

# New genera and species of antipatharian corals (Cnidaria: Anthozoa) from the North Pacific

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New taxa of deep water antipatharian corals of the North Pacific are described. Represented in the family Schizopathidae are: *Bathypathes seculata* spec. nov.; *Umbellapathes* gen. nov.; *U. helioanthes* spec. nov.; *U. bipinnata* spec. nov.; *Dendrobathypathes boutillieri* spec. nov.; *D. fragilis* spec. nov.; *Dendropathes* gen. nov.; *Dendropathes bacotaylorae* spec. nov.; and *Lillipathes wingi* spec. nov. Represented in the family Cladopathidae are *Chrysopathes gracilis* spec. nov. and *Heliopathes pacifica* spec. nov.

## Introduction

Even though many earlier studies dealt solely or in part with the antipatharian fauna of the North Pacific (see Brook, 1889; Silberfeld, 1909; Kinoshita, 1910; van Pesch, 1914; Pax, 1932; Pasternak, 1958, 1976, 1977), a surprisingly large number of undescribed forms have only recently been discovered. This has been mainly due to an increased interest in deep-water coral "reefs" and their associated fauna. New collections of North Pacific antipatharians have become available for study as a result of the efforts of many individuals, including Jim Boutillier (Fisheries and Oceans Canada, Pacific Biological Station, Nanaimo, British Columbia), Bruce Wing and Bob Stone (National Marine Fisheries Service - NOAA Fisheries, Auk Bay Laboratory, Juneau, Alaska), Amy Baco-Taylor [Woods Hole Oceanographic Institution; cruises sponsored by the National Oceanic and Atmospheric Administration (NOAA)], Scott France (University of Louisiana at Lafayette), and Steve Cairns [U.S. National Museum of Natural History (USNM), Smithsonian Institution]. In addition, undescribed North Pacific material, including specimens from the R/V "Albatross" and those from Scripps Institution of Oceanography were found in the USNM collections. Represented in this report are two new genera and seven new species in the family Schizopathidae and two new species in the family Cladopathidae. Holotypes of all new species are deposited in the USNM, Washington, DC. Schizoholotypes of many of the new taxa have also been deposited in the collections of the National Museum of Natural History (RMNH), Leiden, The Netherlands.

## Systematic Treatment

### Schizopathidae Brook, 1889

Diagnosis.— Polyps with six primary and four secondary mesenteries; transverse diameter 2 mm or more. Corallum monopodial or branched; stem and branches pin-

nulate. Pinnules simple or complexly subpinnulate. Spines triangular to conical, often laterally compressed, smooth, simple or rarely with multiple bifurcations at the apex, subequal in size around circumference of axis or larger on one side.

Remarks.— The family was divided by Opresko (2002) into two subfamilies, the Schizopathinae and the Parantipathinae, based on the initial observation that in the Schizopathinae the polyps were typically 3 mm or more in transverse diameter and in the Parantipathinae the polyps were less than 3 mm in transverse diameter. However, the discovery of a new species of *Dendrobathypathes* in the Schizopathinae with polyps reaching a maximum size of only 2.5 mm in transverse diameter (see description of *D. fragilis* spec. nov. below), and a new species of *Lillipathes* in the subfamily Parantipathinae with polyps as much as 3.6 mm in transverse diameter (see description of *L. wingi* spec. nov. below), indicates that polyp size alone cannot be used as a subfamily character. However, it is possible that future studies of living polyps will identify other morphological characters (e.g., size, shape and positioning of the tentacles) that will help clarify the natural relationships within the family. Recent examination of photographs of living polyps of *Parantipathes larix* (Esper, 1788) suggest that the tentacles are very short, even in fully expanded polyps. This appears to be distinctly different from the typical polyps of *Bathypathes* and *Schizopathes* which often have very long tentacles, even in preserved material. Whether this is a character that will prove useful at the subfamily level can only be determined by further study of the living polyps of other genera of the family.

### ***Bathypathes* Brook, 1889**

Type species.— *Bathypathes patula* Brook (1889).

Diagnosis.— Corallum monopodial and pinnulate; rarely branched; attached to hard substrates by a basal plate. Pinnules simple, bilateral and either subopposite or alternating. Spines usually simple, triangular, compressed; rarely with knob-like bifurcations at the apex. Polyps 3-9 mm in transverse diameter.

Species assigned to *Bathypathes*.— Included in the genus are *B. patula* Brook (1889), *B. alternata* Brook (1889), *B. bifida* Thomson (1905), *B. platycaulus* Totton (1923), *B. galathea* Pasternak (1977), *B. erotema* Schultze (1903), and *B. bayeri* Opresko (2001).

### *Bathypathes seculata* spec. nov.

(fig. 1)

Material.— Holotype (USNM 52430; schizoholotype RMNH Coel. 33298), Hawaiian Islands, off Kahu Point, Oahu Id bearing S 77°, E 12.0', 963 fm (1753 m), 31.vii.1902, R/V "Albatross", sta 4125.

Diagnosis.— Colony monopodial, pinnulate; stem usually following a sickle-shaped curvature. Pinnules simple, up to 8 cm long on colony 10 cm in height; arranged along the stem in two lateral or anterolateral rows, 7-9 mm apart in each row, and grouped in subopposite pairs whose members are about 1 mm apart. Spines on the pinnules and stem simple, smooth, triangular, up to about 0.06 mm high; arranged in five to seven rows along the length of the axis, and 0.4 mm apart in each row (approximately three per millimeter). Polyps usually 5-6 mm in transverse diameter, resulting in one to two per centimeter.

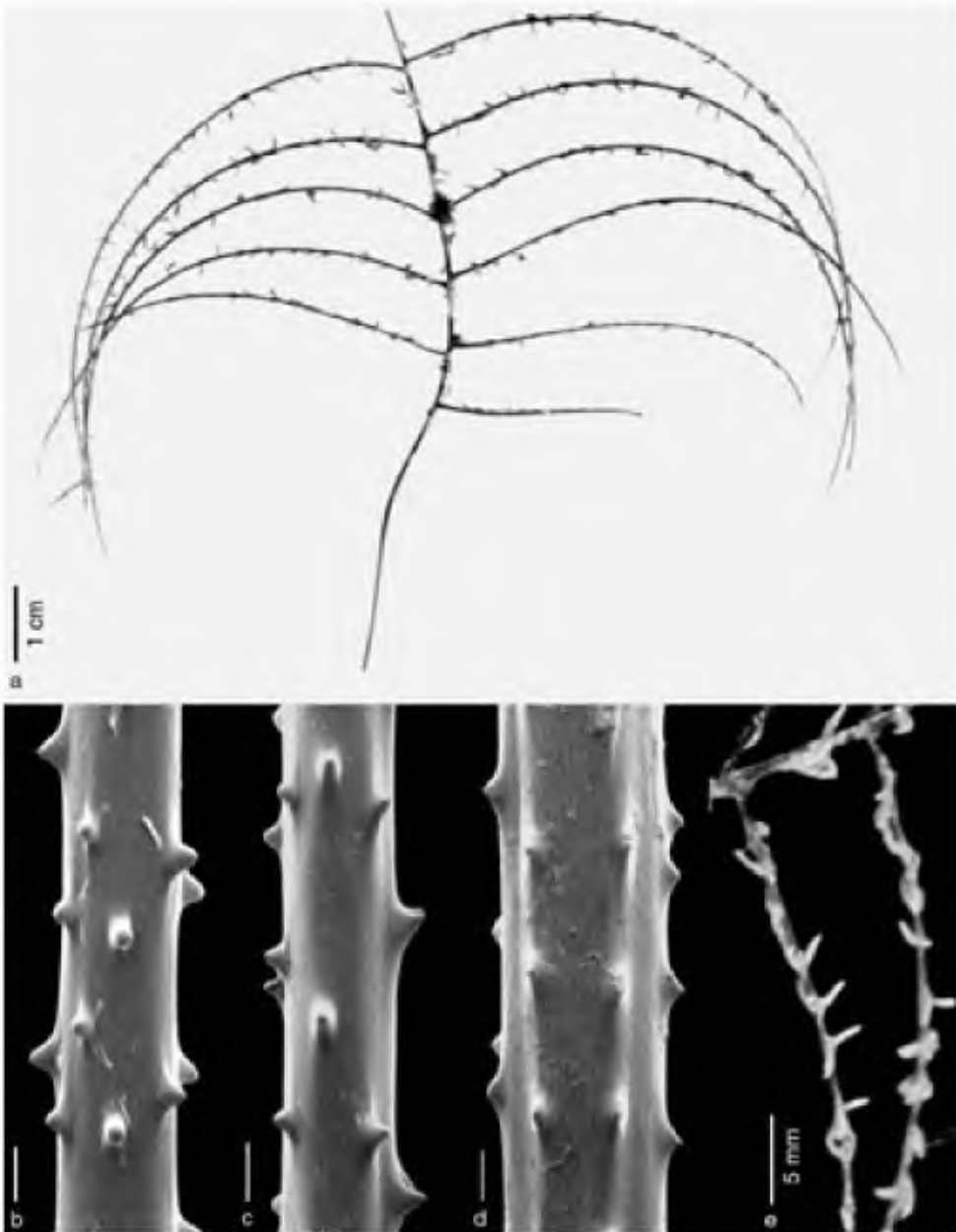


Fig. 1. *Bathypathes seculata* spec. nov., holotype (USNM 52430); a, corallum; b-d, spines on pinnules, scale bars, 0.1 mm; e, polyps.

Description of the holotype.— The holotype (USNM 52430) is 9 cm high and about 16 cm wide (fig.1a; holdfast broken off and not shown). The distal end of the stem is missing, but the very thin axis and relatively large central canal suggest that it would

have soon terminated. The lowermost part of the stem extends vertically for 2 cm at which point it bends sharply forward (in the direction of the polyp side of the axis), then arches vertically and finally curves backward at the top of the corallum. At a height of about 7 mm above basal end of the stem, and extending for a distance of about 15 mm, the surface of the stem is developed into a series of vertically directed, parallel grooves and ridges which have the appearance of a fluted column, and are here collectively referred to as a "striatum". It is at the distal end of the striatum that the stem bends forward. The basal diameter of the stem is 0.35 mm. The diameter increases over the next several centimeters to a maximum of 0.5 mm and then decreases regularly to the top of the corallum. The colony possesses six pairs of pinnules. The pinnules increase in length from 2.7 cm for the lowermost one to 8 cm for those at the top of the corallum. The diameter of the largest pinnule is about 0.35 mm. In each lateral row the pinnules are spaced 7-9 mm apart; and the members of each subopposite pair are about 1 mm apart; those on the left, viewing the front or polyp side of the colony, being lower than those on right. The pinnules extend out anterolaterally, and then curve back toward the abpolypar side of the corallum and also slightly down towards the base. The distal angle formed between the base of the pinnules and the stem is about 70° for the lower pinnules and 90° for the highest ones. The angle formed by the two planes containing the lateral rows of pinnules at their junction with the stem is 90° for the lowermost pinnules, but this increases to 120° at the top of the corallum.

The spines (figs 1b-d) on the pinnules are smooth, triangular, and up to about 0.06 mm tall. They are spaced about 0.4 mm apart (with about three per millimeter), and are arranged rather irregularly in eight or nine rows. The spines on the stem are also irregularly arranged; however, on that part of the stem containing the striatum, spines occur along the edge of the ridges. The polyps (fig. 1e) are mostly 5-6 mm in transverse diameter, the interpolypar space is 2-3 mm and there are 1.5 polyps per centimeter. The tentacles are uniform in size and up to about 3 mm in length in the preserved material.

Remarks.— Because only one specimen was available for study, the maximum size that colonies of this species can attain can not be determined with certainty; however, the fact that the longest pinnules in the holotype are at the top of the corallum suggests that the maximum size may not be much greater than that seen in this specimen.

Comparisons.— The characteristic features of this species are the small size of the corallum, the length of the pinnules relative to the height of the corallum, the sickle-shaped curvature of the stem, and the large polyps. In these characters the species appears to be closely related to *B. bayeri* Opresko (2001) from the Galapagos Islands. The two species are, however, distinctly different in the morphology of the spines. In *B. seculata* the pinnular spines are simple and triangular, but in *B. bayeri* they are multiply knobbed at the apex.

This species is also very similar in appearance to small colonies of *B. patula* Brook, a cosmopolitan species. Both have simple elongate pinnules arranged suboppositely. The two species differ in terms of the relative length of the pinnules. In *B. patula*, the length of the longest pinnules is generally 30-50% of the total height of the corallum even in very small specimens. In *B. seculata* the longest pinnules are 90% of the total height of the corallum.

Etymology.— From the Latin, “seculatus”, in reference to the sickle-shaped curvature of the stem, particularly when seen from the side.

Distribution.— Known only from the type locality in the Hawaiian Islands.

### *Umbellapathes* gen. nov.

Type species.— *Umbellapathes helioanthes*, spec. nov., herein designated.

Diagnosis.— Corallum monopodial and pinnulate, with long unpinnulated stalk; one or more orders of pinnulated branches developing from lowermost primary pinnules. Unpinnulated stalk usually longer than pinnulated section of stem. Pinnules on upper part of stem and on larger branches in two lateral or anterolateral rows with members of one row arranged alternately with those of opposite row. Secondary pinnules sometimes present. Spines conical and smooth, simple or rarely forked, and up to 0.3 mm tall. Polyps 2-4 mm in transverse diameter.

Remarks.— The genus *Umbellapathes* is placed in the Schizopathidae on the basis of the size and transverse elongation of the polyps. The major distinguishing features of the genus are the relatively long unpinnulated stalk and the development of some of the stem pinnules into distinct pinnulated branches. In the subalternate arrangement of the pinnules, the presence of subpinnules, and in the size of the polyps, *Umbellapathes* resembles *Dendrobathypathes* Opresko (2002). The growth form of the corallum of *Umbellapathes* spp. can be viewed as being more determinant than that occurring in *Dendrobathypathes* in that once the corallum reaches a certain size, most of the subsequent growth appears to be due to the development of the pinnules into pinnulated branches, and this growth takes place first and to the greatest extent on the lowermost stem pinnules.

