



Psychropotid holothurians (Echinodermata: Holothuroidea: Elasipodida) collected at abyssal depths from around the Crozet Plateau in the Southern Indian Ocean*

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Abstract

Seven species of holothurians of the family Psychropotidae were collected during the cruise D300 of RRS *Discovery* to Crozet plateau. Three of them, *Benthodytes wolffi*, *Psycheotrepes discoveryi* and *Psychropotes xenochromata* are described as new to science. One species, *Benthodytes abyssicola* Théel, regarded recently as *incertae sedis*, is re-described with designation of a lectotype. Additional notes are provided to descriptions of *Psychropotes scotiae* (Vaney) known from two specimens and *Psychropotes longicauda* Théel, the cosmopolitan highly variable species.

Key words: *Benthodytes*, *Psycheotrepes*, *Psychropotes*, Psychropotidae, new species

Introduction

Holothurians of the family Psychropotidae are among the least studied deep-sea holothurians. The family was defined by Théel (1879, 1882, 1886), who erected four new genera and 14 new species based on the collection of H.M.S. *Challenger*. Subsequently 34 species were described by Verrill (1884), von Marenzeller (1893), Ludwig (1894), Perrier (1896), Hérouard (1896, 1902), Sluiter (1901a, 1901b), Koehler and Vaney (1905), Vaney (1908), Ohshima (1915), H.L. Clark (1920) and Belyaev and Vinogradov (1969). Three of them were later transferred to other orders of holothurians. Many of remaining 31 species were synonymized by Hansen (1975), who revised the family. Hansen also regarded the genus *Euphronides* Théel as a synonym of the genus *Psychropotes* Théel and described five new species. To date the family includes three genera and 22 species. Despite Hansen's great contribution to our knowledge of the Psychropotidae, the status of many species in the family remains unclear. In particular, many problems remain with the cosmopolitan and highly variable species *Psychropotes longicauda* Théel and *P. depressa* (Théel). After Hansen's monograph only a few publications on the taxonomy of the Psychropotidae have appeared (Pawson 1985, Massin & Sibuet 1983 and Gebruk 2008) and the family requires further study.

During the D300 cruise of RRS *Discovery* to Crozet Plateau in December 2005–January 2006 seven species of Psychropotidae were collected. Three of them, *Benthodytes wolffi*, *Psycheotrepes discoveryi* and *Psychropotes xenochromata*, are new to science. One species, *Benthodytes abyssicola* Théel, regarded as *incertae sedis* by Hansen (1975), is re-described following a re-examination of the type series. Additional notes are presented on the morphology and distribution of *Psychropotes scotiae* (Vaney) and *P. longicauda*.

Material and methods

Psychropotid holothurians were collected around the Crozet Plateau using a semi-balloon otter trawl at six stations located in two sites under different productivity regimes (Wolff 2006; Hughes *et al.* 2007). One site (M5) was in a eutrophic area with high input of organic matter located in the east to north-east of the plateau. The second site (M6) was sampled under a high nutrient low chlorophyll area located to the south of the plateau (Table 1).

TABLE 1. Data on trawl stations of D300 cruise of RRS *Discovery*.

Site	Station Nr	Latitude, S	Longitude, E	Depth, m	Date
M5	15773#8	45°43.06'	56°32.16'	4258–4290	12 Dec 2005
M5	15773#17	45°43.47'	56°36.66'	4301–4283	15 Dec 2005
M5	15773#23	45°40.05'	56°35.27'	4269–4275	16 Dec 2005
M5	15773#32	45°40.45'	56°33.70'	4267–4270	20 Dec 2005
M6	15775#4	48°56.21'	51°03.90'	4182–4195	27 Dec 2005
M6	15775#13	49°01.15'	51°04.52'	4187–4191	29 Dec 2005

Holothurians were preserved in 4% buffered formaldehyde and later transferred to 80% ethanol. All the type specimens of the new species are stored at Natural History Museum in London (UK), other material from the D300 cruise is deposited in National Oceanography Centre in Southampton (UK).

Additional material including type material was obtained from the following museums and research centres:

National Oceanography Centre, Southampton, United Kingdom (NOC);

Natural History Museum, London, United Kingdom (NHM);

Swedish Museum of Natural History (SMNH);

Zoological Museum, Natural History Museum of Denmark, University of Copenhagen (ZMUC).

Systematic Part

Order Elasipodida Théel, 1882

Suborder Psychropotina Hansen, 1975

Family Psychropotidae Théel, 1882

Genus *Benthodytes* Théel, 1882

Benthodytes wolffi sp. nov. Rogacheva and Cross

(Fig. 1)

Holotype: NHM 2008.988, Specimen 9.5 cm long and 2.3 cm wide. RRS *Discovery*, Cruise D300, St. 15773#17, 15 December 2005, 45°43.47'S 56°36.66'E, 4283–4301 m, semi-balloon otter trawl.

Paratypes: NHM 2008.989, 1 specimen 10.0 cm long and 2.7 cm wide; NHM 2008.990, 1 specimen 9.2 cm long and 2.0 cm wide; Cat. Nr NHM 2008.991, 1 specimen 9.0 cm long and 2.0 cm wide; NHM 2008.992, specimen 10.2 cm long and 2.7 cm wide. RRS *Discovery*, Cruise D300, St. 15773#17, 15 December 2005, 45°43.47'S 56°36.66'E, 4283–4301 m, semi-balloon otter trawl.

Other material examined: RRS *Discovery*, Cruise D300, St. 15773#8, 3 specimens; St. 15773#23, 1 specimen; St. 15773#32, 19 specimens; St. 15775#4, 13 specimens; St. 15775#13, 26 specimens.

Type locality: Southern Indian Ocean, north-east and south of the Crozet Islands, depth 4182–4301 m.

Etymology. The species was named after George Wolff, the principal scientist on the RRS *Discovery* cruise D300 to Crozet plateau, for his research on the nutrition of deep-sea holothurians.

Diagnosis. Body elongate. Colour in alcohol light violet. Body wall thick and soft. Brim well developed with clearly visible dark violet ambulacral channels. 7 pairs of well developed dorsal papillae up to 7 mm in length arranged in 2 single rows, evenly distributed. 20 tentacles. Deposits absent.

Description of the holotype. Specimen 10.0 cm long and 2.7 cm wide (Fig. 1: A, B). Body convex on the dorsal side especially on the mid-dorsal interradius and more flattened on both right and left dorsal interradii. Skin partially sloughed off. Colour light violet to brownish. Brim with tips of enclosed tube feet and dark coloured ambulacral channels clearly visible. Some of 20 tentacles retracted into pockets. Midventral tube feet 23 pairs. Papillae up to 5 mm in length. Genital papilla clearly visible, slightly smaller than dorsal papillae.

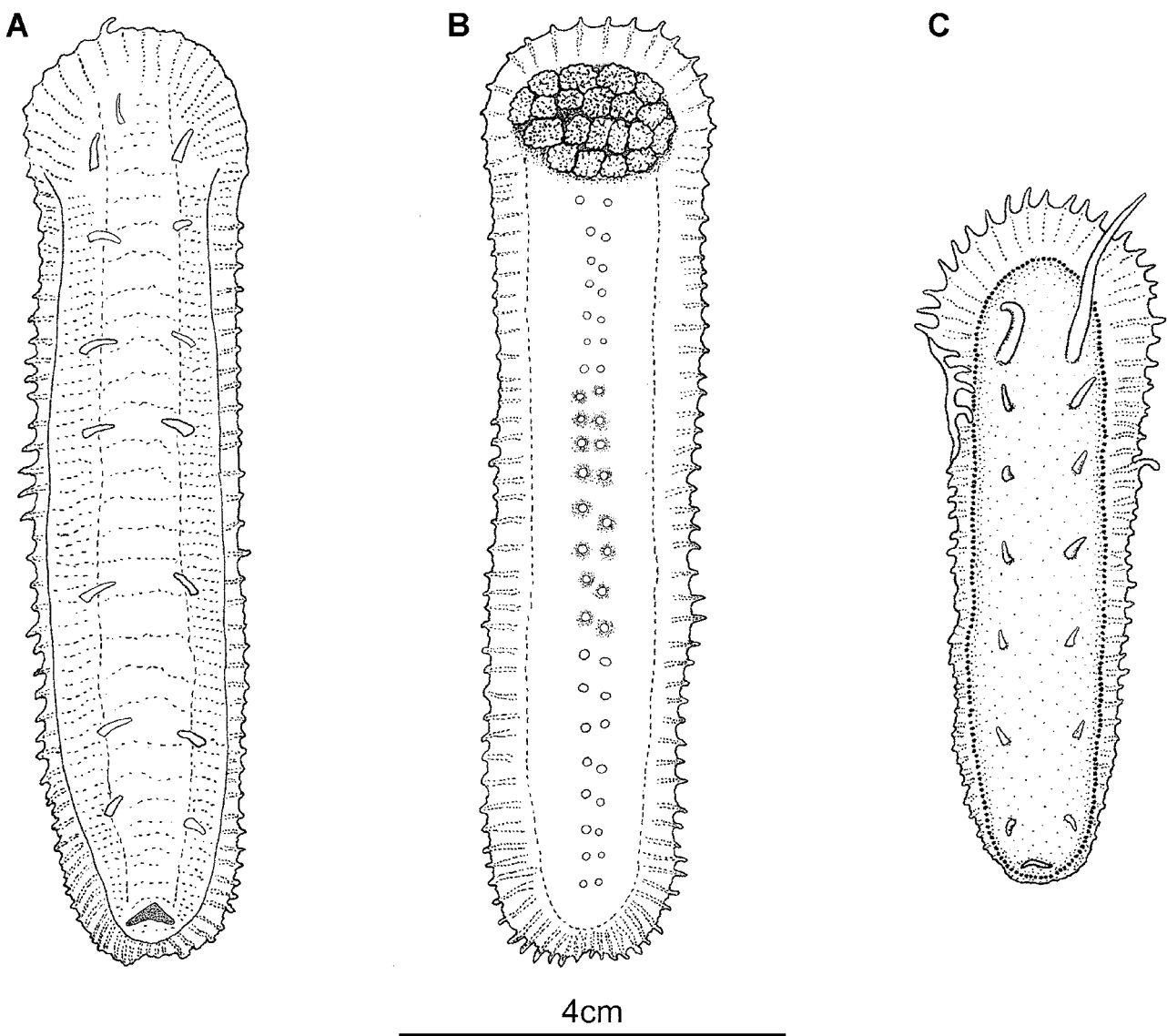


FIGURE 1. *Benthodytes wolffi* sp. nov., holotype. A, dorsal view; B, ventral view; C, specimen from St. 15775#13.

