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CONTENTS

A GUIDE TO THE LARVAE OF NEW ZEALAND SHALLOW WATER CARIDEA
(Crustacea, Decapoda, Natantia)

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ABSTRACT

A guide to the identification of New Zealand's shallow water caridean larvae of the families Alpheidae, Crangonidae, Hippolytidae, Ogyrididae, and Palaemonidae is presented. It gives combinations of characters for identifying the larvae to the level of family, with brief descriptions or keys to genera, and to species where possible.

INTRODUCTION

New Zealand's shallow water[1] caridean fauna comprises species belonging to five families: Alpheidae Bate, 1888, Crangonidae Bate, 1888, Hippolytidae Bate, 1888, Ogyrididae Holthuis, 1955 and Palaemonidae Samouelle, 1819. Larvae of many of these shallow water species have now been described, although much of this information is yet to be published (see Wear 1985). The guide presented here summarises this knowledge. The larvae of New Zealand's offshore Caridea are, however, too poorly known to enable construction of a single, comprehensive key to their larvae. This guide is intended as a preliminary step toward such a key.

The first part of the guide comprises a list of characters which, taken in combination, distinguish caridean larvae from those of other decapods. Larvae of each of the five families are then similarly characterised. Genera or individual species within each family are considered in the form of a key or, in the case of the Hippolytidae, are briefly described.

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[1] Defined as 0-20m after Yaldwyn (1959)

Records of the New Zealand caridean fauna, and data on egg size and number, were obtained from Yaldwyn (1954, 1959, 1960, 1971), Richardson & Yaldwyn (1958) and Hayashi & Miyake (1970). The lists of characters distinguishing larvae of the Caridea and of each family were based principally on Gurney's (1942) "Larvae of Decapod Crustacea" and the keys of Williamson (1957, 1982).

TERMINOLOGY

Terminology used in this guide essentially follows that of Gurney (1942). However, terminology used here to define developmental type and stage is given below.

Unabbreviated development

Species with four or more planktonic zoeal instars in their life history.

Key to zoeal stage

A. Eyes sessile ..... zoea 1
Eyes stalked ..... B

early stage

B. Uropods not freed from telson (Fig. 2F) ..... zoea 2
Uropods freed from telson C

C. Uropod endopod rudimentary (Fig. 2E) ..... zoea 3
Uropod endopod and exopod developed ..... D

D. Pleopods absent or rudimentary (Fig. 2D) ..... zoea 4+

late stage

Pleopods setose and functional ..... postlarvae

Early and late stages are arbitrarily defined. The terms are useful when referring to larvae in which the number of instars is variable or unknown, or when more than one instar is referred to. Early larvae are those in which there are no pleopod buds, and usually refers to zoeae 1-3. Late larvae are those in which all the appendages are present and well formed, and the pleopod buds are large but not yet setose. Intermediate classification into mid-stage larvae is only necessary when

there are a large number of instars and the degree of morphological change between them is small. Mid-stage larvae are zoea 4+ larvae in which pleopod buds are absent or small.

Abbreviated development

Larvae with development abbreviated to three or fewer instars follow the above pattern in development of the eyestalks and uropods. However, all other appendages including pleopod buds are present from zoea 1 onwards. For example, a zoea 3 larva with abbreviated development has rudimentary uropod endopods but also has large pleopod buds and is similar in other respects to late larvae with unabbreviated development.

CARIDEA

Larvae of the Caridea can be distinguished from those of other decapods by the following combination of characters.

Caridean larval characters

1. Carapace and abdomen usually without large numbers of spines.
2. Posterolateral margins of carapace smooth, not produced posteriorly as spines and rarely overlapping more than abdominal somite 1.
3. Abdomen in mid- and late larvae with pleura of somite 2 overlapping those of somites 1 and 3.
4. Antennal exopod unsegmented (e.g. Fig. 2A) or in early larvae semented near distal end only (Fig. 3E).
5. Maxillipeds 1-3 present and with functional natatory exopod from hatching (except in some species with abbreviated development); endopod of maxilliped 1 shorter than that of maxilliped 2 which is shorter than that of maxilliped 3; basis of maxilliped 1 broad and flattened, with endopod at distal margin.
6. Telson dorsoventrally flattened; usually triangular in early larvae and parallel sided or tapering in mid- and late larvae; seta 2 not reduced to a small hair (Fig. 2E).

Family Alpheidae

The following species have been recorded from the New Zealand region: *Alpheopsis garricki* Yaldwyn, 1971, *Alpheus nouvaezealandiae* Miers, 1876, *Alpheus richardsoni* Yaldwyn, 1971, *Alpheus socialis* Heller, 1865 and *Betaeopsis aequimanus* (Dana, 1852). However, Yaldwyn (1959) noted that *Alpheus novaezealandiae* had not been found in New Zealand for 50 years. Early larvae of the other four species have been hatched and reared by the present author, and although not yet studied

in detail, it is possible to distinguish between them on the basis of the key provided below.

Larvae of the family Alpheidae can be distinguished by the following combination of characters.

Alpheid larval characters

1. Supraorbital spines when present without spinules (Fig. 1A).
2. Pereiopod 5 develops before pereiopods 3 and 4, terminal spine of dactylus extremely long (extends at least beyond eyes) and provided with spinules distally (Figs. 1B, C).
3. Protopod of maxilla with 3 endites only, exopod shorter than endopod in early larvae (Fig. 1H).
4. Endopod of maxillule small and unsegmented.
5. Endopod of maxilliped 1 with two or three incomplete segments (as indicated by setation), never with indication of four segments (Figs. 1D, E).
6. Maxillipeds 2-3 and pereiopods raptorial in form, with spiniform serrate and simple setae, dactylus produced into a strong spine (e.g. Figs. 1F, G).

Key to larvae of the New Zealand Alpheidae[1]

A. Rostrum as long as or longer than antennular peduncle; with supraorbital spines from zoea 2; strong posterolateral spines on abdominal somite 5 from zoea 3; pereiopod 5 not developed until zoea 3 (Fig. 1A) ..... *Betaeopsis aequimanus*

Rostrum short, does not extend beyond eyes; without supraorbital spines or posterolateral abdominal spines in zoeae 1-3; pereiopod 5 developed in zoea 2 (Fig. 1B) ..... B

B. Endopod of maxilliped 1 very small, with two incomplete segments (as indicated by setation) (Fig. 1D) ..... *Alpheus richardsoni*

Endopod of maxilliped 1 with three incomplete segments (as indicated by setation) C

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1 Excludes *Alpheus novaezealandiae*

C. Ischium of maxilliped 3 without spiniform seta (Fig. 1F) ..... *Alpheus socialis*

Ischium of maxilliped 3 with spiniform seta (Fig. 1G) ..... *Alpheopsis garricki*

Family Crangonidae

The following species have been recorded from the New Zealand region: *Pontocaris lacazei* (Gourret, 1888), *Pontophilus australis* (Thomson, 1879), *P. acutirostratus* Yaldwyn, 1960, *P. challengeri* Ortmann, 1893, *P. chiltoni* Kemp, 1911, *P. hamiltoni* Yaldwyn, 1971, *P. indicus* de Man, 1918, *P. pilosoides* Stephenson, 1927, *P. quadrispinosus* Yaldwyn, 1971, *P. yaldwyni* Zarenkov, 1968, *Prionocrangon curvicaulis* Yaldwyn, 1960, *Sclerocrangon knoxi* Yaldwyn, 1960, *S. richardsoni* Yaldwyn, 1960. In addition, the Family Glyphocrangonidae may be represented in deep water off New Zealand (Richardson & Yaldwyn 1958), and larvae of species belonging to this family could possibly be confused with those of the Crangonidae on the basis of characters given below.

Early larvae of *Pontocaris lacazei* have been described by De Simón (1979), and larvae of *Pontophilus australis*, *P. chiltoni*, *P. hamiltoni* and *P. pilosoides* by Packer (1983). No other larvae of the New Zealand Crangonidae are known. However, on the basis of their relatively large egg size and on published information for larvae from outside the New Zealand region, the species of *Prionocrangon* and *Sclerocrangon* almost certainly have abbreviated larval development. This is probably also true for the Glyphocrangonidae.

Larvae of the Glyphocrangonidae and *Sclerocrangon* with abbreviated development, described from beyond the New Zealand region, have more than the usual 8+8 telsonic setae (e.g. Dobkin 1965, Makarov 1968). In larvae of *Sclerocrangon* the posterior margin of the telson is either smoothly rounded posteriorly (Fig. 2F) or weakly indented (Sars 1890, Wollebaek 1906, Makarov 1968) whereas in *Glyphocrangon spinicauda* the posterior margin of the telson bears a median spine or "prominence" (Dobkin 1965) (Fig. 2G). To the author's knowledge no larvae of *Prionocrangon* have been described.

All known larvae of the genus *Pontophilus* Leach can be separated into three distinct groups (Packer 1983). The first group includes larvae referred to the genus *Pontophilus*. The second group includes larvae referred to *Philocheras* Stebbing, which was synonymized with *Pontophilus* Leach by Kemp (1911) - a revision followed by the majority of authors with regard to the adults (Lebour 1954, Williamson 1982) but not accepted by authors working with larval material (see Williamson

(1960) for synopses of larval data and keys to the larvae forming these two groups). These groups have been referred to as *'Pontophilus*-group A' and *'Pontophilus*-group B' respectively (Packer 1983). Larvae of *Pontophilus australis*, *P. chiltoni*, *P. hamiltoni* and *P. pilosoides*, from the New Zealand region, form the third group. However, larvae of the five species from New Zealand waters which have yet to be described could belong to any of these three groups, and so provision for this possibility is made in the key given below.

Larvae of the family Crangonidae can be distinguished by the following combination of characters.

Crangonid larval characters

1. Eyes oviform, close together (e.g. Fig. 2A).
2. Carapace with ventral margins convex, without supraorbital spines (Fig. 2D).
3. Inner flagellum of antennule in the form of a stout rod (e.g. Fig. 2A) or of many segments (Fig. 2I).
4. Antennal exopod not distally segmented (except in early larvae of *Pontocaris lacazei* (Fig. 2I).
5. Exopod of maxilla without proximal extension (Fig. 2C, cf. Figs. 3K, 4I).
6. Pereiopod 1 with rudimentary subchela in late larvae, propodus broad (Fig. 2D).

Key to larvae of New Zealand Crangonidae

A. Larvae with all appendages present except the uropods, or uropods present but endopod rudimentary; in latter case pleopod buds large, i.e. abbreviated development ..... *Sclerocrangon*
Prionocrangon
Fam. Glyphocrangonidae

Larvae with unabbreviated development ..... B

B. Abdomen less than twice length of carapace, without dorsomedial spine on somite 3 (although this somite may have paired postero-lateral spines); posterior margin of telson weakly concave or straight C

Abdomen more than twice length of carapace, with dorsomedial spine on somite 3; posterior margin of telson strongly concave ..... D

C. Base of rostrum with concave lateral margins (Fig. 2A); exopods of maxillipeds 2-3 and pereiopods 1-2 with no more than six setae (Fig. 2D); posterior margin of telson straight from zoea 4 onward ..... *Pontophilus australis*
P. chiltoni
P. hamiltoni
P. pilosoides
(other *Pontophilus* spp.?)

