The genus *Hyalomma* Koch, 1844. IX. Redescription of all parasitic stages of *H*. (*Euhyalomma*) *impeltatum* Schulze & Schlottke, 1930 and *H*. (*E*.) *somalicum* Tonelli Rondelli, 1935 (Acari: Ixodidae)

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Abstract *The ticks Hyalomma (Euhyalomma) impeltatum Schulze & Schlottke, 1930 and H. (E.) somalicum Tonelli Rondelli, 1935 [a species resurrected for "Hyalomma ? species" of Hoogstraal (1956) and H. erythraeum of Kaiser & Hoogstraal (1968)] are tentatively considered to belong to the H. (E.) asiaticum group of closely related species. Amongst other features that are fairly similar, males of H. impeltatum can be distinguished from those of H. somalicum by the oval posterior margin of the conscutum, a narrow, subtriangular parma, the lack of ventral sclerotised plaques on median, paramedian and 4th festoons, and an incomplete to complete ivory-coloured stripe on the dorsal aspect of the leg segments; whereas males of H. somalicum have a broad but only slightly convex posterior conscutal margin, in most cases no parma, well-developed sclerotised ventral plaques on all festoons, and only a small ivory-coloured spot on the dorsal aspect of the leg segments. Females of H. impeltatum can be distinguished from those of H. somalicum by the bulging rather than flat preatrial fold of the genital aperture. All parasitic stages of both ticks are illustrated and redescribed, and the characteristics that distinguish the adults from those of other closely related species are detailed. Larger domestic and wild ungulates are the principal hosts of the adults of both ticks. Nymphs and larvae of H. impeltatum parasitise rodents, leporids, birds and lizards, whereas the hosts of the immature stages of H. somalicum are unknown. H. impeltatum is widely distributed in Africa north of the equator, Arabia, the Near East and south-western part of Central Asia; in contrast, H. somalicum has a more limited distribution in East Africa and possibly the Arabian Peninsular. Data on their possible disease relationships are also provided.*

Introduction

Hyalomma (*Euhyalomma*) *impeltatum* Schulze & Schlottke, *1930* was originally described as a subspecies of *H. savignyi* (Gervais, 1844), namely *H. savignyi impeltatum* (see Schulze & Schlottke, *1930*). Later Kratz (*1940*) recognised this taxon at full species level, as *H. impeltatum*, but the tick was not clearly morphologically defined until the descriptive works of Hoogstraal and his co-workers (Hoogstraal, *1956*; Hoogstraal et al., *1981*). Considerable individual and geographical variability throughout its wide distributional range often makes it difficult to identify the adults to the specific level. Identification of *H. impeltatum* based on its immature stages has to all intents and purposes not been attempted.

Hyalomma (*Euhyalomma*) *somalicum* Tonelli Rondelli, *1935* was originally described as a full species (Tonelli Rondelli, *1935*), but Delpy (*1949*) and Tendeiro (*1955*) considered it part of the *H. excavatum* Koch, 1844 species complex. Later Hoogstraal & Kaiser (*1959*) proposed that it be considered a subspecies of *H. impeltatum*, whereas Camicas et al. (*1998*) consider *H. somalicum* a junior synonym of *H. erythraeum* Tonelli Rondelli, 1932.

Hoogstraal (*1956*) briefly described adults of a "*Hyalomma* ? species" from Somalia and adjacent areas, which at that time he could not accommodate in any other valid species. A few years later, Hoogstraal & Kaiser (*1959*) apparently considered this species to be *H. impeltatum somalicum*, but Kaiser & Hoogstraal (*1968*) finally decided that the unknown "*Hyalomma* ? species" should be known as *H. erythraeum*, thus resurrecting this name from amongst the synonyms of *H*. *excavatum* (see Tendeiro, *1955*), and as a questionable synonym of *H*. *impeltatum* (see Hoogstraal, *1956*). Kaiser & Hoogstraal (*1968*) redescribed both sexes and described the larva and the nymph for the first time; since then *H. erythraeum* has been considered a valid species.

After a detailed study of extensive collections of *H. impeltatum* and *H. erythraeum* [*sensu* Kaiser & Hoogstraal (*1968*)], we confirm that these are valid taxa deserving full species rank. However, after the examination of the probable type-specimens and perusal of the original description of *H. erythraeum,* we disagree with the current point of view (Kaiser & Hoogstraal, *1968*) on the nomenclature of this species. In accordance with the rules of priority of the International Code for Zoological Nomenclature, we treat *H. erythraeum* Tonelli Rondelli, *1932* as an objective junior synonym of *H. impeltatum* Schulze & Schlottke, *1930* and resurrect the name *H. somalicum* Tonelli Rondelli, *1935* for *H. erythraeum* of Kaiser & Hoogstraal (*1968*).

Based on a preliminary analysis of morphological characters, we consider that both *H*. *impeltatum* and *H*. *somalicum* belong to the *H.* (*E.*) *asiaticum* group of closely related species. In addition to *H*. (*E*.) *asiaticum* Schulze & Schlottke, *1930*, the other species in this group are *H*. (*E*.) *dromedarii* Koch, 1844 and *H*. (*E*.) *schulzei* Olenev, 1931 (see Apanaskevich et al., *2008*).

Materials and methods

A total of approximately 3,400 males, 2,700 females, 100 nymphs and 300 larvae of *Hyalomma impeltatum*, originating from Afghanistan, Algeria, Chad, Djibouti, Egypt, Eritrea, Ethiopia, Israel, Kenya, Mauritania, Mali, Niger, Nigeria, Oman, Qatar, Saudi Arabia, Somalia, Sudan, Tanzania, Tunisia, Western Sahara and the Yemen; and 369 males, 72 females, 20 nymphs and 50 larvae of *H*. *somalicum*, originating from Djibouti and Somalia, were examined in the present study. Both field-collected and laboratory-reared specimens were scrutinised. The specimens examined are housed in the United States National Tick Collection (USNTC) (Institute of Arthropodology and Parasitology, Georgia Southern University, Statesboro, USA), the Zoological Institute, Russian Academy of Sciences (ZIN RAS) (St Petersburg, Russia), the Natural History Museum of Berlin (NHMB) (Germany), the Field Museum of Natural History (FMNH) (Chicago, USA), the Royal Museum for Central Africa (RMCA) (Tervuren, Belgium), the Gertrud Theiler Tick Museum at the Onderstepoort Veterinary Institute (OVI) (Onderstepoort, South Africa), and in the personal tick collection of Dr J. B. Walker (South Africa). Detailed lists of studied material can be found at: http://0-personal.georgiasouthern.edu.innopac.up.ac.za/~dapanask/data on Hyalomma impeltatum.pdf and http://0-personal.georgiasouthern.edu.innopac.up.ac.za/~dapanask/data on Hyalomma somalicum.pdf.

The immature stages and the more delicate structures of the adults were mounted on slides and examined under a light microscope, as were the macrostructures of males and females under a stereoscopic microscope. The spiracular plates of the nymphs were studied by means of a scanning electron microscope. Measurements are given in micrometres unless otherwise indicated. These measurements are arranged as follows: minimum − maximum (average ± standard deviation, n = number of specimens measured). Their schematic layout is to be found in Apanaskevich (*2003*) and Apanaskevich & Horak (*2006*). The measured specimens of *H. impeltatum* originate as follows: males – Egypt, Ethiopia, Libya, Morocco, Nigeria, Qatar, Saudi Arabia, Somalia, Sudan, Tanzania and the Yemen; females – Egypt, Ethiopia, Libya, Mauritania, Morocco, Saudi Arabia, Somalia, Sudan and the Yemen; nymphs – Egypt, Oman, Senegal and Tanzania; larvae – Egypt, Oman, Saudi Arabia, Senegal, Somalia and Tanzania. The measured specimens of *H. somalicum* originate as follows: males – Djibouti and Somalia; females – Djibouti and Somalia; nymphs and larvae – Somalia.

***Hyalomma* (*Euhyalomma*) *impeltatum* Schulze & Schlottke, 1930**

Syns [after Camicas et al. (*1998*), with corrections] *Hyalomma savignyi impeltatum* Schulze & Schlottke, *1930*; *H. erythraeum* Tonelli Rondelli, *1932* (new synonymy); *H. fezzanensis* Tonelli Rondelli, *1935*; ?*H. leptosoma* Schulze, 1937; ?*H. dromedarii* f. *leptosoma* Schulze, 1937 of Kratz (*1940*); *H. brumpti* Delpy, 1946; *H. impeltatum impeltatum*, Schulze & Schlottke, *1930* of Hoogstraal & Kaiser, *1958b*) (new synonymy); *H. sinaii* Feldman-Muhsam, *1960* (new synonymy).

Type-specimens: The original description was based on males and females (unquantified) from North and West Africa (Schulze & Schlottke, *1930*). Kratz (*1940*) noted that the type-specimen (1 male) originates from Western Sahara (Rio de Oro) and is deposited in the NHMB. Since then, however, the holotype has never been mentioned in the literature. We were unable to find this specimen in either the NHMB or in Schulze's collection at the USNTC, and therefore conclude that the type-specimen has been either lost, destroyed or mislabelled.

Remarks: In the introduction above, we mention the problems regarding the description and identification of *H. impeltatum*; these are compounded by having no holotype specimen. Consequently we have deemed it necessary to designate a neotype. The characters that differentiate the nominal species, for which the neotype has been designated, from other taxa, as well as a description and illustrations that will ensure the recognition of the neotype, are clearly listed and presented in this publication. The specimen selected as the neotype closely corresponds with the only workable description of *H. impeltatum* given by Kratz (*1940*), for which he apparently used the original holotype specimen. Although we examined several specimens originating from Western Sahara, where the holotype originated (Kratz, *1940*), we rejected them as a possible neotype because of their poor condition. Instead the neotype specimen has been selected from Moroccan material, as being the closest to the type-locality. This neotype is deposited in, and is the property of the USNTC (Statesboro, USA).

Here we designate the neotype for *H. impeltatum* as:

Neotype: 1 male; Morocco, Greater Casablanca, Casablanca (33º32′N, 7º35′W); ex Domestic cattle; January-February, 1957; Morocco Veterinary Service leg.; RML 85120.

We found two males in collection lot RML 49651 (*Hyalomma erythraeum* Tonelli Rondelli, Agordat, Maggio 1931, su cani e pecore) in Schulze's collection at the USNTC. These specimens obviously originate from the type-series of *H. erythraeum*, which were probably sent to P. Schulze by M. Tonelli Rondelli (*1932*). Both males were identified in 1957 as *H. impeltatum* by H. Hoogstraal. Our examination of these two males and perusal of the original description of *H. erythraeum* reveal, rather compellingly, that *H. erythraeum* Tonelli Rondelli, *1932* is identical to *H. impeltatum*. We thus conclude that, according to the rules of priority of the International Code for Zoological Nomenclature, *H. erythraeum* is a junior synonym of *H. impeltatum*. For a discussion concerning *H. erythraeum* of Kaiser & Hoogstraal (*1968*), see that presented below for the latter tick.

The most useful descriptions and illustrations of the adults of *H. impeltatum* are to be found in Hoogstraal (*1956*) and Hoogstraal et al. (*1981*). The larva and nymph have been schematically described and illustrated as *H. brumpti* by Rousselot (*1948*); and the larva has been redescribed by Camicas (*1970*).

