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A taxonomic guide to the Echinodermata of the South Atlantic Bight, USA: 1. Sea cucumbers (Echinodermata: Holothuroidea)

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Abstract

A summary account is given of the 33 holothurian species known from the South Atlantic Bight, from Cape Hatteras, North Carolina, to Cape Canaveral, Florida, from the shore to a depth of 200 meters. Four of the six known orders of holothurians are represented in the study area. Each species is diagnosed and illustrated; citations of informative literature and brief discussions of distribution and general biology are included. Also included are dichotomous keys to aid in identification to the species level. A new genus is erected to accommodate *Pseudocolochirus mysticus* Deichmann, 1930. *Ocnus pygmaeus* (Théel, 1886b) and *O. surinamensis* (Semper, 1868) are referred to the genus *Aslia* Rowe, 1970.

Key words: Holothurians, sea cucumbers, South Atlantic Bight, SERTC

Introduction

Since 2001 the Southeast Regional Taxonomic Center (SERTC) at the South Carolina Department of Natural Resources (www.dnr.sc.gov/marine/sertc/about.html) has fostered preparation of an inventory of the biota of the South Atlantic Bight of the USA. The South Atlantic Bight comprises the area between Cape Hatteras, North Carolina to the north and Cape Canaveral, Florida, to the south, out to a depth of 200 meters. Using existing national and regional collections, and materials newly acquired by SERTC, we have prepared annotated checklists of the Echinodermata. The present contribution, on the Class Holothuroidea, is the first of four (in preparation: Classes Ophiuroidea, Asteroidea, and Echinoidea and Crinoidea). Information on the general biology of sea cucumbers is available in several publications, such as Hendler *et al.* (1995), Smiley (1994), Smiley *et al.* (1991). Much of the introductory discussion that follows is derived from Hendler *et al.* (1995). Numerous internet sites provide information, some of which requires verification by reference to peer-reviewed scientific literature.

The approximately 1,300 known species of sea cucumbers (holothurians or holothuroids) are often viewed as unattractive and sluggish, with Hyman (1955) remarking "interest in this group appears relegated to taxonomic specialists." Today, more than fifty years since Hyman wrote those damning words, the sea cucumbers are enjoying attention from a variety of biologists in many fields, ranging from pharmaceutical researchers to aquaculturists to deep-sea ecologists. The sea cucumbers differ markedly from other echinoderms (fig. 1), for they usually do not possess a conspicuous skeleton, and the body wall is usually leathery or soft. But, a close inspection reveals features that link them with their more heavily calcified sister classes, such as the microscopic calcite ossicles, skeletal structures embedded in the body wall. Depending on the species, the ossicles constitute about 3% to 70% of the dry weight of the holothuroid body wall. On the deep-sea floor, holothurians can comprise more than 90% of the ecosystem biomass, and since deep waters cover over 70% of the surface of the earth, holothurians are among the dominant organisms on our planet. In the tropical Indo-Pacific, large sea cucumbers throng quiet lagoons and back reef areas, but in the Atlantic they are usually less conspicuous and less numerous.

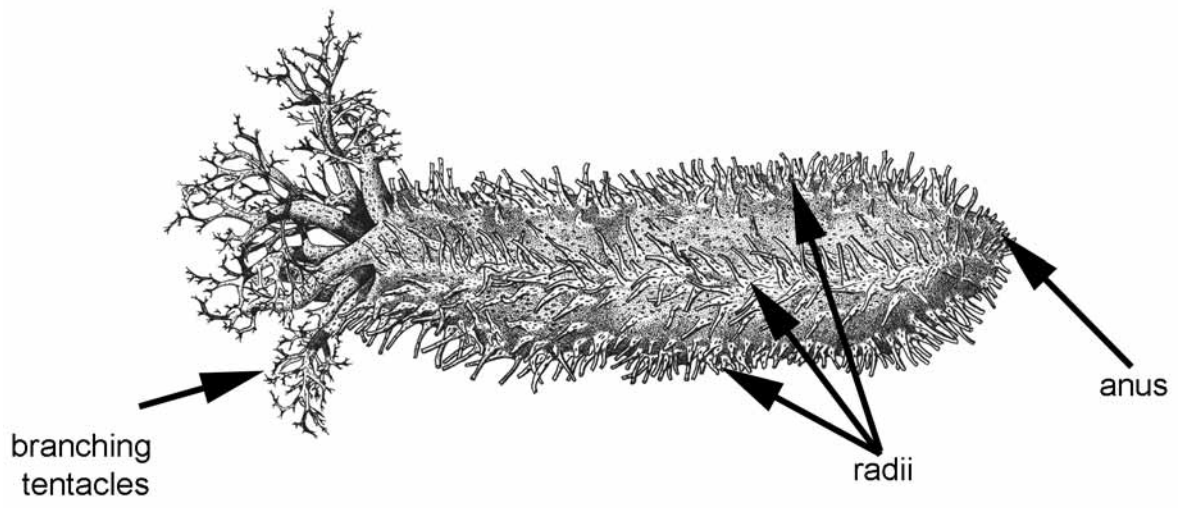

FIGURE 1. A holothurian, Order Dendrochirotida. At left, ten branching tentacles surround the mouth. At the right extremity of the body is the anus. Between oral end and anus are five rows of tube feet defining the radii. A few feet are scattered in the interradii. After Hendler *et al.*, 1995.

Form and function. The anatomical structures of sea cucumbers are depicted in figures 1–5. Sea cucumbers range from a few centimeters in length to at least 2 m. The body (Fig. 1) is approximately cylindrical, with a mouth at one end and an anus at the other. The mouth is surrounded by a ring of eight to 30 retractile feeding tentacles (Fig. 2), which are actually modified tube feet arising from the water vascular system. Five radii run along the body from mouth to anus. Tube feet are usually present - but absent from so-

called "apodous" sea cucumbers - and their arrangement on the body wall can vary considerably. They may be present on all radii, sometimes forming conspicuous bands running from mouth to anus. They are often more numerous ventrally than dorsally, and can be scattered in interradii as well as in the radii. Dorsal tube feet may be modified to form papillae. Holothuroid tube feet usually have a terminal skeletal disc, somewhat like echinoid tube feet.

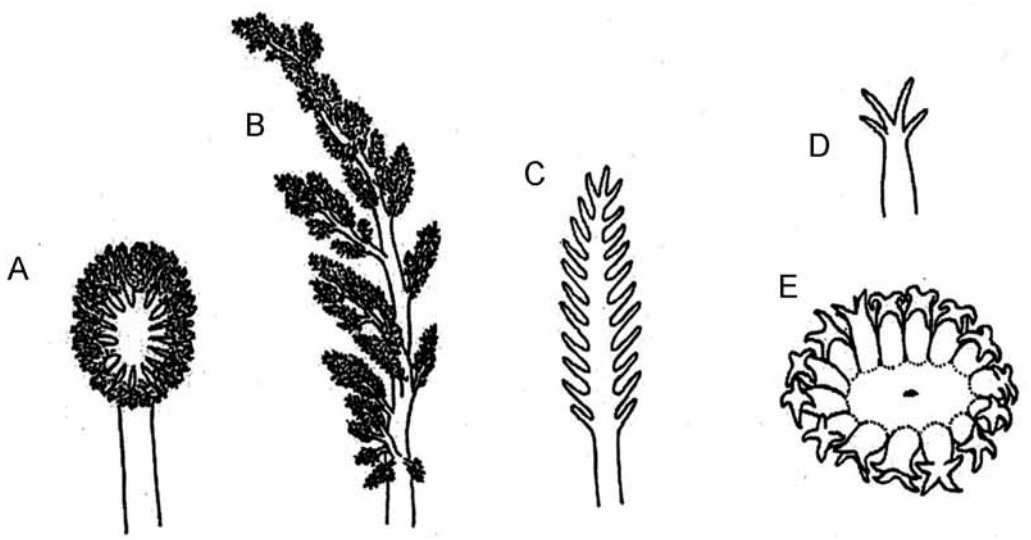

FIGURE 2. Representative holothurian feeding tentacles. A, shield-shaped (Order Aspidochirotida); B, branching (O. Dendrochirotida); C, pinnate (O. Apodida); D, digitate (O. Apodida, O. Molpadiida); E, digitate (O. Molpadiida).

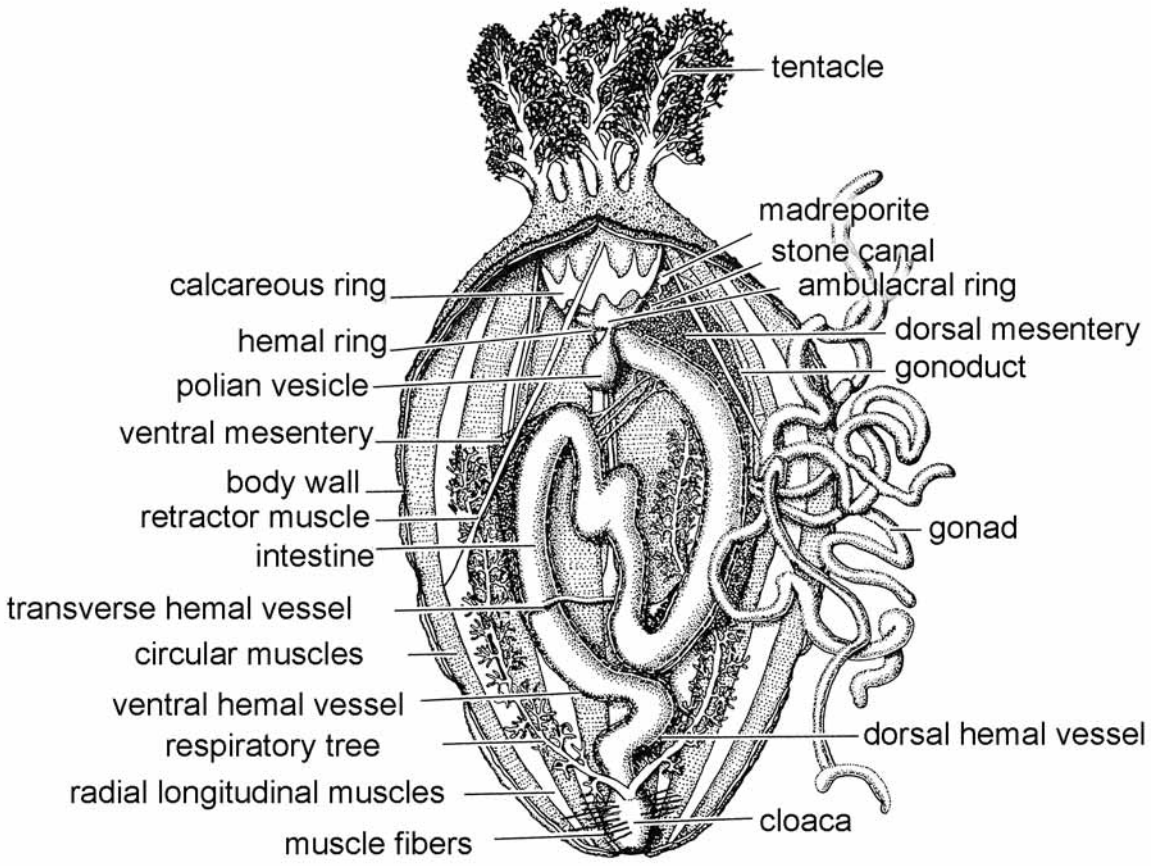

FIGURE 3. A cucumariid holothurian, dissected along the left ventral interradius.

The interior of the body wall is lined with circular muscles overlain by five radial longitudinal muscles (Fig. 3). The esophagus is surrounded by a calcareous ring comprising ten or more sizeable ossicles. There are

usually five radially-placed ossicles and five or more interradials. The shape of the calcareous ring is important in classification (Fig. 4). This ring serves to support the esophagus and is an attachment point for the five longitudinal muscles, which are used to contract the body. When present, the pharyngeal retractor muscles are attached to the ring to withdraw the tentacles. The stomach-intestine runs posteriorly, then anteriorly, then posteriorly again to terminate at the anus. In this class there is no madreporite to be seen on the body wall; it is internal, with a stone canal leading to the water-vascular ring that lies just behind the posterior margin of the calcareous ring. One or more thin-walled, sac-like Polian vesicles also attach to the water ring. The gonad comprises one or two tufts attached to the dorsal body wall, and it is usually composed of numerous branched or unbranched tubules. A single genital duct, running anteriorly in the dorsal mesentery, leads to an opening immediately posterior to the ring of tentacles, in the middorsal interradius. In most large and thick-bodied species, branching respiratory trees occupy the posterior part of the coelomic cavity. They are composed of paired arborescent systems of tubes that are connected by means of a short duct to the terminal, enlarged part of the large intestine, the cloaca. The respiratory trees are aerated by pumping movements of the cloaca. Respiratory trees are absent in the Order Apodida.

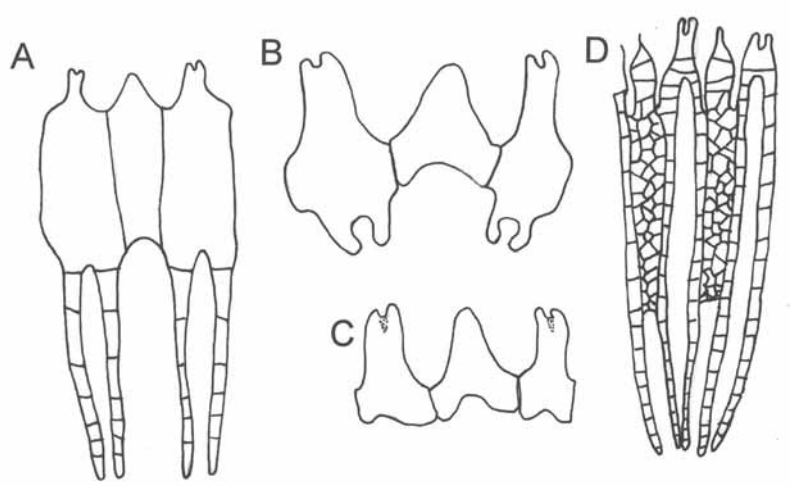

FIGURE 4. Calcareous rings; A, B, C with two radial pieces and one interradial piece, D with two interradial pieces and two notched radial pieces. A, ring with medium posterior projections; B, ring with short posterior projections; C, ring with no posterior projections; D, tubular ring with long, complex, posterior projections.

The sea cucumber skeleton lies in the dermis, and it takes the form of vast numbers of microscopic ossicles. They display a profusion of beautiful geometric shapes, though the form of ossicles in any species is limited, and is usually taxonomically characteristic. Ossicles are denoted by descriptive terms such as buttons, cups, tables, plates, rods, anchors, and wheels (Fig. 5). In some sea cucumbers the presence of ossicles renders the body wall stiff and rough to touch. Details of the shape and size of the ossicles are useful in classification at all taxonomic levels.

There are six orders in the class Holothuroidea, four of which are represented in this region (Dendrochirotida, Aspidochirotida, Molpadiida, Apodida). The Dendrochirotida have a substantial body wall that may be soft or firm. They have an introvert, which is a collar of flexible tissue behind the tentacles that is pulled into the body by retractor muscles. The tentacles are branched or dendritic, and the most ventral pair is usually smallest (fig. 2B). Species with many tentacles have small tentacles either interspersed with the larger ones or forming an inner circlet. The calcareous ring is simple or with well developed posterior processes. Two separate gonadal tufts also characterize the order. As one might surmise, based on the net formed by their tentacles, dendrochirotids are suspension feeders, ingesting microscopic plants such as diatoms and unicellular algae, animals such as protozoa, nematodes, ostracods, copepods, jellyfish, larvae, and microscopic particles of detritus. Their food is trapped in, or adheres to, mucus on the tentacle branches. Representatives of the order are uncommon on reefs, presumably because of the relatively low concentrations of plankton there.

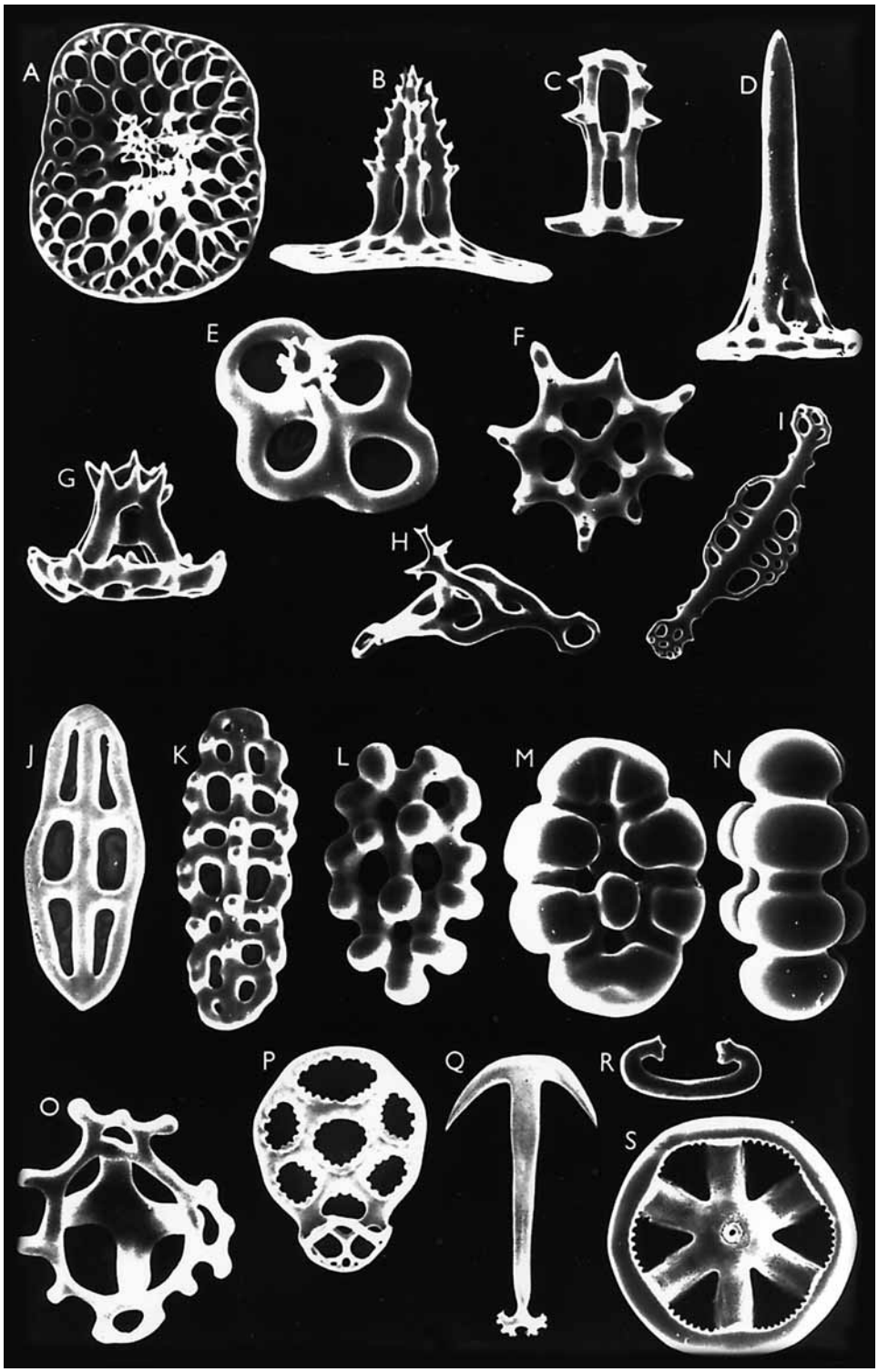

FIGURE 5. Some representative holothurian body wall ossicles. A–E, G–H, tables viewed from various angles; F, crossed cup; I, perforated rod; J–N, smooth and knobbed buttons; O, cup; P, anchor plate; Q, anchor; R, C-shaped rod; S, wheel. Partly after Hendler *et al.*, 1995.

The Aspidochirotida have a thick body wall and conspicuous bilateral symmetry. The ventral surface bears numerous locomotory tube feet, and in some species is flattened into a sole. The tube feet of the dorsal surface are often modified to form papillae. Aspidochirotids have 10 to 30 (usually 20) tentacles that usually are peltate (i.e. each bearing a shield-shaped group of branches arising from a short central stalk - see fig. 2A). A collar (rim composed of fused tube feet) surrounds the tentacles and closes over them when they are retracted, serving the same protective function as the introvert of the Dendrochirotida. The calcareous ring is

simple. The Aspidochirotida are deposit feeders, using short tentacles to pass food to the mouth, and most occur in low energy environments where rich sediments accumulate. They characteristically select for organic content rather than the size of their food particles. They, and other deposit feeding holothurians, consume organic and inorganic detritus and associated microorganisms, protozoans and meiofauna.

The Molpadiida have plump, sausage-shaped bodies, usually tapering posteriorly to form a conspicuous tail. With a couple of deep-sea exceptions, tube feet are absent. The mouth is at the center of a disc ringed by 15 tentacles, each with 2–4 terminal digits (fig. 2E). The body wall ossicles are usually derived from three-holed tables, and they may be elongate rods. In many species the ossicles change from calcium carbonate to a complex of iron phosphates with advancing age, and they break down to form red deposits. Molpadiids are deposit-feeders, usually burrowing into soft sediments.

The Apodida are worm-like, with a thin body wall and 10 to 20 digitate or pinnate tentacles (fig. 2C, D). They characteristically lack tube feet and respiratory trees. Apodids possess easily recognized anchor or wheel ossicles, which may often be seen within their translucent body wall. They are generally nocturnal deposit feeders, collecting particles by the mechanical operations of the tentacles or by the adhesiveness of the tentacles. Discrete sensory organs are more evident in the family Synaptidae than in other sea cucumbers, perhaps related to their delicate construction and mobility. Some species have pigmented photoreceptors at the base of the tentacles and some also have statocysts, organs of balance.

General biology. The slow-moving ways of sea cucumbers are legendary. One *Cucumaria* individual stayed in same spot in an aquarium for two years (Hendler *et al.*, 1995). Some sea cucumbers can move by using their podia; others produce locomotory waves of the body wall, conjuring up the image of a giant caterpillar. Surprisingly, certain species can swim. For example, a *Leptosynapta* species moves through the water by alternately flexing in a U-shape and extending its body (Costello, 1946). Most of the actively swimming species are found in bathyal or abyssal depths.

The sedentary behavior and soft body wall of most sea cucumbers might seem to place them at the mercy of carnivorous fish and crustaceans. It is perhaps not surprising then that there is evidence of toxic compounds sequestered in the bodies of many holothuroids, substances that deter attacks by predators. Also in the defensive arsenal of some aspidochirotid sea cucumbers are the cuvierian tubules attached to respiratory trees. They are very elastic white, pink, or red tubules that are ejected, blind end first, through the anus and, after discharge, stretch up to 20 times their original length. They are not only readily expelled but also rapidly regenerated. Whether cast out singly or as an entire tuft, the tubules swell into sticky threads. The tubules appear to be toxic, and they are extremely adhesive, instantly fouling any object they contact. Some species undergo autoevisceration (ejection of the intestine and related structures) if stressed, but the self-inflicted damage can be repaired by subsequent regeneration. Large aspidochirotids (e.g., *Holothuria*, *Stichopus*, *Actinopyga*) rupture at the cloaca and contract the body wall to expel the respiratory trees, gonads, and gut through the anus. Dendrochirotids (e.g., *Thyone*, *Phyllophorus*) may rupture at the introvert and shed the aquapharyngeal bulb and attached structures.

In most sea cucumber species males and females are separate; 12 hermaphroditic species are known, of which, six are in the family Synaptidae. Spawning individuals usually stretch the anterior extremity off the bottom and into the water. Aspidochirotids characteristically sway to and fro in a "cobra-like" fashion, and dendrochirotids wave their tentacles, ejecting and mixing sex cells. These spawning events may be brief, lasting only seconds, or they may last for several hours. Cases are reported of spawning aggregations and of "pseudocopulation" - the pairing of individuals, a male and a female, with fore-ends intertwined.

Indirectly developing species in the Aspidochirotida and Apodida have a planktonic feeding auricularia larva, with a looped ciliary band that passes over the oral and anal hoods. Some auriculariae have internal ossicles or clear spherules. During metamorphosis, the ciliary band breaks and reforms as rings, and the viscera are modified, but no torsion occurs since the adult body has the same orientation as the larva. The majority of holothuroids develop from a non-feeding yolky vitellaria (also called "doliolaria") larva that has ciliary bands arranged as in the postmetamorphic pelagic juvenile. The pelagic life of these larvae usually spans two weeks to two months, after which the settling juveniles are able to attach to the substratum using their five buccal tube feet.

At least 41 species of sea cucumbers brood their young, a majority of these being in the family Cucumariidae. Brooders deposit eggs in their tentacles, or they use the tentacles to position eggs underneath the body or in special incubatory pockets in the body wall. There are 14 species that retain developing young in the gonad or coelom. Only nine species (in the families Cucumariidae and Holothuriidae) reproduce asexually; one, *Holothuria surinamensis*, occurs in the South Atlantic Bight. The process of asexual transverse fission takes 14 hours to five days, and is followed by regeneration of structures missing from the severed anterior and posterior halves of the animal.

Sea cucumbers host a wide assortment of commensals and parasites, some highly modified, including protozoans, flatworms, polychaetes, copepods, crabs, pycnogonids, clams and snails. One snail produces fine tubes that resemble holothuroid gonadal tubules, and that were long mistaken as part of the host until it was discovered that small snails inside the tubes were actually the developing young of a gastropod parasite. Possibly the most interesting commensal is the pearlfish, which inhabits the posterior intestinal tract or respiratory tree.

Ecological and commercial importance. An active fishery for sea cucumbers has existed for at least 1,000 years. Sloan (1985) and Toral-Granda *et al.* (2008) provide comprehensive reviews of sea cucumber fisheries world-wide. At least 13,371 MT of sea cucmbers are landed every year, mostly from the Japanese and Korean fishery for *Stichopus japonicus* Selenka, and are consumed raw and undried. This species is not only heavily fished, but it is also reared in aquaculture. There is an additional harvest of over 625 MT per year of the North American *Parastichopus* spp., but only the muscle bands of these thin-bodied species are eaten. Dried sea cucumbers, known as trepang (Malaysian) or bêche-de-mer (French rendering of the Portuguese bicho do mar), are gourmet fare on some tables, and have been considered to possess aphrodisiac or curative properties. At least 50 species are harvested or farmed for human consumption, and exported primarily to markets in China, Japan, and other southeast Asian countries.

