

## NEW NEREIDID RECORDS (ANNELIDA: POLYCHAETA) FROM MANGROVES AND SEDIMENT FLATS OF SINGAPORE

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**ABSTRACT.** – Six new records of benthic nereidids are presented from a macroinfaunal survey of Singapore mangroves and their associated intertidal flats. Five are first records of the genera for Singapore: *Dendronereides zululandica*, *Dendronereis arborifera*, *Gymnonereis* cf. *fauveli*, *Namalycastis* cf. *abiuma* and *Paraleonnates* sp. Notably, *Namalycastis* cf. *abiuma* represents the first occurrence of the subfamily Namanereidinae in Singapore waters. Seventy-four polychaete species from 28 families are currently recorded from Singapore, nereidids being predominant with 19 species. An updated species checklist is presented.

**KEY WORDS.** – Polychaeta; Nereididae; mangroves; mudflats; Singapore.

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### INTRODUCTION

The polychaetes of Singapore are poorly known. Published taxonomic accounts of local polychaetes have hitherto been few, the most seminal being a species compilation by Tan & Chou (1993) from historical sources and a series of subtidal benthic surveys from the late 1980s. Tan & Chou's (1993) baseline polychaete checklist presented 64 species from 28 families, of which 29 species were new records for Singapore.

A dearth of polychaete literature followed in the next decade, with published studies on polychaetes occurring very sporadically (see Tan & Chou, 1994; 1996; Glasby & Hsieh, 2006). Otherwise, work on polychaetes has largely been confined to academic theses (e.g., Tan, 1996; Chan, 2004). Consequently, there remains a significant information gap on polychaetes from Singapore, particularly for the mangroves and their associated intertidal sediment flats.

Clearly, current information on local polychaetes is needed. Beyond academic purposes, an up-to date species inventory will support effective conservation management. Such an opportunity arose with a government-led biodiversity assessment of Singapore's natural areas, intended to fill information gaps for enhancing management and policy decision. The mangroves comprised a major component of the study, of which the macroinfauna – primarily polychaetes, bivalves and crustaceans were the foci. This contribution presents new records of nereidids found during the mangrove surveys, with detailed taxonomic descriptions.

### MATERIAL AND METHODS

One hundred and eleven sediment cores (diameter 15 cm, depth 30 cm) were taken from 21 mangroves and their associated mudflats (Fig. 1) between March and October 2006 in Singapore. Sites were mainly representative of the northern coast along the Straits of Johore, and two mangroves in the south of mainland Singapore. Northern and southern offshore islands were also included in the survey.

Polychaetes were extracted from core samples by sieving with freshwater, and afterwards preserved in 70% ethanol. Drawings were made using a dissecting microscope with a camera lucida attachment. Distal drawings (following Bakken, 2006, first suggested by Southern, 1921) were made by wedging the parapod vertically on its broadest edge into an appropriately sized crevice on a small piece of plasticine stuck to the bottom of the Petri dish. These end-view drawings are very useful for elucidating the three dimensional structures of parapodia and arrangements of chaetae.

Polychaete specimens are deposited in the Zoological Reference Collection, Raffles Museum of Biodiversity Research, National University of Singapore, Singapore (ZRC).

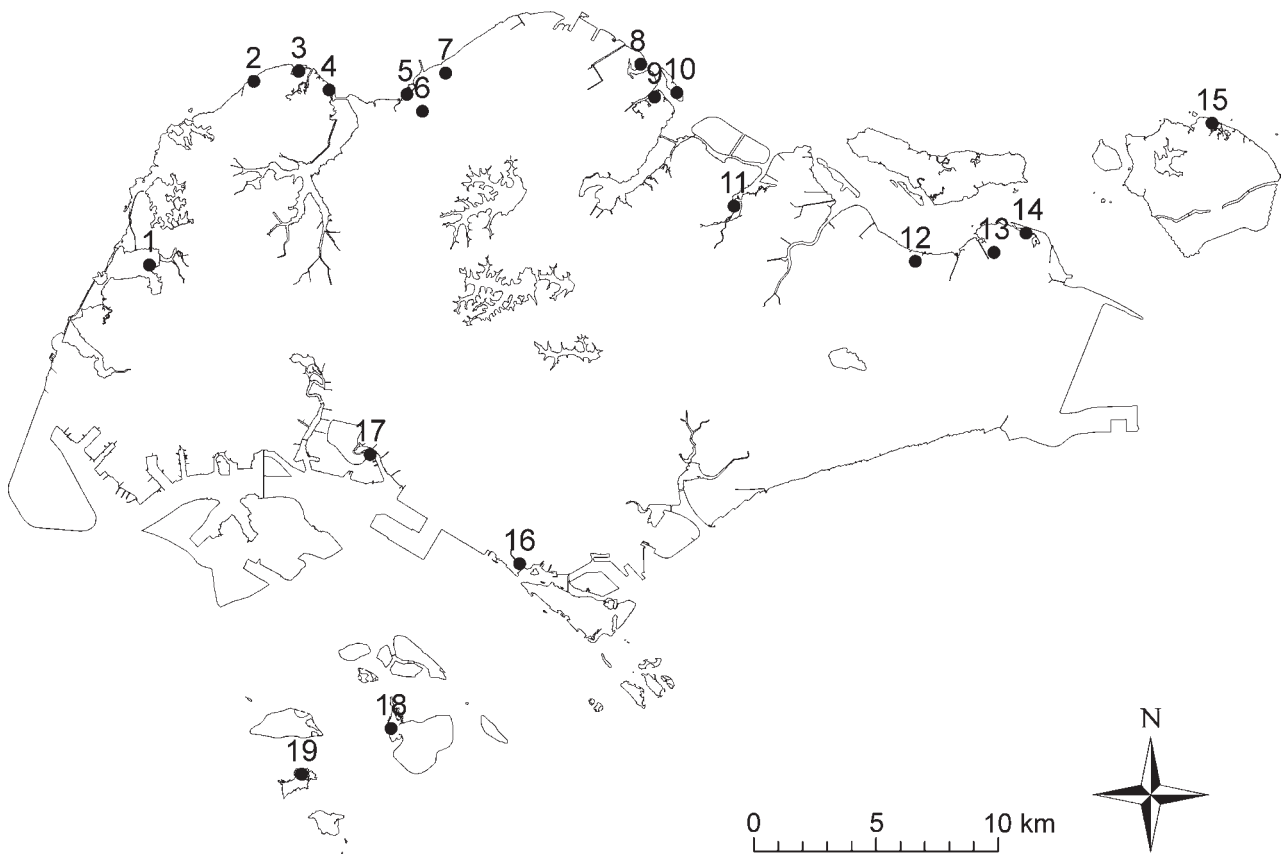


Fig. 1. Map indicating the survey locations in Singapore: 1, Western Catchment Mangroves; 2, Lim Chu Kang Mangroves; 3, Sungei Buloh Wetland Reserve; 4, Kranji Mangrove; 5, Mandai Mangrove; 6, Woodlands Town Garden Mangrov; 7, Sungei Cina Mangrove; 8, Sungei Simpang Mangrove; 9, Sungei Khatib Bongsu; 10, Pulau Seletar; 11, Sungei Punggol Mangrove; 12, Pasir Ris Nature Area; 13, Loyang Mangrove; 14, Changi Creek; 15, Pulau Tekong; 16, Berlayer Creek; 17, Pandan Mangroves; 18, Pulau Semakau; 19, Pulau Pawai.

