

Results of the Rumphius Biohistorical Expedition to Ambon (1990).



Part 12. The Asteroidea (Echinodermata) collected from Ambon, Indonesia

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Fujita, T. & L.M. Marsh. Results of the Rumphius Biohistorical Expedition to Ambon (1990). Part 12. The Asteroidea (Echinodermata) collected from Ambon, Indonesia.

Zool. Med. Leiden, 78 (8), 27.viii.2004: 161-179, figs 1-8.— ISSN 0024-0672.

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Key words: Asteroidea; Echinodermata; Ambon; Indonesia; taxonomy; new combination.

During the Rumphius Biohistorical Expedition (4.xi-17.xii.1990) and some additional field trips to Ambon, a total of 26 species of asteroids were collected. Seven species were new to Ambon, and four species new to Indonesia. The asteroid fauna of Ambon is now represented by 44 species. *Anthenea dif-ficilis* is transferred to the genus *Gymnanthenea*. Taxonomical notes are given on the collected specimens for some species.

Introduction

Ambon is a small island situated in the center of the Moluccas (Maluku) where the marine fauna is very rich. The first to describe asteroids of Ambon was Rumphius (1705). He described four asteroid species, and later von Martens (1902) and Engel (1959) gave Linnean scientific names, *Linckia laevigata*, *Acanthaster planci* and *Proto-reaster nodosus* to three of them, but one of them seemed difficult to be identified. Since then, several workers have studied asteroids from Ambon (table 1): in particular, in the second half of nineteenth century, von Martens (1866), de Loriol (1893), Sluiter (1895) and Döderlein (1896) studied many asteroid species from Ambon. Recently, Guille & Jangoux (1978) studied 31 species of asteroids based on the specimens collected by the Rumphius I expedition in 1973, partly from Ambon.

In the present paper, we report the asteroids collected mainly from Ambon during the Rumphius Biohistorical Expedition conducted by H.L. Strack of the Foundation for the Advancement of Biohistorical Research in 1990 (Strack, 1993, 1998) and two

Table 1. Asteroid fauna of Ambon Island, Indonesia. Species found in this study are in bold face. References. A: von Martens, 1866, B: Studer, 1884, C: Hartlaub, 1892, D: de Loriol, 1893, E: Sluiter, 1895, F: Döderlein, 1896, G: H.L. Clark, 1908, H: Döderlein, 1926, I: Döderlein, 1935, J: Döderlein, 1936, K: Guille & Jangoux, 1978, ps: present study.

Family	Species	Cited as	References	
Luidiidae	<i>Luidia longispina</i> Sladen, 1889	<i>Luidia longispina</i>	K	
	<i>Luidia maculata</i> Müller & Troschel, 1842	<i>Luidia maculata</i>	D	
	<i>Luidia savignyi</i> (Audouin, 1826)	<i>Luidia savignyi</i>	ps	
Astropectinidae	<i>Astropecten alatus</i> Perrier, 1875	<i>Astropecten alatus</i>	E	
	<i>Astropecten indicus</i> Döderlein, 1889	<i>Astropecten indicus</i>	K	
	<i>Astropecten polyacanthus</i> Müller & Troschel, 1842	<i>Astropecten polyacanthus</i>	D, K, ps	
	<i>Astropecten velitaris</i> von Martens, 1865	<i>Astropecten velitaris</i>	F, K	
Asterinidae	<i>Asterina cepheus</i> (Müller & Troschel, 1842)	<i>Asterina burtoni</i>	K	
		<i>Asterina cephea</i>	E, G	
		<i>Asterina cepheus</i>	D, F, ps	
	<i>Asterina coronata</i> von Martens, 1866	<i>Asterina coronata</i>	A, K, ps	
	<i>Asterina spec.</i>	<i>Asterina spec.</i>	ps	
	<i>Disasterina odontacantha</i> Liao, 1980	<i>Disasterina odontacantha</i>	ps	
	<i>Patiriella pseudoexigua</i> Dartnall, 1971	<i>Asterina exigua</i>	D	
		<i>Patiriella exigua</i>	K	
		<i>Patiriella pseudoexigua</i>	ps	
	Archasteridae	<i>Archaster typicus</i> Müller & Troschel, 1840	<i>Archaster typicus</i>	A, D, F, G, K, ps
Goniasteridae	<i>Ogmaster capella</i> (Müller & Troschel, 1842)	<i>Ogmaster capella</i>	K	
	<i>Stellaster childreni</i> Gray, 1840	<i>Stellaster equestris</i>	K	
Oreasteridae	<i>Anthenea viguieri</i> Döderlein, 1915	<i>Anthenea viguieri</i>	H	
	<i>Choriaster granulatus</i> Lütken, 1869	<i>Choriaster granulatus</i>	K	
	<i>Culcita novaeguineae</i> Müller & Troschel, 1842	<i>Culcita arenosa</i>	C	
		<i>Culcita discoidea</i>	A	
		<i>Culcita grex</i>	D	
		<i>Culcita novaeguineae</i>	F, G, K, ps	
		<i>Culcita plana</i>	C	
		<i>Goniodiscus sebae</i>	F	
		<i>Gymnanthenea difficilis</i> (Liao, 1995)	<i>Gymnanthenea difficilis</i>	ps
		<i>Nectria ocellifera</i> (Lamarck, 1816)*	<i>Nectria ocellifera</i>	E
		<i>Pentaceraster alveolatus</i> (Perrier, 1875)	<i>Pentaceraster alveolatus</i>	ps
		<i>Pentaster obtusatus</i> (Bory de Saint Vicent, 1827)	<i>Pentaceropsis obtusatus</i>	D, F
			<i>Pentaceros grayi</i>	E
			<i>Pentaster obtusatus</i>	K
		<i>Protoreaster nodosus</i> (Linnaeus, 1758)	<i>Oreaster turritus</i>	A
			<i>Oreaster muricatus</i> var. <i>intermedia</i>	A
			<i>Oreaster nodosus</i>	G
		<i>Pentaceros turritus</i>	D, F	
		<i>Protoreaster nodosus</i>	I, J, K, ps	
Asteropseidae	<i>Asteropsis carinifera</i> (Lamarck, 1816)	<i>Asteropsis carinifera</i>	K, ps	
		<i>Gymnasteria carinifera</i>	A, E, F	
Acanthasteridae	<i>Acanthaster planci</i> (Linnaeus, 1758)	<i>Acanthaster echinites</i>	D, F	
		<i>Acanthaster planci</i>	K, ps	
Mithrodiidae	<i>Mithrodia clavigera</i> (Lamarck, 1816)	<i>Mithrodia clavigera</i>	F, K, ps	
Ophidiasteridae	<i>Bunaster ritteri</i> Döderlein, 1896	<i>Bunaster ritteri</i>	F	
	<i>Celerina heffernani</i> (Livingstone, 1931)	<i>Celerina heffernani</i>	K, ps	
	<i>Dactylosaster cylindricus</i> (Lamarck, 1816)	<i>Ophidiaster cylindricus</i>	E	
	<i>Fromia eusticha</i> Fisher, 1913	<i>Fromia eusticha</i>	ps	

	<i>Fromia indica</i> (Perrier, 1869)	<i>Fromia indica</i>	K
	<i>Fromia milleporella</i> (Lamarck, 1816)	<i>Fromia milleporella</i>	K
		<i>Linckia milleporella</i>	A
	<i>Fromia monilis</i> (Perrier, 1869)	<i>Fromia monilis</i>	K, ps
	<i>Gomophia gomophia</i> (Perrier, 1875)	<i>Gomophia gomophia</i>	ps
	<i>Gomophia watsoni</i> (Livingstone, 1936)	<i>Gomophia watsoni</i>	ps
	<i>Linckia guildingii</i> Gray, 1840	<i>Linckia guildingii</i>	K
		<i>Linckia pacifica</i>	E
	<i>Linckia laevigata</i> (Linnaeus, 1758)	<i>Linckia laevigata</i>	G, K, ps
		<i>Linckia miliaris</i>	A, D, F
		<i>Linckia rosenbergi</i>	A
	<i>Linckia multifora</i> (Lamarck, 1816)	<i>Linckia multifora</i>	E, F, K, ps
		<i>Linckia multiforis</i>	A
	<i>Nardoa galathea</i> (Lütken, 1865)	<i>Nardoa galathea</i>	K, ps
	<i>Nardoa tuberculata</i> Gray, 1840	<i>Linckia tuberculata</i>	A
		<i>Nardoa pauciforis</i>	E
		<i>Nardoa tuberculata</i>	D, E, F, K, ps
	<i>Ophidiaster granifer</i> Lütken, 1871	<i>Ophidiaster granifer</i>	H, K, ps
	<i>Ophidiaster hemprichi</i> Müller & Troschel, 1842	<i>Linckia pustulata</i>	A
		<i>Ophidiaster hemprichi</i>	K
		<i>Ophidiaster purpureus</i>	D
		<i>Ophidiaster pustulatus</i>	F
	<i>Tamaria pusilla</i> (Müller & Troschel, 1844)	<i>Tamaria pusilla</i>	K
Echinasteridae	<i>Echinaster luzonicus</i> (Gray, 1840)	<i>Echinaster eridanella</i>	D, F
		<i>Echinaster fallax</i>	A
		<i>Echinaster luzonicus</i>	K, ps
	<i>Metrodira subulata</i> Gray, 1840	<i>Metrodira subulata</i>	B

