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New species of *Paratya* (Decapoda: Atyidae) from Australian inland waters – linking morphological characters with molecular lineages

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Abstract

Suter, P.J., Mynott, J.H. and Crump, M. 2022. New species of Paratya (Decapoda: Atyidae) from Australian inland waters – linking morphological characters with molecular lineages. *Memoirs of Museum Victoria* 81: 55–122.

The taxonomic history of the atyid shrimp *Paratya* in Australia has been one of confusion due to the high morphological variability in material collected from its wide range of distribution. Early research concluded that all material should be considered a single species, *P. australiensis* Kemp, pending an acceptable revision. After morphological examination of material throughout the known distribution, others concluded that only a single species occurred in Australia. Molecular studies have recognised at least 10 distinct lineages. In the current study, fresh material was collected, and molecular sequencing was undertaken from a single leg from each specimen. Having confirmed the 10 lineages, the specimens were dissected for morphological examination. These lineages are recognised as distinct species and morphological descriptions are provided for seven new species: *Paratya walkeri* n. sp., *P. spinosa* n. sp., *P. williamsi* n. sp., *P. whitemae* n. sp., *P. strathbogiensis* n.sp., *P. gariwerdensis* n. sp. and *P. rouxi* n. sp. A new combination, *P. arrostra* Riek, is raised from sub-species to species, *P. tasmaniensis* Riek is reinstated and *P. australiensis* Kemp is redescribed. A key based on morphology is included.

Keywords

Taxonomy, glass shrimp, *COI*, morphological variation

Introduction

The freshwater Atyid shrimps in the genus *Paratya* Miers, 1882 (Miers, 1882), are widespread throughout streams in the eastern Pacific with *P. borealis* Marin, 2018, in the Russian far east (Marin, 2018); *P. marteni* Roux, 1925, in the Lesser Sunda Islands, Indonesia (Chace, 1997); *P. boninensis* Satake and Cai, 2005, *P. improvisa* Kemp, 1917, and *P. compressa* in Japan (Marin, 2018; Page et al., 2005a; Satake and Cai, 2005); *P. norfolkensis* Kemp, 1917, in Norfolk Island (Page et al., 2005a); *P. caledonica*, *P. cf intermedia* Roux, 1926, and *P. cf typa* Roux, 1926, in New Caledonia (Page et al., 2005a); *P. curvirostris* (Heller, 1862) in New Zealand (Page et al., 2005a); and *P. australiensis* Kemp, 1917, in Australia (Kemp, 1917; Williams, 1981; Williams and Smith, 1979). Using mitochondrial sequences of *COI* and 16S ribosomal DNA, Page et al. (2005a) examined the dispersal of *Paratya* throughout the South Pacific and hypothesised that these shrimp dispersed via oceanic currents and using the amphidromous life cycle of some of the species.

The Australian shrimps of the genus *Paratya* are widespread throughout eastern Australia, from Queensland to South Australia and Tasmania (Cook et al., 2006; Williams, 1977; Williams and Smith, 1979; fig. 1). The first species of *Paratya* from Australia, *Paratya australiensis*, was described by Kemp (1917).

Since first being described, the taxonomic history of *Paratya* in Australia has been one of confusion due to the high morphological variability in material collected from a wide range of locations. Two authors (Calman, 1926; Roux, 1926) recognised that animals in their collections were not typical in appearance to *P. australiensis*, and Calman (1926) suggested they may represent a distinct local race based on the examination of rostral characters.

Roux (1926) compared specimens from populations from the Horton River near Bingara, North Yanco near Narrandera, Jamberoo on the southern coast of New South Wales, the Nepean River, Parramatta and Marrickville in Sydney, and Middle Harbour in Port Jackson. Importantly, he noted two forms from North Yanco: one with a long rostrum with two postorbital spines and 5–8 ventral rostral spines, and a second with a short rostrum with no postorbital spines and 1–3 ventral rostral spines. Roux (1926) noted that he could not separate samples into regional races, even though the North Yanco sample suggests two taxa because samples from the Sydney area also had specimens with a short rostrum but with postorbital spines. Riek (1953) recognised five taxa and described two new species and two subspecies *Paratya australiensis*, *P. australiensis arrostra*,

P. atacta, *P. atacta adynata* and *P. tasmaniensis*. Walker (1973), in an unpublished honours thesis, suggested all Riek's taxa were conspecific. Williams (1977) considered Riek's revision to be "inadequate and cannot be accepted as a serious taxonomic statement" (p. 403) and "pending an acceptable revision, all Australian forms of *Paratya* are regarded as belonging to a single species, *P. australiensis*" (p. 403). In a subsequent paper by Williams and Smith (1979), all Riek's taxa were formally synonymised with *Paratya australiensis* Kemp.

Williams and Smith (1979) re-described *P. australiensis* and designated a neotype from Riek's material from close to the type location of "Clyde near Sydney", because Kemp's (1917) original type material no longer exists (Williams and Smith, 1979, p. 817). The variability of morphology was documented by these authors (Smith and Williams, 1980; Williams and Smith, 1979) from examination of specimens from populations throughout the known geographical distribution and from a single population in Cardinia Creek near Melbourne, Victoria. They concluded that only a single highly variable species (*Paratya australiensis*) occurred in Australia.

A series of papers on the genetic characteristics of *Paratya* (Baker et al., 2004; Cook et al., 2007; Hancock et al., 1998; Page et al., 2005b) culminated in the paper by Cook et al. (2006), which demonstrated nine distinct lineages over the geographical range of *Paratya*. The nine lineages consisted of widespread lineages (4, 6 and 8), lineages from only a single river (3, 5 and 7) and lineages from geographically adjacent rivers (1, 2 and 9). A further lineage was discovered in south-west Victoria by McClusky (2007). Cook et al. (2006) suggested that there may be defining morphological differences present among the lineages.

This study's aims were to link morphological and molecular data to find distinguishing morphological characters that enable the identification of the separate lineages of *"Paratya australiensis"* and to revise the taxonomy of *Paratya* in Australia.

Specifically, the aims of this study were to:

- use molecular data to assign individual specimens to lineages
- discover morphological diagnostic characters for females and males separately to allow for the morphological identification of the lineages and eliminate any sexual dimorphism of character expression
- test the hypotheses that where molecular differences are present, there are corresponding morphological differences present.

Methods

Study site locations: Study site locations were selected based on information provided by Cook et al. (2006) relating to the location of individual lineages and based on specimens kindly provided by J. Devine from Sydney Water, B. Cook (Queensland), C. Madden (South Australia), J. Conallin (New South Wales), B. Mos and personal collections. Collectors are identified by their initials: B. Cook (BC), Sydney Water (SW), Environment Protection Authority, Victoria (Vic EPA), C. Madden (CM), J. Conallin (JC), J. Mynott (JM), M. Crump (MC), J. Hawking (JH), B. Mos (BM), T. Walker (TW), T. Curmi (TC), S. Oeding (SO), L. Shuveral (LS), B. Kroll (BKr), J. Webb (JW), D. Black (DB), A. Clements (AC), P. S. Lake (PSL), B. Knott (BK) and P. Suter (PS).

Morphology: Terminology of anatomical structures is after Raabe and Raabe (2008). Specimens were examined under a stereo dissecting microscope. The appendages from one side of the body only were dissected with the pereiopods, pleopods, telson, antennae, stylocerite, scaphocerite and mouthparts all mounted on slides using Euparal for further examination.

Measurements were obtained using an eyepiece graticule calibrated with a 5 mm micro-ruler to determine scale.

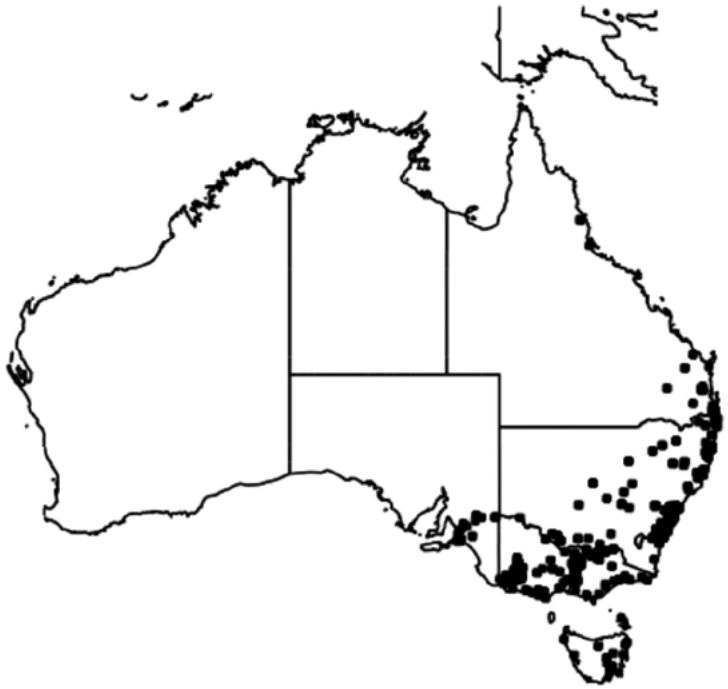
Standard measurements, as illustrated by von Rintelen and Cai (2009), were used throughout. Carapace length was measured from the anterior margin of the carapace to the posterior of the eye orbit; rostral length was measured from the eye orbit to the apex of the rostrum, rostral depth was the maximum depth; length of ventral spine row was from the posterior base of the posterior spine to the anterior base of the most anterior spine; stylocerite and scaphocerite lengths were from the base of each structure to the apex; pereiopod and mouthpart measurements were the maximum length of each segment made on the external margins; width measurements were the maximum width of the segment; total pereiopod length was by addition of length of each segment; telson length was from the base to the apex but not including the terminal spines and the width was maximum width at base.

Measurements were compared directly and after being corrected for body size using the carapace length to compensate for variation related to the size (and age) of an individual. Only mature females were used in the analysis due to the presence of known sexual dimorphisms and the limited number of mature males in the collections. Females were determined by the presence of the broad thelycum located on the 8th thoracic segment; the short lanceolate endopod of the first pleopod, which is similar in shape to the exopod; and the absence of the appendix masculina on pleopod 2. All measurements are reported in the descriptions as the holotype character measure with the range of expression (i.e. maximum and minimum) in parentheses.

Segment ratios for pereiopods were for all segments and exopod length with the carpus length, with the carpus length in parentheses. The antennal peduncle measurement ratios were all compared with the apical segment length (3as). The maxilliped 2 comparisons were the ratios of the apical, mid and basal segments and exopod lengths to the basal segment length with the basal segment length given in parentheses. Segment ratios for maxilliped 3 were the ratios of the apical, mid and basal segments and exopod lengths to the mid segment length with the mid segment length given in parentheses.

All maps were prepared using Cartographica. (www.macgis.com).

Laboratory methods: Genetic techniques were used to assess the relationships within the species *Paratya australiensis* and to determine taxonomic resolution of the previously identified *Paratya* lineages in Cook et al. (2006) and McClusky (2007). Total genomic DNA was extracted using two methods.



a)

b)

Figure 1. Maps: a, distribution of *Paratya* in Australia. Sources include data from Cook et al. (2006); Baker et al. (2004), Cook (2006), Hurwood et al. (2003), McCluskey (2007) and data from this study; b, distribution of *Paratya* specimens analysed in this study. Maps created in Cartographica.

The first DNA extraction method was a standardised proteinase-K/Chelex solution following the protocol of Webb and Suter (2010). Leg tissue was removed from each specimen and placed in 100 μL of Chelex solution (5% Chelex (weight:volume), 0.2% SDS, 10 mM Tris pH 8 and 0.5 mM EDTA) and 10 μL of 20 mg/mL proteinase-K. Specimens were incubated overnight in solution at 55 °C, removed and centrifuged at 1500 rpm for 5 minutes before being placed in a thermocycler for 5 minutes at 95 °C to deactivate the proteinase-K. The extracted DNA was then diluted 1:5 with 1X TE (20 μL DNA extraction: 80 μL TE).

The second DNA extraction method was a Qiagen DNeasy blood and tissue kit following standard protocols (Qiagen Handbook, 2006 www1.qiagen.com/literature/). A region of the cytochrome *c* oxidase subunit 1 gene (*COI*) was amplified using Folmer primers (HCO2198 and LCOI490 (Folmer et al., 1994). All primers were M13-tailed to facilitate sequencing. Polymerase chain reaction conditions for the *COI* fragment used the following protocol: 60 seconds at 94 °C; 5 cycles of 60 seconds at 94 °C, 90 seconds at 45 °C and 90 seconds at 72 °C; 35 cycles of 60 seconds at 94 °C, 60 seconds at 50 °C and 60 seconds at 72 °C; and a final cycle of 4 minutes at 72 °C. Polymerase chain reaction preparations of 40 μL were made either with: (i) 4 μL buffer reagent, 2 μL 50 mM $MgCl_2$, 0.8 μL of each primer, 0.1 μL Platenium taq polymerase (Invitrogen, Melbourne), 1 μL of DNA template and 13.3 μL of ddH_2O, or with (ii) 20 μL Taq mastermix (Qiagen), 1 μL DNA template, 0.8 μL of each primer and 17.4 μL of RNA-free water (Qiagen). Polymerase chain reaction products were sent to Macrogen Inc. (Seoul, Republic of Korea) for purification and sequencing.

Sequence data from previous studies were downloaded from GenBank (Baker et al., 2004; Cook et al., 2006; Hurwood et al., 2003; McClusky 2007) to form a backbone for lineages (Supplementary Table 1). Outgroup sequences were downloaded from GenBank for *Caridina* and other *Paratya* species. Data generated in this study were assembled in DnaBaser version 2.91.5 (Heracle BioSoft SRL, Romania, www.DnaBaser.com) with mismatches, if present, assessed visually. Alignments were generated using MUSCLE (Edgar, 2004) in MEGA version 10.1.8 (Kumar et al., 2018) and translated to protein sequences to check for stop codons. All sequences were trimmed to 434 base pairs to match the sequence length of GenBank data. All new sequences from this study have been deposited on GenBank with the identifiers OL420759–OL420929.

Phylogenetic analysis: Genetic analyses were performed in MEGA version 10.1.8 with base composition for the 383 sequences (in-group only) showing an AT bias overall and particularly at the third codon position (overall: A = 25.5%, T = 34.2%, C = 21% and G = 19.3% (AT = 59.7%); third codon position AT = 77.8%). A test of homogeneity showed that overall, the sequences were predominantly homogenous with the first codon position showing an equal amount of homogeneity and heterogeneity between the sequences. The estimated transition:transversion ratio was R = 3.12. A maximum likelihood test of model selection returned T92+G+I as the best model, with T92+G as the second best. Neighbour-joining analysis was performed in MEGA version 10.1.8 on 397 sequences using the Tamura 3-parameter model with gamma = 0.81, rates among sites homogeneous and 2000 bootstrap pseudo-replicates.

Distances were also assessed in MEGA Version 10.1.8 using the un-corrected p-distance with default assumptions.

Results

Phylogenetic analysis: Genetic data from previous studies were used to form a backbone for previously identified lineages (Baker et al., 2004; Cook et al., 2006; Cook et al., 2002; McClusky, 2007). The ingroup for the analyses included 383 sequences with the backbone comprising 198 sequences (Supplementary Table 1). Ten lineages had been observed in previous studies, 185 sequences generated in this study were analysed against the 10-lineage backbone to assess morphological variation among lineages. Molecular data (fig. 2) showed monophyletic support for all 10 lineages, with sequence data from this study associated with each lineage. Inter- and intra-specific variations were consistent with the values recorded by Cook et al. (2006). Species boundaries were determined by molecular divergences following Costa et al. (2007) and Hebert et al. (2003) and the examination of morphological differences between lineages. The combined approach supports the designation of the lineages as species.

Paratya australiensis and *P. gariwerdensis* show lower support values (fig. 2) due to the presence of sub-clades that are predominantly composed of a small set of sequences from the backbone set. Distance data further reflects the variation, with *P. gariwerdensis* showing a maximum intraspecific distance of 4.8% (Table 1) and inter-specific variation ranging from 4.6–9.7%. Sequences generated in this study for *P. gariwerdensis* aligned in well-supported clades (bootstrap values 84–96%). *Paratya australiensis* shows less divergence distance between sequences, with a maximum intra-specific distance of 2.8%, which is marginally higher than the maximum intra-specific distance for Decapoda (2.57%; Costa et al., 2007), and as stated by Hebert et al. (2003), intra-specific variation is rarely greater than 2%.

Paratya arrostra, *P. whitemae* and *P. tasmaniensis* also showed high intra-specific variation with maxima of 4.1–4.8% (Table 1). These three species have widespread distributions. *Paratya arrostra* comprised five well-supported sub-clades (fig. 3, supplementary fig. 1). Sub-clade E contained the bulk of the sequence data and most of the sequences generated in this study. Sub-clade E showed very little sequence divergence, despite associated specimens occurring over a large geographic area from South Australia, Victoria, New South Wales and Queensland. Sub-clade A included three sequences from this study that were located from the Clarence River catchment near Coffs Harbour, New South Wales, to the Richmond River catchment near Ballina, New South Wales. Subclade B included two sequences from this study from northern Queensland at Tinaroo. Sub-clades C (n = 2) and D (n = 4) comprised haplotypes from Cook et al. (2006).

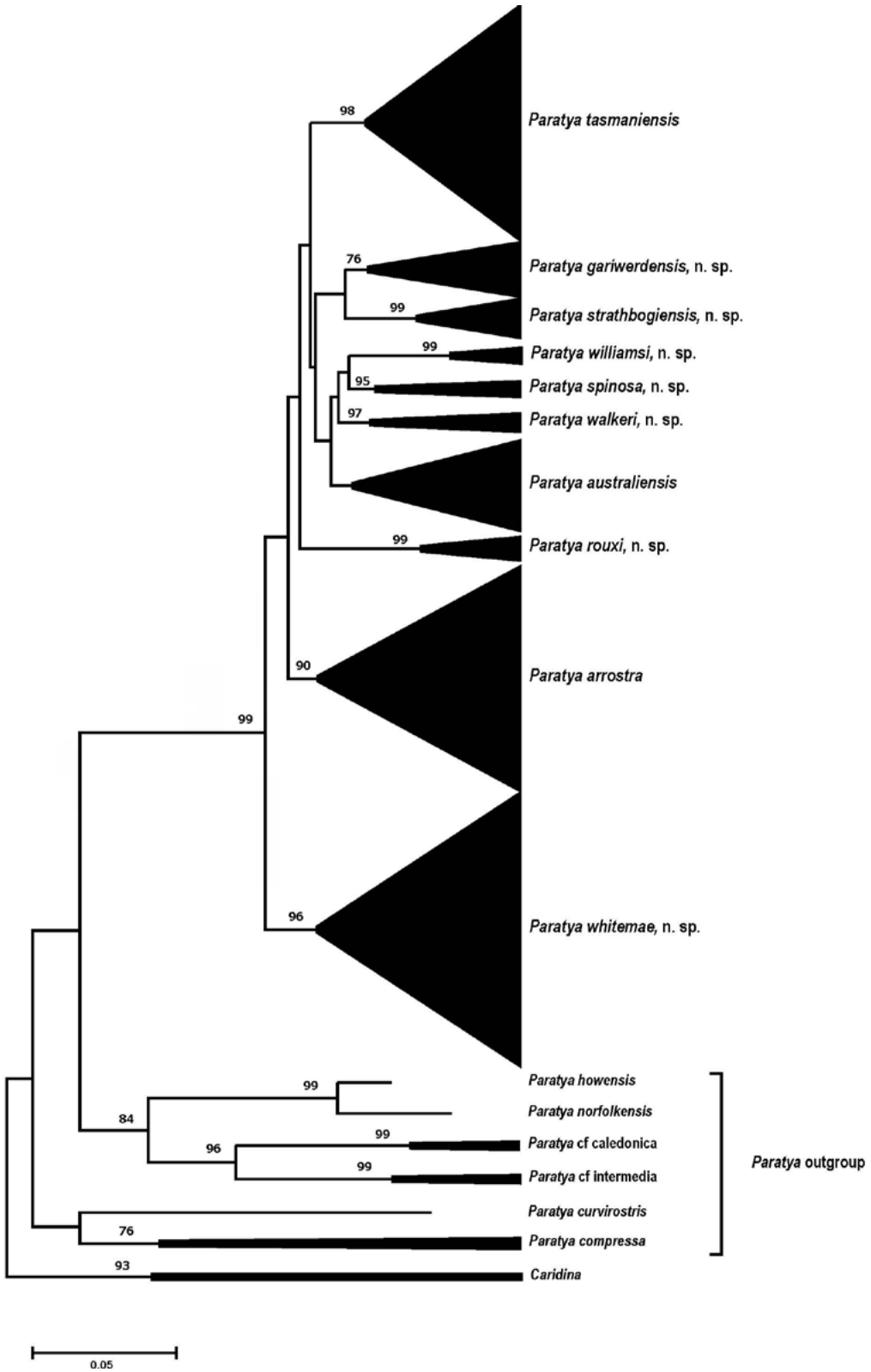


Figure 2. Neighbour-joining analysis of *Paratya* using Tamura-3-parameter, gamma distribution shape parameter of 0.81, homogenous pattern among lineages and 2000 bootstrap pseudoreplicates. Bootstrap values >72% displayed. Sequence data from Cook et al. (2006); Baker et al. (2004), Cook (2006), Hurwood et al. (2003), McCluskey (2007) and this study.

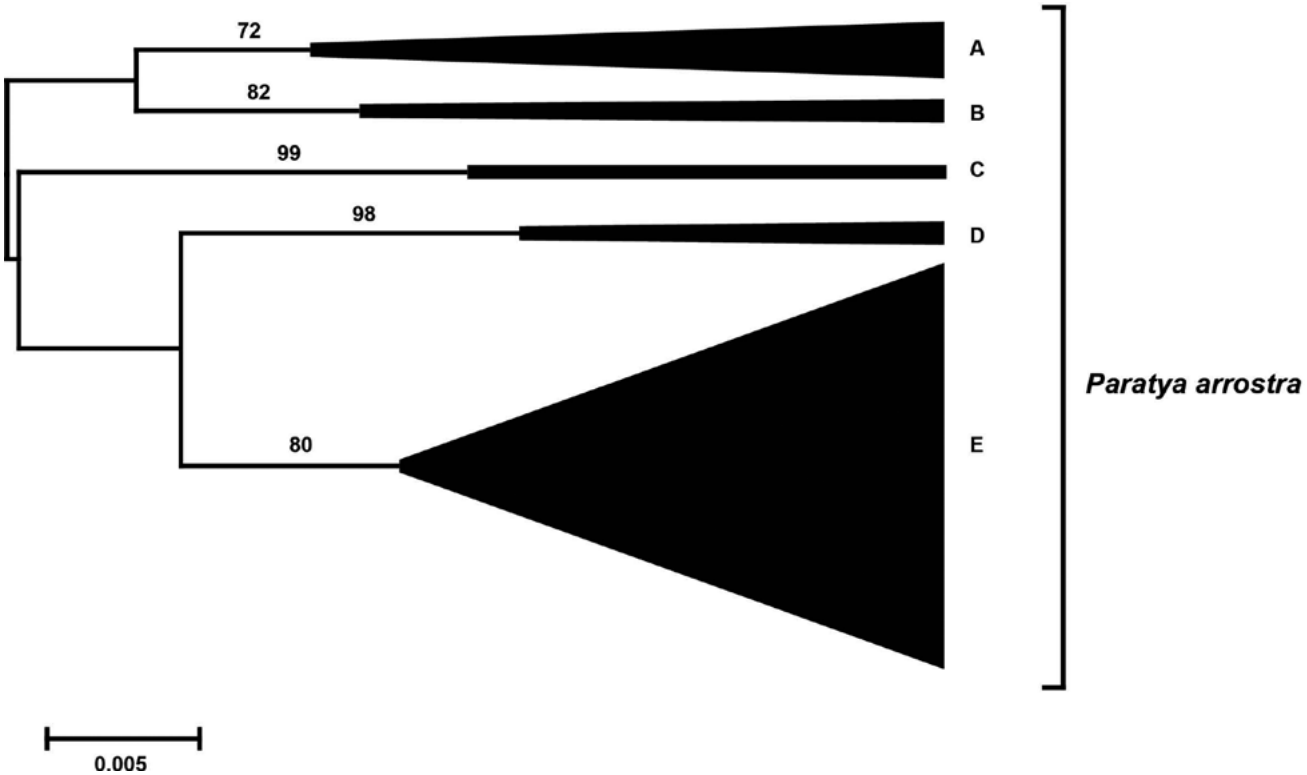


Figure 3. Sub-tree of *Paratya arrostra* Riek, 1953, showing supported subclades. Themajority of material collected across a wide geographical area in this study grouped within a single clade (E), which is equivalent to Lineage 4B in Cook et al. (2006). Previous haplotypes from Cook et al. (2006) form the other sub-clades, but no specific geographical information is known for these sequences. Sub-clades A and B contain some specimens from this study.

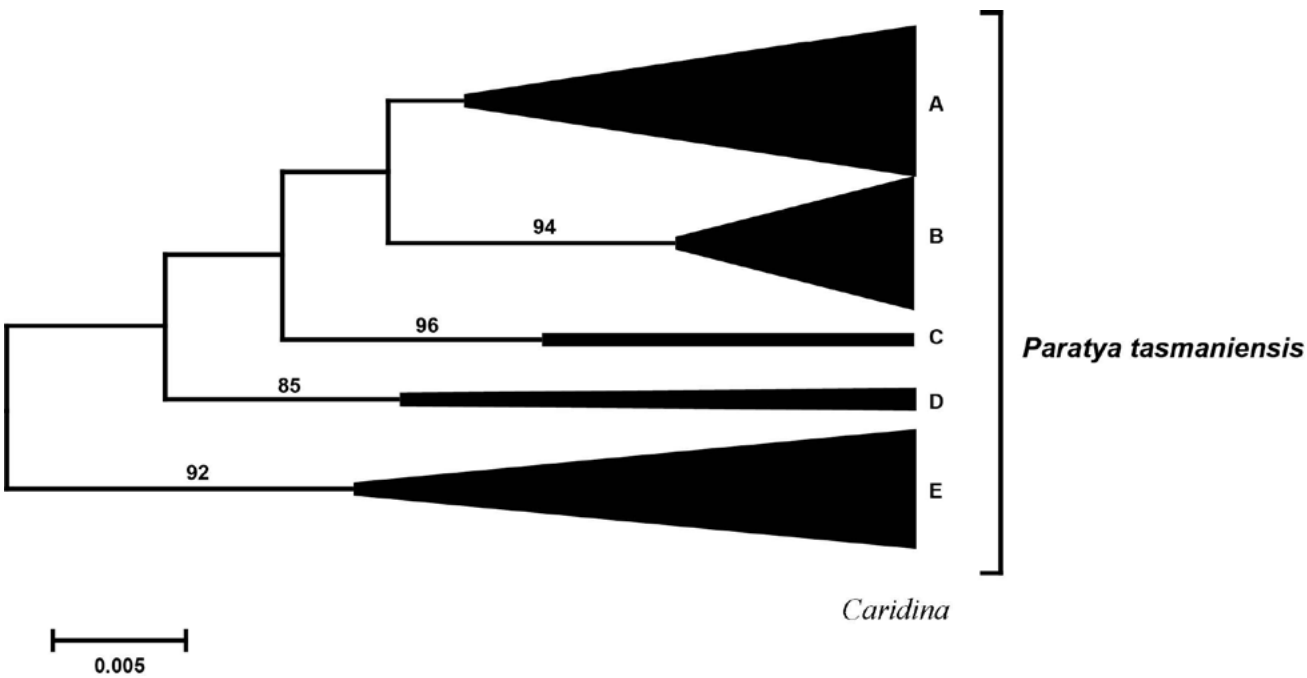


Figure 4. Sub-tree of *Paratya tasmaniensis* Riek, 1953, showing supported sub-clades. Sub-clade A predominantly has material from Tasmania but with a single specimen collected at Hamilton, Victoria. Sub-clade B contains specimens from the Glenelg River catchment, south-west Victoria through to the Hastings River in New South Wales. Sub-clade E contains sequences from Cook (2006) from the Strathbogie area, and sub-clades C and D are from Cook et al. (2006) and McCluskey (2007).

Table 1. Divergence distances for the *Paratya* species recognised in this study and linked to lineages from previous studies. Inter– and intra–specific pairwise p–distances for the CO1 fragment from MEGA version 10.1.8

	P. australiensis		*P. walkeri*		*P. spinosa*		*P. arrostra*		*P. williamsi*		*P. whitemae*		*P. strathbogiensis*		*P. tasmaniensis*		*P. rouxi*		*P. gariwerdensis*	
	Lineage A Baker/Cook 1		Cook 2		Cook 3		McClusky C/Cook 4		Lineage D Baker/Cook 5		Lineage B BakerMcClusky A/Cook 6		Cook 7		Lineage C Baker/Cook 8/ McClusky B		Cook 9		McClusky D	
	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max
P. australiensis Lineage A Baker/Cook1	0.000	**0.028**																		
P. walkeri Cook 2	**0.025**	0.051	0.002	0.012																
P. spinosa Cook 3	**0.030**	0.058	**0.030**	0.039	0.000	0.012														
P. arrostra McClusky C/Cook 4	0.052	0.078	0.059	0.081	0.055	0.081	0.000	**0.048**												
P. williamsi Lineage D Baker/Cook 5	0.039	0.058	0.044	0.051	0.041	0.046	0.076	0.097	0.000	0.002										
P. whitemae Lineage B BakerMcClusky A/Cook 6	0.044	0.067	0.039	0.069	0.044	0.074	0.048	0.078	0.058	0.071	0.000	**0.041**								
P. strathbogiensis Cook 7	0.046	0.062	0.053	0.060	0.044	0.058	0.067	0.085	0.055	0.060	0.053	0.071	0.000	0.005						
P. tasmanienis Lineage C Baker/Cook 8/McClusky B	0.044	0.074	0.055	0.081	0.048	0.076	0.065	0.097	0.060	0.076	0.053	0.085	0.060	0.078	0.000	**0.048**				
P. rouxi Cook 9	0.055	0.071	0.060	0.067	0.051	0.062	0.065	0.085	0.074	0.076	0.055	0.078	0.078	0.083	0.065	0.083	0.000	0.002		
P. gariwerdensis McClusky D	0.048	0.078	0.053	0.071	0.055	0.081	0.062	0.097	0.062	0.081	0.051	0.088	0.046	0.058	0.062	0.094	0.078	0.097	0.002	**0.048**

Paratya tasmaniensis comprised five well-supported sub-clades (fig. 4, supplementary fig. 2). Sub-clade A and B had sequences from this study associated with the backbone material. Sub-clade C (n = 2) and D (n = 4) comprised haplotypes from McClusky (2007) and Cook et al. (2006). Sub-clade E comprised sequences from Cook (2006) with specimens collected from the Granite Creeks area of the Strathbogie Ranges, Victoria.

Paratya whitemae comprised one well-supported and three poorly supported sub-clades (supplementary fig. 3). The well-supported sub-clade contained only sequences from the backbone data (Cook et al., 2006; Hurwood et al., 2003; McClusky, 2007). The bulk of sequences for this species showed very little divergence and comprised one sub-clade, the other sub-clades showed more divergence within the clade.

Paratya walkeri, *P. spinosa* and *P. australiensis* showed low minimum inter-specific variation between each other but were well supported in the neighbour-joining analysis and morphologically. *Paratya spinosa* had 3% divergence from both *P. australiensis* and *P. walkeri*. However, *P. australiensis* and *P. walkeri* had a minimum inter-specific divergence of 2.5% (Table 1). This is consistent with the inter-specific variation within the Atyidae where Chen et al. (2020) observed inter-specific variation as low as 3.3% (3.3–33%) in *Caridina* from China, while Christodoulou et al. (2012) reported 5.9% (5.9–28.7%) variation in *Atyaephyra* and Shih et al. (2019) reported 2.17% (2.17–53%) variation in *Neocaridina*.

Systematics

Genus *Paratya* Miers, 1882

Paratya australiensis Kemp 1917

Diagnosis: Rostrum longer or shorter than carapace, usually slender and pointed; dorsally armed with 11–34 teeth of which 0–4 are postorbital spines; ventrally with 1–14 large serrations; dorsal edge straight or very slightly concave.

Eyes well developed, darkly pigmented.

Carapace with supraorbital spine large and distinct, antennal spine smaller; pterygostomian spine indistinct, but pterygostomium angle quite acute; hepatic spine absent.

Antenna 1 length about half body length. Peduncle with numerous finely setose spines in row near lateral, ventral and distal margins and along medial edge; lateral distal angle of first segment with prominent acute process or stylocerite that reaches to distal border of peduncle segment.

Antenna 2 longer than body. Peduncle first segment without setae, overlapping second segment dorsally, with prominent tooth at outer distal angle; second segment with short row of setae dorsally; third segment with group of setae at inner distal angle. Scaphocerite with regular row of setose spines on inner and distal margins; outer margin extending to a sharp point overreached by lamella. Flagellum long and slender.

Maxillipeds 1 exopod flagellum distinct, well developed and with numerous long setose spines on all margins, approximately half the length of the caridean lobe; caridean lobe broad with numerous short setose spines on outer margins and a few on body of lobe; epipodite small. Maxilliped 2 exopod long and narrow, several setose spines of various lengths near tip and basally. Epipodite with podobranch.

Maxilliped 3 basal segment curved, apical segment with large terminal claw, medial distal margin with broad teeth-like spines, largest in basal third, outer margin with broad tooth-like spines longest in basal third; several transverse spine rows near base; mid and basal segments with several short simple spines. Exopod long and narrow, with several long setose spines near tip and several short setose spines near base. Epipodite with basal conical projection.

Pereiopods 1–5 all possessing an exopodite, only pereiopods 1–4 with epipodite. Pereiopods 1 and 2 with propodus and dactylus forming chelae each with a terminal tuft of setae. Dactylus of pereiopod 3 and 4 with a prominent terminal claw and strong spines on medial margin; dactylus of pereiopod 5 with prominent terminal claw and very regular, comb-like row of numerous small spines on medial margin.

Pleopod 1 male with endopod about half length of exopod, narrowly ovate at base, usually excavated distally with numerous long setose spines laterally and medial spines.

Pleopod 2 appendix masculina present in males, absent in females. Appendix interna long and narrow about one-fifth of length of endopod and exopod, distal margin with long setae. Peduncle with short and long spines.

Telson long and tapers towards posterior, dorsal surface with 2–3 pairs of strong sub-marginal teeth-like spines, posterior margin with 1 pair of spine-like teeth and 6–14 long strong terminal spines.

Paratya australiensis Male neotype

This species was fully described by Williams and Smith (1979) and the description given below adds a morphotype from the Shoalhaven R and the morphometric characters for direct comparisons of all species recognised in this revision.

Paratya australiensis Kemp

Figure 5

Paratya australiensis Kemp (1917); primary type material no longer exists

P. australiensis Riek (1953)

P. australiensis Williams and Smith (1979); neotype male selected from material named by Riek (1953) AM P28693. Neotype examined by MC

Lineage A (Baker et al., 2004)

Lineage 1 (Cook et al., 2006)

Numerous authors referred to *P. australiensis* in both taxonomic (Calman, 1926; Kemp, 1917; Roux, 1926; Smith and Williams, 1980; Williams, 1977; Williams and Smith, 1979) and ecological studies (Baker et al., 2004; Balcombe et al., 2007; Boulton, 2003; Bunn and Hughes, 1997; Chessman and Robinson, 1987; Hancock, 1998; Hancock and Bunn, 1997; Hancock and Bunn, 1999; Hancock et al., 1998; Hart et al., 1991; Hladyz et al., 2012; Hughes et al., 2003; Hughes et al., 1995; Hurwood et al., 2003; Kefford et al., 2004; Marchant et al., 1999; Marchant et al., 1984; Metzeling, 1993; Piola et al., 2008; Reidet al., 2008; Richardson and Humphries, 2010; Smith and Williams, 1980; Walsh and Mitchell, 1995; Williams, 1977), but these ecological studies recognised only a single species from the taxonomic decision by Williams and Smith (1979). Based on current knowledge, these identifications should be revisited.

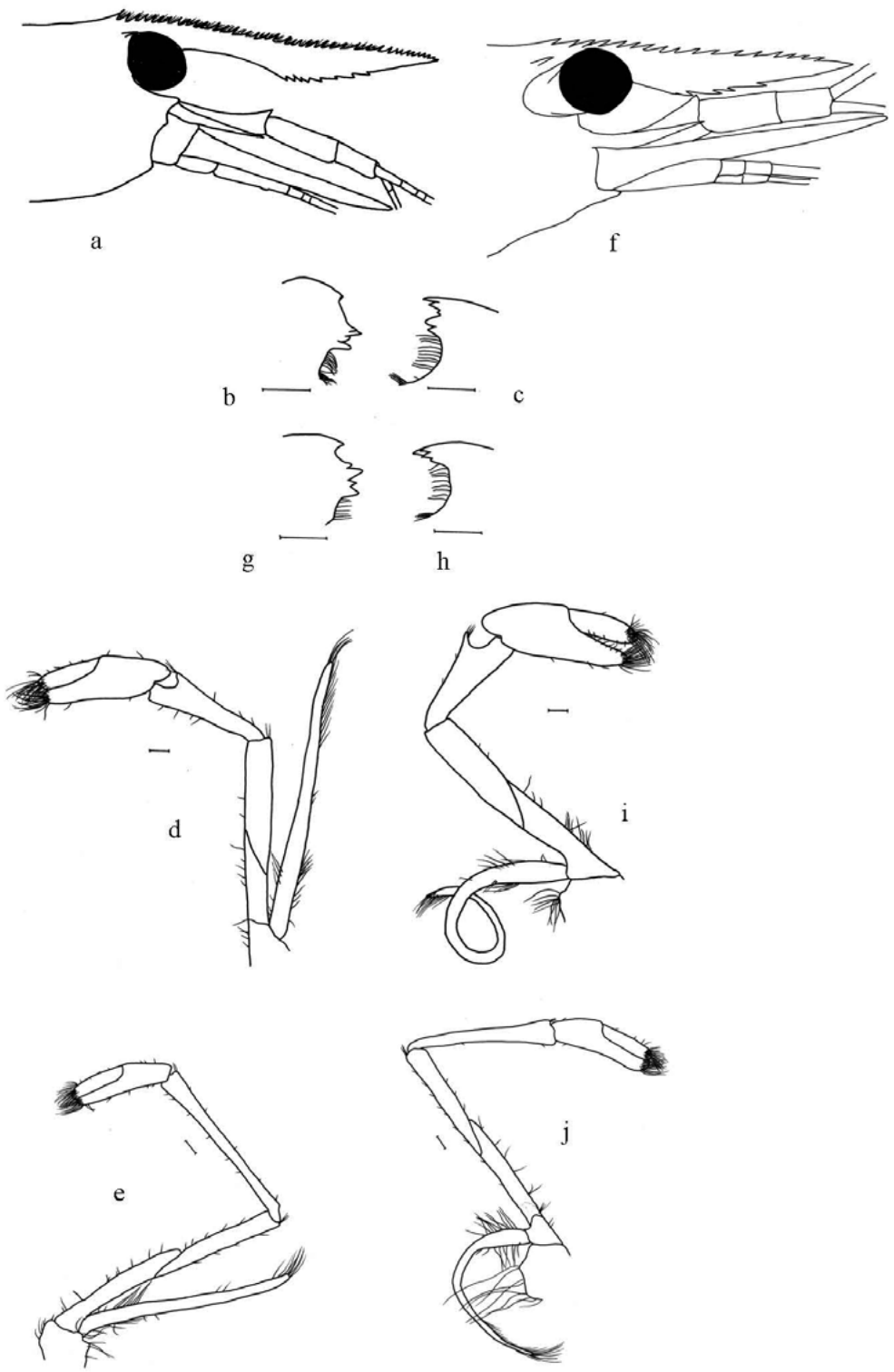


Figure 5. *Paratya australiensis*: a–e, *P. australiensis* Kemp; f–j, *P. australiensis* Shoalhaven morphotype; a, rostrum; b, left mandible incisors; c, right mandible incisors; d, first pereiopod; e, second pereiopod; f, rostrum; g, left mandible incisors; h, right mandible incisors; i, first pereiopod; j, second pereiopod. Scale lines 0.2 mm.