Description. The material is damaged: most specimens lack parts of the skin, some papillae and tentacles; tentacle discs strongly deformed. Body flattened ventrally and slightly convex dorsally. The ratio 'body length: maximum width' varies from 3.7 to 4.6 in a preserved state. Body almost of the same width along the whole length, head-like part of the body slightly wider and posterior end slightly tapered. Skin thick,

sometimes covered with warts. Colour light violet in alcohol. Brim damaged, reaching approximately 0.5 cm; best developed around anterior and posterior parts of the body. Tentacles retracted into pockets. Circum-oral papillae visible in some paratypes. Midventral tube feet about 25 pairs, arranged in a double row, slightly randomly distributed over the mid-ventrum. In one specimen 4 pairs of additional tube feet are in the middle of the ventrum outside the midventral double row; they are darker and of the same size as tube feet within the row. 7 pairs of equally sized dorsal papillae up to 0.5 cm in length. 4 pairs are located on the anterior half of dorsum and the remaining 3 on the posterior half; many paratypes are incomplete and lack papillae. The fourth pair of papillae is closest to the middle of dorsum. In two specimens from St. 15775#13 first pair of papillae is longer significantly, up to 3 cm in length (Fig. 1: C). Genital papilla visible in the holotype and some of the paratypes, located anteriorly from the first pair of dorsal papillae. Deposits absent in the body wall, papillae and tentacles.

Relationships. *Benthodytes wolffi* sp. nov. differs from other species of the genus in having seven pairs of well-developed papillae and twenty tentacles. *B. wolffi* is most closely related to *B. typica* Théel in tentacle number and the size and form of the brim.

The presence of longer papillae in two specimens from St. 15775#13 is a result of condition of preservation. *B. wolffi* probably has long papillae which, however, retract in most specimens during fixation.

***Benthodytes sanguinolenta* Théel, 1882**

(Fig. 2)

Benthodytes sanguinolenta Théel, 1882: 104–105, Pls. XXIII, XL: 4–5, XLII: 6; Ludwig, 1894: 53–60, Pl. I: 1–8; Koehler and Vaney, 1905: 72; Clark, 1913: 233; Ohshima, 1915: 245; Clark, 1920: 142; Clark, 1923a: 162; 1923b: 420; Heding 1940: p. 367; Hansen, 1956: 44–45; 1975: 94–96; Pls. III–VI, IX: 6–7, XII: 4–5; Carney and Carey, 1976: 69; Pawson, 1982: 129–145; Bluhm and Gebruk, 1999: 175, Fig. 3D; Gebruk, 2008: 50, 51.

Material examined: RRS *Discovery*, Cruise D300, St. 15773#8, 28 specimens; St. 15773#17, 101 specimens; St. 15773#23, 133 specimens; St. 15773#32, 79 specimens; St. 15775#4, 11 specimens; St. 15775#13, 17 specimens.

Description of the material. Specimens varying in length from 50 to 350 mm. Body very elongated, with a posterior taper, flattened at the anterior end (Fig. 2: A, B). The ‘body length: maximum width’ ratio was approximately 5.6–5.8; the body is widest at the anterior end. Brim narrow due to contraction and widest at the posterior end. Colour in alcohol ranging from dark violet to violet. Tentacles (Fig. 2: C) 18; a few specimens have 17 probably due to the loss of a tentacle. Post-oral papillae usually 17 (16–18) well developed. Midventral tube feet 47 pairs in a 20 cm long specimen. Dorsal papillae minute, retracted, often only dark coloured water-vascular canals can be found. Dorsal papillae arranged in 2 bands with 1–4 papillae edgewise in a band, narrowing to 1–2 papillae edgewise in a band at posterior end. Sometimes papillae present between the 2 bands. Immediately behind the gonopore, papillae are scattered irregularly, not forming bands. Deposits not found.

Remarks. Specimen morphology fits within the known range of variation of this species, described in detail by Théel (1882) and Hansen (1975).

Distribution. *Benthodytes sanguinolenta* is a well known cosmopolitan species. It has been found in the Atlantic (Mid-Atlantic Ridge, Peru Basin, near Bahama Islands), Pacific (Tasman Sea, Kermadec Trench, off Panama isthmus, Japan and from the Cascadia basin), Indo-Pacific region, South Africa and the Bay of Bengal. The new material from off the Crozet Islands represents the southernmost known record. Depths 768–7250 m.

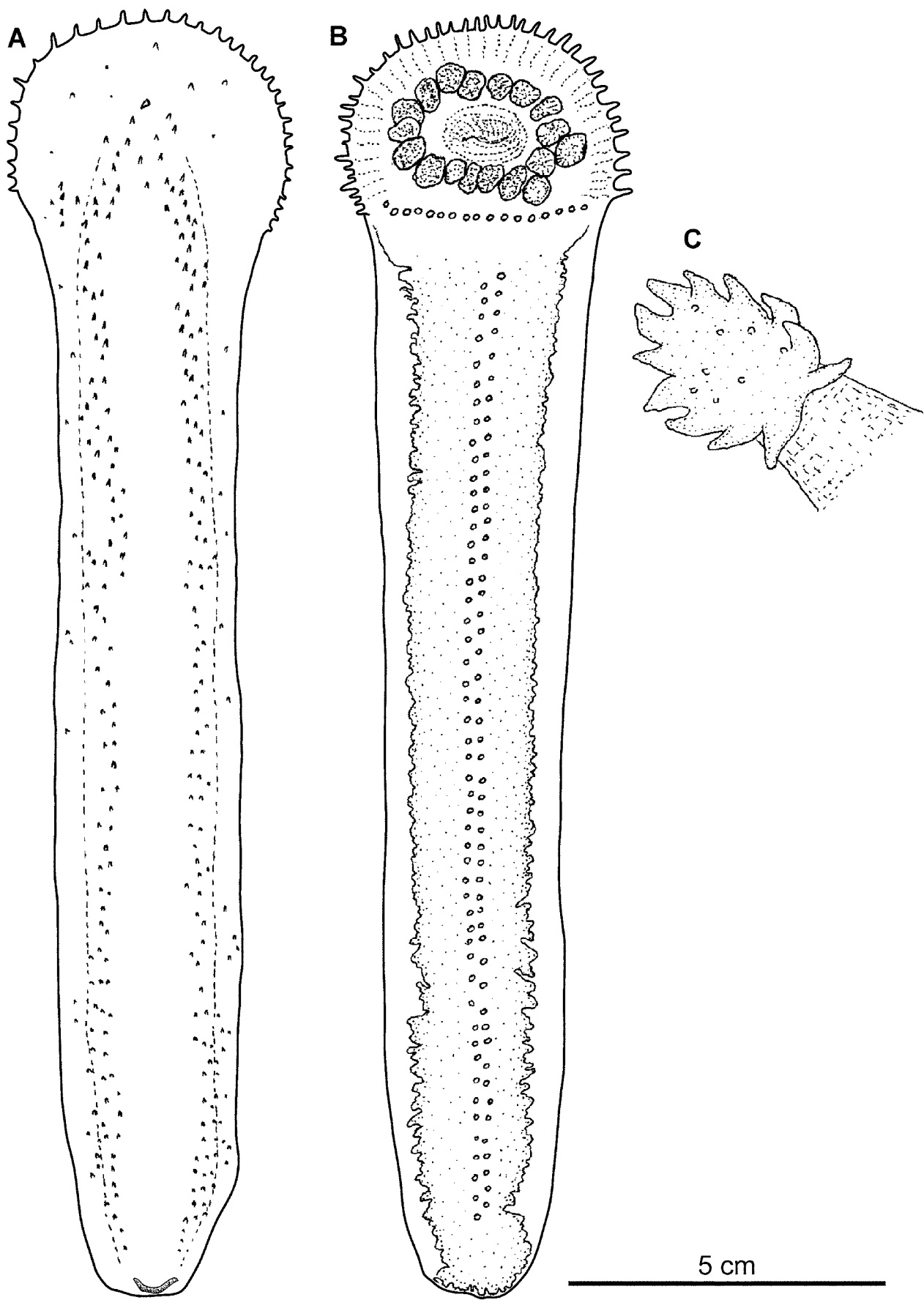


FIGURE 2. *Benthodytes sanguinolenta*, St. 15773#23. A, dorsal view; B, ventral view; C, tentacle.

