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A Systematic Study on the Holothuroidea in Cheju-do

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濟州島產 海鼠類의 分類學的 硏究

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適 要

濟州島產 海鼠類의 分類學的 硏究를 하기 위하여 1969年부터 採集되어 保管된 標本과 1985年 6月부터 1986年 2月까지 濟州島의 7個地域(濟州港, 翰林, 飛揚島, 西歸浦, 塘浦, 城山浦, 牛島)에서 採集한 標本들을 同定, 分類하였다. 그 結果 3亞綱 3目 9種의 海鼠類가 濟州島에 分布하는 것으로 밝혀졌고 이들중 *Holothuria monacaria, H. pardalis, Afrocucumis africana, Leptosynapta ooplax, Polycheira rufescens*등 5種은 韓國 未記錄種이다.

INTRODUCTION

The present investigation is a continuous work for the study on the echinoderm fauna in Korea. As for the fauna of Korean holothurians, Sato (1936) reported three species from Changsungp'o and Chungmu; Kamita and Sato (1943), one species from Inchon; Rho and Shin (1984), five cucumarian species from Korea Strait and Cheju-do; and Yi (1985), three species belonging to Synaptidae. Up to date Korean holothurians have been reported to sum up to ten species, six families, three orders and three subclasses. The systematic study of holothurians has not been done extensively in many areas and only one species, *Pentacta doliolum*, has been reported in Cheju-do.

Thus the present work was done for the study on classification and distribution of the holothurians in Cheju-do which have not been investigated thoroughly.

MATERIALS AND METHODS

The materials used were collected from seven localities of Cheju-do (Cheju-hang, Hallim,

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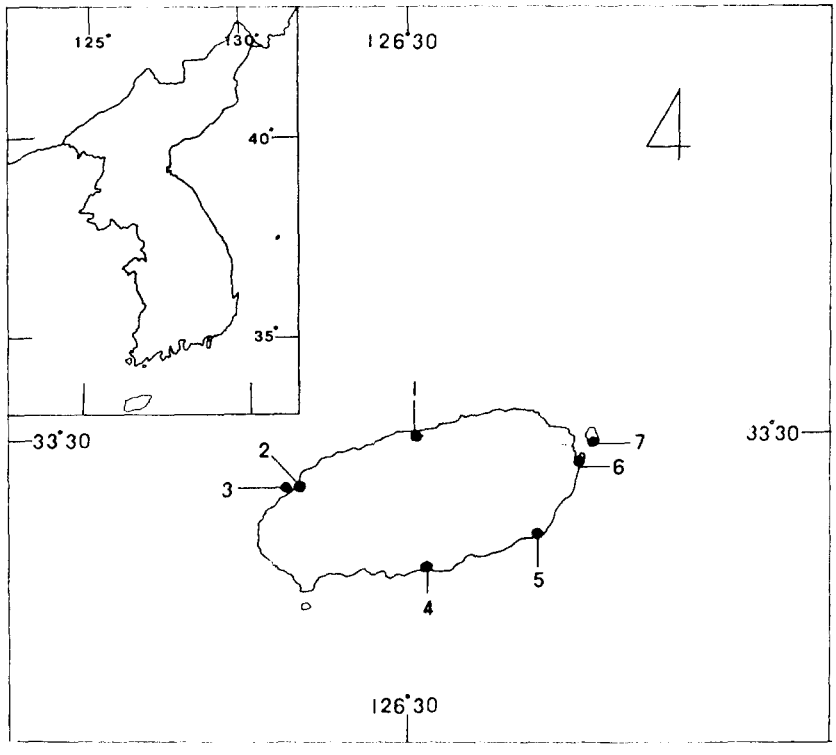

Fig. 1. A map showing the localities where the materials were collected from 1969 to 1986. 1. Cheju-hang 2. Hallim 3. Piyangdo 4. Sŏgwip'o 5. Tangp'o 6. Sŏngsanp'o 7. Udo

Sŏgwip'o, Tangp'o, Sŏngsanp'o and Udo) during the period from December 1969 to February 1986 (Fig. 1). The specimens were collected mainly by the authors using pincette and shovel in the intertidal zone and obtained from the materials caught by the fishnet and fishingreel in the subtidal zone. They were preserved in about 70~80% methyl alcohol.

For the morphological study light microscope and stereomicroscope were used while the characteristics of species were photographed using light microscope (Nikon AFX) and scanning electron microscope (JEOL JSM—35 CF). A brief description of each species and the preparation of plate-figures about newly known species were made.

RESULTS

The holothurians distributed in Cheju-do consist of nine species, six families, three orders, and three subclasses. Of those five species are reported for the first time from Korean waters and they are as follows: *Holothuria monacaria, H. pardalis, Afrocucumis africana, Leptosynapta ooplax* and *Polycheira rufescens.* Up to date *Afrocucumis africana* and *Polycheira rufescens* are found to be distributed only in sea of Cheju-do and all four species except *H.*

monacaria were collected in the intertidal zone.

