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A new genus of paralcyoniid soft corals (Octocorallia, Alcyonacea, Paralcyoniidae) from the Indo-West Pacific

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Abstract: A new genus of paralcyoniid soft corals (Octocorallia: Paralcyoniidae) from the Indo-West Pacific is described and named *Ceeceenus*. The new genus is compared with the related genera *Paralcyonium* Milne Edwards, 1850 and *Studeriotes* Thomson & Simpson, 1909. Four new species are described and included in the new genus. They were found in Thailand, Japan, Palau, Papua New Guinea and Tonga.

Key words: New genus. New species. Coelenterata. Cnidaria. Octocorallia. Alcyonacea. Paralcyoniidae. Indo-West Pacific.

INTRODUCTION

Recently a number of octocoral specimens have been collected in the Indo-West Pacific, which resemble the genus *Paralcyonium*, a genus only known to occur in the Mediterranean and East Atlantic, with only one representative, *P. spinulosum* (Delle Chiaje, 1822). This species has a remarkable colony growth form among octocorals, with a distinctive capsule-like base (pedicel) into which the trunk and branches can be withdrawn. Species of the Indo-Pacific genus *Studeriotes* Thomson & Simpson, 1909, have a similar growth form but differ from *P. spinulosum* in having polyps with a supporting bundle, and lacking platelet-like sclerites. Moreover, colonies of *Studeriotes* are generally large in size while *Paralcyonium* colonies remain rather small. The present specimens are small (Figs. 1a-g), resemble *P. spinulosum* in colony growth form, have platelet-like sclerites, and lack a supporting bundle in the polyps, and therefore can be considered as being related to *Paralcyonium*. For a description of *P. spinulosum* we refer to Weinberg (1977, page 156).

All material from the Indo-Pacific differs from *Paralcyonium* in having tentacular rods; *Paralcyonium* has no sclerites at all in the tentacles. As this character is normally only used to differentiate between species in soft corals, assigning the present material to *Paralcyonium* would at first seem justified. However, very few octocoral genera have been reported with a distribution of Mediterranean, Atlantic, and Indo-Pacific, and so far no specimens of these new taxa have been found from between the Atlantic and Thailand. This disjunct distribution pattern suggests the possibility we are dealing with a closely related new genus. Therefore, we decided to compare not only colony form and sclerites, but also the ultrastructure of the sclerites and molecular data.

We compared the ultrastructure of the sclerites of a specimen of *P. spinulosum* from Naples, Italy (RMNH Coel. 2987) (Fig. 2) with that of the material from Thailand. The two show a noticeably different ultrastructure, but are essentially built of similar lattice; i.e., in both the crystals flare towards the sclerite surface. It is noteworthy that in all material there seems to

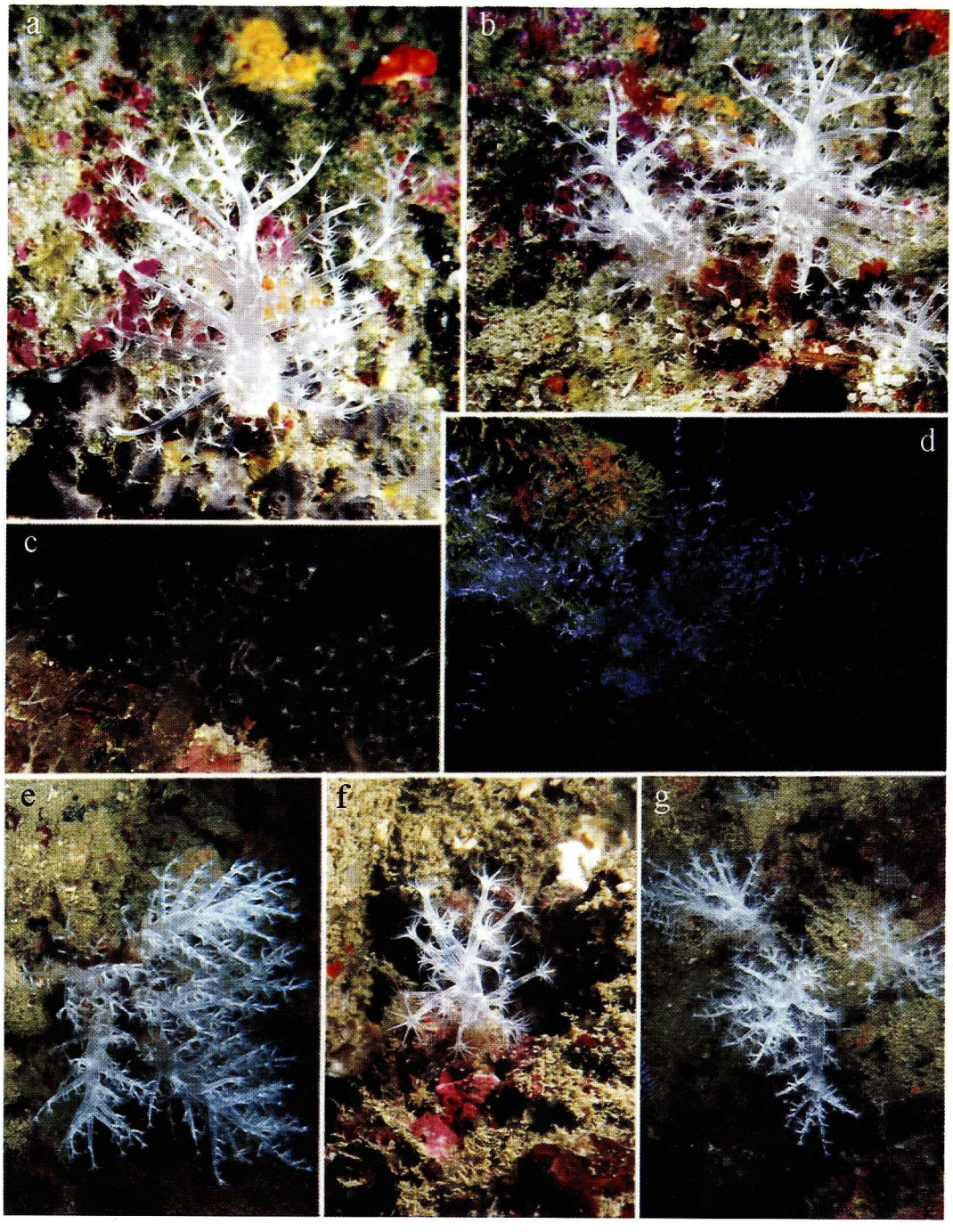

Fig. 1. Live colonies; a-b, *Ceeceenus quadrus* spec. nov.; c-d, *C. torus* spec. nov., c, from Palau, d, from Papua New Guinea; e-g, *C. levis* spec. nov.

be a correlation between sclerite size and crystal shape. *P. spinulosum* has slightly larger sclerites and the larger spindles of the Indo-Pacific material (Fig. 3g) have similar ultrastructure as the medium sized sclerites of *P. spinulosum* (Fig. 2e).

