

Description of a new species of *Marphysa* Quatrefages, 1865 (Polychaeta: Eunicidae) from the west coast of Peninsular Malaysia and comparisons with species from *Marphysa* Group A from the Indo-West Pacific and Indian Ocean

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Abstract

Idris, I., Hutchings, P.A. and Arshad, A. 2014. Description of a new species of *Marphysa* Quatrefages, 1865 (Polychaeta: Eunicidae) from the west coast of Peninsular Malaysia and comparisons with species from *Marphysa* Group A from the Indo-West Pacific and Indian Ocean. *Memoirs of Museum Victoria* 71: 109–121.

A new species of *Marphysa* Quatrefages, 1865 (Polychaeta: Eunicidae) is described from the west coast of Peninsular Malaysia and compared with species from *Marphysa* Group A from the Indo-West Pacific and Indian Ocean. The number of species known within *Marphysa* Group A has been increased, and the concept that *M. mossambica* is a widely distributed species in the Indo-Pacific is refuted. The new species is commercially important and occurs in the mangrove forest along the west coast of Peninsular Malaysia. Notes on the biology, ecology and commercial aspects of *M. moribidii* sp. nov. are presented.

Keywords

polychaete, mangrove, intertidal, commercial polychaete, bait worm, *Marphysa*

Introduction

Studies on polychaete taxonomy in Malaysia are relatively few compared with those of neighbouring countries (Paxton and Chou, 2000; Aungtonya et al., 2002; Al-Hakim and Glasby, 2004; Chan, 2009; Rajasekaran and Fernando, 2012). Publications on polychaetes are scattered, with no specific taxon targeted; examples of the publications are Ong (1995) and Nishi (2001). A recent literature review by Idris and Arshad (2013) indicates that 64 species from 31 families of polychaete have been identified in Malaysia since 1866. Nevertheless, with a total 4675 km of Malaysian coastline it is suggested that the number of polychaete species recorded will increase with additional studies.

As part of the effort to increase the number of identified polychaete species in Peninsular Malaysia, a survey was conducted to identify polychaetes used as baitworms. This survey identified seven species (from four families) that are harvested and used regularly by local recreational fishers

(Idris et al., 2012; Idris and Arshad, 2013). One of the species reported was identified as *Marphysa* cf. *mossambica* (Peters, 1854) and it was found along the west coast of Peninsular Malaysia within the mangrove forest.

The species *Marphysa mossambica* was initially described as *Eunice mossambica* by Peters (1854) with reference to specimens collected from Mozambique:

“*E. mossambica* sp., closely related to *E. sanguinea* Montagu, but different concerning the position of the antennae and the position of the eyes. The external antennae do not protrude beyond the posterior head region and the eyes are located at the outer part of the basis of the internal antennae. Distributed in sandy coastal regions, from Mossambique to Mossimboa, from 11° to 15° south” (sic).

Unfortunately, Peters (1854) description on the species is too brief and did not mention chaetal types or dentition of the jaws, which are critical characters for the identification of this group of worms. Over 100 years later, Fauchald (1987) examined the lectotype material deposited in the Zoologische

Museum, Berlin, Germany, (ZMB F2046) and provided a detailed description of the species.

In 1865, Kinberg identified a specimen from Sydney Harbour (Port Jackson), Australia, as *Nauphanta novaehollandiae* Kinberg, 1865. Many polychaete workers, namely Gravier (1900), Crossland (1903) and Augener (1922), agreed that *N. novaehollandiae* should be synonymised with *M. mossambica*. Augener (1922), however, appears to have preferred to use the name *N. novaehollandiae* rather than *M. mossambica*, as the description made by Kinberg (1865) is more complete. Fauchald (1987), after examining the lectotype (ZMB F2046) and paralectotypes (ZMB 47, ZMB 4005), transferred *M. mossambica* into the genus *Nauphanta* as 'fan-shaped chaetae' were present and there was a total absence of compound chaetae. This differs from Fauchald (1970), who proposed that species of *Marphysa* could be split into five groups, with one referred to as Group A, characterised by lacking any composite chaetae; *M. mossambica* is included within this group. A recent study by Glasby and Hutchings (2010) has suggested that the synonymy of *N. novaehollandiae* with *M. mossambica* be reinstated. They suggested that while Fauchald (1987) regarded the differences where the branchiae and hooks begin as species specific, in fact these differences can be due to size-related variation. A more recent review of the family Eunicidae by Zanol et al. (2014) has included a new character for *M. mossambica*—a wide pectinate chaeta with wide teeth on posterior chaetigers.

Until 2010, *Marphysa* Group A, comprised only two species—*M. mossambica* and *M. simplex* Treadwell, 1922. The latter species was then synonymised with *M. mossambica* (Glasby and Hutchings, 2010), leaving *M. mossambica* as the only species in this group. Nevertheless, a detailed examination of *Marphysa* cf. *mossambica* specimens from Peninsular Malaysia found consistent morphological differences compared with the description of *M. mossambica* that warrant the description of a new species in *Marphysa* Group A.

Materials and methods

Specimens were collected from various locations on the west coast of Peninsular Malaysia (fig. 1). Malaysia is located in the central part of south-east Asia and consists of two land masses — Peninsular Malaysia and east Malaysia. Peninsular Malaysia is a land bordered with Thailand in the north, while Indonesia and Singapore share the maritime limits in the west and south, respectively. The east Malaysia consist of two states i.e. Sabah and Sarawak. Both states are located on the northern part of Borneo island, sharing land border with Indonesia in the south, while Philippines share the maritime border at the east of Sabah. A sovereign Brunei is located on the upper part of the state border between Sabah and Sarawak.

All sampling locations on the west coast of Peninsular Malaysia are similar in terms of habitat — mangrove forest and mudflats. Specimens were relaxed in 7% MgCl₂, then fixed in 10% formalin and later preserved in 70% ethanol.