## TAXONOMY

### Nereididae Lamarck, 1818

#### Namanereidinae Hartman, 1959

#### *Namalycastis* cf. *abiuma* (Grube, 1872)

(Fig. 2)

*Lycastis abiuma* Grube, 1872: 47–49.

*Namalycastis abiuma* (Grube) species group Glasby, 1999: 31, Figs. 1c, 8a, b, 9, Table 4.

**Material examined.** – 1 specimen, atokous, poorly preserved (especially in the middle segments), posteriorly incomplete, 126 chaetigers, 1.7 mm wide at chaetiger 10 excluding parapodia (ZRC.ANN.0001); Singapore, Mandai mangroves, mangrove forest, mud, coll. W. M. F. Chan, 7 Oct.2006.

**Description.** – Specimen white in spirit. Epidermal pigment absent, two pairs of black eyes, two short round antennae barely reaching the anterior tip of the palps. Shallow cleft in the prostomium, four pairs of short tentacular cirri (lost on the right) about the total length of the palps and palpostyles (Fig. 2a). Palpostyles large and spherical. Paragnaths and papillae absent, proboscis smooth. Parapodia uniramous throughout with a large dorsal cirrus and small ventral cirrus set close to the metameres. Notochaetae are absent in all

setigers. Jaws are sclerotized heaviest at the distal lateral edge (Fig. 2b) with six serrations along the length of the jaw, ending in a robust terminal tooth. Proximally where the jaw attaches to the pharynx, the corner segment is pale; the remaining body of the jaw is caramel colored. Anterior and parts of the posterior chaetigers are sufficiently preserved for identification to genus, but the chaetae in the posterior segments have lost all the blades.

In the fifth foot (Fig. 2c, d), the acicular neuropodial ligule is sub-conical with a large dorsal cirrus. By the twelfth foot (Fig. 2e, f), the dorsal cirrus is slender and the neuropodium conical and bilobed, the superior lobe much smaller than its inferior counterpart. In the posterior feet (Fig. 2g, h), the dorsal cirrus is elongated and held erect, the ventral cirrus remaining similar to the anterior feet.

Neurochaetae Type C (sensu Glasby, 1999: 7). The fascicular formula of anterior parapodia are as follows: notopodial chaetae absent; neuropodial supra pre-acicular: heterogomph falcigers with five to ten teeth (Fig. 2i, j); neuropodial sub pre-acicular: heterogomph falcigers; neuropodial supra post-acicular: sesquigomph spinigers (Fig. 2k, l, m); neuropodial sub post-acicular: none. The falcigers generally have between five to seven coarse teeth, with several fine serrations, the end and tip of the blades smooth.

**Habitat.** – Mudflats.

**Remarks.** – Specimen generally conforms to the description of *Namalycastis abiuma* species complex, except for

the absence of epidermal pigments and difference in neurochaetae type – this specimen lacking neuropodial sub-postacicular heterogomph spinigers. This is the first record of the subfamily and genus for Singapore.

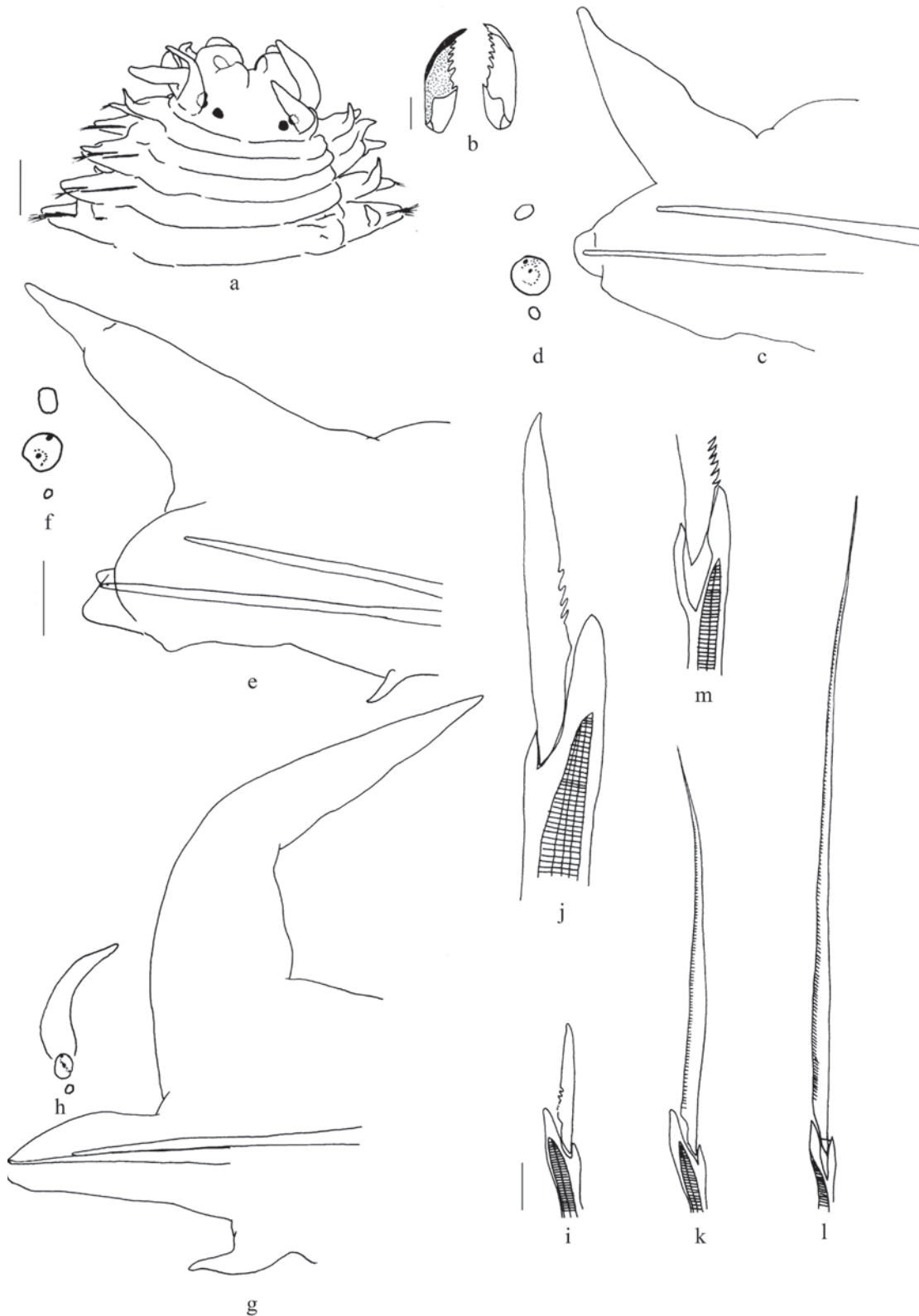


Fig. 2. *Namalycastis* cf. *abiuma* (Grube) species group: a, dorsal view of the head and anterior chaetigers; b, ventral and dorsal view of right jaw; c, d, fifth foot, anterior and distal perspective; e, f, anterior and distal perspective of parapodium 12; g, h, anterior and distal view of posterior foot; i, neuropodial supra pre-acicular heterogomph falciger; j, close-up of heterogomph falciger showing teeth along the blade; k, l, sesquigomph spinigers of the supra-post acicular fascicle of the anterior neuropodium; m, sesquigomph spiniger, close-up of the collar structure. Scale bars: a = 0.5 mm; b = 250  $\mu$ m; e = 0.1 mm; i = 25  $\mu$ m.

**Gymnonereidinae Banse, 1977**

***Dendronereides zululandica* Day, 1951**

(Fig. 3)

*Dendronereides zululandica* Day 1951: 30, Fig. 5a–f [type locality: St. Lucia, Zululand].