Etymology.— The genus name is derived from the Latin “umbella” (parasol), in reference to the general shape of the corallum, and the commonly used suffix “pathes”.

Species assigned to *Umbellapathes*.— Included in the genus are *U. helioanthes* spec. nov., *U. bipinnata* spec. nov., and possibly also *Bathypathes tenuis* Brook. The latter species is also characterized by having a long stalk, and sparsely branched pinnules. Brook reported that this species had alternately arranged pinnules; however, re-examination of one of the type specimens (BM 90.4.9.24) indicated a more subopposite arrangement, with polyps 5-6 mm in transverse diameter; suggesting that the species might be related to *Bathypathes patula*.

Distribution.— The two new species are known only from the North Pacific. *B. tenuis* was collected south of Australia at a depth of 2600 fathoms.

### *Umbellapathes helioanthes* spec. nov.

(figs 2-3)

Material.— Holotype (USNM 1024968; schizoholotype RMNH Coel. 33299), N. Pacific, Laysan Seamount, 25°40.184'N, 171°E23.507'W, 1383 m, NOAA Cruise, “Pisces” 5, Dive 530, spec. 10, 14.x.2003, coll: A. Baco-Taylor and S. Cairns; paratype (USNM 1024967), N. Pacific, Laysan Seamount, 25°39.894'N, 171°24.519'W, 1205 m, NOAA cruise, “Pisces” 5, Dive 534, spec. 16, 20.x.2003, coll: A. Baco-Taylor and S. Cairns.

Diagnosis.— Corallum monopodial and complexly pinnulate. Long unpinnulated stalk topped by a discoidal crown of pinnules and pinnulated branches. Pinnules (or pinnulated branches) on stem generally arranged alternately in two anterolateral to lateral rows. Lowermost stem pinnules developed into branches with up to three orders of pinnulated subbranches. Subpinnules arranged uniserially to biserially. Spines on pinnules conical; mostly 0.05-0.1 mm tall (from midpoint of base to apex); arranged in rows, three to seven of which visible in lateral view, with four to six spines per millimeter in each row. Polyps mostly 3-4 mm in transverse diameter (distance between distal edge of distal lateral tentacles and proximal edge of proximal lateral tentacles); with two or three polyps per centimeter.

Description of the holotype.— The corallum (fig. 2a) is about 35 cm tall and 20 cm wide across the branched (pinnulated) crown. The basal stem diameter is  $3.2 \times 3.8$  mm.

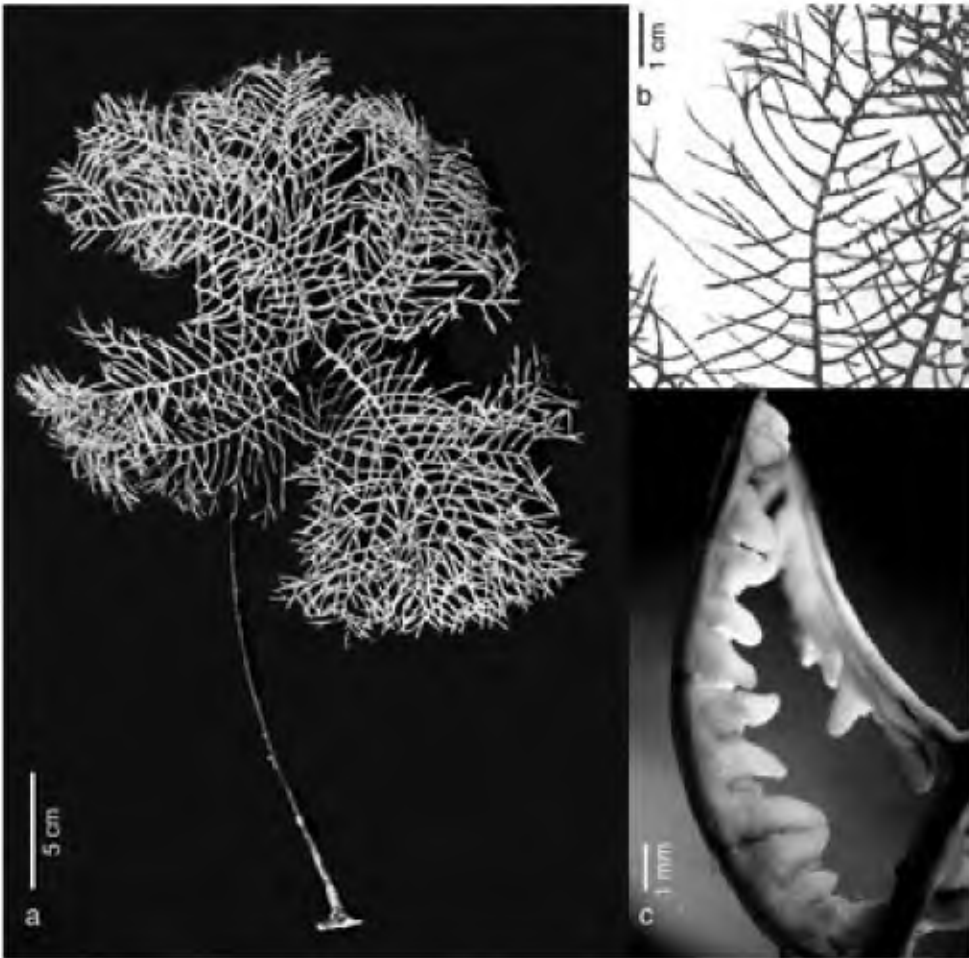


Fig. 2. *Umbellapathes helioanthes* spec. nov., holotype (USNM 1024968); a, corallum; b, pinnules; c, polyps.

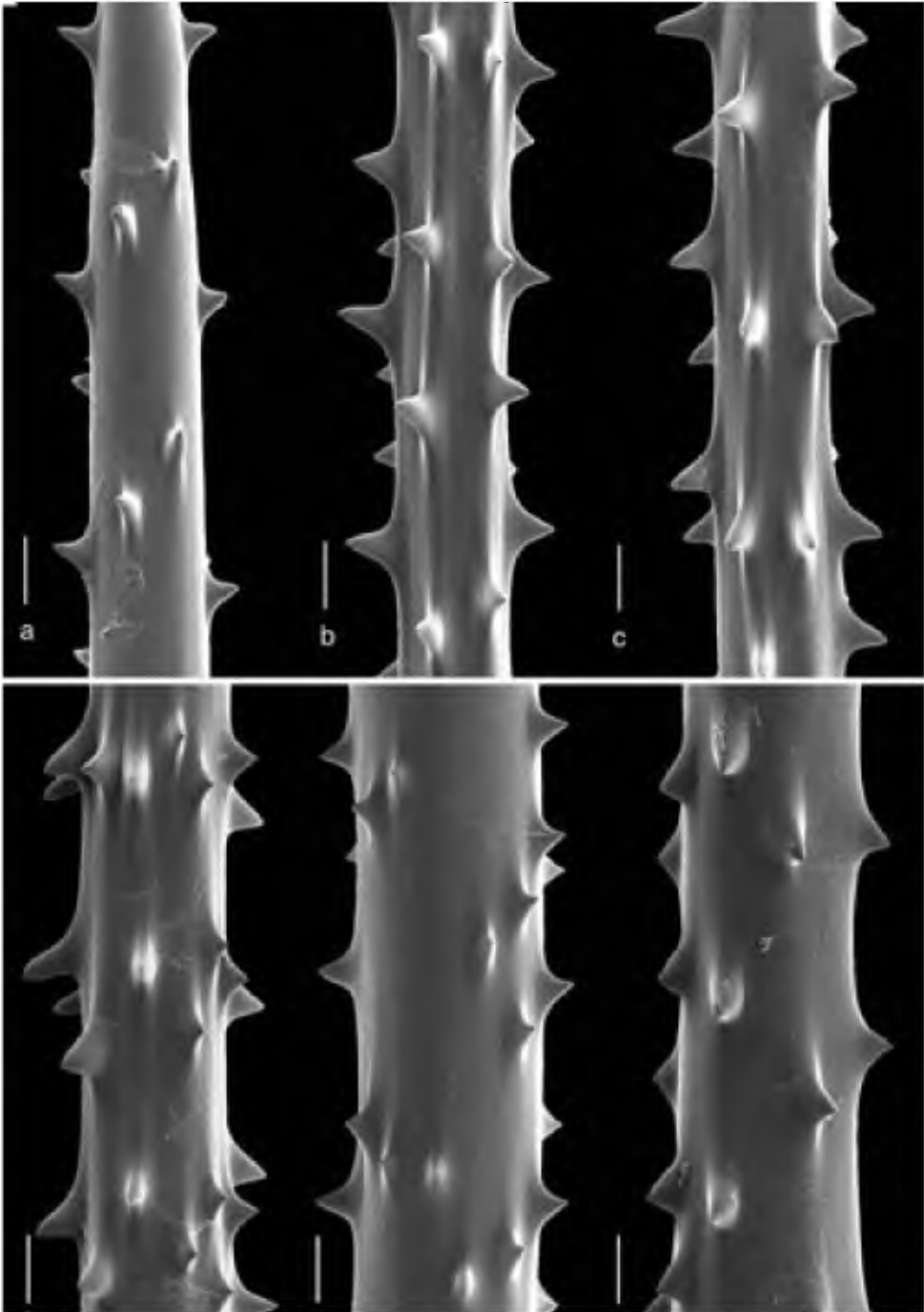


Fig.3. *Umbellapathes helioanthes* spec. nov., holotype (USNM 1024968); a-f, spines on pinnules; scale bars 0.1 mm.

The unpinnulated portion of the stem is about 27 cm long and the branched/pinnulated portion of the stem is about 12 cm long (because the stem is curved, the height of the corallum is less than the total length of the stem). The unpinnulated portion rises vertically and then curves forward and to one side; the pinnulated portion of the stem continues curving forward and then downward. The entire pinnulated section of the corallum has an irregularly circular shape when viewed from the front (polyp side) of the corallum, and a somewhat discoidal shape when viewed from the side. About 40 pinnules or pinnulated branches arise from the stem, although most of these occur in alternating pairs, this pattern is not strictly maintained at the distal end of the stem. Furthermore, the two lowermost stem pinnules, which develop into complexly pinnulated branches, are on the anterior side of the stem. Generally there are two to three orders of branches. The lowermost and longest pinnulated branch is about 14 cm long and at its basal end is about 2 mm in diameter which is slightly thicker than the adjoining part of the stem. This branch projects upward and curves backward. The other large pinnulated branches also curve back toward the abpolypar side of the corallum, thereby delineating a curved plane that is vertical and relatively parallel to the direction of the stem.

On the stem and larger branches the primary pinnules (and pinnulated branches) are arranged biserially and alternately. They are spaced 4-7 mm apart on each side of the axis, and there are about five per centimeter (total for both sides). The pinnules and pinnulated branches are placed anterolaterally to laterally on the stem such that the angle formed by the planes containing the two rows is roughly 150-180°. They are also inclined distally slightly such that the distal angle formed with the stem or branches is 70-80° (sometimes as much as 90°), but on the distal parts of the stem they are more distally inclined. The pinnules/pinnulated branches tend to be curved somewhat back towards the stem or branch from which they project.

The smaller pinnules on the corallum (fig. 2b) are mostly 1-3 cm long and 0.2-0.3 mm in diameter near the base, and they have one or two, rarely up to three, subpinnules that arise on the front side of the axis, extending out of the polyp side of the corallum. These subpinnules are generally arranged uniserially. As a pinnule increases in length additional subpinnules appear more distally and they become more biserially and alternately arranged, thus transforming a pinnule into a pinnulated branch. The interior angle formed by the biserial pinnules is around 90° but this usually becomes wider for the pairs of pinnules more distal on the branch. The arrangement of uniserial subpinnules near the base of a branch, and biserial ones further away from the base is retained on many of the branches; however, on some branches even the most proximal pinnules are arranged biserially.

The spines on the pinnules and branches (figs 3a-f) are conical, acute; 0.05-0.1 mm tall (from midpoint of base to apex), subequal to distinctly unequal (0.1 mm on one side of the axis and 0.05 on the opposite side). The longest spines are usually found on the upper (pinnulated) side of the axis, corresponding to the side on which the polyps occur. The spines on the opposite side of the axis often appear shorter, more laterally compressed, and more flared out along the base. Many of the polypar spines on the primary and secondary pinnules are slanted downward toward the basal end of the pinnule or subpinnule on which they occur. The arrangement of the spines in rows and the spacing of the spines within each row is often very irregular; three to seven rows of spines are visible in lateral view of the axis, and there are four to six spines per millimeter in each row.



On the stem spines are absent on the lowermost 2.5 cm just above the basal plate; higher up they occur irregularly; and beginning about 10 cm above the basal plate they start to show an arrangement in regular rows, up to eight of which can be seen in one lateral view. The spines range in size from about 0.06 mm to 0.1 mm; they are generally triangular with a rounded apex and are flared out along the base in both a distal and basal direction.

Polyps (fig. 2c) occur in a single series, mostly on the upper side of the pinnules, but sometimes on the lateral or lower side. In general, the polyps face out of the front or pinnulated side of the corallum. They are transversely elongated; 3.2-3.6 mm in diameter from the proximal edge of the proximal tentacles to the distal edge of the distal tentacles. There are two to three polyps per centimeter. The tentacles are relatively short and thick, 1 to 1.5 mm long in the preserved material.

Description of the paratype.— In the paratype (USNM 1024967) the branching of the corallum is much looser and more irregular than in the holotype. There is no distinct discoidal crown; instead there are several elongated pinnulated branches ascending vertically. The smallest primary pinnules are up to 3 cm long, and many are simple, i.e., without secondary pinnules, however, a few do have several uniserially arranged secondaries. The primary pinnules are 5-7 mm apart on each side of the axis, with four to five per centimeter (total for both sides). The polypar spines are up to 0.06 mm tall, and the polyps are up to 4 mm in transverse diameter. Thus, in most morphological features, this specimen resembles the holotype; however, the less compact branching pattern and the reduction in the number of uniserial subpinnules suggest that it might represent a different species.

Remarks.— The polyps in *U. helioanthes* have an appearance that is not unlike that occurring in species of *Dendrobathypathes*, *Stauropathes*, and *Dendropathes* gen. nov. (see below); suggesting that these genera are more closely related to each other than to *Schizopathes* and *Bathypathes* and other genera in the family. Further study is warranted.

