

Three Halacarid mites of the genus *Copidognathus* (Acari: Halacaridae) from Zanzibar, Tanzania

Tapas CHATTERJEE¹, Marleen DE TROCH² and Cheon Young CHANG^{3*}

(¹) Department of Biology, Indian School of Learning, I.S.M. Annexe, P.O.- I.S.M., Dhanbad-826004, Jharkhand (India). E-mail: drtchatterjee@yahoo.co.in

(²) Marine Biology Section, Department of Zoology, University of Ghent, B-9000 Ghent (Belgium). E-mail: marleen.detroch@ugent.be

(³) Department of Biology, College of Natural Sciences, Daegu University, Gyeongsan 712-714 (South Korea). *Corresponding Author, E-mail: cychang@daegu.ac.kr

Abstract: Three new halacarid species belonging to the genus *Copidognathus* are described from the east coast of Zanzibar, Tanzania. *Copidognathus corallicolus* sp. nov. is characterized by dorsal setae 2 on membranous cuticle between anterodorsal plate and ocular plate, posterodorsal plate with two single-rosette-pore wide costae, panels on posterodorsal plate subdivided, long rostrum extending to base of fourth palpal segment, tibia IV with a ventromedial pectinate seta, and tarsi III and IV with 4:3 dorsal setae. *Copidognathus fungiae* sp. nov. is a member of *C. tamaeus* group, and characterized by all ventral plates fused in male, posterodorsal plate with two 2- to 3-rosette-pores wide costae, palp a little surpassing anterior end of rostrum, second palpal segment with spinular lamella ventrodistally, ventrolateral lamella of telofemur I with medial edge slightly protruded, and patella IV with 4 setae. *Copidognathus ungujaensis* sp. nov., a member of *C. bairdi* group s. str., is closely allied with *C. sidellus* Bartsch, but differs from it by the presence of areola below second coxal region, almost straight anterior margin of posterodorsal plate, 2 rosette pores between gland pores on posterodorsal plate, lateral and middle costae not joining anteriorly, and more elongated anterior areola on anterodorsal plate.

Résumé : Trois acariens du genre *Copidognathus* (Acari : Halacaridae) de Zanzibar, Tanzanie. Trois nouvelles espèces d'Halacaridae du genre *Copidognathus*, récoltées sur la côte est de Zanzibar (Tanzanie), sont décrites. *Copidognathus corallicolus* sp. nov. est caractérisée par la soie dorsale 2 sur la cuticule membraneuse entre la plaque antérodorsale et la plaque oculaire, la plaque postérodorsale avec deux côtes larges à simple pore en rosette, des panneaux sur la plaque postérodorsale subdivisés, le rostre long s'étendant jusqu'à la base du quatrième segment du palpe, le tibia IV avec une soie ventromédiane pectinée, les tarsi III et IV avec 4:3 soies dorsales. *Copidognathus fungiae* sp. nov. est membre du groupe de *C. tamaeus* et caractérisée par ses plaques ventrales toutes fusionnées chez le mâle, la plaque postérodorsale avec deux côtes larges à 2-3 pores en rosette, le palpe dépassant légèrement l'extrémité antérieure du rostre, le deuxième segment du palpe avec des lamelles épineuses sur le côté ventrodistal, des lamelles ventrolatérales du télofémur I avec le bord médial légèrement saillant, les patella IV avec 4 soies. *Copidognathus ungujaensis* sp. nov., un membre du groupe de *C. bairdi* s. str., est très proche de *C. sidellus* Bartsch, mais diffère de cette espèce par la présence d'une areola sous la seconde région coxale, la marge antérieure de la plaque postérodorsale presque droite, 2 pores en rosette entre les pores des glandes sur la

plaque postérodorsale, des côtes latérales et centrales non fusionnées antérieurement, et une areola antérieure allongée sur la plaque antérodorsale.

Keywords: Acari; Halacaridae; *Copidognathus*; New species; Zanzibar

Introduction

The halacarid fauna of Zanzibar, Tanzania, is poorly known. Lohmann (1893) recorded *Agaue hypertrophica* (Lohmann), *A. thalei* (Lohmann), and Gimbel (1919) reported *Copidognathus zanzibari* (Gimbel) from Zanzibar. Konnerth-Ionescu (1977) reported *Agauopsis bacescui* Konnerth-Ionescu, *C. africanus* Bartsch, 1972 and *Agaue* sp. from Kunduchi, mainland of Tanzania. Some works have been done from the adjacent areas of eastern coast of Africa like Kenya (Chatterjee & De Troch, 2000), Mozambique Channel (Bartsch, 1981 & 1982), Somalia (Morselli & Mari, 1986), Gulf of Suez (André, 1959) and Red Sea (Trouessart, 1899 & 1901a; André, 1938a,b & 1959). In the present paper three new species of the genus *Copidognathus* are described from Matemwe and Makunduchi, the east coast of Unguja, Zanzibar Island.

Materials and methods

Materials were collected from Matemwe (05°52'S, 39°21'E) and Makunduchi (06°25'S, 39°33'E), the east coast of Unguja, Zanzibar, Tanzania, among coralline sediments of *Fungia* and *Tubipora*. Meiofauna samples were washed over a 32 µm sieve after anesthetizing halacarid mites with 7% MgCl₂ solution for about 30 minutes, rinsed with freshwater for osmotic shock, and then fixed and stored in 80% ethanol.

Halacarids were hand-sorted, cleared in lactic acid and mounted in glycerin jelly. Drawings were prepared using a camera lucida under a differential interference contrast microscope with Nomarski optics. Type specimens are deposited in the Acari collection of the Royal Belgian Institute of Natural Science, Brussels, Belgium (specimen number 30.565).

Abbreviations: AD, anterior dorsal plate; AE, anterior epimeral plate; ds₁₋₆, dorsal setae 1-6 on idiosoma; GA, genitoanal plate; GO, genital opening; OC, ocular plate; PAS, parambulacral seta; PD, posterior dorsal plate; PE, posterior epimeral plate; PGS, perigenital setae; P₁₋₄, first to fourth palpal segment; SGS, subgenital setae.

Systematics

Family Halacaridae Murray, 1877
Subfamily Copidognathinae Bartsch, 1983
Genus *Copidognathus* Trouessart, 1888

