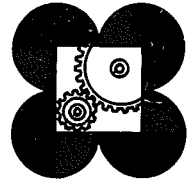


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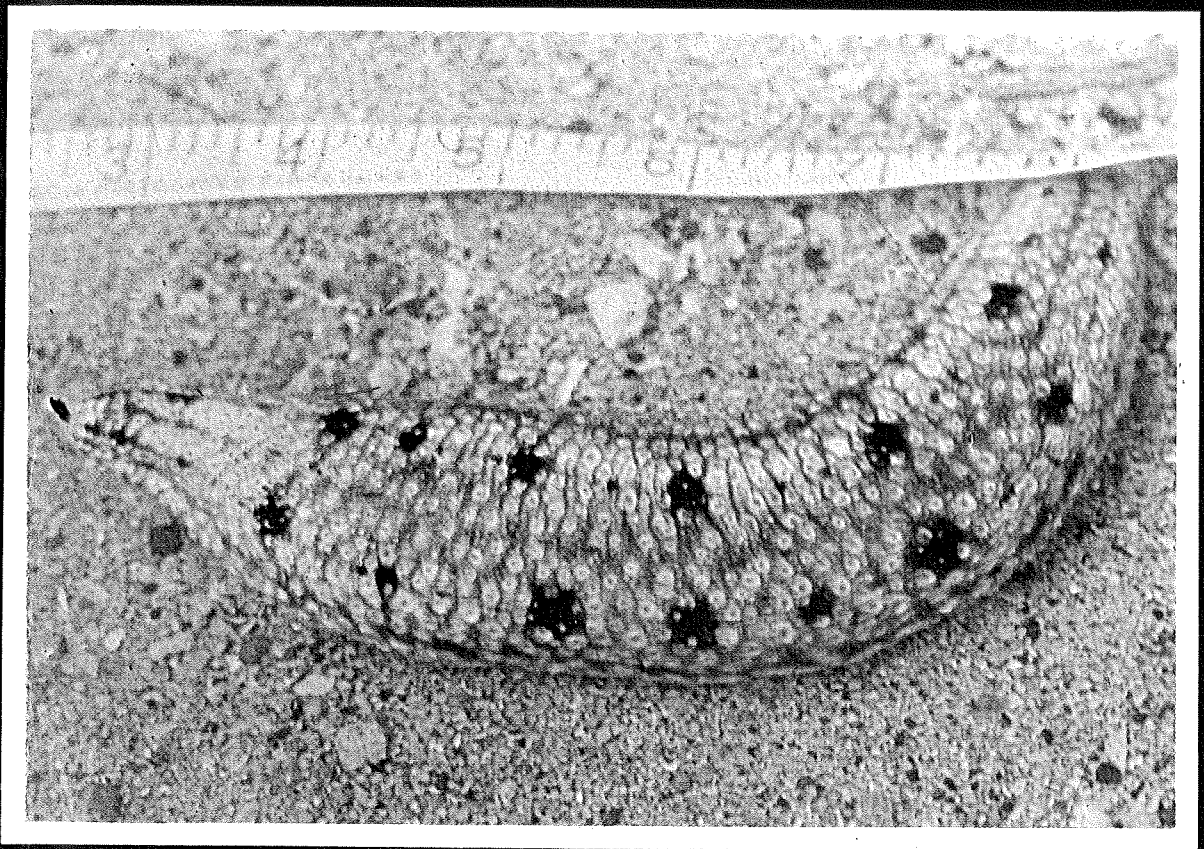
THE PHILIPPINE JOURNAL OF SCIENCE



JULY-DECEMBER 1984

ISSN 0031-7683

VOL. 113 NOS. 3-4



New Philippine record
Holothuria (Theelothuria) notabilis Ludwig

THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 113

JULY-DECEMBER 1984

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A TAXONOMIC REPORT OF SHALLOW-WATER HOLOTHURIANS OF CALATAGAN, BATANGAS

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ABSTRACT

Twenty-seven species of holothurians belonging to seven genera were collected in Calatagan, Batangas from September 1981 to July 1982. Of the three families represented namely Synaptidae, Stichopodidae and Holothuriidae, the last is the most common (with 20 species).

Two species, *Holothuria (Thelothuria) klunzingeri* Lampert and *Holothuria (Thelothuria) notabilis* Ludwig are new records for the Philippines.

The taxonomic scheme used in this paper follows that of Rowe (1969).

All materials are deposited in the Invertebrate Museum of the Marine Sciences Center, University of the Philippines, Diliman, Quezon City.

INTRODUCTION

The earliest report on Philippine holothurians was made by Dr. Carl Semper (1868) which was published in his "Reisen in Archipel der Philippinen". The species he described were collected mostly from the deeper waters of Bohol.

Seale in 1911 listed down 66 species of local holothurians. In 1917, he described 16 principal varieties and 47 commercial grades in his account of trepang industry of Mindanao and Sulu.

The first Filipino to publish work on the Class Holothuroidea was Jose S. Domantay whose taxonomic accounts of the holothurians of Puerto Galera, Zamboanga, Hundred Islands, Turtle Islands and others were published in several papers from 1933 to 1960.

These reports were followed many years later by Geronimo (1976), Santiago (1979) and Tan Tiu (1981) who adopted the latest revision (Rowe, 1969) of the Family Holothuriidae.

A total of 28 species were identified in the area. Two species *Holothuria (Theelothuria) klunzingeri* Lampert and *Holothuria (Theelothuria) notabilis* Ludwig are new records for the Philippines. A systematic key to the holothurian species found in the area is provided which includes notes on color, form and habitat.

METHODS AND MATERIALS

This investigation was done in Calatagan, Batangas from September 1981 to July 1982. Three stations were visited namely Burot, Puting Buhangin and Alvarez Farm. Collections and observations were done mostly at daytime.

The sea cucumbers were identified mainly on the basis of spicules, morphological features such as form and number of tentacles, distribution of tube feet and papillae, color, shape, length and diameter externally and internally, the shape of the calcareous ring around the front end of the gut, number of polian vesicles and presence or absence of cuvierian tubules.

For spicule examination, thin sections of the dorsal and ventral body wall were boiled in 10% NaOH, dissolving the tissues and leaving the calcareous spicules intact. These were then washed with tap water, then with distilled water and finally dehydrated in 95% ethanol. The samples were then examined under the microscope. Spicules were drawn to scale using a camera lucida.

KEY TO THE SPECIES

- 1 Podia (pedicels and papillae) present; body usually stout with more or less thick and muscular body wall; tentacles peltate; spicules in the form of tables, rods, rosettes and perforated plates *ASPIDOCHIROTIDA* 2
- 1' Podia absent, though warty prominences may be present; body vermiform; body wall very thin with sticky surface; spicules in the form of anchor, anchor plates, and miliary granules *APODIDA* 26

- 2 Gonads in a single tuft to the left of the dorsal mesentery; spicules diverse in form and combination; S- and C-shaped rods are lacking *HOLOTHURIIDAE* 3
- 2' Gonads in two tufts on each side of the dorsal mesentery; spicules primarily tables, branched rods or rosettes and S- or C-shaped rods; buttons rarely if ever present *STICHOPODIDAE* 23
- 3 Spicules mostly rods usually dichotomously branched or lobed; tables and buttons never present; 20-30 tentacles; body wall thick and muscular 4
- 3' Spicules variously developed including tables, buttons and modified rosettes 8
- 4 Anus guarded by five calcified anal teeth *ACTINOPYGA* 5
- 4' No calcified teeth but with five groups of anal papillae *BOHADSCHIA* 6
- 5 Spicules are large complex branched rods, some of which may be spiny; numerous dorsal papillae, usually with a covering layer of sand dorsally; color mottled brown black *Actinopyga echinites*
- 5' No large rods, rosettes minute, often incomplete, not usually crowded; color dark brown to black, contracts to nearly round when handled *A. miliaris*
- 6 Spicules include racquet-shaped forms with rosettes, ground color light tan with large dark brown patches and smaller spots; tube feet white-tipped, arranged in three distinct bands dorsally; tentacles grey or black *Bohadschia graeffei*
- 6' Spicules do not include racquet-shaped forms; tube feet scattered dorsally and ventrally 7
- 7 Spicules simple branched rods, color light brown grey with dorsal podia surrounded by brown or black-ringed patches; rarely covered with sand *B. argus*
- 7' Spicules simple to very complex branched rods; color variable, some cream with irregular brown patches, others mainly yellowish orange

- ground color with black spots scattered all over the body; usually buried in the sand *B. marmorata*
- 8 Spicules are tables in combination with rosettes, never buttons 9
- 8' Spicules are tables and buttons only 12'
- 9 Spicules are tables with reduced disc and simple rosettes; color wholly black or grey black dorsally and bright pink ventrally
. *Holothuria (Halodeima) spp.*
- 9' Spicules are tables with well developed disc and complex rosettes . . 12'
- 10 Spicules are tables with reduced disc and simple rosettes; color wholly black *H. (H.) atra*
- 10' Spicules are rosettes and tables with or without disc 11
- 11 Spicules are rosettes and tables without disc; color grey black dorsally and bright pink ventrally *H. (H.) edulis*
- 11' Spicules are rosettes and medium to tall tables with well developed disc *H. (H.) pulla*
- 12 Spicules are complex rosettes and well developed tables with spinose disc and upturned rim; color black with yellow green spots marking the tips of papillae and pedicels; tentacles light yellow green; quite long when relaxed, about 40-50 cm *H. (Acanthotrapeza) coluber*
- 12' Rosettes absent, spicules are tables in combination with buttons only 13
- 13 Spicules are tables in combination with smooth buttons 14
- 13' Spicules are tables in combination with knobbed buttons 18
- 14 Smooth buttons regular and well developed 15
- 14' Smooth buttons irregular and incomplete or in the form of pseudo-buttons 16
- 15 Spicules are moderate-sized tables and buttons with 3-5 pairs of holes; color light brown with bright yellowish papillae borne on warts

