



## New Species of Cirratulidae (Annelida, Polychaeta) from the Caribbean Sea

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### Abstract

Fifteen species in seven genera of Cirratulidae are reported from shallow-water collections in the Caribbean Sea primarily as part of the Caribbean I expedition of the research vessel *Alpha Helix* in 1977 and smaller separate collections from Panama and Venezuela. Thirteen species, all bitentaculates, are new to science. New species include *Aphelochaeta caribbeanensis* n. sp.; six species of *Caulleriella*: *C. angusticrista* n. sp., *C. convexacapa* n. sp., *C. microbidentata* n. sp., *C. parapicula* n. sp., *C. parvinasa* n. sp., and *C. quadrata* n. sp.; *Chaetozone dossena* n. sp.; three species of *Kirkegaardia*: *K. filiformis* n. sp., *K. panamaensis* n. sp., and *K. playita* n. sp.; and two species of *Dodecaceria*: *D. alphahelixae* n. sp. and *D. dibranchiata* n. sp. Additionally, two multitentaculate cirratulids, *Cirriformia* sp. from Panama and *Timarete punctata* (Grube, 1859) from Nicaragua are reported.

**Key words:** *Aphelochaeta*, *Caulleriella*, *Chaetozone*, *Cirriformia*, *Dodecaceria*, *Kirkegaardia*, *Timarete*, new species, Aruba, Belize, Honduras, Nicaragua, Panama, Venezuela

### Introduction

The Cirratulidae is a family of deposit feeding polychaetes that are widespread and often numerically abundant in benthic samples. There are few taxonomic characters so, until recently, this family was poorly known with many species considered to have cosmopolitan distributions and local species were often incorrectly identified. This is certainly the case for the cirratulids of the Caribbean Sea, which are poorly known. In his review of the polychaetes of the Caribbean, Dean (2012) reported 26 species of Cirratulidae; however, the majority of these taxa were identified using names of species known from distant localities (Pacific Ocean, Mediterranean Sea, etc.) and are likely misidentifications. Aguilar-Camacho & Salazar-Vallejo (2011) and Díaz-Díaz *et al.* (2014) recently described new species of *Dodecaceria* and *Caulleriella* from the Caribbean region.

The present study is largely based on shallow-water collections obtained from the Caribbean Sea in the late 1970s as part of the R/V *Alpha Helix* Caribbean 1 (Carib 1) expedition to survey seagrass ecosystems; additional samples from Panama and Venezuela are also included. Benthic samples were collected at sites throughout the Caribbean Sea from Venezuela to Belize. The former Smithsonian Oceanographic Sorting Center (SOSC) sorted the samples to major taxonomic groups, with the cirratulid polychaetes provided to the first author for study. The present study includes 15 species of Cirratulidae, 13 of which are new to science.

The following species are included this study:

*Aphelochaeta caribbeanensis* n. sp.

*Caulleriella angusticrista* n. sp.

*Caulleriella convexacapa* n. sp.

*Caulleriella microbidentata* n. sp.

*Caulleriella parapicula* n. sp.

*Caulleriella parvinasa* n. sp.

*Caulleriella quadrata* n. sp.  
*Chaetozone dossena* n. sp.  
*Kirkegaardia filiformis* n. sp.  
*Kirkegaardia panamaensis* n. sp.  
*Kirkegaardia playita* n. sp.  
*Cirriformia* sp.  
*Timarete punctata* (Grube, 1859)  
*Dodecaceria alphahelixae* n. sp.  
*Dodecaceria dibranchiata* n. sp.

## Materials and methods

**Materials examined as part of this study.** The Carib 1 cruise of the R/V *Alpha Helix* was conducted from 11 June to 18 July 1977 and was focused at collecting sites throughout the Caribbean Sea including Aruba, Belize, Honduras, Nicaragua, Panama, and Venezuela. The coordinates provided with the samples are largely those taken from the location of the moored research vessel. However, the sampling typically occurred away from the R/V *Alpha Helix* by scientists working from small skiffs, often by diving. Therefore, in some locations, the coordinates are not precise relative to where the samples were actually collected. Physical descriptions of actual sampling locations, however, were provided by the SOSC.

Plankton samples were collected with nets having mesh sizes of 60, 200 or 260  $\mu\text{m}$  while benthic samples were collected with either a pipe dredge (PD), a naturalist dredge (ND), a meiobenthic sled (MS) that skimmed the surface and collected sediment to depths of 0 to 50 cm, or a bottom net (BN). Benthic samples were sieved with screens having a 63, 500, 1000, or 2000  $\mu\text{m}$  mesh. Station codes have a base number preceded by the gear type and followed by mesh size if available. For example, MS-12-500 represents a sample collected with the meiobenthic sled at Station 12 and sieved with a 500- $\mu\text{m}$ -mesh screen.

Samples were fixed in buffered formalin with subsequent transfer to 70% ethyl alcohol (ETOH). Samples from the cruise were sorted by the SOSC and cirratulid polychaetes provided to the first author for study. All specimens including holotypes and paratypes are deposited at the National Museum of Natural History, Smithsonian Institution (USNM), Washington, DC.

**Morphological observations.** All specimens were examined and identified using stereomicroscopes and research quality compound microscopes. Photomicrographs were taken with a Nikon D7100 camera mounted on both the stereo- and compound microscopes. Some specimens were stained with a solution of Shirlastain A in water to highlight difficult-to-see surficial morphology. Methyl Green (MG) stain saturated in 70% ETOH was used to elucidate distinct staining patterns evident on some species. Both stains dissipate completely in ETOH. Line drawings were developed in pencil using a drawing tube or *camera lucida* on the compound microscope and later transferred to drawing paper or Mylar and inked.

**Abbreviations used on figures:** anC, anal cirrus; br, branchiae; dCr, dorsal crest; dT, dorsal tentacle; dTh-Ridge, dorsal thoracic ridge; hB, heart body; int, intestine; mo, mouth; neP, neuropodium; noP, notopodium, nuO, nuchal organ; per, peristomium; pig, pigment; pr, prostomium, pyg, pygidium; ten, tentacle; tF, tentacular filament, vGr, ventral groove.

## Systematic Account

### Family Cirratulidae Ryckholt, 1851

**Remarks.** The genera of Cirratulidae are typically divided into three categories: (1) the multitentaculate genera that have multiple sets of tentacular filaments on one or more anterior segments and numerous branchiae along the body including in this study the genera *Cirriformia* and *Timarete*; (2) the bitentaculate sediment dwelling genera that have a pair of dorsal tentacles arising from the posterior margin of the peristomium or dorsally between one or two anterior setigers and branchiae continuing along most of the body including in this study the genera *Aphelochaeta*, *Caulleriella*, *Chaetozone*, and *Kirkegaardia*; and (3) the bitentaculate shell or coral boring species of the genus *Do-*

*decaceria* that have a pair of lateral peristomial tentacles and branchiae limited to a few anterior segments. Details of all cirratulid genera are found in Blake & Magalhães (2019) and an additional genus is included in Blake (2018).

### Genus *Aphelochaeta* Blake, 1991

**Type-species:** *Tharyx monilaris* Hartman, 1960. Original designation by Blake (1991).

**Diagnosis.** (after Blake 2018). Prostomium conical to rounded; peristomium elongate with a pair of grooved dorsal tentacles arising either on or anterior to setiger 1. Anterior segments often expanded, crowded or uncrowded; abdominal segments sometimes beaded or moniliform in appearance; setae simple capillaries lacking distinct serrations using light microscopy but distinct fibrils may be visible using SEM; posterior end frequently expanded, tapering to a simple pygidial lobe.

**Remarks.** The genus *Aphelochaeta* was established by Blake (1991) as part of a revision of the genus *Tharyx*. Bitentaculate cirratulids with non-serrated capillary setae were assigned to the new genus. The absence of setae other than simple capillaries results in species of *Aphelochaeta* being more difficult to identify than those of other bitentaculate genera. In the absence of setal details, systematists are therefore required to use body and segment shape, details of the pre-setiger region, origin of the dorsal tentacles and anterior branchiae, presence or absence of dorsal and ventral grooves and ridges, form of the posterior end, nature of the pygidium, and MG staining patterns to identify individual species. Blake (2018) reviewed a wide range of morphological detail that is available within the genus, but species of *Aphelochaeta* are the most difficult of the bitentaculate cirratulids to identify.

As part of the present study, most specimens identified as *Aphelochaeta* are assigned to a new species, *A. caribbeanensis* n. sp. A few additional specimens of another species were in poor condition and not suitable for further study.

#### *Aphelochaeta caribbeanensis* new species

Figures 1–2

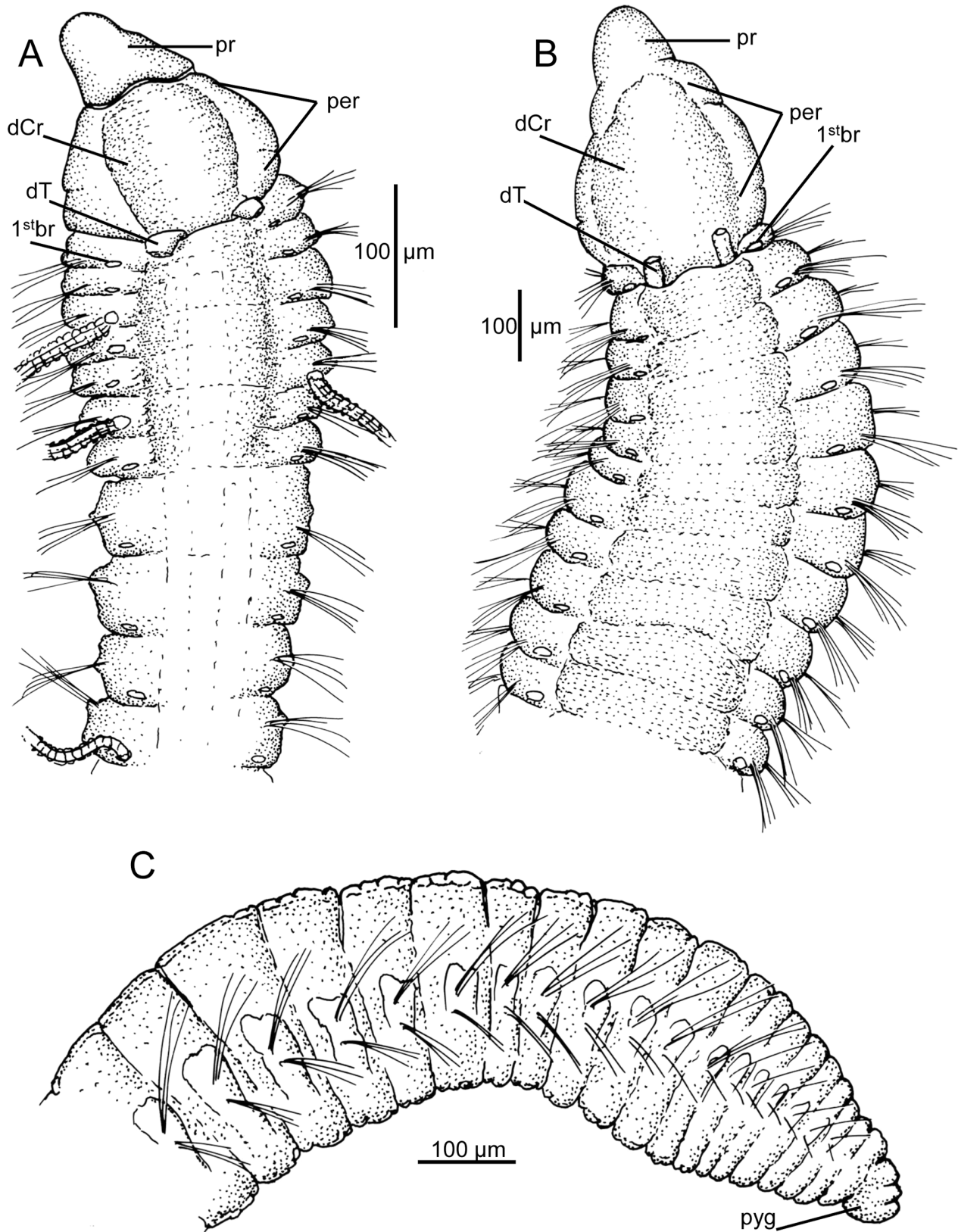
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**Material examined.** Caribbean Sea, Carib 1, R/V *Alpha Helix*, Panama, off Peninsula Valiente, between Crawl Cay and Canal del Tirge, outside Laguna Chiriqui, Sta. ND-30, 09°12.8'N, 82°02.7'W, 08 July 1977, dredged along mangrove bank, 1–2 m, **holotype** (USNM 1557512); Sta. ND-30-500, 2, paratypes (USNM 1557513); **E of Isle de Oro, Bahia Caladonio**, Sta. ND-22-2000, 08°54.7'N, 77°41.0'W, 08 July 1977, dredged in mangrove community, **paratype** USNM 1557514).—**Honduras, Island of Utila**, Sta. MS-47-500, 16°04.5'N, 87°59.2'W, 14 July 1977, meiobenthic sled towed in sand and grass bed 15 m off SW shore of island, 10–20 cm, **paratype** (USNM 1557515).—**Belize, Glovers Reef**, southern end, Sta. MS-53-500, 16°43.8'N, 87°52.0'W, 15 July 1977, meiobenthic sled towed along sandy bottom adjacent to reef crest, 4 m, **paratype** (USNM 1557516).

**Description.** A small species, holotype complete, 3.3 mm long, with segments more or less uniform in width; 0.24 mm wide across anterior and posterior segments; 0.36 mm across middle segments; with 60 setigers. All segments narrow and crowded throughout, wider than long with those of anterior and posterior segments about 5.5 times wider than long (Figs. 1A–C, 2A–C); middle segments somewhat larger, inflated, but not distinctly separated; not moniliform or oval in shape (Fig. 2A–B). Body in cross section with dorsum rounded, elevated over parapodial shoulders; venter flattened throughout, weakly grooved in posterior segments, tapering over last five segments to pygidium. Prominent heart body visible in anterior segments (Fig. 2A). Color in alcohol, light tan, with no pigmentation.

Prostomium conical, broadly rounded on anterior margin separated from peristomium by distinct groove (Figs. 1A–B, 2A); eyespots absent; nuchal organs not observed. Peristomium short, weakly separated into two annular rings with grooves only seen laterally (Fig. 1A–B); dorsum smooth, with rounded dorsal crest beginning posterior to prostomium continuing to setiger 1 (Fig. 1A) or extending slightly on to border of setiger 1 (Fig. 1B and on holotype Fig. 2B); dorsal tentacles arising on posterior border of peristomium, extending partially onto setiger 1 (Fig. 1A–B). First pair of branchiae on setiger 1 dorsal to notosetae; subsequent branchiae in similar location (Fig. 1A–B). Branchiae continuing along most of body.

Parapodia of anterior or thoracic setigers with prominent shoulders (Figs. 1A–B, 2A–B); dorsum elevated along body with parapodia shifted to a more medial position (Fig. 1C). All setae smooth capillaries, some long, but natatory-like capillaries not present. Anterior noto- and neuropodia with fascicles of 10–12 long capillaries, reduced to 7–8 in middle segments and 5–6 in posterior segments.



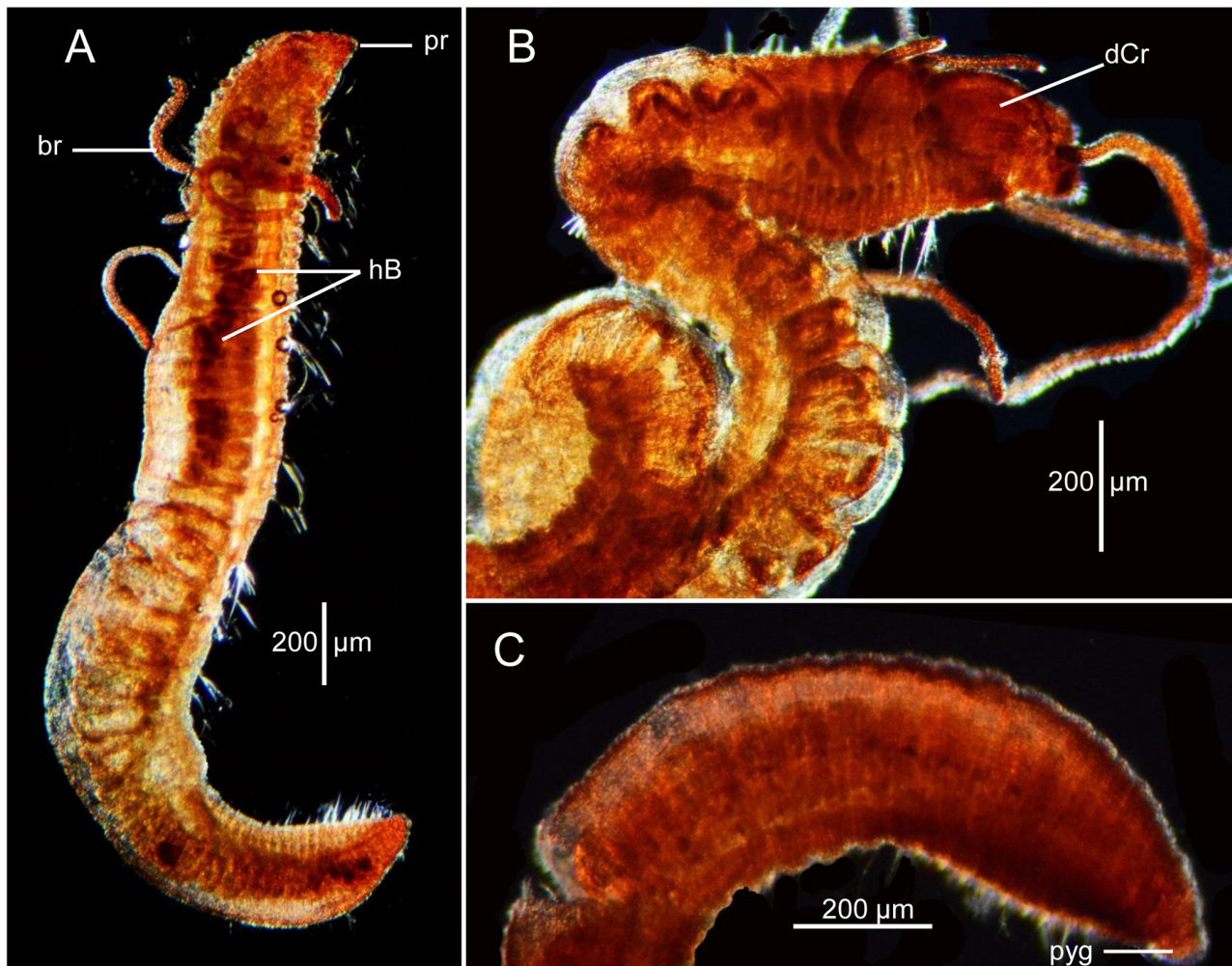
**FIGURE 1.** *Aphelochaeta caribbeanensis* n. sp. Paratypes: A, anterior end, dorsal view (USNM 1557516); B, anterior end, dorsal view (USNM 1557514); C, posterior end, left lateral view (USNM 1557515).

Pygidium a simple terminal lobe ventral to anal opening (Figs. 1C, 2C).

**Methyl Green stain.** No pattern; stain fades rapidly.

**Remarks.** Previous records of *Aphelochaeta* from the Caribbean have been referred to *A. marioni* (Saint-Joseph, 1894) originally described from the Dinard area on the Atlantic coast of France (see Dean 2012 for Caribbean records). Although reported widely, as with many cirratulids, *A. marioni* is poorly known and no type specimens are believed to exist (Blake 1996). Although not based on specimens from the type locality, the description of *A. marioni* by Hartmann-Schröder (1996) from German waters represents the most recent characterization of the species and depicts *A. marioni* as having three prominent peristomial rings that cross the dorsum, dorsal tentacles arising from the level of setiger 1, no dorsal crest, and the first branchiae from setiger 1. Hartmann-Schröder's depiction of *A. marioni* is important because most known species of the genus have a pair of branchiae positioned in close proximity to the dorsal tentacles on the peristomium or have two pairs of branchiae on setiger 1 (Blake 1996, 2018; Doner & Blake 2009; Magalhães & Bailey-Brock 2013; Dean & Blake 2016). With no branchiae on the peristomium or second pair on setiger 1, *Aphelochaeta caribbeanensis* n. sp. is thus more similar to Hartmann-Schröder's concept of *A. marioni* than most other described species. Two recently described species that also lack a pair of branchiae associated with the dorsal tentacles are *A. malefica* Elías & Rivero, 2009 from Argentina and *A. intinctoria* Choi, Juneg & Moon, 2018 from Korea.

