

## New Records of Sea Stars (Asteroidea: Echinodermata) from the Continental Shelf of Taiwan

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**Shyh-Min Chao (2000)** New records of sea stars (Asteroidea: Echinodermata) from the continental shelf of Taiwan. *Zoological Studies* 39(3): 275-284. From July 1995 to August 1998, starfish were collected by trawling sandy substrates at 30-250 m depth along the coast of Taiwan. Nineteen species in 7 families were collected at 6 stations. Six species (*Luidia maculata*, *L. avicularia*, *L. quinaria*, *Distolasterias nipon*, *Coronaster volsellatus*, and *C. sakuranus*) had not previously been reported from Taiwan, and are described and illustrated in the present study. In addition, the abundances of the 19 collected species are tabulated, and information on the recorded 44 species in 13 families of starfish from Taiwan is tabulated.

**Key words:** Starfish, Echinoderms, Taiwan, Taxonomy.

Most starfish from Taiwan have been collected by skin and scuba diving in shallow waters of rocky and reef substrates (Hayasaka 1949, Applegate 1984, Chao and Chang 1989, Chao et al. 1990). Only a few investigations (Hayasaka 1949, Chao 1999a, b, Chao 2000) have been made of Taiwan's sublittoral starfish. To date, only 38 species in 11 families of starfish have been collected from Taiwan (Table 1). Of these, twenty-three species were collected by skin and scuba diving to 20 m in depth, and 15 species were dredged from sandy substrates at depths of 30 to 250 m. Due to the limited nature of these investigations, especially in deep waters, the starfish fauna of Taiwan is not well known.

From July 1995 to August 1998, sublittoral starfish were collected at 6 stations off the coast of Taiwan by trawling sandy bottoms to depths of 250 m (Fig. 1). Six local trawlers were requested to preserve starfish from their daily catch. During this period, nineteen species in 7 families of starfish (Table 2) were collected, of which 6 species are new records for Taiwan (Luidiidae: *Luidia maculata*, *L. avicularia*, and *L. quinaria*; Asteroidea: *Distolasterias nipon*; and Labidiasteridae: *Coronaster volsellatus* and *Coronaster sakuranus*). The families Luidiidae and Labidiasteridae are recorded for the first time in Taiwan. Including the results of the present study, a

total of 44 species in 13 families of starfish has been found along the coast of Taiwan.

Abundances of the 19 species of starfish collected from the 6 trawling locales are tabulated in Table 2. Although the number of trawls is not specified, collected individuals possibly more or less reflect their general and comparative abundance. As species accounts and figures of 13 of the species were recently published (Chao 1999a, b, c), this paper merely discusses and illustrates the species newly recorded in this study. This paper also tabulates the starfish currently reported from Taiwan, including 44 species in 13 families.

### MATERIALS AND METHODS

Trawled individuals were allowed to drain on deck for about 30 min, before being transferred to 10% formalin. After 1 d, specimens were air dried or preserved in 70% alcohol. The author examined preserved specimens, all of which are deposited at the National Museum of Natural Science, Taichung, Taiwan. Identification followed Clark and Rowe (1971) and Liao and Clark (1995). The following abbreviations are used in the text: R = length from disc center to the tip of longest arm, r = length from disc

**Table 1.** Records of the Asteroidea from Taiwan

Taxa	Nature of substratum <sup>a</sup> (depth, m)	Reference <sup>b</sup>
<b>Luidiidae Sladen</b>		
@ <i>Luidia maculata</i> Müller & Troschel	S (40-150)	
@ <i>Luidia avicularia</i> Fisher	S (150)	
@ <i>Luidia quinaria</i> von Martens	S (10-150)	
<b>Acanthasteridae</b>		
<i>Acanthaster planci</i> (Linnaeus)	R (3-7)	1
<b>Archasteridae</b>		
<i>Archaster typicus</i> Müller & Troschel	S (0-3)	1
<b>Pterasteridae</b>		
<i>Eureaster insignis</i> (Sladen)	S (40)	8
<b>Asteriidae</b>		
<i>Coscinasterias acutispina</i> (Stimpson)	P (1-5)	3
@ <i>Distolasterias nipon</i> (Döderlein)	S (150-200)	
<b>Family Labidiasteridae</b>		
@ <i>Coronaster sakuranus</i> (Döderlein)	S (100-150)	
@ <i>Coronaster volsellatus</i> (Sladen)	S (150-200)	
<b>Asterinidae</b>		
<i>Asterina coronata</i> von Martens	P (1-3)	3
<i>A. orthodon</i> Fisher	R (8)	7
<i>Disasterina odontacantha</i> Liao	SR (2)	8
<i>Nepanthis belcheri</i> (Perrier)	R (0-1)	7
<i>Patiriella pseudoexigua</i> Dartnall	R (0)	3
<b>Asteropseidae</b>		
<i>Asteropsis carinifera</i> (Lamarck)	R (1-3)	7
<b>Astropectinidae</b>		
<i>Astropecten polyacanthus</i> Müller & Troschel	S (60)	6
<i>A. vappa</i> Müller & Troschel	S (30-120)	6
<i>A. velitaris</i> von Martens	S (30-50)	2
<i>Craspidaster hesperus</i> (Müller & Troschel)	S (30-100)	1
<i>Ctenopleura sinica</i> (Döderlein)	S (60-150)	6
<i>Dipsacaster pretiosus</i> (Döderlein)	S (60-100)	6
<i>Tethyaster aulophorus</i> (Fisher)	S (120-150)	6
<b>Echinasteridae</b>		
<i>Echinaster callosus</i> von Marenzeller	R (6)	7
<i>Echinaster luzonicus</i> (Gray)	P (1-3)	5
<b>Goniasteridae</b>		
<i>Anthenoides laevigatus</i> (Liao & Clark)	S (110-150)	8
<i>Astrothamna euphyllacteum</i> Fisher	S (200-250)	8
<i>Calliaster childreni</i> Gray	S (100)	7
<i>Mediaster brachiatus</i> Goto	S (100)	8
<i>Stellasteropsis colubrinus</i> Macan	R (4)	7
<b>Ophidiasteridae</b>		
<i>Cistina columbiae</i> Gray	R (3-10)	7
<i>Fromia monilis</i> Perrier	R (5-15)	3
<i>Leiaster speciosus</i> von Martens	R (5)	4
<i>Linckia laevigata</i> Linnaeus	R (1-5)	1
<i>L. multifora</i> (Lamarck)	R (4)	7
<i>Nardoa frianti</i> Koehler	R (10)	3
<i>N. tumulosa</i> Fisher	R (5)	1
<i>Neoferdina insolita</i> Livingstone	R (3-10)	7
<i>Ophidiaster hemprichi</i> Müller & Troschel	R (8)	3
<i>O. armatus</i> Koehler	P (30-40)	8
<b>Oreasteridae</b>		
<i>Anthenea chinensis</i> (Gray)	S (30-60)	7
<i>Culcita novaeguineae</i> Müller & Troschel	R (5-10)	1
<i>Pentacaster chinensis</i> (Gray)	S (40-60)	8
<i>Pentacaster westermanni</i> von Martens	S (60)	4

