

Redescription of the freshwater amphipod *Austrochiltonia australis* (Sayce) (Crustacea: Amphipoda, Chiltoniidae)

RACHAEL A. KING

South Australian Museum, North Terrace, Adelaide, South Australia 5000 and School of Earth and Environmental Sciences, The University of Adelaide, North Terrace, Adelaide, South Australia 5005, Australia. (Rachael.King@samuseum.sa.gov.au)

Abstract

King, R.A. 2009. Redescription of the freshwater amphipod *Austrochiltonia australis* (Sayce) (Crustacea: Amphipoda, Chiltoniidae). *Memoirs of Museum Victoria* 66: 85–93.

Austrochiltonia is an abundant yet taxonomically poorly known freshwater amphipod genus. With two species recognised, they are inadequately defined yet widely identified throughout southern Australian freshwater systems. In an effort towards providing a clear diagnosis of *Austrochiltonia*, its type species, *A. australis*, is re-described from type material. Two distinct male morphotypes are described for the first time and morphological variability within the species is discussed.

Keywords

Crustacea, Amphipoda, Freshwater, Australia, Chiltoniidae, *Austrochiltonia*, *australis*, *subtenuis*

Introduction

The recent discovery of significant diverse genetic lineages of Australian freshwater amphipods in the family Chiltoniidae and the varied phenotypic expression of this diversity (King, in press; Murphy et al. 2009) has highlighted a need for modern taxonomic revision of this group. Two genera are currently known from Australia: *Austrochiltonia* Hurley, 1959 and *Phreatochiltonia* Zeidler, 1991. *Austrochiltonia* with its three existing species (*A. australis* (Sayce, 1901), *A. dalhousiensis* Zeidler, 1991 and *A. subtenuis* (Sayce, 1902)) remains poorly defined, primarily due to confusion surrounding the identification of *A. australis*, the type species.

Sayce (1901) originally described *Hyaella australis* without designating type material or a type locality. He did note that the species was common in Victoria (the lagoons of the River Yarra, Fernshaw, Christmas Hills, Heidelberg, East Kew, Melbourne Botanical Gardens, Elwood swamp) and also in Lake Petrarch, Tasmania. One year later Sayce (1902) described *Chiltonia subtenuis* from Lake Hindmarsh in Victoria and transferred *H. australis* to this genus. Later, both species were transferred to *Austrochiltonia* by Hurley (1959) who restricted *Chiltonia* to New Zealand species based on specialised male pleopod morphology.

With incomplete original descriptions, slight morphological differences between the two species (antennal lengths and presence of the uropod 3 with one or two articles), and overlapping distributions, the validity of *A. australis* and *A. subtenuis* were to some researchers questionable (Hurley 1954, Smith and Swain 1982). Yet, over subsequent years both species

were identified throughout southern Australia. *Austrochiltonia australis* was collected by Smith (1909) from Tasmania, by Chilton (1923) from New South Wales and Victoria, by Hurley (1959) from Lake Leake in Tasmania and by Williams (1962) in Victoria, New South Wales and Tasmania. *Austrochiltonia subtenuis* was collected by Hale (1929) from the Murray River in South Australia and by Williams (1962) from Victoria, Tasmania and Western Australia.

In an attempt to solve the problem, both *A. australis* and *A. subtenuis* were redescribed by Williams (1962), who also selected types, from the Sayce collection in Museum Victoria from locations in Victoria, New South Wales, and Tasmania (material that, according to Williams (1962), Sayce used for his original descriptions of both species). Williams upheld the antennal and uropodal characters separating the *A. australis* and *A. subtenuis* and designated “lectoholotypes”, “lectoallotypes” and “lectoparatypes”. He chose “Yarra Lagoon, East Kew” to be the restricted type locality for *A. australis* recording that Sayce’s illustrations indicated that the specimen originally illustrated was from that locality (the author notes that this locality is more than likely to be the existing “Kew Billabong” which is currently dry). Lake Hindmarsh, in Victoria, was chosen as the type locality for *A. subtenuis* (the author notes that this locality is also currently dry).

By modern standards, Williams’s (1962) descriptions lack sufficient detail to be informative. Two new Australian genera have recently been discovered (King, in press), defined by new sets of morphological characters not fully illustrated by Williams. In addition to this, examination of the type material

of *A. australis* (designated by Williams) showed a greater degree of morphological diversity among males than was reported by Williams (1962). Therefore it was deemed necessary to redescribe the species as a first step towards a robust definition of the genus *Austrochiltonia*. The type material of *A. subtenuis* (designated by Williams) was not located after searches of the collections of Museum Victoria, the South Australian Museum and the Australian Museum. Collections at and around Lake Hindmarsh are currently being coordinated as part of an effort to properly determine the status of that species.

Systematics

Infraorder Talitrida Rafinesque, 1815

Superfamily Talitroidea s.s. Rafinesque, 1815 (Serejo, 2003)

Family Chiltoniidae Barnard, 1972 (Serejo, 2003)

Austrochiltonia australis

Figures 1–4

Synonymy.

Hyaella australis Sayce, 1901: 226–30, pl. xxxvi.

Chiltonia australis Sayce, 1902: 47–48.—?Smith 1909: 70.—?Chilton, 1923: 95.

