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Redescription of *Tharyx killariensis* (Southern) from Ireland and description of two new species of *Tharyx* from the Kattegat, Sweden (Polychaeta, Cirratulidae)

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Abstract

Two new species of the cirratulid genus *Tharyx* are reported from shallow waters in the Kattegat inshore Sweden. In addition, the lectotype of *Tharyx killariensis* (Southern, 1914) is redescribed resulting in a revised concept of the noto- and neuropodial acicular spines of posterior parapodia for that species. These spines were originally reported as bidentate crotchets with sharply pointed teeth; in reality the spines have blunt, knob-shaped tips, typical of several other species of *Tharyx*. Both of the new species are atypical for the genus *Tharyx*. *T. maryae* **n. sp**. has an expanded posterior end more typical of the genus *Aphelochaeta*, but otherwise shares characters of *Tharyx*. *T. robustus* **n. sp.** has a body shape that is consistently broad and dorsoventrally flattened throughout, rather than elongate and narrow as in other species of the genus. Both of the new species, however, have short, blunt-tipped spines in far posterior parapodia. With the addition of the two new species, the genus *Tharyx* now includes 11 species that are compared and contrasted. Morphology that defines and characterizes species of *Tharyx* is reviewed.

Key words: new species, Ireland, Sweden, Annelida, Cirratulidae

Introduction

Among the five bitentaculate genera of the Cirratulidae, the genus *Tharyx* is relatively small in numbers of species, but some species are among the dominant taxa in benthic infaunal assemblages (Hilbig & Blake 2000; Blake 2015).

This study was initiated following the discovery of an unusual cirratulid collected as part of intertidal monitoring on the Swedish coast. After examination, it was determined that these specimens had a body shape that was generally typical of some species of *Aphelochaeta*, yet had setal and other characteristics typical of the genus *Tharyx.* Subsequently, additional specimens from the same locality yielded a second species of *Tharyx*, this one having an expanded posterior end and neuropodial spines in the posteriormost setigers.

To date, the only species of *Tharyx* known from European waters is *T. killariensis* (Southern, 1914), originally described as a *Chaetozone* from Killary Harbor, Ireland, but subsequently moved to the genus *Caulleriella* by Hartman (1959) and then to *Tharyx* by Blake (1991). The species has been reported from several localities in northern Europe, but there has been no published redescription of *T. killariensis* since the original account; most faunal guides and keys simply use Southern's original definition and illustrations of the species. Therefore, before describing and naming the two new species, we considered it important to reexamine Southern's original materials.

This paper presents a redescription of *Tharyx killariensis* based on one syntype specimen provided by the Irish Museum of Natural History and here designated as the lectotype. As will be noted, other specimens in the syntype series were fragments. This description confirms much of what Southern (1914) reported for the species except for the nature of the hooks or spines, which differ from his original illustrations. This investigation confirms that the new material from Sweden represents two species of *Tharyx* new to science. We also take the opportunity to compare the three European species of *Tharyx* with eight species reported elsewhere.

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Material and methods

All specimens were examined with light microscopy using a Wild M-5 stereomicroscope and a Zeiss RA research compound microscope equipped with phase contrast optics. Some specimens were initially stained with a solution of Shirlastain A in water to highlight difficult-to-see surficial morphology. Some specimens were further stained with a saturated solution of Methyl Green in ethyl alcohol in order to determine if distinct patterns were evident on some species. Both stains dissipate completely in ethyl alcohol. Line drawings were made with pencil using a drawing tube or Camera Lucida on the Zeiss RA and later transferred to drawing paper and inked. Photomicrographs were taken with a Nikon D80 camera mounted on both the stereo- and compound microscopes. The syntypes of *Caulleriella killariensis* were provided by the National Museum of Ireland, Natural History (NMINH) courtesy of Mr. Nigel Monahan, Collection Manager. The specimens from Sweden were collected by the second author (PG) and deposited in the Swedish Museum of Natural History, Stockholm (SMNH), Dr. Lena Gustavsson, Curator of Annelids.

Results

Taxonomic account

Family Cirratulidae Ryckholt, 1851

Genus *Tharyx* Webster & Benedict, 1887

Type-species *Tharyx acutus* Webster & Benedict, 1887, designated by Hartman (1959). Revised by Blake (1991).

Diagnosis. Prostomium conical; peristomium elongate, with pair of grooved dorsal tentacles arising on posterior margin anterior to setiger 1; first pair of branchiae typically arising immediately posterior to dorsal tentacles either on posterior margin of peristomium or rarely on anterior margin of setiger 1; abdominal segments sometimes beadlike. Noto- and neuropodia located close to one another, not widely separated. Setae including simple capillaries in anterior and middle setigers, acicular spines in posterior setigers with irregular notched tips, sometimes appearing weakly bidentate, with pair of stunted or rounded knobs but never with distinct, sharply pointed teeth; spines present either in both posterior noto- and neuropodia or only in neuropodia. Pygidium with terminal anus and small ventral lobe or disk.

Remarks. Blake (1991) determined that the type species of the genus *Tharyx, T. acutus* Webster & Benedict, 1887, had knob-tipped hooks or spines in addition to capillaries. This discovery differed from the traditional concept of *Tharyx*, which had been based upon specimens having all capillaries (Hartman 1961). Blake (1991) restricted species of *Tharyx* to those having blunt or knob-tipped spines and moved species having simple and denticulated capillaries to the genera *Aphelochaeta* and *Monticellina*, respectively. The genus *Tharyx* appears most closely related to *Caulleriella* in that both genera have species with modified spines that are more or less bidentate. In addition to the nature of the posterior spines, *Caulleriella* and *Tharyx* species are easily distinguished by the position of the noto- and neuropodia. In *Caulleriella*, the setal fascicles are widely separated from one another, so much so, that in cross section of some species, they appear at four corners of the body. In *Tharyx*, on the other hand, the setal fascicles are close together.

Blake (1991) originally included five species in the genus *Tharyx*, one of which, *T. killariensis* is redescribed in the present paper. Four additional species were added by Blake (1996, 2015) and Magalhães & Bailey-Brock (2013). Two new species discovered in shallow-water sediments in Sweden are here described, bringing the total number of species in the genus to eleven. In addition, another eight species of *Tharyx* are known to the first author from North America and Antarctica. With the number of species thus nearly tripled over the past 24 years, there is now a larger suite of characters available to define the genus than was available in the past. The morphological characters that best define the known species of *Tharyx* are reviewed.

***Tharyx killariensis* (Southern, 1914)**
Figure 1

Chaetozone killariensis Southern, 1914: 113–115, Plate XII, figs. 27 A–D; McIntosh 1923: 491–492, Plate CXXXVI, Fig. 13; Hartmann-Schröder 1971: 355.
Heterocirrus killariensis: Fauvel 1927: 97–98, Fig. 86 d–h.
Caulleriella killariensis: Hartman 1959: 401.
Tharyx killariensis: Blake 1991:19; Hartmann-Schröder 1996: 399–400, Fig. 192.

