

3.3. The Psammaspididae (Syncarida: Crustacea) with Descriptions of New Genera and Species.

Introduction

For many years the Australian syncarids have been a rare ubiquitous group distributed principally in south-eastern Australia, particularly Tasmania, Victoria and South Australia. The Division consisted of two families within the Order Anaspidacea, Anaspididae and Koonungidae, with the Anaspididae being the most conspicuous and containing the most species. In 1974, a new family was discovered in northern NSW by Dr. H.K. Schminke that challenged the conceptual ideas of anaspidacean distribution, diversity and evolution. He suggested this new taxa may represent the missing links between the families Anaspididae and the tiny groundwater Stygocarididae. Six years later another species was discovered on the central north coast of Tasmania which significantly extended the range and habitat types of the Psammaspididae.

In recent years however, there has been a growing concern and interest in the examination and preservation of caves and their fauna. In 1992, the NSW National Parks and Wildlife Service began a program surveying the subterranean invertebrate fauna of NSW caves in order to determine the conservation status of each cave system. The result of this survey has been the discovery of sparse but widespread fauna containing significant distributional and phylogenetic relic species. This interest has also stimulated regional surveys in other locations including Tasmania as well as NSW which has uncovered a large and diverse subterranean and interstitial fauna, with an important component of the biodiversity being many new species of Anaspidacea, Syncarida, in particular representatives of the family Psammaspididae. .

A taxonomic revision on the anaspidacean groundwater family Psammaspididae is presented including a revision of the current genera *Eucrenonaspides* from Tasmania and *Psammaspides* from the Namoi River catchment of northern New South Wales. A new genus is described *Cavernaspides* with two new species *C. bowenparkensis* n. sp. from Bowen Park Cave and *C. vincenti* from Wellington Caves in the Macquarie River catchment of Central; West New South Wales. The Psammaspididae is now confirmed to have a disjunct distributed across the eastern margin of south east Australia from north east New South Wales and into the north east of Victoria, extending south across Tasmania in limestone caves from the north east, north central down to the caves of Ida Bay in the far southern corner. This is the largest distribution of any of the Australian anaspidacean families.

They occur in a broad range of groundwater dependent ecosystems from the limestone caves across their range to the phreatic, coarse grained floodplain alluvials of the northern slope of the Great Dividing Range of northern NSW, to the weathered shale substrates of uplands hanging swamps of the Southern Highlands south of Sydney, NSW, to the fractured basalt aquifers of northern Tasmania. They represent an ancient group with plesiomorphic features including a short round telson, two segmented uropodal rami, a unmodified body plan, multisegmented male petasma and adaptations to subterranean life comparable to

the intercontinental Stygocarididae with a complete absence of eyes, body colour and reduced or absent pleopods. They also contain characteristics shared only with the new family Raptornungidae such as the defensive row of enlarged spear-like spines in the posterior margin of pleonite 6.

A brief review of the family Patagonaspididae has also been included in this section. It is proposed that this family has closer affinities with the Psammaspididae and the Raptornungidae than the Stygocarididae and therefore should be included as a sister family within this clade.



Figure 3.3.1. Psammaspididae. *Cavernaspides bowenparkensis* n. sp. Bowan Park cave, Central west NSW. Length 11.9mm.

Abbreviations

Institutional Abbreviations

Prefixes of registration or catalogue numbers for the Institutions referred to in the text, tables and figures.

P - Australian Museum, Sydney, Australia

QVM - Queen Victoria Museum and Art Gallery, Launceston, Australia

G - Tasmanian Museum and Art Gallery, Hobart, Australia

Classification of the Psammaspididae

Table 3.3.1. Checklist of Species

Superorder SYNCARIDA Packard 1885
Order ANASPIDACEA Calman 1904
Family PSAMMASPIDIDAE Schminke 1974a
Genus <i>Cavernaspides</i> n. gen
<i>Cavernaspides bowenparkensis</i> n. sp.
<i>Cavernaspides vincenti</i> n. sp
Genus <i>Eucrenonaspides</i> Knott & Lake 1980
<i>Eucrenonaspides oinotheke</i> Knott & Lake 1980
Genus <i>Psammaspides</i> Schminke 1974a
<i>Psammaspides williamsi</i> Schminke 1974a

Taxonomy

FAMILY PSAMMASPIDIDAE Schminke 1974

Diagnosis

Modified from Schminke 1974 and Knott & Lake 1980

Small to medium sized; slender anaspidaceans; pleonite 6 posterior margin cove with posteriorly directed row of elongate, stout, simple articulated spines with length 0.5-0.8 length of telson; rounded telson; rostrum bilobed; eyes absent; antennule with sensory organ on the fourth segment in the male; antenna without exopodite; processus incisivus accessorius; mandibular with a three segmented palp; maxillula without palp; masticating surface with processus incisivus accessorius; thoracopods 2-8 each comprising seven segments; thoracopod 1 without epipodite; thoracopod 2-8 similar; thoracopod 2-7 with one; exopodite and one epipodite; thoracopod 7 with a tubular exopodite and epipodite; thoracopod 8 with exopodite or epipodite; anus opening posteriorly on sixth pleonite; anteroventrally at proximal margin of the telson; pleopods rudimentary, when present of one to three segments and without endopodites except in the males; pleopod 1 with multisegmented exopodites; pleopods 1 and 2 modified to form a stygocarid petasma; uropod with two segmented exopodite and endopodite.

Key to the Genera of Psammaspididae and Patagonaspididae

1. Anaspidacean moderate size (5-15mm); blind, white or translucent with rounded or bilobed telson and a bilobed rostrum; uropod exopodite with two segments. 2.

2. Telson single segment, distally round; thoracopods 2-6 exopodites multisegmented with two plumose setae; medial uropod rami two-segmented. 3.
Family Psammaspididae.

3. Telson roundly triangular; pereopod 7 with multisegmented exopodite; pleonites 5 with rudimentary pleopods; mandible right processus incisivus accessorius lacks denticles; antennae with minute exopodite. 4.
Eucrenonaspides.

4. Telson length = width; pereopod 7 with tubular exopodite; pleopods absent on pleonite 5; mandible right processus incisivus accessorius with 18 fine denticles; antennae lacking minute exopodite. 5.
Psammaspides.

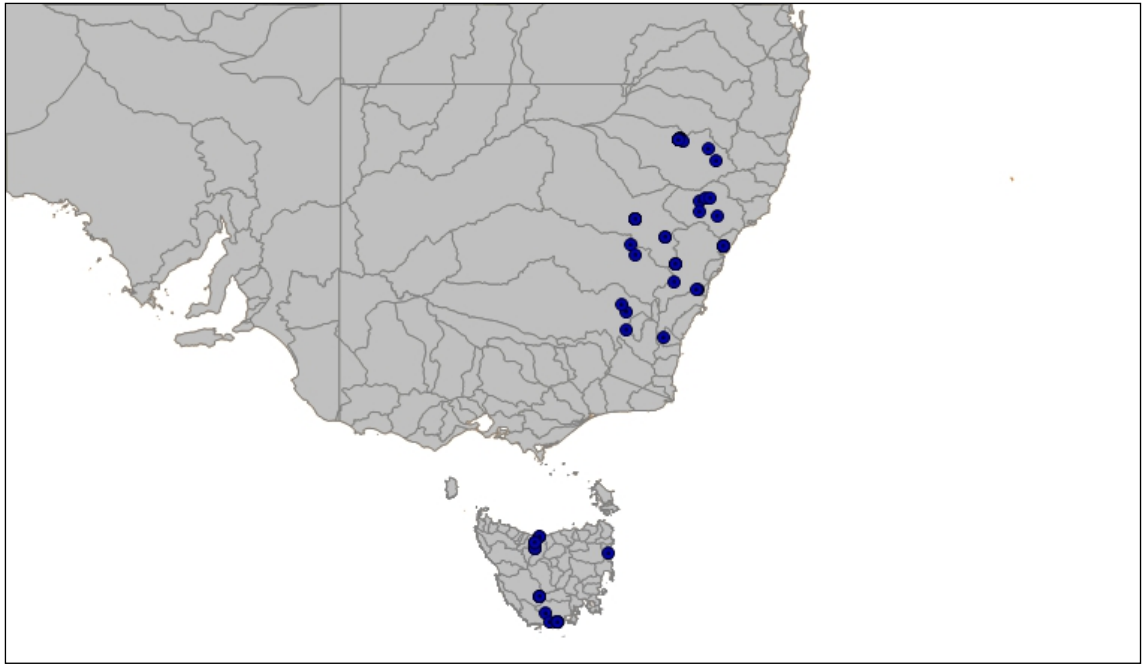
5. Telson length > width; mandible right processus incisivus accessorius without row of fine denticles. 5.
Cavernaspides.

Biology

Psammaspididae occupy similar habitats to the Raptornungidae n. Fam (Family A Serov 2002). These habitats include caves, the interstitial hyporheic zones sand and gravels of rivers and groundwater (aquifers) systems. It was previously considered that the Stygocarididae and the Bathynellacea were the only syncarids found in the meiofauna however recent findings indicate that the anaspidacean family Psammaspididae also occupy this habitat. There is little known about their life cycle and physiology. They are detritus feeders consuming sediment, and possibly algae.

