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Revision of the genus Chordodes (Gordiida: Nematomorpha) from Africa IV. Ultrastructural redescription of Chordodes congolensis Sciacchitano, 1933, Chordodes ferox Camerano, 1897, Chordodes madagascariensis (Camerano, 1893), Chordodes mobensis Sciacchitano, 1958 and reinterpretation of Chordodes maculatus Sciacchitano, 1958 and Chordodes kakandensis Sciacchitano, 1958

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Revision of the genus *Chordodes* (Gordiida: Nematomorpha) from Africa IV. Ultrastructural redescription of *Chordodes congolensis* Sciacchitano, 1933, *Chordodes ferox* Camerano, 1897, *Chordodes madagascariensis* (Camerano, 1893), *Chordodes mobensis* Sciacchitano, 1958 and reinterpretation of *Chordodes maculatus* Sciacchitano, 1958 and *Chordodes kakandensis* Sciacchitano, 1958

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Six species of the genus *Chordodes* from Africa were investigated in order to certify their taxonomic descriptions and verify the species status. Scanning electron microscopy demonstrated that the female of *Chordodes congolensis* has seven types of areoles, while the females of *C. ferox* have six and the male and females of *C. madagascariensis* have four and five areolar types, respectively. The females of these three species have polymorphic crowned areoles with both short and long filaments, these areoles are only observed along the ventral groove. The female of *Chordodes mobensis* has five areolar types and we found that crowned areoles were present in clusters of 10–12 areoles. *Chordodes maculatus* has been synonymized with *C. kolensis* and *C. kakandensis* with *C. schoutedeni*, because no differences could be detected that justify these species as valid.

Keywords: *Chordodes*; Africa; Nematomorpha; scanning electron microscopy

Introduction

The nematomorph genus *Chordodes* occurs, with few exceptions, only in tropical and subtropical regions. The genus *Chordodes* is the largest, according to species numbers, with approximately 90 species described so far (Schmidt-Rhaesa et al. 2008). Many species descriptions do not comply with current standards for taxonomic descriptions. Recent studies have shown that careful investigations of cuticular structures by scanning electron microscopy (SEM) are essential for gaining a more reliable picture of *Chordodes* diversity.

A review of African *Chordodes* species has commenced, and three parts have been published to date (Zanca, De Villalobos et al. 2006; Zanca, Schmidt-Rhaesa et al. 2006; De Villalobos et al. 2007); this is the fourth publication in this series, reporting the investigation of a further six *Chordodes* species. For the terminology of cuticular structures (areoles), see Schmidt-Rhaesa et al. (2008).

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Material and methods

We investigated 44 specimens of 6 species of *Chordodes* from Africa. The exact sources of the material investigated, were as follows: AMT (Africa Museum Tervuren, Belgium – Koninklijk Museum voor Midden-Afrika); MNHNP (Muséum National d'Histoire Naturelle, Paris); MRSNT (Museo Regionale di Science Naturali, Torino, Italy).

One piece of cuticle (5 mm long) of each specimen was cut longitudinally from the middle region of the body using a scalpel with a pointed blade (Schmidt-Rhaesa 2002). All pieces were washed in 1.3 µl distilled water with three drops of rinse-off eye makeup solvent (Clinique) for three minutes in an ultrasonic cleaner. This was followed by three rinses with distilled water, dehydration in a concentrating ethanol series and critical point drying. These pieces were mounted on bronze blocks and gold sputter coated. Mounted specimens were observed using a JEOL JSM 6360 LV scanning electron microscope. All preparations, i.e. the SEM stubs, are stored together with the preserved specimen in the respective museums.

Body measurements were made on outstretched worms using a ruler. Diameters were measured under a dissecting microscope using callipers.

Results

Chordodes congolensis Sciacchitano, 1933

(Figure 1)

Chordodes congolensis Sciacchitano, 1933, p. 52, figure 2.

Holotype

One ♀, Democratic Republic of the Congo, Uélé, TuKu (Sciacchitano 1933) (AMT 1406) (see comments).

Material examined

SEM of mid-body cuticle. Holotype and 1♂ (AMT 1405) (see comments), 1♂ (AMT 1407) (see comments), 1♀ (AMT 1401) (see comments) and 1♀ (MNHNP 86).

Additional specimens

Two ♂♂ (Sciacchitano 1961a).

Host

Indeterminate *Mantis* sp. (AMT 1401) (Sciacchitano 1933).

Description

Holotype. Body colour dark brown, anterior tip tapering. Terminal end rounded. Cuticle contains seven areolar types: simple, bulging, tubercle, thorn, two types of crowned areoles and circumcluster areoles (Figure 1A). Simple areoles oval with grooves over entire surface. Bulging areoles rounded and taller (6.6 µm) than simple ones, surface smooth or with minute spines (Figure 1A–C). Tubercle areoles similar to bulging areoles with blunt tubercle on surface (Figure 1A, B). Thorn areoles (16.6 µm