Material examined. IRELAND, Killary Harbor, Station W. 86, 1914, dredged in rich black mud at 7 fathoms (12.8 m), **lectotype** (NMINH 1914.348). Note: the label suggests two specimens (syntypes) in vial, but these are fragmented parts of the same specimen, here designated as the lectotype.

Additional material. Same station, collected in 1909 from Killary Harbor. Two specimens in vial labeled syntypes are fragments. No head or posterior ends available (NMINH 1909.151).

Description. Lectotype composed of three large fragments and two smaller fragments clearly all from the same specimen and with evidence of prior dissection; collectively about 10 mm long with 77 setigerous segments; anterior fragment 5 mm long with 47 setigers. Largest specimen recorded by Southern (1914) 11 mm long with 84 setigerous segments. Body not pigmented, light tan in alcohol. Body with dorsum of anterior and middle segments elevated above parapodia, forming distinct ridge along body (Fig. 1A–B); first 30 segments narrower and more crowded than middle segments, middle segments not moniliform; far posterior segments again becoming narrow. Venter somewhat flattened throughout body, with narrow, weakly developed mid-ventral ridge formed of raised pads located in middle of each segmental annulus. Pygidium with dorsal anus and flattened ventral lobe (Fig. 1C).

Prostomium triangular, pointed on anterior margin; eyes absent (Fig. 1A–B); nuchal organ a narrow slit on posterior margin. Peristomium about as wide as long, annulations not visible dorsally, but with 2–3 weak divisions ventrally (Fig. 1A). Paired dorsal tentacles arising from posterior margin of peristomium, first pair of branchiae arising on peristomium posterior and slightly lateral to tentacles, but in line with subsequent segmental branchiae (Fig. 1A–B); second pair of branchiae on setiger 1, subsequent branchiae present on at least another 20–25 setigers (Fig. 1B).

Parapodia low mounds from which setal fascicles arise; noto- and neuropodial setal fascicles positioned close to one another throughout. Setae all capillaries for first 50 or so setigers, with 5–7 capillaries in noto- and neuropodia. Southern (1914) reported spines (crotchets) from setiger 56 in neuropodia and setiger 61 in notopodia; lectotype similar with neuropodial spines present from setiger 51; notopodial spines first appearing with a single elongate spine among capillaries on setiger 56; posterior setigers with up to two long, narrow blunted spines and 2–3 capillaries in notopodia and 3–4 short curved spines and 2–3 long capillaries in neuropodia (Fig. 1D). Notoacicular spines long, thin, with narrow rounded tip bearing only a single knob (Fig. 1E); Neuroacicular spines curved, somewhat geniculate with blunt tip bearing two weakly developed knobs; shortest spines ventralmost (Fig. 1F) grading dorsally into longer and thinner capillaries.

Methyl green Stain. No stain retained.

Remarks. The general features originally described by Southern (1914) for *Chaetozone killariensis* are confirmed in the present description, including the nature of body segmentation, prostomium/peristomium, position of the dorsal tentacles, branchiae, and nature of the pygidium. However, Southern's depiction of the spines or crotchets as having two small pointed teeth is not confirmed. The lectotype clearly shows that the tips of the noto- and neuropodial spines are blunted with, at best, two low knobs, not teeth. In this respect, this species belongs in the genus *Tharyx* as defined by Blake (1991). Further, the setal fascicles of noto- and neuropodia are positioned close to one another instead of being widely separated as in most reported species of *Caulleriella* (see Blake 1996).

Tharyx killariensis is similar to most of the known species of *Tharyx* in having spines in both the noto- and neuropodia of posterior setigers. However, the notoacicular spines of *T. killariensis* are few in number, narrow, and blunted, with heavier recurved spines limited to the neuropodia; the spines are also accompanied by capillaries. By having different types of spines in the noto- and neuropodia, *T. killariensis* most closely resembles *T. alaskensis* Blake, 2015 from the Alaskan Arctic. Further, the paired knobs on the tips of the spines are poorly developed in both *T. killariensis* and *T. alaskensis* compared with other species (Blake 1991, 1996, 2015). The two species differ in that capillaries accompany the spines in the posterior noto- and neuropodia of *T. killariensis*, whereas they are absent in *T. alaskensis*. Further, *T. alaskensis* has both the first and second pairs of branchiae located on setiger 1,

whereas *T. killariensis* and other *Tharyx* species have the first pair of branchiae either on the posterior margin of the peristomium or on an achaetous segment anterior to setiger 1.