Dr. Catherine S. McFadden (Harvey Mudd College, Claremont, USA) kindly sequenced two mitochondrial genes, msh1 and ND2, for two specimens from Thailand, and compared the sequences with those of *Studeriotes* spec. and *P. spinulosum*. According to her they group closest to *Paralcyonium* in the tree, but they are quite distinct and lie intermediate between *Paralcyonium* and *Studeriotes*.

As the observed sclerite differences were rather small, and the molecular data were only based on

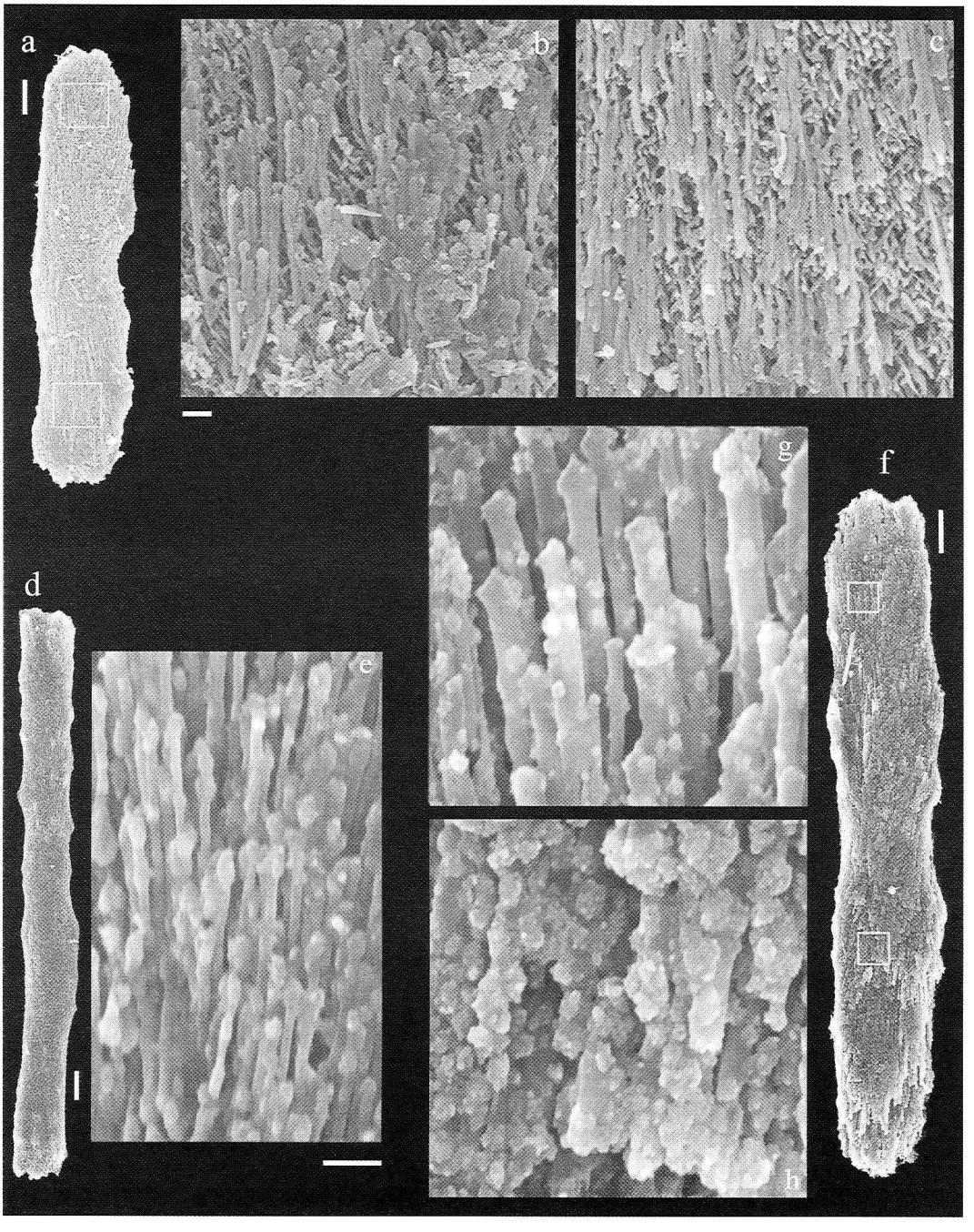

Fig. 2. *Paralcyonium spinulosum* (Delle Chiaje, 1822), RMNH Coel. 2987; three platelets (a, d, f) with ultrastructure (b-c, e, g-h). Scale of platelets 0.01 mm, scales of ultrastructure 0.001 mm.

two specimens, Ofwegen et al. (2004) presented the above findings during the 10th International Coral Reef Symposium, Okinawa, Japan, on a poster entitled "The genus *Paralcyonium* (Octocorallia: Paralcyoniidae) in the Indo-West Pacific", presenting four new species of *Paralcyonium*.

During this conference Pat Colin (Coral Reef Research Foundation, Palau) informed us that he had seen similar colonies to those examined in the current study on Palau and offered to collect some. In addition, after the conference Gustav Paulay (Florida Museum of Natural History, Gainesville, Florida, USA) collected more material from Okinawa.

Using the new material from Palau we once more examined the ultrastructure of the sclerites (Fig. 3); the observed structure was identical to that of the Thai material.