Austrochiltonia australis Hurley, 1959: 765–767.—Williams, 1962: 202–208, figs. 1A–I, 3A–O.—Lowry and Stoddart, 2003: 127.

Material Examined. Lectotype, NMV J11248, male, 8.1mm, Yarra Lagoon, East Kew, Victoria, coll. O.A. Sayce. Paralectotype, NMV J11247, female, 6.2mm, collection information same as for J11248. Paralectotype, NMV J11249, 8 males (11.4mm, 10.5mm, 10mm, 9.5mm, 8.1mm, 7.7mm, 4.7mm, 3.3mm), 4 females (8.6mm (ovigerous), 6.1mm, 5.6mm (ovigerous), 3.9mm). NMV J46778, male, 7.3mm, collection information same as for NMV J11249. NMV J46779, male, 6.8mm, collection information same as for NMV J11249. NMV J46780, female (ovigerous), 8.2mm, collection information same as for NMV J11249.

Distribution. Yarra River and tributaries, Victoria, Australia (Type Locality: Kew Billabong, Melbourne, Victoria (previously called the Yarra Lagoon, East Kew)).

Description. Male (based on large male NMV J46778), length: 7.3mm. Head about as long as deep (fig. 1A). Antenna 1 (fig. 1C) peduncular article 1 1.8 times as long as broad, inner lateral margin with three robust setae, ventral-distal margin with single robust seta; peduncular article 2 shorter than article 1 (0.8 times as long), 2.5 times as long as broad; peduncular article 3 similar length to article 2, 2.8 times as long as broad; flagellum slightly longer than peduncle, of 11 articles, with ventral aesthetascs on the proximal margins of the seven distal articles. Antenna 2 (fig. 1D) about 0.6 times length of antenna 1; peduncular article 3 broader than long, inner-distal margin with two robust setae; peduncular article 4 longer than article 3, 2 times longer than broad, inner lateral margin with three robust setae, distal margin with two robust setae; peduncular article 5 longer than article 4, 3.7 times as long as broad; flagellum slightly shorter than peduncle, of eight articles.

Upper lip (fig. 1I) broader than long, apically bluntly rounded, with numerous short setae along apical margin.

Lower lip (fig. 1J) with bluntly rounded lateral lobes, apical margins rounded, apical and inner margins with numerous short setae. Left mandible (fig. 1H) with incisor of six teeth, *lacinia mobilis* of five teeth, spine row of three plumose setae and triturative molar. Right mandible (fig. 1G) with incisor of six teeth, *lacinia mobilis* of three teeth, spine row of two plumose setae and triturative molar with a long plumose seta. Maxilla 1 (fig. 1B) outer plate with nine setulate robust setae; inner plate with two long apical plumose setae. Maxilla 2 (fig. 1F) outer plate with two apical rows of 12 simple setae; inner plate with two apical rows of 17 simple setae, with a plumose seta on the inner lateral margin. Maxilliped (fig. 1E) inner plate apical margin with two short spine-like robust setae, with plumose seta along apical and inner lateral margins; outer plate with numerous simple setae along apical and inner lateral margins; palp articles 1 and 2 similar width, palp article 2 with numerous simple setae on inner lateral margin; palp article 3 not as broad as articles 1 and 2, with numerous simple setae on inner lateral and distal margins, with three long setulate setae on outer distal margin; palp article 4 short, about 0.3 times as broad as article 3, with unguis and simple setae on distal and outer margins.

Gnathopod 1 (fig. 2A) coxa distally almost as broad as long, distal margin with 33 short simple setae; basis dorsal and ventral margins with scattered long simple setae, ventral distal corner with cluster of simple setae; ischium, and merus ventral distal corners with clusters of setae; carpus with ventral-lateral lobe and row of 13 setulate setae becoming longer distally, dorsal-distal margin with long setulate setae; propodus triangular in shape, 1.7 times as long as broad, ventral-distal corner with one robust seta (near where tip of dactylus touches), ventral-distal margin (adjacent to dactylus length) with short robust and long simple setae, dorsal-distal margin with long simple setae, inner face with 11 robust plumose setae; dactylus curved, fitting against ventral-distal corner of propodus, with dorsal plumose seta. Gnathopod 2 (fig. 2B) coxa short, 1.1 times as long as broad, distal margin with 14 short simple setae; basis dorsal and ventral margins with scattered simple setae; ischium and merus with scattered setae on ventral margins; propodus 1.6 times as long as broad, with proximal lobe covering distal margin of carpus, ventral-distal corner marked with two distinct carina-like lobes and a ventral-distal groove present on inner face to accommodate the tip of the dactylus, ventral distal margin with numerous apically bifid robust setae. Pereopod 3 (fig. 2C) coxa distal margin with 21 short simple setae; basis dorsal and ventral margins with scattered simple setae, ventral distal corners with clusters of setae; ischium ventral distal corners with clusters of setae; merus with distinct dorsal-distal lobe, dorsal margin with three clusters of simple setae, ventral margin with scattered simple setae, ventral distal corner with cluster of setae; carpus ventral margin with robust setae and scattered simple setae; propodus dorsal margin with three clusters of simple setae; ventral margin with nine clusters of robust and simple setae; dactylus dorsal margin with plumose seta, ventral margin with simple seta, unguis present. Pereopod 4 (fig. 2D) coxa with distinct proximal excavated corner, distal margin with 39 short simple setae; basis dorsal and ventral margins with scattered simple

