobiasis in wild animals.

Conflict of interest

The authors declare that have no conflicts of interest.

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