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A Revision of the Family Astropectinidae (Echinodermata: Asteroidea) from Taiwan, with Description of Five New Records

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Shyh-Min Chao (1999) A revision of the family Astropectinidae (Echinodermata: Asteroidea) from Taiwan, with description of five new records. *Zoological Studies* **38**(3): 257-267. From July 1994 to Aug.1998, systematic collections of starfishes by trawling from sandy substrates at 30-200 m depth along the coast off Taiwan were conducted at 9 stations. Six species (*Astropecten polyacanthus*, Astropecten vappa*, Craspidaster hesperus, Ctenopleura sinica*, Dipsacaster pretiosus**, and *Tethyaster aulophorus**) of the Astropectinidae were collected, with five being new records (marked with asterisks). This paper describes these 6 species and reviews the classification of other recorded astropectinids from Taiwan. Two species, *Astropecten vappa* and *Ctenopleura sinica*, first recorded by Hayasaka in 1949 were misidentified as *Astropecten scoparius* and *Ctenopleura ludwigi*, respectively. Species accounts, a key to species, notes on general habitat and distribution, and photos are presented.

Key words: Astropectinidae, Echinoderm, Starfish, Taiwan, Taxonomy.

Except along the eastern coast which plunges steeply into the Pacific Ocean, starfishes are abundant on sublittoral sandy substrates of the continental shelf adjacent to the remaining coastline of Taiwan. Species in the family Astropectinidae are important benthic components on sandy substrates between depths of 30 and 200 m off Taiwan's coast. They are commonly trawled from northeastern to southwestern Taiwan and may often be found in the local fish market. However, there is no systematic work on these sublittoral starfishes from Taiwan. Many starfishes are still undiscovered, especially the sublittoral to deep-water species.

Investigations dealing with starfishes from Taiwan are relatively few. Only 4 papers including records of 19 species in 8 families have been published (Hayasaka 1949, Applegate 1984, Chao and Chang 1989, Chao et al. 1990). Of these 19 species, 15 were collected along rocky coasts from the intertidal zone to a depth of 20 m by scuba and skin diving. Only 4 species were collected by trawling sandy substrates at more than 30 m depth. The 4 trawled species are *Astropecten scoparius*, *Astropecten velitaris*, *Craspidaster hesperus*, and *Ctenopleura ludwigi*. Three of these species were collected by Hayasaka in 1949, while *Astropecten velitaris* was recorded by Chang et al. (1964) and Liao and Clark (1995). *Astropecten scoparius* and *Ctenopleura ludwigi* have not been collected since Hayasaka (1949).

From July 1994 to Aug. 1998, systematic collections of sublittoral starfishes by trawling were carried out at 9 stations along the western (Nanliao, Wuchi, Potsailiao, Mashakou [also known as Masago], Mito, Chungyun [also known as Chunyun], and Tungkang) and northeastern (Tahsi and Nanfangao) coasts of Taiwan (Fig. 1). Starfishes were collected monthly from sandy bottoms to a depth of 200 m. Six species in the family Astropectinidae were collected, 5 of which are new to Taiwan. This paper describes these 6 species. Systematic accounts, a key to species, notes on general ecology and distribution, and photos are presented. This paper also revises the Taiwanese astropectinids for the first time.

MATERIALS AND METHODS

Trawled individuals were allowed to drain on deck for about 30 min, then transferred to 10% for-

malin for 1 d. Specimens were air dried or preserved in 70% alcohol. All specimens are deposited in the National Museum of Natural Science (NMNS), Taichung, Taiwan. Identification is based on *Monograph of shallow-water Indo-West Pacific echinoderms* (Clark and Rowe 1971) and *The echinoderms of southern China* (Liao and Clark 1995). The following abbreviations are used in the text: R = length from disc center to arm tip, r = length from disc center to inter-radial edge (Figs. 2, 3, 4), and NMNS = National Museum of Natural Science.

RESULTS

Key to species of the family Astropectinidae in Taiwan
(adapted from Liao and Clark 1995)

1. Actinal plates extending to arms, usually more than 2 rows 2
   Actinal plates restricted to disc, usually only 1 row, not more than 2 3
2. Madreporite completely covered by paxillae ..... *Dipsacaster pretiosus*
   Madreporite not covered by paxillae ..... *Tethyaster aulophorus*
3. Periphery fringed with large conspicuous spines, at least on infero-marginal plates 4
   Periphery of body appearing smooth, spines at upper end of infero-marginal plates appressed and inconspicuous ..... *Craspidaster hesperus*
4. At least 1 large spine projecting horizontally from upper end of each infero-marginal plate; adambulacral plate with 3 furrow spines 5
   Infero-marginal spines appressed; adambulacral plate with about 5 furrow spines ..... *Ctenopleura sinica*
5. Size small, R usually < 3 cm; large spine only on 1st supero-marginal plate ..... *Astropecten velitaris*
   R usually > 4 cm; most supero-marginal plates armed with spines 6
6. A large, erect, and conical spine on upper end of each supero-marginal plate ..... *Astropecten polyacanthus*
   Usually 1 short blunt spine in middle of some supero-marginal plates ..... *Astropecten vappa*

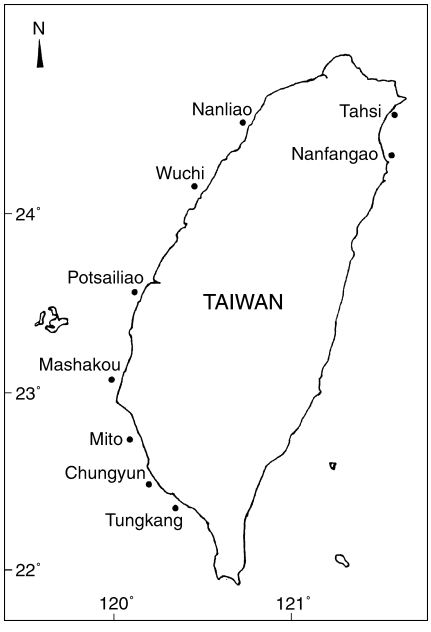


Fig. 1. Map showing the 9 study sites off coast of Taiwan.

