THE RAFFLES BULLETIN OF ZOOLOGY 2004 Supplement No. **11**: 89-102

ASTEROIDEA OF THE ANAMBAS EXPEDITION 2002

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***ABSTRACT.* –** Some 27 sea star species belonging to 9 families have been identified from material collected in the Anambas and Natuna Archipelagos during an expedition made in 2002. Most of the asteroids are common in the South China Sea (SCS) but 2 species are new SCS records, namely *Asterina burtoni* Gray, 1840 and *Fromia elegans* H. L. Clark, 1921. Another taxon, *Neoferdia offreti* (Koehler, 1910) may also be a new record for SCS – it is recorded for the Philippines but its status for the SCS coast of the Philippines is uncertain. Another 2 taxa, *Gomophia egyptiaca* Gray, 1840, and *Pentaceraster decipiens* (Bell, 1884), are rare in SCS and, for *G. egyptiaca*, the present survey has expanded its known geographic range. An additional sea star species is known from photorecords taken in the Anambas in the mid 1990s, bringing the total count of Asteroidea to 28 for these two Archipelagos. The total sea star count for the SCS as a whole now stands at 230.

KEY WORDS. – Asteroidea, Anambas, Natuna, South China Sea.

INTRODUCTION

The South China Sea (SCS) has a rich diversity of tropical echinoderms with close to a thousand species known, of which about 12% are endemic (Lane et al., 2000). The class Asteroidea, represented by 227 SCS species, is second only to the Ophiuroidea in terms of diversity. The inventory is extensive but incomplete, as is knowledge of distribution of taxa. As pointed out earlier (Lane et al., 2000; Ng & Tan, 2000), large areas of the three million square kilometre domain of the South China Sea remain relatively unknown biologically and are of particular interest for biodiversity research. The existing inventories for Echinoderms (and other key faunal and floral groups), published in *The Raffles Bulletin* in 2000 following a 1997 regional Biodiversity Workshop, prompted exploration initiatives, one of them being Expedition Anambas. The southern part of the South China Sea (area 5 in Lane et al., 2000) contains a number of Archipelagic island clusters on the Sunda shelf that had received little, if any, attention from naturalists or biodiversity specialists. This region, specifically the Indonesian Anambas and Natuna islands, was proposed as the focus for an international expedition in March 2002, involving scientists from all authorities bordering the South China Sea.

MATERIAL AND METHODS

Materials were collected during a 10-day International Expedition from 11th to 20th March 2002 on the Indonesian Research Vessel, Baruna Jaya VIII. Several sites in the Anambas and Natuna Archipelagos were sampled. Collection of echinoderm material was done while reef walking on the intertidal area, diving to depths up to 32 m, and by night trawls. Samples were preserved in 70% ethanol. Half of the material has been deposited in Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research, National University of Singapore, and the other half at the Research Centre for Oceanography (RCO), Indonesian Institute of Sciences.

Depth ranges (in metres) for non-endemic SCS taxa include records outside the South China Sea. Occurrence in SCS regions (1-7) refers to Lane et al. (2000). Specimen dimensions [radius to arm tip (R) and radius to inter-radial arc (r)] are in mm unless otherwise stated. Citations for taxa include those with original descriptions and papers with significant taxonomic content and/or illustrations.

Translation of Indonesian geographic terms: Kepulauan = islands or Archipelago; Pulau = island; Tanjung = point or headland; Teluk = bay.

Table 1. Summary of asteroid distribution for Anambas and Natuna. New records for SCS in bold type.

Species	Anambas	Natuna
Luidia hardwicki	•	
Astropecten polyacanthus	•	
Archaster typicus	•	
Anthenea aspera	•	
Choriaster granulatus	•	•
Culcita novaeguineae	•	
Pentaceraster decipiens	•	
Pentaceraster sibogae	•	
Fromia elegans	•	
Fromia indica	•	•
Fromia milleporella	•	•
Fromia monilis	•	•
Fromia pacifica	•	•
Gomophia egyptiaca	•	
Leiaster speciosus	•	
Linckia laevigata	•	•
Linckia multifora	•	•
Nardoa frianti	•	
Neoferdina offreti		•
Ophidiaster granifer	•	
Acanthaster planci	•	
Asterina burtoni	•	•
Asterina coronata	•	•
Cryptasterina pentagona	•	•
Nepanthia belcheri	•	
Euretaster insignis	•	
Echinaster luzonicus	•	•
Metrodira subulata	•	

TAXONOMIC ACCOUNT

FAMILY LUIDIIDAE SLADEN

Genus *Luidia* Forbes

Luidia hardwicki (Gray, 1840)

(Fig. 1)

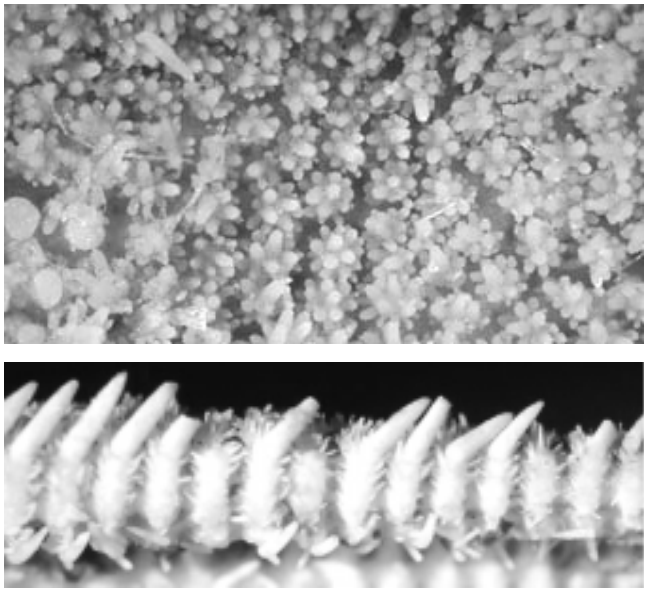


Fig. 1. *Luidia hardwicki*: paxillae on aboral side (above) and inferomarginal spines (below).

Petalaster hardwicki Gray, 1840: 183.
Luidia forficera Sladen, 1889.
Luidia hardwicki - A. M. Clark, 1953: 391; Price, 1983: 32.

Material examined. – EATT 06 (R/r= 22.0/3.3)(RCO).
Sites. – Night trawl, 46m, Teluk Tarempa, Pulau Jemaja, Kepulauan Anambas (Anambas Is.)(from N03°15.31', E106°09.50' to N03°15.28', E106°11.76').

Occurrence in SCS. – 2, 3, 5, 6, 7 (6-220m).

General distribution. – Indian Ocean, S. China Sea, Australia (N. and S. Queensland, Kimberly to N.W Cape, New South Wales) and New Zealand (Kermadec Is.).

FAMILY ASTROPECTINIDAE GRAY

Genus *Astropecten* Gray

Astropecten polyacanthus Müller & Troschel, 1842

(Fig. 2)

Astropecten polyacanthus Müller & Troschel, 1842: 69; Fisher, 1919: 63; Price, 1983: 40; Guille et al., 1986: 120; Gosliner et al., 1996: 252; Moosleitner, 1997: 5; Schoppe, 2000: 39.

Material examined. – EATT 03 (R/r=64.0/11.5)(RCO), (R/r=46/8)(ZRC).
Sites. – Night trawl, 24-31m. Mouth of Teluk Jebung, E. coast of Pulau Jemaja, Kepulauan Anambas (from N02°55.30', E105°50.55' to N02°55.39', E105º51.15').