- arranged in rows along the longitudinal axis of the body
. *H. (Thymiosycia) hilla*
- 15' Spicules are tables with large squarish disc and buttons with only three pairs of holes; yellow brown in color with twelve or more transverse bands along the dorsal line *H. (T.) impatiens*
- 16 Smooth buttons are in the form of pseudobuttons that are often reduced to a single row of 3-4 holes; tables clumsy, disc well developed with upturned rims; spires terminate in a cluster of spines; brownish straw in color with usually two rows of dark brown blotches
. *H. (Lessonothuria) pardalis*
- 16' Smooth buttons are irregular or incomplete forming small lobed or rosette-like bars or appear as knobbed bars; tables not strongly developed, occasionally degenerate or incomplete 17
- 17 Buttons with two narrow slit-like holes and one or two pairs of holes at each end; ground color light brown with dorsal side darker and somewhat mottled with darker shades of brown; papillae borne on tubercles; body wall fairly thick and soft to touch; with cuvierian tubules that are readily released *H. (Mertensiothuria) fuscocinerea*
- 17' Buttons appear as knobbed bars; color brightly mottled cream; whole integument also dotted with dark brownish spots; ventral side with numerous white pedicels; body wall thin and soft; with cuvierian tubules that are not readily released *H. (M.) pervicax*
- 18 Spicules are knobbed buttons which are never modified into hollow fenestrated ellipsoids; tables smooth 19
- 18' Spicules are knobbed buttons which may develop into fenestrated ellipsoids; tables are smooth or knobbed which may form fenestrated spheres 20
- 19 Tables with smooth disc and spires densely covered with spines; buttons simple with moderate-sized irregularly arranged knobs; with 3-5 pairs of holes; color dark ash grey dorsally; with very prominent cream colored tube feet arranged in linear rows at dorsal side; very rough body surface *H. (Metriatyla) albiventer*
- 19' Tables with smooth disc and spires sparsely covered with spines; knob-

- bed buttons with 3-6 pairs of holes; color light grey to greenish dorsally sometimes with dark grey or brown transverse bands; white ventrally; other form greyish black with white spots marking the position of the tube feet *H. (M.) scabra*
- 20 Spicules are tables with disc usually knobbed and spires with numerous spines that may sometimes obscure the disc or become connected to the knobs of the margin to form fenestrated spheres; color cream or greyish white with small dark spots in two rows at dorsal surface; skin rigid *H. (Cystipus) rigida*
- 20' Spicules are tables with smooth or spinose disc and buttons with moderate-sized irregularly arranged knobs 21
- 21 Calcareous ring with radial plates possessing more or less well developed posterior bifurcate prolongations 22
- 21' Calcareous ring never with any indication of posterior bifurcate prolongations on the radial plates; tables with smooth squarish disc; buttons often modified into hollow fenestrated ellipsoids; few simple knobbed buttons; color dark brownish grey or almost black; body wall thick, tough, and massive; large species about 25cm . . . *H. (Microthele) nobilis*
- 22 Spicules are simple buttons with irregular moderate-sized knobs; tables moderately reduced; color dark brownish black to almost black with white dots all over marking the position of the tube feet; with thin body wall; burrows into the sand *H. (Theelothuria) khunzingeri*
- 22' Tables very much reduced; color cream with two dorsal longitudinal rows of alternating dark purplish spots; burrows into the sand *H. (T.) notabilis*
- 23 No rosettes among calcareous deposits; ossicles are tables with rods; branched C- or S-shaped rods, the latter twice as long as the height of the tables; color bluish black with greenish cast; two double rows of large conical warts on the dorsal surface and around the dorsoventral margin; papillae at tips of warts bright orange . . . *Stichopus chloronotus*
- 23' Rosettes among calcareous deposits; C- or S-shaped bodies 2X or 4X the height of the tables 24
- 24 C-shaped bodies 4X height of the tables; rosettes complex with many of the branches anastomosing; color light greenish yellow with slight tinge

- of blue; dorsal podia borne on small bumps; dorsal surface also marked with irregularly arranged brown spots *S. naso*
- 24' C-shaped bodies 2x height of the tables; disc of tables may be small or large, squarish to irregular in shape with four central holes and four to many peripheral holes; color and size variable *S. variegatus*
- 25 Spicules are anchors with stocks unbranched 26
- 25' Spicules are anchors with stocks branched 27
- 26 Spicules are massive anchors, plates and granules; drab green with transverse dark and light patches; thin body wall; rough or sticky to touch; quite long *Synapta maculata*
- 26' Spicules are smaller anchors and plates with miliary granules that are irregularly branched; color bright pink; also with very thin body wall; with 15 tentacles *Pendekaplectana nigra*
- 27 Anchor plate with bridge smoothly curved posteriorly; color variable; usually greyish green with white blotches or cream mottled with black blotches *Opheodesoma grisea*
- 27' Anchor plates forming an angle posteriorly; color uniformly dark brown with greenish grey tentacles *O. glabra*

SYSTEMATIC ACCOUNT

Order Aspidochirotida

Family Holothuriidae

1. *Actinopyga echinites* (Jaeger)

(Pl. 1, Figs. 4a-f)

Actinopyga echinites (Jaeger): Domantay, 1933: 53-54, Pl. 4, fig. 5; 1953b: 120; 1960: 93, fig. 13; Conlu, 1960: 52, Pl. 13, fig. 23; Acosta, 1969: 130, fig. 3; Clark and Rowe, 1971: 176 (distribution), Pl. 27, fig. 1; Geronimo, 1976: 92, fig. 14; Rowe and Doty, 1977: 228, figs. 2e, 6c; Tan Tiu, 1981: 70, Pl. 12, figs. 1-2.

Materials examined: Three specimens collected from Burot, Puting Buhangin and Alvarez Farm (MSCEC 001).

Habitat: Sandy areas with large amounts of coral rubble and sea grass beds; usually exposed with a layer of sand on the dorsal surface.

General Distribution: Known from scattered localities throughout the tropical Indo-West Pacific but not recorded from Hawaii.

2. *Actinopyga miliaris* (Quoy and Gaimard)
(Pl. 1, figs. 5a-e)

Actinopyga lecanora miliaris Panning, 1944: 10, 12

Actinopyga miliaris: Domantay, 1933: 53, Pl. 4, fig. 6; 1953a: 136; 1953b: 110, 120-121; 1957: 32; Clark and Rowe, 1971: 177 (distribution), Pl. 27.

Materials examined: Three specimens collected from the three stations (MSCEC 002).

Habitat: Sandy areas and patch reefs.

General Distribution: Known from scattered localities throughout the Indo-West Pacific area but not recorded from Hawaii.

3. *Bohadschia graeffei* (Semper)
(Pl. 1, figs. 1a-h)

Bohadschia graeffei: Panning, 1944: 44, fig. 13; Rowe, 1969: 130; Geronimo, 1976: 73, Pl. 12, figs. 9a-f; Clark and Rowe, 1971: 176 (distribution), Pl. 27, fig. 7; Rowe and Doty, 1977: 229, figs. 2g, 6e; Tan Tiu, 1981: 68, Pl. 9, figs. 1-2.

Material examined: One specimen collected from 30-ft depth (MSCEC 004).

Habitat: Sandy areas.

General Distribution: Indo-West Pacific including Red Sea and Australia.

4. *Bohadschia argus* Jaeger
(Pl. 1, figs. 2a-h)

Holothuria argus (Jaeger): Domantay, 1933: 60, Pl. 1, fig. 6; 1953b: 110; 1960: 84, fig. 3.

Selenkothuria argus (Jaeger): Acosta, 1969: 107, Pl. 27, figs. 50-51.

Bohadschia argus Jaeger: Panning, 1944: 36, figs. 7-8 (synonymy); Rowe, 1969: 130; Geronimo, 1976: 93, fig. 15; Clark and Rowe, 1971: 176 (distribution), Pl. 27, fig. 6; Rowe and Doty, 1977: 229, figs. 2h, 6f; Tan Tiu, 1981: 68, Pl. 10, figs. 1-2.

Material examined: One specimen found at Alvarez Farm (MSC 005).

Habitat: Patch reefs and sandy areas; rarely in sea grass beds; exposed or

partially buried and often covered with small stones and coral rubble.
General Distribution: Common tropical species also recorded from the islands of the Western Indian Ocean.

5. *Bohadschia marmorata* Jaeger
(Pl. 1, figs. 3a-h)

Bohadschia marmorata marmorata: Panning, 1944: 39, figs. 9-10.

Holothuria marmorata (Jaeger): Domantay, 1953b: 115.

Holothuria vitiensis Semper: Domantay, 1933: 76, Pl. 1, fig. 2; 1953b: 119-120; 1960, 85, fig. 4.

Selenkothuria vitiensis (Semper): Acosta, 1969: Pl. 29, figs. 54-55.

Bohadschia marmorata Jaeger: Rowe, 1969: 129, fig. 2; Clark and Rowe, 1971: 176 (distribution), Pl. 27, fig. 8; Geronimo, 1976: 95, fig. 17; Rowe and Doty, 1977: 229, figs. 3a, 6g-h; Tan Tiu, 1981: 69, Pl. 11, figs. 1-2.

Materials examined: Ten specimens collected from the three stations (MSCEC 006).

Habitat: Sea grass beds and sandy areas; found exposed or buried fully or partially in the sand; often with a layer of sand on the dorsal surface.

General Distribution: Throughout the tropical Indo-West Pacific area except Hawaii.

