

NEW EUBRANCHIATE SPHAEROMATID ISOPODS FROM QUEENSLAND WATERS

K. HARRISON
and

D.M. HOLDICH

Department of Zoology, The University, Nottingham NG7 2RD, England

ABSTRACT

A number of new eubranchiate sphaeromatid isopods are described from the mainland coast and offshore islands of Queensland. *Neonaesa rugosa*, gen. nov., sp. nov. and *Pseudocerceis furculata*, gen. nov., sp. nov. are recorded from a number of coral reefs, whilst *Pistorius bidens*, gen. nov., sp. nov. occurs in beach rock crevices on Heron Island. The genus *Cerceis* Milne-Edwards is represented by three species, two being new, which occur on littoral and sub-littoral algae and amongst coral rubble. *Paradynamene benjamensis* Richardson has been synonymised with *Cerceis bidentata* var. *aspericaudata* Miers, which in turn has been raised to full specific status as *C. aspericaudata*. *Haswellia carnea* (Haswell) is recorded from Queensland for the first time, as is *Paracerceis sculpta* (Holmes). This latter record is the first time *P. sculpta* has been recorded in Australia.

INTRODUCTION

The marine isopod fauna of Queensland is very diverse and isopods are common in some habitats (Holdich and Harrison, 1980a, b, c; 1981a, b; Holdich *et al.*, 1981; Harrison and Holdich, 1982). This is especially true for eubranchiate sphaeromatids in the littoral zone, with species of *Sphaeromopsis* Holdich and Jones and *Dynamenella* Hansen being common in sandy habitats, and *Paradella* Harrison and Holdich and *Dynamenella* species being common in rock crevices and empty barnacle tests (Holdich and Harrison, 1981b; Harrison and Holdich, 1982). *Dynamene curalii* Holdich and Harrison has been found inhabiting intertidal and sublittoral coral (Holdich and Harrison, 1980c), and a species of *Ischyromene* Racovitza has been recorded from southern Queensland (Harrison and Holdich, 1982). Nine additional species of eubranchiate Sphaeromatidae have been recognized from Queensland, and these are described in the present paper. The collecting methods are as described in Harrison and Holdich (1982). The following abbreviations are used below: SEQ, South East Queensland; QM Queensland Museum; AM Australian Museum. The codes following QM or AM are the registered numbers of the specimens in those museums. Any specimen not allocated a

museum registration number has been placed in a collection in the Department of Zoology at the University of Nottingham.

SYSTEMATICS

Order Isopoda

Family Sphaeromatidae

Sub-family Dynameninae

NEONAESA, gen. nov.

GENERIC DIAGNOSIS

Eubranchiate Sphaeromatidae with antennular peduncle article 1 not extended anteriorly as a plate. Both sexes with pereon and pleon lacking processes. Pleon with posterior margins bearing two short, weak, sutures at each side. Exopod of pleopod 5 bearing a large apical squamose boss and two smaller, internal squamose bosses. Lateral margins of pleotelson extending ventrally well beyond level of pereonal margins. Uropodal rami not lamellar, exopod extending beyond the highly reduced endopod. Sexual dimorphism obvious. **Adult male** with penes short, widely separate. Appendix masculina short, arising in distal half of

endopod of pleopod 2. Pleotelson apex with a wide, shallow indentation completely filled by a broad lobe bearing a short median slit. Uropod with exopod thick, longer than that of female, tapering distally. Maxillipedal palp articles 2 to 4 bearing long, setigerous lobes. **Ovigerous female** with mouthparts strongly metamorphosed. Brood pouch formed from four pairs of oostegites arising from pereopods 1 to 4, increasing in size posteriorly and overlapping well in mid-line. Ventral pockets and pouches absent, but brood displaces sternites to fill cephalosome, pereon and pleon. Apex of pleotelson slightly extended with a vertical notch. Exopod of uropod shorter than that of adult male, narrow, terete.

ETYMOLOGY: *Neonaesa*, from the Greek *neos* meaning 'new', + *Naesa* (feminine). (*Naesa* being the name given to specimens of male *Dynamene* Leach in the past (see Holdich, 1968)).

TYPE SPECIES: *Neonaesa rugosa*, sp. nov.

ADDITIONAL SPECIES: none.

REMARKS

This genus bears some resemblance to the genus *Dynamene* but male specimens lack dorsal processes and have a lobed pleotelsonic apex, not an enclosed terminal foramen. They also possess an appendix masculina, do not have peduncle article 2 of the antennule acutely extended, and have the uropodal endopod greatly reduced. Ovigerous female specimens of *Neonaesa* differ from those of *Dynamene* by having a simple pleotelsonic notch, not an enclosed foramen; peduncle article 2 of the antennule simple, not acutely extended; the uropodal endopod reduced; the maxillipedal endite and palp less reduced; and by having the maxilla clearly lobed. *Neonaesa* does not closely resemble any other eubranchiate genus.

NEONAESA RUGOSA, sp. nov.

MATERIAL EXAMINED

HOLOTYPE: Queensland Museum QM W7956, adult male, 2.3 mm, from intertidal reef flat, Heron Island, Queensland (23°25'S, 151°55'E), N.L. Bruce, 8 January 1979.

PARATYPES: QM W7958, ovigerous female, subadult male, immature specimen, same data as Holotype. QM W8046, W8049, W8052, W8053, W8056, W8058, W8062-67, W8069-71, W8073, 216 adult males, 22 subadult males, 69 ovigerous females, 51 immature specimens and non-

ovigerous females, 27 juveniles, from inner reef flat, dead coral, intertidal, Heron Island, SEQ, N.L. Bruce, 23-30 May 1978 and 28 December 1978 to 15 January 1979. QM W8583, W8585-86, 23 adult males, 5 subadult males, 4 ovigerous females, 3 immature specimens, lagoon and 'Canyons', depth 3 to 7 m, Heron Island, SEQ, N.L. Bruce, 27 November 1979 to 8 December 1979. QM W8576, W8580-81, 22 adult males, 5 subadult males, 7 ovigerous females, 1 immature specimen, 1 juvenile, southwest edge, east face and reef slope, depth 11 to 21 m, Wistari Reef, Capricorn Group, N.L. Bruce, 30 November 1979 to 4 December 1979. Australian Museum AM P26994, adult male, ovigerous female, in coral reef rocks, west side of Palfrey Island (off Lizard Island), P. Hutchings and P. Weate, 12 January 1976. AM P26972-85, 21 adult males, 5 subadult males, 4 ovigerous females, 4 immature specimens, lagoon drop off, in coral rocks, depth 7.7 m, Lizard Island, Queensland (14°40'S, 145°30'E), P. Hutchings and P. Weate, 16 January 1976 to 6 November 1976. AM P26986-93, 5 adult males, 1 subadult male, 3 immature specimens, coral reef rocks, depth 3.7 m, Chinaman's Head, Lizard Island, P. Hutchings and P. Weate, 17 January 1976 to 7 November 1976. AM P26051, adult male, coral reef rock, depth 6 m, reef off North Point, Coconut Beach, Lizard Island, P. Hutchings and P. Weate, 17 January, 1975. AM P26058-9, 2 adult males, coral reef rocks, northeast face, Lizard Island, P. Hutchings and P. Weate, 6 January 1975. AM P28827, P28837, P28842, 3 immature specimens, Lizard Island. AM P26004-9, P26030, P26037, 7 adult males, immature specimen, on coral reef rocks, depth 2 to 5 m, back reef of Yonge Reef, P. Hutchings and P. Weate, 7 February 1975. AM P26015, P26020, P26026, 2 adult males, immature specimen, on coral reef rocks, depth 13 to 27 m, outer reef of Yonge Reef, P. Hutchings and P. Weate, 10-19 January 1975. QM W8078, subadult male, reef crest, in coral rock, North Cay, Chesterfield Reefs, Coral Sea (19°48'S, 158°17'E), N.L. Bruce, May 1979. Heron Island, inner reef flat, intertidal dead coral, 3 adult males, D.M. Holdich, 8-11 April 1976. Heron Island, reef flats on brown algae from live coral, immature specimen, G. Hartmann, 3 February, 1976. North Reef, Capricorn Group, lagoon 8 adult males, 1 subadult male, immature specimen, juvenile, N.L. Bruce, 7 June 1978. Lodestone Reef, Great Barrier Reef, dead coral, 7 adult males, 8 subadult males, ovigerous female, 7 immature specimens, 2 juveniles, T. Pearson,

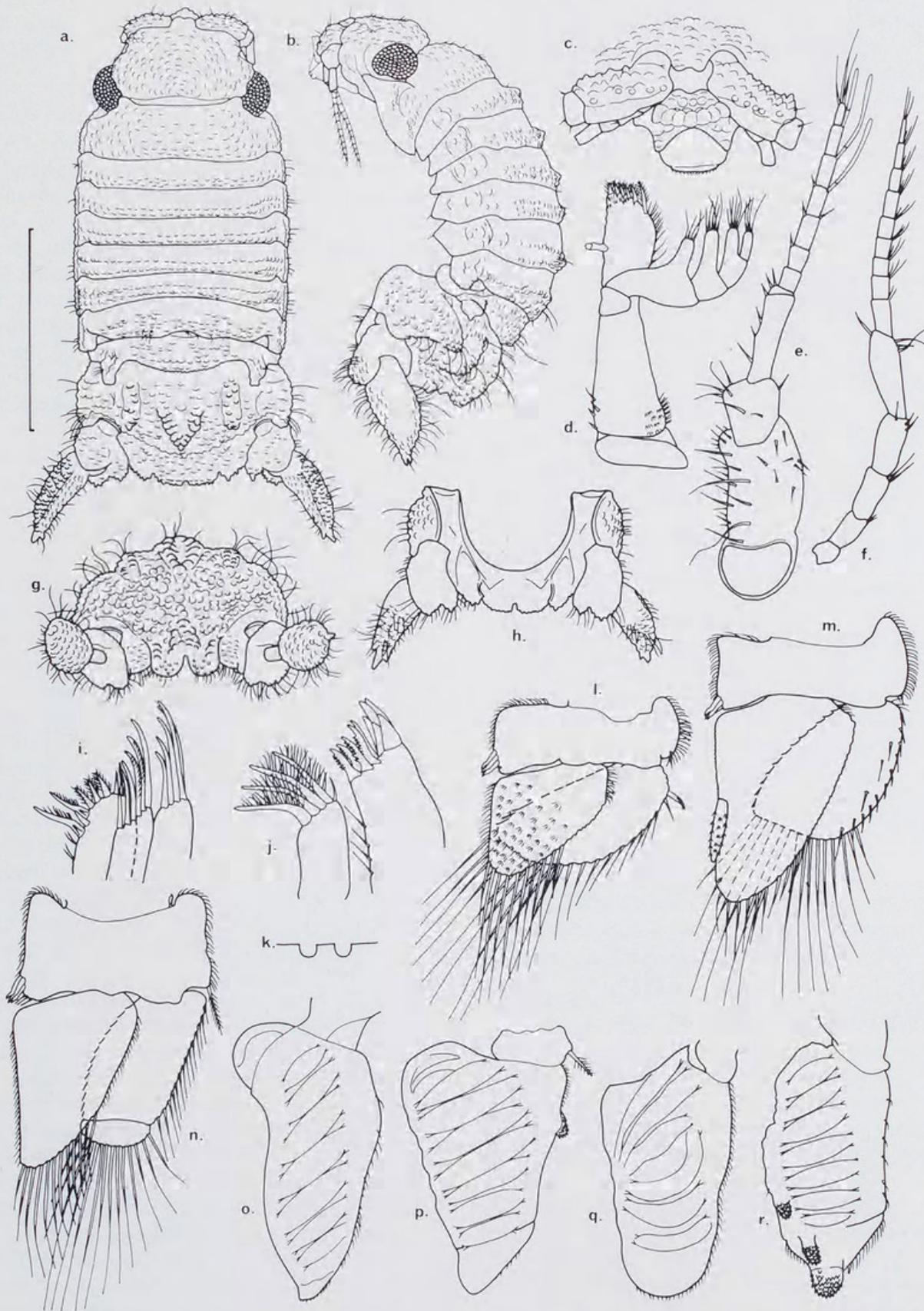


FIG. 1. *Neonaesa rugosa*, gen. nov., sp. nov. Adult male (a) dorsal, (b) lateral, (c) cephalosome, anterior, (d) maxilliped, (e) antennule, ventral, (f) antenna, (g) pleotelson, posterior, (h) pleotelson, ventral, (i) maxilla, (j) maxillule, (k) penes, (l–n) pleopods 1 to 3 respectively, (o) pleopod 4, endopod, (p) pleopod 4, exopod, (q) pleopod 5, endopod, (r) pleopod 5, exopod. Scale line represents 1 mm.