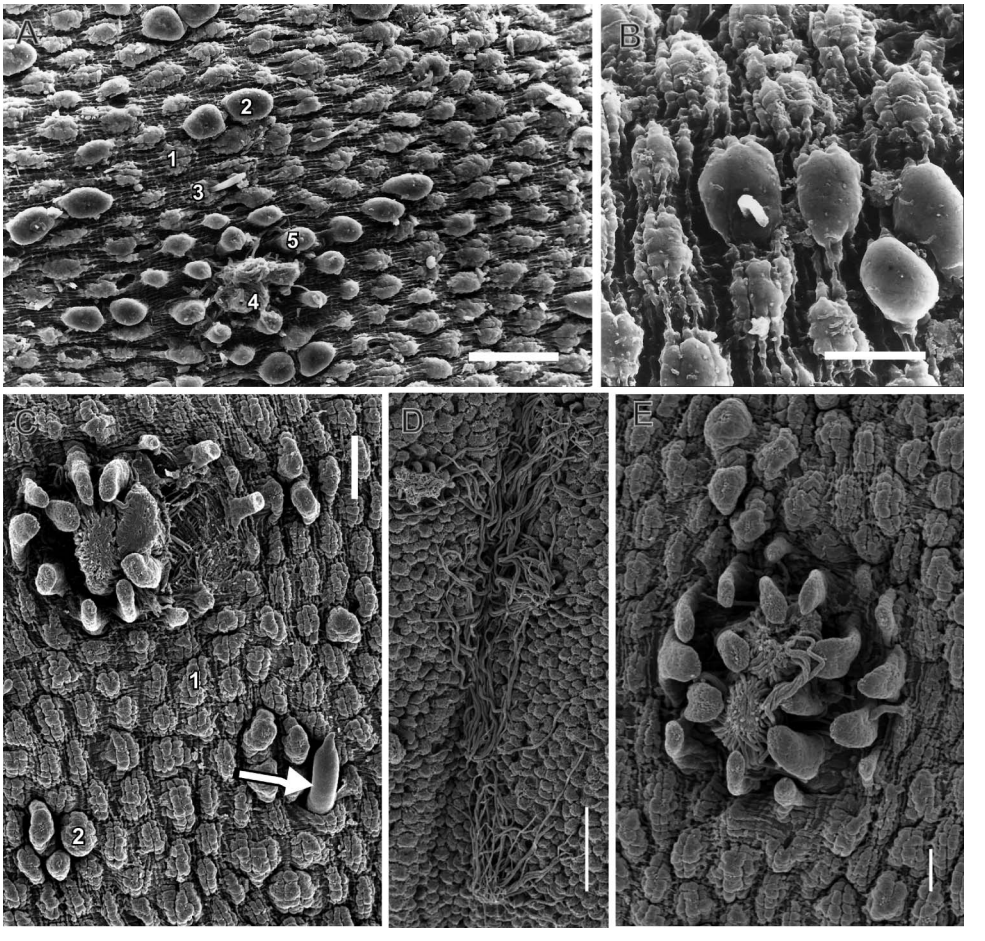

Figure 1. Holotype of *Chordodes congolensis*. (A) Overview of cuticle showing: simple (1), bulging (2), tubercle (3) and cluster of crowned (4) and circumcluster areoles (5); (B) detail of simple, bulging and tubercle areoles; (C) cluster of two crowned areoles with surrounding circumcluster areoles, arrow indicates thorn areole; (D) crowned areoles with long filaments along the ventral midline; (E) cuticle of female specimen (AMT 1401). Scale bars: 50 μm (A, D), 10 μm (B, E), 20 μm (C).

long) present near simple areoles (Figure 1C). Other areolar types occur in clusters of two crowned areoles with crown of short and fine apical filaments, surrounded by 10–12 elevated areoles (the circumcluster areoles, (Figure 1A, E). Circumcluster areoles have minute bristles on apex. Interareolar groove crossed by cuticular transversal cord which appears to connect base of areoles. Another type of crowned areoles with long filaments (up to 120 μm) (Figure 1D) along ventral midline.

Dimensions

Measurements of the specimens investigated were as follows (length in mm/diameter in mm), 61/0.5 holotype (Sciacchitano 1933), 190/1.1 (AMT 1401, as *C. madagascariensis* Sciacchitano, 1933), 130/2, 184/1 (AMT 30180/81, Sciacchitano 1961a), 135/1.5 (MNHNP 86, new record).

Comments

Sciacchitano (1933) described *Chordodes congolensis* from three specimens (AMT 1405, AMT 1406 and AMT 1407) which he interpreted as females, but Sciacchitano (1958) recognized two of them (AMT 1405, AMT 1407) as males (also see Schmidt-Rhaesa et al. 2008). A reinvestigation by SEM showed that the specimens from the Democratic Republic of the Congo: Kasai, Ipamu (AMT 1407) and Flandria (AMT 1405) had the same cuticular pattern as *C. madagascariensis*. Therefore, we transferred these specimens to *C. madagascariensis*. Also, after SEM investigation of the cuticle, we assigned to *C. congolensis* one indeterminate female from Baga Binari deposited in the collections of Muséum National d'Histoire Naturelle, Paris (MNHNP 86) and one female specimen from Bas-Uélé, Gwane (AMT 1401) that Sciacchitano (1933) described as *C. madagascariensis* (see Figure 1E).

Distribution

Democratic Republic of the Congo: Uélé, Tuku (one female (AMT 1406; Sciacchitano 1933)), Bas Uélé, Gwane (one female (AMT 1401; Sciacchitano 1933)), Bamania (two males (Sciacchitano 1961a)), Republic of Guinea: Baga, Binari, Nunez river (one female (MNHNP 86; new record)).

Chordodes ferox Camerano, 1897
(Figure 2)

Gordius verrucosus Baird, 1853 (in part).
Chordodes ferox Camerano, 1897, p. 388, plate II, figures 26, 26a, 26b.

Holotype

One♀, "French Congo" (no further specified location, this region now includes the Republic of the Congo, Gabon and the Central African Republic) (Camerano 1897) (MNHNP 54).

Material examined

SEM mid-body. Holotype, 1♀ (AMT 1374), 1♀ (AMT 1363, see comments), 1♀ (AMT 1376), 1♀ (AMT 1377), 1♀ (AMT 1378), 2♀♀ (AMT 1379), 1♀ (AMT 1382), 1♀ (AMT 1383), 1♀ (AMT 1385) and 1♀ (AMT 31150, see comments).

Host

Indeterminate mantid: (MNHNP 54; Camerano 1897), (AMT 1377, AMT 1378, AMT 1379; Sciacchitano 1933). *Sphodromantis (Rhomboderella) scutata* Bolivar, 1889 (AMT 1363 as *C. madagascariensis* De Beauchamp, 1916). *Polyspilota aeruginosa* (Goeze, 1765) (Schmidt-Rhaesa 2001).

Description

Holotype. Body colour dark brown. Anterior end tapered. Posterior end rounded and cloacal opening terminal.

Cuticle contains different types of areoles: simple, tubercle, thorn, circumcluster and two types of crowned areoles. Simple areoles uniformly distributed on body, low, oval with a smooth surface (Figure 2A, B). Tubercle areoles have a short tubercle arising from an eccentric pore on the areolar surface (Figure 2B). Thorn areoles occur quite scattered between simple areoles (Figure 2B). Circumcluster and crowned areoles occur in groups; circumcluster areoles form a circle of 8–16 areoles surrounding two crowned areoles (Figure 2A). Length of apical filaments in crowned areoles differ because on lateral side of the body they are short (Figure 2A) and along ventral midline they are much longer (up to 180 μm) (Figure 2C). Interareolar furrow with tubercles scarcely distributed among simple areoles.

Dimensions

Measurements of the specimens investigated were as follows (length in mm/diameter in mm), 200/1.5 holotype (Camerano 1897). 321/2.3 (AMT 1363; De Beauchamp 1916). 120/1.5 (AMT 1374; De Beauchamp 1923). Sciacchitano 1933: 116/1 (AMT 1377), 256/1.2 (AMT 1378), 125/1.2, 108/0.50 (AMT 1379), 125/2 (AMT 1382), 161/1.2 (AMT 1383), 229/1.8 (AMT 1385), 202/2 (AMT 31150 Sciacchitano 1961a). According to the literature: 108/0.5 (AMT 1380; Sciacchitano 1933).