SYSTEMATIC ACCOUNTS

Family Astropectinidae Gray

Diagnosis: Supero-marginal and infero-margin-

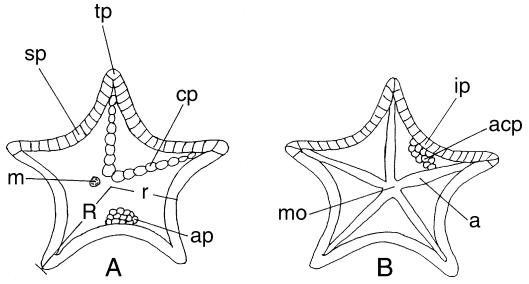


Fig. 2. Terminology of starfish anatomy: A = aboral surface (abactinal), B = oral surface (actinal). a = ambulacra, acp = actinal plate, ap = abactinal plate, cp = carinal plate, ip = infero-marginal plate, m = madreporite, mo = mouth, R = length from disc center to arm tip, r = length from disc center to interradial edge, sp = supero-marginal plate, tp = terminal plate (after Imaoka et al. 1990).

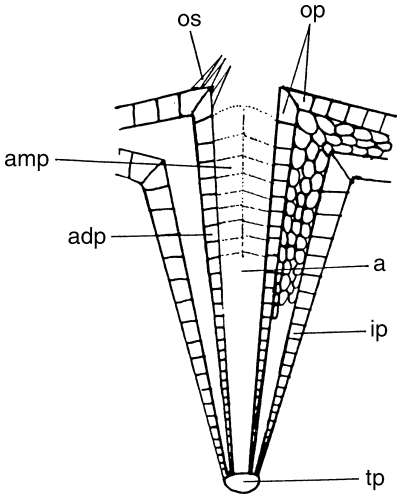


Fig. 3. Oral surface of a typical starfish arm. a = ambulacra, adp = adambulacral plate, amp = ambulacral plate, ip = infero-marginal plate, op = oral plate, os = oral spine, tp = terminal plate (after Chang et al. 1964).

al plates are large and block-like, covered by granules or armed with spinelets, and usually have 1 or more enlarged spines, especially on the infero-marginal plates. Abactinal plates are small and paxilliform. Tube feet taper to a round or conical knob; no terminal disc (sucker).

Genus *Astropecten* Gray

Diagnosis: Both supero-marginal and infero-marginal plates are large and block-like. Each infero-marginal plate bears at least 1 large spine projecting horizontally from the upper end forming a peripheral fringe. The furrow spines are usually 3 per set.

Astropecten polyacanthus Müller and Troschel
(Figs. 5-8)

Astropecten polyacanthus: Chang et al. 1964: 53; Clark and Rowe 1971: 44, pl. 5, fig. 3; Guille et al. 1986: 120; Imaoka et al. 1991: 45; Liao and Clark 1995: 75, fig. 41; Marsh 1974: 68; Okada and Ugida 1981: 49.

Material: NMNS-23180150, Nanfangao,1 specimen, R/r = 8.5 cm/1.5 cm.

Description: Animals with 5 arms. Both oral and aboral sides flattened, but aboral disc slightly convex. Cross section of arm more or less rectangular. Ends of arms curved in dry specimens. The distal-most supero-marginal plate at tip of arm with 2-3 enlarged granules and several conical, blunt, and short spines. Arm length usually < 8 cm. R/r ratio about 5.0. Abactinal plates paxilliform. Each paxilla bearing 10-20 blunt spinelets. Paxillae on middle of arm (i.e., carinal plates) larger than those on periphery. Actinal plates restricted to inter-ambulacral area, usually numbering only 2 and forming a single, short row not extending to arm. Anus in disc center, more

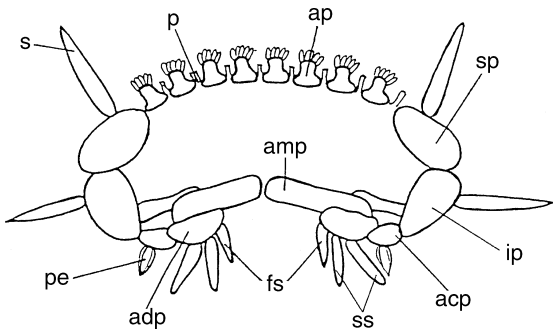
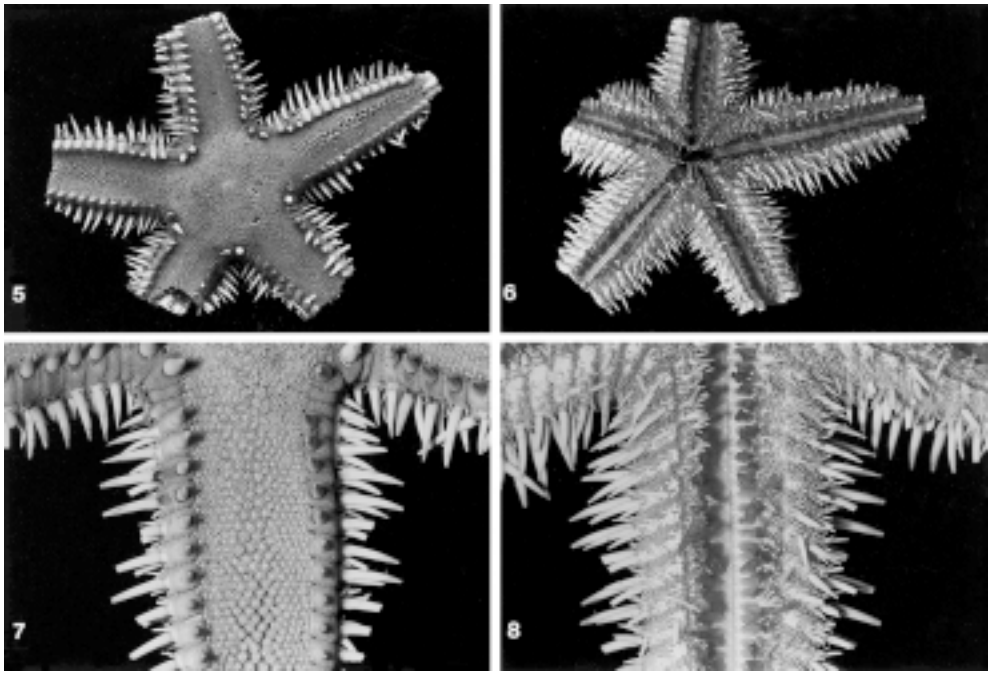


