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Redescription of the fish parasitic "tongue biter" *Cymothoa rhina* Schioedte & Meinert, 1884 (Crustacea: Isopoda: Cymothoidae) from Singapore

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Abstract. *Cymothoa rhina* Schioedte & Meinert, 1884 is redescribed from specimens collected in Singapore, the female of which is designated as neotype. Adult female *Cymothoa rhina* can be identified by the acute anterior margin of the cephalon, anterolateral projections on pereonite 1 extending anteriorly along half the length of the cephalon, pleotelson posterior margin subtruncate (rounded in the male), and pereopod 7 ischium inferior margin with a bulbous protrusion and the basis with a distinct carina (weak in the male). *Cymothoa rhina* is known only from the Philippines, Guam and now Singapore, from Lutjanidae hosts.

Key words. Isopoda, Cymothoidae, taxonomy, *Cymothoa*, fish parasites, Singapore

INTRODUCTION

Bruce & Wong (2015) reviewed the marine isopod fauna of Singapore, recording eleven species in six genera of the fish parasitic isopod family Cymothoidae from Singapore. Cymothoid isopods have long been familiar to fishers and the angling community. In recent times the family has come to the attention of the aquaculture industry, in some case damaging the stock and affecting productivity (e.g., Andrews et al., 2013; Horton & Omura, 2001; Papapanagiotou & Trilles, 2001; Papapanagiotou et al., 1999). The cymothoid fauna of the Indo-Malayan Triangle (see Hoeksema, 2007) can be considered both diverse and reasonable well known (Smit et al., 2014). Many species from this region were described in the earliest era of isopod taxonomy, notably Bleeker (1857) and the monographs of Schioedte & Meinert (1883, 1884). Only Nierstrasz (1915, 1917, 1931) made a later significant contribution. The most recent account for this region is that of Bruce & Harrison-Nelson (1988).

Publications pertinent to the Singaporean region are the revisions of the externally attaching Australian (and Indo-Pacific) genera (Bruce, 1997a–c,) and gill-attaching genera (Bruce, 1990). Martin et al. (2013, 2014a, b, 2015a, b) has revised the Australian buccal-attaching genera. Trilles & Justine (2006, 2010) provided further data on gill-attaching species from New Caledonia. Bruce (2004) reviewed the freshwater isopods of Malaysia and Singapore; no Cymothoidae are known from purely freshwater habitats, though some genera do have freshwater species (e.g., see Tsai & Dai, 1999; Yamano et al., 2011). Overall the Cymothoidae of Singapore and the adjacent region remains very poorly known.

MATERIAL AND METHODS

Specimens were collected from the St John's Island. Mouthparts and pleopods were removed using dissecting needles and forceps. Temporary mounts were made using lactic acid stained with lignin pink. In order to preserve the integrity of the neotype the mandibles were not dissected out. Drawings were made using a Leica MZ125 stereomicroscope with camera lucida. Drawings were inked using Adobe Illustrator CS6 and WACOM Intuos 5 drawing pad (see Coleman, 2003). Descriptions were prepared using DELTA (Descriptive Language for Taxonomy) (Dallwitz, 1980, Dallwitz et al., 1997, 2006; Coleman et al., 2010) using a general Cymothoidae character set. Host nomenclature and distribution were obtained from FishBase (Froese & Pauly, 2013) and Eschmeyer (2015).

Abbreviations. RMBR—Raffles Museum of Biodiversity Research, Singapore; RS—robust seta/setae.

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TAXONOMY

Suborder Cymothoida Wägele, 1989

Superfamily Cymothooidea Leach, 1814

Family Cymothoidae Leach, 1814

Genus *Cymothoa* Fabricius, 1793

Restricted synonymy. Fabricius, 1793: 503.– Milne Edwards, 1840: 264–269.– Schioedte & Meinert, 1884: 223.– Kussakin, 1979: 289.– Brusca, 1981: 185.– Brusca & Iverson, 1985: 45.– Trilles, 1994: 137.– Hadfield, Bruce & Smit, 2011: 58; 2013: 2.

Type species. *Oniscus oestrum* Fabricius, 1793; by subsequent designation (Kussakin, 1979).

Remarks. *Cymothoa* is most easily identified by the strongly vaulted body; widely separated antennal and antennular bases; cephalon deeply immersed in pereonite 1; pereonite 1 anterolateral angles encompassing the cephalon; pereonite 7 extends past pleonite 1; a large blade-like carina on the basis of pereopods 5–7; pleonite 1 not abruptly narrower than other pleonites; uropod rami shorter than the pleotelson and large fleshy fold on pleopods 3–5 (Hadfield et al., 2013).

Generic diagnoses were provided by Brusca (1981) and Brusca & Iverson (1985). Recent diagnoses have been given by Hadfield et al. (2011, 2013). Despite this recent work *Cymothoa* still remains one of the least understood genera (Brusca, 1981; Hadfield et al., 2013) with many species in need of redescription (Hadfield et al., 2013). Schotte et al. (2008) list 47 species of *Cymothoa* worldwide including two nomen dubia.