The specimens of *A. caribbeanensis* n. sp. from Panama and Honduras described here differ from Hartmann-Schröder's (1996) depiction of *A. marioni* in having only one or two weakly developed lateral peristomial rings where the grooves do not cross the dorsum of the peristomium and in having rather than lacking a prominent dorsal crest. It is likely that previous records of *A. marioni* from the Caribbean are the same as *A. caribbeanensis* n. sp.



**FIGURE 2.** *Aphelochaeta caribbeanensis* n. sp. Holotype (USNM 1557512): A, entire worm, dorsal view. Paratype (USNM 1555125); B, anterior end and middle body segments, dorsal view; C, posterior end, left lateral view. Specimen stained with Shirlastain A.

*Aphelochaeta malefica* differs from *A. caribbeanensis* **n. sp.** in having an elongate pre-setiger region twice as long as wide and three prominent peristomial rings the first of which crosses the dorsum and the second and third of which are interrupted by a narrow dorsal crest that extends posteriorly between the parapodia of setiger 1 (Eliás & Rivero 2009). In contrast, the peristomium of *A. caribbeanensis* **n. sp.** is short, as long as wide, or only slightly longer than wide. In addition, there are only 1–2 peristomial rings apparent only laterally and a large, oval-shaped dorsal crest surmounts the entire peristomium.

*Aphelochaeta intinctoria* from Korean waters is similar to *A. caribbeanensis* **n. sp.** in having weakly developed lateral peristomial rings and the peristomium surmounted by a dorsal crest (Choi *et al.* 2018). *A. intinctoria* differs from *A. caribbeanensis* **n. sp.** in having an elongate pre-setiger region that is twice as long as wide instead of as long as wide or only slightly longer and by having three lateral peristomial rings instead of one or two. More importantly, the anterior body segments of *A. intinctoria* are elongate, inflated, not crowded and the middle and posterior body segments are moniliform in shape. In contrast, most body segments of *A. caribbeanensis* **n. sp.** are narrow and crowded throughout with only a few middle segments enlarged; no segments are moniliform.

**Etymology.** The species is named for its location in the Caribbean Sea.

**Distribution.** Honduras to Panama, in sediments associated with mangrove and seagrass; intertidal to 5 m.

## Genus *Caulleriella* Chamberlin, 1919

**Type Species** *Cirratulus viridis* Langerhans, 1881, original designation by Chamberlin (1919).

**Diagnosis.** Prostomium elongate to short, apex rounded to pointed; peristomium elongate to short, dorsal tentacles beginning anterior to setiger 1 or more posteriorly on posterior extension of peristomium. Middle body segments not beaded; parapodia with noto- and neuropodia widely separated from one another. Modified setae including bidentate, crotchet-like hooks not arranged into modified cinctures.

**Remarks.** Blake (2018) partially revised the genus *Caulleriella* by removing several previously described species to other genera, redescribed or commented on previously known species, and described six new species, bringing the total number of known species to 38. Of the known species of *Caulleriella*, only *C. petersenae* Díaz-Díaz, Cardenas-Oliva & Linero-Arana, 2014 from the Caribbean Sea off Venezuela is endemic to the region. Other species reported from the Caribbean Sea include taxa originally reported from northern Europe or the eastern Pacific (Dean 2012) and these are considered questionable by Díaz-Díaz & Salazar-Vallejo (2009). In the present study, six new species were discovered among the Carib 1 collections and are here described. A key to all endemic *Caulleriella* species from the Caribbean Sea is presented. With these six new species, the total number of known species of *Caulleriella* is increased to 44.

## Key to Species of *Caulleriella* from the Caribbean Sea

- 1A. Neuropodial hooks from setiger 1; all hooks bidentate, with prominent main fang and distinct apical tooth. . . . . 3
- 1B. Neuropodial hooks from setiger 6–15; notopodial hooks unidentate; neuropodial hooks bidentate . . . . . 2
- 2A. Neuropodial hooks from setiger 6, each with two minute, forwardly projecting teeth; notopodial hooks from setiger 6, all unidentate; peristomium with 3 annular rings surmounted by prominent dorsal crest carrying dorsal tentacles posteriorly onto setiger 2 . . . . . *Caulleriella microbidentata* **n. sp.**
- 2B. Neuropodial hooks from setiger 15, each bidentate, with small apical tooth above main fang; notopodial hooks from setiger 22–23, each unidentate; peristomium with 4 annular rings surmounted by low, inconspicuous dorsal crest, extending partially onto setiger 1, with dorsal tentacles inserted at anterior margin of setiger 1 . . . . . *Caulleriella quadrata* **n. sp.**
- 3A. Peristomium with dorsal crest, with 2 or 3 annular rings. . . . . 4
- 3B. Peristomium without dorsal crest, with 3 or 4 annular rings . . . . . 5
- 4A. Notopodial bidentate hooks from setiger 9–13; dorsal tentacles arising from posterior margin of peristomium, medial to level of setiger 1; peristomium with two annular rings and large, oval medial dorsal crest; prostomium with small, weakly pigmented nuchal organs . . . . . *Caulleriella convexacapa* **n. sp.**
- 4B. Notopodial bidentate hooks from setiger 17–19; dorsal tentacles arising from posterior margin of peristomium or on setiger 1; peristomium with four annular rings and large, elevated dorsal crest; prostomium with darkly pigmented oval-shaped nuchal organs . . . . . *Caulleriella parapicula* **n. sp.**
- 4C. Notopodial bidentate hooks from setiger 28; dorsal tentacles arising on peristomium anterior to setiger 1; peristomium with three annular rings and elongate, narrow dorsal crest; prostomium with prominent pigmented nuchal organs . . . . .

- ..... *Caulleriella parvinasa* **n. sp.**  
 5A. Pre-setiger region short, slightly wider than long; nuchal organs small, oval, weakly pigmented; notopodial hooks from setiger 16 ..... *Caulleriella angusticrista* **n. sp.**  
 5B. Pre-setiger region elongate, narrow, about twice as long as wide; nuchal organs large, semi-circular, pigmented; notopodial hooks from setigers 17–26 ..... *Caulleriella petersenae*

### *Caulleriella angusticrista* new species

Figure 3

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**Material examined.** Caribbean Sea, Carib 1, R/V *Alpha Helix*, Panama, Playita Point, San Blas Peninsula, Sta. ND-24-1000, 09°32.8'N, 78°59.5'W, 30 June 1977, subtidal, dredged at a depth of 5 m, along edge of mangrove, **holotype** (USNM 1557499).

**Description.** Holotype complete, 3.5 mm long for 65 setigers, 0.25 mm wide across thorax. Anterior or thoracic region with 15 narrow, crowded setigers, with elevated notopodial tori. Thoracic segments rectangular in cross section with thickened notopodial ridge at superior corners and low neuropodial ridge at inferior corners. Middle body segments not as wide as those of thorax, notopodia not elevated dorsally and segments longer, depressed, oval in cross section; parapodial lobes forming low ridges. Color in alcohol pale tan.

Pre-setiger region short, slightly wider than long (Fig. 3A–B). Prostomium conical, narrowing to rounded apex; small, weakly pigmented nuchal organs located dorsolaterally, but dorsally visible beneath first peristomial annulation; eyespots absent; peristomium wider than long, with three annulations; (Fig 3A–B); mid-dorsal posterior margin of peristomium extending as narrow ridge to anterior border of setiger 2 (Fig. 3A). Dorsum of thorax flattened, with narrow mid-dorsal crest extending from posterior peristomial ridge (Fig. 3A). Dorsal tentacles on setiger 1, lateral to peristomial ridge and medial to first pair of branchiae; branchiae dorsal to notosetae on edge of swollen notopodial lobe (Fig. 3A–B); subsequent branchiae similarly positioned relative to notosetae.

Notosetae include 4–8 capillaries for first 15 setigers, single bidentate hook accompanied by three capillaries from setiger 16; subsequent notopodia with 1–3 hooks accompanied by 1–3 capillaries or, occasionally, capillaries absent. Neurosetae include single bidentate hook and two accompanying capillaries in setiger 1, subsequent thoracic setigers with 1–3 hooks and 1–3 accompanying capillaries, last thoracic neuropodia with only three hooks; abdominal neuropodia with 2–5 (usually 5) bidentate hooks, capillaries absent. Hooks with curved shaft; narrow apical tooth above larger main fang, hood absent (Fig. 3C). Last four body segments asetigerous, pygidium rounded with no cirri, anus dorsal.

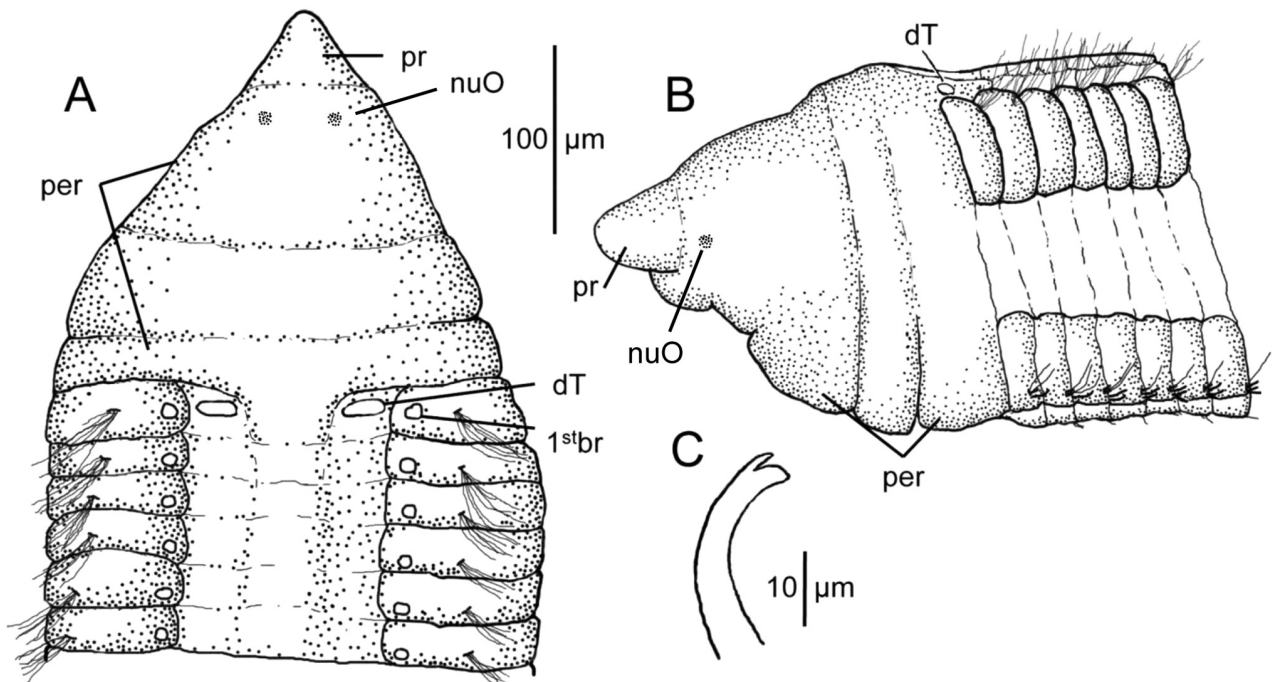
**Methyl Green stain.** Body stains a uniform dark blue with the thorax somewhat more intensely stained; pygidium and prostomium do not stain.

**Remarks.** *Caulleriella angusticrista* **n. sp.** is similar to *C. magnaoculata* Hartmann-Schröder, 1962 from shallow water off Peru in having pigmented nuchal organs that can be mistaken for eyespots, dorsal tentacles that arise between the parapodia of setiger 1, and the first branchiae present lateral to the dorsal tentacles and dorsal to the notosetae on setiger 1. The holotype of *C. magnaoculata* was redescribed by Blake (2018), who pointed out that the large eyespots reported by Hartmann-Schröder (1962) were actually pigmented nuchal organs. The two species differ in that, unlike *C. angusticrista* **n. sp.**, there is a prominent peristomial dorsal crest on *C. magnaoculata* that extends from the middle of the peristomium posteriorly and carries the dorsal tentacles to a position at the level of setiger 1; however, *C. magnaoculata* does not have a dorsal ridge on the anterior segments as in *C. angusticrista* **n. sp.** In addition, the bidentate hooks of *C. magnaoculata* begin on setiger 10 in the neuropodia and setiger 37 in the notopodia; in contrast, the hooks of *C. angusticrista* **n. sp.** begin on setiger 1 in the neuropodia and setiger 16 in the notopodia. The far posterior segments of the holotype of *C. magnaoculata* are regenerating and notosetae are entirely absent, thus making a comparison of the posterior segments with *C. angusticrista* **n. sp.** and other species not feasible.

*Caulleriella angusticrista* **n. sp.** is also similar to *C. cristata* Blake, 1996 from central California in having neuropodial bidentate hooks from setiger 1, a triannulate peristomium, dorsal tentacles shifted posterior to setiger 1, and the first branchiae lateral to the dorsal tentacles. In *C. cristata*, the neuropodia have 7–8 hooks but no capillaries and there is a prominent dorsal crest over the entire three annuli of the peristomium. In contrast, *C. angusticrista* **n. sp.** has 1–5 hooks and a few capillaries at least in the anterior segments and there is no dorsal crest on the peristomium.

**Etymology.** The name is derived from the Latin *angustus*, for narrow and *crista* for crest and emphasizes the narrow longitudinal ridge on the dorsum of the anterior thorax.

**Distribution.** Known only from Panama, from shallow subtidal sediments of mangroves in Playita Point, San Blas Peninsula.



**FIGURE 3.** *Caulleriella angusticrista* n. sp. Holotype (USNM 1557499): A, anterior end, dorsal view; B, anterior view, lateral view; C, neuropodial acicular spine from posterior setiger.

### *Caulleriella convexacapa* new species

Figure 4

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**Material examined.** Caribbean Sea, Honduras, Isla de Utila, Carib 1, R/V *Alpha Helix*, Sta. MS-47-500, 16°4.5'N, 87°59.2'W, 14 July 1977, intertidal, meiobenthic sled, depth 10–20 cm, sand and grass bed 15 m off southwestern shore of island **holotype** (USNM 1557500) and 1 **paratype** (USNM 1557502).—Panama, Carib 1, R/V *Alpha Helix*, Sta. ND-31-500, 09°12.8'N, 82°02.8'W, 08 July 1977, subtidal, dredged, depth 4 m, in sand and grass around Deer Island, off Peninsula Valiente, between Crawl Cay and Canal de Tigre, outside Laguna Chiriqui, **paratype** (USNM 1557501); Sta. 23-333-149, 09°34.6'N, 78°43.2'W, 30 June 1977, bottom plankton sample, 15 m from mangrove shore, Caobos Cay, in Hollandes Cays group between Mayflower Channel and Caribbean Sea, 0–4 m, **paratype** (USNM 1557503).—Panama 69 Project, off Colón, Sta. 69-26, 09°24.4'N, 79°52'W, 24 May 1969, 0–3 m, 1 specimen (USNM 1557504).

**Description.** Holotype complete, 2.0 mm long for 51 setigers, thorax 0.2 mm wide; paratypes 1.9–3.9 mm long for 39–68 setigers, thoracic width 0.2–0.3 mm. Anterior or thoracic segments narrow, crowded, numbering 16 setigers in holotype, 12–19 setigers in paratypes; notopodia and neuropodia widely separated. Notopodia of thoracic segments extending slightly above dorsum. Color in alcohol pale tan.

Pre-setiger region about as long as wide (Fig. 4A–B). Prostomium conical, rounded on anterior margin, eyespots absent, with a pair of faint pigmented nuchal organs on posterior lateral margin also visible dorsally on peristomium. Peristomium as long as wide, biannulate with first annulation longest; with large dome-shaped dorsal crest extending posteriorly to mid-dorsal surface of setiger 2 (Fig. 4A–B). Dorsal tentacles arise at posterior border of peristomium on either side of dorsal crest. First pair of branchiae lateral to dorsal tentacles on setiger 1, dorsal to notosetae (Fig. 4A–B), following branchiae in same location; individual branchia long and thin.

Anterior notosetae simple capillaries with 2–3 setae per fascicle. First notopodial bidentate hooks from setiger

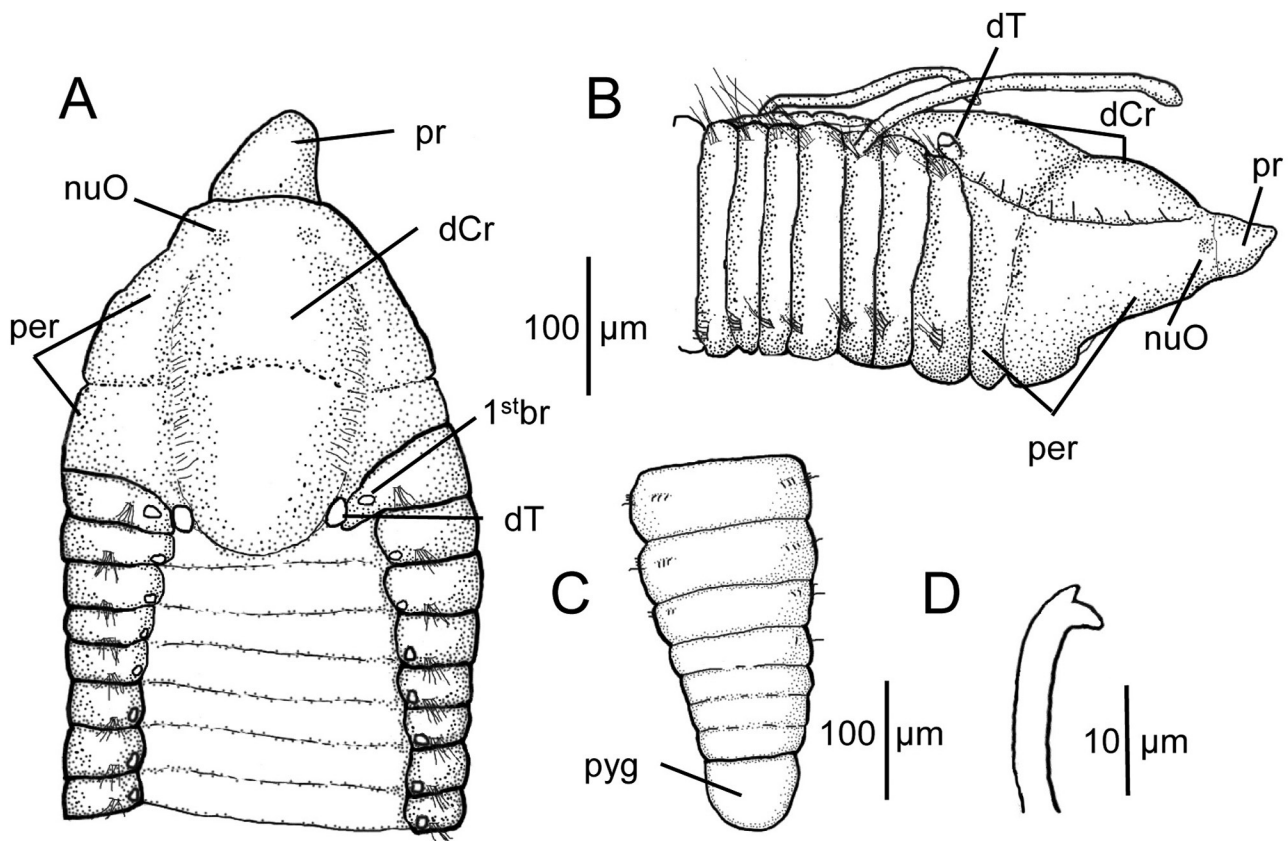


12 in holotype, 9–13 in paratypes; hooks accompanied by capillaries. Three to five hooks in mid-body accompanied by a single capillary (occasionally 2), grading to 4–7 hooks without accompanying capillaries in posterior region. Five to eight bidentate hooks present in all neuropodia from setiger 1; neuropodial hooks occasionally accompanied by a single capillary (2 in one setiger). Bidentate hooks with a small apical tooth above the main fang (Fig. 4D); hood absent.

