The Genera *Catoessa*, *Elthusa*, *Enispa*, *Ichthyoxenus*, *Idusa*, *Livoneca* and *Norileca* n.gen. (Isopoda, Cymothoidae), Crustacean Parasites of Marine Fishes, with Descriptions of Eastern Australian Species

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ABSTRACT. The following genera of Cymothoidae are recorded from Australia: *Catoessa* Schiödte & Meinert, *Elthusa* Schiödte & Meinert, *Enispa* Schiödte & Meinert, *Ichthyoxenus* Herklots, *Livoneca* Leach and *Norileca* n.gen. Full diagnoses are given for *Enispa*, *Livoneca* and *Norileca* n.gen. For the remaining genera provisional diagnoses are given. *Idusa* Schiödte & Meinert is rediagnosed to allow separation from *Catoessa*. All the species described herein would have previously been placed in *Livoneca*. Examination of the type material of *L. redmanii* shows that all other species placed in the genus, except for *L. bowmani* Brusca, are not congeners, and are reassigned, where possible, to other genera. The genus *Livoneca* is found to belong to the Anilocrinae, and is most closely related to the *Nerocila* group of genera. The principal characters used in redefining these genera and assigning *Livoneca* and *Norileca* to the Anilocrinae are the morphology of the brood pouch, pleopods, pleon and cephalon. The species described are *Catoessa ambassae* n.sp., *Elthusa myripristae* n.sp., *E. neocytta* (Avdeev), *E. propinqua* (Richardson), *E. raynaudii* (Milne-Edwards), *E. sacciger* (Richardson), *E. sigani* n.sp., *E. turgidula* (Hale), *Enispa irrequlari*s (Bleeker), *Ichthyoxenus minabensis* (Shiino), *Norileca indica* (Milne-Edwards) and *Norileca triangulata* (Richardson). Discussion is given of the genera treated and the problems present in attempting to diagnose subfamilies within the Cymothoidae. Keys are given to the Australian gill attaching genera and the Australian species of the genera *Elthusa* and *Norileca*.

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This work was initially intended as an account of the species of *Livoneca* Leach, 1818, from Australia. As description of the species progressed it was increasingly apparent that the species under study could not be contained in a single genus. Bruce (1986) gave a diagnosis and description to *Mothocya* and attempted to tabulate comparable characters of *Livoneca*, also commenting that there were inconsistencies in morphology between the species currently being placed in *Livoneca*.

The distinction between *Livoneca* and genera such as *Elthusa*, *Idusa*, *Ichthyoxenus* and *Catoessa* has never been clear. Most species of *Idusa* have been incorrectly placed in that genus (Trilles, 1981). *Ichthyoxenus* and *Livoneca* have been considered synonymous by many authors (e.g. Fryer, 1965, 1968; Lincoln, 1972).

One of the main causes of confusion is that the type species of most of the genera concerned have not been fully described. *Livoneca redmanii*, type species of the genus, was figured by Schiödte & Meinert (1884), but remained effectively undescribed by modern standards. The type specimens have never been figured.A similar situation exists for most genera created by Schiödte & Meinert (1883, 1884).

In redescribing *L. redmanii* two major problems arose. Firstly the cephalic, pleonal, brood pouch and pleopod morphology indicate clearly that the species (and therefore the genus) is most closely allied to *Nerocila*. Secondly, none of the more than 70 species, other than *Livoneca bowmani* Brusca, 1981, subsequently placed in the genus appeared to belong to *Livoneca*. This created the problem of where to assign these most inadequately described species, since most genera of "Livonecinae" are effectively undiagnosed.

Other problems involved the status of the genera *Idusa* and *Ichthyoxenus* and their species. These are discussed in the respective generic sections.

To attempt at least a partial solution I have provided provisional diagnoses to those genera whose type species have not been fully described (*Catoessa*, *Elthusa*, *Ichthyoxenus* and *Idusa*), and where the type species is fully described (*Livoneca*, *Enispa*, *Norileca* n.gen.) I provide a full diagnosis and description.

Species have been assigned to genera on the basis of available descriptions or examination of the types. In many cases species are inadequately described, or types too fragile for detailed examination, and many species

have been placed where they fit best. Most species formerly in *Livoneca* are now placed in *Elthusa*.

As there has been so much confusion over correct generic placement of *Livoneca* species, I have provided a complete list of all species that have been placed in the genus in the past. The most recent comprehensive account is referred to for each species.

Prior to the present work there were few records of gill parasitic isopods from Australia. Hale (1926) recorded four species in two genera, and Avdeev (1975a,b, 1978) increased the total to three genera and seven species. Bruce (1986) added a further seven species, all *Mothocya*, to those known from Australia. The present work records another two genera and nine species (*Catoessa* and *Enispa* are buccal parasites, and the attachment site for *Ichthyoxenus minabensis* is unknown). A key is provided to the gill attaching genera known from Australia, together with keys to the Australian species treated here.

Methods

Methods follow Bruce (1987a). No specimens were obtained by personal collecting, though several were obtained from fishes in the Australian Museum fish collections. In this instance the host fish catalogue number is also given. All fish identifications and names were confirmed by the Australian Museum fish section except where otherwise indicated. All isopod length measurements are in millimetres (mm).

Abbreviations used in the text are: AM – Australian Museum, Sydney, NSW, Australia; BMNH – British Museum (Natural History), London; MHNG – Muséum d'Histoire Naturelle, Geneva, Switzerland; NSW – New South Wales, Australia; NT – Northern Territory, Australia; NTM – Northern Territory Museum, Darwin, NT; Qld – Queensland, Australia; QM – Queensland Museum, Brisbane, Qld; RMNH – Riksmuseum van Natuurlijkie Historie, Leiden; SA – South Australia; SAM – South Australian Museum, Adelaide; Tas – Tasmania, Australia; USNM – Smithsonian Institution, Washington, D.C., USA; Vic – Victoria, Australia; WA – Western Australia; WAM – Western Australian Museum, Perth, WA; ZMA – Zoologisch Museum, Amsterdam.

Host Preferences

For most of the species treated in this work there is insufficient data for any patterns of host use to emerge. The two species of *Norileca* are both associated with open water or pelagic schooling fishes. The genera *Catoessa*, *Enispa* and *Ichthyoxenus* are represented in Australia by a single species each. *Elthusa* is represented by seven species, but there is no discernible pattern. *Elthusa turgidula* is known only from tropical Scaridae, the temperate *E. neocytta* is recorded only from Zeidae and *E. propinqua* is recorded principally from Macrouridae. *Elthusa raynaudii* is in contrast recorded from a wide variety of hosts: eight species in seven genera and five families, plus unidentified hosts in a further two families. The remaining species either lack host data (*E. sacciger*) or are known from single records *E. myripristae*, *E. sigani*).

Position of attachment of these gill parasites varies considerably. *Elthusa myripristae* attaches in a ventral position on the gill, head anteriorly, abdomen against the host's body rather than gill operculum. *Elthusa turgidula* attaches in a medial position on the gill arches, with the head projecting into the buccal cavity. For the other species of *Elthusa* only 'gills' or 'gill cover' has been recorded.

Norileca indica has the head to the anterior, and the abdomen facing outwards, pressed against the gill operculum, positioned ventrally in the gill cavity. This is a position similar to that figured by Tiwari (1953) for *Agarna malayi*.

Cymothoid Classification

Schiödte & Meinert (1881–1884) divided the Cymothoidae into several subfamilies. There were no further developments on cymothoid classification until Brusca (1981) gave his ideas on phylogeny and evolution within the family. Brusca's (1981) interpretation was similar to that offered by Schiödte & Meinert, but the discussion and rationale were far more detailed. Bruce (1987c) gave a diagnosis for the externally attaching lineage, the subfamily Anilocrinae. The principal characters involved in diagnosing the Anilocrinae were the morphology of the brood pouch, pleon and pleopods. No attempt was made to redefine other subfamilies as lack of data on the larger genera precluded assessment of their systematic position.

Recent work on cymothoid taxonomy has yielded many new descriptive and host data (studies by Williams & Williams 1980, 1981, 1986, 1987; Bruce, 1986, 1987a,b,c; Bruce & Bowman, 1989; and Bowman & Tareen, 1983). Host specificity has been shown to be far more restricted in several genera (e.g. *Anilocra*, *Renocila*, *Mothocya*) than previously supposed, while in others (*Nerocila*, temperate species of *Anilocra* and *Elthusa*) host specificity is weak. More importantly, the morphological characters now being described can shed new light on classification within the family.

Position on the host (buccal, gill, burrowing or external), and general body shape have long influenced interpretation of the relationships of cymothoid genera. In earlier classifications appendages were not considered, or at most were regarded as useful in species discrimination only. So it was that the Anilocrinae approximated to external attaching genera, Livonecinae to gill attaching while Ceratothoinae and Cymothoinae were buccal attaching.

The morphological distinction between Cymothoinae and Livonecinae has never been clear, and was based largely on pleon morphology. *Ichthyoxenus*

(Cymothoinae) has been considered by many authors to be a synonym of *Livoneca*. Similarly, Bowman & Tareen (1983) found little to differentiate *Catoessa* from *Livoneca*. Brusca (1981) had earlier recognised this, and placed all the gill and buccal attaching genera in a single lineage (see Brusca's fig.4B).

Good morphological data now exist for the Anilocrinae (Bruce, 1987a,b,c; Brusca, 1981; Bowman & Tareen, 1983; Williams & Williams, 1980, 1981, 1986, 1987), for *Mothocya* (Bruce, 1986), to a lesser extent *Ceratothoa*, *Glossobius* (Bruce & Bowman, 1989; Brusca, 1981), *Cymothoa* (Brusca, 1981, figures for *C. exigua*) and lastly the genera covered in the present study. There are many other contributions, but none has given figures for or described the pleopod morphology and most lack good drawings of mouthparts.

Using the descriptive data of the works just cited, plus the present work, a different and more complex pattern emerges, and the simple lineages illustrated by Brusca (1981) are no longer acceptable.

The pattern proposed is based on the premise that morphology takes precedence over location on the host in a classification. The second is that in many cases body shape is a convergent character, dependent on location on the host. Two examples of such body shape convergence are *Mothocya ihi* Bruce, a mouth parasitic species that looks superficially like other mouth attaching genera but by virtue of cephalic, pleonal and appendage morphology unambiguously belongs to *Mothocya*, all other species of which are gill parasitic. *Nerocila lomatia* Bruce is a gill parasite in a genus of otherwise externally attaching species. *Nerocila lomatia* converges with other gill attaching genera including an asymmetric body shape, pleonal processes reduced, flattened dorsum, and shortened coxae. There are presumably modifications imposed by the confined space of the gill cavity and gill arches. In both cases convergence has not obscured the generic affinity of each species.

The Anilocrinae was defined by Bruce (1987c). There are three genera in the present work, *Enispa*, *Livoneca* and *Norileca*, that show the anilocrine morphology of cephalon, pleon, brood pouch, pleopods, and clearly belong to this subfamily. To postulate the multiple independent evolution of trilobed cephalon, folded pleopods, and anilocrine brood pouch morphology is clearly less parsimonious than a monophyletic origin. The Anilocrinae, although primarily externally attaching, has genera that also use the buccal cavity (*Enispa*) and gill chamber (*Livoneca*, *Norileca*). The potential for members of this subfamily to use gill chamber and buccal attachment sites is easily understood when one sees anilocrine species attaching on the pectoral fin or head, and then in the case of *Nerocila lomatia*, actually in the branchial chamber.

The remaining genera can be separated into two or three groups these being equivalent to the Livonecinae, Cymothoinae and Ceratothoinae in the sense formerly used. Of these, those genera that attach to the gill arches can be clearly delineated, but at present have no nomenclatural standing as the name Livonecinae is herein synonymised with Anilocrinae. The Ceratothoinae can be unambiguously distinguished by antennular and antennal morphology, narrow anterior margin to the cephalon and operculate first pleopods. However, as it is not at all clear that these should be regarded as characters of subfamilial merit. The genera of the Ceratothoinae share an identical pleon and maxilla morphology with *Cymothoa*, type genus for Cymothoinae, and it is not possible to develop a clear conceptual difference between these two taxa at present.

Given that the morphological boundaries of most of the family group names proposed by Schiödte & Meinert are unclear, and that there still inadequate data for many cymothoid genera, it seems preferable to avoid the use of subfamily names other than Anilocrinae and Cymothoinae. It is premature to attempt a comprehensive new classification at present. More detailed morphological data is still needed and is becoming available for more genera. It should soon be possible to perform outgroup analysis, polarise the character states, and subject the family to cladistic analysis. Only by this method will the obscurities that exists within this family be resolved.

Key to Australian Branchial-Attaching Cymothoid Genera

This key is handicapped by the lack of relevant descriptive data for the species of *Cterissa* Schiödte & Meinert, 1884, none of which have had their pleopods described. *Cterissa* is represented in Australia by a single species *C. australiensis* Avdeev, 1975. *Nerocila* Leach is usually an externally attaching genus but one species, *N. lomatia* Bruce, 1987, attaches in the branchial chamber of its host.

1. Coxae manifestly larger on one side than other ..... *Cterissa*

—— Coxae of about equal size on both sides 2

2. Brood pouch without posterior pocket, pleopod rami all lamellar 3

—— Brood pouch with posterior pocket, at least endopod of pleopod 5 with prominent lobes 4

3. Antennule larger than antenna; maxilliped palp article 3 robust, without setae; pereopods with relatively long robust dactyli ..... *Mothocya*

—— Antennule shorter than antenna; maxilliped palp article 3 slender, with setae; pereopods with relatively short dactyli ..... *Elthusa*

4. Pleonites 1 and 2 with ventrolateral process; uropods extending beyond posterior of pleotelson ..... *Nerocila*

—— Pleonites 1 and 2 without ventrolateral processes; uropods not extending beyond posterior of pleotelson ..... *Norileca* n.gen.

Taxonomy

Catoessa Schiödte & Meinert

Catoessa Schiödte & Meinert, 1884: 309, 310.–Bowman & Tareen, 1983: 17.

Type species. *Catoessa scabricauda* Schiödte & Meinert, 1884, by monotypy.

Provisional diagnosis of female. Body strongly vaulted, bilaterally symmetrical, or weakly twisted to one side; about 2.5 times as long as wide. Cephalon weakly immersed in pereonite 1. Pleon narrow, not immersed into pereon; pleonite 1 narrower than 2; pleonites 2-5 subequal in width, lateral margins twisted, leaving gaps between pleonites.

Antennule subequal to, or longer than antenna, always more robust than antenna; bases set wide apart. Mandible palp slender; incisor noticeably elongate. Maxilliped without oostegital lobe. Pereopods without carina on basis, articles not dilated or expanded. Brood pouch arising from sternites 2-4 and 6. Pleopods all lamellar, rami rounded; endopods of pleopods 3-5 with simple proximomedial lobe.

Composition. *Catoessa boscii* (Bleeker, 1857), n.comb., *Catoessa gruneri* Bowman & Tareen, 1983 and *Catoessa ambassae* n.sp.

Remarks. Bowman & Tareen (1983) commented that there was little justification for separating *Catoessa* from *Livoneca*. In the light of new data on *Livoneca* presented here, there is clearly a great deal of difference between these two genera, although *Elthusa* and *Catoessa* have a similar pleopod morphology.

The type species is still not well known, and for this reason the diagnosis given here is provisional. Both *C. gruneri* and *C. ambassae* agree well on generic characters.

Examination of the types of *Livoneca boscii* (RMNH 67) show that it is an unequivocal member of *Catoessa*.

In Australia the genus is represented by the one species.

Catoessa ambassae n.sp.

Figs 1, 2

Type material. HOLOTYPE, female (ovigerous 9.0), Lake Wooloweyah, Yamba, NSW, 19 Nov. 1984, in mouth of *Ambassis jacksoniensis* (AM I26537-09), collected by B. Ingram (AM P37761). PARATYPES, 9 females (ovigerous 7.5, 7.5#2, 7.8, 8.0, 8.5, 8.5#1, 9.3#3, non-ovigerous 7.5, 8.0), same data as holotype (AM P37762-P37766).

Type locality. Lake Wooloweyah, Yamba, NSW, about 29°00'S 153°19'E.

Description of female. Body about 2.5 times as long as wide, widest at pereonite 4; weakly ovoid, bilaterally symmetrical but twisted along longitudinal axis (giving asymmetric impression in dorsal view). Cephalon not deeply immersed in pereonite 1; eyes moderate, 0.36 width of cephalon; anterior margin produced, truncate, turned down, but not posteriorly. Coxae not conspicuous in dorsal view; coxae of pereonite 1 as long as segment; coxae 3-7 all shorter than respective segment. Pereonite 1<2<3<4>5>6>7; pereonites 6-7 decreasing abruptly in length, pereonite 7 being about half as long as 6. Posterior margin of pereonite 7 evenly indented. Pleon about 0.25 width of pereonite 4, not deeply immersed in pereon; all pleonites visible, pleonite 1 manifestly shorter than 2, pleonites 2-5 subequal in width. Pleotelson indented just posterior to articulation with pleonite 5, then widening; broadly rounded posteriorly.

Antennule robust, longer than antenna, composed of 8 articles; bases set wide apart. Antenna with 10 articles, extending to pereonite 1. Mandible incisor acute, elongate; palp articles all elongate, article 3 narrowing distally, with 4 distolateral spines. Maxillule with 4 terminal spines, 2 of which are distally recurved. Maxilla with single spine on lateral lobe, 2 on medial lobe. Maxilliped

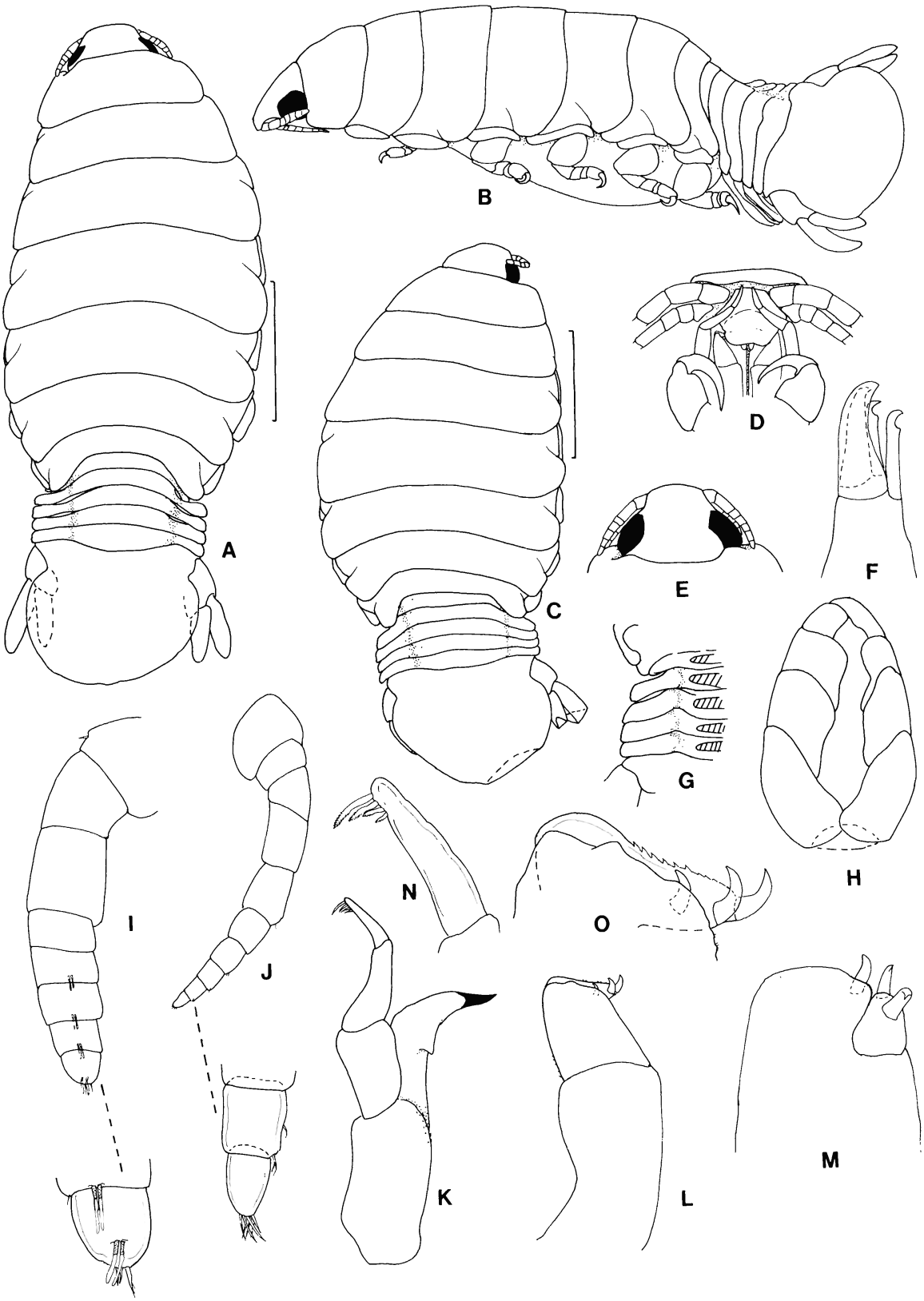

Fig.1. *Catoessa ambassae* n.sp. Figures of female #3 (AM P37765) except where indicated. A, dorsal view, holotype; B, lateral view, holotype; C, dorsal view, female #2 (AM P37764); D, frons, holotype; E, cephalon, holotype; F, maxillule apex; G, right pleonites, ventral view; H, brood pouch; I, antennule; J, antenna; K, mandible; L, maxilliped; M, maxilla apex; N, mandible palp article 3; O, maxilliped article 3. Scale lines represent 2.0 mm.

without laminar lobes; article 3 with 3 recurved spines.

Pereopod 7 slightly longer than 1. Pereopod 1 propodus short, about as long as combined lengths of merus and carpus; ischium about 0.32 length of basis. Pereopods 2 and 3 similar to 1. Pereopods 5-7 similar; pereopod 7 basis with carina, but not expanded; ischium about 0.7 length of basis. Brood pouch made up of 4 pairs of oostegites arising from coxae 2-4 and 6. No oostegites on coxae 1, 5 and 7.

Pleopods all lamellar, without folding or accessory lobes; endopods of pleopods 3-5 with proximomedial lobe. Peduncles 1-4 with 1-5 coupling hooks. Pleopod 1 shortest, exopod circular, exopods 4 and 5 slightly more elongate than 1. All pleopods with exopods longer than endopods. Uropod rami not exceeding posterior of pleotelson; endopod shorter than exopod, apices bluntly rounded.

Male. Not known.

Colour. In alcohol, tan, densely covered with chromatophores which extend onto ventral surfaces, antennule, antenna, pereopods and pleopods.

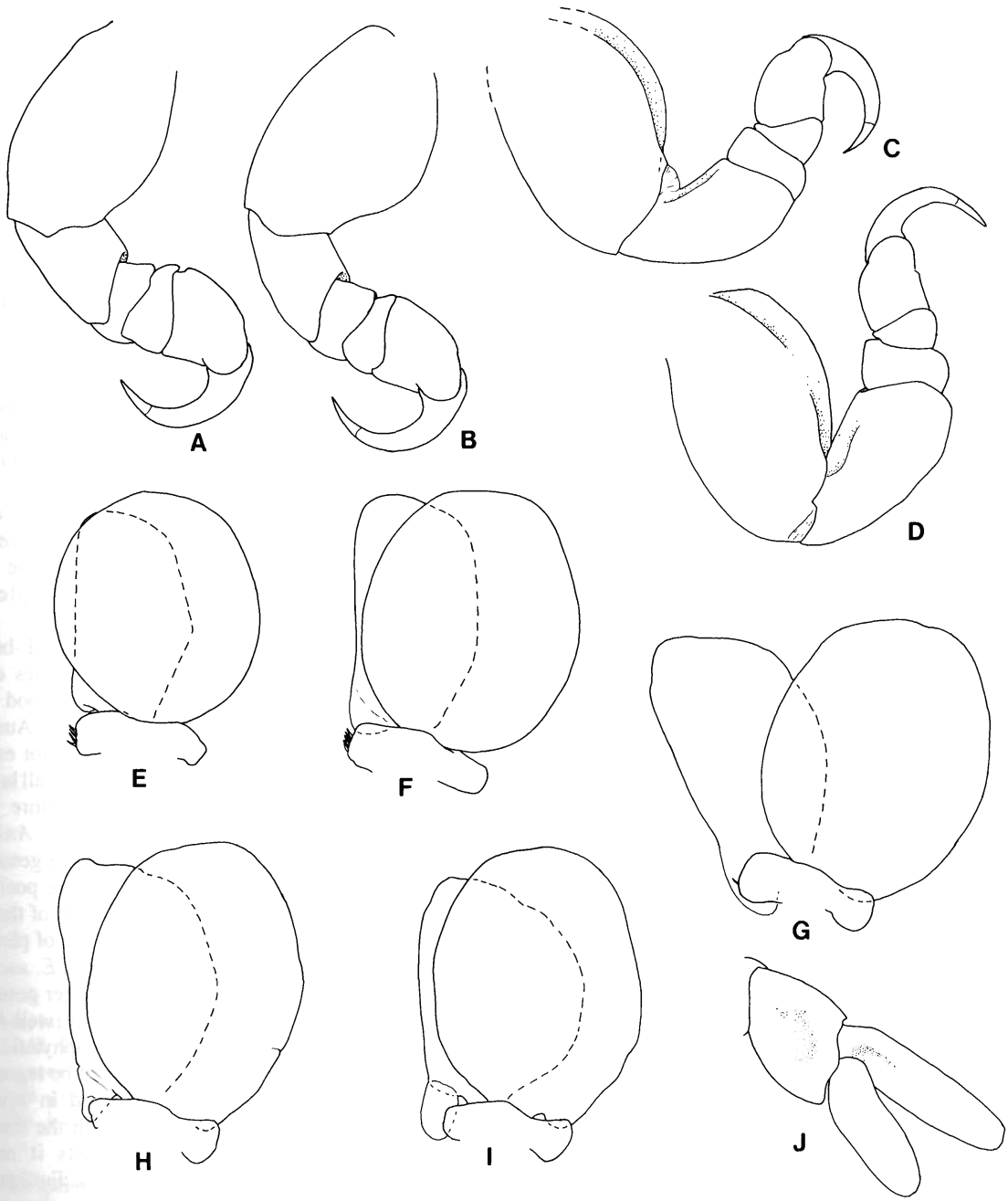

Fig.2. *Catoessa ambassae* n.sp. All figures of female #3 (AM P37765). A–D, pereopods 1, 2, 6, 7 respectively; E–I, pleopods 1-5 respectively; J, uropod.

Size. Mean size for ovigerous female 8.26 mm (n = 8).

Variation. The degree to which the body is rotationally twisted about its axis varies between specimens. The two immature females (lacking penial processes or appendix masculina) are noticeably more slender than ovigerous females (about 3.0 versus 2.5 times as long as wide).

Remarks. This species is readily distinguished from all other Australian cymothoids by the rotational twisting of the body. *Catoessa ambassae* is distinguished from others of the genus by the presence of a truncate rostrum coupled with a broadly rounded pleotelson. *Catoessa boscii* has a triangular pleotelson, *C. scabricauda* has an acute rostral point and *C. gruneri* has a rounded rostral point and posteriorly narrowed pleotelson.

Host. Present material is all from *Ambassis jacksoniensis* an estuarine species. The mode of attachment of isopod to host appears not to have been previously recorded. This isopod is a buccal parasite, but attaches to the lateral internal face of the buccal cavity, with the isopod dorsal surface medial. The head (in preserved specimens) projects beyond the host's mouth.

Distribution. Recorded only from the type locality.

Etymology. The specific name is taken from that of the host genus.

Elthusa Schiödte & Meinert

Elthusa Schiödte & Meinert, 1884: 337.

Type species. *Livoneca emarginata* Bleeker, 1857, by monotypy (Schiödte & Meinert, 1884). One female syntype is held at the Rijksmuseum von Natuurlijke Historie, Leiden.

Provisional diagnosis of female. Body weakly vaulted, symmetrical or weakly twisted; about 1.8–2.3 times as long as wide. Cephalon moderately to strongly immersed in pereonite 1; posterior margin not trilobed. Pleon moderately to deeply immersed into pereonite 7, usually wide (greater than 0.5 width of pereon); pleonite 1 as wide, or only a little narrower than 2.

Antennule shorter than antenna; bases never in contact, varying from close set to wide apart. Mandible palp slender; article 3, or 2 and 3 with setae. Maxilliped with oostegital lobe. Pereopods with carina on basis; pereopods 1-3 with carpus cleft, receiving dactylus apex. Brood pouch arising from sternites 1-4 and 6. Pleopod rami all lamellar, without lobes or folding, progressively decreasing in size from pleopod 1 to 5. Pleopod 5 endopod rounded, or with straight medial margin, never indented.

Composition. All new combinations: *Elthusa atlantniroi* (Kononenko, 1988); *Elthusa californica* (Schiödte & Meinert, 1884), *E. caudata* (Schiödte & Meinert, 1884), *E. foveolata* (Hansen, 1897), *E. frontalis* (Richardson, 1910), *E. intermedia* (Nierstrasz, 1937), *E. menzeisi* (Brusca, 1981), *E. methipia* (Schiödte & Meinert, 1884), *E. nanoides* (Stebbing, 1905), *E. neocytta* (Avdeev, 1975), *E. ochotensis* (Kussakin, 1979), *E. philippinensis* (Richardson, 1910), *E. propinqua* (Richardson, 1904), *E. puhi* (Bowman, 1962), *E. raynaudii* (Milne-Edwards, 1840), *E. sacciger* (Richardson, 1909), *E. samariscii* (Shiino, 1951), *E. samoensis* (Schiödte & Meinert, 1884), *E. splendida* (Sadowsky & Moreira, 1981), *E. tropicalis* (Menzies & Kruczynski, 1983), *E. turgidula* (Hale, 1926), and *E. vulgaris* (Stimpson, 1857); also the new species described in this work *Elthusa myripristae* n.sp. and *Elthusa sigani* n.sp.