Base of rostrum with convex lateral margins (Fig. 2B); exopods of maxillipeds 2-3 and pereiopods 1-2 with more than six setae; posterior margin of telson weakly concave in all larvae ..... *'Pontophilus*-group B'

D. Abdominal somite 5 with strong posterolateral spines; inner flagellum of antennule shorter than carapace (Fig. 2H) ..... *'Pontophilus*-group A'
(? including *P. indicus* & *P. challengeri* from group 1 of Kemp 1916)

Abdominal somite 5 without posterolateral spines; inner flagellum of antennule longer than carapace, of many segments from zoea 2 onward (Fig. 2I) ..... *Pontocaris lacazei*

Family Hippolytidae

Seven species have been recorded from the New Zealand region: *Alope spinifrons* (H. Milne-Edwards, 1837), *Bathyhippolyte yaldwyni* Hayashi & Miyake, 1970, *Hippolysmata morelandi* Yaldwyn, 1971, *Hippolyte bifidirostris* (Miers, 1876), *H. multicolorata* Yaldwyn, 1971, *Nauticaris marionis* Bate, 1888, *Tozeuma novaezealandiae* Borradaile, 1916. Larvae of five of these species have been described by Packer (1983). The remaining two species are *Hippolysmata morelandi*, a shallow water species from northern New Zealand, and *Bathyhippolyte yaldwyni*, which has been taken in deep water off the east cost of the South Island.

The eggs of *B. yaldwyni* are large and few in number, and so this species almost certainly has abbreviated development, and the larvae

should easily be distinguished from those of the other New Zealand Hippolytidae.

Larvae of *Hippolysmata morelandi* should also easily be identified. Known larvae of the genus *Hippolysmata* are characterised by the enormous size and oar-like propodus of pereiopod 5 (Fig. 3C). Gurney (1937) summarised larval characters of this genus.

Only the zoea 1 of *Nauticaris marionis* is known, and no other larvae of the genus have been described. Hence, without information on later larvae of this genus, it is not possible to construct a key to larvae of the New Zealand Hippolytidae. Therefore, in place of such a key, characteristic features of the known New Zealand hippolytid larvae are provided below.

There is such a wide variation of form among larvae of this family that it is difficult to provide a list of characters by which they can be recognised as a group. The following combination of characters is shared by the larvae of all New Zealand species except those of *Hippolysmata morelandi* for which characters 1, 3 and 7 do not apply:

Hippolytid larval characters

1. Eyestalks short, cylindrical rather than tapering proximally.
2. Rostrum extends beyond eyes (except in late larvae of *Alope*), without spines.
3. Maxillule with outer plumose seta and with distal lobe of endopod bearing three setae (Fig. 3J).
4. Exopod of maxilla in mid- and late larvae with proximal extension, and with distal margin almost straight rather than smoothly rounded, always with setae on outer proximal margin (Fig. 3K).
5. Maxillipeds 2 and 3 with flexible rather than spiniform setae (e.g. Fig. 3I, cf. Fig 4E).
6. Both pereiopods 1 and 2 with a well formed chela in late larvae.
7. Antennules not separated at base by more than width of one of them (Fig. 3D).
8. Antennal exopod distally segmented in early larvae (Fig. 3E).
9. Never more than 8+8 telsonic setae.

Diagnostic characters of New Zealand Hippolytidae larvae

Alope spinifrons (Fig. 3G)

Carapace with one pair of anterolateral spines in zoea 1, and two pairs from zoea 2 onward (of which the more dorsal is as long as the antennal protopod in late larvae), with supraorbital spines from zoea 2 onwards; abdominal somites 1-5 without spines; pereiopods 1-4 with exopod bearing six setae when first developed but with up to 12 setae in late larvae; pereiopods 3-5 raptorial in form and pereiopod 5 shorter than pereiopods 2-4 when all developed.

Hippolyte bifidirostris and *H. multicolorata* (Figs. 3A, B)

Carapace with 3-5 pairs of anteroventral spines and one pair of anterolateral spines; region above latter minutely serrated; also with supraorbital spines from zoea 3; abdominal somite 5 with posterolateral spines, also with small posterodorsal spines in *H. multicolorata* only; pereiopods 1-2 with exopod, 3-5 poorly segmented and probably not functional; exopods of pereiopods and maxillipeds with no more than six setae.

Nauticaris marionis (Figs. 3D-F)

Only zoea 1 known; carapace with one pair of anterolateral spines; abdomen with small posterodorsal spines on somite 5 and no other spines; antennal endopod almost twice length of exopod, with small accessory seta, and with long tapering distal portion bearing two rows of widely spaced spines.

Tozeuma novaezealandiae (Fig. 3H)

Long and slender larvae with very prominent, forward-pointing dorsomedial spine on somite 3; also with strong posterolateral spines on abdominal somite 5.

Family Ogyrididae

This family is represented in New Zealand waters by a single species, *Ogyrides delli* Yaldwyn, 1971. Early larvae of *O. delli* have been reared by the author, although they have not yet been described formally.

The only larvae of an ogyridid which have been described in the literature are those of *O. limicola* Williams, 1955, described by Sandifer (1974). The larvae of both *O. delli* and *O. limicola* are similar in many respects to those of the Hippolytidae. *O. delli* larvae should easily be identified by substituting the following for characters 1-4 given above for the Hippolytidae:

Ogyridid larval characters

1. Eyestalks short, oviform, close together (Fig. 4A).

2. Carapace with one pair of anterolateral spines (at pterygostomial angles), and one pair of anteroventral spines; rostrum extends beyond eyes in *O. delli* (but not in *O. limicola*), with subrostral spines from zoea 2 onward (Fig. 4A).
3. Maxillule without outer plumose seta, and with distal lobe of endopod bearing two setae.
4. Exopod of maxilla from zoea 3 onward with proximal extension, with distal margin smoothly rounded, and with reduction in number of setae on outer proximal margin (Fig. 4B).

The larvae of *O. delli* are further characterised by the absence of spines on abdominal somites 1-5 (as are *O. limicola* larvae), and by the loss of telsonic setae 2 and 3 in zoea 4.

Family Palaemonidae

The following species have been recorded from New Zealand waters: *Leander tenuicornis* (Say, 1818), *Palaemon affinis* H. Milne-Edwards, 1837, *Periclimenaeus novaezealandiae* (Borradaile, 1916), *Periclimenes yaldwyni* Holthuis, 1959 and three as yet unnamed species of *Periclimenes* (see Richardson & Yaldwyn, 1958).

Larvae of *L. tenuicornis* have been described by Gurney (1938, 1939) and Gurney & Lebour (1941). Larvae of *Palaemon affinis*, *Periclimenes yaldwyni* and one of the unnamed species of *Periclimenes* have been described by Packer (1983). Larvae of the other species are not known, although Gurney (1924) described larvae from northern New Zealand which could belong to one of the unnamed species of *Periclimenes* (see Packer 1983, p. 187). Larvae of the two species of *Periclimenes* described by Packer (1983) were too similar to separate readily in planton samples.

Very little is known of larvae of the genus *Periclimenaeus* Borradaile. Those described from beyond New Zealand waters are similar in overall morphology to larvae of *Periclimenes* spp. They may or may not have a toothed rostrum and more conspicuous spinules on the dactylus spine of maxilliped 2 by which they could be distinguished from larvae of the genus *Periclimenes* (see Gurney & Lebour 1941 (as *Periclimenes*, subgenus *Periclimenaeus*) and Fig. 4F).

As a group the larvae of this family are superficially similar to those of the family Alpheidae. They can be identified by substituting the following for characters 1-3 given above for the Alpheidae.

Palaemonid larval characters

1. Carapace with supraorbital spines bearing retrorse spinules from zoea 2 onward (Figs. 4C, D, K).
2. Pereiopod 5 not much longer than pereiopod 4 when latter developed (Figs. 4C, K), except in *Leander* (Fig. 4D).
3. Protopod of maxilla with three endites only (Figs. 4I, J), exopod longer than endopod except in early larvae of *Periclimenes*.

Key to larvae of New Zealand Palaemonidae

A. Body with double bend, especially in late larvae; carapace without dorsomedial spines; rostrum shorter than half the length of the antennular peduncle; abdomen without spines on somite 5 (Fig. 4C) ..... *Periclimenes* spp.
Periclimenaeus novaezealandiae?

Body straight or abdomen curved ventrally; carapace with dorsomedial spines bearing spinules from zoea 2 onward; rostrum subequal in length to antennular peduncle; abdomen with posterolateral spines on somite 5 in all zoeae or from zoea 2 onward (Figs. 4D, K) ..... B

B. Carapace never with more than two dorsomedial spines; pereiopods 1-3 with exopod; pereiopod 5 develops before pereiopod 3, much longer than pereiopods 3-4 when latter developed; Maxilliped 1 with inner margin of basis strongly protuberant in all zoeae; endopod of maxilla without basal lobe (Figs. 4D, H, J) ..... *Leander tenuicornis*

Carapace with three dorsomedial spines from zoea 4 onwards; pereiopods 1-4 with exopod; pereiopod 5 not developed before pereiopod 3, not much longer than pereiopods 3-4 when latter developed; maxilliped 1 without inner margin of basis strongly protruberant in early larvae; endopod of maxilla with basal lobe (Figs. 4G, I, K) ..... *Palaemon affinis*

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Abbreviations in Figures 1-4

A1	antennule	fi	internal flagellum
A1P	antennular peduncle	M1-3	maxillipeds 1-3
A2	antenna	OS	outside seta
ALS	anterolateral spine	P1-5	pereiopods 1-5
AS1-5	abdominal somites 1-5	PDS	posterodorsal spine(s)
AVS	anteroventral spine	PE	proximal extension
BL	basal lobe	PLB	pleopod bud
DMS	dorsomedial spine	PLS	posterolateral spine
DS	dactylus spine	R	rostrum
E1-4	endites 1-4	S1-8	telsonic setae 1-8
end	endopod	SOS	supraorbital spine
ex	exopod	T	telson
fe	external flagellum	U	uropod

Legends for Figures 1-4
(scale in mm)

Figure 1: A - *Betaeopsis aequimanus* zoea 3, carapace and abdomen, lateral view. B,C,G,H - *Alpheopsis garricki* zoea 3, lateral view (B), enlarged tip of pereiopod 5 dactylus spine (C), maxilliped 3 (exopod omitted) (G), maxilla (H). D - *Alpheus richardsoni* zoea 3, maxilliped 1 (exopod omitted). E, F - *Alpheus socialis* zoea 3, maxilliped 1 (E) and 3 (F).

Figure 2: A - *Pontophilus australis* zoea 5, anterior dorsal view. B - *Cheraphilus* (=*Pontophilus*) *echinulatus* zoea 5, anterior dorsal view, showing rostrum shape in '*Pontophilus*-group B' species. C-E - *Pontophilus chiltoni*, zoea 5 maxilla (C), zoea 5 lateral view (D), zoea 3 telson and uropods (E). F - *Sclerocrangon boreas* zoea 1, telson. G - *Glyphocrangon spinicauda* zoea 1, telson. H - *Pontophilus spinosus* zoea 5, anterior dorsal view showing the length of antennullar flagellum in '*Pontophilus*-group A' species. (B, H after Sars 1890, F after Makarov 1968, G after Dobkin 1965, I after De Simon 1979)

Figure 3: A, B - *Hippolyte multicolorata* zoea 8, lateral view (A), enlarged dorsal view of spines on abdominal somite 5 (B). C - *Hippolysmata ensirostris* zoea 7, lateral view of cephalothorax (note enormous length of pereiopod 5; other thoracic appendages omitted). D-F - *Nauticaris marionis* zoea 1, dorsal view (D), antenna (E), enlarged dorsal view of spines on abdominal somite 5 (F). G - *Alope spinifrons* zoea 5, lateral view. H, K - *Tozeuma novaezealandiae* zoea 1, lateral view (H), maxilla (K). I, J - *Hippolyte bifidirostris* zoea 3, maxilliped 3 (I), maxillule (J). (C after Pillai 1974)

Figure 4: A, B - *Ogyrides delli* zoea 4, dorsal view of cephalothorax (A), maxilla (B). C - *Periclimenes yaldwyni* zoea 8, lateral view. D, H, J - *Leander tenuicornis* zoea 5(?), lateral view (D), maxilliped 1 (H), maxilla (J). E, G, I, K - *Palaemon affinis* zoea 6, maxilliped 2 (E), maxilliped 1 (G), maxilla (I), lateral view (K). F - *Periclimenaeus* (?) *wilsoni* last larva, maxilliped 2 (exopod omitted). (D, H, J after Gurney 1938, F after Gurney & Lebour 1941, F, H, J scale unknown.)