Material Examined: New South Wales: Neotype male AM P28693 Seven Hills, Sydney: Hawkesbury R at Powells Lane, –33.569 S, 150.745 E, 9 March 2011 (SW); Hawkesbury R at North Richmond, –33.589 S, 150.715 E, 9 March 2011 (SW); Hawksbury R at Wilberforce, –336018 S, 150.8245 E, 21 April 2011 (SW) Nepean R at Penrith Weir, –33.746 S, 150.682 E, 14 April 2011 (SW); Warragamba R upstream of Nepean R confluence, –33.8589 S, 150.611 E, 18 April 2011 (SW); Bedford Ck, Blue Mountains, –33.75 S, 150.4474 E, May 2011 (SW) MC32; Bungonia Ck at Bungonia, –34.8528 S, 149.9437 E, no date (SW), Shoalhaven R at Hillview, –35.1826 S, 149.9541 E, no date (SW); Boro Ck at Marlowe upper Shoalhaven R, –35.3426 S, 149.7386 E, no date (SW); Hacking R at McKell Ave, –34.1524 S, 151.0284 E, 5 May 2011 (SW); South Ck at Richmond Rd, –33.6775 S, 150.8121 E, 30 May 2011 (SW).

Williams and Smith (1979) fully illustrated *P. australiensis*, and these have not been duplicated here. Some comparative characters of the two morphotypes are provided (fig. 5).

Diagnosis: P. australiensis differs from all other species by the following combination of characters: rostrum long, extending beyond antennular peduncle and scaphocerite in Sydney streams, dorsal edge very slightly concave, dorsally armed with 16–28 teeth, 1–3 postorbital spines, ventrally with 4–7 large serrations over a length of 0.60–1.5 mm, distal half of ventral edge more or less straight; left mandible with 4–5 teeth separated by finely ridged notch from a less distinct apical tooth; right mandible with 4 teeth in in 2 separate incisor processes; scaphognathite of maxilla 2 rounded apically almost extending to apex of upper endite; maxilliped 1 with exopod flagellum distinct, well developed and with numerous long setose spines on all margins, approximately four-fifths length of caridean lobe; exopod of maxilliped 2 1.70–2.77 times longer than endopod, epipodite with podobranchs extending just to base of third segment of endopodite; maxilliped 3 with medial distal margin of apical segment of endopod with 9–11 broad teeth-like spines, outer margin with 2–4 broad teeth-like spines plus 2–4 smaller spines, exopod long and narrow, tip over-reaching distal end of basal endopod segment; pereiopod 1 with long carpus and long slender chelae, exopod extending to mid carpus–base of propodus; pereiopod 2 with exopod extending to apex of merus; dactylus of pereiopod 3 with prominent terminal claw and 7–11 strong spines on medial margin, exopod extends to mid merus; dactylus of pereiopod 4 prominent terminal claw and 6–11 spines on medial margin, exopod extends to mid-apical third of merus; dactylus of pereiopod 5 with prominent terminal claw and very regular comb-like row of 55–80 small spines on medial margin, exopod extends to mid merus.

Shoalhaven R morphotype: Rostrum extends beyond peduncle, but not beyond scaphocerite, dorsally armed with 16–17 spines, 0 postorbital spines, ventrally with 2–5 spines over a length of 0.60–1.5 mm.

Carapace*:* length 4.1–8.0 mm.

Rostrum (Williams and Smith, 1979; fig. 1a): long, 4.0–5.6 mm, extending beyond both antennular peduncle and scaphocerite in specimens from the Sydney area (fig. 5a) but slightly shorter and not extending beyond the scaphocerite in specimens from the upper Shoalhaven system (fig. 5f), rostral length 0.62–1.24 times length of carapace, dorsal edge very slightly concave, with slight upwards curve, moderately slender to broad and pointed, rostrum 6.75–9.33 times longer than wide; dorsally armed with 16–25 teeth, ratio of rostral spines to rostral length is 3.15–4.90 with 1–3 post orbital spines in the Sydney morphotype (fig. 5a) or 0 post orbital spines in the Shoalhaven morphotype (fig. 5f); ventrally with 2–6 large serrations over a length of 0.6–1.5 mm all anterior to widest point; distal half of ventral edge more or less straight, ratio of ventral rostral spines length to rostral length = 0.13–0.28 and 3.20–8.00 times more dorsal spines than ventral spines; rostral length 0.92–1.5 times length of scaphocerite.

Antenna 1 (Williams and Smith, 1979; fig. 1, b, c) peduncle 3.40–4.54 mm long, not quite reaching distal tip of scaphocerite, length 0.90–1.07 times as long as scaphocerite. Stylocerite 1.40–2.80 mm long, length 6.89–13.33 longer than width, 0.33–0.43 times carapace length, reaching beyond distal border of peduncle segment, almost to end of acute process on the lateral distal angle of the first segment (fig. 5f).

Antenna 2 (Williams and Smith, 1979; fig. 1d) second segment of peduncle 1.00–1.94 mm long, 0.29–0.44 times length of scaphocerite, 2.53–3.80 times longer than wide. Scaphocerite 3.40–4.72 mm long, 0.60–0.85 times carapace length, 2.76–4.25 times as long as wide.

Mouthparts (Williams and Smith, 1979; figs 1e–i, 2a–c). Left mandible (fig. 5b, g) with 4–5 teeth separated by finely ridged notch from a less distinct apical tooth; spine row immediately below incisor process of 6–10 rugose spines (lifting spines); spine row above molar process of approximately over 20 sparsely setose spines. Right mandible (fig. 5c, h) with 4 teeth separated into 2 incisor groups of 2 teeth, apical and third teeth largest, teeth 2 and 4 shorter; spine row immediately below teeth with 8–10 spines, each finely setose basally; spine row above molar process. Molar process ridged.

Maxilla palps, with 1 long, setose terminal spine and 1–2 simple sub–terminal ones, inner distal angle may be slightly acute.

Maxilla 2 scaphognathite rounded apically almost extending to apex of upper endite. Palps small, terminal parts narrow with 1–2 setose spines.

Maxilliped 1 palp with broad base, short narrow distal lobe, several long setose spines on distal margins. Exopod flagellum distinct, well developed and with numerous long setose spines on all margins, approximately half to four-fifths the length of the caridean lobe.

Maxilliped 2 endopod length 0.68–1.32 mm; exopod long and narrow, length 1.73–2.80 mm, exopod 1.70–2.77 times longer than endopod. Epipodite with podobranchs extending just to base of third segment of endopodite.

Maxilliped 3 endopod length 3.07–7.54 mm, 1.70–2.77 times longer than exopod; with 3 distal segments of similar length; basal segment curved; apical segment with large terminal claw, medial distal margin with 9–11 broad teeth-like spines, largest in basal third, outer margin with 2–4 broad teeth-like spines and 2–4 smaller spines, longest in basal third. Exopod long and narrow, length 1.80–3.62 mm, tip over-reaching distal end of basal endopod segment.

Thoracic appendages (Williams and Smith, 1979; figs 2d, e, 3a–c). Pereiopod 1 (fig. 5d, i). 3.45–5.49 mm long, 0.68–0.91 times length of carapace. Chelae short to long and slender, 1.09–1.93 mm long, propodus 2.55–3.46 times as long as wide, 1.88–2.21 times longer than dactylus; palm length 1.58–1.91 times width and 1.00–1.38 times dactylus length (fig. 5d, i). Carpus long, 1.47–3.08 times longer than greatest width. Segment ratios compared with carpus length 0.54–0.78 : 1.04–1.71 : 1.00 (0.92–1.36) mm : 0.99–1.45 : 0.35–0.84 : 2.21–3.27. Exopod extending to mid carpus–base of propodus.

Pereiopod 2 (fig. 5e, j). length 5.04–9.58 mm, 1.00–1.47 times carapace length. Chelae long and slender 1.11–1.76 mm long, approximately two-thirds carpus length, 3.59–4.14 times as long as wide, palm length 1.71–1.98 times width and 0.82–1.31 times dactylus length (fig. 5e, j). Propodus length 1.61–2.07 times longer than dactylus. Carpus 5.76–8.16 times as long as greatest width, slightly broader distally, distal margin with small excavation. Segment ratios 0.30–0.38 : 0.56–0.72 : 1.00 (1.73–2.84) mm : 0.58–0.96 : 0.34–1.00 : 0.83–1.49. Exopod extending to apex of merus.

Pereiopod 3 slightly longer than pereiopod 2 and more slender, length 5.7–10.08 mm, 1.19–1.60 times carapace length. Dactylus with prominent terminal claw and 7–11 strong spines on medial margin. Propodus length 3.23–4.56 times longer than dactylus, length 9.81–14.3 times as long as wide with 12–15 spines on inner margin. Merus with 1 strong spine on medial margin and 1 near ventral distal margin. Segment ratios 0.38–0.54 : 1.62–1.79 : 1.00 (1.07–1.88) mm : 1.60–2.11 : 0.50–0.77 : 1.60–1.74. Exopod extends to mid merus.

Pereiopod 4 similar to pereiopod 3, 6.09–9.60 mm long, 1.20–1.52 times carapace length. Dactylus with prominent terminal claw and 6–11 spines on medial margin. Propodus length 3.92–4.94 times longer than dactylus, length 10.74–16.50 longer than wide, with 11–17 spines on medial margin; merus with 1 or 2 strong spines on medial margin and 1 near ventral distal margin. Segment ratios 0.37–0.44 : 1.67–1.90) : 1.00 (1.16–1.80) mm : 1.64–2.01 : 0.54–0.82 : 1.18–1.87. Exopod extends to mid-apical third of merus.

Pereiopod 5 similar length to pereiopods 3 and 4, 5.85–9.79 mm long, 1.21–1.57 times carapace length. Dactylus with prominent terminal claw and very regular comb-like row of 55–80 small spines on medial margin. Propodus length 2.83–3.60 times longer than dactylus, length 9.57–16.54 times longer than wide with 8–16 medial teeth. Carpus approximately half propodus length with 1 large spine near distal margin. Merus with 1 strong medial spine and 0–1 distal spines; ischium less than half length of propodus; segment ratios 0.52–0.74 : 1.83–2.09 : 1.00 (1.15–1.85) mm : 1.33–1.90 : 0.58–0.99 : 1.22–1.69. Exopod extends to mid merus.

Abdomen (Williams and Smith, 1979; figs 3d–f, 4a–c). Pleopods peduncle of first pleopod short, 0.23–0.33 times length of carapace, 2.62–3.33 times width, exopod 1.05–1.6 times peduncle length, endopod 0.42–0.83 times peduncle length; second pleopod peduncle short, 0.29–0.44 times length of carapace, 2.31–3.5 times width, exopod 1.00–1.58 times peduncle length, endopod slightly shorter 1.00–1.55 times peduncle length. Length of first peduncle 0.93–1.38 times length of second peduncle length.

Telson length 3.00–4.48 mm, 0.55–0.73 times carapace length, 2.35–3.28 times as long as greatest width, and tapering distally. Dorsal surface with 2 pairs of strong submarginal teeth-like spines. Posterior margin convex with 1 pair of teeth-like spines outermost, 6 long, strong setose spines, and 2 short, simple spines.

Uropods approximately equal to telson length.

Males (Williams and Smith, 1979; fig. 3d–f). Smaller than females, carapace length 5.25 mm; endopod of pleopod 1 strongly excavated with 12 short external spines on medial margin and 17 long setae on inner margin.

Comments: Lineage 1 specimens are consistent with the neotype of *P. australiensis* described and illustrated by Williams and Smith (1979) from Seven Hills near Sydney. Kemp (1917) described *Paratya australiensis* from Clyde, Sydney, but, as the type was missing, Williams and Smith (1979) attempted to find material from the type locality, but were unsuccessful. They selected a specimen from Riek's (1953) collection from the Seven Hills site as the neotype. Both locations (Seven Hills and Clyde) are in the Parramatta R system and are only 10 km apart (Williams and Smith, 1979). The material examined in this study was from adjacent catchments. *P. australiensis* appears restricted to coastal catchments in the Sydney area and in the Shoalhaven catchment. *P. australiensis* does not have an overlapping distribution with *P. walkeri*, *P. spinosa*, *P. strathbogiensis* and *P. gariwerdensis* but it does overlap with *P. arrostra*, *P. williamsi*, *P. whitemae* and *P. tasmaniensis*. *P. whitemae* has been found at the same locality as *P. australiensis*, and both occur in the Hawksbury R and Nepean R.

P. australiensis can be clearly distinguished from the species possessing a short rostrum (*P. arrostra* and *P. rouxi*) by the rostrum extending beyond the peduncle compared with the rostrum that does not extend beyond the peduncle, and characters listed in Table 2.

P. australiensis can be distinguished from all the long rostrum species by the combination of characters listed in Table 3. Main characters include the number of dorsal rostral spines; the number of ventral rostral spine; palm length to width of second cheliped; carpus of pereiopod 1 long; the length of the lower rostral spine row; number of long terminal spines of telson; scaphognathite of maxilla 2 long almost extending to end of endite; right mandible with 2 pairs of incisors (Table 3). The presence of two morphotypes of *P. australiensis* is similar to the observations made on another Australian atyid shrimp, *Australatya*, by Choy et al. (2019).

***Paratya walkeri* n. sp.**

Figures 6–8

http://zoobank.org/urn:lsid:zoobank.org:act:E03B305A-0EDD-4ABD-92E8-566AE860E9E0

Lineage 2 (Cook et al., 2006)

Type material: Holotype New South Wales. Dingo Ck, –30.3103 S, 152.9822 E, 24 May 2015 (BM) PS9. Body in ethanol and antennae, mouthparts, pereiopods and abdominal structures dissected, mounted on 2 slides. Accession Ref. PS9. Australian Museum (AM) Ref No. P.105600.001.

Table 2. Characters that distinguish all *Paratya* species with a long rostrum which extends beyond the antennal peduncle

Character	***Paratya australiensis*** **L1**	***Paratya walkeri*** **L2**	***Paratya spinosa*** **L3**	***Paratya arrostra*** **L4B**	***Paratya williamsi*** **L5**	***Paratya whitemae*** **L6**	***Paratya strathbogiensis*** **L7**	***Paratya tasmaniensis*** **L8**	***Paratya gariwerdensis*** **LD**
Carapace length (mm)	4.1–8.0	5.75–6.25	5.70–6.20	5.10–7.00	4.85–6.00	4.5–6.6	5.6–6.5	5.40–7.50	3.6–4.1
Rostrum longer than carapace	–	+	–/=	+/–	+/=	=	–	+	–
Rostrum extends beyond scaphocerite	+/–	+	+	+/–	=	+	+	+	–
Number of dorsal rostral spines	16–17 or 16–28	24–30	28–30	22–34	21–27	20–34	21–24	22–29	26–28
Number of post-orbital spines	0 or 1–3	2–4	1–3	2–3	2–3	1–4	1–2	2–4	2
Number of ventral rostral spines	2–5 or 4–7	14–16	8–10	4–11	1–5	4–14	4–6	4–13	7–10
Number of ventral spines posterior to greatest depth of rostrum	0	1–2	0–1	0–1	0–1	1–2	0	0	2–3
Length of ventral rostral spine row (mm)	0.6–1.5	2.75–4.00	1.65–3.00	1.10–2.20	0.10–2.00	1.30–2.80	1.30–1.80	2.10–3.40	1.30–1.50
First pereiopod carpus length	Long, 1.73–2.84 mm	Short, 1.25–1.35 mm	Short, 1.12–1.28 mm	Short, 1.01–1.40 mm	Short. 1.05–1.10 mm	Short, 0.87–1.40 mm	Short, 1.13–1.47 mm	Short to long, 1.00–2.67 mm	Very short, 0.88–0.90 mm
First pereiopod chelae shape	Short to long and slender	Long and broad	Short and broad	Short and slender	Short and broad	Short and broad	Short and broad to long and slender	Short and broad to long and slender	Short and broad
First pereiopod Propodus length/ carpus length	1.04–1.71	1.30–1.44	1.29–1.43	1.08–1.84	1.27–1.44	1.14–1.49	1.19–1.31	1.25–1.41	1.26–1.33
First pereiopod propodus length/width	2.55–3.46	2.64–3.04	2.68–2.87	2.50–3.47	2.28–3.02	2.48–3.84	2.86–3.26	2.95–3.43	2.44–3.07
First pereiopod palm length/palm width	1.58–1.91	1.48–1.65	1.44–1.79	1.13–1.90	1.36–1.70	1.56–2.25	1.42–2.14	1.60–1.83	1.39–1.67
Second pereiopod palm length/palm width	1.71–1.98	1.50–1.61	1.45–1.82	1.13–2.08	1.50–1.56	1.50–2.50	2.00–2.22	1.80–3.35	1.22–1.53
Second pereiopod propodus length/ dactylus length	1.61–2.07	1.56–2.06	1.53–1.77	1.43–1.98	1.76–1.80	1.39–1.91	1.67–1.81	1.57–2.06	1.77–2.04
Dactylus 3 teeth	7–11	7–10	7–9	9–11	5–7	7–11	8–13	9–11	6–7
Dactylus 4 teeth	6–11	7–8	7–9	8–12	5–6	8–11	9–12	8–12	7–8
Dactylus 5 comb	55–80	53–62	44–60	70–91	49–66	81–94	64–80	70–85	70–80
Telson length/carapace length	0.55–0.73	0.64–0.74	0.63–0.71	0.51–0.76	0.67–0.72	0.58–0.83	0.57–0.66	0.59–0.70	0.67–0.70
Number of long terminal spines of telson	6	9–10	6–10	7–13, (usually 11–12)	8	8–10	8–12	8–12	6–7
Right mandible incisors	Incisors paired each with 2 teeth, 1 and 3 large, 2 and 4 shorter	Incisors single with 4 teeth, tooth 2 largest, 1, 3, 4 shorter	Incisors single with 4–5 teeth, all large and of equal size	Incisors single 1 and 3 large, 2 and 4 slightly shorter	Incisors single with 4 teeth, 3 and 4 teeth largest 1 and 2 shorter	Incisors single with 3–4 teeth, 2 central teeth largest, 1 and 4 shorter	Incisors paired outer with 2 teeth 1 and 3 large with 2 very short, 4 large, 3 and separated	Incisors single with 4–5 teeth, tooth 3 largest, 1, 2 and 3 smaller	Incisors single with 4 teeth, 1, 2 and 4 smaller than 3
Maxilla 2 scaphognathite	Rounded apically, not truncated	Truncated	Rounded apically, not truncated	Rounded apically, not truncated	Truncated	Rounded apically, not truncated	Truncated	Truncated	Truncated
Distribution	NSW Sydney streams (Parramatta and Shoalhaven rivers)	NSW northern coastal rivers (Tweed and Clarence rivers)	NSW northern coastal rivers (Tweed River)	Widespread, Murray–Darling Basin SA, Coastal streams Vic, north-east NSW, south-east Qld.	NSW, Kangaroo Valley, Shoalhaven catchment	Coastal streams of NSW and Vic, south-east Qld	Vic, streams in the Strathbogie Ranges	Tasmanian, SA, Vic and NSW coastal, inland streams of the Murray–Darling Basin	South-west Vic in streams draining the Grampian Mountains

Note: L1, L2, L3 etc. refer to the lineage of previous publications mentioned in the text.

Table 3. Characters that distinguish all *Paratya* species with a short rostrum that does not extend beyond the antennal peduncle

Character	***Paratya rouxi* (L9)**	***Paratya arrostra* (4B)**	***Paratya arrostra* (4C)**
Carapace length (mm)	4.90–5.30	3.1–7.0	5.5–6.3
Rostrum shorter than carapace	+	+	+
Number of dorsal rostral spines	11–19	19–25	16–19
Number of post-orbital spines	0	2–3	0–1 spine displaced posteriorly and separate from rostral spines
Number of ventral rostral spines	1–3	3–7	4–5
Length of ventral rostral spine row (mm)	<0.4	>0.4	>0.4
Antenna 1 stylocerite and peduncle process	Extends just to basal third of process	Extends almost to end of process	Extends almost to end of process
First pereiopod carpus length	Long, length 7.0–9.3 times width	Long, length 6.2–8.8 times width	Short, length 5.2–5.9 times width
First pereiopod chelae shape	Slender	Slender	Broad/robust
First pereiopod Propodus length/ carpus length	1.2–1.4	1.1–1.8	1.4–2.1
Telson length/carapace length	0.67–0.71	0.44–0.60	0.44–0.60
Number of long terminal spines of telson	10–12	7–13 (usually 11–12)	7–13 (usually 11–12)
Right mandible Incisors	Paired incisors, each with 2 large teeth	Single incisor of 4–5 large teeth	Single incisor with 4–5 large teeth
Maxilla 2 scaphognathite	Truncated, shorter than endite	Rounded apically, not truncated, almost reaching apex of endite	Rounded apically not truncated, almost reaching apex of endite
Distribution	Inland Murray–Darling catchment, NSW	Widespread, Vic, NSW, Qld, SA	South-east Qld

Note: L9, 4B and 4C refer to lineages of Cook et al. (2006).

Paratypes: New South Wales. 5 specimens in ethanol same data as holotype; Accession Ref. PS23, PS8 Genbank Registration OL420929; body in ethanol and other structures dissected, mounted on 2 slides each; AM Ref No. P.105601; 3 specimens in alcohol.

Material Examined: New South Wales: Dingo Ck, –30.3103 S, 152.9822 E, 24 May 2015 (BM).

Diagnosis: P. walkeri differs from all other species by the following combination of characters: rostrum long, extending beyond both antennular peduncle and scaphocerite, dorsal edge very slightly concave, dorsally armed with 24–30 teeth, 2–4 postorbital spines, ventrally with 14–16 large serrations over a length of 2.75–4.00 mm, extending from just posterior of greatest depth; distal half of ventral edge straight; left mandible with 3 teeth separated by a notch from 2 less distinct apical teeth; right mandible with 4 teeth in a single incisor process; scaphognathite of maxilla 2 truncated distally not extending to apex of upper endite; maxilliped 1 with exopod flagellum distinct, well developed and with numerous long setose spines on all margins, approximately two-thirds length of caridean lobe; exopod of maxilliped 2 1.09–2.13 times longer than endopod, maxilliped 3 with medial distal margin of apical segment of endopod with 6–12 broad teeth-like spines, outer margin with 2 broad teeth-like spines, exopod long and narrow, tip over-reaching distal end of basal endopod segment; pereiopod 1 with long carpus and long, robust chelae, exopod extending to mid to apex of carpus; pereiopod 2 with exopod extending to mid-apex of merus; dactylus of pereiopod 3 with prominent terminal claw and 7–10 strong spines on medial margin, exopod extends to mid merus; dactylus of pereiopod 4 prominent terminal claw and 7–8 spines on medial margin, exopod extends to apical third of merus; dactylus of pereiopod 5 with prominent terminal claw and very regular comb-like row of 53–60 small spines on medial margin, propodus with 8–11 medial spines; exopod extends to basal third to mid third of merus. Telson with 9–10 long terminal spines.

Carapace length 6.25 mm (5.75–6.25).

Rostrum long, 6.3 mm (5.75–6.60), extending beyond both antennular peduncle and scaphocerite (fig. 6a), rostral length 1.08 (0.95–1.15) times longer than carapace, dorsal edge curved upwards to tip, broad and pointed, rostral length 9.00 (6.76–9.00) times greater than width; dorsally armed with 29 (24–30) teeth, ratio of rostral spines to rostral length is 4.60 (4.17–4.60); 4 (2–4) postorbital spines; ventrally with 16 (14–16) large serrations (fig. 6a) over a length of 4.00 mm (2.75–4.00), 2 (1–2) spines posterior to widest point; ratio of ventral spine length to rostral length is 0.63 (0.42–0.63) and 1.81 (1.60–2.14), more dorsal spines than ventral spines; rostral length 1.42 (1.25–1.42) times length of scaphocerite.

Antenna 1 peduncle 3.88 (3.40–4.70) mm long, not reaching distal tip of scaphocerite (fig. 6b), 0.87 (0.81–0.91) times length of scaphocerite. Stylocerite 2.88 (2.18–2.88) mm long, length 11.50 (7.25–11.50) longer than wide, 0.46 (0.36–0.46) times carapace length, reaching beyond distal border of peduncle segment to mid or apex of broad acute process on distal angle of first segment.

Antenna 2 (fig. 6c) apical segment of peduncle 1.55 (1.55–1.60) mm long, 0.35 (0.34–0.35) length of scaphocerite, 2.70 (2.56–2.70) longer than wide. Scaphocerite 4.45 (4.45–4.70) mm long, 0.71 (0.71–0.82) times length of carapace, 3.30 (3.24–3.68) longer than wide.

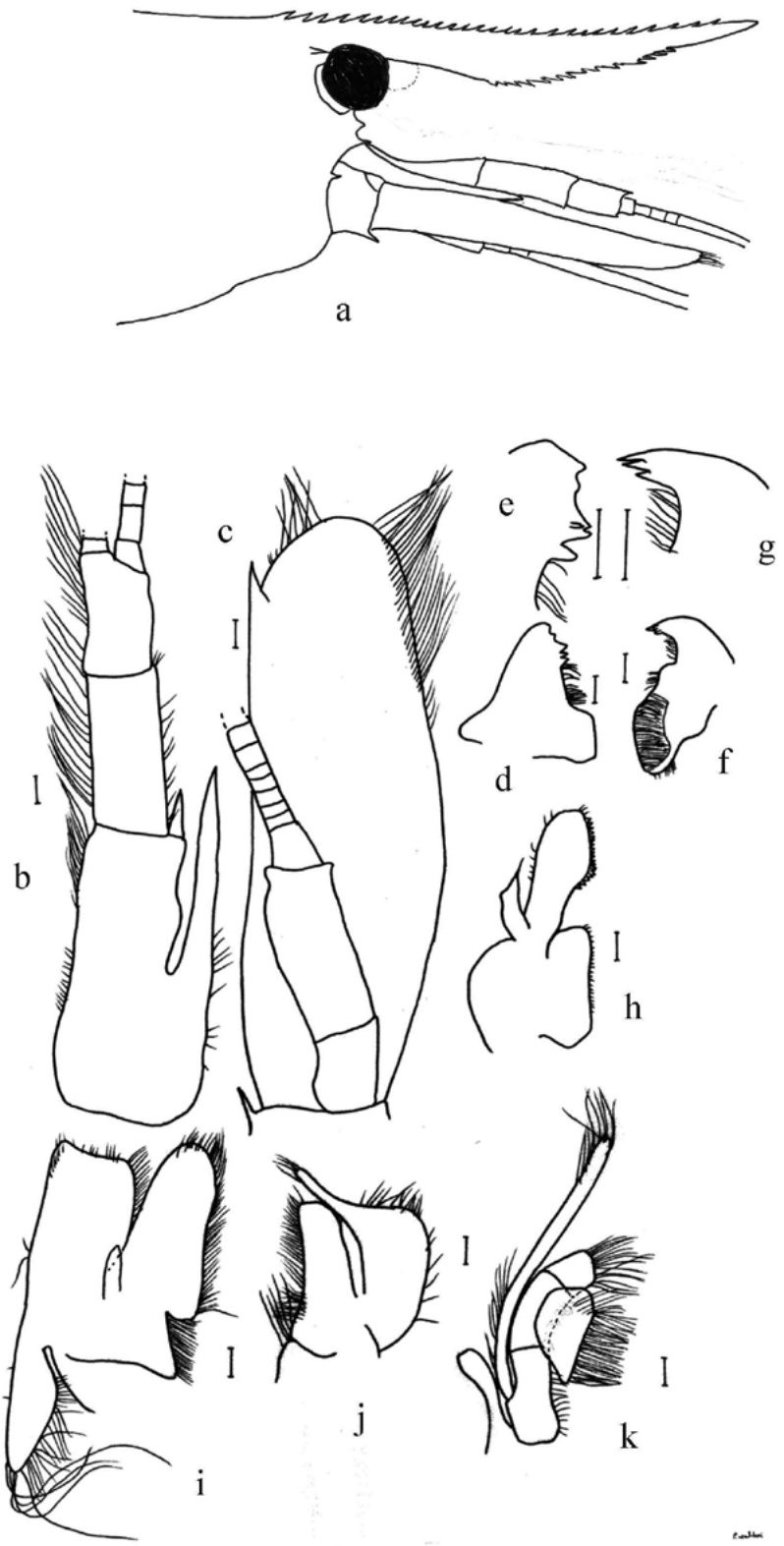


Figure 6. *Paratya walkeri* sp. nov.: a, head region and rostrum; b, antenna 1 peduncle and stylocerite; c, scaphocerite; d, left mandible; e, enlarged incisors; f, right mandible; g, enlarged incisors; h, maxilla 1; i, maxilla 2; j, maxilliped 1; k, maxilliped 2. Scale lines 0.2 mm.

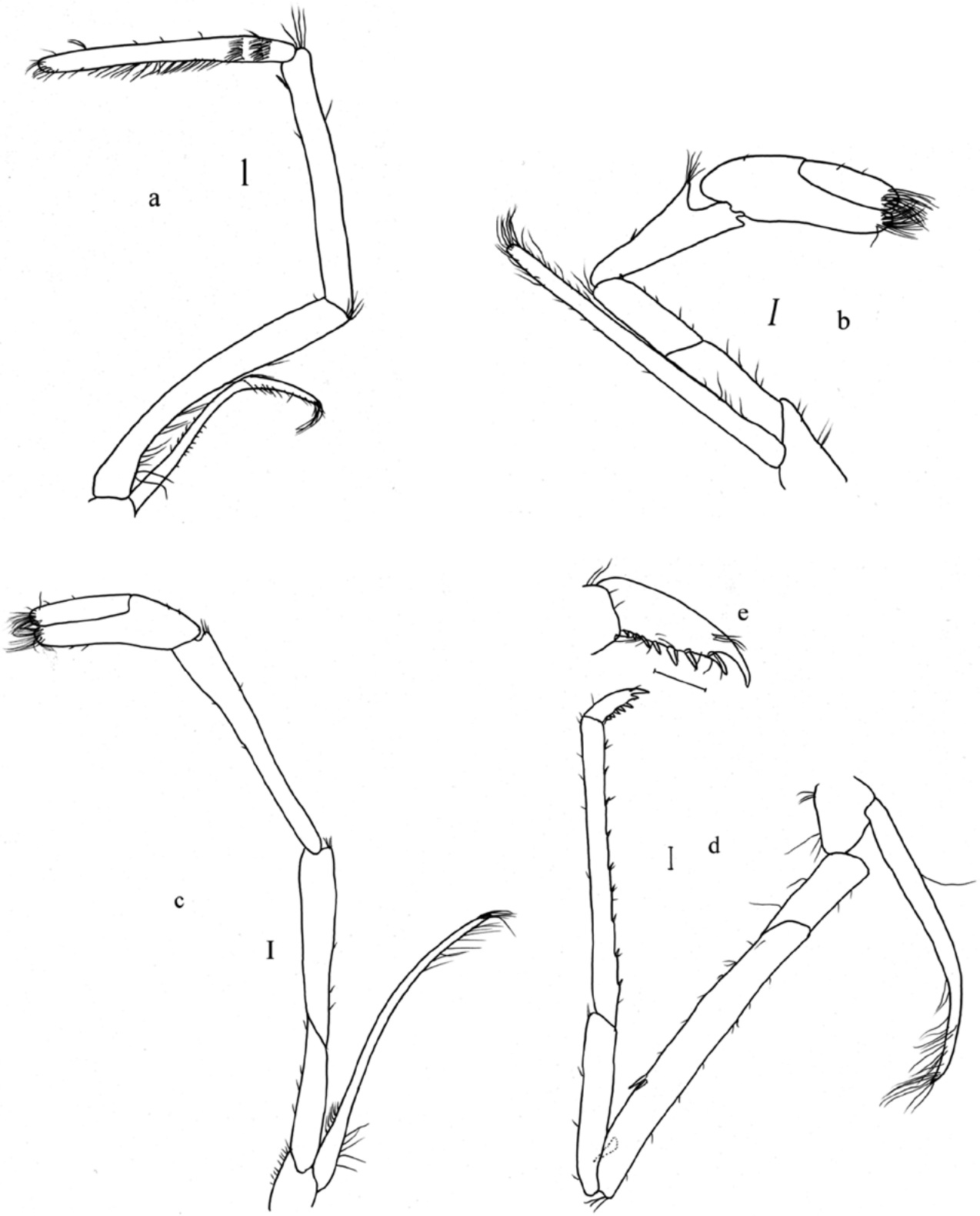


Figure 7. *Paratya walkeri* sp. nov.: a, maxilliped 3; b, pereiopod 1; c, pereiopod 2; d, pereiopod 3; e, dactylus. Scale lines 0.2 mm.

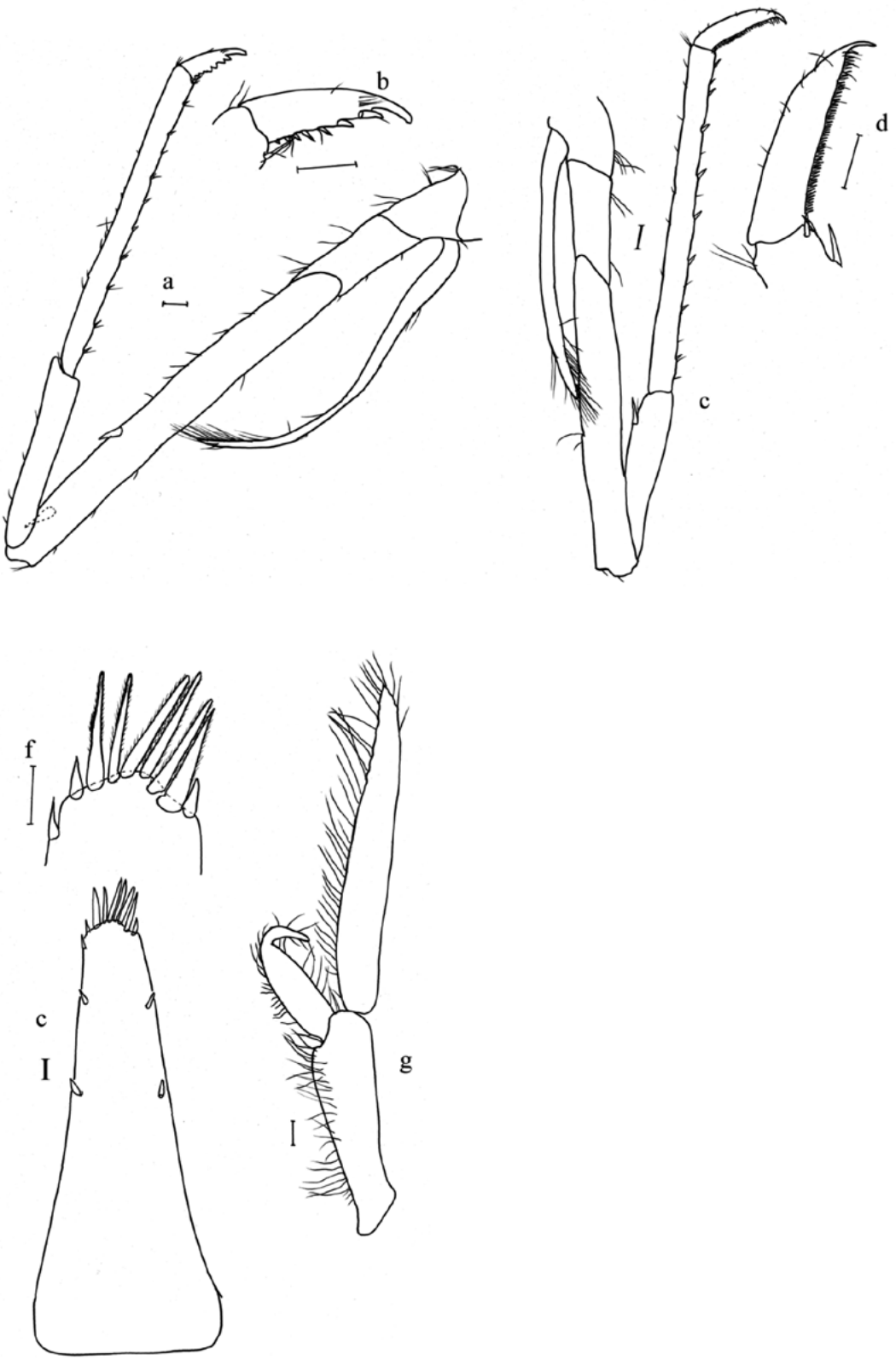


Figure 8. *Paratya walkeri* sp. nov.: a, pereiopod 4; b, dactylus 4; c, pereiopod 5; d, dactylus 5; e, telson; f, telson terminal spines; g, pleopod 1 of female. Scale lines 0.2 mm.

Mouthparts. Left mandible (fig. 6d, e) with 3 teeth separated by a notch from 2 less distinct apical teeth; spine row immediately below incisor process of 6 rugose spines (lifting spines); spine row above molar process of approximately over 20 sparsely setose spines. Right mandible (fig. 6f, g) with 4 teeth in a single incisor process with tooth 2 largest; spine row immediately below teeth with 7 lifting spines; spine row above molar process. Molar process ridged.

Maxilla 1 (fig. 6h) as for *P. australiensis*.

Maxilla 2 scaphognathite truncated distally (fig. 6i), not extending to apex of upper endite.

Maxilliped 1 (fig. 6j) palp with broad base, short narrow distal lobe, and several long setose spines on distal margins. Exopod flagellum distinct, well developed, longer than *P. australiensis* with numerous long setose spines on all margins, approximately Two-thirds to equal length of caridean lobe.

Maxilliped 2 (fig. 6k) endopod 1.14 (1.11–1.30) mm long, exopod long and narrow 2.35 (1.43–2.38) mm long, exopod 2.03 (1.09–2.13) times longer than endopod. Epipodite with podobranch.

Maxilliped 3 (fig. 7a) endopod length 7.38 (7.05–7.58) mm, 2.68–2.69 times longer than exopod, with 3 distal segments of similar length; basal segment curved, apical segment with large terminal claw, medial distal margin with 7 (6–12) broad teeth-like spines, largest 1 in basal third, outer margin with 1 apical tooth-like spine and 1 paired sub-apical setae. Epipodite with basal conical projection.

Thoracic appendages. Pereiopod 1 (fig. 7b) 5.20 (5.12–5.28) mm long, 0.83 (0.83–0.92) times carapace length. Chelae long and broad or short and broad, 1.75 (1.75–1.85) mm long, propodus 3.04 (2.64–3.04) times longer than wide, 2.00 (1.85–2.18) times longer than dactylus, 1.30 (1.30–1.44) times longer than carpus; palm length 1.48 (1.48–1.65) times width and 1.03 (1.03–1.32) dactylus length. Carpus long 2.45 (2.00–2.45) times as long as greatest width, broadening distally, distal margin excavate. Segment ratios 0.65 (0.65–0.78) : 1.30 (1.30–1.44) : 1.00 (1.35 [1.25–1.35] mm) : 1.15 (1.15–1.24) : 0.41 (0.38–0.42) : 2.50 (2.50–2.68). Exopod extending to mid to apex of carpus.