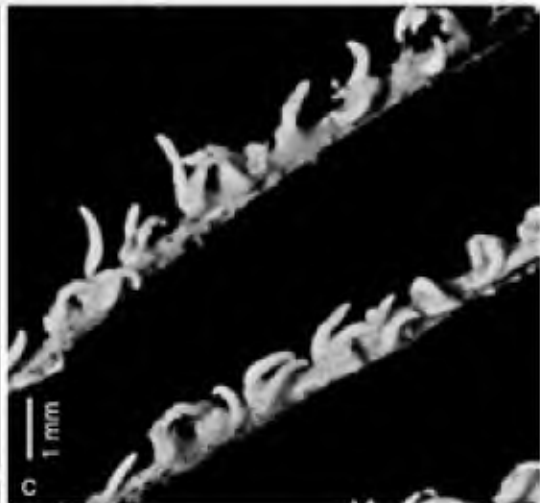
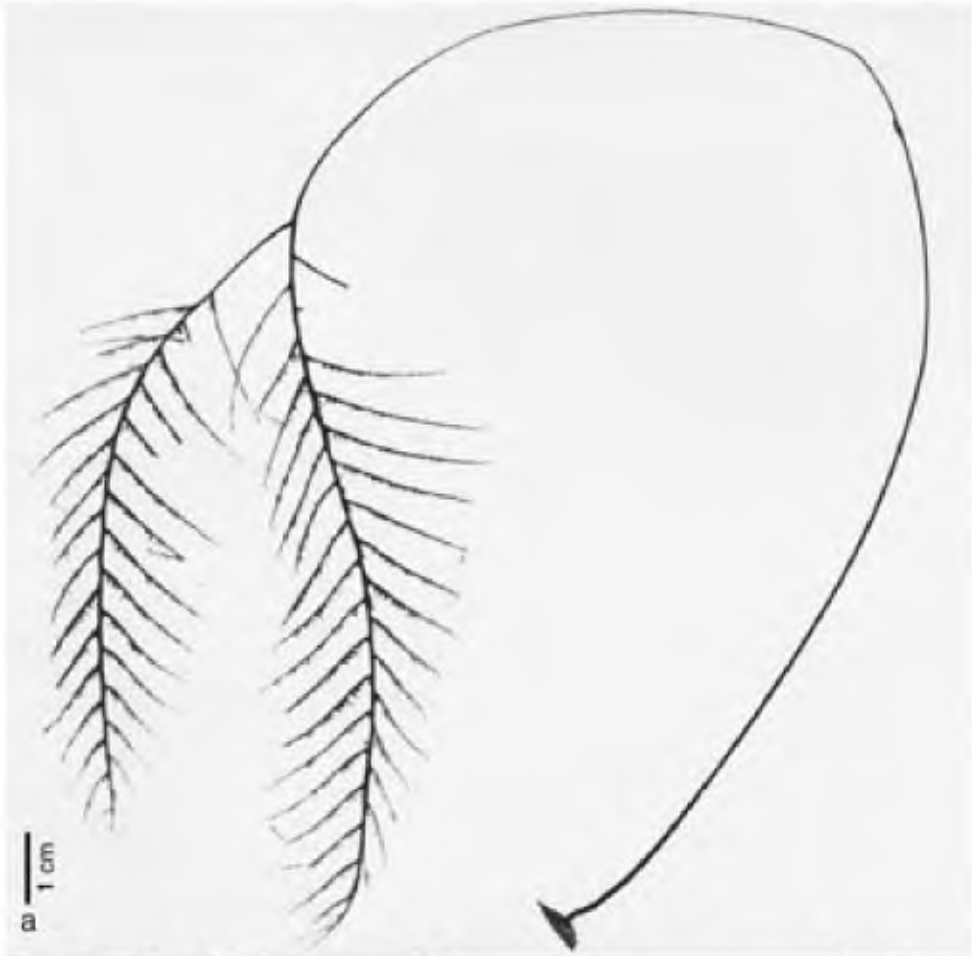
Etymology.— From the Latin "helio" (sun), and "anthus" (flower), an allusion to the general appearance of the corallum.

Distribution.— Known only from the North Pacific.

*Umbellapathes bipinnata*, spec. nov.  
(figs 4-5)

Material.— Holotype (USNM 83542; paratypes USNM 83543, 2 spec.), eastern Pacific, off Punta Banda, Mexico, 31°16.4'N, 117°34.2'W to 31°22.0'N, 117°42.2'W, 1130-1140 fm (2057-2075 m), Scripps Institution of Oceanography, Parker sta 137-60 (Field No, SOB-5), 13.ii.1960.

Diagnosis.— Corallum monopodial and compound pinnate; pinnate branches of first, second, and rarely third order arising from lowermost pinnules of stem. Unpinnulated portion of stem more than half total height of corallum. Pinnules simple, up to 4.5 cm long, arranged alternately in two lateral rows. Spines conical, simple (or rarely forked), with acute to slightly rounded apex and flared base. Spines larger on polyp side of axis; polypar spines up to 0.3 mm tall from apex to middle of base, abpolypar spines 0.06-0.15 mm. Small secondary spines present on some pinnules. Spines arranged



in rows, three to five of which visible in lateral view; with three to four spines per millimeter in each row. Polyps 2-3 mm in transverse diameter; arranged in one row with about three polyps per centimeter.

Description of holotype.— The holotype is a 35.5 cm long specimen (fig. 4a) with an intact basal attachment plate. The unpinnulated portion of the stem is 24.5 cm long and about 0.8 mm in diameter above the basal plate. The 11-cm long pinnulated section contains 39 pinnules, 20 on one side and 19 on the other. The pinnules on the stem (fig. 4b) are situated in two lateral rows and are arranged in a regularly alternating pattern. The stem pinnules are inclined toward the distal end of the stem (with a distal angle of about 60° for the lowermost pinnules, decreasing to about 30° for the pinnules at the top), and they also slant back toward the posterior (abpolypar) side of the corallum. The length of the stem pinnules decreases toward the top of the corallum; the longest simple pinnule is 2.5 cm and has a basal diameter of about 0.4 mm. The lowermost pinnule on the stem is developed into a 9-cm long pinnate branch with 31 pinnules (16 on one side and 15 on the other). The arrangement, size, and orientation are similar to that for the pinnules on the stem. Pinnules on the stem and branch are for the most part spaced about 4 mm apart on each side of the axis, but the lowermost ones on the stem are as much as 8 mm apart. The average density of the pinnules in each lateral row is three per centimeter, and there are four to five pinnules per centimeter for both rows.

The spines (figs 5a-c) on the pinnules are generally conical, with an acute to rounded apex, and a base that is flared out along the axis distally and proximally. They are arranged in regular rows, three or five of which are normally seen in lateral view. Within each row they are spaced at varying distances, from about 0.25 to 0.75 mm apart, but there are usually three and sometimes four per millimeter in each row. The pinnular spines are distinctly larger on the polyp side of the axis; polypar spines are 0.22-0.30

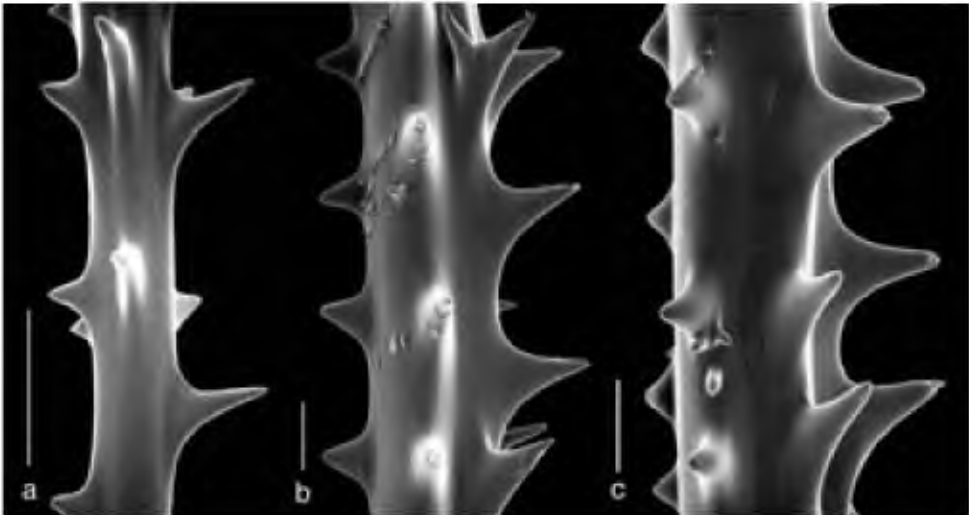


Fig. 5. *Umbellapathes bipinnata* spec. nov., holotype (USNM 83543); a-c, spines on pinnules; scale bar in a, 0.38 mm; scale bar in b and c, 0.20 mm.

◀ Fig. 4. *Umbellapathes bipinnata* spec. nov., holotype (USNM 83543); a, corallum; b, pinnules; c, polyps.

mm from the apex to the middle of the base; abpolypar spines range from 0.06 to 0.15 mm. The largest polypar spines are often found on the distal half of the pinnules, in some cases just below areas where the pinnule was broken off and is in the process of regeneration. In these locations additional small secondary spines may also occur, scattered irregularly or arranged in diagonal rows extending from the base of a normal-sized spine in one row to a neighbouring spine in an adjacent row. These secondary spines are usually less than one-tenth the size of the normal spines, but occasionally they are as much as one-third the size of a regular spine.

Spines are also present on the stem, extending down to near the basal plate. Those nearest the basal plate are not regularly arranged, higher up they occur in rows; three to five of which are visible in lateral view. Some of the spines slant downward towards the base; however, most are similar to those on the pinnules in extending out perpendicular or in being slightly inclined distally. The spines on the stem are larger on the side of the axis corresponding to the polyp-bearing side of the corallum. The largest spines on the lower unpinnulated section of the stem are about 0.1 mm tall, those on the polyp side of the pinnulated section of the stem are up to 0.15 mm tall.

The polyps (fig. 4c) are elongated along the transverse axis and have a typical schizopathid appearance with the distal pairs of tentacles isolated from the central part of the polyp. The two members of each pair of distal tentacles are also joined at their base on a bulbous elevation of the coenenchymal surface. The polyps are arranged uniserially on the anterolateral surface of the pinnules, and are mostly 2.5 mm in transverse diameter (from the distal edge of the distal lateral tentacles to the proximal edge of the proximal lateral tentacles), but they can be as much as 3 mm on some pinnules. The interpolypar space averages about 0.5 mm, resulting in three polyps per centimeter of axis. The tentacles have a maximum length of about 1.2 mm. The saggital tentacles are about equal in size or slightly longer than the lateral tentacles.

Remarks.— The two other specimens in the type series were collected at the same locality as the holotype. One colony is 33 cm high with a lower unpinnulated stalk of 19 cm and an upper pinnulated section of 14 cm; the latter contains 25 pairs of alternating pinnules, the longest of which is 4.5 cm. The pinnules are arranged alternately with 4-5 pinnules per centimeter (total for both rows). One of the lowermost pinnules on the stem is developed into a pinnate branch nearly equal in size to the pinnulate portion of the stem, and one of the lower pinnules of the branch is also developed into a pinnate branch. A third order branch of 6 cm length has pinnules reaching a maximum length of about 2 cm. Both the pinnulated part of the stem and the pinnulated primary and secondary branches are strongly curved downward, relative to the direction of the stem, and, because it is difficult to differentiate the pinnulated portion of the stem from the largest of the branches, the overall appearance of the corallum is that of a long stalk topped by an umbellate grouping of pinnate branches. The spines and polyps of this specimen are not significantly different from those in the holotype.

The third specimen in the type series is a small colony, about 18 cm high, with a pinnulated section of only 4 cm; however, the two lowermost pinnules on the stem are themselves pinnulated and the lowermost of the pinnules of one branch also shows signs of developing into a pinnulated branch. In this specimen the longest pinnules are only 2 cm.

Although possibly altered in shape by being preserved in a rather narrow jar, it

appears that in this species the unpinnulated part of the stem normally extends vertically for a distance and then curves horizontally, perhaps following a corkscrew-like pattern, with the branches and pinnules forming a curved plane set at an angle to the bottom.

Comparisons.— Small unbranched colonies of *U. bipinnata* could be mistaken for *Bathypathes tenuis* Brook; however, in the latter the corallum is smaller (height about 12 cm), the pinnules are subopposite rather than alternate, and the polyps are much larger (5 mm vs. 2-3 mm).

*Umbellapathes bipinnata* is similar to *U. helioanthes* spec. nov. in the general growth form of the colony. The two species can be differentiated by the fact that in *U. bipinnata* only a few of the lowermost primary pinnules develop into pinnulated branches, and the pinnules do not have subpinnules, whereas, in *U. helioanthes* more of the lower stem pinnules become pinnulated branches, and the pinnules have subpinnules. Furthermore, in *U. bipinnata* all the pinnules are arranged bilaterally, but in *U. helioanthes* the subpinnules on the smaller primary pinnules and on the basal part of some of the smaller branches are arranged uniserially. The two species also differ in that the pinnular spines of *U. helioanthes* are usually 0.05-0.1 mm, whereas those of *U. bipinnata* are frequently 0.2-0.3 mm.

Etymology.— From the Latin, "bipinnata" in reference to the multiply pinnate branches.

Distribution.— The holotype and paratypes all came from the same locality, off the Pacific coast of Mexico. The species is not known from any other locality.

### ***Dendrobathypathes* Opresko, 2002 emended**

Type species.— *Dendrobathypathes grandis* Opresko, 2002

Diagnosis.— Corallum monopodial to extensively branched, and pinnulate. Stem, branches and primary pinnules generally in one plane. Primary pinnules arranged alternately in two anterolateral to lateral rows. Secondary pinnules, when present, arranged uniserially and/or biserially on anterior (polypar) or anterolateral sides of primaries. Tertiary and higher order subpinnules, when present, also arranged uniserially and/or biserially, on the anterior (polypar) or anterolateral side of lower order subpinnules. Spines triangular to subconical in lateral view, smooth, acute, simple or rarely bifurcated at apex; sometimes inclined basally relative to the direction of the axis; up to about 0.2 mm tall; subequal or with polypar spines larger than abpolypar spines. Maximum size of polyps 2.5-5 mm in transverse diameter.

