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Hemibranchiate sphaeromatids (Crustacea: Isopoda) from Queensland, Australia, with a world-wide review of the genera discussed

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All known Queensland species of the isopod family Sphaeromatidae, subfamily Sphaeromatinae = hemibranchs, are discussed. The following new taxa are erected: *Calcipila cornuta*, gen. nov., sp. nov.; *Cymodoce tribullis*, sp. nov.; *Cymodoce bipapilla*, sp. nov.; *Paracilicæa aspera*, sp. nov.; *Cilicæopsis glebosa*, sp. nov.; *Cilicæopsis furculata*, sp. nov.; *Cilicæa calcarifera*, sp. nov.; *Zuzara curtispina*, sp. nov.; *Zuzara digitata*, sp. nov.; and *Clianella brucei*, sp. nov. *Exosphaeroma intermedium* Baker is transferred to the genus *Sphaeroma* Latreille. The genus *Dynoides* Barnard is reviewed and its current synonymy is contested. With several new records, this brings the total number of sphaeromatid species known from Queensland to 49, 24 of which are in the subfamily Sphaeromatinae. A checklist of all sphaeromatid species occurring in Queensland waters is given.

From the rest of Australia: *Cymodoce tuberculata* Haswell is given the replacement name *Cymodoce haswelli*, nom. nov.; *Cymodoce granulata* Miers is made a junior synonym of *Cerceis trispinosa* Haswell subfamily Dynameninae; *Zuzara diadema* Leach, *Z. dicantha* Milne Edwards, and *Z. integra* Haswell are made junior synonyms of *Z. semipunctata* Leach; *Cilicæopsis dakini* Tattersall is tentatively transferred to the genus *Paracilicæa* Stebbing.

The genera discussed are reviewed world-wide and among the non-Australian species: *Exosphaeroma papillae* Bayliff is transferred to the genus *Sphaeroma*; *Sphaeroma irakiensis* Ahmed is made a junior synonym of *Sphaeroma annandalei annandalei* Stebbing; *Cymodoce richardsoniae* Nobili is shown to be distinct from *Cymodoce truncata* Leach; *Cymodoce eupyga* Nobili is transferred to the genus *Paracilicæa*; *Dynoides amblysinus* Pillai, *Dynoides castroi* Loyola e Silva and *Exosphaeroma globicaudum* Dana are transferred to the genus *Clianella* Boone; *Dynoides brasiliensis* (Loyola e Silva) and *Sphaeroma savignii* Milne Edwards *sensu* Dana, 1853 are declared to be conspecific with *Clianella castroi*. The name *Sorrentosphaera* Verhoeff is made a junior synonym of *Dynamene* Leach (subfamily Dynameninae).

KEY WORDS:—Isopoda – Sphaeromatidae – hemibranchs – Queensland – taxonomy.

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INTRODUCTION

Prior to 1980 the sphaeromatid isopod fauna of Queensland had received little attention from taxonomists. Although 101 species had been recorded from Australia, only 14 of these had been recorded from Queensland. Haswell (1881: 471) claimed that isopods were extremely rare in Queensland, but recent work has shown that this is far from being the case and that like many tropical regions Queensland may show a greater species diversity than more temperate coasts. For the Sphaeromatidae alone, work published since 1979 has added 17 genera and 23 species to the Queensland records. Most of this recent work has concentrated on the subfamilies Cassidiniinae (the platybranchiate sphaeromatids) (Holdich & Harrison, 1981a; 1983) and Dynameninae (the eubranchiata sphaeromatids) (Holdich & Harrison, 1980; 1981b; 1983; Harrison & Holdich, 1982a, b). Only two recent publications have considered the third subfamily represented in Australia, the Sphaeromatinae (the hemibranchiate sphaeromatids). Carlton & Iverson (1981) briefly provided the first record of *Sphaeroma walkeri* Stebbing from Queensland, and Bruce (1982) described a new species, *Dynoides viridis* Bruce, from Heron Island.

The present paper deals exclusively with the hemibranchiate species found in Queensland, and is based on previously unrecorded material collected by one of the authors (DMH) or provided by museums, universities or individual research workers. These collections contained representatives of all known Queensland species except *Cymodoce mammifera* Haswell (which is known only from an immature specimen) and *Dynoides viridis*. For completeness, however, *D. viridis* is included in the text. In addition, 1 new genus and 10 new species are described, and 3 genera and 3 species are recorded from Queensland for the first time. This brings the number of sphaeromatid species known from Queensland waters to 49 (belonging to 28 genera) and these are listed in Appendix 1. To complement the present study, Appendix 2 gives a brief world-wide review of the genera discussed, and provides checklists of the included species.

METHODS

The present specimens come from a number of sources, and the collection techniques were diverse. However, material collected by D. M. Holdich was obtained by the methods outlined in Harrison & Holdich (1982a).

The museum locations of the specimens examined are indicated below by the following abbreviations: AM, Australian Museum; BM(NH), British Museum (Natural History); CM, Zoological Museum, University of Copenhagen; NTM, Northern Territory Museum; NUZ, Nottingham University, Zoology Department; QM, Queensland Museum; VM, Natural History Museum, Vienna; WAM, Western Australian Museum; ZMUH, Zoological Museum, University of Hamburg.

SYSTEMATICS

The family Sphaeromatidae is represented in Australia by three subfamilies, the Cassidininae, Sphaeromatinae and Dynameninae. These three subfamilies were previously called the Platybranchiatinae, Hemibranchiatinae and Eubbranchiatinae respectively, but Bowman (1981) correctly indicated that under the rules of the International Code of Zoological Nomenclature these names were not correctly formed. The necessary replacement names were provided by Bowman (1981) and Iverson (1982).

The main taxonomic character separating the three subfamilies is the form of pleopods 4 and 5. In the Cassidininae these pleopods have both rami flat and membranous; in the Sphaeromatinae the outer ramus of each is flat, but the inner is convoluted, bearing transverse folds; in the Dynameninae all rami bear transverse folds. Such folding presumably increases the respiratory area of the pleopods, and it is on this character that the former names were based (literally, 'with flat gills'; 'with half gills'; and 'with full gills'). As the terms platybranchiate, hemibranchiate and eubbranchiate have been used extensively and are widely understood, they will be retained here as purely descriptive terms.

All the descriptions in the present work are new, and are not based on those of previous authors. The abbreviations used in these descriptions are as follows: A_1 —antennule; A_2 —antenna; mpts—mouthparts; mnd—mandible; mx_1 —maxillule; mx_2 —maxilla; mxpd—maxilliped; prpd—pereopod; plpd—pleopod.

In the synonymies preceding the descriptions not all references are necessarily given, but an attempt has been made to include all references relevant to Australia, and all those including detailed taxonomic discussion. Where a large number of references have been omitted, this is indicated by the phrase "*et auct.*" (i.e. 'and of authors').

As the literature is so vast it is possible that for some of the old, large genera, e.g. *Sphaeroma* Latreille, some species may have been overlooked. However, Appendix 2 contains all the valid names known to the present authors.

Sphaeroma is the only sphaeromatid genus known to be of economic importance, with several species burrowing into timber placed in the marine environment. The physical damage caused by this burrowing can lead to these species becoming serious pests in tropical regions. Several wood-boring species occur in Queensland, and these are considered below. All other known wood-borers are indicated in Appendix 2. The association between sphaeromatids and wood in brackish-water habitats was discussed by Holdich & Harrison (1983).

Genus *Sphaeroma* Latreille, 1802

Sphaeroma Latreille, 1802; 41, 42. Bosc, 1802; 182–186, pl. 15; *et auct.* *Europosphaera* Verhoeff, 1942: 169–173; Verhoeff, 1943: 281, 282; Forsman, 1952; 154.

Type-species: *Oniscus globator* Pallas, 1772 (a junior synonym of *Oniscus conglobator* Pallas, 1766).

Generic description

Hemibranchiate Sphaeromatidae with endopod of pleopod 3 lacking branchial folds. Both sexes with cephalosome, pereon and pleon lacking dorsal extensions; at most bearing transverse ridges or tubercles. Pleon with postero-

lateral margin bearing two long curved sutures at each side. Pleotelson smooth or tuberculate, with posterior margin smoothly arcuate or subacute or broadly truncate in dorsal view, lacking a notch, groove, foramen or median extension. Mxpd with palp articles 2-4 often lacking lobes, inferior margins straight with dense fringes of setae; some species with palp articles 2-4 bearing low setigerous lobes. Prpds 1-3 with superior surfaces of ischium and merus bearing dense fringes of long stiff setae held perpendicular to surface. Exopod of plpd 5 with an apical, toothed boss; a low, anterior, subapical boss; and two low contiguous interno-distal bosses. Uropod with rami usually lamellar, subequal in length, or exopod slightly longer than endopod; exopod usually externally serrate. Sexual dimorphism not pronounced.

Adult male: Penes short, separate to base, with broadly rounded tips. Appendix masculina present (except in the species *Sphaeroma terebrans* Bate, which completely lacks this structure), arising from interno-proximal angle of endopod of plpd 2 and extending beyond ramal apex.

Ovigerous female: Mpts not metamorphosed. Brood pouch usually formed from three pairs of oostegites arising from prpds 2-4, with those of prpds 3 and 4 at least overlapping well in the midline (*S. triste* Heller bears only two pairs of oostegites arising from prpds 3 and 4; *S. annandalei* Stebbing lacks oostegites completely). Brood not housed in the marsupium thus formed, but held in four pairs of internal pouches: Ventral pockets absent.

Australian species

Sphaeroma intermedium (Baker, 1926), comb. nov.

Sphaeroma quoyanum Milne Edwards, 1840 (NRA)

Sphaeroma serratum (Fabricius, 1787) (NRA)

Sphaeroma terebrans Bate, 1866 (NRA)

Sphaeroma triste Heller, 1865 (NRA)

Sphaeroma walkeri Stebbing, 1905 (NRA)

(NRA = not restricted to Australia. See Appendix 2 for all known species of *Sphaeroma*).

Remarks

Great confusion has surrounded the identity of the original description of this genus. Virtually all authors have assumed that Bosc (1802) provided the first description, and have given the authority as "Bosc" or "Latreille in Bosc". Neither is true. The genus *Sphaeroma* was first described by Latreille in 1802 in Sonnini's edition of the *Histoire Naturelle de Buffon* . . . Later (although apparently in the same year) Bosc discussed the genus in Castel's edition of the same suite of works, where he correctly attributed the name to Latreille.

In his original description, Latreille cited only one species as an example of his new genus, *Oniscus globator* Pallas, 1772 (actually a junior synonym of *O. conglobator* Pallas, 1766). *Oniscus glabator* is therefore the type-species (by monotypy) of the genus *Sphaeroma*. Most authors have not cited the type-species of the genus, but Hurley & Jansen (1977: 69) incorrectly stated that the type-species was *Sphaeroma serratum* (Fabricius, 1787). Hurley & Jansen were presumably following the recommendation of Stebbing (1900: 552, 553) who erroneously believed Bosc's account to be the original description of the genus. (For a brief discussion of the confusion surrounding Bosc's work see Stebbing (loc. cit.) and Omer-Cooper & Rawson, 1934: 35, 36).

Unfortunately the names *Oniscus conglobator* and *O. globator* have been little used and it is no longer possible to determine which species should bear these names. Pallas' original description is inadequate for identification and no type-specimens are known to exist. Under the circumstances, the present authors have appealed to the International Commission on Zoological Nomenclature to use its plenary powers to suppress *Oniscus globator* as the type-species of the genus *Sphaeroma*, and to replace it with the species *Oniscus serratus* Fabricius, 1787.

Sphaeroma is unusual in showing variation in a number of characters which appear to be constant in all other known genera. The maxillipedal palp articles of some species of *Sphaeroma* bear inferior lobes (see Monod, 1931b: 34) while in other species lobes are absent (in all other known genera the degree of lobing is constant). One species of *Sphaeroma* (*S. terebrans*) lacks appendices masculinae while all other known species possess these structures. John (1968: 14, 15) claimed that he found some specimens of *S. terebrans* bearing appendices masculinae, but some of the illustrations in his work are not obviously specimens of *S. terebrans* and it is not certain that the males bearing appendices were that species. Shiino (1957: 172) stated that appendices masculinae were absent in *Sphaeroma retrolaeva* Richardson, but he did not say what criteria he was using to ascertain that his specimens were adult. It is possible that his males were merely subadult, bearing penes but lacking appendices masculinae.) Some species of *Sphaeroma* show a reduction in the size and number of the oostegites of the ovigerous females. This appears to affect only those species which burrow into wood or embankments. All known 'free-living' species have three pairs of fully formed oostegites, but among the boring species: *S. terebrans* has the anterior pair of oostegites reduced, usually just reaching the mid-line; *S. triste* has the anterior pair absent; and *S. annandalei annandalei* Stebbing and *S. annandalei travancorensis* Pillai lack oostegites completely (the brood pouch being composed only of internal pouches). (This variation in oostegite number will be discussed in a separate publication in which the structure of the brood pouch for the whole of the family Sphaeromatidae will be reviewed—K. Harrison, in press b.) The boring species may also show a reduction or loss of the peg-like lacinia mobilis of the left mandible. Dahl & Hessler (1982: 138, 144) indicated that a lacinia mobilis did not aid strong biting and could be lost in some crustacean species. Wood-boring species of *Sphaeroma* often have the mandibular incisor processes narrow and chisel-like, and probably burrow into hard substrata by direct opposition of the incisor edges. Most non-boring species have the incisor processes dentate and the lacinia mobilis well formed.

The distribution of the genus *Sphaeroma* is virtually world-wide with the exception of the polar regions (see Appendix 2) and the species occur intertidally or in the shallow sublittoral zone (0–46 m). Most species are intertidal, often in areas of freshwater input, and some bore into wood, soft rock, or mud embankments (e.g. Cragg & Levy, 1979; Dharmaraj & Nair, 1982).

Sphaeroma walkeri Stebbing, 1905

(Fig. 1)

Sphaeroma walkeri Stebbing, 1905: 31–33, 61, pl. 7; *Et auct.*
(See Carlton & Iverson, 1981 for review).

Description

Adult male: *Sphaeroma* with dorsal surface of cephalosome uneven. Pereonites 1 and 2 smooth. Pereonites 3 and 4 each bearing two irregular transverse rows of low tubercles. Pereonites 5-7 and pleon each bearing one transverse row of prominent, round, blunt tubercles. Pleon with posterior margin bearing an additional row of small round tubercles. Pleotelson long, tapering to a rounded apex. Dorsal surface of pleotelson granulose; either side of midline bearing a longitudinal row of approximately six prominent tubercles; lateral to each of these rows in anterior region is a longitudinal row of three such tubercles; anterior to insertion of uropods are two such tubercles. Lateral margin of pleotelson, in distal half, raised as a ridge. Pleotelson subapically concave, apex slightly upturned. Appendages— A_1 with peduncle article 1 subequal in length to article 3; article 2 short; article 3 slender, cylindrical; 13-articled flagellum extending to level of pereonite 1. A_2 moderately slender; 14-articled flagellum extending to level of pereonite 3. Epistome subtriangular with surface granulose; lateral margins sublinear, tapering anteriorly, apex abruptly tapering to an obtuse tip. Mnds with incisor processes dentate; lacinia mobilis of left mnd well formed, dentate; article 1 of mandibular palp bearing fringe of fine setae. Mx_1 with inner lobe having external terminal spine half length of three internal spines; outer lobe with long fine internal and external setae and terminal spines. Mx_2 with outer lobes bearing long, slender, curved spines; inner lobe bearing a dense internal fringe of setae. $Mxpd$ with palp articles 2-4 lacking lobes; inferior margins straight, bearing dense fringes of long setae; articles 3 and 4 each bearing a distal superior group of long setae. Prpds 1-3 slender; ischium and merus bearing superior fringes of long rigid setae; prpds 2 and 3 with carpus bearing long superior distal setae; prpd 1 with propodus bearing long superior distal setae, and a stout infero-distal spine. Prpds 4-7 robust with basis, ischium, merus and carpus bearing dense superior and inferior fringes of long setae. All prpds with inferior margins of merus, carpus and propodus bearing dense pads of fine setae. Penes each two-thirds as wide as long, slightly subelliptical. Plpd 1 with endopod subtriangular, slightly shorter than apically truncate exopod. Plpd 2 with rami as in plpd 1 but appendix masculina present. Appendix masculina long, slender, straight, $1\frac{1}{3}$ times length of ramus, margins subparallel, but with a subterminal, external indentation and a broadly rounded apex. Plpd 3 with endopod long, subtriangular, slightly longer than apically truncate exopod; exopod lacking an articulation. Bases of plpds 1-3 each bearing three internal coupling hooks. Endopod of plpd 4 with a deep subterminal, internal indentation, leaving apex narrowly rounded, directed internally; exopod with a complete articulation in distal half. Endopod of plpd 5 with apex broadly rounded; exopod with a complete subterminal articulation. Uropod with rami broad, extending just beyond pleotelsonic apex; exopod slightly longer than endopod with five large, triangular, external teeth and an acute apex; endopod with proximal external margin slightly concave, apex narrowly rounded, and dorsal surface bearing prominent median tubercles and an oblique ridge on the basal region.

Ovigerous female: Resembling adult male, but smaller. Prpds 1-3 with merus, carpus and propodus lacking inferior pads of fine setae. Prpd 7 with propodus relatively shorter. All three pairs of oostegites broad and overlapping well in midline.

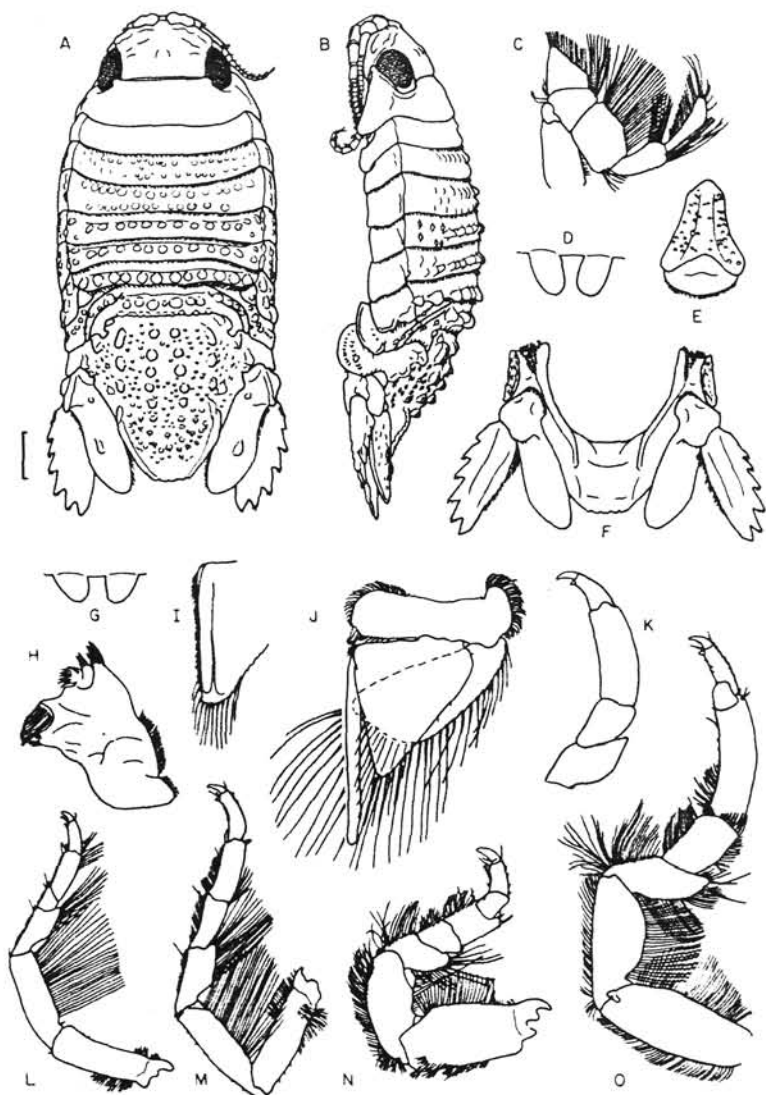


Figure 1. *Sphaeroma walkeri* Stebbing. Adult male, 9.52 mm: A, dorsal; B, lateral; C, maxilliped; D, penes; E, epistome and labrum; F, pleotelson, ventral; H, left mandible; J, pleopod 2; L-O, pereopods 1, 2, 4 and 7 respectively. Subadult male: G, penes; I, endopod of pleopod 2, inner margin; K, distal articles of pereopod 7 (setae omitted). Scale line represents 1 mm.

Non-ovigerous female: As above but lacking brood pouch.

Subadult male: As non-ovigerous female, but bearing penes. Penes each as broad as long, tapering slightly to a broadly rounded tip. Endopod of plpd 2 with appendix masculina visible through cuticle, forming along internal margin.

Remarks

Adult males of this species have the propodus of pereopod 7 relatively longer than in females and immature specimens. This limb may be important during copulatory or pre-copulatory behaviour, when the male grasps the female.

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Sphaeroma walkeri has an extensive distribution (see Appendix 2) which probably results from its tendency to be found alongside wood-boring species. Specimens in this habitat would be liable to dispersal by shipping etc. Although found on wood, there is no evidence that this species is an active borer, and it occurs in a number of other habitats. This species is usually found in fully marine environments (although it is found occasionally in estuaries, as in the present study) and has been recorded from greater depths than any other species of *Sphaeroma* (down to 46 m). Carlton & Iverson (1981) have given a thorough review of the literature and distribution of this species.

Material examined

Queensland: Sutton's Beach, Redcliffe, Moreton Bay (27°14.4'S, 153°06.8'E), under rocks, low tide level, 2 adult ♂♂, 1 subadult ♂, non-ovigerous ♀♀, 5 immature specimens, 1 juvenile (QM: W.8086), coll. N. L. Bruce, 18.vi.1979; Pallarenda, Townsville, from amongst pink striped barnacles and small rock oysters on rocks below splash zone, upper shore, 1 adult ♂, 1 ovigerous ♀, 1 immature specimen (NUZ), coll. D. M. Holdich, 14.v.1976; Pallarenda, from sand around base of wooden pier pile, intertidal, 1 juvenile (NUZ), coll. D. M. Holdich, 14.v.1976; Pallarenda, amongst barnacles, sponges, and fine algae in scrapings from wooden pier pile, mid-shore, 5 adult ♂♂, 7 subadult ♂♂, 8 ovigerous ♀♀, 7 non-ovigerous ♀♀, 17 immature specimens, 57 juveniles (NUZ), coll. D. M. Holdich, 12-14.v.1976; Pallarenda, on driftwood on sandy shore, 5 adult ♂♂, 2 subadult ♂♂, 9 ovigerous ♀♀, 5 immature specimens, 12 juveniles (NUZ), coll. D. M. Holdich, 01.iv.1976 & 25.vii.1976; Ross River Creek, Townsville, at river entrance on wood on open sand area, near stream coming from industrial area, intertidal, 1 immature specimen (NUZ), coll. D. M. Holdich, 23.vi.1976; Ross River Creek, on wood and mud, downstream from Hayle's Wharf, intertidal, 1 immature specimen (NUZ), coll. D. M. Holdich, 14.v.1976; Townsville Harbour, 'James Kirby' jetty, from wood bored by *Teredo* sp. surrounding floating pontoon, 1 ovigerous ♀, 2 juveniles (NUZ), coll. D. M. Holdich, 11.viii.1976; 'James Kirby' jetty, in scrapings of four years of growth of red algae, bryozoans, tube-worms, hydroids, and barnacles on side of pontoon, 1 ovigerous ♀ (NUZ), coll. D. M. Holdich, 11.viii.1976; 'James Kirby' jetty, in scrapings from hull of ocean-going yacht, 7 adult ♂♂, 3 subadult ♂♂, 11 ovigerous ♀♀, 18 non-ovigerous ♀♀, 18 immature specimens, 13 juveniles (NUZ), coll. D. M. Holdich, 11.vii.1976; 'James Kirby' jetty, in barnacle tests on steps and pier piles, intertidal, 1 adult ♂, 3 non-ovigerous ♀♀, 2 immature specimens (NUZ), coll. D. M. Holdich; Townsville Harbour (19°16'S, 146°49'E), from *Padina* sp., 1 adult ♂, 13 subadult ♂♂, 4 ovigerous ♀♀, 24 non-ovigerous ♀♀, 5 immature specimens (NUZ), coll. R. Muffley, 27.ix.1977; Halifax Bay, Townsville (19°00'S, 146°33'E), particulate substratum, depth 8-15.5 m, 2 immature specimens (NUZ), coll. James Cook Univ. Three Bays Survey, 09.iv.1975 & 25.ii.1976; Yorkey's Knob, Cairns, on tree trunk bored by *Teredo* sp. lying on sand near jetty, intertidal, 1 non-ovigerous ♀, 4 immature specimens (NUZ), coll. D. M. Holdich, 28.v.1976; Clifton Beach, Cairns (16°51'S, 145°43'E), at south end of beach on large tree trunk bored by *Teredo* sp., lower shore, 2 immature specimens (NUZ), coll. D. M. Holdich, 30.v.1976.

Sphaeroma triste Heller, 1865

(Figs 2, 3)

Sphaeroma tristis Heller, 1865: 142, pl. 12. Studer, 1883: 18.*Sphaeroma felix* Lanchester, 1902: 379, pl. 35. Nierstrasz, 1931: 192; Barnard, 1936: 177.*Sphaeroma triste*: Nierstrasz, 1931: 192; Barnard, 1936: 177, 178; Pillai, 1961: 17; George, 1963b: 168; George, 1964: 12-16; Kühne, 1971: 77; Cragg & Levy, 1979: 161, 163-165; Cragg & Icely, 1982: 1-6, 8, 10-14, 17-20, 22.

(Unnamed specimen) Baker, 1926: 248, 278, pl. 38, fig. 13.

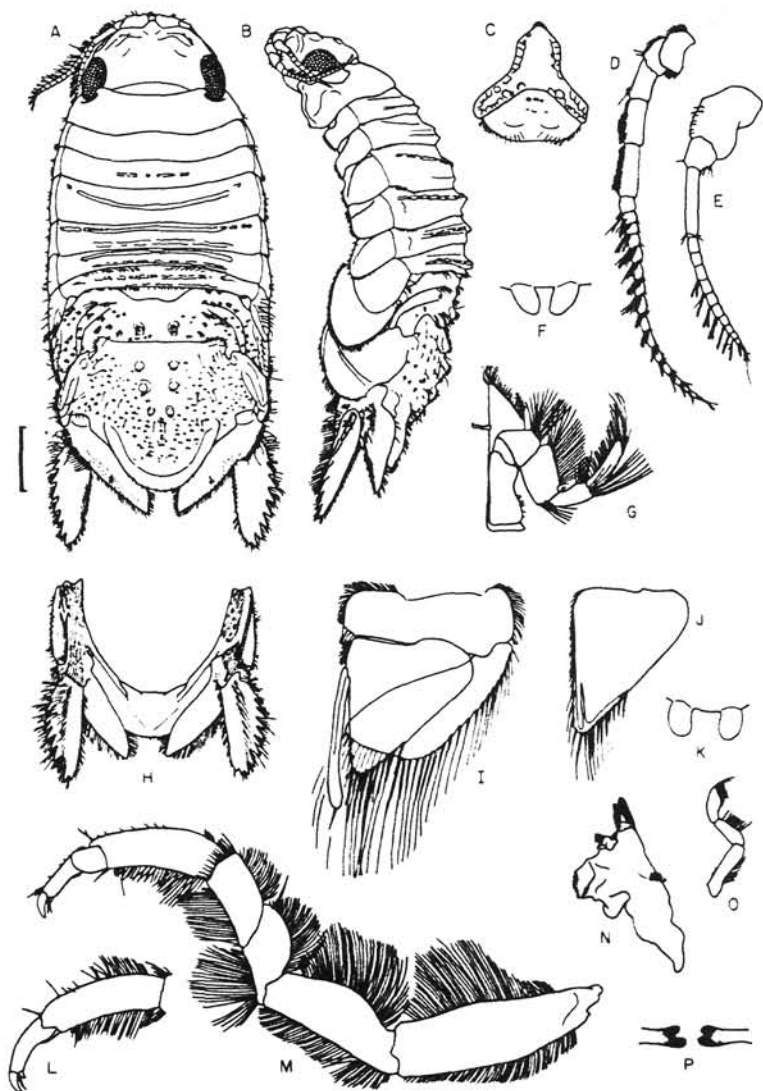


Figure 2. *Sphaeroma triste* Heller. Adult male, 7.32 mm: A, dorsal; B, lateral; C, epistome and labrum; D, antenna; E, antennule; F, penes; G, maxilliped; H, pleotelson, ventral; I, pleopod 2; M, pereopod 7; N, left mandible; O, mandibular palp; P, incisor processes of mandibles. Subadult male: J, endopod of pleopod 2; K, penes; L, distal articles of pereopod 7. Scale line represents 1 mm.

