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Traveling with an invader: ectoparasitic mites of *Hemidactylus frenatus* (Squamata: Gekkonidae) in Colombia

Jorge A. Díaz[1,2], Richard A. Torres[2,3], Luis E. Paternina[4], Diego José Santana[5], Roberto J. Miranda[6]

[1] Programa de Pós-Graduação em Ecologia e Conservação, Instituto de Biociências, Universidade Federal de Mato Grosso do Sul, Campo Grande, CEP 79070-900, Mato Grosso do Sul, Brazil.

[2] Grupo de Investigación en Zoología y Ecología, Universidad de Sucre, Sincelejo, Sucre, Colombia.

[3] Laboratório de Aracnologia, Departamento de Zoologia, Instituto de Ciências Biológicas, Universidade Federal de Minas Gerais, Belo Horizonte, CEP 31270-901, Minas Gerais, Brazil.

[4] Grupo de Investigaciones Biomédicas, Universidad de Sucre, Sincelejo, Sucre, Colombia.

[5] Laboratorio de Zoologia, Instituto de Biociências, Universidade Federal de Mato Grosso do Sul, Campo Grande, CEP 79070-900, Mato Grosso do Sul, Brazil.

[6] Departamento de Investigación en Entomología Médica, Instituto Conmemorativo Gorgas de Estudios de la Salud, Panamá.

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ABSTRACT

Information about natural history of invasive species (such as parasitism) is a relevant issue in order to consider potential threats to native fauna. In this work we report two pterygosomatid mites for the first time in Colombia, *Geckobia bataviensis* and *G. keegani*, parasites of the invasive house gecko *Hemidactylus frenatus*. Although it has not been demonstrated that these mites may infest native gecko lizards, our study highlights the need to explore the prevalence of internal and external parasites in native and invasive geckos, to better evaluate the potential impact of invasive *Hemidactylus* lizards in Colombia.

Key Words: Biological invasions; Parasitism; Mites; Pterygosomatidae; *Geckobia*.

Biological invasions associated to human activities are one of major threats to biodiversity worldwide, with impacts at the population, species and ecosystems levels (Chornesky and Randall, 2003). Invasive animals can disperse their parasites and potentially transmit them, which may pose potential risks to native species (Prenter *et al.,* 2004). Lizards, like other vertebrate groups are hosts for several internal and external parasites (*e.g.,* Avila and Silva, 2010; Fajfer, 2012) that may affect behavior and fitness of individuals. Besides, parasites may present important ecological implications at population level and interspecific relationships of their hosts (Prenter *et al.,* 2004; Norval *et al.,* 2014).

Species of the gekkonid lizard genus *Hemidactylus* Gray, 1825 are common hosts of external parasites such as mites of the family Pterygosomatidae, which comprises 184 species and nine genera, mostly permanent ectoparasites of lizards (Fajfer, 2018). Within Pterygosomatidae, the genus *Geckobia* Mégnin, 1878 exhibits the widest geographic distribution and is composed by 73 species that parasitize lizards of different families, like Gekkonidae, Phyllodactylidae, Carphodactylidae, Diplodactylidae, Eublepharidae, and Liolaemidae (Fajfer, 2012; 2018).

In Colombia, four species of non-native *Hemidactylus* occur*: H. angulatus, H. mabouia, H. garnotii* and *H. frenatus* (Vásquez-Restrepo and Lapwong, 2018), but aspects of their natural history and potential impacts on the native fauna have been poorly studied. Regarding *H. frenatus* (Fig. 1A) in this country, there is information on its geographic distribution, diet and reproduction (Caicedo-Portilla and Dulcey-Cala, 2011; Diaz *et al.,* 2017). However, there are no further data on its parasites. On this matter, we report herein for the first time two Pterygosomatidae mite species parasitizing *Hemidactylus frenatus* in an urban area of Colombia.

We collected 30 specimens of *H. frenatus* (22 adults and 8 juveniles) between 21:00 h and 23:00 h in buildings of the urban area of Sincelejo municipality (9°18'45" N; 75°24'40" W), department of Sucre, Northern Colombia. Lizards were euthanized by a thoracic injection of 2% lidocaine, vouchers were