Ecological effects of sea cucumbers on marine communities are not well documented. *Holothuria arenicola*, a species that lives on sand bottoms, dredges 47 kg/m^2/yr of dry-weight sediment from 15–20 cm below the surface, and this must affect fauna living near the small volcanoes of sediment that mark the sea cucumber's numerous burrows. As well, on Indo-Pacific reef flats, where sea cucumbers may occur in excess of 35/m^2 and where individuals can process 80 g dry weight of sediment/day, there must be some effect on ecological processes. However, sediment is not markedly altered by sea cucumbers, microscopic plants and animals are largely unaffected even when ingested, and sea cucumber feces do not appreciably enrich the sediment.

Important references. A classic but now outdated reference to the fauna of this region is Deichmann's (1930) monograph of the western Atlantic sea cucumbers. Miller & Pawson's (1984) report on the species of the Gulf of Mexico is a helpful adjunct, containing photographs of some Atlantic Bight species and information on distribution. Hendler *et al.* (1995) provide detailed information on 16 of the species treated herein. A general reference to the limited fossil history of the group is Frizzell & Exline (1966). More recent studies of fossil holothuroids have treated deposits of ossicles and the structures of exquisitely preserved, complete specimens (Smith & Gallemi, 1991; Gilliland, 1992). The reproductive biology of holothuroids has recently been reviewed by Smiley *et al.* (1991), and feeding by Jangoux & Lawrence (1982).

Materials and methods

The size of sea cucumbers is given as a total length from the anterior end of the body to the posterior end. The size can change dramatically as the animal contracts and expands, so that body measurements alone are a highly unreliable indicator of the identity of a species. Dissections to study internal anatomy are made by cutting longitudinally on the right or left side of the dorsal body wall. The all-important ossicles in the body wall, tube feet, and tentacles can be studied only with a high-power ("compound") microscope. If a small piece of tissue, cut from the specimen with fine scissors or a razor blade, is placed in a vial or on a glass microscope slide and then covered with several drops of liquid household bleach, the bleach dissolves away the soft tissues, leaving the ossicles, which can then be studied under the microscope. Permanent slide

preparations can be made by carefully replacing the bleach with water several times, allowing the preparation to dry thoroughly, and adding a commercial mounting medium and coverslip to the slide.

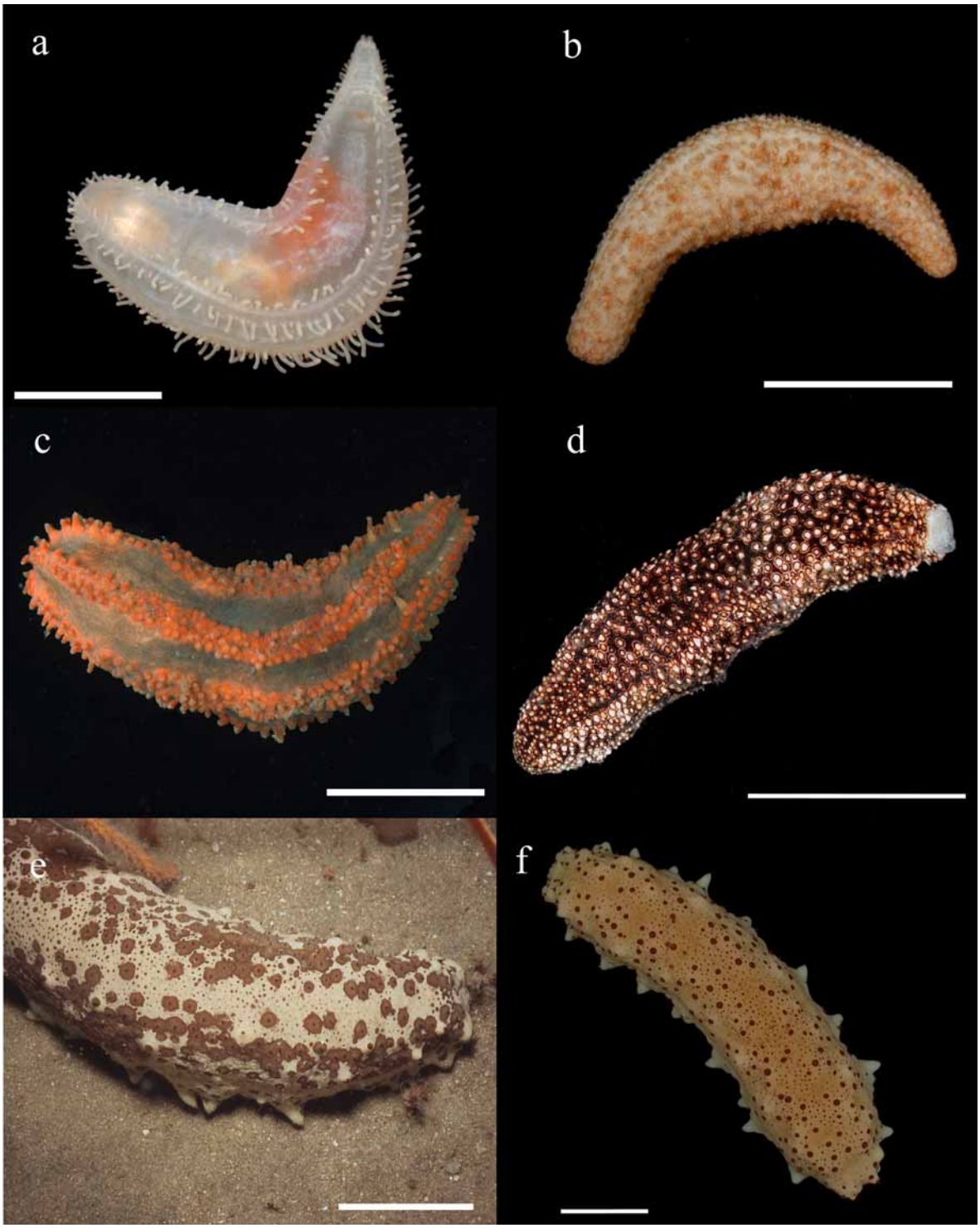

FIGURE 6. Some SERTC holothurians. a) *Pentamera pulcherrima*; b) *Thyonella pervicax*; c) *Aslia pygmaea*; d) *Holothuria princeps*; e) *Actinopyga agassizii*; f) *Isostichopus badionotus*. Scalebars: a = 1 cm; b,c = 2 cm; d,e,f = 5 cm.

We examined scientific publications as well as national (National Museum of Natural History, Washington DC) and regional collections (Duke Marine Laboratory, Beaufort, NC; Grice Marine Laboratory, Charleston SC; South Carolina Department of Natural Resources, Charleston SC; Harbor Branch Oceanographic Institute at Florida Atlantic University) to produce as comprehensive a list as possible of holothurian species from the South Atlantic Bight.

In the brief species descriptions given below, only the original reference and one or more recent useful references are given.

The following abbreviations have been used: DML—Duke Marine Laboratory, Beaufort, NC; GML—Grice Marine Laboratory, College of Charleston, Charleston, SC; MRRI—Marine Resources Research Institute, SCDNR, Charleston, SC; SERTC—Southeast Regional Taxonomic Center, SCDNR, Charleston, SC.

Checklist of South Atlantic Bight holothurians

Class Holothuroidea
Order Dendrochirotida
Family Cucumariidae
Duasmodactyla seguroensis (Deichmann, 1930)
Euthyonacta solida (Deichmann, 1930)
Aslia pygmaea (Théel, 1886a)
Aslia surinamensis (Semper, 1868)
Paracolochirus mysticus (Deichmann, 1930)
Thyonella gemmata (Pourtalès, 1851)
Thyonella pervicax (Théel, 1886a)
Family Sclerodactylidae
Euthyonidiella trita (Sluiter, 1910)
Pseudothyone belli (Ludwig, 1886b)
Sclerodactyla briareus (Lesueur, 1824)
Havelockia scabra (Verrill, 1873)
Family Phyllophoridae
Pentamera pulcherrima Ayres, 1854
Phyllophorus (Urodemella) arenicola Pawson & Miller, 1992
Thyone crassidisca Pawson & Miller 1981
Thyone deichmannae Madsen, 1941
Thyone pawsoni Tommasi, 1972
Thyone pseudofusus Deichmann, 1930
Family Psolidae
Psolus fabricii (Düben & Koren, 1846)
Psolus operculatus (Pourtalès, 1868)
Psolus tuberculosus tuberculosus Théel, 1886b.

Order Aspidochirotida
Family Stichopodidae
Isostichopus badionotus (Selenka, 1867)
Family Holothuriidae
Actinopyga agassizii (Selenka, 1867)
Holothuria (Halodeima) grisea Selenka, 1867
Holothuria (Holothuria) dakarensis Panning, 1939
Holothuria (Semperothuria) surinamensis Ludwig, 1875
Holothuria (Theelothuria) princeps Selenka, 1867
Holothuria (Vaneyothuria) lentiginosa enodis Miller & Pawson, 1979

Order Molpadiida
Family Molpadiidae

Molpadia oolitica (Pourtalès, 1851)

Family Caudinidae

Paracaudina chilensis obesacauda (H.L. Clark, 1908)

Order Apodida

Family Synaptidae

Labidoplax buskii (McIntosh, 1866)

Epitomapta roseola (Verrill, 1873)

Leptosynapta tenuis Ayres, 1851

Family Chiridotidae

Chiridota ferruginea (Verrill, 1882)

Key to Orders of Holothuroidea known from the South Atlantic Bight

1. Tube feet absent. Body cylindrical and worm-like, or fusiform with a conspicuous tail region. No obvious bilateral symmetry. Tentacles digitate or pinnate. Ossicles usually include wheels or anchors 2
- Tube feet present. Body varies in shape, usually displaying bilateral symmetry. Tentacles digitate in a few taxa, but usually richly branched, or shield-shaped. Ossicles do not include wheels or anchors..... 3
2. Body cylindrical. Tentacles 10–12. Respiratory trees and anal papillae absent. Ossicles often include wheels, or anchors ..... Order Apodida
- Body fusiform, narrowing posteriorly to form a conspicuous tail. Tentacles 15. Respiratory trees present; anal papillae may be present. Ossicles not wheels ..... Order Molpadiida
3. Introvert and retractor muscles present. Tentacles usually richly branching, occasionally digitate..... ..... Order Dendrochirotida
- Introvert and retractor muscles absent. Tentacles shield-shaped..... Order Aspidochirotida

Key to members of the Order Dendrochirotida known from the South Atlantic Bight

1. Body limpet-like, partially covered by conspicuous overlapping plates (Family Psolidae) 2
- Body without a partial test; ossicles usually small, inconspicuous 4
2. Five distinct oral valves present..... 3
- Not five distinct oral valves ..... *Psolus fabricii*
3. Dorsal plates with small knobs (tuberculated). Plates in sole with 10 or more perforations..... ..... *Psolus t. tuberculosus*
- Dorsal plates not tuberculated. Plates in sole with about four perforations ..... *Psolus operculatus*
4. Calcareous ring simple, lacking posterior processes. (Family Cucumariidae)..... 5
- Calcareous ring with paired or unpaired posterior processes 11
5. Ossicles in body wall include tables. ..... *Duasmodactyla seguroensis*
- Ossicles in body wall not including tables..... 6
6. Tube feet restricted to radii, at least ventrally, mostly absent from interradii 7
- Tube feet present in radii and interradii. 9
7. Ossicles irregular four-holed plates with low knobs and not including cups ..... *Paracolochirus mysticus*
- Ossicles include cups and buttons. 8
8. Cups irregular, hollow, like reticulated eggs. Buttons of one type, with ten knobs. ..... *Aslia pygmaea*
- Cups deep, concavity defined by four spokes. Buttons of two types: heavier small-holed and delicate large-holed .... *Aslia surinamensis*
9. Tube feet most numerous along radii. Perforated plates in body wall. Cups flattened, shallow, margin solid, with 7–9 teeth. ..... *Thyonella gemmata*
- Tube feet uniformly scattered over body. No perforated plates in body wall..... 10
10. Cups deep with narrow opening; margin fringed with numerous, irregular, small teeth on both inner and outer sides ..... *Euthyonacta solida*
- Cups shallow with wide opening; with 7–10 blunt teeth forming margin..... *Thyonella pervicax*
11. Posterior processes of calcareous ring simple, entire 12
- Posterior processes of calcareous ring complex, composed of a mosaic of minute pieces. 14

12. Ossicles knobbed buttons. Tube feet contain elongate tables ..... *Pseudothyone belli*
- Ossicles tables. Buttons absent. 13
13. Tables oblong to oval, with two-pillared spires. ..... *Euthyonidiella trita*
- Tables squarish, with four-pillared spires. ..... *Sclerodactyla briareus*
14. Tube feet restricted to the radii. ..... *Pentamera pulcherrima*
- Tube feet scattered on body wall. 15
15. With 10 tentacles. 16
- With 20 tentacles. Ossicles tables with scalloped margins and 4–8 perforations. Table spires reduced to form four bluntly pointed projections. ..... *Phyllophorus (Urodemella) arenicola*
16. Ossicles tables with oval disc, four perforations, and thick margins. 17
- Ossicles tables with thin margins, irregular disc outlines, and few to numerous perforations. 18
17. Spires of tables terminating in several short teeth ..... *Thyone pseudofusus*
- Spires of tables terminating in a single blunt spine ..... *Thyone crassidisca*
18. Tables with 20–30 holes. Tables in tube feet with short, non-tapering spires ..... *Havelockia scabra*
- Tables with 4–8 or 8–18 holes. Tables in tube feet with longer, tapering spires 9
19. Tables with 4–8 holes. Tables in tube feet with abruptly tapering spires ..... *Thyone pawsoni*
- Tables with 8–18 holes. Tables in tube feet with gently tapering spires. ..... *Thyone deichmannae*

Key to members of the Order Aspidochirotida known from the South Atlantic Bight

1. Gonad in two tufts, one to each side of the dorsal mesentery. Tables and C-shaped ossicles present. (Family Stichopodidae) ..... *Isostichopus badionotus*
- Gonad in one tuft, lying on the left side of the dorsal mesentery. Tables present, usually accompanied by buttons or plates or rods, no C-shaped ossicles. (Family Holothuriidae) 2
2. Calcified anal teeth present ..... …*Actinopyga agassizii*
- Calcified anal teeth absent. 3
3. Ossicles tables with disc reduced to a simple X-shape; no accompanying buttons, plates, or rods ..... *Holothuria (Semperothuria) surinamensis*
- Ossicles tables with disc not reduced; buttons or plates also present 4
4. Ossicles tables accompanied by buttons which are irregular, twisted, and knobbed, or regular and knobbed ..... ….5
- Ossicles tables accompanied by smooth buttons or smooth perforated plates 6
5. Ossicles buttons, irregular and twisted; huge tack-like tables in feet ..... *Holothuria (Theelothuria) princeps*
- Ossicles buttons regular, with numerous knobs. No huge tack-like tables ..... *Holothuria (Holothuria) dakarensis*
6. Ossicles tables accompanied by smooth buttons with two rows of holes ..... *Holothuria (Vaneyothuria) lentiginosa enodis*
- Ossicles tables accompanied by small, smooth plates with 2–4 central holes and a few smaller marginal holes ..... *Holothuria (Halodeima) grisea*

Key to members of the Order Molpadiida known from the South Atlantic Bight

Ossicles in body wall transformed into dark red phosphatic bodies. Tail ossicles tables. (Family Molpadiidae) ..... *Molpadia oolitica*
- Ossicles in body wall not transformed into dark red phosphatic bodies. Body wall and tail ossicles in form of distinctive crossed cups (Family Caudinidae) ..... *Paracaudina chilensis obesacauda*

Key to members of the Order Apodida known from the South Atlantic Bight

1. Body wall ossicles anchors and anchor plates (Family Synaptidae) 2
- Body wall ossicles wheels, most common near posterior of body (Family Chiridotidae) ..... *Chiridota ferruginea*
2. Anchor plates narrowed posteriorly to form a handle ..... *Labidoplax buskii*
- Anchor plates rounded posteriorly; no handle 3
3. Anchor plates more than 140 µm long. ..... *Leptosynapta tenuis*
- Anchor plates less than 110 µm long. ..... *Epitomapta roseola*

Systematics

Order Dendrochirotida Grube, 1840

Family Cucumariidae Ludwig, 1894

***Duasmodactyla seguroensis* (Deichmann, 1930)**
Figure 7

Phyllophorus seguroensis Deichmann, 1930: 141, pl.17 figs.10–13.
Duasmodactyla seguroensis.—Hendler *et al.*, 1995: 259, figs 140, 178A,B.

Material examined. SERTC S2215, 70.2 miles @ 102 degrees off Charleston Light, SC, 32°30.3'N, 78°28.9'W, 210.3 m, coll. GML Staff, April 11 1978.

Diagnosis. Length up to10 cm with 20 dendritic tentacles, 5 large pairs alternating with 5 smaller pairs. Color dark greenish-brown to mottled brown, with paler feet. Tube feet scattered, except on the introvert where they form 5 distinct rows. All body wall ossicles are tables (66–100 μm), with undulating and scalloped margins perforated by about 12 peripheral and 4 central holes; short 4-pillared spires terminate in 15–16 small spines.

Distribution. SC to FL, Gulf of Mexico, Jamaica, Puerto Rico, Venezuela, Brazil.

Habitat. Coastal areas, seagrass beds. Littoral to13m.

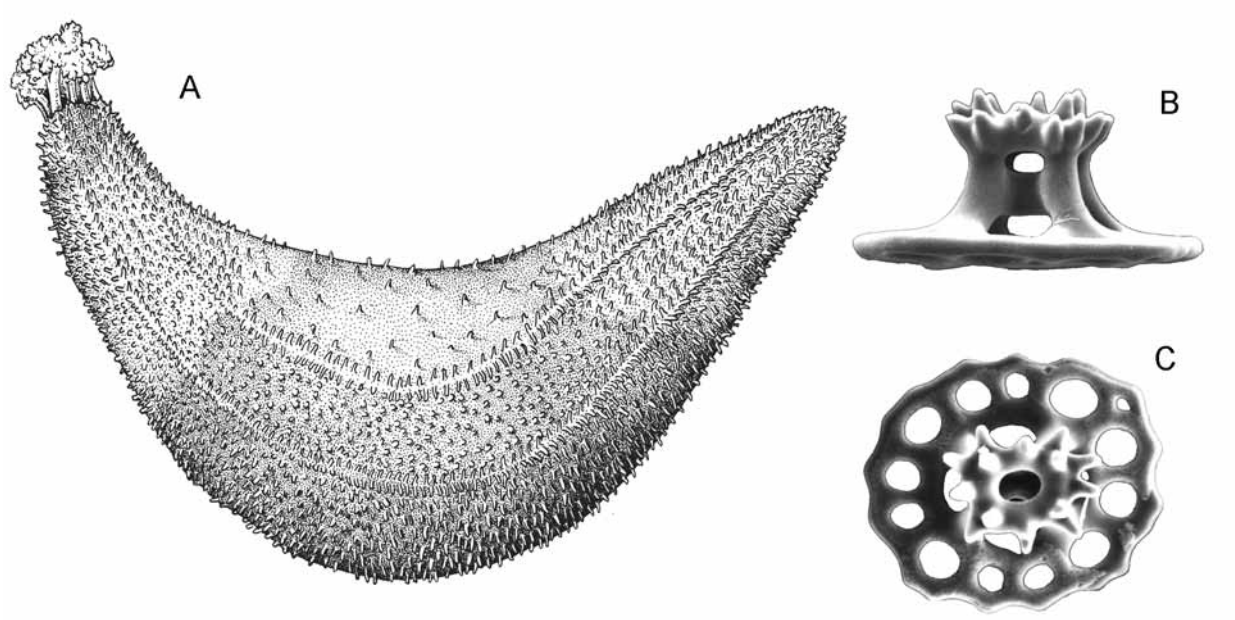

FIGURE 7. *Duasmodactyla seguroensis* (Deichmann, 1930). A, whole animal; B, table in lateral view; C, table, top view.

Remarks. Heding & Panning (1954), without comment, listed *Phyllophorus conchilegum* (Pourtalès, 1868) as a junior synonym of *D. seguroensis*. We can find no evidence to support this step. Deichmann (1930) noted that *D. seguroensis* has a "high" calcareous ring and tables and rosettes in the introvert, while *P. conchilegum* has a "low" calcareous ring and tables and perforated plates in the introvert; in any case, if *P. conchilegum* and *D. seguroensis* were eventually found to be synonymous, the former species-name would have priority.

***Euthyonacta solida* (Deichmann, 1930)**
Figure 8

Thyone solida Deichmann, 1930: 172, pl. 15 figs. 11–17; pl. 16 figs1–2.
Euthyonacta solida.—Miller & Pawson, 1984: 15–17, figs. 7, 8.

Material examined. USNM E22566, S.C., 32°51’30”N, 78°59’00”W, R/V Pelican Sta 182-23, February 12, 1940, 26m. USNM E22607, Florida, off East Coast, 30°28’00”N, 80°43’30”W, R/V Pelican Sta176-8, January 25, 1940, 33m. USNM E33173, Florida, 27°50'N, 80°10'W, R/V Delaware II Sta 027, 25.6m, April 21, 1983, 2. USNM E33184, Florida, 29°50'N, 80°15'W, R/V Delaware II Sta 147, April 27,1983, 90–92m, 5. USNM E33177, Florida, 27°10'N, 80°01'W, R/V Delaware II Sta002, April 20,1983, 43.9–45.7m. USNM E33174, Florida, 29°10'N, 80°30'W, R/V Delaware II Sta 086, April 24,1983, 27.4m, 3. USNM E33176, Florida, 28°00'N, 80°12'W, R/V Delaware II Sta 040, April 22,1983, 27.4m, 2. USNM E33175, Florida, 29°20’00”N, 80°52’42”W, R/V Delaware II Sta 073, May 21, 1984, 20.1m, 2. USNM E39038, Florida, North of Cape Canaveral, 28°35’24”N, 80°18’24”W, R/V Oregon II Sta 45110, March 24,1987, 27.4m. USNM E39037, Florida, North of Cape Canaveral, 28°55’12”N, 80°13’54”W, R/V Oregon II Sta 45093, March19,1987, 46m. USNM E39042, Florida, East of Cape Canaveral, 28°15’00”N, 79°54’54”W, R/V Oregon II Sta 45151, March 21,1987, 183m. USNM E32250, off N.C., 33°48’ 36”N, 76°34’06”W, R/V Oregon II Sta 45110, March 4,1981, 69m. DML 4122, 33º31.4'N, 77º25.2'W, R/V Bluefin Sta MS04, February 7, 1981, 30m. DML 4347, 33º48.6'N, 76º35'W, 99 m.

Diagnosis. Length 10–60mm, body barrel-shaped. Color in life orange-brown with some darker mottling. Five prominent oral valves conceal mouth. Feet uniformly scattered over body surface, capable of complete retraction. Bodywall thick, filled with ossicles consisting of deep cups (40–60 μm in diameter) and buttons (55–100 μm long); no plates.

Distribution. NC to E and W FL, Gulf of Mexico.

Habitat. Crushed shell sediments. 6–124 m.

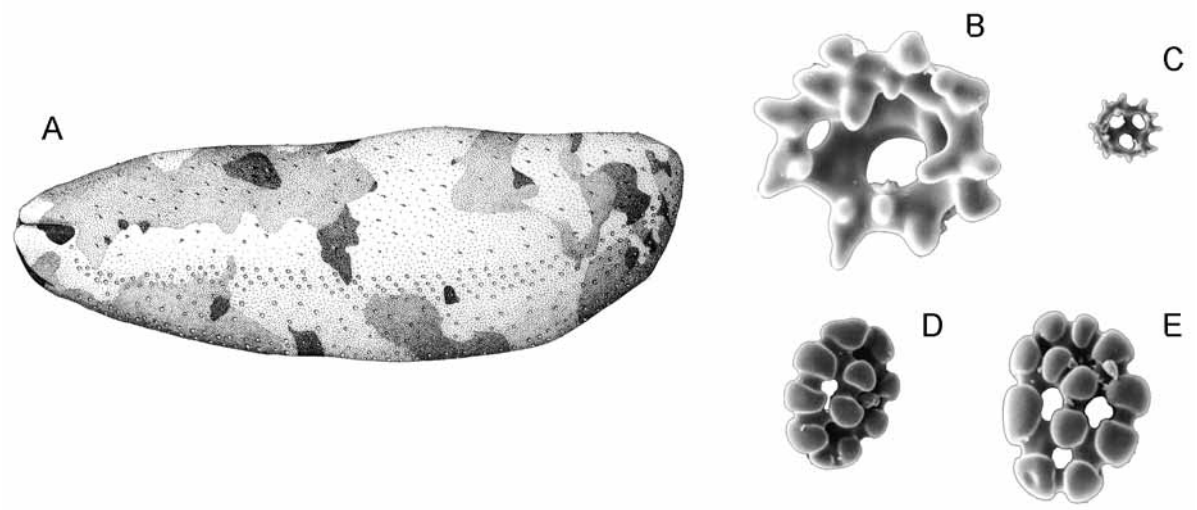

FIGURE 8. *Euthyonacta solida* (Deichmann, 1930). A, whole animal; B, C, cups; D, E, buttons.

Remarks. Deichmann (1954) referred this species to her new genus *Euthyonacta.* Miller & Pawson (1984) found just two specimens in the “Hourglass” collection. Apparently this species is not common where it occurs.

***Aslia* Rowe, 1970**

We are in agreement with our colleague F.W.E. Rowe, who has suggested (personal communication) that the following two species should be transferred from the genus *Ocnus* Forbes, 1841, to *Aslia* Rowe, 1970.

Because these species possess ossicles in the form of four-holed knobbed buttons and an external layer of deep quadrilocular cups, they conform more closely to *Aslia* in the strict sense. In contrast, *Ocnus*, as envisaged by Rowe (1970) and Rowe and Gates (1995) possesses buttons with more than four holes, and simple, shallow, trilocular cups.

