



## Two new species of *Colubotelson* Nicholls, 1944 Tasmania's Lake Pedder: persistence of Phreatoicidae (Crustacea, Isopoda) therein

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### Abstract

The Tasmanian lakes Pedder and Edgar were inundated in 1972 to create a reservoir to feed into a hydroelectric power scheme, despite biologists highlighting the uniqueness of the fauna therein. This fauna included undescribed species of phreatoicidan isopods, which were noted in several subsequent publications but not formally described. In 2010, the original beds of these two lakes were revisited and successfully sampled for these isopods as part of a program to assess the conservation status of the unique fauna of this large freshwater body. These two previously reported species of phreatoicidan are both new to science, distinct from each other and belong to the genus *Colubotelson* Nicholls, so we provide descriptions and illustrations of these species to assist their identification by other biologists. The two species are easily identified by the shape of the pleotelson and setation of the head, although they are separated by considerably more than two hundred specific differences. *C. pedderensis* sp. nov. was collected only from the now deeply submerged bed of the original Lake Pedder, whereas *C. edgarensis* sp. nov. may be found more widely in the current extent of Lake Pedder, owing to its appearance in previously collected samples from the original Lake Pedder as well as in the now drowned area of Lake Edgar. These results bring the known diversity of the family Phreatoicidae in Tasmania to 26 described species, including 16 in the genus *Colubotelson*. The persistence of phreatoicids in Lake Pedder, despite the extensive changes to its ecosystem, suggests that these two species are more resilient than was suspected.

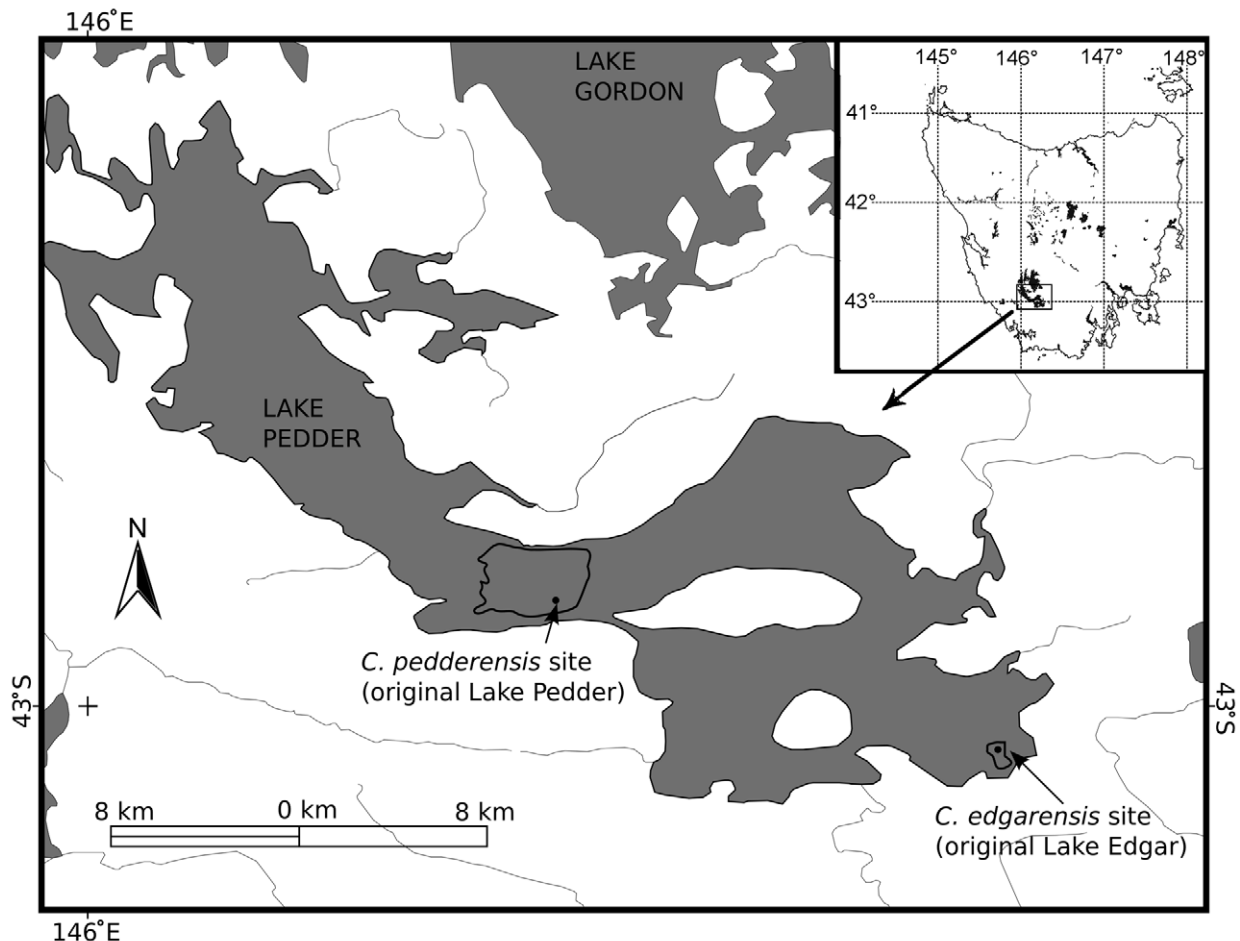
**Key words:** Lake Edgar, conservation status, biodiversity, freshwater benthos

### Introduction

Until the early 1970s, Lake Pedder, in Tasmania's south-west, was a small lake of approximately 9 km<sup>2</sup>, and relatively shallow with a depth of less than 3 m. Lake Pedder had been created geologically by an out-wash of Precambrian quartzites that dammed the Serpentine River (Tyler *et al.* 1996). The bed of the lake originally consisted of pink quartzite sand in the south and of quartz pebbles to the north (Tyler *et al.* 1996). In 1972, the original lake bed was inundated (Felton 2008) following the completion of a series of dams. As a result of flooding, Lake Pedder today is Australia's largest body of freshwater, with an area of 235 km<sup>2</sup> at full supply and a maximum depth 43 m (309 m above sea level).

Lake Edgar lay to south-east of the original Lake Pedder (Fig. 1), and was a much smaller and shallower lake: less than one km<sup>2</sup> and 1.7 m at it deepest (Knott & Lake 1974). The substrate at the greatest depth in Lake Edgar was described as being a black organic ooze (Knott & Lake 1974). Following inundation by the greatly expanded Lake Pedder, the former Lake Edgar now lies drowned within the south-eastern boundary of the new Lake Pedder (Fig. 1).

According to Bayly *et al.* (1972), four endemic species were known to be present at the time of inundation of the original Lake Pedder: the annelids, *Breviatrria multiprostatus* (Brinkhurst, 1971) and *B. pectinatus* (Brinkhurst, 1971), a decapod crustacean, *Parasticoides pulcher* Riek, 1967, and a vertebrate, the fish species *Galaxias pedderensis* Frankenberg, 1968. Subsequently, several endemic taxa new to science were described from the pre-inundation Lake Pedder: a new genus and species of a freshwater planarian (Turbellaria: Tricladida; Ball 1974) collected in 1972, a species of water bug (Hemiptera: Corixidae; Knowles 1974) and two species of caddis-flies (Insecta: Trichoptera; Neboiss 1977) collected in 1965.



**FIGURE 1.** Map of the current extent of Lake Edgar, with original outlines of Lake Pedder and Lake Edgar. Inset shows position of map in Tasmania.

From a broader context, [Tyler \(2001\)](#) argued that Lake Pedder provided important habitats for other undescribed species. Two species of phreatoicid crustaceans, one from Lake Pedder ([Bayly 1973](#)) and another from Lake Edgar (Knott & Lake 1974), were originally recorded as being in the genus *Colubotelson* Nicholls, 1944. Subsequent authors also noted these isopods ([Lake 2001](#); [Tyler 2001](#)) but as the genus *Uramphisopus* Nicholls, 1943, based on an overly broad synonymy in an unpublished thesis. Recent revisions of the classification of the Phreatoicidea ([Wilson & Keable 2001](#); [Poore et al. 2002](#)) restrict the genus *Uramphisopus* to the type species *U. pearsoni* Nicholls, 1943.

With reference to ecological investigations of invertebrates in the original Lake Pedder, the literature is much more sparse. [Bayly \(1973\)](#) reported that an unnamed species of phreatoicid was recorded as being found in freshwater psammon. Knott & Lake (1974) list a number of invertebrates found in Lake Edgar, where identifications were made to the level of family. Their results indicate a *Colubotelson* species from their benthic site 18 at a depth of 1.5–1.7 m. They also refer to a non-pigmented, blind species of *Colubotelson* collected from dead reed beds. Because no blind *Colubotelson* species are known, this record is likely to be of another undescribed genus-level taxon found in Tasmania.

Beginning in 1975 and ending in 1989, ten surveys of the enlarged Lake Pedder were conducted in which samples were collected with the aid of sweep nets, although phreatoicidans did not appear in any of those surveys ([Lake 2001](#)). [Tyler et al. \(1994, 1996\)](#) report, however, that specimens of a phreatoicidan, identified as a species of *Uramphisopus* by P. S. Lake and A. Glaister, were retrieved by scuba divers from the still intact, albeit flooded, beach of the original Lake Pedder. These specimens were undoubtedly one of the species reported in this paper, although none were deposited in a museum or were held in a private collection by the participants. [Tyler et al. \(1994\)](#) commented that “An assessment today of the fate or current status of these species is beggared by the fact that some of them were never officially published in the scientific literature”. The present paper aims to rectify this shortcoming, based on new specimens collected in 2010.

## Methods

**Lake Pedder samples.** A 110 cm dredge with a 15 cm height opening was towed behind a power boat at the following localities: the original Lake Pedder and the former Lake Edgar. A boat was positioned above the submerged bed of the original Lake Pedder (Fig. 1) on 14 February 2010. Many dredges were attempted over the region where Bayly (1973) collected phreatoicids in March, 1972. Despite difficult sampling conditions, a single small sample (272 g when dried) of pink sand was retrieved from the bed of the original Lake Pedder (43°57.771'S, 146°03.06' E, depth 14.2 m), from which 8 adult phreatoicideans were isolated. The same techniques were employed the following day (15 February 2010) over the submerged bed of the former Lake Edgar at 43°0.925'S, 146°20.743' E, where a sample from a depth of 9.2 m was obtained. This sample consisted of two litres of ooze and contained well over 100 phreatoicidean isopods. Additional phreatoicid specimens collected in 1972 by Arturs Neboiss in the pre-inundation Lake Pedder were borrowed from the National Museum of Victoria.

**Taxonomic methods.** All specimens were examined using light microscopy and Scanning Electron Microscopy (SEM). The holotype and multiple paratypes were photographed using a digital camera, and the resulting images processed into plates or used for measurements. Parts were dissected from paratypes in ethanol using a razor blade fragment held in a clamp. Sonication for 3–5 seconds was conducted to remove debris and epibionts from dissected parts. The specimens were dehydrated in 100% ethanol and critical-point dried. The individual parts were vertically mounted at the cut edge on stubs using adhesive carbon spots. For efficient imaging, multiple parts were placed on each stub so they could be viewed without obscuring other parts. The specimen stubs were sputter coated with gold, and imaged using an *Evo LS15 Carl Zeiss* microscope. Figure 1 was prepared using ARCVIEW GIS ver.3.1, and edited in Inkscape (ver 0.48, <http://www.inkscape.org>). Taxonomic figures were prepared using GIMP (ver.2.6.6, <http://Gimp.org>). Backgrounds were deleted from each image, and grey levels were adjusted for a consistent contrast. Measurements were made on digital images of specimens using graphics tablet (Wacom Co., Inc.) and the Java application *ImageJ* (Wayne Rasband, <http://rsbweb.nih.gov/ij/>). The descriptions were generated from a DELTA database (Dallwitz 1980; Dallwitz *et al.* 2000a, 2000b), evaluated using the DELTA program INT-KEY and subsequently edited for clarity. The descriptions have implicit characters that do not appear in the descriptions (list available from first author on request). In descriptions, measurements or ratios may be followed with identification of the specimen used for the measurement by the registration number or by "H" for the holotype male. If two consecutive values are given for a ratio, they are for male and female, respectively, unless otherwise indicated parenthetically. Unless otherwise indicated, the external measurements are from the holotype, and the dissection characters are from the paratypes. The body length is indicated by "bl". Abbreviations for institutions include "AM" for Australian Museum, "QVM" for the Queen Victoria Museum & Art Gallery and "NMV" for National Museum of Victoria.

## Taxonomy

### *Colubotelson* Nicholls, 1944

*Colubotelson* Nicholls, 1944:108. — Poore *et al.*, 2002:72.

**Type species.** *Phreatoicus joyneri* Nicholls, 1926 by original designation.

**Diagnosis.** Phreatoicidae with well developed, fully sessile eyes. Pleotelson dorsal surface in lateral view with ventral inflection at posterior apex, with distinct dorsal inflection proximal to posterior apex; ventral margin anterior to uropods with distally denticulate robust setae medial to ventral row; posterolateral margin forming rounded lobe with robust setae; posterior apex long (length 0.120–0.295 pleotelson length in lateral view), with 2 pairs of robust setae. Right lacinia mobilis indistinctly separated from remainder of spine row. Pereopods V–VII basis dorsal ridge not distinctly separated from basis shaft. Pleopod endopods I–V without setae on margins; Pleopod I exopod lateral margin rounded. Uropod protopod dorsomedial ridge produced, forming bump.

**Remarks.** Although several non-taxonomic works considered *Colubotelson* to be a junior synonym of *Uramphisopus* Nicholls, 1943, the two genera are easily separated because the latter has a large distinctive plate on the uropodal protopod, and the former has only a small bump-like projection. *Colubotelson*, however, differs from *Metaphreatoicus* Nicholls, 1944 by only a few characters such as the rounded lateral margin of pleopod I exopod in

the *Colubotelson*, which is broadly angular in *Metaphreatoicus*. The classification of *Colubotelson* and related genera is further complicated by the generic type species from Victoria and New South Wales possibly being a clade distinct from the Tasmanian species of both genera. Resolution of these issues is beyond the scope of this work.

***Colubotelson edgarensis* Wilson, sp. nov.**

(Figs 2–9)

**Type material.** Holotype male, here designated, bl 10.1 mm, QVM:10:51197, 43°0.925'S, 146°20.743'E, depth 9.2 m, hand operated dredge, A. Osborn & N. Forteach, 15.ii.2010. Paratypes, same data as for holotype: male, bl 11.2 mm, dissected for SEM, QVM:10:51198; male, 8.7 mm, QVM:10:51200, SEM entire; female, bl 7.8 mm, dissected for SEM, QVM:10:51199; 14 ind. QVM 10:51195.

**Type locality.** Australia, Tasmania, Lake Pedder, submerged bed of the former Lake Edgar.

**Other material examined.** Australia, Tasmania, Lake Pedder in its original extent before inundation, col. A. Neboiss, 10.iii.1972: juvenile male NMV J44909; 2 males, 1 juvenile male, 3 preparatory females, NMV J44908.

