TAXONOMIC STUDIES ON THE SPECIES OF *HOLOTHURIA* LINNAEUS, 1767 FROM THE SEAS AROUND INDIA[1]

Part 2

D.B. JAMES[2]

(With a plate and two text-figures)

[*Continued from Vol. 92(1):* 62]

Holothuria (Mertensiothuria) leucospilota (Brandt)

(Pl. 2, A; Fig. 3, A-C)

Stichopus (Gymnochirota) leucospilota Brandt, 1835, p. 51.

Holothuria vagabunda Bell, 1886, p. 28: Mergui Archipelago; Bell, 1887a, p.140: Andaman Island; Bell, 1888, p.389: Tuticorin (Gulf of Mannar); Thurston, 1894, p. 115: Tuticorin (Gulf of Mannar); Pearson, 1903, p. 201: Ceylon (Sri Lanka); Koehler & Vaney, 1908, p. 17: Andaman Island; Laccadives (Lakshadweep).

Holothuria leucospilota A.M. Clark & Davies, 1966, p.603: Maldives; James, 1969, p. 62: Gulf of Mannar, Arabian Sea, Andamans, Laccadives (Lakshadweep); James, 1982, p. 5; Tikader & Das, 1985, p. 99: Andaman & Nicobar Islands; James, 1987, p. 110: Hut Bay (Little Andamans).

Holothuria (Mertensiothuria) leucospilota James, 1982, p. 92: Goa (West coast of India); Soota, Mukhopadhyay & Samanta, 1983, p. 511: Trinket, Nancowry Harbour, Sound Island (Andaman & Nicobar Islands); Mukhopadhyay & Samanta, 1983, p. 305: Lakshadweep; Price & Reid, 1985, p. 4: Galle (Sri Lanka); James, 1986a, p. 585: Lakshadweep-Maldives, Sri Lanka, Gulf of Mannar —Palk Bay, Andaman-Nicobar Islands; James, 1989b, p. 127: Chetlat, Kiltan, Kadmat, Amini, Androth, Kavaratti, Minicoy (Lakshadweep).

Material: Tuticorin (Gulf of Mannar), several specimens; Kilakarai, one specimen; Vizhinjam (Arabian Sea), two specimens; Karwar (West Coast), one specimen; Ratnagiri (Arabian Sea), one specimen; Port Blair (Andamans), several specimens; Hut Bay (Little Andamans), several specimens; Chetlat, several specimens; Kiltan, several specimens; Kadmat, four specimens; Amini, several specimens; Kavaratti, three specimens; Minicoy, five specimens (Lakshadweep), all specimens collected from the intertidal region or from littoral waters, less than a metre in depth.

Description: Large and snake-like forms with leathery skin. The pedicels are large with well developed sucking discs. The tentacles are 20 in number and are ventrally placed. There is a well developed tentacular collar with a fimbriated margin.

In the calcareous ring each radial is large and has a deep groove while the interradial is a short, stump-like projection. There is a single polian vesicle and a single stone canal. The respiratory trees are well developed. Cuvierian tubules are also well developed.

The spicules (Fig. 3, A-C) consist of an external layer of tables with complete or incomplete discs often reduced to four holes, one at the base of each pillar. Spire is low and often partly reduced, but when complete, it ends in a flattened crown of eight or twelve teeth. Inner layer consists of regular six holed buttons. The buttons may sometimes be asymmetrical. Pedicels are with large end plates and a few broad perforated plates with more or less slit-like holes. The buttons (Fig. 3, B) in a specimen collected from Kilakarai (Gulf of Mannar) were mostly incomplete and have a dumb-bell shape with a pair of holes at either end. They were in the process of breakdown. The length of the buttons varies from 0.050 mm to 0.063 mm, and the breadth varies from 0.025 mm to 0.033 mm. The height of the table is *c.* 0.042 mm and the diameter of the disc varied from 0.037 mm to 0.054 mm.

When alive, the colour is reddish-brown but looks black on contraction.

Notes on habits: The species has the peculiar habit of tucking its posterior end under a stone. The

[1]Accepted October 1992.

[2]Central Marine Fisheries Research Institute, Kochi 682031.
Present Address: Tuticorin Research Centre of CMFRI, 90 North Beach Road, Tuticorin 628 001.

anterior end which projects out from the stone keeps on moving with the ventrally directed tenacles. Specimens were sometimes found under coral stones. On being disturbed the animal throws out the cuvierian tubules which are abundant. At Hut Bay (Little Andamans) during February, 1977 in some places as many as 5 to 6 were distributed per square metre. It was also found to be common on the pearl oyster beds off Tuticorin.

Remarks: Both the species *Holothuria (Halodeima) atra* and *Holothuria (Mertensiothuria) leucospilota* are black and occur together at some places. However, they can be separated in the field by the following differences. *Holothuria (Halodeima) atra* is free from cuvierian tubules whereas the other species has plenty of them. The former, when handled in the field, releases a toxin known as holothurin which is red in colour, whereas in the latter species the red toxin is absent. In some places, *Holothuria (Halodeima) atra* is covered by a coating of fine sand, whereas in *Holothuria (Mertensiothuria) leucospilota* sand never covers the body. Finally the former species lies fully exposed without making any attempt to conceal the body, while the latter species keeps the posterior end of the body tucked under a stone. A similar character is also exhibited by the holothurian *Holothuria (Acanthotrapeza) pyxis.* By the above differences, both the species can be separated in the field without any difficulty.

Distribution: This species is widely distributed and is known from the islands of Western Indian Ocean, Mascarene Islands, East Africa, Red Sea, S.E.Arabia, Persian Gulf, Maldives, Lakshadweep, Sri Lanka, Bay of Bengal, North Australia, Philippines, China, South Pacific islands and Hawaiian Islands. James (1969) reported the species for the first time from the Arabian Sea.

Subgenus *Lessonothuria* Deichmann, 1958

Diagnosis: Tentacles 17-30; pedicels and papillae irregularly arranged ventrally and dorsally respectively, a 'collar' of papillae evident around the base of the tentacles, anal papillae usually apparent; body wall soft, not very thick, usually 1(1-3 mm); body almost cylindrical but with more or less distinct, 'flattened' 'sole'; size small to moderate up to 150 mm long; calcareous ring fairly stout, radial plates about twice as long as the interradial plates; spicules consisting of clumsy tables, the spire low to moderate and usually terminating in a ring or cluster of spines, disc well developed and spinose, rarely some tables with smooth-rimmed disc also present, rim often turned up to give a 'cup and saucer' appearance to the table in lateral view, pseudobuttons abundant, usually smooth, sometimes spinose, usually irregular in outline and often reduced to single row of three or four holes, occasionally quite regular buttons are present, with three pairs of holes.

Type-species: *Holothuria pardalis* Selenka, 1867; designated by Deichmann, 1958:295.

Six species are included under this subgenus. Only one species is known from the Indian seas.