***Copidognathus corallicolus* sp. nov.**
(Figs. 1-10)

Material Examined

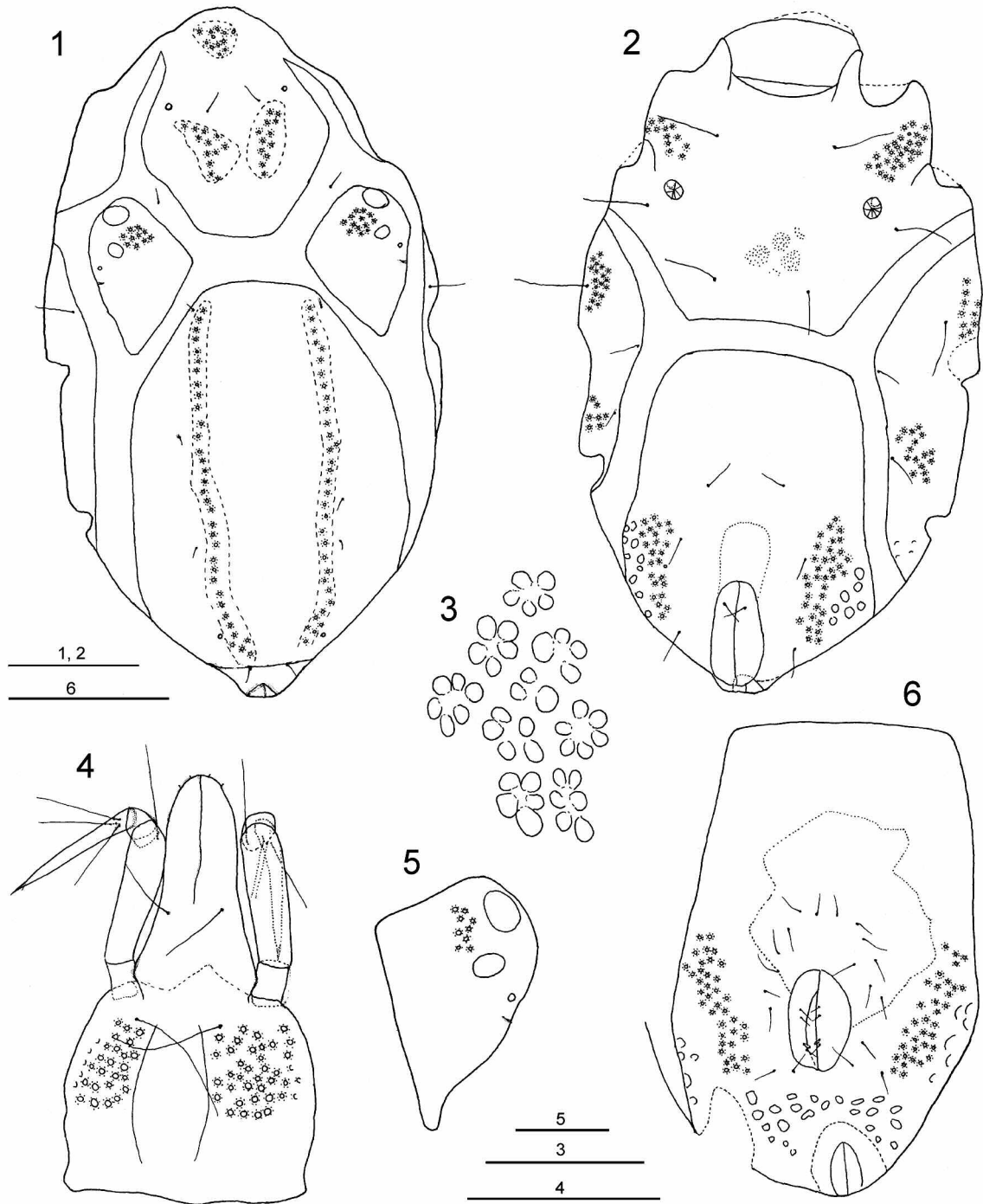
Holotype: female, Matemwe, east coast of Unguja, Zanzibar (among coralline sediments of *Fungia*), 17 August 2004 (*leg.* M. Raes & H. Gheerardyn). Paratype: one male and one female collection data same as in holotype.

Description of holotype female

All dorsal plates separate. Idiosoma (Figs 1 & 2) 264 µm long, 151 µm wide. AD 88 µm long, 72 µm wide. Anterior areola on AD roundish; paired posterior areolae oblong with about 12 rosette pores each. Paired ds₁ anterior to posterior areolae on AD, distance between two setae 18 µm. Pair of gland pores near anterolateral corner of posterior areolae and a little apart from lateral margin of AD; distance between two gland pores 40 µm; ds₂ on membranous cuticle between AD and OC.

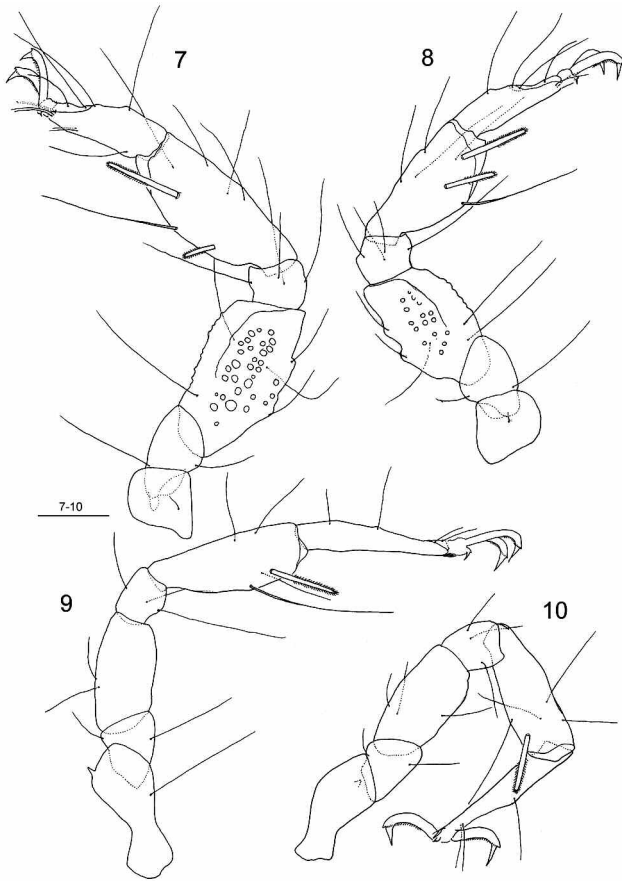
OC 61 µm long, 40 µm wide; length to width ratio about 1.5; with 2 cornea; areola with rosette pores medial to cornea; gland pore near lateral margin of OC distal to posterior cornea; pore canalicula present nearly on lateral margin of OC posterior to gland pore; rest of OC with panels. Brownish pigment found near corneal zone.

PD 147 µm long, 102 µm wide; pair of costae single-rosette-pore wide; rest of plate containing panels, each panel subdivided (Fig. 3); ds₃-ds₅ on PD lateral to porose costae; gland pore lateral to costae posteriorly on PD. Anterior gland pore on PD indistinct. Position of ds₄ more posterior in one side than the other side; distance from ds₃ to ds₄ 46 µm, ds₄ to ds₅ 41 µm, and ds₅ to posterior gland pore 29 µm in one side, while distance from ds₃ to ds₄ 95 µm, ds₄ to ds₅ 21 µm, and ds₅ to gland pore 32 µm in the other side.



Figures 1-6. *Copidognathus corallicolus* sp. nov. (female: 1-4; male: 5, 6). **1.** Idiosoma, dorsal. **2.** Idiosoma, ventral. **3.** Panels between two costae. **4.** Gnathosoma (drawn from paratype female). **5.** OC (panels not shown). **6.** GA of male. Scale bars: 1, 2, 4, 6 = 50 μm ; 3, 5 = 20 μm .

Figures 1-6. *Copidognathus corallicolus* sp. nov. (femelle: 1-4; mâle: 5, 6). **1.** Idiosome, vue dorsale. **2.** Idiosome, vue ventrale. **3.** Panneaux entre deux côtes. **4.** Gnathosome (paratype femelle). **5.** OC (panneaux non montrés). **6.** GA du mâle. Échelle 1, 2, 4, 6 = 50 μm ; 3, 5 = 20 μm .



Figures 7-10. *Copidognathus corallicolus* sp. nov. (female). Legs I-IV. Scale bar = 20 μ m.

Figures 7-10. *Copidognathus corallicolus* sp. nov. (femelle). Pattes I-IV. Échelle = 20 μ m.

