

Key to and Checklist of the Inland Aquatic Amphipods of Australia

J.H. BRADBURY & W.D. WILLIAMS

Department of Environmental Biology, University of Adelaide SA 5005, Australia

jbradbury@zoology.adelaide.edu.au

ABSTRACT. A key to the 74 known species of amphipods inhabiting Australian inland waters is given, as well as a glossary of terms, illustrations, checklist to the species and taxonomic references.

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The amphipods of Australian inland waters have been neglected taxonomically; they are often difficult to collect, frequently cryptic, difficult to identify and have few obvious characters. The result is that amphipods have not been used as environmental indicators by aquatic biologists involved in environmental surveys and the management of water resources, despite their role as significant components of freshwater and other inland aquatic ecosystems and their sensitivity to environmental degradation.

In recent years new foundations for the taxonomy of Australian freshwater amphipods have been published (Williams & Barnard, 1988, Barnard & Williams, 1995). These have promoted subsequent taxonomic works (Bradbury & Williams, 1995, 1996, 1997b; Bradbury *et al.*, 1998), and since 1995 the number of described Australian freshwater amphipod taxa has increased to over 70 species. Nevertheless, more species remain to be described.

Available keys are of limited use in that they are now outdated (e.g., Barnard & Barnard, 1983), address only certain parts of the fauna (e.g., Williams & Barnard, 1988), provide information at higher levels only (e.g., Horwitz *et al.*, 1995), or relate to marine taxa (e.g., Barnard, 1969). This new key, based on contemporary knowledge, enables the identification to species level

of all described Australian inland aquatic amphipods. Figures provided with this key indicate characters of taxonomic importance. A glossary of terms and checklist of all species including author and date and type locality are included.

We have drawn on various sources, particularly original descriptions, as well as available keys, and have re-examined specimens where necessary. Some areas of uncertainty exist: the considerable diversity of Tasmanian species means that many new taxa have yet to be described. Among mainland populations, too, new species have been identified and await description; hypogean specimens from several areas, including Tasmania, South Australia, Queensland and Western Australia, are in the process of analysis. Specimens which do not easily key to a taxon, therefore, are likely to be new to science, unless of marine origin (often found in estuarine waters) or from terrestrial sources (the terrestrial Talitridae inhabit damp areas, often close to shores and streams, and may be found in fresh waters as accidentals). Such taxa are not covered by this key. Efforts should be made to preserve unknown specimens (in 70% ethanol), prevent damage to individuals (by careful handling and packaging), and seek taxonomic guidance. As many details as possible concerning the site (date, exact location, water quality, temperature) and identity of collector should be noted.

The sex of specimens cannot always be determined as immature animals do not often display distinguishing sexual characteristics. Late juvenile and adult females bear oostegites upon the coxae of pereopods two to five. In males, gnathopods are often enlarged, and have notched palms, there is a small penile apparatus at the posterior margin of the seventh sternite, and, particularly in the crangonyctoids and eusirids, calceoli are often present on the second antenna.

Glossary of terms

accessory flagellum. The secondary ramus of antenna 1 attached medially to peduncular article 3, often absent or vestigial. (Fig. 2).

accessory setal row. Of the mandible, consisting of blade setae and plumose setae, lying between incisor and molar. (Fig. 2).

aesthetasc. Sensory setae of antennae, flattened and non-tapering. (Fig. 2).

alae. Wing-like extensions.

article. A segment of an appendage.

basis. Second article of pereopod, in pereopods 5–7 often laterally expanded and posteroventrally lobate. (Fig. 3).

basodactylar. Character located at base of dactyl. (Fig. 3).

basofacial robust seta. Robust seta on basolateral face of appendage; often used in connection with Uropod 1. (Fig. 4).

bifid seta. Seta with the apex divided—as distinct from trigger seta. (Fig. 3).

buccal. Relating to the mouth.

calceolus, (pl. **calceoli**). A small globular or helmet-shaped, articulate sense organ usually on the male second antenna; presumably a modified aesthetasc; of rare occurrence in Gammaridea and most often seen in Eusiridae. Of diagnostic form (type “9”—Lincoln & Hurley, 1981) among crangonyctoids. (Fig. 2).

carpus. Fifth article of pereopod. (Fig. 3).

chelate. Descriptive of the palm of a gnathopod protruding as an immovable finger on which the dactyl closes. Also subchelate, parachelate, carpochelate, propodochelate, merochelate; complexly subchelate or complexly chelate are terms referring to the formation of a false chela by protrusion of teeth, cusps, or lobes from articles other than the sixth and upon which article 7 impinges to form a prehensile condition.

chela. Immovable finger of prehensile appendage.

claw, claw-like. Descriptive of a talon or simple, tapering nail. (Not descriptive of chelae as used in decapod terminology).

compressed. Flattened from side to side.

conjoint. Describing the basal amalgamation of flagellar articles on antennae. (Fig. 2).

coxa, coxal plate. [Terms used synonymously] Article 1 of a pereonal appendage, expanded into a lateral lamella. (Figs. 1, 3).

dactyl. Talon-like terminal article of pereopods (article 7) or maxillipedal palp articles 4. (Figs. 2, 3).

dendritic. Refers to a branching form, in particular of sternal gills; from *dendron* Gr. = tree. (Fig. 4).

denticulate. Finely toothed.

depressed. Flattened dorsoventrally.

dispariramous. Rami not similar; especially of uropods, one (usually the medial) ramus of modified form and reduced length.

emarginate. Descriptive of the concave posterior end of

an uncleft telson or posterodorsal margin of coxa 4 (see also excavate). (Fig. 3).

entire. Descriptive of an uncleft telson.

epigean. Living above ground.

epimeron (pl. **epimera**). Lateral pleuron of pleonites 1–3; the ventrolateral plate-like extension of the body segment, often bearing setae or postventral tooth (spine) of taxonomic significance. (Figs. 1, 4).

epistome. The anterior surface of the head above the labrum; this area is often extended ventrally to appear as a part of the labrum and may be anteriorly produced as a cusp or lobe.

“eusirid”. Used by some authors (e.g., Williams & Barnard, 1988) to describe gnathopods in which the propodus is inflated, palms simplified and elongate, and the flexibility increased by narrowing of the connection between propodus and carpus, the joint being cantilevered; usually both pairs of gnathopods very similar, e.g., gnathopods of perthiids. (Fig. 5). Since Eusiridae have many gnathopod forms this term is best avoided.

excavate. In particular, refers to the concave reduction of the posterodorsal corner of coxa 4 (see also emarginate). (Fig. 3). Sometimes used in reference to a notched gnathopodal palm.

falciform. Having the curved shape of a falcon’s wing; especially refers to the ultimate article of a mandibular palp.

flagellum. The distal portion of either antenna; on the first antenna it commences with article 4, on the second antenna with article 6; because basal peduncular articles of antenna 2 are often difficult to resolve, the juncture may be recognised between the elongated final peduncular article and the shortened first flagellar article which is followed by similar short articles; on antenna 1, however, article 1 of the flagellum is occasionally elongate and apparently composed of non-segregated (thus conjoint) articles. (Fig. 2).

foliaceous. Leaf-like.

fossorial. Associated with the habit of burrowing, often referring to the excessively spinose or setose condition of appendages used for burrowing by Gammaridea; e.g., *Totgammarus eximius* pereopods 5–6, *Pilbarus millsii* pereopod 6.

geniculate. Permanently bent, e.g., in reference to flexed antennae.

gills: coxal. Usually paddle-like, fragile structures attached to coxae, adjacent leg. Absent from first coxa. (Fig. 3).

gills: sternal. Medial or lateral (or both) structures extending from some or all of ventral sternites 2–7—various types: simple = non branching = sausage-like e.g., *Austrogammarus*; or lumpy = bearing small lumps, but not branched e.g., *Jasptorus*; or dendritic = branched e.g., *Neoniphargus* (the presence of some, but not necessarily all, dendritic sternal gills earns the descriptor). (Fig. 4).

gnathopod dimorphism. Sexual variation in the size or form of gnathopods—male organ usually larger, thought to function in copulation as grasping organ, often seen to bear a notch (“excavate”) approximately midway along the palm e.g., *Antipodeus* sp., *Neoniphargus* sp. (Fig. 3).

gnathopods. First two pairs of free thoracic appendages, differing in function and usually in appearance from following pereopods; rarely referred to as pereopods