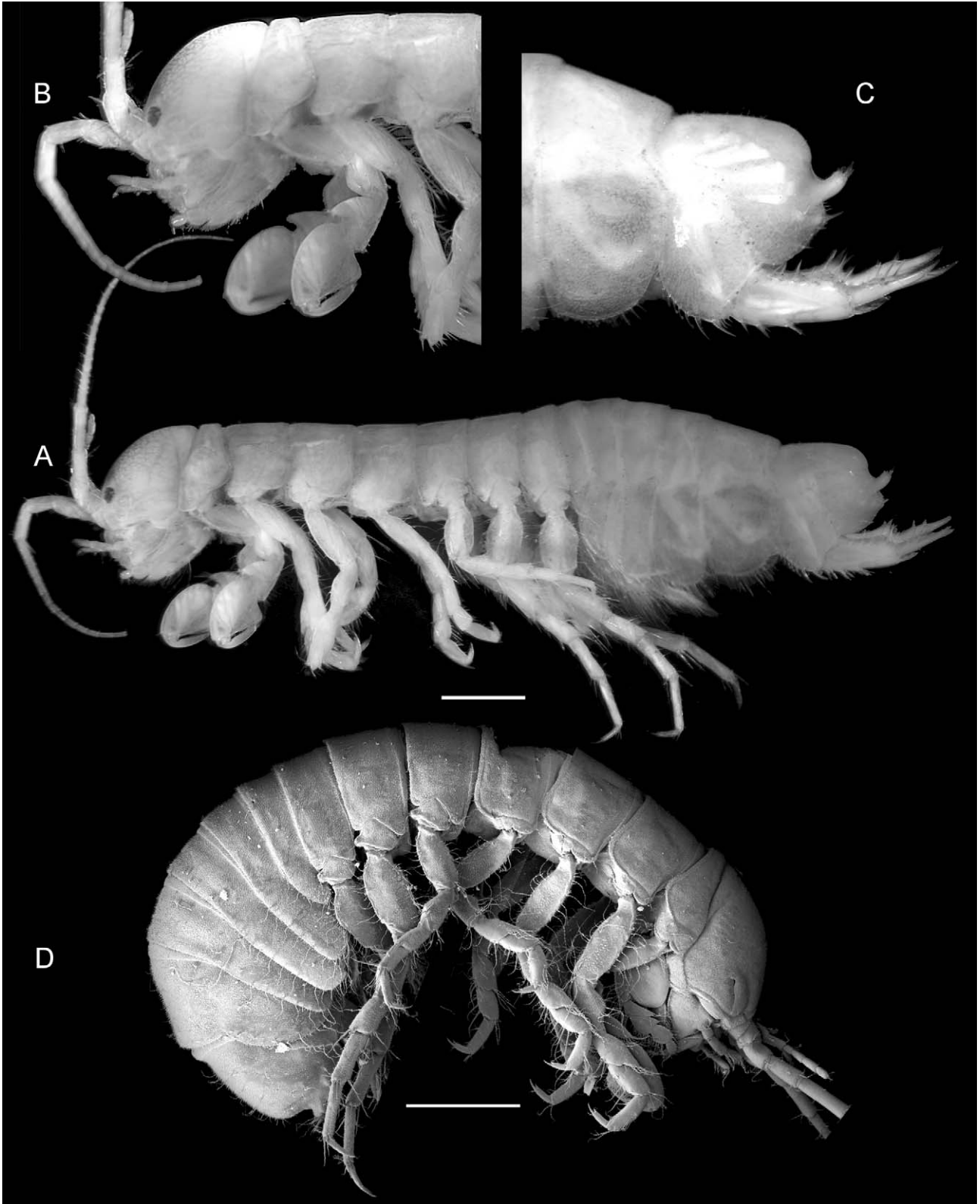
**Diagnosis.** Head lateral margin with only several setae, lacking fringe of elongate setae. Pleotelson lateral length subequal to depth; dorsal surface in lateral view proximal to distal tip with anterior inflection, margin below dorsal inflection concave; posterior apex length less than width, forming angle between 81–85° with adjacent dorsal surface, posterior apex in lateral view distinctly broadening distally, proximally shallower than distal tip; posterolateral margin dorsal lobe with one robust seta; ventral margin anterior to uropods with one row of distally denticulate robust setae. Antenna article 5 shorter than article 4. Mandible molar process left triturating surface ridges directed diagonally to mandibular axis, in line with dorsal condyle. Pereopod I propodus dorsal margin with few short setae in 1 group between proximal and distal margin in addition to single group at distal margin. Pereopod IV propodus palm in male gracile, smoothly convex, without ventral projection. Pleopod II appendix masculina distal tip broadly rounded, with 4 stiff straight setae on apex. Uropod protopod ventral margin with 3 transverse rows of simple setae; endopod shorter than protopod.

**Description.** Body pigmentation light brown-beige throughout body; head with distinct colour pattern with groups of cream coloured globules set amongst white/semi-translucent background. Dark brown band between eyes (width approximately eye diameter).

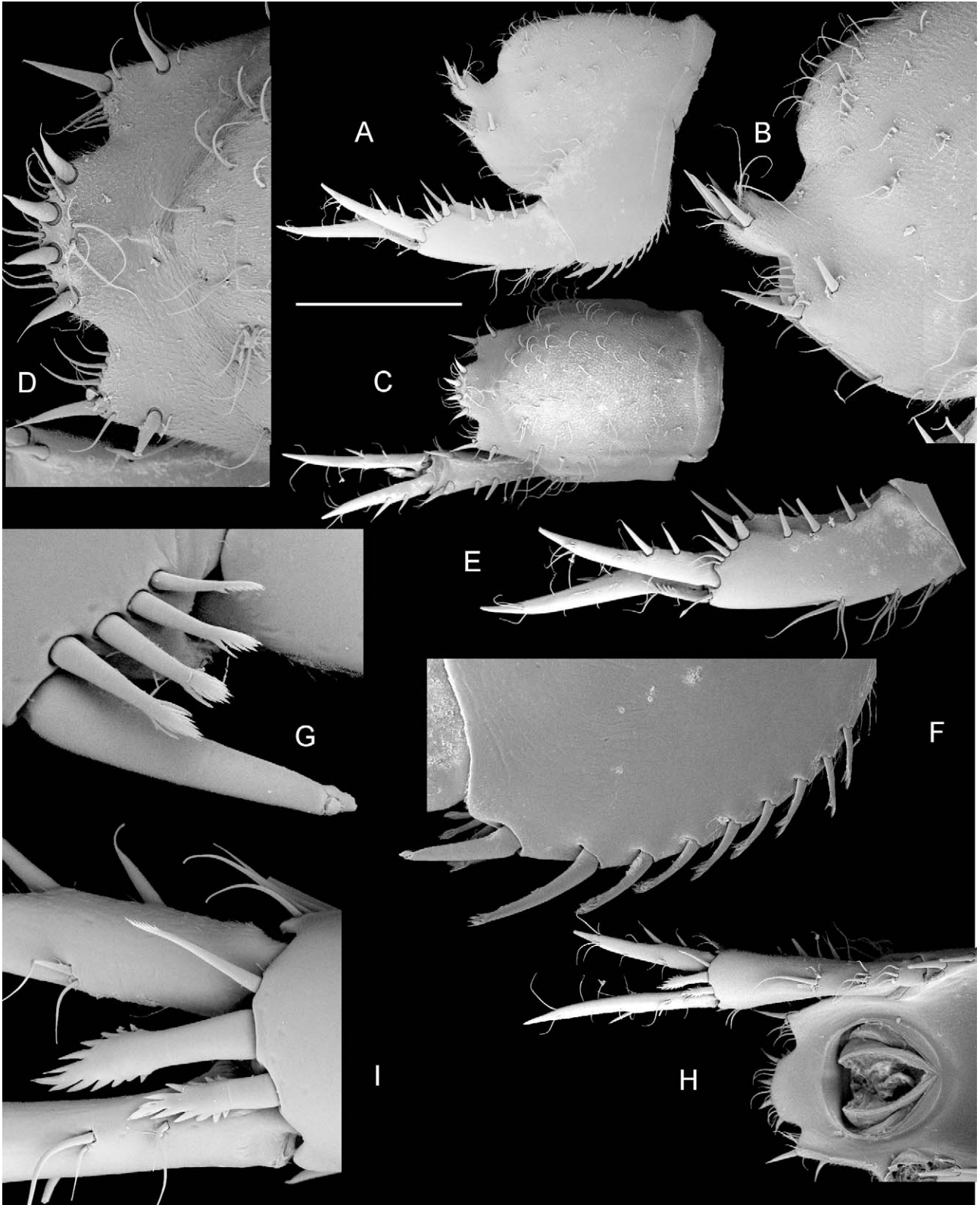
**Head** (Fig. 2, 8). Length shorter than width in dorsal view; lateral profile of dorsal surface smoothly curved; width 0.93 pereonite 1 width; surface smooth and shiny; setae tiny and sparse, fine. Eyes fully sessile; maximum diameter 0.13 head depth; dorsal margin convex, ventral margin straight; orientation of longest axis vertical; ocelli distinguishable (in transmitted light images) as individual units, pigmentation dark. Cervical groove straight, extending nearly to dorsal margin of head. Mandibular (genal or cheek) groove smoothly indented. Mandibular notch present. Clypeal notch present. Antennal notch shallow, without posterior extension.

**Pereon** (Fig. 2). Width exceeding head width; surface smooth; setae on dorsal surface absent. Pereonite 1 in dorsal view wider than medial length, width 0.48 length. Pereonites 2–7 in dorsal view wider than long, length:width ratios 0.53, 0.59, 0.53, 0.5, 0.43, 0.26, respectively. Coxal articulation to pereonites 2–4 nearly fused, 5–7 free.

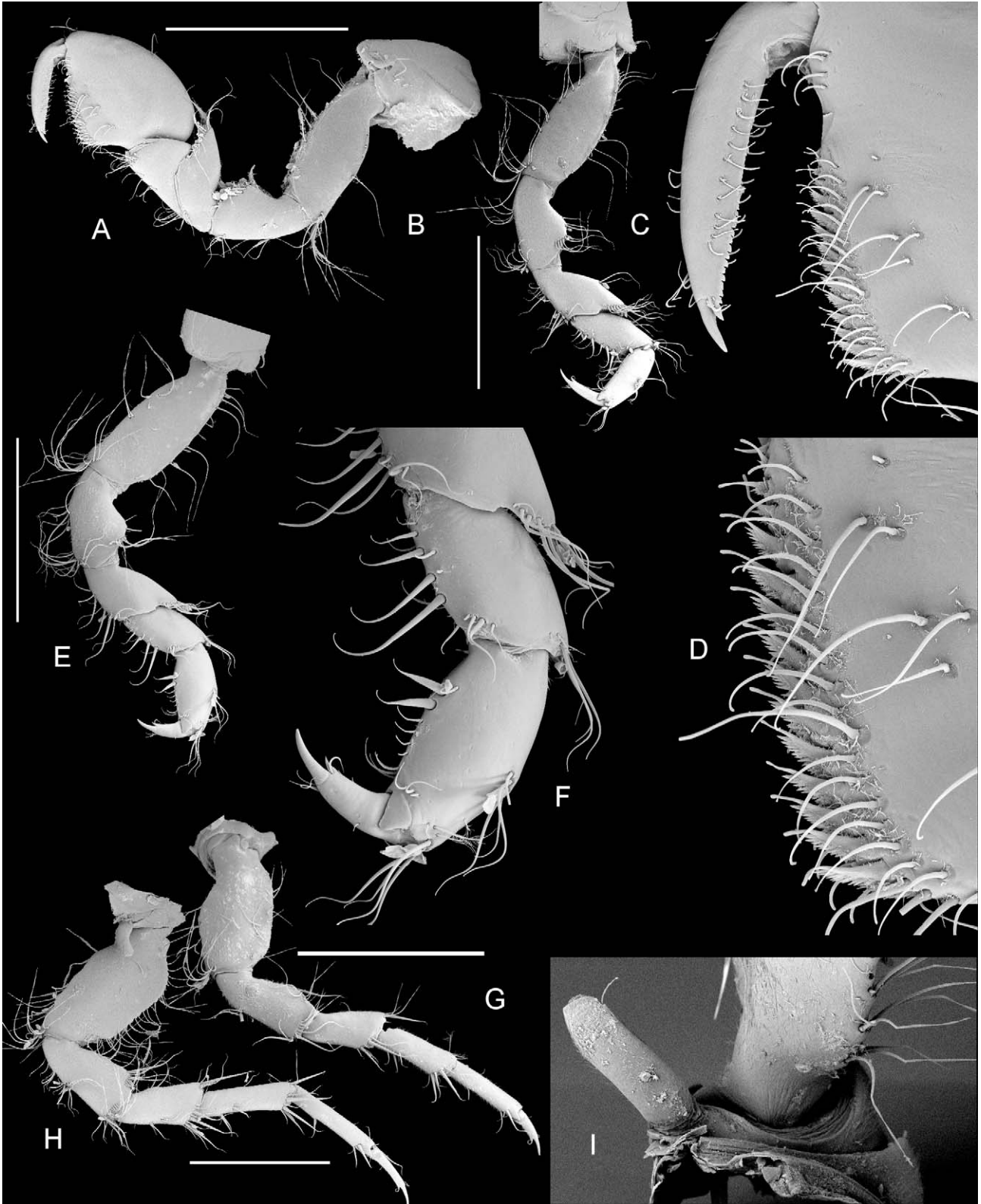
**Pleonites** (Fig. 2). In lateral view much deeper than pereonites, with large pleurae, basal region of pleopods not visible; pleonite 1 pleura distinctly shallower than pleurae of pleonites 2–5. In dorsal view pleonite 2 length less than 0.5 pleonite 5 length, pleonite 3–4 respective lengths more than 0.5 pleonite 5 length, pleonite 1–4 relative lengths unequal, increasing in length from anterior to posterior, 1–4 width 0.77 composite length in dorsal view; pleonites 1–5 dorsal length:width ratios 0.27, 0.34, 0.3, 0.38, 0.59, respectively; depth:pereonite 7 depth ratio: 1.3; 1.7; 1.8; 1.7; 1.5, respectively. Typhlosole (Fig. 8H) minimal, ventral invagination forming laminar projection in cross-section; hindgut caecae present (4 pairs in pleonites 1–2).



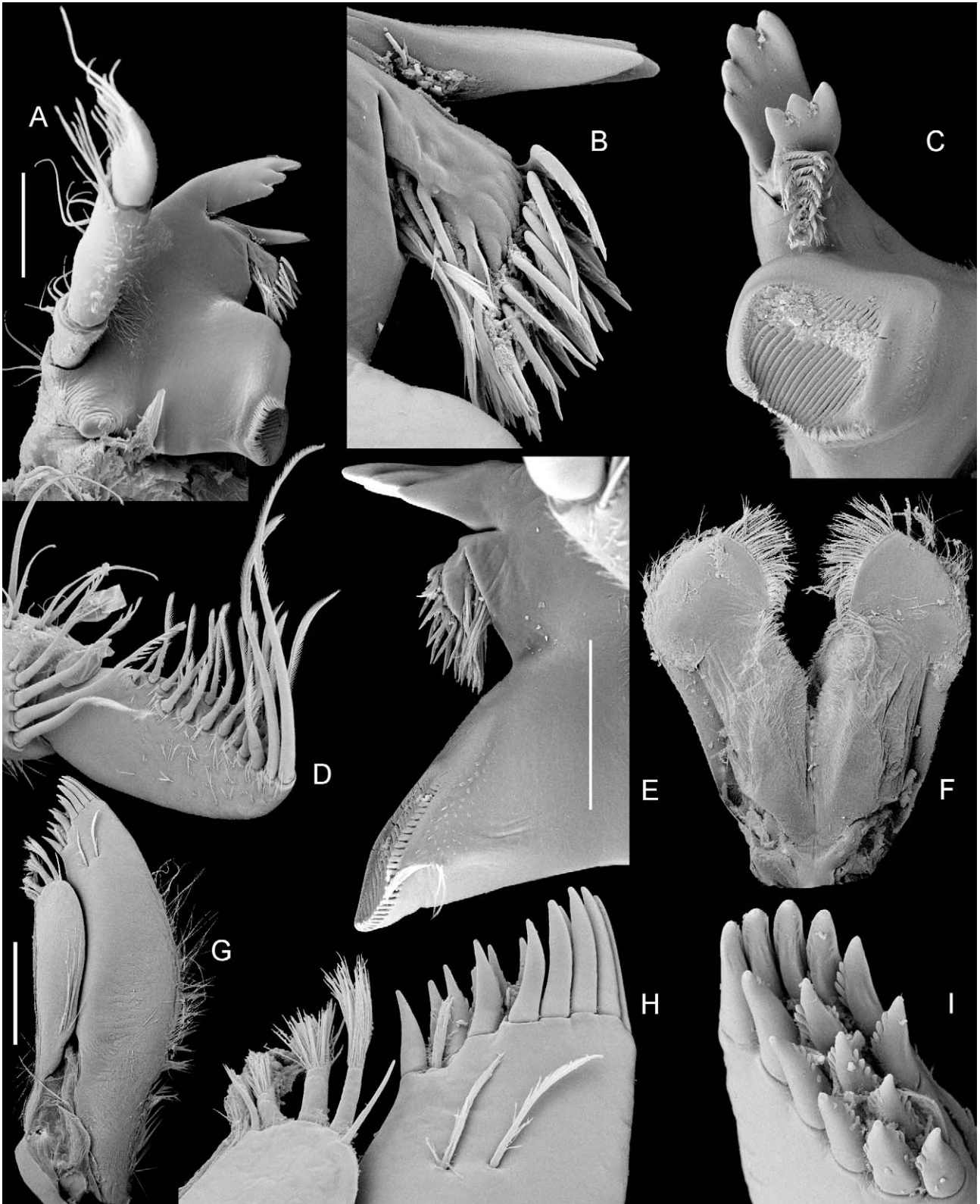
**FIGURE 2.** *Colubotelson edgarensis* sp. nov. A–C, holotype male (QVM:10:51197), left lateral view, with enlargements of head and pleotelson. D, paratype male (QVM:10:51200), right lateral view, SEM. Scale bar 1.0 mm.