Pygidium a simple rounded lobe (Fig. 4C).

**Methyl Green stain.** No pattern. Body stains uniformly green except prostomium and far posterior segments; pygidium not staining.

**Remarks.** *Caulleriella convexacapa* n. sp. is similar to *C. mediterranea* Lezzi, 2017 from the Italian coast of the Mediterranean in that both species have neuropodial hooks from setiger 1 and a similar range for the start of notopodial hooks. Both species also have a biannulate peristomium and dorsal tentacles that arise on the posterior peristomium lateral to the first branchiae on setiger 1. *C. convexacapa* n. sp., however, has a large dorsal peristomial crest that extends posteriorly onto setigers 1–2; no dorsal crest is reported for *C. mediterranea*. In addition, the bidentate hooks of *C. mediterranea* have a crest or hood on the convex side of the shaft; there is no crest or hood present on the bidentate hooks of *C. convexacapa* n. sp.



**FIGURE 4.** *Caulleriella convexacapa* n. sp. Holotype (USNM 1557500): A, anterior end, dorsal view; B, anterior end, right lateral view; C, posterior end, dorsal view; D, neuropodial acicular spine from posterior setiger.

*Caulleriella convexacapa* n. sp. is also similar to *C. suroestense* Blake, 2018 from the Juan Fernandez Islands off the Chilean coast in having a biannulate peristomium with a dorsal crest and the first branchiae arising dorsal to the notosetae on setiger 1 but capillaries are present in posterior notopodia in *C. suroestense* and absent in *C. convexacapa* n. sp. In addition, the notopodial hooks begin on setigers 27–28 in *C. suroestense* and on setiger 12 (9–13) in *C. convexacapa* n. sp. Furthermore, the apical tooth of the bidentate hooks of *C. suroestense* is closely applied to the shaft instead of the more typical erect apical tooth as in *C. convexacapa* n. sp.

**Etymology.** The epithet is from the Latin *convexus* for protuberant and *caput* for head, in reference to the rounded elevated dorsal crest on the peristomium that continues over the dorsal surface between the first two setigers.

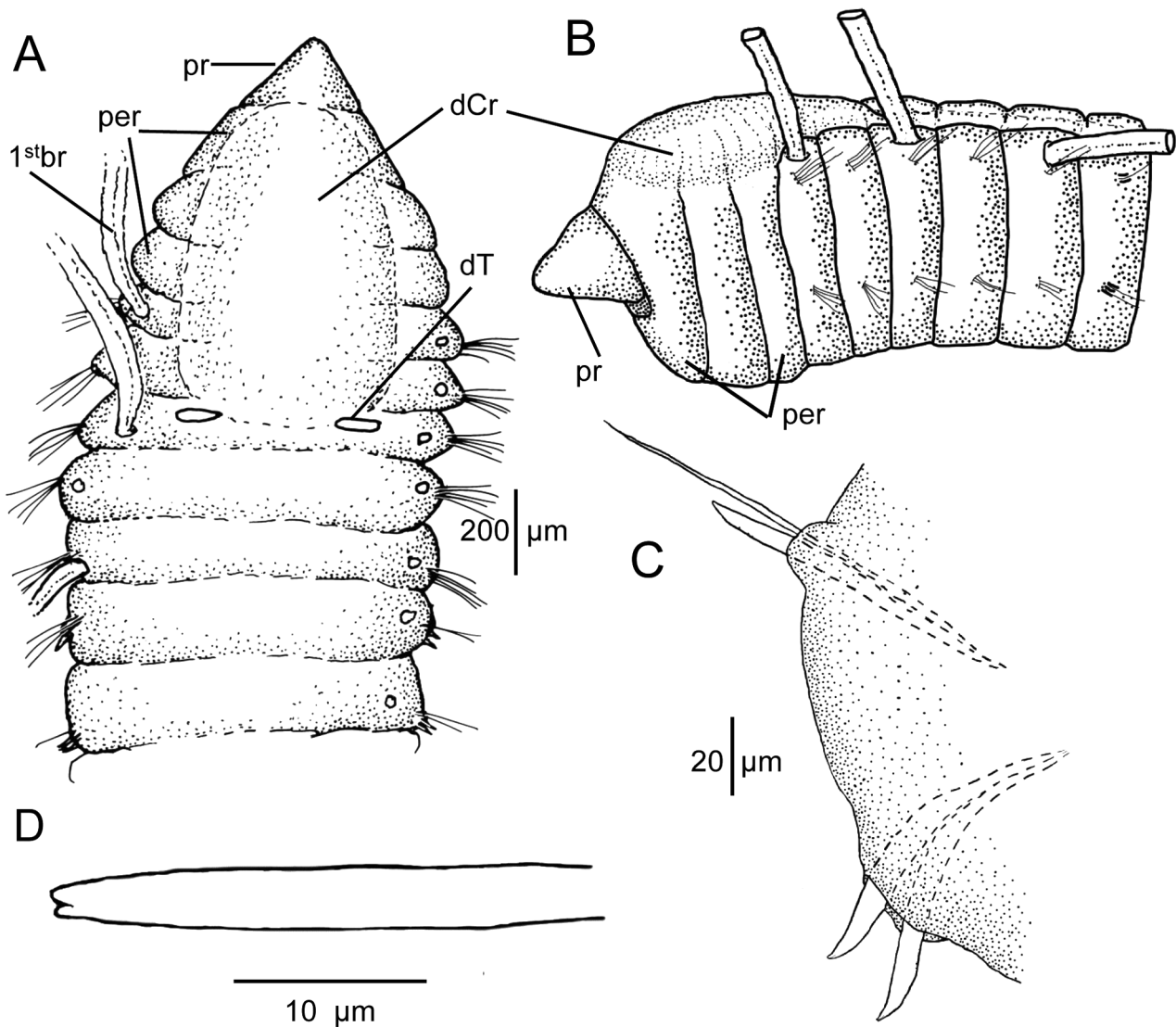
**Distribution.** Honduras, from shallow (10–20 cm) sand and seagrass beds off Isla de Utila.

*Caulleriella microbidentata* new species

Figure 5

urn:lsid:zoobank.org:act:FAAE394B-3B19-4F66-94A2-4EB95DF30BF3

**Material examined.** Caribbean Sea, Carib 1, R/V *Alpha Helix*, Honduras, off mouth of channel to Laguna de Caratasca, north west of Barra Kruta, Sta. ND-41-500, 15°43.2'N, 83°21.6'W, 12 July 1977, subtidal, dredged through grass bed on north bank of channel 1000 m from mouth; depth 10–50 cm, **holotype** (USNM 1557505).—**Aruba, off Oranjestad** in shallow lagoon off west coast of Aruba immediately south of ship channel, Sta. MS-18-500, 12°30.3'N, 70°2.7'W, 26 June 1977, epibenthic sled through grass bed just inside barrier island on west side of lagoon, depth 20 cm, 2 **paratypes** (USNM 1557506).



**FIGURE 5.** *Caulleriella microbidentata* n. sp. Holotype (USNM 1557505): A, anterior end, dorsal view; B, anterior end, lateral view; C, posterior parapodia, anterior view; D, neuropodial weakly bidentate spine from posterior setiger.

**Description.** Holotype complete, 3.6 mm long for 50 setigers with a maximum width of 0.2 mm; one paratype (USNM 1557506) 2.8 mm long for 54 setigers, 0.2 mm maximum width; second paratype (USNM 1557506) 3.3 mm long for 43 setigers (pygidium absent), width 0.2 mm. Holotype with narrow body, thoracic region slightly dorsoventrally depressed, remainder of body dorsoventrally flattened. Pre-setiger region slightly wider than long (Fig. 5A–B). Thorax with 12 setigers, segments narrow, approximately seven times as wide as long. Post-thoracic setigers longer, 1.5 times as wide as long. Last 12 posterior setigers narrowing, approximately twice as wide as long. Color in alcohol light tan.

Prostomium triangular, narrowing to rounded apex; eyespots and nuchal organs not observed; broad mid-dorsal

crest extending from prostomium across peristomium and onto setiger 3 (Fig. 5A–B). Peristomium with three subequal annular rings, not crossing dorsal crest, best observed laterally; dorsal tentacles arising from dorsal surface of setiger 3 due to posterior extension of dorsal crest (Fig. 5A). First pair of branchiae arising dorsal to notosetae of setiger 1 and in a similar position on subsequent setigers (Fig. 5A–B). Notopodia and neuropodia conical lobes with setae emerging distally, widely separated from each other, thoracic podial lobes with a weak triangular pre-setal lobe.

Notosetae of setigers 2–5 all capillaries; one acicular hook from setiger 6, subsequent notopodia with 1–2 hooks, hooks accompanied by a single capillary (this capillary occasionally absent); neurosetae of first five setigers 3–4 capillaries; three hooks from setiger 6, accompanied by two capillaries, subsequent neuropodia with 2–3 hooks usually accompanied by single capillary (Fig. 5C). Notopodial hooks unidentate; neuropodial hooks with tips divided into two minute, forward-projecting teeth (Fig. 5D), bidentate nature difficult to observe at all angles, usually visible only laterally; ventral tooth may be worn giving the appearance of a minute irregularly tipped spine.

No asetigerous segments anterior to the pygidium; pygidium conical, anus ventral.

**Methyl Green stain.** No pattern; body stains uniformly with the prostomium and pygidium unstained.

**Remarks.** *Caulleriella microbidentata* **n. sp.** is unusual in that the dorsal tentacles emerge from setiger 3, carried posteriorly by the dorsal crest over the dorsum of anterior setigers. This arrangement is similar to that of *C. cabbsi* Pocklington & Coates, 2010 in which the dorsal crest extends to setiger 2. The two species differ in that *C. cabbsi* has four peristomial annulations while *C. microbidentata* **n. sp.** has only three and the first branchiae occur on setiger 2 in *C. cabbsi* and on setiger 1 in *C. microbidentata* **n. sp.** Additionally, the notopodial hooks first occur on setiger 15–16 and the neuropodial hooks on setiger 10 in *C. cabbsi* while they both occur on setiger 6 in *C. microbidentata* **n. sp.** The unusual, weakly bidentate hooks of *C. microbidentata* **n. sp.** are distinct from the clearly bidentate hooks of other species of *Caulleriella*. They are similar in many respects to those seen in some species of *Tharyx* Webster & Benedict, 1887. These two genera, however, may be differentiated by the position of the notopodia and neuropodia: species of *Caulleriella* have widely spaced noto- and neuropodial setal fascicles (Fig. 5B) while in *Tharyx* the setal fascicles arise close to one another. The hooks of *C. microbidentata* **n. sp.** could possibly be misconstrued as simple unidentate spines as seen in species of the genus *Chaetozone* but they do not form the distinctive cinctures characteristic of *Chaetozone* (Blake 2015, 2018).

**Etymology.** The name is from the Greek, *mikros* for small and *bidentate*, for two teeth. The species name refers to the very small bidentate teeth on the neuropodial hooks.

**Distribution.** Honduras, subtidally off the mouth of the channel to Laguna de Caratasca.

### *Caulleriella parapicula* new species

Figure 6

urn:lsid:zoobank.org:act:6E1489DF-475A-4EC0-9D4D-D00D9B2BFB84

**Material examined.** Caribbean Sea, Carib 1, R/V *Alpha Helix*, Panama, Golfo De San Blas, Playita Point, Sta. ND-26, 09°32.8'N, 78°59.5'W, 30 June 1977, dredged across seagrass in sand and coral rubble, 30–50 cm, **holotype** (USNM 1557507).

**Description.** A small species, holotype incomplete, 2.7 mm long, 0.3 mm wide across anterior segments, with 46 setigers. All segments crowded, noto- and neuropodia widely separated along entire body. Body weakly divided into an anterior or thoracic region of about 15 narrow segments six times wider than long; posterior segments about three times wider than long. Anterior segments with prominent mid-dorsal ridge, more or less following peristomial crest (Fig. 6A), middle and posterior segments rounded dorsally, but not as a crest. Prominent ventral groove present, best developed in middle body where neurosetae on either edge project into groove; ventral groove more shallow posteriorly. Color in alcohol light tan.

Pre-setiger region large, about as long as thoracic region, slightly longer than wide. Prostomium narrow, elongate, tapering to rounded apex; with large oval-shaped nuchal organs, pigmented internally, resembling eyespots (Fig. 6A). Peristomium with four annular rings of equal width, observed laterally, not crossing elevated and broadly rounded fleshy dorsal crest (Fig. 6A). Dorsal tentacles arise from posterior margin of dorsal crest at level of setiger 1. First branchiae on setiger 1 dorsal to notosetae and lateral to dorsal tentacles; subsequent branchiae in same position; branchiae long, thin, either intact or present as stubs or scars along most of body.

Parapodia of 15–17 anterior or thoracic segments with fleshy and swollen noto- and neuropodia from which se-

tae emerge producing small shoulders on either side of dorsum (Fig. 6A); subsequent segments with less prominent podia. Notopodia initially with 5–7 capillaries; bidentate hooks first present from setigers 17–19, with 1–2 hooks at first, increasing to 3–4 hooks along rest of body, accompanied by 1–2 thin capillaries. Neurosetae from setiger 1 with bidentate hooks in a vertical row numbering 9–10 at first, reduced to about seven posteriorly; not accompanied by capillaries. Individual hooks recurved, weakly geniculate, tapering to pointed fang surmounted by shorter, closely adhering apical tooth (Fig. 6B); dorsal crest or hood not evident on shaft.

Pygidium unknown.

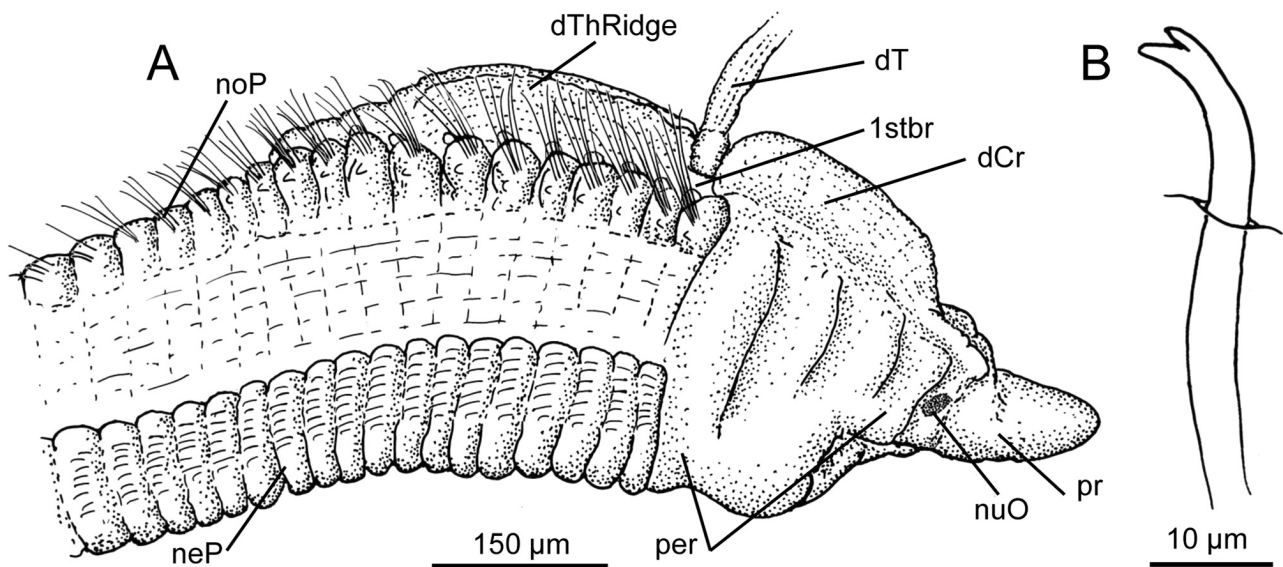
**Methyl Green stain.** No pattern, de-stains rapidly along entire body.

**Remarks.** *Caulleriella parapicula* n. sp. is most similar to *C. apicula* Blake, 1996 from Southern California in shallow shelf depths. Both species have an elongated prostomium with large oval-shaped nuchal organs, a distinctive high dorsal peristomial crest, dorsal tentacles that are shifted posteriorly to the level of setiger 1, a ventral groove along the body into which the neuropodial hooks protrude, and similar bidentate hooks, each with a closely adhering apical tooth. The two species differ in that *C. parapicula* n. sp. has a prostomium that tapers to a rounded tip and has a pair of pigmented nuchal organs, whereas in *C. apicula* the prostomium narrows to a pointed tip and has a pair of distinct eyespots in addition to non-pigmented nuchal organs. Additionally, *C. parapicula* n. sp. has a mid-dorsal crest on anterior setigers that more or less is a continuation of the peristomial crest, four lateral peristomial annular rings, and notopodial hooks that begin on setigers 17–19; in contrast, *C. apicula* has no dorsal ridge on anterior segments, no peristomial annular rings, and the notopodial hooks begin on setigers 80–86.

*Caulleriella parapicula* n. sp. exhibits some similarity to *C. convexacapa* n. sp. described above in having a relatively large, broad dorsal crest that carries the dorsal tentacles on to setiger 1 and an elongated prostomium with a rounded apex. However, the peristomium of *C. convexacapa* n. sp. has only two annular rings that cross the dorsal crest and instead of four annular rings that do not cross the dorsal crest but are limited laterally; additionally, the anterior segments of *C. convexacapa* n. sp. have a smooth, elevated dorsum with individual segments demarcated by distinct segmental grooves instead of a high raised mid-dorsal ridge as in *C. parapicula* n. sp. Furthermore, the nuchal organs, while weakly pigmented, are small and inconspicuous in *C. convexacapa* n. sp. instead of large and conspicuous and the dorsal bidentate hooks begin on setigers 9–13 instead of 17–19.

**Etymology.** The epithet is from the Latin, *par*, for equal to or near and *apiculus* for pointed, and refers to the similarity of the new Caribbean species with *Caulleriella apicula* from California.

**Distribution.** Panama, shallow subtidal, in seagrass and sand.



**FIGURE 6.** *Caulleriella parapicula* n. sp. Holotype (USNM 1557507): A, anterior end, right lateral view; B, neuropodial hook from an anterior setiger.

