

A new species of *Asterodiscides* (Echinodermata, Asteroidea, Asterodiscididae) from the tropical southwest Pacific, and the biogeography of the genus revisited

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ABSTRACT

A new species of *Asterodiscides*, *A. bicornutus* n. sp., is reported from Espiritu Santo, Vanuatu, in the tropical southwest Pacific, a region which may qualify as a southeastern extension of the zone of maximum marine biodiversity known as the coral triangle. The biogeography of the genus, in particular its apparent absence from the equatorial Indo-Malay and west Pacific region and the occurrence of disjunct distributions, is re-examined. An earlier contention that this anomalous distribution pattern could result from shelf extinctions during glacial maxima, with subsequent failure to re-invade the core diversity region during high sea level stands, is rejected. Tropical *Asterodiscides* species generally occur at depths corresponding to the ocean thermocline, an undersampled zone that is deeper in the west Pacific. Further intensive surveys for these comparatively rare asteroids in the core biodiversity region, sampling deeper shelf areas and targeting upwelling zones, together with supportive molecular analyses and investigation of biology (particularly reproductive strategies), are considered essential for a more complete understanding of the biogeography and speciation of this genus.

KEY WORDS

Echinodermata,
Asteroidea,
Asterodiscididae,
Asterodiscides,
Santo,
Vanuatu,
biogeography,
Indo-Malay region,
coral triangle,
ocean thermocline,
new species.

RÉSUMÉ

Une nouvelle espèce d'*Asterodiscides* (Echinodermata, Asteroidea, Asterodiscididae) du Sud-Ouest du Pacifique tropical, et reconsidération de la biogéographie du genre.

Une nouvelle espèce d'*Asterodiscides*, *A. bicornutus* n. sp., est décrite d'Espritu Santo, Vanuatu, dans le Sud-Ouest Pacifique tropical, une région que l'on peut qualifier d'extension vers le sud-est de la zone de biodiversité marine maximale connue sous le nom de Triangle du corail. La biogéographie du genre, en particulier son apparente absence de la région indo-malaise équatoriale et de l'Ouest Pacifique et l'existence de distributions disjointes, est réexaminée. L'affirmation selon laquelle cette distribution irrégulière résulterait d'extinctions sur les plateaux durant les maxima glaciaires, suivies d'échecs dans la recolonisation de la région abritant le noyau de diversité durant les périodes de haut niveau de la mer, est rejetée. Les espèces tropicales d'*Asterodiscides* se trouvent généralement à des profondeurs correspondant au thermocline océanique, une zone sous-échantillonnée qui est plus profonde dans le Pacifique ouest. Des études futures de ces rares Asteroidea dans la région abritant le noyau de biodiversité, un échantillonnage des zones de plateaux plus profondes et des zones d'upwelling, ainsi que des analyses moléculaires et des études de biologie (particulièrement des stratégies reproductives), sont considérés comme essentiels pour une meilleure compréhension de la biogéographie et de la spéciation de ce genre.

MOTS CLÉS

Echinodermata,
Asteroidea,
Asterodiscididae,
Asterodiscides,
Santo,
Vanuatu,
biogéographie,
région indo-malaise,
Triangle du corail,
thermocline océanique,
espèce nouvelle.

INTRODUCTION

The family Asterodiscididae was established by Rowe in 1977 to accommodate three genera: *Asterodiscides* A. M. Clark, 1974, *Paulia* Gray, 1840 and *Amphiaster* Verrill, 1871. *Paulia* and *Amphiaster* species occur in shallow water and are restricted to the eastern tropical Pacific but *Asterodiscides*, comprising 17 nominal species (Rowe 1985; Oguro 1991), is widespread in the tropical Indo-West Pacific, extends also to temperate areas of Australia and New Zealand, and tends to occur in deeper water (Rowe 1985). However, as noted in Rowe's 1985 paper, the known geographic range of *Asterodiscides* apparently does not include the core biodiversity region of the eastern Indo-Malay Archipelago (except for the Philippines) or the archipelagic central-west tropical Pacific (Rowe 1985). Extinction of Tethyan *Asterodiscides* shelf faunas of the eastern Indo-Malay/west Pacific during low sea level stands, followed by recent speciation of isolated peripheral populations and failure to re-invade the "core", was invoked to explain the unusual species distribu-