All ventral plates separate (Fig. 2). AE 86 μ m long, 124 μ m wide; with 3 pairs of ventral setae and a pair of epimeral pores. Epimeral processes I and II coxal in origin; paired ventrolateral areolae between insertion of legs I and II. PE with 3 ventral and 1 dorsal setae; marginal areola above insertion of leg III; ventral areola between insertion of legs III and IV. GA 140 μ m long, 90 μ m wide. GO 40 μ m long, 21 μ m wide. Distance between anterior margin of GO to that of GA 89 μ m. Ovipositor extending beyond GO and beyond second pair of PGS, distance between anterior end of ovipositor to that of GO 23 μ m and to that of GA 66 μ m. Three pairs of PGS present; first and second pairs above anterior margin of GO, third pair posterolateral to middle of GO. Distance between first pair of PGS and anterior margin of GA 66 μ m. Pair of SGS located at anterior 1/6 of GO. Paragenital areolae well developed, surpassing second pair of PGS and almost extending upto level of anterior end of ovipositor.

Gnathosoma 90 μ m long, 50 μ m wide (length to width ratio about 1.8). Palp consisting of 4 segments. Rostrum long extending beyond P_3 . P_1 and P_3 devoid of any seta. P_2 with 1 dorsal seta distally. P_4 with 3 long proximal setae and 1 minute distal seta. Proto- and deuterostral setae situated at tip of rostrum; tritrostral setae (long maxillary setae of rostrum) located below middle of rostrum; gnathosomal base with a pair of setae. Gnathosomal base dorsally panelled, ventrolaterally with rosette pores. Rostral sulcus almost reaching tritrostral setae. Tectum a little protruded.

Chaetotaxy of legs (Figs 7-10): trochanter 1-1-1-0; basifemur 2-2-2-2; telofemur 5-5-2-3; patella 4-4-3-3; tibia 7-7-5-5; tarsus (PAS excluded) 7-4-4-3. Trochanters III and IV with spiniform dorsomedial process. Telofemora I-II panelled, with ventromedial ridge. Telofemur III with 2 dorsal setae, devoid of any ventral seta. Telofemur IV with 2 dorsal, 1 ventral seta. All patella with very small articular (pararthrodial) lamellae. Tibiae I-IV with 2-2-1-1 bipectinate ventromedial setae. Tibiae I-II each with distoventral articular lamella. Tarsus I with 3 dorsal setae, 1 solenidion (16 μ m long), 3 ventral setae and 2 doublets eupathid PAS. Tarsus II with 3 dorsal setae, 1 solenidion (14 μ m long) and 2 singlet eupathid PAS. Tarsus III with 4 dorsal setae and 2 PAS, distance between 2 basidorsal setae more than height of that tarsus. Tarsus IV with 3 dorsal setae and 2 PAS. All legs with 2 lateral claws and a bidentate median claw. Lateral claws with accessory process dorsally and fine pectines ventrally.

Male

Idiosoma 270 μ m long and 152 μ m wide. Posterior part of OC narrow (Fig. 5). Distance between ds_3 and ds_4 44 μ m, between ds_4 and ds_5 46 μ m, and between ds_5 and gland pore 26 μ m. Gnathosoma 88 μ m long, 51 μ m wide, length to width ratio about 1.7. GA 147 μ m long, 92 μ m wide (Fig. 6). GO 43 μ m long, 20 μ m wide; distance between anterior end of GO to that of GA 77 μ m, about 1.9 times of GO length. Nineteen PGS present around GO. Four pairs of SGS present; first, second and fourth pairs thin, while third pair thick and spur-type. Spermatopositor extending far beyond anterior PGS, distance between anterior end of spermatopositor and that of GO 50 μ m. Distance between posterior end of GO to that of GA 39 μ m.

Variability

In male paratype posterior tip of OC is much narrower than in holotype and other specimens (Figs 1 & 5).

Etymology

The specific name *corallicolus* alludes to 'the inhabitant of corals'.

Differential diagnosis

Copidognathus corallicolus sp. nov. is characterized by 3 areolae on AD; a pair of gland pores anterior to posterior areolae near lateral margin of AD; ds₁ anterior to posterior areolae on AD; ds₂ on membranous cuticle between AD and OC; ds₃-ds₅ on PD; PD with 2 costae; areolae and costae containing rosette pores; PD with 2 single-rosette-pore wide costae; panels on PD subdivided; a well-developed epimeral process I from coxal origin; the spermatopositor extending beyond anterior PGS; the tectum shortly triangular; the rostrum tip extending beyond P₃; trochanters III and IV with spiniform dorsomedial process; telofemora III and IV with 0:1 ventral seta; tibiae I-IV with 2, 2, 1, 1 pectinate ventral setae, respectively; 4:3 dorsal setae on tarsi III and IV; 2 basal setae on tarsus III apart from each other.

The present new species is allied with *C. lamelloides* Bartsch, 2000 known from the North Atlantic, the Mediterranean and Black sea (Bartsch, 2000 & 2001) and *C. hartwigi* Bartsch, 1979 from Bermuda, the Atlantic (Bartsch, 1979) and Indian Ocean (Sarma & Chatterjee, 1991). However, *C. corallicolus* is clearly distinguished by the following points. Gland pores on AD are apart from each other in *C. corallicolus*, while close to each other in *C. lamelloides* and *C. hartwigi*. Posterior areolae on AD of *C. corallicolus* are relatively larger than in the two species. Panels on dorsal plates are subdivided in the present species, while not subdivided in *C. lamelloides* and *C. hartwigi*. First and second pairs of female PGS are present above the anterior margin of GO in *C. corallicolus*, while only first pair are above the anterior margin of GO in *C. lamelloides* and *C. hartwigi*. Moreover, costae on PD are 1-rosette-pore wide, and rostrum tip goes beyond P₃ in the present species, while costae of PD 2-rosette-pores wide, and rostrum tip reaches only seta of P₂ in *C. lamelloides*. Areolae are present below second coxal region in *C. hartwigi*, while no areola found below second coxal region in *C. corallicolus*. Lateral claws are ventrally smooth in *C. hartwigi*, while fine pectines are present in *C. corallicolus*. *Copidognathus corallicolus* also resembles *C. attalus* Bartsch, 1999 from western Australia (Bartsch, 1999), *C. boraesus* Bartsch, 1992 from Moorea, Bora Bora, Society Islands, western Pacific (Bartsch, 1992), *C. brevipes* Viets, 1940 from the Mediterranean and Black Sea (Viets, 1940; Bartsch, 1975 & 2000; Morselli & Mari, 1985), *C. leptus* Bartsch, 2002 from Great Meteor Seamount, northeastern Atlantic (Bartsch, 2002), *C. tabellio* (Trouessart, 1894) from the North Atlantic, the Mediterranean and Black Sea (Trouessart, 1894, 1901b; André, 1946; Bartsch, 2000). *Copidognathus corallicolus* is distinguished from all the species above by pectinate ventromedial seta on tibia IV. Moreover, the new species has ds₂ on membranous cuticle, while *C. brevipes* and *C. tabellio* have ds₂ on OC.