Geographic Distribution

The Psammaspididae are distributed in NSW and Tasmania. In NSW they occur along the eastern and western margins of the Great Dividing Range as far west as Wellington in central NSW, north to Manilla and south to the Victorian Border and east to the central coast. There is also one undescribed species from Camperdown in western Victoria although no specimens could be located. In Tasmania, *Eucrenonaspides oinetheke* was collected from a wine cellar in Devonport, North Coast while the undescribed species have been collected from the Woolnorth Region of North West Tasmania, the Florentine Valley in central Tasmania and one record from Rum Pot cave on the north coast of Tasmania.



Map 3.3.1. Distribution of the Psammazoidae in NSW and Tasmania, Australia.

Habitats

The Psammaspididae occurs in three seeming disjunction areas and inhabit a range of habitats from limestone caves to the hyporheic zone of gravel bed streams and the interstitial, aquifer environment with the eroded shale and sandstones within upland perched swamps. The first area covers the east coast of NSW and north eastern Victoria. In NSW they are distributed from northern NSW through the Central West and down to the southern East coast of NSW and Victoria. They inhabit a range of cave types from the active streamways of Jenolan, such as *P. jenolanensis* that was found in Imperial Cave, to still water, impounded karsts such as Wellington Caves as well as the hyporheic zone of many coastal and inland rivers draining east and west of the Great Dividing Range (Figures 3.3.2-4). They have also been collected in the upland swamps along the range.

The second area is along the north east coast of Tasmania where they appear to only occupy the fracture zones with aquifers and limestone cave environment. The third area is located along the south west coast and ranges where they inhabit the limestone cave pools and streamways.



Figure 3.3.2. a & b. Hyporheic zones in the intermittent Cockburn River. Same site on the Cockburn River during flow and drought with both occasions yielding Psammaspididae at 80cm depth under the riverbed.

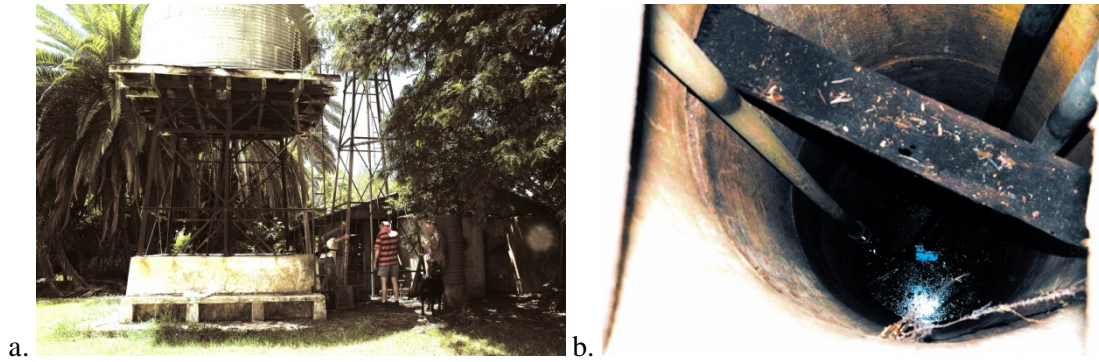


Figure 3.3.3. Phreatic Habitat. a& b. House water well at Maules Creek, Namoi River yielded *Psammaspididae* at 5m depth.



Figure 3.3.4. a. Upper Maules Creek where water from a springhead yielded *Psammaspides* sp. at 5-10cm depth under riverbed; b. Turon River, Sofala, Central West NSW, yielded *Psammaspididae* at 50cm depth under riverbed.

Remarks

The above diagnosis is derived from Schminke (1974), Knott and Lake (1980) and a reexamination of the published illustrations and the new species. In the original diagnosis by Schminke the diagnosis of the

family corresponded to that of the genus *Psammaspides* only. Knott & Lake 1980 changed the diagnosis to incorporate *Eucrenonaspides oinotheke*. The Psammaspididae are distinguished from the other groups of syncarids by having a divided rostrum, both uropodal rami consisting of two articles, and by having a row of long robust spear-like spines on the posterior margin of the last abdominal segment. These characters as well as being totally blind, colourless and having lost or significantly reduced pleopods are strong indicators that this group is highly adapted to an interstitial existence. Previously, the Psammaspididae consisted of two monospecific genera, the first, *Psammaspides williamsi* Schminke 1974, was discovered in river gravel in the highlands of the New England area west of Tamworth, and the other,

Eucrenonaspides oinotheke Knott & Lake 1980, which was found in a spring in a wine cellar in the middle of Devonport in Northern Tasmania. The NSW cave species differ from both of these genera sufficiently to be placed in a new genus. An interesting point is that the new genus has closer affinities with the Tasmanian *Eucrenonaspides* than it does with *Psammaspides*. This indicates quite an ancient period of isolation between the NSW cave faunas and the epigean faunas, since the latest period of separation of the Australian mainland with Tasmania was about 50mya.

In the description of Pleopod 2 Schminke states that there is a tiny exopodite present that resembles that present on Pleopods 3 and 4. As there is no indication of an extra lobe on any of these appendages it must be assumed that he is referring to the elongate plumose setae present on each as a remnant of the exopodites. However, on Pleopod 2 the seta is positioned in the wrong location, being posteromedial where as if it were an exopodite it would be laterally positioned. The pleopod 2 consisting of five segments in the drawing however the segmentation of the protopod into two and the distal two segments are debatable as to whether they are true segmentation as they do not appear articulated.

The arrangement of the row of spinose setae on the dorso lateral margin and not on the medial margin is a contrast to the Stygocarididae which have the most setation on the medial margin. This change is possibly a result of the type of sediments the two groups inhabit. The loss of setation on the outer surface in the Stygocarididae may indicate a more confined and finer grained substrate that causes greater abrasion of external surfaces whereas the greater setation within the Psammaspids would indicate large voids and the need for either extended tactile setae to feel the edges of the voids or for greater protection from the sides given the structure of the setae is strong and dentate. The excessive amounts of armature consisting of long, robust, stiff, lance shaped spines within both the Psammaspididae and the Raptornungidae are striking examples of passive defense mechanisms to ward off attacks within large voids and tunnels. This is a clear indication of the type of habitat or substrate that they have evolved into and can be directly related to the geology and geomorphic processes that have created the sediment types. The ability to actively move the row of long spines on the posterior margin of pleonite 6 from a horizontal to a ventricle position indicates they inhabit large tunnels within the substrate and use these spines to both defend the

rear by presenting a formidable phalanx of spines but to also block the tunnel side so that a predator or indeed competing males may not gain access to the unprotected sides. The development of such exaggerated armature would indicate that the subterranean environment is quite hostile and the risk of predation is high. It may also suggest that as the *Psammaspididae* and *Raptornungidae* are often the largest animals in these habitats and as they have large and strongly muscles forward facing maxillipeds, that they may also be the aggressors and predators with competition by males for mates.

Genus *Cavernaspides*, n. gen

Type species

Cavernaspides bowanparkensis, n. sp.

Etymology

The name refers the habitat that the first species was collected i.e. Bowen Park Limestone Cave.

Diagnosis

Pleonite 6 posterior margin with nine elongate spines extending 0.8 length of telson, spine arrangement is two long lateral spines, one short spine, one long and short medial spine; mandible incisor process without row of fine denticles; pleopod 1 endopodite a single spatulate-shaped segment, with medial lateral margins of posterior surface raised into ridges and separated by a groove; pleopod 2 endopodite two segmented; basal segment sub-rectangular and lack coupling hooks; distal segment longer than the basal segment; posterior surface is flat, continuous, distally with a elongate clavate projection; deep mid groove on anterior surface; medial margin has a convex curve and continuous distally with the proximal margin of the clavate projection; lateral margin is flat to the groove, where it is weakly serrate and produced into a spine which curls under the clavate projection.

Remarks

The main differences between the genera can be seen in the structure of the incisor cusps of the mandible and the male genitalia. Here you can see that the main differentiating feature in the mandibular cusp is the presence of a finely denticulate ridge in *Psammaspides* whereas it is absent in the other two genera. This relationship can be also seen in the structure of the male genitalia which consists of modified endopodites of pleopods 1 and 2. The pleopod 2 endopodite in the new genus consists of a long, two articulated rod with a patch of coupling hooks situated distally on article one, a setose subdistal ridge and a distal stylet. The form found in *Eucrenonaspides* is similar except the stylet is more elongate and blunt. Whereas in *Psammaspides* the structure of pleopod 2 is quite different, the placement of the coupling hook patch is proximal, whereas in the others it is distal and the overall structure of the distal article differs significantly.

***Cavernaspides bowanparkensis*, n. sp**

(Figs.3.3.5-9)

Type Locality

Bowan Park, Cave BP13, Central West, NSW, Australia.

Material examined

Type Material

P.45755, Holotype male, Bowan Park, Cave BP13, NSW., Australia, Alt 513m, Zone 55, 669486.29m E, 6311757.28m S. Eberhard, S., 13-March-1995.