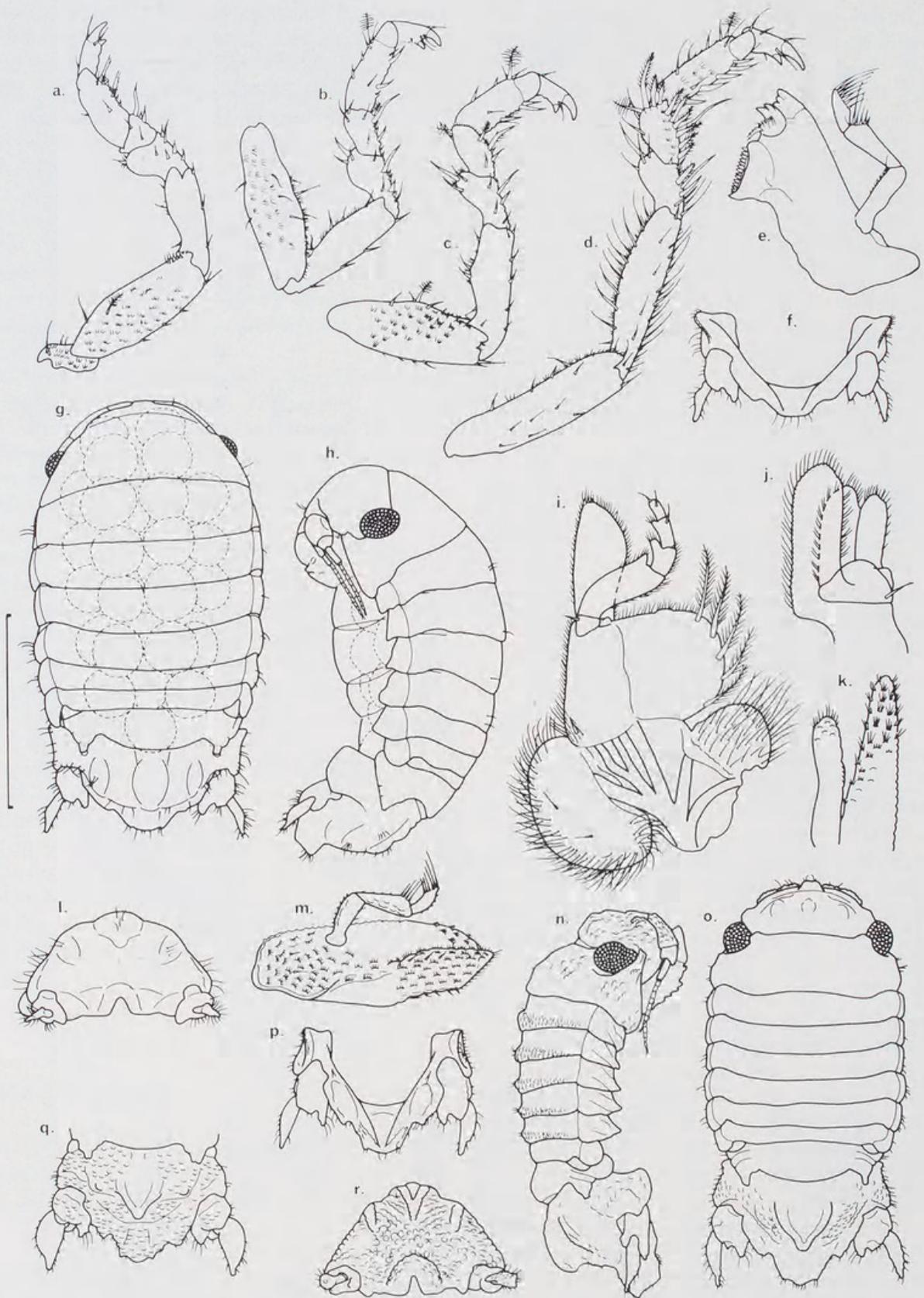


FIG. 2. *Neonaesa rugosa*, gen. nov., sp. nov. Adult male (a-d) pereopods 1, 2, 4 and 7 respectively, (e) left mandible. Oviparous female (f) pleotelson, ventral, (g) dorsal, (h) lateral, (i) maxilliped, (j) maxilla, (k) maxillule, (l) pleotelson, posterior, (m) mandible. Non-oviparous female (n) lateral, (o) dorsal, (p) pleotelson, ventral, (q) pleotelson, posterior. Subadult male (q) pleotelson. Scale represents 1 mm.

August 1976, Mellish Reef, lagoon, on dead coral, depth 6 m, immature specimen, N.L. Bruce, 1 May 1979.

DESCRIPTION

ADULT MALE: (Figs 1, 2a–e). Dorsal surface of body granular. Eyes large, lateral. Epistome with an uneven, transverse ridge. Coxal plates with lateral margins acute. Pleotelson with three uneven, longitudinal ridges, the central being broad anteriorly and tapering to an acute, raised point posteriorly. Posterior margin of pleotelson with three indentations — giving the impression of a broad notch completely filled by a bi-lobed expansion. Dorsal surface of pleotelson, anterior to the median notch, with slight longitudinal ridge.

APPENDAGES: antennule with article 1 of peduncle superiorly tuberculate, not bearing long, acute, distal extensions; article 2 subquadrate; article 3 slender; 8-articled flagellum extending to level of pereonite 2. Antenna subequal in length to antennule with 9-articled flagellum. Mouthparts of usual sphaeromatid form, unmodified; maxillipedal palp articles 2 to 4 bearing pronounced setigerous lobes. Pereopods moderately slender; merus, carpus and propodus bearing long inferior spines. Ischium of each of the posterior pereopods bearing superior and inferior setae. Penes widely separate, each as long as broad with a semi-circular tip. Basis of pleopod 1 with three internal coupling hooks; anterior surface of endopod bearing numerous microtrichia. Pleopod 2 with exopod truncate, shorter than subtriangular endopod; posterior surfaces of both rami bearing microtrichia (not illustrated). Appendix masculina short, cigar-shaped, bearing microtrichia, arising mid-way along internal margin of endopod and extending half-way to ramal apex. Exopod of pleopod 3 with a complete, subterminal articulation. Exopod of pleopod 5 with a subterminal, external, partial articulation. Uropod with endopod bearing an apical notch; exopod thick, granular, expanded dorsoventrally with an acute apex extending well beyond pleotelsonic apex.

COLOUR OF SPECIMENS IN ALCOHOL: cream, most specimens with very small black chromatophores sparsely distributed over dorsal surface. In life specimens are usually red in colour.

OVIGEROUS FEMALE, 2.2 mm: (Fig. 2f–m). Dorsal surface of body smooth. Cephalosome blunt, smoothly rounded. Pereon markedly domed; ova (when present) visible through dorsal body wall. Pleotelson with three low, longitudinal ridges; apex extended, with a simple lambdoid notch. Uropodal endopod narrow with an external

notch; exopod just longer than endopod, narrow, cylindrical, tapering to an acute tip. Mouthparts strongly metamorphosed; mandible partially fused to cephalosome, tip angular with a longitudinal ridge; maxillule with two long, simple lobes; maxilla with three simple lobes; maxilliped with palp reduced, endite expanded proximally as three setose lobes.

NON-OVIGEROUS FEMALE: (Fig. 2n–p, r). Body finely granular (especially obvious in lateral view). Cephalosome with three weak ridges. Pleotelson with a prominent, central, posteriorly tapering boss, and a weak lateral ridge on each side. Apex extended with a simple lambdoid notch. Uropods as in ovigerous female.

SUBADULT MALE: (Fig. 2q). As non-ovigerous female, but exopod of uropod dilated. No obvious penes. Appendix masculina not separate from endopod of pleopod 2, but visible beneath cuticle, partially separated from the endopodal tissue by a suture.

ETYMOLOGY: *Rugosa*, from the Latin *Rugosus* meaning wrinkled.

ECOLOGY AND DISTRIBUTION

This species is known from coral habitats on the offshore islands and reefs along the Queensland coast. It appears to be one of the commonest isopods in this region, occurring both intertidally and sublittorally. Its life style may be similar to that of *Dynamene curalii*, which also occupies coral habitats in Queensland. Both species are strongly sexually dimorphic, and the ovigerous females have reduced mouthparts. As with *D. curalii* juveniles and young adults probably feed on algae associated with corals whilst the mature adults take up a more cryptozoic existence for the reproductive phase of the life-cycle.

REMARKS

In dorsal view *N. rugosa* resembles *Geocereis barbarae* Menzies and Glynn, 1968 but *Geocereis* has the sutures of the pleon reaching the lateral margins; the pleotelson lacking a central boss; pleopod 2 of the adult male of a very different form; and the pleotelson and uropods of females of different form.

Cassidias africana Barnard bears some resemblances to *N. rugosa* but in the adult male the pleotelson bears only one very extended process and the appendix masculina extends well beyond the apex of the pleopodal endopod. The brood pouch of *C. africana* is formed by three pairs of oostegites arising from pereopods 2, 3 and 4, but the brood is housed in internal pouches (K. Harrison pers. obsv.).

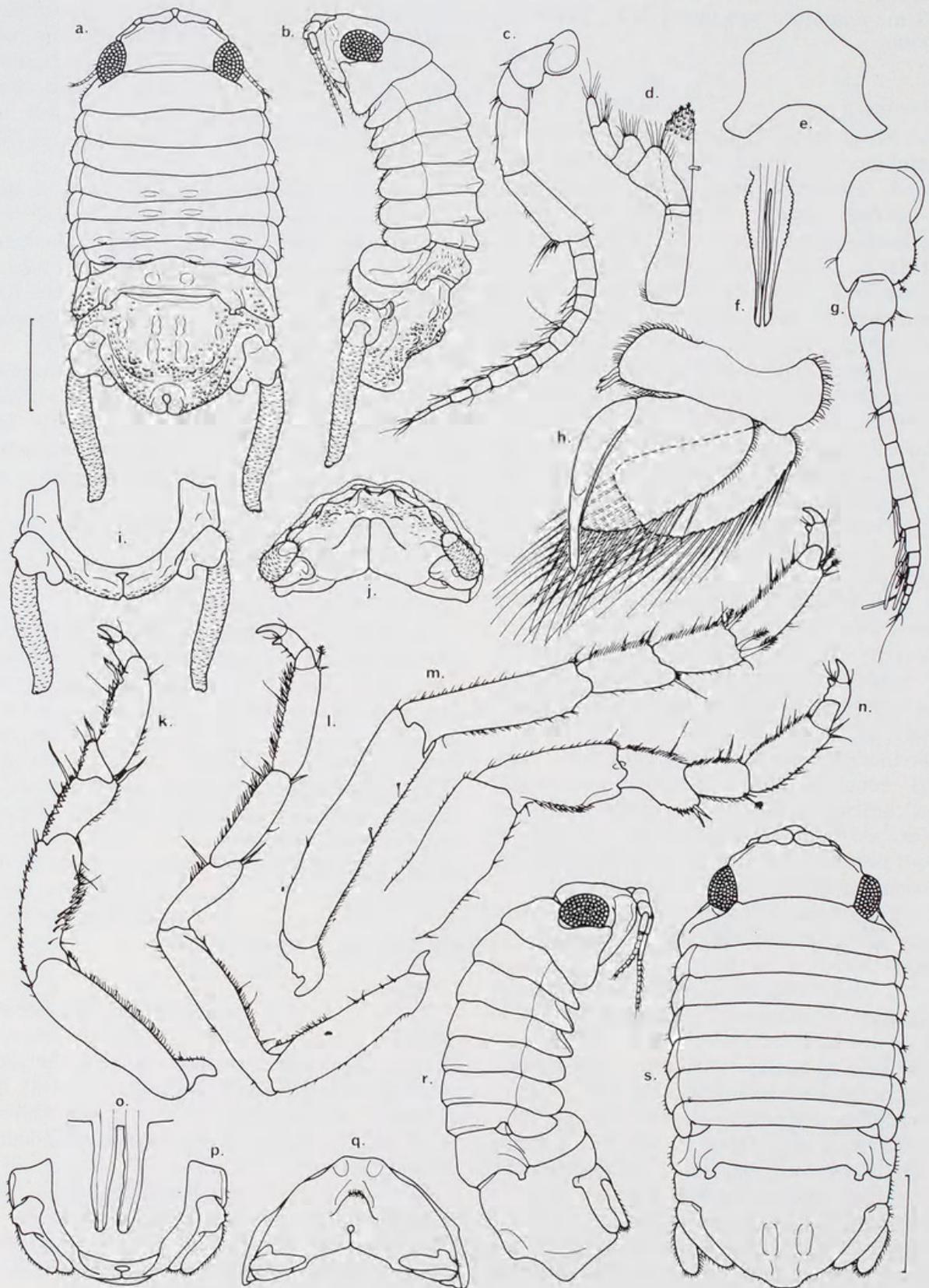


FIG. 3. *Pistorius bidens*, gen. nov., sp. nov. Adult male (a) dorsal, (b) lateral, (c) antenna, (d) maxilliped, (e) epistome, (f) penes, (g) antennule, (h) pleopod 2, (i) pleotelson, ventral, (j) pleotelson, posterior, (k–n) pereopods 1, 2, 7 and 4 respectively. Subadult male (o) penes. Ovigerous female (p) pleotelson, ventral, (q) posterior, (r) lateral, (s) dorsal. Each scale line represents 1 mm.

PISTORIUS, gen. nov.

GENERIC DIAGNOSIS

Eubranchiata Sphaeromatidae with antennular peduncle article 1 not extended anteriorly as a plate. Both sexes with pereon and pleon lacking processes. Pleon with posterior margin bearing two short sutures at each side. Maxillipedal palp articles 2 to 4 bearing weak, setigerous lobes. Exopod of pleopod 5 with a low apical boss, an extended subapical boss and a low internal boss. Lateral margins of pleon and pleotelson extending ventrally well beyond level of pereonal margins. Sexual dimorphism obvious. **Adult male** with penes long, tapering, fused at base. Appendix masculina arising from internoproximal angle of endopod of pleopod 2 and extending beyond ramal apex. Pleotelsonic apex with an enclosed, dorsally directed foramen. Uropodal endopod reduced; exopod subcylindrical, extending well beyond pleotelsonic apex. **Ovigerous female** with mouthparts not metamorphosed. Brood pouch lacking oostegites, formed from two opposing ventral pockets covering the entire ventral pereon and opening in the midline between the fourth pereopods. Apex of pleotelson with a tall vertical face bearing a posteriorly directed foramen connected to the ventral margin by a closed slit. Uropodal rami lamellar, narrow, subequal.

ETYMOLOGY: *Pistorius*, from the Latin *pistor*, meaning 'baker' + the ending *-ius* (masculine). (Named in honour of W.H. Baker).

TYPE SPECIES: *Pistorius bidens*, sp. nov.

ADDITIONAL SPECIES: none.

REMARKS

This genus resembles species of *Dynamenella* but differs in the form of the adult male uropods which have subequal, flattened rami in *Dynamenella*, and in the deep posterior closure of the pleotelsonic foramen. The type species *P. bidens*, sp. nov. is larger than species of *Dynamenella* (see Harrison and Holdich, 1982).

PISTORIUS BIDENS, sp. nov.

MATERIAL EXAMINED

HOLOTYPE: Queensland Museum QM W7962, adult male, 4.35 mm, under slabs of beach rock intertidal (high water neap level), Heron Island, SEQ, N.L. Bruce, 8 December, 1979.

PARATYPES: QM W7963, ovigerous female, data as for holotype. QM W8584, 10 adult males, subadult male, 12 ovigerous females, non-

ovigerous female, 2 juveniles, data as for holotype. Heron Island, beach rock crevice, upper shore, subadult male, 2 ovigerous females, non-ovigerous female, D.M. Holdich, 14 April 1976.

DESCRIPTION

ADULT MALE: (Figs 3a-n, 4). Dorsal surface of cephalosome and pereon smooth. Eyes large, lateral. Epistome short, tip narrowly rounded. Pereonal tergites 4 to 7 each bearing a transverse posterior ridge. Pleon granulose, bearing a low tubercle either side of midline. Pleotelson granulose with two elongate tubercles either side of midline forming irregular longitudinal ridges, and three separate tubercles lateral to each ridge. Apex of pleotelson with a small, elliptical, dorsally-directed foramen, enclosed posteriorly by a long vertical slit.

