A NEW FAMILY AND GENUS OF PHREATOICIDEA (CRUSTACEA: ISOPODA) FROM ARTESIAN SPRINGS IN SOUTHWESTERN QUEENSLAND, AUSTRALIA

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Wilson, G.D.F. & Keable, S.J. 2004 06 30: A new family and genus of Phreatoicidea (Crustacea: Isopoda) from artesian springs in southwestern Queensland, Australia. *Memoirs of the Queensland Museum* **49**(2): 741-759. Brisbane. ISSN 0079-8835.

Two new species of phreatoicidean isopods from artesian springs in southwestern Queensland are described. These taxa have been shown to form a clade that is distinct from all other taxa in the suborder. Therefore, a new genus, *Ponderella*, and a new family, Ponderellidae, are established for this clade. These two epigean species share many features in common with the hypogean family Hypsimetopidae but lack their derived features, such as elongate bodies or curved claw-like uropodal endopods. Both new species share an enlarged fourth article of the antennula, a synapomorphy that occurs in no other phreatoicidean. Their pleotelsons are also distinctive in having relatively unelaborated posterior margins that are indented at the apices. The two species differ in several morphological traits that vary at the generic level or higher in other families of the Phreatoicidea: size of the lacinia mobilis on the right mandible; distinctive modifications of the male pereopod IV in one of the species; presence or absence of propodal articular plates on the posterior pereopods; presence or absence of the pleopodal lateral epipods; and shape of the pleotelson in lateral view. These species occur sympatrically in two adjacent localities in the Eulo mound springs supergroup. Because of their restricted distribution in habitats that lack environmental protection, these species are potentially endangered. ❑ *Phreatoicidea, Isopoda, artesian springs, Queensland, new taxa*.

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Species of phreatoicidean isopods occur throughout Australia (Nicholls, 1943, 1944; Wilson & Keable, 1999, 2001, 2002a,b). Until recently, Queensland was the only state in which phreatoicideans had not been recorded, despite this state having many diverse, potentially suitable habitats. An extended field trip in 1998 by the first author and colleagues along the coastal ranges of Queensland found no phreatoicideans. Recent investigations by Dr Winston Ponder and associates discovered two new phreatoicidean isopod species from artesian springs at Bundoona Homestead and the Eulo Township of southwest Queensland. In addition to the new phreatoicidean isopod species, these sites had 5 new species of hydrobiid gastropods of the genus *Jardinella* (W. Ponder, pers. comm.), with other possible endemics being at least one species of amphipod and a leech. These artesian springs are associated with the Great Artesian Basin, the majority of which is in Queensland. These springs, located in otherwise arid regions, provide a unique habitat for a variety of endemic invertebrates (Ponder, 1986; 2004). Notably, hydrobiid snails have radiated in the Queensland springs (Ponder & Clark 1990).

An initial hypothesis of relationships of the phreatoicidean species, based on the habitat where they occur, suggested that they would be related to *Phreatomerus* Sheppard, 1927, found in artesian springs of South Australia. Further study and a phylogenetic analysis (Wilson & Edgecombe, 2003; available at available at TreeBase, http://www.treebase.org, study accession no. S797, matrix accession no. M1262; reported as 'Qld n sp.1' & 'Qld n sp.2') demonstrated that the unique combination of features in these two species prevents their classification in an existing family. They are unlike any other phreatoicidean and are assigned here to a new genus, *Ponderella* and a new family Ponderellidae.

MATERIALS AND METHODS

Specimens were fixed in either sodium bicarbonate neutralised 10% formalin solution or 95% ethanol. Preparation of specimens for scanning electron microscopy (SEM) included dissection and isolation of individual limbs, ultrasonic cleaning and CO_2 critical point drying. Images were obtained using a Leo 435VP SEM equipped with a Robinson backscatter detector, and then saved as digital TIF files. The images

were placed into digital image figures with the background removed. Pleopod and holotype figures were prepared using a camera lucida and light microscopy, inked, scanned and saved as TIF files. Descriptions were prepared using DELTA (Dallwitz, 1980; Dallwitz, et al., 2000a,b) as employed by Wilson & Keable (1999, 2001, 2002a,b).

ABBREVIATIONS. AM, Australian Museum, Sydney; QM, Queensland Museum; bl, body length; GPS, global positioning satellite fix; ind., individuals, specimen or specimens.

SYSTEMATICS

PONDERELLIDAE fam. nov.

TYPE GENUS. *Ponderella* gen. nov., family monotypic.

DIAGNOSIS. Head with small eyes (diameter less than antennal base), not protruding; antennal notch absent. Pleonites in lateral view much deeper than pereonites, pleurae large, basal region of pleopods not visible, pleonite 1 pleura distinctly shallower than those of pleonites 2-5. Pleotelson postanal ventral surface present, unelaborated; posterior apex indented in dorsal view, free (not strongly reflexed or flattened against dorsal surface); posterolateral margin projecting in lateral view but continuous with apex; ventral margin anterior to uropods narrow (less than width of uropodal insertion). Paragnaths lateral lobe margin densely setulate in compact distomedial region, sparsely setulate distolaterally and medially. Antennula article 4 longer than article 3; penultimate article elongate, tubular, longer than ante-penultimate article; terminal article tiny with single aesthetasc. Mandible incisor processes thin in medial view, width near thickness, resembling dentate spines; right lacinia mobilis distinct, inserting distally at base of projecting spine row with single dentate plate (anterior surface of plate smooth); spine row on projecting ridge between incisor and molar, basal insertions in line between incisor and molar processes. Pereopods V-VI basis dorsal margin angular in cross-section, not plate-like; VII basis dorsal margin with enlarged plate. Pleopods exopods II-V proximal article distolateral lobes subequal to or longer than distal article. Uropod protopod dorsomedial ridge not produced; rami distal tips rounded, cross-sectional shape flattened on dorsal surface only.

Ponderella gen. nov.

TYPE SPECIES. *Ponderella bundoona* sp. nov., here designated.

SPECIES INCLUDED. *Ponderella bundoona* sp. nov., *P. ecomanufactia* sp. nov.

ETYMOLOGY. *Ponderella* honours Winston F. Ponder's many contributions to our knowledge of Australia's freshwater biodiversity, especially his research on artesian springs that resulted in the discovery of these new species.

DESCRIPTION (MALES). *Head.* (Fig. 2A-B) Lateral profile of dorsal surface smoothly curved; width approximately 0.9 pereonite 1 width; surface smooth and shiny; tubercles absent; setae fine. Eyes fully sessile (i.e., not protruding); pigmentation dark. Cervical groove straight (weak). Mandibular notch present (weak). Clypeal notch present (weak). Frontal process above antennula absent. Mouthfield angling ventrally, mandibular insertion axis in lateral view nearly level, line projected anteriorly along mandibular insertion passing below base of antenna; adjacent to posterior margin of head and anterior margin of pereonite 1.

Pereon. (Fig. 1A) Width near head width; surface smooth; setae on dorsal surface scattered, fine. Pereonite 1 dorsal margin in lateral view shorter than on pereonite 2. Pereonites 2-7 in dorsal view wider than long. Coxal articulation of pereonites 2-4 fused, 5-7 free. Lateral tergal plates of pereonites 2-4 not extended over basis. Sternal processes absent. Typhlosole absent, gut round in cross-section; hindgut caecae absent.

Pleonites. (Fig. 1A) In dorsal view 2-4 respective lengths more than half the length of pleonite 5. Pleonite 5 dorsal median ridge absent.

Pleotelson. (Fig. 6E-F) Dorsal surface in lateral view evenly curving (curvature increasing at posterior margin), covered with abundant curled simple setae, median ridge and lateral ridges absent; ventral surface anterior to uropods strongly concave; with single row of simple robust setae; lateral uropodal ridge curving strongly and extending posteriorly from uropods on pleotelson margin, lacking setae.

Antennula. (Fig. 2A,D) Article 3 rudimentary second flagellum absent. Terminal article shorter than penultimate article. Penultimate article length not distinctly longer than other articles; width approximately subequal to ante-penultimate article width. Distal articles oval in cross-section.

Antenna (Fig. 2A-D) article 6 shorter than articles 4 and 5 combined. Flagellum proximal articles without dense cover of cuticular hairs.