Comments

Camerano (1893) identified another specimen from the French Congo (now area of the Republic of the Congo, Gabon and the Central African Republic) as *Gordius verrucosus* Baird, 1853. Römer (1896) noted that all the specimens that had been previously identified as *Gordius verrucosus* were heterogeneous, but that the specimen from the French Congo belonged to the genus *Chordodes*. Camerano (1897) agreed and described the specimen from the French Congo as *C. ferox*. Camerano (1897) described and drew the cuticle of *Chordodes ferox* with four areolar types, corresponding to simple, tubercle, thorn, circumcluster and crowned areoles that are coincident with our investigation. Our SEM investigation revealed that one female (AMT 1363) described by De Bauchamp (1916) as *C. madagascariensis*, has the same cuticular pattern as *C. ferox*. Also Sciacchitano (1961a) assigned one female specimen (AMT 31150) to *Chordodes capensis* that has the same cuticular characteristics of *C. ferox.* Therefore, we re-identified these two specimens as *C. ferox*.

Distribution

"French Congo" (no further specified location, this region now includes the Republic of the Congo, Gabon and the Central African Republic) (one female (AMT 1374; Camerano 1897)). Democratic Republic of the Congo: Kinshasa, Marungu, Mission Strappers (one female (AMT 1363; De Beauchamp 1916); Kisantu (one female (AMT 1374; De Beauchamp 1923)); Bas-Uélé, La Kulu, Bondo (one female (AMT 1371; Sciacchitano 1933)); Sankurú Komi, Lodja (three females (AMT 1379, AMT 1381, AMT 1382; Sciacchitano 1933)); Kisangani (as Stanleyville) (two females (AMT 1383, AMT 1384; Sciacchitano 1933)); Boma (one female (AMT 1378; Sciacchitano 1933)); Equateur Boala Ingende (one female (AMT 20312; Sciacchitano 1958)); Kinshasa Epulu (one female (AMT 31150; Sciacchitano 1961a)).

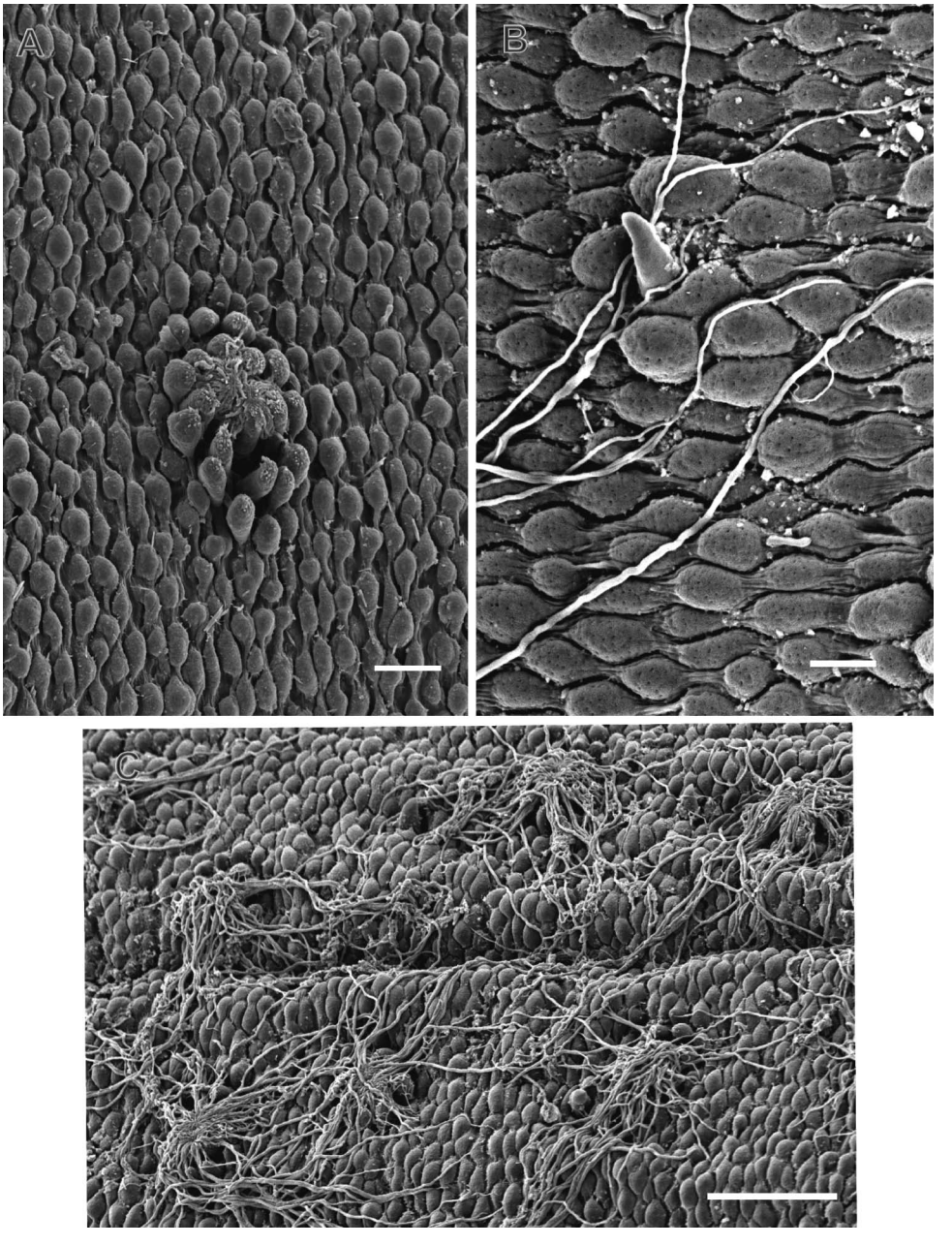

Figure 2. Holotype of *Chordodes ferox*. (A) Overview of cuticle showing simple, tubercle, crowned and circumcluster areoles; (B) thorn and tubercle areoles; (C) longitudinal furrow showing crowned areoles with long filaments. Scale bars: 20 μm (A), 10 μm (B), 50 μm (C).

Chordodes madagascariensis (Camerano, 1893)
(Figures 3 and 4)

Gordius madagascariensis Camerano, 1893.
Chordodes madagascariensis Römer, 1896, p. 284.

