

Prionospio thalanji sp. nov. (Polychaeta: Spionidae) from an anchialine cave, Cape Range, north-west Western Australia

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Abstract – *Prionospio thalanji* sp. nov., a polychaete worm of the family Spionidae, is described from a limestone cave on the Cape Range peninsula, north-west Western Australia. This is the first record of a cavernicolous spionid and is one of the few aquatic species from Cape Range caves with an immediate marine sister taxon.

INTRODUCTION

The Cape Range peninsula of north-west Western Australia abuts the Indian Ocean at 22°S and is largely limestone of Miocene age (Wyrwoll *et al.*, 1993). Extensive cave systems dissect the limestone (Allen, 1993); these include terrestrial caves which harbour troglitic arthropods dominated by arachnids and myriapods (Harvey *et al.*, 1993; Humphreys, 2000b), and anchialine caves with a fauna of aquatic stygobiont fishes, crustaceans and a gastropod (Humphreys, 1993, 2000b).

Anchialine habitats consist of bodies of haline waters, usually with a restricted exposure to open air, always with more or less extensive subterranean connections to the sea, and showing noticeable marine as well as terrestrial influences (Stock *et al.*, 1986). They typically occur in volcanic or limestone bedrock (Iliffe, 2000); the Cape Range region contains the only continental anchialine system described from the southern hemisphere (Iliffe, 2000). These recently recognized ecosystems are yielding an extraordinary diversity of specialised animals, especially crustacea, of which more than 12 new families and a new class have been described in recent years (G.A. Boxshall, personal communication, 1999).

This paper is the first description of annelid worms from the anchialine caves of Cape Range.

MATERIALS AND METHODS

In 1993 and 1994 samples were collected by SCUBA equipped cave divers from various depths using towed plankton nets, hand-held suction devices ('slurp gun'), nets and bottles. Suction samples at this time were from known depths, but

towed net samples were of uncertain origin. The 'slurp gun' is a vigorous sampling method that resulted in damaged specimens, however, subsequent sampling using less vigorous methods (Humphreys, 1999a) has not resulted in additional polychaete material.

Annelid worms from these samples were examined and found to contain three specimens of a polychaete of the family Spionidae, which is described below as a new species. Sample BES 4294 contained a specimen in very poor condition of a different, unidentified polychaete. All specimens are housed in the Western Australian Museum, Perth.

In preparation for field emission scanning electron microscopy the holotype was rehydrated from 70% ethanol, post-fixed in 1% osmium tetroxide for 2 hrs, returned stepwise to 100% ethanol for critical point drying and sputter coating. Observations were made using a Philips XL 30 field emission scanning electron microscope (SEM). The anterior fragment of one paratype, WAM BES 4294 disintegrated when washed from a temporary slide mount and is lost, though 2 posterior fragments remain. Due to the extreme fragility of the specimens (especially branchiae), individual branchiae and parapodia were not removed and figured; their form and proportions were described from the scanning electron micrographs of the holotype.

Abbreviations

WAM: Western Australian Museum
BES: field numbers of biospeleology collection at WAM
C-numeral: Prefix for the Karst Index number denoting caves in the Cape Range karst province.

SYSTEMATICS

Family Spionidae Grube, 1850

Genus *Prionospio* Malmgren, 1867

Prionospio Malmgren, 1867: 201; Blake and Kudenov, 1978: 211–212; Hutchings and Turvey, 1984: 11; Maciolek, 1985: 329–332; Wilson, 1990: 245–246.

Ctenospio M. Sars, 1867: 291.

Anaspio Chamberlin, 1920: 18.

Aquilaspio Foster, 1971: 105; Hutchings and Turvey, 1984: 8.

Minuspio Foster, 1971: 106; Hutchings and Turvey, 1984: 10–11.

Prionospio thalanji sp. nov.

Figures 1–8

Material examined

Holotype

Bundera Sinkhole, Western Australia, Australia, 22°25'S, 113°46'E, 'slurp gun', 24 May 1995, coll. A. Poole, D. Warren W.F. Humphreys, WAM V4161 (BES 4262).

