PARACALLIOPE, A GENUS OF AUSTRALIAN SHORELINES
(CRUSTACEA: AMPHIPODA: PARACALLIOPIDAE)

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Abstract


Species of Paracalliope are widely distributed along south-eastern open-sea shores, brackish and certain freshwater streams of Australia. We describe here extensive collections ranging from southern Queensland through New South Wales and Tasmania to western Victoria. The identity of Phorusa australis Haswell (1880) is now confirmed from numerous toptotypic collections, at Cape Banks, as the first species of Paracalliope described from Australia and as the senior synonym of Paracalliope raymondii Fearn-Warman (1968). Paracalliope larai Knott (1975), a freshwater Tasmanian species, is re-examined and partially re-described. A third mostly marine and widespread new species, P. lowryi, is described and a fourth species, P. victinius, also new, with quite variable brackish-freshwater habitat, is described in numerous collections from Tasmania.

Introduction

The Paracalliopiidae were established by Barnard and Karaman (1982) to include Paracalliope Stebbing, 1899, and Indocalliiope Barnard and Karaman, 1982. Later, Katercaliiope Barnard and Drummond (1984), Doowia Barnard and Drummond (1987) and Yhi Barnard and Thomas (1991) were added to the group. The family is now revised to include species from Australia which heretofore have not been properly examined. The earliest known species from Australia, Paracalliope australis (Haswell, 1880), is properly described for the first time. P. larai Knott is reviewed and two new species are described.

Most species of the Paracalliopiidae have an affinity for brackish water or occur in freshwater or very shallow marine waters along shores, mainly in high tidepools. Their known distribution extends from India to Australia, New Zealand, New Caledonia, and Fiji.

Most of our material comes from Victorian surveys (Western Port and Port Phillip Bay), from Gippsland lakes or from various brackish lagoons and river mouths in New South Wales, Tasmania and Queensland. Collections are in the Museum of Victoria (NMV), The Australian Museum (AM), Queensland Museum (QM) and Tasmanian Museum (TM). Many replicate samples have been identified but only one from each locality is reported here. Maps and station localities for most of the Victorian material are found in Barnard and Drummond (1976, 1978, 1979, 1982).

The Paracalliopiidae and Paracalliope are newly diagnosed, with lists of their taxa. Three keys to genera of the family were given by Barnard and Thomas (1991) and a key to the species of Paracalliope is given here. Numbers in square brackets are geographic codes listed in Barnard and Barnard (1983).

Specimens of Paracalliope are frequently very difficult to handle because they break up easily and preserve poorly. For the most part, the manipulation of specimens is very tedious and frustrating because of these difficulties.

Legends

Capital letters in figures refer to parts; lower case letters to left of capital letters refer to specimens and to the right refer to adjectives as described below: A, antenna; B, body; C, coxa; D, dactyl; E, epimeron; F, accessory flagellum; G, gnathopod; H, head; L, labium; M, mandible; P, pereopod; Q, calceolus; R, uropod; S, maxilliped; T, telson; U, upper lip; V, palp; W, pleon; X, maxilla; Y, gill; Z, oostegite; d, dorsal; l, left; o, opposite appendage to nearby figure; r, right;

* Jerry L. Barnard died on 16 August 1991 shortly after this manuscript was accepted for publication.
s, setae removed and marked with circles-ovals.

**Paracallioopiidae** Barnard and Karaman, 1982

*Diagnosis.* Body plan ordinary but urosomites 2–3 fused together; shape of head ordinary, rostrum and sinus for antenna 2 ordinary, eyes paired; pereopod 7 elongate and different from shorter pereopods 5–6, dactyl of pereopod 7 elongate and setose; gnathopods sexually diverse; mittenform in female, enlarged mitten-form in male, with thin carpi and expanded propodi twisting inward on death. Telson of ordinary length, entire.

Sexual dimorphism. Gnathopods diverse, large in male, small in female.

*Relationship.* Paracallioopiidae differ from Exedicerirotidae in the lack of apical spines on rami of uropods 1–2; from Oedicerotidae in the paired eyes, fused urosomites (occasionally present in Oedicerotidae), non-galeate head and odd gnathopods; from Eusiridae-Calliopiidae in the fused urosomites 1–2 and odd gnathopods; from Dexaminiidae in the greatly elongate pereopod 7 with elongate setose dactyl and the unleft telson.


**Paracalliope** Stebbing

*Paracalliope* Stebbing, 1899: 210 (type species, *Calliipe fluviatilis* Thomson, 1879, original designation).

— J.L. Barnard, 1972: 70.


*Diagnosis.* Paracallioopiidae bearing mandibular palp; inner plate of maxilla 1 fully setose medially; oostegites diverse, 2–3 expanded, 4–5 slender; epimera with angular posteroventral corners; peduncle of uropod 3 elongate. Calceoli like eusirid kind of Lincoln and Hurley (1980: 111) with distal and proximal element extending beyond bulla and receptacle; distal element lin- guiform or arrow-head shaped.

*Species.*


*P. larai* Knott, 1975, fresh water, Tasmania [941].

*P. lowryi* Barnard and Drummond, herein, south-eastern Australia [784].

*P. mapela* Myers, 1985, marine, Fiji [576].

*P. novacealedoniae* Ruflo and Paiotta, 1972, fresh water, New Caledonia [933].

*P. novizealandiae* (Dana, 1852, 1853) (= *P. neozeelandicus* Thomson and Chilton, 1886; Chilton, 1909; J.L. Barnard, 1972), marine, New Zealand [775].

*P. vicinus* Barnard and Drummond, herein, brackish-fresh water, Tasmania [783EF].

Species inquirenda (= *P. fluviatilis* det. of Chilton, 1921), fresh water, Philippines [982].

*Habitat and distribution.* New Zealand, Australia, New Caledonia, Philippines, Fiji, weakly marine, mostly estuarine to fresh water.

**Key to species of Paracalliope** (adults)

(*P. larai* is cited twice because of possible misinterpretation of epimera)

1. No rami of uropods 1–3 with more than 1 spine each ............... 2
   — At least 4 rami of uropods 1–3 each with 2 or more spines ............ 3
2. Female coxa 1 widened distally, coxa 2 tapering distally, carpal lobe of female gnathopod 2 half as long as propodus ..... *P. novacealedoniae*
   — Female coxa 1 tapering distally, coxa 2 broadened distally, carpal lobe of female gnathopod 2 one fourth as long as propodus ..... *P. mapela*
3. Epimera 2–3 with large tooth (fig. 8nW) ............... 4
   — Epimera 2–3 with small tooth (fig. 4E) ............... 6
4. Male gnathopod 1 as small as in female, eyes enlarged (mandibular palp article 3 with 1–3 basofacial setae, outer ramus of uropod 1 with 0–1 spine) .......................... *P. lowryi*

— Male gnathopod 1 enlarged, eyes medium (other characters mixed)  5

5. Mandibular palp article 3 with 0–1 basofacial spine-setae, outer ramus of uropod 1 with 2 spines, epimeron 3 without spines in adult  ....... *P. larai*

— Mandibular palp article 3 with 3 basofacial spine-setae, outer ramus of uropod 1 with 1 spine, epimeron 3 with 3 spines .......... *P. vicinus*

6. Male eyes small, pereopods 3–6 with dactylar slit .......................... 8

— Male eyes large, dactylar slits absent ........................................ 7

7. Male pereopods 3–4 with setae poorly developed, mandibular palp article 3 with 2 basofacial setae .......................... *P. karitate*

— Male pereopods 3–4 with setae large and dense, mandibular palp article 3 lacking basofacial setae ...................... *P. australis*

8. Epimera 2–3 with widely sweeping posterior concavity directly leading to protuberant posteroventral tooth .......................... *P. larai*

— Epimera 2–3 with narrowly contained posterior concavity from which small sharp posteroventral tooth emerges .......... 9

9. Gland cone small, lateral cephalic lobes weak, female gnathopods with medium carpal lobes .......................... *P. novizealandiae*

— Gland cone large, lateral cephalic lobes prominent, female gnathopods with large carpal lobes .......................... *P. fluviatilis*

**Paracalliope australis** (Haswell) comb. nov.

*Pherusa australis* Haswell, 1880; 103, pl. 7 fig. 1. — 1882: 246.