@ indicates new records in this paper.

<sup>a</sup> P = pebble and rock; R = reef; S = sandy bottom; SR = sand bottom at reef area.

<sup>b</sup> 1 = Hayasaka (1949); 2 = Chang et al. (1964); 3 = Chao and Chang (1989); 4 = Chao et al (1990); 5 = Lee and Chen (1994); 6 = Chao 1999a, 7 = Chao 1999b; 8 = Chao 2000.

center to interradial edge, and NMNS = National Museum of Natural Science.

## SPECIES ACCOUNTS

### Family Luidiidae Sladen

Clark and Courtman-Stock 1976: 43; Clark 1982: 158; Clark and Downey 1992: 4-5; Liao and Clark 1995: 68; Rowe and Gates 1995: 73.

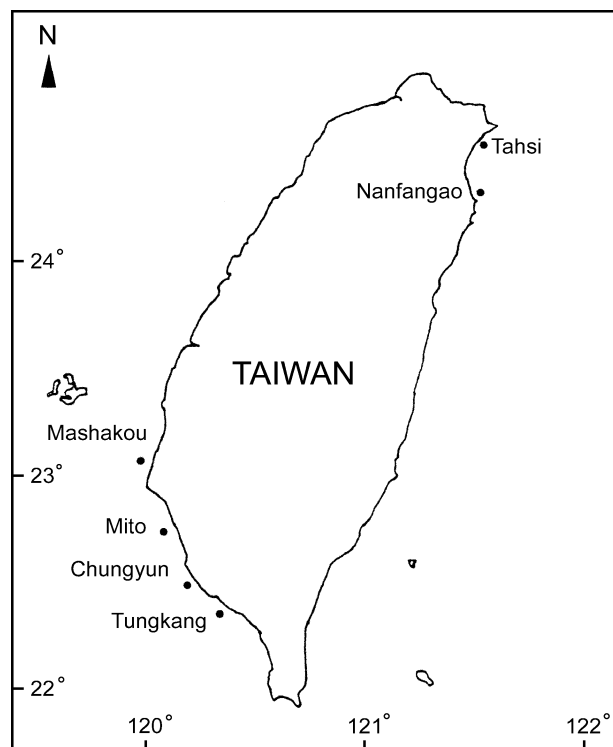
#### *Luidia maculata* Müller et Troschel

(Fig. 3)

*Luidia maculata* Müller & Troschel, 1842: 77 (type locality: Japan); Fisher 1919: 168-170; Chang et al. 1964: 57; Clark and Rowe 1971: 31 (distribution), 43, pl. 4, fig. 3; Hayashi 1973: 48, pl. 7, fig. 4; Marsh 1974: 68; Clark and Courtman-Stock, 1976: 45; Okada and Ugida 1981: 51; Guille et al. 1986: 120-121; Imaoka et al. 1990: 40; Walenkamp 1990: 13-18, figs. 3-5; Liao and Clark 1995: 71, fig. 36; Rowe and Gates 1995: 75.

**Material:** NMNS-2904001, Chungyun, 1 specimen, depth range 40-150 m, sandy substrate.

**Description:** 8 rays; R/r = 200/20 mm. Disc small; body comprised almost completely of rays.



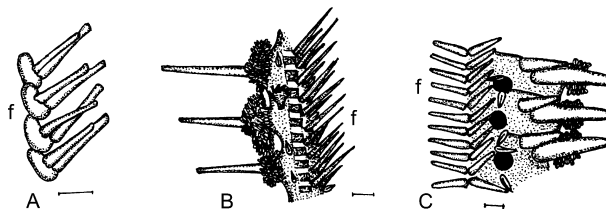
**Fig. 1.** Map showing the collecting sites off Taiwan: Nanfanggao (121°50'E, 24°40'N), Tahsi (121°50'E, 24°55'N), Mashakou (120°E, 23°10'N), Mito (120°10'E, 22°45'N), Chungyun (120°15'E, 22°30'N), and Tung kang (120°25'E, 22°25'N).

**Table 2.** Abundance of starfish from 6 stations

Species	Na	Ta	Ma	Mi	Ch	Tu
<i>Luidia maculata</i>					R	
<i>L. avicularia</i>						R
<i>L. quinaria</i>	A	A	R	R		R
<i>Distolasterias nipon</i>						R
<i>Coronaster sakuranus</i>			R			
<i>C. volsellatus</i>						R
<i>Astropecten polyacanthus</i>	R					
<i>A. vappa</i>			A	A	A	
<i>Craspidaster hesperus</i>						R
<i>Ctenopleura sinica</i>	A	C		R		R
<i>Dipsacaster pretiosus</i>	C	R				R
<i>Tethyaster aulophorus</i>						R
<i>Anthenoides laevigatus</i>						A
<i>Astrothauma euphyllacteum</i>						R
<i>Calliaster childreni</i>			R			
<i>Mediaster brachiatus</i>		R				
<i>Ophidiaster armatus</i>					R	
<i>Anthenea chinensis</i>		A	A			
<i>Pentaceraster chinensis</i>			R			

A = Abundant; more than 20 specimens were collected. C = common; 5-19 specimens were collected. R = rare; less than 5 specimens were collected. Na = Nanfanggao, Ta = Tahsi, Ma = Mashakou, Mi = Mito, Ch = Chungyun, Tu = Tung kang.