Paratypes

Australia, Western Australia: 1 specimen, Bundera Sinkhole, 22°25'S, 113°46'E, 'slurp gun', 26 May 1995, coll. A. Poole, D. Warren, W.F. Humphreys, WAM V4162 (BES 4294); 1 specimen, Bundera Sinkhole, 22°25'S, 113°46'E, 'slurp gun', 21 March 1994, coll. A. Poole, WAM V4163 (BES 1363).

Diagnosis

Prostomium truncate anteriorly, continuing posteriorly to chaetiger 1. Chaetiger 1 with notochaetae. Occipital antenna absent, one pair of eyes. Branchiae simple with ciliated margins, first on chaetiger 2, last on chaetiger 28–30 (probably earlier on small specimens). Dorsal crests absent. Hooded hooks absent in notopodia, hooded hooks with 6 teeth above the main fang present in neuropodia from chaetiger 60–65. Sabre chaetae in ventral neuropodial positions from about chaetiger 20.

Description

The holotype is a complete specimen in two fragments: anterior fragment of 33 chaetigers, posterior fragment of 41 chaetigers. Total size 75 chaetigers, 10 mm long. 0.3 mm wide at chaetiger 10, excluding parapodia. Both fragments mounted on SEM stub excepting neurochaetae from

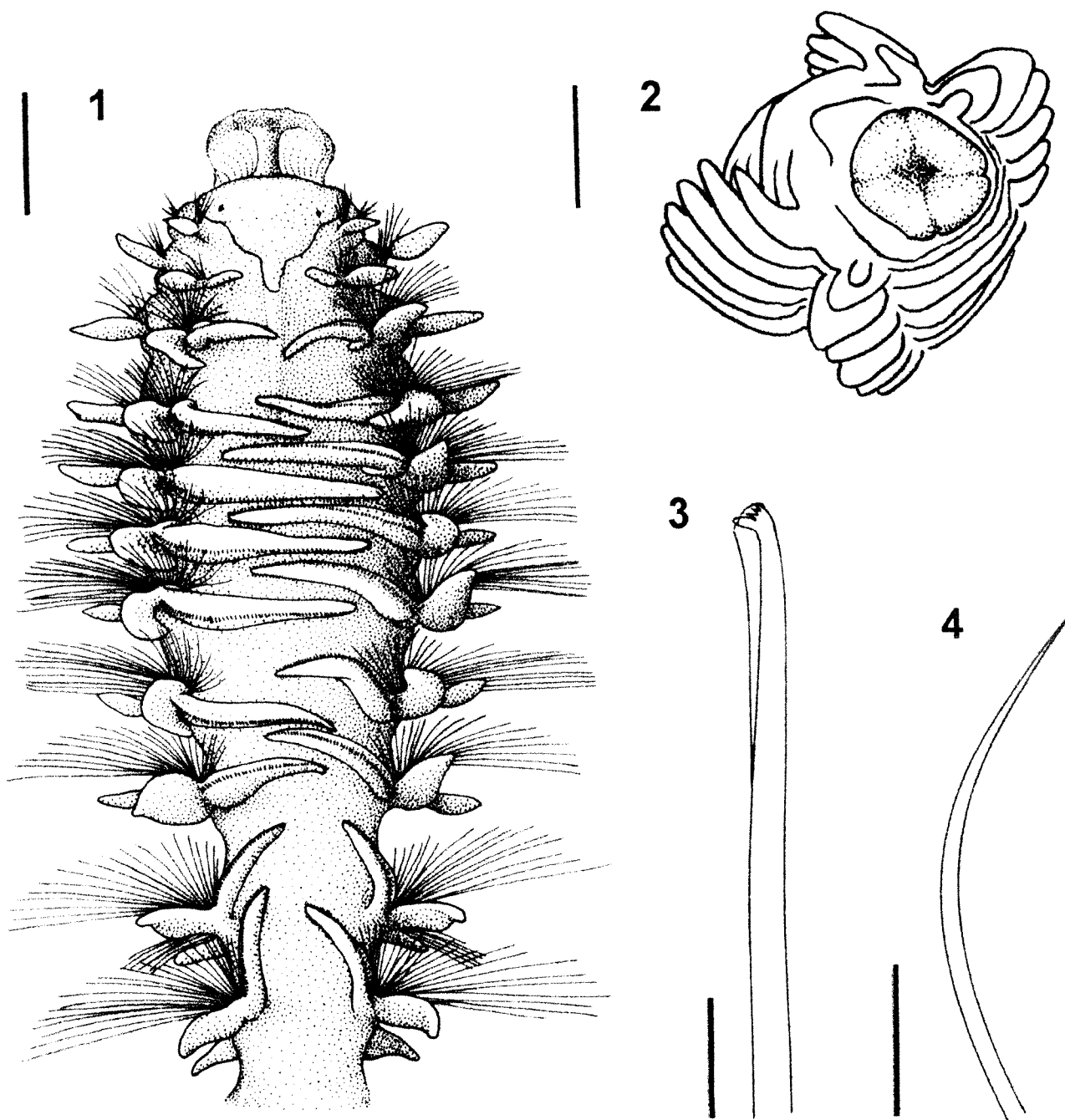
chaetigers 68 and 69 subsequently removed to permanent light microscope slide mount. Paratype WAM V4162 of 3 fragments apparently from a single specimen: anterior fragment of 16 chaetigers, 2 mm long, 0.2 mm wide at chaetiger 10 excluding parapodia; median fragment of 7 chaetigers, 1 mm long; posterior fragment of 11 chaetigers, 1 mm long. Paratype WAM V4163 of 2 fragments apparently from a nearly complete specimen: anterior fragment of 16 chaetigers, 1.5 mm long, 0.3 mm wide at chaetiger 10 excluding parapodia; posterior fragment of 20 chaetigers, 2 mm long.

