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The *Ericthonius* Group, a New Perspective on an Old Problem (Crustacea: Amphipoda: Corophioidea)

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ABSTRACT. The *Ericthonius* group is established based on corophioid taxa with dorsal spines on the telson. Within this group there are three non-aligned genera (*Ericthonius*, *Pseuderichthonius* and *Pseudischyrocerus*) and two robust clades known as the *Cerapus* clade and the *Siphonoecetes* clade. The *Cerapus* clade (five genera) is defined by four synapomorphic characters: a posteriorly directed dactylus on pereopod 7; accessory spines on the dactyli of pereopods 5–7; uniramous uropod 2; and rows of recurved spines on the telson. The *Siphonoecetes* clade (10 genera, Siphonoecetinae of Just, 1983) is defined by: five synapomorphic characters: a short, slender first antenna; a reduced mandibular palp; a simple or weakly subchelate male gnathopod 2; an anteriorly inserted carpus on pereopods 5–6; and no recurved distal spines on the rami of uropod 3. The relationships between these taxa are discussed and the *Cerapus* clade and the *Siphonoecetes* clade are considered to be sister taxa. Although the *Ericthonius* group is an obvious member of the Corophioidea there is currently no evidence to place it in an existing family. All genera in the *Cerapus* clade (*Bathypoma* n.gen., *Cerapus* Say, 1817, *Notopoma* n.gen., *Runanga* J.L. Barnard, 1961, and *Paracerapus* Budnikova, 1989) are diagnosed and a number of species are placed in new combinations. The two new genera, *Bathypoma* and *Notopoma*, are both characterised by a medially expanded peduncle on antenna 1 which functions as an operculum and distinguishes them from all other members of the group. *Bathypoma enigma* n.sp. is the only member of the *Cerapus* clade with a subchelate gnathopod 2 in the male. *Notopoma* contains *N. africana* n.sp., *N. crassicornis* (Bate, 1857), *N. fallohidea* (Lowry, 1981), *N. harfoota* (Lowry, 1981), *N. lutkini* (Tzvetkova, 1990), *N. moorea* n.sp., *N. opposita* (K.H. Barnard, 1931), *N. sismithi* (Stebbing, 1888), *N. stoddartae* n.sp. and *N. stoor*a (Lowry, 1981). A generic key to the *Ericthonius* group is included.

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There has been much discussion in the literature concerning family level taxa in the Corophioidea. J.L. Barnard (1973) established the superfamily Corophioidea for all taxa with a "fleshy" telson (Aoridae, Ampithoidae, Cheluridae, Corophiidae, Isaeidae (= Photidae), Ischyroceridae and Podoceridae (= Dulichiidae)). In that study Barnard included several family groups (Aoridae, Isaeidae) in the Corophiidae.

Bousfield (1973, 1978), Myers (1974, 1981) and Just (1983) have all been sceptical of Barnard's broad concept of the Corophiidae. Myers (1981) and Just (1983) have shown that there are suprageneric taxa among the corophioids which can be differentiated on distinctive synapomorphic characters. Myers (1981) recognised the Aoridae, Corophiidae and Isaeidae and established the new family Neomegamphopidae.

Just (1983) established the Siphonoecetinae in the Corophiidae *sensu stricto*. Just (1988) analysed the phylogenetic relationships within this group using the *Cerapus* complex of Lowry (1985) for outgroup comparisons. Just (1988) raised the point that members of the *Cerapus* clade were placed in the Ischyroceridae and members of the *Siphonoecetes* clade were placed in the Corophiidae, but in his opinion "cerapids" and "siphonoecetids" were sister taxa and the *Cerapus* clade members appeared to be more closely related to the Corophiidae (*sensu* Myers, 1981; Just, 1983).

Barnard & Karaman (1991) were not moved by these arguments and re-amalgamated these families so that the Corophioidea contained the Ampithoidae, Cheluridae, Corophiidae (Aoridae, Corophiidae, Isaeidae, Ischyroceridae) and Podoceridae. They recognised the Siphonoecetinae as a separate taxon within the Corophiidae, but not the subfamily taxon Aorinae established by Myers (1988).

We are investigating this complex problem using cladistic methodology. Our current analyses have not produced clades which we can reconcile with current hierarchical classifications. In this paper we present a cladogram based on all corophioid taxa which have some form of spines on the telson, referred to here as the *Erichthonius* group. We prefer to leave these clades as informal groups until our analyses are completed. The purpose of this cladogram is to indicate the position of the *Cerapus* clade within the context of its presumed sister taxa and to show the relationships between genera in the group. We discuss in detail only the genera of the *Cerapus* clade.

Lowry (1981) suggested the need for a taxon to include species in which the peduncular article 1 of the first antenna was produced anterodistally and medially to form an operculum for closing the tube. The recent redescription of *Cerapus tubularis*, the type species of the genus (Lowry & Berents, 1989), has permitted a new evaluation of genera in the *Cerapus* clade. In our studies of Indo-Pacific taxa several new species with this type of peduncle have been discovered. We describe them below in the new genera *Notopoma* and *Bathypoma*.

In this paper we use the modified scheme of Lowry & Stoddart (1993) for delineating setae on the mandibular

palp and the terminology changes for setae and spines implemented by Lowry & Stoddart (1995). These changes were based primarily on arguments about the homology of setae and spines presented by Oshel & Steele (1988) and Watling (1989). The terminology mainly follows Watling (1989) with a few modifications. Structures which were previously referred to as setae are now referred to as setae or slender setae and what were previously referred to as spines are now called robust setae. Structures which were previously referred to, mainly as, teeth (non-articulating extrusions of the cuticle), are now referred to as spines.

All morphological characters are stored in a DELTA data base (Dallwitz & Paine, 1986) known as CERADEL. The key to genera and all descriptions have been produced from DELTA. The "id" ending is occasionally used for convenience to replace a group name. In this context it has no hierarchical implications.

The following abbreviations are used in the text: **AM**, Australian Museum, Sydney; **BMNH**, The Natural History Museum, London; **NMV**, Museum of Victoria, Melbourne; **SAM**, South African Museum, Cape Town; **USNM**, United States National Museum of Natural History, Washington, D.C.

The following abbreviations are used on the plates: **A**, antenna; **C**, coxa; **D**, dactylus; **E**, epistome; **G**, gnathopod; **MD**, mandible; **MP**, maxilliped; **MX**, maxilla; **P**, peraeopod; **PL**, pleopod; **T**, telson; **U**, uropod; **UR**, urosome; **l**, left; **r**, right.

Phylogenetics

Included Taxa

Taxa belonging to the Corophioidea are considered to be monophyletic because they all have a fleshy telson (J.L. Barnard, 1973). The *Erichthonius* group is considered here to be a monophyletic group within the Corophioidea because all taxa included in the group have dorsal telsonic spines. This conclusion is based on supporting analyses (Lowry & Berents, unpublished) which include all ischyrocerid and corophiid (*sensu stricto*) generic taxa. These analyses indicate that dorsal telsonic spines have evolved only once within the Corophioidea. Fifteen genera have these dorsal spines. An additional three genera (*Concholestes*, *Polynesoecetes* and *Siphonoecetes*) do not have spines, but are aligned with the group because they are well known siphonoecetid taxa which are presumed to have lost their spines.

The *Erichthonius* group (or erichthoniids) contains: genera previously aligned with the Ischyroceridae (Barnard & Karaman, 1991) (*Cerapus* Say, 1817; *Erichthonius* Milne Edwards, 1830; *Pseuderichthonius* Schellenberg, 1926; *Pseudischyrocerus* Schellenberg, 1931 and *Runanga* J.L. Barnard, 1961); genera considered by Just (1983) and Barnard & Karaman (1991) to be in the subfamily Siphonoecetinae (*Africoecetes* Just, 1983;

Australoecetes Just, 1983; *Borneoecetes* Barnard & Thomas, 1984; *Bubocorophium* Karaman, 1981; *Caribboecetes* Just, 1983; *Concholestes* Giles, 1888; *Corocubanus* Ortiz & Nazbul, 1984; *Rhinoecetes* Just, 1983; *Siphonoecetes* Krøyer, 1845; recently described non-aligned genera (*Paracerapus* Budnikova, 1989; *Polynesoecetes* Myers, 1989); and new genera described herein (*Bathypoma* and *Notopoma*).

The corophioid genus *Gammaropsis*, is used as the outgroup for this analysis because it is considered to be the least specialised living corophioid genus (Barnard & Barnard, 1983). The question of immediate sister groups for the *Erichthonius* group is not being considered in this analysis.

Character Description

1. Antenna 1, length in relation to antenna 2. In *Gammaropsis* the length of antenna 1 is subequal to antenna 2 (Fig. 1.1a). In some erichthoniids it is shorter and often more slender (Fig. 1.1b).
2. Antenna 1, shape of peduncular article 1. In *Gammaropsis* and most erichthoniids peduncular article 1 is long and rectangular (Fig. 1.2a). In some genera peduncular article 1 is produced anterodistally and medially (Fig. 1.2b).
3. Antenna 1, accessory flagellum. In *Gammaropsis* and some erichthoniids the accessory flagellum is multiarticulate (Fig. 1.3a). Within the erichthoniids it may be vestigial (Fig. 1.3b) or absent.
4. Mandibular palp. In *Gammaropsis* and most erichthoniids the mandibular palp is well developed and 3-articulate (Fig. 1.4a). In some erichthoniids it is reduced and 2-articulate (Fig. 1.4b).
5. Gnathopod 2 male. In the corophioids the male gnathopod 2 is usually much larger than that of the female. It may be subchelate (Fig. 1.5a), carpochele (Fig. 1.5b) or simple (Fig. 1.5c).
6. Gnathopod 2 male, carpus. In *Gammaropsis* the carpus of gnathopod 2 is shorter than the propodus (Fig. 1.6a). The carpus may be subequal to the propodus (Fig. 1.6b) or longer and larger than the propodus (Fig. 1.6c).
7. Coxa 4. In *Gammaropsis* coxa 4 is as deep as wide (Fig. 1.7a). Coxa 4 may be wider than deep (Fig. 1.7b) or deeper than wide (Fig. 1.7c).
8. Coxa 4. In *Gammaropsis* and most erichthoniids the ventral margin of coxa 4 is smooth (Fig. 1.8a). In some taxa the ventral margin is serrated (Fig. 1.8b).
9. Peraeopod 5 dactylus. The distal part of peraeopod 5 (at least the propodus and dactylus) is directed anteriorly in *Gammaropsis* (Fig. 2.9a). In some erichthoniids the distal part of peraeopod 5 is directed posteriorly (Fig. 2.9b). In *Corocubanus* the distal part of peraeopod 5 is apparently absent.
10. Peraeopod 6 dactylus. The distal part of peraeopod 6 (at least the propodus and dactylus) is directed anteriorly in *Gammaropsis* (Fig. 2.10a). In some erichthoniids it is directed posteriorly (Fig. 2.10b). In *Corocubanus* the distal part of peraeopod 6 is apparently absent.
11. Peraeopod 7 dactylus. The distal part of peraeopod 7 (at least the propodus and dactylus) is directed anteriorly in *Gammaropsis* (Fig. 2.11a). In some erichthoniids it is directed posteriorly (Fig. 2.11b). In *Corocubanus* it is vestigial.
12. Coxa 5. In *Gammaropsis* the coxa 5 has a posterodorsal lobe (Fig. 2.12a). Within the erichthoniids the posterodorsal lobe is occasionally absent (Fig. 2.12b).
13. Peraeopod 5 carpus. In *Gammaropsis* and some erichthoniids the carpus of peraeopod 5 is without denticles or spines (Fig. 2.13a). Within the *Cerapus* and *Siphonoecetes* clades the carpus may have denticles (Fig. 2.13b) or denticles and short spines on a posteroventral lobe (Fig. 2.13c).
14. Peraeopods 5–6 propodus. In *Gammaropsis* and some erichthoniids the propodus is inserted at the distal end of the carpus (Fig. 2.14a). In other taxa the propodus is inserted on the anterior concave side of the carpus of peraeopod 5 or peraeopods 5 and 6 (Fig. 2.14b).
15. Peraeopods 5–7 dactylus. In *Gammaropsis* and some erichthoniids the dactylus has no accessory spines (Fig. 2.15a). In some erichthoniids spines may be present (Fig. 2.15b).
16. Uropod 1 peduncle. In *Gammaropsis* and some erichthoniids there is no distoventral corona (Fig. 2.16a). In other erichthoniids a distoventral corona is present (Fig. 2.16b).
17. Uropod 2 rami. In *Gammaropsis* and some erichthoniids uropod 2 is biramous (Fig. 2.17a). In other erichthoniids uropod 2 is uniramous (Fig. 2.17b) or absent (Fig. 2.17c).
18. Uropod 3 rami. In *Gammaropsis* and some erichthoniids uropod 3 is biramous (Fig. 2.18a). In other erichthoniids uropod 3 may be uniramous (Fig. 2.18b) or the rami may be absent (Fig. 2.18c).
19. Uropod 3 rami. *Gammaropsis* does not have recurved spines on the rami of uropod 3 (Fig. 2.19a). Within the erichthoniids some taxa have recurved spines (Fig. 2.19b).
20. Telson. In *Gammaropsis* and most erichthoniids the telson is entire (Fig. 2.20a). In the *Cerapus* and *Siphonoecetes* clades some taxa have a cleft telson (Fig. 2.20b).
21. Telson. In *Gammaropsis* there are no recurved spines on the telson (Fig. 2.21a). In erichthoniids there are recurved spines in patches (Fig. 2.21b) or rows (Fig. 2.21c) on the dorsum of the telson.

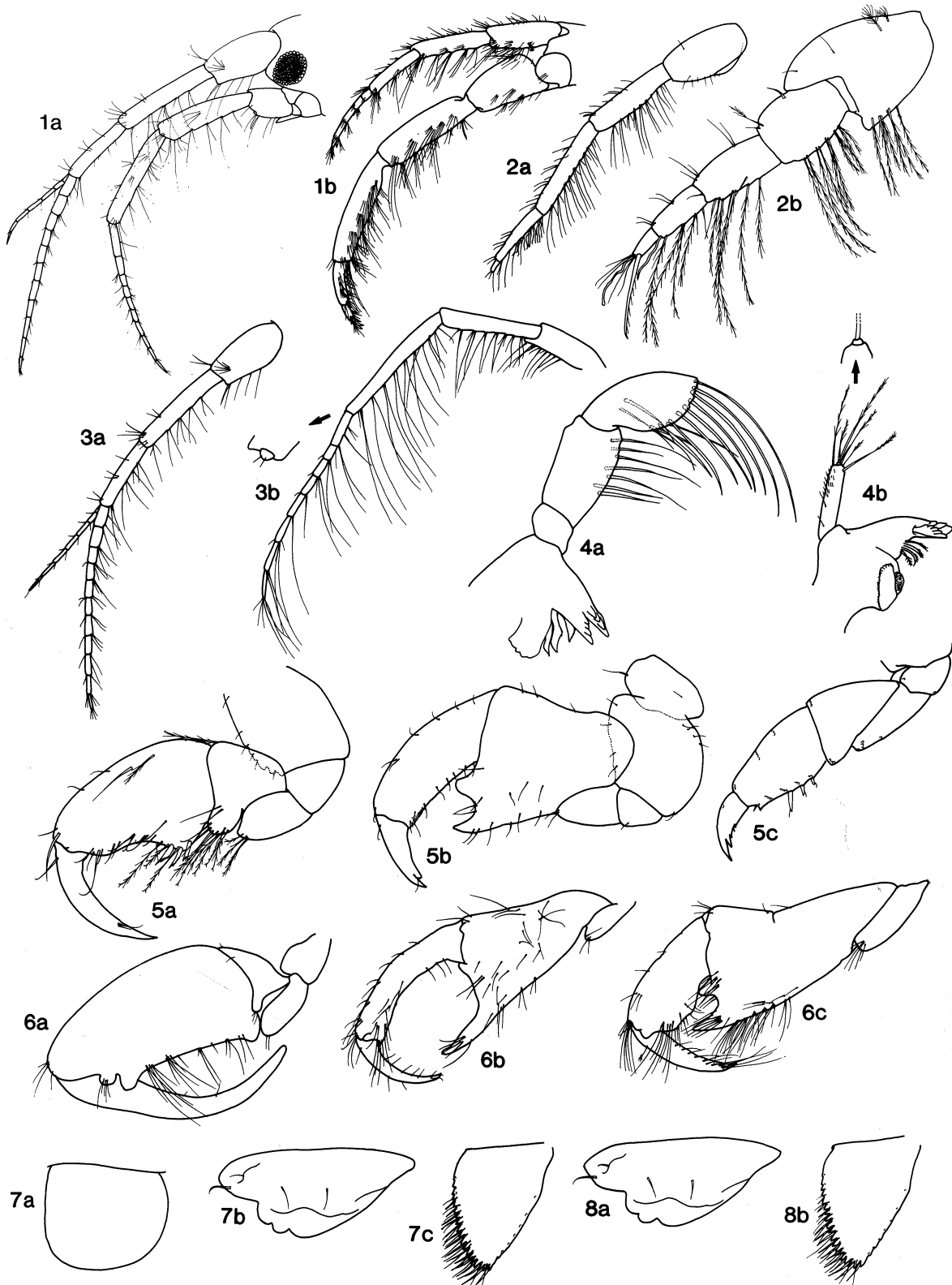


Fig. 1. Character states used in phylogenetic analyses. Antenna 1, subequal in length to antenna 2 (1a); shorter than antenna 2 (1b). Antenna 1, peduncular article 1 slender, rectangular (2a); peduncular article 1 expanded dorsomedially and dorsodistally (2b). Antenna 1 accessory flagellum multiarticulate (3a); vestigial (3b). Mandibular palp 3-articulate (4a); 2- or 1-articulate (4b). Gnathopod 2 male, subchelate (5a); carpochelate (5b); simple (5c). Gnathopod 2 male carpus shorter than propodus (6a); subequal to propodus (6b); longer and larger than propodus (6c). Coxa 4 as deep as wide (7a); wider than deep (7b); deeper than wide (7c). Coxa 4 ventral margin smooth (8a); ventral margin serrated (8b).