**Material examined.** – Six atokous specimens, posteriorly incomplete in all specimens, fairly preserved, largest specimen at 45 chaetigers, 1.5–2.4 mm wide at chaetiger 10 excluding parapodia (ZRC.ANN.0003); mudflats of Mandai mangrove, coll. W. M. F. Chan, 10 Sep.2006.

**Description.** – Specimens pale in spirit, with little pigmentation. Deep median furrow in the prostomium. Four eyes, with short palps and two antennae of similar length (Fig. 3a). Four pairs of short tentacular cirri. Only soft papillae are present on both the oral and maxillary ring. Dental formula: Oral ring presents three papillae on Area V consisting of one large triangular papilla with one or two smaller papillae. Area VI has about two on each side with a triangular shaped papilla similar in size to those of Area V (Fig. 3b). There are about four large triangular papillae on the oral ring in total. Numerous smaller papillae on Area VII form a contiguous ring with Area VIII. A terminal ring of lengthier papillae encircles the distal end of the maxillary ring (Fig. 3b,c). Biramous parapodia with differentiation of the superior notoligules into branchiae (pom-pom like), formed as clusters of filaments. Branchial region commences around the eighth chaetiger. Notochaetae comprise homogomph spinigers, neurochaetae are heterogomph spinigers as well as homogomph stout falcigers with a smooth blade.

The first foot is uniramous, bearing a robust cone shaped dorsal and ventral cirrus. Three ligules are present of which the superior is most developed (Fig. 3d–f). In the sixth foot (Fig. 3g–i), there are four lamelliform notopodial ligules in the dorsal ramus, of almost equal lengths. The neuropodium of the anterior segments is less developed than the dorsal ramus, and is sub-conical consisting of a single chaetigerous neuropodigule and an inferior digit. By chaetiger 10, branchial formation is apparent and the superior notoligules differentiates into seven unequal ligules, while the chaetigerous notoligule remains similar in form (Fig. 3j–l). The neuropodial structure remains similar to the anterior feet. The notochaetae of anterior feet are homogomph spinigers, while the neurochaetae consists of a pre and post acicular bundle of heterogomph spinigers and heterogomph short falcigers ending in a smooth curved blade.

In the middle parapodia, the dorsal cirrus is slender, shorter and discernible from the clusters of gills formed by the prechaetal notoligule (Fig. 3m), the chaetigerous notopodial ligule is clearly discernible from the gills formed by the superior notoligules. The neuropodium is bilobed, the chaetigerous neuropodigule reduced in size. This is clearest when viewed distally (Fig. 3n). Notochaetae of the middle parapods consists of homogomph spinigers. Neurochaetae comprise pre and post acicular bundle of heterogomph spinigers (Fig. 3o) with heterogomph stout falcigers with a

smooth curved blade (Fig. 3p).

**Habitat.** – Generally found in the pneumatophore zone of the mangroves seawards toward the mudflats.

**Remarks.** – A first record of the genus *Dendronereides* for Singapore. *D. zululandica* currently occurs in Australia, South Africa, Ceylon, India and the Indian Ocean.

***Dendronereis arborifera* (Peters, 1855)**

(Fig. 4)

*Dendronereis arborifera* Peters, 1855: 612 [type locality: Indian Ocean, Mozambique]; Fauvel, 1953: 172, Fig. 86c; Day, 1967: 302, Fig. 14.3a–f

**Material examined.** – Four atokous specimens, three posteriorly incomplete but all well preserved, largest specimen 61 chaetigers long, 1.5–1.9 mm wide at chaetiger 10 excluding parapodia (ZRC.ANN.0006), brackish water on mud banks of Changi Creek, Singapore, coll. W. M. F. Chan, 15 Jun.2006.

**Description.** – Specimens light tan in spirit with epidermal pigments on the first few segments. Two pairs of black eyes, prostomium heavily pigmented and antennae about the length of palps. Four pairs of tentacular cirri. Only soft papillae are present on the oral and maxillary ring. Dental formula: Up to three or four nipple like papillae on each side of Area VII, A ring of smaller conical papillae encircling the distal margin of the maxillary ring, including Area IV (Fig. 3a, b). Biramous parapodia with pinnate branchiae arising from the dorsal cirrus of the middle segments. The branchial filaments of the pinnate gills are simple, which begin around chaetiger 10 and are bright red in live material.

At chaetiger five, the dorsal cirrus is slender and slightly lengthier than the prechaetal notoligule. Three notopodial lobes are present in the anterior feet of which the chaetigerous notoligule is shortest. The ventral ramus of the anterior chaetigers comprise five neuropodial ligules that are conical and papilliform, of which the top and bottom most is pronounced (Fig. 4c–e).

In the middle feet, the dorsal cirri develop pinnate branchiae with simple filaments (Fig. 4f–h). The arrangement of the notopodium remains similar to the anterior chaetigers but there is a reduction in the number of neuropodial lobes to four. In the posterior parapodia, the foot is bi-lobed, the neuropodial ramus presents a single large lobe, with the ventral cirrus much shorter and set farther back than the dorsal cirrus (Fig. 4i, j). Notopodial and neuropodial chaetae are similar with only long homogomph spinigers present (Fig. 4k, l).

