REPTILES & AMPHIBIANS

Record Number of Mites, *Geckobia hemidactyli* (Pterygosomatidae), on a Tropical House Gecko (*Hemidactylus mabouia*) in Cuba

Rafael Borroto-Páez and Denise Reyes Pérez

Instituto de Geografía Tropical, Calle F entre 13 y 15, Vedado, La Habana, Cuba (rborroto@geotech.cu [corresponding author], ORCID 0000-0001-5855-5605; borroto@yahoo.com, ORCID 0000-0002-0658-3783)

Parasites often are key players in the invasion processes of their hosts; they can mediate the outcome and impact of invasions or might themselves become invasive species (Dunn 2009; Tompkins et al. 2011). Identifying their presence along with the invasive host species is therefore of utmost importance. The establishment of invasive species can also affect native species by spreading non-native parasites, pathogens, and diseases (Murphy and Myers 1993; Goldberg et al. 1998; Goldberg and Bursey 2000; Kraus 2009; Dunn et al. 2012; Norval et al. 2014; Jiménez Quirós 2014; Dunn and Hatcher 2015; Weterings et al. 2019). However, the effects that introduced ectoparasites hitchhiking on invasive species could have on new native hosts has not been assessed effectively in any areas invaded by their hosts (Kraus 2009).

Within the mite family Pterygosomatidae (Actinedida), the genus *Geckobia* Mégnin 1878 exhibits the widest geographic distribution (Machado et al. 2019) and a high diversity of 73 species that parasitize lizards of families (Gekkonidae, Phyllodactylidae, Carphodactylidae, Diplodactylidae, and Eublepharidae) in the infraorder Gekkota (Fajfer 2012, 2018), but also lizards in the family Liolaemidae (Fajfer and González Acuña 2013) and some turtles (Bauer et al. 1990). Twelve species of *Geckobia* have been recorded in the Americas, of which three are considered exotic hitchhikers that arrived with invasive lizard hosts: *Geckobia bataviensis* (Vitzthum 1926) and *G. keegani* (Lawrence 1953) with the Common House Gecko (*Hemidactylus frenatus*) (Díaz et al. 2020) and *G. hemidactyli* (Lawrence 1936) with the Tropical House Gecko (*H. mabouia*) (Martínez Rivera et al. 2003).

Geckobia hemidactyli is a common and ubiquitous ectoparasite of *Hemidactylus mabouia* and has been recorded from several localities in the Western Hemisphere, suggesting that its entry occurred with the introduction of its host. The mite is present only in adults and subadults, but not in juveniles. To date, *G. hemidactyli* in the Americas has been found only on *H. mabouia*, no other pterygosomatid mites have been identified from live hosts (Martínez Rivera et al. 2003), and mite infestations are rarely reported when new localities of these invasive geckos are identified.

Five species of pterygosomatid mites have been reported from Cuba (Paredes-León et al. 2013), and the genus *Geckobia* is represented by only two species, *G. tarentolae* on the native American Wall Gecko (*Tarentola americana*) (de la Cruz 1973) and *G. hemidactyli* on the invasive Tropical House Gecko, the latter first reported from museum material collected in the 1960s at the U.S. Naval Base at Guantanamo Bay in eastern Cuba (Martínez Rivera et al. 2003). However, *H. mabouia* has been present in Cuba since the colonial period, probably arriving with the slave trade from Africa

Fig 1. Site where a gravid female Tropical House Gecko (*Hemidactylus mabouia*), heavily infested with mites (*Geckobia hemidactyli*), was collected adjacent to a twelve-story building in Boyeros Municipality, Habana, Cuba. Photograph by Rafael Borroto-Páez.

Reptiles & Amphibians ISSN 2332-4961
https://doi.org/10.17161/randa.v29i1.17058

(Kluge 1969; Vanzolini 1978), and *G. hemidactyli*, already widely distributed in Cuba although apparently only recently introduced, could still be spreading to new areas (Borroto-Páez et al. 2020).