Holotype

One ♂ Madagascar, Annanarivo (Camerano 1893) (MRSNT G45).

Material examined

SEM mid-body and posterior end: Holotype and 1♀ (AMT 1363), 1♂ (AMT 1364), 1♂ (AMT 1368), 1♀ (AMT 1369), 1♂ (AMT 1370), 1♂ (AMT 1372), 3♂♂ (AMT 1387–1388), 1♂ (AMT 1389), 1♀ (AMT 20313), 2♂♂ (AMT 23583–23584), 1♀ (AMT 25695), 1♂ (AMT 25700), 1♂ (AMT 25920), 1♂ (AMT 31113).

Host

Indeterminate mantid: (MRSNT G45; Camerano 1893), (AMT 1370, AMT 1372; De Beauchamp 1916); (AMT 1405, AMT 1407 as *C. congolensis* Sciacchitano, 1933); (AMT 25920; Sciacchitano 1958); (AMT 13575; Sciacchitano 1961b). *Sphodromantis scutata* (AMT 1364; De Beauchamp 1916). *Sphodromantis lineola* (Burmeister, 1838) (AMT 1369; De Beauchamp 1916); *Mantis religiosa* Linnaeus, 1758 (AMT 23583–23584, AMT 25700; Sciacchitano 1958).

Description

Body colour varies from medium to dark brown in males. Females dark brown. Anterior tip tapering, distinctly lighter. Male posterior end rounded. Cloacal opening slit like and surrounded by circumcloacal bristles. Anterolateral of cloacal opening with two fields of bristles (Figure 3A, B). Female posterior end slightly invaginated, probably due to desiccation (Figure 3C). Cloacal opening terminal.

Cuticle (Figure 3D, E) includes simple, thorn, tubercle, crowned areoles. Simple areoles rounded, slightly elevated, have a surface with very short projections (Figure 3D). Between them, scarce thin tubercles. Thorn and tubercle areoles occur quite scattered on the cuticular surface (Figure 3D). Thorn areoles surrounded by two or three basal structures that appear to represent areoles (Figure 3D). Crowned areoles highly elevated above the cuticular surface, occurring in clusters of 19–23 areoles. Apical crown of filaments of crowned areoles very short (4.3 to 5.1 μm long) (Figure 3E). In some parts of cuticle two areolar clusters arranged very close to each other (Figure 4A). In males, crowned areoles with short apical filaments occur over whole body surface (Figure 4B), but in females, a second type of crowned areoles with very long filaments (up to 38.5 μm) occur in a double row along both sides of ventral midline (Figure 4C).

Dimensions

Measurements of the specimens investigated were as follows (length in mm/diameter in mm), 188/1.2 holotype (Camerano 1893), 321/2.2 (AMT 1363; De Beauchamp 1916), 210/1.3 (AMT 1364; De Beauchamp 1916), 163/1.5 (AMT 1368; De Beauchamp

1923),174/1.6 (AMT 1369; De Beauchamp 1916), 140/1.2 (AMT 1370; De Beauchamp 1923), 175/1.2 (AMT 1372; De Beauchamp 1923), 150/0.6, 151/0.7, 152/0.7 (AMT 1387-1388; Sciacchitano 1933), 121/0.1, 150/1 (AMT 1407, AMT 1405; as *C. congolensis* Sciacchitano, 1933), 98/1.2 (AMT 20313; Sciacchitano 1958), 119/0.6, 128/0.8 (AMT 23583–23584; Sciacchitano 1958), 315/2.1 (AMT 25695; Sciacchitano 1958), 2140/1.5 (AMT 25700) 159/1.1 (AMT 25920; Sciacchitano 1958), 180/1 (AMT 31113; Sciacchitano 1961a). According to the literature: 214/2 (AMT 13575; Sciacchitano 1961b), 223/1 (AMT 13618; Sciacchitano 1961b).

Comments

Camerano (1893) described a new species, *Gordius madagascariensis,* from a single female specimen. Römer (1896) transferred this species to the genus *Chordodes*. In 1897 Camerano re-studied this specimen and enlarged the description, noting that the characteristics of the posterior end corresponded to a male. Camerano (1893, 1897) described the cuticle of *Chordodes madagascariensis* with three areolar types simple, circumcluster and crowned areoles. Our SEM investigation showed simple, thorn, tubercle and clusters of crowned areoles, but could not found circumcluster areoles. We considered that all of these clusters of areoles are crowned areoles because all of them have a crown of apical filaments. On the other hand, circumcluster areoles may be without structure or carry apical fine bristles (Schmidt-Rhaesa et al. 2008). In 1933, Sciacchitano identified one female (AMT 1389) from Democratic Republic of Congo, Sankuru Kondue, and one male (AMT 25700) from Kinshasa (as Leopoldville) Kalina (Sciacchitano 1958) as *C. madagascariensis*. However, an SEM investigation showed the same pattern of the cuticle as in *Chordodes africanus* (Zanca, De Villalobos et al. 2006). Also two other specimens, one female (AMT 1401) from Democratic Republic of Congo, Gwane, Bas-Úelé (Sciacchitano 1933) and one male (AMT 31113) from Tshuapa that Sciacchitano (1961a) included as *C. madagascariensis*, proved to belong to *Chordodes congolensis* and *C. kolensis* respectively, as revealed by reinvestigation (Zanca, Schmidt-Rhaesa et al. 2006). We also identified as *C. madagascariensis* two males (AMT 1405, AMT 1407) which were described by Sciacchitano (1933) as *C. congolensis*. This investigation also showed that gender assignment in specimens AMT 1372 (De Beauchamp 1923), AMT 1389, AMT 1387–1388 (Sciacchitano 1933) was wrong because they are males. The female (AMT 1369) varies in some respects from the other specimens, having simple areoles with a smooth surface and more numerous thorn areoles.