Benthodytes abyssicola Théel, 1882

(Figs 3–4)

Benthodytes abyssicola Théel, 1882: 106–108, Pl. XXXVI, Fig. 26, 27; XXXVIII, Figs 1–3, XLVI, Figs 9–10.

Benthodytes abyssicola: (incertae sedis) Hansen, 1975: 76.

Benthodytes sordida Théel, 1882: 108–109, Pl. XXIV.

Benthodytes sordida: (incertae sedis) Hansen, 1975: 76.

non *Benthodytes sordida*: Walker *et al.*, 1987: 277–282.

Lectotype (here designated): SMNH Type–7383 (old number 221), H.M.S. *Challenger* St. 298, November 17, 1875, 34°7'S 73°56'W, 2225 fathoms (4072 m), bottom temperature 1.3°C, grey mud. Original label: “N 221, *Benthodytes abyssicola*, Lat. 34°7'S, Long. 73°56'W, 2225 fms, Challenger-Exp.” Specimen 18 cm in length and 6 cm in maximum width.

Paralectotypes: NHM 83.6.18.73, labelled as “*Benthodytes abyssicola*”, H.M.S. *Challenger* St. 298, November 17, 1875, 34°7'S 73°56'W, 2225 fathoms (4072 m), bottom temperature 1.3°C, grey mud, 3 specimens 12.5 cm, 17 cm and ~20 cm long.

NHM 83.6.18.77, labelled as “*Benthodytes sordida*”, H.M.S. *Challenger* St. 298, November 17, 1875, 34°7'S 73°56'W, 2225 fathoms (4072 m), bottom temperature 1.3°C, grey mud, 1 specimen 22 cm long;

NHM 83.6.18.76, labelled as “*Benthodytes sordida*”, H.M.S. *Challenger* St. 158, March 7, 1874, 50°1'S 123°4'E, 1800 fathoms (3294 m), bottom temperature 0.3°C, globigerina ooze, 1 specimen 20 cm long.

NHM 83.6.18.75, labelled as “*Benthodytes sordida*”, H.M.S. *Challenger* St. 157, March 7, 1874, 53°55'S 108°35'E, 1950 fathoms (3569 m), diatom ooze, 1 specimen 23 cm long.

NHM 83.6.18.74, labelled as “*Benthodytes sordida*”, H.M.S. *Challenger* St. 156, February 26, 1874, 62°26'S 95°44'E, 1975 fathoms (3614 m), diatom ooze, 1 specimen 20 cm long.

Other material examined: RRS *Discovery*, Cruise D300, St. 15773#8, 8 specimens; St. 15773#17, 33 specimens; St. 15773#23, 68 specimens; St. 15773#32, 29 specimens; St. 15775#4, 18 specimens; St. 15775#13, 3 specimens.

Diagnosis. Body elongate. Colour in alcohol dark violet. Skin gelatinous. Maximum body width at middle of body. Tentacles 15; circum oral papillae present. Brim narrow, retractile. Midventral tube feet in double row; in middle of ventrum tube feet may be arranged in single zigzag row. Dorsal papillae arranged in 2 rows: 3–4 pairs of large papillae and 1–5 pairs of minute papillae anterior to the first pair of large papillae or between larger ones; sometimes minute unpaired papillae present. Large papillae evenly distributed along dorsum: first pair located on anterior third fourth of dorsum; second pair situated close to middle of dorsum, third pair on posterior third quarter or posterior one third of dorsum; fourth pair if present situated close to anus. Deposits large primary crosses with central bipartite apophyses scattered on dorsum and ventrum. Rods present in tentacles, papillae and tube feet.

Description of the lectotype. Specimen 18 cm in length and 6 cm wide at the maximum point, which lies in anterior half close to middle of body; body tapered to posterior end; body flattened ventrally, slightly convex dorsally (Fig. 4: C, D, E). Skin rather thin. Colour in alcohol brownish. Brim retracted, less than 0.5 cm in width. Tentacles 15 with conspicuous knobs on disc margin. Circum-oral papillae scarcely visible. Midventral tube feet about 30 pairs. Dorsal papillae 8 pairs: 3 pairs of large papillae and 5 pairs of minute ones. First pair of papillae minute, located anterior to gonopore. 3 pairs of minute papillae between first and second pairs of large papillae. No minute papillae between second and third pairs of large papillae. Large papillae increase in size towards posterior of body. Deposits not preserved.

Description of paralectotypes. NHM 83.6.18.73 (Fig. 4: F, G). Only one specimen 12.5 cm long is in satisfactory condition. Two others are strongly damaged and dissected. The specimen has elongate body with maximum width at mid-body. Tentacles 15. Brim narrow. Circum-oral papillae visible. 6 pairs of dorsal papillae and 4 unpaired papilla; 3 pairs of these papillae slightly larger than others; anterior pair located obliquely on first third of dorsum; other 2 pairs on middle and posterior thirds respectively. Deposits not found in body wall and tentacles.

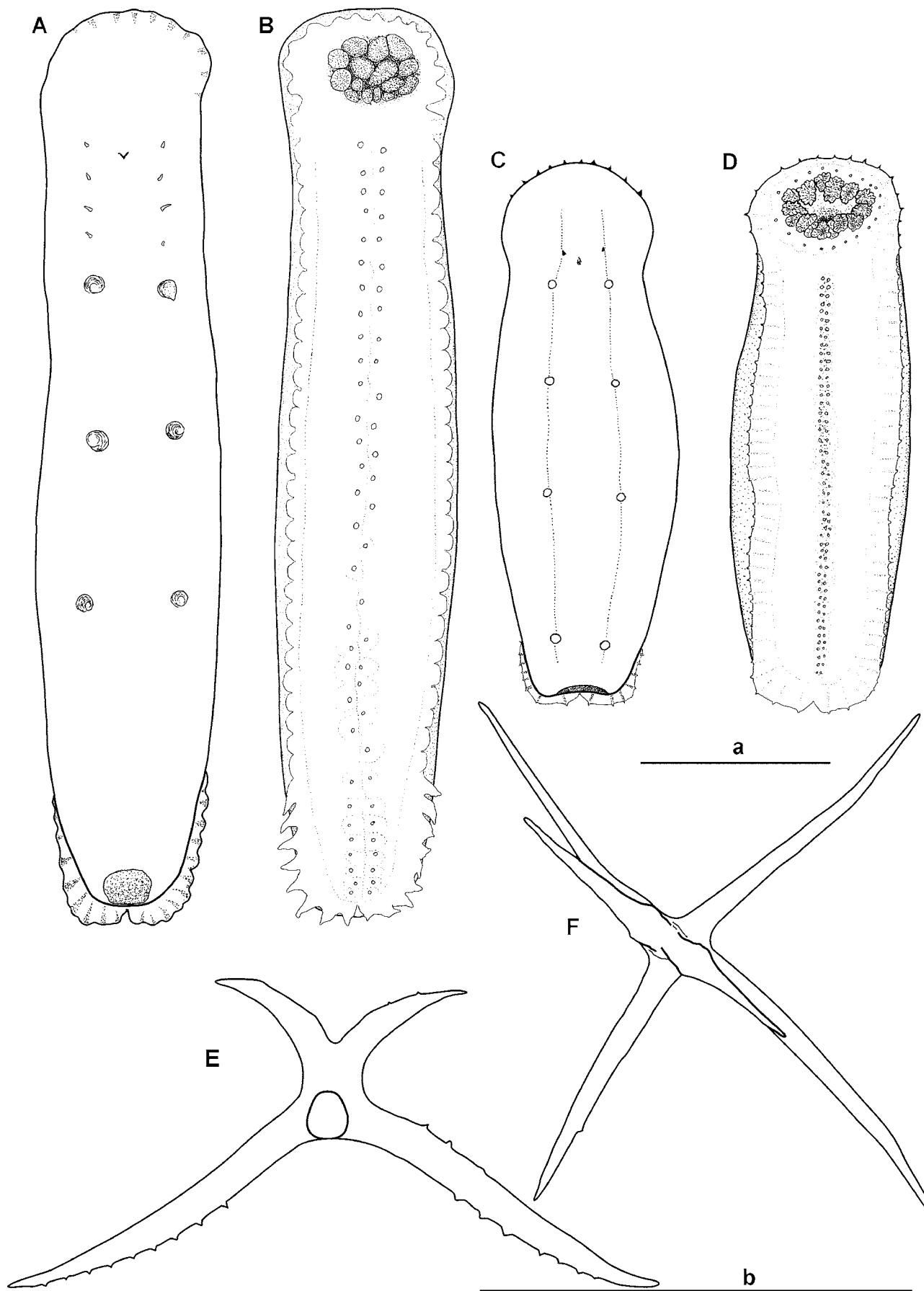


FIGURE 3. *Benthodytes abyssicola*. St. 15773#17 (scale a=5 cm). A, dorsal view; B, ventral view. St. 15773#4 (scale a=5 cm). C, dorsal view; D, ventral view. E, F dorsal deposits (scale b=0.5 mm).

