

Is *Geckobiella stamii* (Acari: Pterygosomatidae) a hyperparasite or phoretic on *Amblyomma dissimile* (Acari: Ixodidae) associated with *Iguana iguana* from Panama?

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Short note

ABSTRACT

In this work, we present the first report of an interaction between *Geckobiella stamii* and *Amblyomma dissimile* removed from green iguanas (*Iguana iguana*) of Panama. From 3045 *A. dissimile* examined, one larva, two females and one male had mites adhered to the body and 23 female and 3 male ticks had mite eggs on the ventral surface of the idiosoma. The eggs were covered with white finger-like covers. The possible nature of the interaction between *G. stamii* and *A. dissimile* is discussed.

Keywords Pterygosomatidae; *Geckobiella stamii*; mite-tick interactions; *Amblyomma dissimile*; *Iguana iguana*; Panamá

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Lizards in the family Iguanidae are commonly parasitized by different groups of ectoparasites, mainly mites and ticks (Corn *et al.*, 2011; Martínez-Salazar *et al.*, 2015). In these reptiles, mites of the genera *Geckobiella* (Pterygosomatidae) and *Amblyomma* (Ixodidae) ticks are among the most frequently observed (Guglielmone *et al.*, 2003; Corn *et al.*, 2011; Paredes-León *et al.*, 2012; Murgas *et al.* 2013). To date, *Geckobiella* comprises 12 species, which parasitize lizards in the families Iguanidae, Phrynosomatidae, Crotaphytidae and Tropiduridae (Paredes-León *et al.*, 2012; Paredes-León and Guzmán-Cornejo, 2015), although individual species often have restricted host ranges. At least 13 species of *Amblyomma* are regular parasites of Neotropical cold-blooded terrestrial vertebrates (Guglielmone *et al.*, 2003). Both types of ectoparasite feed on host blood.

Geckobiella stamii appears to be a specific parasite of iguanas and has been reported from green iguanas (*Iguana iguana*) in captivity in the Netherlands (Jack, 1961), United States (Corn *et al.*, 2011), Mexico (Paredes-León *et al.*, 2012), Panama (Murgas *et al.*, 2013) and Italy (Mendoza-Roldán *et al.*, 2019), and from *Iguana delicatissima* from the Dominican Republic (Knapp *et al.*, 2012). With the exception of some information on taxonomy, hosts and/or distribution, little is known about the biology of *G. stamii*. *Amblyomma dissimile* is among the main parasites of reptiles and amphibians in the Americas, and the green iguana is among its main hosts, although it has also been reported from diverse birds and mammals (Guglielmone *et al.*, 2003).

In this paper, we show interactions between *G. stamii* and *A. dissimile* in different localities of Panama and present some hypotheses on the nature of this association. During a review of the ticks from the Ectoparasite Collection of the Zoological Collection “Dr. Eustorgio Méndez”, Gorgas Memorial Institute of Health Studies (CoZEM-ICGES), specimens of *A. dissimile* were found with mites and/or mite egg covers attached to the idiosoma. Non-adhered mites with similar morphology were also found loose in the vials.

These data corresponded to the following locations: 1 ♀. PANAMÁ: Prov. Chiriquí. Bugaba. 2 April 2015. Ex: *Iguana iguana*. Col: Juan Bernal. 21 ♀, 4 ♂, 1 larva. PANAMÁ: Prov. Panamá. Corozal. 25 October 2018-30 January 2019. Ex: *Iguana iguana*. Col: Indra Rodríguez. 1 ♀. PANAMÁ: Prov. Los Santos. Tonosí, La Honda. 25 March 2019. Ex: *Iguana iguana*. Col: Daniel González. The geographical location of each site is presented in Figure 1.

The ticks were examined individually using a Leica MZ125 stereomicroscope and photographed with a Leica DFC500 digital camera, and the images were processed with the IM50 and Combine ZP photography software. The mites removed from the ticks were mounted on slides with Hoyer solution and observed with a Leica DME. The morphological identification of *G. stamii* was based on the characters described by Jack (1961), Paredes-León *et al.* (2012) and Paredes-León and Guzmán-Cornejo (2015). Mite vouchers were deposited in CoZEM-ICGES.