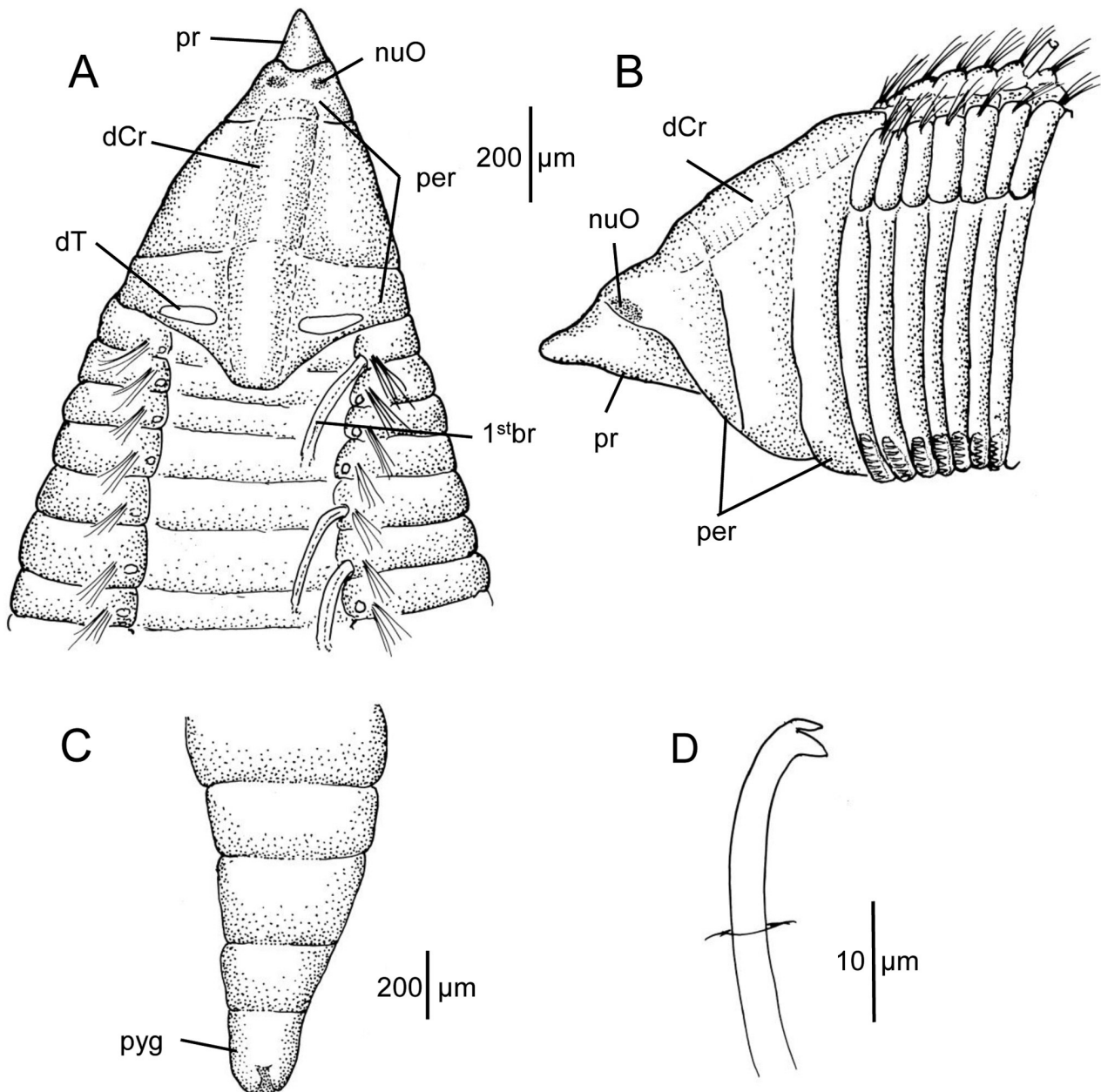
### *Caulleriella parvinasa* new species

Figure 7

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**Material examined.** Caribbean Sea, Carib 1, R/V *Alpha Helix*, Honduras, Cayo Aspero, Isla de Utila, Sta. MS-48-500, 16°04.8'N, 87°00.2'W, 14 July 1977, intertidal, meiobenthic sled, depth 1–10 cm in algae and sand and along a sandy beach interface on leeward side, **holotype** (USNM 1557508).

**Description.** A small species, holotype complete, 3.7 mm long and 0.5 mm wide across thorax for 56 setigers. Anterior or thoracic region wide with crowded segments and notopodial tori elevated over dorsum for 35 setigers. Body rectangular in cross section with thickened notopodial ridge at superior corners and low neuropodial ridge at inferior corners. Neuropodia extending below venter in thoracic region forming a wide, flat groove on each segment for 35 thoracic setigers. Abdominal region a depressed oval in cross-section, parapodial lobes forming low ridges. Color in alcohol pale tan.



**FIGURE 7.** *Caulleriella parvinasa* n. sp. Holotype (USNM 1557508): A, anterior end, dorsal view; B, anterior end, ventral view; C, posterior end, dorsal view; D, neuropodial acicular spine from posterior setiger.

Pre-setiger region triangular, widest posteriorly, about as wide as long at border with setiger 1 (Fig. 7A). Prostomium short, conical, pointed apically, with large, diffusely pigmented nuchal organs located dorsolaterally, but also visible dorsally (Fig. 7A–B). Peristomium large, with three annular rings, second ring longest, widening posteriorly (Fig. 7A–B), third ring extending over setiger 1 and onto dorsum of setiger 2; narrow mid-dorsal crest extending

along most of peristomium including posterior extension over setigers 1–2. Dorsal tentacles visible as wide flattened scars at posterior margin of peristomium anterior to setiger 1 (Fig. 7B). First pair of branchiae on setiger 1, dorsal to notosetae; subsequent branchiae similarly positioned relative to notosetae; branchiae long and thin.

Notosetae include 2–5 capillaries for first 27 setigers, bidentate hooks, accompanied by capillaries, from setiger 28, subsequent setigers with 2–5 hooks accompanied by 1–2 capillaries or, occasionally, capillaries lacking. Setiger 1 with six bidentate neuropodial hooks and single accompanying capillary; hooks increasing to 4–8 in subsequent setigers, sometimes accompanied with a capillary. Hooks with small apical tooth above main fang, crest or hood absent (Fig 7D).

Last three body segments asetigerous, pygidium an elongate rounded cone with groove separating two lobes, anus dorsal (Fig. 7D).

**Methyl Green stain.** No pattern; the body stains a uniform dark blue with exception of the unstained prostomium and pygidium.

**Remarks.** Species with a similar first occurrence of the notopodial and neuropodial hooks and the emergence of the first branchiae on setiger 1 include *Caulleriella cristata* from central California, *C. dulcensis* Dean & Blake, 2007 from Costa Rica, and *C. lajolla* Blake, 1996 from southern California. The first occurrence of the neuropodial hooks is setiger 1 in all species; the first occurrence of notopodial hooks is setiger 28 in *C. parvinasa* n. sp., setiger 14–30 in *C. cristata*, setiger 23 in *C. dulcensis*, and setiger 25–26 in *C. lajolla*. However, all of the previously described species have dorsal tentacles emerging from above setiger 1 or 2 rather than the posterior margin of the peristomium as in *C. parvinasa* n. sp. Additionally *C. dulcensis* and *C. lajolla* lack the dorsal peristomial crest that is present in *C. parvinasa* n. sp. and *C. cristata* lacks accessory capillaries in all neuropodia while they are present in some anterior setigers in *C. parvinasa* n. sp.

**Etymology.** This species name is from the Latin *parvus* for little or less and *nasus* for nose, in reference to the small, conical prostomium.

**Distribution.** Honduras, known only intertidally from a sandy beach in Cayo Aspero, Isla de Utila; occurs in shallow (1–10 cm deep in the sediment) sand and algae.

### *Caulleriella quadrata* new species

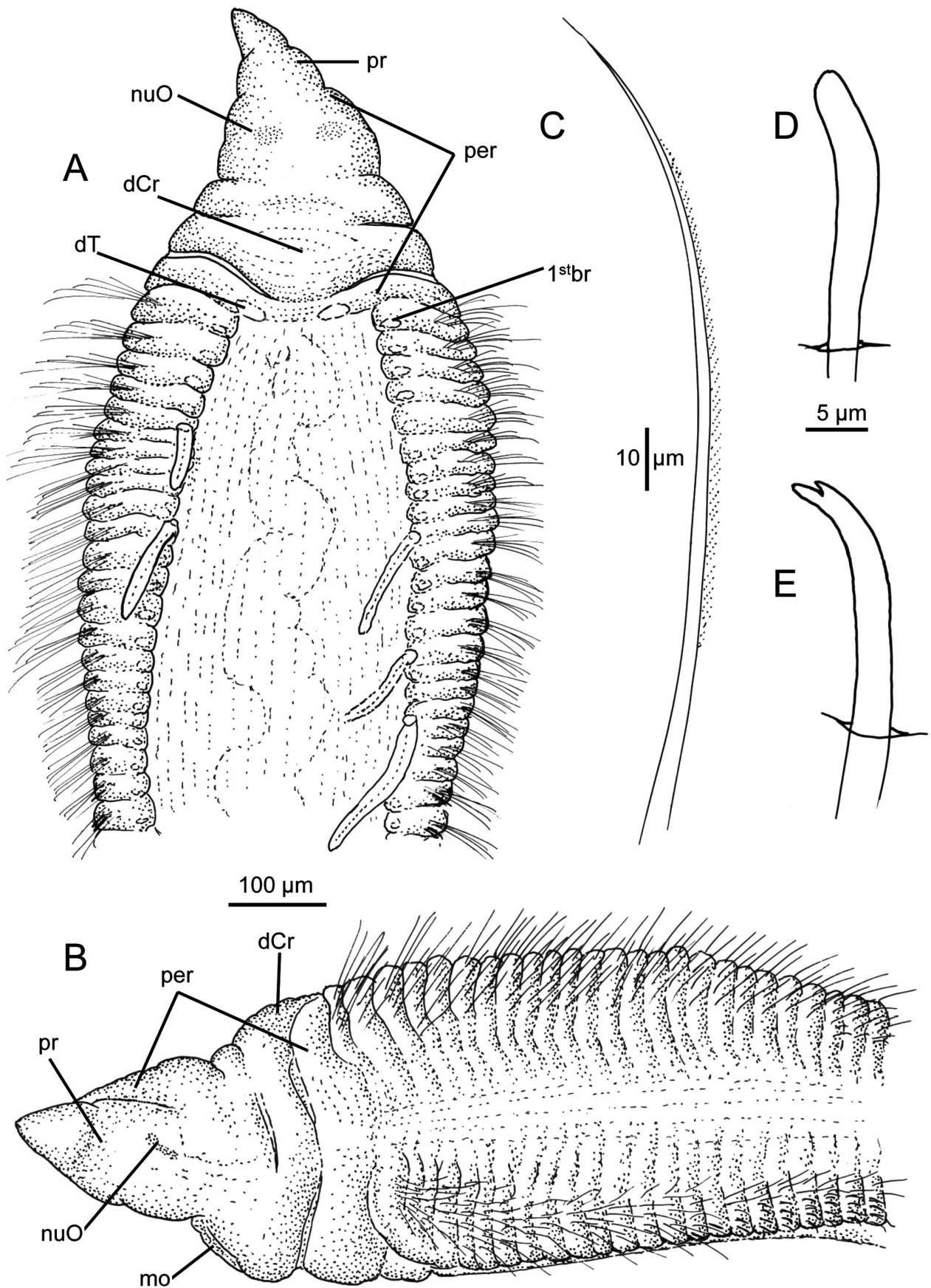
Figure 8

urn:lsid:zoobank.org:act:7248A681-6D0A-4FA2-B28A-A5DC5AC6AF94

**Material examined.** Caribbean Sea, Carib 1, R/V *Alpha Helix*, Panama, Playita Point, south of tip of San Blas Peninsula, Sta. ND-24-1000, 9°32.8'N, 78°59.5'W, 30 June 1977, dredged across sand, grass and rubble at beach, 5 m, **holotype** (USNM 1557509).

**Description.** Holotype incomplete, 2.0 mm long, 0.4 mm wide across anterior setigers, 0.3 across available posterior setigers; with 50 setigerous segments. Body robust, thick and wide anteriorly, tapering posteriorly. Segments rectangular in cross section with noto- and neuropodia located at each of four corners on each segment with lateral longitudinal grooves separating noto- and neuropodia and deep ventral groove separating neuropodia; grooves continuing along entire body. Dorsum weakly rounded, slightly elevated above notopodia across anterior setigers; narrow mid-dorsal groove in middle segments. Color in alcohol opaque white.

Pre-setiger region elongate, triangular, slightly longer than wide. Prostomium triangular, tapering to pointed apex (Fig. 8A); nuchal organs pigmented, oval when seen on posterior lateral margin (Fig. 8B) and when observed dorsally (Fig. 8A), may be mistaken for eyespots. Peristomium with four peristomial rings, variously developed, best seen dorsally (Fig. 8A); first three rings not extending across dorsum; posterior-most ring narrow, nearly continuous across dorsum, possibly an achaetous segment, although branchial scars absent (Fig. 8A–B). Low dorsal crest over second and third rings, best seen in lateral view (Fig. 8B). Peristomium extending weakly over dorsum of setiger 1 (Fig. 8B). Dorsal tentacles on posterior margin of last peristomial ring. First pair of branchiae on setiger 1, dorsal to notosetae; subsequent branchiae in similar position, present for about 40 setigers (Fig 8A).



**FIGURE 8.** *Caulleriella quadrata* n. sp. Holotype (USNM 1557509): A, anterior end, dorsal view; B, anterior end, left lateral view; C, capillary from anterior notopodia; D, posterior notopodial hook; E, posterior neuropodial hook.

Parapodia narrow and crowded along entire body (Fig. 8A–B); individual noto- and neuropodia narrow but swollen, with narrow ridge from which setae arise. Notosetae all capillaries in anterior setigers, 8–10 per fascicle, with thin fringe of fibrils along one edge (Fig. 8C); notopodial hooks from setiger 22–23, numbering 1–2 at first, up to three in posterior segments; hooks accompanied by 2–3 capillaries; notopodial hooks unidentate, with shaft curving to bluntly rounded tip (Fig. 8D). Neuropodia with 4–5 capillaries anteriorly; bidentate hooks from setiger 15; hooks numbering 2–3 at first, increasing to 5–6 in middle segments, then 4–5 in posterior segments; hooks accompanied by 4–5 capillaries initially, then reduced to 2–3 in middle segments and 1–2 posteriorly. Neuropodial hooks with curved shaft tapering to pointed main fang surmounted by closely adhering apical tooth (Fig. 8E).

Far posterior segments and pygidium unknown.

**Methyl Green stain.** No pattern, MG de-stains rapidly.

**Remarks.** *Caulleriella quadrata* n. sp. is distinctive when viewed superficially because the widely separated noto- and neuropodia result in a prominent lateral groove that extends on both sides along the entire body. In addition, there is a deep ventral channel that, in combination with the lateral channels, produces a body that is rectangular in cross-section with the parapodia at the four corners of the rectangle. The species also has distinctive thick unidentate notopodial hooks that have a rounded, blunt tip. No other American species of *Caulleriella* has unidentate notopodial hooks in combination with bidentate neuropodial hooks. Two Antarctic species, *C. antarcticae* Hartman, 1978 and *C. kacysae* Blake, 2018, have unidentate notopodial hooks, but these are deep-water species with long thread-like bodies that lack lateral and ventral grooves, and the notopodial hooks are slender, not thick.

**Etymology.** The epithet is from the Latin, *quadratus*, for four-cornered or square, referring to the widely separated noto- and neuropodia, that in cross-section appear at each of four corners of individual segments.

**Distribution.** Panama, shallow subtidal, 5 m, in sand, grass and rubble.

## Genus *Chaetozone* Malmgren, 1867

**Type species:** *Chaetozone setosa* Malmgren, 1867 by monotypy.

**Diagnosis.** (after Blake 2018). Prostomium blunt to conical; peristomium elongate to short, usually lacking eyespots, with a pair of small nuchal slits or depressions at posterior edge; with a single pair of grooved dorsal tentacles arising from posterior edge of peristomium, or sometimes more posterior on an asetigerous anterior segment, or rarely on an anterior setiger. First pair of branchiae arising from an asetigerous segment or first setiger, sometimes with first two pairs of branchiae on a single anterior segment. Body usually expanded anteriorly and narrowed posteriorly, rarely with middle or posterior body segments beaded or moniliform; posterior end often expanded. Setae include capillaries on most setigers and sigmoid acicular spines in neuropodia and notopodia, with spines typically concentrated in posterior segments; setae forming weakly developed to distinct cinctures with unidentate spines carried on elevated membranes, cinctures with few to many spines sometimes encircling entire posterior end, accompanied with zero to many alternating capillaries; bidentate spines sometimes accompanying unidentate spines in cinctures in juveniles or occasionally in ventral-most position of far posterior setigers of adults; some species with long, natatory-like capillary notosetae. Pygidium a simple lobe, disk-like, or with long terminal cirrus.

**Remarks.** *Chaetozone* is the largest genus of Cirratulidae with 54 species (Blake 2018). According to Dean (2012) only two species, *C. atlantica* McIntosh, 1885 and *C. setosa* Malmgren, 1867 have been reported from Caribbean waters. *Chaetozone setosa* is the type-species of the genus and, although it has been reported globally, is now considered to be limited to the Arctic (Blake 2015). The records of *C. setosa* from Colombia by Dueñas (1999) and Báez & Ardilla (2003) therefore most certainly represent a different species.

The holotype of *C. atlantica*, described by McIntosh (1885) from 713–860 m off St. Thomas, Virgin Islands, is in the British Museum of Natural History (BNH ZK 1885 121.277) and was examined by the first author (JAB). The specimen is incomplete and in poor condition. All setae are capillaries and the species cannot be confirmed as *Chaetozone* and likely belongs to *Aphelochaeta*.

In the present study, a single species, *C. dossena* n. sp. from shallow water in the Bahía de Mochima, Venezuela, has been discovered. Damaged specimens of a second species were also found but are not described here due to their poor condition.



### *Chaetozone dossena* new species

Figures 9–10

urn:lsid:zoobank.org:act:7A2D3EB1-6998-4BF3-99C2-C8E9268E53EF

**Material examined.** Caribbean Sea, Venezuela, Bahía de Mochima, off Cumaná, Sucre State, 22 June 1971, coll. Rex Edwards, low water, 6–10 m in calcareous mud, **holotype** (USNM 49932).

**Description.** Holotype complete with about 95 setigers, posterior segments twisted, 10.5 mm long, 0.65 mm wide across anterior segments, 0.8 mm across largest middle body segments, narrowing in far posterior segments. Anterior 30 segments narrow, dorsoventrally flattened, about 8–10 times wider than long, with dorsum smooth, rounded; venter with distinct groove from about setiger 10–12 continuing through posterior segments; ventral groove narrowing, developing mid-ventral ridge or row of mounds at mid-point where left and right sides of parapodia merge. Anterior parapodia with well-developed lateral shoulders below elevated and rounded dorsum (Figs. 9A; 10A). Middle body segments narrower, then becoming larger, more rounded than anterior setigers, but with individual segments still narrow, about 6–8 times wider than long. Color in alcohol light tan, with few weak pigment speckles on ventral lip of mouth and mid-ventral surface of first setiger (Fig. 9B). A distinctive dorsal blood vessel and heart body apparent in anterior setigers (Fig. 10A).

Pre-setiger region short, about as wide as long (Figs. 9A–B; 10A). Prostomium elongate, triangular, tapering to narrow, rounded, slightly pointed tip (Fig. 9A); eyespots absent; nuchal organs inconspicuous narrow lateral slits. Peristomium with two rings, first short dorsally (Fig. 9A), ventrally larger, forming upper lip of mouth (Fig. 9B); second ring large, inflated, producing rounded dorsal crest (Fig. 9A), ventrally forming lower lip of mouth (Fig. 9B). Dorsal tentacles widely separated, arising from posterior margin of peristomium (Fig. 9A). First pair of branchiae arising from anterior margin of setiger 1, lateral and posterior to dorsal tentacles; second pair of branchiae on posterior margin of setiger 1, dorsal to notosetae (Fig. 9A), thus with two pairs of branchiae on setiger 1.

Anterior setigers with long, basally thickened capillaries numbering 10–12 in both noto- and neuropodia. Notopodial acicular spines first present from setiger 26–27, numbering 1–2 at first, increasing to 3–4 in middle body segments with number of capillaries decreasing to a number equivalent to spines. Neuroacicular spines from setiger 17, replacing several unusually broad, flattened capillaries (Fig. 9D); spines numbering 1–2 initially (Fig. 10B), then increasing to 3–4 in middle body segments (Fig. 10C), accompanied by an equal number of thin capillaries. In posterior setigers, parapodia becoming elevated, forming full cinctured segments with long spines and companion capillaries (Figs. 9C; 10D). Cinctures with spines of left and right sides not merging dorsally, leaving gap with low mid-dorsal groove (Fig. 9C). Cinctured spines numbering 7–9 in notopodia and 6–8 in neuropodia, thus with 13–17 spines on each side. Spines of anterior noto- and neuropodia short, thickened, barely emerging from podial lobes (Figs. 9E–F; 10B–C); posterior spines in cinctured segments long, curved, tapering to rounded tip (Figs. 9G, 10D).