APPENDAGES: antennular peduncle article 1 as long as 2 and 3 together, not bearing long, acute, distal extensions; article 2 subquadrate, article 3 slender; 11-articled flagellum extending to level of pereonite 1. Antenna slender, 13-articled flagellum extending to level of pereonite 2. Mouthparts of usual sphaeromatid form, unmodified; maxillipedal palp articles 2 to 4 bearing low setigerous lobes. Pereopods moderately slender; merus, carpus and propodus bearing inferior pads of fine setae, and several long setae; superior surface of ischium with short fine setae. Propodus of pereopod 1 with a stout, inferodistal, pectinate spine; carpus also with one stout inferodistal spine. Penes broad proximally, tapering distally to narrowly rounded tips; margins crenulate in proximal half. Basis of pleopod 1 with three internal coupling hooks; endopod subtrapezoidal, extending just beyond elliptical exopod. Pleopod 2 with exopod truncate, just shorter than subtriangular endopod. Appendix masculina 1.3 times length of endopod, broad proximally, tapering evenly to a narrowly rounded tip. Exopod of pleopod 3 lacking an articulation. Exopod of pleopod 4 with a partial subterminal external articulation. Exopod of pleopod 5 with a complete subterminal articulation. Uropod with endopod strongly reduced, narrow, subquadrate; exopod long, sinuous subcylindrical, granulose, with apex slightly indented.

COLOUR OF SPECIMENS IN ALCOHOL: cream or red-brown with black chromatophores scattered over entire dorsal surface. Chromatophores may be expanded, giving a grey mottled appearance, or contracted as small black spots.

OVIGEROUS FEMALE, 4-6 mm: (Fig. 3p-s). Dorsal surface of body smooth. Pleotelson with a weak, low ridge either side of midline. Apex of pleotelson with a deep, flat, posteriorly directed face bearing a small foramen connected to ventral margin by a slit. Uropodal rami subequal, lamellar, with rounded apices not reaching apex of pleotelson.

NON-OVIGEROUS FEMALE: as above but lacking brood pouch.

SUB-ADULT MALE: (Fig. 3o). Resembling a non-ovigerous female but bearing penes, separate to base and each 4-5 times as long as broad with a semi-circular tip. Endopod of pleopod 2 with apex slightly extended and an appendix masculina forming beneath the distal cuticle.

ETYMOLOGY: *Bidens*, from the Latin *bi* meaning 'two' + *dens* meaning 'prong'. This refers to the uropodal exopods.

ECOLOGY AND DISTRIBUTION

This species is known only from the upper shore beach rock crevices on Heron Island. It is usually found in crevices occupied by another eubran-
chiate sphaeromatid, *Dynamenella ptychura* Harrison and Holdich, 1982.

PSEUDOCERCEIS, gen. nov.

GENERIC DIAGNOSIS

Eubran-
chiate Sphaeromatidae with antennular peduncle article 1 not extended anteriorly as a plate. Anterior margin of cephalosome broadly rounded, not extended anteriorly to cover proximal regions of antennae; median rostral process directed anteroventrally. Rostral process and epistome visible in dorsal view when mouthparts directed anteriorly. Body noticeably convex; coxal plates directed ventrally. Both sexes with pereon and pleon lacking dorsal processes. Pleon with two long suture lines at either side, one reaching the posterolateral angle, and the other the posterior margin, of the pleonal tergite. Pleotelson bearing three prominent, longitudinal ridges. Antennular peduncle article 1 bearing acute distal processes. Maxillipedal palp articles 2 to 4 with pronounced setigerous lobes. Exopod of pleopod 5 bearing two subapical, extended, squamose bosses, one on either side of the ramus, and a smaller simple boss on the internal margin. Uropodal rami lamellar, exopod greater than half length of endopod. Sexual dimorphism slight or not obvious. **Adult male** with penes separate, short, with semicircular tips. Appendix masculina

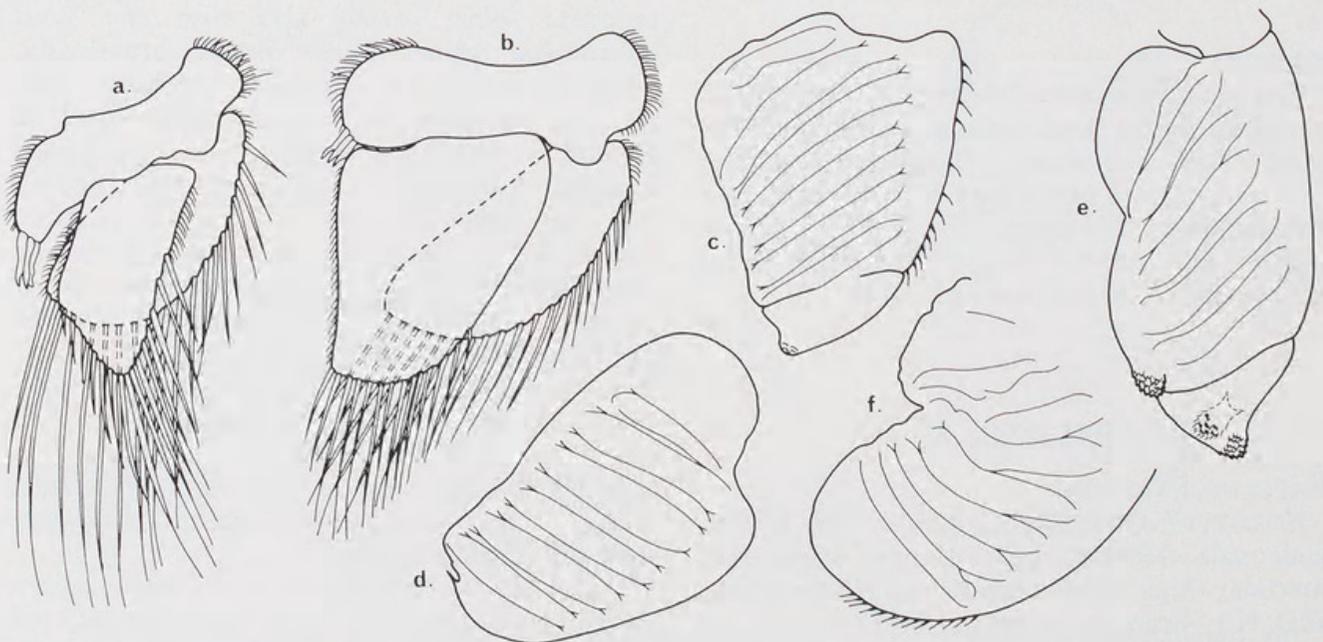


FIG. 4. *Pistorius bidens*, gen. nov., sp. nov. Adult male (a) pleopod 1, (b) pleopod 3, (c) pleopod 4, exopod, (d) pleopod 4, endopod, (e) pleopod 5, exopod, (f) pleopod 5, endopod.

arising from internal margin of endopod of pleopod 2, extending beyond ramal apex to semicircular tips. Apex of pleotelson with a notch which may or may not bear a median tooth. **Ovigerous female** with mouthparts metamorphosed. Brood pouch formed from four pairs of oostegites arising from bases of pereopods 1 to 4. Oostegites increasing in size posteriorly and clearly overlapping at midline. Embryos not held in the marsupium thus formed, but in four pairs of internal pouches. Ventral pockets absent.

ETYMOLOGY: *Pseudocerceis*, from the Greek *pseudo* meaning 'false' + *Cerceis* (feminine).

TYPE SPECIES: *Pseudocerceis furculata*, sp. nov.

ADDITIONAL SPECIES: *Pseudocerceis trilobata* (Baker), comb. nov. for *Cerceis trilobata* Baker, 1908 from Australia. *Pseudocerceis* sp. (see below).

REMARKS

In the form of the appendages, this genus is very close to *Cerceis* Milne-Edwards *sensu stricto*, but differs from it in not having the cephalosome flattened and projecting anteriorly to cover the proximal regions of the antennae, and in being markedly convex, not flattened. All known species of *Pseudocerceis* have three equally prominent projections on the pleotelson. *C. trilobata* Baker lacks the anteriorly extended cephalosome of *Cerceis sensu stricto* (see below) and agrees with the characteristics of *Pseudocerceis* as defined above.

PSEUDOCERCEIS FURCULATA, sp. nov.

MATERIAL EXAMINED

HOLOTYPE: Queensland Museum QM W7959, adult male, 5.52 mm, from intertidal reef flat, Heron Island, SEQ, N.L. Bruce, 15 January 1979.

PARATYPES: QM W7960, subadult male, ovigerous female, data as for holotype. QM W8046, W8049, W8052, W8053, W8058, W8059, W8065, W8067-69, W8072, W8073, 13 adult males, 2 subadult males, 8 ovigerous females, 8 non-ovigerous females, 7 immature specimens, 8 juveniles, intertidal reef flat, Heron Island, SEQ, N.L. Bruce, 5-15 January 1979. QM W8577, adult male, from alga at edge of reef flat, intertidal, Heron Island, SEQ, N.L. Bruce, 6 December 1979. QM W8579, 2 immature specimens, reef crest, boulder zone on north west side, Heron Island, SEQ, N.L. Bruce, 20 November 1979. QM W8578, 2 adult males, ovigerous female, juvenile, edge of reef crest on north east side, Heron Island, SEQ, N.L. Bruce, 6 December 1979. QM W8574, subadult male, reef

edge on north side, Heron Island, SEQ, N.L. Bruce, 4 December 1979. Australian Museum AM P28851, adult male, subadult male, short weed behind reef edge, north side, Wilson Island, Capricorn Group, Queensland (23°18'S, 151°55'E), W.F. Ponder, 4 January 1979. QM W8074, subadult male, on coral rocks in lagoon, depth 1 m, Long Island, Chesterfield Reefs, Coral Sea, N.L. Bruce, 4 May 1979. QM W8075, W8076, subadult male, non-ovigerous female, coral rock in lagoon fringe and reef fringe, depth 1 m, Bennett Island, Chesterfield Reefs (19°55.3'S, 158°23'E), N.L. Bruce, 8 May 1979. QM W8080, non-ovigerous female, coral rock, inner reef, depth 12 m, Bennett Island, N.L. Bruce, 6 May 1979. Heron Island, SEQ, adult male, on dead coral on inner reef flat, intertidal, D.M. Holdich, 11 April 1976. Heron Island, SEQ, adult male, 2 subadult males, non-ovigerous female, 6 immature specimens, 4 juveniles, on *Sargassum* sp., *Laurencia* sp., *Halimeda* sp., *Turbinaria* sp., D.M. Holdich, 13-14 April 1976. Heron Island, southwest reef, subadult male, 2 immature specimens, 4 juveniles, in surf zone at reef edge on algal 'cushions', G. Hartmann, 3 February 1976. Wilson Island, Capricorn Group, ovigerous female, non-ovigerous female, 4 immature specimens, N.L. Bruce, 7 June 1978. Tryon Island, adult male, reef crest, N.L. Bruce, 5 June 1978. Moffat Beach, Caloundra, SEQ, subadult male, N.L. Bruce, 22 June 1978.

DESCRIPTION

ADULT MALE: (Figs 5, 6a-e). Eyes large, lateral. Epistome lambdoid, postero-lateral margins distally dilated, anterior apex acute. Pereon and pleon smooth. Pleotelson granulose with three pronounced, tuberculate ridges; apex with shallow notch obscured by a terminal, subquadrate, extension. Apex of extension emarginate, setose.

APPENDAGES: antennular peduncle article 1 as long as articles 2 and 3 together with two subequal, acute, distal processes; article 2 as long as broad; article 3 three times as long as wide; flagellum with 13 articles, extending to level of pereonite 1. Antenna slender, 13-articled flagellum longer than peduncle, extending to level of pereonite 1. Mouthparts of usual sphaeromatid form, unmodified. Pereopods robust; merus, carpus and propodus bearing inferior pads of short setae. Merus, carpus and propodus of pereopod 1 each with several long, stout, simple spines; pereopods 2 to 7 with more slender spines. Penes each as long as broad. Basis of pleopod 1

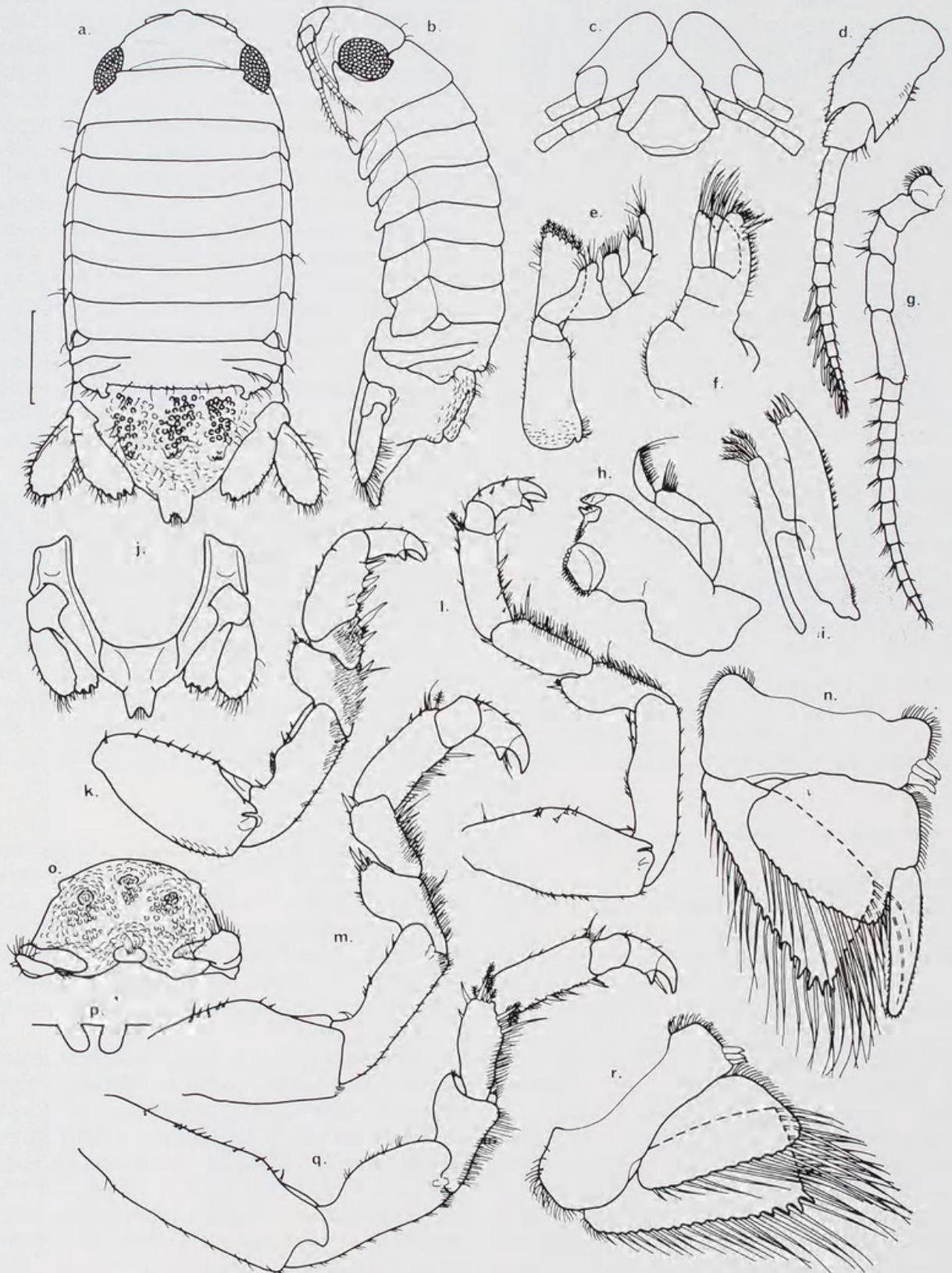


FIG. 5. *Pseudocerceis furculata*, gen. nov., sp. nov. Adult male (a) dorsal, (b) lateral, (c) epistome, labrum and penduncles of antennae, (d) antennule, (e) maxilliped, (f) maxilla, (g) antenna, (h) left mandible, (i) maxillule, (j) pleotelson, ventral, (k-m) pereopods 1, 2 and 4 respectively, (n) pleopod 2, (o) pleotelson, posterior, (p) penes, (q) pereopod 7, (r) pleopod 1. Scale line represents 1 mm.

