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Black Corals of the Flower Garden Banks National Marine Sanctuary

DENNIS M. OPRESKO, MARISSA F. NUTTALL, AND EMMA L. HICKERSON

Black corals (Cnidaria: Anthozoa: Antipatharia) of the Flower Garden Banks National Marine Sanctuary (FGBNMS) are described. A key to the species is provided and supplemented with in situ and laboratory photos. The microscopic skeletal features of the species are illustrated from photographs taken with a scanning electron microscope. Thirteen species of black corals are found in the FGBNMS, belonging to the families Antipathidae (*Antipathes furcata* Gray 1857; *Antipathes atlantica* Gray 1857, *Stichopathes luetkeni* Brook 1889; *Stichopathes pourtalesi* Brook 1889, and *Stichopathes* sp.); Aphanipathidae [*Aphanipathes pedata* (Gray 1857), *Elatopathes abietina* (Pourtales 1874), *Acanthopathes thyoidea* (Pourtales 1880) and *Phanopathes expansa* (Opresko and Cairns 1992)]; and Myriopathidae [*Plumapathes pennacea* (Pallas 1766), *Tanacetipathes tanacetum* (Pourtales 1880), *Tanacetipathes hirta* (Gray 1857), and *Tanacetipathes cf. thamnaea* (Warner 1981)].

INTRODUCTION

Black corals (Order Antipatharia) are colonial organisms that produce a branched or unbranched skeletal axis that is similar in general appearance to that of gorgonian corals; species of both groups are commonly referred to as sea fans, sea bushes, sea feathers, or sea whips. Each colony consists of hundreds to thousands of individual polyps. Antipatharian polyps are generally no more than a few millimeters in diameter and each polyp has six simple (unbranched) tentacles. In contrast, the polyps of gorgonians have eight tentacles and each tentacle is pinnately branched like a feather.

The skeleton of black corals, referred to as the corallum, is organic, and is made of concentric layers of protein and chitin (Goldberg, 1978, 1991). Unlike gorgonians, black corals do not produce any type of calcium carbonate skeletal structures, such as sclerites, in either the skeletal axis or in their soft tissues. All black corals do, however, have skeletal spines, although in some species the spines are present only on the smallest branches. The spines, rarely more than 0.5 mm in height, range in shape from being compressed and triangular (when viewed from the side), to conical, thorn-like, blade-like, needle-like, or even bister-like. In some taxa they become forked, multilobed at the tip, or even antler-shaped in appearance (Opresko, 2001, fig 17b). The spines may be smooth or covered with minute surface features such as papillae, tubercles, or fine striations, details that may only be observable under high magnification.

Although a few species of antipatharian corals are found in waters as shallow as 5 m, most species prefer deeper waters, and some live in the deepest parts of the ocean. In the Atlantic, black corals are only rarely found shallower than

about 20 m. The larvae (planulae) of black corals are hypothesized to be negatively phototactic. This has been shown to be the case for one species studied in the laboratory (Miller, 1996), and the same may be true for other shallow-water species, as colonies are often found under overhangs, in crevices, and in underwater caves or in areas with high levels of suspended particulate matter where light intensity is reduced (Péres and Piccart, 1949; Grigg, 1965).

The Flower Garden Banks National Marine Sanctuary (FGBNMS) encompasses three geographically separate locations south of the Texas and Louisiana coasts on the continental shelf margin in the Gulf of Mexico (Fig. 1). The East and West Flower Garden Banks are 19.5 km apart and are located approximately 160 km south of the Texas/Louisiana border. Stetson Bank is located 48 km northwest of the West FGB, and is 85 miles southeast of Galveston, TX. Antipatharians are relatively common in some areas of the FGBNMS; 13 species have now been recorded from the sanctuary. They occur at depths ranging from 50 to 150 m.

This paper includes: (1) a key to the FGBNMS black coral species; (2) descriptions of the major morphological features of the species; (3) in situ photographs to aid in field identification; (4) laboratory photos of the microscopic skeletal features, which are the key characters used to identify species; and (5) information on the relative abundance of the species within the FGBNMS.

Regarding the last item, reported abundance for each species is based on the use of in situ imagery in deep-reef habitat (Schmahl et al., 2008). Imagery was collected over four cruises between 2009 and 2012 where surveys were conducted randomly over the reef, but biasedly restricted to

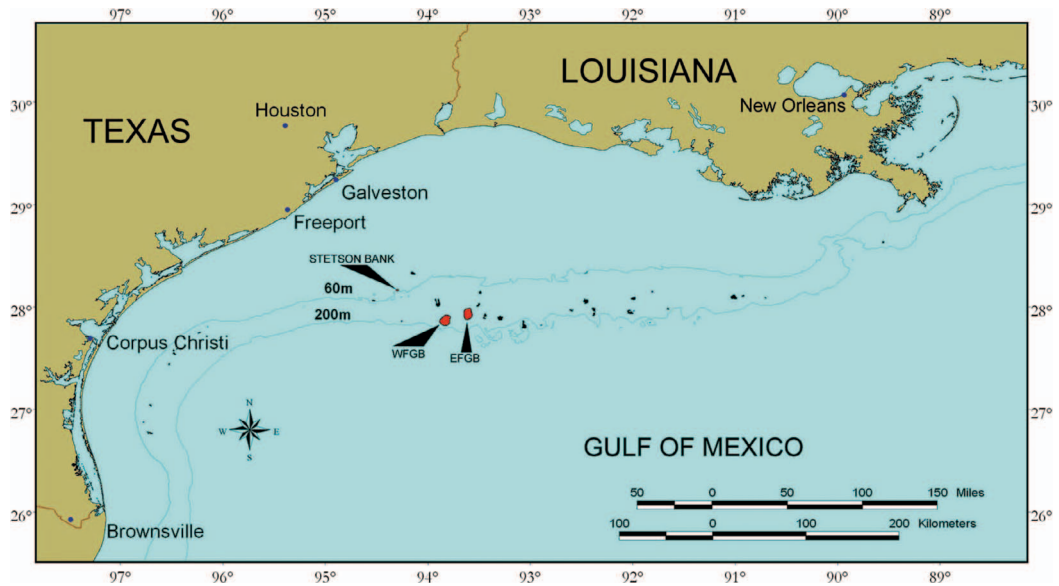


Fig. 1. Location of the Flower Garden Banks National Marine Sanctuary.

hard bottom structure. For genera where in situ identification to species level is difficult (*Stichopathes* spp., *Tanacetipathes* spp., *Acanthopathes thyoidea*, *Phanopathes expansa*, and *Antipathes atlantica*), remarks on associated black coral fauna were not included and the distribution of species among collected specimens is used to infer species abundance within the community, as in situ identifications are not possible. Abundance groups are defined as:

Abundant: Comprises $\geq 20\%$ of observed Antipatharia species in in situ imagery, and $\geq 40\%$ of collected specimens when in situ identifications made to genus level or higher.

Moderate: Comprises 5–20% of observed Antipatharia species in in situ imagery, and 20–40% of collected specimens when in situ identifications made to genus level or higher.

Rare: Comprises $< 5\%$ of observed Antipatharia species in in situ imagery, and $< 20\%$ of collected specimens when in situ identifications made to genus level or higher.

TERMINOLOGY

Some specialized terms are used in the scientific descriptions of antipatharian corals; these are briefly described here:

Acicular: Needle-like, used primarily in reference to the shape of the spines—long and cylindrical, with a sharp or rounded tip.

Abpolypar: Refers to the side of a branch opposite to the side on which the polyps occur (in most species the polyps occur in a single row only on one side of the branch).

Actinopharynx: A tubular involution of ectodermal tissue that extends down from the mouth into the polyp.

Anastomosing: When adjacent branches or branchlets fuse together to form a net-like pattern.

Anisomorphic: Not of equal size—specifically referring to the spines on the polypar side of the axis, in which case the spines around the edges of the polyp are longer than those between the polyps, and sometimes the spines directly below the mouth of the polyp are very small or even absent.

Axis: The skeletal material of the corallum, a so-called scleroprotein lacking any calcareous elements.

Bottlebrush: A type of branching pattern in which the smallest branchlets, referred to as pinnules, extend out horizontally on all sides of the branches. In some cases the colony forms a single upright stem with the pinnules extending out on all sides and often at right angles to the stem.

Branchlets: The smallest branches of a colony, not of uniform size and arrangement (see pinnules).

Central canal: a chambered tube (that may become hollow or secondarily filled) running down the center of the axis of the stem and all branches and pinnules.

Circumpolypar spines: Referring to the spines located around the perimeter of a polyp.

Corallum: A general term referring to the entire colony and particularly to the skeletal part of the colony.

Distal: In the direction of the free end of a branch, branchlet, or pinnule.

Flabellate: Fan shaped, in reference to the shape of the corallum.

Hypostomal: Area on the skeletal axis directly below the mouth of the polyp.

Interpolypar: Area on the colony surface between adjacent polyps.

Lateral tentacles: Two pairs of tentacles; one pair located at the distal end of the polyp, and one pair located at the proximal end of the polyp.

Mesentery: Partitions of tissue that extend from the interior wall of the polyp to the wall of the actinopharynx. Mesenteries divide the upper interior part of the polyp into pie-like sections. The number of mesenteries is usually 10 (6 primary ones and 4 secondary ones); however, in one family the polyps have only 6, and in another family there are 12.

Papillose: Referring to microscopic bumps or protuberances present on the surface of the spines in some species.

Peristomal: Area surrounding the mouth of the polyp.

Pinnules: A name given to small branchlets in a colony when they are all of nearly equal size and are arranged in a symmetrical fashion (e.g., pinnately or in a bottlebrush pattern); sometimes there are smaller subpinnules (called secondary pinnules) on the primary pinnules, and even smaller tertiary pinnules on the secondary pinnules.

Proximal: In a direction toward the base or lower attached part of a branch, branchlet, or pinnule.

Sagittal axis of a polyp: A line running through the center of a polyp at right angles to the direction of a branch, branchlet, or pinnule.

Sagittal tentacles: The two tentacles located in the middle of the polyp, one on each side of the

mouth (at each end of the sagittal axis of the polyp).

Subpinnulate: Branching pattern in which the stem and branches of a colony have pinnules and the pinnules themselves have smaller secondary and possibly tertiary pinnules, which are referred to as subpinnules.

Terminal branchlets: The smallest unbranched branchlets on the corallum.

Transverse axis of a polyp: A line extending through the center of the polyp in the direction of the branch, branchlet, or pinnule.

Transverse diameter of polyp: This is a measurement of the size of the polyp in the direction of the branch (from the distal side of the base of the distal tentacles to the proximal side of the base of the proximal lateral tentacles).

Tuberculate: Referring to a type of skeletal spine that has distinct conical protuberances on its surface.