Fig. 4. Cross section of a typical starfish arm showing plate arrangement. acp = actinal plate, adp = adambulacral plate, amp = ambulacral plate; ap = abactinal paxilla, fs = furrow spine, ip = infero-marginal plate, p = papula, pe = pedicellaria, s = spine, sp = supero-marginal plate, ss = subambulacral spines (after Clark and Rowe 1971).



Figs. 5-8. *Astropecten polyacanthus*. **5,** Aboral surface, R = 8.5 cm; **6,** Oral surface, R = 8.5 cm; **7,** Aboral surface of arm base, R = 8.5 cm; **8,** Oral surface of arm base, R = 8.5 cm.

or less convex, and covered by dense spinelets. Madreporite unexposed, covered by paxillae. Supero- and infero-marginal plates conspicuous and vertically opposite each other. Supero-marginal plates covered by dense spinelets; spinelet shape thick in center of plate and thin on periphery. Each supero-marginal plate (except, characteristically, 2nd and 3rd plates) with an erect conical spine measuring 0.7-0.9 cm. Infero-marginal plates large, covered with appressed spines and spinelets of variable lengths. Each infero-marginal plate with 3-5 large spines projecting outward; size of spines increasing with distance from ambulacra. Adambulacral plates small and narrow, with clusters of 10-15 spines including 3 furrow spines; subambulacral spines showing no clear rows or patterns. Ambulacra space very large in dry specimens. Pedicellariae absent. Oral plates narrow and convex, each with 2 rows of spinelets, the furrow or oral row and suboral row. The 6-8 oral spines extending outwards from mouth center at an angle of 45°. Tube feet in 2 rows, without suckers. Animal is dark purple to dark brown in life. Aboral disc usually darker than arms. Dry specimens fragile. Spines and arm tip fall off or easily broken.

Habitat: Trawlings were conducted in sandy substrate between 60 and 120 m depth. Only 1 specimen was collected.

Taiwan: Specimen was collected from Nanfangao.

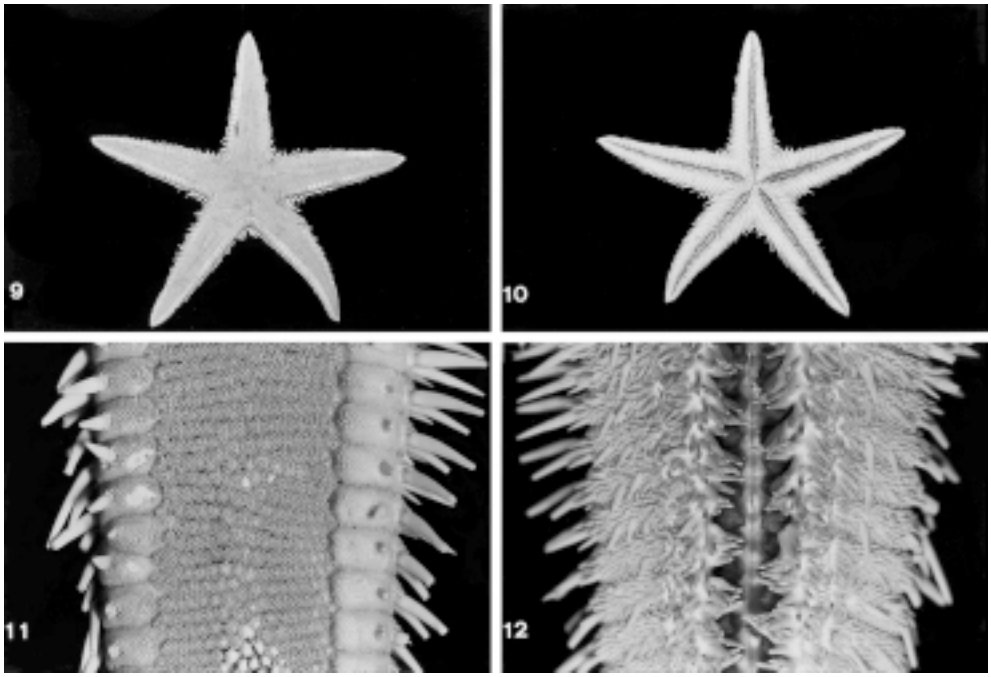
Distribution: *Astropecten polyacanthus* is widely distributed in the Indo-West Pacific area, from the West Indian Ocean to the Hawaiian Is.

***Astropecten vappa* Müller and Troschel**
(Figs. 9-12)

Astropecten vappa: Liao and Clark 1995: 76.
Astropecten vappa inaequalis Fisher, 1919: 69.
Astropecten hartmeyeri Döderlein, 1917: 156, pl. 5, fig. 8, pl. 14, fig. 6-6c.
Astropecten carcharicus Döderlein, 1917: 140, pl. 5, figs. 9, 10, pl. 13, fig. 7, 7a.
Astropecten carcharicus formosanus Döderlein, 1917: 141, pl. 6, fig. 12, pl. 13, fig. 8, 8a.