Allotype: From the type locality. P.45755, 1female

Etymology

Species is named after the type locality.

Diagnosis

Species diagnosis is the same as genus at this time.

Description

Based on holotype male.

Body length of male 11.9 and female 13.7mm; body slender; transparent and colourless when alive; weakly sclerotised.

Cephalon sub-rectangular; divided into two unequal regions by transverse mandibular grooves; larger region is flattened with lateral margins produced ventrally; first thoracic somite fused to head.

Pleon shorter than peron; pereon- pereonites similar in length to each other; pereonites 1 and 2 overlap the front somites; pereonites 3 and posterior overlap posterior somites; female lack seminal receptaculum; pereon consists of seven free somites; pleon has six free somites and a round telson; telson as elongate as wide; fringe of setae on posterior margin; dorsal surface with submarginal simple setae; anus opens at the posterior limit of pleonite 6; no epimeral expansions but with small flanges with setae laterally on ventro-posterior margin of pleonite 1-5.

Rostrum deeply incised with a sub-apical setae on lateral margin; eyes absent; mandibular groove on ventro-posterior margin; the two grooves meet dorsally.

Antennule peduncle with three segments; basal segment lateral margin curved convexly at the proximal margin; medial margin setose; statocyst present and opens through a pore covered by two ball setae; lateral flagellum robust; length of peduncle and outer flagellum about half length of body; medial flagellum slender; male antennules with no sensory organ on proximal margin of lateral flagellum; all specimens have small triangular projection on dorsal margin at proximal margin of lateral flagellum with a

elongate setae; lateral flagellum with 17-29 segments/segments; medial flagellum with 6-10 segments; medial flagellum half length of lateral flagellum.

Antenna peduncle with three segments; one multisegmented flagellum; second peduncle with a small scale; basal segment small; segments 2 and 3 rectangular, setose on lateral margin; segment 3 with several dorsal setae; flagellum with 8-21 segments; vertex bilobed.

Mandible gnathoproximal margin grades into a thin concave masticating structure; this is divided into 1) incisor process 2) processus incisivus accessorius and 3) molar process mandibular palp three segmented; right mandible incisor process has four denticles; left mandible incisor process has five denticles; fifth denticle has serrate margin.

Labrum is bilobed; each lobe bears fine setules on top surface.

Maxillula- two unequal endites on basal podomere; lateral endite larger, with apical two rows of spines and one small plumose setae submarginal on the posterior surface. number of spines is variable between specimens; left maxillula with 8 and the right with 10 setae; right maxillula spines lateral most two straight with notch on medial margin, one is simple, four are serrate and medial three are curved and setose; maxillula medial endite spines have no notches, three serrate, and one curved and setose; medial endite has five large setae apically; medial margin of both endites with fine setules.

Maxilla with two deeply cleft lobes giving the appearance of four lobes; all lobes have apical brush setae; number of brush setae on right and left maxillae – 3,3,3,4 and 3,2,3,3. from medial to lateral lobes; number increases with size/age; medial lobe bears a stout setae on medial margin; thoracopods- all thoracopods have seven segments and a reduced basis.

Maxilliped lacks epipodite; the coxa has a small triangular distomedial projection, as does the ischium, although smaller; basis reduced to a small posterior-lateral plate; basis has one tubular exopodite; setae on all segments except basis; propodus has two rows of stout setae on either side of flattened ventral surface. Thoracopods 2-8 flexed between merus and carpus; thoracopods 2-7 directed anteriorly; thoracopods 8 directed posteriorly; thoracopods 2-7 coxae have one tubular epipodite; thoracopods 2-6 basis have one multisegmented exopodite; thoracopods 7 basis with one tubular exopodite; thoracopods 2-8 are especially setose; thoracopods 2-3 dactyls have four claws; thoracopods 4-8 dactyls have three.

Pleon slightly flattened; pleonite 6 posterior margin with row of elongate spines; pleopods; pleonites 1-5 each with one pair of pleopods; pleonite 1 exopodite elongate, multisegmented; pleonites 2-5 exopodites short with two to three segments; pleopods lack endopodites except pleopods 1-2 in male that form petasma; petasma- directed anteriorly between basis of thoracopod 8; at rest, the two endopodites of pleopod 1 are held obliquely with their medial surfaces confluent; at rest, the two endopodites of pleopod 2 are held within the shallow depression formed by the anterior pair.

Male pleopod 1 endopodite a single spatulate-shaped segment, with medial lateral margins of posterior surface raised into ridges and separated by a groove.

Male pleopod 2 endopodite two segmented; basal segment sub-rectangular and lack coupling hooks; distal segment longer than the basal segment; posterior surface is flat, continuous, distally with a elongate clavate

projection; deep mid groove on anterior surface; medial margin has a convex curve and continuous distally with the proximal margin of the clavate projection; lateral margin is flat to the groove, where it is weakly serrate and produced into a spine which curls under the clavate projection.

Uropod elongate and slender; peduncle and rami dorsal surface flattened; peduncle and rami ventral surfaces rounded; medial ramus shorter than lateral ramus.

Habitat

The cavernicolous environment within the pools and streams and fractures within limestone caves.

Distribution

Only located within type locality within the Macquarie River catchment in the Central West of NSW, Australia.

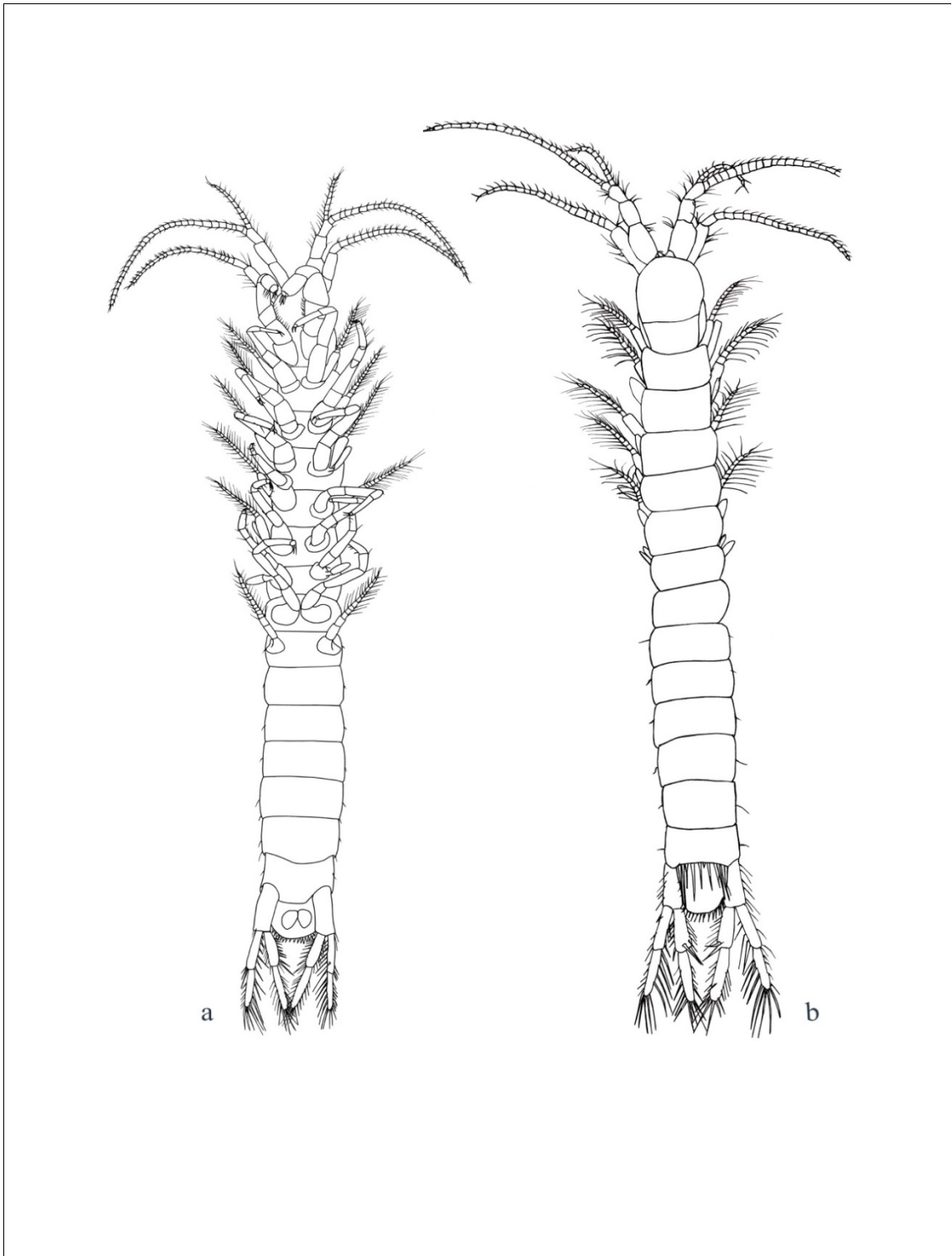


Figure 3.3.5. *Cavernaspides bowanparkensis*, n. sp. Allotype female 13.7 mm. Body: a- female body, ventral view; b- male body, dorsal view.

