



A new species of *Phascolion* (*Phascolion*) (Sipuncula, Golfingiidae) from bathyal benthos off the coast of Western Australia

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Abstract

A new species of *Phascolion* (*Phascolion*) Cutler & Cutler, 1985 from the benthos off Exmouth, Western Australia, is described. *Phascolion* (*P.*) *exmouthensis* sp. nov. can be readily distinguished from other members of the subgenus by the presence of distinctive rectangular papillae which form a collar on the anterior trunk (a new morphological feature for sipunculans), and introvert hooks with non-recurved tips and a narrow base on the bulbous area immediately behind the mouth. The new species and *P.* (*P.*) *ushakovi* Murina, 1974 are the only two (out of 13) species of *Phascolion* (*Phascolion*) known from Western Australia.

Keywords morphology, peanut worm, *Phascolion* (*Phascolion*) *exmouthensis* sp. nov., taxonomy

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Introduction

Members of the genus *Phascolion* Théel, 1875 are small to medium-sized sipunculans, represented by 26 taxa (Cutler and Cutler 1994). They can be found in all three of the world's oceans from intertidal to trench depths (Cutler and Cutler 1994). In the Indo-west Pacific, 20 species have been reported with 12 species endemic to this geographic region (Cutler and Cutler 1994). The genus is characterized by the presence or absence of a hook-bearing introvert one-half to four times the trunk length, a trunk with or without chitinated holdfast papil-

lae, oral disk with tentacles arranged around the mouth, an introvert retractor muscle system modified by fusion of the dorsal pair and partial fusion of ventral pair, a contractile vessel without villi which may be vesicular, a gut with spiral coils and loops or just loose loops, spindle muscles absent, and one nephridium present (Cutler and Cutler 1985; Cutler 1994). The genus is currently divided into five subgenera based on the morphology of the introvert retractor muscle system, contractile vessel and oesophagus, which are: *P.* (*Phascolion*) Théel, 1875, *P.* (*Isomya*) Cutler & Cutler, 1985, *P.* (*Lesenka*) Gibbs,

1985, *P. (Montuga)* Gibbs, 1985, and *P. (Villiophora)* Cutler & Cutler, 1985 (Cutler and Cutler 1985; Cutler 1994). The genus was formerly placed in the family Phascolionidae Cutler & Gibbs, 1985 but has been recently synonymized with Golfingiidae Stephen & Edmonds, 1972 (Kawauchi *et al.* 2012). *Phascolion* species often inhabit soft sediments, but some species are noted for utilizing abandoned gastropod or tusk shells (Cutler and Cutler 1985; Cutler 1994).

During a recent survey off Exmouth, Western Australia, infaunal specimens were collected from the Stybarrow Oil Field as part of an environmental assessment during the decommissioning of deep-sea infrastructure in the area. Specimens were sent to the Western Australian Museum (WAM) and Museum and Art Gallery, Northern Territory (NTM) for initial identification. As a result, two specimens of an unusual sipunculan were identified from two separate samples. Key morphological characters of these sipunculans agree with the diagnosis of the genus *Phascolion*; in addition, these specimens have unevenly sized retractor muscles with the ventral muscle considerably thinner than the dorsal, which fits the morphological characters of the subgenus *Phascolion* (Cutler and Cutler 1985; Cutler 1994). However, the species has a peculiar fence-like collar formed by rectangular papillae on the anterior trunk, which is new to science. The present study, herein, describes a new species of *P. (Phascolion)* from Australia.