Redescription (Figs. 1–7)

Male (Figs. 1–3). *Conscutum* (Fig. 1A, B): length 3.14–4.90 mm (3.84 ± 0.42 mm, n = 100), width 1.95–3.24 mm (2.40 ± 0.29 mm, n = 100), length/width ratio 1.44–1.71 (1.60 ± 0.06, n = 100); yellow- to red-brown in colour; pale marbling absent; broadly oval in shape; widest near mid-length; slight narrowing in region of spiracular plates; rounded posterior margin; cervical and lateral grooves moderately deep, up to 1/3 length of conscutum; marginal grooves short, furrow-like, extending anteriorly for posterior 1/4 of conscutum, dense and deep punctations aligned with marginal groove give it appearance of long but shallow groove reaching almost 2/3 of conscutal length; posteromedian groove does not reach parma and is separated from parma by smooth or wart-like surface; paramedian grooves well defined; caudal field well defined, laterally demarcated by moderate ridges; large punctations sparse, mainly on central, caudal and lateral fields; medium and small punctations vary in density – usually dense, mainly on caudal and lateral fields; parma generally present, narrow, inverted U-shape; 4 distinct festoons. *Genital structures* (Fig. 2A) as illustrated. *Anal shields* (Fig. 2B): 3 pairs; adanal plates long, lateral margin convex, anteromedian margin concave, median projection prominent, posteromedian margin slightly concave, posterior margin bluntly rounded; subanal plates vary in shape and size, from small to medium to very large, subcircular. No sclerotised plaques ventrally on median, paramedian and fourth festoons. *Spiracular plate* (Fig. 2C): dorsal prolongation long, narrow and distinct from body of plate; perforated portion of prolongation gently curved throughout its length. Circumspiracular setae sparse. *Basis capituli* (Fig. 2D, E): without lateral projections; dorsal posterior margin slightly concave; cornua modest. *Palpi* (Fig. 2F): segment I with more than 5 ventromedian setae. *Hypostome* (Fig. 2G): club-shaped; denticulate portion slightly longer than denticle-free portion (small scale-like projections posterior to last large denticle are not considered denticles). *Coxae* (Fig. 2H): posteromedian and posterolateral spurs of coxa I long, subequal in length or posterolateral spur longer than posteromedian spur, juxtaposed, tapering to apices; coxae II–IV each with distinct, broadly triangular posterolateral spur; coxae II and III each with modest, broadly arcuate, posteromedian spur; internal spur on coxa IV distinct, triangular. Ivory-coloured enamel band encircles distal portion of each segment of legs; incomplete or complete (mainly in populations from Arabian Peninsula) ivory-coloured stripe on dorsal aspect of leg segments (Fig. 3A).

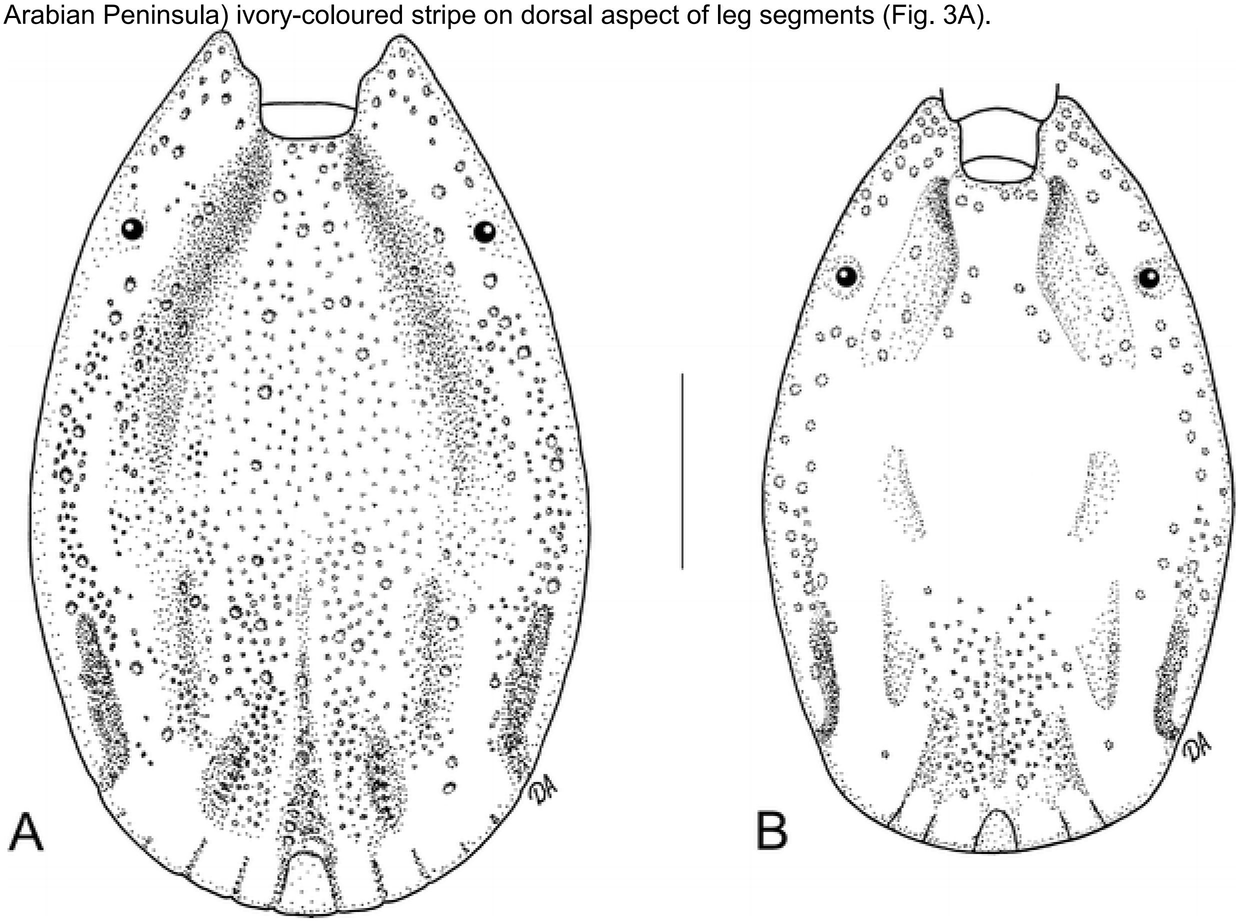

Fig. 1 *Hyalomma impeltatum*, male, conscutum (A, B, showing variations). *Scale-bar*: 1 mm. All setae are omitted

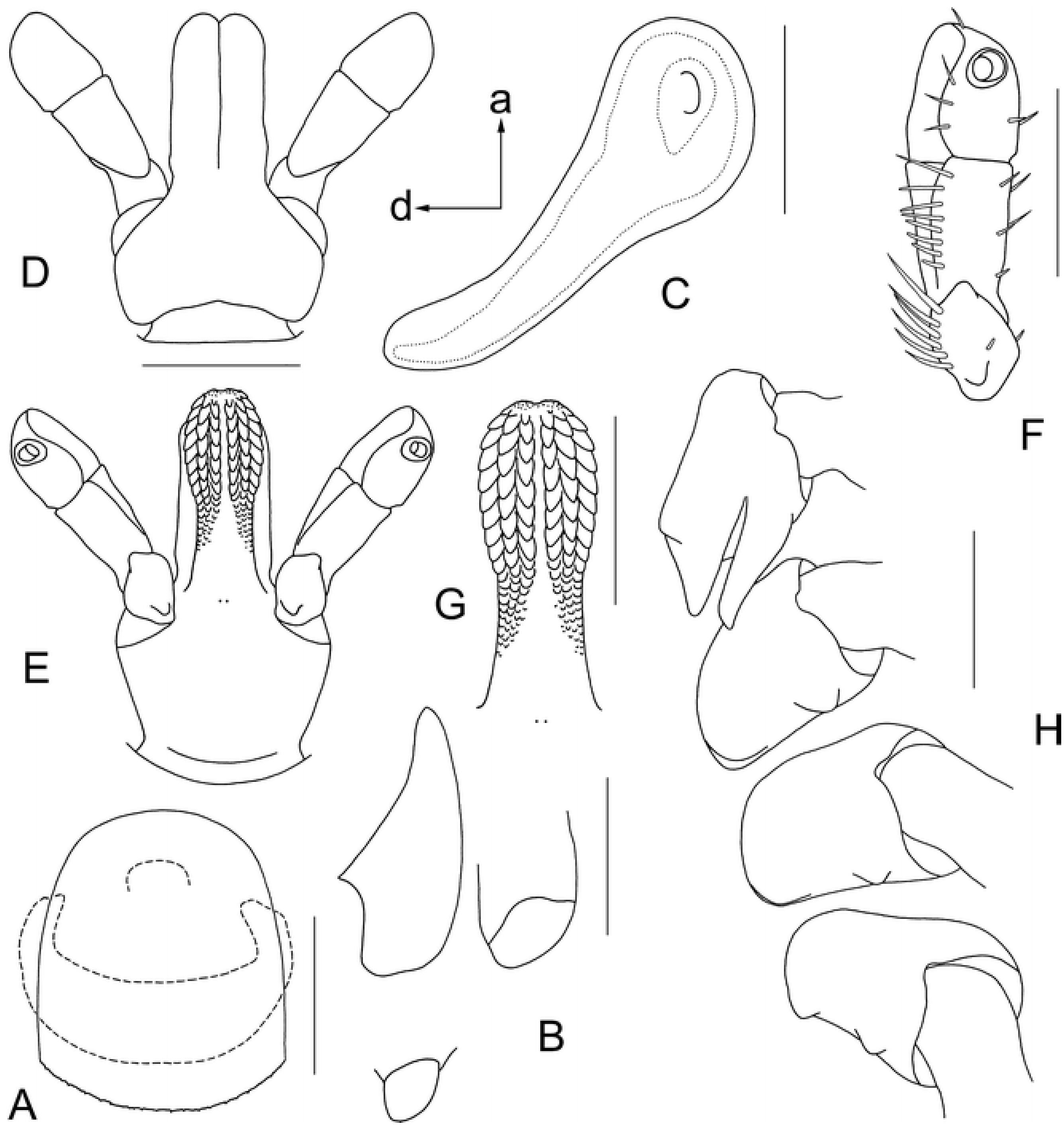

Fig. 2 *Hyalomma impeltatum*, male. A, genital structures; B, anal plates; C, spiracular plate (a, anterior; d, dorsal); D, gnathosoma dorsally; E, gnathosoma ventrally; F, palp ventrally; G, hypostome; H, coxae. *Scale-bars*: A, 200 μm; B, D, E, H, 500 μm; C, F, G, 400 μm. All setae are omitted except drawing F, where only setae of palpal segment IV are omitted

