

Shallow-water Echinoderms of Taiping Island in the South China Sea

Ming-Shiou Jeng

Institute of Zoology, Academia Sinica, Taipei, Taiwan 115, R.O.C.

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Ming-Shiou Jeng (1998) Shallow-water echinoderms of Taiping Island in the South China Sea. *Zoological Studies* 37(2): 137-153. Scuba diving investigations in the reef area around Taiping Island (Itu-Aba Island) found 39 species of 17 families of echinoderms to 40 m depth from 7 survey sites. The echinoderm species, including 5 Crinoidea, 8 Asteroidea, 7 Ophiuroidea, 6 Echinoidea, and 13 Holothuroidea, recorded for the 1st time in this area. Color photographs are given for the 34 species in their natural habitats. *Synaptula lamperti*, *Thelenota rubralineata*, and *Ophiomyxa* sp. are new records from the South China Sea.

Key words: Echinoderm, Taiping Island, South China Sea.

Echinoderms are exclusively marine and are widely distributed in benthic habitats from the intertidal zone to the deep sea. About 6000 living species of echinoderms have been described, of which more than 1000 have been listed for the Indo-West Pacific (Guille et al. 1986). In particular, the shallow-water echinoderm fauna of the Indo-West Pacific is generally considered to be very rich (Clark and Rowe 1971). Taiping Island (Itu-Aba Island), the largest island of the Nansha Islands in the South China Sea, is surrounded by a fringing coral reef. This study is the 1st comprehensive survey of the composition and ecology of the echinoderm populations inhabiting shallow waters (to 40 m) around Taiping Island.

MATERIALS AND METHODS

This study was conducted from 19 to 23 April 1994 at 7 study sites around Taiping Island. I took the No. 2 Yu-Shiun fishing training ship of the Council of Agriculture, Executive Yuan (R.O.C.) from Kaoshiung to Taiping Island; then small boats were used to visit the diving stations. Scuba diving was used throughout the study, and underwater photographs were taken with a Nikon RS underwater camera. The living posture and substratum recorded for the echinoderms were observed and

photo-recorded in situ. Except for some species of crinoids and brittle-stars, most species were identified on the basis of their morphological features, colors, habitat, and postures, the characters commonly used by field researchers. Some specimens were collected by placing them in sealable plastic bags, and they were preserved in 70% ethanol. These specimens are cataloged and deposited at the Institute of Zoology, Academia Sinica (ASIZ), R.O.C. The identification of species mainly followed Chen and Chang (1981), Guille et al. (1986), Chen et al. (1988), Chao and Chang (1989a,b 1990), Allen and Steene (1994), Colin and Arneson (1995), and Gosliner et al. (1996).

Study sites

Taiping Island (also known as Itu-Aba Island, 114°22'E, 10°23'N), is part of the Nansha Islands (Spratly Islands) in the South China Sea (Fig. 1). This island is only 0.5 km² in area with a length of 1289 m and width of 366 m. The surrounding topography of Taiping Island is quite complicated, and typical of tropical coral reefs. Coral communities of Taiping Island are dominated by scleractinian corals with high coral diversity and high coral cover at 1-3 m depth. Alcyonaceans and gorgonaceans are mainly distributed on the reef slopes at depths below 15 m. Wide reef flats and

reef terraces were found on the east and west sides of the island indicating that reef development is better on these sides.

The following section briefly describes the position and depth of study sites (Fig. 1) and the collecting effort (diving hours) at each one.

Site 1: Southwestern side of the island, an old pier, below the average low tide level to 10 m depth. (2 h)

Site 2: South of the island, water depth 1 to 15 m. (1.5 h)

Site 3: Western side of the island, water depth 2 to 12 m. (1.5 h)

Site 4: Northwestern side of the island, water depth 1 to 40 m. (1.5 h)

Site 5: North of the island, water depth 2 to 37 m. (1 h)

Site 6: Northeastern side of the island, water depth 2 to 30 m. (1 h)

Site 7: Eastern side of the island, water depth 2 to 30 m. (1 h)

RESULTS

Table 1 is the checklist of the echinoderm species found in the shallow waters around Taiping Island. The various bottom strata of the coral reef shelter a diversified fauna of 39 species of echinoderms, among which are 5 crinoids, 8 starfishes, 7 brittle-stars, 6 sea-urchins, and 13 holothuroids, and which are here first recorded for Taiping Island. Among them, *Synaptula lamperti*, *Thelenota rubralinata*, and *Ophiomyxa* sp. are new records in the South China Sea.

The echinoderms are listed below in taxonomic order. For each species, information on habitat, locality, and behavior, if known, is given.

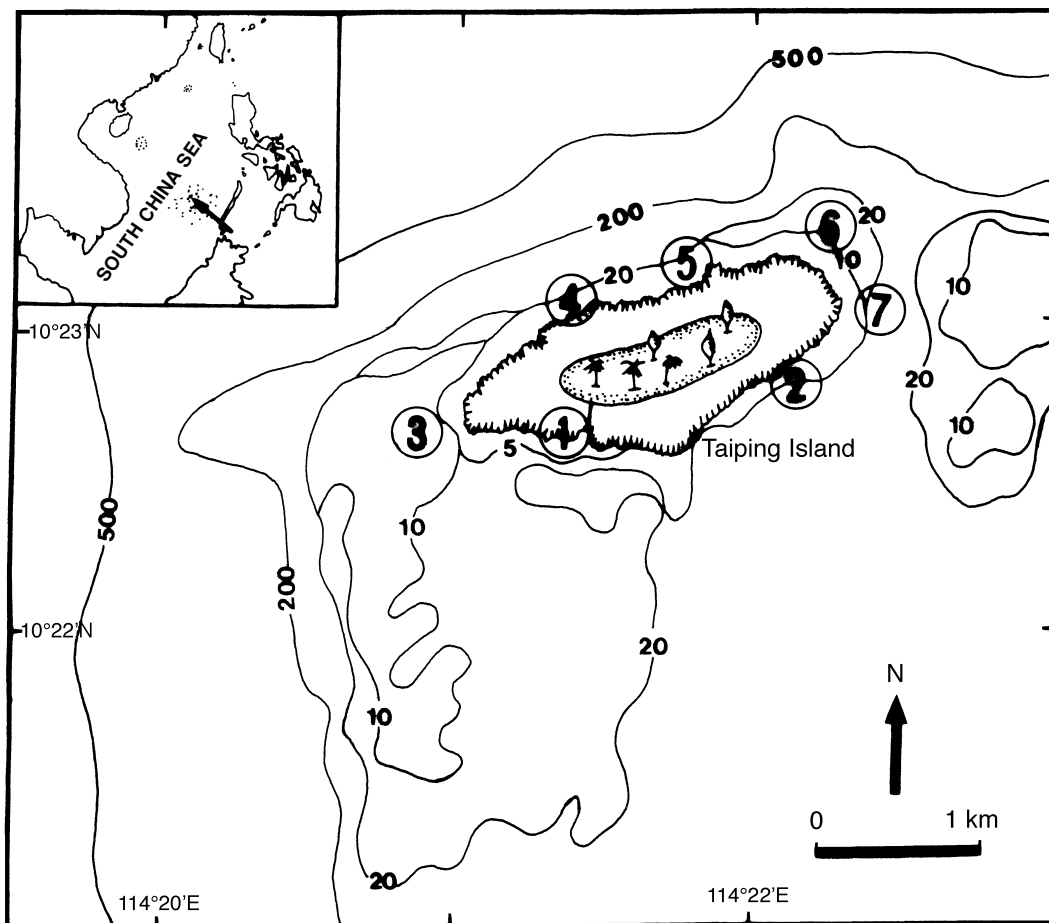


Fig. 1. Map of Taiping Island in the South China Sea, showing the sites mentioned in the text. Depth in meters below mean low tide.