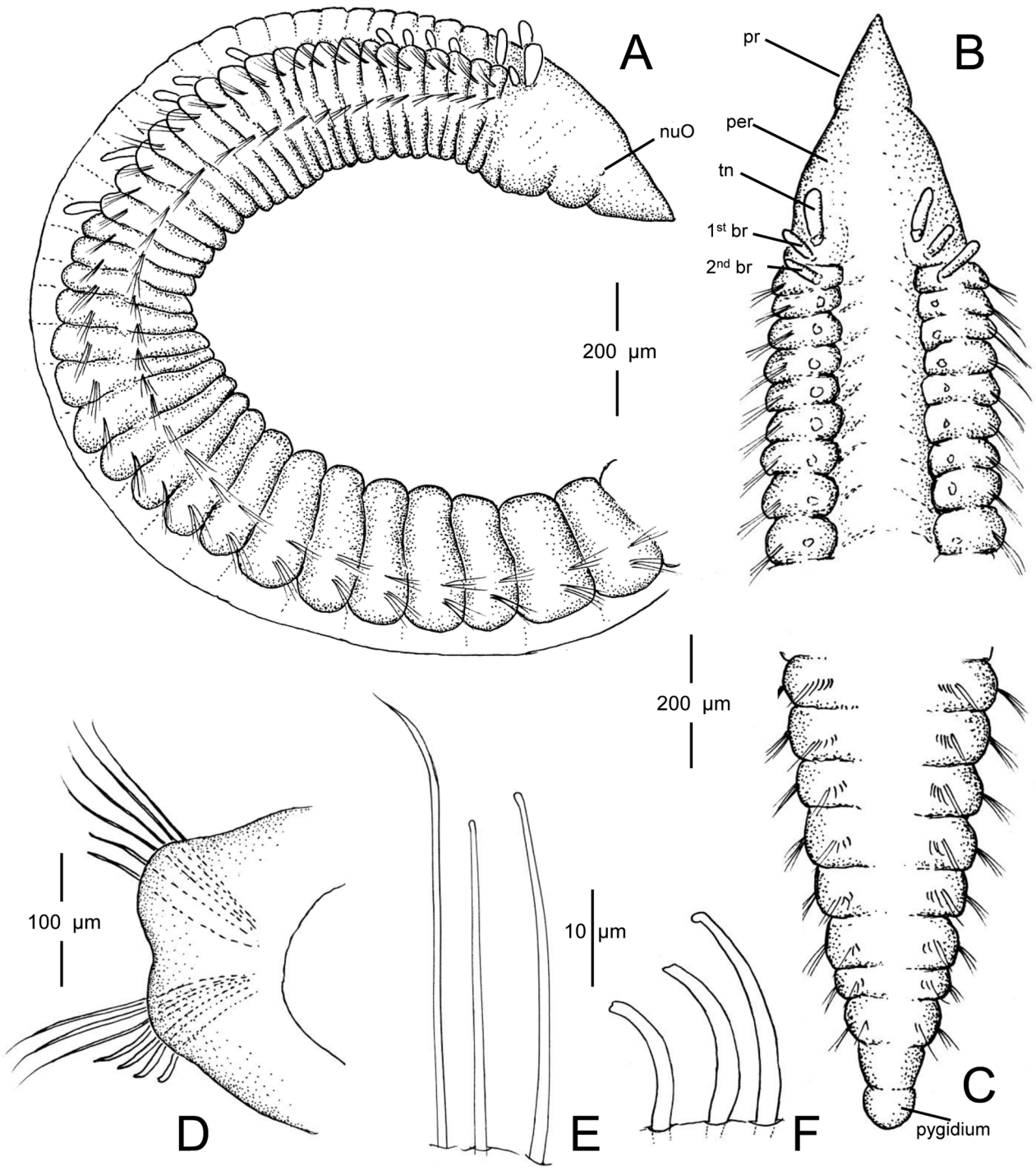

FIGURE 1. *Tharyx killariensis* (Southern, 1914). Lectotype (NMINH 1914.348): A, anterior end, right lateral view; B, anterior end, dorsal view; C, posterior end, dorsal view; D, posterior parapodium; E, capillary and notoacicular spine from posterior notopodium; F, neuroacicular spines from posterior neuropodium. Abbreviations: br, branchiae; nuO, nuchal organ; per, peristomium; pr, prostomium; tn, tentacle.

Most published accounts of *Tharyx killariensis* (e.g. Fauvel 1927; Hartmann-Schröder 1971, 1996) have largely repeated the descriptions and figures of Southern (1914) and as such the actual nature of any specimens subsequently collected and reported as this species in the intervening years from different localities cannot be confirmed. McIntosh (1923) appears to have examined some of Southern's material, but he did not change the

description of the spines; his only illustration was of a notopodial capillary. The brief description by Eliason (1962) from the Skagerrak appears to be a different species because distinct pigment is present on the dorsolateral margins of the peristomium, neuropodial hooks are first present in the anterior one-third of the body instead of the posterior one-third, and notopodial hooks are entirely absent.

Biology. Since the original report from Killary Harbor, Ireland, in shallow subtidal muds, *Tharyx killariensis* has been reported from SW England, the west coast of France, the southern North Sea, and the Wadden Sea as part of various marine benthic community studies. In some recent accounts the species is among the dominant species in low intertidal and shallow subtidal benthic assemblages (Reiss & Kröncke 2001; Nehmer & Kröncke 2003; Callier *et al.* 2009; Schückel *et al.* 2013).

Distribution. Northern Europe: Ireland, SW England, West coast of France, North Sea and Wadden Sea, low intertidal to shallow subtidal.

Tharyx maryae new species

Figures 2, 3A–C

Material examined. SWEDEN, Kattegat, near Varberg, 03 Aug 2012, in sediments near eelgrass beds, 57.11501°N; 12.22611°E, 0.3–1.7 m depth, coll. P. Göransson, holotype (SMNH 8754), four paratypes (SMNH 8755).

Description. A moderate-sized species, holotype complete, 10 mm long, 0.5 mm wide across thorax, 0.8 mm wide across expanded posterior end for 115 setigerous segments; paratypes all incomplete (lacking posteriormost segments), up to 9 mm long, 0.5 mm wide, with about 70 setigerous segments. Color in alcohol light tan to opaque white; lateral black pigment spots present on peristomium of some specimens (Fig. 3A), faded or not apparent on others; some specimens with brown pigment spots in intersegmental grooves along body. Body elongate, laterally expanded through first 20–25 thoracic setigers with narrow crowded segments (Figs. 2A, 3C); abdominal segments narrower, longer and rounded, but not moniliform; posterior 20–25 segments becoming enlarged, forming expanded posterior end with narrow segments, tapering to pygidium with dorsal anus and bulbous ventral lobe (Figs. 2B, 3B). Dorsum of thoracic region broad between notopodia, with segmentation evident (Fig. 2A); dorsal groove absent. Venter generally flattened with mid-ventral line of ridges along entire body from setigers 2–3 (Fig. 3C); ridges formed from ventromedial bulges or pads associated with each segment.

Prostomium triangular, tapering to pointed tip on anterior margin (Figs. 2A, 3A), broadening posteriorly, nuchal organs narrow slits on posterior margin of prostomium, inconspicuous, not pigmented; eyes absent. Peristomium as long as wide, with two annuli surmounted by longitudinal dorsal crest (Fig. 2A). Paired dorsal tentacles on posterior margin of peristomium, with first pair of branchiae located immediately posterior to tentacles on peristomium (Fig. 2A); second pair of branchiae on posterior margin of setiger 1, dorsal to notosetae. Branchiae present on most segments through middle of body.

Noto- and neuropodia with setal fascicles arising close together; anterior parapodia with spreading fascicles of about 5–6 capillary setae in notopodia and 6–7 capillaries in neuropodia; middle body segments with about 9–10 capillaries in notopodia and 5–6 in neuropodia; far posterior notopodia with 4–5 narrow capillaries; neuropodia with 3–4 capillaries and 1–3 short, curved, spines in posteriormost 4–5 setigers (Fig. 2C). Neuroacicular spines initially as straight pointed spine (Fig. 2D) transitioning over next four setigers to blunt-tipped spine (Fig. 2E), then spines with knob-like tips (Figs. 2F–G). On holotype of 115 setigers, neuroacicular spines limited to posteriormost five setigers (111–115).

Methyl Green Stain. Most of body staining initially, tip of prostomium and dorsal peristomial crest clear; stain retained laterally in irregular patches on sides of peristomium and intersegmentally on dorsum, between parapodia, and mid-ventrally on thoracic region where ventral ridges are located sometimes producing a line of paired spots along the venter. The most conspicuous stain is present intersegmentally between the parapodia; no distinct pattern on prostomium and peristomium.

Remarks. Because of the expanded posterior end on the holotype of *T. maryae* **n. sp**., the specimen was initially thought to be a species of *Aphelochaeta*. However, careful inspection of the posterior parapodia revealed the presence of short, curved, blunt-tipped spines ventral to the capillaries in the posteriormost five neuropodia.