Distribution

Angola: Dundo (one male (AMT 13575; Sciacchitano 1961b)); Calonda (one male (AMT 13618; Sciacchitano 1961b)). Democratic Republic of the Congo: Katanga, Elizabethville Mission Stappers (one male and one female (AMT 1364; Beauchamp 1916)); Lunda, Kasongo (one female (AMT 1369; Beauchamp 1916)); Kitempuka (one female (AMT 1371; Beauchamp 1916)); Wombali, Bandundu (one male (AMT 1368; Beauchamp 1923)); Lualuabourg (one male (AMT 1370; Beauchamp 1923)); Mayumbe (one female (AMT 1372; Beauchamp 1923)); Lubumbashi (as Elisabethville) (one male, one female (Sciacchitano 1932)); Province Equateur, Flandria, South of Ingende (one male (AMT 1405; as *C. congolensis* Sciacchitano, 1933)); Kasai Ipamu (one male (AMT 1407; as *C. congolensis* Sciacchitano, 1933)); Boma (three males (AMT 1387, AMT 1388; Sciacchitano 1933)); Equateur, Flandria (one female (AMT

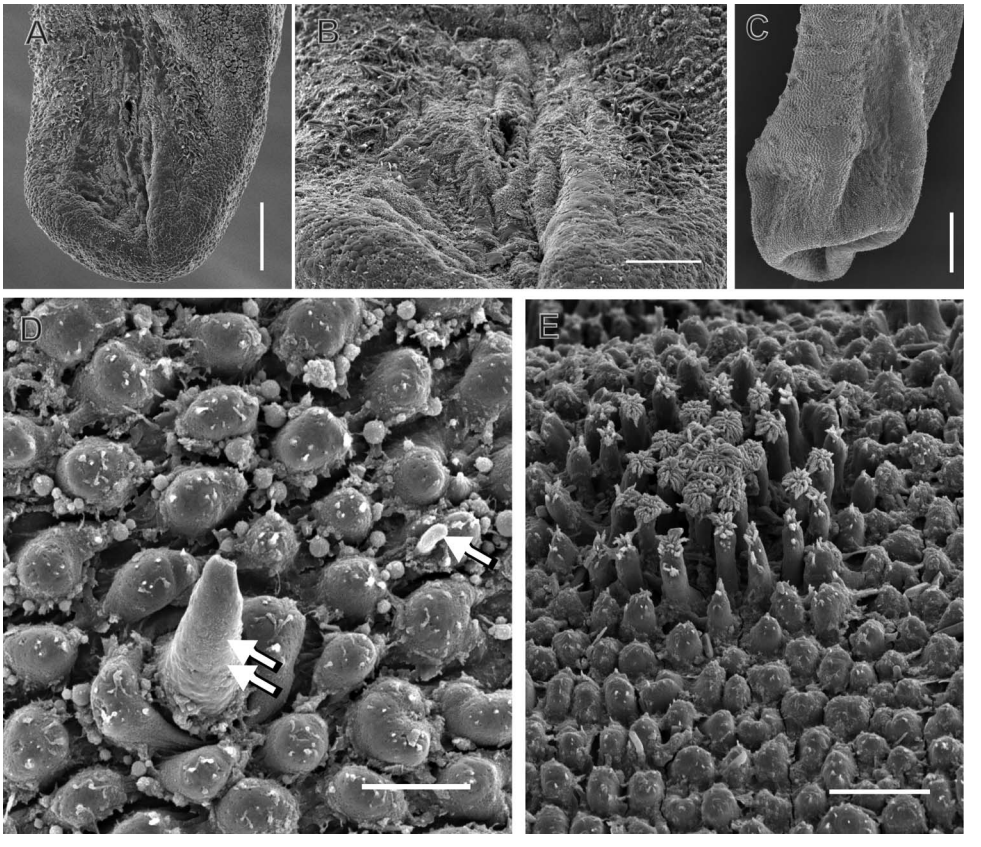

Figure 3. Holotype of *Chordodes madagascariensis*. (A) Ventral view of the male posterior end, showing the cloacal opening; (B) detail of the male posterior end with the cloacal opening surrounded by circumcloacal bristles and two rows of bristles (bristlefields); (C) posterior end of the female; (D) cuticle of the lateral side of the body with simple, tubercle (arrow) and thorn areoles (double arrow); (E) cluster of crowned areoles on the male. Scale bars: 100 μm (A), 50 μm (B), 200 μm (C), 10 μm (D), 20 μm (E).

20313; Sciacchitano 1958)); Boende (two males (AMT 23583, AMT 23584; Sciacchitano 1958)); Kinshasa (one female (AMT 25695; Sciacchitano 1958)); Isle Biana, Lokandu, Maniema (one male, one female (AMT 25920; Sciacchitano 1958)); Guinea (as French Guinea): Fauta Osalan (one male, two females (Camerano 1915)); Madagascar: Antananarivo (as Annanarivo) (one male (MRSNT G45; Camerano 1893)).

Chordodes mobensis Sciacchitano, 1958
(Figure 5)

Chordodes mobensis Sciacchitano, 1958, p. 40, figures 35–38.

Holotype

One ♀ Democratic Republic of the Congo Lualaba:Kakanda (Tanganika, Moba) (Sciacchitano 1958) (AMT 30017).

