



## Original article

Reestablishment of *Amblyomma tenellum* Koch, 1844 (Acari: Ixodidae)Santiago Nava<sup>a</sup>, Lorenza Beati<sup>b,\*</sup>, Jason Dunlop<sup>c</sup>, Alberto A. Guglielmo<sup>a</sup><sup>a</sup> Instituto Nacional de Tecnología Agropecuaria, Estación Experimental Agropecuaria Rafaela and Consejo Nacional de Investigaciones Científicas y Técnicas, CC 22, CP 2300 Rafaela, Santa Fe, Argentina<sup>b</sup> United States National Tick Collection, Institute for Coastal Plain Science, Georgia Southern University, Statesboro, GA 30460, USA<sup>c</sup> Museum für Naturkunde, Leibniz Institute for Research on Evolution and Biodiversity at the Humboldt-University Berlin, Invalidenstrasse 43, D-10115 Berlin, Germany

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## ABSTRACT

Herein, *Amblyomma tenellum* Koch, 1844 (Ixodidae) is reestablished as a valid tick name and removed from the synonymy list of *Amblyomma cajennense* (Fabricius, 1787), while *Amblyomma imitator* Kohls, 1958, is relegated to a junior synonym of *A. tenellum*. *Amblyomma tenellum* is redescribed based on the examination of male type specimens collected by Deppe at the beginning of the 19th century in Mexico and described by Koch in 1844.

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## Introduction

While reassessing the taxonomic status of the ticks related to *Amblyomma cajennense* (Fabricius, 1787) (Ixodidae) (Beati et al., 2013; Nava et al., 2014), we had the opportunity to examine type material of all the species that were synonymised with it. Among these, *Amblyomma tenellum* Koch, 1844 (Ixodidae), is a tick that was formally described by the German arachnologist Carl Ludwig Koch based on material deposited in the Museum für Naturkunde Berlin, Germany. The label and catalogue entry simply reads “Mexico, Deppe” with a footnote in the catalogue book which reads “Koch lag nur 1 ♂ vor” (i.e. Koch could only examine 1 ♂). The 2 male ticks were collected by the German naturalist Ferdinand Deppe (1794–1861) who was born (and died) in Berlin and whose older brother, Wilhelm, was an accountant at the museum under its older name, the Zoologisches Museum Berlin (ZMB).

Ferdinand Deppe was a gardener appointed to the Royal Gardens, but was suggested by the then director of the museum, Hinrich Lichtenstein, as a suitable naturalist for an expedition to Mexico organised by Count von Sack, a chamberlain to the King of Prussia. Their expedition lasted from 1824 to 1827 – although Sack departed earlier in 1825 – the approximate route being Alvarado,

Mexico City, Oaxaca, Tehuantepec, and back via Oaxaca to Alvarado (see Stresemann, 1952, for further details). Deppe subsequently returned to Mexico in 1828 in company with the botanist Wilhelm Schiede. They collected plants and animals primarily in the Veracruz region, but their efforts to sell them to European museums were not economically successful and, in 1830, Deppe was forced to work for a merchant company and travelled mostly in western and northern Mexico, before returning to Germany in 1836. A precise locality or date for the types of *A. tenellum* is unfortunately not available, nor is there any indication of the original host. Nevertheless, the museum was founded in 1810 and thus these specimens are among the oldest acquisitions of the arachnological collections.

Neumann (1899) first reduced *A. tenellum* to a synonym of *Amblyomma maculatum* Koch, 1844 (Ixodidae). Later, after examining Koch's types in Berlin, Neumann (1901) transferred *A. tenellum* to the synonymy list of *A. cajennense*. Tonelli-Rondelli (1937) considered *A. tenellum* to be a valid species, distinct from *A. cajennense*, and she described and illustrated the types in great detail and listed diagnostic characters differentiating *A. tenellum* from all related species. About 2 decades later, Aragão and Fonseca (1953) and Kohls (1958) again synonymised *A. tenellum* with *A. cajennense*. Aragão and Fonseca (1953) ascribed morphological differences between *A. tenellum* and *A. cajennense* to mere intraspecific polymorphism, albeit without actually having examined Koch's types. Kohls (1958) examined the 2 males forming the type series of *A. tenellum* when he established a new tick species, *Amblyomma imitator* Kohls, 1958

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**Fig. 1.** *Amblyomma tenellum* male, dorsal, lectotype (1043a, at the Museum für Naturkunde, Berlin, Germany).



**Fig. 2.** *Amblyomma tenellum* male, ventral, lectotype (1043a, at the Museum für Naturkunde, Berlin, Germany).

(Ixodidae), from southern Texas and Mexico. While morphological differences between the males of *A. imitator* and *A. cajennense* were carefully detailed by Kohls (1958), and later by Sundman (1966) and Hilburn et al. (1989), the similarities between *A. imitator* and *A. tenellum* were mostly ignored. Kohls (1958) mentioned only the fact that the 2 species were related, but regarded *A. imitator* as a different taxon from *A. tenellum* because “to date, characters for positive identification of all males of the latter (*A. tenellum*) have not been discovered”.

