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A new genus of Tainisopidae fam. nov. (Crustacea: Isopoda) from the Pilbara, Western Australia

GEORGE D. F. WILSON
6 College Street, Sydney NSW 2010 Australia; buzw@austmus.gov.au

Abstract

Isopod crustaceans from deep bores in calcrete aquifers of the Fortescue River drainages in the Pilbara Region (Western Australia) are found to be closely related to *Tainisopus* Wilson and Ponder, 1992, but represent a distinct taxon, *Pygolabis humphreysi* **gen. nov., sp. nov**. The two taxa provide information for a diagnosis of a new family of Flabellifera sensu lato, the Tainisopidae. Although similar to *Tainisopus* in many details, *Pygolabis* **gen. nov.** has tong-like uropodal endopods and an elongate pleotelson, thus lacking the presumably primitive condition of *Tainisopus*. The pleotelson of *Pygolabis* **gen. nov.** contains powerful muscles that cause the uropods to rotate medially, bringing the tong-like endopods together. Similar structures in other unrelated hypogean crustaceans are noted. *Pygolabis* **gen. nov.** has a highly complex appendix masculina on the endopod of male pleopod II, unlike the simple appendix masculina seen in *Tainisopus*.

Key words: Isopoda, Flabellifera, Limnoriidea Poore, 2002, Tainisopidae **fam. nov.**, *Tainisopus* Wilson and Ponder, 1992, *Pygolabis* **gen. nov.**, hypogean animals, calcrete aquifers, new species, new genus, new family

Introduction

When *Tainisopus* Wilson and Ponder, 1992 was described, the family designation of this genus was left undecided. An unusual combination of possibly plesiomorphic and advanced features, which obscured the phylogenetic position of *Tainisopus*, precluded its immediate assignment to any existing family of isopods. Wilson and Ponder (1992), however, suggested that *Tainisopus* belonged in the more evolved clades of the Isopoda, based on character polarities discussed in Brusca and Wilson (1991). Despite a lack of higher-level classification, *Tainisopus* has been mentioned in recent publications (Wilson 1996; Botosaneanu 1998; Humphreys 2001; Wilson & Keable 2001, 2002; Jones & Morgan 2002; Poore & Lew Ton 2002).

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Recently, W. F. Humphreys (Western Australian Museum) sent isopod specimens collected from deep bores in groundwater calcretes of the Fortescue and Ashburton drainages of the Pilbara region (mentioned in Jones & Morgan 2002). Examination of these hypogean animals revealed that they belonged to an unknown taxon with affinities to *Tainisopus*. As a result of this discovery, the features of a family that includes *Tainisopus* can be established. This paper defines the new family Tainisopidae and describes the new genus and species, *Pygolabis humphreysi*.

The Pilbara region in Western Australia, where this new stygofaunal genus is found, has substantial Archaean banded iron formations and is a major iron ore mining region (Johnson & Wright 2001). The development of associated open pit mines requires the extraction of groundwater, which may threaten the subterranean aquatic fauna. Rare stygofaunal crustaceans, such as Spelaeogriphacea (Poore & Humphreys 1998) and Amphipoda (Bradbury 2000) have been found in this region. The potential impacts of these mining activities on the stygofauna, however, are largely unknown (Humphreys 2000), despite the potential significance of this fauna (Eberhard & Humphreys 1999). This report adds to the isopod fauna of the Pilbara and will assist the assessment of its significance and vulnerability.

Methods

Preparation for scanning electron microscopy (SEM) involved dissecting parts and dehydrating them to an absolute (100%) ethanol solution. Drying the specimens for SEM was accomplished using a carbon dioxide critical point method. Dissected parts were mounted vertically on SEM stubs using double adhesive carbon spots. Specimens were digitally imaged on a Leo 435VP using a Robinson backscatter detector at the Australian Museum; digital images were saved for later processing. Digital microphotographs were taken using a Wild M5A dissecting microscope and a Canon CoolPix 990 digital camera. All images were processed using Adobe PhotoShop (ver. 7). After deleting the background, the plates were assembled by pasting each image into a transparent layer over a black background. Contrast, brightness and greyscale tones of each image were adjusted to standardise their appearance. Some images were rescaled to match other images (e.g., pereopods) and light micrographs of the pleopods were modified with a sharpen filter to increase the edge contrast.

Descriptions were generated using the taxonomic database system DELTA (Dallwitz 1980; Dallwitz et al. 2000), and diagnoses were constructed from the output of the DELTA program INTKEY. The descriptions use the style and terminology of Wilson (1989) and Wilson & Ponder (1992). Several specimens were used for measurements, including the holotype. In the descriptions, where the holotype had the larger value of two measurements, the phrase ends with “(H)”; if the smaller value, “(h)”. Depositories of specimens are abbreviated as follows: **WAM**, Western Australian Museum, Perth; **AM**, Australian Museum, Sydney; **NMV**, Museum Victoria, Melbourne.

Systematics

Suborder Flabellifera Sars, 1882

Infraorder Limnoriidea Poore, 2002

Tainisopidae fam. nov.

"Enigmata" Poore and Lew Ton, 2002: 345.

Type Genus. *Tainisopus* Wilson and Ponder, 1992; here designated.

Etymology. Tainisopidae is derived from name of the type genus, but the genitive stem is not used to allow a shorter, less cumbersome name.

Diagnosis. Head dorsal surface clearly demarcated from lateral surface by cuticular ridge; frons with thin ridge between antennae, not directly connected to clypeus. Coxa VI oopore on ventromedially produced margin. Penes attaching to coxae VII by triangular broadly flexible region (not on separate sclerite). Pleonites 1-5 flexibly articulated, elongate, lacking pleurae, pleonite 5 enlarged. Pleotelson freely articulating with pleonite 5. Antennula article 1 strongly curved laterally, secondary flagellum rudimentary (minute setose article on article 3 anteromedial distal margin). Antenna protopodal article 1 present, article 3 with rudimentary circular scale surrounded by articular membrane. Mandible distal gnathal margin rotated to approximately right angle to proximal body; molar distally truncate, distal margin with arc-like dentate ridge. Pereopod I with major reflexive hinge between propodus and dactylus, propodus with row of biserrate robust setae in palm region. Pereopods II-III with major reflexive hinges between carpus and propodus, carpus with row of robust setae in palm region; pereopods IV-VII without major reflexive hinges. Pereopods I-V coxae with oostegites. Pleopodal endopod I of both sexes single flattened lobe, endopods III-V in male and II-V in female divided into 2 or 3 lobes. Pleopod II appendix masculina with laterally-facing groove on dorsal surface, with denticles on dorsal ridge of groove; basal lamella absent. Uropod protopod longer than broad, projecting posteriorly.

Description. Head freely articulating with pereonite 1, weakly recessed into pereonite 1; anterior margin medially concave; interantennal rostrum absent, interantennular ridge arc-like, shorter than antennal basal diameter, connecting ventrally to rounded projection between antennae dorsal to clypeus; eyes absent; cervical groove absent; mandible inserting into anterior half of ventral surface; maxillipeds inserting at posterolateral margin. Foregut ventral floor with laterally curving anterior filter plate. Pereonites 2-7 similar in shape, lateral margins linear in dorsal view. Pleonites 1-5 total length more than half length of pereon; pleonites 1-4 lengths subequal; lateral margins not produced ventrally, pleurae absent; articulations flexible (able to rotate in vertical and transverse axis). Pleotelson flattened, width greater than depth, dorsal cuticle smooth; dorsal uropodal ridge absent.

Antennula length 0.17-0.28 body length, emerging near cephalic midline; article 4 shorter than article 3 and article 5, flagellum with 16-26 articles in adults. Antenna length 0.31-0.57 body length in adults; proximal article large and distinct; flagellum with 31-54 articles. Mandible incisor processes dentate, with 4-5 cusps; left lacinia mobilis robust, with 3 cusps and protruding proximal articular condyle; right lacinia mobilis with 2 arc-like dentate plates, anterior plate smaller than posterior plate; spine row positioned at angle (i.e., not parallel) to gnathal axis, right side with 1 less spine than left side; dorsal condyle narrower than molar process, tapering, distally rounded; palp robust, with 3 articles, article 3 distal margin weakly curved, with ventral row of robust denticulate setae. Maxillula lateral lobes with multiple denticulate robust setae; medial lobe medial margin with large medial pappose setae (4 in observed species), medial margin multiple setae in ventral and dorsal rows. Maxilla inner lobe with dentate and setulate setae on distal medial margin, proximal medial margin with fine setae only. Maxilliped elongate and thin, length approximately 5 width, with distinct narrowing proximal to palp insertion, endite extending to or beyond palp article 2. Coxa I fused to pereonite 1, coxae II-III broadly attaching to tergites, not covering entire lateral surface, coxa III longer than coxa II; coxae IV-VII broadly attaching to tergites, covering entire lateral surface. Pereopods II-VII propodus posterodistal margins with articular plates. Pereopod I propodus simple, somewhat inflated, propodal palm concave, without major spines or projections, with row of robust setae; carpus triangular in lateral view, dorsal margin axially compressed to thin flange, ventral margin deeply inserting into merus proximally; merus dorsal margin enlarged, projecting, distally concave, adjacent to propodus. Pereopods II-III with major reflexing hinge between propodus and carpus; propodus much longer than wide, tubular, without robust setae on oppositional (ventral) margin; carpus dorsal margin distally inflated, tapering proximally, palm convex, with row of robust setae; merus dorsal margin enlarged, projecting, distally concave, adjacent to dorsal margin of carpus. Pereopods IV-VII all segments longer than wide. Pleopod exopods broad and lamellar, width near length or only slightly less; exopod I uniarticulate, II-V partially biarticulate (divided by suture line on anterior/ventral face); suture lines, where present broad, margins not constricted at junction. Uropods slightly flattened dorsally, wedge shaped in cross-section with deepest part on lateral side; endopod longer than exopod, subcircular-oval in cross-section.