Methods

Two specimens were collected using an ROV equipped with a push corer (tubes 70 cm long with an internal diameter of 69.9 mm) from the bathyal benthic bottom at ~65 km off North West of Exmouth, Western Australia, Australia in early May of 2018, after sieving the core samples through nested 1.0 mm and 0.5 mm sieves. Of the two, one was found living in a dead tusk shell, *Striodentalium* sp. (Dentaliidae Children, 1934) (Fig. 1A). These specimens were preserved in 10% buffered formalin and later transferred to 70% alcohol for storage. All material was examined under stereo (Leica MZ12.5) and compound microscopes (Leica DM2500). Photographic images of animals as well as body parts of these animals were taken using digital cameras, Canon 5DII, 21.1 megapixels, with MP-E 65 mm macro lens and a COOLPIX P6000, 14 megapixels and Canon EOS 7D Mark II, 20 megapixels) and later enhanced with computer software Helicon Focus v.7.0.2 and PhotoImpact v.8. Drawings were prepared by tracing outlines of examined body parts from digitized images using CorelDRAW® GRAPHIC SUITE X5. The classification scheme for the higher taxa followed Kawauchi *et al.* (2012). Specimens of this study were deposited, with permission, at the Museum and Art Gallery, Northern Territory (NTM), Australia and the National Museum of Natural Science (NMNS), Taiwan, Republic of China.

Taxonomy

Family Golfingiidae Stephen & Edmonds, 1972

Genus *Phascolion* Théel, 1875

Subgenus *Phascolion* Théel, 1875

Phascolion (Phascolion) exmouthensis sp. nov.

Figs 1A–O and 2A

Material examined. Holotype (NTM D001839), Stybarrow Oil Field, Station EH1R-S3-+1 (21°26.532'S 113°49.515'E), Western Australia, benthic soft bottom, -824 m deep, 2 May 2018. Paratypes: 1 specimen (NMNS 8048-001), collection area and habitat type information same as holotype, Station HSXT-S3-+1 (21°28.479'S 113°49.496'E), -839 m deep, 4 May 2018.

Diagnosis. Small worm, trunk length 4.2–6.0 mm. Introvert about 1.3 times of trunk length, with brownish papillae posteriorly. Anterior region of trunk with brownish rectangular and round-tipped papillae, rectangular papillae approximately 33–40 µm (width) x 100–115 µm (length), forming a collar; middle region of trunk with scattered chevron-shaped holdfast papillae, posterior region of trunk with round-tipped papillae. Ventral retractor muscle about 0.6 times of dorsal retractor muscle width. Tentacles slender, digitiform, number exceeding 30, introvert hooks with non-recurved tips and narrow base. Gut in loops with few coils.

Description. Holotype: Complete, ovigerous female (eggs averaging 69 µm diameter, n=10); trunk length 6.0 mm, beige in alcohol (Fig. 1A–C). Paratype: Complete, trunk length 4.2 mm, translucent in alcohol (Fig. 1D). Introvert brownish in alcohol (Fig. 1D), about 1.3 times of trunk length, with round-tipped papillae posteriorly, 35–50 µm (n=5) in height (Fig. 1E). Anterior trunk brownish rectangular and round-tipped papillae present, rectangular papillae approximately 33–40 µm (width) x 100–115 µm (length) (n=5), forming a collar (Fig. 1A–C); middle region of trunk with scattered chevron-shaped papillae, 30–60 µm (n=5) in height (Fig. 1G, H); posterior region of trunk with round-tipped papillae, 35–50 µm (n=5) in height (Fig. 1I, J). Dorsal and ventral retractor muscles partially fused, dorsal retractor muscle originates on body wall near posterior end, ventral retractor muscle originating on body wall about one-third the body length from posterior end, ventral retractor muscle about 0.6 times width of dorsal retractor muscle (Fig. 1K, L). Tentacle crown with slender, digitiform tentacles, number exceeding 30 (Fig. 1M); introvert hooks with non-recurved tips and a narrow base, height and base width approximately 30 µm and 20 µm, respectively (Figs 1N, 2A), located on the bulbous area immediately behind the mouth; contractile vessel without villi; gut in loops