Table 1. Checklist and distribution of echinoderms in the waters around Taiping Island and other regions in the South China Sea

Species	Diving locality ^a							Southern Taiwan	Hong Kong	The Philippines	Xisha Is.	Nansha Is.
	1	2	3	4	5	6	7					
Class CRINOIDEA												
Family Comasteridae												
<i>Comanthina briareus</i> (Bell)		+		+	+	+	+			+		
<i>Comanthus parvicirrus</i> (J. Müller)	+	+	+	+	+	+	+	+	+	+	+	+
<i>Oxycomanthus bennetti</i> (J. Müller)		+		+	+	+	+	+		+		
Family Himerometridae												
<i>Hilmerometra magnipinna</i> A. H. Clark				+	+	+	+	+		+		
Family Colobometridae												
<i>Cenometra bella</i> (Hartlaub)						+	+	+		+		
Class ASTEROIDEA												
Family Oreasteridae												
<i>Choriaster granulatus</i> Lütken				+						+	+	+
<i>Culcita novaeguineae</i> Müller and Troschel			+	+				+		+	+	+
Family Ophidiasteridae												
<i>Fromia milleporella</i> (Lamarck)		+	+							+	+	
<i>Fromia monilis</i> Perrier			+	+			+	+		+		
<i>Linckia laevigata</i> (Linnaeus)		+	+	+	+	+	+	+	+	+	+	+
<i>Nardoa frianti</i> Koehler			+				+	+		+	+	
<i>Neoferdina cumingi</i> (Gray)	+	+								+	+	
Family Echinasteridae												
<i>Echinaster luzonicus</i> (Gray)	+	+	+	+	+	+	+			+	+	+
Class OPHIUROIDEA												
Family Ophiocomidae												
<i>Ophiocoma dentata</i> Müller and Troschel	+	+	+				+	+		+	+	
<i>Ophiocoma erinaceus</i> Müller and Troschel	+	+	+			+				+	+	+
<i>Ophiocoma pica</i> Müller and Troschel		+						+		+	+	+
<i>Ophiomastix annulosa</i> (Lamarck)	+	+	+					+		+	+	
Family Ophiomyxidae												
※ <i>Ophiomyxa</i> sp.						+						
Family Ophiotrichidae												
<i>Ophiothrix lineocaerulea</i> H. L. Clark			+							+		
Family Ophiodermatidae												
<i>Ophiarachnella gorgonia</i> (Müller and Troschel)			+					+	+	+	+	
Class ECHINOIDEA												
Family Diadematidae												
<i>Diadema setosum</i> (Leske)	+	+			+			+	+	+	+	+
<i>Echinothrix calamaris</i> (Pallas)			+		+	+		+	+	+	+	+

Table 1. (Cont.)

Species	Diving locality ^a							Southern Taiwan	Hong Kong	The Philippines	Xisha Is.	Nansha Is.
	1	2	3	4	5	6	7					
Family Stomopneustidae												
<i>Stomopneustes variolaris</i> (Lamarck)			+			+		+		+	+	
Family Toxopneustidae												
<i>Tripneustes gratilla</i> (Linnaeus)		+						+	+	+	+	
Family Echinometridae												
<i>Echinometra mathaei</i> (de Blainville)	+	+	+	+	+	+	+	+	+	+	+	
<i>Echinostrephus molaris</i> (de Blainville)		+	+			+		+		+		
Class HOLOTHUROIDEA												
Family Holothuriidae												
<i>Actinopyga lecanora</i> (Jaeger)							+			+	+	+
<i>Actinopyga mauritiana</i> (Quoy and Gaimard)	+	+		+				+		+	+	+
<i>Bohadschia argus</i> Jaeger				+						+	+	+
<i>Bohadschia graeffei</i> (Semper)					+		+			+		+
<i>Holothuria atra</i> Jaeger	+	+	+				+	+		+		+
<i>Holothuria leucospilota</i> (Brandt)	+	+						+	+	+		
Family Stichopodidae												
<i>Stichopus chloronotus</i> Brandt	+	+	+		+	+	+			+	+	
<i>Thelenota ananas</i> (Jaeger)							+	+		+	+	+
<i>Thelenota anax</i> H. L. Clark		+								+		
* <i>Thelenota rubralineata</i> Massin and Lane							+					
Family Synaptidae												
<i>Opheodesoma grisea</i> (Semper)	+							+		+		
<i>Polyplectana kefersteini</i> (Selenka)				+				+		+		
* <i>Synaptula lamperti</i> Heding					+							
Total species: 39	13	20	18	13	12	14	17	24	8	36	23	15

^aSee Fig. 1.

(+) indicates a confirmed report of the species; * indicates a new record in the South China Sea.

Remarks on geographical distribution are included for species showing considerable range extensions. Restricted synonymy is given for the original name and currently used names including some important references containing synonymies and information on biology and biogeography. Collection numbers are for voucher specimens being curated in the invertebrate collection at the Institute of Zoology, Academia Sinica (ASIZ), R.O.C.

Class Crinoidea

Family Comasteridae

Comanthina briareus (Bell)

(Fig. 2)

Comanthina briareus: Clark and Rowe 1971: 6 (distribution); Guille et al. 1986: 210; Gosliner et al. 1996: 249.

Remarks: This species is common around Taiping Is., and is completely exposed on coral or rock surfaces, its more typical mode of life. This is a large crinoid, which appears as a dense mass of arms and lacks cirri. Black pinnules with white tips alternate with white pinnules. Yellow is also present on the pinnules. The color of this species is consistent. This species is known from Australia,

Indonesia, the Philippines, Japan, Palau, and the Marshall Islands.

***Comanthus parvicirrus* (J. Müller)**

(Fig. 3)

Comanthus parvicirrus: Utinomi and Kogo 1965: 270.
Comanthus parvicirrus: Clark and Rowe 1971: 16 (distribution);
 Clark 1972: 77; Liao 1983: 264; Rowe et al. 1986: 211;
 Guille et al. 1986: 212; Chen et al. 1988: 76.

Remarks: *C. parvicirrus* is one of the most common crinoids around Taiping Is., and is highly variable in color. This species is an inhabitant of the reef infrastructure. Although the disk is hidden within crevices, beneath corals or soft corals, the arms are extended conspicuously into spaces among corals rather than atop them. It is known from the Indian Ocean to the Marshall Islands, in the western Pacific, and northern Australia.