Discussion. The *Tainisopidae* **fam. nov.** is here classified as Flabellifera (sensu lato, cf. Wilson 1998, 1999). This well recognised (Martin & Davis 2001) but poorly defined (Wägele 1989, Brusca & Wilson,1991) suborder name is retained here, despite being omitted by Poore (2002). In this broader concept, Flabellifera includes the previous suborders Valvifera, Anthuridea, Gnathiidea and Epicaridea as subordinate taxa. The suborders established or recognised by Poore (2002), viz. Cymothoida (including anthurideans, gnathiideans and epicarideans), Limnoriidea, Sphaeromatidea (including serolideans) and Valvifera, are used here as infraorders, without change to their names. Defined in this way, Flabellifera corresponds to a monophyletic group (Wägele 1989, Brusca & Wilson 1991)

and resembles the original composition of Sars (1897). This classification identifies four major clades of the Isopoda: Phreatoicidea, Asellota, Oniscidea and Flabellifera. Scutocoxifera Dreyer & Wägele, 2002, whose apomorphies and existence in the cladograms were noted by Brusca & Wilson (1991), unites the latter two suborders. In the absence of a fully phylogenetic system of classification, Scutocoxifera does not fit comfortably into the traditional system, and is not used here. By recognising Flabellifera as a suborder in this broader definition, numerous separate but related suborders are avoided, and a widely used name (Martin & Davis 2001) is retained.

Flabelliferan apomorphies found in Tainisopidae include features such as large lateral coxae broadly attached to the tergites (Fig. 1C; apomorphy of the Scutocoxifera, see Dreyer & Wägele 2002) and broad natatory pleopods with transverse sutures in the broad biarticulate exopods (Fig. 7). Phreatoicidea and Asellota have narrower pleopodal protopods, and the Oniscidea lack exopodal sutures. The new family has oostegites on pereopodal coxa V, which is found in many flabelliferans, whereas Phreatoicidea and Asellota lack an oostegite on coxa V-VII. In Tainisopidae, pereopods I-III are modified for grasping (prehensile), and pereopods IV-VII are less modified walking legs (Fig. 4-5) . These latter features describe a tagmosis of the body into two sections: the first 3 pairs of pereopods differ from the posterior 4 pairs, both in shape and orientation. The Flabelliferans, as a general body plan, have pereopod IV in the posterior tagma, more closely resembling a walking leg. Deviations from this plan are common, and whether the Sphaeromatidea fit this pattern requires further evaluation. Pereopod IV is part of the anterior tagma in Asellota and Phreatoicidea, which may be the plesiomorphic condition owing to its correspondence to the division of the body during ecdysis. The Oniscidea have no pereonal tagmosis, possibly owing to their terrestrial ambulation. Antennula article 1 curves laterally in tainisopids (Fig. 2C), although not as pronounced as in many flabelliferans. The foregut of *Tainisopus* has the form seen in Sphaeromatidae or Limnoriidae, a laterally curving ventral filter plate (unpublished data; Wägele 1989), while the basally derived groups Asellota and Phreatoicidea have longitudinally-oriented ventral filter plates (Wägele 1989). The mandible shows a pattern typical of many flabelliferans with the distal gnathal edge rotated approximately at a right angle to the proximal mandibular body (Fig. 2F).

The question of the relationships of the Tainisopidae within the Flabellifera remains. The classification (modified as above from Poore 2002) can be used as a starting point. The infraorder Cymothoida Wägele, 1989 is defined by distinctive modifications to the mouthparts for carnivory or parasitism and by broad and flat uropods that are lacking in the Tainisopidae. The unique uropods, pleotelson and pleonites (uropods forming a pleopodal cover on a unified pleon) in the infraorder Valvifera removes this group from consideration. The substantial modifications of the head (eyes and mandibles displaced to posterolateral margin of head) and pleotelson (including reduction and fusion) in the infraorder Sphaeromatidea Wägele, 1989 preclude classifying the Tainisopidae in this

infraorder. This consideration leaves the infraorder Limnoriidea Poore, 2002 (p. 196, authorship corrected), which currently contains the divergent families Limnoriidae, Keuphyliidae and Hadromastacidae. The latter taxon may be a highly modified sister group to the Limnoriidae, and placement of the Keuphyliidae in this group is unconvincing. For these reasons, comparison with the Limnoriidae seems most productive. Tainisopidae share with Limnoriidae features that could be regarded as plesiomorphies, including largely unmodified pleonites with pleonite 5 being longer than pleonites 1-4, thick and narrow uropodal protopods and rami (as opposed to broad flattened rami seen in the other infraorders), head not substantially embedded into pereonite 1, maxillipeds set on the posterolateral margin of the head and epistome not present. Both taxa share the shape of the maxilliped, one feature that may be derived: an elongate narrow basis with a well-developed narrow endite; the basis is laterally concave between its origin and the insertion of the palp, thus appearing to have a waist. This feature is not found in the Keuphyliidae, which has a more plesiomorphic form of the maxilliped with a broader, less elongate basis and endite. The maxilliped of the Hadromastacidae resembles that of the Limnoriidae.

Limnoriids are specialised for boring into marine plants or wood and tainisopids are free-living hypogean animals, so numerous details differ between the two families, particularly in the shape of the mandibles, and details of the pereopods and the pleotelson. The similarity between the tong-like uropodal endopod of *Pygolabis* gen. nov. and *Limnoria* Leach, 1814 is striking, although these forms are almost certainly not homologous: *Tainisopus* and *Paralimnoria* Menzies, 1957 have unspecialised endopods, and the pleotelson of *Pygolabis* is substantially different from that of the limnoriids. Nevertheless, the tong-like endopods of *Pygolabis* and *Limnoria* suggest an underlying skeletomusculature that would support such adaptations. The thin, elongate body of the limnoriid genus *Lyseia* Poore, 1987 is similar to the tainisopids, although the homologies of the individual somite shapes are less certain. Of the apomorphies in the diagnosis of the Limnoriidea Poore, 2002, only the reductions of the mandibular gnathal edge, which are undoubtedly adaptations to chewing cellulose-rich substrates in the Limnoriidae, differs from the Tainisopidae. Other characters in Poore's (2002) diagnosis allow inclusion of the Tainisopidae in this infraorder. Given a lack of strong evidence to the contrary, the Tainisopidae is placed among the Limnoriidea Poore as a plesiomorphic member of the group.

Members of the Tainisopidae can be distinguished from other flabelliferan taxa using several characters. The frons of the head of many, but not all, flabelliferans have a well-defined median ridge between the antennae connected to the clypeus (epistome). The tainisopids, however, have a weakly developed, thin bar that does not connect to the clypeus (Fig. 1B in dorsal view, see also Wilson & Ponder 1992, fig. 2E). The penes are attached to triangular extensions of seventh coxae (Fig. 6A), which is unusual among most isopods (Wilson 1991). Both genera of the Tainisopidae have an antenna article 1 and a tiny circular scale surrounded by articular membrane on article 3 (Fig. 2B). This rudimentary scale is unlike the projecting and articulated scale of the Asellota. These two different

forms of the scale are homologous only by position, and not by special similarity. The rudimentary scale may occur elsewhere among the flabelliferans, given that this region is not generally illustrated. The molar process has the plesiomorphic form for the Peracarida (Richter et al. 2002, Edgecombe et al. 2003) but the dentate ridge on anterodistal margin (Fig. 2E-H) is possibly a derived feature. The appendix masculina has a dorsal groove and lateral denticulate ridge (Fig. 6B-D, 7F; Wilson & Ponder 1992: fig. 8C), and no lamellar basal part, unlike many flabelliferans (Fig. 7C). The reflexive hinges of pereopods II-III (Fig. 4C-D), which allow the carpus and propodus to oppose each other, are unusual among most isopods; many flabelliferans with prehensile pereopods II-III have the major articulation between the dactylus and propodus, thus resembling pereopod I. The divided endopod lobes of the pleopods (Fig. 7B, D-E, G) are also unusual and diagnostic for the family. The posteriorly projecting, elongate uropods (Fig. 1A, 6 E-G) are distinctive, although a variety of forms are found among other flabelliferans.