Materials: NMNS-2939005, Potsailiao, 3 specimens, R/r = 7.1 cm/1.9 cm, 8.5 cm/1.8 cm, 7.4 cm/1.7 cm; NMNS-2939006, Chungyun, 2 specimens, R/r = 6.9 cm/1.7 cm, 3.0 cm/1.0 cm; NMNS-2939006, Mashakou, 1 specimen, R/r = 11.1 cm/2.2 cm.

Description: Animals usually with 5 arms. Both oral and aboral sides flat. Arm cross section rectangular. R value usually not > 11 cm. R/r ratio about 5.5. Terminal plate conspicuous and convex. Abactinal plates paxilliform. Paxilla bearing more than 20 elongated granules, central ones being



Figs. 9-12. *Astropecten vappa*. **9,** Aboral surface, R = 11 cm; **10,** Oral surface, R = 11 cm; **11,** Aboral surface of arm base, R = 11 cm; **12,** Oral surface of arm base, R = 11 cm.

larger, peripheral ones in spinelet form. In dry specimens, paxillae on the arm arranged in transverse series, with those on mid-line (carinal plates) spaced further apart. Actinal plates restricted to inter-ambulacral areas; usually only 2 plates forming a single row not extending to arm. Anus in disc center, convex and surrounded by small paxillae. Large individual bearing exposed madreporite. Madreporite of moderate size individual surrounded by several paxillae, while that of small individual usually covered completely by paxillae. Madreporite bearing fine furrows. Both supero- and infro-marginal plates conspicuous and vertically adjacent to each other. Supero-marginal plates covered in center by elongate granules and with fine spinelets on periphery. Inner margin of 1st to 4th supero-marginal plates usually bearing a short conical spine, but this spine absent on some individuals. An additional short conical spine may occur at center of these first 4 plates, but spine presence variable. Beyond the 4th supero-marginal plate usually bearing a spine to about 3/4 R. These conical short spines easily dislodged from plates. Near end of arm, spines are small or missing. Infero-marginal plates covered by appressed and flattened spinelets and several appressed and flattened spines. Two to 3 flattened spines projecting outwards from upper end of each infero-marginal plate. Spine size decreasing with distance from arm base. Ambulacrum large, with 2 rows of tube feet. Tube feet lacking disc. Furrow spines flattened, 3 per set, middle one longest. Subambulacral spines 2-3 per set, smaller than furrow spines. In large specimens, furrow spines and subambulacral spines may be in a cluster. Several spinelets occuring behind subambulacral spines. Pedicellarie absent. Oral plates narrow, slightly convex. A cluster of 5-8 oral spines extending into mouth. Animal is light purple in life on aboral side, lighter on supero-marginal plates, and grayish white on oral side. Color of dry specimens is uniformly light gray to light yellow.

Habitat: Animals were trawled from sandy substrates at 30-120 m depth. They are known to consume the common gastropod, *Nassarius conoidalis* (Deshayes).

Taiwan: Individuals were commonly collected at Nanfangao, Potsailiao, Mashakou, Mito, Chungyung, and Tungkang, This species is very common in sandy substrates from northeastern Taiwan to southwestern Taiwan.

Distribution: Sri Lanka area, East Indies, North Australia, the Philippines, China, and southern Japan.

Remarks: *Astropecten vappa* is a common species from Hainan Is. to Fujian Prov., China. Liao and Clark (1995) gave a full description of character variation, especially the variation of supero-marginal spines. Liao observed that there is considerable variation of supero-marginal spines correlated to some extent with size. He concluded that *A. carcharicus* Dödrerlein and *A. carcharicus formosanus* Döderlin were synonymous with *A. vappa*.

Clark (in Liao and Clark 1995) examined 70 specimens of *A. vappa* from Shark Bay of western Australia where the type specimens were collected. She concluded that the subspecies *A. vappa inaequalis* from Hong Kong and *A. carcharicus* and *A. hartmeyeri* also from Shark Bay are synonymous with *A. vappa*.

Astropecten vappa from Taiwan has the above-mentioned variation in supero-marginal spines. Therefore, I concur with Liao and Clark's conclusion and identify these specimens from Taiwan as *A. vappa*. As no specimens of *A. scoparius* were collected in this 4-yr study, I suspect that specimens collected and identified by Hayasaka (1949) as *A. scoparius* are, in fact, misidentified *A. vappa*.

Genus *Craspidaster* Sladen

Diagnosis: Marginal and actinal plates bear a single series of webbed peripheral spinelets. Periphery of body is more or less smooth. Spines at the upper end of the infero-marginal plates are appressed and inconspicuous. Actinal plates are in 1 row, with a few additional interradial plates.

Craspidaster hesperus (Müller and Troshel)

(Figs. 13-16)

Archaster hesperus Müller and Troschel, 1840: 104; 1842: 66.
Craspidaster hesperus: Fisher 1919: 60, pl. 9, fig. 3; Chang et al. 1964: 53; Clark and Rowe 1971: 30, 44; Liao and Clark 1995: 81, fig. 43; Okada and Ugida 1981: 48.
Pseudarchaster spatuliger Mortensen, 1934: 6, pl. 1, figs. 1-2.

Material: NMNS-23180148, Tungkang, 1 specimen, R/r = 3.1 cm/0.9 cm.

Description: Animal with 5 arms. Cross section of arm rectangular. R/r about 3.4. Abactinal plates paxilliform, extending to end of arm. Paxillae at arm base larger than those at arm end. Paxilla bearing 4-8 central granules and 10-20 periphery spinelets, which are connected by membrane. Actinal intermediate areas small, each containing about 10 actinal plates. Actinal plates aligned in a principal row of 4 plates, with a single plate indicating a 2nd row on either side of interradial mid-line. Actinal plates also paxilliform, with 3-6 central granules and 10-20 spinelets, but these granules and spinelets more sparsely distributed. Anus in disc center, sur-

rounded by small paxillae. Madreporite not exposed, and covered by paxillae. An abnormally enlarged paxilla can be falsely recognized as madreporite by the naked eye (Fig. 19). Supero- and infero-marginal plates conspicuous and vertically opposite each other, both covered with dense granules and with numerous spinelets on periphery. Each infero-marginal plate bearing a flattened spine on the upper end. Furrow spines with 6-8 per set, middle ones longer. Sparsely distributed spinelets surrounding periphery of adambulacral plate. Dry specimen with a narrow ambulacrum. Pedicellariae absent. Oral plates narrow, with 10-20 spinelets. Oral spines fewer than 10, extending to mouth. Tube feet in 2 rows. Dry specimen grayish white.