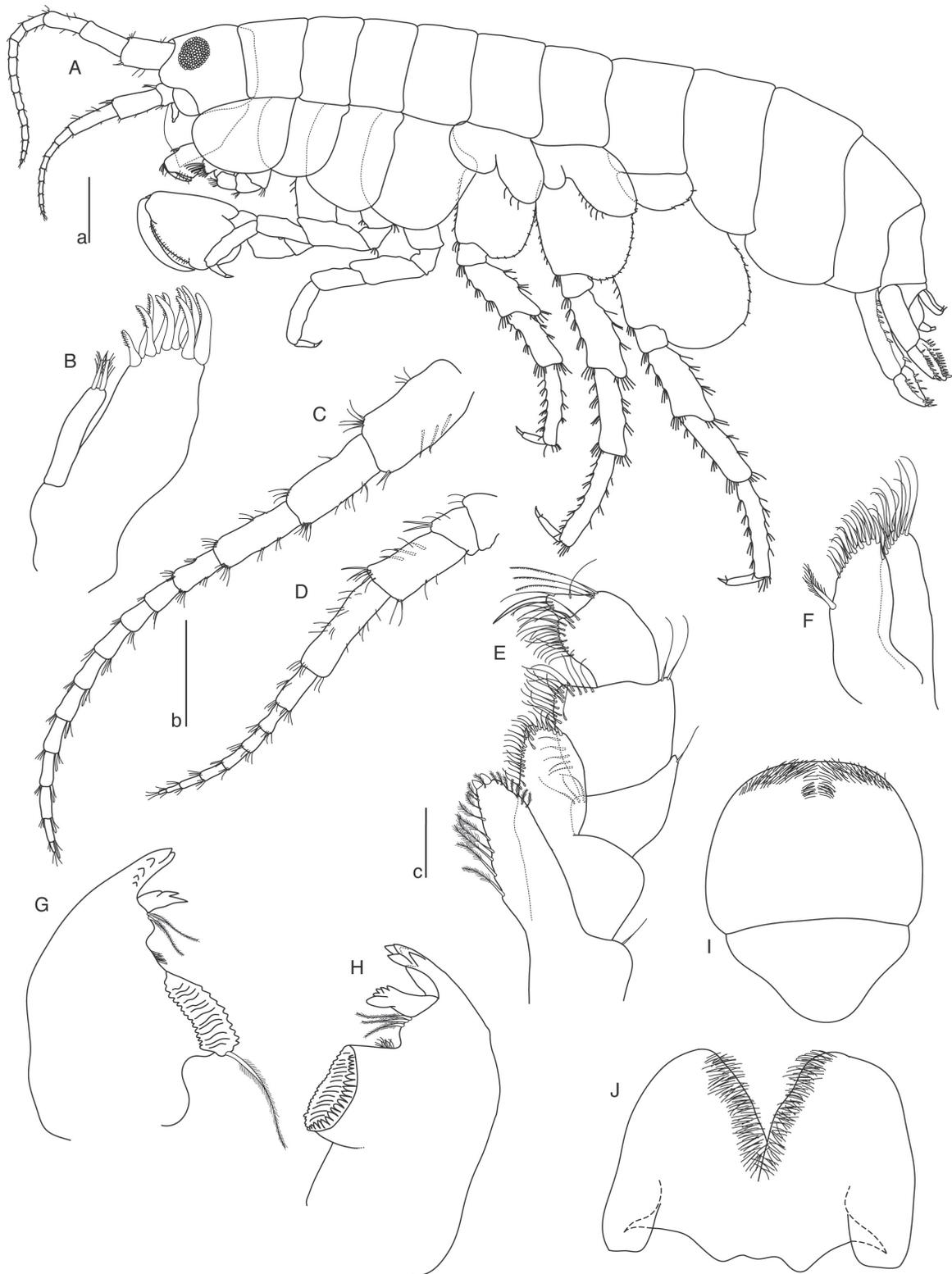


Figure 1. *Austrochiltonia australis* (Sayce), NMV J46778, large male morphotype, 10.5mm: A, Lateral view of body; B, maxilla 1; C, Antenna 1; D, antenna 2; E, maxilliped; F, maxilla 2; G, right mandible; H, left mandible; I, upper lip; J, lower lip. Scales: a(A), 0.5mm; b(C-D), 0.5 mm; c(B,E-H), 0.1mm.