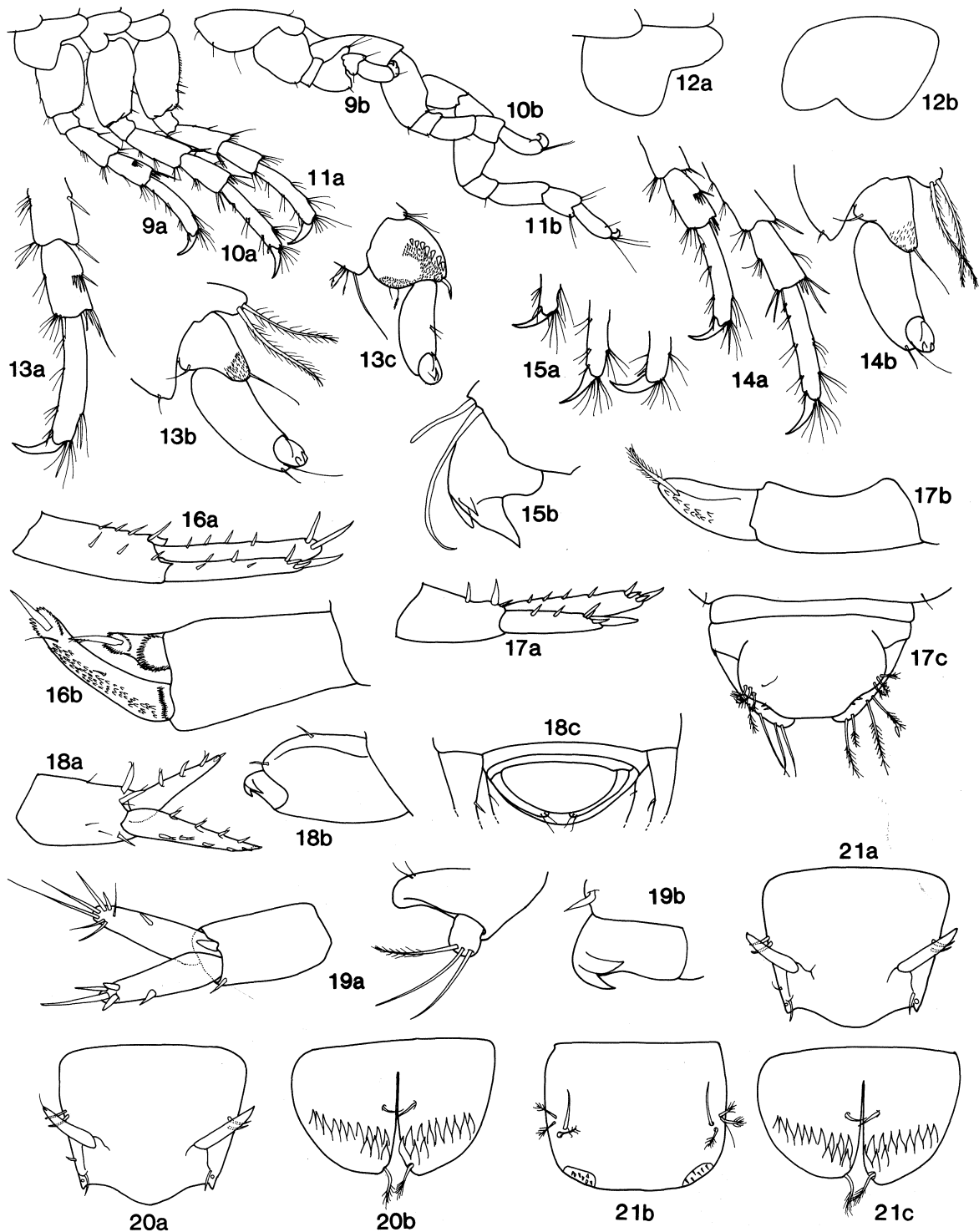


Fig. 2. Character states used in phylogenetic analyses. Peraeopods 5–7, distal part (at least propodus and dactylus) directed anteriorly (9a, 10a, 11a); directed posteriorly (9b, 10b, 11b). Coxa 5 with posterodorsal lobe (12a); without posterodorsal lobe (12b). Peraeopod 5 carpus without denticles or spines (13a); with denticles (13b); with denticles and short spines (13c). Peraeopods 5–6 propodus inserted at distal end of carpus (14a); inserted on anterior concave side of carpus (14b). Peraeopods 5–7 dactylus without accessory spines (15a); with accessory spines (15b). Uropod 1 peduncle without distoventral corona (16a); with distoventral corona (16b). Uropod 2 rami biramous (17a); uniramous (17b); without rami (17c). Uropod 3 rami biramous (18a); uniramous (18b); without rami (18c). Uropod 3 with apical setae (19a); with recurved spines (19b). Telson entire (20a); telson cleft (20b). Telson without recurved spines (21a); with recurved spines in patches (21b); in rows (21c).

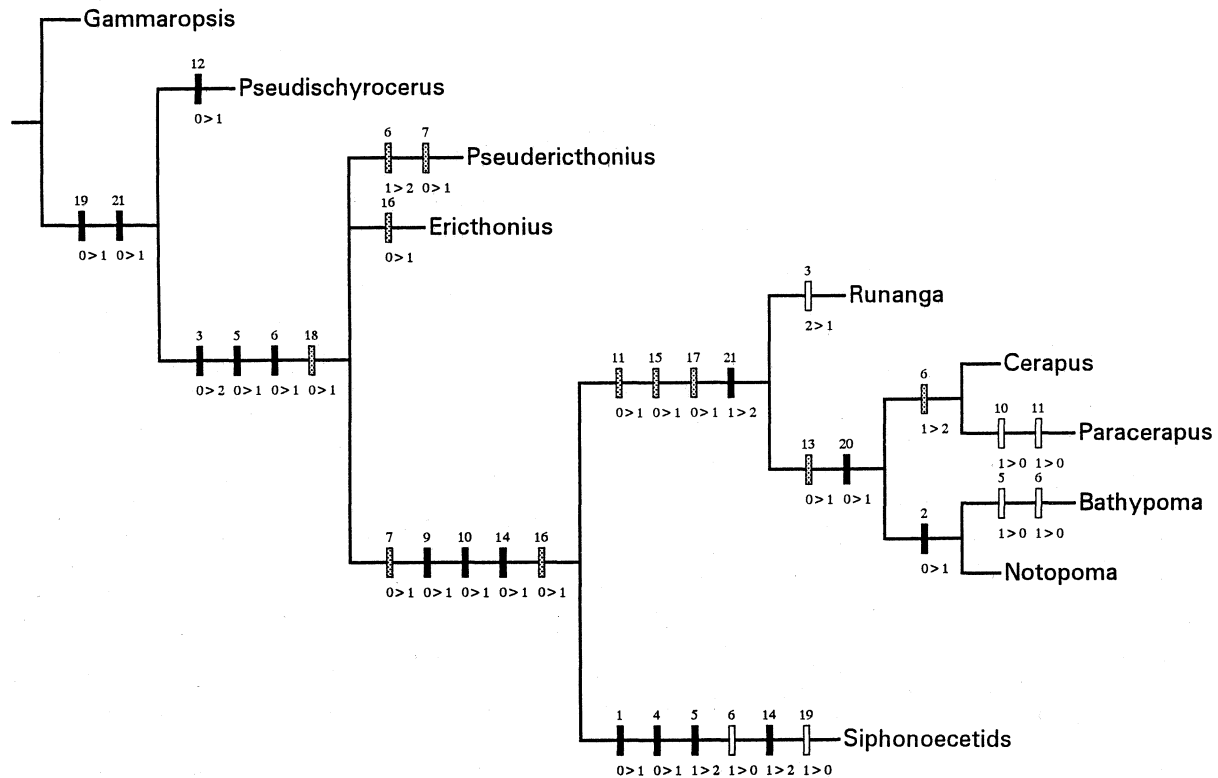


Fig. 3. Hypothesized phylogenetic relations among generic level tax. A black box indicates an apomorphic character; a shaded box indicates a homoplastic character; a white box indicates a reversal. Superscripts refer to characters and subscripts indicate direction. The *Siphonoecetes* clade is represented as a terminal taxon.

Methods and Results

The analyses were performed and examined using HENNIG86 (Farris, 1988) and CLADOS (Nixon, 1991). The matrix of the data is presented in Table 1. The HENNIG86 analyses were run using unordered characters. Implicit enumeration (ie) produced 6 trees (length 62, consistency index 0.54, retention index 0.76). In these six trees *Ericthonius* and *Pseuderichthonius* alternate in position and there is some instability in the position of taxa within the *Siphonoecetes* clade. Using the HENNIG86 command, Nelsen, we generated a strict consensus tree (length 0.69, consistency index 0.49, retention index 0.72) (Fig. 3). Because of work in preparation (Just, pers. comm.) only the synapomorphies defining the *Siphonoecetes* clade (10 genera) are presented and that clade is not discussed further.

Relationships Within the *Ericthonius* Group

Our cladogram indicates three divisions within the *Ericthonius* group. There are three non-aligned genera (*Ericthonius*, *Pseuderichthonius* and *Pseudischyrocerus*) and two robust clades known as the *Cerapus* clade and the *Siphonoecetes* clade. The *Cerapus* clade contains

Bathypoma n.gen.; *Cerapus* Say, 1817; *Notopoma* n.gen.; *Runanga* J.L. Barnard, 1961 and *Paracerapus* Budnikova, 1989. The *Siphonoecetes* clade contains 10 genera listed above (*Siphonoecetinae* of Just, 1988).

The *Ericthonius* group is defined by patches of small or large recurved spines on the dorsum of the telson [21]. The rami of uropod 3 also have recurved spines [19], however, in the *Siphonoecetes* clade the plesiomorphic character state occurs, which we interpret as a loss.

The three non-aligned taxa occur near the base of the tree. *Pseudischyrocerus* is the only member of the *Ericthonius* group which does not have a posterodorsal lobe on coxa 5 [12,1]. *Pseuderichthonius* and *Ericthonius* form a dichotomy which would disappear if the taxa were synonymised.

The majority of the taxa in the *Ericthonius* group share four synapomorphic characters: the accessory flagellum is absent [3,2] (this character reverses in *Runanga* [3,1]); the male gnathopod 2 changes from subchelate [5,2]; the carpus of male gnathopod 2 becomes at least as long as the propodus (reverses in the *Siphonoecetes* clade); uropod 3 becomes uniramous. The two sister clades (the *Cerapus* and *Siphonoecetes* clades) in the *Ericthonius* group share five synapomorphic characters: coxa 4 becomes wider than deep [7,1] or deeper than wide [7,2]; the distal ends of pereopods

5 and 6 are directed posteriorly [9,1] [10,1] (in *Paracerapus*, this character reverses to the plesiomorphic state); in peraeopod 5 the propodus inserts on the anterior margin of the carpus [14,1]; and a distoventral corona of spines develops on the distoventral peduncular margin of uropod 1 [16,1] (changes state several times within the *Siphonoecetes* clade).

The *Cerapus* clade, with five genera, is defined by four synapomorphies: distal end of peraeopod 7 directed posteriorly [11,1] (homoplastic character reversed in *Paracerapus* and independently derived within the *Siphonoecetes* clade; accessory spines present on peraeopods 5–7 [15,1] (homoplastic character independently derived within the *Siphonoecetes* clade); uropod 2 uniramous [17,1] (homoplastic character independently derived within the *Siphonoecetes* clade); and telson with recurved spines in rows [21,2]. Three of these four characters also occur within the *Siphonoecetes* clade. The majority of taxa in both clades have a posteriorly directed dactylus on peraeopod 7. If the change to an anterior direction in *Paracerapus* and in *Siphonoecetes* is considered to be a reversal then the character also helps to define both clades. If no accessory spines on the dactyli of peraeopods 5 to 7 is considered to be a secondary loss in *Siphonoecetes*, then the presence of accessory spines may also be considered as a synapomorphy which helps to define both clades. However, uniramous second uropods in both clades appears to be the result of independently derived events. The recurved spines on the telson is consequently a strong synapomorphy which absolutely defines the *Cerapus* clade.

The *Cerapus* clade has five closely related genera. *Runanga* has the fewest derived characters and is defined by a vestigial accessory flagellum [3,1] (reversal). Other members of the *Cerapus* clade are distinguished from *Runanga* by denticles on the carpus of peraeopod 5 (homoplastic character independently derived within the *Siphonoecetes* clade) [13,1]; and a cleft telson [20,1]. *Cerapus* and *Paracerapus* are defined by having the carpus longer than the propodus in male gnathopod 2 [6,2]. *Paracerapus* differs from *Cerapus* in having the distal ends of peraeopods 6 and 7 directed anteriorly [10,0] [11,0] (reversal to plesiomorphic state). *Bathypoma* and *Notopoma* are differentiated from other members of the *Cerapus* clade by the medially and distally expanded peduncle of antenna 1 [2,1]. *Bathypoma* differs from all other members of the *Cerapus* clade in having a subchelate gnathopod 2 [5,0] with short carpus [6,0] (an apparent reversal to the plesiomorphic state).

The *Siphonoecetes* clade is strongly defined by six synapomorphies: antenna 1 is shorter than antenna 2 [1,1]; the mandibular palp has 1 or 2 articles [4,1]; gnathopod 2 is simple [5,2] (in some genera a secondarily derived subchelate gnathopod develops); the carpus of gnathopod 2 is shorter than propodus (homoplastic) [6,0]; in peraeopods 5–6 the propodus inserts on the anterior margin of the carpus [14,2]; and there are no spines on the ramus of uropod 3 (reversal) [19,2]. This sister clade to the *Cerapus* clade is not discussed further.

Discussion

Much of the evolutionary change in this group of taxa is related to their tube-dwelling behaviour. Examples of morphological changes with obvious functional applications to tube-dwelling are: elongate, robust second antennae; cylindrical body; elongate peraeonite 5 in females; operculum-like peduncle of antenna 1; glands on peraeopods 3 to 4; reduced coxae; reversed distal ends of peraeopods 5 to 7; accessory spines on the dactyli of peraeopods 5 to 7; dorsally ridged urosome; and spines on the dorsum of the telson. Less modified taxa such as *Ericthonius* live in simple nests which cannot be detached and moved around. More highly modified taxa, such as members of the *Cerapus* clade live in complex, movable tubes which they construct from spinning glands in peraeopods 3 and 4 (Lowry, 1981: fig. 9). In the *Siphonoecetes* clade highly modified taxa such as *Concholestes* live in shells, tubes and other independently-made biological structures (Just, 1984: fig. 1).

These evolutionary modifications allow genera with open-ended tubes to reverse positions in the tube, to extend the anterior end of the body out of the tube for feeding or for agonistic behaviour, to shut the tube (in genera with modified peduncles such as *Notopoma*), to crawl and cling with the robust extendible antennae (Barnard *et al.*, 1991). The medially expanded peduncle on antenna 1 functions as an operculum to close the anterior end of the tube. The large carpochele gnathopod of the male is used for agonistic behaviour (pers. obs.), the glands of peraeopod 3 and 4 are used to build the tubes (Giles, 1885; Barnard *et al.*, 1991). The elongation of the female peraeonite 5 increases the volume and hence egg-carrying capacity of the brood chamber. Peraeopods 5–7, uropods and telson are highly modified with spines for gripping the inside of the tube. The dorsal ridges of the urosome form an operculum to close the posterior end of the tube. The huge distoventral hook on the peduncle of uropod 1 in *Cerapus cudjoe* is thought to anchor that species to its tube when it extends its body into the 5 knot currents of Cudjoe Channel (Lowry & Thomas, 1991; Barnard *et al.*, 1991 as *Cerapus* sp. K). The characteristic accessory spines on the dactyli, the reversal of distal ends of peraeopods 5 to 7 and the spines on telson may allow greater purchase on the dorsal surface of the tube.

The relationship of the *Ericthonius* group to other corophioids is not explored in this analysis. But the recurved spines on the rami of uropod 3 indicate a possible relationship to ischyrocerids. Several taxa near the base of the *Ericthonius* group, particularly *Pseudischyrocerus*, do not show strong relationships to other taxa in the clade. *Pseuderichthonius* and *Ericthonius* both have strong derived characters in common with the *Cerapus* clade, particularly the carpochele gnathopod 2 of the male, but they also have patches of telsonic spines, a character state shared with the *Siphonoecetes* clade.

The *Cerapus* and *Siphonoecetes* clades are considered

to be sister taxa. They share several equivocal characters which cannot be resolved at this time, particularly accessory spines on the dactyli of peraeopod 5 to 7 and a posteriorly directed peraeopod 7, which may be considered as derived in a common ancestor or independently derived within each clade.

Distribution Patterns

Members of the *Cerapus* clade are found world-wide in cold-temperate to tropical seas from the intertidal to 1000 m depth. *Notopoma* is the widest ranging genus. It is most diverse in the southern hemisphere where eight of the 10 shallow-water species occur from tropical to subantarctic waters: French Polynesia (1 species); New Zealand (3 species); Australia (1 species); South Africa (1 species); and the subantarctic islands (2 species). A species reported from Argentina as *Cerapus tubularis* by Alonso (1980) is an undetermined species of *Notopoma* and an undescribed species of *Notopoma* lives in northern Papua New Guinea (Lowry & Berents, in prep.). In the northern hemisphere only 2 species are known: one in the North Sea, north-eastern Atlantic, and one in the Bering Sea, western North Pacific.

Cerapus is a shallow-water tropical to temperate genus. In the northern hemisphere it is known from eastern North America (3 species), Japan (1 species), China (1 species) and India (1 species). The record of *C. tubularis* of J.L. Barnard (1962) from southern California is an undescribed species. *Cerapus tubularis* of Nagata (1965) from Japan, may be *C. erae*, but the illustrations are inconclusive. Morino (1976) recorded two forms of *Cerapus tubularis* from Japan, but as he implied, "Form A" is *C. longirostris* Shen, 1936 and "Form B" is *C. erae* Bulycheva, 1952. In the southern hemisphere two species are reported from islands in the South Pacific and two species are also reported from Australia. The record of *C. tubularis* of Hale (1929) from South Australia, is an undescribed species and we know of other undescribed species from this area. The records of *C. tubularis* of Ledoyer (1967, 1969a,b, 1986) from Madagascar etc. and Griffiths (1973, 1974a,b, 1976) from southern Africa represent several undescribed species.

Other genera in the *Cerapus* clade are monotypic or have only a few species with limited distributions.

Runanga is found in relatively deep waters of the Tasman Sea and off the east coast of New Zealand. *Bathypoma* is only known from the slope off south-eastern Australia and *Paracerapus* is known only from coastal areas of the Kamchatka Peninsula and the Commander Islands in the Bering Sea.

Systematics

Key to *Ericthonius* Group Genera

1. Peraeopods 6–7 similar, much longer than peraeopod 5 2
- Peraeopods 5–6 similar, much shorter than peraeopod 7
(*Siphonoecetes* clade) 8
2. Peraeopod 5 propodus inserted at distal end of carpus. Uropod
2 biramous 3
- Peraeopod 5 propodus inserted on posterior concave side of
carpus. Uropod 2 uniramous (*Cerapus* clade) 4
3. Uropod 3 uniramous *Ericthonius/Pseuderichthonius*
- Uropod 3 biramous *Pseudischyrocerus*
4. Antenna 1 without accessory flagellum 5
- Antenna 1 with vestigial accessory flagellum *Runanga*
5. Antenna 1 peduncle rectangular, not produced anterodistally
or medially 6
- Antenna 1 peduncle subquadrate to rectangular, produced
anterodistally and medially 7

6. Peraeopods 5–7 directed posteriorly *Cerapus*
 — Peraeopods 5 directed posteriorly, peraeopods 6–7 directed anteriorly *Paracerapus*
7. Gnathopod 2 male subchelate *Bathypoma*
 — Gnathopod 2 male carpochebate *Notopoma*
8. Uropod 2 biramous 9
 — Uropod 2 uniramous 12
 — Uropod 2 absent 14
9. Head without anterodorsal depression in rostral area 10
 — Head with anterodorsal depression in rostral area *Australoecetes*
10. Antenna 2 flagellum with strong robust setae near distal end 11
 — Antenna 2 flagellum with strong robust setae along most of ventral margin *Siphonoecetes (Orientaloecetes)*
11. Uropod 1 peduncle with distoventral spur. Uropod 3 ramus, distal margin with row of long pappose setae *Siphonoecetes (Centraloecetes)*
 — Uropod 1 peduncle with distoventral corona. Uropod 3 ramus, distal margin with at most a few short, simple setae *Siphonoecetes (Siphonoecetes)*
12. Mandibular palp with 2 articles. Urosomites 1–2 free 13
 — Mandibular palp with 1 article. Urosomites 1–2 fused dorsally *Bubocorophium*
13. Head without anterodorsal depression in rostral area. Antenna 2 flagellum with strong robust setae on distal articles. Uropod 1 peduncle with distoventral corona *Borneoecetes*
 — Head with anterodorsal depression in rostral area. Antenna 2 flagellum with strong robust setae along much of ventral margin. Uropod 1 peduncle without distoventral corona *Rhinoecetes*
14. Gnathopod 2 simple 15
 — Gnathopod 2 strongly subchelate *Concholestes*
15. Uropod 3 without rami 16
 — Uropod 3 uniramous *Africoecetes*
16. Peraeopod 7 dactylus small, well developed 17
 — Peraeopod 7 dactylus vestigial *Corocubanus*
17. Peraeopods 5–7 dactyli without accessory spines. Telson fused dorsally to urosomite 3, with patches of dorsal spines *Caribboecetes*
 — Peraeopods 5–7 dactyli with accessory spines. Telson free, without dorsal spines *Polynesoecetes*

The *Cerapus* Clade

Cerapinae Smith, 1880: 276.

