

A NEW SUBSPECIES OF *HOLOTHURIA LENTIGINOSA*
MARENZELLER FROM THE WESTERN ATLANTIC OCEAN
(ECHINODERMATA: HOLOTHUROIDEA)

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Abstract.—*Holothuria (Vaneyothuria) lentiginosa enodis* new subspecies is described from the Florida-Cuba area. The species is amphi-Atlantic in depths of 69-450 m. In southeast Florida, one population of the new subspecies is closely associated with a reef of the scleractinian coral *Oculina varicosa*. The common western Atlantic pearlfish, *Carapus bermudensis*, is an inquiline of this holothurian.

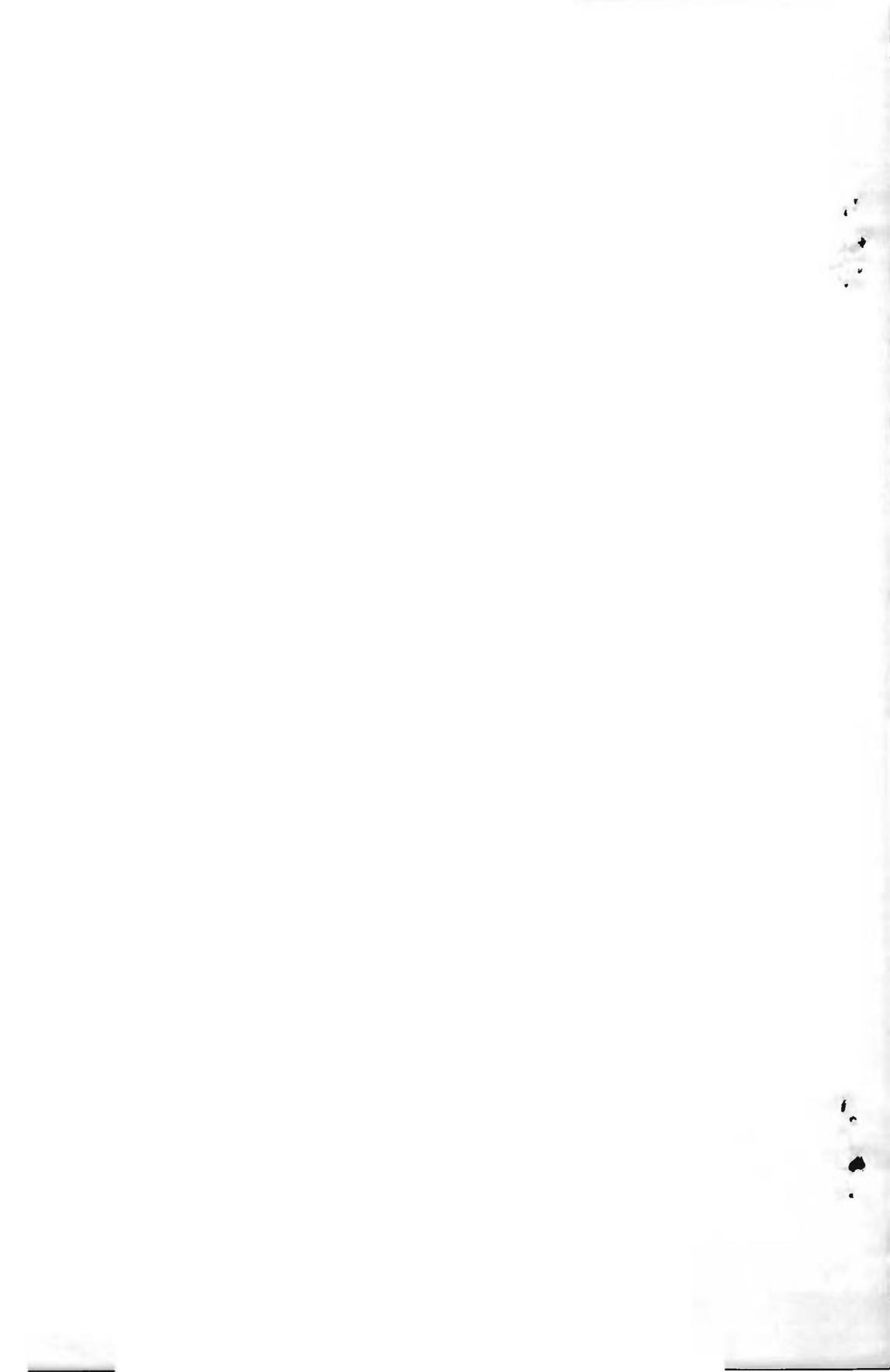
During the course of diving operations with the submersibles *Johnson-Sea-Link I* and *II*, staff members of the Harbor Branch Foundation, Inc. found a large population of an aspidochirote sea cucumber around a reef of the scleractinian coral *Oculina varicosa* Lesueur at a depth of 75-80 m. The reef is located off Fort Pierce, Florida. We first observed the population from the *Johnson-Sea-Link II* during August, 1977, and studies of ecology and reproductive biology were begun at that time. The holothurians are described here as a new subspecies of *Holothuria (Vaneyothuria) lentiginosa* Marenzeller. Some notes on its distribution and habitat preferences are included, together with some information on behavior in an aquarium of the pearlfish, *Carapus bermudensis* (Jones), which was found in association with the holothurians.