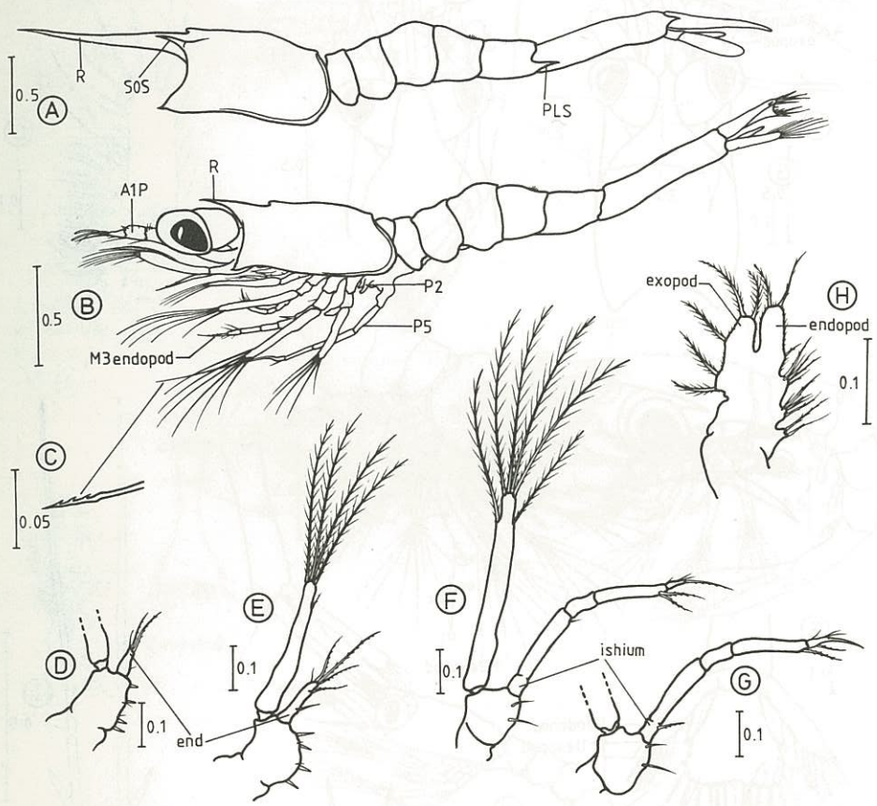

Figure 1

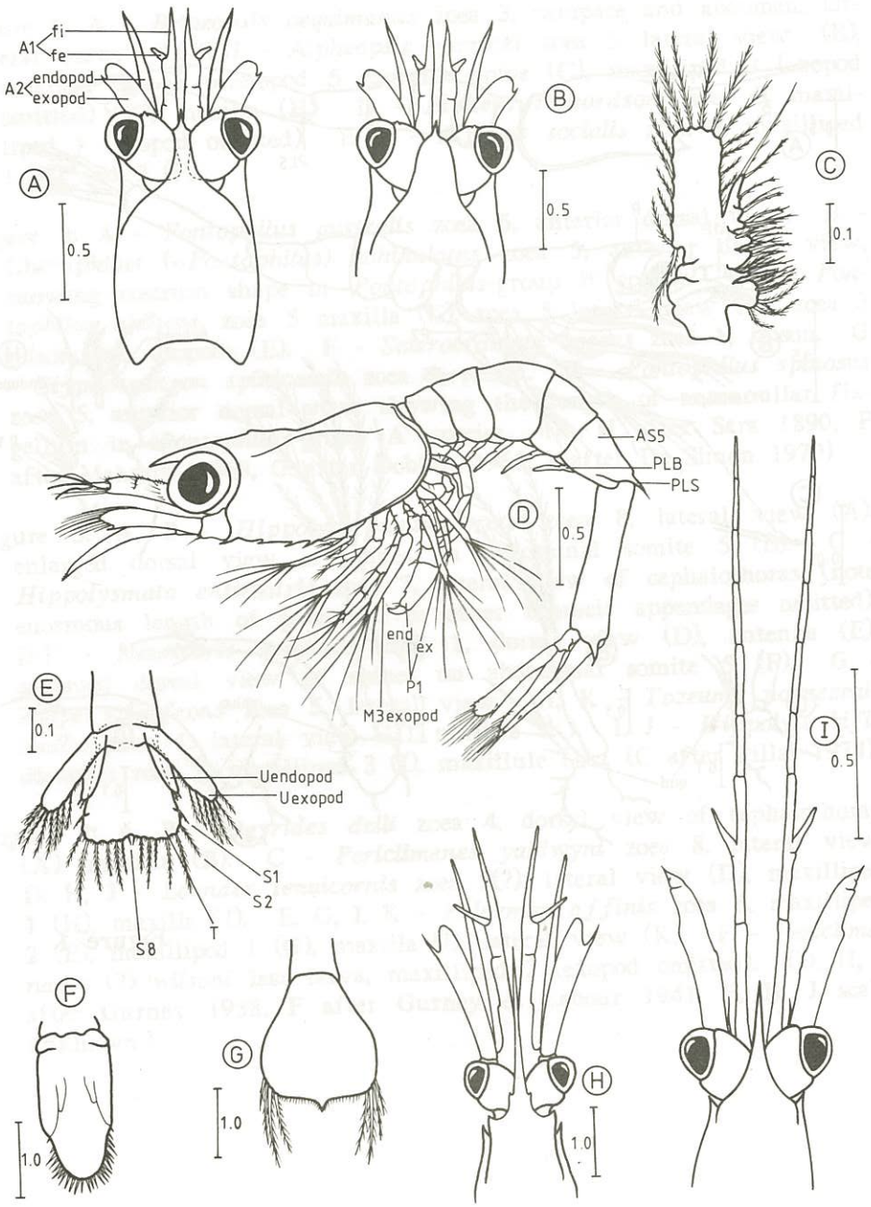

Figure 2

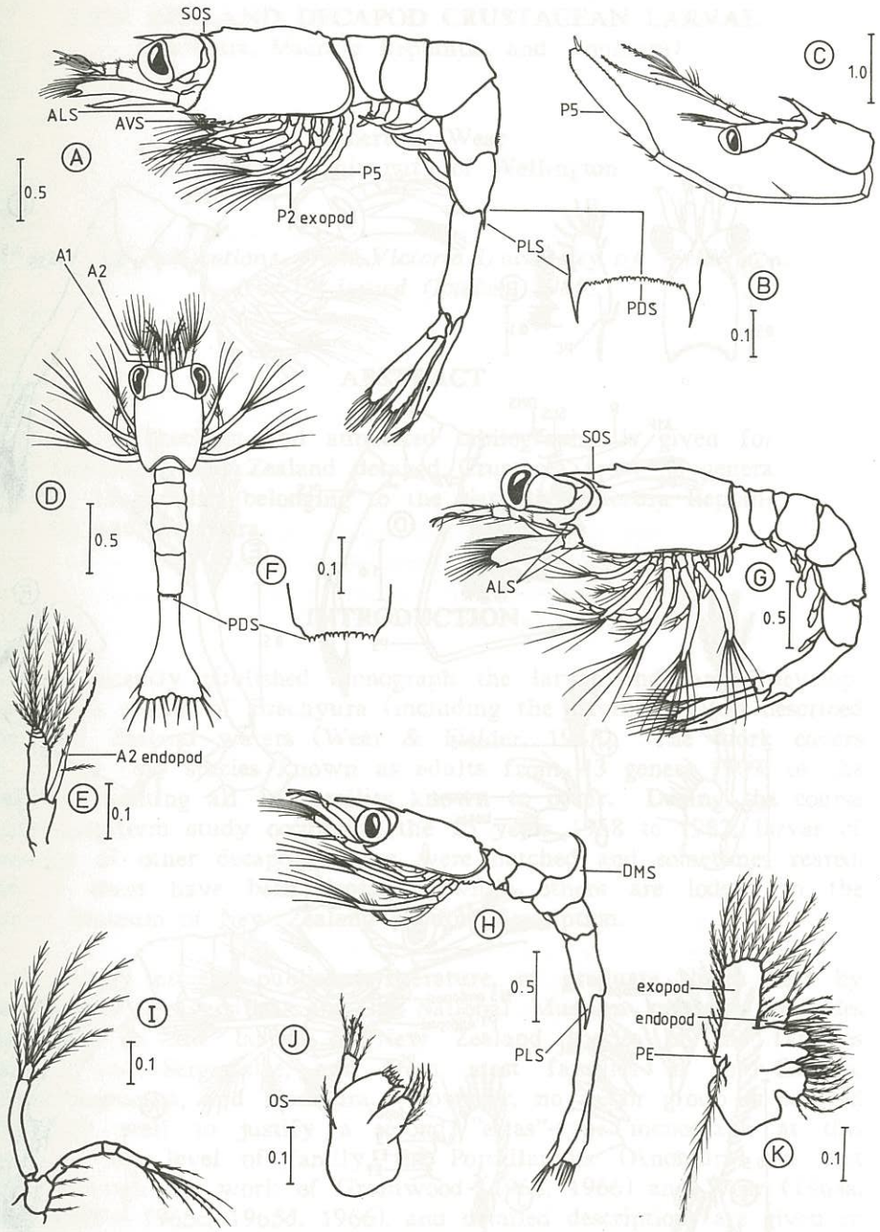

Figure 3

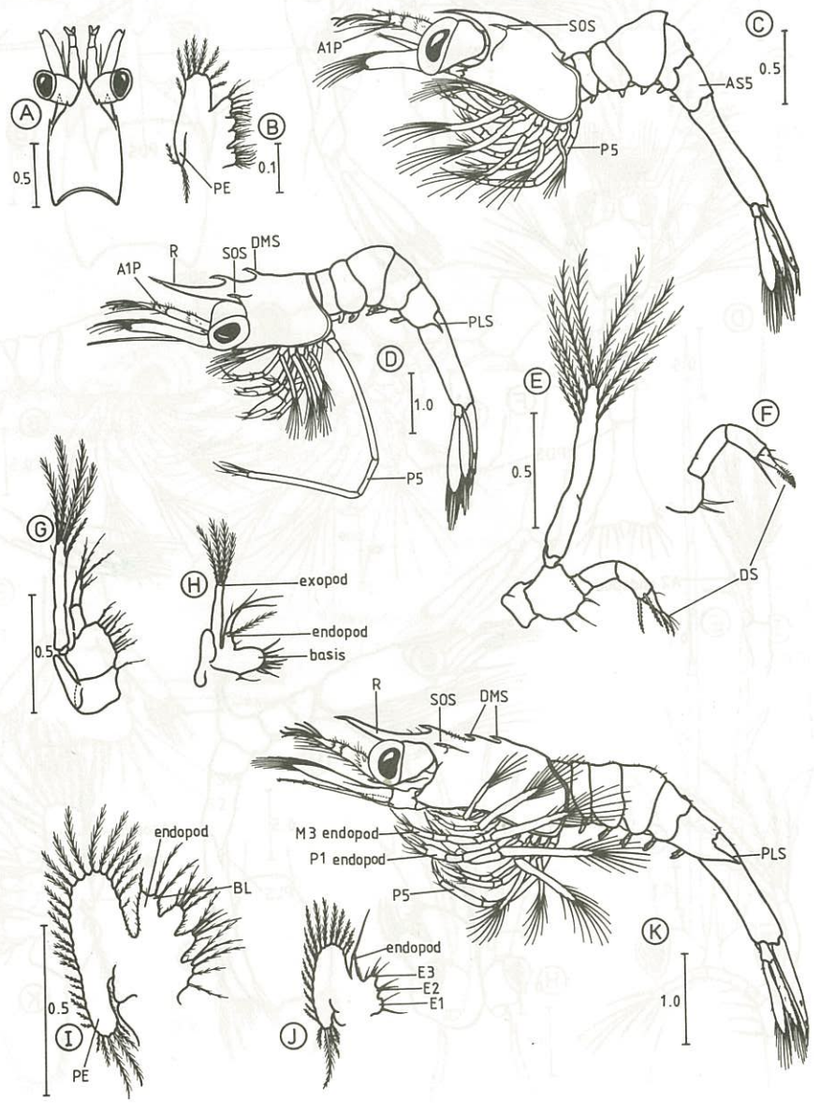

Figure 4

CHECKLIST AND ANNOTATED BIBLIOGRAPHY OF NEW ZEALAND DECAPOD CRUSTACEAN LARVAE

(Natantia, Macrura Reptantia, and Anomura)

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ABSTRACT

A checklist and annotated bibliography is given for larvae of New Zealand decapod Crustacea from 38 genera in 25 families belonging to the Natantia, Macrura Reptantia and Anomura.