with three internal coupling hooks; endopod short, subtriangular; exopod truncate with five external teeth. Pleopod 2 with endopod subtriangular, just shorter than truncate exopod; exopod bearing ten external teeth. Appendix masculina subequal in length to endopod, tapering slightly distally with apex rounded. Pleopod 3 with endopod subtriangular, subequal in length to subelliptical exopod; exopod without an articulation. Exopod of pleopod 4 with a proximal, external, triangular, toothed boss. Exopod of pleopod 5 with a complete, subterminal articulation. Uropodal rami subequal, subelliptical, not reaching level of pleotelsonic apex; distal margin of endopod irregularly dentate; distal margin of exopod weakly crenulate.

COLOUR OF SPECIMENS IN ALCOHOL: cream with dorsal surface of body covered with small brown chromatophores. Chromatophores also present on antennular peduncles, bases of pleopods, and uropods, but are absent from the pereopods. Some male specimens with chromatophores on ventral pereon, and pleotelson bearing dense chromatophores.

OVIGEROUS FEMALE, 4.6 mm: (Fig. 6f, i, k-n). Cephalosome short, strongly convex. Pleotelson with three low, longitudinal ridges, the central being the most prominent. Apex of pleotelson with a ventral notch overhung by a short, broad tooth. Antennae as in adult male. Mouthparts metamorphosed. Mandible fused proximally with cephalosome, apex as a simple lobe; palp unmodified, fully formed. Maxillule with two simple lobes lacking long setae. Maxilla with three simple lobes lacking long setae. Maxilliped with palp reduced, extending only to apex of endite, lobes on articles 2 to 4 lacking long setae; endite proximally expanded as one internal lobe with fine marginal setae, a small external lobe with long plumose setae and a longer external lobe with fine marginal setae. Pereopods lacking dense inferior pads of setae. Pleopods as in adult male (but lacking appendix masculina). Uropods with rami subequal in length, extending to level of pleotelsonic tip with apices rounded, dentate.

SUBADULT MALE: (Fig. 6g, h, j). In dorsal view, resembling ovigerous female but cephalosome less convex and pleotelsonic apex with blunt median tooth more pronounced. This tooth shows variation in size between individuals and in larger forms may be weakly bifid. Penes as low, separate papillae. Tissue of appendix masculina can be seen differentiating beneath cuticle of endopod of pleopod 2.

NON-OVIGEROUS FEMALE: As subadult male (excepting primary sexual characteristics) but median tooth of pleotelsonic apex short.

ETYMOLOGY: *Furculata*, Latin meaning 'with a small fork'.

ECOLOGY AND DISTRIBUTION

Apart from one specimen recorded from Caloundra, a mainland site, this species has only been recorded from islands off the Queensland coast and in the Coral Sea. It has mainly been found associated with intertidal coral or algae on reef flats.

REMARKS

In dorsal view the male of this species bears some resemblance to illustrations of *Holotelson tuberculatus* Richardson. Examination of specimens of *H. tuberculatus* in collections of the British Museum shows this species to be generically distinct. The genus *Holotelson* Richardson is closely related to the genus *Dynamenopsis* Baker and *H. tuberculatus* has a thick, heavily calcified cuticle, and the incisor process of the mandible is smoothly rounded. The pleopods of *H. tuberculatus* lack marginal teeth and are not of cerceid form. The female of *H. tuberculatus* was described by Vanhöffen (1914: 56-59) as his 'new species', *Cassidias trituberculata*.

PSEUDOCERCEIS sp.

MATERIAL EXAMINED

Lodestone Reef (east of Townsville), Queensland, adult male, ovigerous female, non-ovigerous female, 3 immature specimens, 5 juveniles, from dead coral and algae in reef flat pools, intertidal, I. Price, 1976.

DESCRIPTION

ADULT MALE: (Fig. 6o, p, r, s). This specimen is anteriorly badly damaged. Pleotelson granulose bearing three pronounced tuberculate ridges; apex with a shallow notch obscured by an extended, terminal process. Process twice as long as broad with short, dorsal setae, lateral margins parallel, apex upturned, deeply emarginate, setose. Pleopod 2 with exopod bearing six external teeth; appendix masculina subequal in length to endopod, internal margin bearing, a long, shallow indentation in distal half, apex broadly rounded. Uropod with endopod subelliptical, not extending as far as pleotelsonic apex, external margin serrate, distal margin irregularly dentate; dorsal surface with

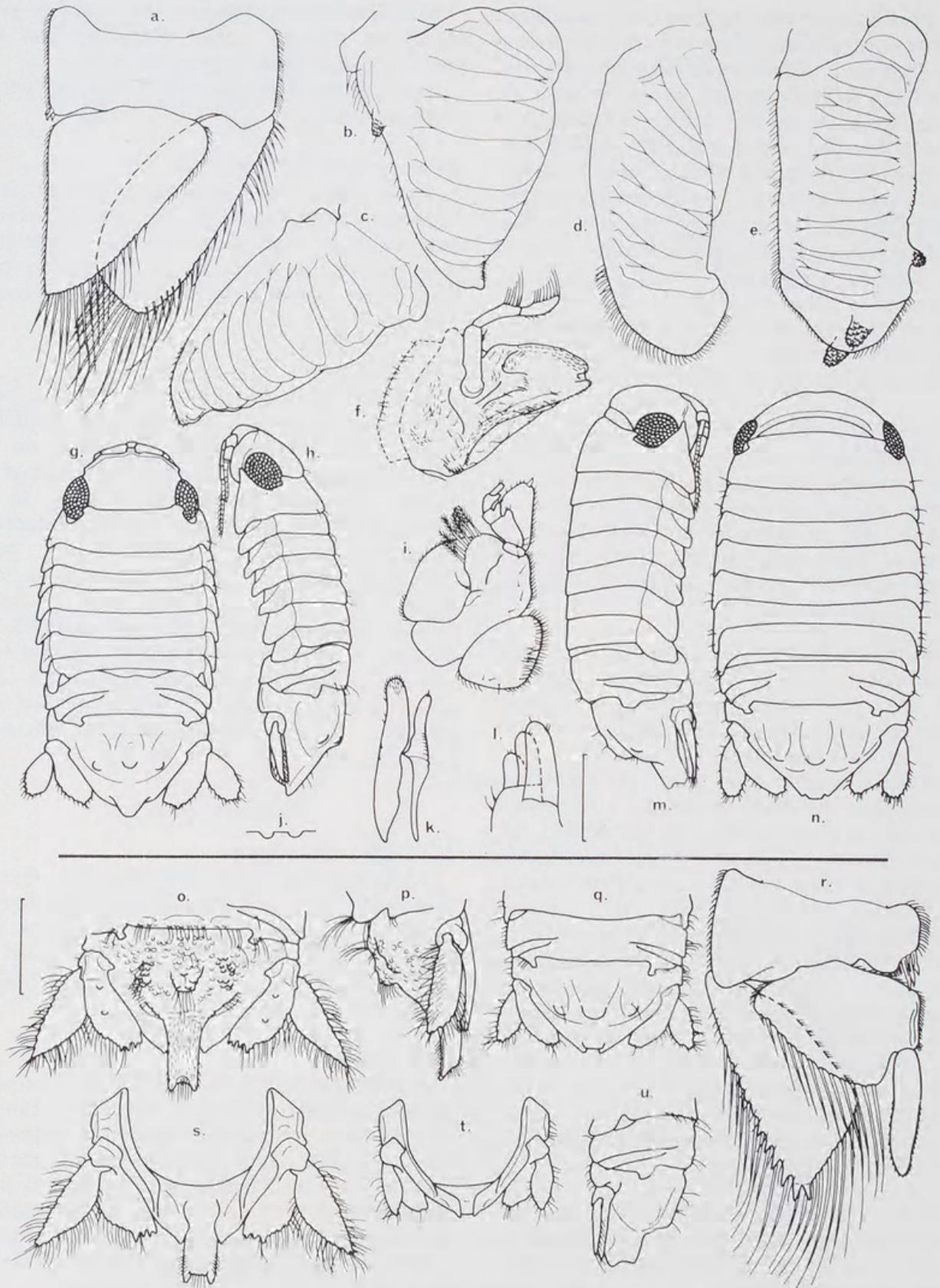


FIG. 6. *Pseudocerceis furculata*, gen. nov., sp. nov. Adult male (a) pleopod 3, (b) pleopod 4, exopod, (c) pleopod 4, endopod, (d) pleopod 5, endopod, (e) pleopod 5, exopod. Ovigerous female (f) right mandible, (i) maxilliped, (k) maxillule, (l) maxilla, (m) lateral, (n) dorsal. Subadult male (g) dorsal, (h) lateral, (j) penes. *Pseudocerceis* sp. Adult male (o) pleotelson, (p) pleotelson, lateral, (r) pleopod 2, (s) pleotelson, ventral. Ovigerous female (q) pleon and pleotelson, dorsal, (t) pleotelson, ventral, (u) pleon and pleotelson, lateral. Scale line represents 1 mm.

one proximal and one median tubercle; exopod longer than endopod, narrowly lanceolate; margins of both rami bearing long setae.

OVIGEROUS FEMALE: (Fig. 6q, t, u). As ovigerous female of *P. furculata* sp. nov., but pleotelsonic notch more pronounced with median tooth shorter, and apex of uropodal exopod slightly acute.

ECOLOGY AND DISTRIBUTION

Known only from dead coral and algae on Lodestone Reef, east of Townsville.

REMARKS

This species is clearly separated from *P. furculata*, sp. nov. by its longer pleotelsonic process and lanceolate uropodal exopod. Unfortunately the only adult male seen was extensively damaged and the authors do not consider it wise to fix this male as the type specimen by describing it as a new species.

CERCEIS Milne-Edwards, 1840

Cerceis Milne-Edwards, 1840: 220, 221.

Paradynamene Richardson, 1905: 305.

New synonym.

Circeis Baker, 1908: 153. — Nierstrasz, 1931: 215 (unjustified emendation).

GENERIC DIAGNOSIS

Eubranchiata Sphaeromatidae with antennular peduncle article 1 not extended anteriorly as a plate. Anterior margin of cephalosome narrowly rounded, extended anteriorly to cover proximal regions of antennae. Median rostral process directed posteroventrally; rostral process and epistome never visible in dorsal view. Body markedly flattened, not strongly domed; coxal plates closely applied forming a continuous lateral margin. Both sexes with pereon and pleon lacking dorsal processes. Pleon with two long suture lines at each side, one reaching the posterolateral angle, and the other the lateral margin, of the pleonal tergite. Antennular peduncle article 1 bearing acute distal processes. Maxillipedal palp articles 2 to 4 with pronounced setigerous lobes. Exopod 5 bearing two subapical, extended, squamose bosses, one either side of the ramus, and a smaller boss — simple or bifid — on the internal margin. Uropodal rami lamellar, exopod greater than half length of endopod. Sexual dimorphism not pronounced. **Adult male** with penes separate, short, with semicircular tips. Appendix masculina arising from internal margin of endopod of pleopod 2, extending beyond ramal apex to a

semicircular tip. Apex of pleotelson with a notch which may or may not bear a median tooth.

Ovigerous female with mouthparts metamorphosed. Brood pouch formed from four pairs of oostegites arising from bases of pereopods 1 to 4. Oostegites increasing in size posteriorly and overlapping well in the midline. Brood not housed in the marsupium thus formed (cf. Hansen, 1905: 108) but in four pairs of internal pouches. Ventral pockets absent.

TYPE SPECIES: *Cerceis tridentata* Milne-Edwards, 1840 (from Australia)

- ADDITIONAL SPECIES: *Cerceis bidentata* Milne-Edwards, 1840 (from Australia)
Cerceis acuticaudata (Haswell, 1882) (from Australia)
Cerceis picta Nierstrasz, 1931 (from Philippines)
Cerceis bicarinata Barnard, 1936 (from the Andaman Islands)
Cerceis granulata Pillai, 1954 (from India)
Cerceis orientalis (Dana, 1853) (immature specimens) (from Singapore)
Cerceis aspericaudata Miers, 1884, comb. nov. (from Australia)
Cerceis pravipalma, sp. nov.
Cerceis pustulosa, sp. nov.

REMARKS

Other species currently in the genus *Cerceis* are not obviously members of this group. *Cerceis trilobata* Baker, 1908 has been transferred to the genus *Pseudocerceis* above. *Cerceis carinata* Glynn, 1970, from Venezuela, differs in the form of the pleonal sutures, the penes and the appendix masculina; article 1 of the antennular peduncle lacks the acute processes; and the cephalosome is not extended anteriorly to cover the antennae. In the three remaining species, all from Australia, (*Cerceis trispinosa* Haswell, 1882; *Cerceis obtusa* Baker, 1908; and *Cerceis ovata* Baker, 1926) the cephalosome does not extend anteriorly to cover the antennae and the pleon is much shorter than in

specimens of *Cerceis sensu stricto*. The correct generic placement of these species is at present unknown.