Material was examined using stereo (Olympus SZ) and compound (Nikon Eclipse E400) microscopes. Detail characters on parapodia 3, 10, 20, 50, 100, 150, 260, 400 and 456 were observed using the scanning electron microscope (SEM) Zeiss

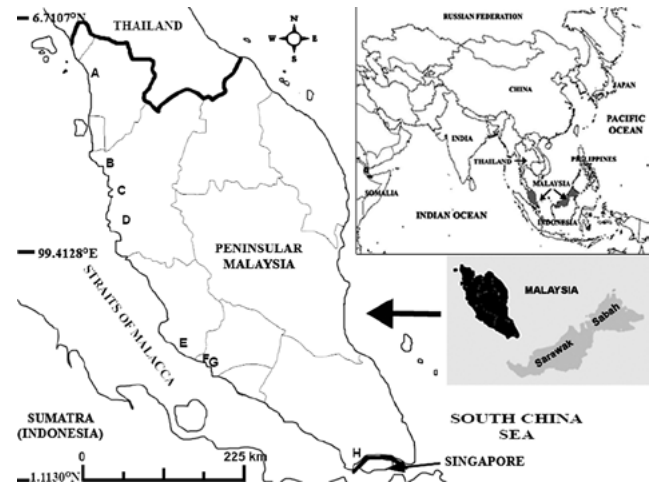


Figure 1. Locations of *Marphysa moribidii* sp. nov. in Peninsular Malaysia: A, Sg. Merbuk estuary, Kedah; B, Kuala Gula, Perak; C, Kg. Terubong Laut, Perak; D, Kg. Sitiawan, Perak; E, Morib mangrove, Selangor; F, Kuala Lukut, Negeri Sembilan; G, Bt. 4, Port Dickson, Negeri Sembilan; H, Tg. Kupang, Johor.

EVO LS15 SEM with a Robinson Backscatter Detector. Biometric measurements of the width of chaetiger 10 (including parapodia) and number of chaetigers on which the branchiae occurred from 35 specimens were made using a stereo microscope with a calibrated eye graticule. Analysis and graphs of size-related data were made using Microsoft Excel® 2010.

Ethanol-preserved specimens were deposited at the Australian Museum, Sydney, (AM) and at the Museum and Art Gallery of the Northern Territory (NTM), Australia.

Lectotype specimens (ZMB 4005, as stated in the specimen jar from the Zoologische Museum, Berlin, not ZMB F2046, as stated in Fauchald (1987)) were re-examined as well as a SEM stub with parapodia from various regions of the body.

Abbreviations

- AM Australian Museum, Sydney
 NTM Museum and Art Gallery of the Northern Territory, Australia
 ZMB Zoologische Museum, Berlin, Germany

Systematics

Order **Eunicida** Dales, 1962

Family **Eunicidae** Berthold, 1827

Genus ***Marphysa*** Quatrefages, 1865

Marphysa moribidii Idris, Hutchings and Arshad sp. nov.

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Figures 2, 3, 4

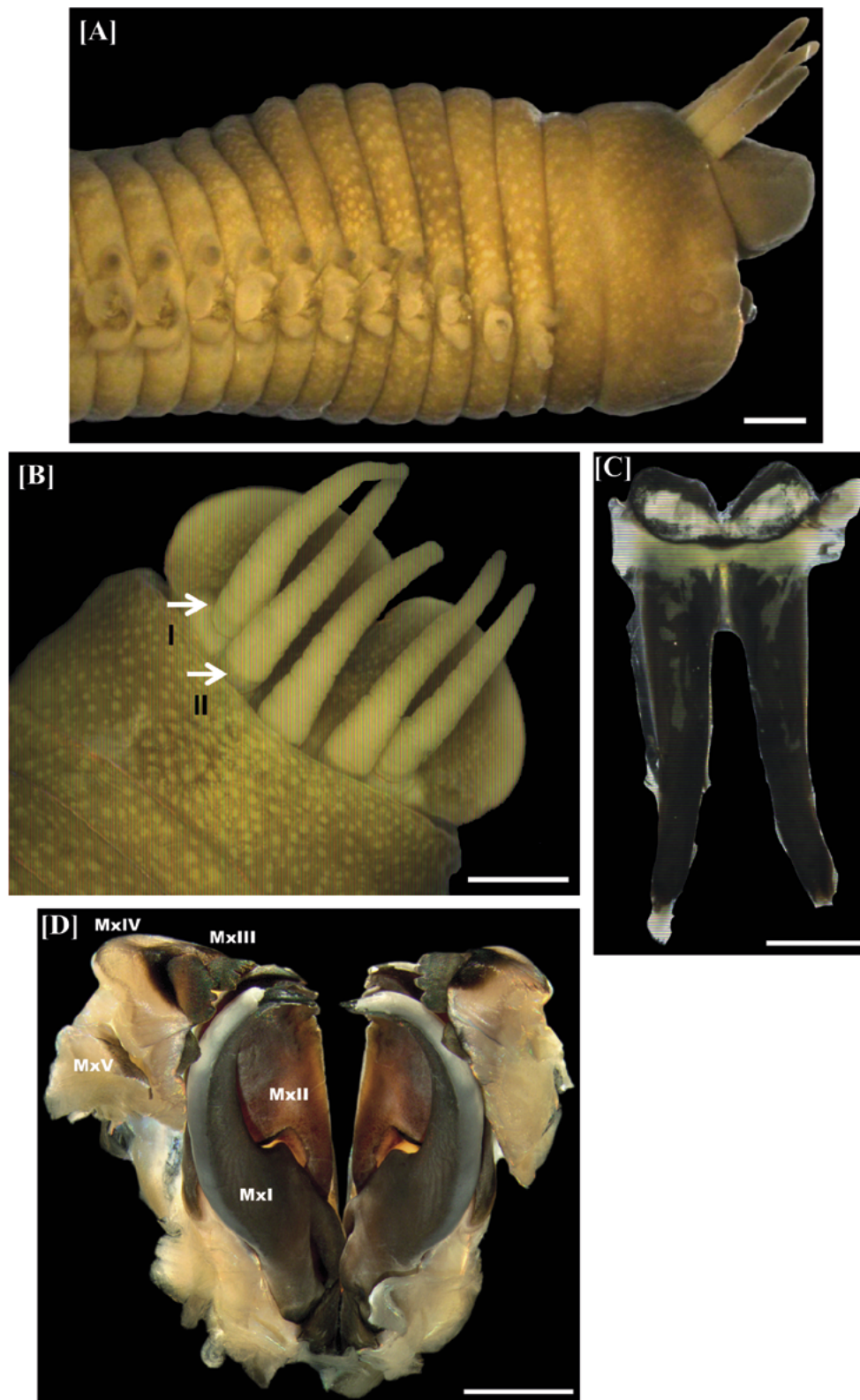


Figure 2. *Marphysa moribidii* sp. nov. [A] anterior section, lateral view. Note on the white spots on the epidermis of the specimen; [B], anterior section, dorsal view, showing the palpophore (I) and ceratophores (II); [C] mandible; [D] maxillae. [A, B, C] from non-type specimens; [D], from holotype (AM W43731). Mx = Maxillae. Scale bars: [A, B, C, D] = 1 mm.