Pygidial segment with anal opening surrounded by three short dorsal cirri and two somewhat longer ventral cirri (Fig. 9C).

**Methyl Green stain.** No stain retained.

**Remarks.** *Chaetozone dossena* n. sp. is a distinctive species. The short pre-setiger region with the bulbous and expanded peristomium with a dorsal crest together with the long, tapering prostomium is unique within known species of the genus. In addition, the short, thick, noto- and neuropodial acicular spines transition to long sigmoid spines in the posterior cinctures. The unusually large capillaries with broad, flattened blades in anterior noto- and neuropodia are also distinct. The first pair of branchiae are interpreted as arising from the anterior edge of setiger 1 resulting in two pairs of branchiae on the first setiger.

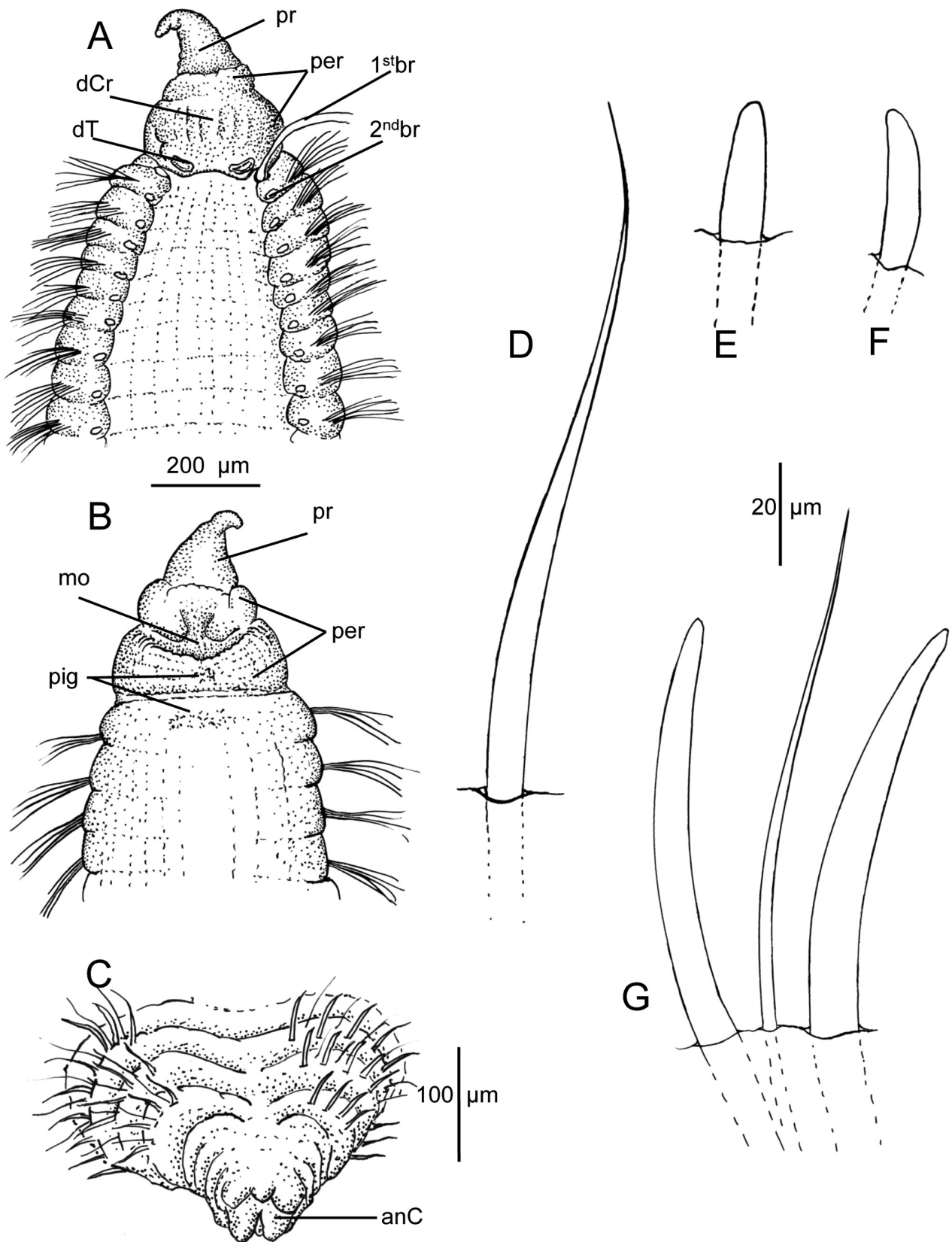
**Etymology.** The epithet, *dossena*, is from the Latin *dossenus* for clown or jester, and refers to the pre-setiger region of this worm, which resembles the hat of a jester.

**Distribution.** Venezuela, known only from shallow subtidal sediments in the Bahía de Mochima.

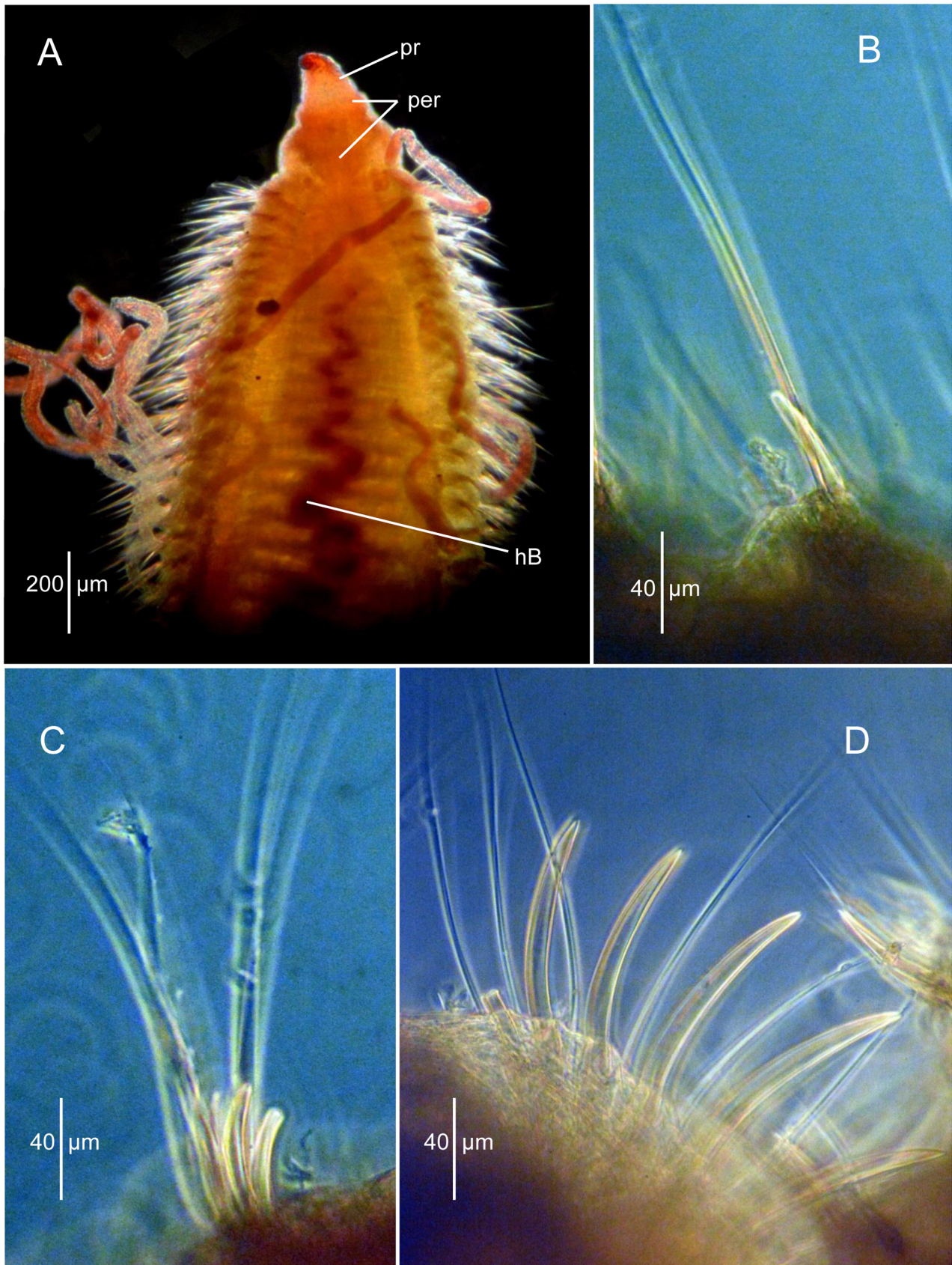
### Genus *Kirkegaardia* Blake, 2016

**Type species:** *Monticellina heterochaeta* Laubier, 1961, designated by Blake (2016).

**Synonym:** *Monticellina* Laubier, 1961. Junior homonym of *Monticellina* Westblad, 1953. *Fide* Blake (2016).



**FIGURE 9.** *Chaetozone dossena* n. sp. Holotype (USNM 49932): A, anterior end, dorsal view; B, anterior end, ventral view; C, posterior end, posterior view; D, neuropodial capillary seta from setiger 15; E–F, neuropodial acicular spines from setigers 17 and 18; G, notopodial acicular spines and capillary from posterior cinctured segment.



**FIGURE 10.** *Chaetozone dossena* n. sp. Holotype (USNM 49932): A, anterior end, dorsal view; B, neuropodial acicular spine and capillaries from setiger 18; C, neuropodial acicular spines and capillaries from about setiger 25; D, notopodial acicular spines and capillaries from posterior cinctured segment. A, Stained with Shirlastain A.

**Diagnosis.** (after Blake 2016). Bitentaculate cirratulids with distinct body regions and all setae distally pointed. Pre-setigerous area typically elongate, cylindrical, with short, blunt prostomium and long peristomium with zero to many weakly developed annulations; dorsal tentacles arising on posterior margin of peristomium, anterior to setiger 1. Thoracic notopodia often shifted dorsally, elevated, producing distinct dorsal groove along thoracic region; other species with thoracic parapodia more lateral, leaving broad elevated dorsum; parapodia of middle and posterior region lateral. Middle body segments longer than wide, frequently bead-like; posterior segments wider than long, somewhat crowded, with posterior most segments usually expanded or enlarged. Setae include simple capillaries with fibrils observed under SEM and denticulated capillaries with distinct denticles present along one edge of seta; denticles visible at 400–1000x; blades usually basally expanded.

**Remarks.** Blake (2016) established *Kirkegaardia* to replace *Monticellina* Laubier, which was preoccupied in the Rhabdozoa. He also reviewed and redescribed all known species and described 16 new species. At present, 38 species are assigned to *Kirkegaardia* (Blake & Magalhães 2019).

In the present study, three new species of *Kirkegaardia* have been identified in the Carib 1 collections. These newly described species increase the total known species of *Kirkegaardia* to 41.

### *Kirkegaardia filiformis* new species

Figure 11

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**Material examined.** Caribbean Sea, Carib 1, R/V *Alpha Helix*, Aruba, western coast, 500 m off Oranjestad, Sta. ND-16-500, 12°30.3'N, 70°02.7'W, 26 June 1977, dredged, 30 m, **holotype** (USNM 1557524).—Belize, near mouth of channel to Southern Lagoon, Sta. PD-69-500, 17°13.2'N, 88°16.5'W, 17 July 1977, subtidal, pipe dredge from anchored vessel, depth 25 m, 8 **paratypes** (USNM 1557525).

**Description.** Holotype incomplete with about 40 setigers, 6.7 mm long, 0.36 mm wide across setiger 6; largest paratype (USNM 1557525) complete with 38 setigers, 6.2 mm long, 0.2 mm across thorax. Thoracic region ten setigers long in holotype, fewer in paratypes; segments about four times as wide as long in anterior segments with weakly developed parapodial shoulders only slightly elevated, dorsal surface weakly convex with narrow dorsal ridge over first four setigers (Fig. 11A). Middle body segments approximately as long as wide, not moniliform, with parapodial lobes greatly reduced and setae emerging directly from body wall. Body round in cross section throughout. Color in alcohol white.

Pre-setiger region twice as long as wide (Fig. 11A). Prostomium triangular, tip rounded, eyespots absent; nuchal organs lateral bulges on holotype, not observed on paratypes. Triannulate peristomium 1.4 times as long as wide, similar in width to anterior setigers; dorsal crest present (Fig. 11A). Dorsal tentacles at posterior margin of peristomium; first pair of branchiae arise dorsal to notosetae on setiger 1 (Fig 11A), branchiae similarly located in subsequent setigers.

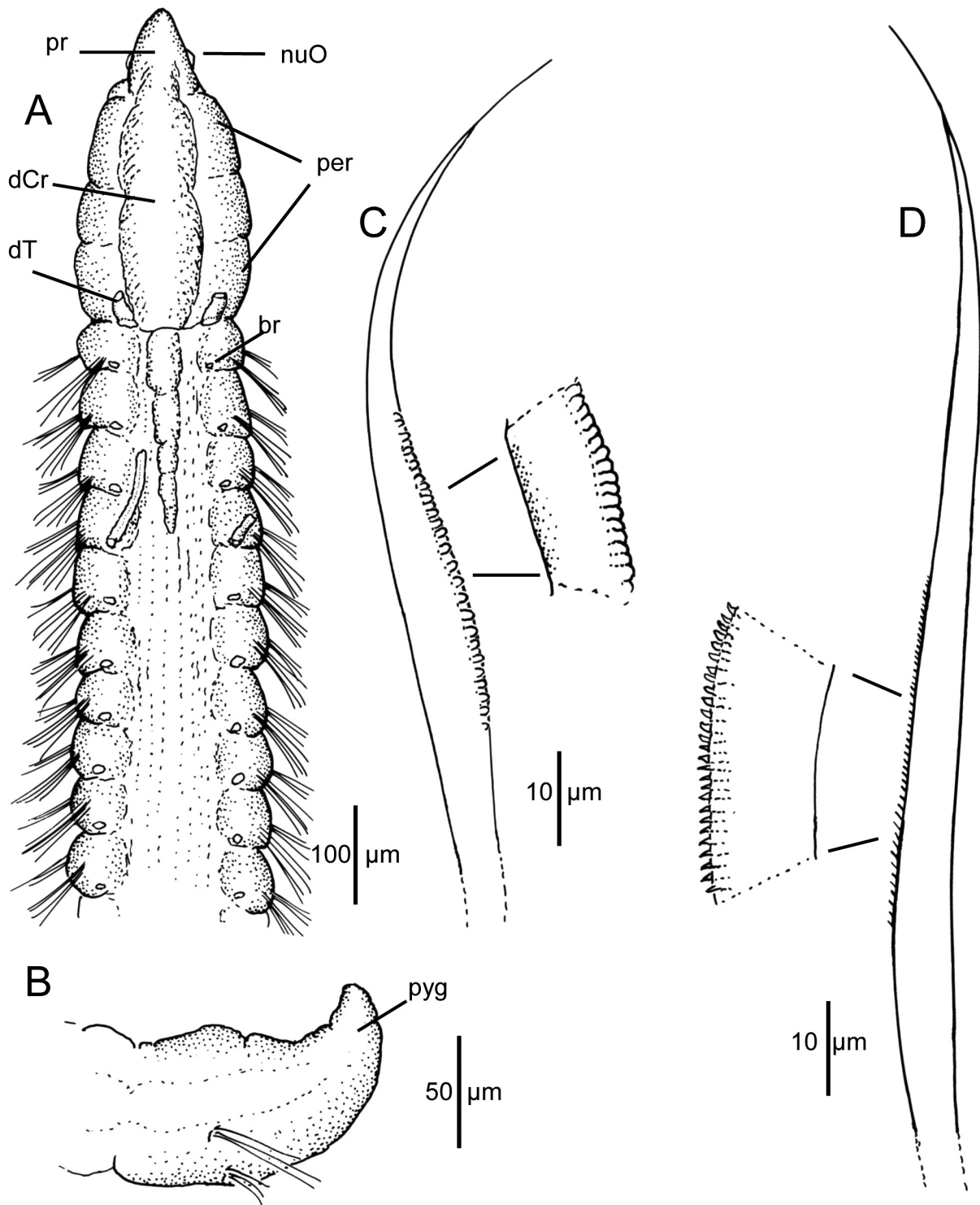
Thoracic parapodia reduced ridges; thoracic notopodia of holotype with 10–12 capillary setae on first 15 setigers, reduced to 7–9 capillaries by setigers 20–22; setiger 35 and posteriormost segments with about 7 capillaries; smaller paratypes with fewer setae. Capillaries include both long, thin smooth capillaries and thicker setae from setiger 12, these with a finely denticulated edge bearing numerous pointed teeth (Fig. 11D). Thickened denticulated capillaries and a few simple, longer, natatory-like capillaries in a few mid-body segments. Anterior neuropodia with 5–8 denticulated capillaries, reduced to 5–6 at about setiger 35. All neuropodial capillaries thicker and shorter than notosetae and denticulated edge with more prominent teeth with a rounded edge (Fig. 11C). Certain views of denticulated neurosetae suggest up to three rows of denticles may occur; details beyond resolution with light microscopy.

Last segment on paratype tapering to narrow pygidium bearing terminal rounded lobe (Fig. 11B).

**Methyl Green stain.** No pattern; middle segments retain diffuse stain longest after differentiation. A few groups of cells retain stain along body, but not consistent.

**Remarks.** Among the known species of *Kirkegaardia*, *K. filiformis* n. sp. is most similar to *K. acunai* Dean & Blake, 2009 from off Pacific Costa Rica, *K. fragilis* Blake, 2016 from abyssal depths in the Pacific Ocean, and *K. kladara* Blake, 2016 from slope depths off North Carolina, USA. Each of these species has the first branchiae occurring singly on setiger 1 together with denticulated setae in both noto- and neuropodia. Of these, the two latter

species have moniliform abdominal segments and an expanded posterior end with crowded segments instead of no moniliform segments and no expanded posterior segments.



**FIGURE 11.** *Kirkegaardia filiformis* n. sp. A, anterior end, dorsal view; B, posterior end, left lateral view; C, denticulated neuropodial capillary, inset not to scale; D, denticulated notopodial capillary, inset not to scale. A, C–D, holotype (USNM 1557524); B, paratype (USNM 1557525).

*Kirkegaardia filiformis* n. sp. is, therefore, most similar to *K. acunai*, the Costa Rican species. The two species differ in that there are four peristomial rings in *K. acunai* instead of three and MG stain produces ventral bands on anterior segments of *K. acunai*, instead of no stain retained at all in *K. filiformis* n. sp. In addition, in *K. acunai* den-

ticulated setae begin in notopodial setigers 24–32 and neuropodial setigers 22–33; in *K. filiformis* **n. sp.** denticulated notosetae begin on setiger 12 and denticulated neurosetae are present from setiger 1.

**Etymology.** The epithet *filiformis*, is from the Latin, *filum*, for thread, and refers to the thin, thread-like body of this species.

**Distribution.** Caribbean Sea, Aruba and Belize, dredged from 25–30 m.

### ***Kirkegaardia panamaensis* new species**

Figures 12–13

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**Material examined.** Caribbean Sea, Carib 1, R/V *Alpha Helix*, Panama, in small lagoon between leeward side of Isla Popa and Cayo Ferro, Sta. ND-30-500, 09°12.8'N, 82°02.7'W, 08 July 1977, dredged along mangrove bank, depth 1–2 m, **holotype** (USNM 1557526).