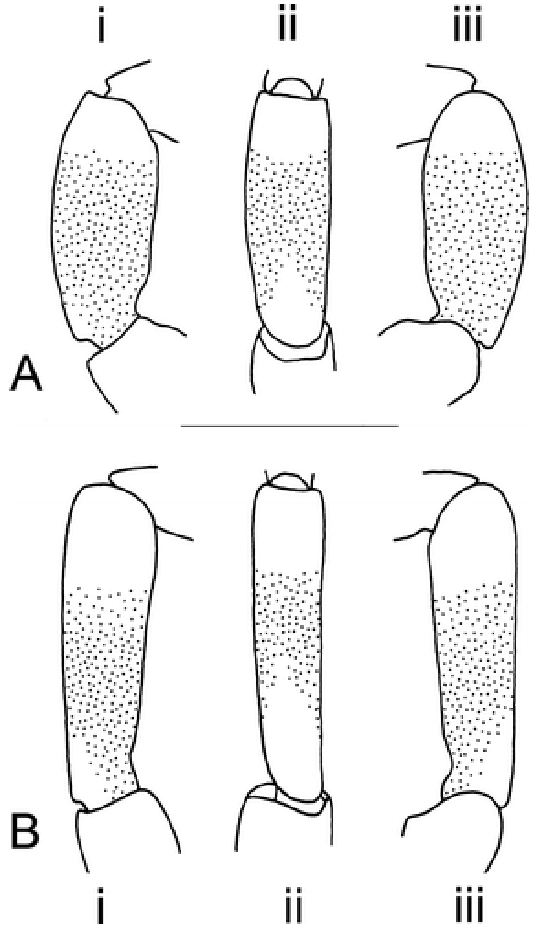

Fig. 3 *Hyalomma impeltatum*, genu IV. A, male: i, lateral view; ii, dorsal view; iii, medial view; B, female: i, lateral view; ii, dorsal view; iii, medial view. *Scale-bar*: 1 mm. All setae are omitted

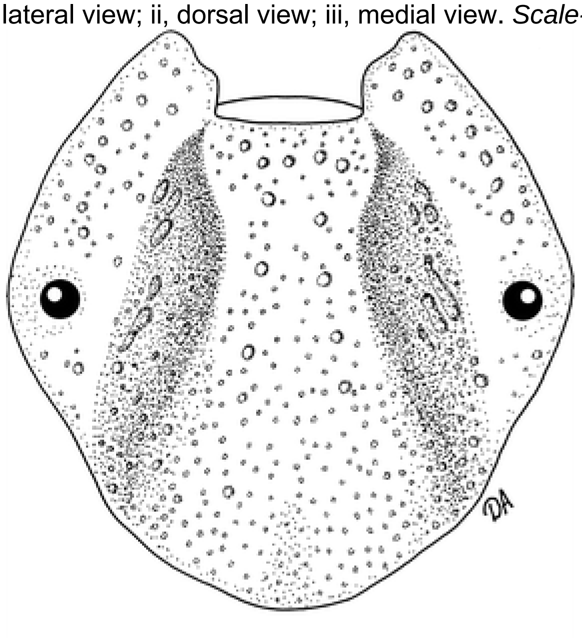

Fig. 4 *Hyalomma impeltatum*, female, scutum. *Scale-bar*: 1 mm. All setae are omitted

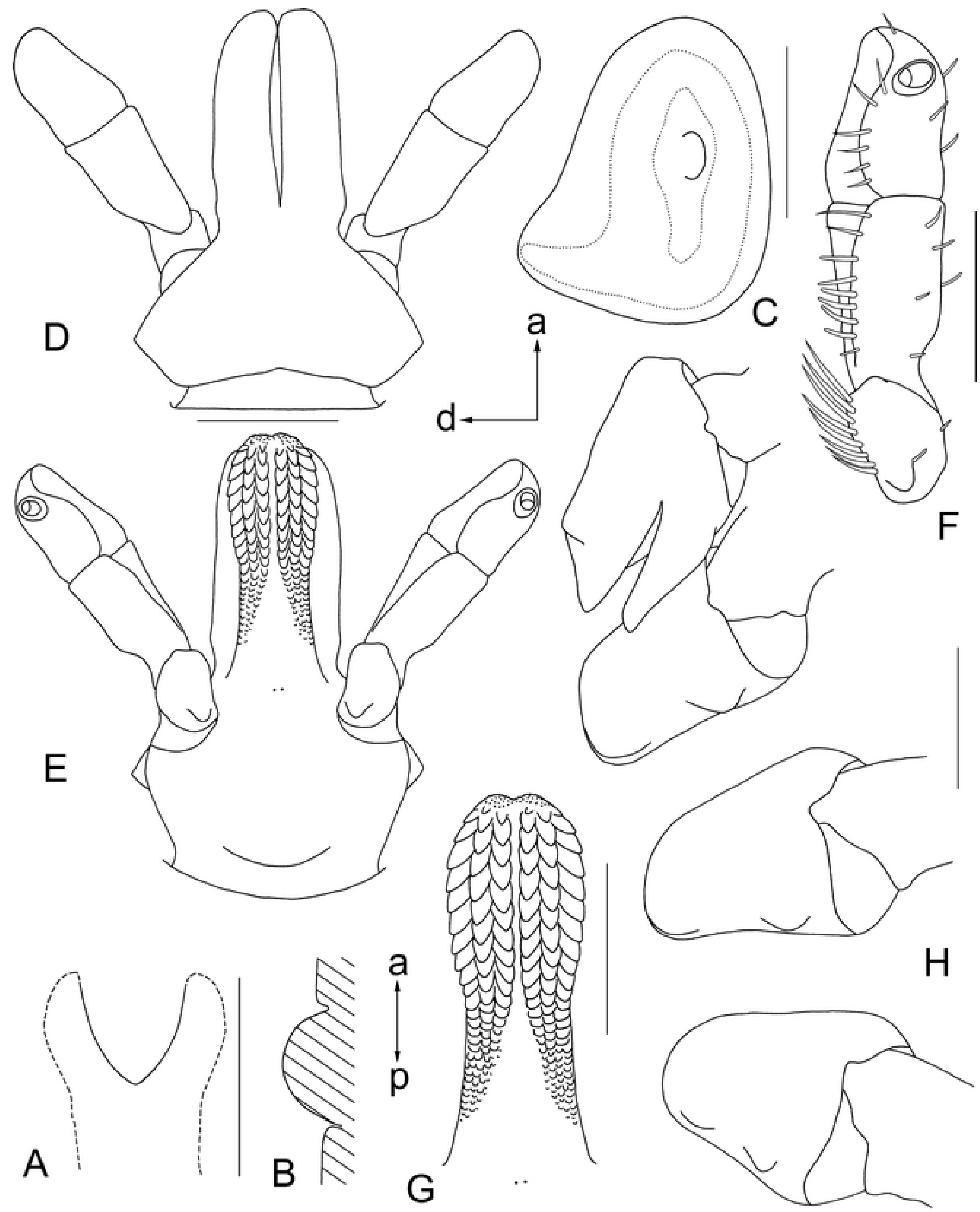

Fig. 5 *Hyalomma impeltatum*, female. A, genital structures; B, longitudinal cut through preatrial fold of schematic genital aperture (a, anterior; p, posterior); C, spiracular plate (a, anterior; d, dorsal); D, gnathosoma dorsally; E, gnathosoma ventrally; F, palp ventrally; G, hypostome; H, coxae. *Scale-bars*: A, 200 µm; C, F, G, 400 µm; E, D, H, 500 µm. All setae are omitted except drawing F, where only setae of palpal segment IV are omitted

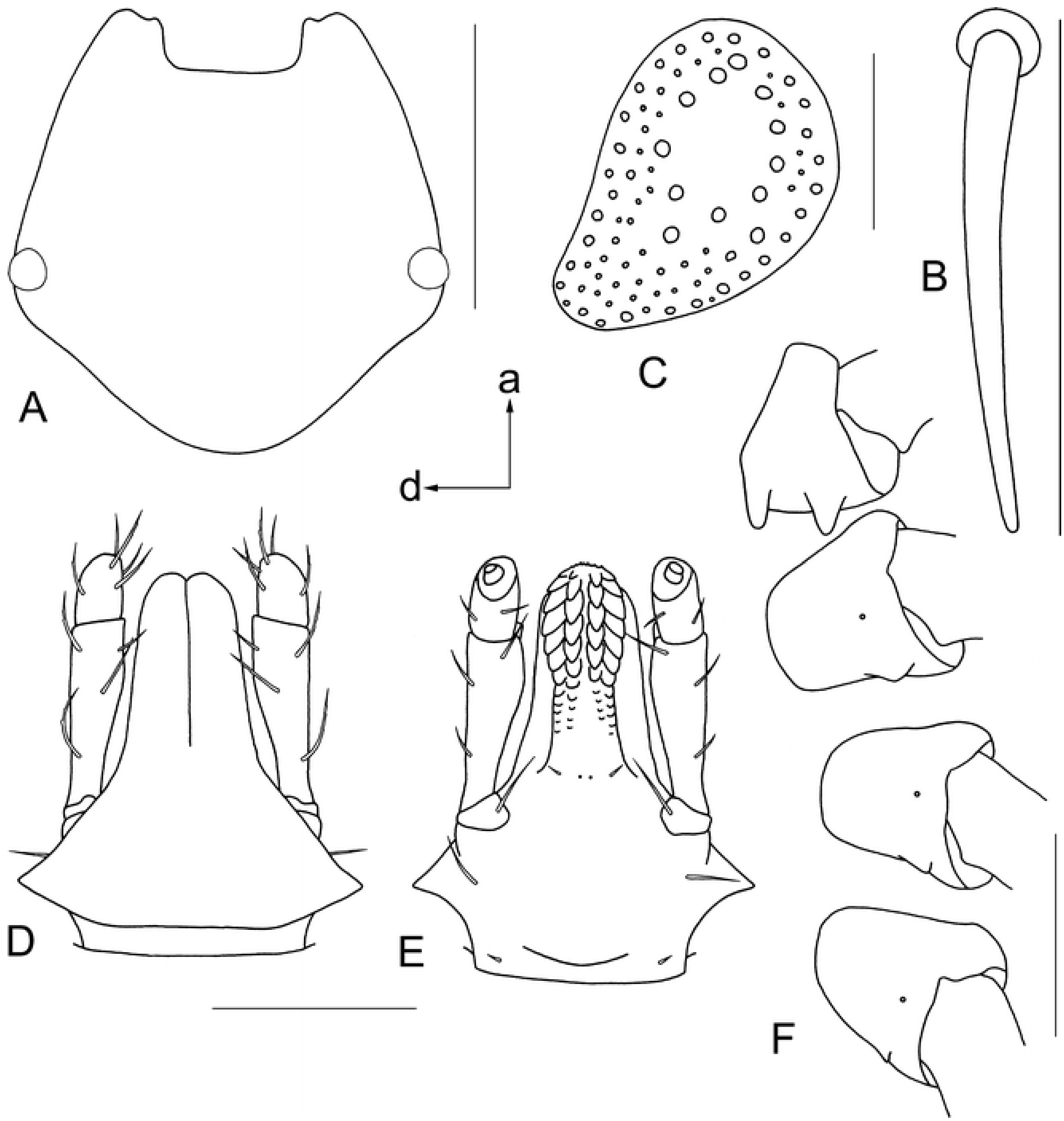

Fig. 6 *Hyalomma impeltatum*, nymph. A, scutum; B, seta of alloscutum; C, spiracular plate (a, anterior; d, dorsal); D, gnathosoma dorsally; E, gnathosoma ventrally; F, coxae. *Scale-bars*: A, 400 μm; B, C, 50 μm; D, E, F, 200 μm. All setae are omitted except drawing D and E, where only setae of palpal segment IV are omitted