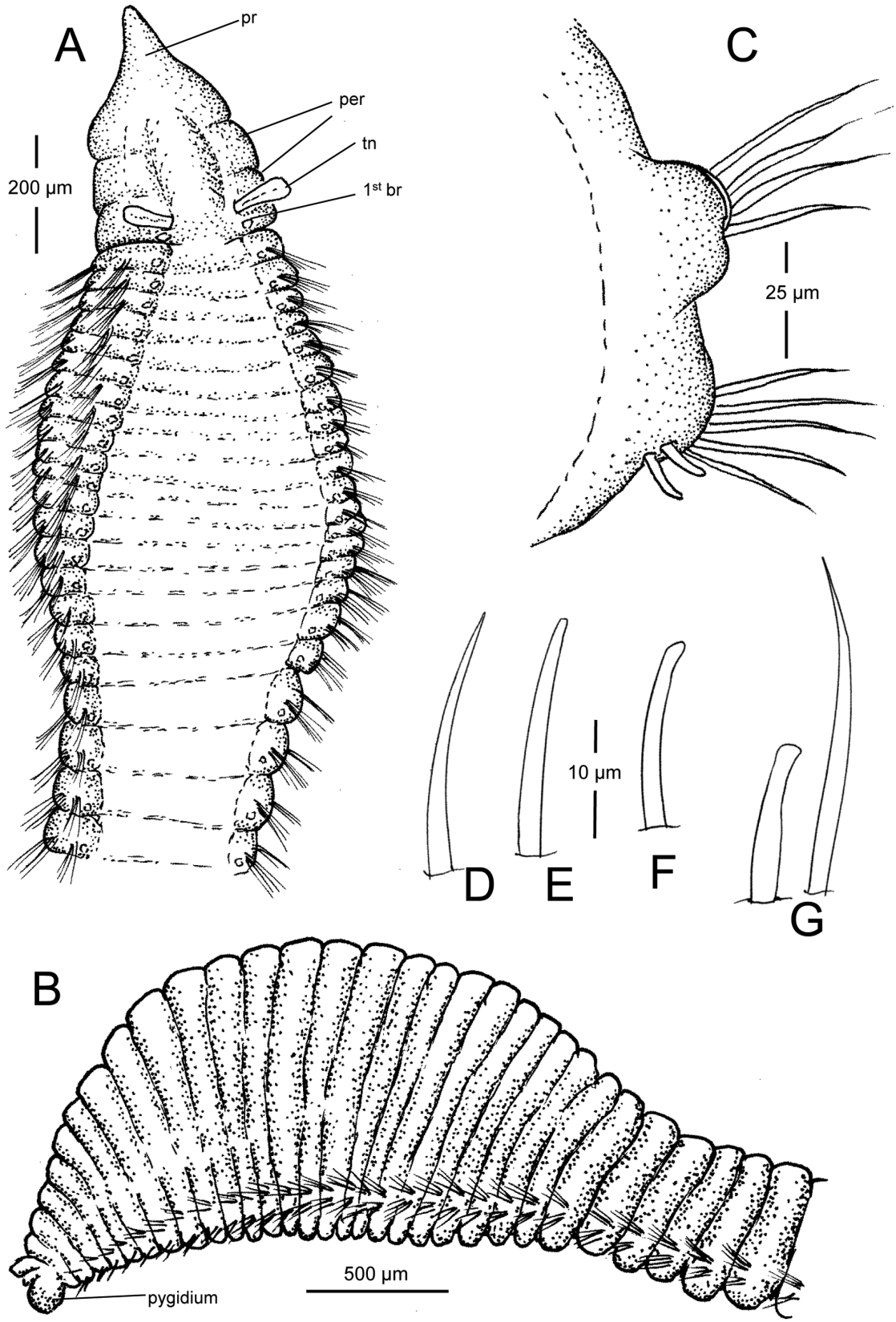

FIGURE 2. *Tharyx maryae* **n. sp.** Holotype (SMNH 8754): A, anterior end, dorsal view; B, posterior end, right lateral view; C, far posterior parapodium; D–G, posterior neuroacicular spines: D, pointed transitional spine from fifth to last setiger on body; E, blunt-tipped spine from fourth to last setiger on body; F, short blunt-tipped spine from second to last setiger on body; G, knob-tipped spine and capillary from last setiger on body. Abbreviations: br, branchiae; per, peristomium; pr, prostomium; tn, tentacle.