Cerapiinae Budnikova, 1989: 55.

Diagnosis. *Antenna 1*: slightly more robust than antenna 2. *Antenna 2*: peduncle elongate, slender. *Mandible*: palp large, 3-articulate. *Gnathopod 1*: subchelate in male and female. *Gnathopod 2*: carpochelate (rarely subchelate) in male, subchelate in female. *Peraeopods 3 and 4*: basis inflated, glandular; dactylus not styliform. *Peraeopods 5 to 7*: distal articles reversed so that dactyli are directed posteriorly; dactyli modified with accessory spines (occasionally unmodified). *Peraeopod 5*: coxa enlarged, broad and long anteriorly with small posterior lobe (usually much larger in female), with or without fringe of long setae; merus short, broad, anterior margin produced to nearly or completely over reach carpus, posterior margin produced into a large setose lobe; carpus short, reniform with posterior lobe covered in minute denticles; propodus inserts into concave margin of carpus. *Peraeopods 6 and 7*: similar to each other; peraeopod 7 slightly longer than peraeopod 6, both longer than peraeopod 5. *Urosomites*: free. *Pleopods*: decreasing in size from pleopod 1 to 3 (occasionally not modified). *Pleopods 2 and 3*: reduced inner ramus (occasionally pleopod 3 uniramous or absent). *Uropod 1*: biramous with a corona of spines at distoventral end of peduncle. *Uropods 2 and 3*: uniramous with reduced or rudimentary ramus. *Telson*: short, notched to deeply cleft, each lobe with a dorsal field of recurved spines.

***Cerapus* clade composition.** Five genera: *Cerapus* Say, 1817; *Runanga* J.L. Barnard, 1961; *Paracerapus* Budnikova, 1989; *Notopoma* n.gen. and *Bathypoma* n.gen.

Generic Diagnoses

Bathypoma n.gen.

Diagnosis. *Antenna 1*: peduncular article 1 with dorsodistal flange partially overlapping article 2 and produced medially to form an operculum; without accessory flagellum. *Mandibles*: left incisor with 5 teeth; left lacinia mobilis with 4 teeth; left accessory setal row with 3 broad robust setae and 3 intermediate plumose setae; right incisor with 5 teeth; right lacinia mobilis with 1 small tooth and a minutely denticulate margin; right accessory setal row with 2 robust setae and 2 plumose setae; mandibular palp short, broad. *Maxilla 1*: outer plates each with 9 setal-teeth. *Gnathopod 2*: subchelate in male and female. *Peraeopods 3 to 7*: dactyli all directed posteriorly. *Peraeopod 4*: merus short, not expanded posteriorly. *Peraeopod 5*: coxa in female larger than in male, without fringe of long setae; dactylus with large unguis and 2 small accessory spines. *Peraeopod 6*: dactylus with large unguis and 2 small accessory spines. *Peraeopod 7*: dactylus with large unguis and 2

small accessory spines. *Pleopod 2*: inner ramus reduced, 1-articulate. *Pleopod 3*: uniramous, 1-articulate ramus. *Uropod 2* with one ramus. *Uropod 3* with one vestigial ramus bearing small recurved spines.

Type species. *Bathypoma enigma* n.sp.

Species composition. *Bathypoma* is monotypic.

Etymology. The name *Bathypoma* is derived from the Greek "poma" for lid and refers to the peduncle of antenna 1 which forms a lid to seal the tube, and "bathys" from the Greek for deep which refers to the depth distribution of the genus.

Remarks. *Bathypoma* is unique because the male has a subchelate gnathopod 2. The complex set of characters which makes up gnathopod 2 is considered important because the morphology of the carpus, propodus and dactylus is completely different from that of the carpochelate gnathopod of other males in the *Cerapus* clade. The major muscle mass of the gnathopod occurs in the propodus rather than carpus which indicates that the gnathopod functions in a different way. The overall morphology of the gnathopod does not suggest a neotenic condition, but it is remarkably similar to gnathopods in the genus *Unciola*.

Cerapus Say

Cerapus Say, 1817: 49.

Baracuma Barnard & Drummond, 1981: 31.

Diagnosis. *Antenna 1*: peduncular article 1 with proximoventral swelling; without accessory flagellum. *Mandibles*: left incisor with 6 teeth; left lacinia mobilis with 5 teeth; left accessory setal row with 2–3 broad robust setae and 2–3 intermediate plumose setae; right incisor with 5–6 teeth; right lacinia mobilis with 1 large tooth and a minutely denticulate margin; right accessory setal row with 2 setae and 2 plumose setae; mandibular palp elongate, slender. *Maxilla 1*: outer plates each with 10 setal-teeth. *Gnathopod 2*: carpochelate in male, subchelate in female. *Peraeopods 3 to 7*: dactyli all directed posteriorly. *Peraeopod 4*: merus short, not expanded posteriorly. *Peraeopod 5*: coxa in female larger than in male, without fringe of long setae; dactylus with large unguis and 1–2 small accessory spines. *Peraeopod 6*: dactylus with large unguis and 2 small accessory spines. *Peraeopod 7*: dactylus with large unguis and 1–2 small accessory spines. *Pleopod 2*: inner ramus reduced, 1-articulate. *Pleopod 3*: inner ramus reduced, 1-articulate ramus. *Uropod 2* with one ramus. *Uropod 3* with one vestigial ramus bearing small recurved spines.

Type species. *Cerapus tubularis* Say, 1817.

Species composition. *Cerapus* currently contains 11 species: *C. alquirtus* (Barnard & Drummond, 1981); *C. benthophilus* Thomas & Heard, 1979; *Cerapus calamicola* (Giles, 1885); *C. cudjoe* Lowry & Thomas, 1991; *C. erae*, Bulycheva, 1952; *C. flindersi* Stebbing, 1888; *C. longirostris* Shen, 1936; *C. micronesicus* Myers, 1995; *C. oceanicus* Lowry, 1985; *C. pacificus* Lowry, 1985; and *C. tubularis* Say, 1817. *Cerapus abditus* Templeton, 1836 is considered to be an unrecognisable species.

Remarks. Lowry & Berents (1989) showed that the elongation of peraeonite 5 in the female is not a generic character among the *Cerapus* clade. They maintained *Baracuma* based on the sternal keel. Budnikova (1989) has synonymised *Baracuma* with *Cerapus*. Other possible generic differences between these tightly defined species are: in *C. erae*, *C. longirostris* and *C. oceanicus* the dactyli of peraeopod 5 have two small accessory spines instead of one; and in *C. alquirtus* and *C. oceanicus* there is only one accessory spine on the dactylus of peraeopod 7.

Notopoma n.gen.

Diagnosis. *Antenna 1*: peduncular article 1 with dorsodistal flange partially overlapping article 2 and produced medially to form an operculum; without accessory flagellum. *Mandibles*: left incisor with 4–5 teeth; left lacinia mobilis with 4 teeth; left accessory setal row with 3–4 broad robust setae and 0–3 intermediate plumose setae; right incisor with 4–5 teeth; right lacinia mobilis with 1 large tooth and a minutely denticulate margin; right accessory setal row with 2 robust setae and 2 plumose setae; mandibular palp short, broad. *Maxilla 1*: outer plates each with 7–10 setal-teeth. *Gnathopod 2*: carpochele in male, subchele in female. *Peraeopods 3 to 7*: dactyli all directed posteriorly. *Peraeopod 4*: merus short, not expanded posteriorly. *Peraeopod 5*: coxa in female subequal or larger than in male, without fringe of long setae; dactylus with large unguis and 1–2 small accessory spines. *Peraeopod 6*: dactylus with large unguis and 2 small accessory spines. *Peraeopod 7*: dactylus with large unguis and 1–2 small accessory spines. *Pleopod 2*: inner ramus reduced, 1-articulate or pleopod uniramous. *Pleopod 3*: one reduced 1-articulate ramus or pleopod absent. *Uropod 2* with one ramus. *Uropod 3* with one vestigial ramus bearing small recurved spines.

Type species. *Notopoma stoddartae* n.sp.

Species composition. *Notopoma* currently contains 10 species: *N. africana* n.sp.; *N. crassicornis* (Bate, 1857); *N. fallohidea* (Lowry, 1981); *N. harfoota* (Lowry, 1981); *N. lutkini* (Tzvetkova, 1990); *N. moorea* n.sp.; *N. opposita* (K.H. Barnard, 1931); *N. sismithi* (Stebbing, 1888); *N. stoddartae* n.sp. and *N. stoor* (Lowry, 1981).

Etymology. The name *Notopoma* is derived from the Greek “poma” for lid and refers to the peduncle of antenna 1 which forms a lid to seal the tube, and “noto” for southern which refers to the distribution of the genus.

Remarks. *Notopoma* differs from *Bathypoma* in having a carpochele gnathopod 2 in the male and from all other genera in the *Cerapus* clade in having an expanded peduncular article 1 on antenna 1. Sars (1894) observed that the peduncular articles function as an operculum in *N. crassicornis*. We have seen this phenomenon a number of times in preserved specimens still in their tubes. Apparently the antenna geniculates strongly between peduncular articles 1 and 2 so that the distal end of the antenna folds back into the tube leaving the dorsal surfaces of the first peduncular articles to form a cap which closes the tube.

Paracerapus Budnikova

Paracerapus Budnikova, 1989: 54.

Diagnosis. *Antenna 1*: peduncular article 1 with anterior and posterior margins parallel; without accessory flagellum. *Mandibles*: left and right incisor, lacinia mobilis, accessory setal row and intermediate setae unknown; mandibular palp elongate, slender. *Maxilla 1*: outer plate, setal-teeth unknown. *Gnathopod 2*: carpochele in male, subchele in female. *Peraeopods 3 to 7*: dactyli 3 to 5 directed posteriorly, dactyli 6 to 7 directed anteriorly. *Peraeopod 4*: merus short, expanded posteriorly. *Peraeopod 5*: coxa, female/male size ratios unknown, without fringe of long setae; dactylus with large unguis, small accessory spines apparently absent. *Peraeopod 6*: dactylus with large unguis, small accessory spines apparently absent. *Peraeopod 7*: dactylus with large unguis, small accessory spines apparently absent. *Pleopod 2*: biramous, inner ramus not reduced. *Pleopod 3*: biramous, inner ramus not reduced. *Uropod 2*: possibly biramous, inner ramus vestigial. *Uropod 3* with one vestigial ramus bearing small recurved spines.

Type species. *Cerapus polutovi* Gurjanova, 1951.

Species composition. *Paracerapus* currently contains 2 species: *Paracerapus comparativus* (Kudrjashov, 1975) and *P. polutovi* (Gurjanova, 1951).

Remarks. In *Paracerapus* the dactyli on peraeopods 6 and 7 remain orientated anteriorly, a primitive condition. This, in addition to no accessory spines on the dactyli and an enlarged coxa 2, are the main differences which separate *Paracerapus* from its sister taxon *Cerapus* and other genera in the group.

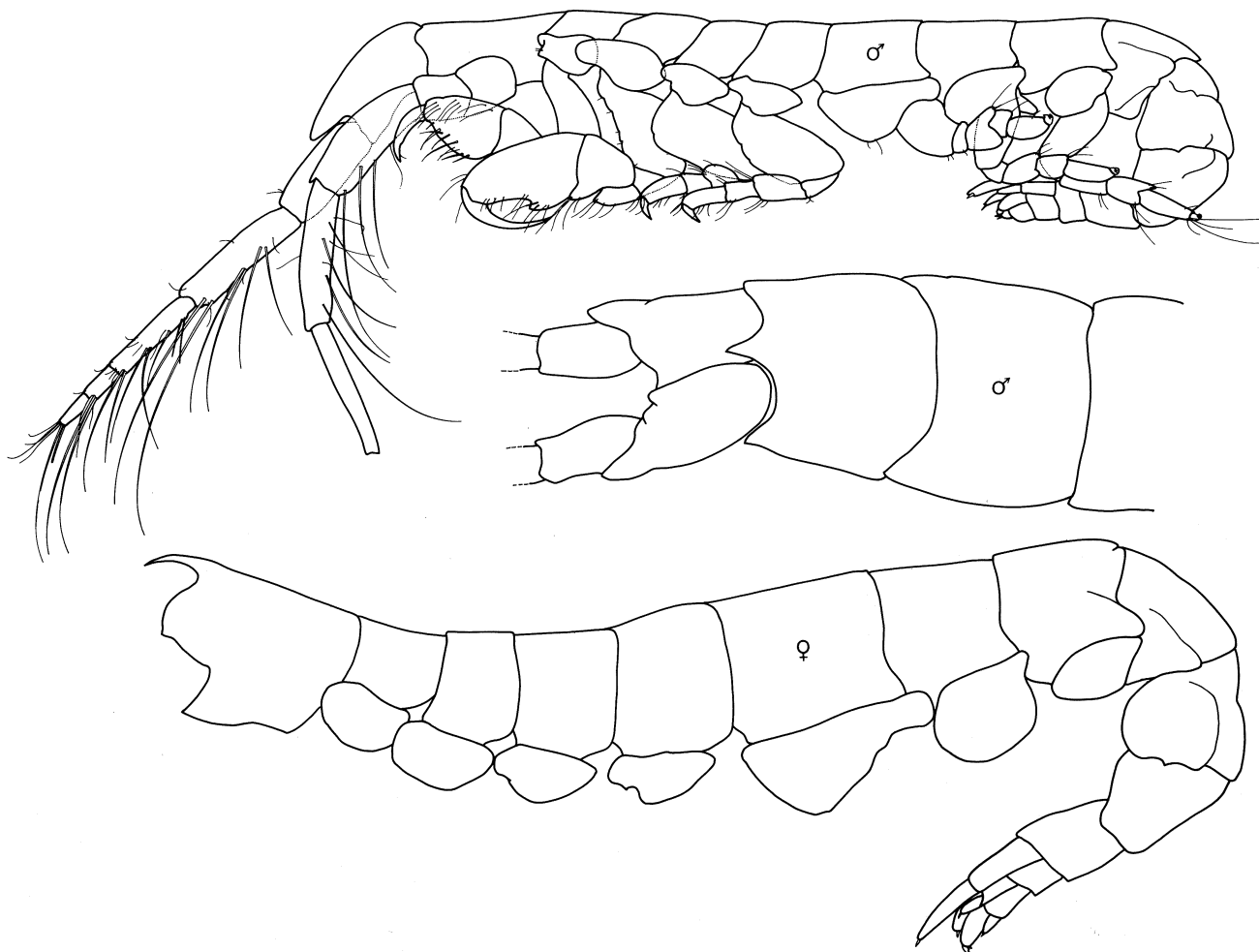


Fig. 4. *Bathypoma enigma* n.sp., lateral view, male holotype, 2.1 mm, NMV J20777; dorsal view, female paratype, 2.6 mm, NMV J20778; east of Freycinet Peninsula, Tasmania.

Runanga J.L. Barnard

Runanga J.L. Barnard, 1961: 117.

Diagnosis. *Antenna 1*: peduncular article 1 with proximoventral swelling; accessory flagellum scale-like. *Mandibles*: left incisor with 5 teeth; left lacinia mobilis with 5 teeth; left accessory setal row with 3 broad robust setae and 2 intermediate plumose setae; right incisor with 5 teeth; right lacinia mobilis with 1 large tooth and minutely denticulate margin; right accessory setal row with 2 broad robust setae and 3 intermediate plumose setae; mandibular palp long, slender. *Maxilla 1*: outer plates each with 9 setal-teeth. *Gnathopod 2*: carpochele in male, subchele in female. *Peraeopods 3 to 7*: dactyli 3 to 5 directed posteriorly, dactyli 6 to 7 directed anteriorly. *Peraeopod 4*: merus long, not expanded posteriorly. *Peraeopod 5*: coxa in female larger than in male, with well-developed fringe of long setae; dactylus with large unguis and 2 small accessory spines.

Peraeopod 6: dactylus with large unguis and 2 small accessory spines. *Peraeopod 7*: dactylus with large unguis and 1 small accessory spine. *Pleopod 2*: inner ramus reduced, 1-articulate. *Pleopod 3*: reduced 1-articulate ramus. *Uropod 2* with one ramus. *Uropod 3* with one vestigial ramus bearing small recurved spines.

Type species. *Runanga coxalis* J.L. Barnard, 1961.

Species composition. *Runanga* contains two species: *R. coxalis* J.L. Barnard, 1961 and *R. wairoa* McCain, 1969.

Remarks. Budnikova (1989) pointed out that in addition to the vestigial accessory flagellum, the shape of the head and the telson help to distinguish *Runanga*. Two other characters (elongate merus on pereopod 4 and strongly setose female coxa 5) also help to distinguish *Runanga* from other genera in the *Cerapus* clade.