- 1 and 2. Various forms recognised: mitten-like, small, rectangular, the palmar angle transverse (as in *Neoniphargus*); cantilevered (erroneously “eusirid”) as in *Perithia*; ovate, in which the palmar angle is strongly oblique, as in the second gnathopod of *Nedsia*. (Figs. 1, 3).
- hyaline**. Clear and translucent, usually relating to lobes of the appendages.
- hypogean**. Living underground.
- incisor**. The apical portion of the mandible usually formed into a toothed chewing edge or untoothed chopping plate. (Fig. 2).
- interstitial**. Found in water filled spaces between substrate such as in coarse stream beds or aquifers in porous sediments.
- ischium**. Third article of pereopod. (Fig. 3).
- joint**. The juncture between two articles of an appendage.
- labium**. (See lower lip).
- labrum**. (See upper lip).
- lacinia mobilis**. An articulated accessory plate proximal to the mandibular incisor (can be absent or missing on either left or right mandibles, occasionally indistinguishable from a robust seta of the accessory seta-row). (Fig. 2).
- lanceolate**. Shaped like the blade of a lance.
- lower lip (labium)**. A fleshy complex posterior to the mandibles, always composed of at least one pair of lobes (outer), often with a medioproximal pair of inner lobes; the lateroproximal ends of the outer lobes are often attenuated as alae and are denoted as mandibular lobes. (Fig. 2).
- magniramous**. Condition of the third uropod in which the inner and outer rami are approximately equally extended.
- mandible**. The anterior movable appendage of the buccal group; usually composed of a body bearing a distal incisor, a lacinia mobilis, robust seta row, molar, and, in most taxa, a 3-articulate (sometimes reduced) palp. (Fig. 2).
- mandibular palp setae**. Setae of palp articles 2 or 3 setae defined according to origin: *A, B, C, D, E, F*. (Fig. 2). (Two nomenclatural systems operate—see Fig. 5).
- maxilla 1**. A pair of cephalic appendages posterior to the lower lip (labium); for taxonomic purposes only three portions of each member are named: the medial (inner) lobe (plate) usually bearing marginal setae, the lateral (outer) and larger lobe (plate) bearing terminal robust setae and, attached to the outer lobe, a palp usually composed of two articles but occasionally absent. (Fig. 2).
- maxilla 2**. A pair of cephalic appendages posterior to maxilla 1; for taxonomic purposes recognised as a pair of lobes (plates) medial and lateral, usually strongly setose. (Fig. 2).
- maxillipeds**. The posterior most pair of “cephalic” appendages, representing the primitive first thoracic segment now amalgamated with the head but in amphipod taxonomy not included in the sequential numbering of thoracic appendages; for taxonomic purposes recognised as a pair of basally amalgamated appendages, each member composed of an inner (proximal) plate, an outer (distal) plate, and a palp of four articles, rarely reduced to 3 or 2 articles or absent. (Fig. 2).
- meral**. Pertaining to the merus (fourth article of the pereopod).
- merus**. Fourth article of pereopod. (Fig. 3).
- molar**. A process of the mandible, located on the mid-medial margin; when completely developed it is a massive, subcylindrical body with a surface of ridges and teeth used for grinding (see triturative). (Fig. 2).
- multispinous**. Condition of dactylus (of pereopods); bearing 2–6+ medial robust setae.
- M**. Used, in conjunction with a number, to indicate the position of an object as a fraction of the distance from the base to the apex of an appendage, e.g., $M = 0.5$ indicates half way from base to apex.
- nail**. Apical portion of dactyl (not always distinct).
- obsolescent**. Lost, become obsolete.
- palmar angle**. The angle the posterior margin of the gnathopodal propodus makes with the palm; varies from transverse in rectangular propodi to strongly oblique in ovate propodi.
- palmar corner**. The point at which the palm meets the posterior margin of the propodus: often bearing modified setae; not clearly defined where the propodus is ovate. (Fig. 3).
- palm**. A posteroventral surface or margin of propodus (article 6) of a gnathopod or pereopod upon which article 7 (dactyl) closes; usually recognisable because of expansion of article 6 or by occurrence of special robust setae or other ornamentation and usually with a proximal defining limit marked by a change in marginal slope or occurrence of special robust setae. (Fig. 3).
- palp**. Terminal articles of a buccal appendage; in Amphipoda, only on mandibles, first maxillae, and maxillipeds as the narrow terminal articles distal to the expanded outer plates or main body. (Fig. 2).
- parviramous**. Condition of the third uropod in which the inner ramus is reduced to a small scale. (Fig. 4).
- pediform**. Shortening and thickening of antennae, especially peduncles. Seen in South African paramelitids, less common among Australian paramelitids, e.g., *Uroctena*.
- peduncle**. The basal articles of a fundamentally biramous appendage; in Amphipoda applied to antennae, pleopods, and uropods; antenna 1 with three peduncular articles, antenna 2 with five peduncular articles (but appendage not biramous); pleopods with one definitive peduncular article but remnants of others occurring proximally; uropods each with one peduncular article. (Figs. 2, 4).
- pereonite**. A segment of the pereon.
- pereon**. The complex of seven free thoracic segments bearing gnathopods and pereopods, not including the maxillipeds. (Fig. 1).
- pereopod**. A walking, grasping, standing, or feeding appendage attached to a pereonite; normally composed of seven articles, including coxa; in Amphipoda the first two pairs are usually termed gnathopods and only the last five pairs of thoracic legs called pereopods (but numbered P3–P7). Terms for articles of the appendages, i.e. coxa, basis, ischium, merus, carpus, propodus, and dactylus are frequently but not universally used in Gammaridea; instead, the articles may be simply numbered from 1 for coxa to 7 for dactyl. (Figs. 1, 3).
- plate**. A flattened lobe on an article of a maxilla or maxilliped.
- pleonite**. A segment of the pleon.
- pleon**. The abdomen (of six free segments in Gammaridea, rarely with some segments coalesced). See urosome. (Fig. 1).
- pleopod**. A biramous swimming appendage on pleonites 1–3, one pair for each pleonite. (Fig. 4).

prebuccal complex. The labrum and epistome together.

prehensile. Adapted for seizing or grasping; applicable to but rarely used for gammaridean gnathopods.

propodus. The sixth article of a thoracic appendage (especially used to denote the palmar article of a gnathopod). (Fig. 3).

pubescence. Very fine setae, often covering the face of an article. (Fig. 2).

rami. Distal articles of biramous appendages, i.e. pleopods and uropods. (Fig. 4).

parviramous: of 3rd uropod; inner ramus reduced to a small scale.

magniramous: of 3rd uropod; inner and outer rami approximately equally extended.

variramous: of 3rd uropod; intermediate condition.

rugose. An area of rough or lumpy appearance.

rugosity. Small setae of characteristic form on the gnathopods and maxillipedal palps of neoni-phargids. (Fig. 3).

scale, scale-like. Terms applied to the accessory flagellum when forming a small lamella immovably fused to article 3 of antenna 1; and to the inner ramus of uropod 3 when strongly reduced and plate-like.

setae and **spines**. A *spine* is an outgrowth of cuticle, whereas a *seta* is pivoted at the base, with a probable distinct genetic origin. "Spine" has been employed loosely in the case of amphipods to indicate, in most cases, what are really *robust setae*, this being the correct term.

simple. Used in amphipod taxonomy to denote the absence of setae on appendages; or the occurrence of but a single article in the ramus of a uropod; or especially to the absence of a palm on a gnathopod (distinction between subchelate and simple is often weak); or to an unbranching or unlumped condition of the sternal gills.

subchelate. Article 6 of a gnathopod or pereopod

having a distal palm against which article 7 closes; a prehensile condition in which the palm is not produced to form a finger; intermediate in condition between chelate and simple.

telson. A flap dorsal to the anus attached to pleonite 6, primitively bilobed but in Amphipoda usually with bases coalesced and often with lobes completely coalesced to form a single plate; i.e. cleft (bilobed), notched, entire (completely coalesced). (Fig. 4).

trigger seta. Seta bearing terminal or subterminal sensory setule. (Fig. 3).

tritulative. Descriptive of the rasp-like surface of a mandibular molar, composed of teeth, ridges, and cusps.
ungulate. Horn-like in shape.

upper lip (labrum). A fleshy lobe attached to the anterior cephalic margin in front of the mandibles; occasionally the anterior surface of the labrum protrudes as a lobe or cusp; often the cephalic area to which the labrum is attached is recognisable as an “epistome” and may also be lobed; or both labrum and epistome may be indistinguishable and produced together as a single lobe.

uropod. One member of the three pairs of terminal pleonal appendages, each formed of a peduncle and two rami (inner rami of uropod 3 often differentiated, reduced or absent, rarely rami of uropods 1–2 absent or reduced). (Fig. 4).

urosome. The complex of pleonites 4, 5, 6, carrying uropods, and telson. Often numbered as urosomites 1, 2, 3. (Fig. 1). (Sometimes fused, e.g., *Paracalliope*).

urosomite. A segment of the urosome.

variramous. Condition of the third uropod in which the inner ramus is intermediate in length between reduction to a small scale (parviramous) and extended approximately equal to the outer ramus (magniramous).