Prostomium (Figures 1, 6) blunt, anteriorly truncate with entire anterior margin; frontal or lateral horns absent. Posterior prolongation of prostomium continuing back to chaetiger 1; free from dorsum. Palps unknown. Occipital antenna absent. Nuchal organ short, at most one segment long. One pair of eyes present as faint pigment spots (no eye structures visible under SEM). Specimen has proboscis partially everted (see figure 1); this everted structure appears almost continuous with the prostomium on the SEM which is annotated to delineate the anterior margin of the prostomium.

Dorsal branchiae free and separate from notopodial lamellae throughout; first present on chaetiger 2; last on 30. Branchiae apinate, with ciliated margins (Figure 7). Dorsal branchiae of anterior-most chaetigers are about 2 times as long as notopodial lobe, reducing in absolute and relative size posteriorly so that by chaetiger 25 branchiae and notopodia are about equal in length. Accessory branchiae absent from posterior part of notopodium. Ventral branchiae absent.

Dorsal crests absent but anterior 22 chaetigers with a single transverse ciliated band across the dorsum of each segment (Figure 7). Chaetiger 1 with notochaetae. Notopodial lobes asymmetrical, lanceolate, neuropodial lobes about half as long as notopodial lobes throughout, both parapodial lobes reducing in size on posterior chaetigers (Figures 5, 8). Neuropodial lobe of chaetiger 2 rounded, approximately symmetrical, lacks any ventral projection and does not differ from neuropodial lobes of adjacent chaetigers (Figure 2). Interparapodial pouches absent.

Chaetigers 2–4 similar, not strongly differentiated. Posterior modified notochaetae absent. Notopodial hooded hooks absent. Neurochaetae of chaetiger 1 simple capillaries similar to those of subsequent chaetigers. Neuropodial hooded hooks present, first on chaetiger 60–65; with 6 accessory teeth in 2 rows of 3 above the main fang; secondary tooth closely applied to the main fang, about 45° (Figure 3). Neuropodial sabre chaetae present from chaetiger 20 or perhaps earlier and are apparently missing



Figures 1-4 *Prionospio thalanji* sp. nov.: 1, holotype, dorsal view (proboscis everted; drawing made prior to preparation of SEM mount), scale 0.2 mm; 2, paratype WAM V4163, ventro-lateral view of anterior end (proboscis everted), scale 0.2 mm; 3 holotype, neuropodial hooded hook, chaetiger 67 or 68, scale 0.01 mm; 4, paratype WAM V4162, sabre chaeta, chaetiger 67 or 68, scale 0.1 mm.

from many chaetigers (Figure 4). Neuropodial spines absent. Hooded hooks with hood closely applied to the head of the hooded hook and no accessory teeth visible using SEM. Neuropodia from chaetigers 68 and 69 removed from the SEM mount and figured using transmitted light (figure 3). Pygidium with paired lateral lappets and vestigial median ventral cirrus (observed prior to mounting specimen but no longer visible in SEM preparation).