Holothuria lentiginosa s.l. has been reported from several localities in the eastern Atlantic (see below). In the western Atlantic, Deichmann (1940) first recorded the species off Cuba, and gave a brief description. She indicated that her specimens were similar to the eastern Atlantic form in many respects; the only difference she noted was that many of the tables in the body wall "have a smooth instead of a dentate margin" (p. 197). After examination of numerous specimens from off Florida, Deichmann's specimens, and material from the eastern Atlantic, we find that there are several consistent differences that warrant separation of the 2 populations at the subspecies level. They may be distinct species, but as they are obviously closely related and definitely allopatric, it would seem the wiser course to regard them as subspecies rather than species.

Order Aspidochirotida
Family Holothuriidae

Holothuria (Vaneyothuria) lentiginosa Marenzeller

Diagnosis.—Tentacles 20. Body more or less cylindrical, with flattened ventral surface; up to 50 cm long. Ossicles include delicate tables with spine



of moderate height and disc with spinose to smooth margin. Spire ends in few teeth, forming irregular Maltese cross. Buttons with 2–5 pairs of perforations, either flat and relatively smooth or twisted. Color variable, pale ventrally, brownish to light reddish dorsally. Internally, one stone canal, one polian vesicle.

Type-specimen.—Monaco (according to Deichmann, 1940).

Type-locality.—Strait of Pico-Fayal, Azores, 130 meters (Marenzeller, 1893).

Remarks.—Rowe (1969) included 5 species under the subgenus *Vaneyothuria*, and noted in his remarks that perhaps 2 of the species are synonyms. Until now, only *H. (V.) zacae* Deichmann from the Gulf of California, southern California and the Galapagos Islands was known to possess large dark brown blotches in a double row along the dorsal surface.

H. (V.) lentiginosa lentiginosa Marenzeller
Fig. 4C–D

Holothuria lentiginosa Marenzeller, 1893:6, pl. I Fig. 1, pl. II Fig. 1a–b.

—Herouard, 1929:53, 63.—Panning, 1934:82, Fig. 68; 1939:532, Figs. 5–6.

—Cherbonnier, 1958:371; 1965:13, pl. II Figs. k–m.

Holothuria pardalis var. *lentiginosa*.—Bedford, 1899:143.

Vaneyothuria lentiginosa.—Deichmann, 1958:307 (in part).

Holothuria (Vaneyothuria) lentiginosa.—Rowe, 1969:151.

Diagnosis.—Dorsally light brown to light reddish, fading to paler color or whitish ventrally. Usually lateral margin of body carries 10–18 conspicuous retractile papillae. Discs of tables 50–100 μm in diameter, conspicuously dentate; tables with smooth discs rare. Buttons 45–60 μm long, strongly contorted, frequently with obliterated or incomplete perforations. Tentacles with extremely numerous small rods of 15 μm minimum length, and less numerous larger rods with coarse prickles along their length.