**FIGURE 3.** *Colubotelson edgarensis* sp. nov. Paratype male (QVM:10:51198), pleotelson and uropods. A, right lateral view. B, posterior margin and apex, lateral view. C, dorsal view. D, posterior apex and posterolateral lobes, dorsal view. E, right uropod, lateral view. F, ventral margin anterior to uropods, distally denticulate robust setae. G, medial view of ventral margin, showing group of medial group of small distally denticulate robust setae. H, posterior margin of pleotelson, ventral view. I, distal group of robust setae on ventral margin of uropodal protopod. Scale bar 1.0 mm.

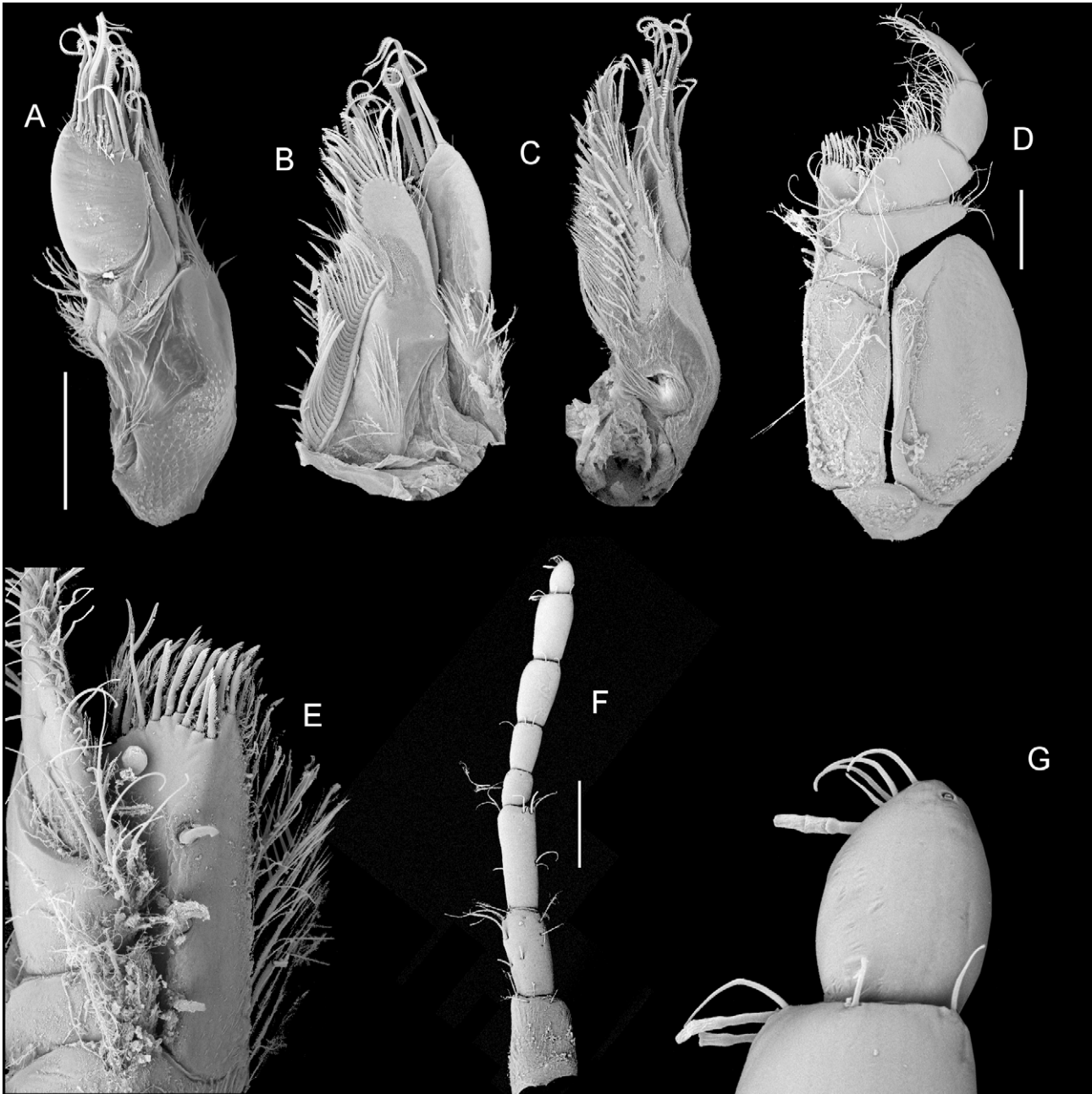


**FIGURE 4.** *Colubotelson edgarensis* sp. nov. Paratype male (QVM:10:51198), pereopods. A, C, D, pereopod I, lateral view, with enlargements of dactylus and palm, and setation of palm. B, pereopod II, lateral view. E–F, pereopod IV, lateral view, with enlargement of dactylus, propodus and carpus. G, pereopod V, lateral view. H, pereopod VII, medial view. I, penes, posterior view. Scale bars 1.0 mm.



**FIGURE 5.** *Colubotelson edgarensis* sp. nov. Paratype male (QVM:10:51198), mouthparts. A–D, left mandible. A, dorsal view. B, lacinia and spine row. C, medial view. E, right mandible, gnathal margin, dorsal view. F, paragnaths, ventral view. G–I, maxillula, ventral view, enlargement of gnathal margin, and medial view of lateral lobe. Scale bars 0.2 mm.





**FIGURE 6.** *Colubotelson edgarensis* sp. nov. Paratype male (QVM:10:51198). A–C, maxilla, ventral, dorsal and medial views. D–E, maxilliped, ventral view and medial view of endite. F–G, antennula, dorsal view and enlargement of distal tip. Scale bar 0.2 mm.

*Pleotelson* (Fig. 2–3, 9). Dorsal surface in lateral view inflected ventrally, covered with abundant elongate setae, length 1.4 width, lateral length 0.13 body length, 0.95 depth, depth 1.2 pereonite 7 depth. Ventral surface anterior to uropods lateral margin convex, margin anterior to uropods length subequal to width of uropodal insertion, with one row of distally denticulate robust setae, including 9 robust setae altogether (with 4 half-size distally denticulate setae at anterior end), robust setae on medial side medial to main row distally denticulate, posterior seta longer than anterior adjacent setae; 4 robust setae medial to main row. Postanal ventral surface unelaborated; lateral uropodal ridge present, terminating at pleotelson margin above uropods, with 4 fine setae (male, QVM:10:51198, female, QVM:10:51199). Posterolateral margin forming rounded lobe, curving dorsally, medial length 0.15–0.17 pleotelson length (female, QVM:10:51199; male, QVM:10:51198); with dorsal position defined by major robust setae; dorsal setal position with one robust seta and 2 setae; with robust seta on dorsolateral surface adjacent to margin. Posterior apex projecting in dorsal view, visible in lateral view, length less than width, 0.15–0.17 pleotelson length (female, QVM:10:51199; male, QVM:10:51198), width 0.4–0.42 pleotelson width (male,

QVM:10:51198; female, QVM:10:51199), forming angle of 81–85° with immediately anterior dorsal surface (male, QVM:10:51198; female, QVM:10:51199), angled 27–38° from horizontal (female, QVM:10:51199; male, QVM:10:51198); with two pairs of robust setae, with numerous fine setae above and below robust setae.

*Antennula* (Fig. 6, 8), male and female, respectively (male, QVM:10:51198; female, QVM:10:51199). Length 0.12, 0.10 body length, with 8, 7 articles. Article 5 length:width 1.8, 1.4. Article 6 length:width 1.8, 1.4. Aes-thetascus (1–2) occurring on anterior end of all distal articles. Terminal article globular, length 1.5–1.7 width, length 0.10–0.15 antennula length. Penultimate article length not greater than other articles. Distal articles in cross-section flattened oval.

*Antenna* (Fig. 2, 8), male and female, respectively. Length 0.40, 0.43 body length. Article 1 absent. Article 5 shorter than article 4. Flagellum length 0.7 antenna length, 0.66 antenna length, with 17–27 articles.

*Mouthfield* (Fig. 5, 8). Clypeus consisting of broad median bar, angular at mandibular fossae, width 0.48 head width (female, QVM:10:51199); labrum ventrally semicircular, left half with slight depression at midpoint. Parag-naths with distally rounded lobes, having medial and lateral setal rows and thickened medial base covered with cuticular spinules, medial setae thicker and denser than lateral setae.

*Mandible* (Fig. 5, 8). Palp length 1 mandible length; article 3 setae with more than 5 setae on medial-distal margins, with 18 setae, coarsely spinulate setae in second row behind marginal row, on margin finely spinulate, medial surface additional setae absent, medial surface naked, surface covered with cuticular hairs (except on medial ridge), cuticular combs absent; article 2 longitudinal row of setae present, separate distal group of setae present; articles 1–2 group of long setae at distal end of dorsolateral margin. Left incisor process with 2 distal and 2 dorsal cusps. Right lacinia mobilis indistinctly separated from remainder of spine row but with bifurcate plate on side distal to spine row. Spine rows on linear pedunculate projection between incisor and molar, distal margin in line with proximal margin in ventral view, basal insertions in line between incisor and molar processes. Left spine row with 15 spines, 9 of which bifurcate, count includes 6 on margin between pedunculate projection and molar. Right spine row with 15 spines, 9 of which bifurcate, count includes 6 on margin between pedunculate projection and molar. Molar process left triturating surface posterodorsal ridge projecting; dorsoposterior margin with spines adjacent to triturating ridges, short fine spines forming dorsal row. Molar process right longer than wide, right row of complex spines adjacent to triturating ridges absent, dorsal side ciliated spine row present, dorsal surface ciliated spine row 2 members altogether, dorsal surface cuticular hairs sparse.

*Maxillula* (Fig. 5). Medial lobe length 0.5 lateral lobe length, width less than lateral lobe, 0.45 lateral lobe width; with 4 pappose setae, with 2 accessory setae, distally denticulate accessory setae present, 1 on distolateral margin and 1 between central pappose setae, short weakly setulate seta on distal tip absent. Lateral lobe distal margin with 9 denticulate robust setae, with 5 smooth robust setae, distal setal row with 5 robust setae; ventral face with 2 plumose setae, ventral face with no simple setae, additional plumose seta among proximal distal robust setae.

*Maxilla* (Fig. 6). Medial lobe width 1.5 outer lateral lobe width, proximal portion smoothly continuous with distal portion, proximal and distal setal rows continuous, setae in ventral basal rows with single row of fine setules, setae in dorsal basal row plumose with smooth long shaft. Outer lateral lobe length subequal to inner lateral lobe, wider than inner lateral lobe, distal margin setal row approximately linear and diagonal to lobe axis, with 10 long bidenticulate setae; inner lateral lobe with 6 long bidenticulate setae; lateral lobes with bidenticulate setae on distal tips and on medial margin (half of medial margin).

*Maxilliped* (Fig. 6). Epipod length:width 1.4; endite length:basis length 0.45–0.46, distal tip rounded. Endite with 3 coupling hooks on right side, 2 on left side, with setulate setae, in fringe, fine cuticular combs scattered in lateral groups of 2–4 combs, groups at approximately equal distance; combs shorter towards distal end, ventral surface setae present; endite short, distal tip with 9 subdistal biserrate setae on ventral surface; dorsal ridge with 13 large distally denticulate plumose setae. Palp insertion on basis without lateral margin plumose setae, with medial margin plumose setae, with 1 simple seta, ventral surface with 3 subdistal smooth setae, without ventral surface subdistal biserrate setae, length:basis length 1–1.1; article 4 length:width 1.4, shape elongate-oval; article 5 length:width 2.7, length:article 4 length 1.0.

*Pereopod I* (Fig. 4), male and female, respectively (male, QVM:10:51198; female, QVM:10:51199). Length:body length 0.28, 0.26. Dactylus projecting beyond palm, length:palm length 1.06; lateral surface with row of fine setae along axis; ventrodorsal margin with row of thin scale-like spines, along 0.39 length; ventrodorsal margin with row of thin scale-like spines, along 0.4 length; claw length:dactylus length 0.17, 0.16, without distal

accessory claws; with 1 distal accessory spine, occurring ventrally, length 0.42 claw length. Propodus length:pereopod length 0.22, 0.19; length:width 1.1, 1.3; dorsal margin setae in 1 group between proximal and distal margin in addition to single group at distal margin, dorsal margin 2 setae altogether (excluding distal group); dorsal margin proximal region recurved and protruding to distodorsal margin of carpus, dorsal margin proximal region not protruding. Propodal palm in male convex to straight; without spines; cuticular fringe well developed; stout denticulate setae serrate, 12 altogether; without stout robust simple setae; setal ridge absent. Propodal palm in female straight; simple spines absent; stout denticulate setae serrate, 9 altogether; stout robust simple setae present; stout robust simple setae conical, 2 altogether, setal ridge absent. Merus distodorsal margin in cross-section spine-like and pointed, with numerous elongate simple setae in male and female. Ischium dorsal margin with 3, 1 simple setae, none robust. Basis length:width 2.4, 2.9; dorsal setae in male positioned along ridge, 7 altogether, in female positioned along ridge, 6 altogether; ventrodorsal margin with 7 elongate setae in male, 2 elongate setae in female, setae longer than ischium.

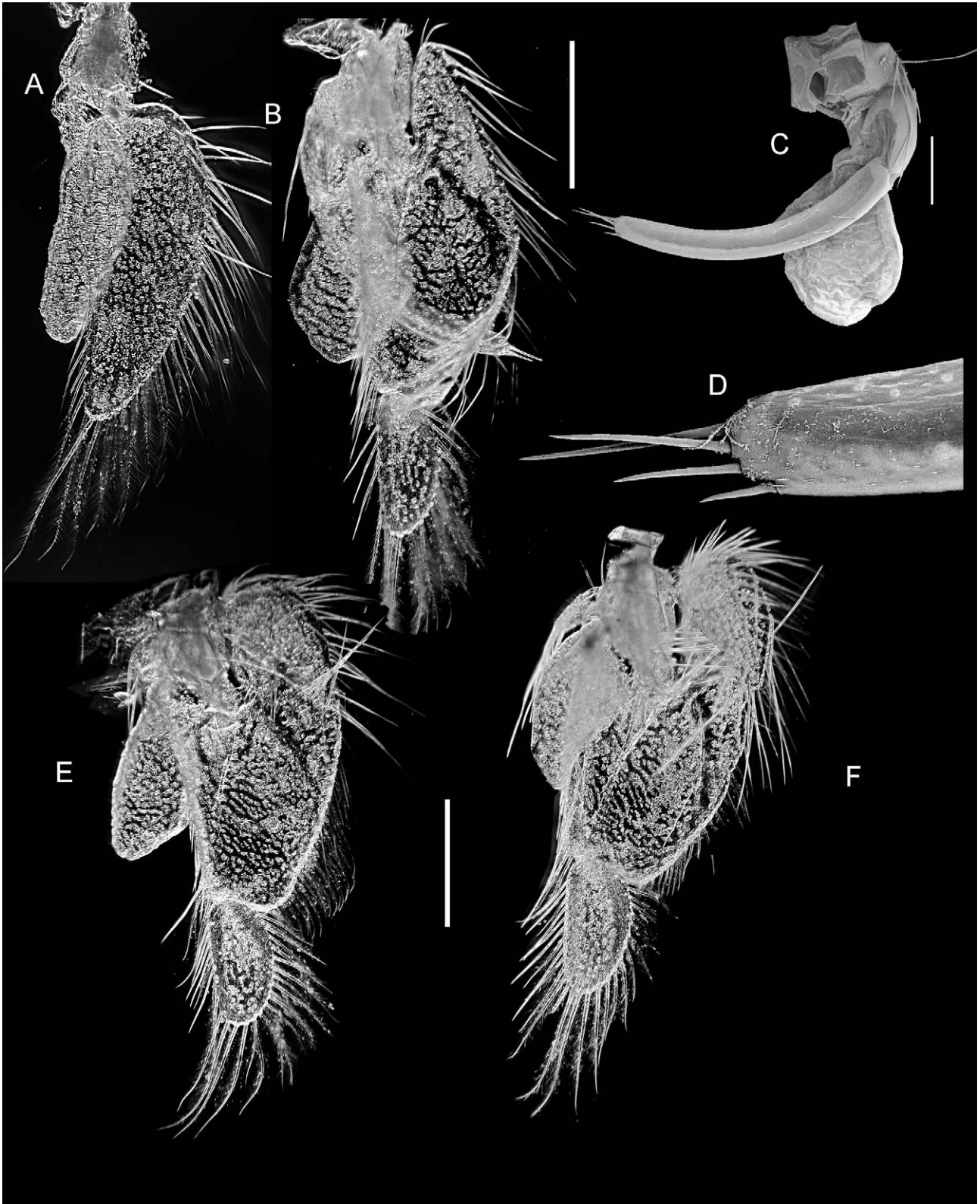
*Pereopods II–III* (Fig. 4, 9). Penicillate setae scattered on dorsal ridge. Dactylus with 1 distal accessory spine, ventral to primary claw, length ratio to that of primary claw 1:4, without spines on ventral margin. Propodus articular plate present; male pereopod II ventral margin with 3 broad based setae, length 0.22–0.28 propodus length, equally spaced along margin; female pereopod II broad-based setae length 0.25 propodus length, occurring at mid margin. Carpus ventral margin setae broad-based, 4–7 (female, QVM:10:51199; male, QVM:10:51198); male pereopod II setal length 0.15–0.48 carpus length, evenly spaced along margin, female pereopod II setal length 0.36–0.93 carpus length, evenly spaced along margin, central 2 setae with larger gap remaining setae. Basis dorsal ridge in cross-section angular and produced but not forming distinct plate, with 18 simple elongate setae in row along ridge, 4 widely spaced setae forming separate adjacent row on lateral surface, of which proximal two simple elongate, distal two penicillate. II–IV basis lateral face ridge absent; ischium dorsal margin with 9 simple setae, none robust.