Hemidactylus mabouia is the most abundant of Cuba's four introduced species of house geckos and is distributed across Cuba and its satellite islands, being particularly abundant in urban and rural areas (Borroto-Páez et al. 2015). It is considered invasive throughout the Caribbean and in most of the tropical and subtropical regions it has colonized outside of its natural African range (Powell et al. 1998, 2011; Weterings and Vetter 2018).

Since 2019, we have observed and counted mites on 56 geckos at three localities in Habana Province and two in Villa Clara Province. We counted mites two or three times using a 10X magnifying glass and verified our counts with photographs.

During the day on 20 February 2022, we collected a gravid female Tropical House Gecko (two eggs, body weight 5.5 g, SVL 65 mm) from under a broken concrete slab on the ground adjacent to the base of a twelve-story building in a densely populated urban zone of Boyeros Municipality, Habana (23°4'15.91"N, 82°23'44.95"W; Fig. 1). Debris (construction material, concrete, and some garbage) around the collection site also sheltered other species of geckos (Ashy Geckolet, *Sphaerodactylus elegans*; White-throated Clawed Gecko, *Gonatodes albogularis fuscus*) and anoles (*Anolis* spp.), all of which were free of mites.

This gecko had the highest number of mites we have encountered on a Tropical House Gecko. The 235 mites (Fig. 2) was almost 100 mites more than the highest infestations previously observed (133, 120, 117, and 100 mites; range 1–132, mean $\bar{x}$ = 37, n = 56). The number of mites per individual or level of infestation is rarely reported but Martínez Rivera et al. (2003) commented that individual geckos might bear three to more than 300 mites, but provided no details of counts.

High level of mite infestations have not been linked to negative effects in the health or body condition of the host or related to any diseases in animals and humans, and the aetiology and clinical significance of such parasites is poorly understood. In fact, the body weight of the gravid female without the weight of the two eggs (0.96 g) was 4.5 g, which is well in the range of geckos in good condition based on our experiences with this species. Similarly, Brennan et al. (2009) found little to no effect of ectoparasitic mites on their hosts.

Epidemiological and zoonotic information about pterygosomatid mites is sparse. Most bacteria in the genus *Rickettsia* are arthropod-borne and *Rickettsia*-like parasites have been recorded from *Hemidactylus mabouia* in Zambia (Patterson and Peirce 1982), where the most abundant mite is *Geckobia hemidactyli*. This bacterium also has been detected in an endemic lizard in New Zealand infected with congeneric mites (*G. naultina*) (Berry 2011). More recently in Brazil, *G. hemidactyli* has tested positive for *Hepatozoon* sp., a protozoan that infects blood in wild and domestic animals (Mendoza-Roldan et al. 2020b).

Relationships between endemic vertebrates and ectoparasite-borne blood pathogens are poorly known, but could represent a medical threat to humans (Mendoza-Roldan et al. 2020a). An invasive and commensal species, like *H. mabouia*, which is very abundant and widely distributed in the Cuban Archipelago, with high rates of ectoparasitic infections, must therefore be of epidemiological and conservation concern. Due to Cuba's isolation, high endemism, and significantly threatened native reptilian fauna, biosecurity should be an important consideration for Cuban wildlife management.

Corn et al. (2011) noted that after an introduction of a mite, new host-parasite interactions can develop among