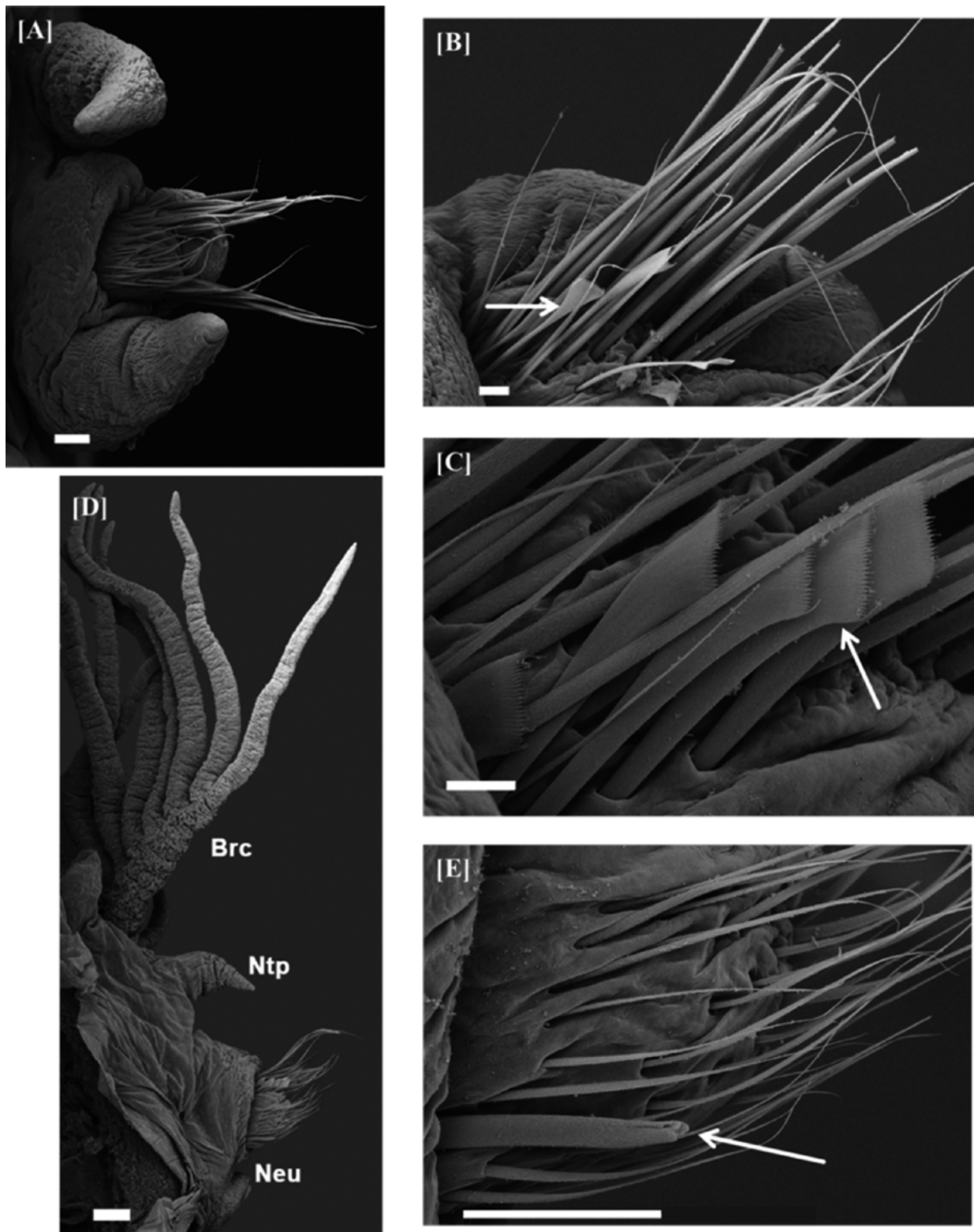


Figure 3. *Marphysa moribidii* sp. nov., [A] limbate and simple capillary chaetae, chaetiger 3; [B] symmetrical pectinate chaeta on the supra-position (arrow), chaetiger 50; [C] asymmetrical pectinate chaetae (arrow), chaetiger 10; [D] whole parapodium with branchia, showing relative length with notopodial cirrus, chaetiger 150; [E] sub-acicular hook (arrow), chaetiger 150. Brc = Branchia; Ntp = Notopodial cirrus; Neu = Neuropodial cirrus. [A, C, D, E] = Paratype, AM W38692; [B] = Non-type (AM W38687). Scale bars: [A, D, E] = 100 μm ; [B, C] = 20 μm .