Neotype designation for *Cymothoa rhina* Schioedte & Meinert, 1884. Species of *Cymothoa* are notoriously variable and the family is particularly plagued by problems of misidentification, ambiguous identity and species identity being fixed to an incorrect binomial. This has come about through two interlinked processes. Variable morphology has resulted in individual species concepts being broadened to include such a wide range of variation that a species was in some cases little narrower than the genus. A classic case in point is *Mothocya melanosticta* Schioedte & Meinert, 1884, nine species of which had over time been identified as that species (see Bruce, 1986). Another example is the profusion of names currently held under the name *Nerocila orbignyi* (Guérin-Méneville, 1832) (see, Bruce, 1987c). More recently the convoluted entanglement of misapplied names *Ceratothoa imbricata* (Fabricius, 1775), *C. trigonocephala* (Leach, 1818) and *C. banksii* (Leach, 1818), has been resolved by detailed redescription of type material (Hadfield et al., 2014, Martin et al., in press). Conversely Bunkley-Williams & Williams (1981) described nine new species of *Anilocra* Leach, 1818 while simultaneously assigning the misapplied name *Anilocra laticauda* Milne Edwards, 1840 to nomen dubium as that species had no precise type locality and significantly also lacked a host data. Such nomenclatural chaos has resulted in species characteristics such as the range of variation, distribution and pattern of host usage being completely inaccurate. Secondly, the practice of redescription of species from at times diverse material, but without recourse to the type material, has caused further identity and identification difficulties. Further complicating the resolution of species identity is that occasionally the syntypes of historic cymothoid species are polytypic. These subsequent 'redescriptions' are then taken to be the accurate ('real") representation of the binomial even though in some cases the identification was incorrect, in effect attaching a name and associated knowledge to an undescribed species. Implicit therefore is that if a cymothoid species has no type material it may well be impossible to identify or redescribe with absolute certainty. Buccal attaching cymothoids such as species of *Cymothoa* are among the most difficult to identify. Without a primary type these historic species names can never be confidently applied and all subsequent identifications may be considered unsafe. The choice is simple—without type material one can place a species into nomen dubium and describe the species in question as new or, with justification, erect a neotype that will determine the concept for that species thereafter.

The original description of *Cymothoa rhina* Schioedte & Meinert, 1884, was given in Latin and accompanied by two life-size figures of the dorsal and later views. The description contains little species-specific detail in comparison to descriptions of the modern (post-1980) era. Fortunately there is a type locality, Zamboanga in the Philippines, and the type hosts were identified, namely *Lutjanus argentimaculatus* and *Lutjanus fulviflamma*, inshore species of Lutjanidae Gill, 1861. There is only one subsequent record of the species, without a host, that of Nierstrraz (1915) from the island of Palau. Schioedte & Meinert (1884) gave the deposition of the type material ("fere decem" [about 10] syntypes) as the Göttingen Museum. This collection was later moved to the Senckenberg Research Institute and Museum in Frankfurt, Germany, with some decapod material going to Natuurlijkie Rieksmuseet, Leiden (now Naturalis Biodiversity Center). Enquiries at these museums and also the Museum für Naturkunde, Berlin and the Zoologisk Museum, Copenhagen failed to reveal any material that could be definitely identified, or indeed even potentially considered to be the type material for this species. It seems that, inevitably, the types were either lost during a move or destroyed during the World War II.

The new material of *Cymothoa rhina* Schioedte & Meinert, 1884 described here comes from the same host genus (*Lutjanus* Bloch, 1790) as that recorded in the original description, and furthermore also from an inshore species, *Lutjanus carponotatus* (Richardson, 1842). Host usage in the Cymothoidae is not random, and species of tropical Cymothoidae and *Cymothoa* generally exhibit a narrow range of host use (see Bruce, 1986, 1987a, b, c, 1990, 1991, Bunkley-Williams & Williams, 1981, Hadfield et al., 2010, 2011, 2013, 2014, Martin et al., 2014a, b, 2015a, b), often restricted to a family or related group of genera. Correspondence of host genus reinforces conspecificity of the Singaporean specimens with the original description.

Although Singapore is some 1400 km distant to the original type locality, it is within the Indo-Malaysian biogeographic region (e.g., see Hoeksema, 2007) and importantly from a similar tropical location. It is extremely unlikely that specimens of this species will be re-collected from the southern Philippines, and arguably host identity (i.e. "type host") is as important as geographic type locality for these parasitic species. We consider the new type locality resulting from the neotype designation to be "as nearly as practicable from the original type locality" (Anon, 1999, ICZN, Art. 75.3.6).

The Singaporean material agrees well with the figures given by Schioedte & Meinert (1884) with the limited comparison that can be made—head shape with the prominently produced and anteriorly narrowed anterior margin, similarly proportioned anterolateral projections of pereonite 1, pleon shape that widens evenly rather than abruptly towards the posterior, and the shape and proportions of the pleotelson and uropods. The figure of the female shows the anterior margin of the cephalon as narrow and truncate, whereas the present material it is acute; the shape of the male cephalon is the same; we attribute the rostrum difference in the females to be developmental, and both males and females of *C. rhina* are unique within the genus in having a narrowed and anteriorly produced rostrum; the usual state being broadly rounded or truncate. The present material, male and female, is smaller than the size range given by Schioedte & Meinert (1884; females 23.5–32.0 mm; males 11–12 mm), but does fall well within the range that is typical for the genus (e.g., see Martin et al., 2015, in press; female length ranges: *C. epimerica* Avdeev, 1979, 19–31 mm; *C. hermani* Hadfield, Bruce & Smit, 2011, 23–37 mm; *C. indica* Schioedte & Meinert, 1884, 15–30 mm; *C. pulchrum* Lanchester, 1902, 21–39 mm). We are confident that the Singaporean and Philippine material is the same species, and we have taken the decision to designate a neotype in order to conserve Schioedte & Meinert's (1884) name and concept of this species and the future use of this name.

Cymothoa rhina **Schioedte & Meinert, 1884**
(Figs. 1–8)

Cymothoa rhina Schiœdte & Meinert, 1884: 253, tab. X (Cym. XXVIII), figs. 1–4.
Cymothoa rhina.— Nierstrasz, 1915: 93; 1931: 136.— Trilles, 1994: 148.— Trilles & Bariche, 2006: 228.

Material examined. Neotype: here designated, ♀ (21 mm ovig.), St John's Island, Singapore, 1°13.116'S, 103°51.079'E; SS0841, RMBR 11189; SW104; from mouth of *Lutjanus carponotatus,* coll. D. Uyeno (ZRC 2014.0118). Non-type — ♂ (7 mm), associated with female, same data (ZRC 2014.0119).