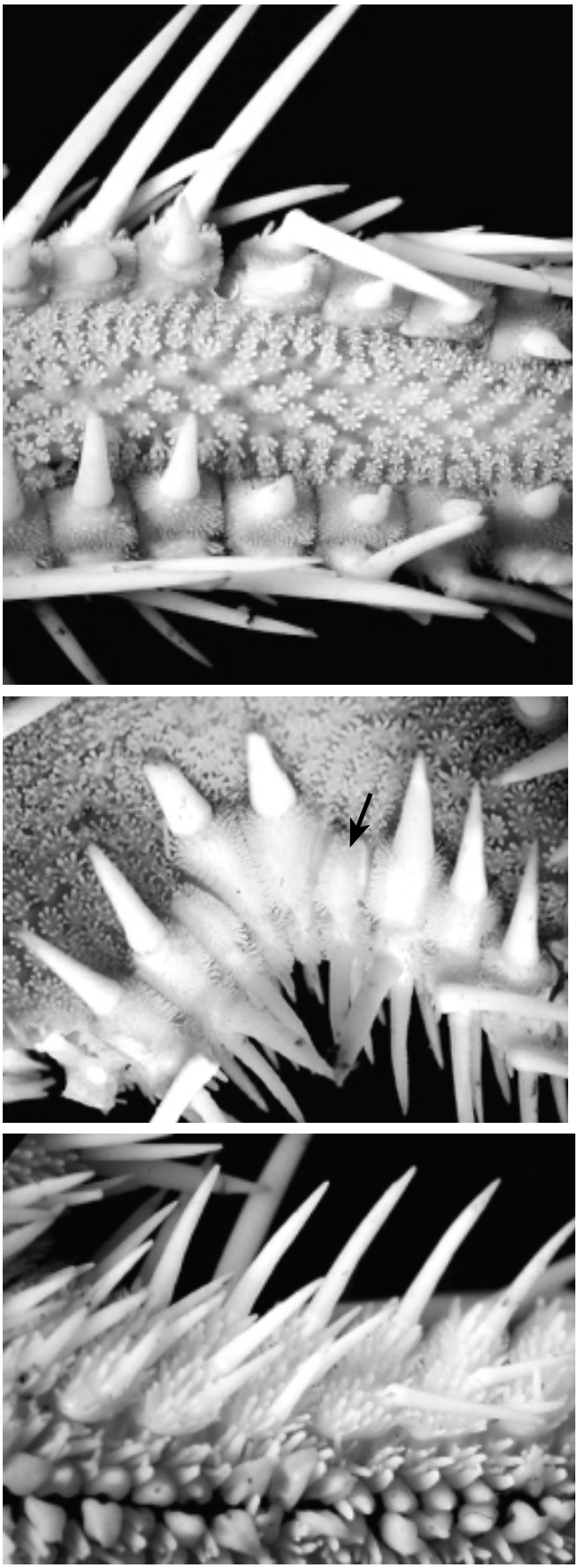


Fig. 2. *Astropecten polyacanthus*: dorsal arm (above); inter-radial arc (centre); inferomarginal spines (below). 2nd superomarginal (arrow) is without spine.

***Occurrence in SCS.* –** 2, 3, 6, 7 (0-144m).

***General distribution.* –** Indo-west Pacific, i.e. Red Sea, Zanzibar, Mozambique, Mauritius, Seychelles, Ceylon, Andaman Is., Maldives, Mergui Archipelago, Hong Kong, China, Taiwan, Philippines, East Indies, Sulu Arch., Aru Is., Fiji, Admiralty Is., Australia (N. and S. Queensland, Kimberly to Abrolhos, Geraldton to Freemantle, New South Wales), Japan, Samoa, Hawaii, Cook Strait.

***Remarks.* –** Characteristically long spine at upper edge of each inferomarginal plate. A stout, vertical spine projects from top of each superomarginal plate, except the 2nd plate, which lacks a spine (Fig. 2) and is shorter in length than the other superomarginals.

FAMILY ARCHASTERIDAE VIGUIER

Genus *Archaster* Müller & Troschel

Archaster typicus Müller & Troschel, 1840
(Fig. 3)

Archaster typicus Müller & Troschel, 1840: 104; Bedford, 1900: 289; Hayashi, 1938a: 419; Sukarno & Jangoux, 1977: 822; Guille et al., 1986: 122.
Astropecten stellaris Gray, 1840.
Archaster nicobarius Mobius, 1859.

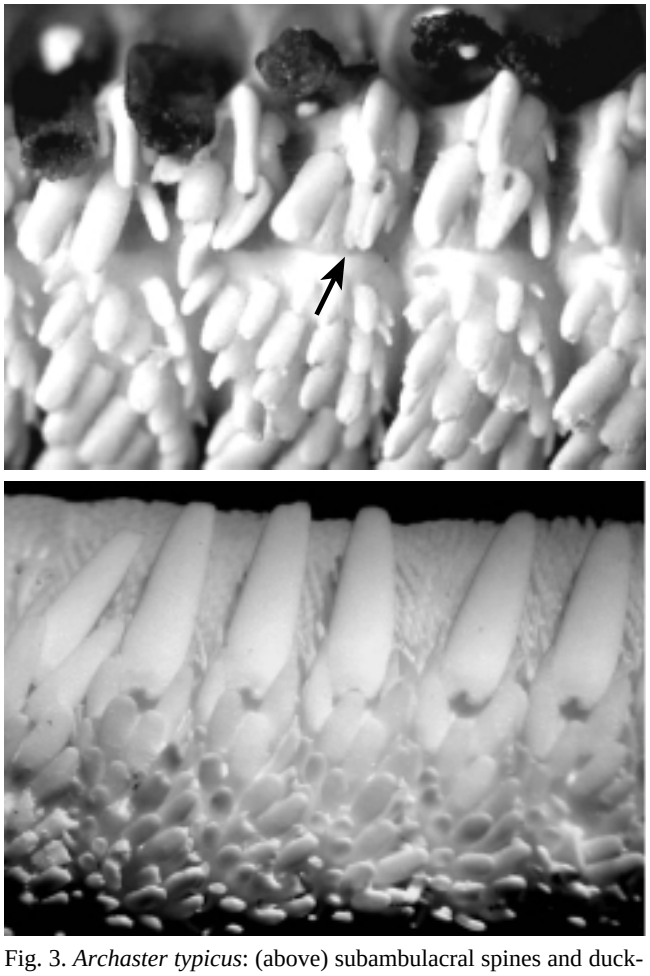


Fig. 3. *Archaster typicus*: (above) subambulacral spines and duck-billed pedicellariae (arrow). Lateral view (below) shows elongated granules of superomarginal plates, primary spines and spatulate spinelets of inferomarginal plates.

Material examined. – EADW04 (R/r=60.5/13.3)(RCO); EAZJ03 (R/r=73.5/14.2)(RCO); EAZJ01, 2 specimens (R/r=70/12, 68/12)(ZRC); EAZJ 03(A) 3 specimens (R/r=71/13, 81/15, 71/13)(ZRC).
Sites. – Teluk Jebung, Pulau Jemaja, Kepulauan Anambas (N02°58.35', E105°40.18').

Occurrence in SCS. – 2, 3, 5, 6 (0-91m).

General distribution. – Indo-west Pacific i.e. Maldives, Nicobar and Andaman through Mergui Arch., Malay Arch., Singapore, Philippines, north Australia, King Is., Sir William James Is., Fiji and Tonga.

Remarks. – Subambulacrals with 3 spatulate spinelets of which the middle one may transform to duck-billed or forceps-type pedicellariae. In specimen EADW 04, pedicellariae were not found, and the spinelets tend to be all the same size. Similarly in East Indonesia forceps-type pedicellariae are present in a specimen of *A. typicus* from P.Tikus, Kupang, but not in specimens collected from Sekotong, Lombok Is. Although the depth range in the literature is indicated up to 91m this asteroid is generally found intertidally.

FAMILY OREASTERIDAE FISHER

Genus *Anthenea* Gray

***Anthenea aspera* Döderlein, 1915**
(Fig. 4)

Anthenea aspera Döderlein, 1915: 28; Mortensen, 1934: 8; H. L. Clark, 1938: 118.

Material examined. – EATT 03 (R/r=73.9/45.2)(RCO).
Sites. – Night trawl 24-31m depth. Mouth of Teluk Jebung, E. coast of Pulau Jemaja, Kepulauan Anambas (between N02°55.30', E105°50.27' to N02°53.71', E105° 50.38').

Occurrence in SCS. – 5, 6 (18m).

General distribution. – West Pacific Ocean including Australia, China, Japan, Hong Kong.

Remarks. – The colouration of this species is known to be variable (Lane & VandenSpiegel, 2004). In the Anambas specimen the aboral surface is cream colored with irregular, brownish areas at arm extremities and encircling a central cream zone. Some reddish-pink pigmentation occurs around the central zone and more distally. Small tubercles occur on the proximal regions of the arms. Abactinal bivalved pedicellariae inconspicuous. Granules on superomarginals reduced on the abactinal side. 1-2 bivalved pedicellariae on each inferomarginal. The superomarginal plates at inter-radial areas have a reduced length/breadth ratio compared to arm superomarginals. The specimen examined differs from those described by VandenSpiegel et al. (1998) as their specimens show dense pedicellariae on the abactinal surface; also, in the present material the superomarginal plates have tubercles but lack granules on the abactinal aspect.