**Description.** Holotype complete, an elongate species with an inflated anterior region (Figs. 12B; 13A), narrow middle and posterior segments, and an expanded posterior end (Figs. 12C, 13B). Holotype 7.9 mm long for 90 setigers; 0.4 mm wide across inflated anterior region, middle body segments 0.3 mm wide, narrowing to 0.2 mm in posterior segments; expanded posterior end 0.3 mm wide. Pre-setiger region about 1.25 times as long as wide (Figs. 12A–B; 13A). Anterior or thoracic region with 14 setigers, parapodia slightly elevated (Fig. 12A), dorsum similarly elevated; venter bulbous, greatly enlarged (Figs. 12B; 13B). Anterior setigers six times as wide as long; middle and posterior segments 1.5 times as wide as long, rounded in cross section; expanded posterior end 14 setigers long and 6–8 times as wide as long, convex dorsally with a wide mid-ventral groove or channel (Figs. 12C; 13C). Color in alcohol light tan.

Prostomium conical with rounded tip, eyespots absent, nuchal organs not observed (Figs. 12A–B, 13A). Peristomium nearly square, with three subequal annulations (Fig. 12A–B). Dorsal tentacles at posterior border of third peristomial annulation (Fig. 12A–B). First pair of branchiae posterior-lateral to dorsal tentacles on anterior border of setiger 1; second pair of branchiae also on setiger 1, dorsal to notosetae (Fig. 12A–B); branchiae on subsequent segments also dorsal to notosetae; branchiae long, filamentous (Fig. 13A), not observed on middle or posterior segments.

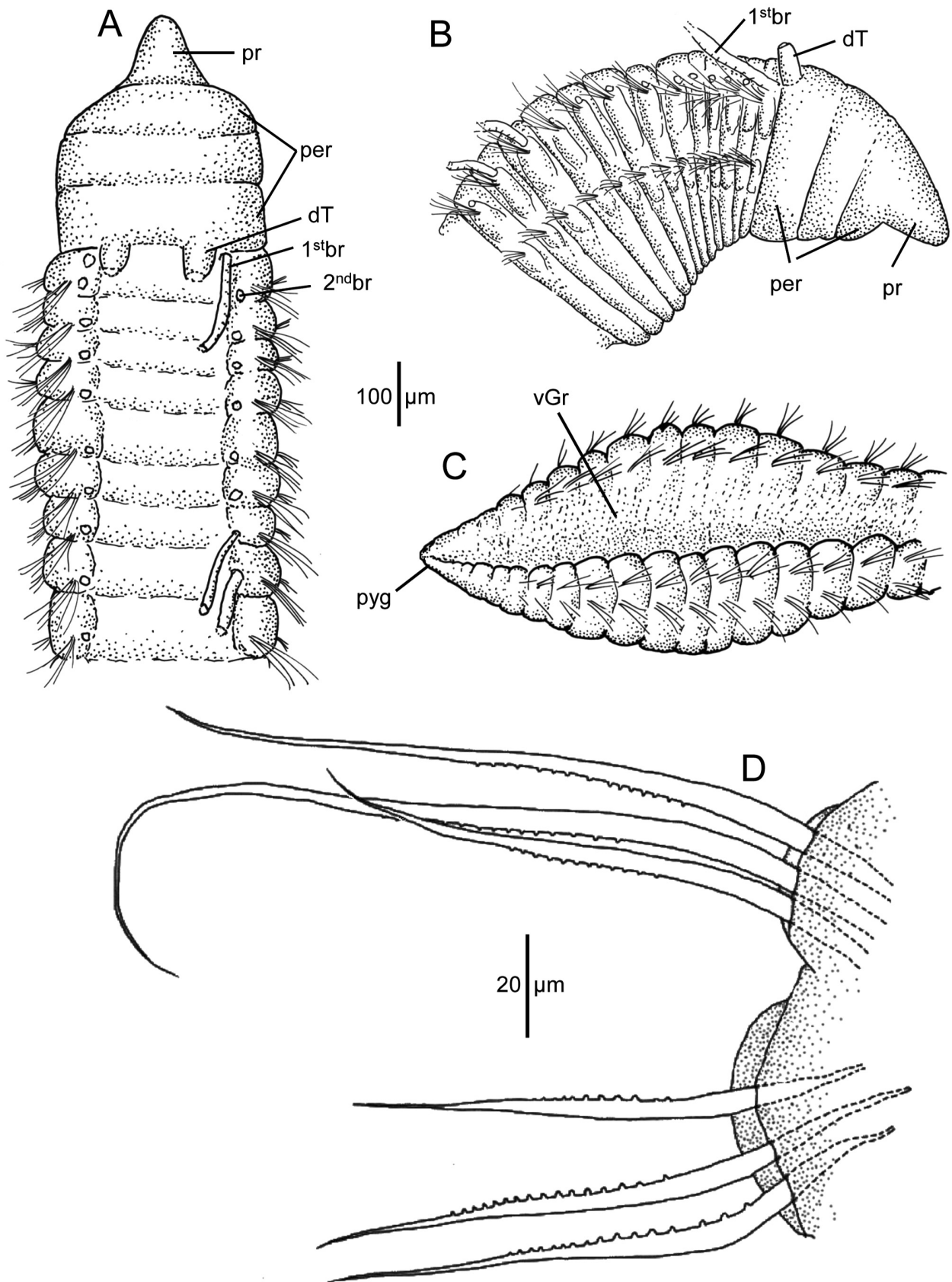
Parapodia low mounds; anterior notopodia with 4–6 blade-like capillaries, with fine denticles visible on shorter capillaries at about setiger 9; abdominal setigers with 5–6 notosetae with more robust denticles at setiger 27, reduced to three notosetae posteriorly until widened posterior region usually with two notosetae. Thoracic neuropodia with 4–6 flattened capillaries with fine denticles visible from about setiger 5, abdominal setigers usually with five neurosetae, robust denticles also becoming visible at about setiger 27, neurosetae reduced gradually to three denticulated capillaries in posterior setigers including widened posterior end (Fig. 12D), reduced to a single neuroseta adjacent to 5–6 segmented asetigerous pre-pygidial region; notosetae slightly longer than neurosetae.

Expanded posterior end with deep ventral groove or channel (Figs. 12C; 13B); pygidium simple rounded lobe ventral to anal opening.

**Methyl Green stain.** No pattern, de-stains rapidly; stain retained longest in expanded thoracic segments, but not concentrated on venter as in related species.

**Remarks.** Superficially, *Kirkegaardia panamaensis* **n. sp.**, with an inflated anterior region, elongate narrow middle segments and an inflated posterior end superficially resembles *Aphelochaeta monilaris* Hartman, 1960. However, the presence of denticulated capillaries clearly defines the species as belonging to *Kirkegaardia*. Among known species of *Kirkegaardia* that have expanded anterior and posterior ends, *K. panamaensis* **n. sp.** is most similar to *K. baptistae* Blake, 1991 from the U.S. Atlantic continental shelf and *K. dutchae* Blake, 2016 from the Puget Sound, U.S. Pacific coast, in that all have expanded anterior and posterior ends, a ventral groove or channel on the posterior end, and lack dorsal thoracic channels or grooves.

Of the two, *K. dutchae* shows the greatest similarity to *K. panamaensis* **n. sp.** in that both species have the first and second pair of branchiae on setiger 1. The two species differ in that denticulated capillaries are lacking in notopodia of *K. dutchae* and are present in *K. panamaensis* **n. sp.** Further, the anterior and posterior ends of *K. panamaensis* **n. sp.** are conspicuously more expanded than in *K. dutchae*. In addition, MG stain is prominently retained on ventral thoracic glands in *K. dutchae* and such glands and MG staining reaction are not present in *K. panamaensis* **n. sp.**



**FIGURE 12.** *Kirkegaardia panamaensis* n. sp. Holotype (USNM 1557526): A, anterior end, dorsal view; B, anterior end, right lateral view; C, posterior end, ventrolateral view; D, posterior parapodium, anterior view with denticulated setae.



**FIGURE 13.** *Kirkegaardia panamaensis* n. sp. Holotype (USNM 01557526): A, anterior end and middle body segments, right lateral view; B, middle and posterior segments, ventrolateral view. Stained with Shirlastain A.

**Etymology.** This species is named for the collection site in Panama.

**Distribution.** Panama, subtidal at 1–2 m along a mangrove bank in a small lagoon between the leeward side of Isla Popa and Cayo Ferro.

### *Kirkegaardia playita* new species

Figures 14

urn: lsid: zoobank.org: act: 8DC06F57-1357-470C-A60D-16D3FA1C0B06

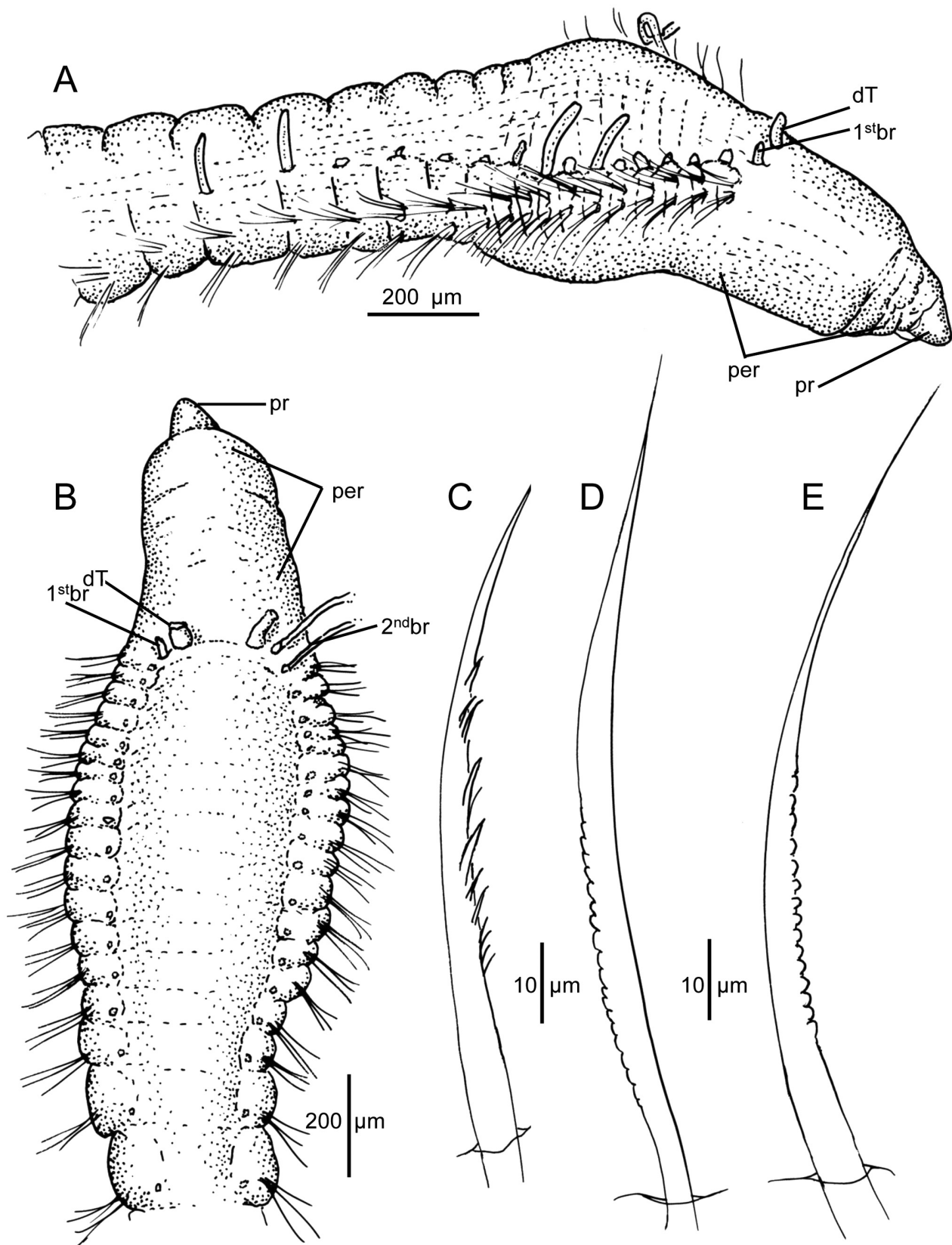
**Material examined.** Caribbean Sea, Carib 1, R/V *Alpha Helix*, Panama, Playita Point, south of tip of San Blas Peninsula, Sta. ND-24-1000, 9°32.8'N, 78°59.'W, 30 June 1977, dredged across sand, grass and rubble at beach, 5 m, **holotype** (USNM 1557527) and 3 **paratypes** (USNM 1557528).

**Description.** Holotype mostly complete with 42 setigers, 5.2 mm long, 0.3 mm across enlarged anterior or thoracic segments, 0.23 mm across mid-body segments; all paratypes incomplete, of similar proportional size as holotype, but with fewer segments. Entire thoracic region distinctly swollen dorsally and ventrally, with crowded segments each about 10 times wider than long (Fig. 14A–B); segmental grooves weakly evident dorsally, inconspicuous ventrally. Middle segments narrower, not crowded, about three times as wide as long (Fig. 14A); far posterior segments as wide as long; no segments oval or moniliform in shape. Body generally cylindrical throughout, with no dorsal or ventral grooves evident. Color in alcohol light tan, with no pigment apparent.

Pre-setiger region elongate, smooth, about 1.4 times as long as wide. Prostomium short, conical tapering to rounded apex (Fig. 14A–B); eyespots absent; nuchal organs narrow lateral slits at posterior margin. Peristomium with relatively smooth surface, with two lateral grooves producing 1–2 weak annular rings anteriorly; rest of peristomium merging indistinctly with thoracic segments (Fig. 14A–B); dorsal tentacles widely spaced, arising anterior to setiger 1 (Fig. 14B); first pair of branchiae lateral to dorsal tentacles; second pair of branchiae on setiger 1, dorsal



to notosetae; subsequent branchiae in similar location (Fig. 14A–B). Branchiae or stub apparent on thoracic segments and following mid-body segments.



**FIGURE 14.** *Kirkegaardia playita* n. sp. Holotype (USNM 1557527): A, anterior end, right lateral view; B, anterior end, dorsal view; C, anterior notopodial capillary; D, posterior notopodial capillary; E, posterior neuropodial capillary.

Parapodia of anterior segments swollen, producing weak shoulders (Fig. 14B); podia reduced to small lobes from which setae emerge; middle and posterior segments with small, inconspicuous podial lobes. Holotype with 5–6 capillary notosetae in thoracic and anterior abdominal segments; neurosetae numbering 4–5 in similar segments. Capillaries of anterior setigers all with smooth margins as viewed in light microscopy (1500 x). Notosetae from about setiger 14–15 of holotype with distinct fibrils along one edge, with some long, thick, probably merged fibrils appearing as pointed barbs (Fig. 14C); from about setiger 20, notosetae with a row of low, blunt denticles along one edge (Fig. 14D). Neurosetae of holotype all smooth capillaries anteriorly, transitioning to denticulate capillaries by setiger 20–22; denticles more prominent in neurosetae (Fig. 14E) than notosetae (Fig. 14D).

**Methyl Green stain.** No pattern, body stains uniformly and de-stains rapidly.

**Remarks.** *Kirkegaardia playita* **n. sp.** is unique in having the entire thoracic region enlarged and swollen and smooth dorsal and ventral thoracic surfaces where the individual segmental morphology is largely obscured. In addition, the pre-setiger region is elongate and smooth, with only 1–2 weak lateral grooves posterior to the prostomium.

*Kirkegaardia panamaensis* **n. sp.** also has an expanded thoracic region but only the venter is noticeably swollen rather than both the dorsal and ventral surfaces being swollen as in *K. playita* **n. sp.** In addition, the peristomium of *K. panamaensis* **n. sp.** is not elongate, but short, about as long as wide, and with three more-or-less prominent annular rings instead of an elongate peristomium with 1–2 anterior weakly developed lateral grooves. Additionally, the serrations on the setae of *K. panamaensis* **n. sp.** more closely resemble short, sharp teeth rather than the rounded, blunt denticles of *K. playita* **n. sp.**

The mud ball worms, *Kirkegaardia luticastella* (Jumars, 1975) and *K. jumarsi* Blake, 2016, also have enlarged and swollen thoracic regions, but these species have other modifications of the body including moniliform segments allowing them to live in spiral burrows within mud balls (Blake 2016). Nevertheless, the enlarged and swollen anterior body segments suggest such species use these body segments to assist hydrostatically in producing cracks in sediment as part of their burrowing activities (Jumars *et al.* 2015).

The unusual structure of serrated notosetae having thickened fibrils or barbs in segments anterior to the more typical denticulate noto- and neurosetae of mid-body and posterior segments of *Kirkegaardia playita* **n. sp.** suggest perhaps a transitional stage in the development of the denticulate setae.

**Etymology.** The epithet is derived from Playita Point, the locality in Panama where the specimens of this species were collected. In Spanish, *playita* is a diminutive of *playa*, a beach; *playita* is thus a small beach.

**Distribution.** Panama, shallow subtidal, 5 m, in sand, grass and rubble.

## Genus *Cirriformia* Hartman, 1936

**Type Species:** *Terebella tentaculata* Montagu, 1808, designated by Hartman (1936).

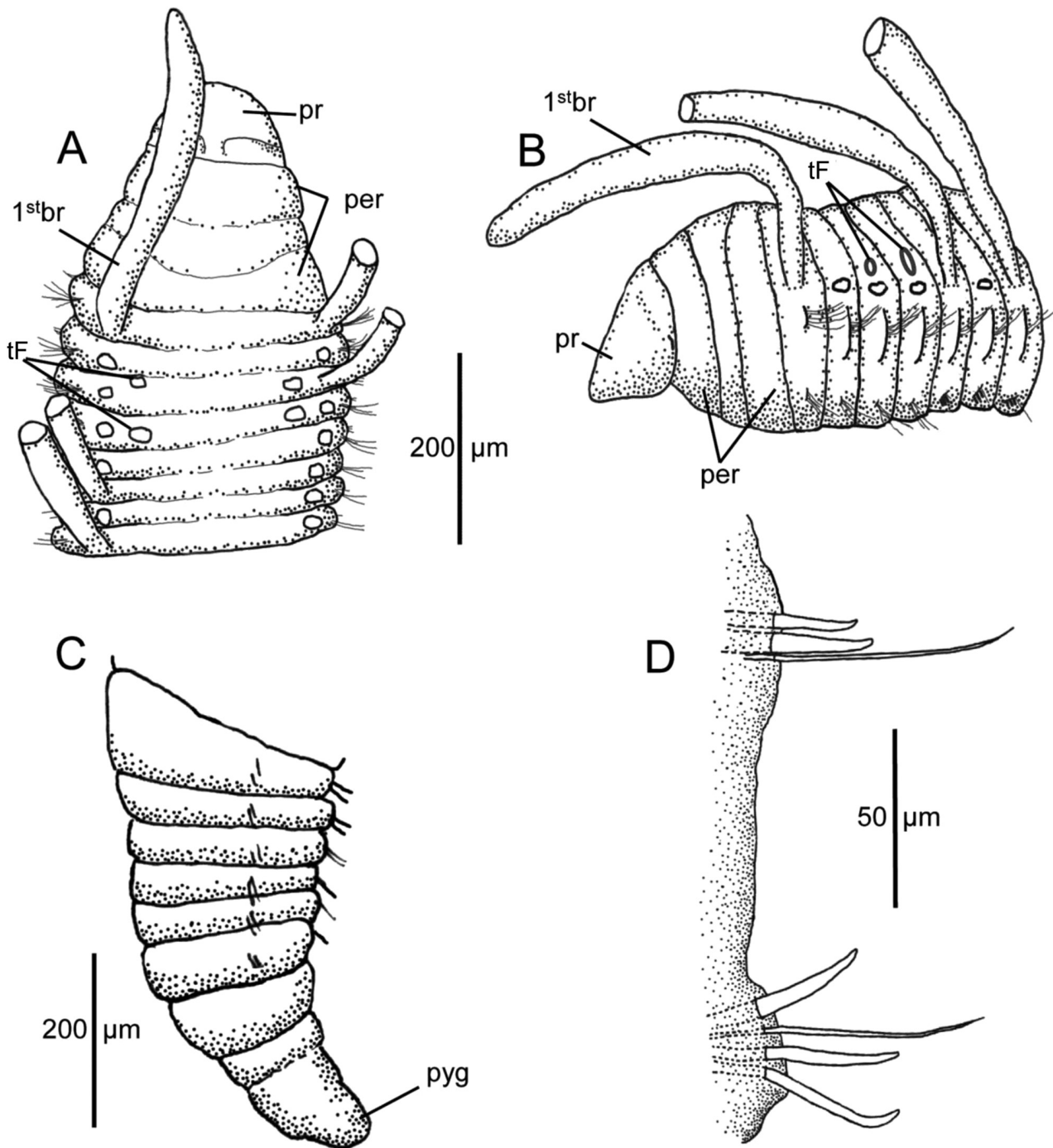
**Diagnosis.** (after Magalhães *et al.* 2014). Prostomium elongate or blunt, usually without eyespots; peristomium with 2–3 annulations. Grooved tentacular filaments limited to 1–3 anterior segments, arising between setigers 2–7. Branchiae occur singly, usually first present from setiger 1, arising close to notopodia throughout, not shifting dorsally in middle body segments and not forming dorsolateral branchial bulges. Parapodia rami well separated. Setae include capillaries and acicular spines.