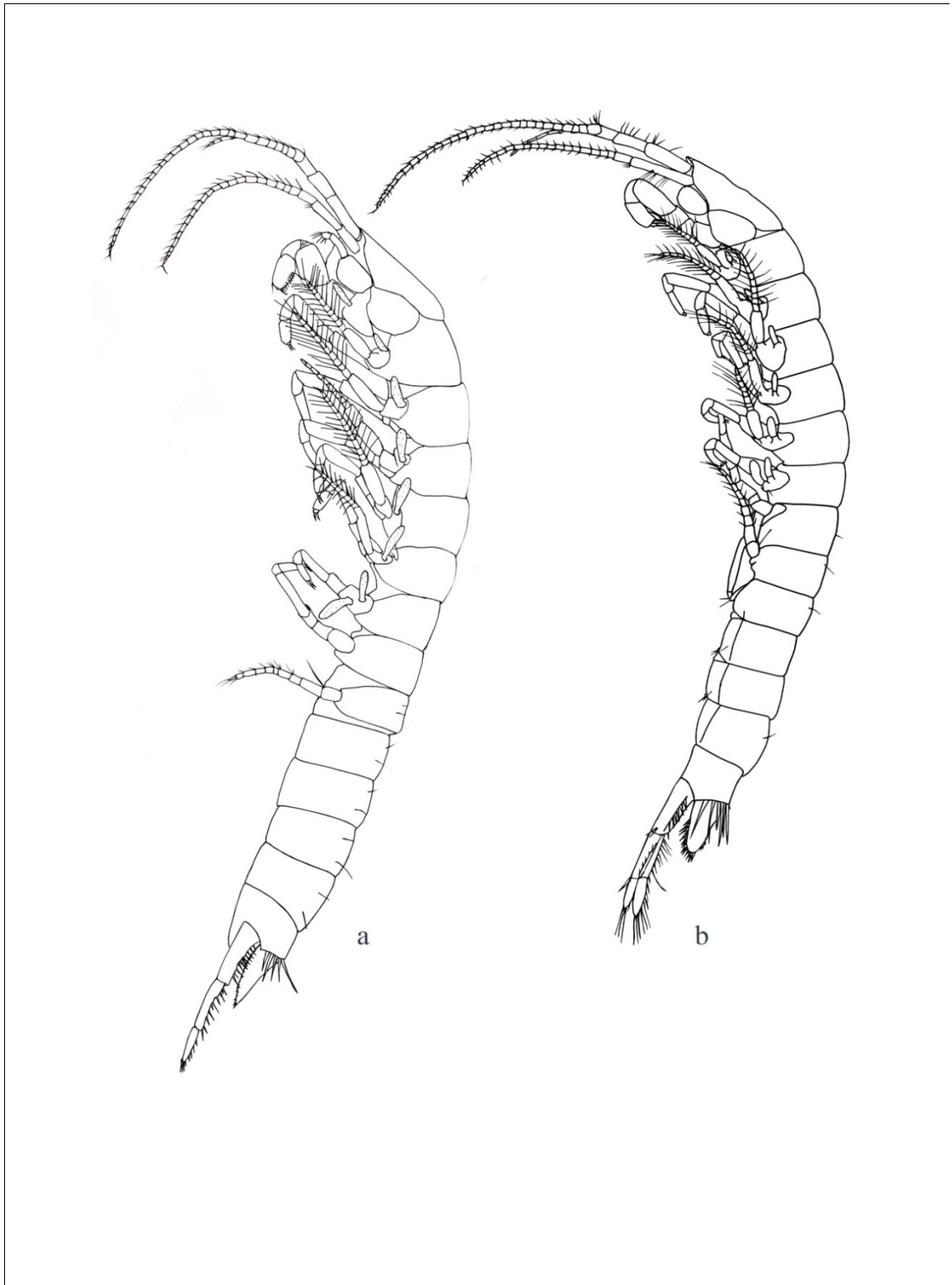


Figure 3.3.6. *Cavernaspides bowanparkensis*, n. sp. Holotype male 11.9mm. Body: a- female body, lateral view; b- male body, lateral view.

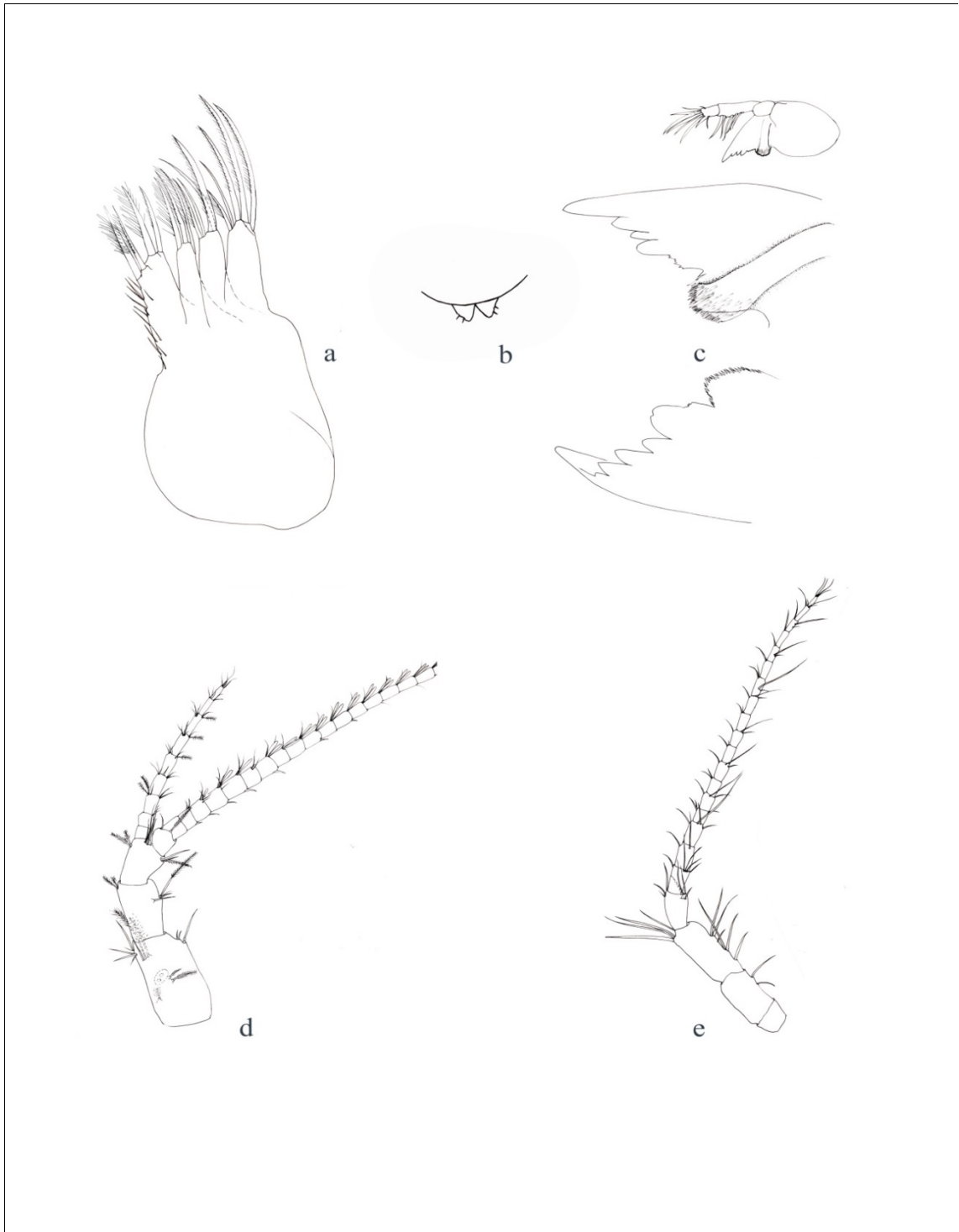


Figure 3.3.7. *Cavernaspides bowanparkensis*, n. sp. Holotype male 11.9mm. Mouthparts: a- Mx2; b- rostrum; c- left mandible with enlargements of left and right mandible incisor processes below. Antennae: d- A1; e- A2.