Remarks. Schiödte & Meinert (1884) gave a Latin diagnosis for *Elthusa* which, by contemporary standards, fails to differentiate the genus from other similar genera. The genus (and the type species) has received no attention since it was established. With the redefinition of *Livoneca* in this present work, and the re-examination of the types of *Elthusa emarginata*, it became apparent that most valid species that were in the past placed in *Livoneca* would be better placed in *Elthusa*.

The principal characters by which *Elthusa* can be identified are the weakly vaulted body shape, cephalon posterior margin not trilobed, a usually wide pleon, antennule shorter than antenna and all pleopods lamellar.

The diagnosis given here is provisional because the fragility of the holotype of the type species did not allow for dissection. The mouthpart and pleopod details given in the diagnosis are derived from the Australian species of *Elthusa*. However, although I could not examine the pleopods of *E. emarginata* in detail, they are all lamellar.

The genus as currently composed is more varied than other large cymothoid genera (e.g. *Anilocra*, *Nerocila*, *Mothocya*), and most species of the genus need to be fully redescribed. Areas of variation are position of the antennule (close set to wide apart), width of the pleon (manifestly narrow in *E. sacciger*) and width of pleonite 5 (narrower than pleonite 4 in *E. neocytta* and *E. sacciger*). These characters are constant within the larger genera for which there exists good data, and it may well be that *Elthusa* as presently constituted is not monophyletic.

The inclusion of *Elthusa turgidula* must be regarded as provisional. Clearly it cannot be retained in *Livoneca*. The very narrow pereonite 1 together with the antennule being larger than the antenna suggests it may be reassigned to another possibly new genus. Further study of related genera is necessary before this step can be taken. At present it is best placed in *Elthusa* but regarded as *incerta sedis*.

Key to Australian Species of *Elthusa*

Note that the key applies only to adult (preferably ovigerous) females, and for most qualitative characters (e.g. couplet 6) reference to the figures is essential.

1. Pleonite 1 manifestly narrower than pleonite 2 ..... *E. turgidula*

—— Pleonite 1 about as wide as pleonite 2 2

2. Pleon less than half as wide a pereon maximum width; posterior coxae bulbous ..... *E. sacciger*

—— Pleon about 72–83% maximum width of pereon; posterior coxae not bulbous 3

3. Pleonite 5 overlapped laterally by pleonite 4; body essentially bilaterally symmetrical ..... *E. neocytta*

—— Pleonites all subequal in width, body twisted to one side 4

4. Cephalon with acute rostral point; posterior coxae small, not conspicuous in dorsal view 5

—— Cephalon anteriorly rounded or truncate; posterior coxae prominent in dorsal view 6

5. Pleonite 1 not visible in dorsal view; pleotelson about 4 times longer than visible pleon ..... *E. myripristae*

—— Pleonite 1 visible in dorsal view; pleotelson less than twice length of pleon ..... *E. propinqua*

6. Antenna longer than antennule; anterior margin of cephalon narrowly truncate (large size: 22–67 mm) ..... *E. raynaudii*

—— Antennule and antenna subequal in length; anterior margin of cephalon widely truncate (small size: 9–13 mm) ..... *E. sigani*

Elthusa myripristae n.sp.

Figs 3–5

Material examined. Female HOLOTYPE (ovigerous 26.0, AM P37773), male (12.5, AM P37774), Escape Reef, outer Barrier Reef 15°49'S 145°50'E, 29 Oct. 1981, on gills of *Myripristis violaceus*, depth 14-17 m (Fish No. I 22582-001), coll. J. Paxton, G. Allen *et al.*

Description of female. Body 1.9 times as long as wide, weakly twisted, widest at pereonite 3; dorsum weakly vaulted. Cephalon deeply immersed in pereonite 1, with distinct median rostral point; eyes 0.45 width of cephalon. Pereonite 1 longest, 6 and 7 shortest; coxae on pereonites 2 and 3 conspicuous in dorsal view, those of pereonites 4-7 short, in dorsal view partly or totally concealed by preceding pereonite. Posterior margin of pereonite 7 deeply indented. Pleonite 1 totally concealed by pereonite 7; pleonites 1-5 increasing slightly in width towards posterior. Pleon, at pleonite 5, 0.77 width of pereonite 3. Pleotelson 2.5 times longer than pleon, 0.70 as long as wide; widest medially.

Antennule with 8 articles, not extending to posterior of cephalon; bases set close together. Antenna longer than antennule, with 11 articles.

Mandible with mediodistal lobe and reduced molar; palp article 1 longest; palp article 3 half as long as 2, with

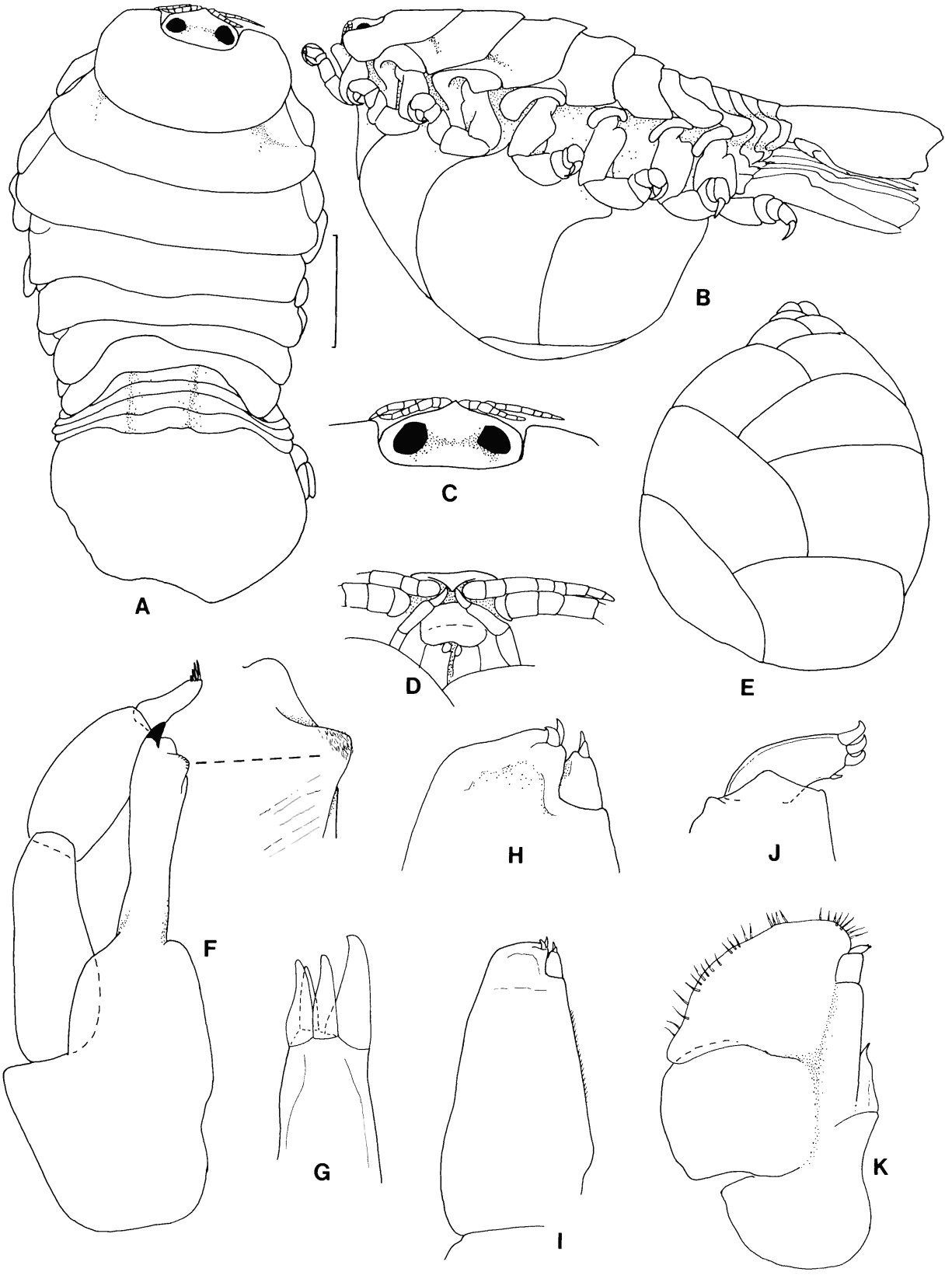

Fig.3. *Elthusa myripristae* n.sp. All figures of holotype. A, dorsal view; B, lateral view; C, cephalon; D, frons; E, brood pouch; F, mandible; G, maxillule apex; H, maxilla apex; I, maxilla; J, maxilliped article 3; K, maxilliped. Scale line represents 5.0 mm.

4 terminal setae. Maxillule with 4 terminal spines. Maxilla widening evenly from apex to base; medial and lateral lobes each with 2 spines. Maxilliped article 3 with 1 small and 3 large terminal spines.

Pereopods all with anterolateral carina on basis; dactylus short, extending to middle of carpus. Brood pouch deep, made up of alternately overlapping pairs of oostegites running from coxae 1 to 4 and 6; sternite 7 with 2 posteriorly placed submedian fleshy lobes.

Pleopod 2 exopod large, overlapping all other pleopods; endopods with proximedial lobe; peduncle with medial lobe. Pleopods 2-5 endopods with small, simple proximedial lobe; peduncles without medial lobes; exopods all with finely granulated patch on distomedial part of ramus. Uropods short, concealed by pleotelson in dorsal view; endopod slightly longer than exopod, margin converging to rounded apex; exopod lateral margin strongly curved.

Male. Dorsum more strongly vaulted than in female, lateral margins straight. Pleonite 1 totally concealed by pereonite 7. Pleotelson broadly rounded. Elongate paired penes on posterior of sternite 7.

Appendages similar to females except for mandible with longer molar; maxilliped articles 3 with larger spines; pleopods with longer peduncles; pleopod 1 peduncle

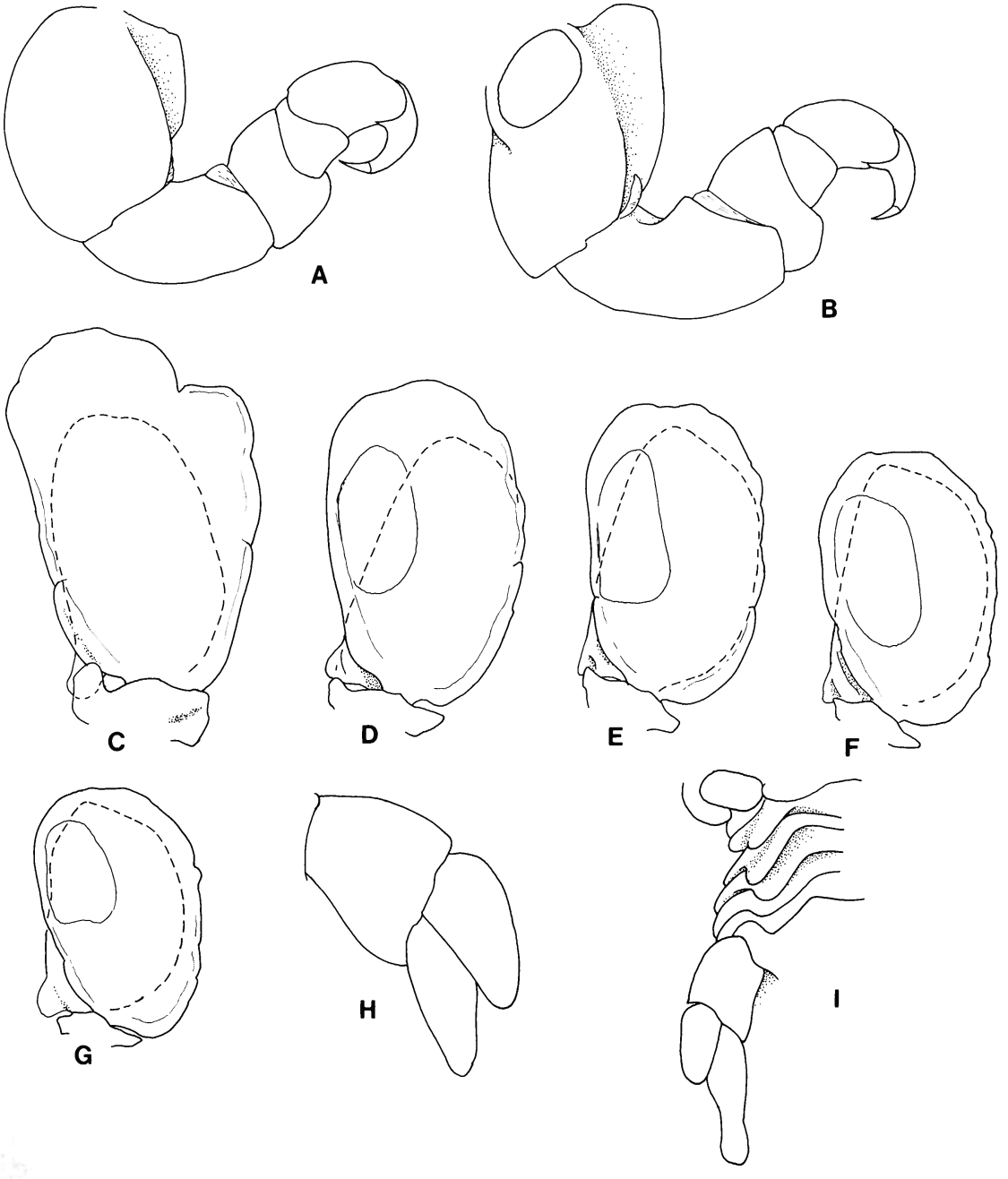

Fig.4. *Elthusa myripristae* n.sp. All figures of holotype. A, pereopod 1; B, pereopod 7; C–G, pleopods 1-5 respectively; H, uropod; I, right pleonites, ventral view.

without medial lobe; pleopod 2 with appendix masculina; uropod rami longer and wider.

Colour. Pale tan in alcohol, chromatophores not apparent.

Remarks. Two species show some similarity to *Elthusa myripristae*: *E. caudata* and *E. propinqua*. *Elthusa myripristae* can be separated from both these species by having pleonite 1 totally concealed in dorsal view by pereonite 7, and by the much smaller coxae on pereonites 4 to 7. *Elthusa propinqua* has a shorter pleotelson with uropods that extend beyond the posterior margin and differs in details of mouthpart, pereopod and pleopod morphology. Additionally *Elthusa propinqua* is a parasite of deepwater continental shelf and slope fishes. *Elthusa caudata* lacks the acute rostral point, but little else is known of this species. Avdeev (1978) listed *E. caudata* as occurring between Australia and New Zealand on *Genypterus blacodes* (Macruridae).

The mandible structure is apparently unique within the genus. Most cymothoids have a laminar molar; in *E. myripristae* this is reduced, and there are instead two small lobes adjacent to the incisor.

Hosts. Known only from *Myripristis violaceus*, attached abdomen innermost, at base of gill cavity.

Distribution. Escape Reef, northern Great Barrier Reef.

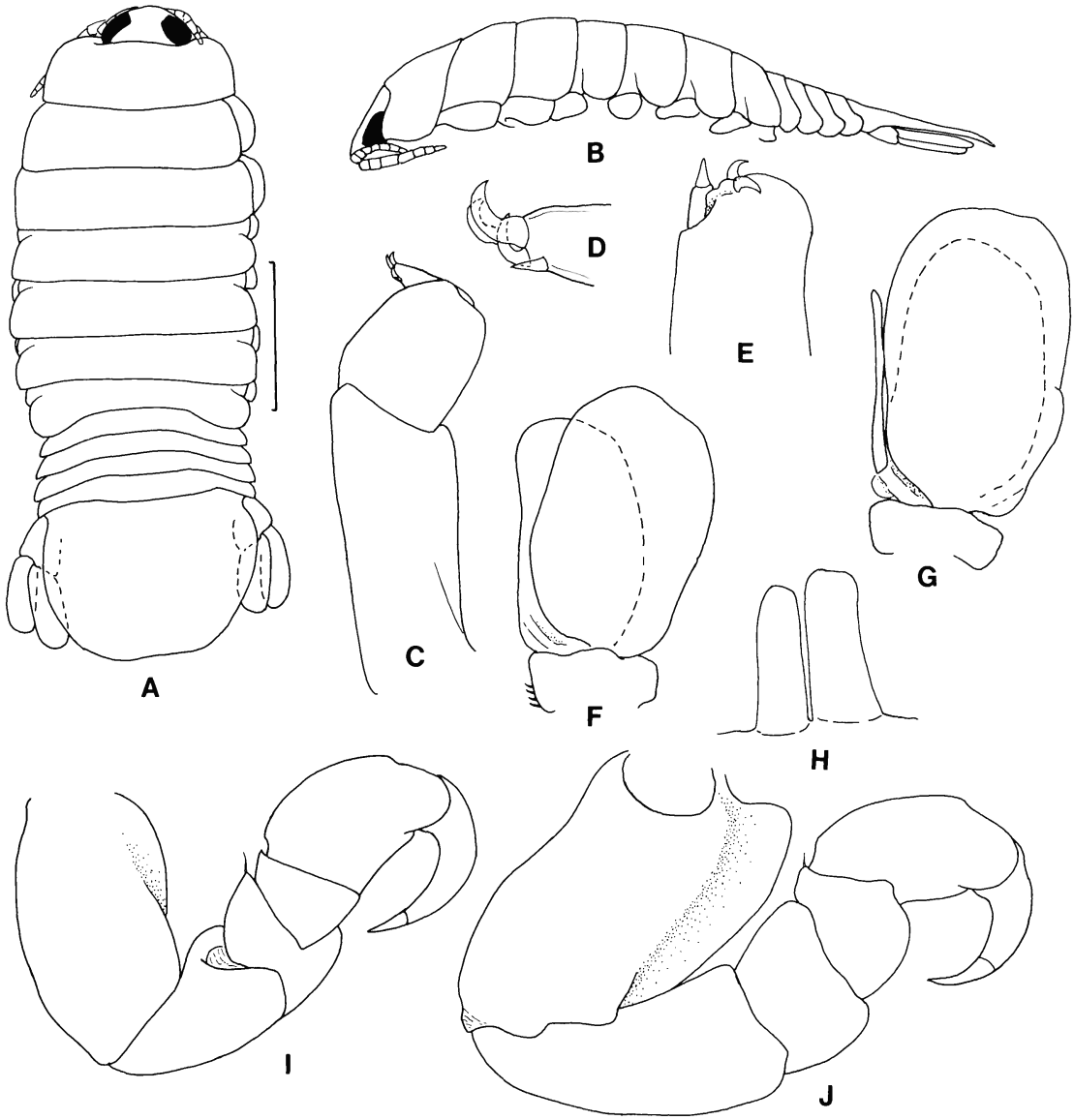

Fig.5. *Elthusa myripristae* n.sp. All figures of male paratype. A, dorsal view; B, lateral view; C, maxilliped; D, maxilliped article 3, apex; E, maxilla apex; F, pleopod 1; G, pleopod 2; H, penes; I, pereopod 1; J, pereopod 7. Scale line represents 3.0 mm.

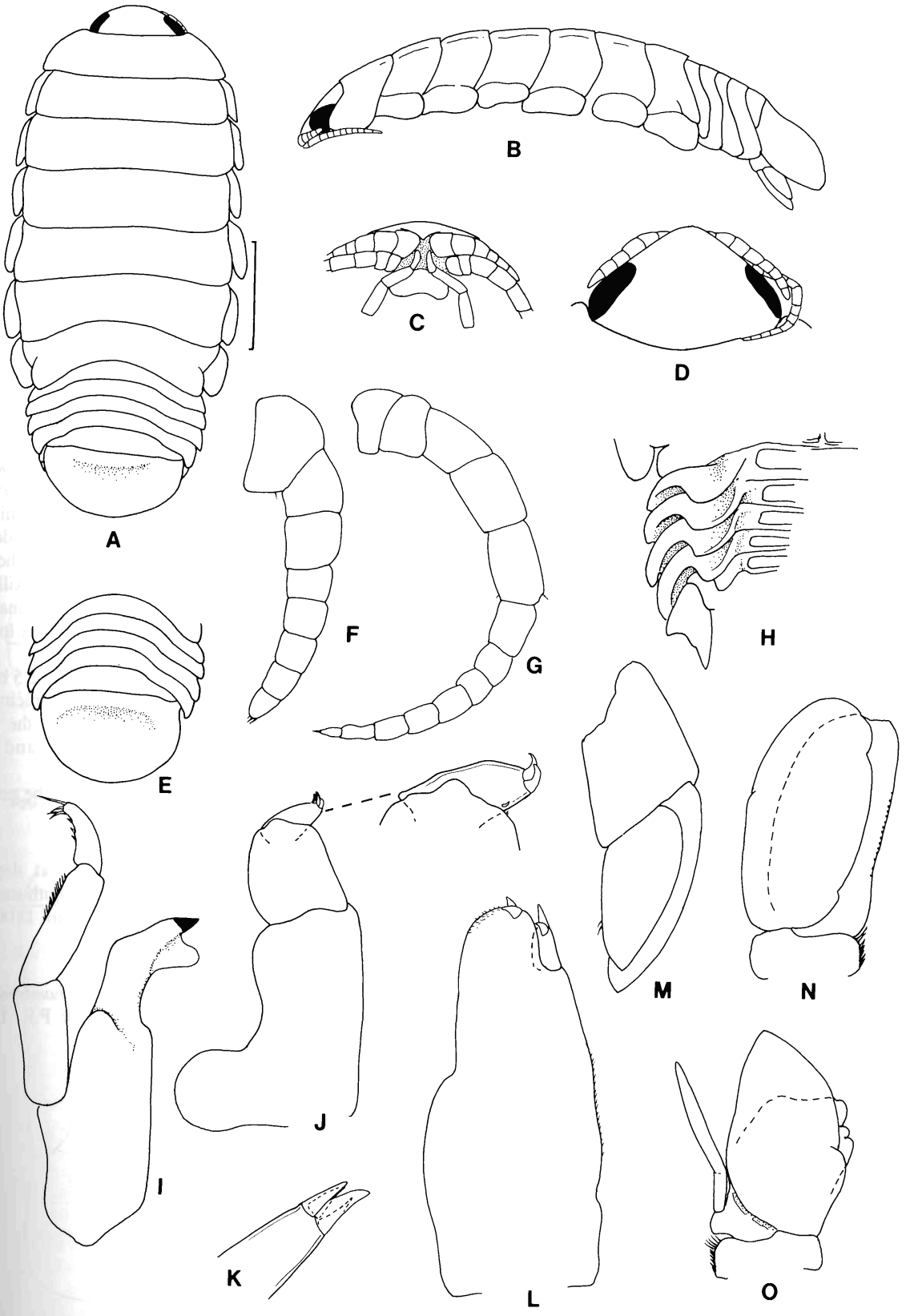

Fig.6. *Elthusa neocytta*. All figures of female 28.0 mm, Maria Island, Tasmania. A, dorsal view; B, lateral view; C, frons; D, cephalon; E, pleon and pleotelson, perpendicular view; F, antennule; G, antenna; H, right pleonites, ventral view; I, mandible; J, maxilliped; K, maxillule apex; L, maxilla; M, uropod; N, pleopod 1; O, pleopod 2 (damaged). Scale line represents 6.0 mm.

Elthusa neocytta (Avdeev)

Figs 6, 7

Lironeca neocyttus Avdeev, 1975a: 247, figs 1, 2.
Livoneca neocyttus.–Stephenson, 1987: 135, 136, figs 1-10.

Material examined. All off Tasmania. Female (non-ovigerous 42.0), off Maria Island, 18 May 1983, in mouth of *Zenopsis nebulosus*, 443-456 m, coll. D. Coleman – CSIRO (AM P37769). Female (non-ovigerous 28.0), off Maria Island, 42°40.3'S 148°25.2'E, 1984, on gill of *Neocyttus rhomboidalis*, 494-504 m, coll. CSIRO – *Soela* (AM P37770). Female (non-ovigerous 26.0), off Strahan, January 1979, gill of *Neocyttus rhomboidalis*, about 600 m, coll. P.R. Last on *Zeehan* (AM P37772). Male/female (17.0), off Strahan, Jan. 1979, gill cavity of *Cyttus transversa*, coll. P.R. Last on *Zeehan* (AM P37771).

Additional material. 8 females (ovigerous 38.0, 41.0, 46.0, 53.0, 58.0, non-ovigerous 33.0, 55.0, 58.0), 13 males (17.0-29.0), north-east of East Sister Island, 39°16'S 148°44.0'E, 13 Oct. 1984, gills of *Neocyttus rhomboidalis*, 660 m, coll. W. Zeidler on *Soela* (SAM C4196).

Type material. Vladivostok, USSR (Avdeev, 1975a).

Type locality. New Zealand (Avdeev, 1975a).

Description. Body about 2.3 times as long as wide, lateral margins subparallel; dorsum moderately convex, with weak longitudinal median depression. Cephalon narrowing evenly to rostral point, triangular in dorsal view. Eyes 0.28 width of cephalon, elongate about 0.48 length of lateral margin. Pereonite 1=2<3<4>5>6>7; widest at pereonite 5.

Coxal plates all as long as respective segment, all conspicuous in dorsal view. Pleonites all visible; widest at pleonite 2 or 3, about 0.7 width of pereonite 5; pleonite 5 with lateral margins overlapped by pleonite 4. Pleotelson semicircular.

Antennule short, not reaching posterior of eye, with 8 articles. Antenna 1.6 as long as antennule, composed of 13 articles.

Pereopods without carina, bosses or dilated articles; pereopod 7 manifestly longer than 1.

Pleopods with all rami lamellar; lateral margins of peduncles 1-4 with coupling hooks. Pleopods 3-5 with endopod proximomedial lobe weakly developed. Uropods not extending beyond posterior of pleotelson, rami flat, endopod with blade-like margins, exopod slightly longer and narrower than endopod.

Colour. Pale cream, one specimen brown in alcohol. Eyes brown.

Size. Present material up to 58.0 mm. Avdeev (1975a) recorded the species up to 48.0 mm.

Remarks. The description is somewhat abbreviated here as there were no ovigerous females present at the time the description was made. All specimens had distorted pleopods.

Although differing in general appearance, *E. neocytta* shares several characters in common with *E. sacciger*. These are: pleonite 5 laterally overlapped by pleonite 4; pleopods all lamellar, with weakly developed endopod proximomedial lobe and with peduncular coupling hooks; pereopod 7 manifestly longer than 1; female maxilliped with 2 laminar lobes [Avdeev, 1975a, fig. 1(7)]; maxilla apically narrowed; mandible palp setose; antenna longer than antennule; and antennule bases close set.

Elthusa neocytta is easily identified by pleonite 5 being laterally overlapped by pleonite 4 and by the semicircular pleotelson. It is separated from *E. sacciger* by the very different body shapes, the wider pleon and the semicircular pleotelson.

The epithet has been emended to agree with the gender of the genus.

Distribution. Known from Tasmania at depths between 443 m and 660 m; common off south-eastern New Zealand at depths between 500 and 1100 m (Stephenson, 1987).

Hosts. In *Zenopsis nebulosus*, *Neocyttus rhomboidalis* and *Cyttus transversa* (all identified by Dr P.R. Last, CSIRO, Hobart).

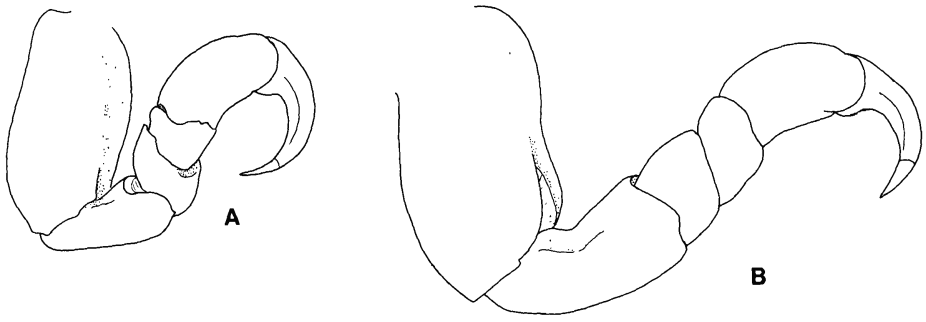

Fig.7. *Elthusa neocytta*. Female, 28.0 mm, Maria Island. A, pereopod 1; B, pereopod 7.