Systematic List

Phylum Echinodermata Klein, 1734 극피동물 문
Class Holothuroidea de Balinville, 1834 해서 강
Subclass Aspidochirotacea Grube, 1840 순수 아강
Order Aspidochirota Grube, 1840 순수 목
Family Holothuriidae Ludwig, 1894 해삼 과
Genus *Holothuria* Linne, 1791 해삼 속
*1. *Holothuria monacaria* (Lesson, 1830) 모나카리해삼
*2. *Holothuria pardalis* Selenka, 1867 점해삼(신칭)
Family Stichopidae Brandt, 1835 돌기해삼 과(신칭)
Genus *Stichopus* Brandt, 1835 돌기해삼 속(신칭)
3. *Stichopus japonicus* Selenka, 1867 돌기해삼
Subclass Dendrochirotacea Grube, 1840 수수 아강
Order Dendrochirotida Grube, 1840 수수목
Family Cucumariidae Ludwig, 1894 광삼 과
Genus *Cucumaria* de Blainville, 1830 광삼 속
4. *Cucumaria multipes* Theel. 1886 다족광삼
Genus Pentacta Goldfuss, 1820 오각해삼 속
5. *Pentacta doliolum* (Pallas, 1766) 오각해삼
Family Phyllophoridae Oestergren, 1907 잎사귀해삼 과(신칭)
Genus *Afrocucumis* 아프리카광삼 속(신칭)
*6. *Afrocucumis africana* (Semper, 1867~68) 보라해삼붙이
Subclass Apodacea Brandt, 1835 무족 아강
Order Apodida Brandt, 1835 무족 목
Family Synaptidae Burmeister, 1837 닻해삼 과
Genus *Leptosynapta* Verrill, 1867 참닻해삼 속(신칭)
7. *Leptosynapta inhaerens* (O.F. Müller, 1776) 아기닻해삼
*8. *Leptosynapta ooplax* (v. Marenzeller, 1881) 둥근닻해삼(신칭)
Family Chirodotidae Ostergren, 1985 바퀴해삼 과(신칭)
Genus *Polycheira* Clark, 1908 많은바퀴해삼 속(신칭)
*9. *Polycheira rufescens* (Brandt, 1835) 보라바퀴해삼

Description of species

*1. *Holothuria monacaria* (Lesson, 1830) 모나카리해삼
(pl. 1, figs. 1-11)

Psolus monacaria Lesson, 1830, p. 225, Taf. 78.

Holothuria decorata v. Marenzeller, 1881, pp. 137-139, Taf. 4, fig. 12; Mitsukuri, 1866, p. 407.

* The asterisk indicates the Holothuroid species which is new to the Korean fauna.

Holothuria monacaria: Theel, 1886, pp. 172-173, 217, pl. VIII, fig. 10; Ludwig, 1888, p. 806; Sluiter, 1901, p. 11; Fisher, 1907, p. 659; Mitsukuri, 1912, pp. 112-118; Ohshima, 1915, p. 247; 1918, p. 142; Clark, 1920, p. 150; Panning, 1934, p. 69; 1951, p. 171.

Holothuria minax Theel, 1886, pp. 173-174, pl. VIII, fig. 8; Mitsukuri, 1896, p. 408.

Holothuria macleari Mitsukuri, 1912, p. 98, Text-fig. 20.

Material examined: Sŏgwip'o, Dec. 12, 1969, B.J. Rho, one specimen; Nov. 30, 1978, B.J. Rho, one specimen.

Description: The body size is measured 22~35 cm long and 5.5~6 cm wide. The shape of body is cylindrical and curved toward dorsal side. The surface of body is very hard. The color of body is brown but the color of dorsum is darker than that of ventrum while the dark brown spots are distributed along the row or papillae on the dorsum. Papillae appears uniformly scattered all over the body and it is difficult to make a clear distinction between papillae and pedicel. Three rows of pedicels are distributed on the ventrum. The number of tentacle is twenty and tentacular papillae is very long. Mouth and tentacle are surrounded by a circle of oral membrane fringed with papillae. Calcareous ring is about 4mm high and the width of interradialia corresponds to half that of radialia. The number of polian vesicle varies according to individuals: either one to two large or several small polian vesicle. Stone canal locates between dorsal mesentary and numbers either five or five to ten according to individuals. Cuvierian organ and a pair of respiratory tree are present. Calcareous deposits in tentacle are irregular supporting rods (40~50 × 10~20 μ) and those in the body wall are buttons (50~100 × 20~80 μ) and tables (60~80 × 45~50 μ). Table has usually smooth disk and spire which ends thirteen to twenty teeth crown but the disk of table has occasionslly spinous margin. Button usually contains three to four pairs of holes but the larger the size, the greater the number and the more irregular the shape.

Remark: The number of polian vesicle and stone canal remarkably varies according to individuals.

Habitat: The species was collected both around and under ledges of rocks in 20~60 m depth in subtidal zone.

Distribution: Korea (Korea Strait, Cheju-do); Japan (Southern Honsyu, Kyusyu, Sikoku); Indo-Pacific Ocean.

*2. *Holothuria pardalis* Selenka, 1867 점해삼

(pl. 2, figs. 1-12)

Holothuria pardalis Selenka 1867, pp. 336-337, Taf. XIX, fig. 85.

Holothuria pardalis: Ludwig, 1888, p. 807; Mitsukuri, 1896, p. 407; Sluiter, 1901, p. 12; Fisher, 1907, pp. 664-666, pl. LXIX, figs. 1, 1a-g; Mitsukuri, 1896, p. 407; 1912, pp. 118-128, text-fig. 22; Ohshima, 1918, p. 142; Clark, 1946, p. 437; James & Pearse, 1969, p. 106.

Holothuria (*Holothria*) *pardalis* Panning, 1935, pp. 3-4.

Lessonothuria pardalis Deichmann, 1958, p. 296; Domantay & Conlu, 1969, p. 171.

Holothuria (*Lessonothuria*) *pardalis* Liao, 1975, p. 216, fig. 16; Sloan, Clark & Taylor, 1979, p. 122.

Material examined: Sŏgwip'o, Oct. 21, 1984, S. Shin, one specimen.