Distribution.—Azores (Marenzeller, 1893), Morocco (Herouard, 1929; Panning, 1939), Congo–Angola area, several localities (Cherbonnier, 1965), Sierra Leone (Cherbonnier, 1958).

Depth range.—100–250 meters.

Remarks.—This subspecies can vary in color to some extent. In Marenzeller's (1893) original description the color figure shows that the dorsal surface was light brown to pinkish with medium brown bases to the small papillae; the ventral surface was pinkish to dirty white. Herouard (1929) described the color as light brown dorsally with brown "points," and white ventrally, with chestnut-colored tubercles. Cherbonnier (1958) noted that the dorsolateral areas of his specimen were greenish-yellow, and he later (1965) described another group of specimens as having whitish-yellow ventral surfaces with scattered dark red spots, and dorsal surfaces brownish-

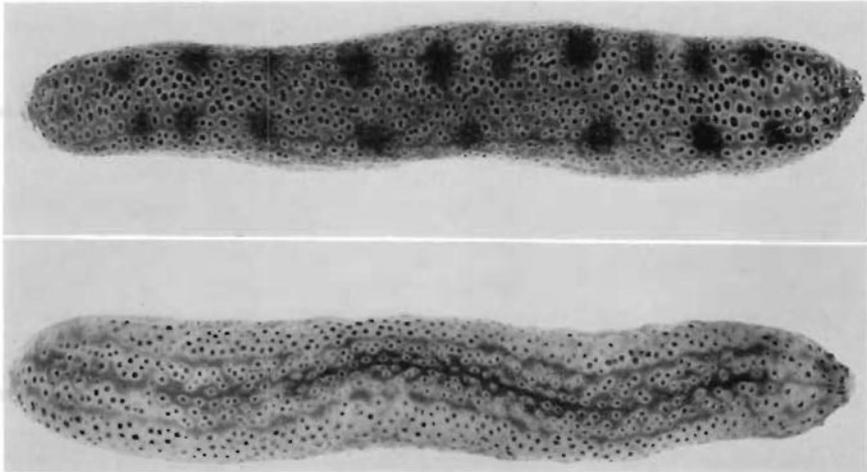


Fig. 1. *Holothuria* (*V.*) *lentiginosa enodis*. Dorsal (upper figure) and ventral (lower) aspects of a live specimen 195 mm long.

red with white spots. Further information on details of color can be obtained from the publications mentioned above.

Material examined.—Dana Sta. 4021, 8°56'W, 33°28'N, 205–235 m, 31 March 1930, 1 specimen (Panning, 1939). Coast of Morocco, collected by Mr. G. Belloc, October 1923, 1 specimen (identified by G. Cherbonnier).

H. (V.) lentiginosa enodis new subspecies
Figs. 1–3, 4A–B

Holothuria lentiginosa.—Deichmann, 1940:196, pl. 33 Figs. 1–7; 1954:391.

Vaneyothuria lentiginosa.—Deichmann, 1958:307 (in part).

Diagnosis.—Dorsally light to very dark brown with 2 longitudinal rows of 5–10 pairs of conspicuous dark brown blotches approximately 7–10 mm in diameter; ventrally usually white to light tan. Discs of tables 45–100 μm in diameter, slightly dentate to smooth. Buttons 45–105 μm long, irregular, often incomplete, but seldom strongly contorted. Rods in tentacles usually more than 200 μm long, with minute spines, often confined to extremities.

Type-specimens.—National Museum of Natural History, Smithsonian Institution Holotype USNM E17291, length 135 mm, R/V *Johnson* Cruise 053, Dive No. JSL 2053 10 April 1978, 27°32.8'N, 79°58.8'W, 79.3 m, silty sand, 14.2°C, collected by R. Jones. Paratypes USNM E17292, 5 specimens, length 150, 155, 130, 135, 110 mm, same locality data as holotype.

Paratypes, Harbor Branch Foundation—Smithsonian Institution Reference Museum, Fort Pierce, Florida, S.I.F.P. 71:064, 4 specimens, length 170, 130, 130, 100 mm, R/V *Johnson* Cruise 049, Dive No. 2279, 7 November 1977, 27°32.8'N, 79°58.8'W, 76.1 m, silty sand, 21.8°C, collected by J. Miller.