Copidognathus falcifer Viets, 1940 from the Adriatic Sea (Viets, 1940) also resembles *C. corallicolus*, but differs from it on the following points: posterior areolae on AD of *C. corallicolus* are relatively longer than that of *C. falcifer*; ds₂ situated on OC in *C. falcifer* (cf. Viets, 1940, Fig. 63), while on membranous cuticle in the present new species; costae on PD are relatively wider in *C. falcifer*; rostrum tip reach the end of P₂ in *C. falcifer*, while it extends beyond P₃ in *C. corallicolus*; the distance between anterior margin of female GO to that of GA is about 1.3 in *C. falcifer* (cf. Viets, 1940, Fig. 64), while 2.2 in *C. corallicolus*; both first and second pairs of female PGS are situated above the anterior margin of GO in *C. corallicolus*, while only first pair are above the anterior margin of GO in *C. falcifer*.

Copidognathus fungiae sp. nov.
(Figs. 11-23)

Material examined

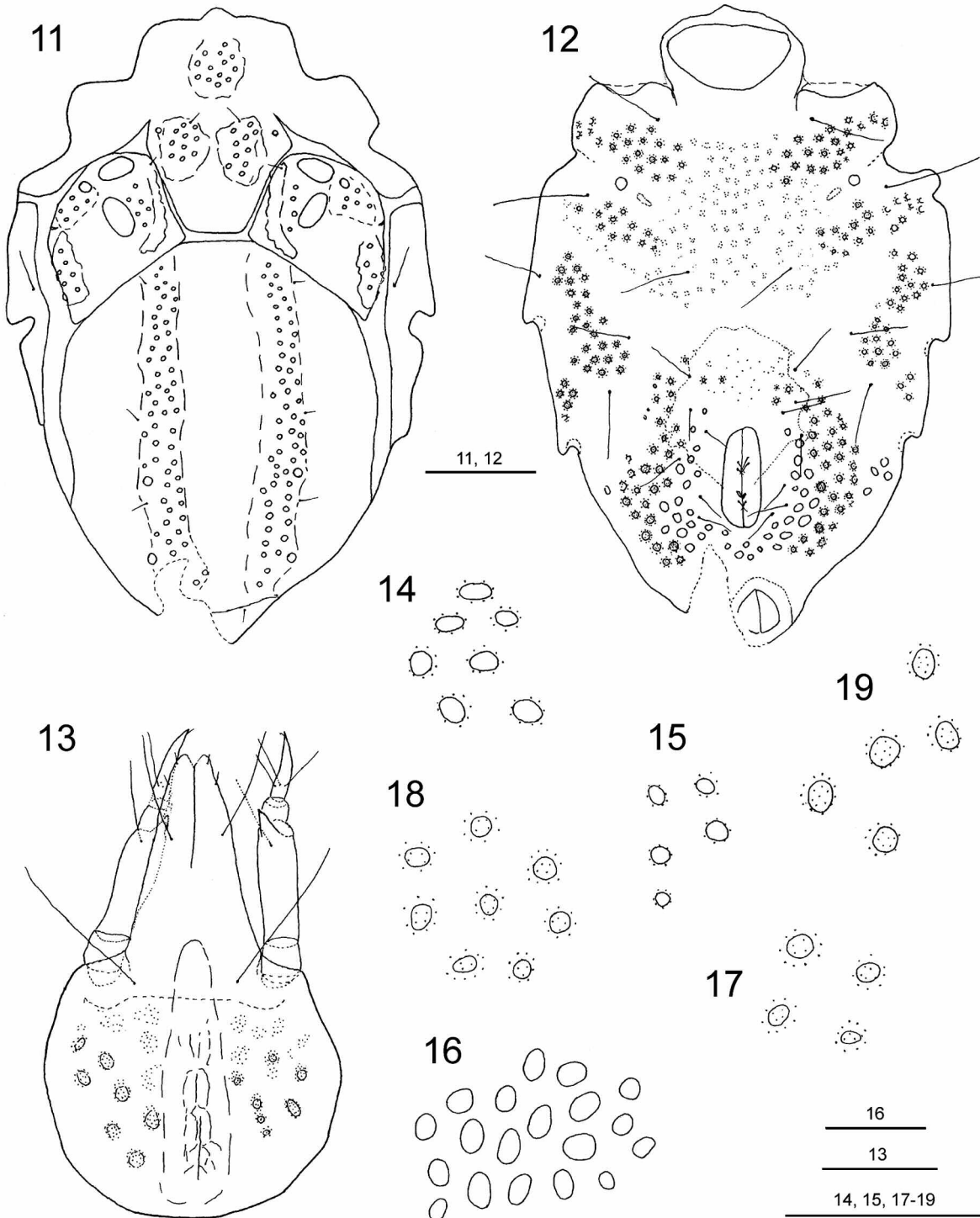
Holotype: male, Matemwe, the east coast of Unguja, Zanzibar (among coralline sediments of *Fungia*), 17 August 2004 (leg. M. Raes & H. Gheerardyn). Paratype: one male, collection data same as in holotype.

Description of holotype male

Idiosoma (Figs 11 & 12) 294 µm long, 194 µm wide. AD, OC and PD separate. Rosette pores on areolae of dorsal plates with prominent ostium; canaliculi faint at deeper integumental layer (Figs. 14, 15). AD 105 µm long, 64 µm wide, length to width ratio about 1.6; with 3 areolae; anterior areola with 13 rosette pores, paired posterior areolae with 10-11 rosette pores each (Figs 11, 14). Remainder of plate panelled. Paired ds₁ anterior to posterior areolae on AD; pair of gland pores lateral to posterior areolae.

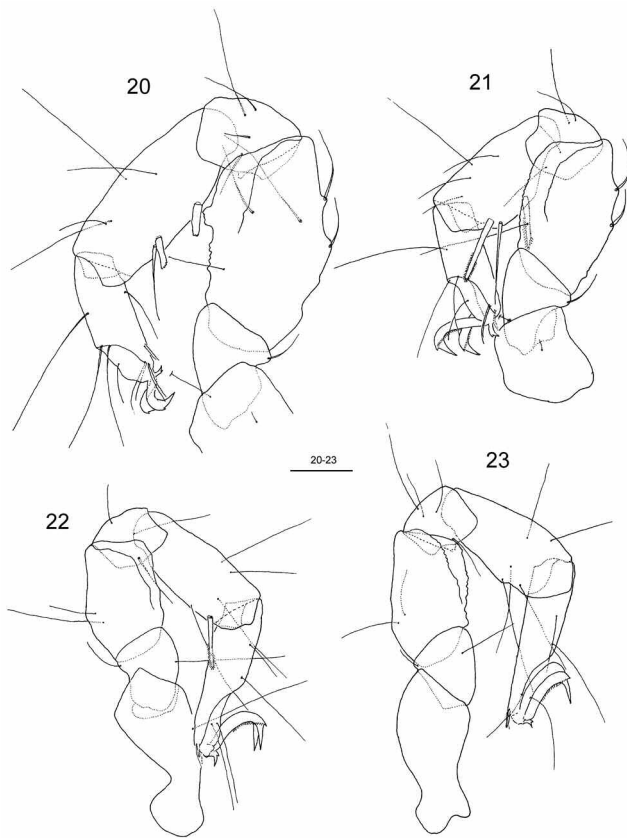
OC 84 µm long, 62 µm wide; length to width ratio about 1.35; with 2 large corneae; rosette pores present on medial and lateral to corneae and on posterolateral parts of OC; gland pore lateral to anterior cornea; pore canalicula present nearly on lateral margin of OC between 2 areolae; rest of OC with panels; ds₂ located at anteromedial corner of OC. Brownish pigment found near corneal zone.