Holothuria (Lessonothuria) pardalis Selenka
(Fig. 3, D & E)

Holothuria pardalis Selenka, 1867, p. 336: Sandwich Island (Hawaiian Island); Ludwig, 1887, p. 1226: Ceylon (Sri Lanka); Theel, 1886, p. 224: Nicobar; Bell, 1888: Gulf of Mannar; Kochler & Vaney, 1908, p. 13: Tavoy, Mergui Archipelago, Cheduba Island, Andaman Island; Gravely, 1927, p. 164: Gulf of Mannar; Gideon *et al.* 1957, p. 704: Gulf of Kutch; Sane & Chhapgar, 1962, p. 673: Bombay; A.M.Clark & Davies, 1966, p. 600: Maldives; Gopalakrishnan, 1969, p. 400: Gulf of Kutch; James, 1969, p. 61: Gulf of Mannar, Andamans, Laccadives (Lakshadweep), Gulf of Kutch; Nagabhushanam & Rao, 1972, p. 291: Minicoy Atoll (Lakshadweep); Satyamurti, 1976, p. 51: Shingle Island (Gulf of Mannar).

Holothuria lineata Bell, 1887a, p. 140: Andaman Island.

Holothuria caesarea Bell, 1887b, p.654: Ceylon (Sri Lanka).

Holothuria (Lessonothuria) pardalis James, 1989b, p.127: Chetlat, Bitra, Kiltan, Minicoy (Lakshadweep).

Material: Pulli Island (Gulf of Mannar), four specimens; Port Blair (South Andamans), several specimens; Rangat Bay (Middle Andamans), two specimens; Mayabunder (North Andamans), one specimen; Port Okha (Gulf of Kutch), two specimens; Ratnagiri (west coast of India), one specimen; Chetlat, three specimens; Kiltan, four specimens; Minicoy, two specimens; (Lakshadweep); Specimens from Pulli Island

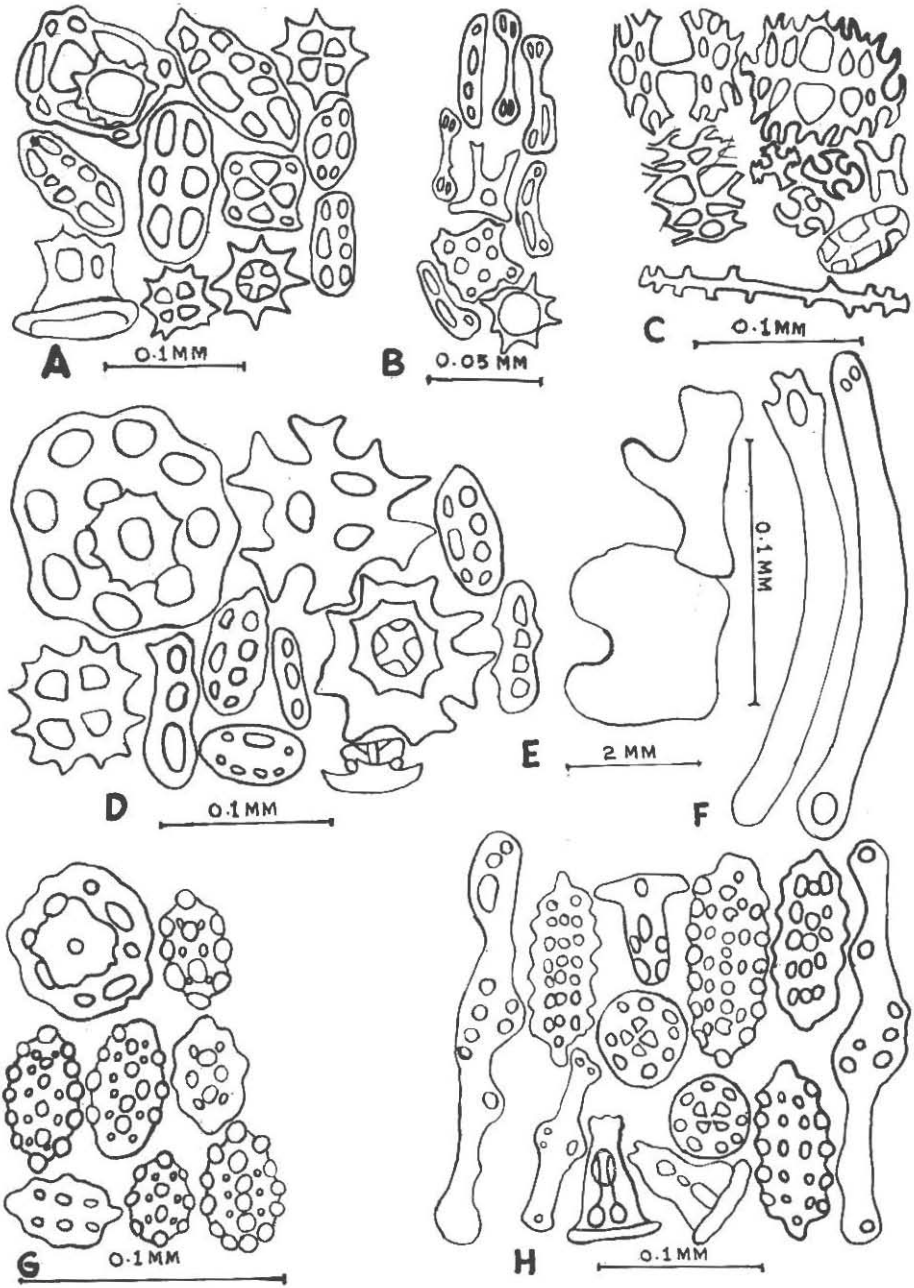


Fig. 3. Spicules of: A-C. *Holothuria (Mertensiothuria) leucospilota* - A. Spicules from the body wall; B. Spicules in the process of breakdown; C. Spicules from tubefeet; D. *Holothuria (Lessonothuria) pardalis*; E. Radial and interradial plates of *Holothuria (L.) pardalis*; F. Spicules from the tubefeet of *Holothuria (L.) pardalis*; G. *Holothuria (Cystipus) rigida* (from adult specimen); H. *Holothuria (Cystipus) rigida)* (from juveniles).

collected from dead coral crevices and other specimens collected under coral stones in the intertidal region.

Description: The length of the specimens examined ranged from 50 mm to 150 mm. The body is spindle-shaped, tapering at both ends. Mouth and anus are terminal. The mouth is surrounded by 20 small tentacles and anus is surrounded by a crown of papillae. The dorsal and ventral sides are not well demarcated. The papillae and pedicels are small and few. They are not arranged in rows or bands. The papillae are 3-4 mm in length and the pedicels are provided with larger discs. The body wall is smooth and thin.

The calcareous ring is comparatively small and delicate, the pieces being rather loosely joined. Interradials are as wide as or wider than the radials (Fig. 3, E). Each radial piece is prolonged slightly further forward than the interradial and has the usual roundish incision. The anterior edge of the interradial has a small tooth. In a specimen dissected, there were two polian vesicles and a single stone canal. The left tree is much longer than the right one.