Other material examined.—University of Miami, R/V *Gerda* Sta. 232, 25°37'N, 79°21'W, 439–421 m, 29/30 January 1964, 1 specimen; R/V *Gerda* Sta. 568, 24°23'N, 82°53'W, 90 m, 12 April 1965, 1 specimen. Museum of Comparative Zoology, Harvard Cat. No. 2014, Cuba, Santa Clara Province, Bahía de Cochinos, 200–255 fathoms, 1 specimen (all of the above identified as *H. lentiginosa* by E. Deichmann).

R/V *Johnson* Cruise 025, Dive No. JSL 2099, 16 September 1976, 27°33.2'N, 79°58.8'W, 76.1 m, silty sand, 1 specimen, S.I.F.P. 71:065 collected by R. Avent; R/V *Johnson* Cruise 031, Dive No. JSL 2149, 23 November 1976, 27°32.8'N, 79°58.8'W, 77.7 m, silty sand, 1 specimen, S.I.F.P. 71:066 collected by F. Stanton; R/V *Johnson* Cruise 038, Dive No. JSL 2163A, 7 February 1977, 27°32.8'N, 79°58.8'W, 80 m, 1 specimen, S.I.F.P. 71:067 collected by F. Stanton; R/V *Johnson* Cruise 049, Dive No. JSL 2279, 7 November 1977, 27°32.8'N, 79°58.8'W, 76.1 m, silty sand, bottom temperature 21.8°C, 3 specimens, S.I.F.P. 71:068 collected by J. Miller; R/V *Johnson* Cruise 049, Dive No. JSL 2282, 9 November 1977, 27°32.8'N, 79°58.8'W, 80.1 m, silty sand, bottom temperature 3.6°C, 13 specimens, S.I.F.P. 71:069 collected by J. Reed.

R/V *Gosnold* Cruise 246, Sta. 697, 6 September 1974, 27°49.5'N, 79°57.8'W, 69 m, 1 specimen, S.I.F.P. 71:070 collected by R. Avent.

Distribution.—Southwest Cuba (Deichmann, 1940), Florida Straits (University of Miami collections), southeast Florida (present study).

Depth range.—69–450 m.

Description.—Total length 15–30 cm, average 20 cm. Body 4–8 times as long as broad, cylindrical, with flattened sole. Mouth subterminal, directed ventrally and surrounded by ring of 35–50 papillae. Anus terminal, directed dorsally. Body wall thick, extremely rigid when contracted. Pedicels



Fig. 2. *Holothuria* (*V.*) *lentiginosa enodis* photographed from submersible *Johnson-Sea-Link II* on seafloor at type-locality. Note small scattered heads of *Oculina varicosa*. In right photograph, dark object at bottom is manipulator arm of submersible, used to collect the holothurians.

numerous, scattered over entire surface, dorsally as pointed papillate podia situated on low warts, ventrally as cylindrical locomotory podia. Radii indistinct. All podia fully contractile and capable of extension to length of 5-7 mm. Ventrolateral podia indistinguishable from others. Tentacles 20 (19 not uncommon), equal, shield-shaped, each frond composed of 9-12 fleshy lobes.

Dorsal body wall light to very dark brown with 2 longitudinal rows of conspicuous dark brown blotches approximately 7-10 mm in diameter (Fig. 1). Usually 5-7 pairs of spots, occasionally up to 10 pairs found. On living specimens a large papillate podium prominent in center of each spot. Ventral body wall usually white to light tan; a darker mid-ventral line runs from mouth to anus. Specimens with darker dorsal coloration also darker ventrally. Dorsal podia dark brown, with white ring around base; ventral podia light to dark brown with white sucking discs.

Calcareous ring moderately strong, radial pieces wider than interradials, each with small anterior notch (Fig. 3A); interradials with moderately sharp anterior projections. Posterior edge of ring undulating. Surface sculpture inconspicuous; 2 shallow depressions lie on radial pieces to left and right of midline.