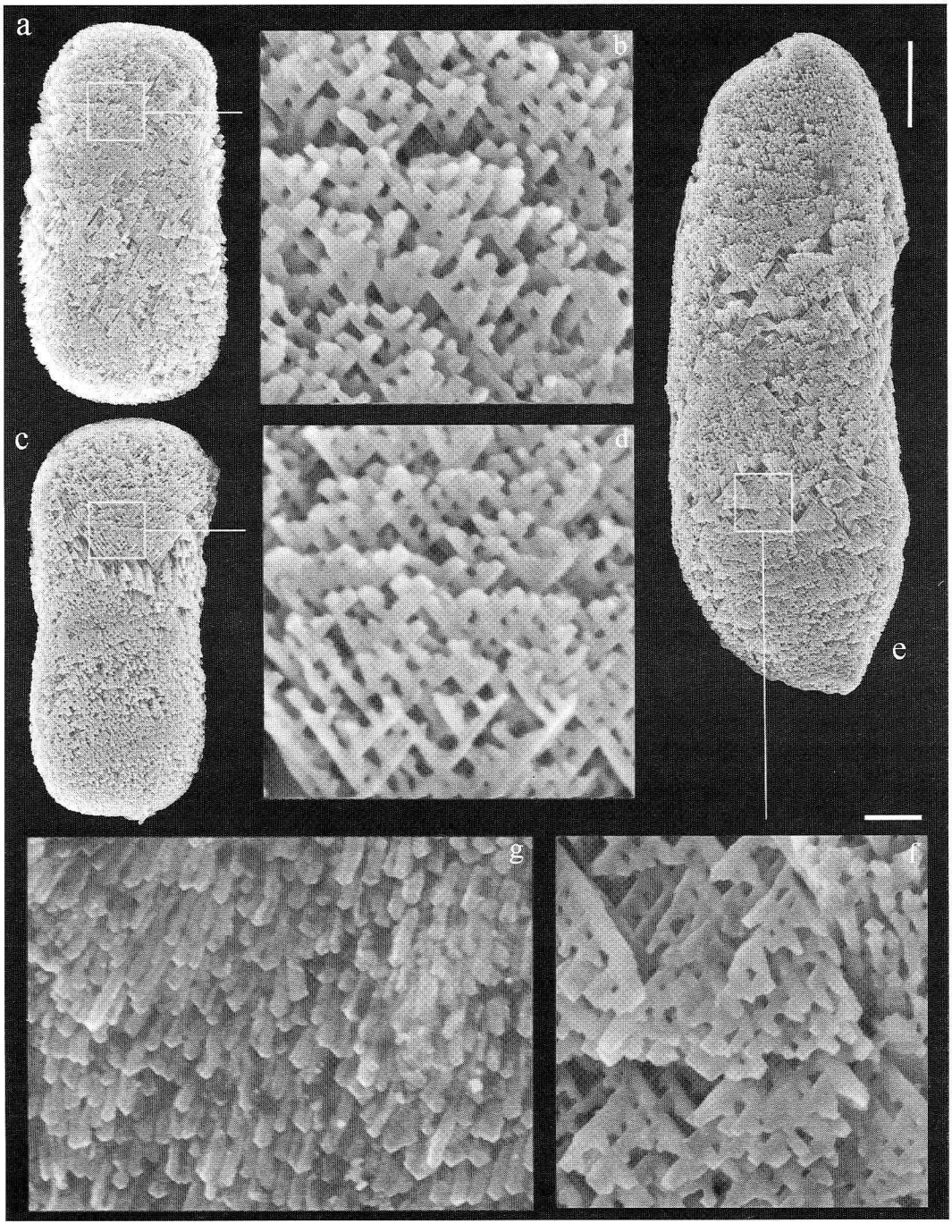

Fig. 3. *Ceeceenus torus* spec. nov., paratype RMNH Coel. 33679; three platelets (a, c, e) with ultrastructure (b, d, f) and pedicel spindle ultrastructure (g). Scale of platelets 0.01 mm, scale of ultrastructure 0.001 mm.

This recent collected material also allowed Dr. McFadden to sequence the Palau and Okinawan material using the msh1 gene. All three species involved proved to have identical sequences. To this Dr. McFadden added "msh1 is relatively invariant among species within most of the genera in this clade (Paralcyoniidae/ Nephtheidae), so the relatively large distance between the new paralcyoniids and *P. spinulosum* suggests a new genus" (pers. comm.).

Additionally, Wirshing et al. (2005), dealing with a molecular study of the octocoral family Plexauridae stated: "In several instances, genera containing Atlantic and Pacific species were recovered as monophyletic (*Muricea* spp., *Bebryce* spp.). However, in at least three cases (*Echinomuricea*

spp., *Thesea* spp., *Villogorgia* spp.), placement of Atlantic and Pacific species in the same genus may reflect convergence of sclerite morphology".

In light of these new molecular data, constant difference in sclerite ultrastructure, different tentacular armature, and disjunct distribution, we decided to describe a new genus for the Indo-Pacific material, rather than assigning it to *Paralcyonium*. The new genus and four new species are described and depicted below. A key to the species of the new genus and *P. spinulosum* is presented.

MATERIALS AND METHODS

For the technical terms used in the descriptions we refer to Bayer et al. (1983). We only measured the polyp width, as the length was often difficult to ascertain due to variable degree of polyp contraction.

Abbreviations used: CRRF = Coral Reef Research Foundation, Palau; RMNH = National Museum of Natural History (NNM), formerly Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands; UF = Florida Museum of Natural History, Gainesville, Florida, USA; ZMTAU = Zoological Museum, Tel Aviv University, Israel.

Ceeceenus gen. nov.

Type species

Ceeceenus levis spec. nov., by original designation.

Diagnosis

Paralcyoniid with colonies formed by groups of polyps, connected to each other by short stolons. Axial polyp with daughter polyps widely spaced forming a loosely branched polyparium, which is retractile within a common pedicel. Trunk, branches, and tentacles of polyps have platelets. Polyps with points composed of spindles, and an indistinct collaret. Pedicel with spindles provided with simple to slightly complex tubercles. No zooxanthellae in the tissue.

Etymology

A combination of letters, gender masculine.

Differentiation

The genus differs from *Studeriotes* Thomson & Simpson, 1909, by forming smaller colonies, having platelets, and lacking a supporting bundle in the polyps. It differs from *Paralcyonium* Milne Edwards, 1850, by having platelets in the tentacles and a different sclerite ultrastructure.

The spindles of the pedicel showed hardly any differences in shape or ornamentation between the different species, the length measured for these spindles of the pedicel also should be considered of limited diagnostic value. For comparison with *P. spinulosum* (see Weinberg, 1977, plate 17) the ornamentation of pedicel spindles of *C. levis* spec. nov. is presented in Fig. 4g-h.

Remarks

Thomson & Dean (1931: 185) reported *Paralcyonium spinulosum* (as *P. elegans*) from the Ceram Sea, Indonesia. They described a specimen kept on formalin, probably a small specimen of *Studeriotes*.

Key to the species of *Paralcyonium* and *Ceeceenus*

1. Tentacles without sclerites.....
P. spinulosum (Delle Chiaje, 1822).
-. Tentacles with platelets..... 2

2. Platelets with both entire and ragged outline
***C. pannosus* spec. nov.**
-. All platelets with entire outline 3

3. Anthocodial spindles rather thick, also filling up the space between points.
Many platelets are squarish in shape
***C. quadrus* spec. nov.**
-. Anthocodial spindles are slender. Platelets mostly elongate 4

4. Anthocodial spindles mostly with protuberances. Below points varying numbers of platelets
***C. torus* spec nov.**
-. Anthocodial spindles mostly without ornamentation. Many platelets are present below points.
***C. levis* spec. nov.**

Ceeceenus levis spec. nov.