Variability

The above description is based on the holotype. Both paratypes also have partly everted proboscis, both have neuropodial sabre chaetae from chaetiger 13, and both lack notopodial hooded hooks (as in the holotype). Neuropodial hooded hooks are present in both paratypes but the segment of first appearance cannot be determined; none are present on either 16 chaetiger anterior fragment. Paratype WAM BES 4294 is the smallest specimen and has

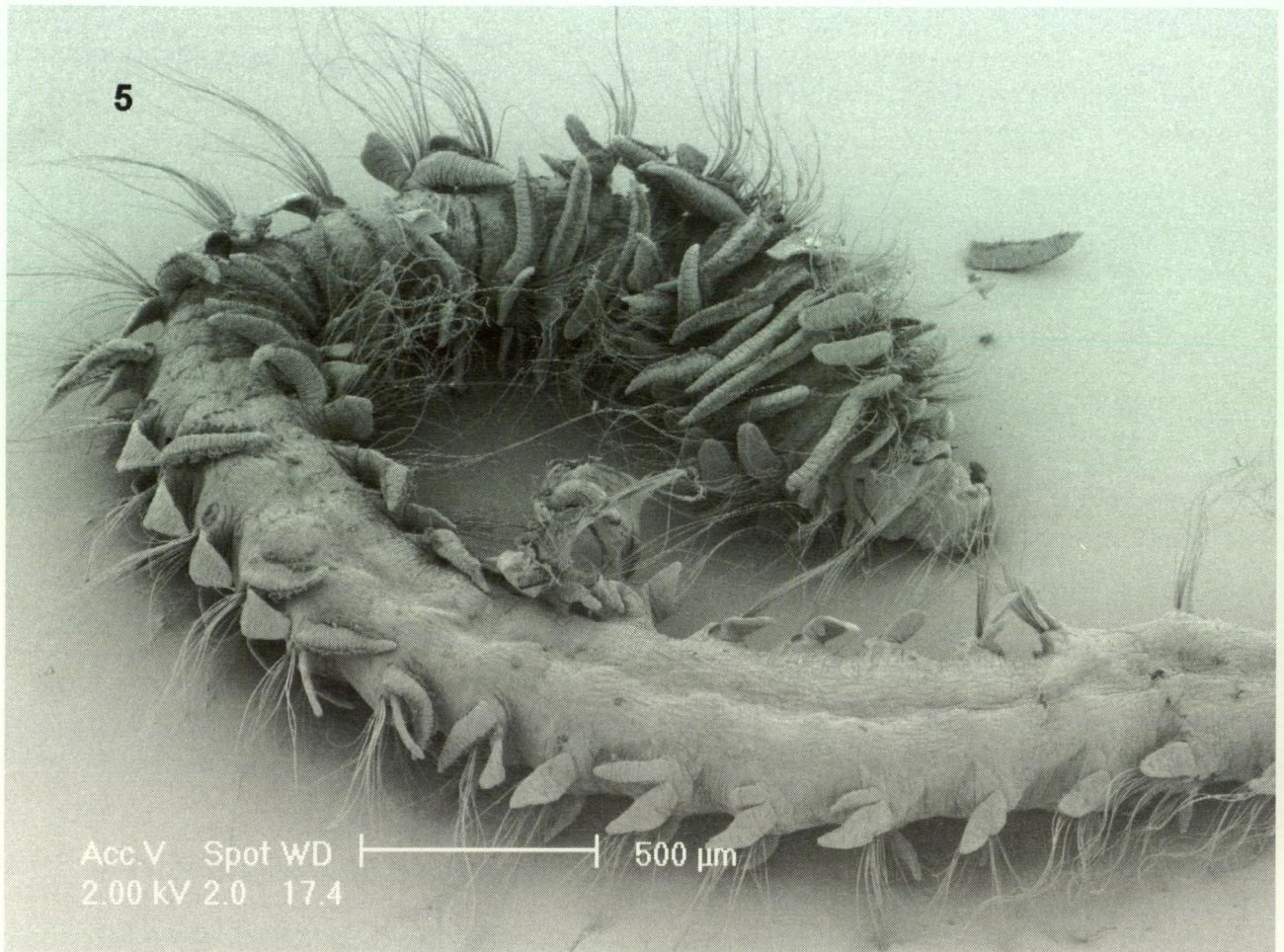


Figure 5 *Prionospio thalanji* sp. nov., holotype. Anterior fragment. Scale 500 μ m.

branchiae to chaetiger 10, however the branchiae are fragile and many appear to be lost from the specimen. Paratype WAM V4163 has branchiae to at least chaetiger 28.