***Aslia pygmaea* (Théel, 1886a)**
Figure 6c, 9

Colochirus pygmaea Théel, 1886a: 83, pl. 4 fig.9.
Pentacta pygmaea .—Deichmann, 1930: 180, pl. 21 figs. 10–16.
Ocnus pygmaeus .— Miller & Pawson, 1984: 17, figs.10, 11.

Material examined. USNM E02639, S.C., Winyan Bay, 33°49’45”N, 78°04’00”W, R/V Fish Hawk, Sta 8275, July 12, 1915, 7fm. USNM E02643, N.C., off Fishing Buoy, 34°20’15”N, 76°49’00”W, R/V Fish Hawk, Sta 8283, July 14, 1915, 16fm. USNM E17189, S.C., 7 miles off Little River, August 1949, 1.4m, 2. USNM E19492, Georgia, 31°40'N, 80°16'W, R/V Pierce, Sta 4D, February 24, 1977, 26m. USNM E19715, Florida, 29°31'N, 80°40'W, R/V Pierce, Sta 7C, Nov.27, 1977, 18m. USNM E19716, Florida, 29°31'N, 80°40'W, R/V Pierce, Sta 4D, February 24, 1977, 26m. SNM E21577, Florida.,28 °05’30”N, 80°11’30”W R/V Silver Bay, Sta 1952, April 20, 1960, 29.3–30.2m, 9. USNM E22625, Florida, off E coast, 29°16’30”N, 80°58’00”W, R/V Pelican, Sta 174-3, Jan. 20, 1940, 18m. USNM E22448, Florida, off NE coast, 30°24'N, 80°26'W, R/V Combat, Sta 200, Jan. 10, 1957, 38–40m. USNM E22551, N.C., 45 miles SSW of Cape, 34°03’30”N, 76°44’00”W, R/V Pelican, Sta 185-2, Feb. 16, 1940, 37m. USNM E22548, N.C., 33°40'N, 78°13’30”W, R/V Pelican, Sta 183-11, Feb. 13, 1940, 16m. USNM E22551, N.C., 45 miles SSW of Cape Lookout, 34°03.5'N, 76°44.0'W, R/V Pelican, Sta 185-2, February 16, 1940, 20fm. USNM E22553, N.C., 34°07’00”N, 77°01’00”W, R/V Pelican, Sta 192-12, March 7, 1940, 27m, 2. USNM E22555, S.C., 33°33’00”N, 77°42’00”W, R/V Pelican, Sta 184-7, Feb. 15, 1940, 16m. USNM E2639, S.C., Winyan Bay, 33°49’45”N, 78°04’00”W, R/V Fish Hawk, Sta 8275, July 12, 1915, 13m. USNM E27787, Georgia, 31°23’30”N, 80°53’06”W, R/V Dolphin, Sta IS02, August 9, 1980, 17m. SNM E27788, Georgia, 31°23’30”N, 80°52’48”W, R/V Dolphin, Sta IS02, August 9, 1980, 17m, 2. USNM E27789, Georgia, 31°23’12”N, 80°53’06”W, R/V Dolphin, Sta IS02, August 9, 1980, 18m.USNM E27790, off S.C., 32°29’54”N, 79°42’36”W, R/V Dolphin, Sta IS01, August 7, 1980, 17m. USNM E27791, Georgia, 31°23’42”N, 80°52’54”W, R/V Dolphin, Sta IS02, August 9, 1980, 17m. USNM E27792, Georgia, 31°23’06”N, 80°53’06”W, R/V Dolphin, Sta IS02, August 9, 1980, 18m. USNM E27793, Georgia, 31°23’12”N, 80°53’ 12”W, R/V Dolphin, Sta IS02, August 9, 1980, 17m. USNM E27794, off S.C., 32°30’00”N, 79°42’18”W, R/V Dolphin, Sta IS01, August 7, 1980, 17m. USNM E27795, off S.C., 31°23’48”N, 80°53’06”W, R/V Dolphin, Sta IS02, August 9, 1980, 17m, 6. USNM E27796, off Georgia, 31°23’42”N, 80°53’06”W, R/V Dolphin, Sta IS02, August 9, 1980, 17m, 5. USNM E28181, off Georgia, 31°23’42”N, 80°53’06”W, R/V Dolphin, Sta IS02, August 9, 1980, 17m. USNM E28182, off S.C., 32°30’00”N, 79°42’18”W, R/V Dolphin, Sta IS01, Jan. 17, 1980, 18m. USNM E28184, off Georgia, 31°23’12”N, 80°53’18”W, R/V Dolphin, Sta IS02, Jan. 29, 1980, 18m, 2. USNM E28185, off Georgia, 31°24’06”N, 80°53’12”W, R/V Dolphin, Sta IS02, Jan.29, 1980, 18m. USNM E28186, off Georgia, 31°23’12”N, 80°52’54”W, R/V Dolphin, Sta IS02, August 9, 1980, 17m. USNM E28210, off Georgia., 31°24’00”N, 80°53’18”W, R/V Dolphin, Sta IS02, Jan. 29, 1980, 16m, 3. USNM E28307, off Georgia., 31°24’00”N, 80°53’24”W, R/V Dolphin, Sta IS02, Jan. 29, 1980, 18m. USNM E28308, off Georgia., 30°26’12”N, 80°12’18”W, R/V Dolphin, Sta IS03, March 11, 1980, 61m. USNM E28315, off Georgia., 30°26’ 5”'N, 80°12’ 06”W, R/V Dolphin, Sta IS03, March 10, 1980, 60m. USNM E29355, off S.C., 32°49’24”N, 78°39’48”W, R/V Bagby, Sta MS06, July 27, 1981, 34m. USNM E29358, off S.C., 31°31’54”N, 79°44’24”W, R/V Oregon, Sta OS01, August 5, 1981, 58m. USNM E29361, off S.C., 32°49’ 30”N, 78°39’48”W, R/V Bagby, Sta MS06, March 15, 1981, 34m, 2. USNM E29374, off S.C., 32°29’ 3”'N, 79°42’30”W, R/V Bagby, Sta IS01, July 26, 1981, 18m. USNM E29388, off Georgia, 31°41’ 0”'N,

80°20’48”W, R/V Bagby, Sta MS02, March 10, 1981, 28m. USNM E29389, off S.C., 32°29’36”N, 79°42’30”W, R/V Bagby, Sta IS01, May 23, 1981, 17m. USNM E29406, off S.C., 32°29’00”N, 78°50’00”W, R/V Oregon, Sta OS06, August 6, 1981, 52m. USNM E29407, off S.C., 32°29’36”N, 79°42’30”W, R/V Bagby, Sta IS01, May 23, 1981, 17m. USNM E29410, off Georgia, 31°41’00”N, 80°20’36”W, R/V Oregon, Sta MS02, April 29, 1981, 52m. USNM E29437, off S.C., 32°49’30”N, 78°39’48”W, R/V Bagby, Sta MS06, March 15, 1981, 34m. USNM E29438, off N.C., 34°23’18”N, 76°33’48”W, R/V Cape Hatteras, Sta IS05, Nov. 10, 1981, 18m. USNM E29439, off N.C., 33°31’54”N, 77°25’30”W, R/V Cape Hatteras, Sta MS04, Nov. 30, 1981, 29m, 3. USNM E29440, off Georgia., 30°26’12”N, 80°12’18”W, R/V Dolphin, Sta OS03, March 11, 1980, 61m. USNM E29456, off N.C., 34°23’36”N, 76°34’54”W, R/V Bluefin, Sta IS05, Feb. 9, 1981, 24m. USNM E29457, off N.C., 34°23’18”N, 76°33’48”, R/V Cape Hatteras, Sta IS05, Nov. 10, 1981, 18m, 5. USNM E29458, N.C., 33°31’42”, 77°24’ 30”W, R/V Dan Moore, Sta MS04, May 18, 1981, 29m, 3. USNM E29459, N.C., 33°31’24”N, 77°24’00”W, R/V Dan Moore, Sta MS04, May 19, 1981, 30m. USNM E29460, off N.C., 34°23’ 06”N, 76°33’48”W, R/V Cape Hatteras, Sta IS05, Nov. 10, 1981, 19m, 11. USNM E29461, N.C., 33°30’36”N, 77°24’12”W, R/V Dan Moore, Sta MS04, August 12, 1981, 28m, 6. USNM E29462, N.C., 33°32’24”N, 77°24’18”W, R/V Dan Moore, Sta MS04, May 18, 1981, 32m, 2. USNM E29463, off N.C., 33°31’48”N, 77°25’06”W, R/V Cape Hatteras, Sta MS04, Nov. 30, 1981, 29m, 2. USNM E29464, N.C., 33°33’30”N, 77°25’00”W, R/V Dan Moore, Sta MS04, May 18, 1981, 34m, 2 . USNM E29465, N.C., 33°32’48”N, 77°24’18”W, R/V Dan Moore, Sta MS04, May 18, 1981, 32m, 6 . USNM E29466, off N.C., 33°32’36”N, 77°24’54”W, R/V Bluefin, Sta MS04, Feb. 7, 1981, 34m. USNM E29467, N.C., 33°32’30”N, 77°24’54”W, R/V Dan Moore, Sta MS04, May 18, 1981, 32m. USNM E29468, off N.C., 33°31’36”N, 77°24’54”W, R/V Dan Moore, Sta MS04, May 19, 1981, 30m. USNM E29469, off N.C., 34°23’06”N, 76°34’12”W, R/V Dan Moore, Sta IS05, May 19, 1981, 20m. USNM E29470, off N.C., 33°31’36”N, 77°24’18”W, R/V Dan Moore, Sta MS04, August 12, 1981, 30m, 5. USNM E29471, off N.C., 33°31’30”N, 77°24’42”W, R/V Cape Hatteras, Sta MS04, Nov. 30, 1981, 30m, 4. USNM E34102, Florida, 14 Nautical Miles E, 27°40'N, 80°06'W, R/V Delaware II, Sta 025, April 21, 1983, 27.4m, 7 . USNM E41645, East of Georgia, 31°23’12”N, 80°53’00”W, R/V Oregon Sta lS02, July 29, 1981, 17m. USNM E41650, East of Georgia, 31°23’18”N, 80°52’54”W, R/V Oregon Sta lS02, October 22, 1981, 17m. USNM E41643, East of S.C., 32°29’18”N, 79°42’48”W, R/V Oregon Sta lS01, Feb. 26, 1981, 17m. USNM E41650, East of Georgia, 31°23’24”N, 80°53’00”W, R/V Oregon Sta lS02, October 22, 1981, 17m, 3 . USNM E41648, East of Georgia, 31°23’36”N, 80°52’54”W, R/V Oregon Sta lS02, October 22, 1981, 17m. USNM E41647, S.C., 32°30’00”N, 79°42’42”W, R/V Oregon, Sta lS01, July 31, 1981, 17m. USNM E41644, S.C., 32°29’48”N, 79°41’54”W, R/V Oregon, Sta lS01, May 2, 1981, 18m. USNM E41646, Georgia, 31°23’12”N, 80°53’12”W, R/V Oregon, Sta lS02, July 29, 1981, 16m. USNM E41651, N.C., 34°23’12”N, 76°34’12”W, R/V Dan Moore, Sta lS05, May 19, 1981, 18m. SERTC 2099, 19.7 miles @ 138 degrees off Charleston Light, SC, 32°31.1'N, 79°35.2'W, coll. GML Staff, 3.7 m, April 24 1977. SERTC 2101, off Isle of Palms, SC, 32°42'N, 79°40'W, coll. GML Staff, 11 m, October 25 1974. SERTC 2129, off ST Helena Sound, SC, 32°12.40N, 79°55.52W, coll. SERTC Staff, 24.4 m, April 29 2005. SERTC 2211, 19.2 miles @ 139 degrees off Charleston Light, SC, 32°31.4'N, 79°36.0'W, coll. GML Staff, 18 m, March 21 1976. SERTC 2459, off Edisto Island, SC, 32°27.18'N, 79°55.70'W, coll. SERTC Staff, 13.4–13.7 m, June 4 2004. DML 3098, 34º30'W, 76º45'W, R/V Eastward Sta E-32-69, October 2, 1969, 20 m. DML 3099, 33º57.5'W, 77º38.5'W, R/V Eastward Sta E-10-71, May 25, 1971, 20 m. DML 3100, 34º05.5'N, 77º27'W, R/V Eastward Sta E-10-71, May 25, 1971, 23 m. DML 3102, 33º58'W, 77º41.5'W, R/V Eastward Sta. E-20-71, August 3, 1971, 14 m. DML 3103, 34º20.2'N, 77º16.5'W, R/V Eastward Sta E-10-71, May 25, 1971, 18 m. DML 3104, 33º50.2'N, 78º10.0'W, R/V Eastward Sta E-28-71, November 26, 1971, 8 m.

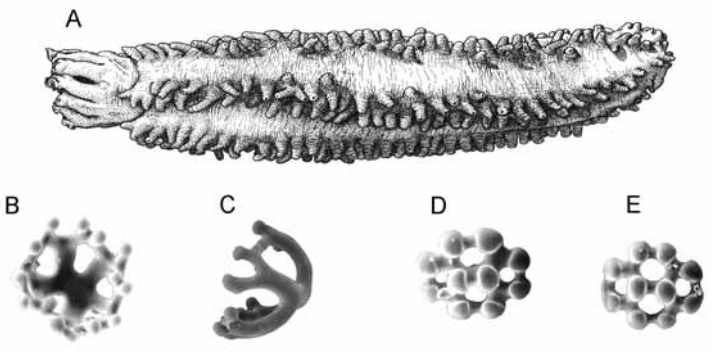

FIGURE 9. *Aslia pygmaea* (Théel, 1886a). A, whole animal; B, C, cups in top and side view; D, E, buttons.

Diagnosis. Length 30–70 mm. Color light brown to chocolate brown; ends of feet lighter, due to wear. Body form characteristic, with heavy, conspicuous tube feet confined to 5 radii. Mouth concealed by 5 prominent oral valves. Body wall rigid, with numerous ossicles consisting of buttons (45–80 μm long) with 10 knobs, and deep cups (45–55 μm in diameter).

Distribution. NC to E and W FL, Gulf of Mexico, Caribbean and Brazil.

Habitat. Intertidal or subtidal on sand and shell bottoms, also inside sponges. 0–37m.

Remarks. Miller and Pawson (1984) note the extraordinary discovery by T.C. Shirley of several specimens of this species living deep inside sponges. No entry point was found, and it was surmised that the holothurians entered the sponges while very young, and grew *in situ.*

***Aslia surinamensis* (Semper 1868)**
Figure 10

Thyone surinamensis Semper 1868: 65, pl. 15 fig. 15; Deichmann, 1930: 173, pl.16 figs. 5–8.
Ocnus surinamensis.—Hendler *et al.*, 1995: 260, figs 141, 178C, D.

Material examined. USNM E23989, N.C., Beaufort, July 11, 1941. USNM E31673, Florida, 27°52’48”N, 80°27’24”W, July 8, 1984, shallow flat.

Diagnosis. Body cylindrical, up to 10 cm long. Color light to dark brown, or gray to purple; feet white, flecked with brown to black spots. Thin body wall rigid and slightly gritty to touch, due to presence of numerous ossicles. Adult with uniform covering of feet. Body wall ossicles knobbed buttons (75–100 μm) and cups (55–75 μm). Cups nearly as large as buttons, with a deep concavity delimited by 4 spokes. The spokes attach to a rim that bears knobs on inner and outer margins.

Distribution. MD to W FL, Gulf of Mexico, Bermuda, Caribbean, Colombia, Surinam, Venezuela.

Habitat. Near shore in less than 1m, beneath rocks, in crevices, and among seagrass.

Remarks. Hendler *et al.* (1995) note that individuals of this species cover themselves with detritus or shell and rock fragments, grasping the fragments with powerful feet. The animal attaches itself so firmly to its preferred substrate of rocks and rubble that it is usually impossible to remove a specimen without tearing off some of the feet.

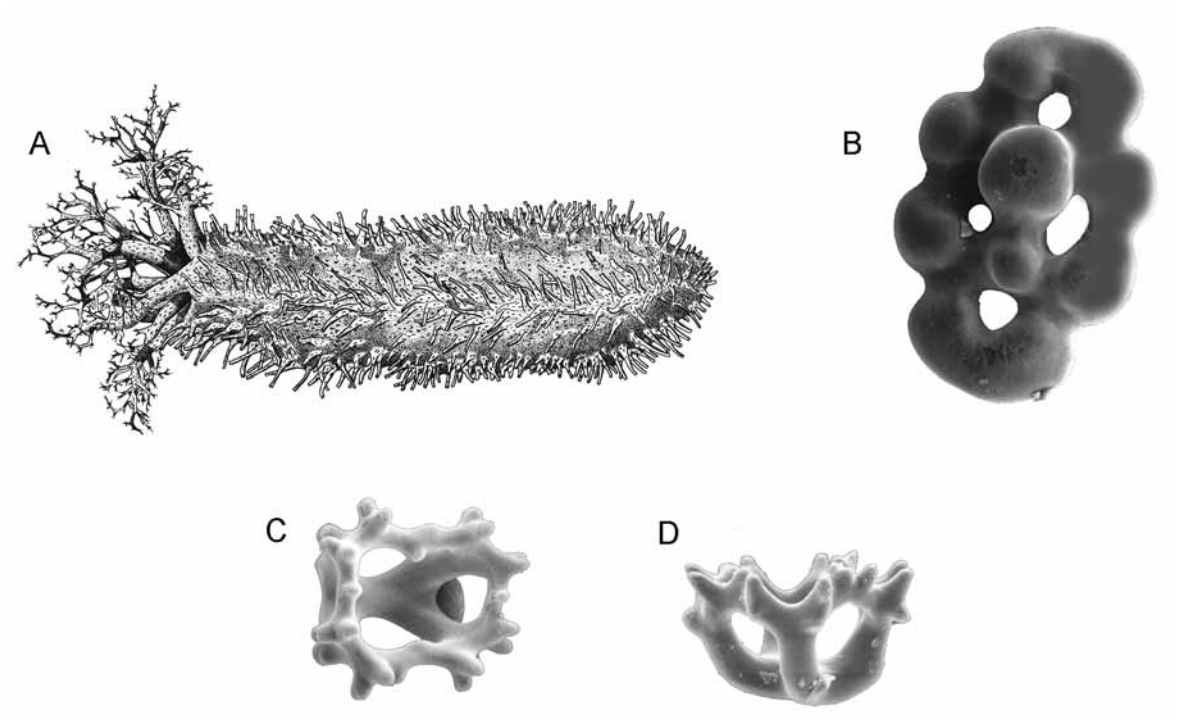

FIGURE 10. *Aslia surinamensis* (Semper 1868). A, whole animal; B, button; C, D, cups in top and side view.

***Paracolochirus*, new genus**

Diagnosis. Tentacles ten, of equal size. Ventral feet in approximately 3 rows; dorsally, scattered papillae. Body wall thick, fleshy. Calcareous ring simple, with undulating posterior margin. Ossicles in body wall four-holed plates with low knobs. Tentacles with numerous c-shaped rods of varying size, usually with terminal perforations. Feet lack endplates.

Type species: *Pseudocolochirus mysticus* Deichmann, 1930, by monotypy.

Type specimen: Catalogue No. 189, Museum of Comparative Zoology, Harvard University.

Remarks. Deichmann (1930) referred her new species *mysticus* to the genus *Pseudocolochirus* "gen. nov." with the type species *Colochirus violaceus* Théel (1886a). Deichmann noted that Pearson had proposed the genus-name *Pseudocolochirus* in a letter to Theodore Mortensen, but had never published it. Clark (1938) confirmed that Pearson (1910) had indeed published the new genus name *Pseudocolochirus*, with *violaceus* Théel as the type species by monotypy. At present, *Pseudocolochirus* comprises two species (see Rowe and Gates, 1995; Thandar and Samyn, 2004), with a broad Indo-West-Pacific distribution in depths of 0–13 m. The western Atlantic *mysticus* Deichmann has knobbed four-holed buttons about 100 µm long in the body wall, and almost exclusively c-shaped rods up to 500 µm long in the tentacles. In contrast, *P. violaceus* has thick and smooth buttons and plates up to 500 µm long, with several partially occluded holes, in the body wall, and in the tentacles elongate perforated plates up to 400 µm long, and much smaller rods of various shapes. Given these differences, and the distribution ranges of the species, it is considered best to erect a new genus to accommodate the species *mysticus*. This matter will be discussed more fully elsewhere (Pawson and Pawson, in preparation).

***Paracolochirus mysticus* (Deichmann 1930)**
Figure 11

Pseudocolochirus mysticus Deichmann, 1930: 182, pl.21 figs.7–9.

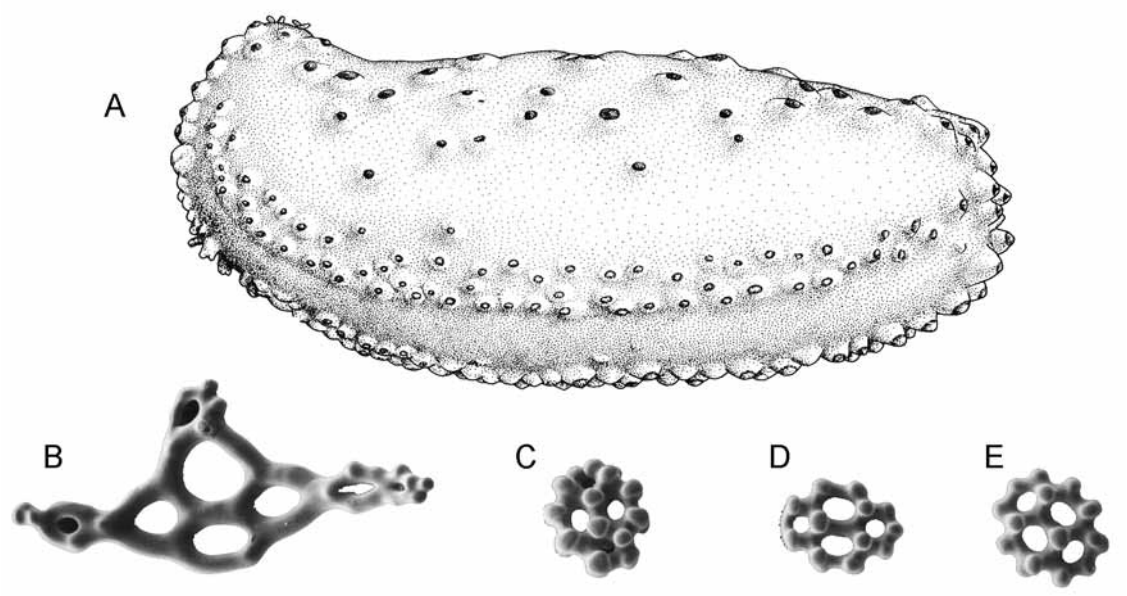

FIGURE 11. *Paracolochirus mysticus* (Deichmann 1930). A, whole animal; B, ossicle from tube foot; C-E, irregular 4-holed ossicles.

Material examined. USNM E16247, S.C., 32°42'N, 78°17'W, no date given, 165m, 7. USNM E2504, N.C., SE Cape Hatteras, 34°39’15”N, 75°33’30”W, R/V Albatross, Sta 2601, October 18, 1885, 195.7m, 11 . USNM E43336, S.C., 32°43’39”N, 78°05’39”W, dive 78 July 5, 1993, 175–196m, 4 . SERTC S# 2214, mouth of Bread and Butter Creek, North Inlet, Georgetown, SC, 33º19.9'N, 79º11.2'W, coll. GML Staff, 2–4 m, January 25 1971. SERTC 2462, Murrells Inlet, SC, 33º30.9'N, 79º02.4'W, coll. D. Knott, May 10 1978. DML 1375, 34º51.5'N, 75º24.2'W, R/V Eastward Sta E-56-65, October 27, 1965, 201 m. DML 4135, 33º48.7'N, 76º34.2'W, R/V Dan Moore Sta 0S05, May 14, 1981, 102 m.

Diagnosis. Barrel-shaped, about 5 cm long. Color light tan to whitish, often with a pinkish tinge. Tentacles bushy, of equal size. Ventral feet ventrally in 3 distinct rows; toward oral and anal ends as few, scattered, broad and low papillae, with dark brown tips. Five dark brown anal papillae and 5 small calcareous anal teeth. Integument thick, fleshy, soft, almost devoid of ossicles, which are irregular 4-holed buttons (100 μm) with low knobs.

Distribution. NC to SC, Gulf of Mexico.

Habitat. Sand/mud.18–215 m.

Remarks. Little is known about the biology of this species, although it is obviously a suspension feeder, and presumably, given the nature of the substrate, a burrowing form.

***Thyonella gemmata* (Pourtalès, 1851)**
Figure 12

Colochirus gemmatus Pourtalès, 1851: 11.
Thyonella gemmata .— Verrill, 1872: 437; Hendler et al, 1995: 263, figs. 143, 179A,B,C,D.
Thyone gemmata .— Deichmann, 1930: 177, pl.17 figs.1–3.

Material examined. USNM 14252, N.C., Beaufort, no date given (gift), 2 . USNM E2655, N.C., Vinyah Bay, R/V Fish Hawk Sta 1645, no date given. USNM E22466, N.C., Beaufort, March 28, 1941, town marsh, 2 . USNM E34103, Florida, 28°50’06”N, 80°44’12”W, R/V Delaware II, Sta 070, May 21, 1984,14.6m. USNM E46901, N.C., Surf City, Topsail Island, NE Wilmington, July 17, 1996, washed ashore, 2. SERTC S# 2065, Dewee Inlet, SC, 32º49'N, 79º43'W, coll. GML Staff, June 30 1967. DML 3722, Bird Shoal, Beaufort, NC, May 1, 1973, intertidal.

Diagnosis. Burrowing form up to 150 mm long. Color mottled gray, brown, olive green, sometimes tan to black. Body usually U-shaped, sometimes straight to slightly curved, swollen medially, slender near ends. Feet cylindrical medially, papillate distally, arranged in distinctive double rows along radii, also scattered in interradii. Body wall rigid with ossicles consisting mostly of knobbed buttons (80–120 μm), shallow cups (45–55 μm in diameter), and perforated plates (up to 400 μm).

Distribution. MA to FL, Gulf of Mexico, Cuba, Yucatàn Peninsula.

Habitat. Muddy or sandy areas, often associated with seagrasses. Low tide to 6m.

