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The ixodid ticks (Acari: Ixodidae) of Cuba

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Abstract

The Neotropical tick fauna includes approximately 200 species belonging to the families Argasidae and Ixodidae. Of the 32 species reported from Cuba, 23 are argasids and nine belong to four ixodid genera (*Ixodes*, *Amblyomma*, *Dermacentor*, and *Rhipicephalus*). *Ixodes capromydis*, a Cuban endemic species, is the only prostriate tick, whereas Metastriata are represented by five *Amblyomma* (*A. albopictum*, *A. cajennense*, *A. dissimile*, *A. quadricavum*, and *A. torrei*), one *Dermacentor* (*D. nitens*), and two *Rhipicephalus* species (*R. sanguineus* and *R.* (*Boophilus*) *microplus*). Herein, we illustrate diagnostic characters and provide a taxonomic key for the Cuban adult Ixodidae based on optical and scanning electron microscopy. For each species, we provide information about the material we examined, geographical distribution, and host association.

Key words: Ticks, Ixodidae, identification key, Cuba

Introduction

Cuba is one of the Islands of the Greater Antilles in the northern Caribbean Sea. Because of their geological history, their insularity, and their location between the Gulf of Mexico and the Atlantic Ocean, the Greater Antilles are considered to be biodiversity hotspots, rich in endemic species. The diversity of ticks (Ixodida: Ixodidae) in Cuba, known from old and rather fragmentary publications, shows affinities with the tick fauna of the neighboring islands. Pérez-Vigueras (1954) published a list of Cuban ticks that included 16 species of Ixodida: *Amblyomma albopictum* Neumann, 1899; *Amblyomma argentinae* Neumann, 1904 (reported as *Amblyomma testudinis*, syn.); *Amblyomma cajennense* (Fabricius, 1787); *Amblyomma dissimile* Koch, 1844; *Amblyomma quadricavum* (Schulze, 1941); *Amblyomma torrei* Pérez Vigueras, 1934; *Dermacentor nitens* (Neumann, 1897) (reported as *Anocentor nitens*); *Ixodes capromydis* Černý, 1966; *Rhipicephalus* (*Boophilus*) *microplus* (Canestrini, 1887) (reported as *B. microplus*); *Rhipicephalus sanguineus* (Latreille, 1806); *Antricola marginatus* (Banks, 1910); *Argas persicus* (Oken, 1818); *Ornithodoros azteci* Matheson, 1935; *Ornithodoros capensis* Neumann, 1901; *Ornithodoros viguerasi* Cooley & Kohls, 1941; and *Otobius megnini* (Dugès, 1883). With the exception of *A. testudinis*, a synonym of *A. argentinae*, which does not actually occur in Cuba, the other species are valid. Only *I. capromydis* is endemic to

Cuba, whereas the remaining ticks also occur in other Central and South American countries (Guglielmone *et al*., 2003). Pérez-Vigueiras' inventory was substantially expanded by Černý (1967a,b), De La Cruz (1970, 1973, 1974a,b,c, 1976a,b, 1978a,b), De La Cruz and Černý (1971) and De La Cruz *et al*. (1981).

Currently, a total of 32 species of ticks (Argasidae and Ixodidae) are known to occur in Cuba (Guglielmone *et al*. 2003; Barros-Battesti *et al*. 2006): 3 *Argas*, 9 *Ornithodoros/Carios*, and 11 *Antricola/Carios* species represent the soft-tick family (Argasidae), while the hard ticks (Ixodidae) include 1 *Ixodes*, 5 *Amblyomma*, 2 *Rhipicephalus*, and 1 *Dermacentor* species.

We provide a revised list of the ticks of Cuba, and illustrated taxonomic keys for the identification of diagnostic characters in adult Cuban Ixodidae based on light and scanning electron microscopy.

Materials and methods

For this study, we examined ticks from the IES Tick Collection (Instituto de Ecología e Sistemática de Cuba, La Habana, Cuba). Additional information on geographical distribution was obtained from the database of the U.S. National Tick Collection (Georgia Southern University, Statesboro, GA, U.S.A.). The synonymy lists are drawn from Camicas *et al*. (1998) and the nomenclature follows Horak *et al.* (2002), Guglielmone *et al.* (2003), and Barker and Murrell (2004). The key combines and slightly modifies keys proposed by Jones *et al.* (1972) and Onofrio *et al.* (2006 a, b).

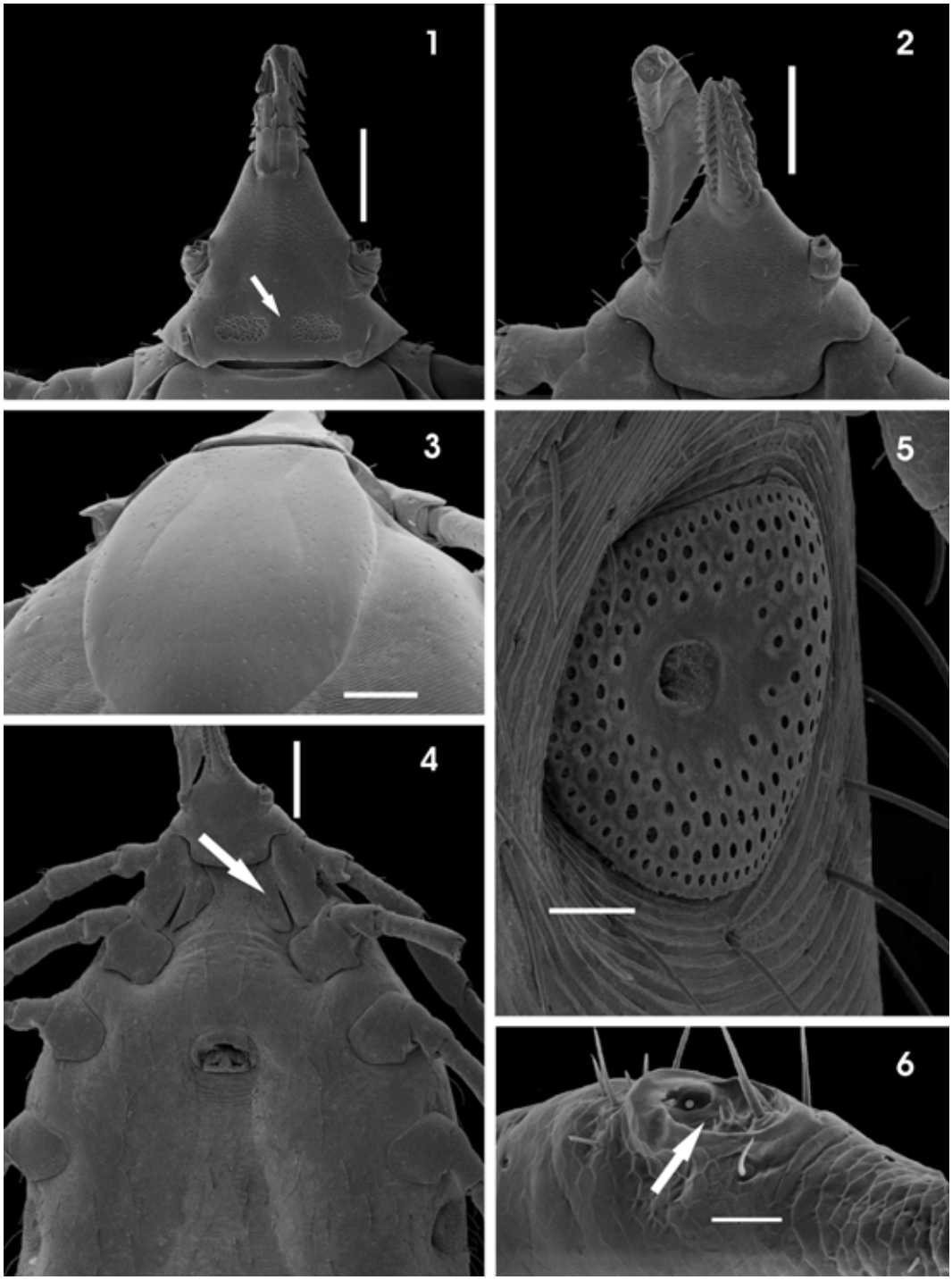
Material preparation

Adult specimens were cleaned and prepared for optical and scanning electron microscopy (SEM) as described by Guimarães *et al*. (2001). Briefly, ticks were dehydrated three times for 30 minutes through graded ethanol series (70%, 80%, 90% and 100%) and were stored in acetone. After critical point drying, micrographs were taken using a Digital Scanning Microscope ZEISS/LEO 440 (Laboratório de Microscopia Eletrônica do Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil). Light microscopy images were taken with a Leica MZ12 stereomicroscope. The photographic images were prepared with Adobe Photoshop v.6. The maps were generated with the Species Mapper tool implemented in Species Link Network (www.cria.org.br), and all illustrations were prepared with CorelDRAW v.12.

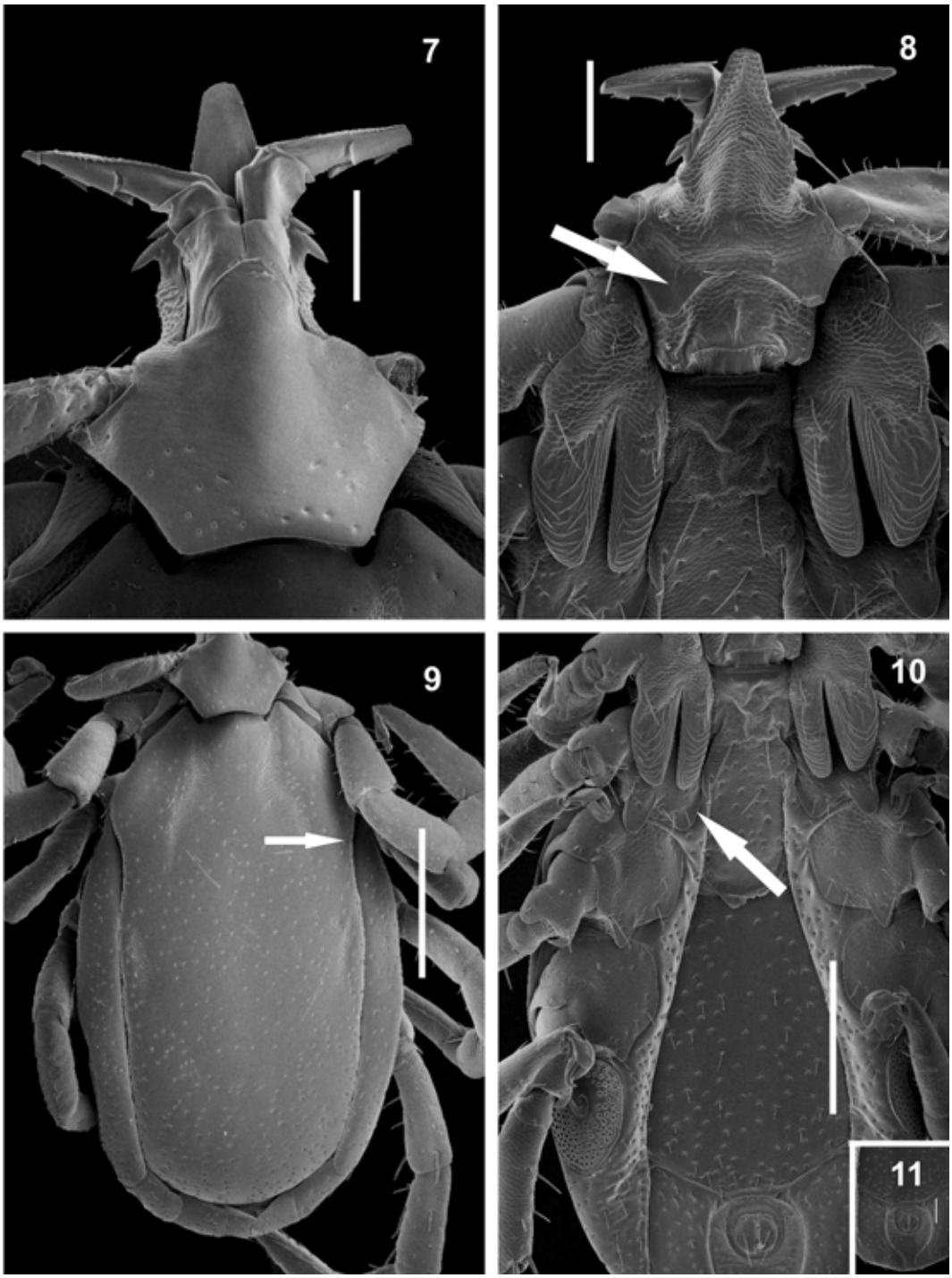
Results and discussion

Ixodes capromydis Černý, 1966 (Figs 1–11, 67)

Diagnosis: Female — Basis capituli triangular (Fig 1), hypostome very long, bluntly pointed, dental formula 2/2 from base to apex (Fig 2); scutum oval, lateral carinae absent (Fig 3); genital aperture between coxae III and IV (Fig 4); spiracular plate rounded with 5 rows of goblets (Fig 5); coxa I without real spurs, but with 2 large and flat lobes; Haller's organ with 6 prehalleral setae and 1 distal seta on the anterior cuticular depression (Fig 6). Male - Basis capituli hexagonal (Fig 7), hypostome with rounded apex, denticles blunt; coxa I without real spurs, but with 2 large and flat lobes (Fig 8), coxa II with 2 short spurs, external spur slightly longer than internal, coxae III–IV each with a single internal spur; scutum with 2 dorsolateral depressions near coxae III (Fig 9); ventral plates well defined, jugular plates absent (Fig 10); anal groove narrowing posteriorly in both sexes (Fig 11).