The original description of *Tainisopus* suggested that the form of the pleotelson was similar to many taxa in the Flabellifera. The addition of *Pygolabis* **gen. nov.** complicates this concept, because its pleotelson is more like that seen in more basally derived isopods, such as the Phreatoicidea (Erhard 1998), with an elongate pre-uropodal part containing powerful musculature attached to the uropods. These similarities are likely to be independent innovations because, in *Pygolabis*, the uropods rotate in a horizontal plane to bring the endopods together, while phreatoicidean uropods owing to their highly vaulted pleotelson rotate in a vertical plane (Erhard 1999). Because *Tainisopus* and *Pygolabis* show divergent forms of the pleotelson, the plesiomorphic state of the pleotelson in the family remains uncertain.

Among other isopods that might be found in hypogean fresh water aquifers, members of Tainisopidae are easily recognisable by their elongate, highly flexible bodies and rapid swimming ability. Although Tainisopidae might be confused with hypogean Cirolanidae (such as *Turcolana* Argano & Pesce, 1980), they lack broad flat uropods and blade-like mandibular molars of the cirolanids. Phreatoicidea are found in similar environments in Western Australia (Knott & Halse 1999; Wilson & Keable 1999), but the pleopods, coxae and body forms are distinctively different in the two groups. Neither Cirolanidae nor Phreatoicidea have pereopods II-III with major reflexive hinges between the propodus and carpus, as is observed in the Tainisopidae. The pleotelson of phreatoicideans is highly vaulted, even in the hypogean forms, while the tainisopid pleotelson has a low lateral profile, much wider than deep. The coxae of Tainisopidae are broad, without the posterior tergites participating in the lateral margin of the posterior pereonites, while the lateral margin of phreatoicidean pereonites includes fairly compact coxae surrounded by tergite.

Pygolabis gen. nov. (Figs. 1-7)

Type Species. *Pygolabis humphreysi* **sp. nov.,** here designated.

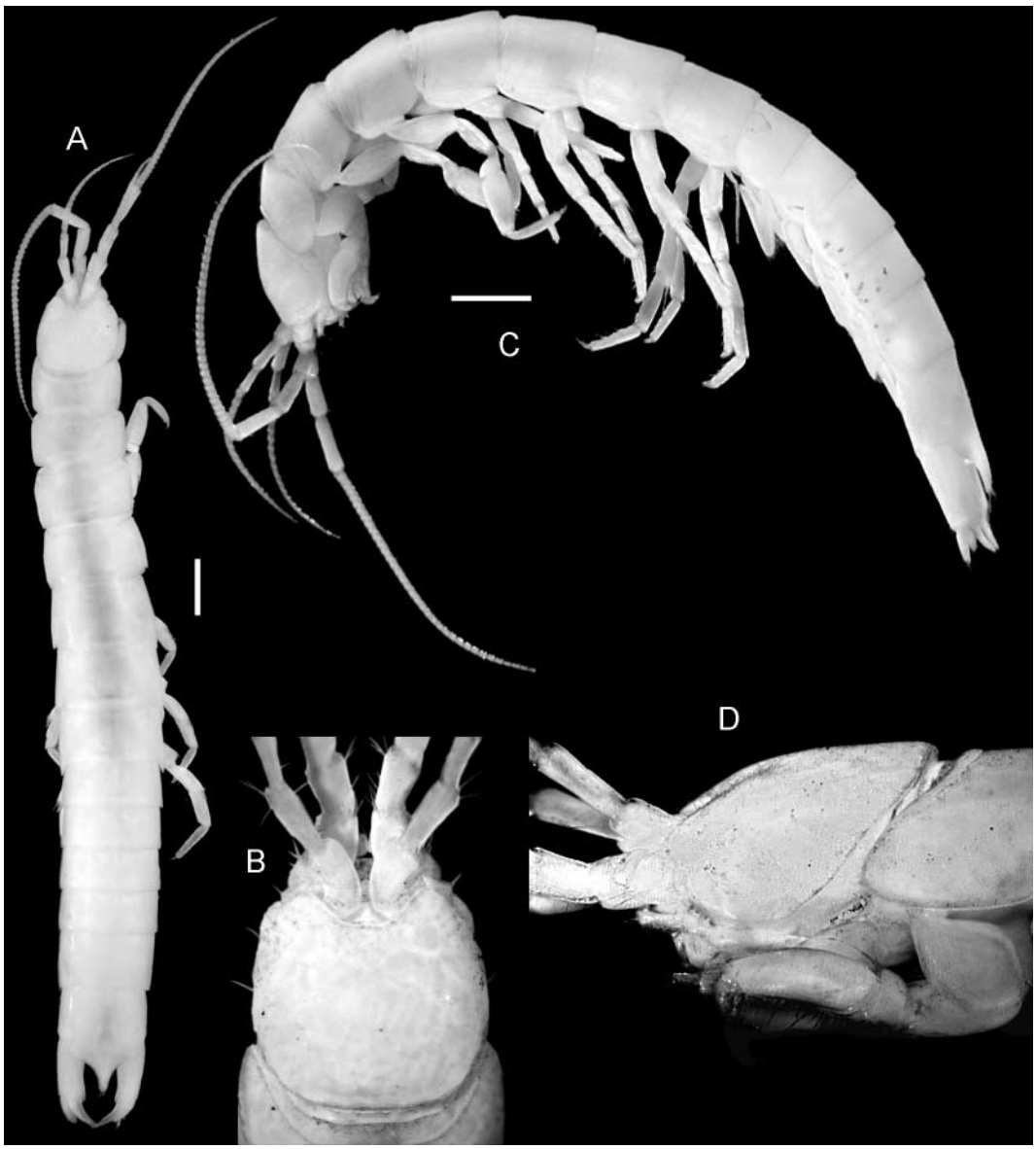
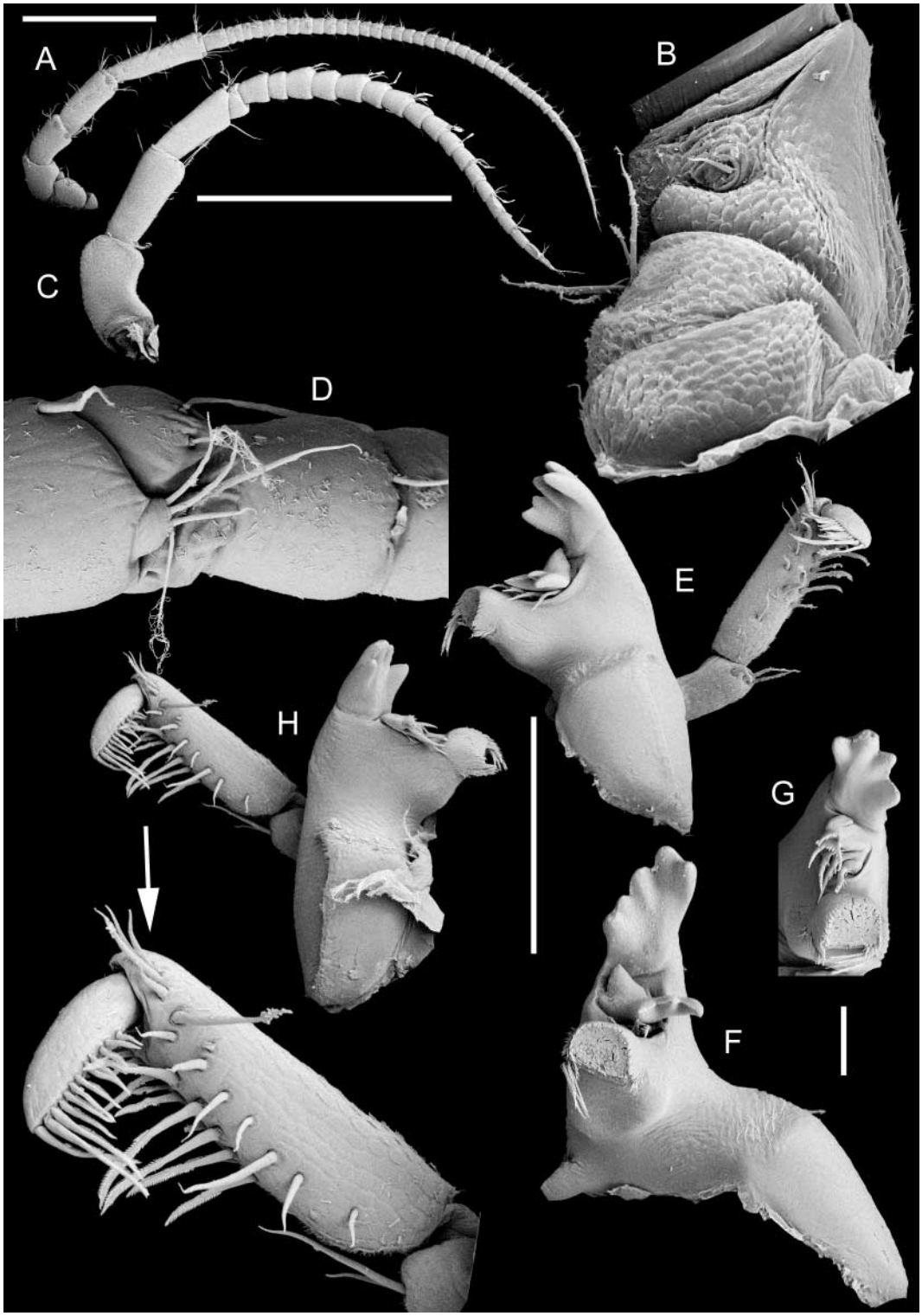