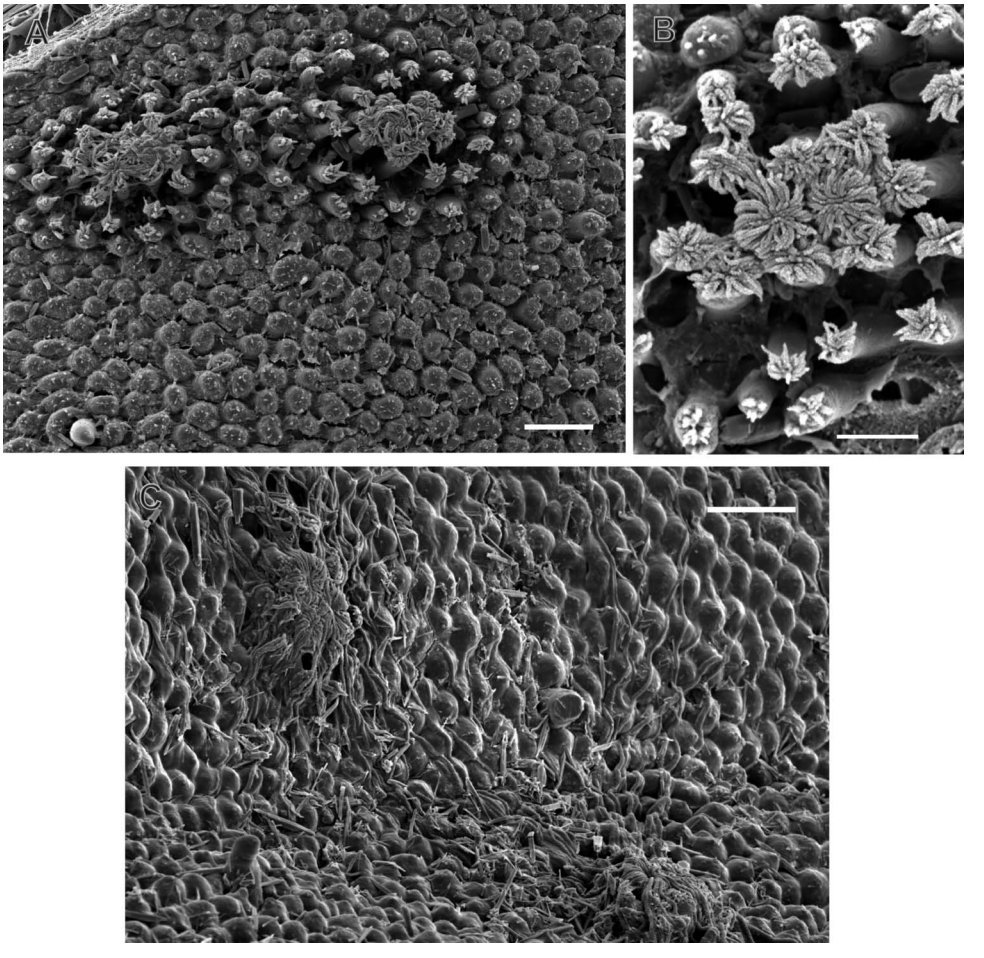

Figure 4. *Chordodes madagascariensis.* (A) Holotype. Two areolar clusters of crowned areoles arranged very close to each other; (B) holotype. Detail of cluster of crowned areoles; (C) crowned areoles with long filaments along the ventral midline of the female specimen (AMT 1405). Scale bars: 20 μm (A, C), 10 μm (B).

Material examined

SEM mid-body. Holotype.

Host

Mantis sp. (Sciacchitano, 1958).

Description

Body colour light brown. Anterior end tapering. Posterior end slightly twisted, bent, probably due to dehydration.

Cuticle contains five areolar types. Simple areoles of various shapes (irregular, round, oval) and sizes. Areolar surface rugged. Scattered among simple areoles clusters of two to three bulging areoles with a smooth surface or with minute bristles.

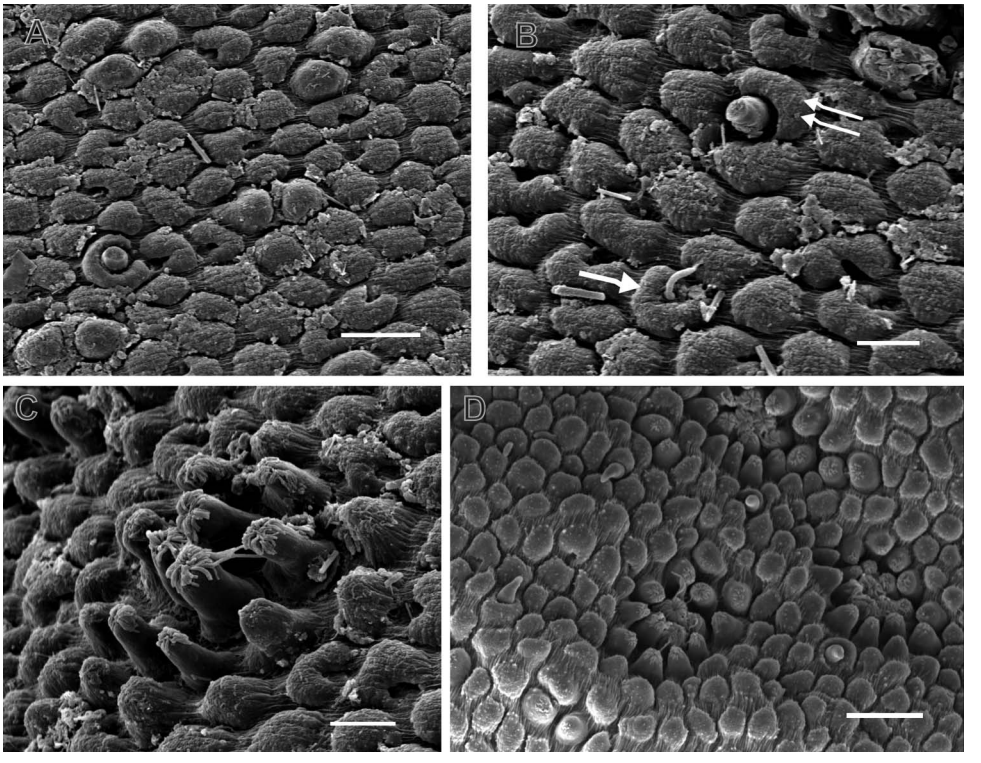

Figure 5. Holotype of *Chordodes mobensis*. (A) Cuticle showing simple, bulging and thorn areoles; (B) thorn areole (double arrow) and tubercle areole (white arrow); (C) clusters containing crowned areoles; (D) midline of the body showing crowned areoles with short filaments and thorn areoles. Scale bars: 20 μm (A), 10 μm (B, C).

Tubercle and thorn areoles present (Figure 5A, B). Thorn areoles originate from a ring-shaped basal structure (Figure 5A, B). Crowned areoles appear in clusters of about 10–12 areoles (Figure 5C). All areoles in these clusters have a crown of short filaments. Areoles in the centre (three to four areoles) elongated, towards the periphery, slender (Figure 5C). Along ventral furrow of the body are crowned areoles with short filaments and numerous thorn areoles (Figure 5D).

Comments

In the original description Sciacchitano (1958) described and drew the cuticle of *Chordodes mobensis* with three areolar types which correspond to the simple, bulging and crowned areoles from our investigation. He also mentioned, without considering it as another areolar type, the presence of a large spine which corresponds to our thorn areoles. Using SEM we were able to describe in detail each one of the areolar types mentioned and add tubercle areoles as a new type.

Chordodes maculatus Sciacchitano, 1958
(Figure 6)

Chordodes maculatus Sciacchitano, 1958, p. 35, figures 25–29.

Material examined (see comments)

SEM mid-body: Type series: 1♀ (AMT 16537), 1♀ (AMT 28955), 1♀ (AMT 25696), 2♀♀ (AMT 25856–25857), 1♀ (AMT 22223), 1♀ (AMT 27672), 2♀♀ (AMT 28955 (see comments) and 1♀ (AMT 32428).

Host

Mantis religiosa (AMT 2223; Sciacchitano 1958), indeterminate mantids (AMT 16537; Sciacchitano 1958) and *Sibylla gratiosa* Rehn, 1912 (AMT 32428; this investigation).

Description

Body colour varies from yellowish brown to very dark brown. Only two females (AMT 28955 and AMT 25696) have in the anterior end a white cap and a dark calotte. Posterior end rounded.