INTRODUCTION

In a recently published monograph the larvae and larval development of 53 species of Brachyura (including the Dromiacea) are described from New Zealand waters (Wear & Fielder, 1985). The work covers 72% of the crab species known as adults from 43 genera (90% of the fauna) representing all 16 families known to occur. During the course of this long-term study occupying the 15 years 1968 to 1982, larvae of a number of other decapod species were hatched and sometimes reared. Some of these have been described while others are lodged in the National Museum of New Zealand pending description.

A survey of the published literature, of graduate theses held by New Zealand Universities, and of National Museum material, provides information on the larvae of New Zealand species of the families Penaeidae and Sergestidae, and from most families in the Caridea, Macrura Reptantia, and Anomura. However, no major group is covered sufficiently well to justify a second "atlas"-type monograph at this stage. At the level of family, the Porcellanidae (Anomura) are best known through the work of Greenwood (1965, 1966) and Wear (1964a, 1964b, 1965b, 1965c, 1965d, 1966), and detailed descriptions are given in an account of larvae of the caridean families Crangonidae, Hippolytidae and Palaemonidae by Packer (1983) in his graduate thesis at Victoria University of Wellington. A guide for the identification of these caridean larvae, and those of the caridean families Alpheidae and Ogyrididae,

is given by Packer (1985).

Although an "atlas" to accompany that of the New Zealand Brachyura is presently inappropriate, there is sufficient information available to proceed with this check list and annotated bibliography as the simplest direct guide to published and unpublished literature, and to the availability of research material, for students of decapod larvae and for scientists working on the zooplankton of our coastal and near offshore waters. Workers wishing to identify planktonic larvae other than the Brachyura should first refer to Williamson's (1957, 1982) illustrated keys to the decapod larvae from European waters. These keys include guides to broad taxonomic groupings which have general relevance worldwide, often to the level of family. A second appropriate step is to consult Gurney's (1942) "Larvae of Decapod Crustacea", which is still the finest synthesis of decapod larval characters yet published. Additional supporting information is available in Bourdillon-Casanova (1960). Short descriptions of larvae of species occurring in New Zealand and Eastern Australian waters are contained in the works of Robert Gurney published in the 1924, 1936 and 1938 reports of the "Terra Nova", "Discovery" and Great Barrier Reef Expeditions respectively. These early records are valuable guides to the identity of several families and genera from which larvae are otherwise undescribed.

This checklist and annotated bibliography includes only those decapods from which larvae have been hatched from adults identified to species, or where in my opinion the evidence is sufficiently strong to establish species indentity beyond reasonable doubt. In cases where early larval descriptions have been superseded by more recent and detailed work, only the most useful and definitive reference is given following the entry for each species. Multiple references are given, where justified, on the basis of additional illustrations or supplementary information, or to support Packer's (1983) unpublished thesis. Seven decapod species hatched, and in some cases reared through all or part of their respective larval development by the author, are accordingly credited (R.G.W.) and included in the following sections together with their relevant National Museum of New Zealand catalogue numbers (N.M.N.Z. Cr.). Full descriptions of these larval life-histories will ultimately be published, but until that time, access to the Museum material may be granted if appropriate.

CHECK LIST OF NEW ZEALAND NATANT, MACRUROUS AND ANOMURAN DECAPOD LARVAE

NATANTIA

Family Penaeidae

Solenocera novaezealandiae Borradaile, 1916
Gurney (1924)

Family Sergestidae

Sergestes (*Sergestes*) *arcticus* Kroyer, 1955
Gurney & Lebour (1940)

Family Rhynchocinetidae

Rhynchocinetes balssi Gordon, 1936
zoeae 1-7 reared, undescribed, N.M.N.Z. Cr. 3279 (R.G.W.)

Family Atyidae

Paratya curvirostris (Heller, 1862)
Ch'ng (1973)

Family Campylonotidae

Campylonotus rathbunae Schmitt, 1926
Pike & Williamson (1966)

Family Palaemonidae

Leander tenuicornis (Say, 1818)
Gurney (1938, 1939)
Palaemon (*Palaemon*) *affinis* H. Milne Edwards, 1837
Lebour (1955), Packer (1983, 1985)
Periclimenes (*Harpilius*) *yaldwyni* Holthuis, 1959
Packer (1983, 1985)
Periclimenes (*Periclimenes*) sp.
Packer (1983, 1985)

Family Hippolytidae

Alope spinifrons (H. Milne Edwards, 1837)
Lebour (1955), Packer (1983, 1985)

Hippolyte bifidirostris (Miers, 1876)
Packer (1983, 1985)
Hippolyte multicolorata Yaldwyn, 1971
Packer (1983, 1985)
Nauticaris marionis Bate, 1888
Packer (1983, 1985)
Tozeuma novaezealandiae Borradaile, 1916
Packer, (1983, 1985)

Family Ogyrididae

Ogyrides delli Yaldwyn, 1971
Packer (1985)

Family Alpheidae

Alpheopsis garricki Yaldwyn, 1971
Packer (1985)
Alpheus richardsoni Yaldwyn, 1971
Packer (1985)
Alpheus socialis Heller, 1965
Packer (1985)
Betaeopsis aequimanus (Dana, 1852)
Packer (1985)

Family Pandalidae

Chlorotocus novaezealandiae (Borradaile, 1916)
zoeae 1-8 reared, undescribed, N.M.N.Z. Cr. 3280 (R.G.W.)

Family Crangonidae

Pontocaris lacazei (Gourret, 1888)
De Simón (1979)
Pontophilus australis (Thomson, 1879)
Thomson & Anderton (1921), Packer (1983, 1985)
Pontophilus chiltoni Kemp, 1911
Packer (1983, 1985)
Pontophilus hamiltoni Yaldwyn, 1971
Packer (1983, 1985)
Pontophilus pilosoides Stephenson, 1927
Packer (1983, 1985)

Family Stenopodidae

Stenopus hispidus (Olivier, 1811)
Gurney (1936, 1942)

MACRURA REPTANTIA

Family Nephropidae

Metanephrops challengeri (Balss, 1914)
Wear (1976)

Family Parastacidae

Paranephrops planifrons White, 1842
Hopkins (1967)

Family Scyllaridae

Ibacus alticrenatus Bate, 1888
Lesser (1974)

Family Palinuridae

Jasus edwardsii (Hutton, 1875)
Batham (1967), Lesser (1974)
Jasus verreauxi (H. Milne Edwards, 1851)
Lesser (1974)

Family Callianassidae

Callianassa filholi A. Milne Edwards, 1878
Gurney (1924), Lebour (1955), Wear (1965a)

Family Upogebiidae

Upogebia danai (Miers, 1876)
Gurney (1924)

Family Axiidae

Calocaris macandreae Bell, 1853
Bourdillon-Casanova (1960), Bull (1934), Gurney (1942)

Family Laomediidae

Jaxea novaezealandiae Wear & Yaldwyn, 1966
Gurney (1924), Wear (1965a), Wear & Yaldwyn (1966)

ANOMURA

Family Chirostylidae

Gastroptychus novaezelandiae Baba, 1974
Pike & Wear (1969)
Uroptychus n.sp.
Pike & Wear (1969)

Family Galatheidae

Munida gregaria (Leach, 1820)
Roberts (1973)
Munida subrugosa (White, 1847)
Roberts (1973)

Family Porcellanidae

Petrolisthes elongatus (H. Milne Edwards, 1837)
Greenwood (1965), Wear (1964a, 1965b)
Petrolisthes novaezelandiae Filhol, 1885
Greenwood (1965), Wear (1964b, 1965c)
Petrocheles spinosus Miers, 1876
Wear (1965d, 1966)

Family Diogenidae

Paguristes barbatus (Heller, 1862)
zoea 1 hatched, undescribed, N.M.N.Z. Cr. 3283 (R.G.W.)
Paguristes pilosus (H. Milne-Edwards, 1837)
zoea 1 hatched, undescribed, N.M.N.Z. Cr. 3284 (R.G.W.)

Family Paguridae

Lophopagurus cf. *thompsoni* (Filhol, 1885)
zoea 1 hatched, undescribed, N.M.N.Z. Cr. 3285 (R.G.W.)
Pagurixus hectori (Filhol, 1885)
zoea 1 hatched, undescribed, N.M.N.Z. Cr. 3286 (R.G.W.)
Pagurus campbelli (Filhol, 1885)
Roberts (1971)
Pagurus novizealandiae (Dana, 1852)
Greenwood (1966)
Pagurus (?) *rubricatus* (Henderson, 1888)
zoea 1 hatched, undescribed, N.M.N.Z. Cr. 3287 (R.G.W.)
Pagurus traversi (Filhol, 1885)
Thomson & Anderton (1921)

Porcellanopagurus edwardsi Filhol, 1884
Roberts (1972)

ANNOTATED BIBLIOGRAPHY OF NEW ZEALAND NATANT, MACRUROUS AND ANOMURAN DECAPOD LARVAE

BATHAM, E.J., 1967. The first three larval stages and feeding behaviour of Phyllosoma of the New Zealand palinurid crayfish *Jasus edwardsii* (Hutton, 1875). **Transactions of the Royal Society of New Zealand, Zoology** 9 : 53-64.

Naupliosoma, and phyllosoma larval stages 1-2 hatched and reared in the laboratory; detailed descriptions, figures and photographs.

BOURDILLON-CASANOVA, L., 1960. Le meroplancton du Golfe de Marseille: les larves de Crustaces Decapodes. **Recueil des travaux de la Station marine d'Endoume, Faculte des sciences de Marseille** Fasc. 30, Bulletin 18 : 1-286.

Calocaris macandreae Bell, 1853
zoeae 1-2, postlarva 1 figured and described in detail (pp. 101-107).

BULL, H.O., 1934. The newly hatched larva of *Calocaris macandreae*, Bell. **Report of the Dove Marine Laboratory, Cullercoats, Northumberland** 3 : 48-50.

Figure and full description.

