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SHALLOW-WATER SEA CUCUMBERS
(ECHINODERMATA: HOLOTHUROIDEA)
FROM CARRIE BOW CAY, BELIZE¹

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In a recent article on the echinoderms of British Honduras (Belize), Devaney (1974) described a fauna of 34 species, of which only one, the synaptid *Euapta lappa* (Muller), was a holothurian. During the Smithsonian Institution's Investigations of Marine Shallow Water Ecosystems (I.M.S.W.E.) Project, based largely at Carrie Bow Cay, Belize (16°48'N, 88°05'W), participating investigators have made general collections of invertebrates, and these include 12 species of holothurians, of which 3 species of the genus *Leptosynapta* are new. In this paper the new species are described, other species are briefly characterized and some illustrated, and a key to all species is provided. A brief description of Carrie Bow Cay habitats can be found in Dahl (1973). All specimens were collected from Carrie Bow Cay, unless otherwise indicated in the species accounts. They were sampled by wading and skin diving in less than 2 m water depth.

Kier (1975) described the echinoids of Carrie Bow Cay, and added a further 13 species to the 7 listed by Devaney. Thus, the total number of echinoderms now reported from Belize is 58. As is to be expected, the fauna is typically Caribbean in character. For the holothurians some interesting new range extensions are reported. No dendrochirotid

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("cucumaria"-type) species have been collected at Belize. In several other Caribbean areas the dendrochirotidids may comprise up to 30% of the holothurian fauna. This hiatus is inexplicable, but may be related in some way to the reduced vagility of the dendrochirotidids (which lack a pelagic larval stage), or to the fact that more collecting needs to be done in areas with hard substrates.

I wish to thank the coordinator of the I.M.S.W.E. Program, Dr. K. Ruetzler, for making the material available for me, and Mr. K. Sandved for photographs. I am grateful to the several individuals named in the text who collected the holothurians described here. The I.M.S.W.E. Program has received support from the Smithsonian Institution and the Exxon Corporation.

KEY TO HOLOTHURIANS KNOWN FROM BELIZE

- 1 (12) Body wall usually thick. Tentacles 20. Tube feet present.
- 2 (3) Anus surrounded by 5 calcified "teeth"
..... *Actinopyga agassizii* (Selenka)
- 3 (2) No such teeth present.
- 4 (5) Burrowing form, body fusiform, with inconspicuous feet.
Light brown with dark brown blotches dorsally
..... *Holothuria arenicola* Semper
- 5 (4) Not burrowing forms, feet more or less conspicuous.
- 6 (11) Tube feet placed upon conspicuous warts, at least dorsally.
- 7 (8) Skin thin, rough to touch. Grey mottled with brown
..... *Holothuria impatiens* (Forskaal)
- 8 (7) Skin thick, more or less smooth. Light to dark brown, mottled. Ossicles in body wall tables and C-shaped bodies.
- 9 (10) C-shaped bodies (when present) approximately as long as tables are high *Isostichopus badionotus* (Selenka)
- 10 (9) C-shaped bodies approximately twice as long as tables are high *Isostichopus macroparentheses* (Clark)
- 11 (6) Warts absent. Skin very thick, smooth, rigid. Dark brown dorsally, yellowish laterally and reddish to pink ventrally *Holothuria mexicana* Ludwig
- 12 (1) Body wall thin, body worm-like, tentacles less than 20. Tube feet absent.
- 13 (22) Skin sticky to touch, due to presence of projecting ossicles in form of anchors supported by anchor plates. No wheels in body wall.
- 14 (17) Arms of anchors smooth; vertex with minute knobs. Anchor