Remarks. In some areas (for example off Folly Beach, SC), this species can be very common, and may wash ashore during storms. Manwell & Baker (1963) and Manwell (1966), based on their analyses of hemoglobin, concluded that two cryptic or sibling species of *Thyonella* were present in Alligator Harbor, NW Florida. These they named "stout" and "thin" but no formal scientific names were applied. Deichmann (personal communication to Manwell & Baker), using conventional taxonomic characters, could find no consistent morphological differences between the stout and thin forms.

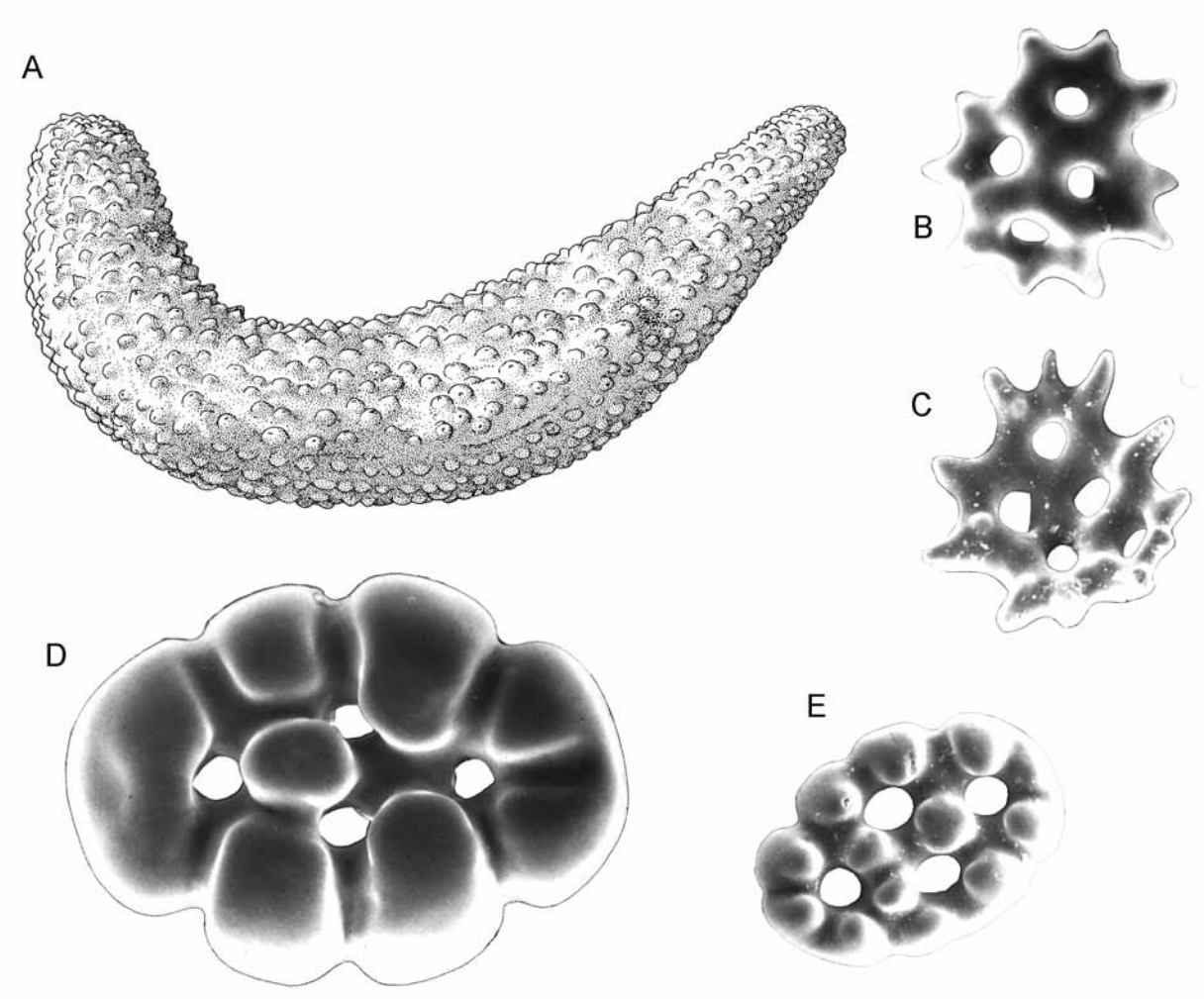

FIGURE 12. *Thyonella gemmata* (Pourtalès, 1851). A, whole animal; B, C, cups; D, E, buttons.

***Thyonella pervicax* (Théel, 1886a)**
Figure 6b, 13

Thyone pervicax Théel, 1886a: 93, pl. 2 fig. 3, pl. 5 fig. 9; Deichmann, 1930: 175, pl. 16 figs.9–12.
Thyonella pervicax.—Hendler et al, 1995: 264, figs 144, 179 E,F,G,H.

Material examined. USNME16425, N.C., Raleigh Bay, Beaufort, Sta. 469, 1965. USNM E16091, Florida. 11 mile SE of Cape, 5m. USNM E19416, off S.C., 32°36'N, 78°39'W, R/V Pierce, Sta 2F, August 21, 1977, 42m. USNM E19432, off S.C., 32°23'N, 80°09'W, R/V Pierce, Sta 3B, Feb. 17, 1977, 13m, 2 . USNM E19452, off S.C., 32°05'N, 79°38'W, R/V Pierce, Sta 3D, Feb. 17, 1977, 33m, 2 . USNM E19455, off S.C., 32°01'N, 79°31'W, R/V Pierce, Sta 3E, August 25, 1977, 46m. USNM E22560, Georgia, 31°20’00”N, 80°17’00”W, R/V Pelican, Sta 178-15, Jan. 31, 1940, 38m, 2 . USNM E22569, Georgia, 31°59’30”N, 80°34’00”W, R/V Pelican, Sta 181-3, Feb. 3, 1940, 15m. USNM E22552, Georgia, 31°41’30”N, 80°01’00”W, R/V Pelican, Sta 179-10, February 1, 1940, 33m. USNM E22558, Georgia, 32°01’00”N, 80°16’00”W, R/V Pelican, Sta 181-7, February 3, 1940, 20m. USNM E22575, N.C., Shacklesford Island, Sept. 12, 1928. USNM E22556, Georgia, 31°11 00'N, 80°52’00”W, R/V Pelican, Sta 178-6, January 31, 1940, 16m. USNM E22570, Florida, 29°40’00”N, 81°09’30”W, R/V Pelican, Sta 176-10, Jan. 25, 1940, 37m. USNM E25293, Florida, 28°26’30”N, 80°12'W, R/V Silver Bay Sta 2032, 37m. USNM E33163, Florida, 30°40'N, 81°11'W, R/V Delaware II, Sta 088, May 22, 1984, 20.1m, 2 . USNM E33164, Florida, 51.5 Nautical miles E, 29°50'N, 80°17'W, R/V Delaware II, Sta 148, April 27, 1983, 62–64m, 2 . USNM E33156, Florida, 31 Nautical miles E, 30°20'N, 80°48'W, R/V Delaware II, Sta 116, April 25, 1983, 32–35m, 4 . USNM E33167, Florida, 19.5 Nautical miles E, 28°00'N, 80°12'W, R/V Delaware II, Sta 040, April 22, 1983, 27.4m. USNM E33172, Florida, 37 Nautical miles E, 29°10'N, 80°17'W, R/V Delaware II, Sta 087, April 24, 1983, 46m. USNM E33162, Florida, 24 Nautical miles E, 28°10'N, 80°13'W, R/V Delaware II, Sta 043, April 22, 1983, 27.4m, 21. USNM E33168, Florida, 24.5 Nautical miles E, 28°15'N, 80°08'W, R/V Delaware II, Sta 055, April 22, 1983, 42m. USNM E33158, Florida, 30°00’18”N, 80°32’48”W, R/V Delaware II, Sta 93, May 23, 1984, 36.6m, 6. USNM E33155, Florida, 29 Nautical miles NE, 30°10'N, 80°49'W, R/V Delaware II, Sta 115, April 25, 1983, 27.4m, 7. USNM E33160, Florida, 31 Nautical miles E, 30°30'N, 80°49'W, R/V Delaware II, Sta 117, April 25, 1983, 27–29m, 6. USNM E33166, Florida, 47 Nautical miles E, 29°40'N, 80°20'W, R/V Delaware II, Sta 110, April 25, 1983, 46–48m, 3. USNM E33171, Florida, 53.5 Nautical miles ENE, 30°00'N, 80°16'W, R/V Delaware II, Sta 141, April 27, 1983, 69.5m, 2 . USNM E33165, Florida, 49.5 Nautical miles E, 29°50'N, 80°19'W, R/V Delaware II, Sta 149, April 27, 1983, 46m. USNM E33170, Florida, 33 Nautical miles E, 29°40'N, 80°36'W, R/V Delaware II, Sta 112, April 25,1983, 27.4m, 2 . USNM E33161, Florida, 30°09 54'N, 80°30 12'W, R/V Delaware II, Sta 092, May 23, 1984, 38.4m, 13. USNM E33159, Florida, 29°19’48”N, 80°29’54”W, R/V Delaware II, Sta 074, May 21, 1984, 33m, 15. USNM E33169, Florida, 29°50’06”N, 81°14’00”W, R/V Delaware II, Sta 083, May 22, 1984, 14.6m. USNM E33157, Florida, 22.5 Nautical Miles ENE, 30°00'N, 80°52'W, R/V Delaware II, Sta 114, April 25, 1983, 27m, 13. USNM E39039, Florida, North of Cape Canaveral, 28°23’54”N, 80°16’42”W, R/V Oregon II Sta 45125, 27.4m, 3. USNM E39040, Florida, East of Cape Canaveral, 28°14’54”N, 80°14’24”W, R/V Oregon II Sta 45126, March 20, 1987, 27.4m, 4 . USNM E39039, Florida, North of Cape Canaveral , R/V Oregon II Sta 45125 March 20, 1987, 27.4m, 3. USNM E46901, N.C., Surf City, Topsail Island, 2. SERTC 1043, off Charleston Harbor, SC, 32°30.18'N, 78°57.52'W, 40.5–41.1 m, coll. SERTC Staff, June 2 2004. SERTC 1044, off Charleston Harbor, SC, 32°36.12'N, 79°04.16'W, 35.1–35.7 m, coll. SERTC Staff, June 2 2004. SERTC 1045, off Ossabaw Island, GA, 31°52.51'N, 79°46.71'W, 38.1–39 m, coll. SERTC Staff, June 3 2004. SERTC 2100, 41.5 miles @ 128 degrees of Charleston Light, SC, 32°19.7'N, 79°12.5'W, 40 m, coll. GML Staff, March 20 1976. SERTC 2103, 55.5 miles @ 109 degrees of Charleston Light, SC, 32°30.5N, 78°57.5W, 40 m, coll. GML Staff, March 31 1979. SERTC 2104, 43.6 miles off Charleston Light, SC, 32°04.7'N, 79°33.7'W, 40 m, coll. GML Staff, April 28 1981. SERTC 2133, off Edisto Island, SC, 32°12.33'N, 79°42.16'W, 30.5 m, coll. SERTC Staff, April 29 2005. SERTC 2280, off Charleston Harbor, SC, 32°23.9'N, 79°06.4'W, 37.5 m, coll. GML Staff, October 26 1974. DML 3105, 34º28’N, 76º09.4’W, 37 m. DML 3106, 34º29.3’N, 76º11.2’W, 37 m.

Diagnosis. Small, burrowing form, 40–70 mm long. Color mottled white or tan and light to dark brown, with conspicuous scattered brown patches. Body tapering gently toward blunt ends. Conical podia uniformly distributed over body surface, retracted to low warts in preserved specimens. Body wall thick, rigid, filled with ossicles consisting of knobbed buttons of two sizes (60–90 μm and 35–55 μm) and shallow cups (40–60 μm) with 10–12 marginal teeth; no perforated plates.

Distribution. MA to E and W FL, Gulf of Mexico, TX, Mexico, Brazil.

Habitat. Burrows in soft, sandy sediments, also on shell and quartz sand bottom covered with algae and seagrass. 6–70 m.

Remarks. Like *T. gemmata*, this species is locally very common (Hendler *et al.*, 1995).

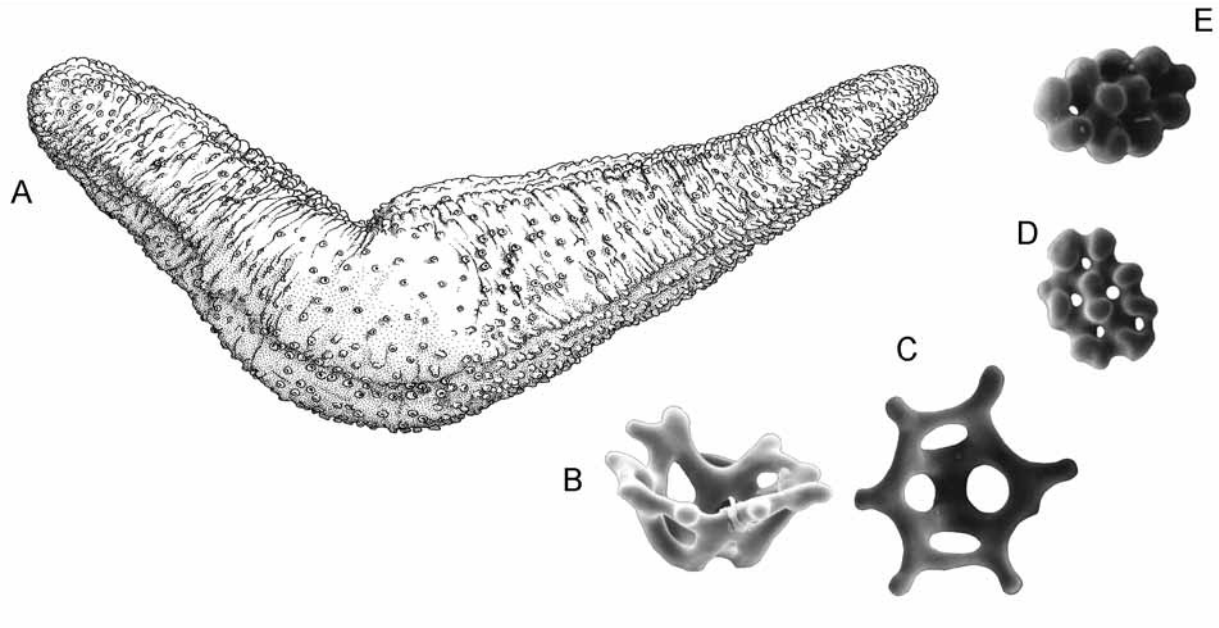

FIGURE 13. *Thyonella pervicax* (Théel, 1886a). A, whole animal; B, C, shallow cups; D, E, buttons.

Family Sclerodactylidae Panning, 1949

***Euthyonidiella trita* (Sluiter, 1910)**
Figure 14

Thyone trita Sluiter, 1910: 339, fig. Ea–c.
Phyllophorus tritus.—Deichmann 1930: 147, pl.18, figs. 4–8.
Euthyonidiella trita.—Hendler, et al, 1995: 267, figs 146, 181G, H.

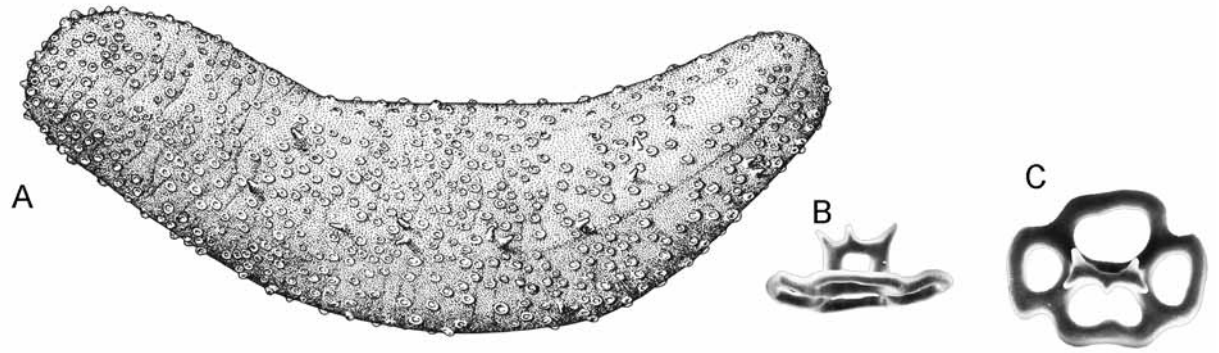

FIGURE 14. *Euthyonidiella trita* (Sluiter, 1910). A, whole animal; B, C, tables in lateral and top view.

Material examined. None.

Diagnosis. A tiny species, up to 3cm in length. Color violet to gray. Numerous cylindrical tube feet scattered over entire body. 18 tentacles of 2 distinct sizes surround mouth. Body wall ossicles oblong tables (up to 70 μm) with irregular margins. Most tables have 4 large disk perforations, but a few have 1 to 4 smaller additional holes. Short spires composed of 2 pillars, each ending in several small spines.

Distribution. NC to E and W FL, Gulf of Mexico, Caribbean.

Habitat. Near the shoreline, under rocks, and in tidal pools. Littoral; low-tide mark to 4m.

Remarks. This is typically a shallow-water species. A single specimen from a depth of 100 m from off North Carolina (USNM E16418) was identified by DLP as *Euthyonidiella* sp. aff. *Trita*, but it could not be referred with any confidence to *trita*. This species has large eggs, 0.5 mm in diameter (Hendler *et al.*, 1995).

***Pseudothyone belli* (Ludwig, 1886)**
Figure 15

Thyone belli Ludwig, 1886, 21, pl. 1 fig. 6; Deichmann, 1930, 176–177, pl.14 figs, 10–13.
Pseudothyone belli .— Miller & Pawson 1984, .27, figs. 19, 20; Hendler et al, 1995: 268, figs 147, 180, A, B, C.

Material examined. USNM E22329, Florida, 27°35'N, 82°50'W, R/VHourglass, StaA, March 3, 1966, 6.1m. USNM E32231, off N.C., 33°32’18”N, 77°25’00”W, work boat, Sta MS04, August 13, 1980, 30m. USNM E32244, off Georgia, 30°26’12”N, 80°12’18”W, R/V Dolphin, Sta OS03, March 11, 1980, 61m.

Diagnosis. Small, burrowing form, up to 50mm. Color dirty white with flecks of brown or maroon, tips of tube feet bordered with a brown ring; in young specimens flecks gray, very numerous, and animal may appear black. Body cylindrical, curved. Feet numerous, scattered over entire body. Body wall rigid, with ossicles consisting of knobbed buttons (70–110 μm); feet with supporting tables.

Distribution. NC, E and W FL, Gulf of Mexico, Bermuda (DLP, field notes), Trinidad and Tobago, Puerto Rico, Panama, Brazil.

Habitat. Burrows in sandy carbonate sediments, crevices in coquinoid limestone ledges. Low-tide mark to 37 m.

Remarks. Miller & Pawson (1984) noted that this species is one of the most common holothurians off Tampa, Florida, where it burrows in soft sediments.

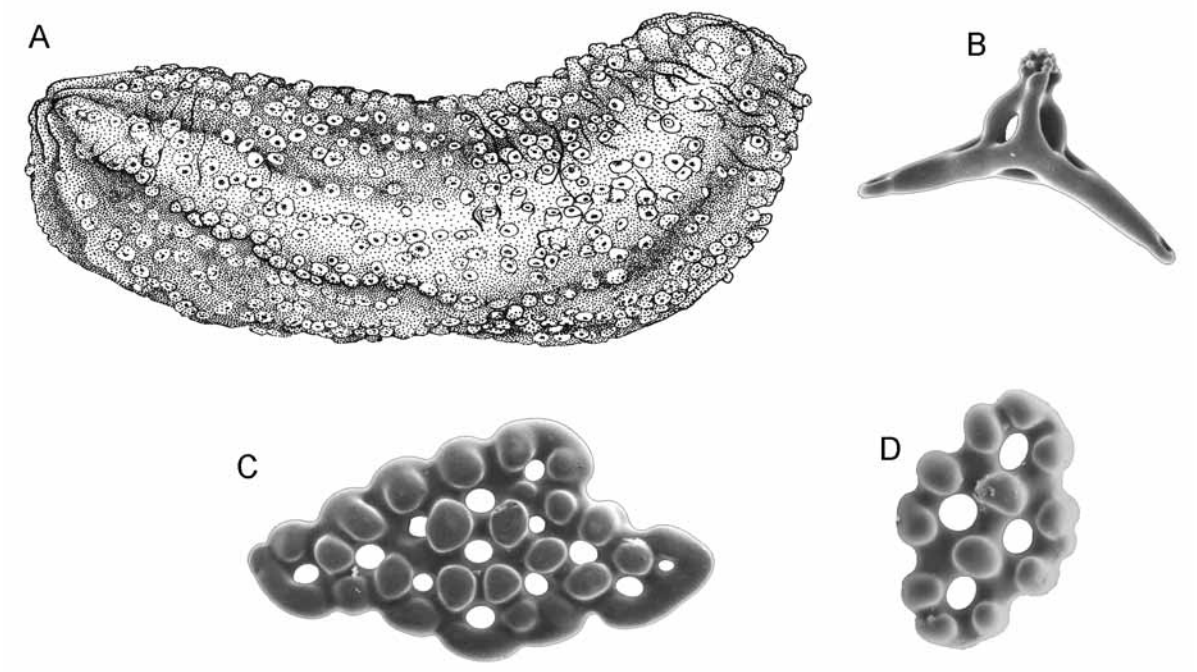

FIGURE 15. *Pseudothyone belli* (Ludwig, 1886). A, whole animal; B, table from tube foot; C, D, knobbed buttons.

***Sclerodactyla briareus* (Lesueur, 1824)**
Figure 16

Holothuria briareus Lesueur, 1824: 161.
Thyone briareus .—Deichmann 1930: 65, pl.13 figs.5–7.
Sclerodactyla briareus .— Hendler *et al*, 1995: 269, figs 148, 180, D, E, F.

Material examined. USNM 3056, S.C., Charleston Bay, 20. (no date given) USNM E02509, N.C., Cape Lookout, R/V Fish Hawk, 1891, 3. USNM E17186, Florida, 15 . USNM E19314, N.C., 28°55'12"N, 80°47'54"W, R/V Oregon II Sta 45091, Feb. 9, 1977,12.8m, 5. USNM E19323, N.C., 33°35'N, 78°05'W, R/V Pierce Sta 1C, Nov. 16, 1977,18m. USNM E22571, Georgia, 31° 31'N, 81°01'W, R/V Pelican, Sta 197-1, March 15, 1940, 11m. USNM E22619, Georgia, St. Simon Sound, Sta CB29-64, Sept. 10, 1929. USNM E2526, N.C., Middle Sound, Near Wilmington,year 1880, 2. USNM E2509, N.C.,Cape Lookout, R/V Fish Hawk, 3. USNM E31612, N.C.,Cape Hatteras, 1982, 5. USNM E34101, Florida, 28°50'06"N, 80°44'12"W, R/V Delaware II, Sta 070, May 21, 1984, 14.6m, 2. USNM E46902, N.C., Surf City, Topsail Island, NE Wilmington, July 17, 1996. USNM E34099, Florida, 28°10'30"N, 80°32'36"W, R/V Delaware II, Sta 018, May 19 1984, 16.5m. USNM E34100, Florida, 59 Nautical Miles E, 30°20'N, 80°14'W, R/V Delaware II, Sta 131, April 27, 1983, 64–66m. USNM E34098, 29°09' 54"N, 80°57'30"W, R/V Delaware II, Sta 072, May 21, 1984, 14.6m, 16. USNM E39036, Florida, NW of Cape Canaveral, 28°55'12"N, 80°47'54"W, R/V Oregon II Sta 45091, March 19, 1987,12.8m, 5. NMNH, 27 lots. SERTC 2098, Key Biscane, Cape Florida, FL, coll. GML Staff, December 14, 1967. SERTC 2454, off Little St Simons Island, GA, 31°13.65'N, 81°14.00 'W, 7 m, coll. MRRI Staff, April 6 2005. SERTC 2455, off St Simons Island, GA, 31°10.99'N, 81°16.03 'W, 7 m, coll. MRRI Staff, April 6 2005. SERTC 2456, Port Royal Sound, SC, 32°15.12'N, 80°40.72'W, coll. MRRI Staff, October 1987. SERTC 2457, off Fernandina Beach, FL, 30°39.88'N, 81°23.60'W, 10 m, coll. MRRI Staff, July 24 2003. SERTC 2206, southwest end of Folly Island, SC, 32°38.3'N, 79°58.5'W, 0.9 m, coll. GML Staff, April 8 1972. SERTC 2209, Isle of Palms, SC, coll. GML Staff, July 1 1962. SERTC 2212, Dewee's Inlet, north end of Isle of Palms, SC, coll. GML Staff, June 30 1970. DML 770, Off Beaufort Inlet, NC, June 13, 1968, 8 m. DML 2091, 34º24'N, 75º49'W, June 28, 1965, 200 m.

Diagnosis. Medium-size, burrowing form, up to 120mm long. Color green or brown, to almost black. Body barrel-shaped, tapering only at the anterior and posterior extremes. Feet numerous, hairlike, scattered over entire body. Body wall thin, with ossicles consisting of tables (60–80 μm diameter) with 4-pillared spire; no buttons.

Distribution. Nova Scotia to E and W FL, AL, LA, MS, TX, Venezuela.

Habitat. Soft muddy substrates, often associated with seagrass beds. 0–66 m.

Remarks. Hendler *et al.* (1995) include extensive notes on the biology of this species.

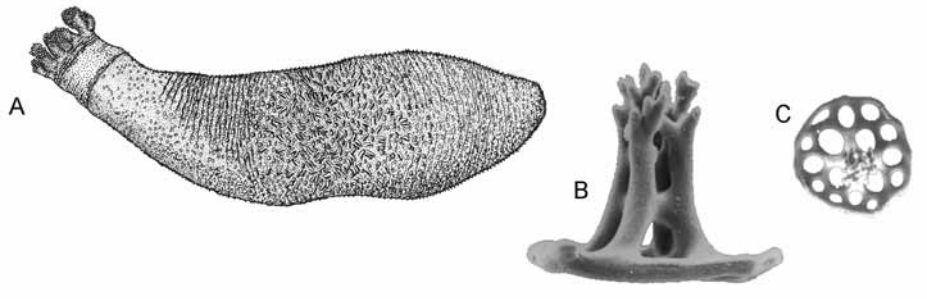

FIGURE 16. *Sclerodactyla briareus* (Lesueur, 1824). A, whole animal; B, C, four-pillared tables in lateral and top view.