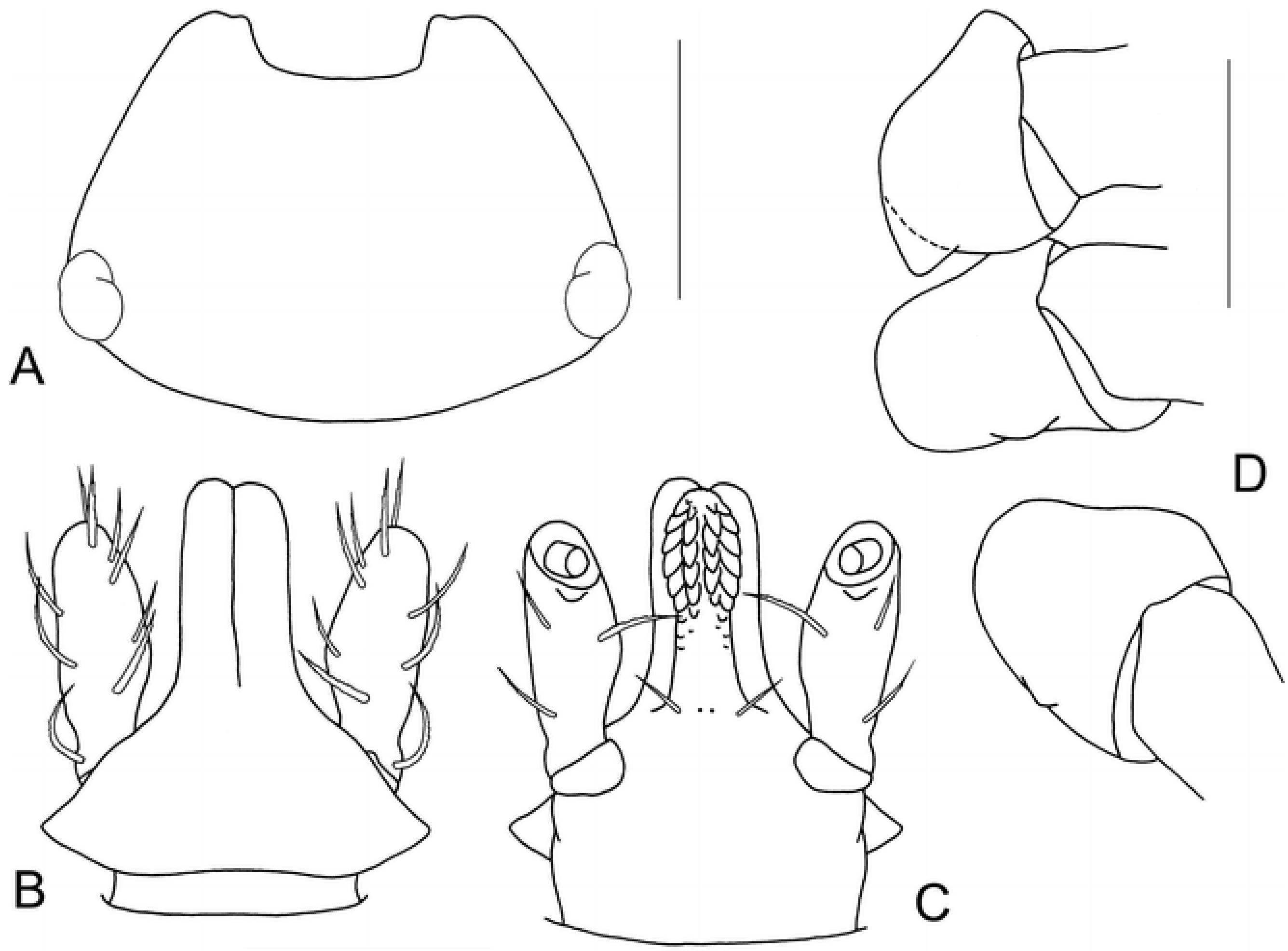

Fig. 7 *Hyalomma impeltatum*, larva. A, scutum; B, gnathosoma dorsally; C, gnathosoma ventrally; D, coxae. *Scale-bars*: A, 150 µm; B, C, D, 100 µm. All setae are omitted except drawing B and C, where only setae of palpal segment IV are omitted

Female (Figs. 3–5). *Scutum* (Fig. 4): length 1.93–2.74 mm (2.25 ± 0.13 mm, n = 100), width 1.90–2.55 mm (2.17 ± 0.12 mm, n = 100), length/width ratio 0.96–1.12 (1.04 ± 0.04, n = 100); yellow- to red-brown in colour; pale marbling absent; nearly as broad as long; posterolateral angles distinct; cervical and lateral grooves moderately deep, extending to posterior margin of scutum; large and medium-sized punctations usually dense, evenly distributed over scutum. *Genital structures* (Fig. 5A): genital aperture narrow, triangular (V-shaped) or arcuate (U-shaped); vestibular portion of vagina strongly bulging; preatrial fold of genital aperture bulging (Fig. 5B). *Spiracular plates* (Fig. 5C): perforated portion of dorsal projection slightly curved and relatively narrow. Circumspiracular setae sparse. *Basis capituli* (Fig. 5D, E): dorsally lateral projections broad and short, hardly visible ventrally; dorsal posterior margin slightly concave; dorsal cornua inconspicuous. *Palpi* (Fig. 5F): segment I with more than 5 ventromedian setae. *Hypostome* (Fig. 5G): club-shaped; denticulate portion slightly longer than denticle-free portion. *Coxae* (Fig. 5H): posteromedian and posterolateral spurs of coxa I long, subequal in length or posterolateral spur longer than posteromedian spur, tapering to apices, juxtaposed, posteromedian spur narrow with tapering apex; coxae II–IV each with distinct, broadly triangular posterolateral spur, with rounded apex; coxae II–IV each with modest, broadly arcuate, posteromedian spur. Coloration of legs similar to that of male (Fig. 3B).

Nymph (Fig. 6). *Scutum* (Fig. 6A): length 488–668 (590 ± 37, n = 71), width 501–707 (586 ± 49, n = 69), length/width ratio 0.86–1.12 (1.01 ± 0.06, n = 69), distance between posterior margin of eyes and posterior margin of scutum 176–254 (215 ± 15, n = 69), width/length ratio of posterior portion of scutum 2.29–3.33 (2.73 ± 0.20, n = 69); posterior margin of scutum broadly rounded; slight posterolateral depressions on either side of scutal extremity. *Setae of alloscutum* (Fig. 6B): taper to rounded apex, without dentation. *Spiracular plates* (Fig. 6C): asymmetrically oval; dorsal prolongation short, blunt at apex; submarginal row of perforations incomplete. *Basis capituli* (Fig. 6D, E): length 322–440 (397 ± 26, n = 68); width 280–384 (330 ± 25, n = 71), length/width ratio 1.10–1.30 (1.20 ± 0.05, n = 68), subhexagonal dorsally, dorsolateral projections distinct and acute from dorsal and ventral aspects. *Palpi* (*segment II*) (Fig. 6D, E): length 150–211 (191 ± 12, n = 71), width 46–60 (54 ± 3, n = 71), length/width ratio 3.00–4.08 (3.56 ± 0.25, n = 71); palpal segment II proximally narrow, gradually expanded distally. *Hypostome* (Fig. 6E): length 168–230 (204 ± 14, n = 69), width 48–74 (58 ± 7, n = 71), length/width ratio 2.89–4.32 (3.55 ± 0.33, n = 69); median file with 6 or 7 large denticles; transition of denticulate portion to denticle-free portion abrupt; denticulate portion nearly as long as denticle-free portion. *Coxae* (Fig. 6F): coxa I with long, narrow, subtriangular spurs nearly equal in length; coxae II–IV each with moderate lateral spur, which decreases in size conspicuously from coxae II to IV; coxal pore present.

Larva (Fig. 7). *Scutum* (Fig. 7A): length 217–256 (235 ± 8, n = 153), width 315–384 (354 ± 16, n = 191), length/width ratio 0.60–0.73 (0.66 ± 0.03, n = 153), distance from posterior margin of eyes to posterior margin of scutum 40–64 (49 ± 4, n = 153), width/length ratio of posterior portion 5.56–8.76 (7.24 ± 0.58, n = 153). Portion of scutum posterior to eyes nearly 1/5 of scutal length; posterior margin of scutum broadly rounded; posterolateral depressions slight or indistinct. *Basis capituli* (Fig. 7B, C): width 140–166 (157 ± 4, n = 191); subhexagonal dorsally; apex of dorsolateral projections directed laterally; dorsolateral projections distinct and acute from ventral aspect. *Palpi* (*segments II and III*) (Fig. 7B, C): length 93–110 (104 ± 3, n = 191), width 35–40 (37 ± 1, n = 191), length/width ratio 2.50–3.06 (2.79 ± 0.09, n = 191); arcuate ventral spur on palpal segment III. *Hypostome* (Fig. 7C): length 72–92 (83 ± 4, n = 187), width 18–23 (21 ± 1, n = 186), length/width ratio 3.39–4.62 (3.88 ± 0.24, n = 186); median file with 5 large denticles; transition of denticulate portion to denticle-free portion abrupt; denticulate portion approximately half of hypostome length. *Coxae* (Fig. 7D): coxa I with large, prominent triangular spur tapering towards apex and directed posteriorly or medially; coxae II and III each with moderate spur, which is broadly arcuate on coxae II and triangular on coxae III. *Genu I*: length 115–154 (137 ± 7, n = 187), width 40–50 (45 ± 2, n = 147), length/width ratio 2.65–3.37 (3.08 ± 0.15, n = 147).

Remarks

Variability

The adults of most populations of *H. impeltatum* from the Arabian Peninsula are often larger, less punctate, more lightly coloured and have a complete dorsal ivory-coloured strip on the leg segments. However, this set of characters can sometimes be observed in specimens from other regions. Variations in the diagnostic characters of normal-sized ticks are: *punctations on male conscutum and female scutum* – large punctations are always sparse, but the density of small or medium-sized punctations can vary, from almost absent to extremely dense, especially on the caudal field of the male conscutum; *subanal plates of male* – extremely variable in size and shape, from very large with a rounded posterior margin, through moderately large and rounded (generally the case on normally developed males) to tiny triangular plates; *perforated portion of dorsal prolongation of spiracular plates of male* – this can sometimes be narrower than usual; and *coloration of legs in adults* – the ivory coloration of the dorsal aspects of leg segments can vary from a relatively small proximal spot to a large longitudinal spot (which is generally the case) to a complete dorsal strip.