- plates with well developed bridge for support of anchors.
Active, conspicuous forms; generally non-burrowing.
- 15 (16) Grey to brown, often longitudinally striped. Body wall often with characteristic hemispherical "bumps." Stock of anchor branched *Euapta lappa* (Müller)
- 16 (15) Green and white mottled or brown and white mottled. No "bumps" on body wall. Stock of anchor unbranched
..... *Synaptula hydriformis* (Lesueur)
- 17 (14) Arms of anchors with teeth; no knobs on vertex. Anchor plates lack true bridge. Inconspicuous burrowing forms.
- 18 (19) Anchors and anchor plates very large, anchors usually exceeding 600 μm in length, plates usually exceeding 400 μm
..... *Leptosynapta insue* Pawson
- 19 (18) Anchors and anchor plates do not exceed 200 μm in length.
- 20 (21) Anchors and anchor plates very small, considerably shorter than 130 μm . Miliary granules resemble rosettes
..... *Leptosynapta nannoplax* Pawson
- 21 (20) Anchors and anchor plates larger, usually exceeding 140 μm in length. Miliary granules more or less C-shaped, with enlarged ends, not resembling rosettes
..... *Leptosynapta roseogradia* Pawson
- 22 (13) Skin more or less smooth, but with numerous scattered papillae containing aggregations of wheels. Brick red to pink
..... *Chiridota rotifera* (Pourtales)

Actinopyga agassizii (Selenka)

Figures 1C, E

Actinopyga agassizii.—Deichmann, 1930, 78, pl. 5, figs. 21–29.

Material examined: Lagoon, west of island, coral sand and turtle grass, 19 April 1972, collected R. J. Larson, 1 specimen; lagoon, April 1974, 1 specimen; Coral berm, 3 May 1974, collected by B. Spracklin, 1 specimen; back reef, 1–2 m, April 1975, collected by M. Carpenter, 2 specimens.

Remarks: Grows to about 20 cm. Five conspicuous calcareous "teeth" surround the anus. Skin thick, leathery. Numerous tube feet dorsally and ventrally. Color variable, but usually with mottled brown and yellow predominating. Tentacles yellow.

Common on sand in grassy areas in shallow water around islands of the West Indies, from Barbados to Florida. One record from Bermuda. The record from Belize is a new range extension into the Western Caribbean.

Holothuria impatiens (Forskaal)*Holothuria impatiens*.—Deichmann, 1930:64, pl. 3, figs. 17, 18.

Material examined: Just inside reef crest, 7 May 1974, collected by F. H. C. Hotchkiss and K. Sandved, 2 specimens; lagoon, west side

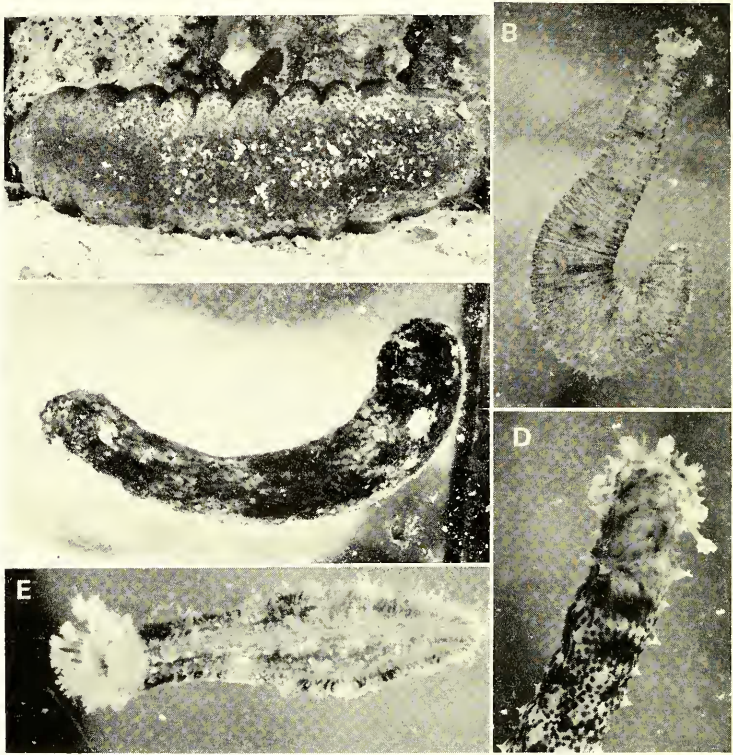


FIG. 1. A, *Holothuria mexicana*, ventral; B, *Holothuria arenicola*, dorsal; C, *Actinopyga agassizii*, dorsal; D, *Isostichopus mactoparenthes*, anterior dorsal; E, juvenile *Actinopyga agassizii*, ventral.

of island, coral sand, turtle grass, under conch shells, 19 April 1972, collected by R. J. Larson, 1 specimen.