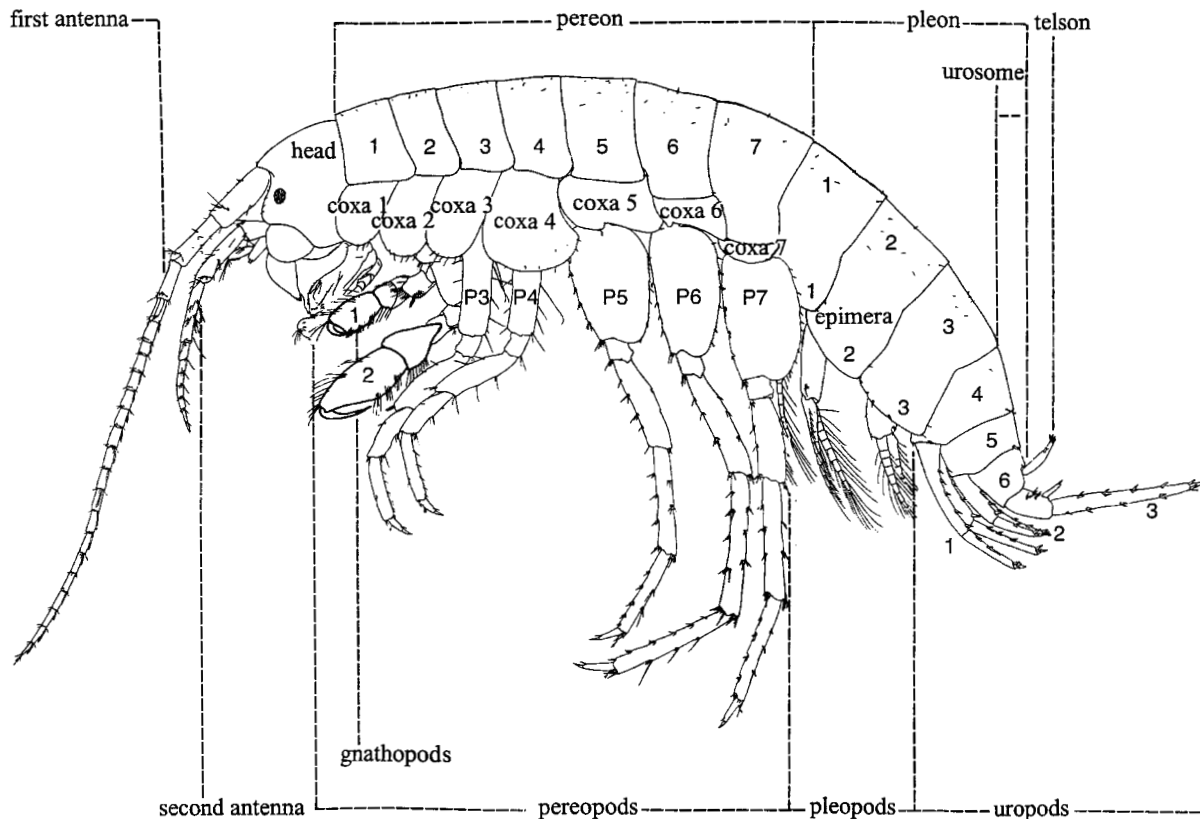


Figure 1. Generalised amphipod showing principal body-parts.

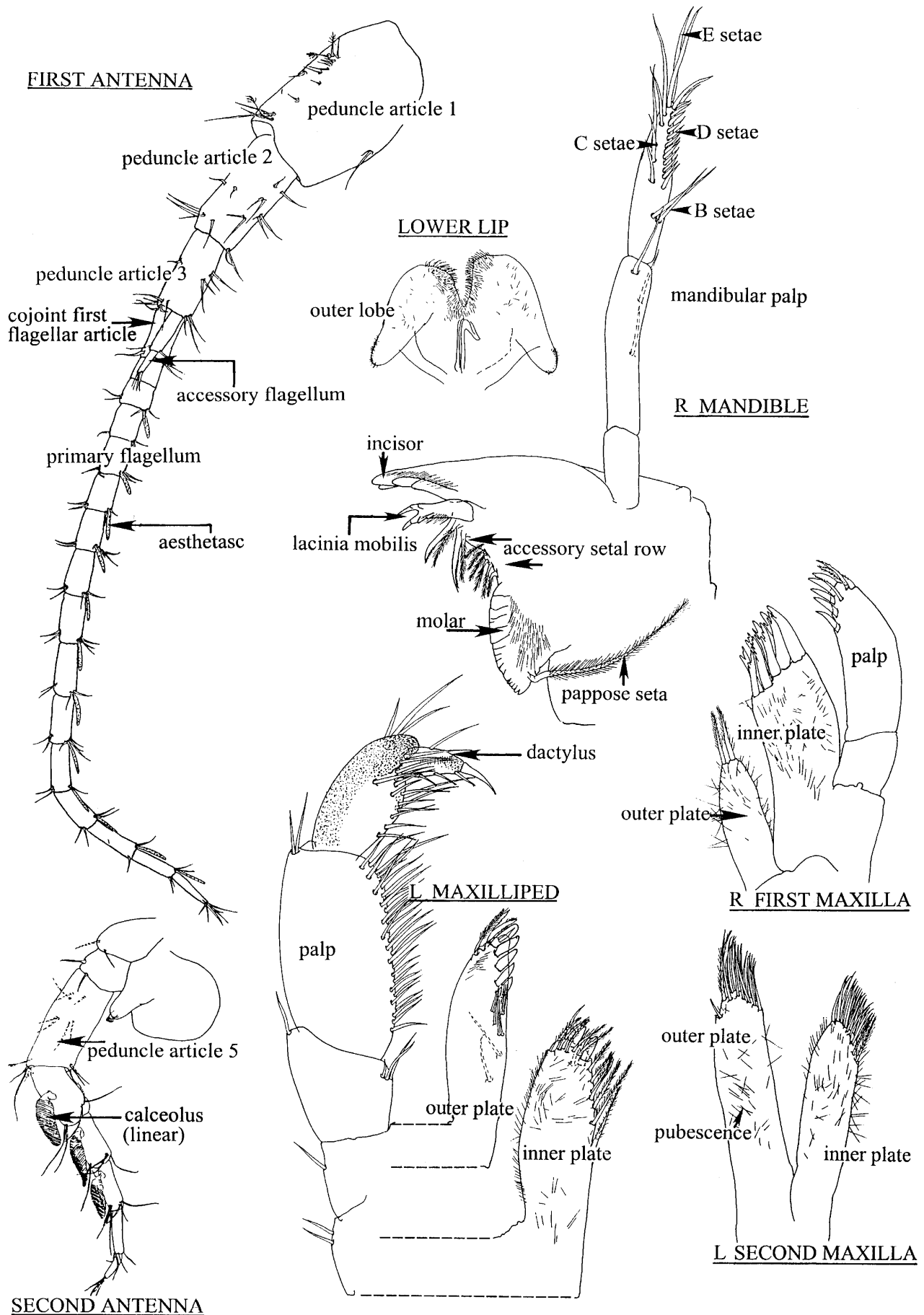


Figure 2. Parts of the head: antennae; lower lip (labium), mandible, first and second maxilla and maxilliped.