Description. *Female*: *Body* 2.0 times as long as greatest width, smooth and polished in appearance, widest at pereonites 5 and 6, narrowest at pereonite 1. *Cephalon* 0.5 times longer than wide, subtriangular, visible in dorsal view. *Frontal margin* acute, not folded. *Eyes* indistinct. *Pereonite 1* smooth with slight indentations produced posteriorly, anterolateral projections extending half length of cephalon. Pereonites 1–6 increasing in length and width; pereonite 7 shorter and narrower than pereonite 6; pereonites 5–7 arched posteriorly. *Coxae* 2–3 posteroventral margins rounded, 4–7 without distinct point. *Pleonites* 1–5 progressively wider, similar in length, smooth and flat posteriorly, lateral margins slightly rounded posteriorly; pleonite 1 partially visible in dorsal view, posterior margins smooth; pleonite 5 with posterolateral margins not overlapped by lateral margins of pleonite 4, posterior margin not bisinuate. *Pleotelson* 0.5 times as long as anterior width; posterior margin subtruncate; dorsal surface without sub-medial depressions; lateral margins convex.

Antennula comprised of 8 articles; peduncle articles 1 and 2 distinct and articulated; article 2 0.8 times as long as article 1; article 3 0.5 times as long as combined lengths of articles 1 and 2, 1.4 times as long as wide. *Antenna* comprised of 10 articles; peduncle article 3 1.5 times as long as article 2, 1.5 times as long as wide; terminal article without setae, extending to posterior margin of cephalon. *Labrum* lateral margins concave, without median point. *Maxillule* simple, with 4 terminal RS. *Maxilla* mesial lobe with 2 recurved RS, partly fused to lateral lobe with 2 recurved RS. *Maxilliped* oostegite lobe lamellar. Maxilliped article 3 with 5 curved RS. Oostegite smooth, with marginal setae.

Pereopod 1 basis 1.5 times as long as greatest width; ischium 0.5 times as long as basis; merus proximal margin without bulbous protrusion; carpus with straight proximal margin; propodus 1.7 times as long as wide; dactylus slender, 1.3 as long as propodus, 3 4.times as long as basal width. *Pereopod 2* propodus 1.4 times as long as wide; dactylus 1.5 times as long as propodus; similar to pereopod 3. *Pereopod 6* basis 1.2 times as long as greatest width; ischium 0.5 times as long as basis; propodus 1.0 as long as wide; dactylus 1.5 times as long as propodus. *Pereopod 7* basis 1.3 times as long as greatest width; ischium 0.9 times as long as basis, with large proximal bulbous protrusion; merus proximal margin with slight protrusion, 0.4 times as long as ischium, 0.7 times as long as wide; carpus without bulbous protrusion; propodus 0.5 times as long as ischium, 1.0 times as long as wide; dactylus slender, 2.2 times as long as propodus, 3.5 times as long as basal width.

Pleopods without setae, lobes increasing in size from pereonite 1 to 5, exopod larger than endopod. *Pleopod 1* exopod 0.9 times as long as greatest width, lateral margin distally concave, distally broadly rounded, mesial margin straight, strongly oblique; endopod 1.2 times as long as wide, lateral margin convex, distally narrowly rounded, mesial margin straight; peduncle 3.1 as wide as long. *Pleopods* 1–5 endopod proximal borders increasing in size, with fleshy folds and medial lobes present and increasing in size.

Uropod as long as pleotelson; peduncle 0.5 times longer than rami; lateral margins without setae. *Endopod* apically rounded, 3.4 times as long as greatest width, lateral margin weakly convex, mesial margin weakly convex. *Exopod* not