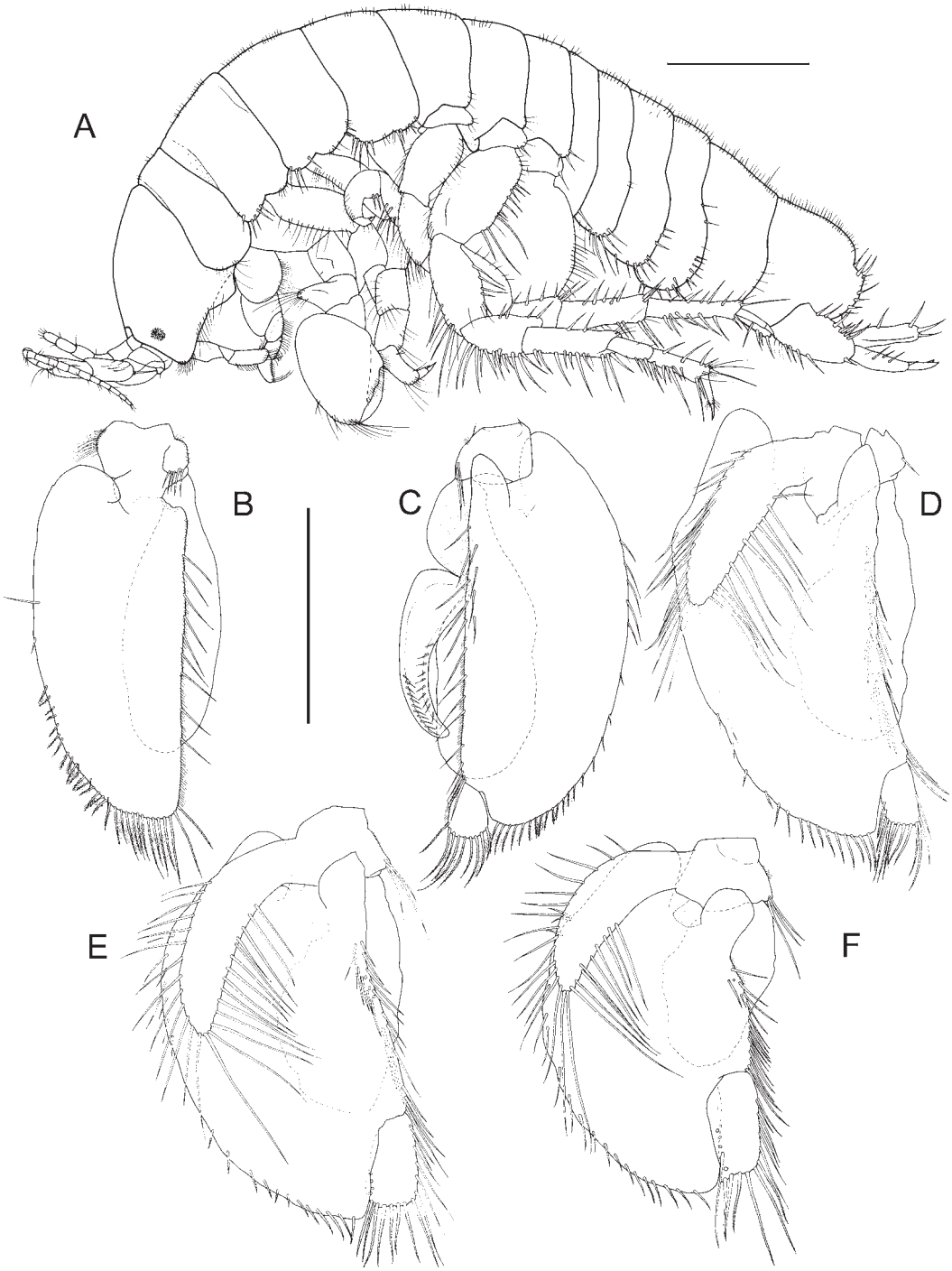

FIG. 1. *Ponderella bundoona* gen. et sp. nov. A, lateral view, holotype ♂, QM W26732; scale bar 2mm. B-F, pleopods I-V, ventral view, ♂, AM P64023; scale bar 1mm.

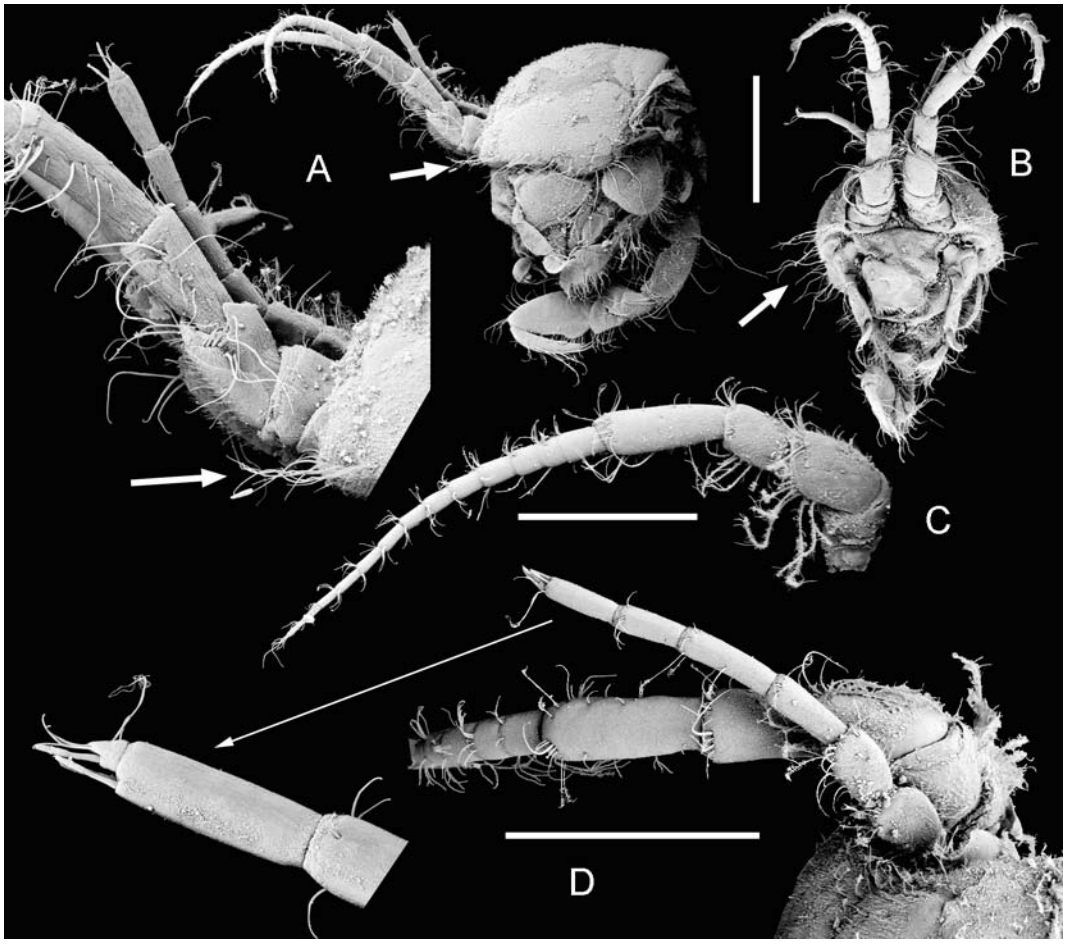

FIG. 2. *Ponderella bundoona* gen. et sp. nov. A-B, head and right pereopod I, left lateral and frontal views, with enlargement of antenna base and antennula, heavy arrow indicates setal fringe, ♀, AM P64022. C-D, antenna and antennula with enlargement of distal tip, ♂, AM P64020. Scale bars 0.5mm.

Mouthfield. (Fig. 2A-B) Clypeus consisting of broad bar rounded at mandibular fossae, deeper on left side; labrum ventrally semicircular in anterior view, deeper on right side, labrum dorsal margin approximately same width as clypeus.

Mandible. (Fig. 3) Palp article 1 easily visible; 2nd article longitudinal row of setae present, separate distal group of setae present; 3rd article without coarsely spinulate setae. Incisor processes thin, resembling denticulate spines, width near thickness. Right incisor process with 4 cusps; left incisor with 3 cusps. Right lacinia mobilis well-separated and distinct from spine row. Left lacinia mobilis with 3 cusps. Spine rows with bifurcate spines, distal margin protruding in ventral view relative to proximal margin. Left spine row with first spine not separated from remaining spines. Molar process stout, heavily keratinised, wider than long; triturating surface heavily ridged, without teeth, spines absent.

Maxillula. (Fig. 4B) Medial lobe with 3 pappose setae; short weakly setulate seta on distal tip absent. Lateral lobe distal margin narrow, with 5 smooth robust setae, distal setal row with 4 robust setae; ventral face with 1 plumose seta, additional plumose seta among proximal distal robust setae.

Maxilla. (Fig. 4C) Medial lobe proximal portion distinctly angled to distal portion; proximal and distal setal rows continuous. Outer lateral lobe length subequal to inner lateral lobe, wider than inner lateral lobe, distal margin setal row with

FIG. 3. *Ponderella bundoona* gen. et sp. nov. A, right mandible, dorsal view and enlargement of incisor process and spine row, arrow indicates scale-like lacinia mobilis, ♂, AM P66836. B-D, left mandible, ♂, AM P 64028: B, dorsal view of distal tip; C, palp, posterior view; D, whole, medial and ventral view; E, enlargement of incisor process, lacinia mobilis and spine row, medial view. Scale bars 0.1mm.

two angles — transverse to lateral margin and oblique on medial margin.

Maxilliped. (Fig. 4D) Epipod distal tip truncate (linear across distal margin). Palp article 4 subcircular (length subequal to width).