Pereiopod 2 (fig. 7c) 7.45 (7.15–7.48) mm long, 1.19 (1.18–1.30) times carapace length. Chelae long and slender 1.70 (1.58–1.68) mm long, nearly two-thirds length of carpus, 2.96 (2.96–3.53) times longer than wide, palm length 1.61 (1.50–1.61) times width and 1.12 (0.70–1.12) times dactylus length. Propodus 2.06 (1.56–2.06) times longer than dactylus. Carpus 7.69 (6.79–7.69) times as long as greatest width, slightly broader distally, distal margin with small excavation. Segment ratios 0.33 (0.33–0.43) : 0.68 (0.66–0.68) : 1.00 (2.50 [2.38–2.50] mm) : 0.80 (0.78–0.82) : 0.49 (0.49–0.57) : 1.36 (1.30–1.41). Exopod extending to apex of merus to base of carpus.

Pereiopod 3 (fig. 7d, e) distinctly longer than pereiopod 2 and more slender 8.65 (8.55–9.70) mm long, 1.38 (1.38–1.69) times carapace length. Dactylus with prominent terminal claw and 7 (7–10) strong spines on medial margin (fig. 7e). Propodus length 5.26 (4.28–5.33) times longer than dactylus, length 15.13 (13.78–15.13) times longer than wide with 9 (7–10) spines on inner margin. Merus with 1 strong spines on medial margin and 1 near ventral distal margin; segment ratios 0.33 (0.32–0.40) : 0.68 (0.66–0.68) : 1.00 (1.65 [1.63–1.80] mm) : 0.80 (0.78–0.82) : 0.49 (0.50–0.57 : 1.36 (1.30–1.41). Exopod extends to mid merus.

Pereiopod 4 (fig. 8a, b) similar to pereiopod 3, 9.35 (9.18–9.35) mm long, 1.50 (1.50–1.60) times carapace length. Dactylus with prominent terminal claw and 7 (7–8) spines on medial margin (fig. 8b). Propodus length 4.44 (3.97–4.44) times longer than dactylus, length 13.33 (11.90–14.40) times longer than wide, with 11 (10–13) spines on medial margin; merus with only 1 strong spine on medial margin and 1 near ventral distal margin. Segment ratios 0.35 (0.39–0.49) : 1.83 (1.70–2.00) : 1.00 (1.75 [1.63–1.75] mm) : 1.85 (1.85–2.15) : 0.56 (0.51–0.62): 1.70 (1.67–1.75). Exopod extends to middle third of merus.

Pereiopod 5 (fig. 8c, d) similar length to pereiopods 3 and 4, 9.15 (9.08–9.28) mm long, 1.46 (1.46–1.61) times longer than carapace. Dactylus with prominent terminal claw and very regular, comb–like row of 53 (53–62) small spines on medial margin (fig. 8d). Propodus length 4.25 (3.68–4.25) times longer than dactylus, length 17.00 (15.00–17.00) times longer than wide with 8 (8–11) long medial teeth and setae on external margin. Carpus with 1 large spines near distal margin. Merus with 1 strong medial spine and 1 distal spine; segment ratios 0.47 (0.47–0.60) : 2.00 (2.00–2.19) : 1.00 (1.70 [1.63–1.70] mm) : 1.76 (1.72–1.82) : 0.62 (0.61–0.69) : 1.61 (1.43–1.61). Exopod extends to mid merus (basal third to mid third of merus).

Abdomen. Pleopod peduncle of first pleopod short, 0.26 (0.26–0.37) times length of carapace length, 2.36 (2.36–4.30) times width, exopod 0.73 (0.73–1.40) times peduncle length, endopod 0.70 times peduncle length (fig. 8g); second pleopod peduncle short, 0.36 (0.29–0.36) times length of carapace, 2.64 (1.67–2.64) times width, exopod 1.29 (1.29–1.54) times peduncle length, endopod slightly shorter 1.13 (1.13–1.46) times peduncle length.

Telson (fig. 8e, f) length 4.00 (4.00–4.25) mm, 0.64 (0.64–0.74) times carapace length, 3.64 (2.86–3.64) times as long as greatest width, tapering distally. Dorsal surface with 2 pairs of strong submarginal teeth-like spines. Posterior margin convex with 1 pair of teeth-like spines outermost, 7 (7–8) long, strong setose spines (fig. 8f).

Uropods approximately equal to telson length.

Males unknown.

Etymology: Named after Dr Terry Walker whose study of *Paratya* in Tasmania (Walker, 1973) initiated subsequent taxonomic and morphometric studies (Smith and Williams, 1980; Williams, 1977; Williams and Smith, 1979) and who has encouraged this morphological study.

Comments: Paratya walkeri may be confused with *P. australiensis*, *P. arrostra* and *P. whitemae* due to the very long rostrum that is slightly concave. *P. walkeri* can be differentiated from all the long rostrum species by the combination of characters in Table 2, including the number of dorsal rostral spines (24–30), number of post orbital spines (2–4), number of ventral spines (14–16) over a length of 2.75–4.00 mm; dactylus 4 with 7–8 medial spines; 1–2 ventral rostral spines posterior to maximum rostrum width.

Distribution: P. walkeri is restricted to the northern coastal rivers of New South Wales in the Tweed R and Clarence R catchments. Cook et al. (2006) recorded this species only in the Tweed R; we recorded it in the Manning R system but not at the Tweed R site. It is possible that *P. walkeri* and *P. spinosa* may coexist.

***Paratya spinosa* n. sp.**

Figures 9–11

http://zoobank.org/urn:lsid:zoobank.org:act:2EBBA831-3594-4725-A47F-530AA42CC609

Lineage 3 (Cook et al., 2006)

Type Material: Holotype New South Wales. Korrumbyn Ck, Tributary of Tweed R, Mt Warning, –28.4 S, 153.3 E, no date (BC). Body in ethanol and antennae, mouthparts, pereiopods and abdominal structures dissected, mounted on 2 slides. Accession Ref. MC11. AM Ref No. P.105602.001.

Paratypes: New South Wales. Details as for holotype, Accession Ref. MC17 Genbank Registration OL420818, MC13 bodies in ethanol and other structures dissected, mounted on 2 slides each and 2 whole specimens.

Material Examined: New South Wales: Korrumbyn Ck, Tributary of Tweed R, Mt Warning, –28.4 S, 153.3 E, no date (BC).

Diagnosis: P. spinosa differs from all other species by the following combination of characters: rostrum long, extending beyond both antennular peduncle and scaphocerite, dorsal edge straight, dorsally armed with 28–30 teeth, 3 postorbital spines, ventrally with 9–10 large serrations over a length of 1.65–3.00 mm, all forward of greatest depth; distal half of ventral edge straight; left mandible with 4 teeth separated by finely ridged notch from a less distinct apical tooth; right mandible with 4–5 teeth in a single incisor process with all teeth large; scaphognathite of maxilla 2 rounded apically extending to apex of upper endite; maxilliped 1 with exopod flagellum distinct, well developed and with numerous long setose spines on all margins, approximately half length of caridean lobe; exopod of maxilliped 2 1.06–1.20 times longer than endopod; maxilliped 3 with medial distal margin of apical segment of endopod with 8–13 broad teeth-like spines, outer margin with 1–2 broad teeth-like spines, exopod long and narrow, tip over-reaching distal end of basal endopod segment; pereiopod 1 with long carpus and short and broad chelae; pereiopod 2 with exopod extending to apex of merus; dactylus of pereiopod 3 with prominent terminal claw and 7–9 strong spines on medial margin, exopod extends to apex of merus; dactylus of pereiopod with a prominent terminal claw and 6–12 spines on medial margin, exopod extends to mid merus; dactylus of pereiopod 5 with prominent terminal claw and very regular comb–like row of 44–60 small spines on medial margin, exopod extends to basal third of merus.

Carapace length 6.20 (5.70–6.20) mm.

Rostrum (fig. 9a) long 6.20 (5.70–6.05) mm, extending beyond both antennular peduncle and scaphocerite, rostral length 0.81 (0.81–1.16) times longer than carapace, dorsal edge straight, moderately slender and pointed; rostral length, 6.25 (6.25–8.25) greater than width; dorsally armed with 28 (28–30) teeth, ratio of rostral spines and rostral length is 5.60 (4.24–5.60), with 1-3 postorbital spines (fig. 9a); ventrally with 9 (8–10) large serrations over a length of 1.65 (1.65–3.0) mm, 1 or 2 spines posterior of greatest depth, distal half of ventral edge straight, ratio of ventral spine length and rostral length is 0.33 (0.33–0.45) with 3.11 (3.00–3.11) times more dorsal spines than ventral spines; rostral length 1.11 (1.11–1.83) times length of scaphocerite.

Antenna 1 (fig. 9b) peduncle 4.45 (3.78–4.56) mm long, not quite reaching distal tip of scaphocerite, length 0.99 (0.89–1.27) times length of scaphocerite. Stylocerite 2.53 (2.2–2.53) mm long, length 7.21 (7.21–9.17) times longer than width, 0.41 (0.39–0.41) times carapace length, reaching beyond distal border of peduncle segment almost to end of broad acute process on distal angle of first segment.

Antenna 2 (fig. 9c) second segment of peduncle 1.50 (1.25–1.68) mm long, 0.33 (0.29–0.47) times length of scaphocerite, 2.50 (2.38–3.23) times longer than wide scaphocerite 4.50 (3.60–4.50) mm long, 0.73 (0.63–0.73) times carapace length, 2.90 (2.57–2.93) times as long as wide.

Mouthparts. Left mandible (fig. 9d, e) with 4 teeth separated by finely ridged notch from a less distinct apical tooth; spine row immediately below incisor process of 10 rugose spines (lifting spines); spine row above molar process of approximately over 20 sparsely setose spines. Right mandible (fig. 9f, g) with 4–5 teeth in a single incisor process, all teeth large and of equal length; spine row immediately below teeth with 9 spines each finely setose basally; spine row above molar process. Molar process ridged.

Maxilla 1 (fig. 9h) palps short, truncate, with 1 long, setose terminal spine and 1 small, simple subterminal one, inner distal angle rounded.

Maxilla 2 palps small, but longer than *P. australiensis*, terminal parts narrow and with 1 sub-apical setose spine. Scaphognathite rounded apically, extending to apex of upper endite (fig. 9i).

Maxilliped 1 (fig. 9j) palp with broad base, short narrow distal lobe, and several long setose spines on distal margins. Exopod flagellum distinct, well developed and with numerous long setose spines on all margins, approximately half length of caridean lobe.

Maxilliped 2 (fig. 9k) endopod 1.19 (1.19–1.26) mm long; exopod long and narrow, length 1.43 (1.33–1.43) mm, exopod 1.06–1.20 times longer than endopod. Epipodite with podobranch.

Maxilliped 3 (fig. 10a) endopod length 4.03 (3.62–6.33) mm, 2.41 (2.41–2.54) times longer than exopod; with 3 distal segments of similar length; basal segment curved, apical segment with large terminal claw, medial distal margin with 9 (8–13) broad teeth-like spines, largest in basal third, outer margin with 1 apical broad tooth–like spines. Exopod long and narrow 1.67 (1.43–2.64) mm long, tip extends beyond distal end of basal endopod segment.

Thoracic appendages. Pereiopod 1 (fig. 10b) 4.98 (4.68–4.98) mm long, 0.80 (0.80–0.82) times carapace length. Chelae short and broad (fig. 10b), 1.65 (1.60–1.68) mm long, propodus 2.87 (2.68–2.87) times as long as wide, 1.83 (1.83–1.97) times longer than dactylus 1.29 (1.29–1.43) times longer than carpus; palm length 1.47 (1.44–1.79) palm width and

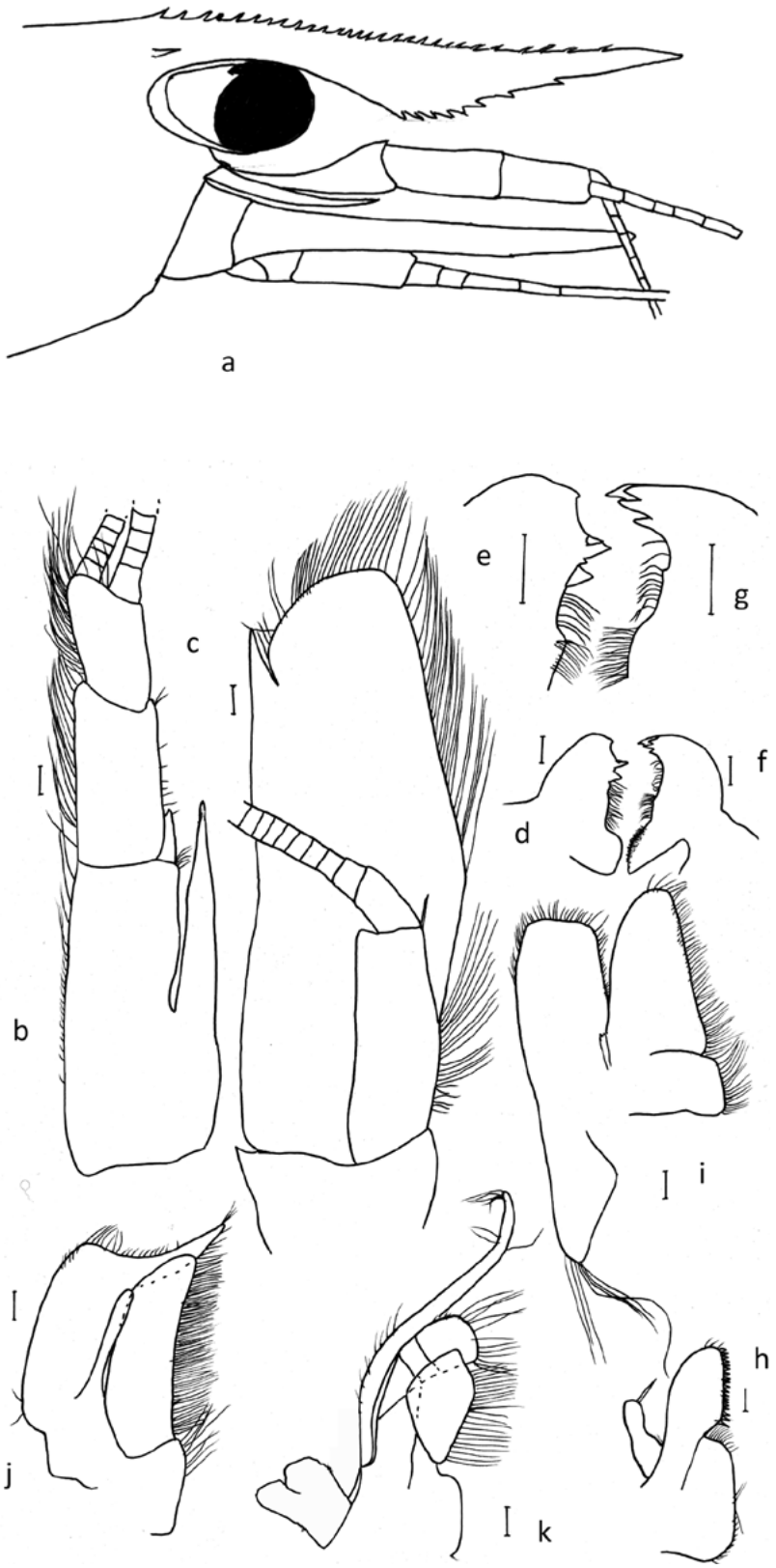


Figure 9. *Paratya spinosa* sp. nov.: a, head region and rostrum; b, antenna 1 peduncle and stylocerite; c, scaphocerite; d, left mandible; e, enlarged incisors; f, right mandible; g, enlarged incisors; h, maxilla 1; i, maxilla 2; j, maxilliped 1; k, maxilliped 2. Scale lines 0.2 mm.

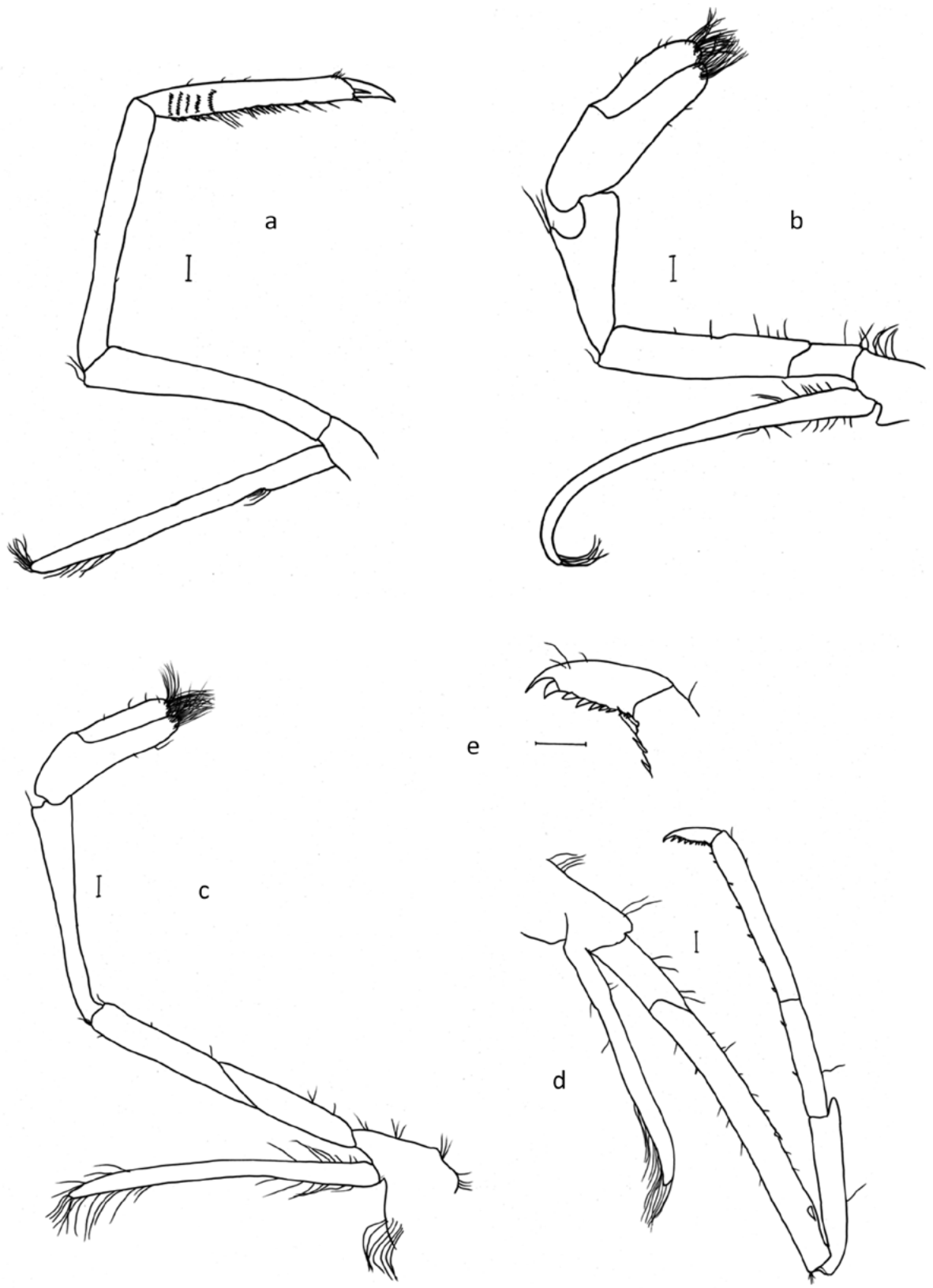


Figure 10. *Paratya spinosa* sp. nov.: a, maxilliped 3; b, pereiopod 1; c, pereiopod 2; d, pereiopod 3; e, dactylus 3. Scale lines 0.2 mm.

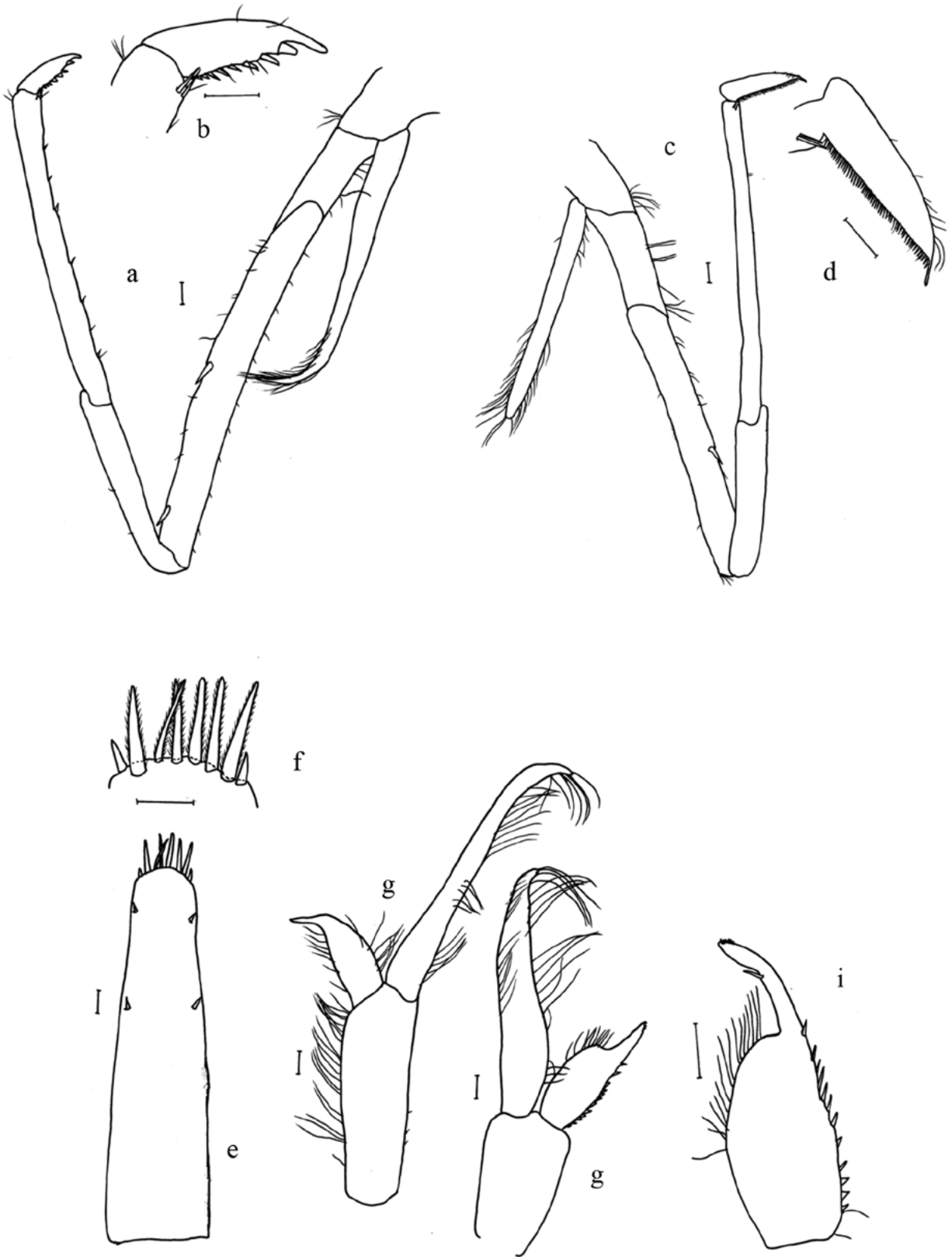


Figure 11. *Paratya spinosa* sp. nov.: a, pereiopod 4; b, dactylus 4; c, pereiopod 5; d, dactylus 5; e, telson; f, telson terminal spines; g, pleopod 1 of female; h, pleopod 1 of male; i, endopod 1 of male. Scale lines 0.2 mm.

0.94 (0.93–1.06) times dactylus length. Carpus long 2.32 (2.27–2.50) times longer than greatest width, broadening distally, distal margin excavate. Segment ratios 0.71 (0.68–0.74) : 1.29 (1.29–1.43) : 1.00 (1.30 [1.12–1.28] mm) : 1.20 (1.18–1.30) : 0.41 (0.41–0.45) : 2.55 (–). Exopod extending to mid carpus.

Pereiopod 2 (fig. 10c) 7.05 (6.71–7.05) mm long, 1.14 (1.11–1.18) times carapace length. Chelae long and slender 1.55 (1.50–1.55) mm long (fig. 10c), 3.10 (3.00–3.19) times longer than wide, 0.65 (0.65–0.69) times carpus length; palm length 1.80 (1.45–1.82) times longer than palm width, 0.77 (0.53–0.77) times length of dactylus. Propodus length 1.77 (1.53–1.77) times longer than dactylus. Carpus 7.38 (5.60–7.38) times longer than greatest width, slightly broader distally with small excavation. Segment ratios 0.36 (0.36–0.45) : 0.65 (0.65–0.69) : 1.00 (2.40 [2.18–2.40] mm) : 0.80 (0.80) : 0.49 (0.49–0.59) : 1.41 (1.41–1.43). Exopod extending to apex of merus.

Pereiopod 3 (fig. 10d, e) distinctly longer than pereiopod 2 and more slender 9.08 (7.48–9.08) mm long, 1.46 (1.31–1.46) times carapace length, dactylus with prominent terminal claw and 9 (7–9) strong spines on medial margin (fig. 10e). Propodus length 4.56 (4.56–4.80) times longer than dactylus, length 12.30 (10.67–12.30) times longer than wide with 8 (6–8) spines on inner margin, outer margin lacks spines. Carpus with 1 large subapical spine. Merus with 1 strong spine on medial margin and 1 near ventral distal margin; segment ratios 0.44 (0.34–0.44) : 1.98 (1.64–1.98) : 1.00 (1.55 [1.55–1.56] mm) : 2.35 (1.58–2.35) : 0.52 (0.52–0.57) : 1.65 (–). Exopod extends to mid merus.

Pereiopod 4 (fig. 11a, b) similar length to pereiopod 3, 9.08 (7.68–9.20) mm long, 1.46 (1.35–1.52) times carapace length. Dactylus with prominent terminal claw and 7 (7–8) spines on medial margin (fig. 11b). Propodus length 4.96 (4.11–4.96) times longer than dactylus, 12.90 (9.74–13.33) longer than wide, with 10 (6–12) spines on medial margin, outer margin without spines; carpus with large subapical spine; merus with 1 strong spine on medial margin and 1 near ventral distal margin. Segment ratios 0.40 (0.37–0.40) : 1.98 (1.50–1.98) : 1.00 (1.63 [1.63–1.65] mm) : 2.09 (1.69–2.20) : 0.51 (0.49–0.56) : 1.71 (1.71–1.82). Exopod extends to mid merus.

Pereiopod 5 (fig. 11c, d). Slightly longer than pereiopods 3 and 4, 9.65 (8.45–9.65) mm long, 1.56 (1.48–1.56) times carapace length. Dactylus with prominent terminal claw and very regular, comb–like row of numerous (44–55) small spines on medial margin (fig. 11d). Propodus length 3.92 (–) times longer than dactylus, length 14.50 (12.6–14.50) times longer than wide with 7 (5–11) long medial teeth, external margin lacking spines. Carpus without large spines near distal margin. Merus with 1 strong medial spine and lacking a distal spine; segment ratios 0.55 (–) : 2.16 (1.56–2.16) : 1.00 (1.68 [1.50–1.81] mm) : 1.85 (1.57–2.23) : 0.75 (0.54–0.75) : 1.67 (1.21–1.92). Exopod extends to mid merus.

Abdomen. Pleopods peduncle of first pleopod short, 0.40 (0.33–0.40) times length of carapace, 4.17 (3.08–4.17) times longer than wide, exopod 1.14 (1.14–1.43) times peduncle length, endopod (fig. 11g), (0.53–0.58) times peduncle length; second pleopod peduncle short, 0.43 (0.37–0.43) times length of carapace, 2.94 (2.81–3.00) times longer than wide, exopod 1.13 (1.13–1.29) times peduncle length, endopod slightly shorter 1.06 (1.06–1.22) times peduncle length. Length of first peduncle 1.06 (1.06–1.13) times length of second peduncle.

Telson (fig. 11e, f) length 4.41 (3.7–4.41) mm, 0.71 (0.63–0.71) times carapace length, 3.14 (2.98–3.14) times longer than greatest width and tapering distally. Dorsal surface with 1–2 pairs of strong submarginal teeth-like spines. Posterior margin convex with 1 pair of teeth-like spines outermost, 7 (6–10) long, strong setose spines (fig. 11f).

Uropods approximately equal to telson length.

Males smaller than females, carapace length 4.5 mm; with endopod of pleopod 1 strongly excavate apically with 12 external spines on medial margin and 15 long setae on inner margin (fig. 11i).

Etymology: Spinosa after the very spiny rostrum with 28–30 dorsal spines and 9–10 ventral spines.

Comments: P. spinosa is most similar to *P. tasmaniensis* but may co-occur with *P. walkeri*. *P. spinosa* can be distinguished from all other long rostrum species by the combination of characters listed in Table 2 including the number of dorsal rostral spines (28–30); number of ventral rostral spines (9–10); right mandible incisors with 4–5 teeth; shape of scaphognathite of maxilla 2.

P. spinosa has a restricted distribution in streams of the northern coastal streams in New South Wales (Tweed R catchment) while *P. tasmaniensis* is widespread in Tasmania, coastal Victoria, New South Wales and Queensland and in the Murray-Darling catchment in New South Wales and South Australia. Cook et al. (2006) recorded lineage 3 in the Clarence R system but we recorded *P. spinosa* only in the Tweed R system. It is possible that both *P. spinosa* and *P. walkeri* may coexist in the Tweed R.

Paratya arrostra (Riek), 1953 comb. nov.

Figures 12–14

Paratya australiensis arrostra Riek, 1953; in part = rostrum mid length (fig. 12a)

Terrors Ck, Dayboro, Queensland. Types examined by MC.

Paratya atacta Riek 1953; in part = rostrum very long, comb. Nov. (fig. 12c)

Upper Nerang R, southern Queensland

Paratya atacta adynata Riek 1953; in part = rostrum mid length, comb. Nov. (fig. 12b). Small creek in upper reaches of Middle Harbour, Sydney, New South Wales

P. australiensis Williams and Smith (1979); neotype male selected from material named by Riek (1953), AM P28693.

Paratya australiensis Gan et al. (2016); determination of the mitogenome of *Paratya australiensis*.

Lineage 4 (Cook et al., 2006)

Lineage C (McClusky, 2007)

Material Examined: Victoria: Hughes Ck at Hughes Ck Rd, –37.0075 S, 145.3212 E, 28 September 2011 (PS, JM, MC); King Parrot Ck at Flowerdale, –37.2953 S, 145.2905 E, 28 September 2011 (PS, JM, MC); Goulburn R past Loch Gary at flood markers, –36.2411 S, 145.2866 E, 28 September 2011 (JM, MC); Yea R at Glenburn, –37.4239 S, 145.4210 E, 28 September (PS, JM, MC);

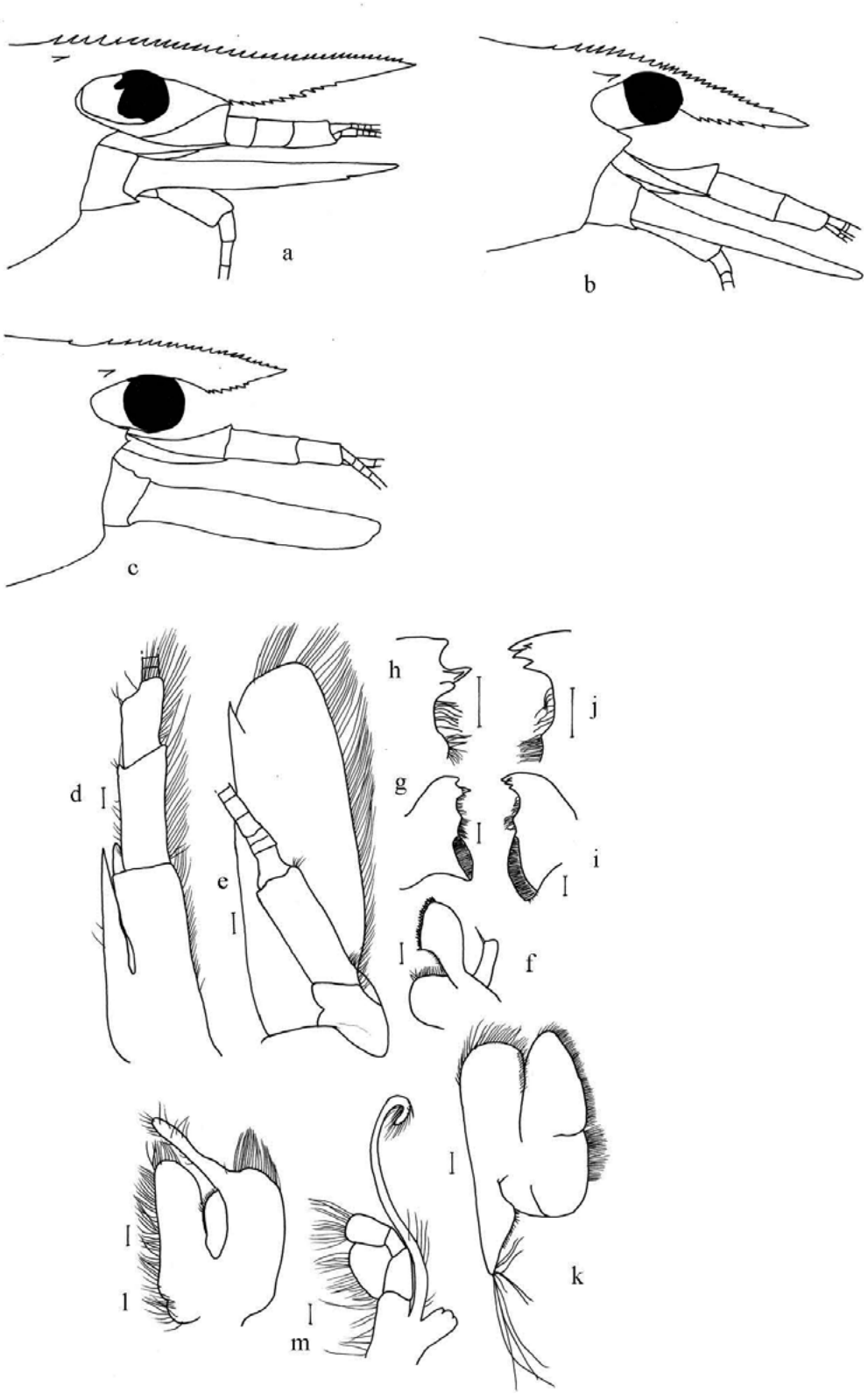


Figure 12. *Paratya arrostra* Riek: a, head region and rostrum of lineage 4 long; b, head region and rostrum of lineage 4 short; c, head region and rostrum of lineage 4c; d, antenna 1 peduncle and stylocerite; e, scaphocerite; f, maxilla 1; g, left mandible; h, enlarged incisors; i, right mandible; j, enlarged incisors; k, maxilla 2; l, maxilliped 1; m, maxilliped 2. Scale lines 0.2 mm.

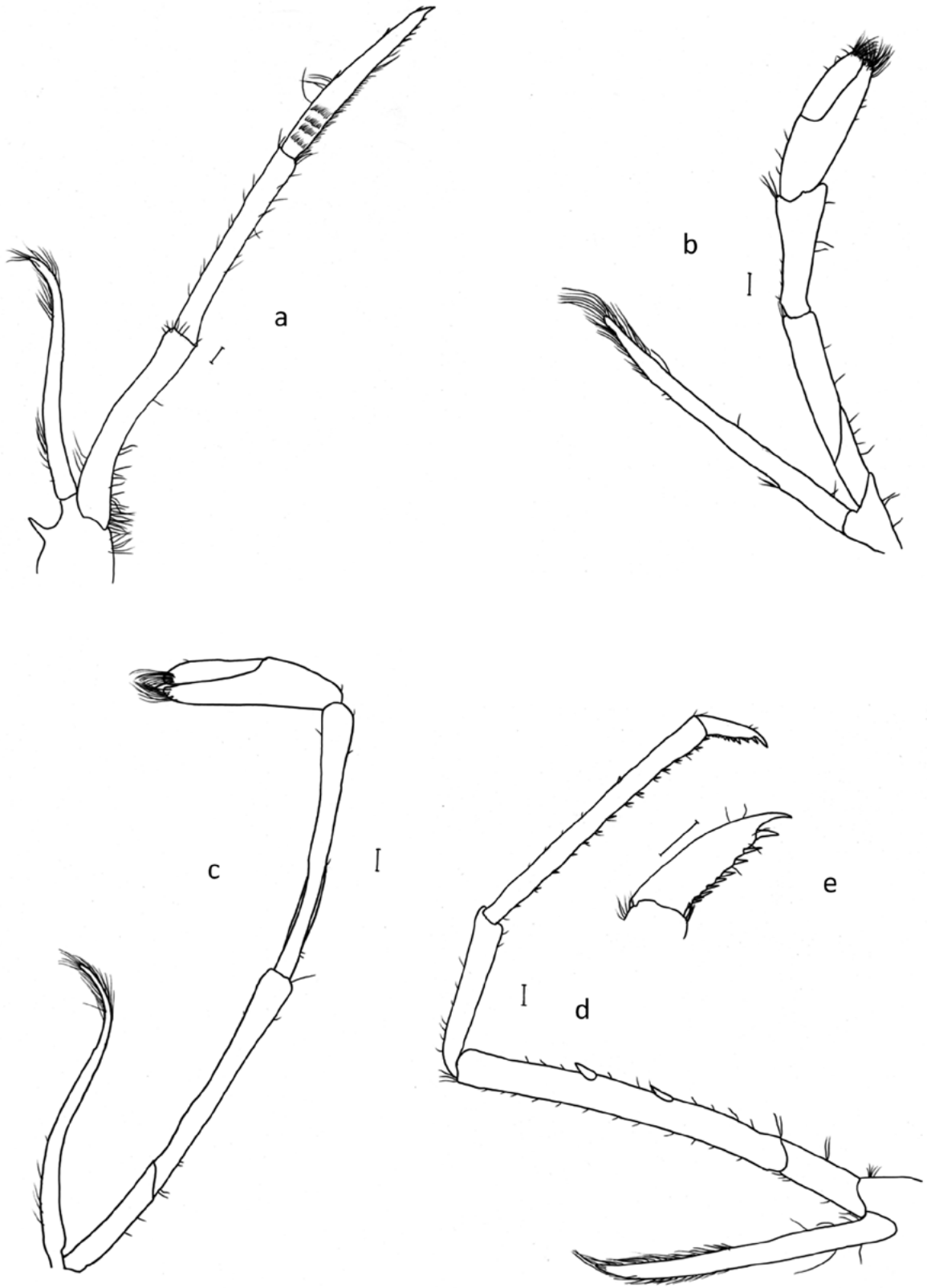


Figure 13. *Paratya arrostra* Riek: a, maxilliped 3; b, pereiopod 1; c, pereiopod 2; d, pereiopod 3; e, dactylus 3. Scale lines 0.2 mm.