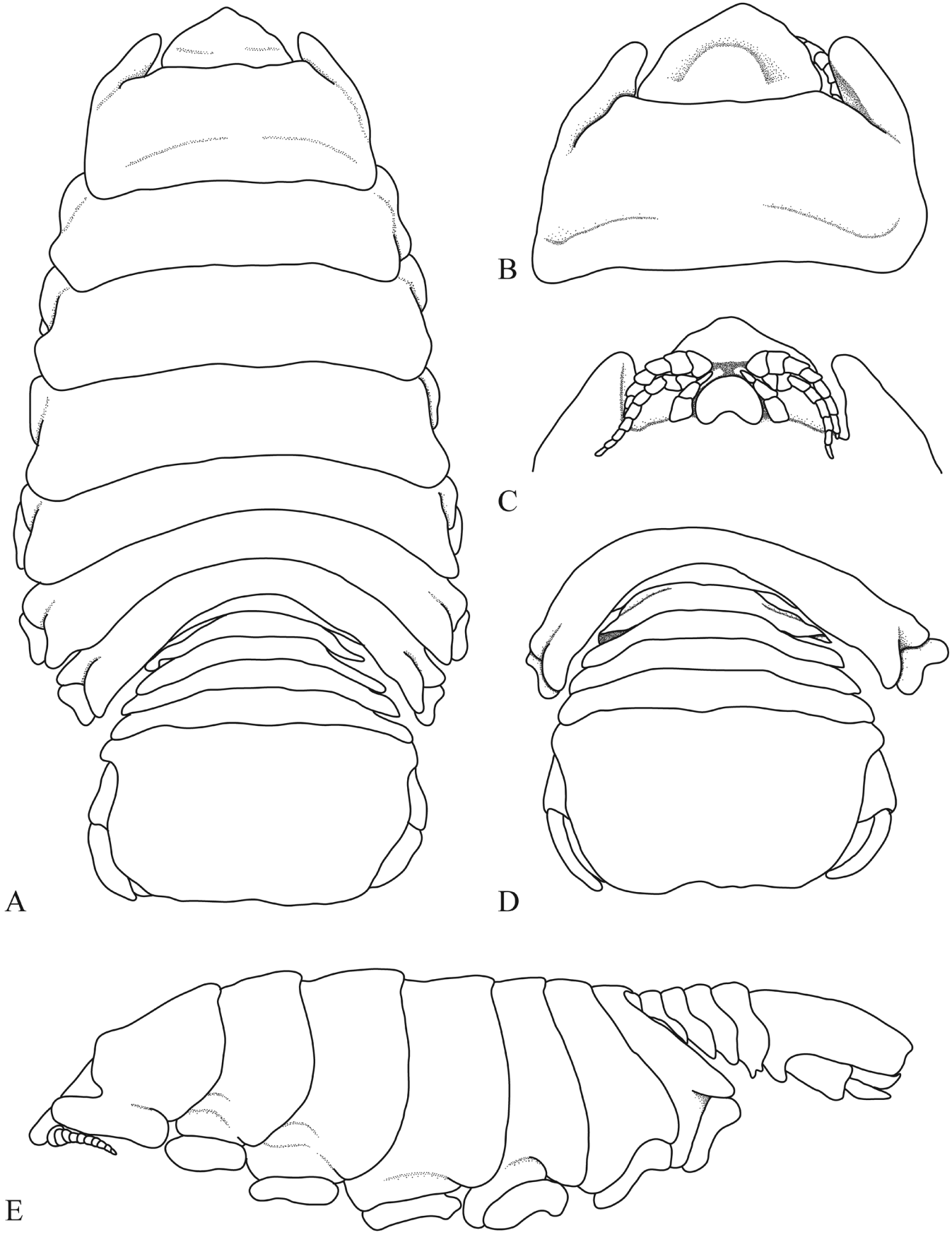

Fig. 1. *Ceratothoa rhina*, ovigerous female neotype (ZRC 2014.0118). A, dorsal view; B, anterodorsal view of pereonite 1 and cephalon; C, ventral view of cephalon; D, dorsal view of pleotelson; E, lateral view.

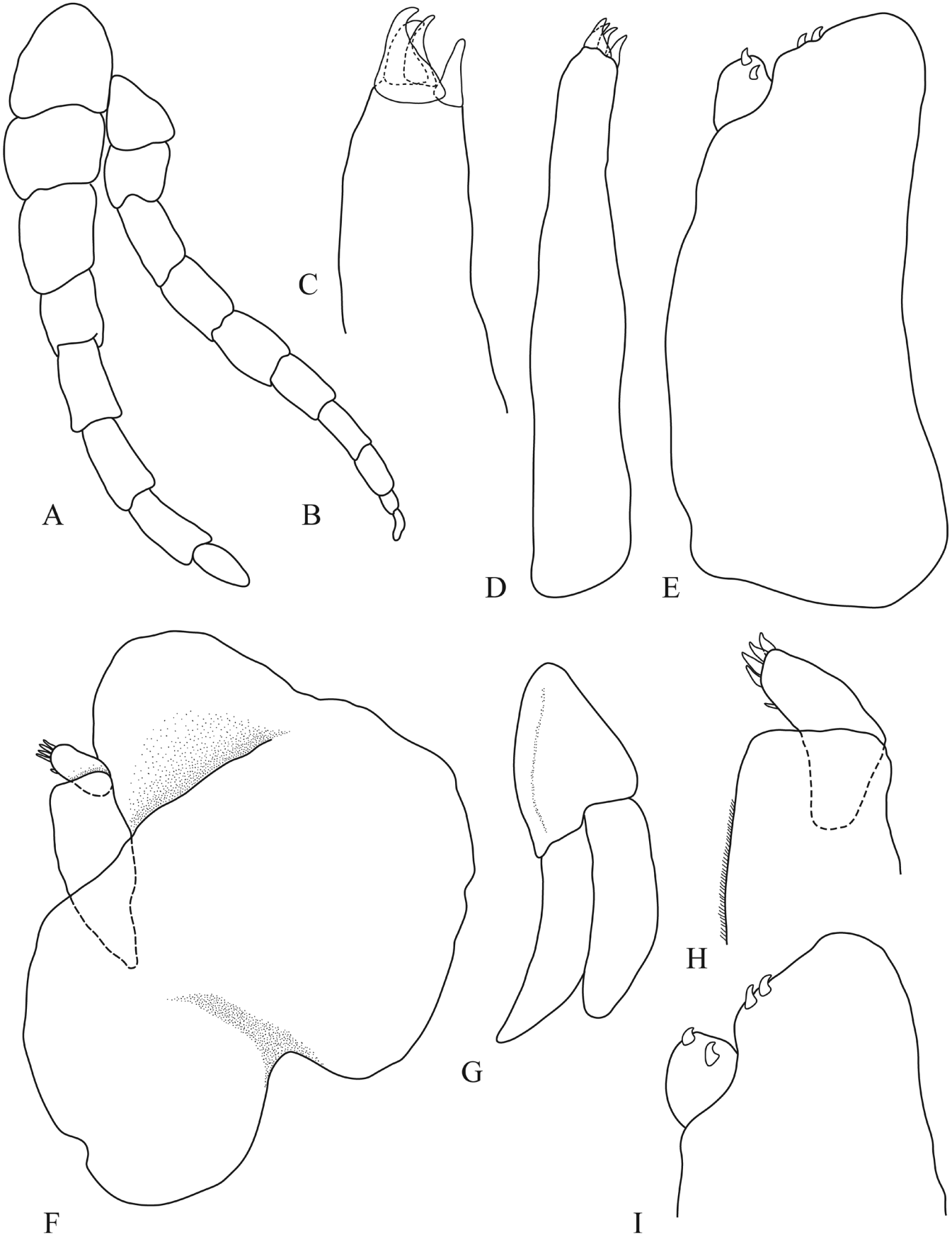

Fig. 2. *Ceratothoa rhina*, ovigerous female neotype (ZRC 2014.0118). A, antennula; B, antenna; C, tip of maxillule; D, maxillule; E, maxilla; F, maxilliped with oostegite; G, uropod; H, maxilliped article 3; I, tip of maxilla.