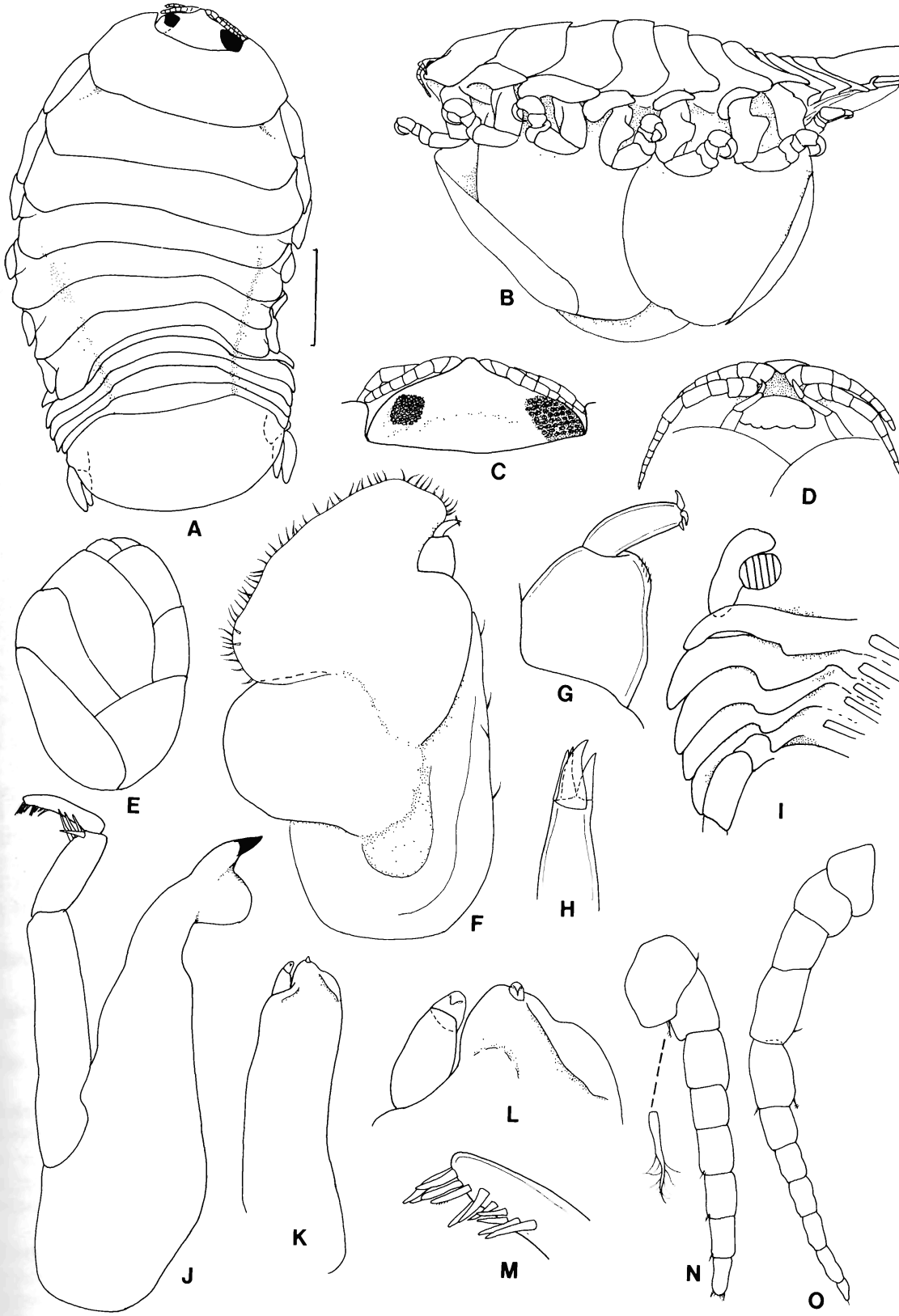

Fig.8. *Elthusa propinqua*. All figures female off Moreton Island (QM W11737). A, dorsal view; B, lateral view; C, cephalon; D, frons; E, brood pouch; F, maxilliped; G, maxilliped articles 2, 3; H, maxillule apex; I, right pleonites, ventral view; J, mandible; K, maxilla; L, maxilla apex; M, mandible palp article 3, apex; N, antennule; O, antenna. Scale line represents 3.0 mm.

Elthusa propinqua (Richardson)

Figs 8, 9

Lironeca propinqua Richardson, 1904: 37, figs 6,7.–Richardson, 1909: 87; 1910: 23.–Thielemann, 1910: 42.–Nierstrasz, 1931: 143.–Barnard, 1936: 170.

Material examined. SYNTYPES, 3 females (ovigerous 22.5 [dissected, pereopods missing], 21.0, 13.5), Port Heda, Japan, Albatross Station 3738 (USNM 29086). Female (ovig 15.5), off Moreton Island, Qld, 27°56'S 154°00'E, 22 Mar. 1983, no host recorded, trawled 565 m, coll. R. Morton on *Iron Summer* (QM W11737).

Additional material. 3 females (ovigerous 15.0, non-ovigerous 10.5, 23.0), south-eastern Queensland, 23°23'S 153°22'E, Apr. 1988, on gills of *Ventrifossa* cf. *nigrodorsalis* (QM I25381), 500 m, coll. *Karumba Pearl* (QM W15431).

Type locality. Port Heda, Japan.

Description. Body 1.8-2.0 times as long as wide; dorsum with broad longitudinal ridge. Cephalon deeply immersed into pereonite 1, twice as wide as long, anterior margin with distinct median point; eyes occupying about 0.44 width of cephalon, facets distinct. Pereonite 3 widest, pereonites 4-7 becoming progressively narrower; all

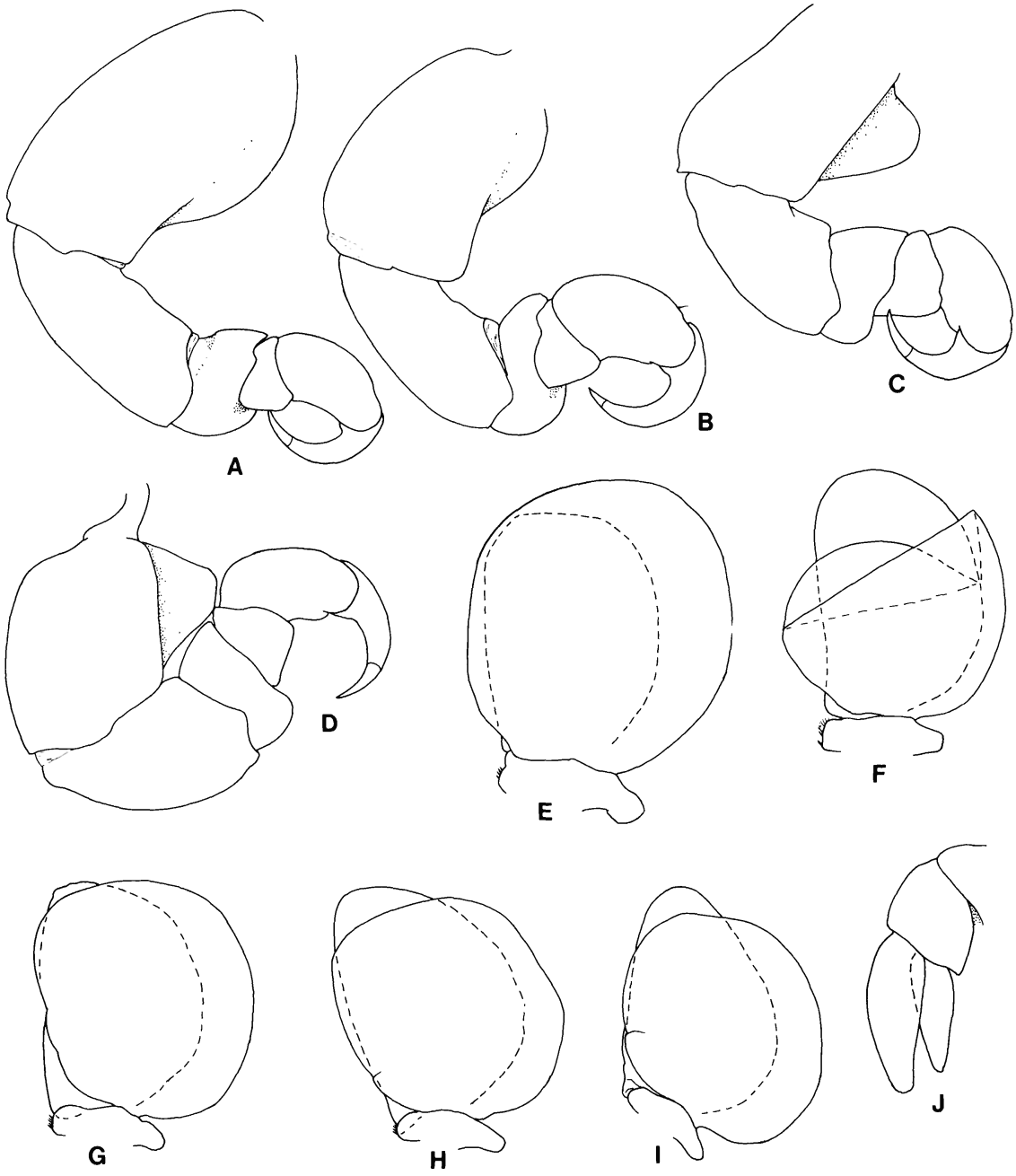

Fig.9. *Elthusa propinqua*. All figures of female, Moreton Island. A-D, pereopods 1, 2, 6, 7 respectively; E-I, pleopods 1-5 respectively; J, uropod.

coxae shorter than respective segment. Pleon 0.86 as wide as pereonite 3; pleonites all about equal in length, lateral extremities narrowed and bent posteriorly; pleonite 1 laterally overlapped by posterolateral angles of pereonite 7. Pleotelson 0.46 as long as wide, posterior margin smoothly curved.

Antennule bases close set, but not contiguous; composed of 8 articles, not extending beyond posterior of cephalon. Antenna bases set more widely apart; composed of 11 articles, extends to pereonite 2.

Mandible incisor acute, molar prominent; palp article 1 about 3 times as long as article 2; palp article 2 with 4 distolateral setae, palp article 3 with 12 stout distolateral spines. Maxillule with 4 terminal spines, one of which is slender. Maxilla with single spine each on medial and lateral lobes. Maxilliped article 3 with 3 weakly recurved spines.

Pereopod 1 longest, pereopods 2-7 progressively decreasing in length. Pereopod 1 basis with smoothly curved anterolateral carina; ischium about 0.7 as long as basis; dactylus curving smoothly. Pereopods 2 and 3 similar to 1, but basis with weak carina. Pereopods 4-7 basis anteromedial margin with proximal carina, increasing in size towards posterior. Pereopod 7 ischium 0.82 as long as basis.

Brood pouch made up of alternately overlapping oostegites arises from coxae 1-4 and 6; oostegites of coxae 1 overlapping mouthparts.

Pleopods all lamellar, all exopods approximately circular, and larger than endopods. Endopod of pleopod 1 subrectangular; endopods of pleopods 2-5 with distal apex becoming increasingly acute; endopods of pleopods 3-5 with proximomedial lobe weakly developed. Peduncles without lobes, medial margin of peduncles 1-4 with coupling hooks. Uropods short, not reaching posterior of pleotelson; peduncle 1.2 times as wide as long; exopod curving medially, lateral margin convex, apex bluntly rounded, endopod lateral margin straight, apex bluntly rounded.

Male. Not known.

Colour. Pale tan in alcohol; eyes orange.

Size. Present material 13.5-22.5 mm.

Remarks. *Elthusa propinqua* has been taken only from moderately deep water, and can be identified by the short cephalon (with moderately large eyes) with an acute rostral point, wide pleon, short uropods, close set antennules and the distinctive basis on pereopods 4 to 7.

Hosts. Recorded from "chalinura" (Richardson, 1909) in Japan, "a macrurid" (Richardson, 1910) in the Philippines, and from the gills of *Macrurus* in India (Barnard, 1936). The present material is from *Ventrifossa* cf. *nigrodorsalis* (identified by Mr J. Johnson, QM), family Macrouridae.

Distribution. Several localities in Japan, (Richardson, 1904, 1909) and the Philippines (Richardson, 1909), now from eastern Australia. Recorded at depths between 340 m to 835 m, the maximum depth being recorded by Barnard (1936).

Elthusa raynaudii (Milne-Edwards)

Figs 10–12

Livoneca Raynaudii Milne-Edwards, 1840: 262.–Krauss, 1843: 66.–Schiödte & Meinert, 1884: 367, pl.12, figs 9-13.–Thielemann, 1910: 42.

Cymothoa Novae-Zealandia White, 1847: 110, *nomen nudum*.

Lironeca novae-zealandia Miers, 1874: 228.–Miers, 1876: 106, pl.III, fig.2.–Miers, 1881: 64, 67.

Lironeca laticauda Miers, 1877: 677, pl.69, fig.5.–Ellis, 1981: 124.

Livoneca Raynaudi.–Gerstaecker, 1882: 259.

Livoneca Novae Zelandiae.–Gerstaecker, 1882: 263.

Lironeca Stewarti Filhol, 1885: 450, pl.4, fig.6.

Lironeca neo-zelanica.–Thomson & Chilton, 1886: 154.

Livoneca raynaudii.–Whitelegge, 1902: 236.–Stebbing, 1910: 125.–Chilton, 1909: 606.–Chilton, 1911: 309.–Chilton, 1912: 135.–Young, 1926: 283.–Hale, 1926: 215, fig.10.–Hale, 1929: 261, figs 253, 259. –Hale, 1940: 303.–Barnard, 1940: 491.–Hurley, 1961: 268.–Hewitt & Hine, 1972: 108.–Sivertsen & Holthuis, 1980: 34.–Beumer, *et al.*, 1982: 33.

Livoneca epimerias Richardson, 1909: 88, fig.13.–Kussakin, 1979: 301, figs 69, 170.

Livoneca raynaudi.–Nierstrasz, 1915: 97.–Nierstrasz, 1931: 145.–Barnard, 1920: 358.–Pillai, 1954: 16.

Livoneca laticauda.–Nierstrasz, 1931: 143.

Lironeca raynaudii.–Brian & Dartevelle, 1949: 176.–Avdeev, 1975: 250.–Avdeev, 1978: 281.–Trilles, 1976a: 778, pl.1, fig. 4; Poore, 1981: 341.

Lironeca raynaudi.–Menzies, 1962: 115, fig.36A-B.–Kensley, 1978: 80, fig.33B.–Moreira & Sadowsky, 1979: 111.

Lironeca magna Mañé-Garzón, 1979: 18, figs 1-5.

Material examined. Female (ovigerous 31.5), off Capricorn Group, south-eastern Queensland, 22°56.7'S 152°12.3'E, 3 Oct. 1980, 342-360 m, on gills of *Physiculus* sp. (QM I18534), coll. QFS on *Graigmin* (QM W10250). Female (ovigerous 67.0 mm), north-east of Wollongong, NSW, 34°21-14'S 151°24-28'E, 3 Aug. 1975, 402 m, on fish, coll. FRV *Kapala* (AM P21037). Female (non-ovigerous 48.0), south-east of Gabo Island, Vic., 10 Nov. 1975, on *Zenopsis nebulosus*, coll. NSW SF on FRV *Kapala* (AM P20821). Tasmania, all coll. CSIRO: Female (non-ovigerous 31.5), male (14.0), Eaglehawk Neck, 6 Aug. 1978, on gill of *Pseudolabrus tetricus*, 5 m depth, coll. P.R. Last (AM P37777). Female (non-ovigerous 47.0), male (14.0), Murdunna, 17 Oct. 1976, on gill of *Meuschenia freycineti*, coll. D. Coleman (AM P37778). Female (non-ovigerous 20.0), Murdunna, 17 Oct. 1976, gill cavity of *Pseudophycis bachus*, coll. D. Coleman (AM P37779). Female (non-ovigerous 30.0), off Strahan, Jan. 1979, on gill of *Cyttus transversa*, about 600 m depth, coll. P.R. Last (AM P37776). Female (non-ovigerous 29.0), Long Reef, Dunally, 14 July 1980,

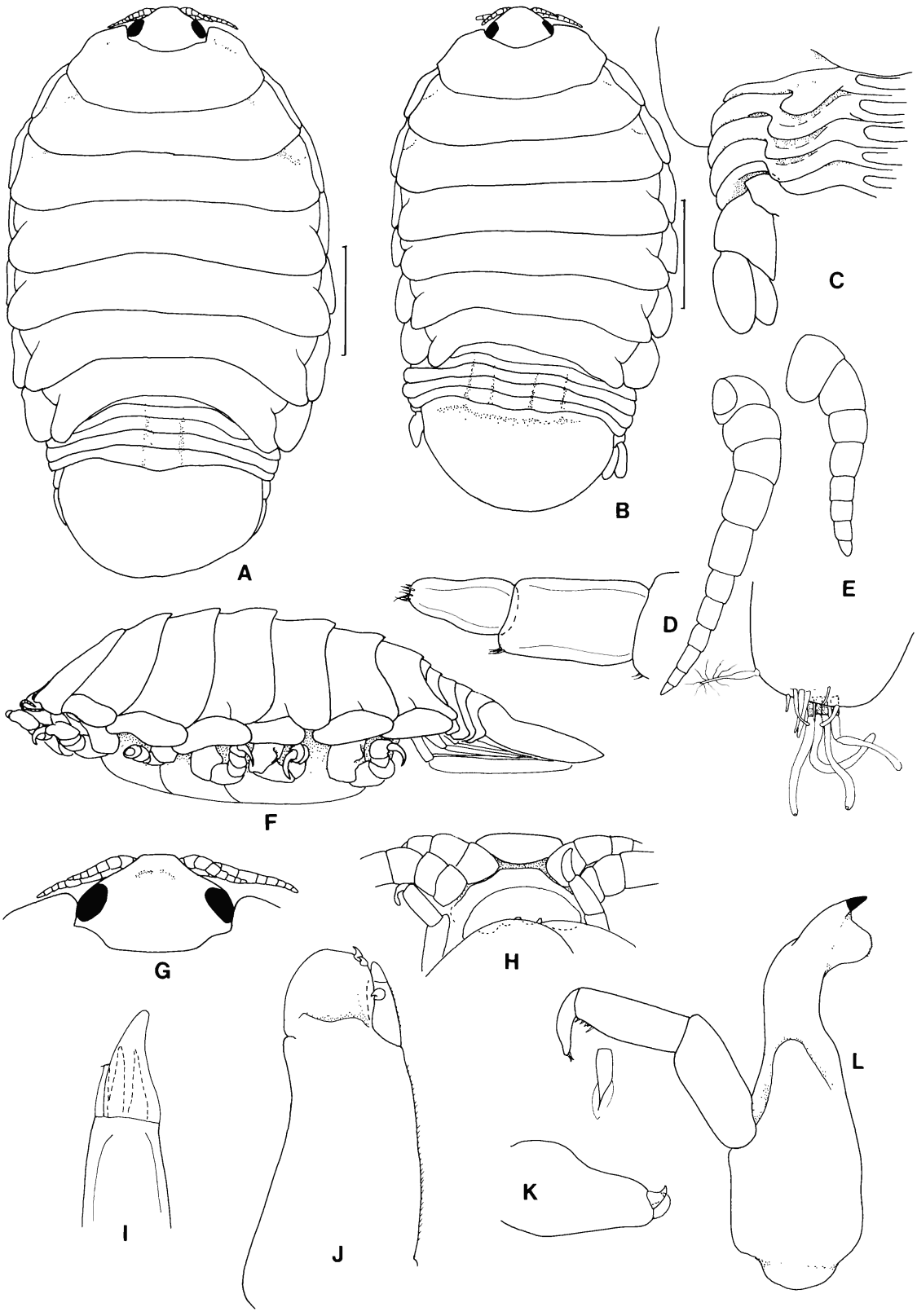

Fig.10. *Elthusa raynaudii*. All figures of Tarrana female, 31.0 mm (AM P37780) except B. A, dorsal view; B, AM G2181, off Coogee, NSW; C, right pleonites, ventral view; D, antenna and terminal article detail; E, antennule and detail; F, lateral view; G, cephalon; H, frons; I, maxillule apex; J, maxilla; K, maxilliped article 3; L, mandible. Scale lines represent 6.0 mm.

on gill of *Gnathanacanthus goetzei*, coll. P. Young, (AM P37775). Female (ovigerous 31.0), Flinder's Reef, Tarrana, Dec. 1981, on gill cover of *Pseudophycis bachus*, depth 10 m, coll. M. Hortle (AM P37780).

Female (ovigerous 47.0), Skua Point, Snares Islands, New Zealand, 1 Mar. 1972, mouth of *Pseudolabrus miles* (AM P30752).

Additional material. Material collected by F.I.S. *Endeavour*. Female, immature, Shoalhaven Bight, NSW, 16 Mar. 1909, 28-82 m (AM E288, E6598). Female, off Gabo Island, Vic., 12 Nov. 1913, about 366 m (AM E4762). Male, off Gabo Island, about 366 m (AM E4836). 2 females, Gabo Island to Everard, 37-366 m (AM E6319). Female, south-south-west of McCann, Vic., 128-183 m (AM E6318). 2 females, south-south-west of McCann, Vic., 27 Aug. 1914, 128 m (AM E5433). 2 females, eastern slope, Bass Strait (AM E6750). Female, off Tasmania (E6746). 2 females, east of Flinders Island, SA, (AM E6737). Male, south-east of Flinders Island, SA, 30 Aug. 1909, 68 m (AM E6743). Female, 80 km south of Cape Wiles, SA, 137 m (AM E4864). 4 females, 3 males, off

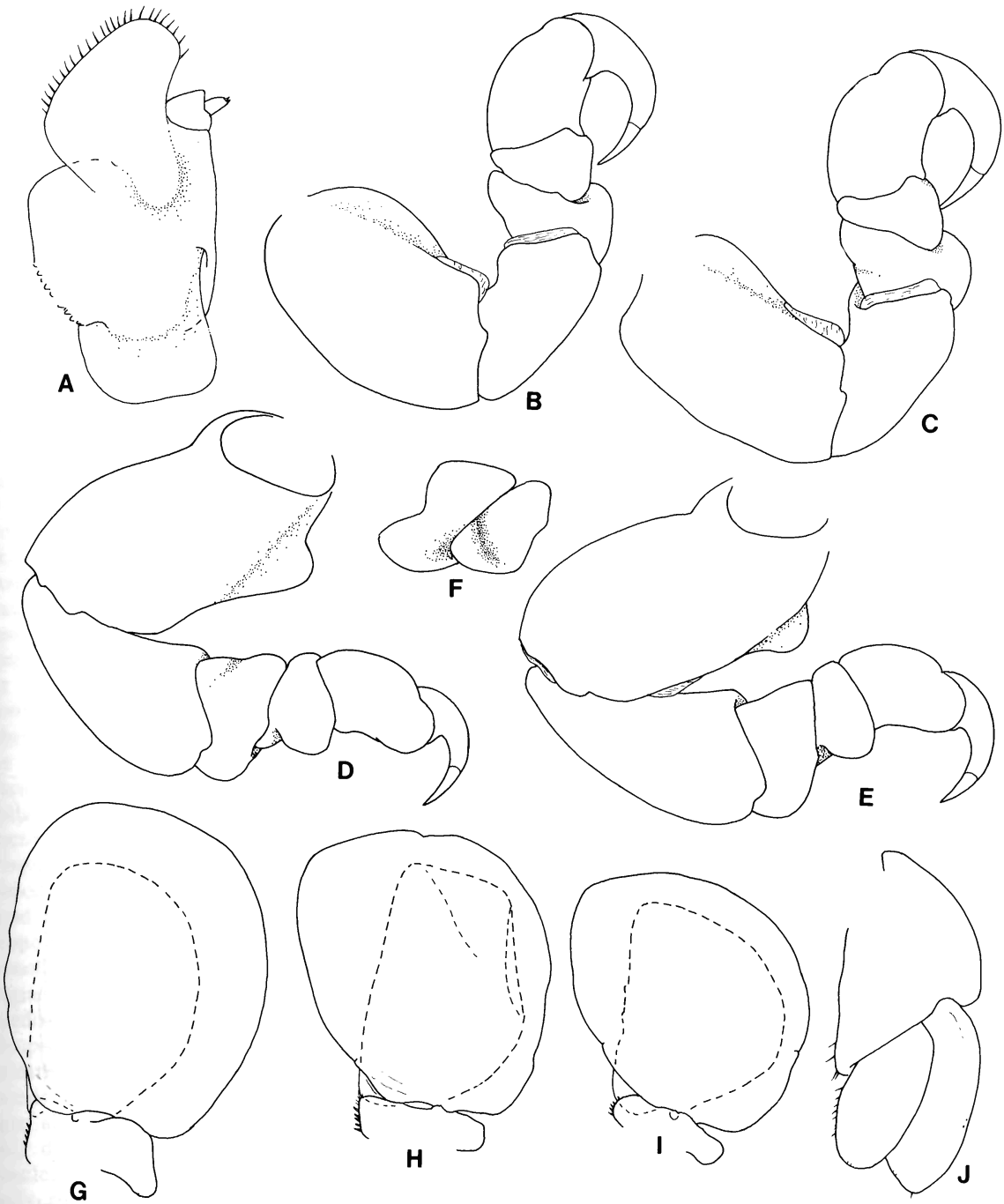

Fig.11. *Elthusa raynaudii*. All figures of Tarrana female. A, maxilliped; B–E, pereopods 1, 2, 6, 7 respectively; F, ventral view of merus and carpus, pereopod 7; G–I, pleopods 1, 2, 4 respectively; J, uropod.

west coast of Tasmania, 140 m, on banded perch (AM E5354). 5 females, 3 males, 2 immature, north-east of East Sister Island, 39°04'S 148°39'E, 13 Oct. 1984, gills of *Cyttus traversi*, 432 m coll. W. Zeidler or *Soela* (SAM C4197). 3 females, 8 males, north-east of East Sister Island, 39°21'S 148°46'E, 12 Oct. 1984, gills of *Cyttus traversi*, 476 m, coll. W. Zeidler, or *Soela* (SAM C4198). Female, off Tasman Head, Bruni Island, 21 Mar. 1914, 128-182 m (AM E6597). 3 females, entrance to Oyster Bay, Tasmania, 30 July 1909 (AM E5684). Female, off Iron Port, Storm Bay, Tasmania, 16 Mar. 1909, off operculum of *Zeus australis* (AM E4854).

HMCS *Thetis* series: 6 females, male, listed as from stations 2, 38 and 42, 9 km east of Cape Three Points, NSW, 33°34'S 151°20'E, 19 Feb. 1898, 65 (also 34°07'S 151°12'E, 12 Mar. 1898, 91 m, and 34°12'S 151°13'E, 13 Mar. 1898, 133 m) (AM P3328). Female, 9 km east of Coogee, NSW, 33°57'S 151°21.5'E, 15 Mar. 1898, 89 m, Stn 44 (AM G2181).

New South Wales: female, Terrigal 33°27'S 151°27'E (AM P4903). Female, Port Jackson, old collection (AM P5821). 2 females, off Botany Bay, 33°59'S 151°12'E, Aug. 1921, 60-102 m, coll. McNeill and Livingstone on *Goonambee* (AM P5426). 2 females, off Botany, Mar. 1927, 73 m, coll. A. Ward on *Bar-ea-mul* (AM P8820). 3 females, off Botany, Oct. 1926, 61 m, coll. A. Ward on *Gunner* (AM P8751). Immature female, off Watamooli, 34°00'S 151°10'E, Oct. 1924, on deck of trawler *Thistle*, coll. C.W. Mulrey (AM P9605). Immature female, male, off coast between Merimbula and Tathra, Mar. 1927, from flathead, coll. A. Ward on *Bar-ea-mul* (AM P8812). Female, male, 13 km south of Green Cape, 20 July 1925,

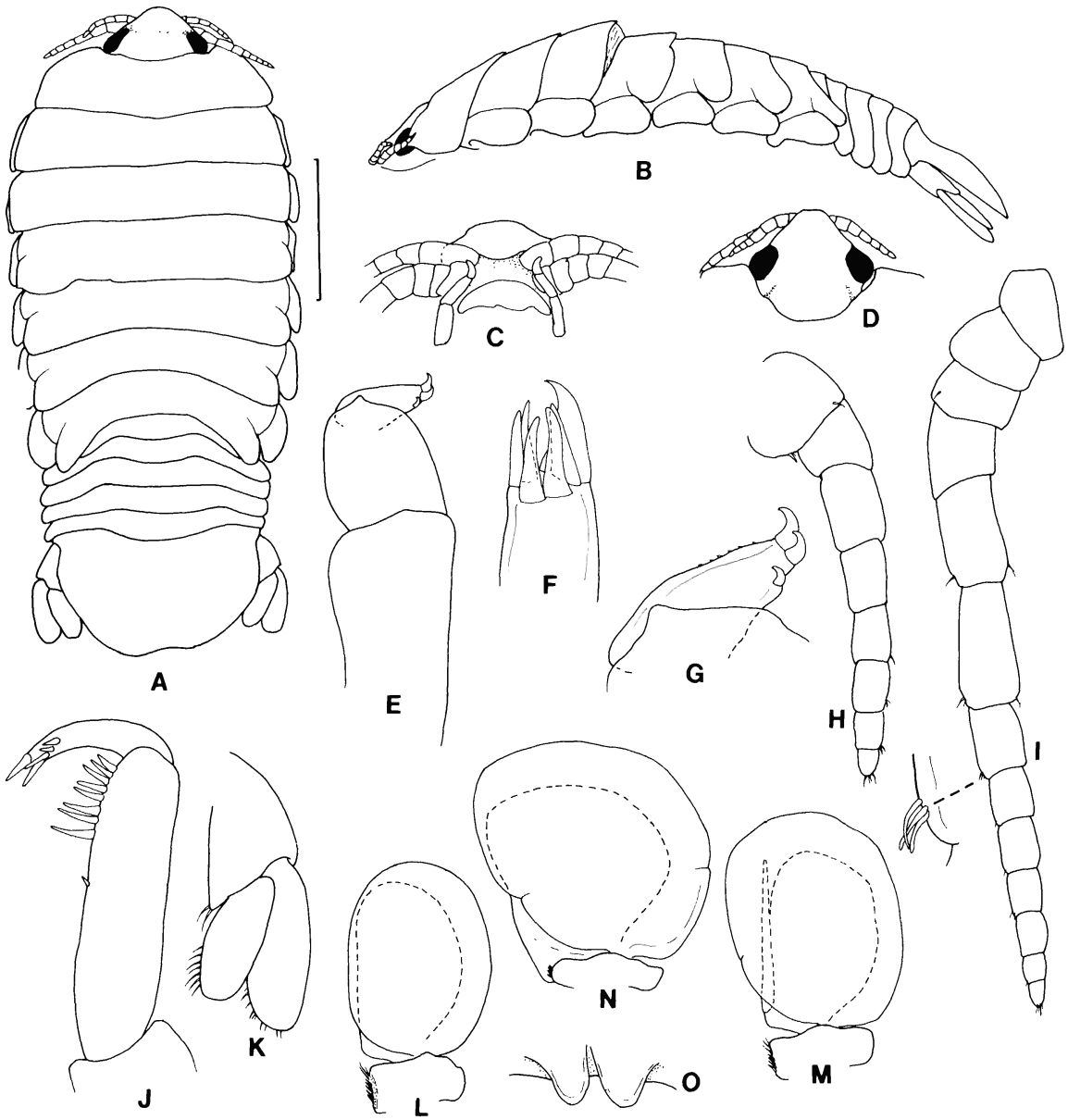

Fig.12. *Elthusa raynaudii*. All figures of male 14.0 mm Murdunna (AM P37778), except N. A, dorsal view; B, lateral view; C, frons; D, cephalon; E, maxilliped; F, maxillule apex; G, maxilliped article 3; H, antennule; I, antenna; J, mandible palp articles 2, 3; K, uropod; L, pleopod 7; M, pleopod 2; N, pleopod 5, – Tarrana; O, penes. Scale line represents 3.0 mm.