Author for correspondence: diazpjorgea@gmail.com

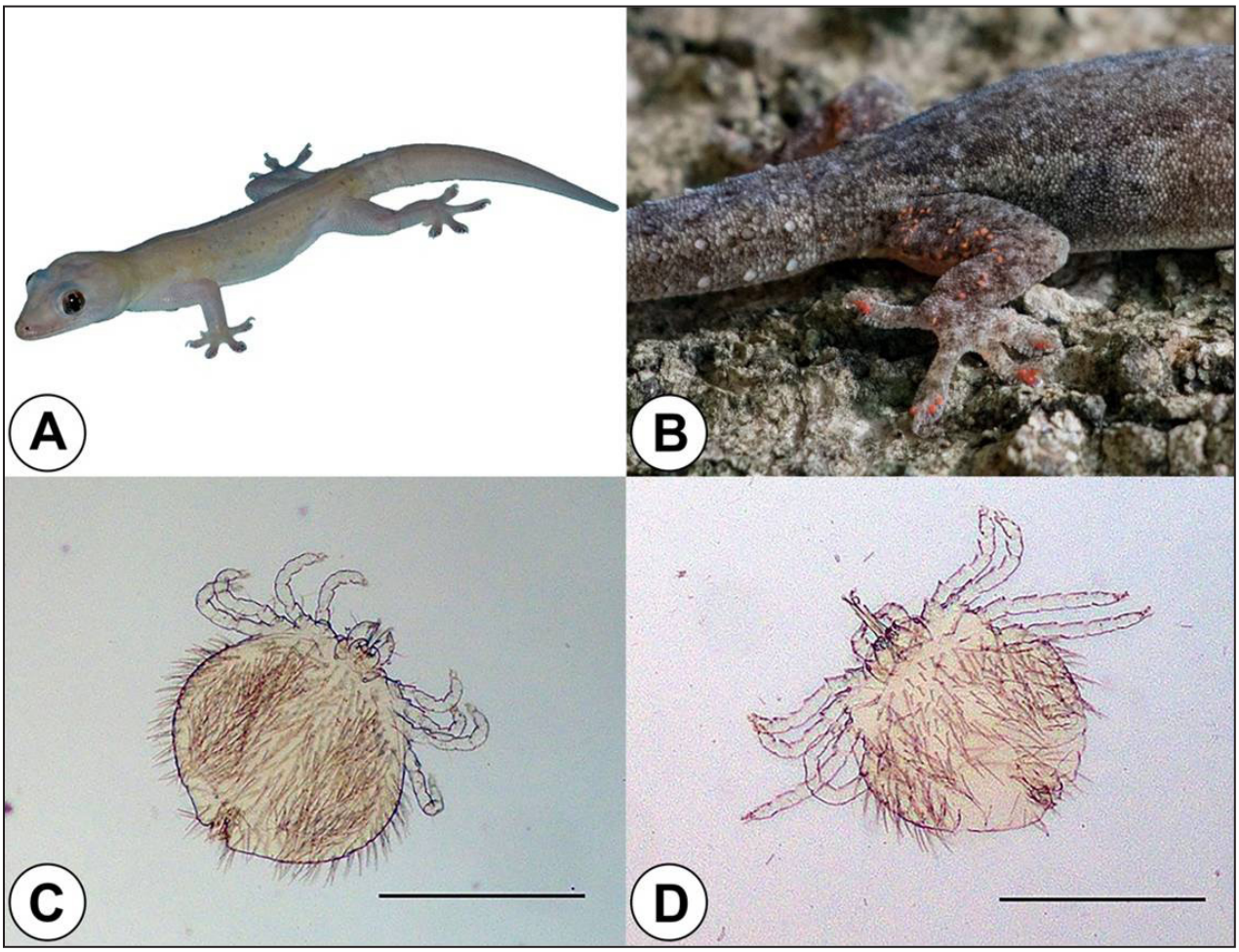

Figure 1. (**A**) Adult specimen of *Hemidactylus frenatus* from Sincelejo municipality; (**B**) Red mites on the dorsum of leg and fingers; (**C**) female of *Geckobia bataviensis* and (**D**) female of *G. keegani*, parasites of *H. frenatus* in the study area (scale bar = 500µm).

fixed in 10% formaldehyde and preserved in 70% ethanol (Pisani, 1973).

We removed external mites (Fig. 1B) from the lizards using entomological tweezers under a stereomicroscope, and preserved them in 70% ethanol. Mites were clarified using lactophenol and permanent mounts were made on microscope slides using Hoyer medium (Faraji and Bakker, 2008). Mites were identified following the key of Bertrand *et al.* (2013) for genera and species of Pterygosomatidae. We also reviewed the original description of *G. keegani* by Lawrence (1953). Prevalence and mean intensity were determined according to Bush *et al.* (1997). Vouchers of *H. frenatus* are housed in the Colección Herpetológica (UIS-R) of the Museo de Historia Natural of the Universidad Industrial de Santander (Colombia) and vouchers of mites are housed in the Colección Zoológica "Dr. Eustorgio Méndez" (CoZEM), Departamento de Investigación en Entomología Médica, Instituto Conmemorativo Gorgas de Estudios de la Salud (Panamá).