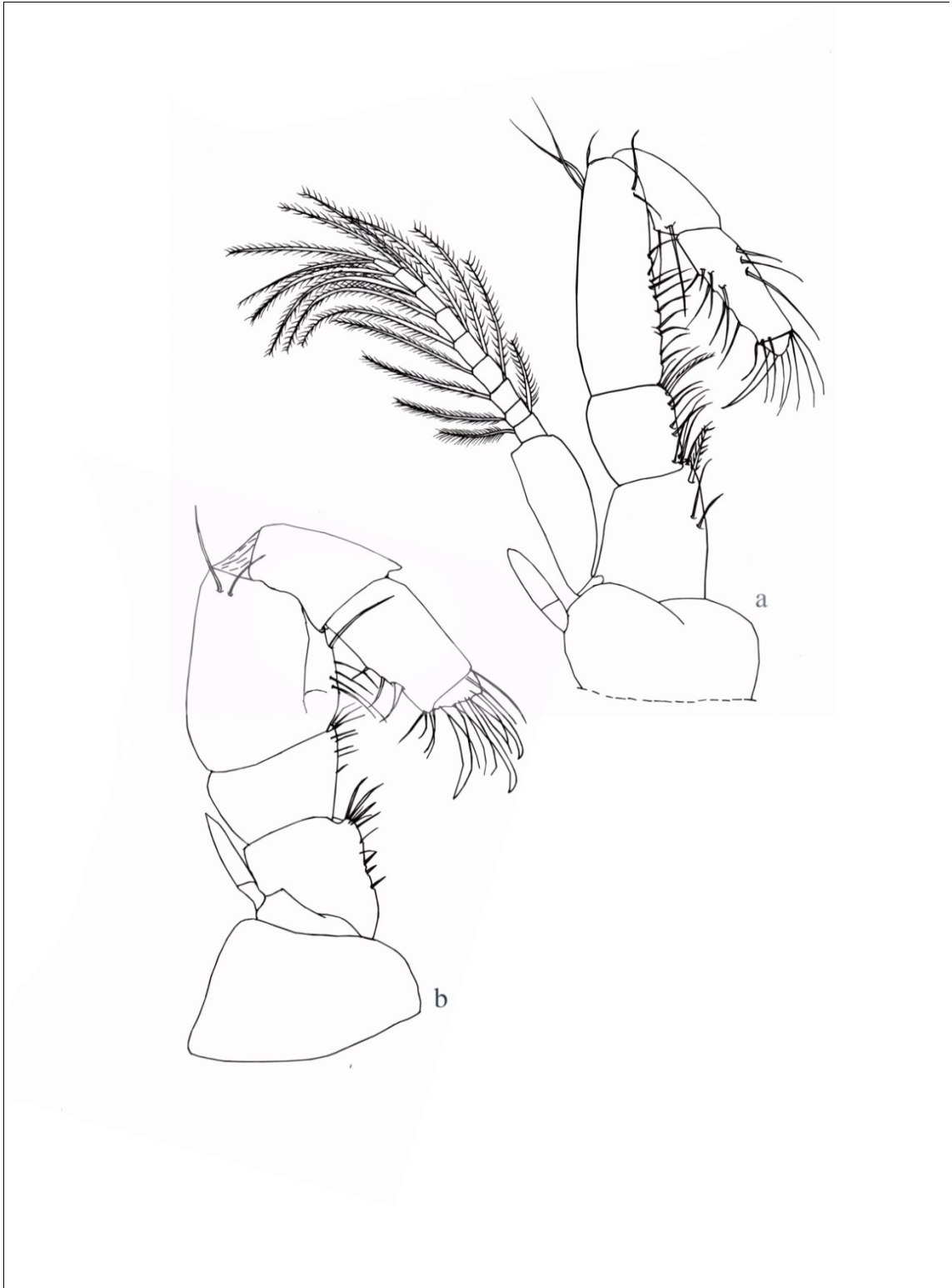


Figure 3.3.8. *Cavernaspides bowanparkensis*, n. sp. Holotype male 11.9mm. Thoracopods: a- Th 2; b- Mxp.

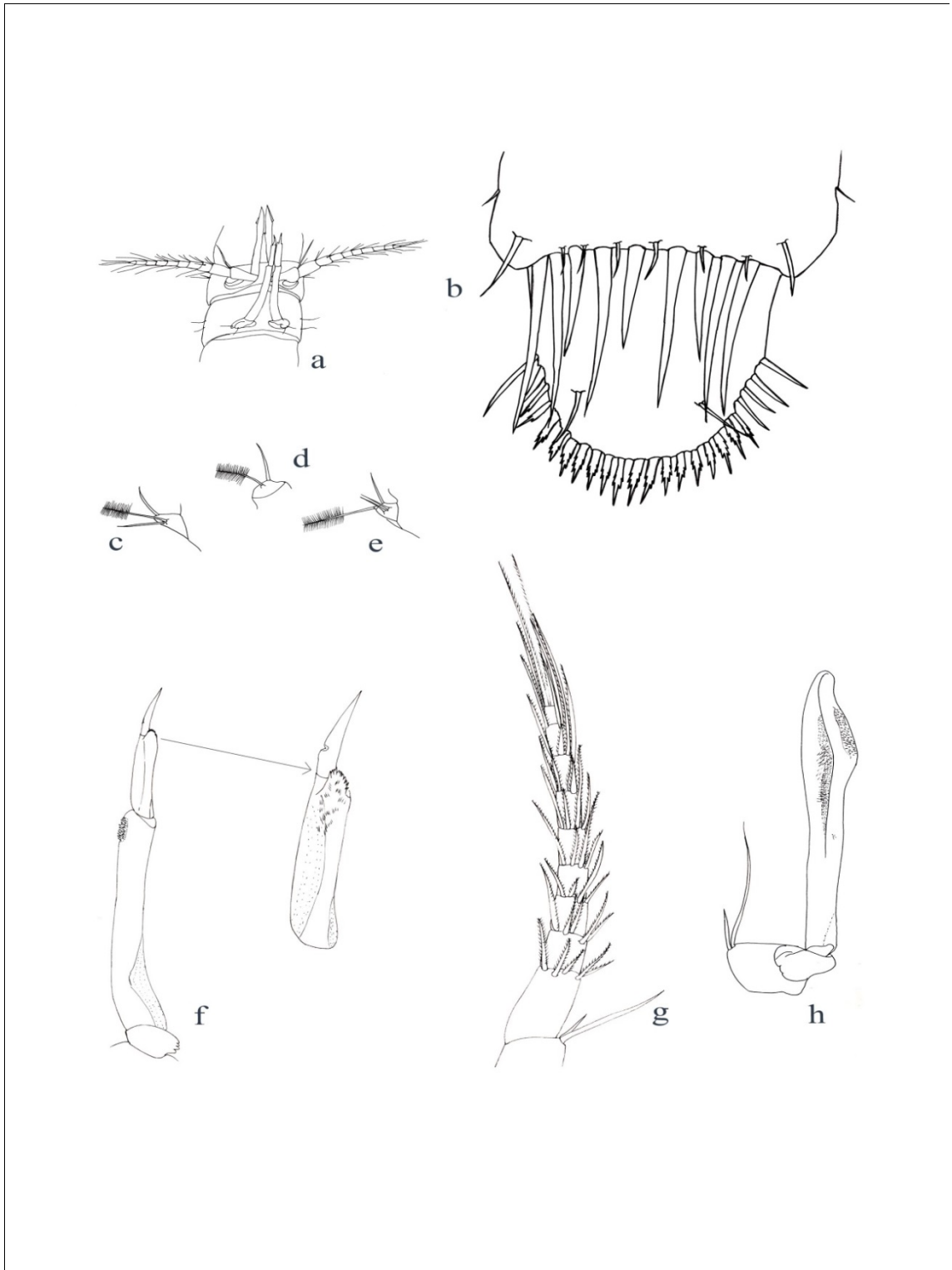


Figure 3.3.9. *Cavernaspides bowanparkensis*, n. sp. Holotype male 11.9mm. a- petasma; b- telson; c- pleopod 3 endopod; d- pleopod 4 endopod; e- pleopod 5 endopod; f- pleopod 1 endopod; g- pleopod 1 exopod; H- pleopod 2endopod.

Cavernaspides vincenti, n. sp

(Figs. 3.3.10-11)

Type Locality

Wellington Caves, Limekilm Cave, 4km from Wellington, Central West NSW, Australia.



Figure 3.3.10. Root mats in Limekilm Cave, Wellington Caves, New South Wales.

Material Examined

Type Material

Holotype. P.45756, 1 female, Wellington Caves, Limekilm Cave, among roots, 4km from Wellington, NSW, Australia, Alt 315m, Zone 55, 681884.36m E, 6389014.43m S, Eberhard, S., 26-April-1995.

Paratypes: Paratypes are all from the type locality: P.45757, 1female, Wellington Caves, Limekilm Cave, among tree roots, 4km from Wellington, NSW, Australia, Alt 315m, Zone 55, 681884.36m E, 6389014.43m S, Serov, P., 26-April-1995; P.45759, 1female, Wellington Caves, McCavity Cave, below

hanging swamp from pool floor, 1.5m depth, 4km from Wellington, NSW, Australia, Alt 315m, Zone 55, 681884.36m E, 6389014.43m S, Eberhard, S., 26-April-1995; P.45760, 2females, Wellington Caves, Limekilm Cave, tree roots, 4km from Wellington, NSW, Australia, Alt 315m, Zone 55, 681884.36m E, 6389014.43m S, Eberhard, S., 08-March-1995; P43374, 2females, Wellington Caves, WE-14, McCavity Cave, water filled extension of Limekilm cave, caught at beginning of "Long Tunnel", 4km from Wellington, NSW, Australia, Alt 315m, Zone 55, 681884.36m E, 6389014.43m S, Vincent, N., Date unknown; P.45752, 1female, Wellington Caves, McCavity Cave, in tree roots, 4km from Wellington, NSW, Australia, Alt 315m, Zone 55, 681884.36m E, 6389014.43m S, Serov, P., 26-April-1995; P.45758, 1 female, Wellington Caves, McCavity Cave, in tree roots, 4km from Wellington, NSW, Australia, Alt 315m, Zone 55, 681884.36m E, 6389014.43m S, Serov, P., 26-April-1995.