(Figs. 1e-g, 4a, e-h, 5, 9)

Material

RMNH Coel. 33672, holotype and 5 microscope slides; station number Phu.19, S Thailand, Phiphi Islands, W Ko Phiphi Le, S of Maya Bay, 7°40'30"N 98°45'42"E, 6 April 2003, coll. B.W. Hoeksema, SCUBA diving, 20-24 m;

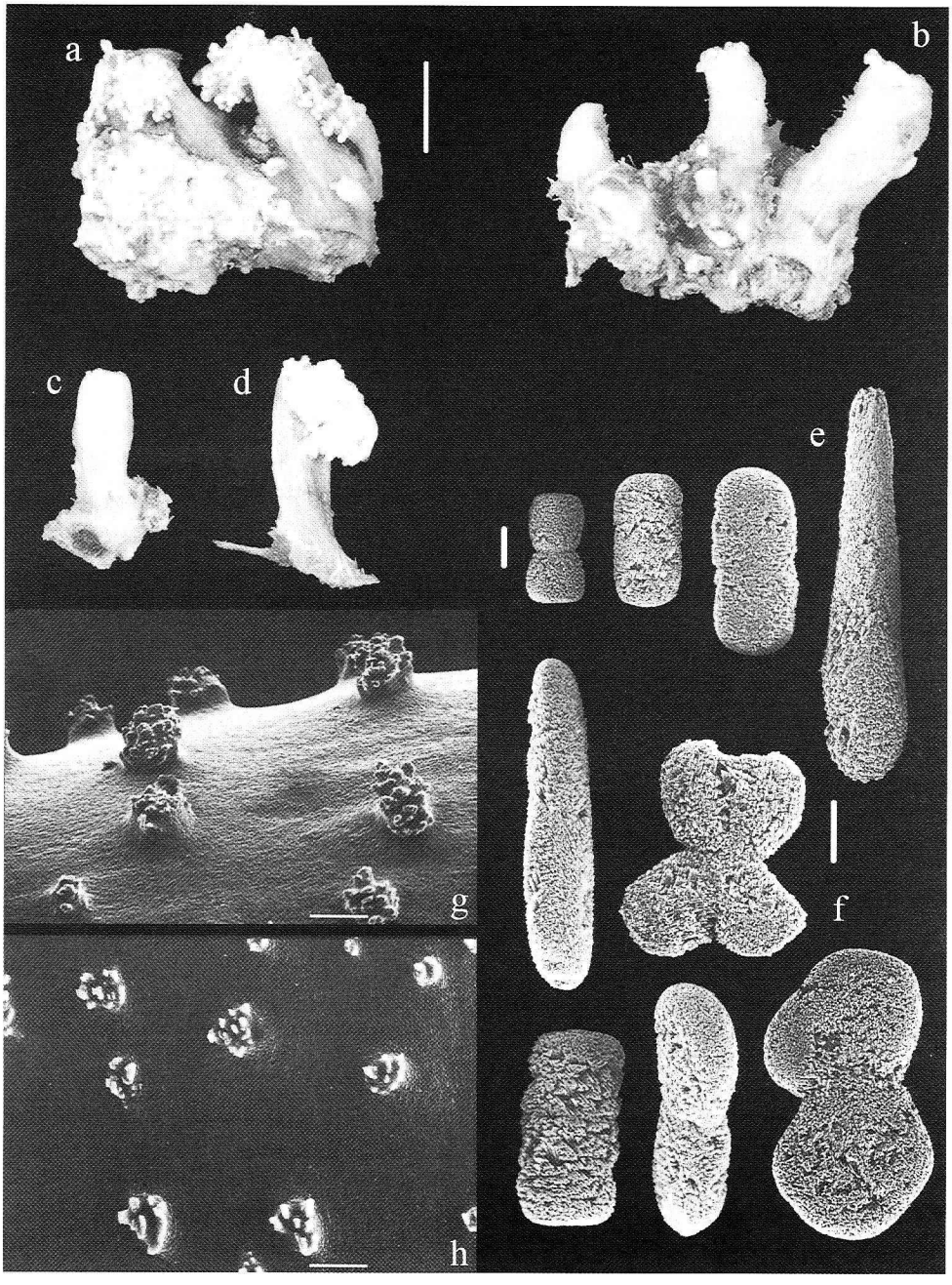

Fig. 4. a, holotype *Ceeceenus levis* spec. nov.; b, holotype *C. quadrus* spec. nov.; c, holotype *C. pannosus* spec. nov.; d, holotype *C. torus* spec. nov.; e-h, *C. levis* spec. nov., e-f, platelets, g-h, ornamentation of pedicel spindles. Scale at a 10 mm, applies to a-d, scales at e-h 0.01 mm.

RMNH Coel. 33673, around 40 paratypes, same data as holotype.

Description

The holotype is a group of six polyp aggregates on a piece of rock (Fig. 4a). The largest of these aggregates is about two cm high, including expanded trunk, and its pedicel is about 0.50 cm wide. The Axial polyps are up to 1.30 mm wide, the smallest daughter polyps only 0.25 mm wide.

Tentacles have platelets that are up to 0.06 mm long (Fig. 5b). Anthocodial spindles mostly without ornamentation (Fig. 5c), up to about 0.35 mm long, arranged in eight points, with often one or two lying horizontally forming a kind of collaret (Fig. 5a). Platelets also occur in between the point spindles, directly below the

points, and in the branches and trunk. They are similar in shape and size to those of the tentacles (Fig. 5d), and are most abundant in the branches, becoming less common in the trunk.

The pedicel has long spindles, up to about 4 mm long, with sparse tubercular sculpture.

Etymology

The Latin "levis", smooth, in reference to the anthocodial spindles without ornamentation.

Remarks

The species resembles *C. quadrus* in that the space between two points is also more or less completely filled with sclerites, but differs in having more elongated platelets and more slender point spindles. *C. levis* has platelets similar to those of *C. torus*, but differs in having numerous anthocodial spindles without ornamentation.

Living colonies in their natural habitat are shown in Fig. 1e-g.

Distribution

The species is only known from the type locality (Fig. 9).