***Oxycomanthus bennetti* (J. Müller)**

(Fig. 4)

Comanthus bennetti: Clark and Rowe 1971: 6 (distribution);
 Meyer and Macurda 1980: 78; Guille et al. 1986: 212.
Oxycomanthus bennetti: Rowe et al. 1986: 259; Chen et al.
 1988: 77; Colin and Arneson 1995: 240; Gosliner et al.
 1996: 250.

Remarks: *O. bennetti* is probably the most conspicuous and widespread species of the Taiping Is. crinoids. This species attaches to prominent coral formations, rocks, or octocorals by the cirri which are well exposed to currents. The entire animal is exposed to view. It is known from the eastern Indian Ocean to the Marshall Islands, and throughout the western Pacific.

Family Himerometridae

***Himerometra magnipinna* Clark**

(Fig. 5)

Himerometra magnipinna Clark 1908: 355; 1918: 73; Clark and
 Rowe 1971: 21 (distribution); Chen et al. 1988: 78.

Remarks: This species grows openly on corals near the reef crest. The deep red color is typical. It is known from Taiwan, China, Japan, the Philippines, the East Indies, and South Pacific Islands.

Family Colobometridae

***Cenometra bella* (Hartlaub)**

(Fig. 6)

Cenometra bella: Clark and Rowe 1971: 19 (distribution);
 Meyer and Macurda 1980: 88; Guille et al. 1986: 216;

Chen et al. 1988: 78; Colin and Arneson 1995: 242.

Remarks: *C. bella* is always found clinging to various gorgonacea (fans or whips) and antipatharian wires. Its distribution is correlated with that of its preferred substrata, wire corals such as *Cirrihipathes*, *Juncella*, and gorgonacea fans. This species is also capable of active swimming. It is known from the western Pacific including Indonesia, Vietnam, the Philippines, and the Marshall Islands.

Class Asteroidea

Family Oreasteridae

***Choriaster granulatus* Lütken**

(Fig. 7)

Choriaster granulatus: Clark and Rowe 1971: 53 (distribution);
 Liao 1980: 154; Guille et al. 1986: 124; Colin and Arneson
 1995: 244; Gosliner et al. 1996: 254.

Remarks: This is a large and unmistakable starfish widely distributed in the Indian Ocean and western Pacific, but it is uncommon around Taiping Is.

***Culcita novaeguineae* Müller and Troschel**

(Fig. 8)

Culcita novaeguineae: Clark and Rowe 1971: 54 (distribution);
 Liao 1980: 154; Guille et al. 1986: 124; Chao and Chang
 1989: 216; Colin and Arneson 1995: 244; Gosliner et al.
 1996: 255.

Remarks: It is a coral predator, somewhat like the crown-of-thorns starfish. A number of color varieties exists, sometimes even in the same location. It occurs throughout the western Pacific but is uncommon around Taiping Is.

Family Ophidiasteridae

***Fromia milleporella* (Lamarck)**

(Fig. 9)

Fromia milleporella: Clark and Rowe 1971: 63 (distribution);
 Liao 1980: 159; Guille et al. 1986: 130; Colin and Arneson
 1995: 246; Gosliner et al. 1996: 258.

Material: ASIZ-54049, 1 specimen, R = 22 mm, r = 7 mm; western Taiping Island; 21 April 1994.

Remarks: This species is found on the exposed surface of rocks of reef flats and always lives within a depth of 3 m in the intertidal area around Taiping Is. It is known from the Indian Ocean to the Marshall Islands.

***Fromia monilis* Perrier**

(Fig. 10)

Fromia monilis: Clark and Rowe 1971: 62 (distribution); Marsh 1977: 258; Guille et al. 1986: 130; Chen and Chang 1989: 216; Colin and Arneson 1995: 246; Gosliner et al. 1996: 259.

Material: ASIZ-54048, 1 specimen, R = 30 mm, r = 8 mm; eastern Taiping Island; 23 April 1994.

Remarks: This species is found on exposed surfaces of rocks, extending to depths of 5-10 m on reef flats around Taiping Is. This species is rather common in the western Pacific.

***Linckia laevigata* (Linnaeus)**

(Fig. 11)

Linckia laevigata Clark and Rowe 1971: 62 (distribution); Liao 1980: 158; Guille et al. 1986: 138; Chen and Chang 1989: 217; Colin and Arneson 1995: 246; Gosliner et al. 1996: 260.

Remarks: It is found on reef flats and other shallow areas around Taiping Is. This blue starfish can be easily recognized and is common throughout the Indo-Pacific.

***Nardoa frianti* Koehler**

(Fig. 12)

Nardoa frianti: Clark and Rowe 1971: 63 (distribution); Liao 1980: 159; Chen and Chang 1989: 217; Gosliner et al. 1996: 261.

Material: ASIZ-54046, 1 specimen, R = 66 mm, r = 12 mm; southern Taiping Island; 20 April 1994.

Remarks: This species was found exposed on rocks at depths of 10-20 m on reef flats of Taiping Is. It is known from the western Pacific.

***Neoferdina cumingi* (Gray)**

(Fig. 13)

Neoferdina cumingi: Clark and Rowe 1971: 65 (distribution); Guille et al. 1986: 132; Colin and Arneson 1995: 248; Gosliner et al. 1996: 261.

Material: ASIZ-54047, 1 specimen, R = 36 mm, r = 10 mm; southern Taiping Island; 20 April 1994.

Remarks: This species is found on exposed surfaces of rocks, extending to depths of 5-15 m on reef flats. It is rare around Taiping Is. and is known from northern Australia to western Polynesia.

Family Echinasteridae***Echinaster luzonicus* (Gray)**

(Figs. 14, 15)

Echinaster luzonicus: Clark and Rowe 1971: 72 (distribution); Liao 1980: 166; Guille et al. 1986: 152; Colin and Arneson 1995: 250; Gosliner et al. 1996: 264.

Materials: ASIZ-54045, 4 specimens, R = 54~75 mm, r = 11~14 mm; Taiping Island; depth 3~10 m; 20 April 1994.

Remarks: This species usually has 6 arms and is somewhat variable in color. It is common around Taiping Is. as well as in the entire tropical Pacific.

Class Ophiuroidea**Family Ophiocomidae*****Ophiocoma dentata* Müller and Troschel**

(Fig. 16)

Ophiocoma dentata: Clark and Rowe 1971: 119 (distribution); Devaney 1970: 12, 1974: 153; Liao 1978: 89; Applegate 1984: 101; Guille et al. 1986: 184; Chao et al. 1991: 119.

Material: ASIZ-50158, 1 specimen, d.d. = 22 mm, a.l. = 96 mm; southern Taiping Island; 20 April 1994.

Remarks: This species is a common sublittoral ophiuran at depths of 3-10 m around Taiping Is. It is found underneath rocks. This species is known from islands of the western Indian Ocean, East Africa, Madagascar, Northern Australia, China, Taiwan, South Pacific Islands, and Hawaii.

***Ophiocoma erinaceus* Müller and Troschel**

(Fig. 17)

Ophiocoma erinaceus: Clark and Rowe 1971: 119 (distribution); Guille et al. 1986: 184.

Materials: ASIZ-50160, 2 specimens, d.d. = 8 and 12 mm, a.l. = 25 and 31 mm; northern Taiping Island; 21 April 1994.