Specimens of *H. frenatus* in the study area were infested by two mite species of the family Pterygosomatidae: *Geckobia bataviensis* Vitzthum, 1926 (Fig. 1C) and *Geckobia keegani* Lawrence, 1953 (Fig. 1D). Both species of *Geckobia* are characterized by the presence of five setae on tibiae I-IV, but they differ because *G. bataviensis* has one setae in trochanter IV, which is absent in *G. keegani* (Bertrand *et al.* 2013).

Mites were observed mainly on the dorsum of posterior legs and in the distal part of the fingers between claws (Fig. 1B). In this study, 80% (24) of the collected lizards were parasitized by at least one species of *Geckobia*. On the other hand, 37.5% (3) of juveniles and 95.45% (21) of adults were parasitized by one or both mite species. From the total, 58.3% (14) of lizards were parasitized by the two mite species at the same time. The prevalence of *G. bataviensis* (50%) was lower than that of *G. keegani* (76.6%) and the mean intensity was similar for both

mites (Table 1).

This is the first record in Colombia of *Geckobia bataviensis* and *G. keegani*, parasitic mites usually dispersed by the Asian house gecko *H. frenatus*, as previously reported from other regions, both in native areas and in those where this gecko was introduced (Bochkov and Mironov, 2000; Frenkel and Vargas, 2005; Heath and Withaker, 2015). *Geckobia bataviensis* is the most common scale mite on *H. frenatus* throughout its distribution, even in sites where this lizard is invasive and can be found along with other mite species but more often found with *G. keegani*, as we observed in the present study (Prawasti *et al.,* 2013; Heath and Withaker, 2015).

In the studied area, we observed *H. frenatus* inhabiting houses also with the native Yellow-headed Gecko *Gonatodes albogularis* (Duméril and Bibron, 1836), which is more frequent in backyards and gardens into crevices. It is known that invasive species can transmit their parasites to native relatives when colonizing new areas, affecting the local parasite dynamics and native host species (Prenter *et al.,* 2004; Barnett *et al.,* 2018). Hoskin (2011) considers that the ectoparasitic mites of *H. frenatus* could represent a potential threat for native lizard species; blood-feeding mites are capable of transmit blood parasites, such as pentastomids of the genus *Raillietiella*, which could affect host reproduction, competitive abilities and survival (Barton, 2007; Hoskin, 2011). Nevertheless, there is still no evidence about transmission of pterygosomatid mites from invasive to native gecko species or vice versa (Bertrand *et al.,* 2008; Barnett *et al.,* 2018). Pterygosomatid mites spend their entire life on geckos, and may be only transmitted during close and prolonged contact (e.g., during mating or fighting). Native and invasive gecko species in Colombia may occupy different microhabitats, which may reduce the chance or eventually prevent mite transmission from the latter (Barnett *et al.,* 2018). In the study area *H. frenatus* and *G. albogularis* occupy different microhabitats and are active at different times of the day (*H. frenatus* is mainly nocturnal and *G. albogularis* is diurnal). Additionally, we did not observed agonistic interactions between them. Thus, we hypothesize that these factors would not favor mite transmission from *H. frenatus* to native geckos (*e.g., G. albogularis*). However, this topic should be evaluated more rigorously.

Hemidactylus frenatus is a common species in the Caribbean Region and inter-Andean valleys of Colombia, occurring generally between 0 and 1600 m. elevation (Caicedo-Portilla and Dulcey-Cala, 2011; this species was also registered in the Amazonia region of Colombia, in Leticia municipality (Caicedo-Portilla, 2019). Therefore, is possible that parasitic mites reported also occur in other ecosystems across the distributional range of this invasive gecko in Colombia. Regarding mites, *H. frenatus* may host other parasites such as cestodes, nematodes, trematodes, coccidia, apicomplexans and pentastomids (Upton *et al.,* 1994; Hanley *et al.,* 1995; Hanley *et al.,* 1998), but the impact of this parasites on native species remains to be studied. Finally, we aim that future research would address the evaluation of the prevalence and effects of external parasites in both native and invasive geckos living in syntopy, to obtain valuable information on the potential impacts of invasive *Hemidactylus* species.

Table 1. Prevalence and mean intensity of parasitism in *Hemidactylus frenatus*.

Mite species	Prevalence (# specimens)	Mean intensity
Geckobia bataviensis	50% (15)	9.66
G. keeganii	76.6% (23)	11.6

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