TAXONOMIC CLASSIFICATION

Seven families are currently recognized in the order Antipatharia: Antipathidae, Schizopathidae, Cladopathidae, Stylopathidae, Leiopathidae, Myriopathidae, and Aphanipathidae (Daly et al., 2007). Representatives of the families Antipathidae, Aphanipathidae, and Myriopathidae are found in the FGBNMS. Families are differentiated on the basis of several taxonomic characters including the number of mesenteries in the polyps, size and shape of the polyps, size and appearance of the tentacles of the polyps, and the morphology of the spines. Within the families, genera are differentiated primarily by the growth form of the corallum. Species may be distinguished by one or more of the following: (1) relative length, thickness, density, and arrangement of the branches; (2) arrangement of the pinnules and subpinnules; (3) size of the polyps; and (4) size and morphology of the spines.

Twenty-nine species of antipatharians (Cnidaria: Anthozoa: Antipatharia) have been reported from the Gulf of Mexico (Cairns et al., 1993), of which 18 species are found in the northwest section of the Gulf that includes the FGBNMS. Thirteen species are included in this report. As more extensive collections are made in the area, and as specific genera (i.e., *Leiopathes*, *Tanacetipathes*, and *Aphanipathes*) are studied in greater detail with advanced molecular techniques, it is possible that additional species will be discovered.

KEY TO THE FGBNMS ANTIPATHARIAN CORALS

- 1a. Coral forming long, unbranched, whip-like colonies that may be straight, curved, or spiral . . . 2
- 1b. Coral forming branched, bushy, or flabellate colonies. 4
- 2a. Upper part of colony in tight coils mostly less than 6 cm in diameter; color white; spines acute, papillose, 0.16–0.18 mm tall. *Stichopathes* sp.
- 2b. Upper part of colony forming wide coils 10 cm or more in diameter 3
- 3a. Spines conical, blunt, very papillose, 0.24–0.35 mm tall; papillae conical. *Stichopathes luetkeni* Brook
- 3b. Spines triangular, acute, faintly papillose, mostly 0.14–0.20 mm tall; papillae elongated *Stichopathes pourtalesi* Brook
- 4a. Colony with pinnules; stem and branches feather-like with pinnules arranged either bilaterally in two rows or bottlebrush-like with pinnules extending out in all directions. 5
- 4b. Colony without pinnules; bushy or fan shaped 6
- 5a. Stem and branches feather-like, with straight, elongate pinnules arranged bilaterally in two rows *Phumapathes pennacea* (Pallas)
- 5b. Stem and main branches with pinnules arranged as in a bottlebrush; pinnules (simple or subpinnulate) in more than two rows and extending out on multiple sides of the axis 10
- 6a. Colony bushy, with long, straight terminal branchlets >2 cm 7
- 6b. Colony fan shaped, with short, straight or curved terminal branchlets, mostly <2 cm 8
- 7a. Terminal branchlets 0.1–0.2 mm thick; branching pseudodichotomous. *Antipathes furcata* Gray
- 7b. Terminal branchlets 0.3–0.4 mm thick, often arranged uniserially with three or four in a row on the upper side of the lower-order branches. *Aphanipathes pedata* (Gray)
- 8a. Spines less than 0.1 mm, triangular, laterally compressed *Antipathes atlantica* Gray
- 8b. Spines greater than 0.2 mm, conical to acicular 9
- 9a. Polypar spines equal in size *Phanopathes expansa* (Opresko & Cairns)
- 9b. Polypar spines unequal in size *Acanthopathes thyooides* (Pourtales)
- 10a. Pinnules simple, without subpinnules. *Elatopathes abietina* (Pourtales)
- 10b. Pinnules with subpinnules 11
- 11a. Primary pinnules long, with only a few subpinnules near the base (proximal end closest to the point of origin) *Tanacetipathes hirta* (Gray)
- 11b. Primary pinnules with subpinnules along more than half of their length. 12
- 12a. Subpinnules mostly on one side of primary pinnules *Tanacetipathes tanacetum* (Pourtales)
- 12b. Subpinnules usually arranged bilaterally on two sides of primary pinnules. *Tanacetipathes* cf. *thamnea* (Warner)

FAMILY ANTIPATHIDAE EHRENBERG, 1834

Species in the family Antipathidae can be unbranched and whip-like (*Stichopathes* and *Cirripathes*), or bushy or fan shaped (*Antipathes*). The polyps can be up to 3 mm in transverse diameter (i.e., in the direction of the branch), but in most species they are around 1 mm in diameter. When alive and fully expanded, the tentacles of the polyps are long and pointed at the tip, and the sagittal tentacles (those on either side of the mouth in the middle of the polyp) are longer than the four lateral tentacles. The minute skeletal spines can vary from being triangular and compressed to cone shaped or somewhat cylindrical. The surface of the spines can be smooth or covered with very fine or coarse papillae, and in some species they are knobbed or multiforked at the apex. Species of the genera *Antipathes* and *Stichopathes* are found within the FGBNMS.

Antipathes atlantica Gray, 1857

Figures 2–3

Colony description.—Colony (Fig. 2) 0.5 m or more in height; moderately to densely branched, usually fan shaped, may be without distinguishable primary branches. Branching to the eighth order or more; branches sometimes anastomos-

ing. Smallest branchlets mostly less than 1 cm long, straight or slightly curved, arranged bilaterally along the sides of the branches.

Skeletal spines.—Spines (Fig. 3a, b) short, triangular, smooth, 0.05–0.07 mm tall, and about equally as wide at their base; arranged in seven to eight rows with 3.5–5.0 spines per millimeter in each row.

Polyps.—Polyps (Fig. 3c) 0.6–1.0 mm in transverse diameter; arranged on the branchlets in a single series and usually present on only one side of the corallum.

Coloration.—Living colonies grayish white or greenish in color.

Remarks.—This species is often difficult to distinguish from *A. gracilis* Gray 1860 except by the color of the living polyps, which in *A. gracilis* are orange. Preliminary DNA studies (pers. comm. C. Umaña) suggest that these may be color morphs of the same species. Found on deep reefs at depths of about 20 to 100 m.

Distribution in FGBNMS.—Widely distributed and abundant in the FGBNMS at depths of 60 m to 100 m; in association with *Stichopathes* spp.,

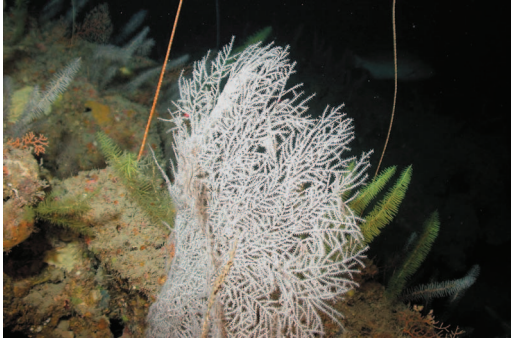


Fig. 2. *Antipathes atlantica* Gray, in situ, FGBNMS.

Tanacetipathes spp., and *Elatopathes abietina*. Associated fauna, utilizing the species as host, include the barnacle *Oxynaspis gracilis* (Wicksten et al., 2014). Dominant black coral in turbid environments.

Antipathes furcata Gray, 1857
Figures 4–5

Colony description.—Colonies (Fig. 4) bushy to broom-like, up to about 40 cm in height, with

long, pseudodichotomous branches and branchlets. Branches extending vertically and away from the stem, with most reaching the top of the corallum; branch angles very narrow, 30° or less. Terminal branches very thin, usually 0.1–0.2 mm in diameter. Young colonies tend to be branched in one plane.

Skeletal spines.—Spines (Figs. 5a, b) short, triangular, laterally compressed, smooth, 0.03–0.07 mm tall and 0.005–0.07 mm wide at their base; arranged in six to eight rows with three to four spines per millimeter in each row. Spines occasionally bifid or forked.

Polyps.—Polyps (Fig. 5c) 0.7–1.0 mm in transverse diameter; arranged in a single series on one side of branches; six to eight polyps per centimeter.

Coloration.—Living colonies are white to grayish in color.

Remarks.—Young colonies grow in a single plane and may look different from older ones, which are bushy and broom-like. Large colonies can

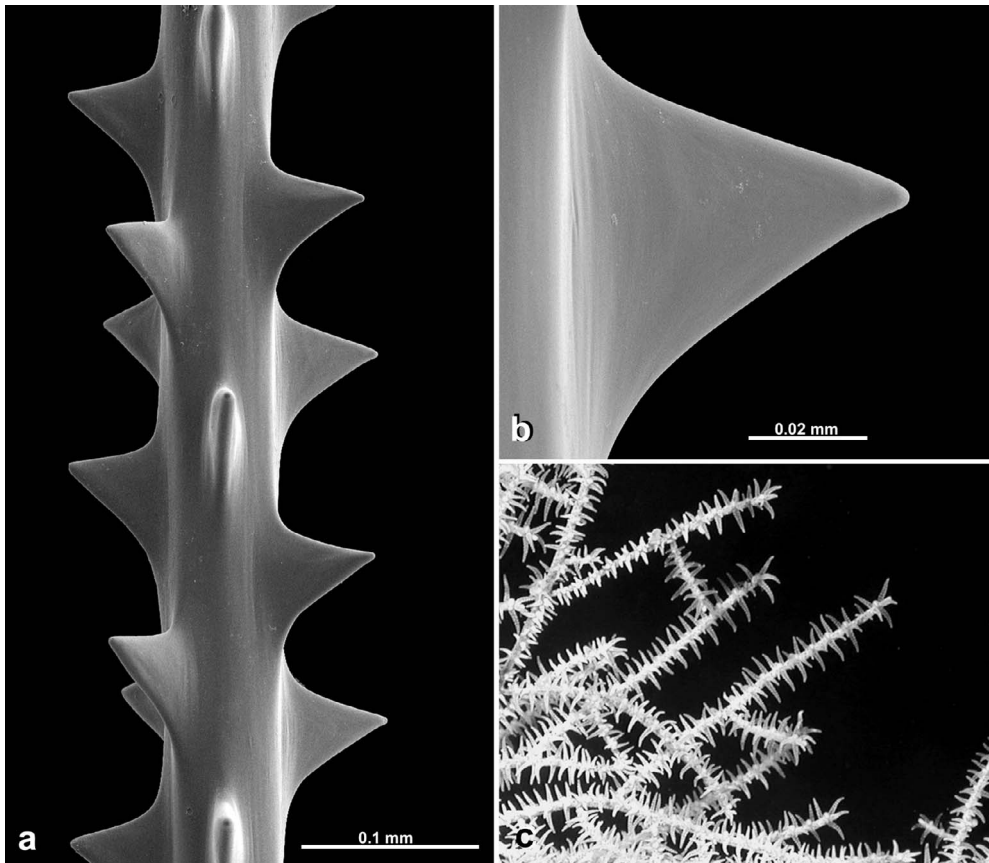


Fig. 3. *Antipathes atlantica* Gray. (a) Spines on a branchlet. (b) Single spine. (c) Polyps.