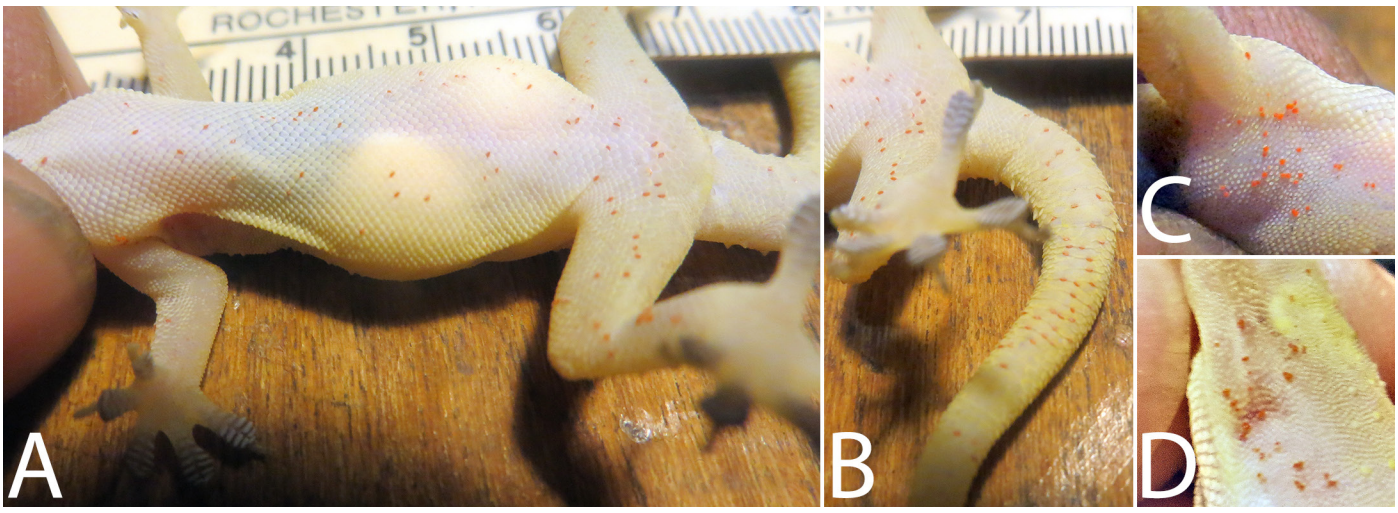

Fig. 2. A gravid female Tropical House Gecko (*Hemidactylus mabouia*) infested with 235 ectoparasitic mites (*Geckobia hemidactyli*) collected on 20 February 2022: (A) Venter (n = 41 mites) and legs (n = 46); (B) underside of the tail (n = 46); (C) right axilla (n = 31); and (D) left axilla (n = 31). Neck, dorsum, and sides, with fewer mites, are not shown. Photographs by Rafael Borroto-Páez.

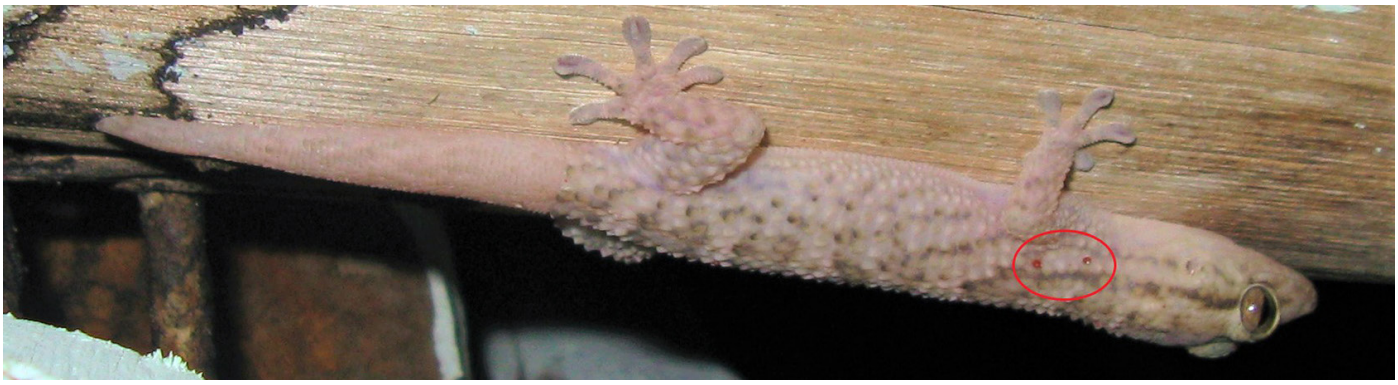

Fig. 3. An American Wall Gecko (*Tarentola americana*) from Cayo La Loma in southern part of the Ana Maria Archipelago, Ciego de Avila Province, Cuba, with two ectoparasites on the left shoulder (see text). Photograph by Rafael Borroto-Páez in 2010.