tion of this genus and its absence (Rowe 1985) from the high biodiversity region, the so-called "coral triangle". An alternative and perhaps more plausible explanation, briefly mentioned by Rowe (1985), is that the eastern Indo-Malay/tropical west Pacific provinces have yet to be adequately sampled for mid- to deep-water Asteroidea. The depths at which many *Asterodiscides* species occur (typically more than 50 m and often in excess of 100 m) are beyond the range of most air-breathing scientific SCUBA diving excursions, yet are often shallower than the depths sampled by historic ocean-going expeditions in the region, such as the "Challenger", "Siboga" and "Albatross", and, more recently, the MUSORSTOM, "Estase", KARUBAR and CORINDON expeditions. Thus it is quite possible that asterodiscidids are under-reported from the East Indies/west Pacific core diversity region. The present paper reports a new species of *Asterodiscides* from Espritu Santo, Vanuatu, collected during the SANTO 2006 Expedition (for a narrative of the expedition, see Bouchet *et al.* [2008], and for a review of the geography and

natural history of Santo, we refer to Bouchet *et al.* [in press]). Vanuatu lies close to the southeast apex of the zone of maximum marine biodiversity (Green & Mous 2004; Hoeksema 2007) and may qualify to be biogeographically incorporated within it (Hoeksema & Gittenberger in press).

The holotype is lodged in the Muséum national d'Histoire naturelle, Paris (MNHN).

SYSTEMATICS

Family ASTERODISCIDIDAE Rowe, 1977

Genus *Asterodiscides* A. M. Clark, 1974

Asterodiscides bicornutus n. sp.

(Figs 1-3)

HOLOTYPE. — Vanuatu. SANTO 2006 Expedition, stn AT076, Espiritu Santo, NW Malo Island, from RV *Alis* trawl, near Wombwanavua Point, 15°38'01.14"S, 167°04'46.20"E-15°38'40.26"S, 167°03'38.28"E, depth 105-135m, 10.X.2006, collected and photographed alive by first author (MNHN IE.2009.4909).

DIAGNOSIS. — Large (R = 102mm) stellate 5-armed asteroid, R/r = 1.7, arms and disc thick (25 mm after preservation), abactinal surface densely covered with stout, conical, pointed spines, some being bicornute or T-shaped with the two points extending to form a spindle shape arising directly from the spine base. Superomarginal plates 4, the terminal ovate or tear-shaped pair being large and conspicuous, the other 3 being small, inconspicuous and located proximally. Inferomarginal plates 6-7, adambulacral furrow spines 6-7 per plate, subambulacral spines in double row.

ETYMOLOGY. — Species name "bicornutus" derived from the Latin "cornu" for horn and referring to the two-horned, T-shaped abactinal spines.

DESCRIPTION

The single specimen, the holotype, is stellate (Fig. 1A); R/r = 102/60 mm. Upper surface of disc and arms convex in profile, flattening after preservation, lower surface flattened but curved upwards toward the arm tip. Rounded madreporite is 4 mm in diameter and located 30% of the interradial distance *r* from the anus. Abactinal armament of conical, bluntly pointed spines 4-8 mm in length, small rounded tubercles, and granules. In addition,

some of the conical spines, which are oriented more horizontally than vertically, have a bulging basal expansion. These are transitional to bicornute spines where the basal expansion is drawn out into a conical point equal or subequal in size and opposite in direction to that of the main conical axis (Figs 1B, F; 2B). Bicornute spines have a sessile T-shaped appearance and are distributed as follows: absent from central disc; along the surface of each arm to the arm apex forming a more or less distinct carinal row and two lateral rows (Fig. 3), often alternating with one, or sometimes two, normal conical spines; also present dorsolaterally and laterally but their distribution is more irregular. Length of bicornute spines, from tip to tip, 8-12 mm. Most spines are encircled at their base by a ring of granules. Papulae are densely but irregularly distributed on the abactinal surface

Actinal surface flattened and covered with a cobblestone-like armament of rounded tubercle clusters, or single rounded tubercles, on each plate (Fig. 1C, E) with smaller angular granules between the tubercles. Tubercle components in each cluster from 2-6 per plate and have flat surfaces where they adjoin and fit together. Distally the actinal tubercles are single and towards the arm tip they show a transition to short, blunt, conical spines (Fig. 1D). Adambulacral plates 50-53 with comb-like arrays of 6 or 7 furrow spines per plate (Fig. 1D). Subambulacral spines in a double series, short, round-ended and tend to be flattened transversely (Figs 1D; 2A). Spines of the outermost subambulacral row, furthest from the ambulacral groove, decrease in size distally near the arm apex (Fig. 1D); approaching the oral region they diminish in size followed by one or two enlarged ones, before diminishing again near the mouth. Spines of the innermost row of subambulacrals become slightly elongated and more cylindrical distally (Fig. 2A), where the arm furrow is curved upwards, before diminishing in size towards the arm tip. Most of the spines in the proximal half of the innermost subambulacral row are split transversely or obliquely, forming doublet pairs, then towards the mouth they become single, robust and prismatic in section, eventually diminishing in size near the mouth.