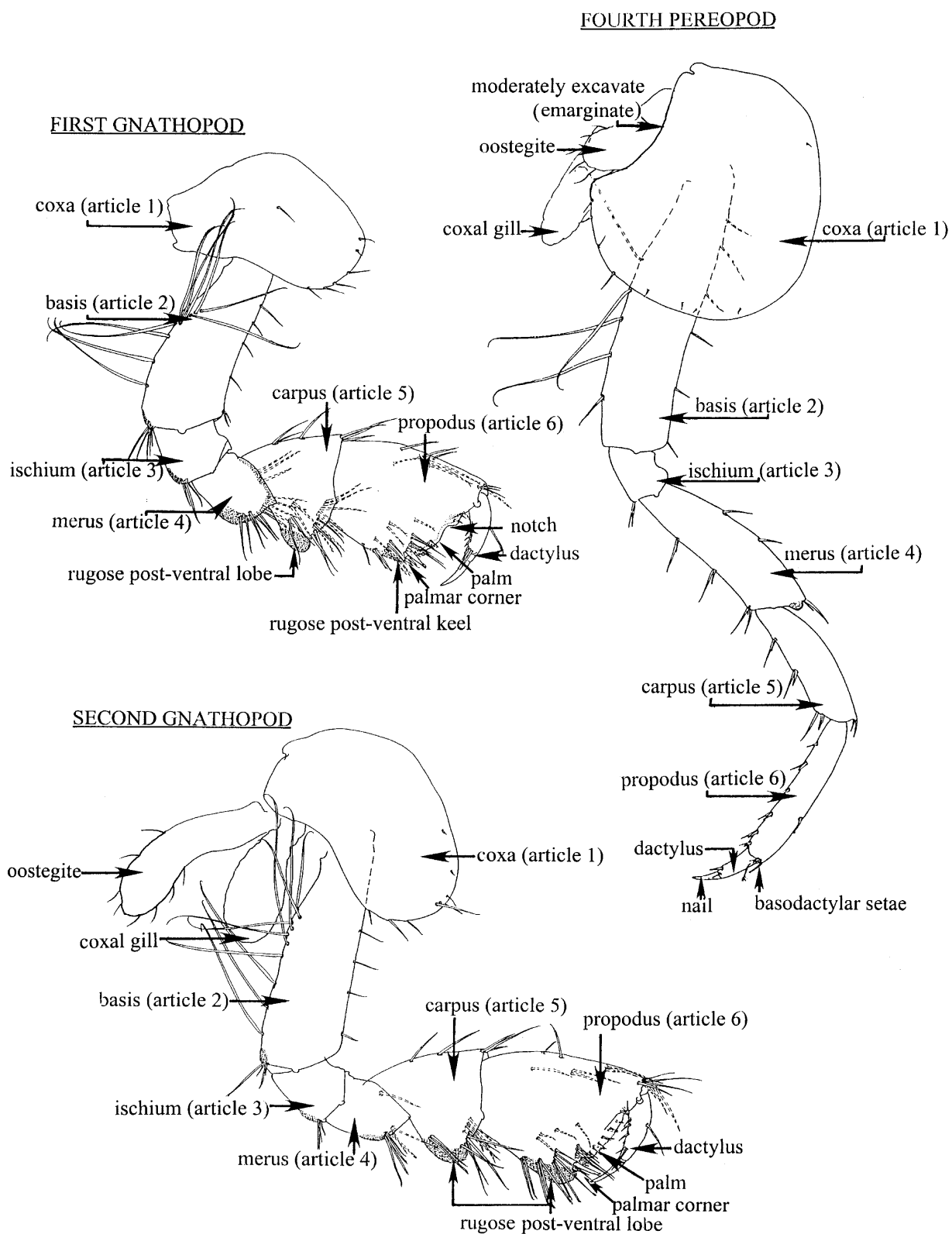


Figure 3. Pereopods: first and second gnathopod, fourth pereopod.

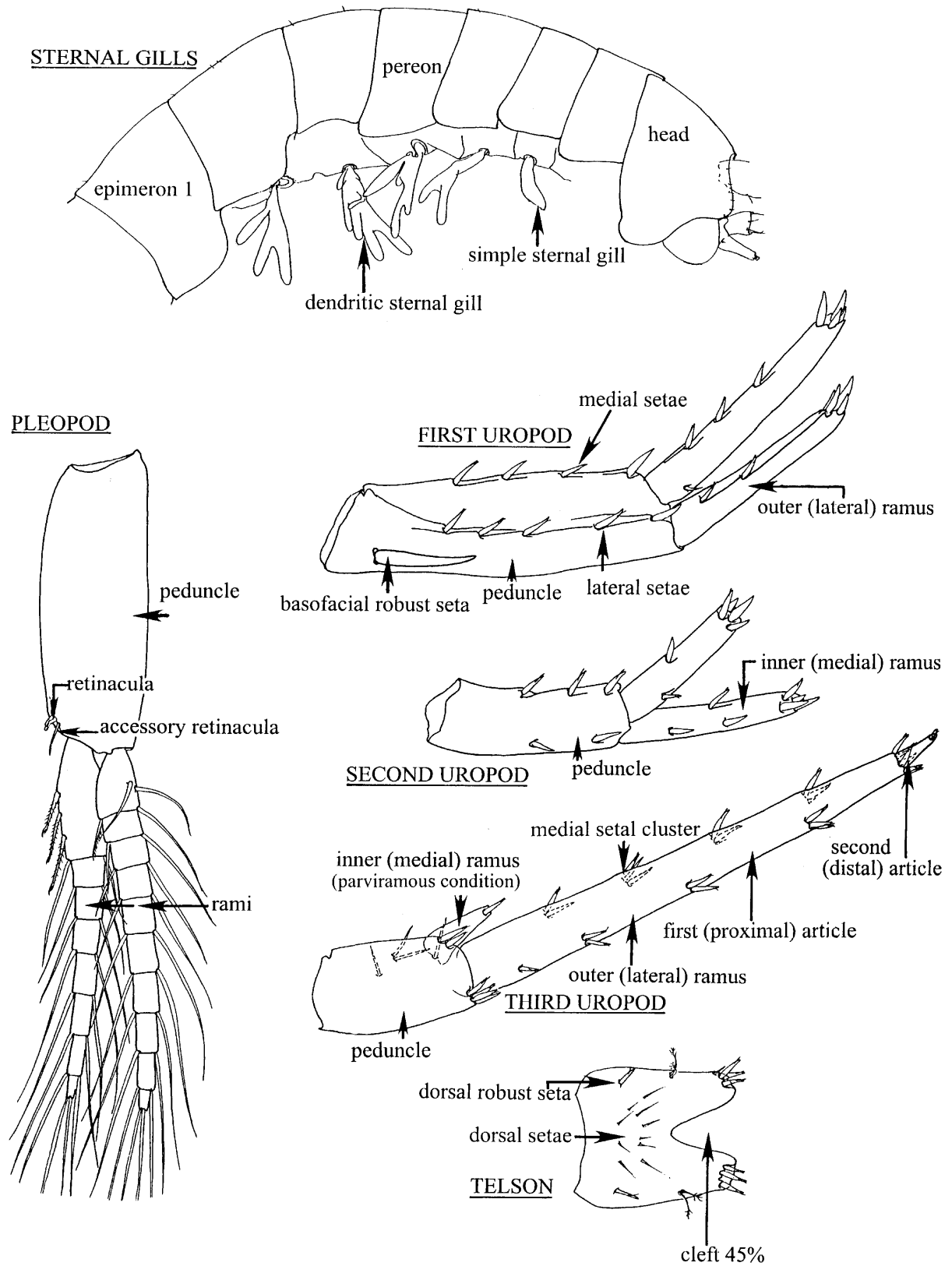


Figure 4. Sternal gills; pleopod; first, second and third uropods; telson.