Large dorsal paxillae usually with 20-25 central granules and 20-30 peripheral spinelets. Paxillae in disc center and along midradial line more irregular and smaller than lateral ones. Lateral paxillae quadrangular, forming longitudinal and transverse rows. Supermarginal plates inconspicuous and covered by paxillae, similar in structure to the adjacent abactinal plates. Inferomarginal plates large, with 3-5 compressed spines in a transverse series and with numerous spines and spinelets of various lengths. Each adambulacral plate with 3 curved and flattened spines aligned perpendicular to furrow, the innermost shortest, the second largest. Two to 4 tricuspid pedicellariae close to 3rd adambulacral spine. With 2 rows of conspicuous tube feet. Bold color pattern of dark and whitish plates on dorsal side; ventral side whitish.



**Fig. 2.** Ambulacral armature of (A) *Coronaster sakuranus* (Döderlein), (B) *Coronaster volsellatus* (Sladen), and (C) *Distolasterias nipon* (Döderlein). Below is the proximal direction. f = furrow. Scale is 1 mm.

**Distribution:** Widely distributed in the Indo-West Pacific Ocean (Clark and Rowe 1971, Rowe and Gates 1995).

***Luidia avicularia* Fisher**  
(Fig. 4)

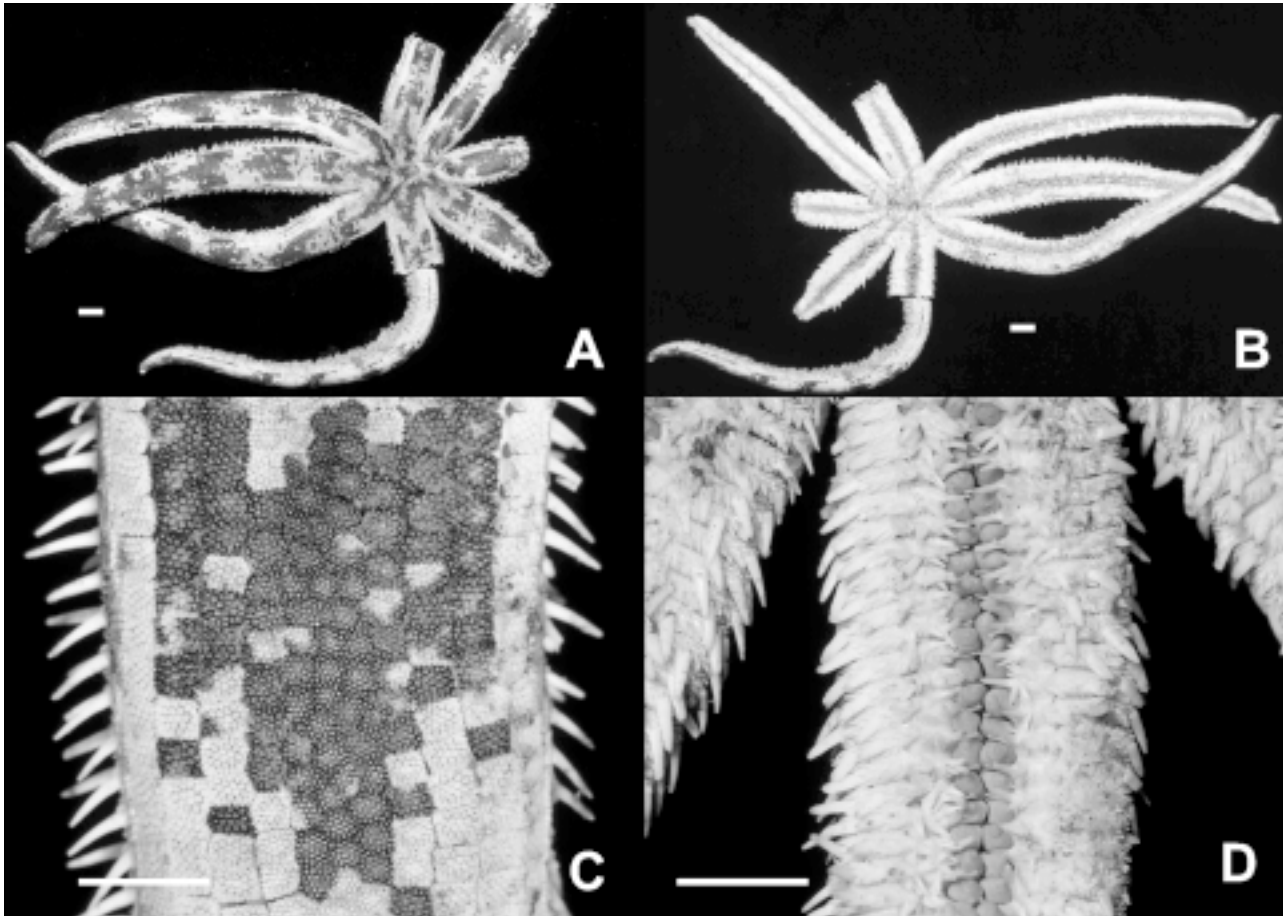
*Luidia avicularia* Fisher, 1913: 203 (type locality: between Samar and Masbate, Philippines); Clark and Rowe 1971: 30 (distribution), 44 (key); Hayashi 1973: 51; Jangoux 1981: 458; Liao and Clark 1995: 69, pl. 3, fig. 3; Rowe and Gates 1995: 74.

*Luidia moroisoana* Goto, 1914: 301; Okada and Ugida 1981: 51.