Related species

Males of *H*. *impeltatum* can be distinguished from those of other species in the *H*. *asiaticum* group by a combination of the following characters: round posterior margin of the conscutum (only slightly convex in *H. somalicum*); dense medium and small punctations (at least on the caudal field) (usually sparser in *H.*

asiaticum, *H. dromedarii* and *H. schulzei*); paramedian festoons not protruding beyond the posterior conscutal margin (protrude in *H. schulzei*); moderately deep and short cervical grooves (very deep and long in *H. asiaticum*, *H. dromedarii* and *H. schulzei*); posteromedian groove does not reach the parma (reaches it in *H. dromedarii*); narrow, inverted U-shaped parma (usually broader U-shape in *H. asiaticum* and *H. dromedarii*, broadly rectangular in *H. schulzei* and normally absent in *H. somalicum*); slightly inwardly curved adanal plates (distinctly curved in *H. dromedarii*, not curved in *H. asiaticum*); subanal shields generally moderate in size (normally very large in *H. dromedarii*); sclerotised plaques absent ventrally on median, paramedian and 4th festoons (always present at least on paramedian and 4th festoons in *H. asiaticum*, *H. dromedarii* and *H. schulzei*, present on all festoons in *H. somalicum*); long dorsal prolongation of spiracular plates (very short in *H. schulzei*), dorsal posterior margin of basis capituli slightly concave (deeply concave and angular in *H. asiaticum*, *H. dromedarii*, *H. schulzei* and *H. somalicum*); and leg segments with large dorsal ivory-coloured enamel spot or complete strip in proximal region (with small spot in *H. somalicum*). Females of *H*. *impeltatum* can be distinguished from those of other species of the *H*. *asiaticum* group by a combination of the following characters: moderately deep cervical grooves (very deep in *H. asiaticum*, *H. dromedarii* and *H. schulzei*); medium and small punctations usually dense (usually sparser in *H. asiaticum*, *H. dromedarii* and *H. schulzei*); narrow V- or U-shaped genital operculum (very wide U-shape in *H. schulzei*); preatrial fold of genital operculum bulging (flat in *H. dromedarii* and *H. somalicum*); posteromedian spur of coxa I relatively narrow, with tapering apex (relatively broad and blunt in *H. dromedarii* and *H. schulzei*); and leg segments with large dorsal ivory-coloured enamel spot or complete strip in proximal region (small spot in *H. somalicum*). Because of insufficient data on the immature stages of *H*. *asiaticum,* the following diagnosis for *H. impeltatum* is given only in relation to those of *H. dromedarii*, *H*. *schulzei* and *H. somalicum*. Nymphs of *H*. *impeltatum* can be distinguished from the latter species by a combination of the following characters: posterior margin of scutum with slight posterolateral depressions on either side of its extremity (moderate posterolateral depressions in *H. dromedarii*, *H. schulzei* and *H. somalicum*); spiracular plates with short, narrow dorsal prolongation with blunt apex (longer and broader prolongation in *H. dromedarii*); submarginal row of perforations on spiracular plate incomplete (complete in *H. dromedarii*); presence of coxal pore (absent in *H. dromedarii* and *H. schulzei*); and measurements and associated ratios (see Apanaskevich et al., *2008* for *H. dromedarii* and *H. schulzei*; see below for *H. somalicum*). Larvae of *H*. *impeltatum* can easily be distinguished from those of *H. dromedarii*, *H*. *schulzei* and *H. somalicum* by the presence of an arcuate ventral spur on palpal segment III. Additional discriminating characters are: portion of scutum posterior to eyes 1/5 of scutal length (1/3.7 in *H. somalicum*); large triangular tapering spur on coxa I directed posteriorly or medially (smaller spur directed laterally in *H. schulzei* and *H. somalicum*); and measurements and associated ratios (see Apanaskevich et al., *2008* for *H. dromedarii* and *H. schulzei*; see below for *H. somalicum*).

Hosts

Hyalomma impeltatum is a three-host species (Rousselot, *1948*; Logan et al., *1989*) or a two-host species (Osman, *1979*). Adults chiefly parasitise various domestic and wild ungulates, such as buffaloes, camels, cattle, donkeys, goats, horses, pigs, sheep, wild goat *Capra hircus* Linnaeus, blue wildebeest *Connochaetes taurinus* (Burchell), black rhinoceros *Diceros bicornis* (Linnaeus), red-fronted gazelle *Eudorcas rufifrons* (Gray), Grevy's zebra *Equus grevyi* Oustalet, Arabian gazelle *Gazella arabica* (Lichenstein), mountain gazelle *Gazella gazella* (Pallas), Arabian tahr *Hemitragus jayakari* Thomas, kob *Kobus kob* (Erxleben), dama gazelle *Nanger dama* (Pallas), Grant's gazelle *N. granti* (Brooke), scimitar-horned oryx *Oryx dammah* (Cretzschmar), gemsbok *O. gazella* (Linnaeus), Arabian oryx *O. leucoryx* (Pallas), wild sheep *Ovis aries* Linnaeus, desert warthog *Phacochoerus aethiopicus* (Pallas), wild boar *Sus scrofa* Linnaeus, African buffalo *Syncerus caffer* (Sparrman) and eland *Taurotragus oryx* (Pallas). There are also records of adults from domestic dogs, caracal *Caracal caracal* (Schreber), West European hedgehog *Erinaceus europaeus* Linnaeus, ostrich *Struthio camelus* Linnaeus and humans (our data; Villiers, *1955*; Hoogstraal, *1956*; Hoogstraal & Kaiser, *1958a*, *b*, *c*, *d*, *1959*, *1960*; Morel, *1958*; Abbassian-Lintzen, *1961*; Morel & Graber, *1961*; Morel & Mouchet, *1965*; Köhler et al., *1967*; Yeoman & Walker, *1967*; Hoffmann et al., *1971*; Morel & Rodhain, *1972*; Bailly-Choumara et al., *1974*; Walker, *1974*; Pegram, *1976*; Hoogstraal et al., *1981*; Pegram et al., *1981*, *1982*; Papadopoulos et al., *1991*). The immature stages of *H. impeltatum* parasitise rodents, leporids and hedgehogs, as well as birds and lizards. These include the lesser Egyptian gerbil *Gerbillus gerbillus* (Olivier), greater Egyptian gerbil *G.*

pyramidum Geoffroy, Baluchistan gerbil *G. nanus* Blanford, bushy-tailed jird *Sekeetamys calurus* (Thomas), jird *Meriones* sp., lesser Egyptian jerboa *Jaculus jaculus* (Linnaeus), greater Egyptian jerboa *J. orientalis* Erxleben, fat sand rat *Psammomys obesus* Cretzschmar, eastern spiny mouse *Acomys dimidiatus* (Cretzschmar), house mouse *Mus musculus* Linnaeus, Cape hare *Lepus capensis* Linnaeus, northern wheatear *Oenanthe oenanthe* (Linnaeus), isabelline wheatear *O. isabellina* (Temminck), common redstart *Phoenicurus phoenicurus* (Linnaeus) and fringe-fingered lizard *Acanthodactylus boskianus* (Daudin) (our data; Hoogstraal, *1956*; Hoogstraal & Kaiser, *1958a*, *c*, *d*, *e*; Feldman-Muhsam, *1960*; Hoogstraal et al., *1981*). Single specimens of the immature stages of *H. impeltatum* have been recorded from domestic camels and sheep (Latif, *1985*), and also from humans (Hoogstraal, *1956*).

Geographical distribution

Hyalomma impeltatum is widely distributed in North Africa, the northern parts of West, Central and East Africa, Arabia, Asia Minor, the Middle East and the south-western parts of Central and South Asia. *Africa*: Algeria, Benin, Burkina Faso, Cameroon, Chad, Djibouti, Ivory Coast, Egypt, Eritrea, Ethiopia, Kenya, Libya, Mauritania, Mali, Morocco, Niger, Nigeria, Senegal, Somalia, Sudan, Tanzania, Tunisia and Western Sahara; *Asia*: Afghanistan, Iran, Iraq, Israel, Jordan, Kuwait, Oman, Pakistan, Qatar, Saudi Arabia, Syria, Turkey and the Yemen (our data; Hoogstraal, *1956*; Hoogstraal & Kaiser, *1958a*, *b*, *1959*, *1960*; Morel, *1958*; Feldman-Muhsam, *1960*; Abbassian-Lintzen, *1961*; Morel & Graber, *1961*; Kaiser & Hoogstraal, *1963*, *1964*; Morel & Mouchet, *1965*; Köhler et al., *1967*; Morel & Rodhain, *1972*; Hoffmann & Lindau, *1971*; Hoffmann et al., *1971*; Bailly-Choumara et al., *1974*; Pegram, *1976*; Rodhain, *1976*; Mohammed, *1977*; Hoogstraal et al., *1981*; Pegram et al., *1981*, *1982*; Papadopoulos et al., *1991*). Except for the Arabian Peninsula and the Middle East, this species seems to be fairly rare in Asia.

Disease relationships

Crimean-Congo haemorrhagic fever virus has been isolated from *H. impeltatum* in Senegal, Nigeria and Ethiopia (Hoogstraal, *1979*), and Wanowrie virus has been isolated from it in Egypt (Hoogstraal et al., *1981*). *H. impeltatum* can be an efficient vector of *Theileria annulata* (Dschunkowsky & Luhs) (Mustafa et al., *1983*) and kinetes of a *Babesia* species have been found in its haemolymph in Nigeria (Dipeolu & Amoo, *1984*).

***Hyalomma* (*Euhyalomma*) *somalicum* Tonelli Rondelli, 1935**

Syns *Hyalomma* ? species of Hoogstraal (*1956*); *H. impeltatum somalicum* Tonelli Rondelli, *1935* of Hoogstraal & Kaiser (*1959*) (new synonymy); *H. erythraeum* Tonelli Rondelli, *1932* of Kaiser & Hoogstraal (*1968*) (new synonymy).

Type-specimens: The original description is based on two males from Hafun, Somalia [previously Dante, Italian Somaliland], September, 1932 (Tonelli Rondelli *1935*). Tonelli Rondelli (*1935*) reported that the ticks had been received from Prof. C. Tedeschi of the Institute of Comparative Anatomy of the University of Pavia (Italy). Unfortunately, we were unable to determine whether the type-specimens still exist or not.

Remarks: Kaiser & Hoogstraal (*1968*) erroneously referred to this species *H. erythraeum*, but this name cannot be used because *H. erythraeum* Tonelli Rondelli, *1932* (*sensu stricto*) is an objective junior synonym of *H. impeltatum* (see explanation above under *H. impeltatum*). The only available junior synonym for *H. erythraeum* of Kaiser & Hoogstraal (*1968*) is *H. somalicum* Tonelli Rondelli, *1935* (see Camicas et al. *1998*). Our examination of the original description of *H. somalicum* confirms this. Thus, in accordance with the International Code of Zoological Nomenclature, we have resurrected the name *H. somalicum* for *H. erythraeum* of Kaiser & Hoogstraal (*1968*).

Valuable descriptions and illustrations of the adults are available in Hoogstraal (*1956*), as *Hyalomma* ? species, and Kaiser & Hoogstraal (*1968*) and Hoogstraal et al. (*1981*), as *H. erythraeum*. The larva and nymph have been described and illustrated by Kaiser & Hoogstraal (*1968*) and Hoogstraal et al. (*1981*) as *H. erythraeum*.