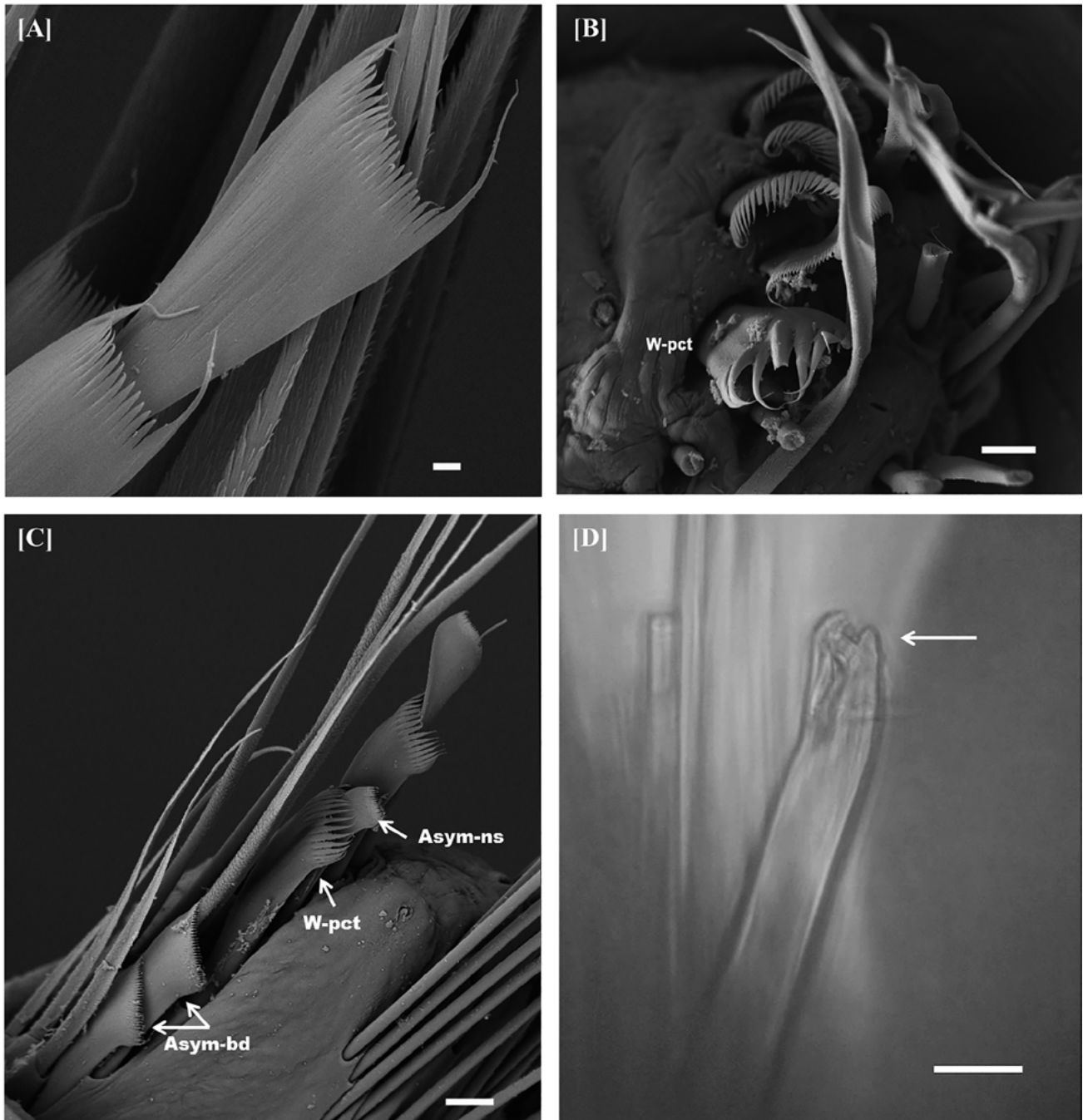


Figure 4. *Marphysa moribidii* sp. nov. [A] details of symmetrical pectinate chaetae, chaetiger 20; [B] wide pectinate chaeta with wide teeth (W-pct), dorsal view, chaetiger 400; [C] asymmetrical pectinate chaetae, all types, chaetiger 456; [D] (arrow) detail of bidentate sub-acicular hook, chaetiger 98. Asym-bd = asymmetrical pectinate with broad shaft; Asym-ns = asymmetrical pectinate with narrow shaft; [A] = non-type (AM W38687); [B, C] = holotype (AM W43731), [D] = non-type specimen. Scale bars: [A] = 3 μ m; [B, C, D] = 20 μ m.

Material examined. Holotype. AM W43731 – male, complete, Pantai Kelanang, Morib, Selangor, 2.75827°N 101.4379°E, coll. I. Idris 19 Jul 2012.

Paratypes. AM W38690 – 2 specs (1 male and 1 female), AM W38691 – 1 female, AM W38692 – 1 female, NTM W024777 – 1 spec. Data same as holotype.

Other material examined: AM W38684 – 1 female complete, NTM W024778 – 1 spec., Sg. Merbuk tributary, 5.6392°N 100.4138°E (range 10 km), coll. local bait digger 9 Feb 2011; AM W38685 – 2 females, NTM W024776 – 1 spec., Kg. Terubong Laut, Larut, Perak, 4.5659°N 100.6557°E (range 2 km), coll. local bait digger 8 Feb 2011; AM W38686 – 1 male, Kuala Gula, Perak, 4.9285°N 100.5086°E (range 5 km), coll. local bait digger 11 Feb. 2011; AM W38689 – 1 male, Tg. Kupang (2nd link bridge), Johore, 1.3956°N 103.6221°E, coll. I. Idris 5 Nov 2010; AM W38693 – 2 males, Kg. Sitiawan, Lumut, Perak, 4.2498°N 100.6893°E, coll. local bait digger 8 Feb 2011; AM W38694 – 1 male, NTM W024775 – 1 spec., Bt. 4, Port Dickson, Negeri Sembilan, 2.5034°N 101.8352°E (range 2 km), coll. local bait digger 20 Jan 2011; AM W38695 – 1 female, NTM W024774 – 1 spec., Kuala Lukut, Negeri Sembilan, 2.5698°N 101.7945°E, coll. local bait digger 20 Jan 2011.

Comparative material examined. *Eunice mossambica* ZMB 4005 Lectotype – female, Mozambique, coll. and det. Peters 1854; *Marphysa mossambica* AM W35469 – female, Dumangas, Iloilo, Philippines, 10.7968°N 122.6695°E, coll. J. Monteros-Recente 7 May 2010, det. C.J. Glasby.

Measurement. Holotype. Mature male (with gametes visible through body wall in parapodia on anterior and mid body segments), complete specimen total length of 333 mm in preserved solution (70% ethanol). Body width at chaetiger 10 (with parapodia) 9.76 mm, total number of segments 465. Paratypes mostly incomplete, body width at chaetiger 10 (with parapodia) 4.8 – 8.0 mm. Longest preserved specimen is AM W38684, with total length of 612 mm and 780 segments.

Description. Holotype (paratype values in parentheses). Body long and slender. Cylindrical at anteriormost part of metastomium until chaetiger 7 (3 – 7) but gradually becoming flattened dorsoventrally towards posterior end. Live worm with blood red branchiae. Anterior metastomium dark red gradually became lighter, slightly transparent towards posterior allowing the alimentary canal to be seen. Preserved specimen olive green with white spots dorsoventrally distributed on anterior; continue mid-dorsally along metastomium to about one-quarter of the body length (figs. 2A and B). White spots visible on live specimen, but faint and not detected on some specimens if the worm was not completely cleaned of adhering sediment.

Prostomium consists of semi-circular, bilobed upper lips with distinct middle notch, appearing as if two lobes present (fig. 2B). Prostomium surface and appendages with almost smooth surface, without articulations. Prostomium appendages slightly curved. Median antenna about the same length as lateral antennae and slightly longer than palps (0.2 – 0.5 times longer). Antennae (median and lateral) about twice the length of the prostomium. Ceratophores and palpophores present, cylindrical, short, with no articulations (fig. 2B). No gap between palps and lateral antennae, but small gaps exist between median and lateral antennae. Eyes absent. Peristomium consists of two rings with length of first ring about 2.5 times longer than second ring. Dorsal part of first

ring slightly longer than ventral side including peristomium fold. Lateral and ventral sides of first peristomium ring (lateral and lower lips) covered with abundant folds (fig. 2A). Mandibles dark brown but with white calcified layer on cutting plates (paratype: transparent cutting plates). Cutting plate sub-oval, flat, no dentition on cutting edge, slightly rough surface with carrier almost parallel (fig. 2C). Maxillae dark brown but becoming paler on edge (fig. 2D). Dental formulae: MxI = 1 + 1, MxII = 4 + 4 (4 + 5 – 6), MxIII = 6 + 0 (8 + 0), MxIV = 4 + 8 (7 + 8) and MxV = 1 + 1 (1 + 1). MxVI is absent.