*Pereopod II ratios*, (Fig. 4, 9) male and female, respectively. Length:body length 0.29, 0.25. Dactylus length:propodus length 0.75, 0.58. Dactylus primary claw length:dactylar length 0.32, 0.35. Propodus length:pereopod length 0.14, 0.16; length:width 2.4, 3.3. Carpus length:pereopod length 0.14, 0.11; length:width 1.4, 1.4. Basis length:pereopod length 0.29, 0.32; length:width 2.5, 3. *Pereopod III ratios*, male and female, respectively. Length:body length 0.29, 0.26. Dactylus length:propodus length 0.55; primary claw length:dactylar length 0.46. Propodus length:pereopod length 0.15; length:width 2.9.

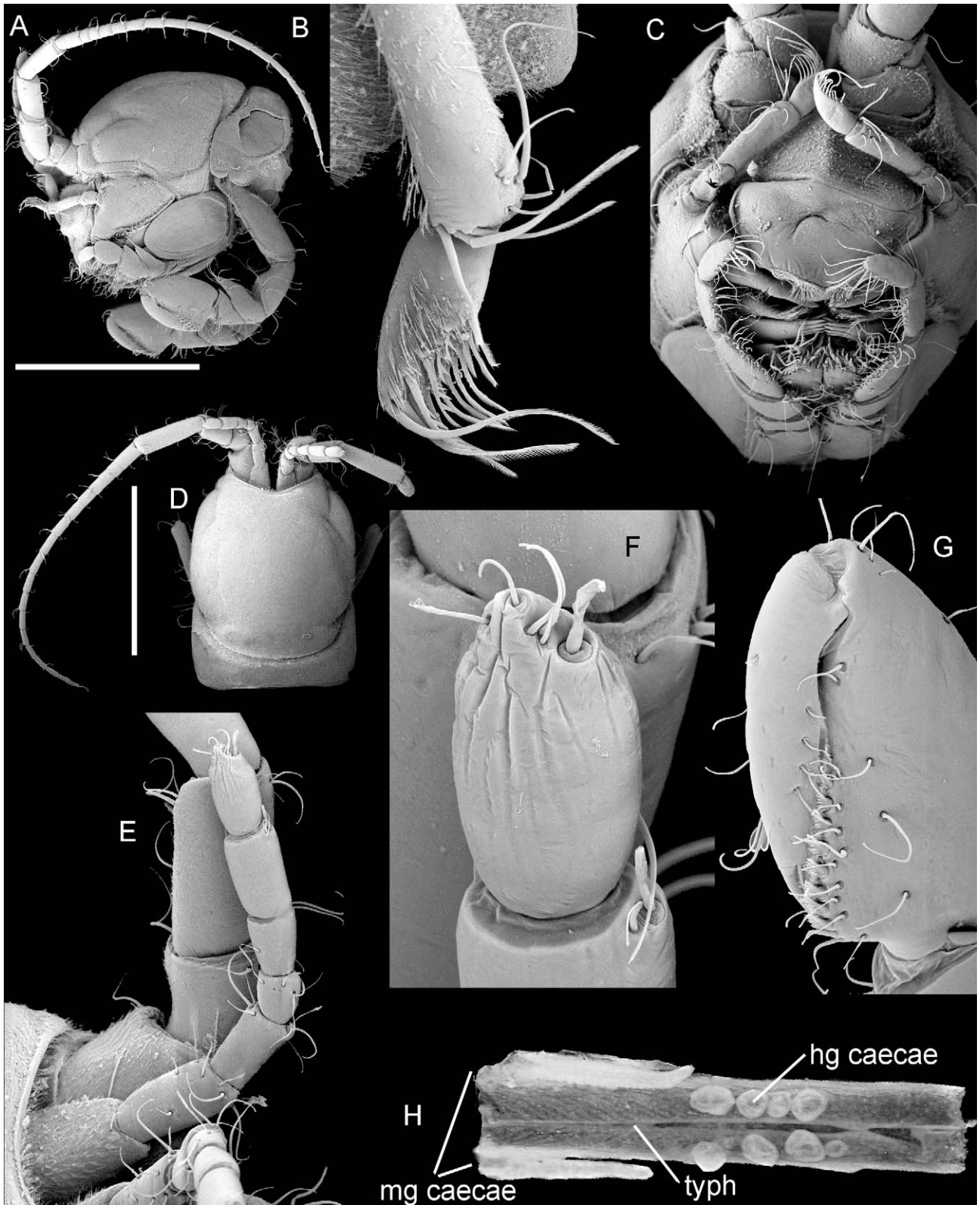
*Pereopod IV* (Fig. 4, 9). In male, subchelate with major hinges on dactylus and propodus. Penicillate setae present in both sexes, occurring on dorsal margin of basis. Basis dorsal ridge in cross-section angular and produced but not forming distinct plate; dorsal ridge with 8 setae in male, with 7 setae in female. Ischium dorsal margin with 7 setae in male, 6 setae in female. Carpus in male ventral margin with 5 broad based setae, 2 distinctly larger than others; in female ventral margin with 3 broad-based setae. Propodus articular plate on posterior side of limb shorter than dactylar claw; in male distal width:palm width 0.39, setae on ventral margin broad-based, with 2 broad based setae on ventral margin, none distinctly larger than others; in female, with 1 broad based seta on ventral margin. Dactylus in male shorter than propodal palm. *Pereopod IV ratios*, male and female, respectively. Length:body length 0.25, 0.24. Basis length:width 2.6, 2.6. Carpus length:pereopod length 0.11, 0.10. Propodus length:pereopod length 0.16, 0.14, length:width 1.9, 2.6. Dactylus distal accessory claw length 0.27, 0.30 primary claw length.

*Pereopods V–VII* (Fig. 4). Penicillate setae dorsodistally on carpus. Dactylus accessory claw ventral to primary claw absent (spine not claw). Propodus articular plate on posterior side of limb present; distal margins with 2 elongate robust setae and 3 broad based setae. Ischium dorsal margin with 7–17 simple setae (pereopod V, VII), none robust. Basis dorsal ridge in cross-section angular, not distinctly separated from basis shaft, with elongate fine setae, positioned along entire margin; lateral face central ridge absent; ventral ridge absent.

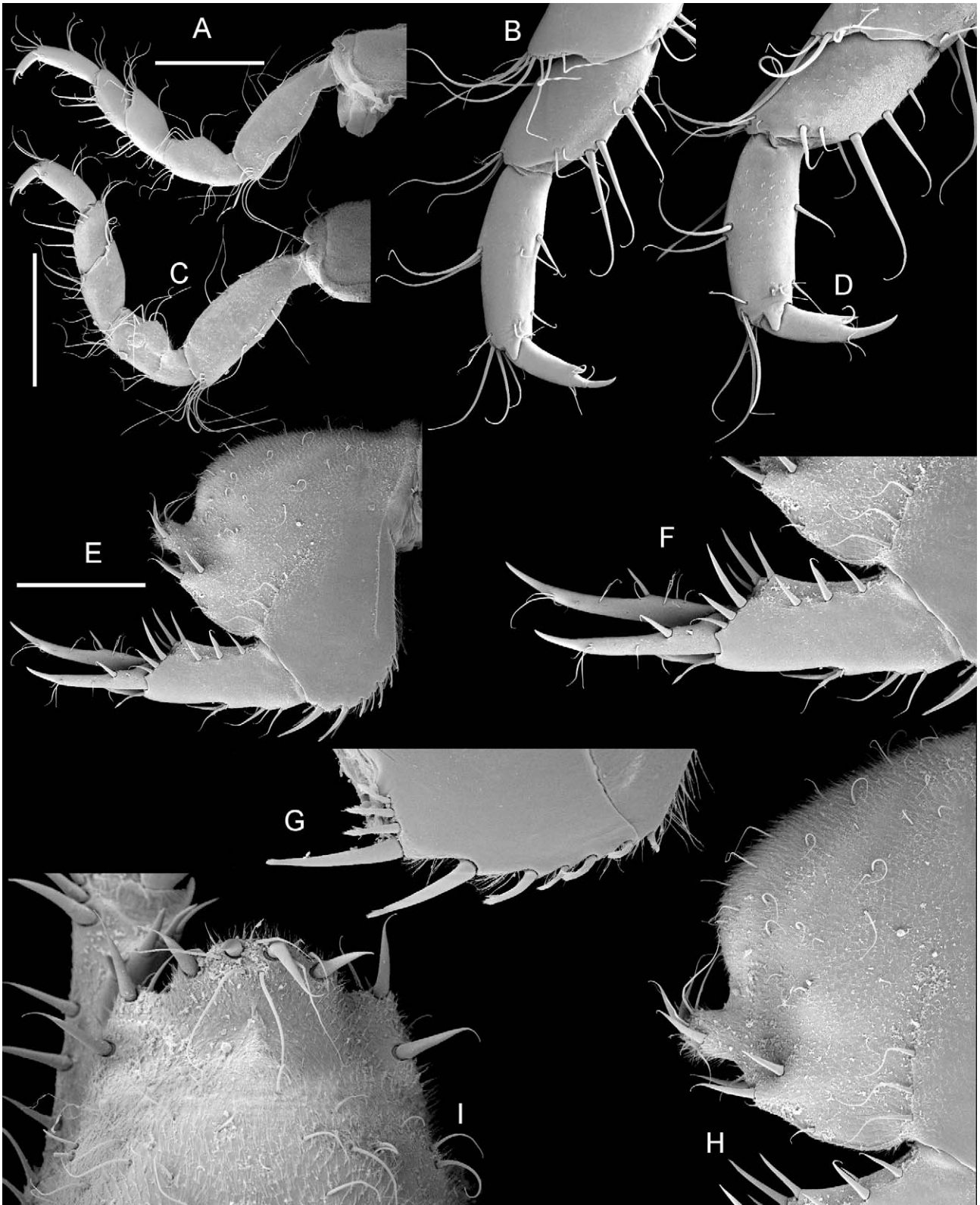
*Pereopod V ratios*, (Fig. 4) male and female, respectively. Length:body length 0.25, 0.24. Dactylus claw length:dactylar length 0.36. Propodus length:pereopod length 0.13–0.16 (male, QVM:10:51200; male, QVM:10:51198), 0.15. Carpus length:pereopod length 0.11–0.16. Basis length:width 1.9–2.2. *Pereopod VI ratios*, male and female, respectively. Length:body length 0.39. Propodus length:pereopod length 0.15, 0.17. Carpus length:pereopod length 0.15, 0.16. *Pereopod VII ratios*, (Fig. 4) male and female, respectively. Length:body length 0.35–0.4 (male, QVM:10:51198; male, QVM:10:51200). Dactylus claw length:dactylar length 0.3. Propodus length:pereopod length 0.15–0.16 (male, QVM:10:51200; male, QVM:10:51198). Carpus length:pereopod length 0.15–0.16 (male, QVM:10:51200; male, QVM:10:51198). Basis length:width 1.8, 2.1.



**FIGURE 7.** *Colubotelson edgarensis* sp. nov. Paratype male (QVM:10:51198), pleopods. A, B, E, F, pleopods I-IV, ventral view, scale bars 0.5 mm. C-D, pleopod II appendix masculina dorsal view with enlargement of distal tip, scale bar 0.2 mm.



**FIGURE 8.** *Colubotelson edgarensis* sp. nov. Paratype female, (QVM:10:51199). A, anterior part of body, lateral view. B, mandibular palp showing distal setae, lateral view. C, mouthfield, anterior view. D, head, dorsal view. E–F, antennula in situ, dorsal view, with enlargement of distal tip. G, pereopod I, dactylus and propodus palm. H, posterior section of hindgut from pleonites 1–2, ventral view, showing indented groove of the typhlosole (**typh**) and 4 pairs of hind gut caecae (**hg caecae**); posterior sections of the midgut caecae (**mg caecae**) shown. Scale bars 1.0 mm.



**FIGURE 9.** *Colubotelson edgarensis* sp. nov. Paratype female, (QVM:10:51199), pereopods (A–D) and pleotelson (E–I). A, C, pereopod II, lateral view. B, D, pereopod IV, lateral view. E, right lateral view. F, uropod, lateral view. G, ventral margin anterior to uropods, medial view, showing posterior group of 3 distally denticulate setae. H–I, posterior margin and apex, lateral and dorsal views. Scale bars 1.0 mm.

*Penes* (Fig. 4). With setae on shaft; distally tubular, tip truncate.

*Pleopods* (Fig. 7). Pleopod I exopod broadest proximally, distal margin rounded, medial margin straight, diver-

gent from lateral margin proximally, dorsal surface lacking setae. Pleopod II in male endopod basal musculature not pronounced; appendix masculina length 0.51 pleopod length, proximal half of shaft solid and rod-like, indented in cross-section, distal tip extending near to distal margin of endopod, broadly rounded, 4 setae on apex with large gap medial to lateral margin setae, lateral margin with 3 setae, medial margin with 2 setae, apex with 4 setae.

**Pleopod Ratios.** (Fig. 7). *Pleopod I*, male and female, respectively. Length:body length 0.11. Exopod length:width 2.5, 2.6. Endopod length:width 3.4, 3.2. Endopod length:exopod length 0.79, 0.83. *Pleopod II*, male and female, respectively. Length:body length 0.15, 0.14. Exopod length:width 3.3, 2.6. Exopod distal article length:exopod length 0.28, 0.27. Endopod length:width 2, 2.3. Endopod length:exopod length 0.49, 0.57. *Pleopod III*, male and female, respectively. Length:body length 0.15, 0.15. Exopod length:width 2.5, 2.2. Exopod distal article length:exopod length 0.28, 0.3. Endopod length:width 2.3, 1.9. Endopod length:exopod length 0.45, 0.51. *Pleopod IV*, male and female, respectively. Length:body length 0.13, 0.14. Exopod length:width 2.2, 2.8. Exopod distal article length:exopod length 0.32, 0.25. Endopod length:width 2, 2.2. Endopod length:exopod length 0.5, 0.44. *Pleopod V*, male and female, respectively. Exopod length:width 2.1. Exopod distal article length:exopod length 0.26. Endopod length:width 2. Endopod length:exopod length 0.5. Exopods I lateral proximal lobe absent, medial proximal lobes absent. Protopods medial margin setose projections present. Protopods epipod III length 1.7 width, epipod V length 1.9 width.

**Uropod** (Fig. 2, 3, 9) Extending posterior to pleotelson apex; dorsomedial ridge produced, forming bump, margin smooth, dorsomedial ridge length:endopod length 0.59, dorsomedial ridge length:endopod length 0.52, setae on margin robust and simple; 3 robust seta (lateral seta thin, half size of central seta), spinose setae present, distoventral margin with 3 robust spinose setae, without robust simple seta; ventral ridge with rows of long laterally projecting setae. Rami distal tips pointed; cross-sectional shape round. Endopod dorsal margin in male with 1 robust seta, placed midlength, in female with 1 robust seta. **Ratios**, male and female, respectively. Uropod Length 1.3, 1.1 pleotelson length. Protopod length:width 3.5, 3.7; length 0.45, 0.46 uropod length. Exopod length 0.72, 0.81 endopod length; dorsal margin with 2, 2 robust setae.

**Distribution.** Found in current Lake Pedder, (Tasmania, Australia), at least at position of old Lake Edgar but probably more widely occurring because it was collected in the original Lake Pedder in 1972 by A. Neboiss.