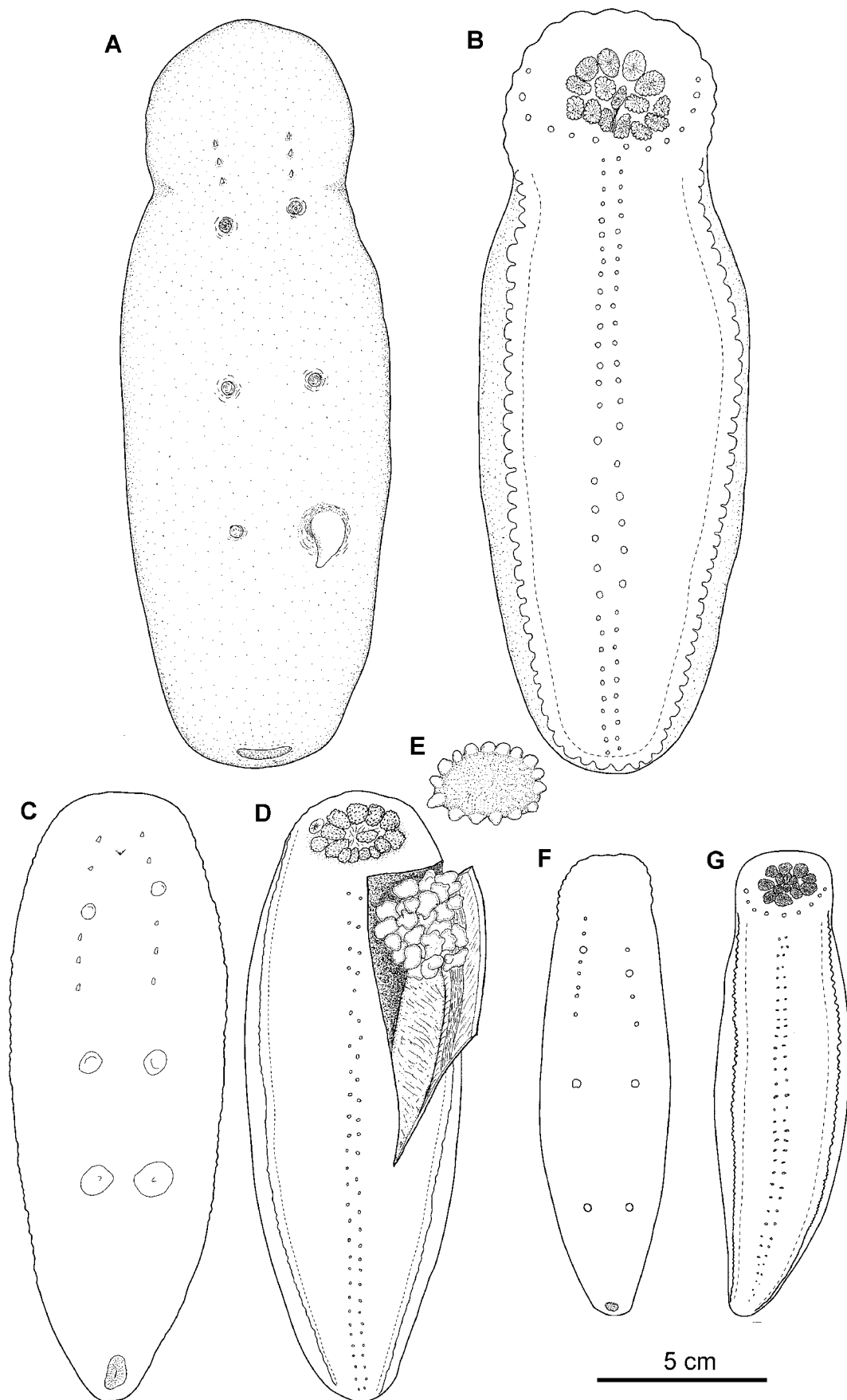


FIGURE 4. *Benthodytes abyssicola*. Paralectotype NHM Cat. Nr. 83.6.18.77. A, dorsal view; B, ventral view; Lectotype C, dorsal view; D, ventral view; E, tentacle disc; Paralectotype NHM Cat. Nr. 83.6.18.73. F, dorsal view; G, ventral view.

NHM 83.6.18.74. Specimen approximately 20 cm in length, strongly damaged. Colour brownish-purple. 3 pairs of minute papillae anterior to 3 pairs of large papillae and 1 pair of minute papillae between middle and posterior pairs of large papillae.

NHM 83.6.18.75. Specimen 23 cm in length and 8 cm in maximum width. Body tongue-shaped, flattened. Colour dark violet. Brim retracted, very narrow. Tentacles 15. 5 pairs of minute papillae anterior from 3 pairs of large papillae. Posteriormost pair of papillae is the largest. Deposits not found.

NHM 83.6.18.76. Specimen 20 cm in length; strongly deformed. Color of dorsum brownish with light violet spots; ventrum dark brown. 15 tentacles in deep pockets. Number and arrangement of both minute and large papillae are as in the paralectotype 83.6.18.77. Posteriormost pair of large papillae larger than others. Deposits not found.

NHM 83.6.18.77 (Fig. 4: A, B). Specimen 22 cm long, maximum width about 8 cm at middle of body; anterior one fourth flattened and defined by dorsal constriction. Skin thin, wrinkled, light brownish dorsally and dark brown ventrally. 3 pairs of minute papillae and 3 pairs of large papillae. Tentacles 15, 2 missing; tentacle discs flattened, with small rounded protuberances in wrinkles. Circum-oral papillae clearly visible. Brim narrow; ends of enclosed tube feet clearly visible. Midventral tube feet more than 30 pairs. Minute papillae anterior to anteriormost large pair. Right papilla of posterior pair significantly larger than left. Deposits not preserved.

Description of the Discovery D300 material. Specimens up to 25 cm in length, in various states of contraction. Body wall varying from relatively thin, gelatinous in some specimens to firm and leathery in others. The 'body length; maximum width' ratio varies from 3.05 in specimens 15 cm long to 5.3 in larger specimens, depending on state of contraction. Brim up to 12 mm in maximum width (at posterior end). Tentacles 15, posterior tentacles smaller than anterior. Circum-oral papillae visible in many specimens. Most specimens with 3 pairs of similarly sized large dorsal papillae located over anterior two thirds of dorsum (Fig. 3: A, B). Some specimens from St. 15775#4 possess a fourth pair of large papillae located on posterior one third of dorsum; other pairs of large papillae have same arrangement (Fig. 3: C, D). Up to 4 pairs of minute papillae in 2 rows in front of the anteriormost pair of large papillae or sometimes between them. The anteriormost pair of minute papillae usually placed slightly anterior to gonopore.

Deposits were found only in the dorsal skin around the anus in some large specimens, others entirely lacked deposits. Deposits typical of the genus *Benthodytes* (Fig. 3: E, F): primary crosses with a finely spinous central bipartite apophyses. Arms usually 0.40–0.45 mm in length (maximum 0.55 mm), with small spines distributed over at least their distal half. Deposits in the tentacle stems simple rods; rods absent in some specimens. Two juvenile specimens, the first 11 mm long and 4 mm wide, and the second 19 mm long and 6 mm wide, from St. 15775#13 had numerous deposits in the dorsal body wall.

Remarks. *Benthodytes abyssicola* and its closest relative *B. sordida* Théel were described from the Southern Indian Ocean and the Pacific (off Chile). According to the original description *B. sordida* differs from *B. abyssicola* by absence of a neck-like portion behind head-part, by a broad and thin anterior brim and by the presence of large papillae and their arrangement which is in contrast to the small dorsal papillae found in *B. abyssicola*. Re-examination of syntypes of *B. abyssicola* and *B. sordida* showed that all syntypes, including syntypes of *B. abyssicola*, have three pairs of large papillae and up to five pairs of minute papillae in front of the anteriormost pair of large papillae. In some syntypes of *B. abyssicola* these papillae are strongly retracted but still visible; large papillae are easily distinguished in the lectotype. The arrangement of papillae in the syntypes of both species is very similar. The "broad and thin brim round the head" and "narrower neck-like portion immediately behind the considerably broader round and flat head-part" could only be detected in the syntype NHM 83.6.18.77. These characters very likely depend on the condition of material.

Hansen (1975) regarded this species as being of an uncertain taxonomical position because of the absence of deposits in the type material. However the presence of three (rarely four) pairs of papillae of larger size is unknown in other species. Moreover it is constant character: it was found in all examined specimens and therefore provides evidence that *B. abyssicola* is a valid species and *B. sordida* a junior synonym.

Specimens from around Crozet Plateau were identified as *Benthodytes abyssicola* based on the presence

and arrangement of three pairs of large papillae in most, absence of a dense layer of deposits from most parts of the body wall, and the presence of a narrow brim and 15 tentacles.

Specimens from the North-East Atlantic identified by Walker *et al.* (1987) as *Benthodytes sordida* probably belong to another species. We re-examined some material representing this species from the same locality stored at NOC Southampton (*Discovery* collection): St. 13368#51, 48°50'N 16°28'W, 4840 m, March 18, 1998, semi-balloon otter trawl, 1 specimen; St. 13200#27, 48°53'N 16°39'W, 4848–4839 m, July 10, 1997, semi-balloon otter trawl, 3 specimens; St. 50811, 49°39'N 14°39'W, 4400–4350 m, August 2, 1980, semi-balloon otter trawl, 4 specimens; St. 13200#9, 48°52'N 16°25'W, 4844–4840 m, July 6, 1997, semi-balloon otter trawl, 4 specimens. Atlantic specimens are similar to *B. abyssicola* in presence of three pairs of large papillae as well as a few pairs of minute papillae and the 15 tentacles but differ by the absence of deposits in the thick body wall and by the shape of the body: the maximum width is in the anterior one third of the body.