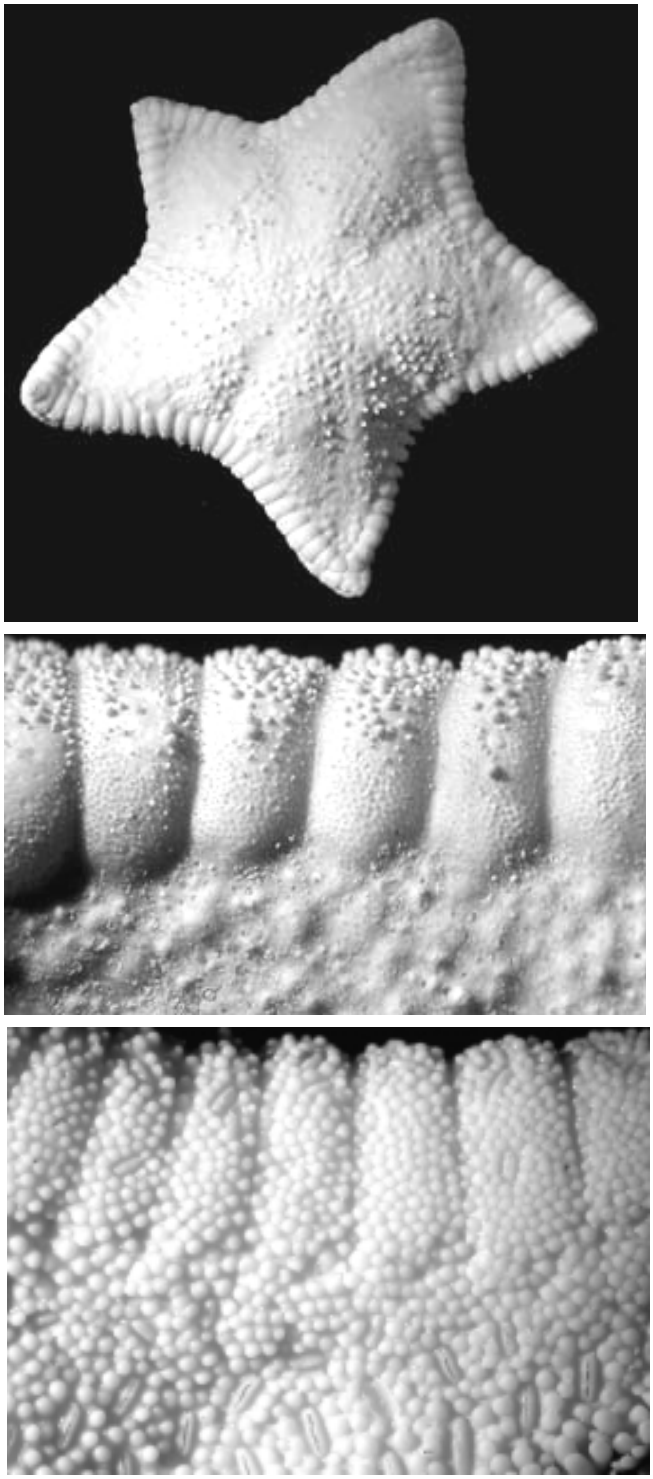


Fig. 4. *Anthenea aspera*: overall distribution of abactinal tubercles (above); granules on abactinal side of superomarginal plates (centre); granulation and pedicellariae on actinal side (below).

Genus *Choriaster* Lütken

Choriaster granulatus Lütken, 1869

Choriaster granulatus Lütken, 1869: 35; Fisher, 1919: 369; Domantay & Roxas, 1938: 217; Guille et al., 1986: 124; Colin & Arneson, 1995: 244; Gosliner et al., 1996: 254; Moosleitner, 1997: 6.

Material examined. – EAD 05 (R/r=96.1/27.5)(RCO).
Sites. – Islet S.E. of Tanjung Yang, S.W. coast of Pulau Matak; mouth of Teluk Jebung (N02º52.80', E105º50.43' to N02º51.23', E105º48.15') - Kepulauan Anambas. Depth to 32m.

Occurrence in SCS. – 2, 3, 4, 5, 6, 7 (0-40m).

General distribution. – Indo-west Pacific i.e. E. Africa, Red Sea, Maldive Is., S. China Sea, Australia (Ashmore, Cartier, Scott Is., Rowley Shoals), South Pacific islands.

Genus *Culcita* L. Agassiz

Culcita novaeguinea Müller & Troschel, 1842

Culcita novaeguinea Müller & Troschel, 1842: 38; Fisher, 1919: 360; H. L. Clark, 1921: 32; Livingstone, 1932: 250; Guille et al., 1986: 124; Colin & Arneson, 1995: 245; Gosliner et al., 1996: 255.

Material examined. – EAD 02 (R/r=32/22)(ZRC), juvenile specimen.
Sites. – Teluk Tiru, Pulau Jemaja, Kepulauan Anambas (N02º57'13.6", E105º50'47.4").

Occurrence in SCS. – 2, 3, 4, 5, 6, 7 (0-90m).

General distribution. – West Pacific including type locality, New Guinea. Indian Ocean (Andaman Is.), Australia (Ashmore, Cartier and Scott reefs and Rowley Shoals).

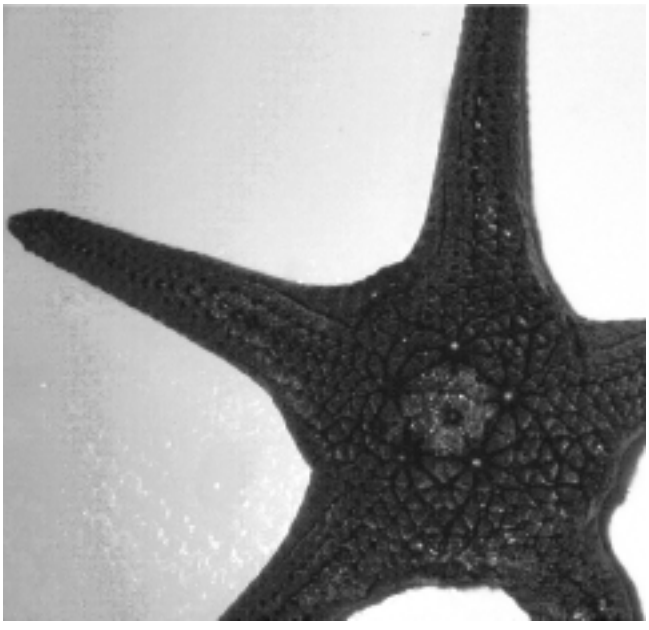


Fig. 5. *Pentaceraster decipiens*, Pulau Jemaja, Anambas.

Genus *Pentaceraster* Döderlein

Pentaceraster decipiens (Bell, 1884)
(Fig. 5)

Oreaster decipiens Bell, 1884: 69.
Pentaceraster decipiens - Clark & Rowe, 1971: 55.

Material examined. – EATT 03 (R/r=182.4/52.6; R/r ratio = 3.47)(RCO).
Sites. – Night trawl (24-31m). Mouth of Teluk Jebung, E. coast of Pulau Jemaja, Kepulauan Anambas (N02°55.30', E105°50.27' to N02°53.71', E105°50.38').

Occurrence in SCS. – 5 (0-20m).

General distribution. – Indonesia.

Remarks. – No spines on inter-radial marginal plates. Blunt tubercles present only on some of the distal superomarginal plates. Abactinal surface has 5 large tubercles on the disc and 4-5 similar tubercles on proximal carinal area of each arm. Dorso-lateral tubercles present only on disc, not on arms. Colour brown with reddish-brown tubercles.

Pentaceraster sibogae Döderlein, 1916
(Fig. 6)

Pentaceraster sibogae Döderlein, 1916: 432; 1936: 353.

Material examined. – EATT 04 (R/r=134.3/43.6; R/r ratio = 3.08)(RCO).
Sites. – Night trawl. Mouth of Teluk Jebung, E. coast of Pulau Jemaja, Kepulauan Anambas.

Occurrence in SCS. – 3, 6 (32-59m).

General distribution. – Southern India and eastwards, Indonesia.

Remarks. – Five large tubercles project from the primary radial abactinal plates. Carinal tubercles increasing in size distally. Many superomarginals have conical or rounded tubercles. Inferomarginals inconspicuous. Colour reddish brown with pale tubercles.

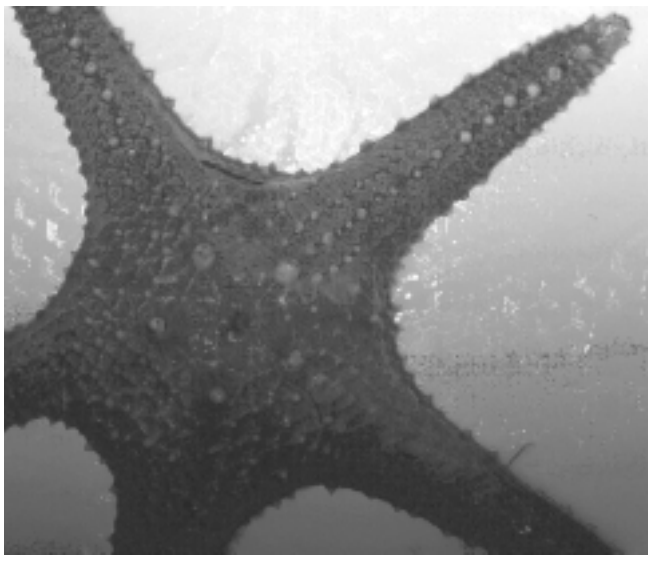


Fig. 6. *Pentaceraster sibogae*, Pulau Jemaja, Anambas.

FAMILY OPHIDIASTERIDAE VERRILL

Genus *Fromia* Gray

***Fromia elegans* H. L. Clark, 1921**

Fromia elegans H. L. Clark, 1921: 43.

***Material examined.* –** EAD 07 (R/r=19.5/1)(RCO).
***Sites.* –** Teluk Air Bandung, Pulau Mubur, Kepulauan Anambas (N3º17'45.3", E106º12'9.8").