Polian vesicle single, bulbous. Stone canal approximately 10 mm long, running anteriorly in dorsal mesentery and terminating in an elongate oval madreporite. Tentacle ampullae conspicuous, approximately 10 mm long. Gonad as one tuft of tubules on left side of dorsal mesentery, located approximately $\frac{1}{3}$ of way along body cavity. Gonoduct opens immediately posterior to tentacles. Left respiratory tree forms well developed rete mirabile in posterior half of body cavity. Right tree extends to extreme anterior end of body cavity. Cuvierian tubules conspicuous.

Ossicles in body wall tables and buttons. Tables (Fig. 3C) with large disc with single central hole surrounded by 8–12 marginal holes. Margins with more or less conspicuous projections. Spire slightly tapering, with variable number (9–12) of short teeth. Dorsal tables slightly larger and more numerous than ventral. Buttons (Fig. 3B) without knobs, irregular, often incomplete, usually with 3 pairs of perforations, although 2 or 4 pairs occur frequently.

Dorsal podia contain tables, buttons, rudimentary end plates and straight to curved supporting rods with one or more terminal perforations (Fig. 3F). Ventral podia contain tables, buttons, well developed end plates and straight or curved supporting rods with more numerous perforations than those of dorsal feet (Figs. 3E, 3G).

Tentacles with straight to irregularly curved supporting rods bearing minute spines distally, and occasionally distal perforations; length of rods 200–450 μm , average 330 μm (Fig. 3D).

In 2 small specimens 47 mm and 65 mm long, tables almost invariably with smooth discs, average disc diameter being 60 μm and 70 μm respectively. Buttons very similar to those of adults, lengths 57 μm and 74 μm respectively (Fig. 4A–B).

Remarks.—Deichmann (1940:196) noted that the color of the specimens she examined from Cuba was “light brown, paler on the ventral side . . .” She made no mention of a double row of dark blotches dorsally, and she surely would have done so had they been present in her specimens. We conclude that the color had faded somewhat in alcohol, as it has in the 2 specimens from the University of Miami. All of these specimens are now mostly uniformly whitish in alcohol, with traces of brownish color dorsally.

This new subspecies is distinguished from the typical subspecies in a variety of ways, but we do not consider the differences sufficient to warrant separation at the species level. In terms of external features, the most conspicuous difference lies in the color. Also important is the fact that the eastern Atlantic subspecies usually has prominent papillae along the ventrolateral edge. Such papillae are absent from western Atlantic forms, but we have observed that in aquaria some ventrolateral papillae are larger than others. The most consistent difference lies in the body wall ossicles.