Material examined. Holotype lost, type locality: Botany Bay [NSW].

Neotype. Botany Bay, Cape Banks, 5 Mar 1985, supralittoral, P. Versteegen, AM P.35636 (male "U") 3.31 mm.

Other type material. Victoria, Gippsland Lakes, Eagle Point, Lake King (37°53'S, 147°41'E), Apr 1957, NMV J157 (1, HOLOTYPE of *Paroediceros raymondii*), NMV J158 (44, 21 slides, PARATYPES of *Paroediceros raymondii* of which a few examined as follows, newly designated by letters and sizes: female "a" 3.53 mm, female "b" 2.91 mm, male "c" 3.24 mm, male "d" 3.48 mm, male "e" 3.38 mm.

Other material. Central Bass Strait, 28 km E of Cape Farewell, King Island, Tasmania (39°32.8'S, 144°16'E), 18 m, fine sand, WHOI epibenthic sled, M. Gomon and G. C. B. Poore RV *Sarina*, 1 Nov 1980 (stn BSS-S 107), NMV J13088 (1).

New South Wales. Neotype locality, AM P.35636 (male "tk" 3.63 mm, male "tm" 2.97 mm, female "tr" 2.60 mm, juvenile "to" 2.48 mm, verifying taxonomy; Twofold Bay, Shadrack Creek, Zostera, mud, I. Vander Velde, AM P.35637 (5); Twofold Bay, Fisheries Creek, 19 Sep 1984, *Raphia* bed, mud, AM P.35638 (11); Dee Why Lagoon (31°31'S, 149°54'E), 0.75 m, 29 Nov 1988, muddy sand and algae, A. Murray and A. R. Jones, AM P.39142 (7); Merimbula (36°54'S, 149°53'E), sand, hand net, M.M. Drummond, 1 Dec 1978, NMV J6904 (juvenile voucher "jb", 1.78 mm), NMV J6903 (juvenile voucher "ja", 1.13 mm). Merimbula, Back Lake, M.M. Drummond, 1 Dec 1975, NMV J13090 (many); Lake Illawarra, entrance, NMV J22287 (3).

Tasmania. Nectarine Creek, near Margate (43°02'S, 147°13'E), T. Walker, NMV J13093 (many), NMV J6912 (female voucher "m", 3.64 mm), NMV J6911 (female voucher "s", 2.89 mm), NMV J6909 (female voucher "p", 3.30 mm, illustrated), NMV J6914 (juvenile voucher "t", 1.86 mm), NMV J6907 (male voucher "h", 2.70 mm), NMV J6915 (juvenile voucher "j", 1.60 mm), NMV J6908 (male voucher "g", 3.71 mm), NMV J6913 (female voucher "u", 2.60 mm), NMV J6910 (female voucher "w", 2.68 mm); Swan River, site 6, D. Hoggins, Tasmanian Fisheries Development Authority, Jul 1978, NMV J6905 (female voucher "k", 3.23 mm, illustrated), NMV J6906 (female voucher "kb", 2.66 mm), NMV J113092 (1); Wandle River, on road from Wynyard to Waratah, P. Suter, 26 Aug 1973, NMV J6954 (2); Swanport, estuary mouth, Tasmanian Fisheries Development Authority, NMV J13087 (9).

Victoria. Gippsland Lakes, Lake Victoria, near Red Bluff (38°03.5'S, 147°31'E), G.C.B. Poore et al., SCUBA, MSL preliminary survey, stn G609-5, 15 Nov 1976, NMV J13084 (1); Lake King, near Paynesville (37°55.5'S, 147°43'E), stn G609-29, NMV J6997 (9); Lake King, near Point Jones (37°55'S, 147°45'E), stn G609-28, NMV J6800 (male voucher "i" 3.86 mm), NMV J6902 (female voucher "k", 3.51 mm), NMV J13085 (many); Lake King, East of Point Scott, Raymond Island (37°54'S, 147°49'E), stn G609-25, NMV J13086 (1); Lake King, near Kelly Head (37°54'S, 149°50'E), sand, hand net, M.M. Drummond, 1 Dec 1978, NMV J6904 (juvenile voucher "jb", 1.78 mm), NMV J6903 (juvenile voucher "ja", 1.13 mm). Merimbula, Back Lake, M.M. Drummond, 1 Dec 1975, NMV J13090 (many); Lake Illawarra, entrance, NMV J22287 (3).
Description of male neotype "tl" 3.31 mm. Ros- 
trum small, lateral cephalic lobe adze-shaped, 
sinus receiving antenna 2 deep, eyes small (artificially 
shrunken), widely separate. Antenna 1 
scarcely shorter than antenna 2, flagellum with 
14 articles, calceoli absent; one aesthetace each 
on articles 9, 11, 12, 13, and rudimentary on 14. 
Gland cone of antenna 2 very prominent, almost 
reaching apex of article 3 (in lateral view), fla-
gellum with 10 articles, one calceolus each on 
articles 3, 4.

Epistome flattened anteriorly, upper lip articulate 
and rounded-truncate below, anterior pub-
escence poorly developed. Mandibles of basic 
gammaridean plan, incisors toothed, right and 
left lacinia mobiles toothed, right and left 
rakers 3 and 4 respectively, first raker on left 
bifid (possibly 2 rakers fused?); molar tritur-
ative, bearing apical seta; palpal hump small, 
articles 1-2 naked, article 3 especially 
pubescent, formula of spines = 3D. 5E, with 3 of 
E setae simple. Others penicillate, basofacial 
setae absent. Inner lobes of lower lip well de-
veloped and fleshy. Inner plate of maxilla 1 almost 
fully setose medially, outer plate with 11 diverse 
spines, palp 2-articulate, spinous apically, right 
and left palps alike. Plates of maxilla 2 subequal 
in size, inner with facial row of setae. Inner 
and outer plates of maxillipede weakly spinose, palp 
short, stout, dactyl unguliform, with about 2 
accessory setules.

Coxae 1-7 short, almost glabrous, almost of 
even depth except coxa 7 shortened, coxa 1 
scarcely expanded in middle, coxa 4 weakly 
excavate posteriorly and weakly lobate poste-
roventrally; coxae 2-6 each with narrow sac-like 
gill with pedunculate base. Medium sized lobe 
on carpus of gnathopod 1 pointing slightly distad, 
propodus ovately expanded, palm about as long 
as posterior margin of propodus, well defined by 
change in slope, palm with organized clusters of 
armaments, dactyl fitting palm, with several 
subapical setules. Carpus of gnathopod 2 form-
ing complex of 2 basal swellings side by side 
and thin posterior lobe curving distad, propodus 
turning inward on death, ovato-rectangular, 
palm oblique, deeply and raggedly excavated, 
with 2 lateral and 4 medial facial spines prox-
imal to ragged margin, dactyl slender, fitting 
palm.

Article 4 of pereopods 3-6 slender, posterior 
margins of articles 4-6 of pereopods 3-4 with 
moderately long setae in fascicles, generally fasci-
cle formula number on articles 4-6 = 4-5-5, 
each fascicle with 1-4 setae (see illustrations). 
Only one member each of pereopods 3 and 6 
with conspicuous slit on dactyls, all with setules. 
Pereopods 5-6 of ordinary amphipod dimen-
sions, 6 slightly larger than 5, article 2 ovate, 
poorly produced posteroventrally, almost 
smooth, each with midfacial ridge, that on 
pereopod 5 naked, that on pereopod 6 setose. 
Pereopod 7 enlarged, article 2 broad and 
subquadrated, weakly and subsharply produced 
posteroventrally, dactyl over 110% as long as 
article 6, with about 6 anterior fascicles of setae, 
numerous single posterior setae in tandem and 
10+ apical setae.