Remarks: Grows to about 20 cm. Tube feet few, scattered, placed on distinct warts, at least dorsally. Skin thin, rough to touch. Color grey with brownish patches.

A "tropicopolitan" species, often uncommon or rare where it occurs. Usually found on sand or in grassy areas.

Holothuria arcuicola Semper

Figure 1B

Holothuria arenicola.—Deichmann, 1930:66, pl. 4, figs. 1-9.

Material examined: Under conch shells, foot of pier, 29 April 1974, collected by F. H. C. Hotchkiss and K. Sandved, 1 specimen; lagoon,

west side of island, near shore, 1 May 1974, collected by F. H. C. Hotchkiss and K. Sandved, 1 specimen; lagoon along west shore of island, low tide, 30 April 1972, collected by R. J. Larson, 1 specimen; back reef, 1–2 m, 1975, collected by K. Sandved, 1 specimen; same locality, 22 April 1975, collected by M. Carpenter, 2 specimens; same locality, 27 April 1975, collected by M. Carpenter, 1 specimen.

Remarks: Grows to about 30 cm. Body slender, fusiform, with very small tentacles. Adapted to a burrowing habit, and often found concealed under rocks and shells. Skin relatively thin and smooth to the touch. Ground color usually light brown, with dark brown patches in 2 series on dorsal surface. Color can vary considerably, probably depending upon chemical properties of the habitat; rust-colored to almost black specimens occur in some areas of the Caribbean.

A "tropicopolitan" species, commonly encountered in suitable habitats.

Holothuria mexicana Ludwig

Figures 1A, 2A

Holothuria mexicana.—Deichmann, 1930:74, pl. 5, figs. 15–20.

Material examined: Lagoon, south end of island, 1 specimen; May 1974, collected by F. H. C. Hotchkiss, 1 fragment; back reef, immediately behind crest, 1–2 m, April 1975, collected by M. Carpenter, 2 specimens.

Remarks: Grows to about 50 cm. Skin very thick, smooth, extremely hard when contracted. In life, body dark brown to blackish dorsally, with flanks yellowish brown, and ventral surface frequently reddish or pink. The reddish to pink ventral coloration disappears in alcohol. The specimen from station 1 above is unusual in being very light brown dorsally. The smaller specimen from the back reef is 110 mm in total length. The ground color is greyish white; ventral feet are light brown with dark brown endplates; dorsal surface with light brown feet and a double row of 4 large dark brown blotches. Deichmann (1930:74) noted that young specimens of this species have similar coloration, but she did not mention the presence of large dark blotches dorsally.

Ranges from Cuba to Curaçao in shallow water (to 20 m) in grassy areas or on muddy sand. This species has been frequently confused with the closely related *H. floridana* Pourtales.

Isostichopus badionotus (Selenka)

Stichopus badionotus.—Deichmann, 1930:80, pl. 5, figs. 30–36.

Material examined: Lagoon, west side of South Water Cay, mixed sand and *Thalassia*, 1 m depth, 4 May 1974, collected by F. H. C. Hotchkiss and K. Sandved, 1 specimen; Coco-Plum Cay, at edge of mangrove swamp, 2 May 1972, collected by R. J. Larson, 1 specimen;

lagoon, west side of island, coral sand, turtle grass, under conch shells, 19 April 1972, collected by R. J. Larson, 1 specimen.

Remarks: Grows to about 20 cm. Skin thick, with low warts dorsally and 3 crowded rows of tube feet ventrally. Color highly variable, from light brown to black, usually with numerous large spots or blotches of dark brown on a lighter background.