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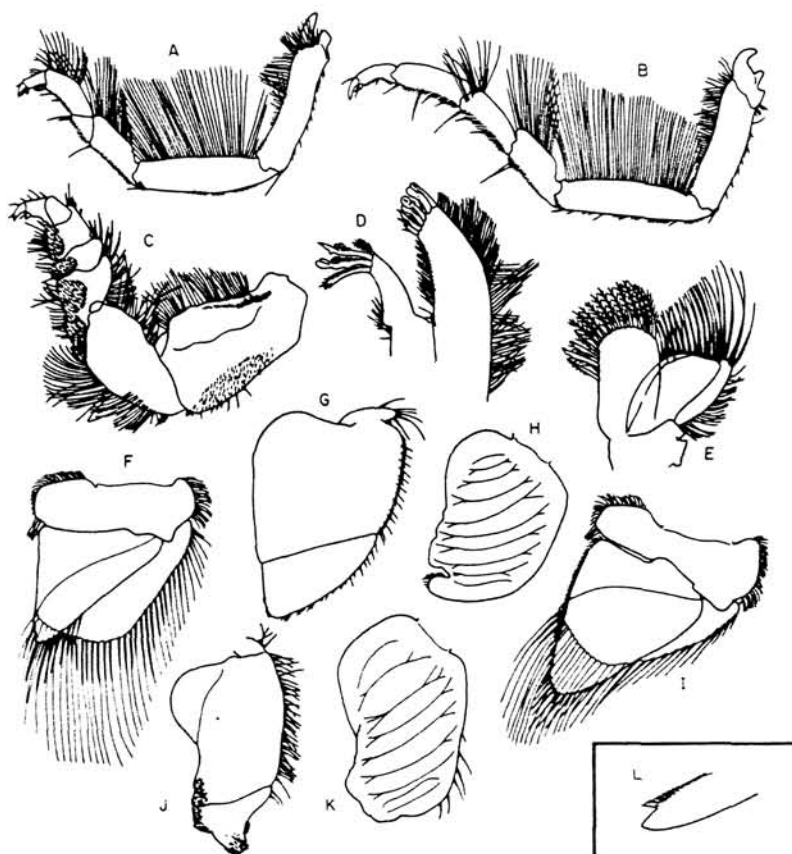


Figure 3. *Sphaeroma triste* Heller. Adult male: A-C, pereopods 1, 2 and 4 respectively; D, maxillule; E, maxilla; F, pleopod 1; G, pleopod 4, exopod; H, pleopod 4, endopod; I, pleopod 3; J, pleopod 5, exopod; K, pleopod 5, endopod. Adult male (Syntype—now chosen as Lectotype): L, endopod of right uropod, dorsal.

Description (Queensland specimens)

Adult male: *Sphaeroma* with dorsal surface of cephalosome uneven. Pereonites 3-7 each bearing one transverse uneven ridge; ridges becoming more pronounced posteriorly. Pleon with a low tubercle either side of posterior midline and surface bearing small tufts of short setae. Pleotelson with apex arcuate, dorsal surface with a covering of short fine setae; anterior region with three low tubercles each side of midline; margin, in distal half, slightly upturned. Appendages— A_1 with peduncle article 1 subequal in length to article 3; article 2 as long as broad; article 3 slender, cylindrical; 12-articled flagellum extending to level of pereonite 1. A_2 slender; 17-articled flagellum extending to level of pereonite 2. Epistome lambdaoid with lateral margins concave and apex obtusely angled. Each mnd with incisor process bifid, with two rounded teeth; left mnd with lacinia mobilis reduced to spine row only, peg absent. Mandibular palps with article 1 bearing fringes of fine setae. Mx_1 with inner lobe having external terminal spine half length of three internal spines; outer lobe with long

fine internal and external setae and a group of terminal spines (the outermost being serrulate). Mx_2 with outer lobes bearing long, slender, curved spines; inner lobe subrectangular, bearing a dense terminal and internal fringe of plumose setae. $Mxpd$ with palp articles 2-4 lacking lobes; inferior margins straight, bearing dense fringes of long setae; article 3 with approximately five superior distal setae half length of article 4; article 4 with approximately 10 superior distal setae, most being just longer than article 5. Prpds 1-3 slender; basis with short superior setae; ischium and merus with dense superior fringes of long rigid setae; merus, carpus and propodus bearing dense inferior fringes of very short setae. Prpd 1 with superior surface of propodus, in distal half, bearing a fringe of long setae. Prpds 2 and 3 with carpus bearing a superior distal group of long setae. Prpd 4 very robust; basis bearing short inferior and long superior setae; ischium with long superior and inferior setae; merus, carpus and propodus short, each with inferior pads of short setae, and superior distal spines. Prpds 5-7 becoming more slender. Prpd 7 slender with basis, ischium, merus and carpus bearing superior and inferior fringes of long setae; propodus four times as long as broad, bearing long inferior setae. Penes elliptical, each twice as long as wide. Plpd 1 with endopod subtriangular, subequal in length to apically truncate exopod. Plpd 2 with rami as in plpd 1; internal margin of endopod with a short proximal row of simple setae; appendix masculina arising one-fifth of ramal length from interno-proximal angle. Appendix subequal in length to endopod, narrow, with proximal margins subparallel; distally dilating slightly and curving away from animal's midline; apex rounded with one short apical seta. Plpd 3 with endopod subtriangular, broad, just longer than apically truncate exopod. Bases of plpds 1-3 each bearing three internal coupling hooks. Endopod of plpd 4 with a subterminal, internal indentation; exopod with a complete articulation in distal half. Endopod of plpd 5 with apex broadly and irregularly truncate; exopod with a complete subterminal articulation. Uropod with endopod extending just beyond pleotelsonic apex, lanceolate with borders bearing short setae; exopod broad, subequal in length to endopod, external margin bearing eight or nine prominent acute teeth along entire length.

Ovigerous female: Resembling adult male in dorsal view. Prpds 1-3 with merus, carpus and propodus lacking inferior pads of fine setae. Only two pairs of oostegites present, arising from pereonites 3 and 4 and overlapping well in midline. No indication of oostegites on pereonite 2.

Non-ovigerous female: As above but lacking brood pouch.

Subadult male: As adult male, but prpds 1-3 lacking inferior pads of fine setae. Prpd 7 with propodus similar to that of adult male but bearing long superior setae in the proximal half. Endopod of plpd 2 with appendix masculina forming beneath cuticle along internal margin. Penes widely separate, each $1\frac{1}{2}$ times as long as wide.

Remarks

When Heller described this species he clearly illustrated the endopod of the uropod as being apically bifid (Heller, 1865: pl. 12, fig. 12). Examination of his type specimens shows that, like the other specimens seen, the endopod is lanceolate and the apex acute. However, in the only adult male type-specimen seen (which has been selected as the Lectotype by the present authors) the

uropodal endopod of one side has the fine marginal setae matted with particulate material. This gives these setae a solid appearance and the overall form is as shown in Fig. 31. Presumably Heller (or his artist) mistook this for a bifid ramus, and thus led to the original error.

The Queensland specimens differ from the type-specimens (and the New Guinea material, which agrees with the types) in having six obvious tubercles on the anterior pleotelson, three each side of the midline. The more northern specimens, including the types, have two obvious tubercles (one each side of the midline) and a slightly smaller tubercle posterior to each of these. As the specimens agree in all other respects, however, it is considered here that this is geographic variation only, with the southern specimens generally showing slightly more prominent pleotelsonic tuberculation than the northern specimens.

Baker (1926) appears to have been the first worker to observe this species in Australia, although he did not identify his specimen, merely illustrating it. Baker's specimen, from Queensland, appears to show pleotelsonic tuberculation resembling that of the more northern specimens.

Sphaeroma triste is an actively wood boring species occurring from NE Australia to India (see Appendix 2). Its presence in brackish-water environments in Australia was recorded by Holdich & Harrison (1983).

Material examined

Western Australia Bay of Rest, Exmouth Gulf, from dead wood in mangrove, 7 subadult ♂♂, 1 non-ovigerous ♀, 1 immature specimen (NUZ), coll. N. L. Bruce, 13.vi.1980. **Queensland**: Eden Island, South Moreton Bay, under log in mollusc faeces and water, 6 subadult ♂♂, 4 non-ovigerous ♀♀, 4 immature specimens (QM: W.6300), coll. J. McNalty, 16.ix.1976; Mouth of Jackson Creek, Brisbane, 1 subadult ♂ (QM: W.6937), coll. P. Davie, 20.viii.1974; Brisbane, 1 juvenile (ZMUH), coll. G. Hartmann, 22.i.1976; Brisbane Harbour (27°30'S, 153°00'E), 3 subadult ♂♂, 1 immature specimen (BM(NH) 1903.12.4.3 7); Calliope River, Gladstone (23°52'S, 151°16'E), 12 subadult ♂♂, 5 non-ovigerous ♀♀, 25 immature specimens, 1 juvenile (QM: W.8136, 8137, 8139, 8142, 8144, 8145, 8152), coll. P. Saenger, 5-7.v.1976; Ross River Creek, Townsville, on wood in mud, downstream from Hayle's Wharf, mid and lower shore, 1 adult ♀, 1 subadult ♂, 3 non-ovigerous ♀♀, 5 juveniles (NUZ), coll. D. M. Holdich, 14.v.1976; Ross River Creek, on permanent wood structures downstream from Hayle's Wharf, mid-shore, 9 adult ♂♂, 7 subadult ♂♂, 8 ovigerous ♀♀, 7 non-ovigerous ♀♀, 27 immature specimens, 54 juveniles (NUZ), coll. D. M. Holdich, 6.v.1976; Ross River, Townsville, at river entrance, upstream from wide sandy area on wooden telegraph pole stranded on muddy shore and heavily bored by *Lyda* sp., lower shore, 2 adult ♂♂, 1 subadult ♂ (NUZ), coll. D. M. Holdich, 6.v.1976; Townsville Harbour, from scrapings from hull of ocean-going vessel moored at jetty of 'James Kirby', 5 juveniles (NUZ), coll. D. M. Holdich, 6.v.1976; Jetty of 'James Kirby', from wood supporting steps, mid-tide level, 2 juveniles (NUZ), coll. D. M. Holdich, 01.vii.1976; Jetty of 'James Kirby', from polystyrene blocks fixed beside harbour ramp (NUZ), coll. Zann, May 1983; Callarenda, Townsville (19°11'S, 146°46'E), on driftwood, intertidal, 2 ovigerous ♀♀ (NUZ), coll. D. M. Holdich, 30.iii.1976 & 25.vii.1976; Callarenda, on permanent wooden pile, mid-shore, 1 subadult ♂, 2 non-ovigerous ♀♀, 2 immature specimens (NUZ), coll. D. M. Holdich,

19.v.1976; Kurrimine, from tree trunk and driftwood jetsam bored by *Teredo* sp., mid-shore, 1 adult ♂, 6 subadult ♂♂, 5 non-ovigerous ♀♀, 32 immature specimens (NUZ), coll. D. M. Holdich, 18-21.v.1976; Newell Beach (north of Mossman), Cairns, from wood bored by *Teredo* sp. and embedded in sand, mid-shore, 1 adult ♂, 7 subadult ♂♂, 11 ovigerous ♀♀, 6 non-ovigerous ♀♀, 2 immature specimens, 5 juveniles (NUZ), coll. D. M. Holdich, 29.v.1976; Yorkey's Knob, Cairns, on tree trunk bored by *Teredo* sp. on sand by jetty, intertidal, 1 ovigerous ♀ (NUZ), coll. D. M. Holdich, 28.v.1976; Clifton Beach, Cairns (16°51'S, 145°43'E), at south end of beach on semi-permanent log, intertidal, 2 immature specimens (NUZ), coll. D. M. Holdich, 30.v.1976. *Northern Territory*: East Point, Fannie Bay, Darwin, in sandstone, 1 adult ♂, 2 subadult ♂♂, 2 ovigerous ♀♀, 3 non-ovigerous ♀♀ (NUZ), coll. N. L. Bruce, 25.vi.1980; Larrakeyah Bay, Darwin, in sandstone, 5 non-ovigerous ♀♀, 2 immature specimens (NUZ), coll. N. L. Bruce, 23.vi.1980; Ludmilla Creek, Darwin, in rotting mangrove timber, low water, 147 specimens (NTM-Cr.000180), coll. J. R. Hanley, 20.vi.1982. *Thursday Island* (Torres Strait, 10°35'S, 142°09'E): Among sand and stones, intertidal, 1 adult ♂, 1 ovigerous ♀, 1 non-ovigerous ♀ (CM), coll. "Galathea" (station 507, 29.ix.1951; *Papua New Guinea*: S. W. Paramana Village, S. E. Port Moresby, in rotten mangrove (*Avicennia* sp.) 1 adult ♂, 3 non-ovigerous ♀♀ (NUZ), coll. M. Robova, 27.xii.1979; Boera Central, from mangrove house post, 2 immature specimens (NUZ), coll. S. Cragg, 26.vii.1980; Bootless Bay Inlet, 5 specimens (NUZ), coll. S. Cragg, July, 1980. *Nicobar Islands* (N.E. Indian Ocean), 1 adult ♂, 1 subadult ♂, 5 ovigerous ♀♀, 6 non-ovigerous ♀♀, 3 immature specimens (VM: Syntypes).

Sphaeroma terebrans Bate, 1866

(Fig. 4)

Sphaeroma terebrans Bate, 1866: 28, pl. 2. Stebbing, 1904: 16-21; Calman, 1921: 217; Baker, 1926: 247, 248, 278, pl. 38; Nierstrasz, 1931: 192; McNeill, 1932: 18, 20-23; McNeill, 1936: 1-3; Barnard, 1940: 405; Pillai, 1954: 9; Pillai, 1955: 129-131, pl. 6; John, 1968: i-v, 1-82, pls 1-9; Kühne, 1971: 75, 76; Cragg & Levy, 1979: 161, 163-167; Cragg & Icely, 1982: 1-14, 17-20, 22; (*et auct.*).

Sphaeroma vastator Bate, 1866: 28, pl. 2, fig. 4.

Sphaeroma tuberculatocrinitum Hilgendorf, 1879: 846, pl. 4, fig. 13. Nierstrasz, 1931: 193.

Sphaeroma destructor Richardson, 1897: 105-107. Richardson, 1905: 282-286; Menzies & Frankenberg, 1966: 47, 48, 89; Schultz, 1969: 128.

Sphaeroma tenebrans: Richardson, 1905: 282 (*lapsus calami*).

Sphaeroma bigranulatum Budde-Lund, 1908: 304, pl. 17, fig. 55. Nierstrasz, 1931: 193.

Description (Hinchinbrook Island specimens)

Adult male: *Sphaeroma* with dorsal surface of cephalosome uneven. Pereonites 2-4 each bearing one transverse uneven ridge; ridge especially prominent on pereonite 4. Pereonite 5 with transverse ridge divided into four tubercles. Pereonites 6 and 7 each bearing a transverse row of four very prominent, acute, conical, setigerous tubercles. Pleon with a prominent, acute setigerous tubercle each side of midline. Pereonites 5-7 and pleon with additional lateral tubercles;

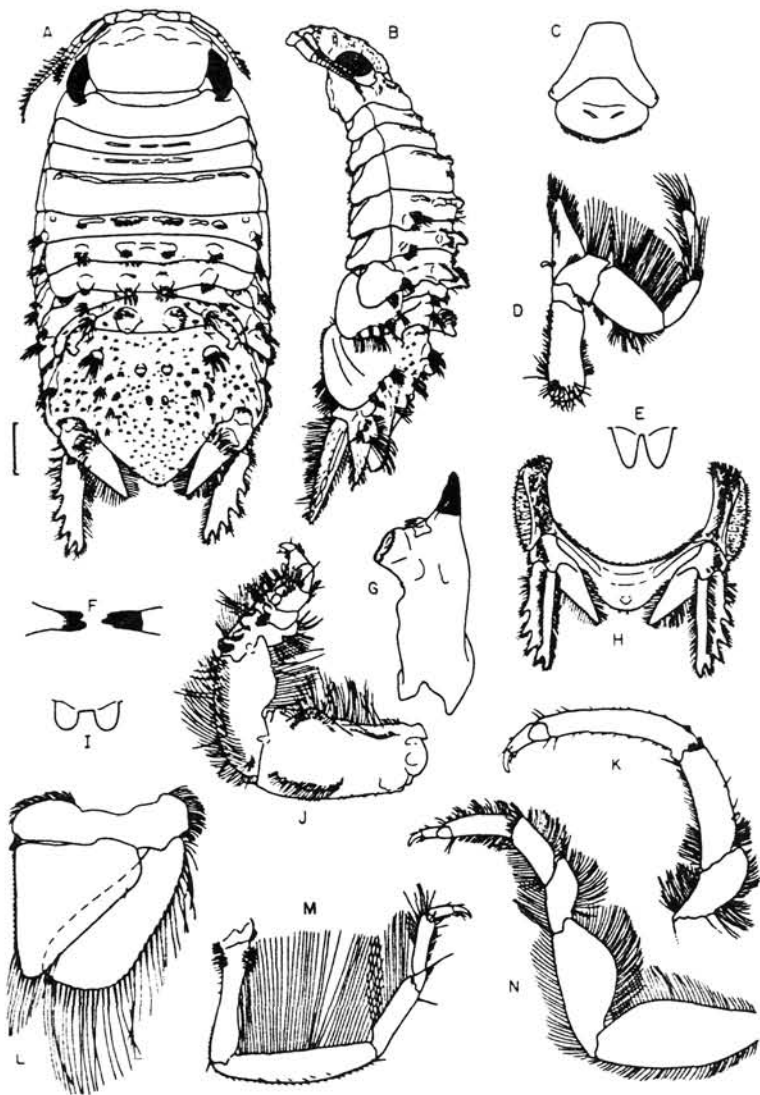


Figure 4. *Sphaeroma terebrans* Bate. Adult male, 9.15 mm: A, dorsal; B, lateral; C, epistome and labrum; D, maxilliped; E, penes; F, incisor processes of mandibles; G, left mandible; H, pleotelson, ventral; J, pereopod 4; K, distal articles of pereopod 7; L, pleopod 2; M, pereopod 1. Subadult male: I, penes; N, pereopod 7. Scale line represents 1 mm.

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lateral tubercles bearing tufts of long setae. Pleotelson with apex subtriangular, narrowly rounded; lateral margins, anterior to uropods, long, smoothly rounded, extending ventrally beyond level of pereonal coxal plates; dorsal surface granulate bearing numerous small tufts of short setae. Anterior region of pleotelson with a large rounded tubercle—bearing long setae—just median to each point of articulation with the pleon, and a smaller, prominent, conical, virtually asetose tubercle either side of midline. Centre of pleotelson with a small low tubercle either side of midline. Ventral subapical rim of pleotelson with one low median tubercle. Appendages—A₁ with peduncle article 1 subequal in length to article 3; article 2 subrectangular, 1.5 times as long as broad; article 3

slender, cylindrical; 11-articled flagellum extending to level of pereonite 1. A_2 moderately slender; 16-articled flagellum extending to level of pereonite 2. Epistome subtriangular with a broadly truncate apex. Left mnd with incisor process as one uneven tooth; lacinia mobilis reduced to spine row only, peg absent. Right mnd with incisor process bifid, forming two subequal rounded teeth. Mandibular palps with article 1 bearing fringes of fine setae. Mx_1 with inner lobe having external terminal spine half length of three internal spines; outer lobe with long, fine internal and external setae and a group of curved terminal spines, the innermost being serrulate. Mx_2 with outer lobes bearing long, slender, curved spines; inner lobe bearing a dense internal fringe of plumose setae. $Mxpd$ with palp articles 2-4 lacking lobes; inferior margins straight, bearing dense fringes of long setae; articles 2 and 3 with superior margins bearing fringes of setae; article 4 with a superior distal group of five long setae. Prpds 1-3 slender; ischium and merus bearing superior fringes of long rigid setae; propodus bearing a superior distal fringe of short setae; carpus and propodus bearing dense inferior fringes of setae. Prpd 4 very robust; basis and ischium bearing long inferior and superior setae, ischium with two superior median spines; merus, carpus and propodus short, stout, inferior margins bearing finely setose protuberances and long setae, superior margin of merus with long setae and a distal group of spines; dactylus short, stout. Prpds 5-7 becoming more slender. Pereopod 7 with basis, ischium and merus bearing continuous superior and inferior margins of long setae; carpus and (especially) propodus elongate; propodus seven times as long as broad, lacking long setae. Penes each twice as long as broad, tapering slightly to a broadly rounded tip. Plpd 1 with endopod subtriangular, subequal in length to apically truncate exopod. Plpd 2 with rami as in plpd 1; appendix masculina absent. Plpd 3 with endopod subtriangular, broad, subequal in length to apically truncate exopod. Bases of plpds 1-3 each bearing three internal coupling hooks. Endopod of plpd 4 with a subterminal, internal indentation; exopod with a complete articulation in distal half. Endopod of plpd 5 with apex broadly rounded; exopod with a complete subterminal articulation. Uropod with rami narrow; endopod apically acute, extending just beyond pleotelsonic apex, margins straight bearing fringes of long setae, dorsal surface with a pronounced proximal tuft of long setae. Exopod of uropod 1.5 times length of endopod, not lamellar; apex acute; external margin bearing four long acute teeth; internal margin straight, bearing a fringe of long setae; ventral surface with a longitudinal keel bearing long setae.

Ovigerous female: Resembling adult male in dorsal view. Prpds 1-3 with merus, carpus and propodus lacking inferior pads of fine setae. Prpd 7 with propodus relatively shorter. Oostegites of pereonites 3 and 4 large, overlapping well in the midline, those of pereonite 2 minute, resembling oostegite 'buds' of non-ovigerous female.

Non-ovigerous female: As above but lacking brood pouch.

Subadult male: As adult male but prpds 1-3 lacking inferior pads of fine setae. Prpd 7 with propodus relatively shorter. Penes widely separate, each as long as broad.

Remarks

The specimens from Hinchinbrook Island are more tuberculate and hirsute than any other specimens seen. They also differ from the other specimens in the

form of the oostegites of the ovigerous female. In the female from Hinchinbrook Island the anterior pair of oostegites are very reduced and resemble the oostegite 'buds' of a non-ovigerous female. In all other ovigerous female specimens seen the anterior pair of oostegites are smaller than the posterior pairs, being narrower and just reaching the midline, but are relatively larger than those of the Hinchinbrook female. The Hinchinbrook specimens were chosen for description and illustration because it is possible that the two adult males were the only adult males in the collections. As this species lacks an appendix masculina (*vide* Calman, 1921) it is difficult to be certain that the males are adult. It was noted above for *Sphaeroma walkeri* that in the adult male the propodus of pereopod 7 is slightly modified. The two adult males of *S. terebrans* from Hinchinbrook Island showed a similar, but far more pronounced, modification of this article, which was greatly elongate and devoid of long setae. A similar elongation was not found in any other male specimens (i.e. specimens with penes) seen. On this basis it is assumed here that all other males were subadult.

An alternative possibility is that the specimens from Hinchinbrook Island represent a marked geographical variation of *S. terebrans* (or even a separate species entirely), but as *S. terebrans* is such a variable species (*vide* Calman, 1921; Pillai, 1955), and as the Hinchinbrook specimens agree with *S. terebrans*, *sensu stricto* in the major taxonomic characters (e.g. structure of pleotelson and uropods, lack of an appendix masculina, reduction of first pair of oostegites), it is assumed that the illustrated specimens are correctly assigned to *S. terebrans*. All the specimens seen that do not come from Hinchinbrook Island agree with previous authors' descriptions for *S. terebrans*, or vary in a manner which has been described by previous authors. It seems possible that the Hinchinbrook specimens may represent a localized morphological variant of *S. terebrans* in the form of the dorsal tuberculation and the anterior pair of oostegites at least. Whether the modified propodus of pereopod 7 is peculiar to the Hinchinbrook specimens will only be decided following further examination of specimens from elsewhere. In a wood-boring species, which seems to be readily dispersed (as indicated by a wide geographic distribution) it seems unusual that a localized morphological variant should arise, but at present no obvious alternative explanation is available.

Regarding variation in this species, the present authors have seen a collection of *S. terebrans* in the British Museum in which one specimen bore three obvious teeth on the exopod of each uropod, not four teeth as is usual for this species.

Miller (1968) tentatively assigned some specimens from Texas to *S. terebrans*. From his illustrations and remarks, these specimens do not appear to belong in this species as the pleotelsonic apex is broadly rounded, not acute, and the pleotelsonic tuberculation does not agree with that characteristic of *S. terebrans*. (Miller, 1968: 9, 11, 12).

Sphaeroma terebrans is an active wood borer which has a wider distribution than any other wood boring species (see Appendix 2). Within the Indian Ocean region, the gap in its distribution in the Middle East probably reflects a lack of wood in that area (*S. terebrans* is seldom found in other habitats—see *Material examined*—below). Another wood boring species, *Sphaeroma annandalei* Stebbing, 1911 does occur in the Middle East (having been recorded from the Persian Gulf as *Sphaeroma irakiensis* Ahmed, 1971 (sic)) but in India *S. annandalei* also

burrows into laterite embankments (specimens of the "*Sphaeroma* sp." mentioned by Dharmaraj & Nair (1982) have been examined by the present authors and were determined to be *S. annandalei annandalei* Stebbing). *Sphaeroma annandalei* may occupy a similar habitat in the Middle East.

In Australia, McNeill (1932; 1936) found that in the Sydney area most marine timber damage was caused by *Sphaeroma quoyanum*, with *S. terebrans* being found mainly in upstream regions of the estuary. Further north around Brisbane, however, *S. quoyanum* was not common, and *S. terebrans* was the major wood borer (although it did little damage in upper river reaches) (McNeill, 1936: 1).

Sphaeroma terebrans has a wide distribution in Queensland, where it is often found boring into the same wood as *S. triste* (pers. obs.). Cragg & Levy (1979) and Cragg & Icely (1982) have reported on the attack of treated timber by these two species in Papua New Guinea, where they are widely distributed in both man-made wooden structures and natural mangrove stands. The effect of boring activity on mangroves is currently controversial. Rehm (1976) stated that damage caused by the burrowing activity of *S. terebrans* posed a serious threat to red mangroves in Florida (U.S.A.), but some workers have suggested that *S. terebrans* actually benefits mangroves by inducing root spreading. This question has not yet been resolved (see Ribí (1981) for review).

Material examined

Western Australia: Bay of Rest, Exmouth Gulf, from dead wood in mangrove, 2 subadult ♂♂, 3 ovigerous ♀♀, 1 non-ovigerous ♀, 4 immature specimens (NUZ), coll. N. L. Bruce, 13.vi.1980. *Queensland:* Woogoompah Island, 'the tidal crossing', South Moreton Bay, 3 non-ovigerous ♀♀ (QM. W.6304), coll. J. McNalty & P. Shanco, 11.vii.1976; Serpentine Creek, Brisbane, riverbank, 3.2 km from mouth, grab sample, 1 immature specimen QM: W6940, coll. P. Davie, 20.viii.1974; Deception Bay 27°10.6'S, 153°02.7'E, in dead mangrove wood amongst mangroves, low tide level, 2 subadult ♂♂, 1 ovigerous ♀, 2 non-ovigerous ♀♀ (QM. W.8085), coll. N. L. Bruce; Pioneer River, Mackay (21°10'S, 149°10'E), from cypress pine piling, 7 subadult ♂♂, 8 non-ovigerous ♀♀ (AM. P.10119); Ross River Creek, Townsville, in holes in stem of small mangrove seedling growing on mud, intertidal, 1 subadult ♂, 1 non-ovigerous ♀ (NUZ), coll. D. M. Holdich, 23.vii.1976; Ross River Creek, at upstream end of creek, on driftwood, dead mangrove branches, and on outside of live mangrove roots, intertidal, 12 subadult ♂♂, 15 ovigerous ♀♀, 16 non-ovigerous ♀♀, 5 immature specimens, 41 juveniles (NUZ), coll. D. M. Holdich, 23.vii.1976; Ross River Creek, in washings from permanent wood, downstream from car ferry, mid-shore, 2 subadult ♂♂, 3 non-ovigerous ♀♀, 3 immature specimens, 20 juveniles (NUZ), coll. D. M. Holdich, 01.vii.1976; Ross River, Townsville (19°16'S, 146°49'E), 12 km from sea, 0.5 km downstream from Aplin Wier (Riverside Park), on driftwood bored by *Teredo* sp. on gravel/sand banks, 1 non-ovigerous ♀ (NUZ), coll. D. M. Holdich, 23.vi.1976; Ross River, on wooden stumps of pier piles of old bridge in mangrove area, intertidal, 8 sub-adult ♂♂, 1 ovigerous ♀, 14 non-ovigerous ♀♀, 27 immature specimens, 33 juveniles (NUZ), coll. 27.vi.1976; Nina Bay, Hinchinbrook Island (18°20.4'S, 146°16.6'E), in logs, brackish water, low tide level, 2 adult ♂♂, 4 subadult ♂♂, 1 ovigerous ♀, 3 immature specimens (QM. W.8084), coll. N. L. Bruce, 28.viii.1979; Herbert

River, caught in drift net, 1 non-ovigerous ♀, 1 juvenile (NUZ), coll. R. Pearson, June 1976; Kurrimine (17°54'S, 146°05'E) from dead tree trunk bored by *Teredo* sp., mid-shore, 1 subadult ♂, 3 non-ovigerous ♀♀, 2 immature specimens (NUZ), coll. D. M. Holdich, 21.v.1976; Clifton Beach, Cairns (16°51'S, 145°43'E), at south end of beach on log bored by *Teredo* sp. in stream by mangroves, 1 ovigerous ♀, 1 immature specimen (NUZ), coll. D. M. Holdich, 30.v.1976. *Papua New Guinea*: Motupore Island, SE Port Moresby, from root of *Rhizophora* sp., 2 ovigerous ♀♀, 2 non-ovigerous ♀♀ (NUZ), coll. S Cragg & M. Rokova, 1979; Bootless Bay Inlet, 18 specimens (NUZ), coll. S. Cragg, 24.x.1980. *Kenya*: Watamu, from mangrove stump at lower edge of mangroves, 1 subadult ♂, 1 ovigerous ♀ (NUZ), coll. D. A. Jones, 1969; Gazi Bay, from tree trunk, 29 specimens (NUZ), coll. D. A. Jones, 1969; Kilindi, from ends of mangroves, particularly at low edge, 24 specimens (NUZ), coll. D. A. Jones, 1969.