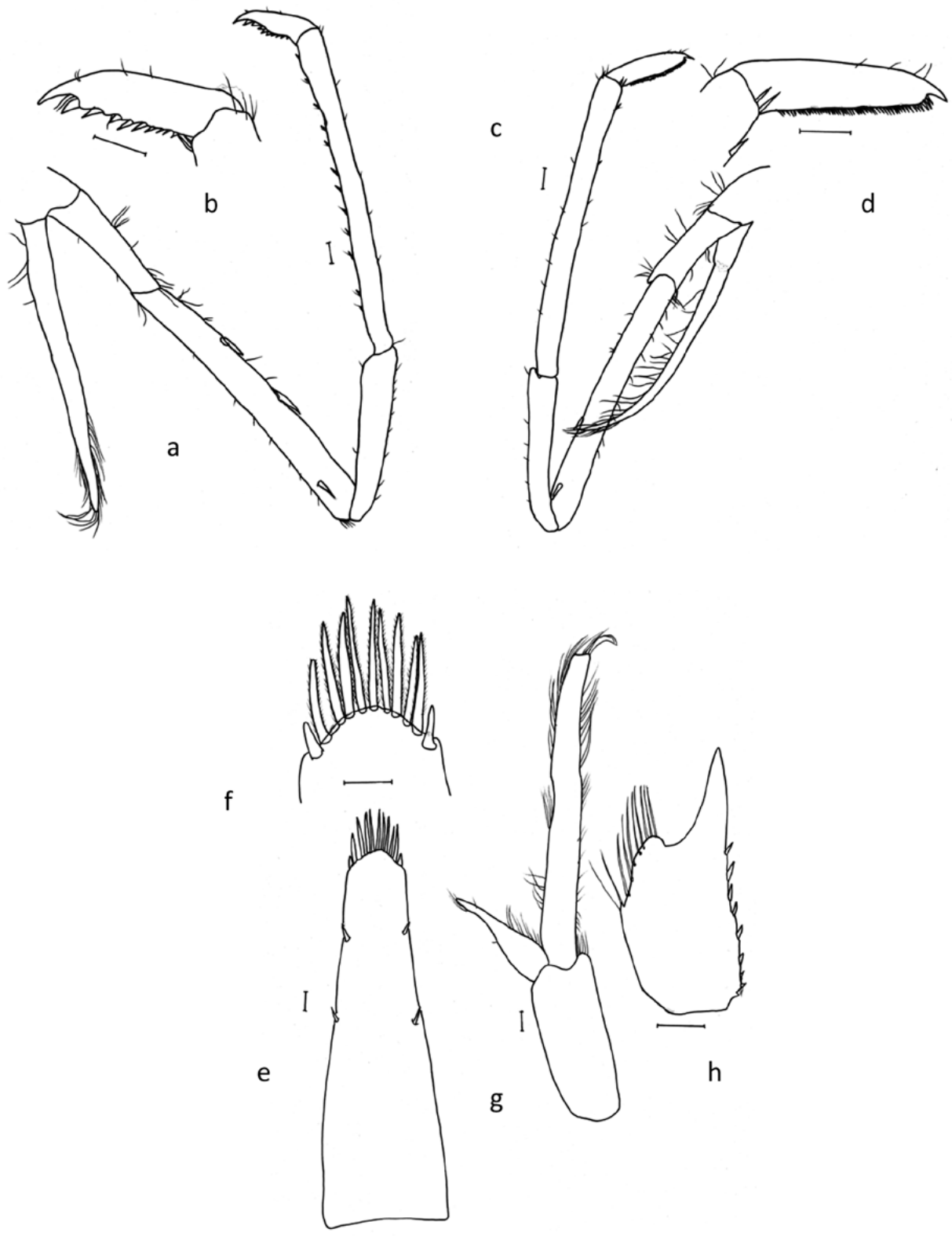


Figure 14. *Paratya arrostra* Riek: a, pereiopod 4; b, dactylus 4; c, pereiopod 5; d, dactylus 5; e, telson; f, telson terminal spines; g, pleopod 1 of female; h, endopod 1 of male. Scale lines 0.2 mm.

Wimmera R downstream of Dimboola Weir, –36.4557 S, 142.0167 E, 6 March 2012 (Vic EPA); Ovens R near Wangaratta, –36.3371 S, 146.3191 E, August 2010 (JM, MC, JM).

New South Wales: Wakool Reserve, –35.4963 S, 144.4541 E, June 2011 (JC); Bagnall's Lagoon, Albury, –36.070 S, 146.854 E, April 2011 (PS); Murray R below Lake Hume, –36.0998 S, 147.0228 E, 12 August 2010 (JW, MC, JM); Hawksbury R at Windsor Bridge, –33.6023 S, 150.8233 E, 10 November 2011 (SW); Hawksbury R at Wilberforce, –33.6020 S, 150.8241 E, 10 September 2011 (SW); Hawksbury R at Sackville Ferry, –33.5003 S, 150.8746 E, 19 September 2020 (SW); Hawksbury R North Richmond, –33.5684 S, 150.7485 E, 9 March 2011 (SW); South Ck Richmond Rd, –33.6775 S, 150.8121 E, 30 March 2011 (SW); McCarrs Ck, –33.6410 S, 151.2780 E, 13 September 2011 (SW); Nepean R at Sharpes Weir, –34.0384 S, 150.6793 E, 15 September 2011 (SW); Nepean R at Grove Rd, –34.0415 S, 150.6964 E, 2 April 2011 (SW); Nepean R at Wallacia Bridge, –33.8655 S, 150.6374 E, 18 April 2011 (SW); Nepean R at Maldon Weir, –34.2034 S, 150.6301 E, 5 April 2011 (SW); Lachlan R, Newell Highway at Forbes, –33.3956 S, 147.9903 E, 3 November 2011 (PS, JM, MC); Lachlan at Cargellico –32.2033 S, 146.3589 E, Jun 1999 (PS, TC); Lachlan R at Glenmore, –33.4413 S, 145.5377 S, July 1999, (PS, TC); Lachlan R at Goolagong, –33.6060 S, 148.4324 E, July 1999 (PS, TC); Lachlan R at Condobolin, –33.0915 S, 147.1476 E, July 1999 (PS, TC); Macquarie R at Dubbo, –32.2470 S, 148.5990 E, 23 September 2010 (PS, MC); Murrumbidgee R at Wagga Wagga; –35.1041 S, 147.3751 E, 11 November 2003 (PS); Billabong Ck at Coree, –35.3556 S, 145.5041 E, 24 June 2001 (PS, LS); Billabong Ck at Moulamein, –35.0913 S, 144.0334 E, 2 April 2001 (PS, LS); Billabong Ck at Urana, –35.3598 S, 146.0942 E, 14 May 2001 (PS, LS); Billabong Ck at Walbundrie, –35.6971 S, 146.7253 E, 14 May 2001 (PS, LS); Billabong Ck at Wanganella, –35.2124 S, 144.3150 E, 2 April 2001 (PS, LS); Way Way Ck, –30.7680 S, 152.9427 E, 24 May 2016 (BM); Maguire Ck –28.8367 S, 153.3364 E Jun 2020 (SO); Maguire Ck –28.8367 S, 153.3364 E (BM); Tucki Tucki Ck, –28.8225 S, 153.3362 S, June 2020 (SO); Pinebrush Ck, –30.1306 S, 153.1328 E (BM); Small creek in upper reaches of Middle Harbour, Sydney, type locality for *P. atacta adynata* Riek 1953; Wattamollaa Ck on Clinton Park Rd Kangaroo Valley, –34.7371 E, 150.5929 S, 27 September 2017 (PS, JM, JH); Kangaroo R at Hampden Bridge, –34.7272 S, 150.5218 E, 26 September 2017 (PS, JM, JH); Stream on Broger Rd Shoalhaven catchment, –34.7105 S, 150.6827 E, 27 September 2017 (PS, JM, JH); Stream on Jarretts Rd – Upper Kangaroo Valley Rd, –34.7036 S, 150.5880 E, 27 September 2017 (PS, JM, JH); Brogers Ck in Shoalhaven catchment, –34.7105 S, 150.6827 E, 27 September 2017 (PS, JM, JH); Orara R at Nana Glen, –30.1328 S, 153.0077 E, no date, (BK); Brogo R at Brogo, –36.5402 S, 149.8265 E, 10 March 1999; Williams R at Coreei Bridge Dungog, –32.3968 S, 151.7631 E, 30 October 2011 (PS, JM, MC); The Falls at Forest Falls Retreat Johns R, –31.709 S, 152.6612 E, 31 October 2011 (MC, JM, PS); The Cascades at Forest Falls Retreat Johns R, –31.70 S,152.655 E, 31 October 2011 (MC, JM, PS); Lake Yarrunga at Bendeela recreation area –34.7398 S, 150.4705 E, 27 September 2017 (PS, JM, JH).

South Australia: Brenda Park wetland south of Morgan, –34.0818 S, 139.6743 E, 8 November 2011 (CM).

Queensland: Terrors Ck, Dayboro, type locality for *P. australiensis arrostra* Riek 1953; Upper Nerang R, southern Queensland, type locality for *P. atacta* Riek 1953; Kilcoy Ck, upper Brisbane R, –26.94 S, 152.568 E, no date (BC); Boar Pocket Ck, Tinaroo, –17.1708 S, 145.6447 E, 20 October 2017 (BM, BKr).

Diagnosis: P. arrostra differs from all other species by the following combination of characters: rostrum variable, long, extending beyond antennular peduncle or extending beyond both the antennular peduncle and scaphocerite, or short not extending beyond the peduncle or intermediate extending beyond peduncle but not the scaphocerite; dorsal edge slightly concave or straight, dorsally armed with 22–34 teeth, 2–3 postorbital spines, ventrally with 3–11 large serrations over a length of 0.40–2.20mm; distal half of ventral edge straight or curved; left mandible with 2–5 (usually 4–5) teeth separated by a smooth angular notch from a distinct apical tooth; right mandible with 4 teeth in 2 separate incisor processes; scaphognathite of maxilla 2 rounded apically extending to apex of upper endite; maxilliped 1 with exopod flagellum distinct, well developed and with numerous long setose spines on all margins, over half length of caridean lobe; exopod of maxilliped 2 2.18–3.45 times longer than endopod, epipodite with long podobranchs extending just to basal third of third segment of endopodite; maxilliped 3 with medial distal margin of apical segment of endopod with 6–8 broad teeth-like spines, outer margin with 2 broad teeth-like spines, exopod long and narrow, tip over-reaching distal end of basal endopod segment; pereiopod 1 with long carpus and long slender chelae, exopod extending to mid to apex of carpus; pereiopod 2 with exopod extending to apex of merus or base of carpus; dactylus of pereiopod 3 with prominent terminal claw and 9–11 strong spines on medial margin, exopod extends to mid merus to base of carpus; dactylus of pereiopod 4 prominent terminal claw and 8–12 spines on medial margin, exopod extends to mid merus; dactylus of pereiopod 5 with prominent terminal claw and very regular comb-like row of 70–90 small spines on medial margin, exopod extends to mid merus.

Morphotypes of P. arrostra: P. arrostra specimens with a very short rostrum not extending beyond the second segment of the antennular peduncle and only to mid scaphocerite (Lineage 4C) can be distinguished from all other species of *Paratya* by this short rostrum, dorsal edge straight and curved down at end, dorsally armed with 16–19 spines, 0–1 postorbital spines, with postorbital separated from other rostral spines, ventrally with 4–5 large serrations over a length of 0.60–1.2 mm, extending from posterior of greatest depth; distal half of ventral edge straight (Table 3).

P. arrostra with the shorter rostrum which does not extend beyond the scaphocerite (lineage 4B) can be distinguished from all other species of *Paratya* by the following combination of characters: 3–7 ventral spines on rostrum extend over a length of less than 1.80 mm; rostral length approximately equal to scaphocerite length 0.73–1.24; exopod of pereiopod 1, 2 and 3 extending to mid merus to base of carpus.

P. arrostra specimens with the longer rostrum character that extends beyond the end of the scaphocerite (Lineage 4B, 4E) differs from all other species of *Paratya* by the following combination of characters: 4–11 ventral spines extending over a length of 0.6–2.2 mm; rostral length 1.14–1.31 times longer than scaphocerite length; carpus of pereiopod 1 short; chelae of pereiopod 1 long and slender (Table 3).

Carapace length 5.10–7.00 mm.

Rostrum variable length either (i, lineages 4B, 4E) long, extending beyond antennular peduncle and to or beyond the end of the scaophocerite (fig. 12a), dorsally slightly concave, moderately slender; length 5.7–7.0 mm, 1.04–1.08 times length of carapace; dorsally armed with 23–34 teeth, ratio of

rostral spines to length 4.6–6.67; 2–3 postorbital eye spines (fig. 12a), ventrally with 4–11 large serrations over a length of 1.10–2.2 mm, extending from posterior of, or from, greatest depth (fig. 12a), distal half of ventral edge straight or curved, ratio of ventral spines to rostral length is 0.11–0.34; rostral length 7.86–8.83 times depth, length 1.14–1.31 times length of scaphocerite or (ii lineage 4B) rostrum short, length 2.50–5.30 mm, rostrum not extending beyond antennular peduncle (fig. 12b); 0.63–0.91 times length of carapace, dorsal edge straight and may be angled downwards (fig. 12b); dorsally armed with 22–29 teeth, ratio of rostral spines to length 4.34–7.60, 2–3 postorbital eye spines (fig. 12b), ventrally with 3–7 large serrations over a length of 0.4–1.8mm all forward of greatest depth (fig. 12b), distal half of ventral edge straight; rostral length/depth 6.33–8.83, length 0.73–1.24 times length of scaphocerite or (iii lineage 4C) rostrum very short 3.10–3.50 mm, not extending beyond the second segment of the antennular peduncle (fig. 12c) and only to half scaphocerite, rostral length 0.49–0.60 times length of carapace, shape broad and pointed, dorsal edge straight and curved down at end; dorsally armed with 16–19 teeth (fig. 12c), ratio of dorsal spines to length is 5.15–5.43 and 3.40–4.00 times more spines than ventral spines; 0–1 postorbital eye spines, when present spine distinctly posterior and separated from other rostral spines (fig. 12c); ventrally with 4–5 large serrations over a length of 0.60–1.20 mm, extending from posterior of greatest depth, ratio of ventral spines to rostral length is 0.18–0.34; distal half of ventral edge straight; rostral length/depth, 5.17–6.60; length 0.80–0.90 times length of scaphocerite.

Antenna 1 (fig. 12d) peduncle not quite reaching distal tip of scaphocerite, but similar length to scaphocerite itself, 0.42–1.06 times as long as scaphocerite; lateral distal angle of first segment with prominent blunt process at outer distal margin with small acute tooth on outer margin of segment but may be absent in some variations. Stylocerite 1.84–2.48 mm long, length 7.21–9.17 longer than width, 0.39–0.41 times carapace length, reaching beyond distal border of peduncle segment (fig. 12d) almost to end of acute process on distal angle of first segment (fig. 12d).

Antenna 2 (fig. 12e) second segment length 1.25–1.68mm long, 0.23–0.34 times length of scaphocerite, 2.00–3.36 longer than width. Scaphocerite 3.70–5.10 mm long, 0.64–0.94 times carapace length and 2.73–4.00 times as long as wide.

Mouthparts. Left mandible (fig. 12g, h) with 2–5 (usually 4–5) teeth separated by smooth angular notch from a distinct acute apical tooth; spine row immediately below incisor process of 8–10 rugose spines (lifting spines); spine row above molar process of approximately over 20 sparsely setose spines. Right mandible (fig. 12i, j) with 4 teeth in 2 separate incisor processes with first and third teeth largest and second and fourth smaller; spine row immediately below teeth with 8–10 spines each finely setose basally; spine row above molar process. Molar process ridged.

Maxilla 1 as for *P. australiensis* (fig. 12f).

Maxilla 2 as for *P. australiensis* (fig. 12k).

Maxilliped 1 as for *P. australiensis* (fig. 12l).

Maxilliped 2 (fig. 12m) endopod length 0.44–1.11 mm; exopod long and narrow, length 2.07–2.69 mm, exopod 2.18–3.45 longer than endopod. Epipodite with long podobranch extending to basal third of third segment of endopodite.

Maxilliped 3 (fig. 13a) endopod length 5.72–7.23 mm, 2.20–2.75 times longer than exopod, with 3 distal segments of similar length; basal segment curved, apical segment with large terminal claw, medial distal margin with 6–8 broad teeth-like spines, largest 2 or 3 in basal half, outer margin with 2 long teeth-like spines in apical third. Exopod long and narrow 2.33–3.07 mm, tip over-reaching distal end of basal endopod segment.

Thoracic appendages. Pereiopod 1 (fig. 13b) length 3.51–5.23 mm, 0.66–0.89 times carapace length. Chelae short and slender (fig. 13b), 1.14–2.08 mm long, propodus 2.50–3.47 times as long as wide, 1.72–3.06 times longer than dactylus, 1.08–1.84 times longer than carpus; palm length 1.13–1.90 times palm width and 0.78–2.09 times dactylus length. Carpus long, 1.95–2.76 times as long as greatest width, broadening distally, distal margin excavate. Merus approximately one-third longer than carpus, parallel-sided. Ischium about one-quarter length of merus. Segment ratios 0.59–0.75 : 1.08–1.84 : 1.00 (1.01–1.40) mm : 1.14–1.84 : 0.40–0.50 : 1.65–3.16. Exopod extending to mid-apex of carpus.

Pereiopod 2 (fig. 13c) length 5.49–7.69 mm, 0.99–1.99 times carapace length. Chelae long and slender (fig. 13c) 1.15–1.63 mm long, half to two-thirds length of carpus, 2.87–4.20 times as long as wide; palm length 1.13–2.08 times longer than wide and 1.05–2.00 longer than dactylus. Propodus length 1.43–1.98 times longer than dactylus. Carpus 6.20–8.81 times as long as greatest width, slightly broader distally, distal margin with small excavation. Merus shorter than carpus, parallel-sided. Ischium about half as long as merus. Segment ratios 0.28–0.43 : 0.50–0.62 : 1.00 (2.29–2.72) mm : 0.73–0.88 : 0.30–0.46 : 1.14–1.22. Exopod extending to apex of merus to base of carpus.

Pereiopod 3 (fig. 13d, e) distinctly longer than pereiopod 2 and more slender 7.27–9.24 mm long, 1.28–1.57 times carapace length. Dactylus with prominent terminal claw and 9–11 strong spines on medial margin (fig. 13e). Propodus length 3.58–4.80 times longer than dactylus, length 11.61–15.77 times longer than wide with 6–13 spines on inner margin. Merus longer than propodus with 1–5 strong spines (usually 2) on medial margin and 1 near ventral distal margin; ischium approximately one-quarter to one-third length of propodus; segment ratios 0.36–0.51 : 1.60–1.88 : 1.00 (1.39–1.75) mm : 1.25–2.05 : 0.46–0.86 : 1.32–1.70. Exopod extends to mid-merus to base of carpus.

Pereiopod 4 (fig. 14a, b) similar to pereiopod 3, 7.69–9.81 mm long, 1.29–1.67 times carapace length. Dactylus with prominent terminal claw and 8–12 spines on medial margin (fig. 14b). Propodus length 3.05–5.00 times longer than dactylus, length 11.11–13.44 times longer than wide, with 11–16 spines on medial margin; merus with 1–3 strong spine on medial margin and 1 near ventral distal margin. Segment ratios 0.37–0.52 : 1.59–1.79 : 1.00 (1.49–1.93) mm : 1.83–2.38 : 0.50–0.68 : 1.35–1.50. Exopod extends to mid merus.

Pereiopod 5 (fig. 14c, d) similar length to pereiopods 3 and 4, 7.85–9.19 mm long, 1.37–1.56 times carapace length. Dactylus with prominent terminal claw and very regular,

comb-like row of numerous (70–91) small spines on medial margin (fig. 14d). Propodus length 2.97–3.91 times longer than dactylus, length 11.94–18.62 times as long as wide with 9–13 long medial spines and external margin without spines. Carpus approximately half propodus length without any large spines near distal margin. Merus similar length to propodus, with 1 strong medial spine and 1 distal spine; ischium one-third length of propodus; segment ratios 0.46–0.65 : 1.79–1.97 : 1.00 (1.52–1.80) mm : 1.54–1.97 : 0.47–0.66 : 1.29–1.61. Exopod extends to mid to apical third of merus.

Abdomen. Pleopods peduncle of first pleopod short, 0.26–0.37 times length of carapace length, 2.40–3.45 times width, exopod 1.29–1.81 times peduncle length, endopod 0.63–0.69 times peduncle length (fig. 14g); second pleopod peduncle short, 0.31–0.47 times length of carapace, 2.47–3.67 times width, exopod 1.09–1.35 times peduncle length, endopod slightly shorter 0.91–1.27 times peduncle length. Length of first peduncle 1.18–1.28 times length of second peduncle. Peduncle of pleopod 5 0.20–0.28 times length of carapace, 1.68–2.31 times width; exopod length 1.57–1.93 times peduncle length; endopod 1.22–1.57 times peduncle length; exopod length 1.14–1.29 times endopod length.

Telson (fig. 14e, f) length 3.10–4.10 mm, 0.51–0.76 times carapace length, 2.36–3.75 times as long as greatest width, and tapering distally, Dorsal surface with 0–2 pairs of strong submarginal teeth-like spines; posterior margin convex with 1 pair of teeth-like spines outermost, 7–13 (usually 11–12) long, strong setose spines (fig. 14f).

Uropods approximately equal to telson length, exopod 1.05–1.33 times telson length, length 2.84–3.19 times width; endopod 0.98–1.29 times telson length, length 3.28–4.25 times width.

Males smaller than females, carapace length 4.36 mm; endopod of first pleopod strongly excavated apically with 9–10 external spines and 10–14 long setae on inner margin (fig. 14h).

Comments: This is the most variable species of *Paratya* showing distinct rostral characteristics from rostrum shorter than the peduncle, rostrum longer than peduncle but not extending beyond the scaphocerite and rostrum long extending beyond the scaphocerite. Riek (1953) observed these distinct groups and described them as species or subspecies based on morphological character expression only. Williams and Smith (1979) considered all the taxa described by Riek were synonyms of *P. australiensis*. With the development of molecular techniques, it is now possible to recognise that these variants are all a single taxon and the taxon *P. australiensis arrostra* Riek is here raised to species level. Genetically, all Lineage 4 specimens have low intraspecific variation, and although Lineage 4C can be reliably identified morphologically (Table 3), it is slightly more difficult to reliably define lineages 4A, 4B, 4D and 4E (Cook et al., 2006) morphologically (Table 2) on the limited material we have been able to analyse. The presence of different morphotypes in this species is similar to the observations by Choy et al. (2019) in the Australian atyid shrimp *Australatya*.

P. arrostra is widely distributed through the Murray–Darling Basin, south-eastern coastal streams in Victoria and New South Wales, north-eastern New South Wales coastal streams, and south-eastern and northern Queensland (fig. 32a). Lineage 4A has been recorded from northern coastal streams in Queensland but we do not have any specimens of this lineage. Lineage 4C is restricted to south-eastern Queensland in the catchments of the Maroochy R, Mary R and Brisbane R. We have recorded *P. arrostra* to occur at sites in South Australia with *P. rouxi* and *P. tasmaniensis*; with *P. rouxi*, *P. whitemae* and *P. strathbogiensis* in Murray–Darling Basin rivers and with *P. whitemae* in coastal rivers.

Gan et al. (2016) defined the complete mitogenome of a species designated as *P. australiensis* from the Lodden R at Baringhup, Victoria. The mitochondrial genome is 15,990 base pairs in length (GenBank accession number: KM978917) and has 37 mitochondrial genes (13 protein-coding genes, 2 rRNAs and 22 tRNAs) and a non-coding region of 1006 base pairs (Gan et al. (2016). This genome (strain APR12) was analysed with the total GENBANK *Paratya* data (Supplementary Table 1) and the species used by Gan et al. (2016) was embedded with *P. arrostra*.

Paratya williamsi n. sp.

Figures 15–17

http://zoobank.org/urn:lsid:zoobank.org:act:F299988B-DF09-4765-A01E-B28875339C5D

Lineage 5 (Cook et al., 2006)

Type Material: Holotype New South Wales. Kangaroo R Hampden Bridge, –34.7272 S, 150.5218 E, 26 September 2017 (PS, JM, JH). Body in ethanol and antennae, mouthparts, pereiopods and abdominal structures dissected, mounted on 2 slides. AM Ref No. P.105603.001; Accession Ref. PS103, Genbank Registration OL420884.

Paratypes: New South Wales. Kangaroo R Hampden Bridge, –34.7272 S, 150.5218 E, 26 September 2017 (PS, JM, JH) Accession Ref. PS98, AM Ref No. P.105.603, Kangaroo Valley R on Gerringong Ck Rd, –34.6868 S, 150.6013E, Accession Ref. PS99, AM Ref No. P.105603, 27 September 2017 (PS, JM, JH), bodies in ethanol and other structures dissected, mounted on 2 slides each.

Material Examined: New South Wales: Hampden Bridge, –34.7272 S, 150.5218 E, 26 September 2017 (PS, JM, JH); Kangaroo Valley R on Gerringong Ck Rd, –34.6868 S, 150.6013 E, 27 September 2017 (PS, JM, JH).

Diagnosis: Paratya williamsi differs from all other species by the following combination of characters: rostrum long, 4.80–5.20 mm, extending beyond antennular peduncle and to end of scaphocerite, rostral length 0.84–1.03 times longer than carapace, dorsal edge curved upwards to tip, narrow and pointed, rostrum 7.16–9.60 times longer than wide, dorsally armed with 21–27 teeth, ratio of rostral spines to rostral length is 4.38–5.38, with 2–3 postorbital spines; ventrally with 1–5 short serrations over a length of 0.10–2.00 mm, 1 spine posterior to greatest depth, distal half of ventral edge straight, ratio of ventral spine length to rostral length is 0.21–1.00 and 4.40–21.00 more dorsal spines than ventral spines; rostral length 1.15–1.34 times length of scaphocerite. Left mandible with 4–5 teeth separated by a notch from 3 less distinct apical

Figure 15. *Paratya williamsi* sp. nov.: a, head region and rostrum; b, antenna 1 peduncle and stylocerite; c, scaphocerite; d, left mandible; e, enlarged incisors; f, right mandible; g, enlarged incisors; h, maxilla 1; i, maxilla 2; j, maxilliped 1; k, maxilliped 2. Scale lines 0.2 mm.

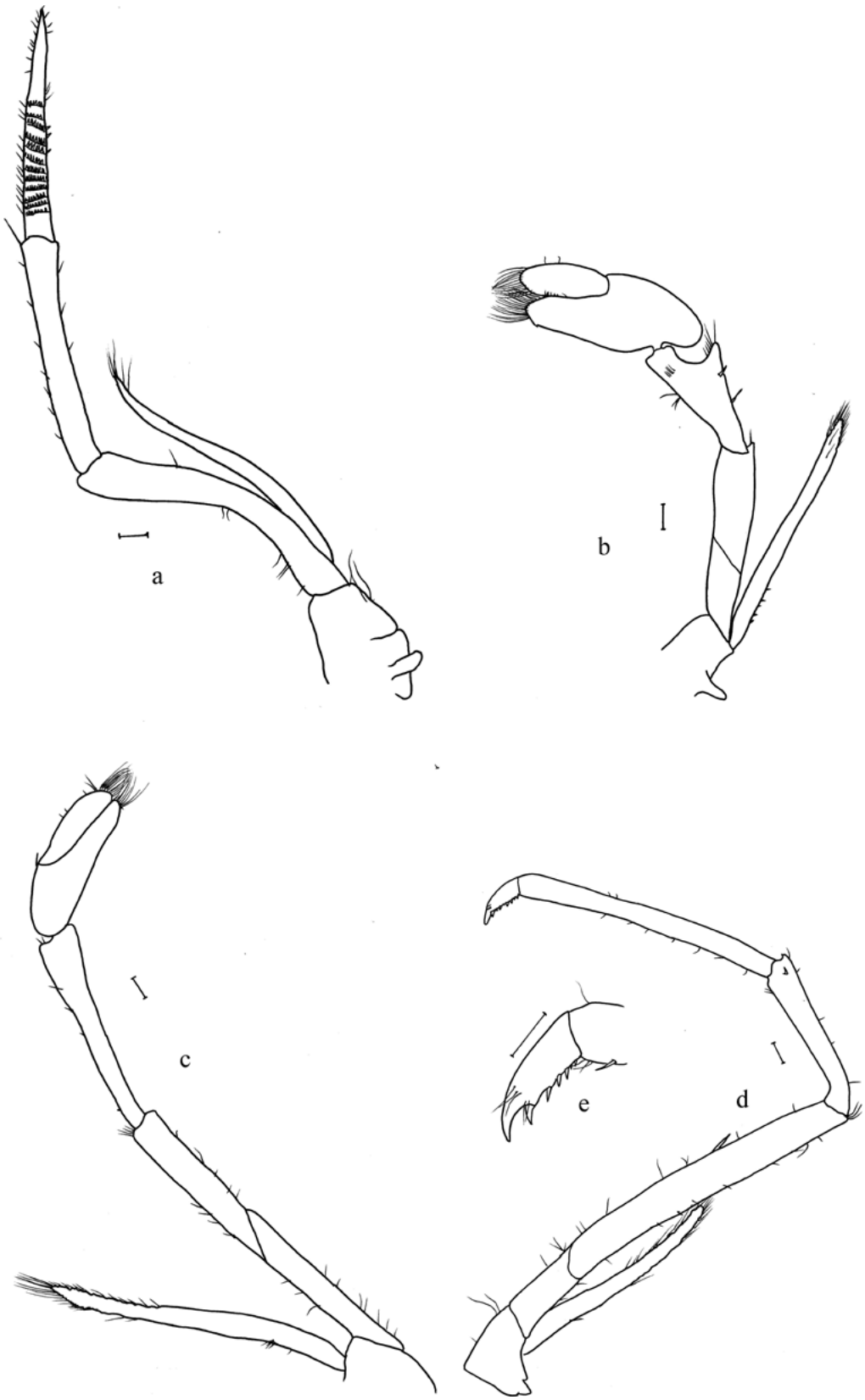


Figure 16. *Paratya williamsi* sp. nov.: a, maxilliped 3; b, pereiopod 1; c, pereiopod 2; d, pereiopod 3; e, dactylus 3. Scale lines 0.2 mm.

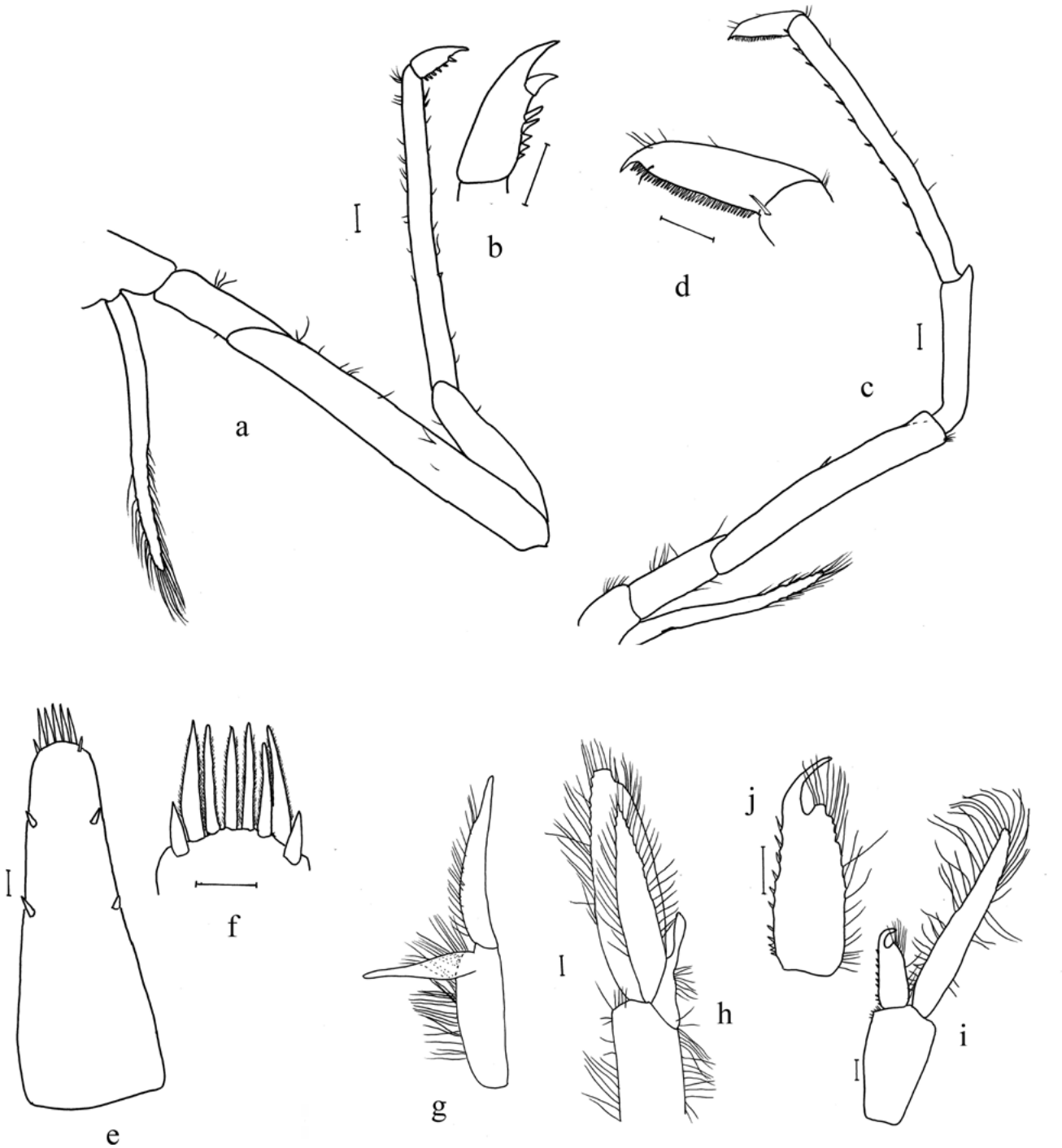


Figure 17. *Paratya williamsi* sp. nov.: a, pereiopod 4; b, dactylus 4; c, pereiopod 5; d, dactylus 5; e, telson; f, telson terminal spines; g, pleopod 1 of female; h, pleopod 2 of female; i, pleopod 1 of male; j, endopod 1 of male. Scale lines 0.2 mm.

teeth; spine row immediately below incisor process of 4–6 rugose spines (lifting spines); right mandible with 4 teeth in a single incisor process with apical and fourth teeth largest separated by 2 smaller teeth. Maxilla 2 with scaphognathite truncated distally, not extending to apex of upper endite. Chelae of pereiopod 1 short and broad, 1.40–1.51 mm long, propodus 2.28–3.02 times as long as wide, 1.87–1.97 times longer than dactylus, 1.27–1.44 times longer than carpus; palm length 1.36–1.70 times longer than wide and 1.00–1.27 times longer than dactylus length. Carpus very short 2.10–2.33 times as long as greatest width. Dactylus of pereiopod 3 with prominent terminal claw and 5–7 strong spines on medial margin. Dactylus of pereiopod 4 with prominent terminal claw and 5–6 spines on medial margin.

Carapace length 5.40 (4.85–6.00) mm.

Rostrum long, 5.40 (4.80–5.20) mm, extending beyond antennular peduncle and to end of scaphocerite (fig. 15a), rostral length 0.96 (0.84–1.03) times longer than carapace, dorsal edge curved upwards to tip, narrow and pointed, rostrum 8.00 (7.16–9.60) times longer than wide, dorsally armed with 24 (21–27) teeth, ratio of rostral spines to rostral length is 4.61 (4.38–5.38), with 2 (2–3) postorbital spines (fig. 15a); ventrally with 3 (1–5) short serrations over a length of 1.50 (0.10–2.00) mm, 1 spine at greatest depth (fig. 15a), distal half of ventral edge straight, ratio of ventral spine length to rostral length is 0.29 (0.21–1.00) and 8.00 (3.50–21.00) more dorsal spines than ventral spines; rostral length 1.27 (1.15–1.34) times length of scaphocerite.

Antenna 1 (fig. 15b) peduncle 2.75 (2.25–2.75) mm long, not reaching distal tip of scaphocerite, 0.90 (0.90–1.00) times length of scaphocerite. Stylocerite 2.25 (2.05–2.30) mm long, length 7.50 (6.83–9.20) longer than wide, 0.42 (0.38–0.45) times carapace length, reaching beyond distal border of peduncle segment but not to end of broad acute process on distal angle of first segment (fig. 15b).

Antenna 2 (fig. 15c) second segment of peduncle 1.50 (1.26–1.50) mm long, 0.37 (0.29–0.37) length of scaphocerite, 2.73 (2.29–2.73) longer than wide. Scaphocerite 4.10 (3.75–4.35) mm long, 0.76 (0.73–0.82) times length of carapace, 3.28 (3.13–3.48) longer than wide.

Mouthparts. Left mandible (fig. 15d, e) with 4–5 teeth separated by a notch from 3 less distinct apical teeth; spine row immediately below incisor process of 4–6 rugose spines (lifting spines); spine row above molar process of approximately over 20 sparsely setose spines. Right mandible (fig. 15f, g) with 4 teeth in a single incisor process with apical and third teeth largest with second and fourth teeth smaller; spine row immediately below teeth with 8–11 lifting spines; spine row above molar process. Molar process ridged.

Maxilla 1 as for *P. australiensis* (fig. 15h).

Maxilla 2 (fig. 15i) scaphognathite truncated distally, not extending to apex of upper endite; palps small, terminal parts narrow and with 1 sub–apical setose spine.

Maxilliped 1 as for *P. australiensis* (fig. 15j).

Maxilliped 2 (fig. 15k) endopod length 0.88 (0.88–1.11) mm; exopod long and narrow 2.15 (2.00–2.50) mm, exopod 2.44 (2.27–2.46) times longer than endopodite. Epipodite with podobranch.

Maxilliped 3 (fig. 16a) endopod length 6.10 (5.68–6.27) mm, 2.71 (2.32–2.71) times longer than exopod; with 3 distal segments of similar length; basal segment curved, apical segment with large terminal claw, medial distal margin with 8 (6–8) broad teeth-like spines, largest 1 in basal third, outer margin with 7 teeth-like spines. Exopod long and narrow, 2.25 (2.25–2.70) mm long, tip reaching basal third of mid segment, with several long setose spines near tip and several short setose spines near base. Epipodite with basal conical projection.

Thoracic appendages. Pereiopod 1 (fig. 16b) 4.65 (4.65–4.73) mm long, 0.86 (0.78–0.98) times carapace length. Chelae short and broad (fig. 16b), 1.40 (1.40–1.51) mm long, propodus 2.54 (2.28–3.02) times as long as wide, 1.87 (1.87–1.97) times longer than dactylus, 1.27 (1.27–1.44) times longer than carpus; palm length 1.36 (1.36–1.70) times longer than wide and equal to dactylus length (1.00–1.27). Carpus very short 2.20 (2.10–2.33) times as long as greatest width, broadening distally, distal margin excavate. Segment ratios 0.68 (0.68–0.76) : 1.27 (1.27–1.44) : 1.00 (1.10 [1.05–1.10] mm) : 1.50 (1.43–1.52) : 0.45 (0.45–0.57) : 1.27 (1.27–2.71). Exopod extending to mid merus (mid merus to mid carpus).