The recent morphological and molecular reevaluation of the taxonomic status of *A. cajennense* – and of related species – revealed that *A. cajennense* is a complex comprising at least 6 different species (Beati et al., 2013; Nava et al., 2014), namely *A. cajennense* sensu stricto, *Amblyomma sculptum* Berlese, 1888 (Ixodidae), *Amblyomma mixtum* Koch, 1844 (Ixodidae), *Amblyomma tonelliae* Nava, Beati & Labruna, 2014 (Ixodidae), *Amblyomma interandinum* Beati, Nava & Cáceres, 2014 (Ixodidae), and *Amblyomma patinoi* Labruna, Nava & Beati, 2014 (Ixodidae). In agreement with Tonelli-Rondelli's (1937) opinion, however, *A. tenellum* was removed from the synonymy of *A. cajennense* based on the reexamination of Koch's types, which did not match morphologically any of the newly described species. The collection data of the material examined for the *A. cajennense* species group are detailed in Nava et al. (2014). These findings prompted the present redescription of *A. tenellum* and its thorough comparison with *A. imitator*; a species which occurs (like *A. tenellum*) in Mexico and Texas and which was so-named by Kohls (1958) because of its morphological resemblance to *A. cajennense*. Despite its phenotypic similarity with *A. cajennense*, *A. imitator* was actually shown to be molecularly more closely related to *Amblyomma americanum* (L.) (Ixodidae), a morphologically very different species, than to the members of the *A. cajennense* group (Beati et al., 2013), confirming the view of Kohls (1958) and Hilburn et al. (1989) that it is a taxonomic entity distinct from the *A. cajennense* group.

The 2 males forming the original type series of *A. tenellum* (Figs. 1–4) are deposited in the Museum für Naturkunde, Berlin, under the collection number ZMB 1043. The specimens were originally dry and pinned, but according to the catalogue notes, they were transferred into alcohol in February 1968. There is a highly faded original green label bearing the name “Deppe” and (probably) “Mexico”, while 3 other older labels read “1043”, “*tenellum*” and “Type”. A more modern label repeats these data and adds a distinction into 1043a and b, but does not specify a lectotype or paralectotype among the 2 animals present nor indicates who proposed this division. In their type catalogue for the Berlin ticks, Moritz and Fischer (1981, p. 362) did not recognise an a and b, but noted: “Für die Beschreibung der Art hatte Koch ein ♂ vorliegen. Unter der Katalognummer ZMB 1043 sind heute aber 2 ♂ registriert,



**Fig. 3.** *Amblyomma tenellum* male, dorsal, paralectotype (1043b, at the Museum für Naturkunde, Berlin, Germany).

die nicht näher differenziert werden können”. (For the description of the species, Koch had 1 ♂ available. Under the catalogue number ZMB 1043, 2 ♂♂ are registered which cannot be readily differentiated.) It would, of course, be better to make the tick that Koch saw the lectotype, but it is impossible to determine now which one he actually used for his description.



**Fig. 4.** *Amblyomma tenellum* male, ventral, paralectotype (1043b, at the Museum für Naturkunde, Berlin, Germany).



**Fig. 5.** *Amblyomma imitator* male, dorsal, allotype (RML10021 at the U.S. National Tick Collection, Statesboro, GA, USA).

## Materials and methods

The specimens are redescribed here, and both were measured and photographed using a BK Plus Lab System camera (Visionary Digital). All measurements are given in millimetres. The description of the scutal ornamentation of the males was carried out following the terminology described in Nava et al. (2014). Males of *A. tenellum* were compared with the males of *A. imitator* deposited in the United States National Tick Collection (USNTC), including the allotype specimen (RML 10021; Figs. 5 and 6). The collection data of *A. imitator* males examined are as follows: Allotype ♂ (RML 10021) ex *Capra hircus*, Brownsville, USA; 1 ♂ (RML 37824), host unknown, Chapulhuacan, Mexico; 1 ♂ (RML 37555) ex human, Taniui, Mexico; 1 ♂ (RML 37445) ex cattle, locality unknown (Cohauila de Zaragoza), Mexico; 3 ♂♂ (RML 15494) ex donkey, Villa de Santiago, Mexico; 1 ♂ (RML 17458) ex human, El Bañito, Mexico; 1 ♂ (RML 17461) ex *Didelphis* sp., El Bañito, Mexico; 10 ♂♂ (RML 57509) ex horse, Santa Fe, Mexico; 1 ♂ (RML 57564) vegetation, Brownsville, USA; 2 ♂♂ (RML 57516) locality and host unknown; 5 ♂♂ (RML 57509) ex horse, Santa Fe, Mexico; 5 ♂♂ (RML 57551) ex *Tayassu tajacu*, Uvalde, USA; 4 ♂♂ (RML 57508) ex horse, Santa Fe (18 miles south of Matamoros), Mexico; 2 ♂♂ (RML 57539) ex cattle, Victoria, Mexico; 4 ♂♂ (RML 57500) ex human, Tampico, Mexico.