Sphaeroma quoyanum Milne Edwards, 1840

(Fig. 5)

Sphaeroma Quoiana Milne Edwards, 1840: 206.

Sphaeroma quoyana: Hedley, 1901: 239, 240, pl. 10; Baker, 1926: 248, 278, pl. 38; McNeill, 1932: 18, 21-23; Iverson, 1974: 166.

Sphaeroma verrucauda White, 1847: 102 (*nomen nudum*). Hedley, 1901: 240.

Sphaeroma pentodon Richardson, 1904a: 214, 215. Richardson, 1905: 286, 287; Nierstrasz, 1931: 193; Schultz, 1969: 129.

Sphaeroma quoyanum: Nierstrasz, 1931: 192; Hurley & Jansen, 1977: 70, 71.

Description

Adult male: *Sphaeroma* with body elliptical, twice as long as wide. Dorsal surface of cephalosome uneven. Pereonites 3-7 each with a broad transverse ridge. Pleon with several low tubercles. Pleotelson with posterior margin broadly arcuate; anterior region bearing many small tubercles and a longitudinal row of five prominent blunt tubercles either side of the midline; posterior region with a short, even, transverse, subterminal ridge. Appendages—A₁ with peduncle article 1 almost as long as articles 2 and 3 together; article 2 slightly broader than long; article 3 slender, cylindrical; 9-articled flagellum extending to level of pereonite 1. A₂ slender, 16-articled flagellum extending to level of pereonite 2. Epistome subtriangular, acute, with lateral margins slightly dilated subterminally. Each mand with incisor process dentate; left mandible with lacinia mobilis bearing a reduced 'peg'. Mandibular palps with article 1 bearing fringes of fine setae. Mx₁ with inner lobe having external terminal spine half length of three internal spines; outer lobe with fine internal and external setae and a group of terminal spines, the innermost being simple, the majority being pectinate. Mx₂ with outer lobes bearing long, curved, slender spines; inner lobe bearing a dense internal fringe of plumose setae. Mxpd with palp articles 2-4 lacking lobes; inferior margins straight, bearing dense fringes of long setae; article 3 with several, and article 4 with approximately five, long superior distal setae. Prpds 1-3 slender; ischium and merus with dense superior fringes of long rigid setae; merus, carpus, and propodus bearing dense inferior fringes of short setae. Prpd 1 with superior surface of propodus, in distal half, bearing a fringe of long setae. Prpds 2 and 3 with carpus bearing a superior distal group of

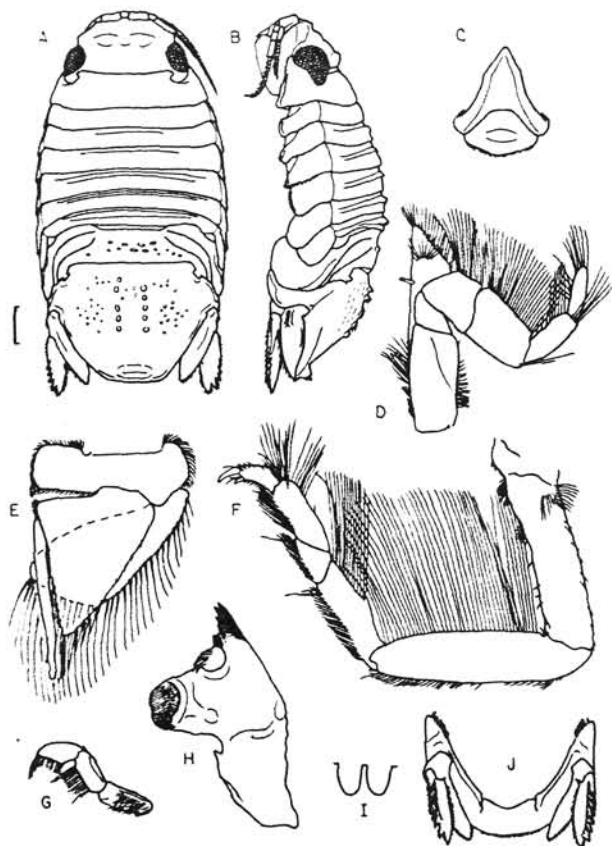


Figure 5. *Sphaeroma quoyanum* Milne Edwards. Adult male, 9.88 mm: A, dorsal; B, lateral; C, epistome and labrum; D, maxilliped; E, pleopod 2; F, pereopod 1; G, mandibular palp; H, left mandible; I, penes; J, pleotelson, ventral. Scale line represents 1 mm.

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long setae. Prpd 4 very robust; ischium with long superior and inferior setae and several long superior spines; merus, carpus and propodus short, each with inferior pads of short setae; merus with superior distal lobe bearing a group of long spines. Prpds 5-7 becoming more slender. Prpd 7 with basis, ischium, merus and carpus bearing superior and inferior fringes of long setae; merus with superior distal group of spines; carpus with a distal row of spines; propodus three times as long as broad with an inferior fringe of setae. Penes each $1\frac{1}{4}$ times as long as broad. Plpd 1 with endopod subtriangular, apex acute, subequal in length to apically truncate exopod. Plpd 2 with rami as in plpd 1; appendix masculina arising from interno-proximal angle of endopod and extending beyond ramal apex. Appendix narrow, with lateral margins subparallel; terminal region, beyond ramal apex, narrowed slightly, weakly sinuous, with a rounded tip. Plpd 3 with endopod subtriangular, just longer than apically truncate exopod. Bases of plpds 1-3 each bearing three coupling hooks. Endopod of plpd 4 with a subterminal internal indentation; exopod with a complete articulation in distal half, apex broadly obtuse. Endopod of plpd 5 with apex broadly rounded; exopod with a complete subterminal articulation. Uropod with endopod extending to level of pleotelsonic apex, lanceolate, with a

border of short setae; exopod subequal in length to endopod, apex acute, external margin bearing five acute teeth in distal half, distal teeth being larger than those proximally; ventral surface of exopod setose in external half.

Ovigerous female: Resembling male in dorsal view. Prpds 1-3 lacking inferior pads of short setae. All three pairs of oostegites overlapping well in midline.

Remarks

This species is an active wood-borer, but it also burrows into soft rock and mud embankments. It is often found in areas of freshwater run-off, especially in areas with a high mud content.

Geographically this species is found on the east coast of Australia and in New Zealand. It is also found on the Pacific coast of North America in California and Mexico, but it was almost certainly introduced to America by trans-Pacific shipping. Queensland appears to be the northernmost distributional limit of this species in the West Pacific region. (See also remarks following *S. terebrans*, above.)

Material examined

Queensland: Coomera Island, Southport, 1 adult ♂ (QM: W.4757); Trinity Inlet, Cairns, 1 ovigerous ♀ (QM: W.4606).

Sphaeroma intermedium (Baker), comb. nov.

(Fig. 6)

Exosphaeroma intermedia Baker, 1926: 249, 278, pl. 39. Hale, 1929b: 34.

Exosphaeroma intermedium: Nierstrasz, 1931: 194.

Description

Adult male: *Sphaeroma* with dorsal surface of cephalosome, pereon, pleon and pleotelson smooth, lacking tubercles and setae, but endopods of uropods, pleotelson, and posterior half of pleon, finely punctate. Pleotelson evenly domed with apex broadly rounded, slightly truncate; ventrally bearing a wide, shallow, apical channel. Appendages— A_1 with peduncle article 1 subequal in length to articles 2 and 3 together, 1.5 times width of article 2, 3.5 times width of article 3; article 3 narrow, cylindrical; 15-articled flagellum extending to level of pereonite 1. A_2 slender, 17-articled flagellum extending to level of pereonite 2. Epistome broad anteriorly with a short acute median process; lateral margins concave. Mnds with incisor processes and lacinia mobilis dentate; article 1 of mandibular palp bearing fringes of fine setae. Mx_1 with internal lobe having external, terminal spine half length of three internal spines; outer lobe with long fine internal and external setae and approximately 11 short, curved, simple, terminal spines. Mx_2 with outer lobes bearing long curved spines; inner lobe bearing a dense terminal fringe of long fine setae, and one long robust, internal, pectinate spine; internal margin, at base of lobes, with a tuft of long setae. $Mxpd$ with palp articles 2-4 bearing low setigerous lobes; articles 3 and 4 each bearing a superior distal group of several long setae. Prpds moderately robust; inferior margins of merus, carpus and propodus with pads of short setae. Prpds 1-3 more robust than those of preceding species, with superior setae on ischium and merus only; setae relatively flexible, those on ischium shorter than length of basis, those on merus shorter than length of propodus. Prpd 4 robust; prpds 5-7

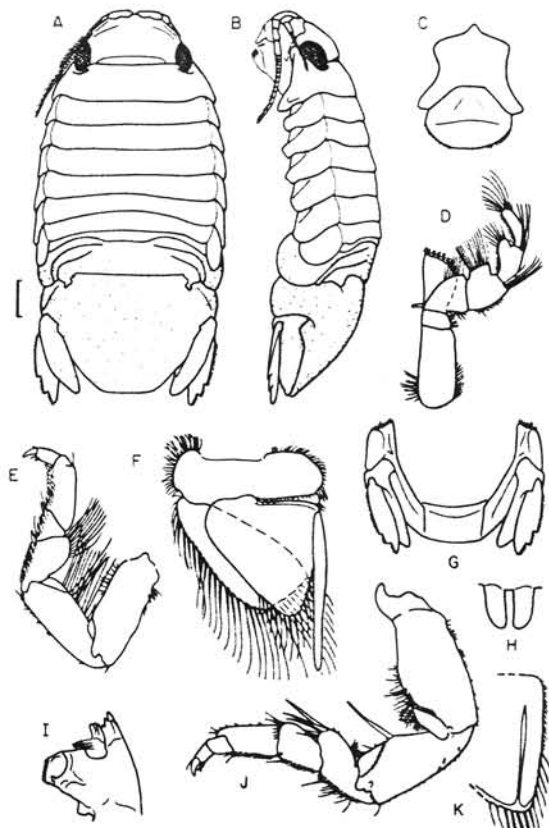


Figure 6. *Sphaeroma intermedium* Baker, comb. nov. Adult male, 10.25 mm: A, dorsal; B, lateral; C, epistome and labrum; D, maxilliped; E, pereopod 1; F, pleopod 2; G, pleotelson, ventral; H, penes; I, left mandible; J, pereopod 4. Subadult male: K, endopod of pleopod 2, internal margin. Scale line represents 1 mm.

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becoming longer and more slender. Prpds 4-7 each with ischium bearing a long, stout, median, superior spine; merus and carpus each bearing a row of superior distal spines. Penes each twice as long as wide, tapering slightly in distal half to rounded apex. Plpd 1 with endopod subtriangular, slightly shorter than apically truncate exopod. Plpd 2 with rami as in plpd 1 but appendix masculina present. Appendix masculina long, slender, straight, $1\frac{1}{3}$ times length of ramus, tapering only slightly in distal half to a narrowly rounded apex. Plpd 3 with endopod broad, subtriangular, subequal in length to apically truncate exopod; exopod with a subterminal, external, oblique, partial articulation. Bases of plpds 1-3 each bearing three internal coupling hooks. Endopod of plpd 4 with a deep subterminal, internal indentation, leaving apex narrowly rounded, directed internally; exopod with a complete articulation in distal half, apex broadly obtuse. Endopod of plpd 5 with apex broadly rounded; exopod with a complete sub-terminal articulation. Uropod with exopod slightly longer than endopod, extending just beyond level of pleotelsonic apex; endopod with apex narrowly rounded; exopod with two low, distal, external teeth and an acute apex.

Ovigerous female: Resembling adult male in dorsal view. Prpds lacking inferior pads of fine setae. All three pairs of oostegites broad, overlapping well in midline.

Non-ovigerous female: As above but lacking brood pouch.

Sub-adult male: As non-ovigerous female but bearing penes. Penes each twice as long as broad, but only half length of adult penes. Endopod of plpd 2 with appendix masculina visible through cuticle, forming along internal margin.

Remarks

In life specimens of this species are unusually dark, almost black, in colour. Baker presumably placed this series in the genus *Exosphaeroma* Stebbing because the articles of the maxillipedal palp bore lobes. This was the major feature used by Stebbing to differentiate his *Exosphaeroma* from *Sphaeroma*. In fact, a number of *Sphaeroma* species bear low lobes on the maxillipedal palps and this is not a reliable feature for separating these two genera. '*Exosphaeroma*' *intermedium* also has long superior setae on pereopods 1-3 (a feature found in *Sphaeroma* but absent in *Exosphaeroma*) (although in the present species these setae are less well pronounced than in other species of *Sphaeroma* and the anterior pereopods are more robust); the exopod of the uropod is externally serrated (a feature which is usual for *Sphaeroma*, but never found in *Exosphaeroma*); and the oostegites of the ovigerous female overlap well in the midline (these structures do not reach the midline in *Exosphaeroma*). '*Exosphaeroma*' *intermedium* should clearly be transferred to the genus *Sphaeroma*. *Sphaeroma intermedium* is close to, if not conspecific with, *Sphaeroma exosphaeroma* Boone, 1918 from the Philippines and Indonesia. The only difference (*vide* Boone's description) is that *S. exosphaeroma* has the pereonites dorsally granulate, while *S. intermedium* is smooth. These species should be carefully compared to determine their true status. *Sphaeroma intermedium* is known only from Queensland and the Gulf of Carpentaria, and although it has been recorded from intertidal wood (see below) there is no evidence to suggest that it is an active wood borer. In northern Queensland it is commonly found under pieces of dead coral, stones and empty mollusc shells on the lower part of sandy beaches.

One ovigerous female in the collections had recently moulted the posterior half of the body, although the oostegites were fully formed on the (smaller) anterior half. This suggests that females of this species moult after releasing the brood, and probably enter an inter-brood condition (with reduced oostegites) as is known to occur in *Sphaeroma hookeri* Leach (Kinne, 1954: 114, 115). This tendency may be usual for all species of *Sphaeroma*.

Material examined

Queensland: Pallarenda, Townsville (19°11'S, 146°46'E), on driftwood and shells, mid-shore, 11 adult ♂♂, 3 subadult ♂♂, 8 ovigerous ♀♀, 8 non-ovigerous ♀♀, 3 immature specimens, 1 juvenile (NUZ), coll. D. M. Holdich, 30.iii.1976-01.iv.1976; Pallarenda, on driftwood and seed pod in a stream running over beach, 1 non-ovigerous ♀, 1 immature specimen (NUZ), coll. D. M. Holdich, 02.iv.1976; Pallarenda, in intertidal sand, 1 immature specimen (NUZ), coll. R. S. Muffley, 28.vi.1977; Kenny, south of Mission Beach, Kurrimine (17°54'S, 146°05'E), under stones on sand near jetty, mid-shore, 4 ovigerous ♀♀ (NUZ), coll. D. M. Holdich, 19.v.1976. Kurrimine, under stones and wood at river entrance, intertidal, 11 adult ♂♂, 9 subadult ♂♂, 11 ovigerous ♀♀, 3 non-ovigerous ♀♀, 35 immature specimens, 8 juveniles (NUZ), coll. D. M. Holdich, 21.v.1976; Kurrimine, from piece of dead coral 50 mm in

diameter, 4 adult ♂♂, 1 subadult ♂, 2 ovigerous ♀♀, 2 non-ovigerous ♀♀, 19 immature specimens, 48 juveniles (NUZ), coll. D. M. Holdich, 21.v.1976; Kurrimine, in driftwood bored by *Teredo* sp. stranded on mid-shore, 2 adult ♂♂, 1 subadult ♂, 1 ovigerous ♀, 1 immature specimen (NUZ), coll. D. M. Holdich, 18 & 21.v.1976; Yorkey's Knob, Cairns (16°51'S, 145°43'E), under stones on sand by jetty, intertidal, 2 subadult ♂♂, 1 ovigerous ♀, 3 non-ovigerous ♀♀, 20 immature specimens, 14 juveniles (NUZ), coll. D. M. Holdich, 26.v.1976; Newell Beach (north of Mossman), under stranded piece of tree bark, lower shore, 4 adult ♂♂, 4 subadult ♂♂, 3 ovigerous ♀♀, 3 immature specimens, 1 juvenile (QM: W. 9652), coll. D. M. Holdich, 29.v.1976.

Genus *Neosphaeroma* Baker, 1926

Neosphaeroma Baker, 1926: 253. Hale, 1929a: 272, 274; Nierstrasz, 1931: 198; Monod, 1931b: 67-78; Menzies, 1954: 4-6.

Type-species: *Cassidina laticauda* Whitelegge, 1901.

Generic description

Hemibranchiate Sphaeromatidae with endopod of plpd 3 bearing several branchial folds. Both sexes with cephalosome, pereon and pleon lacking dorsal extensions. Pleon with postero-lateral margin bearing two long curved sutures at each side. Pleotelson smooth, weakly convex, with apex smoothly arcuate in dorsal view, lacking a notch, groove, foramen or median extension. Mxpd with palp articles 2-4 bearing pronounced, narrow, setigerous lobes. Prpds 1-3 with superior surfaces of ischium and merus bearing, at most, several short superior setae or spines. Both rami of plpd 4 with short, terminal, plumose setae. Exopod of plpd 5 with an apical toothed boss; a low, subapical anterior boss; a small marginal interno-distal boss; and two small interno-distal bosses on the proximal article. Uropod with rami lamellar, exopod shorter than endopod; exopod bearing an externo-distal notch. Sexual dimorphism not pronounced.

Adult male: Penes long, slender, separate to base. Appendix masculina arising from interno-proximal angle of endopod of plpd 2 and extending beyond ramal apex. Appendix strongly reflexed (*N. laticaudum* (Whitelegge)) or linear (*N. australe* (Whitelegge)). Internal margin of endopod of plpd 1 with a longitudinal fold acting as a cover for the penes.

Ovigerous female: Mpts not metamorphosed. Brood pouch formed from three pairs of oostegites arising from prpds 2-4 and just overlapping in the midline. Brood not housed in the marsupium thus formed, but held in internal pouches (number not known). Ventral pockets absent.

Australian species

Neosphaeroma australe (Whitelegge, 1902)

Neosphaeroma laticaudum (Whitelegge, 1901)

Remarks

The two additional species (both from Australia) currently housed in *Neosphaeroma* do not appear to belong in this genus. *Neosphaeroma plumosum* (Whitelegge, 1902) (the adult male of which is not known) must be excluded as it has a deep vertical notch in the pleotelsonic apex, not an arcuate, entire apex

as in *Neosphaeroma*, *sensu stricto*. *N. pentaspinis* Baker, 1926 has the sutures on the pleon extending to the lateral, not the posterior, margins. Menzies (1954; 5) has implied that *N. pentaspinis* may be a species of the platybranchiate genus *Gnorimosphaeroma* Menzies.

In his original diagnosis of *Neosphaeroma* Baker said that the endopod of pleopod 1 was "modified in the male into an appendage of probably sexual use". Specimens of many genera which bear long penes habitually carry these penes tucked beneath the first pair of pleopods (i.e. lying between pleopods 1 and 2) in the midline (pers. obs.). In some genera (e.g. *Cymodoce* Leach—see below) the endopod of pleopod 1 bears a proximal, internal, oblique groove which carries the penis as it passes from the anterior to the posterior of this pleopod. In *Neosphaeroma* this tendency has been extended and the entire inner margin of the endopod of pleopod 1 is folded longitudinally to form a cover for the penis of that side (which lies dorsal to it and is hidden by it in ventral view).

Neosphaeroma is characterized by having a small number of branchial folds on the endopod of pleopod 3. Only one other sphaeromatid genus is known to bear folds on the endopod of pleopod 3, the genus *Caecocassidias* Kussakin, but *Caecocassidias* bears folds over the entire ramus (and is otherwise a eubranchiata form) (pers. obs.).

Neosphaeroma has been recorded only from New South Wales, where it occurs sub-littorally. The following is the first record of this genus from Queensland.

Neosphaeroma australe (Whitelegge, 1902)

(Figs 7, 8)

Sphaeroma australis Whitelegge, 1902: 250–252.

Neosphaeroma australe: Baker, 1926: 253–254, 278, pl. 41; Nierstrasz, 1931: 198; Monod, 1931b: 70; Menzies, 1954: 5.

Description

Adult male: *Neosphaeroma* with body elliptical; dorsal surface smooth. Pleotelson evenly but weakly domed, with apex broadly rounded; ventrally bearing a wide, shallow, apical channel. Appendages— A_1 with peduncle article 1 subequal in length to articles 2 and 3 together; article 2 subcircular; article 3 cylindrical, three times as long as broad; 12-articled flagellum extending to level of pereonite 1. A_2 slender, 10-articled flagellum extending to level of pereonite 3. Epistome broad, proximal lateral margins subparallel; apex subtriangular, blunt. Mnds with incisor processes and lacinia mobilis dentate; article 1 of mandibular palp lacking fringes of fine setae. Mx_1 with inner lobe having four pectinate spines subequal; external lobe with approximately nine short curved spines, fine marginal setae absent. Mx_2 of usual sphaeromatid form, unmodified. $Mxpd$ with palp articles 3 and 4 each bearing a short superior distal seta. $Prpds$ moderately robust. $Prpd$ 1 with inferior margin of merus bearing three equidistant, short, simple spines and a pad of short fine setae; inferior margin of carpus with two, and of propodus with four, long stout plumose spines; merus with superior distal lobe bearing several short spines. Succeeding $prpds$ with inferior margins of merus, carpus and propodus bearing short inferior spines; merus and carpus with superior distal lobes bearing short spines. $Prpd$ 7 with

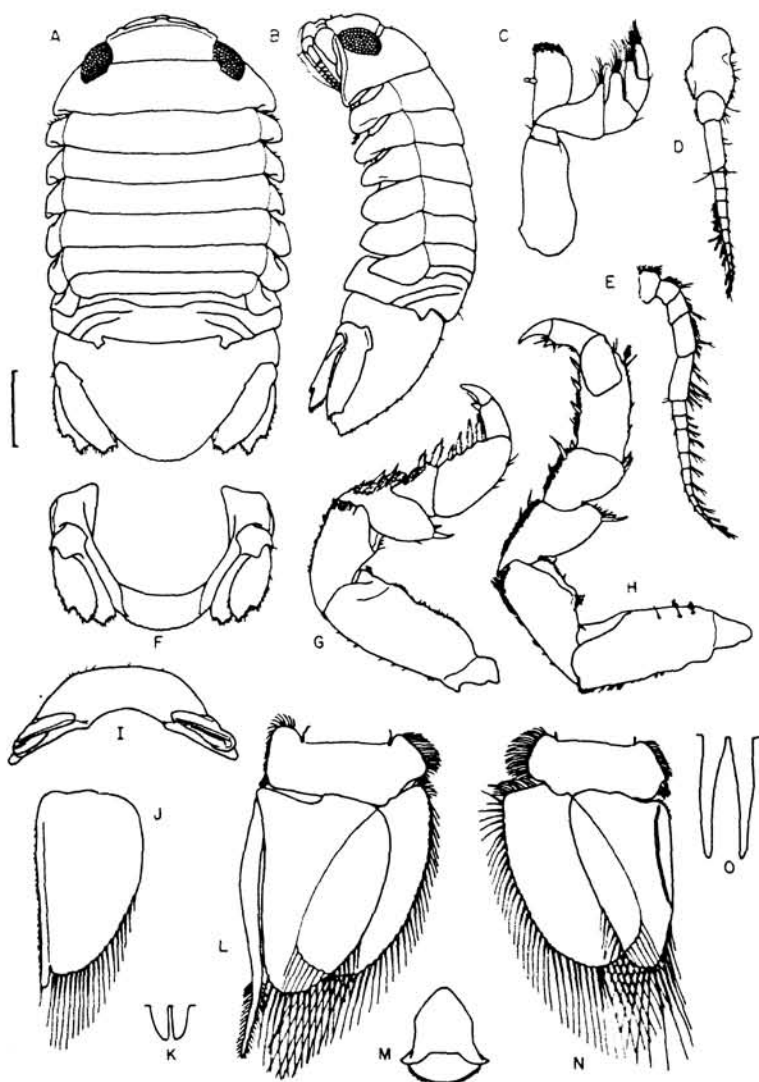


Figure 7. *Neosphaeroma australe* (Whitelegge). Adult male, 5.7 mm: A, dorsal; B, lateral; C, maxilliped; D, antennule; E, antenna; F, pleotelson, ventral; G, pereopod 1; H, pereopod 2; I, pleotelson, posterior; L, pleopod 2; M, epistome and labrum; N, pleopod 1; O, penes. Subadult male: J, endopod of pleopod 2; K, penes. Scale line represents 1 mm.

basis and ischium slender, bearing only short setae; merus with a group of superior distal spines, one median inferior spine, and two distal inferior spines; carpus with one proximal inferior, and two median inferior, spines, and a distal row of approximately 12 plumose spines; propodus with four pairs of inferior spines. Penes each five times as long as basal width, tapering to narrowly rounded apex. Plpd 1 with endopod elongate, ovate, narrowly rounded apically, inner margin with a longitudinal fold; endopod subequal in length to subelliptical exopod. Plpd 2 with endopod broad, subovate, subequal in length to subelliptical exopod. Appendix masculina slender, 1.33 times length of

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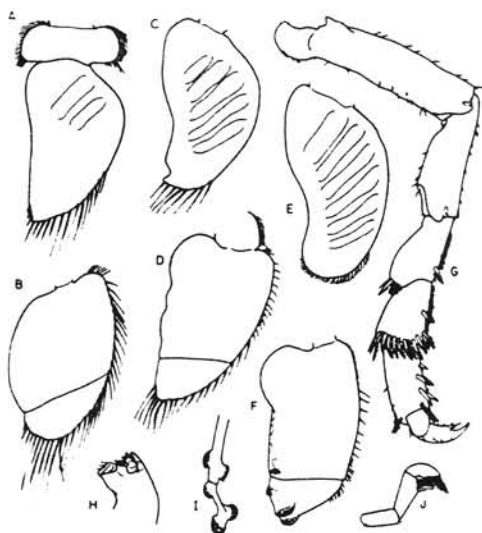


Figure 8. *Neosphaeroma australe* (Whitelegge). Adult male: A, pleopod 3. endopod; B, pleopod 3. exopod; C, pleopod 4. endopod; D, pleopod 4. exopod; E, pleopod 5. endopod; F, pleopod 5. exopod; G, pereopod 7; H, left mandible; I, exopod of pleopod 5, distal region of internal margin, internal view; J, mandibular palp.

endopod; margins subparallel and naked to level of ramal apex, distal quarter tapering to a narrowly rounded apex and bearing long marginal setae. Plpd 3 with endopod bearing two distinct proximal branchial folds; exopod subovate with a complete subterminal articulation. Bases of plps 1–3 each bearing three internal coupling hooks. Exopod of plpd 4 with a complete subterminal articulation; endopod with a weak, internal, subterminal indentation. Endopod of plpd 5 with apex broadly rounded, bearing only short simple setae; exopod with a complete subterminal articulation. Endopod of uropod with apex emarginate, almost reaching level of pleotelsonic apex; exopod just shorter than endopod, with distal external margin bearing a marked indentation.