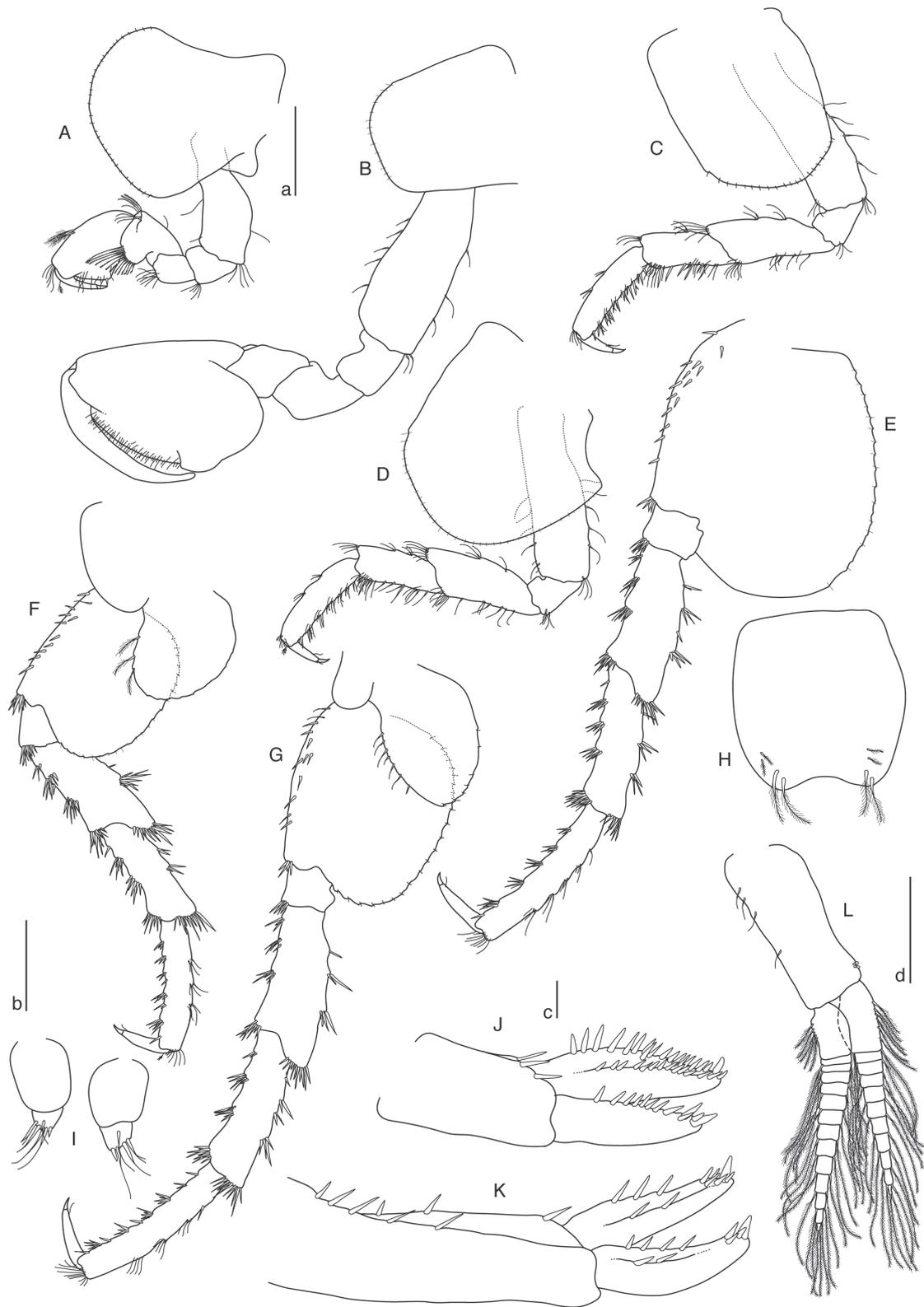


Figure 2. *Austrochiltonia australis* (Sayce), NMV J46778, large male morphotype, 10.5mm: A, gnathopod 1; B, gnathopod 2; C, pereopod 3; D, pereopod 4; E, pereopod 7; F, pereopod 5; G, pereopod 6; H, telson; I, left and right uropod 3; J, uropod 2; K, uropod 1; L, pleopod 1. Scales: a(A-G), 0.5mm; b(I), 0.1mm; c(H, J-K), 0.1mm; d(L), 0.5mm.