Habitat: Animal was trawled from sandy substrates at 80 m depth. Only 1 specimen was collected.

Taiwan: Specimen was collected from Tungkang.

Distribution: Bay of Bengal, East Indies, the Philippines, China, and southern Japan.

Remarks: The above characters are based on a dry specimen with R = 3.1 cm.

Genus *Ctenopleura* Fisher

Diagnosis: Animals resemble *Astropecten* but have a crowded row of gonads extending along arms. Infero-marginal plates bear a lateral oblique row of 3-5 appressed spines, and 1-5 flattened, appressed spines on the lower surface. Furrow spines are 4-5 per set instead of 3, the usual number in *Astropecten*. Subambulacral spines are small, often forming a fasciculate pedicellaria.

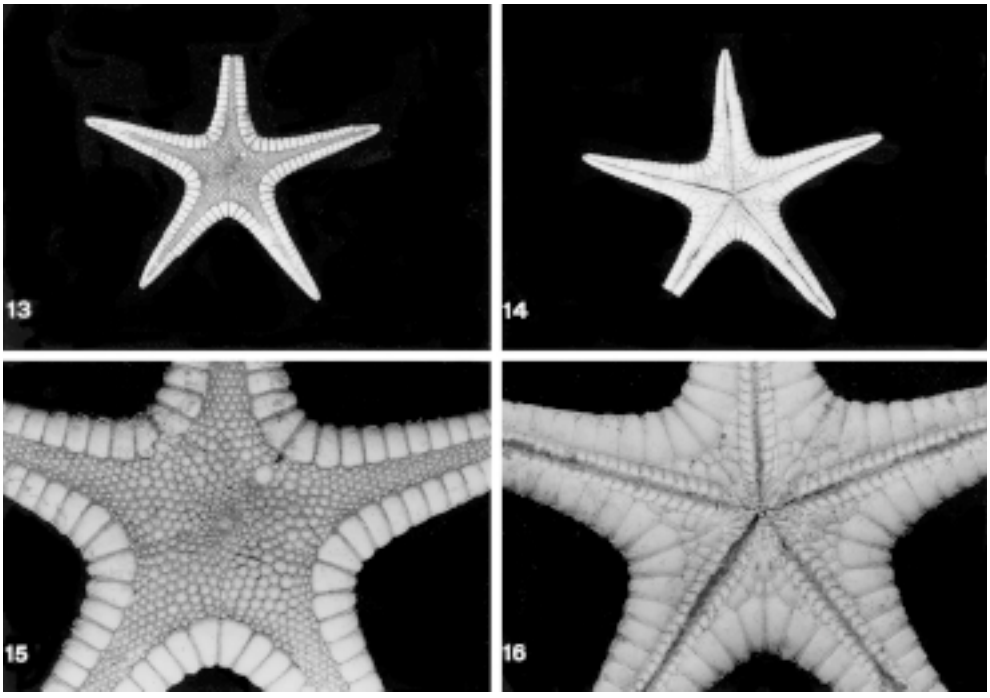
Ctenopleura sinica (Döderlein)

(Figs. 17-20)

Astropecten sinicus Döderlein, 1917: 64, pl. 16, fig. 1-1c.
Ctenopleura sinica: Liao and Clark 1995: 82, fig. 44, pl. 3, fig. 4, pl. 4, fig. 2.

Materials: NMNS-2939004, Mito, 2 specimens, R/r = 5.9 cm/1.5 cm, R/r = 2.7 cm/0.9 cm; NMNS-2939007, Nanfangao, 1 specimen, R/r = 5.9 cm/1.8 cm.

Description: Animals bearing 5 arms. Terminal plate conspicuous. R no greater than 10 cm. R/r ratio about 4.2. Abactinal plates paxilliform, extending to arm end. Paxillae tall, with about 12 spinelets on top and periphery. Spinelets similar in size and shape. When relaxed or extended, paxilla with 2 central and about 10 periphery spinelets; when contracted, spinelets in a cluster. Each abactinal plate surrounded by about 6 papulae. Actinal plates in a row, restricted to the inter-ambulacral area, and



Figs. 13-16. *Craspidaster hesperus*. **13,** Aboral surface, R = 3.1 cm; **14,** Oral surface, R = 3.1 cm; **15,** Abactinal surface, showing the paxillae and an enlarged paxilla (indicated by arrow), R = 3.1 cm; **16,** Actinal surface showing the few actinal plates, R = 3.1 cm.

covered with many appressed spines. Anus in disc center, more or less convex, covered by small paxillae. In many small individuals, anus surrounded by small paxillae. Madreporite surrounded by 7-10 paxillae, partly exposed, and having numerous fine furrows. Supero-marginal plates covered with scale-like spinelets, and with fine spinelets on plate periphery. Large specimens with a row of 4-12 appressed short spines on supero-marginal plates. These appressed spines usually absent or variable in size on small individuals. Appressed spines usually absent on 1st through 3rd supero-marginal plates. Individuals with R = 10 cm with 35 supero-marginal plates. Infero-marginal plates occurring opposite supero-marginal plates, and covered with numerous appressed spinelets. At upper or outer end of each infero-marginal plate, with an oblique row of 3-4 appressed spines measuring 0.4-0.6 cm. On actinal surface of each infero-marginal plate with 2 or 3 appressed spines at 0.2-0.3 cm. Adambulacral plate with 4-6 blunt furrow spines and more than 10 subambulacral spinelets. Ambulacra medium sized and with 2 rows of tube feet without terminal discs. Oral plates elongated and convex. A cluster of oral spines projecting horizontally into mouth; middle 2 spines larger. In life, animals light purple on abactinal plates and pink on supero-marginal plates. Oral surface grayish yellow. Alcohol-preserved specimens grayish white.