Pleopods ordinary, peduncle elongate, rami 
elongate, subequal and multiarticulate. No 
pleonal epimerae present, each with tiny pos-
teroventral tooth and weakly to strongly convex 
posterior margin (epimera 2 weakest), epime-
ron 1 with 1-2 (L + R) facial spines and 3 ante-
roventral setae, epimera 2 with 3-4 (R + L) 
ventral but submarginal spines in tandem 
horizontally, epimera 3 with 1 submarginal 
spine and 1 setule in tandem horizontally near 
anteeroventral edge. Uropods 1-2 extending 
subequally, uropod 3 slightly shorter, dorsola-
teral margin of peduncle on uropod 1 with 7 
spines, and discernible apical gap, medial with 
one apical spine, outer ramus scarcely shorter 
than inner, outer with 1 dorsal spine, inner with 1. 
Peduncle of uropod 2 with 2 dorsolateral 
spines, medial with one apical, outer ramus 
shorter than inner, outer with 2 dorsal spines, 
inner with 2. Peduncle of uropod 3 elongate, 
with 1 dorsomedial spine and basal setule, outer 
ramus scarcely shorter than inner, as long as ped-

Figure 1. Paracalliopoe australis, unattributed figures = male “m” holotype: 3.64 mm; g = male “g” 3.71 mm; ka = 
male “ka” 3.23 mm; p = female “p” 3.30 mm; s = female “s” 2.89 mm.
uncle, with 1 dorsal spine, inner with 1 dorsal spine, each ramus with subapical setule. Telson linguiform, entire, with 2 pairs of dorsolateral setules in middle and one apicalateral setule on one side only.

Description of adult male "m". Rostrum small, lateral cephalic lobe adze-shaped, sinus receiving antenna 2 deep, eyes of medium size, widely separate. Antenna 1 scarcely shorter than antenna 2, flagellum with 16 articles, one calceolus each on articles 1, 2, 3, 4, 5, 7; one aesthetasc each on articles 11, 13, 14, 15 and rudimentary on 16. Gland cone of antenna 2 very prominent, almost reaching apex of article 3 (in lateral view), flagellum with 17 articles, one calceolus each on articles 1, 2, 3, 4, 5, 7. Epistome flat anteriorly, upper lip articulate and rounded-truncate below, anterior pubescence poorly developed. Mandibles of basic gammariidan plan, incisors toothed, right and left laciniae mobiles toothed, right and left rakers 3 and 4 respectively, first raker on right bifid (possibly 2 rakers fused?); molar triturative, bearing apical seta; palpal hump small, articles 1–2 naked, article 3 especially pubescent, formula of spines = 4D. 3E, with 2 of E setae simple, others penicillate, basofacial setae absent. Inner lobes of lower lip well developed and fleshy. Inner plate of maxilla 1 almost fully setose medially, outer plate with 11 diverse spines, palp 2-articulate, spinose apically, right and left palps alike. Plates of maxilla 2 subequal in size, inner with facial row of setae. Inner and outer plates of maxillipede weakly spinose, palp short, stout, dactyl unguiform, with about 4 accessory setules.

Coxae 1–7 short, almost glabrous, almost of even depth except coxa 7 shortened, coxa 1 scarcely expanded in middle, coxa 4 weakly excavate posteriorly and weakly lobate posteroventrally; coxae 2–6 each with narrow sac-like gill with pediculate base. Medium sized lobe on corpus of gnathopod 1 pointing slightly distad, propodus ovately expanded, palm about as long as posterior margin of propodus, well defined by change in slope, palm with organized clusters of armsments, dactyl fitting palm, with several subapical setules. Corpus of gnathopod 2 forming complex of 2 basal swellings side by side and thin posterior lobe curving distad, propodus turning inward on death, ovatorectangular, palm oblique, deeply and raggedly excavate, with 3 lateral and 4 medial facial spines proximal to ragged margin, dactyl slender, fitting palm.

Article 4 of percepods 3–6 slender, posterior margins of articles 4–6 of percepods 3–4 with long setae in fascicles, generally fascicle formula number on articles 4–6 = 4–5–7, each fascicle with 1–6 setae (see illustrations). Dactyls with conspicuous slit and setules. Percepods 5–6 of ordinary amphipod dimensions, 6 slightly larger than 5, article 2 ovate, poorly produced posteroventrally, almost smooth, each with midfacial ridge, that on percepod 5 naked, that on percepod 6 setose. Percepod 7 enlarged, article 2 broad and subquadrate, weakly and subsharply produced posteroventrally, dactyl over 90% as long as article 6, with about 5 anterior fascicles of setae, numerous single posterior setae in tandem and 7+ apical setae.

Pleopods ordinary, peduncle elongate, rami elongate, subequal and multiarticulate. No pleonal epimeron dominant, each with tiny posteroventral tooth and weakly to strongly convex posterior margin (epimeron 2 weakest), epimeron 1 with 2 facial spines and 5 anteroventral setae, epimeron 2 with 4 ventral but submarginal spines in tandem horizontally and one strongly facial smaller spines, epimeron 3 with 2 submarginal spines in tandem horizontally near anteroventral edge. Uropods 1–2 extending subequally, uropod 3 slightly failing same extension, dorsolateral margin of peduncle on uropod 1 with 9 spines, medial with one apical spine, outer ramus scarcely shorter than inner, outer with 2 dorsal spines, inner with 3. Peduncle of uropod 2 with 6 dorsolateral spines, medial with one apical, outer ramus shorter than inner, outer with 5 dorsal spines, inner with 3. Peduncle of uropod 3 elongate, with 2 dorsomedial spines and basal setule, outer ramus scarcely shorter than inner, as long as peduncle, with 2 dorsal spines, inner with 2 dorsal spines, each ramus with subapical setule. Telson linguiform, entire, with 2 pairs of dorsolateral setules in middle and one apicalateral setule on each side.

Female paratype "f" 2.60 mm. Eyes of medium size. Flagellum of antenna 1 with 6 articles, article 5 with one aesthetasc. Flagellum of antenna 2 with 10 articles. Gnathopods, see illustrations. Article 7 of percepod 7 about 90%
as long as article 6, with 3 anterior setae, 2 pairs of posterior setae and 10 apical setae. Epimeron 1 with 1 facial spine and 2 anterodorsal setules; epimeron 2 with 2 facial spines; epimeron 3 lacking spines. Spine formulas on peduncle, outer ramus and inner ramus of uropods: uropod 1 = 1-1-1-1-1-1(slight gap)-1, 1, 1; uropod 2 = 1-1, 2, 2; uropod 3 = 1, 1, 1.

Female "p". Percopod 7 broken. Like male but antennae lacking calceoli, flagellum of antenna 1 with 11 articles, one aesthetasc each on articles 6, 8, 9, 10. (11 rudimentary); flagellum of antenna 2 with 13 articles. Coxa 1–4 longer than in male, coxa 1 somewhat nasiform and posterodorsally extended, coxa 2–3 narrow, coxa 4 with strongly beveled ventral margin toward posterior side. Oostegites 2–3 broad, 4–5 narrow and setose. Gnathopods feeble, equally slender and almost of same length, carpi as long as propodi, gnathopod 1 much more slender and slightly more elongate than in male, carpus with large lobe pointing distad, propodus subrectangular but weakly expanding apically, palm subtransverse; carpus of gnathopod 2 with weak posterior lobe, palm oblique. Pereopods 3–4 poorly setose compared with male (see illustrations). See female "s" for percopod 7 distinction below. Differences of epimera probably varietal (see illustration), one spine of epimeron 1 more ventral, one of epimeron 2 poorly developed, one of epimeron 3 missing and other weak. Some uropods better spinous than in male: outer and inner rami respectively with spines as follows: uropod 1 = 3 and 3, uropod 2 = 3 and 3, uropod 3 = 2 and 2.

Female "s". Percopod 7 showing major female differences from male, percopod 7 shorter and dactyl much shorter than article 6. anterior and posterior setae fewer but apical setae dense. Flagellum of antenna 1 with 9 articles, one aesthetasc each on articles 6, 7, 8, 9 (rudimentary).

Young male "t". Calceoli absent, flagellum of antenna 1 with 8 articles, one aesthetasc each on articles 5, 6, 7; flagellum of antenna 2 with 7 articles. Epimeron 1 with one facial spine and one anterodorsal seta, epimeron 2 with one facial spine, epimeron 3 lacking spines. Spine formula on outer and inner rami of uropod 1 = 0-1, uropod 2 = 1-1, uropod 3 = 1-1, peduncle of uropod 3 with 3 dorsal spines! (2 medial, 1 lateral).