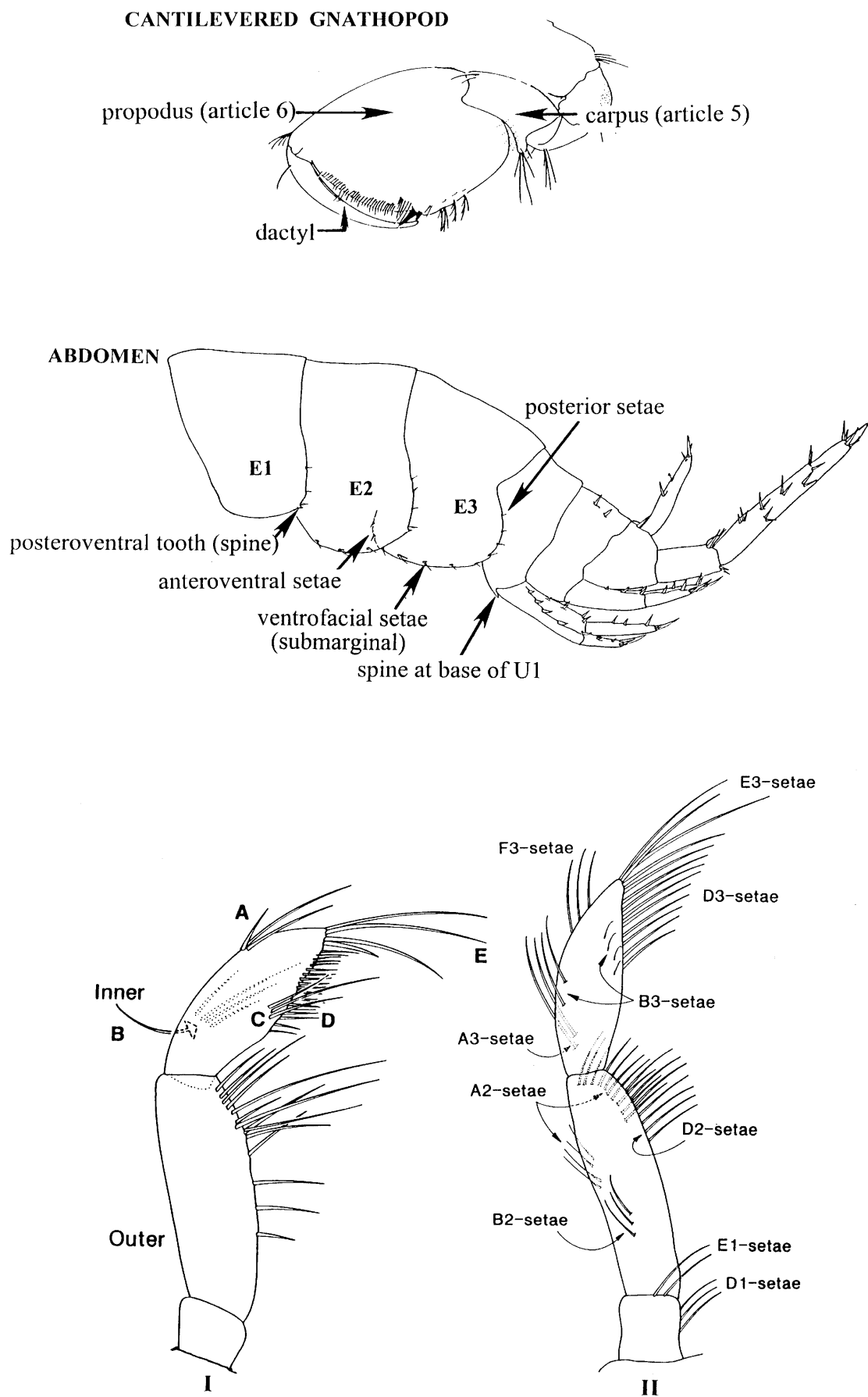


Figure 5. Cantilevered first and second gnathopods, abdomen indicating epimera, stylised mandibular palp indicating setal nomenclature of: I—Barnard & Barnard (1983), after Karaman (1969); II—Lowry & Stoddart (1993).

Key to families

- 1 Third uropod reduced, ramus, if present, minute; mandibles without palps 2
- Third uropod prominent and biramous (with few exceptions), mandibles with palps 3
- 2 First antenna larger than second (p. 10) **Ceinidae**
- First antenna smaller than second **Talitridae**
- Land hoppers (Talitridae) sometimes occur as accidentals in streams or littoral regions. Not included in this key. Refer to Friend (1987).
- 3 Peduncle of uropod 1 bearing robust basofacial seta; antennae without calceoli; sternal gills absent (p. 10) **Melitidae**
- Peduncle of uropod 1 without robust basofacial seta; antennae with or without calceoli, sternal gills present or absent 4
- 4 Rami of uropod 3 equal or subequal, undifferentiated (magniramous) 5
- Rami of uropod 3 unequal, differentiated (i.e. dispariramous), inner ramus modified, reduced, sometimes absent 7
- 5 Rami of uropod 3 cylindrical, gnathopod 1 distinctly larger than gnathopod 2 (p. 11) **Bogidiellidae**
- Rami of uropod 3 lanceolate, gnathopods subequal 6
- 6 Urosomites 2–3 fused; dactylus of pereopod 7 elongate, longer than propodus, setose (p. 12) **Paracalliopiidae**
- Urosomites 2–3 separate; dactylus of pereopod 7 neither elongate nor setose (p. 12) **Eusiridae**
- 7 Telson entire; antenna 1 accessory flagellum absent (p. 12) **Corophiidae**
- Telson cleft or notched; antenna 1 accessory flagellum present, with 2 or more articles (p. 13, **Crangonyctoidea**) 8
- 8 Gnathopod carpus cantilevered with propodus, sternal gills dendritic (p. 13) **Perthiidae**
- Gnathopod carpus/propodus joint ordinary; sternal gills absent, simple, lumped or dendritic 9
- 9 Sternal gills simple or absent, gnathopods without posterior distal rugosities (p. 13) **Paramelitidae**
- Sternal gills simple, dendritic or lumpy, gnathopods with posterior distal rugosities (p. 16) **Neoniphargidae**

Family Ceinidae

The widespread genus *Austrochiltonia* is the principal representative of this family. There is some dispute on the familial position of the genus; Barnard & Barnard (1983) placed the genus in the Ceinidae, whereas Zeidler (1991) recommended the family Hyalellidae as more appropriate on the basis of the form of the mandible, third uropod and telson. Two very similar, widespread, species, *A. australis* and *A. subtenuis*, have been recognised

(Sayce, 1901, 1902; Williams, 1962), but some dispute the validity of this distinction, pointing out that they are often sympatric and can interbreed (S.J. Smith & Swain, 1982). For the sake of completeness, and pending revision, both are included in this key. Another two taxa, *A. dalhousiensis* and *Phreatochiltonia anopthalma*, are described from Dalhousie Springs, South Australia (Zeidler, 1991, 1997).

Key to genera and species of Ceinidae

- 1 Eyes absent; coxa 4 poorly excavate posteriorly; pereopod 4 distinctly longer than pereopod 5 *Phreatochiltonia anopthalma*
- Eyes present; coxa 4 moderately to deeply excavate posteriorly; pereopod 4 shorter than pereopod 5 2
- 2 Third uropod without rami *Austrochiltonia subtenuis*
- Third uropod uniramous 3
- 3 Carpus of gnathopod 1 shorter than propodus, antennal flagellae of less than 10 articles *Austrochiltonia dalhousiensis*
- Carpus of gnathopod 1 longer than propodus, antennal flagellae more than 10 articles *Austrochiltonia australis*

Family Melitidae

Most representatives of this family are thought to be of ancient marine origin (Cretaceous) and are restricted to areas of the continent inundated by the sea during the Cretaceous. These are devoid of species of more ancient freshwater lineage (Bradbury & Williams,

1997a). Four genera have been recognised in Australia: *Brachina* (1 species); *Norcapensis* (1 species); *Nedsia* (8 species); and *Melita* (1 species, restricted to an artificial coastal freshwater lake in New South Wales, possibly of marine origin).

Key to genera and species of Melitidae

- 1 Lower lip bearing distinct inner lobes; third uropod outer ramus article 1 foliaceous, bearing small marginal robust setae and slender setae, second article large, foliaceous and similarly armed; telson lobes subtriangular, bearing weak slender setation 2
- Lower lip inner lobes absent or obsolescent; third uropod outer ramus article 1 cylindrical, with marginal clusters of long, sharp robust setae, second article small, naked except for a single subapical, slender trigger seta; telson lobes ovate to subrectangular, bearing strong, stout setation 10
- 2 Mandibular palp of three articles *Norcapensis mandibulis*
- Mandibular palp reduced to two articles 3
- 3 Second maxilla with sparse marginal basomedial pubescence on inner plate only, or no pubescence on either plate 4
- Second maxilla with moderate to dense marginal pubescence on both plates 6

- 4 Pleonites without dorsal robust setae *Nedsia straskraba*
 — Pleonites with dorsal robust setae 5
- 5 Epimera 1 without distolateral robust setae; peduncle of uropod 1 with a lateral row of short facial robust setae besides the basofacial and distal robust setae; palmar corner of gnathopod 1 rounded; outer plate of maxilliped tapering from base to apex and with weak medial cusps *Nedsia fragilis*
 — Epimera 1 with distolateral robust setae, peduncle of uropod 1 without facial robust setae besides basofacial and distal robust setae, palmar corner of gnathopod 1 subquadrate, outer plate of maxilliped not tapering, but rounded apically and with strong medial cusps *Nedsia humphreysi*
- 6 Posterior margins of pleon smooth, epimera without facial robust setae other than ventral submarginal robust setae 7
 — Posterior margins of pleon sculptured into cusps, epimera with facial robust setae as well as ventral submarginal robust setae 9
- 7 Urosomite 1 bearing a posteroventral spine at the base of the first uropod, rami of pleopods with more than six articles, maxillipedal palp article 3 without organised comb rows of setae at base of dactyl *Nedsia hurlberti*
 — Urosomite 1 without spine at base of uropod 1, rami of pleopods of less than 6 articles, maxillipedal palp article 3 bearing rows of comb setae basal to dactyl 8
- 8 Coxa 1 with one or more anterior robust setae, without slender anterior setae; telson without dorsal setae; length of maxillipedal outer plate $2 \times$ width *Nedsia urifimbriata*
 — Coxa 1 without anterior robust seta(e), with slender anterior setae; telson with dorsal setae; length of maxillipedal outer plate not more than $1.6 \times$ width *Nedsia douglasi*
- 9 Postero-lateral margins of pleonite 4 with robust setae, medial margin of outer plate of maxilliped rough, with 5 indentations *Nedsia macrosculptilis*
 — Postero-lateral margins of pleonite 4 without robust setae, medial margin of outer plate of maxilliped smooth, with 4 indentations *Nedsia sculptilis*
- 10 Mandibular palp two articulate; propodus of first gnathopod without anterior or medial palmar humps; setae of antennae, pereopods, uropods and telson not plumose *Brachina invasa*
 — Mandibular palp three articulate; propodus of first gnathopod with anterior and medial palmar humps; plumose setae on antennae, pereopods, uropods and telson *Melita plumulosa*

Family Bogidiellidae

Hypogean or interstitial. One species is known; *Bogidomma australis*. It is recorded from Barrow Island, Western Australia.