FIGURE 1. *Pygolabis humphreysi* **gen. nov., sp. nov** (holotype male WAM C33562, light micrographs): A, C. Body, dorsal and lateral; B, D. Head, dorsal and lateral. (scale bars 1 mm)

FIGURE 2. *Pygolabis humphreysi* (paratype male AM P64993, SEM of antennae and mandibles): A-B. Antenna, left ventral and articles 1-3 lateral; C-D. Antennula, left ventral and rudimentary second flagellum medial; E-F. Left mandible, ventral and medial; G-H. Right mandible, medial and enlargement of palp articles 2-3 ventral. (scale bars: A, C 1 mm; E, H 05.mm; F, G 0.1mm)



Etymology. The genus name is derived from the Greek words "pyge" (tail) and "labis" (forceps or tongs, feminine).

Diagnosis. Pereonite 1 lateral length subequal or shorter than other pereonites. Pleotelson distal margin produced medially and concave distolaterally, region anterior to uropods elongate, uropods inserting ventrally approximately halfway along length of pleotelson; ventral surface anterior and medial to insertion of uropods flat, anus opening posteroventrally, in distal half of pleotelson just posteromedial to uropod insertions, preanal ridge present. Mandible incisor in medial view broader than molar process. Penes narrow and tapering distally, width much less than half length. Pleopod II appendix masculina biarticulate, shorter than exopod, expanding distally after constricted midpoint; ventral surface with deep groove lined with elongate cuticular hairs and combs; dorsal surface strongly expanded laterally with denticulate ridge (visible on ventral side), with large spines along ridge projecting anteromedially, distal spines distinctly longer than proximal spines; distal tip with rounded cup lined with dense cuticular combs. Pleopod II of female and III-V of both sexes endopods bilobed and tumescent, broader than long, with transverse folds, both lobes near same thickness. Pleopod II exopod uniarticulate in male, biarticulate in female. Pleopod V exopod not reaching anus. Uropods inserting approximately half way along pleotelson; protopod robust sensillate setae absent, with small tooth-like setae along medial margin; both rami without robust sensillate setae, long thin simple setae occurring along endopod lateral margin and all margins of exopod; endopod with row of small tooth-like setae, mostly placed proximally, distally pointed medially curved robust claw; exopod flattened and distally rounded.

Discussion. Despite being broadly similar to *Tainisopus* Wilson and Ponder, 1992, *Pygolabis* **gen. nov.** differs markedly in having a powerful pair of grasping claw-like uropodal endopods (hence their name “tail-tongs”). Modifications of the pleotelson appear to service these tongs. The cuticle is thick and strong, and the enlarged anterior portion of the pleotelson has powerful extrinsic retractor muscles attached to the uropods. So strong is the association between the uropods and the pleotelson that several attempts to remove the uropods without damaging the pleotelson proved futile (hence the cracks seen in Figure 6E-G). The endopods are apparently used to grip the substrate and were found to be difficult to remove from nets in which they were captured (W.F. Humphreys, S. Anstee, pers. comm.). Similar structures are found on the tail appendages of other hypogean crustaceans: Hypsimetopidae (Wilson & Keable in preparation) or Bathynellacea (e.g., Schminke 1973). These unrelated animals having similar structures suggests that some unknown, possibly hydrological, characteristic of the hypogean environment may select for these modified grasping appendages. Some specimens, including the holotype and associated paratypes of *P. humphreysi* sp. nov. (field number BES4836), were captured in traps, suggesting that this species may be predatory or a scavenger. Whether the uropodal tongs of *Pygolabis* could be used to hold prey, similar to the forceps of Dermaptera (earwigs) or Japygidae, is unknown. Owing to the difficulty of observing this species in situ,

live observations in an aquarium might assist our understanding of these unusual stygofaunal isopods.

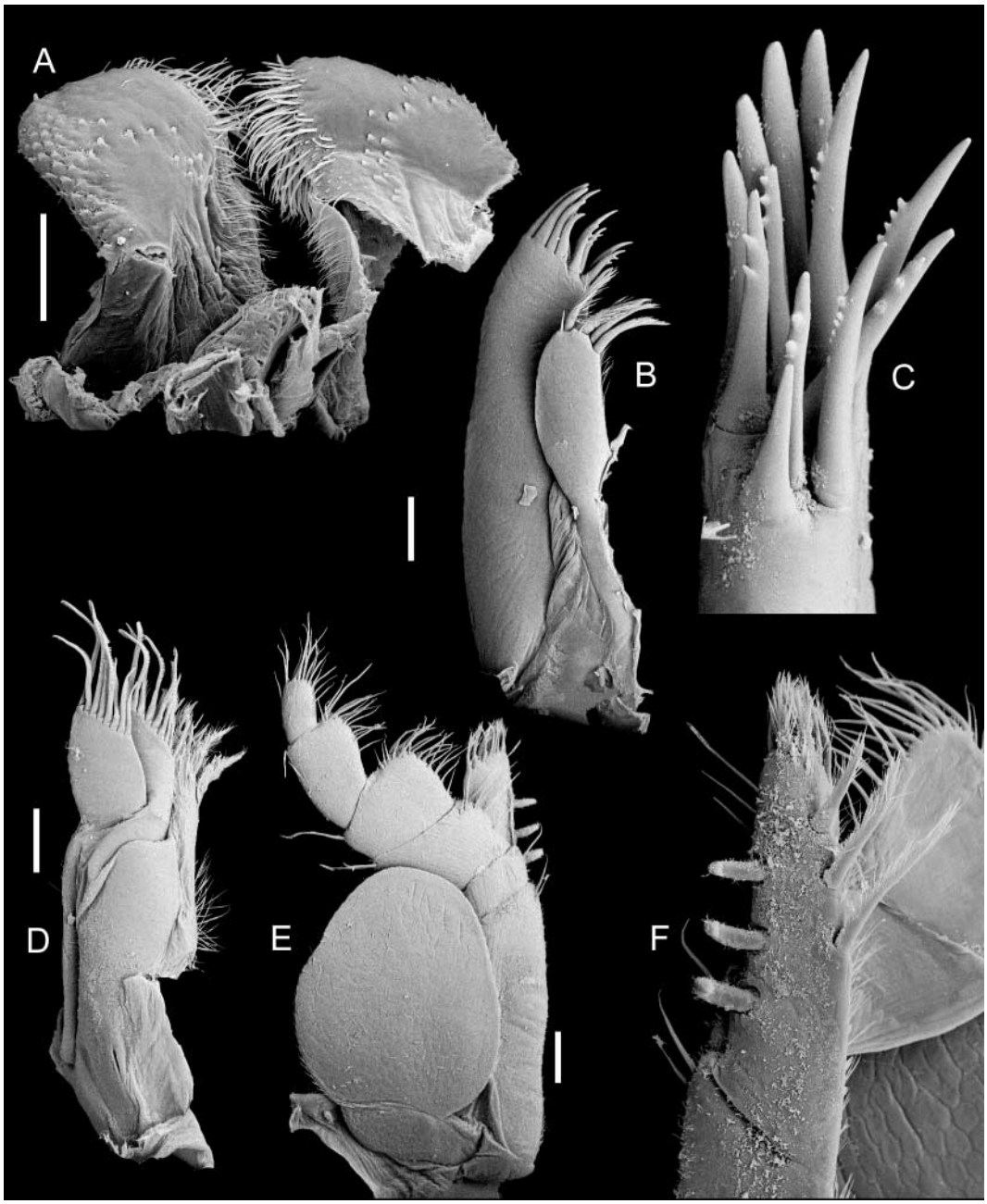


FIGURE 3. *Pygolabis humphreysi* (paratype male AM P64993, SEM of mouthparts): A. Paragnaths, ventral; B-C. Maxillula, right ventral and lateral lobe medial; D. Maxilla, right ventral; E-F. Maxilliped, right ventral and endite medial (scale bars A-B, D-E 0.1mm)