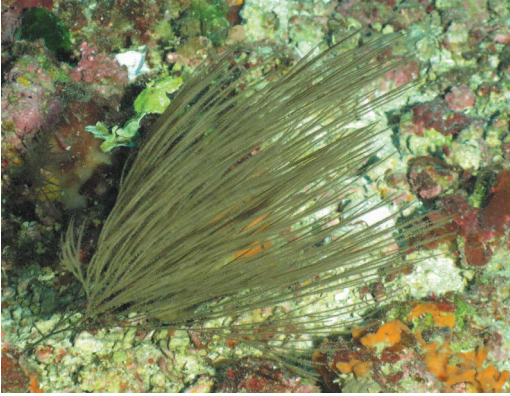


Fig. 4. *Antipathes furcata* Gray, in situ, FGBNMS.

sometimes be confused with *Aphanipathes pedata* (see below); however, in the latter the branches are thicker and more often uniserially arranged. The spines in the FGBNMS specimens are slightly smaller than those of the type.

Distribution in FGBNMS.—Widely distributed and moderately abundant at depths of 50 m to 135 m, notably deeper than other published records for the species (Gray, 1857; Opreko, 1974). At the FGBNMS, the species occurs in association with

E. abietina, *Stichopathes* spp., and multiple octocoral species. Associated fauna, utilizing the species as host, include *O. gracilis* (Wicksten et al., 2014).

***Stichopathes luetkeni* Brook, 1889**

Figures 6–7

Colony description.—Corallum (Fig. 6) unbranched, 1 m or more in height and up to about 3 mm in diameter at base; lower part of stem usually straight or slightly curved; upper part may form wide spirals 10 cm or more in diameter.

Skeletal spines.—Spines (Fig. 7a, b) conical to subcylindrical, rounded at the apex, covered with numerous small knob-like or cone-shaped papillae. Spines larger on polyp side of the axis, up to 0.34 mm tall (range 0.24–0.35 mm); abpolypar spines up to 0.25 mm. Seven or eight rows of spines visible on section of stem 0.8 mm in diameter, with two to three spines per millimeter in each row.

Polyps.—Polyps (Fig. 7c) up to about 1.4 mm in transverse diameter, arranged in a single series and very crowded together with five to seven polyps per centimeter.

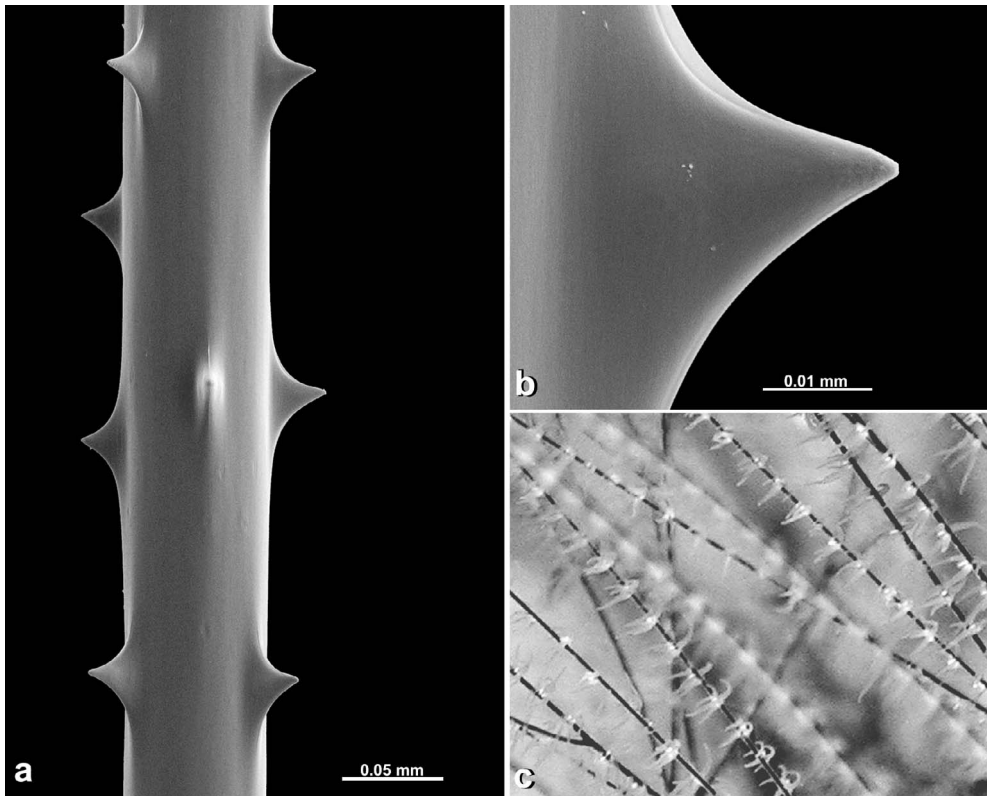


Fig. 5. *Antipathes furcata* Gray. (a) Spines on a small branchlet. (b) Single spine. (c) Polyps.



Fig. 6. *Stichopathes luetkeni* Brook, in situ, FGBNMS.

Coloration.—Living colonies may be orange, beige, or reddish-brown with translucent tentacles.

Remarks.—Colonies in the Caribbean often have a reddish coloration; those from the FGBNMS are more often orange to cream-colored. The species is similar to *S. occidentalis* (Gray), which has the same general growth form, but is often yellow or greenish in color. The spines of both species are very similar in appearance; however,

the polypar spines in *S. luetkeni* are up to 0.36 mm tall, whereas those in *S. occidentalis* are usually less than 0.24 mm. The spines in the specimen shown in Figure 7a,b are at the lower end of the size range for *S. luetkeni*.

Distribution in FGBNMS.—Widely distributed and moderately abundant at depths of 50 m to 75 m, and found in both reef and soft bottom habitats. Previously recorded at depths of 60 m to 90 m (on the basis of a search of the online catalog of the Invertebrate Zoology Collection, U.S. National Museum of Natural History (USNMNH), Smithsonian Institution, 2014).

***Stichopathes pourtalesi* Brook, 1889**
Figures 8–9

Colony description.—Corallum (Fig. 8) unbranched, 1 m or more in height, stem forming coils or spirals from near base or with lower portion straight. Spirals 10 to 20 cm in diameter.

Skeletal spines.—Spines (Fig. 9a, b) on upper part of stem triangular to conical, covered, to various

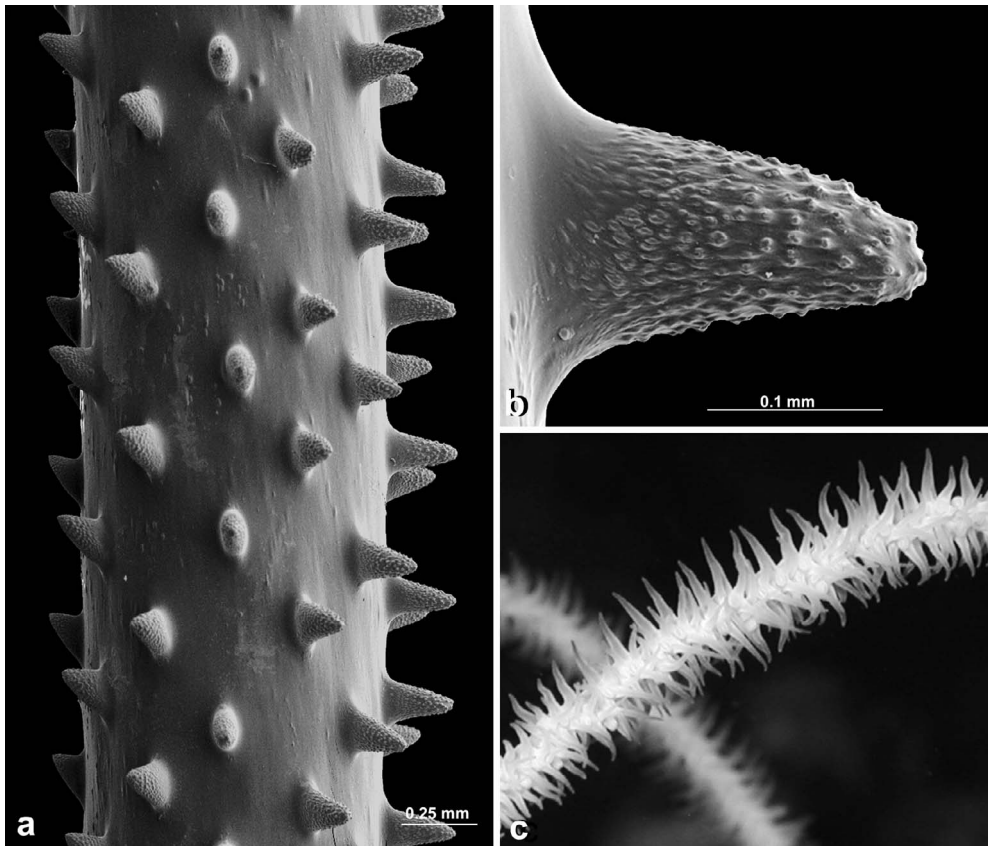


Fig. 7. *Stichopathes luetkeni* Brook. (a) Spines on stem. (b) Single spine. (c) Polyps.

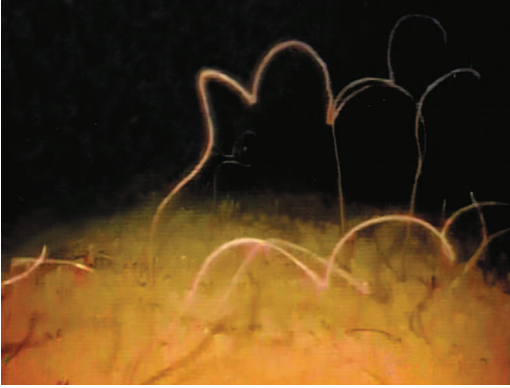


Fig. 8. *Stichopathes pourtalesi* Brook, in situ (video frame grab), FGBNMS.

degrees, with small elongated papillae. Spines on lower part of stem sometimes with forking or multiple lobes at apex, and with larger more rounded papillae. Polypar spines 0.1 to 0.20 mm tall (usually 0.14–0.17 mm); abpolypar spines 0.06–0.12 mm. Four to seven rows of spines visible in lateral view, with two to three spines per millimeter in each row.

Polypts.—Polypts (Fig. 9c) up to about 1.7 mm in transverse diameter, arranged in a single series with four to seven polypts per centimeter.

Coloration.—Living colonies white or light orange in color.

Remarks.—This species is found throughout the Caribbean and Gulf of Mexico. The type was recently redescribed by Bo and Opresko (2015).