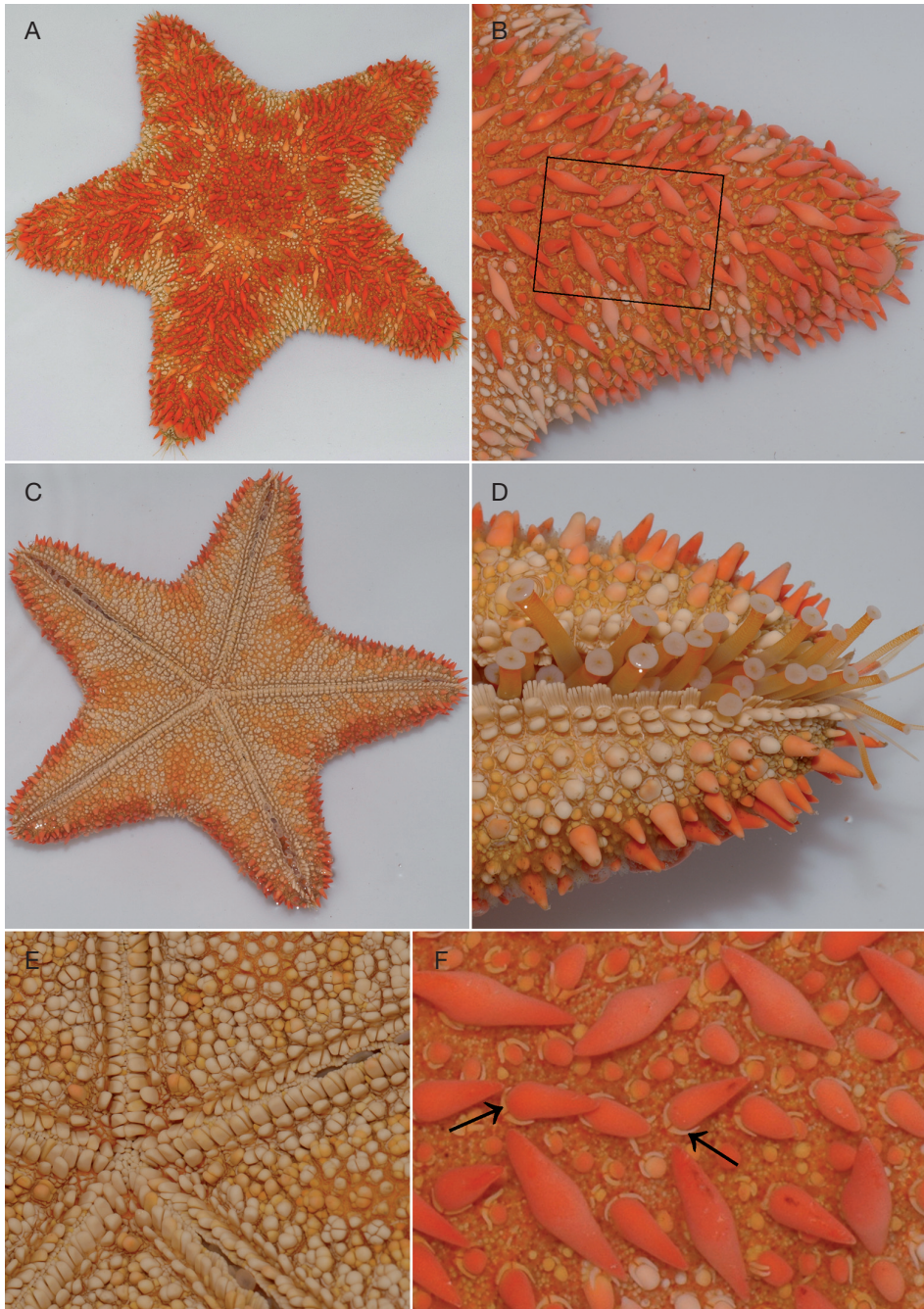


FIG. 1. — *Asterodiscides bicornutus* n. sp., holotype, images of living animal: **A**, abactinal view, R = 102 mm; **B**, abactinal view of arm, area delineated by box is shown enlarged in Figure 1F; **C**, actinal view; **D**, apical portion of arm; actinal view showing distended tube feet, actinal plate ornamentation, a double row of subambulacral spines and the comb-like arrays of subambulacral spines; **E**, oral centre; **F**, close-up of area demarcated by box in Figure 1B; both bicornute and conical spines are evident; open forceps-type pedicellariae (arrows) are present at the bases of spines and tubercles.