CH'NG, T.K., 1973. Aspects of the biology of the New Zealand freshwater shrimp *Paratya curvirostris* (Heller) in the Horokiwi stream. **B.Sc. (Hons.) research project, Victoria University of Wellington,** pp. 60 (unpublished).

Breeding biology; zoeae 1-6 reared in the laboratory, figured and described in detail; notes on larval ecology.

De SIMÓN, M., 1979. Primeros estadios larvarios de *Pontocaris lacazei* (Gourret) (Decapoda, Macrura, Crangonidae) obtenidos en laboratorio. **Investigación pesquera** 43 : 565-580.

Zoeae 1-4 reared in laboratory, figured and fully described.

GREENWOOD, J.G., 1965. The larval development of *Petrolisthes elongatus* (H. Milne Edwards) and *Petrolisthes novaezelandiae* Filhol (Anomura, Porcellanidae) with notes on breeding. **Crustaceana** 8 : 285- 307.

Prezoea and zoea 1 laboratory reared; remainder of life-history including megalopa from plankton verified by stage to stage rearing; figures of all larval stages for both species.

GREENWOOD, J.G., 1966. Some larval stages of *Pagurus novae-zelandiae* (Dana, 1852) (Decapoda, Anomura). **New Zealand Journal of Science** 9 : 545-558.

Prezoea and zoea 1 hatched in laboratory; glaucothoe (postlarva 1) from plankton; detailed descriptions and figures, with notes on breeding.

GURNEY, R., 1924. Crustacea. Part 9. Decapod larvae. **British Antarctic Terra Nova Expedition, 1910. Natural History Reports, Zoology,** 8 : 37-202.

Many decapod larvae taken at "Terra Nova" stations 93-148 between Three Kings Islands and Bay of Islands, Northern New Zealand, figured and described; most larvae identifiable only to family or tentatively to genus. Larvae identified by Gurney, or subsequently by me with certainty or reasonable certainty are:

Solenocera novaezealandiae Borradaile, 1916
description and figures of protozoea and zoea 2 (pp. 75-76).
Stenopus hispidus (Olivier, 1811)
description of zoea 2 (p. 134-5, fig. 54b).
Callianassa filholi A. Milne Edwards, 1878
description of complete larval development of zoeae 1-5; zoeae 1 and 5 plus selected appendages figured (pp. 162-164).
Upogebia danai (Miers, 1876)
complete larval life-history (zoeae 1-4 and postlarva 1) described; zoea 4, postlarva 1, and selected appendages of other larvae figured (pp. 165-171).
Jaxea novaezealandiae Wear & Yaldwyn, 1966
zoeae 1, 2 and 4-6 described; zoeae 1 and 2 plus selected appendages of later larvae figured (pp. 150-155, as *Jaxea* sp.).

GURNEY, R., 1936. Larvae of decapod Crustacea Part 1. Stenopidea. **'Discovery' Reports** 13 : 107-170.

Stenopus hispidus (Olivier, 1811)

zoea 1 hatched, described and figured in detail; zoeae 5 and 9 from plankton figured and described (pp. 110-115).

GURNEY, R., 1938. The larvae of the decapod Crustacea. Palaemonidae and Alpheidae. **Scientific Reports of the Great Barrier Reef Expedition** 6 : 1-60.

Leander tenuicornis (Say, 1818)
zoea 1 hatched in the laboratory described and figured, zoea 2 reared and described briefly (pp. 4-6).

GURNEY, R., 1939. A late larval stage of the *Sargassum* prawn, *Leander tenuicornis* (Say), and a note on the statocyst of the adult. **Annals and Magazine of Natural History** series 2, 3 : 120-126.

Zoea 5 from plankton figured and described; postlarva 1 from floating *Sargassum* described briefly.

GURNEY, R., 1942. **Larvae of Decapod Crustacea.** London, Ray Society, pp. 306.

A synthesis of decapod larval characters and discussion of natural groupings; includes the following specific references:

Stenopus hispidus (Olivier, 1811)
illustrations of zoea 4 and selected appendages of other larval stages; summary of larval characters (pp. 236-239).
Calocaris macandreae Bell, 1853
summary of larval characters and illustrations of zoea 2 and telson of zoea 3 (pp. 242-243).

GURNEY, R. & LEBOUR, M.V., 1940. Larvae of decapod Crustacea. Part VI. The genus *Sergestes*. **'Discovery' Reports** 20 : 1-68.

Sergestes (*Sergestes*) *arcticus Kroyer, 1855*
elaphocaris stages 2-3, acanthosoma stage 2 and mastigopus stage 1 described; elaphocaris 2 and acanthosoma 2 figured, with selected appendages of other larval stages (pp. 19-21).

HOPKINS, C.L., 1967. Breeding in the freshwater crayfish *Paranephrops planifrons* White. **New Zealand Journal of Marine and Freshwater Research** 1 : 51-58.

Freshwater, with abbreviated development; no free-swimming larval stages; hatched juveniles described and figured.

LEBOUR, M.V., 1955. First stage larvae hatched from New Zealand decapod Crustacea. **Annals and Magazine of Natural History** series 12, 8 : 43-48.

Zoea 1 of *Palaemon* (*Palaemon*) *affinis* H. Milne Edwards, 1837, *Alope spinifrons* (H. Milne Edwards, 1837) and *Callianassa filholi* A. Milne Edwards, 1878 all hatched from identified adults, briefly described, and sketched in outline only. The two former species will be difficult to identify from this work (see Packer 1983).

LESSER, J.H.R., 1974. Identification of early larvae of New Zealand spiny and shovel-nosed lobsters (Decapoda, Palinuridae and Scyllaridae). **Crustaceana** 27 : 259-277.

Full descriptions, comparisons and figures of laboratory hatched and reared larvae as follows:
Jasus edwardsii (Hutton, 1875)
stage 3 phyllosoma.
Jasus verreauxi (H, Milne Edwards, 1851)
naupliosoma and phyllosoma stages 1-3.
Ibacus alticrenatus Bate, 1888
naupliosoma and 1st phyllosoma larval stage.

PACKER, H.A., 1983. Larval morphology of some New Zealand shallow water shrimps (Crustacea, Decapoda, Caridea) of the families Crangonidae, Hippolytidae, and Palaemonidae. **M.Sc. thesis, Victoria University Wellington** pp. 232, (unpublished).

Full descriptions and excellent illustrations of larvae from the following species reared in the laboratory:
Palaemon (*Palaemon*) *affinis* H. Milne Edwards, 1837
complete larval development of 10 zoeae and 1st postlarva; a detailed comparison between laboratory reared and planktonic larvae.
Periclimenes (*Harpilius*) *yaldwyni* Holthuis, 1959
zoea 1 and notes on later larvae.
Periclimenes (*Periclimenes*) sp.
zoea 1 and notes on later larvae.
Alope spinifrons (H. Milne Edwards, 1837)
zoea 1 and notes on later larvae.
Hippolyte bifidirostris (Miers, 1876)
complete larval development (8 zoeae and 1st postlarva).
Hippolyte multicolorata Yaldwyn, 1971
complete zoea larval development of 8 instars.
Nauticaris marionus Bate, 1888
zoea 1.

Tozeuma novaezealandiae Borradaile, 1916
zoea 1.
Pontophilus australis (Thomson, 1879)
complete larval development (5 zoeae and 1st postlarva).
Pontophilus chiltoni Kemp, 1911
complete larval development (5 zoeae and 1st postlarva).
Pontophilus hamiltoni Yaldwyn, 1971
zoea 1.
Pontophilus pilosoides Stephensen, 1927
zoea 1.

PACKER, H.A., 1985. A guide to the larvae of New Zealand's shallow water Caridea (Crustacea, Decapoda, Natantia). **Zoology Publications from Victoria University of Wellington** 78 : 1-16.

A list of characters, common to larvae of the families Alpheidae, Crangonidae, Hippolytidae, Ogyrididae, and Palaemonidae from N.Z. waters; keys to the identification of shallow water genera and species. The work includes reference to the following species of the Alpheidae and Ogyrididae which are not fully described in Packer (1983):

Alpheopsis garricki Yaldwyn, 1971
zoeae 1-4, N.M.N.Z. Cr. 3226-3227.
Alpheus richardsoni Yaldwyn, 1971
zoeae 1-3, N.M.N.Z. Cr. 3228-3230.
Alpheus socialis Heller, 1865
zoeae 1-3, N.M.N.Z. Cr. 3231.
Betaeopsis aequimanus (Dana, 1852)
zoea 1-4, N.M.N.Z. Cr. 3232-3234.
Ogyrides delli Yaldwyn, 1971
zoeae 1-4, N.M.N.Z. Cr. 3343.

PIKE, R.B. & WEAR, R.G., 1969. Newly hatched larvae of the genera *Gastroptychus* and *Uroptychus* (Crustacea, Decapoda, Galatheidea) from New Zealand waters. **Transactions of the Royal Society of New Zealand, Biological Sciences** 11 : 189-195.

First zoea of *Gastroptychus novaezelandiae* Baba, 1974 and of *Uroptychus* n.sp. hatched in captivity, figured and described in detail; development abbreviated with larvae unlikely to be found in plankton samples.

PIKE, R.B. & WILLIAMSON, D.I., 1966. The first zoeal stage of *Campylonotus rathbunae* Schmitt and its bearing on the systematic position of the Campylonotidae (Decapoda, Caridea). **Transactions**

of the Royal Society of New Zealand, Zoology 7 : 209-213.

Zoea 1 hatched in captivity fully described and figured.

ROBERTS, P.E., 1971. Zoea larvae of *Pagurus campbelli* Filhol, 1885, from Perseverance Harbour, Campbell Island (Crustacea, Decapoda, Paguridae). **Journal of the Royal Society of New Zealand,** 1 : 187-196.

A planktonic series of 4 zoea larval instars fully described and figured; identification based on zoea 1 reared from prezoea larvae hatched in captivity.

ROBERTS, P.E., 1972. Larvae of *Porcellanopagurus edwardsi* Filhol, 1885 (Crustacea; Decapoda; Paguridae) from Perseverance Harbour, Campbell Island. **Journal of the Royal Society of New Zealand,** 2 : 383-391.

Four zoeal instars identified as a planktonic series based on prezoea larvae hatched in captivity; all larval stages fully described and figured.

ROBERTS, P.E., 1973. Larvae of *Munida subrugosa* White (1847) from Perseverance Harbour, Campbell Island. **Journal of the Royal Society of New Zealand,** 3 : 393-408.

Complete larval life-history of 5 zoeal instars and megalopa from the plankton, all fully described and figured. This species is now considered to be a synonym of *M. gregaria* (Leach, 1820).

THOMSON, G.M. & ANDERTON, T., 1921. History of the Portobello Marine Fish-Hatchery and Biological Station. **Bulletin Board of Science and Art, New Zealand** 2 : 1-131.

Figures of newly hatched zoea larvae of several decapod species with very little accompanying description. Useful illustrations are given of the following larvae:

Pontophilus australis (Thomson, 1879), p. 107
Munida gregaria (Leach, 1820), pp. 104-5
Pagurus traversi (Filhol, 1885), p. 102

WEAR, R.G., 1964a. Larvae of *Petrolisthes elongatus* (H. Milne Edwards, 1837) (Crustacea, Decapoda, Anomura). **Transactions of the Royal Society of New Zealand, Zoology** 5 : 39-53.

Zoea 1 hatched; subsequent zoeae from plankton and by instar to instar laboratory rearing; megalopa by rearing only; figures and full descriptions of all stages.

WEAR, R.G., 1964b. Larvae of *Petrolisthes novaezelandiae* Filhol, 1885 (Crustacea, Decapoda, Anomura). **Transactions of the Royal Society of New Zealand, Zoology** 4 : 229-244.