* *Nectria* is considered to be an endemic genus to southern Australia, and this record is doubtful.

short field trips in 1989 and 1998. Specimens from Ambon stations sampled during the Rumphius IV Expedition in 1980 and two other field trips are added, including three species not previously recorded from Ambon. A total of 164 asteroid specimens were examined. They included 26 (and 1 unidentified) species of 21 genera of 10 families. The asteroid fauna of Ambon Island is compiled here (Table 1) and seven species are reported from Ambon Island for the first time.

Materials and methods

Asteroids were collected during the Rumphius Biohistorical Expedition around Ambon Island at 19 stations from 4 November to 17 December, 1990 (Fig. 1). Detailed information about the Rumphius stations was given in Strack (1993, 1998). During the Rumphius IV Expedition in 1980, asteroids were collected at three stations and one additional site as follows: St. AM V (east of Ery, 3°44'11"S, 128°7'54"E, 1.xi.1980); St. AM VI (Ery, 3°45'15"S, 128°7'33"E, 30.x.1980); St. AM VII (Latuhalat, 3°46'37"S, 128°7'15"E, 1.xi.1980); additional site (Nusaniwe, 26.xi.1980) (Fig. 1). Some additional specimens were also collected from Ambon by H.L. Strack (Strack, 1993) at St. S3 (Paso, Baguala Bay, 6.x.1989) and at St. S4 (Pombo Island, 8.x.1989), by the first author at St. F1 (Hukurila, 12.xii.1998), St. F2 (Guru Guru, Poka, 12.xii.1998), St. F3 (Waiheru, 12.xii.1998) and St. F4 (Ery, 13.xii.1998). The specimens were collected directly by handpicking at low tide, by snorkeling, and by scuba diving, except 3 animals collected

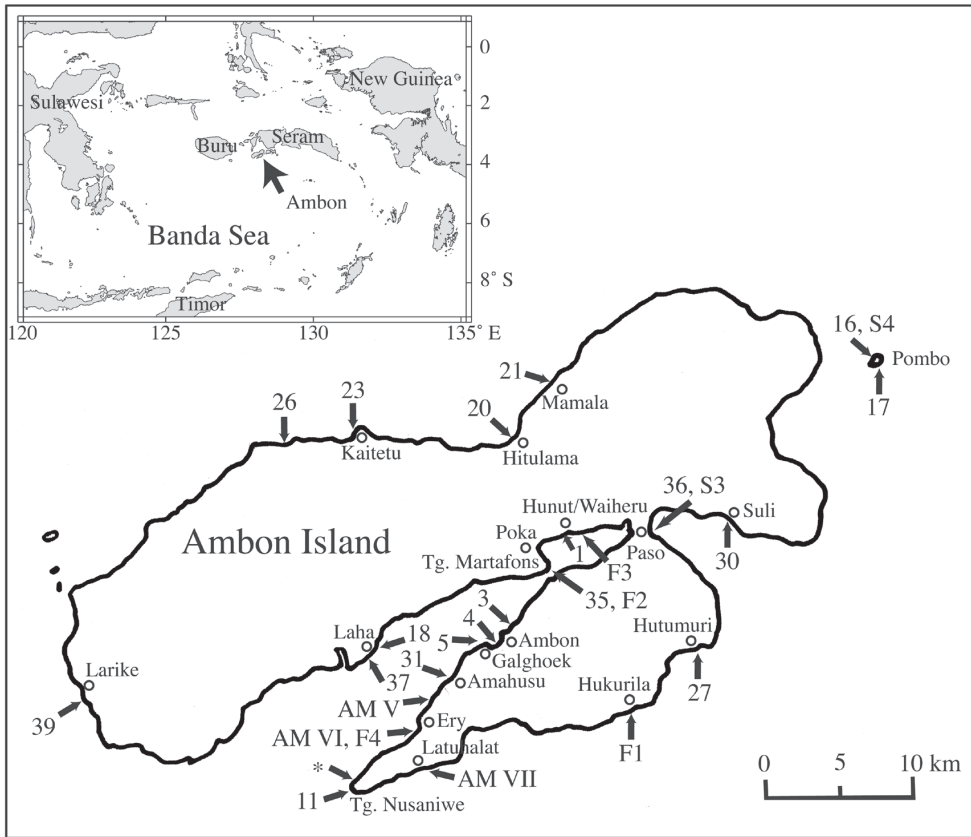


Fig. 1. Sampling locality. Sampling stations are indicated by arrows. Numerals only denote station number of the Rumphius Expedition in 1990. AM IV-VII and an asterisk are Ambon stations and an additional site of Rumphius IV Expedition. F1-4 and S3-4 show the position of additional sampling by the first author and H.L. Strack, respectively.

by a beam trawl net (Sts. F2 and F3). The specimens were mostly fixed in neutralized formalin and preserved in ethanol or directly put into ethanol. Some larger specimens have been dried. The specimens are deposited at the National Museum of Natural History, Leiden (RMNH), the Western Australian Museum (WAM), and the National Science Museum, Tokyo (NSMT).

Systematic account

Family Luidiidae Sladen, 1889

Genus *Luidia* Forbes, 1839

Luidia (Luidia) savignyi (Audouin, 1826)

(fig. 2A)

Material.— RMNH Ech. 6100, St. 31, 2-4 m deep, on sand, 1 specimen, R/r = 49.3/9.3 mm.