Remarks: *Bohadschia vitiensis*, *B. bivittata*, and *B. marmorata* were treated by Domantay (1960) as three distinct species but as conspecific by others authors such as Panning (1929), Rowe and Doty (1977). The author follows the views of the latter three taxonomists and groups the three forms with different color patterns under *B. marmorata*. Rowe and Doty believed that this species exhibits a wide range of color patterns and increased spicule complexity with growth.

6. *Holothuria (Halodeima) atra* Jaeger
(Pl. 2, figs. 1a-d)

Holothuria atra Jaeger: Fisher, 1907: 657, Pl. 70, figs. 2a-c; Domantay, 1933: 61-62, Pl. 12, fig. 20; 1954: 339.

Halodeima atra: Panning, 1944: 61, fig. 29.

Ludwigothuria atra: Deichmann, 1958: 312, Pl. 2, figs. 18-23; Acosta, 1969: 104, Pl. 24, figs. 48-49.

Holothuria sanguinolenta Bell: Domantay, 1933: 73, Pl. 3, fig. 3.

Holothuria (Halodeima) atra Jaeger: Rowe, 1969: 129, fig. 2; Clark and Rowe, 1971: 176 (distribution), Pl. 27, fig. 8; Geronimo, 1976: 95,

fig. 17; Rowe and Doty, 1977: 229, figs. 3a, 6g-h; Tan Tiu, 1981: 69, Pl. 11, figs. 1-2.

Materials examined. Five specimens collected from the three stations (MSCEC 007).

Habitat: Sandy areas, sea grass beds and patch reefs.

General Distribution: Throughout the tropical Indo-Pacific.

7. *Holothuria (Halodeima) edulis* Lesson
(Pl. 3, figs. 1a-i)

Holothuria edulis Lesson: Domantay, 1954: 342.

Holothuria (Holothuria) edulis: Panning, 1934: 43, fig. 36 (synonymy).

Halodeima edulis. Panning, 1944: 65, 32.

Holothuria (Halodeima) edulis: Rowe, 1969: 138; Clark and Rowe, 1971: 176 (distribution), Pl. 27, fig. 14; Rowe and Doty, 1977: 231, figs. 3e, 7b.

Material examined: One specimen collected from a reef area (MSCEC 008).

Habitat: Sandy areas in the coral reef.

General Distribution: Throughout the tropical Indo-West Pacific area except Hawaii.

8. *Holothuria (Halodeima) pulla* Selenka
(Pl. 3, figs. 2a-e)

Holothuria pulla Panning, 1944: 9.

Holothuria atra Domantay, 1933: 61-62, Pl. 2, fig. 6.

Holothuria pulla Semper, 1868: 92, 279; Panning, 1934: 34; Domantay, 1953a: 135; 1953b: 110, 116-117; +954a: 337, 347-348; 1957: 32.

Holothuria (Halodeima) pulla Selenka: Rowe, 1969; Clark and Rowe, 1971: 177 (distribution).

Materials examined: Four specimens collected from Burot and Puting Buhangin (MSCEC 009).

Habitat: Sandy areas with sea grass beds; rarely on patch reefs; sometimes with thin covering of sand and mucus on the dorsal surface.

General Distribution: Reported only in scattered regions in the Indo-West Pacific like East Africa and Madagascar, East Indies, and South Pacific Islands.

Remarks: This species is usually confused with *H. atra* because of their resemblance in life when both are relaxed and the tentacles are extended.

Both are black in life but *H. pulla* has a thinner body wall and is softer in texture and has cuvierian organs. Pedicels and papillae are more conspicuous than in *H. atra*. *H. pulla* does not give out a purplish exudate when squeezed.

9. *Holothuria (Acanthotrapeza) coluber* Semper
(Pl. 2, figs. 2a-m)

Holothuria coluber Semper: Domantay, 1933: 62, Pl. 1, fig. 9

Holothuria (Acanthotrapeza) coluber Semper: Rowe, 1969: 138; Clark and Rowe, 1971: 176, Pl. 27, fig. 13; Tan Tiu, 1981: 74, Pl. 16, figs. 1-3, Pl. 29, figs. 1-2c.

Materials examined: Three specimens collected from Burot, Puting Buhangin and Alvarez Farm (MSCEC 010).

Habitat: Sandy areas; with the anterior part exposed and the posterior part of the body hidden under large rocks or coral heads making it hard to pull out.

General Distribution: Reported only from the East Indies, North Australia and the Philippines.

10. *Holothuria (Thymiosycia) hilla* Lesson
(Pl. 4, figs. 2a-f)

Holothuria monacaria (sensu Theel, 1886, non Lesson, 1830) Panning, 1934: 69, fig. 47 (synonymy).

Holothuria gyrifer: Domantay, 1954: 343.

Brandothuria gyrifer: Deichmann, 1958: 294, Pl. 1, figs. 16-18.

Holothuria (Thymiosycia) hilla Lesson: Rowe, 1969: 147; Clark and Rowe, 1971: 178 (distribution), Pl. 28, fig. 9; Rowe and Doty, 1977: 232, figs. 4b, 8b; Tan Tiu, 1981: 75, Pl. 17, figs. 1-2, Pl. 29, figs. 1-2g.

Materials examined: Three specimens collected from Puting Buhangin (MSCEC 011).

Habitat: Sandy areas especially with coral rubble; found under rocks or boulders or among corals.

General Distribution: Throughout the tropical Indo-Pacific area.

11. *Holothuria (Thymiosycia) impatiens* (Forsk.)
(Pl. 4, figs. 1a-d)

Holothuria (Holothuria) impatiens: Panning, 1935: 86, fig. 72 (synonymy)

- Holothuria impatiens* (Forsk.) Fisher, 1907: 666-668, Pl. 69, figs. 4a-d; Domantay, 1954: 344
- Holothuria (Thymiosycial) impatiens* (Forsk.): Rowe, 1969: 145, fig. 13; Clark and Rowe, 1971: 178 (distribution), Pl. 28, fig. 8; Geronimo, 1976: 46, figs. 4a-d, Rowe and Doty, 1977: 233, figs. 4c, 7e; Tan Tiu, 1981: 76, Pl. 18, figs. 1-2.

Material examined: One specimen collected from Alvarez Farm (MSCEC 012)

Habitat: Sandy areas with coral rubble.

General Distribution: Throughout the tropical Indo-Pacific and Atlantic Oceans and the Mediterranean.

12. *Holothuria (Lessonothuria) pardalis* Selenka
(Pl. 4, figs. 3a-f)

- Holothuria (Holothuria) pardalis*: Panning, 1935: 3, fig. 106 (synonymy).
- Lessonothuria pardalis*: Deichmann, 1958: 295, Pl. 2, figs. 1-17.
- Holothuria (Lessonothuria) pardalis*: Rowe, 1969: 149, fig. 15; Clark and Rowe, 1971: 176 (distribution), Pl. 28, fig. 11; Rowe and Doty, 1977: 233, fig. 4e.

Material examined: One specimen collected from Alvarez Farm (MSCEC 013).

Habitat: Sandy areas; found under rocks and coral fragments.

General Distribution: Throughout the tropical Indo-West Pacific area.

13. *Holothuria (Mertensiothuria) fuscocinerea* Jaeger
(Pl. 5, figs. 2a-j)

- Mertensiothuria fuscocinerea* (Jaeger): Deichmann, 1958: 300-302, Pl. 3, figs. 12-23.
- Holothuria (Mertensiothuria) fuscocinerea* Jaeger: Rowe, 1969: 149; Clark and Rowe, 1971: 176 (distribution); Tan Tiu, 1981: 78, Pl. 20, figs. 1-2a, Pl. 29, figs. 1-2f.

Materials examined: Three specimens collected from Burot, Puting Buhangin and Alvarez Farm (MSCEC 014).

Habitat: Sandy areas with coral rubble and few patches of sea grass; found tucked in crevices or rocks or under coral fragments.

General Distribution: Found in scattered regions in the Indo-West Pacific area.

14. *Holothuria (Mertensiothuria) pervicax* Selenka
(Pl. 5, figs. 1 a-j)

- Holothuria pervicax*: Fisher, 1907: 655, Pl. 68, figs. 2a-c.
- Holothuria (Holothuria) curiosa* var. *pervicax*: Panning, 1935: 6, fig. 109 (synonymy).
- Mertensiothuria pervicax*: Deichmann, 1958: 297.
- Holothuria (Mertensiothuria) pervicax* Selenka: Rowe, 1969: 149; Clark and Rowe, 1971: 176 (distribution); Rowe and Doty, 1977: 234, figs. 4g, 8i; Tan Tiu, 1981: 79, Pl. 21, figs. 1-2.

Material examined: One specimen collected from Burot (MSCEC 015).

Habitat: Sandy areas, found among rocks.

General Distribution: Throughout the tropical Indo-Pacific area.

15. *Holothuria (Metriatyla) albiventer* Semper
(Pl. 6, figs. 2a-e)

- Holothuria (Metriatyla) albiventer* Semper: Rowe, 1969: 160; Clark and Rowe, 1971: 176 (distribution), Pl. 28, fig. 2; Tan Tiu, 1981: 82, Pl. 26, figs. 1-2.

Materials examined: Two specimens collected from Burot and Alvarez Farm (MSCEC 016)

Habitat: Sandy areas.

General Distribution: Throughout the Indo-Pacific area.

16. *Holothuria (Metriatyla) scabra* Jaeger
(Pl. 6, figs. 1a-g)

- Holothuria scabra* Jaeger: Domantay, 1933: 74-76, Pl. 2, fig. 3; 1953b: 117; 1960: 86, figs. 5a-d; Conlu, 1960: 58, Pl. 11, fig. 17.
- Holothuria (Metriatyla) scabra* Jaeger: Rowe, 1969: 160, fig. 20; Clark and Rowe, 1971: 178 (distribution), Pl. 28, fig. 15; Geronimo, 1976: 48, fig. 6; Tan Tiu, 1981: 83, Pl. 25, figs. 1-3.