Distribution in FGBNMS.—Widely distributed and abundant at depths of 75 to 110 m. Occasionally found in dense communities in soft bottom habitat.

***Stichopathes* sp.**

Figures 10–11

Colony description.—Corallum (Fig. 10) unbranched, 80 cm or more in height; lower part of stem straight, upper part in tight coils or spirals, 6 cm or less in diameter.

Skeletal spines.—Spines (Figs 11a, b) conical but somewhat compressed laterally, and triangular in lateral view, with a very sharp apex, covered with

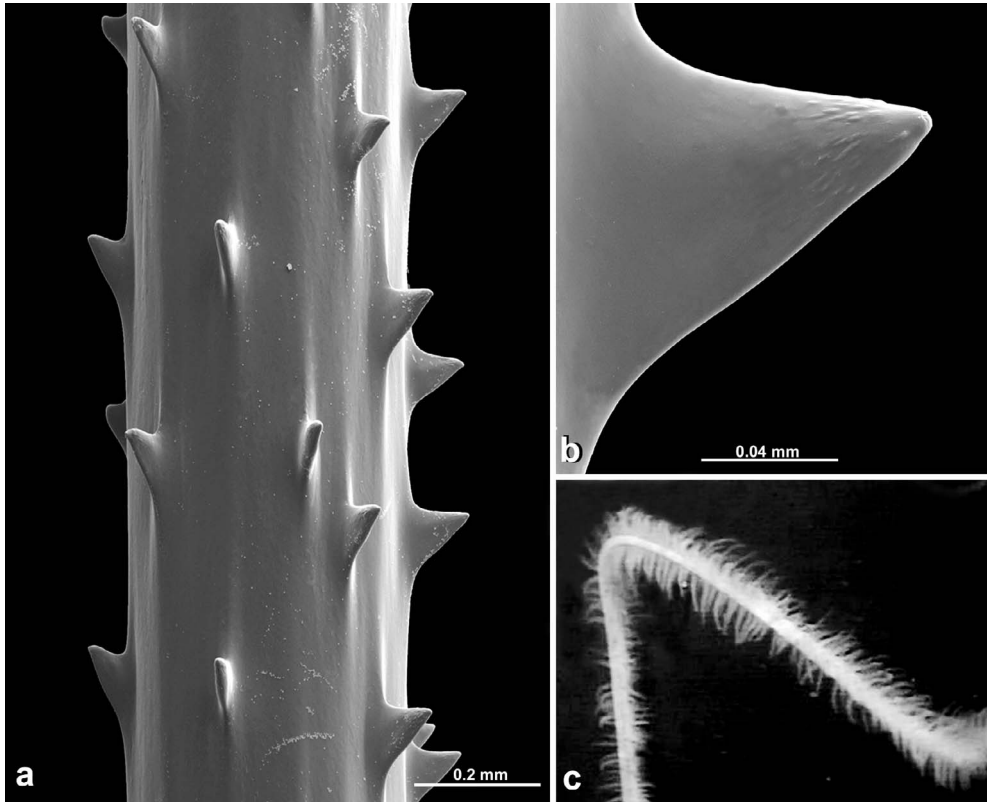


Fig. 9. *Stichopathes pourtalesi* Brook. (a) Spines on stem. (b) Single spine. (c) Close-up view of colony, in situ, showing expanded tentacles of polypts (image digitally enhanced).

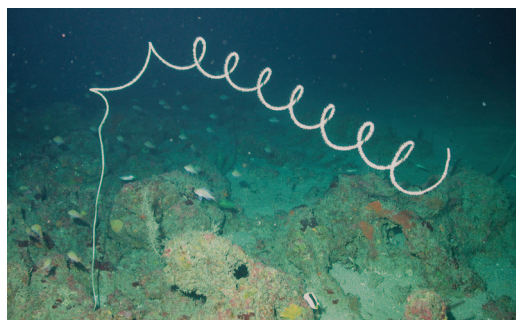


Fig. 10. *Stichopathes* sp., in situ, FGBNMS.

rounded papillae of various sizes. Polypar spines up to 0.18 mm tall; abpolypar spines up to 0.16 mm. Nine rows of spines are visible on a section of stem about 0.9 mm in diameter, with two to three spines per millimeter in each row.

Polyps.—Polyps (Fig. 11c) about 1.2 mm in transverse diameter, arranged in a single series with five to six polyps per centimeter.

Coloration.—Living colonies white.

Remarks.—This species can be distinguished from *S. luetheni* by the fact that the colony grows in the form of tight spirals. Differences also exist in the shape of the spines, with *S. luetheni* having blunter spines with smaller, but more distinct, conical papillae. At this time, the species cannot be assigned to any nominal species; however, not all nominal species have been adequately characterized, particularly in regard to the size and morphology of the spines. In terms of the size of spines, this species is similar to *S. occidentalis* (Gray); however, in the latter species the spines are generally blunter and have surface sculpturing similar to that in *S. luetheni*. Furthermore, colonies of *S. occidentalis* are usually greenish-yellow and do not form tight spirals.

Distribution in FGBNMS.—Rare at a depth of approximately 80 m.

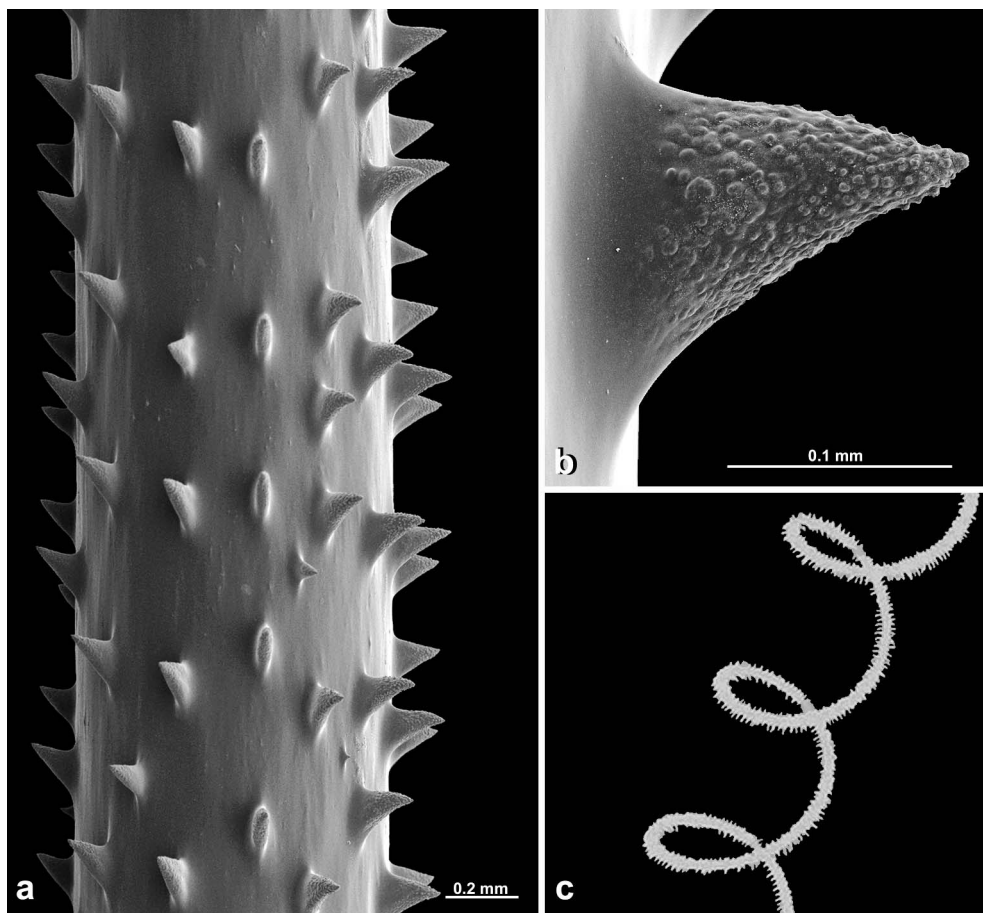


Fig. 11. *Stichopathes* sp. (a) Spines on stem. (b) Single spine. (c) Close-up view of colony, in situ (image digitally enhanced).

FAMILY APHANIPATHIDAE OPRESKO, 2004

Three genera in the family Aphanipathidae occur in the FGBNMS: *Aphanipathes*, *Phanopathes*, and *Acanthopathes*. *Aphanipathes* is characterized by a bushy corallum with elongate branches, whereas both *Phanopathes* and *Acanthopathes*, form flabellate colonies. The latter two genera are differentiated by the morphology of the skeletal spines; in *Phanopathes* spines on the polyp side of the axis are all about the same size; in *Acanthopathes* the spines on the polyp side of the axis are larger around the perimeter of polyp (circumpolypar spines) and smaller directly below the center of the polyp (hypostomal spines). Polyps in this family range in size from 0.5 mm in some species to about 2 mm in others. The tentacles of the polyps when fully expanded are subequal or similar to those of the Antipathidae, with the sagittal tentacles longer than the laterals. The spines are tall, conical to cylindrical, and usually have distinct tubercles on their surface. The spines on the polyp side of the axis are usually longer than those on the opposite side.

Aphanipathes pedata (Gray, 1857)

Figures 12–13

Colony description.—Bushy, broom-like colonies (Fig. 12) as much as 1 m or more in height, branched to the eighth order or more. Corallum densely branched, with relatively long, straight thick branches, often arranged uniseriably on the upper side of the lower-order branches. Terminal branches 10 cm or more in length, 0.3–0.4 mm in thickness, with narrow distal branch angles (30–45°). Branching relatively dense, with 10 to 15 branches per 10 cm.

Skeletal spines.—Spines (Fig. 13a, b) subcylindrical in appearance, with distinct cone-shaped tubercles over most of their surface. Polypar spines up to 0.4 mm tall; abpolypar spines up to 0.22 mm. Five rows of spines visible on branchlets 0.26 mm in diameter, with about four spines per millimeter in each row.

Polyps.—Polyps (Fig. 13c) 1.2–1.7 mm in transverse diameter, arranged in a single row on one side of the branchlets, with five to eight individuals per centimeter. Tentacles 0.5–1.0 mm (in preserved material) and arranged in three nearly equidistant pairs.

Coloration.—Polyps white, off-white, or slightly pinkish due to the underlining brownish skeletal axis.

Remarks.—Specimens collected in the FGBNMS have larger polypar spines than those described

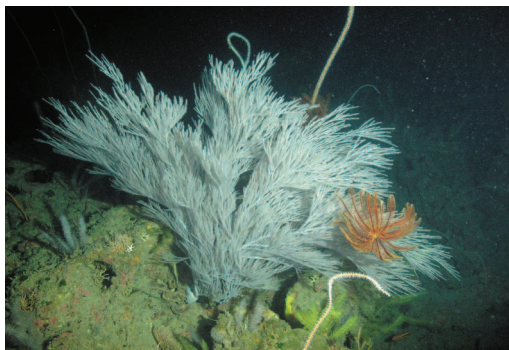


Fig. 12. *Aphanipathes pedata* (Gray), in situ, FGBNMS.

for the type specimen that was collected in the Caribbean.