Relationships. *B. abyssicola* differs from other species of *Benthodytes* in having three or four pairs of evenly distributed large dorsal papillae, with minute dorsal papillae also present. In morphology this species is most closely related to *Benthodytes* from the North-East Atlantic that is apparently a new species.

Distribution. Southern Indian Ocean, Pacific Ocean (off Chile). Depths 3294–4301 m.

Genus *Psycheotrephes* Théel, 1882

***Psycheotrephes discoveryi* sp. nov.** Rogacheva and Cross

(Fig. 5)

Psycheotrephes magna Hansen, 1975 (partim.): 97–99, figs. 37–37, Pl. XII:6.

Holotype: NHM 2008.984. Specimen 28 cm long and 4.5 cm in width. RRS *Discovery*, Cruise 300, St. 15773#23, 16 December 2005, 45°40.05S 56°35.27E, 4269–4275 m.

Paratypes: NHM 2008.985. 1 specimen 19 cm long and 6.5 cm wide. Fragments from 3.9 cm to 28.3 cm in length. RRS *Discovery*, Cruise D300, St. 15773#23, 16 December 2005, 45°40.05S 56°35.27E, 4269–4275 m; NHM 2008.986–987. Fragments of 2 specimens. RRS *Discovery*, Cruise D300, St. 15773#23, 16 December 2005, 45°40.05S 56°35.27E, 4269–4275 m.

Type locality: Southern Indian Ocean, to north-east and to south of the Crozet Isles, depth 4182–4301 m.

Diagnosis. Body dark violet, elongate, dorsum slightly convex, ventrum flattened. Brim narrow. Tentacles 18. 3 pairs of minute papillae on anterior half of dorsum. Deposits small crosses with short, smooth central apophysis. Arms up to 0.1 mm long with 1 or 2 spines of same size as central apophysis or slightly smaller. Arms bent downwards.

Description of material. Specimens have suffered extensive damage; the following description represents a synthesis of characters derived from specimens and fragments. Body elongate, length from 3.9 cm to 28.3 cm. Colour dark violet. Skin soft and relatively thin. 'Body length: maximum width' ratio 6.2 (it was possible to measure this ratio only in one specimen 28.3 cm long). Brim up to 1.7 cm wide in the largest specimen with prominent tips of tube feet; brim visible only from ventral side. Tentacles: 18; tentacle discs with numerous marginal knobs. Midventral tube feet arranged in double row, small and retractile. 3 pairs of minute papillae are located on anterior part of dorsum; the posteriormost pair slightly larger. Deposits (Fig. 5: A–G) small corroded crosses with arms 0.05–0.1 mm and central pointed apophysis; arms curved downwards, their distal part not bent upwards; arms possess 2 or rarely 1 large spine of the same size as central apophysis or slightly smaller. Arms sometimes possessing very small spines on the distal parts. Tripartite deposits occasionally present in dorsal skin. Deposits not observed in ventrum.

Remarks. The genus *Psycheotrephes* includes four species, two of which, *P. exigua* Théel and *P. recta* (Vaney), are known only from single records. The species *P. magna* was described by Hansen (1975) on material from two localities: off Madagascar–Mombasa (*Galathea* St. 234) and Kermadec Trench (*Galathea* St. 663). The holotype was designated from the Station 234. Re-examination of the type material in ZMUC

revealed significant differences in deposit morphology in specimens from different stations. Specimens from the Station 234 have deposits with numerous spines that possess additional spines, spines often branched and arms curved upwards or horizontally on their distal parts. Deposits of this type are characteristic of *P. magna*. In contrast, specimens from Kermadec Trench have deposits with simple non-branched spines and arms which are not curved upwards on their distal parts (Fig. 5: F, G). This type of deposit is typical of *P. discoveryi* and therefore we consider these specimens to belong to *P. discoveryi*.

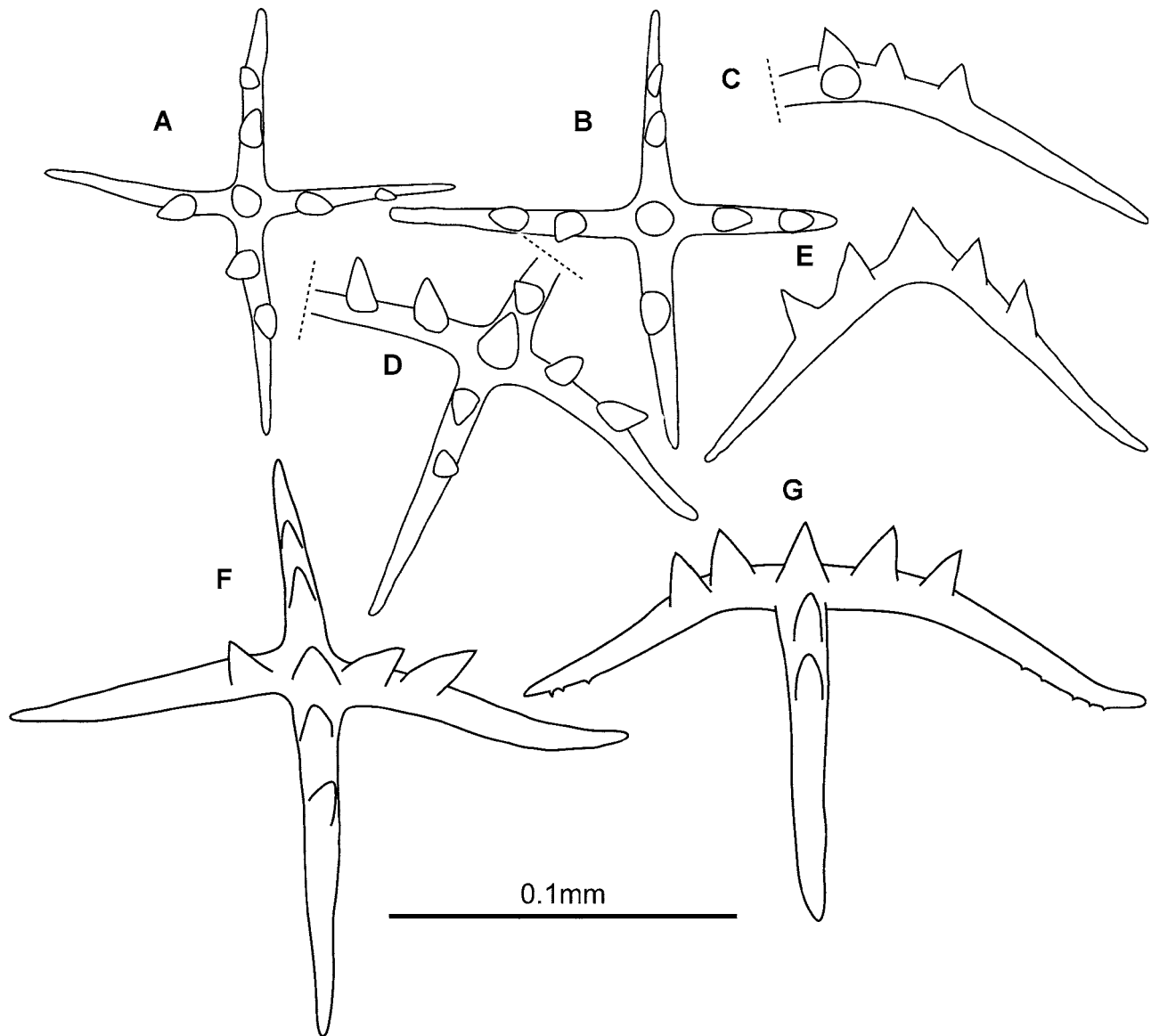


FIGURE 5. *Psycheotrephes discoveryi* sp. nov., dorsal deposits: A–E, holotype; F–G, *Galathea*, St. 663.

Relationships. *Psycheotrephes discoveryi* sp. nov. differs from other species in the genus in possessing only simple, non-branched spines on arms of primary crosses; and in the arms not displaying an upward inclination to their distal portions. *P. discoveryi* resembles *P. magna* in presence of three pairs of dorsal papillae and 18 tentacles.

Distribution. Southern Indian Ocean off Crozet Plateau, Kermadec Trench. Depths 4182–4410 m.

Genus *Psychropotes* Théel, 1882

Psychropotes scotiae (Vaney, 1908)

(Fig. 6)

Euphronides scotiae Vaney, 1908: 418–419, Pls. I: 8–9, III: 39–40.

Psychropotes scotiae: Hansen, 1975: 111; Massin and Sibuet, 1983: 169–174, Pls. I–III.

Material examined: RRS *Discovery*, Cruise D300, St. 15773#8, 7 specimens; St. 15773#17, 4 specimens; St. 15773#23, 20 specimens; St. 15773#32, 3 specimens; St. 15775#4, 15 specimens; St. 15775#13, 1 specimen.