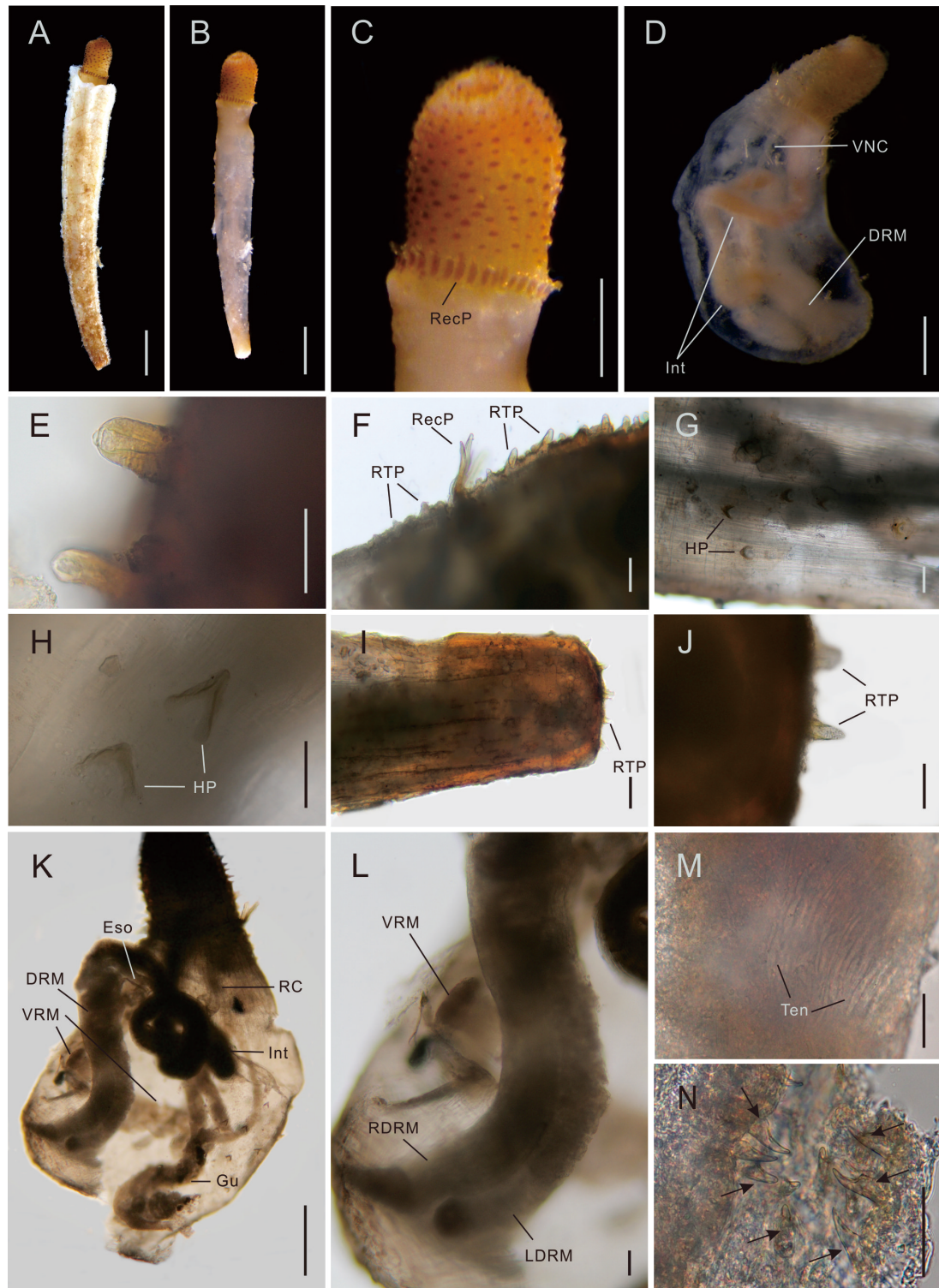
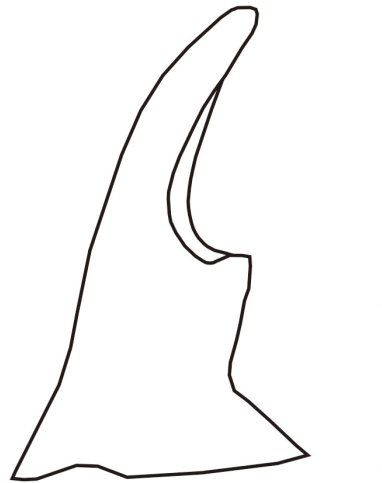