Ovigerous female: Resembling adult male except in sexual characters.

Non-ovigerous female: As above but lacking brood pouch.

Subadult male: As non-ovigerous female but bearing short penes, each $2\frac{1}{2}$ times as long as broad with rounded tip, and endopod of plpd 2 with appendix masculina forming along internal margin. Appendix fused along length of endopod, but extending slightly at apex, with one terminal seta.

Remarks

In dorsal view *N. australe* resembles a species of *Sphaeroma*, but it can be distinguished by the single indentation of the uropodal exopod, and not a row of teeth as in (for example) *Sphaeroma intermedium*. *Neosphaeroma laticaudum* differs from *N. australe* in having the uropodal endopod apically rounded, not emarginate.

Whitelegge's specimens came from off New South Wales at a depth of 32–52 fathoms and were found associated with mud and stones. The present specimens were from coral at a depth of 23 m in Queensland waters.

Material examined

Queensland: Flat Rock, off Stradbroke Island (27°23.5'S, 153°33'E), on *Antipatharia* sp., depth 23 m, 3 adult ♂♂, 1 subadult ♂; 2 ovigerous ♀♀, 1 non-ovigerous ♀, 1 immature specimen, 1 juvenile (QM. W8082), coll. M. Ready, 13.vi.1979.

Genus *Cymodoce* Leach, 1814

Cymodoce Leach, 1814: 433; *et auct.*

Cymodice: Leach, 1815: 353, 368 (*lapsus calami*?).

Cymodyce: Leach, 1815: 368 (err. typ.?).

Cymodocea Leach, 1818: 342, 343; *et auct.* (Unjustified emendation.)

Type species: *Cymodoce truncata* Leach, 1814.

Generic description

Hemibranchiate Sphaeromatidae with endopod of plpd 3 lacking branchial folds. Both sexes with cephalosome, pereon and pleon lacking dorsal extensions. Pleon bearing two long, straight, parallel sutures at each side; sutures extending to postero-lateral angle. Pleotelsonic apex with a marked notch bearing a median tooth. Prpds 1-3 with superior surfaces of ischium and merus bearing, at most, several short superior setae or spines. Exopod of plpd 5 with apex and internal margin of distal article covered with fine teeth; anterior surface of distal article bearing a long projecting boss, toothed in its distal half; interno-distal angle of proximal article bearing two small toothed bosses. Sexual dimorphism obvious.

Adult male: Penes long, slender, separate to base. Appendix masculina sublinear, not recurved, arising from interno-proximal angle of endopod of plpd 2 and extending well beyond ramal apex. Posterior margin of pleon with a short posterior deflection on each side, between the midline and the point of articulation with the pleotelson. Pleotelson usually more tuberculate than that of female. Mxpd with palp articles 2-4 bearing pronounced setigerous lobes. Uropod with endopod thickened, pronounced, not reduced; exopod lamellar, slightly shorter than, to slightly longer than, endopod.

Ovigerous female: Mpts metamorphosed; mnds partially fused with cephalosome, incisor and molar processes absent, each mandibular apex with a longitudinal external ridge; mx₁ as two simple lobes; mx₂ as three simple subequal lobes; mxpd with endite expanded proximally as setigerous lobes, palp not reduced, but lobes short, lacking setae. Brood pouch formed from four pairs of oostegites arising from prpds 1-4 and overlapping in the midline. Anterior pair of oostegites each with a longitudinal fold such that the anterior region of the oostegite covers the posterior mpts. Brood not housed in the marsupium thus formed, but held in five pairs of internal pouches. Ventral pockets absent. Pleon with posterior margin simple, lacking short posterior deflections. Uropod with both rami lamellar; exopod slightly shorter than endopod, usually lacking an external notch, occasionally bearing, at most, a weak external indentation.

Australian species

Cymodoce aculeata aculeata Haswell, 1881

Cymodoce aculeata grandis Baker, 1929

- Cymodoce longistylis* Miers, 1884 (NRA)
Cymodoce pelsarti Tattersall, 1922
Cymodoce haswelli, nom. nov. for *C. tuberculata* Haswell, 1882 (see Remarks)
 ? *Cymodoce bidentata bidentata* Haswell, 1882
 ? *Cymodoce bidentata tasmanica* Baker, 1929
 ? *Cymodoce convexa* Miers, 1876 (NRA)
 ? *Cymodoce coronata coronata* Haswell, 1882
 ? *Cymodoce coronata fusiformis* Baker, 1929
 ? *Cymodoce coronata intermedia* Baker, 1929
 ? *Cymodoce mammifera* Haswell, 1881

***Cymodoce tribullis*, sp. nov.**

***Cymodoce bipapilla*, sp. nov.**

(NRA = not restricted to Australia. See Appendix 2 for all known species of *Cymodoce*).

Remarks

The question-marks in the above list denote some doubt that these species definitely belong in the genus *Cymodoce*. *Cymodoce coronata* differs from other species of *Cymodoce* in its smoother, less tuberculate pleotelson, its reduced uropodal exopods (especially in the subspecies *fusiformis*), and in the acute pleotelsonic apex of the female. *Cymodoce bidentata* differs from other *Cymodoce* species in its very reduced uropodal exopods, in the great elongation of the posterior deflections of the pleonal margin (these are also extended to some extent in *C. coronata intermedia*), and in the presence of only several acute tubercles on the pleotelson rather than the ridged bosses and many tubercles more usual in this genus. At present it is considered wise to leave these species within the genus *Cymodoce*, but to note their deviation from the usual form. *Cymodoce mammifera* appears to have been based on an immature specimen which may be a species of *Cymodoce*, but which has not been recorded (with certainty) since Haswell's original description (see remarks following *C. longistylis* and *C. pelsarti*—below). *Cymodoce convexa* was described for specimens from New Zealand, and as only females were described, it is not certain that these specimens belong in the genus *Cymodoce* (*Cymodoce, sensu stricto* is not known from New Zealand—see Appendix 2). Whitelegge (1902: 260, 261) recorded *C. convexa* from New South Wales but as he did not illustrate his specimens it is not clear that they are the same species as the *C. convexa* of Miers. Whitelegge did not examine any adult males.

The species not marked with a question-mark do appear to be species of *Cymodoce*. The name *Cymodoce tuberculata* was preoccupied by *C. tuberculata* Costa when Haswell described and named his species in 1882. Haswell's name is a junior primary homonym and must be replaced by a *nomen novum*. The opportunity is taken here to rename this species *Cymodoce haswelli* in honour of its original author.

Of the remaining Australian species currently housed in *Cymodoce*: *C. gaimardii* (Milne Edwards, 1840) is clearly not a species of *Cymodoce* (it lacks ornamentation and shows virtually no sexual dimorphism) and will probably require the formation of a new genus to house it; *C. tuberculosa tuberculosa* Stebbing, 1873, *C. tuberculosa bispinosa* Baker, 1910, and *C. multidentis australis* Baker, 1929 are all discussed (with related species) in Appendix 2; *C. aspera*

Haswell, 1881) is known only from female specimens, and from the structure of the pleotelson and uropods this species would not appear to be a species of *Cymodoce* (but its correct generic placement is unknown): *C. inornata* Whitelegge, 1902 is known only from one female specimen, but the deep, acute notch in the exopod of the uropod indicates that this is not a female of *Cymodoce*, and it is probably a female of a species of *Cilicæa* Leach or *Paracilicæa* Stebbing; *C. longicaudata* Baker, 1908 has been made the type-species of a new genus elsewhere (Harrison, in press a); the species called by some authors *Cymodoce pubescens* (Milne Edwards, 1840) will be discussed below under *Paracilicæa*. Examination by the present authors of the type-specimen of *C. granulata* Miers, 1876 has shown that this is identical to specimens of the eubranchiate species *Cerceis trispinosa* (Haswell, 1882). Miers (1884: 307) implied that his *C. granulata* was a cerceid eubranche when he said it was "probably not specifically distinguishable from *Cerceis tridentata*". Miers was not, however, correct as to the specific identity of his species, and *C. granulata* is conspecific with *C. trispinosa*. Normally, as *Cymodoce granulata* is the older name, this species would be called *Cerceis granulata* (Miers) and the name *Cerceis trispinosa* would become an invalid synonym. Unfortunately, the binomen '*Cerceis granulata*' is preoccupied by *Cerceis granulata* Pillai, 1954. Under the International Code of Zoological Nomenclature (1961) Miers' species must take the name of its oldest available junior synonym. In this case that synonym is *Cerceis trispinosa* (Haswell), which becomes the name to be used. (The present authors do not believe that *Cerceis trispinosa* is actually a species of *Cerceis*, *sensu stricto* (see Harrison & Holdich, 1982b)). The South African species *Cymodoce unguiculata* Barnard, 1914 has been reported twice from Australian waters. These records are of immature specimens (Baker, 1926: 259) and females (Seed, 1973: 208) only. As the adult male was not recorded, it must remain uncertain that the specimens collected did, in fact, belong to this species.

The genus *Cymodoce* overall is in a very confused state. *Cymodoce* was one of the first sphaeromatid genera to be described, and initially all species which lacked dorsal extensions and had the apex of the pleotelson tridentate were placed in this genus (just as all species which had the apex entire were placed in *Sphaeroma*). *Cymodoce* has continued to expand and approximately 90 binomina have been formed within this genus. Some of these binomina have been shown to be junior synonyms and some species have been removed to other genera, but approximately 66 species remain in *Cymodoce*. Many of these species bear little affinity to the type-species, *C. truncata*, and this genus still suffers from its historical legacy, with workers placing any hemibranchiate species which bears a tridentate apex—and which does not obviously fall within the scope of other, more rigorously defined, genera—in *Cymodoce* (e.g. '*Cymodoce*' *alia* Kensley, 1975; '*Cymodoce*' *velutina* Kensley, 1975; '*Cymodoce*' *iocosa* Hurley & Jansen, 1977). As more sphaeromatid species have been described, a greater understanding of morphological and phylogenetic relationships within the family has been achieved; generic diagnoses have become more detailed and restrictive; and many species have been redistributed to more appropriate genera or have had new genera formed to house them (e.g. *Dynamene*, another genus formed by Leach in 1814, has had approximately 32 binomina formed within it, but only 8 species now remain in this genus. *Dynamenella* Hansen, 1905 has had 46 binomina formed within it, but only 11 species appear to belong in this genus). Unfortunately, little revisionary attention has been directed at the genus

Cymodoce, which remains an unreasonably large taxonomic repository containing many unrelated species. An attempt has been made here and in Appendix 2 to draw attention to this problem and to indicate some of the species which need further investigation. A detailed revision of this large genus, however, is beyond the scope of the present study (and, indeed, would form the basis of an extensive project in its own right).

The genus *Cymodoce*, *sensu stricto* is predominantly an Old World genus occurring from Japan to Australia, India, Africa, and Europe, although it is also known from Brazil, and one species, *C. japonica* Richardson, has been introduced to western North America. Species of *Cymodoce* are usually collected from the intertidal and shallow sublittoral zones, but *C. japonica* has been collected from a depth of 1547 m.

***Cymodoce tribullis*, sp. nov.**

(Figs 9, 10)

Description

Adult male: *Cymodoce* with dorsal surface of cephalosome and pereonites 1-3 smooth. Pereonites 4-7 each with two transverse rows of small tubercles. Pleon with scattered uneven tubercles of various sizes; posterior margin with four pronounced tufts of setae; lateral regions bearing many long setae. Pleotelson bearing scattered, small, prominent tubercles; anterior region, either side of midline, with a prominent longitudinal ridge, dilating posteriorly as a boss bearing a blunt bifid process; ridges bearing many long setae; processes on bosses each bearing long setae in the cleft, and an internal row of short, stiff, dark brown setae; region lateral to ridges with two prominent tubercles, one posterior to the other. Posterior region of pleotelson, in midline, with a large smoothly domed boss, lacking a median tooth. Apex of pleotelson markedly tridentate; lateral teeth blunt, uneven; median tooth extending well beyond level of lateral teeth, broad, apically emarginate, with a ventral subterminal row of short, stiff, dark brown setae. Appendages— A_1 with peduncle article 1 subequal in length to articles 2 and 3 together; article 2 short; articles 1 and 2 granulose; article 3 narrow, cylindrical, smooth; 16-articled flagellum extending to level of pereonite 2. A_2 slender, 21-articled flagellum extending to level of pereonite 4. Epistome lambdoid, granulose; lateral margins each with a median, antero-laterally directed bulge; apex acute. Mnds with incisor processes—and lacinia mobilis of left side—bluntly dentate. Mx_1 with inner lobe bearing four pectinate spines; outer lobe bearing approximately 10 moderately stout spines, the innermost being pectinate. Mx_2 with two outer lobes each bearing approximately 10 long spines; inner lobe with a row of plumose spines. $Mxpd$ with palp article 2 bearing a low superior distal seta; article 4 with one short superior distal seta. Prpds moderately slender. Prpd 1 with ischium bearing one superior median spine; merus and carpus bearing inferior pads of short setae; merus with superior distal lobe bearing several spines, inferior margin bearing six spines; carpus with three inferior spines; propodus with four inferior spines. Prpds 2-6 each with merus, carpus and propodus bearing inferior fringes of fine setae and slender spines. Prpd 7 with ischium bearing one long superior spine; merus and carpus each with a small group of superior distal spines, and a row of long inferior spines; propodus lacking inferior setae, bearing four equidistant,

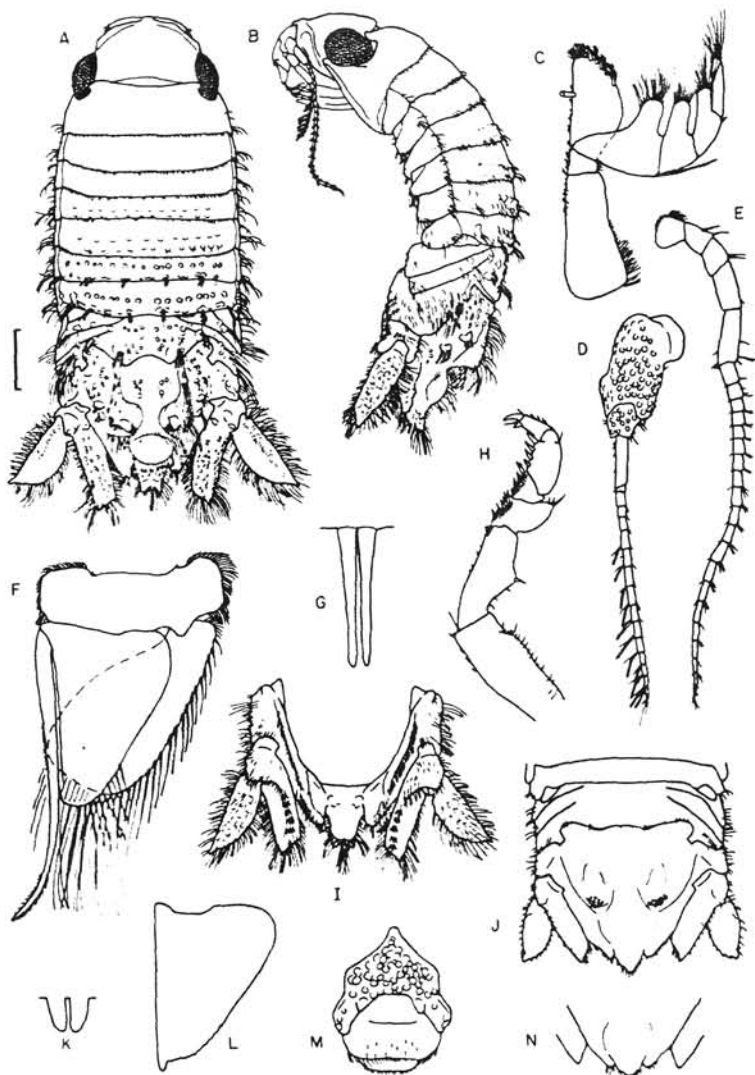


Figure 9. *Cymodoce tribullis* sp. nov. Adult male (Paratype), 7.87 mm: A, dorsal; B, lateral; C, maxilliped; D, antennule; E, antenna; F, pleopod 2; G, penes; H, pereopod 1; I, pleotelson, ventral; M, epistome and labrum. Sub-adult male (Paratype): J, pleon and pleotelson, dorsal; K, penes; L, endopod of pleopod 2 (setae omitted). Non-ovigerous female (Paratype): N, apex of pleotelson and uropodal endopods. Scale line represents 1 mm.

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inferior spines. Penes long, slender, each 10 times as long as basal width, tapering evenly to a narrowly rounded apex. Basis of plpd 1 bearing four internal coupling hooks; endopod narrow, subtriangular, inner margin bearing a longitudinal fold (this margin acting as a cover for the distal half of the penes during life); exopod subelliptical, slightly longer than endopod. Plpd 2 with basis bearing three internal coupling hooks; rami as plpd 1, but internal margin of endopod bearing an appendix masculina. Appendix masculina slender, slightly more than $1\frac{1}{2}$ times as long as endopod, tapering evenly to a narrowly rounded apex; distal one-fifth bearing short marginal setae. Plpd 3 with basis

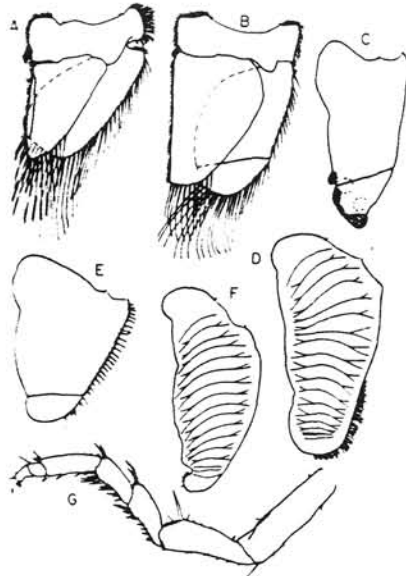


Figure 10. *Cymodoce tribullis* sp. nov. Adult male (Paratype): A. pleopod 1; B. pleopod 3; C. pleopod 5, exopod; D. pleopod 5, endopod; E. pleopod 4, exopod; F. pleopod 4, endopod; G. pereopod 7.

bearing three internal coupling hooks; endopod broad, subtriangular, apex narrowly truncate; exopod subelliptical, slightly longer than endopod, with a complete subterminal articulation. Endopod of plpd 4 narrow with an internal, subterminal indentation, apex narrowly rounded; exopod broad, subtriangular, with short, simple, external setae and a complete subterminal articulation. Endopod of plpd 5 narrow with short, simple, external distal setae; apex evenly rounded; exopod narrow with a complete subterminal articulation. Uropod with rami subequal, extending just beyond pleotelsonic median, apical tooth. Endopod of uropod subrectangular, three times as long as broad with distal margin slightly oblique, externo-distal angle acute; dorsal surface granulose with one proximal tubercle; lateral margins bearing long setae, ventral surface with a longitudinal row of small groups of short, stiff, dark brown setae. Exopod of uropod ventrally and laterally setose; external margin straight; internal margin smoothly arcuate, tapering to an acute apex.

Subadult male: Cephalosome, pereon and pleon smooth. Pleon with posterior margin bearing only slight indication of a blunt posterior deflection either side of midline. Pleotelson lacking tubercles, bearing a weak, low, sparsely setose boss either side of midline midway to apex. Apex of pleotelson tridentate; all three teeth bluntly arcuate, the central being broader than, and extending well beyond, the lateral teeth. Endopod of uropod smooth, sparsely setose, with oblique apex extending to level of lateral pleotelsonic apical teeth; external distal angle acute. Exopod of uropod lanceolate, apex acute, internal distal margin uneven. Penes short, each twice as long as broad with a semi-circular tip. Endopod of plpd 2 with internal margin extended at apex as a short, narrow, blunt projection.

Non-ovigerous female: Resembling subadult male in dorsal view, but median, apical, pleotelsonic tooth blunt and not extended as far.

Etymology

Cymodoce plus Latin *tri* + *bullis*, i.e. with three bosses.

Remarks

Of the known species of *Cymodoce*, *C. tribullis* sp. nov. most closely resembles *C. zanzibarensis* Stebbing from East Africa. *Cymodoce tribullis* is most obviously distinct from *C. zanzibarensis* in having each anterior pleotelsonic ridge dilated posteriorly as a hemispherical dome, and by having each ridge appearing continuous in lateral view, not divided by a median depression as in *C. zanzibarensis*.

Cymodoce tribullis is known only from dead intertidal coral and floating algae at Magnetic Island, Townsville.

Material examined

Holotype: Adult ♂, 7.9 mm (QM: W.9642), Horseshoe Bay, Magnetic Island, Queensland (19°10'S, 146°50'E), from floating *Sargassum* sp., coll. D. M. Holdich, 24.iv.1976.

Paratypes: From type-locality, collection details as above, 7 adult ♂♂, 10 subadult ♂♂, 35 non-ovigerous ♀♀, 5 immature specimens, 2 juveniles (1 subadult ♂ and 1 non-ovigerous ♀ as QM: W.9643); Picnic Bay, Magnetic Island, in dead intertidal coral, 2 adult ♂♂ (NUZ), coll. D. M. Holdich, 09.vii.1976

Cymodoce bipapilla, sp. nov.

(Figs 11, 12)

Cymodoce longistylis: Baker, 1929: 53, 61, pl. 6.

Description

Specimens of this species vary morphologically with geographical location on the coast of Queensland. Northern specimens (including the holotype) differ from southern specimens and will be treated separately.

Northern specimens—adult male (Figs 11A-C, E-K, 12): *Cymodoce* with dorsal surface of cephalosome and pereonites 1-4 smooth. Pereonites 5-7 each bearing two transverse rows of low tubercles. Pleon with scattered small tubercles. Pleotelson, posterior to each short deflection of the posterior margin of the pleon, with a short longitudinal tubercle. Overall, pleotelson bearing scattered small tubercles over most of surface; region midway to pleotelsonic apex with a large conical boss either side of midline, each boss with a small apical projection which curves dorsally; region lateral to each boss bearing a curved longitudinal row of several tubercles which are larger than the scattered tubercles; region anterior and median to each boss bearing one prominent tubercle. Posterior to bosses, pleotelson bearing a short conical projection in midline; region posterior to projection subtriangular, flat—not markedly domed—bearing small tubercles. Posterior margin of pleotelson tuberculate, tridentate, median tooth subquadrate; all three teeth subequal in length, apically truncate; incision, either side of median tooth, deep, ending in a circular foramen visible only in dorso-lateral view. Appendages— A_1 with peduncle article 1 longer than articles 2 and 3 together; article 2 short; article 3 narrow, cylindrical; 14-articled flagellum extending to level of pereonite 2. A_2

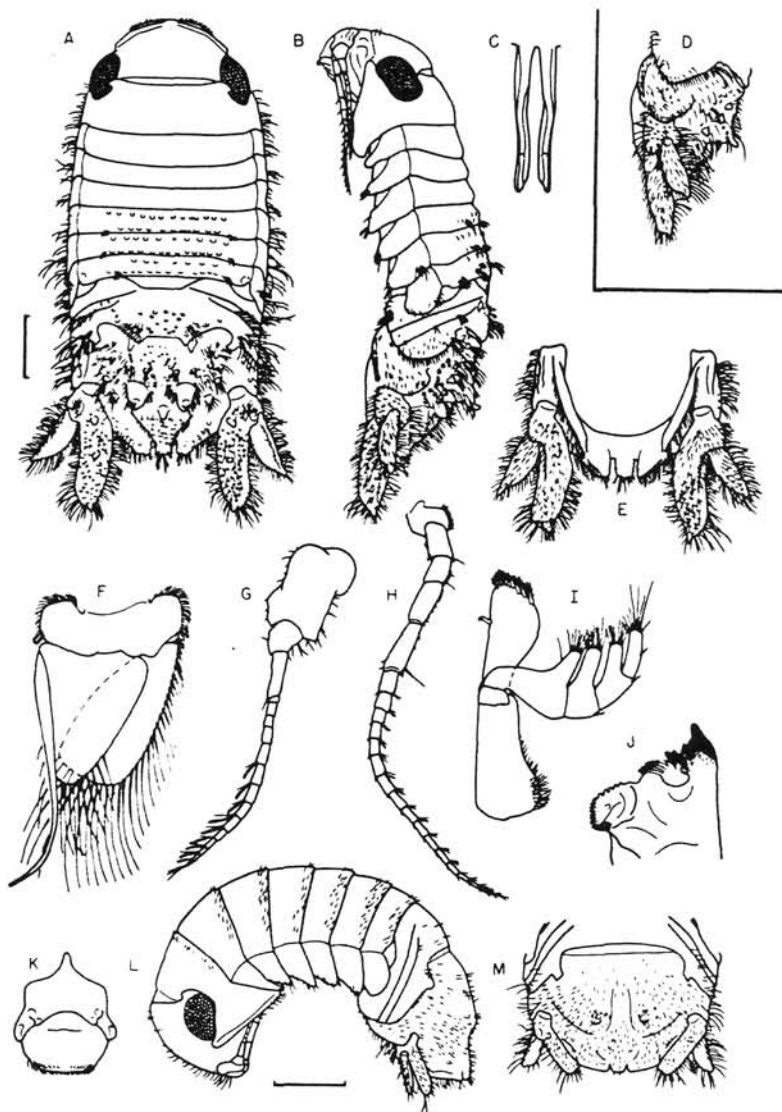


Figure 11. *Cymodoce bipapilla* sp. nov. Adult male (Paratype), northern specimen, 6.9 mm: A, dorsal; B, lateral; C, penes; E, pleotelson, ventral; F, pleopod 2; G, antennule; H, antenna; I, maxilliped; J, left mandible; K, epistome and labrum. Ovigerous female (Paratype), northern specimen: L, lateral; M, pleotelson, dorsal. Adult male (Paratype), southern specimen: D, pleotelson, lateral. Scale line represents 1 mm in each case.

slender, 18-articled flagellum extending to level of pereonite 3. Epistome broad with a short, acute apex. Mnds with incisor processes—and lacinia mobilis of left side—dentate. Mx_1 with inner lobe bearing four pectinate spines and a short, simple, external, terminal seta; outer lobe bearing approximately nine short curved spines, those in the inner half being pectinate. Mx_2 with two outer lobes each bearing approximately eight curved spines; inner lobe with a row of plumose spines. $Mxpd$ with palp articles 3 and 4 each bearing one short superior distal seta, article 5 with one short superior median seta. $Prpds$ moderately

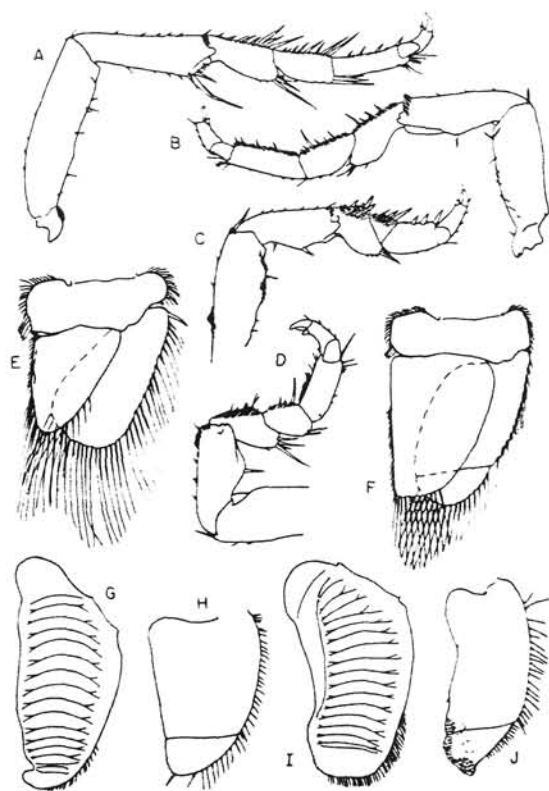


Figure 12. *Cymodoce bipapilla* sp. nov. Adult male (Paratype, northern specimen: A-D, pereopods 7, 2, 1 and 4 respectively; E, pleopod 1; F, pleopod 3; G, pleopod 4, endopod; H, pleopod 4, exopod; I, pleopod 5, endopod; J, pleopod 5, exopod.

slender. Prpd 1 with ischium bearing one short, superior, median spine; merus and carpus bearing inferior pads of short setae and several inferior spines; merus with superior distal lobe bearing several spines; carpus and propodus each bearing three inferior spines. Prpds 2-6 each with merus, carpus and propodus bearing inferior fringes of fine setae and slender spines; ischium with one short superior median spine; merus and carpus each with superior distal lobe bearing several long spines. Prpd 7 slender, with ischium, merus and carpus bearing a superior distal group of long spines; merus and carpus each with inferior margin bearing a row of long spines; propodus with four short, inferior, equidistant spines. Penes each 10 times as long as broad with lateral margins subparallel and apex narrowly rounded. Plpd 1 with basis bearing four internal coupling hooks; endopod subtriangular with a slight longitudinal groove in the internal proximal margin, plumose setae present in distal half of internal margin, and apex bluntly arcuate; exopod subelliptical, apex broadly rounded, extending beyond apex of endopod; proximal external margin of exopod with one stout spine. Basis of plpd 2 bearing three internal coupling hooks; rami as in plpd 1 but subequal in length and exopod lacking proximal external spine. Appendix masculina twice length of endopod, slender, tapering evenly to a narrowly rounded apex. Plpd 3 with basis bearing three internal coupling hooks; endopod subtriangular, just shorter than exopod, with a broadly truncate apex; exopod

subelliptical with a complete subterminal articulation. Plpd 4 with endopod bearing a subterminal, internal indentation; exopod with a complete subterminal articulation. Plpd 5 with endopod subreniform, apex broadly arcuate, exopod with a complete subterminal articulation. Uropod with endopod granulose, setose, curved, lateral margins subparallel, inner margin slightly convex; distal half of endopod projecting beyond pleotelsonic apex; dorsal surface of endopod with one proximal tubercle, one median tubercle, and a short, acute, apical projection. Exopod of uropod two-thirds width of, and two-thirds length of, endopod; ventral and lateral surfaces setose; external margin straight, internal margin convex, with a short, acute apex.