Remarks: This species is found inside crevices of rocks or underneath pebbles. It occurs occasionally around Taiping Is. It is known from the Indo-West Pacific.

***Ophiocoma pica* Müller and Troschel**

(Fig. 18)

Ophiocoma pica: Clark and Rowe 1971: 118 (distribution); Devaney 1970: 19; 1974: 159; Liao 1978: 88; Applegate 1984: 102; Chao et al. 1991: 119.

Material: ASIZ-50156, 1 specimen, d.d. = 13 mm, a.l. = 32 mm; southern Taiping Island; 20 April 1994.

Remarks: This species was always found inside crevices of branching corals, but some larger

specimens were found underneath rocks and pebbles. It is a common species around Taiping Is. It is known throughout the Indo-West Pacific area.

***Ophiomastix annulosa* (Lamarck)**
(Fig. 19)

Ophiomastix annulosa: Clark and Rowe 1971: 120 (distribution); Devaney 1978: 280; Liao 1978: 91; Applegate 1984: 104; Guille et al. 1986: 180; Chao et al. 1991: 123.

Remarks: This species is common inside crevices of rocks at depths of 1-10 m around Taiping Is. It is known from the Indo-West Pacific including northern Australia, southern Japan, Taiwan, and South Pacific Islands.

Family Ophiomyxidae

***Ophiomyxa* sp.**
(Fig. 20)

Materials: ASIZ-50169, 3 specimens, d.d. = 18~21 mm, a.l. = 55~70 mm; eastern Taiping Island; 22 April 1994.

Remarks: This species' common name is crinoid brittle star. The entire body is black, and specimens were collected from an eastern Taiping reef slope at 25-m depth from 2 individuals of the crinoid *Comanthina briareus* (Bell). It was often found on crinoids and was located on the oral disk.

Family Ophiotrichidae

***Ophiotrix lineocaerula* H. L. Clark**
(Fig. 21)

Ophiotrix lineocaerula: Clark and Rowe 1971: 113 (distribution).

Materials: ASIZ-50155, 5 specimens, d.d. = 5~7 mm, a.l. = 13~25 mm; western Taiping Island; 21 April 1994.

Remarks: The specimens collected are the juvenile brittle star. The taxonomic character used here is the 2 dark lines on each arm being continuous with those lines running along the adradial edge of each radial shield. They were collected from the branching coral *Pocillopora verrucosa* (Ellis and Solander) at depths of 3~10 m. It was previously known from North Australia areas.

Family Ophiidermatidae

***Ophiarachnella gorgonia* (Müller and Troschel)**
(Fig. 22)

Ophiarachnella gorgonia: Clark and Rowe 1971: 125 (distribution);

Liao 1978: 93; Guille et al. 1986: 192; Gosliner et al. 1996: 268.

Material: ASIZ-50157, 1 specimen, d.d. = 15 mm, a.l. = 44 mm; western Taiping Island; 21 April 1994.

Remarks: This species is uncommon and found underneath rocks and pebbles in shallow waters around Taiping Is. It is known from the Indo-West Pacific.

Class Echinoidea

Family Diadematidae

***Diadema setosum* (Leeke)**
(Fig. 23)

Diadema setosum: Clark and Rowe 1971: 140 (distribution); Liao 1978: 111; Guille et al. 1986: 34; Colin and Areson 1995: 225; Gosliner et al. 1996: 272.

Remarks: This urchin is well known for having long, sharp, brittle spines. It is common on sandy or pebble bottoms around reefs of Taiping Is. This species is known throughout the Indo-Pacific region.

***Echinothrix calamaris* (Pallas)**
(Fig. 24)

Echinothrix calamaris: Clark and Rowe 1971: 140 (distribution); Guille et al. 1986: 34; Colin and Areson 1995: 225; Gosliner et al. 1996: 272.

Remarks: This species is uncommon and found on rocks or reefs around Taiping Is. It has a number of color patterns in the spines. This species is known from Polynesia to the Red Sea, and the eastern coast of Africa.

Family Stomopneustidae

***Stomopneustes variolaris* (Lamarck)**
(Fig. 25)

Stomopneustes variolaris: Clark and Rowe 1971: 153 (distribution); Liao 1978: 110; Allen and Steene 1994: 239.

Remarks: This species is often found on rocky areas, and habitats inside crevices or grooves of rock. This urchin is uncommon around Taiping Is. It is known from the western Indian Ocean to China, Japan, Taiwan, Australia and South Pacific Islands.

Family Toxopneustidae

***Tripneustes gratilla* (Linnaeus)**
(Fig. 26)

Tripneustes gratilla: Clark and Rowe 1971: 142 (distribution); Liao 1978: 115; Guille et al. 1986: 40; Allen and Steene 1994: 239; Colin and Arneson 1995: 256; Gosliner et al. 1996: 274.

Remarks: This species has a number of color forms. It will cover itself with bits of seagrass or algae for protection from predators. Its gonad is used for food by the inhabitants of Taiping Is. It is found throughout the Indo-West Pacific region, including Hawaii.

Family Echinometridae

Echinometra mathaei (de Blainville)

(Fig. 27)

Echinometra mathaei: Clark and Rowe 1971: 157 (distribution); Guille et al. 1986: 42; Allen and Steene 1994: 237; Colin and Arneson 1995: 256; Gosliner et al. 1996: 275.

Remarks: This species is found on rocky areas inside wear holes or grooves of rock, and is very common around Taiping Is. It is found in the tropical and subtropical Indo-West Pacific.

Echinostrephus molaris (de Blainville)

(Fig. 28)

Echinostrephus molaris: Clark and Rowe 1971: 157 (distribution); Chen and Chang 1981: 82; Liao and Li 1985: 151.

Remarks: This species has 3 pore-pairs in each arc. The spines without white tips can be used to distinguish *E. molaris* from *E. aciculatus*. It excavates depressions in rocks for protection. This urchin is known from the Indian Ocean to the western Pacific including North Australia, China, Japan, Taiwan, and South Pacific Islands.

Class Holothuroidea

Family Holothuriidae

Actinopyga lecanora (Jaeger)

(Fig. 29)

Actinopyga lecanora: Guille et al. 1986: 72; Allen and Steene 1994: 26; Gosliner et al. 1996: 277.

Material: ASIZ-50052, 1 specimen collected from a north Taiping Island reef slope at 10 m depth.

Remarks: This is a large species found on open rocky bottoms. It is uncommon around Taiping Is., but seems to be rather common and dominant in other tropical Indo-West Pacific areas.

Actinopyga mauritiana (Quoy and Gaimard)

(Fig. 30)

Actinopyga mauritiana: Clark and Rowe 1971: 176 (distribution); Liao 1975: 208; Rowe and Doty 1977: 228; Guille et al. 1986: 72; Chao and Chang 1989: 116; Allen and Steene 1994: 242.

Remarks: This species is commonly found in the outer areas of intertidal platforms and subtidal zone at depths down to 5 m around Taiping Is. It sucks tightly on the rock with its numerous tube-feet. It is distributed throughout the tropical Indo-West Pacific.

Bohadschia argus Jaeger

(Fig. 31)

Bohadschia argus: Clark and Rowe 1971: 176 (distribution); Liao 1975: 206; Guille et al. 1986: 76; Allen and Steene 1994: 243; Colin and Arneson 1995: 260; Gosliner et al. 1996: 278.