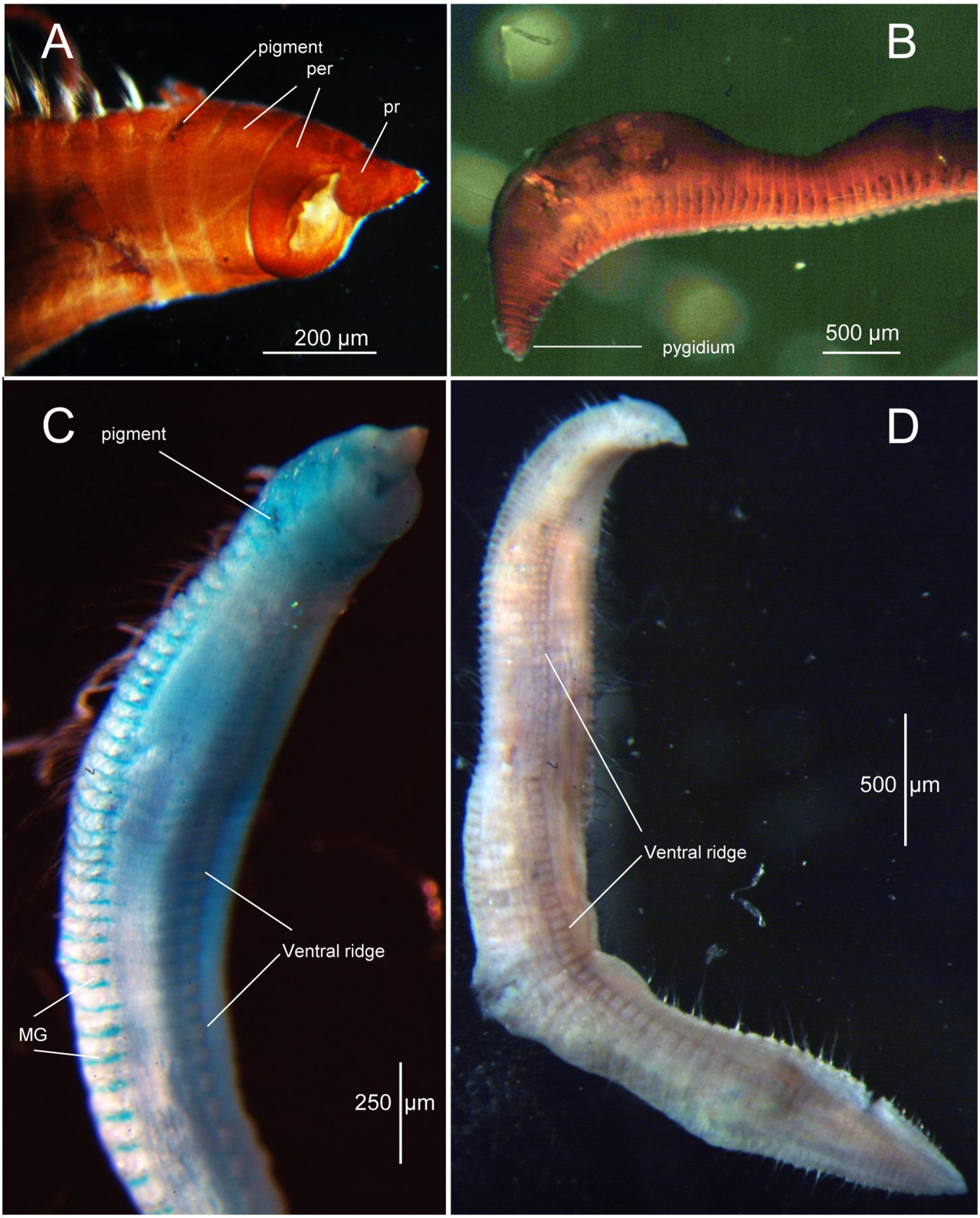

FIGURE 3. *Tharyx maryae* **n. sp.** Holotype (SMNH 8754): A, anterior end, right lateral view; B, posterior end, right lateral view. Paratype (SMNH 8755): C, anterior two thirds of body in ventrolateral view. *Tharyx robustus* **n. sp.** Holotype (SMNH 8756): D, entire animal in ventral view. A–B stained with Shirlastain A; C, stained with methyl green. Abbreviations: MG, methyl green; per, peristomium; pr, prostomium.

These spines transition from curved pointed setae among capillaries to short curved blunt-tipped spines with knob-like tips in the very last setigers. No spines were observed in the notopodia. Because the neuropodial spines are limited to the very posteriormost setigers, they will not be observed in fragmented specimens. Therefore other characters will be required in order to identify the species. Other features of the body are similar to related species of *Tharyx*. These include the raised crest on the peristomium, the occurrence of lateral black pigment spots on the peristomium; the position of the paired dorsal tentacles on the posterior margin of the peristomium followed by the first pair of branchiae also on the peristomium and the generally elongated form of the body. In addition, the methyl green staining pattern in conjunction with the paired peristomial pigment spots readily differentiates this species from other cirratulids observed in these collections.

Tharyx maryae **n. sp.** differs from all other species of the genus in having an expanded posterior end and with the neuropodial spines limited to the five posteriormost setigers. The expanded posterior end suggests a close relationship of *T. maryae* **n. sp.** with species of *Aphelochaeta* also having this character. Among eight species of *Aphelochaeta* described by Blake (1996) from the eastern Pacific, six species had the posterior end expanded in some form. Of these, none had the first pair of branchiae positioned immediately posterior to the dorsal tentacle on the peristomium as is typical for species of *Tharyx*. When branchiae were present on the peristomium, they were positioned lateral to the tentacles. There are no described species of *Aphelochaeta* from European waters that have characters similar to those of *T. maryae* **n. sp.**

Etymology. This species is named for the late Dr. Mary Elizabeth Petersen, in recognition of her numerous contributions to polychaete systematics and research on cirratulids.

Biology. The specimens of *Tharyx maryae* **n. sp.** were collected by one us (PG) in connection with a benthic macrofauna mapping project in sediments in and outside eelgrass (*Zostera marina*) beds near Varberg on the west coast of Sweden. Salinity and temperature variation in this shallow area is high (20–30 PSU; <0°C to >25°C). The worms occurred in four of 30 quantitative haps-corer samples, calculated to each contain 160–400 ind/m^2 with a biomass of <0.01–0.8 g/m^2 (variation in specimen length was 6–12 mm). These samples were taken at 0.3–1.7 m depth in coarse to fine sand with a low organic content (about 1–2 % loss on ignition) and almost no vegetation, outside or in the margin of the eelgrass bed. The associated fauna were relatively scarce in most samples (6–12 species and 3,093 ind/m^2) and were dominated by *Hediste diversicolor* (O.F. Müller, 1776), *Peringia ulvae* Pennant, 1777, *Tubificoides benedii* Udekem, 1855, and *Scoloplos armiger* (O.F. Müller, 1776). The fauna in the eelgrass beds was richer and more diverse in most samples, with a representation of polychaetes and several species of crustaceans and molluscs.

Both *Tharyx maryae* **n. sp** and *T. robustus* **n. sp.** (described below) were found in the same sample together with an anterior fragment of *Aphelochaeta* sp., also likely new to science. These specimens were taken in relatively fine sediment with higher organic content outside the eel grass beds where small patches of the algae *Ruppia* spp. and *Fucus vesiculosus* (Linnaeus, 1753) were found; however, cirratulids were recorded in sediments almost entirely free of vegetation in three of the four samples. These results suggest that *T. maryae* **n. sp.** and *T. robustus* **n. sp.** are very tolerant of variations in salinity and temperature and prefer relatively coarse sand with almost no vegetation and low competition from other species.

Distribution. Known only from the west coast of Sweden in low water.

***Tharyx robustus* new species**

Figures 3D, 4

Material examined. SWEDEN, Kattegat, near Varberg, 03 Aug 2012, in sediments near eelgrass beds, 57.11501°N; 12.22611°E, 0.3–1.7 m depth, coll. P. Göransson, holotype (SMNH 8756), six paratypes (SMNH 8757).

Description. A moderate-sized species, holotype complete, 8 mm long, 1.0 mm wide for 105 setigerous segments; paratypes include complete and incomplete specimens, 4–6 mm long, 0.5 mm wide, with 80–116 setigerous segments. Color in alcohol light tan to opaque white, with a cluster of black pigment on posterior lateral margins of peristomium (Fig. 4C); some specimens with brown pigment in lateral segmental grooves in middle of body. Body broad, dorsoventrally flattened throughout with numerous narrow segments (Figs. 3D, 4A–B). Anterior segments becoming widest at about setiger 15, continuing posteriorly, narrowing at about setiger 60, then