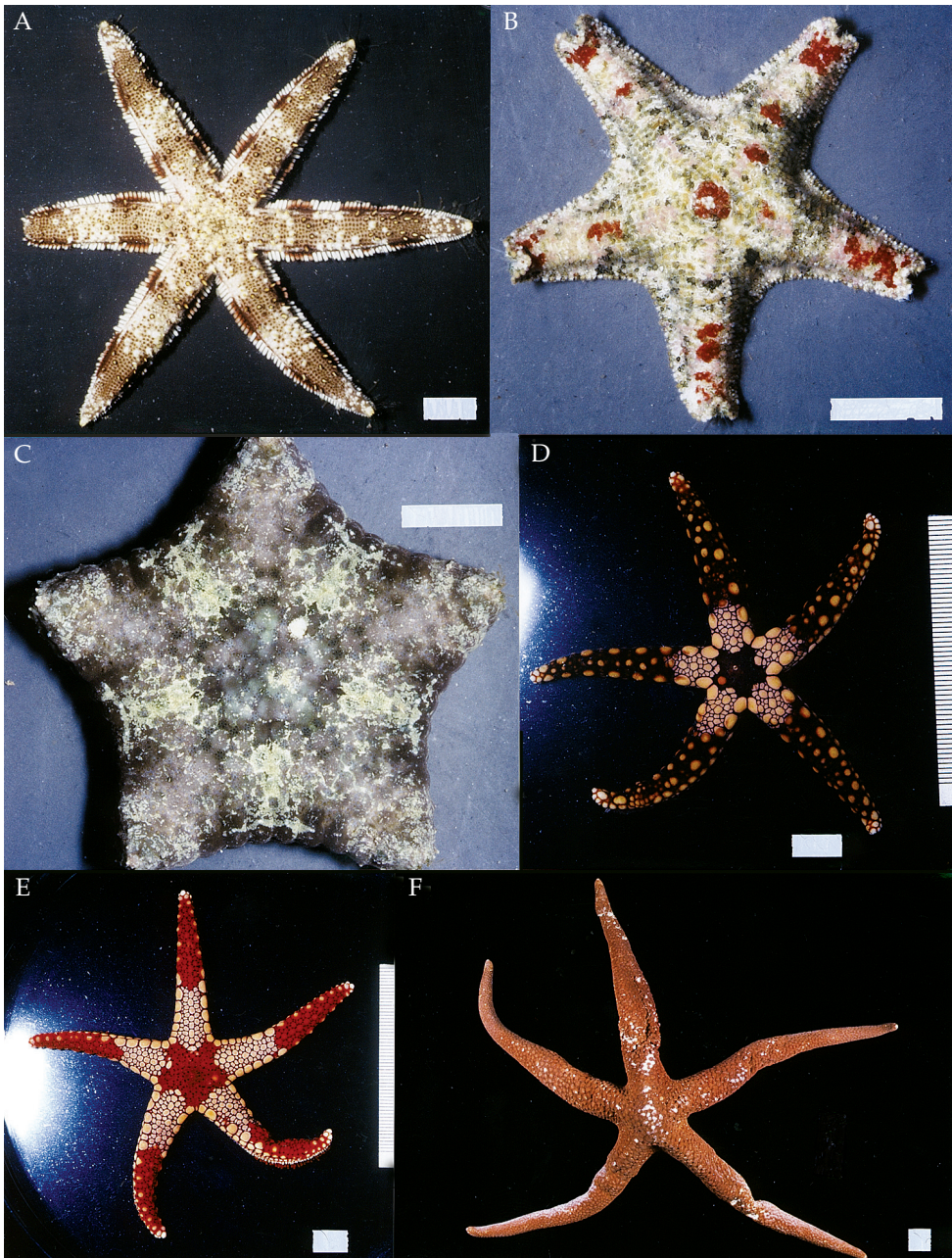


Fig. 2. **A:** *Luidia (Luidia) savignyi* (Audouin, 1826). RMNH Ech. 6100, live specimen. **B:** *Asterina cepheus* (Müller & Troschel, 1842). RMNH Ech. 6150, live specimen. **C:** *Culcita novaeguineae* Müller & Troschel, 1842. RMNH Ech. 6147, live specimen. **D:** *Celerina heffernanii* (Livingstone, 1931). NSMT E-4215, live specimen. **E:** *Fromia monilis* (Perrier, 1869). NSMT E-4214, live specimen. **F:** *Nardoa galatheae* (Lütken, 1865). NSMT E-4212, dry specimen. All horizontal scales: 1 cm. A-C: Photo courtesy of H.L. Strack.

Synonymy.— See A.M. Clark, 1989: 247.

Remarks.— This species has been reported widely from the Indian Ocean and also from the Philippines and Marshall Islands (A.M. Clark & Rowe, 1971), but is new to Indonesian waters and Ambon. The present specimen has 6 arms, but the species has usually 7 arms. Two species of *Luidia* have been reported from Ambon: *L. maculata* Müller & Troschel, 1842 (de Loriol, 1893: 379) and *L. longispina* Sladen, 1889 (Guille & Jangoux, 1978: 50). *Luidia savignyi* can be distinguished from the above two species by the number of arms and the sporadically distributed conical spines on abactinal papillae.

Family Astropectinidae Gray, 1840

Genus *Astropecten* Gray, 1840

Astropecten polyacanthus Müller & Troschel, 1842

Material.— RMNH Ech. 6105, St. 31, 2-4 m deep, 1 specimen, R/r = 17.3/5.45 mm; RMNH Ech. 6166, St. 35, on sand flat, 1 specimen, R/r = 72.7/16.1 mm.

Synonymy.— See A.M. Clark, 1989: 266.

Family Asterinidae Gray, 1840

Genus *Asterina* Nardo, 1834

Asterina cepheus (Müller & Troschel, 1842)
(fig. 2B)

Material.— RMNH Ech. 6151, St. 17, 1-3 m deep, 1 specimen, R/r = 17.65/8.9 mm; RMNH Ech. 6154, St. 20, intertidal, under rocks, 2 specimens, R/r = 18.75/9.95, 9.65/4.25 mm; RMNH Ech. 6149, St. 23, 1.5 m deep, under rocks, 1 specimen, R/r = 20.3/10.6 mm; RMNH Ech. 6153, St. 26, intertidal, under coral rocks, 2 specimens, R/r = 19.6/8.55, 14.4/6.75 mm; RMNH Ech. 6150, St. 27, 1 m deep, 3 specimens, R/r = 21.0/9.05, 19.6/9.8, 18.2/8.9 (6 arms) mm; RMNH Ech. 6152, St. 27, 0-0.5 m deep, 5 specimens, R/r = 16.4/7.85, 16.4/7.65, 16.3/8.0, 16.25/7.7, 14.3/7.05 mm; WAM Z 13581, St. AM V, 0-1 m deep, under coral slab, 1 specimen, R/r = 20/10 mm (6 arms).

Synonymy.— See A.M. Clark, 1993: 208; Liao & A.M. Clark, 1995: 130.

Asterina coronata von Martens, 1866

Material.— RMNH Ech. 6144, St. 18, 1-2 m deep, 4 specimens, R/r = 14.75/7.2, 14.5/7.5, 10.9/6.05, 9.8/5.0 mm; RMNH Ech. 6143, St. 23, 1.5 m deep, under rocks, 4 specimens, R/r = 21.5/9.05 (6 arms), 18.8/7.8, 17.15/8.45, 14.75/6.5 mm; RMNH Ech. 6140, St. 36, intertidal, 1 specimen, R/r = 11.3/6.6 mm; RMNH Ech. 6141, St. 37, intertidal, 1 specimen, R/r = 13.6/7.1 mm; RMNH Ech. 6142, St. 37, intertidal, 4 specimens, R/r = 27.7/13.9, 25.15/12.45, 22.2/10.3, 18.2/8.95 mm; RMNH 6156, St. S3, low water mark, under rocks, 1 specimen, R/r = 11.45/6.1 mm.

Synonymy.— See A.M. Clark, 1993: 208.

Remarks.— As Guille & Jangoux (1978: 58) suggested, these specimens also show intermediate form between *A. coronata coronata* and *A. coronata cristata* Fisher, 1916. Fisher (1919: 414), in his key, distinguished these two subspecies by the numbers of adambulacral furrow spines, actinal spines, enlarged abactinal plates and spines on those plates. The adambulacral furrow spines of the present specimens are 5-6 (rarely