Remarks.— The occurrence of relatively small polyps in *D. fragilis* spec. nov. (see below) necessitates redefining the diagnostic boundaries of the genus.

Species assigned to *Dendrobathypathes*.— Included in the genus are *D. grandis* Opresko (2002), *D. isocrada* Opresko (2002), *D. boutillieri* spec. nov., and *D. fragilis* spec. nov.

#### *Dendrobathypathes boutillieri* spec. nov. (figs 6-7)

Material.— Holotype (USNM 1014186; schizoholotype, RMNH Coel. 33330), Gulf of Alaska, British

Columbia, Queen Charlotte Islands, Graham Id, 54°5.03'N, 134°7.12'W, 2.ix.2002, 1722-2083 m, coll. J. Boutillier, spec. No. 66; paratype (USNM 1071806), same locality data as holotype; spec. No. 48; paratype (USNM 1071807), North Pacific, Gulf of Alaska, 53°38.77'N, 133°30.93'W, 4.ix.2002, 1707-2109 m, coll. J. Boutillier, spec. No. 150.

**Diagnosis.**— Corallum branched and pinnulate; stem, branches, and primary pinnules generally in one plane. Primary pinnules arranged alternately along the stem and branches in two anterolateral rows. Secondary pinnules not very common; when present arranged uniserially on front side of primary pinnules. Tertiary and quaternary pinnules not present. Spines simple (rarely forked), conical, acute, slightly compressed; subequal to slightly larger on one side of the axis (usually but not always corresponding to the polypar side). Polypar spines mostly 0.1-0.14 mm tall, but up to 0.18 mm; abpolypar spines generally shorter than polypar spines by 0.02 to 0.04 mm. Polyps 3.6 to about 5 mm in transverse diameter; arranged in one series with two to three polyps per centimeter.

**Description of the holotype.**— The holotype material consists of three branches taken from a larger colony (fig. 6a) which was not retained. One branch is 15 cm tall, about 14 cm wide and has an axial diameter at its basal end of about 3 mm. The primary pinnules are situated along the stem in two anterolateral rows and the individual pinnules on the two sides are arranged in an alternating pattern (fig. 6b). Within each row the pinnules are spaced 5-8 mm apart and there are three or four pinnules per centimeter (total for both rows). The interior angle formed by the two rows of primary pinnules is close to 90°. The pinnules are also inclined towards the upper end of the corallum. Most of the smallest simple primary pinnules are not more than 2 cm long and have a basal diameter of about 0.5 mm (excluding spines). The primary pinnules only occasionally possess one (rarely two) secondary pinnules, and when present, these are arranged uniserially on the anterior (polypar) side of the primary, and thus project out of the polypar side of the corallum. The secondary pinnules are generally not more than about 1 cm in length and have a basal diameter of not more than 0.4 mm. The secondary pinnules are inclined towards the distal end of the primary pinnule from which they arise. Tertiary pinnules are not present.

The pinnular spines (figs 7a-f) are generally conical with a rounded to somewhat acute apex, and are slightly compressed laterally; a few have a forked apex. Most project out at right angles to the axis, but many are angled slightly towards the base of the pinnule on which they occur. They are arranged in not always regular rows along the length of the axis, four to six of which are usually visible in lateral view. Within each row the spines are spaced at varying distances apart, from about 0.35 mm to as much as 0.75 mm, but generally there are three to four spines per millimeter in each row. The pinnular spines are larger on one side of the axis which usually, but not always, corresponds to the polyp side. The largest spines are mostly 0.1 to 0.14 mm tall, but a few can be as much as 0.18 mm (as measured from middle of the base to the apex). The "abpolypar" spines are generally 0.02-0.04 mm shorter than the polypar spines.

Polyps occur only on one side of the corallum, corresponding to the pinnulated side. They are arranged uniserially, usually on the lateral side of the pinnules and subpinnules, and thus face out at right angles to the general vertical direction of the corallum. The polyps (fig. 6c) are mostly 4-5 mm in transverse diameter (range 3.5 mm to about 5



Fig. 6. *Dendrobathypathes boutillieri* spec. nov., holotype (USNM 1014186); a, corallum (not retained); b, branches with pinnules; c, side view of one polyp.

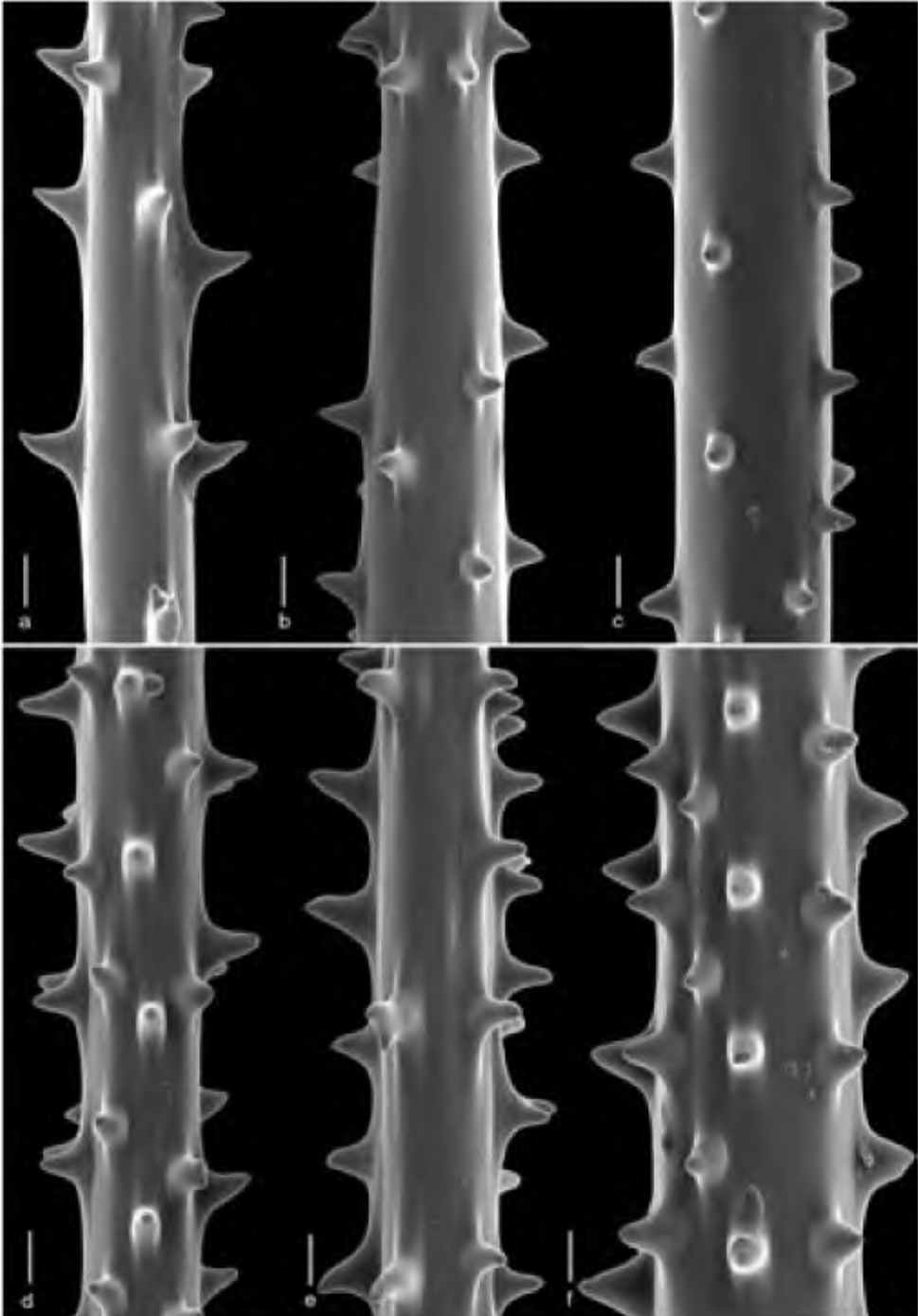


Fig. 7. *Dendrobathypathes boutillieri* spec. nov., holotype (USNM 1014186); a-f, spines on pinnules; scale bars, 0.1 mm.



mm) as measured from the distal edge of the distal lateral tentacles to the proximal edge of the proximal lateral tentacles. There are two (sometimes three) polyps per centimeter. The tentacles are relatively thick and blunt, and about 2 mm in height in the preserved material.

Remarks.— The two dry paratypes are very similar to the holotype in overall pin-nulation pattern (i.e., with only scattered uniserial secondary pinnules). Furthermore, there are also similarities in the length of the smallest simple pinnules (maximum of about 2.5 cm), the density of the pinnules (usually four, rarely five, per centimeter), and size of the spines (usually not more than 0.14 mm). These specimens also show that the overall growth form of the corallum is planar and that the branching is not very dense.

Comparisons.— This species can be differentiated from the related species *D. grandis* Opresko (2002) and *D. isocrada* Opresko (2002) by the more widely spaced and less extensively subpinnulated pinnules.

Etymology.— Named in recognition of Jim Boutillier who collected the type material of this species, as well as samples of other species and made them available for study.

*Dendrobathypathes fragilis* spec. nov.  
(figs 8-9)

Material.— Holotype (USNM 99798; schizoholotype, RMNH Coel. 33300), North Pacific, Japan, off Honshu Island, 33°23'40"N, 135°33'00"E, 29.viii.1906, 587 fm, R/V "Albatross", sta. 4969.

Diagnosis.— Corallum monopodial and complexly pinnulate. Primary pinnules arranged biserially and alternately along stem, and developing into quasi-branches with up to seven or eight orders of subpinnules. Secondary pinnules arranged mostly biserially on anterior (polyp) side of primary pinnules. Higher order subpinnules not uniform in size, number or arrangement. Fusions of adjacent subpinnules common. Spines simple, conical, with acute or rounded apex. Polypar spines up to 0.07 mm tall; abpolypar spines about 0.04 mm. Polyps usually 2 to 2.5 mm in transverse diameter; interpolypar space 0.4-0.5 mm; three to four polyps per centimeter.

Description of the holotype.— The holotype (fig. 8a) is 15 cm tall, about 9 cm wide and about 1 cm in thickness. The stem extends to the top of the colony and there are no independent branches; however, the primary pinnules can become so extensively subpinnulated that they have the appearance of branches although they are not substantially thicker than the subpinnules. The unpinnulated portion of the stem is about 1 cm long and 1.0 mm thick near the base. The upper portion of the stem is curved back away from the polyp-bearing side of the corallum. The primary pinnules are arranged along the stem in two lateral to anterolateral rows; with the members of each row alternating with those of those of the opposite row (fig. 8b). On the lower parts of the corallum the primary pinnules are mostly 2-3.5 cm long, and on the upper part they are 1-2 cm long. The largest primary pinnules have a thickness at the base of about 0.4 mm. Within each lateral row the pinnules are spaced from 3.5 to 5 mm apart, and there are five to eight pinnules per centimeter (total for both rows). The interior angle formed by the two rows of primary pinnules is close to 90°, but the pinnules are very strongly curved back toward the posterior side of the corallum. These primary pinnules are inclined slightly



Fig. 8. *Dendrobathypathes fragilis* spec. nov., holotype (USNM 99798); a, corallum; b, pinnules; c, polyps.

towards the upper end of the corallum (distal angle of around  $60^\circ$ ). The primary pinnules possess up to seven or more orders of subpinnules. The lowest order subpinnules, or secondary pinnules, are generally arranged biserially and alternately, with

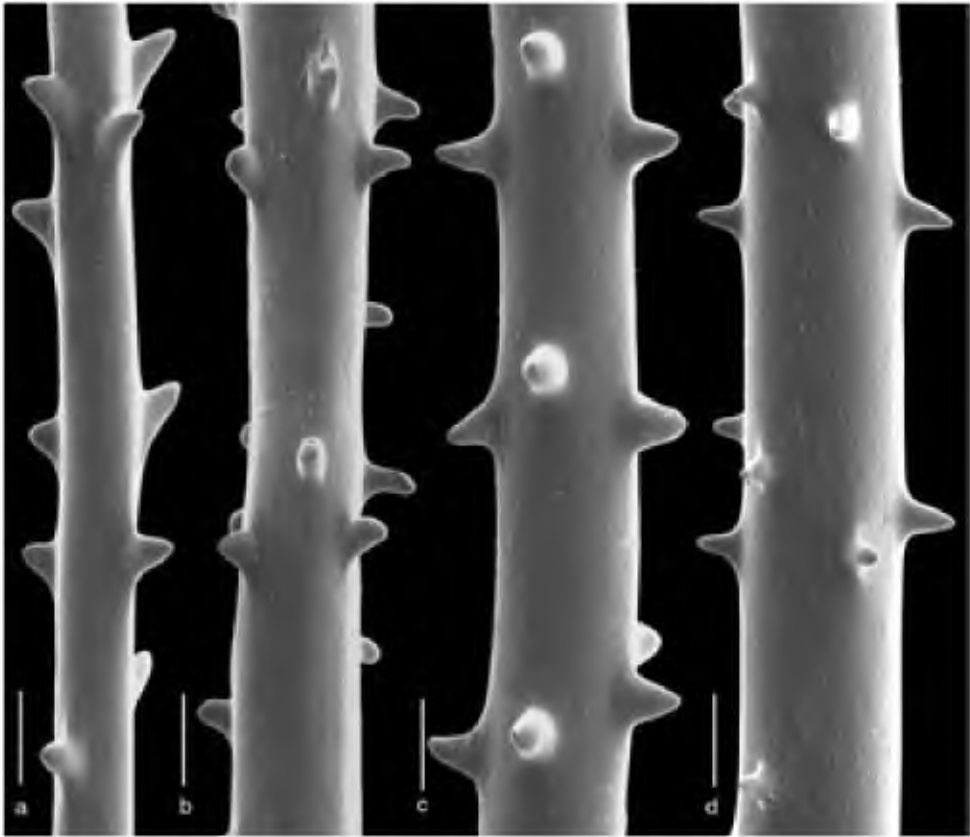


Fig. 9. *Dendrobathypathes fragilis* spec. nov., holotype (USNM 99798); a-d, spines on pinnules; scale bars, 0.1 mm.

an interior angle ranging from 30 to 150°; they project slightly out of the plane defined by the primary pinnules and the stem. The secondary pinnules are up to several centimeters in length and the lowest ones are positioned 1 to 2.5 mm from the base of the primaries.