Remarks: This is a large holothurian, reaching well over 40 cm in length. This species is uncommon on reefs around Taiping Is. It is found throughout the tropical Indo-Pacific.

Bohadschia graeffei (Semper)

(Fig. 32)

Bohadschia graeffei: Clark and Rowe 1971: 176 (distribution); Guille et al. 1986: 76; Allen and Steene 1994: 243; Colin and Arneson 1995: 260; Gosliner et al. 1996: 278.

Remarks: The variegated brown body cover with small spots and black tentacles is characteristic for this species. This species is found in shallow waters around Taiping Is. It is distributed in the tropical Indo-West Pacific.

Holothuria atra Jaeger

(Fig. 33)

Holothuria atra: Clark and Rowe 1971: 177 (distribution); Liao 1975: 210; Rowe and Doty 1977: 224; Guille et al. 1986: 80; Chao and Chang 1989: 117; Allen and Steene 1994: 243; Colin and Arneson 1995: 260; Gosliner et al. 1996: 279.

Remarks: This species is quite common on subtidal platforms around Taiping Is. It eats coral sand and digests the organic matter. It is a common species throughout most of the Indo-Pacific.

Holothuria leucospilota (Brandt)

(Fig. 34)

Holothuria leucospilota: Clark and Rowe 1971: 176 (distribution); Liao 1975: 215; Rowe and Doty 1977: 225; Guille et al. 1986: 84; Chao and Chang 1989: 119; Allen and Steene 1994: 244; Colin and Arneson 1995: 262; Gosliner et al. 1996: 280.

Remarks: This species lives in tidal pools or

under rocks of various substrata in shallow water areas. It is a common holothurian around Taiping Is. and is found throughout the tropical Indo-Pacific.

Family Stichopodidae

***Stichopus chloronotus* Brandt** (Fig. 35)

Stichopus chloronotus: Clark and Rowe 1971: 178 (distribution); Liao 1975: 203; Guille et al. 1986: 94; Allen and Steene 1994: 245; Colin and Arneson 1995: 262; Gosliner et al. 1996: 281.

Remarks: This species is easily recognized by its black color with rows of pointed papillae along the corners of the body. It is common in shallow water areas around Taiping Is. It is known from the Indian Ocean throughout the tropical western Pacific to Hawaii.

***Thelenota ananas* (Jaeger)** (Fig. 36)

Thelenota ananas: Clark and Rowe 1971: 178 (distribution); Liao 1975: 204; Guille et al. 1986: 100; Chao and Chang 1989: 116; Allen and Steene 1994: 246; Colin and Arneson 1995: 262; Gosliner et al. 1996: 282.

Remarks: This species is easily recognized by its abundant papillae which, although thorn-like and sharp, are soft and flexible. It is a large holothurian, reaching well over 50 cm in length. This species was found on rocks or dead coral fragments at depths of 10-30 m in reef areas of Taiping Is. It is known from western Pacific areas.

***Thelenota anax* Clark** (Fig. 37)

Thelenota anax: Clark and Rowe 1971: 178 (distribution); Liao 1975: 205; Guille et al. 1986: 100; Allen and Steene 1994: 246; Colin and Arneson 1995: 262; Gosliner et al. 1996: 282.

Remarks: This is another large species which is uncommon in the reefs of Taiping Is. Its shape is reminiscent of a loaf of bread and it is often mottled in color. It is known from the Marshall Is., Xisha Is. (China), New Caledonia, and Torres Strait of North Australia.

***Thelenota rubralineata* Massin and Lane** (Fig. 38)

Thelenota rubralineata: Allen and Steene 1994: 247; Colin and Arneson 1995: 262; Gosliner et al. 1996: 282.

Remarks: Only 1 specimen was found on the deep reef environment (40 m depth) at Taiping Is.

It has fine red lines over the entire body and many spines along the corners of the body. It was previously known from Papua New Guinea and Micronesia.

Family Synaptidae

***Opheodesoma grisea* (Semper)** (Fig. 39)

Opheodesoma grisea: Clark and Rowe 1971: 186 (distribution); Rowe and Doty 1977: 226; Chao and Chang 1989: 120; Kerr 1994: 171.

Remarks: It is very soft and flexible, with its body being greatly expanded with water. It is found in tidal pools or small gulf and bay areas to depths of 10 m at reef areas of Taiping Is. It is known from East Africa, Bay of Bengal, East Indies, Red Sea, the coast of Arabia, Ceylon to the Philippines, Taiwan, North Australia, eastern Caroline Islands, and Hawaii.

***Polyplectana kefersteini* (Selenka)** (Fig. 40)

Polyplectana kefersteini: Clark and Rowe 1971: 186 (distribution); Liao 1975: 222; Rowe and Doty 1977: 226; Guille et al. 1986: 106; Chao and Chang 1989: 121.

Remarks: This species is found on sponges around Taiping Is., and may also be found under rocks or pebbles of gulf or bay areas within depths of 5-30 m in reef areas. It is known from North Australia, Indonesia, North Australia, and Hawaii, and now in the South China Sea.

***Synaptula lamperti* Heding** (Fig. 41)

Synaptula lamperti: Hammond and Wilkinson 1985: 2; Colin and Arneson 1995: 264; Gosliner et al. 1996: 284.

Remarks: This small synatid reaches only several centimeters in length but it occurs in large numbers on sponges around Taiping Is. Hammond and Wilkinson (1985) showed that *S. lamperti* gains nutritional advantage from the association by ingesting and assimilating exudates of sponges. It is known from Micronesia, New Caledonia, and Papua New Guinea, and now from the South China Sea.

DISCUSSION

The echinoderm fauna of Taiwan has been studied by Hayasaka (1948 1949), Chen and



Fig. 2. *Comanthina briareus*; site 2: -15 m.

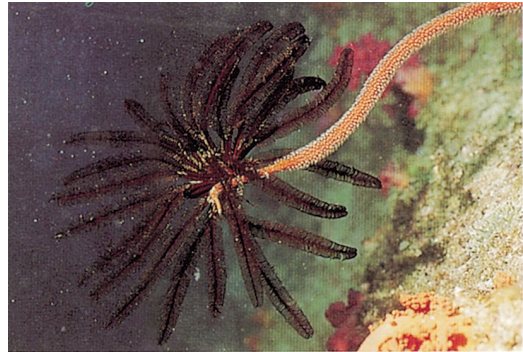


Fig. 6. *Cenometra bella*; site 7: -30 m.



Fig. 3. *Comanthus parvicirrus*; site 2: -12 m.

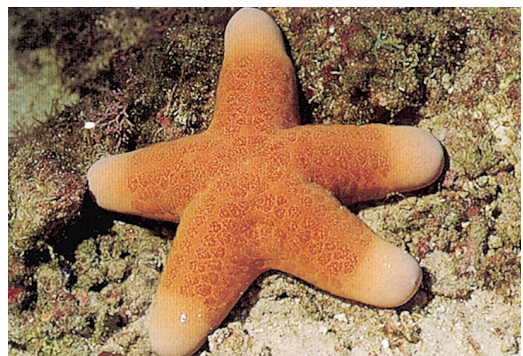


Fig. 7. *Choriaster granulatus*; site 4: -40 m.