CERCEIS PUSTULOSA, sp. nov.

MATERIAL EXAMINED

HOLOTYPE: Queensland Museum QM W7964, adult male 11.0 mm, on sub-littoral algae and lower shore algae, Alma Bay, Magnetic Island, Townsville, Queensland (19°10'S, 146°50'E), D.M. Holdich, 9 July 1976.

PARATYPES: QM W7965, subadult male, 6 non-ovigerous females, 3 immature specimens, 3 juveniles, same data as holotype. Picnic Bay, Magnetic Island, in coral rubble, intertidal, juvenile, D.M. Holdich, 17 March 1976. Horseshoe Bay, Magnetic Island, from floating *Sargassum* sp., 3 immature specimens, D.M. Holdich, 24 April 1976.

DESCRIPTION

ADULT MALE: (Fig. 7a-j, m). *Cerceis* with eyes large, lateral. Epistome lambdoid with sinuous lateral margins and an acute apex. Each pereonal tergite with posterior margin bearing a lateral row of short setae. Dorsal surface of pereonite 7 laterally granulose. Pleon and pleotelson covered with short setae. Pleon posteriorly granulose. Pleotelson with a low, anteromedian, finely granulose boss bearing a prominent posterior tubercle, and a long tuberculate protuberance each side of the median boss. Apex of pleotelson with a deep notch, filled by a large, blunt, triangular, granulose, overhanging process, extending beyond level of notch opening; at each side of proximal region of process is a small circular foramen.

APPENDAGES: antennular peduncle article 1 longer than articles 2 and 3 together with two acute distal processes enclosing article 2, the inferior process being longer than the superior; article 2 short with a short, curved, posterior tooth; article 3 slender, curved; 17-articled flagellum extending to level of pereonite 1. Antenna slender, flagellum extending to level of pereonite 3. Mouthparts of usual sphaeromatid form, unmodified. Pereopods robust; merus, carpus and propodus bearing inferior pads of short setae. Merus, carpus and propodus of pereopod 1 with an inferior row of long simple spines. Penes each three times as long as broad. Basis of pleopod 1 with three internal coupling hooks; endopod short, subtriangular; exopod truncate with 10 pronounced external teeth. Pleopod 2 with

endopod subtriangular; exopod truncate with 17 pronounced external teeth. Appendix masculina just longer than endopod; broad proximally, tapering to mid point; distal half with lateral margins subparallel; apex narrowly rounded, curved slightly towards animal's midline. Exopod of pleopod 3 with a complete subterminal articulation. Exopod of pleopod 4 with a triangular, proximal, external toothed boss. Exopod of pleopod 5 with one small, internal, marginal, toothed boss and two larger subterminal bosses. Endopod of uropod superiorly granulose and setose in external half; extending beyond pleotelsonic apex with distal margin irregular, anterodistal and posterodistal angles bearing posteriorly directed processes; exopod longer than endopod, broadly lanceolate with an acute apex; ventral surface of endopod convex, granulose.

COLOUR OF SPECIMENS IN ALCOHOL: cream with a single transverse row of faint chromatophores along the posterior margin of the tergite of pereonite 7.

SUBADULT MALE: (Fig. 7k, n, o, p, r). *Cerceis* with dorsal surface of body smooth. Each pereonal tergite with posterior margin bearing a row of short setae. Pleotelson dorsally setose with a low anteromedian boss and a low protuberance either side of this. Pleotelsonic apex with a broad notch filled by a broad median, triangular tooth extending beyond notch opening. Penes each twice as long as broad. Endopod of pleopod 2 with appendix masculina forming beneath cuticle, not externally visible. Endopod of uropod dorsally setose with distal margin irregular, anterodistal angles and posterodistal angles bearing posteriorly directed processes; exopod lanceolate with an acute tip and a serrate internodistal margin.

NON-OVIGEROUS FEMALE: (Fig. 7l, q). As subadult male (excepting primary sexual characters) but tooth in pleotelsonic notch short, extending only to level of notch opening.

ETYMOLOGY: *Pustulosa*, Latin meaning 'full of pimples'.

ECOLOGY AND DISTRIBUTION

Known only from Magnetic Island, Australia where it was collected from littoral and sub-littoral algae and coral rubble.

REMARKS

This species closely resembles *Cerceis granulata* from India but differs in the form of the dorsal pleotelsonic tuberculation; the shape of the uropodal exopod; the shape of the appendix masculina; and in having a relatively longer pleon.

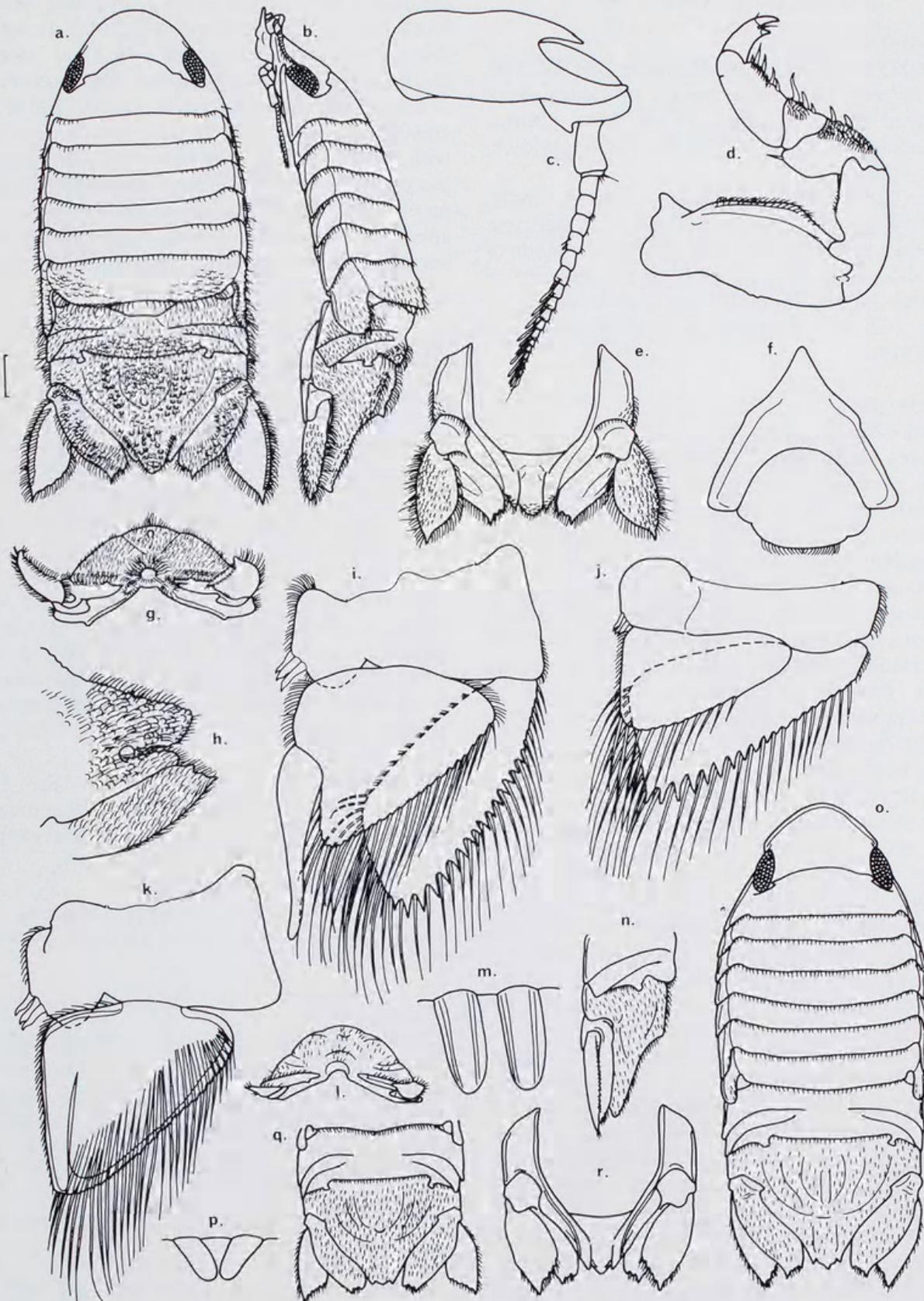


FIG. 7. *Cerceis pustulosa*, sp. nov. Adult male (a) dorsal, (b) lateral, (c) antennule, (d) pereopod 1, (e) pleotelson, ventral, (f) epistome and labrum, (g) pleotelson, posterior, (h) pleotelsonic apex, dorsolateral, (i) pleopod 2, (j) pleopod 1, (m) penes. Subadult male (k) pleopod 2 (exopod omitted), (n) pleotelson, lateral, (o) dorsal, (p) penes, (r) pleotelson, ventral. Non-ovigerous female (l) posterior, (q) pleon and pleotelson. Scale line represents 1 mm.

CERCEIS PRAVIPALMA, sp. nov.

MATERIAL EXAMINED

HOLOTYPE: Queensland Museum QM W7966, male, 6.9 mm, on *Sargassum* sp. on muddy shore with dead coral, mid-shore, Yule Point, Cairns, Queensland (16°51'S, 145°43'E), D.M. Holdich, 29 May 1976.

PARATYPES: QM W7967, subadult male, immature specimen, juvenile, data as for holotype. Australian Museum AM P28820 (+ microslide of pleopods), semi-moulted adult male, vicinity of Thursday Island, Torres Strait, Queensland, P.C. Young (CSIRO Fisheries and Oceanography), April 1979.

DESCRIPTION

ADULT MALE: (Figs 8a-i, k, l, 9a-f). *Cerceis* with eyes large, lateral. Epistome lambdaoid with sinuous lateral margins and an acute apex. Each pereonal tergite with posterior margin bearing a lateral row of short setae. Lateral margins of body bearing long setae. Pleon and pleotelson covered with short setae. Pleon with posterior sutures restricted to posterior third; posterior margin with a row of small tubercles. Pleotelson granulose with a low median protuberance either side of midline and a smaller anteromedian boss. Apex of pleotelson with a deep, quadrate notch and a large triangular, blunt, median process not reaching level of notch opening.

APPENDAGES: antennular peduncle article 1 longer than articles 2 and 3 together with two acute distal processes enclosing article 2, the inferior process being longer than the superior; flagellum extending to level of pereonite 1. Antenna slender, flagellum extending to level of pereonite 3. Mouthparts of usual sphaeromatid form, unmodified. Pereopods robust; merus, carpus and propodus bearing inferior pads of short setae. Merus, carpus and propodus of pereopod 1 with an inferior row of long, stout, simple spines. These articles of pereopods 2 to 7 with fewer, less stout spines. Penes each four times as long as broad. Basis of pleopod 1 with three internal coupling hooks; endopod short, subtriangular; exopod long, truncate with four pronounced external distal teeth. Pleopod 2 with endopod broader than long; exopod truncate with 15 pronounced external teeth. Appendix masculina 1½ times length of endopod, narrow, tapering slightly to narrowly rounded apex with an external, subterminal indentation. Pleopod 3 with endopod subtriangular, elongate, subequal in length to subelliptical exopod; exopod with a complete, subterminal articulation. Exopod of

pleopod 4 with a triangular, proximal, external toothed boss. Exopod of pleopod 5 with a complete subterminal articulation and one small internal, marginal, toothed boss, and two larger subterminal bosses. Endopod of uropod superiorly granulose and setose, extending beyond pleotelsonic apex with distal margin irregular, anterodistal and posterodistal angles bearing posteriorly directed processes; exopod just longer than endopod with apex acute, lateral margins bearing long setae, dorsal surface concave, and internal margin distally notched and subapically crenulate.

COLOUR OF SPECIMEN IN ALCOHOL: cream, lacking chromatophores.

SUBADULT MALE: (Fig. 8j, m-o). *Cerceis* with dorsal surface of body smooth. Each pereonal tergite with posterior margin bearing a lateral row of short setae. Pleon with posterior sutures restricted to posterior third. Pleotelson dorsally setose with a low median protuberance either side of midline and a smaller anteromedian boss. Pleotelsonic apex with a shallow notch with a short, median, overhanging process. Penes each twice as long as broad. Endopod of pleopod 2 with appendix masculina forming beneath cuticle, not externally visible. Endopod of uropod dorsally setose, smooth, with posterodistal angle extended as an acute process; exopod broadly lanceolate, internal margin not notched or subapically crenulate.

ETYMOLOGY: *Pravipalma*, from the Latin *pravus* meaning 'deformed', + *palma* meaning 'an oar blade'. This refers to the uropodal exopod.

ECOLOGY AND DISTRIBUTION

Known only from intertidal seaweed near Cairns, and from the Torres Straits in Northern Queensland.

REMARKS

This species does not clearly resemble any of the known species. It can be distinguished from *C. pustulosa*, sp. nov. by its indented uropodal exopods; its shorter median, apical, pleotelsonic process; the form of the appendix masculina; and by its relatively longer pleon.

CERCEIS ASPERICAUDATA Miers, 1884 comb. nov.

Cerceis bidentata Milne-Edwards, var. *aspericaudata* Miers, 1884: 306, 307, 666, pl. 33.

Paradynamene benjamensis Richardson, 1905: 305-7. Nierstrasz, 1931: 212. Menzies and Frakenberg, 1966: 9. Schultz, 1969: 121.
New Synonym.