FIGURES 1–6. *Ixodes capromydis*, female. 1. Basis capituli triangular, dorsal view, very long, with small porose areas (arrow) (bar: 200µm); 2. Basis capituli, ventral view, slender hypostome (bar: 200µm); 3. Idiosoma dorsal view: scutum elongate, with shallow punctations (bar: 200µm); 4. Idiosoma, ventral view, coxa I with 2 large and flat lobes (arrow), the external wider than the internal; coxae II–IV each with a short, sharp external spur (bar: 300µm); 5. Spiracular plate rounded (bar: 40µm); 6. Haller's organ with 6 prehalleral setae and 1 distal seta in the anterior cuticular depression (arrow) (bar: 30µm).



FIGURES 7–11. *Ixodes capromydis* male. 7. Dorsal view, basis capituli hexagonal, (bar: 100µm); 8. Basis capituli, ventral view, with two lateral auriculae (arrow) on the meso-transversal ridge (bar: 120µm); 9. Idiosoma dorsal view, scutum with 2 dorsolateral depressions near coxae III (arrow) (bar: 400µm); 10. Idiosoma ventral view, coxa I with 2 large and flat membranous lobes; coxa II with two short spurs (arrow); coxae III–IV, each with a single spur (bar: 300µm); 11. Anal groove converging posteriorly (bar: 300µm).

Type information: *Ixodes capromydis* Černý, 1966, female holotype labeled as CU 1098, collected on *Capromys pilorides relictus* Allen, 1911 (= *C. p. ciprianoi*) (Woods *et al*. 2001), Guayacanal, Isla De La Juventud, 18 April 1965, Orlando H. Garrido, leg; allotype male, and paratypes (3 males, 2 females, 6 nymphs and 4 larvae collected on the same host as the holotype, and 1 female, 3 nymphs and 3 larvae, collected at the same locality on the same day, and from the same host species — CU 1099). The types are deposited at the Instituto de Ecología y Sistemática (=Instituto de Biología, Academia de Ciencias de Cuba, La Habana — IBAC). Černý (1966) mentioned that additional paratypes were deposited at the IPCAS (Institute of Parasitology, Academy of Sciences of the Czech Republic, Prague).

Hosts: *Capromys pilorides* (Rodentia: Capromyidae). According to Borroto Páez *et al.* (1992), five subspecies are included in this taxon (*ciprianoi*, *doceleguas*, *gundlachianus*, *pilorides*, and *relictus*). Nevertheless, *C. p. ciprianoi* was synonymized with *C. p. relictus* by Woods *et al*. (2001) because no genetic differentiation of cytochrome b was found for *ciprianoi* and *relictus*. This synonymy was maintained by Wilson and Reeder (2005).

Geographical distribution: Endemic species, only reported from Guayacanal, Isla De La Juventud (Fig 67), Cuba (Černý 1966).

Comments: There are no recent reports on this tick species and, therefore, the current status of its distribution is unknown. However, the host is widespread on the Cuban mainland, Isla De La Juventud, the Sabana archipelago, the Doce Laqunas archipelago, and many other islands of the Cuban archipelago. They are also abundant in Guantanamo Province (Woods & Kilpatrick 2005).

***Dermacentor nitens* (Neumann, 1897) (Figs 12–17, 68)**

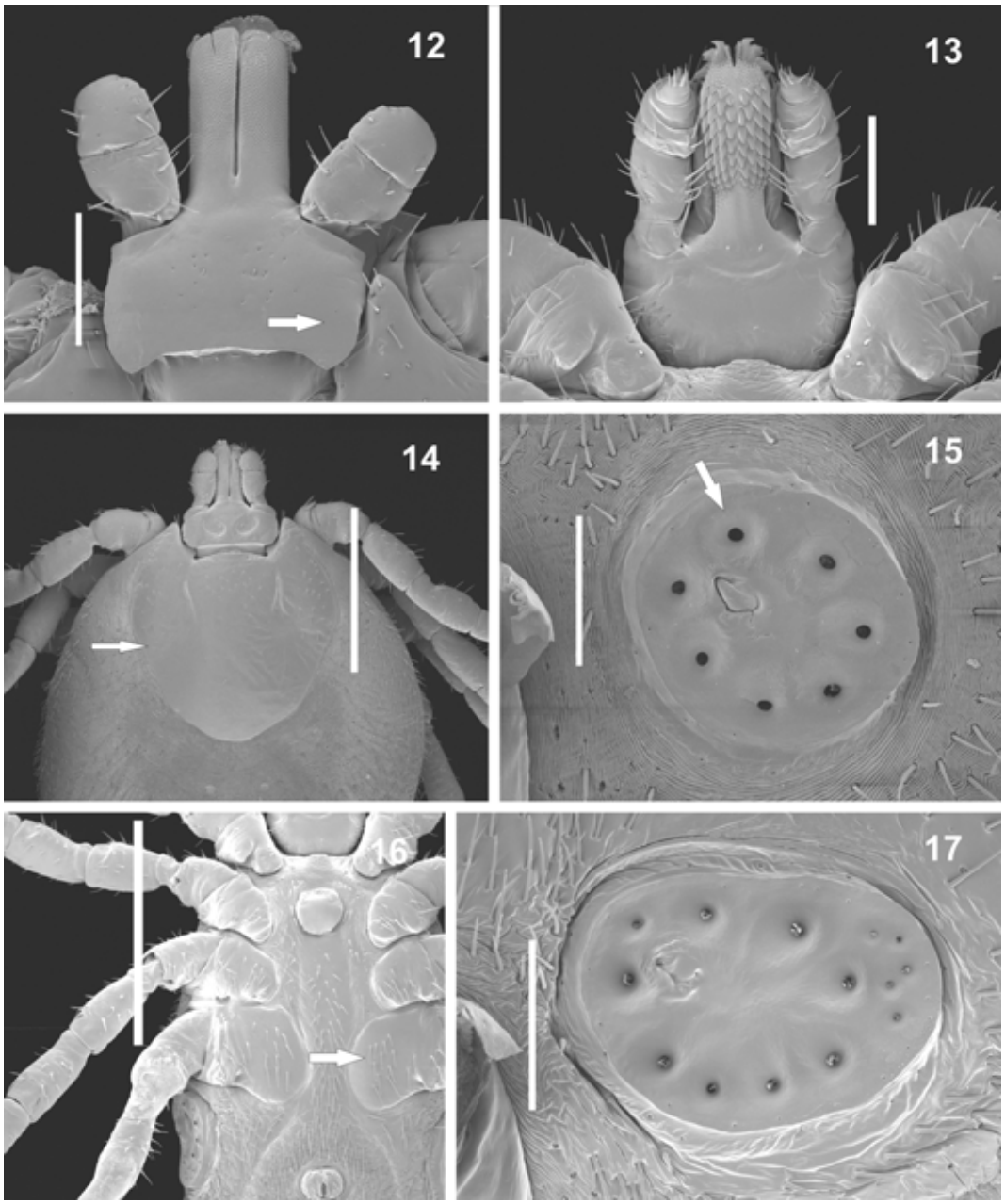
Dermacentor nitens Neumann, 1897: Mohler 1939, 39. Anocentor columbianus Schulze, 1937: Osorno-Mesa 1940, 6. Otocentor nitens (Neumann, 1897) Cooley, 1938: Vogelsang & Santos Dias, 1953, 3. Anocentor nitens (Neumann, 1897) Mohler, 1939.

Diagnosis: Female and male — Basis capituli rectangular (Fig 12), hypostome 4/4 (Fig 13); eyes present (Fig 14); scutum inornate; spiracular plates elliptical with 4–10 large aeropyles arranged in a circle around the ostium (Figs 16–17). In the male, coxa IV is much longer and wider than coxae I–III (Fig 15).

Hosts: Equines.

Geographical distribution: Pérez-Vigueras (1934) listed the following localities as occurrence areas of *D. nitens* — Provinces of La Habana, Pinar del Rio, Santa Clara, Matanzas, and Camaguey. Although local scientists (R. de la Vega; M.R. Hernández, personal communication) know that this tick is currently widespread in the Cuban archipelago, collection data only report it from La Havana, Pilón, and the Isle of Pines (Fig 68).

Comments: Guglielmone *et al.* (2003) hypothesized that this tick was imported to Cuba from other American regions. *Dermacentor nitens* is common in the Caribbean Islands, Mexico, and Central and South America. Less often, it is also found in the southern United States. This species can transmit *Babesia caballi*, the causative agent of equine piroplasmosis (Guglielmone *et al*. 2006a). Occasionally, this tick will bite humans, as reported from Bolivia, Colombia and Brazil (Guglielmone *et al*. 2006b).

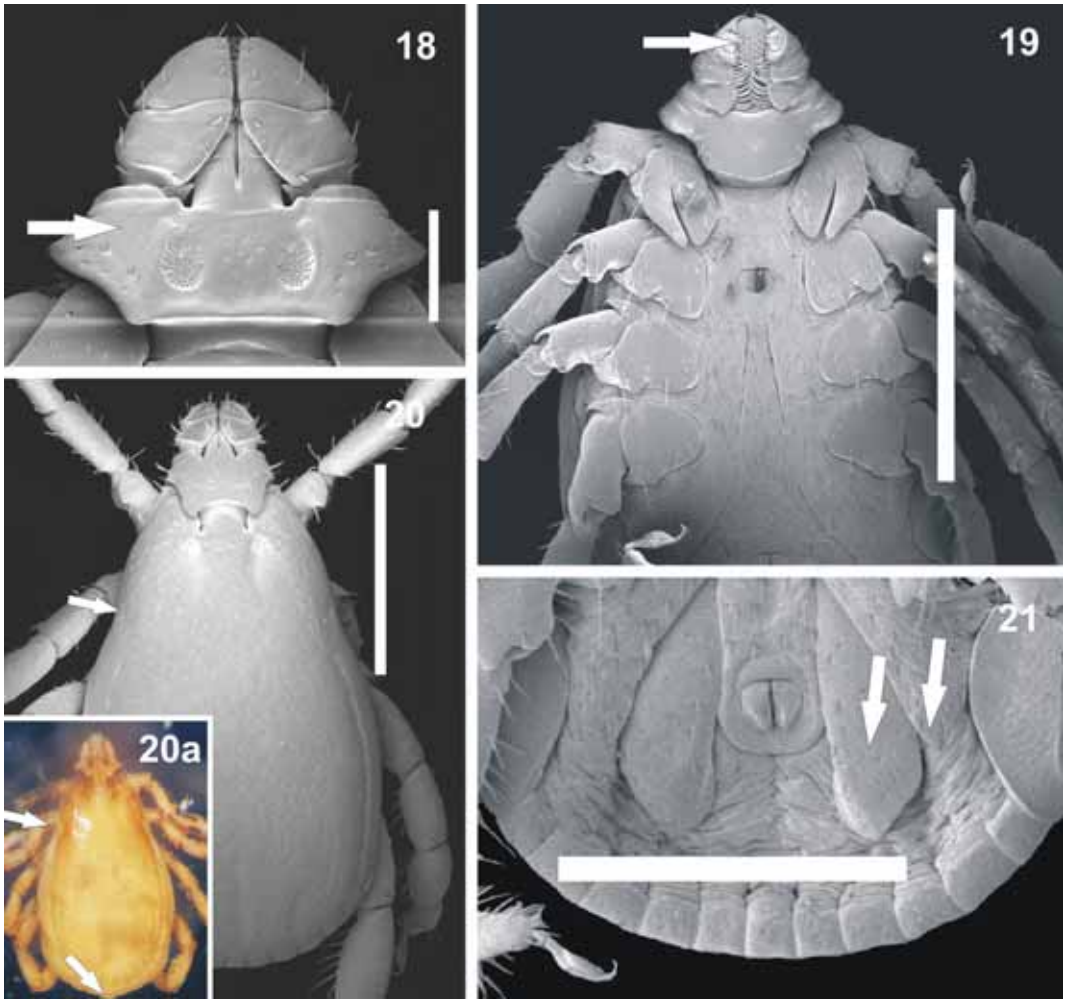


FIGURES 12–15. *Dermacentor nitens* female. 12. Basis capituli rectangular, dorsal view (arrow) (bar: 200µm); 13. Basis capituli, ventral view, hypostomal dentition 4/4 (bar: 200µm); 14. Idiosoma dorsal view, scutum inornate, eyes present (arrow) (bar: 1000µm); 15. Spiracular plate circular to elliptical with about 7 aeropyles (arrow) (bar: 200µm).

FIGURES 16–17. *Dermacentor nitens* male. 16. Idiosoma ventral view, coxae I–II with 2 short and broad spurs, coxae III–IV each with 1 spur, coxa IV overall much larger than coxae I–III (arrow) (bar: 1000µm); 17. Spiracular plate elliptical with 9 large aeropyles around the spiracular ostium (bar: 200µm).