Etymology

Named after Neil Vincent, who was the first person to collect this species.

Diagnosis

Pleonite 6 posterior margin with nine elongate spines; telson broad and rounded with lateral margin with four to five simple, robust spines; laterodistal margin with fringe of approximately 36 barbed or pectinate spines; dorsal subdistal surface with approximately 10 simple spines; maxilla medial endite with two large, pectinate spines and three small pectinate spines; left incisor process with seven denticles with no minute medial denticles; diastema very small, width to mandible width ratio 0.075; molar process on each mandible similar consisting of masticating surface covered in many minute, robust simple spinules and no grinding surface; maxillula medial endite with five plumose setae, one small robust and a row of fine setules on distomedial margin; lateral lobe with 11 robust, dentate spines arranged in two rows; maxilla consists of four lobes; medial endite 1 with eight distal plumose setae and eight slender, simple setae on medial margin; lobe 2 with four distal plumose setae; lobe 3 with six distal plumose setae; lateral lobe 4 with six distal plumose setae and one small simple setae on distolateral margin.

Description

Based on holotype female.

Body not very chitonised; body length 15mm; body length to width ratio 8.0; cephalon fuse with 1 thoracic segment to form cephalothorax; cephalon-pereon equal to pleon-telson; seven free pereonites; six free pleonites; pereonites and pleonites subequal in length; all body segments equal in width except pleonites 4-6 wider; telson, rounded; all pereonites have appendages. Pleon with reduced appendages on 1-4; pleonite 5 with no appendages; pleonite 6 with two rows of setae on posterior margin; subdistal margin with one row of 10 short, simple setae; distal margin with row of 11 elongate, robust simple spines of variable length extending to approximately half length of telson; distolateral surface with one small, simple seta on each side. Telson posterior margin with a narrow fringe of short, barbed spines; dorsal

surface with eight spines directed dorsally adjacent to margin; telson broad and rounded with length to width ratio 0.8; lateral margin without setae length to telson length ratio 0.31; lateral margin with four to five simple, robust spines; laterodistal margin with fringe of approximately 36 barbed or pectinate spines; dorsal subdistal surface with approximately 10 simple spines; rostrum bilobed with two short lateral simple setae; eyes absent.

Antennula inserted anteriorly adjacent to rostrum; antennule length to body length ratio 0.5; antennula peduncle with three segments; lateral flagellum with 23-24 segments; medial flagellum with seven to eight segments; medial flagellum length to lateral flagellum length ratio 0.14; peduncular segment 1 with statocyst on mid dorsal surface; statocyst oval with two ball setae and 32 short penicillate setae; distomedial corner with three groups of short penicillate setae; antenna length to antennula length ratio 0.64.

Antenna peduncle composed of three segments; antenna flagellum with 18 segments.

Labrum strongly vaulted, with setules along posterior margin; paragnath lobes separate; each lobe elongate rectangular with setules on medial and distomedial margin.

Mandibular palp with three segments; proximal segment shortest with no setae and a length to width ratio 1.55; medial segment longest with length to width ratio 4.37; medial segment with six elongate, simple setae equally spaced on medial margin; distal segment with length to width ratio 1.37; distal segment with 13-14 elongate, simple setae on distal and medial margins; right incisor process with five denticles (right mandible) or seven (left mandible); right incisor accessory process with 18 minute denticle; left incisor process with seven denticles; left incisor accessory process with seven minute denticle; diastema very small, width to mandible width ratio 0.075; molar process on each mandible similar consisting of masticating surface covered in many minute, robust simple spinules and no grinding surface.

Maxillula medial endite with five plumose setae, one small robust and a row of fine setules on distomedial margin; lateral lobe with 11 robust, dentate spines arranged in two rows.

Maxilla consists of four lobes; medial endite with eight distal plumose setae and eight slender, simple setae on medial margin; lobe 2 with four distal plumose setae; lobe 3 with six distal plumose setae; lateral lobe 4 with six distal plumose setae and one small simple setae on distolateral margin.

Maxilliped coxa with a triangular extension on the medial edge with three terminal, robust, simple setae; coxa with no epipodite; basis very narrow, with two segmented tubular exopodite; praeischium with 12 simple setae along medial margin and a tuft of seven setae on distolateral corner; dactylus four claws; thoracopods 2-6 - thoracopod 2 coxa with one small, tubular epipodite.

Thoracopods 1-7 continuously decreasing in length; thoracopods 8 longest; thoracopod basis not fused with the ischium; thoracopods similar; thoracopod 2 basis with no exopodite; thoracopods 3-6 coxa with one large, tubular epipodite; thoracopods 3-6 basis with 1 large multisegmented exopodite with two elongate plumose setae, one on each distal corner; thoracopod 7 coxa with one large, tubular epipodite; thoracopod 7 basis with one large, tubular exopodite; thoracopod 8 with no epipodites or exopodites;

dactylus with four claw consisting of one longest, two moderately long and one short claw; dactylus with four claws.

Pleopods 3-4 reduced to single segments with three to four short, simple setae and four short and one elongate plumose setae; pleopod 5 without appendages.

Male pleopod 1 protopod short, length to width ratio 0.56, with one simple seta on the subdistal lateral margin; pleopod 1 exopodite multisegmented with seven segments, each with two elongate plumose setae, one on each distal corner; pleopod 1 endopodite single segment, folded to produce a medial groove along the length of the segment; medial margins with mid rounded extension; dorsal medial margin extension with row of seven coupling hook setae and tapered distally; ventral margin extension with row of approximately 20 minute dentate spines followed with rectangular distal tip.

Pleopod 2 in males consisting of five segments; protopod segment 1 with two simple setae and one elongate, plumose setae on posterior margin; protopod segment 2 with simple, medial setae; endopodite segment 1 elongate, medially curved, length to width ratio 3.0 with circular group of coupling hook setae on subproximal medial margin; coupling hooks setae appear two segmented with two digitate extensions; endopodite segment 2 elongate, narrow, length to width ratio 2.4 with one row five dentate, distally directed spines on the lateral and medial margins; endopodite segment 3 stylet shaped, medially curved with fine rounded tip; length to width ratio 16.5 with a narrow lateral extension extending from mid-length to the tip.

Uropod protopod length to total length of exopodite 0.65; protopod robust and elongate, length to width ratio 1.65; protopod dorsolateral margin with 17 robust, dentate setae; protopod ventromedial margin with two elongate, plumose setae; exopodite 2 subequal segmented rami; proximal segment length to width ratio 3.0; lateral margin with 16 robust, dentate setae of variable lengths; medial margin with 10 robust, dentate setae of variable lengths; distal segment length to width ratio 3.3; lateral margin with seven robust, dentate setae of increasing lengths distally; medial margin with six robust, dentate setae of increasing lengths distally; distal margin with four robust, dentate setae of subequal lengths; dorsal surface with one subdistal, robust, dentate seta; endopodite 2 subequal segmented rami; proximal segment length to width ratio 2.7; lateral margin with 11 robust, dentate setae of subequal lengths; medial margin with 12 robust, dentate setae with lengths increasing distally; dorsal surface with two large and four small plumose setae on lateral side and one subdistal, robust, dentate setae; distal segment length to width ratio 2.9; lateral margin with five robust, dentate setae of subequal length medial margin with four robust, dentate setae of subequal and one minute simple seta; distal margin with four robust, dentate setae of subequal lengths; dorsal surface with one subdistal, robust, dentate seta.

Habitat

Limestone caves within cave pools.

Distribution

Restricted to type locality within the Macquarie River catchment.