Habitat: Animals were collected from sandy substrates at 60-150 m depth.

Taiwan: Nanfangao, Tahsi, Mito, Tungkang.

Distribution: From Hainan Is. to eastern Guangdong, China.

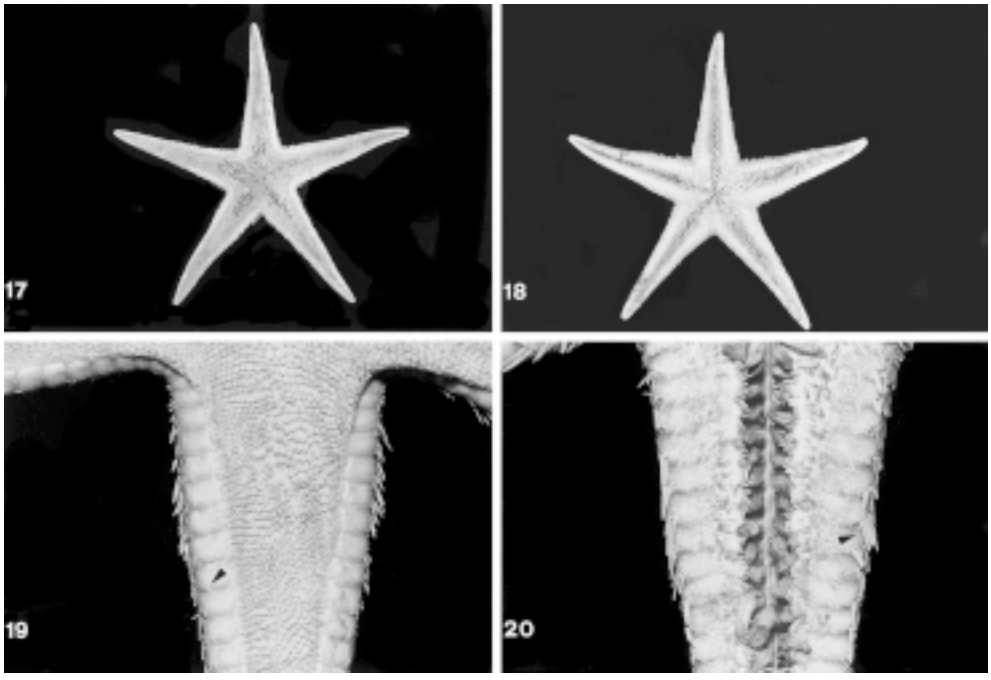
Genus *Dipsacaster* Alcock

Diagnosis: Animals bear a broad disc and large actinal intermediate area. The supero-marginal plates are smaller than the infero-marginal plates, which often project further laterally, thus defining the border of the arm. The infero-marginal plates are armed with a tuft of spines at the outer edge, rarely absent. Gonads are in a series along either side of the abactinal integument of the arm, extending past the middle. Papulae are distributed over the entire paxillar area. Pedicellariae are absent.

Dipsacaster pretiosus (Döderlein)
(Figs. 21-24)

Astrogonium pretiosum Döderlein, 1902: 326.
Dipsacaster pretiosus: Hayashi 1973: 19, pl. 3, figs. 2-3; Liao and Clark 1995: 84, pl.5, figs.1-2; Okada and Ugida. 1981: 48.

Materials: NMNS-2939002, Potsailiao, 3 speci-



Figs. 17-20. *Ctenopleura sinica*. **17,** Aboral surface, R = 10 cm; **18,** Oral surface, R = 10 cm; **19,** Aboral surface of arm base, showing abactinal paxillae and a few appressed short spines on the supero-marginal plates (indicated by arrow), R = 10 cm; **20,** Oral surface of arm base, showing the appressed spines on the upper end of the infero-marginal plate (indicated by arrow), R = 10 cm.

mens, R/r = 3.6 cm/1.4 cm, 3.9 cm/1.5 cm, 2.3 cm/1.2 cm; NMNS-23180149, Tahsi, 1 specimen, R/r = 4.4 cm/1.6 cm; NMNS-2939003, Nanfangao, 2 specimens, R/r = 4.4 cm/1.7 cm, 3.9 cm/1.3 cm.

Description: Animals bearing 5 arms. Arms shorter than those of other astropectinids. Arm in cross section rectangular. Both oral and aboral surfaces flat. Dry specimens more rigid than other astropectinids, except for arm tip. Angle between 2 arms a little over 90°. Terminal plate conspicuous. R usually no greater than 4.5 cm. R/r ratio of 4 specimens about 3. Abactinal plates covered with paxillae, extending to arm end. Each paxilla bearing 4-9 blunt central spinelets and 10-20 peripheral spinelets. Actinal plates numbering 30-40, arranged in several rows. The row adjacent to the adambulacral plates extending to middle of each arm. Each actinal plate covered with 10-15 easily dislodged spinelets. Anus in disc center, surrounded by small paxillae. Madreporite covered with several large paxillae. Denuded of these paxillae, the madreporite showing numerous fine furrows. Supero-marginal plates numbering 18-20, lacking spines, but covered with easily dislodged granules. Infero-marginal plates opposite supero-marginal plates. Infero-marginal plates covered with scale-like flat granules with smaller peripheral granules. Adambulacral plates small and contiguous to infero-marginal plates. Furrow spines 6-8 per set, the middle 2 spines longest. Subambulacral spines 2-3 per set, smaller than furrow spines. Sometimes these subambulacral spines are in a cluster, making it hard to distinguish rows. Pedicellariae absent. Oral plates narrow and convex, with numerous spinelets. A cluster of 15-20 oral spines projecting into mouth. Ambulacra bearing 2 rows of tube feet. Animals reddish orange in life. Specimens in alcohol or dry specimens grayish white.