The spicules (Fig. 3, D) consist of tables, buttons and curved rods. The tables are provided with spinous discs, usually somewhat irregular in shape and have a low spine with generally eight teeth. The top of the table is square-shaped. The diameter of the discs of the table varies from 0.048 mm to 0.066 mm, and the height of the tables varies from 0.045 mm to 0.052 mm. The disc of each table has a central hole and eight small peripheral holes. Four spires arise from the base of the disc and are connected by a cross beam. The edge of the disc is slightly irregular, and in some specimens the edge is smooth and slightly raised. Buttons and pseudobuttons are present. The buttons are arranged in rings or in circles and are smooth with three or four pairs of holes. The pseudo-buttons are usually irregular in outline and often reduced to a single row of three or four holes. The length of the buttons varies from 0.038 mm to 0.91 mm, and the breadth from 0.017 mm to 0.038 mm.

Colour is variable. In the living condition light brown with white and dark patches. In large forms (150 mm in length) there are 8 to 15 pairs of brown spots. Small specimens (50 mm in length) are light brown with very small brown specks scattered over it. Spots characteristic of the adult are absent.

Remarks: Specimens below 50 mm are difficult to separate from *Holothuria (Thymiosycia) arenicola,* since both show the same colour pattern and live together. In small *Holothuria (Thymiosycia) arenicola,* the cloacal opening has a light brown ring round it. The species *Holothuria (Lessonothuria) multipilula* described as new by Liao (1976) is based on a young specimen (48 mm in length) of *Holothuria (Lessonothuria) pardalis.* The differences pointed out by him in the tables are clearly due to the immaturity of the specimen.

Notes on habits: This is one of the commonest holothurians around Port Blair (Andamans) and also at Lakshadweep, usually found buried in sand under coral stones. Though not an active holothurian, the tentacles are well extended during movements. It occurs along with *Holothuria (Thymiosycia) impatiens, H. (Thymiosycia) arenicola* and *H. (Thymiosycia) hilla.* A fossorial form like *H. (Thymiosycia) arenicola,* the surface of the body has very few pedicels and papillae and the body appears to be smooth. Burrowing is effected through the alternate circular and longitudinal contractions of the muscles. At Pullivasal Island in the Gulf of Mannar, this species lives inside the crevices of dead coral colonies. It was impossible to pull out the specimens from the coral crevices as they were too large for the crevices. When the holothurians were small, they must have entered the coral crevices to take shelter, and as they grow larger their body gets constricted at certain places in order to be accommodated in the crevices, as the holothurians themselves cannot bore into the corals. Most of the specimens, when they were removed from the dead coral colony by breaking the colony into small pieces, were found to have deep scars, constrictions and different colour pattern at the places of constriction. The obvious reason for the holothurians to lodge themselves in the coral colony is for shelter. For food, they have

to entirely depend on the organisms swept in by the current of water during high tide. At Chetlat Island in Lakshadweep, one specimen was lodged deep in a dead coral colony.

Distribution: It is known from the islands of the Western Indian Ocean, Mascarene Islands, East Africa and Madagascar, Red Sea, S.E. Arabia, West Cost of India, Lakshadweep, Sri Lanka, Bay of Bengal, East Indies, North Australia, Philippines, China, South Pacific Islands and the Hawaiian Islands. James (1969) recorded it for the first time from Lakshadweep. A widely distributed species.

Subgenus *Cystipus* Haacke, 1880

Diagnosis: Tentacles 20; pedicels more or less confined to the ventral ambulacral areas, papillae small and scattered dorsally, a lateral flange of papillae sometimes evident, anal papillae and 'collar' of papillae around the base of the tentacles not apparent; body wall not very thick, usually 2 (1-8) mm, often gritty to the touch; body rather vermiform or dorsoventrally flattened; size small to moderate, up to 200 mm long; calcareous ring fairly stout with radial plates twice as long as interradial plates, spicules consisting of tables with usually knobbed discs and low spire bearing many short spines which are sometimes numerous, buttons usually simple with large regularly or irregularly arranged knobs, generally 3-4 pairs, but up to 7 pairs, of relatively small holes which may become obscured somewhat by the immensity of the knobs, rarely the buttons are modified into fenestrated ellipsoides.

Type-species: *Cystipus pleuripus* Haacke, 1880, by monotypy; a synonym of *Stichopus rigidus* Selenka, 1867, according to Deichmann, 1958.

Rowe (1969) included nine species under this subgenus. He is of the opinion that all of them included under the subgenus *Cystipus* are valid. The nominal genera *Fossothuria* and *Jaegerothuria* of Deichmann (1958) are synonymous with the subgenus *Cystipus*.

Four species are known under this subgenus from the Indo-West Pacific. Only one species is known from Indian seas.

Holothuria (Cystipus) rigida (Selenka)
(Fig. 3, G - H)

Stichopus rigidus Selenka (Partime) 1867, p. 317: Zanzibar, Hawaii.

Holothuria rigida James, 1982, p. 5; Tikader & Das, 1985, p. 99: Andaman & Nicobar Islands;

Holothuria (Cystipus) rigida Soota *et al.* 1983, p. 509: Port Blair, Little Andaman, Sound Island, Nancowry; James, 1986a, p. 585: Lakshadweep-Maldives, Andaman-Nicobar Islands; James, 1989b, p. 127: Kiltan (Lakshadweep).

Material: Port Blair (South Andamans), four specimens, Mayabunder (North Andamans), one specimen; Kiltan (Lakshadweep), two specimens, all found buried in the sand under stones in the intertidal region.

Description: The specimens examined varied in length from 20 mm to 90 mm. The body is dorso-ventrally flattened with the two ends blunt. The body wall is rigid. The dorsal side is convex and the ventral side is flat. The body is clearly demarcated into dorsal and ventral sides by the presence of flange of papillae which are triangular. In small forms (30-50 mm in length), the dorsal side has low warts of different sizes. On the ventral side, there are three bands of pedicels. Each band has two rows of pedicels. They are small and retracted. In large forms (90 mm in length), the dorsal side is smooth and free from warts. On the midventral region there are two rows of pedicels which are closely placed. The other two rows of pedicels are just below the lateral flange of papillae. These rows are distinct with two or three pedicels arranged side by side.

The radial pieces have the anterior end broader with a deep notch and small depression at the narrow posterior end. The interradials have an anterior knob-like projection (Fig. 3, H).

The spicules consist of buttons, tables and supporting plates. In large forms (90 mm in length), the buttons (Fig. 3, G) are short with regular knobs on them. Each button has eight knobs at the centre. The length of the buttons is 0.08 mm, and the breadth is 0.04 mm. In large forms, some of the buttons are without knobs and have three pairs of holes. In smaller forms (35 mm in length) the buttons are long with seven knobs on each side. The

tables are simple with 1-3 knobs and end in two or three low projections. The supporting plates in the pedicels are roughly fusiform with one or two holes at either end and a few holes at the centre.