Rhipicephalus sanguineus (Latreille, 1806) (Figs 18–21, 69) (*sanguineus* group)

Rhipicephalus sanguineus Latreille, 1806 : 157. *Ixodes sanguineus* Latreille, 1806. *Ixodes linnaei* Audouin, 1826. *Ixodes hexagonus sanguineus* Séguy, 1835. *Rhipicephalus macropis* Schulze, 1936. *Ixodes dugesi* Gervais, 1844. *Rhipicephalus limbatus* Koch, 1844. *Rhipicephalus linnei* Koch, 1844. *Rhipicephalus rutilus* Koch, 1844. *Rhipicephalus siculus* Koch, 1844. *Rhipicephalus carinatus* Frauenfeld, 1867. *Rhipicephalus rubicundus* Frauenfeld, 1867. *Rhipicephalus stigmaticus* Gerstäcker, 1873. *Rhipicephalus beccarii* Pavesi, 1883. *Rhipicephalus brevicollis* Neumann, 1897. *Rhipicephalus (Eurhipicephalus) sanguineus* Neumann, 1904. *Rhipicephalus (Eurhipicephalus) sanguineus v. brevicollis* Neumann, 1904. *Rhipicephalus sanguineus brevicollis* Neumann, 1904. *Boophilus dugesi* Dönitz, 1907. *Eurhipicephalus sanguineus* Stephens & Christopher, 1908. *Rhipicephalus texanus* Banks, 1908. *Rhipicephalus breviceps* Warburton, 1910. *Rhipicephalus dugesi*, Neumann, 1911. *Rhipicephalus sanguineus sanguineus*, Neumann, 1911.



FIGURES 18–19. *Rhipicephalus sanguineus* female. 18. Basis capituli hexagonal (arrow) (bar: 200µm); 19. Hypostome and palpi short, dentition 3/3 (arrow) (bar: 1000µm).
FIGURES 20–21. *Rhipicephalus sanguineus* male. 20. Idiosoma dorsal view, scutum inornate, eyes present (arrow) (bar: 1000µm); 20a. Caudal process, short and slightly rounded (arrow). 21. Idiosoma ventral view, two adanal plates and 2 vestigial accessory plates (arrow) (bar: 1000µm).

Diagnosis: Female and male — Basis capituli hexagonal (Fig 18), hypostome and palpi short, dentition 3/3 (Fig 19); scutum inornate; eyes and festoons present (Figs 20–20a). In males, the caudal process is short and slightly rounded (Fig 20a); two long and broad spurs present on coxa I, coxae II–IV each with one spur; 2 adanal plates and 2 vestigial accessory plates present (Fig 21).

Hosts: Domestic dogs.

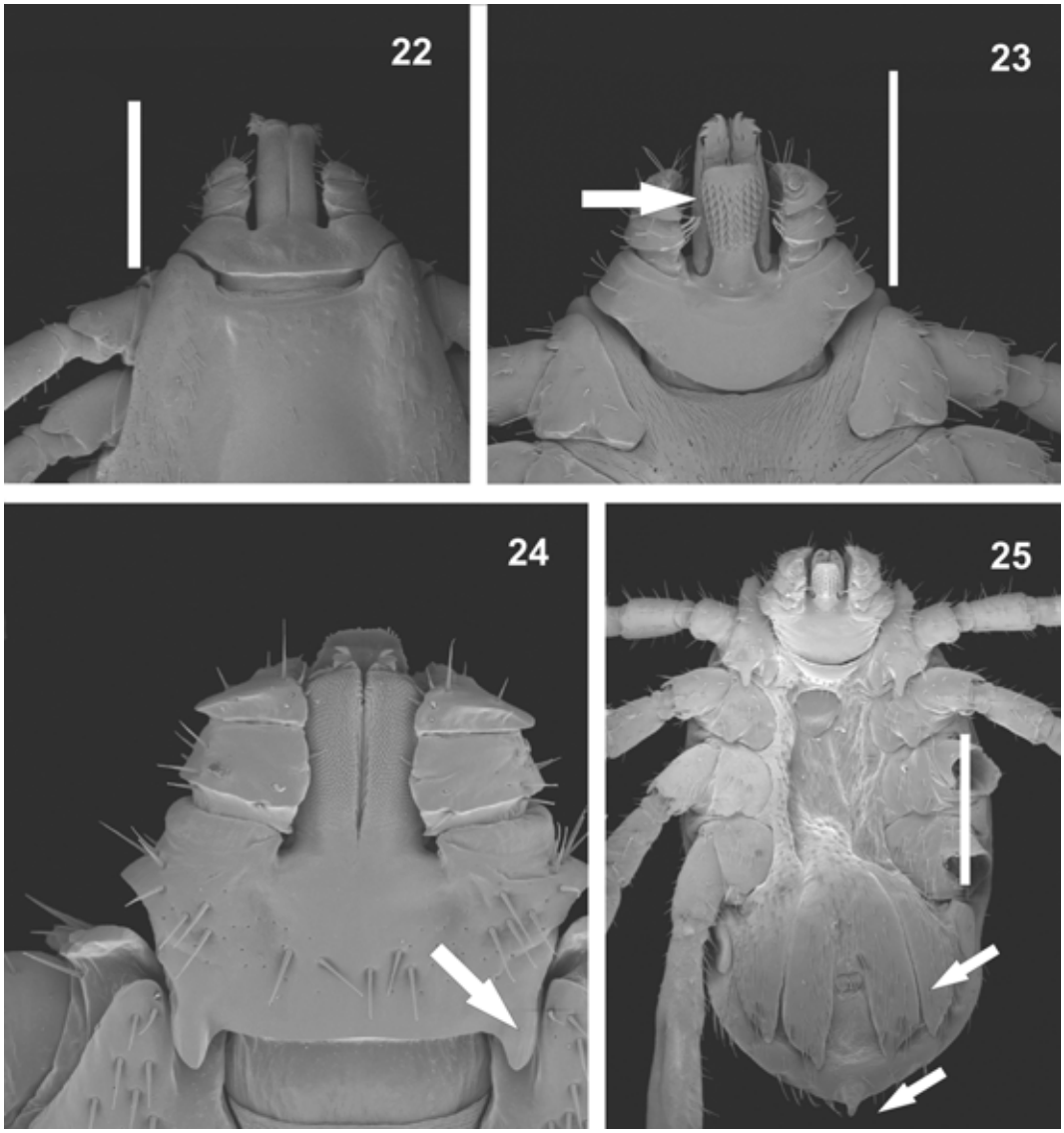
Geographical distribution: This species has a worldwide distribution. It is commonly believed that this Afrotropical tick's cosmopolitanism stems from having followed the migratory routes of humans and, more importantly, their dog companions (Oliveira *et al*. 2005). In Cuba, the species has been found in the provinces of La Habana, Camague, San Juan y Martínez, Isle of Pines, Santiago de Las Vegas, and Pinar del Rio (Fig 69).

Comments: The preferred host of this tick is the domestic dog. However, in the absence of dogs, it can feed on humans (Guglielmone *et al*. 2006b; Dantas-Torres *et al*. 2006). This tick is the vector of *Rickettsia conorii*, the causative agent of human Mediterranean spotted fever, in the Mediterranean area (Beati & Raoult 1998), and *Rickettsia massiliae* in Europe (Beati & Raoult 1993), Argentina (Cicuttin *et al*. 2004), and the United States (Eremeeva *et al*. 2006a). A case of human rickettsiosis caused by *R. massiliae* was reported from France (Vitale *et al*. 2006). *Rhipicephalus sanguineus* is also associated with the transmission of canine babesiosis and erhlichiosis (Perez *et al*. 1996). More recently, *R. sanguineus* was found infected with *Rickettsia rickettsii*, the agent of Rocky Mountain spotted fever, in Arizona (Eremeeva *et al*. 2006b), confirming earlier findings (Mariotte *et al.* 1944), and Brazil, where it is considered a suspected vector (Labruna 2009). It is important to note, however, that the taxonomic status of *R. sanguineus* is presently under scrutiny. There is evidence that *R. sanguineus* may comprise more than one species in the Americas (Szabó *et al*. 2005). If this hypothesis were confirmed, the taxonomic status of Cuban *R. sanguineus* might require revision.

Rhipicephalus (*Boophilus*) *microplus* (Canestrini, 1887) (Fig. 22–25, 70)

Rhipicephalus (*Boophilus*) *microplus* (Canestrini, 1887). Murrell & Barker, 2003. *Haemaphysalis micropla* Canestrini, 1887. *Rhipicephalus microplus* Canestrini, 1890. Lahille, 1905. *Rhipicephalus annulatus caudatus* Neumann, 1897. *Rhipicephalus caudatus* Neumann, 1897. Arthur, 1960. *Rhipicephalus australis* Fuller, 1899. *Rhipicephalus annulatus v. caudatus* Neumann, 1897. Neumann, 1901. *Boophilus australis* (Fuller, 1899). Cooley, 1946. *Rhipicephalus annulatus v. australis* Fuller, 1899. Roberts, 1934. *Rhipicephalus annulatus v. microplus* (Canestrini, 1887). Lahille, 1905. Lahille, 1905. *argentinensis* Neumann, 1901. *Rhipicephalus annulatus microplus* Neumann, 1901. *Rhipicephalus annulatus v. argentinus* Neumann, 1901. *Rhipicephalus* (*Boophilus*) *argentinus* Neumann, 1904. Doss & Anastos, 1977. *Boophilus annulatus australis* (Fuller, 1899). Cooley, 1946. *Boophilus annulatus caudatus* (Canestrini, 1897). Keegan & Toshioka, 1957. *Boophilus annulatus microplus* (Canestrini, 1887). Lahille, 1905. *Boophilus caudatus* (Neumann, 1897). Hoogstraal, 1956. *Boophilus microplus* (Canestrini, 1887). Lahille, 1905. *Margaropus microplus* (Canestrini, 1887). Doss & Anastos, 1977. *Margaropus australis* Manson, 1907. *Margaropus microplus* Hunter & Hooker, 1907. *Margaropus annulatus australis* Newstead, 1909. *Margaropus annulatus microplus* Rohr, 1909. *Margaropus annulatus argentinus* Castellani & Chalmers, 1910. *Margaropus caudatus* Castellani & Chalmers, 1910. *Margaropus microplus* Castellani & Chalmers, 1910. *Margaropus annulatus caudatus* Neumann, 1911. *Margaropus micropla* Neumann, 1911. *Margaropus annulatus microphilus* Castellani & Chalmers, 1919. *Margaropus annulatus mexicanus* Valadez, 1923. *Boophilus annulatus subsp. calcaratus* Sharif, 1928. *Boophilus* (*Uroboophilus*) *caudatus* Minning, 1934. *Boophilus* (*Uroboophilus*) *cyclops* Minning, 1934. *Boophilus* (*Uroboophilus*) *distans* Minning, 1934. *Boophilus* (*Uroboophilus*) *fallax* Minning, 1934. *Boophilus* (*Uroboophilus*) *krijgsmani* Minning, 1934. *Boophilus* (*Uroboophilus*) *longiscutatus* Minning, 1934. *Boophilus* (*Uroboophilus*) *microplus* Minning, 1934. *Boophilus* (*Uroboophilus*) *rotundiscutatus* Minning, 1934. *Boophilus* (*Uroboophilus*) *sharifi* Minning, 1934. *Uroboophilus distans* Schulze, 1935. *Uroboophilus sinensis* Schulze, 1935. *Boophilus* (*Pal-*

poboophilus) *minningi* Kishida, 1936. *Boophilus intraoculatus* Minning, 1936. *Uroboophilus cyclops* Schulze, 1936. *Uroboophilus indicus* Minning, 1936. *Uroboophilus occidentalis* Minning, 1936. *Palpoboophilus brachyuris* Kishida, 1939. *Palpoboophilus minningi* Kishida, 1939. *Uroboophilus australis* Kishida, 1939. *Uroboophilus caudatus* Kishida, 1939. *Uroboophilus fallax* Kishida, 1939. *Uroboophilus krijgsmani* Kishida, 1939. *Uroboophilus longiscutatus* Kishida, 1939. *Uroboophilus microplus* Kishida, 1939. *Uroboophilus rotundiscutatus* Kishida, 1939. *Uroboophilus sharifi* Kishida, 1939. *Boophilus* (*Margaropus*) *annulatus v. australis* Taumanoff, 1944. *Boophilus microplus annulatus* Floch, 1956.



FIGURES 22–23. *Rhipicephalus (Boophilus) microplus* female. 22. Basis capituli hexagonal, dorsal view (bar: 500µm); 23. Basis capituli ventral view, hypostomal dentition 5/5 (arrow) (bar: 500µm).
FIGURES 24–25. *Rhipicephalus (Boophilus) microplus* male. 24. Basis capituli dorsal view, cornua present (arrow) (bar: 200µm); 25. Idiosoma ventral view, caudal process slightly pointed and 4 well defined adanal plates (arrow) (bar: 500µm).

Diagnosis: Female and male — Basis capituli hexagonal (Fig 22), hypostome and palpi short, dentition 5/5 (Fig 23); cornua present (Fig 24); scutum inornate, festoons absent, eyes present. In

males, caudal process pointed, 4 adanal plates present (Fig 25).

Hosts: Bovines and equines in general.

Geographical distribution: This species is largely found in tropical and subtropical areas of the world (Estrada-Peña *et al*. 2006). Although this tick is known to occur wherever cattle are raised (R. de la Vega, personal communication), few collections have been preserved in Cuba. The species has been collected from the provinces of San Juan y Martínez, Santiago De Las Vegas, Pinar Del Rio, Bayamo, Guane, Isla De La Juventud, and Santiago De Cuba (Fig 70).

Comments: In other parts of its range, this species parasitizes a number of wild animals and may occasionally bite humans (Guglielmone *et al*. 2006a). In the Neotropics, it has been reported from Venezuela, Colombia, Peru, Brazil and Argentina (Guglielmone *et al.* 2006a). It is also known to be responsible for the transmission of *Babesia* spp. and, to a lesser extent, *Anaplasma marginale*, agents that can cause severe disease in cattle and often have major impacts on livestock production.

