New records of the mites Geckobia bataviensis Vitzthum, 1926 and Pterygosoma dracoensis Jack, 1962 (Trombidiiformes: Pterygosomatidae) from Timor-Leste

Fernando de C. Jacinavicu1†1, Ricardo Bassini-Silva1,2†, Fabrício H. Oda3, Hinrich Kaiser4,5†

1Laboratório de Coleções Zoológicas, Instituto Butantan, São Paulo, SP, Brazil. 2Departamento de Patologia, Reprodução e Saúde Única, Faculdade de Ciências Agrárias e Veterinárias-UNESP, Jaboticabal, SP, Brazil. 3Laboratório de Zoologia, Departamento de Química Biológica, Universidade Regional do Cariri, Crato, CE, Brazil. 4Department of Biology, Victor Valley College, Victorville, CA, USA. 5Leibniz Institute for the Analysis of Biodiversity Change, Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany.

†Corresponding author: fcjacinavicius@gmail.com

Received: November 01, 2021. Accepted: December 01, 2021. Published: December 07, 2021.

Abstract. We report on the presence of scale mites (Trombidiiformes: Pterygosomatidae) parasitizing three species of lizards in Timor-Leste. Geckobia bataviensis Vitzthum, 1926 was found associated with the Common House Gecko, Hemidactylus frenatus Duméril & Bibron, 1836, and the Indopacific Tree Gecko, Hemiphyllodactylus typus Bleeker, 1860, whereas Pterygosoma dracoensis Jack, 1962 was found on the patagia of a Timor Flying Dragon, Draco timoriensis Kuhl, 1820. The association of G. bataviensis with H. frenatus was well documented previously, but this is the first properly documented record of this mite for Timor-Leste. Our report of G. bataviensis on H. typus is the first association of this mite with this gecko. This is the second report of P. dracoensis on D. timoriensis and the first for Timor-Leste.

Keywords: Scale mites, ectoparasites, Hemidactylus frenatus, Hemiphyllodactylus typus, Draco timoriensis.

Mites of the family Pterygosomatidae Oudemans, 1910 (Acari: Trombidiiformes) are permanent ectoparasites primarily associated with several groups of lizards (Fajfer 2015; 2018; 2020). These pterygosomatids or scale mites are organized into 13 genera that comprise over 180 species (Fajfer 2019). Among them, Geckobia Mégner, 1878 is a diverse group (> 65 species) specialized to parasitize geckos (Gekkonidae Gray, 1825; Phyllodactylidae Gamble, 1878; Diplodactylidae Kluge, 1967; Carphodactylidae Kluge, 1967; Eublepharidae Boulenger, Greenbaum & Jackman, 2008; Carphodactylidae Kluge, 1967) and tree iguanas (Liolaemidae Frost & Etheridge, 1989) (Bertrand 2013). In contrast, Pterygosoma Peters, 1849 includes at least 50 species associated with African and Asian agamid lizards (Fajfer 2020).

During the first comprehensive amphibian and reptile survey of Timor-Leste (Kaiser et al. 2011; 2013; O’Shea et al. 2012; 2015; Sanchez et al. 2012), ectoparasite samples from various reptiles were included in the ancillary collections. Among these were mites from the geckos Hemidactylus frenatus Duméril & Bibron, 1836 (Gekkonidae) and Hemiphyllodactylus typus Bleeker, 1860 (Gekkonidae), and from the flying dragon Draco timoriensis Kuhl, 1820 (Agamidae). We here report on new records for Geckobia bataviensis Vitzthum, 1926 parasitizing the two gecko species and Pterygosoma dracoensis Jack, 1962 parasitizing the flying dragon in Timor-Leste.

Lizard specimens included in this report were collected in Timor-Leste during two research surveys (January-February 2010, June-July 2012). They were euthanized using pericardial injections with 1% procaine, fixed in 10% formalin, and preserved in 70% ethanol. Mites were removed by gentle tugging with fine-point forceps during the post-mortem, pre-fixation examination and preserved in 95% ethanol.