Description: The body size is measured 8 cm long and 1.8 cm wide. The shape of body is cylindrical and curved slightly toward the dorsal side. The surface of body is thick. The color of body is brown but the color of dorsum is darker than that of ventrum. And at each ambulacrum on the dorsum twelve darker stripesis arranged in a row along the ventral side of dorsum. The number of tentacle is twelve. Pedicels are uniformly distributed along both dorsal and ventral sides. Along the dorsal side the papillae is not distinguished from pedicels. Calcareous ring is about 1mm high and 1.5 mm wide but the size of interradialia is about 1 mm wide. Polian vesicle is very long and stone canal is small and both are present at equal number of one each. A pair of cuvierian organ is present and respirtory tree is also present. Calcareous deposit in tentacle is supporting rods (245~260 × 18~20 μ) and that of body wall is tables (90~100 × 58~60 μ), buttons (60~80 × 30~33 μ) and supporting rods (280~300 × 30~35 μ). Table has generally a spinous margin and irregular spire with two or more cross beams which ends seven to twelve teeth crown. Button is usually half-sided with three or four holes and rarely three or four pairs of holes. Supporting rod is usually curved and ended with three or four holes.

Remark: This species is characterized by commonly having the half-sided buttons.

Habitat: These was collected from the crevices of rocks in the intertidal zone.

Distribution: Korea (Cheju-do); Japan (Kyusyu); Ogasawara Is.

3. *Stichopus japonicus* Selenka, 1867 돌기해삼

Stichopus japonicus Selenka, 1867, p. 318, pl. 18, fig. 33-36.

Stichopus japonicus japonicus: v. Marenzeller, 1881, p. 136, Taf. V, fig. 11; Theel, 1886, pp. 160, 194, pl. VII, fig. 3; Murakami, 1986, p. 408; Clark, 1920, p. 563; Augustin, 1908, p. 6, Text-fig. 4; Murakami, 1912, pp. 163-171, pl. IV, figs. 32-44; Ohshima, 1915, pp. 247-248; 1918, p. 144; Clark, 1922, p. 61; Chang, 1948, p. 75; Liao, 1979, p. 116.

Stichopus (*Holothuria*) *armatus* Theel, 1886, p. 196; Mitsukuri, 1896, p. 408.

Stichopus japonicus var. *typicus* Theel, 1886, p. 61, pl. VIII, fig. 2.

Material examined: Hallim, Aug. 7, 1970, B.J. Rho, one specimen; Sŏngsanp'o, Feb. 14, 1976, B.J. Rho, one specimen; Cheju-hang, Dec. 5, 1978, B.J. Rho, two specimens; Piyangdo, Feb. 5. 1986, S. Shin, one specimen.

Habitat: This species was collected from the crevices of rocks in the intertidal zone and caught by fishnet in 10~50 m depth in the subtidal zone.

Distribution: Korea (Sea of Japan, Korea Strait, Cheju-do, Yellow Sea); Japon (Hokkaido-Ryukyu Is.); Hong Kong; Sachalin; Vladivostok.

4. *Cucumaria multipes* Theel, 1886 다족광삼

Cucumaria multipes Theel, 1886, p. 72, pl. 4, fig. 4.

Cucumaria multipes: Mitsukuri, 1896, p. 409; 1912, pp. 246-248, pl. 8, fig. 69, text-fig. 49; Ohshima, 1918, p. 145; Chang, 1948, pp. 76-78, pl. 10, fig. 5; Rho & Shin, 1984, p. 44, pl. 2, figs. 1~9.

Material examined: Cheju-hang, Oct. 22, 1984, S. Shin, one specimen.

Habitat: This species was obtained from the materials caught by fishnet in 15m depth in the intertidal zone.

Distribution: Korea (Korea Strait, Cheju-do); Japan(Hokkaido, Yokohama); China.

5. *Pentacta doliolum* (Pallas, 1766) 오각해삼

Actinia doliolum Pallas, 1766, p. 152, pl. 11, figs. 11~12.

Colochirus australis: Theel, 1886, p. 122, pl. 4, fig. 6.

Colochirus doliolum: Sluiter, 1901, p. 99; Mitsukuri, 1912, p. 218; Ohshima, 1918, p. 146; Rho & Shin, 1984, p. 46, pl. 4, figs. 1~14.

Pentacta australis: Clark, 1946, p. 392.

Pentacta doliolum: William *et al.*, 1982, p. 288.

Material examined: Sŏgwip'o, Feb. 7, 1986, S. Shin, one specimne.

Habitat: This species was obtained from the materials caught by fishnet in 20m depth in the subtidal zone.

Distribution: Korea (Korea Strait, Cheju-do); Japan (Hokkaido-Kagoshima Bay); Indo-Pacific Ocean.

*6. *Afrocucumis africana* (Semper, 1867~68) 보라해삼붙이
(pl. 3, figs. 1~13)

Cucumaria africana Semper 1867~68, p. 53, Taf. XV, fig. 16.

Cucumaria africana; Theel, 1886, p. 108.

Pseudocucumis africana: Ludwig, 1888, p. 815; Sluiter, 1901, p. 107; Mitsukuri, 1912, p. 257~261, pl. Ⅷ, fig. 66, text-fig. 52; Ohshima, 1911, pp. 53~56, 1918, p. 147.

Afrocucumis africana: Sloan, Clark & Taylor, 1979, p. 124; Clark, 1980, p. 489.

Material examined: Sŏgwip'o, Aug. 2, 1970, B.J. Rho, one spcimen; Sŏngsanp'o, Aug. 9, 1970, B.J. Rho, three specimens; Sŏgwip'o, July 14, 1973, B.J. Rho, three specimens; Sŏngsanp'o, Apr. 14, 1974, B.J. Rho, one specimen; Apr. 13, 1975, B.J. Rho, one specimen; Feb. 14, 1976, B.J. Rho, seven specimens; Dec. 1, 1978, B.J. Rho, two specimens; July 12, 1979, S. Shin, 41 specimens; Oct. 21, 1984, S. Shin, two specimens.