Pereopods. (Fig. 1A) Coxae not projecting laterally. Pereopod I (Fig. 5A-B) subchelate. Dactylus dorsal margin dense group of elongate setae absent; ventral margin proximal projection absent; ventrodistal margin smooth; with 1 distal accessory claw; distal accessory spines absent. Propodus dorsal margin setae in several groups between proximal and distal margin; proximal region recurved and protruding to distodorsal margin of carpus. Propodal palm (proximal to medial spine) concave; with 1 proximal simple spine (rounded), with 1 median simple spine, with several small distal simple spines, composite spines absent; cuticular fringe weakly developed; medial rugose cuticular pad absent; stout denticulate setae absent; stout robust simple setae absent; elongate broad-based setae absent. Merus distodorsal margin in cross-section shelf-like and U-shaped (in cross section), with numerous elongate simple setae. Pereopods II-III (Fig. 5F) dactylus shorter than propodus, lateral spine absent; propodus articular plate absent; basis dorsal ridge in cross-section angular but not forming distinct plate, dorsal ridge proximal knob absent. Pereopod IV (Fig. 5E) prehensile in male, subchelate with major hinges on dactylus and propodus, limb simple in female; dactylus longer than propodal palm; propodus with multiple broad based setae on ventral margin, some distinctly larger than others, articular plate on posterior side of limb absent in female; carpus of male with single setal row; basis dorsal ridge in cross-section angular but not forming distinct plate. Pereopods V-VII (Fig. 6A-C) basis lateral face central ridge absent, ventral ridge present (weak), setae absent; basis VII dorsal ridge distal margin rounded; ischium VII dorsal ridge flange absent.

Penes. (Fig. 6D) Curved posteriorly; extending past midline and onto pleonite 1; cuticle smooth, with setae on shaft; distally broadening, distal tip flattened.

Pleopods. (Fig. 1B-F) Lateral proximal lobes on exopods I-V, medial proximal lobes on exopods II-V. Endopods unilobed; I-V without setae on margins. Protopods medial margins without coupling hooks, with minutely serrate setae; protopod I lateral epipod absent, protopod II lateral epipod absent. Pleopod I exopod broadest proximally, distal margin rounded, lateral margin rounded, medial margin straight - divergent from lateral margin proximally, dorsal surface lacking setae, ventral surface flat; protopod length subequal to that of other pleopods, width subequal length. Pleopod II endopod appendix masculina curved, distal tip extending beyond half length of endopod, not reaching distal margin of endopod; proximal half of shaft broadly concave in ventral cross-section, not forming tube; distal tip acutely rounded, distal tip margins smooth; with multiple setae on margin, occurring laterally and medially. Pleopod II endopod distal margin rounded; exopod distal segment longer than wide.

Uropod. (Fig. 6E,G) Protopod extending posteriorly subequal to pleotelson apex; dorsomedial ridge in dorsal view parallel to ventral margin, setae on margin robust and simple; dorsolateral margin setae robust and simple; distomedial margin without spinose setae; ventral ridge without rows of long laterally projecting setae. Endopod subequal-longer than exopod, straight-curving dorsally; dorsal margin robust setae along length; spine on dorsal margin absent; ventral margin convex-straight proximally. Exopod shorter than pleotelson; exopod dorsal margin with multiple robust setae.

DISCUSSION. Species of *Ponderella* gen. nov. possess both unique synapomorphies and a combination of other characters that contributed to their isolated position in phylogenetic analyses of the Phreatoicidea (see Wilson & Edgecombe, 2003). The long fourth article of the antennula (longer than article 3; Figs 2D, 8B) is a putative synapomorphy separating *Ponderella bundoona* n.sp. and *P. ecomanufactia* n.sp. from all other phreatoicidean genera. While article 4 can be large in some hypsimetopid species, being subequal to the next distal article, it is never longer than article 3. Additionally, the paragnaths, a feature not often used in isopod systematics, are contracted and have relatively thick (in a dorsoventral direction) distomedial brushes of setae in *Ponderella* (Fig. 4A). Most other phreatoicideans have a thin, dense row of setae that curves around the margin from the inner medial edge to the lateral edge (e.g., Wilson & Keable, 2002b: fig. 4A). Also in most other taxa, the lengths of the paragnath setae taper to shorter lengths medially, and in *Ponderella* these setae are all near the same length. In *Ponderella*, pleopod exopods II-V have the proximal article distolateral lobe (Figs 1B-F) subequal or longer

FIG. 4. *Ponderella bundoona* gen. et sp. nov. A-B, ♂, AM P64020; C-D, ♂, AM P 64028. A, paragnaths, ventral view. B, maxillula, ventral view, with enlargement of inner lobe tip and medial view of outer lobe robust setae. C, maxilla, ventral and dorsal views. D, maxilliped, ventral view, with enlargement of endite, medial oblique view. Scale bars 0.1mm.

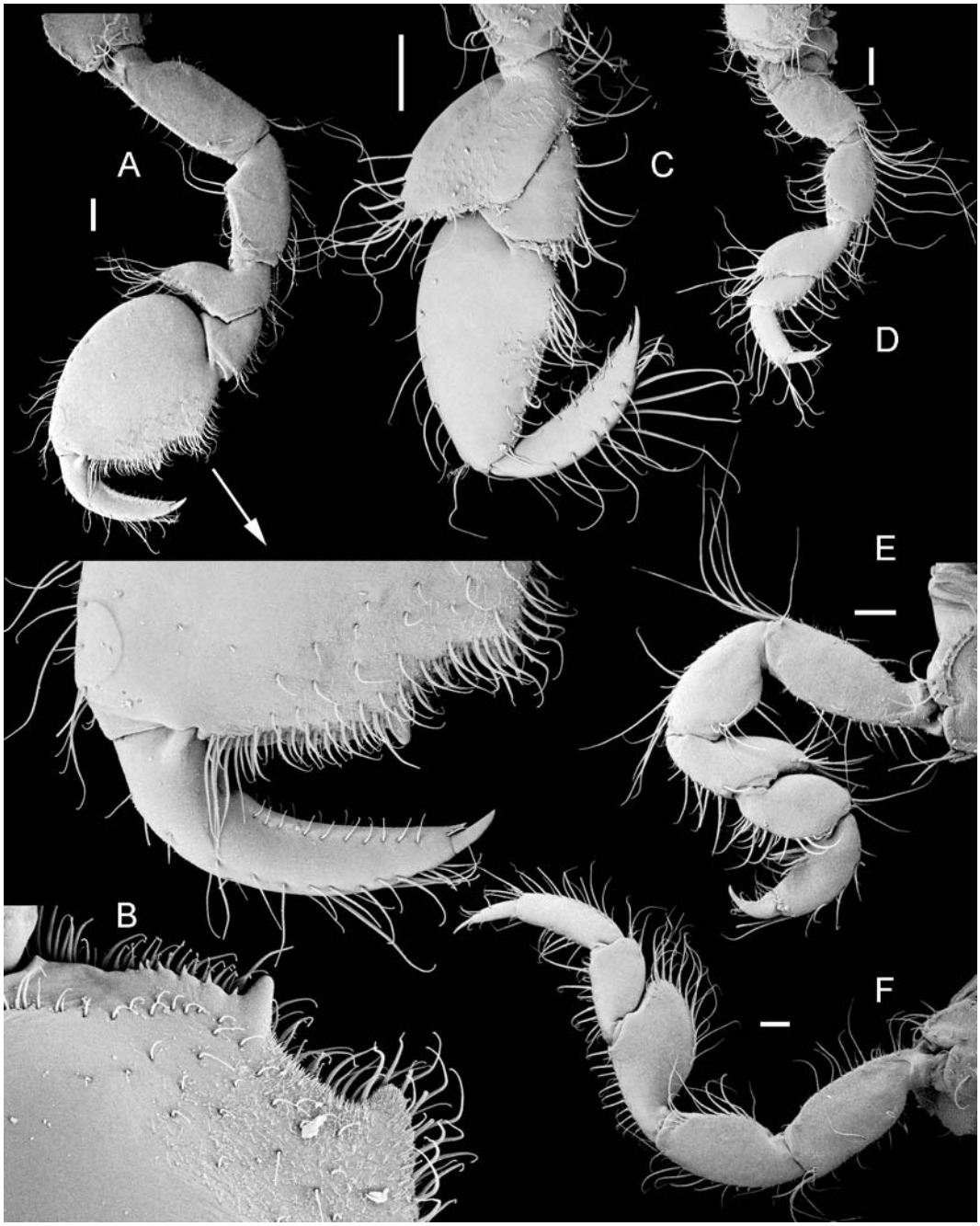

FIG. 5. *Ponderella bundoona* gen. et sp. nov. A-B, left pereopod I, lateral view, with enlargement of palm medial view; E-F, pereopods IV (right) and II (left), lateral views, ♂, AM P 64028. C-D, pereopod I (distal articles only) and IV; left lateral views, ♀, AM P64022. Scale bars 0.1mm.