Scale mites were removed from preservative and slide-mounted in Hoyer’s medium, following the procedure described by Barros-Battesti et al. (2021). Mite specimens were deposited in the Acarological Collection of the Instituto Butantan, São Paulo, Brazil (IBSP) under accession numbers IBSP 16506-16511. They were identified to genus using the key to pterygosomatid genera of Bertrand (2013), and to species using keys for Geckobia (Bertrand 2013) and Pterygosoma (Fajfer 2020). Microscope images were taken using a Leica DM400B compound microscope with phase contrast. Extended focal range images were compiled using the Leica Application Suite v. 2.5.0, and images were further improved using Adobe Photoshop v. 13.0.

Geckobia bataviensis Vitzthum, 1926

Specimens. We recovered a total of 52 female specimens of G. bataviensis (Fig. 1A-C) from the following five geckos: H. frenatus (USNM 579085), collected at 3.2 km south of Tua Koin Lodge, Ataúro Island, Dili Municipality, Timor-Leste (8°16'13''S; 125°36'8''E, elevation 30 m) on 30 January 2010, two females (IBSP 16506); H. frenatus (USNM 579735) collected at Barry’s Place, Ataúro Island, Dili Municipality, Timor-Leste (8°13'6''S; 125°36'41''E, sea level) on 28 January 2012, five females (IBSP 16509); H. frenatus (USNM 580492) collected near Bagua, Baucau Municipality, Timor-Leste (8°37'12''S; 126°39'29''E, elevation 439 m) on 30 June 2012, 25 females (IBSP 16508); H. frenatus (USNM 579079) collected on a tree in the dry bed of the Marae River, west of Maubara, Liquiça Municipality, Timor-Leste (8°37'22''S; 125°10'14''E, elevation 30 m) on 6 February 2010, 14 females (IBSP 16508); H. typus (USNM 580503) collected at Ossohuna, Baucau Municipality, Timor-Leste (8°40'41''S; 126°37'01''E, elevation 105 m) on 29 January 2010, 50 females (IBSP 16506-16511). They were identified to genus using the key to pterygosomatid genera of Bertrand (2013), and to species using keys for Geckobia (Bertrand 2013) and Pterygosoma (Fajfer 2020). Microscope images were taken using a Leica DM400B compound microscope with phase contrast. Extended focal range images were compiled using the Leica Application Suite v. 2.5.0, and images were further improved using Adobe Photoshop v. 13.0.

Geckobia bataviensis Vitzthum, 1926

Specimens. We recovered a total of 52 female specimens of G. bataviensis (Fig. 1A-C) from the following five geckos: H. frenatus (USNM 579085), collected at 3.2 km south of Tua Koin Lodge, Ataúro Island, Dili Municipality, Timor-Leste (8°16'13''S; 125°36'8''E, elevation 30 m) on 30 January 2010, two females (IBSP 16506); H. frenatus (USNM 579735) collected at Barry’s Place, Ataúro Island, Dili Municipality, Timor-Leste (8°13'6''S; 125°36'41''E, sea level) on 28 January 2012, five females (IBSP 16509); H. frenatus (USNM 580492) collected near Bagua, Baucau Municipality, Timor-Leste (8°37'12''S; 126°39'29''E, elevation 439 m) on 30 June 2012, 25 females (IBSP 16508); H. frenatus (USNM 579079) collected on a tree in the dry bed of the Marae River, west of Maubara, Liquiça Municipality, Timor-Leste (8°37'22''S; 125°10'14''E, elevation 30 m) on 6 February 2010, 14 females (IBSP 16508); H. typus (USNM 580503) collected at Ossohuna, Baucau Municipality, Timor-Leste (8°40'41''S; 126°37'01''E, elevation 938 m) on 1 July 2012, six females (IBSP 16507).