**Remarks.** The easiest feature to distinguish *Colubotelson edgarensis* **sp. nov.** from its co-occurring congener *C. pedderensis* **sp. nov.** is its more strongly reflexed (in lateral view) and broader (in dorsal view) pleotelson posterior apex or terminal tip, what Nicholls (1944) called the “tailpiece”. The pleotelson dorsal surface just anterior to the posterior apex is concave so that this margin appears to have a posteriorly projecting hump, whereas in *C. pedderensis* **sp. nov.** this margin is roughly linear. A more detailed list of differences is included in the remarks for this latter species. Among other *Colubotelson* species, both species appear to be closely related, as they share several similarities. The pleotelson of both species has a ventral margin anterior to uropods with only distally denticulate robust setae, whereas other species have a mixture of simple setae, robust setae and distally denticulate setae. Both species also share an antennal article 5 shorter than article 4 and an uropodal endopod shorter than protopod, which occurs in other combinations in *Colubotelson* and related genera. Overall both species share 376 similarities out of 794 characters (INTKEY set to match = exact; list available from first author on request).

### ***Colubotelson pedderensis* Wilson, sp. nov.**

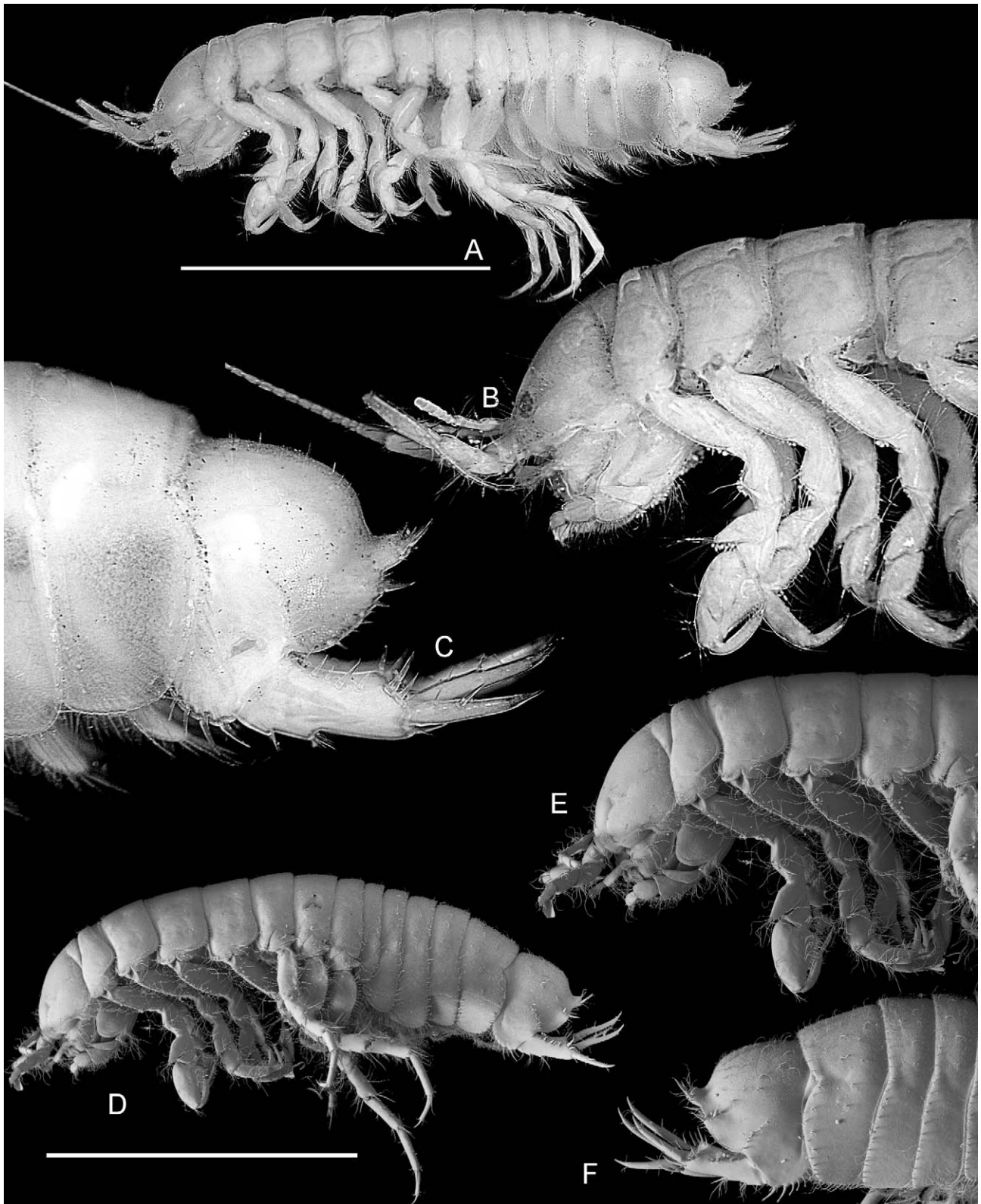
(Fig. 10–18)

**Type material.** Holotype male, here designated, bl 10.0 mm, QVM:10:51201, 43°57.771'S, 146°03.06' E, depth 14.2 m, hand operated dredge, A. Osborn, N. Forteach, 14.ii.2010. Paratypes, same data as for holotype: male, bl 10.2mm, dissected for SEM, QVM:10:51202; male bl 10.1 mm, SEM entire, QVM:10:51204; female, bl 8.7 mm, QVM:10:51203; 3 inds, QVM:10:51205.

**Type locality.** Australia, Tasmania, Lake Pedder.

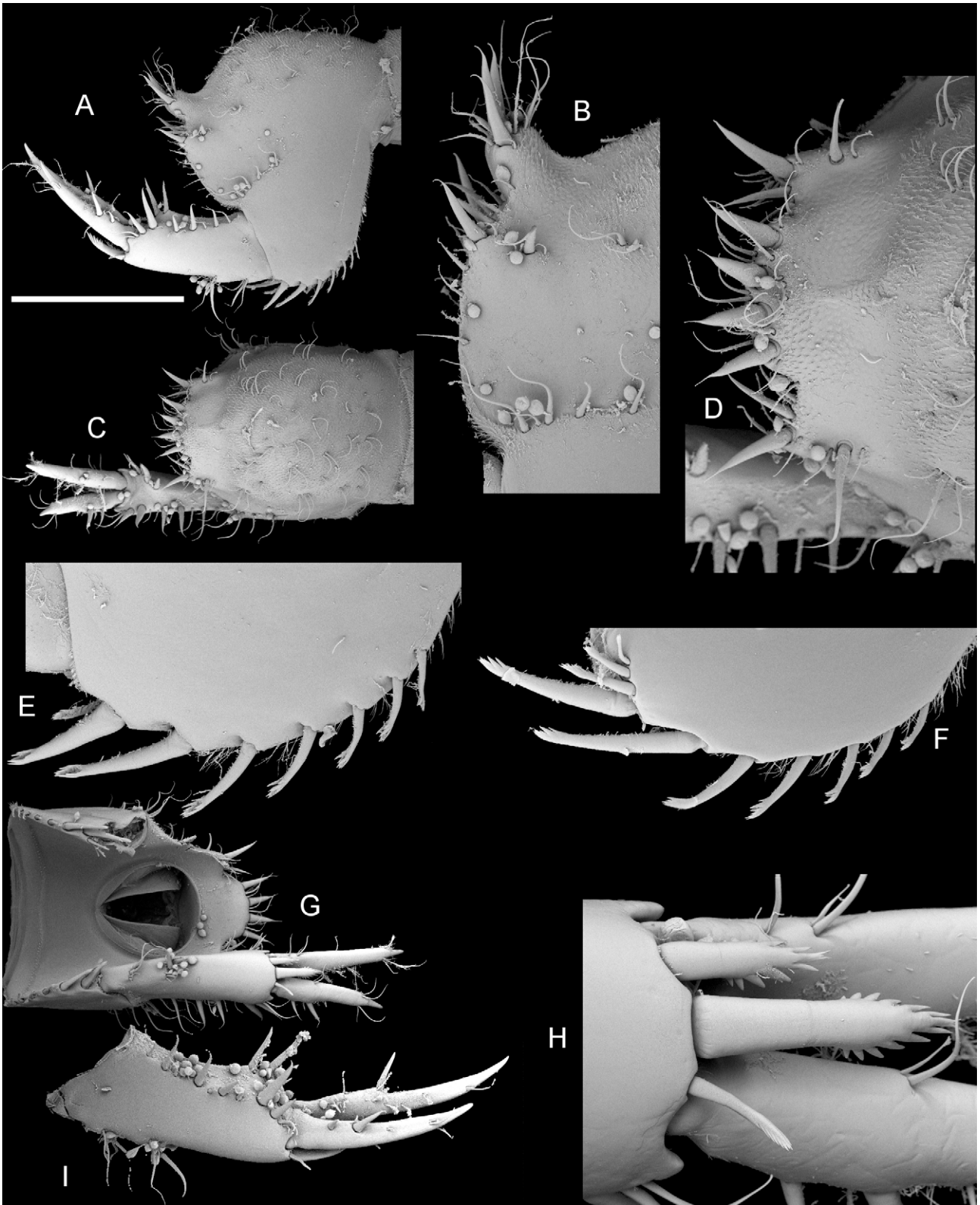
**Diagnosis.** Head lateral margin with fringe of closely-spaced elongate setae. Pleotelson lateral length less than depth; dorsal surface in lateral view proximal to posterior apex without anterior inflection, margin below dorsal inflection linear in lateral view; posterior apex length less than width, forming angle between 91°–106° with adjacent dorsal surface, apex in lateral view weakly narrowing distally, dorsal and ventral surfaces approximately parallel; ventral margin anterior to uropods with one row of distally denticulate robust setae; posterolateral margin dorsal setal position with multiple robust setae, ventrolateral setae subequal to dorsomedial setae. Antenna article 5

shorter than article 4. Mandible molar process left triturating surface ridges directed transversely to mandibular axis, originating distally to dorsal condyle; Pereopod I propodus dorsal margin elongate setae in several groups between proximal and distal margin. Pereopod IV propodus palm in male robust, with ventral projection. Pleopod II appendix masculina distal tip broadly truncate, with 3 stiff straight setae on apex. Uropod protopod ventral margin with 2 transverse rows of simple setae; endopod shorter than protopod.

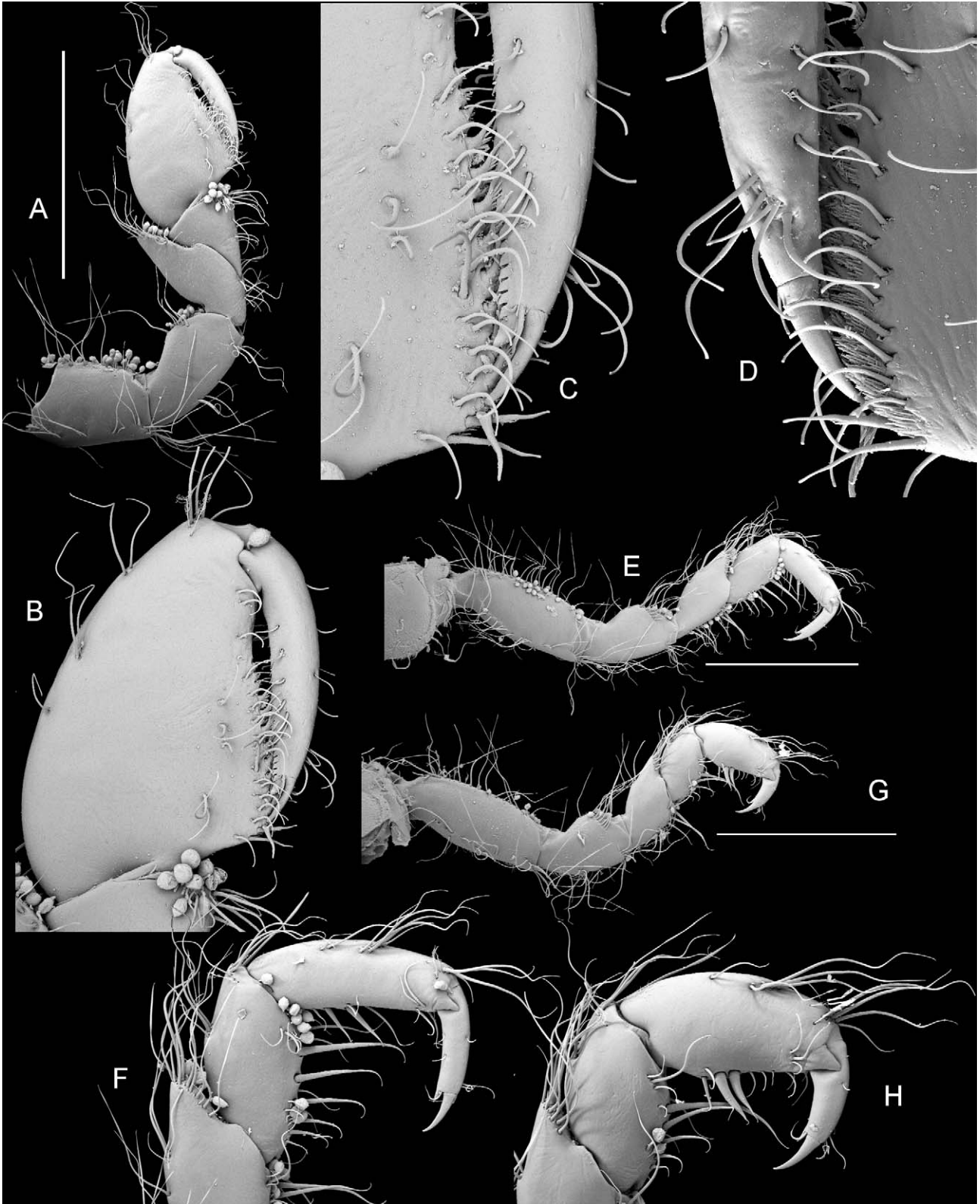


**FIGURE 10.** *Colubotelson pedderensis* sp. nov. Lateral views, with enlargements of anterior and posterior parts of the body. A–C, holotype male (QVM:10:51201). E–F, paratype male (QVM:10:51204). Scale bars 5.0 mm.

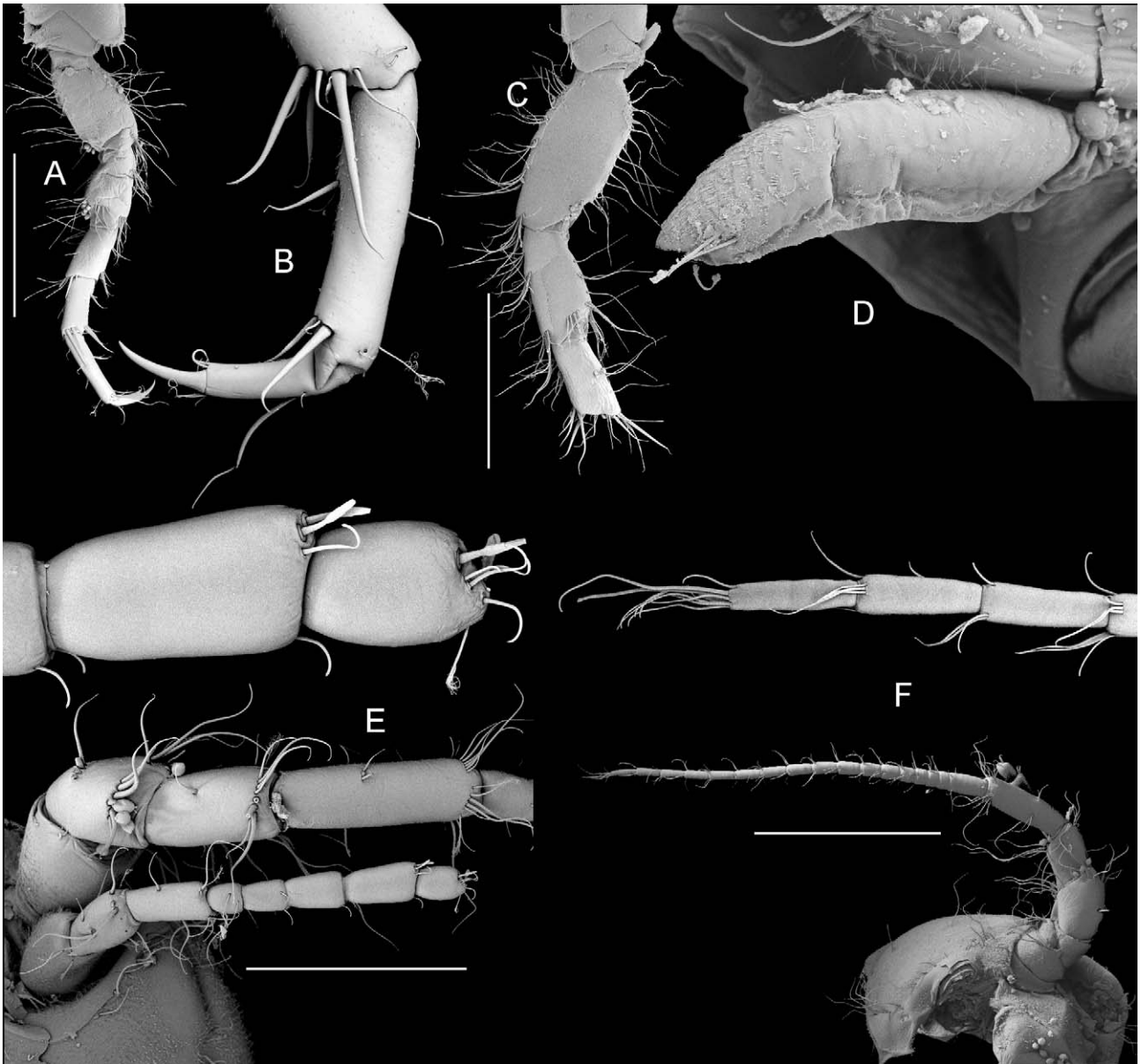




**FIGURE 11.** *Colubotelson pedderensis* sp. nov. Paratype male (QVM:10:51202), pleotelson and uropods. A, right lateral view. B, posterior margin and apex, lateral view. C, dorsal view. D, posterior apex and posterolateral lobes, dorsal view. E, ventral margin anterior to uropods, distally denticulate robust setae. F, medial view of ventral margin, showing group of medial group of small distally denticulate robust setae. G, posterior margin of pleotelson, ventral view. H, distal group of robust setae on ventral margin of uropodal protopod. I, left uropod, lateral view. Small globular objects are epizoic peritrichs. Scale bar 1.0 mm.