From a total of 3042 examined *A. dissimile* ticks (1454 larvae, 768 nymphs, 215 females

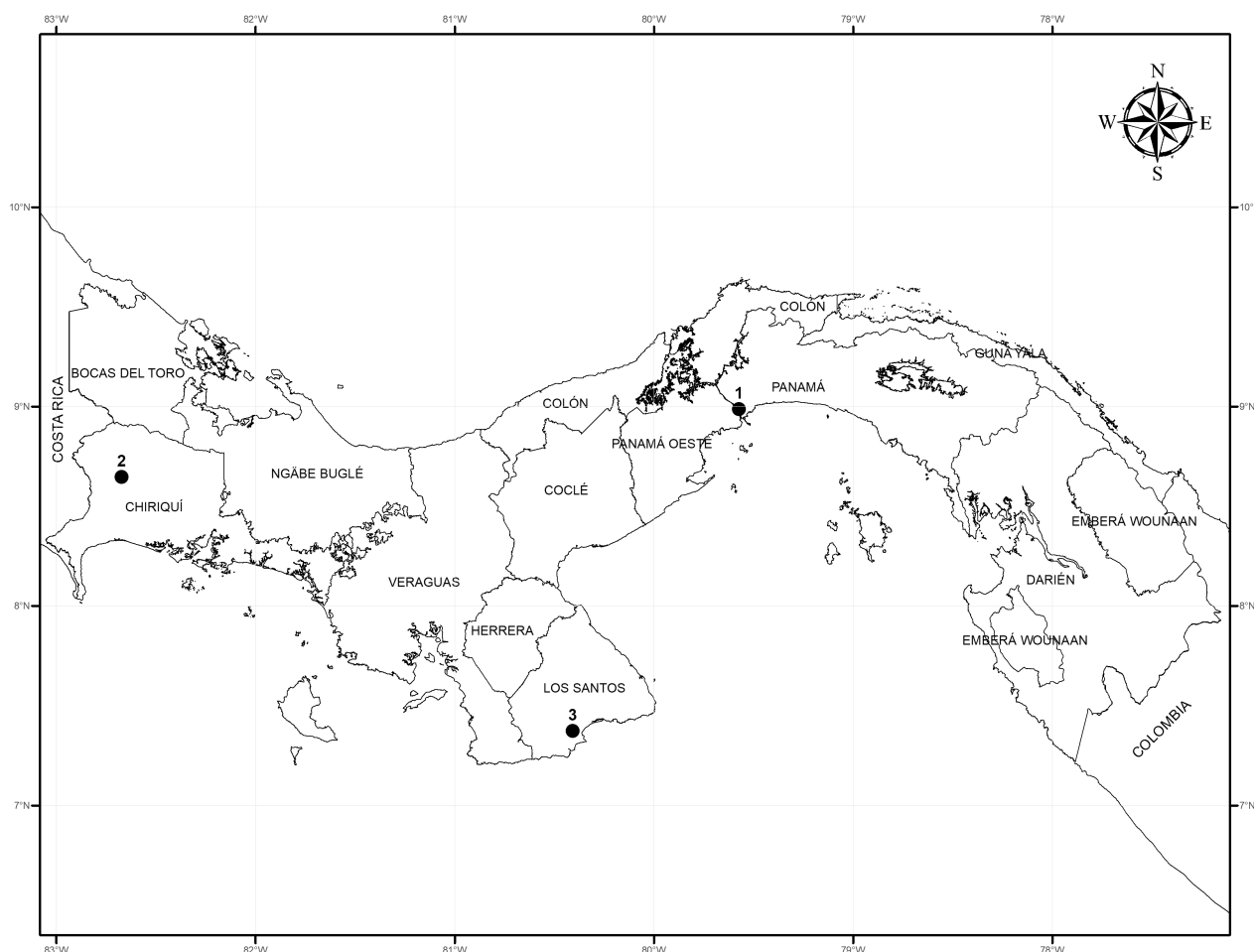


Figure 1 Map of the locations where *Geckobiella stamii* was found associated with *Amblyomma dissimile*. 1: Corozal, Panamá province; 2: Bugaba, Chiriquí province; 3: Tonosí, Los Santos province.



Figure 2 Egg covers of *Geckobiella stamii* attached to the ventral surface of *Amblyomma dissimile*.

and 605 males), two females, one male and one larva had mites adhering to different parts of the idiosoma. Twenty-three females and 3 males had with white finger-like covers on the ventral surface of the idiosoma, that protected eggs. The number of covers per tick varied from 1 to several tens (Figures 2 and 3).

This is the first interaction report between *G. stamii* and *A. dissimile* and is one of the few records of mites associated with ticks. The findings obtained from three locations, separated by hundreds of kilometers, suggests that this association is not a local event. Until now, the known interactions between mites and other arthropods include predation, parasitism, hyperparasitism (parasitism of parasites) and phoresy, and there are few reports of mite-tick interactions (Walter and Proctor, 1999; Durden *et al.*, 2018).