PD 155 µm long, 146 µm wide; paired costae 2- to 3-rosette-pores wide; remainder of plate panelled, panels between two costae not subdivided (Fig. 16); 1 or 2 (few) panels between costae and lateral margin of PD subdivided; ds₃-ds₅ along lateral margin of costae on PD, distance between ds₃ and ds₄ 61 µm, and between ds₄ and ds₅ 43 µm. Two pairs of gland pores present: 1 pair anterior to ds₅, other pair posterior to ds₅ on lateral side of costa. Membranous cuticle between AD, OC and PD very narrow. Anal setae (ds₆) located on dorsal side of anal cone.



Figures 11-19. *Copidognathus fungiae* sp. nov., male. **11.** Idiosoma, dorsal. **12.** Idiosoma, ventral. **13.** Gnathosoma. **14.** Part of posterior areola on AD. **15.** Part of costa on anterior half of PD. **16.** Panels between two costae. **17.** Part of areola below coxa I. **18.** Part of areola on PE. **19.** Part of perigenital areola, posterior side. Scale bars: 11, 12 = 50 µm; 13-19 = 20 µm.

Figures 11-19. *Copidognathus fungiae* sp. nov., mâle. **11.** Idiosome, vue dorsale. **12.** Idiosome, vue ventrale. **13.** Gnathosome. **14.** Partie de l'areola postérieure sur AD. **15.** Partie de la côte sur la moitié antérieure du PD. **16.** Panneaux entre deux côtes. **17.** Partie de l'areola sous le coxa I. **18.** Partie de l'areola sur PE. **19.** Partie de l'areola périgénitale, côté postérieur. Échelles: 11, 12 = 50 µm; 13-19 = 20 µm.



Figures 20-23. *Copidognathus fungiae* sp. nov., male. Legs I-IV. Scale bars = 20 μ m.

Figures 20-23. *Copidognathus fungiae* sp. nov., mâle. Pattes I-IV. Échelles = 20 μ m.

All ventral plates fused (Fig. 12). Ventral shield 258 μ m long. Area representing AE containing 3 pairs of setae. Porose areolae (Figs 12 & 17) present below first and second coxal regions on AE. PE area with ventral and marginal areolae (Figs 12 & 18); with 3 ventral and 1 dorsal setae. GO 45 μ m long, 18 μ m wide; spermatopositor large, 82 μ m long, extending beyond anterior PGS; with 6 PGS on left side and 7 PGS on right side of GA. Four pairs of SGS present; first, second and fourth pairs thin, while third pair thick and spur-type. Porose areolae present at paragenital area (Figs. 12, 19).

Gnathosoma (Fig. 13) 93 μ m long, 59 μ m wide. Palp consisting of 4 segments. Palp a little surpassing anterior end of rostrum. P_1 and P_3 devoid of any seta. P_2 with dorsal seta distally and spinular lamella protrusion ventrodistally. P_4 with 3 long proximal setae and 1 minute distal seta. Proto- and deuterostral setae situated at tip of rostrum; tritrostral setae located at anterior half of rostrum; gnathosomal base with a pair of setae (basirostral setae). Distance between tritrostral seta and tip of rostrum 17 μ m; distance between tritrostral seta and basirostral seta 29 μ m. Rostral

sulcus extending backward beyond tritrostral setae. Gnathosomal base dorsally panelled, ventrolaterally porose (some parts with shallower foveae, canaliculi in dipper integumental layer; while some parts contain only canaliculi in groups). Tectum truncate.

Chaetotaxy of legs (Figs 20-23): trochanter 1-1-1-0; basifemur 2-2-2-2; telofemur 5-5-2-2; patella 4-4-3-4; tibia 7-7-5-5; tarsus (PAS excluded) 7-4-4-4. Telofemora I-IV each with ventromedial and ventrolateral lamella. Medial edge of ventrolateral lamella on telofemur I slightly protruding. Small articulating lamellae present on tibiae I-IV. Tibia I with 3 ventral setae (1 long, pointed ventral seta and 2 thick, smaller ventromedial setae with anterior tip delicately serrated). Tibia II with 1 long, pointed ventral seta and 2 thick, pectinate ventromedial setae (proximal seta shorter than distal seta). Tibia III with 1 thick, pectinate ventromedial seta. All setae of tibia IV smooth. Tarsus I with 3 dorsal setae, 1 solenidion (14 μ m long), 3 ventral setae and 2 doublets eupathid PAS. Tarsus II with 3 dorsal setae, 1 solenidion (15 μ m long) and 2 doublets eupathid PAS. Distance between 2 basidorsal setae of tarsi III and IV less than height of the segment, proximal basal seta smaller than distal basal seta. All legs with 2 lateral claws and 1 bidentate median claw. Lateral claws with accessory process dorsally. Lateral claws of tarsi II-IV with ventral pecten.

Etymology

The specific name is taken from the *Fungia* coral, where the new species was found.

Differential diagnosis

There are many species groups in the genus *Copidognathus*. One of such groups is *C. bairdi* Newell, 1947 group (Newell, 1947; Bartsch, 1984 & 1997). Bartsch (1997) subdivided the *bairdi* group into five subgroups viz. *bairdi* group s. str., *ornatus* group, *spinula* group, *tamaeus* group and *gibberipes* group. The present species belongs to *tamaeus* group. Main characteristics of *tamaeus* group are: palps short, hardly surpassing the rostrum; P_2 with spinular lamella; telofemur I often with spinular ventral lamella; tibia I with 2 blunt spurs with spinose tips (Bartsch, 1997). Three species are known in *C. tamaeus* Bartsch, 1992 group so far: *C. tamaeus* Bartsch from Moorea, Bora Bora, Society Islands, western Pacific (Bartsch, 1992), and Andaman Islands, Indian Ocean (Chatterjee, 1996), *C. malaysius* Bartsch, 1993 from Archipelago Tioman, eastern coast of Malaysia (Bartsch, 1993), *C. elaboratus* Bartsch 1997 from northern Australia (Bartsch, 1997).

Anterior part of PD is relatively broader in *C. elaboratus* and *C. malaysius*. Costae on PD are 2- to 3-rosette-pores wide in *C. fungiae*, while only 1-rosette-pore wide in *C. tamaeus*. The length to width ratio of AD is about 1.6 in

C. fungiae, while about 1.2 in *C. malaysius*. Lateral claws of tarsi II-IV are smooth in *C. elaboratus*, while pectinate in *C. fungiae*. Panels between two costae on PD are subdivided, and ventrolateral lamella on telofemur I is very small in *C. elaboratus*, while panels between two costae are not subdivided, and ventrolateral lamella is relatively more developed in *C. fungiae*. *Copidognathus tamaeus* has very small posterior areolae on AD, while *C. fungiae* has relatively wider ones. Posterolateral areola is present on OC in *C. fungiae*, while absent in *C. tamaeus*. Porose areolae are present below first coxa, second coxa, and PE area in *C. fungiae*, while the areolae are absent in *C. malaysius*. Moreover, *C. fungiae* can be distinguished from the three species of the *tameus* group by having rosette pores below first coxa, second coxa and PE area.

***Copidognathus ungujaensis* sp. nov.**
(Figs. 24-32)

Material examined

Holotype: male, Matemwe, the east coast of Unguja, Zanzibar (among coralline sediments of *Fungia*), 17 August 2004 (leg. M. Raes & H. Gheerardyn). Paratypes: one female, one male, collection data same as in holotype. Additional materials: five males, one female, collection data same as in holotype; two males, one female Makunduchi, the east coast of Unguja, Zanzibar (among coralline sediments), 17 August 2004 (leg. M. Raes & H. Gheerardyn).