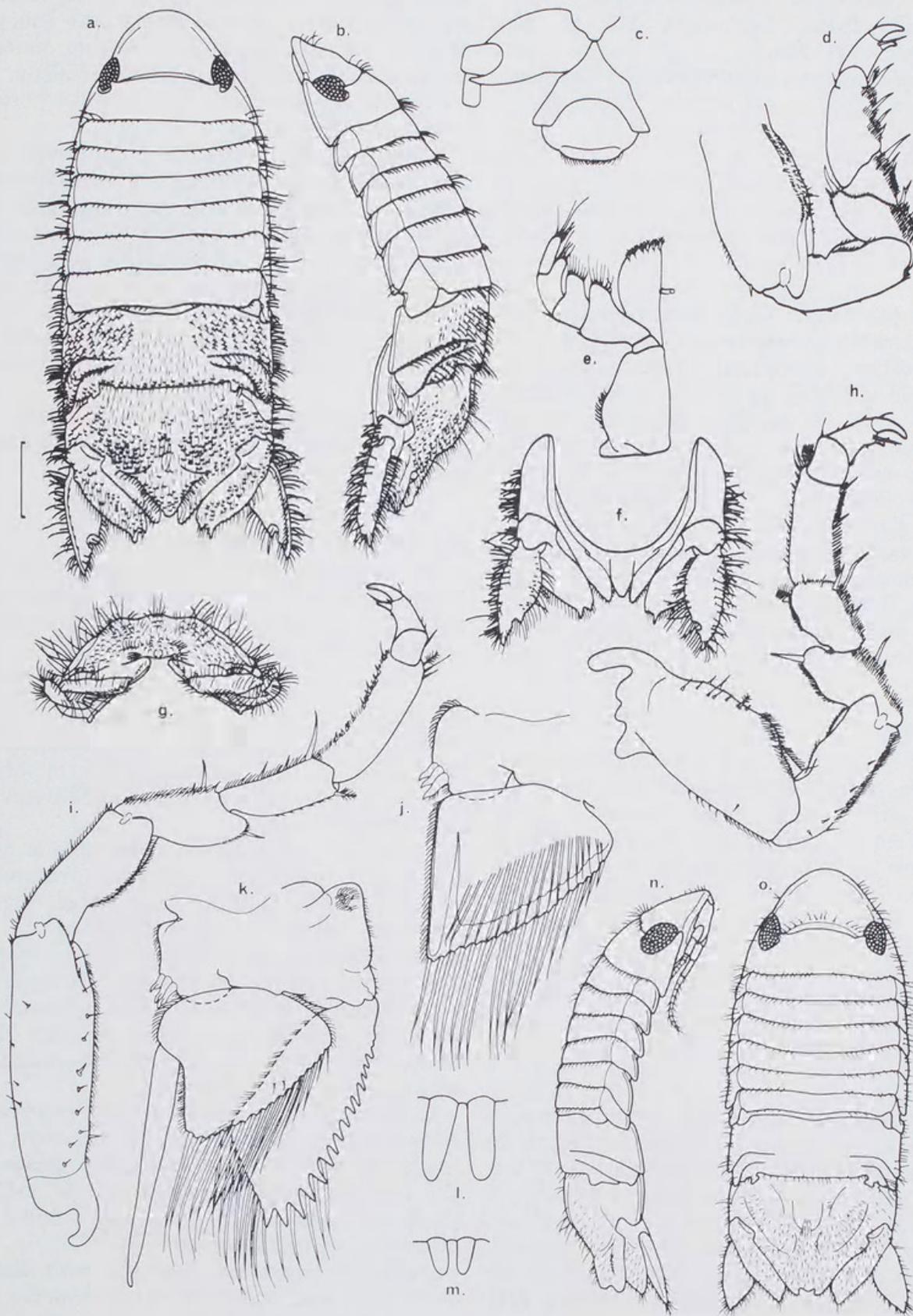


FIG. 8. *Cerceis pravipalma*, sp. nov. Adult male (a) dorsal, (b) lateral, (c) epistome, labrum and antennular peduncle, (d) pereopod 1, (e) maxilliped, (f) pleotelson, ventral, (g) pleotelson, posterior, (h) pereopod 5, (i) pereopod 7, (k) pleopod 2, (l) penes. Subadult male (j) pleopod 2 (exopod omitted), (m) penes, (n) lateral, (o) dorsal. Scale line represents 1 mm.

Cerceis tridentata Milne-Edwards, var. *intermedia* Baker, 1926: 270, 279, pl. 50. Nierstrasz, 1931: 216.

Circeis tridentata var. *aspericaudata*: Nierstrasz, 1931: 216.

MATERIAL EXAMINED

HOLOTYPE: British Museum (Natural History) BM (NH) 1882. 7, adult male, 12.4 mm, depth 12.8 m, Prince of Wales Channel, Torres Strait, Queensland, H.M.S. Alert.

OTHER MATERIAL: Queensland Museum QM W7970, 5 non-ovigerous females, 2 juveniles, on *Sargassum* sp., sub-littoral fringe, Kurrimine, Queensland (17°54'S, 146°05'E), D.M. Holdich, 27 May 1976. Alma Bay, Magnetic Island, Queensland, from algae and wood on old pier pile, intertidal, non-ovigerous female, D.M. Holdich, 26 April 1976. Bay of Rest, Exmouth Gulf, Western Australia, on *Sargassum* sp., intertidal, subadult male, 2 immature specimens, juvenile, N.L. Bruce, 12 June 1980. Bundegi Reef, Exmouth Gulf, on *Sargassum* sp., intertidal, 3 subadult males, 3 non-ovigerous females, immature specimen, 3 juveniles, N.L. Bruce, 14 July 1978.

DESCRIPTION

ADULT MALE: (Fig. 9g, i-1, n-p). *Cerceis* with eyes large, lateral. Epistome lambdoid, smoothly convex with arcuate lateral margins. Each pereonal tergite with posterior margin bearing a lateral row of short setae. Posterior margins of pereonite 7 and pleon, and pleonal sutures, bearing rows of small tubercles. Pleotelson granulose with a short, low, anterior, median boss with a similar but longer boss at each side. Apex of pleotelson narrow, with a deep, acute, lambdoid notch. Anterior to notch is a broad, long, acute tooth with a small circular foramen at each side of the base.

APPENDAGES: antennule with peduncle article 1 longer than articles 2 and 3 together with two acute distal processes enclosing article 2, the inferior process being longer than the superior; 12-articled flagellum extending to level of pereonite 1. Antenna slender, flagellum subequal in length to peduncle, extending to level of pereonite 3. Appendix masculina extending well beyond apex of endopod of pleopod 2; broad proximally, tapering distally, to a narrowly rounded tip, slender in distal half and curved away from ramus. Endopod of uropod with anterodistal angle arcuate, posterodistal angle extended as an

acute process extending well beyond level of pleotelsonic apex; exopod longer than endopod, external margin granulose, arcuate, internal margin convex, tapering to a narrow acute tip.

COLOUR OF SPECIMEN IN ALCOHOL: cream, lacking chromatophores.

SUBADULT MALE: (Fig. 9h q, r). *Cerceis* with eyes large, lateral. Epistome lambdoid, smoothly convex with arcuate lateral margins. Pereon and pleon smooth. Pleotelson with a low boss either side of midline; each boss bearing a low irregular tubercle. Apex of pleotelson with a deep notch with a short, blunt, median tooth. Penes widely separate, each as long as broad. Appendix masculina forming within cuticle of endopod of pleopod 2.

NON-OVIGEROUS FEMALE: (Fig. 9m). As subadult male but pleotelsonic notch without a median tooth.

ECOLOGY AND DISTRIBUTION

In Queensland known from Kurrimine and Magnetic Island from intertidal algae. Also recorded from the Torres Straits and on intertidal algae in Western Australia.

REMARKS

Miers' (1884) variety does not fit closely the description of *C. bidentata* given by Milne-Edwards and its elevation to full specific status is considered necessary.

Nierstrasz (1931) reported this species as *C. tridentata* var. *aspericaudata*, presumably because Hansen (1905: 127) stated that *C. bidentata* was the female of *C. tridentata* or a closely related species. Nierstrasz did not mention *C. bidentata* and was presumably treating it as a junior synonym of *C. tridentata*. *C. bidentata* is retained here as it is known only from Milne-Edwards' description and its conspecificity with *C. tridentata* is not certain.

Comparison of the adult male type specimen of *Paradynamene benjamensis* Richardson with Miers' holotype of *C. aspericaudata* shows that the two specimens are taxonomically indistinguishable and *P. benjamensis* should be considered a junior synonym.

Australian specimens agreeing with Baker's description of *C. tridentata* var. *intermedia* were compared with a subadult male and a non-ovigerous female (type specimens) of *P. benjamensis* and were found to be identical. *C. tridentata* var. *intermedia* is therefore founded on immature specimens of *C. aspericaudata*.

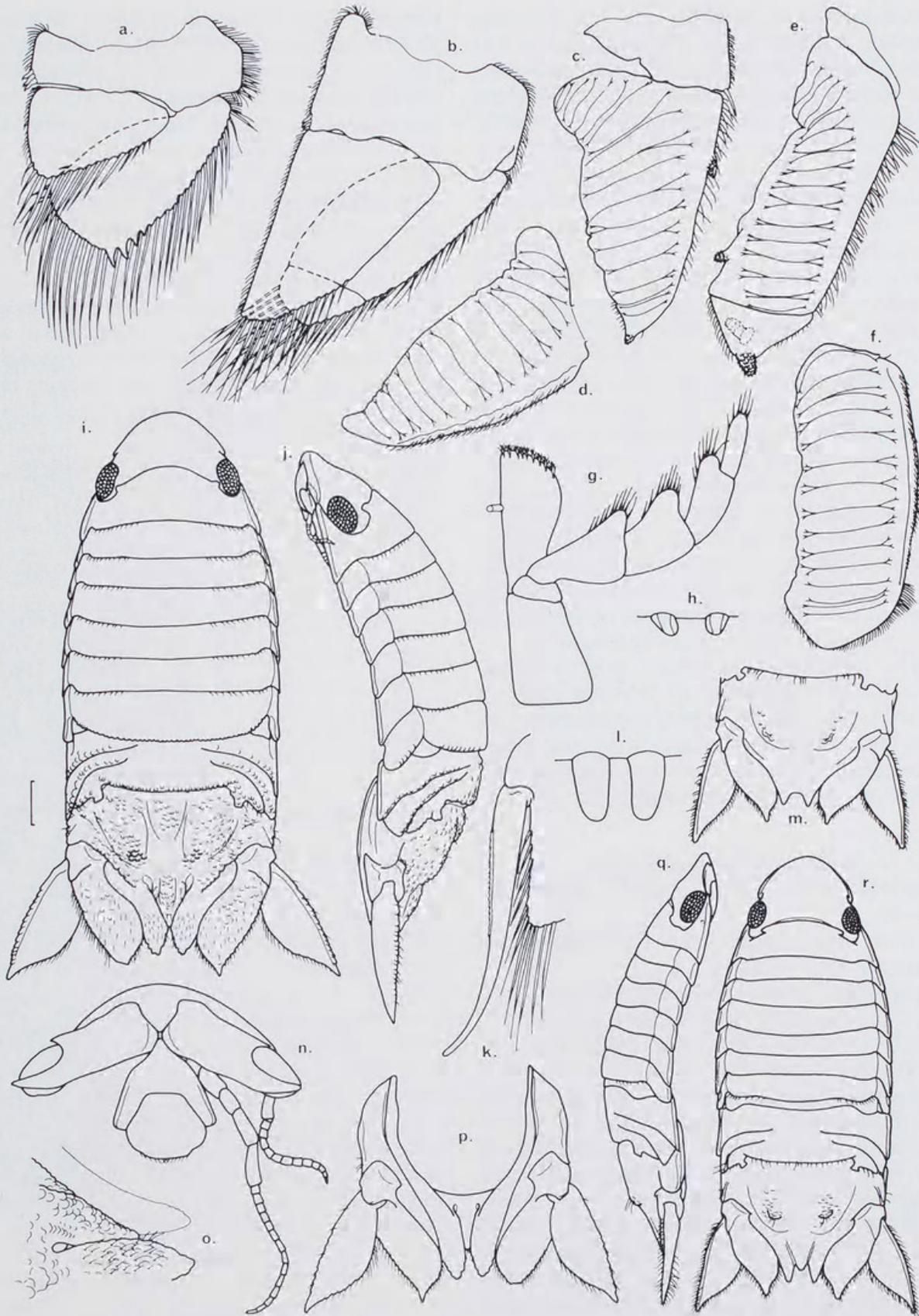


FIG. 9. *Cerceis pravipalma*, sp. nov. Adult male (a) pleopod 1, (b) pleopod 3, (c) pleopod 4, exopod, (d) pleopod 4, endopod, (e) pleopod 5, exopod, (f) pleopod 5, endopod. *Cerceis aspericaudata* Miers, comb. nov. Adult male (holotype), (g) maxilliped, (i) dorsal, (j) lateral, (k) appendix masculina, (l) penes, (n) cephalosome, ventral, (o) pleotelsonic apex, dorsolateral, (p) pleotelson, ventral. Subadult male (h) penes, (q) lateral, (r) dorsal. Non-ovigerous female (m) pleotelson. Scale represent 1 mm.

Paradynamene benjamensis was described by Richardson (1905) in her monograph on the isopods of North America. The specimens came from a bottle marked 'Gulf Weed' in the Museum of Comparative Zoology at Harvard University. The collector, date of collection and collection locality were unknown. Richardson presumably assumed 'Gulf' to indicate the Gulf of Mexico and the fact that these specimens were in an American museum probably reinforced the assumption that they were from North American waters. Menzies and Frankenberg (1966) stated that *P. benjamensis* might occur off the Georgian coast, but referred only to Richardson's original publication. Schultz (1969) apparently put these two 'records' together when he said for *P. benjamensis*, "Range: Atlantic coast and in Gulf Stream. This species was found in floating algae in the Gulf Stream". In fact, no record of *P. benjamensis* has ever been confirmed from North America. As this species is identical to *C. aspericaudata*, a species known only from Australia, it seems most likely that the type specimens of *P. benjamensis* were collected from weed in an unknown gulf in Australia, and it is interesting to note that specimens of *C. tridentata* var. *intermedia* have been collected from floating *Sargassum* sp. in the Gulf of Carpentaria (*vide* Baker, 1926: 270) and from this weed in Queensland and Western Australia. There is no reason to believe that *C. aspericaudata* occurs anywhere other than in Australia.

PARACERCEIS Hansen, 1905

Paracerceis Hansen, 1905: 77, 83, 87, 90, 91, 108, 125-27.

Paracirceis Nierstrasz, 1931: 215 (unjustified emendation).

Sergiella Pires, 1980: 212-218. Pires, 1981: 219, 220.