In the living condition, the colour is yellowish-white on the dorsal side and light yellow on the ventral side. Larger forms have ten pairs of light black spots on the dorsal side.

Remarks: *Holothuria jousseaumei,* described by Cherbonnier (1955) from the Red Sea, is a synonym of *Holothuria (Cystipus) rigida,* since the new species is based on a young specimen of 30-40 mm length. A specimen of *H. (Cystipus) rigida* of 35 mm length collected from Port Blair (Andamans) has the same type of spicules described for *H. jousseaumei* by Cherbonnier (1955). After its first report, no specimen has been referred to this species.

The specimens identified as *H. (Cystipus) rigida* by Mukhopadhyaya (1988) appear to have been based on juvenile specimens of *H. (Metriatyla) scabra* which are common in the localities mentioned by him. The spicules of juveniles of *H. (Metriatyla) scabra* (Fig. 4, B) bear a resemblance to those of *H. (Cystipus) rigida.* It was not possible to get the specimens from the Indian Museum to re-examine them.

Notes on habits: It is a secretive species found buried in sand and lives under stones. In small specimens (30-50 mm in length), sand sticks to the body as a coating. It is an inactive holothurian, showing very little movement in the living condition, thus it escapes attention during collection.

Distribution: Known from the Mascarene Islands, East Africa and Madagascar, Red Sea, East Indies, North Australia, Philippines and South Pacific Islands. James (1986a) reported this species for the first time from the Bay of Bengal and from the Lakshadweep (James 1989b).

Subgenus *Theelothuria* Deichmann, 1958

Diagnosis: Tentacles 18-20; pedicels irregularly arranged on the flattened ventral surface, papillae small to large and conical, irregularly arranged dorsally except for the lateral flange of papillae, a 'collar' of papillae usually present around the base of the tentacles, anal papillae usually apparent; body wall usually very thin and parchment-like, rarely more than 1 (1-2) mm thick, gritty to the touch; body with a distinctly flattened ventral 'sole,' arched dorsally; size moderate to large, up to 250 mm long; calcareous ring stout and well developed, radial plates with more or less well developed posterior bifurcations, radial plates up to twice as long as the interradial plates, both radials and interradials may be longer than broad; spicules consisting of well-developed tables with smooth or spinose discs, sometimes the disc multi-armed, spire low, moderate or high, usually terminating in a cluster of small spines, some tables with perfectly smooth spire tapering to a pointed apex giving the whole table a tack-like appearance, buttons either simple with irregular moderate-sized knobs or modified into fenestrated ellipsoids.

Type-species: *Holothuria pinceps* Selenka, 1867; designated by Deichmann, 1958:325.

Ten species are included in this subgenus of which only one is known from the seas around India.

Holothuria (Theelothuria) spinifera Theel, 1886

(Pl. 2, B; Fig. 4, A)

Holothuria spinifera Theel, 1886, p. 175: Philippines; Pearson, 1913, p. 88: Ceylon (Sri Lanka); James, 1969, p. 61: Gulf of Mannar & Palk Bay; James, 1973, p. 710: Gulf of Mannar & Palk Bay; James, 1982, p. 5; James, 1983a, p. 102; Rao *et al.*, 1985, p. 89: Gulf of Mannar.

Holothuria (Theelothuria) spinifera Mary Bai, 1980, p. 15; James, 1986a, p. 585: Sri Lanka, Gulf of Mannar-Palk Bay; James, 1986b, p. 1: Gulf of Mannar & Palk Bay, James, 1989a, p. 6: Gulf of Mannar & Palk Bay.

Material: Mandapam (Gulf of Mannar), two specimens, at 5 metres depth; Devipattinam (Palk Bay), several specimens, 2-10 metres; Tuticorin (Gulf of Mannar), several specimens, 2-5 metres.

Description: The specimens examined were 150-200 mm in length. The body is cylindrical and robust with both ends rounded. Mouth is surrounded by a collar of papillae. There are 20 tentacles. Anus is surrounded by five distinct cylindrical papillae, which gives a stellate appearance. On the dorsal side, there are a number of long papillae which are sparsely distributed. On the ventral side, there are

large pedicels which are thinly distributed. There is no regular arrangement either for the pedicels or papillae.

Spicules (Fig. 4, A) consist of buttons, tables and supporting plates. The buttons are either knobbed or smooth. Very small buttons are smooth. Generally there are three pairs of holes for each button. Sometimes the middle hole is larger than the other two. Very rarely, some buttons are smooth. The length of the buttons varies from 0.035 mm to 0.066 mm, and the breadth from 0.024 mm to 0.038 mm. The tables have short spires and broad discs. Generally there are 8 to 10 peripheral holes which are oval in shape. At the centre of the spire, there is a single hole. The top of the spire ends in an expanded rectangle which has spinous margins. There is a single cross-bar for each table. The height of each table is 0.07 mm. The diameter of the discs varies from 0.071 mm to 0.085 mm. The papillae have long tables which have irregular discs with numerous holes. The spire has two to four holes and two to three cross beams. The tip of the spire of these tables is blunt. The height of the tables varies from 0.21 mm to 0.026 mm, and width varies from 0.12 mm to 0.28 mm. The supporting plates are numerous and common among the calcareous deposits of this species.

The supporting plates are large and most of them are elongated, while a few are short and broad. Each of them has a number of holes. Generally, the tables at the centre are larger than those at either end. The length of the supporting plates varies from 0.10 mm to 0.28 mm, and breadth from 0.047 mm to 0.141 mm.

In the living condition, light brown with white markings. The ventral side is paler in colour.

Distribution: The distribution of this species is restricted. It is known from the Red Sea, Persian Gulf, Gulf of Mannar and Palk Bay, Sri Lanka, North Australia, Philippines and China.

Remarks: Earlier, this was one of the two species commercially processed from the Gulf of Mannar and Palk Bay. Hornell (1917) wrote that this species has a very high value for *Bêche-de-mer,* but in recent years this is not preferred by buyers.

Subgenus *Metriatyla* Rowe, 1969

Diagnosis: Tentacles 20; pedicels irregularly arranged on the flattened ventral 'sole', papillae usually quite large and conical and irregularly arranged dorsally, a lateral flange of papillae sometimes evident, a 'collar' of papillae around the base of the tentacles often present, anal papillae variously developed; body wall usually quite thin, about 2 (1-5) mm thick, and gritty to the touch; body is usually flattened ventrally, arched dorsally; size small to moderate, up to 200 mm long; calcareous ring quite well developed with radial plates up to three times as long as the interradials; spicules consisting of well-developed tables with smooth disc and spire either of moderate height or high, terminating in a few to many small spines, tables rarely absent, buttons simple, with moderate-sized irregularly arranged knobs and three to ten pairs of relatively large holes.