Records. Geckobia bataviensis is a widely distributed scale mite that has been recorded parasitizing several species of the lizard genera Hemidactylus Goldfuss, 1820, Gehyra Gray, 1834, and Gekko Laurenti, 1768. It is the most common scale mite associated with H. frenatus (Fig. 2A), a human commensal gecko that has been introduced to many tropical and subtropical areas all over the world from its presumed Indo-Malayan origin (Vitzthum 1926; Domrow 1983; Haitlinger 1988;
Domrow 1991; Lever 2003; Paredes-León et al. 2008; Hoskin 2011; Prawasti et al. 2013; Heath & Whitaker 2015; Diaz et al. 2020). Other than *H. frenatus*, *G. bataviensis* is known to parasitize several other members of the genus *Hemidactylus*, including H. "brookii" in Asia (Bochkov & Mironov 2000), *H. turcicus* (Linnaeus, 1758) in Mexico (Paredes-León et al. 2008), *H. platyurus* (Schneider, 1797) (reported as *Cosymbatus platyurus* by Prawasti et al. 2013), and *H. garnoti* Duméril & Bibron, 1836 in Hawaii (Tenório 1985). Heath & Whitaker (2015) identified scale mites collected on lizards by New Zealand MPI quarantine authorities and reported the presence of *G. bataviensis* on transported geckos *Geckyrna mutillata* (Wiegmann, 1834), *G. oceanica* (Lesson, 1830), *Gekko gecko* (Linnaeus, 1758), H. cf. *brookii*, *Hemidactylus flaviviridis* Rüppell, 1835, *H. frenatus*, *H. garnoti*, and *H. platyurus*, arriving from American Samoa, Australia, Cambodia, China, Cook Islands, Ecuador, Fiji, French Polynesia, Hong Kong, Japan, Malaysia, New Caledonia, Niue, Pakistan, Philippines, Papua New Guinea, Réunion, Samoa, Singapore, Solomon Islands, Taiwan, Thailand, Timor-Leste, Tonga, Tuvalu, Vanuatu, Vietnam, and Wallis Island. However, these authors did not specifically connect localities and hosts, making a specific host-parasite association impossible.

**Taxonomy.** *Geckobia bataviensis* displays significant morphological variability and was once considered distinct from its current junior synonyms *G. gledaviana* Hirst, 1926, *G. nepalii* Hriegarud, Joshee & Soman, 1959, and *G. cosymboti* Cuy, 1973 (Domrow 1983; Hattlinger 1988). However, studies using integrative tools and species delimitation might be able to confirm if these morphological variations are indeed intraspecific or should be considered species specific. According to Bertrand (2013), *G. bataviensis* can be reliably identified by the absence of setae in Genus I and IV (Fig. 1 A-C).

**Association.** Our report of *G. bataviensis* on *H. typus* is the first association of this mite with this gecko. Our specimens confirm the association of *G. bataviensis* with *H. frenatus*, and this is the first locality-specific record for this scale mite in Timor-Leste. Among the parasitized individuals, mites were invariably present on the toes, in the spaces between the claw and the lamellae (Fig. 2A). There did not appear to be any difference in mite numbers or position between front and hind toe infections. Additional areas of mite attachment were primarily the ventral parts of the hind legs, with very few mites found on the venter itself. We never located these mites on dorsal surfaces.

**Pterygosoma dracoensis Jack, 1962**

Specimens. Even though multiple specimens were present on the body of the lizard (Fig. 2B), we were only able to recover a single complete female specimen of *P. dracoensis* (IBSP 16510; Fig. 1D-F) from a female *D. timoriensis* (USNM 579711) collected from a tree opposite the Dare Memorial Museum, Dili Municipality, Timor-Leste (8°35′49″S; 125°34′35″E, elevation 545 m) on 26 January 2012.

**Records.** *Pterygosoma dracoensis* was originally described by Jack (1962) from type material collected from different specimens on different islands in the Indonesian archipelago. Jack (1962) based the description on female and male type specimens obtained from *Draco lineatus amboinensis* (Lesson, 1834) in the Moluccas (Ambon, Seram), and a nymph and larvae from *D. boschmai* Hennig, 1936 (reported as *D. reticulatus* Günther, 1864) in the Lesser Sundas (Flores). Additional listed material of this species was collected from specimens of *D. beccari* W. Peters & Doria, 1878 from Indonesia (South Sulawesi), *D. blandfordi* Boulenger, 1885 from southern Thailand (Malay Peninsula), *D. lineatus* Daudin, 1802 from Indonesia (Java), *D. ornatus* Gray, 1845 from the central Philippines (Dinagat), *D. volans* Linnaeus, 1785 from the “East Indies,” *D. cornutus* Günther, 1864 from Borneo, *D. spilopterus* (Wiegmann, 1834) from the northern Philippines (Luzon), *D. timoriensis* from Indonesia (Alor), and on *D. moculatus* (Gray, 1845) from India (Arunachal Pradesh) (Jack 1962; Fajfer 2020).

**Taxonomy.** *Pterygosoma dracoensis* can be identified by the type of ps setae (tapered and serrate) and the numerous dorsal-median setae (Fig. 1D-F).