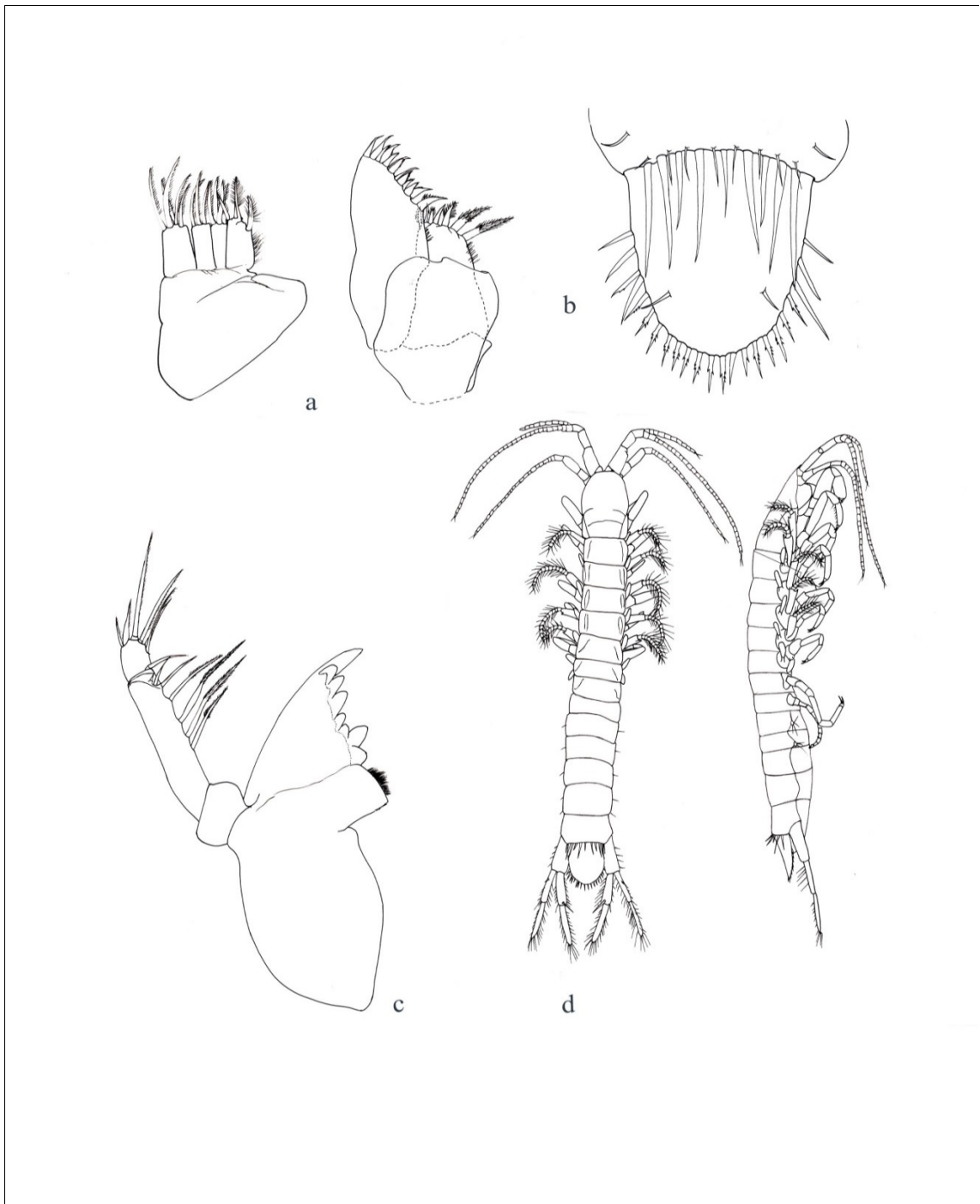


Figure 3.3.11. *Cavernaspides vincenti*, n. sp. Holotype male 15mm (all drawings are male except those indicated). Body and mouthparts: a- Mx2 (left) and Mx2 (right); b- telson; c- right Mandible; d- female body dorsal view (left) & female body lateral view (right).

Genus *Eucrenonaspides* Knott & Lake 1980

Eucrenonaspides. Knott, B. & Lake, P.S. 1980. *Eucrenonaspides oinotheke* gen. et sp. n (Psammaspididae) from Tasmania and a new taxonomic scheme for Anaspidacea (Crustacea, Syncarida). *Zoological Scripta*. 9(1). (1980): 25-33 [25].

Type species

Eucrenonaspides oinotheke Knott & Lake 1980.

Diagnosis

Modified from Knott & Lake 1980.

Pleonite 6 posterior margin with 11 elongate spines with the longest extending to 0.9 of telson length; spine arrangement is three short spines, one long and a medial short spine; telson as elongate as wide a distolateral fringe of spines on posterior margin with five lateral, short, robust, simple spine and eight stout serrate spines on apex; dorsal surface with two submarginal simple setae; transparent and colourless when alive; rostrum bilobed, deeply incised with one sub-apical setae on lateral margin; thoracopod 1 comprising seven complete segments, without epipodites; thoracopods 2-6 each with multisegmented exopodites and one epipodite; thoracopod 7 with tubular exopodite and one epipodite; thoracopod 8 without both exopodite and epipodite; pleonite 5 with rudimentary pleopod; male pleopod 1 endopodite a single spatulate-shaped segment, with medial lateral margins of posterior surface raised into ridges and separated by a groove; pleopod 2 endopodite two segmented; basal segment sub-rectangular and lack coupling hooks; distal segment longer than the basal segment; posterior surface is flat, continuous, distally with a elongate clavate projection; deep mid groove on anterior surface; medial margin has a convex curve and continuous distally with the proximal margin of the clavate projection; lateral margin is flat to the groove, where it is weakly serrate and produced into a spine which curls under the clavate projection; uropod elongate and slender; peduncle and rami dorsal surface flattened; peduncle and rami ventral surfaces rounded; medial ramus shorter than lateral ramus.

Species Composition

Eucrenonaspides oinotheke

Eucrenonaspides oinotheke Knott & Lake 1980

Eucrenonaspides oinotheke. Knott, B. & Lake, P.S. 1980. *Eucrenonaspides oinotheke* gen.et sp.n (Psammaspididae) from Tasmania and a new taxonomic scheme for Anaspidae (Crustacea, Syncarida). Zoological Scripta. 9(1). (1980): 25-33 [25].

Type locality

(6) Payton Place, Devonport, Tasmania from a spring in a wine cellar, Tasmania, Australia,

Material Examined

Type material. All material is from the type locality. Holotype: (G1871/1 and slide G1871/2). (6) Payton Place, Devonport, Tasmania from a spring in a wine cellar, Tasmania, Australia, Alt 38m, Zone 55, 444728.83m E, 5441382.14m S, Sheehan, K., 17-August-1975.

Allotype: G1872.

Paratypes: G1873, G1874 and slides G1875/1-11), 1male, 4females; P.65472, 2 specimens.

Diagnosis.

Species diagnosis is the same as the genus at this time

Description

Modified from Knott & Lake 1980

Body length of largest female 13.8mm; body slender; pleon shorter than peron; weakly sclerotised; no epimeral expansions but with small flanges with setae laterally on ventro-posterior margin of pleonite 1-5; pereon- pereonites similar in length to each other; pereonites 1 and 2 overlap the front somites; pereonites 3 and posterior overlap posterior somites.

Cephalon sub-rectangular; divided into two unequal regions by transverse mandibular grooves; larger region is flattened with lateral margins produced ventrally; pleonite 6 posterior margin with 11 elongate spines with the longest extending to 0.9 of telson length; spine arrangement is three short spines, one long and a medial short spine; telson as elongate as wide a distolateral fringe of spines on posterior margin with five lateral, short, robust, simple spine and eight stout serrate spines on apex; dorsal surface with two submarginal simple setae; transparent and colourless when alive; rostrum bilobed, deeply incised with one sub-apical setae on lateral margin; eyes absent; mandibular groove on ventro-posterior margin; the two grooves meet dorsally.

Antennula peduncle with four segments; basal segment lateral margin curved convexly at the proximal margin ; medial margin setose; statocyst present and opens through a pore covered by two ball setae; lateral flagellum robust; length of peduncle and outer flagellum about half length of body; medial flagellum slender; male antennules with no sensory organ on proximal margin of lateral flagellum; all

specimens have small triangular projection on dorsal margin at proximal margin of lateral flagellum with an elongate setae; lateral flagellum with 17-29 segments/segments; medial flagellum with 6-10 segments; medial flagellum half length of lateral flagellum.

Antenna peduncle with three segments; one multisegmented flagellum; second peduncle with a small scale; basal segment small; segments 2 and three rectangular, setose on lateral margin; segment 3 with several dorsal setae; flagellum with 8-21 segments; vertex bilobed.

Mandible gnathoproximal margin grades into a thin concave masticating structure; this is divided into 1) incisor process 2) processus incisivus accessorius and 3) molar process mandibular palp three segmented; right mandible incisor process has four denticles; left mandible incisor process has five denticles; fifth denticle has serrate margin; lower lip is bilobed; each lobe bears fine setules on top surface.

Maxillula has two unequal endites on basal podomere; lateral endite larger, with apical two rows of spines and one small plumose setae, submarginal on the posterior surface. number of spines is variable between specimens; left maxillula with eight and the right with 10 setae; right maxillula spines lateral most two straight with notch on medial margin, one is simple, four are serrate and medial three are curved and setose; left maxillula spines have no notches, three serrate, and one curved and setose; medial endite has five setae apically; medial margin of both endites with fine setules.

Maxilla with two deeply cleft lobes giving the appearance of four lobes; all lobes have apical brush setae; number of brush setae on right and left maxillae – 3,3,3,4 and 3,2,3,3. from medial to lateral lobes; number increases with size/age; medial lobe bears a stout setae on medial margin.

Female lacks seminal receptaculum.