Ovigerous female: Body smooth; pereonites bearing a posterior, transverse row of short setae. Pleotelson broader than long; apex broadly rounded with a short incision either side of midline; dorsal surface bearing short setae and a low, median bulge either side of midline. Uropods with endopods setose, subrectangular, extending just beyond pleotelsonic apex; each exopod two-thirds length of endopod, external margin straight, internal margin arcuate, uneven.

Non-ovigerous female: Resembling ovigerous female but body less setose; apex of pleotelson with median tooth slightly more acute and extending just beyond lateral teeth; and exopod of uropod relatively longer, just shorter than endopod.

Southern specimens (from Moreton Bay) (Fig. 11D): These are indistinguishable from the northern specimens in every respect except the form of the apical projections of the two large median bosses on the pleotelson of the adult male. In the southern specimens these projections are straight continuations of the bosses, whereas in the northern specimens they curve dorsally (Fig. 11D, cf. Fig. 11B).

Etymology

Cymodoce plus Latin *bi* + *papilla*, i.e. with two nipples.

Remarks

The difference between the southern and northern specimens is so slight that it is almost certain that the two are geographical variants of the same species. The northern variant is known only from the coast north of Port Curtis, while the southern is known only from the coast south of Bribie Island.

The specimens illustrated by Baker (1929) as *Cymodoce longistylis* Miers do not appear to be that species, as has been indicated by Barnard (1936: 180) and Pillai (1965: 77) who suggested that Baker's specimens were closer to *C. pelsarti* Tattersall. Baker's illustrations appear to resemble *C. bipapilla* more than *C. pelsarti*. As Baker's specimens were from Port Hacking, New South Wales, it is assumed here that, in the shape of the pleotelsonic bosses, they will resemble the present southern specimens.

Of the known species of *Cymodoce*, adult males of *C. bipapilla* most closely resemble adult males of *C. pelsarti* Tattersall. *Cymodoce bipapilla* can be distinguished by having a short, narrow projection on each large pleotelsonic boss; a median tubercle on the dorsal surface of the uropodal endopod; and by lacking the smoothly domed, hemispherical, subapical boss on the dorsal surface of the pleotelson (having a flat granulose region instead). In addition, the three teeth of the tridentate pleotelsonic apex tend to be truncate in *C. bipapilla*, not bifid as in *C. pelsarti*.

Cymodoce bipapilla has been confused with *C. longistylis* and *C. pelsarti* (see comments above), but the present collections contained new records for both of these species, and they are described below.

Cymodoce bipapilla has been found mainly in cryptic, intertidal habitats and on shallow, sublittoral algae.

Material examined

Holotype: Adult ♂, 7.0 mm (QM. W.9640), Picnic Bay, Magnetic Island, Queensland (19°10'S, 146°50'E), in dead coral, mid-shore, coll. D. M. Holdich, 26.iv.1976.

Paratypes: *Northern specimens*—Queensland: From type-locality, collection details as for holotype, 4 adult ♂♂, 3 ovigerous ♀♀, 2 non-ovigerous ♀♀, 5 juveniles (QM: W.9641); Picnic Bay, Magnetic Island, from semi-permanent logs and pieces of wood at top of dead coral zone, mid-shore, 1 adult ♂, 2 ovigerous ♀♀, 3 non-ovigerous ♀♀, 2 immature specimens (NUZ), coll. D. M. Holdich, 09.vii.1976; Horseshoe Bay, Magnetic Island, in dead coral, mid-shore, 1 adult ♂ (NUZ), coll. D. M. Holdich, 25.iv.1976; Rowes Bay, Townsville, from coral rubble and stones on muddy shore, 1 adult ♂, 3 ovigerous ♀♀ (NUZ), coll. D. M. Holdich, 24.iii.1976; Eastern end, Mangrove Beach, Lizard Island (14°40'S, 145°30'E), sediment sample from high detritus area amongst mangrove roots, depth 1.2 m, 1 adult ♂ (AM: P.28833), coll. J. K. Lowry, 11.x.1978; off Bampffield Head, Prince of Wales Island, Torres Strait (10°43'S, 142°07'E), beam trawl over sea-grass beds, 3 adult ♂♂ (AM: P.28818), coll. P. C. Young, 19.iv.1979; Rat Island, Port Curtis (24°10'S, 151°30'E), 1 adult ♂ (AM: P.10695), coll. W. Boardman, July 1929. *Southern specimens*—Queensland: Pumicestone Passage, Bribie Island, Moreton Bay, 1 adult ♂, 1 ovigerous ♀, 1 non-ovigerous ♀ (NUZ), coll. N. L. Bruce, 15.ix.1978; Redcliffe Point, Moreton Bay, in dead *Mytilus* sp., 1 adult ♂, 2 ovigerous ♀♀ (NUZ), coll. N. L. Bruce, 18.vii.1978; Scarborough Point, Moreton Bay, 1 adult ♂, 1 non-ovigerous ♀ (NUZ), coll. N. L. Bruce, 18.ix.1978; Tangalooma, Moreton Bay, 1 adult ♂, 1 non-ovigerous ♀ (QM. W.7216), coll. C.S.I.R.O., 08.x.1972; Myora Banks, Moreton Bay, 1 adult ♂ (QM: W.5753), coll. R. Hamlyn-Harris; Dunwich, North Stradbroke Island, Moreton Bay, intertidal, 2 adult ♂♂, 2 subadult ♂♂, 2 non-ovigerous ♀♀ (QM: W.3744), coll. D. F. Boesch, Dec. 1971; Dunwich, from dead barnacles, amongst dead oyster shells, and on *Sargassum* sp., 6 adult ♂♂, 2 subadult ♂♂, 4 non-ovigerous ♀♀, 6 ovigerous ♀♀, 11 immature specimens, 1 juvenile (NUZ), coll. N. L. Bruce, 18–21.vii.1978. Polka Point, Dunwich, 1 adult ♂ (NUZ); coll. N. L. Bruce, 21.vi.1978.

Cymodoce longistylis Miers, 1884 (Fig. 13)

Cymodocea longistylis Miers, 1884: 305, 306, 666, pl. 33.

Cymodoce longistylis: Richardson, 1910b: 27; Nierstrasz, 1931: 199, Monod, 1934: 15, 16, pl. 37; ? Barnard, 1936: 179–181. — 4700

Cymodoce coronata: Hale, 1933: 559, 560. — 4643

Cymodoce zanzibarensis: Hale, 1933: 560. — 4769

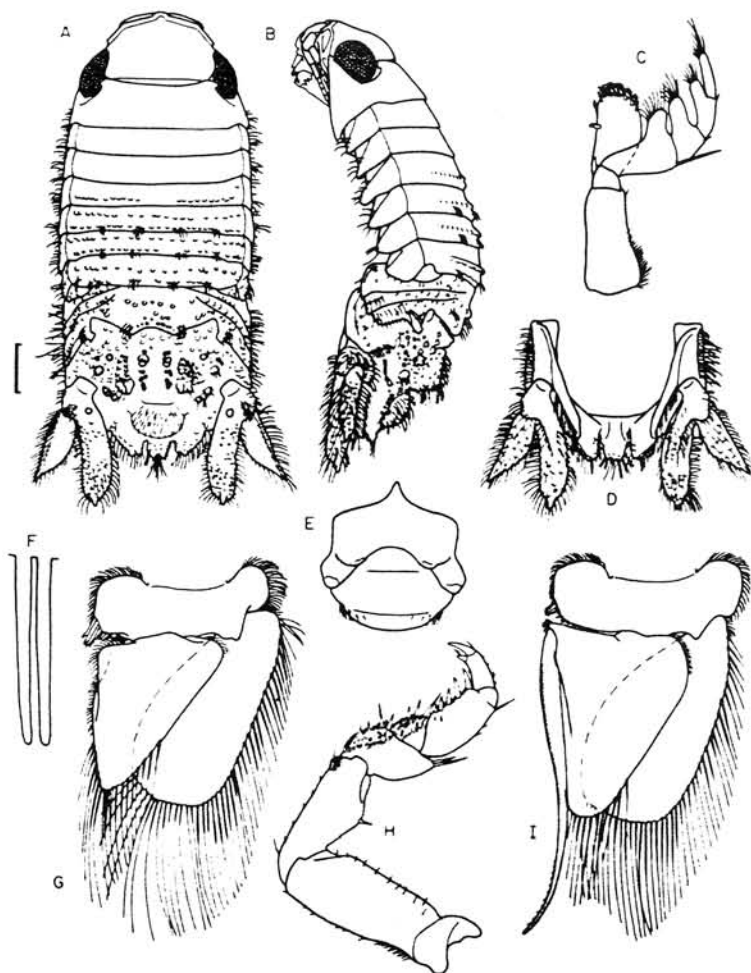


Figure 13. *Cymodoce longistylis* Miers. Adult male, 9.15 mm: A, dorsal; B, lateral; C, maxilliped; D, pleotelson, ventral; E, epistome and labrum; F, penes; G, pleopod 1; H, pereopod 1; I, pleopod 2. Scale line represents 1 mm.

Description (Thursday Island specimens)

Adult male: *Cymodoce* with dorsal surface of cephalosome and pereonites 1-3 smooth. Pereonite 4 with one, and pereonites 5-7 each with two, transverse rows of small tubercles, Pleon with scattered small tubercles. Pleotelson, posterior to each short deflection of the posterior margin of the pleon, with an uneven tubercle. Overall, pleotelson anteriorly tuberculate; tubercles smooth, hemispherical, either discrete or fused in small groups. Either side of anterior midline, pleotelson bearing an uneven longitudinal row of tubercles; lateral to each of these rows, pleotelson bearing a longitudinal tuberculate ridge terminating half way to pleotelsonic apex as a group of large, raised, fused tubercles. Lateral to posterior end of each ridge, pleotelson with a group of large fused tubercles; region anterior and lateral to this group with one large tubercle, and anterior and medial to this tubercle, a second large tubercle by the anterior end of the ridge. Posterior half of pleotelson, in midline, with a large smooth

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(27)

domed boss bearing setae (but lacking an antero-median spine). Posterior margin of pleotelson tuberculate, tridentate; median tooth subquadrate; all three teeth subequal in length and each bearing two apical dorsal tubercles giving a bifid effect in dorsal view. Appendages— A_1 with peduncle article 1 subequal in length to articles 2 and 3 together; article 2 short; article 3 slender, cylindrical; 14-articled flagellum extending to level of pereonite 1. A_2 slender, 17-articled flagellum extending to level of pereonite 3. Epistome broad with a short acute apex. Mnds each with incisor process dentate. Left mnd with lacinia mobilis dentate. Mx_1 with inner lobe bearing four subequal, curved, pectinate spines and a very short external distal spine; outer lobe bearing approximately 11 stout curved spines. Mx_2 with each outer lobe bearing approximately 11 long curved spines; inner lobe bearing long, stout plumose distal and internal spines. $Mxpd$ with palp article 2 bearing one long superior distal seta; articles 3 and 4 each with a very short superior distal seta. $Prpds$ moderately slender. $Prpd$ 1 with ischium bearing one median superior spine; merus and carpus each with inferior pads of short fine setae; merus with superior distal lobe bearing several long spines, inferior margin bearing five spines; carpus with three inferior spines; propodus with five inferior spines. $Prpds$ 2–6 becoming longer and more slender; inferior margins of merus, carpus and propodus with fringes of long fine setae and long slender simple spines. $Prpd$ 7 with ischium and merus bearing long superior distal spines; carpus with long distal and inferior spines; propodus lacking inferior setae, bearing a row of six short simple spines. Penes long, slender, each 15 times as long as wide with subparallel lateral margins and a semi-circular tip. $Plpd$ 1 with basis bearing four internal coupling hooks; endopod subtriangular, just shorter than subelliptical exopod, with apex acute, and proximal internal margin bearing a short longitudinal groove; exopod with one long, stout, proximal, external spine. $Plpd$ 2 with basis bearing three internal coupling hooks; rami as in $plpd$ 1 but endopod subequal in length to exopod, with apex narrowly rounded. Appendix masculina slender, $1\frac{3}{4}$ times length of endopod, tapering evenly to a narrowly rounded apex which curves towards animal's midline; internal margin, in distal half, bearing very short setae. $Plpd$ 3 with basis bearing three internal coupling hooks; endopod subtriangular, just shorter than subelliptical exopod, with apex narrowly truncate; exopod with a complete subterminal articulation. Endopod of $plpd$ 4 with narrowly rounded apex deflected internally; exopod subtriangular with simple external setae, one plumose apical seta, and a complete subterminal articulation. Endopod of $plpd$ 5 with apex broadly rounded; exopod with simple external setae and a complete subterminal articulation. Uropod with endopod granulose, setose, curved, with lateral margins subparallel, inner margin slightly convex; distal half of endopod projecting beyond level of pleotelsonic apex to a rounded tip bearing a short, acute, terminal projection; endopod with one proximal dorsal tubercle. Exopod of uropod subequal in width to, and just shorter than, endopod, setose, outer margin straight, inner margin convex, tapering distally to an extended acute apex.

Remarks

The precise identity of Barnard's specimens (1936: 179, 180) is not known as he did not figure his material. He also (incorrectly) synonymized *Cymodoce zanzibarensis* Stebbing with *C. longistylis*, but he has not been followed in this.

The record of this species by Baker (1929) has been discussed above under *C. bipapilla*, sp. nov. The only other record for *C. longistylis* was by Pillai (1965: 75-77) but his specimens, which he did figure, are clearly not of this species. They differ from *C. longistylis* in having the pleotelson less tuberculate; in having the median, apical, pleotelsonic tooth extending well beyond the lateral teeth; in having the uropodal endopod extending only just beyond the pleotelsonic apex; in having the uropodal exopod longer than the endopod; and in having the subapical pleotelsonic boss relatively shorter. It would appear that Pillai's specimens belong to a new species and should be redescribed as such. Pillai also described some specimens which he recorded as *Cymodoce mammifera*, (Pillai, 1965: 77, 78). These specimens are almost certainly subadult males and females of the species he refers to as *C. longistylis* and were collected from the same locality.

Examination of Hale's specimens of *C. coronata* Haswell and *C. zanzibarensis* Stebbing from the Low Isles (Hale, 1933) has shown that these are actually adult male specimens of *C. longistylis*.

Cymodoce longistylis, *sensu stricto* can be distinguished from other species of *Cymodoce* by its pleotelsonic ornamentation, especially the row of tubercles lying medial to each pleotelsonic ridge.

Cymodoce longistylis has been recorded from Lizard Island; Torres Strait; the Philippine Islands; Indonesia; Indo-China; and Singapore. In addition, Barnard's specimens were from the Nicobar Islands.

This species has been collected from the shallow sub-littoral zone (2-36 m) and on several occasions has been caught when attracted to lights (Richardson, 1910b: 27; Monod, 1934: 16).

Material examined

Queensland: Battery Point, Thursday Island, Torres Strait (10°35'S, 142°13'E), beam trawl over sea-grass beds, 2 adult ♂♂ (AM: P28816), coll. P. C. Young, 17.iv.1979; vicinity of Thursday Island, 14 adult ♂♂ (AM: P.28820), coll. P. C. Young, April 1979; off Mangrove Beach, Lizard Island (14°40'S, 145°28'E), in mixed algae from bommie, depth 2 m, 1 adult ♂ (AM: P.28822), coll. J. K. Lowry, 28.ix.1978; Low Isles, on reef, 3 adult ♂♂ (BM(NH): 1933.9.20.1-3); Low Isles, Anchorage Reefs, 1 adult ♂ (BM(NH): 1931.6.11.1.).

Cymodoce pelsarti Tattersall, 1922 (Figs 14, 15)

Cymodoce pelsarti Tattersall, 1922: 15, 16, 19, pls 2, 3. Hale, 1929b: 35; Nierstrasz, 1931: 200.

Description

Specimens of this species vary morphologically with geographical location. The specimens from the east coast of Queensland are contrasted here with specimens from Western Australia (which include the type material).

West coast specimens (from Rottnest Island)—adult male (Figs 14A-F, 15A-I, K-N): *Cymodoce* with dorsal surface of cephalosome and pereonites 1 and 2 smooth; pereonites with an anterior transverse depression. Pereonites 3-7 with posterior transverse rows of tubercles. Pleon with an anterior transverse row of tubercles and dorsal surface bearing smaller, scattered tubercles. Pleotelson,

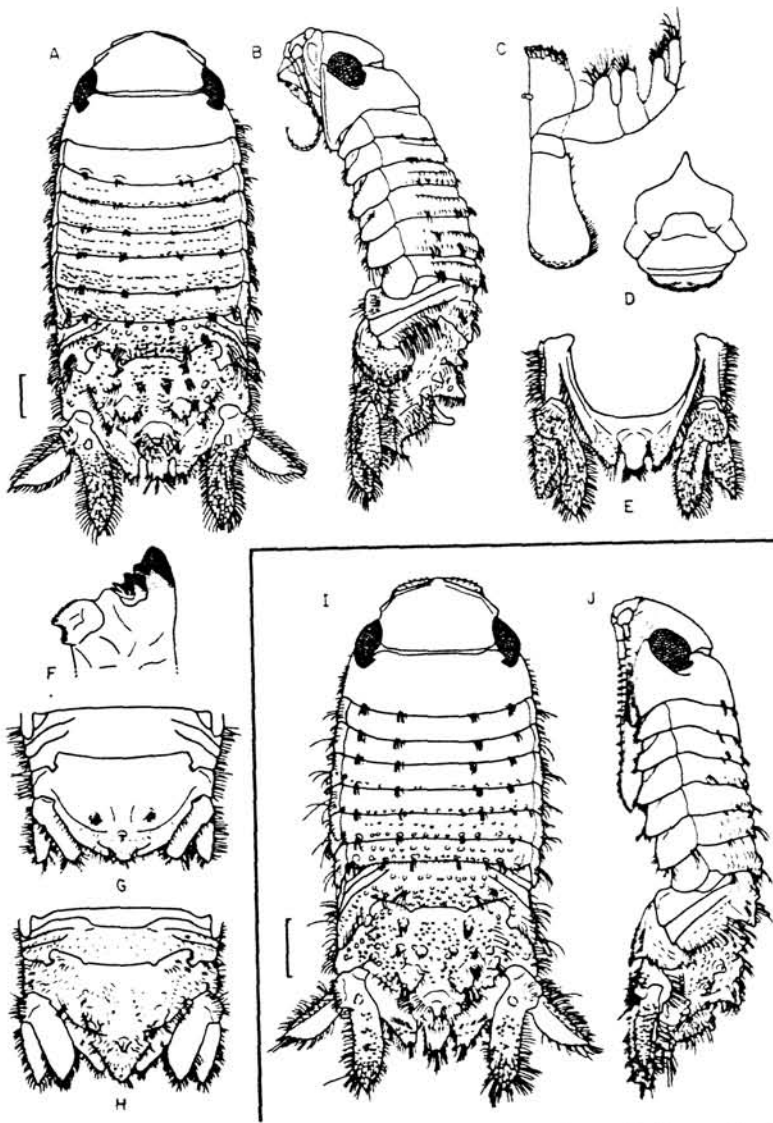


Figure 14. *Cymodoce pelsarti* Tattersall. Adult male, western specimen, 10.43 mm: A, dorsal; B, lateral; C, maxilliped; D, epistome and labrum; E, pleotelson, ventral; F, left mandible. Ovigerous female, western specimen: G, pleon and pleotelson, dorsal. Subadult male, western specimen: H, pleon and pleotelson, dorsal. Adult male, eastern specimen, 8.24 mm: I, dorsal; J, lateral. Scale lines represent 1 mm in each case.

posterior to each short deflection of posterior margin of pleon, with a prominent dentate tubercle. Overall, pleotelson bearing scattered small tubercles over most of surface. Posterior to two anterior dentate tubercles, pleotelson with a transverse row of six prominent tubercles, three each side of midline. Posterior to, and midway between, the first two tubercles either side of the midline, pleotelson with a prominent conical projection with a bituberculate apex; lateral to each of these projections, and posterior to the outermost of the transverse row of tubercles, pleotelson bearing two prominent tubercles, one

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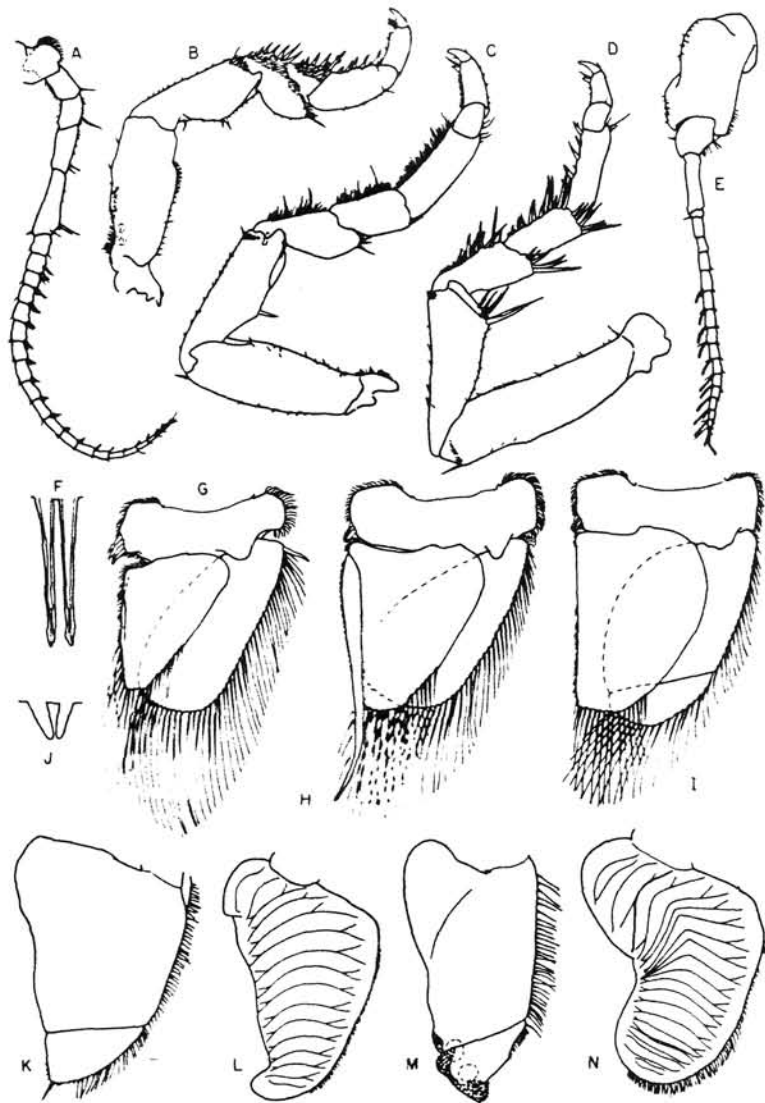


Figure 15. *Cymodoce pelsarti* Tattersall. Adult male, western specimen: A, antenna; b-D, pereopods 1, 2 and 7 respectively; E, antennule; F, penes; G-I, pleopods 1, 2 and 3 respectively; K, pleopod 4, exopod; L, pleopod 4, endopod; M, pleopod 5, exopod; N, pleopod 5, endopod. Sub-adult male, western specimen: J, penes.

posterior to the other, the more posterior being obviously bifid. In subapical midline, pleotelson bearing a smooth, setose, domed boss with a prominent, blunt, anterior projection; projection with apex deflected slightly anteriorly. Posterior margin of pleotelson tuberculate, tridentate; median tooth subquadrate; all three teeth subequal in length, apically bifid, setose; incision, either side of median tooth, deep. Appendages— A_1 with peduncle article 1 longer than articles 2 and 3 together; article 2 short; article 3 narrow, cylindrical; 16-articled flagellum extending to level of pereonite 2. A_2 slender, 21-articled flagellum extending to level of pereonite 4. Epistome broad, with a

short acute apex. Mnds with incisor processes dentate; left mnd with incisor process weakly bidentate and lacinia mobilis tridentate. Mx_1 with inner lobe bearing four subequal, pectinate spines only; outer lobe bearing approximately 10 short curved spines, those in the inner half being pectinate. Mx_2 with two outer lobes each bearing approximately 10 slender curved spines; inner lobe with a row of approximately ten plumose spines. Mxpd with palp article 4 bearing one short superior distal seta; article 5 with one short superior median seta. Prpds moderately slender. Prpd 1 with ischium bearing two short superior median spines; merus with superior distal lobe bearing a small group of short spines; merus and carpus bearing dense inferior pads of short setae; merus with 6, carpus with 5, and propodus with 5, prominent inferior spines (the most proximal being short in each case). Prpds 2-6 each with merus, carpus and propodus bearing inferior fringes of fine setae and slender spines; ischium with superior median spines; merus and carpus with superior distal spines. Prpd 7 slender, with ischium, merus and carpus bearing long superior distal spines; ischium and merus with complete inferior fringes of long spines; propodus with six prominent inferior spines, the most proximal being shortest. Penes each 10 times as long as broad; apex narrowly rounded with an apical internal indentation. Plpd 1 with basis bearing four internal coupling hooks; endopod subtriangular with a slight longitudinal groove on the internal proximal margin, plumose setae present on distal half of internal margin, and apex narrowly arcuate; exopod subelliptical, apex broadly rounded, extending beyond apex of endopod; proximal external margin of exopod with one stout spine. Basis of plpd 2 bearing three internal coupling hooks; rami as in plpd 1 but subequal in length and exopod lacking proximal external spine. Appendix masculina $1\frac{1}{2}$ times length of endopod, slender, tapering evenly to a narrowly rounded apex. Plpd 3 with basis bearing three internal coupling hooks; endopod subtriangular, just shorter than exopod, with a broadly truncate apex; exopod subelliptical with a complete subterminal articulation. Endopod of plpd 4 with a narrowly rounded apex deflected internally; exopod subtriangular with a complete subterminal articulation and one short apical seta. Endopod of plpd 5 subreniform with apex broadly rounded; exopod with a complete subterminal articulation. Uropod with endopod granulose, setose, curved, lateral margins subparallel, inner margin slightly convex; distal half of endopod extending beyond pleotelsonic apex; dorsal surface of endopod with one proximal tubercle and an acute apical projection. Exopod of uropod subequal in width to, and three-quarters length of, endopod; ventral and lateral surfaces granulose and setose; external margin straight, internal margin arcuate, with a short, acute apex.

Ovigerous female (West coast specimen—Fig. 14G): Body smooth. Pleotelson broader than long; apex setose, broadly rounded, with a short incision either side of midline; median tooth thus produced, broad, truncate, overlapping lateral 'teeth' proximally, and bearing a low, dorsal, subterminal tubercle. Main dome of pleotelson with a shallow median groove; each lateral bulge with one prominent posterior tubercle. Endopod of uropod subrectangular, setose, extending to level of pleotelsonic apex with distal angles rounded; exopod just shorter than endopod with external margin straight, internal margin convex, both margins irregular, setose.

Non-ovigerous female (West coast specimen): Resembling ovigerous female

but sub-apical pleotelsonic tubercle visible only in lateral view as a very slight swelling.

