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First report of *Ornithodoros puertoricensis* (Argasidae) and *Amblyomma dissimile* (Ixodidae) on *Tamandua mexicana* (Myrmecophagidae)

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Ticks are blood-sucking ectoparasites recognized for their ability to parasitize domestic, wild, and human vertebrates. These are important in the medical and veterinary fields due to the health problem that they can represent to their hosts (Bowman & Nuttall 2008). These problems can be directly due to causing anemia, allergic reaction, and flaccid paralysis, or indirectly due to the transmission of pathogens (Sonenshine & Roe 2013). Ticks belong to the order Ixodida, which consists of three extant families: Ixodidae (hard ticks), Argasidae (soft ticks), and Nuttalliellidae. The Ixodidae family comprises around 758 species distributed in 17 genera, while in the Argasidae around 219 species are distributed in five genera which are still controversial (Muñoz-Leal *et al.* 2020; Guglielmone *et al*. 2021). The distribution of the Ixodidae and the Argasidae families can be considered cosmopolitan, mainly of medium and warm climates, although specimens have been found in sub-Antarctic biogeographic regions (Guglielmone *et al*. 2004).

Tamandua mexicana y *Tamandua tetradactyla* are mammals belonging to the Pilosa order, in the family Myrmecophagidae (Alzate-Gavira *et al*. 2016). These mammals inhabit tropical and subtropical dry and humid forests, deciduous and evergreen. They can also be found in mangroves and grasslands with some trees (Superina *et al*. 2010). *Tamandua mexicana* is distributed in México, Guatemala, El Salvador, Honduras, Costa Rica, Panamá, Colombia, northwest Venezuela, Ecuador and northwest Perú. *Tamandua tetradactyla* is found in Colombia, Venezuela, Brazil, Bolivia, east of Ecuador and Perú and northern Argentina. In Colombia, *T. mexicana* is found in the northwestern, while *T. tetradactyla* is established in the southeast (Navarrete & Ortega 2011; Alzate-Gavira *et al*. 2016).

Although in recent years there has been an increase in tick studies in the Caribbean region, studies that contribute to their diversity, distribution and ecology are still necessary to understand the dynamics of disease transmission. In particular, studies about argasids are scarce, so contributing to the knowledge of their distribution and ecology is important. This study reports new interactions of hard and soft tick species with *T. mexicana.*

The female *T. mexicana* was found by chance encounter during the dry season in a fragment of tropical dry forest in the department of Magdalena, Colombia (11°13'18.31" N, 74°11'08.80" W, elevation 21 m). A total of 17 larvae of soft ticks (Fig. 1), and 49 larvae and 5 nymphs of hard ticks (Figs. 2 and 3, respectively) were collected alive on *T. mexicana*, highlighting that these were in large numbers scattered throughout the entire body of the animal. The collected larvae were taken

from the ventral and dorsal areas, these being the places with the highest infestation. The ticks were collected using entomological forceps with a thin tip and removed from the distal part of the capitulum to avoid detachment of the hypostome (oral organ that pierces the skin) and these were preserved in vials with absolute ethanol. Ticks were identified using a Leica M205A motorized industrial microscope and following specific taxonomic keys and descriptions (Hooker *et al*. 1912; Endris *et al*. 1989; Martins *et al*. 2010). Micrographs were taken from a specimen of each type of tick and stage, using the equipment mentioned above.

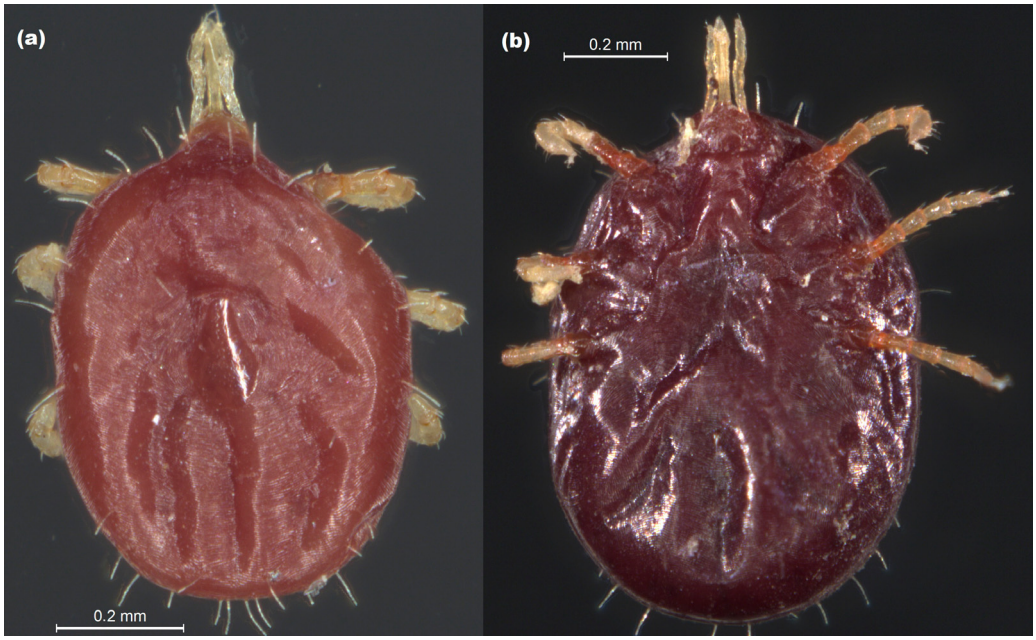

FIGURE 1. Larva of *Ornithodoros puertoricensis.* **(a)** Dorsal view, **(b)** Ventral view.