Amblyomma albopictum **Neumann, 1899 (Figs 26–34, 71)**

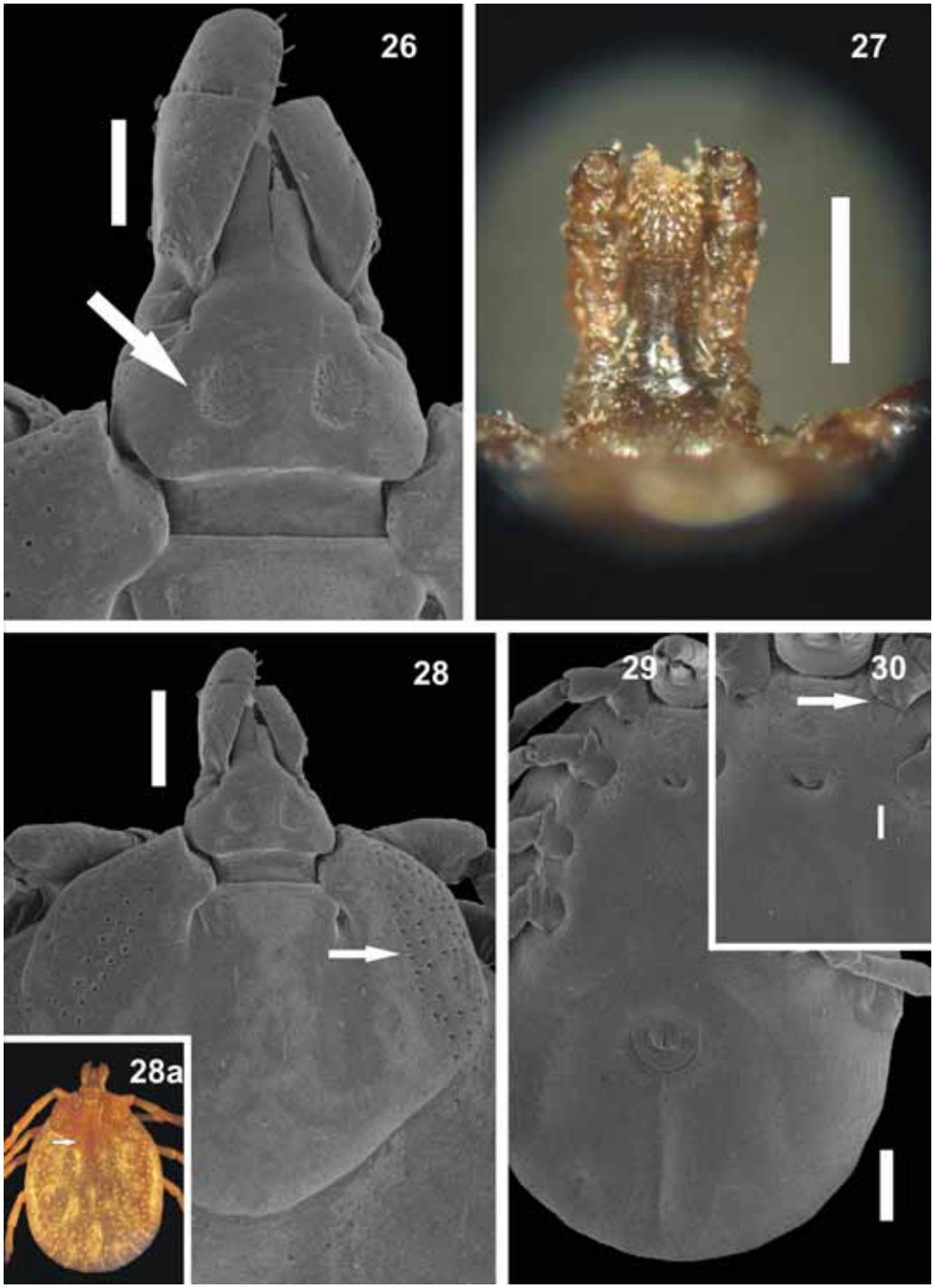
Amblyomma albopictum Neumann, 1899. Neumann, 1911. Clifford & Kohls, 1942. *Ixodes variegatus* Lucas, 1852 nec Fabricius (1798) 1805. Neumann, 1899. *Amblyomma haitianum* Schulze, 1941. Santos Dias, 1958. *Amblyomma* (*Keiransiella*) *albopictum* Neumann, 1899. Santos Dias, 1993. *Amblyomma* (*Cerny-omma*) *albopictum* Neumann, 1899. Camicas et al., 1998.

Diagnosis: Female — Basis capituli rectangular, porose areas oval (Fig 26), dental formula 3/3 (Fig 27); scutum ornate with whitish spots less evident in the cervical and posterior areas, and deep punctations in the lateral fields (Figs 28–28a); coxa I with 2 very short spurs, the internal vestigial and the external less than 1/5 the length of the coxa, coxae II–IV with 1 very short spur each (Figs 29–30). Male — Basis capituli and hypostomal dentition (Figs 31–32) as in female; scutum with few punctations in the lateral fields, marginal groove absent, and ornate with whitish spots mainly between the cervical grooves (Figs 33–33a); spurs on coxae I–IV as in the female (Fig 34).

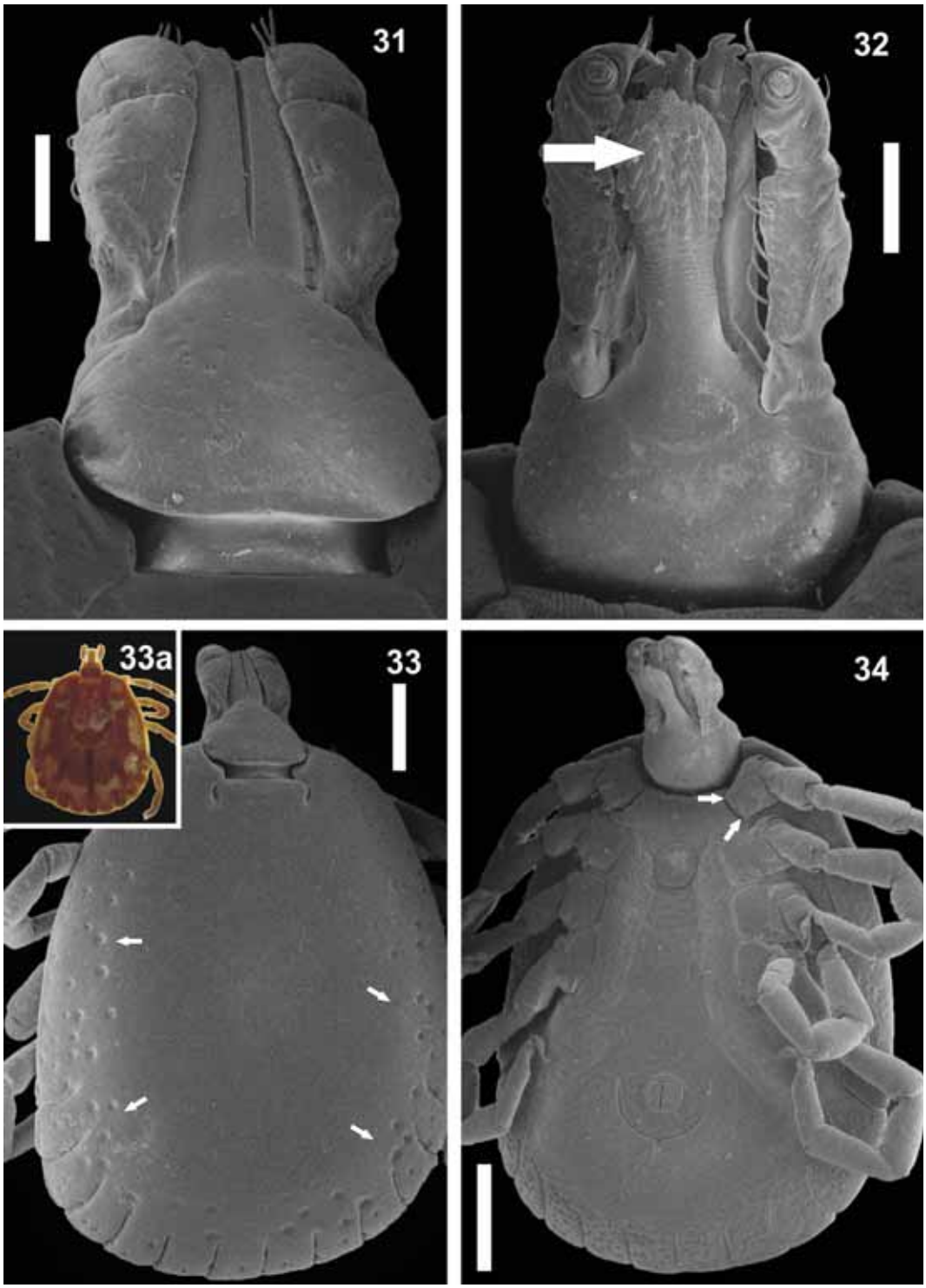
Hosts: *Cyclura nubila nubila* (Gray), *Epicrates angulifer* Bibron, *Alsophis cantherigerus* (Bibron), *Leiocephalus carinatus* (Gray) (Reptilia: Iguanidae), and *Sphiggurus villosus* (F. Cuvier) (Rodentia: Erethizontidae).

Geographical distribution: Provinces of Camaguey, Doce Leguas Cayos, Isle of Pines, La Habana, and Isla De La Juventud (Fig 71). This species also occurs in Costa Rica, Haiti, Honduras and the Dominican Republic (Onofrio *et al*. 2006b). Its reported presence in Brazil (Neumann 1899; Aragão 1936) is questionable (Dantas-Torres *et al.* 2009).

Comments: Neumann (1899) stated that *A. albopictum* was described from 40 males collected from iguanas (*C. nubila*) from La Habana, Cuba, and the species was previously described as *Ixodes variegatus* Lucas, 1852. Neumann (1899) reported a male of *A. albopictum* collected on *S. villosus* (= *Cercolabes villosus*) from Brazil, but he did not mention where the type series from La Habana and the male from Brazil were deposited. Although at that time Neumann was a professor at the École Nationale de Vétérinaire (Toulouse, France), the types were not deposited in the local collection. A male from the type series (syntype N 2866) examined by one of us (DMBB) is deposited in the British Museum (The Natural History Museum, London) (Keirans & Hillyard 2001). Neumann (1899) also commented on another 6 males from Cuba, collected at an unknown locality, deposited in the Museum National d'Histoire Naturalle, Paris, France; however, this information has not been confirmed. Robinson (1926) misunderstood Neumann (1899) and included Guyana in the range of this tick species.



FIGURES 26–30. *Amblyomma albopictum* female. 26. Basis capituli dorsal view, porose areas (arrow) (bar: 200µm); 27. Basis capituli ventral view, hypostomal dentition 3/3 (bar: 200µm); 28. Idiosoma dorsal view, scutum smooth in central area, with deep punctations in the lateral fields (arrow) (bar: 300µm); 28a. Whitish spots less evident in the cervical and posterior fields of the scutum (arrow); 29. Idiosoma ventral view (bar: 400µm); 30. Coxa I with 2 very short spurs, the internal vestigial and the external less than 1/5 of the length of article (arrow) (bar: 200µm).



FIGURES 31–34. *Amblyomma albopictum* male. 31. Basis capituli, dorsal view (bar: 200µm); 32. Basis capituli, ventral view, hypostomal dentition 3/3 (arrow) (bar: 200µm); 33. Idiosoma dorsal view, punctations in the lateral fields (arrow) (bar: 600µm); 33a. Scutum ornate with whitish spots mainly between the cervical grooves; 34. Idiosoma ventral view, spurs on coxae I–IV as in the female (arrow) (bar: 400µm).

Amblyomma cajennense (Fabricius, 1787) (Figs 35–42, 72)

Amblyomma cajennense (Fabricius, 1787). *Acarus cajennensis* Fabricius, 1787. Koch, 1844. *Ixodes cajennensis* Fabricius, 1805. Neumann, 1911. *Ixodes crenatus* Say, 1821. Neumann, 1911. Robinson, 1926. *Amblyomma cajennense* Koch, 1844. *Amblyomma mixtum* Koch, 1844. Neumann, 1899. *Amblyomma tenellum* Koch, 1844. Neumann, 1901. *Ixodes cayennensis* Conil, 1877. *Ixodes herrerae* Dugès, 1887. Neumann, 1911. Robinson, 1926. *Amblyomma sculptum* Berlese, 1888. Neumann, 1899. *Ixodes mixtus* Moniez, 1896. Neumann, 1901. *Amblyomma parviscutatum* Neumann, 1899. Robinson, 1926. *Amblyomma cajennense parviscutatum sensu* Neumann, 1905. Robinson, 1926. *Amblyomma versicolor* Nuttall & Warburton, 1908. Neumann, 1911. *Amblyomma cajennense cajennense* Neumann, 1911. *Amblyomma finitimum* Tonelli-Rondelli, 1937. Voglsang & Santos Dias, 1953. *Amblyomma tapiri* Tonelli-Rondelli, 1937. Voglsang & Santos Dias, 1953. *Amblyomma (Amblyomma) cajennense* Santos Dias, 1993.