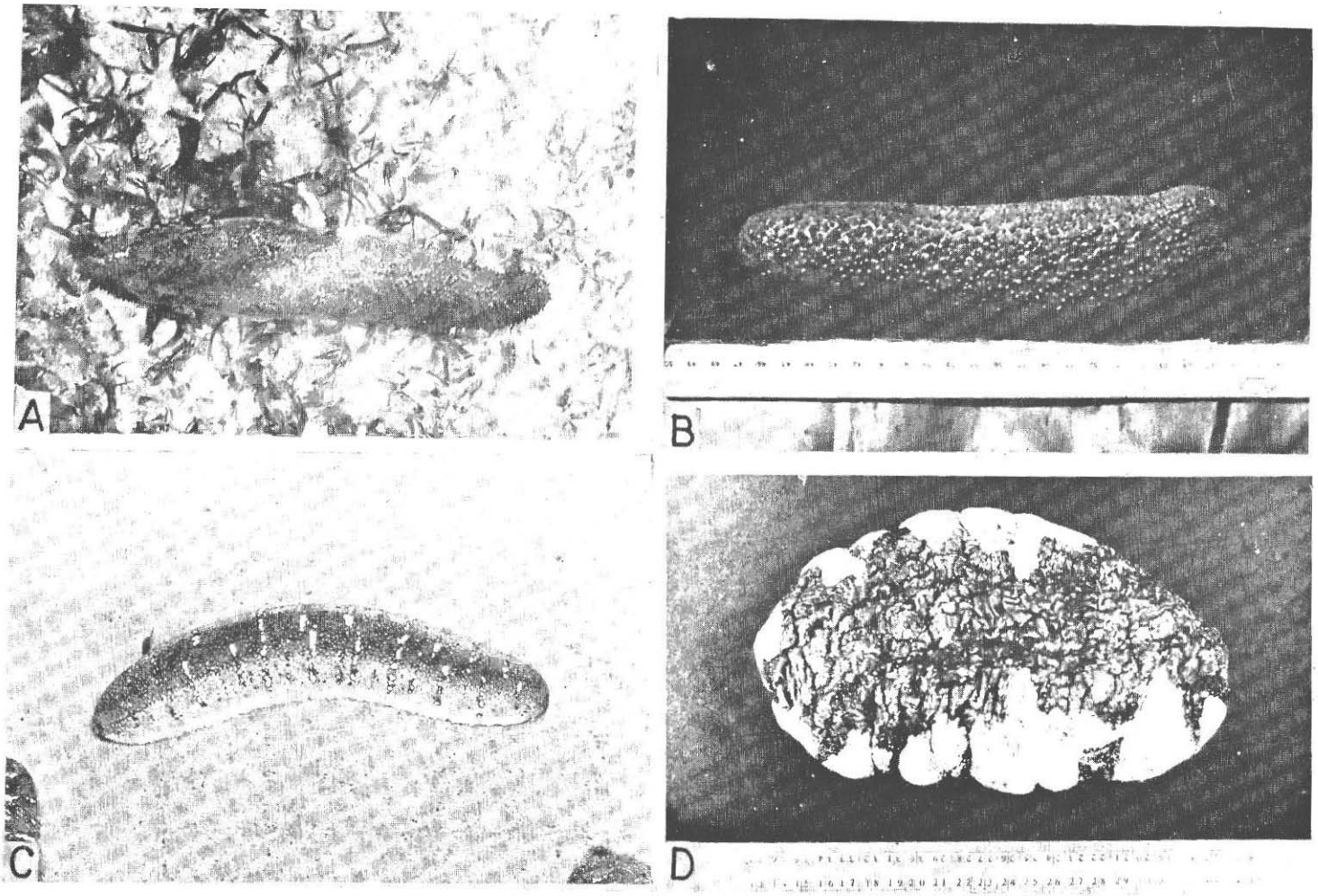
Type-species: *Holothuria scabra* Jaeger, 1833:23; designated by Rowe, 1969:160. Nine species are included under this subgenus. Four species are known from the seas around India. One species has been collected and presented in this work.

KEY TO THE INDIAN SPECIES OF THE SUBGENUS

1. Tables high, with up to seven cross pieces ..... *H. (Metriatyla) martensi* Semper, 1868
1'. Tables of moderate height 2
2. Tables terminate in a large mass of spines ..... *H. (Metriatyla) albiventer* Semper, 1868
2'. Tables terminate in a few small spines 3
3. Dorsal side of the body usually with light yellow cross bands ..... *H. (Metriatyla) scabra* Jaeger, 1833
3'. Dorsal side of the body with round markings ..... *H. (Metriatyla) ocellata* Jaeger, 1833

Holothuria (Metriatyla) scabra Jaeger
(Pl. 2, C; Fig. 4, B & C)

Holothuria scabra Jaeger, 1833, p. 23: East Indies; Ludwig, 1887, p. 1224: Ceylon (Sri Lanka); Koehler & Vaney, 1908, p. 16: Andaman Islands, Mergui Archipelago; Pearson, 1910, p. 193: Mergui Archipelago; Gravely, 1927, p. 165: Gulf of Mannar. James, 1969, p. 61: Gulf of Mannar, Gulf of Kutch; James, 1973, p. 710: Gulf of Mannar & Palk Bay; Satyamurti, 1976, p.53: Krusadai



A. *Holothuria* (*Mertensiothuria*) *leucospilota* (*in situ*); B. *Holothuria* (*Theelothuria*) *spinifera*; C. *Holothuria* (*Metriatyla*) *scabra*; D. *Holothuria* (*Microthele*) *nobilis*.

Island (Gulf of Mannar); James, 1978, p. 60: Palk Bay; Parulekar, 1981, p. 33: Malvan; James, 1982, p. 5: James, 1983a, p. 94: James, 1983b, p. 85: Mayabunder, Diglipur (Andamans); Tikader & Das, 1985, p. 99: Andaman & Nicobar Islands; Rao *et al.*, 1985, p. 89: Gulf of Mannar & Palk Bay; James, 1987, p. 112: Diglipur & Mayabunder (Andamans).

Holothuria cadelli Bell, 1887a, p. 144: Andaman Island; Daniel & Halder, 1974, p. 419: Andamans.

Holothuria gallensis Pearson, 1903, p. 203: Ceylon (Sri Lanka).

Holothuria (Metriatyla) scabra Mary Bai, 1980, p. 15; Soota, *et al.* 1983, p. 512: Andamans; James, 1986a, p. 585: Lakshadweep-Maldives, Sri Lanka, Gulf of Mannar & Palk Bay; James, 1986b, p. 2: Gulf of Mannar & Palk Bay, Andamans, Gulf of Kutch; James, 1989b, p. 6: Andamans, Gulf of Mannar & Palk Bay; James, 1991, p. 651.

Holothuria (Metriatyla) ocellata Mukhopadhyay, 1988, p. 6: Gulf of Mannar (Non Jaeger, 1833, p. 19).

Holothuria (Cystipus) rigida Mukhopadhyay, 1988, p. 7: Krusadai, Pamban, Mandapam Camp, Vedalai, (Gulf of of Mannar) (Non *H. scarba* Jaeger, 1833, p. 19.