The number and arrangement of the tertiary and higher order subpinnules is not very regular, and higher order subpinnules may be larger and more extensively developed (with more orders of subpinnules) than other lower order ones. Successive orders may consist of only one or two subpinnules; however, when there are more than two, they tend to be biserial and alternate in arrangement. Many subpinnules are curved towards the distal end of the lower order subpinnule from which they arise, and the next higher order subpinnule often develops on the convex side of the curved lower order one. Fusions occur frequently among adjacent subpinnules. The smallest unbranched subpinnules on the corallum are generally 1 cm or less in length and usually no more than about 0.2 mm in thickness. There are at most about four subpinnules per centimeter on the outer parts of the corallum.

The pinnular spines (figs 9a-d) are generally conical, with a rounded apex. They are

arranged in rows along the length of the axis, three or four of which are usually visible in lateral view. Within each row they are spaced from 0.23 to 0.36 mm apart. The spines are slightly larger on one side of the axis corresponding to the polyp-side of the corallum. The largest spines are about 0.07 mm tall, as measured from middle of the base to the apex. The abpolypar spines are usually not more than 0.04 mm tall. In places some of the polypar spines appear to be inclined towards the base of the pinnule.

Polyps occur only on the anterior side of the corallum. They are arranged uniserially; usually on the lateral or upper side of the pinnules and subpinnules. The polyps (fig. 8c) are mostly 2 to 2.5 mm in transverse diameter (from the distal edge of the distal lateral tentacles to the proximal edge of the proximal lateral tentacles). The oral cone is elevated about 0.4 mm. The tentacles are short, 0.4-0.5 mm in length. The interpolypar space ranges from about 0.4 to 0.5 mm, and there are three to four polyps per centimeter.

Remarks.— Based on the presence of two rows of primary pinnules, the pattern of subpinnulation, and the shape of the spines, this species is referred to the genus *Dendrobathypathes*. In previously described species of this genus the polyps are at least 3 mm in transverse diameter. The small size of the polyps in *D. fragilis* (2.0-2.5 mm) necessitates expanding the generic definition.

Comparisons.— This species can be differentiated from others in the genus (*D. grandis*, *D. isocrada* and *D. boutillieri*) by its thinner pinnules, shorter spines and smaller polyps. In terms of its extensive subpinnulation, *D. fragilis* is closest to *D. isocrada*; however, the two can be differentiated by the fact that in *D. fragilis* the corallum is essentially monopodial, whereas in *D. isocrada* it is branched, with some of the main branches similar in size to the stem.

Etymology.— From the Latin “fragilis”, in reference to the narrowness of the stem and pinnules.

### *Dendropathes* gen. nov.

Type Species.— *Dendropathes bacotaylorae* spec. nov. (see description below).

Diagnosis.— Corallum branched and distinctly pinnulate. Stem and branches generally lying in one plane. Pinnules simple, in four rows, with each anterolateral pinnule generally inserted distal to nearest lateral pinnule on same side of axis. Spines subconical, up to about 0.14 mm tall. Polyps up to 3 mm in transverse diameter; tentacles (in preserved material) short and thick.

Remarks.— The general morphology of the corallum and the size and appearance of the polyps of this genus suggests a relationship to the Schizopathidae; however, histological studies have not been conducted to determine whether the number of primary and secondary mesenteries corresponds to that occurring in the family (six primary mesenteries and four secondaries). Of the other genera in the Schizopathidae, *Dendropathes* is similar to *Lillipathes* in having four rows of simple pinnules; however, in *Dendropathes* the anterolateral pinnules are inserted distal to the adjacent lateral pinnules on the same side of the axis, whereas in *Lillipathes* the anterolateral pinnules are usually inserted below the adjacent lateral pinnules.

Etymology.— Derived from the Greek “dendron” (tree), and the commonly used suffix “pathes”.

Species assigned to *Dendropathes*.— In addition to the type species, *D. bacotaylorae*

spec. nov., one other nominal species, *Antipathella intermedia* Brook (1889), may belong to this genus. In *A. intermedia* the pinnules are also arranged in four rows, but the arrangement is much less regular than in *D. bacotaylorae*. The type specimen of *A. intermedia* is dry and Brook did not report finding any polyps; however, re-examination of the type revealed that there was soft tissue remaining that was overlooked by Brook. The dried polyps were estimated to be about 2 mm in transverse diameter, suggesting that this species is likely to have affinities to the Schizopathidae and not to the Antipathidae.

Distribution.— Both the type species, *D. bacotaylorae*, and *A. intermedia* Brook were collected in the North Pacific.

*Dendropathes bacotaylorae* spec. nov.  
(figs 10-11)

Material.— Holotype (USNM 1024966; schizoholotype RMNH Coel. 33301), N. Pacific, Twin Bank, 23°15.578'N, 163°0.024'W, 408.2 m, NOAA Cruise, "Pisces" 5, Dive.545, 1.xi.2003, coll. A. Baco-Taylor and S. Cairns.

Diagnosis.— Corallum branched and pinnulate. Stem and branches generally flabellate, with simple pinnules arranged in four rows, two lateral and two anterolateral, and also in groups of two pinnules each; anterior pinnule of each group on each side of axis inserted distal to the lateral pinnule. Pinnules simple, generally less than 1 cm in length; anterolateral pinnules slightly shorter than lateral pinnules. Spines conical, simple, with rounded apex. Spines larger on polyp side of axis; polypar spines mostly 0.1-0.12 mm from apex to middle of base, abpolypar spines about two-thirds the size of the polypar spines. Polyps 1.6-2.4 mm, sometimes up to 3 mm, in transverse diameter; with four to five polyps per centimeter.

Description of the holotype.— The holotype is only a branch from a much larger colony (estimated to be 1 m tall and 1.5 m wide) which was not retained. The branch (fig. 10) is 28 cm tall and about 12 cm wide, and has an axial diameter of  $3.6 \times 4.6$  mm at its basal end. The corallum is subbranched mostly to the first and second order and generally in one plane. One secondary branch is 17 cm long and has a basal axial diameter of 1.8 mm. All the branches are densely covered with simple pinnules. The pinnules (fig. 11a) are arranged along the length of the branches in four rows, two of which are generally lateral in position and two are anterolateral. The pinnules in one lateral row are offset from those in the opposite lateral row such that they follow an alternating pattern along the axis. The position of the anterolateral pinnules relative to the adjacent lateral pinnules varies considerably in regularity. Based on the location of the polyps on the pinnules, and the assumption that the polyps face out in the same direction on each side of a branch, it was determined that, where there is a regular pattern, each anterolateral pinnule is positioned distal to the adjacent lateral pinnule, and is inserted on the axis at a position that is near the point of insertion of the next distal lateral pinnule on the opposite side of the axis. Therefore, the pinnules have the appearance of being grouped in pairs, each pair consisting of one lateral pinnule and one anterolateral pinnule from the opposite side of the axis. The lateral pinnules are mostly 7-9 mm long (up to about 1.1 cm) with a basal diameter of 0.2-0.3 mm, and they are inclined distally (distal angle mostly 45-50°). They are also spaced about 2-3 mm apart in each row, resulting

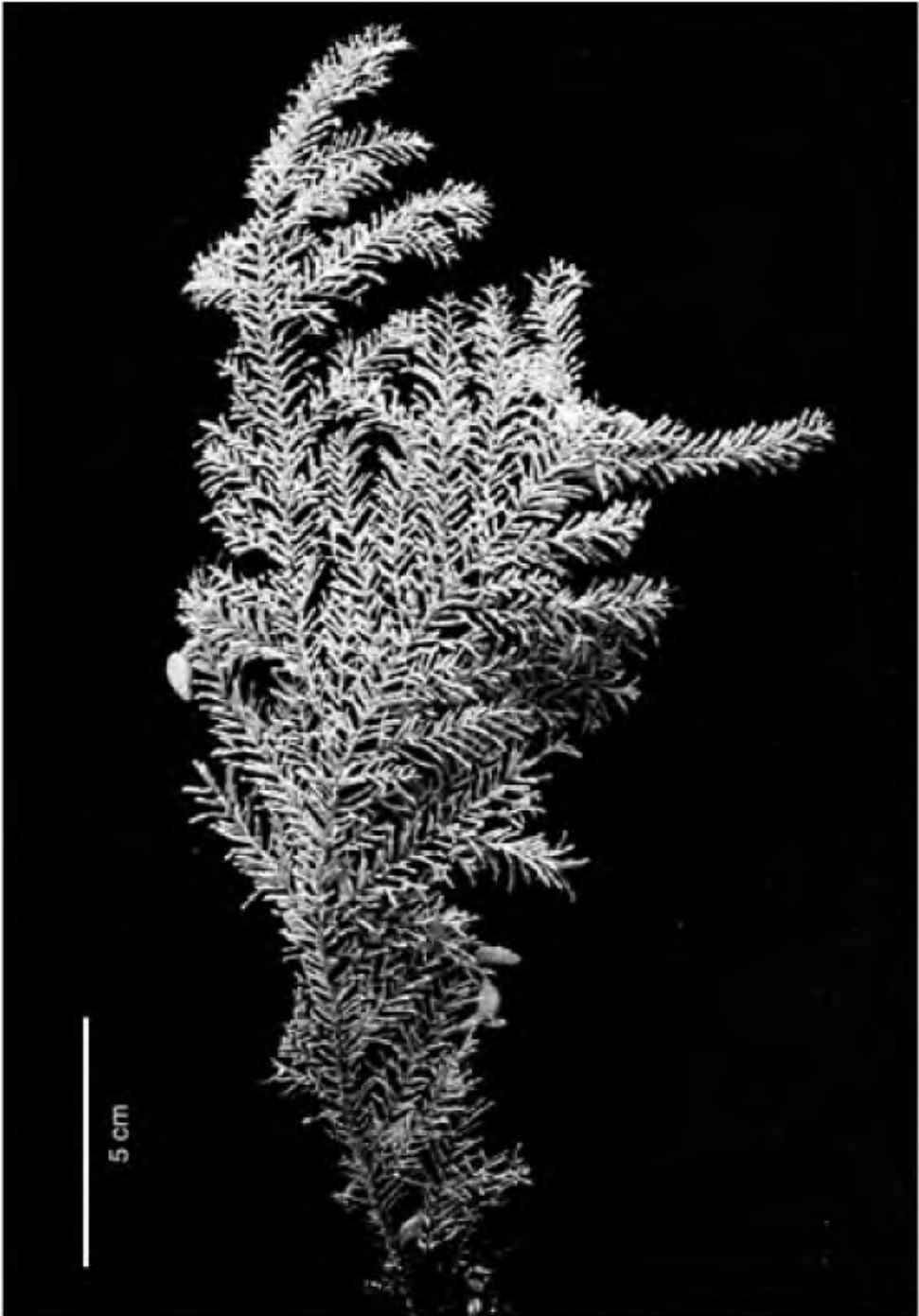


Fig. 10. *Dendropathes bacotaylorae* spec. nov., holotype (USNM 1024966); branch from corallum.

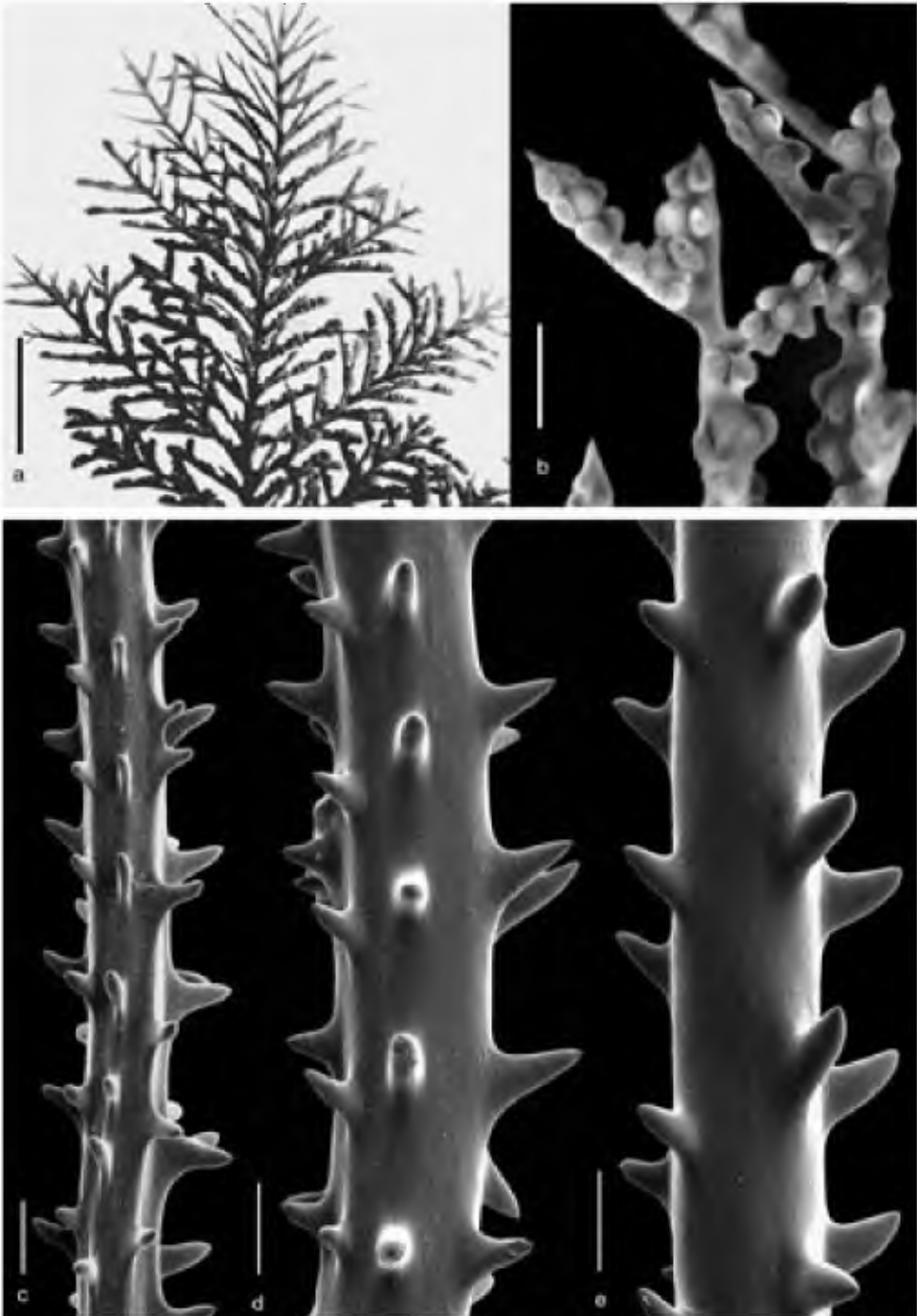


Fig. 11. *Dendropathes bacotaylorae* spec. nov., holotype (USNM 1024966); a, pinnules; b, polyps; c-e, spines on pinnules; scale bars in c-e, 0.1 mm.

in about 12-16 per centimeter (total for all four rows). The anterolateral pinnules are often shorter than the lateral pinnules by 3-4 mm. The interior angle of the two rows of lateral pinnules is close to 180°. The anterolateral pinnules are also inclined distally about the same amount as the lateral pinnules. The interior angle of the two rows of anterolateral pinnules is 60-90°.