Family Paracalliopiidae

Represented by a single genus, *Paracalliope*; two inland aquatic species recorded from Tasmania.

Key to species of *Paracalliope*

- 1 Mandibular palp third article bearing 0–1 basofacial robust setae; uropod 1 outer ramus with 2 robust setae; epimeron 3 without robust setae *Paracalliope larai*
- Mandibular palp third article bearing 3 basofacial robust setae; uropod 1 outer ramus with 0–1 robust seta; epimeron 3 with 3 robust setae *Paracalliope vicinus*

Family Eusiridae

Represented in Australian inland waters by two genera, *Pseudomoera* and *Paraleptamphopus*. The genus *Paraleptamphopus* is reported from Tasmania (Richardson, 1987), without specific identification; *Pseudomoera* is present as two species, both reasonably widespread in mainland southeastern Australia.

Key to genera and species of Eusiridae

- 1 Telson entire *Paraleptamphopus*
- Telson cleft 2
- 2 First maxilla inner plate medial margin oblique, bearing medial setae *Pseudomoera fontana*
- First maxilla inner plate bearing only terminal setae *Pseudomoera gabrieli*

Family Corophiidae

This family is represented by one known species, *Paracorophium excavatum*, from the Brisbane River.

Superfamily Crangonyctoidea

This superfamily, represented also in the Holarctic, but dominantly Nearctic, is the most widespread and significant of Australian freshwater amphipod groups, and is thought to have dispersed from Pangea via Notogean fresh waters (Barnard & Barnard, 1983). Three Australian families are recognised, two endemic to Australia. All are cold-water species derived from ancient pre-Gondwanan stock, and are restricted to those areas of the continent not inundated by the sea during the

Cretaceous, and where cool waters are found. Thus, representatives are most numerous in Tasmania and the highlands of the southeast and the cool, wet southwest, but do occur as relict species in underground streams and wet caves in warmer areas. Among the three families, Perthiidae are known only from Western Australia, whereas Neoniphargidae and Paramelitidae occur in Tasmania, Victoria, New South Wales and Western Australia, with a few specialised members elsewhere.

Family Perthiidae

There is only one known genus of the family, *Perthia*, with two species found in southwestern Western Australia.

Key to species of *Perthia*

- 1 Uropod 3 parviramous, inner ramus short; telson without dorsal robust setae; merus and carpus of pereopods 3–7 with long setae *Perthia branchialis*
- Uropod 3 variramous, inner ramus long; telson with dorsal robust setae; merus and carpus of pereopods 3–7 without long setae *Perthia acutitelson*

Family Paramelitidae

The family Paramelitidae is represented in Australia by eleven genera, of which seven are monospecific: *Chillagoe*, from Chillagoe caves, Queensland, *Giniphargus*, from Gippsland, Victoria, *Hurleya*, *Protocrangonyx*, *Totgammarus* and *Toulrabia* from southwestern Australia, and *Pilbarus* from northwestern

Australia. Of the other genera, *Austrogammarus* is widespread across southeastern Australia, *Austrocrangonyx* is found around the Barrington Tops in New South Wales, *Antipodeus* is restricted to Tasmania, and *Uroctena* to southwestern Australia.

Key to genera and species of Paramelitidae

- 1 Sternal gills absent 2
- Sternal gills present and simple 8
- 2 Mandibular palp article 1 much longer than wide, article 2 with few setae, article 3 without A setae *Pilbarus millsii*
- Mandibular palp article 1 about as long as wide, article 2 moderately setose, article 3 bearing A setae (*Antipodeus*) 3
- 3 Posterior setae on article 2 of pereopods 5–7 long; long setae present on articles 2–6 of pereopods 5–7; coxae 1–3 with long ventral setae *Antipodeus niger*
- Posterior setae on article 2 of pereopods 5–7 short; long setae absent on articles 2–6 of pereopods 5–7; coxae 1–3 with only short ventral setae 4
- 4 Ventral setae of antennae 1–2 long and dense; telson very short, apical setae absent 5
- Ventral setae on antennae 1–2 short to long and sparse to numerous (but never long and dense); telson not very short, with apical setae 6

- 5 Gnathopods sexually dimorphic—male palm notched; article 6 of pereopods 3–4 with evenly spaced robust sets of setae; rami of uropods 1–2 with long marginal and apical robust setae *Antipodeus wellingtoni*
- Gnathopods not sexually dimorphic; article 6 of pereopods 3–4 with unevenly spaced robust sets of setae; rami of uropods 1–2 with short marginal and apical robust setae *Antipodeus ripensis*
- 6 Article 2 of mandibular palp only slightly longer than article 3; gnathopods not sexually dimorphic; telson cleft 100 percent *Antipodeus mortoni*
- Article 2 of mandibular palp distinctly longer than article 3; gnathopods sexually dimorphic; telson cleft about 70 percent 7
- 7 Ventral setae on antennae 1–2 short and numerous; calceoli absent on male antenna 2; basodactylar robust setae and setae of pereopods 5–7 short; setae on article 2 of mandibular palp mostly short *Antipodeus antipodeus*
- Ventral setae on antennae 1–2 long and sparse; calceoli present on male antenna 2; basodactylar robust setae and setae of pereopods 5–7 long; setae on article 2 of mandibular palp mostly long *Antipodeus franklini*
- 8 Telson entire *Protocrangonyx fontinalis*
- Telson cleft 9
- 9 Coxa 1 tapering distally; some dactyls of pereopods 3–7 multispinous *Totgammarus eximius*
- Coxa 1 not tapering distally; pereopods 3–7 dactyls not multispinous 10
- 10 Inner ramus of male uropod 3 moderately elongate—equal to or greater than $0.5 \times$ outer ramus (vari- or magniramous) (*Austrogammarus*) 11
- Inner ramus of male uropod 3 short—less than $0.5 \times$ outer ramus (parviramous) or absent 17
- 11 Coxa 4 heavily setose ventrally; uropod 3 (male hermaphrodite) with only slender setal clusters medially on outer ramus; articles 4–6 of pereopods 5–7 with many long setae *Austrogammarus australis*
- Coxa 4 poorly setose ventrally; uropod 3 with robust setae in medial slender setal clusters on outer ramus; articles 4–6 of pereopods 5–7 with few long setae 12
- 12 Urosomites with only 1 or none dorsal robust seta on each side 13
- Some urosomites with 2+ robust setae on each side 15
- 13 Epimeron 1 lacking anteroventral setae; thick robust setae on article 6 of pereopods 3–4 with more than 1 per set; uropod 2 lacking setae; telson with dorsal robust setae *Austrogammarus smithi*
- Epimeron 1 bearing anteroventral setae; thick robust setae on article 6 of pereopods 3–4 with only 1 per set; uropod 2 bearing seta(e); telson lacking dorsal robust setae 14