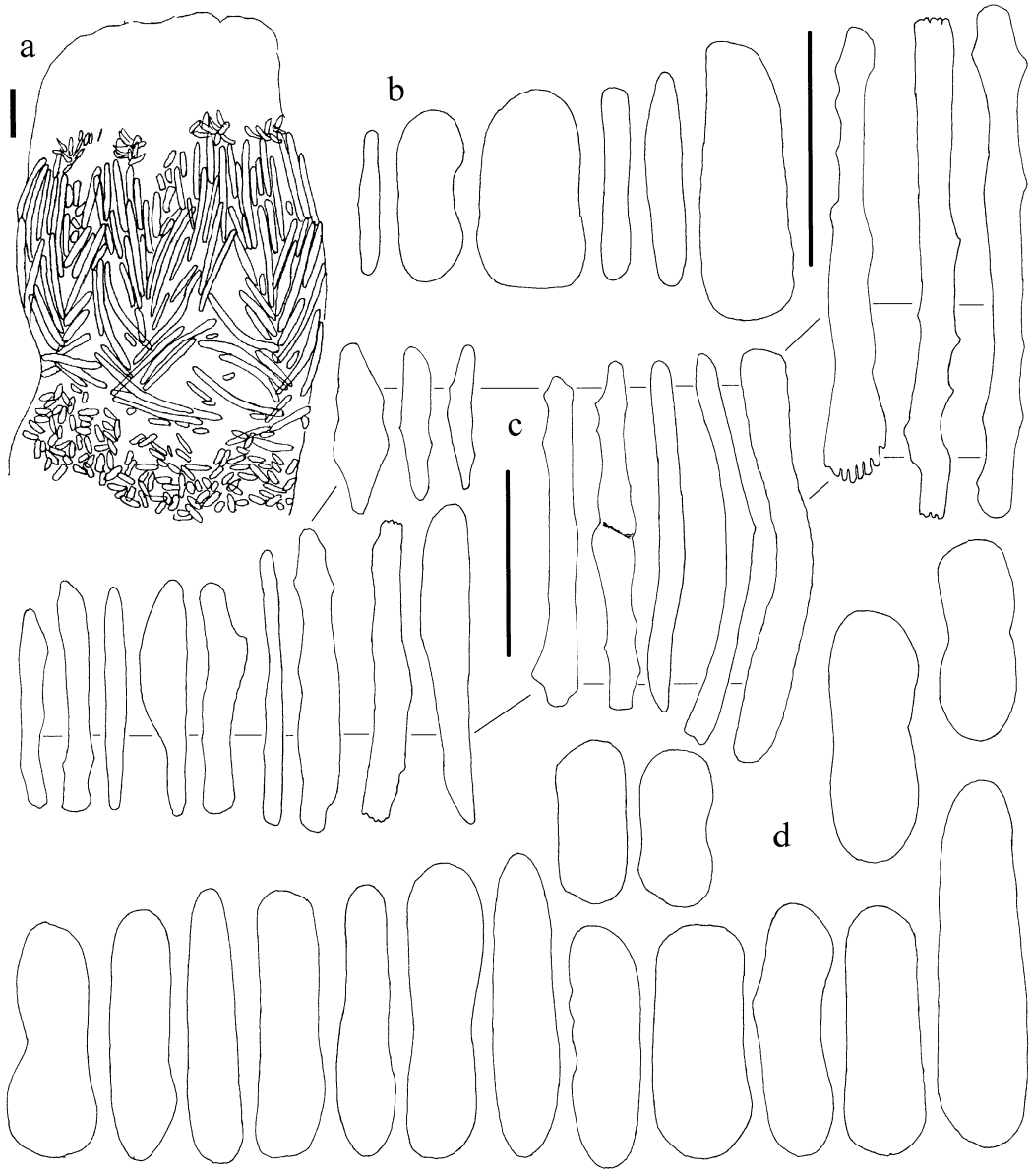

Fig. 5. *Ceeceenus levis*; holotype RMNH Coel. 33672; a, lateral view of polyp armature; b-d, sclerites; b, tentacles; c, points; d, trunk. Scales 0.10 mm.

Ceeceenus pannosus spec. nov.

(Figs. 4c, 6, 9)

Material

UF 899, holotype Tonga, Haapai Group, north end of Haano Island, forereef, in crevice, 33 m, 19°38.15'S 174°17.933'W, coll. G. Paulay, 11 September 1996; RMNH Coel. 33674, 2 microscope slides of holotype.

Description

The holotype is about two cm high and 0.70 mm wide (Fig. 4c). It is cylindrical in shape and the trunk with all anthocodiae is withdrawn into the pedicel. The Axial polyps are up to about 1 mm wide, the smallest daughter polyp only 0.50 mm wide.

Tentacles have platelets up to 0.05 mm long, with an entire or ragged edge. Most tentacles are withdrawn within the polyp body, in only one polyp were platelets clearly visible, and these five were depicted (Fig. 6b). Anthocodiae have sparsely tuberculated spindles (Fig. 6c), up to about 0.60 mm long, arranged in eight points, with one or two often lying horizontally, forming a kind of collaret (Fig. 6a). In between these points some