Description of holotype male

Idiosoma (Figs 24 & 25) 304 μm long, 182 μm wide. All dorsal plates separate. Areolae on dorsal plates with prominent ostium and canaliculi. Anterior half of AD joining with dorsal part of AE. AD 105 μm long, 69 μm wide. AD with frontal process and 4 areolae; anterior areola elongate with about 13 rosette pores; 2 middle areolae large with about 20 rosette pores each; posterior areola marginal with 12 rosette pores. Paired ds_1 anterior to middle areolae on AD; pair of gland pores lateral to middle areolae.

OC 86 μm long, 56 μm wide, length to width ratio of OC about 1.5; with 2 large cornea; areolae present both medial and lateral to cornea and in posterior part of OC; gland pore lateral to anterior cornea; pore canalicula present nearly on lateral margin of OC, posterior to lateral areola; ds_2 near anterior margin of OC.

PD 195 μm long and 132 μm wide, narrowing anteriorly; paired middle costae 2-rosette-pores wide, paired lateral costae 1- or 2-rosette-pores wide. Each rosette pore with a big ostium and 7-12 canaliculi in and around it. Rest of plate containing panels, each panel subdivided (Fig. 26); ds_3 - ds_5 situated on PD, lateral to middle costae; distance between ds_3 and ds_4 61 μm , and ds_4 to ds_5 43 μm . Two pairs of gland

pores present posterior to ds_5 on middle costa of PD.

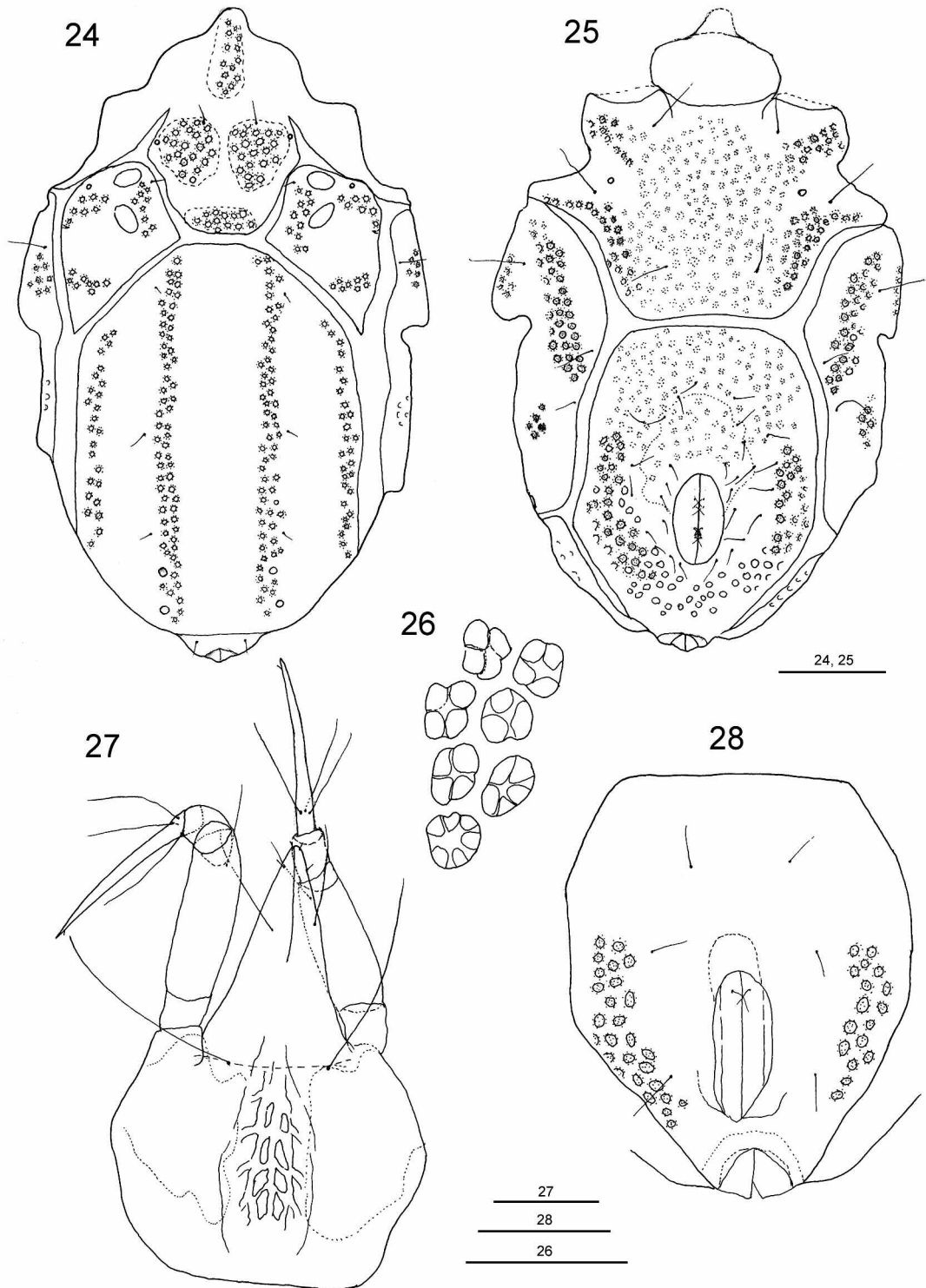
All ventral plates separate (Fig. 25). AE 101 μm long and 152 μm wide. AE with 2 pairs of areolae below first and second coxal area; 3 pairs of ventral setae and a pair of epimeral pores present. PE with 3 ventral and 1 dorsal setae; with ventral, lateral and dorsal areolae. GA 152 μm long, 110 μm wide. GO 44 μm long, 24 μm wide. Distance between anterior end of GO to that of GA 51 μm , about 1.6 times of GO length. Twenty nine PGS present; anterior one 27 μm apart from anterior margin of GA, just anterior to anterior margin of spermatopositor. Spermatopositor extending 38 μm ahead from anterior margin of GO. Four pairs of SGS present. Distance between posterior end of GO and that of GA 40 μm .

Gnathosoma (Fig. 27) 89 μm long, 59 μm wide. Palp consisting of 4 segments. P_1 and P_3 devoid of any seta. P_2 with 1 dorsal seta distally. P_4 with 3 long proximal setae and 1 minute distal seta. Proto- and deutorostral setae situated at tip of rostrum; tritorostral setae located anterior half of rostrum; gnathosomal base with a pair of setae (basirostral setae). Distance between tritorostral seta and tip of rostrum 18 μm ; distance between tritorostral seta and basirostral seta 29 μm . Rostral sulcus extending beyond tritorostral setae, about 0.62 of total rostrum length. Gnathosomal base ventrolaterally porose. Tectum almost truncate.