Pereiopod 2 (fig. 16c) 6.20 (5.80–7.50) mm long, 1.15 (1.15–1.25) times carapace length. Chelae long and slender (fig. 16c), 1.50 (1.35–1.50) mm long, nearly two-thirds length of carpus, 2.33 (2.25–3.33) times longer than wide, palm length 1.56 (1.50–1.56) times longer than width and 0.82 (0.82–1.20) times dactylus length. Propodus length 1.76 (1.76–1.80) times longer than dactylus. Carpus 5.71 (5.14–8.33) times as long as greatest width, slightly broader distally, distal margin with small excavation. Segment ratios 0.43 (0.34–0.43) : 0.75 (0.60–0.75) : 1.00 (2.00 [1.80–2.50] mm) : 0.68 (0.68–0.80) : 0.68 (0.60–0.75) : 1.50 (1.24–1.50). Exopod extending to apex of merus to base of carpus.

Pereiopod 3 (fig. 16d, e) distinctly longer than pereiopod 2 and more slender 8.45 (7.65–9.15) mm long, 1.56 (1.53–1.58) times carapace length. Dactylus with prominent terminal claw and 5 (5–7) strong spines on medial margin (fig. 16e). Propodus length 4.58 (4.46–4.58) times longer than dactylus, length 11.00 (10.00–14.50) times longer than wide with 13 (11–13) spines on inner margin. Merus with 1–3 strong spines on medial margin and 1 near ventral distal margin; segment ratios 0.40 (0.37–0.40) : 1.83 (1.67–1.83) : 1.00 (1.50 [1.50–1.65] mm) : 2.13 (2.03–2.13) : 0.67 (0.40–0.67) : 1.53 (1.53–1.88). Exopod extends to mid merus (mid merus to apex of merus).

Pereiopod 4 (fig. 17a, b) similar to pereiopod 3, 7.80 (7.45–9.63) mm long, 1.44 (1.34–1.54) times carapace length. Dactylus with prominent terminal claw and 5 (5–6) spines on medial margin (fig. 17b). Propodus length 5.40 (4.75–5.40) times longer than dactylus, length 10.80 (10.00–11.40) times longer than wide, with 11 (8–13) spines on inner margin; merus with 0–2 strong spines on medial margin and 1 near ventral distal margin. Segment ratios 0.36 (0.36–0.40) : 1.93 (1.79–1.93) : 1.00 (1.40 [1.40–1.50] mm) : 1.93 (1.80–2.04) : 0.71 (0.50–0.71) : 1.71 (1.61–1.71). Exopod extends to mid merus.

Pereiopod 5 (fig. 17c, d) slightly shorter than pereiopods 4, 7.65 (7.20–8.30) mm long, 1.42 (1.38–1.48) times longer than carapace. Dactylus with prominent terminal claw and very regular, comb-like row of 50 (49–66) spines on medial margin

(fig. 17d). Propodus length 4.07 (3.93–4.07) times longer than dactylus, length 14.25 (11.00–14.25) times longer than wide with 7 (7–10) long inner teeth and setae on external margin. Carpus with 1 large spines near distal margin. Merus with 1 strong medial spine and 1 distal spine; segment ratios 0.50 (0.47–0.56) : 2.04 (1.91–2.20) : 1.00 (1.40 [1.25–1.60] mm) : 1.71 (1.50–1.92) : 0.71 (0.64–0.78) : 1.43 (1.31–1.43). Exopod extends to base to third of merus.

Abdomen. Pleopods peduncle of first pleopod short 1.90 (1.50–2.35) mm, 0.35 (0.31–0.39) times length of carapace length, 2.92 (2.92–5.85) times width, exopod 1.08 (1.08–1.28) times peduncle length, endopod 0.60 (0.45–0.80) times peduncle length (fig. 17g); second pleopod peduncle short, 0.42 (0.36–0.45) times length of carapace, 2.50 (2.33–2.81) times width, exopod 1.16 (–) times peduncle length, endopod slightly shorter 1.04 (–) times peduncle length (fig. 17h).

Telson (fig. 17e, f) length 3.50 (3.50–4.00) mm, 0.65 (0.67–0.72) times carapace length, 3.04 (2.81–3.17) times as long as greatest width, tapering distally. Dorsal surface with 2 pairs of strong submarginal teeth-like spines. Posterior margin convex with 1 pair of teeth-like spines outermost, 6 (6–8) long, strong terminal setose spines (fig. 17f).

Uropods approximately equal to telson length.

Male smaller than female, carapace length 4.7mm; endopod of pleopod 1 strongly excavated and strongly curved (fig. 17i, j) with 11 short spines on outer margin and 12 long setae on inner margin (fig. 17j).

Etymology: The specific epithet is in honour of the late Prof. W. D. Williams who encouraged and inspired a generation of Australian limnologists and who provided one of us (PS) a unique opportunity for post-graduate study at Adelaide University.

Comments: P. williamsi has an overlap of distribution with *P. australiensis* and *P. arrostra*. Characters that distinguish these species from *P. williamsi* are listed in Table 2.

P. williamsi may also be confused with *P. whitemae* and *P. tasmaniensis*, both of which are widespread and may have distributions that overlap, but they can be distinguished by the following combination of characters: dactylus of pereiopod 3 with 5–7 teeth; dactylus of pereiopod 4 with 5–6 teeth; dactylus of pereiopod 5 with a comb of 49–74 spines; first cheliped palm length 1.00–1.27 times dactylus length; 1–5 ventral rostral spines over a length of 0.10–2.00 mm (Table 2).

P. williamsi is restricted to the upper Kangaroo Valley in the Shoalhaven R catchment south of Sydney and can be found co-existing with *P. whitemae* and *P. tasmaniensis*.

***Paratya whitemae* n. sp.**

Figures 18– 20

http://zoobank.org/urn:lsid:zoobank.org:act:24D43065-1D31-42BC-A846-7BFB163778AB

Lineage 6 (Cook et al., 2006)
Lineage A (McClusky, 2007)

Type Material: Holotype New South Wales. The Falls at Forest Falls Retreat Johns R, –31.709 S, 152.6612 E, 31 October 2011 (MC, JM, PS); Body in ethanol and antennae, mouthparts, pereiopods and abdominal structures dissected, mounted on 2 slides. Accession Ref. MC108, AM Ref No. P.105604.

Paratypes: New South Wales. The Falls at Forest Falls Retreat Johns R, –31.709 S, 152.6612 E, 31 October 2011 (MC, JM, PS) Male, Accession Ref MC110, Genbank Registration OL420801; Bagnall's Lagoon, Albury, –36.070 S, 146.854 E, April 2011 Accession Ref. MC95, 97, 99 (PS) Genbank Registration OL420871, OL420872, OL420874; Wakool Reserve, –35.4963 S, 144.4541 E, June 2011 (JC); Nepean R at Maldon Weir, –33.7414 S, 150.6846 E, 5 April 2011 Accession Ref. MC37 (SW), Genbank Registration OL420834; Nepean R at Macquarie Grove Rd, –34.0414 S, 150.6953 E, 2 April 2011 Accession Ref. MC34 (SW), Genbank Registration OL420834; Bedford Ck –33.75 S, 150.447 E Accession Ref. MC31 (SW), Genbank Registration OL420830; Hawkesbury R at Wilberforce, –33.5702 S, 150.8382 E, 21 April 2011 Accession Ref. MC24 (SW), Genbank Registration OL420824; O'Hares Ck near George R, –34.095 S, 150.835 E, 20 April 2011 Accession Ref. MC21–23 (SW), Genbank Registration OL420821–OL420823; bodies in ethanol and other structures dissected, mounted on 2 slides each.

Material Examined: New South Wales: Bagnall's Lagoon, Albury, –36.070 S, 146.854 E, April 2011 (PS); Murray R below Lake Hume, –36.0998 S, 147.0228 E, 12 Aug 2010 (JW, MC, JM); Wakool Reserve, –35.496 S, 144.454 E, June 2011 (JC); Nepean R at Maldon Weir, –33.7414 S, 150.6846 E, 5 April 2011 (SW); Nepean R at Macquarie Grove Rd, –34.0414 S, 150.6953 E, 2 April 2011 (SW); Bedford Ck, –33.75 S, 150.447 E, 4 May 2011 (SW); Hawkesbury R at Wilberforce, –33.5702 S, 150.8382 E, 21 April 2011 (SW); O'Hares Ck near George R, –34.095 S, 150.835 E, 20 April 2011 (SW); Woolgoolga Ck, –30.1306 S, 153.1378 E, (BM), Way Way Ck, –30.7681 S, 153.1378 E, (BM); Nambucca Ck, –30.6408 S, 152.8558 E, (BM); Bellinger R, –30.4261 S, 152.7794 E, (BM); The Falls at Forest Falls Retreat Johns R, –31.709 S, 152.6612 E, 31 October 2011 (MC, JM, PS); Jerrys Ck near Forest Falls Retreat Johns R, –31.7146 S, 152.6625 E, 30 October 2011 (MC, JM, PS); The Cascades at Forest Falls Retreat Johns R, –31.70 S,152.655 E, 31 October 2011 (MC, JM, PS); Williams R at Cooreei Bridge Dungog, –32.3968 S, 151.7631 E, 29 October 2011 (MC, JM, PS); Trimble Ck in Shoalhaven catchment, –34.6847 E, 150.5252 S, 26 September 2017 (PS, JM. JH); Small Ck on Kangaroo Valley Rd, Kangaroo Valley, –34.7229 S, 150.5293 S, 27 September 2017 (PS, JM, JH); Lake Yarrunga at Bendeela Recreation Area, –34.7398 S, 150.4705 E, 27 September 2017 (PS, JM, JH); Manning R at Wingham Brush, –31.8706 S, 152.3825 E, 16 September 2016 (BM); Kangaroo R Hampden Bridge, –34.7272 S, 150.5218 E, 27 September 2017 (PS, JM. JH); Lachlan R at Glenmore, –33.4413 S, 145.5377 S, July 1999, (PS, TC); Lachlan at Cargellico –32.2033 S, 146.3589 E, June 1999, (PS, TC); Orara R at Nana Glen, –30.1328 S, 153.0077 E, no date, (BK); Hawksbury R at Sackville Ferry, –33.5003 S, 150.8746 S, 19 September 2020 (SW); Stream on Gerrigong Ck Rd, Upper Kangaroo Valley, –34.6870 S, 150.6000 E, 27 September 2017 (PS, JM. JH); Dingo Ck, –30.3103 S, 152.9822 E, 24 May 2015 (BM); Ellenborough R at Ellenborough Falls, –31.6113 S, 152.2925 E, 31 October 2011 (PS, JM, MC); Blaxland Ck on Armidale Rd, –28.8997 S, 152.7864 E, 8 December 2011 (JW, DB).

Diagnosis: P. whitemae differs from all other species by the following combination of characters: rostrum long, extending beyond both antennular peduncle and scaphocerite, dorsal edge very slightly concave and curved upwards, dorsally armed with 20–34 teeth, 1–4 postorbital spines, ventrally with 4–11 large serrations over a length of 1.30–2.80 mm, extending from just posterior to greatest depth; distal half of ventral edge straight; left mandible with 4–5 teeth separated by finely ridged U-shaped notch from a short blunt/acute apical tooth; right mandible with

Figure 18. *Paratya whitemae* sp. nov.: a, head region and rostrum; b, antenna 1 peduncle and stylocerite; c, scaphocerite; d, left mandible; e, enlarged incisors; f, right mandible; g, enlarged incisors; h, maxilla 1; i, maxilla 2; j, maxilliped 1; k, maxilliped 2. Scale lines 0.2 mm.

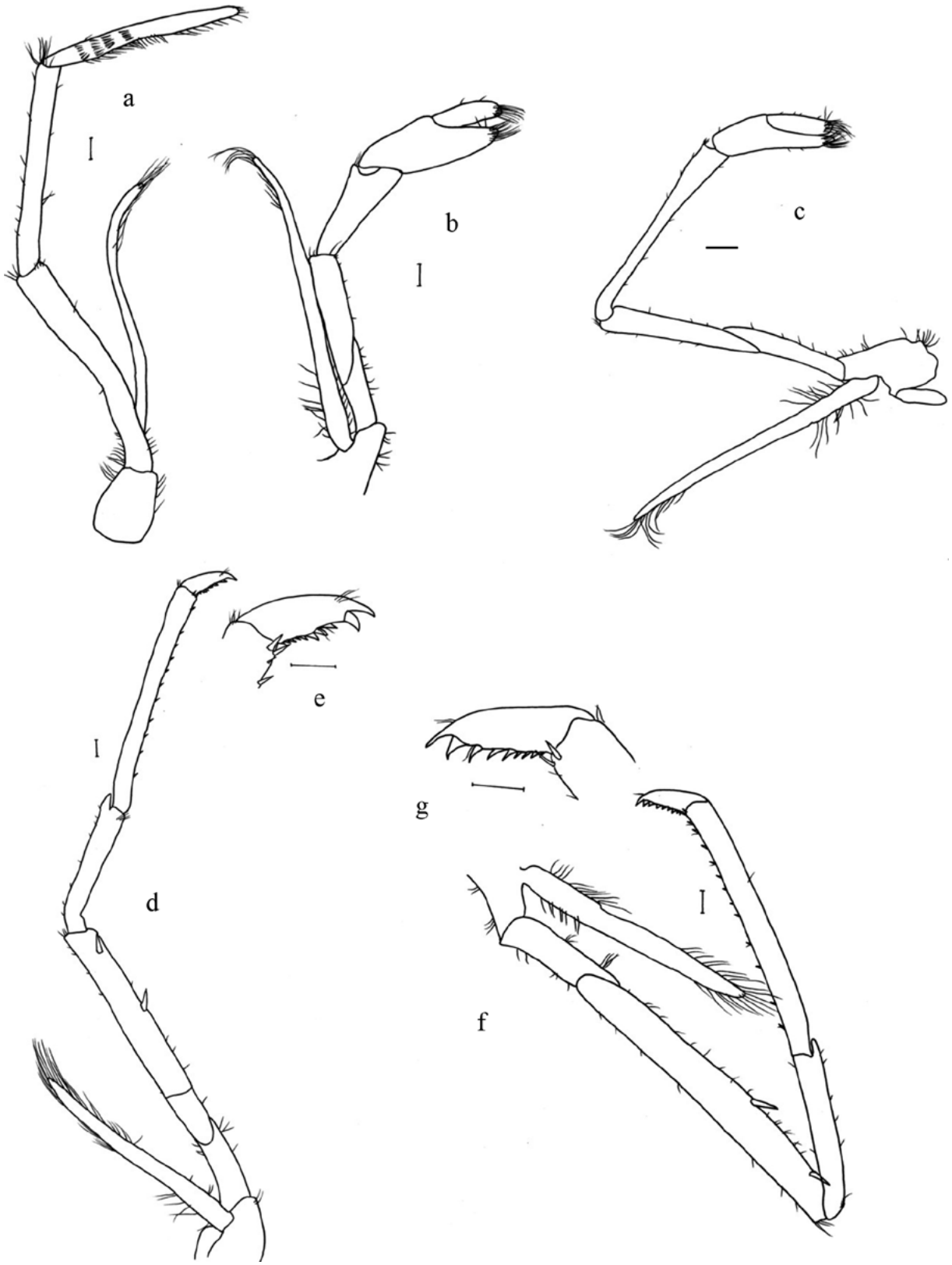


Figure 19. *Paratya whitemae* sp. nov.: a, maxilliped 3; b, pereiopod 1; c, pereiopod 2; d, pereiopod 3; e, dactylus 3; f, pereiopod 4; g, dactylus 4. Scale lines 0.2 mm.

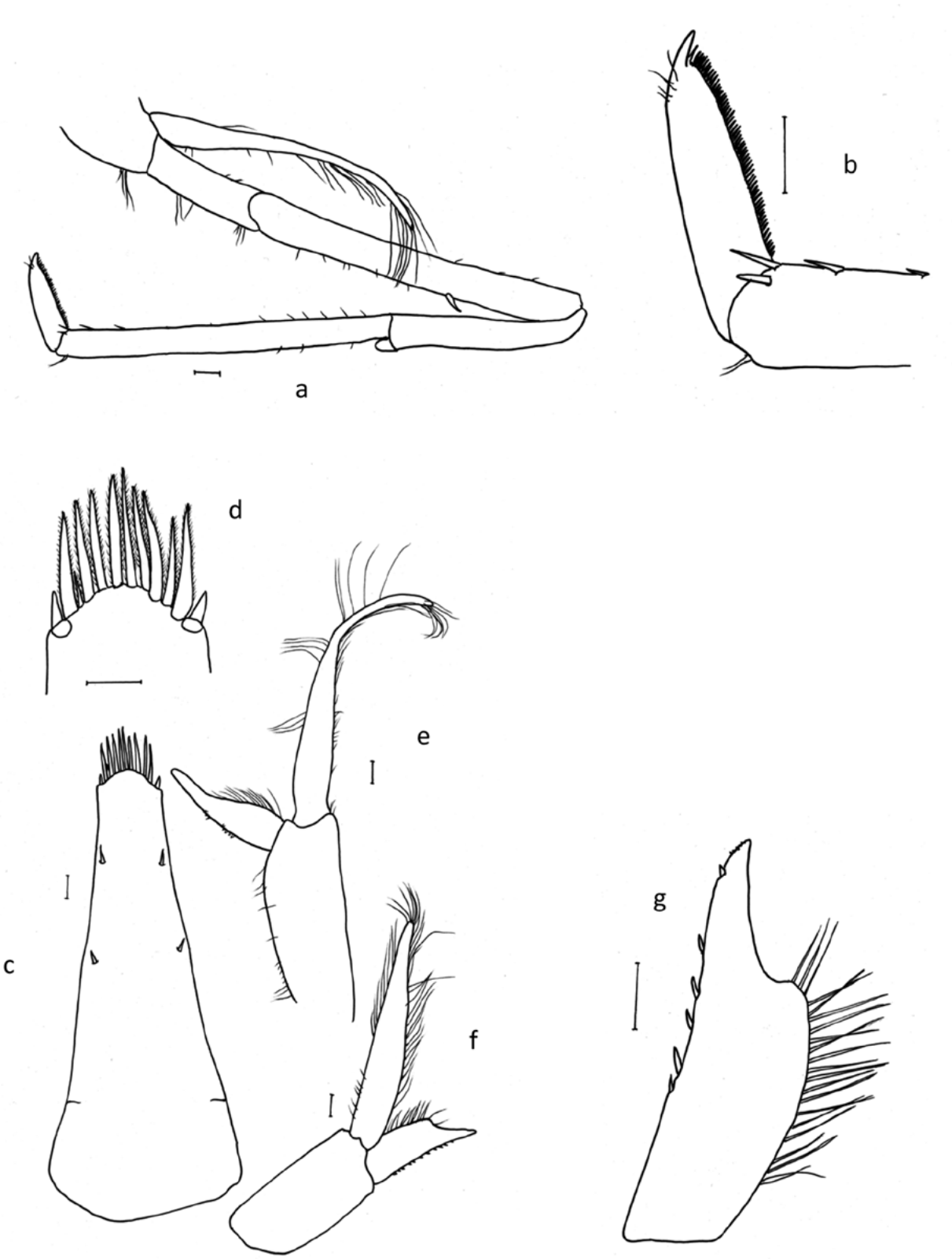


Figure 20. *Paratya whitemae* n. sp.: a, pereiopod 5; b, dactylus 5; c, telson; d, telson terminal spines; e, pleopod 1 of female; f, pleopod 1 of male; g, endopod 1 of male. Scale lines 0.2 mm.

3–4 teeth in a single incisor process; exopod of maxilliped 2 1.63–2.96 times longer than endopod; maxilliped 3 with medial distal margin of apical segment of endopod with 7–11 broad teeth-like spines, outer margin with 1–3 broad teeth-like spines, exopod long and narrow, tip over-reaching distal end of basal endopod segment; pereiopod 1 with long carpus and short and broad chelae, exopod extending to base–apex of carpus; pereiopod 2 with exopod extending to mid merus to base of carpus; dactylus of pereiopod 3 with prominent terminal claw and 7–11 strong spines on medial margin, exopod extends to mid merus; dactylus of pereiopod 4 prominent terminal claw and 8–11 spines on medial margin, exopod extends to mid merus; dactylus of pereiopod 5 with prominent terminal claw and very regular comb-like row of 81–94 small spines on medial margin, exopod extends to basal third of merus.

Carapace length 5.7 (4.5–6.6) mm.

Rostrum long 6.82 (4.55–6.82) mm, extending beyond the antennular peduncle and scaphocerite (fig. 18a), rostral length longer than carapace 1.2 (0.83–1.26) times length of carapace, shape long and slender with dorsal edge curved upwards, pointed, rostrum 8.52 (5.53–9.57) longer than rostral width; dorsally armed with 33 (20–34) teeth, ratio of number of dorsal spines to length is 4.84 (3.68–6.15), 2 (1–4) postorbital eye spines (fig. 18a); ventrally with 6 (4–14) large spines over a length of 1.88 (1.30–2.80) mm, with 1–2 spines posterior to greatest width (fig. 18a), distal half of ventral edge straight; ratio of ventral spine row length to rostral length is 0.28 (0.23–0.46) and 4.57 (2.43–5.80) times more dorsal spines than ventral spines; rostral length 1.38 (1.04–1.77) times length of scaphocerite.

Antenna 1 (fig. 18b) peduncle short 3.05 (3.05–5.28) mm, not reaching distal tip of scaphocerite, length 0.62 (0.62–1.12) times as long as scaphocerite. Stylocerite 1.97 (1.60–2.64) mm long, length 0.35 (0.32–0.51) times carapace length, reaching beyond distal border of peduncle segment and middle to just beyond process on first segment (fig. 18b).

Antenna 2 (fig. 18c) second segment of peduncle 1.03 (1.03–1.80) mm, 0.21 (0.21–0.45) times length of scaphocerite, length 2.50 (2.35–3.75) times width. Scaphocerite 4.94 (3.10–5.20) mm long, 0.87 (0.69–0.96) times carapace length, 2.93 (2.93–3.85) times as long as wide,

Mouthparts. Left mandible (fig. 18d, e) with 4–5 teeth separated by slightly ridged shallow U-shaped notch from a short blunt/acute apical tooth; spine row immediately below incisor process of 7–9 rugose spines (lifting spines); spine row above molar process of approximately over 40 sparsely setose spines. Right mandible (fig. 18f, g) with 3–4 robust teeth in incisor process with 2 central teeth larger than apical and inner teeth; spine row immediately below teeth with 8–12 spines each finely setose basally; spine row above molar process. Molar process ridged.

Maxilla 1 as for *P. australiensis* (fig. 18h).

Maxilla 2 as for *P. australiensis* (fig. 18i).

Maxilliped 1 as for *P. australiensis* (fig. 18j).

Maxilliped 2 (fig. 18k) endopod 1.40 (0.87–1.40) mm long; exopod long and narrow, length 2.56 (1.73–2.87) mm, exopod 1.82 (1.63–2.96) times longer than endopod. Epipodite with long podobranch extending to basal third of third segment of endopodite.

Maxilliped 3 (fig. 19a) endopod length 7.0 (4.85–8.3) mm, 3.38 (2.32–3.38) times longer than exopod; with 3 distal segments of similar length; basal segment curved, apical segment with large terminal claw, inner margin with 9 (7–11) broad teeth-like spines, largest 2–4 in basal half, outer margin with 1 (1–3) long teeth-like spines near terminal spine and a single spine on outer margin; several transverse spine rows near base; mid and basal segments with several short simple setae. Exopod 2.07 (1.63–2.85) mm long, narrow, tip over-reaching distal end of basal endopod segment.

Thoracic appendages. Pereiopod 1 (fig. 19b) short, 5.85 (3.56–5.85 mm), 1.03 (0.73–1.03) times carapace length. Chelae short and broad (fig. 19b), 1.6 (1.09–1.67) mm long, 2.59 (2.48–3.84) times as long as wide, 2.0 (1.82–2.48) times longer than dactylus; palm length 1.55 (1.55–2.25) longer than palm width and 1.22 (0.82–1.22) times dactylus length. Carpus short, 2.88 (2.10–2.88) times longer than greatest width. Segment ratios 0.61 (0.55–0.68) : 1.22 (1.14–1.49) : 1.00 (1.08 [0.87–1.40] mm) : 1.60 (1.11–1.60) : 0.64 (0.30–0.64) : – (2.26–2.60). Exopod extending to base–apex of carpus.

Pereiopod 2 longer than pereiopod 1, 7.23 (5.41–7.83) mm long, 1.28 (1.11–1.47) times carapace length. Chelae long and slender (fig. 19c), 1.60 (1.20–1.80) mm long, half to two-thirds length of carpus, 3.47 (3.43–4.33) times as long as wide, palm length 2.04 (1.5–2.50) times palm width and 0.87 (0.86–1.29) times dactylus length. Propodus 1.48 (1.39–1.91) times longer than dactylus. Carpus 6.54–7.48 times as long as greatest width, slightly broader distally, distal margin with small excavation. Merus shorter than carpus, parallel–sided. Ischium about half as long as merus. Segment ratios 0.39 (0.29–0.43) : 0.58 (0.56–0.70) : 1.00 (1.80–2.83) mm : 0.77 (0.66–0.82) : 0.29 (0.36–0.56) : – (1.06–1.33). Exopod extending to mid of merus to base of carpus.

Pereiopod 3 (fig. 19d, e) distinctly longer than pereiopod 2 and more slender 10.11 (7.12–10.21) mm long, 1.78 (1.38–1.78) times carapace length. Dactylus with prominent terminal claw and 10 (7–11) strong spines on medial margin (fig. 19e). Propodus length 4.28 (3.82–4.69) times longer than dactylus, length, 19.52 (12.10–19.52) times longer than wide with 11(10–18) spines on inner margin. Merus with 1 strong spine on medial margin and 1 near ventral distal margin; segment ratios 0.42 (0.37–0.49) : 1.82 (1.61–1.88) : 1.00 (1.91 [1.27–2.00] mm) : 1.91 (1.74–2.23) : 0.64 (0.45–0.64) : – (1.54–1.75). Exopod extends to mid to apex of merus.

Pereiopod 4 (fig. 19f, g) similar length to pereiopod 3, – (6.67–9.63) mm long, – (1.45–1.62) times carapace length. Dactylus with prominent terminal claw and – (8–11) spines on medial margin (fig. 19g). Propodus – (3.58–5.00) times longer than dactylus; length – (12.37–16.00) times longer than wide, with – (11–16) spines on inner margin; merus with 1–2 strong spine on medial margin and 1 near ventral distal margin. Segment ratios – (0.22–0.52) : – (1.56–2.10) : 1.00 (– [1.17–1.92] mm): – (1.77–2.23) : – (0.49–0.71) : – (1.25–1.77). Exopod extends to mid merus.

Pereiopod 5 (fig. 20a, b) similar length to pereiopod 4, 9.16 (6.57–9.73) mm long, 1.62 (1.24–1.75) times carapace length. Dactylus with prominent terminal claw and very regular, comb–like row of numerous 72 (72–94) small spines on medial margin (fig. 20b). Propodus 4.09 (2.78–4.22) times longer than

dactylus, length 14.08 (10.42–18.93) times longer than wide with 14 (10–14) long medial teeth, 2 distally and external margin without teeth. Carpus without any large spines near distal margin. Merus with 1 strong medial spine and 1 distal spine; segment ratios 0.45 (0.45–0.71) : 1.85 (1.84–2.41) : 1.00 (1.88 [1.08–1.88] mm) : 1.64 (1.56–1.79) : – (0.52–0.89) : 1.25 (1.07–1.36). Exopod extends to basal to mid third of merus.

Abdomen. Pleopods peduncle of first pleopod short, 1.64 mm, 0.28 (0.30–0.38) times length of carapace, 1.82 (1.82–3.08) times width, exopod 1.83 (1.06–1.83) times peduncle length, endopod 0.97 (0.42–0.97) times peduncle length (fig. 20e); second pleopod peduncle short, – (0.33–0.58) times length of carapace, – (2.50–3.88) times width, exopod – (0.91–1.35) times peduncle length, endopod slightly shorter – (0.83–1.20) times peduncle length. Length of first peduncle – (1.07–1.74) times length of second peduncle.

Telson (fig. 20c, d) length 3.67 (3.20–4.40) mm, 0.65 (0.58–0.83) times carapace length, 3.00 (2.83–3.66) times longer than greatest width, tapering distally. Dorsal surface with 2 pairs of strong submarginal teeth-like spines. Posterior margin convex with 1 pair of teeth-like spines outermost, 4 (4–10) long strong setose spines (fig. 20d).

Uropods approximately equal to telson length.

Male smaller than females, carapace length 4.9–6.0 mm; endopod of first pleopod strongly excavated apically with 8–12 external spines and 11–15 long setae on inner margin (fig. 20f, g)

Etymology: Named in honour of the late Dr Mary E. White (AM), an Australian paleobotanist and whose environmental publications are inspirational and whose generosity to us while staying at The Falls Forest Retreat (New South Wales; type locality) will be remembered always.

Comments: P. whitemae may be confused by other widespread species and is found in the same areas as *P. australiensis*, *P. arrostra* and *P. tasmaniensis*. It can be distinguished from all other long rostrum species by the carpus of pereiopod 1 which is long with a short, robust chelae; the rostrum is concave with ventral rostral spines extending from posterior to the greatest width, extending over a length of 1.30–2.80 mm (Table 2).

Paratya whitemae is a widespread species in the coastal streams of Victoria, New South Wales and in south-eastern Queensland and in the Murray R in the Murray–Darling Basin (fig. 32b) and may co-exist with *P. australiensis*, *P. arrostra*, *P. williamsi*, *P. rouxi* and *P. tasmaniensis* at various locations throughout its range.

Paratya strathbogiensis n. sp.

Figures 21–23

http://zoobank.org/urn:lsid:zoobank.org:act:6B825EFF-D5BB-407E-9CA9-CAA2BB6F92A0

Lineage 7 (Cook et al., 2006)

Type Material: Holotype Victoria. King Parrot Ck at Flowerdale, –37.2953 S, 145.2905 E, 28 September 2011 (PS, JM, MC). Body in ethanol and antennae, mouthparts, pereiopods and abdominal structures dissected, mounted on 2 slides. Accession Ref. MC49. Museum of Victoria Ref No NMV J75163. Genbank Registration OL420843.

Paratypes: Victoria. 1 male and 3 females, King Parrot Ck at Flowerdale, –37.2953 S, 145.2905 E, 28 September 2011 Accession Ref. MC40, 43, 46, 47 (PS, JM, MC) NMV J75164–J75167, Genbank Registration OL420836, OL420839, OL420846, OL420847; 2 males King Parrot Ck above Goulburn R confluence, –37.0075 S, 145.3212 E, 28 September 2011 Accession Ref. MC53–54 (PS, JM, MC) NMV J75168–J75169, Genbank Registration OL420845–OL420846; bodies in ethanol and other structures dissected, mounted on 2 slides each.

Material Examined: Victoria: King Parrot Ck at Flowerdale, –37.2953 S, 145.2905 E, 28 September 2011 (PS, JM, MC); King Parrot Ck above Goulburn R confluence, –37.0075 S, 145.3212 E, 28 September 2011 (PS, JM, MC).

Diagnosis: P. strathbogiensis differs from all other species by the following combination of characters: rostrum long, extending beyond both antennular peduncle and scaphocerite, dorsal edge straight, dorsally armed with 21–24 teeth, 1–2 postorbital spines, ventrally with 4–6 large serrations over a length of 1.30–1.80 mm, all forward of greatest depth; distal half of ventral edge straight; left mandible with 4 large teeth separated by a ridged straight ridged notch from a blunt apical tooth; right mandible with 4 teeth in 2 separate incisor processes with first, third and fourth teeth large; scaphognathite of maxilla 2 truncated apically and square at distal margin not extending to apex of upper endite; exopod of maxilliped 2 1.88–2.34 times longer than endopod, epipodite with long podobranchs extending to basal third of third segment of endopodite; maxilliped 3 with medial distal margin of apical segment of endopod with 8–9 broad teeth-like spines, outer margin with 2 broad teeth-like spines, exopod long and narrow, tip over-reaching distal end of basal endopod segment; pereiopod 1 with short carpus, chelae short–long and broad, exopod extending to base-mid carpus; pereiopod 2 with exopod extending to mid merus; dactylus of pereiopod 3 with prominent terminal claw and 8–13 strong spines on medial margin, exopod extends to mid merus; dactylus of pereiopod 4 prominent terminal claw and 9–12 spines on medial margin, exopod extends to apical third of merus; dactylus of pereiopod 5 with prominent terminal claw and very regular comb–like row of 64–80 small spines on medial margin, exopod extends to mid merus.

Carapace length 6.3 (5.6–6.5) mm.

Rostrum long 5.90 (5.30–6.00) mm, extending beyond the antennular peduncle and scaphocerite (fig. 21a), rostral length is 0.94 (0.82–1.00) times length of carapace, shape long and slender with straight dorsal edge, pointed (fig. 21a); rostrum 8.43 (7.50–9.33) times longer than wide; dorsally armed with 21 (21–24) spines, ratio of number of dorsal spines to length is 3.56 (3.56–4.29) with 2 (1–2) postorbital eye spines; ventrally with 6 (4–6) large serrations over a length of 1.80 (1.30–1.80) mm, all spines anterior of greatest width; distal half of ventral edge straight, ratio of ventral spine length to rostral length is 0.31 (0.23–0.31), with 3.50 (3.50–6.00) more dorsal spines than ventral spines; rostral length 1.48 (1.19–1.51) times length of scaphocerite.

Antenna 1 (fig. 21b) peduncle 4.48 (3.80–4.68) mm long, not reaching distal tip of scaphocerite, length 1.12 (0.83–1.12) times scaphocerite length. Stylocerite 2.20 (2.04–2.24) mm long, length 9.17 (6.88–9.33) times longer than width, 0.35 (0.33–0.36) times carapace length, reaching beyond distal border of peduncle segment extending to middle of process on distal angle of first segment (fig. 21b).

Figure 21. *Paratya strathbogiensis* sp. nov.: a, head region and rostrum; b, antenna 1 peduncle and stylocerite; c, scaphocerite; d, left mandible; e, enlarged incisors; f, right mandible; g, enlarged incisors; h, maxilla 1; i, maxilla 2; j, maxilliped 1; k, maxilliped 2. Scale lines 0.2 mm.

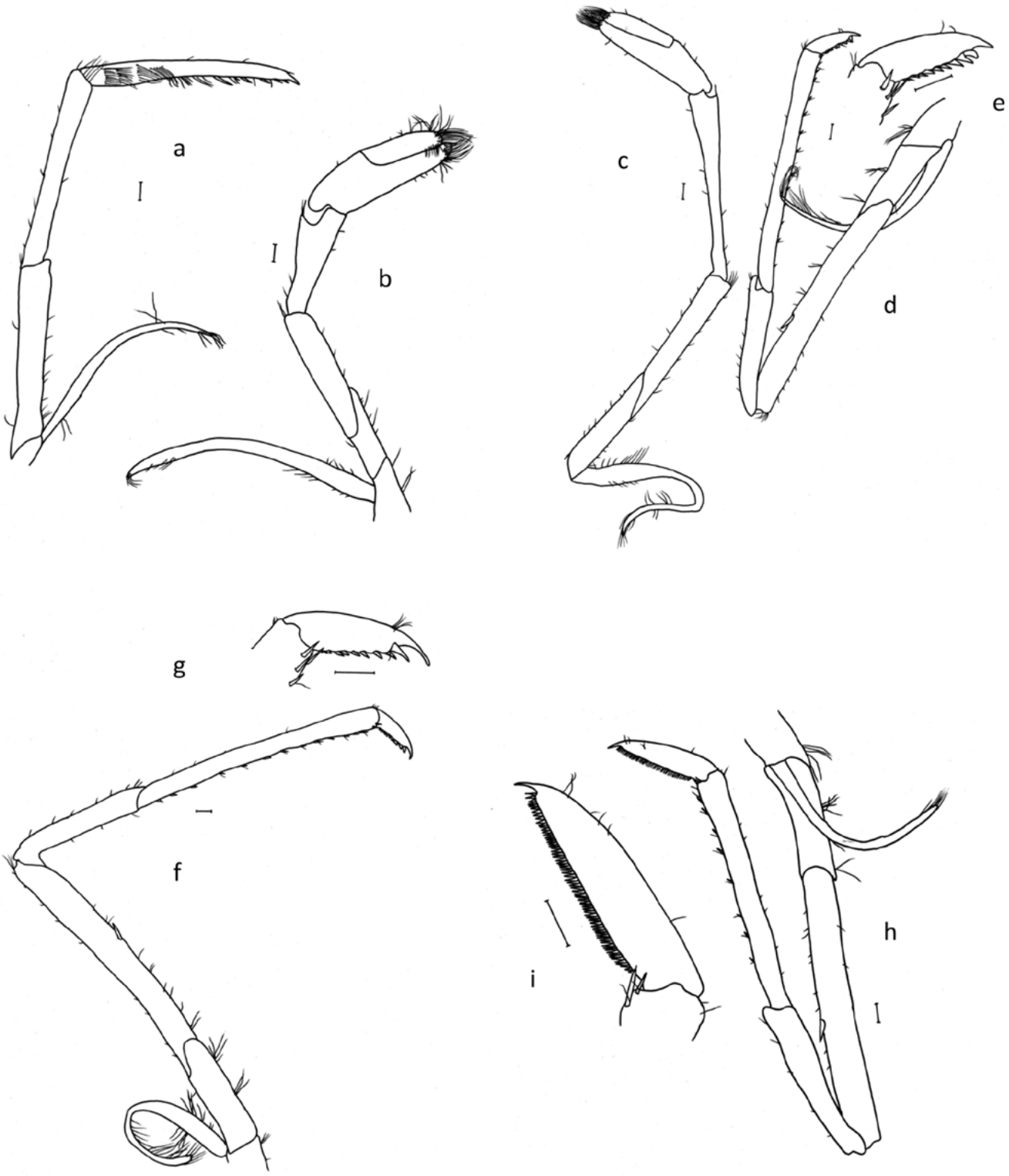


Figure 22. *Paratya strathbogiensis* sp. nov.: a, maxilliped 3; b, pereiopod 1; c, pereiopod 2; d, pereiopod 3; e, dactylus 3; f, pereiopod 4; g, dactylus 4; h, pereiopod 5; i, dactylus 5. Scale lines 0.2 mm.