- 14 Telson cleft about 80 percent; inner ramus of female uropod 3 elongate— $0.6 \times$ length of outer ramus, with lateral robust seta groups, apex with slender setae only *Austrogammarus saycei*
- Telson cleft 100 percent; inner ramus of female uropod 3 short— $0.3 \times$ length of outer ramus, without lateral robust seta groups, apex with robust and slender setae *Austrogammarus haasei*
- 15 Pleonite 5 with 3 dorsal robust setae on each side; pleonite 4 with 2 dorsal robust setae on each side *Austrogammarus spinatus*
- Pleonite 5 with 4–5 dorsal robust setae on each side; pleonite 4 with 3 dorsal robust setae on each side 16
- 16 Coxa 4 moderately excavate; oostegites ovate; epimera with 1–6–7 ventromarginal robust setae; pleonites 4–5 with 5+–6+ dorsal robust setae; uropod 2 extending to less than $0.7 \times$ length uropod 1 in intact specimen; telson not reaching beyond peduncle of uropod 3, with lateral marginal setae extending from M0.25 to apex *Austrogammarus telsosetosus*
- Coxa 4 strongly excavate; oostegites tending subrectangular; epimera with 3–5–5 ventromarginal robust setae; pleonites 4–5 with no more than 3 and 5 dorsal robust setae; uropod 2 extending as far as uropod 1 in intact specimen; telson reaching beyond peduncle of uropod 3, lateral marginal setae extending from M0.75 to apex *Austrogammarus multispinatus*
- 17 Inner ramus of uropod 3 absent or minute, less than $0.1 \times$ length of outer ramus 18
- Inner ramus of uropod 3 present, $0.1 \times$ or more than length of outer ramus 19
- 18 Gnathopods small, gnathopod 2 smaller than gnathopod 1; antenna 2 tending pediform; antenna 1 accessory flagellum 4 articles; body vermiform *Giniphargus pulchellus*
- Gnathopods large, subequal; antenna 2 normal; antenna 1 accessory flagellum 2 articles; body not vermiform *Chillagoe thea*
- 19 Article 2 of outer ramus of uropod 3 large; $0.4 \times$ or more length of article one (*Uroctena*) 20
- Article 2 of outer ramus of uropod 3 absent or short, less than $0.4 \times$ length of article one 24
- 20 Antennae 1–2 densely setose, setae long and drooping; telson cleft 50%; gnathopods of both sexes bearing long anterior setae on carpus and propodus, article 2 of male gnathopod 2 lacking robust setae *Uroctena setosa*
- Antennae 1–2 poorly setose, setae short and stiff; telson cleft 75+ percent; gnathopods of both sexes lacking long anterior setae on carpus and propodus, article 2 of male gnathopod 2 with lateral robust setae 21
- 21 Article 2 of male gnathopod 2 with anterior robust setae 22
- Article 2 of male gnathopod 2 with slender anterior setae 23
- 22 Article 2 of male gnathopod 2 with 4 sets (3–4 setae in each) of posterolateral robust setae *Uroctena affinis*
- Article 2 of male gnathopod 2 with 2 sets (2 setae in each) of posterolateral robust setae *Uroctena whadjukia*

- 23 Article 2 of male gnathopod 2 with about 10–14 lateral robust setae; eyes absent young of *U. affinis* and *Uroctena westralis*
- Article 2 of male gnathopod 2 with about 6–8 lateral robust setae; eyes well developed, but white young of *U. affinis* and *Uroctena yellandi*
- 24 Coxal gill 7 present (*Austrocrangonyx*) 25
- Coxal gill 7 absent 26
- 25 Hyaline hump on article 4 of gnathopod 1 large; dominant robust seta number in sets of article 6 of pereopods 3–4 = 2 *Austrocrangonyx barringtonensis*
- Hyaline hump on article 4 of gnathopod 1 small; dominant robust seta number in sets of article 6 of pereopods 3–4 = 1 *Austrocrangonyx hynesi*
- 26 Third uropod outer ramus with small second article; mandibular palp article three lacking C setae *Hurleya kalamundae*
- Third uropod outer ramus without second article; mandibular palp article three bearing C setae *Toulrabia willsi*

Family Neoniphargidae

This family consists of eight genera: *Neoniphargus*, the largest, with ten species from New South Wales, Victoria and Tasmania; *Wesniphargus* with two species from Western Australia; *Neocrypta* with six species from caves in New South Wales, and five monospecific

genera: *Jasptorus solepti* and *Wombeyanus botellus* from caves in New South Wales, *Tasniphargus tyleri* and *Yulia yuli* from Tasmania, and *Uronyctus longicaudus* from South Australia.

Key to genera and species of Neoniphargidae

- 1 Sternal gills simple (sausage-shaped) 2
- Sternal gills dendritic or bearing lumps 9
- 2 Gnathopods 1–2, ischium, merus and propodus, but not carpus, bearing rugose posterior keels *Uronyctus longicaudus*
- Gnathopods 1–2 carpus and propodus bearing rugose posterior keels 3
- 3 Telson cleft 50% *Wombeyanus botulosus*
- Telson cleft less than 25% (*Neocrypta*) 4
- 4 Flagellum of second antenna of 4 articles 5
- Flagellum of second antenna of 5–8 articles 7
- 5 Length of first antenna $0.4 \times$ body length *Neocrypta robinae*
- Length of first antenna 0.5 or more \times body length 6
- 6 Outer rami of pleopods of 2 or 3 articles *Neocrypta simoni*
- Outer rami of pleopods of 6 articles *Neocrypta annae*
- 7 Gnathopod 2 bearing facial rugosities *Neocrypta georginae*
- Gnathopod 2 without facial rugosities 8

- 8 Pereopods 5–7 article two moderately expanded posteriorly, ovate, margins convex *Neocrypta primaris*
- Pereopods 5–7 article two slightly expanded posteriorly, sub rectangular, margins almost straight to concave *Neocrypta moniae*
- 9 Sternal gills bearing lumps 10
- Sternal gills dendritic (some, if not all) 12
- 10 Propodi of gnathopods expanded apically at palmar corner; third uropod outer ramus first article cylindrical, elongate, length $4 \times$ peduncle; plumose setae absent from both rami *Jasptorus solepti*
- Propodi of gnathopods not apically expanded at palmar corner; third uropod outer ramus first article foliaceous, length $2 \times$ peduncle, medial plumose setae present on both rami (*Wesniphargus*) 11
- 11 Propodi of gnathopods bearing posterior rugosities; pereopod 5 moderately setate with few robust setae; carpus and propodus of pereopod 6 strongly setose; coxa four apically ovate; inner ramus of third uropod extending to M0.7 of article 1 of outer ramus *Wesniphargus yanchepensis*
- Propodi of gnathopods without posterior rugosities; pereopod 5 bearing few setae and numerous robust setae; carpus and propodus of pereopod 6 without setae; coxa four apically subquadrate; inner ramus of third uropod extending to less than M0.4 of article 1 of outer ramus *Wesniphargus nichollsi*
- 12 Antennae 1–2 with long dense setae, basal articles of primary flagella on antennae 1–2 elongate (conjoint) *Tasniphargus tyleri*
- Antennae 1–2 with short sparse setae, basal articles of primary flagella on antenna 1–2 short 13
- 13 Pleopod peduncles strongly setose, outer ramus of uropod 1 with long apical spur in male *Yulia yuli*
- Pleopod peduncles not strongly setose, outer ramus of uropod 1 without long apical spur in male (*Neoniphargus*) 14
- 14 Dactyls of pereopods 3–7 multispinose on inner margin; uropod 3 inner ramus with 2–3 apical robust setae; posterior lobes of coxae 5–7 with strong setae 15
- Dactyls of pereopods 3–7 not multispinose on inner margin; uropod 3 inner ramus with 0–1 apical robust seta; posterior lobes of coxae 5–7 with weak setae 16
- 15 Third uropod inner ramus with a single, naked apical seta; epimera without posteroventral teeth; telson longer than broad, cleft 77%; outer plate of first maxilla bearing 9 denticulate robust setae; antenna 1 accessory flagellum extending beyond first article of primary flagellum *Neoniphargus coolemanensis*
- Third uropod inner ramus with 2–3 apical setae, one of which is sparsely plumose; epimera with small posteroventral teeth; telson no longer than broad, cleft 56%; outer plate of first maxilla bearing seven denticulate robust setae; antenna 1 accessory flagellum not extending beyond first article of primary flagellum *Neoniphargus spenceri*