Juvenile "j". Flagellum of antenna 1 with 6 or 7 articles, aesthetasc present on articles 4-5 or 5-6-7; flagellum of antenna 2 with 7 articles. Slit on dactyls of percopods 3–6 dim. Epimeron 1 with one facial spine and 2 anterodorsal setae, epimeron 2 with 2 facial spines, epimeron 3 without spines. Spine formulas on uropods, peduncle of uropod 1 = 3, both rami = — 0; peduncle of uropod 2 = 1, each ramus with 1; outer ramus of uropod 3 = 0, inner = 1.

Juvenile "ja", smallest available. Flagellum of antennae 1–2 with 5 and 6 articles respectively; length ratio of peduncular articles = 5:3:3. Posterior margin of article 6 on percopods 3–4 with only 1 conjoint pair of setae, slits absent. Epimeron 1 with one tiny facial setae, no other armaments, spine formula of epimeron 2 = 1, of epimeron 3 = 0. Spine formulas of uropod 1 = 3 (gapped)-0-0, of uropod 2 = 1-0-1, of uropod 3 = 0-0-0. Article 2 of percopod 7 with one posterodorsal seta, article 7 of long form, with 3 main apical setae, 2 short posterodorsal setae, and 3 other marginal setae.

Variables of males "c, d, e, f, g, h." Sizes between 2.70 and 4.55 mm. Flagellum of antenna 1 with as many as 18 articles, calceolus formulas = 2, 3, 4, 6 or 2, 3, 4, 5, 7 or 2, 3, 4, 5, 6, 7 or 2, 3, 4, 6, 8. Aesthetasc on 10 only on 9-11-13-15-16-17-18, or 10-12-13-14, or 11-13-15-16-17-18. Antenna 2 flagellum with up to 20 articles, calceolus formulae either 1, 2, 3, 4, 5, 6, 8 or 2, 3, 4, 5, 7, 9 or 2, 3, 4, 6, 8 or 3, 4, 6. Eyes enlarged or not. Articles 5 and 6 of percopods 3–4 with up to 6 or 7 setal fascicles. Epimeron 1 with 1–2 facial spines and 2, 3, 4, 5 or 6 anterodorsal setae; epimeron 2 with 3 or 5 or 4 and 1 rudimentary facial spines; epimeron 3 with 1, 2 or 3 facial spines. Teeth of epimera occasionally obsolescent or blunted. Spine formulas on uropods, peduncle of uropod 1 = 5, 6, 9, 10; outer ramus = 1, 2; inner ramus = 2, 3; uropod 2 peduncle = 4, 5, 6; outer ramus = 2, 3, 4, 5; inner ramus = 2, 3, 4; peduncle of uropod 3 = 2, 3; outer ramus = 2, 3; inner ramus = 2, 3.

Variables of females "a, b, k, s, u, w." Sizes between 2.60 and 3.53 mm. Flagellum of antenna 1 with up to 11 articles, of antenna 2 up

Figure 3. Paracalliope australis, unattributed figures = male "m" holotype, 3.64 mm; p = female "p" 3.30 mm; s = female "s" 2.89 mm.
to 12 articles; aesthetascs on flagellum of antenna 1 = 6, 7, 8, 9 or 7, 9, 10, 11. Epimeron 1 with 1–2 facial spines and 3, 4, 5, 8 anteroventral setae; epimeron 2 with 2, 3, 5, 6 facial spines; epimeron 3 with 0, 1, 2, 3 facial spines. Spine formulas on uropods, peduncle of uropod 1 = 5, 8, 10, 11; outer ramus = 1, 2; inner ramus = 2, 3; uropod 2 peduncle = 2, 3, 4, 6; outer ramus = 2, 3, 4; inner ramus = 2, 3, 4; peduncle of uropod 3 = 2, 3; outer ramus = 1, 2; inner ramus = 1, 2, 3. Article 7 of pereopod 7 aberrant in female "a" (with 8 eggs), as long as in male.

**Aberrant male** "ha", 3.22 mm. aberrant because of absence of spine on outer ramus of uropod 1 and slight gap present between ultimate and penultimate spines on peduncle of uropod 1, otherwise *P. australis* characters typical: epimera, pereopods 3–4, dactylar slits. head shape, mandibular palp article 3 and eyes.

**Aberrant male** "ka" and female "kb." Eyes enlarged (illustrated), ommatidia slightly dispersed, pigment weak; thus intermediate in eye size between ordinary specimens of *P. australis* and specimens of *P. lowryi*; specimens otherwise with scarcely any excessive gap in spines on uropod 1, setae of epimeron 1 weak.

**Male** of NMV J13088. Identification doubtful because mandibular palps and pereopods 3–4 missing, third uropods aberrant; provisionally identified as *P. australis* because of small teeth of epimera but gnathopod 1 scarcely enlarged (thus like *P. lowryi*); well developed spination of uropods like *P. lowryi*; but epimeron 1 with anteroventral setules unlike *P. lowryi*.

**General variables.** Specimens of this species often preserve poorly; various appendages fall off or are broken apically, especially pereopod 7 and uropod 3. The internal contents of the head often preserve poorly so that the tissue shrinks and the eyes fall ventrally and occasionally break up. This unfortunately happens also in the companion species *P. lowryi* so that the excellent distinction in eye size between the two species is often obscured by observational anomalies.

The usefulness of analyzing dactylar slits on pereopods 3–6 is very low because so many specimens of *P. australis* that should have the slits well apparent seem to be either poorly preserved or so near their moment of ec dysis that the slits are so dim as to be useless for identification.

There is considerable variation in the size of posterodorsal setules-spines on article 2 of pereopod 7.

The excessive gap between ultimate and penultimate spines on the peduncle of uropod 1 is about 95% accurate in separating *P. lowryi* from *P. australis* but a few specimens of *P. australis* have a slightly increased gap so that the character is not wholly reliable. In the material at hand, one can state for certainty that lack of the excessive gap is wholly characteristic of *P. australis*.

**Relationship.** This species is very close to the three known species of *Paracalliope* from New Zealand (J.L. Barnard, 1972) but differs from *P. fluviatilis*, *P. karitane* and *P. novizealandiae* in the presence of long setae on articles 5–6 of male pereopods 3–4. Most specimens of *Paracalliope australis* also differ from *P. fluviatilis* and *P. novizealandiae* in the presence of the conspicuous slit in the dactyls of pereopods 3–6, but this slit is occasionally absent in *P. australis*. The Australian species is therefore very similar to *P. karitane* but differs from that species in the lack of basolateral setae on article 3 of the mandibular palp. It also differs from *P. karitane* in the less tumid propodi on male and female gnathopods, smaller teeth on epimera 2–3, and the small carpal lobes of female gnathopod 1.

**Paracalliope australis** differs further from *P. novizealandiae* in the lack of AB setae on the mandibular palp, the presence of more spines on the rami of uropods 1–3, the larger earpal lobe of female gnathopod 2, the smaller earpal lobe of female gnathopod 1, the presence of more spines on epimera 1–2 and the less tumid propodi of male gnathopods 1–2.

**Paracalliope australis** further differs from *P. fluviatilis* in the smaller carpal lobe of female gnathopod 1, the more slender female gnathopod 1, the more beveled female coxa 1, and the shorter palm on male gnathopod 1.

Although size of eyes, shape of teeth on epimera, and usual lack of excessive gap between spines on uropod 1 are all characteristics of 95% of the specimens of *P. australis* the best characters distinguishing this species from *P. lowryi* is the presence of setules, setae or weak spines on the anteroventral margin (not face) of epimeron 1 and the small teeth of epimera 2–3. This situ-

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Figure 4. *Paracalliope australis*, unattributed figures = male "m" holotype, 3.64 mm; d = male "d" 3.48 mm; ka = male "ka" 3.23 mm; p = female "p" 3.30 mm.
tion makes identification rather tedious as these plates are difficult to see in undissected individuals.

**Distribution.** New South Wales, Victoria, and Tasmania, shoreline tidepools of open sea. 0–18 m. inlets, estuaries and Gippsland Lakes.