Subadult male (West coast specimen—Figs 14H, 15J): Cephalosome and pereon smooth. Pleon sparsely setose; posterior margin with a short denticle either side of midline. Pleotelson setose with a shallow median groove; each lateral bulge with a large, irregular, posterior tubercle and a very small, low, lateral tubercle. Apex of pleotelson extended, tridentate, median tooth acute, subtriangular, larger and longer than lateral teeth, with a narrowly rounded apex. Proximal dorsal surface of median tooth with a prominent, acute, median tubercle, larger and more pronounced than that of ovigerous female. Penes short, each three times as long as broad. Endopod of plpd 2 with only a very slight terminal extension to internal margin, but developing appendix visible through cuticle along internal margin.

East coast specimens (from Queensland) (Fig. 14I, J): These specimens are virtually identical to specimens from the West coast. Adult males differ in having the projection on the median, subterminal, pleotelsonic boss short, not long and curved, and (in alcohol) in having the subterminal boss pale orange in colour, not cream as in western specimens. Females and subadult males of the eastern specimens lack any indication of a dorsal, median, subapical tubercle on the pleotelson.

Remarks

The differences between the eastern and western specimens are relatively minor, and it seems likely that the two are geographical variants of the same species. However, until more is known about this species, it is wise to record the collection details separately. Hale (1929b) did not describe his specimens, but as they were collected from Princess Charlotte Bay in North Queensland, it seems probable that they will be found to resemble the present east coast specimens. It is recommended here that future records of this species be accompanied by a description adequate to allow inclusion in one of the two groups described here, or detailing differences from these groups.

Cymodoce pelsarti is known only from islands off the west coast of Australia and off the coast of Queensland, and it has been recorded once from the mainland, at Cape Ferguson in Queensland. This species has usually been collected intertidally from rock, coral rubble and algae.

For the similarities and distinctions between *C. pelsarti* and *C. bipapilla*, sp. nov. see remarks for that species (above). *Cymodoce pelsarti* also bears a strong resemblance to illustrations of *Cymodoce ornata* Richardson (Richardson, 1906: 6, fig. 10) but can be distinguished in having the exopods of the uropods acute, not blunt, and by having two tubercles lateral to each pleotelsonic boss. *Cymodoce pelsarti* bears some resemblance to the illustrations of *Cymodoce alis* Barnard, 1955 from South Africa, but differs in the form of the uropods and the posterior margin of the pleon.

In the same paper in which he described *C. pelsarti*, Tattersall described some specimens which he tentatively assigned to *Cymodoce mammifera* Haswell. From his illustrations of the subadult male, these specimens would appear to belong to a species of *Cymodoce*, but they differ from *C. pelsarti* in not having a short, subapical tubercle on the dorsal surface of the pleotelson (which occurs in all the west coast specimens seen by the present authors), and in having the uropods of

the sub-adult male relatively shorter than those of the subadult male of *C. pelsarti*. The identity of these specimens is not known, but the uropods are also shorter than in Haswell's illustrations of *C. mammifera*, (Haswell, 1881: pl. 18, fig. 1), and they cannot be assigned to that species.

Material examined

Western Australia: (West coast specimens): Sandy Island, Abrolhos Islands, 2 adult ♂♂ (Syntypes) (BM(NH) 1921.12.19: 41-42); North Point, Rottneest Island (32°00'S, 115°30'E), on reef flat, 2 adult ♂♂ (WAM: 86-80); Eagle Bay, Rottneest Island, 1 adult ♂ (WAM: 87-80); coll. C. Sharma, 26.iii.1977; Mabel Cove, Rottneest Island, from under surface of rocks, exposed shore, intertidal, 9 adult ♂♂, 5 subadult ♂♂, 1 ovigerous ♀, 8 non-ovigerous ♀♀, 1 immature specimen (NUZ), coll. N. L. Bruce, 05.vi.1980; Parker Point, Rottneest Island, from sandstone rock, 4 adult ♂♂, 4 ovigerous ♀♀, 1 non-ovigerous ♀ (NUZ), coll. N. L. Bruce, 06.vi.1980; Longreach Bay, Rottneest Island ("The Basin"), from burrows in sandstone, 2 adult ♂♂, 1 ovigerous ♀, 1 non-ovigerous ♀ (NUZ), coll. N. L. Bruce, 06.vi.1980. *Queensland* (East coast specimens): Picnic Bay, Magnetic Island, Townsville (19°10'S, 146°50'E), on coral rubble and *Sargassum* sp., intertidal, 9 adult ♂♂, 1 subadult ♂ (NUZ), coll. D. M. Holdich, 17.iii.1976; Cape Ferguson (19°15.8'S, 147°3.5'E), under rock, low tide level, 1 adult ♂ (QM: W.8050), coll. N. L. Bruce; Heron Island, Capricorn Group (23°25'S, 151°55'E), on *Dictyota* sp. and *Sargassum* sp. behind reef crest, intertidal, 2 adult ♂♂, 1 non-ovigerous ♀, 3 immature specimens, 1 juvenile (NUZ), coll. D. M. Holdich, 13.vi.1976; Heron Island, on nigger-head (coral rubble), intertidal, 1 adult ♂ (NUZ), coll. D. M. Holdich, 13.iv.1976; Heron Island, on dead coral, algae, and rock, on intertidal reef flat, 9 adult ♂♂, 2 subadult ♂♂, 1 ovigerous ♀, 5 non-ovigerous ♀♀, 2 immature specimens, 2 juveniles (QM. W.8049, 8059, 8575, NUZ), coll. N. L. Bruce, 13-15.i.1979 & 06.xii.1979, D. M. Holdich, 7-9.iv.1976; One Tree Island, Capricorn Group, from lagoon (at night), low tide, 1 adult ♂, 3 non-ovigerous ♀♀, 16 immature specimens, 30 juveniles (AM: P.28850), coll. F. Talbot, 04.xii.1966.

Genus *Calcipila*, gen. nov.

Type species: *Calcipila cornuta*, sp. nov.

Generic description

Hemibranchiate Sphaeromatidae with endopod of plpd 3 lacking branchial folds. Both sexes with pereon and pleon lacking dorsal extensions. Pleon bearing two long, straight, parallel sutures at each side; sutures extending to postero-lateral angle. Apex of pleotelson with a short median notch bearing a weak median tooth. Prpds 1-3 with superior surfaces of ischium and merus bearing, at most, several short superior setae or spines. Exopod of plpd 5 with apex and internal margin of distal article covered with fine teeth; anterior surface of distal article bearing a long, slender, projecting boss; boss lacking teeth in its proximal half; interno-distal angle of proximal article bearing two toothed bosses. Uropod with both rami lamellar, extending to level of pleotelsonic apex; exopod shorter and narrower than endopod. Sexual dimorphism not marked, but may be present in form of A₁.

Adult male: Penes slender, separate to base. Appendix masculina arising from interno-proximal angle of endopod of plpd 2 and extending just beyond ramal apex. A_1 with peduncle article 1 bearing a long, flat, antero-distal extension; extension longer than remainder of article. Mxpd with palp articles 2-4 bearing pronounced setigerous lobes.

Ovigerous female: (Not known, but certain characters can be deduced from the form of the non-ovigerous female. The following is an indication of the form of the ovigerous female.)

Not known if mpts metamorphosed. Brood pouch formed from four pairs of oostegites arising from pereonites 1-4 (not known whether these oostegites overlap in the midline or not, or whether internal pouches are present). Not known whether ventral pockets are present. A_1 with peduncle article 1 lacking an antero-distal extension.

Etymology

Latin *Calx* + *Pila*, i.e. limestone + ball (feminine).

Australian species

***Calcipila cornuta*, sp. nov.**

Remarks

If the specimens seen are indicative of the genus as a whole, this genus has some of the largest individuals in the family Sphaeromatidae (over 23 mm).

Calcipila does not closely resemble any other hemibranchiate genus. The tridentate pleotelsonic apex is suggestive of the genera *Cymodoce*, *Paracilicæa* Stebbing, and *Cassinella* Whitelegge. *Calcipila* is separated from all of these by the form of the antennules of the adult male; from *Cassinella* by the form of the coxal plates and the uropods; from *Paracilicæa* by the form of the uropods; and from *Cymodoce* by the form of the pleon, pleotelson, uropods, and general body form.

Calcipila is currently known only from the two type-specimens from sublittoral particulate substrata in Queensland.

***Calcipila cornuta*, sp. nov.**

(Figs 16, 17)

Description

Adult male: *Calcipila* with body heavily calcified, broad, sub-elliptical, 1.5 times as long as broad. Cephalosome broad, abruptly declivous anteriorly, with many small tubercles, and a large blunt tubercle either side of posterior midline. Eyes large, dorsally and ventrally calcified; facets present in a transverse band only. Pereonite 1 bearing small scattered tubercles. Pereonites 2-6 smooth, virtually lacking tubercles. Pereonite 7 bearing a weak row of small tubercles along posterior margin. Coxal plates of pereonites 2-7 each bearing a median proximal tubercle. Coxal plate of pereonite 5 overlapping that of pereonite 6, and that of pereonite 6 overlapping that of pereonite 7. Pleon with scattered tubercles along posterior margin, and a row of tubercles anterior to each suture line. Pleotelson twice as broad as long, strongly domed, abruptly flattening

subterminally; main dome bearing numerous small tubercles either side of a marked median longitudinal depression. Posterior margin of pleotelson crenulate, broadly transverse, with, either side of midline, a short, acute, triangular projection lying on either side of a narrow, shallow notch; notch with a short weak median tooth in dorsal view. Appendages— A_1 with peduncle article 1 with antero-distal angle extended laterally to midway along flagellum; extension with anterior margin straight, posterior margin smoothly arcuate, broader medially than proximally, apex blunt, rounded; postero-distal angle of article 1 short, acute. Peduncular article 2 of A_1 short, broader than long; article 3 slender, cylindrical; 20-articled flagellum extending to level of pereonite 1. A_2 slender, unmodified; 25-articled flagellum extending to level of pereonite 4. Epistome lambdoid; apex broadly rounded; lateral margins each with a proximal subtriangular extension. Labrum with surface bearing a deep depression either side of midline. Mnds with incisor processes bluntly dentate. Left mnd with lacinia mobilis as a blunt tridentate peg; setal row present as two stout, curved, apically bifid spines. Mx_1 with inner lobe bearing four subequal terminal spines and a very short external distal spine; outer lobe bearing approximately 10 long, curved, simple, terminal spines. Mx_2 with each outer lobe bearing six long simple spines; inner lobe bearing stout, long, terminal and internal spines. Mxp with palp article 4 bearing several short, fine, superior distal setae. Prpds robust. Prpd 1 broad; basis with a short superior tubercle; ischium with several superior median spines and short inferior setae; merus with superior lobe bearing a group of short spines, inferior margin bearing a dense row of eight long, very stout spines; carpus with five, and propodus with eight, long, very stout, inferior spines. Prpd 2 with basis bearing one curved superior tubercle; ischium bearing several superior spines and short inferior setae; merus and carpus each bearing a small distal group of short slender spines; merus with eight, carpus with eight, and propodus with nine, very stout inferior spines. Remaining prpds not removed for detailed examination. Penes each four times as long as broad, tapering slightly to narrowly rounded apices. Plpd 1 with endopod subtriangular, two-thirds length of broad subelliptical exopod. Plpd 2 with endopod subtriangular, just shorter than exopod; exopod similar to that of plpd 1. Appendix masculina just longer than ramus, slender, straight, with margins subparallel almost to level of endopodal apex, then tapering from external margin to narrow tip. Plpd 3 with endopod broad, subtriangular with slightly truncate apex; exopod broad, subelliptical, subequal in length to endopod with a complete subterminal articulation. Bases of plpds 1–3 each bearing three internal coupling hooks. Endopod of plpd 4 with an internal, subterminal indentation; exopod with a complete subterminal articulation and two apical plumose setae. Endopod of plpd 5 with apex broadly rounded; exopod with a complete subterminal articulation. Uropod with endopod subrectangular, extending almost to level of pleotelsonic apex, postero-distal angle with a short acute projection; exopod narrow, lanceolate, extending almost to apex of endopod with external margin crenulate, and apex slightly outcurved.

Non-ovigerous female: Resembling male in general view, but two tubercles on cephalosome very weak. Apex of pleotelson with projections either side of notch shorter than those of adult male. Peduncle article 1 of A_1 with antero-distal

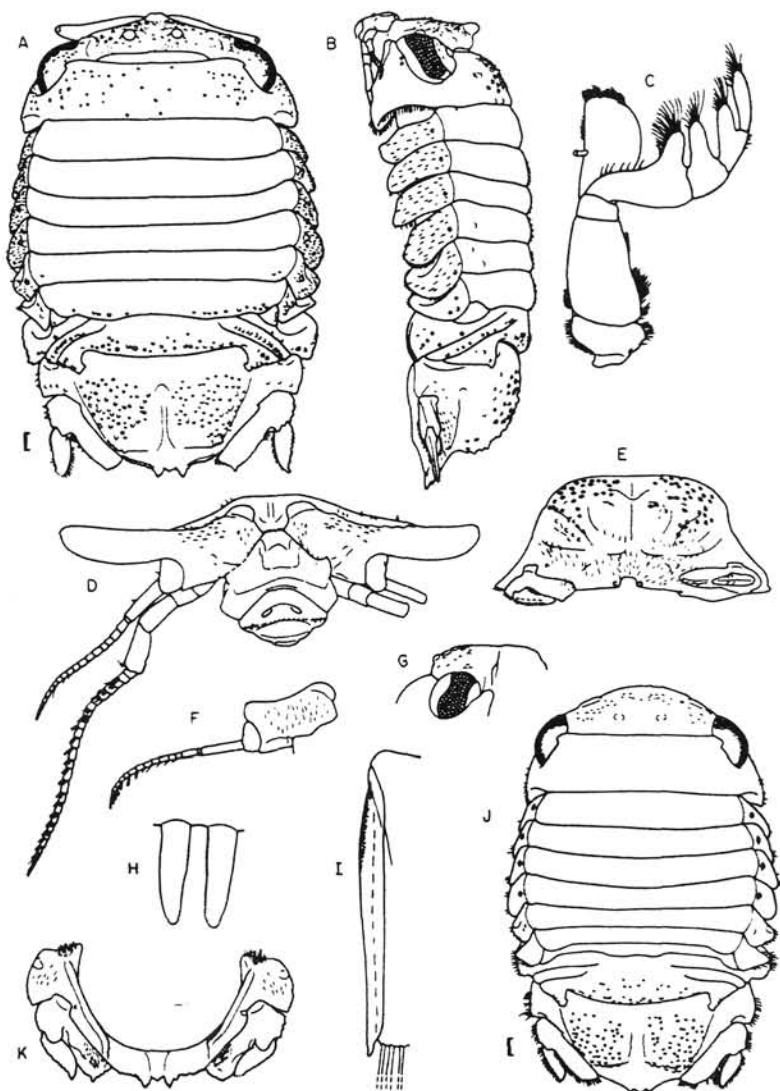


Figure 16. *Calcipila cornuta* gen. nov., sp. nov. Adult male (Holotype), 26.72 mm: A, dorsal; B, lateral; C, maxilliped; D, cephalosome ventral; E, pleotelson, posterior; H, penes; I, appendix masculina (and inner margin of endopod of pleopod 2); K, pleotelson, ventral. Non-ovigerous female (Paratype), 23.42 mm: F, antennule; G, cephalosome, lateral; J, dorsal. Scale lines each represent 1 mm.

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angle broadly rounded, not extended. Endopod of uropod with postero-distal angle smoothly rounded, not angled; exopod with apex blunt. Pereonites 1-4 each bearing a short oostegite 'bud' at base of each prpd. Ventrum opaque, hence presence/absence of possible internal pouches could not be ascertained.

Etymology

Calcipila plus Latin *cornuta*, i.e. horned.

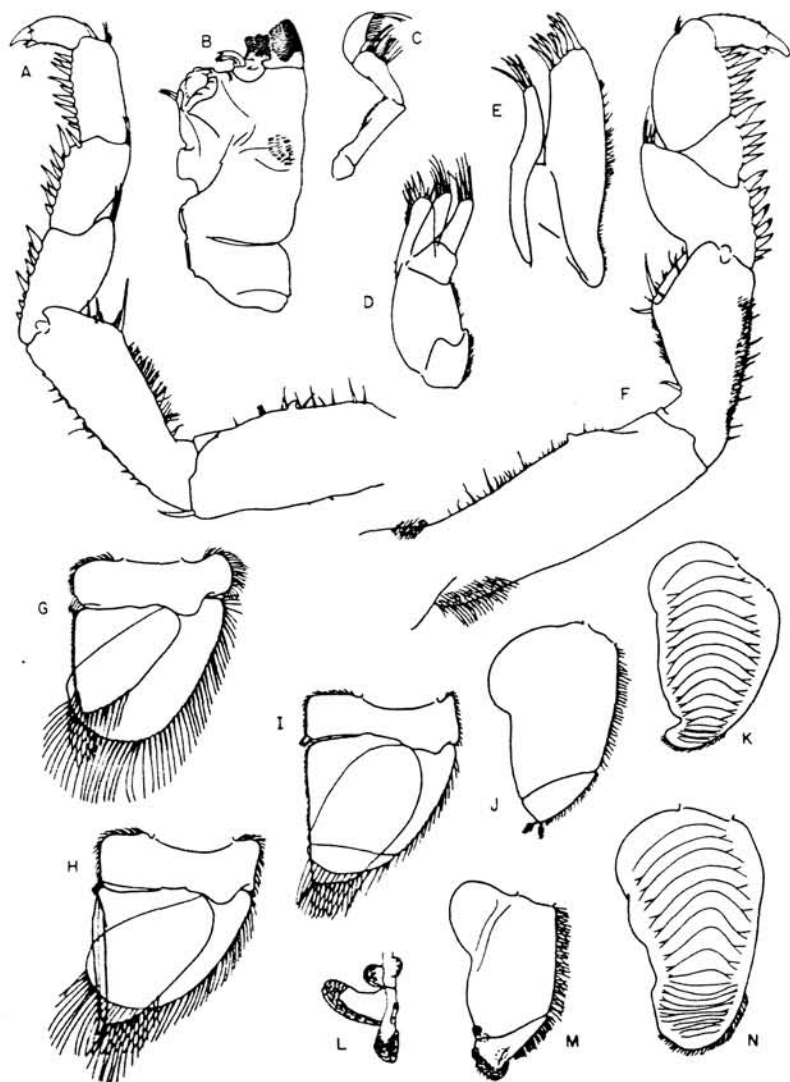


Figure 17. *Calcipila cornuta* gen. nov., sp. nov. Adult male (Holotype): A, pereopod 2; B, left mandible; C, mandibular palp; D, maxilla; E, maxillule; F, pereopod 1; G-I, pleopods 1 to 3 respectively; J, pleopod 4, exopod; K, pleopod 4, endopod; L, exopod of pleopod 5, distal region of internal margin, internal view; M, pleopod 5, exopod; N, pleopod 5, endopod.

Remarks

Calcipila cornuta sp. nov. is only known from particulate substrata in Moreton Bay.

Material examined

Holotype: Adult ♂, 26.7 mm (QM: W.3341), 1 mile south of South West Rocks, Moreton Bay, Queensland, sand and mud, depth 3.66 m, coll. S. Cook, Sept. 1970.

Paratype: Off St Helena Island, Moreton Bay, on high carbonate gravel, depth 12.0 m, 1 non-ovigerous ♀ (QM: W.9645), coll. T. Bradshaw, 24.viii.1981.

Genus *Paracilicæa* Stebbing, 1910

Paracilicæa Stebbing, 1910a: 84, 106, 107. Hale, 1929a: 272, 288; *et auct.*

Type species: *Paracilicæa hanseni* Stebbing, 1910

Generic description

Hemibranchiate Sphaeromatidae with endopod of plpd 3 lacking branchial folds. Both sexes with cephalosome, pereon and pleon lacking dorsal extensions. Pleon bearing two long, straight, parallel sutures at each side; sutures extending to postero-lateral angle. Pleotelsonic apex with a marked notch bearing a median tooth. Prpds 1-3 with superior surfaces of ischium and merus bearing, at most, several short superior setae or spines. Exopod of plpd 5 with apex and internal margin of distal article covered with fine teeth; anterior surface of distal article bearing a long, projecting, finely toothed boss; interno-distal angle of proximal article bearing two toothed bosses. Sexual dimorphism obvious, especially in the form of the uropods and in the dorsal ornamentation of the pleotelson.

Adult male: Penes slender, separate to base. Appendix masculina sublinear, arising from interno-proximal angle of endopod of plpd 2 and extending beyond ramal apex. Mxpd with palp articles 2-4 bearing pronounced setigerous lobes. Uropod with endopod reduced; exopod elongate, thickened, subcylindrical or subelliptical in transverse section, extending posteriorly well beyond pleotelsonic apex.

Ovigerous female: Mpts metamorphosed—mnds partially fused with cephalosome, incisor and molar processes absent; mx₁ as two simple lobes; mx₂ as three simple lobes; mxpd with endite expanded proximally as setigerous lobes, palp not reduced but lobes lacking setae, endite bearing coupling hook. Brood pouch formed from four pairs of oostegites arising from pereonites 1-4 and overlapping in the midline. Anterior pair of oostegites broad, each with a longitudinal fold such that the anterior region of the oostegite covers the posterior mpts. Brood not housed in the marsupium thus formed, but held in five pairs of internal pouches. Ventral pockets absent. Uropod with rami lamellar, extending approximately to level of pleotelsonic apex; exopod with external margin entire or bearing a distal indentation.

Australian species

Paracilicæa flexilis Baker, 1929

Paracilicæa gigas Baker, 1929

Paracilicæa pubescens (Milne Edwards, 1840)

Paracilicæa stebbingi Baker, 1926

? *Paracilicæa dakini* (Tattersall, 1922), comb. nov. (for *Cilicæopsis dakini* Tattersall)

? *Paracilicæa hamata* (Baker, 1908)

? *Paracilicæa septemdentata* (Baker, 1910)

***Paracilicæa aspera*, sp. nov.**

(See Appendix 2 for all known species of *Paracilicæa*).

Remarks

The species currently housed in the genus *Paracilicæa* show considerable variation from one another, and it is probable that in future this genus will be divided. As the problem is not easy to resolve without a detailed taxonomic investigation of all the species, the genus will be considered here without an attempt at major revision.

For the Australian species the following observations can be made.

Tattersall's specimens of *Cilicæopsis dakini* are excluded from *Cilicæopsis* by having a median tooth in the apical pleotelsonic notch and by lacking a pleonal extension (see below). They are also excluded from *Cilicæa* Leach by lacking a pleonal extension (despite the fact that Barnard (1936: 181) referred to the curved posterior margin of the pleon as "a well developed median lobe" and suggested that the species should be included in *Cilicæa*). Among the current genera Tattersall's specimens agree most closely with the genus *Paracilicæa* (although the broadly truncated epistome does not agree with most species currently housed in this genus).

Paracilicæa hamata is unusual for *Paracilicæa* in lacking sexual dimorphism. This species also has unusually hooked uropodal exopods and the tooth in the pleotelsonic notch is very elongate.

Paracilicæa septemdentata has a broadly truncated epistome and the toothed uropods are unusually ornate.

When a revision of *Paracilicæa* is carried out, it seems unlikely that the species *P. dakini*, *P. hamata* and *P. septemdentata* will be retained in this genus.

The history of the species *Paracilicæa pubescens* (Milne Edwards) is very involved, but can be outlined as follows.

Milne Edwards' original description of *Sphaeroma pubescens* consisted only of a short diagnosis (1840: 209), and he did not illustrate his specimens. In 1881 Haswell described some specimens from Port Jackson, New South Wales, which he assigned to Milne Edwards' species. Haswell illustrated an example of his specimens (apparently a female or immature specimen) (1881: pl. 17, fig. 1 and transferred the species to the genus *Cymodoce* as "*Cymodoce pubescens*". In 1884 Miers suggested that Milne Edwards' species was based on the female of *Cilicæa latreillei* Leach, and some authors subsequently synonymized these. Baker (1926) described some specimens which he believed to belong to Milne Edwards' species. He gave the first clear description of the adult male, and tentatively transferred the species to the genus *Paracilicæa* as "*Paracilicæa (?) pubescens*". Baker presumably transferred the species because in the adult male the uropodal exopod was twice the length of the endopod. However, Baker also saw specimens which appeared, from the structure of the appendix masculina, to be adult males, but which had the uropodal rami subequal in length, as in the female. He did not give the collection locality for these additional specimens, but said that the males with the extended uropodal exopods were common on the east coast and had not been found on the south coast. Hale (1929a), in his monograph on the crustaceans of South Australia, described the male form with the extended uropodal exopod. It is not clear whether Hale was describing a new collection (and hence providing the first record of such males from the south coast) or, more probably, merely examining Baker's material in the South Australian Museum. Naylor (1966) described specimens from Port Phillip Bay, Victoria, which resembled the additional males examined by Baker in appearing

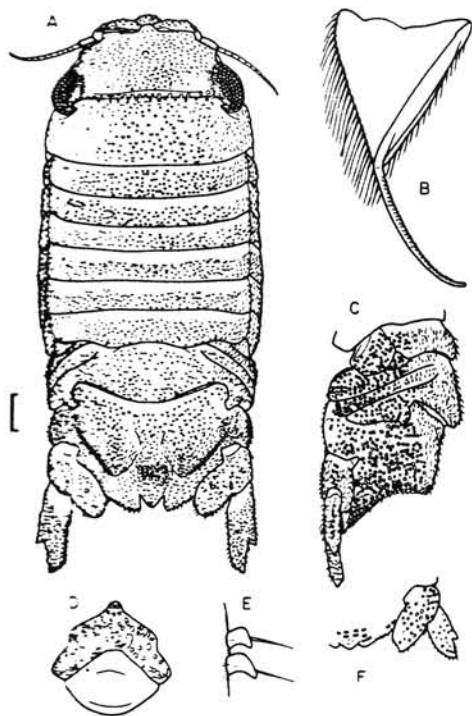


Figure 18. *Paracilicæa pubescens*: Milne Edwards. Adult male (Lectotype), 13.36 mm: A, dorsal; B, pleopod 2; C, pleon and pleotelson, lateral; D, epistome and labrum; E, pleotelsonic setation, high power. Subadult male: F, pleotelsonic apex and uropod. Scale line represents 1 mm.

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 adult, but having the uropodal rami subequal in length. Naylor assigned these specimens to Milne Edwards' species, following Nierstrasz (1931) in transferring this species back to *Cymodoce*. Naylor suggested that Baker's males with extended uropodal exopods might belong to "some other species", but he gave no reason for identifying his males with Milne Edwards' species in preference to males with extended uropodal exopods (Naylor, 1966: 188, 189).

The present authors have examined Milne Edwards' type material (Natural History Museum, Paris. Reg. no. Is 1221) and Fig. 18A-E show an adult male specimen. This would appear to belong to the species *Paracilicæa pubescens*, *sensu* Baker. Naylor's specimens (and presumably Baker's additional specimens) do not belong to this species. Therefore, there would appear to be two distinct species: *Paracilicæa pubescens* (Milne Edwards) from the east coast of Australia; and "*Cymodoce pubescens*" *sensu* Naylor from the south coast. The species recorded by Naylor should be redescribed as new, and as adult males bear little resemblance to adult males of *Cymodoce* (see above), a new genus will probably be needed for this species.

Some previous authors have considered the form of the pubescence to be a character specific to *P. pubescens*. This is not so. Females and immature specimens of at least some species of *Cilicæa* Leach may bear pubescence similar to that shown by *P. pubescens* (personal observation). The similarity of female and immature specimens of *P. pubescens* to female and immature specimens of

related species means that some of the records for Milne Edwards' species (e.g. Stebbing, 1910a; Nierstrasz, 1931; Seed, 1973) may be incorrect.

Species of *Paracilicæa* are known only from Australia and East Africa.

