

# *Amblyomma geocheleone*, a New Species of Tick (Acari: Ixodidae) from the Madagascan Ploughshare Tortoise

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**ABSTRACT** The male and female of *Amblyomma geocheleone* n. sp. are described and illustrated by both scanning electron micrographs and line drawings. Specimens of this new tick species were recovered from the endangered ploughshare tortoise, *Geochelone yniphora* (Vaillant), in northwestern Madagascar. This relatively large tick is morphologically most similar to *Amblyomma nuttalli* Dönitz, which occurs in mainland sub-Saharan Africa where it mainly parasitizes other species of tortoises. However, several characters distinguish the new species from *A. nuttalli* including the scutal ornamentation in both sexes and the characteristic patterns of shallow grooves on the alloscutum of the female of *A. geocheleone*. Because the adult stages of *A. geocheleone* are almost certainly host specific ectoparasites of the ploughshare tortoise, this new tick species is also probably endangered.

**KEY WORDS** *Amblyomma geocheleone*, new species, Ixodidae, Madagascar, Madagascan ploughshare tortoise

THE WORLD TICK fauna has been relatively well studied taxonomically (Keirans 1992, Camicas et al. 1998) largely because of the relevance of many species to disease causation and/or pathogen transmission. However, undescribed tick species are still occasionally collected. In this article we describe a fairly large, new species of tick belonging to the genus *Amblyomma*, from an endangered Madagascan tortoise. Ticks were recovered from the ploughshare tortoise (sometimes referred to as the ploughshare, angonoka, or angulated tortoise), *Geochelone yniphora* (Vaillant) during a conservation-based study of its ecology in northwestern Madagascar (Smith et al. 1999a, 1999b). The tick fauna of Madagascar has been treated by Uilenberg et al. (1979).

## Materials and Methods

In December 1994, ticks were collected from ploughshare tortoises at the Ambatomainty-Andranolava population, west of Baly Bay, Madagascar (see map in Smith et al. 1999b). During nearly 2 yr of continuous intensive study of ploughshare tortoises at another site, Cape Sada, ticks were not observed, which is suggestive that ticks may not be present in that population.

Tick specimens recovered from tortoises in the field were stored in 70% ethanol. Representative specimens of each sex were measured using a Wild Heerbrug MM5 235 electronic micrometer fitted to a Leitz low-

power binocular microscope. In the descriptions that follow, all measurements are in millimeters; a range is given with a mean in parentheses. Other specimens were prepared for scanning electron microscopy following techniques described by Corwin et al. (1979). Black and white inked drawings were prepared of each sex to show scutal ornamentation and other features.

## *Amblyomma geocheleone* Durden, Keirans & Smith new species (Figs. 1–4)

**Male (Figs. 1 and 2).** Four unengorged or partially engorged specimens measured. *Body* (Figs. 1 and 2A). Length from apices of scapulae to posterior body margin 3.77–4.30 (4.00), breadth 3.38–3.61 (3.47). Outline oval, broadest at level of spiracular plates. Genital aperture broadly U-shaped (Fig. 2B). Spiracular plate as in female (Fig. 4F).

*Capitulum* (Fig. 2 C and D). Basis capituli ornate dorsally with central golden yellow marking surrounded by medium brown (Fig. 1). Length of basis capituli from palpal insertion to posterior margin of basis 0.37–0.38 (0.38), breadth 0.71–0.77 (0.74). Posterior margin almost straight, cornua short, blunt; external margins rounded. Length of palpal article I 0.14–0.15 (0.14); length of palpal article II 0.55–0.65 (0.60); length of palpal article III 0.21–0.29 (0.25); suture between II and III distinct. Hypostome (Fig. 2D) elongate, broadly rounded apically with corona of fine denticles and small central notch. Total length of hypostome 0.75–0.80 (0.78); length of toothed portion 0.32–0.37 (0.34). Hypostomal dentition 3/3 with seven teeth per file.