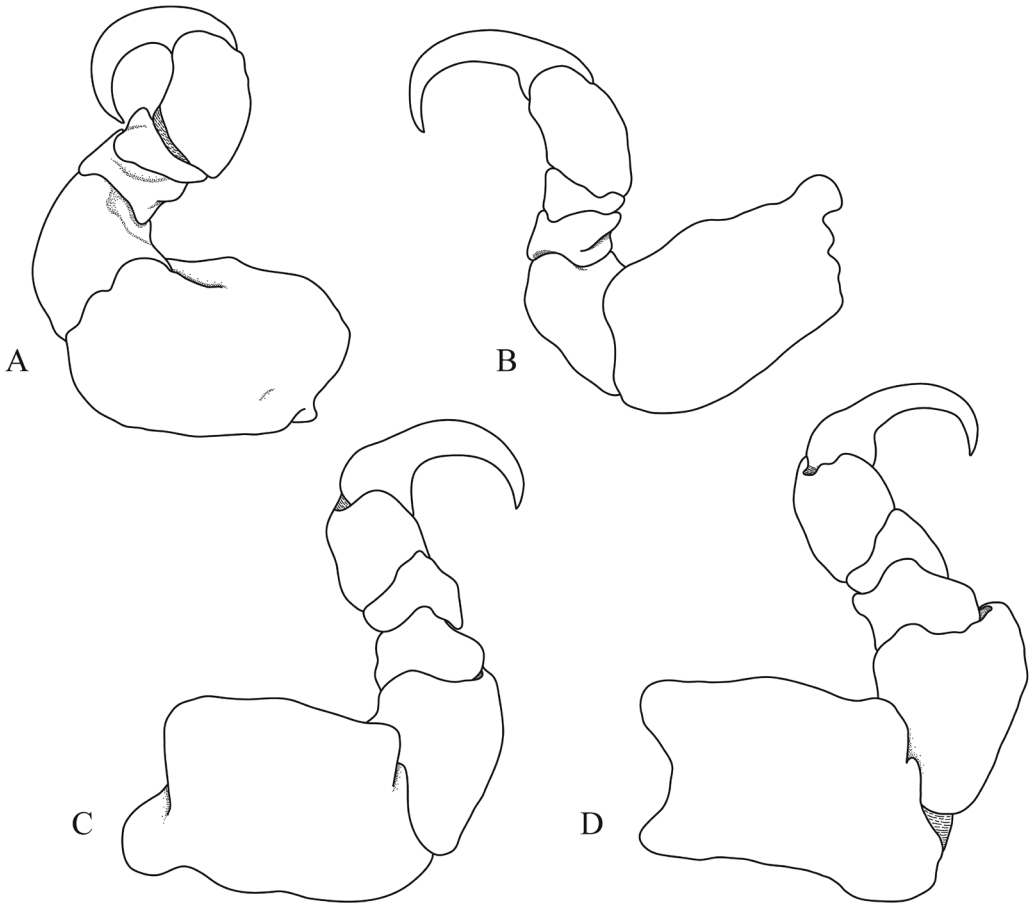

Fig. 3. *Ceratothoa rhina*, ovigerous female neotype (ZRC 2014.0118). A, pereopod 1; B, pereopod 2; C, pereopod 6; D, pereopod 7.