Common on muddy sand or in grassy areas, in shallow water, from Bermuda to Panama.

Isostichopus macropareutheses (Clark)

Figure 1D

Stichopus macropareutheses H. L. Clark, 1922:61, pl. 4, figs. 1-7; Deichmann, 1930:82, pl. 5, figs. 37-43; H. L. Clark, 1933:110 [*macropareutheses*].

Isostichopus badionotus.—Deichmann, 1963:106.

Material examined: Back reef, 1-2 m, April 1975, collected by M. Carpenter, 1 specimen.

Remarks: Grows to about 12 cm. In the field, virtually indistinguishable from *I. badionotus*, and can be positively identified only after examination of the spicules. Deichmann (1963) was inclined to regard *I. macropareutheses* as a juvenile stage of *I. badionotus* which has exceptionally large C-shaped ossicles. The difference between these C-shaped ossicles in the two forms is dramatic, particularly when one compares juveniles of *I. badionotus* with *I. macropareutheses*. I cannot agree with Deichmann's contention, and thus prefer to retain *I. macropareutheses* as a separate species.

In life, "bright brown, with very dark rings around the bases of the papillae which have yellow tips" (Clark, 1933:110). The present specimen is 30 mm long. Color photograph shows light brown body with dark brown dorsal feet and light to dark brown ventral feet; tentacles are more or less colorless.

The species is also known from Antigua, Jamaica and the Tortugas, in shallow water.

Euapta lappa (Muller)

Figure 2B

Euapta lappa.—H. L. Clark, 1924:464, pl. 1, figs. 5-7; 1933:118.

Material examined: Lagoon, 2 specimens; just inside reef crest, 6 May 1974, collected by F. H. C. Hotchkiss and K. Sandved, 1 specimen; reef flat, south end, east side of island "Penicillus" rock zone, 1 specimen; lagoon, west side of island, coral sand, turtle grass, under conch shells, 19 April 1972, collected by R. J. Larson, 2 specimens.

Remarks: Grows to about 100 cm. Color grey to brown, often longitudinally striped. Body wall prickly to touch, owing to presence

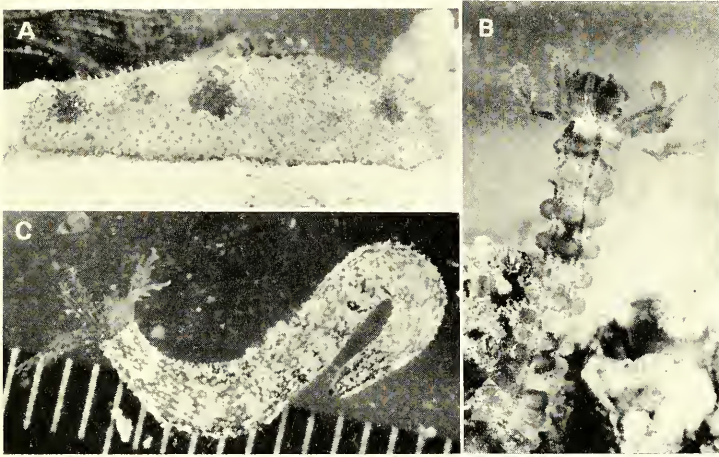


FIG. 2. A, young *Holothuria mexicana*, lateral; B, *Euapta lappa*, anterior dorsal; C, *Synaptula hydriformis*, dorsal.

of projecting spicules (anchors). Tentacles plume-like. Body often displays rows of characteristic conspicuous hemispherical protuberances.

An active reef-dwelling form often associated with lumps of dead coral. Can swim to a limited extent. Ranges the entire Caribbean in shallow water.

Synaptula hydriformis (Lesneur)

Figure 2C

Synaptula hydriformis.—H. L. Clark, 1924:473, pl. 3, figs. 5, 6, pl. 4, fig. 4; 1933:119.

Material examined: Foot of boat pier, bulk sample no. 2, 29 April 1974, collected by F. H. C. Hotchkiss and K. Sandved, 8 specimens; just inside reef crest, 6 May 1974, collected by F. H. C. Hotchkiss and K. Sandved, 1 specimen; back reef, 1–2 m, April 1975, collected by K. Sandved, 1 specimen.