Description: The body size is measured 4.8~7.1 cm long and 0.7~1.7 cm wide. The shape of body is cylindrical and slightly curved towad the dorsal side. The surface of body is soft. The color of body is dark purple on the dorsum but of the ventrum and the both end of body is lighter than that of the dorsum. Pedicels are arranged distinctly in two rows along each ambulacrum and the number of those is slightly less on the dorsum. The number of tentacle is twenty and tentacles are characteristically arranged in two

circles. Five small tentacles are arranged in circular form inside, five median-size tentacles are seen just opposite small tentacles on inner circle and two large tentacles are located between each of two median-size ones. Calcareous ring is composed of five lradiaia with very short tail and five interradialia. Five retractor muscles are separated from the body wall up to the half point of anterior body length. One polian vesicle and one stone canal are found. And a pair of respiratory tree is present. Calcareous deposit in tentacle is supporting rods (90~190 × 25~32 μ) with perforated ends and that of body wall is large button-shaped plates(170~250μ) with holes and spines, and broad supporting rods (150~200 × 35~50 μ) with perforated ends.

Remark: This species is characterized by the state of arrangement of tentacles and thepresence of the large, button-shaped plates with holes and spines.

Habitat;These was collected from the crevices rocks and under the gravels in the intertidal zone.

Distribution: Korea (Cheju-do); Japan (Kyusyu-Ryukyu Is.); Malay is.; Indo-Pacific Ocean.

7. *Leptosynapta inhaerens* O.F. Müller, 1776 아기닻해삼

Synapta inhaerens O.F. Müller, 1776, p. 232.

Synapta inhaerens: Theel, 1886, p. 24.

Synapta gracilis: Theel, 1886, p. 25.

Leptosynapta inhaerens: Clark, 1907, p. 88, pl. V. figs. 14, 15, 18, 20; Ohshima, 1913, p. 253, Taf. Ⅵ, fig. 4; 1914, p. 468; 1918, p. 153; Mortensen, 1927, pp. 427-429, fig. 261; Deichmann, 1930, p. 208; Oguro, 1961, p. 193, figs. 1~3; Yi, 1985, p. 3, pl. 1, figs. 1~4.

Material examined: Udo, Oct. 7, 1985, J.H. Park, four specimens; Sŏngsanp'o, Oct. 8, 1985, J.E. Soe, one specimen; Dangp'o, Oct. 10, 1985, J.H. Park, one specimen.

Habitat: This species was collected at the muddy sand in the intertidal zone.

Distribution: Korea (Cheju-do, Yellow Sea); Cosmopolitan.

*8. *Leptosynapta ooplax* (v. Marenzeller, 1881) 둥근닻해삼

(pl. 4, figs. 1~5)

Synapta ooplax v. Marenzeller, 1881, p. 122.

Synapta ooplax: Theel, 1886, p. 25; Murakami, 1896, p. 412; Sluiter, 1901, p. 124.

Leptosynapta ooplax: Clark, 1907, p. 24, 90; Ohshima, 1913, p. 254, Taf. Ⅵ, fig. 5; 1914, p. 469; 1918, p. 148, p. 148; Chang, 1948, p. 88.

Material examined: Sŏgwip'o, Dec. 9, 1969, B.J. Rho, six specimens.

Description: The body size is measured 3.3~6 cm long and 0.3~0.5 cm wide. The shape of body is cylindrical and elongated. The surface of body is very soft and more or less transparent. The color of body is pale pink. The number of tentacle is twelve and each tentacle has nine to thirteen digits but eleven digits is most common. Clacareous ring is very small, about 1mm high and radialia have one hole as a result of the passage of radial nerves. And the number of interradialia is one or two. Retractor muscle is separ-

ated from the body wall up to the half point of anterior body length. One polian and one stone canal are present. Calcareous deposit is anchors (105~110 × 45 × 10 μ) anchor plates (55~70 × 45~50 μ) and miliary granules (20~22 × 8 μ). The stalk of anchor with spinous end is long and longitudinally same wide and anchor arm has one or two spines. Anchor plate is oval and more or less wider at the posterior end. Miliary granules are oval and dumbbell-shaped.

Remark: The sense cup is not observed with this species which is characterized by the presence of longitudinally same wide anchor and oval anchor plate.

Habitat: This species was collected at the muddy sand in the intertidal zone.

Distribution: Korea (Chejudo); Japan (Southern Honsyu, Kyusyu, Sikoku); China.

*9. *Polycheira rufescens* (Brandt, 1835) 보라바퀴해삼

(pl. 5, figs. 1~8)

Chirodota rufescens Brandt, 1835, p. 59.

Chirodota rufescens: Mitsukuri, 1896, p. 413; Sluiter, 1901, p. 133.

Chirodota variabilis Augustin, 1908.

Polycheira rufescens: Ohshima, 1913, pp. 258-259, Taf. Ⅵ, fig. 9; Clark, 1907, p. 120 pl. Ⅶ, figs. 14~18; Ohshima, 1918, p. 147; Clark, 1946, p. 458 'Liao, 1975, p. 223; Clark, 1980, p. 490.

Material examined: Sŏgwip'o, Aug. 3, 1970, B.J. Rho, two specimens; July 8, 1972, B.J. Rho, one specimen; Feb. 16, 1976, B.J. Rho, one specimen; July 19, 1979 S. Shin, one specimen.

Description: The body size is measured 7~13 cm long and 1.2~1.5 cm wide. The shape of body is long cylindrical The surface of body is fragile and wrinkled circularly along the whole body. The color of body is dark brown and more darker in the tentacle and the both end of body. The number of tentacle is seventeen to nineteen but eighteen is most common. Each tentacle has twenty two to twenty seven number of small digits. Calcareous ring is very small and about 1mm high and both interradiiala and radialia is nearly same in shape and size. The number of polian vesicle is six to twelve and respiratory tree is not present. Calcareous deposit in tentacle is supporting rods (100~150 × 11~15 μ) with spinous end whereas that in the body wall is small rods (25~70 × 10 μ) and wheels (55~110 μ) which is six-rayed and spinous in the inner margin. The larger wheel is present on the outer body wall which appears as a white spot to a naked eye.