***Paracilicæa aspera*, sp. nov.**

(Figs 19, 20)

Description

Adult male: *Paracilicæa* with dorsal surface of cephalosome and pereonite 1 bearing small, scattered anterior and lateral tubercles. Cephalosome, in addition, with one small median tubercle. Pereonites 2-7 and pleon bearing numerous, small, prominent, hemispherical tubercles over most of surface; posterior margin of pleon curved, arcing posteriorly in midline. Pleotelson short, broad, covered with small tubercles, bearing a shallow, longitudinal, median groove; bulge, either side of midline, bearing a short, tuberculate, conical apex. Posterior margin of pleotelson tuberculate with a deep notch either side of midline; central tooth, thus formed, subtriangular with a short apical tubercle; each lateral tooth directed postero-medially, subequal in length to median tooth. Appendages— A_1 with peduncle article 1 longer than articles 2 and 3 together; article 2 short; articles 1 and 2 bearing scattered short setae; article 3 slender, cylindrical; 22-articled flagellum extending to level of pereonite 1. A_2 slender; flagellum with more than 17 articles (both antennae of holotype broken). Epistome lambdaoid, broad, with a short, blunt apex. Mnds each with incisor process weakly dentate. Mx_1 with outer lobe bearing stout, simple, curved spines. Mx_2 with outer lobes bearing stout simple spines; inner lobe with a row of plumose spines. $Mxpd$ with palp article 2 bearing two short superior distal setae; article 3 with one short superior distal seta; article 4 with one short superior median and one short superior distal seta. Prpds moderately slender. Prpd 1 with basis bearing several superior tubercles; ischium bearing a prominent narrow superior median lobe bearing short spines; merus with a superior distal lobe bearing two short spines and an inferior border of eight stout spines; carpus with five stout inferior spines; propodus with six stout inferior spines. Following prpds more slender with bases bearing two longitudinal superior rows of tubercles, and merus, carpus and propodus bearing more, but less stout, spines. Prpd 7 slender with basis lacking tubercles, and carpus bearing an additional distal row of spines. Penes relatively short, each three times as long as broad, tapering to an obliquely truncate tip. Plpd 1 with endopod short, subtriangular, bearing an internal, proximal, longitudinal fold; exopod twice length of endopod with one stout external proximal spine. Plpd 2 with endopod subtriangular; exopod $1\frac{1}{2}$ times length of endopod, subelliptical. Appendix masculina $1\frac{1}{3}$ times length of endopod; lateral margins subparallel to level of endopodal apex, then dilating slightly and tapering abruptly to a narrow styliform apex. Plpd 3 with endopod broad, almost semi-circular, internal margin straight; exopod broad, subelliptical, with a complete subterminal articulation. Plpds 1-3 each with basis bearing three internal coupling hooks. Plpd 4 with endopod bearing an internal, subterminal indentation and a short internal terminal seta; exopod with a small marginal, proximal, external lobe, a complete subterminal articulation, and two short apical setae. Endopod of plpd 5 with apex broadly rounded; exopod bearing a complete subterminal

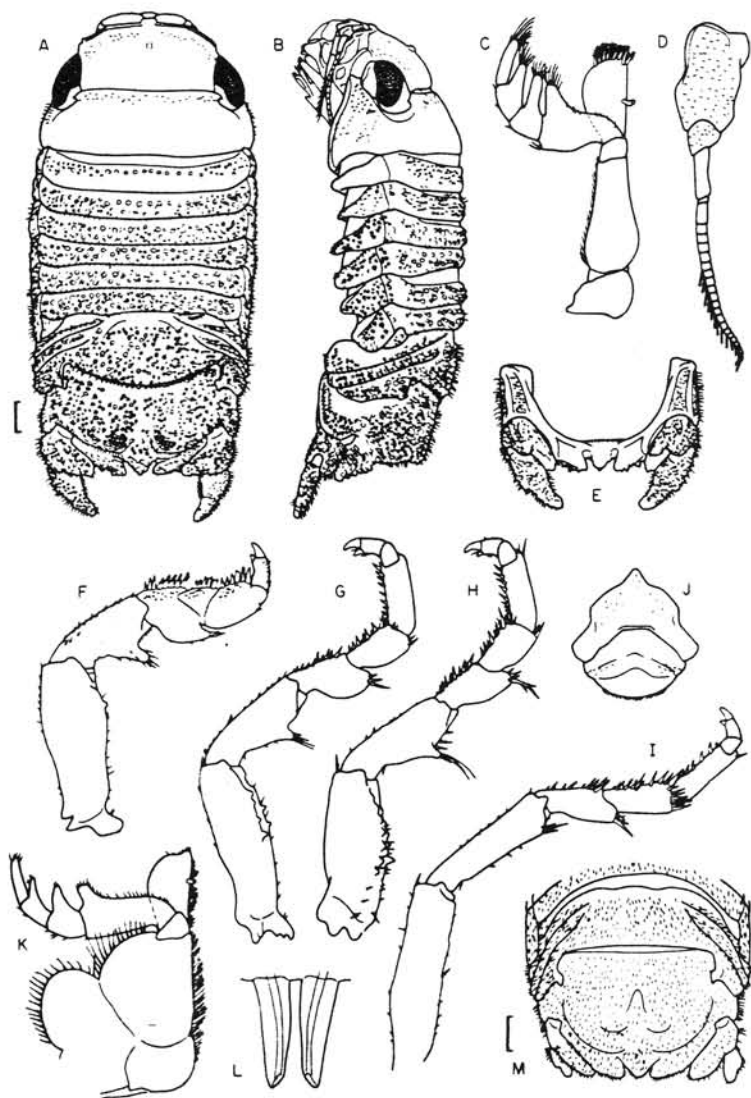


Figure 19. *Paracilicæa aspera* sp. nov. Adult male (Holotype), 14.82 mm: A, dorsal; B, lateral; C, maxilliped; D, antennule; E, pleotelson, ventral; F-I, pereopods 1, 2, 4 and 7 respectively; J, epistome and labrum; L, penes. Ovigerous female (Paratype): K, maxilliped; M, pleon and pleotelson, dorsal. Scale line represents 1 mm in each case.

articulation. Uropod with endopod short, tuberculate, apex extending to level of pleotelsonic apex, rounded with a short acute median extension; exopod twice length of endopod, tuberculate, inner margin convex, apex narrowly rounded, deflected internally, outer margin with distal half inset from proximal half.

Ovigerous female: Body smooth, covered with short, fine setae. Pleotelson with a weak boss either side of midline; apex tridentate with central tooth blunt, subtriangular, extending to level of lateral teeth. Uropod with endopod extending just beyond pleotelsonic apex, unevenly rounded; exopod just shorter than endopod, with apex broadly rounded and external margin distally indented.

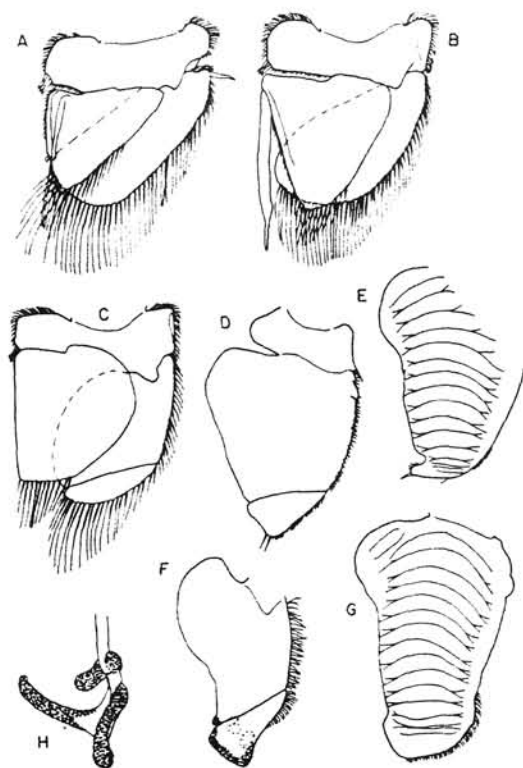


Figure 20. *Paracilicæa aspera* sp. nov. Adult male (Holotype): A-C, pleopods 1, 2, and 3 respectively; D, pleopod 4, exopod; E, pleopod 4, endopod; F, pleopod 5, exopod; G, pleopod 5, endopod; H, pleopod 5, distal region of internal margin, internal view.

Etymology

Paracilicæa plus Latin *aspera*, i.e. rough.

Remarks

Paracilicæa aspera sp. nov. can be distinguished from other species in the genus *Paracilicæa* by the very tuberculate nature of the dorsal body surface; in having relatively shorter penes; in having small lobes on the external margins of the exopods of pleopods 4; in having relatively longer anterior lobes on the exopods of the fifth pleopods; and in having tubercles on the bases of the pereopods.

Although these differences are marked, this species agrees with others in the genus *Paracilicæa* in the major characters. Given the variation between species currently housed in this genus (see *Remarks*—above) this new species is best placed in *Paracilicæa*.

Paracilicæa aspera is known only from the type locality, and no habitat details are known.

Material examined

Holotype: Adult ♂, 14.8 mm (QM: W.5752), Southport, Queensland, coll. R. Pohlman, 1920.

Paratype: From type locality, 1 ovigerous ♀ (QM: W.5752).

Paracilicæa stebbingi Baker, 1926
(Fig. 21)

Paracilicæa stebbingi Baker, 1926: 263, 264, 278, pl. 43. Nierstrasz, 1931: 206; Hale, 1933: 559.

Description

Adult male: *Paracilicæa* with body heavily calcified, smooth, glabrous. Dorsal surface of cephalosome and pereon lacking ornamentation. Pleon with four low longitudinal ridges in central region, and area around sutures uneven. Pleotelson, in anterior half, bearing six low longitudinal ridges; in posterior half, either side of midline, bearing a large, blunt, overhanging, conical boss; area proximal and external to each boss with a short blunt projection; vertical surface posterior to each boss granulose. Apex of pleotelson obtuse with a broad deep notch; notch broadening abruptly anteriorly, producing a 'T' shape, but

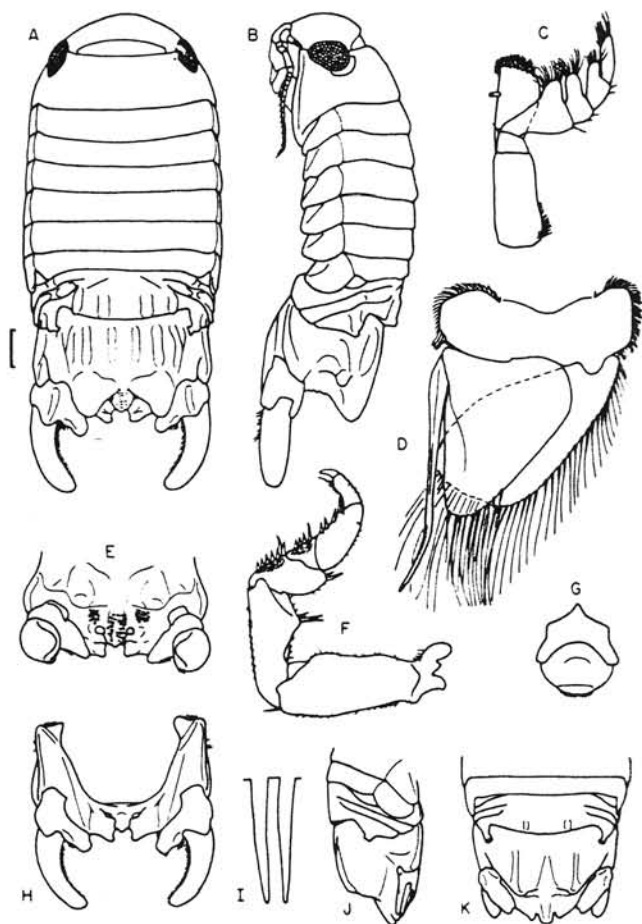


Figure 21. *Paracilicæa stebbingi* Baker. Adult male, 10.98 mm: A, dorsal; B, lateral; C, maxilliped; D, pleopod 2; E, pleotelson, posterior; F, pereopod 1; G, epistome and labrum; H, pleotelson, ventral; I, penes. Ovigerous female: J, pleon and pleotelson, lateral; K, pleon and pleotelson, dorsal. Scale line represents 1 mm.

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anterior mid point of notch bearing a pronounced tooth. Tooth slightly broader than longitudinal section of notch, and extending halfway to pleotelsonic posterior margin; apex of tooth weakly trilobed; dorsal surface granulose. Appendages— A_1 with peduncle article 1 longer than articles 2 and 3 together; article 2 short, just longer than broad; article 3 slender, cylindrical; 20-articled flagellum extending to posterior margin of pereonite 1. A_2 slender; 19-articled flagellum extending to level of pereonite 3. Epistome broad with a short acute apex. Mnds each with incisor process only weakly dentate; left mnd with lacinia mobilis weakly dentate. Mx_1 with inner lobe bearing four subequal pectinate spines and a very short external distal spine; outer lobe bearing 10 curved spines. Mx_2 with each outer lobe bearing long curved spines; inner lobe bearing plumose spines. $Mxpd$ with palp article 2 bearing one moderately short superior distal seta; articles 3 and 4 each bearing two short superior distal setae. Prpds moderately slender. Prpd 1 with ischium bearing several superior median setae; merus with superior lobe bearing two superior distal spines; merus and carpus each bearing an inferior pad of short setae and an inferior row of spines; merus with six stout, and one longer slender, spines; carpus with four spines increasing in length from proximal to distal; propodus with four inferior spines. Prpd 2 longer and more slender than prpd 1. Prpds 3 and 4 becoming slightly more robust and superior spines becoming longer and more numerous. Prpds 5–7 becoming longer and more slender. Penes slender, each 10 times as long as wide, tapering gradually to a narrowly rounded tip. Plpd 1 with basis bearing five internal coupling hooks; endopod subtriangular, just shorter than subelliptical exopod, with apex acute and proximal internal margin bearing a short longitudinal groove. Plpd 2 with basis bearing three internal coupling hooks; rami as in plpd 1 but subequal in length. Appendix masculina slender, $1\frac{1}{2}$ times length of endopod, tapering evenly to a narrow apex which curves towards animal's midline. Plpd 3 with basis bearing three internal coupling hooks; endopod subtriangular, broad, subequal in length to subelliptical exopod; exopod with a complete subterminal articulation. Endopod of plpd 4 with an internal subterminal indentation and a short internal subterminal spine; exopod with a complete subterminal articulation. Endopod of plpd 5 with apex broadly rounded; exopod with a complete subterminal articulation. Uropod with endopod narrow, tapering slightly to an unevenly rounded apex, extending posteriorly just beyond pleotelsonic apex; exopod cylindrical, twice length of endopod, curving medially to a blunt hemispherical tip and bearing several fine internal setae.

Ovigerous female: Cephalosome and pereon resembling those of adult male. Pleon with a low tubercle either side of posterior midline. Pleotelson with a low median longitudinal depression, producing a low bulge either side of midline; each bulge with a weak longitudinal ridge. Pleotelsonic apex with a narrow notch either side of midline; central tooth thus formed extending just beyond lateral teeth with a broadly rounded tip and a weak dorsal longitudinal ridge. Uropod with rami subequal, not extending as far as pleotelsonic tip; apex of endopod slightly indented; apex of exopod smoothly rounded.

Remarks

This species is known only from intertidal coral in Queensland. Previous records are for Cairns Reef at Cooktown (Baker, 1926) and Low Isles (Hale, 1933).

Material examined

Queensland: Heron Island, Capricorn Group (23°25'S, 151°55'E), in cavity of dead coral, rubble zone of reef, 1 adult ♂ (NUZ), coll. D. M. Holdich, 08.iv.1976; North-west Island, Capricorn Group, on reef, 1 adult ♂, 1 ovigerous ♀ (AM: P.10368), coll. F. A. McNeill, Dec. 1931; Low Isles, on reef, 1 adult ♂ (BM(NH): 1933.9.20.5).

Genus *Cilicaeopsis* Hansen, 1905

Cilicaeopsis Hansen, 1905: 83, 90, 91, 104, 119, 120, 123. Hale, 1929a: 272, 291; Seed, 1973: 209; *et auct.*

Type-species: *Cilicaea granulata* Whitelegge, 1902.

Generic description

Hemibranchiate Sphaeromatidae with endopod of plpd 3 lacking branchial folds. Both sexes with cephalosome and pereon lacking dorsal extensions. Pleon bearing two long, straight, parallel sutures at each side extending to posterolateral angle. Pleotelsonic apex with a semicircular notch lacking any indication of a median tooth. Prpds 1-3 with superior surfaces of ischium and merus bearing, at most, several short superior setae or spines. Exopod of plpd 5 with apex and internal margin of distal article covered with fine teeth; anterior surface of distal article bearing a long, slender, projecting, toothed boss; internodal angle of proximal article bearing two small toothed bosses. Sexual dimorphism pronounced.

Adult male: Penes slender, separate to base. Appendix masculina sublinear, arising from interno-proximal angle of endopod of plpd 2 and extending beyond ramal apex. Pleon with posterior margin extended posteriorly in midline; process freely projecting. Mxpd with palp articles 2-4 bearing pronounced setigerous lobes. Uropod with endopod reduced; exopod elongate, thickened, subcylindrical or subelliptical in transverse section, extending posteriorly beyond level of pleonal extension.

Ovigerous female: Mpts metamorphosed—mnds partially fused with cephalosome, incisor and molar processes absent, mandibular apices as flat quadrate surfaces juxtaposed in midline; mx₁ as two simple lobes; mx₂ as three simple lobes; mxpd with endite bearing distal coupling hook, expanded proximally as setigerous lobes, palp not reduced but lobes lacking setae. Brood pouch formed from four pairs of oostegites arising from pereonites 1-4 and overlapping in the midline. Brood not housed in the marsupium thus formed, but in five pairs of internal pouches. Ventral pockets absent.

Pleon with posterior margin simple, lacking a posterior extension. Uropod with rami lamellar, subequal or with exopod slightly longer than endopod; endopod with apex truncate; exopod with apex narrowly rounded, external margin lacking a notch or indentation.

Australian species

Cilicaeopsis granulata (Whitelegge, 1902)

Cilicaeopsis sculpta Baker, 1929

Cilicaeopsis whiteleggei (Stebbing, 1905) (NRA)

***Cilicaeopsis glebosa*, sp. nov.**

***Cilicaeopsis furculata*, sp. nov.**

(NRA = not restricted to Australia. See Appendix 2 for all known species of *Cilicaeopsis*).

Remarks

Hansen erected this genus with the characters "Abdominal notch semicircular, without any vestige of mesial lobe. Endp. of urp. rudimentary in the male". He chose as the type-species *Cilicæa granulata* Whitelegge, which bears a pronounced pleonal extension in the adult male (see below). Of two other Australian species Hansen stated (1905: 123) "Whitelegge describes two aberrant species established on males, *Cilicæa styliifera* (Whitel.) and *C. ornata* (Whitel.), which differ strongly from *C. granulata* (Whitel.) as to the shape of the upper side of the abdomen, but agree with it in possessing a semicircular abdominal notch and rudimentary endp. of urp., while exp. of urp. is extremely elongate; I think that these two species can be referred to *Cilicæopsis*, but without an examination of any of them, or, at least of closely allied species, I cannot decide the question". The crucial point is that the other two species mentioned both lack a posterior pleonal extension in the adult male. Subsequent authors have included these species in *Cilicæopsis*, despite Hansen's hesitation, with the result that the definition of *Cilicæopsis* has been fixed (by implication) as 'adult male with or without a posterior pleonal extension'. The presence of such an extension appears to be an important generic character within the family Sphaeromatidae, and the rejection of this character for the genus *Cilicæopsis* has led to the placement of a number of inappropriate species in this genus. Seed (1973: 209) recognized that some of the species in this genus appeared to need a new genus erecting to house them, but he did not take the matter further. Indeed, he placed a further inappropriate, new species in the genus. In an effort to alleviate some of the confusion, the generic diagnosis of *Cilicæopsis* is restricted here, and the presence of a posterior pleonal extension is made a central characteristic for the genus. (In effect, the genus *Cilicæopsis* can be seen to resemble the genus *Cilicæa* Leach, but with the pleotelsonic apical notch lacking a median tooth.)

The redefinition of the genus *Cilicæopsis* means that a number of Australian species currently housed in this genus must be excluded from it. These species are: *C. styliifera* (Whitelegge, 1902); *C. ornata* (Whitelegge, 1902); *C. corpulensis* Baker, 1926; and *C. floccosa* Seed, 1973. The correct generic placement of these species is not known. *Cilicæopsis halei* Baker, 1926 and *C. obesa* Baker, 1926 are known only from female specimens, but neither of these species appears to belong in *Cilicæopsis*. *Cilicæopsis halei* appears to belong to the same genus as *C. styliifera*, while *C. obesa* appears to belong to a separate, undescribed, genus. *Cilicæopsis dakini* Tattersall has been transferred to the genus *Paracilicæa* above.

Species of *Cilicæopsis*, *sensu stricto* are known only from West and East Australia, the Coral Sea, Indonesia, South Philippines and Sri Lanka. Specimens have been collected sublittorally (2.7–175 m) usually on particulate substrata.

Cilicæopsis granulata (Whitelegge, 1902)
(Figs 22, 23)

Cilicæa granulata Whitelegge, 1902: 271–274. Hansen, 1905: 123.

Cilicæopsis granulata: Hale, 1929a: 291–292; Nierstrasz, 1931: 210.

Description (Coral Sea specimens)

Adult male: *Cilicæopsis* with dorsal surface of cephalosome and pereonites bearing numerous small, prominent, blunt tubercles. Pleon with median

anterior region lacking tubercles, lateral regions bearing tubercles. Median dorsal surface of pleon bulbous; posterior margin, median to points of articulation with pleotelson, extended posteriorly, converging evenly to midpoint of pleotelson. From midpoint of pleotelson, pleon bearing a posteriorly directed process subequal in length to anterior pleon; lateral margins of process subparallel, apex weakly tridentate. Pleonal anterior bulge and posterior process covered with small tubercles; process with a subterminal, ventral patch of short setae. Pleotelson bearing small tubercles over entire surface except for a short distance anterior to the posterior margin; posterior margin truncate with a pronounced median notch; notch smoothly curved, lateral margins extending posteriorly just beyond rest of posterior margin, producing two short teeth. Appendages— A_1 with peduncle article 1 longer than articles 2 and 3 together; article 2 short; articles 1 and 2 tuberculate, article 1 with one proximal ventral tubercle more pronounced than remainder; article 3 slender, cylindrical; 15-articled flagellum extending to level of pereonite 1. A_2 slender, 18-articled flagellum extending to level of pereonite 2. Epistome lambdoid, tuberculate, apically truncate. Mnds each with incisor process smoothly rounded. Mx_1 with inner lobe bearing four subequal pectinate spines and one very short, simple, distal, external seta; outer lobe bearing approximately nine curved stout spines. Mx_2 with lobes relatively slender, two outer lobes each bearing approximately seven slender spines; inner lobe bearing a row of plumose spines. $Mxpd$ with palp articles 2 and 3 each bearing a very short superior distal seta. $Prpds$ moderately slender. $Prpd$ 1 with basis bearing several small superior tubercles; merus with superior lobe bearing two short setae, inferior margin with four stout spines and a pad of very short setae; carpus with three stout inferior spines and a pad of very short setae; propodus with four stout inferior spines. Succeeding $prpds$ each with basis bearing low superior tubercles; ischium with one superior spine; merus and carpus bearing an inferior fringe of short setae and slender spines; propodus with inferior spines. Penes each five times as long as broad, tapering slightly to a rounded apex. Surface of penes covered with microtrichia. $Plpd$ 1 with basis bearing five internal coupling hooks; endopod short, subtriangular; exopod $1\frac{1}{2}$ times length of endopod, with apex truncate. $Plpd$ 2 with basis bearing three internal coupling hooks; rami as in $plpd$ 1. Appendix masculina linear, $1\frac{1}{2}$ times length of endopod; lateral margins tapering to a narrowly rounded apex, but margins dilated slightly for a short distance just beyond level of endopod tip. $Plpd$ 3 with basis bearing three internal coupling hooks; endopod broad, subtriangular, just shorter than exopod, with a truncate apex; exopod subelliptical, with a broad apex and a complete subapical articulation. Endopod of $plpd$ 4 with a narrow, internal, subapical incision; exopod subtriangular with a complete subterminal articulation. Endopod of $plpd$ 5 subreniform with apex broad; exopod narrow with a complete subterminal articulation. Uropod with endopod tuberculate, antero-dorsal surface with one proximal and one median tubercle slightly more pronounced than the others; endopod as long as broad with posterior margin concave, apex truncate, acute postero-distal angle extending just beyond level of pleotelsonic apex; exopod thick, coarsely tuberculate, lanceolate, broadest at midpoint, distal half extending beyond level of apex of pleonal process, acute apex slightly deflected laterally.

Subadult male: Tubercles on body more acute than those of adult male.

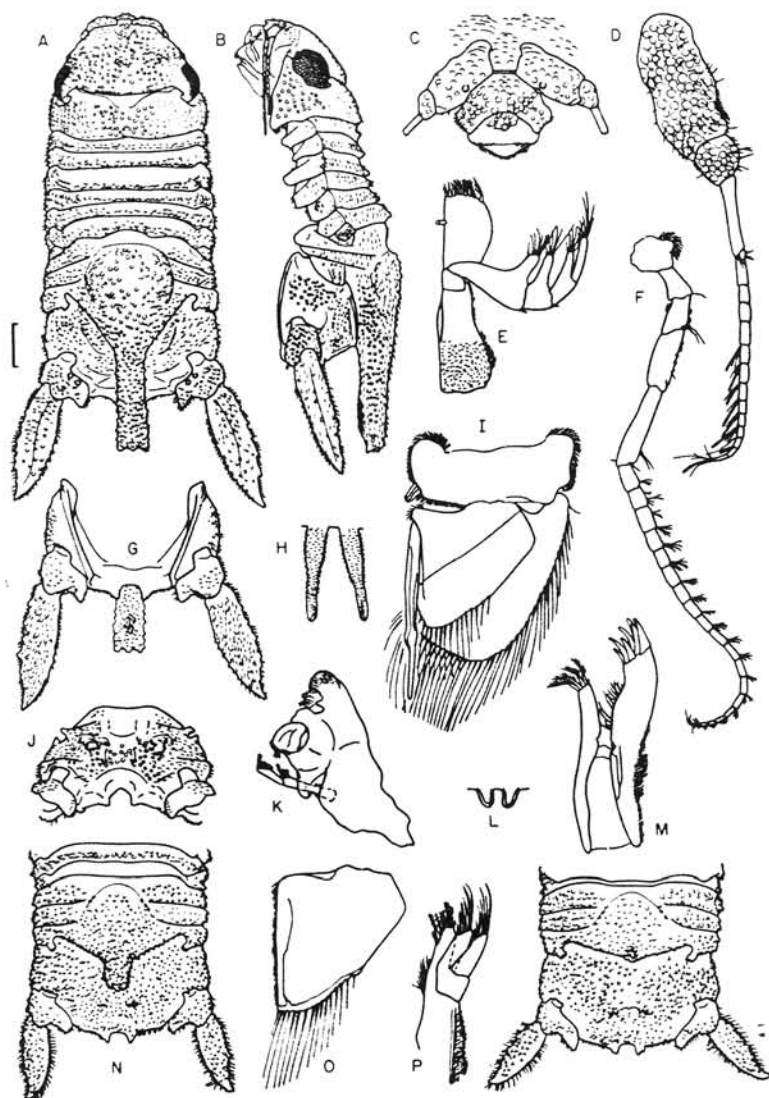


Figure 22. *Cilicacopsis granulata* (Whitelegge). Adult male, 8.97 mm: A, dorsal; B, lateral; C, epistome and labrum, and antennular peduncles; D, antennule; E, maxilliped; F, antenna; G, pleotelson, ventral; H, penes; I, pleopod 2; J, pleotelson, posterior; K, left mandible; M, maxillule; P, maxilla. Subadult male: L, penes; N, pereonite 7, pleon and pleotelson, dorsal; O, endopod of pleopod 2. Non-ovigerous female: Q, pleon and pleotelson, dorsal. Scale line represents 1 mm.

Posterior margin of pleon converging in anterior one-third of pleotelson, bearing a short, tuberculate, apically dentate process; process $1\frac{1}{2}$ times as long as broad, extending to midpoint of pleotelson. Pleotelson similar to that of adult male, but tuberculate over entire dorsal surface, bearing a small pronounced group of tubercles each side of midline in posterior half (in adult males these groups are obscured by the pleonal process). Uropod with endopod shorter and relatively narrower than that of adult male; lateral margins converging slightly to truncate apex; exopod similar in shape to, but relatively slightly shorter than, that of adult male. Penes separate at base, each twice as long as broad.