Distribution in FGBNMS.—Widely distributed in moderate abundance at depths of 80 m to 130 m; in association with *Tanacetipathes* spp. and various octocoral species.

Phanopathes expansa (Opresko and Cairns, 1992)

Figures 14–15

Colony description.—Fan-shaped colonies (Fig. 14), generally less than 20 cm high. Stem usually not distinct. Branches nonanastomosing, very crowded, and often overlapping. Smallest branchlets short, 5–9 mm long, straight, or curved distally, arranged bilaterally, but not uniformly on the lower-order branches.

Skeletal spines.—Spines (Fig. 15a, b) conical, with acute apex and with distinct conical tubercles on distal half of surface. Polypar spines up to 0.25 mm tall and of uniform size; abpolypar spines 0.09–0.13 mm tall. Pinnular spines 0.28–0.33 mm apart in one row, resulting in four to five spines per millimeter in each row.

Polyps.—Polyps (Fig. 15c) uniseriably arranged on one side of the corallum, about 0.8 mm in transverse diameter; interpolypar space about 0.3–0.4 mm, with eight or nine polyps per centimeter.

Coloration.—Polyps and coenenchyme bright white.

Remarks.—Species of *Phanopathes* are easy to recognize by their flabellate growth form, uniformly sized spines with distinct tubercles, and small polyps. This species has not yet been collected outside the Gulf of Mexico.

Distribution in FGBNMS.—Widely distributed and in moderate abundance at depths of 80 m to

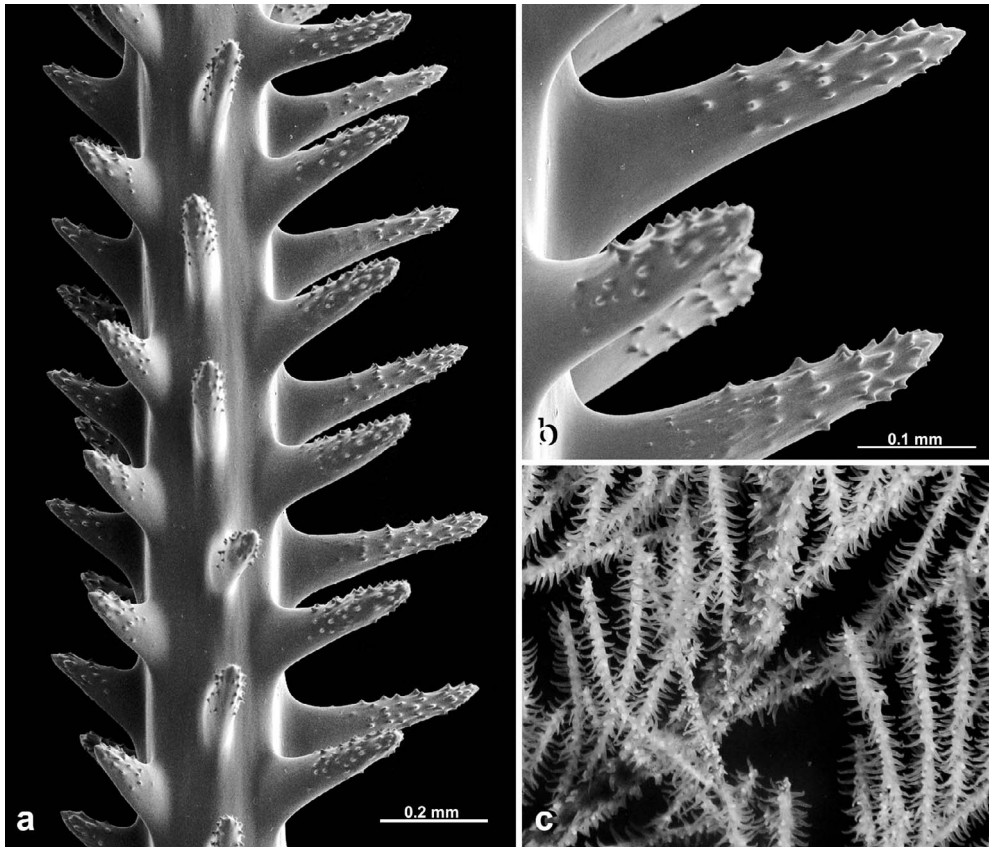


Fig. 13. *Aphanipathes pedata* (Gray). (a) Spines on a small branchlet. (b) Close-up view of spines. (c) Polyps on branches.

115 m, in association with *Stichopathes* spp. and various octocoral species. Associated fauna, utilizing the species as host, include the barnacle *O. gracilis* and the shrimp *Pseudopontonides principis* (Wicksten et al., 2014).

Acanthopathes thyoidea (Pourtalès, 1880)
 (Figures 16–17)

Colony description.—Fan-shaped colonies (Fig. 16), densely branched, mostly in a single plane, branching to the 10th order or more. Colonies large, 25 cm or more in height. Branches nonanastomosing and only occasionally overlapping. Stem and main branches usually contrasting sharply in thickness from the terminal branchlets. Branchlets mostly 1–2 cm long and arranged in bilateral pattern but not uniformly spaced.

Skeletal spines.—Spines (Fig. 17a, b) anisomorphic, unequal in shape and size around the circumference of the axis and also on the polyp side of the axis. Largest spines occur on the outer

fringes of the polyps (circumpolypar spines); they are needle-like, with a smooth surface or have a few small tubercles near their tip. The spines directly below the center of the polyp (hypostomal spines) are often very reduced in size, and those occurring between adjacent polyps and on the abpolypar side of the axis are usually of an intermediate size. The circumpolypar spines are up to 0.6 mm tall, the longest of these often



Fig. 14. *Phanopathes expansa* (Opresko & Cairns), in situ, FGBNMS.

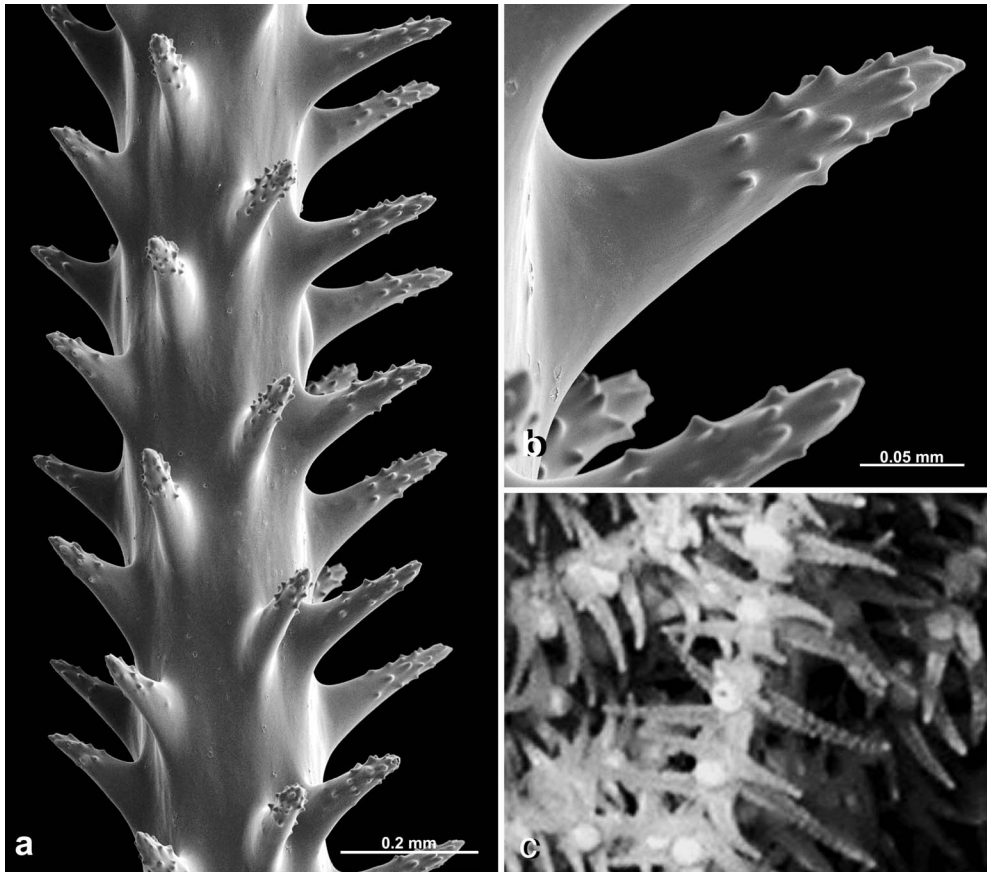


Fig. 15. *Phanopathes expansa* (Opresko & Cairns). (a) Spines on a small branchlet. (b) Single spine. (c) Polyps.

occurring around the proximal lateral tentacles. The interpolypar and abpolypar spines are about 0.2 mm long. There is a tendency for the abpolypar spines directly opposite the polyps to become enlarged. The hypostomal spines are usually less than 0.05 mm long and are often absent on the larger branchlets. The spines are not uniformly arranged in rows and are not evenly spaced apart; therefore, their density can only be roughly estimated to be about six per millimeter.

Polyps.—Polyps (Fig. 17c) small, about 1.0 mm in transverse diameter, separated by an interpolypar space of 0.3–0.4 mm. They are arranged uniserially, seven to eight per centimeter, on a single side of the corallum. The tentacles are small, only 0.2 mm long, and on the larger branches they are atrophied.

Coloration.—Polyps and coenenchyme white or grayish; thicker branches appearing dark gray.

Remarks.—In dried specimens lacking soft tissue there is usually a distinct difference in coloration

of the main branches and the smallest terminal branches. The main branches are often a shiny black, whereas the smallest branchlets are various shades of brown. The largest branches often appear jointed because of the higher-order branches becoming thicker than the immediate lower-order branch, whereas the latter decreases in size beyond the point of the bifurcation.



Fig. 16. *Acanthopathes thyoides* (Pourtales), in situ, FGBNMS.