Material: Diglipur (North Andamans), several specimens; Rangat (Middle Andamans), several specimens; Port Blair (South Andamans), several specimens; Mandapam (Gulf of Mannar & Palk Bay), several specimens; Tuticorin (Gulf of Mannar), several specimens; Jamnagar (Gulf of Kutch), two specimens, all specimens collected from the intertidal to 5 metres depth.

Description: The specimens examined varied in length from 30 mm to 400 mm. The body is robust with both the ends blunt. The dorsal side is convex and the ventral side is flat. The skin in large specimens (300-400 mm length) is very thick (10-15 mm) and slimy to touch. On the dorsal side, there are many small papillae which are mainly scattered and often inconspicuous. On the ventral side the pedicels are densely distributed without any arrangement. Each dark spot on the ventral side represents one pedicel.

There are two large polian vesicles and a single stone canal. The calcareous ring is of the usual type. The left respiratory tree is much larger than the right. The paired radial muscles are not in firm contact with the body wall.

The spicules consist of tables and buttons. They differ remarkably in smaller (50 mm in length) and larger (200-350 mm in length). Smaller specimens have buttons (Fig. 4, B), which are large with five pairs of holes in addition to a single hole at each end. All buttons are knobbed. In addition to the buttons, there are also irregular perforated plates. The tables are short and the margins are not quite round. Each table has a few to many holes. The tables are short with a horizontal cross bar and a crown of spines at the top, which are visible in lateral view. In the apical view, eight outwardly pointed spines are seen. In large specimens (Fig. 4, C), the tables are short with a central hole and eight peripheral holes. The spire consists of four vertical bars which terminate in a few spines. There is a tier of cross bars in the spire.

The buttons are small and have generally three pairs of holes. The pedicels have small terminal plates.

Colour in the living condition is grey to black on the dorsal side, and white ventrally. Generally, smaller specimens are totally black and larger specimens have a number of irregular yellow transverse bands on the dorsal side. One specimen was brown.

Notes on habits: This species is characteristic of muddy-sandy regions, and prefers less saline waters. During low tide, a number of them can be seen half buried as the posterior end of the body is always kept outside. Small forms (50 mm to 90 mm in length) are seen to lie freely on the muddy ground during low tide. At some places there are 2-10 juveniles distributed in an area of five square metres. It occurs from the intertidal region to 10 metres depth, but is mostly distributed at depths of 1-5 metres.

A pea crab *Pinnotheres deccanensis* lives inside the cloaca. James (MS) has presented a detailed account on the habits of the association. Chopra (1932) reported the occurrence of this crab inside the same species of holothurian from the Andamans. Jones and Mahadevan (1965) gave an account of this association from the Gulf of Mannar.

I have collected two gastropod parasites *Prostilifer* sp. from this species. It appears to be very rare and forms a gall in the body wall. Only the tip of the shell is seen outside, and when it is touched it is withdrawn. In each gall, only one specimen is found. The parasite is firmly entrenched

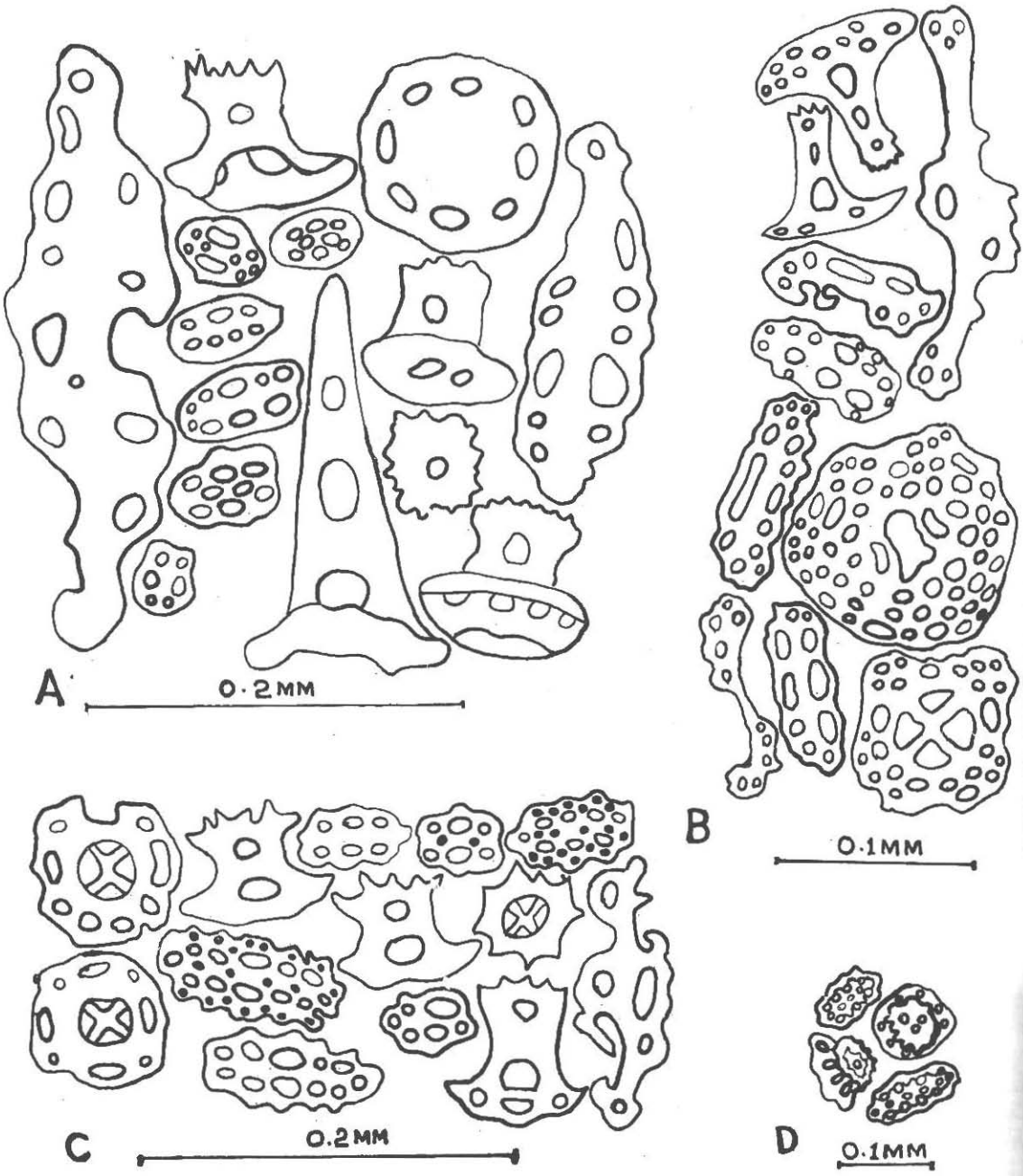


Fig. 4. Spicules of: A. *Holothuria* (*Theelothuria*) *spinifera*; B. *Holothuria* (*Metriatyla*) *scabra* (from juvenile); C. *Holothuria* (*Metriatyla*) *scabra* (from adult); D. *Holothuria* (*Microthele*) *nobilis*.

in the body wall, and can be taken out only by cutting the body wall. Waren (1983) reported *P. subpellucida* from the body wall of *Bohadschia argus* from the Pacific. Usually a male and a female are found together in the same gall.