54 m, coll. N. Boardman on *Bar-ea-mul* (AM P8231, P8236). 3 females, 29 km south of Montague Island, Mar. 1927, from John Dory, 91 and 109 m, coll. A. Ward on *Bar-ea-mul* (AM P8813, P8815). 2 females, off Eden, Apr. 1927, from flathead, 73 m, coll. A. Ward on *Bar-ea-mul* (AM P8825, P8827). 2 females, male, between Port Stephens and Jervis Bay, July 1980, on *Rexea solandri*, 282-457 m, on *Kapala* (AM P37282).

Also examined. Holotype of *Livoneca epimerias* Richardson (USNM 39504), syntypes of *Livoneca laticauda* Miers (BMNH 1862: 96).

Type material. I have not examined the type specimens of this species. Trilles (1976a) provided a photograph of *Elthusa raynaudii* but did not specify which of the specimens it was that he was illustrating. The types are held at the Muséum National d'Histoire Naturelle, Paris. Examination of the holotype of *Livoneca epimerias* Richardson (USNM 39504) failed to reveal any differences from material currently being identified as *E. raynaudii*.

Type locality. Cape Bonne-Espérance (collected by M. Raynaud), Cape of Good Hope, South Africa.

Description of female. Body ovate, symmetrical or weakly twisted, about 1.75 times as long as wide; widest at pereonite 5. Cephalon moderately immersed in pereonite 1, anterior margin produced, turned down; eyes 0.33 width of cephalon. Pereonites 1 and 5 longest; pereonite 1>2<3<4<5>6>7. Posterior margin of pereonite 7 evenly indented. Pleonite 1 largely concealed by pereonite 7; pleonite 1 slightly narrower than 2; pleonites 2-5 subequal in width. Pleotelson short, semicircular or flattened semiarc in shape.

Antennule shorter than antenna, bases set wide apart; composed of 8 articles. Antenna extending to pereonite 1, composed of 11 articles.

Mandible with prominent molar; palp with 5 and 2 setae on distolateral margin of articles 2 and 3 respectively. Maxillule with 1 broad and 3 narrow spines. Maxilla with 2 spines each on medial and lateral lobes respectively. Maxilliped article 3 with 2 terminal spines.

Pereopods increasing in length posteriorly. Basis of pereopods 1-3 with weak carina; dactylus not extending beyond carpus; carpus with posterior margin cleft. Pereopod 5-7 basis with carina most pronounced proximally. Brood pouch made of alternately overlapping oostegites arising from coxae 1-4 and 6. Sternite 7 with 2 submedian fleshy lobes on posterior margin.

Pleopods 1-5 becoming progressively smaller. Exopod manifestly larger than endopod on all pleopods. All pleopods with coupling hooks on peduncle medial margin; all rami lamellar; endopod proximomedial lobe weakly developed. Uropod exopod about as long as peduncle, slightly longer than endopod; both rami broadly rounded, not reaching posterior margin of pleotelson.

Male. Body lateral margin subparallel, about 2.2 times as long as wide. Pleon proportionally longer than in female.

Appendages similar to those of female but antenna proportionally longer and composed of 13 articles; mandible palp with more setae; maxillule with 1 broad and 5 slender spines; maxilliped article 3 with recurved spines; pereopods 5-7 proportionally longer and more slender than in female; pereopod 2 with spines at posterodistal angle of basis 1 ischium, merus, carpus and propodus; pleopod 2 with appendix masculina as long as endopod, arising sub-basally.

Colour. Pale brown or tan in alcohol, chromatophores not apparent.

Size. Ovigerous females 22.0-67.0 mm, mean 30.83 mm (n = 31); length/width 1.35-2.0 mm, mean 1.67 (n = 25). Non-ovigerous females 22.0-49.0 mm, mean 29.25 (n = 20); length/width 1.45-2.2 mm, mean 1.79 (n = 16). Males 14.0- 21.0 mm, mean 16.79 (n = 12); length/width 1.60-2.25 mm, mean 2.03 (n = 4).

Variation. The relative width of the pleon varies and a wider pleon is shown in Figure 16B (AM G2181). Very large specimens (48.0 mm, AM P20821 and 67.0 mm, AM P21037) have proportionally longer pleotelsons. Most specimens are symmetrical, occasionally an animal may be slightly twisted to the left or right.

Remarks. This species, described by Milne-Edwards (1840) from the Cape of Good Hope has been widely recorded in the southern oceans. From figures given, descriptive accounts and recorded host identities it seems probable that most records are accurate. The records of Pillai (1954) on clupeid hosts and Powell (1959, quoted in Stephenson 1969) on a hemiramphid should be regarded as doubtful.

Elthusa raynaudii is characterised by the wide anterior margin to the cephalon, large size, ovate body shape, short pleon and pleotelson, short uropods and the basis of pereopods 5-7 with the proximal part of the carina forming a boss.

Two other large species, *E. neocyttus* and *E. sacciger*, are easily distinguished by having the lateral margins of pleonite 5 completely encompassed by pleonite 4. In addition, *E. sacciger* has a prominently ovoid body with a very narrow pleon.

Livoneca rafineskii Leach, 1818, suggested by Trilles (1976) as the possible senior name for this species is a junior synonym of *Livoneca redmanii* Leach (see *L. redmanii*). *Livoneca laticauda* Miers, proved, on examination of the types, to be indistinguishable from *E. raynaudii*, as was so for *Livoneca epimerias* Richardson. The figures given by Mañé-Garzón (1979) for *Lironeca magna* also force the conclusion that it is a junior synonym of *E. raynaudii*.

Livoneca ochotensis Kussakin, 1979, is very similar to *E. raynaudii*, but Kussakin's figures show some slight differences. Without detailed redescription it is not possible to evaluate its status. Kussakin (1979) also

transfered Gurjanova's (1936) record of *E. raynaudii* to *L. ochotensis*. The occurrence of *E. raynaudii* in Japan (Richardson, 1909) suggests the status of *E. ochotensis* needs to be critically re-evaluated.

Hosts. Australian records: *Physiculus* sp., *Physiculus barbatus*, *Pseudophycis bachus* (F. Moridae); *Pseudolabrus tetricus* (F. Labridae); *Meuschenia freycineti* (F. Monocanthidae); *Gnathanacanthus goetzei* (F. Gnathanacanthidae); *Zenopsis nebulosus*, *Cyttus australia*, *Cyttus traversi* (F. Zeidae); *Rexea solandri*. Unidentified by scientific names: banded perch (F. Serranidae), flathead (F. Platycephalidae).

Other records have been summarised by Trilles (1976); see also Sivertsen & Holthuis (1980). New Zealand records have been summarised by Hewitt & Hine (1972), with additional records given by Poore (1981).

Pillai (1954) recorded *Pellona brachysoma* and *Stolopherus commersoni* and Powell (1959) recorded *Hemiramphus intermedius* as hosts (quoted by Stephenson, 1969), but these records require confirmation.

Distribution. The northernmost Australian record is from off the Capricorn Group, 22°S; common off the mid-New South Wales coast, Tasmania and Victoria; there are no records from South Australia and Western Australia. Also recorded (under several names) from New Zealand, South Africa, Uruguay, (Mañé-Garzón, 1979), southern Chile (Menzies, 1962), Tristan da Cuhna (Sivertsen & Holthuis, 1980).

Elthusa sacciger (Richardson)

Figs 13–15

Livoneca sacciger Richardson, 1909: 87, fig.12.–Gurjanova, 1936: 90,91, fig.45.–Shiino, 1951: 86, fig.2A.–Shiino, 1965: 544, figs 7, 27.
Livoneca saccigera.–Nierstrasz, 1931: 144 (lapsus).
Lironeca sacciger.–Kussakin, 1979: 300, fig.168.

Material examined. Female HOLOTYPE (ovigerous 33.0), off Mizimoko Light, Japan, 23 Aug. 1906, 786 m, Albatross Stn 4957, coll. U.S. Fish Commission Steamer *Albatross* (USNM 39503). 3 females (ovigerous 40.0, 39.0, 37.0), male (21.5), off Sydney, NSW, 33°43.0'S 152°1.5'E, 11 Oct. 1984, 995 m, coll. NSW State Fisheries *Kapala* (AM P37767). Female (35.0), 2 males (24.0, 17.0), off Sydney, NSW, 33 34.5'S 151 58'E, 21 Dec. 1976, 823 m, coll. NSW State Fisheries *Kapala* (AM P37768).

Type locality. Off Mizimoko Light, Japan.

Description of Australian female. Body 1.5-1.8 times as long as wide, bilaterally symmetrical, widest at pereonite 5; pereonite 1<2<3<4<5>6>7. Cephalon with rostral point; eyes about 0.2 width of cephalon. Coxae of pereonites 2-4 each shorter than respective segment; coxae of pereonites 5-7 project laterally, bulbous; posterior margin of pereonite 7 deeply indented. Pleon about 0.4-0.5 width of pereonite 5; pleonites 1 and 2 laterally overlapped by pereonite 7; lateral margin of pleonite 4 posteriorly directed, laterally overlapping pleonite 5. Pleotelson 0.7-0.8 times as long as wide, subtriangular to posteriorly rounded.

Antennule basal articles in contact; composed of 8 articles, extending to pereonite 1. Antenna bases set wide apart; composed of 12 articles, extending about halfway along pereonite 1; articles 4 and 5 distinctly longer than 1-3; articles 6-12 short, becoming progressively shorter.

Mandible palp articles 2 and 3 with abundant short setae on distolateral margin. Maxillule with 5 spines. Maxilla tapering distally, 2 spines each on medial and lateral lobes. Maxilliped with 2 laminar oostegital lobes; article 3 with 3 weakly curved spines.

Pereopods 1-3 manifestly shorter than 5-7; pereopods 5-7 with weak carina on basis. Pereopod 1 dactylus smoothly curved, extending to middle of carpus; dactylus of all pereopods with slender unguis.

Brood pouch made up of alternatively overlapping oostegites arising from sternites 1-5, anterior pair of oostegites overlapping mouthparts.

Pleopods all lamellar; pleopods 3-5 endopod proximomedial lobe weakly developed. Pleopod 2 with appendix masculina about 0.6 length of endopod. Peduncles 1-4 each with about 6 coupling hooks and with plumose setae. Uropod rami not extending beyond posterior of pleotelson; rami subequal in length, with subparallel margin and abruptly rounded to subtruncate apices.

Male. Body 2.5 times as long as wide, subparallel; pleon not immersed in pereonite 7. Eyes larger than female. Uropods extend beyond posterior of pleotelson. Antennule and antenna similar to female, but antenna extends to anterior of pereonite 2. Appendages similar to female but maxilliped article 3 with 4 hooked spines and mandible palp more setose.

Smallest male (swimming stage) with spinose pereopods, setose margins to the uropods and pleotelson, and with wide rounded uropodal rami.

Colour. Pale tan in alcohol.

Size. Females 33.0-40.0 mm; males 17.0-24.0 mm.

Remarks. This large species has numerous distinctive characters. Adult females are bilaterally symmetrical and distinctively ovoid in shape, the posterior coxae are bulbous, the pleon is short (about 0.12 as long as the body), pleonite 5 is overlapped by pleonite 4, pereopods 5 to 7 distinctly longer than 1 to 3 and pleopods 1 to 4 with large coupling hooks and plumose setae on the peduncle. There are no other similar species of *Elthusa*, and the bulbous coxae allows easy identification.

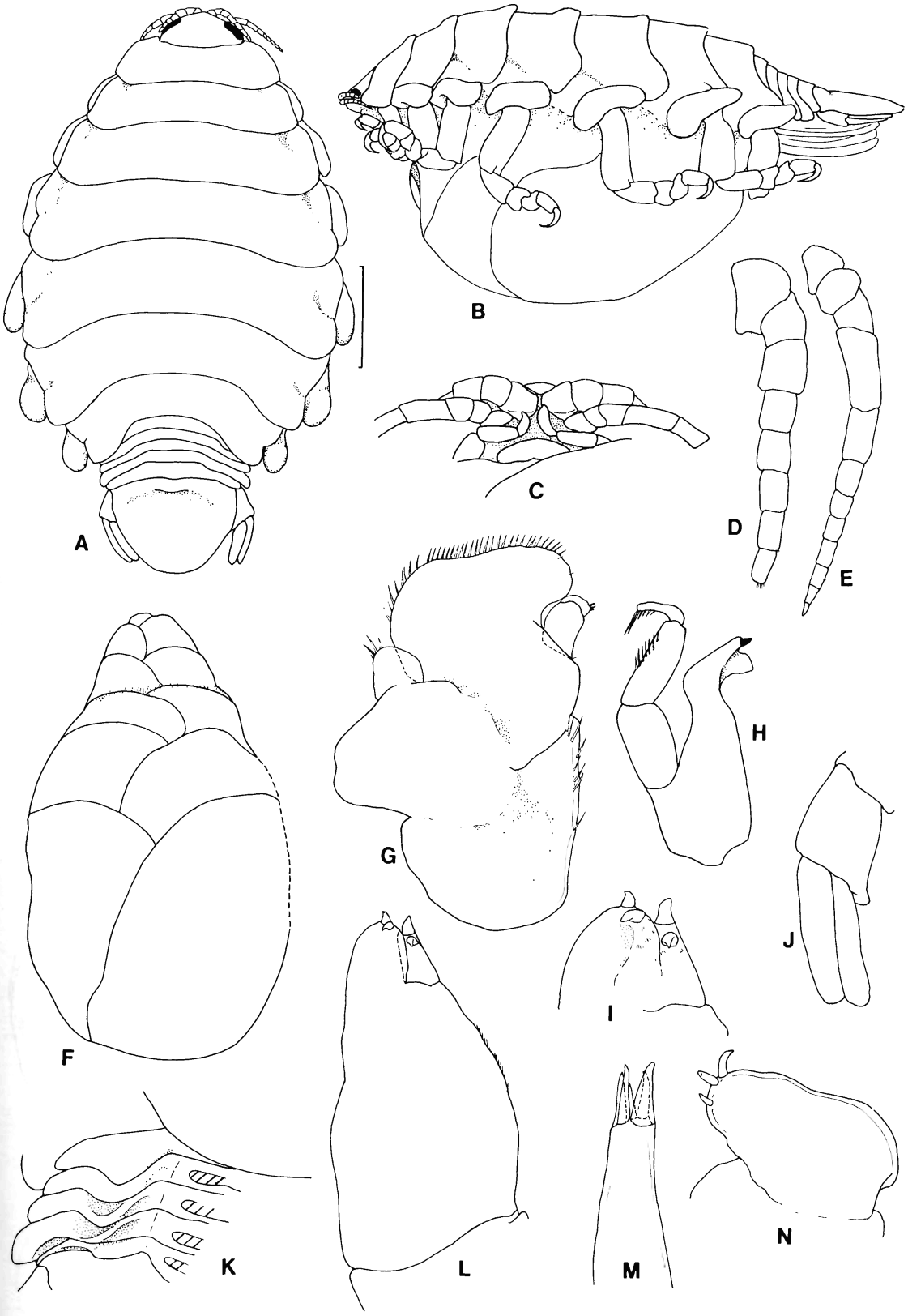

Fig.13. *Elthusa sacciger*. All figures of female, 39.0 mm except F. A, dorsal view; b, lateral view; C, frons; D, antennule; E, antenna; F, brood pouch, 37.0 mm; G, maxilliped; H, mandible; I, maxilla apex; J, uropod; K, right pleonites, ventral view; L, maxilla; M, maxillule apex; N, maxilliped article 3. Scale line represents 7.0 mm.

Hosts. Australian material lacked host data. Richardson (1909) recorded the species from "mouth of *Synaphobranchus*", and Shiino (1951) recorded the host *Synaphobranchus pinnatus*, Family Synaphobranchidae. These are 'cutthroat eels' which occur at depths between 200 and 3000 m.

Distribution. Previous records are all from Japan or north-western Pacific. Present material from off the central coast of New South Wales at the depths of 823 and 995 m.

Elthusa sigani n.sp.

Figs 16–18

Material examined. Female HOLOTYPE (ovigerous

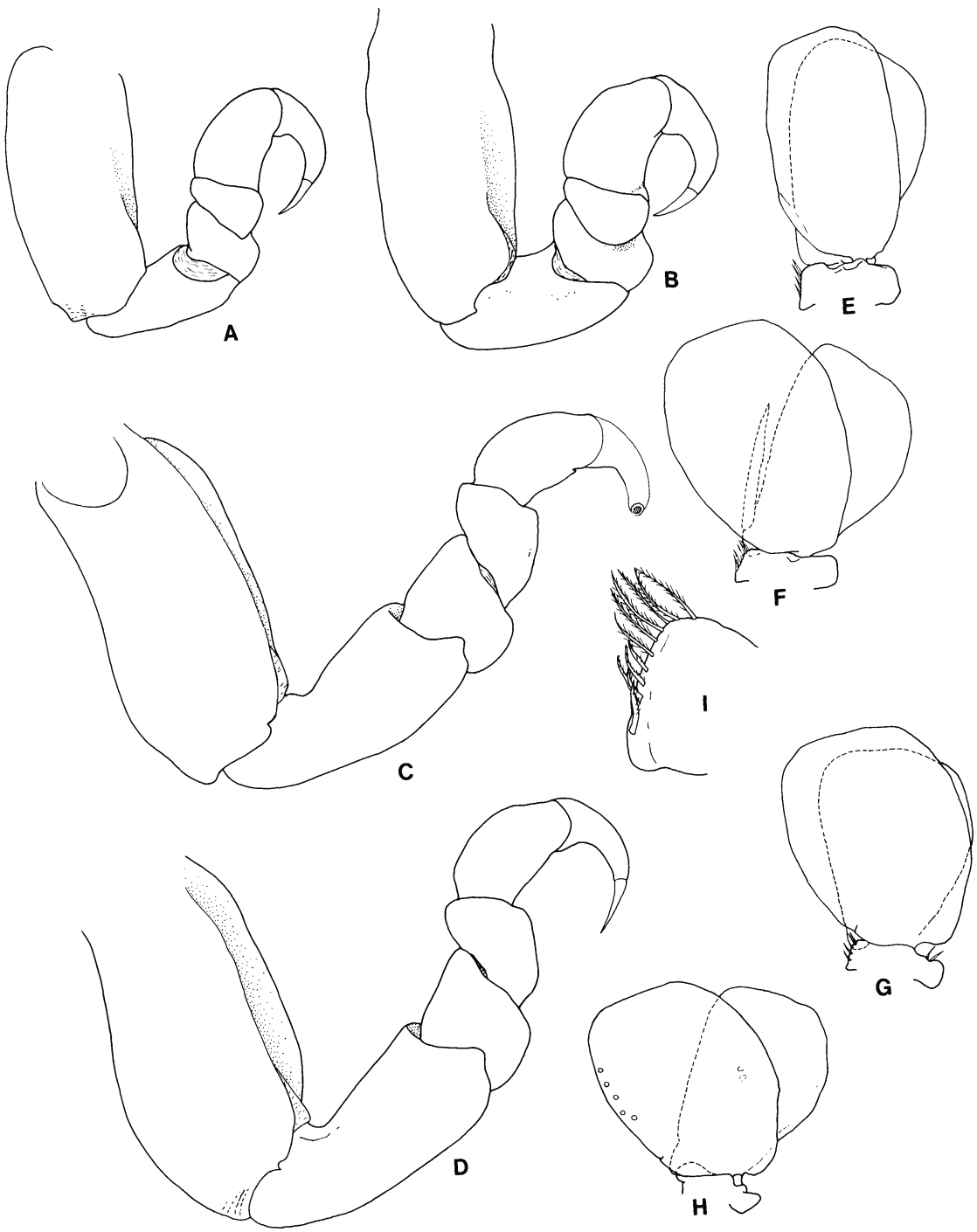

Fig.14. *Elthusa sacciger*. All figures of female 39.0 mm. A-D, pereopods 1, 2, 6, 7 respectively; E–H, pleopods 1-3, 5 respectively; I, medial margin of pleopod 2 peduncle.

13.0), North Stradbroke Island, Moreton Bay, south-eastern Qld, 17 May 1985, on *Siganus spinus*, coll. Kui-po Leung (QM W13080). PARATYPES, 2 females (ovigerous about 12.0, non-ovigerous about 12.0, both without heads and first pereopods), male (6.0), same data as holotype (QM W13081). 3 females (ovigerous 10.5 dissected, non-ovigerous 10.0, 9.5), 7 males (5.0, 5.5, 6.0, 6.5, 8.0), locality as for holotype, 18 May 1985 (QM W13082).

Type locality. North Stradbroke Island, Queensland, Australia, about 27°26'S 153°25'E. (North Stradbroke is a large island of about 30 km; as no data was available as to the locality of collection it has been arbitrarily fixed here as the west coast between Dunwich and Amity Point).

Description of female. Body about 1.8 times as long as wide, dorsum weakly vaulted; widest at pereonite 5, twisted to one side. Cephalon anterior margin narrowed in front of eyes, forming broad subtruncate rostrum. Pereonite 1>2<3<4<5<6>7; pereonite 1 indented to receive cephalon, with 2 small lateral lobes behind eyes. Coxae of pereonites 2-4 inconspicuous or not visible in dorsal view; coxae of pereonite 6 as long as segment, coxae of pereonite 7 longer than segment. Coxae and pereonite lateral margins form an even outline. Pleon about 0.75 width of pereon, all pleonites visible; lateral margins of pleonite 1 concealed by pereonite 7; posterior pleonites very slightly narrower than anterior. Pleotelson narrowing from anterolateral margin, posterior margin broadly rounded.

Antennule extending to posterior of eyes; antenna

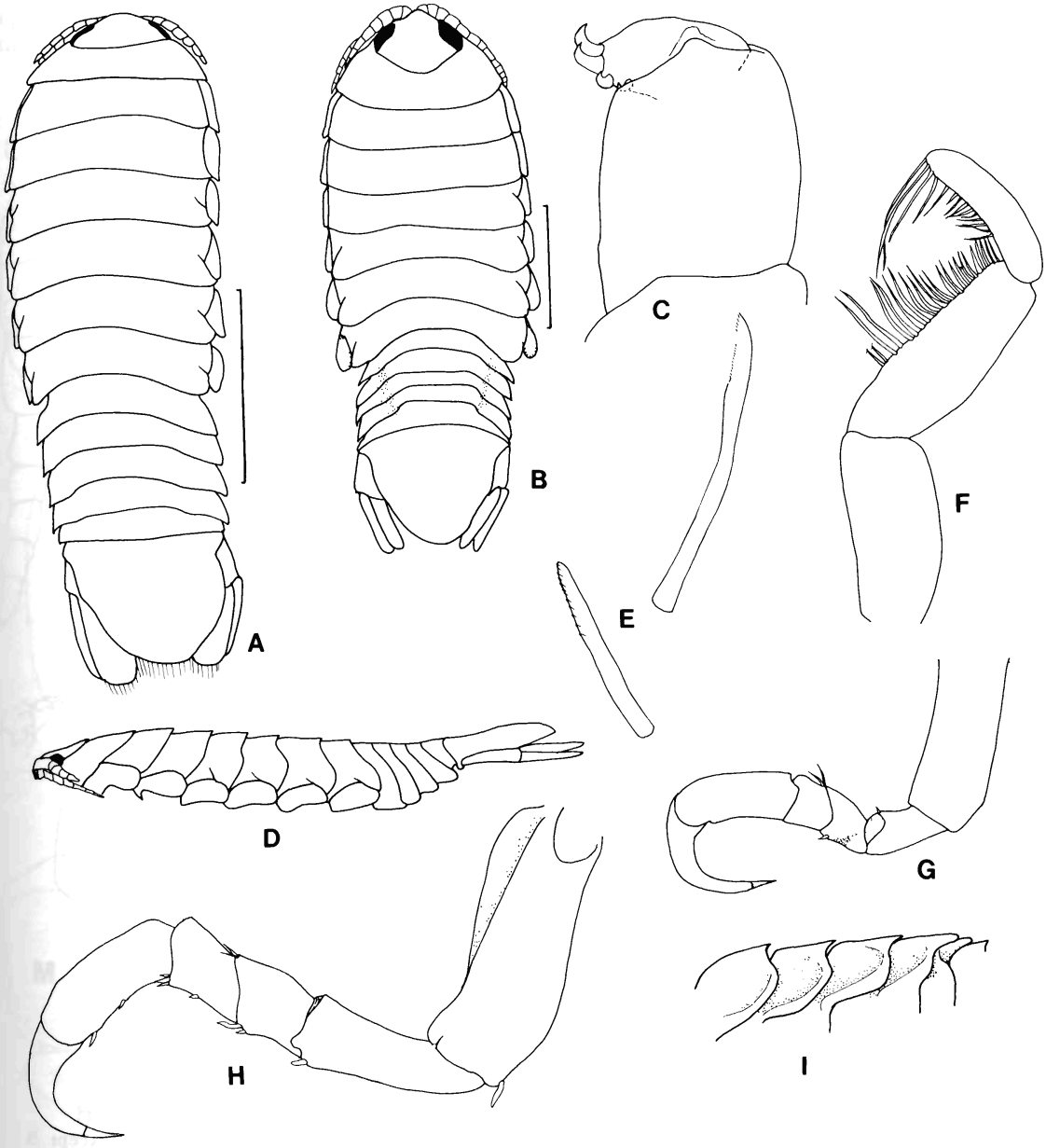

Fig.15. *Elthusa sacciger*. Figures of 17.0 mm except B and D. A, dorsal view; B, dorsal view, 21.5 mm; C, maxilliped articles 2 and 3; D, lateral view; E, spines from mandible palp article 3; F, mandible palp; G, pereopod 1; H, pereopod 7; I, left pleonites, ventral view. Scale lines represent 5.0 mm.