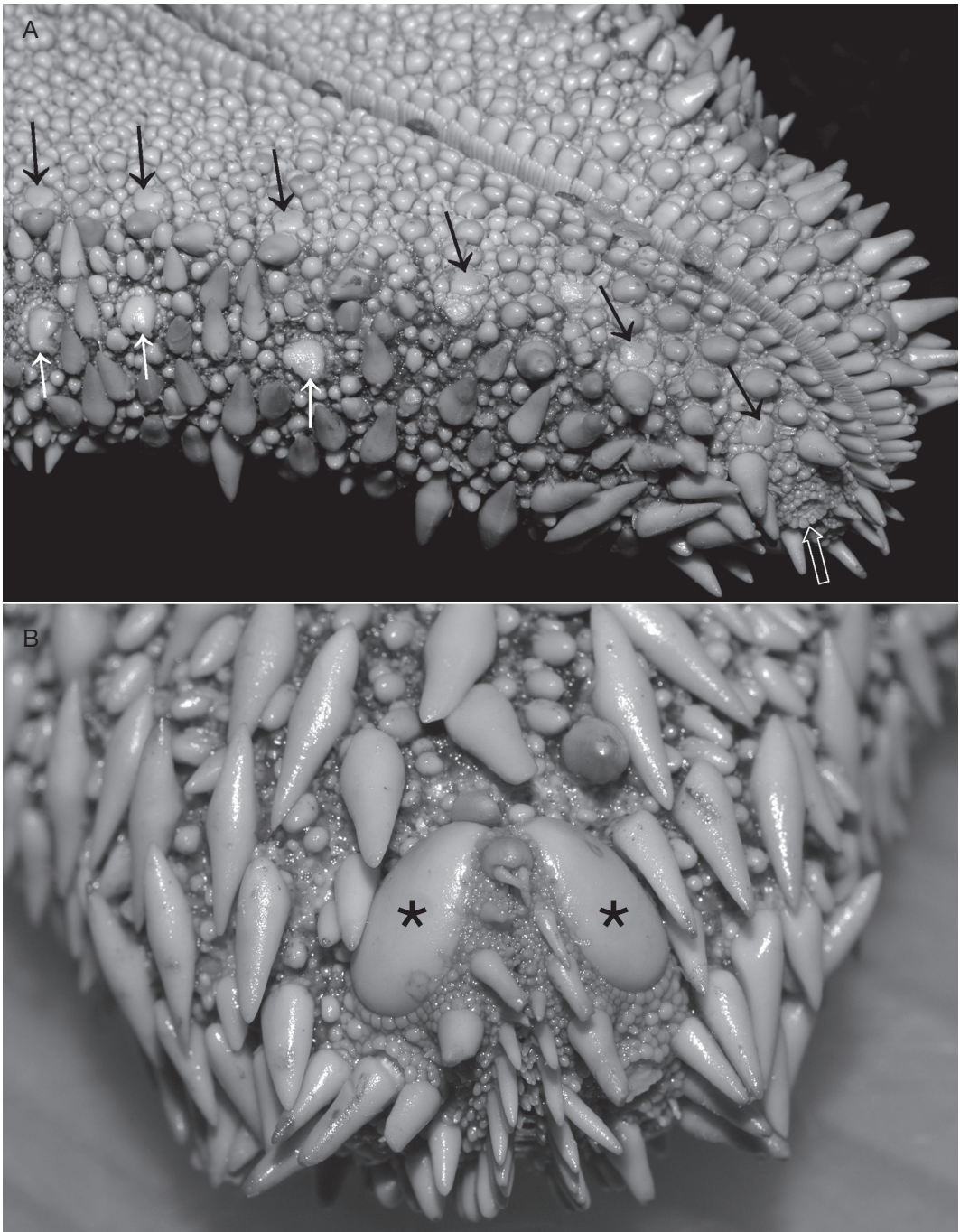


FIG. 2. — *Asterodiscides bicornutus* n. sp., holotype, alcohol preserved specimen; **A**, ventro-lateral view of arm showing the positions of the six inferomarginal plates (black arrows) and the three proximally located superomarginal plates (white arrows), the white block arrow indicates where a spine has become detached, showing a ring of granules at the spine base; **B**, dorsal view of re-curved arm apex showing the large pair of tear-shaped, terminal superomarginals (*). Many of the abactinal spines are bicornute.