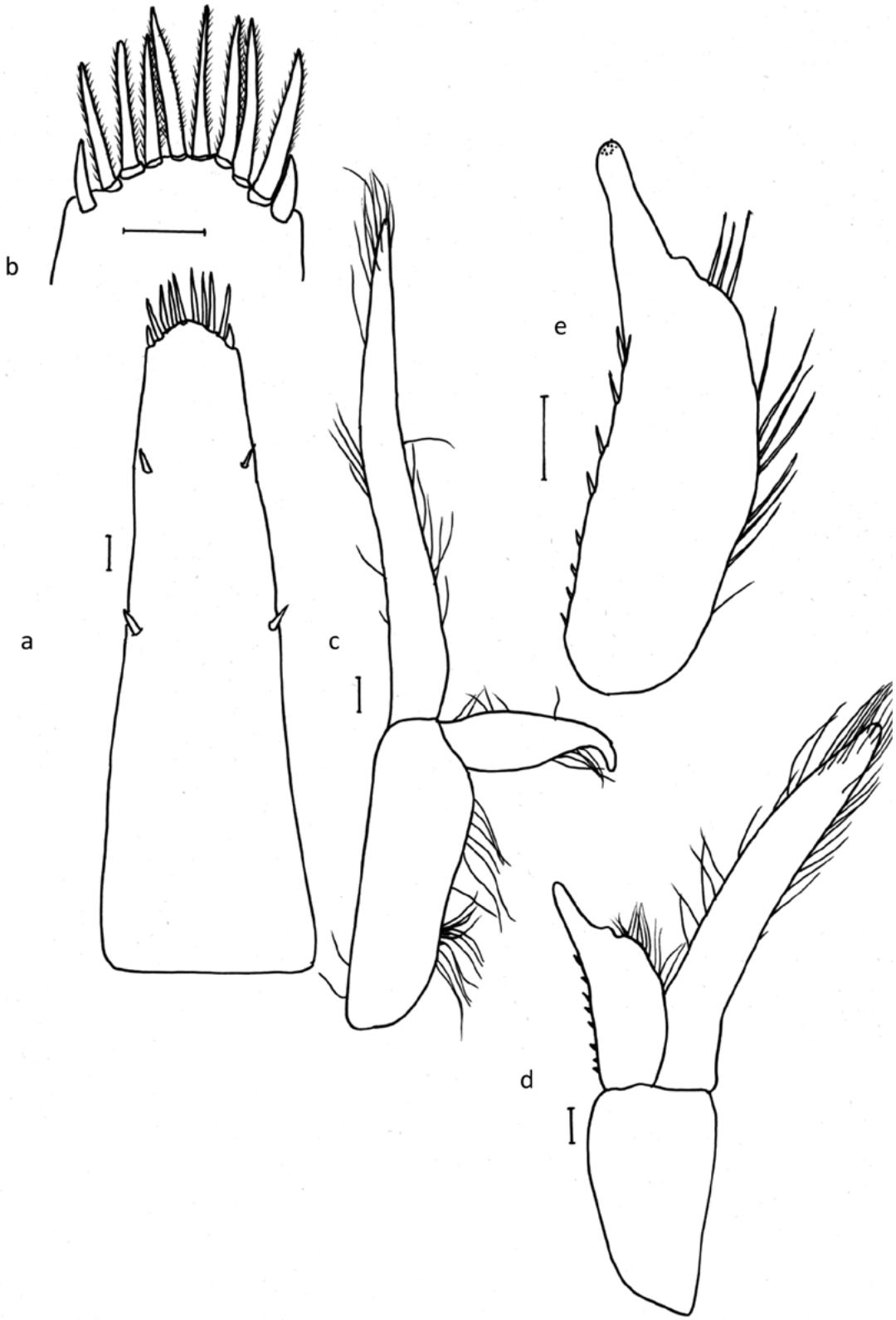


Figure 23. *Paratya strathbogiensis* sp. nov.: a, telson; b, telson terminal spines; c, pleopod 1 of female; d, pleopod 1 of male; e, endopod 1 of male. Scale lines 0.2 mm.

Antenna 2 (fig. 21c) second segment of peduncle 1.40 (1.20–1.52) mm long, 0.35 (0.25–0.38) times length of scaphocerite, 2.92 (2.53–3.18) times longer than wide. Scaphocerite 4.00 (3.70–4.80) mm long, 0.63 (0.63–0.75) times carapace length, 2.67 (2.47–2.87) times as long as wide.

Mouthpart. Left mandible (fig. 21d, e) with 4 large teeth separated from a blunt apical tooth by a ridged almost straight notch. Spine row with 7 spines, each finely setose, spine row above molar process of approximately over 40 sparsely setose spines. Right mandible (fig. 21f, g) with 4 large teeth in 2 separate incisor processes consisting of one large apical tooth and 1 small tooth and two larger separated inner teeth, Apical, third and fourth teeth large. Spine row immediately below teeth with 10 spines each finely setose, spine row above molar process. Molar process ridged.

Maxilla 1 (fig. 21h) as for *P. australiensis*.

Maxilla 2 (fig. 21i) scaphognathite truncated apically and squared off at distal margin, not extending to apex of upper endite (fig. 21i).

Maxilliped 1 (fig. 21j) as for *P. australiensis*.

Maxilliped 2 (fig. 21k) endopod length 1.09 (1.01–1.16) mm; exopod long and narrow, length 2.13 (2.00–2.40) mm, 1.95 (1.88–2.34) times longer than endopod. Epipodite with long podobranch extending to basal third of third segment of endopodite.

Maxilliped 3 (fig. 22a) endopod length 6.67 (6.35–7.36) mm, 2.77 (2.52–2.80) times longer than exopod; with 3 distal segments of similar length; basal segment curved; apical segment with large terminal claw, medial distal margin with 7 (7–9) broad teeth-like spines, largest 3 in basal half, outer margin with 1 long tooth-like spine near terminal spine and 1 long spine in proximal third. Exopod 2.40 (2.27–2.67) mm long, narrow, tip over-reaching distal end of basal endopod segment (fig. 22a).

Thoracic appendages. Pereiopod 1 (fig. 22b) short, 5.09 (3.09–5.44) mm long, 0.81 (0.48–0.84) times carapace length. Chelae short to long and broad (fig. 22b), 1.60 (1.48–1.83) mm long, propodus 3.00 (2.86–3.26) times as long as wide, 1.76 (1.76–2.36) times longer than dactylus, 1.19–1.31 times longer than carpus; palm length 2.08 (1.42–2.14) times palm width and 1.59 (1.27–1.69) times dactylus length. Carpus short, 2.88 (2.30–3.21) times longer than greatest width, broadening distally. Segment ratios 0.74 (0.54–0.74) : 1.31 (1.19–1.31) : 1.00 (1.22 [1.13–1.47] mm) : 1.41 (1.04–1.41) : 0.43 (0.42–0.52) : 2.28 (2.00–2.28). Exopod extending to base–mid carpus.

Pereiopod 2 (fig. 22c) longer than pereiopod 1, 7.17 (6.85–7.89) mm long, 1.14 (1.11–1.22) times carapace length. Chelae long and slender (fig. 22c), 1.63 (1.47–1.76) mm long, 3.59 (3.57–4.06) times as long as wide, palm length 2.09 (2.00–2.22) times longer than palm width, 1.15 (0.91–1.15) times length of dactylus. Propodus 1.74 (1.67–1.81) times longer than dactylus. Carpus 6.28 (6.28–8.00) times as long as greatest width, slightly broader distally, distal margin with small excavation. Segment ratios 0.38 (0.35–0.42) : 0.67 (0.61–0.72) : 1.00 (2.42 [2.37–2.67] mm) : 0.84 (0.80–0.85) : 0.44 (0.35–0.59) : – (1.08). Exopod extending to mid merus (fig. 22c).

Pereiopod 3 (fig. 22d, e) distinctly longer than pereiopod 2 and more slender 8.67 (8.47–9.40) mm long, 1.38 (1.35–1.51) times carapace length. Dactylus with prominent terminal claw and 13 (8–13) strong spines on medial margin (fig. 22e). Propodus 4.60 (4.50–4.93) times longer than dactylus, length 14.38 (12.77–14.86) times longer than wide with 14 (8–14) spines on inner margin. Merus with 1 strong spine on medial margin and 1 near ventral distal margin. Segment ratios 0.38 (0.35–0.39) : 1.77 (1.63–1.89) : 1.00 (1.73 [1.57–1.88] mm) : 1.69 (1.69–2.03) : 0.54 (0.50–0.55) : 1.46 (1.43–1.46). Exopod extends to mid merus.

Pereiopod 4 (fig. 22f, g) similar to pereiopod 3, 9.12 (8.89–9.36) mm long, 1.45 (1.37–1.45) times carapace length. Dactylus with prominent terminal claw and 12 (9–12) spines on medial margin (fig. 22f, g). Propodus 3.78 (3.78–4.04) times longer than dactylus, length 11.94 (11.89–14.37) times longer than wide, with 16 spines on medial margin; merus with 1 strong spine on medial margin and 1 near ventral distal margin. Segment ratios 0.44 (0.41–0.44) : 1.68 (1.66–1.69) : 1.00 (1.80 [1.80–1.81] mm) : 1.96 (1.73–1.96) : 0.42 (0.42–0.52) : – (1.62). Exopod extends to mid-apex of merus.

Pereiopod 5 (fig. 22h, i) similar length to pereiopod 4, 9.00 (7.80–9.00) mm long, 1.43 (1.20–1.43) times carapace length. Dactylus with prominent terminal claw and very regular, comb–like row of numerous 64 (64–80) small spines on medial margin (fig. 22i). Propodus 3.11 (3.04–3.51) times longer than dactylus, length 12.00 (11.86–14.47) times longer than wide with 11 (10–11) long medial teeth and external margin without teeth. Carpus without any large spines near distal margin. Merus with 1 strong medial spine and 1 distal spine. Segment ratios 0.58 (0.49–0.63) : 1.82 (1.72–2.05) : 1.00 (1.76 [1.60–1.82] mm) : 1.69 (1.53–1.78) : 0.61 (0.54–0.61) : 1.06 (1.06–1.50). Exopod extends to mid merus.

Abdomen. Pleopods peduncle of first pleopod short, 0.29 (0.13–0.32) times length of carapace, 2.64 (1.21–3.00) times width, exopod 1.41 (1.31–3.35) times peduncle length, endopod 0.78 (0.44–0.78) times peduncle length (fig. 23c); second pleopod peduncle short, 0.37 (0.34–0.38) times length of carapace, 2.94 (2.50–2.94) times width, exopod 1.11 (1.11–1.51) times peduncle length, endopod slightly shorter 1.06 (1.06–1.33) times peduncle length. Length of first peduncle 1.27 (1.11–2.53) times length of second peduncle.

Telson (fig. 23a, b) length 3.80 (3.30–4.20) mm, 0.60 (0.57–0.66) times carapace length, 3.17 (2.80–3.17) times longer than greatest width, tapering distally. Dorsal surface with 2 pairs of strong submarginal teeth-like spines. Posterior margin convex with 1 pair of teeth-like spines outermost, 10 (8–12) long, strong setose spines (fig. 23b).

Uropods slightly longer than telson length.

Male smaller than females, carapace length 4.42 mm; endopod of first pleopod curved, not strongly excavated with 10 external spines and 16 spines on inner margin (fig. 23d, e).

Etymology: After the Strathbogie Range area in Victoria, where this species occurs and was first recognised as a distinct lineage by Cook (2006).

Comments: P. strathbogiensis shares the characteristics of a long straight rostrum extending beyond the scaphocerite with *P. spinosa*, *P. whitemae* and *P. tasmaniensis*. It differs from all other species by having a long slender palm of the chelae of pereiopod 2 (>2.00 times width); rostrum with 21–24 dorsal

spines of which 1–2 are postorbital spines and 4–6 ventral spines over a length of 1.30–1.80 mm; stylocerite extends to the middle of the process on the apex of the antenular segment 1; scaphognathite of maxilla 2 truncated (Table 2).

P. strathbogiensis is restricted to the upper Goulburn R in the Strathbogie Ranges central Victoria and overlaps with *P. tasmaniensis* (Cook, 2006) and *P. arrostra*.

Paratya tasmaniensis Riek, 1953

Figures 24–26

Paratya tasmaniensis Riek, 1953 (fig. 24a); type examined by MC.
Paratya australiensis Williams and Smith, 1979
Lineage 8 (Cook et al., 2006)
Lineage B (McClusky, 2007)

Type Locality: Small stream at Kingston, Tasmania, just above the tidal zone, 10 January 1947 (Browns R).

Material Examined: Tasmania: Coal R near Campania, –42.6887 S, 147.4359 E, 11 July 2011 (PS); George R on Billabong Bay Rd near St Helens, –41.3137 S, 148.2656 E, 9 July 2011 (PS); Elizabeth R at Campbelltown, –41.9332 S, 147.4934 E, 13 July 2011 (PS); Browns R at Kingston, –42.9659 S, 147.3117 E, 12 July 2011 (PS); Swamp off Five Mile Rd, Flinders Island, 39.9053 S, 147.9746 E, 1 November 1973 (TW, PSL, BK).

Victoria: Wimmera R downstream of Dimboola Weir, –36.4557 S, 142.0167 E, 6 March 2012 (Vic EPA); Glenelg R at Ford Reserve, –37.2472 S, 141.8458 S, 11 July 2017 (BM); Hamilton Lake boat ramp, –37.7327 S, 142.0399 E, 2 February 2018 (PS); Glenelg R, –37.9289 S, 141.2782 E, 1 November 2017 (AC); Glenelg R near Kanagulk, –37.1497 S, 141.8637 E, 1 November 2017 (AC).

New South Wales Stream on Gerrigong Ck Rd, Upper Kangaroo Valley, –34.6870 S, 150.6000 E, 27 September 2017 (PS, JM. JH); Kangaroo R, Hampden Bridge, –34.7272 S, 150.5218 E, 27 September 2017 (PS, JM. JH); Maguire Ck, –28.0837 S, 153.3364 E 26 May 2015 (BM); Hastings R off Oxley Highway, –31.4647 S, 152.6278 E, 1 November 2011 (PS, JM, MC).

South Australia. Brenda Park wetland south of Morgan, –34.0818 S, 139.6743 E, 8 November 2011 (CM).

Diagnosis: P. tasmaniensis differs from all other species by the following combination of characters: rostrum long, extending beyond both antennular peduncle and scaphocerite, dorsal edge straight or very fine curve, dorsally armed with 22–29 spines, 2–4 postorbital spines, ventrally with 4–13 large serrations over a length of 2.10–3.40 mm, all forward of greatest depth; distal half of ventral edge straight; left mandible with 4 teeth separated by smooth notch then 4 short ridges at base of a less distinct apical tooth; right mandible with 4 teeth in a single incisor process with large third tooth; scaphognathite of maxilla 2 truncated and square apically extending to two-thirds length of upper endite; maxilliped 1 with exopod flagellum distinct, well developed and with numerous long setose spines on all margins, over half length of caridean lobe; exopod of maxilliped 2 1.57–2.50 times longer than endopod, epipodite with long podobranchs extending just to base of third segment of endopodite; maxilliped 3 with medial distal margin of apical segment of endopod with 8–11 broad teeth-like spines, outer margin with 3–9 teeth-like spines, exopod long and narrow, tip over-reaching distal end of basal endopod segment; Pereiopod 1 with short and broad to long and slender chelae, carpus short to long and exopod extending to mid-apex of carpus; pereiopod 2 with exopod extending to mid merus; dactylus of pereiopod 3 with prominent terminal claw and 9–11 strong spines on medial margin, exopod extends to mid merus; dactylus of pereiopod 4 prominent terminal claw and 8–12 spines on medial margin, exopod extends to mid merus; dactylus of pereiopod 5 with prominent terminal claw and very regular comb-like row of 70–85 small spines on medial margin, exopod extends to basal to mid merus.

Carapace length 5.40–7.50 mm.

Rostrum long 5.65–7.10 mm, extending beyond the antennular peduncle and well beyond the scaphocerite (fig. 24a), rostral length 0.88–1.26 times carapace length, shape long and slender, usually straight, pointed; rostral length 6.90–8.50 times greater than width; dorsally armed with 22–29 teeth, ratio of dorsal spines to length is 3.33–4.60, 2–4 postorbital spines (fig. 24a); ventrally with 4–13 large spines over a length of 2.10–3.40 mm, at to anterior to point of greatest width (fig. 24a), distal half of ventral edge straight, ratio of ventral spine length to rostral length is 0.33–0.48 with 2.00–6.50 more dorsal spines than ventral spines; rostral length 1.15–1.69 times length of scaphocerite.

Antenna 1 (fig. 24b) peduncle short 4.04–5.52 mm long, not reaching distal tip of scaphocerite, 0.78–1.31 times scaphocerite length. Stylocerite 2.20–2.84 mm long, length 6.88–12.00 longer than wide, 0.33–0.41 times carapace length, reaching beyond distal border of peduncle segment extending almost to apex or just beyond distal angle process (fig. 24b).

Antenna 2 (fig. 24c) second segment 1.20–1.68 mm long, length 1.88–2.83 times width and 0.23–0.37 times length of scaphocerite. Scaphocerite 4.0–5.4 mm long, 2.86–4.33 times as long as wide and 0.56–0.85 times carapace length.

Mouthparts. Left mandible (fig. 24d, e) with a blunt apical tooth and 4 short ridges at its base, separated from incisors by part smooth and part ridged U-shaped notch. Incisors with 2 large teeth and 2 slightly smaller robust teeth at base. Spine row with 10 spines, each finely setose. Right mandible (fig. 24f, g) with incisors with 4 large teeth in a single incisor process, with third tooth larger than other 3. Spine row immediately below teeth with 9 spines each finely setose, spine row above molar process. Molar process ridged.

Maxilla 1 (fig. 24h) as for *P. australiensis*.

Maxilla 2 (fig. 24i) scaphognathite truncated and square apically extending to approximately two-thirds length of upper endite.

Maxilliped 1 (fig. 24j) as for *P. australiensis*.

Maxilliped 2 (fig. 24k) endopod 0.97–1.17 mm long, exopod long and narrow, length 1.55–2.93 mm, exopod 1.57–2.50 longer than endopod. Epipodite with long podobranch extending to basal third of third segment of endopodite.

Maxilliped 3 (fig. 25a) endopod 5.41–8.32 mm long, 2.34–3.12 times longer than exopod; with 3 distal segments of similar length; basal segment curved, apical segment with large terminal claw, medial distal margin with 8–11 broad teeth-like spines, largest 1–2 in basal half, outer margin with 1–2 long teeth-like spines; middle segment with 2–3 medial spines and 0–4 spines on outer margin. Exopod long and narrow 2.67–3.33 mm, 0.32–0.43 times length of endopod, extends to base of mid segment.

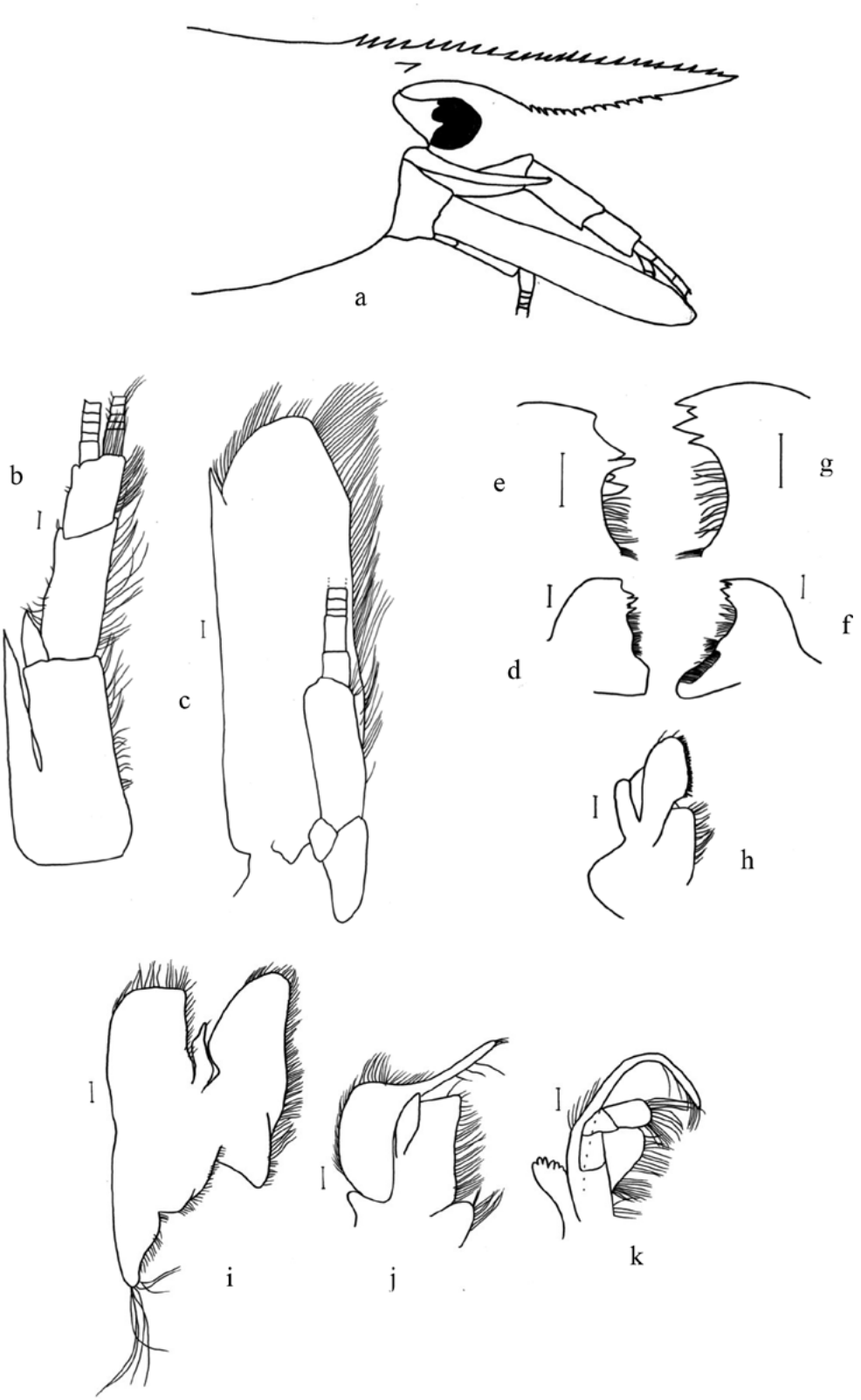


Figure 24. *Paratya tasmaniensis* Riek: a, head region and rostrum; b, antenna 1 peduncle and stylocerite; c, scaphocerite; d, left mandible; e, enlarged incisors; f, right mandible; g, enlarged incisors; h, maxilla 1; i, maxilla 2; j, maxilliped 1; k, maxilliped 2. Scale lines 0.2 mm.

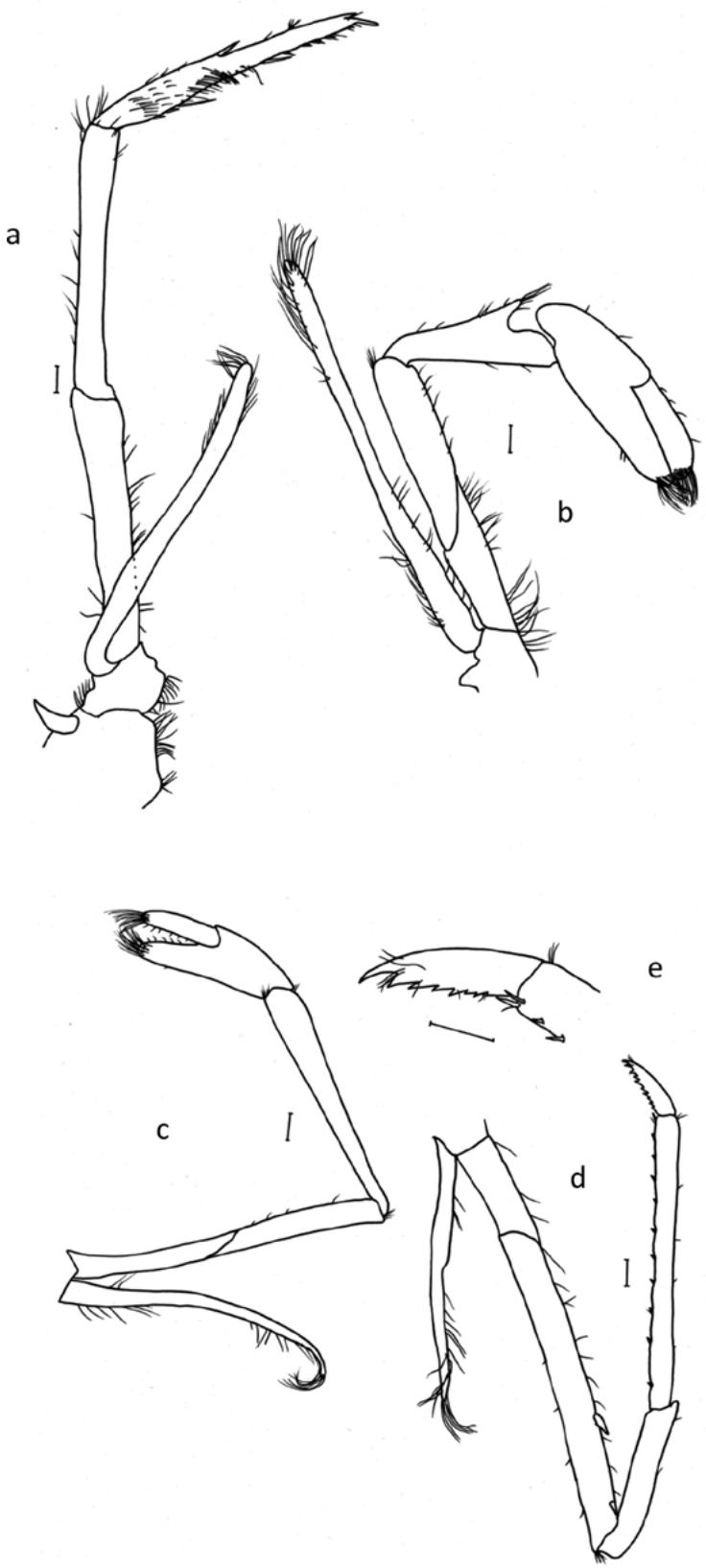


Figure 25. *Paratya tasmaniensis* Riek: a, maxilliped 3; b, pereiopod 1; c, pereiopod 2; d, pereiopod 3; e, dactylus. Scale lines 0.2 mm.

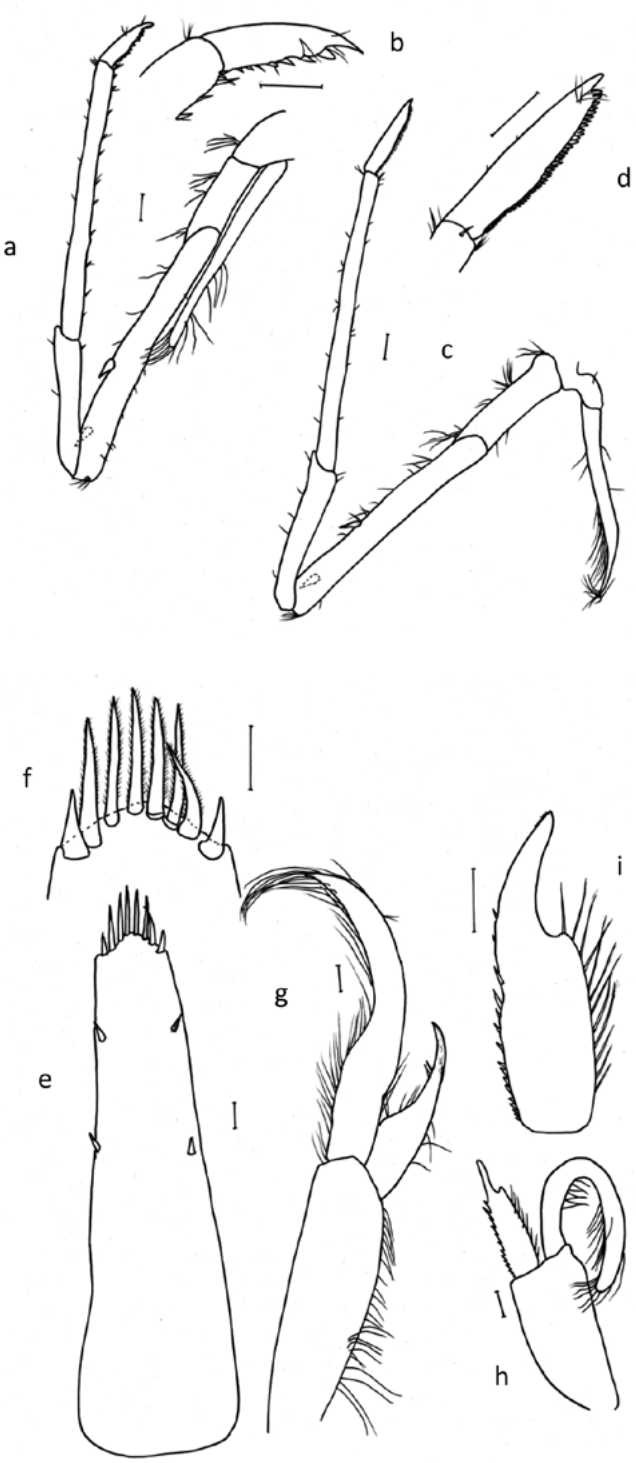


Figure 26. *Paratya tasmaniensis* Riek: a, pereiopod 4; b, dactylus 4; c, pereiopod 5; d, dactylus 5; e, telson; f, telson terminal spines; g, pleopod 1 of female; h, pleopod 1 of male; i, endopod 1 of male. Scale lines 0.2 mm.

Thoracic appendages. Pereiopod 1 (fig. 25b) short, 4.87–5.68 mm long, 0.74–0.84 times carapace length. Chelae short and broad to long and slender (fig. 25b), 1.49–1.87 mm long, 2.95–3.43 times as long as wide, 1.75–2.22 times longer than dactylus, 1.25–1.41 times longer than carpus; palm length 1.60–1.83 longer than palm width, 1.33–1.67 times dactylus length. Carpus short to long, 2.00–2.87 times as long as greatest width, broadening distally, distal margin excavate. Segment ratios 0.45–0.78 : 1.25–1.41 : 1.00 (1.00–2.67) mm : 1.17–1.80 : 0.44–0.53 : 2.51–2.68. Exopod extending to mid-apex of carpus.

Pereiopod 2 (fig. 25c) longer than pereiopod 1, 6.76–8.17 mm long, 0.91–1.29 times carapace length. Chelae long and slender (fig. 25c), 1.47–1.81 mm long, 3.06–3.93 times as long as wide, half to two-thirds length of carpus; palm length 1.80–3.35 longer than palm width, 0.80–1.35 times length of dactylus. Propodus 1.57–2.06 times dactylus length. Carpus long 5.79–7.22 times as long as greatest width, slightly broader distally. Segment ratios 0.31–0.40 : 0.59–0.71 : 1.00 (2.16–2.81) mm : 0.75–1.15 : 0.34–0.50 : 0.90–1.38. Exopod extending to mid merus.

Pereiopod 3 (fig. 25d, e) distinctly longer than pereiopod 2 and more slender, length 8.43–10.05 mm, 1.32–1.71 times carapace length. Dactylus with prominent terminal claw and 9–11 strong spines on medial margin (fig. 25e). Propodus 3.87–4.81 times longer than dactylus, length 11.36–14.17 times longer than wide with 11–18 spines on inner margin and 3 transverse spines apically. Merus with 1 strong spine on medial margin and 1 near ventral distal margin. Segment ratios 0.34–0.46 : 1.48–1.77 : 1.00 (1.66–2.03) mm : 1.63–2.06 : 0.44–0.63 : 1.40–1.76. Exopod extends to mid merus.

Pereiopod 4 (fig. 26a, b) similar to pereiopod 3, 8.63–10.47 mm long, 1.29–1.76 times carapace length. Dactylus with prominent terminal claw and 8–12 spines on medial margin (fig. 26b). Propodus 3.78–4.80 times longer than dactylus, length 8.06–15.54 times longer than wide, with 14–19 spines on medial margin, none on outer margin; merus with 1–2 strong spines on medial margin and 1 near ventral distal margin. Segment ratios 0.32–0.43 : 1.52–1.77 : 1.00 (1.66–2.13) mm : 1.73–2.08 : 0.41–0.66 : 1.55. Exopod extends to mid merus.

Pereiopod 5 (fig. 26c, d) similar length to pereiopod 4, 8.31–10.03 mm long, 1.15–1.68 times carapace length. Dactylus with prominent terminal claw and very regular, comb-like row of numerous (70–85) small spines on medial margin (fig. 26d). Propodus 3.21–4.54 times longer than dactylus, length 11.80–14.71 times longer than wide with 8–14 long medial teeth and external margin without teeth. Carpus without any large spines near distal margin. Merus 1 strong spine on medial margin and 1 near ventral distal margin. Segment ratios 0.41–0.61 : 1.85–2.02 : 1.00 (1.59–1.93) mm : 1.45–1.76 : 0.53–0.70 : 0.99–1.52. Exopod extends to basal to mid third of merus.

Abdomen. Pleopods peduncle of first pleopod short, 0.27–0.37 times length of carapace, 2.00–3.93 times width, exopod 1.11–1.78 times peduncle length, endopod 0.55–0.88 times peduncle length (fig. 26g); second pleopod peduncle short, 0.34–0.42 times length of carapace, 2.25–2.94 times width, exopod 1.11–1.63 times peduncle length, endopod slightly shorter 0.91–1.50 times peduncle length. Length of first peduncle 0.96–1.34 times length of second peduncle.

Telson (fig. 26e, f) length 3.80–4.70 mm, 0.59–0.70 times carapace length and tapering distally, 2.83–3.79 times as long as greatest width. Dorsal surface with 2 pairs of strong submarginal teeth-like spines. Posterior margin convex with 1 pair of teeth-like spines outermost, 6–12 long strong setose spines (fig. 26f).

Uropods approximately equal to telson length.

Males endopod of first pleopod excavated apically with 10–14 short spines on external margin and 16–18 long spines on inner margin (fig. 26h, i).

Comments: P. tasmaniensis was described by Riek (1953) from Browns R at Kingston, Tasmania. It is the only species in Tasmania with a wide distribution on the eastern, southern and northern streams, also on the northern west coast streams and on Flinders Island. It does not occur in lakes of the central plateau, except at Lakes Crescent and Sorrell at an altitude of 800 m (McClusky, 2007). *P. tasmaniensis* also occurs on the mainland coastal and inland streams in South Australia, Victoria and New South Wales (fig. 32c). It shares the characteristics of a long straight rostrum extending beyond the scaphocerite with *P. spinosa* and *P. strathbogiensis* and the distinguishing characters are given in Table 2.

Walker (1973), in his study of Tasmanian *Paratya*, described the morphological characteristics of *P. tasmaniensis* (not including mouthparts) and described the life history from the Coal R and a small wetland at Pawleena.

Paratya rouxi n. sp.

Figures 27–29

http://zoobank.org/urn:lsid:zoobank.org:act:8319F351-EA76-4AF9-9C63-63F0CEB5E292

P. australiensis Roux
Lineage 9 (Cook et al., 2006)

Type Material: Holotype New South Wales. Wakool Reserve, –35.496 S, 144.454 E, June 2011 (JC). Body in ethanol and antennae, mouthparts, pereiopods and abdominal structures dissected, mounted on 2 slides. AM Ref No. P.105605, Accession Ref. MC83, Genbank Registration OL420861.

Paratypes: New South Wales. Wakool Reserve, –35.4963 S, 144.4541 E, June 2011 Accession Ref. MC672 Genbank Registration OL420849, PS1–PS2 (JC), Bodies in ethanol and other structures dissected, mounted on 2 slides each.

Material Examined: As for type material.

Diagnosis: P. rouxi differs from all other species by the following combination of characters: rostrum very short, extending just beyond the first segment of the antennular peduncle, rostrum short and broad with a downward curve, dorsally armed with 11–19 spines, 0 postorbital spines, ventrally with 1–2 spines over a length of less than 0.4 mm, all forward of greatest depth; distal half of ventral edge straight, rostral length 0.57–0.73 times length of scaphocerite; left mandible with 4 teeth in two groups separated by smooth U-shaped notch from a distinct apical tooth; right mandible with 4 teeth in two separate incisor processes; scaphognathite of maxilla 2 truncated apically with an inner lobe almost extending to apex of upper endite; maxilliped 1 with exopod flagellum distinct, well developed and with numerous long setose spines on all margins, over half length of caridean lobe; exopod of maxilliped 2 1.9–2.7 times longer than endopod, epipodite with long podobranchs extending to basal third of third segment of endopodite; maxilliped 3 with medial distal margin of apical segment of endopod with 7–10 broad teeth-like spines, outer margin with 2 long teeth-like spines near terminal spine and 1 mid outer spine, exopod long and narrow, tip over-reaching distal end of basal endopod segment; pereiopod 1 with long carpus and long slender chelae; pereiopod 2 with exopod extending to mid merus; dactylus of pereiopod 3 with prominent terminal claw and 10–12 strong spines on medial margin, exopod extends to mid merus; dactylus of pereiopod 4 prominent terminal claw and 8–12 spines on medial margin, exopod extends to apical third of merus; dactylus of pereiopod 5 with prominent terminal claw and very regular comb–like row of 70–80 small spines on medial margin, exopod extends to mid merus.

Carapace length 4.90 (4.90–5.30) mm.

Rostrum very short (fig. 27a), 2.70 (2.10–2.75) mm long, extending just beyond the first segment of the antennular peduncle, 0.55 (0.49–0.55) times length of carapace, shape convex, short and broad with downward curve, pointed; rostrum 6.75 (5.00–6.75) longer than wide; dorsally armed with 19 (11–19) spines (fig. 27a), ratio of dorsal spine number to length is 7.04 (4.61–7.04) without postorbital eye spines; ventrally with 1 (1–2) spines over a length of 0.10 (0.10–0.40) mm, all anterior to greatest width; distal half of ventral edge straight, ratio of ventral spines length to rostral length is 0.03 (0.04–0.15) and 19.00 (6.00–19.00) more dorsal spines than ventral spines; rostral length 0.73 (0.57–0.73) times length of scaphocerite.

Antenna 1 (fig. 27b) peduncle short, 3.24 (3.24–3.64) mm long, not reaching distal tip of scaphocerite, 0.88 (0.88–0.98) times scaphocerite length. Stylocerite 1.80 (1.80–2.03) mm long, length 11.25 (9.00–11.25) longer than wide, 0.37 (0.34–0.38) times carapace length, just reaching beyond distal border of peduncle segment and to base of distal angle process (fig. 24c).

Antenna 2 (fig. 27c) second segment 1.16 (1.00–1.30) mm long, 0.31 (0.27–0.34) times length of scaphocerite and 2.42 (2.42–2.50) times width. Scaphocerite 3.70 (3.65–3.80) mm long, 0.76 (0.70–0.76) times carapace length and 3.36 (2.71–3.36) times as long as wide.

Mouthparts. Left mandible (fig. 27d, e) with incisors of 4 teeth (2 large teeth and 2 robust teeth (one small and one large) at base), separated from a large acute apical tooth by a smooth U-shaped notch. Spine row with 9 spines, each finely setose, spine row above molar process of approximately over 40 sparsely setose spines. Right mandible (fig. 27f, g) with 4 teeth in 2 separate incisor processes with apical and second teeth large. Spine row immediately below teeth with 12 spines each finely setose, spine row above molar process. Molar process ridged.

Maxilla 1 (fig. 27h) as for *P. australiensis*.

Maxilla 2 (fig. 27i) scaphognathite apex truncated with an inner lobe, almost extending to apex of endite.

Maxilliped 1 (fig. 27j) as for *P. australiensis*.

Maxilliped 2 (fig. 27k) endopod 0.80 (0.76–0.84) mm long; exopod length 2.07 (1.60–2.07) mm, long and narrow, exopod 2.58 (1.90–2.71) longer than endopod. Epipodite with long podobranch extending to basal third of third segment of endopodite.