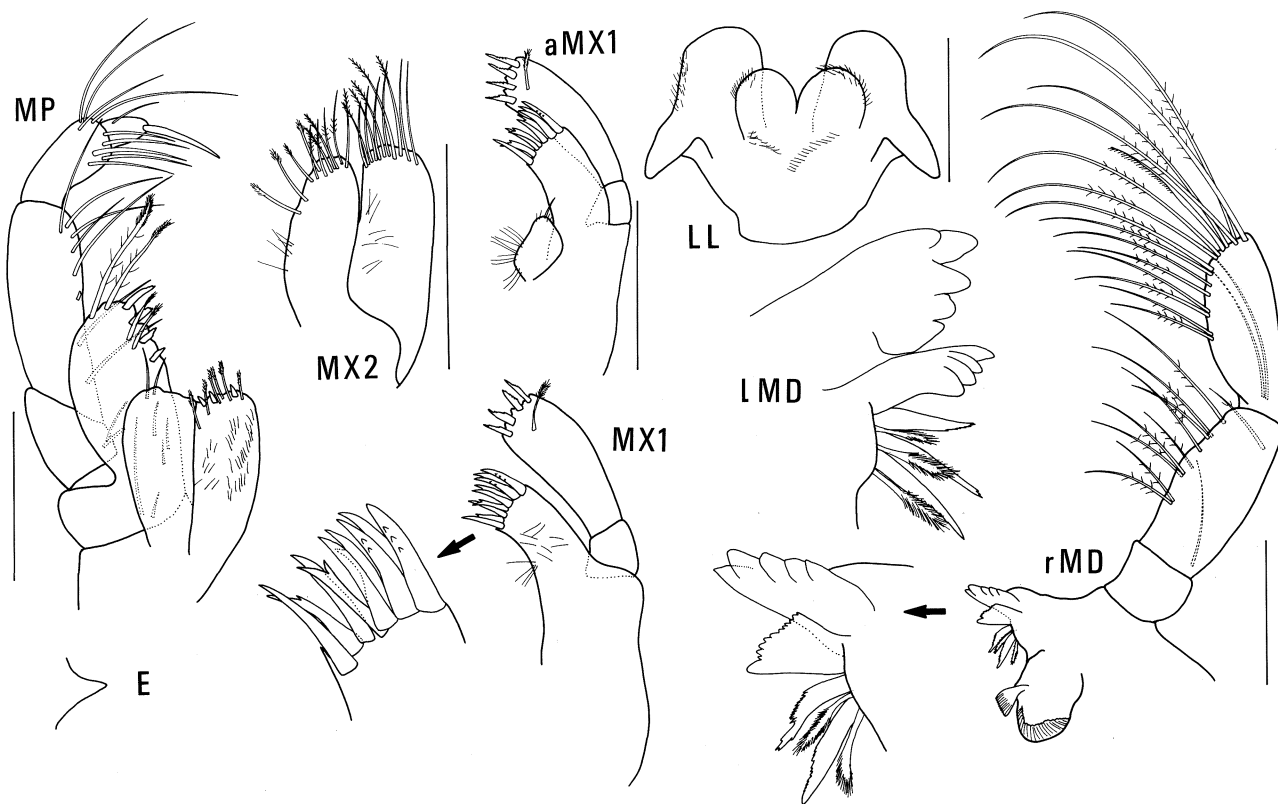


Fig. 5. *Bathypoma enigma* n.sp., male holotype, 2.1 mm, NMV J20777; epistome from male paratype, AM P40434; east of Freycinet Peninsula, Tasmania. Scales represent 0.1 mm.

Species Descriptions

Bathypoma

Bathypoma enigma n.sp.

Figs 4–8

Type data. HOLOTYPE, male, 2.07 mm, NMV J20777; PARATYPE, female, 2.60 mm, NMV J20778; PARATYPE male, NMV J20779; 31 PARATYPES, NMV J14644; PARATYPE male, 2 mm, AM P40434; 20 PARATYPES, AM P40435; east of Freycinet Peninsula, Tasmania, Australia, 42°2.20'S 148°38.7'E, coarse shelly sand, 800 m, epibenthic sled, M.F. Goman and party on RV *Franklin*, 27 July 1986, SLOPE 45; PARATYPE, NMV J14645, east of Freycinet Peninsula, Tasmania, Australia, 42°0.20'S 148°37.7'E, coarse shelly sand, 720 m, epibenthic sled, M.F. Goman and party on RV *Franklin*, 27 July 1986, SLOPE 46; PARATYPE, NMV J14459, south of Point Hicks, Victoria, Australia, 38°19.60'S 149°24.30'E, rock, rubble, clay, sand, biogenic sediment, 930–951 m, epibenthic sled, M.F. Goman and party on RV *Franklin*, 23 July 1986, SLOPE 33.

Material described. Holotype male, 2.07 mm; dimorphic characters based on paratype female, 3.60 mm.

Description. *Head:* rostrum short, curved down, apically acute, length 0.3 × head; lateral cephalic lobe well developed, ventral corner acute, subocular margin deeply recessed, anteroventral corner acute, ventral margin horizontal, posterior margin vertical. *Antenna 1:* long, 0.5 × body length, without scales; peduncular article 1 produced dorsodistally and dorsomedially, dorsodistal projection 0.4 along article 2, length 0.7 × peduncular article 3; accessory flagellum absent; flagellum long, 3-articulate (female 2), aesthetascs present along ventral margin, article 1 long, 2.8 × article 2. *Antenna 2:* subequal in length to antenna 1; peduncle without scales; flagellum 4-articulate (female 4), article 1 long, 2.6 × article 2.

Epistome and upper lip: fused, produced, acute. *Mandible:* left incisor with 5 cusps, right incisor with 5 cusps; left lacinia mobilis with 4 cusps, right with one large cusp and minutely serrate margin; left accessory setal row with 3 pappose robust setae, with 3 intermediate plumose setae, right accessory setal row with 2 pappose robust setae, with 2 intermediate plumose setae; molar triturating, molar flake on left and right side, molar seta absent; palp article 2 short, broad, length 2.1 × breadth, 1 × article 3, with 1 proximal and 1 distal A2-setae, 5 submarginal A2- and 4 submarginal B2-setae; article 3 clavate, long, 2.5 × breadth, with 2 proximal A3-setae, 4 submarginal A3- and 4 submarginal B3-setae and 7

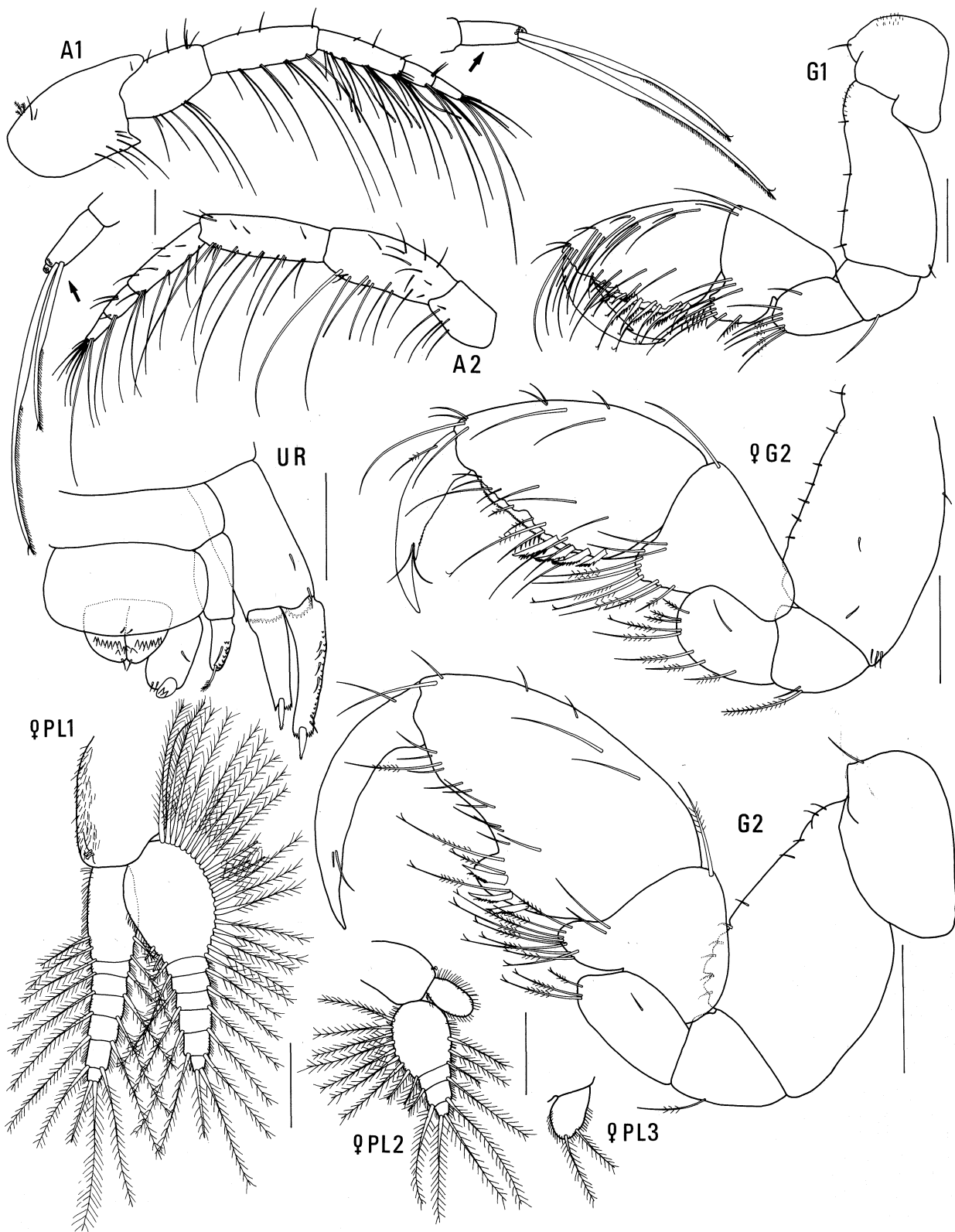


Fig. 6. *Bathypoma enigma* n.sp., male holotype, 2.1 mm, NMV J20777; gnathopod 2 and pleopods from female paratype, 2.6 mm, NMV J20778; east of Freycinet Peninsula, Tasmania. Scales represent 0.1 mm.

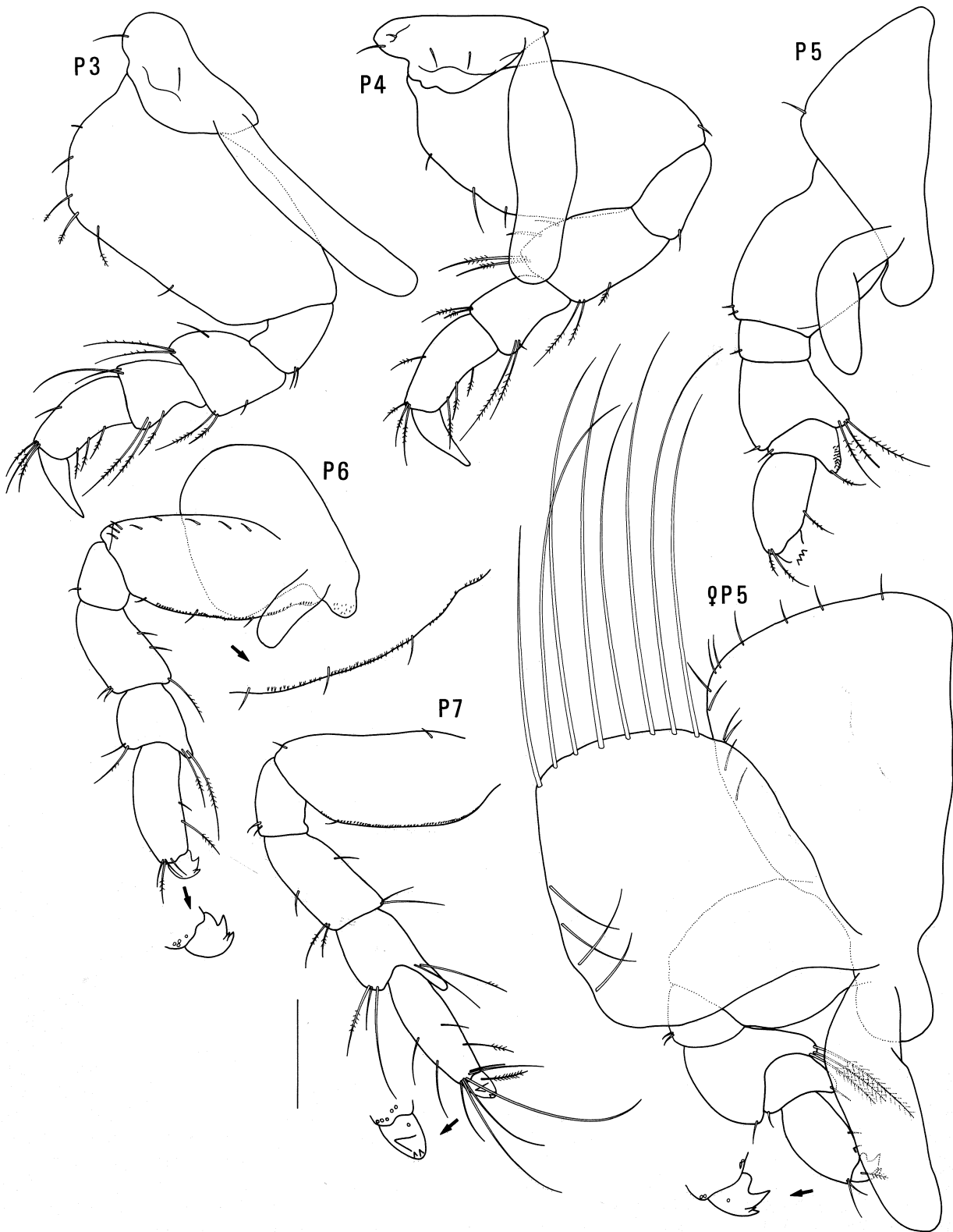


Fig. 7. *Bathypoma enigma* n.sp., male holotype, 2.1 mm, NMV J20777; peraeopod 5 from female paratype, NMV J20778; east of Freycinet Peninsula, Tasmania. Scales represent 0.1 mm.

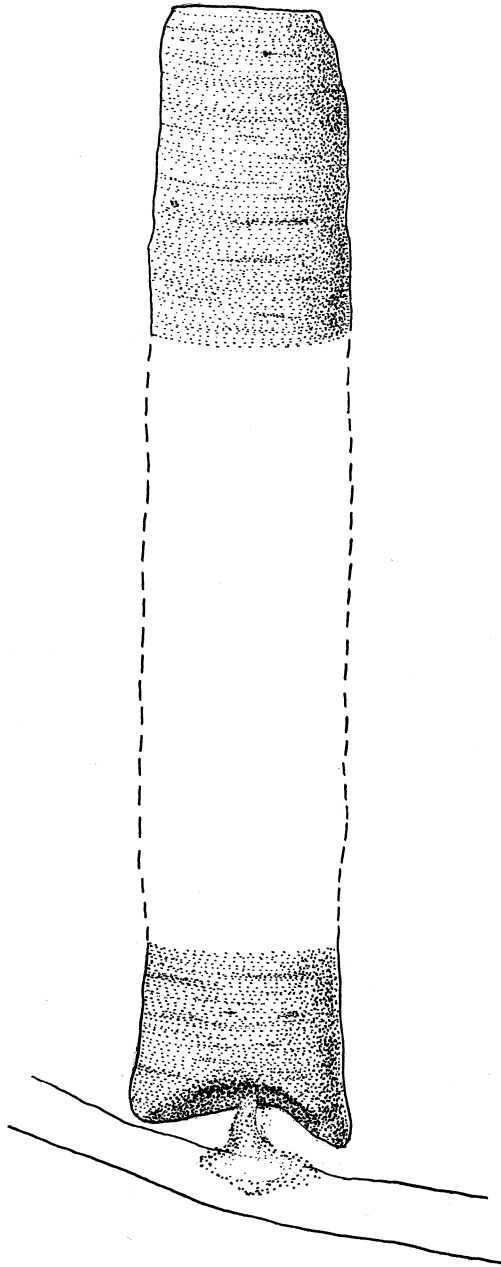


Fig. 8. *Bathypoma enigma* n.sp., tube from paratype of NMV J14644; east of Freycinet Peninsula, Tasmania.

E3-setae terminally. *Maxilla 1*: inner plate small, with 1 simple apical seta; outer plate with 9 setal-teeth; right palp with 3 and left with 3 terminal robust setae, flag seta present on distolateral corner, right palp with 1 and left with 1 subterminal setae. *Maxilla 2*: outer plate slightly broader than inner; inner plate with setae distally along medial margin. *Maxilliped*: inner plate subrectangular with 3 nodular robust setae, without subterminal robust setae on medial corner, oblique setal row with 6 plumose setae; outer plate with 2 apical plumose setae, and 4 apicomедial robust setae; palp

article 2, length $2.9 \times$ breadth, article 3, length $2 \times$ breadth.

Peraeonite 5: male, length $1.4 \times$ breadth, female, length $1.2 \times$ breadth. *Gnathopod 1*: subchelate; coxa not fused to peraeonite 1 in male or female, length $1.3 \times$ depth, without anteroventral lobe; basis in male with sparse setae along anterior margin, in female with sparse setae along anterior margin, without robust setae along anterior margin; carpus length $1.1 \times$ depth with setose posterior lobe, anterior margin without setae in male and female; propodus length $1.6 \times$ depth, with 5 rows of anteromedial setae; palm extremely acute, sparsely setose, with barbed robust setae. *Gnathopod 2*: subchelate in male and female; coxa not fused to peraeonite 2 in male or female, length $1.7 \times$ depth, without anteroventral lobe; basis short, broad, length $1.4 \times$ breadth; carpus small, short, compressed, length $0.8 \times$ breadth, posterior margin without tooth; propodus length $1.7 \times$ depth; with broad tooth bearing 3 barbed robust setae defining proximal end of palm; dactylus $0.8 \times$ as long as propodus.

Peraeopod 3: coxa not fused to peraeonite 3 in male or female, length $2 \times$ depth, without anteroventral lobe; basis length $1.6 \times$ breadth, with inflated anterodorsal corner, with plumose setal group, without denticles along anterior margin; ischium length $1.6 \times$ breadth; merus without ridges; carpus with 2 simple setae along distal half of anterior margin, with 3 plumose setae along distal half of posterior margin; propodus with 3 plumose setae along posterior margin. *Peraeopod 4*: coxa not fused to peraeonite 4 in male or female, length $2.2 \times$ depth, without anteroventral lobe; basis length $1.5 \times$ breadth, without setal group along anterior margin; ischium long, length $1.8 \times$ breadth; carpus with 2 plumose setae along distal half of anterior margin, with 2 plumose setae along distal half of posterior margin; propodus with 3 plumose setae along posterior margin. *Peraeopod 5*: coxa, length $2.3 \times$ depth, without patches of small setae; anterior lobe of merus not extending beyond anterior margin of carpus, posterior lobe with 3 plumose setae; propodus with 2 setae along posterior margin, dactylus short, unciniate with two accessory spines. *Peraeopod 6*: coxa with patch of small setae; basis with short, sparse setae anteriorly, with small denticles along posterior margin; merus, length $1.6 \times$ breadth, without small anterodistal lobe; carpus without anterodistal lobe, with posterodistal lobe, posterodistal corner bearing small setal bunch; propodus, anterodistal corner bearing large setal bunch; dactylus short, unciniate with two accessory spines. *Peraeopod 7*: coxa without posterodorsal lobe, without patch of small setae; basis without denticles along anteroproximal margin, with small denticles along posterior margin; merus, length $2 \times$ breadth, without small anterodistal lobe, posterodistal corner bearing small setal bunch; carpus without anterodistal lobe, with well-developed posterodistal lobe, anterodistal corner bearing small setal bunch; propodus posterodistal corner bearing small setal bunch, anterodistal corner bearing large setal bunch; dactylus short, unciniate with two accessory spines.

Oostegites: from gnathopod 2 to peraeopod 5. *Gills*: from peraeopod 3 to peraeopod 6.