**Habitat.** – On clay and mud banks of estuaries and brackish waters.

**Remarks.** – A new record of the genus for Singapore.

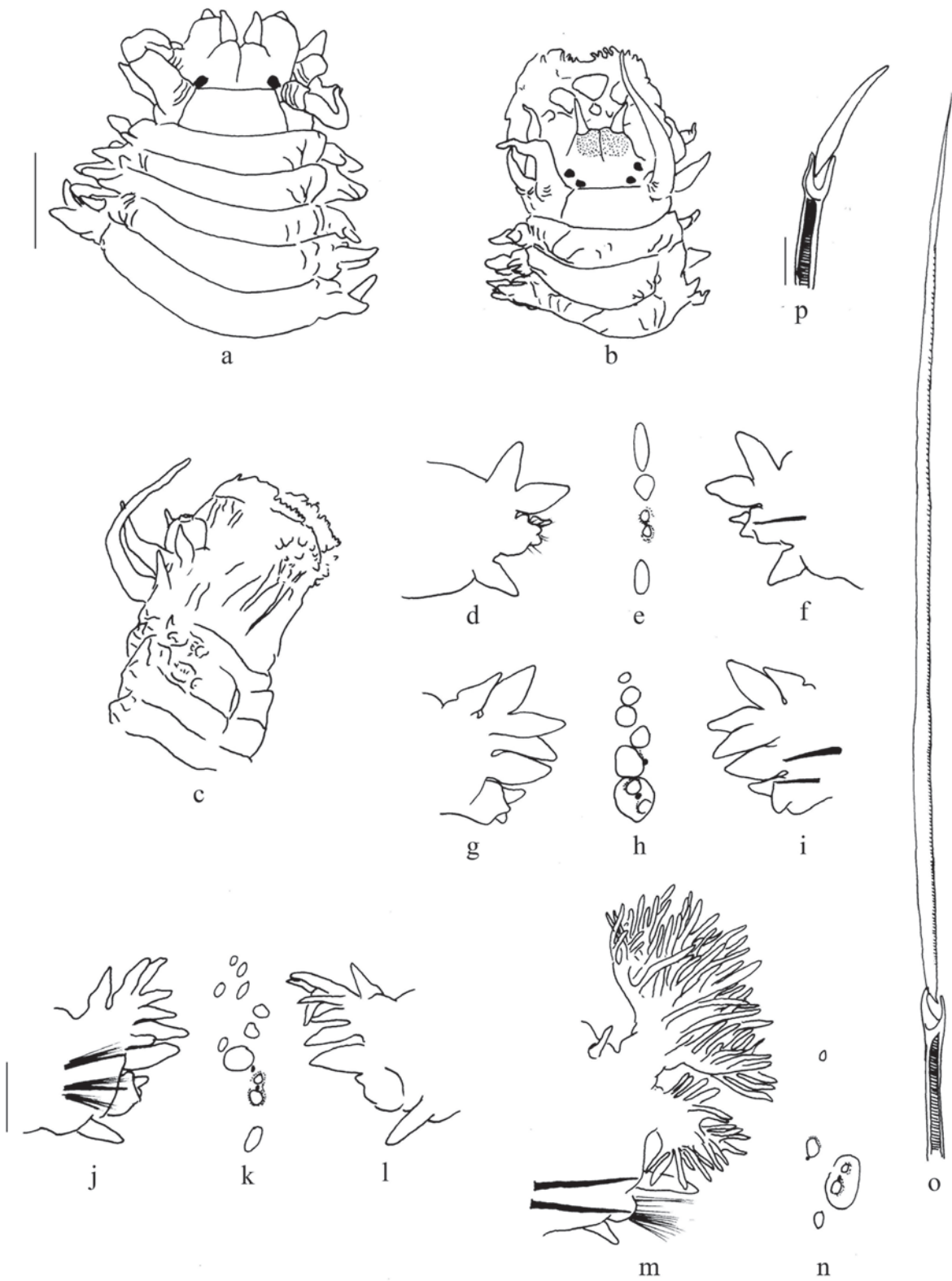


Fig. 3. *Dendronereides zululandica*: a, dorsal view of head; b, everted proboscis, dorsal view; c, lateral view of everted proboscis; d-f, posterior, distal and anterior views of the first foot; g-i, posterior, distal and anterior views of the sixth foot; j-l, parapod 10, anterior, distal and posterior perspectives; m, n, anterior and distal views of middle feet; o, heterogomph spiniger; p, homogomph falciger with smooth curved blade. Scale bars: a = 1 mm; j = 0.5 mm; p = 12.5  $\mu$ m.

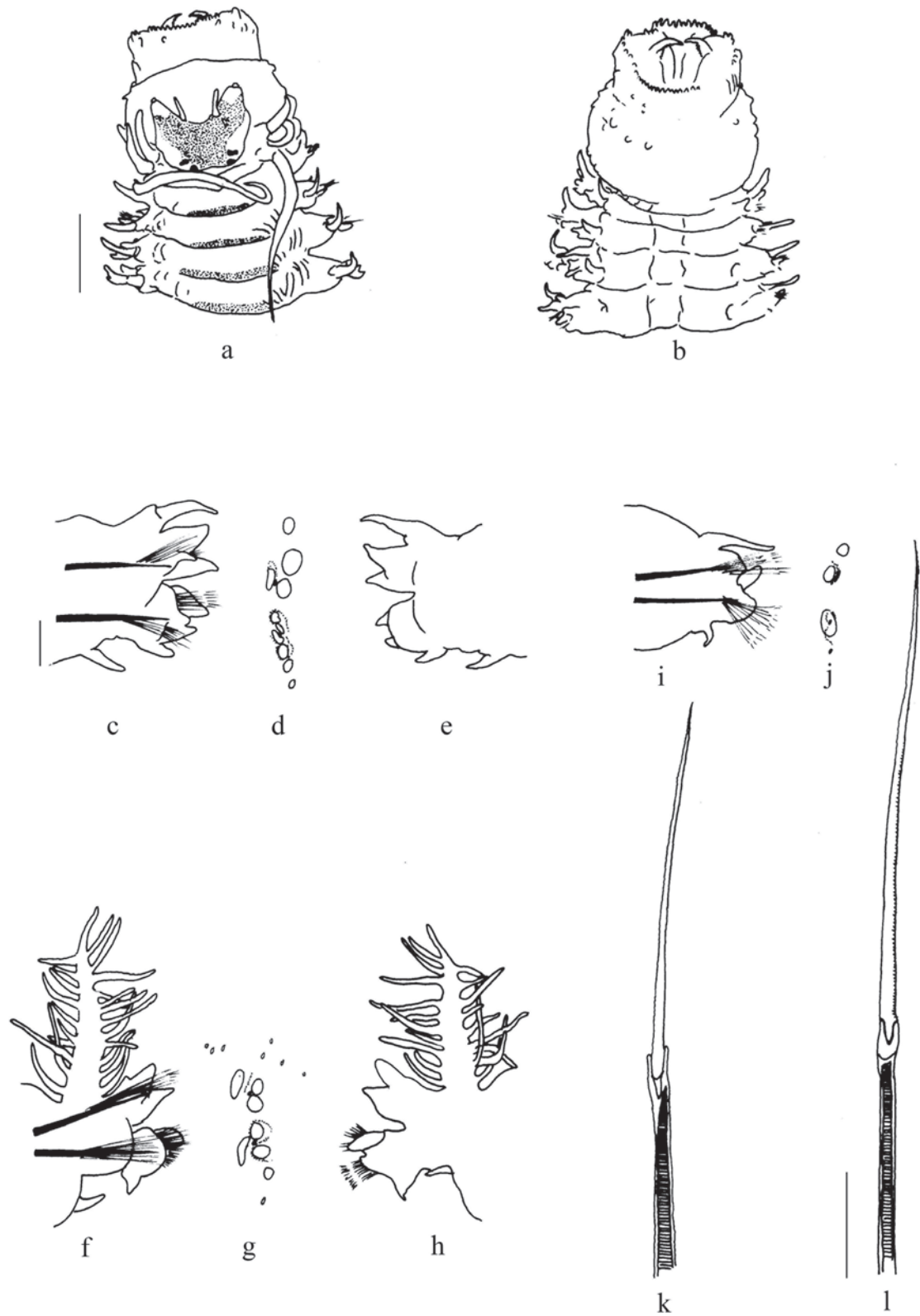


Fig. 4. *Dendronereis arborifera*: a, dorsal view of the head and everted proboscis; b, ventral view of the head and proboscis; c–e, anterior, distal and posterior views of the fifth parapodium; f, g, 14<sup>th</sup> foot, anterior, distal and posterior views; i, j, anterior and distal perspective of posterior parapodia; k, l, long homogomph spinigers. Scale bars: a = 1 mm; c = 300  $\mu$ m; l = 50  $\mu$ m.

***Gymnonereis cf. fauveli* Pillai, 1961**  
(Fig. 5)

*Gymnonereis fauveli* Pillai, 1961: 37, Figs. 1A–G, 2A–F.  
*Gymnonereis cf. fauveli* Hilleberg & Nateewathana, 1988: 10,  
Figs. 4–6.

**Material examined.** – One incomplete specimen missing posterior segments, well preserved, 42 chaetigers, 0.9 mm wide at chaetiger 10 excluding parapodia (ZRC.ANN.0005); Singapore, mudflat off western catchment area, on fine mud with sand, coll. W. M. F. Chan, 26 Apr.2006.

**Description.** – Specimen light brown in spirit with no pigmentation. Two pairs of small black eyes and four pairs of tentacular cirri are present. The antennae are long and slender, almost equal to the length of the head with equally long and slender palpophores (Fig. 5a). Head and chaetigers unpigmented. Papillae were not observed with dissection of the pharynx. Jaws are smooth, without teeth and translucent yellow with diagonal striations. Dorsal flaps absent.