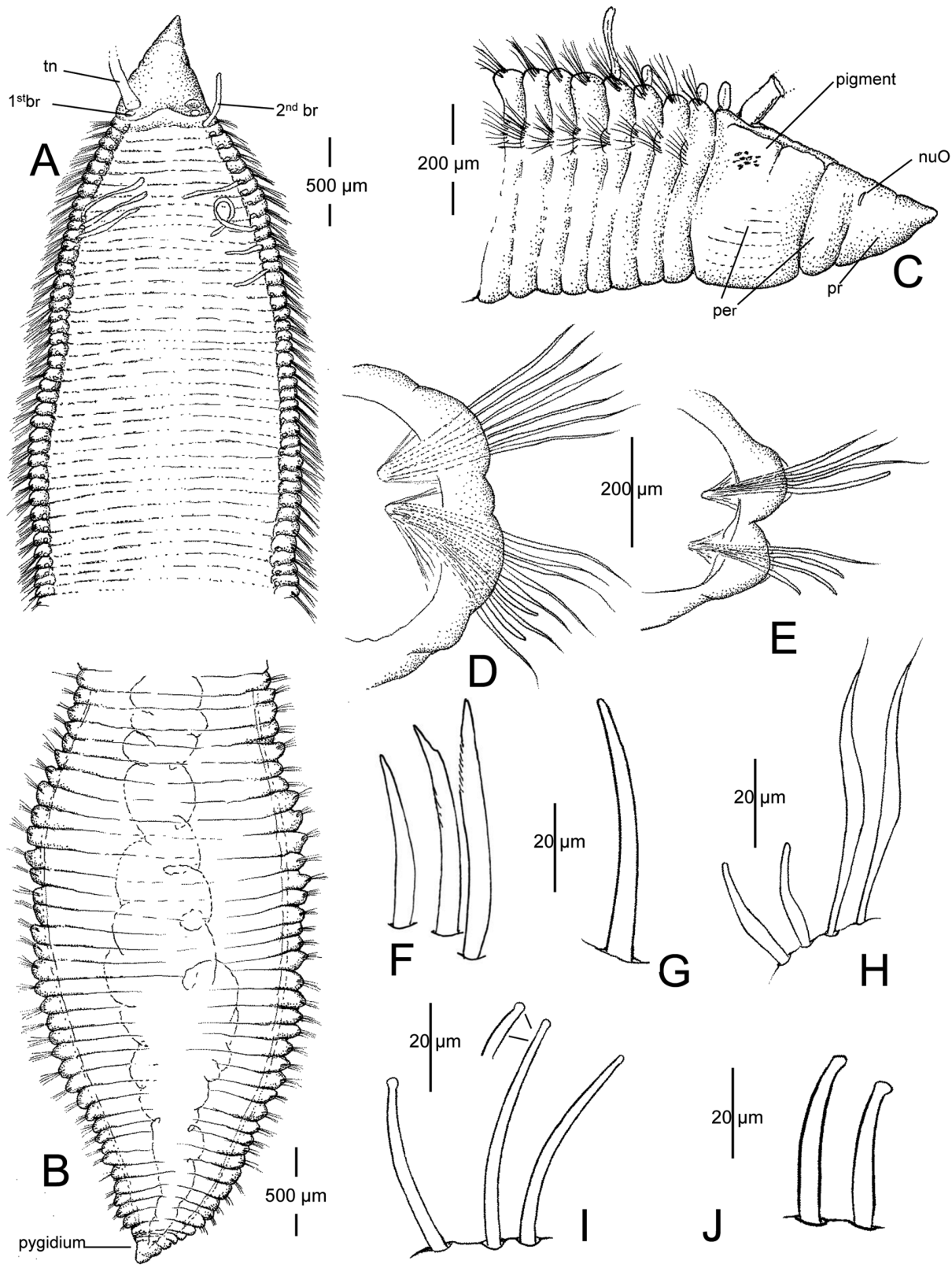

FIGURE 4. *Tharyx robustus* **n. sp.** Holotype (SMNH 8756): A, anterior end, dorsal view; B, posterior end, dorsal view; C, anterior end, right lateral view. Paratypes (SMNH 8757): D, posterior setiger 80, anterior view; E, far posterior setiger 90, anterior view; F, anteriormost notopodial aciculars transitional between capillaries and blunt-tipped spines (G); G, notopodial acicular spine from setiger 90 (E); H, neuroacicular spines and capillaries from setiger 80 (D); I, neuroacicular spines from E; J, detail of neuroacicular spines from another paratype. Abbreviations: br, branchiae; nuO, nuchal organ; per, peristomium; pr, prostomium; tn, tentacle.

expanding again in posterior region, narrowing in far posterior segments to a simple pygidium consisting of a narrow, conical lobe; anal cirri absent (Fig. 4B). Venter flattened, with shallow ventral groove bearing mid-ventral ridge formed of two raised pads where each segment meets at ventral mid-line (Fig. 3D).

Prostomium triangular, acutely pointed on anterior margin, broadening posteriorly (Figs. 3D, 4A, C); peristomium wider than long with weak dorsolateral groove forming two indistinct annuli (Fig. 4C). Nuchal organs inconspicuous, located on posterior margin of prostomium (Fig. 4C), not pigmented; eyes absent. Dorsal tentacles present on posterior margin of peristomium, with first pair of branchiae located immediately posterior to tentacles, also on peristomium (Figs. 4A, C); second pair of branchiae on posterior margin of setiger 1, medial to notosetal fascicle; in posterior setigers branchiae arise in middle of segment rather than on posterior margin.

Parapodia on both sides of body separated from broad dorsum by a narrow groove extending from peristomium to end of body; individual notopodia slightly elevated above this groove, less obvious in posterior one-third of body (Fig. 4A). Broad dorsum of body raised above parapodia, rounded, low, without mid-dorsal groove (Fig. 4A).

Noto- and neuropodia with setal fascicles arising close together (Figs. 4D, E), anterior parapodia with spreading fascicles of about 7–8 capillary setae in notopodia and 8–10 capillaries in neuropodia; in far posterior notopodia, 2–3 transitional pointed setae (Fig. 4F) occur with capillaries from about setiger 85 replaced by stiff elongate spines from about setiger 88–90 (Fig. 4H); neuropodial spines first present from setigers 80–90 with 3–7 capillaries and 1–3 short, spines with variable lengths (Figs. 4H–J); all spines blunt-tipped, with apex weakly expanded, knob-like (Figs. 4I–J). Transitional notopodial spines with angled pointed tip, sometimes with fibrils visible along shaft.

Methyl Green Stain. No distinct stain apparent; most of the body stains darkly, but de-stains rapidly leaving no pattern after differentiation. The prostomium and pygidium never retain stain.

Remarks. In having a robust dorsoventrally flattened body with crowded segments along its entire length, *T. robustus* **n. sp.** most closely resembles *T. retusisetus* (Hutchings & Murray, 1984) from New South Wales, Australia. The latter species however, has posterior spines with sub-bidentate knob-like tips that are typical of many species of *Tharyx* (Blake 1991, 1996). In contrast, the posterior spines of *T. robustus* **n. sp.** are variable in length and have only a single knob on the end of the spine and are only weakly expanded. None of these spines resemble the sub-bidentate spines found in several other species. The kind of transitional notopodial spines found in *T. robustus* has not been reported in other species, but may have been overlooked. The robust body and narrow crowded segments of *T. robustus* **n. sp.** are atypical for species of *Tharyx* and are more reminiscent of species of *Aphelochaeta*. However, another feature that allies this species with *Tharyx* is the position of the dorsal tentacles and first pair of branchiae. In nearly all previously described species of *Tharyx*, the tentacles occur on the peristomium with the first pair of branchiae occurring directly posterior to them, also on the peristomium (Blake 1991, 1996, 2015). This is exactly how these two structures are positioned in *T. robustus* **n. sp.** In addition, lateral peristomial pigment spots are present on *T. robustus* **n. sp.** These are known from other species of *Tharyx* including *T. kirkegaardi* Blake, 1991, *T. circacutus* Blake, 2015, *T. maryae* **n. sp.,** and other species as yet undescribed (Blake, pers. obs.). Such pigment has not been reported for species of *Aphelochaeta* or other bitentaculate cirratulids.