The spines (figs 11c-e) are conical with a rounded apex. The polypar spines are typically 0.08-0.12 mm in size and distinctly larger than the abpolypar spines which are mostly 0.05-0.07 mm. The polypar spines on the anterolateral pinnules are up to 0.14 mm and are slightly larger than those on the lateral pinnules.

The polyps (fig. 11b) are mostly 1.6-2.4 mm in transverse diameter, although some are as large as 3.0 mm. They occur in a single series on the upper, lower or anterior side of the pinnules, leaving one side without polyps; therefore, the corallum has a distinct polypar and abpolypar side. There are usually four polyps per centimeter (sometimes as many as five per centimeter). The tentacles are short and thick.

Etymology.— Named in recognition of Amy Baco-Taylor whose NOAA cruises to the North Pacific have resulted in the discovery of a number of new species and genera of antipatharian corals.

Distribution.— Found at one locality in the northeastern Pacific.

### ***Lillipathes* Opresko, 2002, emended**

Type species.— *Antipathes lilliei* Totton, 1923.

Diagnosis.— Corallum branched sparsely, mostly to the second and third order; stem and branches pinnulate. Pinnules simple, arranged bilaterally, primarily in four rows (in some species pinnules of one or both anterolateral rows may be missing on parts of the corallum) and also in alternating groups of two pinnules each on either side of the axis; anterior pinnule of each pair originating just below lateral pinnule. Spines simple, triangular, compressed, up to 0.1 mm tall. Polyps usually 2-3 mm in transverse diameter.

Remarks.— The genus was established on the basis of the pinnules occurring in four rows and in alternating pairs (Opresko, 2002). In the new species described below, specimens were found in which one or both of the anterolateral pinnules is occasionally missing on parts of the corallum, resulting in only two or three rows of pinnules, thus necessitating an emendation to the diagnosis of the genus. Species are differentiated by the length and density of the pinnules, and the size of the spines. *Lillipathes* is very closely related to *Parantipathes* which typically has six or more rows of simple pinnules; however, one species referred to *Parantipathes* (*P. wolffi* Pasternak, 1977) has four rows of pinnules on parts of the corallum and six rows elsewhere.

Species assigned to *Lillipathes*.— Included in the genus are *L. lilliei* (Totton, 1923), *L. quadribrachiata* (van Pesch, 1914), and *L. wingi* spec. nov.

#### *Lillipathes wingi* spec. nov. (figs 12-13)

Material.— Holotype (USNM 1014106; schizoholotype RMNH Coel. 33302), 54°54'N, 134°17.2'W to 54°57.7'N, 134°21.2'W, 518 m, R/V "Alaskan Leader", sta 107, sample No. AB02-61, 11.vii.2002, coll. B.



Wing; paratype (USNM 1014107), 56°54.2'N, 136°05.8'W, to 56°57.4'N, 136°06.2'W, 733-759 m, R/V "Alaskan Leader", sta 102B, sample No. AB02-56, 17.vii.2002, coll. J. Karinen; paratype (USNM 1014108), 53°58.9'N, 148°31.78'W, to 53°57.5'N, 148°33.85'W, 640-705 m, R/V "Alaskan Leader", sample No. AB02-68, 02.vii.2002, coll. N. Maloney; paratype (USNM 1014110) 53°42.23'N, 133°24.94'W, 1152-1192 m, 04.ix.2002, coll. J. Boutillier, sample No. 130; paratype (USNM 1014187), 54°05.03'N, 134°7.12'W, 1722-2083 m, 02.ix.2002, coll. J. Boutillier, sample No. 70.

**Diagnosis.**—Corallum moderately branched, mostly in one plane; stem and branches pinnulate. Pinnules arranged mostly in four rows, two lateral and two anterior, and also in alternating biserial to bilateral groups of two pinnules each (one or both of the anterior pinnules may be missing on parts of corallum). Pinnules simple, up to about 5 cm long; anterior pinnules slightly shorter than lateral pinnules. Spines conical, simple, with rounded apex. Spines larger on polyp side of axis; polypar spines up to 0.1 mm tall from apex to middle of base, abpolypar spines about one-half to two-thirds the size of the polypar spines. Polyps 2.4 mm to 3.6 mm in transverse diameter.

**Description of the holotype.**—The colony is 51 cm tall (fig. 12a), about 36 cm wide and has a basal stem diameter of  $3.7 \times 4.3$  mm. It is branched to the third order. The branches generally lie in a single plane. The stem extends to the top of the corallum, but is broken off at its distal end. The lowermost 2.5 cm of the stem is unpinnulated, and the next 4 cm has only two rows of pinnules. Above this point there are three to four rows, with four rows occurring at a height of about 9 cm above the base. Over most of the corallum there are two lateral rows and two anteriolateral rows. The lateral rows are not always strictly lateral in position in that the interior angle formed by the two rows may be slightly less than 180°, especially near the tips of the branches. The interior angle formed by two anterior rows increases from about 90° at the tips of the branches to 120-150° further down, resulting in a bilateral arrangement, with two rows on each side of the axis (fig. 12b). The pinnules are also grouped in pairs with one lateral and one anterolateral pinnule in each pair; the anterolateral pinnules are positioned slightly below (1-2 mm) the adjacent lateral pinnule. The pairs of pinnules on either side of the axis are separated by a space of about 2.5-3 mm. There are usually 10-12 pinnules per centimeter, counting those in all rows; however, there can be as many as 14 per centimeter. The pinnules on the smaller branches are mostly 1-2 cm long, whereas those on the larger branches and stem are up to about 4 cm long with a basal diameter of about 0.4 mm. Generally, the lateral pinnules are longer than the anterior pinnules by 0.5 cm to 1 cm; however, anterior pinnules occasionally appear longer than an adjacent lateral. The distal angle that the pinnules form with the branch is in the range of 60-70°.

The spines (figs 13a-c) on the pinnules are conical, smooth, usually with a rounded apex. The polypar spines on the pinnules are mostly 0.07-0.10 mm tall; the abpolypar spines are 0.03 to 0.05 mm shorter. Double spines are occasionally present, especially on the polypar side of the axis. Four to six rows of spines can be seen in lateral view. The spacing of the spines within each row is not uniform and the distances between the middle of the bases of adjacent spines can range from as little as 0.18 mm to as much as 0.37 mm; the most common distance is 0.25-0.30 mm, resulting in four to five spines per millimeter in a row.

The specimen is dry, therefore information on the polyps is limited; however, sufficient soft tissue remains to indicate that the polyps are usually about 2.4 mm in transverse diameter, and may be as much as 3.2 mm.



Fig. 12. *Lillipathes wingi* spec. nov., holotype (USNM 1014106); a, entire corallum; b, close-up of pinules

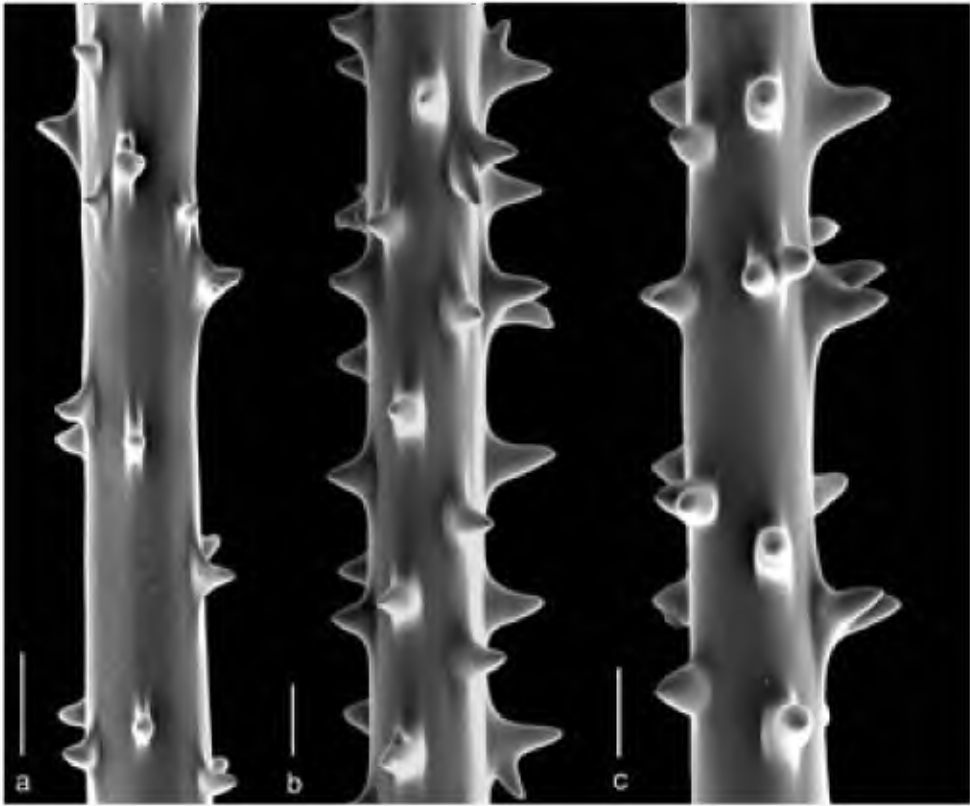


Fig. 13. *Lillipathes wingi* spec. nov., holotype (USNM 1014106); a-c, spines on pinnules; scale bars, 0.1 mm.

Remarks.— The paratypes are similar to the holotype in general appearance, but vary somewhat in several characters. One paratype has slightly longer pinnules (up to 5 cm); several others have fewer pinnules on portions of the corallum (one or both the anterior pinnules may be missing), and in one small sample of a third specimen the polyps were found to be up to 3.6 mm in transverse diameter.

Comparisons.— Two other species have been assigned to this genus, *L. lilliei* (Totton, 1923) and *L. quadibrachiata* (van Pesch, 1914). The pinnules in *L. wingi* (maximum length of about 5 cm) are distinctly shorter than those in *L. lilliei* (9–11 cm) and longer than those reported for *L. quadibrachiata* (lateral pinnules at most 2.9 cm and anterior pinnules 0.5–1.0 cm). The spines in *L. wingi* (0.1 mm) are slightly larger than those in *L. lilliei* (0.07 mm) but considerably larger than those reported for *L. quadibrachiata* (not more than 0.03 mm). Re-examination of the type of *L. quadibrachiata* revealed that the polyps were 1.5 mm to about 2.0 mm in transverse diameter and those in *L. lilliei* were reported to be 1.8–2.3 mm, whereas those in *L. wingi* are 2.4 to 3.6 mm in transverse diameter. Thus, there are sufficient characters to clearly separate the three species.

Etymology.— Named in recognition of Bruce Wing who collected and made available the type specimen of this species and many other specimens of other species of antipatharians from the northeastern Pacific.

Distribution.— Found at numerous locations off the Pacific coast of Canada and Alaska.

### **Cladopathidae Kinoshita, 1910**

Diagnosis.— Polyps with six primary mesenteries but no secondary mesenteries. Actinopharynx may be present or absent. Polyps elongated transversely in the direction of the axis; transverse diameter 2 mm or more, as measured from distal edge of distal lateral tentacles to proximal edge of proximal lateral tentacles. Corallum monopodial or branched, and pinnulate. Pinnules simple or with one or more orders of subpinnules. Spines conical to acicular, smooth-surfaced, subequal around the circumference of the axis, or taller on one side. Spines equally developed on all pinnules or more strongly developed on anterior pinnules or subpinnules.

Remarks.— The family is divided into three subfamilies, the Cladopathinae, containing the genera *Cladopathes* Brook (1889), *Trissopathes* Opresko (2003), and *Chrysopathes* Opresko (2003), the Hexapathinae, containing *Hexapathes* Kinoshita (1910), and *Helioopathes* Opresko (2003), and the Sibopathinae, containing the single genus *Sibopathes* van Pesch (1914). For further discussion of these subfamilies see Opresko (2003).

### **Cladopathinae Kinoshita, 1910**

Diagnosis.— Polyps generally 2-4 mm (but up to 6 mm) in transverse diameter. Corallum bushy or flabellate; and pinnulate. Primary pinnules arranged in two to six rows and usually also in bilateral groupings. Pinnules simple or subpinnulate. Tertiary pinnules, as well as secondaries, present in some species. Spines simple, smooth, deltoid to conical to acicular in lateral view.

### ***Chrysopathes* Opresko, 2003**

Type species.— *Chrysopathes formosa* Opresko, 2003.