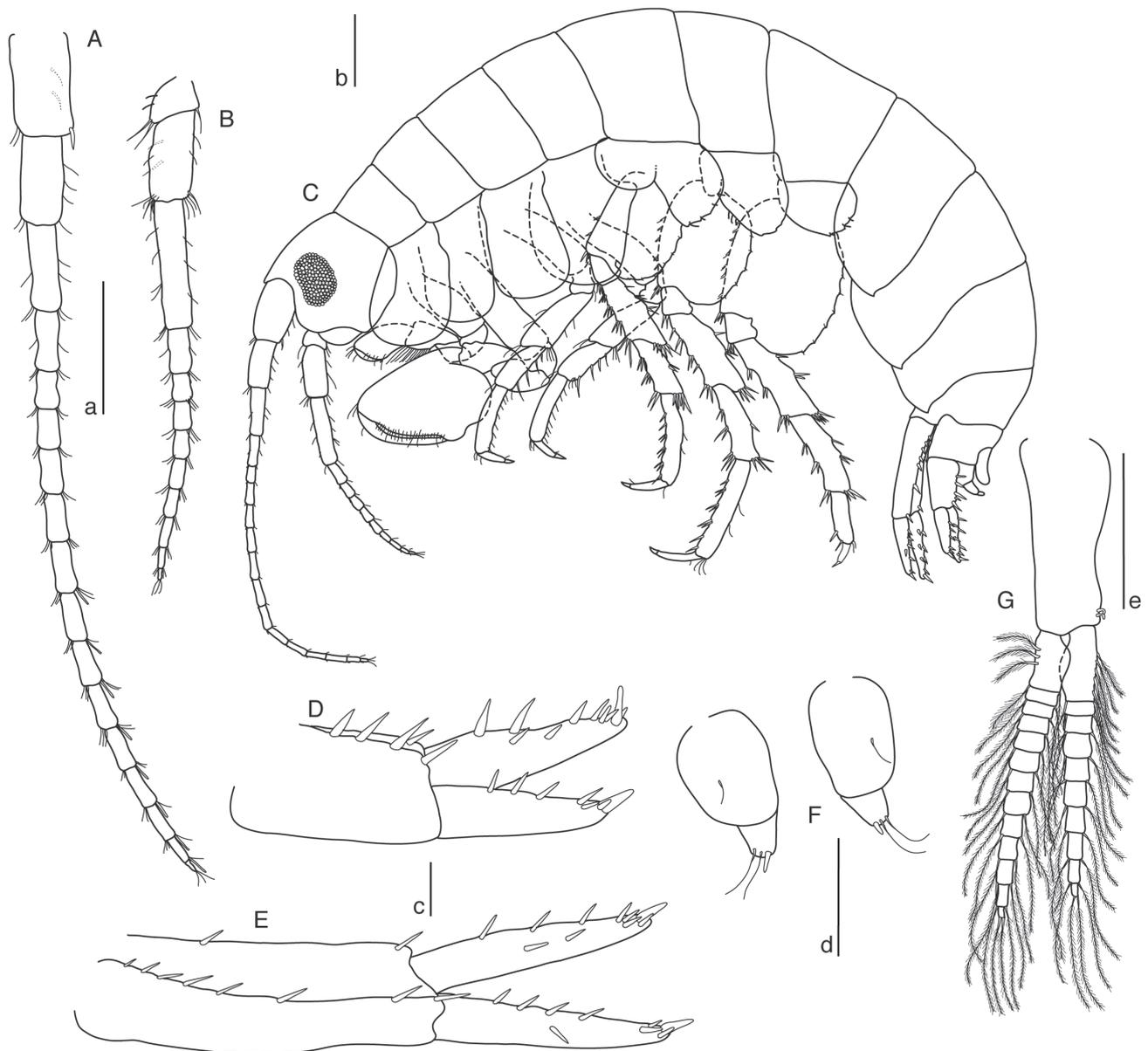


Figure 3. *Austrochiltonia australis* (Sayce), NMV J46779, small male morphotype, 4.7mm: A, antenna 1; B, antenna 2; C, lateral view of body; D, uropod 2; E, uropod 1; F, left and right uropod 3; G, pleopod 1. Scales: a(A-B), 0.5mm; b(C), 0.5mm; c(D-E), 0.1mm; d(F), 0.1mm; e(G), 0.5mm.

setae, ventral distal corner with cluster of simple setae; ischium ventral distal corner with cluster of setae; merus with distinct dorsal-distal lobe, dorsal margin with three clusters of simple setae, ventral margin with scattered simple setae, ventral distal corner with cluster of setae; carpus dorsal margin with three clusters of simple setae, ventral margin with scattered robust and simple setae; propodus ventral margin with eight clusters of robust and simple setae; dactylus dorsal margin with plumose seta, ventral margin with simple seta, unguis present. Pereopod 5 (fig. 2F) coxa anterior lobe with one short seta,

posterior lobe with three long plumose setae and 9 short setae along margin; basis 1.2 times as long as broad, dorsal margin with 11 robust setae along length, dorsal-distal margin with seven robust setae, ventral margin subtly crenulated and with 24 short simple setae along length; ischium dorsal-distal margin with distal robust setae; merus with strong postero-distal lobe, dorsal margin with robust setae in four clusters, ventral margin with robust setae in three clusters; carpus as long as merus, dorsal margin with robust setae in four clusters, ventral margin with robust setae in three clusters; propodus