***Occurrence in SCS.* –** new record for SCS.

***General distribution.* –** Indonesia, Philippines, N. & W. Australia.

***Remarks.* –** Superomarginal plates not obviously alternating in size as in *Fromia monilis*. Currently maintained as valid species. This species is possibly a synonym of *Fromia indica* (Perrier, 1869) according to Marsh, 1977.

***Fromia indica* (Perrier, 1869)**

Scytaster indica Perrier, 1869: 63 [255].
Fromia indica - Koehler, 1910: 140; H. L. Clark, 1921: 42; A. M. Clark, 1967: 188; Jangoux, 1978: 295; Guille et al., 1986: 132; Colin & Arneson, 1995: 245; Gosliner et al., 1996: 258; Coleman, 2000: 243.

***Material examined.* –** EAD 05 (R/r=28.4/6.2)(RCO), (R/r=23/6)(ZRC); EAD 06 (R/r=32.6/6.5)(RCO); EAD 09 (R/r=19.2/4.3)(RCO), (R/r=20/5.5)(ZRC); EAD 10, 2 specimens (R/r=25.2/6.3; 25/6.3)(RCO); EAD 11(R/r=23.4/5.5)(RCO), 2 specimens (R/r=24/6; 23/5.5)(ZRC); EAD 12 (R/r=21.5/5.3)(RCO); EAD 13 (R/r=14/8.1)(RCO), 2 specimens (R/r=44/6; 18/4)(ZRC).
***Sites.* –** Kepulauan Anambas: S.W. coast of Pulau Matak (N02º52.8', E105º50.43' to N02º51.23', E105º48.15' (30-32m); Kepulauan Natuna: S. & S.E. coast of Pulau Laut (N04º38'54.8", E107º57'43.3" and N04º37'39.8", E107º58'18.1"); N.W. of Pulau Natuna Besar (formerly Pulau Bunguran) (N04º13'57.0", E108º11'05.3"); N.E. coast of Pulau Salor.

***Occurrence in SCS.* –** 2,3,6 (0-44m).

***General distribution.* –** Bay of Bengal, Indonesia, S. China Sea, S. Japan, Fiji , New Caledonia.

***Remarks.* –** Actinal plate armament consists of low, blunt spinelets or elongated granules not appreciably different from those on adambulacrals.

***Fromia milleporella* (Lamarck, 1816)**

Asterias milleporella Lamarck, 1816: 564.
Linckia milleporella - Muller & Troschel, 1840: 103.
Fromia milleporella - H. L. Clark, 1921: 40; Hayashi, 1938a: 205; Marsh, 1977: 257; Guille et al., 1986: 130; Gosliner et al., 1996: 258; Coleman, 2000: 244.

***Material examined.* –** EAD 08 (R/r=25.1/7.1)(RCO); EAD 09 (R/r=19.35/6.1)(RCO), (R/r=20/5)(ZRC); EAD 10 (R/r=16.4/7.2)(RCO), 3 specimens (R/r=28/9;25/9;23/8.5)(ZRC); EAD 03 (R/r=22/5.5)(ZRC); EAD 11 (R/r=26/8)(ZRC); EAD 12 (R/r=14/4)(ZRC).
***Sites.* –** Kepulauan Anambas: Teluk Airbandung, S.E of Pulau Mubur (N03º18'05.5", E106º12'29.4"); E. coast Pulau Jemaja (N03º14'34.9", E106º14'32.6"); Kepulauan Natuna: S. & S.E. coast Pulau Laut (N04º38'54.8", E107º57'43.3" and N04º37'39.8", E107º58'18.1"); Pulau Panjang (N04º13.57'0", E108º11'05.3").

***Occurrence in SCS.* –** 2,3,4,5,6,7 (0-73m).

***General distribution.* –** Tropical Indo-West Pacific.

***Remarks.* –** Colour is uniformly pinkish-red.

***Fromia monilis* (Perrier, 1869)**

Scytaster monilis Perrier, 1869: 62 [254].
Fromia monilis - H. L. Clark, 1921: 46; Hayashi, 1938b: 425; Marsh, 1977: 258; Jangoux, 1978: 296; Guille et al., 1986: 130; Colin & Arneson, 1995: 246; Gosliner et al., 1996: 259; Coleman, 2000: 245.

***Material examined.* –** EAD 02 (R/r=31.2/8.35)(RCO); EAD 03, 2 specimens (R/r=37.75/8.0; 31.0/7.0)(RCO); EAD 10 (R/r=23.3/6.1)(RCO), 8 specimens (R/r range 34/8 – 26/7)(ZRC); EAD 04, 2 specimens (R/r=38/10 – 6 arms, 2 madreporites; 32/8 – 5 arms)(ZRC); EAD 05 (R/r=33/8)(ZRC); EAD 06, 3 specimens (R/r=26/6; 22/5; 18/4)(ZRC); EAD 07 (R/r=23/5); EAD 08 (R/r=20/5)(ZRC).
***Sites.* –** Kepulauan Anambas: N. edge of Teluk Tiri, Pulau Jemaja (N02º57'13.6", E105º50'47.4"); E. coast Pulau Jemaja (N03º14'34.9", E106º14'32.6"); Pulau Siantan & Pulau Mubur. Kepulauan Natuna: S.E. Pulau Laut (N04º37'39.8", E107º58'18.1").

***General distribution.* –** Red Sea, Andaman Is., S. China Sea, Indonesia, S. Japan, N.W. Australia, Caroline Is., New Caledonia.

***Occurrence in SCS.* –** 2,3,5,6,7 (0-51m).

***Fromia pacifica* H. L. Clark, 1921**

Fromia pacifica H. L. Clark, 1921: 42; Guille et al., 1986: 130.

***Material examined.* –** EAD 04 (R/r=29/7)(ZRC); EAD 11 (R/r=28/5.5)(ZRC).
***Sites.* –** N03º15'19.9", E106º14'32.6" (Anambas); N04º37'39.8", E107º58'18.1" (Natuna).

***Occurrence in SCS.* –** 3,6 (0-30m).

***General distribution.* –** South China Sea, W. Polynesia, New Caledonia, Hawaiian Is.

***Remarks.* –** *Fromia pacifica* is distinguished from other species of *Fromia* by clusters of enlarged central granules on the more distal marginal plates.

Genus *Gomophia* Gray

Gomophia egyptiaca Gray, 1840
(Fig. 7)

Gomophia egyptiaca Gray, 1840: 286; Koehler, 1910: 157; H. L. Clark, 1921: 55; A. M. Clark, 1967: 176; 1952: 206; Guille et al., 1986: 134; Gosliner et al., 1996: 260; Coleman, 2000: 246.

Material examined. – EAD 07 (R/r=53.1/8.3)(RCO), (R/r=57/8)(ZRC); EAD 08 (R/r=73.4/9.4)(RCO).
Sites. – S. & S.E. Pulau Mubur, Kepulauan Anambas (N03º17'45.3", E106º12'09.8" and N03º18'05.5", E106º12'29.4").

Occurrence in SCS. – 6 (0-80m).

General distribution. – Red Sea, East Africa, Mauritius, Sri Lanka, Christmas Is., S. Moluccas, Queensland, New Caledonia, S. Polynesia.

Remarks. – Overall body colour is dark brown with cream coloured tubercles and conical protruberances. Conical protruberances are granule covered except for smooth, conical, nipple-like extremity. Inferomarginals have central spine projecting ventrally – these are prominent at the tip of the arm but diminish in size and disappear proximally.

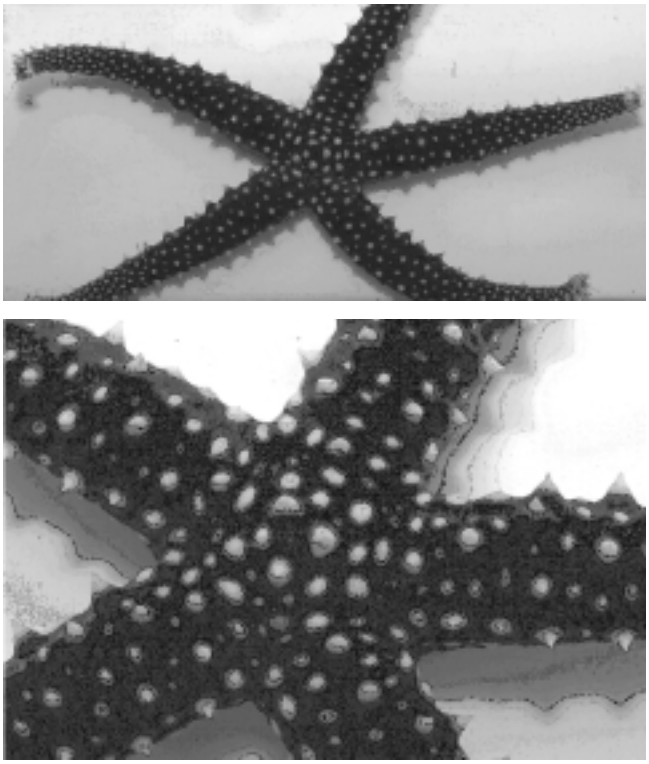


Fig. 7. *Gomophia egyptiaca*: general aboral view (above); close-up of central region (below).