Remark: Genital gland was well developed in the specimens collected in August. This species is characterized by the presence of six-rayed wheel.

Habitat: This species was collected under the gravels burried at sandy substrate in the intertidal zone.

Distribution: Korea (Cheju-do); Japan (South of Sagami Bay); China; Taiwan; Hong Kong; Philippine; Indo-Pacific Ocean.

ABSTRACT

For the systematic study of the Holothuroidea in Cheju-do the present study was done with the materials collected from seven localities of Cheju-do (Cheju-hang, Piyangdo, Hallim, Sŏgwip'o, Tangp'o, Sŏngsanp'o, Udo) during the period from December 1969 to February 1986. As a result the holothurians in Cheju-do consit of nine species, six families, three orders and three subclasses. Of those five species are reported for the first time from Korean waters and they are as follows: *Holothuria monacaria, H. pardalis, Afrocucumis africana, Leptosynapta ooplax* and *Polycheira rufescens.*

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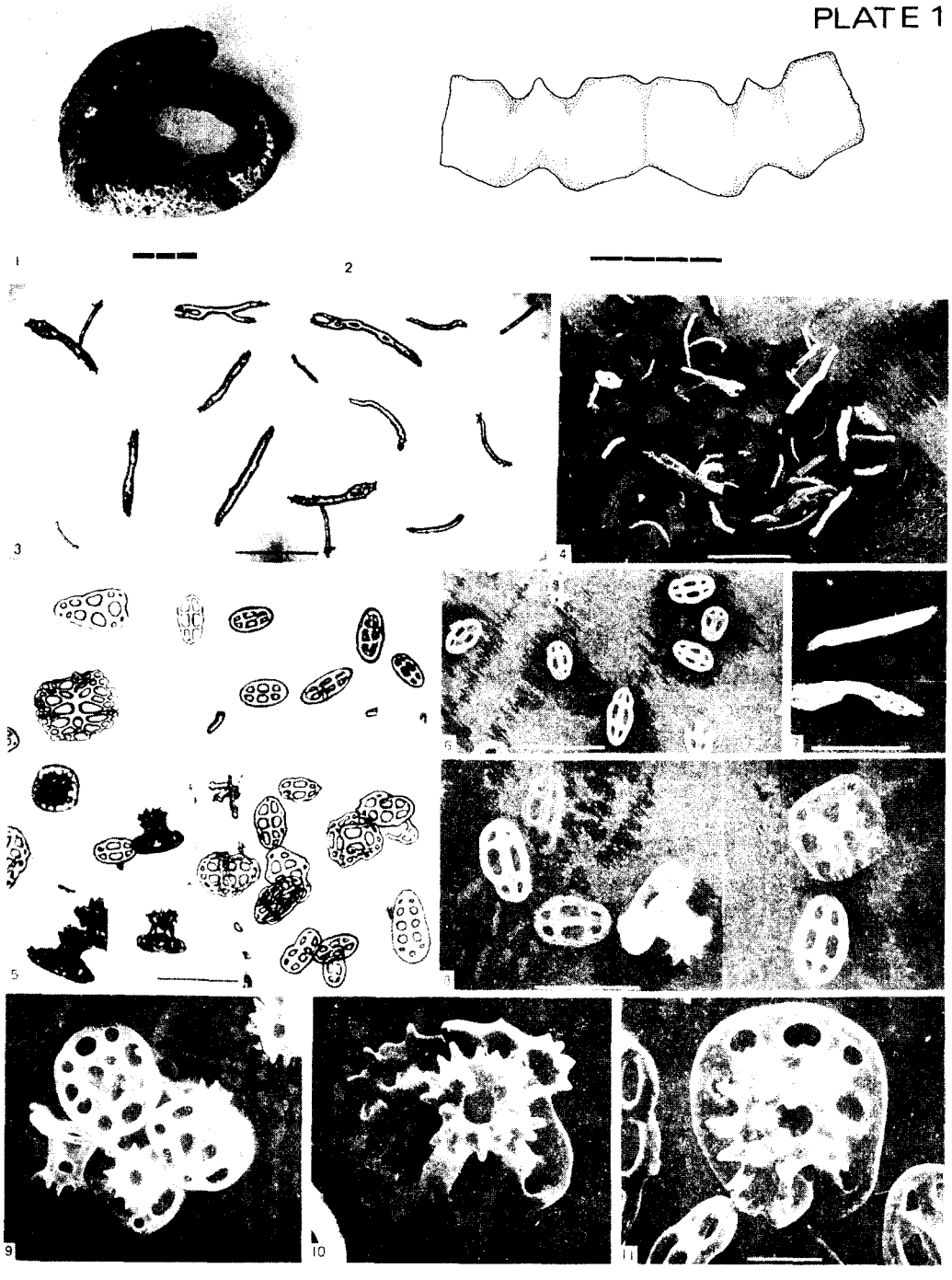
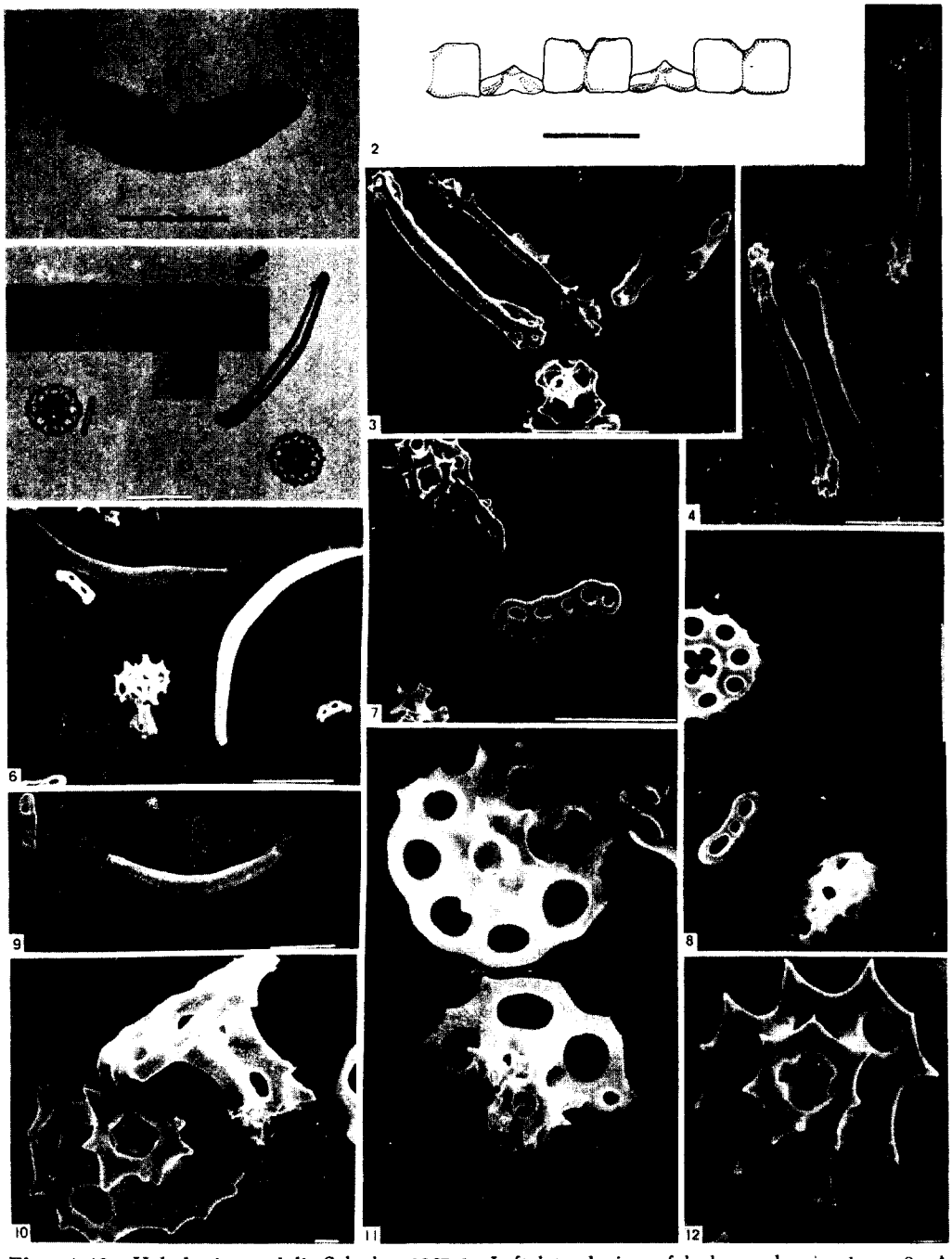
PLATE 1