**Material:** NMNS-3166001, Tungkang, 1 specimen, 150 m depth, sandy substrate.

**Description:** 9 rays; R/r = 129/16 mm. Disc small; body comprised almost completely of rays. Paxillae in disc center and midline of arms smaller than lateral ones. Dorsolateral arm plates larger, quadrangular, forming 3 longitudinal and transverse series. Outermost row of lateral arm plates usually with a central spine, 6-12 small spines, and 30-40

peripheral spinelets; 2nd row of lateral arm plates usually without central spine, but with 5-6 short spines and 25-30 peripheral spinelets; 3rd row of lateral arm plates with fewer central short spines and peripheral spinelets. Paxillae on mid-dorsal arm plates and central disc plates with 3-5 granuliform spinelets and about 20 peripheral spinelets. Supermarginal plates inconspicuous and covered by paxillae, indistinguishable from neighboring abactinal plates. Inferomarginal plates large, with 3-5 compressed spines in a transverse series, and with numerous, smaller peripheral spines and spinelets. Adambulacral plates with 3 curved and flattened spines aligned at right angles to furrow, the innermost shortest, the third largest. A bicuspid straight pedicellaria below the innermost adambulacral spine; two larger bicuspid straight pedicellariae near base of 3rd adambulacral spine. With 2 rows of conspicuous tube feet. Oral plates narrow, with 10-15 spines projecting upward and toward mouth. Bicuspid straight pedicellariae in furrow near mouth.



**Fig. 3.** *Luidia maculata*. (A) Dorsal view, (B) Ventral view, (C) Dorsal view of arm, (D) Ventral view of arm. R = 200 mm. Scale is 10 mm.

*Distribution:* Southeastern Japan, South China, the Philippines, East Indies, northern Australia (Liao and Clark 1995), and southern Taiwan.

*Remarks:* *Luidia avicularia* is distinguishable from *L. maculata* by having enlarged central spines or spinelets on the paxillae and by the presence of bicuspid pedicellariae close to the adambulacral spines. Fisher (1919) regarded *L. moroisoana* as separate from *L. avicularia*, but Hayashi (1973) and Jangoux (1981) synonymized *L. moroisoana* with *L. avicularia*.

***Luidia quinaria* von Martens**

(Fig. 5)

*Luidia maculata* var. *quinaria* von Martens, 1865: 352 (type locality: Nagasaki, SW, Japan).

*Luidia quinaria* Goto, 1914: 293, pl. 7, figs. 104-112; Chang et al. 1964: 55; Hayashi 1973: 41, pl. 7, fig. 1; Okada and Ugida 1981: 51; Imaoka et al. 1990: 39; Liao and Clark 1995: 72, fig. 38.

*Materials:* NMNS-2931073, Nanfangao; 2904005, Tungkang; 2904003, Tahsi; 2905005, Mito; 2905003, Mashakou; 2905001, Mashakou; 11 specimens; depth range 10-150 m, sandy substrate.

*Description:* 5 rays; R/r = 118/17 mm. Arms broad and flattened, with a distinct dark area in disk center and along midradial (carinal) line. Disc small; body comprised almost completely of rays. Paxillae on lateral arm plates large, quadrangular, forming longitudinal and transverse rows; those on mid-dorsal arm plates and central disc smaller, rounder or pentagonal. Large paxillae usually with 10-20 central granules and 20-30 peripheral granular spinelets. Paxillae in disc center and along midradial line smaller and with fewer central granules and peripheral spinelets. Superomarginal plates inconspicuous, covered completely by lateral paxillae. Superomarginal plates with 1-2 bivalvate pedicellariae arranged in a longitudinal series along side of rays.