At Port Blair (Andamans) during February, 1978 a total of 462 juveniles ranging in length from 65 mm, to 160 mm were collected from the intertidal region at South Point. These were transferred to an enclosed place for further growth. After six months, they had grown to a good size.

Remarks: It is surprising that Pearson (1903) describes this well known species as a new species *Holothuria gallensis* from Sri Lanka. This is the most valuable species for processing from India. Fresh specimens cost Rs. 30-50 depending on size and processed material costs Rs. 650.00 to Rs. 700.00 per kg. James (1986e) wrote on the quality improvement of *Bêche-de-mer* James (1973, 1986b, 1987, 1989a, 1989c) and also wrote on the *Bêche-de-mer* from *Holothuria (Metriatyla) scabra* and other species.

James *et al.* (1988), for the first time, succeeded in inducing this holothurian to spawn in the laboratory and produce seed. Now culture and sea ranching of this species is taken up by the C.M.F.R. Institute.

Distribution: Known from the Mascarene Islands, East Africa, Madagascar, Red Sea, S.E. Arabia, Sri Lanka, Gulf of Mannar and Palk Bay, East Indies, North Australia, Philippines, China and South Pacific Islands. This species is not distributed in Lakshadweep. (The distributional record given by James (1986a) from Lakshadweep-Maldives is based on distributional record given by A.M. Clark and Rowe (1971) from Maldives.)

Subgenus *Microthele* Brandt, 1835

Diagnosis: Tentacles 20; pedicels and papillae indistinguishable, scattered ventrally and dorsally, no apparent 'collar' of papillae around the base of the tentacles, anus usually with five calcified papillae only, though in smaller specimens (up to 200 mm long) more papillae may be present, and in very large specimens (over 400 mm long) anal papillae may be entirely lacking; body wall very thick, usually 5 (5-10 mm); body rather cylindrical; size large or even massive, up to 600 mm long; calcareous ring massive, with distinctly scalloped anterior margin, radial and interradial plates squarish, the radials being about twice the length of the interradials; spicules consisting of stout, well developed tables with smooth squarish disc, spire of moderate height, terminating in many small spines, buttons usually always hollow fenestrated ellipsoids though a few simple buttons may be present.

Type-species: *Holothuria (Metriatyla) maculata* Brandt, 1835: 54 = *Muelleria nobilis* Selenka, 1867; designated by A.M. Clark & F.W.E. Rowe, 1967:100). At present, only one species is included under this subgenus.

Holothuria (Microthele) nobilis (Selenka)

(Pl. 2, D; Fig. 4, D)

Mulleria nobilis Selenka, 1867, p. 313: Zanzibar, Sandwich Islands (Hawaiian Islands).

Holothuria maculata Bell, 1887 a, p. 140: Andaman Island.

Holothuria (Microthele) nobilis Price & Reid, 1985, p. 4: Chetlat Island (Lakshadweep); James, 1989a, p. 5: Lakshadweep, Andamans; James, 1989b, p. 128: Chetlat, Kiltan, Kadmat, Amini, Kavaratti, (Lakshadweep); James, 1989c, p. 148: Lakshadweep.

Microthele nobilis A.M. Clark & Davies, 1966, p. 600: Maldives; James, 1969, p. 61: Lakshadweep. James, 1973, p. 707.

Material: Port Blair (South Andamans), one specimen; Chetlat, several specimens; Kadmat, three specimens; Amini, several specimens; Kavaratti, two specimens; Minicoy, one specimen, all collected from the lagoon, depth less than a metre.

Description: The specimens examined varied in length from 250 mm to 400 mm. The body is massive and tubular in shape. Live weight varies from 2 to 3 kg in fresh condition. Body wall is 10-15 mm in thickness. Pedicels and papillae are indistinguishable. Dorsal papillae are more thinly scattered than the ventral pedicels. Anus is surrounded by five calcified papillae. Calcareous ring is massive with distinctly scalloped anterior margin. The radials and interradials are squarish.

Radials are twice the length of the interradials. Tentacular ampullae are very large.

Spicules (Fig. 4, D) consist of tables and buttons. The tables are robust with smooth discs and the spires terminate in 15-20 small spines. The diameter of the table varies from 0.06 mm to 0.08 mm. The disc of the tables is either irregularly rounded or square-shaped. The inner layer has closely packed hollow fenestrated ellipsoids which are 0.07 mm in length. They have four rows of holes. A few simple knobbed buttons are also present.

This species occurs in two colour forms, white and black. At Lakshadweep the colour pattern is as follows. The general colour is black on the dorsal side and white or yellowish white mottled with black or brown on a white background.

Notes on habits: The species lies freely in the lagoon in the adult stage and is often covered with a coating of sand. Young white forms live among the algae. The white form is found in more than 3 m depth of water. It occurs up to 30 metres depth. It is most abundant on clean sand among the reefs. The black form is found in shallow waters from the reef to about a depth of 3 m.

Remarks: The species is very valuable for *bêche-de-mer* preparation. Though abundant in Lakshadweep, it is not processed at present. The white form is said to be more valuable for processing than the black one.

Distribution: It is distributed in the Islands of the Western Indian Ocean, Mascarene Islands, East Africa and Madagascar, Red Sea, Lakshadweep, Maldives, Sri Lanka, Andamans, East Indies, North Australia, Philippines, China, South Pacific Islands and the Hawaiian Islands.