Pleopods 1 to 3: decreasing in size. *Pleopod 1*: peduncle with patch of small setae, with 2 small distomedial hooks; rami subequal in length; inner ramus without patch of small setae, 7-articulate; outer ramus, article 1 evenly swollen, 7-articulate. *Pleopod 2*: peduncle without patch of small setae, with 1 small distomedial hook; biramous, inner ramus without patch of small setae, reduced, 1-articulate, length $0.4 \times$ outer ramus; outer ramus broad, 4-articulate, without patch of small setae. *Pleopod 3*: peduncle without patch of small setae, without distomedial hooks; inner ramus absent. *Uropod 1*: biramous, peduncle with distoventral corona of cuticular teeth, length $1 \times$ outer ramus, without distoventral spine; outer ramus with lateral row of denticles, with 4 lateral setae, with large apical robust seta; inner ramus length $0.8 \times$ outer ramus, without setae, with apical robust seta. *Uropod 2*: uniramous, peduncle length $2.1 \times$ breadth, $1.7 \times$ ramus; ramus small, with denticles and 1 apical robust seta. *Uropod 3*: uniramous, peduncle length $1.7 \times$ breadth; ramus with 2 curved spines. *Telson*: length $0.7 \times$ breadth, cleft $0.90 \times$ length, each lobe with 9 to 8 anteriorly directed spines in two rows.

Parasites. Some specimens of *Bathypoma enigma* had a parasitic copepod attached to the head between antennae 1. These specimens were examined by Grygier (pers. comm.) and identified as males and females of an undescribed species of a nicothoid copepod *Sphaeronella* sp. The specimens are held at the Museum of Victoria, registration NMV J15063.

Tube. Composed of annulated fine grains occasionally with detritus and foraminiferans.

Etymology. The name *enigma* refers to the subchelate second gnathopod of the species.

Remarks. At present this is the sole species in the genus.

Distribution. Off south-eastern Australia in 720 to 951 m depth.

Notopoma

Notopoma africana n.sp.

Figs 9–12

Type data. HOLOTYPE, male, 2.48 mm, SAM A15547; PARATYPE, female, 3.56 mm, SAM A41200; 14 PARATYPES, 7 males, 7 females, SAM A41201; 4 PARATYPES, 2 males, 2 females, AM P40663; south-east of St. Lucia, South Africa, $28^{\circ}31.7'S$ $32^{\circ}34.0'E$, 680 m, biological dredge, RV *Meiring Naude*, 24 May 1976, stn SM103.

Material described. Based on holotype male, 2.48 mm; dimorphic characters based on paratype female, 3.56 mm.

Diagnosis. *Antennae*: long, slender. *Mandible*: palp article 2 long, slender, length $2.8 \times$ breadth, article 3 slender, blade-like. *Maxilla 1*: outer plate with 7 setal-teeth. *Gnathopod 2*: male propodus very broad, slightly curved, length $1.7 \times$ width. *Peraeopod 7*: dactylus with two accessory hoods. *Pleopod 2*: biramous. *Pleopod 3*: small, uniramous.

Description. *Head*: rostrum short, curved down, apically acute, length $0.29 \times$ head; lateral cephalic lobe well developed, ventral corner rounded, subocular margin deeply recessed, anteroventral corner subquadrate, ventral margin horizontal, posterior margin vertical. *Antenna 1*: long, $0.53 \times$ body length, peduncle with tiny scales; peduncular article 1 produced dorsodistally and dorsomedially, dorsodistal projection 0.1 along article 2, length $1.1 \times$ peduncular article 3; accessory flagellum absent; flagellum long, 4-articulate (female 5), aesthetascs present along ventral margin, article 1 long, $2 \times$ article 2. *Antenna 2*: subequal in length to antenna 1; peduncle without scales; flagellum 5-articulate (female 6), article 1 long, $2.3 \times$ article 2.

Epistome and *upper lip*: fused, produced, subacute. *Mandible*: left and right incisors each with 5 cusps; left lacinia mobilis with 4 cusps, right with 1 large and 1 small cusp and minutely serrate margin; left accessory setal row with 3 pappose robust setae (damaged on holotype, 3 on paratype male), with 3 intermediate plumose setae (damaged on holotype, 3 on paratype male), right accessory setal row with 2 pappose robust setae, with 2 intermediate plumose setae; molar triturating, molar flake only on right side, molar seta only on left side; palp article 2 long, slender, length $2.8 \times$ breadth, $1 \times$ article 3, with 1 proximal and 1 distal A2-setae, 4 submarginal B2-setae and 2 D2-setae along posterior margin; article 3 slender, blade-like, long, $3.4 \times$ breadth, with 3 proximal A3-setae, 2 submarginal A3- and 2 submarginal B3-setae, and 7 E3-setae. *Maxilla 1*: inner plate small, with 1 simple apical seta; outer plate with 7 setal-teeth; right and left palps each with 3 terminal robust setae, flag seta present on distolateral corner, right and left palps each with 1 subterminal setae. *Maxilla 2*: not known. *Maxilliped*: inner plate subrectangular with 3 nodular robust setae, with 1 subterminal seta on medial corner, oblique setal row with 6 plumose setae; outer plate with 3 apical plumose setae, and 2–3 apicomedial robust setae; palp article 2, length $2.8 \times$ breadth, article 3, length $1.7 \times$ breadth.

Peraeonite 5: male, length $1 \times$ breadth, female, length $1.3 \times$ breadth. *Gnathopod 1*: subchelate; coxa not fused to peraeonite 1 in male or female, length $1.2 \times$ depth, without anteroventral lobe; basis in male with sparse setae along anterior margin, in female with sparse setae along anterior margin, without robust setae along anterior margin; carpus length $1.6 \times$ depth with setose posterior lobe, anterior margin without setae in male and female;

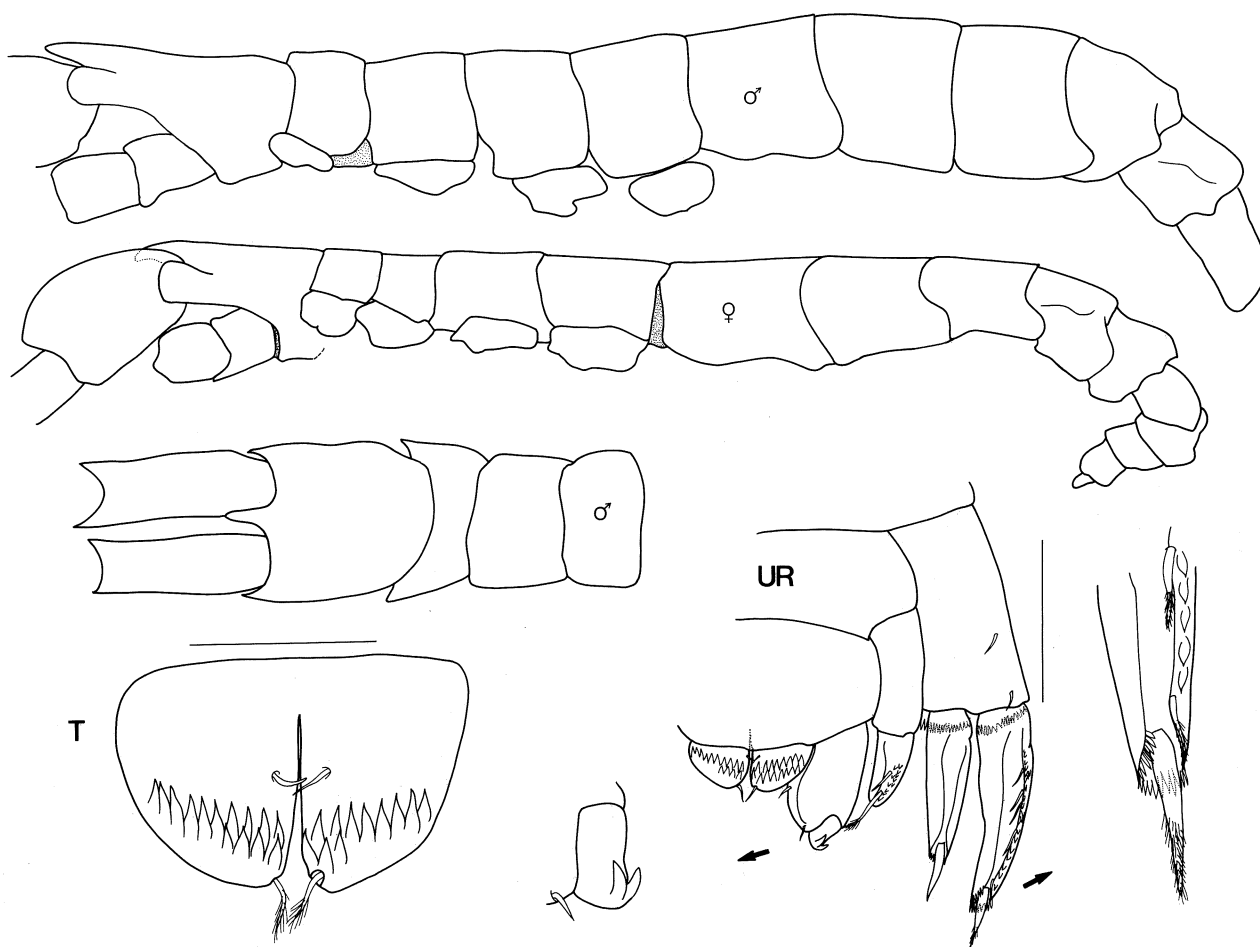


Fig. 9. *Notopoma africana* n.sp., lateral view, urosome, telson, male holotype, 2.48 mm, SAM A15547; dorsal view, male paratype, SAM A41201; lateral view, female paratype, SAM A41201, off St. Lucia, South Africa. Scales for urosome and telson represent 0.05 mm.

propodus length $1.7 \times$ depth, with 4 rows of anteromedial setae; palm extremely acute, sparsely setose, with barbed robust setae. *Gnathopod 2*: carpochebate in male, subchelate in female; coxa not fused to peraeonite 2 in male or female, length $1.3 \times$ depth, without anteroventral lobe; basis short, broad, length $1.1 \times$ breadth; carpus massive, long, broad, length $1.1 \times$ breadth, posterior margin without tooth; palm transverse, palm narrowly excavate, anterodistal tooth small, located distal to articulation with propodus, posterodistal tooth well defined, medium in size, length $1.4 \times$ width, without robust setae; propodus very broad, slightly curved, length $1.7 \times$ width, without tooth on posterior margin, with tooth on posterodistal corner; dactylus, length $0.74 \times$ propodus.

Peraeopod 3: coxa not fused to peraeonite 3 in male or female, length $3.3 \times$ depth, without anteroventral lobe; basis length $1.8 \times$ breadth, without inflated anterodorsal corner, with plumose setal group, without denticles along anterior margin; ischium length $1 \times$ breadth; merus without ridges; carpus with 1 plumose seta along distal half of anterior margin, with 3 plumose setae along distal half of posterior margin; propodus

with 3 plumose setae along posterior margin. *Peraeopod 4*: coxa not fused to peraeonite 4 in male or female, length $1.9 \times$ depth, without anteroventral lobe; basis length $1.7 \times$ breadth, without setal group along anterior margin; ischium short, length $0.9 \times$ breadth; carpus with 1 plumose setae along distal half of anterior margin, with 2 plumose setae along distal half of posterior margin; propodus with 3 plumose setae along posterior margin. *Peraeopod 5*: coxa, length $1.7 \times$ depth, without patches of small setae; anterior lobe of merus not extending beyond anterior margin of carpus, posterior lobe with 3 plumose setae; propodus with 1 seta along posterior margin, dactylus short, uncinuate with two accessory spines. *Peraeopod 6*: coxa without patch of small setae; basis with short, sparse setae anteriorly, without small denticles along posterodistal margin; merus, length $1.6 \times$ breadth, without small anterodistal lobe; carpus without anterodistal lobe, with posterodistal lobe, posterodistal corner bearing small setal bunch; propodus, anterodistal corner bearing large setal bunch; dactylus short, uncinuate with two accessory spines. *Peraeopod 7*: coxa tapering and truncated posteriorly, without patch of small setae; basis without denticles



Fig. 10. *Notopoma africana* n.sp., male holotype, 2.48 mm, SAM A15547; off St. Lucia, South Africa. Scales represent 0.1 mm.

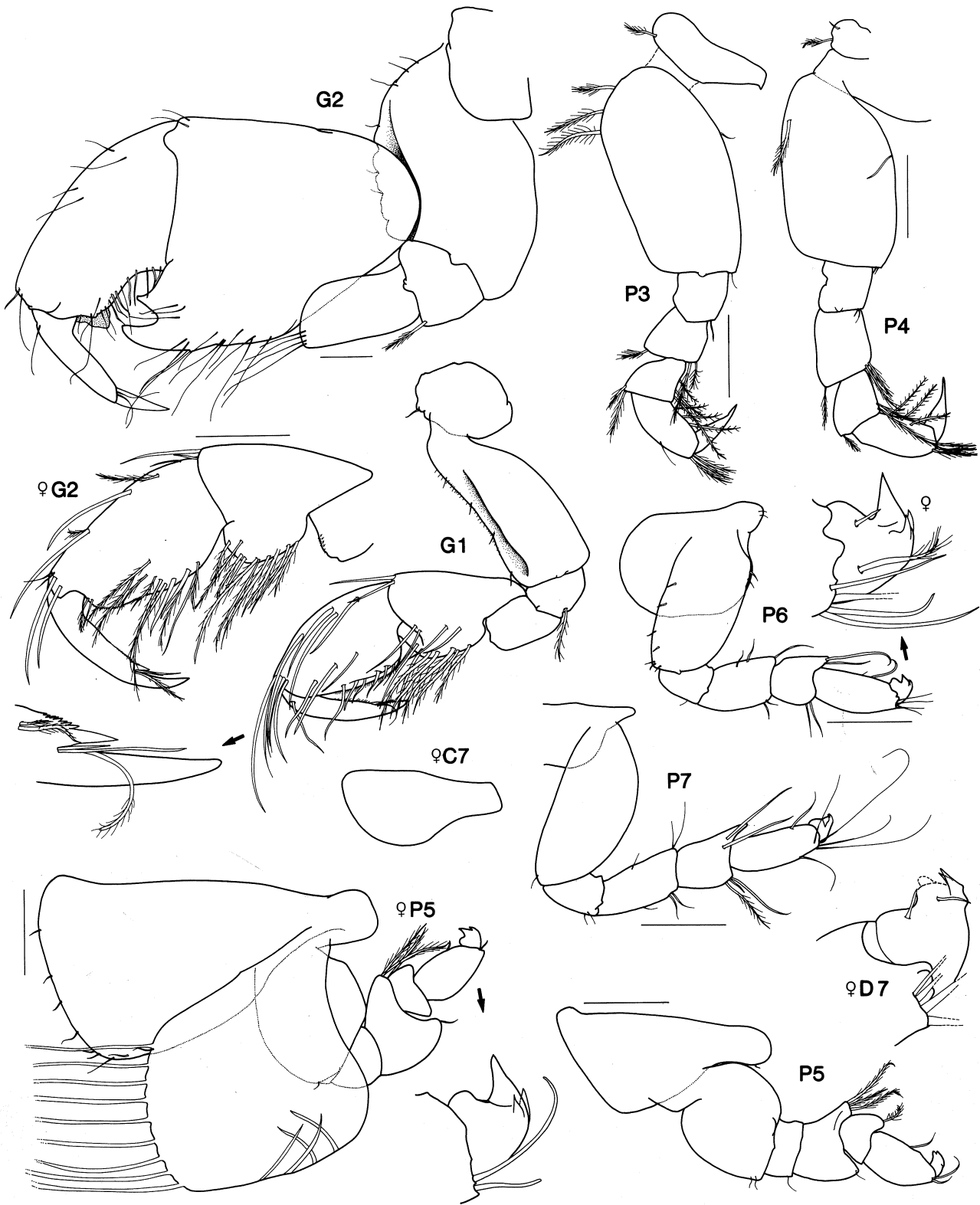


Fig. 11. *Notopoma africana* n.sp., male holotype, 2.48 mm, SAM A15547; female paratype, SAM A41200; off St. Lucia, South Africa. Scales represent 0.1 mm.

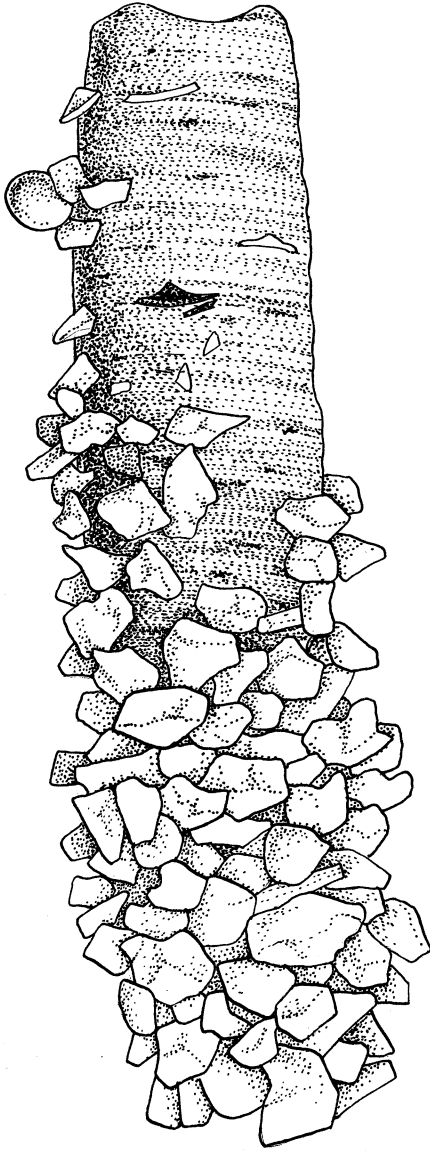


Fig. 12. *Notopoma africana* n.sp., tube; off St. Lucia, South Africa.

along anteroproximal margin, without small denticles along posterodistal margin; merus, length $1.7 \times$ breadth, without small anterodistal lobe, posterodistal corner bearing small setal bunch; carpus without anterodistal lobe, with well-developed posterodistal lobe, anterodistal corner bearing small setal bunch; propodus, posterodistal corner without setal bunch, anterodistal corner bearing large setal bunch; dactylus short, uncinuate with two accessory spines.

Oostegites: from gnathopod 2 to peraeopod 5. *Gills*: from peraeopod 3 to peraeopod 6.

Pleopods 1 to 3: decreasing in size. *Pleopod 1*: peduncle without patch of small setae, with 2 small distomedial hooks; rami subequal in length; inner ramus without patch of small setae, 6-articulate; outer ramus,

article 1 with straight medial margin, 7-articulate. *Pleopod 2*: peduncle without patch of small setae, with 1 small distomedial hook; biramous, ramus without patch of small setae, inner ramus reduced, 1-articulate, length $0.5 \times$ outer ramus; outer ramus broad, 3-articulate, without patch of small setae. *Pleopod 3*: peduncle without patch of small setae, with 1 small distomedial hook; inner ramus absent. *Uropod 1*: biramous, peduncle with distoventral corona of cuticular teeth, length $1 \times$ outer ramus, without distoventral spine; outer ramus with lateral row of denticles, with 4 lateral setae, with large apical robust seta; inner ramus length $0.8 \times$ outer ramus, without setae, with apical robust seta. *Uropod 2*: uniramous, peduncle length $2.6 \times$ breadth, $1.7 \times$ ramus; ramus small, with denticles and 1 apical robust seta. *Uropod 3*: uniramous, peduncle length $1.5 \times$ breadth; ramus with 2 curved spines. *Telson*: length $0.7 \times$ breadth, cleft $0.74 \times$ length, each lobe with 14 to 11 anteriorly directed spines in two rows.

Tube. Composed of annulated fine detrital grains with large grains of sand or shell grit at one end.

Etymology. The name *africana* refers to the distribution of the species.