Diagnosis. Body elongate; anteriorly depressed, maximum width and height at base of unpaired dorsal appendage. Brim narrow. Tentacles 16. Dorsal papillae from 1–6 pairs located on anterior half of dorsum; posteriormost pair larger, located close to the middle of dorsum. Unpaired appendage short: 0.13–0.25 of body length; placed on posterior third of dorsum and ~ 0.25 of body length from posterior end. Deposits in outer layer of body wall in form of small crosses with short central branched apophysis and downwardly angled spinous arms, up to 0.12 mm in length. Ventral deposits smaller, less spinous. Tri- and pentapartite deposits often present in dorsum and ventrum.

Description of material. Specimens varying in length from 1.8 to 25.2 cm. Colour in alcohol: violet to dark violet. Body wall rough, covered with small warts, giving a verrucose appearance. Body elongated, rounded at both ends; posterior end narrower than anterior (Fig. 6: A, B). Anterior part of body depressed, increasing in width and height towards base of unpaired appendage. Brim narrow, visible only from ventral side. Tentacles 18 (11 in non-mature specimen). Midventral tube feet about 30 pairs, in double row. Dorsal papillae 3 pairs; 2 anterior pairs minute, behind gonopore; posteriormost pair larger and distal to other papillae, occupying mid-dorsal region. Unpaired appendage short: 0.13–0.17 of body length, with broad base. Deposits (Fig. 6: C–J): small crosses with arms up to 0.12 mm in length on dorsum and up to 0.08 mm in length on ventrum. Tripartite deposits (Fig. 6: E, H) often present on dorsum and ventrum. Arms bent downward. Central apophyses short (up to 0.03 mm), robust, branched. Arms possess large bifurcate spines; ventrally deposits are less spinous. Arms constricted distally or with clavate ends (especially on ventral deposits).

Remarks. Specimens examined were identified as *Psychropotes scotiae* based on presence of 16 tentacles, short unpaired appendage on posterior third of dorsum, deposits with short, robust central apophyses, spines and abundant tri- and pentapartite deposits.

P. scotiae was long known from a single Antarctic specimen. Another specimen was collected in the Cape Basin (Massin and Sibuet, 1983). Discovery of this species around Crozet has enabled clarification of the diagnosis. All specimens are similar in possessing 16 tentacles, numerous tripartite deposits and in the length and arrangement of the unpaired appendage. At the same time they differ in the number of dorsal papillae: the holotype bears one pair; a specimen from the Cape Basin has six pairs, and specimens from around the Crozet Plateau have three pairs. All known specimens share similarities in deposit morphology, tentacle number and size and arrangement of unpaired dorsal appendages; the number of papillae is a variable character. The number of dorsal papillae can be an important taxonomic character in the Elasipodida, but it varies in many species of the family Psychropotidae, such as *Psychropotes depressa*, *P. verrucosa*, *Benthodytes typica*, *Psycheotrepthes magna* and others. Also, papillae can be easily lost during collection and/or preservation; it is possible that some of the papillae were lost from the holotype of *P. scotiae*.

Distribution. Antarctic (the Scotia Sea 62°10'S 41°20'W, 3246 m), South Atlantic (the Cape Basin 32°28'S 13°24'E, 3675 m), South Indian Ocean (off Crozet Isles, 4182–4301 m). Depths 3246–4301 m.

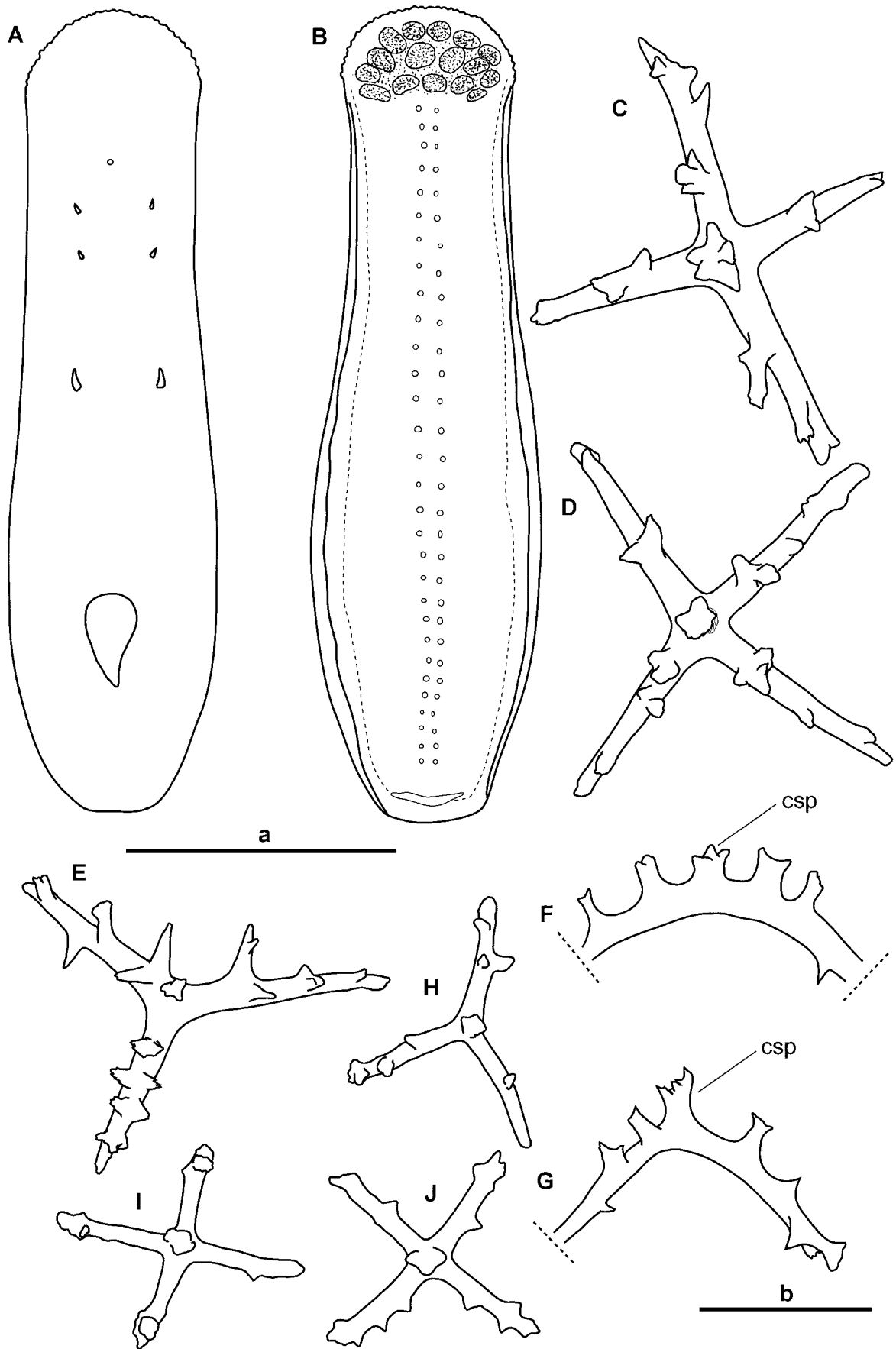


FIGURE 6. *Psychropotes scotiae*, St. 15773#23. A, dorsal view; B, ventral view (scale a=5 cm); C–G, dorsal deposits; H–J, ventral deposits (scale b=0.1 mm).

Genus *Psychropotes* Théel, 1882

Psychropotes longicauda Théel, 1882

(Fig. 7)

Psychropotes longicauda Théel, 1882: 96–98, Pls. XXVII: 1, XXVIII, XXXV: 13–17, XXXVII: 10; Agatep 1967: 67, Pl. XI: 1–7; Hansen, 1975: 115–126, Figs. 49–54, Pls. VII: 4–6, XII: 7; Sibuet, 1977: 549–563; Massin et al., 1978: 253–259; Billett et al., 1985: 405, Figs. 1, 4; Walker et al., 1987: 277–282; Gebruk, 1993; Bluhm and Gebruk, 1999: 173–174, Fig. 3A; Wigham et al., 2003: 409–441; Gebruk 2008: 50, 51.

Psychropotes longicauda var. *monstrosa* Théel, 1882: 98–99, Pls. XXIX: 2, XXX, XXXIX: 1.

Psychropotes longicauda var. *fusco-purpurea* Théel, 1882: 99, Pls. XXIX: 1, XXXV: 11.

Psychropotes longicauda var. *antarctica* Vaney, 1908: 419–420.

Psychropotes buglossa E. Perrier, 1886: 283, Fig. 200; R. Perrier, 1902: 445–453, Fig. 7, Pls. XIII: 3–4, XX: 16–28; Hérouard, 1923: 105–108, Pls. I: 32, VI: 2.

Psychropotes raripes Ludwig, 1894: 48–51, Pl. V: 1–16; Ohshima 1915: 244; Clark 1920: 140–141, Pl. I: 1; Carney and Carey, 1976: 67–74.

Psychropotes dubiosa Ludwig, 1894: 52–53, Pl. II: 5–7.

Psychropotes grimaldii Hérouard, 1896: 167, Fig. 2; Hérouard, 1902: 25–27, Pl. III: 1–2.

Psychropotes fucata R. Perrier, 1896: 902; R. Perrier, 1902: 453–455, pl. XX: 29–30.

Psychropotes laticauda Vaney, 1908: 420–422, Pl. II: 14, 24.

Psychropotes brucei Vaney, 1908: 422–423, Pls. I: 13, II: 21–22, III: 41–42.