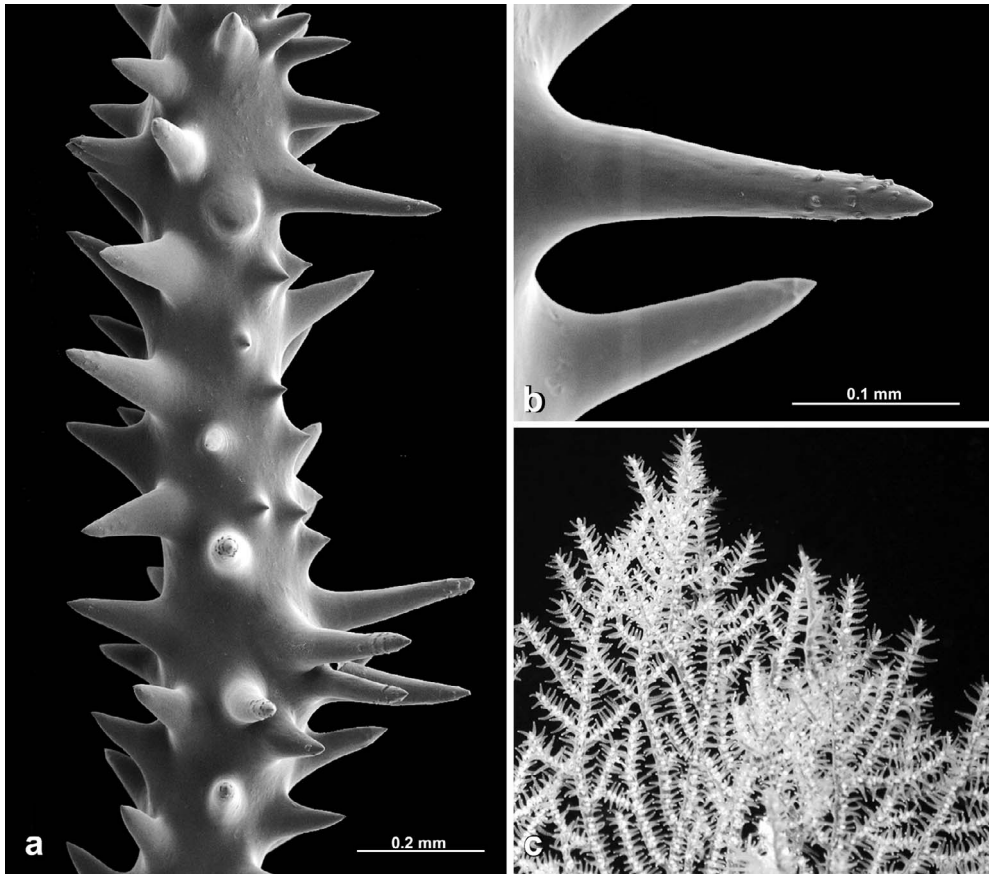


Fig. 17. *Acanthopathes thyooides* (Pourtalès). (a) Spines on a small branchlet. (b) Individual spines. (c) Polyps on branchlets.

See Opresko (1972) for additional information on this species.

Distribution in FGBNMS.—Widely distributed and in moderate abundance at depths of 100 m to 130 m; found in association with *E. abietina*. Associated fauna, utilizing the species as host, include the barnacle *O. gracilis*, the shrimp *Pseudopontonides* cf. *anthipathophilis*, and the squat lobster *Uroptychus marissae* (Wicksten et al., 2014).

***Elatopathes abietina* (Pourtalès, 1874)**
 Figures 18–19

Colony description.—Sparsely branched; stem and branches bottlebrush in appearance (Fig. 18). Colonies generally less than 20 cm in height. Pinnules simple, unbranched, arranged in four to six rows and sometimes in alternating biserial, semispiral groups of varying regularity. Colonies occur in two growth forms and in two color morphs. In one morphotype, branching is largely from near the base of the corallum. In the second,

branching can originate at different heights on the corallum. Both morphotypes may be whitish or greenish in color when alive. Major branches relatively long, sometimes as long as the stem, usually curved upward, extending vertically. Pinnules short and straight, usually 0.5–0.6 cm in length, about 0.3 mm thick, and spaced 1.5–3 mm

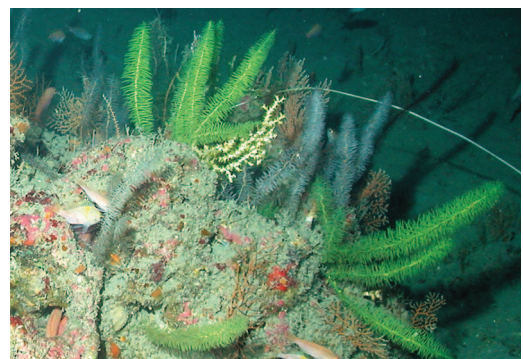


Fig. 18. *Elatopathes abietina* (Pourtalès), green and white color morphotypes, in situ, FGBNMS.

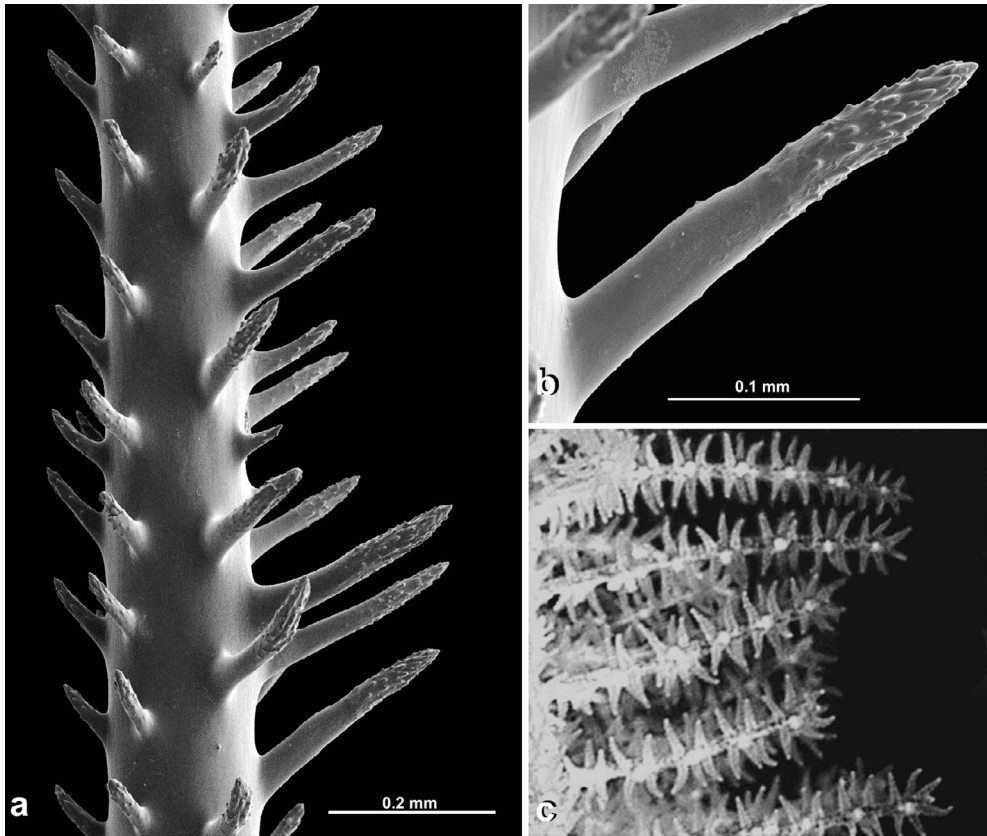


Fig. 19. *Elatopathes abietina* (Pourtalès). (a) Spines on a pinnule. (b) Single spine. (c) Polyps on pinnules.

apart in one row, with a total of 23–26 pinnules per centimeter along the length of the stem or branch.

Skeletal spines.—Spines (Fig 19a, b) long, cylindrical, smooth, or with a varying number of tubercles; unequal in size around the circumference of axis and also unequal in size on the polyp side of the axis. Polypar spines on the distal and lateral sides of the polyps 0.3 to 0.4 mm tall (often longest around the proximal lateral tentacles), straight or slightly curved upward. The interpolypar spines are about one-half as long as the circumpolypar ones. The hypostomal spines are 0.1 mm or less. The abpolypar spines are about 0.15 mm and often strongly inclined distally. Spines generally decreasing in size on larger branches and stem. On the pinnules, eight or nine rows of spines are visible (in one lateral view), each of which contains nine or 10 spines per millimeter.

Polyps.—The polyps (Fig. 19c) measure 0.8 mm in the transverse diameter. Polyps on pinnules arranged in single row on one side of the axis, usually with eight polyps per centimeter.

Coloration.—In the FGBNMS the species occurs in two color forms, white and green.

Remarks.—There is considerable variability in the size, number, and arrangement of the pinnules, and in the morphology of the spines of specimens that have been assigned to this species (see Opresko, 1972:1009). In specimens that are most similar to the type, the pinnules are short, subequal in length, and arranged around the axis in subspiral patterns; the corallum is branched primarily from near the base (Fig. 18). In other specimens the pinnules can be very unequal in size and they tend to be arranged bilaterally; the branching may occur primarily on the upper parts of the corallum. The spines range from being almost smooth to distinctly covered in tubercles (Fig. 19b).

Distribution in FGBNMS.—Widely distributed and moderately abundant at depths of 55 m to 150 m, and found in association with other aphanipathids, as well as with *Tanacetipathes* spp. and various octocoral species. Associated fauna, utilizing the species as host, include the barnacle *O. gracilis* (Wicksten et al., 2014).



Fig. 20. *Plumapathes pennacea* (Pallas). (a) In situ. (b) Close-up view of branches and pinnules, FGBNMS.

FAMILY MYRIOPATHIDAE OPRESKO, 2001

Two genera in the family Myriopathidae are found in the FGBNMS, *Plumapathes* and *Tanacetipathes*; both form pinnulate colonies. In *Plumapathes*, the pinnules are simple (without subpinnules) and arranged bilaterally in two rows, like a feather. In *Tanacetipathes*, the primary pinnules occur in four or five rows and are also arranged in groups around the circumference of the axis to create a bottlebrush-like pattern. On some of these primary pinnules there can be one or more orders of subpinnules. The polyps in these genera are usually not more than 1.0 mm in diameter, and the tentacles are relatively short, with a rounded tip. The spines are conical to blade-like, smooth or very finely papillose or striated, and up to 0.3 mm tall on the smallest branchlets or pinnules. On the large branches and stem, the spines are usually very narrow and cylindrical, and those at the base of the stem can be forked or antler-shaped in some spines.

***Plumapathes pennacea* (Pallas, 1766)
 Figures 20–21**

Colony description.—Large, sparsely to densely branched, pinnulate colonies (Fig. 20a), up to 1.5 m or more in height. Overall branching irregular, bushy to planar; larger branches distinct and relatively long. Stem and branches with simple pinnules, up to 6 cm long, arranged bilaterally in two anterolateral or lateral rows

(Fig. 20b); members of each row spaced 1–3 mm apart. Pinnules in each row offset from adjacent ones in the opposite row, resulting in an alternating pattern.