Parapodia consisting of notopodial and neuropodial cirri, as well as post-chaetal lobe. Pre-chaetal lobe absent (fig. 3A). Notopodial cirri gradually change from subulate to conical towards posterior parapodia. Neuropodia initially with conical cirri gradually becoming sub-conical towards posterior end. Base of notopodial cirri sub-ovulate in anterior chaetigers without inflation but gradually becoming circular in median and posterior chaetigers. Post-chaetal lobe sub-conical in first chaetiger, gradually becoming sub-triangular by chaetiger three, low and broad from chaetiger four to around chaetiger 130, then gradually decreasing in size from chaetiger 131 towards posterior end. Branchiae first emerge from base of dorsal cirri at chaetiger 35 (33 – 39) and disappear by last 20 chaetigers. Number of branchial filaments gradually increases from one to maximum 11 (6 – 14), filaments arranged as pectinate type in mid-body, number of filaments decreases to one filament on posterior segments (fig. 3D). Length of branchial stem shorter than neuropodial cirri by chaetiger 35 (33 – 39), the chaetiger on which branchiae first emerge. Branchial stem length then gradually increases until about 10 – 15 times longer than notopodial cirri by chaetiger 70, where maximum number of branchial filaments is reached (13 in type specimens, 14 in non-types).

Chaetae divided into two fascicles: supra-acicular and sub-acicular chaetae with aciculae located in middle (lateral view) (fig. 3A). Six types of chaetae present: thick limbate; slender capillary; symmetrical pectinate; asymmetrical pectinate with narrow shaft; asymmetrical pectinate chaetae with broad shaft; and wide pectinate chaetae with wide teeth (figs. 3B, C; figs. 4A, B, C). Limbate chaetae longer and thicker than capillaries but both serrated. Limbate and capillary chaetae present in both fascicles throughout body. Number of limbate chaetae range from 28 – 41 until about chaetiger 100 and then reducing to 13 – 19 chaetae in posterior region. Capillary chaetae present in small numbers (<10) throughout. Symmetrical pectinate chaetae characterized as having both outer teeth of the same length with slender shaft (fig. 3B; fig. 4A). Symmetrical pectinate chaetae present from chaetiger five (chaetiger three in paratype), apparently absent after chaetiger five until chaetiger 50, then present again from chaetiger 51 onwards. Asymmetrical pectinate chaetae only present from chaetiger 100 onwards in type specimens and characterised as having the outer teeth of different length to the median teeth with broad or narrow shafts (fig. 3C, figs. 4B, C). The wide-toothed pectinate chaetae with wide body are present in holotype from about chaetiger 400 onwards (figs. 4B, C). Numbers of pectinate chaetae per parapodia ranged from one to six for both holotype and paratypes. Aciculae 3 –

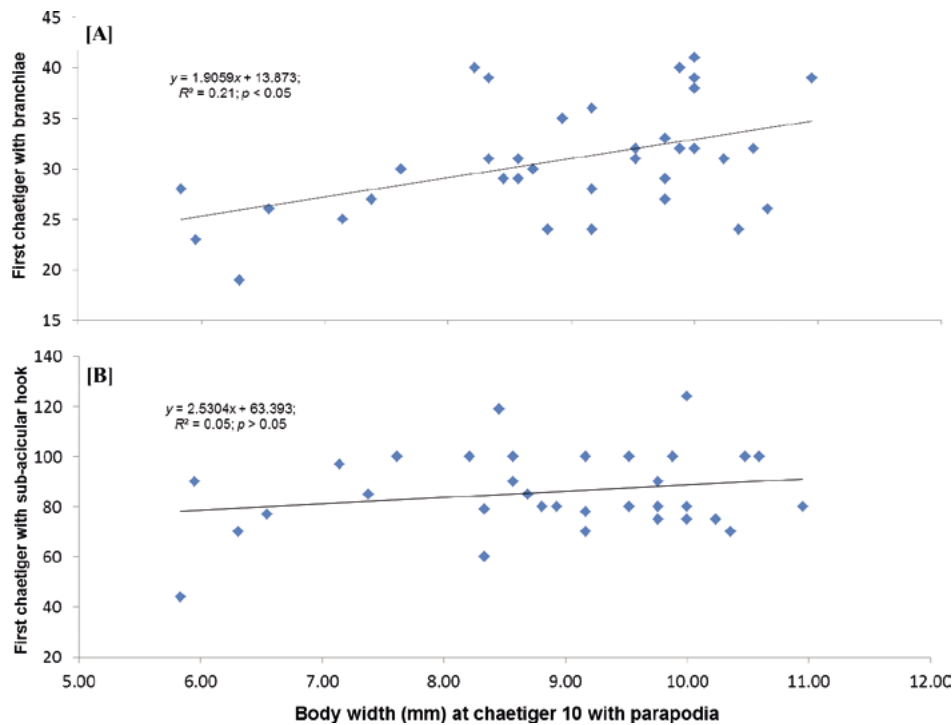


Figure 5. Relationships between body width (at chaetiger 10 with parapodia) and [A], first chaetiger with branchiae; and [B], first chaetiger with subacicular hook of *Marphysa moribidii* sp. nov., from Morib mangrove, Malaysia. Regression equations and coefficients are for all data points ($n = 35$).

4 per parapodium, dark brown, distally pointed, and arranged straight and almost parallel between fascicles. No sub-acicular hooks in holotype; however in paratypes, bidentate hooks present from median chaetiger (chaetiger 71 in one paratype only), but occurring irregularly.

Pygidium typical of *Marphysa* species, two pairs of unequally sized pygidial cirri inserted ventrally, arranged on top of each other. Largest: dorsal, two times height of pygidium, smallest about one-quarter height of pygidium.

Etymology. The name '*moribidii*' refers to the location (Morib mangrove) where the type specimens were collected. Morib is also the landing site of the 46th Indian Beach Group under the Allied Forces to mark the end of the Japanese occupation of Malaya in 1945. The local name for *Marphysa moribidii* is ruat bakau (mangrove worm).

Intraspecific variation. Information on the morphological variation present in this species is based upon detailed examination of 914 specimens collected from the type locality from June 2011 to December 2012. However, of these, only 136 specimens were complete. The large number of incomplete specimens was due to the method of collecting by digging with a shovel and the fragility of the animals. Length of complete specimens in preserved 70% ethanol ranges from 7 – 477 mm, with the number of chaetigers varying from 113 – 580. However, there is an incomplete specimen with 600 chaetigers, indicating that the number of chaetigers can be higher or similar to the longest deposited specimen (AM W38684). Body colour varies from dark olive green to light

brown. In some specimens, the white spots are absent. Peristomium flap on the anterior of first ring can extend until it covers the ceratophores and palpophores. However, in some specimens, the flap was not detected or was reduced.