Materials examined: Four specimens collected from the three stations (MSCEC 017).

Habitat: Sandy areas especially with coral rubble; rarely in sea grass beds; the common form usually found partially buried or exposed with a thin layer of sand covering the dorsal surface.

General Distribution: Throughout the Indo-West Pacific area.

Remarks: Two forms are included. The more common is light grey to greenish dorsally sometimes with dark grey or brown transverse bands; white ventrally; arched dorsally, flattened ventrally; medium to large size about 16-28 cm in length.

The other form showing an odd color pattern is greyish black with white spots marking the position of the tube feet; dorsoventrally flattened; with thick and hard body wall; medium-sized about 18-20 cm in length.

17. *Holothuria (Cystipus) rigida* (Selenka)
(Pl. 7, figs. 2a-f)

Fossothuria rigida: Deichmann, 1958: 321, Pl. 8, figs. 1-13 (synonymy).

Holothuria (Cystipus) rigida (Selenka): Rowe, 1969: 155, fig. 18; Clark and Rowe, 1971: 176 (distribution), Pl. 28, fig. 13; Rowe and Doty, 1977: 233, figs. 4d, 7f; Tan Tiu, 1981: 81, Pl. 23, figs. 1-2.

Materials examined: Three specimens collected from Burot and Puting Buhangin (MSCEC 018).

Habitat: Sandy areas especially with coral rubble; found under coral heads and boulders.

General Distribution: From East Africa to Hawaii, the Galapagos, the west coast of North America to the Panamic region to the West Indies.

18. *Holothuria (Microthele) nobilis* (Selenka)
(Pl. 7, figs. 1a-g)

Actinopyga nobilis (Selenka): Fisher, 1907: 647.

Argiodia maculata (Brandt): Domantay, 1933: 55, Pl. 1, fig. 1.

Microthele nobilis (Selenka): Domantay, 1953b: 122.

Holothuria (Microthele) nobilis: Panning, 1929: 131, fig. 15 (synonymy); Rowe, 1969: 162, fig. 21; Clark and Rowe, 1971: 178 (distribution), Pl. 27, fig. 10, Pl. 28, fig. 20; Geronimo, 1976: 53, fig. 11; Rowe and Doty, 1977: 231, figs. 3f, 7d; Tan Tiu, 1981: 84, Pl. 27, figs. 1-4.

Materials examined: Two specimens collected from Burot (MSCEC 019).

Habitat: Sandy areas; usually covered with sandy layer; also among corals.

General Distribution: Throughout the tropical Indo-West Pacific area.

19. *Holothuria (Theelothuria) klunzingeri* Lampert
(Pl. 8, figs. 2a-f)

Holothuria (Theelothuria) klunzingeri Lampert: Rowe, 1969: 157; Clark and Rowe, 1971: 179 (distribution).

Materials examined: Three specimens collected only from Puting Buhangin (MSCEC 020).

Habitat: Sandy areas; burrowing forms that emerge only at night.

General Distribution: This species has not been previously reported in the Philippines. Recorded only in the Red Sea.

20. *Holothuria (Theelothuria) notabilis* Ludwig
(Pl. 8, figs. 1a-e)

Holothuria (Theelothuria) notabilis Ludwig: Rowe, 1969: 157; Clark and Rowe, 179 (distribution).

Materials examined: Three specimens collected from Puting Buhangin (MSCEC 021).

Habitat: Sandy areas; burrowing forms found together with *H. klunzingeri*; also emerging at night.

General Distribution: This species has not been previously reported in the Philippines. Recorded from the East Indies and Australia.

Family Stichopodidae

21. *Stichopus chloronotus* Brandt
(Pl. 9, figs. 1a-d)

Stichopus chloronotus. Clark, 1922: 53, Pl. 2, figs. 1-10 (synonymy); Domantay, 1933: 77-78, Pl. 3, fig. 2; 1954: 351; 1960: figs. 18a-g; Clark and Rowe, 1971: 178 (distribution), Pl. 27, fig. 18; Rowe and Doty, 1977: 277, figs. 2c, 6a; Tan Tiu, 1981: 65, Pl. 7, figs. 1-3.

Materials examined: Two specimens collected from Alvarez Farm and near Puting Buhangin (MSCEC 022).

Habitat: Sandy areas and patch reefs, found exposed on rocks and sand.

General Distribution: Throughout the tropical Indo-West Pacific Ocean from East Africa to Hawaii.

22. *Stichopus naso* Semper
(Pl. 10, figs. 2a-h)

Stichopus naso Semper, 1868: S. 72, Taf. 18, Taf. 30, fig. 3; Clark, 1922: S. 61; Clark and Rowe, 1971: 179 (distribution).

Materials examined: Two specimens collected from Puting Buhangin (MSCEC 023).

Habitat: Sandy areas.

General Distribution: Reported only from the Philippines.

Remarks: Two forms are included. One is light greenish yellow with a slight tinge of blue; dorsal podia borne on small bumps; dorsal surface also

marked with several irregularly arranged brown spots; small, about 13-15 cm long.

The other form is very large, dirty white in color with black spots scattered all over the surface; about 20 cm in length.

23. *Stichopus variegatus* Semper
(Pl. 9, figs. 2a-g)
(Pl. 10, figs. 1a-e)

Stichopus variegatus Semper, 1868: 73, Pl. 16, fig. 1; Domantay, 1933: 79-80, Pl. 2, fig. 1; 1953: 123; 1960: 99, figs. 19a-g; Clark and Rowe, 1971: 178 (distribution), Pl. 27, fig. 20; Tan Tiu, 1981: 66, Pl. 8, figs. 1-2.

Materials examined: Four specimens collected from Burot, Puting Buhangin and Alvarez Farm (MSCEC 024).

Habitat: The smaller form is usually found in clumps closely associated with sponges, algae and sea grass. All other forms were collected from sandy areas.

General Distribution: Throughout the Indo-West Pacific area.

Remarks: Four individuals which look quite differently in body form and color pattern are included. One is small with dark olive green color and large tuberculous papillae which when extended are almost one-third the width of the body; with thick body wall. The body is arched dorsally; about 10-15 cm.

Another is yellowish to greenish in color with the dorsal surface marked with irregular rows of mammiform protruberances at the tips of which are the dorsal papillae; each dorsal papilla with concentric fine dark lines; with very thick body wall; very large form about 30-35 cm.

A third form has yellow green to orange ground color with large circular warts scattered irregularly on the dorsal surface; dorsal papillae dark brown; ventral surface grey; with thick body wall which disintegrates easily; large species about 30-35 cm.

The fourth form is brown in color with numerous dark spots scattered all over the surface; large form about 30-33 cm. (Note: Since the concept of "variety" has no formal status in modern Zoological systematics, the author has suppressed the variety *Stichopus variegatus* var. *hermanii* Semper and included all the above forms under *Stichopus variegatus* Semper.)

Order Apodida

Family Synaptidae

24. *Synapta maculata* (Chamisso and Eysendhardt)
(Pl. 11, figs. 1a-b)

Synapta maculata (Chamisso and Eysendhardt): Clark, 1924: 471-473, Pl. 3, figs. 1-2, Pl. 4, fig. 1, Pl. 5; Domantay, 1933: 89, Pl. 2, fig. 7; 1954: 353; 1960: fig. 23; Clark and Rowe, 1971: 186 (distribution), Pl. 26, fig. 20, Pl. 30, fig. 9; Geronimo, 1976: 100-101, fig. 23; Rowe and Doty, 1977: 234, figs. 5a, 8e; Tan Tiu, 1981: 60, Pl. 2, figs. 1-2, Pl. 29, figs. 1-2b.

Materials examined: Two specimens collected from Burot and Puting Buhangin (MSCEC 026).

Habitat: Sandy areas.

General Distribution: Throughout the Indo-West Pacific area but not recorded from Hawaii.

25. *Pendekaplectana nigra* (Semper)
(Pl. 11, figs. 2a-b)

Pendekaplectana nigra (Semper): Clark and Rowe, 1971: 187 (distribution).

Materials examined: Three specimens collected from the three stations (MSCEC 027).

Habitat: Sandy areas with sea grass beds; usually found coiled around blades of *Enhalus*.

General Distribution: East Indies, North Australia and the Philippines.

26. *Opheodesoma grisea* (Semper)
(Pl. 11, figs. 3a-b)

Opheodesoma grisea: Fisher, 1907: 723; Clark, 1924: 466, Pl. 2, figs. 1-3; Domantay, 1960: 105, fig. 24; Clark and Rowe, 1971: 186 (distribution), Pl. 30, fig. 11; Rowe and Doty, 1977: 235, figs. 5d, 8g; Tan Tiu, 1981: 62, Pl. 4, figs. 1-2, Pl. 29, figs. 1-2a.

Materials examined: Ten specimens collected from the three stations (MSCEC 028).

Habitat: Sandy areas with sea grass beds.

General Distribution: East Africa, Red Sea, Coast of Arabia, Ceylon to the Philippines.

27. *Opheodesoma glabra* (Semper)
(Pl. 11, figs. 4a-b)

Opheodesoma glabra (Semper): Fisher, 1907: 723; Clark, 1924: 465-466, Pl. 2, figs. 4-6; Clark and Rowe, 1971: 185 (distribution); Tan Tiu, 1981: 63, Pl. 5, figs. 1-2.

Materials examined: Three specimens collected from the three stations (MSCEC 209).

Habitat: Sandy areas especially with sea grass beds

General Distribution: East Indies, Australia, Philippines and South Pacific Islands.