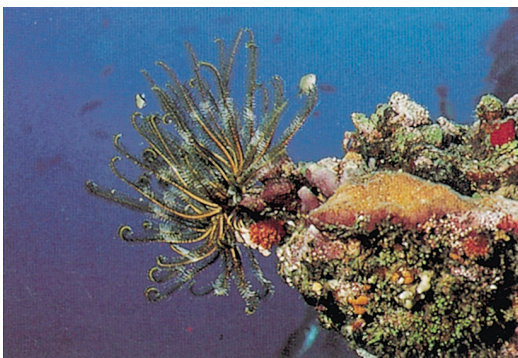


Fig. 4. *Oxycomanthus bennetti*; site 4: -30 m.

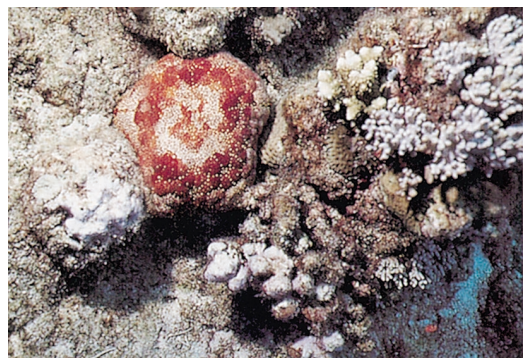


Fig. 8. *Culcita novaeguineae*; site 3: -10 m.



Fig. 5. *Hilmerometra magnipinna*; site 7: -25 m.

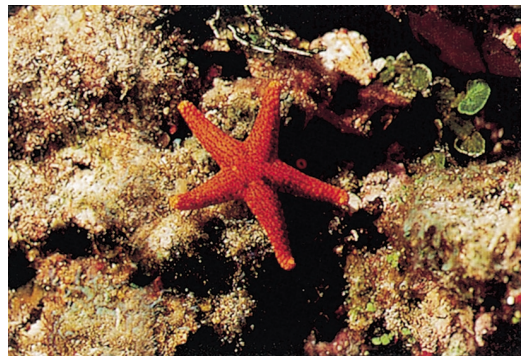


Fig. 9. *Fromia milleporella*; site 3: -8 m.



Fig. 10. *Fromia monilis*; site 7: -10 m.

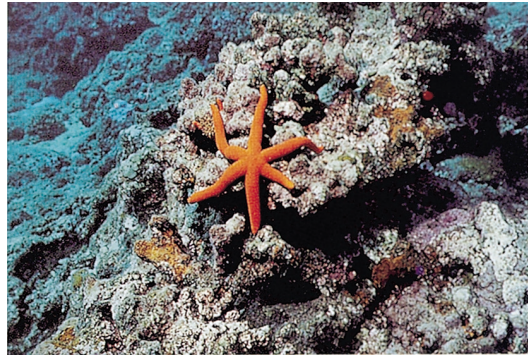


Fig. 14. *Echinaster luzonicus*; site 5: -15 m.

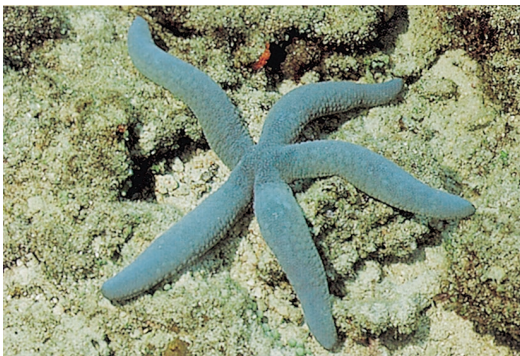


Fig. 11. *Linckia laevigata*; site 7: -15 m.

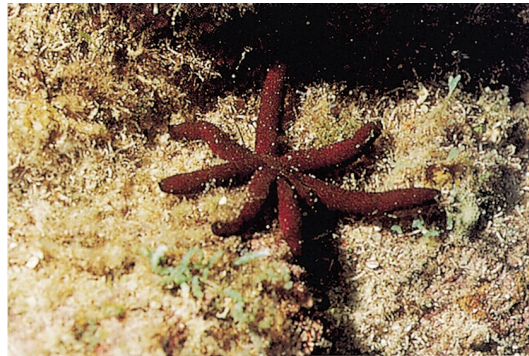


Fig. 15. *Echinaster luzonicus*; site 3: -5 m.



Fig. 12. *Nardoa frianti*; site 3: -10 m.



Fig. 16. *Ophiocoma dentata*; site 3: -10 m.



Fig. 13. *Neoferdina cumingi*; site 1: -5 m.



Fig. 17. *Ophiocoma erinaceus*; site 1: -2 m.

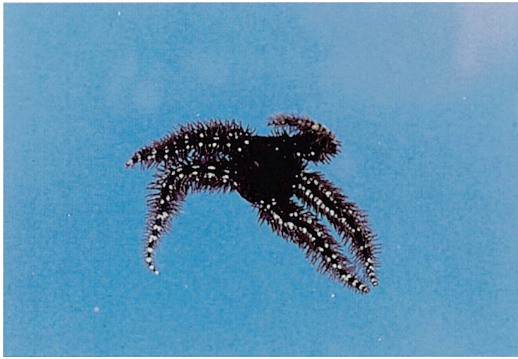


Fig. 18. *Ophiocoma pica*; ASIZ-50156.

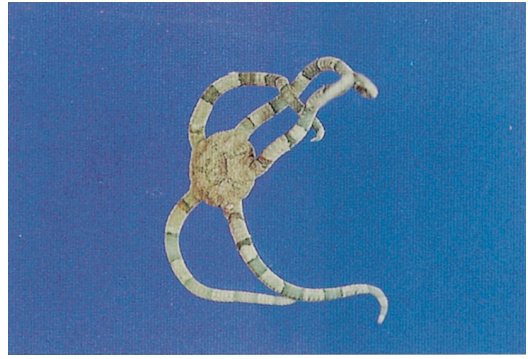


Fig. 22. *Ophiarachnella gorgonia*; ASIZ-50157.

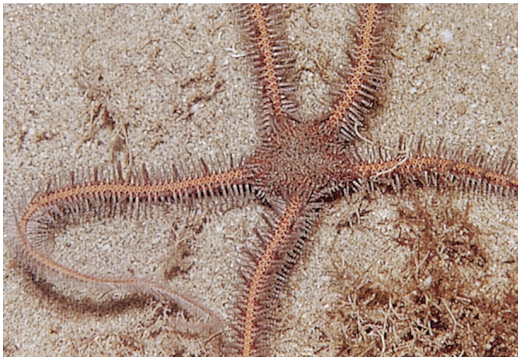


Fig. 19. *Ophiomastix annulosa*; site 3: -3 m.



Fig. 23. *Diadema setosum*; site 7: -3 m.



Fig. 20. *Ophiomyxa* sp.; ASIZ-50169.