In the first two chaetigers, the parapodia are uniramous with a dorsal cirrus and a shorter dorsal ligule appearing (and referred to) as paired dorsal cirri. The neuropodial and subpodial ligules are digitiform, with a notopodial post chaetal lobe. The ventral ligule and cirrus are subequal and slender, giving the appearance of two ventral cirri. The dorsal cirrus and ligule are positioned dorso-ventrally; the ventral cirrus and ligule laterally (Fig. 5b–f). The double dorsal cirri appear from chaetiger one to 12.

The notopodium of chaetiger six presents a long dorsal cirrus and a dorsal ligule about half the length of the dorsal cirrus. The presetal notopodial ligule is conical, thickset, the aciculum black with a curved tip (Fig. 5g). The ventral ramus (Fig. 5h, i) is similar to the first two parapodia. Enlarged cirrophores begin at chaetiger 14. At chaetiger 20, the enlarged cirrophore is apparent, held erect (Fig. 5j–l), with bristle numbers greatly reduced. The tip of the notoaciculum is now straight; the neuropodium reduced to a large single lobe, with the ventral ligule and ventral cirrus positioned laterally. The posterior feet are wider but otherwise remain similar to chaetiger 20, with the exception of the dorso-ventral arrangement of the ventral ligule and cirrus (Fig. 5m–o).

The neuropodia from chaetiger five to 13 are concentrated with bundles of bristles consisting of hemigomph spinigers with long serrations on the end blade (Fig. 5p), natatory chaetae (Fig. 5q) and homogomph falcigerous chaetae with a simple curved end piece (Fig. 5r). The natatory chaetae differ from the typical spiniger structure in that the collar (bearing the end piece) is closed and the end piece attaches via a keyhole.

**Remarks.** – This is the first record of the genus for Singapore. Regarded as conspecifics to *Gymnonereis fauveli*, *G. cf. fauveli* is very similar to the former; Hilleberg and Nateewathana (1988) erected this species in their emendation

of *Gymnonereis*, based on differences in the starting position of the dorsal cirrus and the absence of dorsal flaps. The material in this paper fits well to the description.

**Nereidinae Johnston, 1865**

***Ceratonereis (Composetia) burmensis* (Monro, 1937)**  
(Fig. 6)

*Nereis (Ceratonereis) burmensis* Monro, 1937: 532, Fig. 1a–f [type locality: Maugman, Laos (Burma)]; Fauvel, 1953: 196.  
*Ceratonereis (Composetia) burmensis* Hartmann-Schroder, 1985: 49.  
*Ceratonereis burmensis* – Wu et al., 1985: 174, Figs. 98A–I, 99A–G; Sun & Yang, 2002: 95, Fig. 47A–F.

**Material examined.** – Three atokous specimens, two complete, well preserved, 2.0–2.2 mm wide at chaetiger 10 excluding parapodia (ZRC.ANN.0004), on banks of mud, along middle part of estuary, Changi Creek, Singapore, coll. W. M. F. Chan, 15 Jun.2006; Six atokous specimens, one complete, all fairly preserved, 1.7–3.0 mm wide at chaetiger 10 excluding parapodia, complete specimen at 120 chaetigers (ZRC.ANN.0004), Mandai mangroves, Singapore, on mud and sand, coll. W. M. F. Chan, 10 Sep.2006.

**Description.** – Specimens pale yellow to light brown in spirit. Prostomium not incised, two short antennae, four eyes set in a wide trapezium, palps short, with button like palpostyles (Fig. 6a). Four pairs of tentacular cirri, the longest reaching back to the chaetiger eight. The prostomium and first 10 chaetigers are heavily pigmented in mature specimens. Unpigmented individuals are rare. Paragnath formula: Chitinous paragnaths present only on the maxillary ring (Fig. 6b, c), Area I, between seven to 10 conical paragnaths set in an irregular lozenge (variable for conspecifics from other regions, see Remarks); Area II, long, curved conical paragnaths set in a crescent; Area III, three to four rows of small conical paragnaths; Area IV, oblique patch of nine to 12 paragnaths. The first parapodium is uniramous (Fig. 6d), with a dorsal and ventral cirrus, the former slightly shorter. There are five ligules in the first foot, of which the dorsal and ventral most are best developed. All ligules in the first parapodium are triangular but slightly elongated compared to the other anterior feet. The middle three ligules are positioned in a triangle (Fig 6e, f), the basal two inserted side by side and of equal length.

The anterior feet presents a triangular notopodial ligule with two similarly shaped inferior notopodial lobes that are subequal in length. The dorsal ramus of the anterior feet thus appears to have three triangular languets (sensu Monro, 1937), of which the median is slightly shorter than the rest (Fig. 6g–i). The neuropodial ligules of the anterior parapodia have three lobes. Notochaete in the anterior setigers are all homogomph spinigers, neurochaete consisting of three bundles of chaete: a superior bundle of homogomph spinigers, a median bundle of homogomph and heterogomph spinigers and an inferior bundle of