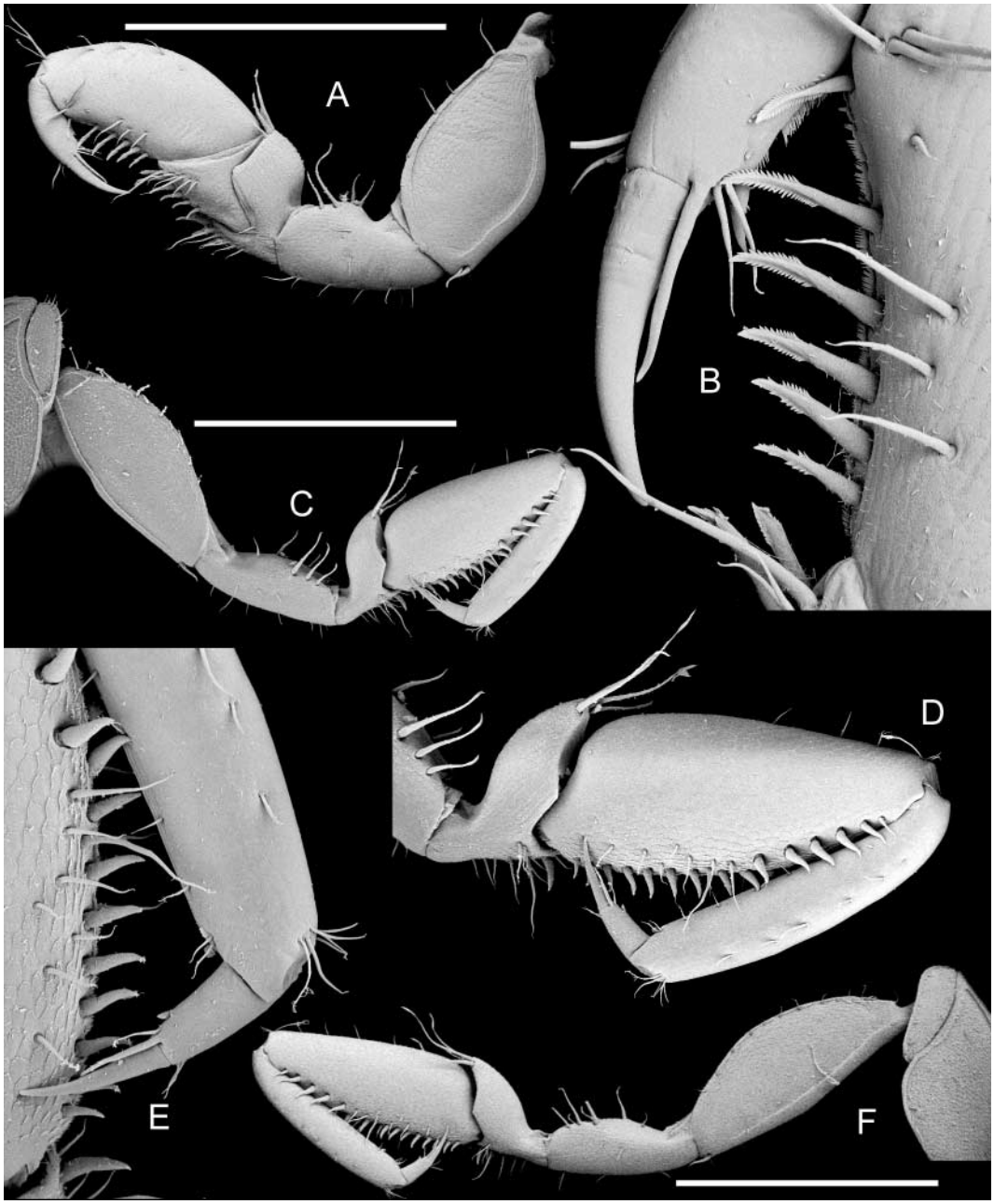


FIGURE 4. *Pygolabis humphreysi* (paratype male AM P64993, SEM of anterior pereopods): A-B. Pereopod I, left lateral and enlargement of palm; C-E. Pereopod II, right lateral and enlargements of distal podomeres; F, Pereopod III, left lateral. (scale bars A, C, F 1 mm)

The body shape also differs between the two genera: *Tainisopus* is broader and flatter (body length approximately 5 times width) compared to the distinctly thinner *Pygolabis* (body lengths 7-8 times width). The male pleopod II appendix masculina is also different:

it is relatively undifferentiated in *Tainisopus* (Wilson & Ponder 1992: fig. 8B-C), somewhat similar to that seen in other Flabellifera, whereas in *Pygolabis*, it bears a complex arrangement of grooves, denticles and spines (Figs. 6B-D, 7C, F). Similarly modified structures occur in the Asellota or Oniscidea (Wilson 1991), although not this particular form.

Pygolabis humphreysi sp. nov. (Figs. 1-7)

Type fixation. Holotype male, WAM C33562, here designated.

Etymology. The species is named in honour of Dr William F. Humphreys, whose exploration and biological study of the Western Australian calcrete aquifers has discovered many new taxa, including this new genus and species.

Type Material: Holotype male, body length 14.2 mm, pleopod II separate and photographed, **WESTERN AUSTRALIA: Pilbara Region: Newman Borefield:** 23°20'S 119°51'E, fld.no. BES4836 trap 24.vii.1997 (W.F. Humphreys, S.M. Eberhard) (WAM C33562). Paratypes: female, body length 14.6 mm, pleopods dissected, same data as holotype, (AM P64992), 2 males, same data as holotype (WAM C33563); 1 male, body length 11.9 mm, dissected for SEM, Bore W29, 23°24'S 119°47'E, fld.no. BES5496 19.xi.1998 (S.M. Eberhard) (AM P64993); female, 23°20'S 119°51'E, fld.no. BES4801 Haul net 22.vii.1997 (W.F. Humphreys, S.M. Eberhard) (WAM C33564); male, 23°19'S 119°51'E, fld.no. BES4826 Haul net 23.vii.1997 (W.F. Humphreys, S.M. Eberhard) (WAM C33565); female, 23°19'S 119°51'E, fld.no. BES4838 Haul net 24.vii.1997 (W.F. Humphreys, S.M. Eberhard) (WAM C33566); 2 males, Bore W135, 23°17'S 119°52'E, fld.no. BES6377 20.xi.1998 (S.M. Eberhard) (WAM C33567); 1 spm., Bore W256, 23°12'S 119°53'E, fld.no. BES3515 11.xi.1998 (S.M. Eberhard) (WAM C33568); male and female, Bore W157, 23°13'S 119°54'E, fld.no. BES3535 12.xi.1998 (S.M. Eberhard) (NMV J52441); female, Bore W28, 23°24'S 119°47'E, fld.no. BES5499 19.xi.1998 (S.M. Eberhard) (WAM C33569); 1 spm., 23°19'S 119°51'E, fld.no. BES4816 Haul net 22.vii.1997 (W.F. Humphreys, S.M. Eberhard) (WAM C33570).

Diagnosis. Body medial length 7–8.2 (H) width at pereonite 3. Head dorsal surface distinctly convex in lateral view. Pleopod II appendix masculina rounded cup on distal tip narrow, cup width subequal to groove width proximal to distal tip, teeth on lateral margin barely projecting from lateral margin, proximal teeth subequal to lateral teeth in middle of ridge, ~23–29 (H) teeth altogether.

Description. Head length 0.77 width, 1.4 pereonite 1 medial length; dorsal surface covered with scattered fine setae; antennal notch present; clypeus rounded, proximal width 0.46 head width, extending between antennal insertions; mandibular articular fossa narrower than clypeal height; labrum distally rounded, without setae, symmetrical.

Pereonites total medial length 0.49–0.54 body length; dorsal surfaces with scattered fine setae, setae density dorsally uniform, with 1–2 thin transverse cuticular ridges.