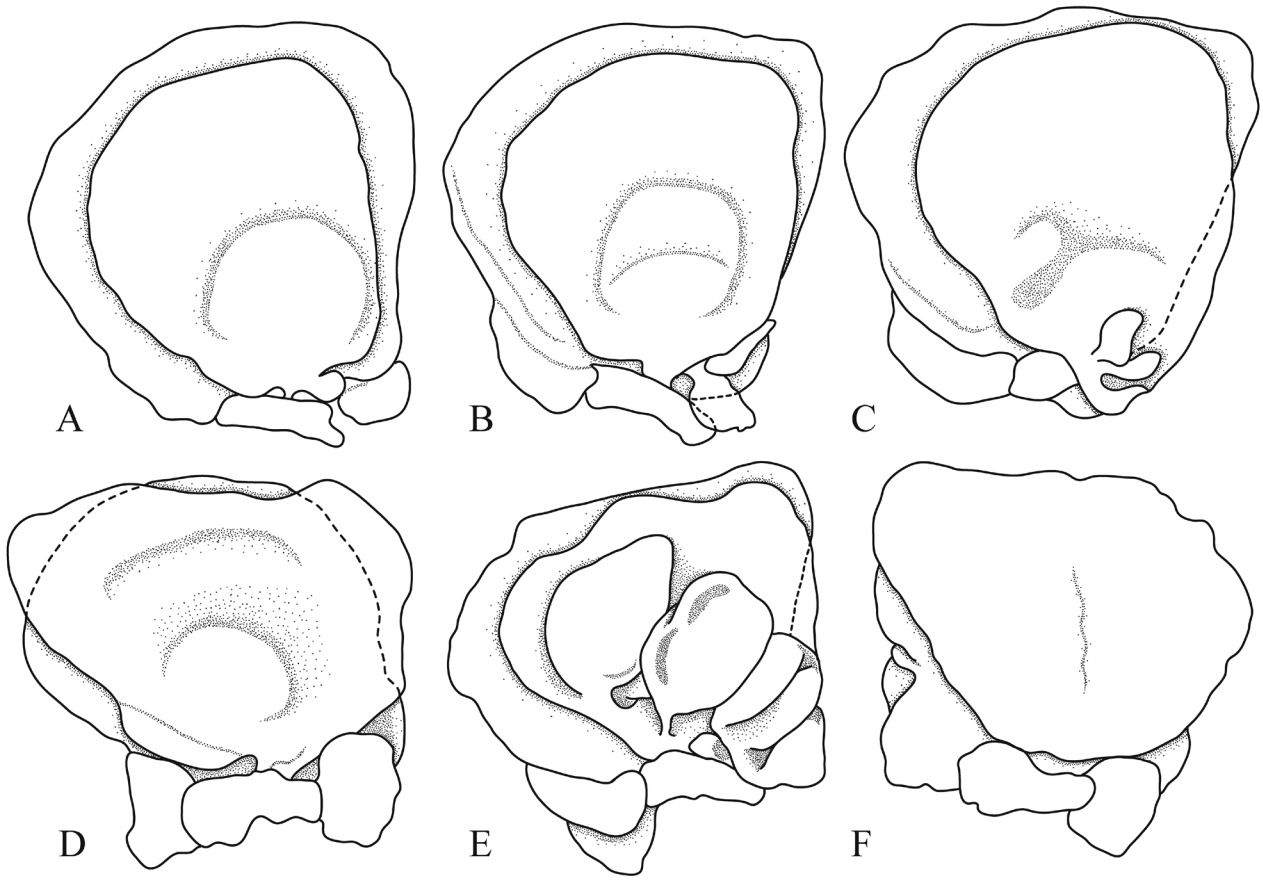

Fig. 4. *Ceratothoa rhina*, ovigerous female neotype (ZRC 2014.0118). A, dorsal pleopod 1; B; dorsal pleopod 2; C, dorsal pleopod 3; D, dorsal pleopod 4; E, dorsal pleopod 5, F, ventral pleopod 5.

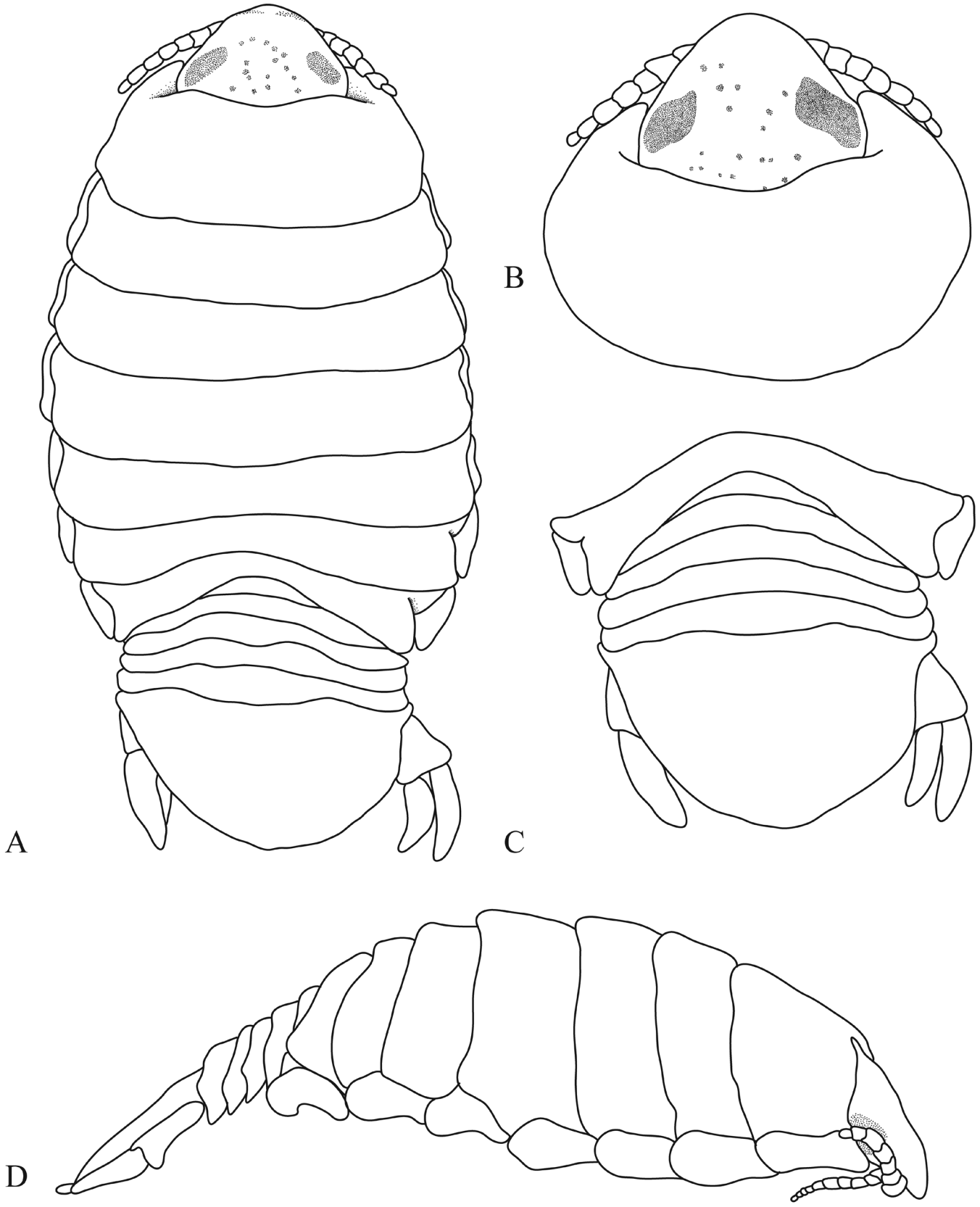

Fig. 5. *Cymothoa rhina*, male (ZRC 2014.0119). A, dorsal view; B, anterodorsal view of pereonite 1 and cephalon; C, dorsal view of pleon and pleotelson; D, lateral view.