Diagnosis.— Primary pinnules arranged in six rows and usually also in alternating biserial groups of three pinnules each. In each grouping of three the anterolateral pinnule is placed slightly below (relative to the direction of the branch) the adjacent lateral/posterolateral pinnule, and the posterolateral pinnule is placed slightly above the posterior primary pinnule. Primary pinnules subequal in length or with laterals longer than those in anterior and posterior rows. Subpinnules confined to the anterior pinnules or present on lateral and posterior pinnules as well. Subpinnules arranged irregularly or alternately, and only rarely in subopposite pairs. Secondary pinnules usually smaller than primary pinnules.

Remarks.— Although the younger parts of colonies may have only four rows of primary pinnules, the typical condition in this genus is six rows. The primary pinnules in the posterior-most rows are usually not very well developed.

Species assigned to *Chrysopathes*.— Species assigned to this genus include *C. formosa* Opresko (2003) and *C. speciosa* Opresko (2003), and *C. gracilis* spec. nov.

Distribution.— Although all described species of this genus are known only from the northeastern Pacific, undescribed material in the collections of the USNM and the

Rosenstiel School of Marine and Atmospheric Science, University of Miami, reveal that the genus is also represented in the western Atlantic.

*Chrysopathes gracilis* spec. nov.  
(figs 14-15)

Material.— Holotype (USNM 94490; schizoholotype RMNH Coel. 33303), North Pacific, Fieberling Guyot, 32°27.6'N, 127°29.5'W, 14.x.1990, 640 m, coll. S. France, "Alvin" Dive 2294.

Diagnosis.— Corallum small, delicate, sparsely branched. Stem and branches with primary pinnules arranged in four rows near tips of branchlets, increasing to six rows on lower sections of branchlets. Primary pinnules mostly simple except on lower section of stem where some anterior pinnules may have a single, small secondary pinnule on abpolypar side. Primary pinnules 1-2 cm long, 0.07-0.15 mm in diameter near base, and 4.5-5 mm apart in each row (about three per centimeter, with a total of up to 15 per centimeter for all rows). Spines on pinnules simple, smooth, acute; subequal, triangular in lateral view; mostly 0.04-0.07 mm tall; distally inclined towards the tips of the pinnules. Polyps 1.8-2.4 mm in transverse diameter, and arranged in one series, with three to four polyps per centimeter.

Description of holotype.— The corallum is about 16 cm tall (fig. 14a) and has one major branch originating on the lower half of the stem, and a very short branch slightly higher up. The stem extends to the top of the corallum and has a basal diameter of 0.8 mm. On the upper part of the stem and the main branch the primary pinnules tend to have a bilateral arrangement, further down they are more evenly distributed around the circumference of the axis. The groups of pinnules (fig. 14b) do not follow a spiral pattern, in that the lateral pinnule is usually inserted higher on the axis (relative to the direction of the stem or branch) than the anterior or posterior ones in each group. The lateral pinnules are usually the longest (up to 2 cm and 0.07-0.15 mm in diameter near the base), followed by the anterior ones, with the posterior primaries often quite short. The secondary pinnules, where present, tend to project out laterally or slightly basally relative to the vertical direction of the stem. The primary pinnules are 4.5-5 mm apart in each row, resulting in about three per centimeter for each row, with a total of fifteen per centimeter for all rows. The pinnular spines are quite small, only about 0.04 mm near the base of the pinnules, slightly taller and more inclined distally towards the tips of the pinnules (figs 15a-d). The spines do not appear to be larger on any one side of the axis. Four to five rows of spines can be seen in lateral view, and although the spacing of the spines is not very regular, they are typically about 0.3 mm apart resulting in about four spines per millimeter in one row. The polyps (fig. 14c) are arranged in a single row, and are confined mostly to the lateral sides of the pinnules, although some can be positioned more towards the upper or lower sides. Because of the thinness of the pinnules, the polyps stand out very distinctly from the corallum. They are mostly about 2 mm in transverse diameter (range 1.8-2.4 mm) as measured from the proximal edge of the proximal lateral tentacles to the distal edge of the distal lateral tentacles. They are relatively widely spaced apart, and arranged in single series with three to four polyps per centimeter. The tentacles are up to about 0.5 mm in length in the preserved material.



Fig. 14. *Chrysopathes gracilis* spec. nov., holotype (USNM 94490); a, entire corallum; b, close-up of pinnules; c, polyps.

Remarks.— The non-spiral arrangement of the primary pinnules, and the occurrence of secondary pinnules on the abpolypar side of the anterior primaries, link this species to the Cladopathinae, and the presence of six rows of primary pinnules, even though they are present only on the lower parts of the corallum, connects the species to *Chrysopathes*. The thinness of the pinnules, the infrequent occurrence of secondary pinnules, and the small size of the spines separate this species from the two other species in the genus, *C. speciosa* Opresko (2003), and *C. formosa* Opresko (2003).

Etymology.— From the Latin “gracilis”, in reference to the thinness of the pinnules and subpinnules.

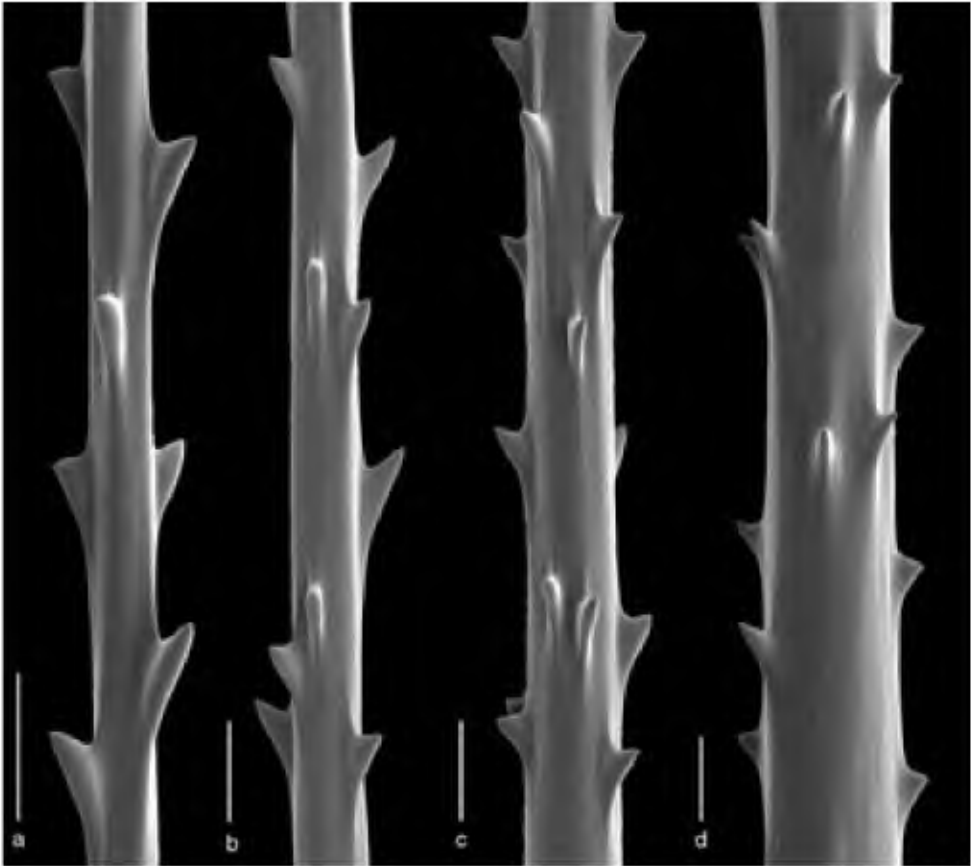


Fig. 15. *Chrysopathes gracilis* spec. nov., holotype (USNM 94490); a-d, spines on pinnules; scale bars, 0.1 mm

Distribution.— The species is known only from the type locality, Fieberling Guyot, in the northeastern Pacific.

### Hexapathinae Opresko, 2003

Diagnosis.— Polyps 3-9 mm in transverse diameter; with an actinopharynx and six complete mesenteries and no secondary mesenteries. Corallum monopodial or very sparsely branched, and pinnulate. Pinnules arranged in two lateral (sometimes anterolateral or posterolateral) rows and in one or more anterior rows. Lateral pinnules simple; anterior pinnules simple or subpinnulated. Spines conical to subcylindrical, subequal or larger on the anterior pinnules and subpinnules.

Remarks.— The Hexapathinae is distinguished from the other subfamilies of the Cladopathidae (Cladopathinae and the Sibopathinae) mainly by the fact that the corallum is usually monopodial, and the anterior pinnules are not regularly arranged relative to the lateral pinnules.

### *Heliopathes* Opresko, 2003 emended

Diagnosis.— Corallum monopodial and pinnulate. Pinnules in two lateral rows and in one or more anterior rows. Lateral pinnules simple; anterior pinnules short, generally not longer than 1 cm, and subpinnulate. Polyyps 5 to 6 mm in transverse diameter.

Remarks.— The genus *Heliopathes* Opresko (2003) was established on the basis of the lateral pinnules extending above the top of the corallum, the spines on the anterior pinnules being larger than those on the lateral pinnules, and the anterior pinnules being very short and extensively subpinnulated. In the new species described below, the spines on the anterior pinnules are similar in size to those on the lateral pinnules, and it has been reported that in some species of *Hexapathes* the lateral pinnules extend above the top of the corallum (Tina Molodtsova, personal communication, 2004). Thus, the only remaining character distinguishing *Heliopathes* from *Hexapathes* is the size and subpinnulation of the anterior pinnules. However, recent observations on the polyyps of *H. pacifica*, spec. nov. indicate that polyyps on the anterior pinnules are morphologically different from those on the lateral pinnules (see discussion below). It remains to be verified whether these specialized polyyps also occur in other species of *Heliopathes* and also in species of the genus *Hexapathes*.

Species assigned to *Heliopathes*.— Included in the genus are *H. americana* Opresko (2003), *H. heterorhodos* Cooper (1909), and *H. pacifica* spec. nov.

#### *Heliopathes pacifica* spec. nov. (figs 16-17)

Material.— Holotype (USNM 1070758), North Pacific, Derickson Seamount, 53°0.999'N, 161°13.676'W, 3563 m, 21.vii.2003, NOAA Cruise, "Jason" II, Dive 93, spec. No. 16, coll. A. Baco-Taylor; paratype (USNM 1070760), North Pacific, Derickson Seamount, 53°6.72'N, 161°17.978'W, 4511 m, 23.vii.2003, NOAA Cruise, "Jason" II, Dive 94, spec. No. 6, coll. A. Baco-Taylor.

Diagnosis.— Corallum monopodial and pinnulate; pinnules arranged in two lateral rows and one or two irregular anterior rows. Lateral pinnules simple, elongate, arranged alternately and inclined and curved distally; anterior pinnules short, less than 1 cm, subpinnulate. Anterior pinnules with one to four secondary pinnules, nearly equal in size to the anterior primary. Secondary pinnules sometimes subpinnulate, with tertiary pinnules occurring on the upper and lower sides. Anterior primary pinnules and subpinnules extending out nearly perpendicular to the plane containing the stem and lateral pinnules. Spines on lateral pinnules small (about 0.06 mm or less), triangular, acute, compressed. Spines on anterior pinnules about the same size as those on the lateral pinnules or only slightly larger, especially on subpinnules. Polyyps on lateral pinnules 4-6 mm in transverse diameter (from distal edge of distal lateral tentacles to the proximal edge of the proximal lateral tentacles). Polyyps on anterior pinnules and subpinnules highly modified, with tentacles reduced or absent.

Description of the holotype.— The holotype (fig. 16a) is about 22 cm high and about 12 cm wide (many of the lateral pinnules are broken), with a basal stem diameter of about 2.5 mm. The unpinnulated portion of the stem is 6 cm in length and the pinnulated portion is about 16 cm. The surface of the stem is smooth for a distance of about 3



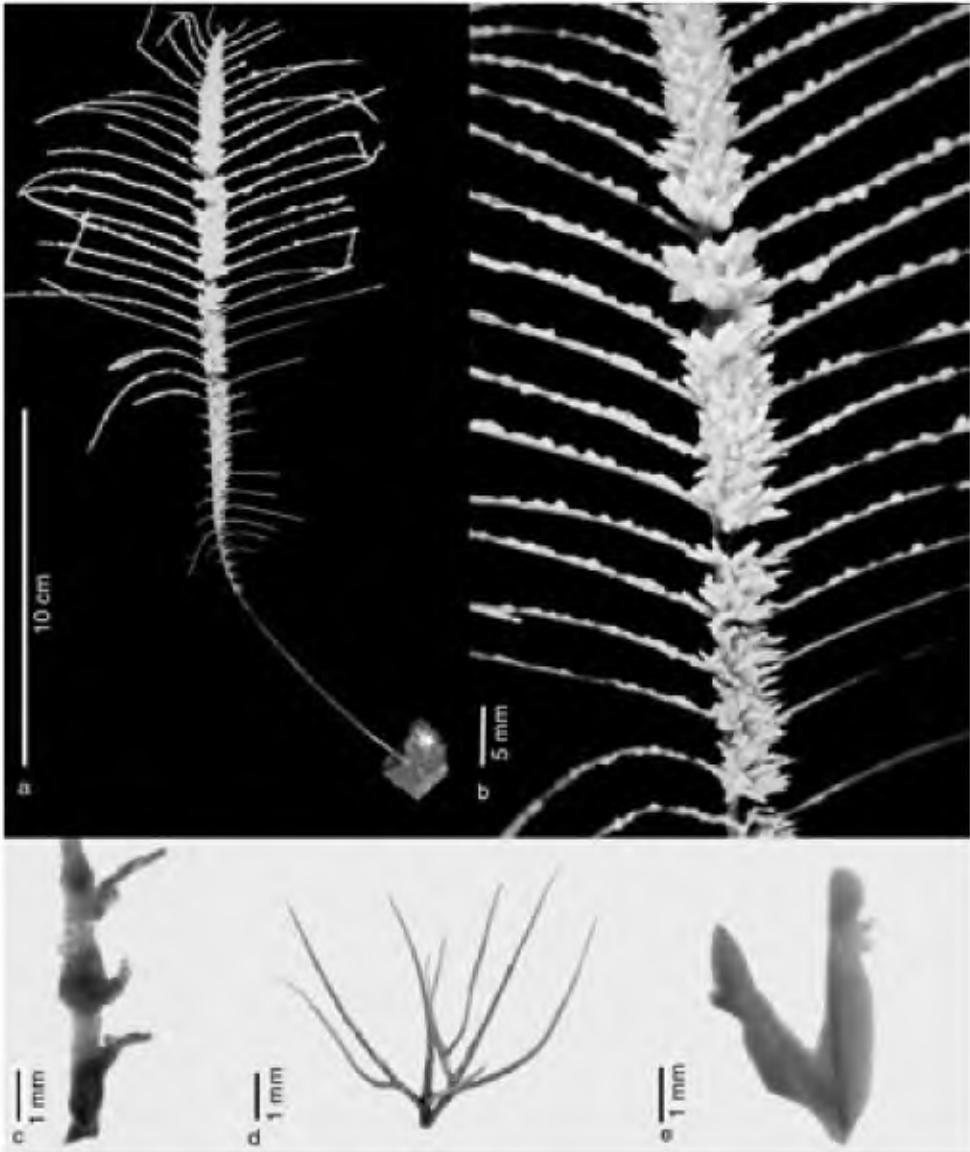


Fig. 16. *Heliopathes pacifica* spec. nov.; a, entire corallum of holotype, (USNM 1070758); b, close-up view of holotype showing anterior pinnules and subpinnules covered with polyps; c, single polyp on lateral pinnule of paratype (USNM 1070760); d, anterior primary pinnule and subpinnules of holotype; e, polyps on anterior pinnule and subpinnule of holotype.

mm above the basal plate; higher up, for a distance of 5.2 cm it is fluted with grooves and ridges (striatum) which extends about 1.5 cm past the start of the pinnulated portion of the corallum.