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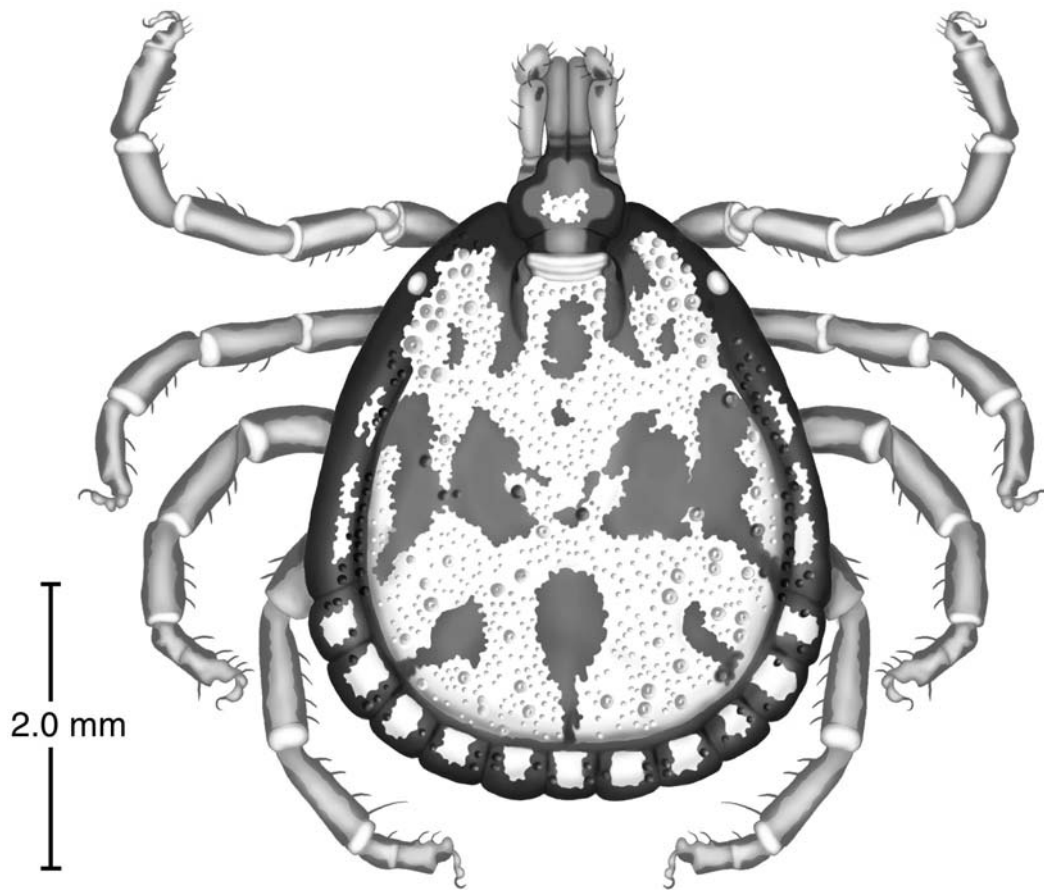


Fig. 1. Male, *A. geochelone* (RML 122391), dorsal view.

**Scutum** (Figs. 1 and 2A). With shallow emargination; scapulae short, bluntly rounded. Cervical pits comma shaped, relatively deep. Marginal groove comprised of a few deep pits anteriorly in the vicinity of the eye, becoming more numerous and partially coalescing near festoon 1. Background color ranging from golden yellow to dull cream, with medium brown markings as in Fig. 1. Following nomenclature used by Matthyse and Colbo (1987): brown frontal spot, cervical stripe, marginal line, posteroaccessory stripe and posteromedian stripe distinct on each side, lateral dark spots enlarged and coalesced, falciform and anteroaccessory stripes enlarged and coalesced. Ornamentation present on all festoons (Fig. 1). Punctations fairly numerous especially near margins and in scapular areas, with a few punctations centrally.

**Legs** (Fig. 2B). Coxa I with two moderately large, blunt spurs, with internal spur slightly longer than external spur. Coxae II-IV each with one external spur, broadly rounded on II and III, but longer and narrower on IV; internal spurs absent on coxae II-IV. Trochanters without spurs. Tarsus I 0.84–0.94 (0.89) long, 0.27–0.29 (0.28) broad. Tarsus IV 0.66–0.73 (0.71) long, 0.21–0.22 (0.21) broad.

**Female** (Figs. 3 and 4). Four partially engorged or engorged specimens measured.

**Body** (Fig. 4A). Length from apices of scapulae to posterior body margin 7.43–13.92 (10.06), breadth 5.84–8.12 (6.96), outline broadly elongate, broadest just anterior to level of spiracular plates. Genital aperture (Fig. 4B) broadly U-shaped. Spiracular plate (Fig. 4F) suboval in shape, broadest posteriorly, with numerous small goblet cells posteriorly and elongate macula. Alloscutum distinctive with relatively consistent pattern of depressions as shown in Fig. 3. Alloscutal setae fairly numerous and somewhat clumped especially in and around depressions and anterolaterally (Fig. 3).