**Paracalliope lowryi** sp. nov.

**Figures 5–8**

**Material.** Holotype. Victoria, Gellibrand River mouth (38°35'S, 143°20'E), hand, J.D. Kudenov, 1976. NMV J6916 (male "x", 5.07 mm. illustrated).


**Description.** Holotype male "x". Rostrum small, lateral cephalic lobe mammilliform, sinus receiving antenna 2 deep, eyes huge, almost touching medially. Antenna 1 scarcely shorter than antenna 2. flagellum with 15 articles. one calceolus each on articles 1, 2, 3, 4, 6; one aesthetasc each on articles 5, 7, 9, 11, 13, 14 and rudimentary on 15. Gland cone of antenna 2 moderately prominent. flagellum with 15 articles, one calceolus each on articles 2, 3, 4, 5. Calcioli like P. australis but distal element more rounded and less attenuate apically.

Epistome flat anteriorly, upper lip articulate and rounded-truncate below, with long stiff anterior pubescence. Mandibles of basic gammaridean plan, incisors toothed. right and left laciniae mobiles toothed. right and left rakers 3 and 4 respectively, first raker on right weakly bifid and more strongly feathered than in P. australis; molar triturative, bearing apical seta; palpum hump small, articles 1–2 naked, article 3 especially pubescent, formula of spines = 8D, 3E. Setae simple, others serrate or pinnate or penicillate, basofacial setae 1–2. Inner lobes of lower lip well developed, slightly fleshy. Inner plate of maxilla 1 almost fully setose medially, outer plate with 11 diverse spines, palp 2-articulate, spinose apically, right and left palps alike. Plates of maxilla 2 subequal in size, inner with facial row of setae. Inner and outer plates of maxillipeds weakly spinose, palp short, stout, dactyl ungiform, with about 4 accessory setules.

Coxae 1–7 short, almost glabrous. almost of even depth except coxa 7 shortened. coxa 1

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Figure 5. *Paracalliope lowryi*, new species. unattributed figures = male "x", holotype. 5.07 mm: bc = male "bc" 3.00 mm; n = female "n" 3.48 mm.
scarcely expanded in middle, coxa 4 weakly excavate posteriorly and weakly lobate posterovertrally; coxae 2-6 each with narrow sac-like gill with pediculate base. Gnathopod 1 of small size as in female, medium sized lobe on carpus apically situated and pointing slightly distad, propodus expanding apicad, palm shorter than posterior margin of propodus, well defined by change in slope, palm with organized clusters of armaments, dactyl fitting palm, with several subapical setules. Gnathopod 2 enlarged, carpus forming complex of 2 basal swellings side by side and thin posterior lobe curving distad, propodus turning inward on death, ovato-rectangular, palm oblique, poorly excavate, with 3 lateral and 5 medial facial spines, dactyl slender, fitting palm.

Article 4 of pereopods 3-6 slender, posterior margins of articles 4-6 of pereopods 3-4 poorly armed, setae short, sparse, in about 3 groups. Dactyls lacking slit, with conspicuous setules. Pereopods 5-6 of ordinary amphipod dimensions. 6 slightly larger than 5, article 2 ovate, poorly produced posterovertrally, with many posterior setules, each with weakly setose mid-facial ridge. Pereopod 7 enlarged, article 2 broad and subquadrilateral, weakly and subsharply produced posterovertrally, dactyl [in males unknown, broken on all specimens].

Pleopods ordinary, peduncle elongate, rami elongate, subequal and multiarticulate. No pleonal epimeron dominant, first with obsolescent, second and third each with sharp or sub-sharp medium tooth, posterior margins strongly convex, epimeron 1 with 3 facial spines and no anterovertral setae, epimeron 2 with 5 ventral but submarginal spines, epimeron 3 with 3 ventrofacial spines, all epimeral spines horizontal and in tandem. Uropods each 1-2 extending equally, uropod 3 slightly failing same extension, dorsolateral margin of peduncle on uropod 1 with 6 spines, long gap between ultimate and penultimate, medial with one apical spine, outer ramus scarcely shorter than inner, outer with no dorsal spine, inner with 4. Peduncle of uropod 2 with 4 dorsolateral spines, medial with one apical, outer ramus shorter than inner, outer with 4 dorsal spines, inner with 4. Peduncle of uropod 3 elongate, with 3 dorsosmedial spines, outer ramus scarcely shorter than inner, as long as peduncle, with 5 dorsal spines, inner with 3 dorsal spines, each ramus with subapical setule. Telson linguiform, entire, with 2 pairs of dorsolateral setules in middle and one apicolateral setule on each side and one basolateral setule on each side.

Female "n". Like male but antennae lacking calceoli, eyes smaller than male but much larger than male of *P. australis*, flagellum of antenna 1 with 10 articles, one aesthetasc each on articles 4, 6, 8, 9, rudimentary on 10; flagellum of antenna 2 [broken but presumed to lack calceoli also]. Coxa 1-4 longer than in male, coxa 1 somewhat nasiform and tapering distally, coxae 2-3 narrow, coxa 4 with better defined and quadrilateral posterior lobe. Oostegites 2-3 broad, 4-5 narrow and setose. Gnathopods feebly, equally slender and almost of same length, carpi as long (or longer) than propodi, gnathopod 1 much more slender and slightly more elongate than in male, carpi with weak apical lobe pointing weakly distad, propodus expanding apicad, palm slightly oblique; carpus of gnathopod 2 with strong posterior lobe situated distally and pointing distad, palm less oblique than on gnathopod 1. Pereopods 3-4 like male but article 4 broader. Pereopod 7 [on female "cd" with elongate dactyl bearing 3 long and several short apical setae, anterior and posterior margins each with 4 and 3 sets of short pairs of setae]. Spination on epimera and uropods variates (probably not sexual), spines on epimera 1, 2, 3 = 2, 4, and 3. Lateral or dorsal spine formulas of peduncle on uropods 1, 2, 3 = 6, 4, 2; outer rami = 1, 4, 2; inner rami = 3, 4, 3.

Female "cd". Pereopod 7 drawn in entirety (most specimens of both sexes losing this appendage on death). Flagellum of antenna 1 with 7 articles, of antenna 2 with 8. Epimera 1-3 spine formula = 1-2-1. Uropodal spine formulas (peduncle, outer and inner rami respectively), uropod 1 = 5-0-1, uropod 2 = 3-2-3, uropod 3 = 2-1-1.

Young male "he". Top and side of head illustrated because major adults with eyes shrunk after death. Flagellum of antenna 1 with 11 articles, one calculeus only on article 3, one aesthetasc each on articles 5, 7, 9, 10. Flagellum of antenna 2 with 12 articles, one calculeus each on articles 1, 2, 3. Spines on epimera 1-3 = 2-3-1.

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Figure 6. *Paracalliope lowryi*, new species, unattributed figures = male "x", holotype, 5.07 mm; n = female "n" 3.48 mm; 0 = male "o" 3.83 mm.
Uropodal spine formulas (as above), uropod 1 = 7-0-1, uropod 2 = 3-3-3, uropod 3 = 3-1-2.

Aberrant male "ab". Tooth on epipera 2–3 small (illustrated) but epipera 1 lacking anteroventral setae; spine count on epipera 1–3 = 1-2-0; spine counts on uropods (as above), uropod 1 = 5-0-1, uropod 2 = 2-2-2, uropod 3 = 1-0-1; each main flagellum of antennae 1-2 with 9 articles.

Aberrant male "mb". Tooth on epipera 2–3 especially large and notch above tooth stronger (illustrated); spine count on epipera 1–3 = 2-5-0, no anteroventral setae on epipera 1; spine count on uropod 1 = 6-0-2, uropod 2 = 3-4-3, uropod 3 = missing; gnathopod 2 of *P. lowryi* form; mandibular palp article 3 normal, thus with 2 basofacial setae.

Aberrant male 665. Epipera 1–3 spine counts = 2-1-2, uropod 1 spine counts, uropod 1 = 7(gap normal)-2-3, uropod outer ramus = 4, inner = 3; uropod 3 outer ramus = 3, inner = 3.