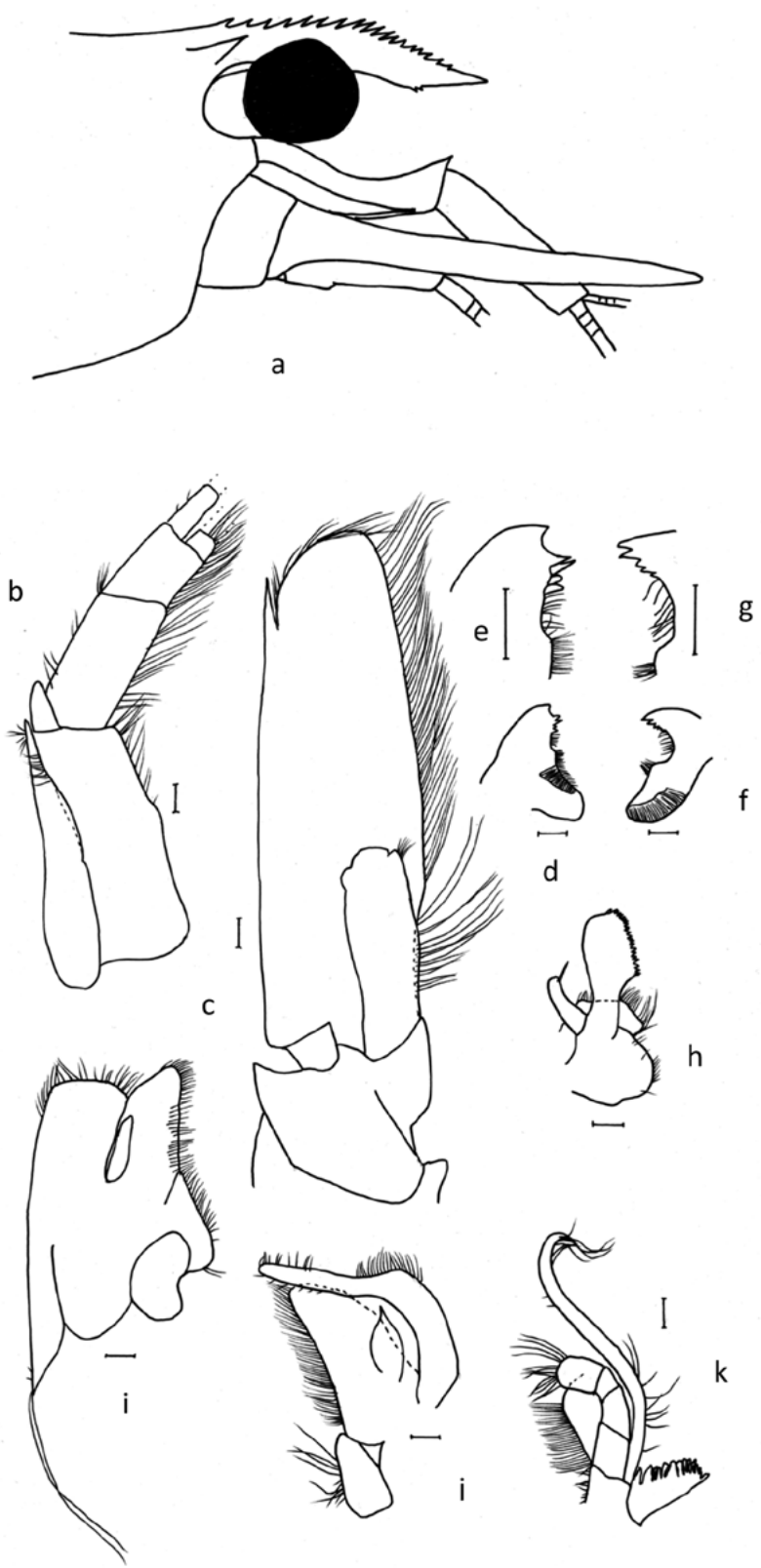


Figure 27. *Paratya rouxi* sp. nov.: a, head region and rostrum; b, antenna 1 peduncleand stylocerite; c, scaphocerite; d, left mandible; e, enlarged incisors; f, right mandible; g, enlarged incisors; h, maxilla 1; i, maxilla 2; j, maxilliped 1; k, maxilliped 2. Scale lines 0.2 mm.

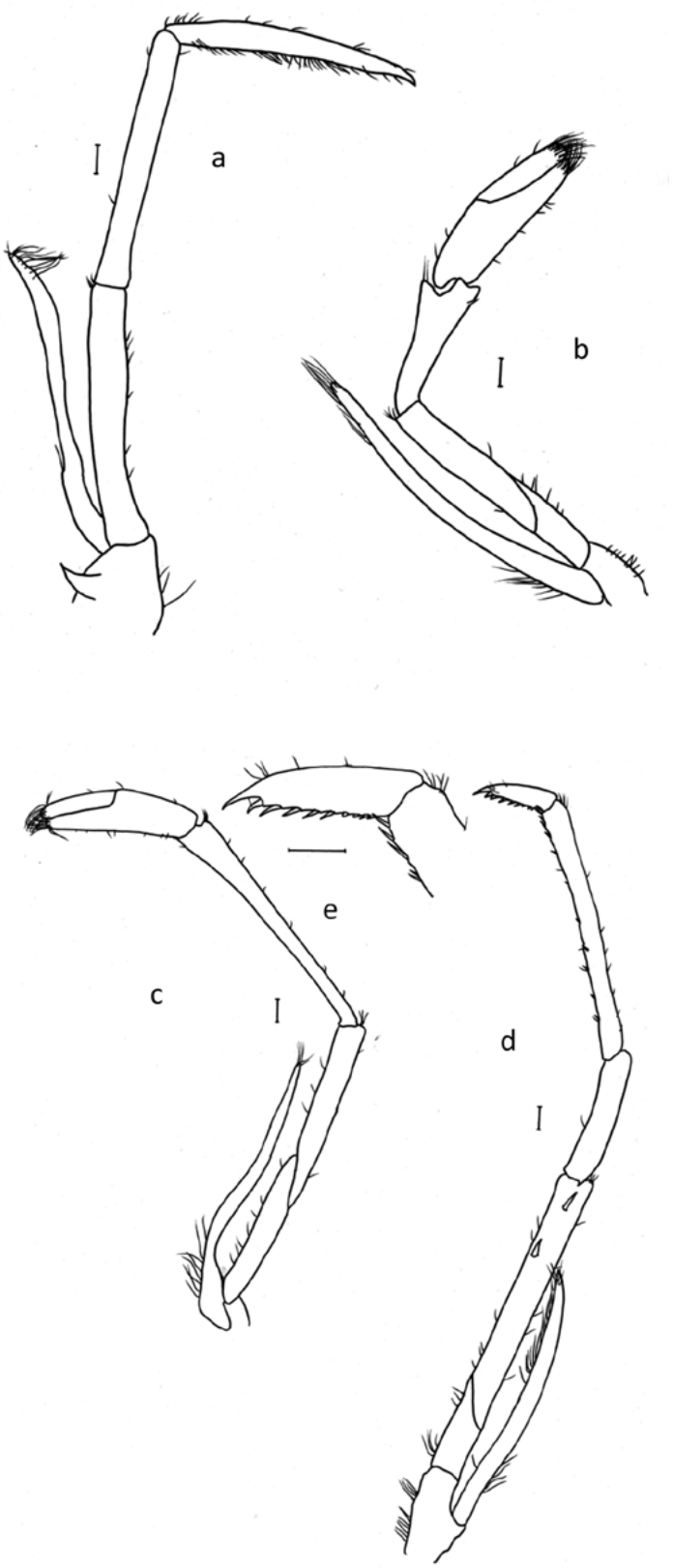


Figure 28. *Paratya rouxi* sp. nov.: a, maxilliped 3; b, pereiopod 1; c, pereiopod 2; d, pereiopod 3; e, dactylus 3. Scale lines 0.2 mm.

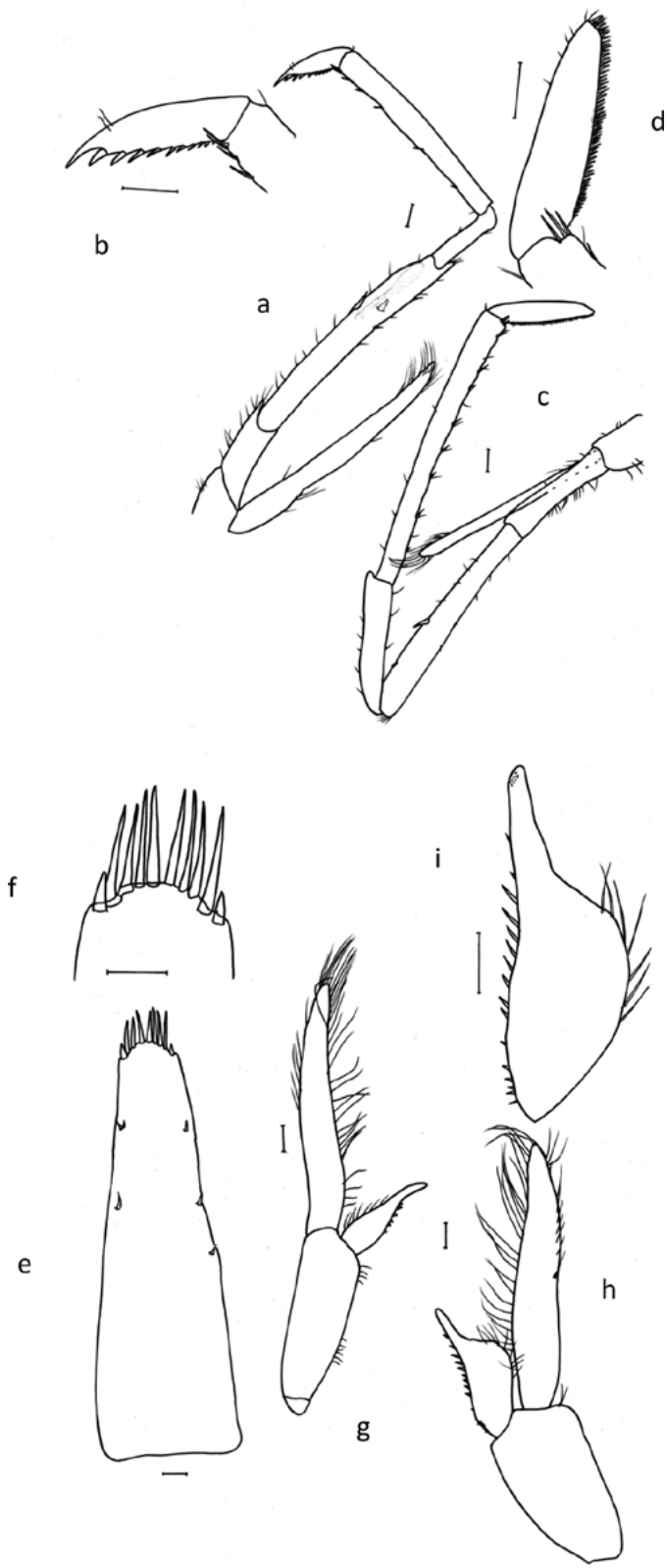


Figure 29. *Paratya rouxi* sp. nov.: a, pereiopod 4; b, dactylus 4; c, pereiopod 5; d, dactylus 5; e, telson; f, telson terminal spines; g, pleopod 1 of female; h, pleopod 1 of male; i, endopod 1 of male. Scale lines 0.2 mm.

Maxilliped 3 (fig. 28a) endopod 5.36 (5.36–5.95) mm long, 2.51 (2.07–2.51) times longer than exopod; basal segment curved, apical segment with large terminal claw, medial distal margin with 8 (8–10) broad teeth-like spines, largest 3 in mid half and 1 long spine in basal third, outer margin with 1 long tooth-like spines near terminal spine and 1 mid outer spine. Exopod 2.13 (2.13–2.88) mm long, narrow, tip over-reaching distal end of basal endopod segment.

Thoracic appendages. Pereiopod 1 (fig. 28b) short, 3.92 (3.92–4.25) mm long, 0.80 (0.74–0.85) times carapace length. Chelae short and slender (fig. 28b), 1.33 (1.25–1.35) mm long, propodus 3.85 (3.10–3.85) times as long as wide, propodus length 2.17 (1.92–2.17) times longer than dactylus; palm length 2.11 (1.90–2.11) times palm width, 1.36 (1.06–1.36) times dactylus length. Carpus long, 2.33 (2.33–3.00) times longer than greatest width. Segment ratios 0.66 (0.54–0.66) : 1.43 (1.16–1.43) : 1.00 (0.93 [0.93–1.13] mm) : 1.33 (1.15–1.33) : 0.44 (0.40–0.45) : – . Exopod extending to mid-apex of carpus.

Pereiopod 2 (fig. 28c) longer than pereiopod 1, 6.00 (6.00–6.90) mm long, 1.22 (1.19–1.38) times carapace length. Chelae long and slender (fig. 28c), 1.33 (1.28–1.33) mm long, half to two-thirds length of carpus, 4.00 (3.63–4.00) times as long as wide, palm length 2.38 (2.22–2.38) times palm width, 1.27 (1.25–1.27) times longer than dactylus. Propodus length 1.92 (1.85–2.04) times longer than dactylus. Carpus 6.96 (6.96–9.27) times as long as greatest width, slightly broader distally, distal margin with small excavation. Segment ratios 0.33 (0.27–0.33) : 0.63 (0.54–0.63) : 1.00 (2.13 [2.13–2.40] mm) : 0.79 (0.77–0.79) : 0.39 (0.38–0.39) : 0.94 (0.94–1.10). Exopod extending to mid-apical third of merus.

Pereiopod 3 (fig. 28d, e) distinctly longer than pereiopod 2 and more slender 6.96 (6.48–7.20) mm long, 1.42 (1.22–1.44) times carapace length. Dactylus with prominent terminal claw and 10 (10–12) strong spines on medial margin (fig. 28e). Propodus 3.40 (3.40–4.13) times longer than dactylus, length 12.31 (12.31–12.47) times longer than wide with 7 (7–10) spines on inner margin. Merus with 2 (1–2) strong spine on medial margin and 1 near ventral distal margin. Segment ratios 0.48 (0.47–0.54) : 1.65 (1.65–2.00) : 1.00 (1.29 [1.13–1.35] mm) : 2.19 (1.88–2.22) : 0.54 (0.54–0.78) : – (1.75–2.04). Exopod extends to mid merus.

Pereiopod 4 (fig. 29a, b) similar to pereiopod 3, 6.83 (6.05–6.83) mm long, 1.39 (1.14–1.39) times carapace length. Dactylus with prominent terminal claw and 8 (8–12) spines on medial margin (fig. 29b). Propodus 3.36 (3.03–3.58) times longer than dactylus, length 14.00 (12.57–14.00) times longer than wide, with 11 (8–11) spines on medial margin and 1 apically on outer margin; merus with 2 strong spine on medial margin and 1 near ventral distal margin. Segment ratios 0.52 (0.52–0.63) : 1.75 (1.75–2.04) : 1.00 (1.28 [1.07–1.28] mm) : 2.06 (2.00–2.06) : 0.52 (0.52–0.58) : 1.85 (1.85–2.00). Exopod extends to apical third of merus.

Pereiopod 5 (fig. 29c, d) similar length to pereiopod 4, 7.08 (6.48–7.08) mm long, 1.44 (1.22–1.44) times carapace length. Dactylus with prominent terminal claw and very regular, comb-like row of numerous 72 (70–80) small spines on medial margin (fig. 29d). Propodus 2.90 (2.59–3.00) times longer than dactylus, length 13.13 (12.94–13.13) times longer than wide, with 8 (8–9) long medial teeth and external margin without teeth. Carpus without any large spines near distal margin. Merus with 1 strong medial spine and 1 distal spine; ischium one-third length of propodus; segment ratios 0.71 (0.67–0.78) : 2.05 (1.93–2.16) : 1.00 (1.28 [1.20–1.43] mm) : 1.67 (1.67–1.83) : 0.81 (0.67–0.81) : 1.61 (1.50–1.67). Exopod extends to mid third of merus.

Abdomen. Pleopods peduncle of first pleopod short, 0.41 (0.29–0.41) times length of carapace length, 2.67 (2.38–3.00) times width, exopod 1.25 (1.25–1.42) times peduncle length, endopod – (0.60) times peduncle length (fig. 29g); second pleopod peduncle short, 0.45 (0.38–0.55) times length of carapace, 2.93 (1.60–3.93) times width, exopod 1.14 (0.84–1.23) times peduncle length, endopod slightly shorter – (0.80–1.13) times peduncle length. Length of first peduncle 1.10 (1.10–1.83) times length of second peduncle.

Telson (fig. 29e, f) length 3.50 (3.50–3.75) mm, 0.71 (0.66–0.71) times carapace length and tapering distally, 3.24 (2.50–3.48) times as long as greatest width. Dorsal surface with 2 (2–3) pairs of strong submarginal teeth-like spines. Posterior margin convex with 1 pair of teeth-like spines outermost, 12 (8–12) long strong setose terminal spines (fig. 29f).

Uropods approximately equal to telson length.

Male smaller than females, carapace length 3.88 mm; endopod of pereiopod 1 not strongly excavated with 8 short spines on outer margin, 2 spines at apex of finger-like projection and a long spine at base of projection, inner margin with 10 long setae (fig. 29h, i).

Etymology: This species is named after Dr Jean Roux, who in 1926 clearly recorded the characteristics that are diagnostic for *P. rouxi* from North Yanco in New South Wales. Roux also recognised a second morphological form of *Paratya* at the same location, similar to specimens from the Sydney area. Roux was not prepared to describe a new species based on the rostral characters, especially as similar morphology was present in the area of the type for *P. australiensis*. The second morphological form was probably *P. arrostra*.

Comments: P. rouxi can be confused with *P. arrostra* (4C) because both have a short rostrum, but *P. rouxi* lacks post-orbital spines, has 1–2 ventral rostral spines, telson 0.66–0.70 times carapace length, rostral length 0.57–0.73 times scaphocerite length, pereiopod 1 has a long slender carpus and chelae with carpus length 2.33–3.00 times longer than wide, pereiopod 2 with dactylus 0.27–0.33 times carpus length and propodus 0.54–0.63 times carpus length and propodus 3.63–4.00 times longer than wide, whereas *P. arrostra* (4C) has 0–1 post-orbital spines, 4–5 ventral spines, telson 0.44–0.60 carapace length, rostral length 0.80–0.90 times scaphocerite length, pereiopod 1 has a short carpus and robust, broad cheliped with carpus length 1.71–1.91 times longer than wide, pereiopod 2 with dactylus 0.45–0.53 times carpus length and propodus 0.74–0.79 times carpus length and propodus 2.98–3.08 times longer than wide (see Table 3).

The distribution of *P. rouxi*, which is found in streams in the Murray Darling Basin in New South Wales, does not overlap the short rostrum *P. arrostra* (4C), which occurs in the Conondale Ranges south-eastern Queensland and in the St George district in the upper Condamine R catchment, Queensland (Calman, 1926).

***Paratya gariwerdensis* n. sp.**

Figures 30, 31

http://zoobank.org/urn:lsid:zoobank.org:act:D691687B-83DC-4E45-81AB-26BE4F224714

Lineage D McClusky (2007)

Type Material: Holotype Victoria. Stokes R near Dartmoor –37.8745 S, 141.3014 E, 3 February 2018 (PS). Body in ethanol and antennae, mouthparts, pereiopods and abdominal structures dissected, mounted on 2 slides. Accession Ref. PS41 Genbank Registration OL420914, Museum of Victoria Ref No NMV J75170.

Paratypes: Victoria. Stokes R near Dartmoor –37.8745 S, 141.3014 E, 3 February 2018 Accession Ref PS40, Genbank Registration OL420913, PS46 Genbank Registration OL420918 (PS), NMV J75171–J75172; bodies in ethanol and other structures dissected, mounted on 2 slides each; Wannon R S of Coleraine –37.6652 S, 141.6632 E, 3 February 2018 Accession Ref. PS42–43 Genbank Registration OL420915 (PS) NMV J75173–J75174.

Material Examined: Victoria. Stokes R near Dartmoor –37.8745 S, 141.3014 E, 3 February 2018 (PS); Wannon R south of Coleraine –37.6652 S, 141.6632 E, 3 February 2018 (PS).

Diagnosis: Paratya gariwerdensis differs from all other species by the following combination of characters: rostrum long, 4.00–6.25 mm, extending beyond antennular peduncle and just to end of scaphocerite, rostral length 1.02–1.25 times longer than carapace, dorsal edge curved downwards to tip, narrow and pointed; rostral length 8.40–12.50 times greater than width; dorsally armed with 22–29 teeth, ratio of rostral spines to rostral length is 4.21–6.67; 1–2 postorbital spines; ventrally with 7–10 large serrations over a length of 1.30–2.35 mm, 2–3 spines posterior to greatest depth, distal half of ventral edge straight; ratio of ventral spine length to rostral length is 0.32–0.38 and 2.60–4.00 more dorsal spines than ventral spines; rostral length 1.27–1.35 times length of scaphocerite. Antennular peduncle 2.85–3.63 mm long, not reaching distal tip of scaphocerite, length 0.89–0.94 times length of scaphocerite. Stylocerite 1.35–2.08 mm long, length 6.60–8.30 times width, 0.38–0.43 times carapace length, reaching beyond distal border of peduncle segment but not to end of broad acute process on distal angle of first segment. Right mandible with 4 teeth in a single incisor process with all teeth approximately equal sized; spine row immediately below teeth with 5–8 lifting spines. Scaphognathite of maxilla 2 truncated distally. Pereiopod 1, 3.55–4.10 mm long, 0.82–0.99 times carapace length. Chelae short and broad, 1.10–1.30 mm long, propodus 2.44–3.07 times as long as wide, 1.91–2.19 times longer than dactylus, 1.21–1.33 times longer than carpus; palm length 1.39–1.67 times longer than wide and 1.08–1.20 times dactylus length. Carpus very short, 2.19–2.50 times as long as greatest width. Pereiopod 2 5.05–5.98 mm long, 1.20–1.40 times carapace length. Chelae long and slender 1.15–1.30 mm long, approximately two-thirds length of carpus, 2.61–3.47 times as long as wide, palm length 1.22–1.73 times longer than width and 0.84–0.96 times dactylus length. Propodus 1.68–2.04 times longer than dactylus. Carpus 6.27–7.82 times as long as greatest width. Pereiopod 3 dactylus with prominent terminal claw and 6–7 strong spines on medial margin; propodus length 3.27–3.84 times longer than dactylus, length 10.29–13.00 times longer than wide with 11–13 spines on inner margin. Pereiopod 4, 5.40–7.00 mm long, 1.32–1.54 times carapace length: dactylus with prominent terminal claw and 7–8 spines on medial margin; propodus length 3.75–3.90 times longer than dactylus, length 11.43–14.29 times longer than wide, with 10–11 spines on medial margin. Pereiopod 5, 5.65–7.80 mm long, 1.38–1.57 times longer than carapace; dactylus with prominent terminal claw and very regular, comb–like row of 44–54 small spines on medial margin; propodus length 3.00–3.11 times longer than dactylus, length 11.63–17.40 times longer than wide with 8–13 long medial teeth and no spines on external margin. Posterior margin of telson convex with 1 pair of teeth-like spines outermost, 8–9 long strong terminal setose spines.

Carapace length 4.00 (3.60–4.10) mm.

Rostrum long, 4.40 (4.00–6.25) mm, extending beyond antennular peduncle and just to end of scaphocerite (fig. 30a), rostral length 1.10 (1.02–1.25) times longer than carapace, dorsal edge curved downwards to tip, narrow and pointed; rostral length 9.78 (8.40–12.50) times greater than width; dorsally armed with 28 (22–29) teeth, ratio of rostral spines to rostral length is 6.36 (4.21–6.67); 2 (1–2) postorbital spines (fig. 30a); ventrally with 7 (7–10) large serrations over a length of 1.50 (1.30–2.35) mm, 2–3 spines posterior to greatest depth (fig. 30a), distal half of ventral edge straight; ratio of ventral spine length to rostral length is 0.33 (0.33–0.38) and 4.00 (2.60–4.00) more dorsal spines than ventral spines; rostral length 1.35 (1.27–1.35) times length of scaphocerite.

Antenna 1 (fig. 30b) peduncle 3.05 (2.85–3.63) mm long, not reaching distal tip of scaphocerite, length 0.94 (0.89–0.94) times length of scaphocerite. Stylocerite 1.70 (1.35–2.08) mm long, length 7.56 (6.60–8.30) times width, 0.43 (0.38–0.43) times carapace length, reaching beyond distal border of peduncle segment but not to end of broad acute process on distal angle of first segment (fig. 30b).

Antenna 2 (fig. 30c) second segment of peduncle 0.93 (0.88–1.13) mm long, 0.28 (0.28-0.31) length of scaphocerite and 2.31 (2.31–3.66) longer than wide. Scaphocerite 3.25 (3.15–3.90) mm long, 2.95 (2.95–3.56) longer than wide, 0.81 (0.78–0.88) times length of carapace.

Mouthparts. Left mandible (fig. 30d, e) with 4 teeth separated by a ridged notch from 1 less distinct apical tooth; spine row immediately below incisor process of 5–7 rugose spines (lifting spines); spine row above molar process of approximatelyover 20 sparsely setose spines. Right mandible (fig. 30f, g) with 4 teeth in a single incisor process with all teeth approximately equal sized; spine row immediately below teeth with 5–8 lifting spines; spine row above molar process. Molar process ridged.

Maxilla 1 (fig. 30h) as for *P. australiensis*.

Maxilla 2 scaphognathite truncated distally, not extending to apex of upper endite (fig. 30i); palps small, terminal parts narrow and with 1 sub–apical setose spine.

Maxilliped 1 (fig. 30j) as for *P. australiensis*.

Maxilliped 2 (fig. 30k) endopod 0.75 (0.73–0.93) mm long; basal segment length short, exopod long and narrow 1.75 (1.19–1.75) mm long, exopod 2.34 (1.28–2.34) times longer than endopod. Epipodite with podobranch.

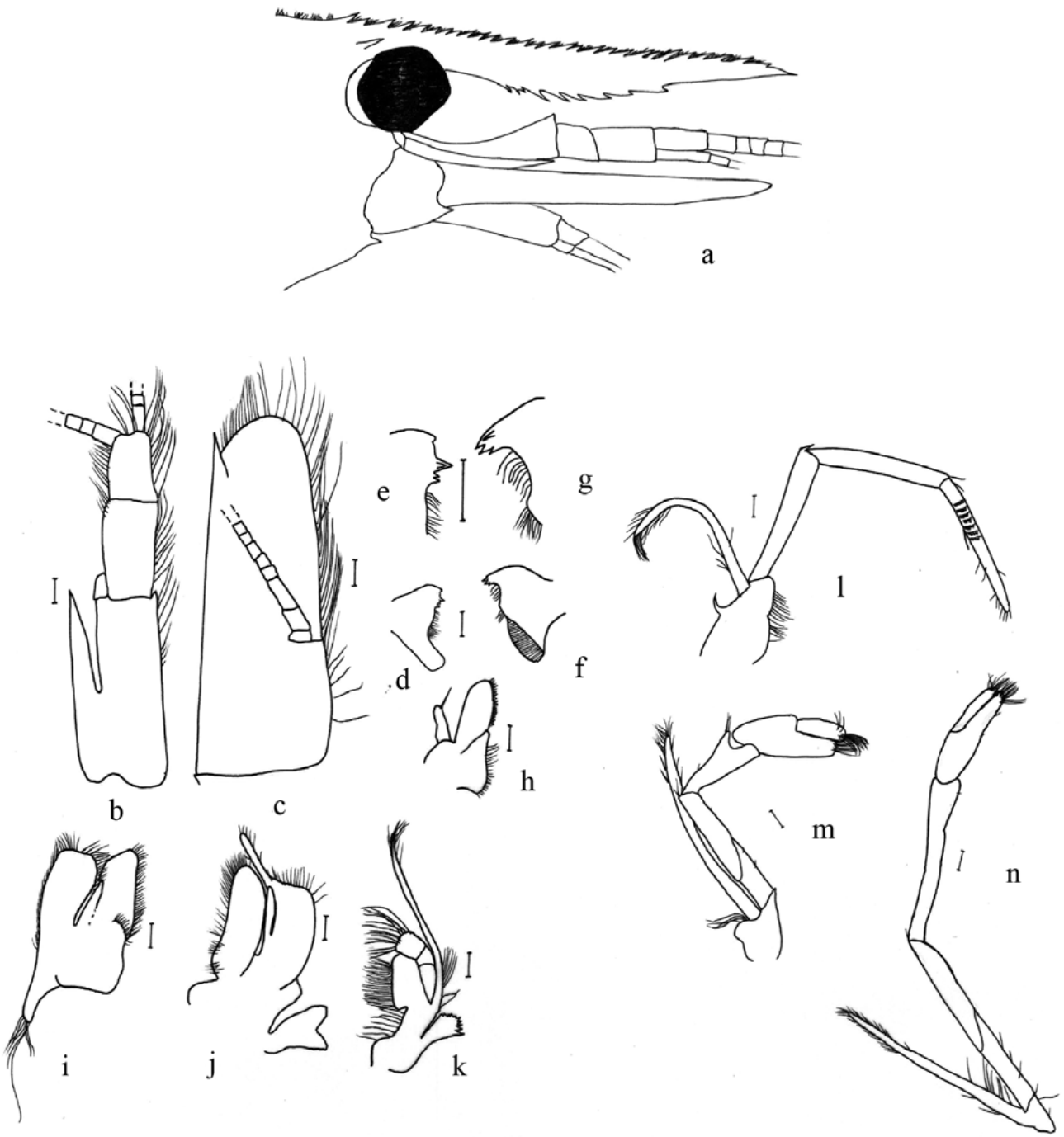


Figure 30. *Paratya gariwerdensis* n.sp.: a) head region and rostrum; b, antenna 1 peduncle and stylocerite; c, scaphocerite; d, left mandible; e, enlarged incisors; f, right mandible; g, enlarged incisors; h maxilla 1; i, maxilla 2; j, maxilliped 1; k maxilliped 2; l, maxilliped 3; m, peraeopod 1; n, peraeopod 2. Scale lines 0.2mm.

Maxilliped 3 (fig. 31i) endopod 4.63 (4.20–5.88) mm long, 2.37 (2.37–2.92) times longer than exopod; with 3 distal segments of similar length; basal segment curved, apical segment with large terminal claw, medial distal margin with 9 (6–9) broad teeth-like spines, largest 1 or 2 in basal third, outer margin with 2 (2–4) teeth-like spines plus 1 apical spine. Exopod long and narrow, 1.95 (1.55–2.25) mm long, tip reaching basal third of mid segment.

Thoracic appendages. Pereiopod 1 (fig. 30m) 3.60 (3.55–4.10) mm long, 0.90 (0.82–0.99) times carapace length. Chelae short and broad (fig. 31b), 1.10 (1.10–1.30) mm long, propodus 2.44 (2.44–3.07) times as long as wide, 1.91 (1.91–2.19) times longer than dactylus; palm length 1.39 (1.39–1.67) times longer than wide and 1.09 (1.08–1.20) times dactylus length. Carpus very short, 2.19 (2.19–2.50) times longer than greatest width, broadening distally, distal margin excavate. Segment ratios 0.66 (0.60–0.66) : 1.26 (1.21–1.33) : 1.00 (0.88 [0.88–1.08] mm) : 1.23 (1.16–1.33) : 0.63 (0.42–0.63) : 2.49 (1.58–2.49). Exopod extending to mid carpus (apex merus–mid carpus).

Pereiopod 2 (fig. 30n) 5.08 (5.05–5.98) mm long, 1.27 (1.20–1.40) times carapace length. Chelae long and slender (fig. 31c) 1.18 (1.15–1.30) mm long, 2.61 (2.61–3.47) times longer than wide, palm length 2.00 (1.22–1.73) times longer than width, 0.96 (0.84–0.96) times dactylus length. Propodus length 2.61 (2.61–3.29) times width, 2.04 (1.68–2.04) times longer than dactylus. Carpus 6.27 (6.27–7.82) times longer than greatest width, slightly broader distally, distal margin with small excavation. Segment ratios 0.33 (0.33–0.37) : 0.68 (0.60–0.68) : 1.00 (1.73 [1.73–2.15] mm) : 0.81 (0.74–0.81) : 0.45 (0.43–0.45) : 1.22 (1.11–1.22). Exopod extending to apex of merus.

Pereiopod 3 (fig. 31a, b) slightly longer than pereiopod 2 and more slender 5.83 (5.53–7.13) mm long, 1.46 (1.35–1.61) times carapace length. Dactylus with prominent terminal claw and 7 (6–7) strong spines on medial margin (fig. 31e). Propodus length 3.27 (3.27–3.84) times longer than dactylus, length 10.29 (10.29–13.00) times longer than wide with 12 (11–13) spines on inner margin. Merus with 1 strong spine on

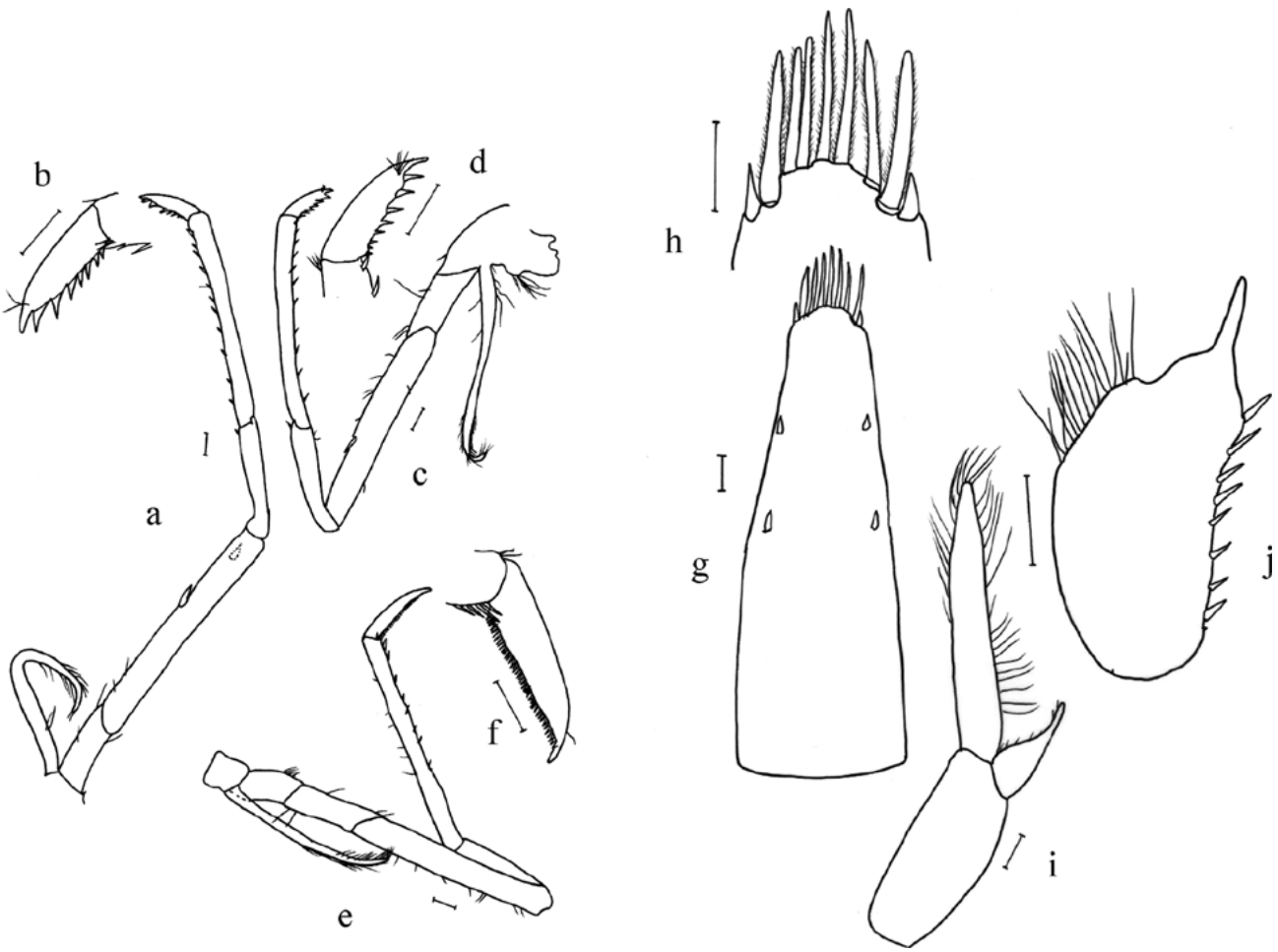


Figure 31. *Paratya gariwerdensis* sp. nov.: a, pereiopod 3; b, dactylus 3; c, pereiopod 4; d, dactylus 4; e, pereiopod 5; f, dactylus 5; g, telson; h, telson terminal spines; i, pleopod 1 of female; j, endopod of pleopod 1 of male. Scale lines 0.2 mm.

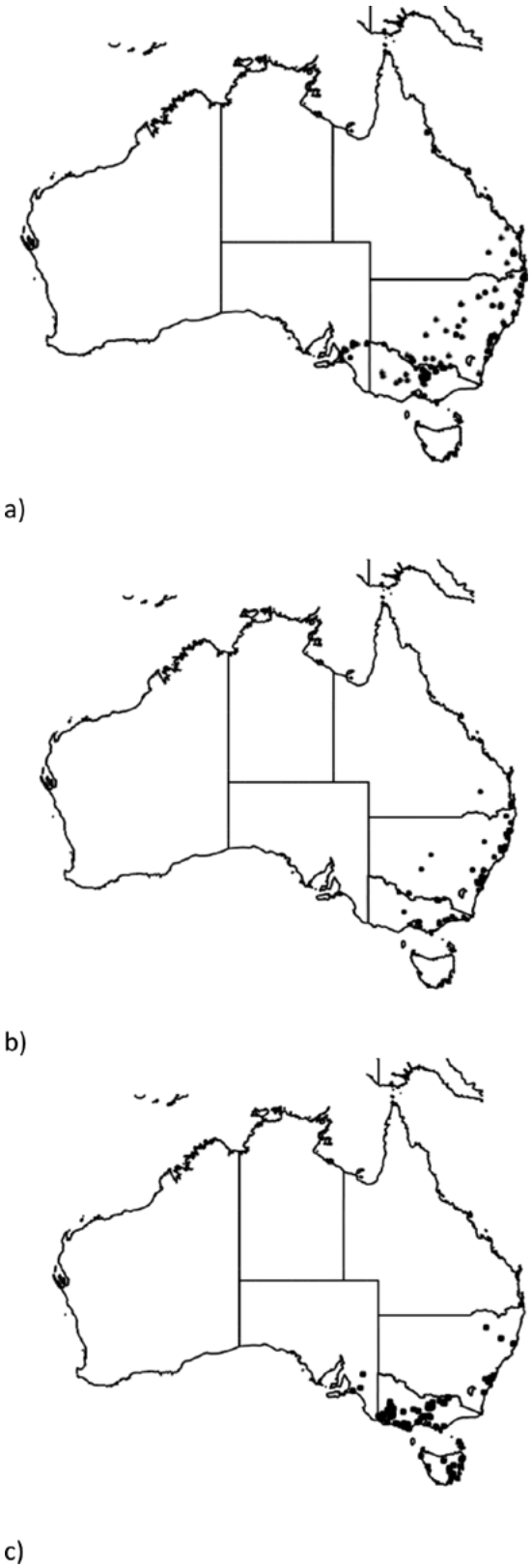


Figure 32. Distribution of material examined in this study: a, *P. arrostra*; b, *P. whitemae*; c, *P. tasmaniensis*. Maps created in Cartographica.

medial margin and 1 near ventral distal margin. Segment ratios 0.48 (0.48–0.53) : 1.57 (1.57–1.95) : 1.00 (1.15 [1.00–1.25] mm) : 1.96 (1.96–2.15) : 0.54 (0.54–0.75) : 1.52 (1.50–1.92). Exopod extends to mid merus.

Pereiopod 4 (fig. 31c d) similar to pereiopod 3, 5.68 (5.40–7.00) mm long, 1.42 (1.32–1.54) times carapace length. Dactylus with prominent terminal claw and 8 (7–8) spines on medial margin (fig. 31g). Propodus length 3.81 (3.75–3.90) times longer than dactylus, length 11.43 (11.43–14.29) times longer than wide, with 11 (10–11) spines on medial margin; merus with 1 strong spine on medial margin and 1 near ventral distal margin. Segment ratios 0.53 (0.50–0.53) : 2.00 (1.88–2.00) : 1.00 (1.00–1.25) mm : 2.05 (1.95–2.05) : 0.63 (0.58–0.63) : 1.80 (1.60–1.80). Exopod extends to mid third of merus.