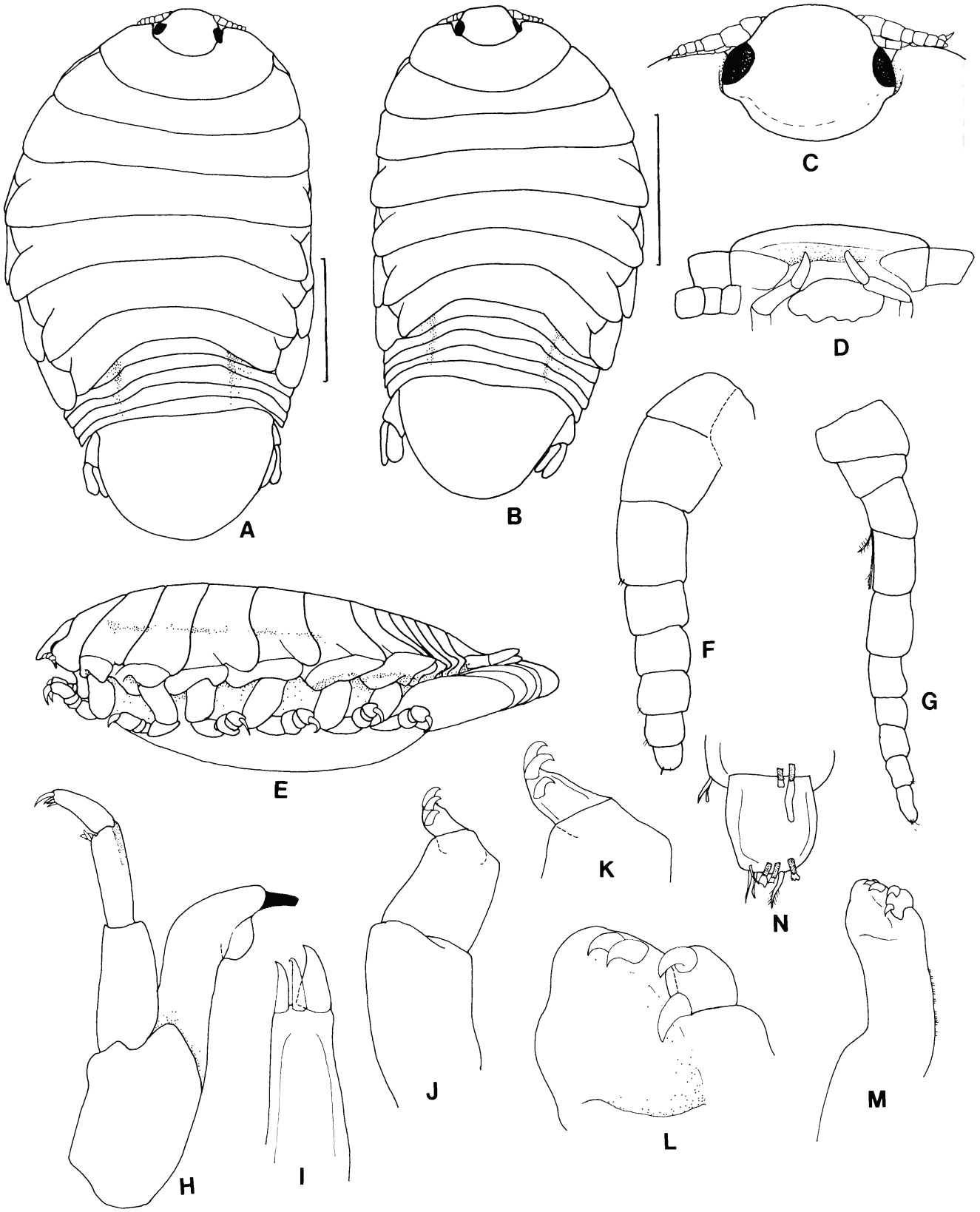

Fig.16. *Elthusa sigani* n.sp. A, C–E holotype, remainder female 10.5 mm (QM W13082) except B. A, dorsal view; B, dorsal view, 10.0 mm (QM 13082); C, cephalon; D, frons; E, lateral view; F, antennule; G, antenna; H, mandible; I, maxillule apex; J, maxilliped; K, maxilliped article 3; L, maxilla apex; M, maxilla; N, antennule, terminal article. Scale lines represent 3.0 mm.

longer, composed of 10 articles.

Mandible incisor robust, apex blunt; palp slender, article 1 longest; 2 spines at distolateral angle of article 2, 4 terminal spines on article 3. Maxillule with 2 slender and 1 broad based spine. Maxilla with 2 large curved spines each on medial and lateral lobe. Maxilliped without oostegital lobe; article 3 with 3 large recurved spines.

Pereopods 1-3 similar to each other. Pereopod 1 basis with feeble carina; merus posterior margin deeply cleft; dactylus slender, with anteroproximal depression. Pereopods 5-7 similar, except pereopod 7 only with distinct carina on basis; pereopod 7 merus deeply cleft, dactylus similar to that of pereopod 1. Brood pouch made up of pairs of alternately overlapping oostegites arising from sternites 2, 3, 4 and 5.

Pleopods 1 smaller than 2, pleopods 2, 3 and 4 approximately equal in size, pleopod 5 smaller than 4. Pleopod 2 with reduced appendix masculina arising in submedial position. Pleopods 3-5 endopod proximomedial lobe weakly developed. Peduncles to pleopods 1-4 with coupling hooks. Uropods short, reaching about half way along length of pleotelson, exopod slightly longer than endopod, both rami with broadly rounded apices.

Male. Body bilaterally symmetrical, about 2.0 as long as wide. Pleon about 0.80 width of pereon.

Appendages all similar to those of female but antennule and antenna slightly longer; mandible palp article 3 with slightly longer terminal setae. Pereopods with small spines on posterior margin of palm and carpus; carpus of pereopods 1-3 not deeply cleft; pleopod 2 appendix masculina longer than endopod, attached subbasally; uropods longer, extending to posterior of pleotelson. Paired penes present.

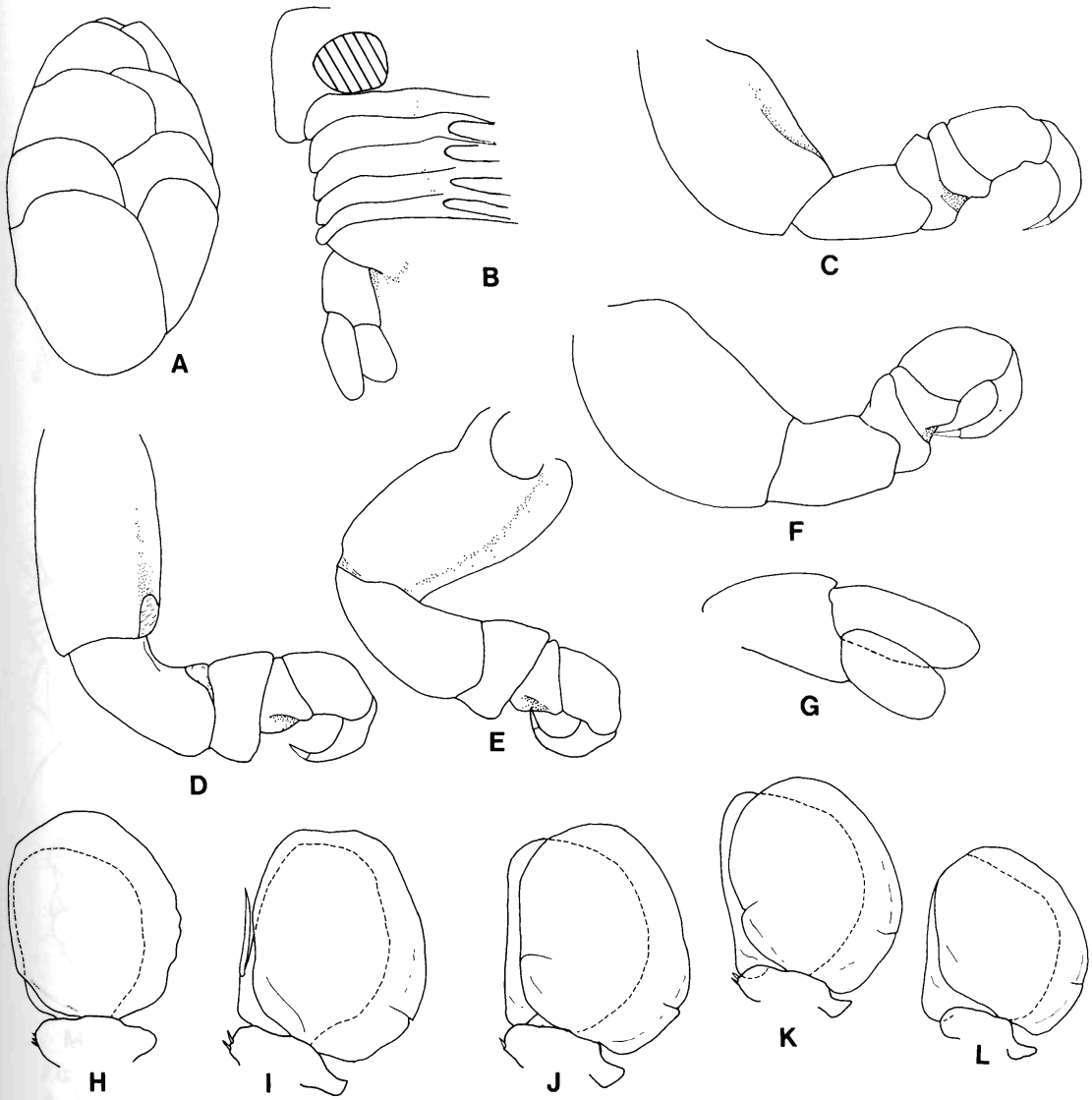

Fig.17. *Elthusa sigani* n.sp. All figs 10.5 mm (QM 13082). A, brood pouch; B, right pleonites, ventral view; C–F, pereopods 1, 2, 6, 7 respectively; G, uropod; H–L, pleopods 1-5 respectively.

Colour. White in alcohol, black chromatophores along lateral and posterolateral margin of pereonites and coxae, extending onto lateral margin of uropod peduncle and rami.

Size. Females to 13.0 mm, males between 5.0 and 8.0 mm.

Variation. Females may be twisted to left or to right, and coxae are longest on the most convex side.

Remarks. This small species is readily distinguished from all other Australian species of *Elthusa* by the even body outline, broad rostrum, antennules set wide apart, relatively long coxae and a wide pleon. The very much larger *Elthusa raynaudii* has similar coxal and pleonal morphology, but has a narrow rostrum, lacks the deeply cleft carpus on the pereopods and also has a distinct brood pouch and pleopod morphology.

The only similar Indo-Pacific species is the little

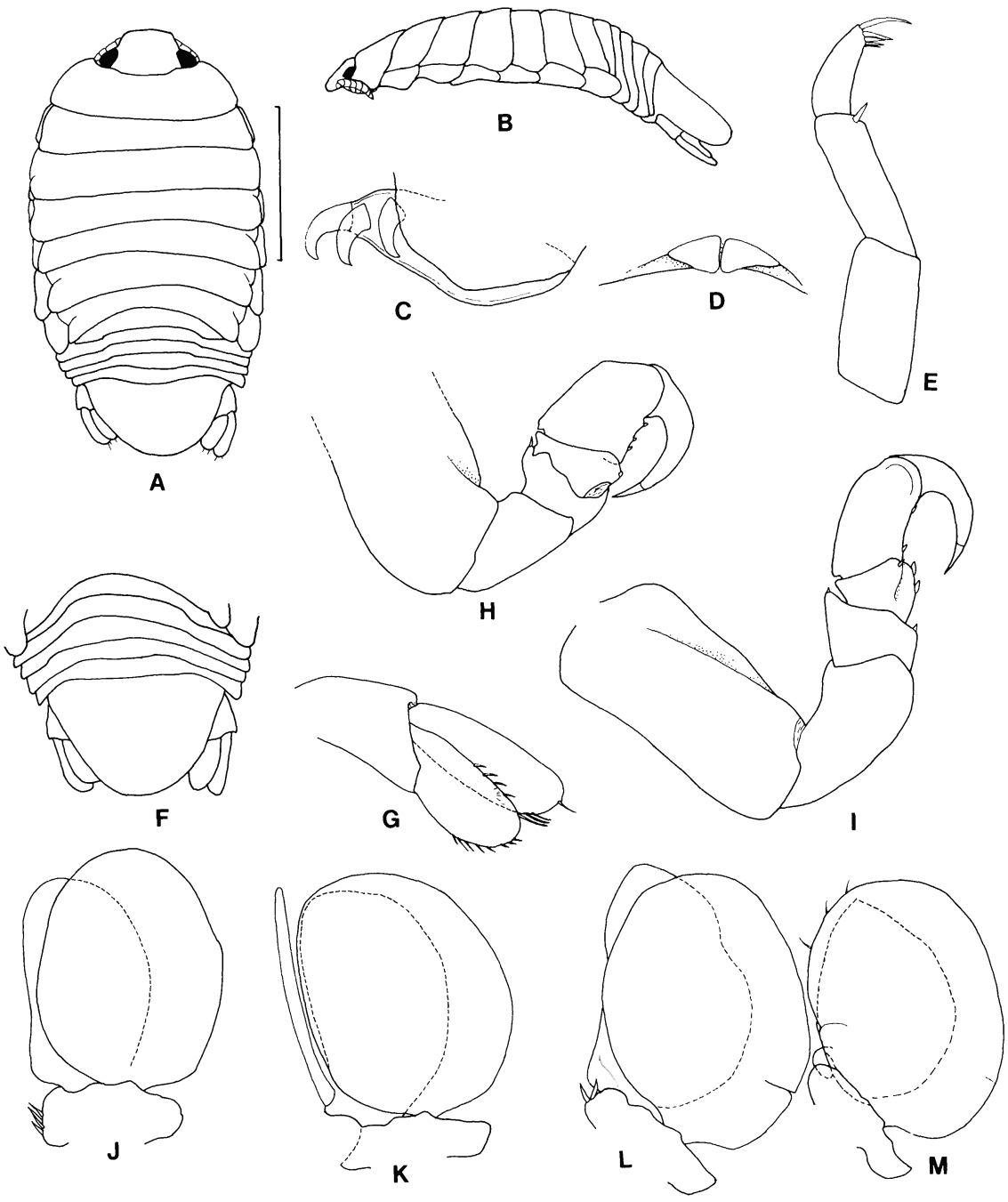

Fig.18. *Elthusa sigani* n.sp. All figs of male 5.5 mm (QM 13082). A, dorsal view; B, lateral view; C, maxilliped article 3; D, penes; E, mandible palp; F, pleon, perpendicular view; G, uropod; H, pereopod 1; I, pereopod 7; J–M, pleopods 1-3, 5 respectively. Scale line represents 2.0 mm.

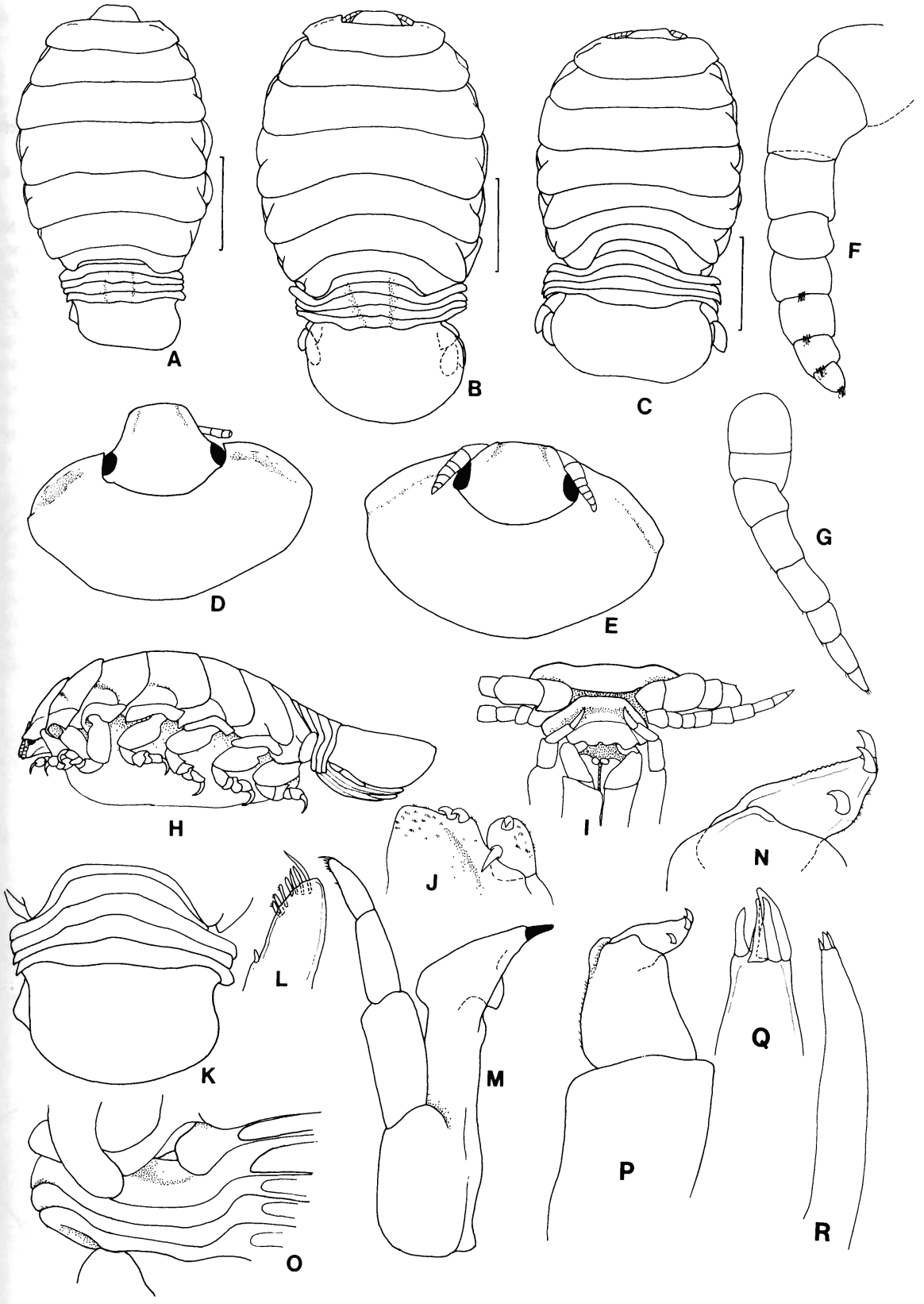

Fig.19. *Elthusa turgidula*. Figures of female 18.5, ex *Scarus sordidus* except where indicated. A, holotype, dorsal view; B, dorsal view; C, female 15.0 mm, ex *S. venosus*; D, cephalon, holotype; E, cephalon, ex *S. venosus*; F, antennule; G, antenna; H, lateral view; I, frons; J, maxilla apex; K, pleon and pleotelson, holotype; L, mandible palp article 3; M, mandible; N, maxilliped article 3; O, right pleonites, ventral view; P, maxilliped; Q, maxillule apex; R, maxillule. Scale lines represent 4.0 mm.

known *Elthusa emarginata*. This species is larger (21.5-27.0 mm) and has distinctive cephalic, pereopodal and coxal morphology.

Distribution. Known only from the type locality.

Hosts. *Siganus spinus* (F. Siganidae); position on the host was recorded only as on gills. Host specimens were not seen by the author.

Etymology. Epithet is derived from that of the host genus.

Elthusa turgidula (Hale)

Figs 19–21

Livoneca turgidula Hale, 1926: 217, fig.11.–Nierstrasz, 1931: 144.

Material examined. Female HOLOTYPE (15.0), Fremantle, WA, 12 Sept. 1922, coll./don., G.E. Nicholls (WAM 10034). Male ALLOTYPE (9.5), Cottesloe, WA, Sept. 1924, coll./don. Glauert (WAM 11126). One Tree Island, Great Barrier Reef, 23°30'S 152°05'E: female (ovigerous 18.5), male (8.0), 20 Oct. 1967, gills of *Scarus*

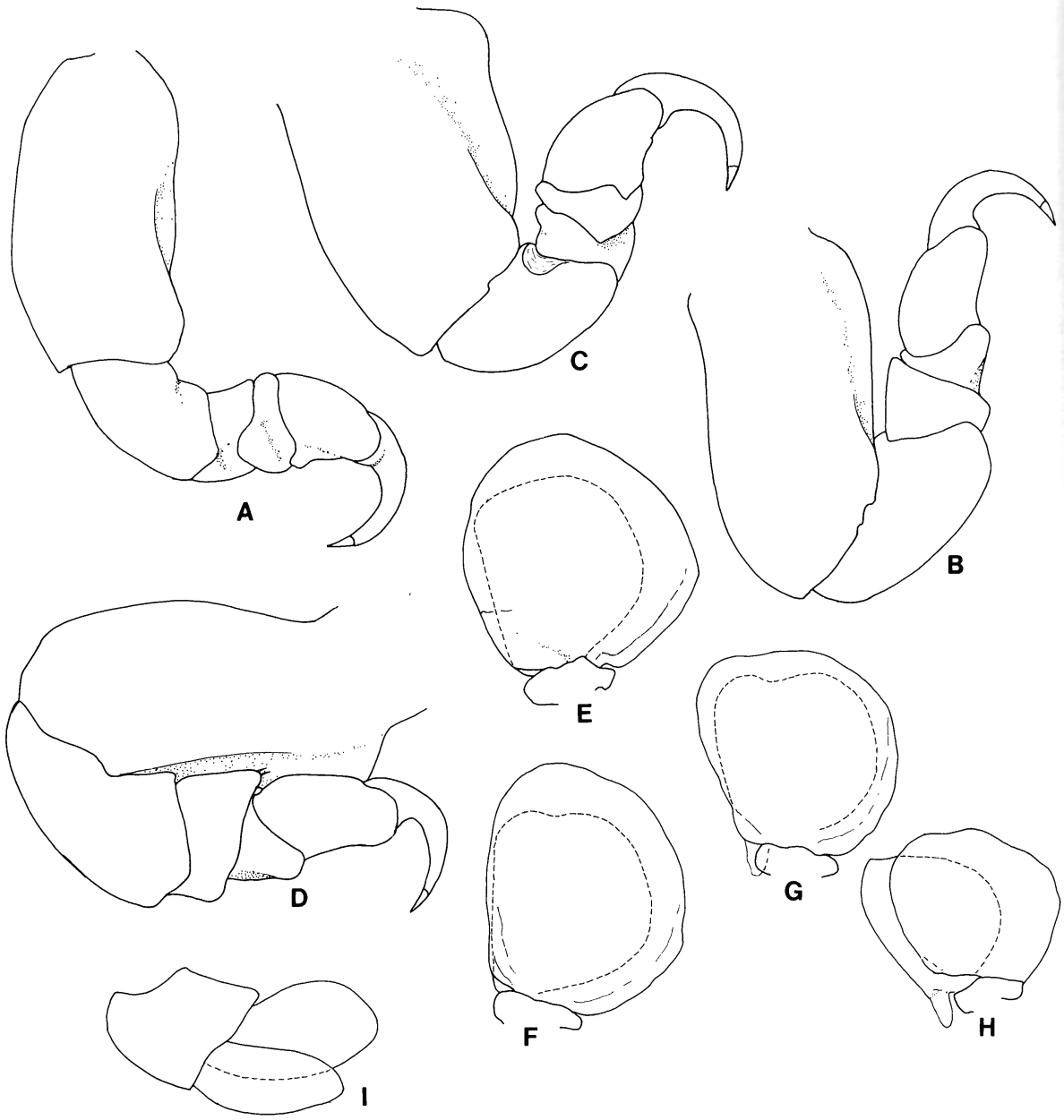

Fig.20. *Elthusa turgidula*. All figures from female 18.5 mm, ex *S. sordidus*. A–D, pereopods 1, 2, 6, 7 respectively; E–M, pleopods 1-3, 5 respectively; I, uropod.

sordidus (AM I15634-023) depth 2 m, coll. F. Talbot and party (AM P37781). Female (non-ovigerous 15.0), 2 Dec. 1966, gills of *Scarus venosus* (AM I15623-28), coll. Talbot (AM P37782). Male (12.5), 19 Sept. 1968, gills of *Scarus* sp. (AM I17445-137), coll. H.K. Larson (AM P37783).

Type locality. Fremantle, Western Australia.

Description of female. Body 1.7 times as long as wide, dorsum moderately vaulted; anteroposteriorly arched; widest at pereonite 3 or 4. Cephalon deeply immersed in pereonite 7; anterior margin weakly to moderately produced; anterolateral margins with indistinct ridge; eyes small, 0.23 width of cephalon. Pereonite 1>2<3<4>5>6>7. Pereonite 1 with sublateral depression. Coxae not conspicuous in dorsal view. Pereonite 7 posterior margin deeply indented. Pleon 0.31 (holotype to 0.52) width of pereon; pleonite 1 less than half as wide as pleonite 2; pleonites 2-5 about equal in width. Pleotelson broadly and smoothly rounded, about 1.0-0.66 as wide as long.

Antennule extending to posterior of eye, robust; antenna shorter and more slender than antennule, composed of 8 articles; bases of both widely separated.

Mandible palp slender, article 3 with 7 stout distomedial setae. Maxillule with 5 terminal spines. Maxilla distally wide; 2 hooked spines each on medial and lateral lobes. Maxilliped without laminar lobes; article 3 with 3 recurved spines.

Pereopods 1-4 slightly shorter than 5-7. Pereopod 1 basis with outer lateral carina; pereopods 2-7 basis with carina. Pereopods 5-7 carpus with grooved posterior margin.

Pleopods with all rami lamellar; peduncles without accessory lamellae; endopods of pleopods 3-5 with simple proximomedial lobe. Pleopods 1-5 progressively decreasing in size. Uropods short, about half length of pleotelson; exopod shorter than endopod, apex acute; endopod apex broadly rounded.

Male. Generally similar to female but for: body margins subparallel and coxae more conspicuous in dorsal view; triangular penes present on sternite 7; pleopod 2 endopod with prominent appendix masculina; uropods with both rami broadly rounded; mandible palp article 3 with longer setae.

Colour. Pale tan in alcohol.

Size. Females 15.0-18.5 mm, males 8.0-12.5 mm.

Variation. The holotype has the anterior margin of the cephalon more strongly produced than the One Tree Island specimens. Relative width of the pleon from 0.31-0.52 width of pereonite 4. The pleotelson has the posterior margin evenly rounded or slightly flattened.

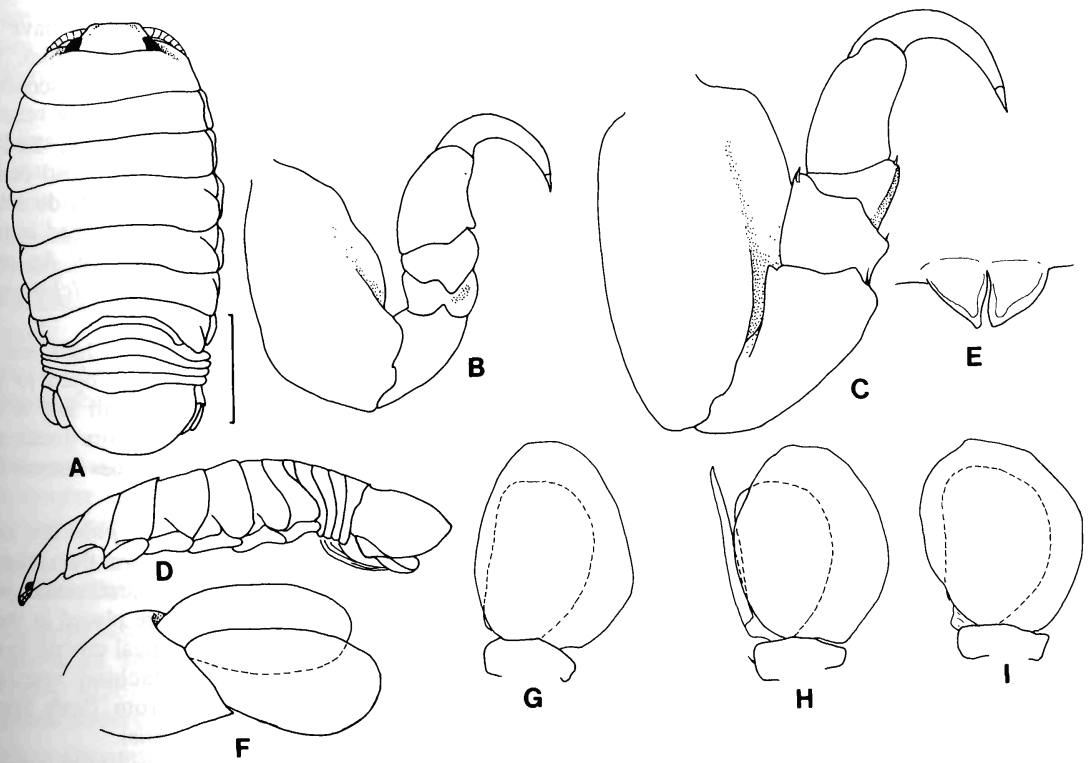

Fig.21. *Elthusa turgidula*. All figures of male, ex *S. sordidus*. A, dorsal view; B, pereopod 1; C, pereopod 7; D, lateral view; E, penes; F, uropod; G–I, pleopods 1-3 respectively. Scale line represents 2.0 mm.

The cephalon is angled down in all specimens except the holotype and allotype.

Remarks. The very narrow first pleonite, wide anterior margin to the cephalon with anterolateral ridges and widely separated antennule bases separates this species from all others of the genus.

Hosts. *Scarus sordidus*, *Scarus venosus* and an unidentified *Scarus* sp., all at One Tree Island. The female isopod attaches about half way along a gill arch, with the abdomen facing laterally to the host ("outwards"), and the head projecting into the buccal spaces of the host.

Distribution. Cottesloe and Fremantle, WA; One Tree Island, southern Great Barrier Reef.

Ichthyoxenus Herklots

Ichthyoxenus Herklots, 1870: 128.–Schiödte & Meinert, 1884: 297.–Richardson, 1913: 559.–Shen, 1936: 5.–Brian & Darteville, 1949: 132.–Lincoln, 1972: 329.–Kussakin, 1979: 291.

Type species. *Ichthyoxenus jellinghausi* Herklots, 1870, by monotypy. The types (3 females, 1 male) are held at the Rijksmuseum van Natuurlijke Historie, Leiden. New material of this species is needed before it can be redescribed.

Provisional diagnosis. Body vaulted; strongly ovate, nearly circular in dorsal view; bilaterally symmetrical. Cephalon not deeply immersed in pereonite 1. Coxa all short, rounded. Pleon narrow (less than 0.5 pereon), pleonite 1 partly overlapped by pereonite 7.

Antennule shorter than antenna, bases set apart. Pereopods with distal articles (ischium to carpus) flattened, widest distally; dactylus short, flattened (not rounded in section as in other genera). Pleopods (of type species) not known.

Composition. Other than the type species, it is at present uncertain how many described species should be placed in this genus. On the basis of the provisional diagnosis above, or recorded habitat, I include the following: *Ichthyoxenus africana* (Lincoln, 1972), n.comb., *Ichthyoxenus amurensis* (Gersfeldt, 1858), *Ichthyoxenus expansus* Van Name, 1920, *Ichthyoxenus formosanus* Harada, 1930, *Ichthyoxenus geei* Boone, 1921, *Ichthyoxenus japonensis* Richardson, 1913, *Ichthyoxenus montanus* Schiödte & Meinert, 1884, *Ichthyoxenus sinensis* Shen, 1936, *Ichthyoxenus tanganyikae* (Fryer, 1965). To this list of freshwater species I add the marine species *Ichthyoxenus micronyx* (Miers, 1880) n.comb., *Ichthyoxenus minabensis* (Shiino, 1956) n.comb. and *Ichthyoxenus puhi* (Bowman, 1962), n.comb.