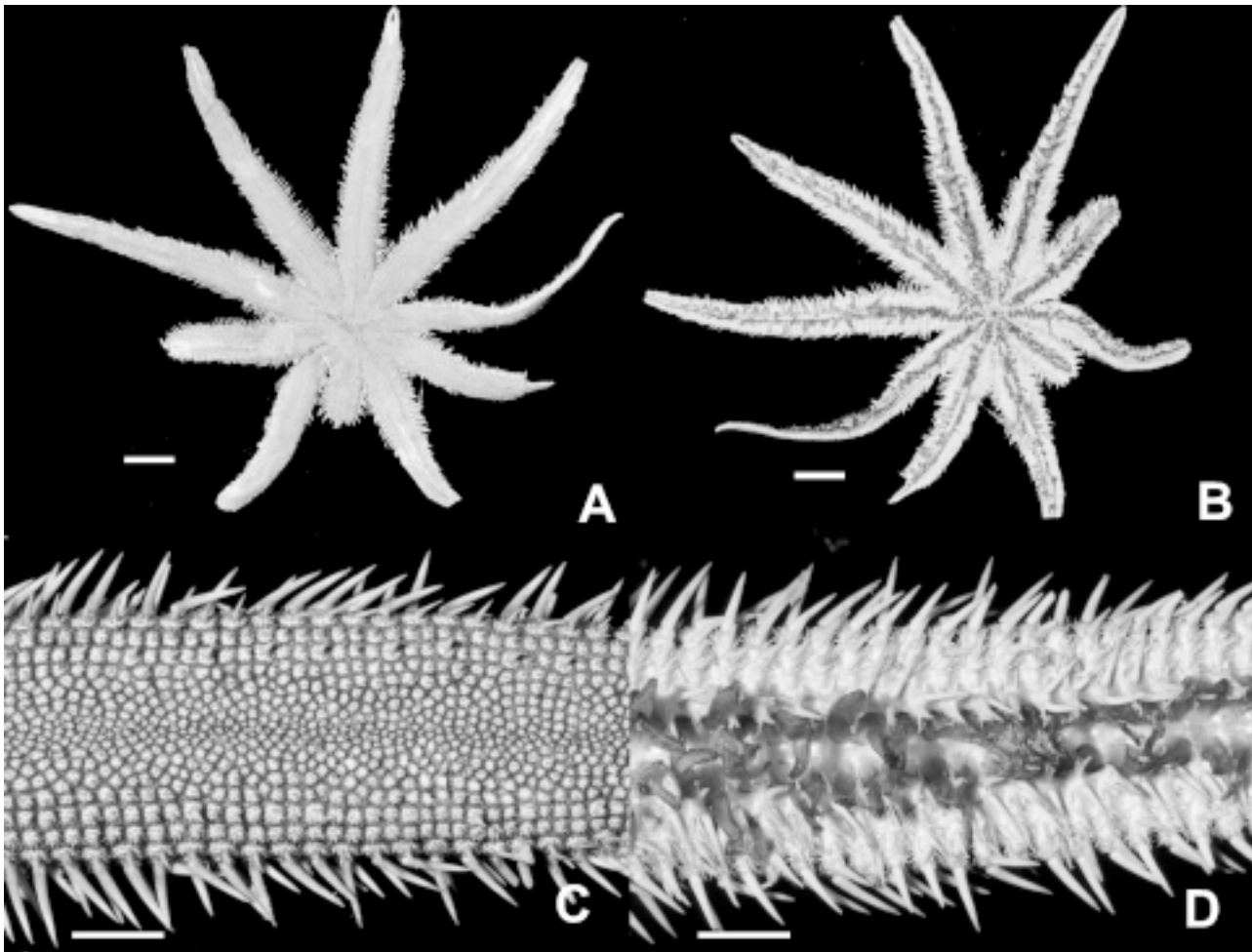


Fig. 4. *Luidia avicularia*. (A) Dorsal view, (B) Ventral view, (C) Dorsal view of arm, (D) Ventral view of arm. R = 129 mm. Scale is 5 mm.

Inferomarginal plates large, with a large flat spine at abactinal corner, several compressed short spines, numerous peripheral spinelets. One large bicuspid pedicellaria near base of large spine. Each ambulacral plate with 3 flat spines aligned perpendicular to furrow, innermost and 2nd slightly curved; outermost spine straight, with large bicuspid pedicellaria at base. With 2 rows of conspicuous tube feet.

*Distribution:* From the Yellow Sea to western Guangdong in China, from Hokkaido to Kyushu in Japan (Liao and Clark 1995), and Taiwan.

#### Family Asteroiidae Gray

Clark and Courtman-Stock 1976: 43; Clark and Downey 1992: 413-415; Liao and Clark 1995: 140-141; Rowe and Gates 1995: 26.

#### *Distolasterias nipon* (Döderlein) (Figs. 2C, 6)

*Asterias nipon* Döderlein, 1902: 334 (type locality: Japan).  
*Distolasterias nipon* Fisher, 1928: 103-105, pl. 43, fig. 5, pl. 60, fig. 2, 2a, pl. 81, fig. 8; Imaoka et al. 1991: 102.

*Material:* NMNS-300093, -300094, -303176, 3 specimens, Tungkang, depth range 150-200 m, sandy substrate.

*Description:* 5 rays, usually of different length. Disc small. R/r = 116-120/8-10 mm. Ray subpentagonal in cross section. Abactinal skeletons of ray composed of tight network of carinal and dorsolateral ossicles, usually in 3-5 longitudinal lines. Carinal plates imbricated in a regular line. Marginals also imbricated. A group of 6-12 papulae in each mesh of