## *Amblyomma tenellum* Koch, 1844

### Redescription of male (Figs. 1–4)

Body oval to pyriform in outline, broadest at level of legs IV, total length 2.92–3.03, length from apices of scapulae to posterior body margin 2.60–2.69, width 1.87–2.10, scapulae pointed, marginal groove complete, and delimiting all festoons, eyes flat; scutum ornate and glabrous, heavily punctated in all areas, with brown spots delimited by whitish enamelled stripes, cervical spots elongated posteriorly, limiting spots and antero-accessory spots clearly defined, first and second lateral spots fused and third lateral spot clearly outlined and horizontally oriented, postero-median spot long (sometimes club-shaped) and narrower than enamelled



**Fig. 6.** *Amblyomma imitator* male, ventral, allotype (RML10021 at the U.S. National Tick Collection, Statesboro, GA, USA).

stripe separating it from postero-accessory spot. Festoons: longer than wide, with chitinous ventral plates (carenas). Basis capituli sub-rectangular, width 0.47–0.50, length 0.57–0.60, posterior margin slightly concave, cornua rounded; total length of palpi 0.40–0.43, segment I with small and blunt posteriorly projecting spur; hypostome spatulate, dental formula 3:3, apex with corona of fine denticles. Spiracular plates comma-shaped. Legs: coxae I with 2 distinct spurs of medium length, external one being the longest; coxae II–III with short rounded spur protruding from ridge-like edge; coxae IV with long, straight internal spur not reaching level of anus, trochanters with no spurs.

The diagnostic characters unique for the males of *A. tenellum* are a combination of their body outline being oval to pyriform, scutal ornamentation and punctuations corresponding to the patterns outlined in Figs. 1 and 3, scapulae pointed, presence of carenas, hypostomal dentition 3:3, absence of spurs on trochanter I and on metatarsi II–IV, coxa IV with a long straight spur not reaching the level of the anus, and coxae I with 2 distinct spurs of medium length, the external one being the longest.

Morphologically, males of *A. tenellum* can easily be distinguished from any of the species belonging to the *A. cajennense* species complex using morphological characters. *Amblyomma tenellum* has an oval to pyriform body outline, while in the species of the *A. cajennense* species complex the body outline is rounder. Males of *A. tenellum* are generally smaller than the ticks of the *A. cajennense* species complex. However, size should be used with caution when identifying ticks of this species complex, as an important intraspecific variation may occur. Similarly, the ornamentation pattern is also sometimes variable among the species of the *A. cajennense* complex (Nava et al., 2014). However, considering that *A. mixtum* is the only species of the *A. cajennense* complex found in sympatry with *A. tenellum*, the scutal punctation is diagnostic. In *A. mixtum*, the punctation is much less numerous and dense than in *A. tenellum*, giving the former a smooth and almost shiny appearance.

However, we were unable to find morphological features for distinguishing Koch's types of *A. tenellum* from Kohl's allotype of *A. imitator*. The specimens are almost identical in size, body outline, ornamentation, and punctation. The principal difference is the size of the carenas, which are notably larger in the allotype male of *A. imitator*. Nevertheless, when other males of *A. imitator* deposited at the USNTC were examined, it became evident that the size of the carenas is highly variable. Intraspecific variation of the size of carenas is not uncommon and has also been observed in other *Amblyomma* species (Guglielmone et al., 1990; Labruna et al., 2005). In addition, the types of *A. tenellum* had initially been pinned and were preserved dry. The drying process may have contributed to the overall shrinking of these specimens over the years. The justification given by Kohls (1958) for considering *A. imitator* to be a different taxon from *A. tenellum* was the lack of characters for positive identification of the latter, but the evidence presented in this work rejects the statement of Kohls (1958) and reveals that diagnostic characters for *A. tenellum* are obvious and furthermore that they coincide with the diagnostic characters proposed for the identification of *A. imitator* as per Kohls (1958), Sundman (1966), and Hilburn et al. (1989). In contrast to these authors, we did not consistently observe a larger gap between the spurs of coxa I in *A. imitator* when compared with the same spurs in *A. cajennense*. Kohls (1958) concluded his description of *A. imitator* by affirming that "Review of the synonymy of *A. cajennense* (Fabricius' material lost), *A. mixtum*, and *A. tenellum*, revealed that, with the possible exception of *A. tenellum*, none of the synonymic names are available for the new species", thus indicating that he was aware of the similarity between the 2 taxa. The results of our morphological study of the type specimens of *A. tenellum* corroborate the findings of Tonelli-Rondelli (1937). Because the senior synonym (*A. tenellum*) has been



used as a valid name after 1899 (Tonelli-Rondelli, 1937) in conformity with article 23.9.1.1 of the International Code of Zoological Nomenclature (1999), *A. imitator* must be relegated to a synonym of *A. tenellum*. One of the 2 males of *A. tenellum* deposited in Berlin (ZMB 1043a) is hereby formally designated as the lectotype, while the other specimen (1043b) is a paralectotype.

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