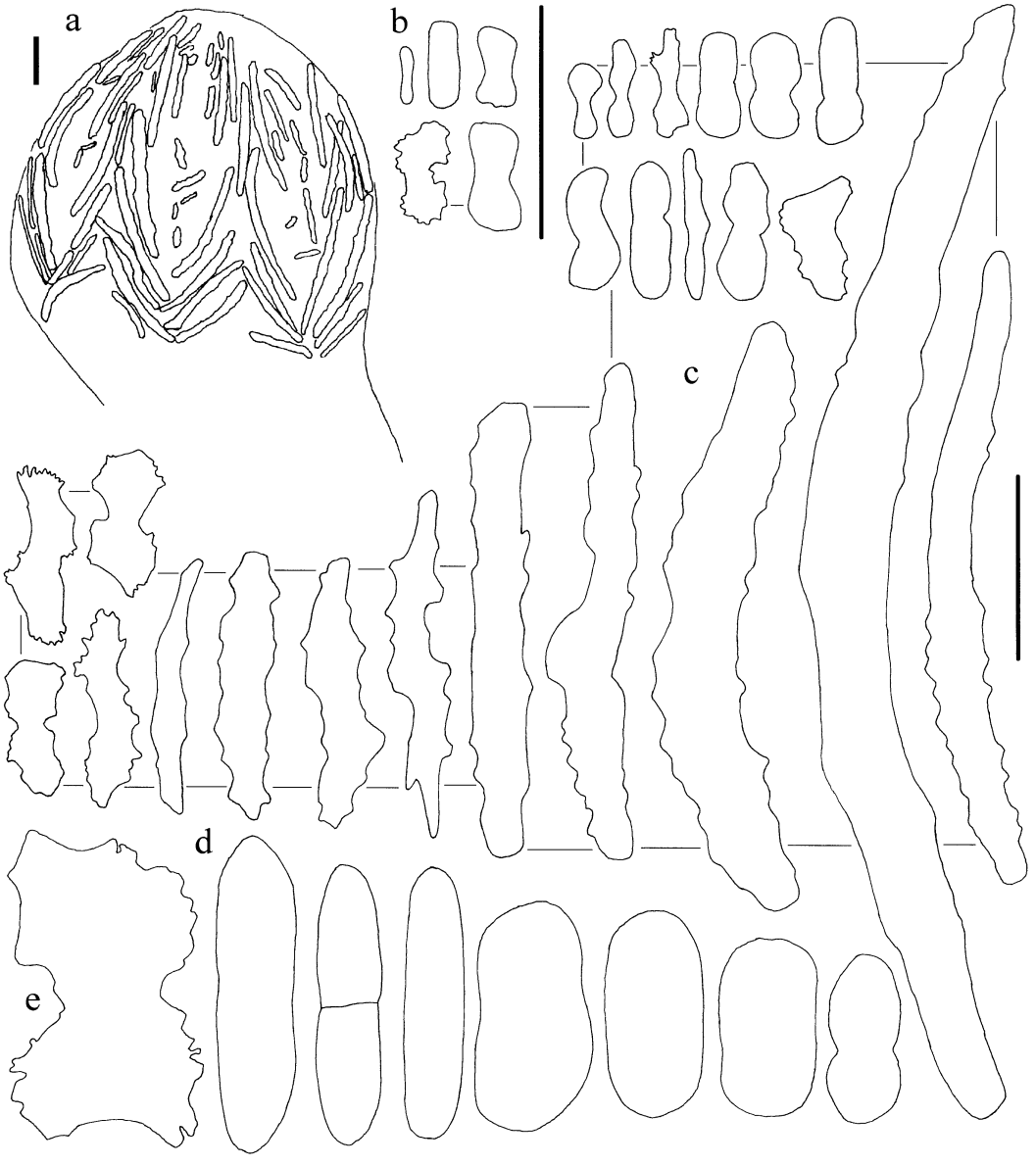

Fig. 6. *Ceeceenus pannosus*; holotype UF 899; a, lateral view of polyp armature; b-e, sclerites; b, tentacles; c, points; d, trunk; e, probably from trunk. Scales 0.10 mm.

smaller spindles and platelets are also present, the latter similar in shape to the tentacular ones (Fig. 6c, e). Below the points platelets are completely lacking, but in the trunk they are present, slightly longer than those of the tentacles (Fig. 6d).

Pedicel has long spindles, up to about 3 mm in length, with sparse tubercular sculpture.

Etymology

The Latin "pannosus", ragged, in reference to the ragged edge of several of the platelets.

Remarks

The species differs from the other three *Ceeceenus* species in having platelets with a ragged edge and much longer anthocodial spindles.

Distribution

The species is only known from the type locality (Fig. 9).

Ceeceenus quadrus spec. nov.

(Figs. 1a-b, 4b, 7, 9)

Material

ZMTAU Co 31079, holotype, Japan, Okinawa, Akajima Island, Fukakanese 32 m, 26°10.242'N 127°13.831'E, coll. Y. Benayahu; RMNH Coel. 33675, 3 microscope slides of holotype; ZMTAU Co 31082, paratype, same data as holotype; RMNH Coel. 33676, 2 microscope slides of paratype; UF 2858, 5 paratypes, Japan, Okinawa, Ie Island, Kanan-zaki, NW end of island, outer reef slope, 10-15 m, 26°44.35'N 127°48.605'E, coll. G. Paulay & S. Kinjo, 8 July 2004; RMNH Coel. 33677, 1 microscope slide of UF 2858.

Description

The holotype is a group of three polyp aggregates on a piece of rock (Fig. 4b). The largest of these aggregates is about two cm high, and its pedicel is up to 0.8 cm wide. In all three aggregates most of the anthocodiae and the complete trunk are withdrawn into the pedicel. The Axial polyps are up to about 1.40 mm wide, the smallest daughter polyp only 0.60 mm wide.

Tentacles have platelets up to 0.07 mm long (Fig. 7b). Anthocodial spindles mostly without ornamentation (Fig. 7c), up to about 0.35 mm long, arranged in eight points, with one or two often lying horizontally forming a kind of collaret (Fig. 7a). The space between the points is also completely filled with spindles, but these are somewhat shorter than the point spindles. Directly below the points and in the branches and trunk platelets similar to those of the tentacles occur, but these are slightly longer and wider (Fig. 7d). The number of platelets below the points varies, sometimes only a few are present; towards the trunk the number increases.

Pedicel has long spindles, up to about 6 mm long, with sparse tubercular sculpture.

Etymology

The Latin "quadrus", square, in reference to the square shaped platelets found in the branches and trunk.

Remarks

The species resembles *C. levis*, but differs in having somewhat wider anthocodial spindles and somewhat more square platelets.

The species feels more rigid than the other *Ceeceenus* species, probably because it has larger pedicel spindles.

The ZMTAU Co 31082 paratype is a single aggregate of polyps of similar size, but with completely withdrawn trunk and anthocodiae. The UF 2858 paratypes are also single colonies but have expanded trunk and anthocodiae. They show several polyps with sclerite arrangement more like that of *C. torus* or *C. levis*, i.e. with points clearly separated from each other and with some platelets in between adjacent points. Also the anthocodial spindles show more ornamentation than usual for *C. guadrus*, resembling that of *C. torus*. However, the UF 2858 material shows the same square platelets and the same variation in number of platelets below the points as the holotype and paratype ZMTAU Co 31082.

Living colonies are shown in Fig. 1a-b.

Distribution

The species is only known from two localities near Okinawa, Japan (Fig. 9).

Ceeceenus torus spec. nov.

(Figs. 1c-d, 3, 4d, 8, 9)

Material

UF 900, five colonies, one of which was chosen as the holotype (Fig. 4d), Papua New Guinea, Milne Bay Province, Alotau, patch reef, under overhang on small ledge, about 15 m, coll. J. Starmer, 8 June 1998; RMNH Coel. 33678, 3 microscope slides of the holotype; RMNH Coel. 33679, Palau, West channel, about 30 m, coll.

Pat Colin, 8 February 2005, four paratypes and two microscope slides.

Description

The holotype has a pedicel about 2 cm high and 0.70 cm wide. The trunk and anthocodiae are expanded but are hanging down from the pedicel (Fig. 4d).