**Association.** Here, we report the second association of *P. dracoensis* with *D. timoriensis*, from a new locality, Timor-Leste. The female *Draco* with these mites was the only individual among the entire collection, on which we were able to locate parasites. Mites were attached on the ventral surface of the left patagium (Fig. 2B), including one additional adult and several nymphs. The collection was complex based on the size and vulnerability of these organisms, and only a single adult was ultimately available for study.
Acknowledgements

For their assistance with fieldwork, we thank the students of the Winter 2010 and Summer 2012 surveys, Zach Brown, Melissa Carrillo, Jester Ceballos, Scott Heacox, Stephanie Hughes, Andrew Kathriner, Eric Leatham, Aaren Marsh, Gloria Morales, Justin Rader, Caitlin Sanchez, Dan Suzio, David Taylor, Marianna Tucci, and MJ Weil. Our fieldwork would not have been as productive nor entertaining without the wonderful assistance of our young Timorese colleagues, Venancio Sanchez, Dan Suzio, David Taylor, Marianna Tucci, and MJ Weil. Our gratitude to Claudia Abate-Debat, former special advisor in Prime Minister Gusmão’s Office, who opened many doors and helped us in so many ways overcome hurdles. We thank Manuel Mendes, Director of National Parks, for issuing collecting and export permits. The work on the mites was supported by the Fundação de Amparo à Pesquisa do Estado de São Paulo under grants 2017/01416-7, 2018/24667-8, and 2020/11755-6 to the second author, and 2019/19853-0 to the first author. This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brazil - Finance Code 001. Research in Timor-Leste was funded in part by student travel grants from the Associated Student Body at Victor Valley College and the Victor Valley College Foundation. This paper is Contribution No. 25 from the Tropical Research Initiative at Victor Valley College.

Authors’ Contributions

FCJ and RB-S examined, confirmed the identification of the mites and deposited the slides at the IBSP Collection. FCJ, RB-S, and FHO performed the study. HK confirmed the identification of the hosts and collected the samples. FCJ, RB-S, FHO, and HK co-wrote the manuscript.

References

Barros-Battesti, D. M.; Jacinavicius, F. C.; Bauchan, G.; Bassini-Silva, R. (2021) Chapter 24: Techniques for studies on Acariformes. In: Barros-Battesti, D. M.; Machado, R. Z.; André, M. R. (Eds.), Brazilian ectoparasite fauna of veterinary importance, Volume I, Mite fauna of veterinary importance: Acariformes, pp. 294-303. Jaboticabal: CBPV.

Bertrand, M.; Kukushkin, O.; Pogrebnyak, S. (2013) A new species of mites of the genus Geckobia (Prostigmata, Pterygosomatidae), parasitic on Mediodactylus kotschyi (Reptilia, Gekkota) from Crimea. Vestnik Zoologii, 47: 1-13. doi: 10.2478/vzoz-2013-0009

Bochkov, A. V.; Mironov, S. V. (2000) Two new species of the genus Geckobia (Acar: Pterygosomatidae) from geckons (Lacertilia: Gekkonomorpha) with a brief review of hostparasite associations of the genus. Russian Journal of Herpetology, 7: 51-58. doi: 10.30906/1026-2296-2000-7-1-61-68

Diaz, J. A.; Torres, R. A.; Paternina, L. E.; Santana, D. J.; Miranda, R. J. (2020) Traveling with an invader: ectoparasitic mites of Hemidactylus frenatus (Squamata: Gekkonidae) in Colombia. Cuadernos de herpetología, 34(1): 79-82. doi: 10.31017/CdH.2020.2019-027

Drow, R. (1983) Acari from Operation Drake in New Guinea I. Pterygosomatidae. Acarologia, 24: 393-402.

Domrow, R. (1991) Acar Protstigmata (excluding Trombiculidae) parasitic on Australian vertebrates: an annotated checklist, keys and bibliography. Invertebrate Taxonomy, 4: 1283-1376. doi: 10.1071/IT99101283

Fajfer, M. (2020) A systematic revision of the scale mite genus Pterygosoma Peters, 1849 (Acariformes: Pterygosomatidae). Zootaxa, 4805(1): 001-147. doi: 10.11646/zootaxa.4805.1.1

Fajfer, M. (2018) New species and records of scale mites (Acariformes: Pterygosomatidae) from geckos (Squamata: Gekkonidae and Capromastacidae). BioMed Research International, 2018: 9290308. doi: 10.1155/2018/9290308

Fajfer, M. (2019) Systematics of reptile-associated scale mites of the genus Pterygosoma (Acariformes: Pterygosomatidae) derived from external morphology. Zootaxa, 4603 (3): 401-440. doi: 10.11646/zootaxa.4603.3.1

Fajfer, M. (2012) Acari (Chelicera) - Parasites of reptiles. Acarina, 20(2): 108-129.