Cuticle includes simple areoles with varying shapes, oval or rounded, with smooth surface (Figure 6A). Bulging areoles appear isolated or in clusters of two or three areoles. Thorn areoles conical, elevated and surrounded by two, three or four basal structures that appear to represent areoles (Figure 6A, B). Number of crowned areoles varies from one (Figure 6C) to two (Figure 6A, B) with a crown of short filaments. In the majority of the specimens investigated, crowned areoles surrounded by 18–23 circumcluster areoles (Figure 6A). However, specimens (AMT 25856, AMT 27672 and AMT 32428) have crowned areoles surrounded by 8–10 circumcluster areoles (Figure 6B). Along ventral groove another type of crowned areole with very long filaments (up to 146 μm) (Figure 6D). Interareolar furrow with scarce tubercles with round apex.

Dimensions

Measurements of the specimens investigated were as follows (length in mm/diameter in mm). Sciacchitano (1958): 267/2, 175/2, 394/1.80, 248/1.75, 146/1, 179/1.7, 150/1.5, 146/1.5, 267/2.5 and 143/1 (this investigation).

Comments

Sciacchitano (1958) described *Chordodes maculatus* on the basis of six females and two males from different localities. The present reinvestigation by SEM revealed that specimens (AMT 25856 and AMT 28955) that Sciacchitano (1958) interpreted as males are really females. The female specimen (AMT 32428) contains a label "*Chordodes maculatus,* det. Sciachitano 1965 col. Deuelle 5/1960, host: *Sibylla gratiosa*", but Sciacchitano never published this record. Sciacchitano (1958), in the original description of *C. maculatus,* described the cuticle with four areolar types and a thick hook. These features are coincident with simple, bulging, crowned, circumcluster and thorn areoles in the present investigation. However, the same cuticular pattern is present in specimens of *Chordodes kolensis* (Zanca, De Villalobos et al. 2006). Therefore, *C. maculatus* is regarded as a synonym of *Chordodes kolensis*. We observed variations in the number of circumcluster areoles in the studied specimens with respect to the holotype (Zanca, De Villalobos et al. 2006), but we considered that these differences were not sufficient to distinguish a separate species.

Distribution

Sciacchitano, 1958: Democratic Republic of the Congo: Bolobo, lake Leopoldo II (one female), Ubangi, Libenge (one female), Kinshasa (ex Leopoldville) (three females), Ubangi Bokapo (Lisala) (three females), Tshuapa Boende (one female), Yangambi (one female, new record).

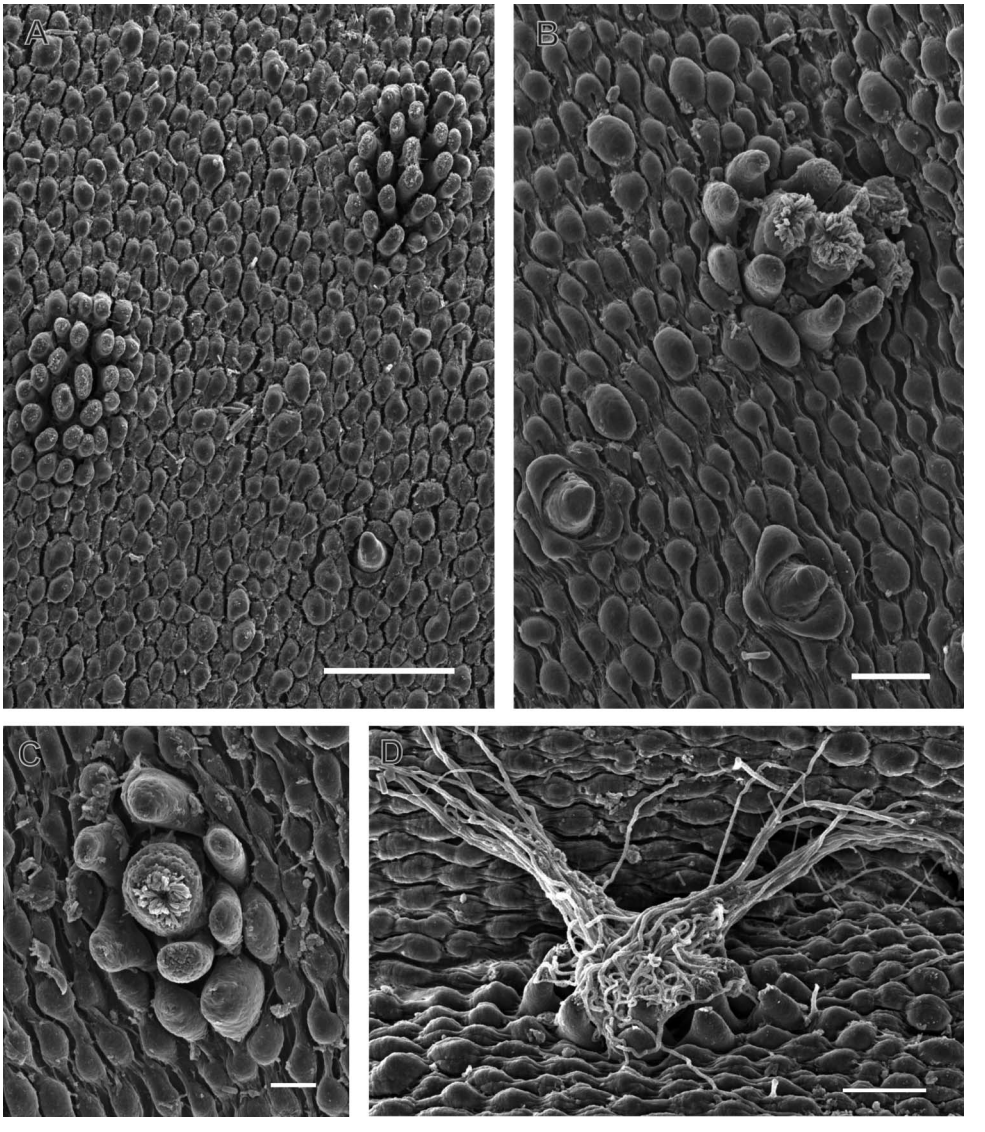

Figure 6. *Chordodes maculatus* (type series). (A) General view of the midbody cuticle; (B) higher magnification showing simple, thorn, bulging, crowned and circumcluster areoles; (C) areolar cluster with one crowned areole of the female (AMT 32428); (D) longitudinal furrow of the female with crowned areoles with long filaments. Scale bars: 50 μm (A); 20 μm (B, D), 10 μm (C).

Chordodes kakandensis Sciacchitano, 1958
(Figure 7)
Chordodes kakandensis Sciacchitano, 1958, p. 37, figures 30–32.