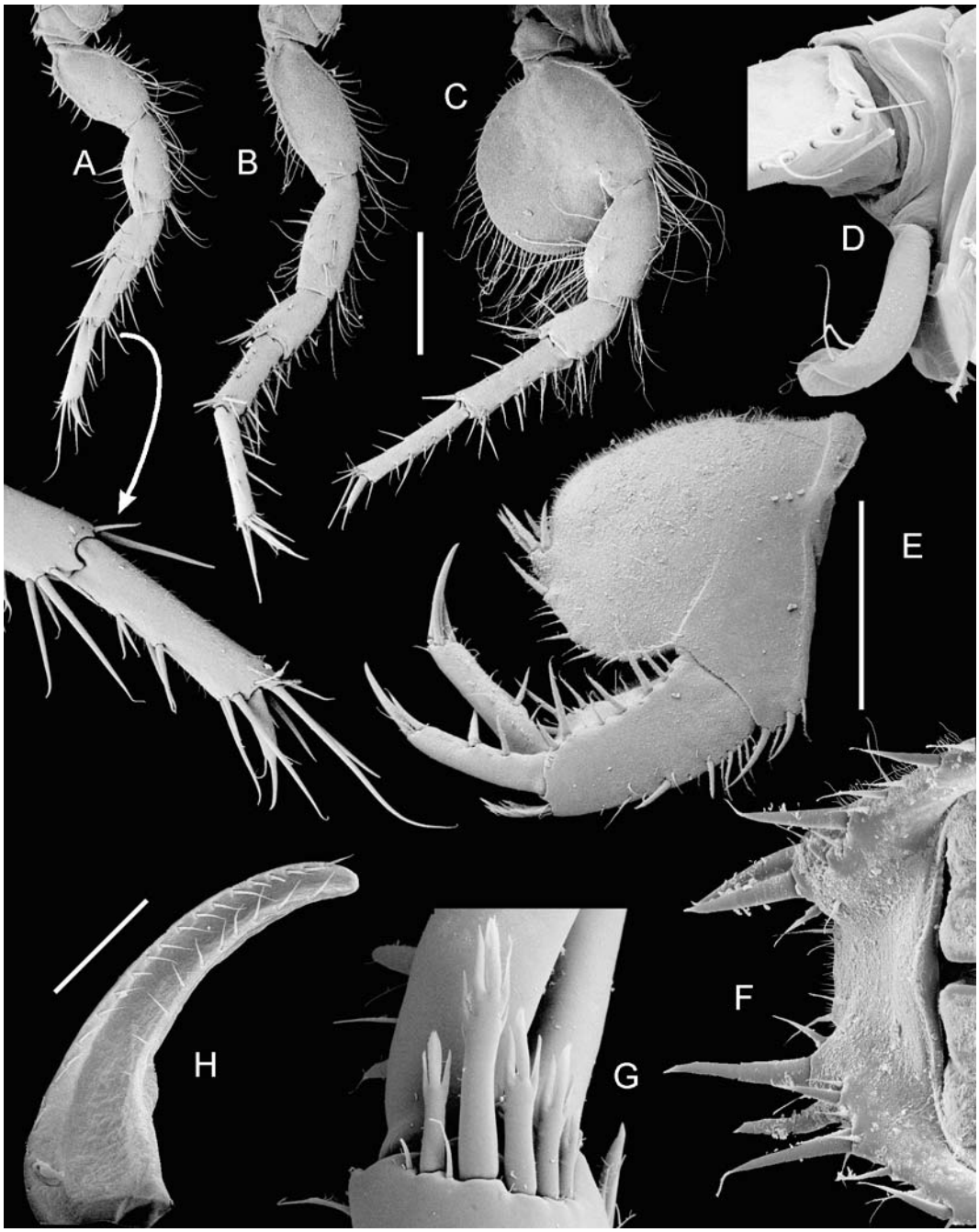

FIG. 6. *Ponderella bundoona* gen. et sp. nov. ♂, AM P 64028. A-C, pereopods V-VII, right lateral view, scale bar 0.5mm. D, penes, right side, anterior view. E, pleotelson and uropods; scale bar 0.5mm. F, pleotelson apex, ventral view. G, uropod protopod, ventral view of distal tip showing spinose setae. H, pleopod II appendix masculina, ventral view; scale bar 0.1mm.

than the distal article. This feature otherwise is only found in the hypsimetopid clade (i.e., *Hypsimetopus* Sayce, 1902; *Hyperoedesipus* Nicholls & Milner, 1923; *Nicholllsia* Chopra and Tiwari, 1950; *Phreatoicoides* Sayce, 1900; *Pilbarophreatoicus* Knott & Halse, 1999). Also similar to some hypsimetopids, the mandibular right lacinia is a simple flat toothed plate and is unlike those of the phreatoicid or the amphisopid clades, where an additional anterior toothed lobe is present. The right lacinia of the phreatoicids differs further in being more spine-like and incorporated into the spine row. As in the hypsimetopids, phreatoicids, and the genera *Mesamphisopus* Nicholls, 1943 and *Crenisopus* Wilson and Keable, 1999, the antennula has a tiny distal article and an elongate penultimate article. In these latter taxa, the penultimate article is variously inflated, while it is thin and tubular in *Ponderella*. In all of these taxa mentioned, the tiny terminal article has only a single aesthetasc, evidence that it has not been fused with other articles. In contrast, the amphisopids (excluding *Mesamphisopus*) appear to have several terminal antennular articles that are fused because the last article has several distinct clusters of aesthetascs. The penultimate antennular article of amphisopids is not elongate nor does it consist of several fused articles.

Although sharing several features with the hypsimetopids as noted above, species of *Ponderella* lack many of their derived characters. The pleonites are not substantially modified, being deeper than the pereonites; the body is not thin and elongate; the pleotelson is deeper than long; eyes are present, although small; the pereopods are not attenuated in any way; the uropods lack specialisations such as medially curved claw-like endopods. This pattern in *Ponderella*, however, is plesiomorphic within the Phreatoicidea.

Other notable characters that indicate relationships of *Ponderella* species are found in the pereopods and the pleotelson. Although the basis dorsal margin on the posterior pereopods varies considerably among the phreatoicideans, *Ponderella* species are unique in lacking dorsal processes on the bases of pereopods V and VI, and having an enlarged dorsal plate on the basis of pereopod VII (Figs 6A-C). The rounded dorsal plate of the pereopod VII basis in *P. bundoona* n.sp. is similar to that occurring in *Phreatomerus* Sheppard, 1927 but this latter taxon also has large plates on pereopod bases V-VI. The position of posterior pereopods (V-VI) in preserved specimens of *Ponderella* suggest that these legs can rotate at the coxae well forward of a line perpendicular to the body axis, whereas they are held more posteriorly in most other phreatoicideans (except the semiterrestrial *Phreatoicopsis* Spencer & Hall, 1896).

The shape of the posterior margin of the pleotelson (fig.6E-F, 12A-B) is also distinctive in species of *Ponderella*, largely because it lacks substantial elaboration, such as posterolateral plates or lobes, or a reflexed posterior apex. Genera with a similar pleotelson include *Crenisopus*, *Mesamphisopus* and *Protamphisopus* Nicholls, 1943. In the first two of these taxa, the pleotelson lateral margins converge smoothly to a variously projecting posterior apex. *Ponderella* species differ because the pleotelson apex appears indented in dorsal view and the posterolateral margins project posteriorly beyond the apex. Other taxa that have unelaborated pleotelson margins (e.g., *Phreatoicopsis* or the hypsimetopids) differ because their anus is adjacent to the margin of the posterior apex; i.e., it has no postanal ventral surface. We are uncertain of the condition of the postanal surface in the fossil taxon *Protamphisopus* Nicholls, 1943, but this taxon lacks any of the pleotelson specialisations seen in the hypsimetopids (Wilson & Edgecombe, 2003), and thus is more similar to *Ponderella*. Consideration of potential outgroups and the observed basal phylogenetic position of *Crenisopus* and *Ponderella* suggests that this unelaborated form of the pleotelson may be plesiomorphic.