Fajfer, M. (2015) Mites of the new species group nitidus (Acariformes: Pterygosomatidae: Geckobia), parasites of lizards in South America. Systematic Parasitology, 90(2): 213-220. doi: 10.1007/s11230-014-9545-9

Haitlinger, R. (1988) Species of Geckobia Megnin, 1878 (Acar, Protstigmata, Pterygosomidae) from Madagascar and Vietnam. Wiadomosci Parazytologiczne, 34: 161-175.

Heath, A. C.; Whitaker, A. H. (2015) Mites (Acar: Pterygosomatidae, Macronyssidae) taken from lizards intercepted at the New Zealand border. Systematic and Applied Acarology, 20: 739-757. doi: 10.11158/saa.20.7.3

Hoskin, C. J. (2011) The invasion and potential impact of the Asian House Gecko (Hemidactylus frenatus) in Australia. Austral Ecology, 36: 240-251. doi: 10.1111/j.1442-9993.2010.02143.x

Jack, K. M. (1962) New species of Pterygosoma (Acar, Pterygosomatidae). Proceedings of the Zoological Society of London, 138: 579-603.

Kaiser, H.; Lopez Carvalho, V.; Ceballos, J.; Freed, P.; Heacox, S.; Lester, J.
B.; Richards, S. J.; Trainor, C. R.; Sanchez, C.; O’Shea, M. (2011) The herpetofauna of Timor-Leste: a first report. *Zookeys*, 109: 19-86. doi: 10.3897/zookeys.109.1439

Kaiser, H.; Sanchez, C.; Heacox, S.; Kathriner, A.; Varela Ribeiro, A.; Afranio Soares, Z.; Lemos de Araujo, L.; Mecke, S.; O’Shea, M. (2013) First report on the herpetofauna of Ataúro Island, Timor-Leste. *Check List*, 9(4): 752-762. doi: 10.15560/9.4.752

Lever, C. (2003) *Naturalized Reptiles and Amphibians of the World*. New York: Oxford University Press.

O’Shea, M.; Sanchez, C.; Kathriner, A.; Lopes Carvalho, V.; Varela Ribeiro, A.; Afranio Soares, Z.; Lemos de Araujo, L.; Kaiser, H. (2012) First update to herpetofaunal records from Timor-Leste. *Asian Herpetological Research*, 3: 114-126. doi: 10.3724/SPJ1245.2012.00114

O’Shea, M.; Sanchez, C.; Kathriner, A.; Mecke, S.; Lopes Carvalho, V.; Varela Ribeiro, A.; Afranio Soares, Z.; Lemos de Araujo, L.; Kaiser, H. (2015) Herpetological diversity of Timor-Leste: updates and a review of species distributions. *Asian Herpetological Research*, 6(2): 73-131. doi: 10.16373/j.cnki.ahr.140066

Paredes-León, R.; García-Prieto, L.; Guzmán-Cornejo, C.; León-Régagnon, V.; Pérez, T. M. (2008) Metazoan parasites of Mexican amphibians and reptiles. *Zootaxa*, 1904: 1-166. doi: 10.11646/zootaxa.1904.1.1

Prawasti, T. S.; Farajallah, A.; Raffiudin, R. (2013) Three species of ectoparasite mites (Acari: Pterygosomatidae) infested geckos Indonesia. *Hayati Journal of Biosciences*, 20: 80-88. doi: 10.4308/hjb.20.2.80

Sanchez, C.; Lopes Carvalho, V.; Kathriner, A.; O’Shea, M.; Kaiser, H. (2012) First report on the herpetofauna of the Oecusse District, an exclave of Timor-Leste. *Herpetology Notes*, 5: 137-149.

Tenório, J. (1985) Two new lizard mites from Hawaii. *Proceedings of the Hawaiian Entomological Society*, 25: 19-20.

Vitzthum, H. G. (1926) Malayische Acari. *Tribüa*, 8: 1-198.