Remarks. The status of the genus *Ichthyoxenus* has long been questioned, first by Miers (1880), then Gerstaecker (1882), followed by Monod (1931), Brian & Dartevelle (1949), and in more detail by Fryer (1965) and Lincoln (1972). The two central themes to the argument of these authors was the supposed synonymy of *Ichthyoxenus* to *Livoneca* (Miers, 1880; Gerstaecker, 1882; Monod, 1931; Brian & Dartevelle, 1949) and the supposed polyphyletic origin of *Ichthyoxenus* (Fryer, 1965; Lincoln, 1972). The emphasis of all authors was that the habitat could not be used to discriminate genera, that the "genus" arose independently on several occasions and that *Ichthyoxenus* was undoubtedly a synonym of *Livoneca*.

Brusca (1981:131) contributed to the discussion by suggesting that *Ichthyoxenus* should be used for all Asiatic freshwater flesh burrowers, with the implication that species in such different habitats (gill/buccal attaching versus flesh burrowing) warrant separate genera. The logic of this is no different to that of separating genera by marine versus freshwater.

An important aspect of this discussion is that no authors redescribed or redefined the genera concerned and their opinions were based only on the literature and on species they had at hand, which in some cases were none. Morphological criteria were often not considered, or considered and then discounted such as in Brusca's (1981) assertion that the two genera could not be distinguished by morphological criteria. The type species of both *Livoneca* and *Ichthyoxenus* were at that time effectively undescribed.

It is now apparent that two genera have little in common, are belong to separate subfamilies. Previous considerations of their status, based on a misconception of *Livoneca*, are invalid. Undoubtedly the genus *Ichthyoxenus* needs a full revision, and a full redescription of the type species. It is also certain that several species of freshwater cymothoids do not belong in *Ichthyoxenus*, but until they are described in full, their true generic position remains uncertain. An annotated list of all freshwater "*Livoneca*" and *Ichthyoxenus* is here provided.

The majority of species are from China and the Far East. The status of many species is open to question (Harada, 1936; Trilles, 1976), and all are in need of redescription. *Ichthyoxenus micronyx* lacks detailed habitat data and it is not known if it does burrow into host flesh.

Ichthyoxenus minabensis and *I. puhi* are not flesh burrowers, and also are rather narrower than others of the genus. These species have the characteristic pereopod morphology, and for this reason are placed in the genus. At present there are no morphological criteria to separate gill attaching from buccal attaching species (e.g. *I. expansus*, *I. tanganyikae*) from flesh burrowing species (e.g. *I. jellinghausi*, *I. sinensis*).

In common with several cymothoid genera and species, the generic spelling used has varied. Van Name (1920) and Brusca (1981) used *Ichthyoxenos*; Dartevelle (1939) used *Ichtyoxenus*.

Freshwater Species Previously Placed in *Livoneca* and *Ichthyoxenus*.

1. *Livoneca africana* Lincoln, 1972. Lake Tanganyika, Tanzania. From the mouth of two species of cichlid fishes. Here transfered to *Ichthyoxenus*.
2. *Ichthyoxenus amurensis* (Gersfeldt, 1858). Figured by Kussakin (1979).
3. *Livoneca daurica* Miers, 1877. Junior synonym of *Ichthyoxenus amurensis* (Kussakin, 1979).
4. *Livoneca enigmatica* Fryer, 1968. Taken from the body surfaces and gill cavity of two species of clupeid fishes. I am uncertain of the correct generic position.
5. *Ichthyoxenus expansus* Van Name, 1920. Holotype taken from gills of a characinid fish, Uele River, Zaire.
6. *Ichthyoxenus formosanus* Harada, 1930. Taiwan.
7. *Ichthyoxenus geei* Boone, 1921. Soochow, China (Shen, 1936). From external surface of hosts.
8. *Ichthyoxenus japonensis* Richardson, 1913. Lake Biwa and at Omi on Lake Yogo, Japan.
9. *Ichthyoxenus jellinghausi* Herklots, 1870. Type species for the genus. Additional figures given by Richardson (1913).
10. *Livoneca guianensis* Van Name, 1925. Katarbo, British Guiana. From gills of river fishes (Van Name, 1936). I am uncertain of the correct generic position, it does not agree with the diagnosis for *Ichthyoxenus*.
11. *Livoneca lazzari* (Pearse, 1921). Van Name (1936) repeats the description. The species is based on immature material, and I am uncertain of the correct generic position.
12. *Ichthyoxenus montanus* Schiödte & Meinert, 1884. Himalayas.
13. *Ichthyoxenus opisthopterygium* Ishii, 1916. Lake Biwa, Japan.
14. *Livoneca orinoco* Bowman & Ungria, 1957. This species does not belong to *Ichthyoxenus*.
15. *Livoneca parasilura* Shen, 1936. Peiping, Hopei Province, China. Differs markedly from other freshwater species, and appears most similar to *Livoneca sensu strictu*.
16. *Ichthyoxenus sinensis* Shen, 1936. Peiping, Hopei Province, China. Parasitic in the body.
17. *Livoneca symmetrica* Van Name, 1925. Katarbo, British Guiana, on several species of river fishes (Van Name, 1936). I am uncertain of the correct generic position, but it is not an *Ichthyoxenus*.
18. *Livoneca tanganyikae* Fryer, 1965. Recorded from mouth, on one species of host only. Lake Tanganyika, Tanzania.
19. *Ichthyoxenus tchangi* Yü, 1935. Yunnan, China.

Ichthyoxenus minabensis (Shiino)

Figs 22, 23

Indusa minabensis Shiino, 1951: 83, fig.3.

Material examined. Female (non-ovigerous 17.0), Marian Plateau, 22°34.8'S 153°38.7'E, 16 Nov. 1985, on *Chaunax fimbriata*, 316 m depth, coll. A.J. Bruce on FRV *Soela* (NTM Cr6699).

Types. Deposition of the type specimens was not indicated by Shiino (1955).

Type locality. Off Minabe, Wakayama Prefecture, 182-366 m.

Description. Body strongly vaulted, symmetrical, about 1.9 times as long as wide. Cephalon anterolateral margin straight, converging to apical point, apex of which is turned down; eyes about 0.3 width of cephalon. Pereonite 1 distinctly narrower than pereonite 2; pereonites 2-5 with lateral margins thickened; posterolateral margins of pereonites 2-7 produced, rounded. Pereonites 1<2<3>4<5>6>7; pereonite 5 widest. Coxae all shorter than respective segment; anterior margin of coxae 5-7 concealed by preceding segment. Pleonite 1 lateral margins overlapped by posterolateral margins of pereonite 7; pleonites subequal in width, about 0.3 width of pereonite 5. Pleotelson as long as wide, posterior margin broadly rounded.

Antennule bases close set but not contiguous; composed of 8 articles, extending beyond posterior of eye. Antenna bases set wide apart; composed of 11 articles, extending to pereonite 1.

Mandible palp article 3 with about 6 short setae. Maxillule with 4 terminal spines. Maxilla with 2 spines each on medial and lateral lobes. Maxilliped article 3 with 3 recurved terminal spines.

Pereopods 1-3 manifestly shorter than 5-7. All pereopods without carina on bases, and all with short flat sided dactylus. Pereopod 1 merus dilated. Pereopod 7 merus and carpus somewhat flattened and expanded (1.4 and 1.7 times as wide as long respectively).

Pleopods all lamellar, peduncles and rami without lamellar lobes; proximomedial lobe of endopods 3-5 weakly developed. Pleopod 1 largest, 5 smallest. All exopods with dense distomedial patch. Uropods short, extending about half way along pleotelson, both rami bluntly rounded; exopod slightly longer than endopod.

Colour. Pale brown in alcohol, eyes black.

Remarks. This specimen agrees entirely with the English description and figures given by Shiino (1951), and is also recorded from the same host species.

The most similar species to *I. minabensis* is *I. puhi* (Bowman). The distinctive pereonite morphology is shared by both species, and *I. minabensis* differs from

I. puhi by having the cephalon anterior margin narrow, narrower pleon, wider uropod rami, and the uropod endopod shorter than the exopod (in *I. puhi* the endopod is longest). Both species are from sedentary, bottom-dwelling hosts.

Miers (1880) described a similar species, *Livoneca micronyx* from Mauritius. Examination of the type specimen shows that this species differs in having the merus of pereopods 6 and 7 more distinctly lobed, lateral margin of the pereonites not thickened, and the

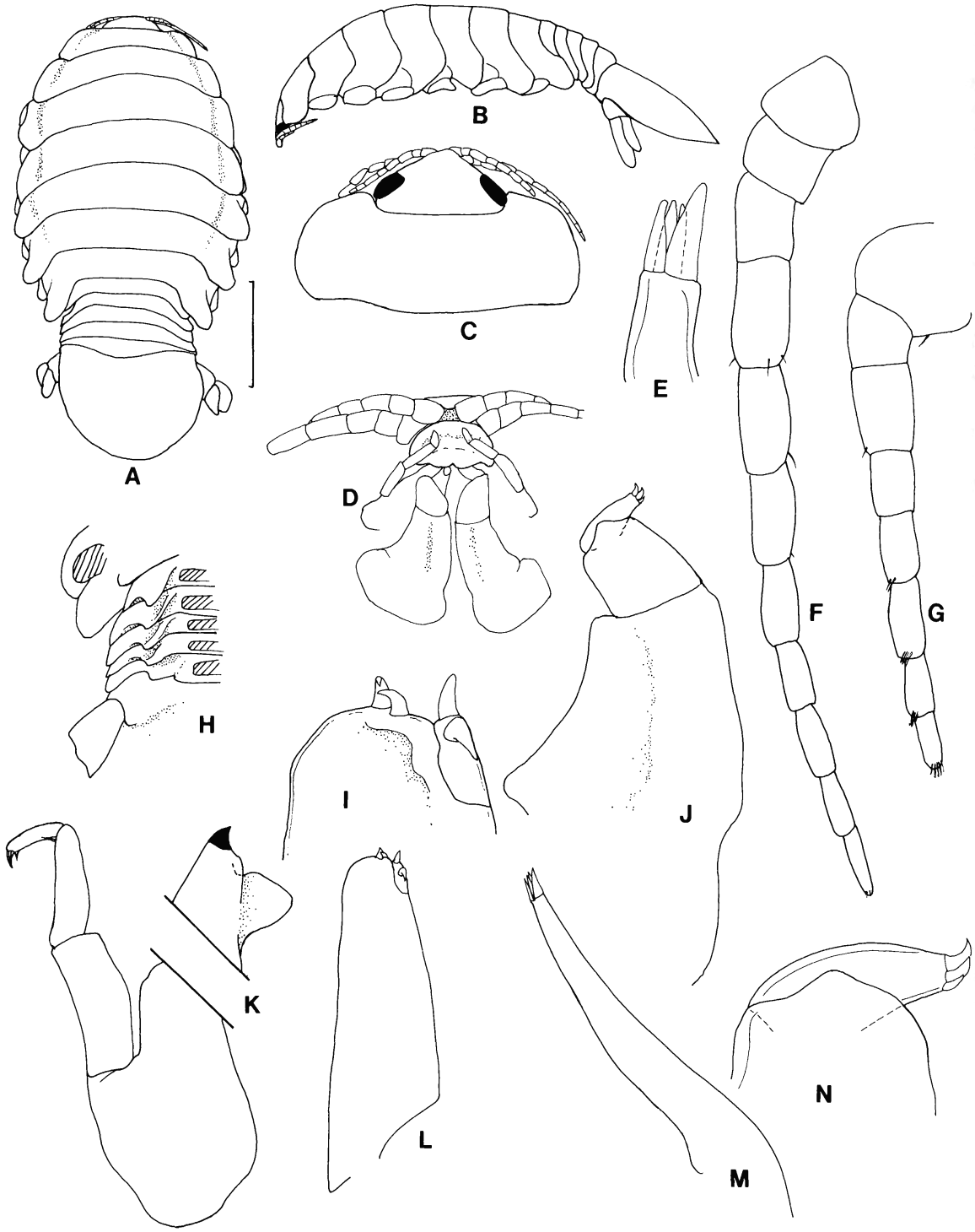

Fig.22. *Ichthyoxenus minabensis*. Figs all NTM Cr6699. A, dorsal view; B, lateral view; C, head, pereonite 1; D, frons; E, maxillule apex; F, antenna; G, antennule; H, right pleonites, ventral view; I, maxilla apex; J, maxilliped; K, mandible (broken); L, maxilla; M, maxillule; N, maxilliped article 3. Scale line represents 4.0 mm.

pleonites overlapping one another laterally.

Hosts. Recorded from the mouth of *Chaunax fimbriatus* by Shiino (1955), the position of the present material was not recorded.

Distribution. One previous record from Japan, here recorded from north-eastern Australia.

Idusa Schiödte & Meinert

Idusa Schiödte & Meinert, 1884: 334.–Trilles, 1981: 593 [not *Indusa* (*lapsus*)].–Richardson, 1905: 246 [not *Idusa*].–Brusca, 1981: 190.

Type species. *Idusa plagusiae* Schiödte & Meinert, 1884; held at the Zoologisk Museum, Copenhagen.

Provisional diagnosis of female. Body twisted to one side; dorsum moderately vaulted. Cephalon moderately immersed in pereonite 1, posterior margin not trilobed. Coxae all small, all shorter than respective segment. Pleon not immersed in pereon; pleonite 1 manifestly narrower than 2; pleonites 2-5 subequal in width.

Antennule shorter than antenna; both antennule and antenna slender; bases set very close. Mouthparts not known. Pereopods slender, basis without carina, dactylus large. Pleopods with rami all lamellar; without accessory lobes; peduncles without accessory lobes.

Composition. Only one other species: *Idusa dieuzeidei* Dollfus, 1950 (see Trilles, 1976b).

Remarks. This is yet another genus in which species have been placed, and diagnosed with only limited knowledge of the morphology of the type species.

It is clear that Richardson's (1905) diagnosis was based on *Idusa carinata*. Brusca's (1981) diagnosis, largely the same as Richardson's (1905) diagnosis, is also obviously based on *I. carinata*. Trilles (1981) indicated that of the species then placed in *Idusa* (again misspelt by several authors as *Indusa*) other than the type species, only *I. dieuzeidei* could be considered to belong to the genus. The other species were *I. carinata* Richardson, *I. ophueseni* Pillai, 1954, *I. pustulosa* Pillai, 1954 and *I. malayi* (Tiwari, 1953). Of these, *I. malayi* has been placed back into *Agarna* by Bowman & Tareen, 1983 and *I. ophueseni* is a synonym of *Agarna malayi* (see Pillai, 1964).

Idusa pustulosa differs little from *Agarna malayi* (see Pillai, 1964) and should be transfered to *Agarna*. *Idusa carinata* will at present have to be retained in the present combination as *incerta sedis*. While agreeing with *Idusa* in the antennules being close set, small compact coxae, and narrow pleon, it differs in having an ovate and symmetrical body, cephalon deeply immersed in pereonite 7, pleonite 1 not markedly narrower than 2, more robust antenna and robust pereopods, the bases which are carinate.

There are at present no species of this genus recorded from Australia. The rediagnosis of this genus was necessary to allow for positive generic location of

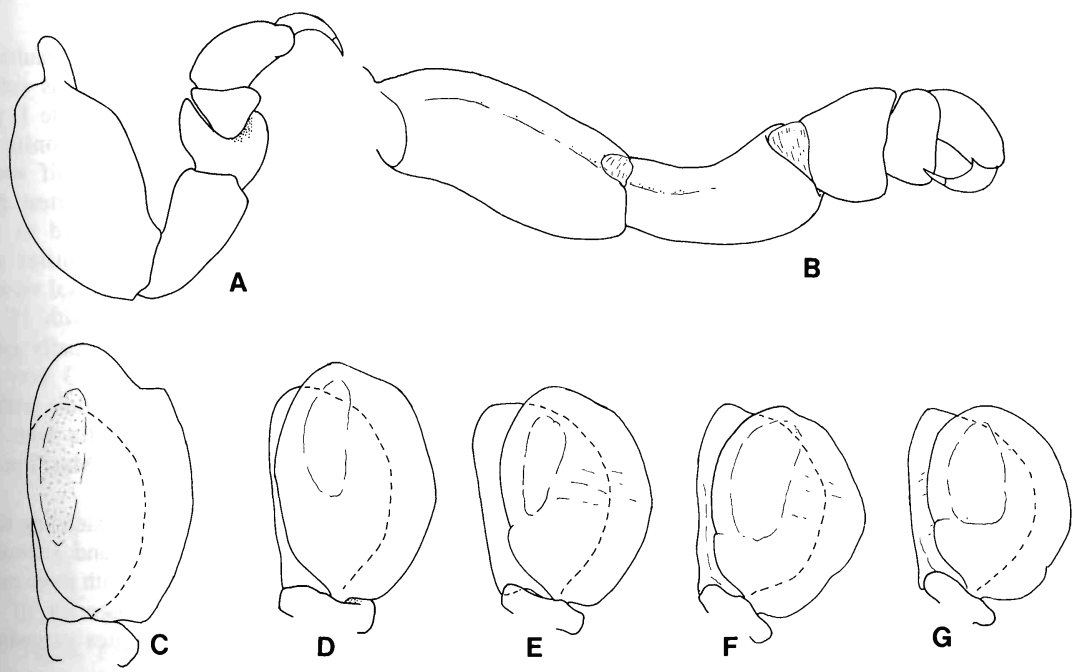

Fig.23. *Ichthyoxenus minabensis*. All figs NTM Cr6699. A, pereopod 1; B, pereopod 7; C–G, pleopods 1-5 respectively.

Catoessa ambassae, which is in many ways similar to *Idusa plagusiae*, an Indian Ocean species (Schiödte & Meinert, 1884).

The diagnosis given here is provisional as fresh material of the type species is needed before a full description can be provided.

Anilocrinae Schiödte & Meinert

Remarks. Bruce (1987c) rediagnosed the subfamily Anilocrinae and provided a key to the then known Indo-West Pacific genera. That key now applies only those genera attaching externally on the host. Two further genera are here added to the Indo-West Pacific representatives of the subfamily: *Enispa* Schiödte & Meinert and *Norileca* n.gen. The transfering of *Livoneca* into the Anilocrinae in effect also synonymises Livonecinae with Anilocrinae.

Enispa Schiödte & Meinert

Enispa Schiödte & Meinert, 1884: 292.

Type species. *Cymothoa irregularis* Bleeker, 1857 by monotypy. Two ovigerous female syntypes (collected by Bleeker) are held at the Rijksmuseum van Natuurlijke Historie, Leiden (RMNH 62).

Diagnosis of female. Body strongly vaulted, about 3 times as long as wide. Cephalon moderately immersed in pereonite 1, posterior margin weakly trilobed. Coxae of pereonites 2-4 as long as respective segment; coxae of pereonites 5-7 longer than respective segment. Pleon not immersed in pereon, all segments visible in dorsal view; lateral margins ventrally directed. Pleotelson cupola shaped, vaulted.

Antennule shorter than antenna, bases set wide apart.

Pereopods without basal carina, articles not dilated. Brood pouch arising from sternites 1-4, and 6, with posterior pocket; oostegites of sternite 6 posteriorly produced and extending over pleopods. Pleopods with laminar lobes on lateral margin of peduncle and proximomedial angle of endopods 1 and 2; pleopods 3-5 with folded proximomedial lobe; endopods of pleopods 3-4 with single large fold, endopod of pleopod 5 with 2 large complexly folded lobes, distal margin indented.

Composition. *Enispa convexa* (Richardson, 1905), n.comb. The figures given by Brusca (1981) allow this species to be confidently placed in this genus (see the *Livoneca* species list for comments of *E. convexa*).

Remarks. This is yet another small genus of Schiödte & Meinert's that has long been ignored. The type species was until now effectively undescribed, and consequently the genus itself undefined by contemporary standards. It can be distinguished from all other anilocrine genera by the strongly vaulted body shape and the rounded pleotelson. Typically the uropods are held concealed under the pleotelson, and are not visible in dorsal view.

The morphology of the brood pouch and pleopods places this genus within the Anilocrinae as redefined by Bruce (1987c). The pleopods are nearly identical to those of *Nerocila*.

Enispa irregularis (Bleeker)

Figs 24, 25

Cymothoa irregularis Bleeker, 1857: 34, pl.2, fig.11.–Gerstaecker, 1882: 261.

Cymothoa paradoxa Haller, 1880: 378, pl.18, figs 5-7.–Gerstaecker, 1882: 261.

Enispa irregularis.–Schiödte & Meinert, 1884: 293, pl.11, figs 1-4.–Nierstrasz, 1915: 95.–Nierstrasz, 1931: 137.–Trilles, 1979: 259, pl.1, fig.6.

Material examined. 2 females (ovigerous 19.0, 23.0, SYNTYPES), Oost Indie, coll. P. Bleeker (RMNH 62). Female (ovigerous 17.0, holotype of *C. paradoxa*), dans la bouche d'une *Caranx carangus* Bloch, (locality illegible: ?Madagascar), trouvé par G. Lunel (MHNG 14). Female (ovigerous 13.5), Jan. 1910, and female (ovigerous 15.5), Aug. 1910, both Baai v Batavia (= Jakarta, Java, Indonesia), coll. P.J. Buitendijk (RMNH 61). Female (non-ovigerous 15.0), Arafura Sea, 12°18'S 127°27'E, 25 Sept. 1984, from stomach of trawled dolphin, coll. D. Hembrost (NTM Cr6563).

Type locality. Amboina, Indonesia (Bleeker, 1857).

Description of female. Body strongly vaulted, about 2.3 times as long as wide; lateral margins subparallel. Cephalon moderately immersed in pereonite 1, posterior margin trilobed; eyes indistinct. Pereonite 1 with anterolateral margin produced, about half way along cephalon; pereonite 1 longest, 2 and 7 shortest; pereonite 1>2<3=4=5<6>7. Pleon about one third as wide as pereon, lateral margins of all pleonites arching posteriorly. Pleotelson subquadrate in dorsal view.

Antennule with 8 articles, antenna with 11 articles; articles 1 and 2 of both appearing partially coalesced. Mandible palp article shortest; article 3 very slightly longer than 2, markedly flattened. Maxillule with 1 large and 3 slender terminal spines. Maxilla with 2 small spines each on medial and lateral lobe. Maxilliped article 3 with 2 terminal recurved spines.

Pereopod 1 robust; dactylus large, extending to merus; basis with weak carina. Pereopods 2 and 3 similar to 1. Pereopods 5-7 longer than 1-3; basis with more prominent carina; dactylus extending to posterior of carpus. Brood pouch with posterior oostegites extending over pleopods.

Pleopods as for generic diagnosis. Uropod rami shorter than peduncle; endopod slightly longer than exopod, both rami bluntly rounded.

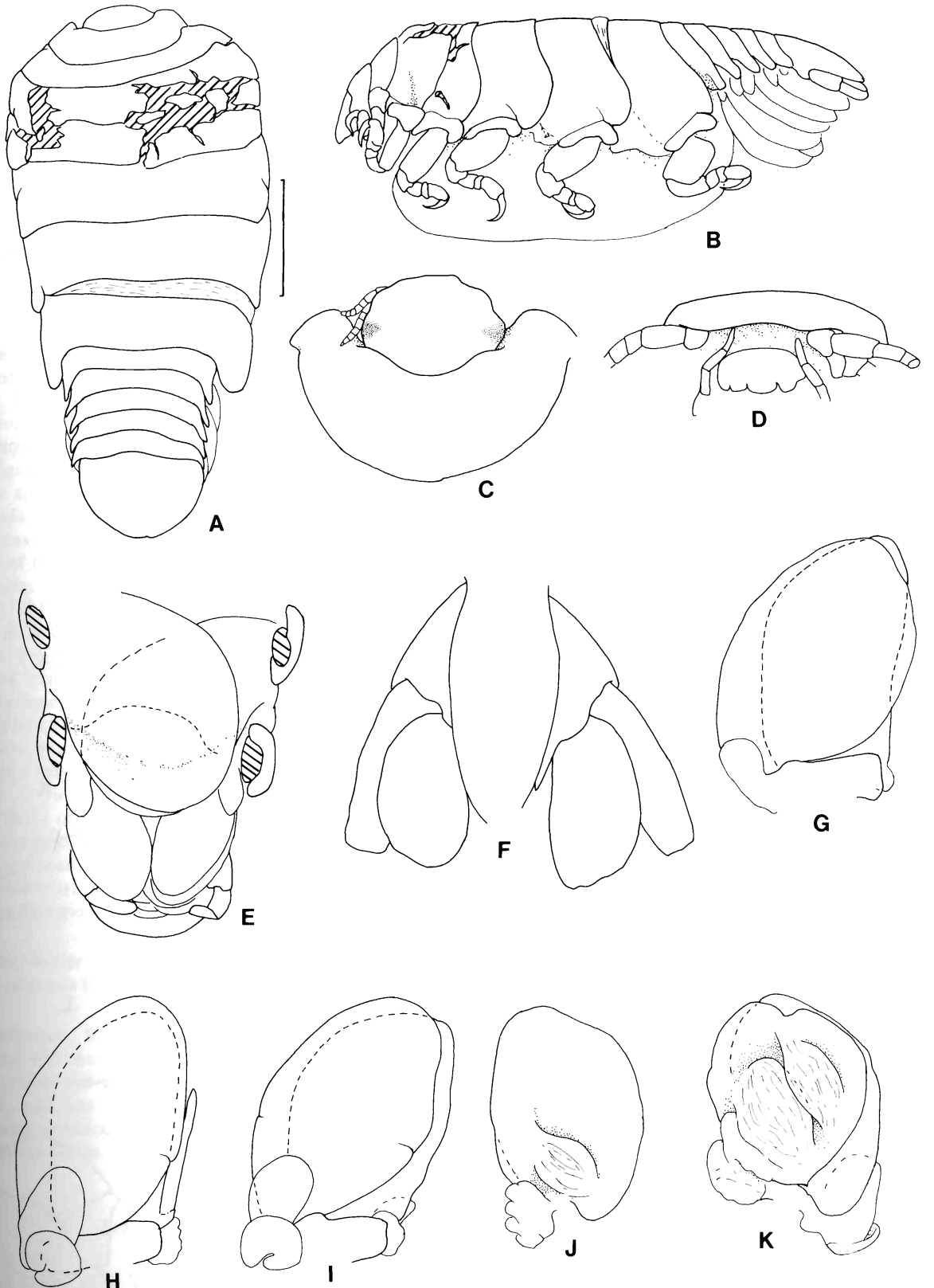

Fig.24. *Enispa irregularis*. A–C, F, 23.0 mm syntype; G–K, female 15.5 mm RMNH 61; remainder as indicated. A, dorsal view; B, lateral view; C, cephalon, pereonite 1; D, frons 19.0 mm syntype; E, posterior of brood pouch, 13.5 mm syntype; F, left and right uropods, *in situ*; G–I, pleopods 1-3 respectively; J, pleopod 3 endopod, dorsal side; K, pleopod 5 endopod dorsal view. Scale line represents 5.0 mm.

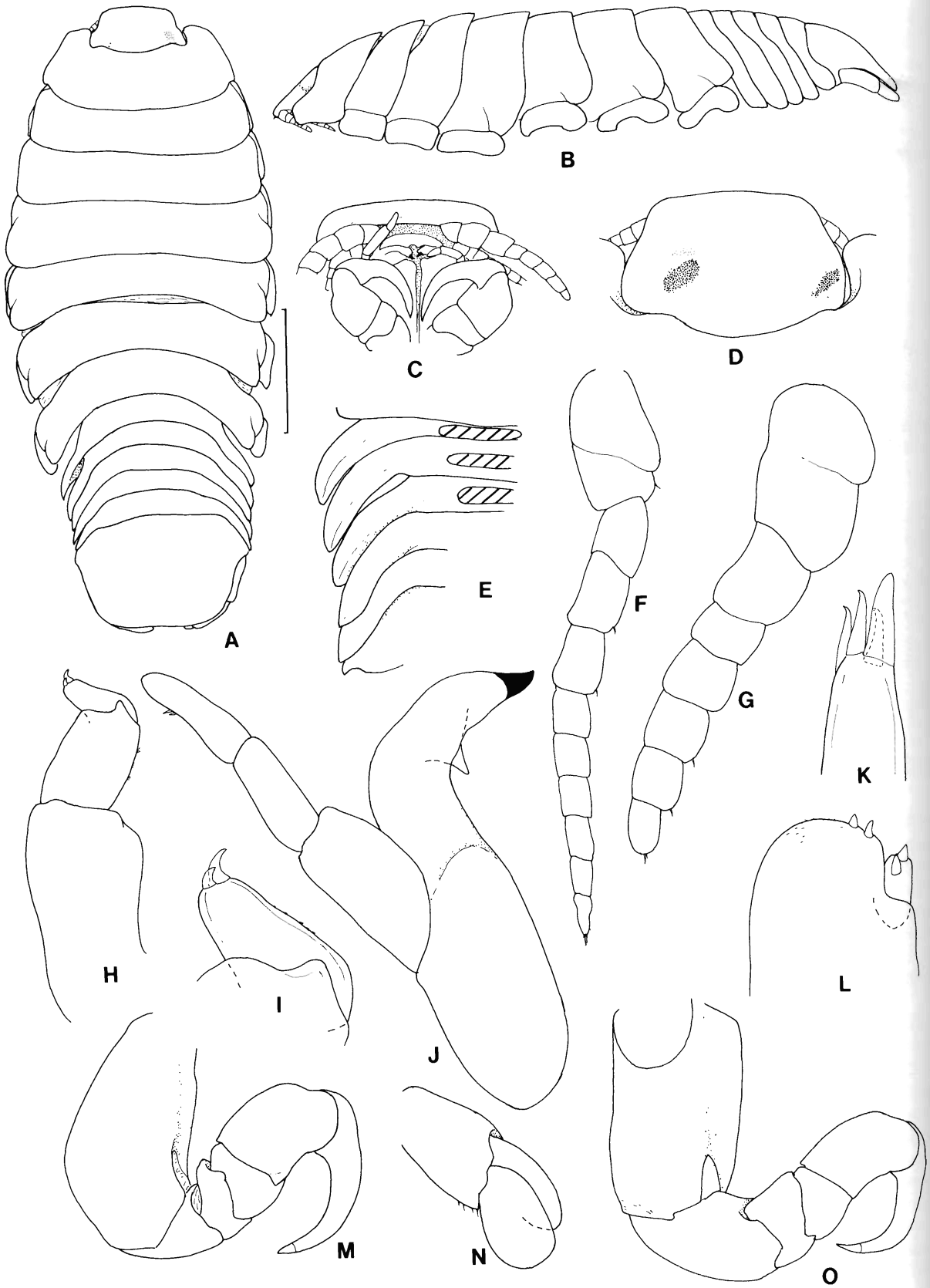

Fig.25. *Enispa irregularis*. All figs of NTM Cr6563. A, dorsal view; B, lateral view; C, frons; D, cephalon; E, right pleonites, ventral view; F, antenna; G, antennule; H, maxilliped; I, maxilliped article 3; J, mandible; K, maxillule apex; L, maxilla apex; M, pereopod 1; N, uropod; O, pereopod 7. Scale line represents 3.0 mm.