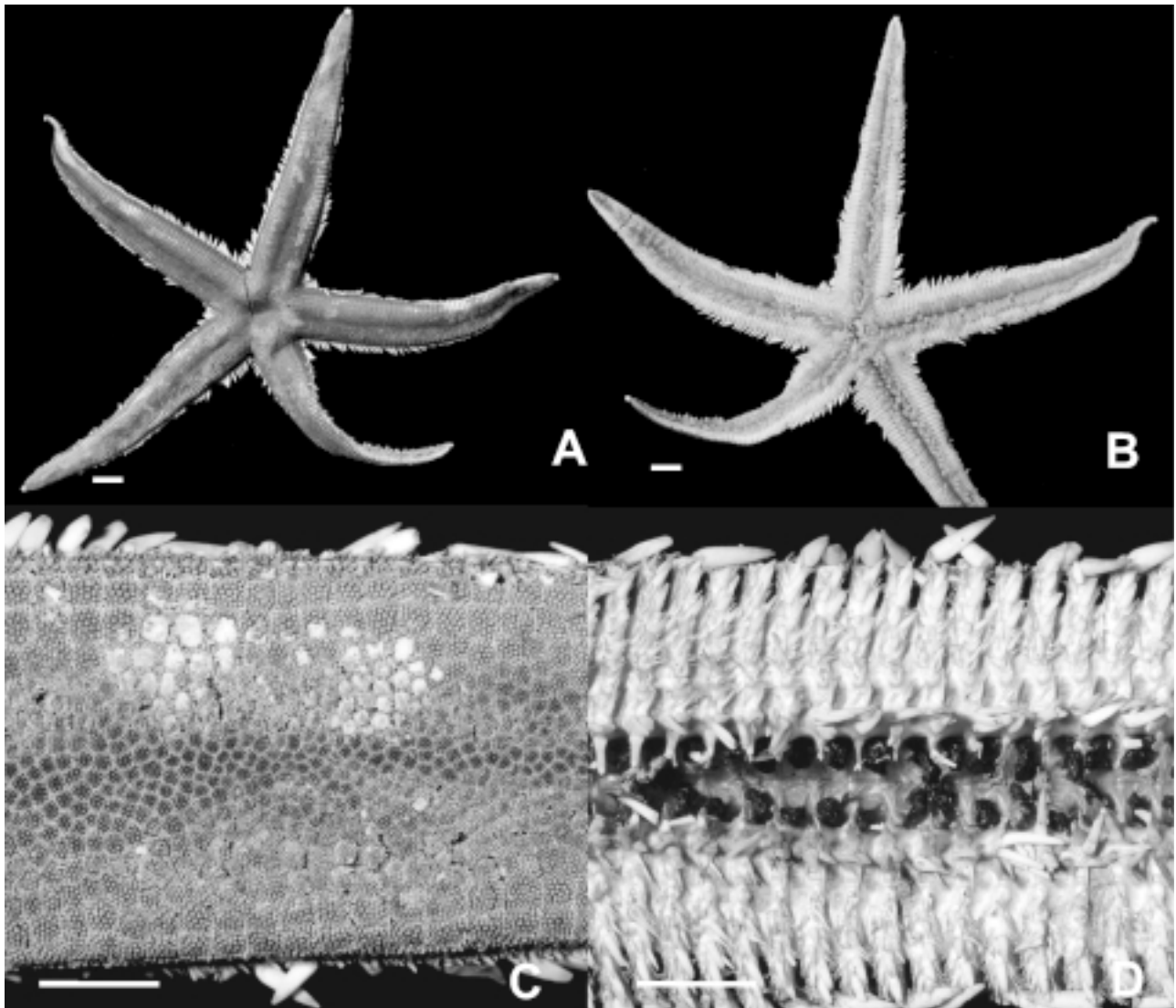


Fig. 5. *Luidia quinaria*. (A) Dorsal view, (B) Ventral view, (C) Dorsal view of arm, (D) Ventral view of arm. R = 118 mm. Scale is 5 mm.

skeleton. Abactinal plates bearing conical spines encircled by wreath of crossed pedicellariae. Superomarginal plates bearing large conical spines. Inferomarginal plate bearing 2 or 3 spines, the lower 2 always smaller than the uppermost. Adambulacral plate bearing 1 furrow spine, and 1 subambulacral spine of similar size and shape. One to 2 straight pedicellariae between subambulacral spine and inferomarginal spine. Sparse straight pedicellariae on furrow margin.

*Distribution:* East and South China Sea, Hong Kong, Japan (Shiu and Liao 1994), and southern Taiwan.

#### Family Labidiasteridae

Clark and Downey 1992: 458, 459.

#### *Coronaster sakuranus* (Döderlein)

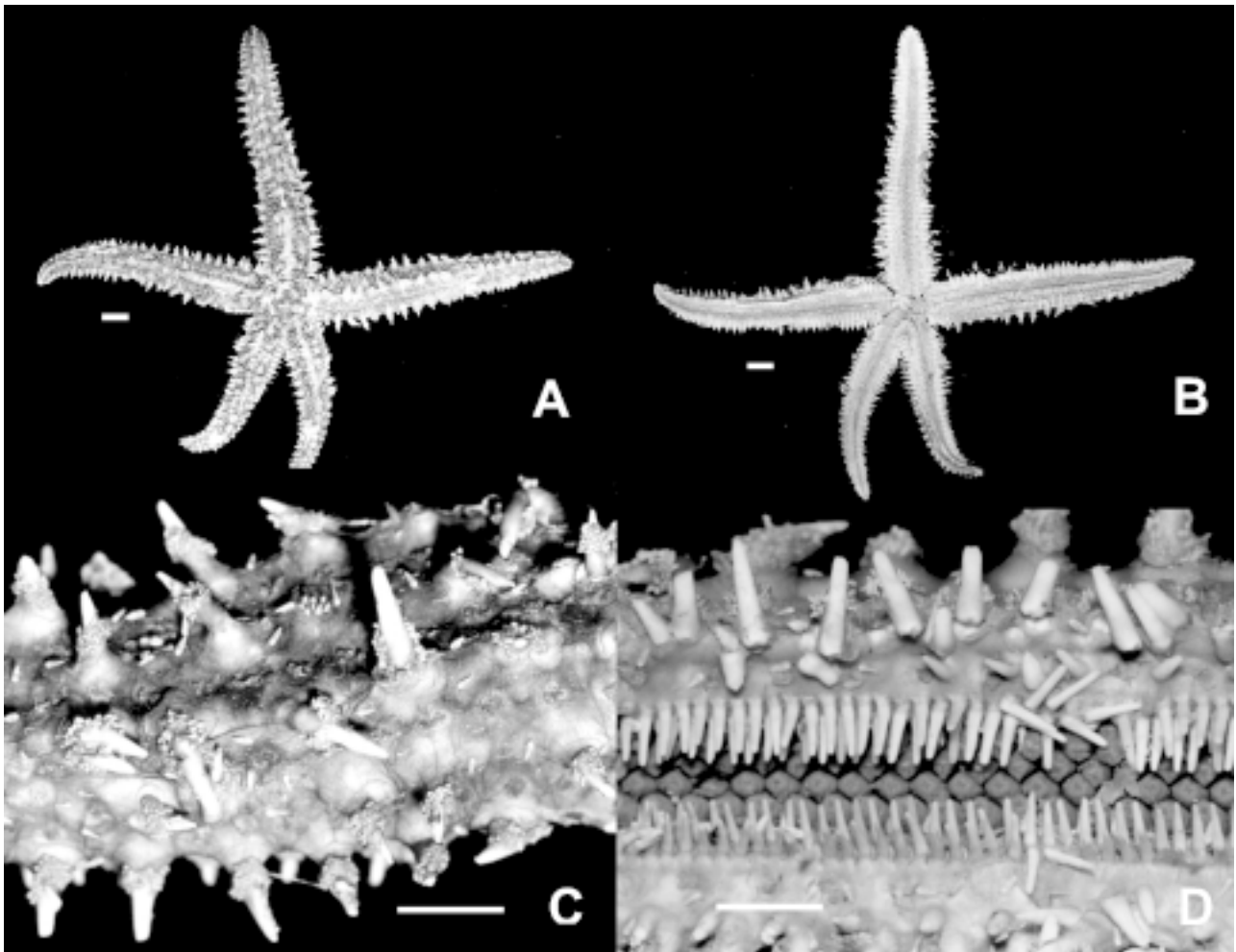
(Figs. 2A, 7)

*Asterias volsellata* var. *sakuranus* Döderlein, 1902: 332 (type locality: SE Japan).

*Coronaster sakuranus* Hayashi, 1943: 188; 1973: 98; Imaoka et al. 1991: 97.

*Material:* NMNS-303101, 1 specimen, Masha-kou; dredged at about 100-150 m in depth, sandy substrate.