Skeletal spines.—Spines (Fig. 21a, b) conical to subcylindrical, smooth to very faintly papillose, with acute to rounded tip, often distally inclined; 0.12 to 0.35 mm tall on polyp side of the axis and up to 0.15 mm tall on the abpolypar side of the axis. Spines on pinnules arranged in 7–10 longitudinal rows with 3.5–7.0 spines per millimeter in each row. Spines on larger branches and stem narrow and needle-like.

Polyps.—Polyps (Fig. 21c) not more than 0.8 mm in transverse diameter, arranged on the pinnules in a one row with 10–13 polyps per centimeter.

Coloration.—Two color morphs, one grayish and the other orange-brown.

Remarks.—Most common at depths of 20 to 60 m, often found growing on wrecks or other man-made structures such as the supports for oil platforms (see Oakley, 1988; Boland and Sammarco, 2005). Occurs throughout the Caribbean and north into the Gulf of Mexico.

Distribution in FGBNMS.—Narrowly distributed and rare at depths of 50 m to 90 m; notably absent in deeper depth ranges (up to 230 m), where they have been recorded in other studies

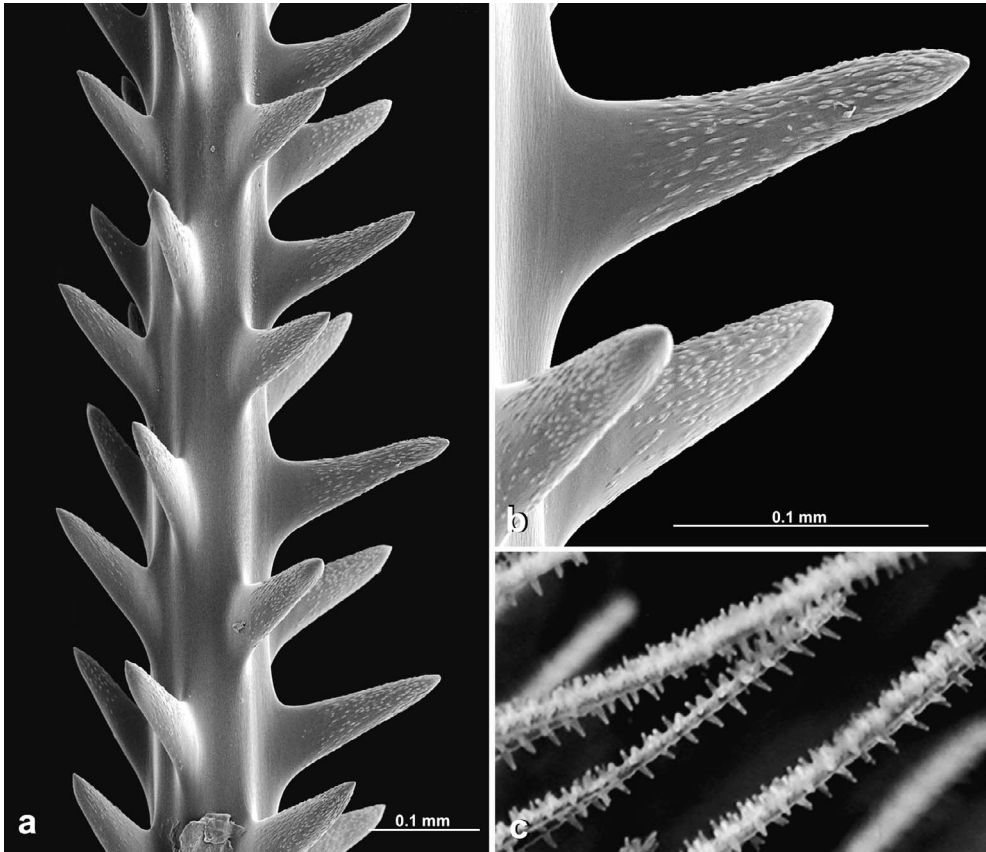


Fig. 21. *Plumapathes pennacea* (Pallas). (a) Spines on a pinnule. (b) Close-up view of spines showing papillae. (c) Polyps on pinnules.

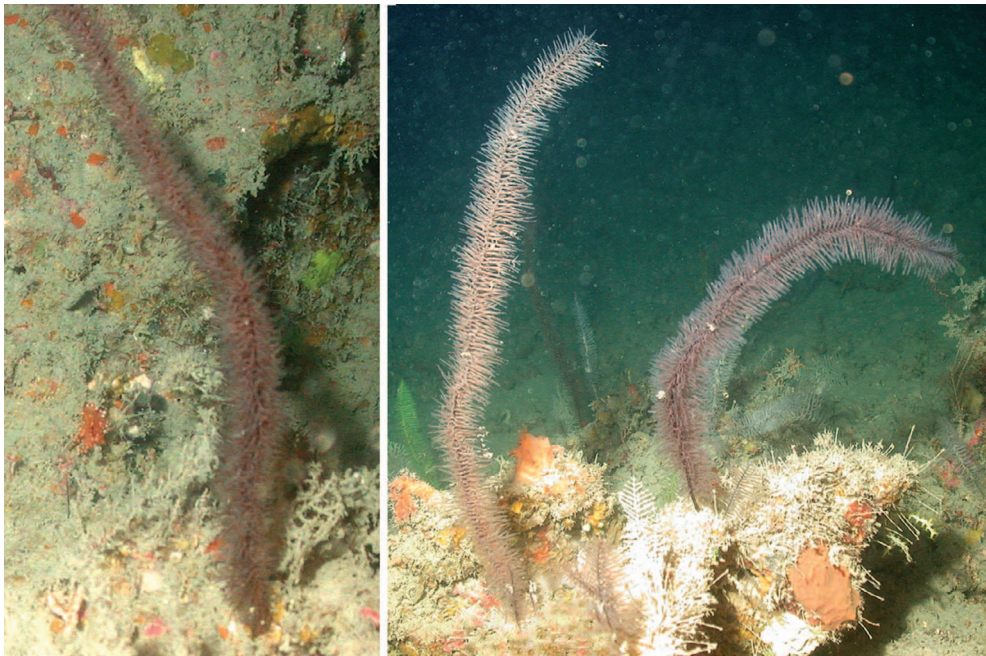


Fig. 22. *Tanacetipathes tanacetum* (Pourtalès), in situ, FGBNMS.

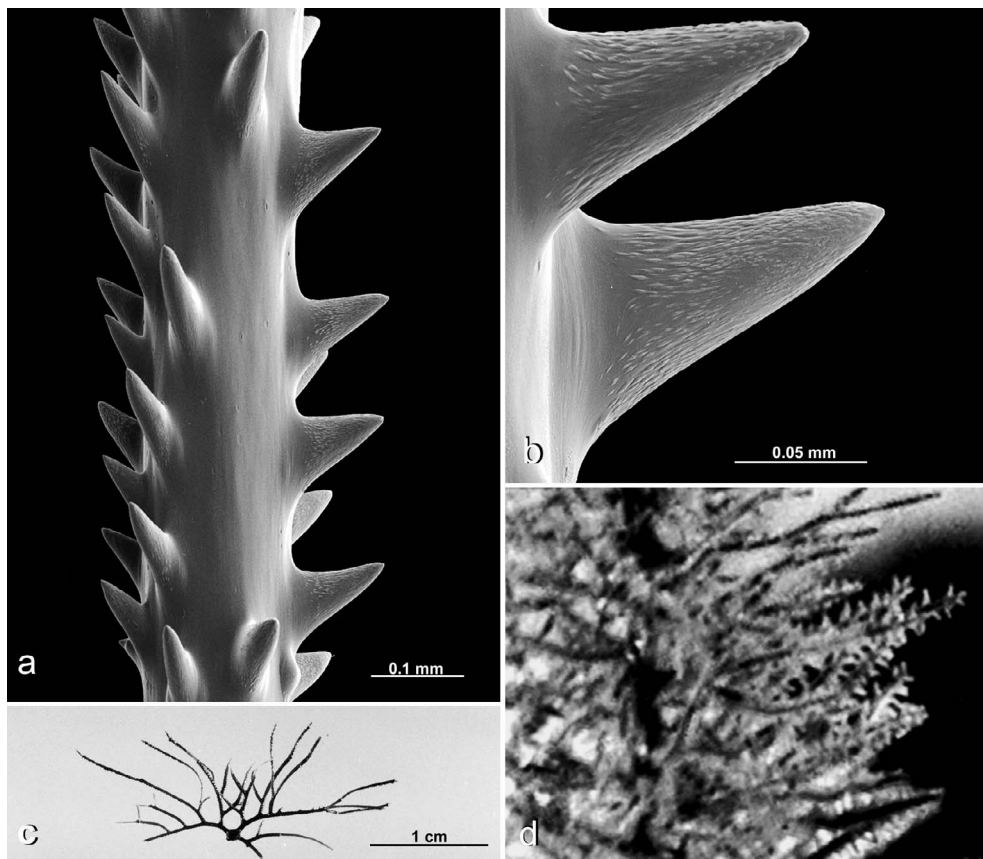


Fig. 23. *Tanacetipathes tanacetum* (Pourtalès). (a) Spines on a pinnule. (b) Individual spines. (c) Cross-section of branch showing arrangement of pinnules. (d) Pinnules with polyps (image digitally enhanced).

(Opresko, 1974; Colin, 1978; CITES, 2010). They occur in association with species of *Stichopathes*.

Tanacetipathes tanacetum (Pourtalès, 1880)
 Figures 22–23

Colony description.—Grows as a single stalk (Fig. 22a, b) or sparsely branched from the base; rarely densely branched throughout the corallum. Stem and branches complexly pinnulate (Fig. 23c). Stem and branches with four to six rows of primary pinnules that are also arranged biserially and in alternating groups along the length of the axis. Pinnules stand out at right angles to the stem. Posterior primary pinnules mostly 1.0–2.5 cm long, often curved back toward the anterior (polyp) side of the corallum. Primary pinnules typically with two and sometimes three orders of subpinnules (Fig 23c). Four or more secondary pinnules arranged mostly uniserially on posterior (abpolypar) side of primaries; tertiary pinnules occurring uniserially on abpolypar side of secondary pinnules. Quaternary pinnules sometimes present on tertiaries.

Skeletal spines.—Spines (Fig. 23a, b) conical, with acute to rounded apex, usually with very faint, elongated papillae or striations on upper part of surface, extending out at right angles to axis or distally inclined, 0.13–0.3 mm tall on polyp side of the axis, smaller on abpolypar side.

Polyps.—Polyps (Fig. 23d) in a single series on one side of the pinnules and subpinnules, 0.6–0.8 mm in transverse diameter, with 10–13 polyps per centimeter.

Coloration.—Color of living colonies grayish to dark brown.