Holotype

One ♀, Democratic Republic of the Congo Lualaba: Kakanda (Tanganika, Moba) (Sciacchitano 1958) (AMT 29888).

Material examined

SEM mid-body: Holotype.

Host

Unknown.

Description

Holotype: body colour light brown. Anterior end narrows slightly towards apex with white calotte. Posterior end undivided, cloacal opening terminal.

Body cuticle includes five types of areoles (Figure 7A, B). Simple areoles round or oval with warty surface with or without minute bristles on top. Tubercle areoles and thorn areoles present (Figure 7B). Clusters of two crowned areoles surrounded by 12–16 circumcluster areoles with minute bristles at the apex. Crowned areoles highly elevated above cuticular surface, with apical ring of filaments. Along ventral midline there is another type of crowned areoles with very long filaments (up to 135 μm) (Figure 7C).

Dimensions

Measurement of the specimen investigated: 180 mm long and 1 mm wide (Sciacchitano 1958).

Comments

Sciacchitano (1958) described *Chordodes kakandensis* on the basis of one female specimen. He mentioned and drew three areolar types, corresponding to simple, thorn and clusters of crowned and circumcluster areoles from our investigation. From the SEM reinvestigation, we distinguished another type of areole, the tubercle areoles. The same cuticular pattern is present in *Chordodes schoutedeni* (Sciacchitano 1933; Zanca, Schmidt-Rhaesa et al. 2006) and we therefore regard *C. kakandensis* as a synonym of *C. schoutedeni*. In this study we observed a new characteristic of the female of *C. schoutedeni* that has never been described before: along the ventral furrow there are crowned areoles with long filaments.

Discussion

Our reinvestigation by SEM confirmed that *Chordodes congolensis*, *C. ferox*, *C. madagascariensis* and *C. mobensis* are distinct and recognizable species, but we

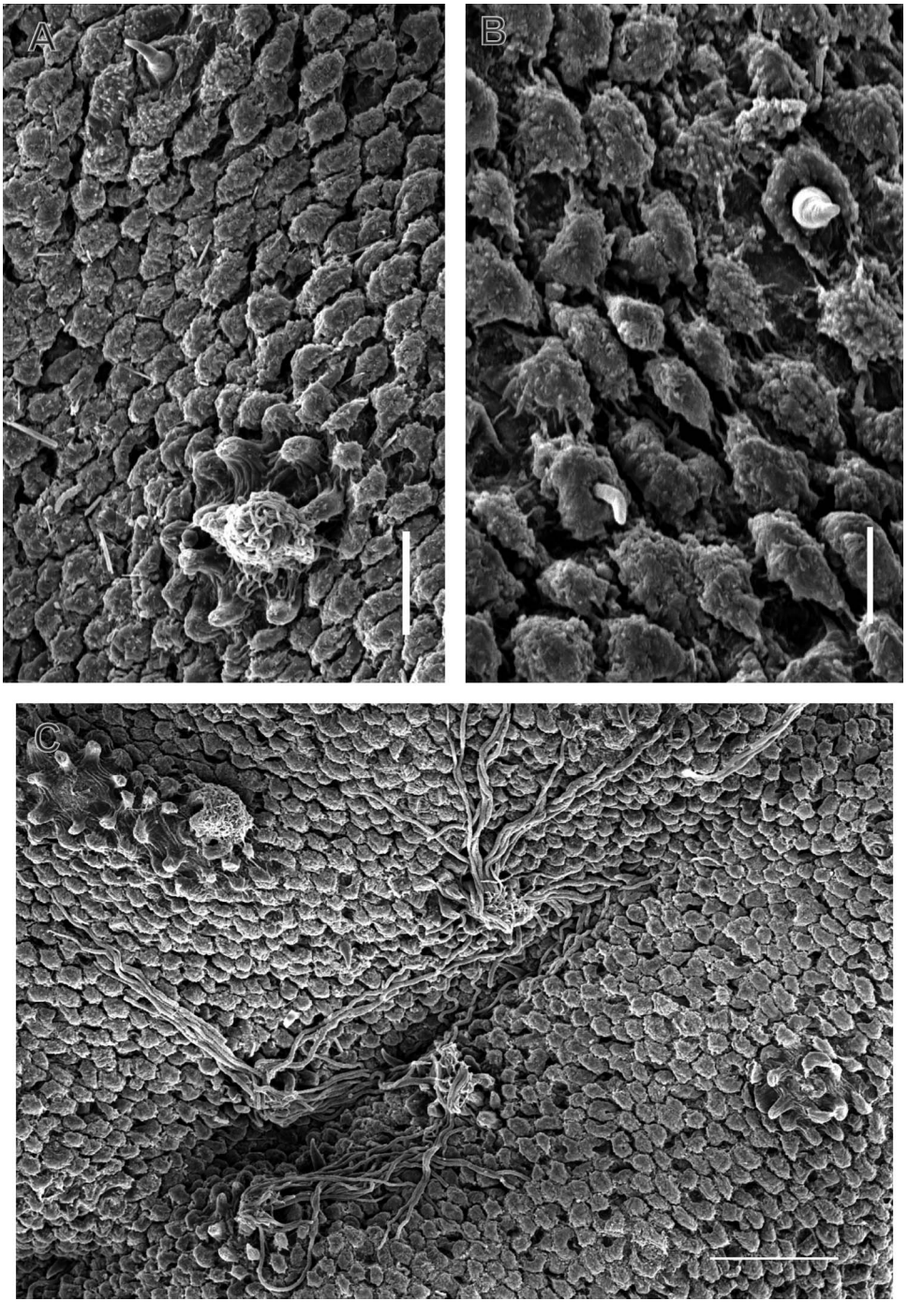

Figure 7. *Chordodes kakandensis* (holotype). (A) Overview of the midbody cuticle; (B) thorn and tubercle areoles; (C) midline of the body showing crowned areoles with long filaments. Scale bars: 20 μm (A), 10 μm (B), 50 μm (C).

synonymized *C. maculatus* with *C. kolensis* and *C. kakandensis* with *C. schoutedeni* because no differences could be detected that justify the recognition of these species as separate valid entities.

Chordodes madagascariensis and *C. mobensis* have clusters of areoles including only crowned areoles but *C. congolensis* and *C. ferox* have a pair of crowned areoles surrounded by a ring of circumcluster areoles. The females of *C. congolensis, C. ferox* and *C. madagascariensis* have crowned areoles with long filaments along the ventral midline. This type of crowned areoles was not observed in the female of *C. mobensis*.

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