*Description:* 10 slender rays; R/r = 110/11 mm. Skeletal plates cruciform, forming open network interconnected by slender plates. Carinal and superomarginal plates in nearly longitudinal series, but interconnected plates irregularly arranged. Three to 5 groups of 5-18 papulae in each mesh of skeleton. Each plate usually bearing a 2-3-mm spine encircled by wreath of crossed pedicellariae. Adambulacral plates small, each bearing 2 slender spines, a furrow and subambulacral spine. Wide space between



**Fig. 6.** *Distolasterias nipon*. (A) Dorsal view, (B) Ventral view, (C) Dorsal view of arm, (D) Ventral view of arm. R = 120 mm. Scale is 5 mm.

neighboring adambulacral plates. One crossed pedicellaria near base of furrow spine. Disc lost. Animal in life reddish brown. Alcohol-preserved specimen light brown.

*Distribution:* Kagoshima Bay to Sagami Bay, southeastern Japan, East China Sea (Imaoka et al. 1991), and western Taiwan.

***Coronaster volsellatus* (Sladen)**

(Figs. 2B, 8)

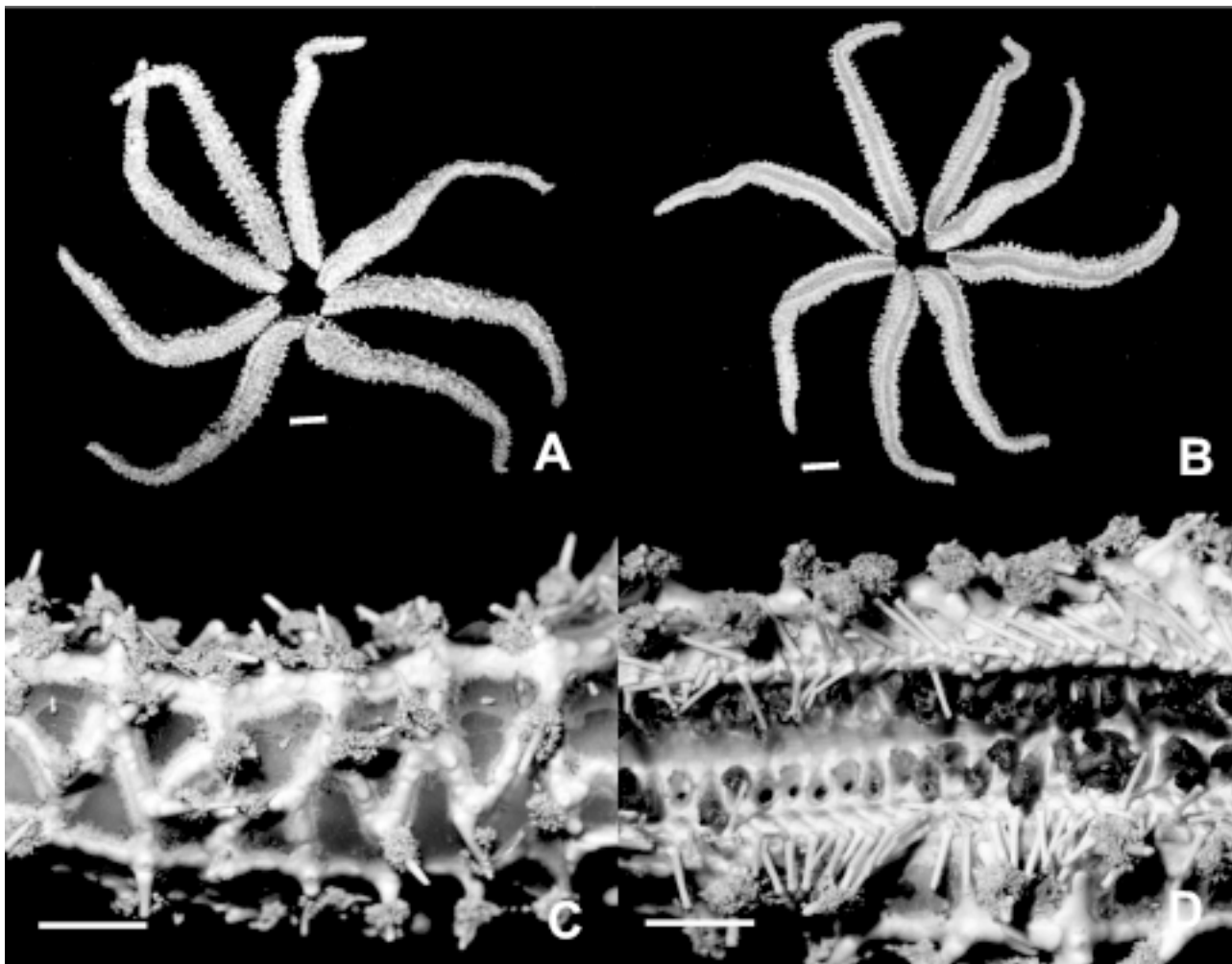
*Asterias (Stolasterias) volsellata* Sladen, 1889: 584-585, pl. 107, figs. 1-4 (type locality: near Cebu, Philippines).

*Coronaster volsellatus* Fisher, 1919: 496-497, pl. 135, fig. 4, pl. 151, fig. 2; Fisher 1928: 88; Chang et al. 1964: 73; Clark and Courtman-Stock 1976: 92; Okada and Ugida 1981: 62; Clark and Downey 1992: 460, fig. 68a, b; Liao and Clark 1995: 142; Rowe and Gates 1995: 28.

*Material:* NMNS-300095, Tungkang, 1 speci-

men; depth range 150-200 m, sandy substrate.