Tentacles have platelets up to 0.06 mm long (Fig. 8b). Anthocodiae have sparsely tuberculated spindles (Fig. 8c), up to about 0.35 mm long, arranged in eight points, and often one or two lying horizontally forming a kind of collaret (Fig. 8a). In between these points some smaller spindles and platelets are also present, the latter similar in shape to the tentacular ones.

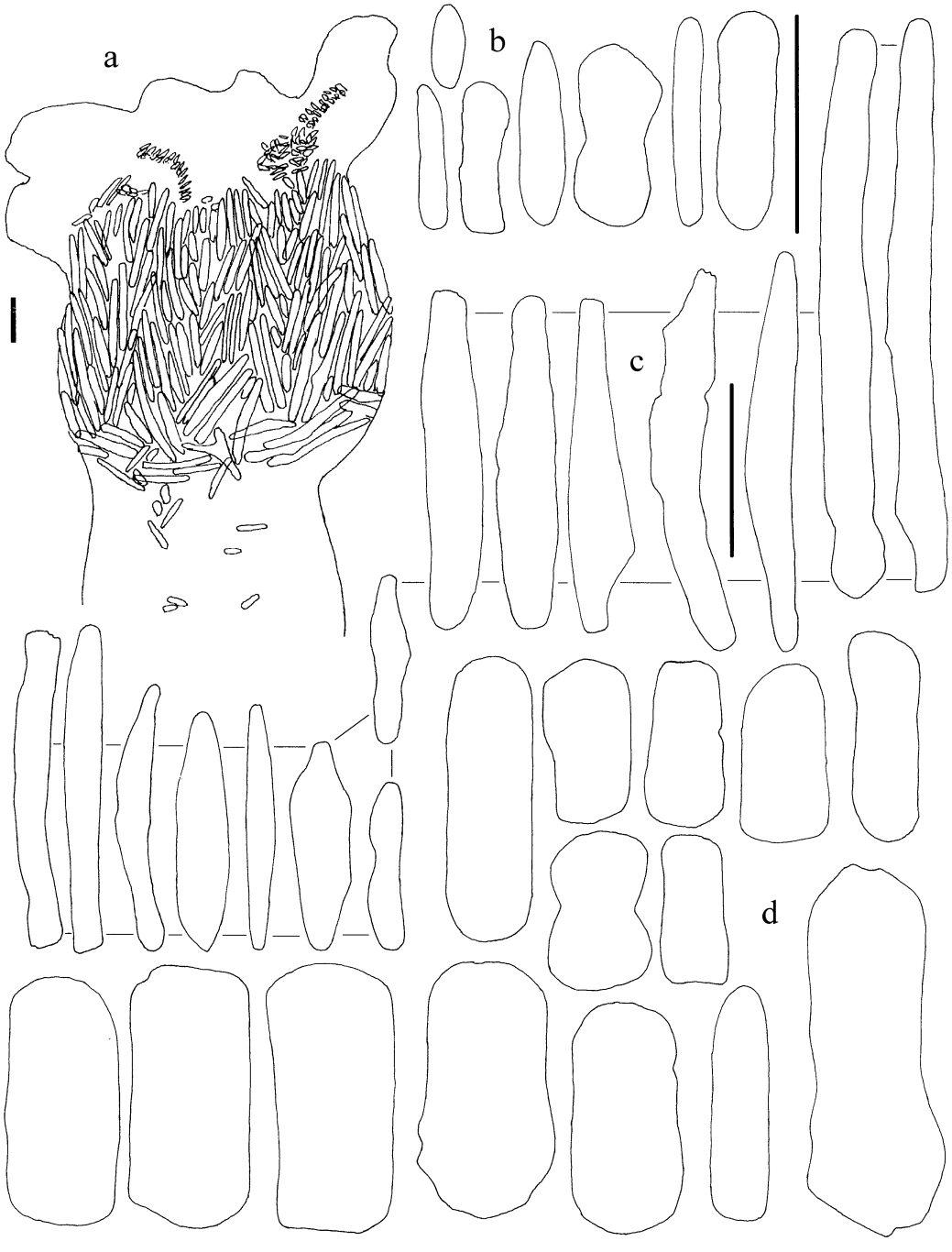

Fig. 7. *Ceeceenus quadrus*, holotype ZMTAU Co 31079; a, lateral view of polyp armature; b-d, sclerites; b, tentacles; c, points; d, trunk. Scales 0.10 mm.