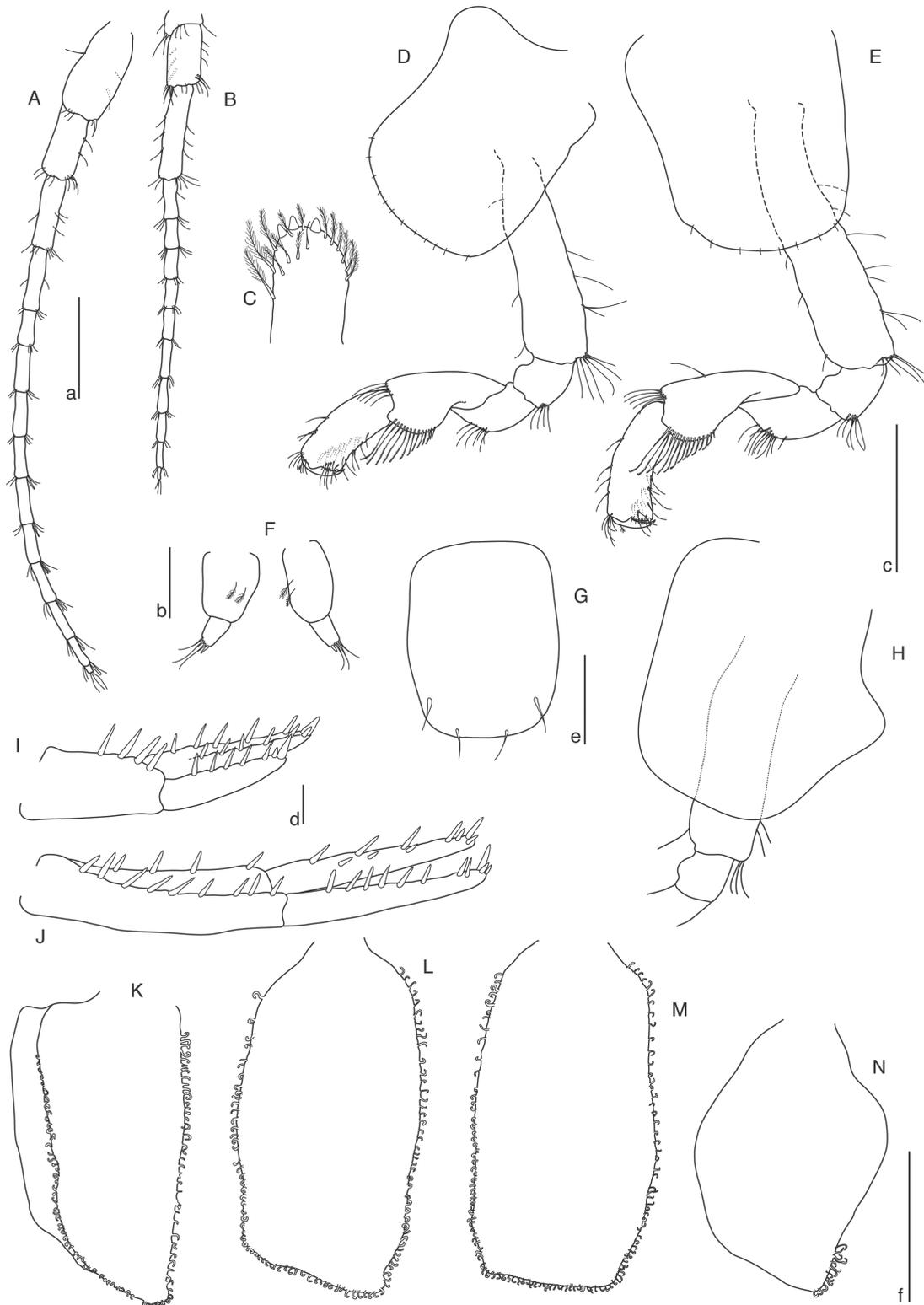


Figure 4. *Austrochiltonia australis* (Sayce), NMV J46780, ovigerous female, 8.6mm: A, antenna 1; B, antenna 2; C, inner plate of maxilliped; D, gnathopod 1; E, gnathopod 2; F, left and right uropod 3; G, telson; H, pereopod 4 coxa; I, uropod 2; J, uropod 1; K, oostegite on coxa 2; L, oostegite on coxa 3; M, oostegite on coxa 4; N, oostegite on coxa 5. Scales: a(A-B), 0.5mm; b(F), 0.1mm; c(D-E), 0.5mm; d(I-J), 0.1mm; e(G), 0.1mm; f(K-N), 0.5mm

longer than merus, dorsal margin with eight clusters of robust setae, ventral margin with three clusters of simple setae, ventral distal corner with cluster of simple setae; dactylus with plumose seta on ventral margin, unguis present. Pereopod 6 (fig. 2G) coxa posterior lobe with seven robust setae and seven short setae along margin; basis slightly longer than broad, dorsal margin with 12 robust setae along length, distal end of dorsal margin with cluster of robust setae, ventral margin subtly crenulated and with 23 short simple setae along length; ischium dorsal margin with distal robust setae; merus with strong postero-distal lobe, dorsal margin with robust setae in four clusters, ventral margin with robust setae in four clusters; carpus as long as merus, dorsal margin with robust setae in four clusters, ventral margin with robust setae in five distal clusters; propodus longer than merus, dorsal margin with nine clusters of robust setae, ventral margin with five clusters of simple setae; dactylus with plumose seta on ventral margin, unguis present. Pereopod 7 (fig. 2E) coxa ventral margin with five short simple setae; basis longer than broad, dorsal margin with 15 robust setae along length, distal end of dorsal margin with four robust setae, ventral margin subtly crenulated and with 18 short simple setae along length; ischium dorsal margin with distal cluster of robust setae; merus with strong postero-distal lobe, dorsal margin with robust setae in four clusters, ventral margin with robust setae in five clusters; carpus as long as merus, dorsal margin with robust setae in five clusters, ventral margin with robust setae in four distal clusters; propodus longer than merus, dorsal margin with six clusters of robust setae, ventral margin with six clusters of simple setae; dactylus with plumose seta on ventral margin, unguis present.

Pleopods 1-3 similar (fig. 2K), unmodified (as in *Chiltonia*), peduncle inner margins with two distal retinacula (coupling hooks).