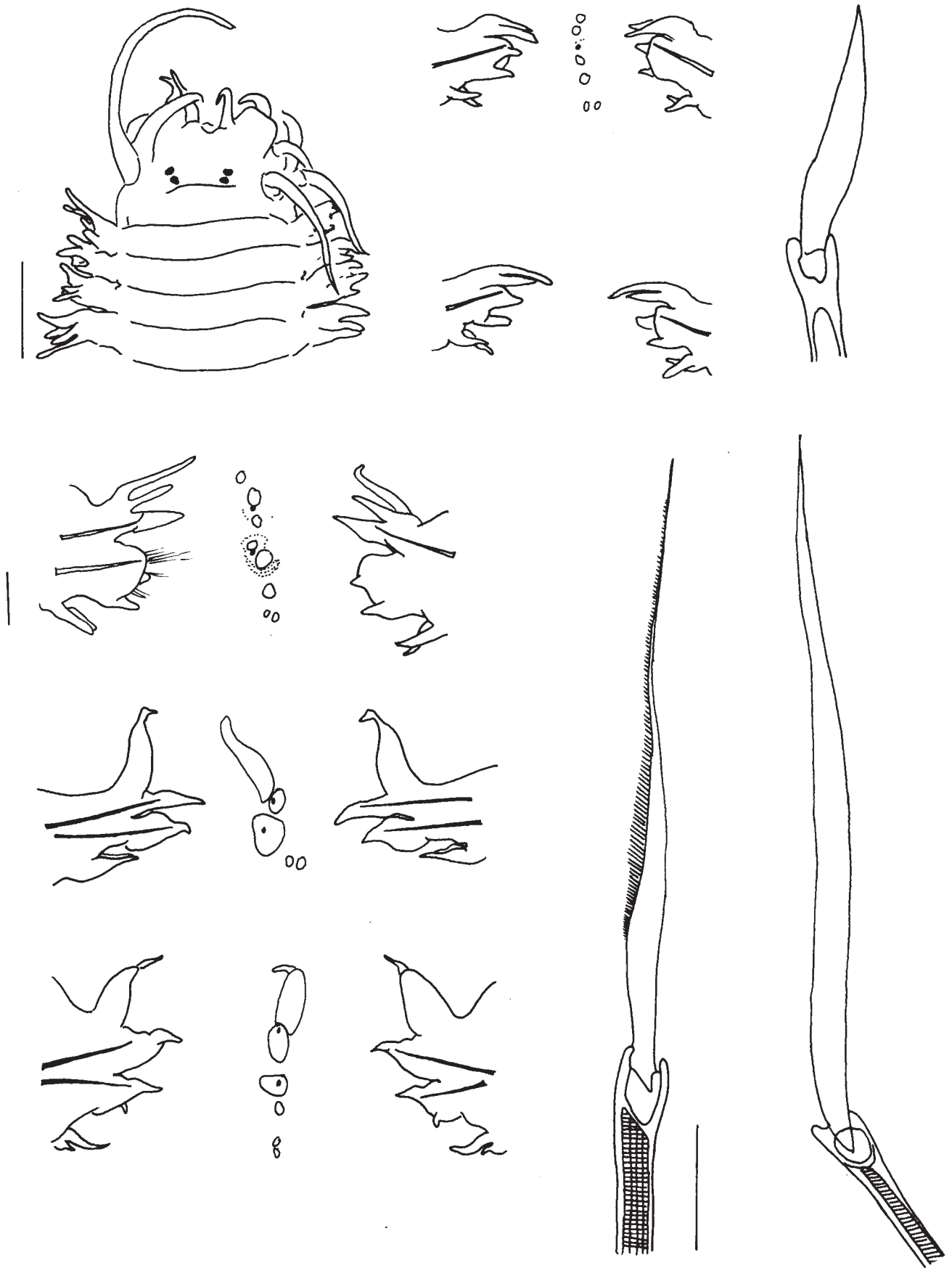


Fig. 5. *Gymnonereis* cf. *fauveli*: a, dorsal view of the head; b–d, anterior, distal and posterior views of the first foot; e, anterior view of the second parapodium; f, posterior view of the second parapodium; g–i, anterior, distal and posterior perspectives of the 20<sup>th</sup> feet; m–o, anterior, distal and posterior perspectives of the hind feet; p, hemigomph spinigers; q, natatory bristle, note the circular enclosed collar; r, homogomph falciger with a simple curved end blade. Scale bars: a = 0.5 mm; g = 0.25 mm; p = 50  $\mu$ m.



heterogomph spinigers. The blades of spinigers have finely serrated edges. The arrangement of ligules and fascicles of chaetae remain similar in the middle feet (Fig. 6j–l). By the 72<sup>nd</sup> parapodium, three neuropodial ligules remain, while the middle notopodial ligule is reduced in size (Fig. 6m, n). Long neuropodial heterogomph falcigers with serrated edges are present in the middle and posterior parapodia (Fig. 6o). Homogomph and heterogomph spinigers are shown in Fig. 6p, q.

**Habitat.** – Lower to middle reaches of estuaries, on mud banks and sandy patches.

**Remarks.** – There appears to be much morphological variation in *Ceratonereis burmensis*, especially with respect to paragnath numbers in Area I. Monro (1937) first described the type specimens with “a more or less rectangular patch of very small paragnaths” in Area I. Wu et al. (1984) reported a range of up to five cones in specimens from China, and cited differences in specimens collected from different habitats (one from estuaries, 0 from soft mud, Peigang and five from coral reefs). Specimens from Ranong, Thailand range between none to three in the same paragnath area (G. Paterson, 2007 pers. comm.), while those collected from Singapore range have up to 11. Most specimens however present seven cones arranged in an elongated diamond patch. Only one male heteronereid was observed with a bare patch in Area I. The distinctive raised pad on which the long dagger-like paragnaths of Area II arise from, as described by G. Paterson in the British NHM website is present only in specimens from Sungei Pandan. There are also distinctions in chaetal type. Specimens of Wu et al. (1984) and those collected in this study present homogomph spinigers throughout the notopodia, homogomph spinigers, heterogomph spinigers and heterogomph long falcigers in the neuropods. Specimens from Ranong, Thailand, in contrast, usually exhibit homogomph spinigers and heterogomph falcigers (G. Paterson, pers. comm.).

Sexual dimorphism is pronounced in live material. Females develop a deep emerald green in the anterior chaetigers, retaining some of the original pink colour in the posterior segments. Males develop a yellow hue, especially along the anterior the chaetigerous segments. With the onset of epitoky, eyes enlarge in both sexes with distinct differentiation in the posterior segments of the body. Notoligules of the posterior chaetigers enlarge and differentiate into fan shaped structures. The development of paddle-chaete in the posterior segments is apparent in heteronereids of both sexes. Gonads are stored throughout the anterior chaetigers and parapodia and are presumably broadcast through rupture of the body walls. Paragnath formula is maintained during epitoky.

***Paraleonnates* sp.**

(Fig. 7)

**Material examined.** – 1 incomplete specimen, atokous, well preserved, incomplete length at 15 cm, 97 chaetigers, 7 mm wide at

chaetiger 10 excluding parapodia (ZRC.ANN.0002), Northwestern shore of Pulau Tekong, Singapore, upper littoral zone, on shingle, coll. W. J. Ngiam, 25 Mar.2006

**Description.** – Specimen deep grey in spirit; graphite black with purple iridescent highlights on the dorsal surface of the segments when alive. Edges of segments are well defined by a light brown band similar in colour to the parapodia. Four red eyes, palps short, palpophores short and button like (Fig. 7a). Antennae long with a wedge in the centre of the prostomium. Longest tentacular cirri reaches back to the chaetiger 14. Dental formula: Area I – patch of conical paragnaths in three rows continuous with Area II, Area III – ca. 56 to 58 conical paragnaths contiguous with Area IV, forming a contiguous band of large and small denticles around the distal end of the maxillary ring. Area V and VI – highly wrinkled; Area VII and VIII – three triangular papillae are barely discernible from the oral ring (Fig. 7b). Jaws black and heavily sclerotized.

In the sixth parapod, the dorsal cirrus is long, slender and almost double the length of the notoligules. The notopodium consists of two triangular notopodial ligules of subequal length, the inferior notopodial ligule being slightly shorter (Fig. 7c). The ventral ramus comprises three digitiform languets and one flap like structure held laterally when viewed distally (Fig. 7d). The chaetigerous neurologule is shortest amongst the three ligules, the ventral two lengthier and more slender. The ventral cirrus is set closer to the chaetiger and extends to the beginning of the dorsal cirrus.

In the chaetiger 10, the structure of the neuropodium changes slightly such that the superior neurologule is of equal length to its inferior counterparts (Fig. 7e), but the flap-like structure remains (Fig. 7f). In the middle parapodia, marked differences are presented in the neuropodium, where the flap-like structure is lost and the superior neurologule is held most forward (Fig. 7g, h); thus presenting only three neurologules in the ventral ramus of the middle feet. Ventral cirrus size is greatly reduced. In the 97<sup>th</sup> foot, the dorsal and ventral cirri are further reduced and there is an additional flat papilla-like structure inserted dorsally just before the dorsal cirrus (Fig. 7i, j). The superior notoligule is enlarged, lamelliform while the postchaetal notopodial ligule remains short. The neuropodial ligules elongate slightly relative to the middle chaetigers. Only homogomph and heterogomph spinigers are present (Fig. 7k–m).