Redescription (Figs. 8–14)

Male (Figs. 8–10). *Conscutum* (Fig. 8): length 3.41–4.80 mm (4.27 ± 0.28 mm, n = 100), width 2.11–3.41 mm (2.94 ± 0.21 mm, n = 100), length/width ratio 1.32–1.64 (1.45 ± 0.06, n = 100); red-brown in colour; pale marbling absent; broadly oval in shape; widest near mid-length; slight narrowing in region of spiracular plates; posterior margin broad, only slightly convex; cervical and lateral grooves moderately deep, up to 1/3 length of conscutum; marginal grooves short, furrow-like, extending anteriorly to posterior 1/4 of conscutum; dense and deep punctations aligned with marginal groove give it appearance of long but shallow groove almost reaching 2/3 of conscutal length; posteromedian groove separated from parma or median festoon by region with wart-like or smooth surface; paramedian grooves diverge anteriorly, clearly delineated; caudal field well defined, demarcated laterally by moderate ridges; some large punctations anteriorly on central, lateral and caudal fields; medium-sized punctations fairly dense anteriorly on conscutum and very dense on caudal and lateral fields; parma usually absent, occasionally triangular parma present; 4 or 5 distinct festoons. *Genital structures* (Fig. 9A) as illustrated. *Anal shields* (Fig. 9B): 3 pairs; adanal plates long, broad, lateral margin convex, anteromedian margin slightly concave, median projection prominent, posteromedian margin concave, posterior margin convex; subanal plates usually moderate in size, asymmetrically oval. Sclerotised plaques present ventrally on median and paramedian festoons. *Spiracular plate* (Fig. 9C): dorsal prolongation long and clearly distinct from body of plate; perforated portion of dorsal prolongation straight, relatively narrow, curved at its tip. Circumspiracular setae sparse. *Basis capituli* (Fig. 9D, E): without lateral projections; dorsal posterior margin angular, deeply concave; cornua modest. *Palpi* (Fig. 9F): segment I with >5 ventromedian setae. *Hypostome* (Fig. 9G): club-shaped; denticulate portion slightly longer than denticle-free portion. *Coxae* (Fig. 9H): posteromedian and posterolateral spurs of coxa I long, equal in length or posterolateral spur longer than posteromedian spur, juxtaposed, tapering to apices; coxae II–IV each with distinct, broadly arcuate posterolateral spur; coxae II and III each with moderate, broadly arcuate, posteromedian spur; internal spur on coxa IV distinct, triangular. Ivory-coloured enamel band encircles distal portion of each segment of legs; small dorsal ivory-coloured enamel spot present proximally (Fig. 10A).

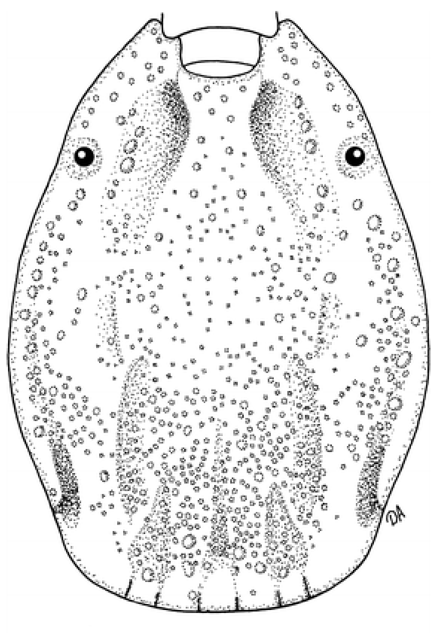

Fig. 8 *Hyalomma somalicum*, male, conscutum. *Scale-bar*: 1 mm. All setae are omitted

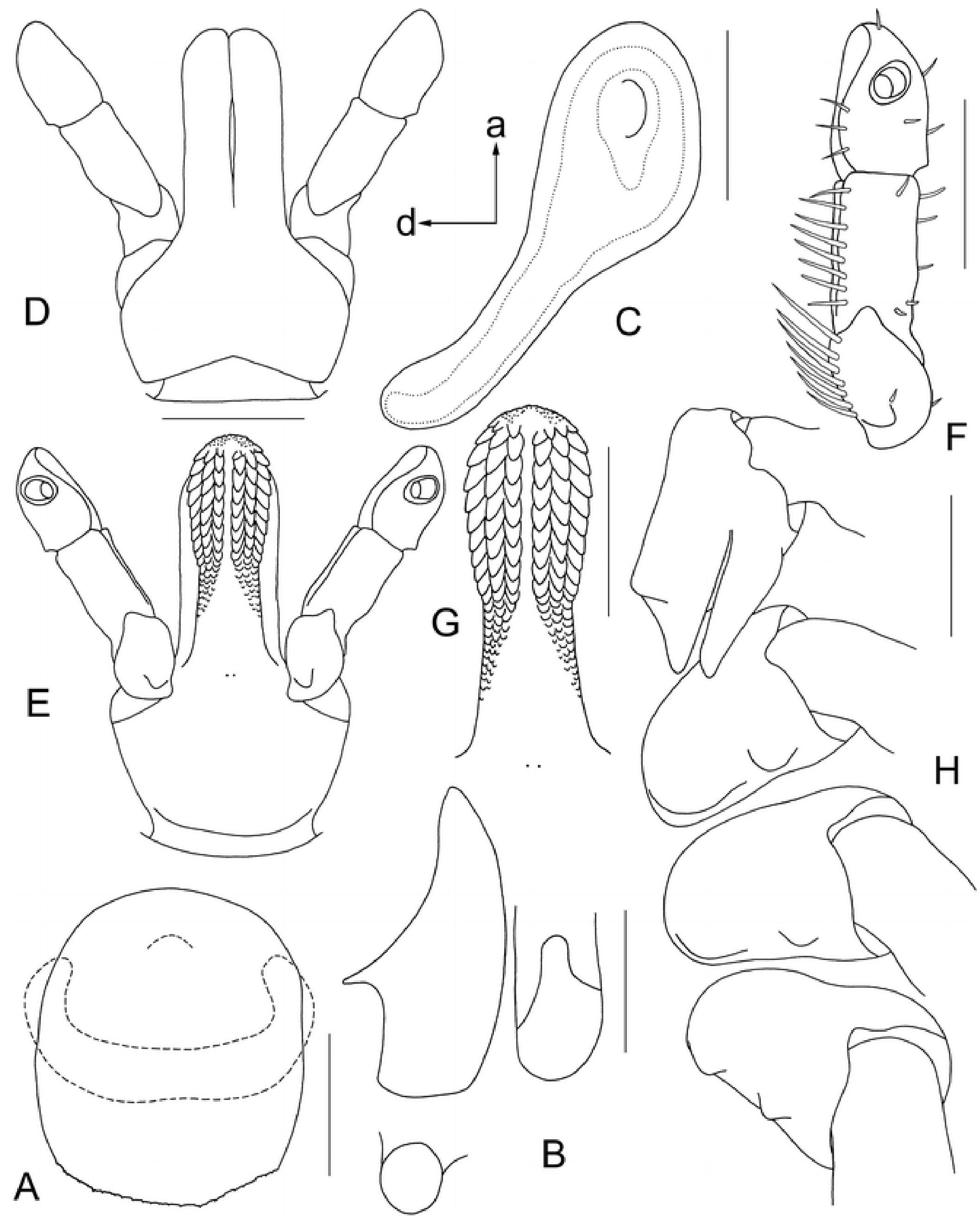

Fig. 9 *Hyalomma somalicum*, male. A, genital structures; B, anal plates; C, spiracular plate (a, anterior; d, dorsal); D, gnathosoma dorsally; E, gnathosoma ventrally; F, palp ventrally; G, hypostome; H, coxae. *Scale-bars*: A, 200 μm; B, D, E, H, 500 μm; C, F, G, 400 μm. All setae are omitted except drawing F, where only setae of palpal segment IV are omitted

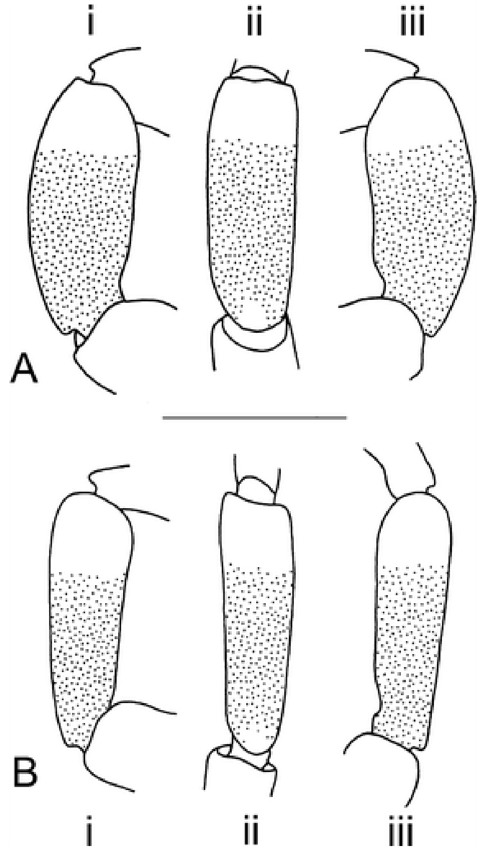

Fig. 10 *Hyalomma somalicum*, genu IV. A, male: i, lateral view; ii, dorsal view; iii, medial view; B, female: i, lateral view; ii, dorsal view; iii, medial view. *Scale-bar*: 1 mm. All setae are omitted

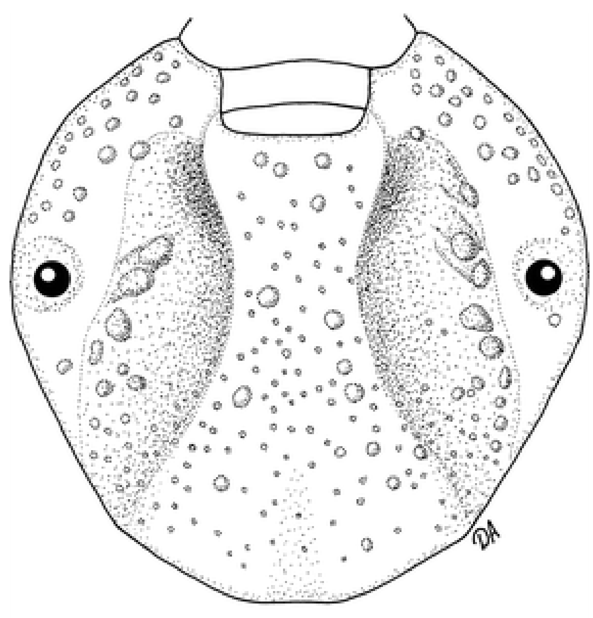

Fig. 11 *Hyalomma somalicum*, female, scutum. *Scale-bar*: 1 mm. All setae are omitted