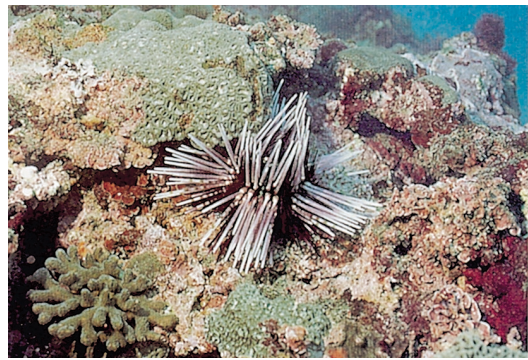


Fig. 24. *Echinothrix calamaris*; site 6: -10 m.

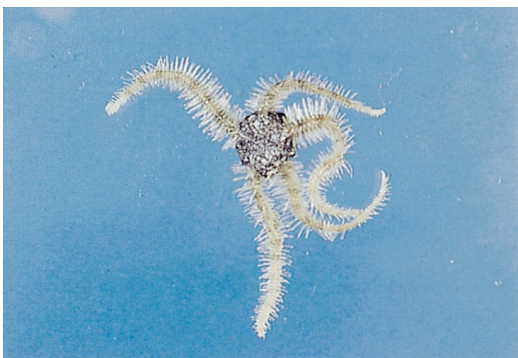


Fig. 21. *Ophiothrix lineocerulea*; ASIZ-50155.

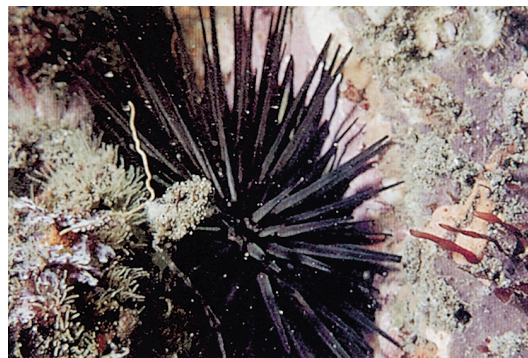


Fig. 25. *Stomopneustes variolaris*; site 6: -5 m.

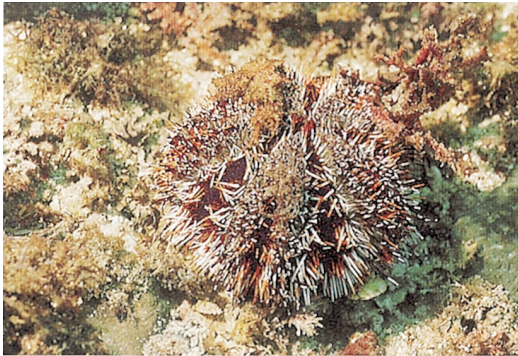


Fig. 26. *Tripneustes gratilla*; site 2: -3 m.

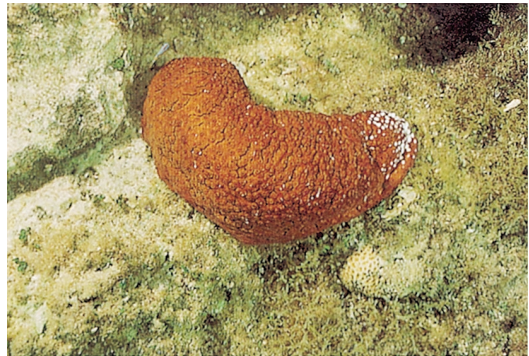


Fig. 30. *Actinopyga mauritiana*; site 1: -5 m.

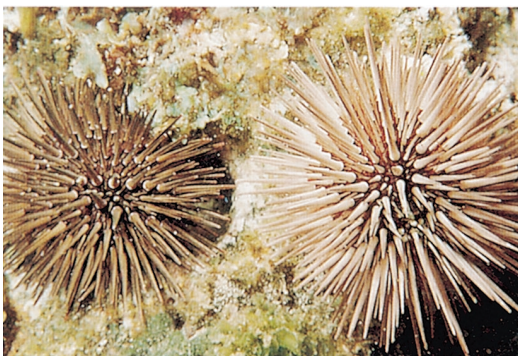


Fig. 27. *Echinometra mathaei*; site 6: -2 m.

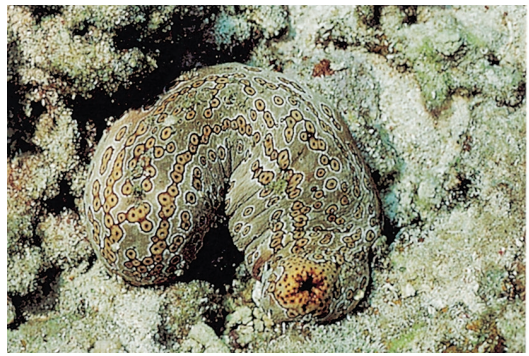


Fig. 31. *Bohadschia argus*; site 4: -30 m.

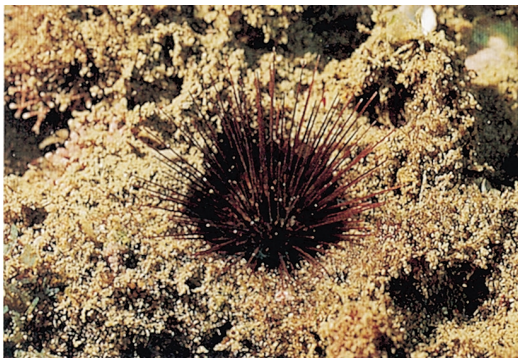


Fig. 28. *Echinostrephus molaris*; site 2: -2 m.



Fig. 32. *Bohadschia graeffei*; site 7: -20 m.



Fig. 29. *Actinopyga lecanora*; ASIZ-50052.



Fig. 33. *Holothuria atra*; site 1: -3 m.

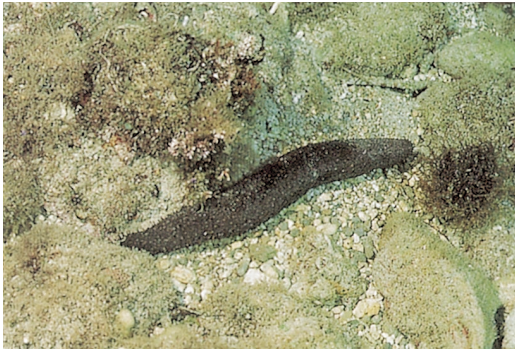


Fig. 34. *Holothuria leucospilota*; site 1: -5 m.



Fig. 38. *Thelenota rubralineata*; site 7: -40 m.

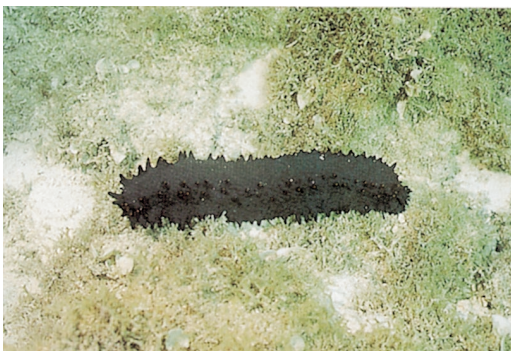


Fig. 35. *Stichopus chloronotus*; site 1: -3 m.



Fig. 39. *Opheodesoma grisea*; site 1: -5 m.