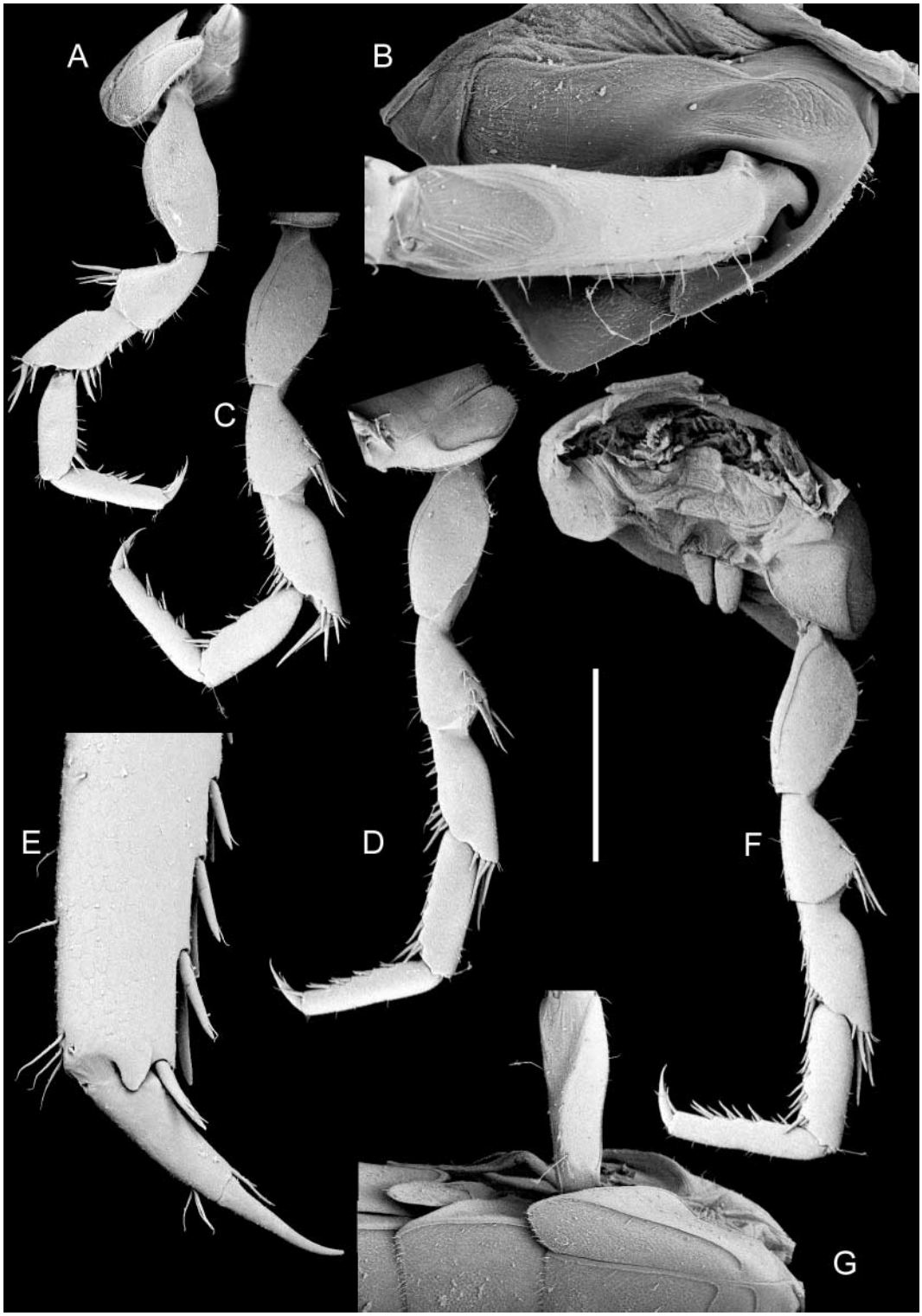


FIGURE 5. *Pygolabis humphreysi* (paratype male AM P64993, SEM of posterior pereopods): A-B. Pereopod IV, left posterior and ventral enlargement of coxa basis; C. Pereopod V, left lateral; D-E. Pereopod VI, left lateral and medial enlargement of propodus dactylus showing articular plate; F-G. Pereopod VII and pereonite 7, left anterolateral oblique and lateral enlargement of coxal-tergal margin. (scale bar A, C, D, F 1 mm)

Pleonites with scattered sparse fine setae; total medial length 0.26–0.28 (H) body length; pleonites 1–4 relative lengths subequal, all shorter than pereonite 7, medial lengths 0.05, 0.05, 0.05, 0.05, 0.06-0.07 (H) body length, respectively; pleonite 5 subequal in length to pereonite 7.

Pleotelson medial length 1.14–1.41 (H) width in adults, 0.47 pleon length; with scattered simple setae; posterolateral margins without robust sensillate setae, with ~20 small non-sensillate simple setae (including several submarginal setae).

Penes oval in cross-section, with elongate thin-walled and tapering extension.

Antennula length 0.17–0.24 (H) body length, with 22–26 (H) articles; article 1 with few simple setae, surface with cuticular scales on medial margin; article 2 subequal to article 1; article 3 shorter than article 1, without penicillate setae; secondary flagellum on article 3 with several large simple setae and at least 1 penicillate seta; distal flagellar articles with simple setae and aesthetascs on distal margins, most articles only with 1 aesthetasc, none with more than 2, each aesthetasc consisting of narrow proximal peduncle, enlarged thin distal section and distal tip with tiny pore.

Antenna 0.31–0.40 (H) body length; with 48–54 (H) articles; articles 1–3 increasing in length distally, surface with cuticular combs or scales, with few simple setae; article 4 subequal to article 3; articles 5–6 longer, increasing in length distally; flagellum length 0.63–0.72 (H) antenna total length.

Mandible articular axis approximately at right angles to incisor; incisor broader than molar process in medial view; left lacinia mobilis large, flattened and cuspidate, distinctly separated from spine row; right lacinia mobilis indistinctly separated from remainder of spine row, bifurcate with two dentate plates (smaller plate on anterior surface of larger plate); spine row on ridge between incisor and molar, with remaining spines other than lacinia mobilis not bifurcate, left side with 4 denticulate spines, right side with 3 denticulate spines. Palp length 0.71 mandible length; article 1 with 2 distal simple setae; article 2 with 2 longitudinal rows of setae (1 setulate setae and 1 simple setae), additional distal transverse row of simple setae present, medial cuticular surface forming combs; article 3 weakly curved, with 12 setae, setae finely setulate, coarsely spinulate setae absent.

Maxillule medial lobe with 4 pappose setae; with 2 additional small simple accessory setae on distolateral margin and between medial pappose setae. Lateral lobe with 12 distal robust setae, including 7 denticulate; ventral face setae absent.