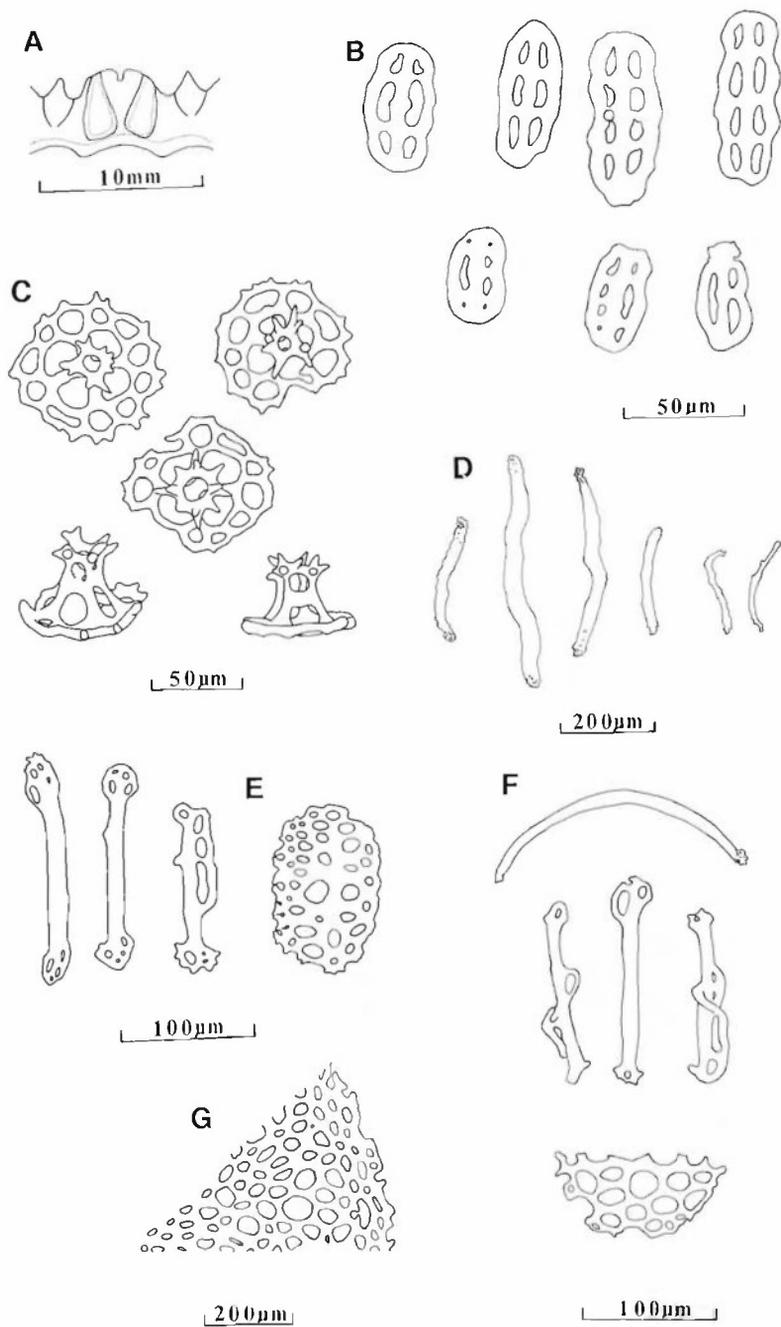


Table 1. Dimensions of body wall ossicles in *H. lentiginosa*. Ossicles can vary greatly in size within a single specimen. Generally, ossicles from ventral body wall are slightly smaller than those from dorsal body wall. S.D. = standard deviation.

	Dorsal tables (diameter, μm)	Dorsal buttons (length, μm)
<i>Holothuria</i> (V.) <i>lentiginosa lentiginosa</i>		
Dana Sta. 4021 (Copenhagen Museum)	106	85
Coast of Morocco (Paris Museum)	95	59
<i>Holothuria</i> (V.) <i>lentiginosa enodis</i>		
Southeast Florida (R/V Johnson)	72 (59-99, S.D. 7.18)	59 (46-105, S.D. 13.18)
Cuba (MCZ Harvard No. 2104)	97	77
Florida Straits (Univ. of Miami, <i>Gerda</i> 232)	100	83
Florida Straits (Univ. of Miami, <i>Gerda</i> 568)	70	68

The tables are much less dentate in the western Atlantic form, and are often quite smooth (compare Figs. 3C and 4D). The buttons are much more contorted in the eastern Atlantic form (compare Figs. 3B and 4C). The tentacle rods are smaller and much more numerous in the eastern Atlantic form and the larger rods have coarser "prickles" along their length.

The *Oculina varicosa* habitat: The type-locality lies in 80 m of water off Fort Pierce, Florida. It is a large reef capped with luxuriant growth of the scleractinian coral *O. varicosa*. The reef consists of 3 major ridges running in an east-west direction and cresting at a depth of 64 m. Estimated dimensions are length 220 m, width 90 m. The southern (upcurrent Gulf Stream) boundary is composed of massive *Oculina* heads situated on a 30-45° slope. The slope on the northern (downcurrent) boundary is shallower, with scattered *Oculina* heads. The entire reef is surrounded by a bottom of silty sand littered on the north, east and west with coral debris and many small, unattached heads. The area adjacent to the southern boundary is free of any reef litter.

The pearlfish, *Carapus bermudensis*: Pearlfish of the genus *Carapus* have been reported several times in association with the shallow water sea cucumbers (e.g., Dawson, 1971; Smith and Tyler, 1969; Haburay *et al.*, 1974).