Remarks: Grows to about 10 cm. Prickly to touch due to projecting spicules (anchors). Two color phases, mottled green and white and mottled brown and white, can occur. Some correlation exists between habitat type (red or brown or green algae frequently) and color of body wall, but exceptions occur; for example, in Bermuda the brown form is conspicuous among clumps of the green *Penicillus*. Green form only known so far from Carrie Bow Cay. Viviparous; apparently can breed all year round in Bermuda.

Ranges from Bermuda to Brazil. Usually found in weed in shallow water.

Leptosynapta Verrill, 1867

The Carrie Bow Cay collections contain a total of 11 complete specimens and several fragments of synaptids which can be referred to the genus *Leptosynapta*. Surprisingly, the specimens represent 3 new and distinctive species. While I am reluctant to describe 3 further species in a genus which is already quite large (approximately 25 species) and requires revision, it is clear that under currently accepted taxonomic criteria for the family Synaptidae, the present species must be regarded as new. It seems likely that further collecting in sandy areas of the Caribbean will reveal a large and diverse fauna of burrowing synaptids; such habitats have received very little attention from collectors in the past.

The 3 species described below do not appear to be closely related to one another, but each shares some important features with other western Atlantic congeners.

***Leptosynapta imswi*, new species**

Figure 3

Diagnosis: Anchors and anchor plates of one kind, very large, anchors usually exceeding 600 μm in length, plates exceeding 400 μm in length. Miliary granules numerous, in form of C-shaped rods with enlarged ends.

Material examined: Holotype (USNM E15854, specimen 57 mm long), lagoon, sand, north end, west side of Carrie Bow Cay, Belize, 27 April 1974, collected by F. H. C. Hotchkiss and K. Sandved. Paratypes 3 complete specimens and 11 fragments (USNM E15855) from same locality as holotype.

Etymology: The species is named for the Smithsonian Institution I.M.S.W.E. program (Investigations of Marine Shallow Water Ecosystems).

Description: Total length ranges from 7 to approximately 90 mm; probably species exceeds 120 mm in life. Specimens uniformly whitish, body wall translucent when expanded; color in life pink to light brown. Conspicuous anchors project through body wall rendering specimens very prickly to touch. Tentacles 12, each with 5–6 pairs of digits and a terminal digit; digits increase in length distally, and terminal digit is longest (Fig. 3F). Inner (oral) surfaces of tentacles with double row of well developed sensory cups.

Body wall deposits comprise large anchors and anchor plates of one kind, and numerous miliary granules. Anchors and plates at anterior, middle and posterior of body wall essentially similar, although developmental stages of these ossicles more numerous posteriorly. Anchors average 630 μm in length (standard deviation 2.49; standard error 0.83), 374 μm in width, arm-tip to arm-tip (standard deviation 2.01; standard error 0.67), 126 μm in width of stock (standard de-