***Havelockia scabra* (Verrill, 1873)**
Figure 17

Thyone scabra.—Deichmann,1930:166, pl.13, figs. 3,4.
Havelockia scabra.—Panning, 1949: 466; Pawson, 1977: 12, text-fig. 14.

Material examined. None.

Diagnosis. Body strongly curved, reaching 10 cm in length. Color whitish, often with a brownish tinge. Feet hair-like, uniformly distributed. Body wall stiff, filled with ossicles in form of irregular tables (up to 130 μm in diameter) with 7–10 or more holes and a 2-pillared spire ending in indistinct teeth. In introvert tables have larger, more delicate and more circular disk and low spire.

Distribution. MA to E and W FL, Gulf of Mexico.

Habitat. Sand/mud. 10 – 1,170 m.

Remarks. This is presumably a burrowing species. Nothing more is known about its biology.

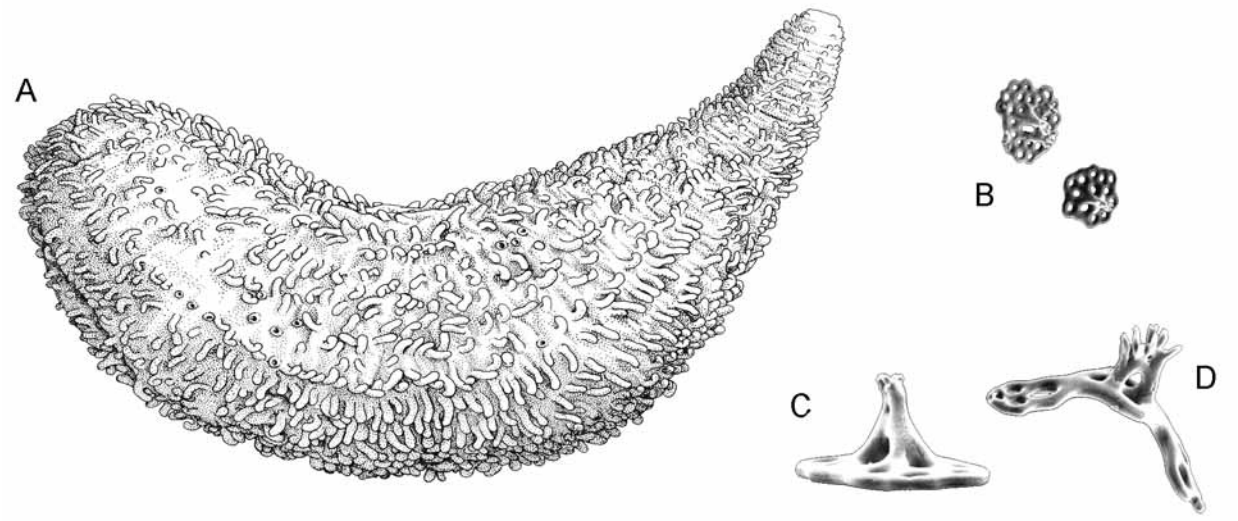

FIGURE 17. *Havelockia scabra* (Verrill, 1873). A, whole animal; B, tables from body wall; C, D, tables from tube feet.

Family Phyllophoridae Östergren, 1907

***Pentamera pulcherrima* Ayres, 1854**
Figure 6a, 18

Pentamera pulcherrima Ayres, 1854: 121; Pawson, 1977: 12, text-fig. 16.
Cucumaria pulcherrima .— Deichmann, 1930: 157, pl.11 figs.13–16.

Material examined. SERTC 1046, Inlet Creek, behind Sullivan's Island, SC, 32°47.7'N, 79°49.24'W, 2.4 m, coll. SERTC Staff, May 13 2004. SERTC 1047, Folly Beach, SC, 32°39.2'N, 79°56.5'W, coll. J. Monck, April 9 2004. SERTC 2130, off Charleston Harbor, 32°30.28'N, 79°38.56'W, 20.1 m, coll. SERTC Staff, April 30 2005. SERTC 2458, southeast end of Folly Island, SC, 32°38.56'N, 79°58.47'W, 0.7 m, coll. D. Knott, February 26 2002. SERTC 2208, Edisto Beach, SC, 0.5 m, coll. GML Staff, March 19 1973.

Diagnosis. Body about 5 cm in length, with anterior and posterior ends upturned. Color white to pinkish to dirty brown. Feet confined to radii. Tentacles 10, bushy, with the 2 ventral smaller. Skin thin, wrinkled and stiff because of the abundance of ossicles. Ossicles regular, oval tables (to 70 μm long) with 4 holes and a low spire, composed of 2 rods ending in 2–3 blunt teeth. A few thin, elongate plates with 2 central holes, and a variable number of smaller holes near the ends, may be found. A great number of irregular plates crowded around anus.

Distribution. Gulf of Mexico, W FL, SC.

Habitat. Sand/mud. 0–27 m.

Remarks. This beautiful little sea cucumber can be very common where it occurs, and can wash ashore in large numbers during storms (Folly Island, SC).

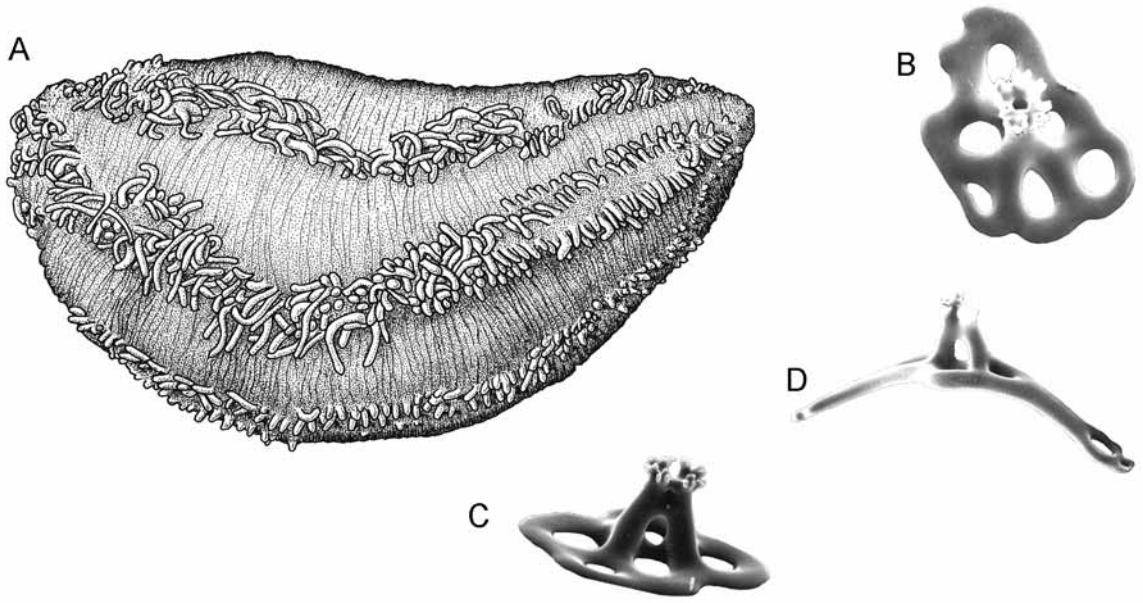

FIGURE 18. *Pentamera pulcherrima* Ayres, 1854. A, whole animal; B, C, tables from body wall; D, table from tube foot.

***Phyllophorus (Urodemella) arenicola* Pawson & Miller, 1992**
Figure 19

Phyllophorus (Urodemella) occidentalis.—(in part) Miller & Pawson, 1984: 36. Not *Phyllophorus (Urodemella) occidentalis* (Ludwig, 1875)

Phyllophorus (Urodemella) arenicola Pawson & Miller, 1992: 483; Hendler *et al.* 1995: 273, figs. 150, 182 A, B, C.

Material examined. USNM E19258, off S.C., 32°54’00”N, 79°12’00”W, R/V Pierce Sta 2B, Feb. 12, 1977, 16m. USNM E19259, off S.C., 32°54'N, 79°12'W, R/V Pierce Sta 2B, Feb. 12, 1977, 16m. USNM E19258, off Georgia, 30°57’04”N, 79°58’01”W, R/V Pierce Sta 5H, Nov. 25, 1977, 92m. USNM E19706, off Florida, 29°27’59”N, 80°57’08”W, R/V Pierce Sta 7B, Nov. 27, 1977, 21m. USNM E19709, off Florida, 29°28’00”N, 80°57’09”W, R/V Pierce Sta 7B, Nov. 27, 1977, 21m. USNM E19710, off Florida, 29°28’00”N, 80°57’07”W, R/V Pierce Sta 7B, March 4, 1977, 21m. USNM E19712, off Florida, 29°27’59”N, 80°57’08”W, R/V Pierce Sta 7B, May 20, 1977, 20m, 2 . USNM E19713, off Florida, 29°28’00”N, 80°57’08”W, R/V Pierce Sta 7B, Sept. 4, 1977, 20m, 2 . USNM E19710, off Florida, 29°28’00”N, 80°57’08”W, R/V Pierce Sta 7B, Sept. 4, 1977, 20m. USNM E32254, off N.C., 33°48’18”N, 76°34’18”W, R/V Cape Hatteras Sta OS 05, Nov. 11, 1981, 100m. USNM E34104, off Florida, About 50.5 miles NE of St. Augustine Inlet, 30°11'N, 80°15'W, R/V Delaware II Sta 138, April 27, 1983, 64m, 3. USNM E34105, off Florida, 27°50’12”N, 80°00’12”W, R/V Delaware II Sta 009, May 18, 1984, 64m, 2 . USNM E34106, off Florida, 30°31'N, 80°10'W, R/V Delaware II Sta 126, April 26, 1983, 64m, 4 . USNM E34107, off Florida, 28°39’54”N, 80°25’24”W, R/V Delaware II Sta 065, May 20, 1984, 18.3m.

Diagnosis. Body U-shaped, approximately cylindrical, may exceed 30cm in length. Color uniform to variegated light reddish brown. Tentacles 20 in 2 rings, 5 large pairs in outer ring alternating with 5 small pairs in inner ring. Body wall ossicles square tables (66 µm in length), commonly with 4 to 8 perforations, of which 2 are larger than others; spire reduced to form 4 vertical projections. Introvert and tentacles with tables and rosettes.

Distribution. Gulf of Mexico, NC to E FL.

Habitat. sublittoral; offshore in soft sediment. 6–158 m.

Remarks. Miller and Pawson (1984:36), in their discussion of *Phyllophorus (Urodemella) occidentalis* (Ludwig, 1875) from the Gulf of Mexico, noted that this species occurred off eastern Florida. Further study showed that the eastern Florida specimens represented a new species described later as *Phyllophorus (Urodemella) arenicola* Pawson & Miller, 1992.

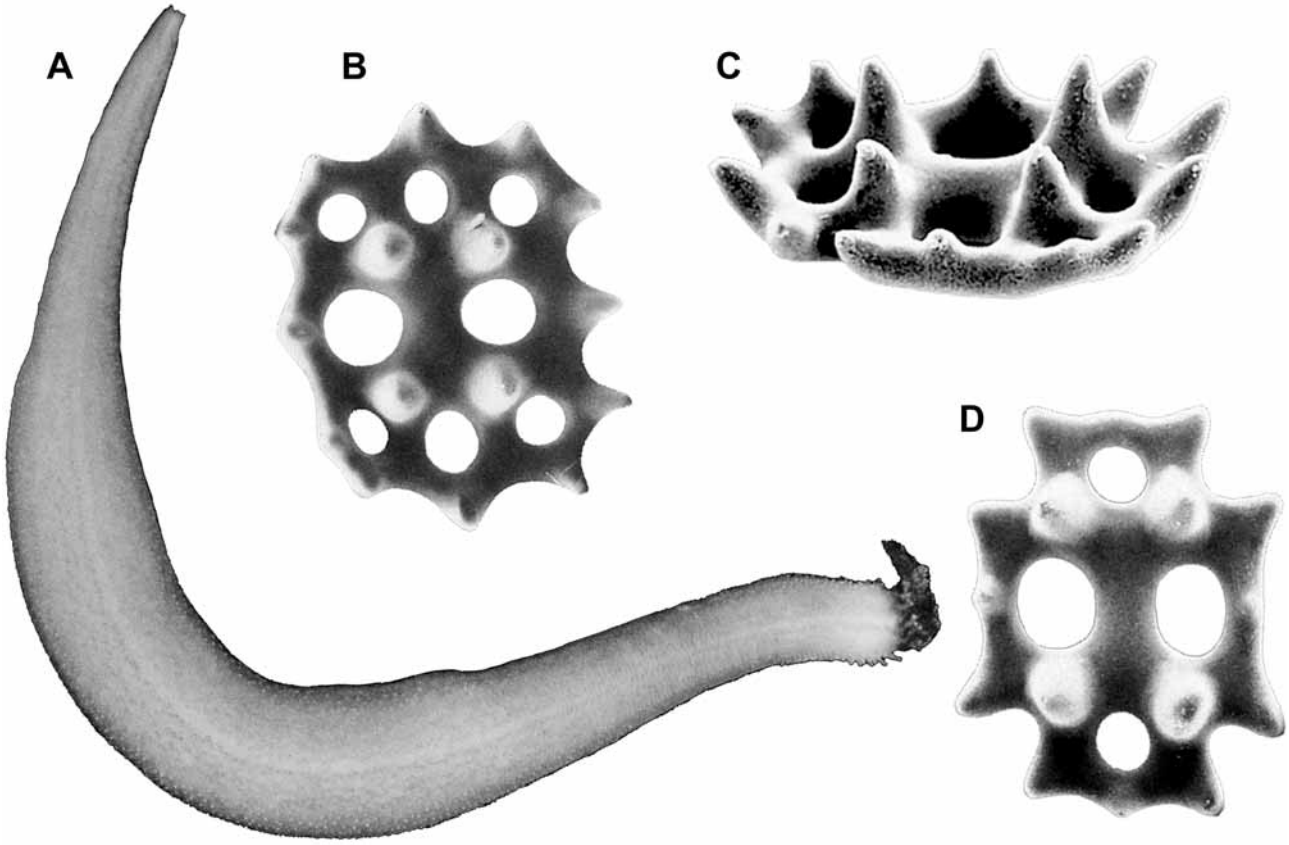

FIGURE 19. *Phyllophorus* (*Urodemella*) *arenicola* Pawson & Miller, 1992. A, whole animal; B, C, D tables in top and oblique views.

***Thyone crassidisca* Pawson and Miller 1981**
Figure 20

Thyone crassidisca Pawson and Miller, 1981: 400, figs. 1, 2B, 4; Miller and Pawson, 1984: 37, figs.29, 30.

Material examined. USNM E21113, Florida, E of New Smyrna Beach, 30°00'N, 80°52'W, R/V Gosnold, Sta 621, Aug. 16, 1974, 27m. USNM E19453, off S.C., 32°05'N, 79°38'W, R/V Pierce, Sta 3D, Feb. 17, 1977, 33m. USNM E19533, off Georgia., 31°03'N, 80°26'W, R/V Pierce, Sta 5E, Feb. 26, 1977, 34m. USNM E19534, off Georgia., 31°01'N, 80°17'W, R/V Pierce, Sta 5F, Aug. 30, 1977, 40m, 2 . USNM E19535, off Georgia., 31°01’N, 80°17'W, R/V Pierce, Sta 5F, Nov. 24, 1977, 40m. USNM E19573, off Georgia., 30°59'N, 80°08'W, R/V Pierce, Sta 5G, July 16, 1979, 20m. USNM E19704, off Florida, 29°28'N, 80°57'W, R/V Pierce, Sta 7B, July 16, 1979, 34m. USNM E19705, off Florida., 29°28'N, 80°57'W, R/V Pierce, Sta 7B, May 21, 1977, 20m. USNM E20287, off Florida., 29°34'N, 80°22'W, R/V Pierce, Sta 7D, Nov. 27, 1977, 44m. USNM E22484, N.C., 33°57’30”N, 77°01'W, R/V Silver Bay Sta 1695, Feb. 29, 1960, 35m. USNM E41653, S.C., 32°29’06”N, 78°49’06”W, R/V Oregon Sta OS06, August 6, 1981, 54m.

Diagnosis. Body fusiform, up to 60 mm long, tapering toward bluntly rounded ends. Color whitish to light brown, with darker patches. Feet numerous, scattered over entire body; strongly contracted in preserved

specimens. Tentacles 10, ventral pair smaller. Body wall tables (70–110 μm) with 4 perforations and spire terminating in single blunt spine.

Distribution. NC to FL, Eastern Gulf of Mexico.

Habitat. Quartz sand and crushed shell. 6–45 m.

Remarks. Nothing is known of the biology of this species.

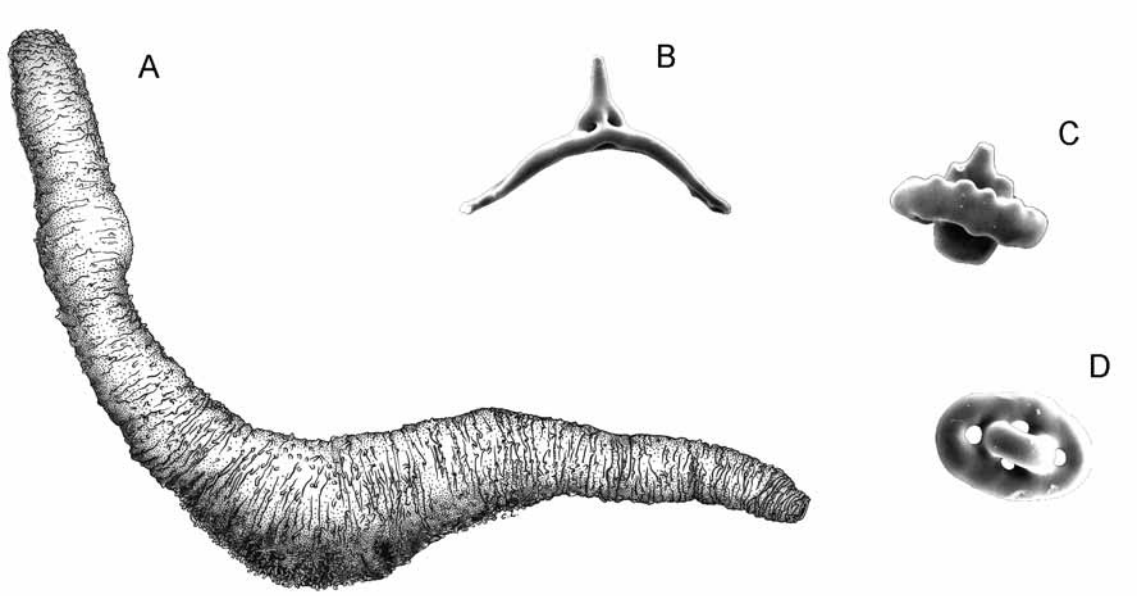

FIGURE 20. *Thyone crassidisca* Pawson & Miller 1981. A, whole animal; B table from tubefoot; C, D, tables from bodywall.

***Thyone deichmannae* Madsen, 1941**

Figure 21

Thyone fusus (O.F. Müller)?.—Deichmann, 1930: 167, pl. 14 figs. 1–5.
Thyone deichmannae Madsen, 1941: 26; Hendler et al, 1995: 276, figs.153, 182H - J.
Thyone inermis.—Pawson and Miller, 1981: 394; Miller & Pawson, 1984: 40, figs 32, 33.
Not *Thyone inermis* Heller, 1868.

Material examined. USNM E16416, N.C., R/V Eastward E-56-65, N.C., 34°31.1'N, 75°55'W, Oct 27, 1965, 80m, 4(as *fusus*). USNM E16417, N.C., R/V Eastward 1423, 1965, 60m, (as *fusus*). USNM E19681, off Florida., 30°23'N, 80°18'W, R/V Pierce, Sta 6F, Sept. 1, 1977, 48m, (as *fusus*). USNM E19754, off Florida., 29°34'N, 80°22'W, R/V Pierce, Sta 7D, Sept. 2, 1977, 44m, (as *fusus*). USNM E19755, off Florida., 29°34'N, 80°22'W, R/V Pierce, Sta 7D May 20, 1977, 44m, (as *fusus*). USNM E32246, off N.C., 33°32'12"N, 77°25'06"W, R/V Eastward, Sta MS04, Sept. 4, 1980, 29m, (as *inermis*). DML 1387, 33º54.6'N, 76º23.2'W, R/V Eastward E-28-65, May 21, 1965, 64 m. DML 1401, 34º26.5'N, 75º58.1'W, R/V Eastward E-28-65, May 21, 1965, 60 m. DML 1505, 34º28.8'N, 76º13.4'W, R/V Eastward E-54-65, October 12, 1965, 28 m.

Diagnosis. Body cylindrical, up to 120 mm long, covered with numerous hair-like feet arranged in indistinct double rows along radii, scattered in interradii. Color grayish-brown. Tentacles 10, ventral pair smaller. Ossicles tables (65–135 μm) with more than 4 perforations; spire of supporting tables gently tapering.

Distribution. NC to FL, Gulf of Mexico.

Habitat. Soft sediment such as crushed shell, quartz sand, and calcareous silt. 6–366 m.

Remarks. Pawson and Miller (1981: 395) tentatively accepted Madsen's (1941) opinion that the western Atlantic specimens formerly referred to the European species *Thyone inermis* Heller, 1868 should be referred to another species, for which the name *T. deichmannae* Madsen was available, but it was not until the publication of Hendler *et al.* (1995) that this step was formally taken.

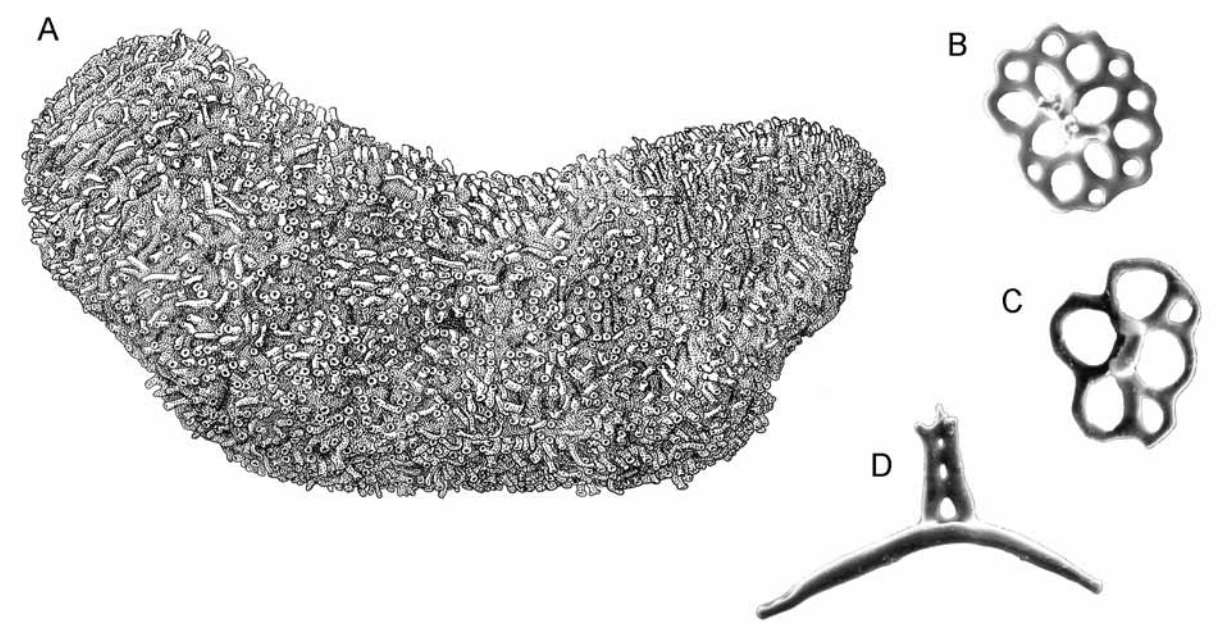

FIGURE 21. *Thyone deichmannae* Madsen, 1941. A, whole animal; B, C, tables from body wall; D, table from tube foot.

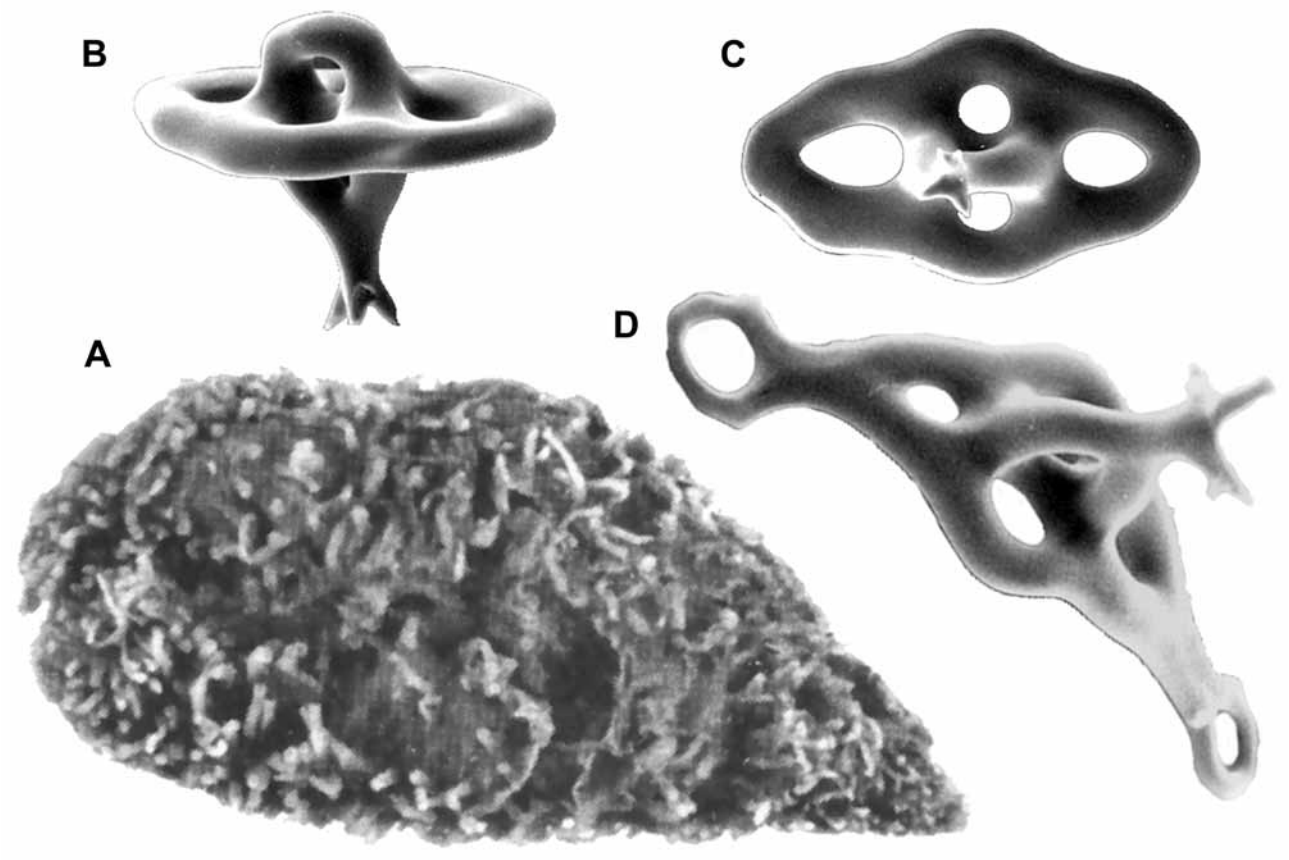

FIGURE 22. *Thyone pawsoni* Tommasi, 1972. A, whole animal; B, C, tables from body wall; D, table from tube foot.

