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Notas científicas / Scientific note

A case of gynandromorphism in *Amblyomma mixtum* (Acari, Ixodidae)

Un caso de ginandromorfismo en *Amblyomma mixtum* (Acari, Ixodidae)

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Abstract: Gynandromorphism is a condition in which an organism simultaneously exhibits male and female morphological characteristics. In Colombia, the taxon *Amblyomma cajennense* is represented by the species *Amblyomma patinoi* and *Amblyomma mixtum*. In September of 2014, in the Colombian Orinoco region, adult ticks were collected and determined from natural infections in bovines and equines. A gynandromorph was described from a natural infestation on a bovine, and morphologically classified as *A. mixtum*. This is the first literature report of a gynandromorph of *A. mixtum*, and the first description of a gynandromorph for a tick species in Colombia.

Key words: Biology, ticks, Neotropic.

Resumen: Ginandromorfismo es una condición donde un organismo exhibe simultáneamente características morfológicas de macho y hembra. En Colombia el taxón *Amblyomma cajennense* está representado por las especies *Amblyomma patinoi* y *Amblyomma mixtum*. En septiembre de 2014 en la Orinoquía colombiana, de infecciones naturales de bovinos y equinos, se colectaron y determinaron garrapatas adultas. En una infección natural de bovino se describió un ginandromorfo clasificado morfológicamente como *A. mixtum.* Éste es el primer registro en la literatura de un ginandromorfo *A. mixtum*, y la primera descripción de un ginandromorfo para una especie de garrapata en Colombia.

Palabras clave: Biología, garrapata, Neotropico.

Introduction

Until a few years ago, the taxon *Amblyomma cajennense* (Fabricius, 1787) represented a single tick species distributed from southern United States to northern Argentina (Estrada-Peña *et al.* 2004). Recently, the taxon was reorganized into a complex of six valid species: *A. cajennense sensu stricto* (Fabricius, 1787) (restricted to the Amazonian region), *Amblyomma mixtum* Koch, 1844 (from Texas to western Ecuador), *Amblyomma sculptum* Berlese, 1888 (northern Argentina, Bolivia, Paraguay, Brazil), *Amblyomma interandinum* Beati, Nava and Cáceres, 2014 (inter-Andean valley of Peru), *Amblyomma tonelliae* Nava, Beati and Labruna, 2014 (dry areas of northern Argentina, Bolivia, and Paraguay), and *Amblyomma patinoi* Labruna, Nava and Beati, 2014 (Eastern Cordillera of Colombia) (Beati *et al*. 2013; Nava *et al*. 2014). In Colombia, this species complex is currently represented by *A. patinoi* (Nava *et al*. 2014) and *A. mixtum* (Rivera-Páez *et al*. 2016). Nevertheless, the current knowledge of the distribution of these species in America is likely incomplete and a species-level definition is necessary (Nava *et al*. 2014). At least three species of the complex, namely *A. sculptum*, *A. mixtum*, and *A. patinoi*, are important vectors of the bacterium *Rickettsia rickettsii*, the causal agent of the Rocky Mountain spotted fever, the deadliest tick-borne bacterial disease of the world (Krawczak *et al*. 2014; Labruna *et al*. 2014; Faccini-Martínez *et al*. 2015).

Gynandromorphs are individuals that possess phenotypic characteristics of males and females, and have been reported in several insect, spider, and tick taxa (Eritja 1996; Labruna *et al*. 2002). Their maturation begin during embryonic development, due to a loss of or damage to sex chromosomes, binucleated eggs, or infections related to *Wolbachia* species, a common endosymbiont (Narita *et al*. 2010; Keskin *et al*. 2012). Gynandromorphism in ixodid ticks is little known, but the phenomenon has been extensively reviewed and approximately 77 naturally-occurring cases have been documented (Prusinski *et al*. 2015). In the genus *Amblyomma*, over 20 cases have been reported among nine species, including *A. cajennense*, from which two cases have been reported (Labruna *et al*. 2002). Based on the geographical origin (southeastern Brazil) of these cases in *A. cajennense*, they are likely to correspond to *A. sculptum.* To date, no descriptions or records of gynandromorph presence have been reported in ticks in the Colombian territory.

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Material and methods

During a field study on ticks infesting domestic animals in the Colombian Orinoco region, Arauca municipality, Arauca department (07°3'55"N, 70°44'2"W) during September of 2014 (Rivera-Páez *et al*. 2016), the presence of a gynandromorphy specimen of *A. mixtum* was noticed and collected from a cow (*Bos taurus*). The gynander was taxonomically evaluated (Jones *et al*. 1972; Nava *et al*. 2014), through a light microscope (Leica M205C stereomicroscope) and a scanning electron microscope (SEM) (Hitachi Scanning Electron Microscope, model TM3000) following techniques described by Corwin *et al*. (1979).