ECOLOGICAL OBSERVATIONS

Of the three stations visited, Burot harbors the highest population (1222 individuals in 800 m² covered) of holothurians. The landward side of this area is generally sandy, with coral rubble and is partially exposed during low tide. In this habitat occur species such as *Bohadschia marmorata*, *Holothuria atra*, and *H. scabra* which are usually found covered with sand.

The predominant species in Burot is *Actinopyga echinites* and groups of this are observed among patches of *Thalassia* and *Cymodocea*. *Holothuria pulla* is often found together with this species.

Two hundred meters from the shore, dense coral growth extends towards the abrupt drop-off into the Calatagan Inlet. Near this region of living corals were collected two individuals of *Holothuria nobilis*. Low counts of this highly priced commercial form in this locality could be due to harvesting by local fishermen. *H. coluber* and *H. fuscocinerea* are restricted to boulder cover.

In Puting Buhangin, a large part of this area is exposed at low tide. This exposed area is mostly sandy with plenty of coral rubble and pebbles. Only burrowing forms were observed like *H. klunzingeri*, *H. notabilis* (the two new records discovered in the locality) and *H. rigida*. Such cryptic holothurians were observed moving out of their holes only at night.

This sandy zone is followed seaward by a large patchy zone of *Thalassia* and *Cymodocea* inhabited by *Actinopyga echinites*, *H. pulla*, *A. miliaris*, *Synapta maculata*, *Opheodesoma grisea* and *O. glabra*. The boulders strewn

across the flat also provide shelter for *H. hilla*, *H. coluber*, *H. fuscocinerea*, and *Stichopus naso*.

Alvarez Farm is distinguished from the other two stations by the character of the substrate which is generally sandy-muddy, the dominance of tall *Enhalus* grasses and the extensive growth of numerous algal species and large drab and brightly colored sponges. This is where the smaller form of *Stichopus variegatus* accounts for more than 86% of the holothurian fauna of the place.

Groups of 5-20 individuals per square meter are found closely associated with algal species like *Laurencia*, *Hydroclathrus* and *Eucheuma*. Aggregations are also observed at the base of *Enhalus* grasses and crowded on top of large encrusting sponges such as *Geodia*, *Callyspongia*, *Adocia* and *Strongylophora*.

Where sponges, algae and *Enhalus* are lacking, *S. variegatus* may be found singly or in pairs separated by a distance of 2-4 meters. Only a few individuals of this species were observed in Burot and Puting Buhangin. Such abundance of *S. variegatus* in Alvarez Farm could probably be explained by the widespread growth of sponges, algae and *Enhalus* among which this appears to prefer to live.

Larger individuals of *H. atra*, *H. scabra*, *B. marmorata* and *A. echinites* were also noted in the area. Cryptic forms like *H. impatiens* and *H. pardalis* were also collected under stones and boulders. Coiled around blades of *Enhalus* are young individuals of *Pendekaplectana nigra*.

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CAPTIONS FOR PLATES AND FIGURES

Plate 1

- Figure 1 A-D Racquet-shaped spicules of *Bohadschia graeffei*
E-H Branched and simple rods of *B. graeffei*
Figure 2 A-H Branched rods of *B. argus*
Figure 3 A-H Simple and branched rods of *B. marmorata*
Figure 4 A Spiny rod of *Actinopyga echinites*
B-F Large branched rods of *A. echinites*
Figure 5 A-E Dichotomous rods of *A. miliaris*

Plate 2

- Figure 1 A-B Rosettes of *Holothuria atra*
C Side view of table of *H. atra*
D Disc of table of *H. atra*
Figure 2 A-F Rosettes of *H. coluber*
G-H Discs of tables of *H. coluber*
I Side view of table
J-M Supporting rods of *H. coluber*

Plate 3

- Figure 1 A-F Rosettes of *H. edulis*
G Side view of table
H Disc of table
I Spire of table
Figure 2 A Tall table of *H. pulla*
B Moderate-sized table of *H. pulla*
C-D Discs of table
E Button-like spicules of *H. pulla*

Plate 4

- Figure 1 A-B Six-holed buttons of *H. impatiens*
C Disc of table of *H. impatiens*
D Side view of table
Figure 2 A-D Buttons of *H. hilla*
E Side view of table of *H. hilla*
F Disc of table
Figure 3 A-D Pseudobuttons of *H. pardalis*
E Disc of table of *H. pardalis*
F Supporting spicule of *H. pardalis*

Plate 5

- Figure 1 A-H Bars of *H. pervicax*
I-J Discs of tables of *H. pervicax*
Figure 2 A-D Irregular buttons of *H. fuscocinerea*
E-G Discs of tables of *H. fuscocinerea*
H-J Supporting spicules of *H. fuscocinerea*

Plate 6

- Figure 1 A-C Buttons of *H. scabra*
D Side view of table of *H. scabra*
E-G Discs of tables of *H. scabra*
Figure 2 A-C Buttons of *H. albiventer*
D Disc of table
E Side view of table

Plate 7

- Figure 1 A-B Buttons of *H. nobilis*
C Fenestrated ellipsoid of *H. nobilis*
D-E Side view of tables of *H. nobilis*
F-G Discs of table
Figure 2 A-C Knobbed buttons of *H. rigida*
D Disc of table of *H. rigida*
E Spire of table
F Supporting rod of *H. rigida*

Plate 8

- Figure 1 A-C Buttons of *H. notabilis*
D Side view of table
E Disc of table

Figure 2 A-C Buttons of *H. klunzingeri*
D-F Discs of tables of *H. klunzingeri*

Plate 9

Figure 1 A C-shaped spicule of *Stichopus chloronotus*
B Side view of table of *S. chloronotus*
C Disc of table
D Spire of table
Figure 2 A C-shaped spicule of first two forms of *Stichopus variegatus*
B Side view of table of *S. variegatus* (first two forms)
C-D Discs of tables
E-F Rosettes of *S. variegatus* (first two forms)
G Supporting rod of *S. variegatus* (first two forms)

Plate 10

Figure 1 A C-shaped spicule of last two forms of *S. variegatus*
B Side view of table of *S. variegatus* (last two forms)
C Disc of table
D-E Rosettes of *S. variegatus* (last two forms)
Figure 2 A C-shaped spicule of *S. naso*
B-C Tall and short tables of *S. naso*
D Disc of table
E Spire of table
F-G Rosettes of *S. naso*
H Supporting rod

Plate 11

Figure 1 A Anchor of *Synapta maculata*
B Anchor plate of *S. maculata*
Figure 2 A Anchor of *Pendekaplectana nigra*
B Anchor plate of *P. nigra*
Figure 3 A Anchor of *Opheodesoma grisea*
B Anchor plate of *O. grisea*
Figure 4 A Anchor of *O. glabra*
B Anchor plate of *O. glabra*

Plate 12

Map showing the three study stations set up in Calatagan.