Although sympatric, each species of *Ponderella* is distinctive in features that are usually constant within a phreatoicidean genus. For example, pleopod III-V protopod lateral epipods are present in *Ponderella bundoona* and absent in *P. ecomanufactia*. The right lacinia is a large plate in *P. ecomanufactia*, but a small tooth at the base of the spine row in *P. bundoona*. The incisor process appears to be smaller and less projecting in *P. bundoona* than in *P. ecomanufactia* (compare Figs 3A and 9A). The antennae are different sizes, compared to the body length, being short in the more diminutive *P. bundoona* and elongate in *P. ecomanufactia*. The fourth pereopods are highly dimorphic in *P. ecomanufactia*, with an expanded plate on the carpus in the male, while the same limb of *P. bundoona* is not as robust. *Ponderella ecomanufactia* males have a propodal articular plate on pereopod IV (absent in females) while both sexes of *P. bundoona* lack the plate. Both

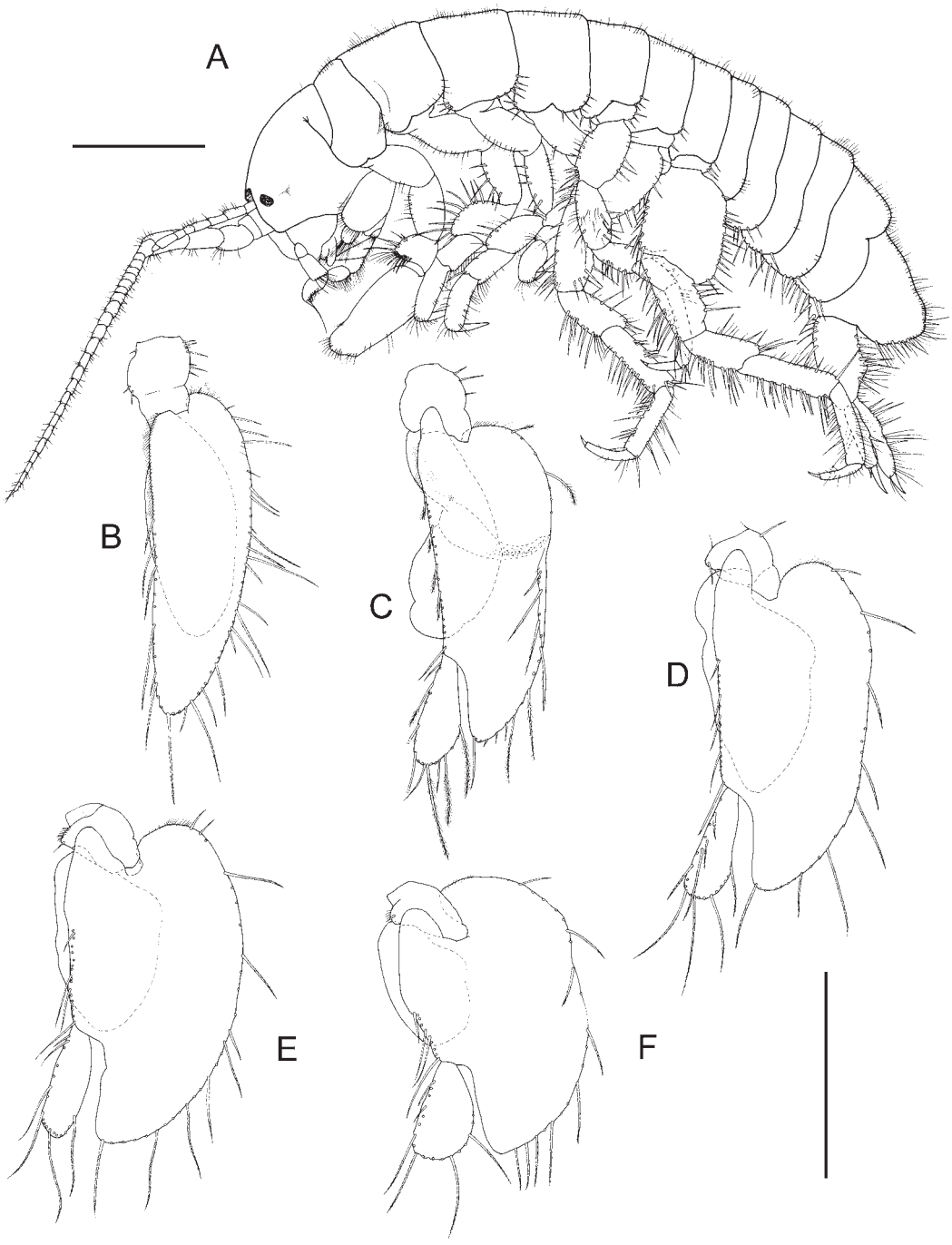

FIG. 7. *Ponderella ecomanufactia* gen. et sp. nov. A, lateral view, holotype ♂, QM W26730; scale bar 2mm. B-F, pleopods I-V, ventral view, ♂, AM P64014; scale bar 1mm.

sexes of *P. ecomanufactia* have propodal articular plates on the posterior pereopods V-VII; these are missing in *P. bundoona*. The shape and relative setation of the pereopod VII bases are distinct (compare Figs 6C and 11D) and are useful for separating the two species in a sample. The shape and setation of the pleotelson also differ considerably between the two species, with *P. ecomanufactia* having a less inflected dorsal profile and many more setae on the posterior margin. The two species are so different that they might be assigned to separate genera were more species known from this clade. Based on the current knowledge of this clade, however, we do not create two monotypic genera that would be phylogenetically redundant with the species-level taxa. No new information is added by creating separate genera, so the species can stand for any superspecific hypothesis.

Ponderella species are apparently restricted to a small area of southwestern Queensland, in environmentally degraded springs (W. Ponder, pers. comm.). Similar springs in New South Wales and South Australia have become extinct (e.g., Hergott Bore, the type locality for *Phreatomerus latipes*), and as water resources are increasingly depleted in the arid western regions of Queensland, we are concerned that these two species could become critically endangered. Exploratory activity throughout the Great Artesian Basin may find additional populations of *Ponderella*, but for the moment we assume that they are extremely narrow range endemics. Because they represent a unique morphology among the Phreatoicidea, like many of the other taxa in the group, they afford considerable phylogenetic diversity to the areas where they occur. To preserve this diversity, immediate efforts are needed to protect the springs in which these isopods occur.

Ponderella bundoona sp. nov.
(Figs 1-6)

'Qld n sp.2': Wilson & Edgecombe, 2003: 455, 464, fig.14.

ETYMOLOGY. *"bundoona"* is derived from Bundoona Homestead Springs, and is used as a noun in apposition.

TYPE MATERIAL. Holotype: QM W26732, ♂ bl 6.6mm, "Bundoona" Homestead springs, Queensland, 27°57.15'S 144°46.21'E, 0-1.6m depth, in flowing water at spring head and outflow (15-20 cm from spring head), W.F. Ponder & C. Lydeard, 2 May 2001, QMS-4, #51805. Paratypes: same collection data as holotype - AM P64020, ♂ bl 9.0mm; AM P64021, ♂ "B" bl 6.7mm; AM P64022, ♀ bl 4.7mm; AM P64023, ♂ "A"; AM P64024, ♀ bl 5mm; AM P64025, 3 ind.; AM P64026, ♂ "C"; QM W26733, 2 ♀♀, ♂; AM P64027, 13 ind.; AM P64028, ♂ bl 6.3mm; AM P64019, many ind. Other collections near "Bundoona" Homestead springs, Queensland, Australia, AM numbers: P64029, on mud and submerged vegetation from edges of spring and in water, W.F. Ponder & C. Lydeard, 2 May 2001; P66836-7, main spring, outflow area, edges of spring, deeper pools with sedges, W.F. Ponder, J.H. Waterhouse & A.C. Miller, 4 April 2002.

OTHER MATERIAL. Collections by W.F. Ponder, J.H. Waterhouse & A.C. Miller, 4-6 April 2002. Springs on Bundoona Homestead (sites near 27°57.12'S 144°46.15'E), Queensland, AM numbers: P68023, head of small spring flowing into pool, near main spring, seepage; P68024, body of small spring flowing into pool, near main spring; P68025, area around head of spring, mostly on thick wet mud, out of water flow; P68026, head of spring, on wet sand, mostly out of water flow; P68027, main flow area, seepage/flow areas of spring, short sedges & duck weed; P68028, main body of spring, still pool with lots of duck weed & sedges; P68029, head of spring, on mud & in water; P68046, main flow area, seepage/flow areas of spring, short sedges and duck weed; P68047, from edges of spring, deeper pools with sedges; P68031-4 and P68048-9, pools west of road to Quilpie (27°56.48'S 144°46.70'E), on & in mud & on vegetation, both in & out of water. Near Eulo township, Queensland, Australia, spring west of Paroo River (28°09.5'S 145°02.8'E), AM P68030, in small pools and lower outflows, mostly under grasses in mid section of mound.

DIAGNOSIS. Head, lateral margin above mandibles with row of elongate thin setae. Pleotelson lateral length less than depth, dorsal margin in lateral view with major inflection differentiating apex from dorsal surface; posterior margin with no elongate thin setae. Antenna short, length 0.3-0.38 body length. Mandible incisor process short, not extending to level of spine row; right lacinia mobilis tiny, scale-like, not extending to base of first spine in spine row. Pereopods propodus I-VII articular plate absent in both sexes; dactylus I in male projecting subequal to palm; propodus I palm in male with strong medial spine; carpus IV in male ventral margin not flattened laterally; basis VII dorsal plate strongly convex, almost circular; margin with many elongate fine setae; propodus V-VII distally truncate; dactylus V-VII thin, spine-like, shorter than most distal propodal setae. Pleopod protopods III-V with narrow, lobe-like lateral epipods. Uropod protopod distoventral margin with 5 robust spinose setae.

DESCRIPTION (MALE). *Coloration.* Patches of brown on head, clypeus, labrum, antennules and antenna, otherwise opaque white in ethanol.