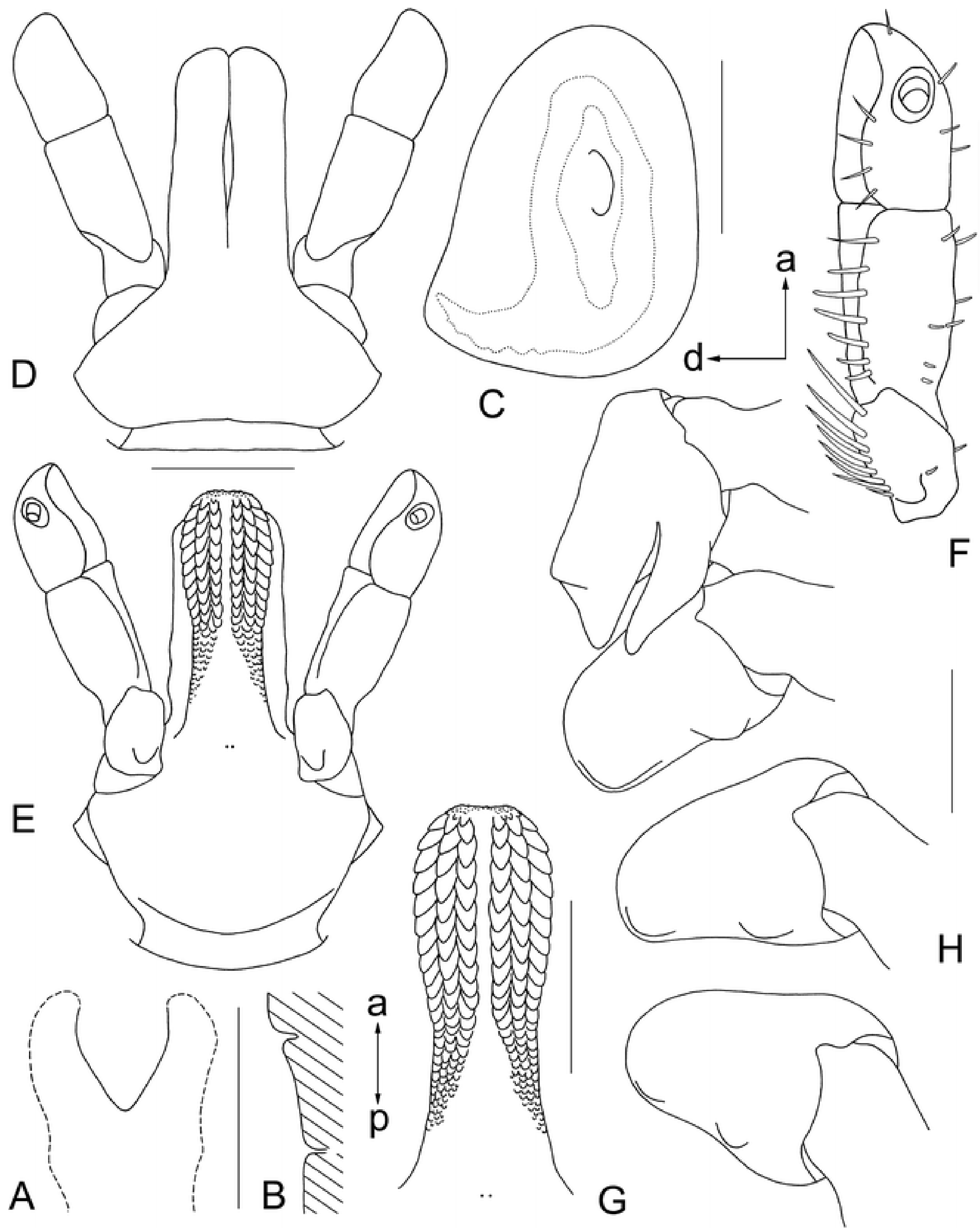

Fig. 12 *Hyalomma somalicum*, female. A, genital structures; B, longitudinal cut through preatrial fold of schematic genital aperture (a, anterior; p, posterior); C, spiracular plate (a, anterior; d, dorsal); D, gnathosoma dorsally; E, gnathosoma ventrally; F, palp ventrally; G, hypostome; H, coxae. *Scale-bars*: A, 200 µm; C, F, G, 400 µm; E, D, H, 500 µm. All setae are omitted except drawing F, where only setae of palpal segment IV are omitted

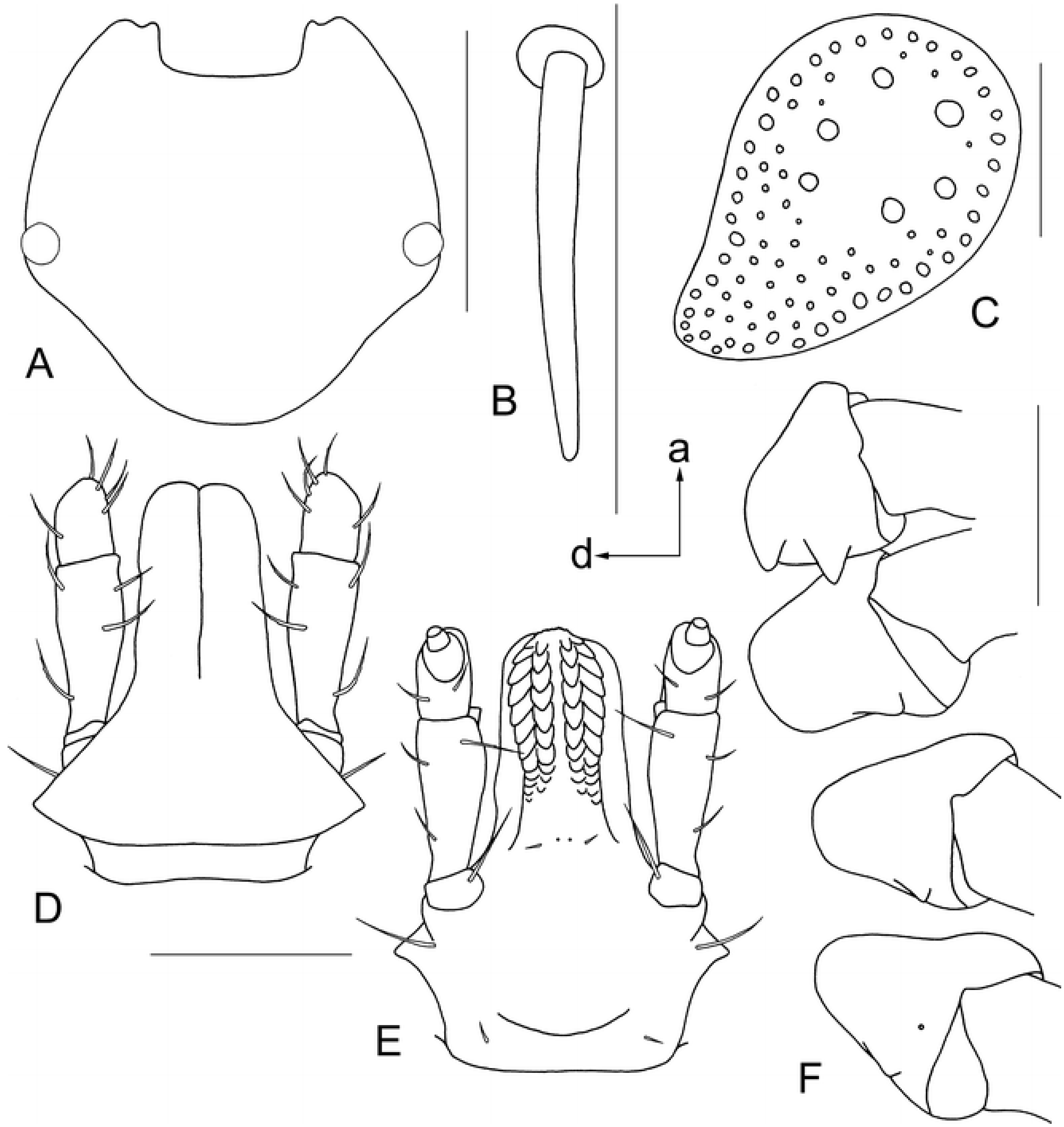

Fig. 13 *Hyalomma somalicum*, nymph. A, scutum; B, seta of alloscutum; C, spiracular plate (a, anterior; d, dorsal); D, gnathosoma dorsally; E, gnathosoma ventrally; F, coxae. *Scale-bars*: A, 400 μm; B, C, 50 μm; D, E, F, 200 μm. All setae are omitted except drawing D and E, where only setae of palpal segment IV are omitted

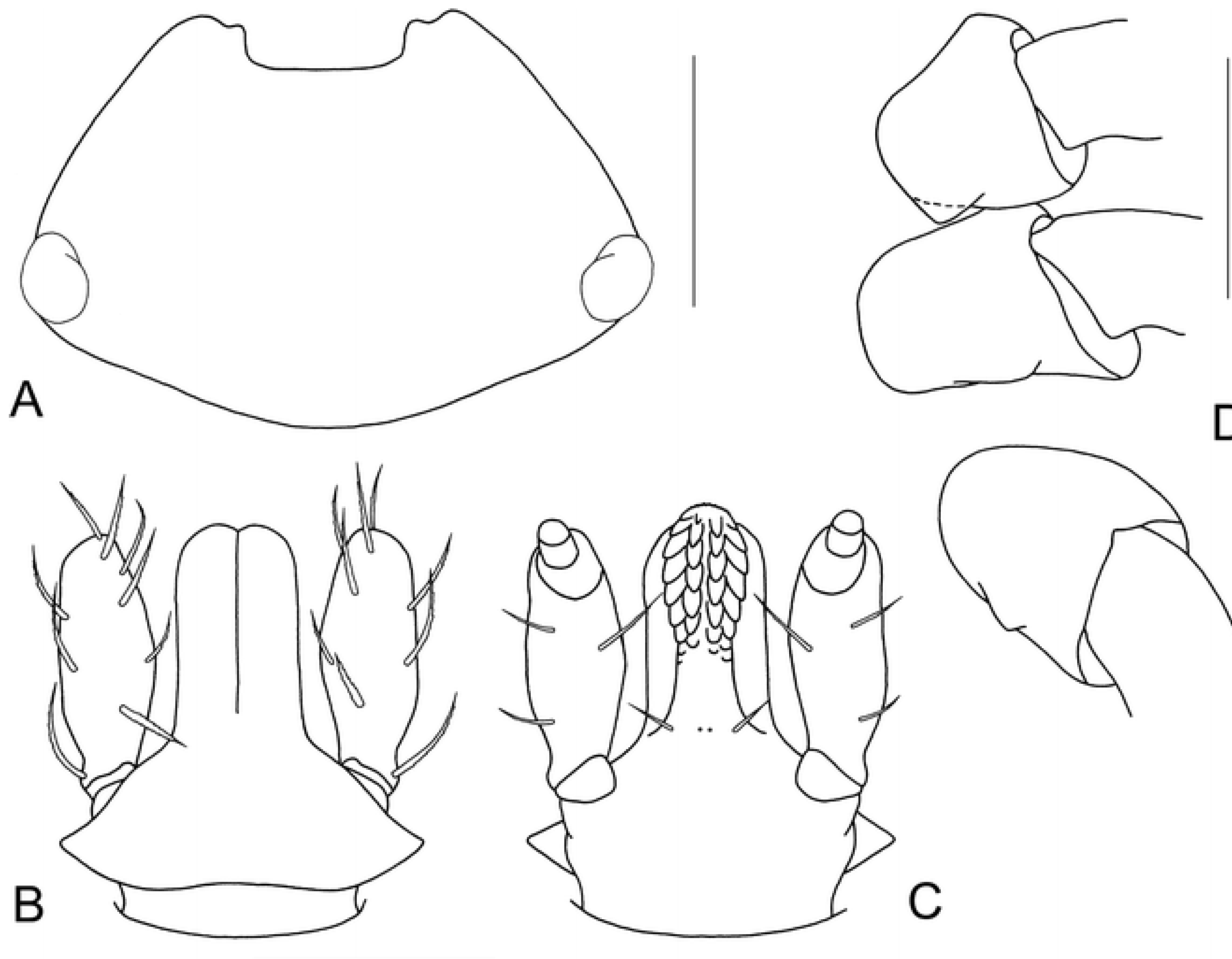

Fig. 14 *Hyalomma somalicum*, larva. A, scutum; B, gnathosoma dorsally; C, gnathosoma ventrally; D, coxae. *Scale-bars*: A, 150 µm; B, C, D, 100 µm. All setae are omitted except drawing B and C, where only setae of palpal segment IV are omitted