Male "o". Gnathopod 2 illustrated (shrunken on holotype). Pereopod 7 broken. One calcoculus each on articles 2, 3, 5 of antenna 1 flagellum. Spines of epipera 1–3 = 2-4-1. Spine formulas of uropods (as above), uropod 1 = 5-0-3, uropod 2 = 3-3-3, uropod 3 = 2-1-2.

Male "q". Pereopod 7 and uropod 3 broken. One calcoculus each on articles 1, 3, 4, 5 of antenna 1 flagellum. Spines of epipera 1–3 = 1-3-1. Spine formulas of uropods (as above), uropod 1 = 6-0-3, uropod 2 = 3-4-4.

Female "p". Uropod 3 missing. Flagellum of antenna 1 with 7 articles. Spines of epipera 1–3 = 1-3-1. Spine formulas of uropods (as above), uropod 1 = 5-0-3, uropod 2 = 3-3-3.

Males “cd*” and “ce*” from P664, Cape Banks and male “jc” from P666, Jacksons Creek, Qld. Characterized by absence of spines on epipera 3, male “jc” with no spines on outer ramus of uropod 1 and the others with one spine on that ramus. Male “jc” also lacks spines on the inner ramus of uropod 1. Males “cb” and “cc” have one spine on the inner ramus. Male “cc” has only 2 basofacial setae on article 3 of the mandibular palp and female “cf” has none (like *P. larai*). Female “cf” does have one spine on epipera 3.

Six specimens from P665. Epipera 3 with 2 spines.

Variations. There is considerable variation in several attributes of *P. lowryi* but we cannot link it to speciation. We are beset with the common dilemma of having material from widely separated localities that shows considerable variation but no morphological basis to divide the material into infra-species. Much of the variation is expressed in counts of spines and setae which vary with the sizes of the demic members from various localities and with growth stages of both sexes. The samples appear to express a mixture of breeding seasons because fully terminal adults are often lacking.

For example, early in our studies we were able to separate adults of the freshwater *P. larai* from the brackish-marine *P. lowryi* by the presence of 0–1 spine on the outer ramus of *P. lowryi* (versus 2 spines in *P. larai*) but we finally found a specimen of *P. lowryi* from the type locality with the requisite 2 spines. Knott (1975) showed in his table 2 the wide variation in spines even in the limited material he had of a single species from one locality (20 observations). Juveniles and males generally have fewer spines on all 9 positions (counting peduncle and 2 rami for each of 3 uropods) of uropods than do females. We find this generally true of *P. lowryi* and can include similar results on epipera 1–3 but with some demes of *P. lowryi* entirely lacking spines on epipera 3. Fortunately, all of our reported samples have both males and females; *P. lowryi* is therefore identifiable from the small male gnathopod 1.

Notes on material and illustrations. The material is difficult to analyse because of mostly broken pereopod 7 and antenna 2, often missing uropod 3 and usually shrunken eyes owing to collapse of cephalic tissues; from dorsal view, however, adult eyes are always seen as clearly larger than in *P. australis*. The head of the holotype is shown with collapsed eyes but male “be” is illustrated with normal eyes. The molar is like that shown for *P. australis*. Spines on outer plate of maxilla I are often worn as shown in the holotype, but have normal extension as on female “n”. Gill and female oostegites are similar to those shown for *P. australis*.

Etymology. Named for Dr James K. Lowry, Figure 7. *Paracalliope lowryi*, new species, unattributed figures = male “x”, holotype, 5.07 mm; cd = female “cd” 2.49 mm; n = female “n” 3.48 mm.

Relationship. This species is unique in Paracalliope for the small male gnathopod 1 which is like female gnathopod 1 in size and shape. This species differs from *P. australis* in: (1) the much larger eyes in both sexes; (2) the slightly different shape of head; (3) the weak setation of pereopods 3–4 in the male; (4) the lack of a slit in the dactyls of pereopods 3–6 (which is a very unreliable character in some of the *P. australis* material); (5) the larger teeth of epimera 2–3; (6) the absence of anteroventral setae on epimeron 1; (7) the long gap between ultimate and penultimate spines on the dorsolateral margin of the peduncle on uropod 1; (8) the reduction of spines on the outer ramus of uropod 1 to the formula 0–1; and (9) the presence of a pair of baso-facial setae or a single spine-seta on article 3 of the mandibular palp. Minor differences found in *P. lowryi* include the stronger pubescence of the upper lip, the weakness of the bifid condition on the first right raker spine on the mandible; the slightly wider male coxa 1 relative to coxa 2; the less comma-shaped female coxa 1; broader female coxa 2; more strongly defined lobe of coxa 4; different shape of lobe on carpus of gnathopod 1; thinner and smaller male gnathopod 1; shorter article 6 relative to articles 4–5 on pereopods 3–4; longer spines on epimeron 1; and the presence of more (3) spines on the inner ramus of uropod 3 in the largest adults.

See *P. larai* and *P. vicinus* for distinctions from this species.

Distribution. Victoria, Tasmania and New South Wales, in estuaries and inlets, Gippsland lakes, intertidal.
Paracalliiope vicinus sp. nov.

Figures 9–10


Description. Holotype, male "wg". Rostrum small, lateral cephalic lobes bluntly coniform, sinus receiving antenna 2 moderate, eyes medium, widely separate. Antenna 1 scarcely shorter than antenna 2, flagellum with 14 articles, one calceolus each on articles 2, 3, 4, 5, 7; one aesthetasc each on articles 6, 8, 10, 12, 13, and rudimentary on 14. Gland cone of antenna 2 very prominent, almost reaching apex of article 3 (in lateral view), flagellum with 14 articles, one calceolus each on articles 2, 4, 6, 8.

Epistome flat anteriorly, upper lip articulate and rounded-truncate below, anterior pubescence poorly developed. Mandibles of basic gammaridean plan, incisors toothed, right and left laciniae mobile toothed, right and left rakers 3 and 4 respectively; molar triturative, bearing apical seta; palp palp hump small, articles 1–2 naked, article 3 especially pubescent, formula of spines = 3A, 10D, 4E, with all of E setae simple, others penicillate, basofacial setae present. Inner lobes of lower lip well developed and fleshy. Inner plate of maxilla 1 almost fully setose medially (but left side abberant, only setose halfway), outer plate with 11 diverse spines, palp 2-articulate, spinose apically, right and left palps alike. Plates of maxilla 2 subequal in size, inner with facial row of setae. Inner and outer plates of maxilliped weakly spinose, palp short, stout, dactyl ungiform, with 5 accessory setules.

Coxae 1–7 short, almost glabrous, almost of even depth except coxa 1 shortened, coxa 1 scarcely expanded in middle, coxa 4 weakly excavate posteriorly and weakly lobate posteroventrally; coxae 2–6 each with narrow sac-like gill with pediculate base. Large lobe on carpus of gnathopod 1 pointing slightly distad, propodis ovately expanded, palm about as long as posterior margin of propodis, well defined by change in slope, palm with organized clusters of armaments, dactyl fitting palm, with several subapical setules. Carpus of gnathopod 2 forming complex of 2 basal swellings side by side and thin posterior lobe curving distad, propodis turning inward on death, ovatoangular, palm oblique, moderately and raggedly exuvate, with 4 lateral and 4 medial facial spines proximal to ragged margin, dactyl slender, fitting palm.

Article 4 of pereopods 3–6 slender, posterior margins of articles 4–6 of pereopods 3–4 with moderately long setae in fascicles, generally fascicle formula number on articles 4–6 = 3-4-6, each fascicle with 1–4 setae (see illustration).
Each of pereopods 3–6 with conspicuous slit on dactyls, all with setules. Pereopods 5–6 of ordinary amphipod dimensions, 6 slightly larger than 5, article 2 ovate, poorly produced posteroventrally, almost smooth, each with midfacial ridge, that on pereopod 5 naked, that on pereopod 6 setose. Pereopod 7 enlarged, article 2 broad and subquadrate, weakly and subsharply produced posteroventrally, dactyl 95% as long as article 6, with 4 anterior fascicles of setae, numerous single posterior setae in tandem and 8 apical setae.