PLATE 1

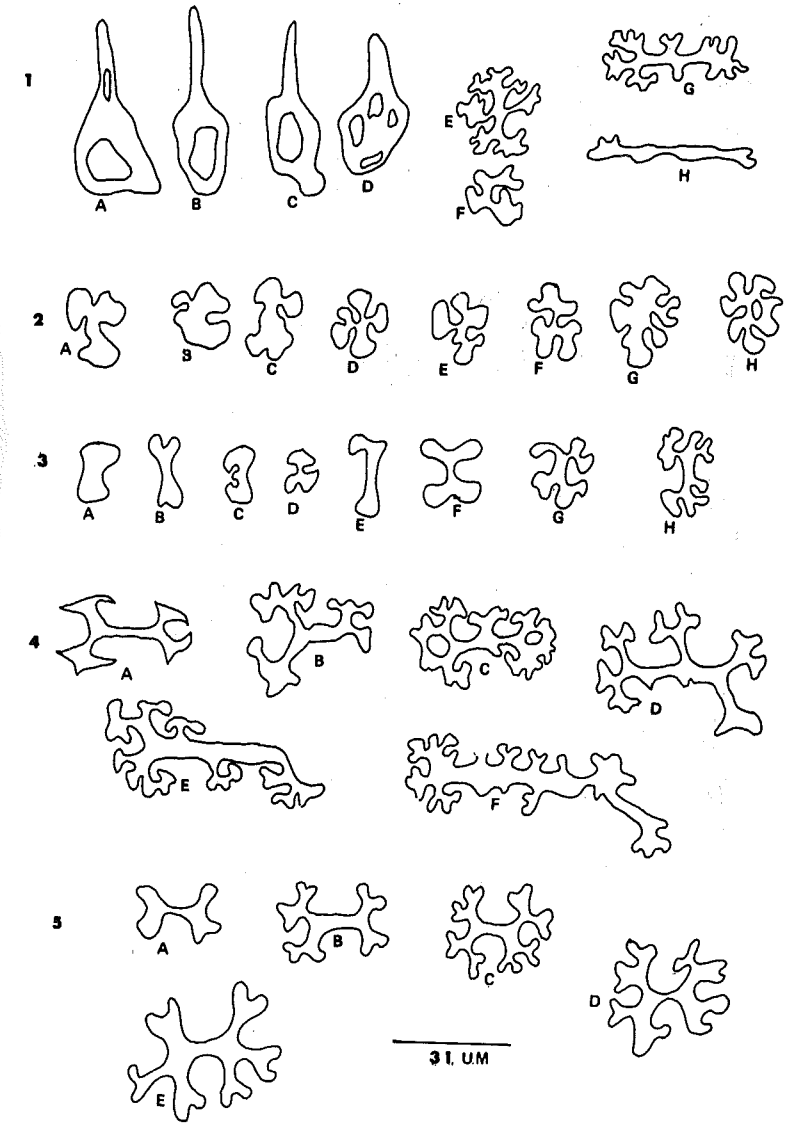


PLATE 2

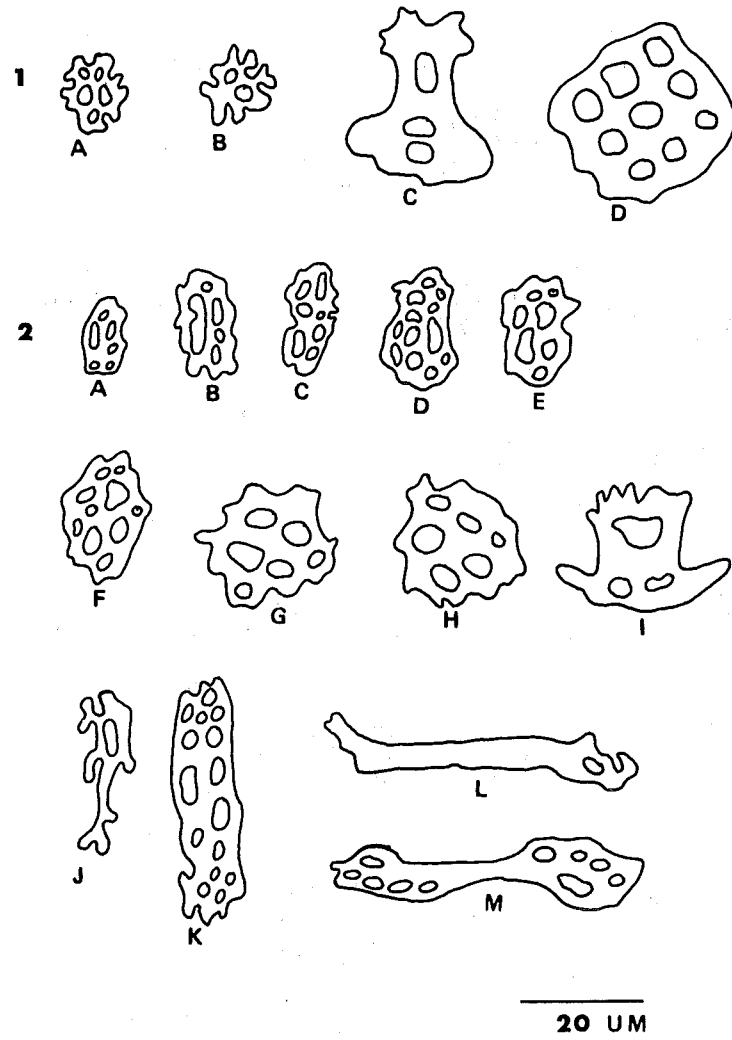


PLATE 3

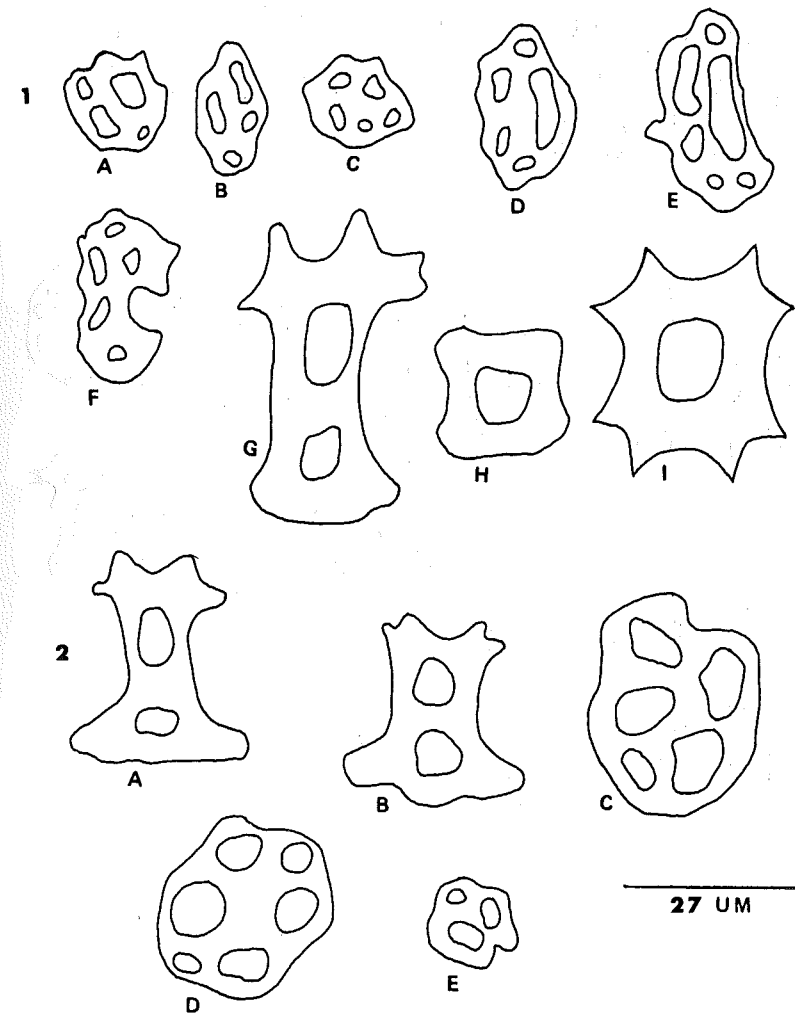


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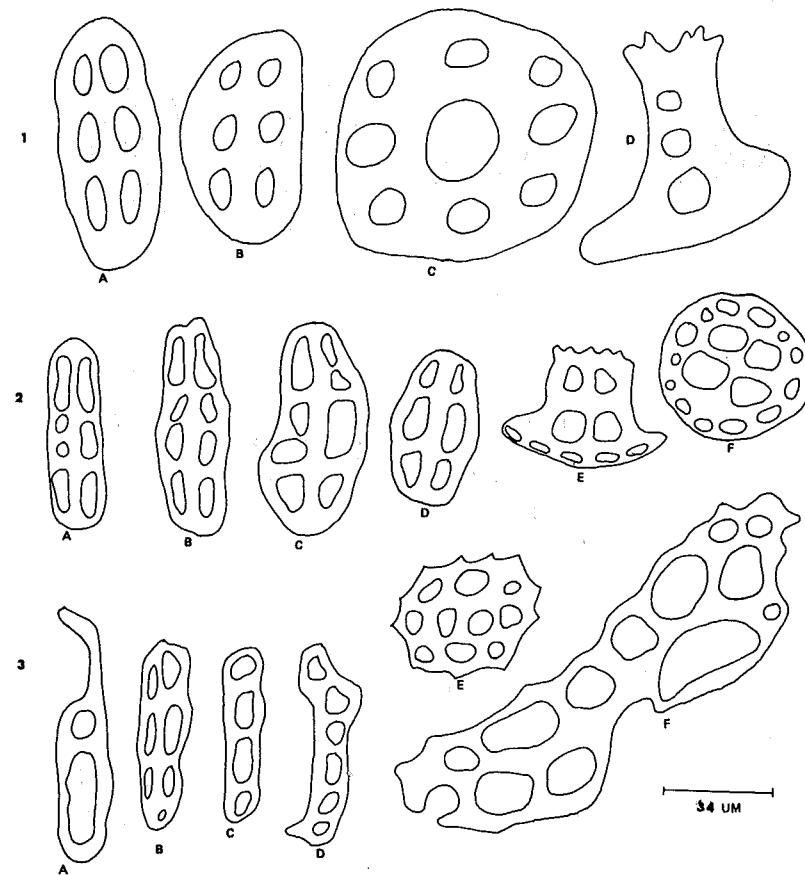


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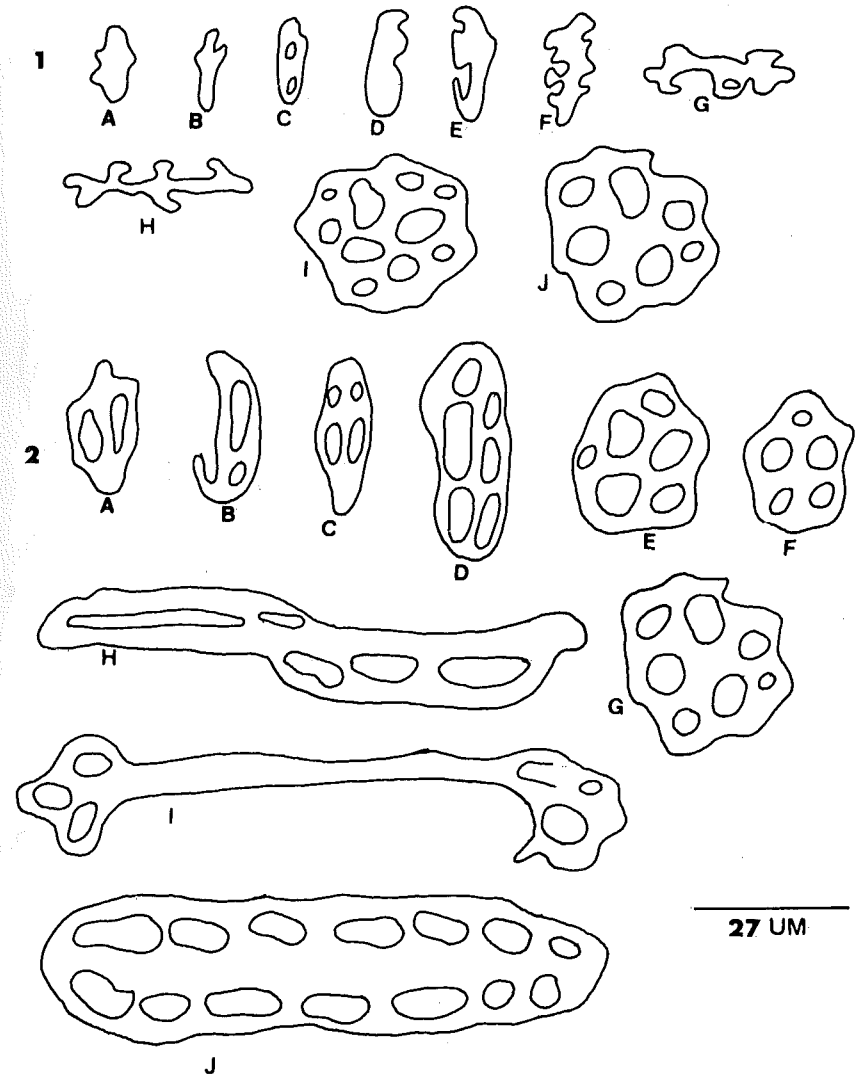