The chaetiger number at which the branchiae commence varies greatly in non-type specimens. The branchiae begin from chaetiger 4 – 63 as a single filament (in some specimens two to three filaments) and can reach a maximum number of 14 filaments in non-type specimens. The distribution of bidentate, sub-acicular hooks is irregular; they are present from chaetiger 44 in some specimens (figs. 3E, 4D). Some specimens also possess two bidentate sub-acicular hooks at the midsection of the body (chaetigers 60 – 78).

The relationship between body width at chaetiger 10 and the chaetiger on which the branchiae appear (fig. 5A) shows a significant positive linear relationship ($R^2 = 0.21$; $n = 35$; $p < 0.05$).

The positive relationship for these morphological characters is similar to that found in *M. cf. mossambica* and occurring in the synonymised *M. novaehollandiae* (Glasby and Hutchings, 2010). However, the correlation value of *M. moribidii* and *M. cf. mossambica* differs significantly between the two species ($z = 3.19$, $p < 0.05$).

Moreover, the relationship between body width and the chaetiger on which the sub-acicular hook appears (fig. 5B) is not statistically significant ($R^2 = 0.05$; $n = 35$; $p > 0.05$). Thus the appearance of sub-acicular hooks on the parapodia is not in a predictable pattern for *M. moribidii* sp.nov.

Table 1. Morphological comparison between *Marphysa moribidii* sp. nov., *Marphysa mossambica* and *Marphysa* cf. *mossambica* (*sensu* Fauchald, 1987 and *sensu* Glasby and Hutchings, 2010) from Australia. Variations (ranges) in population in parentheses. *Distinguishing characteristic.

Characteristics	<i>Marphysa moribidii</i> sp. nov. (present study)	<i>Eunice (Marphysa)</i> <i>mossambica</i> (Lectotype; Fauchald 1987 and present study)	<i>Nauphanta</i> <i>novaeollandiae</i> (<i>Marphysa</i> cf. <i>mossambica</i> (<i>sensu</i> Fauchald 1987))	<i>Marphysa</i> cf. <i>mossambica</i> (<i>sensu</i> Glasby and Hutchings, 2010)
Location	West coast of Peninsular Malaysia (type locality: Morib mangrove)	South-west of Indian Ocean (Mozambique)	South-west Pacific Ocean (Australia)	Arafura Sea, south-east Indian Ocean (Australia)
Preserved body length (mm) (chaetiger 10 incl. parapodium)	9.8 (7.1 – 47.7)	10	40 (measured at chaetiger 20)	(2.2 – 9.0)
Body shape	Rounded initially, but becoming flatter starting from chaetiger 7 towards posterior	Rounded until chaetiger 10, then flattened towards posterior	Not mentioned	Rounded initially, flattened in middle and posterior body
Body pigmentation*	Olive green with white spots on dorsal and ventral sides of anterior section	Not mentioned (no white spots, light brown pigmentation; pers. obs.)	Not mentioned	No pigmentation
Prostomium shape	Anteriorly truncate, bilobed with distinct mid notch	Frontally truncate, bilobed with shallow mid notch	Anteriorly truncate, bilobed with distinct mid notch	Bilobed
Prostomium appendages (surface)	Smooth throughout	Smooth throughout	Smooth throughout	Smooth throughout
Ceratophore	Present	Present	Present	Present
Median antenna (length relative to palps)	Slightly longer than palps	Mid antenna reaching to chaetiger 3	Slightly longer	Twice length of palps
Median antenna (length relative to prostomium)	About ~1 time (2 times) length of prostomium	1.5 times longer than prostomium	Reaching chaetiger 2	About 1.5 times length of prostomium
Mandibles	Flat, dark-brown carrier and calcerous layer on cutting plate	Not mentioned (light brown, transparent at the edge; pers. obs.)	Not mentioned	Dark brown; lighter-coloured cutting plate
Maxillae	Dark brown, but becoming lighter at the edge	Not mentioned	Not mentioned	Brown, edges and sutures darker brown
MxI (number of teeth; left + right)	1 + 1	1 + 1	1 + 1	
MxII (number of teeth; left + right)	4 + 4 (5 – 6)	(5 – 7) + (5 – 7)	5 + 6	(5 – 7)
MxIII (number of teeth; left + right)	6 (8) + 0	(4 – 7) + 0	? + 0	

Characteristics	<i>Marphysa moribidii</i> sp. nov. (present study)	<i>Eunice (Marphysa) mossambica</i> (Lectotype; Fauchald 1987 and present study)	<i>Nauphanta novaehollandiae</i> (<i>Marphysa cf. mossambica</i> (sensu Fauchald 1987))	<i>Marphysa cf. mossambica</i> (sensu Glasby and Hutchings, 2010)
MxIV (number of teeth; left + right)	4 (7) + 8	(4–5) + (8–9)	? + 8	
MxV (number of teeth; left + right)	1 + 1	1 + 1	? + 1	
Branchiae – first chaetiger emerges ^a	35 (4 – 63)	(30 – 49)	30	(14 – 46)
Branchiae – last chaetiger emerges	About 20 chaetigers before pygidium	About 20 – 25 chaetigers before pygidium	Not mentioned	About 20 – 25 chaetigers before pygidium
Branchiae – max. filaments ^a	11 (14)	6	6	6
Post-chaetal lobe – shape anteriorly	First chaetiger: sub-conical but gradually becoming subtriangular, low and broad and slightly bilobed after chaetiger 100	Pre- and post-chaetal lobes continuous around dorsal edge of neuropodium	Low and broad	Low and broad
Pectinate chaetae – first present ^a	Present from chaetiger 5 (3)	Present on mid-body chaetigers (~100)	Present beginning from the mid-section towards posterior	Present on first few chaetigers
Pectinate chaetae – symmetry ^a	Four types – 1. Symmetrical, narrow shaft with thin teeth (~30) 2. Asymmetrical with thinner teeth (>30) and broad shaft 3. Asymmetrical with thinner teeth (<30) with narrow shaft 4. Wide body with wide teeth (~8)	Three types of asymmetrical (no. teeth): 1. Coarse teeth (~30) with broad shaft 2. Thinner teeth (~30) with narrow shaft 3. Wide body with wide teeth (~8)	Pectinate (symmetrical?) on anterior segment and fan chaetae (asymmetrical?) on posterior segments	Asymmetrical pectinate chaetae throughout
Pectinate chaetae: no. of teeth (anterior)	21	Not mentioned	Not mentioned	(15 – 25)
Pectinate chaetae – no. of teeth (midbody and posterior chaetigers)	44	Up to 50 teeth	Fan chaetae – ~35 teeth	(30 – 40)
Pectinate chaetae – no. per parapodia ^a	(1 – 6)	(1 – 10)	No info on pectinate chaetae, but fan chaetae are ≥ 2	(0 – 2)