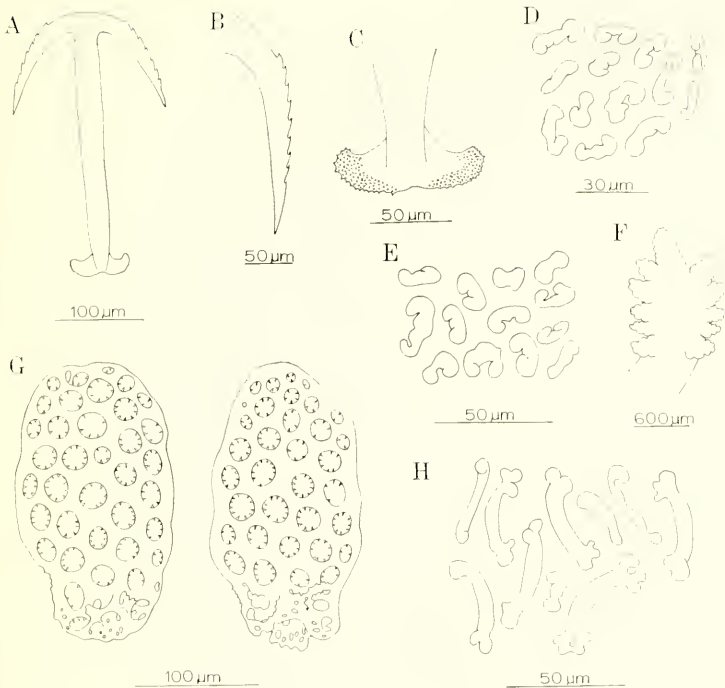


FIG. 3. *Leptosynapta insuc* n. sp. A, Anchor; B, Detail of anchor arm; C, Detail of anchor stock; D, Miliary granules from body wall; E, Ossicles from tentacle stem; F, Outline of tentacle; G, Anchor plates; H, Ossicles from tentacle digits.

viation 1.26; standard error 0.42). Arms carry up to 10 conspicuous sharp teeth. Stock unbranched, but equipped with numerous small sharp projections (Fig. 3A–C). Anchor plates elongate, approximately oval, with numerous toothed perforations (Fig. 3G); central perforations tend to be larger than others. No true bridge for support of anchors, but in area of support, anchor plate strengthened by having an irregular “pseudo-bridge” in form of a double layer of calcite. Anchor plates average $447 \mu\text{m}$ in length (standard deviation 3.09; standard error 1.03), and $246 \mu\text{m}$ in greatest width (standard deviation 0.84; standard error 0.28). Miliary granules numerous everywhere in body wall, highly variable in shape, but generally tending to have enlarged, recurved ends. Granules up to approximately $30 \mu\text{m}$ in length (Fig. 3D).

Stems of tentacles with ossicles similar to miliary granules of body wall but tending to be slightly smaller (Fig. 3E). In tentacle digits

ossicles tend to be more elongate, length up to 45 μm , and some have perforated ends (Fig. 3H).

Remarks: This is one of the few species of *Leptosynapta sensu lato* which has very large anchors and anchor plates. *L. acanthia* H. L. Clark, known only from Bermuda, has anchors and plates which are similar in size to those in *L. inswe*, but the plates have fewer perforations, and further, *L. acanthia* has numerous small anchors 140–210 μm in length and plates of approximately the same size (Clark, 1924:478); such deposits are apparently lacking from *L. inswe*. *L. multipora* H. L. Clark also has large anchors and plates but lacks the numerous military granules.

***Leptosynapta roseogradia*, new species**

Figure 4A–D

Diagnosis: Anchors of one type, usually less than 200 μm long, anchor plates of one type, usually less than 160 μm long. Military granules C- or bracket-shaped, numerous. Radial pieces of calcareous ring perforated for radial nerve.

Material examined: Holotype (USNM E15856, specimen 36 mm long), lagoon, sand, north end, west side of Carrie Bow Cay, Belize, 27 April 1974, collected by F. H. C. Hotchkiss and K. Sandved. Paratypes 3 specimens (USNM E15857) from same locality as holotype.

Etymology: The species is so named to indicate its superficial similarity to *Epitomapta roseola*.

Description: Total length 16, 26, 36, and 40 mm. Specimens white to yellowish, body wall thin, translucent; color in life pink to light brown. Tentacles 12, each with 5–6 pairs of digits and a terminal digit, which is longest. Sensory cups present in small numbers on oral surface of tentacles.

Radial pieces of calcareous ring perforated for passage of radial nerve. Ciliated funnels all of one type, small, approximately 100 μm in length.