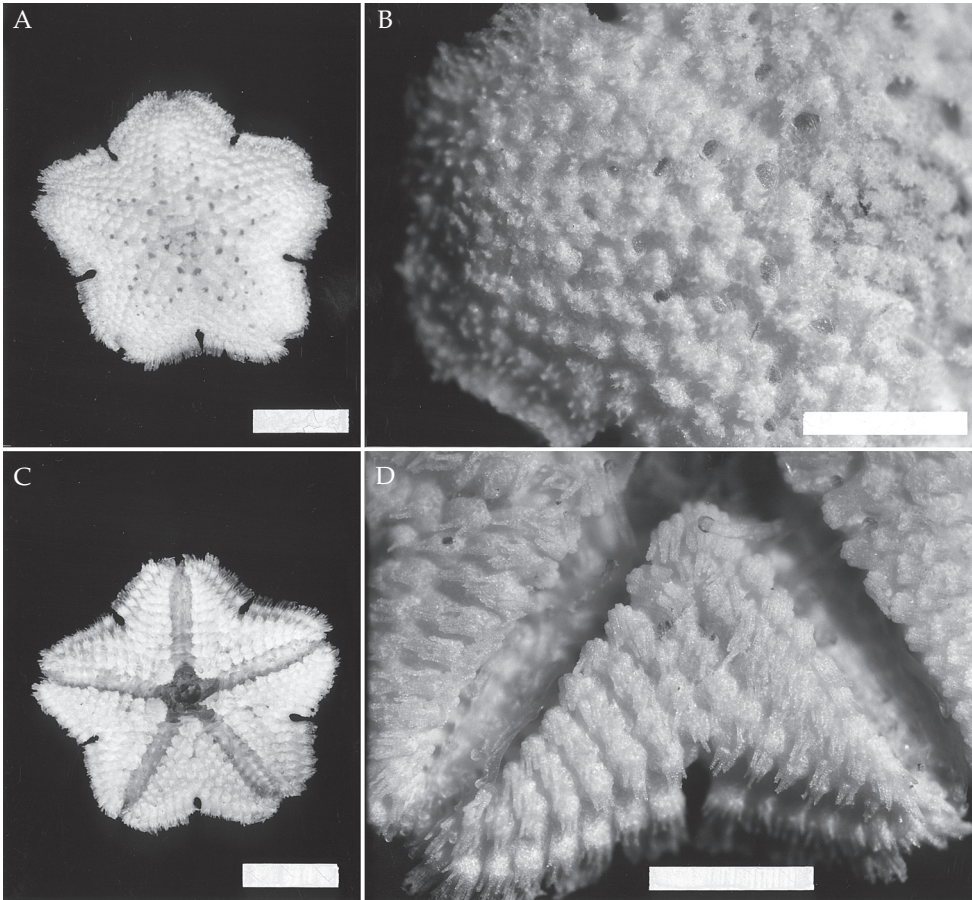


Fig. 3. *Asterina* spec. NSMT E-4219, dry specimen. **A:** Whole body, dorsal view. Scale 2 mm. **B:** Enlarged view of dorsal side. Scale 1 mm. **C:** Whole body, ventral view. Scale 2 mm. **D:** Enlarged view of ventral side. Scale 1 mm.

7 or 8) in number, the actinal spines are usually 2 or 3 but range 1-5. The number of enlarged abactinal plates varies from 10 to 25 according to the body size, small animals have only inconspicuous ones, ca. 5-10 in number. The number of spinelets on the enlarged plates range ca. from 10 to 25 spines. Therefore we believe there are inadequate grounds for maintaining these two subspecies.

Asterina spec.
(fig. 3)

Material.— NSMT E-4219, St. F4, 0-16 m deep, 1 specimen (dry), R/r = 3.1/2.1 mm.

Remarks.— One possibly juvenile *Asterina* specimen could not be identified. The body is flat (1 mm thick) and pentagonal with concave interradial arcs of which the

center has a deep notch. Abactinal plates are regularly arranged transversely in radial part. The number of spines on abactinal plates depends on the plate size; large plates have ca. 15 spines. The abactinal spines have 3-4 terminal teeth. Papular pores are large, found only in radial proximal part. Inferomarginal plates bear 4 long flat spines on their edge, and the spines form the body margin. Actinolateral plates are arranged in regular chevrons, and have 3 (range 2-4) spines. Adambulacral plates have 4-5 furrow spines. Oral plates have 5 furrow and 3-4 suboral spines. We believe it is inadvisable to describe this species on the basis of a single very small specimen.

Genus *Disasterina* Perrier, 1875
Disasterina odontacantha Liao, 1980
 (fig. 4)

Material.— NSMT E-4218, St. F4, 0-16 m, 1 specimen (dry), R/r = 11/6 mm.

Synonymy.— See A.M. Clark, 1993: 219.

Remarks.— The body is covered by a skin obscuring the underlying plates, but the plates are visible when dried. Abactinal plates are irregular shaped and form a slightly imbricated, reticulate network. Most abactinal plates have 1-2 spines. Several abactinal plates in the interradiar area are larger than the other ones. Papulae are distributed on almost the whole abactinal surface. The madreporite is situated at a position about 1/4 of the distance from the disc center to the margin. Actinolateral plates are arranged in rows from the adambulacral plates towards the margin, and the rows are separated from each other by an uncalcified area. Each actinolateral plate has 1 spine. Adambulacral plates have 3 furrow spines and one large subambulacral spine. Oral plates have 1 large spine near the tip and 3 smaller spines distally. There is no suboral spine. Most of the oral spines, adambulacral furrow spines, subambulacral spines and actinolateral spines have 2-3 terminal small teeth. There is a large oval uncalcified area situated just distal to each pair of oral plates.

This species has been known only from Xisha island in South China Sea (Liao, 1980: 169), and is new to Indonesian waters and Ambon.

Genus *Patiriella* Verrill, 1913
Patiriella pseudoexigua Dartnall, 1971

Material.— RMNH Ech. 6136, St. 17, 1-3 m deep, 2 specimens, R/r = 14.8/12.2, 13.5/10.0 (6 arms) mm; RMNH Ech. 6132, St. 18, intertidal, 4 specimens, R/r = 18.9/12.6, 18.15/11.8, 15.7/11.55, 15.4/10.9 mm; RMNH Ech. 6134, St. 18, intertidal, on and under rocks, 2 specimens, R/r = 10.2/8.2, 7.8/6.9 mm; RMNH Ech. 6135, St. 27, 0-0.5 m deep, 1 specimen, R/r = 14.6/9.9 mm; RMNH Ech. 6133, St. S3, low water mark, under rocks, 2 specimens, R/r = 14.45/10.55, 13.7/11.0 mm; NSMT E-4220, St. F1, intertidal, 19 specimens, R/r = 9.7/6.9, 9.6/7.0, 9.5/8.1, 9.0/7.7, 8.9/7.5 (6 arms), 8.9/7.1, 8.3/6.4, 8.2/6.9, 7.8/6.4, 7.8/6.0, 7.7/5.6, 7.6/6.2, 7.5/6.4, 7.5/5.6, 7.4/5.5, 7.0/5.5, 5.1/3.6, 4.9/3.3, 4.8/3.7 mm.

Synonymy.— See A.M. Clark, 1993: 226.

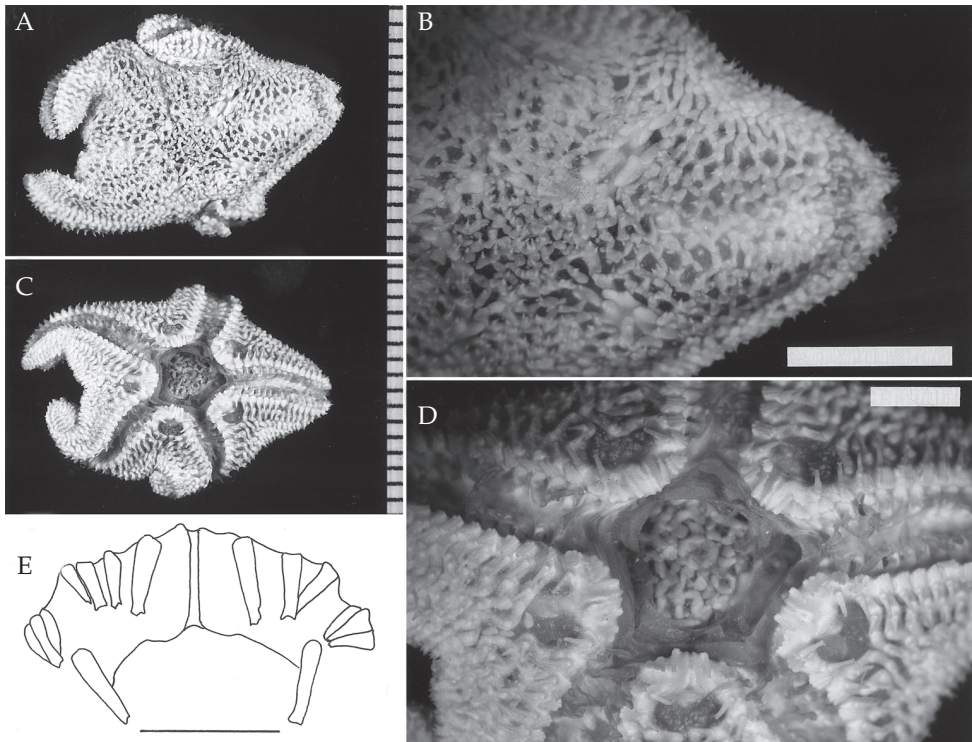


Fig. 4. *Disasterina odontacantha* Liao, 1980. NSMT E-4218, dry specimen. **A:** Whole body, dorsal view. One scale graticule 1 mm. **B:** Enlarged view of dorsal side. Scale 4 mm. **C:** Whole body, ventral view. One scale graticule 1 mm. **D:** Enlarged view of ventral side. Scale 2 mm. **E:** Mouth plate. Scale 1 mm.