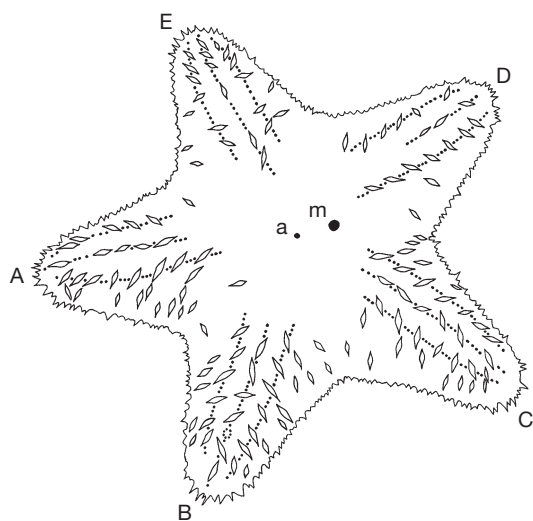


FIG. 3. — *Asterodiscides bicornutus* n. sp., outline drawing of abactinal surface illustrating the positions of bicornute spines only, and the general alignment of the more dorsal of these into a carinal and two dorso-lateral rows (indicated by dotted lines). The anus (**a**) and madreporite (**m**) are included as reference points. A ring of dots on arm B marks the position of a missing spine whose identity, conical or bicornute, is not known.

Marginal plates do not form a contiguous series but are widely separated. Superomarginals comprise three small proximal plates and one prominent, terminal plate on each side of each arm. Each plate is encircled by a ring of granules. Proximal superomarginals (Fig. 2A, white arrows) are rounded or somewhat irregular in shape. The large, ovate-elongate, terminal superomarginals are convex in profile; they taper distally, with the narrow ends of each pair almost meeting, close to the terminal plate of the ambulacral groove (Fig. 2B). Inferomarginal plates, numbering 6-7 (Fig. 2A, black arrows), are similar in size to many of the nearby actinal tubercles but are distinguished by their flatter appearance.

Pedicellariae are numerous and found on abactinal, actinal, superomarginal, inferomarginal and, infrequently, adambulacral plates. They are forceps-shaped and located at the base of spines or tubercles (Fig. 1F, arrows). Each jaw is tapered and U-shaped in section with flat faces apposed to each other when in the closed position. The pair of jaws is often curved laterally to fit the curvature of the spine base or tubercle.

Colour in life

Body wall of disc and arms a yellow sandy hue on upper and lateral surfaces. Colour of many spines and tubercles ranges from orange-red to pale pink with the orange-red pigmented spines forming a well-defined circular area centrally on the disc, then more diffuse areas peripherally towards the ends of the arms. Other spines and tubercles located between, or sometimes within, the orange-red zones are cream or pale pink (Fig. 1A, B, F). The large terminal superomarginal plates are orange to pink. Abactinal papulae are reddish. Actinal surface is sandy yellow to pale cream with broad, orange-yellow streaking along interradial zones and parallel but irregular minor streaks of the same colour at intervals along the arms (Fig. 1C).

REMARKS

Asterodiscides bicornutus n. sp. is most closely related to *Asterodiscides grayi* Rowe, 1977 in that 21 of the 22 morphological characters derived from the first 16 character sets for *A. grayi* in Rowe's (1985) original character matrix match those for the new species described here (also see phenetic analysis below). Characters 17 and 18 of Rowe (1985) are omitted from the present analysis due to ambiguity or deficiency in data. Additionally, forceps-shaped pedicellariae, present on abactinal, actinal, superomarginal and inferomarginal plates in *A. grayi* (Rowe 1977) are present also in *A. bicornutus*. Oguro (1991), in describing *A. japonicus* from Japan, extends Rowe's 1985 character matrix to include pedicellariae for the genus but he does not include the information on pedicellariae noted in Rowe's account (1977) for *A. grayi*. A striking difference between *A. bicornutus* n. sp. and *A. grayi* is the presence in the former of bicornute pointed abactinal spines (Table 1, attribute 23). These T-shaped bicornute spines distinguish this specimen not only from *A. grayi* but also from any known species in the genus. Conical abactinal spines in *A. grayi*, all of them with single apices, occur in three size ranges (Rowe 1977), the largest forming carinal and lateral rows that are similar in disposition to the rows of bicornute spines described here. Bicornute spines are however considered to be sufficiently distinctive to merit the designation of a new *Asterodiscides* species.