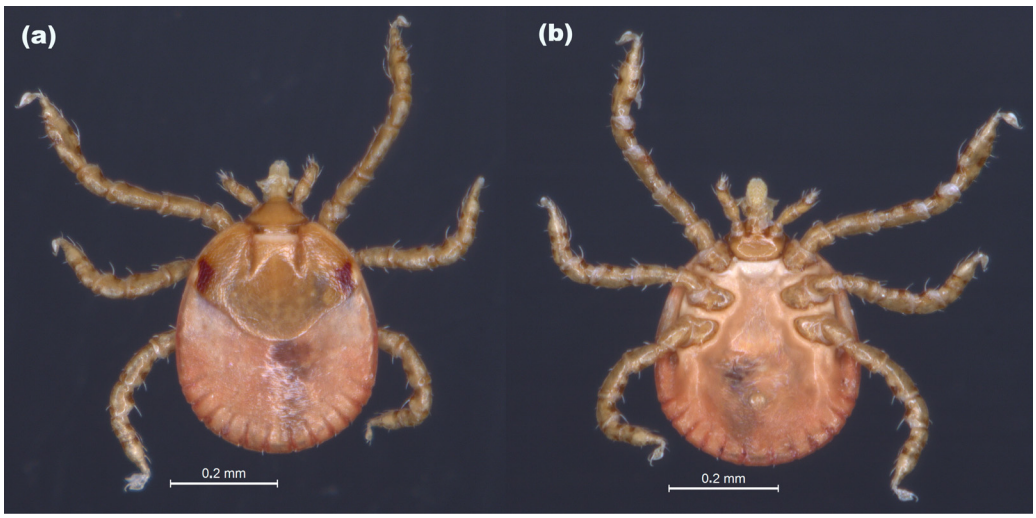

FIGURE 2. Larva of *Amblyomma dissimile*. **(a)** Dorsal view, **(b)** Ventral view.

FIGURE 3. Nymph of *Amblyomma dissimile.* **(a)** Dorsal view, **(b)** Ventral view.

For the confirmation of the species, two pools containing three larvae, one for each species were subjected to amplification and sequencing of CO1 and 16S rRNA genes. All the other specimens were kept as vouchers in the molecular biology lab of Universidad del Magdalena. 16S rRNA amplification was performed using primers 16S + 1 (5'-CCGGTCTGAACTCAGATCAAGT-'3) and 16S-1 (5'-GCTCAATGATTTTTTAAATTGCTGT-'3) (Mangold *et al.* 1998) and CO1 amplifica tion was performed using two pairs of primers: ArF2 (5'-GCICCIGAYATRGCITTYCCI CG-3 ') and ArF5 (5'-GTRATIGCICCIGCIARIACIGG-3') (Gibson *et al.* 2014) and LCO1490 (5'-GGT CAA CAA ATC ATA AAG ATA TTG G -3 ') and HCO2198 (5' - TAA ACT TCA GGG TGA CCA AAA AAT CA-3 ') (Folmer *et al.* 1994). 16S rRNA and CO1 genes were sequenced in both directions. The sequences were edited with the BioEdit program (Hall *et al.* 2011) and the evaluation of the nucleotide sequences was carried out through comparative analysis with the existing sequences in the GenBank database using the BLASTN program (National Center For Biotechnology Information - http: //www.ncbi.nlm.nih.gov/).

The specimens were morphologically and molecularly identified as *Amblyomma dissimile* and *Ornithodoros puertoricensis*. For *O. puertoricensis*, edited sequences were of 421 pb for the 16S rRNA (GenBank accession number: OK086765) and of 561 bp for the CO1 (GenBank accession number: OK086764). For *A. dissimile*, sequences were of 388bp for 16S rRNA (GenBank accession number: OK086764) and 561 bp for CO1 (GenBank accession number: OK086766). All sequences were compared with GenBank reference sequences. A 99.51% identity percentage was obtained for *O. puertoricensis* MZ005590.1 and MZ005589.1 (López *et al.* 2021) with the 16S rRNA sequence. For the CO1 sequence, an identity of 82.55% was obtained with the species *Ornithodoros spheniscus* MN027573.1 (Muñoz-García *et al*. 2019), this is due to the fact that in GenBank there are no records of sequences of this gene for *O. puertoricensis*. For *A. dissimile* an identity of 98.97% was obtained with the sequence of 16S rRNA KY389391.1 (Ulloa *et al*. 2019) and 100% for the sequence of CO1 MF095086.1 (Santodomingo *et al.* 2018).

There are few records of ticks on *T. mexicana*, all of which correspond to hard tick species (Muñoz-García *et al.* 2019; Guglielmone *et al.* 2021). *Amblyomma dissimile* is a tick whose main hosts are amphibians and reptiles (Guglielmone & Nava 2010), however, it has also been found parasitizing a large number of hosts, including birds and mammals (Nava *et al.* 2017). *Ornithodoros puertoricensis*, on the other hand, has been found parasitizing mammals, reptiles, and birds (Endris *et al*., 1989; Bermúdez *et al*. 2010), and had been reported by Jones et al (1972) parasitizing *T. tetradactyla* in Falcon State, Venezuela. Until now, in Colombia, there was only one record of *O. puertoricensis* in mammals of the species *Canis familiaris* in the department of Sucre (Paternina *et al*. 2009).

Our study is first record of a tick species of the Argasidae family (*O. puertoricensis*) and *A. dissimile* on *T. mexicana* and extends the geographic distribution of *O. puertoricensis* in Colombia.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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