native and exotic ectoparasites and native and exotic reptilian hosts. Although at this time, no evidence suggests that pterygosomatid mites are transmitted from invasive to native species of geckos or vice versa (Bertrand et al. 2008; Barnett et al. 2018), the ecological implications of recently introduced mites in Cuba (Borroto-Páez et al. 2020), especially with such high levels of infection as we have documented for *G. hemidactyli* on an abundant house gecko (*H. mabouia*), raises concerns about a native mite (*Geckobia tarentolae*) that infests the native American Wall Gecko.

A photograph taken by RBP in 2010 of an American Wall Gecko on Cayo La Loma, in the southern part of the Ana Maria Archipelago, Ciego de Avila Province, Cuba (Fig. 3), clearly shows the presence of two orange mites on its shoulder (the first published image of *T. americana* with an ectoparasite). The only two mites known to occur on *T. americana* are in the genus *Bertrandiella* (idiosoma distinctly longer than wide) and *Geckobia* (idiosoma subcircular or barely oval) (Paredes-León et al. 2013). Unfortunately, the resolution of the photograph is not sufficient to determine if the rounded ectoparasites are *G. tarentolae* or another species.

Acknowledgements

Boris A. Fabres, Environmental Protection in the Caribbean (EPIC), helped with English and made useful suggestions that improved this manuscript. Luis F. de Armas, formerly of the Institute of Ecology and Systematics, Habana, provided opportune comments and suggestions.

Literature Cited

Bauer, A.M., A.P. Russell, and N.R. Dollahon. 1990. Skin folds in the gekkonid lizard genus *Rhacodactylus*: a natural test of the damage limitation hypothesis of mite pocket function. *Canadian Journal of Zoology* 68: 1196–1201. https://doi.org/10.1139/z90-178.

Barnett, L.K., B.L Phillips, A.C. Heath, A. Coates, and C.J. Hoskin, 2018. The impact of parasites during range expansion of an invasive gecko. *Parasitology* 145: 1400–1409. https://doi.org/10.1017/S003118201800015X.

Barry, M., M.A. Peirce, A.C.G. Heath, D.H. Brunton, and R.K. Barraclough. 2011. A new blood parasite within the relict endemic New Zealand gecko *Hoplodactylus duvaucelii*. *Veterinary Parasitology* 179: 199–202. https://doi.org/10.1016/j.vetpar.2011.02.004.

Bertrand, M., N. Cole, and D. Moodry. 2008. Adaptation in parasitic mites: spread by the host or stay with the host?, pp. 137–146. In: M. Bertrand, S. Kreiter, K.D. McCoy, A. Migeon, M. Navajas, M.-S. Tixier, L. Vial (eds.), *Integrative Acarology. Proceedings of the 6th European Congress of the European Association of Acarolgists Montpellier, 21–25 July 2008*. European Association of Acarolgists, Montpellier, France. https://hal.archives-ouvertes.fr/hal-03068797.

Borroto-Páez, R., R. Alonso Bosch, B.A. Fabres, and O. Alvarez García. 2015. Introduced amphibians and reptiles in the Cuban Archipelago. *Herpetological Conservation and Biology* 10: 985–1012.

Borroto-Páez, R., C. Martínez Rivera, and D. Reyes Pérez. 2020. Mites (*Geckobia hemidactyli*, Actinedida: Pterygosomatidae) in Tropical House Geckos (*Hemidactylus mabouia*) in Cuba: A review with new distribution records. *Reptiles & Amphibians* 27: 1–8. https://doi.org/10.17161/randa.v27i3.14852.

Brennan, A.M., E.J. Censky, and R. Powell. 2009. Effects of chigger mite (Acari: Trombiculidae) infections of *Ameiva* (Squamata: Teiidae) from the Anguilla Bank. *Contemporary Herpetology* 2009: 1–3. https://doi.org/10.17161/ch.v0i1.11932.