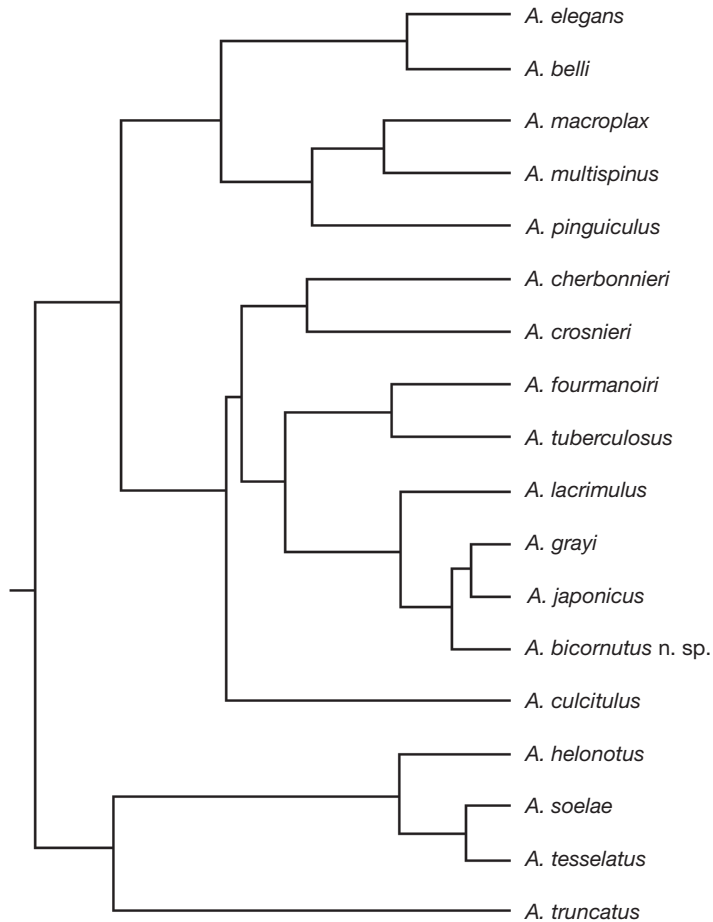


FIG. 4. — UPGMA dendrogram analysis of species relationships within the genus *Asterodiscides* A. M. Clark, 1974. Distances (branch lengths) are as follows: (((((a1:7.56,a2:7.56):13.79,(a3:9.38,a4:9.38):5.24,a7:14.62):6.73):7.53,(((a5:15.06,a6:15.06):4.89,((a8:8.81,a14:8.81):7.86,(a13:8.10,((a15:2.88,a17:2.88):1.51,a18:4.39):3.71):8.57):3.27):1.11,a16:21.06):7.82):6.34,((a9:8.26,(a10:3.18,a11:3.18):5.08):21.29,a12:29.56):5.66).

DISCUSSION

ASTERODISCIDES PHENETICS

A UPGMA cluster analysis of species relationships within the genus *Asterodiscides* was undertaken using the on-line dendrogram construction utility D-UPGMA (García-Vallvé 2006). This methodology, although it lacks the ability to distinguish plesiomorphies and apomorphies, is here considered adequate at species level. The analysis is based on the character matrix of Rowe (1985) converted to binary format (Table 1) and incorporating data

for *A. bicornutus* n. sp. from the present study and for *A. japonicus* (Oguro 1991). The dendrogram clusters of: 1) *soelae-tesselatus-helonotus-truncatus*; 2) *elegans-belli-macroplax-multispinus-pinguiculus*; 3) *cherbonnieri-crosnieri*; and 4) *grayi-japonicus-bicornutus-lacrimulus-tuberculosus-fourmanoiri* (Fig. 4) more or less conform to the four species subgroups elucidated earlier by Rowe (1985: table 3). A further similarity is the remaining questionable relationship of *A. culcitulus* (Fig. 4). The only difference (which comes about because characters are unweighted in the present phenetic analysis)

TABLE 1. — UPGMA binary character matrix of *Asterodiscides* A. M. Clark, 1974 taxa.