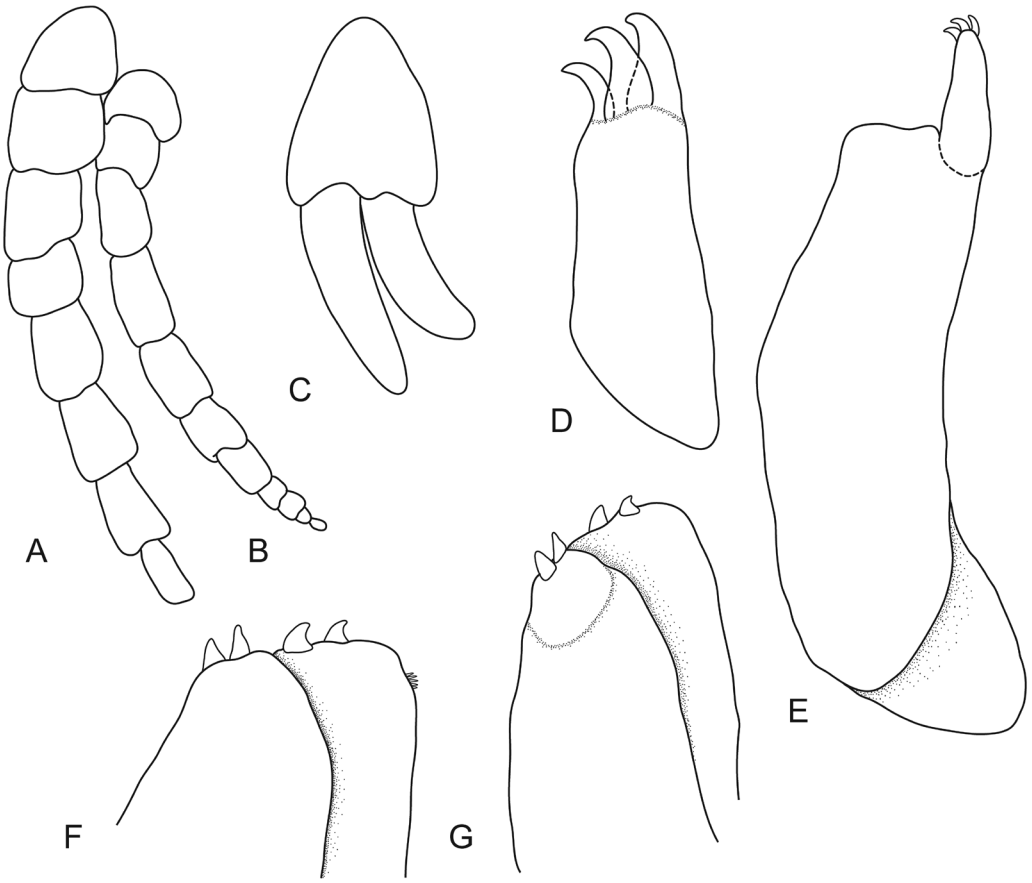

Fig. 6. *Cymothoa rhina*, male (ZRC 2014.0119). A, antennula; B, antenna; C, uropod; D, tip of maxilliped; E, maxilliped; F, tip of maxilla; G, maxilla.

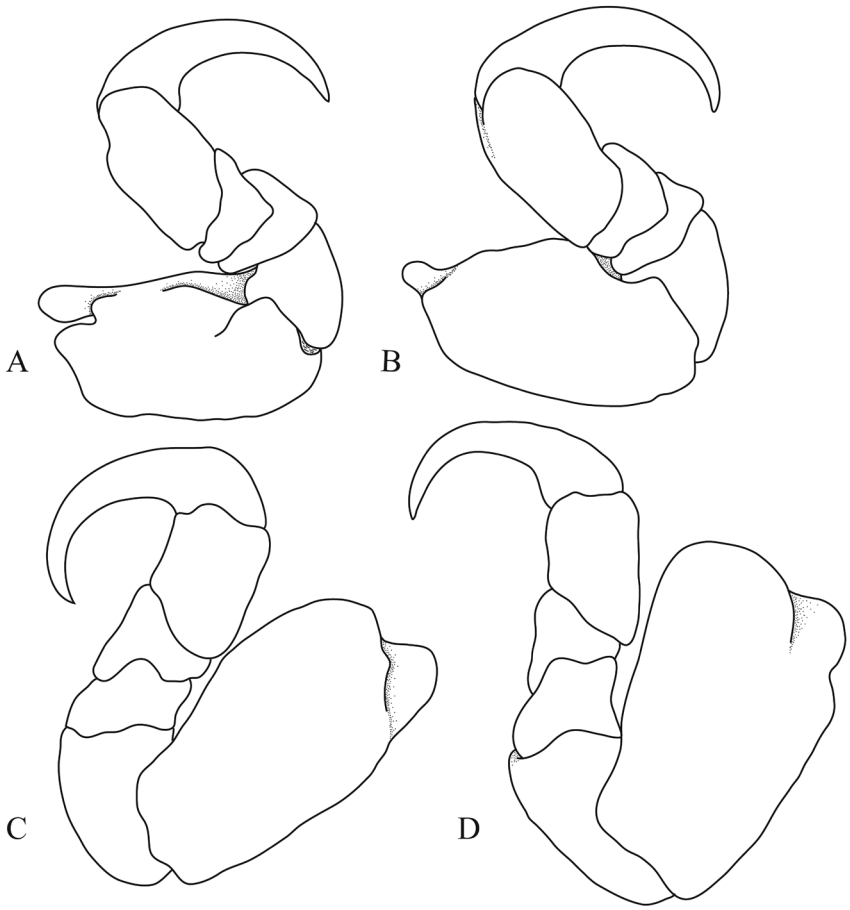

Fig. 7. *Cymothoa rhina*, male (ZRC 2014.0119). A, pereopod 1; B, pereopod 2; C, pereopod 6; D, pereopod 7.