Zoea larvae obtained from plankton and by instar to instar laboratory rearing; megalopa by rearing only; figures and full descriptions of complete larval life history.

WEAR, R.G., 1965a. Zooplankton of Wellington Harbour, New Zealand. **Zoology Publications from Victoria University of Wellington** 38 : 1-31.

Callianassa filholi A. Milne Edwards, 1878
drawing of zoea 1 hatched, with notes on abundance of larvae in plankton (pp. 14-15, Fig. 6a).
Jaxea novaezealandiae Wear & Yaldwyn, 1966
drawing of zoea 1 from plankton with notes on occurrence of larvae (p. 14, Fig. 5d).

WEAR, R.G., 1965b. Breeding cycles and pre-zoea larva of *Petrolisthes elongatus* (Milne Edwards, 1837) (Crustacea, Decapoda). **Transactions of the Royal Society of New Zealand, Zoology** 5 : 169-175.

Figures and full description of prezoea hatched; larva non-planktonic.

WEAR, R.G., 1965c. Pre-zoea larva of *Petrolisthes novaezelandiae* Filhol, 1885 (Crustacea, Decapoda, Anomura). **Transactions of the Royal Society of New Zealand, Zoology** 6 : 127-132.

Figures and full descriptions of prezoea hatched; larva non-planktonic.

WEAR, R.G., 1965d. Larvae of *Petrocheles spinosus* Miers, 1876 (Crustacea, Decapoda, Anomura) with keys to New Zealand porcellanid larvae. **Transactions of the Royal Society of New Zealand, Zoology** 5 : 147-168.

Five zoeal instars obtained from plankton and by laboratory rearing; megalopa by rearing only; all stages fully described and figured.

WEAR, R.G., 1966. Pre-zoea larva of *Petrocheles spinosus* Miers, 1876 (Crustacea, Decapoda, Anomura). **Transactions of the Royal Society of New Zealand, Zoology** 8 : 119-124.

Figures and full descriptions of prezoea larva hatched; larve non-planktonic.

WEAR, R.G., 1976. Studies on the larval development of *Metanephrops challengeri* (Balss, 1914) (Decapoda, Nephropidae). **Crustaceana** 30 : 113-122.

Zoea 1 hatched in captivity, fully described and figured; development abbreviated with this single larval stage unlikely to be found in plankton samples.

WEAR, R.G. & YALDWYN, J.C., 1966. Studies on thalassinid Crustacea (Decapoda, Macrura Reptantia) with a description of a new *Jaxea* from New Zealand and an account of its larval development. **Zoology Publications from Victoria University of Wellington,** 41 : 1-27.

Zoea 1, 3, and 7 and postlarva 1 of *Jaxea novaezealandiae* fully described; figures and details of postlarva and of larval series supplementing Gurney's (1924) descriptions of zoea stages 2 and 4-6 are given; larval series obtained from plankton and by instar to instar rearing; postlarva by rearing only.

ACKNOWLEDGEMENTS

I wish to thank Dr D.R. Fielder of the Zoology Department, University of Queensland, Australia, for his assistance with planning this bibliography during early 1978, and Dr G.C. Poore of the Ministry of Conservation, Melbourne, Australia, for confirming identification of published work on the larvae of *Upogebia danai*. I am grateful to Dr J.C. Yaldwyn, Director of the National Museum of New Zealand for keeping me abreast of current work in taxonomy of the adults and new records of decapod Crustacea from the New Zealand region as they became known. Mr W.R. Webber of the National Museum and Dr C.L. McLay of the Zoology Department, University of Canterbury, are acknowledged for their help in identifying some adult material.

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KEYS TO AID IN THE IDENTIFICATION OF MARINE HARPACTICOID COPEPODS

Amendment Bulletin No. 5

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INTRODUCTION

Included in this Bulletin is an important series of papers by Kunz on the Family Tetragonicipitidae that have caused me to completely recast the keys to this family. As in previous Bulletins (Wells, 1978, 1979, 1981, 1983) the page numbers in parentheses are those of the original Keys (Wells, 1976).

Key to Families

1. Couplet 9 (p. 6) can be misleading; amend by replacing "at outer distal corner" with "on outer border".

2. To make the key comprehensive for Family Tachidiidae
   (a) add a new couplet to follow couplet 41 (p. 9) –
   42a. Enp. P.1 of 2 segments ..... Tachidiidae
   Enp. P.1 of 3 segments 42b
   (b) renumber couplet 42 as 42b,
   (c) note that couplet 40 now leads to couplets 41 and 42a.

I am indebted to Morten Jødal and Michael Gee for suggesting these improvements.

Family Canuellidae

1. Add these new codons to KGG 1 (p. 18)
   7:6:4:4/6:5:4:3/a/3/8 ..... *Canuellina tuba* Por, 1983
   5:4:4:4/6:5:4:4/a/3/7 ..... *Brianola vangoethemi* Fiers, 1982
   7:7:5:4/6:5:4:4/a/3/8 ..... *Scottolana glabra* Fiers, 1982
   S. dissimilis Fiers, 1982
   S. uxoris Por, 1983

2. *Scottolana antillensis* Fiers, 1984c to codon for *S. inopinata* in KGG 1 (p. 18).

3. Fiers (1982) describes *Canuella paenelantica* n.sp. and states that he gives this name "because of the resemblance to *Canuella elantica* Por, 1967". Actually the correct name is *elanitica* (Por 1967: 106). Clearly *paenelantica* is an incorrect spelling due to a *lapsus calami* by Fiers and must be emended to *paenelanitica* (International Code of Zoological Nomenclature, 1985, Art. 32(c)(ii)).

4. *Canuella paenelanitica* Fiers, 1982 to codon for *C. perplexa* and *C. furcigera* in KGG 1 (p. 18).

5. Fiers (1982) erects *Parasunaristes* new genus. In KGG 1 (p. 19)
   (a) Amend generic name of *Sunaristes dardani*, *Ellucana curticaudata* and *E. chelicerata* to *Parasunaristes*.
   (b) Add *P. cucullaris* Fiers, 1982 to codon for *P. dardani*.

6. Fiers (1982) redescribes the female of *Ellucana longicauda* and (1984c) gives the first description of the male.

Family Cerviniidae

1. *Eucanuella longirostrata* Itô, 1983 to genus codon in KGG 1 (p. 21).

2. *Cervinia plumosa* Itô, 1983 to codon for *C. tenuiseta* and *C. unisetosa* in KGG 100 (p. 23).

3. Add these new codons to KGG 200 (p. 24)
   5/2/5:7:7:7/4:5:6:5/>abd ..... *Cerviniopsis muranoi* Itô, 1983
   ?/?/5:5:5:4/4:5:5:3/=abd ..... *C. minutiseta* Itô, 1983

Family Ectinosomatidae

1. *Arenosetella longiseta* Kunz, 1983 to genus codon in KGG 1 (p. 28).

2. *Pseudobradya beduina faialensis* Kunz, 1983 to species codon in KGG 100 (p. 29).

3. *Bradya* (*Bradya*) *pugiochaeta* Arlt, 1983 to subgenus codon in KGG 200 (p. 31).

4. Hicks & Schriever (1983) erect the new genus *Kliella* to accommodate *K. spinosa* n.sp. and *Halophytophilus* ? *triarticulatus* Klie, 1949. As a consequence
   (a) Add a new character-state to character 5 of KGG 1 (p. 27) -- 3:p = 3 segments; prehensile.
   (b) The genus requires a new codon in KGG 1 (p. 28) -- fa/3/bl:3/n/3:p.

Family Darcythompsoniidae

1. Mielke (1982) redescribes *Darcythompsonia fairliensis* (note that the legends for his Abb. 3 and 4 are transposed). As a consequence the following are amended codons for KGG 1 (p. 37)
   1:1/1:2/4:4/0:0:0:1/3:4:4:4 ..... *D. scotti*
   1:1/0:1 *or* 1:2/4:4/0:0:0:1/3:4:4:4 ..... *D. fairliensis*
   1:1/ ? /3:?/0:0:0:1/3:4:4:4 ..... *D. inopinata*

2. *Leptocaris azoricus* Kunz, 1983 requires a new codon in KGG 1 (p. 37) -- 0:2/0:2/3:5/1:1:0:0/2-3:3:3:3.

Family Harpacticidae

Add *Harpacticus longiantennata* Apostolov & Petkovski, 1980 to footnote c of KGG 100 (p. 46).

Family Tisbidae

1. *Tisbe spinulosa* Bradford & Wells, 1983 and *T. caymanensis* Yeatman, 1984 to genus codon in KGG 100 (p. 49).

2. The new genus *Volkmannia* Boxshall, 1979, with its two new species, *forficulata* and *attenuata*, to codon for *Tisbe* and *Bathyidia* in KGG 100 (p. 49). Boxshall discusses these three genera and lists points of detail by which they can be separated (see also Wells, 1983).

3. KGG 300 (see Wells, 1983)
   (a) *Neotisbella gigas*, a new genus and species by Boxshall (1979) requires a new codon -- 8/4/7:8:8/5:6:5/2:2:2.
   (b) As Apostolov & Petkovski (1980) reduce *Zosime bathybia* to a subspecies of *Z. incrassata*, delete *Z. bathybia* from footnote b.

Family Porcellidiidae

Porcellidium tapui Hicks & Webber, 1983 is added to this monogeneric family (see p. 12).

Family Clytemnestridae

Boxshall (1979) points out that the family name Pseudopeltidiidae is not valid and must be replaced by Clytemnestridae (see character 8 of

Key to Families (p. 6) and note 3 on p. 11).

Family Tegastidae

Syngastes spinifer Fiers, 1983 to genus codon in KGG 1 (p.56).

Family Thalestridae

1. KGG 1 (p. 58)
   (a) Add these new codons
   3:2/7:8:8/1:1/3/p:d ..... *Pseudotachidius horikoshii* Itô, 1983
   3:3/6:6:6/1:1/3/p:f ..... *P. minutus* Itô, 1983
   2:2/6:7:7/2:2/3/p:f ..... *Diarthrodes zavodniki* Apostolov & Petkovski, 1980
   (b) *Pseudotachidius bipartitus pacificus* Itô, 1983 to the species codon (see Wells, 1981).

2. *Paradactylopodia striata* Kunz, 1983 to genus codon in KGG 100 (p. 61). Kunz gives a key to this genus.

Family Parastenheliidae

Pallares (1982a) adds two new species, *Parastenhelia costata* and *P. minuta* to this monogeneric family (see p. 12).

Family Diosaccidae

1. The previously unknown male of *Stenhelia* (*D.*) *minuta* is described by Marinov & Apostolov (1981).

2. KGG 100 (p. 73)
   (a) amend column 3 of codon for *Robertgurneya*^{d} to 0:0:0.
   (b) delete codon for *Robertgurneya smithi* and add the species to footnote d.
   (c) Add *Haloschizopera bathyalis* Schriever, 1984a to footnote c.

3. KGG 110 (p. 74)
   (a) *Amphiascoides breviarticulatus* Kunz, 1983 requires a new codon -- =Exp/se/7/5:5/3:5.
   (b) Add *Paramphiascella austroatlantica* Pallares, 1982a to footnote b (p. 75).

4. *Bulbamphiascus cibimae* Pallares, 1982a to genus codon in KGG 230 (p. 80).

5. Kunz's (1983) specimens of *Eoschizopera reducta* show enhanced

setation; amend the species codon in KGG 300 (p. 85) to read -- 0:1:1/3-4:3-4:2/4:4:5.