Diagnosis: Female — Basis capituli subtriangular (Fig 35), palpi and hypostome very long (Fig 36), dental formula 3/3; idiosoma with white pilosity (Fig 37), scutum covered with whitish spots mainly in the central and posterior areas, whereas the lateral and posterior margins are brown (Fig 37a); coxa I with 2 spurs pointed and well separated, the external spur twice as long as the internal; festoons with chitinous ventral tubercles (Fig 38). Male — Basis capituli, palpi, and hypostome as in the female (Fig 39–40); scutum with numerous punctations, absent in the elevated lateral and posterior areas, marginal groove present (Fig 41), scutum brown with whitish spots (Fig 41a); coxa I with 2 spurs as in the female, coxa IV with 1 spur as long as or longer than the article (Fig 42).

Hosts: Domestic animals and humans. In the Neotropical Region *A. cajennense* infests humans more than others species of *Amblyomma* (Guglielmone *et al.* 2006b). Other mammals, such as buffalos, dogs, pigs, sheep, goats, rabbits, and several medium and large wild mammals, are also commonly infested (Guglielmone *et al*. 2003).

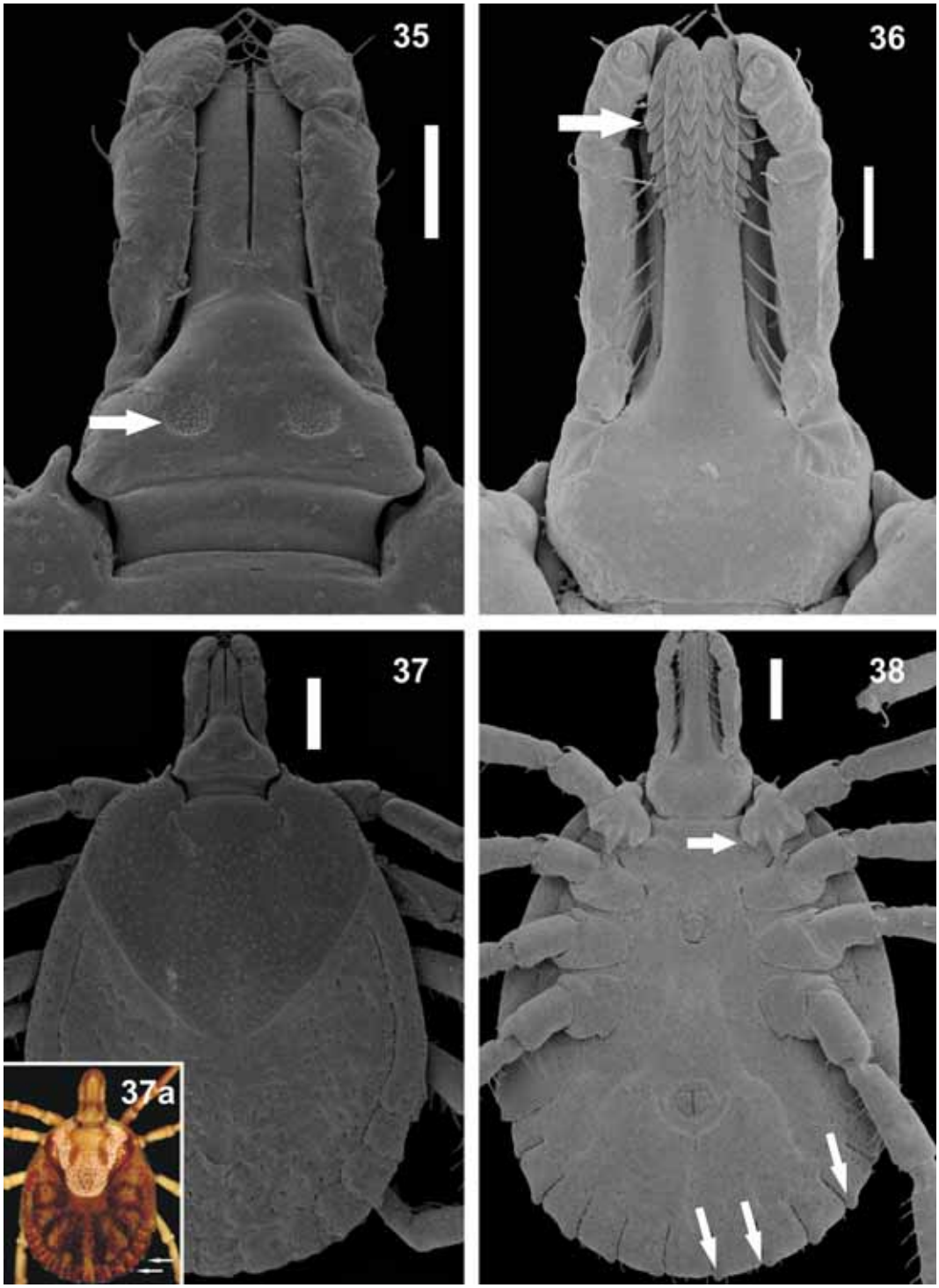
Geographical distribution: In Cuba *A. cajennense* has been found in the provinces of Santiago de Cuba, Camaguey, and Isla De La Juventud (Fig 72). According to Guglielmone *et al.* (2003), *A. cajennense* is distributed throughout the Americas, from the southern United States (Texas), through Central America (including the Antilles), to northern Argentina, except Chile, Uruguay, and southernmost Brazil.

Comments: This New World species was described from specimens collected in Cayenne, the capital of French Guyana. In the Neotopical ecozone, it is the main vector of *Rickettsia rickettsii*, the causative agent of Rocky Mountain/Brazilian spotted fever. *Amblyomma cajennense* is also a competent vector of Venezuelan equine encephalomyelitis virus and, to a lesser extent, *Erhlichia ruminantiun* (Guglielmone *et al*. 2006a). The taxonomic status of this tick is undergoing a full revision. Molecular analyses indicate that *A. cajennense* is a species complex (L. Beati, personal communication). The taxonomic status of Cuban *A. cajennense* may therefore need to be revisited in the near future.

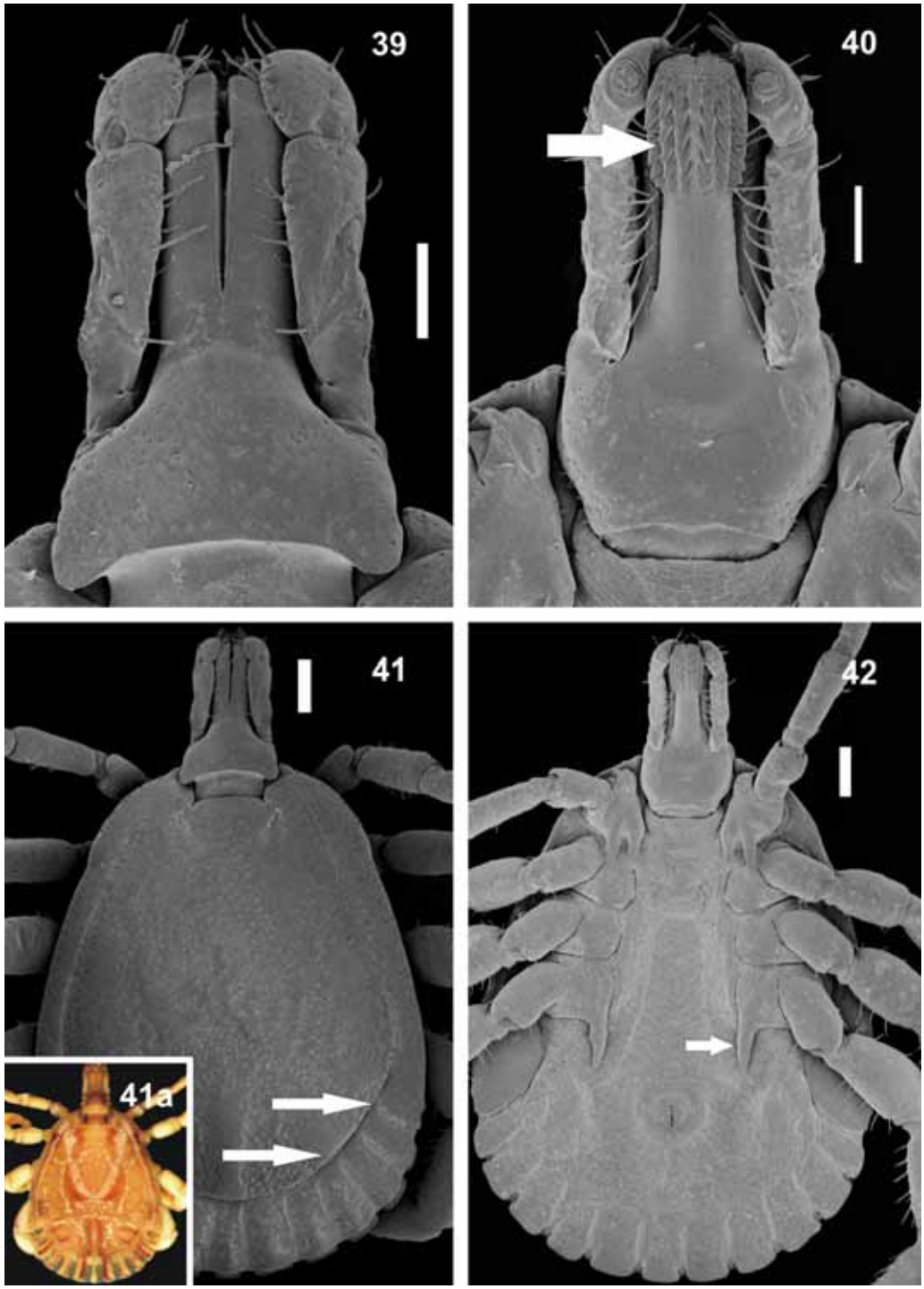
Amblyomma dissimile Koch, 1844 (Figs 43–50, 73)

Amblyomma dissimile Koch, 1844. *Ixodes bibroni* Gervais, 1842. *Amblyomma trinitatis* Turk, 1948. *Amblyomma bibroni* Gervais, 1842

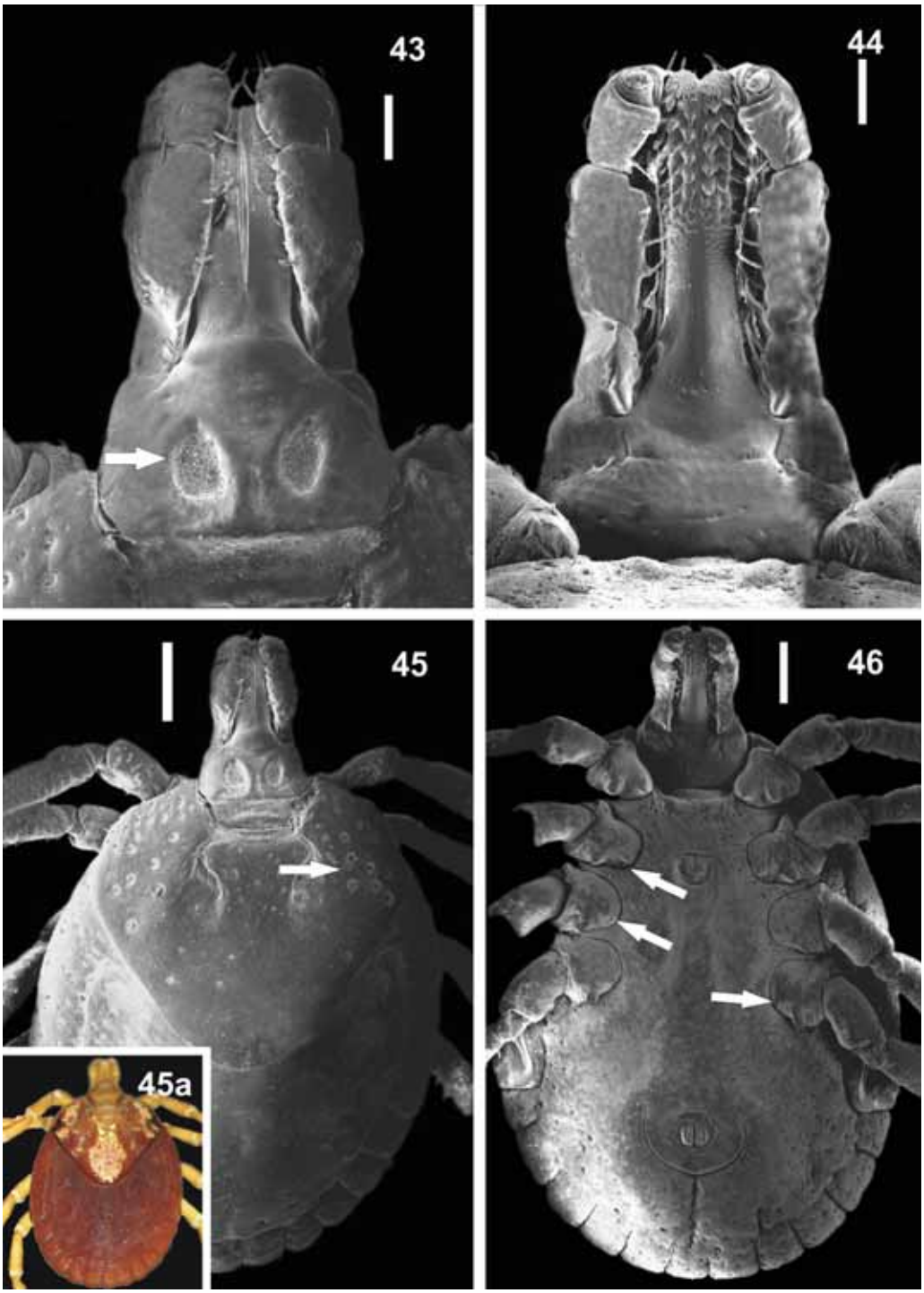
Diagnosis: Female — Basis capituli subrectangular, porose areas oval elongate, separated by about the width of one porose area (Fig 43), palpi and hypostome long, dental formula 3/3 (Fig 44); scutum with deep and large punctations on lateral fields, behind the eyes, longitudinal whitish spots between cervical grooves, and other smaller spots on lateral fields (Figs 45–45a); coxae I–IV each with two