Head. (Figs 1A, 2A-B) Length shorter than width in dorsal view; setae in row along ventral margin, fine. Eyes maximum diameter 0.12 head depth;

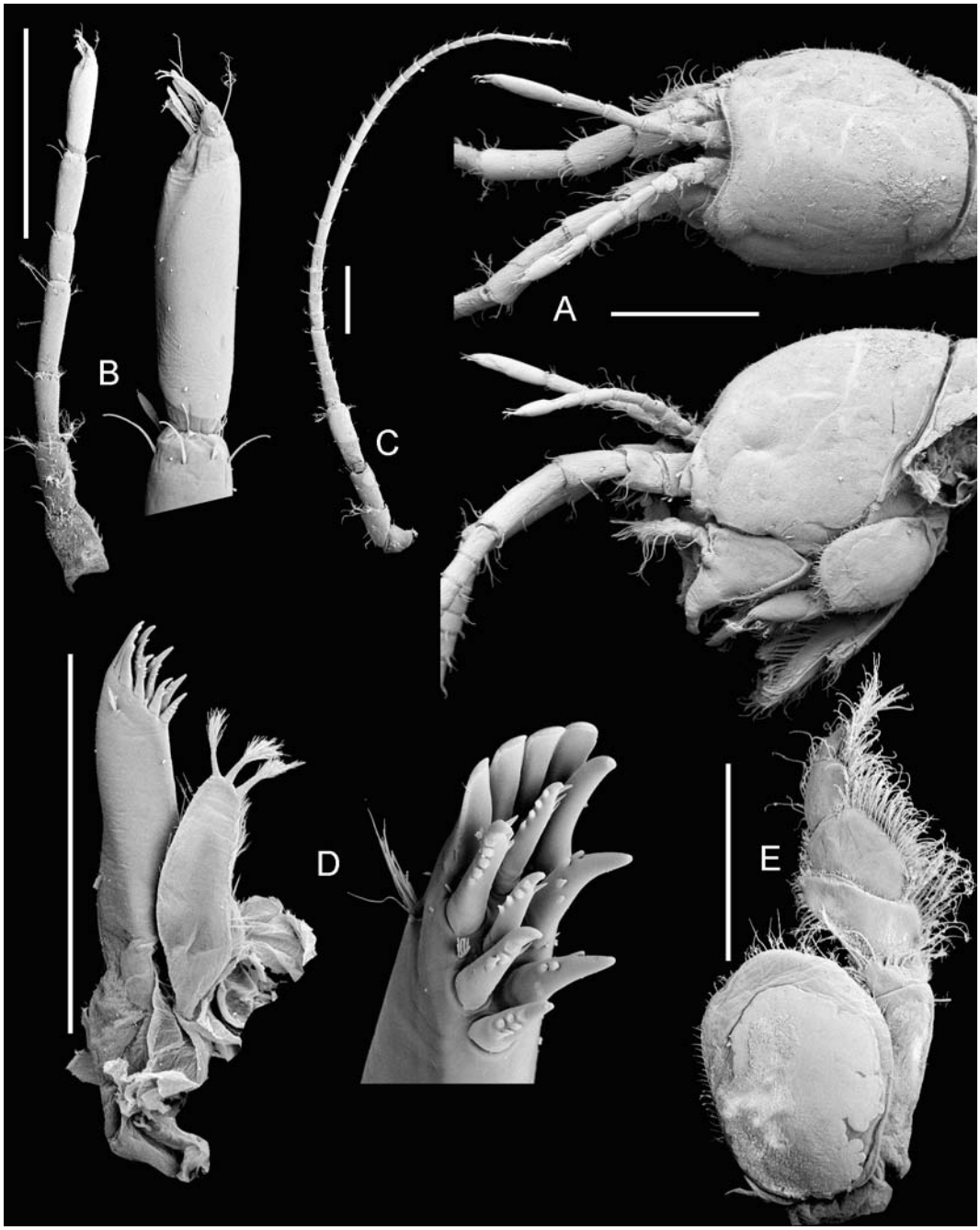

FIG. 8. *Ponderella ecomanufactia* gen. et sp. nov. A, head, dorsal and lateral, ♀, AM P64013. B-C, antennula and antenna, ♂, AM P64012. D, maxillula with enlargement of lateral lobe in medial view, ♂, AM P64011. E, maxilliped, ventral view, ♂, AM P64014. Scale bars 0.5mm.

approximately round; ocelli distinguishable as individual units. Cervical groove (weakly) extending just above antero-lateral margin of pereonite 1. Mandibular groove absent.

Pleonites. (Fig. 1A) 1-4 relative lengths subequal, width 0.62 composite length in dorsal view.

Pleotelson. (Fig. 6E-F) Dorsal length 1.16 width; lateral length 0.13 body length, 0.93 depth; depth 1.63 pereonite 7 depth; margin anterior to uropods 0.53 width of uropodal insertion. Posterolateral margin with distinct inflection differentiating apex; projecting in lateral view; apex compressed anteriorly.

Antennula. (Fig. 2A,D) Length 0.14 body length, with 7 articles. Article 6 with 2 aesthetascs, 1 on article 7, all tiny.

Antenna. (Fig. 2) Article 5 shorter than article 4. Flagellum length 0.51 total antenna length, with 13 articles.

Mouthfield. (Figs 2A-B, 4A) Clypeus width 0.61 head width.

Mandible. (Fig. 3) Palp length 0.68 mandible length; 3rd article relatively linear. Left spine row with 10 spines, 7 of which bifurcate. Right spine row with 9 spines, 7 of which bifurcate.

Maxillula. (Fig. 4B) Medial lobe length 0.89 lateral lobe length; width 0.91 lateral lobe width; with 1 'accessory' seta between medial pappose setae, simple. Lateral lobe with 6 denticulate robust setae.

Maxilla. (Fig. 4C) Medial lobe width 0.69 outer lateral lobe width.

Maxilliped. (Fig. 4D) Endite distal tip with 20 (approximately) subdistal biserrate setae on ventral surface; medial margin with 2 coupling hooks on left side, 1-2 on right side (1 short coupling hook, longer setae distally with cusps half way along, similar to cusps on receptaculi); dorsal ridge with 11 large distally denticulate plumose setae (proximal setae not noticeably denticulate and distal setae not noticeably plumose). Palp insertion on basis ventral surface with 5 subdistal smooth setae.

Pereopod I. (Fig. 5A) Propodus dorsal margin with 10 setae altogether (excluding distal group); propodus palm ridge present, without setae; basis ventrodistal margin with multiple elongate setae. Pereopod IV (Fig. 5E) dactylus distal accessory claw absent; propodus with 2 broad-based setae on ventral margin (and 3 additional fine setae), 1 distinctly larger than remainder.

Penes. (Fig. 6D) Length 0.27 body width at pereonite 7.

Pleopods. (Fig. 1B-F) Protopods medial margins I with epipod, II-V with small projections. Pleopod II endopod appendix masculina basal musculature pronounced; with 19-25 setae on margin; length 0.37 pleopod length.

Uropod. (Fig. 6E-G) Total length 1.64 pleotelson length. Protopod length 0.48 uropod total length. Endopod shorter than protopod, dorsal margin with 1–6 robust setae (1–2 dorsally at midpoint, 3–4 distally). Exopod length 0.88 endopod length; dorsal margin with 3 robust setae.

SEXUAL DIMORPHISM, FEMALE DIFFERENCES. Antenna flagellum with 11 articles. Pereopod I (Fig. 5C) dactylus projecting beyond palm; ventrodistal margin with row of sharp spines distally, thin scale-like spines proximally, along 0.55 total length. Propodus dorsal margin proximal region not protruding. Propodal palm concave proximally, straight distally; simple spines absent, with finely serrated composite spines along length; setal ridge absent. Uropod total length 1.56 pleotelson length. Endopod with 4-7 robust setae (4 dorsally, 3 distally). Exopod dorsal margin with 2-6 robust setae (2 dorsally, 4 distally).

DISTRIBUTION. "Bundoona" Homestead springs and springs to the west of Paroo River, near Eulo Township, Queensland, Australia.

Ponderella ecomanufactia sp. nov.
(Figs 7-12)

'Qld n sp.1': Wilson & Edgecombe, 2003: 455, 464, fig.14.

ETYMOLOGY. For the Eco Manufacturing Centre of Fuji Xerox Australia.

TYPE MATERIAL. Holotype: QM W26730, ♂ bl 7.8mm, "Bundoona" Homestead springs, Queensland, 27°57.15'S 144°46.21'E, 0-1.6m depth, in flowing water at spring head and outflow (15-20cm from spring head), W.F. Ponder & C. Lydeard, 2 May 2001, QMS-4, #51805. Paratypes: same collection data as holotype - AM P64011, ♂, specimen 1; AM P64012, ♂, specimen 2; AM P64013, ♀, specimen 3; AM P64014, specimen 4; AM P64015, ♀, specimen 5; QM W26731, 2 ♀♀, 1 ♂; AM P64016, 2 ind.; AM P64010, 14 ind. Nearby collections by W.F. Ponder & C. Lydeard, 2 May 2001, AM P64017, on mud and submerged vegetation from edges of spring and in water. Nearby collections by W.F. Ponder, J.H. Waterhouse & A.C. Miller, April 2002, AM P66838-9, main spring, outflow area, edges of spring, deeper pools with sedges.