Chaetotaxy of legs (Figs 29-32): trochanter 1-1-1-0; basifemur 2-2-2-2; telofemur 5-5-2-2; patella 4-4-3-4; tibia 7-7-5-5; tarsus (PAS excluded) 7-4-4-4. Telofemur I with ventromedial ridge and very narrow outermost ventrolateral lamella. Telofemur III shorter than telofemur IV. Telofemora III and IV devoid of ventral seta. Tibia I with 2 long, smooth, pointed distoventral setae and 1 short, thick proximoventral seta. Tibia II with 1 slender, smooth ventral seta and 2 ventromedial bipectinate setae (distal bipectinate seta longer than proximal seta). Tibia III with 1 thick, pectinate ventromedial seta. All setae of tibia IV smooth. Tarsus I with 3 dorsal setae, 1 solenidion, 3 ventral setae and 2 doublets eupathid PAS. Tarsus II with 3 dorsal setae, 1 solenidion and 2 doublets eupathid PAS. Distance between 2 basidorsal setae of tarsi III and IV less than height of tarsus. All legs with 2 lateral claws and 1 bidentate median claw. Lateral claws with accessory process dorsally. Lateral claws II-IV with ventral pecten.

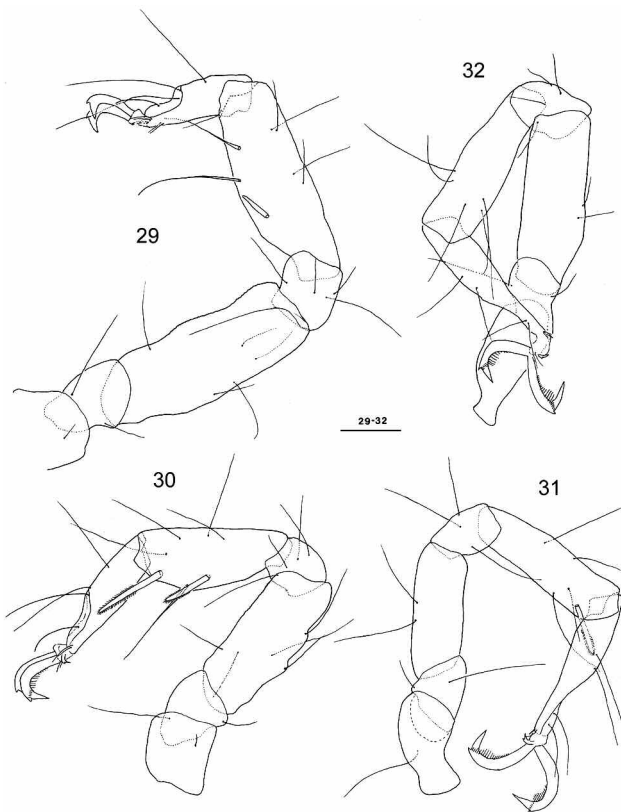
Female

Idiosoma 284 μm long. GA 160 μm long, 128 μm wide (Fig. 28). GO 56 μm long, 22 μm wide; distance between anterior end of GO to that of GA 75 μm , about 1.3 times of GO length. Three pairs of PGS present. First two pairs above anterior margin of GO, third pair beside posterior part of GO. Pair of SGS present at anterior part of GO. Ovipositor short. Distance between posterior end of GO to that of GA 30 μm .



Figures 24-28. *Copidognathus ungujaensis* sp. nov., male: 24-27; female: 28. **24.** Idiosoma, vue dorsale. **25.** Idiosoma, ventral. **26.** Panels between two costae. **27.** Gnathosoma. **28.** GA of female. Scale bars: 24, 25, 28 = 50 μm ; 26, 27 = 20 μm .

Figures 24-28. *Copidognathus ungujaensis* sp. nov., mâle: 24-27; femelle: 28. **24.** Idiosome, vue dorsale. **25.** Idiosome, vue ventrale. **26.** panneaux entre deux côtes. **27.** Gnathosome. **28.** GA of femelle. Échelles: 24, 25, 28 = 50 μm ; 26, 27 = 20 μm .



Figures 29-32. *Copidognathus ungujaensis* sp. nov., male. Legs I-IV. Scale bars = 20 μ m.

Figures 29-32. *Copidognathus ungujaensis* sp. nov., mâle. Pattes I-IV. Échelle = 20 μ m.

Variability

In a few specimens, middle of tectum was shown as very small protuberance like a projection.

Differential diagnosis

In having the characteristics of 4 longitudinal costae with rosette pores and 2 pairs of prominent gland pores on PD, patella IV with 4 setae, palps surpassing the rostrum, ventral setae of tibia IV smooth, tarsi III-IV with 4 dorsal setae, *Copidognathus ungujaensis* sp. nov. should be designated as a member of *C. bairdi* group *s. str.* (Bartsch, 1997). Among the congeners of this group, the present species is very closely related to *C. sidellus* Bartsch, 1985 from Philippines (Bartsch, 1985), but differs from it on the following points: anterior areola on AD is more elongated in *C. ungujaensis*; posterior two gland pores on PD are close to each other in *C. sidellus*, while about 2 rosette pores are present between gland pores in *C. ungujaensis*; areola is present below second coxal region in *C. ungujaensis*, while absent in *C. sidellus*; anterior margin of PD is concave in *C. sidellus*, while almost flat in *C. ungujaensis*;

lateral and middle costae do not join anteriorly in *C. ungujaensis*, while they join in *C. sidellus*.

Four species of *C. bairdi* group were recorded from adjacent areas viz. *C. africanus* Bartsch from South Africa and Tanzania (Bartsch, 1972; Konnerth-Ionescu, 1977); *C. frontispinus* Bartsch, 1972 from South Africa (Bartsch, 1972); *C. sideus* Bartsch, 1982 from Mozambique (Bartsch, 1982) and India (Chatterjee & Sarma, 1993); *C. arabicus* Chatterjee & Chang, 2004 from India (Chatterjee & Chang, 2004).

Copidognathus africanus, *C. frontispinus* and *C. sideus* can be distinguished from *C. ungujaensis* by having ds_5 posterior to anterior gland pores on PD. In males of *C. africanus* all ventral plates are fused, while separated in *C. ungujaensis*. *Copidognathus frontispinus* has bean-shaped middle areolae on AD. Length to width ratio of AD is about 0.9 in *C. sideus*, while 1.5 in *C. ungujaensis*.

Posterior areolae on AD are away from each other in *C. arabicus*, while bigger and close each other in *C. ungujaensis*. Middle costae of PD are 3-rosette-pores wide in *C. arabicus*, while 2-rosette-pores wide in *C. ungujaensis*. Lateral and middle costae do not join anteriorly in *C. ungujaensis*, while they join in *C. arabicus*. Moreover, nature of rosette pores on dorsal plates are different between the two species, in *C. arabicus* only the ostium is present, and canaliculi are not visible in each rosette pores, but in *C. ungujaensis* there are prominent canaliculi around the ostium.

Remarks

Many specimens were infested by suctorians.

Acknowledgements

Thanks are due to PhD students Maarten Raes and Hendrik Gheeardyn (Ghent University, Belgium) for collecting material from Zanzibar and thesis students Ruth Teerlynck and Katia Guilini (Ghent University, Belgium) for sorting halacarids from the samples. The sampling campaign was organized within the frame of a research programme of the Fund for Scientific Research (FWO-Flanders, Belgium). The last author (CYC) thanks Dr. Bartsch for providing numerous references. We are grateful to two anonymous reviewers who made valuable suggestions for improvement of the manuscript. The first author (TC) is indebted to the Brain Pool Program, Korea. The second author (MDT) acknowledges a post-doctoral fellowship from the FWO-Flanders, Belgium.

References

- André M. 1938a.** Description de six halacariens de la Mer Rouge. 1^{ère} partie. *Bulletin du Muséum d'Histoire Naturelle*, **10**: 57-63.
André M. 1938b. Description de six halacariens de la Mer Rouge.