There are two types of pinnules (fig. 16b), simple, elongate lateral pinnules and

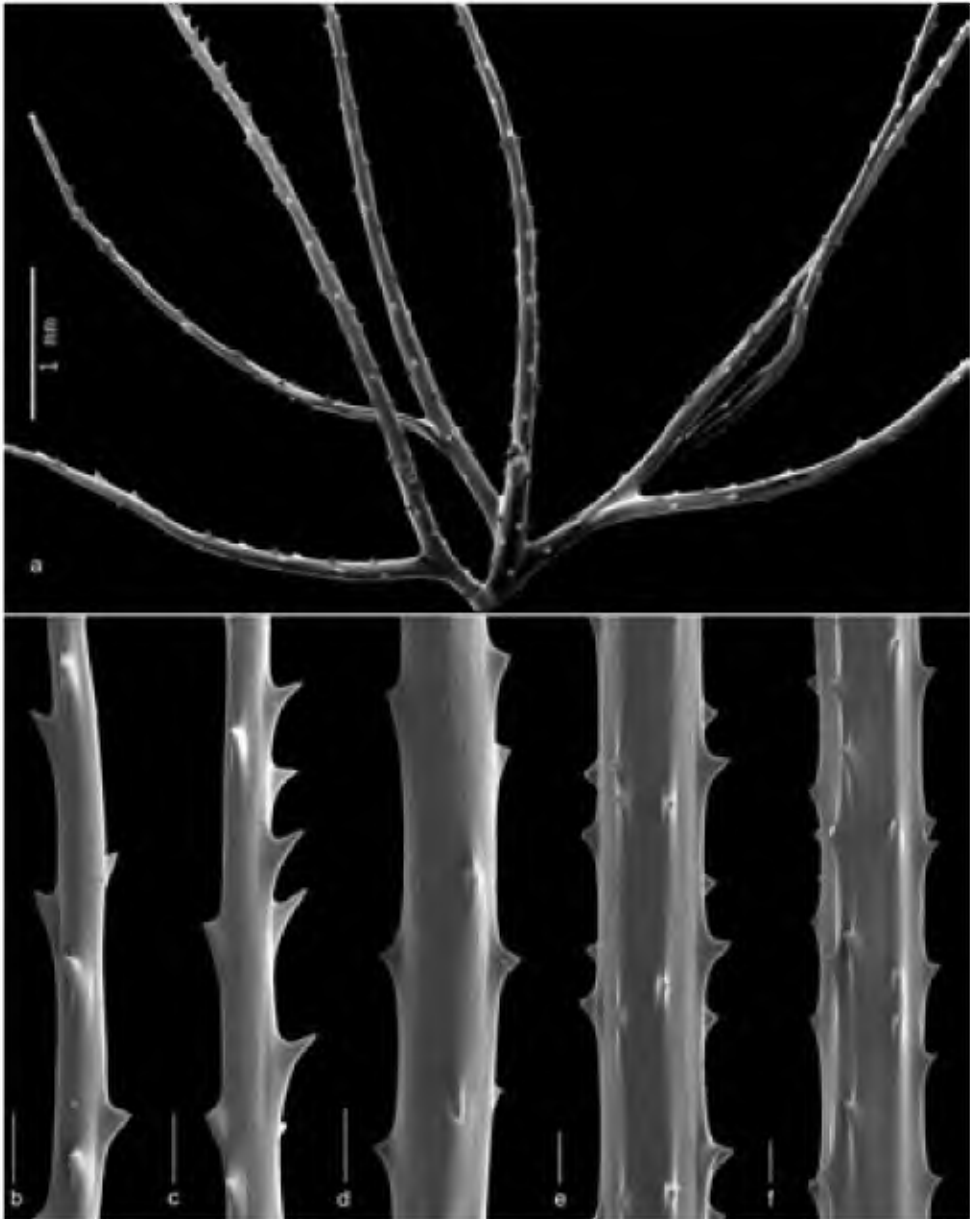


Fig. 17. *Heliopathes pacifica* spec. nov., holotype (USNM 1070758); a, anterior primary pinnule and sub-pinnules; b-c, spines on anterior subpinnules; d, spines on anterior primary pinnule; e-f, spines on lateral pinnule; scale bars in b-f, 0.1 mm.

short, subpinnulated anterior pinnules. The lateral pinnules are arranged alternately such that adjacent pinnules on the same side of the stem are about 5 mm apart, whereas those on opposite sides are 2-2.5 mm apart. This results in about three pinnules per

centimeter on one side, and a total of five per centimeter, counting those on both sides. The lowermost lateral pinnule is on the right side of the stem and is subopposite (about 1 mm) from the next more distal pinnule on the left side. All the lateral pinnules are broken at their tip; the remaining sections are up to 5.5 cm long and about 0.4 mm in diameter near their base. The lower lateral pinnules extend out nearly at right angles to the stem; higher up they are more inclined distally (distal angle about  $45^\circ$  near the top). The interior angle formed by the two planes containing the lateral pinnules is about  $150^\circ$  for the lowermost pairs and close to  $180^\circ$  for the higher ones.

The anterior primary pinnules (figs 16d, 17a) are 6-7 mm in length, up to 0.25 mm in diameter near their base, and they are spaced 1.5 to 2 mm apart in a single irregular row, with eight to ten occurring along 1 cm of axis. They extend out almost at right angles to the stem. The lowermost anterior pinnule is located distal to the point of insertion of the second lowermost lateral pinnule. The anterior pinnules have one or two orders of subpinnules. The number and arrangement of the subpinnules is not strictly regular from pinnule to pinnule. Up to four secondary pinnules occur on some primaries; the two lowermost of which arise 0.4-0.8 mm above the base of the anterior primary and are situated almost opposite one another (about 0.2 mm apart) and on the lateral sides of the primary (relative to the direction of the stem). The two distal secondaries, when present, tend to arise on the upper and lower surface of the primary and are about 0.5 mm apart. The secondary pinnules are curved distally, and some become nearly parallel to the direction of the anterior primary from which they originate. The secondaries reach a length of 5-6 mm and have a basal diameter of about 0.14 mm. Tertiary subpinnules, when present, tend often occur on the upper and/or lower sides of secondary subpinnules. They are also curved distally relative to the secondary pinnule, and are 3-4 mm in length and about 0.1 mm in basal diameter. Thus, the primary, secondary and tertiary pinnules extend out about the same distance away from the stem.

The spines on the lateral pinnules (figs 17e-f) are small, triangular, compressed and nearly at right angles to the axis. They are mostly 0.03 to 0.06 mm tall (from the apex to the center of the base). Four or five rows can be seen in one lateral view. The spacing of the spines within each row is very variable, ranging from 0.07 mm to more than 0.4 mm; however, most commonly they are 0.32-0.37 mm apart, resulting in about four per millimeter. Spines on the anterior primary pinnules (fig. 17d) are similar to those on the lateral primary pinnules. Spines on the subpinnules are in many cases also similar in size and shape to those on the primary pinnules; however, on the distal portions of some subpinnules, the spines (figs 17b-c) are slightly larger (up to 0.07 mm), more acute, and more distally directed than those on the primary pinnules, and with the proximal edge flared out along the axis.

Polyps are present on the holotype. On the lateral pinnules they are from 3.9 to 5.5 mm in transverse diameter, although most are 4.5-5.2 mm. They are arranged in a single row, with two to three polyps per centimeter. On the anterior primary pinnules and subpinnules the polyps appear to be highly modified (fig. 16e). They are elongated and tear-drop in shape with the basal portion usually wider than the distal portion. The mouth is situated not in the middle of the polyp but is offset towards the distal end. In most of the polyps examined no tentacles could be seen; however, in a few cases a sin-

gle pair of tentacles appeared to be appressed against the surface of the polyp near the level of the mouth and extending towards the distal end. It is difficult to say what the normal condition of these polyps was when alive, and to what extent the tissues became degraded after collection. It should also be noted that the interior of these modified polyps seemed to be filled with tissue and droplets of an oily substance which, when released, floated to the surface. One interpretation of these observations is that these polyps are highly modified reproductive zooids and that the oily material is yolk. In other species of *Heliopathes* eggs have been found in remnants of soft tissue associated with the anterior pinnules (see Opresko, 2003). In the specimen described here, eggs were also found in a normally appearing polyp located on the proximal portion of a lateral pinnule.

Remarks.— The paratype (USNM 1070760) is larger than the holotype, about 32 cm in height, and is broken off at both the top and at the basal end of the stem. The remaining unpinnulated part of the stem is 13 cm long, and the pinnulated portion is 19 cm long. The longest lateral pinnules are about 14 cm in length and 0.8 mm in diameter at the basal end (excluding spines). The lateral pinnules are mostly about 9 mm apart (range 6 to 10 mm), and they are generally not more than three lateral pinnules per centimeter (total for both sides of the axis). The anterior pinnule/subpinnule clusters are no more than about 6.5 mm in height and they are spaced 2-2.5 mm apart, resulting in six to eight per centimeter. As in the holotype, the polyps on the lateral pinnules (fig. 16c) are 5-6 mm in transverse diameter, with less than two polyps per centimeter. The polyps on the anterior pinnules and subpinnules are similar to those described for the holotype.

Comparisons.— *Heliopathes pacifica* spec. nov. differs from the two other species assigned to this genus [*H. americana* Opresko (2003) and *H. heterorhodos* Cooper (1909)] in having much smaller spines on the anterior pinnules and subpinnules. In *H. pacifica* these spines are no more than 0.07 mm tall, whereas in the other two species the spines are as much as 0.13 mm tall.

Etymology.— From "Pacific" in reference to the type locality.

Distribution.— Both the holotype and paratype came from the north Pacific.

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## References

- Brook, G., 1889. Report on the Antipatharia.— Rep. Sci. Res. Voy. H.M.S. Challenger, Zool. 32 (80): 1-222, pls 1-15.
- Cooper, C.F., 1909. Antipatharia. Reports of the Percy Sladen Trust Expedition to the Indian Ocean.— Trans. Linn. Soc. London. (Zool. Ser. 2) 12: 301-323.
- Esper, E.J.C., 1788-1830. Die Pflanzenthiere in Abbildungen nach der Natur mit Farben erleuchtet nebst Beschreibungen.— Nürnberg.
- Kinoshita, K., 1910. On a new antipatharian *Hexapathes heterosticha* n. gen. and n. sp.— Annotat. Zool. Japonenses 7: 231-234.
- Opresko, D.M., 2001. A new species of antipatharian coral, *Bathypathes bayeri*, (Cnidaria: Anthozoa: Antipatharia) from the Galapagos Islands. — Bull. Biol. Soc. Wash. 10: 204-209.
- Opresko, D.M., 2002. Revision of the Antipatharia (Cnidaria: Anthozoa). Part II. Schizopathidae.— Zool. Med. Leiden 76: 411-442.
- Opresko, D.M., 2003. Revision of the Antipatharia (Cnidaria: Anthozoa). Part III. Cladopathidae.— Zool. Med. Leiden 77: 495-536.
- Pasternak, F.A., 1958. Die Tiefsee Antipatharien des Kurilen-Kamchatka Grabens.— Trud. Inst. Oceanolog. 27: 180-191.
- Pasternak, F.A., 1976. New data on the composition and distribution of the deep-sea antipatharians (Hexacorallia: Antipatharia) in the Pacific, Indian, and Atlantic oceans.— Trud. Inst. Oceanolog. 99: 45-58.
- Pasternak, F.A., 1977. Antipatharia.— *Galathea* Rept. 14: 157-164.
- Pax, F., 1932. Beiträge zur Kenntnis der Japanischen Dörnchenkorallen.— *Zool. Jahrb. (Syst.)* 63: 407-450.
- Pesch, A.J., van, 1914. The Antipatharia of the Siboga Expedition.— Siboga Expedition Monographie, 17: 1-258, pls 1-8.
- Schultze, L.S., 1903. Die Antipatharien der Deutschen Tiefsee-Exped., 1898-1899.— *Wiss. Ergeb. Deutsch. Tiefsee-Exped., Valdivia Exped.* 3: 89-100, pls 13-14.
- Silberfeld, E., 1909. Diagnosen neuer Japanischer Antipatharien aus der Sammlung von Herrn Prof. Doflein.— *Zool. Anz.*, 34: 760-763.
- Thomson, J., 1905. Report on the Antipatharians, Scotia Collection.— *Proceedings of the Royal Physical Society of Edinburgh* 16(3): 70-79.
- Totton, A.K., 1923. Coelenterata. Part III, Antipatharia (and their Cirripede commensals).— *British Antarctic (Terra Nova) Exped., 1910-1913. Nat. Hist. Rep., Zool.*, 5: 97-120, pls 1-2, figs 1-18.

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