Etymology. The name of this species is derived from the word "robust," and refers to the nature of the overall body shape which is unlike most other species of *Tharyx*.

Biology. Same data as for *T. maryae* (see above).

Distribution. Known only from the west coast of Sweden in low water.

Discussion

Tharyx is a relatively small genus among the bi-tentaculate cirratulids; it was revised by Blake (1991) to include species having blunt- or knob-tipped spines in the posterior noto- and/or neuropodia. Five species were originally included in *Tharyx;* subsequent studies by Blake (1996, 2015) and Magalhães & Bailey-Brock (2013) increased the total number of described species to nine. *Tharyx retierei* described by Lechapt (1994) from the Atlantic coast of Morocco has aristate notosetae and pseudocompound neurosetae and does not otherwise agree with the generic definition of *Tharyx*. With the description of *T. maryae* **n. sp.** and *T. robustus* **n. sp.** in the present paper, there are

now 11 named species in the genus. Several additional species of *Tharyx* from the U.S. Atlantic and Gulf coasts, Antarctica, and deep-water off northern California are known, but to date are not described. When these additional taxa and others are described the genus will likely reach about 20 species. Morphological details of the 11 known species of *Tharyx* are presented in Table 1.

It has now been 24 years since Blake (1991) first redescribed *Tharyx* and restricted the genus to a small group of five species that shared a limited suite of characters. With six additional species now known and others soon to be described, the generic definition of *Tharyx* and other genera must inevitably change to accommodate newly discovered characters or variants of other characters.

Blake (2015) listed several important characters for defining species of *Tharyx*: (1) a long, narrow body shape, (2) location of the dorsal tentacles on the posterior part of the peristomium followed by the first pair of branchiae also on the peristomium, or, as in one species, on the anterior margin of setiger 1, (3) presence/absence of lateral peristomial pigment spots, (4) presence/absence of posterior notopodial acicular spines, and (5) nature of the posterior acicular spines. With regard to body shape, *Tharyx killariensis* redescribed here represents a typical species of *Tharyx* in all regards. However, both of the two new species have some characteristics that also occur in the genus *Aphelochaeta.*

Body shape. Except for *Tharyx retusisetus* and *T. robustus* ***n.*** **sp**., which have bodies that are broad throughout, all other species of *Tharyx* described to date have long, slender bodies beginning with a narrow elongated head region (prostomium + peristomium) and continuing through anterior, middle, and posterior segments. The anterior segments tend to be somewhat shorter and wider than middle and posterior segments, but a larger inflated thoracic region is generally lacking. *T. maryae* **n. sp.** is the first to have a moderately expanded thoracic region and an inflated posterior region. Middle body segments of most species of *Tharyx* are as long as wide, and in some species, middle and posterior segments are moniliform.

Ventral grooves and ridges. The nature of the venter has largely been ignored in previous accounts of bitentaculate Cirratulidae. In general, however, previously described species of *Tharyx* have a rounded or flattened venter that lacks the distinct and sometimes deep ventral grooves reported for some species of *Aphelochaeta* (Blake 1996). A weakly developed ventral groove was reported for *T. alaskensis* and *T. circacutus* by Blake (2015) and is also present in *T. acutus* (Blake 1991, unpublished). Both *T. maryae* **n. sp.** and *T. robustus* **n. sp.** have a prominent ventral ridge line composed of a distinct row of pads or blocks located between each segment along the mid-line. In *T. robustus* **n. sp.** the pads composing this ridge are divided into two per segment. A ventral ridge line also occurs in *T. acutus* (Blake unpublished) and has also been reported for several species of *Chaetozone* (Blake 2015); similar ridges have been observed in species of *Aphelochaeta* (Blake unpublished).

Location of the dorsal tentacles and first pair of branchiae. For both *T. maryae* **n. sp.** and *T. robustus* **n. sp.**, the dorsal tentacles are located on the posterior margin of the peristomium, immediately followed by the first pair of branchiae also on the peristomium as is typical for most species of *Tharyx.* In *T. alaskensis* the first pair of branchiae are on the anterior margin of setiger 1 and the second pair are on the posterior margin of the same setiger; *T. alaskensis* is the only species to date known to have the first two branchiae on setiger 1; Blake (2015) reported this arrangement for several species of *Chaetozone* and suggested that a segment anterior to the position of setiger 1 might have been lost because many species of that genus have a separate achaetous segment. To date, however, no evidence of a separate achaetous segment between the peristomium and setiger 1 has been identified in any species of *Tharyx*.

Presence/absence of lateral peristomial pigment spots. At least four described species of *Tharyx* have groups of black pigment on the posterior lateral margins of the peristomium: *T. kirkegaardi, T. circacutus*, *T. maryae* **n. sp.**, and *T. robustus* **n. sp.** When present, this pigment provides an immediate clue to the identity of the genus.

Presence/absence of posterior notopodial acicular spines. All species of *Tharyx* have neuropodial spines, but some, like *T. acutus* the type species, *T. circacutus*, and *T. maryae* **n. sp.**, lack notopodial spines. When present, notopodial spines may be of the same structure as the neuropodial spines as in *T. kirkegaardi* or of an entirely different kind as in *T. alaskensis*, *T. killariensis*, and *T. robustus* **n. sp.** Transitional notopodial spines that are pointed, but not capillary tipped have been observed on segments prior to the initiation of the knob-tipped spines in *T. robustus* **n. sp.**

Nature of the posterior acicular spines. The acicular spines of *Tharyx* species are typically geniculate or sigmoid shape in the neuropodia and variably shaped in the notopodia. Notopodial spines when present are usually

TABLE 1. Some taxonomic characters of 11 species of *Tharyx*.