- 16 Gnathopods sexually dimorphic (male palms notched); coxa 4 not deeply emarginate in males; robust setae on outer ramus of proximal article uropod 3 arranged singly *Neoniphargus tasmanicus*
- Gnathopods not sexually dimorphic (male palms not notched); coxa 4 deeply emarginate in males; robust setae on outer ramus of proximal article uropod 3 arranged in multiples 17
- 17 Uropod 3 not extending beyond uropods 1–2; robust setae on uropods 1–2 long *Neoniphargus thomsoni*
- Uropod 3 extending beyond uropods 1–2; robust setae on uropods 1–2 short or medium sized 18
- 18 Calceoli present on both antennae 1–2 in males; medial margin of outer ramus of proximal article of uropod 3 with several plumose setae in male *Neoniphargus fultoni*
- Calceoli not present on antenna 1 (sometimes in antenna 2) in males; medial margin of outer ramus proximal article of uropod 3 without several plumose setae in male 19
- 19 Antenna 2 without calceoli in males; long setae present on posterior margins of propodi of pereopods 5–7 *Neoniphargus alpinus*
- Antenna 2 with calceoli in males; long setae lacking on posterior margins or propodi of pereopods 5–7 20
- 20 Uropod 3 peduncle with very long apicomedial robust seta (spur) in male, outer ramus of third uropod less than $2 \times$ peduncle; telson cleft 70%; eyes large *Neoniphargus exiguus*
- Uropod 3 peduncle with only short apicomedial robust seta in male, outer ramus of third uropod $2-3 \times$ peduncle; telson cleft less than 70%; eyes vestigial or absent 21
- 21 Eyes vestigial; outer plate of maxilla 1 bearing 7 denticulate robust setae; posterior lobes of coxae 5–7 without robust setae; outer ramus of third uropod $2 \times$ length of peduncle; telson cleft 60%, each lobe bearing 2 lateral robust setae *Neoniphargus obrieni*
- Eyes absent; outer plate maxilla 1 bearing 5 or 9 denticulate robust setae; posterior lobes of coxae 5–7 with 1–2 robust setae; outer ramus of third uropod $3 \times$ length of peduncle; telson cleft 50% or less, lobes without lateral setation 22
- 22 Outer plate of maxilla 1 bearing 9 denticulate robust setae; peduncle of uropod 1 bearing medial robust setae; telson as long as third urosomite, cleft 40%, with 3 apical robust setae on each lobe *Neoniphargus secus*
- Outer plate of maxilla 1 bearing 5 denticulate robust setae; peduncles of uropod 1 without medial robust setae; telson shorter than third urosomite, cleft 50%, with 1 apical robust seta on each lobe *Neoniphargus richardi*

Check list of species**Corophiidae**

Paracorophium excavatum Stebbing 1899—Brisbane River, Qld.

Ceinidae

Austrochiltonia australis (Sayce, 1901)—widespread

Austrochiltonia subtenuis (Sayce, 1902)—widespread

Austrochiltonia dalhousiensis Zeidler, 1997—Dalhousie Springs, S.A.

Phreatochiltonia anopthalma Zeidler, 1991—Dalhousie Springs, S.A.

Eusiridae

Paraleptamphopus sp. (Stebbing, 1899)—Tas.

Pseudomoera fontana (Sayce, 1902)—Woods Point, Vic.

Pseudomoera gabrieli (Sayce, 1901)—Dandenong Range and Gippsland, Vic.

Paracalliopiidae

Paracalliope larai Knott, 1975—Tas.

Paracalliope vicinus, Barnard & Drummond, 1992—Tas., King Island, southern Vic.

Melitidae

Nedsia douglasi Barnard & Williams, 1995—North West Cape, W.A.

Nedsia straskraba Bradbury & Williams, 1996—Barrow Island, W.A.

Nedsia fragilis Bradbury & Williams, 1996—Barrow Island, W.A.

Nedsia humphreysi Bradbury & Williams, 1996—Barrow Island, W.A.

Nedsia hurlberti Bradbury & Williams, 1996—Barrow Island, W.A.

Nedsia urifimbriata Bradbury & Williams, 1996—Barrow Island, W.A.

Nedsia macrosculptilis Bradbury & Williams, 1996—Barrow Island, W.A.

Nedsia sculptilis Bradbury & Williams, 1996—Barrow Island, W.A.

Norcapensis mandibulis Bradbury & Williams, 1997b—North West Cape, W.A.

Brachina invasa Barnard & Williams, 1995—Flinders Ranges, S.A.

Melita plumulosa Zeidler, 1988—coastal N.S.W.

Bogidiellidae

Bogidomma australis Bradbury & Williams, 1996—Barrow Island, W.A.

Crangonyctoidea**Paramelitidae**

Austrogammarus australis (Sayce, 1901)—Dandenong Range, Vic.

Austrogammarus smithi Williams & Barnard, 1988—Magnet Creek, northwest Tas.

Austrogammarus haasei (Sayce, 1901)—Dandenong Range, Vic.

Austrogammarus saycei Williams & Barnard, 1988—Dandenong Range, Vic.

Austrogammarus spinatus Williams & Barnard, 1988—Dandenong Range, Vic.

Austrogammarus multispinatus Williams & Barnard, 1988—Dandenong Range, Vic.

Austrogammarus telsosetosus Barnard & Williams, 1995—Lake Bonney, S.A.

Austrocrangonyx barringtonensis (Chilton, 1916)—Barrington Tops, N.S.W.

Austrocrangonyx hynesi Williams & Barnard, 1988—Barrington Tops, N.S.W.

Antipodeus antipodeus (G.W. Smith, 1909)—Mole Creek, Tas.

Antipodeus wellingtoni (G.W. Smith, 1909)—Mount Wellington, Tas.

Antipodeus niger (G.W. Smith, 1909)—Hartz Mountains. Tas.

- Antipodeus ripensis* (G.W. Smith, 1909)—Great Lake, Tas.
Antipodeus murtoni (Thomson, 1893)—Huon River Valley, Tas.
Antipodeus franklini Williams & Barnard, 1988—Huon River Valley, Tas.
Hurleya kalamundae Straskraba, 1966—Kalamunda, W.A.
Uroctena affinis Nicholls, 1926c—near Perth, W.A.
Uroctena westralis (Chilton, 1925)—near Perth, W.A.
Uroctena setosa Nicholls, 1926c—Katanning and near Perth, W.A.
Uroctena yellandi Nicholls, 1926d—south of Armadale (near Perth), W.A.
Uroctena whadjukia Barnard & Williams, 1995—Wungong System, W.A.
Giniphargus pulchellus (Sayce, 1899)—Thorpdale, Gippsland, Vic.
Protocrangonyx fontinalis Nicholls, 1926a—Darling Range, W.A.
Toulrabia willsi Barnard & Williams, 1995—Stirling Range, W.A.
Chillagoe thea Barnard & Williams, 1995—Chillagoe Caves, Qld.
Totgammarus eximius Bradbury & Williams, 1995—southwest W.A.
Pilbarus millsii Bradbury & Williams, 1997b—Millstream, Pilbara, W.A.

Neoniphargidae

- Tasniphargus tyleri* Williams & Barnard, 1988—Great Lake, Tas.
Neoniphargus thomsoni Stebbing, 1899—Mount Wellington, Tas.
Neoniphargus spenceri (Sayce, 1901)—Plenty Range, Vic.
Neoniphargus fultoni Sayce, 1902—Warburton, Vic.
Neoniphargus obrieni Nicholls, 1926b—Mount Buffalo, Vic.
Neoniphargus alpinus G.W. Smith, 1909—Mount Read, Tas.
Neoniphargus exiguus G.W. Smith, 1909—near Kingston, Tas.
Neoniphargus tasmanicus G.W. Smith, 1909—Great Lake, Tas.
Neoniphargus coolemanensis Bradbury & Williams, 1997b—Murray Cave, Cooleman Plain, N.S.W.
Neoniphargus secus Bradbury & Williams, 1997b—Gurungah Cave, Wombeyan Cave system, N.S.W.
Neoniphargus richardi Bradbury & Williams, 1997b—River Cave, Wombeyan Cave system, N.S.W.
Wesniphargus nichollsi (Straskraba, 1964)—Cannington, W.A.
Wesniphargus yanchepensis Bradbury & Williams, 1997b—Yanchep Cave, W.A.
Neocrypta primaria Bradbury & Williams, 1997b—Limekiln Cave, Wellington, N.S.W.
Neocrypta robinae Bradbury & Williams, 1997b—Diprotodon Cave, Canomodine, N.S.W.
Neocrypta moniae Bradbury & Williams, 1997b—Bowen Park cave system, N.S.W.
Neocrypta georginae Bradbury & Williams, 1997b—Apple Tree Cave, Copperhania, N.S.W.
Neocrypta annae Bradbury & Williams, 1997b—Bowen Park Cave system, N.S.W.
Neocrypta simoni Bradbury & Williams, 1997b—Paradox Cave, Jenolan, N.S.W.
Wombeyanus botulosus Bradbury & Williams, 1997b—Bullio Cave, Wombeyan Cave system, N.S.W.
Jasptorus solepti Bradbury & Williams, 1997b—Wee Jasper Cave system, N.S.W.
Uronyctus longicaudus Stock & Iliffe, 1990—Mount Gambier area, S.A.
Yulia yuli (G.W. Smith, 1909)—Yules Lake, Tas.

Perthiidae

- Perthia branchialis* (Nicholls, 1924)—southwest W.A.
Perthia acutitelson Straskraba, 1964—southwest W.A.

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