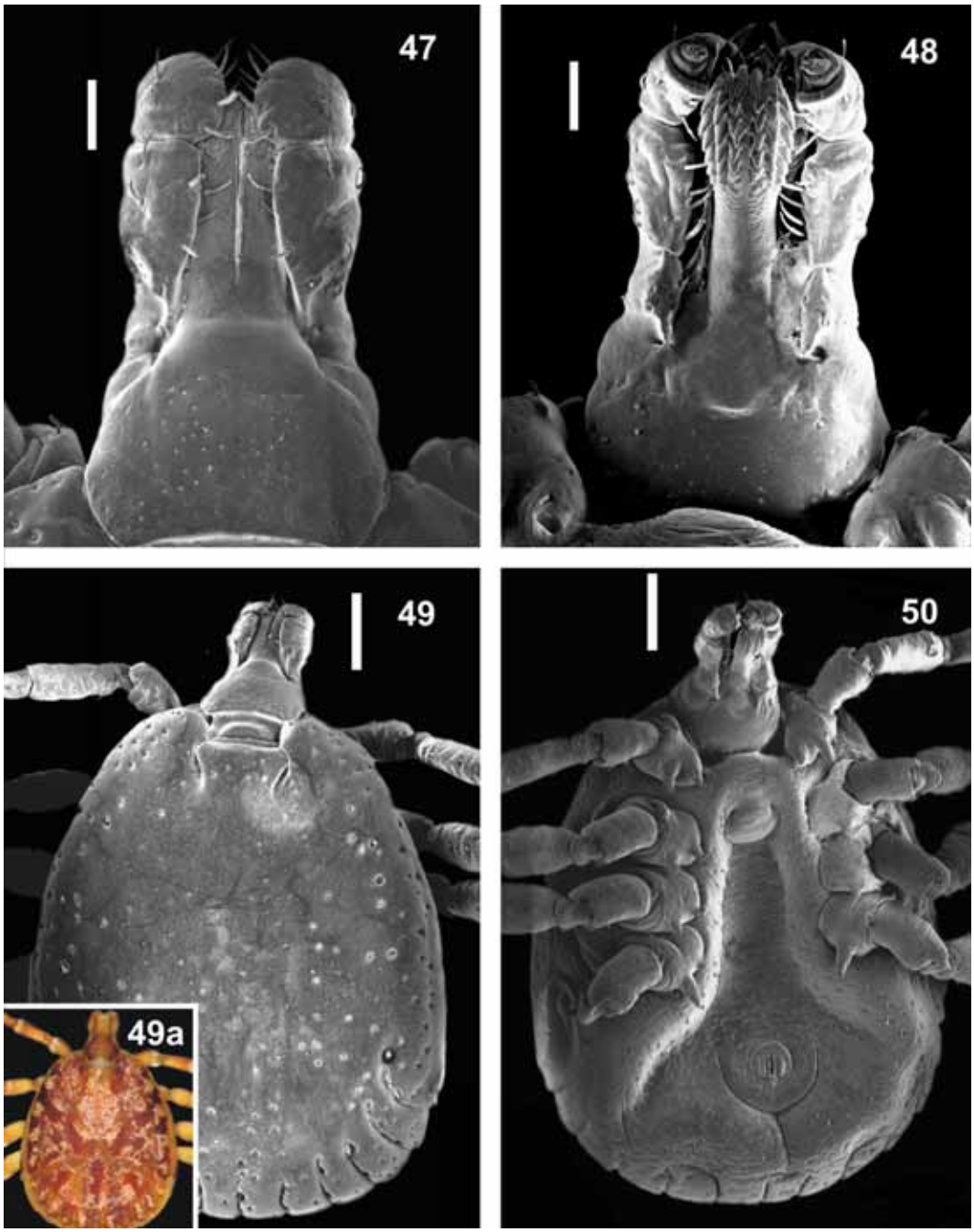
FIGURES 35–38. *Amblyomma cajennense* female. 35. Basis capituli, dorsal view, porose areas small (arrow) (bar: 200µm); 36. Basis capituli, ventral view, palpi and hypostome long, dental formula 3/3 (arrow)(bar: 200µm); 37. Idiosoma dorsal view, with whitish pilosity (bar: 400µm); 37a. Scutum ornate festoons with ventral chitinous tubercles (arrow); 38. Idiosoma ventral view, coxa I with 2 spurs pointed and separated (arrow), external twice as long as internal spur; festoons with chitinous tubercles (arrow) (bar: 400µm).



FIGURES 39–42. *Amblyomma cajennense* male. 39. Basis capituli dorsal view, similar to the female (bar: 200µm); 40. Basis capituli ventral view, palpi and hypostome long, dental formula 3/3 (arrow) (bar: 200µm); 41. Idiosoma dorsal view, scutum with numerous punctations, absent in the elevated lateral and posterior areas, marginal groove present (arrow) (bar: 400µm); 41a. Scutum brown with whitish spots; 42. Idiosoma ventral view, coxa I with 2 spurs similar to the female, coxa IV with 1 spur as long as or longer than the article (arrow) (bar: 400µm).



FIGURES 43–46. *Amblyomma dissimile* female. 43. Basis capituli, dorsal view, porose areas oval (arrow) (bar: 180µm); 44. Basis capituli, ventral view, palpi and hypostome long, dental formula 3/3 (bar: 180µm); 45. Idiosoma dorsal view, scutum with large punctations on lateral fields, behind the eyes (arrow) (bar: 600µm); 45a. Scutum brown, whitish spots present between the cervical grooves, on scapulae and on lateral fields; 46. Idiosoma ventral view, coxae I–IV each with two spurs (arrow), the external longer than internal (bar: 500µm).



FIGURES 47–50. *Amblyomma dissimile* male. 47. Basis capituli dorsal view, subrectangular, similar to the female (bar: 180µm); 48. Basis capituli ventral view, palpi and hypostome long, dental formula 3/3 (bar: 180µm); 49. Idiosoma dorsal view, scutum with large and deep punctations, marginal groove absent (bar: 600µm); 49a. Scutum ornate, brown with whitish spots; 50. Idiosoma ventral view, all coxae each with two spurs, on coxa IV the external is three times longer than internal (bar: 600µm).

spurs, the external longer than the internal (Fig 46). Male — Basis capituli (Fig 47), palpi, hypostome and dentition (Fig 48) as in the female; scutum ornate (Fig 49a), with large and deep punctations

irregularly distributed, marginal groove absent (Fig 49); coxae I–III each with two spurs, the external twice as long as the internal, external spur on coxa IV three times longer than the internal (Fig 50).

Hosts: Reptiles and amphibians. In Cuba, this species has been found feeding on *Bufo fustiger* Schwartz, *Bufo peltacephalus* Tschudi (Amphibia: Bufonidae), *Cyclura* spp. (Reptilia: Iguanidae), and *Capromys pilorides* (Say) (Rodentia: Capromyidae).

Geographical distribution: Provinces of Pinar Del Rio, Santiago de Cuba, Havana and Isla De La Juventud (Fig 73). The geographical distribution of *A. dissimile* extends from Argentina to southern Mexico, the Caribbean, and the southern U.S. (Guglielmone *et al*. 2003).

Comments: Amblyomma dissimile closely resembles *Amblyomma rotundantum* Koch, 1844, a parthenogenetic tick that also feeds on reptiles and amphibians. Because of this similarity, Bodkin (1918) and Dunn (1918) confused the two species. Since the geographical distribution of *A. rotundatum* also includes islands close to Cuba and many countries in Central America, we are reasonably sure that the lack of reports of its presence in Cuba is related to the small number of investigators there.

Amblyomma quadricavum (Schulze, 1941) (Figs 51–58, 74)

Aponomma quadricavum Schulze, 1941. *Amblyomma arianae* Keirans & Garris, 1986. *Amblyomma (Adenopleura) arianae* Santos Dias, 1993. *Amblyomma (Cernyomma) quadricavum* Camicas, Hervy, Adam & Morel, 1998.

Diagnosis: Female — basis capituli rectangular (Fig 51), hypostomal dentition 3/3 (Fig 52); idiosoma as broad as long (Fig 53), scutum inornate, light brown, cervical grooves absent (Fig 53); coxa I with two short triangular spurs, internal spurs absent on coxae II-IV (Fig 54). Male — basis capituli rectangular (Fig 55), hypostomal dentition as in the female (Fig. 56); marginal groove absent (Fig 57), scutum inornate (Fig 57a); coxa I with two short spurs, internal smaller than external, internal spur of coxae II–IV absent, external spur broadly triangular (Fig 58).

Hosts: B. fustiger, B. peltacephalus (Amphibia: Bufonidae), and the snakes *E. angulifer* and *A. cantherigerus* (Reptilia: Iguanidae).

Geographical distribution: Endemic to Cuba. Provinces of Pinar Del Rio, Havana, and Cienfuegos (Fig 74).

Comments: This species was originally described as *Aponomma quadricavum*, and until recently it was thought to be the only *Aponomma* in the Neotropical Region (Guglielmone *et al*. 2003). This tick was mistaken for an *Aponomma* because of its poorly developed eyes (Keirans & Klompen, 1996). Currently, *Aponomma* is no longer considered a valid genus by Barker & Murrell (2004), although these authors incorrectly list *A. arianae* as valid, when, according to Guglielmone *et al*. (2009), it is a junior synonym of *A. quadricavum*.

Amblyomma torrei Pérez Vigueras, 1934 (Figs 59–66, 75)

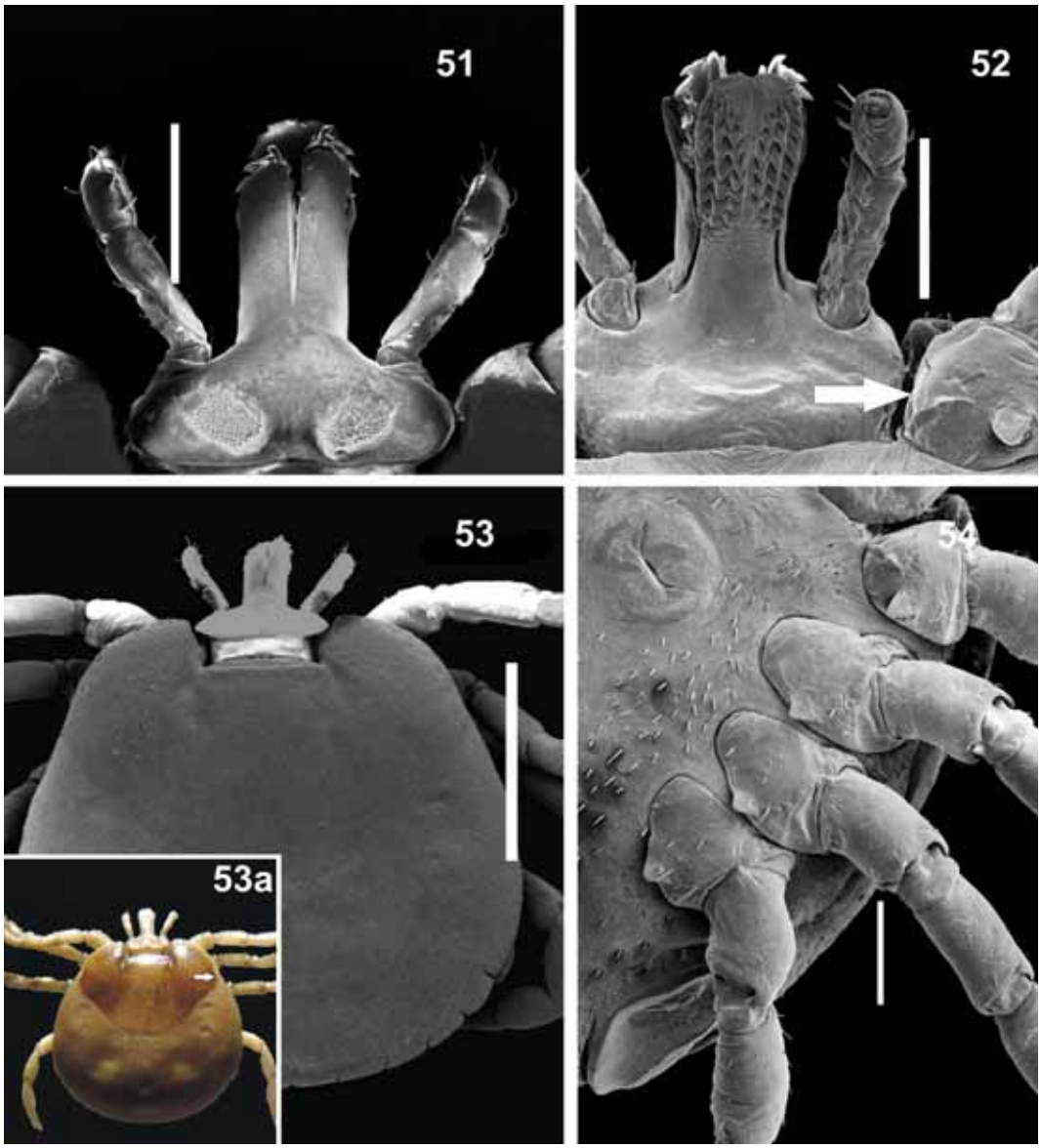
Amblyomma (Adenopleura) torrei Santos Dias, 1993. *Amblyomma (Cernyomma) torrei* Camicas, Hervy, Adam & Morel, 1998.