Remarks. *Notopoma africana* shows similarities to *N. fallohidea* in the long slender antenna and deeply cleft telson, but in *N. africana* the mandibular palp is more slender, the outer plate of maxilla 1 has 10 setal-teeth, article 2 of the maxillipedal palp is longer and pleopod 3 is uniramous.

Notopoma sismithi also has a long slender first antenna and the maxillipedal palp article 2 is long and slender as in *N. africana*. But *N. sismithi* has a shorter, broader mandibular palp and the shape of the palm in the male second gnathopod is convex.

Distribution. South-east of St Lucia, South Africa, Indian Ocean in 680 m depth.

Notopoma moorea n.sp.

Figs 13–15

Type data. HOLOTYPE, male, 1.80 mm, AM P42279; PARATYPE, male, AM P42280; PARATYPE, female, 2.0 mm, AM P42281; coral slope of exposed fringing reef near Afareaitu, Moorea, Society Islands, French Polynesia, $17^{\circ}33.7'S$ $149^{\circ}56.5'W$, dead corals, 1–2 m, H.G. Müller, 26 March 1988.

Material described. Based on holotype male, 1.8 mm; dimorphic characters based on paratype female, 2.0 mm.

Diagnosis. *Antennae*: short, robust. *Mandible*: palp article 2 short, broad, length $1.8 \times$ breadth, article 3 clavate. *Maxilla 1*: outer plate with 9 setal-teeth.

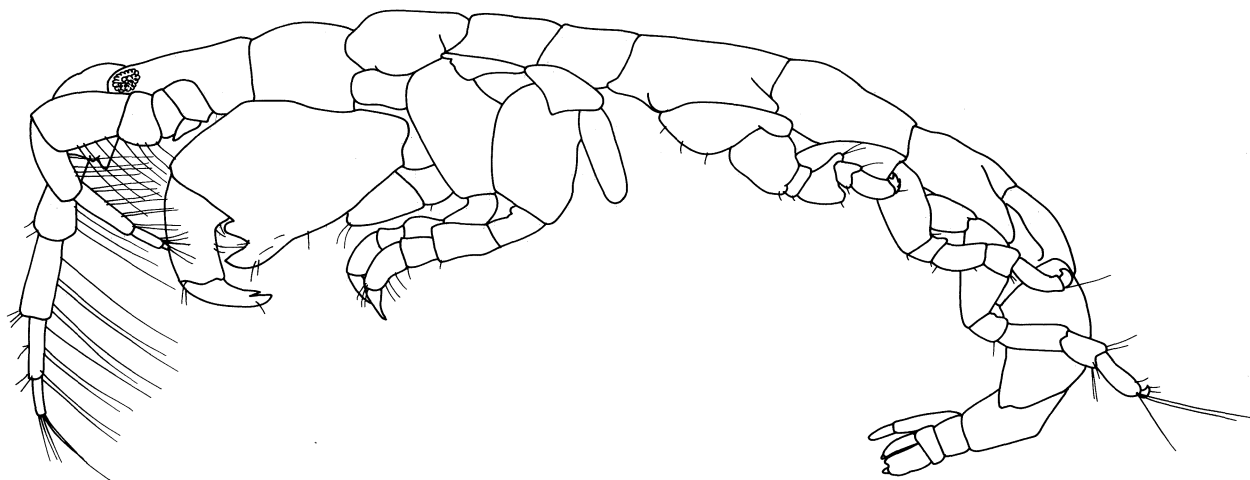


Fig. 13. *Notopoma moorea* n.sp., lateral view, male holotype, 1.8 mm, AM P42279; Moorea, Society Islands, French Polynesia.

Gnathopod 2: male propodus very broad, slightly curved, length $2.1 \times$ width. *Peraeopod 7*: dactylus with one accessory spine. *Pleopod 2*: biramous, inner ramus vestigial. *Pleopod 3*: small, uniramous.

Description. *Head*: rostrum short, straight, apically rounded, length $0.2 \times$ head; lateral cephalic lobe well developed, ventral corner rounded, subocular margin deeply recessed, anteroventral corner subquadrate, ventral margin horizontal, posterior margin vertical. *Antenna 1*: short, $0.28 \times$ body length, without scales; peduncular article 1 produced dorsodistally and dorsomedially, dorsodistal projection 0.5 along article 2, length $1.9 \times$ peduncular article 3; accessory flagellum absent; flagellum short, 2-articulate (female 2), aesthetascs present along ventral margin, article 1 long, $2.1 \times$ article 2. *Antenna 2*: subequal in length to antenna 1; peduncle without scales; flagellum 3-articulate (female 3), article 1 long, $2.6 \times$ article 2.

Epistome and *upper lip*: fused, produced, subacute. *Mandible*: left incisor with 4 cusps, right incisor with 5 cusps; left lacinia mobilis with 4 cusps, right with one large cusp and minutely serrate margin; left accessory setal row with 3 pappose robust setae, without intermediate plumose setae, right accessory setal row with 2 pappose robust setae, with 2 intermediate plumose setae; molar triturating, palp article 2 short, broad, length $1.8 \times$ breadth, $1 \times$ article 3. Without proximal A2-setae. Without distal A2-setae, with 4 posterior submarginal A2-setae, with 4 B2-posterior submarginal setae, without D2-setae; article 3 clavate, long, $2.3 \times$ breadth, without proximal A3-setae, without distal A3-setae, without submarginal A3-setae, with 3 posterior submarginal B3-setae, with 7 D3-setae, and 3 E3-setae. *Maxilla 1*: inner plate small, without setae; outer plate with 9 setal-teeth; right palp with 5 terminal robust setae, without subterminal setae. *Maxilla 2*: unknown. *Maxilliped*: unknown.

Peraeonite 1: without lateral keel in male. *Peraeonite 2*: without sternal keel in male. *Peraeonite 5*: male, length $2 \times$ breadth, female, length $2.1 \times$ breadth. *Gnathopod 1*: subchelate; coxa not fused to peraeonite 1 in male or female, length $1.9 \times$ depth, without anteroventral lobe; basis in male with sparse setae along anterior margin, in female with sparse setae along anterior margin, without robust setae along anterior margin; carpus length $1 \times$ depth with setose posterior lobe, anterior margin without setae in male and female; propodus length $1.4 \times$ depth, with 5 rows of anteromedial setae; palm acute, sparsely setose, with barbed robust setae. *Gnathopod 2*: carpochelate in male, subchelate in female; coxa not fused to peraeonite 2 in male or female, length $1.8 \times$ depth, without anteroventral lobe; basis short, broad, length $1 \times$ breadth; carpus massive, long, broad, length $1.1 \times$ breadth, posterior margin without tooth; palm slightly obtuse, palm narrowly excavate, anterodistal tooth large, located near articulation with propodus, posterodistal tooth well defined, medium in size, length $1.5 \times$ width, without robust setae; propodus very broad, slightly curved, length $2.1 \times$ width, without tooth on posterior margin, with smooth posterodistal corner; dactylus, length $0.5 \times$ propodus.

Peraeopod 3: coxa not fused to peraeonite 3 in male or female, length $3 \times$ depth, without anteroventral lobe; basis length $1.5 \times$ breadth, with inflated anterodorsal corner, with setae along anterior margin, without denticles along anterior margin; ischium length $1.5 \times$ breadth; merus without ridges; carpus with 1 simple seta along distal half of anterior margin, without setae along posterior margin; propodus with 3 plumose setae along posterior margin. *Peraeopod 4*: coxa not fused to peraeonite 4 in male or female, length $1.8 \times$ depth, without anteroventral lobe; basis length $1.5 \times$ breadth, without setal group along anterior margin; ischium long, length $1.5 \times$ breadth; carpus with 2 simple setae along distal half of anterior margin, with 2 simple setae along posterior

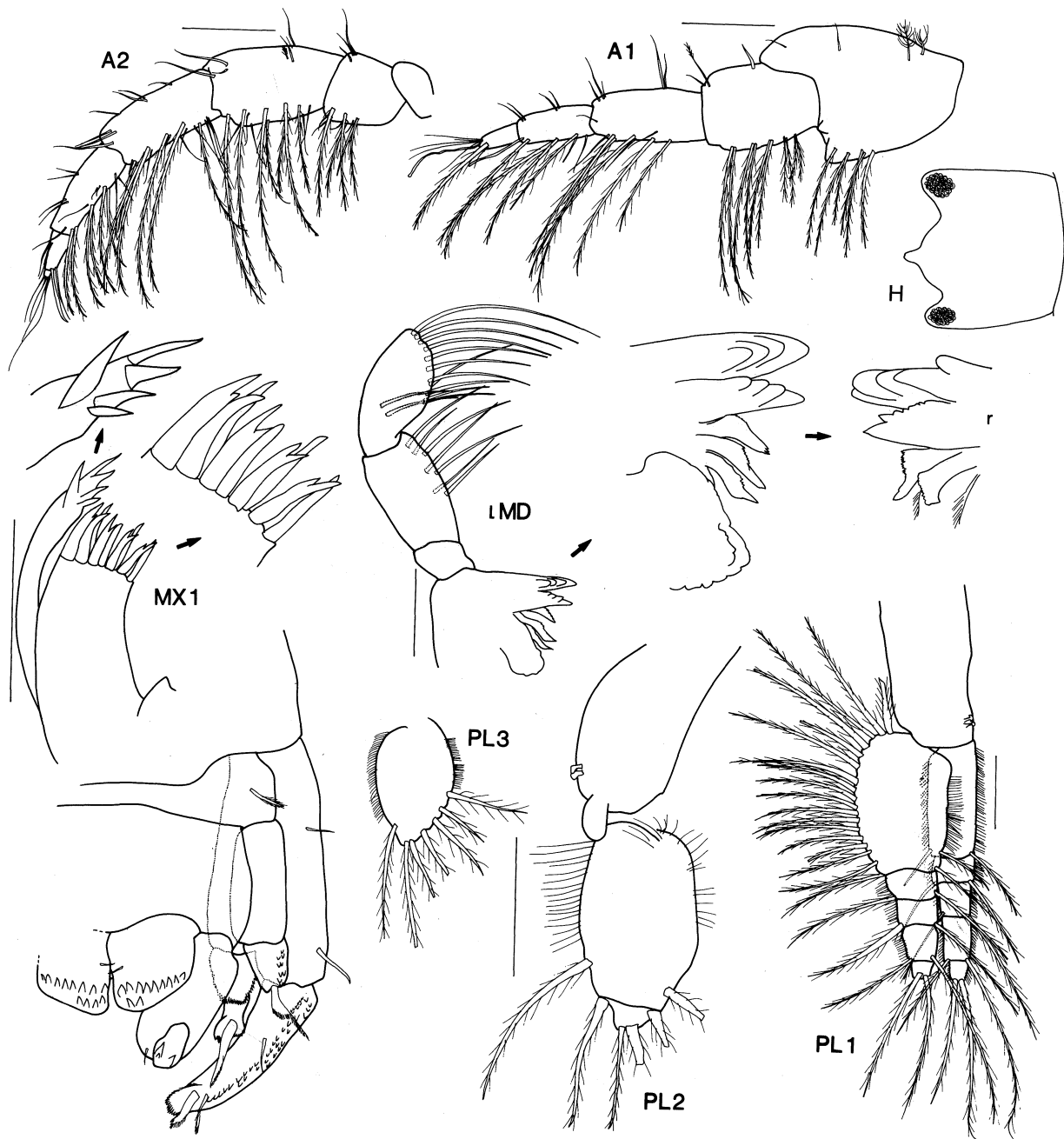


Fig. 14. *Notopoma moorea* n.sp., male holotype, 1.8 mm, AM P42279; Moorea, Society Islands, French Polynesia. Scales for A1-2 represent 0.1 mm, scales for MD, MX1, PL1-3 represent 0.05 mm.

margin; propodus with 3 simple setae along posterior margin. *Peraeopod 5*: coxa, length $1.8 \times$ depth, without patches of small setae; anterior lobe of merus not extending beyond anterior margin of carpus, posterior lobe with 2 plumose setae; propodus without setae along posterior margin, dactylus short, uncinete with two accessory spines. *Peraeopod 6*: coxa without setal fringe ventrally, without patch of small setae; basis without anterior setae. With small denticles along posterodistal margin. Merus, length $1.4 \times$

breadth, without small anterodistal lobe; carpus without anterodistal lobe, without posterodistal lobe, posterodistal corner bearing small setal bunch; propodus, anterodistal corner bearing small setal bunch; dactylus short, uncinete with two accessory spines. *Peraeopod 7*: coxa with posterodorsal lobe, with patch of small setae; basis without denticles along anteroproximal margin, with small denticles along posterodistal margin; merus, length $1.7 \times$ breadth, without small anterodistal lobe, posterodistal

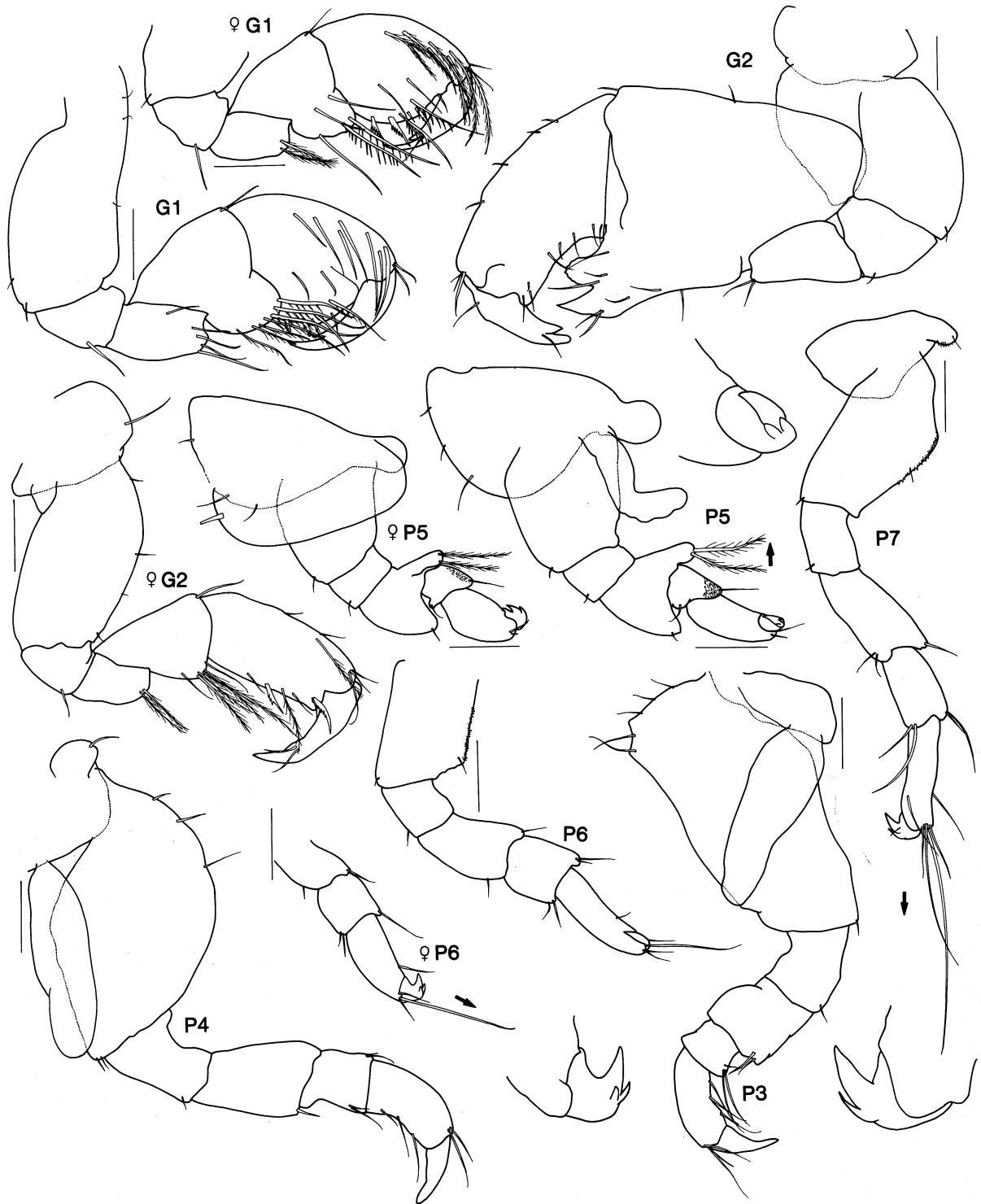


Fig. 15. *Notopoma moorea* n.sp., male holotype, 1.8 mm, AM P42279; female, 2.0 mm, AM P42281; Moorea, Society Islands, French Polynesia. Scales represent 0.1 mm.

corner bearing small setal bunch; carpus without anterodistal lobe, without posterodistal lobe, anterodistal corner bearing small setal bunch; propodus posterodistal corner bearing small bunch of long setae,

anterodistal corner bearing small seta; dactylus short, uncinuate with one accessory spine.

Oostegites: from gnathopod 2 to pereopod 5. *Gills:* from pereopod 3 to pereopod 6.

Pleopods 1 to 3: decreasing in size. *Pleopod 1*: peduncle without patch of small setae, with 2 small distomedial hooks; rami subequal in length; inner ramus without patch of small setae, 5-articulate; outer ramus, article 1 with straight medial margin, 5-articulate. *Pleopod 2*: peduncle without patch of small setae, with 2 small distomedial hooks; biramous, inner ramus reduced, without patch of small setae, 1-articulate, length $0.2 \times$ outer ramus; outer ramus broad, 2-articulate, without patch of small setae. *Pleopod 3*: peduncle unknown; inner ramus unknown; outer ramus broad, 1-articulate, without patch of small setae. *Uropod 1*: biramous, peduncle with distoventral corona of cuticular teeth, length $1.3 \times$ outer ramus, without distoventral spine; rami with distoventral corona of cuticular teeth outer ramus with lateral row of denticles, with 1 medial seta, with large apical robust seta; inner ramus length $0.5 \times$ outer ramus, without setae, with apical robust seta. *Uropod 2*: uniramous, peduncle length $2.1 \times$ breadth, $2.5 \times$ ramus; ramus small, with denticles and 1 apical robust seta. *Uropod 3*: uniramous peduncle length $2.3 \times$ breadth; ramus with 3 curved spines. *Telson*: length $0.6 \times$ breadth, cleft $0.5 \times$ length, each lobe with 12 to 11 anteriorly directed spines in two rows.

Tube. Probably without a tube.

Etymology. The name *moorea* refers to the type locality of the species.

Distribution. Afareaitu, Moorea, Society Islands, French Polynesia, in depths of 1 to 2 m.

Notopoma stoddartae n.sp.

Figs 16–18

Type data. HOLOTYPE, male, 2.74 mm, AM P40436; PARATYPE, male, 2.30 mm, AM P40437; PARATYPE, female, 2.15 mm, AM P40438; 49 PARATYPES, AM P40470; 20 PARATYPES, USNM 274136; outer reef edge near the wreck of the *Runic*, Middleton Reef, Tasman Sea, $29^{\circ}27.4'S$ $159^{\circ}03.7'E$, rubble, algae, coarse sediment, 12 m, J.K. Lowry & R.T. Springthorpe, 5 December 1987, site 8.1; 30 PARATYPES, AM P40471, outer reef slope near the wreck of the *Fuku Maru*, Middleton Reef, Tasman Sea $29^{\circ}29.1'S$ $159^{\circ}08.1'E$, coral rubble, 12 m, Australian Museum Party, 7 December 1987, site 20; 6 PARATYPES, BMNH 1995.716–721, outer slope west of the wreck of the *Yoshin Maru Iwaki*, Elizabeth Reef, Tasman Sea, $29^{\circ}57.2'S$ $159^{\circ}01.2'E$.