Habitat: Animals were trawled from sandy substrates at 60-100 m depth.

Taiwan: Nanfangao, Tahsi, Potsailiao.

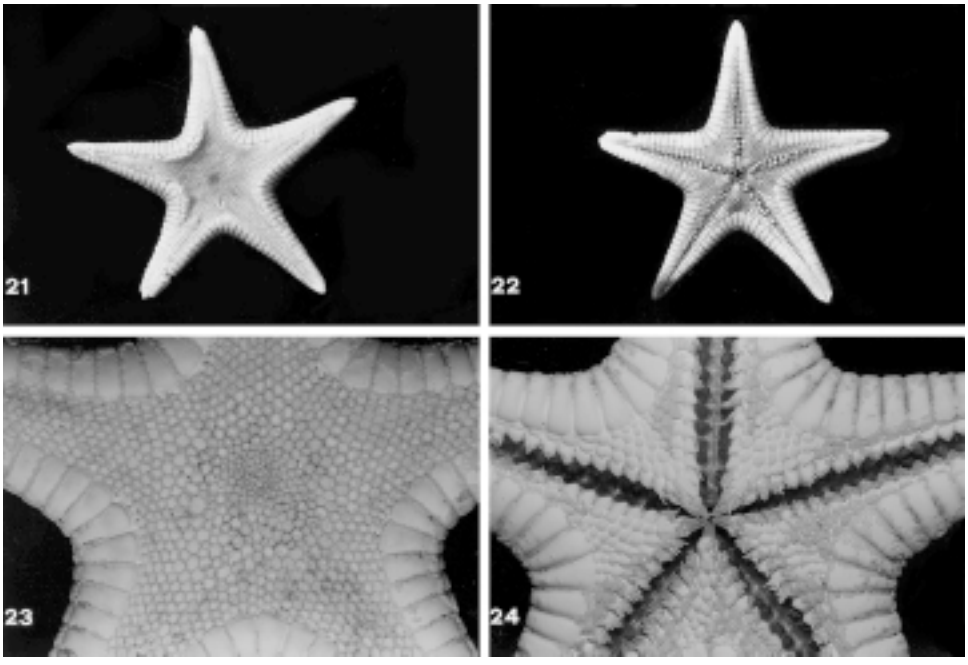
Distribution: southern Japan, eastern Laos to Macao (21°-23°N).

Genus *Tethyaster* Sladen

Diagnosis: Animals have a large actinal intermediate area. Several rows of actinal plates extend far along the arm. The supero-marginal plates are uniformly covered with granules or short spinelets, but lack enlarged spines. The infero-marginal plates bear a few enlarged appressed spines. Madreporite is naked. Adambulacral armament is similar to that of astropectinids. Gonads extend far along the arm. Papulae are distributed over the entire paxillar area.

Tethyaster aulophorus (Fisher)
(Figs. 25-28)

Anthosticte aulophora Fisher, 1911: 417, 1919: 140, pl. 17, fig. 1,



Figs. 21-24. *Dipsacaster pretiosus*. **21,** Aboral surface, R = 4.5 cm; **22,** Oral surface, R = 4.5 cm; **23,** Abactinal surface showing the paxillae and denuded supero-marginal plates, R = 4.5 cm; **24,** Multiple rows of partly denuded actinal plates, R = 4.5 cm.

pl. 18, fig. 3, pl. 19, fig. 2, pl. 38, fig. 3, pl. 39, fig.1a-d.
Tethyaster aulophorus: Clark and Clark 1954: 23, Liao and Clark 1995: 85, pl. 6, figs. 1, 2.

Material: NMNS-2939001, Tungkang, 1 specimen, R/r = 11 cm/2.3 cm.

Description: Animal bearing 5 arms. Terminal plate conspicuous. R usually no greater than 15 cm. R/r ratio about 4.8. Abactinal plates paxilliform, extending to arm end. In dry specimen, the carinal paxillae larger than those of periphery. Peripheral paxillae in transverse rows. Paxillae on arm base bearing 4-8 elongate central granules and 10-25 periphery spinelets. Actinal plates restricted to several rows in actinal intermediate area, with 1st row extending to 1/4 R. Each plate covered with numerous appressed spinelets. Spinelets large in middle of each plate, and fine and sharp on periphery. Anus covered by fine paxillae, not exposed. Madreporite surrounded by more than 10 paxillae, partly exposed, and with numerous fine furrows. Supero-marginal plates covered with granules and with fine spinelets on the periphery; without spines. Individual with R = 11 cm has 65 supero-marginal plates. Infero-marginal plates aligned opposite supero-marginal plates, and covered with numerous appressed spinelets and a row of 3-5 appressed spines measuring 0.2-0.3 cm in length. Adambulacral plate with a cluster of 7-12 spines, including 5-7 furrow spines bordering the ambulacral edge of plate. Pedicellariae absent. Ambulacra of medium size, and bearing 2 rows of tube feet without disc (sucker). Oral plates elongated and convex, with numerous spinelets. A cluster of about 20 oral spines projecting at a 45° angle away from mouth cavity. Animal in life reddish brown on aboral side, darker on disc, carinal areas, and supero-marginal plates. Oral side grayish white. Alcohol-preserved specimen uniformly grayish white.