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Fig. 3. *Holothuria* (V.) *lentiginosa enodis*, ossicles: A, Part of calcareous ring; B, Buttons from dorsal body wall; C, Tables in plan and profile view; D, Rods from tentacles; E, Perforated rods from ventral podia; F, Rods and plate from dorsal podia; G, Part of endplate from ventral podium.

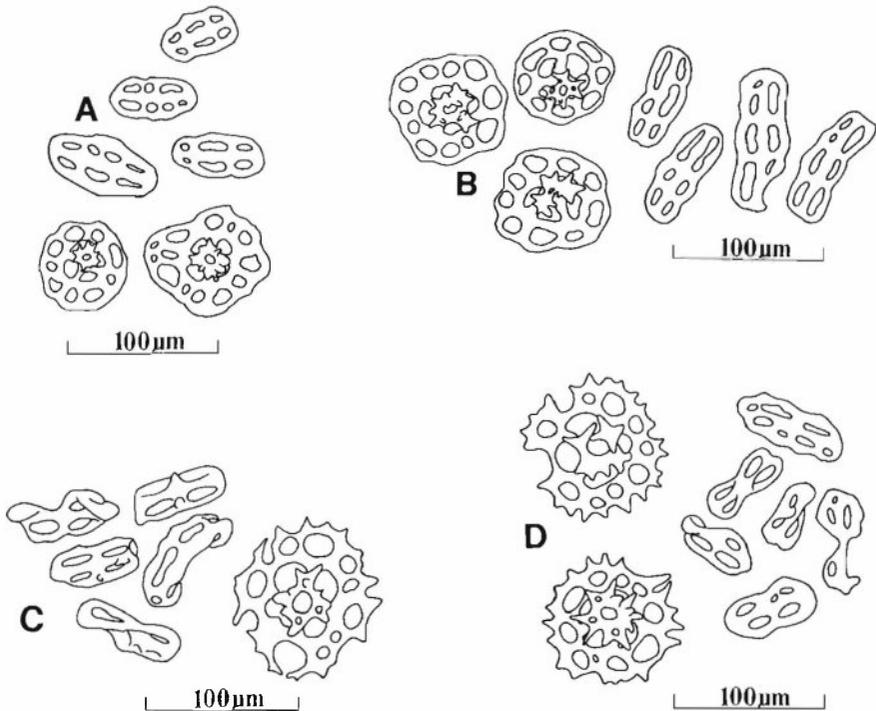


Fig. 4. *Holothuria* (*V.*) *lentiginosa enodis*, ossicles. A, Tables and buttons from 47 mm specimen; B, Tables and buttons from 65 mm specimen. *Holothuria* (*V.*) *lentiginosa lentiginosa*, ossicles; C, Table and buttons of specimen from Dana Sta. 4021 (Copenhagen Museum); D, Tables and buttons of specimen from Morocco (Paris Museum).

There are very few reports of occurrence in deep water holothurians. Cherbonnier (1965) noted that some specimens of *H. (V.) lentiginosa lentiginosa* contained *Fierasfer imberbis* (Linnaeus) (= *Carapus acus* (Brünnich)), but he offered no further information on his material.

Our material, collected alive by the submersible, has been retained alive in aquaria for many weeks. One of us (J.E.M.) observed that a pearlfish was present in a tank containing several specimens of *H. (V.) lentiginosa enodis*. The fish, total length 77 mm, was identified by Dr. D. M. Cohen of the National Marine Fisheries Service as *Carapus bermudensis* (Jones). During the 2 weeks following the discovery of the fish, some observations were made of its behavior. The fish emerged only in subdued light; during full daylight it would seek shelter inside the host. Head-first entry into the

anus was effected after the fish tapped its way along the holothurian's dorsal surface until the anus was encountered. Active swimming was not frequently observed; more often than not the direction of movement was backwards and upwards. The fish spent much time suspended head down in the water, gently undulating its dorsal and anal fins to maintain its position. For the week prior to its death the fish remained outside its host and could not be persuaded to re-enter the host. It remained stationary in the corner of the aquarium or nestled head-down between the holothurian and the glass, with the attenuated body coiled in several "S"-turns. Occasionally the fish would mouth the sediment, but no ingestion was observed. The fish died (of starvation?) after 83 days in captivity.

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