Material described. Based on holotype male, 2.74 mm; dimorphic characters based on paratype female, 2.15 mm.

Diagnosis. *Antennae*: short, robust. *Mandible*: palp article 2 article 2 short, broad, length $1.6 \times$ breadth, article 3 broad, clavate. *Maxilla 1*: outer plate with

9 setal-teeth. *Gnathopod 2*: male propodus broad, curved, length $3.2 \times$ width. *Peraeopod 7*: dactylus with one accessory spine. *Pleopod 2*: uniramous. *Pleopod 3*: absent.

Description. *Head*: rostrum short, straight, apically rounded, length $0.37 \times$ head; lateral cephalic lobe well developed, ventral corner rounded, subocular margin deeply recessed, anteroventral corner subquadrate, ventral margin horizontal, posterior margin vertical. *Antenna 1*: short, $0.3 \times$ body length, without scales; peduncular article 1 produced dorsodistally and dorsomedially, dorsodistal projection 0.4 along article 2, length $1.2 \times$ peduncular article 3; accessory flagellum absent; flagellum short, 2-articulate (female 2), aesthetascs absent, article 1 long, $2.1 \times$ article 2. *Antenna 2*: subequal in length to antenna 1; peduncle without scales; flagellum 3-articulate (female 3), article 1 long, $2.8 \times$ article 2.

Epistome and *upper lip*: fused, produced, subacute. *Mandible*: left incisor with 4 cusps, right incisor with 4 cusps; left lacinia mobilis with 4 cusps, right with 2 large cusps and minutely serrate margin; left accessory setal row with 2 pappose robust setae, without intermediate plumose setae, right accessory setal row with 2 pappose robust setae, without intermediate plumose setae; molar triturating, molar flake on left and right side, molar seta absent; palp article 2 short, broad, length $1.6 \times$ breadth, $0.9 \times$ article 3, with 1 proximal and 1 distal A2-setae, 5 submarginal A2-setae, and 4 submarginal B2-setae; article 3 clavate, short, $2.3 \times$ breadth, with 3 proximal A3-setae, 5 submarginal A3- and 5 submarginal B3-setae and 6 E3-setae. *Maxilla 1*: inner plate small, with 1 simple apical seta; outer plate with 9 setal-teeth; right and left palps each with 3 terminal robust setae, flag seta present on distolateral corner, right and left palps each with 2 subterminal setae. *Maxilla 2*: outer plate broader than inner; inner plate with setae distally along medial margin. *Maxilliped*: inner plate subrectangular with 3 nodular robust setae, without subterminal robust setae on medial corner, oblique setal row with 7 plumose setae; outer plate with 2 apical plumose setae, and 4 apicomedial robust setae; palp article 2, length $2.1 \times$ breadth, article 3, length $1.7 \times$ breadth.

Peraeonite 5: male, length $1.8 \times$ breadth, female, length $1.8 \times$ breadth. *Gnathopod 1*: subchelate; coxa not fused to peraeonite 1 in male or female, length $1.5 \times$ depth, with short anteroventral lobe; basis in male with sparse setae along anterior margin, in female with sparse setae along anterior margin, with robust setae along anterior margin; carpus length subequal \times depth with setose posterior lobe, anterior margin without setae in male and female; propodus length $1.3 \times$ depth, with 6 rows of anteromedial setae; palm acute, sparsely setose, with barbed robust setae. *Gnathopod 2*: carpochele in male, subchelate in female; coxa not fused to peraeonite 2 in male or female, length $1.6 \times$ depth, without anteroventral lobe; basis short, broad, length $1 \times$ breadth; carpus massive, long, broad, length $1.1 \times$ breadth, posterior margin without tooth; palm transverse, broadly excavate, anterodistal tooth large, located near

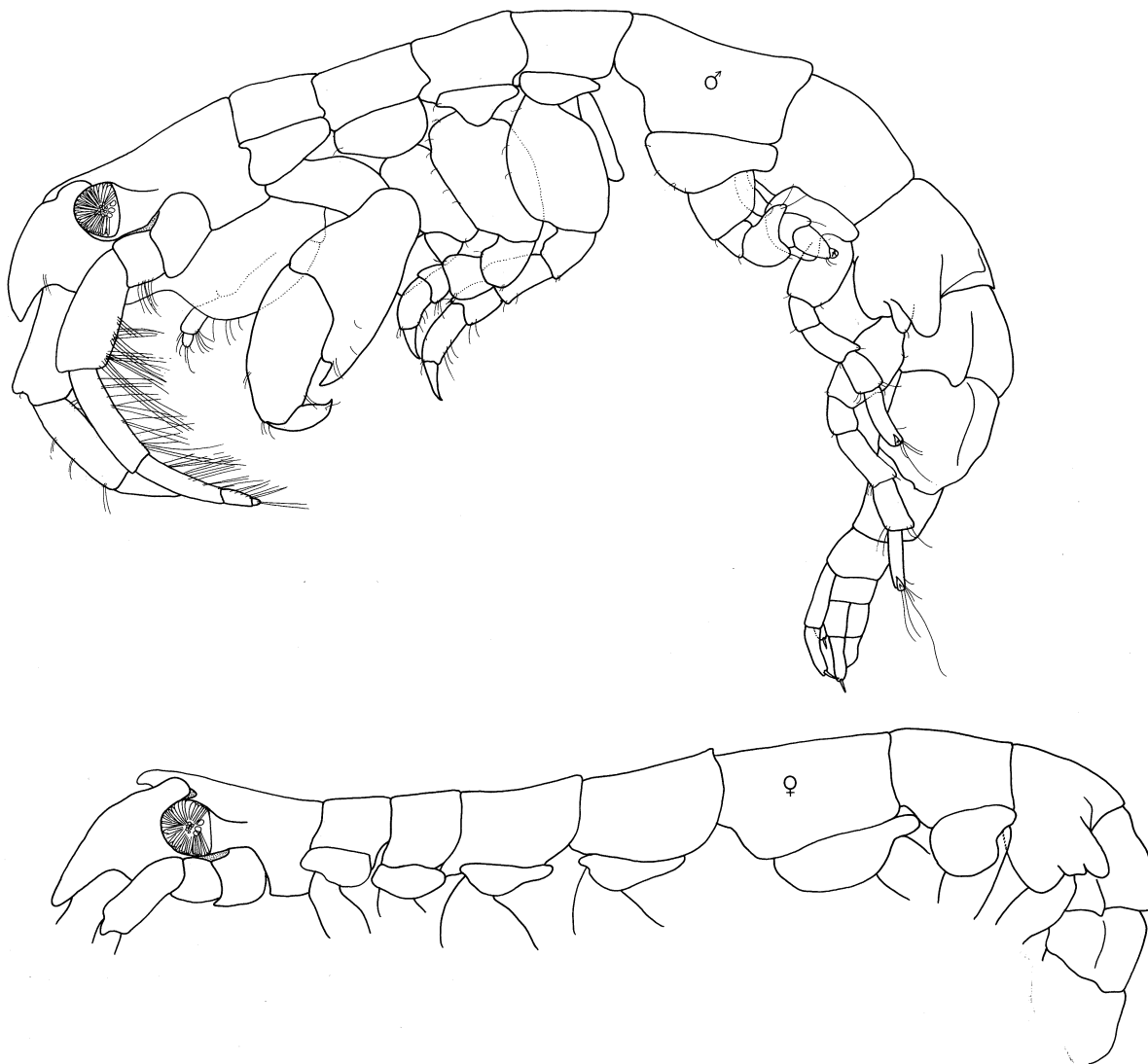


Fig. 16. *Notopoma stoddartae* n.sp., lateral view, male holotype, 2.3 mm, AM P40436; dorsal view, female paratype, AM P40438; Middleton Reef, Tasman Sea.

articulation with propodus, posterodistal tooth well defined, medium in size, length $1 \times$ width, without robust setae; propodus broad, curved, length $3.2 \times$ width, without tooth on posterior margin, with rugose posterodistal corner; dactylus, length $0.4 \times$ propodus.

Peraeopod 3: coxa not fused to peraeonite 3 in male or female, length $2.3 \times$ depth, with small anteroventral lobe; basis length $1.1 \times$ breadth, with inflated anterodorsal corner, without setal group, with denticles along anterior margin; ischium length $1.8 \times$ breadth; merus without ridges; carpus with 1 simple seta along distal half of anterior margin, with 2 plumose setae along distal half of posterior margin; propodus with 3 plumose setae along posterior margin. *Peraeopod 4:* coxa not fused to peraeonite 4 in male or female, length $2.4 \times$ depth, without anteroventral lobe; basis length $1.2 \times$ breadth, without setal group along anterior margin; ischium long, length $1.8 \times$ breadth; carpus with 2 simple setae along distal half

of anterior margin, with 1 plumose seta along distal half of posterior margin; propodus with 3 simple setae along posterior margin. *Peraeopod 5:* coxa, length $1.8 \times$ depth, without patches of small setae; anterior lobe of merus not extending beyond anterior margin of carpus, posterior lobe with 2 plumose setae; propodus with 1 seta along posterior margin, dactylus short, unciniate with two accessory spines. *Peraeopod 6:* coxa without patch of small setae; basis without anterior setae, with small denticles along posterodistal margin; merus, length $1.7 \times$ breadth, without small anterodistal lobe; carpus without anterodistal lobe, without posterodistal lobe, posterodistal corner bearing small setal bunch; propodus, anterodistal corner bearing large setal bunch; dactylus short, unciniate with two accessory spines. *Peraeopod 7:* coxa with posterodorsal lobe, without patch of small setae; basis without denticles along anteroproximal margin, with small denticles along posterodistal margin; merus, length $2.3 \times$ breadth,



Fig. 17. *Notopoma stoddartae* n.sp., male holotype, 2.3 mm, AM P40436; Middleton Reef, Tasman Sea. Scales for antennae represent 0.1 mm, the remainder represent 0.05 mm.

without small anterodistal lobe, posterodistal corner bearing small setal bunch; carpus without anterodistal lobe, with small posterodistal lobe, anterodistal corner

bearing small setal bunch; propodus posterodistal corner bearing small setal bunch, anterodistal corner bearing large setal bunch; dactylus short, uncinete

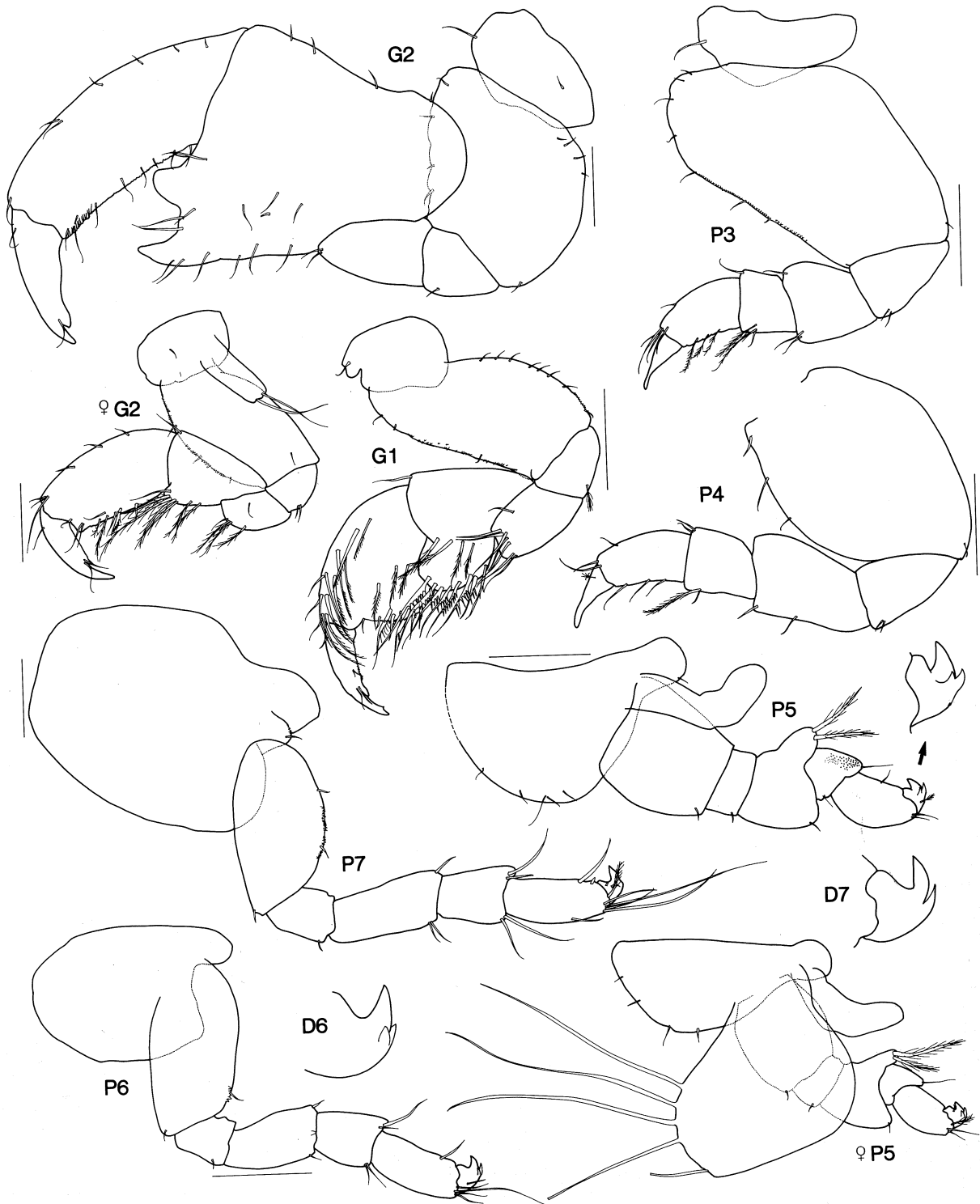


Fig. 18. *Notopoma stoddartae* n.sp., male holotype, 2.3 mm, AM P40436; gnathopod 1, peraeopod 5 plus dactylus from female paratype, AM P40438; Middleton Reef, Tasman Sea. Scales represent 0.1 mm.

with one accessory spine.

Oostegites: from gnathopod 2 to peraeopod 5. *Gills*: from peraeopod 3 to peraeopod 6.

Pleopods 1 to 3: pleopod 1 larger than 2, pleopod 3 absent. *Pleopod 1*: peduncle without patch of small setae, with 2 small distomedial hooks; rami subequal

in length; inner ramus without patch of small setae, 4-articulate; outer ramus, article 1 with straight medial margin, 5-articulate. *Pleopod 2*: peduncle without patch of small setae, without distomedial hooks; uniramous, ramus without patch of small setae. *Uropod 1*: biramous, peduncle with distoventral corona of cuticular teeth,

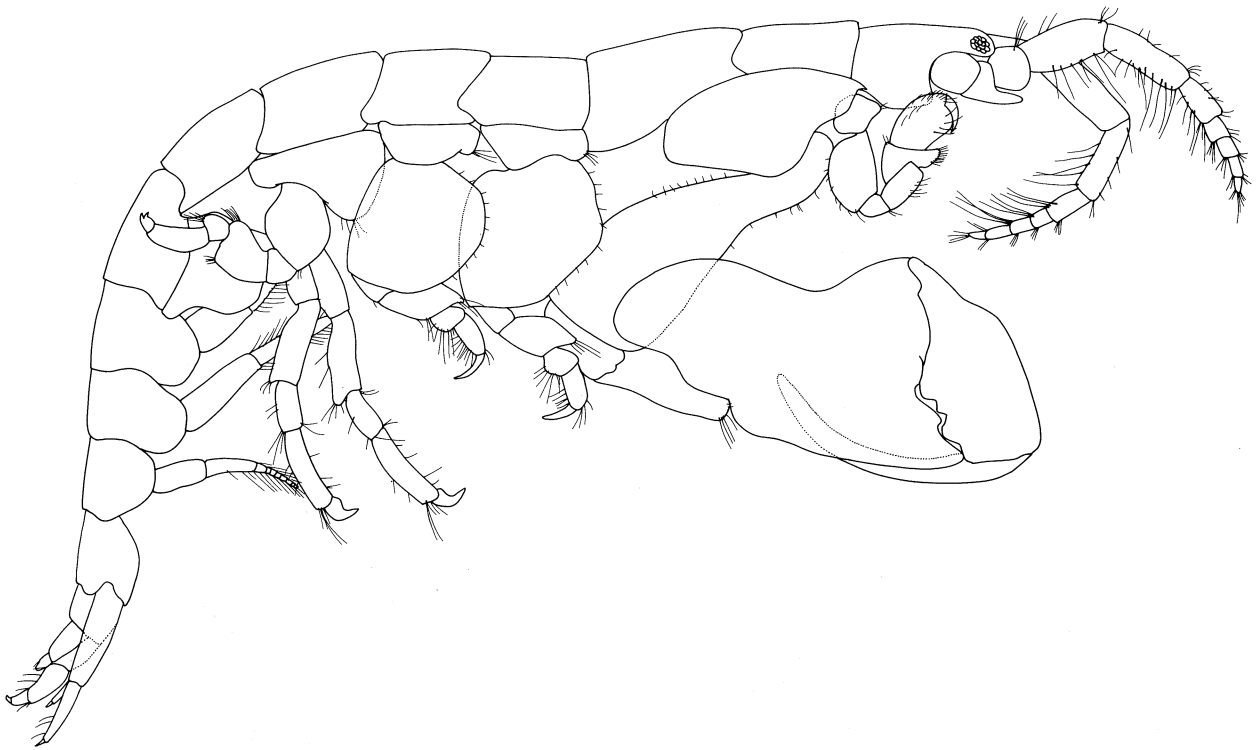


Fig. 19. *Paracerapus polutovi* Gurjanova, 1951, lateral view, male paratype, 6.2 mm, AM P41691; East Kamchatka, Bering Sea.

length $1.1 \times$ outer ramus, without distoventral spine; outer ramus with lateral row of denticles, with 2 medial setae, with large apical robust seta; inner ramus length $0.3 \times$ outer ramus, without setae, with apical robust seta. *Uropod* 2: uniramous, peduncle length $1.7 \times$ breadth, $1.3 \times$ ramus; ramus small, with denticles and 1 apical robust seta. *Uropod* 3: uniramous, peduncle length $1.7 \times$ breadth; ramus with 5 curved spines. *Telson*: length $0.5 \times$ breadth, cleft to base, each lobe with 12 to 12 anteriorly directed spines in two rows.

Tube. Composed of detritus and sand grains.

Etymology. This species is named in recognition of the contribution of Helen Stoddart to amphipod systematics.

Remarks. *Notopoma stoddartae* shows similarities to species with short antenna 1 and with short mandibular palp (*N. harfoota*, *N. opposita* and *N. stoora*). It is very similar to *N. stoora*, but *N. stoora* differs in the carpus of pereopods 6 and 7 which is posterodistally lobate, the presence of pleopod 3, and it is brightly coloured. *Notopoma opposita* has well-developed posterodistal lobes on the carpus of pereopods 6 and 7, and two accessory spines on the dactylus of pereopod 7. *Notopoma harfoota* has a very distinctive female first gnathopod which distinguishes it from other species in the genus.