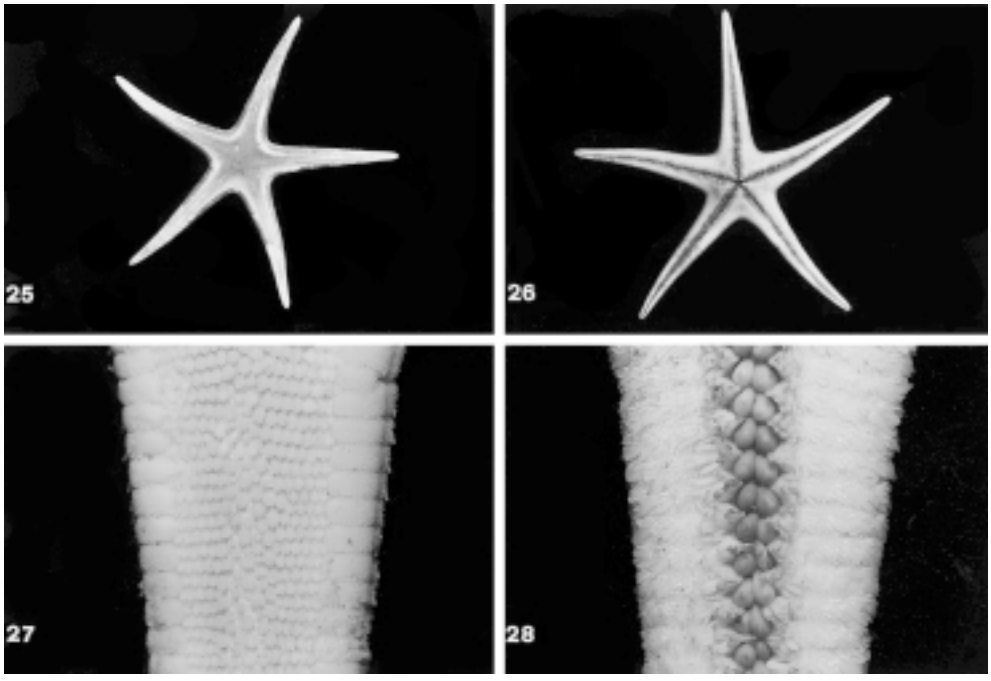
Habitat: Animal was trawled from sandy substrates between 120 and 150 m depth. Only 1 individual was collected.

Taiwan: The specimen was collected from Tungkang.

Distribution: the Philippines, Hainan Is., and SE Taiwan.

DISCUSSION

To date, a total of 7 species in the family Astropectinidae have been recorded from Taiwan. Although *Astropecten velitaris* is reported as common off the western coast of Taiwan (Liao and Clark 1995), I did not collect this species during this study, possibly due to its small size.



Figs. 25-28. *Tethyaster aulophorus*. **25,** Aboral surface, R = 11 cm; **26,** Oral surface, R = 11 cm; **27,** Abactinal surface of arm base showing paxillae and granules on the supero-marginal plates, R = 11 cm; **28,** Actinal surface of arm base showing various appressed spinelets on the infero-marginal plates, R = 11 cm.

Although *Ctenopleura ludwigi* was recorded from Taiwan by Hayasaka (1949), it is a questionable identification. This species is commonly found in southern Japan. I did not, however, collect any specimen in these 4 yr of trawling. Thus, I suspect it does not occur in Taiwanese waters. Clark and Rowe (1971) did not include this species in their important book *Monograph of Shallow-water Indo-West Pacific Echinoderms*. Liao and Clark (1995) did not record this species from the waters of southern China. I did collect many specimens of *Ctenopleura sinica* from Nanfangao, Tahsi (northern Taiwan), and Tungkang (southern Taiwan). Thus I suspect the *C. ludwigi* collected by Hayasaka (1949) was misidentified, and that his specimens instead represent *C. sinica*. Unfortunately, there is no description of this species in the original paper of Hayasaka, and the published photograph lacks sufficient detail for identification. Therefore, collection of positively identified specimens of *C. ludwigi* from Taiwan is needed to confirm its distribution from Japan to Taiwan.

Astropecten scoparius is another questionable species. Liao and Clark (1995) confirmed that all specimens of *A. scoparius* from southern China were identifiable as *Astropecten vappa* due to the variability of the spines on the supero-marginal plates. All the specimens in our collection are *A. vappa.* No *A. scoparius* was collected during this 4-yr study. Thus, I suspect the *A. scoparius* recorded by Hayasaka (1949) was misidentified specimens of *A. vappa*.

I also reviewed the descriptions of *Astropecten scoparius* from Japan (Okada and Ugida 1981, Imaoka et al. 1990). Both descriptions and photographs of *A. scoparius* are very similar to *Astropecten vappa*. Thus, I suspect some *A. vappa* were identified as *A. scoparius*. It is even possible that *A. vappa* is a synonym of *A. scoparius*. A further study of these 2 species is necessary.

The type specimen of *Dipsacaster pretiosus* (Döderlein) is from Japan. Liao and Clark (1995) recorded this species from eastern Laos to Macao (21-23°N). This species are commonly collected from northern to western Taiwan. Thus, distribution of *D. pretiosus* now extends from southern Japan to eastern Laos.

Among these 7 recorded species, only 3 species (*Astropecten vappa*, *Astropecten velitaris*, and *Ctenopleura sinica*) are common in waters off Taiwan. The other 4 species are rare species.

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臺灣之楯海星科海星（棘皮動物門：海星綱）及五種新記錄種

趙世民[1]

從 1994 年 7 月到 1998 年 8 月，以底拖船在臺灣沿海 30-200 公尺的沙面進行海星採集。共採獲 6 種楯海星科海星（多棘楯海星 *Astropecten polyacanthus**，華普楯海星 *Astropecten vappa*，鑲邊海星 *Craspidaster hesperus*, 中華櫛肋海星 *Ctenopleura sinica**，美麗雙沙海星 *Dipsacaster pretiosus**，海神海星 *Tethyaster aulophorus**），其中 5 種為臺灣新記錄種（有 * 號）。本報告描述這 6 種海星並訂正前人有關本科的記錄。其中 Hayasaka (1949)記錄的楓葉楯海星 *Astropecten scoparius* 和陸氏櫛肋海星 *Ctenopleura ludwigi*，應該是華普楯海星 *Astropecten vappa* 和中華櫛肋海星 *Ctenopleura sinica*。種的描述、檢索表、棲地、地理分布及標本照均包含在本文中。

關鍵詞：楯海星科，海星，棘皮動物，分類，臺灣。

[1] 國立自然科學博物館