Genus *Leiaster* Peters

Leiaster speciosus von Martens, 1866

Leiaster speciosus von Martens, 1866: 70; H. L. Clark, 1921: 74; Hayashi, 1938b: 211; Jangoux, 1980: 94; Guille et al., 1986: 136; Gosliner et al., 1996: 260.

Material examined. – Photorecord only, taken by 2nd author on 09 May.1996 (DJWL archive, no. ECH.075.10). Photographed in situ on reef slope at night.
Site. – Repong, Anambas.

Occurrence in SCS. – 2,3,5,6 (0-81m)

General distribution. – Indonesia, S. China Sea, Philippines, Ryukyus Is., E. Australia, Lord Howe Is., New Caledonia (10-30m).

Genus *Linckia* Nardo

Linckia laevigata (Linnaeus, 1758)

Asterias laevigata Linnaeus, 1758: 662.
Linckia laevigata - H. L. Clark, 1921: 64; Livingstone, 1932: 254; Hayashi, 1938b: 434: Marsh, 1977: 260; Guille et al., 1986: 138; Gosliner et al., 1996: 260; Moosleitner, 1997: 10; Coleman, 2000: 248, 249.

Material examined. – EAD 02 (R/r=18.5/2.0)(RCO), 2 specimens (R=105mm & 113mm)(ZRC); EAD 04 (R/r=22.6/3.5)(RCO); EAD 05, 3 specimens (R/r=19.9/2.4; 18.4/3.0;21.2/3.4)(RCO); EAD 06 (R/r=16.3/1.4)(RCO); EAD 10 (R/r=19.9/2.5)(RCO); EAD 12, 4 specimens (R/r=17.4/2.4; 8.3/1.3; 14.4/2.0; 8.4/1.9)(RCO); EAD 01, 3 specimens (R=109mm; R/r=117/14; R=110mm)(ZRC); EAZJ 03, 2 specimens (R=108mm, 96mm)(ZRC); EAZJ 12 (R=119mm)(ZRC).
Sites. – Kepulauan Anambas: N. edge of Teluk Tiru, Pulau Jemaja, (N02°57'13.6", E105°50'47.4"); E. coast Pulau Jemaja (N03º15'19.9", E106º13'48.3"); Pulau Mubur; S.W. coast Pulau Matak (N02º52.8', E105º50.43' to N02º51.23', E105º48.15'). Kepulauan Natuna: S.E. Pulau Laut (N04º37'39.8", E107º58'18.1"); S. tip of Pulau Batubilis, off W. coast Pulau Natuna Besar (formerly Pulau Bunguran) (N03º56.26', E107º7.50"). Depth 30-32m.

Occurrence in SCS. – 2, 3, 4, 5, 6, 7 (0-60m).

General distribution. – Indo-West Pacific: East Africa, Mozambique, Mauritius, Zanzibar, Red Sea, Persian Gulf, Maldives, Madras, Andaman Is., Philippines, Bacan, Celebes, Flores, Timor, Amboina, New Guinea, New Caledonia, Guam, Caroline Is., Fiji, Samoa, Hawaii Is., Australia (Kimberly to Abrolhos, Ashmore, Cartier, Scott Is., Rowley Shoals, N. Queensland).

Linckia multifora (Lamarck, 1816)

Asterias multifora Lamarck, 1816: 565.
Linckia multifora - Fisher, 1919: 400; H. L. Clark, 1921: 66; Hayashi, 1938b: 435; Ely, 1942: 19; Price, 1983: 45; Guille et al., 1986: 138; Gosliner et al., 1996: 260; Moosleitner, 1997: 10; Coleman, 2000: 249, 250.

***Material examined.* –** EAD 02 (R/r=18.5/2.0)(RCO); EAD 04 (R/r=22.6/3.5)(RCO); EAD 05, 3specimens (R/r=19.9/2.4; 18.4/3.0; 21.2/3.40)(RCO); EAD 06 (R/r=16.3/1.4)(RCO); EAD 10 (R/r=19.9/2.5)(RCO); EAD 12, 4 specimens (R/r=17.4/2.4; R/r=8.3/1.3; R/r=14.4/2.0; R/r=8.4/1.9)(RCO).
***Sites.* –** Kepulauan Anambas: N. edge of Teluk Tiru, Pulau Jemaja (N02°57'13.6", E105°50'47.4"); E. coast of Pulau Jemaja (N03°15'19.9", E106°13'48.3"); and S.W. coast of Pulau Matak (N02°52.80', E105°50.43' to N02°51.23', E105°48.15'); Kepulauan Natuna: rocky islet S.E. of Pulau Laut (N04°37'39.8", E107°58'18.1"); N.W. of Pulau Bungaran (N04°13'57.0", E108°11'05.3"). Depth 30-32m.

***Occurrence in SCS.* –** 2, 3, 4, 5, 6, 7 (0-69m).

***General distribution.* –** Tropical Indo-West Pacific: Mozambique, Mauritius, Madagascar, Seychelles, Red Sea, Maldives, Sri Lanka, Christmas Is., Philippines, Hong Kong, Japan, Sulawesi, Amboina, Australia (Ashmore, Cartier, Scott Is., Rowley Shoals, north Queensland, Kimberly to Abrolhos), New Caledonia, Micronesia, Fiji, Samoa, Society Is., Hawaii.

Genus *Nardoa* Gray

Nardoa frianti Koehler, 1910
(Fig. 8)

Nardoa frianti Koehler, 1910: 158; Fisher, 1919: 385; A. M. Clark, 1967: 178; Gosliner et al., 1996: 261.

***Material examined.* –** 1 specimen, EAD 04 (R/r=85.7/11.3)(RCO); 1 specimen, EAD 05 (R/r=69/8)(ZRC).

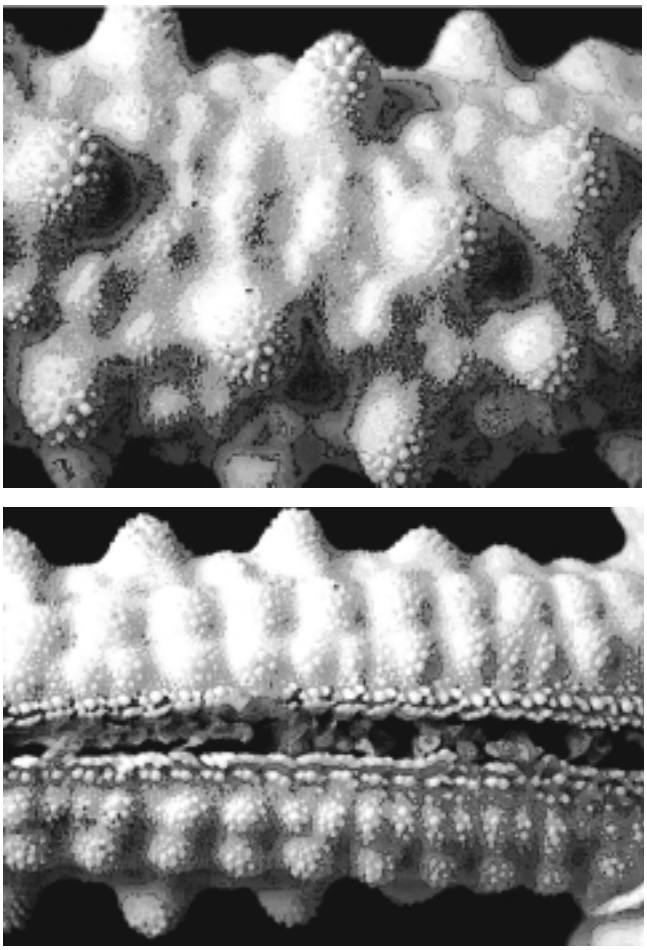


Fig. 8. *Nardoa frianti*: abactinal view (above) and abactinal view (below) of arm.

***Sites.* –** E. coast Pulau Jemaja (N03º15'19.9", E106º13'48.3"); S.W. coast Pulau Matak (N02º52.80', E105º50.43' to N02º51.23', E105º48.15'). 30-32m.

***Occurrence in SCS.* –** 2,3 (0-51m).

***General distribution.* –** Andaman Is., S. China Sea, Philippines, Caroline Is., New Caledonia.

Genus *Neoferdina* Livingstone

Neoferdina offreti (Koehler, 1910)
(Fig. 9)

Ferdina offreti Koehler, 1910: 143.
Neoferdina offreti - Jangoux, 1973: 778; Marsh, 1977: 263; Jangoux & Aziz, 1984: 867; Moosleitner, 1997:11; Coleman, 2000: 252.

***Material examined.* –** EAD 11 (R/r= 37.2/11.3)(RCO), 2 specimens (R:r=35/11; 33/9)(ZRC).
***Sites.* –** Rocky islet S.E. of Pulau Laut, Kepulauan Natuna (N4°37'39.8", E107°58'18.1").

***Occurrence in SCS.* –** 3? (0-62m).

***General distribution.* –** Indian Ocean, i.e. Amirantes Is., Seychelles, Maldives, Andaman Is.and Bay of Bengal. Caroline Is., New Caledonia.