6. KGG 400 (p. 86)
   (a) Add these new codons
   4/6:8:8/8/d:?/lss ..... *S.* (*D.*) *intermedia* Marinov & Apostolov, 1981
   4/7:8:8/7/d:d/lss ..... *S.* (*D.*) *stephensoni* Greenwood & Tucker, 1984
   (b) *S.* (*D.*) *islandica* Schriever, 1982b to codon for *S.* (*D.*) *cornuta* and *S.* (*D.*) *longipilosa* (p. 86).
   (c) *Stenhelia* (*D.*) *adriatica* Marinov & Apostolov, 1981 to codon for *S.* (*D.*) *latisetosa* (p. 87).

7. Add these new codons to KGG 700 (p. 91)
   2/3/6:7:7/f:?/4:2 ..... *Pseudomesochra scheibeli* Schriever, 1982b
   2/3/4:4:4/f:?/4:6 ..... *Schizopera arconae* Arlt, 1983.

8. *Schizopera soyeri* Kunz, 1983 to codon for *S. arenicola* and *S. nichollsi* in KGG 800 (p. 93).

9. *Stenhelia* (*D.*) *noodti* Schriever, 1982b requires a new codon in KGG 900 (p. 96) -- 6:7:7/5:5:4/d.

Family Ameiridae

1. KGG 1 (p. 101)
   (a) Add these new codons
   3:2/3:3:3/3:3:2/5/0 ..... *Psyllocamptus minutus* Pallares, 1982a
   2:2/2:2:2/3:3:3/6/na ..... *Malacopsyllus hirsutus* Itô, 1983
   (b) Add *Parapseudoleptomesochra hellenica* Pesce, 1981a and *P. attirei* Dumont, 1984 to footnote d on p. 103 (see Wells, 1978).

2. KGG 300 (p. 107)
   (a) Add these new codons
   s/0:0:0/1:1:1/3:4:4/2 ..... *Pseudameiropsis argentinus* Pallares, 1982b
   s/0:1:1/0:1:1/4:4:4/2 ..... *Nitocra baltica* Arlt, 1983
   s/0:0:0/1:1:1/5:4:5/1 ..... *N. mediterranea pontica* Apostolov, 1980
   s/0:0:0/1:1:1/3:3-4:4-5/1 ..... *N. lacustris azorica* Kunz, 1983
   (b) Note that on p. 108 the codon for *N. mediterranea* now refers to the nominate subspecies only.
   (c) Note that in footnote b (p. 108) *N. lacustris* now refers to the subspecies *lacustris*, *sinoi* and the new subspecies *pacificus* Yeatman, 1983 only.
   (d) *Abyssameira reducta*, a new genus and species by Itô (1983),

and *Sarsameira knorri* Reidenauer & Thistle, 1983 to codon for *Sarsameira pendula.*

3. *Parameiropsis magnus* Itô, 1983 to codon for *P. peruanus* in KGG 310 (p. 109).

4. *Nitocra pseudospinipes* Yeatman, 1983 requires a new codon in KGG 330 (p. 111) – 7:7:7/0:0:0/3-4:6/3:5-6.

5. KGG 400 (p. 114)
   (a) Add these new codons
   0:0:0/1:1:1/1:1:1/4:5:4/3:5/? ..... *Ameira faroerensis* Schriever, 1982b
   0:0:0/1:1:1/1:1:1/4:5:5/4:5/4:5 ..... *A. confluens* Reddy, 1984
   0:0:0/1:1:1/1:1:1/4:5:5/3-4:2/? ..... *Pseudameira antennulata* Schriever, 1984a
   0:0:0/1:1:1/1:1:1/3:3:3/4:2/? ..... *P. trisetosa* Schriever, 1984a
   (b) Kunz's (1983) specimens of *Ameira tenella* increase the degree of variation known for this species. As a consequence amend its codon (p. 115) to – 0:0:0/0:0-1:1/0:0:0/4:4-5:4/4:5-6/?
   (c) *Proameira thetiensis* Pallares, 1982a to codon for *P. simplex* and *P. arenicola* (p. 116).
   (d) *Pseudameira mixta adriatica* Apostolov & Petkovski, 1980 to species codon (see Wells, 1981).

6. Add these new codons to KGG 600 (p. 118)
   4:4:5/1:1:1/3:2:2/3:4/? ..... *Nitocrella rhodiensis* Pesce, 1983a
   4:4:5/1:1:1/2:2:2/4:4/2:5 ..... *N. achaiae* Pesce, 1981a
   4:4:4/1:1:1/2:2:2/3:4/2:5 ..... *N. morettii* Pesce, 1984
   4:4:4/1:1:1/2:2:1/2-3:4/? ..... *N. juturna* Cottarelli, 1975
   4:4:4/1:1:1/1:2:1/2:4/? ..... *N. maggii* Pesce, 1983b

7. KGG 700 (p. 120)
   (a) *Nitocrella skyrensis* Pesce, 1981b requires a new codon – 4:4:4/1:1:1/2:2:2/2:4/2:4.
   (b) *Nitocrella somalica* Dumont, 1981 to codon for *N. petkovskii* (see Wells, 1983).

Family Paramesochridae

1. KGG 1 (p. 124; see Wells, 1983)
   (a) Add these new codons
   3:3:3:3/3/3/5 ..... *Diarthrodella lancifera* Kunz, 1983
   2:3:3:3/3/3/6 ..... *D. galapagoensis* Mielke, 1984b
   2:2:3:3/3/2/7 ..... *D. chilensis* Mielke, 1985
   2:1:1:2/2/0/4 ..... *Scottopsyllus langi* Mielke, 1984b

   (b) *Diarthrodella convexa* Kunz, 1983 and *D. neotropica* Mielke, 1984b to codon for *D. secunda.*
   (c) *D. parorbiculata pacifica* Mielke, 1984b to species codon.
   (d) *Rossopsyllus kerguelensis quellonensis* Mielke, 1985 to species codon.
   (d) Add *Leptopsyllus punctatus* and *L. platyspinosus*, new species by Mielke (1984b), to footnote e (p. 125).
   (e) Kunz (1983) gives a key to *Diarthrodella.*

2. KGG 100 (p. 126)
   (a) *Paramesochra unaspina* Mielke, 1984b requires a new codon – 4/4:4:2/0:0:0/2:3/0:3
   (b) *P. kunzi* Mielke, 1984a to codon for *P. dubia.*
   (c) *P. helgolandica galapagoensis* Mielke, 1984b to species codon.

3. KGG 200 (p. 127)
   (a) Add these new codons
   4:4:2/1:1:1/1:3/0:4 ..... *Kliopsyllus atlanticus* Kunz, 1983
   4:4:2/1:1:1/ ? /0:4 ..... *K. miguelensis* Kunz, 1983
   4:4:3/1:1:1/1:3/0:3 ..... *K. panamensis* Mielke, 1984a
   (b) *Kliopsyllus constrictus pacificus* Mielke, 1984a to species codon (p. 127).
   (c) Add *Kliopsyllus regulexstans* and *K. similis*, new species by Mielke (1984b), to footnote b (p. 128).
   (d) Add *Kliopsyllus unguiseta* Mielke, 1984b to footnote c (p. 128).

4. Mielke (1984a, b) describes *Apodopsyllus panamensis*, *A. aberrans* and *A. arcuatus.* These and other recent additions to this genus make interpretation of characters 3 and 4 of KGG 300 (p. 129) rather difficult. Replace KGG 300 with this new version.

KGG 300 - characters

1. P.1 Exp.
   n = number of segments

2. P.1 Exp., distal (or only) segment
   n = number of setae and/or spines

3. P.5♀
   n = total number of setae and/or spines

4. P.5♂
   n = total number of setae and/or spines

KGG 300

P.1 Exp. segs.	P.1 Exp. distal seg. setae	P.5♀ setae	P.5♂ setae	
2	4	6	4	*Apodopsyllus vermiculiformis*
				A. panamensis
				A. arcuatus
2	4	5	4	*A. africanus listensis*
2	4	4	4	*A. africanus* s.str.
				A. schultzi
				A. unguiformis
2	4	4	3	*A. bermudensis*
2	4	3(4?)	3	*A. adaptatus*
2	4	4	?	*A. madrasensis*
2	4	2	3	*A. spinipes*
2	4	?	5	*A. perplexus*
1	5	5	5	*A. camptus*
1	5	4	4	*A. littoralis*
				A. lynceorum
1	5	3-4	4	*A. arenicolus*
1	5	3	3	*A. depressus*

Family Tetragonicipitidae

Kunz (1984c) reviews the family and discusses its phylogeny. He places *Fearia* as a synonym of *Tetragoniceps* and declares *Phyllopodopsyllus pirgos* to be a juvenile male of *P. thiebaudi.*

Kunz (1984a, b) describes five new species of *Phyllopodopsyllus* (*angolensis, petkovskii, geddesi, gertrudi, mielkei,* with a subspecies *m. californicus*) and two new subspecies of *P. longipalpatus* -- *l. madagascarensis* and *l. hawaiiensis.*

Pallares (1982a) redescribes *Phyllopodopsyllus mossmani* and places *P. paramossmani* in its synonymy.

Oniscopsis inabai Kitazima, 1983 is added to the genus.

These additions and amendments, together with the fact that the present key does not adequately deal with sexual dimorphism in *Phyllopodopsyllus*, have led me to construct the following new keys to the family to replace KGG 1 (pp. 131-133).

KGG 1 - characters

1. Cephalothorax ornamentation
   p = process at posterior lateral corner present
   a = process at posterior lateral corner absent
2. A.1, large dentiform projection
   (Note: usually similar in both sexes, but may be reduced in the male and well developed in the female)
   a = absent
   1 = present on first segment
   2 = present on second segment
3. P.1 Enp.
   n = number of segments
4. P.2-P.4., distal (or only) segment
   n:n:n = number of setae and spines on P.2, P.3 & P.4
5. P.2-P.4 Exp.3
   n:n:n = number of setae and spines on P.2, P.3 & P.4

KGG 1

Cph. orn.	A.1 proj.	P.1 Enp.	P.2-P.4 Enp. distal seg. setae	P.2-P.4 Exp.3 setae	
p	1	2	3:3:2	6:6:5	*Laophontella typica*
p	1	2	3:3:1	6:6:5	*L. armata*
p	1	2	3:3:1	6:6:4-5	*L. horrida*
a	1	2	4:4:4	6:7:7	*Tetragoniceps prima*
a	1	2	3:3:3	6:5:7	*T. bergensis*
a	1	2	3:3:3	5:5:5	*T. bookhouti* ♀
a	1	2	3:3:3	5:4:7	*T. truncata*
a	1	2	3:3:3	4:4:5	*T. malleolatus*
a	1	2	3:3:?	6:5:4	*T. longicaudata*
a	1	2	?:3:3	?:5:6	*T. scotti*
a	1	2	2:3:3	5:5:5	*T. bookhouti* ♂
a	1	2	2:2:3	4:3:5	*T. brownei* ♀
a	1	2	2:?:3	5:?:6	*T. arenicolous*
a	1	2	?:?:2	?:?:7	*T. dubius*
a	1	2	?	?	*T. brevicauda*
a	2	3	3:3:2	5:4:5	*Protogoniceps*
a	2	2	2-3:1-3:1-3	4-5:4-6:4-7	**KGG 100**
a	2	2	?	?	*Phyllopodopsyllus minor*
a	a	3	2:2:2	4:4:4	*Pteropsyllus*
a	a	3	3:3:4	4:4:7	*Diagoniceps trifidus*
a	a	3	3:3:3	5:5:8	*D. menaiensis*
a	a	2	4:4:4-5	6:7:8	*D. bocki*
a	a	2	4:4:4	6:7:8	*D. kunzi*

a	a	2	3:3:3	5:6:8	*D. monodi*
a	a	2	2-3:2-3:2-4	4-5:4-6:5-7	**KGG 200**
a	a	2	2-3:1:1	3:2:2	*Oniscopsis*
a	a	2	2:2:3	4:3:5	*Tetragoniceps brownei* ♂
a	a	2	?	?	*Phyllopodopsyllus tristanensis*