Comments

The genus *Prionospio* has been divided into generic or subgeneric groupings as defined by different combinations of pinnate and simple branchiae (Blake and Kudenov, 1978; Maciolek, 1985; Wilson, 1990; Sigvaldadottir, 1998). Sigvaldadottir (1997, 1998) found it likely that these subgroups of *Prionospio* were artificial and did not represent monophyletic groups. Nevertheless, branchial characters remain among the most useful for distinguishing species. *Prionospio thalanji* is apparently most similar to other species having multiple pairs of simple, laterally ciliated branchiae. Australian species sharing these characteristics are *Prionospio tatura* Wilson, 1990, *P. wambiri* Wilson, 1990; *P. yuriel* Wilson, 1990. However, none of these species has more than 12 pairs of branchiae and all possess notopodial hooded hooks. If branchial number alone is taken as the best indicator of

relationships among *Prionospio* spp., *P. polybranchiata* Fauvel, 1929 from the Gulf of Manaar, Indian Ocean, with 39 pairs of branchiae and similar hooded hooks (Maciolek, 1985) would be the most likely sister taxon to *P. thalanji*. However, there is no parsimony analysis to support this proposition. *Prionospio polybranchiata* is readily distinguished from *P. thalanji* by the presence of notopodial hooded hooks (absent in *P. thalanji*) and by the appearance of neuropodial hooded hooks at chaetiger 22 (they are not present until at least chaetiger 60 in *P. thalanji*). *Prionospio thalanji* is apparently unique in the genus in lacking notopodial hooded hooks and in the late appearance of neuropodial hooded hooks.

Prionospio thalanji is apparently the first spionid polychaete recorded from cave environments (Hartmann-Schröder, 1986). Spionids are rare in freshwater environments, although two species of *Boccardia* are known from coastal dune freshwater lakes in south-eastern Australia (Blake and Woodwick, 1976), and *Orthoprionospio cirriformia* Blake and Kudenov, 1978 is widespread in areas of reduced salinity in south-eastern Australia.



Figure 6 *Prionospio thalanji* sp. nov., holotype. Prostomium. Dashed line distinguishes anterior margin of prostomium from everted pharynx. Arrow indicates branchial scar on chaetiger 1. Scale 100 µm.

Distribution

Bundera Sinkhole, Cape Range peninsula, north-west Western Australia.

The surface salinity of Bundera Sinkhole, to the marked thermocline at a depth of about 8 m, was about 19 g l⁻¹ TDS. An halocline between 8 and 18 m brings the deep salinity to about 34 g l⁻¹ and it is in this more saline water that *Prionospio thalanji* occurs, together with the typical anchialine fauna.

Bundera Sinkhole is the only continental anchialine system known in the southern hemisphere (Humphreys, 1999a; Humphreys *et al.*, 1999). It is typical of an arid zone anchialine system in having brackish water overlying seawater and subject to marine tides, although situated 1.7 km inland. It has an especially complex physico-chemical stratification, exhibiting multiple hydrogen sulphide layers, oxygen and redox minima and the characteristic signals of chemoautotrophic energy production by sulphur and nitrogen bacteria (Humphreys, 1999a). This physicochemical stratification is vulnerable to mixing disturbance by divers (Humphreys *et al.*, 1999). This site and the regional fauna and

characteristics are discussed more fully elsewhere (Poore and Humphreys, 1992; Bruce and Humphreys, 1993; Humphreys, 1993, 1999a, 2000a, 2000b; Yager and Humphreys, 1996; Humphreys *et al.*, 1999).

Etymology

The species name *thalanji* is an alternative simplified spelling of the Aboriginal tribal group Thalanyji, who live in the Cape Range area.