Female (Figs. 10–12). *Scutum* (Fig. 11): length 1.91–2.90 mm (2.34 ± 0.22 mm, n = 25), width 1.91–2.71 mm (2.42 ± 0.23 mm, n = 25), length/width ratio 0.88–1.11 (0.97 ± 0.06, n = 25); dark red-brown in colour; pale marbling absent; slightly broader than long; posterolateral angles prominent; cervical and lateral grooves moderately deep, extending to posterior margin of scutum; large punctations sparse; medium-sized punctations moderately dense, evenly distributed over scutum. *Genital structures* (Fig. 12A): genital aperture narrow, long, V-shaped; vestibular portion of vagina markedly bulging; preatrial fold of genital aperture flat (Fig. 12B). *Spiracular plates* (Fig. 12C): perforated portion of dorsal projection short, narrow and slightly curved. Circumspiracular setae sparse. *Basis capituli* (Fig. 12D, E): dorsally lateral projections short, visible as sharp points ventrally; dorsal posterior margin straight or slightly concave; dorsal cornua inconspicuous. *Palpi* (Fig. 12F): segment I with more than 5 ventromedian setae. *Hypostome* (Fig. 12G): club-shaped; denticulate portion slightly longer than denticle-free portion. *Coxae* (Fig. 12H): posteromedian and posterolateral spurs of coxa I long, equal in length or posterolateral spur longer than posteromedian spur, tapering to apices, juxtaposed; posteromedian spur narrow with tapering apex; coxae II–IV each with distinct, broadly triangular posterolateral spur; coxae II–IV each with moderate, broadly arcuate, posteromedian spur. Coloration of legs similar to that of male (Fig. 10B).

Nymph (Fig. 13). *Scutum* (Fig. 13A): length 556–612 (580 ± 15, n = 14), width 572–644 (612 ± 18, n = 14), length/width ratio 0.90–1.03 (0.95 ± 0.03, n = 14), distance between posterior margin of eyes and posterior margin of scutum 215–246 (225 ± 8, n = 14), width/length ratio of posterior portion of scutum 2.58–2.85 (2.71 ± 0.08, n = 14); posterior margin of scutum broadly rounded; relatively deep posterolateral depressions on either side of scutal extremity. *Setae of alloscutum* (Fig. 13B): tapers to rounded apex, without denticles. *Spiracular plates* (Fig. 13C): irregularly oval; dorsal prolongation distinct, narrow, short, with blunt tip; submarginal row of perforations incomplete. *Basis capituli* (Fig. 13D, E): length 372–424 (394 ± 18, n = 6); width 308–342 (325 ± 9, n = 14), length/width ratio 1.14–1.29 (1.20 ± 0.05, n = 6); sub-hexagonal dorsally, lateral projections visible ventrally as sharp points. *Palpi (segment II)* (Fig. 13D, E): length 170–190 (182 ± 7, n = 14), width 58–70 (64 ± 3, n = 14), length/width ratio 2.56–3.03 (2.86 ± 0.13, n = 14); palpal segment II proximally narrow, gradually expanding distally. *Hypostome* (Fig. 13E): length 190–226 (207 ± 12, n = 9), width 62–78 (70 ± 6, n = 11), length/width ratio 2.81–3.35 (2.97 ± 0.18, n = 9); median file with 7 large denticles; transition of denticulate portion to denticle-free portion abrupt; denticulate portion twice as long as denticle-free portion. *Coxae* (Fig. 13F): coxa I with long, narrow, subtriangular spurs nearly equal in length; coxae II–IV each with moderate lateral spur; spurs conspicuously decrease in size from coxae II to IV; coxal pore usually present (mainly on coxa IV).

Larva (Fig. 14). *Scutum* (Fig. 14A): length 224–252 (239 ± 7, n = 40), width 356–388 (369 ± 10, n = 40), length/width ratio 0.62–0.68 (0.65 ± 0.02, n = 40), distance from posterior margin of eyes to posterior margin of scutum 58–72 (65 ± 3, n = 40), width:length ratio of posterior portion 5.23–6.33 (5.70 ± 0.26, n = 40). Portion of scutum posterior to eyes 1/3.7 of scutal length; posterior margin of scutum broadly rounded; posterolateral depressions slight or indistinct. *Basis capituli* (Fig. 14B, C): width 138–156 (149 ± 4, n = 40); sub-hexagonal dorsally; apex of dorsolateral projections directed laterally; dorsolateral projections from ventral aspect distinct and acute. *Palpi (segments II* and *III)* (Fig. 14B, C): length 101–114 (110 ± 3, n = 39), width 37–40 (39 ± 1, n = 39), length/width ratio 2.66–3.00 (2.83 ± 0.08, n = 39). *Hypostome* (Fig. 14C): length 86–96 (91 ± 3, n = 39), width 22–26 (23 ± 1, n = 39), length/width ratio 3.58–4.13 (3.86 ± 0.14, n = 39); median file with 5 or 6 large denticles; transition of denticulate portion to denticle-free portion abrupt; denticulate portion slightly more than 1/2 of hypostome length. *Coxae* (Fig. 14D): coxa I with small to moderate, subtriangular spur, directed laterally; coxae II and III each with moderate spur – arcuate on coxa II and triangular on coxa III. *Genu I*: length 146–172 (160 ± 5, n = 40), width 42–51 (47 ± 2, n = 31), length/width ratio 3.14–3.67 (3.44 ± 0.11, n = 31).

Remarks

Related species

Males of *H*. *somalicum* can be distinguished from those of the other species of the *H*. *asiaticum* group by a combination of the following characters: broad, only slightly convex posterior margin of the conscutum (distinctly convex in all other species of the *H. asiaticum* group); dense medium and small punctations (sparser in *H. dromedarii* and *H. schulzei*, usually sparser in *H. asiaticum*); paramedian festoons not protruding beyond the posterior conscutal margin (protrude in *H. schulzei*); moderately deep, short cervical grooves (very deep and long in *H. asiaticum*, *H. dromedarii* and *H. schulzei*); posteromedian groove does not reach the central festoon (reaches parma in *H. dromedarii*); parma usually absent (usually present in all other species of *H. asiaticum* group); slightly curved, inwardly directed adanal plates (conspicuously curved in *H. dromedarii*, not curved in *H. asiaticum*); subanal plates moderate in size (usually very large in *H. dromedarii*); sclerotised plaques present ventrally on all festoons (absent on median, paramedian and 4th festoons in *H. impeltatum*); long dorsal prolongation of spiracular plates (very short in *H. schulzei*), dorsal aspect of basis capituli angular and posterior margin deeply concave (rounded and moderately concave in *H. impeltatum*); and leg segments with very small dorsal ivory-coloured enamel spot proximally (larger spot or complete dorsal strip in all other species of the *H. asiaticum* group). Females of *H*. *somalicum* can be distinguished from those of other species of the *H*. *asiaticum* group by a combination of the following characters: punctation of the scutum dense (sparser in *H. dromedarii* and *H. schulzei*, usually sparser in *H. asiaticum*); moderately deep cervical grooves (very deep in *H. asiaticum*, *H. dromedarii* and *H. schulzei*); narrow V-shaped genital aperture (wide U-shaped in *H. schulzei*); preatrial fold of the genital aperture flat (bulging in *H. asiaticum* and *H. impeltatum*); long, relatively narrow posteromedian spur on coxa I (shorter and broader in *H. dromedarii* and *H. schulzei*); and leg segments with very small dorsal ivory-coloured enamel spot proximally (larger spot or complete dorsal strip in all other species of the *H. asiaticum* group). Because of insufficient morphological data on the immature stages of *H. asiaticum,* the following diagnosis for *H. somalicum* is given in relation only to those of *H. dromedarii*, *H. impeltatum* and *H. schulzei*. Nymphs of *H. somalicum* can be distinguished from those of the *H. asiaticum* group by a combination of the following characters: posterior margin of the scutum with distinct moderate posterolateral depressions on either side of its extremity (indistinct slight depressions in *H. impeltatum*); spiracular plates with relatively short, narrowly blunt dorsal prolongation (longer and broader blunt prolongation in *H. dromedarii*); submarginal row of perforations on the spiracular plate incomplete (complete in *H. dromedarii*); and measurements and their associated ratios (see Apanaskevich et al., *2008*, for *H. dromedarii* and *H. schulzei*; see above for *H. impeltatum*). Larvae of *H. somalicum* can be distinguished from those of *H. dromedarii*, *H. schulzei* and *H. impeltatum* by a combination of the following characters: portion of the scutum posterior to the eyes is 1/3.7 of the scutal length (1/5 in other species of the *H. asiaticum* group); absence of a ventral arcuate spur on palpal segment III (spur present in *H. impeltatum*); spur on coxa I small to moderate with its apex directed laterally (spur larger and directed posteriorly or medially in *H. dromedarii* and *H. impeltatum*); and measurements and their associated ratios (see Apanaskevich et al., *2008*, for *H. dromedarii* and *H. schulzei*; see above for *H. impeltatum*).

Hosts

Hyalomma somalicum is a three-host species (Kaiser & Hoogstraal, *1968*). The principal hosts for the adults appear to be camels. Other records of adults are from cattle, sheep, goats and horses (our data; Kaiser & Hoogstraal, *1968*; Pegram, *1976*; Hoogstraal et al., *1981*; Pegram et al., *1981*, *1982*). The hosts of the immature stages are unknown.

Geographical distribution

Hyalomma somalicum has a fairly restricted geographical distribution, with its core in Somalia. *Africa*: Djibouti, Ethiopia and Somalia; *Asia*: Saudi Arabia and the Yemen (our data; Kaiser & Hoogstraal, *1968*; Pegram, *1976*; Hoogstraal et al., *1981*; Pegram et al., *1981*, *1982*). It is not clear whether *H. somalicum* was introduced into the Arabian Peninsula, or is native to the region, or whether the Asian records are a result of misidentification. We have been unable to confirm the presence of this species in the Yemen. All of the USNTC specimens (three males and two females), which were collected from domestic sheep in Yemen by I. Helmy and H. Touhamy during 1973, and that were previously identified as '*H. erythraeum*' *sensu* Kaiser & Hoogstraal (Pegram et al., *1982*), have been re-identified as *H. dromedarii* (HH 55799 – 1 female, HH 55806 – 2 males and 1 female) and *H. impeltatum* (HH 55811 – 1 male) by the senior author. Hoogstraal (*1956*) also mentioned specimens of *Hyalomma* ? species (= *H. somalicum*) from south-eastern Egypt (Gebel Elba). In subsequent publications both he and other authors did not include Egypt within the distribution range of *H. somalicum*.

Disease relationships

The relationship between *H. somalicum* and disease-causing agents has not been investigated.

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