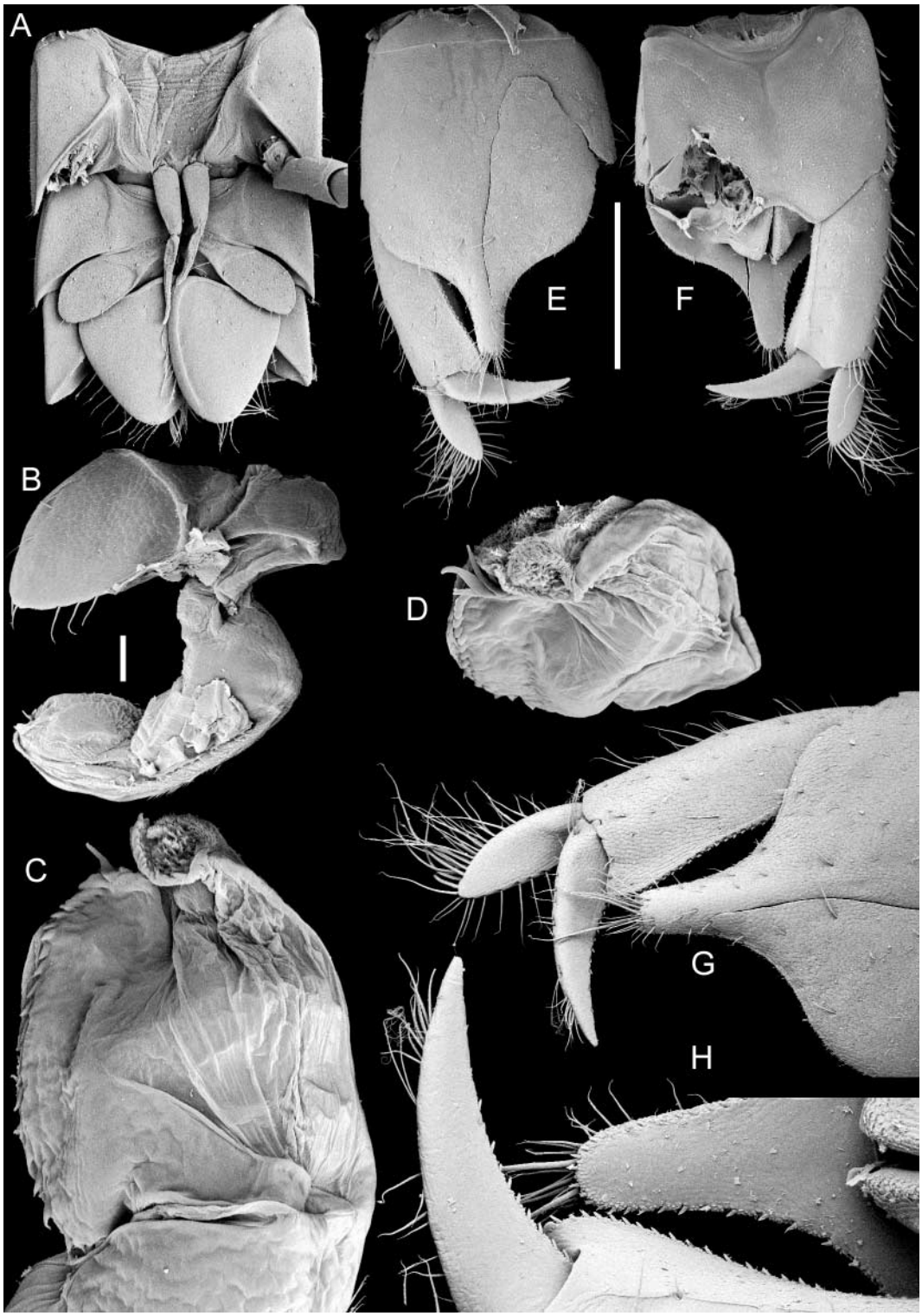


FIGURE 6. *Pygolabis humphreysi* (paratype male AM P64993, SEM of pleon, appendix masculina and uropods): A. Pereonite 7, penes, pleonites 1-2 and pleopods I, ventral. B-D, pleopod II appendix masculina and protopod ventral, distal tip enlargement dorsal and lateral; E-H, Pleotelson and left uropod, dorsal, ventral, distal enlargement dorsal and ventral. (scale bars: A, E-F 1 mm, B 0.1mm)

Maxilla outer lateral lobe with 9 comb setae. Medial lobe medial margin slightly concave distally; extent of setae confined to distal half of medial margin past insertion of lateral lobes; with 2 large medial pappose setae; ~5 setae in ventral row (obscured in SEM); 12 setae in dorsal row; setae in ventral and dorsal rows with spinules and setules.

Maxilliped epipod length 1.2 width, distal margin narrowly rounded; palp basal width 0.23 length; endite with 3 coupling hooks on both sides.

Pereopod I propodus and carpus ventral margins with robust bidenticulate sensillate setae, 6, 1 (5 robust setae present but only 1 bidenticulate) respectively. Pereopods II-III carpus and I-III merus ventral margins with smooth robust sensillate setae, carpus with 16–20, 16–18 (H) respectively (distally in two rows), lateral setal row with 5–6 (H) robust setae. Coxae II lateral sutures indistinct; III-VII well indented laterally, with broad medial extension toward midline, pereopod III triangular; IV-VII elongate, covering entire lateral margin.

Pleopods lying flat on ventral surface of pleon, weakly enclosed laterally by respective pleonites, II-IV each weakly overlapped by preceding pleopod (i.e., by about half-length); protopods medial margin with curved serrate robust setae; exopods with fewer than 27 marginal plumose setae (21–26). Pleopod I endopod thin and flattened; in female length 0.53 exopod length; distal margin rounded, with only 2–3 small plumose setae. Pleopod II male endopod appendix masculina lateral margin proximally concave; medial margin cuticular combs absent; teeth barely projecting from lateral margin, separated by at least tooth width for only part of length, with 3 distal elongate spine-like teeth; distal segment length 1.52 width (light microscope measurements), not projecting - forming smoothly rounded arc. Pleopod II female endopod without setae. Pleopod III-V endopods without setae.

Uropods length 0.24 body length, 0.94 pleotelson length. Protopod extending beyond pleotelson distal margin, length between insertions and distal margin 1.1 length of pleotelson posterior margin (between insertions and pleotelson distal tip); medial margin with 20 small tooth-like setae; ventrolateral margin with abundant long thin laterally-projecting setae. Endopod length 0.70 protopod length, 1.4 exopod length; medial margin with proximal and distal penicillate setae, medial margin with 12–14 (h) small tooth-like setae. Exopod length 0.43 protopod length.

Distribution. Calcrete aquifers of the upper Fortescue River, near Newman, Western Australia (Pilbara Region).

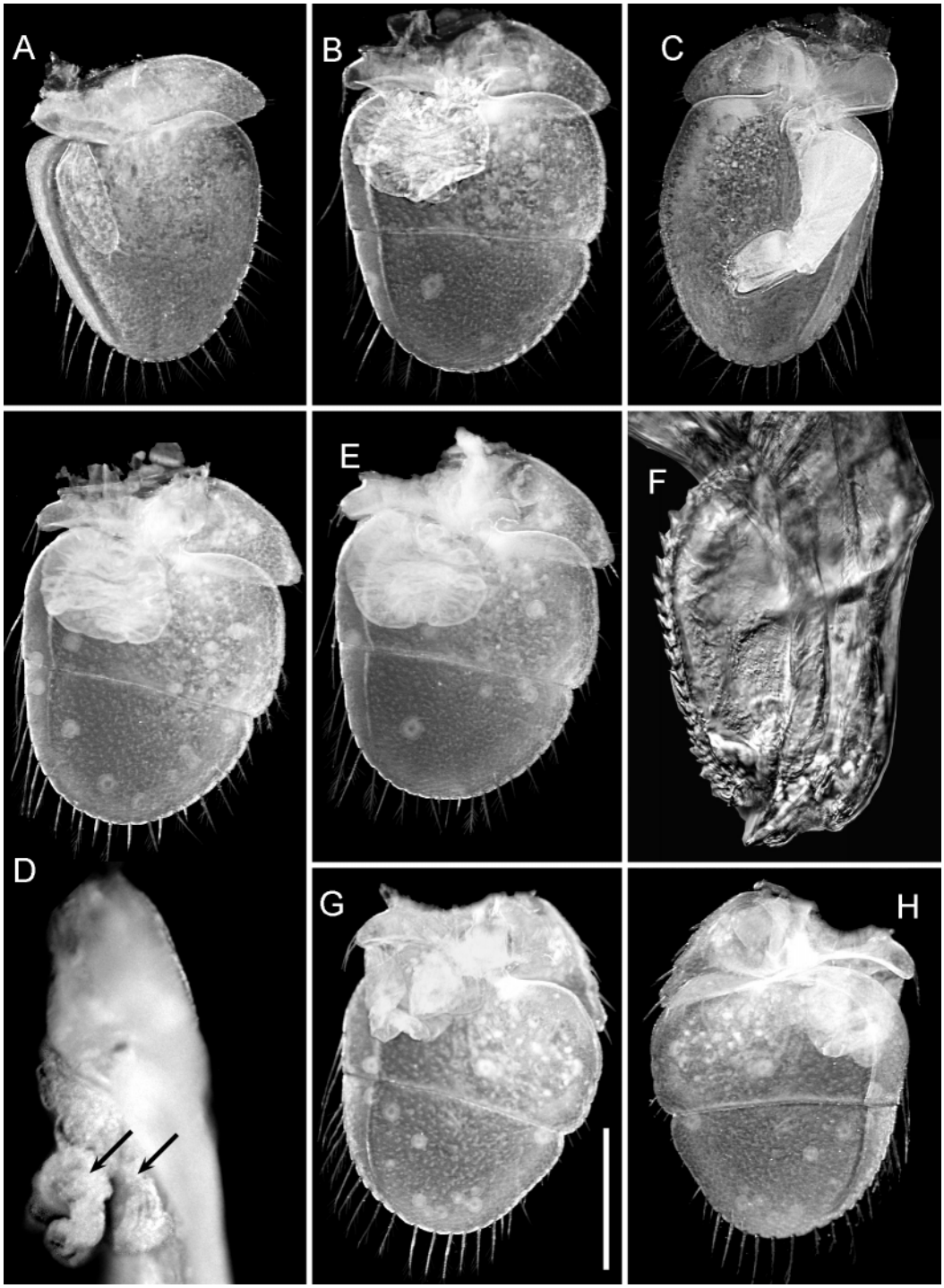


FIGURE 7. *Pygolabis humphreysi* (light micrographs: A-B, D-E, G-H, paratype female, AM P64992; C. holotype male, WAM C33562; F. paratype male, AM P64993): A-B, D-E. female pleopods I-IV, right dorsal, lateral view of endopod III lobes indicated with arrows in D; C. male pleopod II, left dorsal; F. appendix masculina, left ventral; G-H. female pleopod V, right dorsal and ventral. (scale bar A-C, D-E, G-H 1 mm, shown in G)

Discussion. Although *Pygolabis* gen. nov. is currently monotypic, at least three undescribed species of this genus inhabit other borefields of the Pilbara region (research in progress). These species occur at Hardey River (a tributary of the Ashburton River), Paraburdoo and Weeli Wolli. They differ in the relative shapes of the head in lateral view, length of the body compared to width, and in details of the male pleopod II endopod, (particularly number and size of denticles that line the dorsal margin of groove and size of the distal cup of the appendix masculina). The diagnosis for *P. humphreysi* sp. nov. was constructed using these comparisons. The species also differ in the lengths of the limbs compared to the body, although this feature is not fully assessed.