Euphronides dyscrita Clark, 1920: 139, Pl. II: 3.

Nectothuria translucida Belyaev and Vinogradov, 1969: 711–716, Figs. 1–4.

?*Psychropodes longicaudata* Carney and Carey, 1982: 597–607.

Material examined: RRS *Discovery*, Cruise D300, St. 15773#8, 20 specimens; St. 15773#17, 113 specimens; St. 5773#23, 114 specimens; St. 15773#32, 95 specimens; St. 15775#4, 17 specimens; St. 15775#13, 11 specimens.

Description of material. Body length varying from 1.8 cm to 34 cm. Colour in alcohol: violet to dark violet. Body elongate, anterior part flattened and is the widest part of body, which decreases in width posteriorly, and increases in height towards unpaired dorsal appendage. Brim well developed on anterior and posterior ends of body, with maximum width around anterior part. Anterior brim consists of about 15 pairs of tube feet, and posterior brim of 7–8 pairs. Ventrolateral tube feet 17–19 pairs. Tentacles 18. Midventral tube feet large, conspicuous, sparsely distributed along middle of ventrum. Papillae minute, located on anterior half of dorsum. Distance between papillae increases towards posterior end of body. Unpaired dorsal appendage bifurcate, positioned close to posterior end of the body; varying in length from 0.2 of body length in large specimens to 0.25–0.29 in small specimens, equal in width at the basis to body width. An unpaired appendage of 0.29 of body length was found only in 2 large specimens from St. 15773#23. Deposits in form of crosses with short central apophysis up to 0.02 mm, branched rarely smooth and downwardly inclined arms up to 0.15 mm long, contracted to ends. Arms with spines (up to four large spines per arm regularly distributed); proximal spines from half to about the same length with central apophysis; bipartite spines were occasionally observed; small spines at the end of arms. Few giant crosses were found on dorsum of 2 specimens: their arms reached 0.3 mm and central apophyses 0.08 mm, proximal spines were smaller significantly than central apophyses, about 0.17 of its length. Ventral deposits rods, tripartite or crosses, all with prominent spines.

Remarks. *P. longicauda* is a well known cosmopolitan species. It is found in all oceans except the Arctic from a wide depth range. Many authors have repeatedly pointed out the high variability of morphological characters in this species; and have even described new species and subspecies (see synonymy). In the last revision of the family Hansen (1975) synonymized nine species and three subspecies into “*longicauda*” because of intermediate stages between different morphological types. However, we suggest that *P. longicauda* includes more than one species and that the species needs to be revised (A.V. Gebruk, personal communication and our own data). Specimens found from around the Crozet Plateau resemble *Psychropotes laticauda* Vaney in deposit morphology, and this is probably a distinct species (slides of deposits of syntypes of this species made by Dr. Bent Hansen were studied at ZMUC).

Distribution. Cosmopolitan. All oceans except the Arctic. Depths 2210–6134 m.

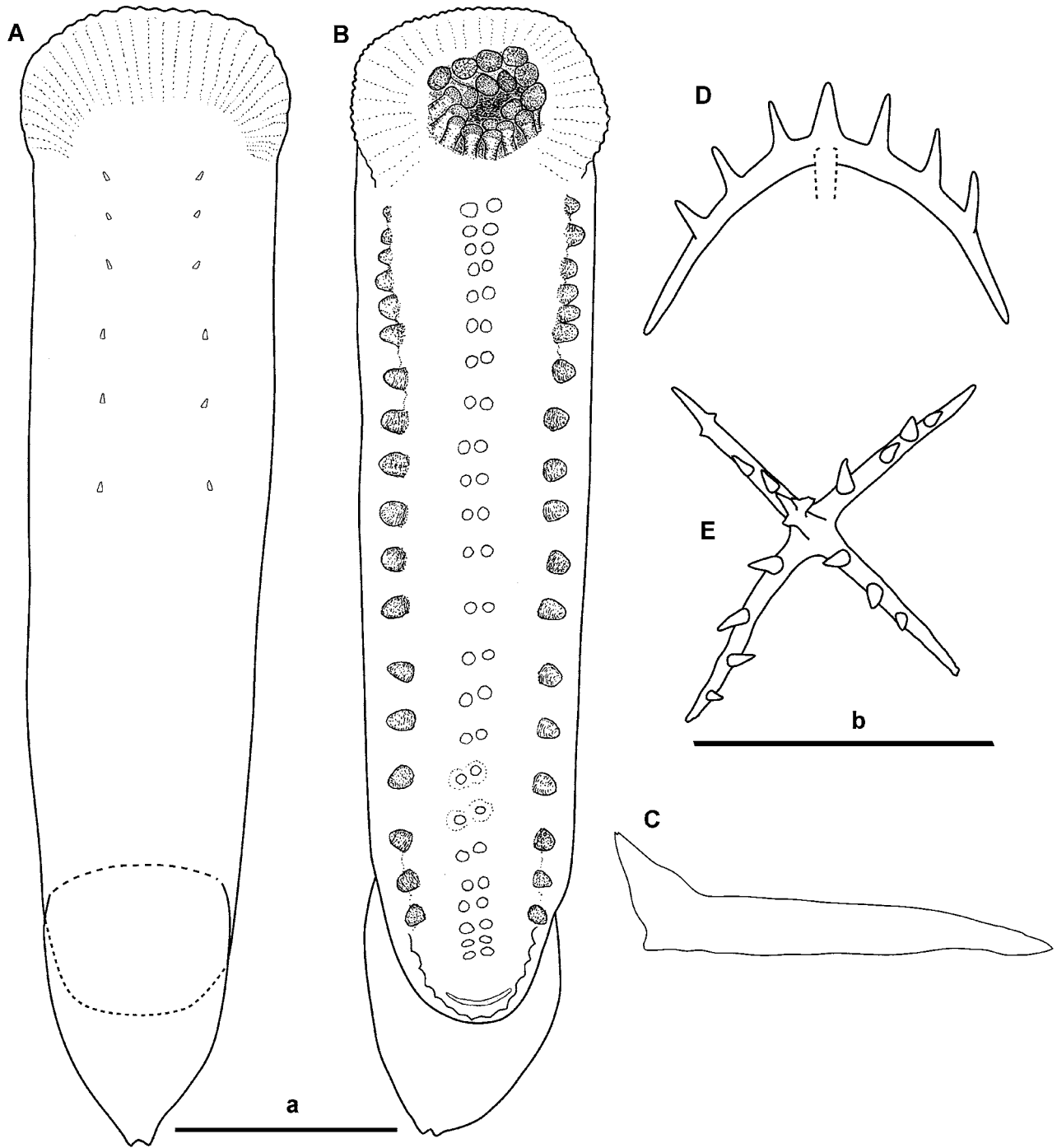


FIGURE 7. *Psychropotes longicauda*, St. 15773#32. A, dorsal view; B, ventral view (scale a=5 cm); C, side view schematically; D, E, dorsal deposits (scale b=0.15 mm).

Psychropotes xenochromata sp. nov. Rogacheva and Billett
(Fig. 8–9)

Holotype: NHM 2009.1. Specimen 54 mm long and 19 mm of maximum width. RRS *Discovery*, Cruise D300, St. 15773#32, 20 December 2005, 45°40.45'S 56°33.70'E, 4267–4270 m, semi-balloon otter trawl.