Deposits in body wall anchors, anchor plates and numerous military granules. Anchors and plates at anterior, middle and posterior of body essentially similar, but differing in dimensions:

Anterior	anchors	length	167 μm	S.D. 1.36	S.E. 0.43
	plates	length	154 μm	S.D. 1.29	S.E. 0.42
Mid-body	anchors	length	192 μm	S.D. 2.6	S.E. 0.93
	plates	length	182 μm	S.D. 3.6	S.E. 1.29
	plates	width	142 μm	S.D. 2.46	S.E. 0.89
Posterior	anchors	length	148 μm	S.D. 1.32	S.E. 0.44
	plates	length	144 μm	S.D. 1.42	S.E. 0.45

Anchors (Fig. 4A) have 1–3 serrations on arms; stock with numerous small teeth. Anchor plates (Fig. 4D) approximately oval, with 7

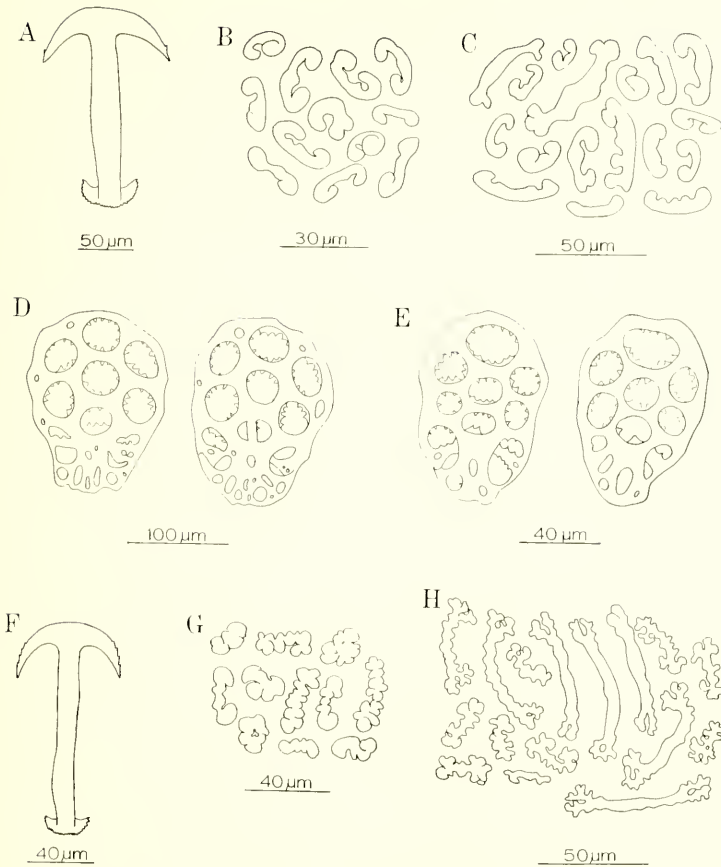


FIG. 4. *Leptosynapta roseogradia* n. sp. A, Anchor; B, Miliary granules from body wall; C, Ossicles from tentacle stems and digits; D, Anchor plates. *Leptosynapta nannoplax* n. sp. E, Anchor plates; F, Anchor; G, Miliary granules from body wall; H, Ossicles from stems and digits of tentacles.

major perforations, always toothed, also with varying numbers of smaller perforations. Plate distinctly narrower at articular end, with several small perforations. No true supporting bridge for anchor. Body wall with minute miliary granules (Fig. 4B) more or less C- or bracket-shaped, with enlarged ends. Size variable, largest granules approximately $25\ \mu\text{m}$ in length.

Tentacle stems and digits contain granules similar to those in body

wall, and digits in particular have more elongate rods (Fig. 4C) up to 60 μm in length.

Remarks: This is another distinctive species of *Leptosynapta*. The anchors and anchor plates strongly resemble those of *Epitomapta roscola* (Verrill) from Woods Hole, Bermuda, and Jamaica, but *E. roscola* has imperforate radial pieces in the calcareous ring, ciliated funnels of two types, and anchor plates which are considerably smaller (110 μm , Heding, 1928:237) than those of *L. roscogradia*. Within the genus *Leptosynapta*, *L. tenuis* (Ayers) from the north-eastern United States shares some features with this new species, but differs in having larger anterior and posterior anchors, smaller anterior anchor plates, and differently shaped miliary granules and tentacle rods. Further, in *L. tenuis*, the anterior and posterior anchors are distinctly different in appearance, a feature not observed in *L. roscogradia*.