OTHER MATERIAL. Collections by W.F. Ponder, J.H. Waterhouse & A.C. Miller, during April 2002. Springs on Bundoona Homestead (near 27°57.12'S 144°46.15'E), Queensland, AM numbers: P68050, main spring, main flow area, seepage/flow areas of spring, short sedges and duck weed; P68051, except from edges of spring, deeper

FIG. 9. *Ponderella ecomanufactia* gen. et sp. nov. ♂, AM P66838. A-C, right mandible, dorsal view, with enlargement of distal tip, dorsal and medial views. D-E, left mandible, medial enlargement of distal tip and ventral view of gnathal edges. Scale bars, 0.1mm.

pools with sedges; P68035, head of small spring flowing into pool, near main spring, seepage; P68036, body of small spring flowing into pool, near main spring; P68037, main spring, area around head of spring, mostly on thick wet mud, out of water flow; P68038, main spring, head of spring, on wet sand, mostly out of water flow; P68040, main spring, main body of spring, still pool with lots of duck weed & sedges; P68041, on mud & in water; P68043-5, west of road to Quilpie (27°56.48'S 144°46.70'E), on & in mud & on vegetation, both in & out of water. Near Eulo Township, Queensland, Australia, spring to the west of Paroo River (28°09.51'S 145°02.17'E), AM numbers: P64018, in small pools and lower outflows; P68042, in & on mud (some out of water), mostly under grasses in mid section of mound.

DIAGNOSIS. Head lateral margin above mandibles with only scattered tiny setae, row of elongate thin setae absent. Pleotelson lateral length subequal to depth, dorsal margin in lateral view without major inflection in margin differentiating apex; posterior margin with many elongate thin setae. Antenna long, length 0.49-0.62 (male, female, respectively) body length. Mandible incisor processes normal length, extending to level of spine row; right lacinia mobilis large, extending to level of first spine in spine row. Pereopods propodus articular plates II-III absent, IV in male present, but absent in female, V-VII present in both sexes; dactylus I in male projecting beyond palm; propodus I palm with low rounded medial spine; carpus IV in male ventral margin produced into laterally flattened rounded plate; basis VII dorsal plate weakly convex, almost sublinear; margin with short simple setae; propodus V-VII distally tapering; dactylus V-VII basally broad and tapering distally, longer than most distal propodal setae. Pleopod protopods III-V without lateral epipods. Uropod protopod distoventral margin without robust spinose setae, with 4 robust simple setae.

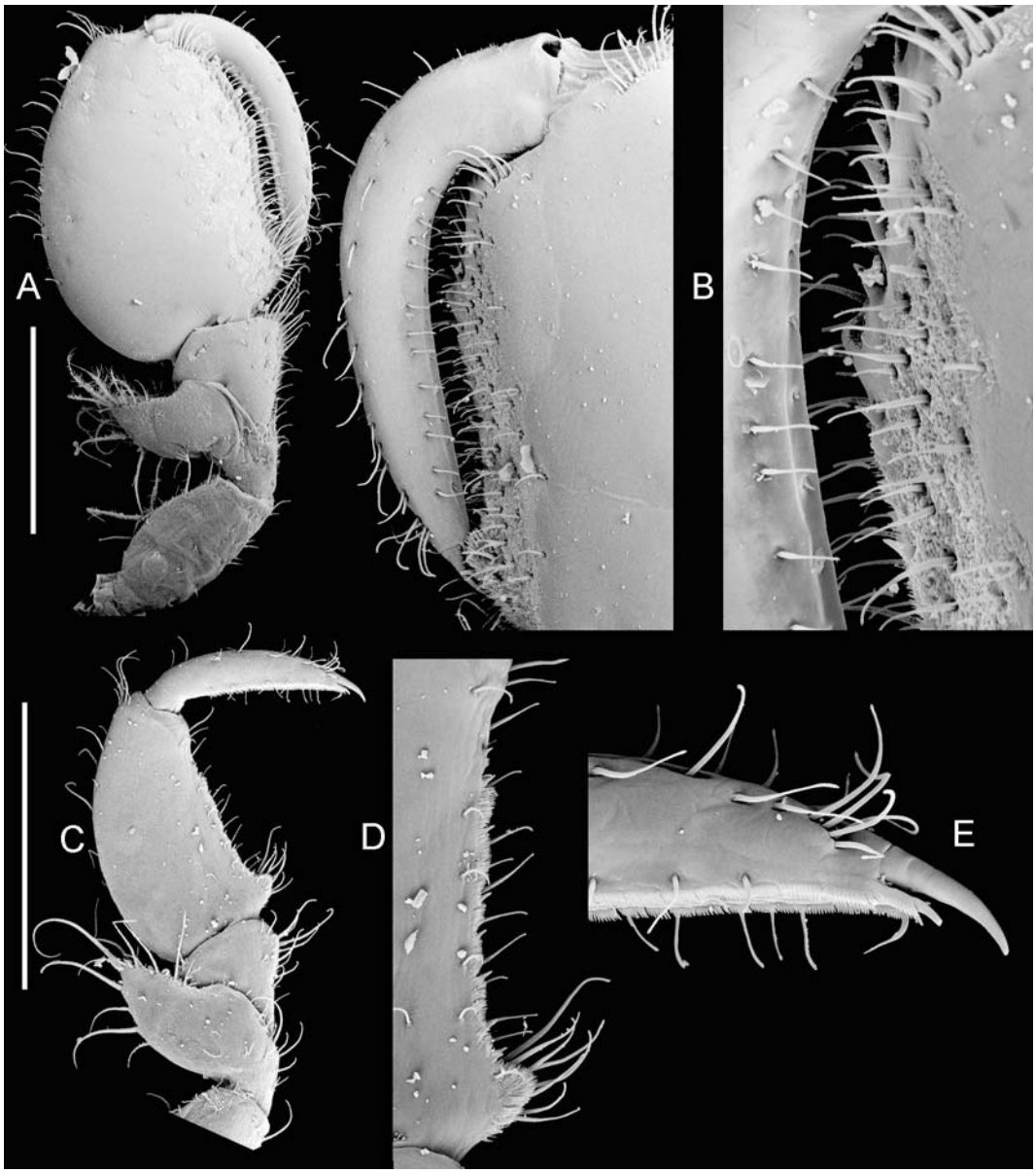

FIG. 10. *Ponderella ecomanufactia* gen. et sp. nov. A-B, pereopod I, right lateral view and enlargements of palm in medial view, ♂, AM P64011. C-E, pereopod I, right lateral view of distal segments with enlargements of the propodal palm and dactylus distal tip, ♀, AM P64013. Scale bars 0.5mm.

DESCRIPTION (MALE). *Coloration* tan to dark brown dorsally and anteriorly, pereopods lighter, in ethanol.

Head. (Fig. 8A) Length subequal to width in dorsal view; setae sparse. Eyes maximum diameter 0.13 head depth; approximately triangular (apex ventral); ocelli not distinguishable as individual units. Cervical groove straight, extending nearly to dorsal margin of head. Mandibular groove smoothly indented.