**Remarks.** – It is unfortunate that only a single incomplete specimen was found and subsequent efforts to locate more specimens have been futile. This is a first record of the genus for Singapore, but the species could not be assigned due to the fact that the specimen is incomplete – posterior chaetigers are required for identification to species. The genus currently comprise only two species: *Paraleonnates uschakovi* and *P. bolus*. Wu et al. (1985) noted that the largest *P. uschakovi* specimen totaled 280 chaetigers, with a metameric width of 12 mm. This specimen found here has a width of 10 mm and it may thus be inferred that there remains at least another half of the length to be examined (the specimen has just

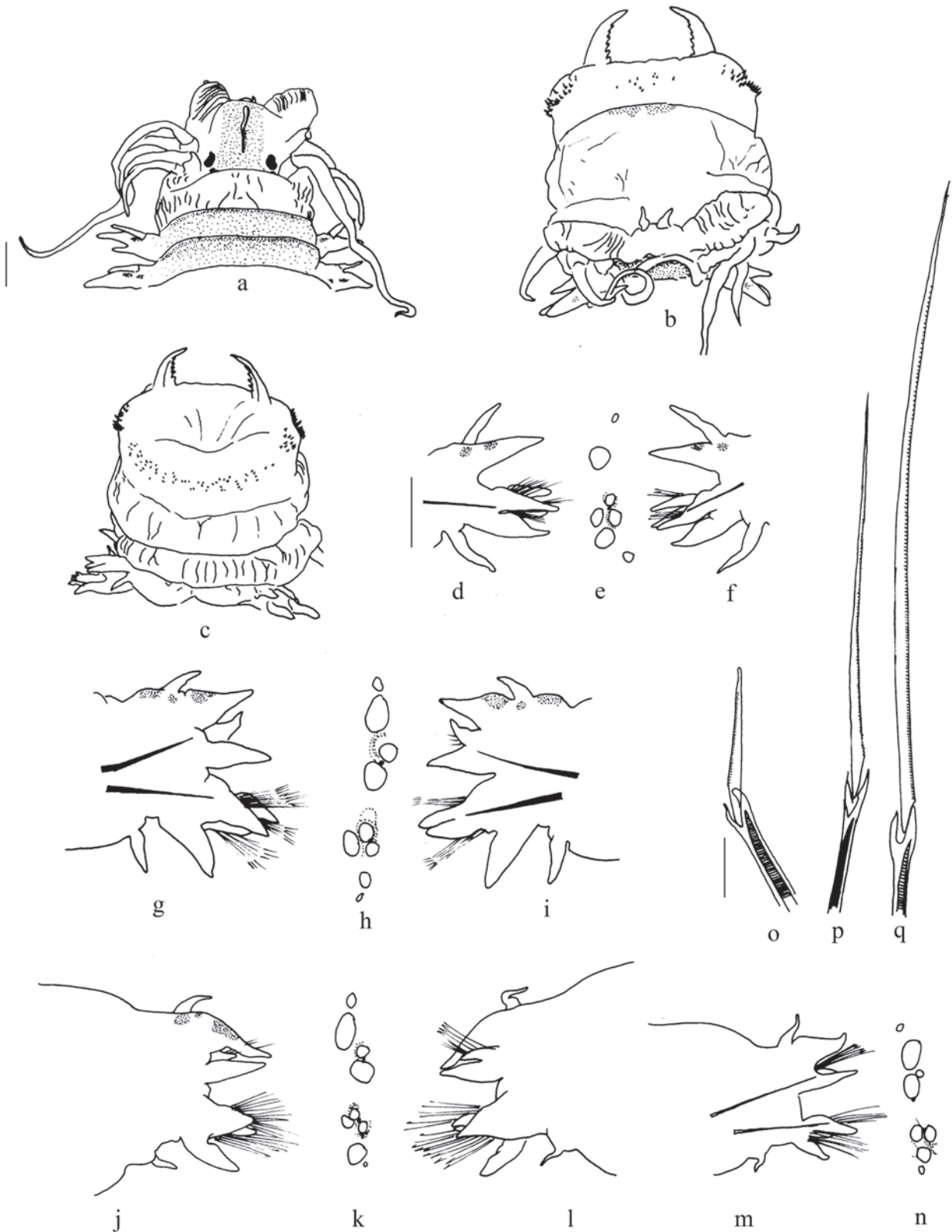


Fig. 6. *Ceratonereis (Compositia) burmensis*: a, dorsal view of head; b, dorsal view of everted proboscis showing paragnath arrangement in Areas I and II, note the long dagger-like paragnaths in Area II; c, ventral perspective of proboscis illustrating three irregular rows of small cones in Area III; d, anterior view of first parapod; e, distal view of first parapod illustrating the arrangement of the cirri, ligules, aciculum and fascicles of chaetae; f, posterior view of first parapodium; g, fifth parapodium, anterior view; h, distal perspective of fifth foot; i, posterior view of fifth parapodium; j–l, anterior, distal and posterior view of 41<sup>st</sup> foot; m, anterior view of parapod 72; n, distal view of hind feet; o, heterogomph falciger with a slender terminal piece; p, short homogomph spiniger; q, long heterogomph spiniger. Scale bars: a = 0.5 mm; d = 0.5 mm; p = 25  $\mu$ m.