**FIGURE 12.** *Colubotelson pedderensis* sp. nov. Paratype male (QVM:10:51202), pereopods. A–D, pereopod I, lateral view, with enlargements of dactylus and palm, and setation of palm, lateral and medial views. E–F, pereopod II, lateral view, with enlargement of dactylus, propodus and carpus. G–H, pereopod IV, lateral view, with enlargement of dactylus, propodus and carpus. Small globular objects are epizoic peritrichs. Scale bars 1.0 mm.



**FIGURE 13.** *Colubotelson pedderensis* sp. nov. Paratype male (QVM:10:51202). A–B, pereopod V, lateral view, with enlargement of dactylus and propodus, medial view. C, pereopod VII, segments distal to merus lost, lateral view. D, penes, posterior view. E, antennula, in situ, with enlargement of distal tip. F, antenna, in situ, with enlargement of distal tip. Scale bars: A, C, F 1.0 mm; D, E 0.5 mm.

**Description.** Body pigmentation brown, irregular white bars laterally extending along pereonites.

**Head** (Fig. 10, 17). Length shorter than width in dorsal view; lateral profile of dorsal surface smoothly curved; width 0.8 pereonite 1 width; surface smooth; setae scattered, fine. Eyes fully sessile; maximum diameter 0.2 head depth (female, QVM:10:51203); dorsal margin convex, ventral margin straight; orientation of longest axis vertical; ocelli distinguishable as individual units, pigmentation dark. Cervical groove straight, extending nearly to dorsal margin of head. Mandibular (genal or cheek) groove smoothly indented. Mandibular notch present. Clypeal notch present. Antennal notch shallow, without posterior extension.

**Pereon** (Fig. 10). Width near head width; surface smooth; setae on dorsal surface absent. Pereonite 1 in dorsal view wider than medial length, 0.3 (H). Pereonites 2–7 in dorsal view wider than long, Length: width, respectively: 0.42, 0.37, 0.41, 0.4, 0.38, 0.26. Coxal articulation to pereonites 2–4 nearly fused, 5–7 free.

**Pleonites** (Fig. 10). In lateral view much deeper than pereonites, with large pleurae, basal region of pleopods not visible; pleonite 1 pleura distinctly shallower than pleurae of pleonites 2–5. In dorsal view pleonite 2 length less than 0.5 pleonite 5 length, 3–4 respective lengths more than 0.5 pleonite 5 length, 1–4 relative lengths unequal,

increasing in length from anterior to posterior, 1–4 width 0.93 composite length in dorsal view; length:pleon length ratios 0.22. 0.23. 0.33. 0.34. 0.53, respectively. Pleonites 1–5 depth ratio with pereonite 7 depth, respectively: 1.3; 1.6; 1.7; 1.7; 1.5. Typhlosole minimal, ventral invagination forming laminar projection in cross-section; hindgut caecae present (4 pairs in pleonites 1–2).

*Pleotelson* (Fig. 10, 11, 18). Dorsal surface in lateral view inflected ventrally, sparsely covered with short setae, length 1–1.3 width (H; male, QVM:10:51202), lateral length 0.13–0.14 body length (male, QVM:10:51202), 0.82–0.83 depth (male, QVM:10:51202), depth 1.2–1.4 pereonite 7 depth (female, QVM:10:51203; H). Ventral surface anterior to uropods lateral margin convex, margin anterior to uropods length subequal to width of uropodal insertion. Ventral margin anterior to uropods 1.7 width of uropodal insertion (male, QVM:10:51202; female, QVM:10:51203), with one row of distally denticulate robust setae, including 7 robust setae altogether (with medial row of 3 half size distally denticulate setae at posterior end), robust setae on medial side medial to main row distally denticulate, 3 altogether, posterior seta longer than anterior adjacent setae. Postanal ventral surface unelaborated, lateral uropodal ridge present, terminating at pleotelson margin above uropods, with 4–7 fine setae (male, QVM:10:51202; female, QVM:10:51203). Posterolateral margin forming rounded lobe, curving dorsally; medial length 0.13–0.14 pleotelson length (male, QVM:10:51202; female, QVM:10:51203), with one position defined by major robust setae; dorsal setal position with multiple robust setae, ventrolateral setae subequal to dorsomedial setae (2 robust setae); dorsal setal position with 2 setae; with robust seta on dorsolateral surface adjacent to margin. Posterior apex projecting in dorsal view, visible in lateral view, length less than width, 0.16 pleotelson length, width 0.39–0.44 pleotelson width (female, QVM:10:51203; male, QVM:10:51202); forming angle of 91–106° with immediately anterior dorsal surface (female, QVM:10:51203; male, QVM:10:51202), angled 14–23° from horizontal (male, QVM:10:51202; female, QVM:10:51203); with two pairs of robust setae, with numerous fine setae above and below robust setae.

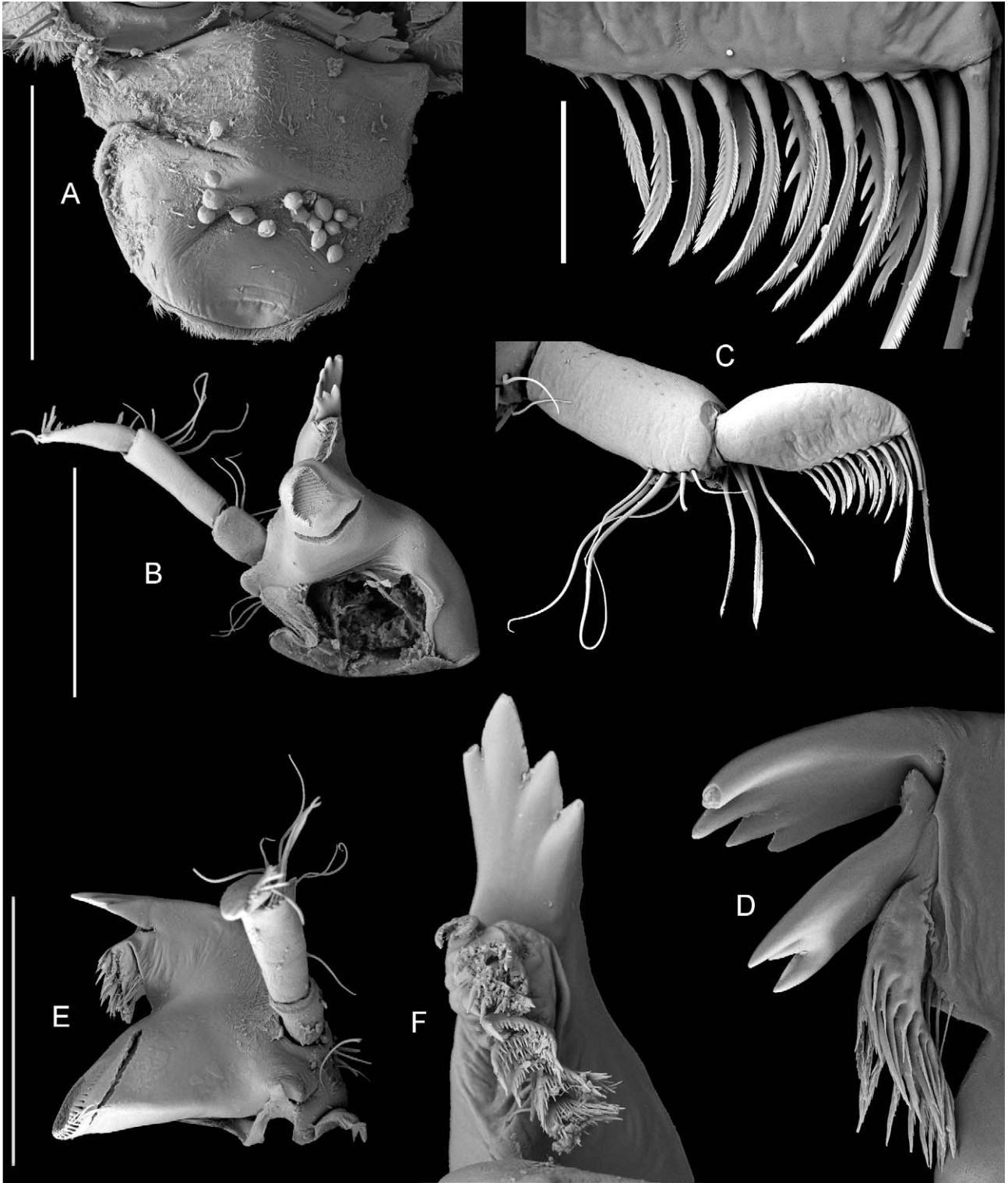
*Antennula* (Fig. 13, 17), male and female, respectively (male, QVM:10:51202; female, QVM:10:51203). Length 0.11, 0.12 body length, with 8, 7 articles. Article 5 length:width 1.5–2.1. Article 6 length:width 1.6, 1.7. Aesthetascs (1–2) small occurring on anterior end of distal articles. Terminal article globular, length 1.5–2.1 width, length 0.1–0.14 antennula length. Penultimate article length not greater than other articles; moderately inflated, width greater than ante-penultimate article. Distal articles in cross-section flattened oval.

*Antenna* (Fig. 13, 17), male and female, respectively (male, QVM:10:51202; female, QVM:10:51203). Length 0.33, 0.36 body length. Article 5 shorter than article 4. Flagellum length 0.60, 0.61 antenna length, with 17, 20 articles.

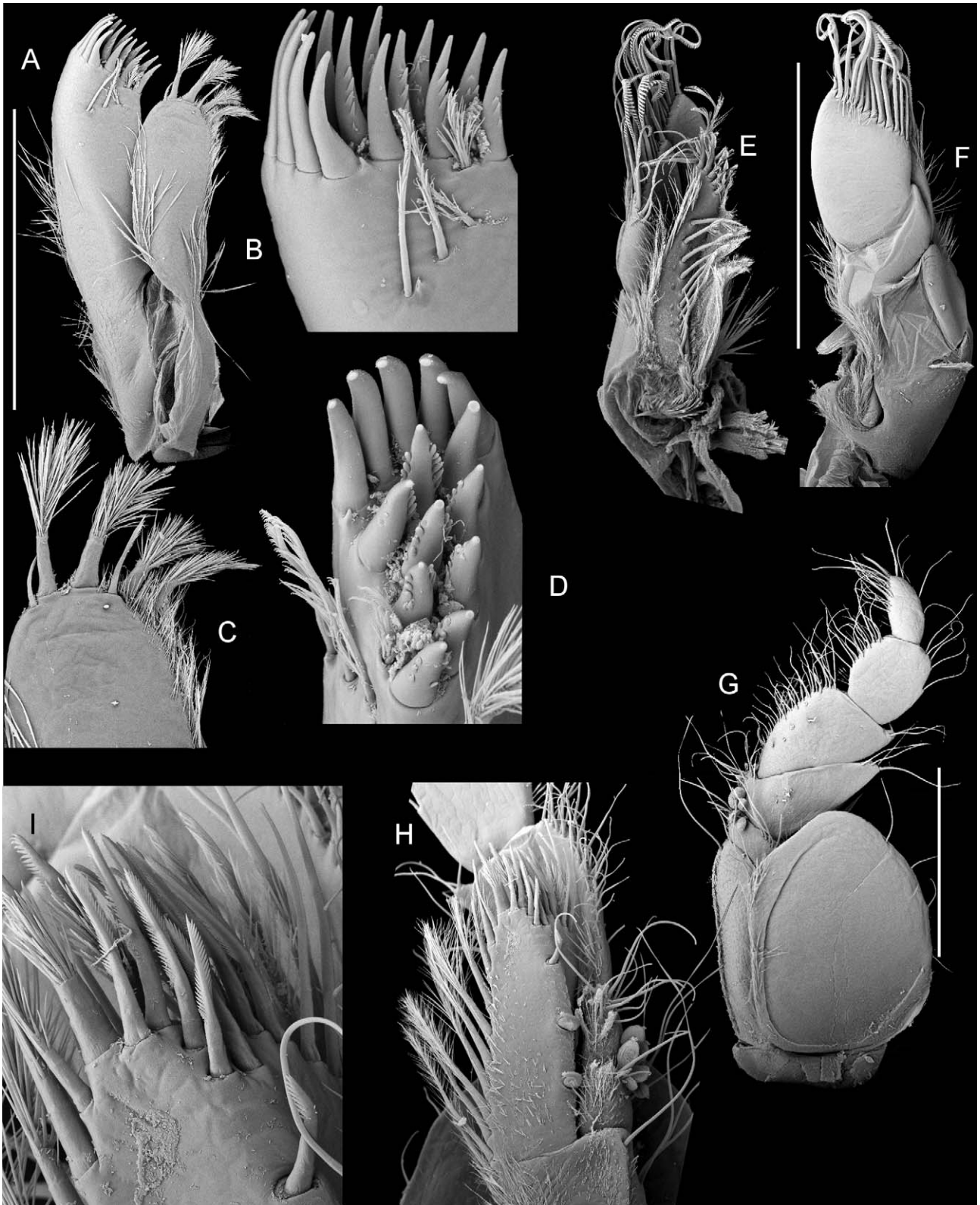
*Mouthfield* (Fig. 14, 17). Clypeus consisting of broad median bar, angular at mandibular fossae, width 0.52 head width; labrum ventrally semicircular, left half with slight depression at midpoint. Paragnaths with distally rounded lobes.

*Mandible* (Fig. 14, 17). Palp length 0.75 mandible length; article 3 setae with more than 5 setae on medial-distal margins, with 16 setae, coarsely spinulate setae in second row behind marginal row, on margin finely spinulate, medial surface additional setae absent, medial surface naked, surface lacking cuticular hairs, cuticular combs absent; article 2 longitudinal row of setae present, separate distal group of setae present; articles 1–2 group of long setae at distal end of dorsolateral margin. Left incisor process with 2 distal and 2 dorsal cusps. Right lacinia mobilis indistinctly separated from remainder of spine row but with bifurcate plate on side distal to spine row. Spine rows on linear pedunculate projection between incisor and molar, distal margin in line with proximal margin in ventral view, basal insertions in line between incisor and molar processes. Left spine row with 12 spines, 8 of which bifurcate, count includes 4 on margin between pedunculate projection and molar. Right spine row with 13 spines, 8 of which bifurcate, count includes 5 on margin between pedunculate projection and molar. Molar process left dorso-posterior margin with spines adjacent to triturating ridges, short fine spines forming dorsal row. Right molar process longer than wide, row of complex spines adjacent to triturating ridges absent, dorsal side ciliated spine row present, dorsal surface ciliated spine row 2 members altogether, dorsal surface cuticular hairs sparse.