Family Archasteridae Viguiet, 1878
Genus *Archaster* Müller & Troschel, 1840
Archaster typicus Müller & Troschel, 1840

Material.—RMNH Ech. 6119, St. 1, ca. 1 m deep, 1 specimen, R/r = 52.95/11.4 mm; RMNH Ech. 6178, St. 3, intertidal, 3 specimens, R/r = 42.7/9.3, 42.2/9.25, 33.7/7.6 mm; RMNH Ech. 6121, St. 3, tide pool, 2 specimens, R/r = 46.1/9.15, 40.4/9.05 mm; RMNH Ech. 6123, St. 4, tide pool, 2 specimens, R/r = 45.2/9.75, 39.4/8.2 mm; RMNH Ech. 6124, St. 4, tide pool, 1 specimen, R/r = 35.25/8.0 mm; RMNH Ech. 6126, St. 4, tide pool, 1 specimen, R/r = 25.0/6.3 mm; RMNH Ech. 6118, St. 16, 3 specimens, R/r = 66.65/14.25, 63.8/12.8, 53.3/12.65 mm; RMNH Ech. 6116, St. 20, 6 specimens, R/r = 54.0/11.9, 48.0/10.35, 46.55/11.1, 44.4/9.35, 44.05/10.0, 39.15/7.9 mm; RMNH Ech. 6125, St. 20, intertidal, under rocks, 1 specimen, R/r = 35.9/9.0 mm; RMNH Ech. 6122, St. 26, intertidal, under coral rocks, 1 specimen, R/r = 51.4/10.95 mm; RMNH Ech. 6117, St. 30, 1-2 m deep, 3 specimens, R/r = 56.35/11.35, 52.5/10.7, 49.35/11.9 mm; RMNH Ech. 6120, St. S4, 0.2 m deep, sandy bottom, 1 specimen, R/r = 56.25/12.2 mm. NSMT E-4221, St. F2, 1 specimen, R/r = 32.3/7.7 mm. NSMT E-4222, St. F3, 2 m deep, sandy bottom, 1 specimen, R/r = 48.5/9.9 mm. NSMT E-4223, St. F3, 2 m deep, sandy bottom, 1 specimen, R/r = 10.6/3.7 mm. WAM Z 13582, St. AM VII, 0-1 m deep, on coral rubble, 1 specimen, R/r = 35/8 mm.

Synonymy.— See A.M. Clark, 1993: 240.

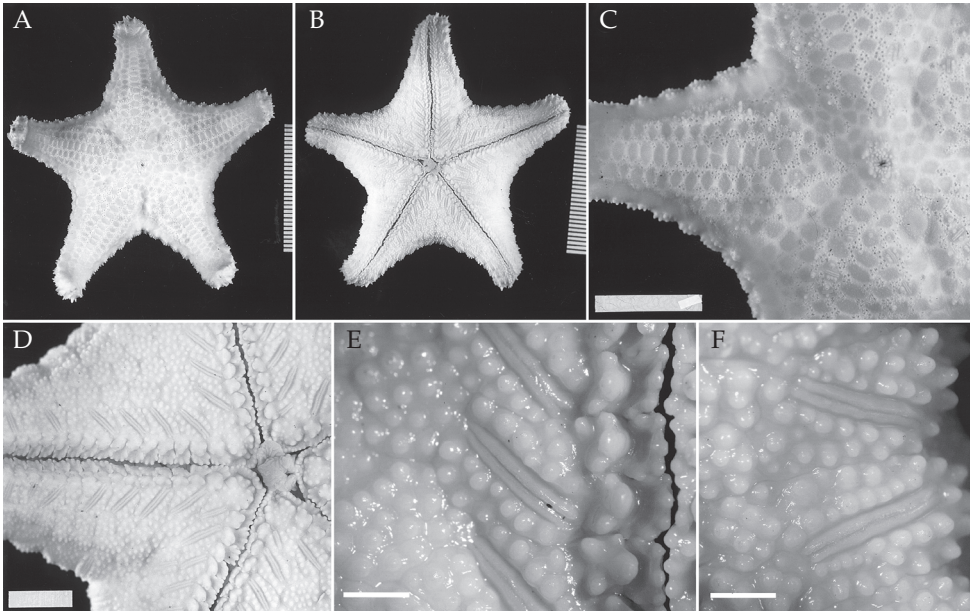


Fig. 5. *Gymnanthenea difficilis* (Liao, 1985). RMNH Ech. 6101, alcohol specimen. **A:** Whole body, dorsal view. One scale graticule 1 mm. **B:** Whole body, ventral view. One scale graticule 1 mm. **C:** Enlarged view of dorsal side. Scale 5 mm. **D:** Enlarged view of ventral side. Scale 5 mm. **E:** Adambulacral plates and actinolateral plates. Scale 1 mm. **F:** Inferomarginal plates. Scale 1 mm.

Family Oreasteridae Fisher, 1911

Genus *Gymnanthenea* H.L. Clark, 1938

Gymnanthenea difficilis (Liao, 1995) **comb. nov.**

(fig. 5)

Material.—RMNH Ech. 6101, St. 18, 2 m deep, 1 specimen, R/r = 39.1/16.55 mm.

Synonymy.—*Anthenea difficilis* Liao in Liao & A.M. Clark, 1995: 99-102, pl. 10 figs 1-2.

Remarks.—The present specimen shows a relatively large R/r ratio (2.4). The body is covered by skin. The tubercles on abactinal surface are very small, rare and irregularly distributed; a few plates bear bivalved pedicellariae. There are 10 superomarginals. The abactinal surface of the superomarginal plates is bare with several granules on the outer edge. Each inferomarginal plate has one large bivalve pedicellaria (ca. 2.3 mm in length and 0.4 mm in width) and granules. There are two series of adambulacral spines, a row of ca. 5 furrow spines and 3-4 subambulacral spines, with one central spine usually larger than the others. The subambulacral spines, especially in the case of 4 spines, are arranged in a group rather than a row. A series of actinal plates adjoining the adambulacral plates has a large pedicellaria similar in size and shape to that of inferomarginal plates surrounded by granules. Most of the other actinal plates have only granules, up to 16 in number.

Gymnanthenea was erected by H.L. Clark (1938) as a genus separated from *Anthenea* Gray, 1840, based on one row of subambulacral spines in *Gymnanthenea* compared to two distinct rows in *Anthenea*, and the bare upper end of superomarginal plates present only in *Gymnanthenea*. Only the type species *G. globigera* (Döderlein, 1915) with a synonym of *G. laevis* H.L. Clark, 1938 is currently included in *Gymnanthenea*. The present specimen shares the above characteristics with *G. globigera*, and *A. difficilis* should be transferred to *Gymnanthenea*. *Gymnanthenea difficilis* is distinguished from *G. globigera* in having very large pedicellariae on inferomarginal plates and on the actinal plates adjacent to the furrow. It also lacks the single enlarged granule on the upper part of the superomarginal plates found in *G. globigera*. Liao & A.M. Clark (1995: 102) suggested that *Gymnanthenea* might be a synonym of *Anthenea* but in our opinion the two genera are sufficiently distinct to remain separate.

This species has been reported only from Guandong and Fujian Provinces, southern China, and is new to Indonesia and Ambon.

Genus *Choriaster* Lütken, 1869

Choriaster granulatus (Linnaeus, 1758)

Material.— RMNH Ech. 6173, St. 3, 3 specimens (dry), R/r = 118/47, 111/47, 108/44 mm.

Synonymy.— See A.M. Clark, 1993: 298.

Remarks.— While assigning catalogue numbers only one specimen could be recovered, probably the other two were misplaced in the collection.

Genus *Culcita* L. Agassiz, 1836

Culcita novaeguineae Müller & Troschel, 1842

(fig. 2C)

Material.— RMNH Ech. 6174, St. 3, 4 specimens (dry), R/r = 134/80, 132/83, 115/80, 99/75 mm; RMNH Ech. 6148, St. 17, intertidal, under rocks, 1 specimen, R/r = 15.0/10.35 mm; RMNH Ech. 6145, St. 20, 1 specimen, R/r = 45.75/32.95 mm; RMNH Ech. 6147, St. 21, intertidal, under rocks, 1 specimen, R/r = 25.0/17.4 mm; RMNH Ech. 6146, St. 23, 1.5-2 m deep, 1 specimen, R/r = 25.6/17.75 mm; RMNH Ech. 6171, St. 39, 10 m deep, 1 specimen, R/r = 83/72 mm.