Figure 1. *Phascolion (Phascolion) exmouthensis* sp. nov.; A–C, E, G, I, J, holotype (NTM D001839); D, F, H, K–O, paratype (NMNS 8048-001). A, the worm in a tusk shell; B, whole animal with the tusk shell removed; C, close-up of anterior region of the worm; D, whole animal; E, close-up of round-tipped papillae on introvert; F, pointed-tipped papillae on introvert at anterior body region of the worm; G, chevron-shaped holdfast papillae at middle body region of the worm; H, close-up of chevron-shaped holdfast papillae at middle body region of the worm; I, posterior body region of the worm; J, close-up of point tipped papillae at posterior body region of the worm; K, internal organs of the worm; L, close-up of retractor muscles; M, tentacles at the mouth area; N, introvert hooks (indicated with arrows). (Abbreviations: DRM, dorsal retractor muscle; Eso, esophagus; Gu, gut; HP, holdfast papillae; Int, introvert; LDRM, left dorsal retractor muscle; RDRM, right dorsal retractor muscle; Rec, rectum; RecP, rectangular papilla; RTP, round-tipped papilla; Ten, tentacles; VNC, ventral nerve cord; VRM, ventral retractor muscle). Scale: A, B, D, 1.0 mm; C, G, K, 0.5 mm; F, I, L, 0.1 mm; E, H, J, M, N 0.05 mm.