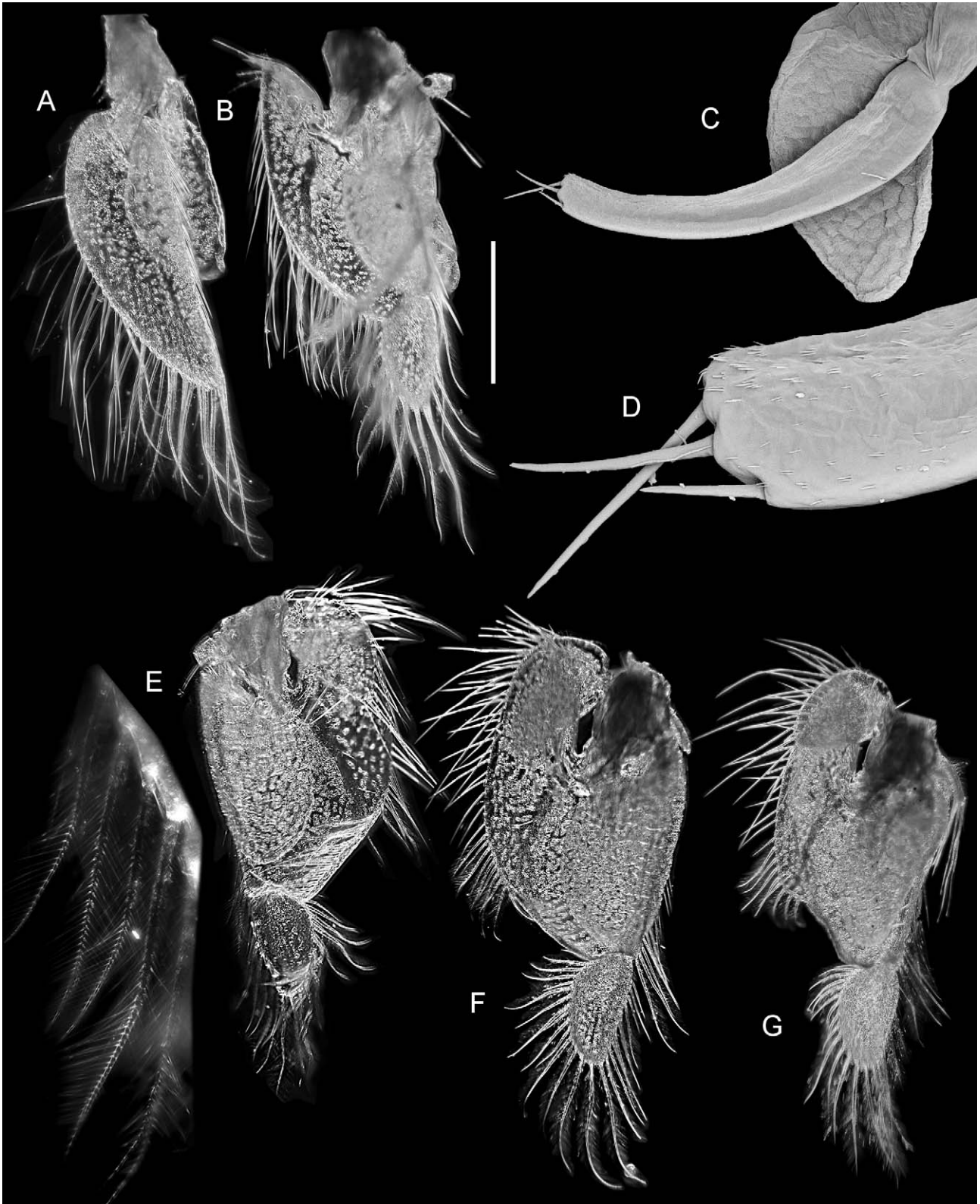
*Maxillula* (Fig. 15). Medial lobe length 0.58 lateral lobe length, width less than lateral lobe, 0.92 lateral lobe width; with 4 pappose setae; with 2 accessory setae, distally denticulate accessory setae, one on distolateral margin and one between central pappose setae; short weakly setulate seta on distal tip absent. Lateral lobe distal margin with 8 denticulate robust setae, with 6 smooth robust setae, distal setal row with 5 robust setae; ventral face with 2–3 plumose setae, ventral face with no simple setae, additional plumose seta among proximal distal robust setae.



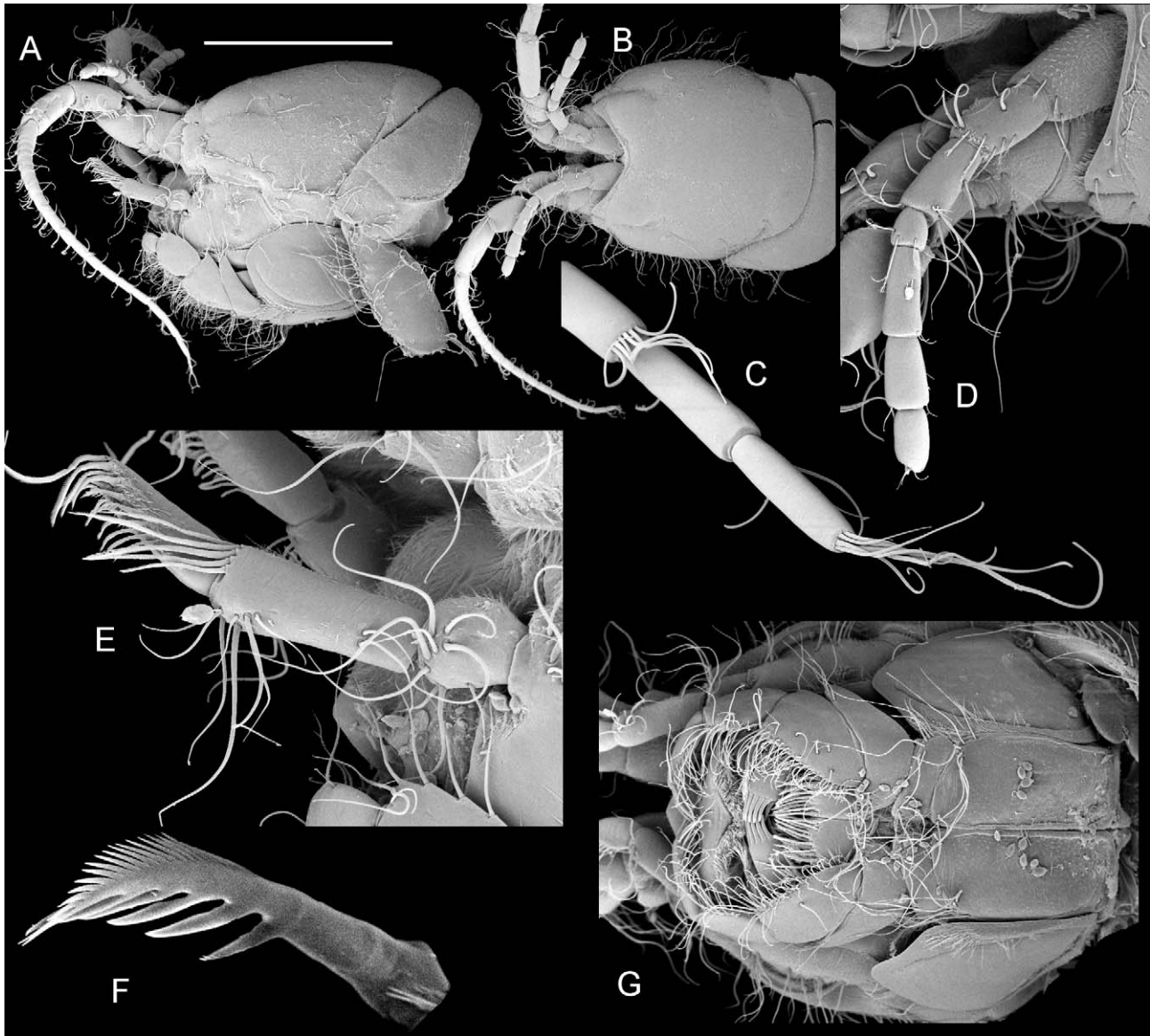
**FIGURE 14.** *Colubotelson pedderensis* sp. nov. Paratype male (QVM:10:51202), anterior mouthparts. A, labrum, anterior view, small globular objects are epizoic peritrichs. Scale bar 1 mm. B–D, left mandible medial view, palp distal articles with enlargement of setae (scale bar 0.05 mm), and ventral view of distal gnathal margin. E–F, right mandible, dorsal view and medial view of incisor and spine row. A, B, E scale bars 0.5 mm.



**FIGURE 15.** *Colubotelson pedderensis* sp. nov. Paratype male (QVM:10:51202), mouthparts. A–D, maxillula: ventral view, enlargement of lateral and medial lobe, lateral lobe, medial view. E–F, maxilla: medial and ventral views. G–I, maxilliped: ventral view, medial view of endite, enlargement of endite distal tip setae. Scale bars 0.5 mm.



**FIGURE 16.** *Colubotelson pedderensis* sp. nov. Paratype male (QVM:10:51202), pleopods, light micrographs in ventral view: A, I; B–D, II with SEM enlargements of appendix masculina and distal tip; E, III with enlargement of setae on exopod distal article; F–G, IV–V. Scale bar 1.0 mm.

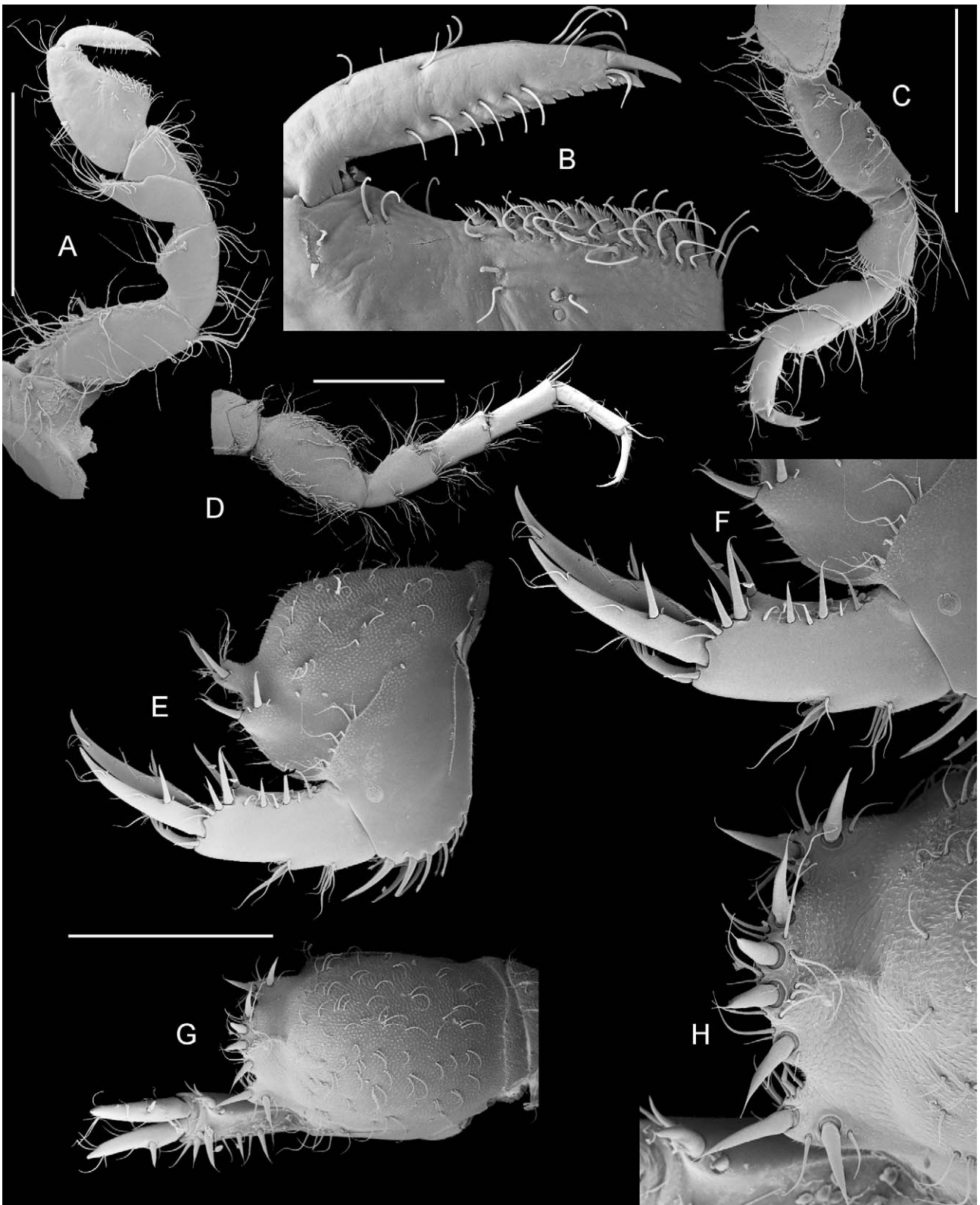


**FIGURE 17.** *Colubotelson pedderensis* sp. nov. Paratype female (QVM:10:51203), head. A, lateral view. B, dorsal view. C–D, antenna with enlargement of distal tip. E–F, mandibular palp with enlargement of denticulate seta on palp article 3. G, ventral view. Scale bar 1 mm.

*Maxilla* (Fig. 15). Medial lobe proximal portion smoothly continuous with distal portion; proximal and distal setal rows continuous, setae in ventral basal rows with single row of fine setules, setae in dorsal basal row plumose setae with smooth long shaft, setae in distal row 5 robust setae with setules at mid lower shaft and row of teeth (12–16) at distal tip. Outer lateral lobe length subequal to inner lateral lobe, wider than inner lateral lobe, distal margin setal row approximately linear and diagonal to lobe axis, with 14 long bidenticulate setae; inner lateral lobe with 10; lateral lobes with bidenticulate setae on distal tips and on medial margin (half of medial margin).

*Maxilliped* (Fig. 15). Epipod length:width 1.3–1.4. Endite length:basis length 0.45, distal tip rounded, medial margin with 3 coupling hooks on right side, 2 coupling hooks on left side, endite with setulate setae, in fringe; fine cuticular combs present, combs scattered in lateral groups of 2–4 combs, groups at approximately equal distance, shorter towards distal end; ventral surface setae present, short, in medially placed longitudinal rows; distal tip with 9 subdistal biserrate setae on ventral surface; dorsal ridge with 12 large distally denticulate plumose setae. Palp insertion on basis without lateral margin plumose setae, with medial margin plumose setae, with 1 simple seta, ventral surface with 3 subdistal smooth setae, without ventral surface subdistal biserrate setae; length:basis length 1; width across articles 2–3:endite width 2.2; article 4 length:width 1.1–1.3, article 4 shape elongate-oval; article 5 length:width 3.3, article 5 length:article 4 length 1.





**FIGURE 18.** *Colubotelson pedderensis* **sp. nov.** Paratype female (QVM:10:51203). A–B, pereopod I, with enlargement of palm. C, pereopod II, lateral view. D, pereopod VII, lateral view. E–H, pleotelson: lateral view, uropod, dorsal view, posterior margin. Scale bars 1 mm.

*Pereopod I* (Fig. 12), male and female, respectively. Length:body length 0.28, 0.35. Dactylus length subequal to palm, length:palm length 0.96; lateral surface with row of fine setae along axis; ventrodistal margin with row of thin scale-like spines, along 0.42, 0.47 length; claw length:dactylus length 0.19, 0.20, without distal accessory claws; with 1 distal accessory spine, occurring ventrally, 0.42 claw length. Propodus length:pereopod length 0.3, 0.21, length:width 1.4, 1.3; dorsal margin setae in several groups between proximal and distal margin, dorsal

margin 5 setae altogether (excluding distal group); dorsal margin proximal region not protruding. Propodal palm in male convex; without simple spines; medial cuticular fringe well developed; stout denticulate setae serrate, 11 altogether; without stout robust simple setae; setal ridge absent. Propodal palm in female convex; simple spines absent; stout denticulate setae present, serrate, 10 altogether; stout robust simple setae absent; setal ridge absent. Merus distodorsal margin with numerous elongate simple setae. Ischium dorsal margin present, with 5, 9 simple setae, none robust. Basis length:width 1.4, 1.9; dorsal setae in male positioned along ridge, 7 altogether, in female positioned along ridge, 17 altogether; ventrodorsal margin with 9 elongate setae in male, 9 elongate setae in female, setae longer than ischium.

*Pereopods II–III* (Fig.12, 18). Penicillate setae scattered on dorsal ridge. Dactylus with 1 distal accessory spine, ventral to primary claw, length 0.25 primary claw length, without spines on ventral margin. Propodus articular plate present; ventral margin with 4, 2 broad based setae, pereopod II setal length in male ranging 0.14–0.28 propodus length (shortest, longest), 3 proximally, approximately equally spaced, 1 distally, in female 0.21–0.29 propodus, both setae near mid margin. Carpus ventral margin with 6, 5 broad-based setae, pereopod II setal length ranging 0.19–0.74, 0.30–0.59 carpus length. Basis II dorsal ridge in cross-section angular but not forming distinct plate, with 24 simple elongate setae in row along ridge, 3 simple elongate setae forming separate adjacent row at adjacent end. Pereopod II–IV basis lateral face ridge absent; ischium dorsal margin with 11 simple setae, ischium dorsal margin including 1 robust.