Synonymy.— See A.M. Clark, 1993: 299.

Remarks.— Young of this species have a flat body and conspicuous marginal plates like goniasterids (Pl. 1C), and are quite different from cushion-form adults; they were formerly described as another species *Goniodiscus sebae* Müller & Troschel, 1842. Döderlein (1896) reported adult and young specimens from Ambon as separate species *C. novaeguineae* and *G. sebae*. Later Döderlein (1898) argued that the genus *Culcita* has the closest phylogenetical affinity to *G. sebae*, and H.L. Clark (1908) showed *G. sebae* is a synonym of *C. novaeguineae* after examining a specimen from Ambon.

Genus *Pentaceraster* Döderlein, 1916

Pentaceraster alveolatus (Perrier, 1875)

(fig. 6)

Material.— RMNH Ech. 6106, St. 35, 0.5-2 m deep, 1 specimen, R/r = 35.0/14.85 mm.

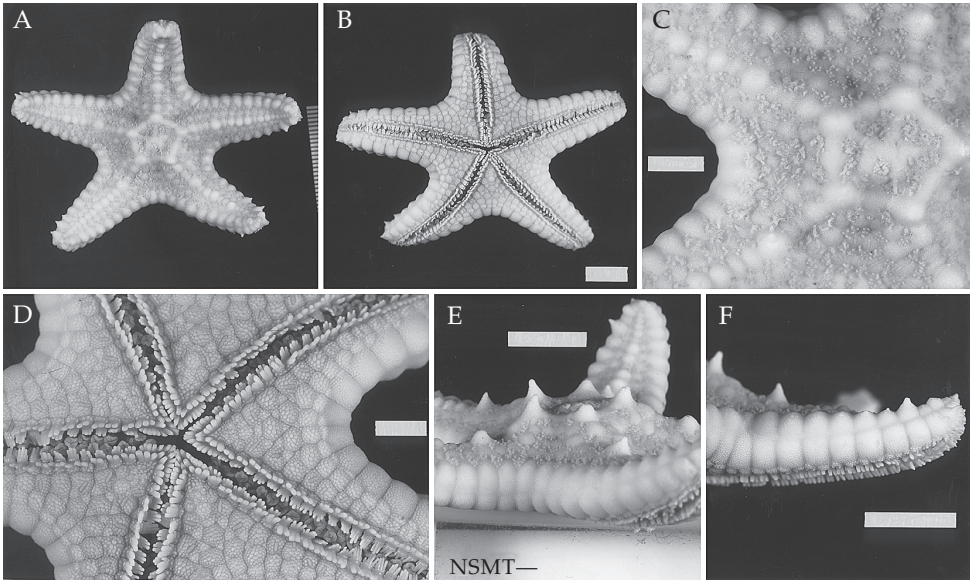


Fig. 6. *Pentaceraster alveolatus* (Perrier, 1875). RMNH Ech. 6106, alcohol specimen. **A:** Whole body, dorsal view. One scale graticule 1 mm. **B:** Whole body, ventral view. Scale 1 cm. **C:** Enlarged view of dorsal side. Scale 5 mm. **D:** Enlarged view of ventral side. Scale 5 mm. **E:** Lateral view of disc. Scale 1 cm. **F:** Marginal plates. Scale 1 cm.

Synonymy.— See A.M. Clark, 1993: 310.

Remarks.— The specimen has 5 primary plates with a conspicuously projected conical tubercle. Some carinal plates are convex with a tubercle. Dorso-lateral plates are relatively large and papular areas are well defined. Many dorso-lateral plates have a large slender bivalve pedicellaria. There are 12 superomarginal and inferomarginal plates; several distal ones have a conical tubercle. Adambulacral plates have 4-5 (rarely 6) furrow spines and 2-3 subambulacral spines with several granules along their adradial edge. One series of actinolateral plates extends to the arm tip having a bivalve pedicellaria similar to those on dorsal surface. The other actinolateral plates are covered by granules only.

This young *Pentaceraster* specimen appears to belong to *P. alveolatus*. However, *P. alveolatus* shows considerable variation, especially in the number and shape of abactinal tubercles and of the marginal plates spines, and it is difficult to distinguish between young specimens of this species and *P. multispinus* (von Martens, 1866) and *P. regulus* (Müller & Troschel, 1842) (Döderlein, 1936; A.M. Clark & Rowe, 1971). *Pentaceraster alveolatus* has been collected from Hainan Island (China), the Philippines, New Britain Island (Papua New Guinea), New Caledonia, Samoa and Billiton (Belitung), Indonesia (A.M. Clark, 1993), but is new to Ambon.

Genus *Protoreaster* Döderlein, 1916
Protoreaster nodosus (Linnaeus, 1758)

Material.— St. 3, 1 specimen (dry), R/r = 102/31 mm.

Synonymy.— See A.M. Clark, 1993: 318.

Remarks.— While assigning catalogue numbers the specimen was not found, probably it is misplaced in the collection.

Family Asteropseidae Hotchkiss & A.M. Clark, 1976

Genus *Asteropsis* Müller & Troschel, 1840

Asteropsis carinifera (Lamarck, 1816)

Material.— RMNH Ech. 6176, St. 20, 0.5-2 m deep, 1 specimen, R/r = 83/25 mm; RMNH Ech. 6103, St. 26, intertidal, under coral rocks, 1 specimen, R/r = 60.9/23.55 mm.

Synonymy.— See A.M. Clark, 1993: 320.

Family Acanthasteridae Sladen, 1889

Genus *Acanthaster* Gervais, 1841

Acanthaster planci (Linnaeus, 1758)

Material.— RMNH Ech. 6102, St. 17, 1 specimen, R/r = 69/27.5 mm.

Synonymy.— See A.M. Clark, 1993: 323.

Family Mithrodiidae Viguiier, 1878

Genus *Mithrodia* Gray, 1840

Mithrodia clavigera (Lamarck, 1816)

Material.— RMNH Ech. 6177, St. 39, 3 m deep, under rocks, 1 specimen, R/r = 227/22 mm.

Synonymy.— See A.M. Clark, 1993: 324-325.

Family Ophidiasteridae Verrill, 1870

Genus *Celerina* A.M. Clark, 1967

Celerina heffernani (Livingstone, 1931)
(fig. 2D)

Material.— RMNH Ech. 6104, St. 16, 5-10 m deep, 1 specimen, R/r = 36.4/8.3 mm; NSMT E-4215, St. F4, 0-16 m, 1 specimen, R/r = 42.65/8.5 mm; WAM Z 13583, St. AM VII, 8-10 m deep, outer reef slope, 1 specimen, R/r = 47/8 mm.

Synonymy.— See A.M. Clark, 1993: 328.

Remarks.— This asteroid species has a very similar appearance to *Fromia monilis*. However, it can be distinguished by having intermarginal plates, actinal papulae, and adambulacral armature, which is in a single row of paired (occasionally 3) pointed spines on each plate in contrast to the flat truncated furrow and subambulacral spines of *Fromia monilis*. In life the colour is darker than that of *F. monilis*.

Genus *Fromia* Gray, 1840*Fromia eusticha* Fisher, 1913

Material.— WAM Z 13584, St. AM VI, 1 specimen, R/r = 40/8.5 mm; WAM Z 13586, AM VII, 30 m deep, outer reef slope, 1 specimen, R/r = 34/8 mm; WAM Z 13585, Nusaniwe, 25 m deep, sand slope, 1 specimen, R/r = 44/9 mm.

Synonymy.— See A.M. Clark, 1993: 331.

Remarks.— Superficially similar in appearance and colour to *F. monilis*, *F. eusticha* has little or no alternation in size of superomarginal plates. Some abactinal granules and most of the actinal granules have the form of split granule pedicellariae. The adambulacral armature is similar to that of *F. monilis*.

This species has been collected from the Philippine Islands, the Marshall Islands and east Indonesia (A.M. Clark, 1993), and is new to Ambon.