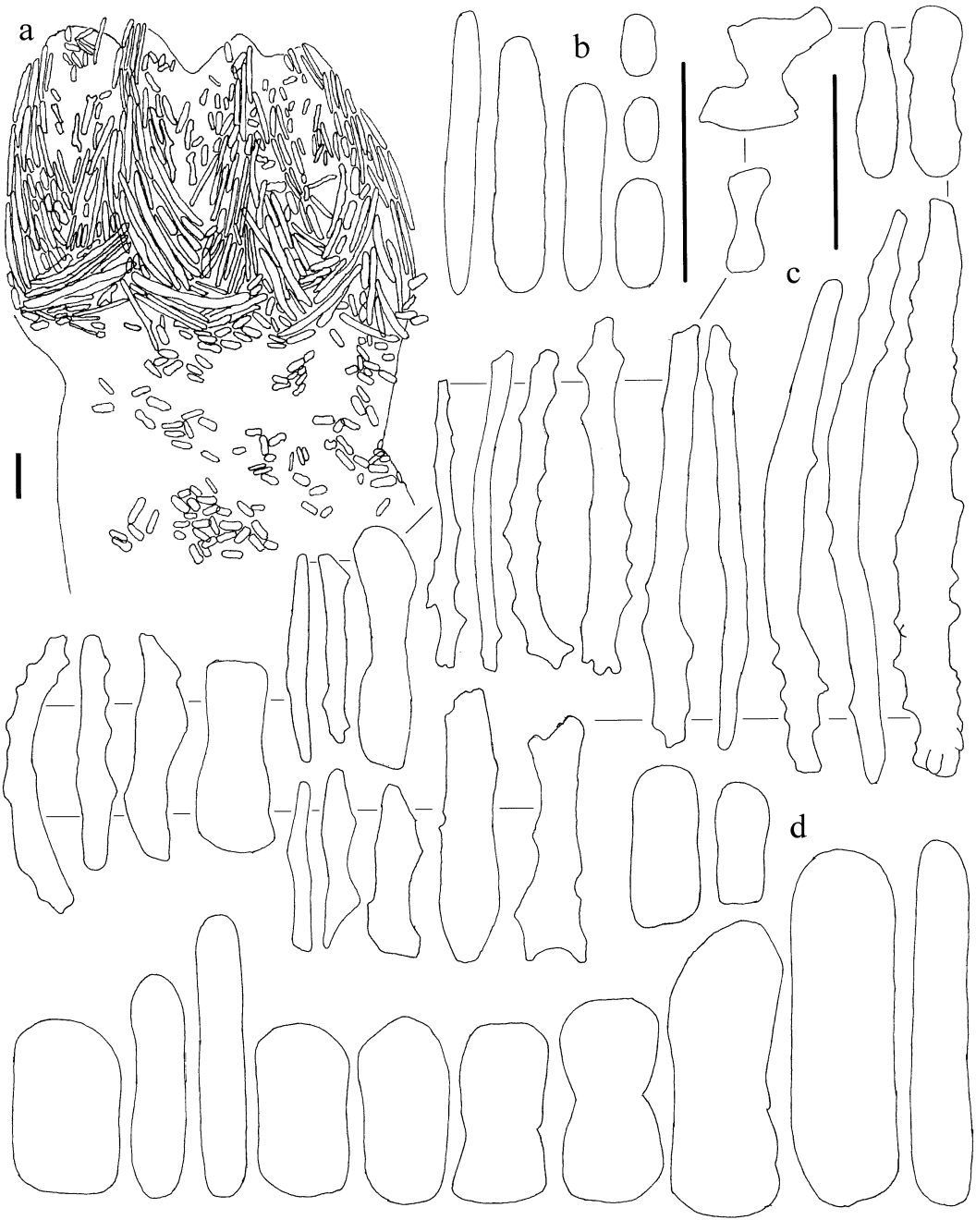

Fig. 8. *Ceeceenus torus*; holotype UF 900; a, lateral view of polyp armature; b-d, sclerites; b, tentacles; c, points; d, trunk. Scales 0.10 mm.

Directly below the points and in the branches and trunk, platelets similar to those of the tentacles occur, but they are slightly longer (Fig. 8d). Pedicel has long spindles, up to about 5 mm long, with sparse tubercular sculpture.

Etymology

The Latin "torus", protuberance, in reference to the anthocodial spindles with protuberances, a noun in apposition.

Remarks

The species resembles *C. levis* but differs in having point spindles that are more tuberculate and fewer sclerites between adjacent points.

Living colonies are shown in Fig. 1c-d.

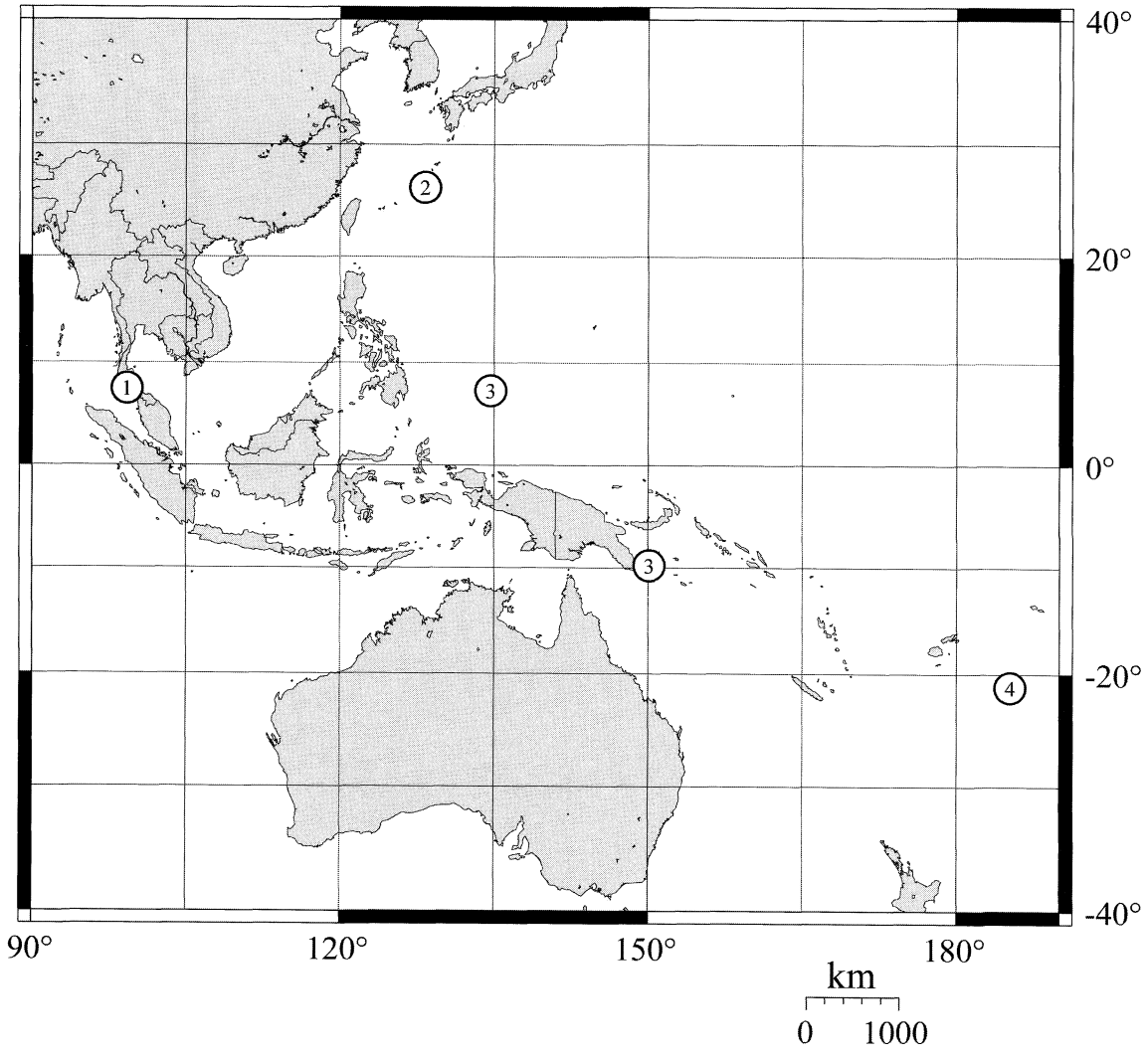

Fig. 9. Distribution of Indo-Pacific *Ceeceenus* species. 1 = *C. levis* spec. nov.; 2 = *C. quadrus* spec. nov.; 3 = *C. torus* spec. nov.; 4 = *C. pannosus* spec. nov.

Distribution

The species is known from the type locality Papua New Guinea, and Palau (Fig. 9).

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