*Pereopod II ratios* (Fig.12, 18), male and female, respectively. Length:body length 0.33, 0.36. Dactylus length:propodus length 0.76, 0.74; primary claw length:dactylar length 0.32, 0.32. Propodus length:pereopod length 0.16, 0.15; length:width 3, 2.7. Carpus length:pereopod length 0.11, 0.11; length:width 1.5, 1.4. Basis length:pereopod length 0.26, 0.29; length:width 2.2, 2.3. *Pereopod III ratios*, male and female, respectively. Length:body length 0.3, 0.29. Dactylus length:propodus length 0.67. Propodus length:pereopod length 0.16; length:width 3. Carpus length:pereopod length 0.11; length:width 1.3. Basis length:pereopod length 0.31; length:width 2.2.

*Pereopod IV* (Fig. 12). In male, subchelate with major hinges on dactylus and propodus. Penicillate setae present in both sexes, in male occurring on dorsal margin of basis and posterolateral surface of propodus, near distal end. Basis dorsal ridge in cross-section angular, not forming distinct plate, with 24 setae, 18 in female. Ischium dorsal margin with 5-10 setae. Carpus ventral margin in male with 5 broad based setae, 3 distinctly larger than others; in female with 3 broad based setae. Propodus articular plate on posterior side of limb shorter than dactylar claw; in male distal width:palm width 0.63, with 3 broad based setae on ventral margin, 2 distinctly larger than remainder, in female with 1 broad based seta on ventral margin. Dactylus in male shorter than propodal palm; ventral claw length approximately 0.25 primary claw length. *Pereopod IV ratios*, male, female respectively. Length:body length 0.28, 0.31. Basis length:width 2.4, 2.4. Propodus length:pereopod length 0.17, 0.15. Propodus length:width 1.7, 2.5. Carpus length:pereopod length 0.12, 0.11.

*Pereopods V–VII* (Fig. 10, 13, 18). Penicillate setae on dorsal ridge of basis, or dorsodistally on propodus. Dactylus accessory claw ventral to primary claw absent (spine not claw). Propodus articular plate on posterior side of limb present; distal margins with 2 elongate robust setae (Pereopod V). Ischium dorsal margin with 7–12 simple setae (pereopod V, VII, 12 including setae in rows on lateral surfaces immediately adjacent to dorsal margin), including 1 robust seta. Basis dorsal ridge in cross-section, not distinctly separated from basis shaft, with elongate fine setae, positioned along entire margin; lateral face central ridge absent; ventral ridge absent.

*Pereopod V ratios* (Fig. 13), male and female, respectively. Length:body length 0.28, 0.33. Dactylus claw length:dactylar length 0.43. Propodus length:pereopod length 0.17, 0.16. Carpus length:pereopod length 0.12, 0.14. Basis length:width 1.9, 2.1. *Pereopod VI ratios*, male and female, respectively. Length:body length 0.43. Propodus length:pereopod length 0.16. Carpus length:pereopod length 0.16. *Pereopod VII ratios*, (Fig. 13, 18) male and female, respectively. Length:body length 0.39, 0.44. Dactylus claw length:dactylar length 0.4. Propodus length:pereopod length 0.16. Carpus length:pereopod length 0.16. Basis length:width 2.2, 2.0.

*Penes* (Fig. 13). With cuticular hairs on shaft; distally tubular; tip truncate.

*Pleopods* (Fig. 16). Exopods I lateral proximal lobe absent, medial proximal lobes absent. Protopods medial margin setose projections present. Pleopod I exopod broadest proximally, distal margin rounded, medial margin straight, divergent from lateral margin proximally, dorsal surface lacking setae; protopod longer than wide (ratio 1.3). Pleopod II in male endopod basal musculature not pronounced; appendix masculina length 0.52 pleopod length, proximal half of shaft solid and rod-like, indented in cross-section, distal tip extending near to distal margin of endopod, truncate, 1 seta on margin near proximal end, lateral margin with 1 seta, apex with 4 setae.

*Pleopod ratios* (Fig. 16), in male only. Pleopod I exopod length:width 2.5; endopod length:width 2.1; endopod length:exopod length 0.73. Pleopod II length:body length 0.13; exopod length:width 2.1, distal article length:exopod length 0.31; endopod length:width 1.8, length:exopod length 0.48. Pleopod III length:body length 0.13; length 1.7 width; exopod length:width 2.1, distal article length:exopod length 0.28; endopod length:width 2.1, length:exopod length 0.48. Pleopod IV length:body length 0.13; exopod length:width 1.9, distal article length:exopod length 0.29, length:width 2.1; endopod length:exopod length 0.59. Pleopod V length:body length 0.11; epipod V length:width 1.5; exopod length:width 1.8, distal article length:exopod length 0.31; endopod length:width 2.1, length:exopod length 0.56.

*Uropod* (Fig. 10, 11, 18). Extending posterior to pleotelson apex; dorsomedial ridge produced, forming bump, margin smooth, setae on margin robust and simple, 3 robust seta (lateral seta thin, half size of central seta); dis-toventral margin with 3 robust spinose setae, without robust simple seta; ventral ridge with rows of long laterally projecting setae. Rami distal tips pointed; cross-sectional shape round. Endopod dorsal margin in male with 1 robust seta, placed midlength; in female with 1 robust seta. *Uropod ratios*, male and female, respectively. Length 1.2, 1.2 pleotelson length. Protopod length:width 2.7, 3.2; length 0.46, 0.46 uropod length, dorsomedial ridge length:endopod length 0.54, 0.50. Exopod length 0.84, 0.85 endopod length; dorsal margin with 2, 1 robust seta.

**Distribution.** Found in current Lake Pedder, (Tasmania, Australia), at the position of its previous pre-inundation extent.

**Remarks.** *Colubotelson pedderensis* sp. nov. can be distinguished from *C. edgarensis* sp. nov. by the following features, with the latter species indicated in parentheses and order of value for identification. The pleotelson posterodorsal margin in lateral view is linear (concave), posterior apex is weakly narrowing distally (broadening, with a proximal constriction), forming an angle subequal or greater than 90°, range 91°–106° (less than 90°, range 73°–83°). The lateral margin of the head has a fringe of closely-spaced elongate setae (only a few short setae). Pereopod IV propodus palm of the male is robust, with a weak inflection at the position of the robust setae (palm not robust, smoothly concave); in other species of *Colubotelson*, the male propodal palm is even more robust with a larger inflection and larger setae. The uropodal protopod ventral margin has 2 transverse rows of simple setae (3 rows). The male pleopod II appendix masculina has a truncate distal tip, with 3 stiff straight setae on apex (rounded, with 4 setae). The DELTA database includes 182 characters that differ (list available from first author), although many differences are small, and undoubtedly not significant.

## Discussion

**Diversity of Phreatoicidae in Tasmania.** These two species bring the known Tasmanian diversity of family Phreatoicidae to 26 described species, including 16 in the genus *Colubotelson* (Table 1). We are aware of at least 5 other undescribed species, including 2 possibly genus-level taxa, one of which is in the Lake Pedder collections loaned by the Victorian Museum. The Great Lake of Tasmania has a surprising number of species (Nicholls 1944), including all known *Mesacanthotelson* Nicholls, 1944 (4 species), *Uramphisopus* Nicholls, 1943 (1 species) and *Onchotelson* Nicholls, 1944 (2 species), plus 3 nominal species of *Colubotelson*. Owing to many unsurveyed areas in Tasmania, total diversity of this family is likely to be much higher. Phreatoicidians in other geographic regions show extremely small range endemism (e.g., Wilson *et al.* 2009), so the number of phreatoicid species could be at least an order of magnitude more than currently known.

**Conservation status of the Lake Pedder endemic benthic fauna.** Our research has recovered both species of isopods known prior to inundation in 1972 (Forteath & Osborn 2012). Although the hydrography of the lake is substantially changed from its original form, at least one of the species, *C. edgarensis* sp. nov., was present in large numbers in the sample obtained. We are uncertain whether the other species, *C. pedderensis* sp. nov. is rare or not owing to insufficient data. Clearly more sampling should be conducted to establish a better understanding of the distribution of these species. For example, whether the previously constrained populations have spread throughout the new lake bottom is currently unknown. From our findings, we infer that these isopods and perhaps other members of the endemic fauna may be relatively resilient to changes in the lacustrine hydrography. Tasmanian lakes must have changed considerably since the last glacial maximum (Macphail 1979), so the artificial flooding of Lake Pedder may have mimicked prehistoric natural changes. We, however, have no information about how the specific habitats and their populations may have changed. These isopods at least have survived recent anthropogenic changes to their habitat.

**TABLE 1.** Described species of Phreatoicidae from Tasmania.

Species	Locality
<i>Colubotelson campestris</i> Nicholls, 1944	Hobart coastal, Univ. Tasmania campus
<i>Colubotelson chiltoni</i> (Sheppard, 1927)	Great Lake, Shannon Lagoon
<i>Colubotelson dubius</i> Nicholls, 1944	Todds Corner, Great Lake
<i>Colubotelson edgarensis</i> <b>sp. nov.</b>	Lake Pedder
<i>Colubotelson evansi</i> Nicholls, 1944	Waratah, West Tasmania
<i>Colubotelson flynni</i> Nicholls, 1944	Eaglehawk Neck, East Tasmania
<i>Colubotelson fontinalis</i> Nicholls, 1944	Lemana Junction, coastal North Tasmania
<i>Colubotelson gesmithi</i> Nicholls, 1944	Mt. Field
<i>Colubotelson huonensis</i> Nicholls, 1944	Near sea level at Port Huon
<i>Colubotelson intermedius</i> Nicholls, 1944	Great Lake, Shannon Lagoon
<i>Colubotelson minor</i> Nicholls, 1944	Pine Lake, North of Great Lake
<i>Colubotelson pedderensis</i> <b>sp. nov.</b>	Lake Pedder
<i>Colubotelson saycei</i> Nicholls, 1944	Lake Petrarch
<i>Colubotelson setiferus</i> Nicholls, 1944	Scottsdale, northeast Tasmania
<i>Colubotelson tattersalli</i> (Sheppard, 1927)	Todds Corner, Great Lake
<i>Colubotelson thomsoni</i> Nicholls, 1944	Mt. Wellington
<i>Mesacanthotelson decipiens</i> Nicholls, 1944	Great Lake
<i>Mesacanthotelson fallax</i> Nicholls, 1944	Great Lake
<i>Mesacanthotelson setosus</i> Nicholls, 1944	Great Lake
<i>Mesacanthotelson tasmaniae</i> (Thomson, 1894)	Great Lake
<i>Metaphreatoicus affinis</i> Nicholls, 1944	Wombat Moor, South-central Tasmania
<i>Metaphreatoicus magistri</i> Nicholls, 1944	Adventure Bay, Bruny Island
<i>Onchotelson brevicaudatus</i> (Smith, 1909)	Great Lake
<i>Onchotelson spatulatus</i> Nicholls, 1944	Great Lake
<i>Paraphreatoicus relictus</i> Nicholls, 1944	Stringy-bark Creek at Woodbury
<i>Uramphisopus pearsoni</i> Nicholls, 1943	Great Lake

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## Literature cited

- Ball, I.R. (1974) A new genus of freshwater triclad from Tasmania, with reviews of the related genera *Cura* and *Neppia* (Turbellaria, Tricladida). *Life Science Contributions, (Royal Ontario Museum)*, 99, 1–48.
- Bayly, I.A.E. (1973) The sand fauna of Lake Pedder: a unique example of colonization by the Phreatoicoidea (Crustacea: Isopoda). *Australian Journal of Marine and Freshwater Research*, 24, 303–306.
- Bayly, I.A.E., Lake, P.S., Swain, R. & Tyler, P.A. (1972) Lake Pedder: its importance to biological science. In: *Pedder Papers, Anatomy of a Decision*. Australian Conservation Foundation, pp. 41–49.
- Brinkhurst, R.O. (1971) Family Tubificidae. In: Brinkhurst, R. O. & Jamieson, B. G. M. (Eds) *Aquatic Oligochaeta of the world*. Toronto, Buffalo: University of Toronto Press, pp. 444–625.
- Dallwitz, M.J. (1980) A general system for coding taxonomic descriptions. *Taxon*, 29, 41–46.
- Dallwitz, M.J., Paine, T.A. & Zurcher, E.J. (2000a) User's guide to the DELTA editor. Available from <http://delta-intkey.com>
- Dallwitz, M.J., Paine, T.A. & Zurcher, E.J. (2000b) User's guide to the DELTA system: a general system for processing taxonomic descriptions. Edition 4.12, December 2000. CSIRO, Canberra, 158 pp.
- Felton, H. (2008) *Ticklebelly tales and other stories from the people of the Hydro*. Hydro Tasmania, Hobart, 511 pp.
- Forteach, G.N. R. & Osborn, A.W. (2012) Survival of endemic invertebrates of Lake Pedder and Lake Edgar subsequent to inundation. *Records of the Queen Victoria Museum*, no. 116, 1–26.
- Frankenberg, R. (1968) Two new species of galaxiid fishes from the Lake Pedder region of southern Tasmania. *Australian Zoology*, 14, 268–274.
- Knott, B. & Lake, P.S. (1974) A brief survey of the macro-invertebrate fauna of Lake Edgar and its immediate environs (South West Tasmania). *Tasmanian Naturalist*, 36, 1–19.
- Knowles, J.N. (1974) A revision of Australian species of *Agraptocorixa* Kirkaldy and *Diaprepocoris* Kirkaldy (Heteroptera: Corixidae). *Australian Journal of Marine and Freshwater Research*, 25(1), 173–191
- Lake, P.S. (2001) The fauna of Lake Pedder – changes after the flooding and thoughts on restoration. In: C. Sharples (Ed), *Lake Pedder: Values and Restoration*. Centre for Environmental Studies, University of Tasmania, Hobart, pp. 87–98.
- Macphail, M.K. (1979) Vegetation and climates in southern Tasmania since the last glaciation, *Quaternary Research* 11(3), 306–341.
- Neboiss, A. (1977) A taxonomic and zoogeographic study of Tasmanian caddis-flies (Insecta: Trichoptera). *Memoirs of the National Museum of Victoria*, 38, 1–208.
- Nicholls, G.E. (1943) The Phreatoicoidea Part I. The Amphisopidae. *Papers and Proceedings of the Royal Society of Tasmania* 1942, 1–145.
- Nicholls, G.E. (1944) The Phreatoicoidea Part II. The Phreatoicidae *Papers and Proceedings of the Royal Society of Tasmania* 1943, 1–156.
- Poore, G.C.B., Knott, B., Lew Ton, H.M. & Wilson, G.D.F. (2002) Suborder Phreatoicoidea Stebbing, 1893. In: Poore, G. C. B. & Beesley, P. L. (Eds), *Crustacea: Malacostraca: Syncarida, Peracarida: Isopoda, Tanaidacea, Mictacea, Thermosbaenacea, Spelaeogriphacea*. CSIRO Publishing, Melbourne, Australia, pp. 62–80.
- Riek, E.F. (1967) The Tasmanian freshwater crayfish genus *Parastacoides* (Decapoda: Parastacidae). *Australian Journal of Zoology*, 15, 999–1006.
- Tyler, P.A. (2001) Lake Pedder — A limnologist's lifetime view. In: Sharples, C. (Ed), *Lake Pedder: Values and Restoration*, Occasional Paper No. 27, Centre for Environmental Studies, University of Tasmania, pp. 51–60.
- Tyler, P.A., Sherwood, J., Magilton, C. & Hodgson, D. (1994) Some biological consequences of the flooding of Lake Pedder. In: *Pedder Report*, School of Aquatic Science and Natural Resources Management, Deakin University, Warnambool, Victoria, pp. 1–11.
- Tyler, P.A., Sherwood, J.E., Magilton, C.J. & Hodgson, D.A. (1996) Limnological and geomorphological considerations underlying Pedder 2000 — the campaign to restore Lake Pedder. *Archiv für Hydrobiologie*, 136, 343–361.
- Wilson, G.D.F. & Keable, S.J. (2001) Systematics of the Phreatoicoidea. *Crustacean Issues*, 13, 175–194.
- Wilson, G.D.F., Humphrey, C.L., Colgan, D.J., Gray, K.-A. & Johnson, R.N. (2009) Monsoon-influenced speciation patterns in a species flock of *Eophreatoicus* Nicholls (Isopoda; Crustacea). *Molecular Phylogenetics and Evolution*, 51, 349–364.