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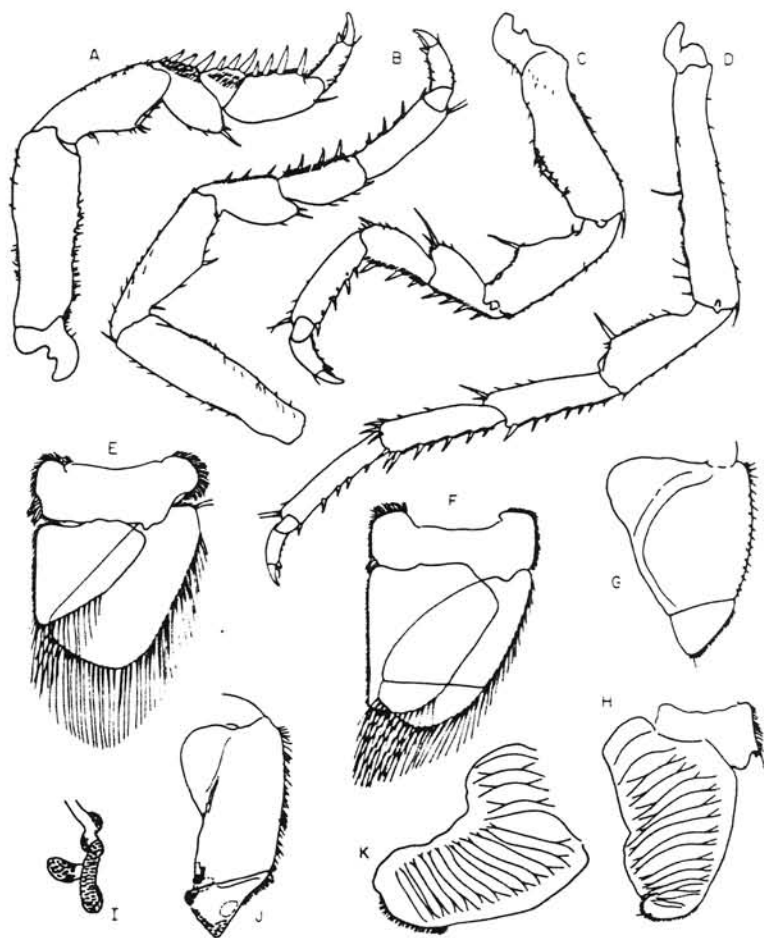


Figure 23. *Cilicaeopsis granulata* Whitelegge. Adult male: A-D, pereopods 1, 2, 4 and 7 respectively; E, pleopod 1; F, pleopod 3; G, pleopod 4, exopod; H, pleopod 4, endopod; I, distal internal margin of exopod of pleopod 5, internal view; J, pleopod 5, exopod; K, pleopod 5, endopod.

Appendix masculina not apparent in form of endopodal cuticle, but visibly forming along internal margin beneath cuticular surface.

Non-ovigerous female: Resembling subadult male excepting primary sexual characteristics and form of pleon. Posterior margin of pleon obtuse, weakly deflected posteriorly in midline; apex of angle with a slight posterior bulge. Rudimentary oostegites present on pereonites 1, 2, 3 and 4.

Remarks

This species is easily separated from other species of *Cilicaeopsis* by the tridentate nature of the pleonal process of the adult male.

Cilicaeopsis granulata appears to be a deep water species occurring off the east and south coasts of Australia from the Great Australian Bight north to Queensland and the Coral Sea.

Material examined

Queensland: Coral Sea (26°33'S, 153°31'E), on gravel, depth 86 m, 5 adult ♂♂, 3 subadult ♂♂, 13 non-ovigerous ♀♀, 2 juveniles (CM), coll. "Galathea" (Station 539), 05.xi.1951; 9 miles north-east of One Tree Island, Capricorn Group, on mud overlying shell and dead coral, depth 175 m, 1 adult ♂ (AM: p.25007), coll. B. Goldman *et al.*, July 1969; trawled off Cape Moreton, depth 119 m, 1 adult ♂ (QM: W.3342), coll. D. Harris; trawled off Moolodaba, 1 adult ♂ (QM: W.5737), coll. S. Midgeley, June 1967.

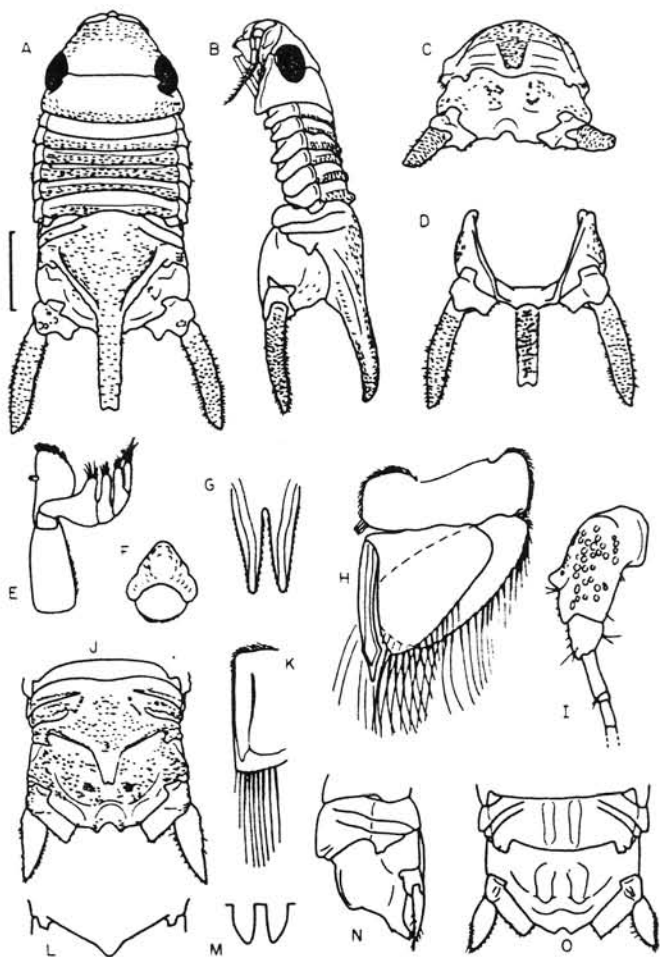
Cilicaeopsis whiteleggei (Stebbing, 1905)
(Figs 24, 25)

Cilicaea whiteleggei Stebbing, 1905: 39, 40, 62, pl. 9.

Cilicaeopsis whiteleggei: Richardson, 1910b: 29; Hale, 1929b: 35; Nierstrasz, 1931: 206-208.

Description

Adult male (from Halifax Bay) (Fig. 24A-I): *Cilicaeopsis* with dorsal surface of cephalosome bearing low tubercles in anterior half. Each pereonite with posterior half of tergite bearing low tubercles; posterior margin of pereonite 7 weakly bilobed. Median dorsal surface of pleon bulbous, with low tubercles; posterior margin, median to points of articulation with pleotelson, extended posteriorly, converging evenly to subapical region of pleotelson. From subapical region of pleotelson, pleon bearing a posteriorly directed process subequal in length to anterior pleon; lateral margins of process subparallel, apex emarginate and slightly downturned. Process and anterior pleonal bulge bearing low tubercles. Pleotelson with a small group of tubercles either side of midline; posterior margin truncate with a shallow median notch; notch smoothly curved, lacking a median tooth, lateral margins extending posteriorly just beyond rest of posterior margin, producing two short blunt teeth. Appendages—peduncle article 1 of A₁ 1.5 times length of articles 2 and 3 together, tuberculate, with a blunt inferior tooth in distal half; article 2 short; article 3 narrow, cylindrical: 9-articled flagellum extending to level of pereonite 1. A₂ slender, 13-articled flagellum extending to level of pereonite 2. Epistome lambdoid, tuberculate, tapering to a narrowly rounded apex. Mnds each with incisor process smoothly rounded. Mx₁ with inner lobe bearing four pectinate spines increasing in size from external to internal, and one very short, external, terminal seta; outer lobe with a group of curved spines, some being pectinate. Mx₂ with two outer lobes each bearing approximately seven simple spines; inner lobe with approximately nine plumose spines. Mxpd with palp articles lacking superior setae. Prpds moderately slender. Prpd 1 with basis and ischium each bearing a superior median spine; merus with superior distal lobe bearing one short stout spine, inferior margin bearing a pad of very short setae and two inferior and two infero-distal spines; carpus with an inferior pad of short setae and two inferior spines; propodus with three inferior spines; spines on propodus and infero-distal spine of carpus appear sub-apically serrulate. Subsequent prpds more slender with merus, carpus and propodus bearing inferior fringes of fine setae and slender spines. Penes each 3½ times as long as broad, tapering to a narrowly rounded apex and bearing microtrichia. Basis of plpd 1 bearing four internal



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 Figure 24. *Cilicapsis whiteleggi* (Stebbing). Adult male (from Halifax Bay), 4.05 mm: A, dorsal; B, lateral; C, posterior; D, pleotelson, ventral; E, maxilliped; F, epistome and labrum; G, penes; H, pleopod 2; I, peduncle and proximal flagellar articles of antennule. Subadult male (from Lizard Island): J, pleon and pleotelson, dorsal; K, inner margin of endopod of pleopod 2; M, penes. Immature male (from Lizard Island): L, posterior margin of pleon. Ovigerous female (from Halifax Bay): N, pleon and pleotelson, lateral; O, pleon and pleotelson, dorsal. Scale line represents 1 mm.

coupling hooks; endopod subtriangular; exopod $1\frac{1}{2}$ times length of endopod, truncate, bearing one marginal, proximal, external spine. Plpd 2 with basis bearing three internal coupling hooks; endopod subtriangular, just shorter than exopod; exopod subelliptical, truncate. Appendix musculina broad, just longer than endopod; lateral margins proximally subparallel; at level of endopodal apex, margins dilating with an obtuse angle at each side; distal to dilation, margins converging to a short, narrow, apical extension with a narrowly rounded tip. Plpd 3 with basis bearing three internal coupling hooks; endopod broad, apically truncate; exopod $1\frac{1}{2}$ times length of endopod, apically truncate with a complete subterminal articulation. Plpd 4 with endopod narrow, bearing one short apical spine; exopod subtriangular with a complete articulation in distal half. Plpd 5 with endopod subreniform, apex broadly rounded; exopod

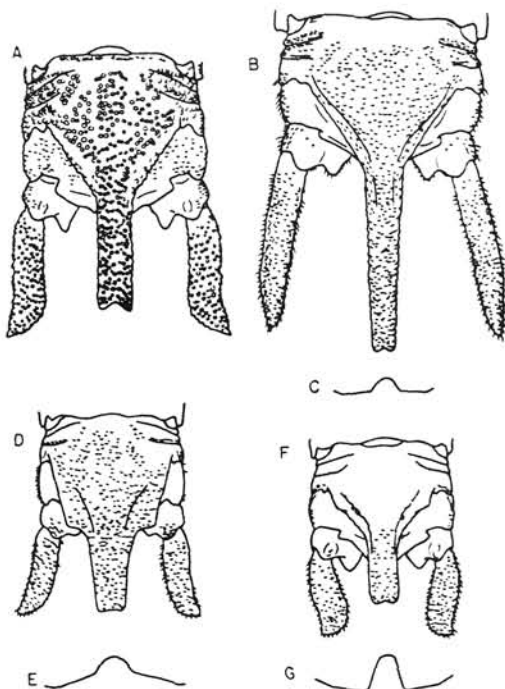


Figure 25. *Cilicacopsis whiteleggei* (Stebbing). Variation shown by adult male specimens from different localities. A, dorsal (from "north of Wistari Reef") (pleotelsonic apex damaged); B, dorsal, and C, apical pleotelsonic notch (from Lizard Island); D, dorsal, and E, apical pleotelsonic notch (from Bennett Island, Chesterfield Reefs); F, dorsal, and G, apical pleotelsonic notch (from Heron-Wistari Channel). All specimens drawn to same scale.

narrow with a complete subterminal articulation. Uropod with endopod reduced, as long as broad with external margin concave and apex weakly emarginate; exopod cylindrical, tuberculate, five times as long as broad tapering distally to an acute, slightly out-turned apex.

Subadult male (from Lizard Island) (Fig. 24J, K, M): Dorsal surface of body weakly tuberculate. Posterior margin of pleon converging in anterior quarter of pleotelson, bearing a short median process which extends to mid-point of pleotelson; process tapering slightly to a rounded apex bearing a median notch. Pleotelson tuberculate over most of surface, bearing a small pronounced group of tubercles each side of midline; tubercles sparse in subapical region. Uropod with endopod twice as long as broad, subrectangular; exopod flat, lanceolate, twice as long as endopod. Penes each as long as broad, tapering slightly to a rounded apex. Appendix masculina not apparent in form of endopodal cuticle, but visibly forming within endopod along internal margin.

Ovigerous female (from Halifax Bay) (Fig. 24N, O): Body smooth. Pleon with a low longitudinal ridge either side of midline. Pleotelson with a longitudinal ridge either side of anterior midline; apex with a smoothly rounded median notch. Uropod with rami lamellar, subequal; endopod subrectangular; exopod lanceolate, blunt.

Non-ovigerous female (from Heron Island): Similar to ovigerous female in dorsal view, but body granulose; pleon tumid in mid-region; pleotelson with

small, scattered, acute tubercles; and apex of uropodal exopod slightly out-turned.

Immature male (from Lizard Island) (Fig. 24L): As non-ovigerous female in dorsal view but with uropodal rami subequal in length and posterior margin of pleon bearing a short, weak posterior projection.

Remarks

The immature male of *C. whiteleggei* bears some resemblance to *C. laevis* Nierstrasz from Indonesia (which was apparently founded on an immature or sub-adult male specimen). However, *C. laevis* differs in having the pleotelson smoothly domed—lacking ridges—and in having the uropodal exopod longer than the endopod.

Adult males of *C. whiteleggei* appear to show a remarkable capability for variation in the form of the pleon and uropods. Nierstrasz (1931: 207) illustrated some of the variation for his specimens from Indonesia. The Queensland specimens described here show a similar variation (Fig. 25), even between specimens occurring in close geographical proximity. This variation is more marked than any variation found in any other sphaeromatid species described in the present work, but the factors controlling such variation are not known. All the adult males collected from Halifax Bay showed the same form (Fig. 24A). Specimens resembling the Halifax Bay material were collected from Heron Island, yet specimens collected from the channel between Heron Island and Wistari Reef showed a markedly different configuration (Fig. 25F). Although noticeably different specimens have never been collected in the same sample, the different variants do not appear to represent different species (the specimens are similar in the form of the appendages, and a wide range of forms occurs, not a small number of distinct forms). Intensive, detailed sampling of this species needs to be carried out in an effort to discover the factors related to this remarkable variation.

Cilicæopsis whiteleggei appears to be a predominantly sublittoral species occurring in Sri Lanka (the type-locality); the Philippines; Indonesia; and NE Australia and the Coral Sea. In Queensland it has been found associated with sublittoral sand and coral rubble.

Material examined

Queensland: Bennett Island, Chesterfield Reefs, Coral Sea (19°55.3'S, 158°23'E), coral rock on lagoon fringe, depth 1 m, 1 adult ♂ (QM. W.8076), coll. N. L. Bruce, 08.v.1979; Lizard Island (14°40'S, 145°30'E), Osprey Inlet, from sand on reef rocks with clumps of hard and soft coral and rubble, depth 6 m, 2 juveniles (AM. P.27019), coll. P. Weate, 17.iv.1978; Lizard Island, lagoon entrance, between Bird Islet and Trawler Beach, fine sand, depth 15.2 m, 2 adult ♂♂, 5 immature ♂♂ (AM. P.28824, 28825), coll. J. K. Lowry & P. C. Terrill, 05.x.1978; Lizard Island, off Southern Point, Mermaid Cove, from sand between coral outcrops, depth 6.1 m, 1 immature ♂ (AM. P.28828), coll. C. Short & P. C. Terrill, 08.x.1978; Lizard Island, 100 m horizontally offshore from Freshwater Beach, sand, depth 1.5 m, 1 adult ♂, 1 immature ♂ (AM. P.28829), coll. C. Short, 10.x.1978; Lizard Island, off Chinaman's Ridge, fine sand, depth 12.2 m, 1 immature ♂ (AM. P.28835), coll. J. K. Lowry, 13.x.1978; Lizard Island, reef edge 200 m north-west of Palfrey Island, sand at base of reef.

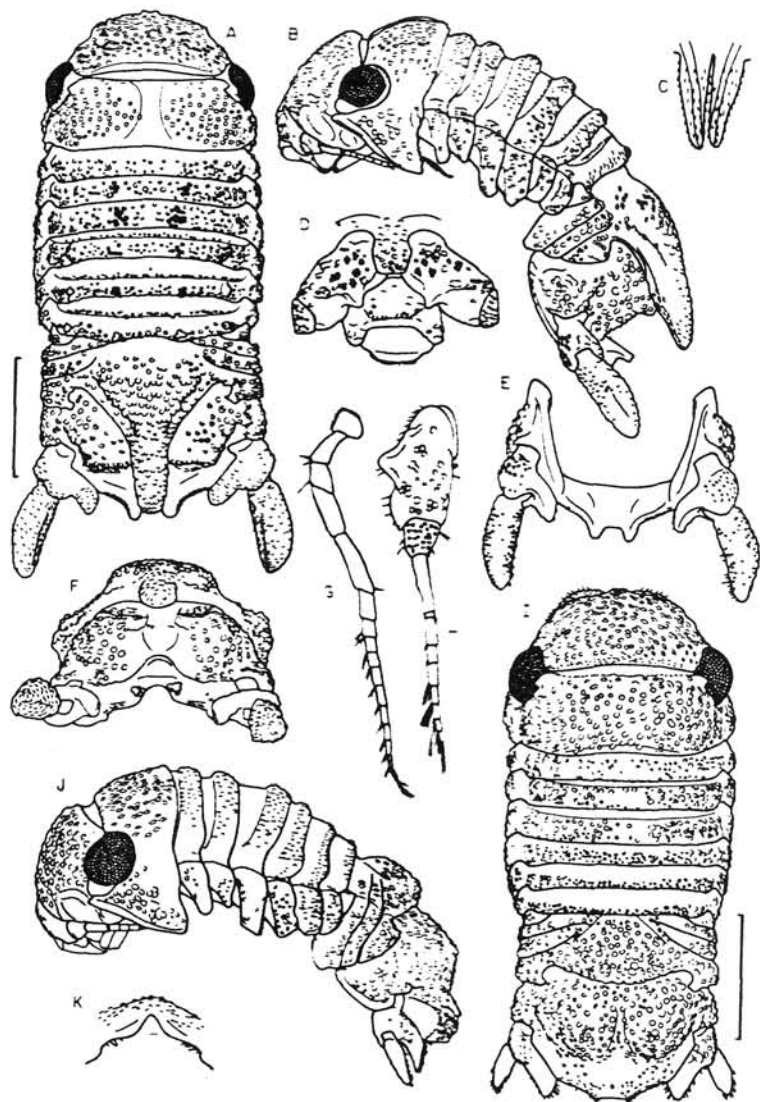
depth 12.2 m, 1 subadult ♂ (AM: P.28838), coll. J. K. Lowry, 16.x.1978; Lizard Island, reef edge 200 m north-west of Palfrey Island, filamentous alga from sandy area, depth 9.1 m, 3 immature ♂♂ (AM: P.28839), coll. P. C. Terrill, 16.x.1978; near Lizard Island, 1 mile south-west of Eagle Island, sand and rubble at reef base, depth 12.2 m, 3 immature ♂♂ (AM: P.28840, 28843), coll. J. K. Lowry & A. R. Jones, 17.x.1978; Halifax Bay, Townsville (19°2.5'S, 146°31.5'E), soft mud on sandy mud, depth 10.8 m, 3 adult ♂♂, 1 sub-adult ♂, 2 immature ♂♂, 1 ovigerous ♀, 1 juvenile (NUZ), James Cook University Three Bays Survey, 23.xi.1976 & 23.ii.1977; Heron Island, Capricorn Group (23°25'S, 151°55'E), reef flat, 300 m horizontally from beach rock, 1 adult ♂ (QM: W.8066), coll. N. L. Bruce, 08.i.1979; Heron Island, 2 non-ovigerous ♀♀ (NUZ), coll. A. J. Bruce; Heron-Wistari Channel, depth 18.3 m, 4 adult ♂♂, 8 ovigerous ♀♀ (QM: W.9650), coll. A. J. Bruce, 30.viii.1980; North Wistari Reef, near Heron Island, 1 km from reef crest, medium coarse sand, depth 24.4 m, 1 adult ♂ (QM: W.7895), coll. D. Fisk, 1977; North Wistari Reef, from surface of skeleton of *Heteropsammia* sp. on sand, depth 24.4 m, 2 adult ♂♂, 1 ovigerous ♀ (NUZ), coll. D. Fisk, 18.vii.1978; north of Wistari Reef, on bryozoan, depth 24.4 m, 1 adult ♂, coll. D. Fisk, 16.ix.1978.

***Cilicaeopsis glebosa*, sp. nov.**

(Figs 26, 27)

Description (Halifax Bay specimens)

Adult male: *Cilicaeopsis* with dorsal surface of cephalosome and pereonite 1 covered with small, blunt, prominent tubercles: pereonite 1 with a shallow, median, longitudinal depression. Pereonites 2-7 each bearing small tubercles in posterior half; pereonites 3-7 each with four small equidistant groups of slightly more pronounced tubercles along posterior margin; pereonite 7 with posterior margin weakly bilobed. Pleon covered with small tubercles; antero-median region bulbous; posterior margin, median to points of articulation with pleotelson converging evenly to mid-point of pleotelson. From mid-point of pleotelson, pleon bearing a posteriorly directed process; process extending to level of pleotelsonic apex, lateral margins subparallel, but tapering slightly dorso-ventrally; apex of process smoothly rounded in dorsal view. Pleotelson with a large, tuberculate, angular boss either side of midline; apex medially extended with a smoothly curved median notch lying between two prominent, blunt, posteriorly directed teeth. Dorsal surface of pleotelson with a thick, pronounced, semi-circular, postero-dorsally directed 'shelf'; shelf overhanging proximal region of apical notch. Appendages— A_1 with peduncle article 1 longer than articles 2 and 3 together; article 2 short; articles 1 and 2 tuberculate; article 1 with one large, prominent, median, ventral, conical tooth which overlaps epistome; article 3 slender, cylindrical; 9-articled flagellum extending to pereonite 1. A_2 slender, 11-articled flagellum extending to level of pereonite 3. Epistome broad, lambdoid, tuberculate, apically truncate. Mnds each with incisor process broadly rounded. Mx_1 with internal lobe with four pectinate spines increasing in length from external to internal; outer lobe bearing 10 curved spines, several being pectinate. Mx_2 with each outer lobe bearing six fine spines; inner lobe bearing a row of plumose spines. $Mxpd$ with palp articles lacking superior setae. $Prpds$ moderately slender. $Prpd$ 1 with



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 Figure 26. *Cilicaeopsis glebosa* sp. nov. Adult male Paratype, 4.23 mm: A, dorsal; B, lateral; C, penes; D, epistome and labrum, and proximal peduncles of antennules; E, pleotelson, ventral; F, posterior; G, antenna; H, antennule; Non-ovigerous female Paratype, 4.1 mm: I, dorsal; J, lateral; K, apex of pleotelson, posterior. Scale line represents 1 mm in each case.

ischium bearing one short, superior, median spine; merus with superior distal lobe bearing one short spine, inferior margin bearing three stout spines; carpus bearing two long, stout, inferior spines; propodus with three stout inferior spines. Prpds 2-7 more slender with ischium, merus and carpus bearing short superior spines, and merus, carpus and propodus bearing short inferior spines. Penes each three times as long as broad, tapering gradually to a narrowly rounded apex; surface bearing numerous microtrichia. Plpd 1 with endopod subtriangular; exopod $1\frac{1}{2}$ times length of endopod with apex truncate. Plpd 2 with rami as in plpd 1 except endopod relatively slightly longer. Appendix

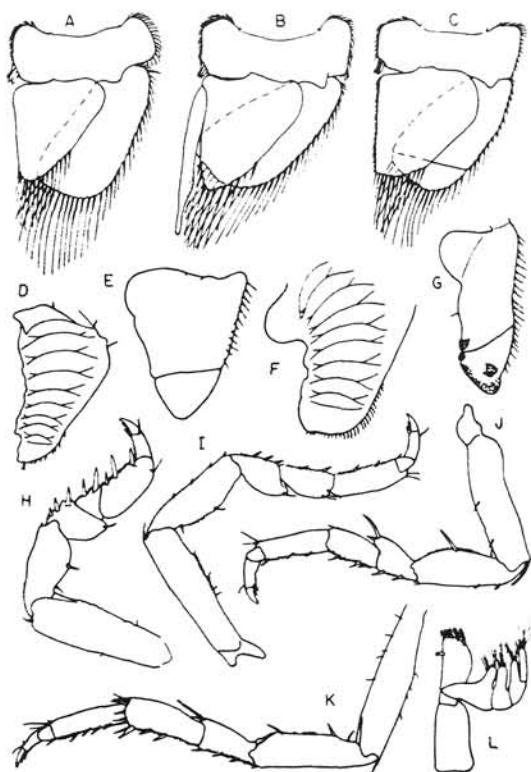


Figure 27. *Cilicaeopsis glebosa* sp. nov. Adult male (Paratype): A-C, pleopods 1, 2 and 3 respectively; D, pleopod 4, endopod; E, pleopod 4, exopod; F, pleopod 5, endopod; G, pleopod 5, exopod; H-K, pereopods 1, 2, 4 and 7 respectively; L, maxilliped.

masculina linear, $1\frac{1}{2}$ times length of endopod, proximally broad with lateral margins sub-parallel to level of endopodal apex; at level of endopodal apex external margin dilating slightly and bearing microtrichia; beyond level of endopod appendix margins converging to a narrow process with lateral margins subparallel and apex narrowly rounded. Plpd 3 with endopod broad, just shorter than exopod, with apex broadly truncate; exopod apically broad with a complete sub-terminal articulation. Bases of plpds 1-3 each bearing three internal coupling hooks. Plpd 4 with endopod narrow, apex acute; exopod subtriangular with a complete subterminal articulation. Plpd 5 with endopod subreniform, with a slight internal, apical, marginal deflection; exopod narrow with a complete subterminal articulation. Uropod with endopod reduced, dorsally tuberculate, posterior margin concave, anterior margin convex, apex narrowly rounded, not extending posteriorly to level of pleotelsonic apex; exopod subcylindrical, tuberculate, internal margin linear, external margin convex, apex narrowly rounded, distal half of ramus extending beyond pleotelsonic apex.

Non-ovigerous female: Cephalosome and pereonite 1 covered with small blunt tubercles. Pereonites 2-7 each with posterior half of tergite covered with small tubercles. Pleon medially bulbous, dorsal surface covered with small tubercles, posterior margin weakly arcuate. Pleotelson almost twice as broad as long with

a slight longitudinal median depression producing a low bulge either side of midline; dorsal surface covered with small tubercles except postero-laterally (where endopod of uropod slides over surface) and subapically in midline. Apex of pleotelson in dorsal view only slightly extended posteriorly in midline; in posterior view, apex bearing a notch as deep as wide with a smoothly rounded margin. Uropod with endopod subrectangular with an oblique apex extending to level of pleotelsonic apex, proximal region bearing dorsal tubercles; exopod lanceolate, blunt, just shorter than endopod.

Ovigerous female: Resembling non-ovigerous female in dorsal view.

Etymology

Cilicaeopsis plus Latin *glebosa*, i.e. full of lumps.

Remarks

Cilicaeopsis glebosa sp. nov. is easily separated from other species of *Cilicaeopsis* by its relatively shorter, smoothly rounded pleonal process and by the possession of a prominent projection anterior to the pleotelsonic notch.

Cilicaeopsis glebosa is known only from the shallow sublittoral region on particulate substrata in Queensland.

Material examined

Holotype: Adult ♂, 4.23 mm (QM: W.9646), Halifax Bay, Townsville, Queensland (19°9.5'S, 146°42.5'E), muddy sand, depth 2.7 m, coll. James Cook University Three Bays Survey, 24.ii.1977.

Paratypes: *Queensland*: From type locality, collection details as for holotype, 1 ovigerous ♀ (QM: W.9647): Halifax Bay (19°5.5'S, 146°34.5'E), particulate substratum, depth 7 m, 1 adult ♂ (QM: W.9647), coll. James Cook University Three Bays Survey, 23.vii.1974; Halifax Bay (19°7.5'S, 146°42.5'E), sandy mud, depth 6.8 m, 1 adult ♂, 1 non-ovigerous ♀ (QM: W.9647), coll. James Cook University Three Bays Survey, 24.xi.1976; Halifax Bay (19°0.5'S, 146°33.5'E), particulate substratum, depth 11 m, 1 non-ovigerous ♀ (NUZ), coll. James Cook University Three Bays Survey, 23.ii.1977; Moreton Bay half a mile south of South-west rocks, Peel Island, sand, shell and grit, depth 9.3 m, 1 adult ♂ (QM: W.3743), coll. W. Stephenson & S. Cook, Sept. 1971.

Cilicaeopsis furculata, sp. nov.

(Fig. 28)

Description

Adult male: *Cilicaeopsis* with dorsal surface of cephalosome and pereonite 1 covered with low tubercles. Pereonites 2-7 each with posterior half bearing one transverse row of low tubercles. Pleon covered with low tubercles except for narrow transverse anterior band. Posterior margin of pleon, lateral to each point of articulation with pleotelson, bearing a short, prominent, acute process; medial to points of articulation, margin directed postero-medially but turning posteriorly at mid-point of pleotelson, producing a broad, posteriorly directed process. Process broader than deep, tuberculate, extending just beyond level of pleotelsonic apex to a bifid tip; process ventrally slightly concave in lateral view, dorsally convex. Pleotelson tuberculate with a large angular boss either side of