DISCUSSION

The presence of apinnate ciliated branchiae is probably a derived condition within *Prionospio*, and other taxa with this condition are widely distributed in marine environments around the world (Sigvaldadóttir, 1998). The genus *Prionospio* is dominated by marine species, with a few estuarine representatives; none are known from truly freshwater or anchialine habitats. Thus, *Prionospio thalanji* is apparently a sister taxon to a marine species, though which one is unknown.

Among aquatic species so far recorded from

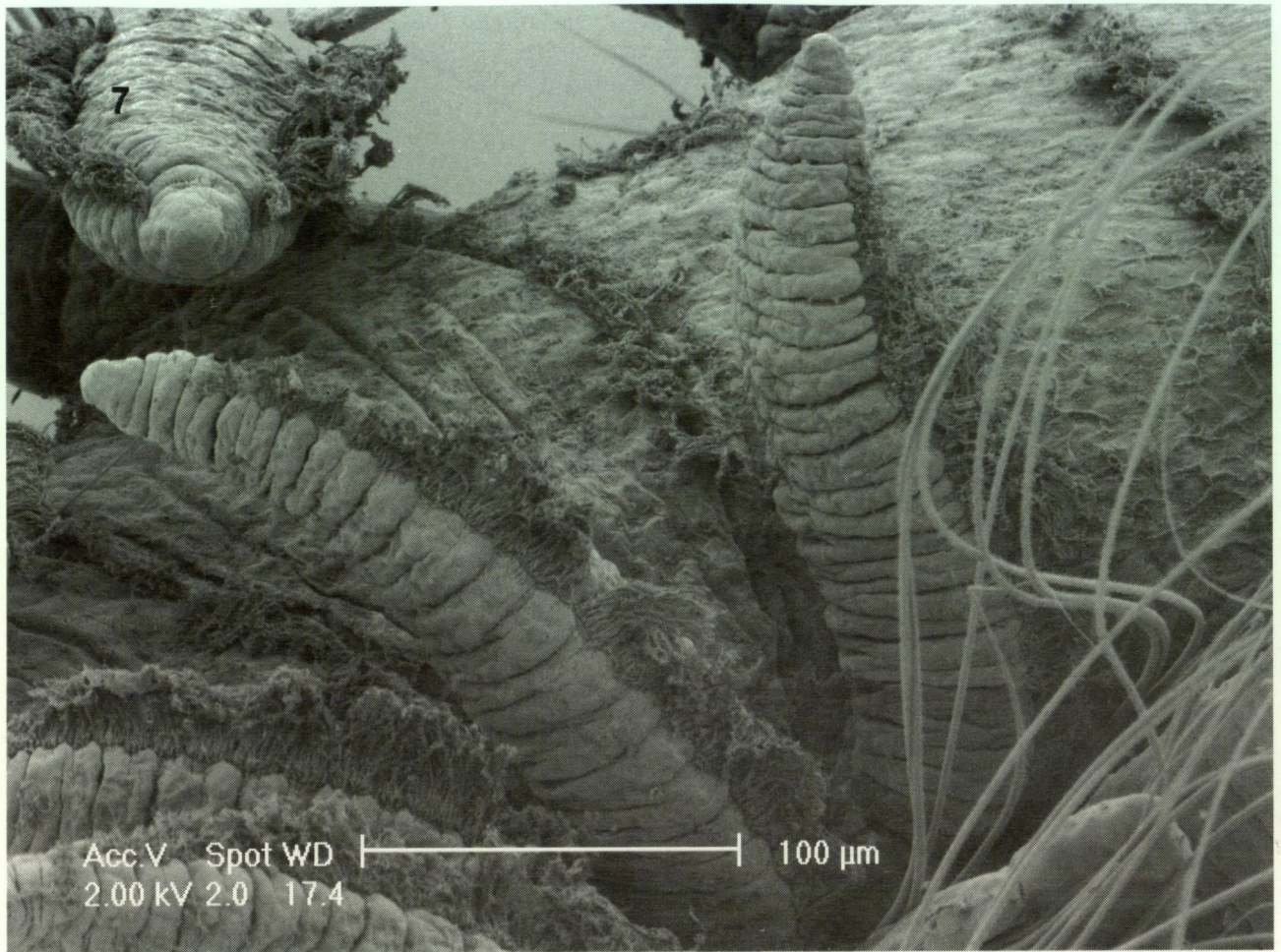


Figure 7 *Prionospio thalanji* sp. nov., holotype. Ciliated branchiae and ciliated transverse dorsal bands, chaetigers 10, 11. Scale 100 µm.

anchialine caves of Cape Range, several have clear affinities with marine taxa: the gastropod mollusc *Iravadia* sp., which was recorded from the brackish part of Bundera Sinkhole, where it was exposed to full sunlight, belongs to a genus that is otherwise estuarine (Slack-Smith, 1993).