Characteristics	<i>Marphysa moribidii</i> sp. nov. (present study)	<i>Eunice (Marphysa) mossambica</i> (Lectotype; Fauchald 1987 and present study)	<i>Nauphanta novaehollandiae</i> (<i>Marphysa cf. mossambica</i> (sensu Fauchald 1987))	<i>Marphysa cf. mossambica</i> (sensu Glasby and Hutchings, 2010)
Pectinate chaetae – outer teeth	Slightly longer than inner teeth	Long thickened superior edge	Pectinate chaetae – similar length for outer and inner teeth	Slightly longer than inner teeth, one longer than other
Sub-acicular limbate capillaries	Present	Present	Present	Present
Sub-acicular limbate capillaries – first present	Chaetiger 1	Chaetiger 1	Chaetiger 1	Chaetiger 1
Sub-acicular hooks	Absent (present)	Present	Present	Present
Sub-acicular hooks – tips	Hooded, bidentate	Bidentate	Bidentate	Bidentate
Sub-acicular hooks – first chaetiger	(44 – 100); irregular pattern	(58 – 73); irregular pattern	44; irregular pattern	58 (23 – 68)
Sub-acicular hooks – max no.	2	Not mentioned	Not mentioned	1
Aciculae – max no.	4	Not mentioned	2	4
Aciculae – colour	Dark brown	Dark to light brown	Brown	Brown
Pygidium	2 pairs of cirri located on the ventral side (one long pair, one short-and-small pair)	Not mentioned	Not mentioned	Not mentioned

Biology and ecology. *Marphysa moribidii* sp. nov. is dioecious and iteroparous. This can be seen by the presence of oocytes of varying sizes in every month (Idris et al., in prep.). Sexual dimorphism is not present in *M. moribidii* sp. nov. The population at the type locality (Morib mangrove) (fig. 1) is unevenly distributed and can be found down to depths of about 450 mm from the surface in the mangrove area with *Rhizophora apiculata*, *Avicennia alba* and *Sonneratia caseolaris*. The new species is a sub-surface deposit feeder based on analysis of its intestinal contents (Idris et al., in prep.).

Distribution. Along the Straits of Malacca, Singapore, in the mangrove area with *Rhizophora* spp., *Avicennia alba* and *Sonneratia caseolaris*.

Economic exploitation. *M. moribidii* sp. nov. is one of the polychaete species harvested as bait worms in Peninsular

Malaysia (Idris and Arshad, 2013). The species is harvested and sold in Malaysian states along the Straits of Malacca, except Perlis. Five to ten individuals of *M. moribidii* sp. nov. (mostly incomplete) are sold for MYR10 (~US\$3). Although the *M. moribidii* sp. nov. fishery is currently unregulated and undocumented, selling of this species is believed to have been conducted for many years. Most bait diggers harvest the species either on a part-time basis (mainly on weekends due to low demand on weekdays, except for school and public holidays) or for personal use. Some bait diggers also sell worms to fishing shops or are contracted by them to collect the worms. Fortunately, harvesting and selling of *M. moribidii* sp. nov. is very localized since the worms do not live outside their natural habitat for a long period (2 – 3 days), and coelomic fluid from broken specimens has been found to accelerate the mortality of other worms when packed together (pers. obs.).

Marphysa mossambica (Peters, 1854)

Marphysa mossambica Gravier, 1900: 267, pl. 14, figs 89–90, text figs 137–139.—Crossland, 1903: 139–140, pl. 15, figs 7–10.—Day 1967, 395, fig. 17.5 i–m.

Synonymy.

Eunice mossambica Peters, 1854: 612.

Nauphanta novaehollandiae Kinberg, 1865: 564; 1910: 43, pl. 16, fig. 23, 23B, C, F, G.

Marphysa simplex Treadwell, 1922: 151–152, text-fig. 39, pl. 5, figs 8–12.

Nauphanta mossambica Fauchald, 1987: 376–378, fig. 1.

Figure 6.

Material examined. Lectotype. ZMB 4005 – complete, female. Paralectotypes. (6): ZMB 47 and ZMB F2046, all specimens were collected at Moçambique, coll. Peters 1854.

Remarks. We re-examined the lectotype (ZMB 4005) and the associated SEM stubs used in Zanol et al. (2014). The anterior section was photographed while the following parapodia have been mounted: 2, 32, 96, 160, 224 and 252. The anterior section of *M. mossambica* is light brown and the white spots absent (fig. 6A). The limbate chaetae are observed throughout the chaetigers (fig. 6B). We observed that *M. mossambica* has three types of pectinate (described as ‘fan’ by Fauchald, 1987) chaetae: two asymmetrical and one with few teeth (figs. 6C, D, E), confirming the observations of Zanol et al. (2014). The first asymmetrical type consists of chaetae with about 30 teeth with broad shaft (figs. 6C, D), while the second asymmetrical type also has about 30 teeth but with shaft narrower than the first type (fig. 6E). The other type, with only eight to nine large saw-like teeth (identified as ‘wide-toothed pectinate’ by Zanol et al. 2014) is situated basally to the asymmetrical pectinate chaetae (figs. 6C, D). This type of pectinate chaeta only appears in posterior chaetigers (found in chaetigers 224 and 252) at the base of the chaetal fascicle and is easily obscured by limbate chaetae and other pectinate chaetae. We were able to observe this type of chaeta under SEM (also observed under SEM by Zanol et al. 2014) and only under light microscope with careful adjustment, which may explain why Fauchald (1987) failed to describe them when he re-examined the lectotype. Fauchald (1987, his figs. 1b, c) illustrates two types of pectinate chaetae, varying in the number of teeth—one with about 20 and one with 40, neither markedly asymmetrical, although, as seen in figs. 6C–E, they are clearly asymmetrical. These two types of pectinate chaetae are present from the early mid-body (>30 segments), which contradicts an earlier observation by Fauchald (1987), that they do not occur until after parapodia 100.

Glasby and Hutchings (2010) recorded *M. mossambica* from various locations in Australia, but did not examine the lectotype, relying on Fauchald’s (1987) revised description. Re-examination of other Australian material from Queensland identified as this species (AM W33021) under the SEM did not reveal the pectinate chaetae with only 8–9 teeth, and we now

believe that the Australian material listed by Glasby and Hutchings (2010) needs to be re-examined as it may represent another undescribed species in this complex (we are now referring to it as *Marphysa* cf. *mossambica* until further studies are completed).

Discussion

With the exception of the pectinate chaetae types and characters on *M. mossambica*, all three species (*M. moribidii*, *M. mossambica* and *M. cf. mossambica*) are difficult to differentiate due to the subtlety of their differences. Details of *M. moribidii* and comparisons with the other two sibling species are shown in table 1.