KGG 100-200 - characters

(*The same five characters are used in both KGG*)

1. P.2 Enp.2
   n = number of setae
   (Note: In the male the "setae" may include a long straight apophysis)
2. P.3 Enp.2
   n:n = number of setae in ♀ and ♂
3. P.4 Enp.2
   n:n = number of setae in ♀ and ♂
4. P.2-P.3 Exp.3
   n:n = number of setae
5. P.4 Exp.3
   n:n = number of setae in ♀ and ♂

KGG 100

P.2 Enp.2	P.3 Enp.2 ♀:♂	P.4 Enp.2 ♀:♂	P.2-P.3 Exp.3	P.4 Exp.3 ♀:♂	
3	3:3	3:3	5:6	6:6	*Phyllopodopsyllus chavei*
3	3:3	3:3	4:4	5:5	*P. medius*
3	3:3	3:2	5:6	7:7	*P. bermudae*
3	3:3	3:2	5:6	7:6	*P. setouchensis*
					P. mielkei s.str.
3	3:3	3:2	4:4	7:7	*P. danielae*
3	3:3	3:2	4:4	7:6	*P. simplex*
3	3:3	3:2	4:4	6:6	*P. pauli*
					P. opisthoceratus
3	3:3	2:1	5:6	6:6	*P. minutus*
3	3:2	3:2	5:6	7:7	*P. parafurciger*
					P. curtus
3	3:2	3:2	5:6	5-7:6	*P. furciger*
3	3:2	3:2	5:6	6:6	*P. longicaudatus*
3	3:2	3:2	4:4	6:6	*P. borutzkyi*
3	3:?	3:?	5:6	6:?	*P. mielkei californicus*
3	3:?	3:?	4:4	6:?	*P. laticauda*
3	3:?	2:?	4:4	6:?	*P. bahamensis*
3	2:3	3:2	5:5	5:5	*P. langi*
3	2:2	2:2	5:6	7:7	*P. parabradyi*

3(2♂)	3:2	3:2	5:6(5♂)	6:6	*P. bradyi*
2	3:3	3:2	4:4	6:6	*P. paraborutzkyi*
2	2:2	3:2	4:4	4:4	*P. geddesi*
2	2:2	2:2	4:4	5:5	*P. hermani*

KGG 200

P.2 Enp.2	P.3 Enp.2 ♀:♂	P.4 Enp.2 ♀:♂	P.2-P.3 Exp.3	P.4 Exp.3 ♀:♂	
3	3:3	3:4	5:5	7:7	*Diagoniceps laevis*
3	3:3	3:3	4:4	7:6	*Phyllopodopsyllus berrieri*
3	3:3	3:2	5:6	7:6	*P. briani*
					P. petkovskii
3	3:3	3:2	5:6(5♂)	7:6	*P. angolensis*
3	3:3	3:2	5:5	7:6	*P. thiebaudi*
3	3:3	3:2	5:5	7:5	*P. gertrudi*
3	3:3	3:2	4:4	7:6	*P. punctatus*
3	3:3	3:2	4:4	6-7:6	*P. mossmani*
3	3:?	3:?	5:6	6:?	*P. aegypticus*
3	3:?	3:?	4:4	7:?	*P. hibernicus*
					P. laspalmensis
3(2♂)	3:3	3:2	4:4	6:6	*P. hardingi*
2	2:3	2:2	4:4	6:6	*P. biarticulatus*
2	2:?	3:?	4:4	6:?	*P. xenus*
2	2:?	2:?	4:4	6:?	*P. paraxenus*
					P. longipalpatus s.str.
2(3♂)	2:2	2:2	4:4	7:5	*P. l. madagascarensis*
2(3♂)	2:2	2:2	4:4	7:6	*P. l. hawaiiensis*

Family Cylindropsyllidae

1. KGG 1 (p. 141)
   (a) *Arenopontia trisetosa* Mielke, 1982 requires a new codon — s/2:na/f/1:1:2/p.
   (b) *Notopontia galapagoensis* Mielke, 1982 to codon for *Syrticola flandricus* (see Wells, 1983).

2. KGG 200 (p. 143)
   (a) *Stenocaris baltica* Arlt, 1983, known only from the male, requires a new codon — 2:2:2/ns/0:1/na.
   (b) As *S. pygmaea* is a synonym of *S. pontica* delete the codon for the former and amend the codon for *S. pontica* to read 1-2:1:2/ns/1:1/6.

3. KGG 300 (p. 144)
   (a) *Leptastacus ctenatus* and *L. spatuliseta*, new species by Mielke

(1982), require a new codon -- p/2/0:0:1/3:4:5/1:1:0/1:1:2.

(b) *Leptastacus dispinosus dispinosus* Mielke, 1982 and *L. d. panamensis* Mielke, 1983a to codon for *L. minutus*.

4. *Arenopontia peteraxi* Mielke, 1982 requires a new codon in KGG 600 (p. 149) -- 4/3:3:3/1-2:1-2:2/4:4/r.

5. *Psammopsyllus stri* and *P. falciseta*, new species by Mielke (1983b), require a new codon in KGG 700 (p. 151) -- ♀/0/3:2:2/3:2:2/3:3.

Family Cletodidae

1. Schriever (1982a, 1984a) describes three species in a new genus, *Thieliella*, that he assigns to the Family Ancorabolidae. In a later note Schriever (in press) recognizes that this is not correct and that

(a) *Thieliella endopodita* must be transferred to *Cletodes*. It requires a new codon in KGG 600 (p. 167) -- a/1:2/0:0/d:1:5/d:0:4.

(b) *T. nordatlantica* and *T. reducta* are synonyms of *Monocletodes varians*.

2. KGG 1 (p. 154)

(a) Schriever (1983, 1984b) describes five new species of *Metahuntemannia* which require these treatments

(i) *M. pseudomagniceps*: ♂ requires a new codon -- 3:2/3:3:3/2:2/4:6:6:/4:3; ♀ to footnote b (p. 159).

(ii) *M. bifida* ♀ (male not known) requires a new codon -- 3:1/3:3:3/0:0/4:4:4/na:na.

(iii) *M. triarticulata* requires new codons --
3:bs/3:3:3/2:2/5:6:6/1:2 ..... ♀
3:bs/3:3:3/2:2/5:6:6/3:4 ..... ♂

(iv) *M. atlantica* and *M. arctica* females (males are not known) to codon for *M. gorbunovi* ♀ and *M. spinosa* ♀ (p. 155).

(b) Add these new codons for new species by Schriever (1983)
3:1/3:3:3/1:1/7:7:7/5:5 ..... *Mesocletodes parabodini*
3:2/3:3:3/2:2/6:6:5/3-4:4-5 ..... *M. variabilis*
3:2/3:3:3/0:0/4:4:4/na:na ..... *Paranannopus plumosus*

(c) *Mesocletodes trisetosa* Schriever, 1983 requires a new codon and a new footnote -- 3:1/3:3:3/1:1[1]/4:4:5/2:1
i) in this species P.4 Enp. is represented by a seta only.

(d) *Heteropsyllus serratus* Schriever, 1983 to codon for *H. rostratus* and *H. masculus* (p. 158).

(e) Amend codon for *Paranannopus elongatus* (see Wells, 1981) to -- 3:2/3:3:3/3:2/3:3:3/1:1. Note that this is also the codon for *Cylindronannopus primus* (p. 156).

(f) Schriever (1983) describes the previously unknown female of *Paranannopus langi*. As a consequence delete the male symbol from the species codon (p. 156).

3. After Arlt (1983)

(a) Amend columns 3 and 4 of codon for *Enhydrosoma longifurcatum* in KGG 500 (p. 165) to d-f:3:2-3/d-f:2:2.

(b) In KGG 600 amend column 4 of codon for *Cletodes longicaudatus* (p. 167) to d:2-3:5, and for *Cletodes longifurca* (p. 168) to d:2:5-6.

4. The genus name *Echinocletodes* Pallares, 1982a is preoccupied by *Echinocletodes* Lang, 1936 (Family Ancorabolidae). I propose its replacement by *Rosacletodes* n.gen., whose sole and type species is *Echinocletodes kuehnemanni* Pallares, 1982a. The species requires new codons in KGG 1 (p. 154) --
2:1/2:1:1/0:0/4:4:4/1:1 ..... ♀
2:2/2:3:2/0:0/4:4:5/1:1 ..... ♂

Family Laophontidae

1. Cottarelli & Mura (1982) describe three new species of *Afrolaophonte* which require these treatments

(a) *A. michaelae*: ♂ to codon for *A. pori* in KGG 1-♂♂ (p. 188); ♀ requires a new codon in KGG 1-♀♀ (p. 172) -- 1:1:2/0:1:1/3:4/1/6.

(b) *A. aequatorialis*: ♂ to codon for *A. schmidti* (see Wells, 1983) in KGG 1-♂♂ (p. 188); ♀ requires a new codon in KGG 1-♀♀ (p. 172) -- 1:1:1/0:1:1/4:5/1/6.

(c) *A. leonis*: ♂ unknown, ♀ to codon for *A. schmidti* in KGG 1-♀♀ (p. 172).

Note also that Cottarelli & Mura's legends for Figs. 3 and 4 are partially transposed.

2. *Novolaophonte viatorum* Cottarelli, Saporito & Puccetti, 1983, a new genus and species, requires new codons --
in KGG 1-♀♀ (p. 172) -- 2:1s:1/0:0:0/4:3/1/5
in KGG 1-♂♂ (p. 188) -- 3:3:3/1:1/1:3/1/3.

3. *Paronychocamptus anomalus* Reddy, 1984: ♀ to codon for *Psammolaophonte spinicauda* in KGG 1-♀♀ (p. 173), ♂ requires a new codon in KGG 400-♂♂ (p.194) -- 6:6:5/1:1:1/4:4:3/0:0/p.

4. *Laophontina noodti* Kunz, 1983 requires a new codon in KGG 1-♀♀ (p.172) -- 3s:1:2/0:1:1/3:5/1/6. The male is unknown.

5. In KGG 600-♀♀ (p. 179) the codon for *Paralaophonte innae* (see Wells, 1983) should read -- 6:7:7/1:1:1/0:0:0/4:5:4/0:0:0.

6. Fiers (1984a) removes *Paralaophonte spinicauda* to *Laophonte* and makes slight amendments to the description of the male. As a consequence

(a) amend genus name in KGG 1200-♀♀ (p. 182) and KGG 500-♂♂ (p. 195),

(b) add *Laophonte spinicauda* to footnote a of KGG 1100-♂♂ (p. 197).

7. *Quinquelaophonte parasigmoides* is placed incorrectly in KGG 1800-♀♀ (p.185); transfer this species and its codon to KGG 1400-♀♀ (p. 183). Similarly, transfer this species from footnote h to footnote i of KGG 1-♂♂ (p. 191).

8. *Pseudonychocamptus marinovi* Apostolov & Petkovski, 1980 requires a new codon in KGG 1900-♀♀ (p. 185) - 6:6:6/1:1:1/0:0:0/4:5:4/0:1:1. The male is unknown.

Family Latiremidae

Delamarella phyllosetosa Kunz, 1984d requires a new codon (with an accompanying note) in KGG 1 (see Wells, 1978) -- 9/3:2/4/0:0/*

* the segments bear a number of short, broad structures, of which possibly two are true setae.

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