Remarks.—Specimens assigned to this species fall into two groups on the basis of the size of the spines; in one group the polypar spines are generally less than 0.15 mm and in the second the polypar spines are commonly 0.2–0.3 mm. Colonies with small spines are the typical form of the species (see Perez et al., 2005). The morphotype with the larger spines may prove to be a different species. Found on deep reefs



Fig. 24. *Tanacetipathes hirta* (Gray), in situ, FGBNMS.

usually at depths of 100–200 m. Known from Brazil north to the Gulf of Mexico.

Distribution in FGBNMS.—Widely distributed in moderate abundance at depths of 80 m to 120 m; found in association with *Stichopathes* spp., *E. abietina*, *Antipathes furcata*, and various species of octocorals. Associated fauna utilizing the species as host include the shrimp *P. principis*, the squat lobster *U. marissae*, and scale worms from the genus *Malmgreniella* (Wicksten et al., 2014).

Tanacetipathes hirta (Gray, 1857)

Figures 24–25

Colony description.—Sparsely branched, pinnulated colonies (Fig. 24), usually less than 0.5 m in height. Branching to the third or fourth order; branches usually arising laterally at right angles to the lower branches. Stem and branches usually with four rows of primary pinnules (maximum six), arranged biserially and in alternating groups of three along the length of the axis. Posterior primary pinnules usually 2–3 cm long and two to six times longer than anterior primary pinnules (Fig 25c). Secondary pinnules usually confined to the posterior (abpolypar) side of the basal section of the primary pinnules; tertiary pinnules few in number (one to three) and restricted to the posterior side of those secondaries nearest the base of each primary (Fig 25c).

Skeletal spines.—Spines (Fig. 25a, b) conical, acute, slightly inclined distally, smooth or very faintly papillose; 0.07–0.16 mm tall on polyp side of the axis and 0.03–0.10 mm on the abpolypar side of the axis.

Polyps.—Polyps (Fig. 25d) in a single series, 0.7–0.8 mm in transverse diameter, with 10–12 polyps per centimeter.

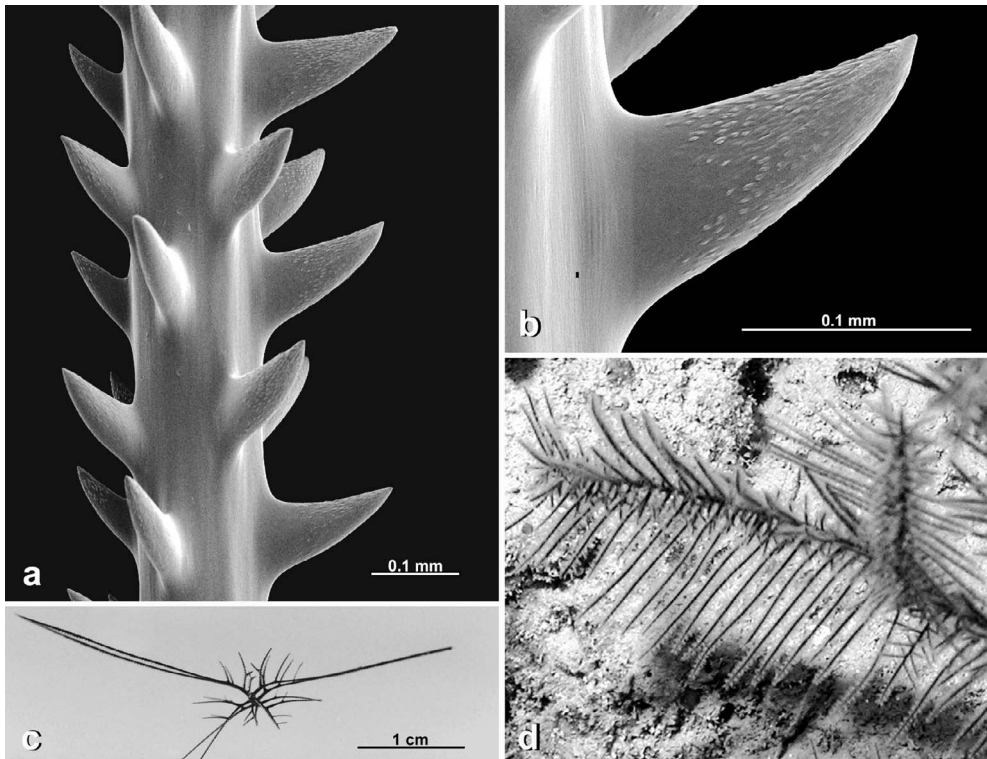


Fig. 25. *Tanacetipathes hirta* (Gray). (a) Spines on a pinnule. (b) Individual spine. (c) Cross-section of branch showing arrangement of pinnules. (d) Branch and pinnules with polyps.

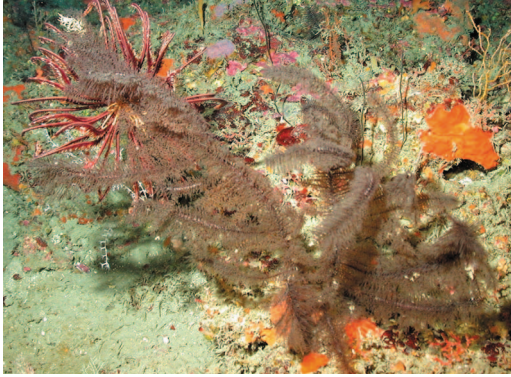


Fig. 26. *Tanacetipathes* cf. *thamnea* (Warner), in situ, FGBNMS.

Coloration.—Living colonies grayish purple in color.

Remarks.—The FGBNMS specimen illustrated differs from the typical form of *T. hirta* in having polypar and abpolypar spines that are slightly larger in size than those found in most specimens of this species collected outside the Gulf. Found at depths of 25 to 400 m throughout the Caribbean and north into the Gulf of Mexico.

Distribution in FGBNMS.—Widely distributed in moderate abundance at depths of 85 m to 100 m; found in association with other *Tanacetipathes* spp., *Stichopathes* spp., *A. furcata*, and octocoral species. Associated fauna utilizing the species as host include the barnacle *O. gracilis*, the oyster *Pteria colymbus*, and scale worms from the genus *Malmgreniella* (Wicksten et al., 2014).

Tanacetipathes cf. *thamnea* (Warner, 1981)
Figures 26–27

Colony description.—Strongly branched, densely pinnulated colonies, 20–40 cm in height (Fig 26). Branching to the second and third order, tending to be planar; lower-order branches relatively long compared with stem. Stem and branches with four rows of primary pinnules arranged biserially, with two rows on each side. Pairs of pinnules (consisting of one posterior/abpolypar and one anterior/polypar) arise alternately from the sides, about 2 mm apart. Posterior primary pinnules up to about 1.8 cm long. Secondary pinnules numerous, 5–10 per centimeter, often arranged biserially and alternating; tertiary pinnules on

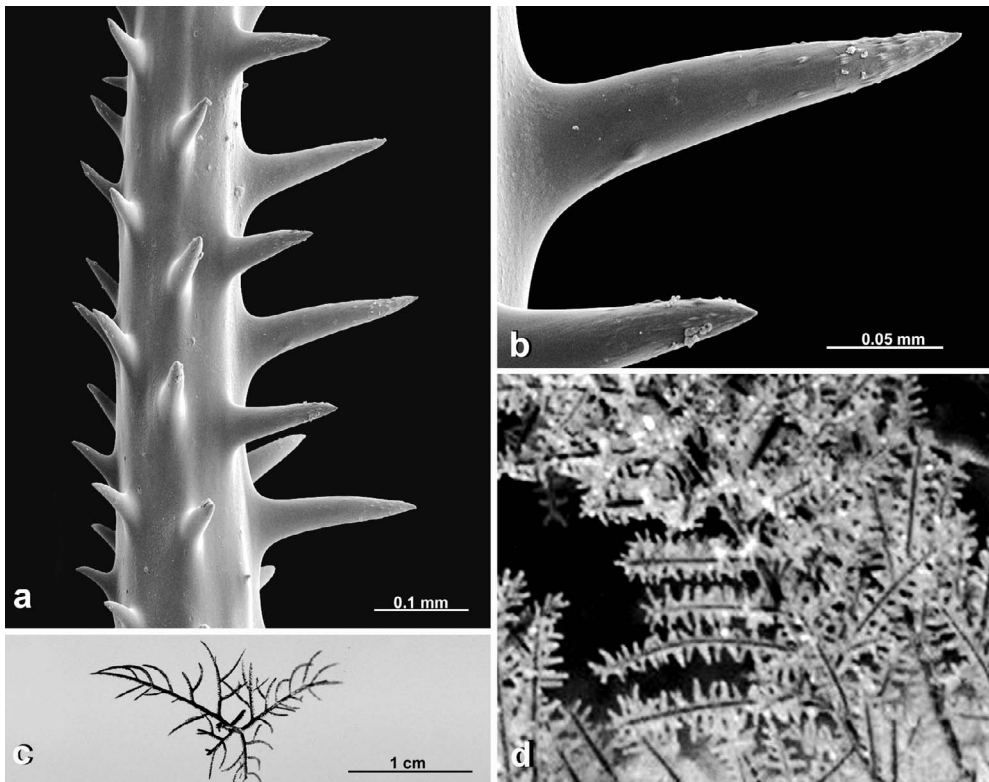


Fig. 27. *Tanacetipathes* cf. *thamnea* (Warner). (a) Spines on a pinnule. (b) Enlarged view of a two spines. (c) Cross-section of branch showing the arrangement of pinnules. (d) Polyps on pinnules.

posterior (abpolypar) side of those secondaries nearest the base of each primary (Fig. 27c).

Skeletal spines.—Spines (Fig. 27a, b) subcylindrical, acute, smooth, or with a few faint, elongated papillae near the apex (Fig. 26b), nearly at right angles to axis or slightly inclined distally; up to 0.21 mm tall on polyp side of the axis and about 0.07 mm on the abpolypar side of the axis.

Polyps.—Polyps (Fig. 27d) in a single series, 0.5–0.65 mm in transverse diameter, with 10–17 polyps per centimeter.

Coloration.—Living colonies pinkish to dark brown in color.

Remarks.—The specimens from the FGBNMS differ from the typical form in being more densely branched and also in having somewhat shorter primary pinnules (mostly less than 1.8 cm vs 2.5 cm in the typical form) (see Warner, 1981). The spines of the FGBNMS specimens and the type are similar in size and shape; however, in the original description of *T. thamnea* no mention is made of the very faint papillae that can be seen in the spines of the FGBNMS specimens. Found at depths of about 30 to 100 m from Brazil to the northern Gulf of Mexico.

Distribution in FGBNMS.—Distributed in moderate abundance at depths of 75 m to 90 m, and found in association with *Stichopathes* spp. and octocoral species. Associated fauna utilizing the species as host include the shrimp *P. principis*, the squat lobster *U. marissae*, and scale worms of the genus *Malmgreniella* (Wicksten et al., 2014).

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