- 2^{ème} partie. *Bulletin du Muséum d'Histoire Naturelle*, **10**: 166-172.
- André M. 1946.** Halacariens marins. *Faune de France*, **46**: 1-152.
- André M. 1959.** Acari. I. Contribution à l'étude des Halacariens de la Mer Rouge. *Mission Robert Ph. Dollfus en Egypte*, **26**: 93-119.
- Bartsch I. 1972.** Halacaridae (Acari) aus Südafrika. *Mitteilungen aus dem hamburgischen zoologischen Museum und Institut*, **69**: 5-32.
- Bartsch I. 1975.** Beitrag zur Halacaridenfauna des Eulitorals bei Banyuls-sur-Mer (Mittelmeer) (Halacaridae, Acari). *Mitteilungen aus dem hamburgischen zoologischen Museum und Institut*, **72**: 137-155.
- Bartsch I. 1979.** *Copidognathus hartwigi* n. sp. (Halacaridae, Acari), eine Meeremilbe neu für die Fauna Bermudas. *Acarologia* **20**: 93-96.
- Bartsch I. 1981.** Halacaridae (Acari) aus dem Kanal von Moçambique. *Cahiers de Biologie Marine*, **22**: 35-63.
- Bartsch I. 1982.** Weitere Halacaridae (Acari) aus dem Kanal von Moçambique. *Cahiers de Biologie Marine*, **23**: 435-457.
- Bartsch I. 1984.** New species of the *bairdi* group in the genus *Copidognathus* (Acari, Halacaridae). *Bulletin of Marine Science*, **35**: 199-210.
- Bartsch I. 1985.** Zur Halacaridenfauna (Halacaridae, Acari) der Philippinen Beschreibung von drei neuen Arten. *Mitteilungen aus dem hamburgischen zoologischen Museum und Institut*, **82**: 269-277.
- Bartsch I. 1992.** Halacariden von den Inseln Moorea und Bora Bora, Gesellschaftsinseln, Polynesien (Arachnida: Acari). *Senckenbergiana biologica*, **72**: 465-488.
- Bartsch I. 1993.** Halacaridae (Acari) von Malaysia Beschreibung von drei Arten der Gattung *Copidognathus*. *Entomologische Mitteilungen Zoologischen Museum, Hamburg*, **11**: 45-58.
- Bartsch I. 1997.** Copidognathinae (Halacaridae, Acari) from Northern Australia. Description of four new species. In: *Proceedings of the sixth international marine biological workshop. The Marine Flora and Fauna of Darwin Harbour, Northern Territory, Australia* (J.R. Hanley, G. Caswell, D. Megirian & H.K. Larson eds), pp. 231-243.
- Bartsch I. 1999.** Halacaridae (Acari) from Western Australia. Four species of *Copidognathus*. In: *The seagrass Flora and Fauna of Rottmest Island, Western Australia* (D. I. Walker & F. E. Wells eds). Western Australian Museum, Perth, pp. 315-331.
- Bartsch I. 2000.** *Copidognathus lamelloides* sp. n. (Copidognathinae, Halacaridae, Acari), a new species from European waters. *Entomologische Mitteilungen Zoologischen Museum, Hamburg*, **13**: 219-228.
- Bartsch I. 2001.** Black Sea Copidognathinae (Arachnida, Acari, Halacaridae): a review. *Mitteilungen aus dem Museum für Naturkunde in Berlin, Zoologische Reihe*, **77**: 247-275.
- Bartsch I. 2002.** Halacaridae (Acari) from the Great Meteor Seamount (Northeastern Atlantic): description of two new *Copidognathus* species. *Entomologische Mitteilungen Zoologischen Museum, Hamburg*, **14**: 71-82.
- Chatterjee T. 1996.** Record of *Copidognathus tamaeus* Bartsch (Halacaridae: Acari) from the Indian Ocean. *Journal of the Marine Biological Association of India*, **38**: 141-143.
- Chatterjee T. & Chang C.Y. 2004.** Two new *Copidognathus* halacarids (Acari: Halacaridae) from Mumbai coast of India (Arabian Sea). *Italian journal of Zoology*, **71**: 265-269.
- Chatterjee T. & De Troch M. 2000.** Halacaridae (Acari) from Gazi Bay (Kenya): description and biogeography of three new and two new species. *Hydrobiologia*, **427**: 177-194.
- Chatterjee T. & Sarma A.L.N. 1993.** Occurrence of *Copidognathus sideus* Bartsch, 1982 (Halacaridae: Acari) from Indian Ocean. *Journal of the Bombay Natural History Society*, **90**: 304-308.
- Gimbel O. 1919.** Über einige neue Halacariden. *Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut*, **36**: 105-130.
- Konnerth-Ionescu A. 1977.** Marine Acari (Arachnida, Acari) from the littoral waters of Tanzania. *Travaux du Muséum d'Histoire Naturelle 'Grigore Antipa'*, **18**: 67-71.
- Lohmann H. 1893.** Die Halacarinen der Plankton-Expedition. In: V. Hensen, Ergebnisse der in den Atlantischen Ocean von Mitte Juli bis Anfang November 1889 aus geführten Plankton Expedition der Humboldt Stiftung, **1-5, 2(G.a B)**: 15-95.
- Morselli I & Mari M. 1985.** Ricerche sugli alacaridi della coste livornesi, IV. Osservazioni su alcune specie raccolte su fondi sabbiosi della zona di piombino. *Atti della Società di Scienze Naturali, Memorie, Serie B*, **91**: 201-220.
- Morselli I. & Mari M. 1986.** Researches on the coast of Somalia. The shore and the dune of Sar Uanlea. 39. On three interstitial species of Halacaridae (Acari). *Monitore zoologico Italiano, N.S. supplemento*, **21**: 137-148.
- Newell I.M. 1947.** A systematic and ecological study of the Halacaridae of eastern North America. *Bulletin of the Bingham Oceanographic Collection*, **10**: 1-232.
- Sarma A.L.N. & Chatterjee T. 1991.** Occurrence of *Copidognathus hartwigi* Bartsch (Halacaridae: Acari) from Indian Ocean. *Journal of the Bombay Natural History Society*, **88**: 300-302.
- Trouessart E. 1894.** Note sur les acariens mariens (Halacaridae) récoltés par M. Henri Gadeau de Kerville sur le littoral du département de la Manche (Juillet-Aout 1893). *Bulletin de la Société des amis des sciences naturelles, Rouen*, **9**: 139-175.
- Trouessart E. 1899.** Description d'espèces nouvelles d'Halacaridae. *Bulletin de la Société d'études scientifiques d'Angers*, **29**: 209-227.
- Trouessart E. 1901a.** Description d'espèces nouvelles d'Halacaridae (2^e note). *Bulletin de la Société Zoologique de France*, **26**: 145-150.
- Trouessart E. 1901b.** Note sur les acariens marins (Halacaridae) récoltés par M. Henri Gadeau de Kerville dans la région d'Omonville-la-Rogue (Manche) et dans la fosse de la Hague (Juin-Juillet 1889). *Bulletin de la Société des amis des sciences naturelles, Rouen*, **4**: 247-266.
- Viets K. 1940.** Meeremilben aus der Adria (Halacaridae und Hydrachnellae, Acari). *Archiv für Naturgeschichte (Neue Folge)*, **9**: 1-135.