Diagnosis: Female — Basis capituli rectangular (Fig 59), hypostomal dentition 3/3 (Fig 60); idiosoma with white pilosity, scutum ornate with 2 whitish spots on scapulae and numerous small punctations on lateral fields (Fig 61); coxa I with two short spurs, the internal vestigial; coxae II–IV

with one short spur (Fig 62). Male — Basis capituli and hypostomal dentition as in the female (Fig 63–64); scutum smooth in its central area but with numerous small punctations distributed laterally and mostly coinciding with the whitish spots (Fig 65a), marginal groove absent (Fig 65); coxa I with two short spurs, the internal vestigial, coxae II–IV with one short spur (Fig 66).

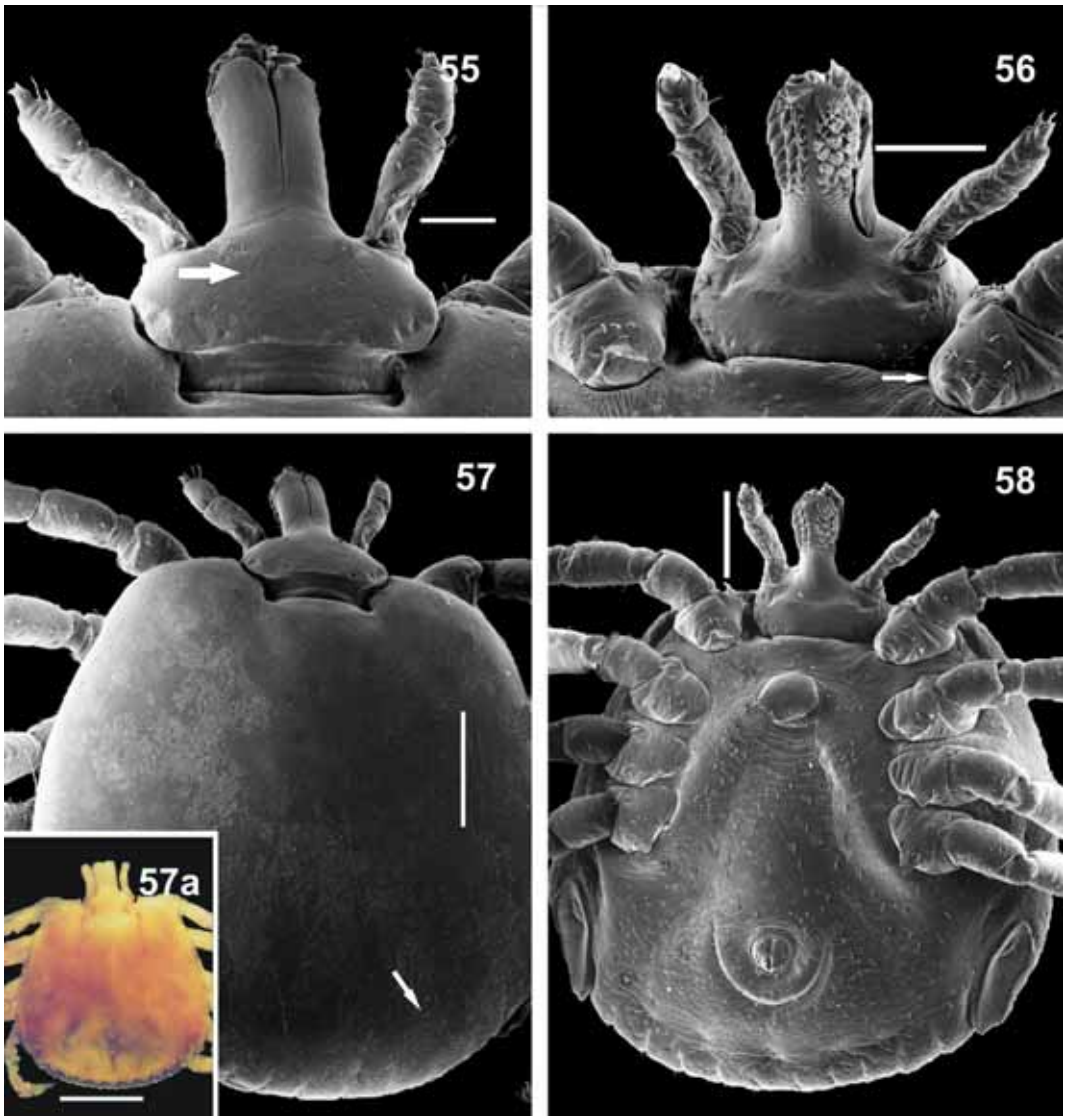
Hosts: B. fustiger (Amphibia: Bufonidae), *C. n. nubila* (Reptilia: Iguanidae), *Anolis sagrei* Cocteau, *Anolis luteogularis* Noble & Hassler (Reptilia: Polychrotidae) and *Leiocephalus carinatus* Gray (Reptilia: Tropiduridae).

Geographical distribution: Camaguey, La Habana, Playa De Jaimanitas, Guanahacabibes, and Pinar Del Rio (Fig 75). It is also found in the Cayman Islands (Guglielmone *et al*., 2003).



FIGURES 51–54. *Amblyomma quadricavum* female. 51. Gnathosoma dorsal view (bar: 300µm); 52. Gnathosoma ventral view and spurs on coxa I (arrow) (bar: 300µm); 53. Idiosoma dorsal view (bar: 300µm); 53a. Scutum inornate, eyes very small (arrow); 54. Coxae I–IV, internal spur on coxae II–IV absent (bar: 600µm).

Comments: This species is represented by few specimens in the IES and USNTC. Although we have not examined the types of *A. torrei* and *Amblyomma cruciferum* Neumann, 1901, the two species appear to be close to each other in their original descriptions (Whittick 1939; Robinson 1926). However, the ornamentation of *A. torrei* is very different from that described for *A. cruciferum* (Robinson 1926).

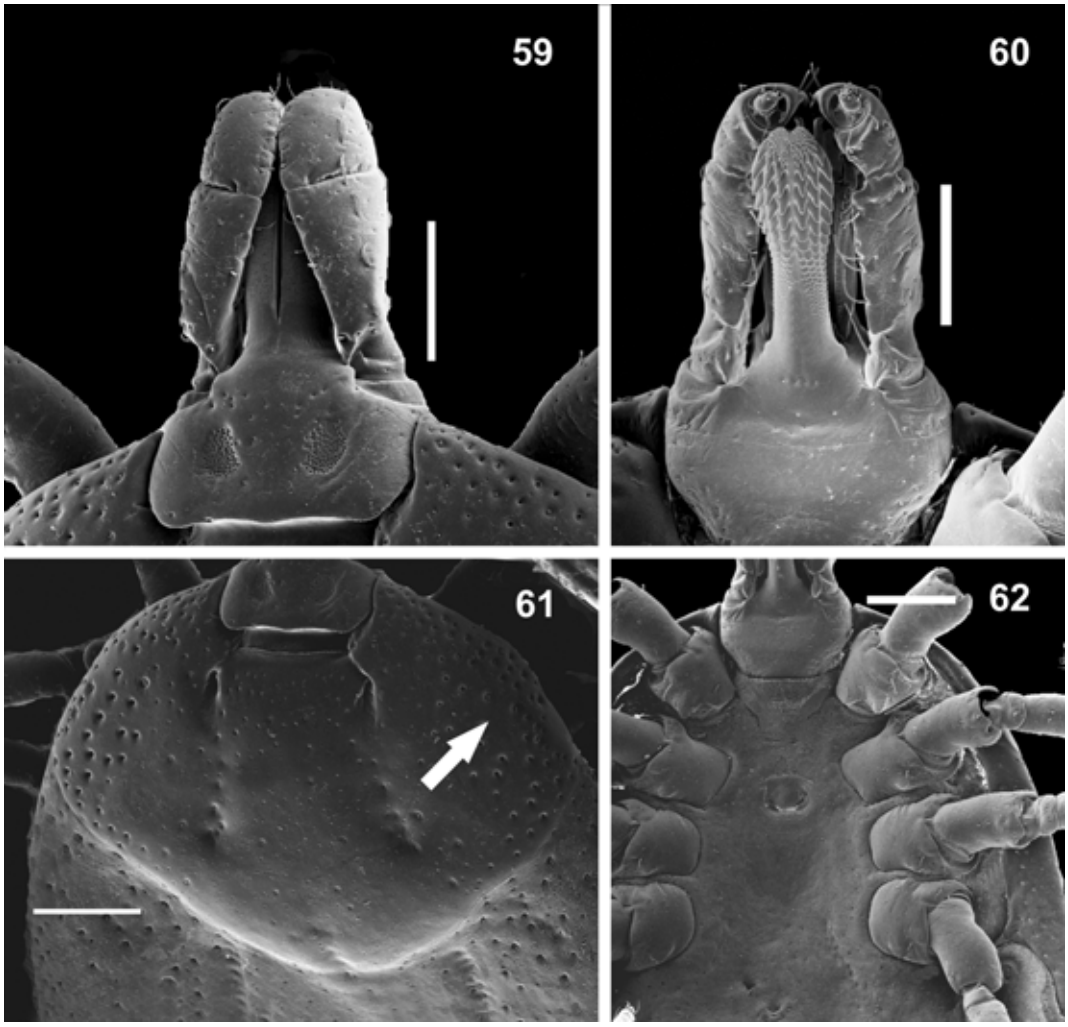


FIGURES 55–58. *Amblyomma quadricavum* male. 55. Gnathosoma dorsal view basis capituli rectangular (bar: 120µm); 56. Gnathosoma ventral view and spurs on coxa I (arrow) (bar: 200µm); 57. Idiosoma dorsal view, marginal groove absent (arrow) (bar: 400µm); 57a. Scutum inornate, light brown with darker brown stripes marking the very small eyes; 58. Coxae I–IV, internal spur on coxae II–IV absent (bar: 300µm).

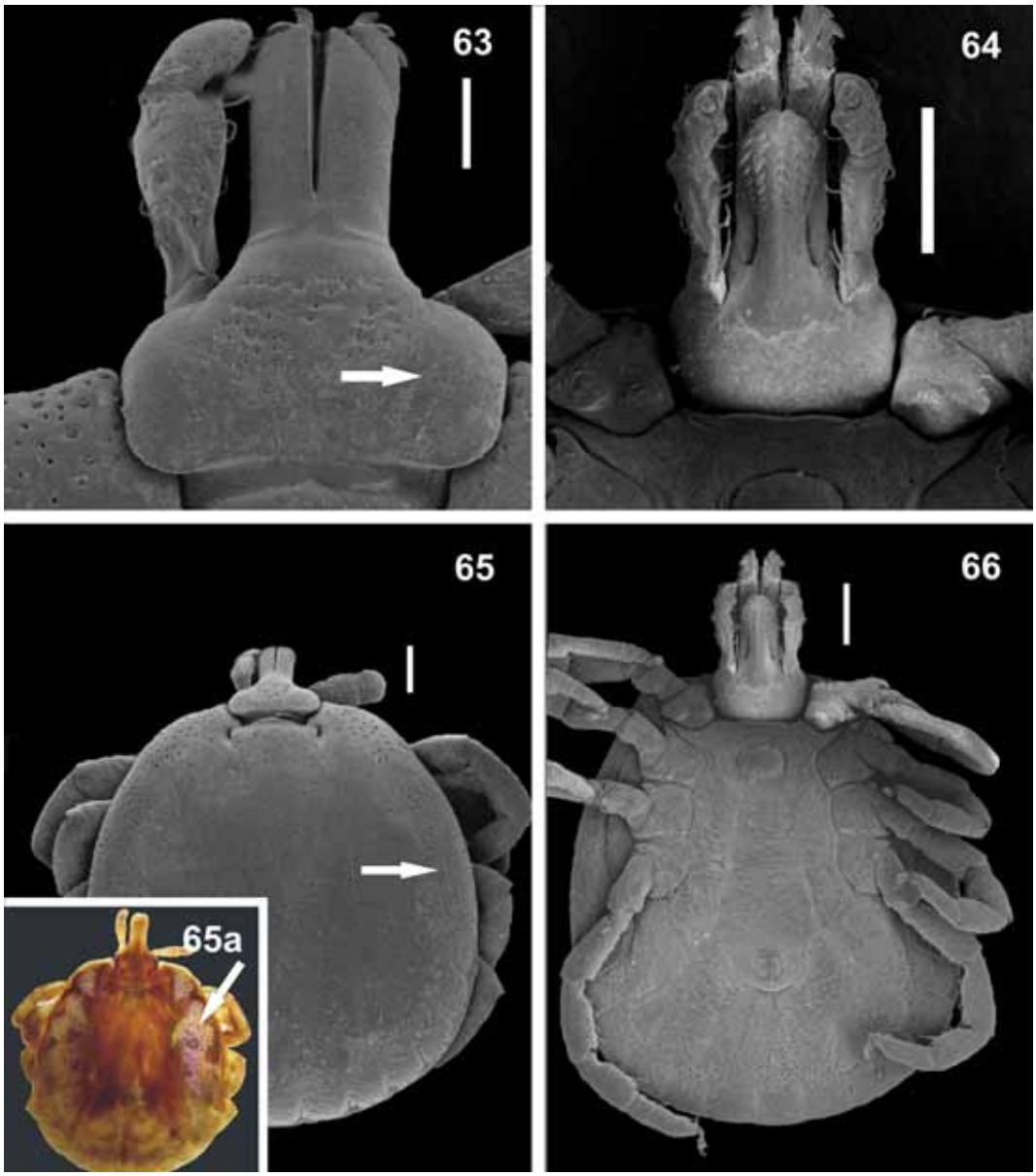
General comments

Of the 45 species of *Ixodes* known to occur in the Neotropical area, only *I. capromydis* is endemic to Cuba (Nava *et al.* 2009a, Guglielmone *et al.* 2009). With the exception of *A. cruciferum* Neumann

1901 and *A. rotundatum* Koch 1844, all Caribbean *Amblyomma* species associated with reptiles or amphibians also occur in Cuba. In contrast, the *Amblyomma* taxa associated with mammals, well represented in the Caribbean and the surrounding continental countries, are almost absent from Cuba (Onofrio *et al.* 2006a, Nava *et al.* 2009b). This may be due to the fact that the mammalian fauna of Cuba is mostly represented by domestic or imported species [e.g. *Odocoileus virginianus* (Zimmermann)] (Borroto Páez 2009), which are not suitable hosts for many host-specific *Amblyomma* species. For instance, the immature stages of *Amblyomma longirostre* (Koch, 1844) feed on birds while the adults exclusively feed on porcupines. Although its immatures are often carried by their hosts to a number of Neotropical and Nearctic areas, *A. longirostre* is only established in areas where porcupines are available, which is not the case for Cuba.