A



B

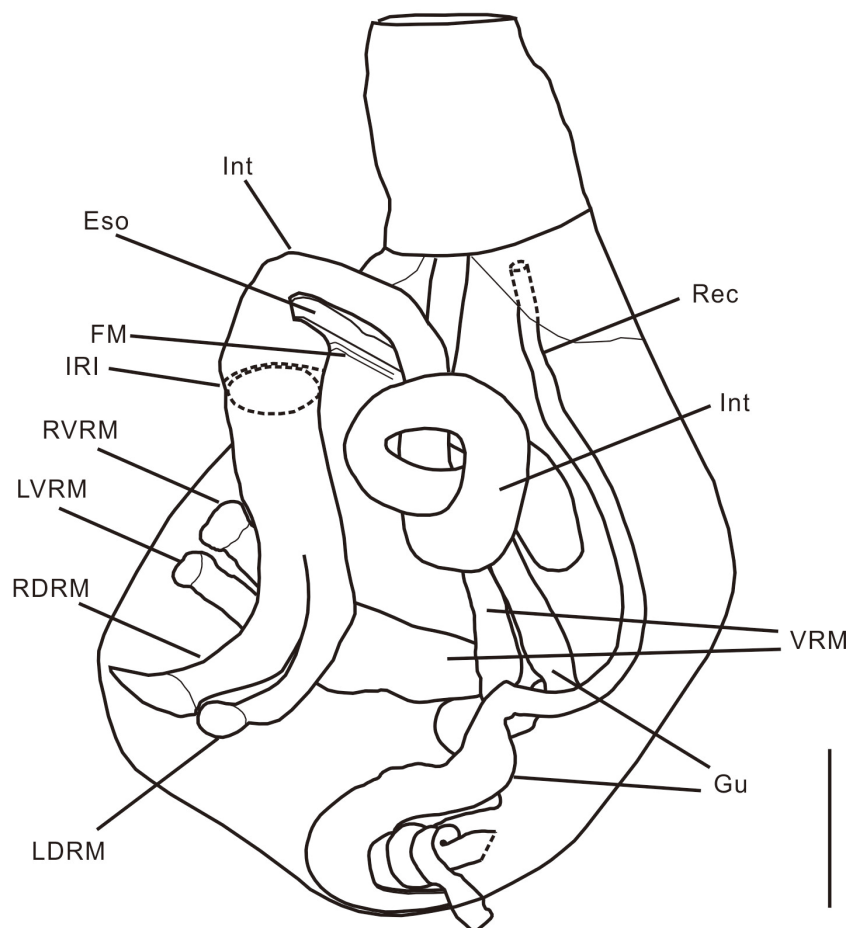


Figure 2. *Phascolion (Phascolion) exmouthensis* sp. nov.; paratype (NMNS 8048-001): A, line drawing of an introvert hook; B, line drawing of internal organs of the worm, papillae on the anterior of trunk and introvert not shown. (Abbreviations: An, anus; Eso, esophagus; FM, fixing muscle; Gu, gut; Int, introvert; IRI, interface between dorsal retractor muscle and introvert; LDRM, left dorsal retractor muscle; LVRM, left ventral retractor muscle; Ne, nephridium; RDRM, right dorsal retractor muscle; Rec, rectum; RVRM, right ventral retractor muscle; VRM, ventral retractor muscle). Scales: A, 0.01 mm; B, 0.5 mm.

with few coils (Figs 1K, 2); anus at anterior of trunk; single nephridium, nephridiopore posterior to anus.

Etymology. The name is derived from the name of nearby town of Exmouth, Western Australia, Australia, close to where the worm was collected.

Distribution. Only known, formally, from the type locality (bathyal benthic habitat at ~65 km northwest of Exmouth, Western Australia, Australia); however, numerous additional specimens of purportedly the same species collected by Dr James Blake are known from deep water off Brunei (Harlan Dean, pers. comm.).

Remarks. The subgenus *Phascolion* has 12 known species: *P. (P.) abnorme* Fischer, 1894, *P. (P.) bogorovi* Murina, 1973, *P. (P.) caupo* Hendrix, 1975, *P. (P.) hybridum* Murina, 1981, *P. (P.) medusae* Cutler & Cutler, 1980, *P. (P.) megaethi* Cutler & Cutler, 1979, *P. (P.) pharetratum* Sluiter, 1902, *P. (P.) psammophilus* Rice, 1993, *P. (P.) robertsoni* Stephen & Robertson, 1952, *P. (P.) strombus strombus* (Montagu, 1804), *P. (P.) strombus cronullae* Edmonds, 1980, and *P. (P.) ushakovi* Murina, 1974 (Cutler and Cutler 1985; Cutler 1994). Of these 12 species, only *P. (P.) ushakovi* has been reported from Western Australia (Cutler and Cutler 1985; Cutler 1994). *Phascolion (P.) exmouthensis* sp. nov. can be readily distinguished from the aforementioned species by the presence of rectangular papillae which form a collar on the anterior trunk (Cutler 1994: 127–132; Fig. 1A–D). *Phascolion (P.) exmouthensis* sp. nov. does share a feature of having digitiform tentacles at the mouth area with *P. (P.) medusae* and *P. (P.) robertsoni*. However, the latter two species have type III hooks (recurved, round-tipped and broad base), whereas *P. (P.) exmouthensis* sp. nov. has type I hooks (non-recurved tips and narrow base) (Cutler and Cutler 1980: 3, fig. 1, 1985: 819, fig. 7A; Cutler 1994: 115, 128, 130, fig. 30J, 31B; Figs 1N, O, 2). Moreover, the dorsal retractor muscle of *P. (P.) medusae* is several times larger than the ventral muscle, whereas that of *P. (P.) exmouthensis* sp. nov. is approximately 1.7 times larger than the ventral muscle (Cutler and Cutler 1985; Fig. 1K). The introvert of *P. (P.) robertsoni* is completely covered with small hemispherical papillae, but that of *P. (P.) exmouthensis* sp. nov. is covered with point-tipped papillae (Stephen and Robertson 1952; Fig. 1C, F).

Disclosures

None

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