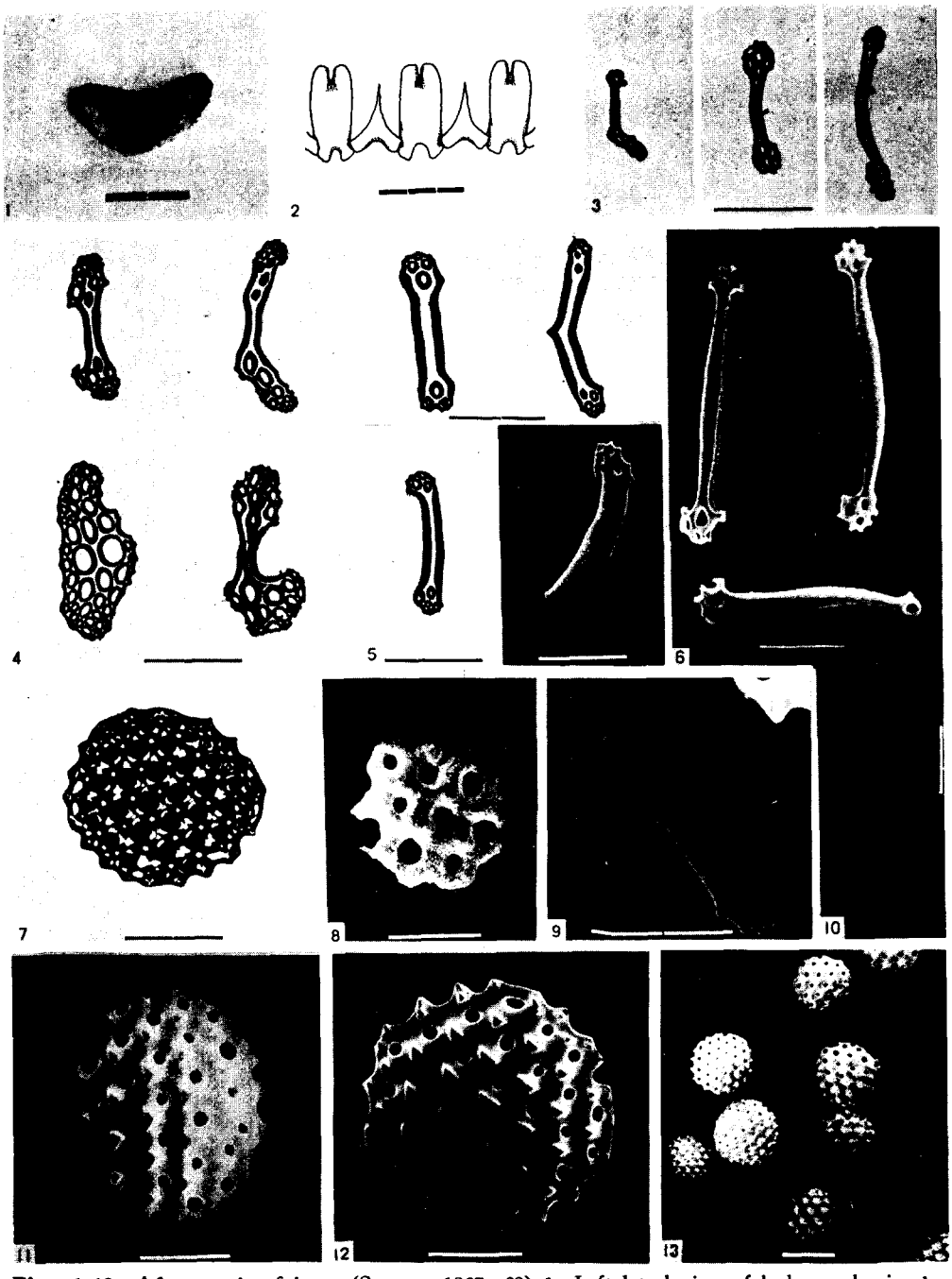
Figs. 1-11. *Holothuria monacaria* (Lesson, 1830) 1. Left laterial view of body, scale size 1 cm. 2. A part of calcareous ring, scale size 1 cm. 3, 4, 7. Supporting rods of tentacle, scale size 0.5 mm. 5. Buttons and tables of body wall, scale size 0.2 mm. 6. Buttons of body wall, scale size 0.2 mm. 8, 9. Buttons and tables of body wall, scale size 0.1 mm. 10, 11. Tables of body wall, scale size 0.03 mm.