Dr G. Hartmann-Schröder determined a number of polychaetes collected from the anchialine system on the Cape Range peninsula. *Sphaerosyllis centroamericana* Hartmann-Schröder, 1959 (Syllidae) was also collected from Bundera Sinkhole as well as from small shallow karst windows—Tantabiddi Rockholes, C-332 (21°55'S, 113°59'E), Wobiri Rockhole, C-414 (21°50'S, 114°04'E) and C-506 (22°28'S, 113°44'E). Specimens were also obtained from Jarvis Well C-362 (22°36'S, 113°41'E), a deep pastoral well which also contained *Typosyllis* (*Ehlersia*) cf. *broomensis* Hartmann-Schröder, 1979 (Syllidae). In contrast to *Prionospio thalanji*, all were characterized as 'normal' marine forms.

A new species of harpacticoid copepod in the genus *Phyllopodopsyllus* occurs in this anchialine system at the northern end of the peninsula (Karanovic *et al.*, in press). It is the only known

occurrence of the genus outside strictly marine habitats but it displays clear stygomorphies, being colourless and lacking the nauplius eye (Karanovic *et al.*, in press).

Other aquatic taxa known from the Cape Range anchialine cave system have their closest affinities with aquatic and/or cavernicolous taxa that are now remote from the Cape Range caves. Their affinities principally lie with the fauna from anchialine caves on either side of the North Atlantic (Humphreys, 2000b; Jaume *et al.*, in press), and the lineages occupy the Tethyan track (Stock, 1993). In the deeper part of Bundera Sinkhole at depths between 18 and 33 m, occurs an anchialine community, the general structure of which is predictable from the Caribbean region, the Canary Islands and northwestern Australia (e.g. Yager and Humphreys, 1996; Danielopol *et al.*, 2000; Jaume *et al.*, in press). It includes the genera *Lasioneustes* (Remipedia), *Danielopolina* (Ostracoda: Halocyprida: Thaumatoocyprididae), *Liagoceradocus* (Crustacea: Hadziidae), *Stygiocaris* (Decapoda: Atyidae), *Bunderia* (Calanoida: Epacteriscidae), *Stygocyclopi* (Calanoida: Pseudocyclopiidae) and