The narrow terminal projection of the pleotelson of *P. humphreysi* shows considerable variability in its length, apparently correlated with body length. The smallest specimens examined had a short pleotelson tip well anterior to the distal margin of the uropodal protopod, while the tip in the largest specimens reached nearly to this point. The undescribed species of *Pygolabis* also vary in the form of the pleotelson tip, although their allometries have not been examined.

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References

Argano, R. & Pesce, G. L. 1980. A cirolanid from subterranean waters of Turkey (Crustacea, Isopoda, Flabellifera). *Revue Suisse de Zoologie*, 87 (2), 439-444.

Botosaneanu, L. (1998) Sources: aux portes du Styx. *In*: L. Botosaneau (Ed) *Studies in Crenobiology.* Backhuys Publishers, Leiden, pp. 229-250.

Bradbury, J.H. (2000) Western Australian stygobiont amphipoods (Crustacea: Paramelitidae) from the Mt Newman and Millstream regions. *Records of the Western Australian Museum*, Supplement, 60, 1-102.

Brusca, R.C. & Wilson, G.D.F. (1991) A phylogenetic analysis of the Isopoda with some classificatory recommendations. *Memoirs of the Queensland Museum*, 31, 143-204.

Dallwitz, M.J. (1980) A general system for coding taxonomic descriptions. *Taxon*, 29, 41-46.

Dallwitz, M.J., Paine, T.A. & Zurcher, E.J. (2000) *User's guide to the DELTA system: a general system for pro-*

cessing taxonomic descriptions, Edition 4.12, December 2000. CSIRO, Canberra, 158 pp.
Dreyer, H. & Wägele, J.W. (2002) The Scutocoxifera tax. nov. and the information content of nuclear ssu rDNA sequences for reconstruction of isopod phylogeny (Peracarida: Isopoda). *Journal of Crustacean Biology*, 22(2), 217-234.
Edgecombe G.D., Richter, S. & Wilson, G.D.F. (2003) The mandibular gnathal edges: Homologous structures throughout Mandibulata? *In* M. Hamer (Ed) *Proceedings of the 12th International Congress of Myriopodology. African Invertebrates*, 44 (in press, 21 pp.)
Eberhard, S.M. & Humphreys, W. F. (1999) Stygofauna survey – Ore Body 23 (Newman) and mine area. *Report for BHP Iron Ore* (unpublished, summarised in Johnson & Wright 2001).
Erhard, F. (1998) Morphological and Phylogenetical Studies in the Isopoda (Crustacea). Part 1: The Pleon Trunk in the Phreatoicidea. *Stuttgarter Beiträge zur Naturkunde, Serie A (Biologie)*, 581, 1-42.
Erhard, F. (1999) Morphological and phylogenetical studies in the Isopoda (Crustacea). Part 2: The pleopods and uropods in the Phreatoicidea. *Stuttgarter Beiträge zur Naturkunde, Serie A (Biologie)*, 597, 1-56.
Humphreys, W.F. (2000) The Pilbara stygofauna: a synopsis. *Report for Waters and Rivers Commission* (unpublished, summarised in Johnson & Wright 2001).
Humphreys, W.F. (2001) Groundwater calcrete aquifers in the Australian arid zone: and unfolding plethora of stygal diversity. *Records of the Western Australian Museum*, Supplement 64, 233-234.
Johnson, S.L. & Wright, A.H. (2001) Central Pilbara Groundwater Study. Water and Rivers Commission, *Hydrogeological Record Series*, Report HG8, 102 pp. (http://www.wrc.wa.gov.au/public/HG/hg8/)
Jones, D.S. & Morgan, G.J. (2002) *A Field Guide to Crustaceans of Australia Waters*, 2nd Edition. Reed New Holland, Frenchs Forest, NSW, 224 pp.
Knott, B. & Halse, S.A. (1999) *Pilbarophreatoicus platyarthricus* n.gen., n.sp. (Isopoda: Phreatoicidea: Amphisopodidae). *Records of the Australian Museum*, 51(1), 33-42.
Martin, J.W. & Davis, G.E. (2001) An Updated Classification of the Recent Crustacea. *Natural History Museum of Los Angeles County Science Series*, 39, 124 pp.
Poore, G.C.B. (1987) Lynseiidae (Isopoda: Flabellifera), a new monotypic family from Australia. *Journal of Crustacean Biology*, 7(2), 258-264.
Poore, G.C.B. Ed. (2002) *Zoological Catalogue of Australia: Crustacea: Malacostraca: Syncarida, Peracarida: Isopoda, Tanaidacea, Mictacea, Thermosbaenacea, Spelaeogriphacea*, Vol.19.2A. CSIRO Publishing, Melbourne, Australia, 433 pp.
Poore, G.C.B. & Humphreys, W.F. (1998) First record of Spelaeogriphacea from Australasia: a new genus and species from an aquifer in the arid Pilbara of Western Australia. *Crustaceana (Leiden)*, 71, 721-742.
Poore, G.C.B. & Lew Ton, H.M (2002) Enigmata. *In*: Poore, G.C.B. (Ed) *Zoological Catalogue of Australia: Crustacea: Malacostraca: Syncarida, Peracarida: Isopoda, Tanaidacea, Mictacea, Thermosbaenacea, Spelaeogriphacea*, Vol.19.2A. CSIRO Publishing, Melbourne, Australia, p. 345.
Richter S., Edgecombe G.D., Wilson, G. D. F. (2002) The lacinia mobilis and similar structures – a valuable character in arthropod phylogeny? *Zoologischer Anzeiger*, 241, 339-361.
Sars, G.O. (1897) Isopoda. Part III, IV. Anthuridae, Gnathiidae, Aegidae, Cirolanidae, Limnoriidae. In: An Account of the Crustacea of Norway with Short Descriptions and Figures of All the Species, Vol. 2. Bergen Museum, Bergen, Norway. pp. 41-80 (Plates XVIII-XXXII).
Schminke, H. K. (1973) Evolution, systematics and zoogeography of the family Parabathynellidae (Bathynellacea, Malacostraca). *Mikrofauna des Meersbodens*, 24, 1-192.
Wägele, J.W. (1989) Evolution und phylogenetisches System der Isopoda. Stand der Forschung und neue Erkenntnisse. *Zoologica*, 140, 1-262.
Wilson G.D.F. (1989) A systematic revision of the deep-sea subfamily Lipomerinae of the isopod crustacean family Munnopsidae. *Bulletin of the Scripps Institution of Oceanography* 27, 1-138
Wilson G.D.F. (1991) Functional morphology and evolution of isopod genitalia. *In*: Bauer, R. & Martin, J. (Eds.) *Crustacean Sexual Biology*. University of Columbia Press, New York, pp. 228-245.
Wilson, G.D.F. (1996) Of uropods and isopod crustacean trees: A comparison of "groundpattern" and cladistic methods. *Vie et Milieu*, 46, 139-153.
Wilson, G.D.F. (1998) Historical influences on deep-sea isopod diversity in the Atlantic Ocean. *Deep-Sea Research II*, 45, 279-301.
Wilson, G.D.F. (1999) Some of the deep-sea fauna is ancient. *Crustaceana (Leiden)*, 72, 1020-1030.
Wilson, G.D.F. & Keable, S.J. (2001) Systematics of the Phreatoicidea. *In*: Kensley, B.F. & Brusca, R.C. (Eds.) *Isopod Systematics and Evolution*, Crustacean Issues 13, A.A.Balkema Publishers, Amsterdam, pp. 175-194.
Wilson, G.D.F. & Keable, S.J. (2002) New Phreatoicidea (Crustacea, Isopoda) from Grampians National Park, with revisions of *Synamphisopus* and *Phreatoicopsis*. *Memoirs of Museum Victoria* 59(2), 457-529.
Wilson, G.D.F. & Ponder, W.F. (1992) Extraordinary new subterranean isopods (Peracarida, Crustacea) from the Kimberley Region, Western Australia. *Records of the Australian Museum*, 44, 279-298.