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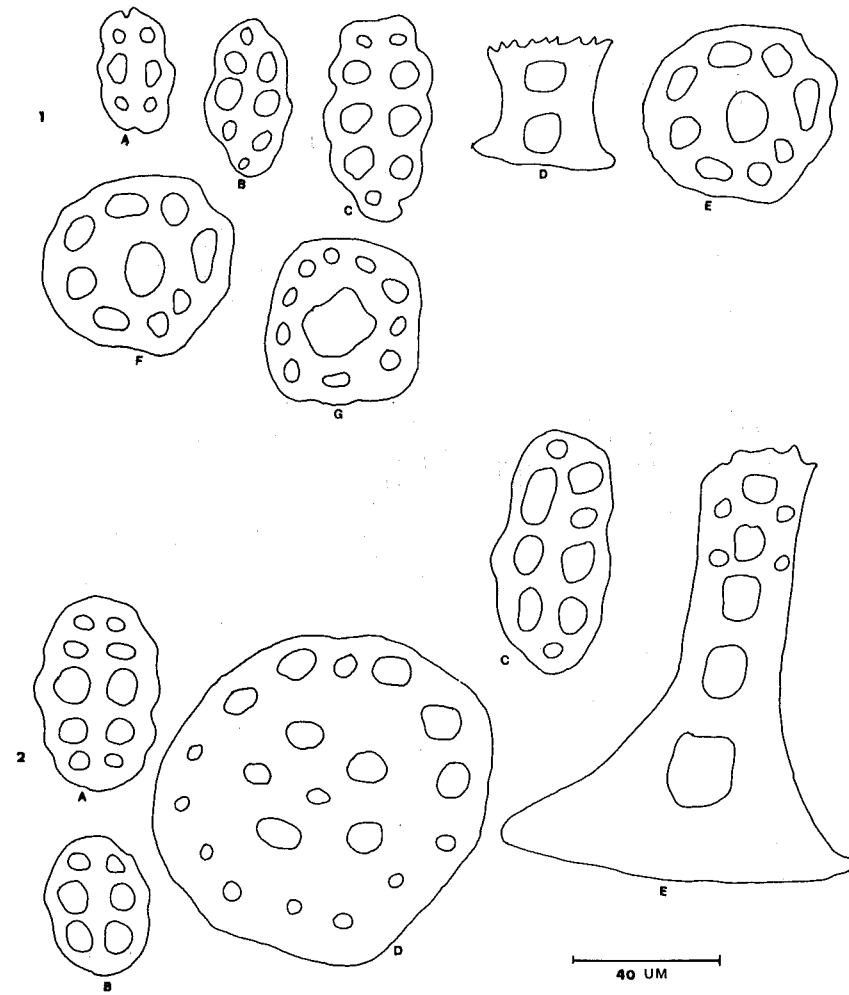


PLATE 7

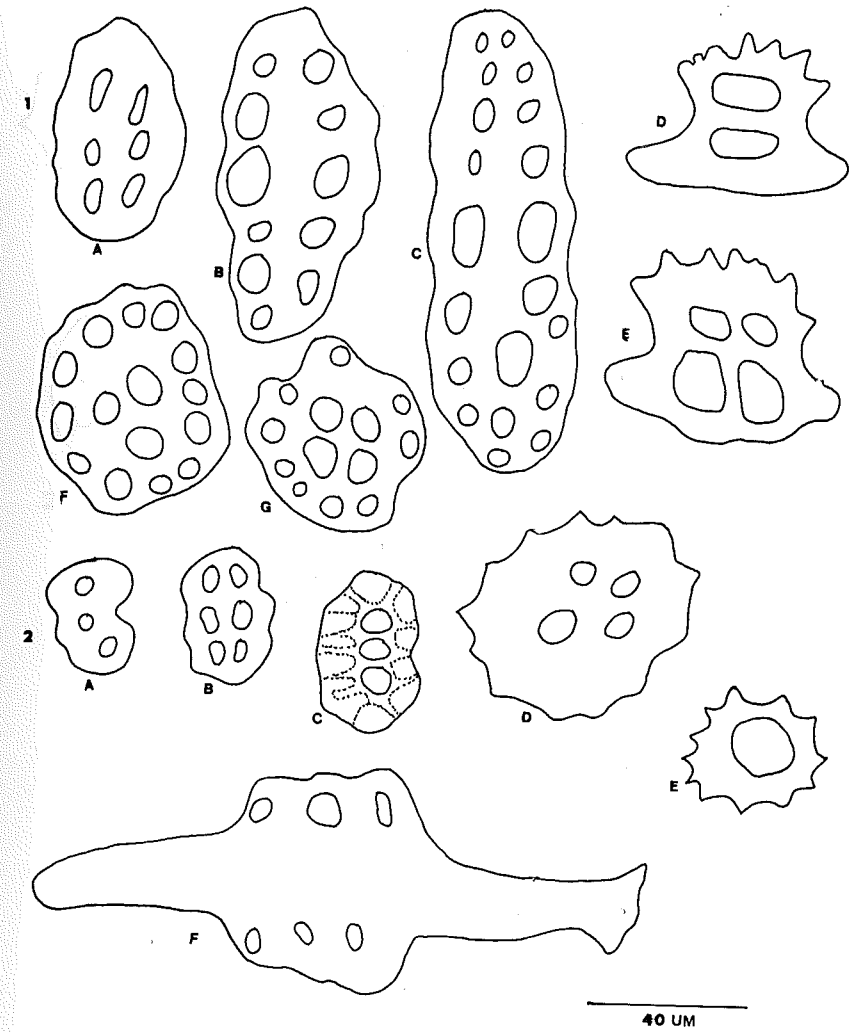
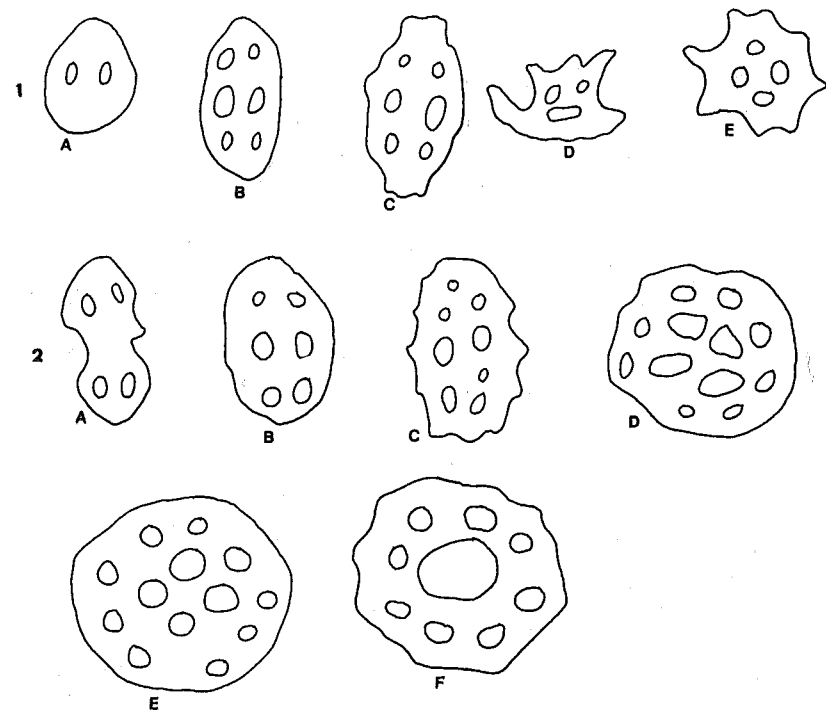
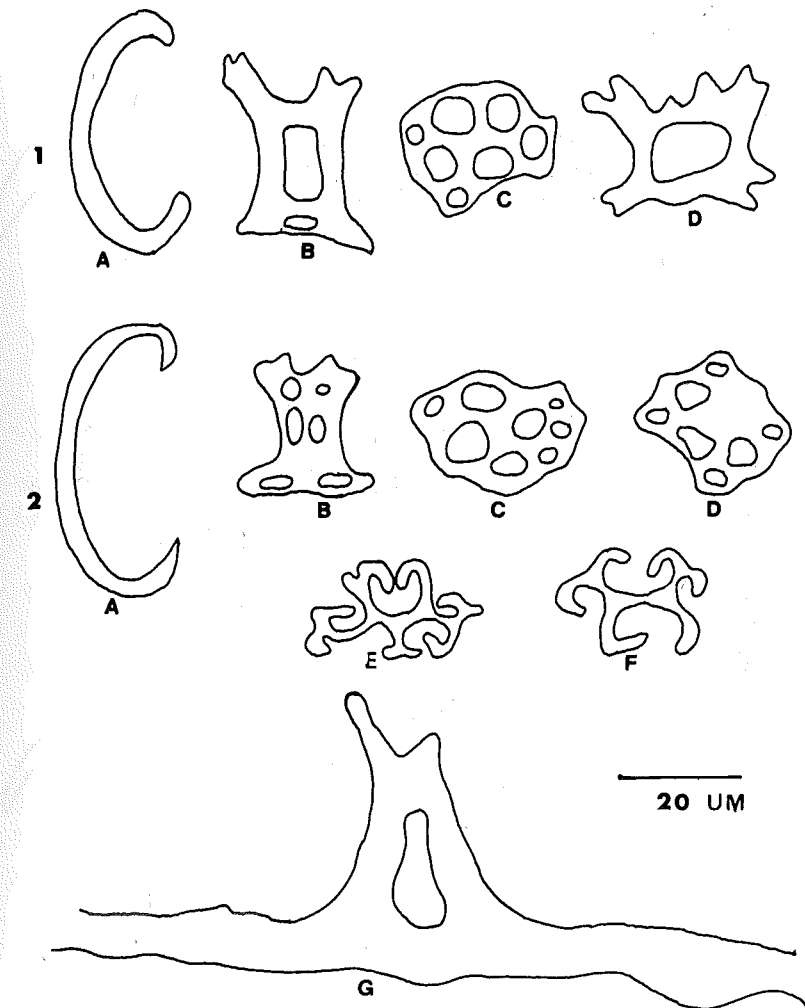