Attribute	<i>A. elegans</i> (Gray, 1847)	<i>A. belli</i> Rowe, 1977	<i>A. macroplox</i> Rowe, 1985	<i>A. multispinus</i> Rowe, 1985	<i>A. cherbonnieri</i> Rowe, 1985	<i>A. crosnieri</i> Rowe, 1985	<i>A. pinguiculus</i> Rowe, 1977	<i>A. fourmanoiri</i> Rowe, 1985	<i>A. helonotus</i> (Fisher, 1913)	<i>A. soelae</i> Rowe, 1985	<i>A. tessellatus</i> Rowe, 1977	<i>A. truncatus</i> (Coleman, 1911)	<i>A. lacrimulus</i> Rowe, 1977	<i>A. tuberculosus</i> (Fisher, 1906)	<i>A. grayi</i> Rowe, 1977	<i>A. culcitus</i> Rowe, 1977	<i>A. japonicus</i> Oguro, 1991	<i>A. bicornutus</i> n. sp.
	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11	a12	a13	a14	a15	a16	a17	a18
1 R:r > 1.50	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1
2 > 3 superomarginals	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
3 Proximal superomarginals discernable in large individuals	0	0	0	0	1	1	0	0	0	1	1	1	1	1	1	1	1	1
4 Distalmost superomarginal vd > hd	0	0	0	1	0	0	1	1	0	0	0	0	1	1	1	0	1	1
5 Distalmost superomarginal larger than proximal ones	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
6 Distalmost superomarginal convex or very convex, not flat	0	0	0	0	1	1	1	1	0	0	0	1	0	1	1	0	1	1
7 Inferomarginals below distalmost superomarginal < 6	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1
8 Inferomarginals discernable in large specimens?	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
9 Some abactinal tubercles form conical or pointed spines	1	1	1	1	0	0	1	0	0	0	0	0	1	1	1	0	1	1
10 Subspherical abactinal tubercles	1	1	0	1	1	1	1	1	0	0	0	0	0	1	1	1	0	0
11 Abactinal tubercles inverted cones	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0
12 Abactinal tubercles cylindrical	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
13 Profile of actinal tubercles angular	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
14 Basal ring of tubercle granules present	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	1	1
15 Interstitial granules present	0	0	1	1	0	1	1	1	1	1	0	0	1	1	1	1	1	1
16 > 10 subequal granules per actinal plate	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0
17 < 10 but > 1 subequal granules per actinal plate	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	1	1
18 Single actinal tubercle	0	1	1	1	0	0	1	1	1	1	1	1	0	1	0	0	0	0
19 Furrow spines per adambulacral plate never < 5	0	0	0	0	1	1	0	1	0	0	0	0	1	1	1	1	1	1
20 > 1 series of subambulacral spines	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1
21 Only one subambulacral spine per plate in 1st series	0	0	1	1	0	1	1	1	1	1	1	1	0	0	0	0	0	0
22 Depth range extends to 100 m or more	1	1	0	1	1	1	0	1	0	0	0	1	1	1	1	1	1	1
23 Some abactinal spines bicornute (T-shaped)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

is a closer linkage of *crosnieri-cherbonnieri* to the *tuberculosus-grayi* group, an outcome which cuts across the two major species groupings based on 3 or 4 superomarginal plates (Rowe 1985). This appears to support Rowe's (1985) reluctance to subdivide the genus. *Asterodiscides bicornutus* n. sp.

is most closely related to the *grayi-japonicus* pair (Fig. 4). Unfortunately Oguro (1991) appears to have missed Rowe's (1985) record and discussion of a specimen of *A. grayi* from Japan when he described *A. japonicus*. It continues to be the opinion of the authors that there is little to distinguish the latter

two forms and *A. japonicus* is probably a synonym of *A. grayi*. Further clarification of the relationships within the genus, which may be possible from suitably preserved, historical museum collections, must await a molecular assay of the taxa.

BIOGEOGRAPHIC DISTRIBUTION

The distribution of the Indo-Pacific asterodiscidids, at both family and genus level, has been reviewed at length by Rowe (1985). With regard to *Asterodiscides* species, several interesting features of their distribution stand out. Most notable is the apparent absence of this genus from the equatorial regions of the Indo-Malay Archipelago and the central-west Pacific (Rowe 1985). Furthermore, in contrast to many Indo-west Pacific echinoderm taxa, each *Asterodiscides* species has a relatively restricted distribution in the Indo-Pacific (Rowe 1985), as is the case for *Asterodiscides bicornutus* n. sp. described here. Rowe (1985) proposed two alternative hypotheses to account for the absence of *Asterodiscides* from the Indo-Malay region. Firstly, he considered support for Springer's (1982) "Extinction Hypothesis". In this case he (Rowe 1985) reasoned that shelf emergence and extinction of shelf faunas during Pleistocene glacial maxima, with subsequent failure to re-invade following marine transgressions, is considered a likely explanation for both the absence of *Asterodiscides* from the core region of maximum marine biodiversity, and for speciation of isolated remnant populations around the periphery of the Indo-Malay region. This analysis, while plausible, appears upon reflection to present potential problems, as follows. The loss of shelf habitat might not necessarily lead to extinction of species in the Archipelagic Indo-Malay/west Pacific region, but simply result in range contraction (admittedly dramatic) as species move down (over many generations) to maintain preferred depth. The fact that this anomalous distribution and speciation pattern is unique to *Asterodiscides* and is not seen in other shelf echinoderms, argues against such an extinction hypothesis. However it should be noted that the low abundances or rarity of asterodiscidids (they are generally found as singletons or in very small numbers) might make these shelf taxa more vulnerable to extinction during glacial maxima and