***Thyone pawsoni* Tommasi, 1972**
Figure 22

Thyone pawsoni.—Tommasi, 1972: 19, figs. 12–15; Miller and Pawson,1984: 42, figs.34, 35.

Material examined. USNM E19415, off S.C., 32°36'N, 78°39'W, R/V Pierce, Sta 5B, Aug.31, 1977, 42m. USNM E19512, off Georgia, 31°12'N, 81°08'W, R/V Pierce, Sta 2F, May 12, 1977, 11m. USNM E30513, off N.C., 33°32’48”N, 77°24’18”W, R/V Dan Moore Sta MS04, May 18, 1981, 32m. USNM E30513, off N.C., 33°47’42”N, 76°34’48”W, R/V Dan Moore Sta OS05, May 14, 1981, 104m. USNM E32253, off N.C., 33°49’06”N, 76°34’24”W, R/V Dan Moore Sta OS05, Aug. 11, 1981, 62m. USNM E41652, Florida, 30°37’00”N, 81°10’42”W, R/V Bagby, Sta lS03, Aug. 4, 1980, 22m. DML 3107, 34º29'N, 76º13.2'W, R/V Eastward E-32-69, October 1, 1969, 37 m.

Diagnosis. Body 10 to 60mm long, tapering abruptly posteriorly to form short tail. Color chestnut – yellowish to brown. Radii indistinct. Tentacles 10, ventral pair smaller. Ossicles tables (85–135 μm), often with more than 4 perforations; spire of supporting tables abruptly tapering.

Distribution. SC to FL, Eastern Gulf of Mexico, Venezuela.

Habitat. Burrows in silt-covered quartz sand and crushed shell sediment. 6–51 m.

Remarks. Smaller individuals of this species may have tables with mostly four perforations, but scattered tables with more than four perforations can usually be found.

***Thyone pseudofusus* Deichmann, 1930**
Figure 23

Thyone pseudofusus.—Deichmann, 1930: 168, pl. 14 figs. 6–9; Hendler *et al*, 1995: 277, figs 154, 182K - M.

Material examined. USNM E29371, off S.C., 32°29’06”N, 78°49’06”W, R/V Oregon, Sta OS06, Aug. 6, 1981, 54m. USNM E29373, off S.C., 32°49’30”N, 78°39’48”W, R/V Bagby, Sta MS06, March 15, 1981, 34m, 2. USNM E29375, off S.C., 32°29’00”N, 78°49’12”W, R/V Oregon, Sta OS06, Aug. 6, 1981, 54m. USNM E29380, off S.C., 32°29’36”N, 79°42’30”W, R/V Bagby, Sta IS01, Oct. 23, 1981, 17m. USNM E29381, off S.C., 32°49’18”N, 78°39’42”W, R/V Bagby, Sta MS06, Oct. 28, 1981, 33m. USNM E29393, off Georgia., 31°41’06”N, 80°20’48”W, R/V Bagby, Sta MS02, May 14, 1981, 27m. USNM E29408, off S.C., 32°49’18”N, 78°39’42”W, R/V Bagby, Sta MS06, Oct. 28, 1981, 33m, 4. USNM E29411, off Georgia, 31°23’36”N, 80°53’ 12”W, R/V Bagby, Sta IS02, May 13, 1981, 17m. USNM E29413, off Georgia, 31°23’36”N, 80°53’12”W, R/V Bagby, Sta IS02, Aug. 4, 1981, 18m. USNM E29441, off Georgia., 31°41’ 06”N, 80°20’48”W, R/V Bagby, Sta MS02, March 10, 1981, 28m. USNM E29442, off S.C., 32°29’06”N, 78°49’18”W, R/V Oregon, Sta OS06, May 4, 1981, 48m, 2. USNM E29443, off N.C., 34°24’12”N, 76°35’48”W, R/V Onslow Bay, Sta IS05, July 28, 1981, 18m. USNM E29453, off Georgia, 31°23’36”N, 80°53’12”W, R/V Bagby, Sta IS02, May 13, 1981, 17m, 2 . USNM E30284, off Georgia, 31°23’36”N, 80°53’12”W, R/V Bagby, Sta IS02, Aug. 4, 1981, 18m. USNM E30516, off N.C., 34°24’06”N, 76°35’42”W, R/V Onslow Bay, Sta IS05, April 27, 1981, 18m. USNM E32245, off N.C., 33°32’36”N, 77°25’24”W, R/V Eastward, Sta MS04, Sept. 4, 1980, 33m. DML 1481, 34º07.5'N, 76º14.5'W, R/V Eastward Sta 4943, July 1, 1966, 75 m. DML 4348, 33º31.7'N, 77º24.5'W, R/V Dan Moore Sta BLM65818127, May 18, 1981, 29 m. DML 4367, 33º33.5'N, 77º25'W, R/V Dan Moore Sta BLM65818125, May 18, 1981, 34 m.

Diagnosis. Body tapering, up to 20 mm long, with mouth and anus directed dorsally. Color whitish. Feet in double rows along radii, scattered on interradii, especially ventrally. Tentacles 10, ventral pair smaller. Body wall with thick tables (105–140 μm) with 4 perforations and spire terminating in several teeth.

Distribution. NC to FL, Gulf of Mexico, West Indies, Tobago, Panama, Colombia, Brazil, Yucatán.

Habitat. Burrows in calcium carbonate particles covered in dense layer of white calcareous silt, beneath the rubble at the base of limestone ledges on the east coast of Florida. 6–46 m.

Remarks. Hendler *et al.* (1995) remark upon the apparent deposit-feeding propensities of this species.

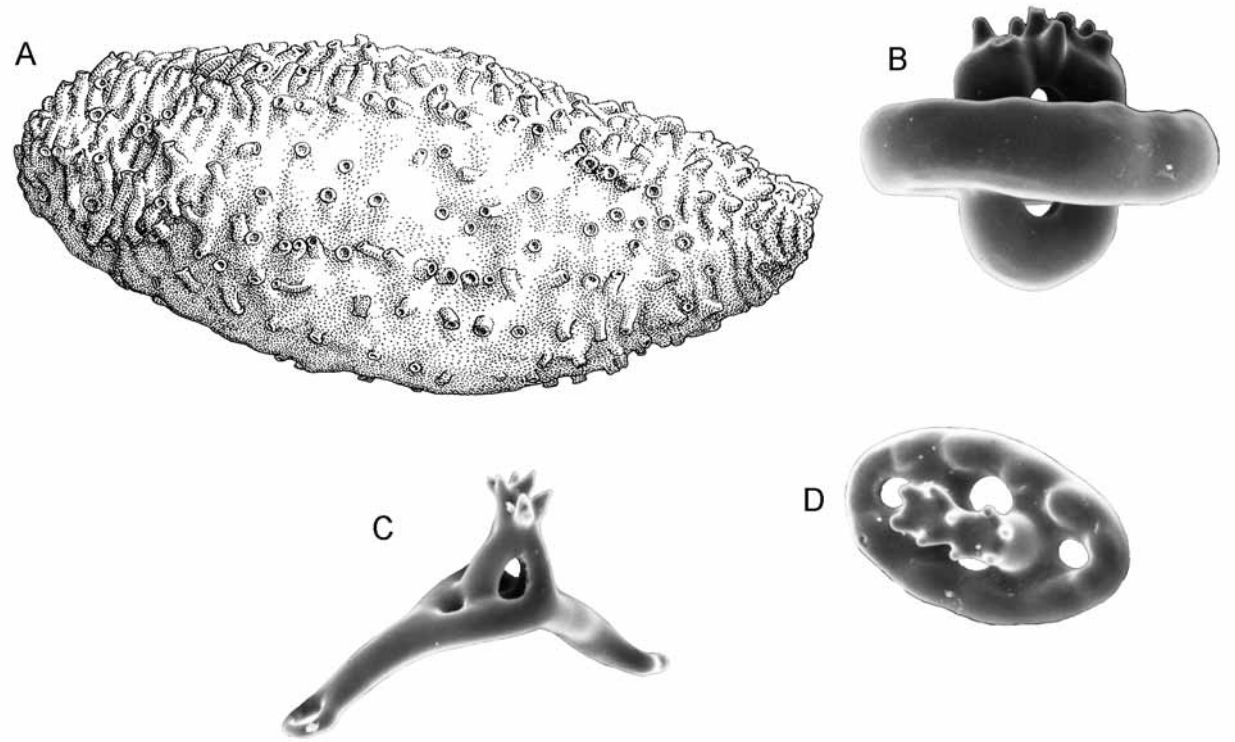

FIGURE 23. *Thyone pseudofusus* Deichmann, 1930. A, whole animal; B, D, tables from body wall; C, table from tube foot.

Family Psolidae Forbes, 1841

***Psolus fabricii* (Düben & Koren, 1846)**
Figure 24

Cuvieria fabricii Düben & Koren 1846: 316.
Psolus fabricii.—Deichmann, 1930: 191; Pawson, 1977: 12, fig. 14; Miller & Turner, 1986: 484.

Material examined. DML 677, Off Cape Lookout, NC, 34º12'N, 76º11'W, September 14, 1962, 73 m.

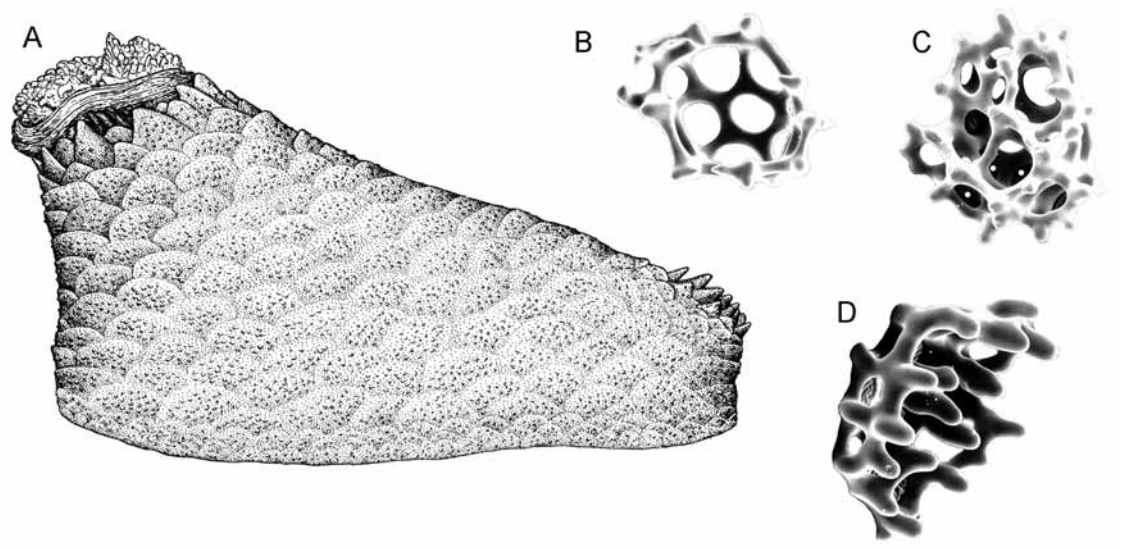

FIGURE 24. *Psolus fabricii* (Düben & Koren, 1846). A, whole animal; B, C, D, cups and ellipses.

Diagnosis. Length up to 19cm. Color presumably whitish to yellowish. Sole thick and leathery. Scales in young covered with pearl-like granules; in adults granules fuse with scales to form irregular ridges. 8–10 scales between mouth and anus. Five to 6 blunt triangular oral scales, not forming distinct oral valves; inside these, 5 narrow tooth-like scales; around anus, 5 anal teeth, and outside these 1–2 circles of scales, 5–6 in each circle. Ossicles numerous complicated cups or ellipses (60–200µm).

Distribution. Norway to New England, NC.

Habitat. Usually attached to hard substrates. 0–1800 m.

Remarks. Mortensen (1932) notes that some Arctic specimens of this species were overgrown with hydroids.

***Psolus operculatus* (Pourtalès, 1868)**
Figure 25

Cuviera operculatus Pourtalès, 1868: 127.
Psolus operculatus.—Deichmann, 1930:187, pl.20, figs. 1,2; Miller and Turner, 1986: 484.

Material examined. USNM E19419, off S.C., 32°30'N, 78°29'W, R/V Pierce, Sta 2G, Nov. 20, 1977, 218m, 2.

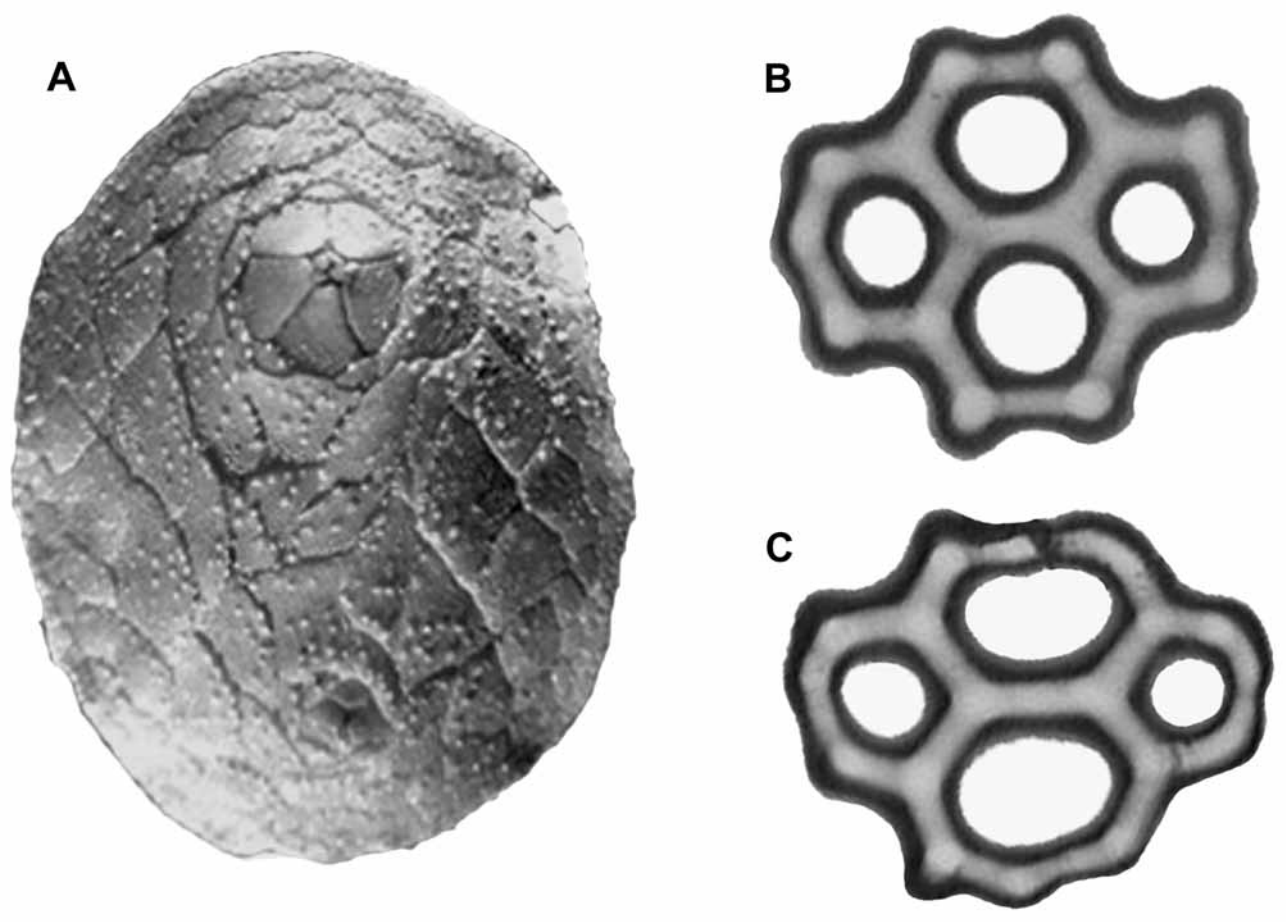

FIGURE 25. *Psolus operculatus* (Pourtalès, 1868). A, whole animal; B, C, buttons.

Diagnosis. Deichmann: Length up to 4cm; body flattened, with medium thick sole. Color unknown. Dorsal scales thin, smoothly overlapping, covered with grains in adults. Five blunt interradial oral valves which are unable to completely close oral aperture; five narrow teeth internal to oral valves. Anus surrounded

by a few circles of scales. Three to five or as many as seven dorsal scales between the oral and anal apertures. Ossicles in sole heavy four-holed buttons (90–120 μm) with knobbed margin also knobs in the middle; ossicles become more solid with smaller holes towards margin of sole.

Distribution. SC, FL, Gulf of Mexico.

Habitat. Usually attached to hard substrates. Depth: 150–274m.

Remarks. Records of this species from Northern Europe are apparently erroneous, according to Deichmann (1930).

***Psolus tuberculosus tuberculosus* Théel, 1886b**
Figure 26

Psolus tuberculosus Théel, 1886b: 13.
Psolus tuberculosus.—Miller & Pawson, 1984: 46, figs.38–40, figs. 38, 39; Miller & Turner, 1986: 484.

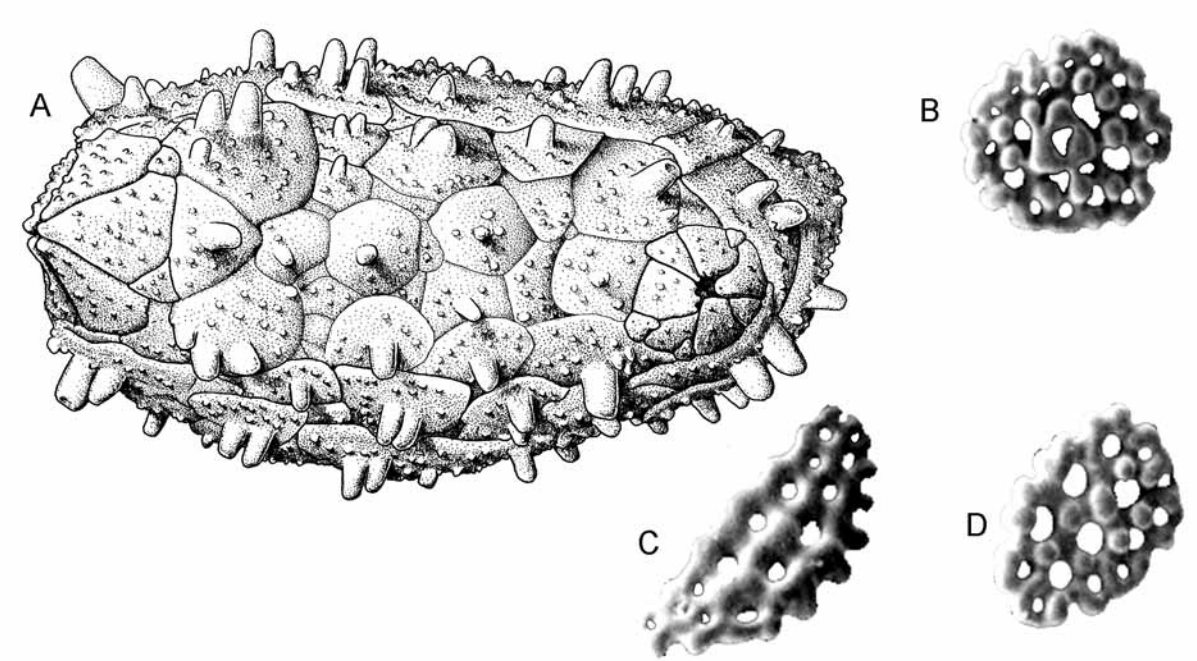

FIGURE 26. *Psolus tuberculosus tuberculosus* Théel, 1886b. A, whole animal; B–D, knobbed plates from sole.

Material examined. USNM E20188, Off Georgia, 30°57'N, 79°58'W, R/VPierce, Sta 5H, May 17, 1977, 183m. USNM E22850, Florida, 30°11'N, 80°17'W, R/V Combat, Sta 72, August 31, 1956, 59m, 7. USNM E23110, Florida, 30°11'N, 80°17'W, R/V Combat, Sta 72, August 31, 1956, 59m. SNM E32772, off Georgia, 30°26’12”N, 80°12’18”W, R/V Dolphin, Sta OS03, March 11, 1980, 61m, 3. USNM E32773, off Georgia, 33°48’54”N, 76°34’12”W, R/V Cape Hatteras, Sta OS05, Nov. 11, 1981, 79m, 7. USNM E33146, Florida, 28°30'N, 79°59'W to 28°29'N, 79°59'W, R/V Delaware II, Sta 062, April 23, 1983, 137.2m. USNM E33148, Florida, 56.5 Nautical Miles NE, 30°11'N, 80°15'W, R/V Delaware II, Sta 138, April 27, 1983, 64m, 4. USNM E33149, Florida, 68.5 Nautical miles E, 30°40'N, 80°07'W, R/V Delaware II, Sta 120, April 26,1983, 64m, 7. USNM E33150, Florida, 54.5 Nautical miles ENE, 30°00'N, 80°15'W, R/V Delaware II, Sta 142, April 27, 1983, 92m, 7. USNM E33151, Florida, 27 Nautical miles E, 27°50'N, 79°58'W, R/V Delaware II, Sta 30, April 21, 1983, 92m, 9 . USNM E33152, Florida, 66 Nautical miles E, 30°31'N, 80°10'W, R/V Delaware II, Sta 126, April 26, 1983, 64m, 7. USNM E33153, Florida, 62 Nautical miles E, 30°20'N, 80°12'W, R/V Delaware II, Sta 132, April 27, 1983, 92m, 12 . USNM E33154, Florida, 65.5 Nautical miles E, 30°30'N, 80°09'W, R/V Delaware II, Sta 127, April 26, 1983, 92m, 38. SERTC 2207, 56 miles @ 127 degrees off Charleston Light, sc, 32º12.0'N, 78º58.5'W, 92 m, coll. GML Staff, April 12 1974. SERTC 2461, off

Charleston Harbor, SC, 32º44.5'N, 79º27.0'W, 79 m, coll. MRRI Staff, April 1 1975. DML 1379, 33º56.5'N, 75º24.5'W, R/V Eastward E-36-65, July 24, 1965, 94 m. DML 1381, 34º07.5'N, 76º09.1'W, R/V Eastward E-33-65, July 6, 1965, 112 m. DML 4349, 33º48.9'N, 76º34.3'W, R/V Dan Moore, Sta BLM 65818170, August 11, 1981, 72 m. DML 4350, 33º48.2'N, 76º34.4'W, R/V Dan Moore, Sta BLM 65818095, May 14, 1981, 116 m.

Diagnosis. Small form, 10–33mm long. Body flattened ventrally, forming distinctly recessed sole, bordered by double ring of tube feet. Color bright orange, fading to light brown in alcohol. Body wall rigid dorsally, invested with heavy imbricating plates, many possessing distinct tubercle or blunt spine. Mouth dorsal, concealed by 5 large valves with smaller valves at base. Anus dorsal, bordered by 2 circles of small scales. Ossicles in sole large perforated plates (130–260 μm) with numerous perforations.

Distribution. NC to E and W FL, Gulf of Mexico, Dominican Republic.

Habitat. Usually attached to hard substrates. 73–243 m.

Remarks. This species is apparently common on suitable hard substrates. *Psolus tuberculosus destituta* Deichmann, 1930, from off Barbados, differs from the typical subspecies in having fewer, larger dorsal plates and in lacking small scales at the base of the oral valves.

Order Aspidochirotida Grube, 1840

Family Stichopodidae Haeckel, 1896

Isostichopus badionotus (Selenka, 1867)

Figure 6f, 27

Stichopus badionotus Selenka, 1867: 316, pl. 18 fig. 20; Deichmann, 1930: 80, pl. 5, figs. 30–36.
Isostichopus badionotus.—Hendler *et al.* 1995: 280, figs 156, 187G – I.
Stichopus macroparentheses H.L. Clark, 1922: 61, pl. 1 figs. 1–7.—Deichmann, 1930: 82, pl. 5 figs. 37–43.
Isostichopus macroparentheses.—Pawson, 1976: 374, fig. 1D.