Male. Not known.

Colour. Pale tan in the Northern Territory specimen, no chromatophores apparent.

Size. 13.5-23.0 mm.

Variation. The largest syntype has the uropod rami subequal in length, with the exopod apex subtruncate and the posterior margin of the pleotelson rounded rather than subquadrate. With the limited material at hand it is not possible to assess intraspecific variation for this species.

Remarks. This species has been rarely recorded since first described; the only illustrations are of whole animals. Superficially this does look like a species of *Cymothoa*, but the pleon, pereopod and pleopod morphology clearly separates it from that genus.

The figures given by Menzies *et al.* (1955) of *Livoneca convexa* appear identical to the material at hand of *E. irregularis*, the only difference being in the spination of the maxilla of ovigerous females. In particular the uropods of the present material agrees with that figured by Menzies *et al.* (1955) rather than that figured by Brusca (1981). Brusca's (1981) material also differs in having the pleotelson posterior margin more narrowly rounded. From his remarks it is apparent that Brusca examined material from two species of Carangidae. Brusca designated a neotype and neoallotype from a very different host (Serranidae, *Serranus* sp.) to that recorded by Menzies *et al.* (Carangidae, *Chloroscombrus orqueta*) and from a very different habitat (demersal compared to pelagic). In view of the morphological differences the conspecificity of material from *Serranus* with that from *Chloroscombrus* must be questioned. Similarly, the status of *E. convexa* (*sensu* Menzies *et al.* 1955, on *Chloroscombrus*) in relation to *E. irregularis* also needs further examination.

Hosts. Haller (1880) recorded the species from *Caranx carangus* Bloch. No other host records exists.

Distribution. Reliable records are from Indonesia, Amboina and Australia. I cannot determine where Haller's (1880) material originated. The label is not clearly legible, and has a name that could equally be Madagascar or Macassar. Haller (1880) stated the locality as the Indian Ocean.

Livoneca Leach

Livoneca Leach, 1818: 351. Not *Livoneca* or *Lironeca* of all other authors.

Type species. *Livoneca redmanii* Leach, 1818. The holotype is held at the British Museum (Natural History), London (BMNH 1979: 401.1).

Diagnosis of female. Body weakly vaulted, twisted to one side. Cephalon anterior margin folded back, but not projecting between antennal bases. Posterior margin trilobed. Coxal plates as long or longer than respective segment. Pleon not immersed in pereon, pleonites becoming progressively narrower towards posterior; ventrolateral margin of pleonites 1 and 2 or 1-3 weakly bilobed.

Antenna longer than antennule, bases set wide apart, not dilated or flattened. Mandible palp articles slender, not flattened or expanded.

Pereopods robust, all with large dactylus, without expanded carina on basis. Brood pouch formed from alternately overlapping oostegites arising from coxae 1-4 and 6; those of coxae 6 longest, extending posteriorly over pleopods; anteriorly directed flap on sternite 7 forms posterior pocket. Pleopod 1 laminar, peduncle lateral margin expanded, laminar. Pleopods 2-5 with peduncle medial margin massively branchiated; pleopod 3 with branchiae on endopod proximomedial angle. Endopods 3 and 4 with posterior surface lobed, endopod of pleopod 5 massively lobed and folded. Uropod rami extending beyond posterior of pleotelson.

Composition. *Livoneca bowmani* Brusca, 1981.

Remarks. *Livoneca*, regarded as one of the largest cymothoid genera, has grown steadily in size, since first established. If the synonymy of *Ichthyoxenus* (e.g. Miers, 1880; Monod, 1931; Fryer, 1965; Lincoln, 1972) were accepted, then at the present time 90 species would be included.

Although species were regularly added to the genus since its inception, very few workers since Schiödte & Meinert (1884) have attempted to diagnose the genus. The only recent attempts to diagnose *Livoneca* are those of Brusca (1981), and Bruce (1986). The problems posed by the genus are evident when one considers that of the 15 characters listed by Brusca (1981), 13 are qualified (i.e. multistate, or prefaced by words like usually, often, generally). Of the three unqualified characters, two were specifically contradicted by the species figured in that work. Bruce (1986) in the table of characters for *Livoneca* managed six qualified characters out of ten, but qualified the entire set of characters by stating that the diversity of morphology shown by *Livoneca* was incompatible with that normally shown by a single cymothoid genus.

It is now apparent that the uncritical placing of species into *Livoneca* was, in part, due to lack of descriptive data for the type species. Consequently generic diagnoses did not so much diagnose the genus *Livoneca*, but an amalgam of species that did not readily fit into other genera. Several of the related genera such as *Elthusa*, *Enispa*, *Ichthyoxenus* and *Idusa* were similarly poorly known, without adequate descriptions of their type species, and lacked intelligible diagnoses that would have allowed separation from *Livoneca*.

It is clear now (though not from the Latin diagnosis

of Schiödte & Meinert, 1884) that most valid species belong to *Elthusa*, and that most generic diagnoses (e.g. Richardson, 1905; Menzies, 1962; Menzies & Glynn, 1968; Brusca, 1981; Bruce, 1986) more effectively diagnose *Elthusa*.

Livoneca, here redefined, differs abundantly from all but one of the former species placed in the genus. The cephalic, pereopodal, pleopodal and pleonal morphology clearly identify it as belonging to the Anilocrinae (*sensu* Bruce, 1987c). Although this may seen a large departure from the lineages proposed by Brusca (1981), on morphological criteria it fits well. Furthermore, the morphological and parasite site differences between *Nerocila lomatia* Bruce, 1988 (a branchial parasite) and *Livoneca redmanii* are slight compared to those between *L. redmanii* and genera such as *Elthusa*, *Mothocya* or *Ichthyoxenus*.

There has been long running disagreement over the correct generic spelling, authors using *Livoneca* or *Lironeca*. Arguments for the two spellings can be found in Monod (1931:5) and Sivertsen & Holthuis (1980). Under the ICZN (third edition) *Livoneca* is clearly the correct spelling (Art 32c(ii)), and this spelling should be used in future.

There are no Australian species recorded for this genus.

Marine Species Previously Placed in *Livoneca*

1. *L. atlantniroi* Kononenko, 1988. Recorded from the Bay of Biscay, here transferred to *Elthusa*.
2. *Ichthyoxenus asymmetrica* Ahmed, 1970. From Kor Abdullah, Arabian Gulf, Iraq; ectoparasitic, from an hypersaline habitat. The description and figures given for this species do not allow a generic or species assessment to be made.
3. *L. boscii* Bleeker, 1857. Malaysia, here transfered to *Catoessa* (types RMNH 67).
4. *L. bowmani* Brusca, 1981. East Pacific, differs from *L. redmanii* by having acute uropod apices. The only species other than the type species that is now retained in *Livoneca*.
5. *L. californica* Schiödte & Meinert, 1884. East Pacific, recently redescribed by Brusca (1981); here placed in *Elthusa*, but this species is in some ways similar to *Mothocya* (see Bruce, 1986).
6. *L. carryensis* Gourret, 1891. Trilles (1976b) includes this species as a synonym of *L. sinuata*.
7. *L. caudata* Schiödte & Meinert, 1884. Recorded only from Japan, here transfered to *Elthusa* (types RMNH 68).
8. *L. circularis* Pillai, 1954. Known only from India (Pillai, 1964). The generic position of this species is entirely uncertain, but it does not belong to any of the genera treated in this work.
9. *L. contracta* Miers, 1880. *Ceratothoa contracta* Miers, n.comb. is here transfered to *Ceratothoa*, the genus most appropriate for this species. The antennule, pereopod and pleon morphology all agree with *Ceratothoa* (sensu Bruce & Bowman, 1989), although the body shape is much wider. Known only from Mier's (1880) record from Australia (syntypes BMNH 1844: 105; 1846: 89).
10. *L. convexa* Richardson, 1905a. Redescribed by Brusca (1981), this species agrees totally with the genus *Enispa*. It differs from the only other species, *Enispa irregularis*, in having acute uropod apices. Brusca (1981) designated a neotype and neoallotype, but as that action did not meet the requirements of the ICZN (Art 75) with regard to habitat, host or nomenclatural problems, the neotype designation is invalid (see also comments under remarks for *Enispa irregularis*).
11. *L. cumulus* Haller, 1880. Now *Agarna cumulus*, see Trilles (1981) for synonymy.
12. *L. desmarestii* Leach, 1818. Synonym of *L. redmanii* (syntypes BMNH 1979: 33).
13. *L. dubia* Nierstrasz, 1918 and 1931. Nierstrasz (1918, 1931) published both accounts as new species (Bruce, 1987b); a synonym of *Renocila ovata*.
14. *L. ellipsoidea* Haller, 1880. There is no locality with the syntypes of this species, but examination of the types show this species to be a junior synonym of *L. redmanii* (syntypes MHNG).
15. *L. emarginata* Dana, 1853. Long accepted as a synonym of *L. redmanii* (see Trilles, 1976a).
16. *L. emarginata* Bleeker, 1857. East Indies. The type species for *Elthusa* (syntypes RMNH 66).
17. *L. engraulidis* (Barnard, 1936). Transfered to *Agarna* by Pillai (1954, 1965), later transfered to *Joryma* by Bowman & Tareen (1983).
18. *L. epimerias* Richardson, 1909. Synonym of *E. raynaudii*, present work.
19. *L. foveolata* (Hansen, 1897). Removed from *Irona* to *Livoneca* by Bruce (1986), the species is here transfered to *Elthusa*.
20. *L. frontalis* Richardson, 1910. Transfered to *Elthusa* (syntypes USNM 39504); Philippines.
21. *L. intermedia* Nierstrasz, 1931. Indonesia; I have not seen the type material of this species.
22. *L. indica* Edwards, 1840. Transfered to *Norileca*, present study.
23. *L. lata* Dana, 1853. Synonym of *L. redmanii*, present study.
24. *L. laticauda* Miers, 1877. Synonym of *E. raynaudii*, present study.
25. *L. longistylis* Dana, 1853. Accepted to be a synonym of *L. redmanii*, see Trilles (1976a) for synonymy.
26. *L. lunelli* Haller, 1880. Examination of the types show this species to be a synonym of *Elthusa emarginata* (syntypes MHNG).
27. *L. magna* Mañé-Garzón, 1979. Synonym of *E. raynaudii*, present study.
28. *L. mediterranea* Heller, 1868. Trilles (1976b) includes this Mediterranean species under the synonymy for *Livoneca sinuata*. This species is similar to *Livoneca sensu strictu*, but needs further

description before its correct generic position can be ascertained.

29. *L. menziesi* Brusca, 1981. East Pacific; transfered to *Elthusa*.
30. *L. methipia* Schiödte & Meinert, 1884. I have not seen the types of this species, but it appears to belong to *Elthusa*. Known only from Rio de Janeiro.
31. *L. micronyx* Miers, 1880. Mauritius; the habitat of this species is not known, but the morphology agrees with *Ichthyoxenus*.
32. *L. nanoides* (Stebbing, 1905). Transfered to *Livoneca* from *Irona* by Bruce (1986), now transfered to *Elthusa*.
33. *L. nasicornis* Nierstrasz, 1917. Long recognised as a synonym of *Argathona rhinoceros* (Family Corallanidae) (see Bruce, 1982).
34. *L. neocytta* Avdeev, 1975. To *Elthusa*, present work.
35. *L. novaezelandiae* Miers, 1874. Synonym of *E. raynaudii*, present work.
36. *L. ochotensis* Kussakin, 1979. Transfered to *Elthusa*; this species is very similar to *E. raynaudii*. Sea of Ochotsk.
37. *L. olivacea* De Kay, 1844. Listed as a synonym of *L. ovalis* by Kussakin (1979) and on that basis here included as a synonym of *L. redmanii*.
38. *L. ornata* Heller, 1868. Listed as a junior synonym of *L. indica* by Trilles (1976a). I have not seen the type material for this species and can make no comment.
39. *L. ovalis* (Say, 1818). Synonym of *L. redmanii*, Trilles (1976a) and present study.
40. *L. panamensis* Schiödte & Meinert, 1884. Synonym of *Elthusa vulgaris*, see Brusca (1981) for synonymy.
41. *L. parva* Nierstrasz, 1915. Transfered to *Elthusa* (holotype RMNH 71); Indonesia.
42. *L. philippinensis* Richardson, 1910. Transfered to *Elthusa* (types USNM 40916); Philippines.
43. *L. plagulophora* Haller, 1880. Transfered to *Mothocya* by Bruce (1986).
44. *L. pomatoi* Gaillat Airoldi, 1940. *Incerta sedis*, current descriptions of this species do not allow for generic assessment; most recently treated by Trilles (1976b); Mediterranean.
45. *L. pontica* Borcea, 1933. Probable synonym of *Mothocya taurica*, see Bruce (1986) for discussion; Mediterranean.
46. *L. propinqua* Richardson, 1910. To *Elthusa*, present work.
47. *L. pterygota* Koelbel, 1879. Synonym of *Agarna cumulus*, see Trilles (1981).
48. *L. puhi* Bowman, 1962. This species is most similar to *Ichthyoxenus minabensis*, from which it differs by having a bluntly rounded anterior margin to the cephalon, wider pleon and narrower uropod exopod. As it agrees with the diagnosis given here for *Ichthyoxenus* it is transfered to that genus. *L. puhi* was collected from moray eels.
49. *L. punctata* Uljanin, 1872. Probable synonym of *Mothocya taurica*, see Bruce (1986) for discussion.
50. *L. raynaudii* Edwards, 1840. To *Elthusa*, present work.
51. *L. rafineskii* Leach, 1818. Examination of the syntypes (BMNH 1979: 338) show this to be a synonym of *L. redmanii*, not of *E. raynaudii* as suggested by some authors (Sivertsen & Holthuis, 1980; Trilles, 1976a).
52. *L. redmanii* Leach, 1818. Type species for the genus; Caribbean.
53. *L. renardi* Bleeker, 1857. Belongs to *Mothocya*, see Bruce (1986) for synonymy.
54. *L. reniformis* Menzies & Frankenberg, 1966. The description of this species does not allow for generic assessment, it may belong to *Idusa*; Georgia, USA.
55. *L. ricinoides*. Referred to by Risso (1816), current status uncertain.
56. *L. sacciger* Richardson, 1909. To *Elthusa*, present study.
57. *L. samariscii* Shiino, 1955. Transfered to *Elthusa*; the species clearly does not belong to *Livoneca*, but the description is not sufficiently detailed to be sure of its generic position; Japan.
58. *L. samoensis* Schiödte & Meinert, 1884. Transfered to *Elthusa*; Samoa. I have not seen the types of this species.
59. *L. sinuata* Koelbel, 1879. Trilles (1976b) places the older name *L. mediterranea* as a questionable synonym; Mediterranean.
60. *L. soudanensis* Richardson, 1911. *Incerta sedis*; there exists only a brief description without figures for this West African species; Trilles (1976a) has given a photograph of the holotype.
61. *L. splendida* Moreira & Sadowsky, 1981. Brazil. Very similar to *E. raynaudi*, appearing to differ only in having the posterior margin of pereonite 7 more deeply indented.
62. *L. stewarti* Filhol, 1885. Synonym of *E. raynaudii*, present study.
63. *L. taurica* (Czerniavsky, 1868). Transfered to *Mothocya* by Bruce (1986), the status of this species and synonyms is uncertain; Black Sea.
64. *L. tenuistylis* Richardson, 1912. Atlantic Panama. From Richardson's (1912) description and figures and that the position on the host was between pectoral and pelvic fins, it would appear that this species belongs with one of the externally attaching anilocrine genera.
65. *L. texana* Pearse, 1952. *Incerta sedis*; I have not seen the type material, nor any adequate figures for this species; Gulf of Mexico.
66. *L. triangulata* Richardson, 1910. To *Norileca*, present work.
67. *L. triloba* De Kay, 1844. Listed in the synonymy of *L. ovalis* Kussakin (1979), and therefore now accepted as a synonym of *L. redmanii*.
68. *L. tropicalis* Menzies & Kruczynski, 1983. Transfered to *Elthusa*; Gulf of Mexico.
69. *L. turgidula* Hale, 1926. To *Elthusa*, present work.
70. *L. vulgaris* (Stimpson, 1857). Transfered to *Elthusa*; an East Pacific species, recently redescribed by Brusca (1981).

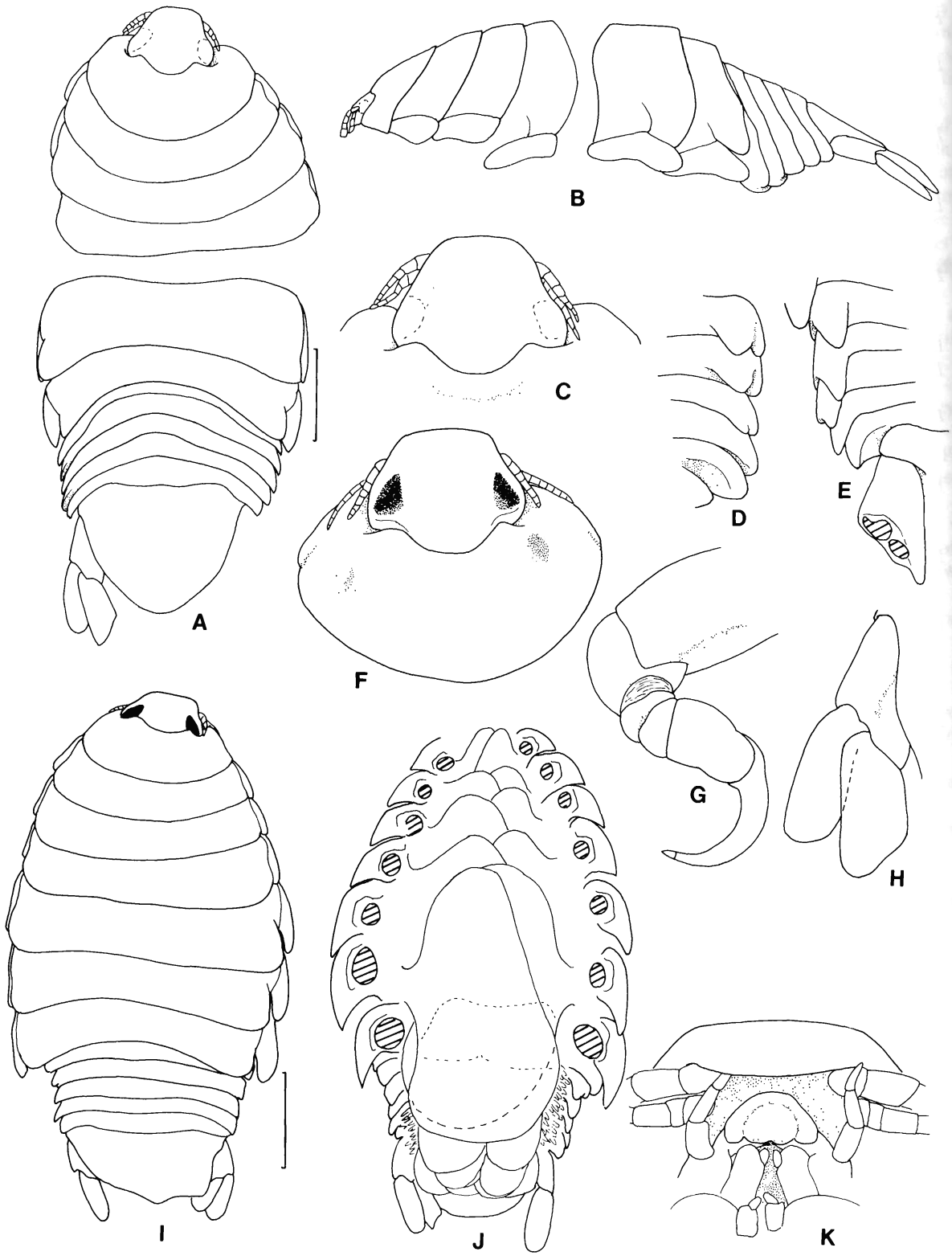

Fig.26. *Livoneca redmanii*. A–D, G, H, holotype, remainder female #1, USNM 171630. A, dorsal view; B, lateral view; C, cephalon; D, right pleonites, dorsolateral view; E, right pleonites, ventral view; F, head, pereonite 1; G, pereopod 1; H, left uropod, *in situ*; I, dorsal view; J, ventral view of brood pouch; K, frons. Scale line represents 4.0 mm.

Livoneca redmanii Leach

Figs 26,27

Livoneca Redmanii Leach, 1818: 352.–Desmarest, 1825: 308.–Lucas, 1850: 251.
Livoneca Desmarettii Leach, 1818: 352 (lapsus).
Livoneca Rafineskii Leach, 1818: 352.–Desmarest, 1825: 308.
Cymothoa ovalis Say, 1818: 394.–de Kay, 1844.
Livoneca Desmarestii.–Desmarest, 1825: 308.–Edwards, 1839: pl.66, fig.3a-e.–Edwards, 1840: 261.–Lucas, 1850: 251.
Livoneca Desmaresti.–Bosc, 1830: 146.–Gerstaecker, 1882: 267.
Livoneca Redmanii.–Edwards, 1839: pl.66, figs 4-4a.–Edwards, 1840: 261.
Cymothoa triloba de Kay, 1844: 46, pl.10, fig.40.
Lironeca Redmanii.–White, 1847: 109.
Lironeca Desmarestii.–White, 1847: 109.
Lironeca Raffineskii.–White, 1847: 109.
Lironeca ovalis.–White, 1847: 109.–Alperin, 1966: 122.–Menzies & Frankenberg, 1966: 9.–Schultz, 1969: 164, fig.249.–Overstreet, 1978: 48, fig.49.–Williams & Williams, 1979: 123.–Kussakin, 1979: 296, figs 162,163.–Moreira & Sadowsky, 1979: 111.–Ellis, 1981: 124.
Livoneca rafineskii.–Lucas, 1850: 251.
Livoneca longistylis Dana, 1853: 754, pl.50, fig.3a-b.
Livoneca emarginata Dana, 1853: 755, pl.50, fig.4a-b (not *L. emarginata* Bleeker, 1857).
Livoneca lata Dana, 1853: 756, pl.50, fig.51-c.
Livoneca ovalis.–Harger, 1873: 572, pl.6, fig.29.–Harger, 1880a: 162.–Harger, 1880b: 395, 428, 434, pl.11, fig.67a-f.–Gerstaecker, 1882: 267.–Stebbing, 1893: 352.–Richardson, 1900: 222.–Richardson, 1905: 263, figs 276,277.–Rathbun, 1905: 4, 39.–Summer, Osborn & Cole, 1913: 658.–Light, 1937: 71, figs 1-4.–Behre, 1950: 18.–Miner, 1950: 442, pl.143.–Briggs, 1970: 55.
Livoneca ellipsoidea Haller, 1880: 386, pl.18, figs 16,17.
Livoneca Redmanni.–Gerstaecker, 1882: 265.–Schiödte & Meinert, 1884: 353, pl.14, figs 6-12.–Stebbing, 1893: 352.
Livoneca redmanni.–Richardson, 1905: 261, figs 274,275.–Van Name, 1925: 462.–Gurjanova, 1936: 86.–Menzies, 1962: 115.–Kussakin, 1979: 294.
Lironeca redmanni.–Hutton, 1964: 447.–Menzies & Frankenberg, 1966: 9.–Menzies & Glynn, 1968: 46, fig.4D-G.–Schultz, 1967: 163, fig.247.–Menzies & Kruczynski, 1983: 40, 58.
Lironeca redmanii.–Trilles, 1976a: 774, pl.1, fig.2.–Trilles, 1981: 594, pl.4, figs 19-22.
Lironeca redmani.–Ellis, 1981: 124.

Material examined. HOLOTYPE (about 25.0, in 2 pieces), Jamaica (Whites Ms catalogue no 213), coll. Redman, presented by W.E. Leach (BMNH 1979:410.1). 2 females, syntypes of *L. ellipsoidea*, no original label (MHNG). 5 females (ovigerous 21.0, 22.0, 22.0, 23.0), male 15.0, Gulf of Morrosquillo, Colombia, about 9°30'N 76°21'W, 28 Nov. 1968, from gills of *Scomberomorus cavalla* (King Mackeral) (USNM 171630).

Remarks. Detailed figures are given here to fully illustrate the generic characters of *Livoneca*. Similarly the species can be identified from these figures. It can be seen from the synonymy that *Livoneca redmanii* is a widely recorded species, with a distribution extending from the Caribbean along the eastern United States seaboard as far north as Wood's Hole, Massachusetts (Richardson, 1905). It can easily distinguished from the only congener, the allopatric *Livoneca bowmani* by bluntly rounded rather than acute uropod apices.

Norileca n.gen.

Type species. *Livoneca indica* Milne-Edwards, 1840.

Diagnosis of female. Body weakly vaulted, twisted to one side. Cephalon posterior margin weakly or not trilobed. Coxae narrow, those of pereonites 3-7 shorter than respective segment; those of 5-7 as long as respective segment. Pleon not immersed in pereon; pleonite 1 longest; pleonites 1-5 becoming progressively narrower.

Antennule subequal to, or shorter than antenna, bases set wide apart. Mandible palp article 2 flattened, greatly expanded. Maxilliped without oostegital lobes. Pereopods without expanded lobes; bases without expanded carina. Brood pouch made up from pairs of alternately overlapping oostegites arising from coxae 2-5. Pleopods 1-4 with laminar rami; peduncles 2-5 with laminar lobe on lateral margin; endopods 3-5 with folded proximomedial lobe; endopod 5 with 2 large folded lobes, distal margin medially indented. Pleopods 1-5 progressively increasing in size.

Composition. *Norileca triangulata* (Richardson, 1910) n.comb.

Remarks. This genus is most similar to *Livoneca* with which it shares a similar percopod, cephalon and pleon morphology. *Norileca* has the cephalon weakly trilobed, and the lateral margin of pleonites 1 to 3 are never bilobed. Other major differences to *Livoneca* are the expanded mandible palp article, lack of folds on endopods of pleopods 3 and 4 and lack of branchiated pleopod peduncles.