PLATE 8



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PLATE 9



20 UM

PLATE 10

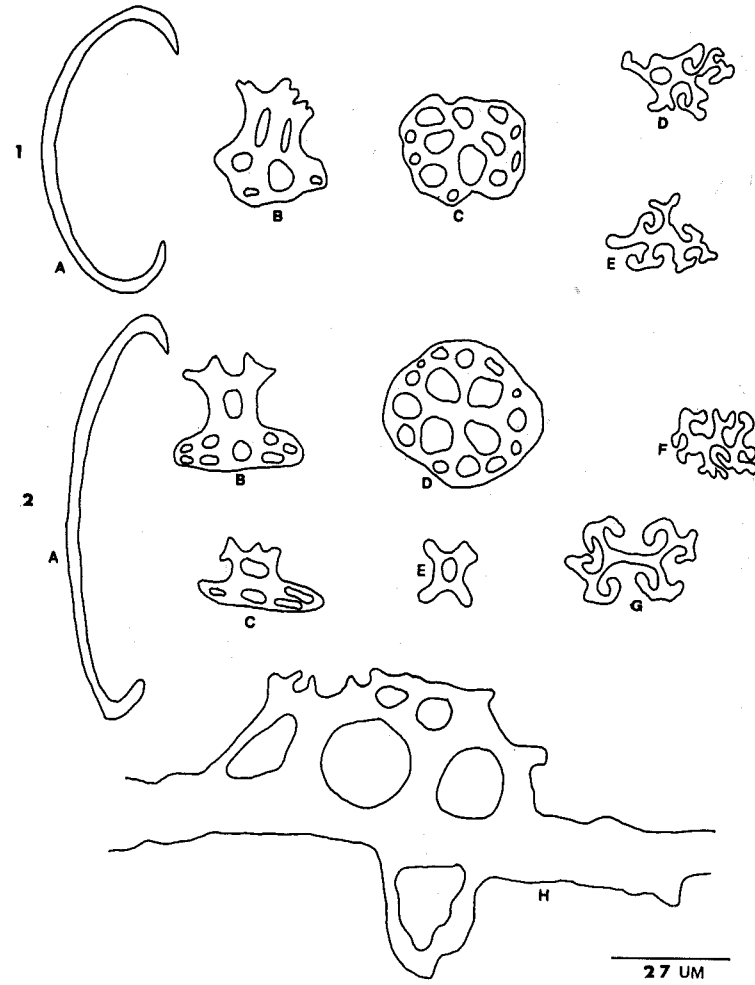


PLATE 11

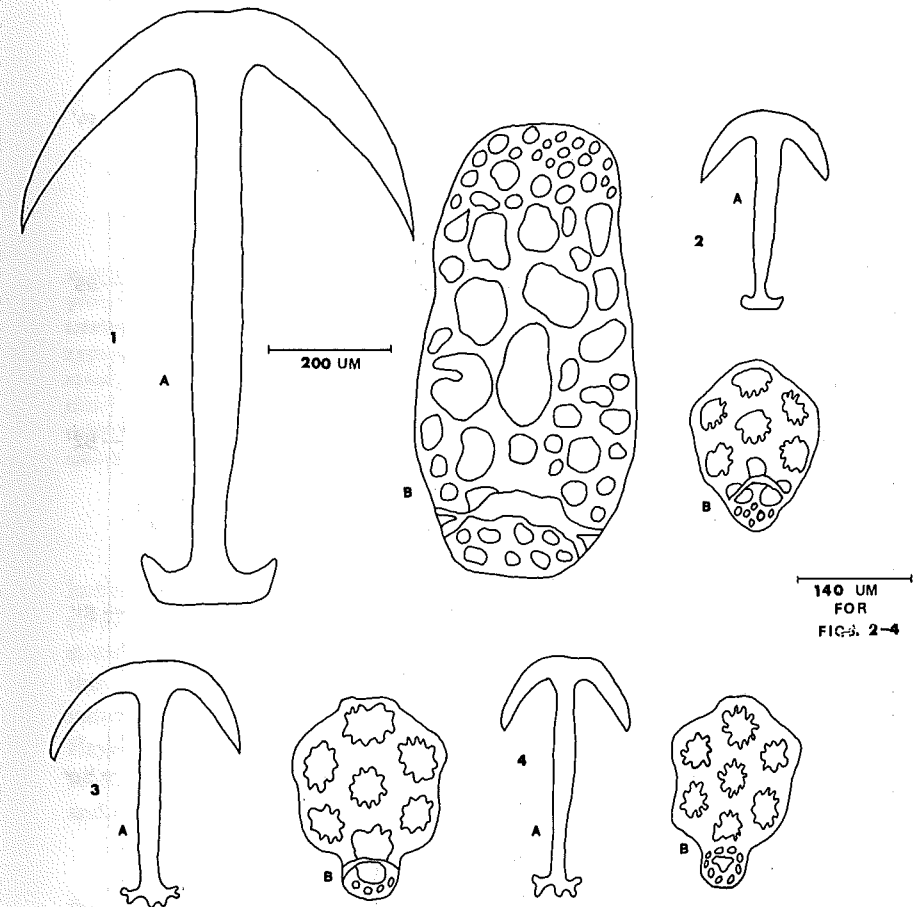
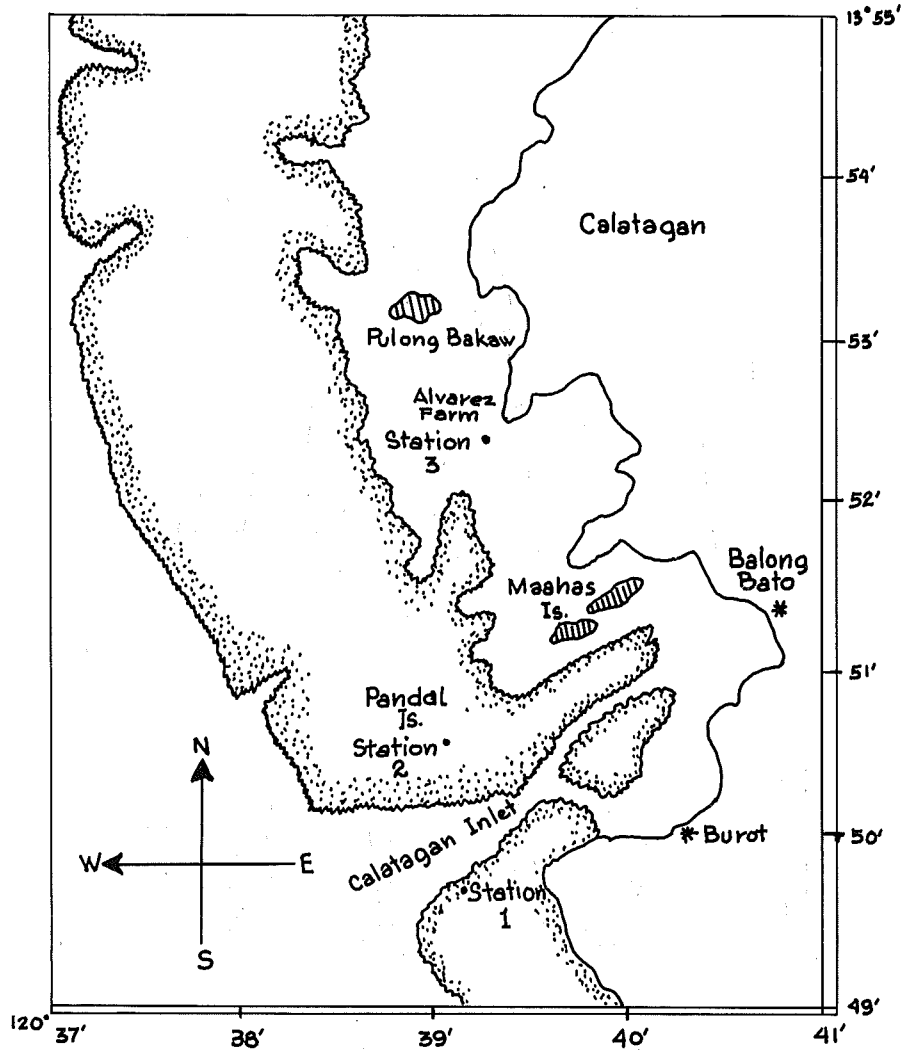


PLATE 12



Map showing the three study stations set up in Calatagan.