Distribution. Elizabeth and Middleton Reefs, Tasman Sea in depths of 12 to 21 m.

Paracerapus

Paracerapus polutovi (Gurjanova)

Figs 19–21

Cerapus polutovi Gurjanova, 1951: 946, fig. 658.

Paracerapus polutovi. Budnikova, 1989: 54.

? *Cerapus comparativus* Kudrjashov, 1975: 364, fig. 1.

? *Paracerapus comparativus*. Budnikova, 1989: 54.

Type data. PARATYPES, male, 6.2 mm, AM P41691, female, 6.1 mm, male, AM P41692, East Kamchatka, Bering Sea, 20–29 m, 13 July 1934, stn 539.

Material described. Based on paratype male, 6.2 mm; dimorphic characters based on paratype female, 6.1 mm.

Diagnosis. *Antennae*: short, slender. *Mandible*: palp article 2 short, broad, length $1.8 \times$ breadth, article 3 broad, clavate. *Maxilla* 1: outer plate with 10 setal-teeth. *Gnathopod* 2: male propodus broad, slightly curved, length $2.4 \times$ width. *Pereopod* 7: dactylus with row of accessory spines. *Pleopod* 2: biramous. *Pleopod* 3: biramous.

Description. *Head*: rostrum very short, straight, apically rounded; lateral cephalic lobe well developed, ventral

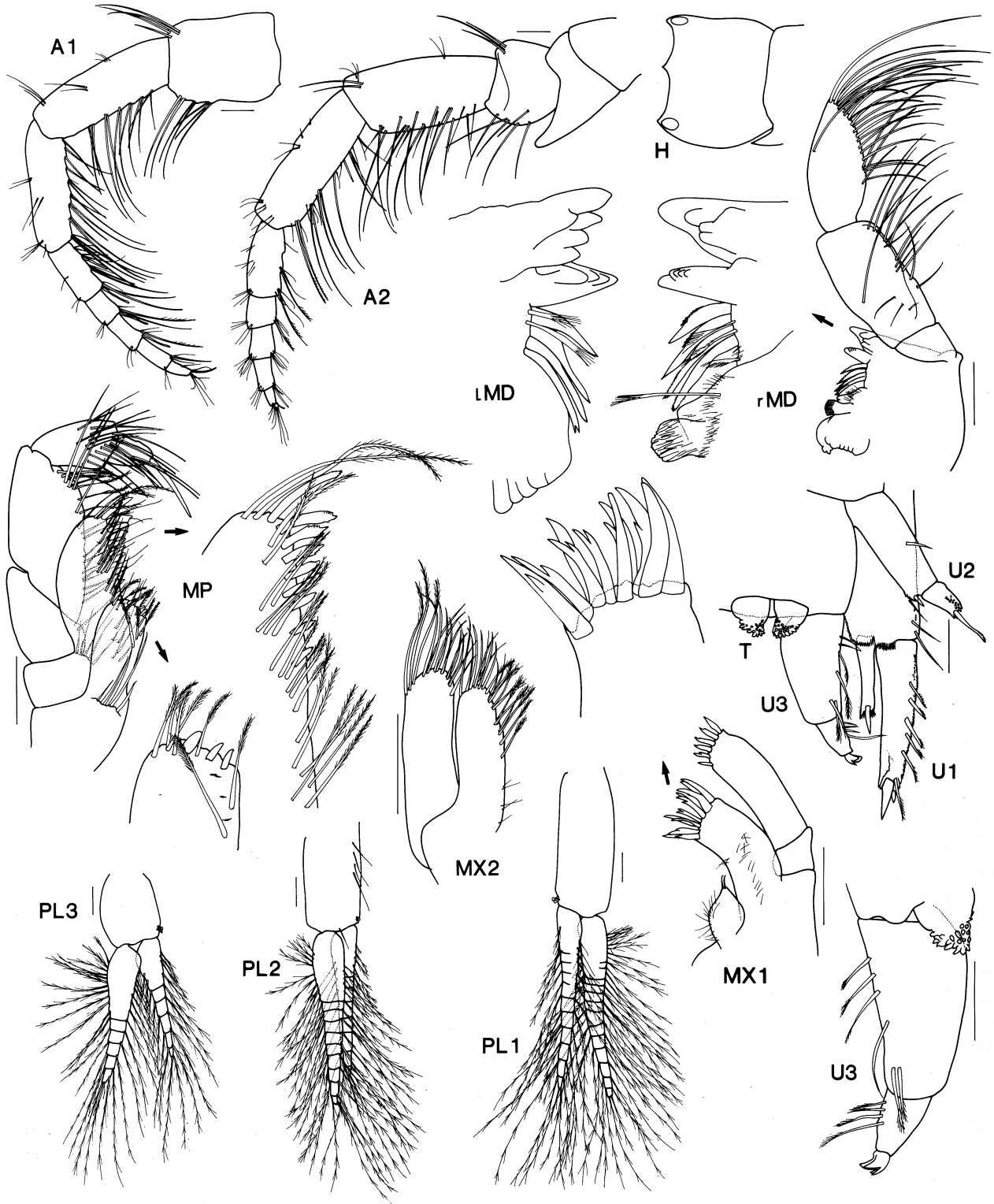


Fig. 20. *Paracerapus polutovi* Gurjanova, 1951, lateral view, male paratype, 6.2 mm, AM P41691; East Kamchatka, Bering Sea. Scales represent 0.1 mm.

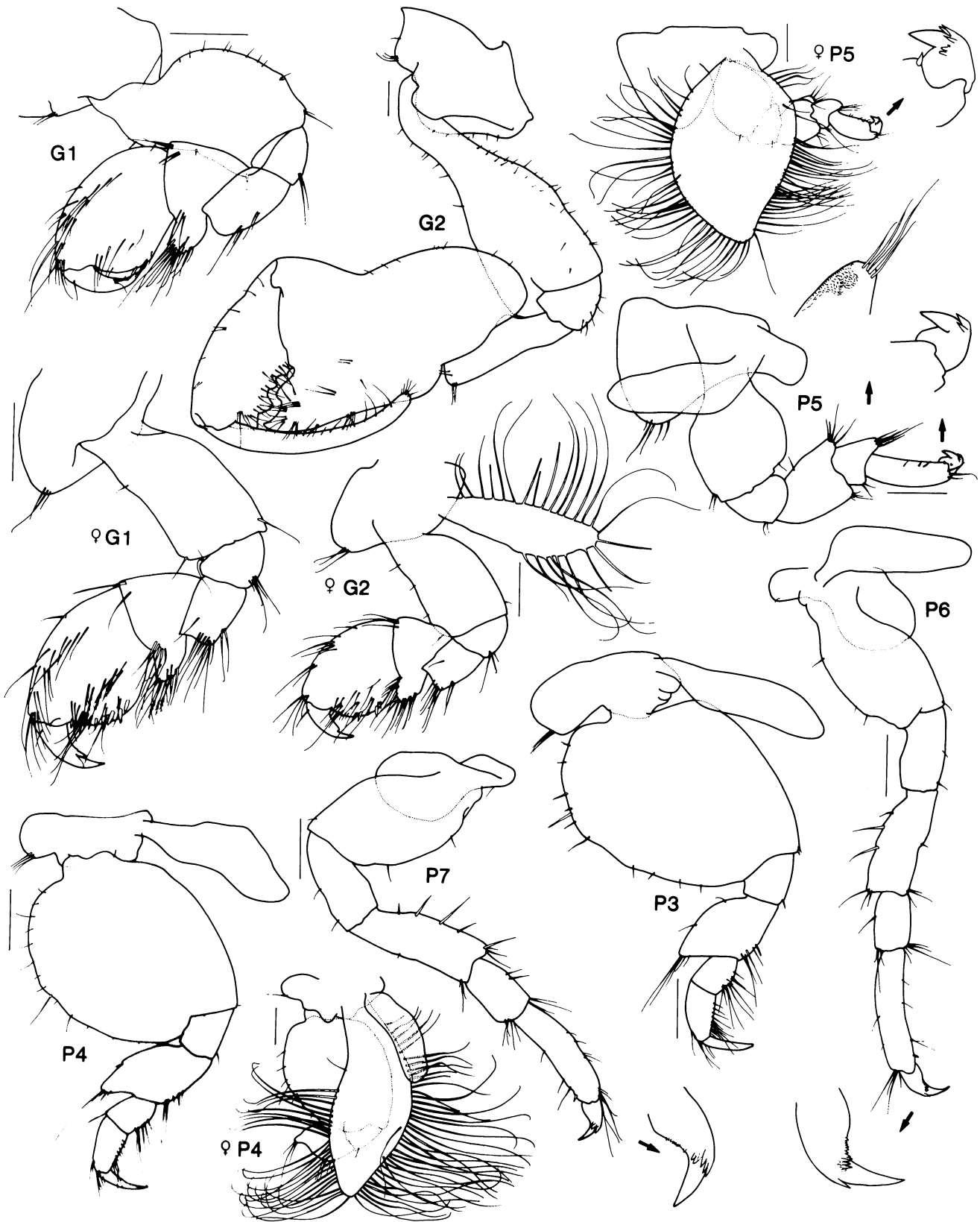


Fig. 21. *Paracerapus polutovi* Gurjanova, 1951, lateral view, male paratype, 6.2 mm, AM P41691; female, 6.1 mm, male, AM P41692; East Kamchatka, Bering Sea. Scales represent 0.2 mm.

corner rounded, subocular margin deeply recessed, anteroventral corner subquadrate, ventral margin horizontal, posterior margin vertical. *Antenna 1*: short, $0.27 \times$ body length, without scales; peduncular article 1 with very weak keel, length $0.7 \times$ peduncular article 3; accessory flagellum absent; flagellum long, 5-articulate (female 5), aesthetascs absent, article 1 long, $2 \times$ article 2. *Antenna 2*: subequal in length to antenna 1; peduncle without scales; flagellum 5-articulate (female 6), article 1 long, $2.2 \times$ article 2. *Epistome* and *upper lip*: fused. *Mandible*: left incisor with 4 cusps, right incisor with 4 cusps; left and right lacinia mobilis each with 4 cusps; left accessory setal row with 4 pappose robust setae, with 2 intermediate plumose setae, right accessory setal row with 4 pappose robust setae, with 3 intermediate plumose setae; molar triturating, molar flake on left and right side, molar seta only on right side; palp article 2 short, broad, length $1.8 \times$ breadth, $1 \times$ article 3 with 1 proximal A2-seta, with 5 posterior submarginal A2-setae, with 3 proximal and 10 posterior submarginal B2-setae, without D2-setae; article 3 clavate, long, $2.2 \times$ breadth, with 1 proximal A3-seta, with distal A3-setae, with 10 posterior submarginal B3-setae, with 13 D3-setae and 3 E3-setae. *Maxilla 1*: inner plate small, with 2 simple apical setae; outer plate with 10 setal-teeth; palp with 6 terminal robust setae, without subterminal setae, flag seta present on distolateral corner. *Maxilla 2*: outer plate broader than inner; inner plate with setae distally along medial margin. *Maxilliped*: inner plate subrectangular with 3 nodular robust setae, without subterminal robust setae on medial corner, oblique setal row with 8 plumose setae; outer plate with 2 apical plumose setae, and 8 apicomedial robust setae; palp article 2, length $2 \times$ breadth, article 3, length $1.7 \times$ breadth.

Peraeonite 1: without lateral keel in male. *Peraeonite 2*: without sternal keel in male. *Peraeonite 5*: male, length $1.7 \times$ breadth, female, length $0.8 \times$ breadth. *Gnathopod 1*: subchelate; coxa not fused to peraeonite 1 in male or female, length $1.2 \times$ depth, without anteroventral lobe; basis in male with sparse setae along anterior margin, in female with sparse setae along anterior margin, without robust setae along anterior margin; carpus length $0.76 \times$ depth with setose posterior lobe, anterior margin without setae in male and female; propodus length $1.6 \times$ depth, with 7 rows of anteromedial setae; palm acute, without setae, with barbed robust setae. *Gnathopod 2*: carpochele in male, subchelate in female; coxa not fused to peraeonite 2 in male or female, length $1.7 \times$ depth, without sharp anteroventral cusp; basis long, bottle-shaped, length $2.6 \times$ breadth; carpus massive, very long, slender, length $1.5 \times$ breadth, posterior margin without tooth; palm obtuse, broadly excavate, without anterodistal tooth, posterodistal tooth well defined, medium in size, length $1 \times$ width, without robust setae; propodus broad, curved, length $2.4 \times$ width, without tooth on posterior margin, with teeth along posterior margin; dactylus, length $10.4 \times$ propodus.

Peraeopod 3: coxa not fused to peraeonite 3 in male or female, length $2.3 \times$ depth, without anteroventral

lobe; basis length $1.1 \times$ breadth, without inflated anterodorsal corner, with setae along anterior margin, without denticles along anterior margin; ischium length $1.2 \times$ breadth; merus without ridges; carpus with 4 simple setae along distal half of anterior margin, with 10 simple setae along posterior margin; propodus with a few setae along posterior margin. *Peraeopod 4*: coxa not fused to peraeonite 4 in male or female, length $2.4 \times$ depth, without anteroventral lobe; basis length $1.2 \times$ breadth, without setal group along anterior margin; ischium long, length $1.4 \times$ breadth; carpus without setae along distal half of anterior margin, with 7 simple setae along posterior margin; propodus with 8 simple setae along posterior margin. *Peraeopod 5*: coxa, length $1.5 \times$ depth, without patches of small setae; anterior lobe of merus not extending beyond anterior margin of carpus, posterior lobe with 4 simple setae; propodus with 4 setae along posterior margin, dactylus short, unciniate with two accessory spines. *Peraeopod 6*: coxa without setal fringe ventrally, without patch of small setae; basis without anterior setae, without small denticles along posterodistal margin; merus, length $2.5 \times$ breadth, without small anterodistal lobe; carpus without anterodistal lobe, without posterodistal lobe, posterodistal corner bearing small setal bunch; propodus, anterodistal corner bearing large setal bunch; dactylus short, unciniate with rows of accessory spines. *Peraeopod 7*: coxa with posterodorsal lobe, without patch of small setae; basis without denticles along anteroproximal margin, without small denticles along posterodistal margin; merus, length $3 \times$ breadth, without small anterodistal lobe, posterodistal corner bearing small setal bunch; carpus without anterodistal lobe, without posterodistal lobe, anterodistal corner bearing large setal bunch; propodus posterodistal corner bearing small setal bunch, anterodistal corner bearing small robust seta; dactylus short, unciniate with rows of accessory spines.

Oostegites: from gnathopod 2 to peraeopod 5. *Gills*: from peraeopod 3 to peraeopod 6.

Pleopods 1 to 3: decreasing in size. *Pleopod 1*: peduncle without patch of small setae, with 2 small distomedial hooks; rami subequal in length; inner ramus without patch of small setae, 11-articulate; outer ramus, article 1 with straight medial margin, 15-articulate. *Pleopod 2*: peduncle without patch of small setae, with 2 small distomedial hooks; biramous, inner ramus without patch of small setae, rami subequal in length, inner ramus 8-articulate; outer ramus broad, 10-articulate, without patch of small setae. *Pleopod 3*: peduncle without patch of small setae, with 2 small distomedial hooks; rami subequal in length, without patch of small setae. *Uropod 1*: biramous, peduncle with distoventral corona of cuticular teeth, length $1.3 \times$ outer ramus, without distoventral spine; outer ramus with lateral row of denticles, with 6 lateral setae, with large apical robust seta; inner ramus length $0.53 \times$ outer ramus, without setae, with apical robust seta. *Uropod 2*: uniramous, peduncle

length $2.5 \times$ breadth, $2.8 \times$ ramus; ramus small, with denticles and large apical robust seta. *Uropod* 3: uniramous peduncle length $1.6 \times$ breadth; ramus with 3 curved spines. *Telson*: length $0.5 \times$ breadth, cleft to base, each lobe with 22 to 25 anteriorly directed spines in two rows.

Tube. Unknown.

Remarks. According to Kudrjashov (1975) *Paracerapus polutovi* and *P. comparativus* (Kudrjashov, 1975) are closely related. Kudrjashov (1975) believed that the shape of the propodus of gnathopod 1 clearly distinguished the two species, but our illustration of the propodus is different to that of Gurjanova (1951), and appears more similar to that of Kudrjashov for *P. comparativus*. In males the carpochele palm of *P. polutovi* is not as recessed as that of *P. comparativus*, but this condition may be related to the age of the individuals. It is possible that these two species are synonymous. *Paracerapus comparativus* is known from Iturup in the Kuril Islands, an island chain extending south from the Kamchatka Peninsula. *Paracerapus polutovi* occurs in the Commander Islands to the east of the Kamchatka Peninsula. *Paracerapus comparativus* needs to be redescribed in detail before its true relationship to *P. polutovi* can be considered.

Distribution. East Kamchatka and Commander Island, Bering Sea, littoral to 29 m depth.

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Table 1. Matrix for HENNIG86 analysis of *Erichthonius* group generic relationships.

Character	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	14	17	18	19	20	21	
<i>Gammaropsis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Pseudischyrocerus</i>	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	
<i>Pseuderichthonius</i>	0	0	2	0	1	2	1	0	0	0	0	?	0	0	0	0	0	1	1	0	1	
<i>Erichthonius</i>	0	0	2	0	1	1	0	0	0	0	0	0	0	0	0	1	0	1	1	0	1	
<i>Bathypoma</i>	0	1	2	0	0	0	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	2
<i>Cerapus</i>	0	0	2	0	1	2	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	2
<i>Notopoma</i>	0	1	2	0	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	2
<i>Paracerapus</i>	0	0	2	0	1	2	1	0	1	0	0	0	1	1	1	1	1	1	1	1	1	2
<i>Runanga</i>	0	0	1	0	1	1	1	0	1	1	1	0	0	1	1	1	1	1	1	1	0	2
<i>Siphonoecetes</i>	1	0	2	1	2	0	1	0	1	1	0	0	0	2	0	1	0	1	0	0	0	
<i>Caribboecetes</i>	1	0	2	1	2	0	0	1	1	1	1	0	2	2	0	1	2	2	0	0	1	
<i>Concholestes</i>	1	0	2	1	0	0	0	1	1	1	1	0	1	2	0	0	2	2	0	0	0	
<i>Africoecetes</i>	1	0	2	1	2	0	2	1	1	1	1	0	2	2	0	0	2	1	0	0	1	
<i>Rhinoecetes</i>	1	0	2	1	0	0	0	0	1	1	0	0	1	2	1	0	1	1	0	0	1	
<i>Borneoecetes</i>	1	0	2	1	0	0	2	0	1	1	1	0	2	2	1	1	1	1	0	0	1	
<i>Bubocorophium</i>	1	0	2	2	0	0	2	1	1	1	1	0	1	2	1	1	1	1	0	0	1	
<i>Australoecetes</i>	1	0	2	1	2	0	1	0	1	1	1	0	2	2	1	1	0	1	0	0	1	
<i>Polynesoecetes</i>	1	0	2	1	2	0	2	0	1	1	1	0	2	2	1	0	2	2	0	0	0	
<i>Corocubanus</i>	1	0	2	2	2	0	2	0	2	2	2	0	?	2	?	0	2	2	0	0	1	