PLATE 2



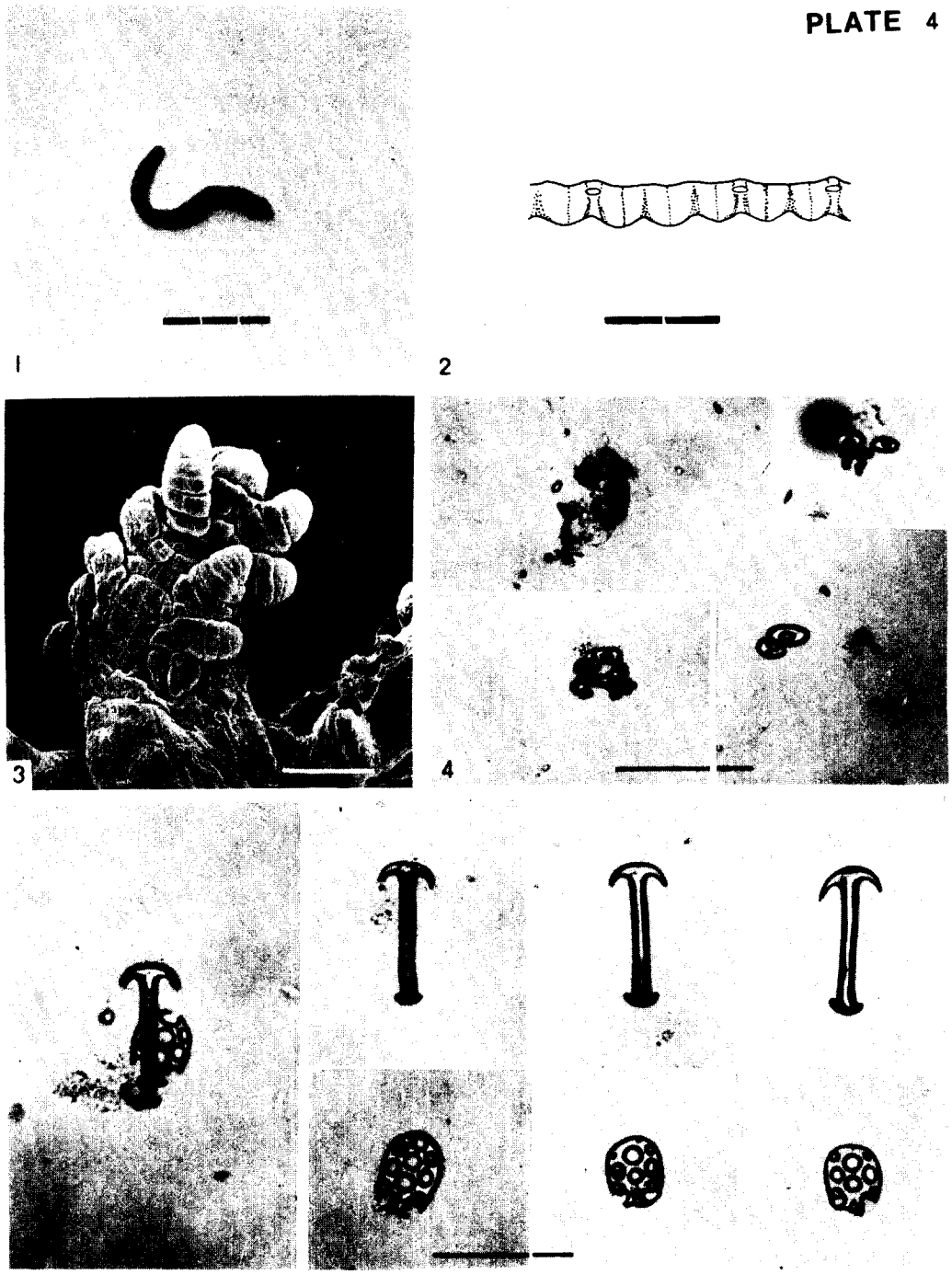
Figs. 1-12. ***Holothuria pardalis*** Selenka, 1867 1. Left lateral view of body, scale size 1 cm. 2. A part of calcareous ring, scale size 1 mm. 3. Supporting rods of tentacle and half-sided buttons and table of body wall, scale size, 0.1 mm. 4. Supporting rods of tentacle, scale size 0.1 mm. 5, 6, 7, 8, 9. Supporting rods, half-sided buttons and tables of body wall, scale size 0.1 mm. 10, 11, 12. Tables of body wall, scale size 10 μ.