Pleopods ordinary, peduncle elongate, rami elongate, subequal and multiarticulate. No pleonid epimeron dominant, epimeron 1 with tiny posteroventral tooth, epimera 2–3 each with medium tooth, each with strongly convex posterior margin, epimeron 1 with 2 facial spines and no anteroventral setae. epimeron 2 with 5 ventral but submarginal spines in tandem horizontally, epimeron 3 with 3 submarginal spines in tandem horizontally. Uropods 1–2 extending subequally, uropod 3 slightly failing same extension, dorsolateral margin of peduncle on uropod 1 with 10 spines, no discernible apical gap, medial with one apical spine, outer ramus scarcely shorter than inner, outer with 1 dorsal spine, inner with 3. Peduncle of uropod 2 with 3 dorsolateral spines, medial with one apical, outer ramus shorter than inner, with 3 dorsal spines, inner with 4. Peduncle of uropod 3 elongate, with 2 dorsomedial spines and basal setule, outer ramus as long as inner, slightly shorter than peduncle, with 3 dorsal spines, inner with 2 dorsal spines, each ramus with subapical setule. Telson linguiform, entire, with 2 pairs of dorsolateral setules in middle and one apicolateral setule on each side.

Male "q" 3.22 mm. Teeth of epimera 2–3 slightly enlarged (Fig. 9qW), outer ramus of uropod 1 lacking spine, apical gap present on dorsal spines of peduncle on uropod 1, setae on pereopods 3–4 weak.

Female "wj" 3.00 mm. Like male but eyes much smaller, antennae broken, see female "wi" below. Coxae 1–4 longer than in male. Oostegites 2–3 broad, 4–5 narrow and setose. Gnathopods feeble, equally slender, 2 slightly longer, carpi shorter than propodi, gnathopod 1 much more slender and slightly more elongate than in male, carpus with large lobe pointing distad, propodus subrectangular but weakly expanding apically, palm subtransverse; carpus of gnathopod 2 with large posterior lobe pointing distad, palm subtransverse. Pereopods 3–4 poorly setose compared with male but setae better developed than in male of P. lowryi (see illustration of P. lowryi). Pereopod 7 with dactyl 85% as long as article 6. Spines of epimera 1–3 = 2–3–1. Uropods outer and inner rami respectively with spines as follows: uropod 1 = 2 and 3, uropod 2 = 3 and 4, uropod 3 = 2 and 1; peduncle of uropod 1 with spines in formula: 1-1-1-1-gap1-gap1-gap1, peduncle of uropod 2 with 3 spines, of 3 with 2.

Male "qr" 4.27 mm. Tooth of epimera 2–3 large as in P. larai but mandibular palp with 3 A-B setae, epimera 3 with 3 ventral spines, therefore identified as P. vicinus.

Female "wi" 3.56 mm. Flagell of antennae 1 and 2 with 11 and 12 articles, calceoli and aesthetascs absent.

Specimens from NMV J6961, Kellevie. Tooth of epimera 2–3 as large as in P. lowryi but identified as P. vicinus because male gnathopod 1 enlarged. male setae of pereopods 3–4 of the longer form. eyes small. outer ramus of uropod 1 without spines.

Relationship. This species is apparently most similar to P. larai but differs in the slightly smaller teeth of epimera 2–3, the lack of a significant excessive gap in the spination sequence on the peduncle of uropod 1, the better developed setae on male peropods 3–4, the presence of 3 spines on epimera 3 in adults, the presence of only 1 spine (rarely 2) on the outer ramus of male uropod 1, and the fully developed basal setae on article 3 of the mandibular palp. The similarity between the two species resides in the almost identical conditions of male gnathopod 1 and female gnathopods 1–2.

This species differs from P. lowryi in the large male gnathopod 1, the slightly smaller teeth on epimera 2–3, lack of significant gap in spination on peduncle of uropod 1, slightly better developed setation of male pereopods 3–4, the enlarged gnathopod 1 (like P. larai) which is a small replica of male gnathopod 2, with short carpus, deep carpal lobe and expanded propodus; in the stouter female gnathopod 1 with carpus relatively enlarged, its lobe larger and the

Figure 9. Paracalliope vicinus, new species, unattributed figures = male holotype "wg" 5.33 mm; j = female "wj" 3.00 mm; q = male "q" 3.22 mm.
propodus more expanded; in female gnathopod 2 with larger carpal lobe and shorter anterior margin of carpus.

It differs from *P. australis* in the slightly larger teeth of epimera 2–3, the slightly lesser development of setae on male pereopods 3–4, the very slightly larger male gnathopod 1 with articles 5–6 slightly more expanded; the much stouter female gnathopod 1 with much larger carpal lobe, shorter carpus, and more expanded articles 5–6; the larger carpal lobe of female gnathopod 2; and the well developed basofacial setae on article 3 of the mandibular palp.

It differs from *P. novizealandiae* in the reduced spination on the outer ramus of uropod 1, the presence of more AB setae on the mandibular palp, and the larger carpal lobes on the female gnathopods.

It differs from *P. fluviatilis* in the stouter propodi of female gnathopod 1, the lack of spines on epimeron 3 and possibly the presence of more posterior setal groups on article 6 of pereopods 3–4 (but we are comparing males with females of the different species). The two species are otherwise virtually identical. The spines on uropods 1–2 were not described in *P. fluviatilis*.

It differs from *P. karitane* in the presence of spines on epimeron 3, the larger carpal lobes on female gnathopods, the presence of more AB setae on the mandibular palp and the reduced spination on uropods 1–3.

**Etymology.** *Vicinus* (L.), near, in reference to the similarity of this species to *P. larai*.

**Distribution.** Tasmania, lagoons, estuaries, inlets, creeks, apparently mostly fresh water, in marine localities apparently in trickles of freshwater crossing mudflats, intertidal.

*Paracalliope larai* Knott

**Figures 11–13**


**Material.** Holotype. Tasmania, Dip River above falls, 200 m altitude, 23 km direct line from Bass Strait, 1973–1974, Tasmanian Museum G1625 (male).

Paratypes. Type locality, TM G1626 a, b, G1627 a, b (30 specimens).

Other material. Tasmania, Dip Falls, AMMM, JLH & PS, 30 Nov 1974, NMV J6948 (many), NMV J22288 (male voucher “d”, 2.57 mm, maxilliped illustrated), NMV J22289 (male voucher “a”, 2.54 mm, J22289 illustrated), NMV J22290 (male voucher “c”, 2.67 mm), NMV J22293 (female voucher “w”, 2.05 mm, J22293 illustrated), NMV J22291 (female voucher “e”, 1.94 mm), NMV J22292 (female voucher “v”, 1.80 mm).

**Note.** The holotype male and one female were examined by us many years ago and the following descriptions, minus body measurements are presented. New figures were made from the toptotypic material in the Museum of Victoria, male “a” and female “w” to follow.

**Description.** Male holotype. Rostrum small, lateral cephalic lobe adze-shaped, sinus receiving antenna 2 deep, eyes small (artificially shrunken), widely separate. Antenna 1 scarcely shorter than antenna 2, flagellum with 14 articles, calceoli absent; one aesthetasc each on articles 9, 11, 12, 13, and rudimentary on 14. Gland cone of antenna 2 very prominent, almost reaching apex of article 3 (in lateral view), flagellum with 10 articles, one calceolus each on articles 3, 4.

Epistome flat anteriorly, upper lip articulate and rounded-truncate below, anterior pubescence poorly developed. Mandibles of basic gammaridean plan, incisors toothed, right and left laciniae mobiles toothed, right rakers 4, first raker bifid (possibly 2 rakers fused?); molar triturative, bearing apical seta; palp hump small. Articles 1–2 naked, article 3 especially pubescent, formula of spines = 3D, 5E, with 3 of E setae simple, others penicillate, basofacial setae absent. Inner lobes of lower lip well developed and fleshy. Inner plate of maxilla 1 almost fully setose medially, outer plate with 11 diverse spines, palp 2-articulate, spinose apically, right and left palps alike. Plates of maxilla 2 subequal in size, inner with facial row of setae. Inner and outer plates of maxilliped weakly spinose, palp short, stout, dactyl ungiform, with about 2 accessory setules.