Pereiopod 5 (fig. 31e f) slightly longer than pereiopods 4, 5.78 (5.65–7.80) mm long, 1.44 (1.38–1.57) times longer than carapace. Dactylus with prominent terminal claw and very regular, comb–like row of 44 (44–54) small spines on medial margin (fig. 31i). Propodus length 3.00 (3.00–3.11) times longer than dactylus, length 11.63 (11.63–17.40) times longer than wide with 11 (8–13) long medial teeth and no spines on external margin. Carpus with 1 large spine near distal margin. Merus with 1 strong medial spine and 1 distal spine Segment ratios 0.84 (0.67–0.84) : 2.51 (2.10–2.51) : 1.00 (0.93 [0.93–1.30] mm) : 2.00 (1.77–2.00) : 0.73 (0.65–0.88) : 1.68 (1.35–1.68). Exopod extends to basal third to mid third of merus.

Abdomen. Pleopods peduncle of first pleopod short 0.28 (0.28–0.35) times length of carapace length, 2.20 (2.20–3.36) times width, exopod 1.52 (1.27–1.52) times peduncle length, endopod 0.64 (0.64–0.80) times peduncle length. (fig. 31l); second pleopod peduncle short, 0.34 (0.34–0.40) times length of carapace, 2.62 (2.62–4.13) times width, exopod 1.27 (1.21–1.36) times peduncle length, endopod slightly shorter 1.16 (1.08–1.32) times peduncle length. Length of first peduncle 1.25 (1.00–1.33) times length of second peduncle.

Telson (fig. 31g h) length 2.80 (2.63–2.80) mm, 0.70 (0.53–0.70) times carapace length, 3.03 (2.76–3.06) times as long as greatest width, and tapering distally. Dorsal surface with 2 pairs of strong submarginal teeth-like spines. Posterior margin convex with 1 pair of teeth-like spines outermost, 9 (6–9) long strong terminal setose spines (fig. 31h).

Uropods slightly longer than telson.

Males smaller than females, carapace length 4.34 mm; endopod of first pleopod strongly excavated apically with 8–10 external spines and 19 long setae on inner margin (fig. 31j).

Etymology: Gariwerd is the aboriginal name for the Grampians Mountains, the Grampians (Gariwerd) National Park in south-western Victoria.

Comments: Paratya gariwerdensis is restricted to the south-western Victoria in streams that drain the Grampians Mountains where it has been recorded with *P. arrostra* and *P. tasmaniensis*.

The long concave rostrum extending beyond the antennular peduncle is a character shared with *P. walkeri*, *P. spinosa*, *P. arrostra*, *P. williamsi* and *P. tasmaniensis*. Three of these species (*P. walkeri*, *P. spinosa* and *P. williamsi*) have not been recorded in Victoria.

Paratya gariwerdensis can be distinguished from the species with a long rostrum by a combination of characters in Table 2 including: ventral spines cover length of 1.30–2.35 mm; stylocerite extending to mid process on apex of basal segment of antennule 1; carapace length of 3.60–4.10 mm; dactylus 3 with 6–7 medial spines; dactylus 4 with 7–8 medial spines; pereiopod 1 length 0.82–0.99 times carapace length; pereiopod 4 propodus length 1.88–2.00 times longer than carpus 4 length; dactylus 5 length 0.67–0.84 times longer than carpus 5 length; propodus 5 length 2.10–2.51 times longer than carpus 5 length; pereiopod 1 length 3.55–4.10 mm; pereiopod 2 length 5.05–5.98 mm; pereiopod 3–5 less than 7.80 mm; scaphognathite of maxilla 2 truncated; right mandible with a single group of incisor teeth, all 4 of similar size

Conclusion

Ten species have been recognised in this study because of the linkage between the molecular and morphological characteristics. The aims were all addressed with the genetic lineages all described with morphological characteristics. It must be added that, without the benefits of the molecular data, the conclusion by Williams and Smith (1979) of a single species is credible, but Riek's (1953) revision, although with some inadequacies as outlined by Williams (1977), was a serious attempt to address the morphological variability observed in this genus.

Key to female *Paratya* from Australia

The following key is based on mature females and caution is required if identifying immature specimens. We have found that mature males can be identified with this key. Many of the species will key out in several couplets because we have tried to incorporate the variation present in each species of *Paratya*.

1 Rostrum short, not extending beyond antennal peduncle (figs12b, c, 27a) 2

1' Rostrum long, extending beyond antennal peduncle figs 5a, f, 6a, 9a, 12a, ... 4

2(1) No post – orbital spines (fig. 27a), rostrum with 1–3 ventral spines over a length of less than 0.4 mm, all anterior to widest point; right mandible with paired incisors, each with two large teeth (fig. 27g); stylocerite extending to basal third of peduncle process (fig. 27b); scaphognathite of maxilla 2 truncated shorter than endite (fig. 27i) ..... *P. rouxi* n.sp. [Inland Murray–Darling Basin, New South Wales]

2' Post–orbital spines present (fig. 12b, c), rostrum with rostrum with 3–7 ventral spines over a length of 0.4–1.1 mm; right mandible with single incisor of 4–5 large teeth (fig. 12j); stylocerite extending almost to end of peduncle process (fig. 12d); scaphognathite of maxilla 2 rounded apical almost to apex of endite (fig. 12k) 3

3(2) 2–3 post orbital spines all contiguous with rostral spines, 3–7 ventral spines over a length of 0.4–1.8mm, all anterior of widest point (fig. 12b) ..... *P. arrostra* (lineage 4B short rostrum)

3' 1 post–orbital spine separated posteriorly from other rostral spines (fig. 12c), 4–5 ventral spines over a length of 0.6–1.2 mm, with some spines posterior to greatest width ..... *P. arrostra* (lineage 4C very short rostrum)

4(1) Rostrum long extending to end or beyond scaphocerite (figs 5a, 6a, 9a, 12a, 18a, 21a, 24a, 30a) 8

4' Rostrum long but not extending beyond scaphocerite (figs 5b, 12a, 15a) 5

5(4) Post-orbital spines absent (fig. 5f); 16–17 dorsal rostral spines ..... *P. australiensis* (in part) [New South Wales, Shoalhaven R catchment]

5' Post-orbital spines present (1–3) (figs 12a, 15a); greater than 21 dorsal rostral spines 6

6(5) Small species, carapace length less than 4.1mm; 2–3 ventral rostral spines posterior to greatest width of rostrum (fig. 30a); south-western Victoria ..... *P. gariwerdensis* n.sp. [South-western Victoria in streams draining the Grampians Mts]

6' Larger species with carapace length greater than 4.8 mm; maximum of 2 ventral rostral spines posterior to greatest width of rostrum (fig. 12a), or all spines anterior greatest width of rostrum (figs 15a, 18a) 7

7(6) First pereiopod chelae shape short and slender (fig. 13b); telson with usually 9–10 long terminal spines (fig. 14f) but may be as few as 5 or as many as 12 spines; dactylus 3 with 8–11 teeth; dactylus 4 with 8–12 teeth ..... *P. arrostra* (long rostrum)

7' First pereiopod chelae shape short and broad (figs 16b, 19b); telson with usually 6–8 long terminal spines (fig. 17f); dactylus 3 with 5–8 teeth; dactylus 4 with 5–6 teeth ..... *P. williamsi* n.sp. [New South Wales, Upper Kangaroo Valley in the Shoalhaven catchment]

8(4) Ventral spines of rostrum all anterior to widest point 9

8' Ventral spines of rostrum 1-2 posterior to widest point 11

9(8) Rostrum shorter than carapace; ventral rostral spines extend over a length less than 2.0 mm 10

9' Rostrum longer than carapace; ventral rostral spines extend over a length greater than 2.0 mm ..... *P. tasmaniensis* [Tasmania and coastal streams in south-east Australia]

10(9) Ventral rostral spines extend over a length of 0.6–1.5 mm (fig. 5a); telson with 6 long terminal spines (fig. 4c in Williams and Smith, 1979); carpus of pereiopod long (1.47–2.84 mm) (fig. 5d, i) ..... *P. australiensis* in part [New South Wales coastal, Sydney area south of Newcastle]

10' Ventral rostral spines extend over a length of 1.3–1.8 mm (fig. 21a); telson with 6–10 long terminal spines (fig. 23b) ..... *P. strathbogiensis* n.sp. [Victoria, Strathbogie Ranges in the upper Goulburn R catchment]

11(8) Rostrum with greater than 14 ventral spines (fig. 6a) ..... *P. walkeri* n.sp. [New South Wales coastal, Bellinger and Tweed catchments]

11' Rostrum with <14 ventral spines 12

12(11) First pereiopod chelae shape short and slender (fig. 13b); telson with usually 9–10 long terminal spines (fig. 14f) but may be as few as 5 or as many as 12 spines ..... *P. arrostra* (long rostrum)

12' First pereiopod chelae shape short and broad (figs 16b, 19b); telson with usually 4–10 long terminal spines (figs 11f, 23d) 13

13(12) Rostrum length longer than carapace length; Dactylus 4 with 8–11 teeth; dactylus 5 with comb of 72–94 spines; propodus 2 length 3.0–3.2 times width; 0.53–0.77 length of dactylus 2 ..... *P. whitemae* n.sp. [Widespread mainland Australia, Victoria coastal and inland Murray–Darling Basin, New South Wales coastal and inland Murray–Darling Basin, Queensland coastal, South Australia inland MDB]

13' Rostrum length shorter than carapace length; dactylus 4 with 7–8 teeth (fig. 11b); dactylus 5 with comb of less than 60 spines; propodus 2 length 3.4–4.3 times width; 0.86–1.3 times length of dactylus 2 ..... *P. spinosa* n.sp. [New South Wales, northern coastal rivers (Tweed R catchment)]

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Supplementary material

Supplementary Table 1: GenBank sequence data used as a genetic backbone for the morphological examination of lineages. GenBank accession number, source publication and new species determination for the sequences.

Sequence	Group	Species determination	Publication source
EU251947 1 McClusky haplotype D9	McClusky D	*P. gariwerdensis*	McCluskey unpublished thesis 2
EU251946 1 McClusky haplotype D8	McClusky D	*P. gariwerdensis*	McCluskey unpublished thesis 2
EU251945 1 McClusky haplotype D7	McClusky D	*P. gariwerdensis*	McCluskey unpublished thesis 2
EU251944 1 McClusky haplotype D6	McClusky D	*P. gariwerdensis*	McCluskey unpublished thesis 2
EU251943 1 McClusky haplotype D5	McClusky D	*P. gariwerdensis*	McCluskey unpublished thesis 2
EU251942 1 McClusky haplotype D4	McClusky D	*P. gariwerdensis*	McCluskey unpublished thesis 2
EU251941 1 McClusky haplotype D3	McClusky D	*P. gariwerdensis*	McCluskey unpublished thesis 2
EU251940 1 McClusky haplotype D2	McClusky D	*P. gariwerdensis*	McCluskey unpublished thesis 2
EU251939 1 McClusky haplotype D12	McClusky D	*P. gariwerdensis*	McCluskey unpublished thesis 2
EU251938 1 McClusky haplotype D11	McClusky D	*P. gariwerdensis*	McCluskey unpublished thesis 2
EU251937 1 McClusky haplotype D10	McClusky D	*P. gariwerdensis*	McCluskey unpublished thesis 2
EU251936 1 McClusky haplotype D1	McClusky D	*P. gariwerdensis*	McCluskey unpublished thesis 2
EU251935 1 McClusky haplotype C7	McClusky C/Cook 4	*P. arrostra*	McCluskey unpublished thesis 2
EU251934 1 McClusky haplotype C6	McClusky C/Cook 4	*P. arrostra*	McCluskey unpublished thesis 2
EU251933 1 McClusky haplotype C5	McClusky C/Cook 4	*P. arrostra*	McCluskey unpublished thesis 2
EU251932 1 McClusky haplotype C4	McClusky C/Cook 4	*P. arrostra*	McCluskey unpublished thesis 2
EU251931 1 McClusky haplotype C3	McClusky C/Cook 4	*P. arrostra*	McCluskey unpublished thesis 2
EU251930 1 McClusky haplotype C2	McClusky C/Cook 4	*P. arrostra*	McCluskey unpublished thesis 2
EU251929 1 McClusky haplotype C1	McClusky C/Cook 4	*P. arrostra*	McCluskey unpublished thesis 2
EU251928 1 McClusky haplotype B9	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EU251927 1 McClusky haplotype B8	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EU251926 1 McClusky haplotype B7	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EU251925 1 McClusky haplotype B6	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EU251924 1 McClusky haplotype B5	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EU251923 1 McClusky haplotype B4	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EU251922 1 McClusky haplotype B3	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EU251921 1 McClusky haplotype B2	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EU251920 1 McClusky haplotype B16	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EU251919 1 McClusky haplotype B15	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EU251918 1 McClusky haplotype B14	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EU251917 1 McClusky haplotype B13	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EU251916 1 McClusky haplotype B12	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EU251915 1 McClusky haplotype B11	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EU251914 1 McClusky haplotype B10	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EU251913 1 McClusky haplotype B1	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EU251912 1 McClusky haplotype A6	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	McCluskey unpublished thesis 2
EU251911 1 McClusky haplotype A5	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	McCluskey unpublished thesis 2
EU251910 1 McClusky haplotype A4	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	McCluskey unpublished thesis 2
EU251909 1 McClusky haplotype A3	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	McCluskey unpublished thesis 2
EU251908 1 McClusky haplotype A2	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	McCluskey unpublished thesis 2
EU251907 1 McClusky haplotype A1	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	McCluskey unpublished thesis 2
EF076817 1 Cook HAPY	McClusky C/Cook 4	*P. arrostra*	McCluskey unpublished thesis 2
EF076816 1 Cook HAPF	McClusky C/Cook 4	*P. arrostra*	McCluskey unpublished thesis 2
EF076815 1 Cook HAPQ	McClusky C/Cook 4	*P. arrostra*	McCluskey unpublished thesis 2
EF076814 1 Cook HAPS	McClusky C/Cook 4	*P. arrostra*	McCluskey unpublished thesis 2

Sequence	Group	Species determination	Publication source
EF076813 1 Cook HAPR	McClusky C/Cook 4	*P. arrostra*	McCluskey unpublished thesis 2
EF076812 1 Cook HAPG	McClusky C/Cook 4	*P. arrostra*	McCluskey unpublished thesis 2
EF076811 1 Cook HAPO	McClusky C/Cook 4	*P. arrostra*	McCluskey unpublished thesis 2
EF076810 1 Cook HAPZ	McClusky C/Cook 4	*P. arrostra*	McCluskey unpublished thesis 2
EF076809 1 Cook HAPE	McClusky C/Cook 4	*P. arrostra*	McCluskey unpublished thesis 2
EF076808 1 Cook HAPC	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EF076807 1 Cook HAPOO	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EF076806 1 Cook HAPI	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EF076805 1 Cook HAPD	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EF076804 1 Cook HAPH	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EF076803 1 Cook HAPL	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EF076802 1 Cook HAPMM	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EF076801 1 Cook HAPM	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EF076800 1 Cook HAPP	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EF076799 1 Cook HAPB	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	McCluskey unpublished thesis 2
EF076798 1 Cook HAPA	McClusky C/Cook 4	*P. arrostra*	McCluskey unpublished thesis 2
AY641791 1 Baker haplotype 33	Cook 7	*P. arrostra*	Cook et al. (2006)
AY641790 1 Baker haplotype 32	Cook 7	*P. arrostra*	Cook et al. (2006)
AY641789 1 Baker haplotype 63	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY641788 1 Baker haplotype 56	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY641787 1 Baker haplotype 55	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY641786 1 Baker haplotype 54	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY641785 1 Baker haplotype 62	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY641784 1 Baker haplotype 58	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY641783 1 Baker haplotype 66	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY641782 1 Baker haplotype 65	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY641781 1 Baker haplotype 81	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Cook et al. (2006)
AY641780 1 Baker haplotype 82	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Cook et al. (2006)
AY641779 1 Baker haplotype 118	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY641778 1 Baker haplotype 131	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY641777 1 Baker haplotype 129	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY641776 1 Baker haplotype 130	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY641775 1 Baker haplotype 128	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY641774 1 Baker haplotype 108	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY641773 1 Baker haplotype 116	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY641772 1 Baker haplotype 106	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY641771 1 Baker haplotype 104	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY641770 1 Baker haplotype 111	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY641769 1 Baker haplotype 114	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY641768 1 Baker haplotype 113	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY641767 1 Baker haplotype 110	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY308175 1 Baker isolate P1GC1	Cook 9	*P. rouxi*	Cook et al. (2006)
AY308174 1 Baker isolate SHC33	Lineage D Baker/Cook 5	*P.williamsi*	Cook et al. (2006)
AY308173 1 Baker isolate BC372	Cook 7	*P. strathbogiensis*	Cook et al. (2006)
AY308172 1 Baker isolate TR51	Lineage D Baker/Cook 5	*P.williamsi*	Cook et al. (2006)
AY308171 1 Baker isolate BC370	Cook 7	*P. strathbogiensis*	Cook et al. (2006)
AY308170 1 Baker isolate LY5	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY308169 1 Baker isolate Cro4	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY308168 1 Baker isolate NCK3	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)

Sequence	Group	Species determination	Publication source
AY308167 1 Baker isolate SHA3	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY308166 1 Baker isolate TWR2	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY308165 1 Baker isolate RY6	Cook 2	*P.walkeri*	Cook et al. (2006)
AY308164 1 Baker isolate LY6	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY308163 1 Baker isolate 3Mo1	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY308162 1 Baker isolate SHA4	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY308161 1 Baker isolate KN3	Cook 3	*P. spinosa*	Cook et al. (2006)
AY308160 1 Baker isolate GCK5	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY308159 1 Baker isolate NCK4	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY308158 1 Baker isolate TWR1	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY308157 1 Baker isolate WR3	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY308156 1 Baker isolate JCK2	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Cook et al. (2006)
AY308155 1 Baker isolate WR1	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY308154 1 Baker isolate GIN1	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY308153 1 Baker isolate MCK3	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY308152 1 Baker isolate PR1	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY308151 1 Baker isolate RY5	Cook 2	*P.walkeri*	Cook et al. (2006)
AY308150 1 Baker isolate RY2	Cook 2	*P.walkeri*	Cook et al. (2006)
AY308149 1 Baker isolate PR2	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY308148 1 Baker isolate BC112	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY308147 1 Baker isolate GIN2	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY308146 1 Baker isolate BC113	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY308145 1 Baker isolate BC234	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY308144 1 Baker isolate MCK1	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY308143 1 Baker isolate Vck2	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY308142 1 Baker isolate BC141	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY308141 1 Baker isolate RY1	Cook 2	*P.walkeri*	Cook et al. (2006)
AY308140 1 Baker isolate DIN2	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY308139 1 Baker isolate 85-3	Lineage A Baker/Cook 1	*P.australiensis*	Cook et al. (2006)
AY308138 1 Baker isolate BRLR1	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY308137 1 Baker isolate 85-12	Lineage A Baker/Cook 1	*P.australiensis*	Cook et al. (2006)
AY308136 1 Baker isolate TR55	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY308135 1 Baker isolate WES1	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY308134 1 Baker isolate Vck3	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY308133 1 Baker isolate 85-13	Lineage A Baker/Cook 1	*P.australiensis*	Cook et al. (2006)
AY308132 1 Baker isolate BC52	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY308131 1 Baker isolate RY3	Cook 2	*P.walkeri*	Cook et al. (2006)
AY308130 1 Baker isolate 011-5	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Cook et al. (2006)
AY308129 1 Baker isolate BRHR1	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Cook et al. (2006)
AY308128 1 Baker isolate Yan4	McClusky C/Cook 4	*P. arrostra*	Cook et al. (2006)
AY308127 1 Baker isolate 032-2	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Cook et al. (2006)
AY308126 1 Baker isolate 85-6	Lineage A Baker/Cook 1	*P.australiensis*	Cook et al. (2006)
AY308125 1 Baker isolate KN5	Cook 3	*P. spinosa*	Cook et al. (2006)
AY308124 1 Baker isolate KN1	Cook 3	*P. spinosa*	Cook et al. (2006)
AY308123 1 Baker isolate ECK1	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Cook et al. (2006)
AY308122 1 Baker isolate BR4	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Cook et al. (2006)
AY308121 1 Baker isolate LNA1	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Cook et al. (2006)
AY308120 1 Baker isolate SHC32	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Cook et al. (2006)
AY308119 1 Baker isolate 013-2	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Cook et al. (2006)

Sequence	Group	Species determination	Publication source
AY308118 1 Baker isolate 034-3	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Cook et al. (2006)
AY308117 1 Baker isolate MUR1	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Cook et al. (2006)
AY308116 1 Baker isolate KN2	Cook 3	*P. spinosa*	Cook et al. (2006)
AY308115 1 Baker isolate 032-3	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Cook et al. (2006)
AY308114 1 Baker isolate 013-3	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Cook et al. (2006)
AY308113 1 Baker isolate BR3	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Cook et al. (2006)
AY308112 1 Baker isolate CON4	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Cook et al. (2006)
AY308111 1 Baker isolate PAR4	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Cook et al. (2006)
AY308110 1 Baker isolate DAL2	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Cook et al. (2006)
AY308109 1 Baker isolate S91-2	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Cook et al. (2006)
AY308108 1 Baker isolate TR36	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Cook et al. (2006)
AY308107 1 Baker isolate NCK1	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Cook et al. (2006)
AY308106 1 Baker isolate BC442	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Cook et al. (2006)
AY308105 1 Baker isolate H31	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Baker et al. (2004)
AY308104 1 Baker isolate H30	Lineage A Baker/Cook 1	*P.australiensis*	Baker et al. (2004)
AY308103 1 Baker isolate H29	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Baker et al. (2004)
AY308102 1 Baker isolate H28	Lineage D Baker/Cook 5	*P.williamsi*	Baker et al. (2004)
AY308101 1 Baker isolate H27	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Baker et al. (2004)
AY308100 1 Baker isolate H26	Lineage A Baker/Cook 1	*P.australiensis*	Baker et al. (2004)
AY308099 1 Baker isolate H25	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Baker et al. (2004)
AY308098 1 Baker isolate H24	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Baker et al. (2004)
AY308097 1 Baker isolate H23	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Baker et al. (2004)
AY308096 1 Baker isolate H22	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Baker et al. (2004)
AY308095 1 Baker isolate H21	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Baker et al. (2004)
AY308094 1 Baker isolate H20	Lineage A Baker/Cook 1	*P.australiensis*	Baker et al. (2004)
AY308093 1 Baker isolate H19	Lineage A Baker/Cook 1	*P.australiensis*	Baker et al. (2004)
AY308092 1 Baker isolate H18	Lineage A Baker/Cook 1	*P.australiensis*	Baker et al. (2004)
AY308091 1 Baker isolate H17	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Baker et al. (2004)
AY308090 1 Baker isolate H16	Lineage A Baker/Cook 1	*P.australiensis*	Baker et al. (2004)
AY308089 1 Baker isolate H15	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Baker et al. (2004)
AY308088 1 Baker isolate H14	Lineage A Baker/Cook 1	*P.australiensis*	Baker et al. (2004)
AY308087 1 Baker isolate H13	Lineage A Baker/Cook 1	*P.australiensis*	Baker et al. (2004)
AY308086 1 Baker isolate H12	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Baker et al. (2004)
AY308085 1 Baker isolate H11	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	Baker et al. (2004)
AY308084 1 Baker isolate H10	Lineage A Baker/Cook 1	*P.australiensis*	Baker et al. (2004)
AY308083 1 Baker isolate H9	Lineage A Baker/Cook 1	*P.australiensis*	Baker et al. (2004)
AY308082 1 Baker isolate H8	Lineage A Baker/Cook 1	*P.australiensis*	Baker et al. (2004)
AY308081 1 Baker isolate H7	Lineage A Baker/Cook 1	*P.australiensis*	Baker et al. (2004)
AY308080 1 Baker isolate H6	Lineage A Baker/Cook 1	*P.australiensis*	Baker et al. (2004)
AY308079 1 Baker isolate H5	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Baker et al. (2004)
AY308078 1 Baker isolate H4	Lineage A Baker/Cook 1	*P.australiensis*	Baker et al. (2004)
AY308077 1 Baker isolate H3	Lineage A Baker/Cook 1	*P.australiensis*	Baker et al. (2004)
AY308076 1 Baker isolate H2	Lineage A Baker/Cook 1	*P.australiensis*	Baker et al. (2004)
AY308075 1 Baker isolate H1	Lineage A Baker/Cook 1	*P.australiensis*	Baker et al. (2004)
AF534904 1 Hurwood Pa11	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Hurwood et al. (2003)
AF534903 1 Hurwood Pa10	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Hurwood et al. (2003)
AF534902 1 Hurwood Pa9	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	Hurwood et al. (2003)
AF534901 1 Hurwood Pa8	McClusky C/Cook 4	*P. arrostra*	Hurwood et al. (2003)
AF534900 1 Hurwood Pa7	McClusky C/Cook 4	*P. arrostra*	Hurwood et al. (2003)

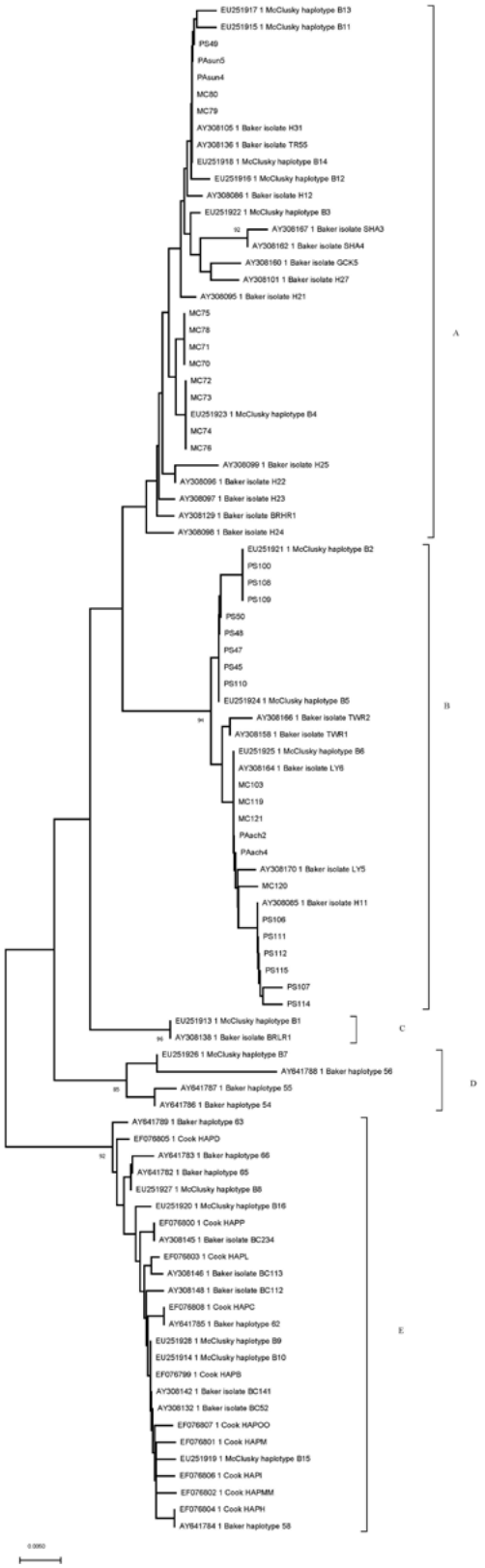
Sequence	Group	Species determination	Publication source
AF534899 1 Hurwood Pa6	McClusky C/Cook 4	*P. arrostra*	Hurwood et al. (2003)
AF534898 1 Hurwood Pa5	McClusky C/Cook 4	*P. arrostra*	Hurwood et al. (2003)
AF534897 1 Hurwood Pa4	McClusky C/Cook 4	*P. arrostra*	Hurwood et al. (2003)
AF534896 1 Hurwood Pa3	McClusky C/Cook 4	*P. arrostra*	Hurwood et al. (2003)
AF534895 1 Hurwood Pa2	McClusky C/Cook 4	*P. arrostra*	Hurwood et al. (2003)
AF534894 1 Hurwood Pa1	McClusky C/Cook 4	*P. arrostra*	Hurwood et al. (2003)
AY622605 1 Paratya howensis	Paratya outgroup		
AY661487 1 Paratya curvirostris	Paratya outgroup		
AY661488 1 Paratya compressa	Paratya outgroup		
AY661489 1 Paratya compressa	Paratya outgroup		
AY661490 1 Paratya compressa	Paratya outgroup		
AY661491 1 Paratya compressa	Paratya outgroup		
AY661492 1 Paratya norfolkensis	Paratya outgroup		
AY661493 1 Caridina indistincta	Caradina		
AY661494 1 Caridina cf imitatrix	Caradina		
AY661495 1 Paratya cf caledonica	Paratya outgroup		
AY661496 1 Paratya cf caledonica	Paratya outgroup		
AY6614981 Paratya cf caledonica	Paratya outgroup		
AY661499 1 Paratya cf intermedia	Paratya outgroup		
AY661500 1 Paratya cf intermedia	Paratya outgroup		
AY661501 1 Paratya cf intermedia	Paratya outgroup		
0L420759 JWA2019	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420760 JWA2020	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420761 JWA2023	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420762 JWA2026	McClusky C/Cook 4	*P. arrostra*	This study
OL420763 JWA2027	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420764 JWA2028	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420765 JWA2032	McClusky C/Cook 4	*P. arrostra*	This study
OL420766 JWA2033	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420767 JWA2034	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420768 JWA2035	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420769 JWA2036	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420770 JWA2113	McClusky C/Cook 4	*P. arrostra*	This study
OL420771 JWA2116	McClusky C/Cook 4	*P. arrostra*	This study
OL420772 JWA2118	McClusky C/Cook 4	*P. arrostra*	This study
OL420773 JWA2119	McClusky C/Cook 4	*P. arrostra*	This study
OL420774 JWA2123	McClusky C/Cook 4	*P. arrostra*	This study
OL420775 JWA2125	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420776 JWA2126	McClusky C/Cook 4	*P. arrostra*	This study
OL420777 JWA2127	McClusky C/Cook 4	*P. arrostra*	This study
OL420778 JWA2129	McClusky C/Cook 4	*P. arrostra*	This study
OL420779 JWA2131	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420780 JWA2132	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420781 JWA2135	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420782 JWA2136	McClusky C/Cook 4	*P. arrostra*	This study
OL420783 JWA2137	McClusky C/Cook 4	*P. arrostra*	This study
OL420784 JWA2138	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420785 JWA2141	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420786 JWA2143	McClusky C/Cook 4	*P. arrostra*	This study

Sequence	Group	Species determination	Publication source
OL420787 JWA2144	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420788 JWA2184	McClusky C/Cook 4	*P. arrostra*	This study
OL420789 JWA2435	McClusky C/Cook 4	*P. arrostra*	This study
OL420790 JWA2436	McClusky C/Cook 4	*P. arrostra*	This study
OL420791 JWA2437	McClusky C/Cook 4	*P. arrostra*	This study
OL420792 JWA2438	McClusky C/Cook 4	*P. arrostra*	This study
OL420793 JWA2439	McClusky C/Cook 4	*P. arrostra*	This study
OL420794 JWA2440	McClusky C/Cook 4	*P. arrostra*	This study
OL420795 JWA2441	McClusky C/Cook 4	*P. arrostra*	This study
OL420796 MC1	McClusky C/Cook 4	*P. arrostra*	This study
OL420797 MC10	McClusky C/Cook 4	*P. arrostra*	This study
OL420798 MC101	McClusky C/Cook 4	*P. arrostra*	This study
OL420799 MC103	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420800 MC109	Lineage B BakerMcClusky A/Cook 6	*P. tasmaniensis*	This study
OL420801 MC110	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420802 MC115	Lineage B BakerMcClusky A/Cook 6	*P. tasmaniensis*	This study
OL420803 MC116	Lineage B BakerMcClusky A/Cook 6	*P. tasmaniensis*	This study
OL420804 MC117	Lineage B BakerMcClusky A/Cook 6	*P. tasmaniensis*	This study
OL420805 MC119	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420806 MC120	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420807 MC121	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420808 MC125	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420809 MC126	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420810 MC130 F	Cook 7	*P. strathbogiensis*	This study
OL420811 MC133	McClusky C/Cook 4	*P. arrostra*	This study
OL420812 MC134	McClusky C/Cook 4	*P. arrostra*	This study
OL420813 MC135	Cook 9	*P. rouxi*	This study
OL420814 MC136	Cook 9	*P. rouxi*	This study
OL420815 MC137	Cook 9	*P. rouxi*	This study
OL420816 MC138	Cook 9	*P. rouxi*	This study
OL420817 MC14	Cook 3	*P. spinosa*	This study
OL420818 MC17	Cook 3	*P. spinosa*	This study
OL420819 MC2	McClusky C/Cook 4	*P. arrostra*	This study
OL420820 MC20	McClusky C/Cook 4	*P. arrostra*	This study
OL420821 MC21 F	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420822 MC22	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420823 MC23	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420824 MC24	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420825 MC26	Lineage A Baker/Cook 1	*P. australiensis*	This study
OL420826 MC28	Lineage A Baker/Cook 1	*P. australiensis*	This study
OL420827 MC29	Lineage A Baker/Cook 1	*P. australiensis*	This study
OL420828 MC3	McClusky C/Cook 4	*P. arrostra*	This study
OL420829 MC30	Lineage A Baker/Cook 1	*P. australiensis*	This study
OL420830 MC31	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420831 MC32	Lineage A Baker/Cook 1	*P. australiensis*	This study
OL420832 MC33	Lineage A Baker/Cook 1	*P. australiensis*	This study
OL420833 MC34	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420834 MC37	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420835 MC4	McClusky C/Cook 4	*P. arrostra*	This study

Sequence	Group	Species determination	Publication source
OL420836 MC40	Cook 7	*P. strathbogiensis*	This study
OL420837 MC41	McClusky C/Cook 4	*P. arrostra*	This study
OL420838 MC42	Cook 7	*P. strathbogiensis*	This study
OL420839 MC43	Cook 7	*P. strathbogiensis*	This study
OL420840 MC46	Cook 7	*P. strathbogiensis*	This study
OL420841 MC47	Cook 7	*P. strathbogiensis*	This study
OL420842 MC48	Cook 7	*P. strathbogiensis*	This study
OL420843 MC49	Cook 7	*P. strathbogiensis*	This study
OL420844 MC52	Cook 7	*P. strathbogiensis*	This study
OL420845 MC53	Cook 7	*P. strathbogiensis*	This study
OL420846 MC54	Cook 7	*P. strathbogiensis*	This study
OL420847 MC63	McClusky C/Cook 4	*P. arrostra*	This study
OL420848 MC66	McClusky C/Cook 4	*P. arrostra*	This study
OL420849 MC672	Cook 9	*P. rouxi*	This study
OL420850 MC70	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420851 MC71	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420852 MC72	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420853 MC73	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420854 MC74	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420855 MC75	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420856 MC76	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420857 MC78	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420858 MC79	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420859 MC80	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420860 MC82	McClusky C/Cook 4	*P. arrostra*	This study
OL420861 MC83	Cook 9	*P. rouxi*	This study
OL420862 MC84	Cook 9	*P. rouxi*	This study
OL420863 MC86	McClusky C/Cook 4	*P. arrostra*	This study
OL420864 MC87	McClusky C/Cook 4	*P. arrostra*	This study
OL420865 MC88	McClusky C/Cook 4	*P. arrostra*	This study
OL420866 MC89	McClusky C/Cook 4	*P. arrostra*	This study
OL420867 MC9	McClusky C/Cook 4	*P. arrostra*	This study
OL420868 MC90	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420869 MC90 F8	McClusky C/Cook 4	*P. arrostra*	This study
OL420870 MC91	McClusky C/Cook 4	*P. arrostra*	This study
OL420871 MC95	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420872 MC97	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420873 MC98	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420874 MC99	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420875 PJ1	Lineage A Baker/Cook 1	*P. australiensis*	This study
OL420876 PJ2	Lineage A Baker/Cook 1	*P. australiensis*	This study
OL420877 PJ3	Lineage A Baker/Cook 1	*P. australiensis*	This study
OL420878 PJ4	Lineage A Baker/Cook 1	*P. australiensis*	This study
OL420879 PJ5	McClusky C/Cook 4	*P. arrostra*	This study
OL420880 PJ6	McClusky C/Cook 4	*P. arrostra*	This study
OL420881 PS100	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420882 PS101	McClusky C/Cook 4	*P. arrostra*	This study
OL420883 PS102	Lineage D Baker/Cook 5	*P. williamsi*	This study
OL420884 PS103	Lineage D Baker/Cook 5	*P. williamsi*	This study

Sequence	Group	Species determination	Publication source
OL420885 PS104	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420886 PS105	Lineage D Baker/Cook 5	*P. williamsi*	This study
OL420887 PS106	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420888 PS107	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420889 PS108	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420890 PS109	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420891 PS110	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420892 PS111	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420893 PS112	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420894 PS113	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420895 PS114	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420896 PS115	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420897 PS116	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420898 PS117	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420899 PS12	Cook 2	*P. walkeri*	This study
OL420900 PS14	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420901 PS15	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420902 PS16	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420903 PS18	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420904 PS20	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420905 PS22	McClusky C/Cook 4	*P. arrostra*	This study
OL420906 PS24	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420907 PS25	Lineage A Baker/Cook 1	*P. australiensis*	This study
OL420908 PS26	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420909 PS27	Lineage A Baker/Cook 1	*P. australiensis*	This study
OL420910 PS28	Lineage A Baker/Cook 1	*P. australiensis*	This study
OL420911 PS29	Lineage A Baker/Cook 1	*P. australiensis*	This study
OL420912 PS4	McClusky C/Cook 4	*P. arrostra*	This study
OL420913 PS40	McClusky D	*P. gariwerdensis*	This study
OL420914 PS41	McClusky D	*P. gariwerdensis*	This study
OL420915 PS43	McClusky D	*P. gariwerdensis*	This study
OL420916 PS44	McClusky D	*P. gariwerdensis*	This study
OL420917 PS45	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420918 PS46	McClusky D	*P. gariwerdensis*	This study
OL420919 PS47	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420920 PS48	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420921 PS49	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420922 PS50	Lineage C Baker/Cook 8/McClusky B	*P. tasmaniensis*	This study
OL420923 PS51	McClusky D	*P. gariwerdensis*	This study
OL420924 PS53	McClusky D	*P. gariwerdensis*	This study
OL420925 PS54	McClusky D	*P. gariwerdensis*	This study
OL420926 PS55	McClusky D	*P. gariwerdensis*	This study
OL420927 PS6	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420928 PS7	Lineage B BakerMcClusky A/Cook 6	*P. whitemae*	This study
OL420929 PS8	Cook 2	*P. walkeri*	This study

Supplementary Figure 1: Expanded sub-tree for *Paratya arrostra* Riek from fig. 3 in text.



Supplementary Figure 2: Expanded sub-tree for *Paratya tasmaniensis* Riek from fig. 4 in text.

Supplementary Figure 3: Expanded sub-tree for *Paratya whitemae* n.sp.