PLATE 3



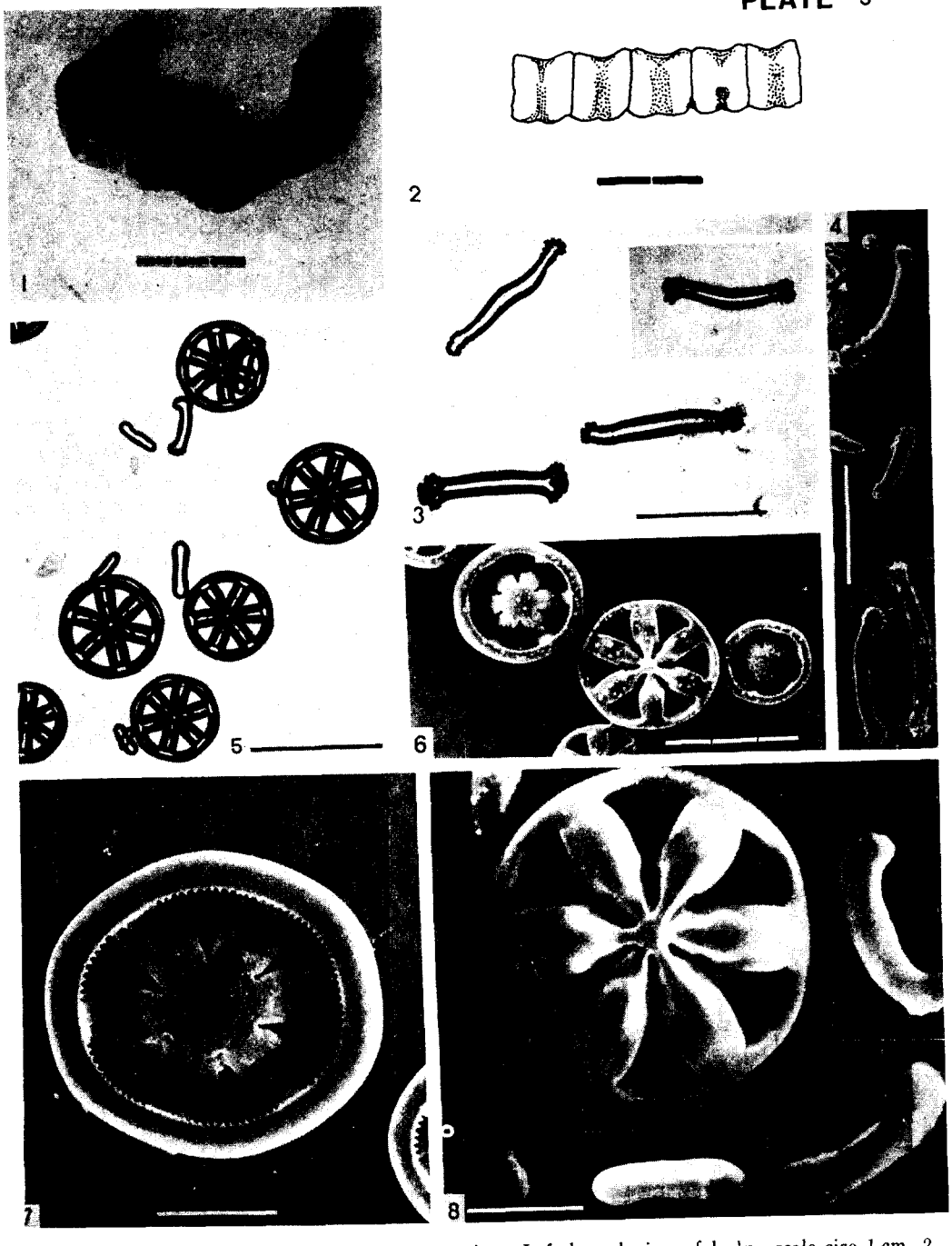
Figs. 1-13. *Afrocucumis africana* (Semper, 1867~68) 1. Left latral view of body, scale size 1 cm. 2. A part of calcareous ring, scalesize 1 mm. 3, 6. Supporting rods with perforated end of tentacle, scale size 0.2 mm. 4, 5. Supporting rods and perforated plates of body wall, scale size 0.1 mm. 6, 9, 10. Supporting rods of body wall, scale size 50 μ. 7, 8, 11, 12, 13. Button-shaped plates of body wall, scale size 0.1 mm.

PLATE 4



Figs. 1–5. *Leptosynapta ooplax* (v. Marenzeller, 1881) 1. Right lateral view of body, scale size 1 cm. 2. A part of calcareous ring, scale size 1 mm. 3. A tentacle with eleven digits, sclae size 0.2 mm. 4. Miliary granules of body wall, scale size 0.1 mm. 5. Anchors and anchor plates of body wall, scale size 1 mm.

PLATE 5



Figs. 1-8. *Polycheira rufescens* (Brandt, 1835) 1. Left lateral view of body, scale size 1 cm. 2. A part of calcareous ring, scale size 1 mm. 3, 4. Supporting rods with spine end of tentacle, scale size 0.1 mm. 5. Wheels and miliary granules of body wall, scale size 0.2 mm. 6, 7. Wheels of body wall, scale size 30 μ. 8. Wheels and miliary granules of body wall, scale size 30 μ.