***Leptosynapta nannoplax*, new species**

Figure 4E-11

Diagnosis: Anchors and anchor plates very small, anchors usually less than 125 μm in length, anchor plates usually less than 90 μm in length. Miliary granules resemble rosettes.

Material examined: Holotype (USNM E15858, specimen 31 mm long), lagoon, sand, north end, west side of Carrie Bow Cay, Belize, 27 April 1974, collected by F. H. C. Hotchkiss and K. Sandved. Paratypes 2 specimens (USNM E15859) from same locality as holotype.

Etymology: The specific name is derived from Greek *nannos* small, and *plax*, a plate, in reference to the diminutive ossicles in the body wall.

Description: Total length of 3 specimens 26, 27 and 31 mm. Species may exceed 50 mm in life. Specimens white, body wall translucent; color in life pink to light brown. Twelve pinnate tentacles, with 3-5 pairs of digits and a terminal digit which is the longest. Sensory cups present on oral surface of tentacles.

Body wall ossicles comprise very small anchors and anchor plates of one kind, and minute miliary granules. Anchors and plates at anterior, middle, and posterior of body similar, but differing slightly in dimensions:

Anterior	anchors	length	86 μm	S.D. 0.79	S.E. 0.25
	plates	length	83 μm	S.D. 0.51	S.E. 0.16
Mid-body	anchors	length	107 μm	S.D. 4.36	S.E. 1.53
	plates	length	90 μm	S.D. 1.91	S.E. 0.64
	plates	width	61 μm	S.D. 1.62	S.E. 0.51
Posterior	anchors	length	124 μm	S.D. 0.70	S.E. 0.22
	plates	length	88 μm	S.D. 0.71	S.E. 0.24

Anchors carry up to 4 or 5 distinct serrations on arms; stock is toothed but not strongly so (Fig. 4F). Anchor plates elongate oval, usually with 7 large dentate perforations, and several smaller holes at anchor support area (Fig. 4E). No true bridge for anchor support, but usually a double layer of calcite is more or less well developed. Miliary granules scattered, usually less than 40 μm in length (Fig. 4G). They bear close resemblance to rosettes found in other groups of apodous holothurians.

Tentacle stems and digits contain numerous deposits similar to miliary granules of body wall; in addition, digits in particular contain elongate rods up to approximately 70 μm in length (Fig. 4H).

Remarks: Very few species of *Leptosynapta* have anchors and plates of such small size, and apparently none have miliary granules which resemble rosettes in combination with small anchors and plates. *L. micropatina* Heding from Tobago has anchors and plates of the same order of size as *L. nannoplax*, but does not possess the rosette-like miliary granules. Further, the anchor plates of *L. micropatina* usually contain smaller perforations at the wider ends of the plates in addition to the larger dentate perforations; these are lacking from *L. nannoplax*.

In view of the relatively small size of *L. nannoplax*, it is conceivable that this is the young form of a known species; if this is the case, then it is to be expected that the rosette-like miliary granules disappear or are supplanted by granules of a different type as the animal grows.

Chiridota rotifera (Pourtales)

Chiridota rotifera.—Heding, 1928:293, figs. 59, 60; H. L. Clark, 1933: 122.

Material examined: Foot of pier, bulk sample no. 2, 29 April 1974, collected by F. H. C. Hotchkiss and K. Sandved, 5 specimens; subtidal, bulk sample, 28 April 1974, collected by F. H. C. Hotchkiss and K. Sandved, 1 specimen; back reef, in conch shell, 1 m depth, 27 April 1975, collected by K. Sandved, 1 specimen.

Remarks: Grows to about 10 cm. Body smooth to touch, with more or less conspicuous aggregations of calcareous spicules ("wheel papillae") scattered in rows along the interradial areas, especially dorsally. Ground color light brick-red to pink. Viviparous.

Common on sand under rock in shallow water; also occurs in sandy beaches. Ranges from Brazil to Bermuda.

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