*Description:* 10 slender rays; R/r = 154/14 mm. Disc low, small, with sparse spines. Base of ray low, well distinguished from disc. Ray nearly rectangular in cross section. Disc ossicles radially arranged. Abactinal ossicles in 3 longitudinal series. Carinal plates connected to supermarginals by transverse bars of similar plates forming an open, quadrangular meshwork (Fig. 2C). Two lateral series of inferomarginals connecting with subambulacral plates. Transverse bars of similar plates between these regular longitudinal series of plates. Several papulae and straight pedicellariae on membrane. Slender spines on skeleton arranged in 5 longitudinal series; numerous crossed pedicellariae encircling spines. Spines on disc smaller than those on rays, wreathed by crossed pedicellariae. Adambulacral plates small, bearing a small furrow spine and a larger



**Fig. 7.** *Coronaster sakuranus*. (A) Dorsal view, (B) Ventral view, (C) Dorsal view of arm, (D) Ventral view of arm. R = 110 mm. Scale is 5 mm.



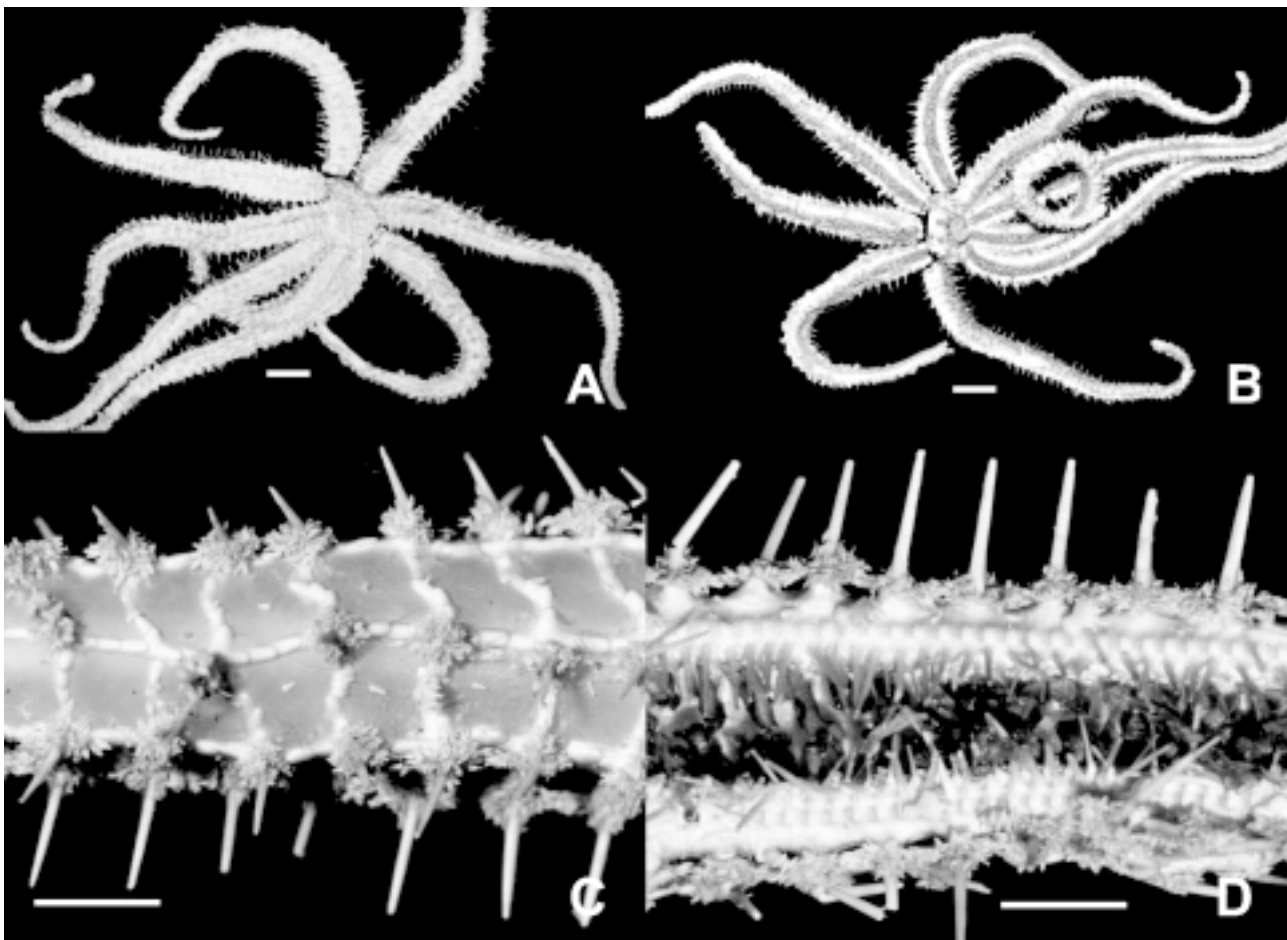
subambulacral spine. Actinal plate absent. Sparse unguiculate (felipedal) pedicellariae on surface of adambulacral plates or between inferomarginal and adambulacral plates.

**Distribution:** Morocco, South Africa, southern Japan, southern China, the Philippines, southeastern oceanic NSW (Australia); known from off Newcastle to Brush Is., depth range 82-630 m (Clark and Downey 1992, Liao and Clark 1995, Rowe and Gates 1995), and Taiwan.

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**Fig. 8.** *Coronaster volsellatus*. (A) Dorsal view, (B) Ventral view, (C) Dorsal view of arm, (D) Ventral view of arm. R = 154 mm. Scale is 5 mm.

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## 底拖網採獲的臺灣海星及六種新記錄種

趙世民<sup>1</sup>

從 1995 年 7 月到 1998 年 8 月，以底拖船在臺灣東北及西南沿海 30-250 公尺深的沙底進行海星採集，採獲 7 科 19 種海星，其中 6 種為新記錄種：斑砂海星 *Luidia maculata*、松砂海星 *L. avicularia*、砂海星 *L. quinaria* (砂海星科 Luidiidae)、座冠叉海星 *Coronaster volsellatus*、櫻花冠叉海星 *Coronaster sakuranus* (叉棘海星科 Labidiasteridae)、日本長腕海盤車 *Distolasterias nipon* (海盤車科 Asteriidae)。本報告描述這 6 種海星。本文亦表列這 19 種的豐富度。此外，臺灣已記錄的 13 科 44 種海星也表列在本文中。

**關鍵詞**：海星，棘皮動物，臺灣，分類。

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