consequent habitat reduction. If asterodiscidids are indeed absent from the equatorial belt of the Indo-Malay and west Pacific region then it is hard to explain the disjunct distributions of some forms, notably *A. grayi* which is recorded only from waters around southern Japan in the northern hemisphere (Rowe 1977; Oguro 1991 – as *A. japonicus*) and, in the southern hemisphere, from the NE Australia-Norfolk Island-Kermadec Islands area (Rowe 1985). Furthermore, failure of asterodiscidids to re-invade the core region during glacial minima and elevated sea level stands is difficult to explain given that ocean currents circulate both towards and away from the east Indian Archipelago (Fell 1953; Warren 1966; Van Andel 1979) and given that even wide marine biogeographic barriers are sporadically permeable to propagules (Lessios *et al.* 1998; Lessios & Robertson 2006).

Secondly, invoking "parsimony" Rowe (1985) suggested that the lack of asterodiscidid specimens from the equatorial Indo-Malay/west Pacific core diversity region, is due to the fact that material has yet to be collected despite the many expeditions in the region; namely the historical "Challenger", "Siboga", and "Albatross" expeditions and, more recently, the MUSORSTOM, "Estase", KARUBAR and CORINDON expeditions. In this regard one key feature of asterodiscidid distribution – their bathymetric distribution – has not, thus far, received much attention. The genus is tropical to sub-tropical to temperate, but in the tropics representatives are typically found at depths towards 100 m, or more. Temperature profiles at collection sites are generally not reported in the taxonomic literature but depths of the order of 100 m typically correspond to the ocean thermocline depth and represent cooler conditions of the 20°C (or cooler) isotherm (Reverdin *et al.* 1986; Verstraete 2001). The ocean thermocline depth is not stable and may change by 20–30 m during El Niño Southern Oscillation events but in the Pacific, westward equatorial currents lead to a piling up of water in the west Pacific and a marked deepening of the thermocline layer in the 5°N to 5°S equatorial belt (Verstraete 2001). While the thermocline is shallow (30–50 m) in the eastern equatorial Pacific (90°W) it deepens considerably (150–200 m) in the west Pacific (Verstraete 2001).

The preferred thermal zone for equatorial asterodiscidids is thus probably beyond the depth range attainable by air-breathing SCUBA diving photographers and diving scientists in the Indo-Malay/west Pacific region, and probably beyond the depth capability of many small-boat dredging surveys. The larger regional expeditions have tended to focus on deeper waters, thus the mid-depths favoured by asterodiscidids may have been underrepresented in faunal surveys to date. A prediction arising from this argument is that suitable locations to search (using SCUBA) for *Asterodiscidides* in the equatorial Indo-Malay/west Pacific might be regions where upwellings are known to occur. ROV surveys at thermocline depths might also be productive.

The discovery of *Asterodiscidides bicornutus* n. sp., at a latitude of 15°S, at Espiritu Santo, Vanuatu in the southwest Pacific, appears to fit the pattern of isolated species distributions occurring around the periphery of the Indo-Malay Archipelagic region. However, Vanuatu is located close to the southeast apex of the zone of maximum marine biodiversity (Green & Mous 2004; Hoeksema 2007) and, on the basis of a high species inventory for mushroom corals, revealed during the SANTO 2006 Expedition, may in fact qualify to be biogeographically included within it (Hoeksema & Gittenberger in press). Targetted surveys of deeper shelf depths and upwelling zones elsewhere within the core biodiversity region may well reveal new asterodiscidid records.

What we lack, and what is crucial to our further understanding of *Asterodiscidides* and its distribution, is information on the biology, including behaviour and reproductive strategies (even if this latter can only be sought through histological examination). Such future research would unquestionably help elucidate why they are so infrequently collected and whether reproductive strategies account (at least partially) for the distribution patterns we observe. Further, molecular analyses might clarify relationships among the 17 (18?) species so far described.

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