**Capitulum** (Figs. 3 and 4 C and D). Basis capituli ornate dorsally with variable brownish and golden yellowish patterns (Fig. 3). Length of basis capituli from palpal insertion to posterior margin of basis 1.37–1.42 (1.39), breadth 0.810–0.880 (0.822), posterior margin straight, lateral margins broadly rounded, cornua small and broadly rounded. Porose areas moderate in size, deeply depressed, diameter of one area 0.163, interporose area 0.154. Length of palpal article I 0.105–0.118 (0.110); length of palpal article II 0.665–0.680 (0.671); length of palpal article III 0.260–0.277 (0.263); suture between articles II and III distinct. Hypostome elongate, apically rounded with corona of fine denticles. Total length of hypostome 0.880–0.920

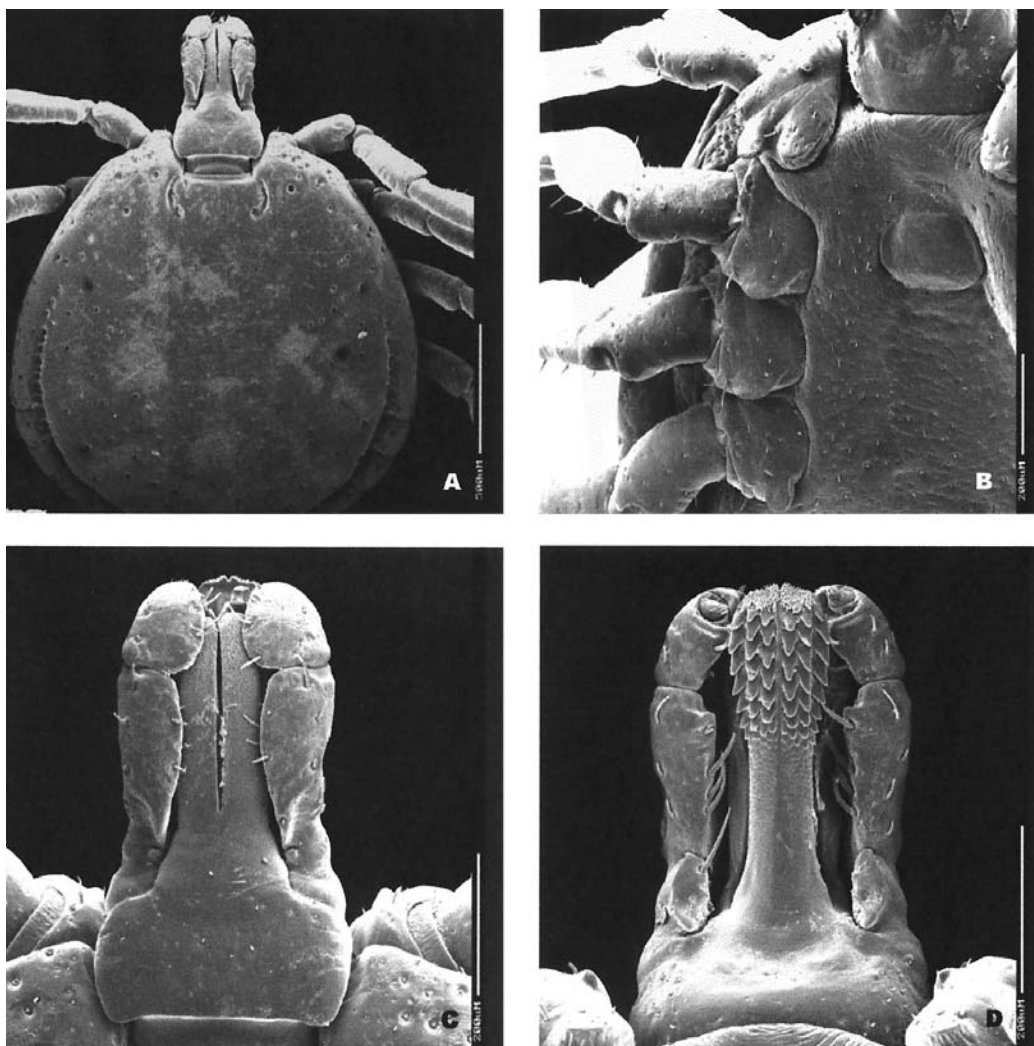


Fig. 2. Male, *A. geochele* (RML 122391). (A) Scutum and dorsal capitulum (scale bar = 500  $\mu\text{m}$ ). (B) Coxae I-IV (scale bar = 200  $\mu\text{m}$ ). (C) Capitulum, dorsal view (scale bar = 200  $\mu\text{m}$ ). (D) Capitulum, ventral view (scale bar = 200  $\mu\text{m}$ ).

(0.894), length of toothed portion 0.422–0.433 (0.427), dentition 3/3 with seven teeth per file.

**Scutum** (Figs. 3 and 4 A and E). Length 2.25–2.38 (2.29), breadth 2.32–2.42 (2.36), ornate (Fig. 3), with somewhat variable brown and yellowish markings, but anterior markings darker than posterior markings, with a postero-medial dark extension, and (in most specimens) a light spot (cervical spot of Matthyse and Colbo 1987) medial to each cervical groove. Cervical grooves moderate in length, deep anteriorly, comma-shaped. Punctations numerous and deep in anterolateral areas, otherwise almost absent.

**Legs** (Fig. 4B). Coxa I with prominent internal and external spur, the latter being slightly longer. Coxae II-IV each with short external spur, broadly rounded on II and III, longest on IV; internal spurs absent. Trochanters without spurs. Tarsus I 1.040–1.068 (1.054) long, 0.276–0.288 (0.281) broad. Tarsus IV 0.493–0.506 (0.498) long, 0.217–0.229 (0.223) broad.

**Material Examined.** HOLOTYPE  $\delta$ , ALLOTYPE  $\eta$ , 5 PARATYPE males, and 3 PARATYPE females, ex

*Geochele yniphora* at Andrafiavaly (45° 3.4' E, 16° 6.9' S), in the Ambatomainty-Andranolava region, Mahajanga Province, MADAGASCAR, 23 and 30 December 1994; collectors: L. L. Smith and M. E. Howe. Holotype and allotype deposited in the U.S. National Tick Collection (USNTC) at Georgia Southern University, Statesboro, GA, USA under accession numbers RML 122391 and RML 122427; paratypes deposited in the USNTC and in The Natural History Museum, London.

**Etymology.** The new species is named *geochele* in reference to the host genus.

**Species Relationships.** *Amblyomma geochele* shares some morphological characters with *Amblyomma nuttalli* Dönitz, an apparently closely related tick which mainly parasitizes tortoises in much of sub-Saharan Africa excluding Madagascar (Robinson 1926, Walker 1991). Preferred hosts of *A. nuttalli* are the hinged tortoise, *Kinixys belliana* Gray, and the leopard tortoise, *Geochele pardalis* (Bell), although monitor lizards and large snakes are occasionally parasitized and immature stages can also feed on certain