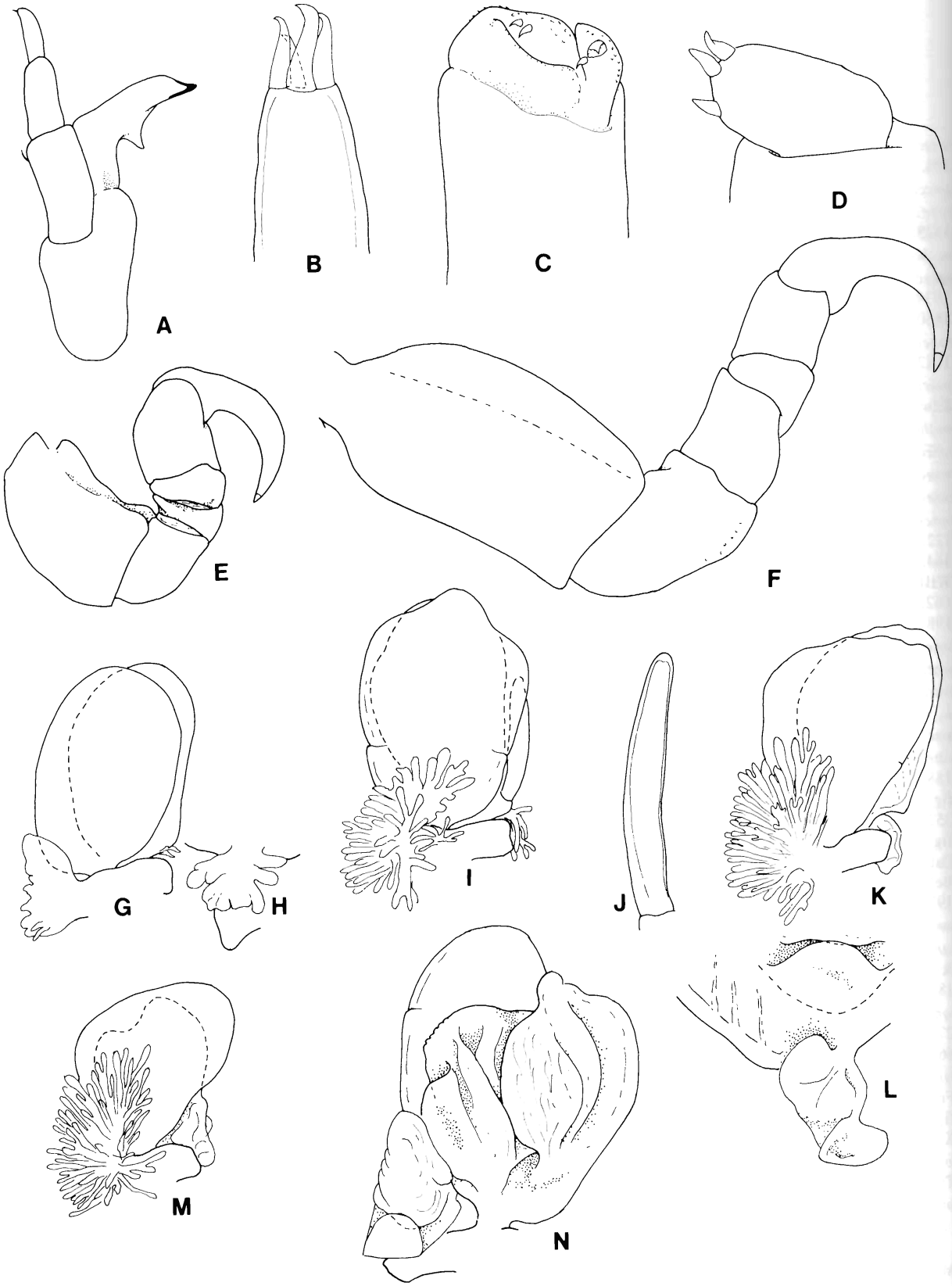

Fig.27. *Livoneca redmanii*. All figs of female #1, USNM 171630. A, mandible; B, maxillule apex; C, maxilla apex; D, maxilliped article 3; E, pereopod 1; F, pereopod 7 (dashed line indicate start of carina); G, pleopod 1; H, pleopod 1 endopod, dorsal proximomedial angle; I, pleopod 2; J, appendix masculina; K, pleopod 3; L, pleopod 3 endopod, dorsal proximomedial angle; M, pleopod 5; N, pleopod 5 dorsal view (branchiae omitted).

Key to the Species of *Norileca*

1. Body weakly twisted to one side, pleonite 5 manifestly narrower than pleonite 1; maxilliped palp article 2 about as long as article 3 ..... *N. triangulata*

—— Body twisted to one side, pleonite 5 about as wide as pleonite 1; maxilliped palp article 2 about 3 times as long as article 3 ..... *N. indica*

Norileca indica (Milne-Edwards) n.comb.

Figs 28, 29

Livoneca indica Milne-Edwards, 1840: 262.–Bleeker, 1857: 21.–Gerstaecker, 1882: 261.–Schiödte & Meinert, 1884: 362, pl.15, figs 3-6.–Richardson, 1910: 24.–Nierstrasz, 1915: 99.–Nierstrasz, 1931: 142.–Borcea, 1933: 482.–Beumer, *et al.*, 1982: 33.

Lironeca indica.–Trilles, 1976: 77, pl.2, fig.3.–Trilles, 1979: 266.–Avdeev, 1978: 281.–Rokicki, 1982: 205, figs 1, 2.

Livoneca ornata Heller, 1868: 145, pl.12, fig.15.–Gerstaecker, 1882: 261.

Material examined. Female (non-ovigerous 17.0), male (11.0), Table Head, Port Essington, Cobourg Peninsula, NT, 11°14'S 132°11'E, 10 Sept. 1985, surface night light, coll. R. Williams (NTM Cr6700). Male (11.0), as previous, but on *Herklotichthyes* sp. (NTM Cr4051). Female (non-ovigerous 28.0), Arafura Sea, NT, 10°26.5'S 136°07.0'E, 22 Nov. 1980, in gill chamber of *Selar crumenophthalmus* (AM I21956-006), 58 m depth, coll. AM, FRV *Soela* (AM P37760).

Additional material examined. 3 females, 2 males, *Siboga* Expedition Stn 172, Gisser, 26-28 Aug. 1899, reported on by Nierstrasz (1931) (ZMA). All Arafura Sea. Female, 10°22'S 136°35'E, 12 Nov. 1986, coll. W. Houston (NTM Cr4646). Female, 10°08.3'S 136°45.5'E, 17 Mar. 1985, coll. W. Houston (NTM Cr3263). Male, BYBE 2, 19 June 1987, 80 m (NTM Cr5886). Female, 10°20'S 134°22'E, 11 June 1987, 59 m, coll. NT Fish. Observer (NTM Cr5889).

Type material. Holotype held at the Muséum Nationale d'Histoire Naturelle, Paris.

Type locality. Milne-Edwards (1840) gave Sumatra as the type location.

Description. Body about 2.4-2.5 times as long as wide, twisted to one side; widest at pereonite 4; dorsum moderately convex with ill-defined longitudinal median ridge. Cephalon not deeply immersed in pereonite 1, anterior margin subtruncate; eyes 0.47-0.52 width of cephalon. Pereonite 1 with posterolateral angles weakly produced. Coxae of pereonite 2 as long as segment; coxae of pereonites 3-7 all about 0.8 as long as respective segment. Posterior margin of pereonite 7 weakly concave. Pleon 0.66-0.74 width of pereonite 4, with all segments about as wide as pereonite 7, pleonite 5 as wide as pleonite 1; lateral margins posteriorly directed. Pleotelson triangular, anteromedial surface vaulted.

Antennule extending to pereonite 1, bases set wide apart, composed of 8 articles; antenna slightly longer than antennule, with 9 articles. Mandible with large palp, article 2 flattened, expanded; article 3 0.35 as long as article 2. Maxilliped article 3 with 4 large recurved spines.

Pereopod 1 ischium 0.69 length of basis; dactylus curving abruptly at about proximal 0.2 of its length, extending to anterior of carpus, which has recess that receives dactylus apex. Pereopods 2 and 3 similar to 1 but slightly longer. Pereopods 4-7 similar to each other; pereopod 7 ischium 1.03 length of basis, dactylus extends to posterior of carpus which has recess that receives dactylus apex; propodal palm with 2 small spines.

Pleopods not examined in detail, but appear essentially the same as that of male, but appendix masculina absent. Uropods about 0.55-0.60 length of pleotelson, rami subequal in length, apices rounded; endopod slightly tapered.

Male. Body not twisted, lateral margin sub-parallel. Coxae longer than in female. Pleon 0.73 width of pereon. Uropods about 0.8 length of pleotelson. Pereopod 1 with 5 small spines on propodal palm. Pleopod 1 peduncle with lateral lobe, pleopods 2-5 with peduncle lateral lobe expanded. Pleopod 2 with appendix masculina as long as endopod. Pleopods 3-5 endopods with folded proximomedial lobe. Pleopod 5 endopod distal margin medially indented, posterior surface complexly folded.

Colour. Pale brown, black chromatophores over dorsal surface, particularly on pleon, and also pleotelson which appears black.

Size. Present material 17-28 mm, Trilles (1976) reports 18-33 mm for ovigerous females, and records 13 non-ovigerous females (without locality) from 10.5-17.0 mm. It is possible that the smaller of these could be *L. triangulata*.

Variation. In both female specimens, the pleotelson is distorted. The specimen from *Selar crumenophthalmus* has a more distinct mediodorsal ridge, and has the

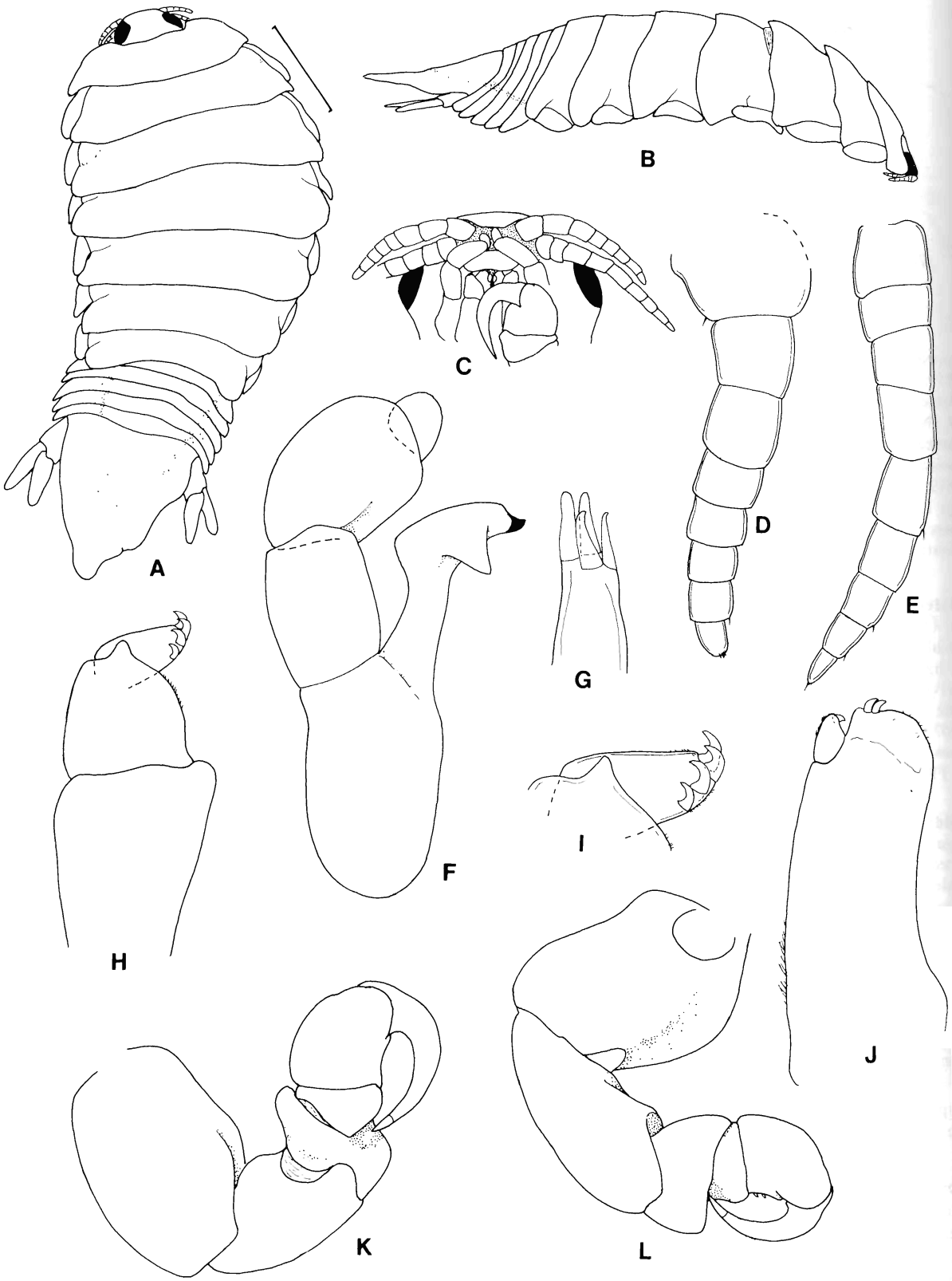

Fig.28. *Norileca indica*. All figs of female 17.0 mm NTM Cr6700. A, dorsal view; B, lateral view; C, frons; D, antennule; E, antenna; F, mandible; G, maxillule apex; H, maxilliped; I, maxilliped article 3; J, maxilla; K, pereopod 1; L, pereopod 7. Scale line represents 3.0 mm.

pleonites more strongly produced.

Remarks. This species can easily be distinguished from *Norileca triangulata* by the larger size, twisted body shape, straight sided pleon, shorter uropods and shorter mandible palp article 3.

The pleopods of both females were damaged and fragile, and could not be dissected and described. Pleopods of females always have the folding on the lobes more developed than males. As can be seen the folding and lobes are already well developed in the male specimen and females will have similar pleopods but with more complex folding.

Hosts. *Selar crumenophthalmus* and *Herklotichthyes* sp. The specimen on *S. crumenophthalmus* was positioned ventrally in the gill cavity, cephalon to the anterior with the sternum facing out (i.e. laterally) (see fig. 1, Rokicki, 1982); three pereopods had their dactyli hooked around the gill operculum. The gill itself was considerable atrophied. Avdeev (1978) recorded *Atule melan* and *Rasteliger kanangurta*; Rokicki (1982) recorded *Selar crumenophthalmus*.

Distribution. Present material is all from the Arafura Sea, off the Northern Territory coast. Previous records Sumatra, Indonesia, Philippines and New Guinea (Trilles, 1976) and off Mozambique (Rokicki, 1982). Avdeev (1978) lists the species from north-western Australia.

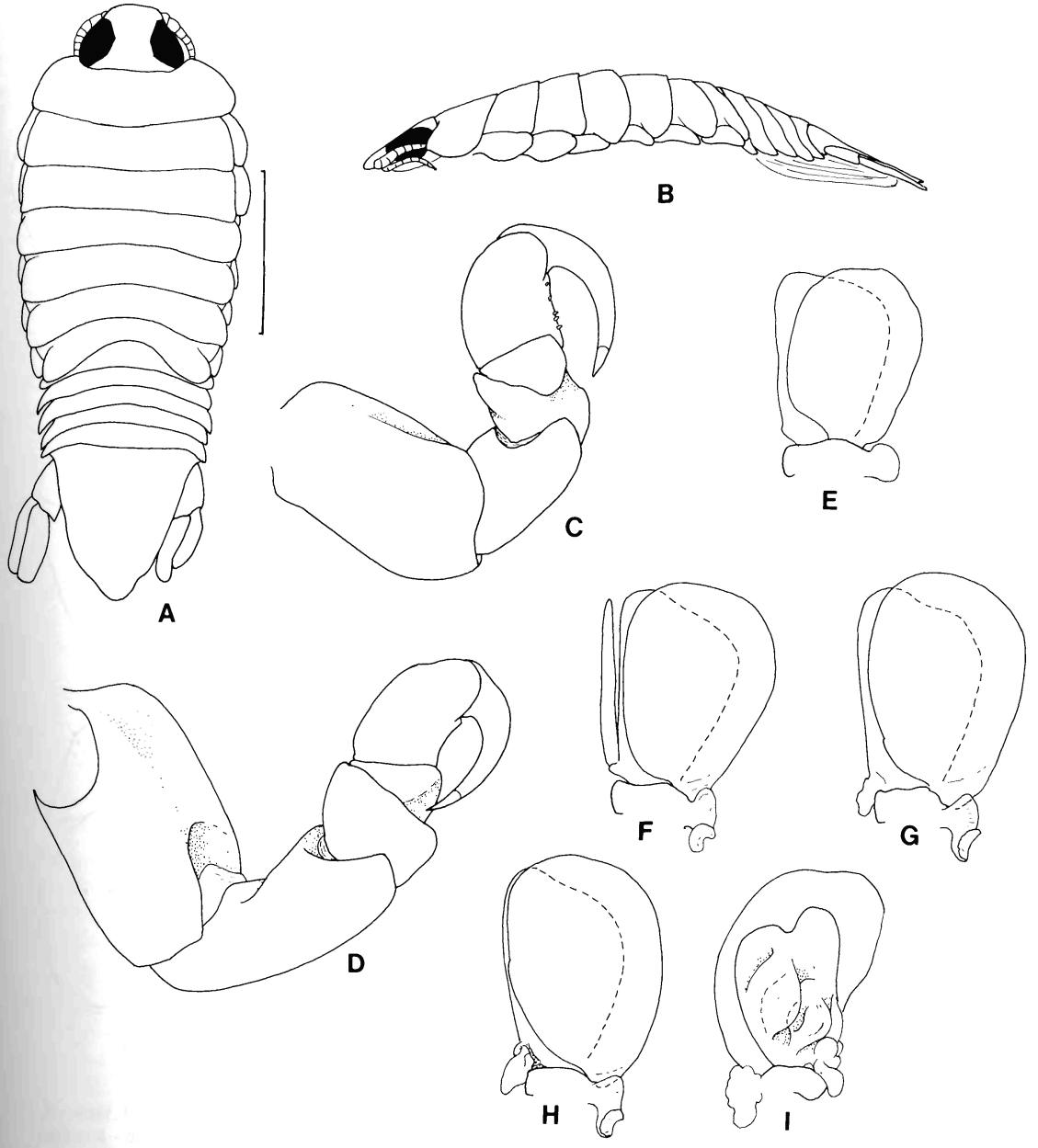

Fig.29. *Norileca indica*. All figs of male 11.0 mm, NTM Cr4051. A, dorsal view; B, lateral view; C, pereopod 1; D, pereopod 7; E–I, pleopods 1-5 respectively. Scale line represents 3.0 mm.

Norileca triangulata (Richardson) n.comb.

Figs 30, 31

Livoneca triangulata Richardson, 1910: 23, fig.22.– Nierstrasz, 1931: 143.

Material examined. Syntypes, 2 females (ovigerous 9.2, 9.5), male (9.0), Tanimdao Island, Philippine Islands, 25 Feb. 1908, anchorage, at night light, US Bureau of Fisheries Philippine Albatross Expedition 1907-8 (USNM 40915).

Australian material. Female (non-ovigerous 12.5), Eel Reef, Cape York, Qld, 12°32'S 143°32'E, 20 Feb. 1979, surface light over 55 m, gill of *Parexocoetus brachypterus* coll. AM-AIMS (AM P37759). Female (non-ovigerous 12.0), 2 males (7.5, 9.0), off Michaelmas Cay, Great Barrier Reef, 16°42'S 146°10'E, May-June 1926, on *Parexocoetus brachypterus* (Fish No. IA-2784, IA-2786), coll. T. Iredale & G.P. Whitley (AM P37737), P37758). Female (ovigerous 17.5), Mooloolabah, south-eastern Qld, 2 May 1985, on gills of *Sardinella gibbosa*, coll. C. Keenan (QM W13112).

Type locality. Tanimdao Island, Philippines (Richardson, 1910).

Description of Australian females. Body 2.2-2.5

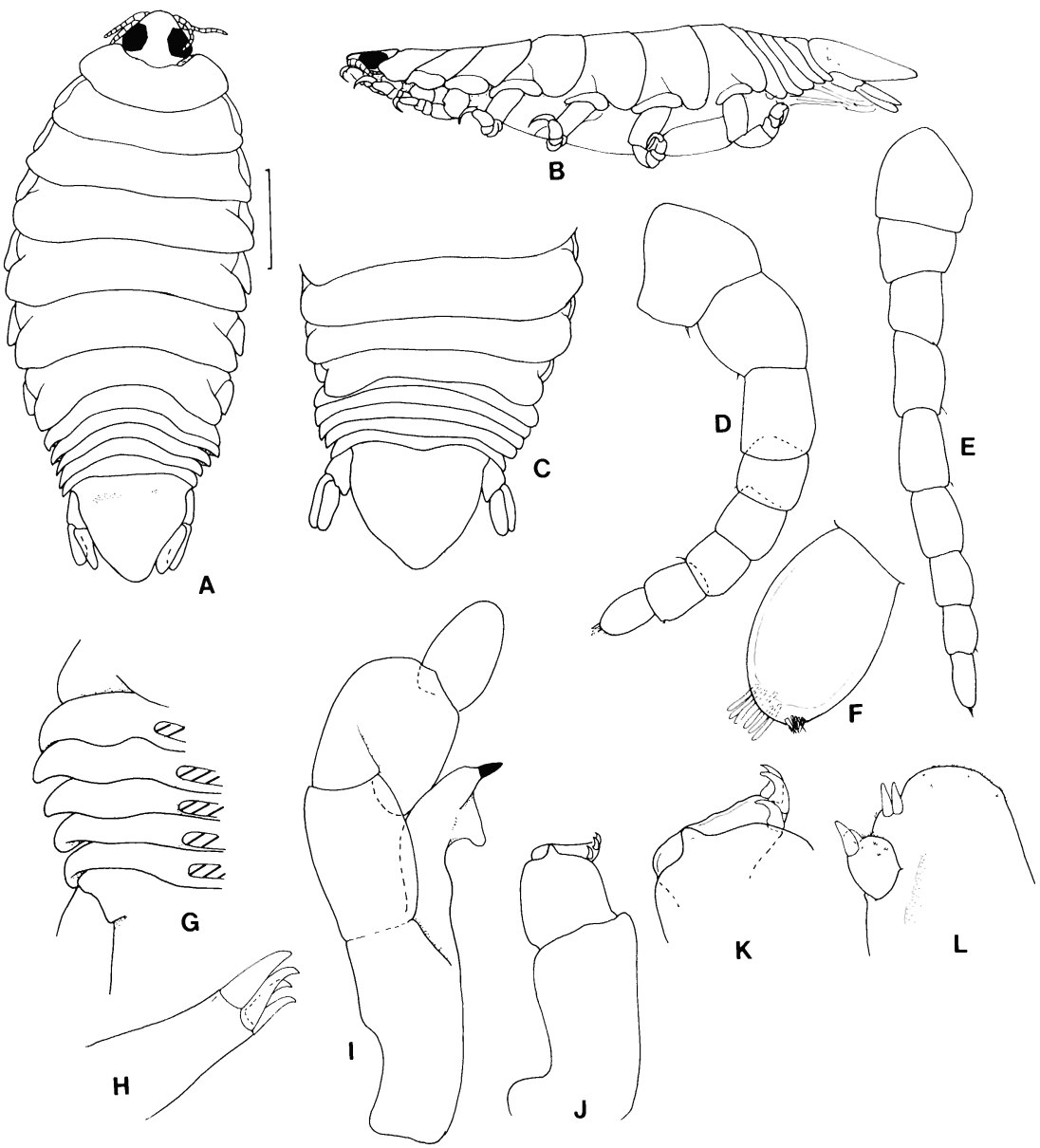

Fig.30. *Norileca triangulata*. All figures of female ex *Sardinella gibbosa*, except C. A, dorsal view; B, lateral view; C, posterior, female 12.5 mm Cape York; D, antennule; E, antenna; F, antennule terminal article; G, right pleonites, ventral view; H, maxillule apex; I, mandible; J, maxilliped; K, maxilliped article 3; L, maxilla apex. Scale line represents 3.0 mm.

times as long as wide, weakly twisted; widest at pereonite 4 or 5; dorsum weakly convex. Cephalon not deeply immersed in pereonite 2; eyes 0.6-0.7 width of cephalon; anterior margin smoothly rounded, not turned down. Coxae of pereonite 2 as long as segment; those of pereonites 3-4 shorter than respective segment. Coxae all narrow, from 0.46 as wide as long (pereonite 2) to 0.23 as wide as long (pereonites 4-6). Pereonite 7 posterior margin with moderate indentation. Pleonite 1 longest, as wide or slightly wider than pereonite 7; pleonite 5 distinctly narrower than 1 (0.75-0.83 or wider). Pleotelson triangular.

Antennule bases set widely apart; extends to pereonite 2, composed of 8 articles. Antenna slightly longer, with 9 articles. Mandible palp large, article 2 expanded; article 3 0.77 as long as article 2. Maxillule with 4 terminal spines. Maxilla with 2 spines each on medial and lateral lobes. Maxilliped with laminar lobes; article 3 with 3 large recurved spines.

Pereopod 1 with ischium 0.80 as long as basis; propodus with 5 spines on palm; dactylus abruptly angled at proximal 0.2, extending to merus. Pereopods 2 and 3 similar to 1, but pereopod 2 with 3 spines on propodal palm, and pereopod 3 without. Pereopods 4-7 similar to each other, all bases with distinct anterolateral carina. Pereopod 7 basis and ischium subequal in length; dactylus extending to posterior of carpus.

Pleopod 1 rami round, peduncle lateral lobe weakly developed; pleopods 2-5 with peduncle lateral lobe well developed. Pleopods 3-5 endopods with folded

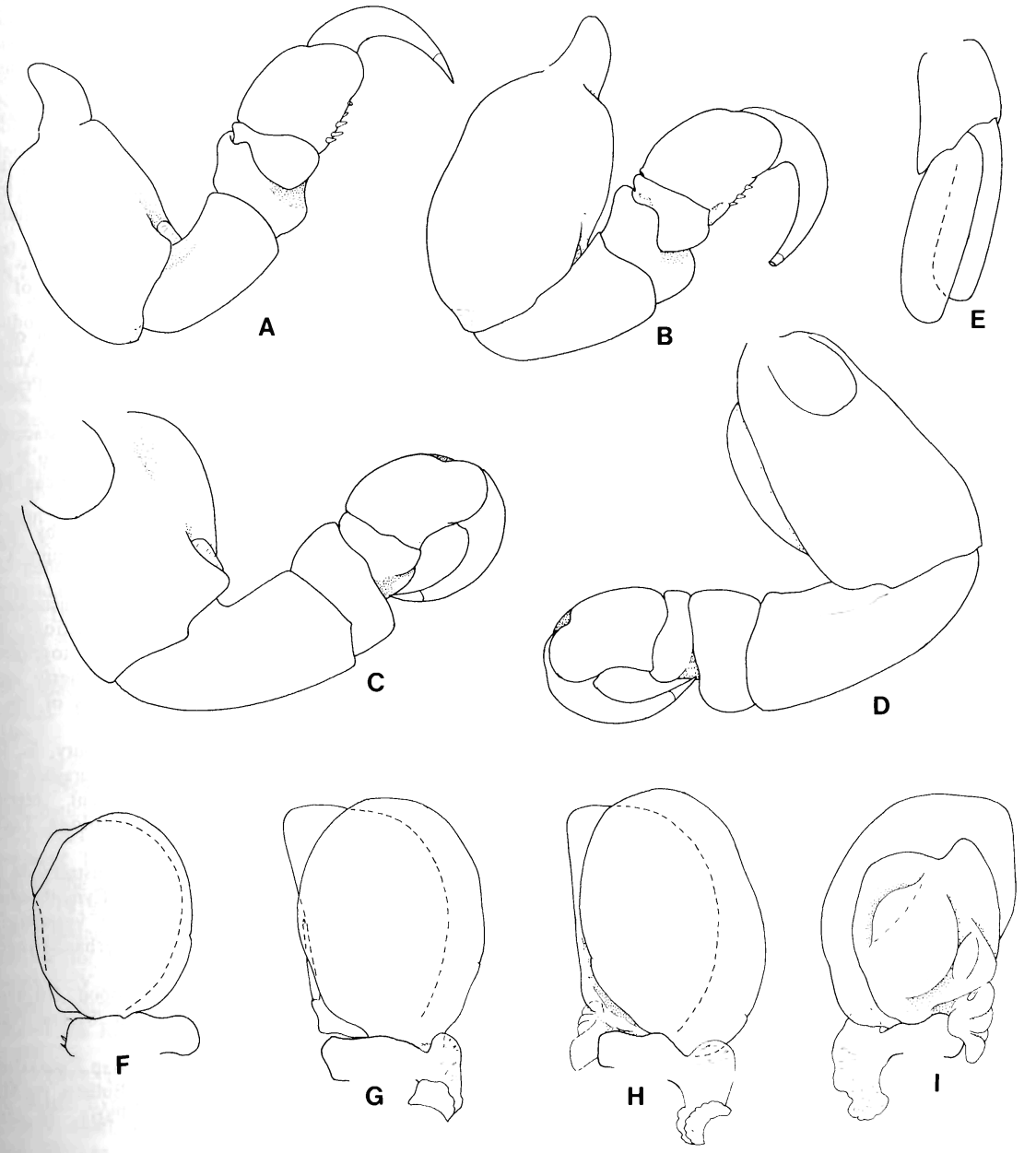

Fig.31. *Norileca triangulata*. All figs of female ex *Sardinella gibbosa*. A–D, pereopods 1, 2, 6, 7 respectively; E, uropod; F–I, pleopods 1, 2, 4, 5 respectively. Scale line represents 3.0 mm.

proximomedial lobe; pleopod 5 endopod posterior surface complexly folded. Uropods about 0.75 length of pleotelson, endopod slightly longer than exopod, both rami subequal in length.

Male. Both males (a pair from one host) are in very poor condition, but appendages do not differ significantly from those of the females.

Colour. Pale tan in alcohol, with chromatophores thinly spread on dorsal surfaces.

Size. Ovigerous females from 9.2-17.5 mm, males 7.5-9.0mm.

Remarks. This species is characterised by a nearly flat dorsum, large eyes, cephalon weakly immersed in pereonite 7, weakly twisted body, mandible palp article 2 greatly expanded, pleonite 5 narrower than 1 and triangular pleotelson.

Norileca triangulata can be distinguished from *N. indica* by several characters, the easiest to observe being the nearly straight body, larger eyes, pleonite 5 narrower than 1 and the proportionally longer uropods. Other characters are discussed under the 'Remarks' for *N. indica*. A further difference between the two species is that *N. triangulata* attaches with sternites innermost, while *N. indica* attaches with sternites outermost. Host and capture data indicate that both species occur on surface schooling fishes.

Hosts. Present material from *Parexocoetus brachypterus*, *Sardinella gibbosa*.

Distribution. Philippine Islands (Richardson, 1910); present material from Queensland — Eel Reef, Cape York; Michaelmas Cay, near Cairns; and Mooloobah, south-eastern Queensland.

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