GENERIC DIAGNOSIS

Eubranchiata Sphaeromatidae with antennular peduncle article 1 not extended anteriorly as a plate. Both sexes with pereon and pleon lacking dorsal processes. Pleon with posterior margin bearing two curved, parallel sutures at each site. Exopod of pleopod 5 with three equidistant, extended, squamose bosses — one apical and two internal. Sexual dimorphism pronounced. **Adult male** with penes separate to base, broad, with semicircular tips. Appendix masculina arising in distal half of endopod of pleopod 2, extending beyond ramal apex to a semi-circular tip. Pleotelsonic apex extended with a wide median notch bearing one or more acute teeth. Uropodal

endopod short, reaching, at most, half way to pleotelsonic apex; exopod long, narrow, often cylindrical, extending beyond pleotelsonic apex. Maxillipedal palp articles 2 to 4 bearing pronounced setigerous lobes. **Ovigerous female** with mouthparts strongly metamorphosed. Brood pouch formed from four pairs of oostegites arising from pereopods 1 to 4 and overlapping in the midline. Oostegites increasing in size posteriorly. Brood not housed in narsupium thus formed but in internal pouches. Ventral pockets absent. Pleotelsonic apex slightly extended, lacking a toothed notch but bearing a semicircular ventral channel, visible in posterior view. Uropodal rami lamellar, subequal in length, not reaching apex of pleotelson. Pleotelsonic tuberculation less pronounced than in adult male.

TYPE SPECIES: *Paracerceis caudata* (Say, 1818) (from south eastern North America).

ADDITIONAL SPECIES: *Paracerceis cordata* (Richardson, 1899) (from west coast of N. America).

P. gilliana (Richardson, 1899) (from California).

P. sculpta (Holmes, 1904) (from California, Mexico, Brazil, Hawaii and Australia).

P. beddardi (Stebbing, 1905) (from Sri Lanka).

P. edithae (Boone, 1930) (from Puerto Rico and Haiti).

P. angulata (Richardson, 1901) (from Florida — adult male unknown).

P. nuttingi (Boone, 1921) (from Barbados — adult male unknown).

P. tomentosa (Schultz & McCloskey, 1967) (from North Carolina — adult male unknown).

PARACERCEIS SCULPTA (Holmes, 1904)

Dynamene sculpta Holmes, 1904: 300-302, pl. 34.

Cilicæa sculpta Richardson, 1905: 318, 319. Stebbing, 1905: 35.

Paracerceis sculpta Richardson, 1905: IX.
 Menzies, 1962: 340, 341, fig. 2. Miller, 1968: 9,
 14. Pires, 1981: 219, 220.
Sergiella angra Pires, 1980: 212–218. Pires, 1981:
 219, 220.

MATERIAL EXAMINED

Queensland Museum QM W7968, adult male, non-ovigerous female, from side of pontoon near Hayle's Wharf, Ross River Creek, Townsville, Queensland (19°16'S, 146°49'E), P. Otteson, October 1975.

DESCRIPTION

ADULT MALE, 7.82 mm: (Fig. 10a–p, s). Dorsal surface of cephalosome and pereon smooth. Eyes large, lateral. Epistome with a short apex between two pronounced lateral bulges. Pereonite 7 with posterior margin of tergite granulose. Pleon granulose with a low, bifid, central tubercle and one simple tubercle on each side. Pleotelson with main dome granulose, bearing three pronounced longitudinal ridges, the central being dorsally concave. Posterior to main dome, pleotelson bearing an intricate, symmetrical arrangement of short setae surrounding a prominent median conical tubercle. Lateral margins of pleotelson straight, apex extended with a broad deep median notch. Notch with a central anterior tooth and a larger curved anterolateral tooth at each side. Posterior margin of pleotelson, between notch and lateral margins, slightly indented.

APPENDAGES: antennular peduncle article 1 longer than 2 and 3 together, not bearing long, acute, distal extensions; article 2 broader than long, article 3 slender; 11-articled flagellum extending to level of pereonite 1. Antenna slender, 13-articled flagellum extending to level of pereonite 1. Mouthparts of usual sphaeromatid form, unmodified; maxillipedal palp articles 2 to 4 with pronounced setigerous lobes. Pereopods moderately robust; merus, carpus and propodus bearing inferior pads of short setae and spines of various lengths. Pereopod 1 more robust than other pereopods; merus, carpus and propodus bearing long, stout, inferior spines. Penes short, each 1.5 times as long as broad. Basis of pleopod 1 with three internal coupling hooks; endopod subtriangular, half size of exopod; exopod broad, truncate, extending beyond endopod with two apical teeth and an external, submarginal row of setae. Pleopod 2 with exopod as in pleopod 1 but with ten external teeth; endopod subtriangular; appendix masculina broad with lateral margins subparallel, extending well beyond endopodal

apex. Exopod of pleopod 3 with a complete subterminal articulation. Exopod of pleopod 4 with a proximal external toothed boss. Exopod of pleopod 5 with a subterminal, external, partial articulation. Uropod with endopod reduced, bearing a median dorsal tubercle, apex acute; exopod smooth, greatly extended, curved, subcylindrical, tapering to a narrowly rounded apex.

COLOUR OF SPECIMEN IN ALCOHOL: red-brown, lacking obvious chromatophores.

NON-OVIGEROUS FEMALE, 5.34 mm: (Fig. 10q, r, t). *Paracerceis* with dorsal surface of body smooth. Pleotelson with three low, smooth longitudinal ridges; apex slightly extended with a simple ventral groove. Uropodal rami subequal, not reaching pleotelsonic apex; endopod truncate; exopod rounded.

DISTRIBUTION

This species has previously been recorded from California, Brazil, Mexico and Hawaii. It has presumably been carried to Townsville (an international harbour) by trans-Pacific shipping.

REMARKS

The illustrated male specimen bears a number of spirorbid polychaete tubes on the pleotelson. The growth of epibionts, especially on the pleotelson, is not uncommon in certain sphaeromatids, e.g. adult male specimens of *Dynamene*.

HASWELLIA Miers, 1884

Calyptura Haswell, 1881: 476 (preoccupied name).

Haswellia Miers, 1884: 311.

GENERIC DIAGNOSIS

Eubranchiata Sphaeromatidae with antennular peduncle article 1 not extended anteriorly as a plate. Pleon with two long suture lines at either side, one reaching the posterolateral angle, and the other the lateral margin, of the pleonal tergite. Exopod of pleopod 5 bearing two subapical, extended, toothed bosses, one on either side of the ramus, and a small prominent internal boss. Sexual dimorphism pronounced. **Adult male** with penes separate, short, each with a semicircular tip. Appendix masculina arising in distal half of endopod of pleopod 2, extending beyond ramal apex to a semicircular tip. Tergum of pereonite 7 extended posteriorly as a broad process, reaching beyond pleotelsonic apex. Apex of pleotelson with a deep notch bearing a median tooth. Uropodal rami various, exopod greater than half length of

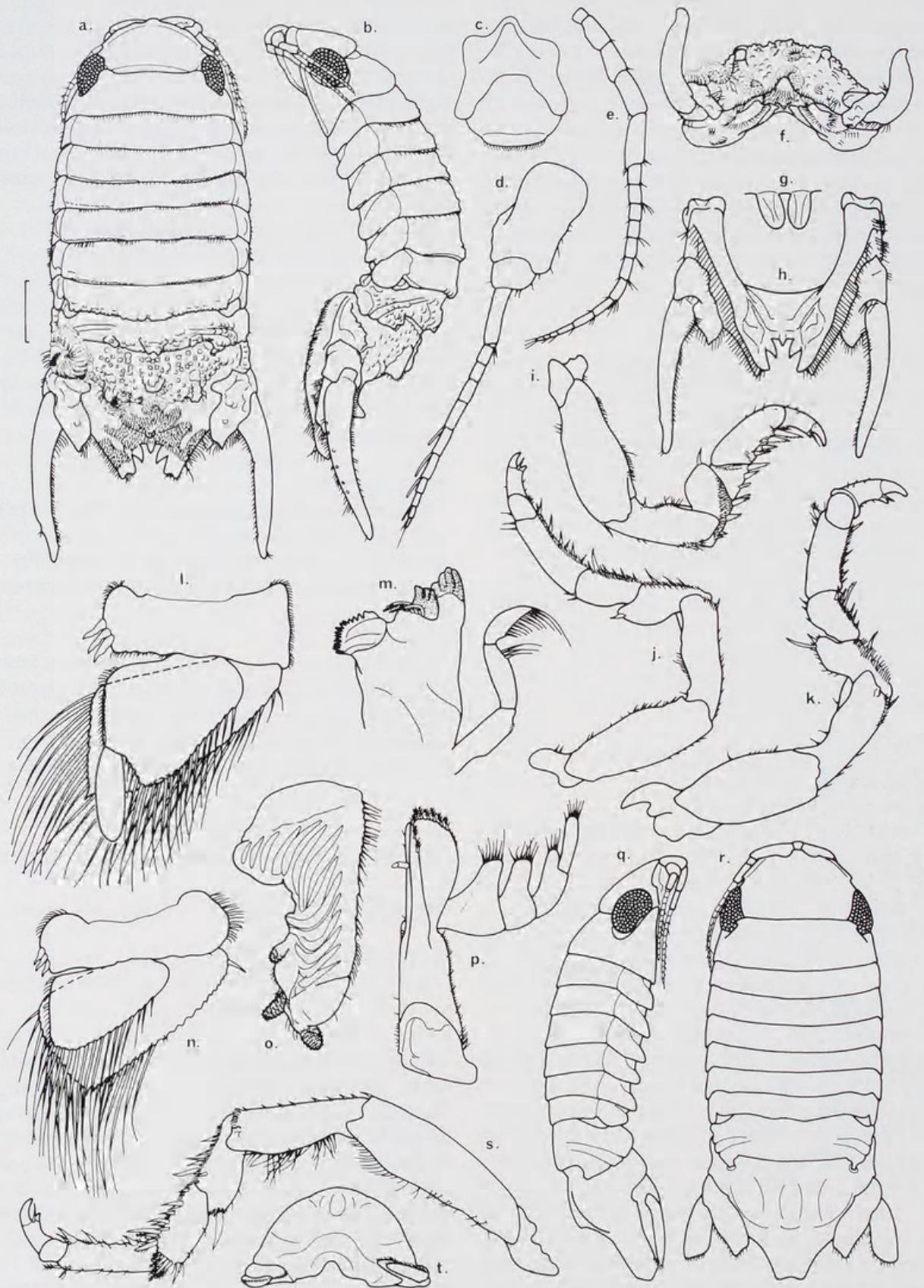


FIG. 10. *Paracerceis sculpta* (Holmes). Adult male (a) dorsal, (b) lateral, (c) epistome and labrum, (d) antennule, (e) antenna, (f) pleotelson, posterior, (g) penes, (h) pleotelson, ventral, (i-k) pereopods 1, 2 and 4 respectively, (l) pleopod 2, (m) left mandible, (n) pleopod 1, (o) pleopod 5, exopod, (p) maxilliped, (s) pereopod 7. Non-ovigerous female (q) lateral, (r) dorsal, (t) posterior. Scale line represents 1 mm.

endopod, extending beyond pleotelsonic apex. Maxillipedal palp articles 2 to 4 bearing setigerous lobes. **Ovigerous female** with mouthparts strongly metamorphosed. Brood pouch formed from four pairs of oostegites arising from bases of pereopods 1 to 4. Oostegites increasing in size posteriorly and overlapping well in midline. Brood not housed in marsupium thus formed but in four pairs of internal pouches. Ventral pockets absent. Tergum of pereonite 7 not extended posteriorly as a process. Pleotelson bearing a median protuberance; apex at most weakly tridentate with a ventral channel. Rami of uropods lamellar, subequal, reaching level of pleotelsonic apex.

TYPE SPECIES: *Haswellia carnea* (Haswell, 1881) (from Australia).

ADDITIONAL SPECIES: *Haswellia emarginata* (Haswell, 1882) (from Australia).

H. cilicoides Baker, 1908 (from Australia).

H. juxtacarnea Baker, 1926 (from Australia).

H. intermedia Baker, 1926 (from Australia).

H. glauerti Baker, 1929 (from Australia).

H. anomala Haswell, 1881 (from Australia — adult male unknown).

REMARKS

Haswell (1881: 473, Pl. 16) described the subadult male of a species of *Haswellia* as *Sphaeroma* (?) *anomala*. Baker (1926: 273) said this species bore some resemblance to the females of *Haswellia emarginata* and Naylor (1966: 192, 194) and Seed (1973: 211) synonymised the two species as *Haswellia anomala*. Comparison by the present authors of a subadult male specimen of *H. emarginata* (together with Baker's illustration of a subadult male — 1908: pl. 10, fig. 4), with specimens of *Sphaeroma anomala* in the British Museum (Natural History) (reg. nos 95. 11. 4. 40-41) (together with Haswell's (1881: pl. 16, fig. 4) and Baker's (1926: pl. 48, figs 8, 9) illustrations of *S. anomala*) shows some differences. The subadult males of *H. emarginata* differ from specimens of *H. anomala* in having the extension of pereonite 7 bilobed, not simple, and relatively shorter. The shape of the uropodal endopod also differs in the two species. While doubt exists that *H. emarginata* and *H. anomala* are conspecific, it seems wise to keep the two names separate. *H. anomala* was originally

described from Port Jackson at the same time as *H. carnea* (also from Port Jackson) and it is possible that *H. anomala* is the subadult male of that species. Females and immature specimens of *H. carnea* have never been described.

HASWELLIA CARNEA (Haswell 1881)

Calyptura carnea Haswell, 1881: 476, pl. 17, fig. 4.

Haswellia carnea: Miers, 1884: 311. Baker, 1926: 273, 274, 279, pl. XLIX.

MATERIAL EXAMINED

Queensland Museum QM W8045, adult male, from sponge, depth 20 m, Flat Rock, North Stradbroke Island, Brisbane, Queensland (27°23.5'S, 153°33'E), M. Ready, 3 July 1979.

DESCRIPTION

ADULT MALE, 6.16 mm: (Fig. 11). *Haswellia* with dorsal surface of cephalosome and pereonites 1 to 6 smooth. Eyes large, lateral. Epistome short; surface uneven; apex narrow, acute. Dorsal process of pereonite 7 broad, scutiform, covering entire pleon and pleotelson and extending well beyond pleotelsonic apex. Process granulose with a weak, distal, median, setose keel; apex deflected ventrally. Pleotelsonic apex with a broad notch with a quadrate median tooth not reaching level of notch opening.