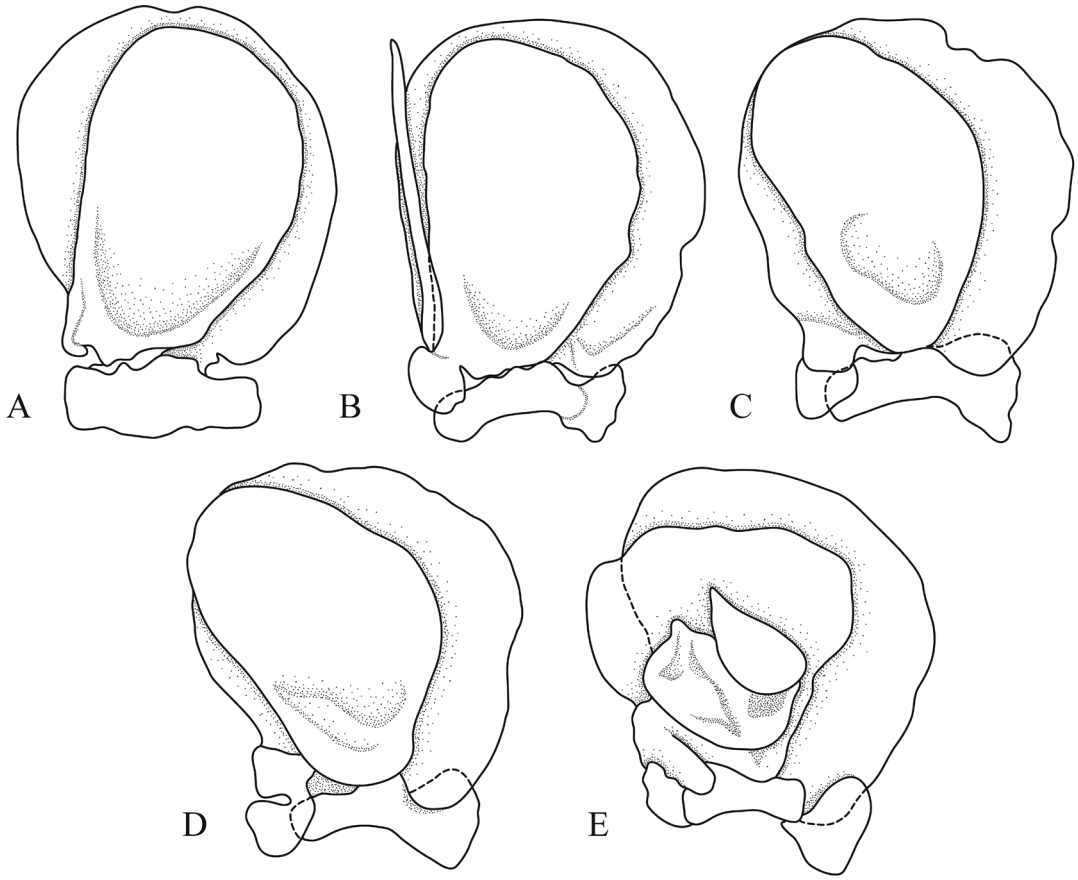

Fig. 8. *Cymothoa rhina*, male (ZRC 2014.0119). A, dorsal pleopod 1; B; dorsal pleopod 2; C, dorsal pleopod 3; D, dorsal pleopod 4; E, dorsal pleopod 5.

extending to end of endopod, 3.5 times as long as greatest width, without setae.

Description. *Male*: Similar to female except body oval. *Cephalon* 0.6 times as long as wide. *Frontal margin* subacute. *Eyes* distinct, 0.3 as wide as cephalon. *Pereonite 1* without anterolateral projections extending half length of cephalon; pereonites 2–4 similar in width. *Pleonites* 1–5 similar in width, pleonite 5 posterior margin weakly bisinuate. *Pleotelson* 0.4 times as long as anterior width; subacute; lateral margins convex, posterior margin evenly rounded, with weak median point. *Maxillule* simple with 3 terminal robust RS. Maxilliped article 3 with 3 curved RS. *Pereopod* 6 and 7 basis weakly carinate; ischium with weak bulbous protrusion. *Pleopod 2* with appendix masculine, distally acute, 0.9 times as long as endopod, distally acute.

Colour. Ivory white. Male with pigments lightly scattered on pleotelson and pleon.

Size. Present material: non-ovigerous female 21 mm, male 7 mm. Other reports include ovigerous female: 23.5–32 mm; non ovigerous female 26 mm; male 11–19 mm (Schioedte & Meinert 1884; Nierstrasz, 1915).

Hosts. From *Lutjanus carponotatus* (Richardson, 1842) (Lutjanidae), the Spanish flag snapper; present material. Previously reported from mangrove red snapper *Lutjanus argentimaculatus* (Forsskål, 1775) [as *Mesoprion gembra* (Bloch & Schneider, 1801)] and the dory snapper *Lutjanus fulviflamma* (Forsskål, 1775); see Schioedte & Meinert, 1884].

Distribution. Central Indo-Pacific; present material from Singapore. Previous records are from the Philippines (Schioedte & Meinert, 1884) and Palau (Nierstrasz, 1915).

Remarks. *Cymothoa rhina* Schioedte & Meinert, 1884 is one of the eight *Cymothoa* species known from the Indo-Malaysian region (Trilles, 1994) and is distinctive within the genus in being the only species with a triangular anterior margin to the cephalon in the adult female. *Cymothoa rhina* is identified by the following characters: subtriangular cephalon, eyes indistinct, anterolateral projections on pereonite 1 extending half the length of the cephalon, subtruncate pleotelson posterior margin, uropod rami not extending beyond pleotelson, pleon narrower than pereonite 7, pereopod 7 ischium inferior margin with bulbous protrusion and the superior margin of the pereopod 7 basis with a distinct carina. The female differs slightly from Schioedte & Meinert's (1884) figures by having a more rounded pleotelson. The male has distinct eyes, acute anterolateral projections of pereonite 1, a rounded pleotelson with a weak apical point and chromatophores lightly scattered over the dorsal surfaces of pereonite 1, pleon and pleotelson. The male specimens from Singapore agree well with Schioedte & Meinert's (1884) figure.

Cymothoa truncata Schioedte & Meinert, 1884 and *Cymothoa eremita* (Brünnich, 1783) both occur in the general region, but can be distinguished by having a subtruncate anterior cephalic margin. *C. truncata* also differs from *C. rhina* by the uropodal rami not extending to the pleotelson posterior margin, the rounded pleotelson posterior margin and pereonite 1 with blunt and broad anterolateral projections. *C. eremita* differs from *C. rhina* in having uropods that are well short of the posterior margin of the pleotelson (extend to pleotelson posterior margin *C. rhina*), and the anterolateral margins of pereonite project anteriorly and are apically narrowly rounded (not projecting and blunt in *C. rhina*).

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