Coxae 1–7 short, almost glabrous, almost of even depth except coxa 7 shortened, coxa 1 scarcely expanded in middle, coxa 4 weakly excavate posteriorly and weakly lobate posteriorly, coxae 2–6 each with narrow sac-like gill with pediculate base. Medium sized lobe on carpus of gnathopod 1 pointing slightly distad, propodus ovately expanded, palm about as long as posterior margin of propodus, well defined by change in slope, palm with organized clusters of armaments, dactyl fitting palm, with several
Figure 11. Paracalliope larai, unattributed figures = male “a” 2.54 mm; w = female “w” 2.05 mm.
Figure 12. Paracalliope larai, unattributed figures = male "a" 2.54 mm; w = female "w" 2.05 mm.
subapical setules. Carpus of gnathopod 2 forming complex of 2 basal swellings side by side and thin posterior lobe curving distad, propodus turning inward on death, ovatolicentric, palm oblique, deeply and raggedly excavate, with 2 lateral and 4 medial facial spines proximal to ragged margin, dactyl slender, fitting palm.

Article 4 of pereopods 3–6 slender, posterior margins of articles 4–6 of pereopods 3–4 with moderately long setae in fascicles, generally fascicle formula number on articles 4–6 = 4–6–5, each fascicle with 1–4 setae (see illustrations). Only one member each of pereopods 3 and 6 with conspicuous slit on dactyls, all with setules. Pereopods 5–6 of ordinary amphipod dimensions, 6 slightly larger than 5, article 2 ovate, poorly produced posteroventrally, almost smooth, each with midfacial ridge, that on pereopod 5 naked, that on pereopod 6 setose. Pereopod 7 enlarged, article 2 broad and subquadrate, weakly and subsharply produced posteroventrally, dactyl over 110% as long as article 6, with about 6 anterior fascicles of setae, numerous single posterior setae in tandem and 10+ apical setae.

Pleopods ordinary, peduncle elongate, rami elongate, subquale and multiarticulate. No pleonal epimeron dominant, each with tiny posteroventral tooth and weakly to strongly convex posterior margin (epimeron 2 weakest), epimeron 1 with 1–2 (L + R) facial spines and 3 anteroventral setae, epimeron 2 with 3–4 (R + L) ventral but submarginal spines in tandem horizontally, epimeron 3 with 1 submarginal spine and 1 setule in tandem horizontally near anteroventral edge. Uropods 1–2 extending subequally, uropod 3 slightly failing same extension, dorsolateral margin of peduncle on uropod 1 with 7 spines, and discernible apical gap, medial with one apical spine, outer ramus scarcely shorter than inner, outer with 1 dorsal spine, inner with 1. Pedunule of uropod 2 with 2 dorsolateral spines, medial with one apical, outer ramus shorter than inner, outer with 2 dorsal spines, inner with 2. Pedunule of uropod 3 elongate, with 1 dorsomedial spine and basal setule, outer ramus scarcely shorter than inner, as long as peduncle, with 1 dorsal spine, inner with 1 dorsal spine; each ramus with subapical setule. Telson linguiform, entire, with 2 pairs of dorsolateral setules in middle and one apicolateral setule on one side only.

Female. Pereopod 7 broken. Like male but antennae lacking calceoli, flagellum of antenna 1 with 11 articles, one aesthetasc each on articles 6, 8, 9, 10, 11 (rudimentary); flagellum of antenna 2 with 13 articles. Coxae 1–4 longer than in male, coxa 1 somewhat nasiform and posteroventrally extended, coxae 2–3 narrow, coxa 4 with strongly beveled ventral margin toward posterior side. Oostegites 2–3 broad, 4–5 narrow and setose. Gnathopods feeble, equally slender and almost of same length, carpi as long as propodi, gnathopod 1 much more slender and slightly more elongate than in male, carpus with large lobe pointing distad, propodus subrectangular but weakly expanding apically, palm subtransverse; carpus of gnathopod 2 with weak posterior lobe, palm oblique. Pereopods 3–4 poorly setose compared with male (see illustrations). See female “s” for pereopod 7 distinction below. Differences of epimera probably varietal (see illustration), one spine of epimeron 1 more ventrad, one of epimeron 2 poorly developed, one of epimeron 3 missing and other weak. Some uropods better spined than in male; outer and inner rami respectively with spines as follows: uropod 1 = 3 and 3, uropod 2 = 3 and 3, uropod 3 = 2 and 2.

Male “a”. Topotypic specimen illustrated; written material here describing and clarifying attributes not illustrated; flagellum of antenna 1 with one calceolus each on articles 1 and 2; flagellum of antenna 2 with one calceolus each on articles 2, 4 and 6; following parts like our figures of P. australis: accessory flagellum; lower lip; and other mouthparts with following variations: right mandible, except palp (figured); left mandible, except lacinia mobilis with 5 teeth; inner plate of maxilla 1 with 16 setae; inner plate of maxilla 2 with 12 setae in facial row; inner plate of maxilliped with 5 medial setae, no apicofacial medial spine; peduncle 4 like pereopod 3, size identical; gills of coxae 2, 4, 5, 6 all like figured gill of coxa 3.

Female “w”. Gnathopods and pereopod 7 illustrated; otherwise like male “a” but smaller, armaments fewer; eyes also large as in male; flagellum of antenna 1 with 7 articles, of antenna 2 with 7 articles; calceoli absent; article 2 of gnathopod 2 lacking any enlarged setae; oostegites normal for genus, of coxa 3 largest and broadly ovate, of coxa 2 similar but slightly smaller, of coxa 4 slender, of coxa 5 shorter than 4 but

Figure 13. Paracalliope laral, male “a” 2.54 mm.
slightly wider; gills of coxae 2–6 sac-like, longer than broad, generally similar but minor size gradient from large to slightly smaller in this order: 4, 5, 6, 3, 2; epimeron I lacking anterovelar setules, epimera 1–3 with 1–2–0 ventral spines, posteroventral tooth as in male; peduncles of uropods 1–3 with 3–2–1 spines, inner and outer rami respectively with 2–2, 2–3, 1–1 spines.

Remarks. We have examined the holotype and paratypes. We have only three corrections to make to Knott’s fine description. According to his description the accessory flagellum is absent and no basofacial setae occur on the third article of the mandibular palp. In fact, the holotype has one thick and short basofacial spine whereas many of the paratypes lack this element. An articulate accessory flagellum is present on the holotype and paratypes. The cephalic-ocular lobe is not as sharp as depicted by Knott.

Relationship. The male of Paracalliope larai differs from P. lowryi in the enlarged gnathopod 1 which is like male gnathopod 2, has larger eyes more closely appressed, and has only 0–1 basofacial setae on mandibular palp article 3; in the female the carpus of gnathopod 1 is shorter and lobe larger compared to P. lowryi.

The vast majority of adult specimens of P. lowryi have spines on epimeron 3 and less than 2 spines on the outer ramus of uropod 1, whereas all adult specimens of P. larai lack spines on epimeron 3 but have 2+ spines on the outer ramus of uropod 1. Unfortunately, to ameliorate absolute characterization, there are a few specimens of P. larai from the Dip River above the falls which also lack spines on epimeron 3 and at least one other specimen which has 1 spine on the outer ramus of uropod 1.

The presence (P. lowryi) or absence (P. larai) of basofacial setae on mandibular palp article 3 would be a good character difference except that the holotype of P. larai, in contrast to several of its paratypes, has one basofacial spine-seta.

The rather strong ecological difference between the provenance of P. larai (200 m altitude in a freshwater stream above or near a falls) and P. lowryi (lagoons and high tide pools) suggests to us that there is a distinction between these two “species” but obviously further studies of specimens in freshwater streams may demonstrate that the weak differences we have found are at best phenotypic.

Paracalliope larai differs from other species of the genus in Australia and New Zealand in the broadly sweeping posterior concavity leading directly to the posteroventral tooth on epimera 2–3.

Distribution. Tasmania, Dip Falls and stream above falls.

Acknowledgements

We thank the numerous collectors of material and owe special thanks for assistance to Drs G.C.B. Poore, J.K. Lowry, P.B. Berents, and Mr Robin Wilson; and to Mrs E. Harrison-Nelson for help in the laboratory. Carolyn Cox Lyons (Figures 1–8) of New York City and Linda B. Lutz (Figures 9–13) of Vicksburg, Mississippi, inked our illustrations.

References