APPENDAGES: antennular peduncle article 1 longer than 2 and 3 together, bearing moderately pronounced acute distal projections; article 2 short; article 3 slender; 14-articled flagellum extending to level of pereonite 1. Antenna slender; 15-articled flagellum extending to pereonite 2. Mouthparts of usual sphaeromatid form, unmodified; maxillipedal palp articles 2 to 4 with pronounced setigerous lobes. Pereopods moderately robust; merus, carpus and propodus bearing inferior pads of fine setae and several long setae. Pereopod 1 with inferior margins of merus, carpus and propodus bearing long, stout spines. Penes twice as long as broad with lateral margins subparallel. Basis of pleopod 1 with three internal coupling hooks; exopod long, truncate with four externodistal teeth; endopod short, subtriangular. Pleopod 2 with exopod as in pleopod 1 but bearing 11 external teeth; endopod broad, subtriangular. Appendix masculina as long as endopod, with apex broadly rounded. Exopod of pleopod 3 with a complete, subterminal articulation. Exopod of pleopod 4 with a proximal, external squamose boss. Exopod of pleopod 5 with a subterminal, external, partial articulation. Both rami of uropod

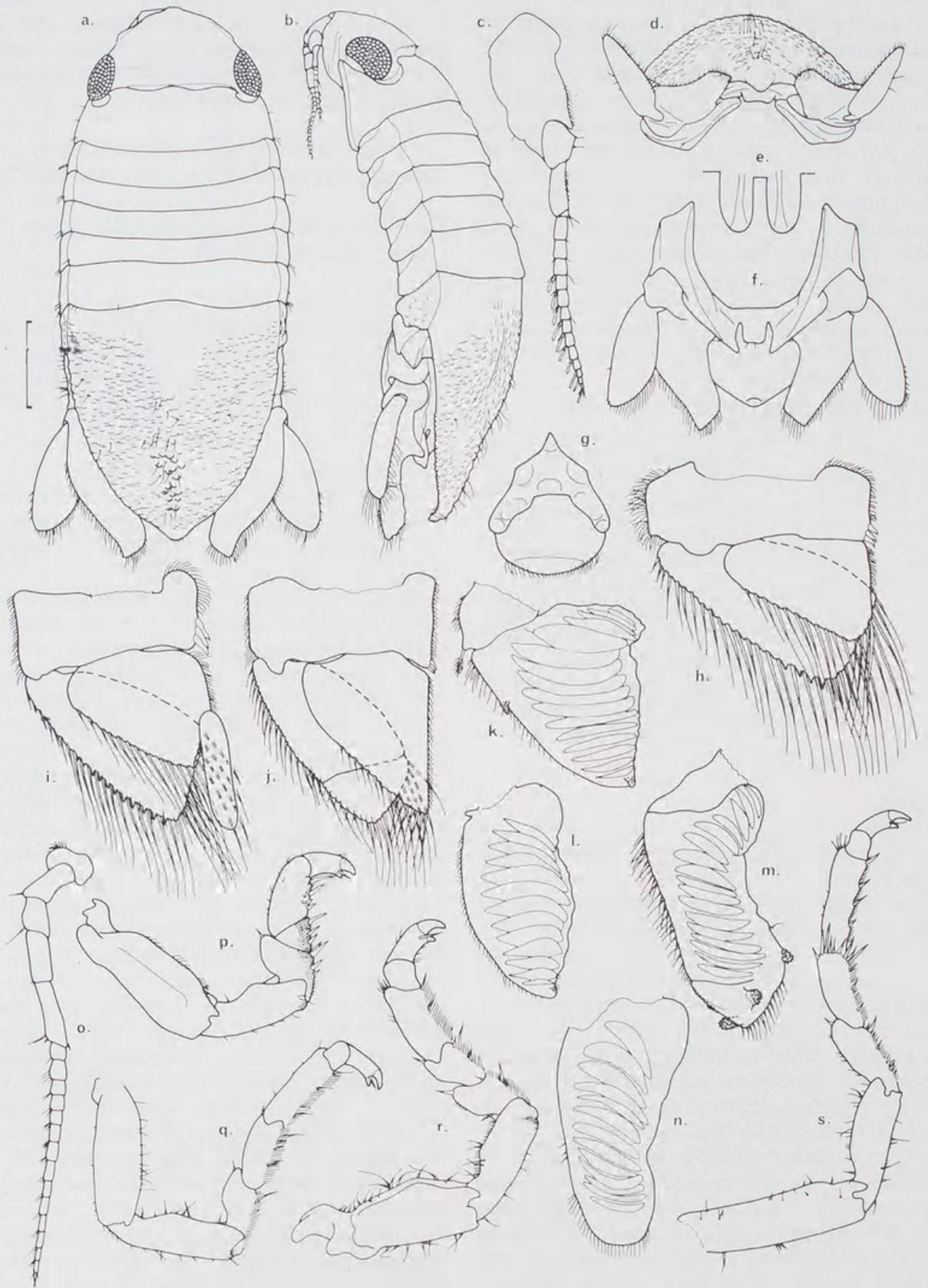


FIG. 11. *Haswellia carnea* (Haswell). Adult male (a) dorsal, (b) lateral, (c) antennule, (d) posterior, (e) penes, (f) pleotelson, ventral, (g) epistome and labrum, (h-j) pleopods 1 to 3, respectively, (k) pleopod 4, exopod, (l) pleopod 4, endopod, (m) pleopod 5, exopod, (n) pleopod 5, endopod, (o) antenna, (p-s) pereopods 1, 2, 4 and 7 respectively. Scale line represents 1 mm.

extending well beyond pleotelsonic apex, with setose margins; endopod with outer margin convex and inner margin concave. Apex truncate extending beyond subelliptical exopod.

COLOUR OF SPECIMEN IN ALCOHOL: cream with dorsal process cream-brown. Dorsal surface and ventral pereon covered with small black chromatophores.

ECOLOGY AND DISTRIBUTION

Baker (1926) reported that this species was common on the coast of New South Wales. This is the first record for Queensland where it was found in a sponge at 20 m depth.

REMARKS:

This specimen only differs from the published descriptions in lacking an acute extension on the apex of the uropodal exopod.

ACKNOWLEDGEMENTS

Thanks are due to the Nuffield Foundation and the Natural Environment Research Council for research grants; to Professor C. Burdon-Jones (James Cook University) and Professor P.N.R. Usherwood (Nottingham University) for the provision of laboratory facilities; the Queensland Museum, the Australian Museum, the British Museum (Natural History), and the Museum of Comparative Zoology, Harvard University for the loan of specimens; and especially to N.L. Bruce and G. Hartmann for the provision of many specimens. Thanks are also due to Dr A.H. Sommerstein (Classics Dept., Nottingham University) for checking the construction of the new names.

LITERATURE CITED

- BAKER, W.H., 1908. Notes on some species of the isopod family Sphaeromidae, from the South Australian coast. *Trans. Roy. Soc. S. Australia* **32**: 138-62, Pls 1-10.
1926. Species of the isopod family Sphaeromidae, from the Eastern, Southern, and Western coasts of Australia. *Trans. Roy. Soc. S. Australia* **50**: 247-79, Pls 38-53.
1929. Australian species of the isopod family Sphaeromidae (continued). *Trans. Roy. Soc. S. Australia* **52**: 49-61, Pls 1-6.
- BARNARD, K.H., 1936. Isopoda collected by R.I.M.S. Investigator. *Rec. Ind. Mus.* **38**: 147-91.
- BOONE, P.L., 1921. Report on the Tanaidacea and Isopoda (collected by the Barbados-Antigua Expedition from the University of Iowa in 1918). *Univ. Iowa Stud. nat. Hist.* **9**(5): 91-8, Pl. 1.
1930. New decapod and isopod crustaceans from Gonave Bay, Haiti. *Zoologica* **12**(4): 41-53, Figs 7-10. (Not seen).
- DANA, J.D., 1853. Crustacea. *United States Exploring Expedition*, **13**: 696-805.
- GLYNN, P.W., 1970. A systematic study of the Sphaeromatidae (Crustacea: Isopoda) of Isla Margarita, Venezuela, with descriptions of three new species. *Mem. Soc. Cienc. Nat. La Salle* **30**(85): 5-48.
- HANSEN, H.J., 1905. On the propagation, structure and classification of the family Sphaeromidae. *Quart. Journ. Microsc. Sci.* **49**(1): 69-135, Pl. 7.
- HASWELL, W.A., 1881. On some new Australian marine Isopoda — Part I. *Proc. Linn. Soc. N.S.W.* **5**(4): 470-81, Pls 16-19.
1882. On some new Australian marine Isopoda — Part II. *Proc. Linn. Soc. N.S.W.* **6**: 181-96, Pls 3, 4.
1884. A revision of the Australian Isopoda. *Proc. Linn. Soc. N.S.W.* **9**(4): 1001-15, Pls 50-3.
- HARRISON, K. and D.M. HOLDICH, 1982. Revision of the genera *Dynamenella*, *Ischyromene*, *Dynamenopsis* and *Cymodocella* (Crustacea: Isopoda), including a new genus and five new species of eubranchiate sphaeromatids from Queensland waters. *Journal of Crustacean Biology*, **2**(1): 84-119.
- HOLDICH, D.M., 1968. A systematic revision of the genus *Dynamene* (Crustacea: Isopoda) with descriptions of three new species. *Publ. Staz. zool. Napoli* **36**: 401-26.
- HOLDICH, D.M. and K. HARRISON, 1980a. Morphological variation in the *Serolis minuta*-group (Isopoda: Serolidae) from Australian waters. *Zool. J. Linn. Soc.* **68**: 373-86.
- 1980b. The isopod genus *Gnathia* Leach from Queensland waters with descriptions of nine new species. *Aust. J. Freshwat. Res.* **31**: 215-40.
- 1980c. The isopod genus *Dynamene* from Australian waters, with description of a new species from coral reefs. *Mem. Qd Mus.* **20**(1): 163-70.

- 1981a. Platybranch sphaeromatids (Crustacea: Isopoda) from the Australian region with description of a new genus. *Rec. Aust. Mus.* **33**(12): 617-43.
- 1981b. The sphaeromatid isopod genus *Sphaeromopsis* Holdich and Jones in African, Australian and South American waters. *Crustaceana* **41**(3): 286-300.
- HOLDICH, D.M., K. HARRISON, and N.L. BRUCE, 1981. Cirolanid isopod crustaceans from the Townsville region of Queensland, Australia, with descriptions of six new species. *J. nat. Hist.* **15**: 555-605.
- HOLMES, S.J., 1904. Remarks on the sexes of sphaeromids with a description of a new species of *Dynamene*. *Calif. Acad. Sci. Proc.*, Ser. 3. *Zool.* **3**: 296-306, Pl. 34.
- MENZIES, R.J., 1962. The marine isopod fauna of Bahia de San Quintin, Baja California, Mexico. *Pac. Naturalist* **3**(11): 337-48.
- MENZIES, R.J. and D. FRANKENBERG, 1966. 'Handbook of the Common Marine isopod Crustacea of Georgia.' (University of Georgia Press: Athens).
- MENZIES, R.J. and P.W. GLYNN, 1968. The common marine isopod Crustacea of Puerto Rico. *Stud. Fauna Curaçao* **27**: 1-133.
- MIERS, E.J., 1884. Crustacea in 'Report of the Zoological Collections made in the Indo-Pacific Ocean During the Voyage of H.M.S. "Alert" 1881-1882.' (British Museum (Natural History): London).
- MILLER, M.A., 1968. Isopoda and Tanaidacea from buoys in coastal waters of the continental United States, Hawaii, and the Bahamas (Crustacea). *Proc. Unit. Stat. Nat. Mus.* **125** (3652): 1-53.
- MILNE-EDWARDS, H., 1840. 'Histoire Naturelle des Crustacés,' 3. (Librairie Encyclopedique de Roret: Paris).
- NAYLOR, E., 1966. Port Phillip Bay Survey 1957-1963. Isopoda. *Mem. Nat. Mus. Vict.* **27**: 183-98, 377-84, Chart 1.
- NIERSTRASZ, H.F., 1931. Die Isopoden der Siboga-Expedition. 3. Isopoda Genuina. 2. Flabellifera. In Weber, M., *Siboga-Expedite. No. 114* (Monogr. **32c**): 123-233.
- PILLAI, N.K., 1954. A preliminary note on the Tanaidacea and Isopoda of Travancore. *Bull. Res. Inst. Univ. Travancore*, **3**: 1-23.
- PIRES, A.M.S., 1980. *Sergiella angra*, a new genus and species of Sphaeromatidae (Isopoda) from Brazil. *Crustaceana*, **38**(2): 212-8.
1981. *Sergiella angra* Pires, 1980, a junior synonym of *Paracerceis sculpta* (Holmes, 1904) (Isopoda, Sphaeromatidae). *Crustaceana* **41**(2): 219-20.
- RICHARDSON, H., 1899. Key to the isopods of the Pacific coast of North America, with descriptions of twenty-two new species. *Proc. Unit. Stat. Nat. Mus.* **21**: 815-69.
1905. A monograph on the isopods of North America. *Bull. U. S. Nat. Mus.* **54**: 1-727.
- SAY, T., 1818. An account of the Crustacea of the United States (cont.). Description of three new species of the genus *Naesa*. *Journ. Acad. Nat. Sci. Philadelphia* **1**(2): 482-5.
- SCHULTZ, G.A., 1969. 'How to know the marine isopod crustaceans.' (Wm C. Brown Company: Dubuque, Iowa).
- SCHULTZ, G.A. and L.R. McCLOSKEY, 1967. Isopod crustaceans from the coral *Oculina arbuscula* Verrill. *J. Elisha Mitchell Scientific Soc.* **83**(2): 103-13.
- SEED, W.F. 1973. Pearson Island Expedition 1969-11. Crustacea: Isopoda. *Trans. Roy. Soc. S. Austr.* **97**(3): 207-21.
- STEBBING, T.R.R., 1905. Report on the Isopoda collected by Prof. Herdman in Ceylon in 1902. *Report on the Pearl Oyster Fisheries of the Gulf of Manaar. Rep. No. 23*: 1-64.
- VANHÖFFEN, E., 1914. Die Isopoden der Deutschen Südpolar-Expedition, 1901-1903. *Deutsche Südpolar-Expedition 1901-03*, **15** *Zoologie* **7**(4): 447-598.



Mack, Amy E. and Holdich, D M. 1982. "New eubranchiata sphaeromatid isopods from Queensland waters." *Memoirs of the Queensland Museum* 20(3), 421–446.

View This Item Online: <https://www.biodiversitylibrary.org/item/218055>

Permalink: <https://www.biodiversitylibrary.org/partpdf/218372>

Holding Institution

Queensland Museum

Sponsored by

Atlas of Living Australia

Copyright & Reuse

Copyright Status: In copyright. Digitized with the permission of the rights holder.

License: <http://creativecommons.org/licenses/by-nc-sa/4.0/>

Rights: <https://biodiversitylibrary.org/permissions>

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at <https://www.biodiversitylibrary.org>.