With exception of quiescent instars (protonymph and tritonymph), all stages of *Geckobiella* are parasites of reptiles, and there are no suggested instances of predation or hyperparasitism for this species. Reports of tick hyperparasites have been mainly reported when ticks parasitize other ticks (Bhat, 1968; Labruna *et al.*, 2007; Durden *et al.*, 2018). To our knowledge, the only report of mites parasitizing ticks was reported by Durden *et al.* (2015), who found a larva of *Leptus* (Erythraeidae) on *Amblyomma torrei* in the Bahamas. In that paper, the authors showed a picture where one larva is attached to the leg articulation of the tick, allowing ingestion of hemolymph. Unlike *Geckobiella*, larvae of *Leptus* are known parasites of arthropods (Southcott, 1999; Haitlinger, 2000; Mcaloon and Durden, 2000; Miranda and Bermúdez, 2008).

Many details on the biology of *Geckobiella* remain unknown, especially relating to oviposition and host questing behaviors. Murgas *et al.* (2013) reported eggs of *G. stamii* placed on the scales of *I. iguana*, suggesting that *G. stamii* is a permanent parasite. Our observations, however, show that female *G. stamii* can deposit her eggs on *A. dissimile*, secreting a protective cover, similar to that described by Goodwin (1953) for *G. texana*. Thus, it is possible that *G. stamii* use *A. dissimile* as a surrogate substrate for oviposition.

Since the females of *A. dissimile* detach from the iguana host to oviposit in the soil and subsequently die, using the tick as substrate for oviposition could represent a disadvantage for *G. stamii* if the tick dies far from a new host. However, if the tick female detaches into nesting

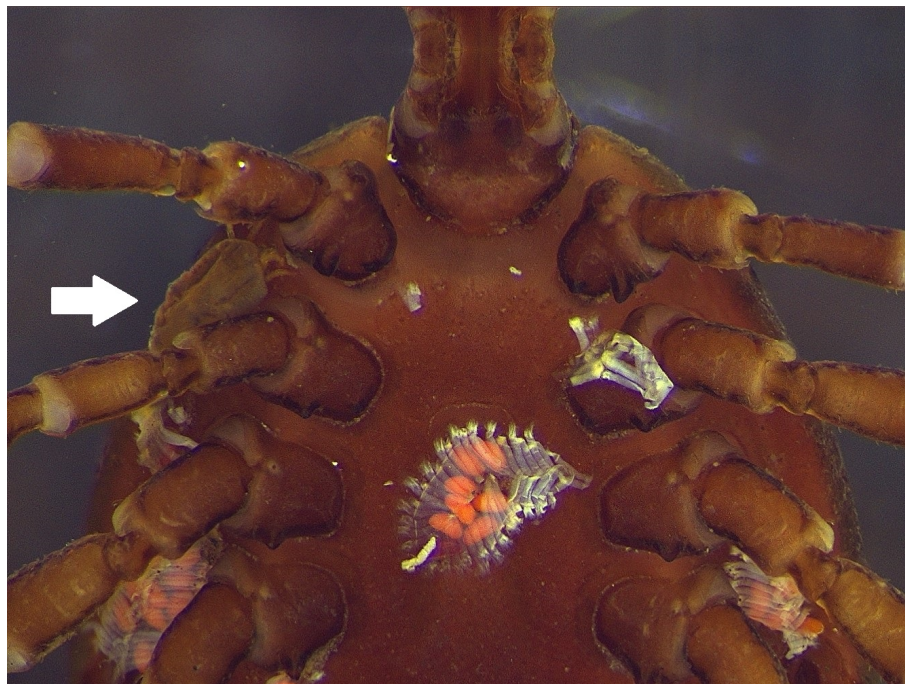


Figure 3 *Geckobiella stamii*, adult (white arrow) and egg covers, attached to ventral surface of *Amblyomma dissimile*.

or resting sites of the iguana, it would facilitate mite larvae accessing another iguana host. In this sense, *G. stamii* “gains” mobility by placing its eggs on a species (e.g. *A. dissimile*) with a higher dispersal capacity. This reasoning could also be assumed for male or immature ticks, since it is possible that their movements allow transportation to other parts of the iguana. Thus, it is possible that *G. stamii* uses *A. dissimile* as a way to reach new potential hosts (in the case of larvae and female of *A. dissimile*) or other parts of the body of the iguana (in the case of the male of *A. dissimile*).

These observations present an interesting interaction between these two parasites of green iguanas. Despite the wide distribution of *A. dissimile* in the Americas, this type of behavior has not been previously recorded, which could mean that a unique example of phoresy or hyperparasitism has gone unnoticed for now. Further observations are now necessary to improve our understanding of the nature and frequency of this association.

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