Uropod 1 (fig. 2L) peduncle distinctly longer than rami, dorsal margin with five robust setae along the length of the outer margin and five along the inner margin; outer ramous with distal cluster of four robust setae and two rows of robust setae along length, outer margin with four robust setae, inner margin with two robust setae; inner ramous with distal cluster of six robust setae and two rows of robust setae along length, outer margin with two robust setae, inner margin with three robust setae. Uropod 2 (fig. 2J) peduncle similar length to rami, dorsal margin with three long robust setae; outer ramous slightly smaller than inner ramous, with distal cluster of four robust setae, with one row of eight robust setae along length; inner ramous with two rows of robust setae along length, outer margin with fourteen robust setae, inner margin with eighteen robust setae (distal cluster of setae obscured by rows of setae). Uropod 3 (fig. 2I) with two articles; first article 2.8 times longer than second article; second article distal margin with one short robust seta, and one to three long robust seta apically and one long seta subapically.

Telson (fig. 2I) slightly longer than broad, apically slightly concave with pairs of two long and two short plumose setae around each distal corner.

Small male (based on small male NMV J46779). Length: 6.8mm. Similar to large male except for the following: Antenna

1 (fig. 3A) flagellum of 14 articles, with ventral aesthetascs on the proximal margins of the eight distal articles. Antenna 2 (fig. 3B) flagellum of nine articles. Maxilliped inner plate apical margin with three spine-like setae. Gnathopod 1 (fig. 3C) coxa longer than broad, distal margin with 12 short simple setae. Gnathopod 2 (fig. 3C) coxa distinctly longer than broad, with seven short setae along margin. Pereopods 3 and 4 (fig. 3C) lacking setae along coxal margin and the dorsal margin of the propodus. Pereopods 5-7 (fig. 3C) with fewer coxal setae, with fewer numbers of setal clusters along articles.

Pleopod 1 (fig. 3G) rami with fewer articles than in large male.

Uropod 1 (fig. 3E) peduncle slightly longer than rami, dorsal margin with up to nine robust setae along the length of the outer margin and up to three along the inner margin; rami straight (not curved as in large male); outer ramous with distal cluster of four robust setae and two rows of robust setae along length, outer margin with four robust setae, inner margin with one robust seta; inner ramous with distal cluster of five or six robust setae and two rows of robust setae along length, outer margin with two robust setae, inner margin with three robust setae. Uropod 2 (fig. 3D) peduncle similar length to rami, dorsal margin with four to five long robust setae; outer ramous slightly smaller than inner ramous, with distal cluster of four robust setae, with one row of three robust setae along length; inner ramous with distal cluster of five robust setae, with two rows of robust setae along length, outer margin with two robust setae, inner margin with three to four robust setae. Uropod 3 (fig. 3F) second article distal margin with one short robust seta, and one to two long robust seta apically.

Female (based on female NMV J46780). Length: 8.2mm. Similar morphology to (large) male except for the following: Antenna 1 (fig. 4A) flagellum of 11 articles, with ventral aesthetascs on the proximal margins of the six distal articles. Antenna 2 (fig. 4B) flagellum of ten articles. Maxilliped inner plate apical margin (fig. 4C) with three spine-like setae. Gnathopod 1 (fig. 4D) coxa longer than broad, distal margin with 12 short simple setae; propodus rectangular in shape, around 2.5 times as long as broad, inner face with 10 robust setae. Gnathopod 2 (fig. 4E) similar to gnathopod 1 except propodus over 3 times as long as broad, coxa with eight short setae along margin. Pereopod 4 (fig. 4H) coxa ventral margin not as broadly rounded as in large male.

Uropod 1 (fig. 4J) peduncle similar length to or slightly longer than rami, dorsal margin with up to 10 robust setae along the length of the outer margin and up to five robust setae along the inner margin; outer ramous with distal cluster of five robust setae and one row of six robust setae along length; inner ramous with distal cluster of four robust setae and two rows of robust setae along length, outer margin with three robust setae, inner margin with three robust setae. Uropod 2 (fig. 4I) peduncle dorsal margin with up to four long robust setae; outer ramous slightly smaller than inner ramous, with distal cluster of three robust setae, with one row of four robust setae along length; inner ramous with distal cluster of four robust setae, with two rows of robust setae along length, outer margin with up to five robust setae, inner margin with up to five robust

setae. Uropod 3 (fig. 4F) second article with one short robust seta, and one to two long robust seta apically.

Telson (fig. 4G) longer than broad, apically blunt with pairs long setae apically and laterally.

Oostegites present on coxae 2 to 5 (figs. 4K-N) to form the marsupium, margins with scattered curved hooks.

Variation. Antenna 1: the number of flagellum articles varied from nine to 14 with no clear correlation between sex or body size. Antenna 2: the number of flagellum articles varied from seven to nine with no clear correlation between sex or body size. Despite the differing number of flagellar articles in both antennae, the standard lengths of the two were consistent between sexes and sizes, with antenna 1 1.4-1.6 times as long as antenna 2. It should be noted that Williams (1962) recorded antennal length ratios from 1.4 to 2.0 for *A. australis*. This could reflect sample size differences between this study and Williams' but there may be reason to suspect that cryptic species may have been inadvertently included in his study (see discussion).