Zoogeography

The genus *Holothuria* is common and well represented in the seas around India. Of the 18 species of Holothuria collected from the Lakshadweep, west coast of India, east coast of India, Gulf of Mannar and Palk Bay and the Andaman and Nicobar Islands, only one species namely *Holothuria (Semperothuria) cinerascens* was collected from all the five geographic locations mentioned above. Surprisingly, it is not the ubiquitous holothurian *Holothuria (Halodeima) atra* of the Indian Seas. This species needs algal beds for its existence and is found to feed extensively on the calcareous alga *Halimeda* sp. Of the 18 species, 13 were collected from Lakshadweep, 6 from the West Coast of India, 2 from the East Coast of India and 17 from the Andaman and Nicobar Islands. *Holothuria (Theelothuria) spinifera* is not distributed in the Andaman and Nicobar Islands, Lakshadweep and also on the west coast of India. It has a restricted and discontinuous distribution, being known from the Red Sea, Persian Gulf, Gulf of Mannar and Palk Bay, Sri Lanka, North Australia, Philippines and China. James (1983a) reported this species for the first time from Madras (east coast of India). *Holothuria (Metriatyla) scabra,* the most valuable species for *Bêche-de-mer* preparation from India is not distributed in Lakshadweep. James (1986a) listed *Holothuria (Metriatyla) scabra* in the Distributional Table under the region Lakshadweep-Maldives, based on positive record of the specimens in the British Museum (A.M. Clark and Rowe 1971). A.M. Clark and Spencer Davies (1966) state that Gardiner's locality labels were removed while the collections were still in Colombo and the Maldive specimens were mixed up with others from Chagos Archipelago, Seychelles, Amirantes and Red Sea. *Holothuria (Metriatyla) scabra* collected from the Red Sea, Seychelles or other locality would have been given the wrong locality label as Maldives. The papers published on the Maldive echinoderms and a collection of echinoderms from the Maldives examined by the author do not contain this species. To-day *Bêche-de-mer* is a flourishing industry in the Maldives. James and Ali Manikfan (1994) wrote a paper on the *Bêche-de-mer* industry of Maldives in which no mention of the species is made. One of us (AM) examined large samples at Maldives and could not find a single specimen. As a result of a thorough survey, it is certain that it does not occur at Lakshadweep (James 1989b, 1989c). The faunal composition of the two regions is similar and therefore it is safe to conclude that the positive

record from the British Museum is based on wrong locality label. The east and west coasts of India are poorly represented by the genus *Holothuria* due to lack of coral reefs. This excludes the Gulf of Mannar and Palk Bay and also the Gulf of Kutch. Intensive collections have not been made from the Gulf of Kutch. The distribution of the species of *Holothuria* from the five regions is given in Table 1.

TABLE 1

DISTRIBUTION OF THE SPECIES OF *Holothuria* FROM INDIAN SEAS

Name of the species	LK	WC	EC	GM&PB	A&N
Holothuria (Acanthotrapeza) pyxis	—	—	—	—	+
Holothuria (Cystipus) rigida	+	—	—	—	+
Holothuria (Halodeima) atra	+	+	—	+	+
Holothuria (Halodeima) edulis	+	—	—	+	+
Holothuria (Lessonothuria) pardalis	+	+	—	+	+
Holothuria (Mertensiothuria) fuscocinerea	+	—	—	—	+
Holothuria (Mertensiothuria) leucospilota	+	+	—	+	+
Holothuria (Mertensiothuria) pervicax	+	—	—	—	+
Holothuria (Metriatyla) scabra	—	+	—	+	+
Holothuria (Microthele) nobilis	+	—	—	—	+
Holothuria (Platyperona) difficilis	+	—	—	—	+
Holothuria (Selenkothuria) erinaceus	—	—	—	—	+
Holothuria (Selenkothuria) moebii	—	+	—	+	+
Holothuria (Semperothuria) cinerascens	+	+	+	+	+
Holothuria (Theelothuria) spinifera	—	—	+	+	—
Holothuria (Thymiosycia) arenicola	+	—	—	—	+
Holothuria (Thymiosycia) hilla	+	—	—	+	+
Holothuria (Thymiosycia) impatiens	+	—	—	—	+

LK-Lakshadweep; WC-west coast; EC-east coast; GM & PB- Gulf of Mannar & Palk Bay; A & N- Andaman & Nicobar Islands.

As a result of my studies, the range of the following species has been extended to the localities noted against them.

Holothuria (Selenkothuria) moebii- Arabian Sea; *Holothuria (Selenkothuria) erinaceus*- Arabian Sea; *Holothuria (Mertensiothuria) leucospilota*- Arabian Sea; *Holothuria (Platyperona) difficilis*- Lakshadweep; *Holothuria (Lessonothuria) pardalis*- Lakshadweep; *Holothuria (Thymiosycia) arenicola*- Lakshadweep; *Holothuria (Thymiosycia) impatiens*- Lakshadweep; *Holothuria (Cystipus) rigida*- Lakshadweep; *Holothuria (Mertensiothuria) pervicax*- Lakshadweep; *Holothuria (Mertensiothuria) fuscocinerea*- Andaman & Nicobar Islands; *Holothuria (Mertensiothuria) pervicax*- Andaman & Nicobar Islands; *Holothuria (Cystipus) rigida*- Andaman & Nicobar Islands.

HABITS OF DIFFERENT SPECIES

The species of the genus *Holothuria* live chiefly among corals as fugitive forms. That is why a good number of species are collected from Lakshadweep Islands, Gulf of Mannar and Palk Bay and Andaman and Nicobar Islands. Rowe (1969) listed surf-zone species, fugitive species and fossorial species. In addition to these three divisions, there are forms which live freely like *Holothuria (Halodeima) atra, Holothuria (Halodeima) edulis* and *Holothuria (Microthele) nobilis.* Table 2 lists the species according to their habit.

From the Table 2, it is seen that fugitive forms are maximum (8 nos.), followed by fossorial forms (5 nos.), free living forms (3 nos.) and surf zone forms (2 nos.). It is also seen that all species belonging to one subgenus do not exhibit the same habit. The same species exhibits different habits at different places. *H. (Halodeima) edulis,* which is a free living form occurring below low-water mark in the Indian seas, is reported to live under stones at Guam by Rowe and Doty (1977). *H. (Selenkothuria) erinaceus,* which is reported to be a surf zone species, is found to be fossorial at Andamans, burying completely in mud. Similarly *H. (Thymiosycia) arenicola* which is listed as fugitive species by Rowe (1969) is truly fossorial at

TABLE 2

LIST OF THE SPECIES UNDER THE GENUS *Holothuria* ACCORDING TO THEIR HABITS

Free living species	Surf zone species	Fugitive species	Fossorial species
H. (H.) atra	*H. (S.) moebii*	*H.(T.) impatiens*	*H.(T.) arenicola*
H. (H.) edulis		*H.(T.) hilla*	*H.(T.) spinifera*
H. (M.) nobilis	*H.(S.)cinerascens*	*H.(M.) pervicax*	*H.(C.) rigida*
		H.(M) fuscocinerea	*H.(M.) scabra*
		H.(M.) leucospilota	*H.(S.) erinaceus*
		H.(L.) pardalis	
		H.(A.) pyxis	
		H.(P.) difficilis	
3 nos.	2 nos.	8 nos.	5 nos.

Lakshadweep. At times, *H. (Mertensiothuria) leucospilota* occurs along with *H. (Halodeima) atra* as a free living species. *H. (Mertensiothuria) leucospilota* has the habit of tucking its posterior end under rocks, whereas in case of *H. (Acanthotrapeza) pyxis* the posterior end is firmly entrenched among rocks and it is impossible to pull out specimens without damaging them. *H. (Theelothuria) spinifera* buries completely into sand, whereas *H. (Metriatyla) scabra* is partly buried and keeps the posterior end out of sand. Rowe (1969) has listed *Holothuria (Halodeima) atra* and *H. (Microthele) nobilis* as fugitive forms. These species were never encountered under stones in the Indian Seas.

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