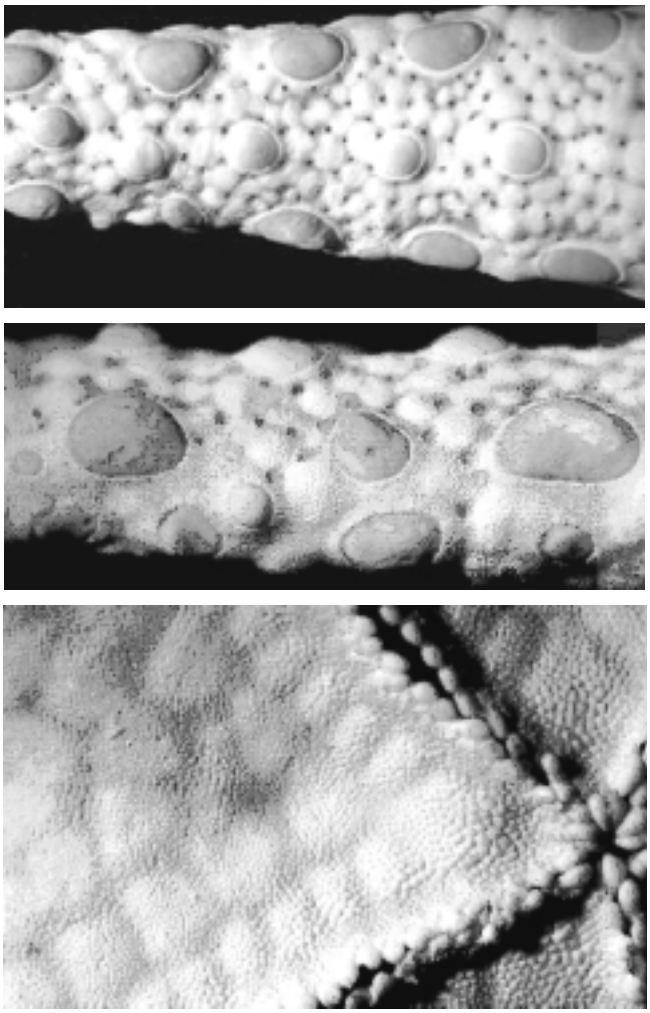


Fig. 9. *Neoferdina offreti*, dorsal (above) and lateral (centre) view of arm; actinal view of disc (below).

***Remarks.* –** Rows of naked carinal and marginal plates – marginal ones darkly pigmented. No pores on the ventral side.

Genus *Ophidiaster* L. Agassiz

Ophidiaster granifer Lütken, 1872

Ophidiaster granifer Lütken, 1872: 276; H. L. Clark, 1921: 81; Hayashi, 1938b: 437.

***Material examined.* –** EAD 05 (R/r=17/2; 11/1.5)(ZRC).
***Sites.* –** Anambas (N02º52.80', E105º50.43' to N02º51.23', E105º48.15').

***Occurrence in SCS.* –** 3,4,5,6 (0-123m).

***General distribution.* –** South China Sea, Indonesia, N. Australia, New Caledonia, Tonga.

FAMILY ACANTHASTERIDAE SLADEN

Genus *Acanthaster* Gervais

Acanthaster planci (Linnaeus, 1758)

Asterias planci Linnaeus, 1758: 823.
Acanthaster planci - Fisher, 1919: 441; H. L. Clark, 1921: 101; Hayashi, 1938b: 442; Guille et al., 1986: 146; Colin & Arneson, 1995: 249; Coleman, 2000: 254; Schoppe, 2000: 37.

***Material examined.* –** EAD 02 (R=87mm – specimen has 14 arms)(ZRC).
***Sites.* –** N. edge of Teluk Tiri, Anambas (N02º57'13.6", E105º50'47.4"). Two examples photographed by second author (DJWL photo archive nos. ECH.075.13-15) at Pulau Bawah, Anambas, 10 May.1996.
.
***Occurrence in SCS.* –** 2,3,4,5,6,7 (0-54m).

***General distribution.* –** Tropical Indo-West Pacific and E. Pacific.

FAMILY ASTERINIDAE GRAY

Genus *Asterina* Nardo

Asterina burtoni Gray, 1840
(Fig. 10)

Asterina burtoni Gray, 1840: 289; James & Pearse, 1969: 84; Sloan, 1979: 98; Price, 1983: 47; Guille et al., 1986: 144; Coleman, 2000: 253.

***Material examined.* –** EAD 02 (R/r=4.1/2.0)(RCO); EAD 03 (R/r=6.1/2.3)(RCO); EAD 11, 2 specimens (R/r=8.1/4.7; 6.65/4.10)(RCO); EAJL 01(R/r=19.2/6.2)(RCO); EAD 06 (R/r=4.5/2)(ZRC).
***Sites.* –** N. edge of Teluk Tiru (N02°57'13.6", E105°50'47.4"); and E. coast of Pulau Jemaja, Kepulauan Anambas (N03°14'34.9", E106°14'32.6"); S.E. Pulau Laut, Kepulauan Natuna (N04°37'39.8", E107°58'18.1").

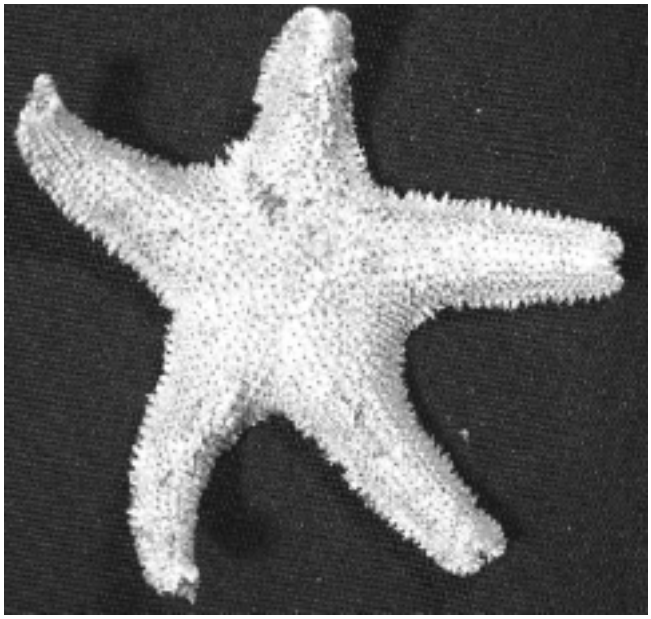
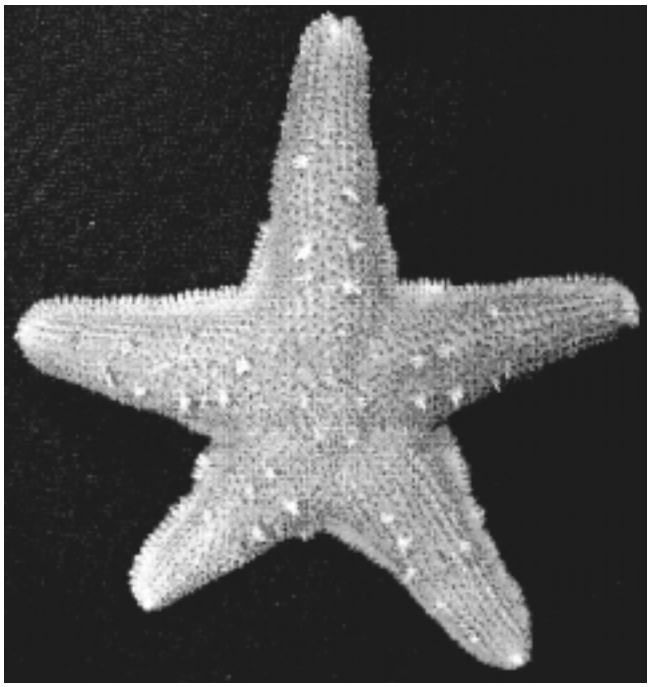


Fig. 10. *Asterina burtoni*: dorsal view.



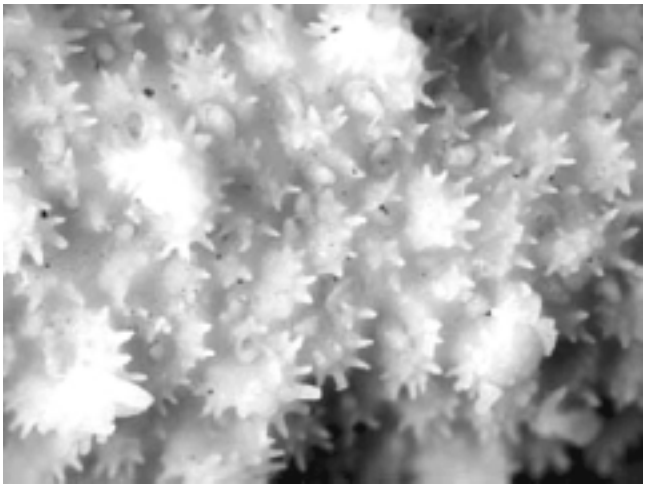


Fig. 11. *Asterina coronata*: general dorsal view (above) and close-up (below).