Species/ Character	Body shape	Posterior segments	Prostomium	Nuchal organs	Number of Peristomial annulations	Tentacles	1st branchiae
T. acutus Webster & Benedict, 1887	Elongate, narrow, crowded segments	Thick, narrow, expanded laterally; small conical pygidium	Narrow, elongate, pointed	Narrow slits, not pigmented	2–3	Posterior margin of peristomium	Posterior to tentacles on peristomium
T. alaskensis Blake, 2015	Elongate, narrow, thicker in middle segments	Expanded, narrow crowded segments; ventral pygidial disk	Triangular, pointed on anterior margin	Small crescent-shaped; not pigmented	2–3	Posterior margin of peristomium	Posterior to tentacles on setiger 1; 2nd branchiae also on setiger 1
T. circacutus Blake, 2015	Elongate, slender, widest anteriorly, segments as wide as long in middle body	Segments as wide as long; near moniliform near end of body; pygidium small ventral lobe	Triangular, pointed on anterior margin	Small narrow slits surrounded by pigmented cells	1	Posterior margin of peristomium	Posterior to and lateral to tentacles on peristomium
T. killariensis (Southern, 1914)	Elongate, weakly expanded in middle segments	Narrowing posteriorly, pygidium a flattened rounded lobe	Triangular, tapering to pointed tip	Narrow slits, not pigmented	2–3 ventrally	Posterior margin of peristomium	Posterior to and lateral to tentacles on peristomium
T. kirkegaardi Blake, 1991	Elongate, narrow, thicker in middle segments	Tapering , smaller specimens with beadlike segments; pygidium small ventral lobe	Narrow, acutely, pointed	Narrow slits, not pigmented	1–2	Posterior margin of peristomium	Posterior to tentacles on peristomium
T. longisetosus (Hutchings & Murray, 1984)	Elongate, threadlike	Narrow, tapering to ventral flattened flange-like pygidium	Short, conical, pointed tip	Not observed	3	Posterior margin of peristomium	Posterior to and lateral to tentacles on peristomium
Tharyx maryae **n. sp**	Elongate expanded anteriorly; narrow in middle; with enlarged posterior end	Enlarged, swollen posterior end tapering to pygidium with bulbous ventral lobe	Triangular, narrowing to pointed tip	Narrow slits, not pigmented	2	Posterior margin of peristomium	Posterior to tentacles on peristomium
T. parvus Berkeley & Berkeley, 1929	Narrow anteriorly, thick in thoracic region; segments becoming longer in mid-body	Thick, tapering to simple pygidial lobe; venter flattened, weakly concave	Short, narrowing to pointed tip	Not observed	1	Posterior margin of peristomium	Posterior to tentacles on peristomium
T. retusisetus (Hutchings & Murray, 1984)	Broad, swollen, flattened in middle segments, tapering posteriorly	Dorso-ventrally flattened, tapering to broad, flattened, cup-shaped pygidium	Short, conical, rounded on anterior margin	Not observed	3	Posterior margin of peristomium	Posterior to and lateral to tentacles on peristomium; branchiae absent on setiger 1
T. robustus **n. sp.**	Broad, dorsoventrally flattened throughout with numerous narrow segments	Narrowing posteriorly to simple, pointed pygidial lobe	Triangular, acutely pointed on anterior margin	Slit-like, not pigmented	1	Posterior margin of peristomium	Posterior to tentacles on peristomium
T. tumulosus Magalhães & Bailey-Brock, 2013	Slender, elongate, thorax weakly expanded	Narrowing posteriorly, segments weakly moniliform; pygidium simple rounded lobe	Elongate, triangular, pointed on anterior margin	Vertical slits, not pigmented	3	Posterior margin of peristomium	Posterior and lateral to tentacles on setiger 1; 2nd branchiae also on setiger 1

……continued on the next page

TABLE 1. (Continued)

Species/ Character	Peristomial pigment spots	Methyl Green stain	Posterior notopodial spines	Posterior neuropodial spines	Geographic Distribution	Reference
T. acutus Webster & Benedict, 1887	Absent	Present, on body segments as dorsal bands, weak ventrally	Absent	Begin far posterior setigers; recurved, with knobby tip	U.S. Atlantic coast, shelf depths	Blake 1991; Blake, unpublished
T. alaskensis Blake, 2015	Absent	Absent	From posterior one-third; spinous, straight, blunt tips	From mid-body; curved, geniculate, with blunt tips	Alaskan arctic, subtidal	Blake 2015
T. circacutus Blake, 2015	Present	Present on body segments	Absent	From mid-body; curved, geniculate, blunt tips	Puget Sound, subtidal	Blake 2015
T. killariensis (Southern, 1914)	Absent	Absent	From far posterior setigers (ca. 56); spines thin, straight with blunt tip	From far posterior setigers (ca. 51); spines thick, curved, geniculate, with 2 weakly developed knobs	Northern Europe, subtidal	Southern 1914; this paper
T. kirkegaardi Blake, 1991	Present	Head heavily stained with clear ocular areas; venter with bands on anterior segments	From far posterior setigers; curved with flattened tips and subapical serrations	From posterior one-third of body, curved, with flattened tip and subapical serrations	U.S. Atlantic & eastern Pacific slope and abyssal depths	Blake 1991, 1996
T. longisetosus (Hutchings & Murray, 1984)	Absent	?	From far posterior setigers; spines, same as neuropodial spines	From posterior one-third; hooks with, tapering shaft and flattened knob-like tip	Australia, NSW, shallow subtidal	Hutchings & Murray 1984
Tharyx maryae **n. sp**	Present	In inter-segmental grooves; weak along mid-ventral ridge	Absent	Posterior-most (ca. 5) segments; pointed spines transition to short, curved, knob-tipped spines	Sweden, shallow subtidal	This paper
T. parvus Berkeley & Berkeley, 1929	Absent	Speckles on dorsum of some anterior setigers; some intersegmental stain	From far posterior setigers; spines same as neuropodial spines	From far posterior setigers; spines curved, knob-tipped	NE Pacific, shallow subtidal	Blake 1996
T. retusisetus (Hutchings & Murray, 1984)	Absent	?	From far posterior setigers (ca. 70); hooks with knob-like tip	From mid-body setigers ca. 45); hooks with knob-like tip	Australia, NSW, subtidal	Hutchings & Murray 1984
T. robustus **n. sp.**	Present	No Pattern	From far posterior setigers transition from pointed spines to narrow blunt-tipped spines	From far posterior setigers; hooks short, curved, with pointe or knob-like tips	Sweden, shallow water	This paper
T. tumulosus Magalhães & Bailey-Brock, 2013	Absent	No pattern, body stains uniformly	From far posterior setigers; short and long with knob-like tips and serrated shaft	From far posterior setigers; short and long with knob-like tips and serrated shaft	Hawaii, off Oahu, subtidal	Magalhães & Bailey-Brock, 2013

less geniculate or curved, and narrower as in *T. alaskensis* and *T. killariensis.* Tips of the acicular spines are blunt-tipped, flattened, or with an irregular shape that is knobby or sub-bidentate but not distinctly bidentate as in species of *Caulleriella*. The shaft immediately below the curved tip may be finely serrated as in *T. kirkegaardi*. In the present study, the notopodial spines of *T. robustus* **n. sp.** have been found to transition from a pointed spine with an angled tip to one with a blunted tip. Similarly, in *T. maryae* **n. sp**., the neuropodial spines are initially long and narrow, transitioning into short, curved spines with knob-like tips. It is likely that other species, upon further study, will be found with transitional spines.

Capillaries do not alternate with spines in posterior segments as in species of *Chaetozone*. Instead, the ventral spines of the neuropodia and dorsal spines of the notopodia grade into capillaries that become progressively longer and thinner. Further, the short, geniculate or sigmoid shape of the neuropodial and some notopodial spines of *Tharyx s*pecies are entirely different from the longer, more numerous and robust spines found in species of *Chaetozone*. Overall, the spines of *Tharyx* species are inconspicuous to an observer using a stereomicroscope when compared to the larger conspicuous armature of *Chaetozone* species (see Blake 2000, 2006, 2015).

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