### *Cirriformia* sp.

Figure 15

**Material examined.** Caribbean Sea, Carib 1, R/V *Alpha Helix*, Panama, in small lagoon between leeward side of Isla Popa and Cayo Ferro, Sta. ND-30-500, 09°12.8'N, 82°2.7'W, 08 July 1977, dredged, along mangrove bank, depth 1–2 m, 2 specimens (USNM 1557510).

**Description.** Complete specimen 3.5 mm long, maximum width 0.6 mm, with 41 setigers; incomplete specimen 7.2 mm long, maximum width 0.7 mm, with 78 setigers. Body thick throughout, with segments subequal. Dorsum rounded, venter flattened with a mid-ventral groove throughout. Color in alcohol gray-brown to light tan, body with a mid-ventral white line.



**FIGURE 15.** *Cirriformia* sp. (USNM 1557510): A, anterior end, dorsal view; B, anterior end, left lateral view; C, posterior end, left lateral view; D, posterior parapodium, anterior view.

Prostomium broadly rounded anteriorly, with slightly swollen dorsolateral ridges posteriorly; eyespots absent (Fig. 15A–B). Peristomium as long as first six setigers with three annuli; second annulus slightly enlarged dorsally. Paired tentacular filaments present on setigers 3 and 4; on larger specimen those of segment 4 arise from middle of segment dorsal to branchiae, right tentacular filament arises similarly on setiger 3 while filament on left side arises at anterior border of segment; smaller specimen with two pairs of tentacular filaments arising from middle of both setigers 3 and 4. Branchiae from setiger 1, continuing until last few posterior setigers; present just dorsal to notopodia. Notopodia and neuropodia both slightly elevated ridges along the body; neuropodia widely separated from notopodia (Fig. 15D).

Setiger 1 notosetae include five long capillaries, subsequent seven setigers with 2–4 long capillaries usually accompanied by a single shorter capillary, all capillaries with fine teeth along one edge; three spines present on setiger 9, subsequently 1–3 spines often accompanied by 1–2 long capillaries or spines appearing without capillaries. Neurosetae begin as 2–3 long capillaries accompanied by 1–2 short capillaries; neuropodial spines begin on setiger 7, one side of body with three spines accompanied by single short capillary, other side with single, reduced, slightly hooked spine accompanied by two long and two short capillaries; following setigers with 2–3 spines, only occasionally accompanied by a single long capillary (Fig. 15D). Spines amber in color; notopodial spines shorter, straighter, and sometimes thicker than neuropodial spines; neuropodial spines slightly recurved (Fig. 15D).

Posterior end of body with three weakly differentiated asetigerous segments and a rounded pygidial lobe, anus dorsal (Fig. 15C).

**Methyl Green stain.** Body stains uniformly light blue except for the prostomium, the asetigerous posterior segments, and the pygidium.

**Remarks.** Due to the few tentacular cirri present and the small size of the specimens, it may be that these are juveniles, making it more prudent to regard this as *Cirriformia* sp. rather than assigning a species identification. Blake (1975) described a 16-setiger juvenile of *C. moorei* Blake 1996 (as *C. spirabranca*) as lacking tentacular cirri. Wilson (1936) also noted a lack of tentacular cirri at the 25–30 setiger stage of *C. tentaculata* (Montagu, 1808). Tentacular cirri apparently develop at the late juvenile stage and perhaps these specimens of *Cirriformia* sp. have not yet developed their full complement of cirri. Magalhães *et al.* (2014) found bidentate hooks in juveniles of their new species, *Cirriformia chicoi* from Brazil and suggested that the presence of bidentate hooks may be characteristic of multitentaculate cirratulid juveniles. However, Okuda (1946) and Stephenson (1950) have both described juveniles of the genus *Cirratulus* as lacking bidentate hooks. Blake (1975), as well as Wilson (1936), also noted the first branchiae appear anterior to the first setiger of *Cirriformia moorei* and *C. tentaculata*, respectively. Neither bidentate hooks (even in the 72-setiger specimen) or pre-setigerous branchiae occur in *Cirriformia* sp., perhaps indicating they may be an adult or early adult form. Additionally, juveniles of *C. moorei* and *C. tentaculata* had only weakly developed branchiae on the first several anterior setigers whereas the branchiae of *Cirriformia* sp. extend to posterior setigers, also suggesting these specimens may be adults.

Dean (2012) listed five species of *Cirriformia* identified in the Caribbean Sea. Of these five, *C. chrysotherma* is now recognized as belonging in the genus *Protocirrinieris* (Petersen 1991) and *C. filigera* and *C. melanocantha* are both now recognized as belonging in the genus *Timarete*. Magalhães *et al.* (2014) reviewed all eight species of *Cirriformia* in the Atlantic Ocean and presented a table of morphological characters for each. *Cirriformia capillaris* (Verrill, 1900), reported from Bermuda by Verrill (1900) and Hartman (1942), is similar to *Cirriformia* sp. in the first occurrence of neuropodial spines (setiger 8 in *C. capillaris* and setiger 7 in *Cirriformia* sp.) and the posterior neuropodia having mainly spines with only an occasional single accompanying capillary seta. Verrill (1900) did not note the first occurrence of notopodial spines in *C. capillaris*. *Cirriformia* sp. differs from *C. capillaris* in having only single dorsal tentacles on setigers 3 and 4 while in *C. capillaris* there is a transverse group of three tentacles on each side on setiger 4. Additionally, Verrill (1900) reported that branchiae occurred only rarely in the posterior half of the body in *C. capillaris* but in *Cirriformia* sp. they occur on all segments to the posterior end. Verrill (1900) characterized the “buccal” segment as undivided but the peristomium of *Cirriformia* sp. is finely subdivided into three subequal segments with only weak separations.

**Distribution.** Collected subtidally at 1–2 m along a mangrove bank in a small lagoon between the leeward side Isla Popa and Cayo Ferro, Panama.

## Genus *Timarete* Kinberg, 1866

**Type species:** *Cirratulus anchylochaetus* Schmarda, 1861, by original designation.

**Synonym:** *Ambo* Chamberlin, 1918. **Type species:** *Ambo perbranchiata* Chamberlin, 1918, p. 177, by priority.

**Diagnosis** (after Blake & Magalhães 2019): Prostomium wedge shaped, rounded on anterior margin, with or without eyespots. Body nearly round in cross-section, with segments distinct. Grooved tentacular filaments arising in two groups from the dorsum of two or more anterior chaetigers, posterior to chaetiger 1. Branchiae occurring singly or with several filaments per parapodium, individual branchial filaments robust, becoming more dorsal in origin in middle body segments, with each sometimes forming a dorsolateral bulge over notopodium. Setae including capillaries and acicular spines.

## ***Timarete punctata* (Grube, 1859)**

*Cirrhatus punctata* Grube, 1859:107.

*Cirrhatus nigromaculatus* Grube, 1869:24–25.

*Cirriiformia punctata*: Hartman, 1956: 292.

*Timarete punctata*: Petersen, 1999:116; Çinar, 2007:755–764, figs. 2–5 (synonymy); Magalhães *et al.* 2014:18–19 (synonymy); Dean 2017:131–132.

**Material examined.** Caribbean Sea, Carib 1, R/V *Alpha Helix*, Nicaragua, Mid Ham Cay, Sta. 39, 14°34.7'N, 82°58.0'W, 11 July, 1977, subtidal, interstices of coral rock, coarse coral rubble piled on old reef crest by storms, with some living coral, 1 specimen (USNM 1557511).

**Description.** Specimen incomplete with 50 setigers, 5.0 mm long, pre-setigerous region narrower (0.5 mm wide) than remainder of body (1.0 mm wide). Prostomium rounded, peristomium triannulate. Tentacular filaments five pairs from setiger 3–4, each filament with dark brown rings and scattered brown spots; branchiae from setiger 1, located dorsal and adjacent to notopodia, shifting dorsal to notosetae by setiger 15. Body beige with numerous scattered brown spots on both dorsal and ventral surfaces; dorsal filaments with dark brown rings and spots, branchiae uniformly brown-gray with occasional dark spots.

Anterior noto- and neuropodia with 3–4 capillary setae, notopodial spines from setiger 10; neuropodial spines from setiger 5; mid-body with a single notopodial spine accompanied by three capillaries, neuropodia with 3–4 spines and a single accompanying capillary.

**Methyl Green stain.** No pattern; body stains uniformly light blue.

**Remarks.** This specimen agrees well with specimens described by Magalhães *et al.* (2014) from São Pedro and São Paulo, Brazil. Those authors reported notopodial spines beginning between setigers 9–25 and neuropodial spines from setigers 6–17, both of which agree with the current specimen. The mottled pigment on the body, tentacular cirri, and branchiae are also similar to published reports.

**Distribution.** *Timarete punctata* was originally described from the Bahamas and has been reported from several sites in the Caribbean (Dean 2012; 2017) and as far South in the Atlantic Ocean as the coast of Paraíba in Brazil. Çinar (2007) redescribed the type material and reported the species from the Mediterranean Sea. Based upon molecular analysis, Magalhães *et al.* (2014) suggested that *T. punctata* might be a complex of species. Seixas *et al.* (2017) investigated the genetic diversity of this species (including individuals from Panama) and found a wide geographic distribution probably associated with human-mediated transport.

## **Genus *Dodecaceria* Örsted, 1843**

**Type species:** *Dodecaceria concharum* Örsted, 1843, by monotypy

**Synonym:** *Zeppelina* Vaillant, 1890

**Type species:** *Ctenodrilus monostylos* Zeppelin, 1883, by original designation. *Fide* George & Petersen (1991).

**Diagnosis.** Prostomium blunt or rounded on anterior margin, forming hood over mouth. Peristomium long, achaetous, with a pair of thick, grooved dorso-lateral tentacles at junction with setiger 1. One to several pairs of branchial filaments extending over 1 to few anterior segments. Setae include simple capillaries and stout, acicular hooks that are either simple, chisel-shaped, spoon-shaped, or with subapical serrations.

**Remarks.** *Dodecaceria* species are unusual among cirratulids in having complex life cycles involving asexual fragmentation as well as sexual reproduction (Petersen 1999; Blake & Magalhães 2019). The alternation of asexual and sexual reproductive modes and the morphologies during the different modes has led to differing opinions and considerable confusion regarding the names and validity of what are often relatively common species. For example, George & Petersen (1991) determined that species of the genus *Zeppelina* were based on regenerating or asexually reproducing specimens of other genera, mostly *Dodecaceria*.

Specimens of *Dodecaceria* are difficult to work with because they typically need to be extracted from burrows in shells or calcareous rock where they live. Because they are able to extend both their anterior and posterior ends from the burrow opening, preserved specimens are often preserved in a U-shaped form and as such tend to fragment when manipulated. In addition, the tentacles and branchiae, which are concentrated on anterior segments,

are typically thick and firmly attached, and do not readily break away with handling as with the sediment-dwelling bitentaculate cirratulids. Because most specimens are found intact with branchiae and tentacles that obscure the pre-setiger region, the anterior morphology is difficult to study unless these filaments are removed. As in the bitentaculate genera, the nature of the peristomium, origin of the tentacles, and placement of the first branchiae are important systematic characters.

To date, twenty species, based largely on the works of Gibson (1978), George & Petersen (1991), and Petersen (1999), are currently recognized (Blake & Magalhães 2019). Dean (2012) recorded four species of *Dodecaceria* from Caribbean waters, but these were identified with names of species known from other parts of the world and are thus doubtful. The only species of *Dodecaceria* actually described from the Caribbean region are *D. diceria* Hartman, 1951 from the Florida Keys and *D. carolinae* Aguilar-Camacho & Salazar-Vallejo, 2011 from the Yucatán Peninsula, Mexico. In the present study, two new species have been identified from the Carib 1 collections from shallow-water calcareous habitats off Panama.

### ***Dodecaceria alphahelixae* new species**

Figures 16–17

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**Material examined.** Caribbean Sea, Carib 1, R/V *Alpha Helix*, Panama, Sta. ND-31, 09°12.8'N, 82°02.7'W, 08 July 1977, dredged, in grass and sand around Deer Island, NE tip of Isla Popa, specimens removed from coral rock, 4 m, **holotype** (USNM 1557518) and **paratype** (USNM 1557519).

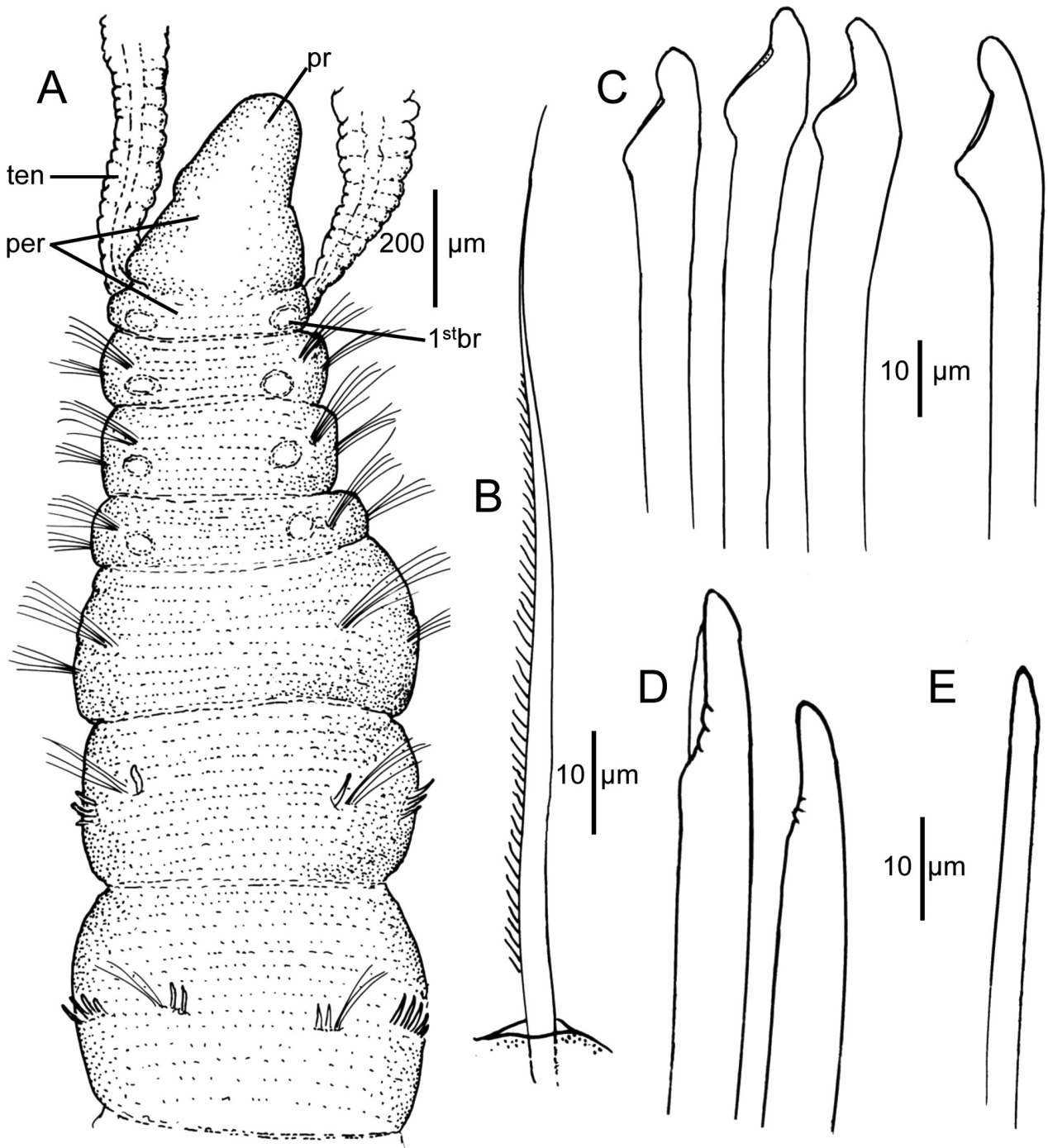
**Description of holotype.** Holotype complete, with 32 setigers, 6.62 mm long, 0.5 mm across anterior segments, expanded to width of 0.6 mm across middle segments, tapering to a width of 0.55 mm across posterior segments. Anterior segments about three times wider than long (Fig. 16A), middle segments larger, swollen, tapering to narrow crowded segments posteriorly (Fig. 17). Body generally cylindrical in anterior and middle segments, with posterior region becoming dorsoventrally flattened. Segmental annular rings poorly developed except in far posterior segments where a few segmental grooves cross individual segments. Color in alcohol dark reddish brown (Fig. 17) with pigment in numerous irregular transverse patches encircling individual segments.

Prostomium conical, tapering to rounded anterior margin (Fig. 16A); eyespots absent; nuchal organs longitudinal lateral slits. Peristomium smooth with two achaetous rings with annuli only apparent laterally; first ring longest; second ring possibly an achaetous segment (Fig. 16A); no dorsal crest. Tentacles arising laterally on second ring (Fig. 16A), these becoming thick, with distinct ventral groove and numerous folds along length. Branchiae four pairs, all of approximately same length or monomorphic (*sensu* Aguilar-Camacho & Salazar-Vallejo 2011); first pair arising from achaetous segment dorsal to tentacles; branchial pairs 2–4 from setigers 1–3 dorsal to notosetae (Fig. 16A). Each branchia relatively thick, with folds or grooves along their length.

Parapodia poorly developed with setae arising directly from body wall or notch. Setigers 1–4 with capillaries only, 5–6 per fascicle; capillaries with fine serrations along one edge (Fig. 16B). Heavy hooked setae from setiger 5 in both noto- and neuropodia; neuropodia with five hooks and no capillaries; notopodia with one hook and four capillaries. Neuropodia of setiger 6 with five hooks; notopodia with two hooks and three capillaries. Setiger 7 with five hooks in neuropodia and seven hooks in notopodia; capillaries absent. Numbers of hooks fewer in subsequent segments, decreasing from five to three in neuropodia and seven to three in notopodia to about middle of body or about setiger 15. One to two capillaries resume in notopodia from about setiger 20. Hooks through middle body segments all spoon shaped with large subapical boss (Fig. 16C). Hooks in more posterior segments not as heavy, with spoon shape not as evident and subapical boss reduced or absent (Fig. 16D). Hooks in last few setigers narrow, pointed acicular spines (Fig. 16E), accompanied by 1–2 capillaries.

Posterior segments narrowing to pygidium (Fig. 17) consisting of a simple rounded lobe ventral to anal opening.

**Variability.** Paratype (USNM 1557519) small, 1.8 mm long, 0.25 mm wide with 22 setigerous segments. Two pairs of branchiae, first on achaetous segment, second on setiger 1; possible scars of a third branchial pair observed. Capillary setae only in setigers 1–4. Spoon-shaped hooks begin on setiger 5 with four hooks in neuropodia and four in notopodia; setiger 6 with four hooks in neuropodia and six in notopodia; setiger 7 with 5–6 hooks in neuropodia and three in notopodia. Most hooks with enlarged spoon-like tip with large subapical boss.