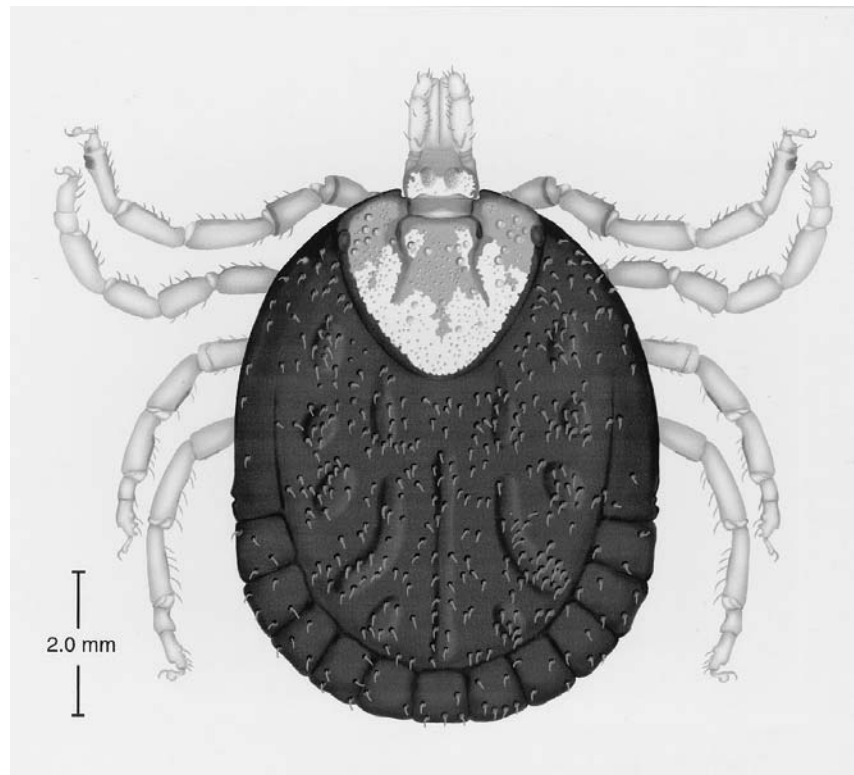


Fig. 3. Female, *A. geochelone* (RML 122427), dorsal view.

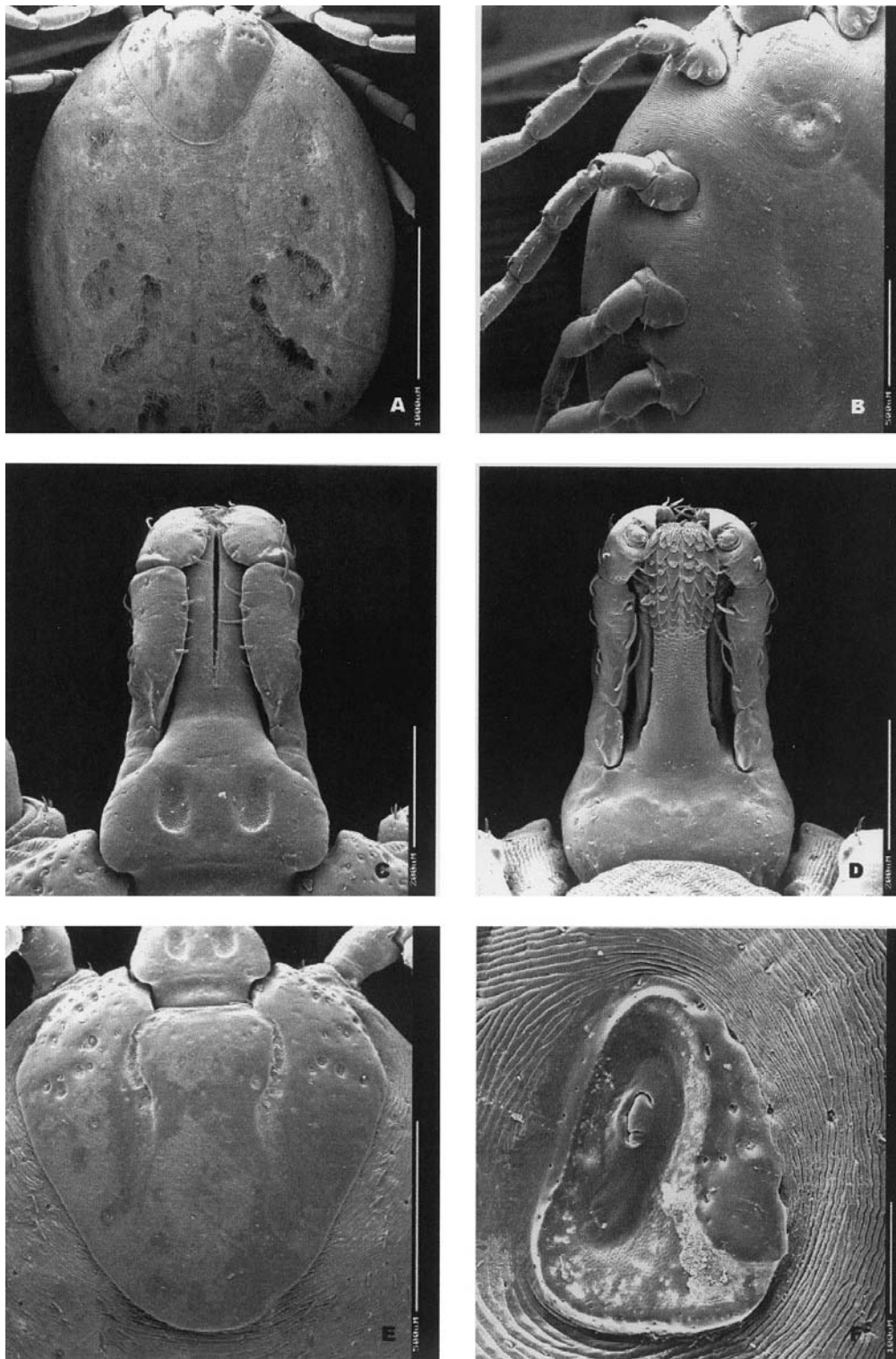
birds and mammals (Walker 1991). The leg coxae are almost identical in both *A. geochelone* and *A. nuttalli* with both species having two distinct fairly broad spurs on coxa I, one broad spur on each of coxae II and III, and a narrower, longer spur on coxa IV. However, the spurs on coxae II and III are broader in *A. nuttalli* than in *A. geochelone*. Females of these two species are easily distinguished based on the presence of distinct alloscutal depressions in *A. geochelone* (Fig. 3) but not in *A. nuttalli*. Further, females of *A. nuttalli* have a broad central band (tapering posteriorly) and a distinct lateral band on each side, of yellowish ornamentation (see figure 41 in Robinson 1926) on the scutum whereas females of *A. geochelone* have dark central and anterolateral yellowish scutal ornamentation (Fig. 3). Males of these two species can also be separated based on scutal ornamentation. Although the scutal ornamentation can be somewhat variable, males of *A. geochelone* always have a central dark patch between the cervical grooves (Fig. 1), whereas males of *A. nuttalli* do not (see figure 40 in Robinson 1926).