Corn, J.L., J.W. Mertins, B. Hanson, and S. Snow. 2011. First reports of ectoparasites collected from wild-caught exotic reptiles in Florida. *Journal of Medical Entomology* 48: 94–100. https://doi.org/10.1603/M10065.

de la Cruz, J. 1973. Nueva especie de ácaro del género *Geckobia* Megnin, 1878 (Acarina; Pterygosomidae) parásito de la *Tarentola americana* (Gray) de Cuba. *Poeyana* 102: 1–6.

Díaz, J.A., R. Torres, L. Paternina, D. Santana, and R. Miranda. 2020. Traveling with an invader: Ectoparasitic mites of *Hemidactylus frenatus* (Squamata: Gekkonidae) in Colombia. *Cuadernos de Herpetología* 34: 1–4. https://doi:10.31017/CdH.2020.(2019-027).

Dunn, A.M. 2009. Parasites and biological invasions. *Advances in Parasitology* 68: 161–184. https://doi.org/10.1016/S0065-308X(08)00607-6.

Dunn, A.M. and M.J. Hatcher. 2015. Parasites and biological invasions: Parallels, interactions, and control. *Trends in Parasitology* 31: 189–199. https://doi:10.1016/j.pt.2014.12.003.

Dunn A.M., M.E. Torchin, M.J. Hatcher, P.M. Kotanen, D.M. Blumenthal, J.E. Byers, C.A.C. Coon, V.M. Frankel, R.D. Holt, R.A. Hufbauer, A.R. Kanarek, K.A. Schierenbeck, L.M. Wolfe, and S.E. Perkins. 2012. Indirect effects of parasites in invasions. *Functional Ecology* 26: 1262–1274. https://doi.org/10.1111/j.1365-2435.2012.02041.x.

Fajfer, M. 2012. Acari (Chelicerata) – parasites of reptiles. *Acarina* 20: 108–129.

Fajfer, M. 2018. New species and records of scale mites (Acariformes: Pterygosomatidae) from geckos (Squamata: Gekkonidae and Carphodactylidae). *BioMed Research International* 2018: 1–8. https://doi.org/10.1155/2018/9290308.

Fajfer, M. and D. González-Acuña. 2013. Pterygosomatid mites of a new species group *ligare* (Acariformes: Pterygosomatidae: Pterygosoma) parasitizing tree iguanas (Squamata: Liolaemidae: *Liolaemus*). *Zootaxa* 3693: 301–319. https://doi.org/10.11646/zootaxa.3693.3.1.

Goldberg, S.R. and C.R. Bursey. 2000. New helminth records for one teiid and four gekkonid lizard species from the Lesser Antilles. *Caribbean Journal of Sciences* 36: 342–344.

Goldberg, S.R., C.R. Bursey, and H. Cheam. 1998. Gastrointestinal helminths of

four gekkonid lizards, *Gehyra mutilata, Gehyra oceanica*, *Hemidactylus frenatus* and *Lepidodactylus lugubris* from the Mariana Islands, Micronesia. *The Journal of Parasitology* 84: 1295–1298. https://doi.org/10.2307/3284696.

Jiménez Quirós, R. 2014. Riesgo potencial para la salud humana por *Salmonella* proveniente del geco casero introducido (*Hemidactylus frenatus*) en dos regiones de Costa Rica. Unpublished Tesis de Magister Scientiae, Universidad Nacional, Heredia, Costa Rica.

Kluge, A.G. 1969. The evolution and geographical origin of the New World *Hemidactylus mabouia-brooki* complex (Gekkonidae, Sauria). *University of Michigan Museum of Zoology Miscellaneous Publication* 138: 1–78.

Kraus, F. 2009. *Alien Reptiles and Amphibians: A Scientific Compendium and Analysis*. Invading Nature, Springer Series in Invasion Biology 4. Springer, Dordrecht, The Netherlands.