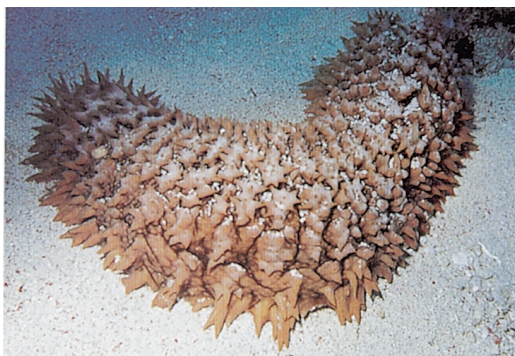


Fig. 36. *Thelenota ananas*; site 7: -25 m.

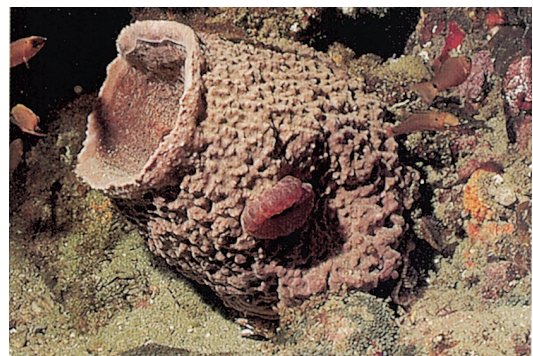


Fig. 40. *Polyplectana kefersteini*; site 4: -35 m.



Fig. 37. *Thelenotaanax*; site 2: -15 m.

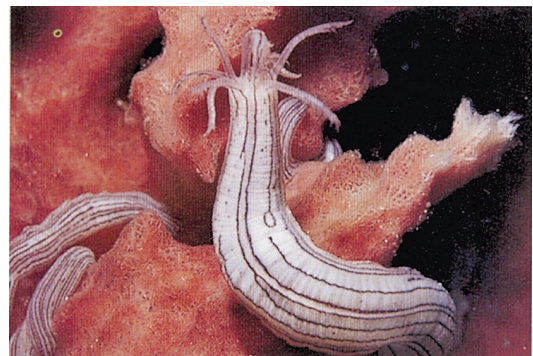


Fig. 41. *Synaptula lamperti*; site 5: -35 m.

Chang (1981), Applegate (1984), Run et al. (1988), Chen et al. (1988), Chao and Chang (1989a,b), Chao et al. (1991). In these studies, 20 crinoids, 16 starfishes, 25 brittle-stars, 21 sea-urchins, and 23 holothuroids were recorded. According to Liao (1975 1978a,b 1980 1983) who reported the echinoderms of Xisha Islands (China), there are 3 crinoids, 38 brittle-stars, 17 starfishes, 26 sea-urchins, and 41 holothuroids. Li (1991) reviewed and provided additional reports on echinoderms from the region of Nansha Islands (South China Sea), and included 197 species. Liao and Clark (1995) showed that the list of echinoderms includes species distributed in southern China, but not including Taiping Island and Nansha Islands. Clark (1982) presented 95 species of echinoderms in the fauna of Hong Kong and southern China. Although only 3 species I report here are new records in the South China Sea, the inventory of echinoderms from the small area of Taiping Island shows a remarkable faunal exuberance comparable to that of southern Taiwan, and there is no doubt that additional species remain to be discovered.

Generally, comasterids live within the infrastructure of the reef, while non-comasterids live in exposed habitats (Meyer 1979). However, both *Comanthina briareus* and *Oxycomanthus bennetti* completely expose their arms in the water column. On the other hand, non-comasterids, especially of the Colobomtridae, cling to gorgonians or perch on the surface of corals or rocks during day time. Since color variation is commonly seen in crinoids (Meyer and Macurda 1980, Zmarzly 1984), color patterns are not a reliable character for species identification.

The shallow-water asteroid fauna of Taiping Island is relatively poor compared with that of the Philippines. Aside from the 2 more abundant species, *Linckia laevigata* and *Echinaster luzonicus*, other more bigger-bodied species such as *Choriaster granulatus* and *Culcita novaeguineae* were rarely collected in shallow waters. I would not expect to regularly collect these uncommon species.

This paper includes 7 species of ophiurans collected during this study. All specimens were found under pebbles, rocks, dead coral fragments, or in crevices of branching coral in shallow waters. There may be more uncommon species yet to be found in the reef area.

An analysis of the holothurian faunal composition of Taiping Island indicates that most species are typical Indo-West Pacific coral reef species. Among them, *Actinopyga lecanora*, *Stichopus*

chloronotus, *Thelenota rubralineata*, and *Synaptula media* have never been recorded from Taiwan. *A. lecanora* and *T. rubralineata* each have only 1 specimen found indicating that they are rare around Taiping Island.

Tripneustes gratilla is one of the most common and variable species of Indo-Pacific urchin, but is uncommon in shallow waters of Taiping Island. This may be because its gonad is used for food by the inhabitants of Taiping Island. *Echinometra mathaei* and *Echinostrephus molaris* were commonly found on shallow-water reefs in holes and crevices. However, *Diadema setosum* is also abundant in shallow-water areas where it may form dense aggregations.

The marine littoral fauna of Taiping Island includes echinoderm species common to all regions of the Indo-West Pacific. In different areas, numbers of echinoderm species are also more or less high, but the actual number recorded may be a result of the level of sampling effort. According to the survey of organisms of coral reefs by Chang et al. (1982), scleractinian corals dominate the areas under the average low tide level as they do around Taiping Island. The crown-of-thorns, *Acanthaster planci*, was not found in this study, thus coral destruction by this animal is not serious. However, I found much dead coral at all diving stations. The 3-m water depth line seems to be a natural boundary; above it coral grows well, but below it dead coral is frequent and only small living coral colonies are found. This indicates that coral communities of Taiping Island may have been heavily damaged by natural catastrophes or artificial destruction in the last decade.

Acknowledgments: I gratefully acknowledge the support for this research through a grant from the Council of Agriculture, R.O.C., and coordination and administrative assistance from the National Museum of Marine Biology and Aquarium. I also sincerely thank Dr. Lee-Shing Fang and his staff for providing diving facilities and for assisting my work at Taiping Island; Mr. Ming-Lung Chang for assisting me with field work; Prof. Chang-Feng Dai of the Institute of Oceanography, National Taiwan University also provided 2 slides for this report. Taxonomic advice on brittle-stars from Dr. Shyn-Min Chao was invaluable. The manuscript was typed with help from Miss Yu-Ju Shen. I am very grateful to Dr. Tin-Yam Chan of the Institute of Marine Biology, National Taiwan Ocean University for reading of the manuscript.

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南沙太平島海域棘皮動物相

鄭明修¹

本文記述潛水調查產於南沙太平島海域 7 個測站水深 40 公尺以淺，所拍攝或採集到 17 科 39 種的棘皮動物種類。這些種類都是首次記錄種，包括 5 種海百合，8 種海星，7 種陽燧足，6 種海膽和 13 種海參。其中 34 種的記錄是以生態照片表現該種之活體色彩及其棲所。*Synaptula lamperti*, *Thelenota rubralineata* 和 *Ophiomyxa* sp. 則是南中國海域新的記錄種。

關鍵詞：棘皮動物，太平島，南中國海。

¹中央研究院動物研究所