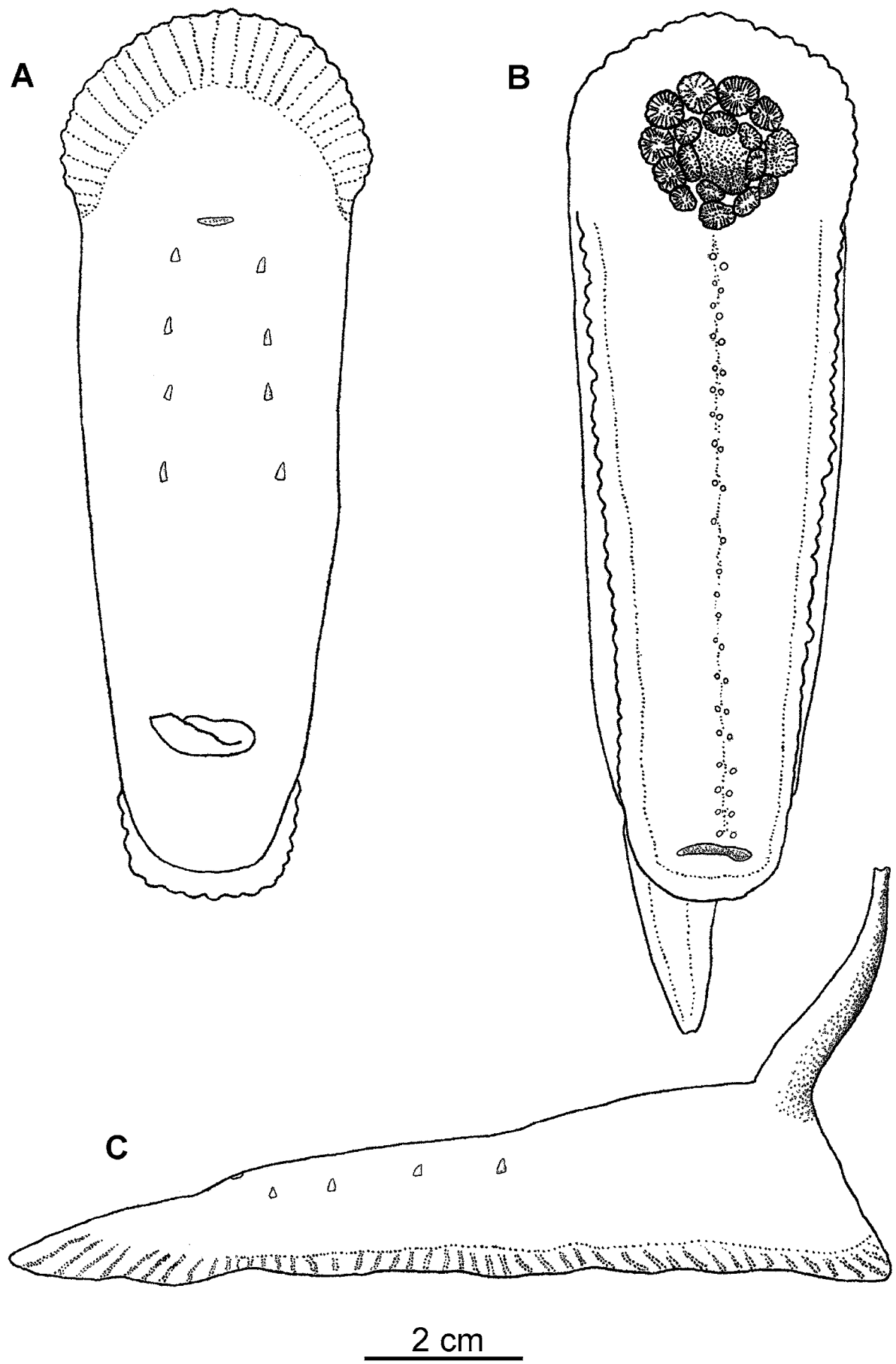


FIGURE 8. *Psychropotes xenochromata* sp. nov., holotype. A, dorsal view; B, ventral view, C, side view.

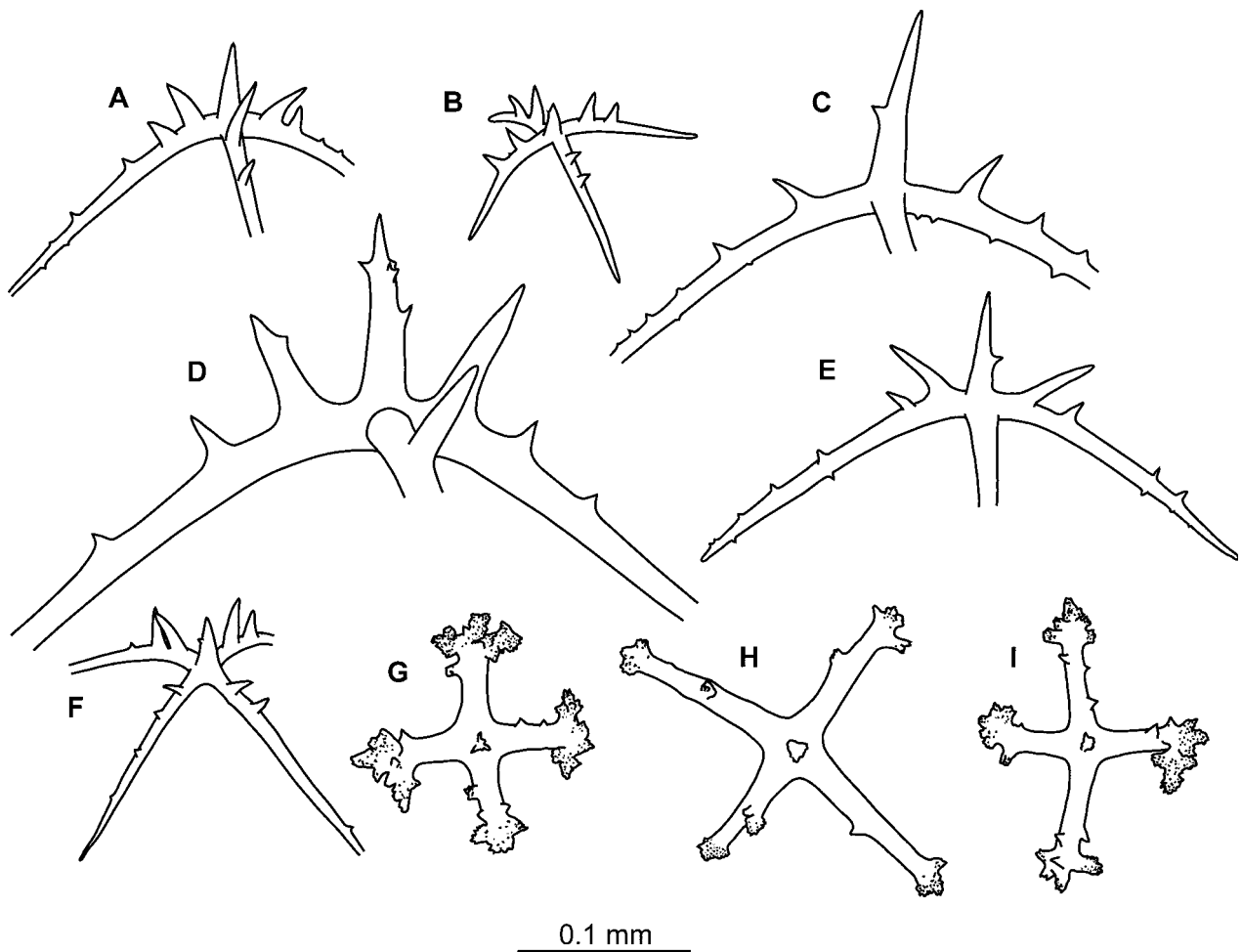


FIGURE 9. *Psychropotes xenochromata* sp. nov. A–F, dorsal deposits; G–I, ventral deposits.

Paratypes: NHM 2009.2–4. 3 damaged specimens 55 mm, 60 mm and 65 mm long. RRS *Discovery*, Cruise D300, St. 15773#17, 15 December 2005, 45°43.47'S, 56°36.66'E, 4301–4283 m, semi-balloon otter trawl; NHM, Cat. Nr NHM 2009.5. 1 damaged specimen 12 cm long. RRS *Discovery*, Cruise 300, St. 15775#13 49°01.15'S, 51°04.52'E, 4187–4191 m, semi-balloon otter trawl.

Type locality: Southern Indian Ocean, to north-east and to south of the Crozet Isles, depth 4187–4301 m.

Etymology. The name “*xenochromata*” derives from Greek *xenos* ξένος unusual and *chroma* χρώμα colour according to the uncommon colour of upper layer of skin.

Diagnosis. Body yellowish-green, elongate, dorsum slightly convex, ventrum flattened. Brim narrow. Tentacles 18. 4 pairs of minute papillae on anterior half of dorsum. Unpaired dorsal appendage bifurcate, placed 0.2 of body length from posterior end; varying in length from 0.2 to 0.5 of body length. Deposits on dorsum crosses, central apophysis with spines. Arms 0.1–0.3 mm long with 2 proximal spines larger than other spines on arms. Arms bent downwards. Ventral deposits with straight arms; ends of arms clavate with numerous spines; central apophysis short with numerous spines.

Description of the holotype. Specimen 54 mm long, 19 mm in maximum width in the anterior part, 16 mm width in the middle of body (Fig. 8: A, B, C). Colour in alcohol brownish-green. Brim narrow, with tips of tube feet. Tentacles 18. Midventral tube feet about 20 pairs sparsely distributed along the middle of ventrum. 4 pairs of papillae, posteriormost pair slightly larger, located close to the middle of dorsum. Unpaired dorsal appendage 17 mm long, 5 mm wide at the basis, with 2 knobs at the end, located 9.5 cm in from posterior end; flattened, tapered to the end.

Description of material. Specimens have suffered extensive damage except the holotype. Body elongate,

length from 5.5 cm to 12.0 cm; maximum body width at anterior end. Colour of skin green, deeper layers light violet. Skin with dense layer of deposits; all specimens have lost some skin. Papillae and most of midventral tube feet lost except holotype. Tentacles 18. Unpaired dorsal appendage strongly damaged. Dorsal crosses (Fig. 9: A–F) with arms up to 0.4 mm in length and central apophysis up to 0.12 mm in length. Central apophysis with 1 or more small spines. Arms curved downwards, contracted to ends. 2 rarely 1, proximal spines larger than others; first proximal spine always larger than second and from 0.33 to 0.75 of the length of central apophysis. Small spines often occur on ventral side of arms (Fig. 9: A, C, E). Ventral crosses smaller than dorsal. Central apophysis small and branched. Arms up to 0.2 mm long, not curved, with few spines, some of them branched, with small spines. Arms with enlarged ends covered numerous spines.

Relationships. *Psychropotes xenochromata* sp. nov. differs by greenish colour of skin and dorsal crosses with 2 proximal spines larger than others. Green colour has never been reported in any species of the genus *Psychropotes*. Dorsal crosses in their morphology resemble those in *Psychropotes longicauda* s. l.

Remarks. The green colour of skin in psychropotids has been recently reported for the genus *Benthodytes*, in *B. gosarsi* (Gebruk, 2008).

Distribution. Southern Indian Ocean off Crozet Plateau. Depth 4187–4301 m.

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