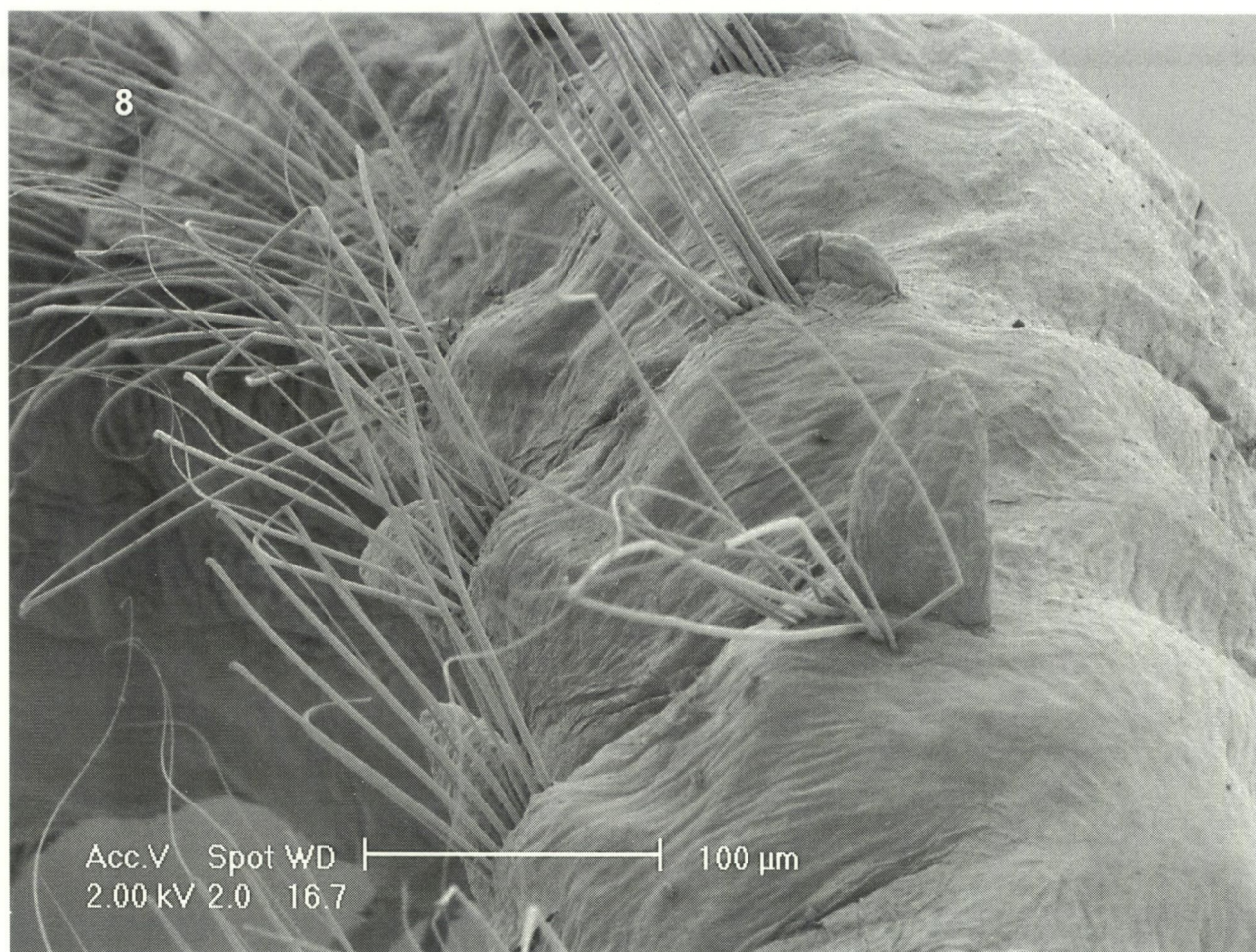


Figure 8 *Prionospio thalanji* sp. nov., holotype. Notopodia and neuropodia, chaetigers 50–55. Scale 100 µm.

Speleophria (Misophrioida: Speleophriidae). In the photic zone, above the thermohalocline, this anchialine system also contains a number of non-stygal invertebrates, including *Halicyclops* (Copepoda: Cyclopidae), ostracods, *Iravadia* sp. (Mollusca: Iravadiidae), water striders (Gerridae: Hemiptera) and *Kiefferulus* (Chironomidae: Diptera). A fuller description of the surface fauna associated with these karst wetlands is given elsewhere (Humphreys, 2000a, 2000b).

Elsewhere in the anchialine system of the Cape Range peninsula and Barrow Island occur other 'tethyan' taxa, including *Ophisternon* (Synbranchiformes: Synbranchidae), *Halosbaena* (Thermosbaenacea), and *Haptolana* (Isopoda: Cirolanidae). The gudgeon, *Milyeringa* (Perciformes: Eleotridae), the affinities of which are unknown, occurs throughout the anchialine system (Humphreys, 1999b, in press).

The 'tethyan' lineages probably have a long stygal history, i.e. restricted to subterranean realms, following vicariant events resulting from the movement of the tectonic plates during the Mesozoic (Humphreys, 2000b; Jaume *et al.*, in press). No such ancient origin need be invoked to explain the presence of *Prionospio thalanji* and

Iravadia sp. in Cape Range caves as both have probable sister taxa that are widespread in adjacent marine environments. Molecular systematic studies that estimate times of genetic divergence between *Prionospio thalanji* and *Iravadia* sp. and their respective marine sister taxa are required to test the plausible hypothesis that these two taxa have diverged from non-cavernicolous ancestors more recently than other aquatic inhabitants of the Cape Range cave system.

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