Mouthparts are generally well conserved throughout the Chiltoniidae however two of the large male morphotypes, exhibited a reduction in setation on the maxilliped inner plate (from 3 to 2 spine-like setae) (fig. 1E). Both males showing the reduction in setae were at the smaller end of the "large male" morphotype (7.3mm, 7.7mm). Other large males had three setae, along with all the small males and the females (fig. 4C), which is the consistent state across the family. When Williams (1962) described *A. australis* and *A. subtenuis*, he illustrated *A. subtenuis* with two setae on the maxillipedal inner plate but did not further mention it compared to *A. australis* (which he illustrated and described with three setae). This character may be variable within both species.

Remarks. Lowry and Stoddart (2003) accepted Williams' interpretation of *Austrochiltonia australis* and relabelled his invalid type names ("lectoholotype" became the lectotype NMV J11247 and "lectoallotypes" became paralectotype NMV J11248). However, they indicated that NMV J11247 was a male and NMV J11248 was a female, which is incorrect. They also did not refer to the additional paralectotypes identified by Williams.

Both the lectotype male (NMV J11248) and the paralectotype female (NMV J11247) designated by Williams have been damaged over time. Examination of the paralectotypes (NMV J11249) showed better preserved specimens and so the descriptions here have been based on two males (NMV J46778, NMV J46779) and a female (NMV J46780) taken from NMV J11249 and then compared with all existing types to note any variability.

Discussion

The discovery of two separate male morphotypes in the type material was surprising and has never been recorded for amphipods in this family. A similar large male morphotype has been found in samples tentatively identified as *A. subtenuis* (waiting confirmation from type locality specimens) but not in chiltoniid species from mound springs in South Australia (pers. observ.) indicating that this could be some sort of adaptation linked to stream habitats.

One character used by Williams (1962) to define *A. australis* is upheld here: all the animals examined possessed a uropod 3 with two articles. Two other characters Williams used to define *A. australis* were not found here to be informative: the length of antenna 1 vs. the body length and the length of the flagellum in antenna 1 vs. the length of the peduncle. Both were found here to be widely variable across size classes and sexes. *A. australis* can be most easily identified by the presence of a uropod 3 with two articles, a large eye and antenna 1 distinctly longer than antenna 2.

Williams (1962) identified and measured specimens of *A. australis* from Tasmania, Victoria and New South Wales. However, based on the lack of modern taxonomic treatments of these species and the recent discovery of greater chiltoniid species diversity elsewhere in Australia (Murphy et al. 2009; R. King, pers. observ.) it can not be ruled out that similar cryptic diversity exists across Australia. In fact, Williams' (1962) measurements indicated much more variation between antennal lengths than was recorded here in the type material. Without having made a detailed examination of populations from these localities it is difficult to conclude that the specimens that Williams measured from New South Wales and Tasmania are the same species as described here. Therefore the locality of *A. australis* should be restricted to the Yarra River and its tributaries, since the type locality no longer exists, until a sufficient survey can be conducted across Victoria, Tasmania and New South Wales.

Acknowledgements

I am grateful to Wolfgang Zeidler for participating in informative discussions on chiltoniid morphology. Many thanks to Gary Poore and Jo Taylor (Museum Victoria) for arranging the loan of the type material. This work was funded by an Australian Biological Resources Study (ABRS) National Taxonomy Research Grant (No. 208-61).

References

- Chilton C. 1923. Occasional notes on Australian Amphipoda. *Records of the Australian Museum* 14(2): 79-100.
- Hurley, D. E. 1954. Studies on the New Zealand amphipodan fauna. No. 2. The family Talitridae: the freshwater genus *Chiltonia* Stebbing. *Transactions of the Royal Society of New Zealand* 81(4): 563-577.
- Hurley, D. E. 1959. *Austrochiltonia*, a new generic name for some Australian freshwater amphipods. *Annals and Magazine of Natural History*, 13(1): 765-768.
- King, R. A. In press. Two new genera and species of chiltoniid amphipods from freshwater mound springs in South Australia. *Zootaxa*.
- Lowry, J.K. & Stoddart, H.E. 2003. Crustacea: Malacostraca: Peracarida: Amphipoda, Cumacea, Mysidacea. In Beesley, P.L. & Houston, W.W.K. (Eds), *Zoological Catalogue of Australia*, Vol. 19.2B, 531 pp, Melbourne: CSIRO Publishing, Australia.
- Murphy, N. P., Adams M. and Austin A. D. 2009. Independent colonization and extensive cryptic speciation of freshwater amphipods in the isolated groundwater springs of Australia's Great Artesian Basin. *Molecular Ecology*, 18: 109-122.
- Sayce, O. A. 1901. Description of some new Victorian freshwater Amphipoda. *Proceedings of the Royal Society of Victoria*, 13(2): 225-242.

- Sayce, O. A. 1902. Description of some new Victorian freshwater Amphipoda. No. 2. *Proceedings of the Royal Society of Victoria*, 15(1): 47–58.
- Smith, G.W. 1909. The freshwater Crustacea of Tasmania, with remarks on their geographical distribution. *Transactions of the Linnaean Society of London (Zoology)*, (2)11: 61–91.
- Smith, S. J. and Swain, R. 1982. Observations on the Taxonomy of *Austrochiltonia* (Hurley) (Amphipoda: Ceinidae). *Bulletin of the Australian Society for Limnology*, 8: 39–43.
- Williams W. D. 1962. The Australian freshwater amphipods. *Australian Journal of Marine and Freshwater Research* 13: 198–216.