Results and discussion

All male and female specimens in the Orinoquía region of Colombia (Rivera-Páez *et al*. 2016) presented external morphological characters of *A. mixtum*, the males of *A. mixtum* the principal diagnostic character is the tick body outline, round in *A. mixtum* and oval in *A. patinoi* (Figs. 1A, 2A) and females of *A. mixtum* can be differentiated from females belonging to the other species of the group by the combination of notal setae stout and long, more densely distributed on the posterior half of the notum (Fig. 2A), small tubercles (Fig. 2A), and a U-shaped genital aperture with 2 narrow lateral flaps (Nava *et al*. 2014). Dorsally, the gynandromorph of *A. mixtum* showed the left idiosoma with male characteristics and a right idiosoma with typical female characteristics. Conversely, the capitulum possessed female traits at both sides, including a pair of porose areas and equal-sized palps (Figs. 1A, 2A-2B). A dorsal midline separated the scutum in the male side, where it covered the alloscutum, and the female side showed a reduced scutum, typical of females (Figs. 1A, 2A). The scutum of the specimen showed typical female ornamentation and punctations on the right side, and typical male ornamentation and punctuations on the left side as well (Figs. 1A, 2A). The dorsal midline ended at the middle of the sixth festoon, which had male and female halves corresponding to the rest of the dorsal area. A distinct complete lateral groove, typical of *A. mixtum* males, was also present at the male half (Figs. 1A, 2A).Ventrally, the results support those observed at the dorsal view, with a left side that corresponds to the typical male, and a right side corresponding to female, with the ventral midline extending from the capitulum to the sixth festoon (Figs. 1B, 2C). The spurs on coxae I–III were typical of the corresponding sex on each side; conversely, coxa IV spur is typically male at both sides, corresponding to a single long, stout, pointed spur (Figs. 1B, 2C-2D).

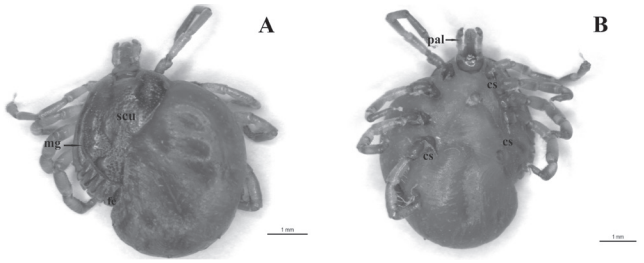

Figure 1. (A) Dorsal and **(B)** Ventral view of *Amblyomma mixtum* gynandromorph. (cs) coxal spur, (fe) festoons, (mg) marginal groove, (pal) palps, (scu) scutum.

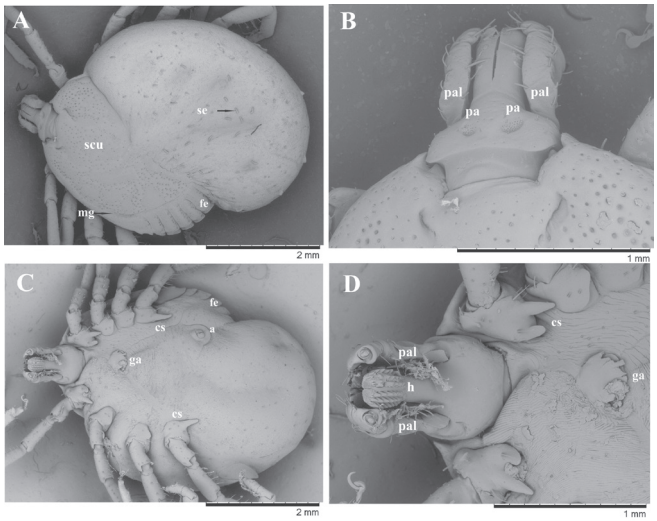

Figure 2. Scanning Electron Microscopy (SEM) of *Amblyomma mixtum* gynandromorph. **A.** dorsal view. **B.** dorsal basis capitulum. **C.** ventral view. **D.** ventral basis capitulum. (a) anal aperture, (cs) coxal spur, (fe) festoons, (ga) genital aperture, (mg) marginal groove, (h) hypostome, (pal) palps, (pa) porose area, (scu) scutum, (se) setae.

According to previous definitions of the types of gynandromorphism in ticks (Campana-Rouget 1959), the gynandromorph of *A. mixtum* described in this study is classified as a gynander intriqué of a protogynander, which means that the external sex-linked features are equally represented, except for ''islands'' of male or female chitin embedded in areas of the opposite sex. In the present specimen, these "islands" are present in the capitulum (mostly of the female type) at the male side, and at coxa IV of the female side. The most common type of gynandromorphism is a bipartite protogynander, whereas gynander intriqué is very rare in ticks (Labruna *et al*. 2002; Keskin *et al*. 2012). Among the genus *Amblyomma,* the bipartite protogynander is indeed the most common type of gynandromorphism (Labruna *et al*. 2002; Campana-Rouget 1959).

This research represents the first record of a tick gynandromorphin Colombia, and the first for *A. mixtum*.

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