Machado, I., G. Gazêta, J. Pérez, R. Cunha, and A. Giupponi. 2019. Two new species of the genus *Geckobia* Mégnin, 1878 (Acariformes, Prostigmata, Pterygosomatidae) from Peru. *Zootaxa* 4657: 333–351. https://doi.org/10.11646/zootaxa.4657.2.6.

Martínez Rivera, C.C., A.G. Negrón, M. Bertrand, and J. Acosta. 2003. *Hemidactylus mabouia* (Sauria: Gekkonidae), host of *Geckobia hemidactyli* (Actinedida: Pterygosomatidae), throughout the Caribbean and South America. *Caribbean Journal of Science* 39: 321–326.

Mendoza-Roldan, J.A., D. Modry, and D. Otranto. 2020a. Zoonotic parasites of reptiles: A crawling threat. *Trends in Parasitology* 36: 677–687. https://doi.org/10.1016/j.pt.2020.04.014.

Mendoza-Roldan, J.A., S. Rocha Ribeiro, V. Castilho-Onofrio, A. Marcili, B. BorghiSimonato, M.S. Latrofa, G. Benelli, D. Otranto, and D.M. Barros-Battesti. 2020b. Molecular detection of vector-borne agents in ectoparasites and reptiles from Brazil. *Ticks and Tick-borne Diseases* 12: 101585. https://doi.org/10.1016/j.ttbdis.2020.101585.

Murphy, T.J. and A.A. Myers. 1993. A review of *Salmonella* infections in reptiles with particular reference to Gekkonidae. *Amphibia-Reptilia* 14: 357–371. https://doi.org/10.1163/156853893X00057.

Norval, G., S.R. Goldberg, C.R. Bursey, J. Mao, and K. Slater. 2014. Internal parasites of lizards from Taiwan. *Herpetological Conservation and Biology* 9: 484–494.

Paredes-León, R., N. Cuervo-Pineda, and T.M. Pérez. 2013. Pterygosomatid mites from Cuba, with the description of a new species of *Bertrandiella* (Acari: Prostigmata: Pterygosomatidae). *Revista Mexicana de Biodiversidad* 84: 1142–1152. https://doi.org/10.7550/rmb.36498.

Patterson, J.W. and M.A Peirce. 1982. Intraerythrocytic parasites of reptiles from Lochinvar National Park, Zambia. *African Journal of Ecology* 20: 293–295.

Powell, R., R.I. Crombie, and H.E.A. Boos. 1998. *Hemidactylus mabouia*. *Catalogue of American Amphibians and Reptiles* 674: 1–11.

Powell, R., R.W. Henderson, M.C. Farmer, M. Breuil, A.C. Echternacht, G. van Buurt, C.M. Romagosa, and G. Perry. 2011. Introduced amphibians and reptiles in the Greater Caribbean: Patterns and conservation implications, pp. 63–143. In: A. Hailey, B.S. Wilson, and J.A. Horrocks (eds.), *Conservation of Caribbean Island Herpetofaunas. Volume 1: Conservation Biology and the Wider Caribbean*. Brill, Leiden, The Netherlands. https://doi.org/10.1163/ej.9789004183957.i-228.38.

Tompkins, D.M., A.M. Dunn, M.J. Smith, and S. Telfer. 2011 Wildlife diseases – from individuals to ecosystems. *Journal of Animal Ecology* 80: 19–38. https://doi.org/10.1111/j.1365-2656.2010.01742.x.

Vanzolini, P.E. 1978. On South American *Hemidactylus* (Sauria, Gekkonidae). *Papéis Avulsos de Zoologia* 31: 307–343.

Weterings, R. and K. Vetter. 2018. Invasive house geckos (*Hemidactylus spp*.): Their current, potential and future distribution. *Current Zoology* 64: 559–573. https://doi.org/10.1093/cz/zox067.

Weterings, R., M. Barbetti, and H.L. Buckley. 2019. Hypothesis: Do invasive house geckos exacerbate dengue fever epidemics? *Biological Invasions* 21: 3533–3543. https://doi.org/10.1007/s10530-019-02066-x.