***Occurrence in SCS.* –** New record for SCS.

***General distribution.* –** West Indian Ocean, Red Sea, Laccadives, Maldives, Nicobar, Mergui, East Indies, Philippines, West Pacific, northern Australia, New Caledonia, Society Is.

Asterina coronata von Martens, 1866
(Fig. 11)

Asterina coronata von Martens, 1866: 73; Fisher, 1919: 414.

***Material examined.* –** EAJL 01, 3 specimens (R/r=25.2/9.45; 23.8/9.9; 24.34/9.6)(RCO); EAJL 07 (R/r=26/11)(ZRC).
***Sites.* –** N. edge of Teluk Tiru, Pulau Jemaja, Kepulauan Anambas; N.E. coast Pulau Panjang, Kepulauan Natuna.

***Occurrence in SCS.* –** 3, 5, 6 (0-18m).

***General distribution.* –** Sri Lanka, S. China Sea, East Indies, Philippines, northern Australia, Polynesia.

***Remarks.* –** Elevated clusters of spinelets are scattered on the abactinal side but around the aboral centre they form a coronal ring.

Genus *Cryptasterina* Dartnall, Byrne, Collins & Hart

Patiriella Verrill, 1913.

Cryptasterina pentagona (Muller & Troschel, 1842) new combination
(Fig. 12)

Asteriscus pentagonus Muller & Troschel, 1842: 42.
Asterina pentagona von Martens, 1866: 74.
Patiriella pseudoexigua Dartnall, 1971: 43.
Cryptasterina pentagona Dartnall et al., 2003: 359.

***Material examined.* –** EAJL 01, 3 specimens (R/r=14.4/11.7; 13.5/8.6; 9.4/7.1)(RCO), 2 specimens (R/r=13/9; 12/8.5)(ZRC); EAJL 04 (R/r=13.5/9.4)(RCO); EAZJ 03, 2 specimens (R/r=11.8/7.8; 13.6/8.4)(RCO); EAZJ 07 (R/r=11.0/7.0)(RCO); EAZJ 11, 4 specimens (R/r=11.3/8.0; 8.3/7.0; 8.1/6.0; 7.4/5.6)(RCO), (R/r=9.5/6.5)(ZRC), 10 specimens (6-armed specimens: R/r=16.6/11.5; 15/12; 7/5.5; 5-armed specimens: R/r=13.5/10; 12/8.5; 11.5/8; 11.5/8; 11/7.5; 11/7; 8/6.6)(ZRC); EAJL 02 (R/r=13.5/9.5)(ZRC).
***Sites.* –** Anambas Is.: N. & E. coast of Teluk Tiru, Pulau Jemaja; S.E. coast of Nulwan peninsula, Peninting, Pulau Matak, (N02°53'10", E105°48'30.1"); Teluk Airbandung, Pulau Mubur (N03°17.95', E106°13.10'); Kepulauan Natuna: N.E. coast of Pulau Salor (N03°53.73', E107°55.20').

***Occurrence in SCS.* –** (as "*Patiriella pseudoexigua*") 3, 4, 5, 6 (0-45 m).

***Remarks.* –** Five oral spines and 1 suboral spine present on each oral plate. Several 6-armed specimens are recorded for the Natuna area. The exiguoid group of asterinid sea stars are separated from other *Patiriella* species on the basis of an aspinous adradial row of plates bordering the adambulacrals, a feature which is clearly visible in the Anambas/Natuna material. The exiguoids are all very similar morphologically and the new genus *Cryptasterina* has been designated largely on evidence of mtDNA sequences (cited in Dartnall et al., 2003). The present material closely matches the description in Dartnall et al. (2003) for *Cryptasterina pentagona* (formerly *Patiriella pseudoexigua*).

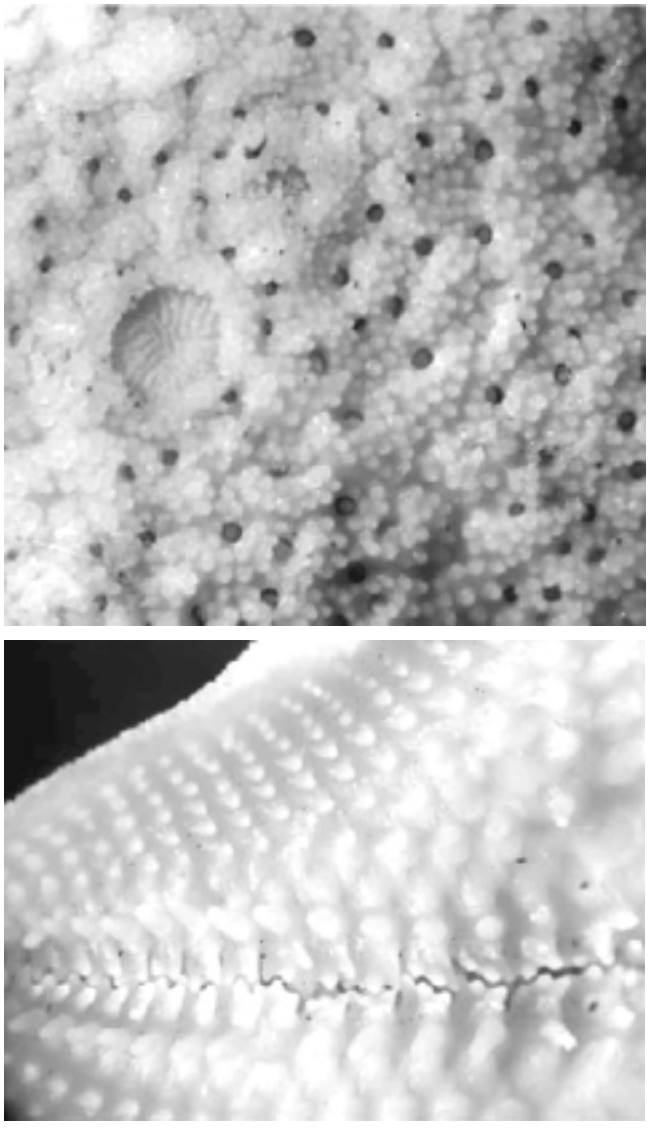


Fig. 12. *Cryptasterina pentagona*: dorsal (above) and ventral view (below).

Genus *Nepanthia* Gray

***Nepanthia belcheri* (Perrier, 1876)**
(Fig. 13)

Asterina (Nepanthia) belcheri Perrier, 1876: 240.
Asterina (Nepanthia) brevis Perrier, 1875: 321 (according to Rowe & Marsh, 1982).
Asterina suffarcincta Sladen, 1888: 328.
Nepanthia belcheri - Rowe & Marsh, 1982: 99.

***Material examined.* –** EATT 06 (R/r=18/6.1)(RCO).
***Sites.* –** Night trawl (46m), Teluk Tarempa, Kepulauan Anambas (N03°15.31', E106°9.50' to N03º15.28', E106º11.79').

***Occurrence in SCS.* –** 2,5,6,7 (0-128m).

***General distribution.* –** Burma, Mergui Arch., Bay of Bengal, Singapore, N. Australia, Philippines, China & S. Japan, S. Pacific Is.

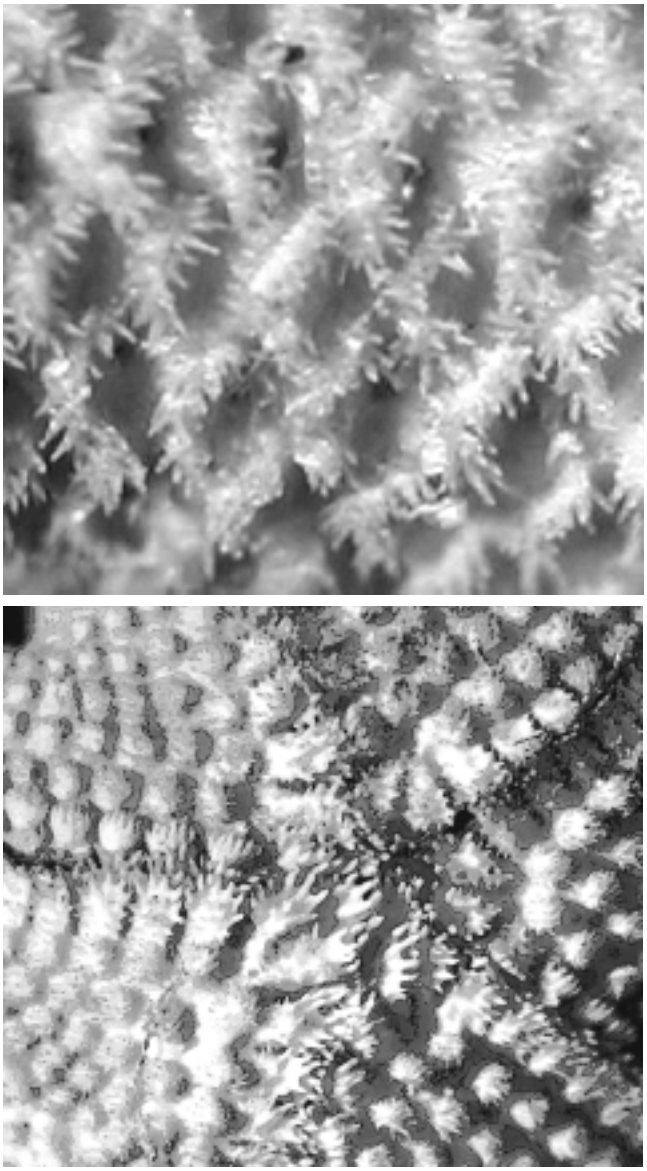


Fig. 13. *Nepanthia belcheri*: dorsal plates (above) and ventral disc (below).