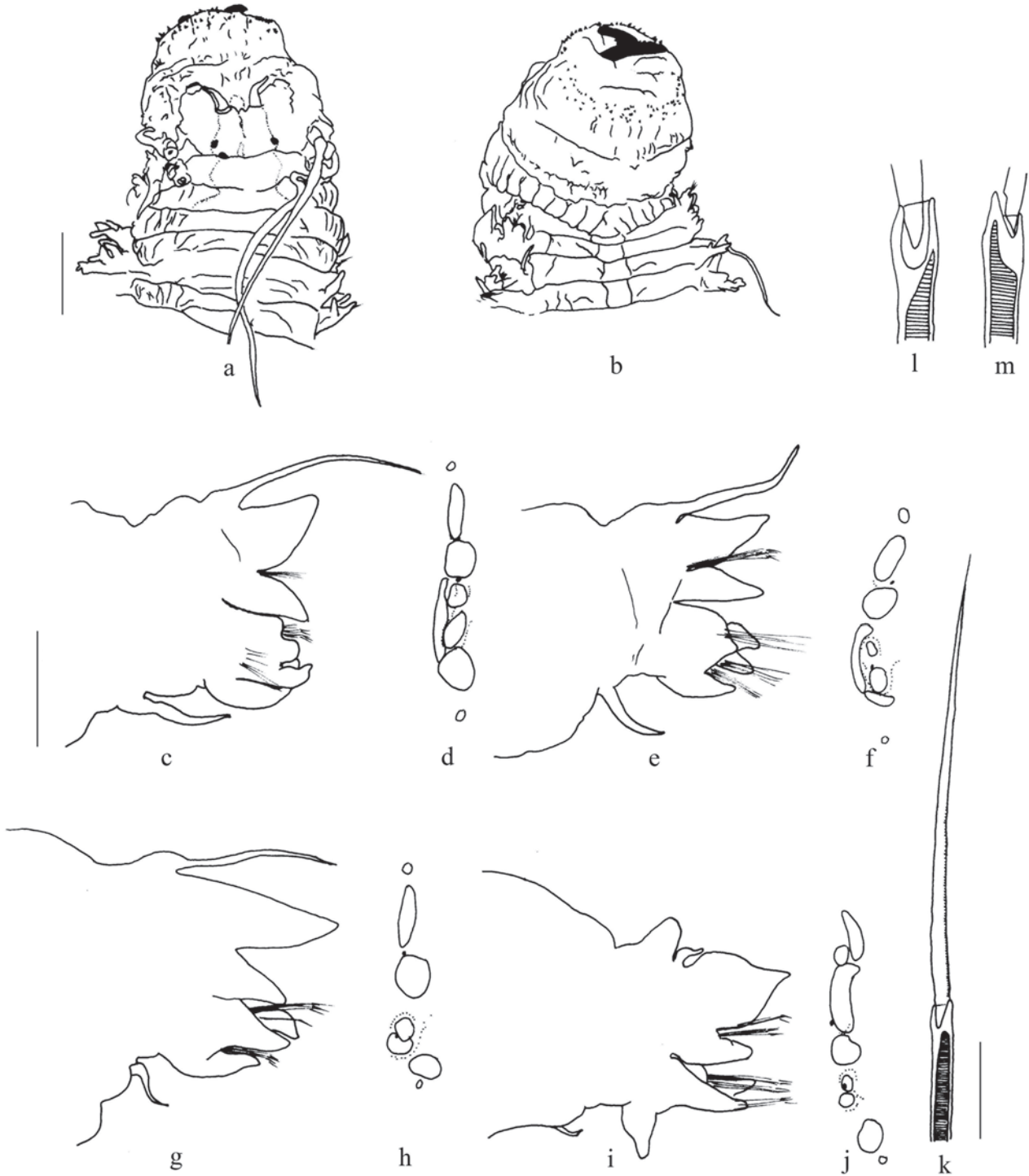


Fig. 7. *Paraleomnates* sp.: a, dorsal view of head, everted proboscis and anterior segments; b, ventro lateral view of proboscis illustrating the triangular papillae in Area VII and VIII; c, d, anterior and distal perspective of the sixth parapodium; e, f, anterior and distal views of the 10<sup>th</sup> foot; g, h, anterior and distal views of the 42<sup>nd</sup> parapodium; i, j, 97<sup>th</sup> foot, anterior and distal perspectives; k, homogomph spiniger; l, close-up of homogomph collar; m, heterogomph spiniger, close-up of the collar. Scale bars: a = 2.6 mm; c = 1 mm; l = 118  $\mu$ m.

over 100 chaetigers). Another complete specimen is needed to ascertain its identity.

## DISCUSSION

Of the six new records presented, five are first occurrences of the genera for Singapore, namely, *Dendronereides*, *Dendronereis*, *Gymnonereis*, *Namalycastis* and *Paraleonnates*. Notably, *Namalycastis* represents a first occurrence of the subfamily Namanereidinae for Singapore. The fair number of new records at the genus level, despite some being common at publicly accessible locations (e.g. *Dendronereides* and *Dendronereis* are widespread in mangroves at Changi Creek and Pasir Ris Park, respectively), indicates the rather scant scientific attention paid to these ecologically important animals.

With these new records and other more recent published works on Singapore nereidids (Tan & Chou, 1994; 1996; Glasby & Hsieh, 2006), the total number of nereidid species recorded from Singapore is now 19 species in ten genera. While Singapore's nereidid diversity compares poorly with Australia (17 genera, 70 species; Wilson et al., 2003) and China (19 genera, 73 species; Sun & Yang, 2002), it is comparable to Japan (9 genera, 22 species; Imajima, 1964). The present study brings to total some 74 polychaete species from 28 families currently reported for Singapore. An updated checklist of Singapore polychaetes, sensu Tan & Chou (1993) is presented in Table 1.

Further polychaete surveys of the mangroves, and assessments of the reef associated intertidal habitats are needed to complement the current data. Much of Singapore's polychaete fauna remain to be discovered, and more new records can be expected.

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Table 1. Updated list of polychaete species from Singapore (sensu Tan & Chou, 1993).

<b>Aphroditidae</b>	<b>Nephtyidae</b>	<b>Opheliidae</b>
<i>Pontogenia indica</i>	<i>Aglaophamus dibranchis</i>	<i>Ammotrypane aulogaster</i>
<b>Polynoidae</b>	<i>Nephtys sphaerocirata</i>	<b>Capitellidae</b>
<i>Paralepidonotus ampullifera</i>	<b>Glyceridae</b>	<i>Capitella capitata</i>
<i>Iphione muricata</i>	<i>Glycera convoluta</i>	<b>Maldanidae</b>
<b>Amphinomidae</b>	<i>Glycera rouxii</i>	<i>Euclymene lombricoides</i>
<i>Chloeia flava</i>	<b>Goniadidae</b>	<b>Oweniidae</b>
<i>Eurythoe complanata</i>	<i>Goniada cf. maculata</i>	<i>Owenia fusiformis</i>
<b>Hesionidae</b>	<b>Onuphidae</b>	<b>Flabelligeridae</b>
<i>Leocrates claparedii</i>	<i>Diopatra neapolitana</i>	<i>Pherusa monroi</i>
<i>Podarke latifrons</i>	<i>Diopatra bulohensis</i>	<b>Terebellidae</b>
<b>Phyllodocidae</b>	<b>Eunicidae</b>	<i>Loimia medusa</i>
<i>Anatides madeirensis</i>	<i>Eunice antennata</i>	<i>Nicolea gracilibranchis</i>
<i>Eteone siphodonta</i>	<i>Eunice aphroditois</i>	<i>Thelepus gracilis</i>
<i>Eulalia magalhensis</i>	<i>Eunice coccinioides</i>	<i>Thelepus setosus</i>
<b>Alciopidae</b>	<i>Eunice grubei</i>	<b>Terebellidae</b>
<i>Naiades cantrainii</i>	<i>Eunice hirschi</i>	<i>Loimia medusa</i>
<b>Syllidae</b>	<i>Eunice lucei</i>	<i>Nicolea gracilibranchis</i>
<i>Syllis spongicola</i>	<i>Eunice nesiotis</i>	<i>Thelepus gracilis</i>
<i>Syllis gracilis</i>	<i>Euniphysa aculaeta</i>	<i>Thelepus setosus</i>
<b>Nereididae</b>	<i>Marphysa disjuncta</i>	<b>Trichobranchidae</b>
<i>Ceratonereis hircinicola</i>	<i>Marphysa macintoshi</i>	<i>Terebellides storemi</i>
<i>Ceratonereis mirabilis</i>	<i>Nauphanta mossambica</i>	<b>Sabellidae</b>
<i>Ceratonereis burmensis</i>	<i>Lysidice collaris</i>	<i>Hypsicomus phaeotaenia</i>
<i>Dendronereides zululandica</i>	<b>Arabellidae</b>	<i>Pseudopotamilla reniformis</i>
<i>Dendronereis arborifera</i>	<i>Arabella iricolor</i>	<i>Potamilla leptochaeta</i>
<i>Gymnionereis fauveli</i>	<b>Lumbrinereidae</b>	<i>Sabellastarte indica</i>
<i>Leonnates decipiens</i>	<i>Lumbrinereis hartmani</i>	
<i>Leonnates jouseaumei</i>	<i>Lumbrinereis latreilli</i>	
<i>Namalycastis cf. abiuma</i> species group	<b>Lysaretidae</b>	
<i>Paraleonnates</i> sp.	<i>Oenone fulgida</i>	
<i>Perinereis barbara</i>	<b>Spionidae</b>	
<i>Perinereis cultifera</i> var. <i>perspicillata</i>	<i>Prionospio komaeti</i>	
<i>Perinereis cultifera</i> var. <i>striolata</i>	<i>Prionospio malayensis</i>	
<i>Perinereis nuntia</i> var. <i>brevicirris</i>	<b>Poecilochaetidae</b>	
<i>Perinereis rombodonta</i>	<i>Poecilochaetus serpens</i>	
<i>Perinereis singaporiensis</i>	<b>Chaetopteridae</b>	
<i>Perinereis vancaurica</i>	<i>Chaetopterus variopedatus</i>	
<i>Pereinereis viridis</i>	<b>Cirratulidae</b>	
<i>Tylonereis heterochaeta</i>	<i>Cirratulus cirratulus</i>	