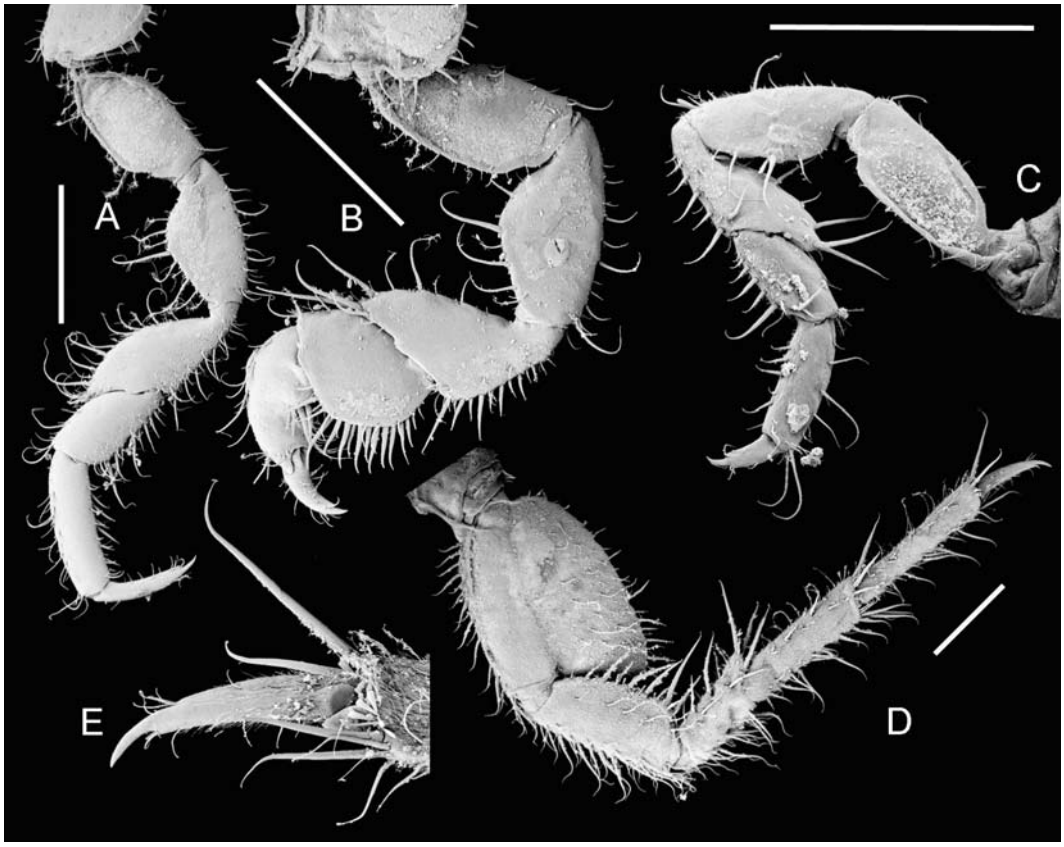

FIG. 11. *Ponderella ecomanufactia* gen. et sp. nov. A-B, pereopods II and IV, left lateral view, ♂, AM P64011. C, pereopod IV, right lateral view, ♀, AM P64013. D-E, pereopod VII, left lateral view with enlargement of dactylus and articular plate, ♂, AM P64014. Scale bars 0.5mm.

Pleon. (Fig. 7A) Pleonites 1-4 relative lengths unequal, increasing in length from anterior to posterior, width 0.79 composite length in dorsal view.

Pleotelson. (Fig. 12A-B) Dorsal length 1.39 width; lateral length 0.14 body length, 1 depth; depth 1.5 pereonite 7 depth; margin anterior to uropod length 0.48 uropod insertion length. Posterolateral margin uninterrupted (without major inflection in margin differentiating apex).

Antennula. (Fig. 8A-B) Length 0.13 body length, with 8 articles. Article 6 with 1 aesthetasc, 3 on article 7, 1 on article 8, all tiny.

Antenna. (Fig. 8C) Article 5 length subequal to article 4. Flagellum length 0.75 total antenna length, with 27 articles.

Mouthfield. Clypeus width 0.55 head width; paragnaths margin broadly curving, lateral setal rows sparse (observations from AM P64014).

Mandible. (Fig. 9) Palp length 0.85 mandible length; 3rd article crescent-like. Left incisor process with 1 small denticle on dorsal margin. Left spine row with 12 spines, 5 of which bifurcate (approximately). Right spine row with 12 spines, 5 of which bifurcate.

Maxillula. (Fig. 8D) Medial lobe length 0.77 lateral lobe length; width 0.88 lateral lobe width; without 'accessory' setae. Lateral lobe with 7 denticulate robust setae.

Maxilla. Medial lobe width 0.77 outer lateral lobe width.

Maxilliped. (Fig. 8E) Endite distal tip with multiple subdistal biserrate setae on ventral surface; medial margin with 4 coupling hooks on left side, 4 on right side; dorsal ridge with 14 large distally denticulate plumose setae (proximal setae not noticeably denticulate and distal setae

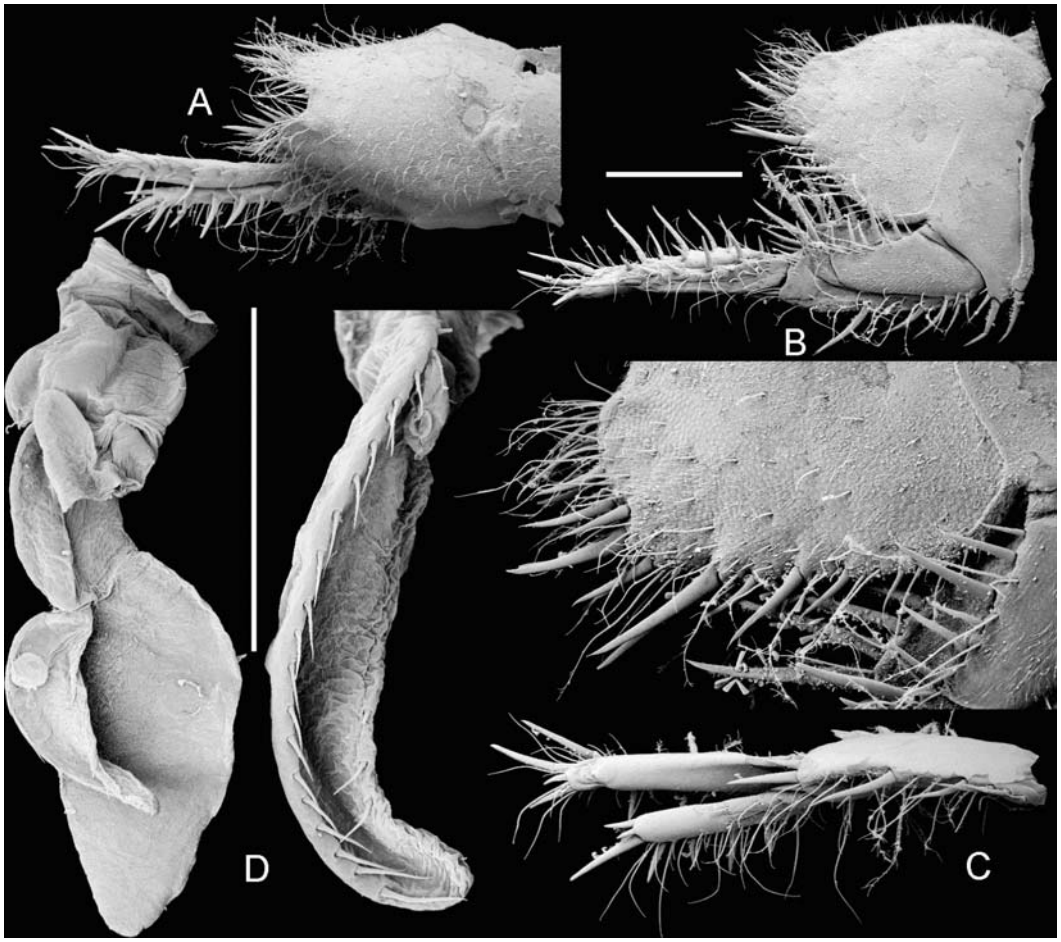

FIG. 12. *Ponderella ecomanufactia* gen. et sp. nov. ♂, AM P64011. A-B, pleotelson, dorsal and lateral views; C, uropod, left ventral view. D, pleopod II endopod and enlargement of appendix masculina. Indentation and wrinkling in the uropod are drying artefacts. Scale bars 0.5mm.

not noticeably plumose). Palp insertion on basis ventral surface without subdistal smooth setae.

Pereopod I. (Figs 10A-B, 11B) Propodus dorsal margin with 15 setae altogether (excluding distal group); propodus palm setal ridge absent; basis ventrodistal margin with 1 elongate seta. Pereopod IV dactylus distal accessory claw present, propodus with 4 broad based setae on ventral margin (about 11 other fine setae on margin), 2 distinctly larger than remainder (grading in size from 2 smaller setae); articular plate in male on posterior side of limb shorter than dactylar claw.

Penes. Length 0.32 body width at pereonite 7.

Pleopods. (Fig. 7B-F) Protopods medial margin III-V with epipods. Pleopod II endopod appendix masculina basal musculature not pronounced; with 38 setae on margin; length 0.25 pleopod.

Uropod. (Fig. 12B-C) Total length 1.82 pleotelson length. Protopod length 0.34 uropod total length. Endopod subequal to protopod length; dorsal margin with 9–11 robust setae. Exopod length 0.8 endopod length; dorsal margin with 6 robust setae.

SEXUAL DIMORPHISM, FEMALE DIFFERENCES. Antennula with 7 articles. Antenna flagellum with 24 articles. Pereopod I (Fig. 10C-E) subchelate (but propodus much narrower than male, tending toward simple). Dactylus

length subequal to palm; ventrodistal margin with multiple rows of minute sharp spines, along 0.62 total length. Propodal palm simple spines absent, with 1 large proximal finely serrated composite spine and smaller finely serrated composite spines along length. Uropod total length 1.48 pleotelson length. Protopod length 0.43 uropod total length. Endopod with 7 robust setae.

DISTRIBUTION. "Bundoona" Homestead Springs and springs to the west of Paroo River, near Eulo Township, Queensland, Australia.

ACKNOWLEDGEMENTS

We thank Winston Ponder, who discovered these new species, for providing us with many specimens and for providing the site information used in this manuscript. We also thank Anna Cerra for taking many of the SEM images, Sue Lindsay for assisting with SEM in the latter parts of preparing this manuscript, and Kate Dempsey for inking our pencil illustrations. We are grateful for reviews of the manuscript by Gary Poore and Niel Bruce. This research was supported by a grant from the Australian Biological Resources Study (Department of Environment and Heritage).

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