Material examined. USNM E9808, S.C., Racoon Key, July 3, 1963. USNM E22529, S.C., 53 miles ESE of Port Royal Sound, 32°03'N, 79°49 30'W, R/V Pelican, Sta 181-13, Feb. 3, 1940, 26m. USNM E22900, S.C., 32°42'N, 78°52'W, R/V Silver Bay, Sta 8B-1370, October 21, 1959, 17–19fm. USNM E27835, off Georgia, 30°53’48”N, 80°36’24”W, R/V Dolphin Sta MS03, August 22, 1980, 33m. USNM E27836, off S.C., 31°43’36”N, 80°13’18”W, R/V Dolphin Sta MS01, Aug. 20, 1980, 27m. USNM E27837, off Georgia, 31°40’54”N, 80°20’42”W, R/V Dolphin Sta MS02, August 12, 1980, 28m. USNM E28212, off Georgia, 30°53’48”N, 80°36’ 18”W, R/V Dolphin Sta MS03, August 22, 1980, 35m. USNM E28560, off Georgia, 31°41’ 06”N, 80°20’54”W, R/V Dolphin Sta MS02, August 12, 1980, 28m. USNM E28588, off Georgia, 30°53’24”N, 80°36’24”W, R/V Dolphin Sta MS03, March 12, 1980, 37m, 3. USNM E33178, Florida, 56.5 Nautical miles E, 30°11'N, 80°15'W, R/V Delaware II, Sta138,April 27, 1983, 64m. USNM E33179, Florida, 38.5 Nautical miles E, 29°43'N, 80°29'W, R/V Delaware II, Sta 111, April 25, 1983, 36.6-34.8m. USNM E33180, Florida, 34.5 Nautical miles E, 29°30'N, 80°29'W, R/V Delaware II, Sta 100, April 24, 1983, 29.3m. USNM E33181 Florida, 50.5 Nautical miles E, 29°40'N, 80°16'W, R/V Delaware II, Sta 109, April 25, 1983, 64m. USNM E33182, Florida, 31 Nautical miles E, 30°20'N, 80°48'W, R/V Delaware II, Sta 116, April 25, 1983, 32–35m, 5. USNM E39041, Florida, East of Cape Canaveral, 28°15 00'N, 79°54 54'W, R/V Oregon II Sta 45151, March 21, 1987, 183m. USNM E41654, East of Georgia, 30°41’00”N, 80°20’36”W, R/V Oregon Sta MS02, March 9, 1981, 28m. USNM E41655, E of Georgia, 31°40’48”N, 80°20’36”W, R/V Oregon, Sta MS02, April 28, 1981, 28m, 2. USNM E41656, East of S.C., 31°31’36”N, 79°44’48”W, R/V Oregon Sta OS01, August 5, 1981, 58m. USNM E41657, N.C., 33°48’48”N, 76°34’24”W, R/V Eastward, Sta OS05, March 4, 1981, 64m, 2 . SERTC 1041,off Anastasia Island, FL, 30º01.51'N, 80º16.61'W, 63 m, coll. MRRI Staff, August 30 2004. SERTC 2132, St Helena Sound, SC, 32º12.40'N, 79º55.52'W, 24.4 m, coll. SERTC Staff, April 29 2005.

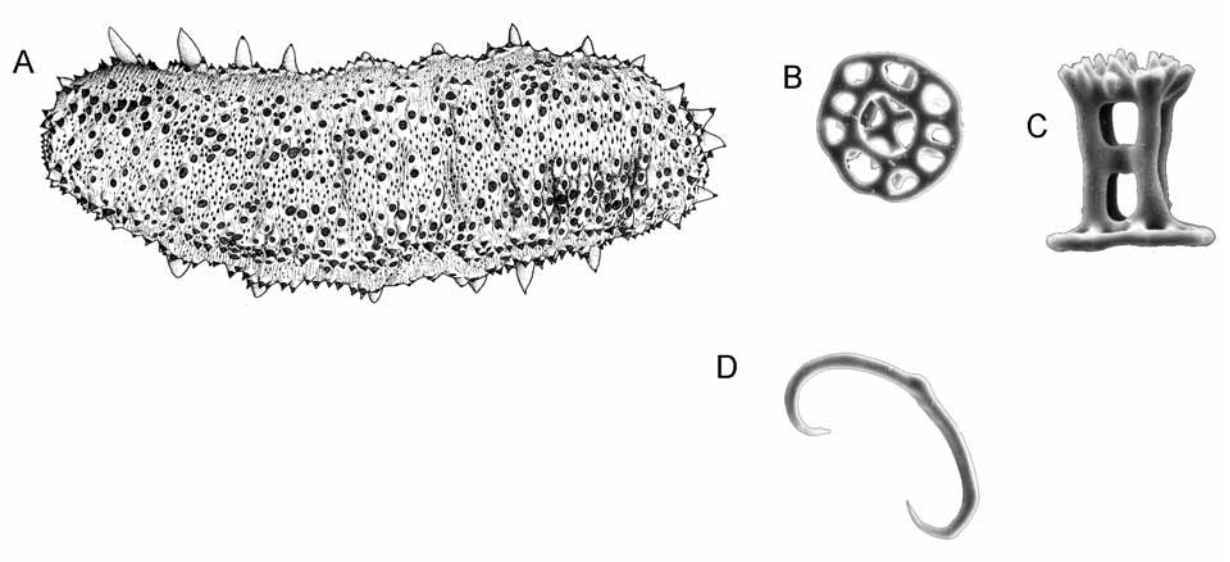

FIGURE 27. *Isostichopus badionotus* (Selenka, 1867). A, whole animal; B, C, tables in top and lateral view; D, C-shaped ossicle.

Diagnosis. Length up to 450 mm. Color extremely variable, ranging from light brown to blackish, with numerous spots and blotches often present. Body wall extremely thick, with distinct, low warts dorsally and laterally. Dorsal and ventral surface sharply defined by lateral rim of conspicuous papillae. Ventral surface flat, covered with numerous, cylindrical tube feet crowded into three rows. Ossicles include tables (40–60 μm in diameter) and C-shaped ossicles, which are approximately 1–2 times as long as tables are high.

Distribution. NC to TX, Ascension Island, Gulf of Guinea, Bermuda, Bahamas, Belize, Panama, Colombia, Venezuela, Mexico, Cuba, Yucatán.

Habitat. Mud, sand, rocks, seagrass beds, sandy bottoms, deep-water coral reefs. 0–65m.

Remarks. The relative size of the C-shaped ossicles varies considerably. *I. macroparentheses* (Clark) was based entirely upon specimens whose C-shaped rods were unusually large. Cutress (1996) showed that Clark's "species" fell within the range of variation of *I. badionotus*. This species can vary greatly in color, from very light brownish to black. A common color form is light brown with scattered dark brown spots, hence the commonly used name "chocolate chip sea cucumber".

Family Holothuriidae Ludwig, 1894

***Actinopyga agassizii* (Selenka, 1867)**
Figure 6e, 28

Mülleria Agassizii Selenka, 1867: 311.
Actinopyga agassizii.—Hendler *et al.*, 1995: 282–284, figs 157, 180G,H,I.

Material examined. None.

Diagnosis. Adult specimens reach 350mm in length. Color variable, from yellowish to brownish, often mottled. The body wall is thick and leathery. The ventrally positioned mouth is surrounded by 20–30 large, peltate tentacles, which often are extended. There are 5 conspicuous, white, calcareus teeth surrounding the anus. Body wall ossicles are rosettelike elements (30–70 μm long), which vary from simple "dog biscuit" shapes to complex rods with dichotomously branched ends.

Distribution. SC to S FL, Gulf of Mexico, Bermuda, Bahamas, Cuba, Belize, Hispaniola, Jamaica, Barbados.

Habitat. Coral reef, rocky areas, seagrass beds, on sandy bottoms of lagoons in 0–54m.

Remarks. This large tropical/subtropical species is apparently not common in the northern part of the South Atlantic Bight.

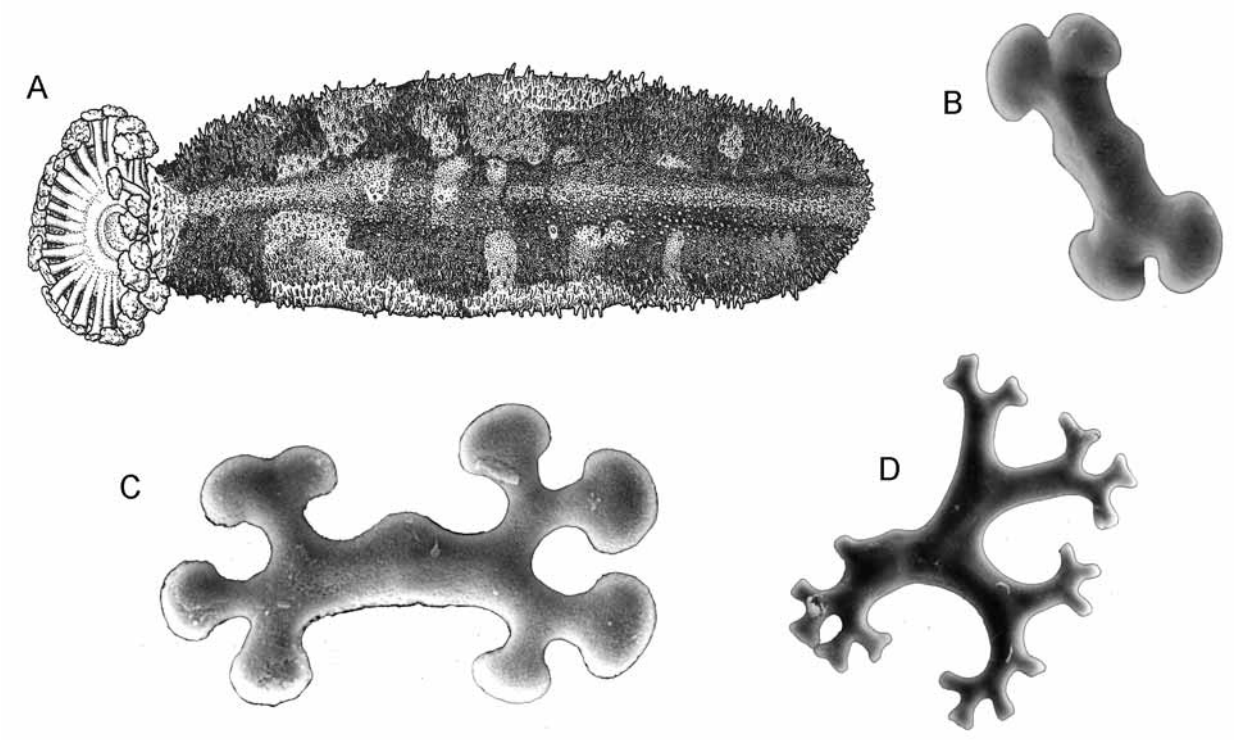

FIGURE 28. *Actinopyga agassizii* (Selenka, 1867). A, whole animal; B, C, D, simple to complex rosettes.

Holothuria (Halodeima) grisea **Selenka, 1867**
Figure 29

Holothuria (Halodeima) grisea.—Hendler *et al.*: 287, figs 160, 184A–H.

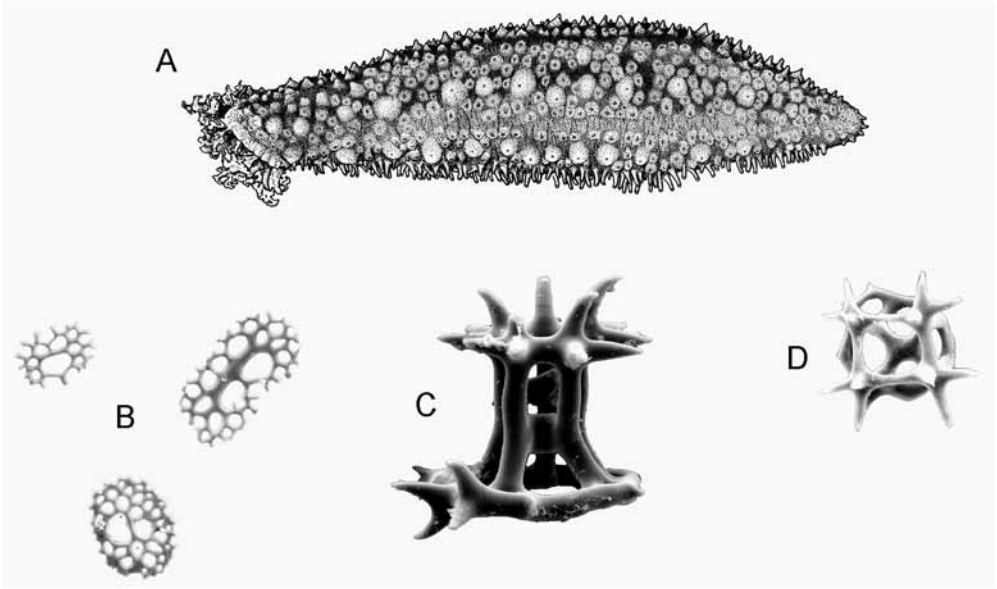

FIGURE 29. *Holothuria* (*Halodeima*) *grisea* Selenka, 1867. A, whole animal; B, plates from body wall; C, D, tables in lateral and top view.

Material examined. USNM E21378, Florida, Cape Canaveral, 28°13'N, 80°36'W, , Sta FLA#15, June 30, 1965, 2m.

Diagnosis. This species can reach a length of 25cm. The striking, harlequin colors, with bright red and yellow tints, are distinctive. The mouth is directed slightly downward, with 20–25 bushy peltate tentacles. The body wall ossicles, tables (up to 60 μm) with about 12 marginal spines on the disk, are scattered. There is also an inner layer of plates (50 μm) with 2 or 4 central holes, and the margins of the plates are equipped with blunt teeth.

Distribution. N FL, TX, Gulf of Mexico, Puerto Rico, Panama, Lesser Antilles, Colombia, Brazil, Jamaica, West Africa, Venezuela, Ascension.

Habitat. Seagrass flats, sandy bottoms. Littoral.

Remarks. This species uses its numerous tube feet to gain a tenacious grip on hard substrates. As a consequence it may be found in shallow water, where wave action apparently does not present problems.

Holothuria (Holothuria) dakarensis Panning, 1939

Figure 30

Holothuria stellati dakarensis Panning, 1939
Holothuria (Holothuria) dakarensis.—Pawson and Shirley, 1977: 915, Fig.1.

Material examined. USNM E29683, off Georgia, 31°23’42”N, 80°53’00”W, R/VOregon, Sta IS02, April 28, 1981, 16m. USNM E29549, off Georgia, 31°23’24”N, 80°53’24”W, R/VOregon, Sta IS02, March 4, 1981, 17m. USNM E32249, off N.C., 33°32’06”N, 77°25’00”W, R/VBluefin, Sta MS04, Feb. 7, 1981, 35m. USNM E32238, off Georgia, 31°23’30”N, 80°53’12”W, R/VDolphin, Sta IS02, Jan. 28, 1981, 16m. DML 3112, 34º20'N, 76º53.3'W, R/V Eastward E-10-71, May 24, 1971, 25 m.

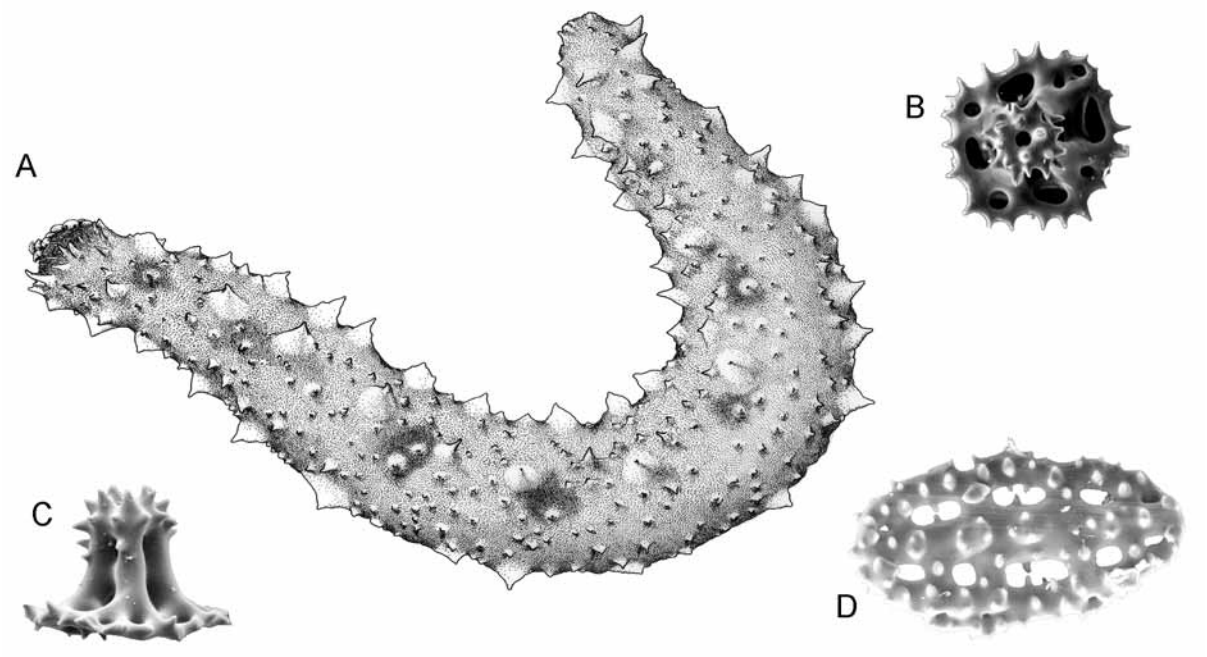

FIGURE 30. *Holothuria (Holothuria) dakarensis* Panning,1939. A, whole animal; B, C, tables in top and lateral view; D, button.

Diagnosis. Length up to 14 cm. Color in life light brown, ventral side paler. Body approximately cylindrical, mouth and anus terminal. Dorsal surface conspicuously different from ventral, with numerous evenly scattered conical papillae. Dorsolaterally, few papillae (approximately 10 on each side) conspicuously

larger than others. Ventral feet numerous, may aggregate into radii in bands 4–6 tube feet wide. Body wall relatively thin, leatherly, rough to touch due to numerous ossicles. Ossicles in body wall tables (68–86μm) and buttons (95–126μm)

Distribution. NC, GA, TX, Gulf of Mexico, Senegal, Angola.

Habitat. Prefers to live near or under rocks in sand/mud in 10–54m.

Remarks. This amphi-Atlantic species was found to be common in rocky habitats at Seven and One-Half Fathom Reef, off Padre Island, Texas (Pawson & Shirley, 1977), and it is apparently fairly common in offshore habitats in the current study area.

Holothuria (Semperothuria) surinamensis Ludwig, 1875

Figure 31

Holothuria (Semperothuria) surinamensis.—Hendler *et al.*1995: 294, figs 166, 185D,E,F; Cutress 1996: 70.

Material examined. USNM16640, S.C., Charleston, March, 1880, 2. USNM16689, S.C., Blackfish Bank, off Charleston, March 1880. USNM E29353, off Georgia, 31°41'06"N, 80°20' 36"W, R/VOregon, Sta MS02, March 9, 1981, 28m. USNM E32248, off Georgia, 31°40'54"N, 80°20'42"W, R/VOregon, Sta MS02, April 29, 1981, 27m. SERTC 2205, off Ferry Island, Bermuda, 32º21.8'N, 64º42.8'W, coll. GML Staff, April 4 1972.

Diagnosis. Large, burrowing form, up to 200 mm. Color in life light yellow to dark brown. Body cylindrical. Podia few, scattered, papillate dorsally, cylindrical ventrally, Cuvierian organ absent. Ossicles consisting of tables (35–40 μm) with reduced discs, and large flat rods (up to 400 μm), no buttons.

Distribution. SC, E and W FL, Gulf of Mexico, Caribbean, Bermuda.

Habitat. Usually near shore, sand and shell bottoms, shallow flats, beneath rocks, in seagrass beds. 0–42 m.

Remarks. This thin-skinned species can be extremely common in its preferred habitats.

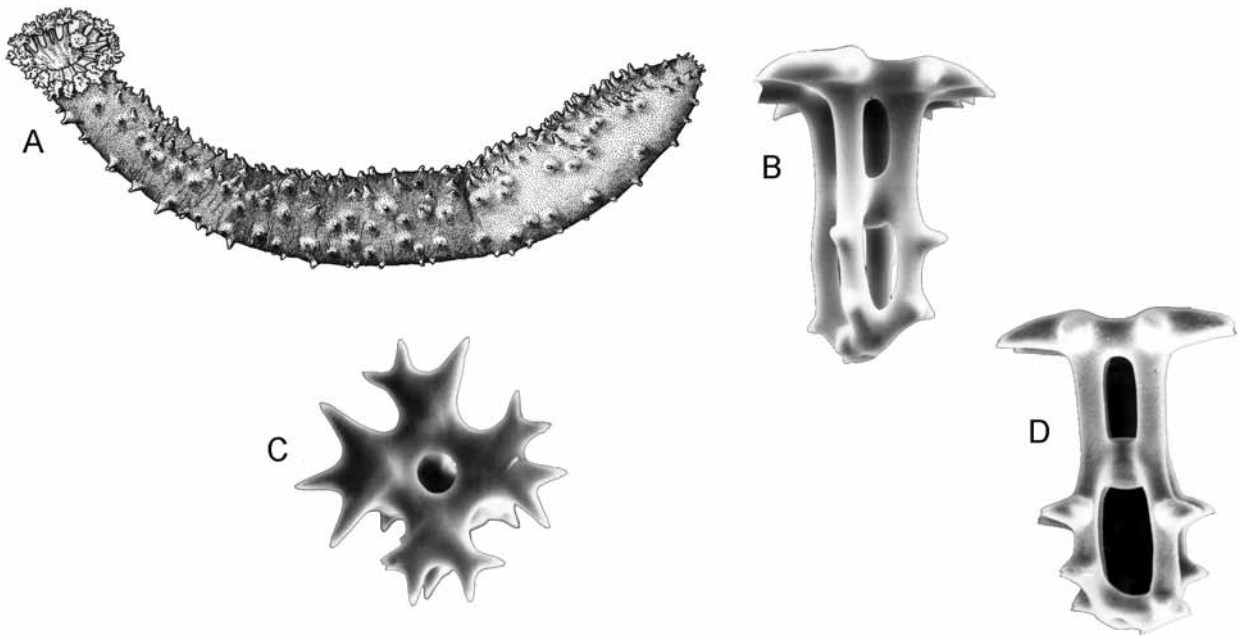

FIGURE 31. *Holothuria (Semperothuria) surinamensis* Ludwig, 1875. A, whole animal; B, C, D, tables in lateral and top view.

***Holothuria (Theelothuria) princeps* Selenka, 1867**
Figure 6d, 32

Holothuria (Theelothuria) princeps.—Hendler *et al.*1995: 296, figs 167, 185G,H,I,J; Cutress 1996: 74, Figs. 17–22, 23A.

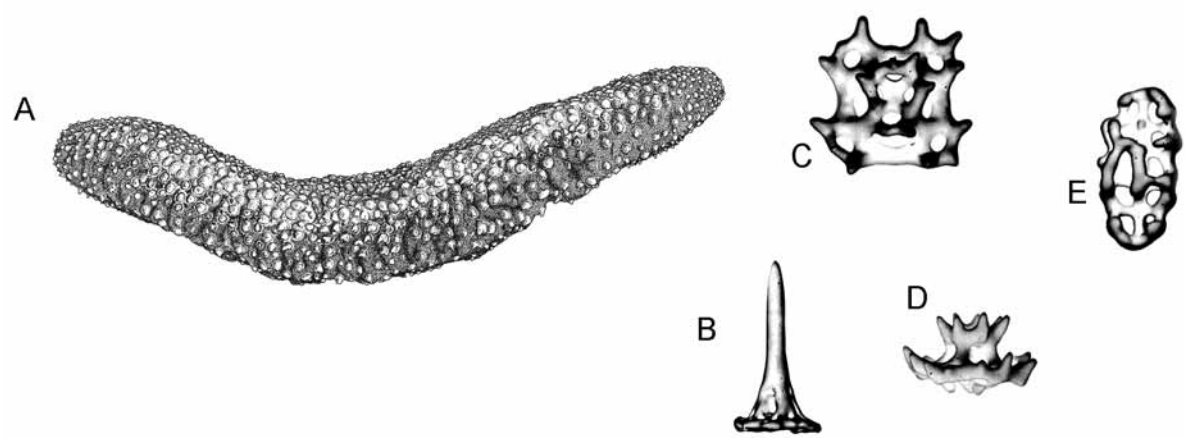

FIGURE 32. *Holothuria (Theelothuria) princeps* Selenka, 1867. A, whole animal; B, tack-like table; C, D, tables in top and lateral view; E, irregular button.

Material examined. USNM E16863, Florida, Indian Passage, Feb. 25, 1951, 13m, 7. USNM E17109, Georgia, E of Sapelo Island, R/V Pelican, Sta 197-3,March 15,1940, 60m, 3 . USNM E19325, off N.C., 33°35'N, 78°05'W, R/VPierce, Sta 1C, Feb. 11, 1977, 18m, 2 .USNM E19471, off Georgia, 31°45'N, 80°28'W, R/V Pierce, Sta 4C, August 25 1977, 16m, 3. USNM E22159, S.C., Florida, off E coast, 31°55'N, 80°19'W, R/V Pelican, Sta 39, April 27,1956, 22–26m, 2. USNM E22554, Florida, off E coast, 30°28’00”N, 80°50’30”W, R/V Pelican, Sta 200-7, March 27, 1940, 27m. USNM E22530, S.C., 44 miles SE of Charleston, 32°30'N, 79°16'W, R/V Pelican, Sta 182-11, Feb. 4, 1940, 33m. USNM E22564, Georgia, 32°01’30”N, 80°07’30”W, R/V Pelican, Sta 181-9, Feb 3, 1940, 22m, 2 . USNM E22562, Georgia, 31°41’00”N, 80°24’ 30”W, R/V Pelican, Sta 196-2, March 14, 1940, 22m. USNM E22559, Georgia, 30°50’00”N, 80°25’00”W, R/V Pelican, Sta 180-3, Feb.2, 1940, 20m. USNM E22565, Georgia, 31°59’30”N, 80°34’00”W, R/V Pelican, Sta 181-3, Feb. 3, 1940, 15m, 2 . USNM E22561, Georgia, 31°11’00”N, 80°52’00”W, R/V Pelican, Sta 178-6, Jan. 31, 1940, 16m. USNM E2778, S.C., 32°29'N, 79°37'W, R/V Silver Bay, Sta 5725, 20.1–22.9m, 2 . USNM E33183, Florida, 29 Nautical miles NE, 30°10'N, 80°49'W, R/V Delaware II, Sta115, April 24,1983, 27.4m, 3. USNM E34094, Florida, 22.5 Nautical Miles ENE, 30°00'N, 80°52'W, R/V Delaware II, Sta 114, April 25, 1983, 27m, 9 . USNM E34096, Florida, 30°20’06”N, 81°13’12”W, R/V Delaware II, Sta 086, May 22, 1986, 18.3 m, 3. USNM E34095, Florida, 30°40’00”N, 81°11’00”W, R/V Delaware II, Sta 088, May 22, 1984, 20.1m, 2. SERTC 2127, off Folly Island, SC, 32º20’22”N, 79º32.30'W, 31.1 m, coll. SERTC Staff, April 28 2005. SERTC 2131, off Edisto Island, SC, 32º12.33', 79º42.16'W, 30.5 m, coll. SERTC Staff, April 29 2005.