Fromia monilis (Perrier, 1869)

(fig. 2E)

Material.— RMNH Ech. 6130, St. 3, 6 m deep, on coral, 2 specimens, R/r = 60.1/12.15, 60.0/11.95 mm; RMNH Ech. 6131, St. 16, 2 m deep, 1 specimen, R/r = 42.9/9.35 mm; NSMT E-4214, St. F4, 12.2 m deep, 1 specimen, R/r = 51.8/11.8 mm.

Synonymy.— See A.M. Clark, 1993: 332.

Genus *Gomophia* Gray, 1840*Gomophia gomophia* (Perrier, 1875)

(fig. 7)

Material.— RMNH Ech. 6107, St. 11, 10 m deep, 2 specimens (dry), R/r = 150/18, 109/15 mm; NSMT E-4211, St. F4, 14.4 m deep, 1 specimen (dry), R/r = 123/12 mm; WAM Z 13587, St. AM V, coral and sand, 2-3 m deep, 1 specimen R/r = 140/15 mm; WAM Z 13588, St. Am VI, coral and sand, 3-5 m deep, 1 specimen, R/r = 115/12 mm.

Synonymy.— *Nardoa gomophia*, see A.M. Clark 1993: 342. *Gomophia gomophia*; Rowe & Gates, 1995: 83.

Remarks.— There are many hemispherical abactinal tubercles one of which is up to ca. 4 mm in diameter and up to ca. 3 mm in height. The body is covered by granules, which are larger on the apex of the tubercles than on their sides and in the papular areas. The abactinal plates decrease in size and convexity distally and become slightly elongate. Two marginal series are discernible but show somewhat irregular arrangement in some parts; there are no intermarginal plates. Some superomarginals are also tuberculate irregularly alternating with convex plates. Inferomarginals are usually convex and the size is diminishing toward to the arm tip. There is one long row of actinolaterals decreasing in size toward the arm tip and extending to about two thirds to three quarters of the arm length, and a second row of a few plates in the arm angle. Papulae are distributed on the abactinal surface where the abactinal skeleton is reticulated with the papular areas except the distal one third of arm and also on actinal sur-

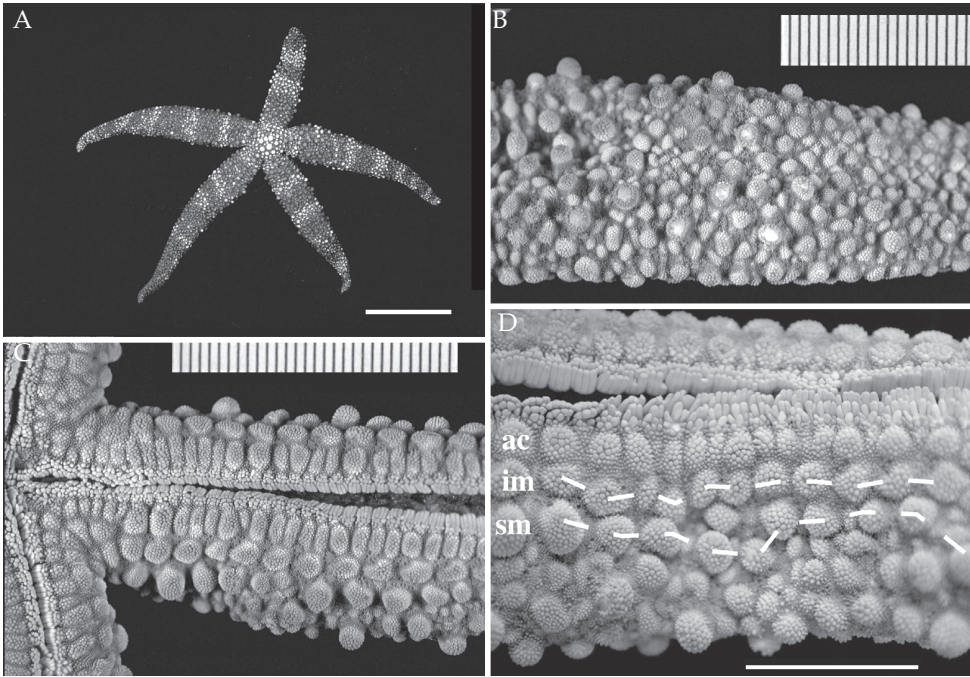


Fig. 7. *Gomophia gomophia* (Perrier, 1875). NSMT E-4211. **A:** Whole body, dorsal view. Living specimen. Scale: 5 cm. **B:** A part of arm, dorsal view. Dry specimen. One scale graticule 1 mm. **C:** A part of arm, ventral view. Dry specimen. One scale graticule 1 mm. **D:** A part of arm, ventrolateral view showing the arrangement of marginal plates. Dry specimen. Scale 1 cm. Abbreviations. ac: actinolateral plate, in: inferomarginal plate, sm: superomarginal plate.

face between inferomarginals and actinolaterals. Adambulacral plates have 4-5 furrow spines, and also have from several to ten granuliform spines on subambulacral surface of which 3-4 inner ones are often larger than the others forming a row.

Living specimens were red with cream or white bands on the arms, another was all red with faint bands near the arm tips. Formalin specimens are light brown almost uniformly.

Gomophia gomophia differs from *G. frianti* in lacking intermarginal plates, in having a much longer series of actinal plates and different granulation.

This species has been reported from the Philippines, South China Sea, Northern Australia, New Caledonia and southwest Pacific Ocean (Rowe & Gates, 1995), and is new to Indonesian and Ambon waters.

Gomophia watsoni (Livingstone, 1936)
(fig. 8)

Material.— NSMT E-4216, St. F1, 0-12 m, 1 specimen, R/r = 57/9 mm.

Synonymy.— *Ophidiaster watsoni* Livingstone, 1936: 386-387, pl. 28 figs 1, 3, 5, 7.

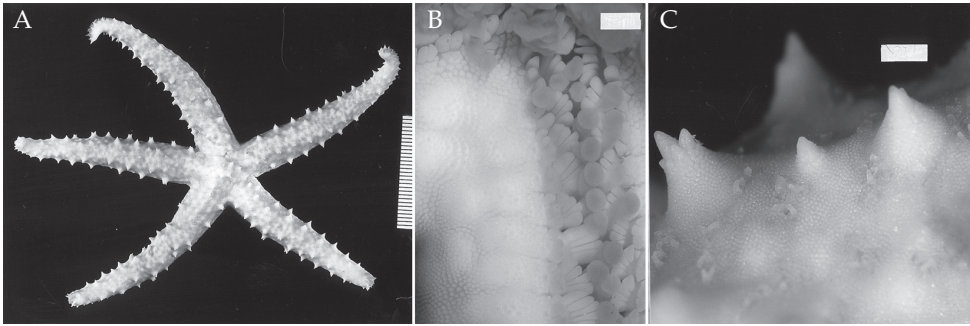


Fig. 8. *Gomophia watsoni* Livingstone, 1936. NSMT E-4216, alcohol specimen. **A:** Whole body, dorsal view. One scale graticule 1 mm. **B:** Adambulacral plates and actinolateral plates. Scale 1 mm. **C:** Enlarged view of tubercles of arm part. Scale 1 mm.

Gomophia watsoni; Jangoux, 1986: 134-135, colour photo; Rowe & Gates, 1995: 84. *Gomophia egyptiaca*; Eudean, 1965: 230 (non *Gomophia egyptiaca* Gray, 1840).

Remarks.— The abactinal and actinal plates are covered by granules. Some abactinal plates have small tubercles with usually 1-2 (sometimes 3-5) nipple-like conical spines at their apex. Some superomarginals are also tubercular with similar nipple-like spines. Inferomarginals are alternatively tubercular or convex in middle arm part, and the distalmost ones are tubercular, though the height is lower than the abactinal and superomarginal tubercles. Papulae are only found on abactinal surface, and each pore area has up to ca. 10 papulae. There are intermarginal plates in proximal 1/3 of arms. Adambulacral plates have 4-5 furrow spines and 3 subambulacral spines. The subambulacral spines are smaller than the furrow ones. Oral plates have 7 furrow and 3-4 suboral spines. Actinal intermediate plates are completely covered by granules.