FIGURES 59–62. *Amblyomma torrei* female. 59. Gnathosoma dorsal view (bar: 300µm); 60. Gnathosoma ventral view (bar: 300µm); 61. Scutum with small punctations on lateral margins (arrow) (bar: 400µm); 62. Coxae I–IV, internal spur on coxae II–IV absent (bar: 400µm).



FIGURES 63–66. *Amblyomma torrei* male. 63. Gnathosoma dorsal view basis capituli rectangular (arrow) (bar: 200µm); 64. Gnathosoma ventral view and spurs on coxa I (bar: 400µm); 65. Idiosoma dorsal view, marginal groove absent (arrow) (bar: 400µm); 65a. Scutum brown with two longitudinal spots from scapulae to posterior margin (arrow); 66. Coxae I–IV, two short spurs on coxa I–II, internal spur absent on coxae III–IV (bar: 400µm).

Keys to the genera and species of ixodid ticks (Acari: Ixodidae) in Cuba

Males

1. Anal groove posterior to anus, eyes present 2

- Anal groove anterior to anus, eyes absent . . . . . *Ixodes capromydis* (Figs 7–11)

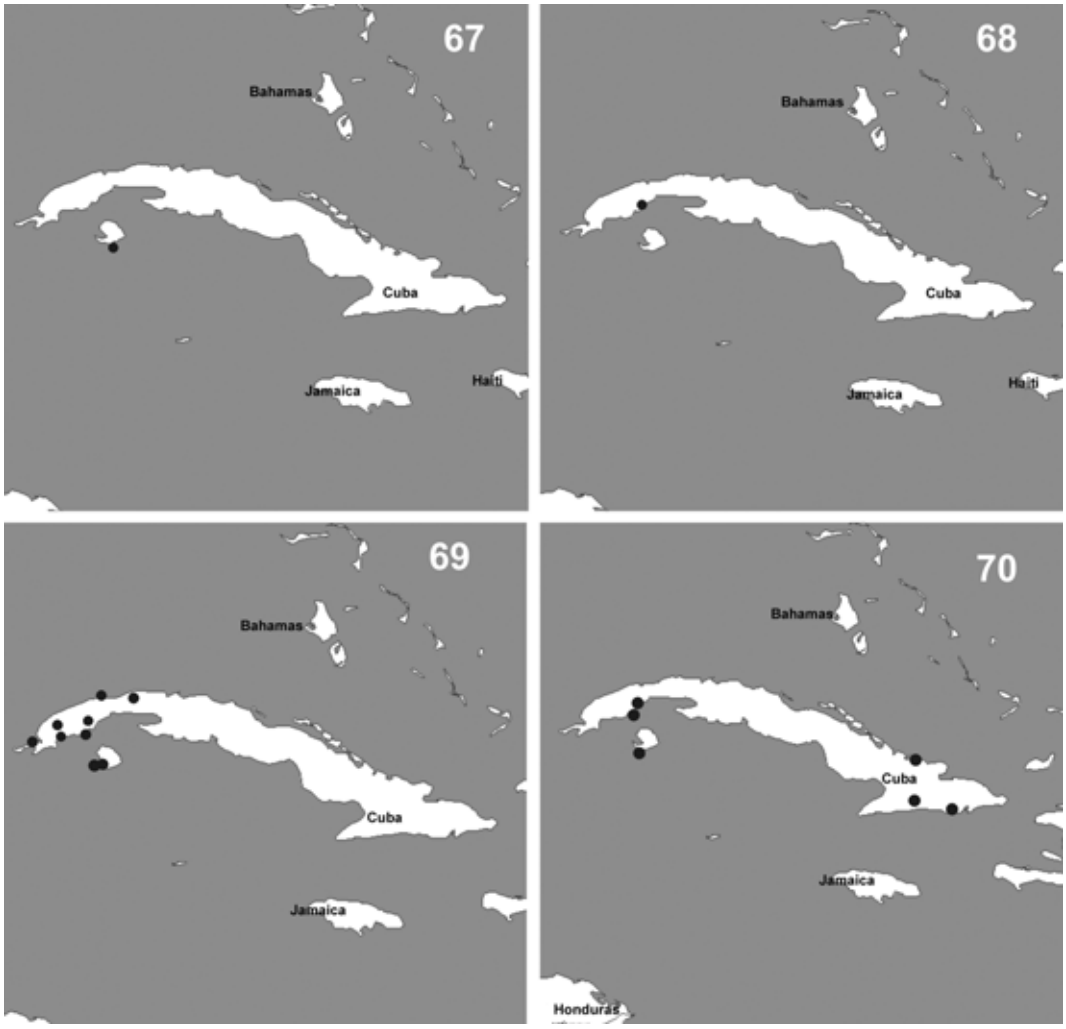
2. Hypostome and palpi short; article II of palpi (femur) as wide as long 3
- Hypostome and palpi long; article II of palpi (femur) twice as long as wide, eyes present . . . . . *Amblyomma*.....5

3. Basis capituli hexagonal; adanal and accessory plates evident or vestigial 4
- Basis capituli rectangular; adanal and accessory plates absent; coxa IV larger than coxae I–III . . . . . *Dermacentor nitens* (Figs 16–17)

4. Caudal process short and slightly rounded; 2 adanal plates and 2 vestigial accessory plates; festoons present . . . . . *Rhipicephalus sanguineus* (Figs 20–21)
- Caudal process slightly pointed; 4 adanal plates; festoons absent . . . . . *R.* (*Boophilus*) *microplus* (Figs 24–25)

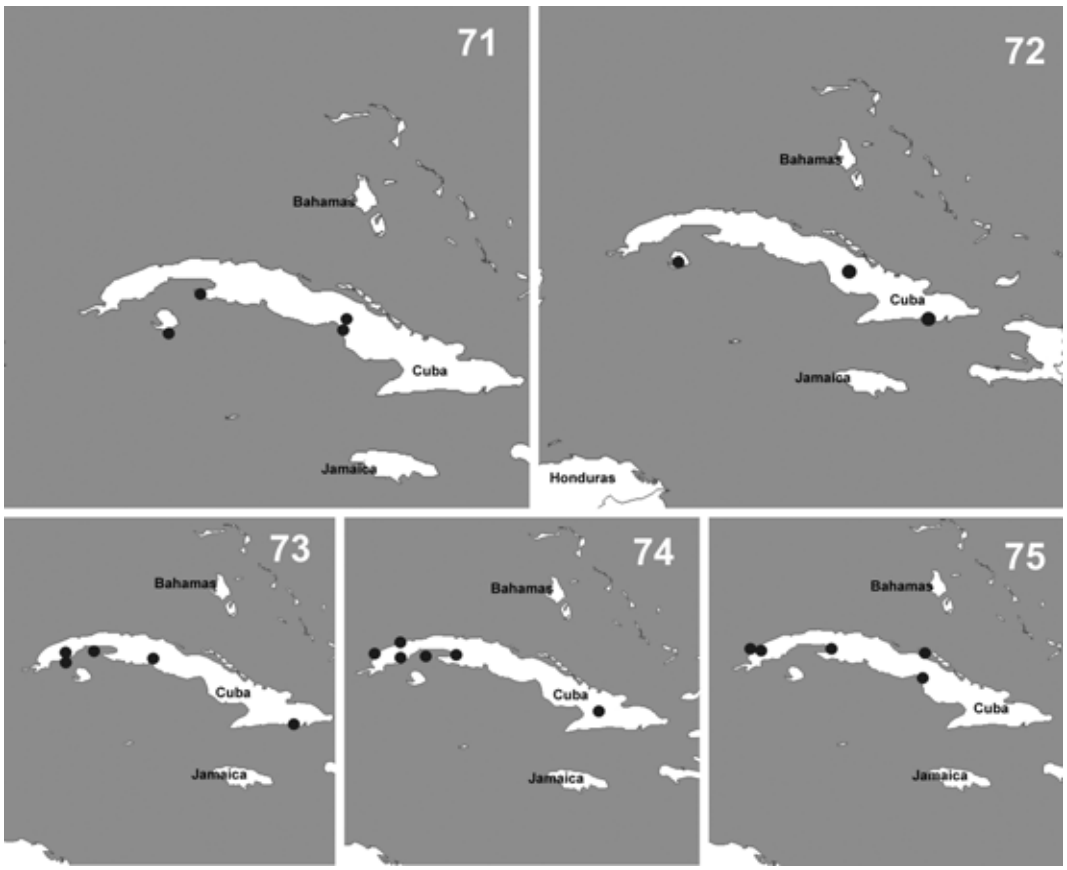
5. Marginal groove absent 6
- Marginal groove present . . . . . *A. cajennense* (Figs 39–42)

6. Scutum ornate 7
- Scutum inornate, eyes poorly developed. . . . . *A. quadricavum* (Figs 55–58)



FIGURES 67–70. Maps of the geographical distribution of: 67. *Ixodes capromydis*. 68. *Dermacentor nitens*. 69. *Rhipicephalus sanguineus*. 70. *Rhipicephalus (Boophilus) microplus*.

7. Coxae I–III with two short but evident spurs; coxa IV with two spurs, the external three times as long as the internal. . . . . .*A. dissimile* (Figs 47–50)
- Coxa I with two short spurs, the internal vestigial; coxae II–IV with one short spur 8
8. Scutum ornate, with large punctations in the lateral fields, less evident in the posterior margin; punctations absent from central area . . . . . .*A. albopictum* (Figs 31–34)
- Scutum ornate with 2 whitish spots on scapulae; 2 pairs of ventral sclerotized circular areas anterior to festoons 3 and 4 . . . . . *A. torrei* (Figs 63–66)



FIGURES 71–75. Maps of the geographical distribution of the Cuban *Amblyomma* species: 71. *Amblyomma albopictum*. 72. *Amblyomma cajennense*. 73. *Amblyomma dissimile*. 74. *Amblyomma quadricavum*. 75. *Amblyomma torrei*.

Females

1. Anal groove posterior to anus 2
- Anal groove anterior to anus . . . . . *I. capromydis* (Figs 1–6)
2. Hypostome and palpi short; article II of palpi (femur) almost as wide as long 3
- Hypostome and palpi long; article II of palpi (femur) twice as long as wide . . *Amblyomma*.....5
3. Dorsum of basis capituli hexagonal 4
- Dorsum of basis capituli rectangular; hypostome 4/4; spiracular plates elliptical with large aeropyles disposed in a circle around the ostium . . . . . *D. nitens* (Figs 12–15)
4. Hypostomal dentition 5/5; 2 short and rounded spurs on coxa I. . . . . .

. . . . . *R.* (*Boophilus*) *microplus* (Figs 22–23)
- Hypostomal dentition 3/3; 2 long and broad spurs on coxa I, longer than the article. . . . . *R. sanguineus* (Figs 18–19)

5. Chitinous tubercles present at internal angles of festoons (except on central festoon). . . . . *A. cajennense* (Figs 35–38)
- Chitinous tubercles on festoons absent 6

6. Scutum ornate 7
- Scutum inornate, eyes poorly developed. . . . . *A. quadricavum* (Figs 51–54)

7. Two evident spurs on coxae I–IV; scutum with longitudinal spots on lateral fields and between cervical grooves, with 12 deep and large punctations placed behind the eyes . . . . . *A. dissimile* (Figs 43–46)
- Coxa I with two short spurs, the internal vestigial; coxae II–IV with one short spur. 8

8. Scutum ornate; punctations present on the lateral fields, absent in the central area; idiosoma glabrous . . . . . *A. albopictum* (Figs 26–30)
- Scutum ornate with 2 whitish spots on scapulae; idiosoma with white pilosity . . . . . *A. torrei* (Figs 59–62)

Acknowledgements

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