Diagnosis. Large cylindrical form, up to 300mm. Color in life brown and white, with light ring around base of most dorsal papillae. Body wall thick, strongly contracted in preserved specimens. Podia numerous, scattered over entire body, dorsally as papillae, ventrally as cylindrical tube feet. Ossicles abundant, consisting of irregular tables (45–65 μm) and irregular knobbed buttons (40–80 μm). Large tack-like tables in ends of papillae. Cuvierian organs absent.

Distribution. NC, to E and W FL, Bahamas, Caribbean, Mexico, Colombia, Venezuela.

Habitat. Burrows in sandy mud and shell substrates and seagrass. 0–73 m.

Remarks. In NMNH also as *Holothuria imperator* Deichmann, 1930. Cutress (1996) notes that Deichmann (1958) withdrew this species, and Miller & Pawson (1984) synonymized *imperator* with *princeps*. Cutress (1996, p.84) believed that the *imperator/princeps* problem needed to be examined anew.

***Holothuria (Vaneyothuria) lentiginosa enodis* Miller and Pawson, 1979**
Figure 33

Holothuria (Vaneyothuria) lentiginosa enodis Miller & Pawson, 1979: 912.

Material examined. USNM E22849, Florida, off E coast, 29°30'N, 80°11'W, R/V Combat, Sta 489, August 19,1957, 137m, 3. USNM E26373, Florida, off E coast, 27°32'48"N, 79°58'48"W, Johnson Sea, Sta 1429, August 15, 1977, 75m. USNM E29627, off N.C., 33°48'48"N, 76°34' 24"W, R/VEastward, Sta OS05, March 4, 1981, 64m. USNM E32251, off N.C., 33°48'12"N, 76°34'24"W, R/VDan Moore, Sta OS05, May 14, 1981, 116m. USNM E34097, Florida, 54 Miles E, 29°50'N, 80°14'W, R/V Delaware II, Sta 146, April 27, 1983, 135.4m. SERTC 1042, off Anastasia Island, FL, 29º52.24'N, 80º16.94'W, 60 m, coll. MRRI Staff, August 31 2004.

Diagnosis. Body cylindrical, flattened ventrally, up to 50 cm long. 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. Tables (45–100 µm) with slightly dentate to smooth discs, and buttons (45–105µm) present, the latter irregular, often incomplete, but seldom strongly contorted. Rods in tentacles with minute spines, often confined to extremities

Distribution. NC to E and W FL, southwest Cuba, Bahamas.

Habitat. Soft sediments around *Oculina* reefs. 69–466 m.

Remarks. The species *H. (Vaneyothuria) lentiginosa* is amphi-Atlantic; in the eastern Atlantic it is known from the Azores and West Africa (Miller and Pawson, 1979). The subspecies *H. (V.) lentiginosa lentiginosa* appears to be restricted to the western Atlantic.

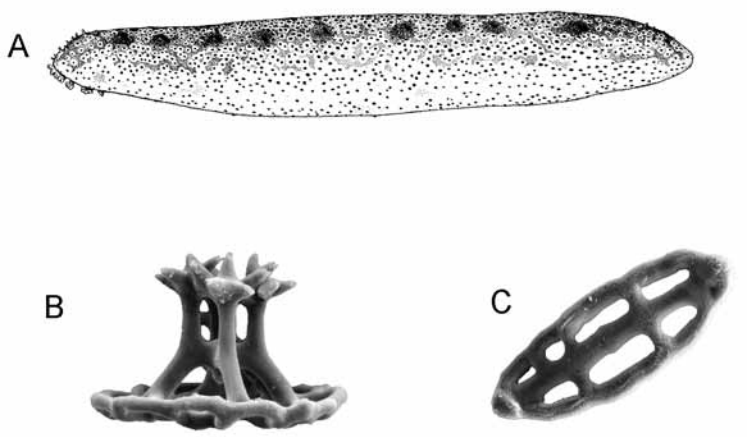

FIGURE 33. *Holothuria (Vaneyothuria) lentiginosa enodis* Miller and Pawson, 1979. A, whole animal; B, table in lateral view; C, button.

Order Molpadiida Haeckel, 1896

Family Molpadiidae Müller, 1850

***Molpadia oolitica* (Pourtalès 1851)**
Figure 34

Chiridota oolitica Pourtalès 1851: 13.
Molpadia oolitica.—Pawson et al, 2001: 322, figs. 3C–E.

Material examined. DML 1475, N.C., 4°22.8'N, 75°51.4'W, R/V Eastward E-60-65, 3 November 29, 1965, 200 m.

Diagnosis. Large species up to 150 mm long; phosphatic bodies abundant, therefore adult animals dark red to blackish. Body wall ossicles three-pillared tables (245 µm in diameter), with up to 12 holes, disc with marginal projections as holes often incomplete; tables reduced with age. Tail with elongate oval tables (110µm long), with three-pillared spire and up to 20 perforations.

Distribution. MA south to E and W FL, Gulf of Mexico.

Habitat. Mud, buried or in shallow depressions in seabed. 90–720 m.

Remarks. The dark red to blackish body of this species, and the posterior grayish tail, are distinctive.

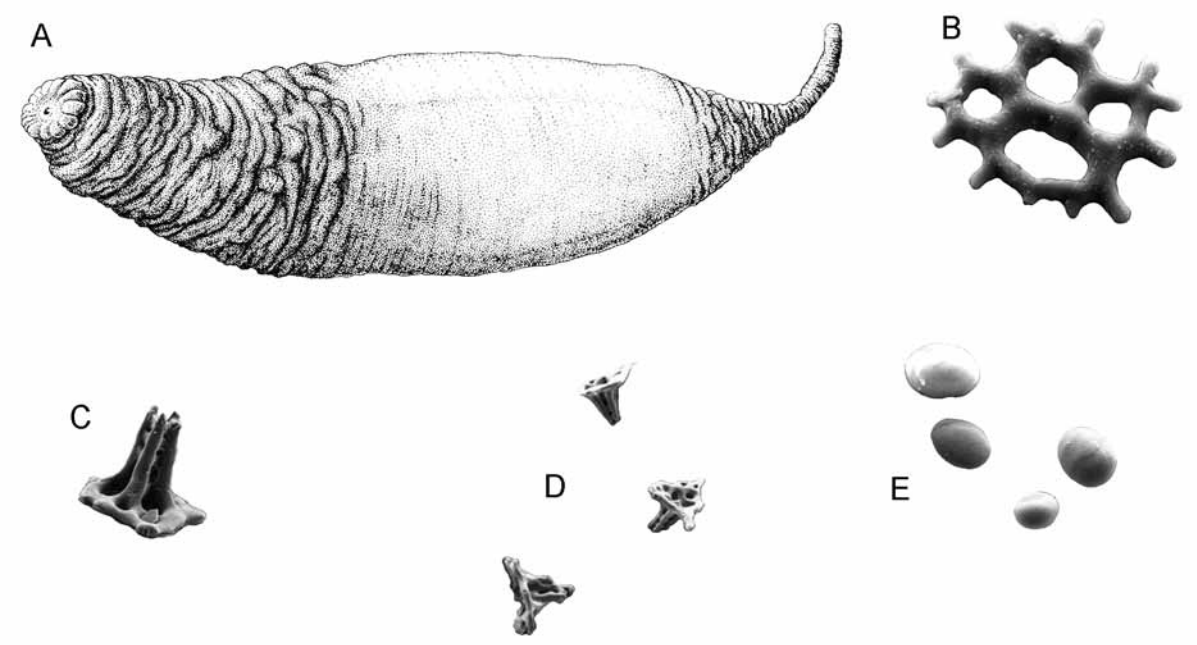

FIGURE 34. *Molpadia oolitica* (Pourtalès 1851). A, whole animal; B, C, body wall tables; D, tail tables; E, phosphatic deposits.

Family Caudinidae Heding, 1931

***Paracaudina chilensis obesacauda* (H.L. Clark, 1908)**
Figure 35

Caudina obesacauda Clark, 1908: 38, pl. 9, figs. 1–5.
Paracaudina chilensis obesacauda.—Miller and Pawson, 1984: 66, figs.53, 54.—Hendler *et al.* 1995: 302, figs. 171, 187 J,K.—Pawson *et al.* 2001: 324, figs. 5A,B.

Material examined. SERTC 2460, off St Catherines Island, GA, 31º27.42'N, 81º05.46'W, 9 m, coll. MRRI Staff, October 13 2004.

Diagnosis. Medium-sized, burrowing form, up to 150mm. Color in life white to grey. Body barrel-shaped, with distinct, tapering tail. Podia absent. Body wall and tail with ossicles of one type, crossed cups (45–65 µm).

Distribution. SC to E and W FL, TX, Gulf of Mexico, Indo-Pacific.

Habitat. Infaunal, soft, sandy sediment. 0–10m.

Remarks. The astonishingly broad distribution of this species has led to a re-examination, by various authors, of the taxonomic characters – mostly in the ossicles – and the conclusion that this is a single variable species.

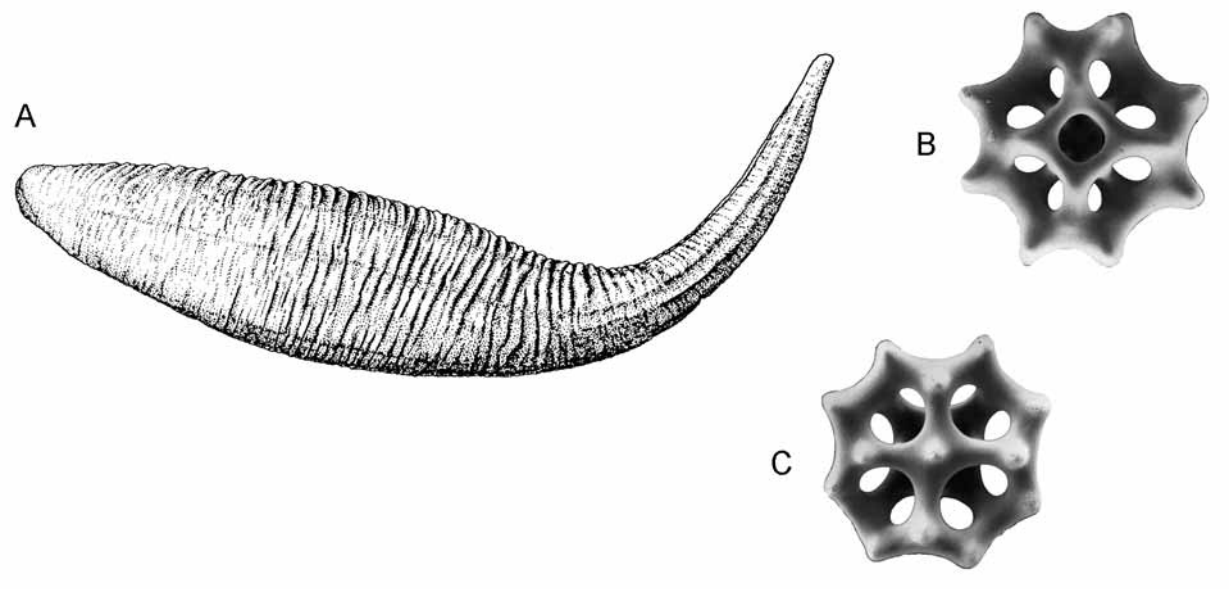

FIGURE 35. *Paracaudina chilensis obesacauda* (H.L. Clark, 1908). A, whole animal; B, C, crossed cups.

Order Apodida Brandt, 1835

Family Synaptidae Östergren, 1898

***Epitomapta roseola* (Verrill, 1874)**
Figure 36

Leptosynapta roseola Verrill, 1874: 716.
Epitomapta roseola.—Clark, 1908: 93, pl. 5, figs.16,17,19,21; Hendler *et al.* 1995: 303, figs. 172, 188E–J.

Material examined. USNM E19357, off S.C., 32°57'N, 79°17'W, R/V Pierce, Sta 2A, Feb. 12, 1977, 12m, 3. USNM E19360, off S.C., 32°54'N, 79°12'W, R/V Pierce, Sta 2B, Nov. 19, 1977, 16m. USNM E19361, off S.C., 32°54'N, 79°12'W, R/V Pierce, Sta 2B, May 14, 1977, 16m, 2 . USNM E19362, off S.C., 32°54'N, 79°12'W, R/V Pierce, Sta 2B, May 13, 1977, 16m. USNM E19398, off S.C., 32°40'N, 78°47'W, R/V Pierce, Sta 2E, Aug. 18, 1977, 37m. USNM E19469, off Georgia, 31°45'N, 80°28'W, R/V Pierce, Sta 4C, Aug.25, 1977, 16m, 3. USNM E19634, off Florida, 30°23'N, 81°15'W, R/V Pierce, Sta 6B, Aug. 31, 1977, 15m, 2. DML 2087, 34º36'N, 76º28.7'W, June 24, 1965, 10 m.

Diagnosis. This tiny, worm-shaped form can reach a length of 10cm, but most specimens are smaller. Color in life pinkish. The mouth is surrounded by 12 digitate tentacles, each with 7 fingerlike projections. The body ossicles are anchors (140–170 μm), anchor plates (averaging 118 μm), and C- or O-shaped miliary granules. Anchors from the anterior portion of the body have smooth flukes; those near the posterior end are longer and have serrate flukes.

Distribution. MA to E and W FL, Gulf of Mexico, Bermuda.

Habitat. Beneath rocks in fine gravel and coarse sand. 0–10m.

Remarks. The presence of tiny C- or O-shaped miliary granules distinguishes this species from other synaptids.

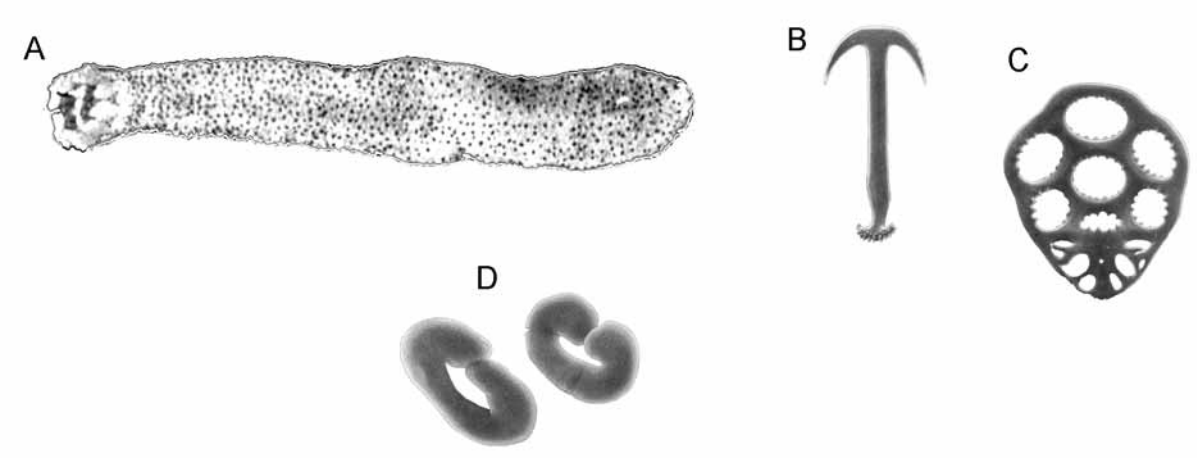

FIGURE 36. *Epitomapta roseola* (Verrill, 1873). A, whole animal; B, anchor; C, anchor plate; D, miliary granules.

***Labidoplax buskii* (McIntosh, 1866)**
Figure 37

Synapta buskii McIntosh, 1866
Labidoplax buskii.—Clark, H.L., 1908: 94, pl.5, fig.23; Pawson 1967: 152, figs.1–4.

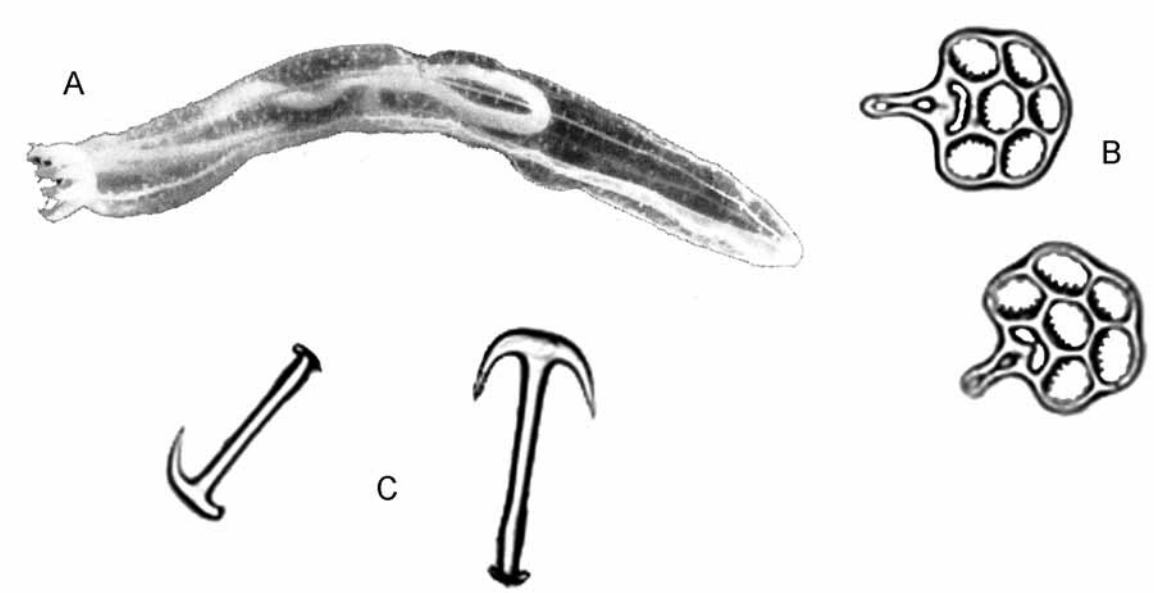

FIGURE 37. *Labidoplax buskii* (McIntosh, 1866). A, whole animal; B, anchor plates; C, anchors.

Material examined. None

Diagnosis. A small form, up to 30mm long. Color pale, body wall semi-transparent with numerous calcareous deposits, grayish and without pigment, and appears whitish in alcohol. Body cylindrical with 11 tentacles, each with three digits, of which central digit is largest. Small lateral digits arising in distal one-third of tentacle. Tentacles have no calcareous deposits. Ossicles anchors (120–160 μm) and anchor plates (100–140 μm), the anchor plates distinctive in shape, with a narrow posteriorly-directed "handle".

Distribution. Northern Europe, MA to W FL.

Habitat. Clay bottoms; burrows in muddy substrates. 18–2117 m.

Remarks. This species has a broad geographic and bathymetric range.

***Leptosynapta tenuis* (Ayres, 1851)**
Figure 38

Synapta tenuis Ayres, 1851:11.
Leptosynapta tenuis.—Hendler *et al.*, 1995: 308, figs.174, 189A–E.

Material examined. None.

Diagnosis. This slender, worm-shaped species reaches about 15cm in length. Color of transparent body wall light violet. Surrounding the mouth are 12 tentacles, each with 9–11 digits of which the terminal one is the longest, and 15–25 sensory cups on the inner surface. The ossicles consist of anchors (110–200 μm), anchor plates (120–160 μm), and miliary granules. The number of teeth on the anchor flukes vary from none to approximately seven. The miliary granules are numerous, especially in the tentacle stalks. They are in the shape of tiny, straight to curved rods, C-shapes, or dumb-bells.

Distribution. MA to E and W FL, Caribbean, Gulf of Mexico.

Habitat. Sandy and muddy sediments, sometimes associated with seagrass rhizomes. Littoral, less than 1 m.

Remarks. Often referred to in the past as L. inhaerens (O.F. Müller, 1776); L. inhaerens is now usually regarded as restricted to the NE Atlantic.

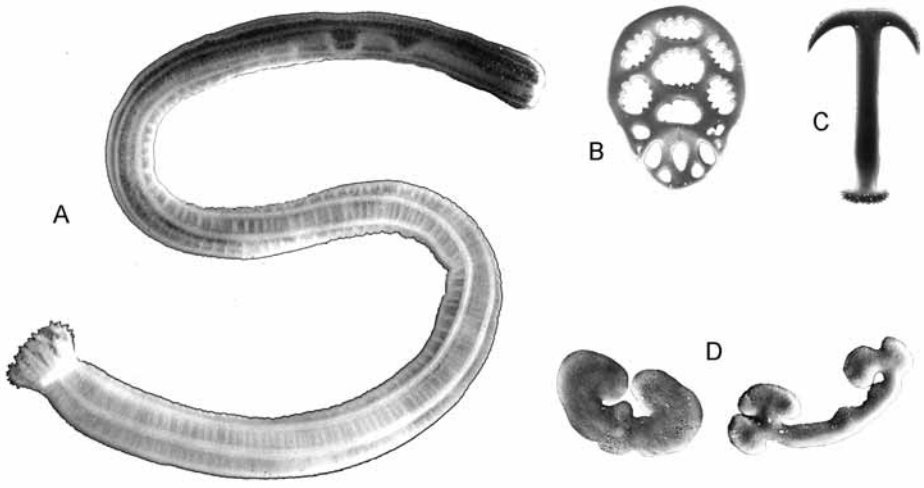

FIGURE 38. *Leptosynapta tenuis* (Ayres, 1851). A, whole animal; B, anchor plate; C, anchor; D, miliary granules.

Family Chiridotidae Östergren, 1898

***Chiridota ferruginea* (Verrill, 1882)**
Figure 39

Toxodora ferruginea Verrill, 1882: 220; Clark, 1908: 126; Deichmann, 1930: 213.
Chiridota ferruginea.—Deichmann, 1940: 232, pl. 41 figs. 4–7.
Chiridota wigleyi Pawson, 1976: 405, fig. 1F–H; 1977, 13.

Material examined. DML 2092, 34º20'N, 75º49'W, June 28, 1965, 200 m.

Diagnosis. Cylindrical body up to 12cm long. Color in alcohol is dark reddish brown.
Wheel papillae very scarce, apparently restricted to dorsal interradii. Wheels (averaging 90 μm in diameter) typical of the genus. Radial and interradial areas of the body wall with numerous curved rods (50–80 μm) with bifurcated ends. Tentacles with curved rods with branching ends.

Distribution. MA to SC.

Habitat. Mud/sand. 70–301m.

Remarks. Verrill (1882) created a new genus *Toxodora* for his new species *T. ferruginea.* Verrill, and also Clark (1908), believed that this new species lacked the wheel ossicles that are typical of the genus *Chiridota,* to which this species might otherwise have been assigned. Pawson (1976) described *Chiridota wigleyi* n.sp. from the same general geographic area as *Toxodora ferruginea.* Deichmann (1940) had discovered that type-specimens of *Toxodora ferruginea* indeed possessed wheels near the posterior end of the body. *Toxodora* Verrill, 1882 is therefore a subjective junior synonym of *Chiridota* Eschscholtz, 1829, and *Chiridota wigleyi* Pawson, 1976, is a subjective junior synonym of *Chiridota ferruginea.*

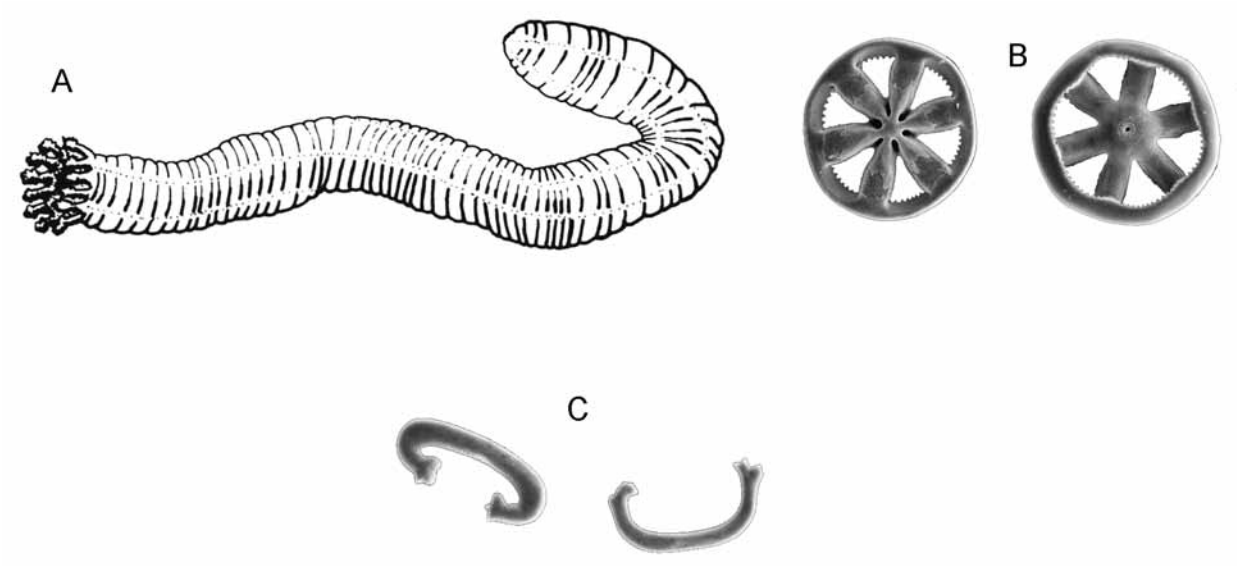

FIGURE 39. *Chiridota ferruginea* (Verrill, 1882). A, whole animal; B, wheels; C, curved rods.

Acknowledgements

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