This species is closely related to *Gomophia egyptiaca* Gray, 1840 and *G. egyptiaca egeriae* A.M. Clark, 1967, but can be distinguished from them by having smaller (height less than 2.0 mm) tubercles. This specimen is an aberrant form of *G. watsoni* because of multiple tips of tubercle nipples. The species has been found from Australia (Livingstone, 1936), New Caledonia (Jangoux, 1986), and Morotai Island, Indonesia (L.M. Marsh & F.W.E. Rowe, unpublished data), but is new to Ambon. Guille & Jangoux (1978) reported *G. egyptiaca* from Ambon, small specimens of which are similar to *G. egyptiaca egeriae*.

Genus *Linckia* Nardo, 1834

Linckia laevigata (Linnaeus, 1758)

Material.— RMNH Ech. 6172, St. 3, 5 specimens (dry), R/r = 160/20.5, 134/18.0, 122/17.8, 121/15.0 (4 arms), 112/16.25 mm; RMNH Ech. 6175, St. 5, ca. 1-2 m deep, 1 specimen, R/r = 108/19 mm; RMNH Ech. 6160, St. 17, low water mark, 1 specimen, R/r = 38.15/7.25 mm; RMNH Ech. 6167, St. 18, 2-3 m deep, 1 specimen, R/r = 98/20 mm; RMNH Ech. 6168, St. 20, 0.5-2 m deep, 1 specimen, R/r = 98/14 mm; RMNH Ech. 6158, St. 21, low water mark, 2 specimens, R/r = 43.8/8.0, 39.1/7.95 mm; RMNH Ech. 6161, St. 21, 10-15 m deep, 1 specimen, R/r = 57.3/10.0 mm; RMNH Ech. 6162, St. 26, intertidal, under coral rocks, 1 specimen, R/r = 46.75/9.9 mm; RMNH Ech. 6157, St. 27, 0-0.5 m deep, 1 specimen, R/r = 80.6/17.0 mm; RMNH Ech. 6159, St. 30, 1-2 m deep, 1 specimen, R/r = 41.7/7.9 mm;

NSMT E-4210, St. F4, 13.2 m deep, 1 specimen (dry), R/r = 136/18 mm; WAM Z 13589, St. AM V, 3-4 m deep, coral and sand, 1 specimen, R/r = 168/22 mm.

Synonymy.— See A.M. Clark, 1993: 338.

Remarks.— While assigning catalogue numbers only one specimen was found from St. 3 (RMNH Ech. 6172), probably the other four were misplaced in the collection.

Linckia multifora (Lamarck, 1816)

Material.— RMNH Ech. 6137, St. 20, intertidal, under rocks, 1 specimen, R/r = 40.2/6.0 mm; RMNH Ech. 6138, St. 21, 15 m deep, 1 specimen, R/r = 29.05/4.1 mm; RMNH Ech. 6139, St. 26, intertidal, under rocks, 1 specimen, R/r = 32.8/5.05 mm.

Synonymy.— See A.M. Clark, 1993: 339.

Genus *Nardoa* Gray, 1840

Nardoa galatheae Lütken, 1865

(fig. 2F)

Material.— NSMT E-4212, St. F4, 1 specimen (dry), R/r = 132.0/16.7 mm; WAM Z 13590, St. AM VI, coral and sand, 1 specimen, R/r = 140/16 mm; WAM Z 13591, St. AM VI, 3-5 m, coral and sand, 1 specimen, R/r = 128/16 mm.

Synonymy.— See A.M. Clark, 1993: 341.

Remarks.— The specimens agree well with the description and photograph by Guille & Jangoux (1978: 56). There are no tubercular abactinal plates and most abactinal plates are moderately convex; there is no superomarginal alteration of convex and flat plates as in *Gomophia*. The colour in life is uniform dark brown or dark reddish brown but one specimen (WAM Z 13591) was brown with the outer one third of the arms cream. In dry specimens, the two colour forms are undistinguishable.

Nardoa tuberculata Gray, 1840

Material.— RMNH Ech. 6169, St. 18, 1-2 m deep, 1 specimen, R/r = 110/19 mm; RMNH Ech. 6170, St. 20, 0.5-2 m deep, 1 specimen, R/r = 94/13 mm; RMNH Ech. 6128, St. 23, 0-1.5 m deep, under rocks, 1 specimen, R/r = 88.4/16.0 mm; RMNH Ech. 6129, St. 23, 1.5-2 m deep, 1 specimen, R/r = 73.0/14.8 mm; RMNH Ech. 6127, St. 26, intertidal, under coral rocks, 3 specimens, R/r = 85.0/15.6, 66.8/14.7, 64.8/16.1 mm.

Synonymy.— See A.M. Clark, 1993: 343.

Remarks.— The colour in life is cream to beige, banded with mid to dark brown.

Genus *Ophidiaster* L. Agassiz, 1836

Ophidiaster granifer Lütken, 1871

Material.— RMNH Ech. 6165, St. 17, 1-3 m deep, 2 specimens, R/r = 20.8/5.25, 20.55/5.7 mm; RMNH Ech. 6164, St. 17, intertidal, under rocks, 1 specimen, R/r = 17.75/4.7 mm; RMNH Ech. 6163, St. 21, low water mark, 1 specimen, R/r = 27.5/6.9 mm.

Synonymy.— See A.M. Clark, 1993: 347.

Family Echinasteridae Verrill, 1870
Genus *Echinaster* Müller & Troschel, 1840
Echinaster luzonicus (Gray, 1840)

Material.— RMNH Ech. 6113, St. 11, 1 specimen, R/r = 82.1/13.25 mm; RMNH Ech. 6111, St. 20, 5-8 m deep, 1 specimen, R/r = 67.9/11.95 mm; RMNH Ech. 6110, St. 21, low water mark, 6 specimens, R/r = 70.7/12.0, 51.8/10.0, 34.8/8.85, 30.6/5.55, 28.4/6.55, 17.7/4.95 mm; RMNH Ech. 6112, St. 21, 10-15 m deep, 1 specimen, R/r = 21.4/5.4; RMNH Ech. 6114, St. 21, intertidal, 2 specimens, R/r = 38.0/5.6, 21.8/3.1 mm; RMNH Ech. 6109, St. 30, 1-2 m deep, 1 specimen, R/r = 53.2/11.3 mm; RMNH Ech. 6108, St. 37, 2 m deep, 1 specimen, R/r = 75.7/14.7 mm; RMNH Ech. 6115, St. 39, 2 m deep, 1 specimen, R/r = 83.1/17.85 mm; NSMT E-4217, St. F1, 0-12 m, 1 specimen, R/r = 35.4/12.6 mm.

Synonymy.— See A.M. Clark, 1996: 224.

Acknowledgments

We would like to express our sincere gratitude to Hermann L. Strack of the Foundation for the Advancement of Biohistorical Research, Dordrecht, for providing us this opportunity to examine the Rumphius asteroid collection, and to Dr Maya Borel Best of the National Museum of Natural History, Leiden for her generous help throughout this study. We also thank the members of the Rumphius Biohistorical Expedition in 1990 for collecting material during the Expedition. Dr Michel Jangoux of the Université Libre de Bruxelles, Dr Yulin Liao of the Institute of Oceanology, Chinese Academy of Sciences, and Miss Ailsa M. Clark formerly of the Natural History Museum, London, gave us helpful information. The first author is indebted to the Research and Development Center for Oceanology, Indonesian Institute of Sciences (RDCO-LIPI) and its Ambon Station for their help in sampling during the Japan-Indonesian Cooperative Research Program supported by a grant of the Core University Program from the Japan Society for the Promotion of Science (JSPS) in 1998. The second author is indebted to RDCO-LIPI for the opportunity to take part in the Rumphius IV Expedition to the northern Moluccas on the R.V. *Samudera* in 1980, to the members of the Expedition and to the staff of the Ambon station for their assistance. The Commonwealth Department of Science and Environment, Canberra, Australia, through the Association for Science Co-operation in Asia (ASCA) is thanked for financial support for the work in Indonesia. A part of this work was also supported by a grant-in-aid for International Scientific Research (No. 12575008, headed by Dr Shunsuke F. Mawatari of Hokkaido University) from the Japanese Ministry of Education, Science, Sports, Culture and Technology to the first author.

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Received: 14.v.2003

Accepted: 25.ix.2003

Edited: L.P. van Ofwegen