Our study highlights the need for obtaining complete specimens to allow examination of parapodia from all sections of the animal. This is probably why specimens from the western part of the Indian Ocean are still being identified as *M. mossambica*. The specimens nearest to *M. mossambica* were identified in Singapore (Chan, 2009), India (Nicobar Is.) (Rajasekaran and Fernando, 2012) and the Taiwan Straits (Paxton and Chou, 2000). We suggest that specimens from these locations as well as other parts of the Western Pacific should be re-examined. In particular, the posterior chaetigers need to be studied in order to determine the presence or absence of wide pectinate chaetae with wide teeth.

Although *Marphysa* is a species-rich genus (Orensanz, 1990), some species have been described as having a cosmopolitan distribution. One is *M. sanguinea* Montagu, 1813, which has been reported from all oceans of both northern and southern hemispheres, except for the polar regions (see Day, 1967; Miura, 1977; Gathof, 1984; Paxton and Chou, 2000; Prevedelli et al., 2007). However, Hutchings and Karageorgopoulos (2003), as well as Lewis and Karageorgopoulos (2008), have challenged the cosmopolitan status of *M. sanguinea*. Hutchings and Karageorgopoulos (2003) suggest that the distribution of *M. sanguinea* is restricted to northern Europe, and that records from other parts of the world should be checked. Certainly, the records of *M. sanguinea* from South Africa have been found to represent another species (Lewis and Karageorgopoulos, 2008), and this has been confirmed both morphologically and molecularly.

Acknowledgements

Help with fieldwork from students and staff of the Marine Biotechnology Laboratory at the Institute of Bioscience, Universiti Putra Malaysia was greatly appreciated, as were useful comments received from the two anonymous reviewers. Thanks also go to Sue Lindsay from the Australian Museum for fantastic SEM images and Sandy Ritcher (University of Leipzig, Germany) for translation of Peters (1854). This project was partly funded by the Research University Grant Scheme (RUGS): Grant No. 9300303 awarded to Izwandy Idris and Aziz Arshad. The Australian Museum generously awarded a student grant to the first author, enabling attendance at the 11th International Polychaete Conference (Sydney) to present this paper.

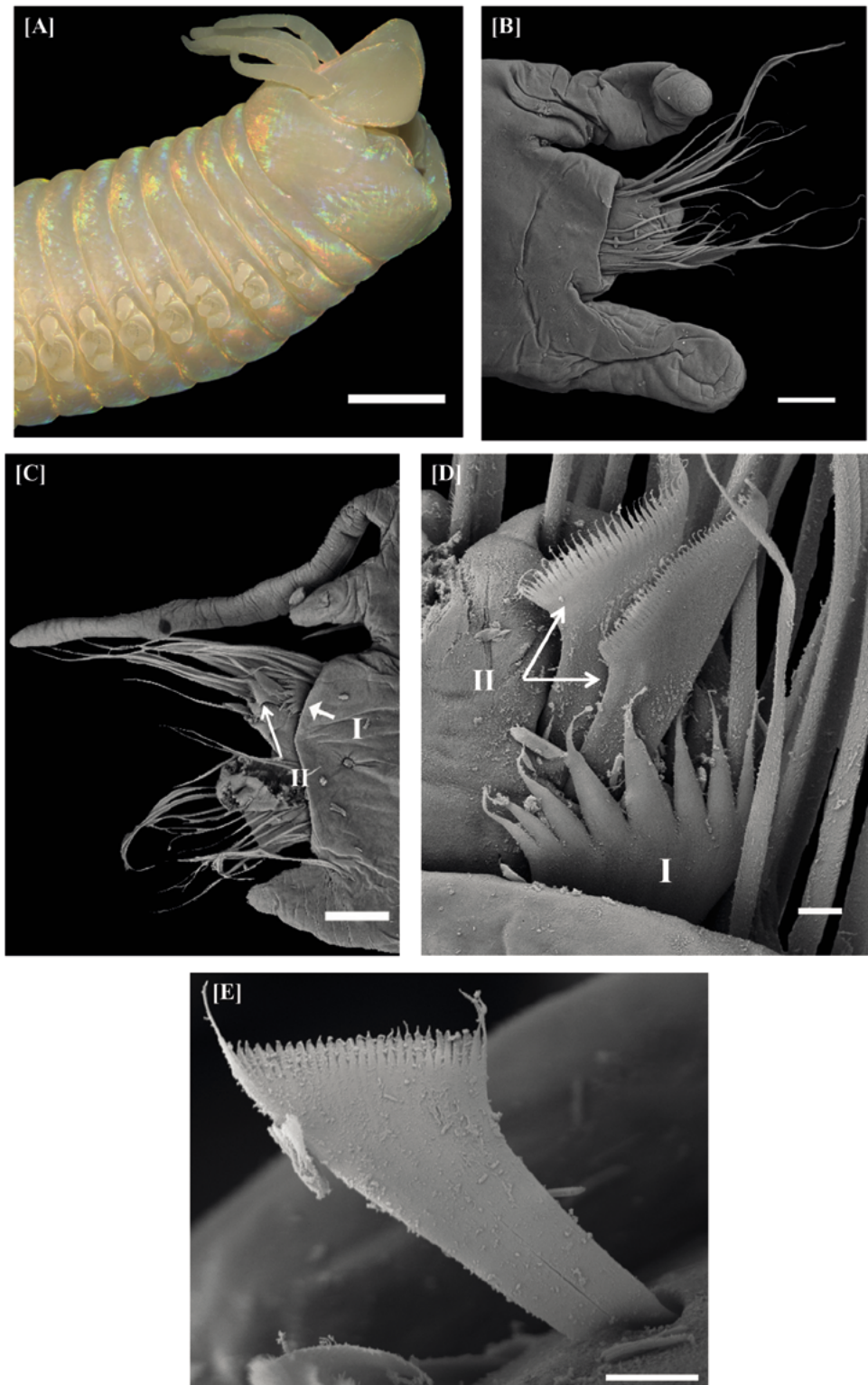


Figure 6. *Marphysa mossambica*. [A] anterior section, lateral view; [B] limbate chaetae, unique character for Group A, chaetiger 2; [C] two types of pectinate chaetae (arrows), I: wide teeth and wide body, and II: asymmetrical pectinate with broad shaft, chaetiger 224; [D] details of pectinate chaetae, I: wide teeth and wide body, and II: asymmetrical pectinate with broad shaft, showing the cryptic position of wide teeth and wide body chaeta, chaetiger 224; [E] another type of pectinate chaeta, asymmetrical pectinate with narrow shaft, chaetiger 224. Scale bars: [A] = 5 mm; [B, C] = 100 μm ; [D, E] = 10 μm . All images are from the lectotype (ZMB 4005).

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