### Discussion

The ploughshare tortoise is endemic to the island of Madagascar and is considered one of the rarest tortoises in the world. The five known populations are small and isolated from one another; all are concentrated within a 100-km<sup>2</sup> area in the vicinity of Baly Bay in the northwestern part of the island (Smith et al.

1999b). The restricted distribution of this species is thought to be the result of historical commercial exploitation as well as habitat alteration due to frequent anthropogenic bush fires (Juvik et al. 1981, Curl et al. 1985). Ploughshare tortoises occur only in bamboo-scrub habitat that is dominated by bamboo (*Perrierbambos madagascariensis*), shrubs (*Terminalia* spp.), and palms (*Bismarkia nobilis*) (Smith et al. 1999a). Three of the five ploughshare tortoise populations are located east of Baly Bay (Cape Sada, Ankasakabe, and Beheta) and two west of the Bay (Betainalika and Ambatomainty-Andranolava) (see figure 2 in Smith et al. 1999b). The east and west populations are separated by the Andranomavo River, and it is unlikely that there is any contact and exchange between these tortoise populations.

Because *Amblyomma geochelone* has been collected only from the ploughshare tortoise in part of its range in northwestern Madagascar, it is likely that adult stages of this tick feed exclusively on this tortoise. Immature stages of this tick probably also feed on this tortoise but it is possible that nymphs and especially larvae, also feed on other vertebrates. This assumption is based on the host specificity of some other tortoise-associated ticks such as *Amblyomma tuberculatum* Marx, the adults of which exclusively parasitize the gopher tortoise, *Gopherus polyphemus* (Daudin), in the southeastern United States, whereas nymphs and larvae are progressively less host specific (Keirans and Durden 1998). Because *A. geochelone* appears to be host specific and has not been described previously, it



**Fig. 4.** Female, *A. geochelone* (RML 122427). (A) Scutum and alloscutum (scale bar = 1,000  $\mu\text{m}$ ). (B) Coxae I-IV (scale bar = 500  $\mu\text{m}$ ). (C) Capitulum, dorsal view (scale bar = 200  $\mu\text{m}$ ). (D) Capitulum, ventral view (scale bar = 200  $\mu\text{m}$ ). (E) Scutum (scale bar = 500  $\mu\text{m}$ ). (F) Spiracular plate (scale bar = 100  $\mu\text{m}$ ).

is very likely that, like its host, it is endangered. Durden and Keirans (1996) discuss other rare and endangered tick species including the ecological and evolutionary importance of parasite conservation in

natural host populations. Coincidentally, a new species of ectoparasitic pterygosomatid mite, *Geckobia enigmatica* Bertrand and Pedrono, was recently described (Bertrand and Pedrono 1999) from *G.*

*yniphora*, suggesting that additional unique parasites may be associated with this tortoise.

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