**FIGURE 16.** *Dodecaceria alphahelixae* n. sp. Holotype (USNM 1557518): A, anterior end, dorsal view; B, notopodial capillary, anterior setiger; C, four neuropodial hooks from mid-body segments; D, neuropodial hooks from posterior segment; E, notopodial hook from a far posterior setiger.

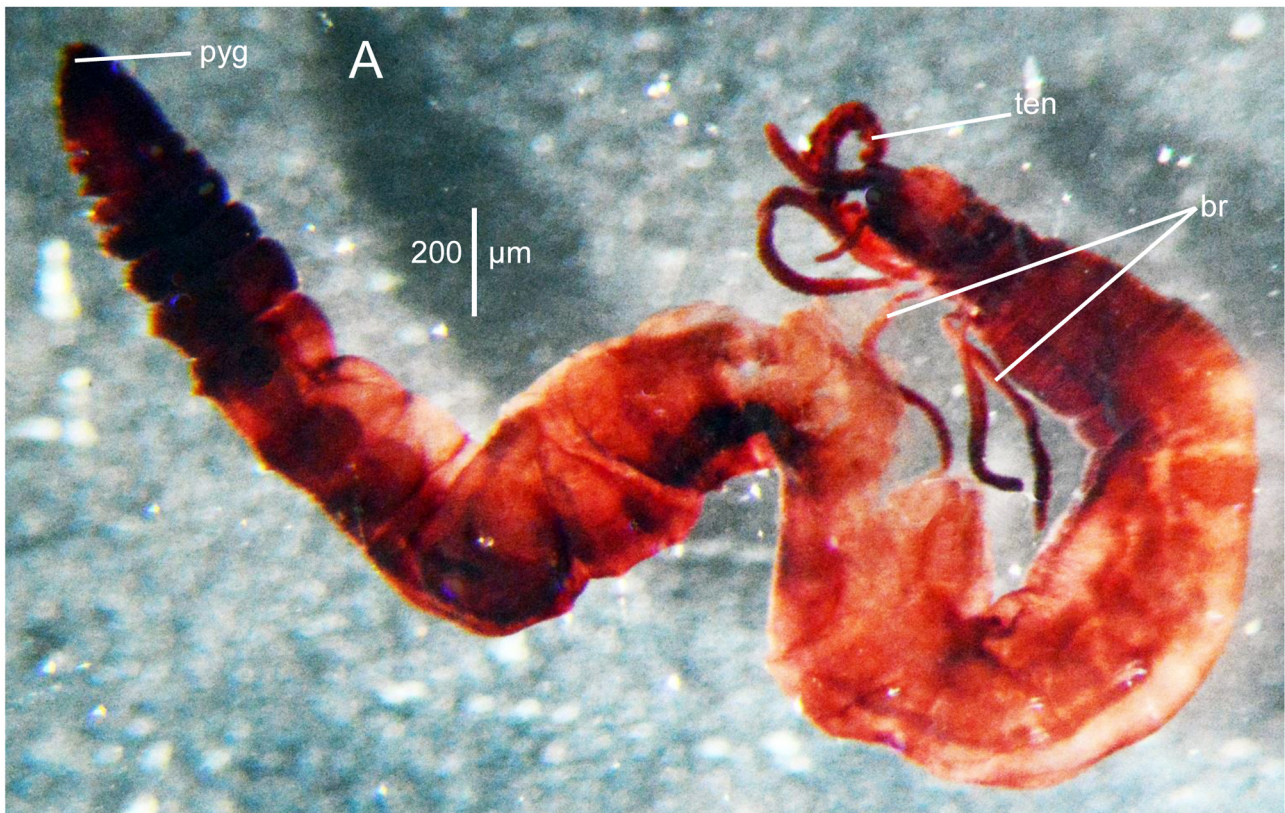
**Methyl Green stain.** MG largely obscured by heavy dark reddish brown pigment.

**Remarks.** Among the known species of *Dodecaceria*, only two have a reduced number of branchiae and hooked setae beginning from an anterior setiger as in *D. alphahelixae* n. sp.: *D. ater* (Quatrefages, 1866) from France and *D. gallardoii* Carrasco, 1977 from Chile. However, *D. ater* is described as having chisel-shaped hooks (Blake & Magalhães 2019: Fig. 4F) instead of spoon-shaped hooks and has 5–6 pairs of branchiae instead of four. *Dodecaceria gallardoii* is reported to have three pairs of branchiae instead of four and hooks begin on setiger 6 instead of 5 (Carrasco 1977). In addition, *D. gallardoii* has two pair of branchiae on the achaetous segment instead of one and the

hooks are described as having heavy transverse subapical ribs or ridges instead of with a distinct scoop shape with a prominent boss as in *D. alphahelixae* **n. sp.**

**Etymology.** This species named for the R/V *Alpha Helix*, the vessel used to support the Caribbean I expedition.

**Distribution.** Panama, shallow subtidal, in hard substrates.



**FIGURE 17.** *Dodecaceria alphahelixae* **n. sp.** Holotype (USNM 1557518): A, entire worm, lateral view.

### *Dodecaceria dibranchiata* new species

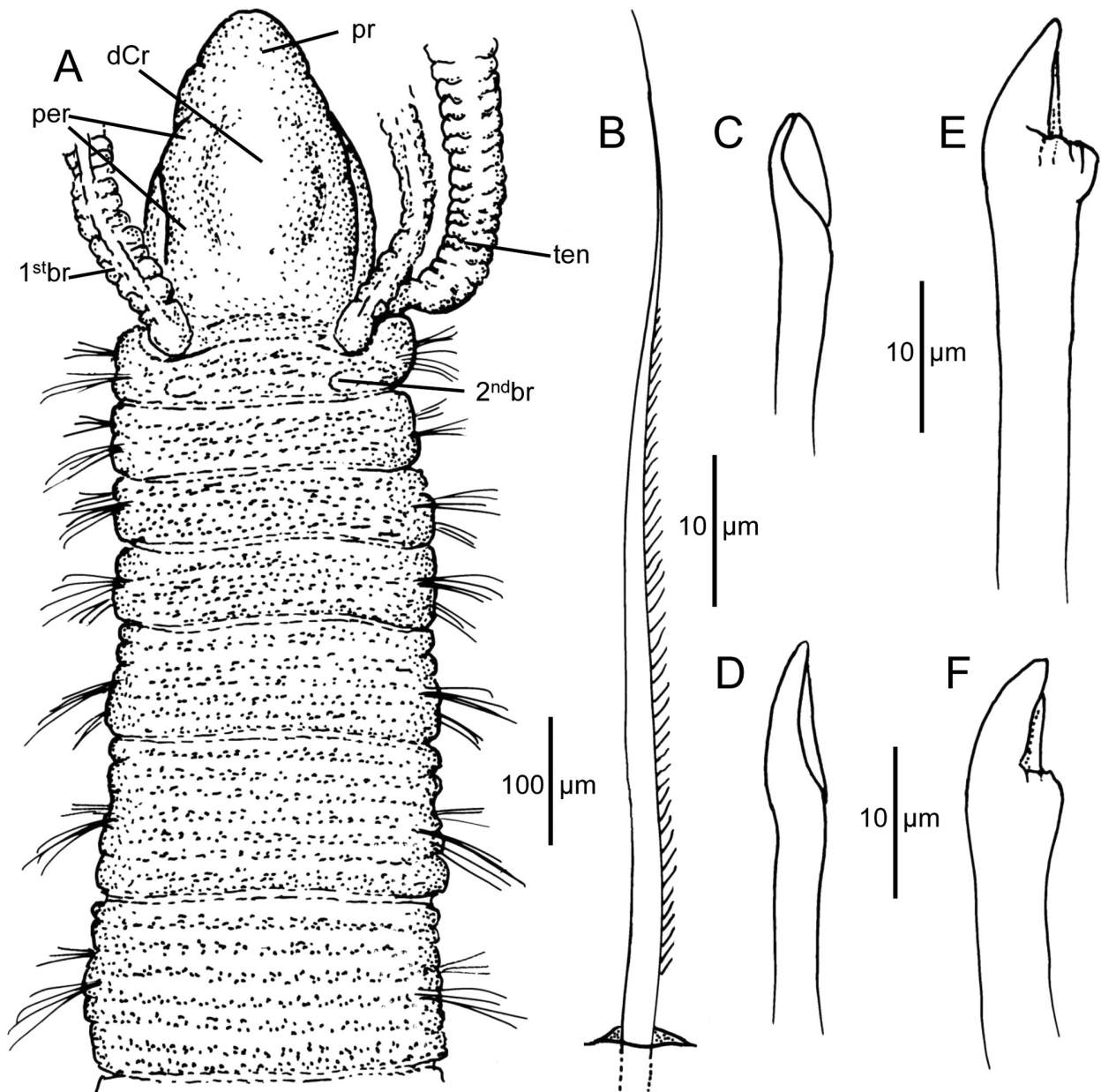
Figures 18–19

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**Material examined.** Caribbean Sea, Carib 1, R/V *Alpha Helix*, Panama, Golfo De San Blas, Playita Point, Sta. ND-26, 09°32.8'N, 78°59.5'W, 30 June 1977, dredged in sand, and coral rubble, 30–50 cm, **holotype** (USNM 1557520), 26 **paratypes** + fragments (USNM 1557521).—off Peninsula Valiente, between Crawl Cay and Canal del Tirge, outside Laguna Chiriqui, Sta. ND-30, 09°12.8'N, 82°02.7'W, 08 July 1977, dredged along mangrove bank, between Isla Popa and Cayo Ferro, 1–2 m, 2 specimens (USNM 1557522); Sta. ND-31, 09°12.8'N, 82°02.7'W, 08 July 1977, dredged in grass and sand around Deer Island, NE tip of Isla Popa, specimens removed from coral rock, 4 m, 12 specimens + fragments (USNM 1557523).

**Description.** Holotype complete, 6.2 mm long for 45 setigers, 0.25 mm across anterior segments, expanded to width of 0.6 mm across middle segments, tapering to a width of 0.25 mm across posterior segments. Complete paratype (USNM 1557521) 5.5 mm long with 40 setigers. Anterior segments about 3.2 times wider than long (Figs. 18A; 19A), middle segments larger, about as wide as long, then tapering posteriorly to narrow crowded segments about eight times wider than long (Fig. 19A–B). Body generally cylindrical throughout with posterior region becoming dorsoventrally flattened (Fig. 19B). Some anterior segments biannulate; annuli generally not apparent in middle and posterior segments. Color in alcohol tan to dark brown, some segments with transverse rows of brown to black pigment spots, flecks of pigment along most of body, providing some specimens with darkened areas on some segments. A distinct heart body observed in mid-body segments; intestinal tract obvious along entire body (Fig. 19A–B).



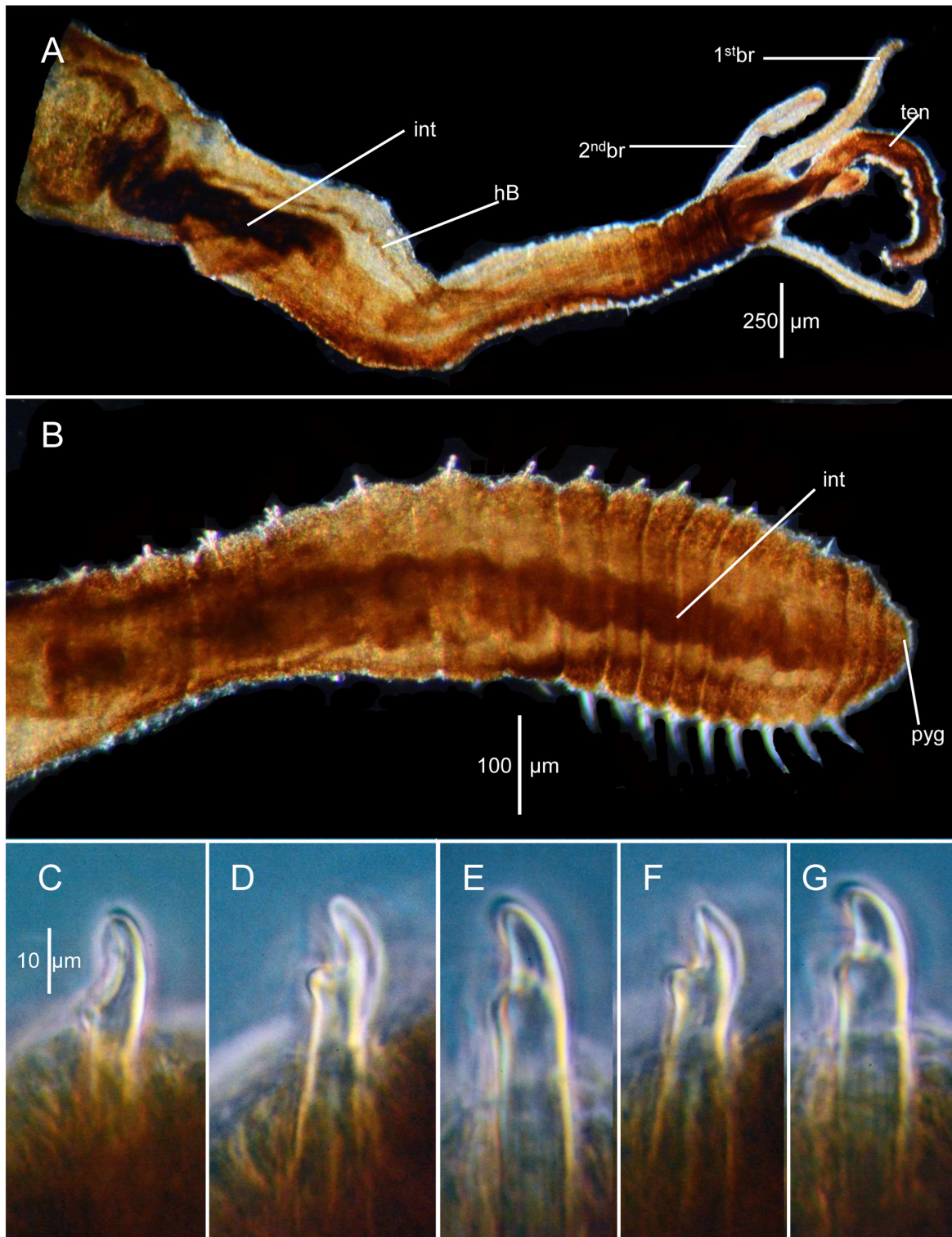


**FIGURE 18.** *Dodecaceria dibranchiata* n. sp. Holotype (USNM 1557520): A, anterior end, dorsal view; B, capillary notoseta from anterior setiger; C–D, notopodial hooks from a middle body setiger; E–F, neuropodial hooks from a middle body setiger.

Prostomium conical, with broadly rounded anterior margin (Fig. 18A); eyespots absent; nuchal organs longitudinal lateral slits indistinctly separated from peristomium. Peristomium smooth, elongate, annular rings absent, with little or no evidence of lateral grooves (Fig. 18A); with low rounded dorsal crest present; separate achaetous segment at posterior margin absent, but weak groove separates peristomium from setiger 1 (Fig. 18A). A pair of thick tentacles arise laterally at posterior-lateral margin of peristomium, these with distinct groove and with numerous transverse folds along length (Figs. 18A; 19A). Branchiae two pairs: first pair arising from posterior margin of peristomium, dorsal to tentacles; second pair of branchiae arising from setiger 1, dorsal to notosetae (Figs. 18A; 19A). Each branchia thick, with folds or grooves along length; both branchiae of same length or monomorphic.

Parapodia poorly developed in anterior setigers with setae arising directly from body wall or from notch. Anterior setigers with long, narrow capillaries with fine serrations along one edge (Fig. 18B). Heavy hooked setae from setigers 9–12 in notopodia (9 in holotype) and 8–11 in neuropodia (8 in holotype). Capillaries 3–4 in anterior setigers, then reduced to 1–2 after hooks appear; capillaries absent from about setiger 12–14, resuming from about setiger 20–25 (20 in holotype). Holotype and most paratypes with one notopodial hook initially, then increasing to no more than three hooks in middle segments, reduced to 1–2 hooks in posterior segments. Neuropodia with one

hook initially, increasing to four per fascicle in middle segments, then reduced to 1–2 in posterior segments. All hooks spoon shaped, but with notopodial hooks slenderer, less curved, and with either a reduced or absent subapical boss (Figs. 18C–D; 19C). Neuropodial hooks thicker, more robust, with distinct spoon shape and with enlarged subapical boss (Figs. 18E–F; 19D–G).



**FIGURE 19.** *Dodecaceria dibranchiata* n. sp. Holotype (USNM 1557520): A, anterior and middle body segments, right lateral view; B, posterior end, dorsolateral view; C, notopodial hook from a middle body setiger; D–G, neuropodial hooks from middle body setigers.

Pygidium a broad terminal lobe ventral to anal opening (Fig. 19B).

**Methyl Green stain.** No pattern, stain not retained.

**Remarks.** *Dodecaceria dibranchiata* n. sp. is most similar to *D. laddi* Hartman, 1954 that also exhibits two pairs of branchiae and is from the Marshall Islands in coral reefs, *D. gallardoi* with three pairs of branchiae from Chile (Carrasco 1977), and *D. diceria* with 1–2 pair of branchiae from shelf depths off Florida (Hartman 1951). Of these three species, *D. laddi* and *D. gallardoi* differ from *D. dibranchiata* n. sp. in having a distinct achaetous segment between the peristomium and setiger 1 from which the first branchiae arise (Hartman 1954; Carrasco 1977), whereas *D. dibranchiata* n. sp. lacks such an achaetous segment and the first pair of branchiae arise directly from the posterior margin of the peristomium. In addition, *D. gallardoi* has two of three branchial pairs anterior to setiger 1. Instead of typical spoon-shaped hooks with a subterminal boss as seen in *D. dibranchiata* n. sp., *D. gallardoi* has hooks with a prominent subterminal row of transverse ribs.

*Dodecaceria diceria*, like *D. dibranchiata* n. sp., is described as lacking a distinct achaetous segment between the peristomium and setiger 1 and with the first pair of branchiae arising from the posterior margin of the peristomium. The species was originally described and illustrated as having only a single pair of branchiae; however, Hartman (1951) did note that some specimens had a second short pair on setiger 1. Both pairs of branchiae on *D. dibranchiata* n. sp. are of equivalent length, but the species differs from *D. diceria* most importantly in the nature of the modified hooks. In *D. diceria* the hooks have a distinctly serrated frontal margin instead of being spoon-shaped as in *D. dibranchiata* n. sp. Further, *D. diceria* is an offshore shelf species that according to Hartman (1951) occurs in shells of living gastropods. *D. diceria* has also been reported, but not characterized, from benthic samples from the North Sea in depths greater than 100 m (Gibson 1996). In contrast, *D. dibranchiata* n. sp. is an intertidal to shallow subtidal (4 m) species that bores into coralline rock.

**Etymology.** The epithet is from the Greek, *di*, for two or double, and *branchos*, for gill, and represents the presence of two pair of branchiae in most specimens of this species.

**Biology & habitat.** A few non-type specimens from Sta. ND-31 (USNM 1557523) were ovigerous, with hundreds of oocytes in the coelom. The largest eggs were ovoid in shape, 45 x 60 µm, with a large germinal vesicle. Only minimal evidence of regeneration of anterior or posterior segments was found on 3–4 paratypes from Sta. ND-26 (USNM 1557521).

Some paratypes from Sta. ND-26 were found in burrows in small pieces of coral rock still with the sample residue. The worms were removed by pressing the point of a steel dissecting needle into the rock. This resulted in the burrows splitting open and allowing the worms to be recovered intact. Individual worms were nearly always in a U-shape with the anterior and posterior ends side by side, indicating that at the time of preservation both the mouth and anus were extended from the same burrow opening.

**Distribution.** Panama, low water, 0–4 m, in burrows in coral rock.

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