FAMILY PTERASTERIDAE PERRIER

Genus *Euretaster* Fisher

***Euretaster insignis* (Sladen, 1882)**
(Fig. 14)

Retaster insignis Sladen, 1882: 200; 1889: 482.
Euretaster insignis - Jangoux, 1984: 289; Guille et al., 1986: 148.

***Material examined.* –** EATT 04, 3 specimens (R/r=18.8/7.6; 30.2/13.7; 35.6/17.3)(RCO), 2 specimens (R/r=56/27 – has 5 adambulacral spines in proximal comb rows (ZRC); R/r=20/9 – has 4 adambulacral spines in proximal comb rows).
***Sites.* –** Night trawl. Mouth of Teluk Jebung, Pulau Jemaja, Kepulauan Anambas.

***Occurrence in SCS.* –** 2, 3, 4, 5, 6, 7 (0-132m).

***General distribution.* –** Malaysia, S. China, East Indies, Philippines, Australia (N. and S. Queensland, Northern Territory, Kimberly to Abrolhos, Geraldton to Freemantle, Cape Leeuwin, New South Wales), Samoa.

***Remarks.* –** Aboral surface cream coloured with orange pigmentation at arm tips, proximal interradial areas, entire ambulacral furrow and around some of the spines. One of the smaller *Euretaster* specimens (EATT 04, R/r=20/9) keys out as *Euretaster cribrosus* on the basis of comb-row spine number but it is possibly a juvenile of *E. insignis*.

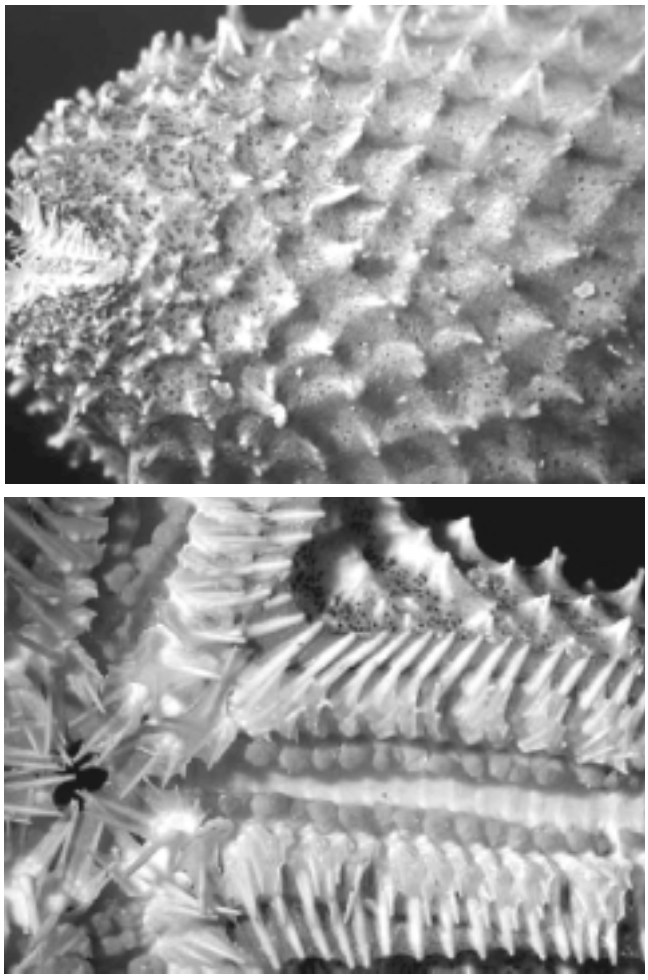


Fig. 14. *Euretaster insignis*: dorsal arm (above) and ventral view (below).

FAMILY ECHINASTERIDAE VERRILL

Genus *Echinaster* Müller & Troschel

***Echinaster luzonicus* (Gray, 1840)**

Othilia luzonicus Gray, 1840: 282.
Echinaster luzonicus – H.L. Clark, 1921: 98; Domantay & Roxas, 1938: 230; Hayashi, 1940:123; Guille et al., 1986: 152; Colin & Arneson, 1995: 249, 250; Gosliner et al., 1996: 264.

***Material examined.* –** EAD 04 (R/r=85.4/8.1)(RCO), (R/r=68/9)(ZRC); EAD 10, 2 specimens (R/r=61.2/10.5; 74.2/13.0)(RCO), (R/r=70/10)(ZRC), 4 specimens (R ranging from 45-72mm, the smallest being a 6-armed comet stage)(ZRC); EAD 11 (R/r=19.5/5.5)(RCO), (6 arms R/r=39/8)(ZRC); EAZJ 05 (R/r=73.0/12.7)(RCO).
***Sites*. –** Kepulauan Anambas: E. coast of Pulau Jemaja, (N03º15'19.9", E106º13'48.3"); S.E. coast of Niulwan peninsula, Pulau Matak, (N03º13.67', E106º15.95'). Kepulauan Natuna: S.E. of Pulau Laut (N04º37'39.8", E107º58'18.1").

***Occurrence in SCS.* –** 2,3,4,5,6,7 (0-73m).

***General distribution.* –** Western India, Maldives, Bay of Bengal, S. China Sea, N. Australia, Caroline Is.

Genus *Metrodira* Gray

***Metrodira subulata* Gray, 1840**

Metrodira subulata Gray, 1840: 282; Koehler, 1910: 172.

***Material examined.* –** EATT 06 (R/r=22.2/3.4)(RCO).
***Sites.* –** Night trawl (46m), Teluk Tarempa, Kepulauan Anambas (N03º15.31', E106º9.50' to N03º15.28', E106º11.79').

***Occurrence in SCS.* –** 2, 5, 6, 7 (0-15m).

***Remarks.* –** The Anambas record extends the known depth range for this species to 46m.

DISCUSSION

A total of 28 species of Asteroidea are now known from the Anambas/Natuna region with 27 of these being recorded in the 2002 collections of Expedition Anambas and a further species recorded earlier (unpublished observations of 2nd author). More taxa were found at Anambas than at Natuna (Table 1) but this probably reflects the greater sampling effort at the former site. Two species, namely *Asterina burtoni* Gray, 1840, and *Fromia elegans* H. L. Clark, 1921, are new records for the South China Sea (SCS). Two other recorded taxa, *Gomophia egyptiaca* Gray, 1840, and *Pentaceraster decipiens* (Bell, 1884), are rare in the SCS and, for the former, the present survey has expanded its known geographic range to the southern SCS. With the addition of the Anambas/Natuna new records for the SCS, the total asteroid count for the SCS as a whole now stands at 230.

The most diverse family of shallow-water asteroids in the tropical Indo-Pacific, the Ophidiasteridae, is well represented in the present survey, with 11 species recorded. The occurrence of the ophidiasterid *Neoferdina offreti* at Natuna represents the first record for this genus in the southern part of the South China Sea and possibly a new SCS record for the species as its status for the SCS coast of the Philippines is uncertain (Lane et al., 2000). One often overlooked group of sea-stars, the tropical, exiguoid asterinids of the genus *Cryptasterina* (formerly under *Patiriella*), are of particular taxonomic and conservation interest. These generally inhabit inter-tidal cobbles and rocks and in the Anambas region were mostly found in front of mangroves where rocks and dead corals lay on the sand. They tend to show high levels of endemism (Dartnall et al., 2003). The present material is currently assigned to *Cryptasterina pentagona* but a critical re-examination, including molecular methods, may reveal additional cryptic taxa. A sea-star notable as much for its absence – at least in large numbers – as for its presence, is the coral predator, the crown-of-thorns starfish *Acanthaster planci*. It was sighted only infrequently at Anambas and not at all at Natuna.

The Expedition Anambas survey has greatly increased knowledge of the biodiversity of Echinoderms in general and asteroids in particular for the southern South China Sea but the present inventory is not thought to be complete. Low species numbers for the asteroid families Luidiidae and Astropectinidae and the absence of records for Goniasteridae indicate that further sampling, particularly at night and in deeper waters, would be likely to reveal additional sea-star taxa.

ACKNOWLEDGEMENTS

The first author is very grateful to Dr. Aznam Aziz for his assistance. The photographs for Figs. 5-7 were taken by Tan Heok Hui.

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