Maxilliped lacks epipodite; the coxa has a small triangular distomedial projection, as does the ischium, although smaller; basis reduced to a small posterior-lateral plate; basis has one tubular exopodite; setae on all segments except basis; propodus has two rows of stout setae on either side of flattened ventral surface. Thoracopods 2-8 flexed between merus and carpus; thoracopods 2-7 directed anteriorly; thoracopods 8 directed posteriorly; thoracopods 2-7 coxae have one tubular epipodite; thoracopods 2-6 basis have one multisegmented exopodite; thoracopods 7 basis has one tubular exopodite; thoracopods 2-8 are setose; thoracopods 2-3 dactyls have four claws; thoracopods 4-8 dactyls have three; pleon slightly flattened.

Pleonites 1-5 each with one pair of pleopods; pleonite 1 exopodite elongate, multisegmented. Pleonites 2-5 exopodites short with two to three segments; pleopods lack endopodites except pleopods 1-2 in male that form petasma; petasma- directed anteriorly between basis of thoracopod 8; pleonite 6 posterior margin with row of elongate spines; at rest, the two endopodites of pleopod 1 are held obliquely with their medial surfaces confluent; at rest, the two endopodites of pleopod 2 are held within the shallow depression formed by the anterior pair.

Male pleopod 1 endopodite a single spatulate-shaped segment, with medial lateral margins of posterior surface raised into ridges and separated by a groove.

Male pleopod 2 endopodite 2 segmented; basal segment sub-rectangular and lack coupling hooks; distal segment longer than the basal segment; posterior surface is flat, continuous, distally with a elongate clavate

projection; deep mid groove on anterior surface; medial margin has a convex curve and continuous distally with the proximal margin of the clavate projection; lateral margin is flat to the groove, where it is weakly serrate and produced into a spine which curls under the clavate projection.

Uropod elongate and slender; peduncle and rami dorsal surface flattened; peduncle and rami ventral surfaces rounded; medial ramus shorter than lateral ramus.

Habitat

Phreatic freshwater within fractured rock, basalt aquifers.

Distribution

Only occurs in type locality in Devonport, northern Tasmania.

Genus *Psammaspides* Schminke 1974

Psammaspides. Schminke, H.K. 1974b. *Psammaspides williamsi* gen. n., n. sp, Ein Vertreter einer Neuen Familie mesopsammaler Anaspidae (Crustacea, Syncarida). Zoological Scripta 3(4): 177-183 [178].

Type species

Psammaspides williamsi Schminke 1974 by original designation.

Diagnosis

Modified from Knott & Lake 1980.

Telson broad and rounded with length to width ratio 0.8; lateral margin without setae length to telson length ratio 0.31; lateral margin with four to five simple, robust spines; laterodistal margin with fringe of approximately 36 barbed or pectinate spines; dorsal subdistal surface with approximately 10 simple spines; rostrum bilobed with a narrow cleft; eyes absent; maxillula medial endite with five subequal plumose setae, one small robust and a row of fine setules on distomedial margin; maxilla without palp; thoracopod 1 without epipodite; thoracopod 2-8 similar; thoracopod 2-7 with one exopodite and one epipodite; thoracopod 7 with a tubular exopodite and epipodite; thoracopod 8 without exopodite or epipodite; pleopod 1 with three segments; protopod short, length to width ratio 0.56, with one simple seta on the subdistal lateral margin; pleopod 1 exopodite multisegmented with seven segments, each with two elongate plumose setae, one on each distal corner; pleopod 1 endopodite single segment, folded to produce a medial groove along the length of the segment; medial margins with mid rounded extension; dorsal medial margin extension with row of seven coupling hook setae and tapered distally; ventral margin extension with row of approximately 20 minute dentate spines followed with rectangular distal tip; pleopod 2 in males- ;pleopod 2 consisting of five segments; protopod segment 1 with two simple setae and one elongate,

plumose setae on posterior margin; protopod segment 2 with simple, medial setae; endopodite segment 1 elongate, medially curved, length to width ratio 3.0 with circular group of coupling hook setae on subproximal medial margin; coupling hooks setae appear two segmented with 2 digitate extensions; endopodite segment 2 elongate, narrow, length to width ratio 2.4 with one row of five dentate, distally directed spines on the lateral and medial margins; endopodite segment 3 stylet shaped, medially curved with fine rounded tip; length to width ratio 16.5 with a narrow lateral extension extending from mid length to the tip; pleonite 6 posterior margin with 11 elongate spines extending 0.55 length of telson; the spine arrangement is one long lateral spin, two short, one long and two short medial spines; pleopods 3-4 reduced to minute, single segments; pleopod 5 without appendages; uropod with two segmented exopodite and endopodite.

Species Composition

Psammaspides williamsi Schminke 1974a\

Psammaspides williamsi Schminke 1974

(Fig. 3.3.12)

Psammaspides williamsi Schminke, H.K. 1974b. *Psammaspides williamsi* gen. n., n. sp, Ein Vertreter einer Neuen Familie mesopsammaler Anaspidacea (Crustacea, Syncarida). *Zoological Scripta* **3(4)**: 177-183, fig. 1-21 [178].

Type locality

Halls Creek, New England, New South Wales, Australia



Map 3.3.2. Regional map showing the type locality of *P. williamsi* from Halls Creek east of Manilla in NW New South Wales, Australia.



Figure 3.3.12. Halls Creek type locality.

Type Material

Holotype male. The type specimen is tentatively in the collection of H.K. Schminke. Sample AL 25, Halls Creek, New England, New South Wales, Australia; 500m above the church of Hall's Creek on the road to Watson's Creek (near Tamworth), excavations to 95cm deep in the gravel of the shore, 1.90m and 8.00m from the edge of the stream, Alt 427m, Zone 56, 298896.97m E, 6597504.58mS, Schminke, H.K., 24-May-1968. Temperature 15° C; accompanying fauna: Bathynellidae, Nematoda, Cyclopoida, Harpacticoida

Diagnosis

Species diagnosis the same as the genus at this time.

Redescription

Based on holotype and modified from Schminke 1974

Body weakly sclerotised; body length 6.7mm; body length to width ratio 8.0; cephalon fused with one thoracic segment to form cephalothorax; cephalon-pereon equal to pleon-telson; all body segments equal in width except pleonites 4-6 wider; telson, rounded; pereonites and pleonites subequal in length; antennula inserted anteriorly adjacent to rostrum; all pereonites have appendages; pleon with reduced appendages on 1-4; pleonite 5 with no appendages; pleonite 6 with two rows of setae on distal margin; subdistal margin with one row of 10 short, simple setae; distal margin with row of 11 elongate, robust simple spines of variable length extending to approximately half length of telson; distolateral surface with one small, simple seta on each side.

Telson wider than long, round; telson broad and rounded with length to width ratio 0.8; lateral margin without setae length to telson length ratio 0.31; lateral margin with four to five simple, robust spines; laterodistal margin with fringe of approximately 36 barbed or pectinate spines; dorsal subdistal surface with approximately 10 simple spines; rostrum bilobed with two short lateral simple setae; eyes absent. Antennule length to body length ratio 0.5; antennula peduncle three segments; lateral flagellum with 23-24 segments; medial flagellum with seven to eight segments; medial flagellum length to lateral flagellum length ratio 0.14; peduncular segment 1 with statocyst on mid dorsal surface; statocyst oval with two ball setae and 32 short penicillate setae; distomedial corner with three groups of short penicillate setae. Antenna length to antennula length ratio 0.64; antenna peduncle composed of three segments; antenna flagellum with 18 segments.

Labrum strongly vaulted, with setules along posterior margin (not illustrated);

Paragnath lobes separate; each lobe elongate rectangular with setules on medial and distomedial margin.

Mandibular palp with three segments; proximal segment shortest with no setae and a length to width ratio 1.55; medial segment longest with length to width ratio 4.37; medial segment with six elongate, simple setae equally spaced on medial margin; distal segment with length to width ratio 1.37; distal segment with 13-14 elongate, simple setae on distal and medial margins; right incisor process with five denticles (right

mandible) or seven (left mandible); right incisor accessory process with 18 minute denticle; left incisor process with seven denticles; left incisor accessory process with seven minute denticle; diastema very small, width to mandible width ratio 0.075; molar process on each mandible similar consisting of masticating surface covered in many minute, robust simple spinules and no grinding surface.

Maxillula medial endite with five subequal plumose setae, one small robust and a row of fine setules on distomedial margin; lateral lobe with 11 robust, dentate spines arranged in two rows. Maxilla consists of four lobes; medial endite with eight distal plumose setae and eight slender, simple setae on medial margin; lobe 2 with four distal plumose setae; lobe 3 with six distal plumose setae; lateral lobe 4 with six distal plumose setae and one small simple setae on distolateral margin.

Maxilliped coxa with a triangular extension on the medial edge with three terminal, robust, simple setae; coxa with no epipodite; basis very narrow, with two segmented tubular exopodite; praeischium with 12 simple setae along medial margin and a tuft of seven setae on distolateral corner; dactylus with four claws.

Thoracopods 1-7 continuously decreasing in length; thoracopods 8 longest; thoracopod basis not fused with the ischium; thoracopods similar; thoracopods 2-6- thoracopod 2 coxa with one small, tubular epipodite; thoracopod 2 basis with no exopodite; thoracopods 3-6 coxa with one large, tubular epipodite; thoracopods 3-6 basis with one large multisegmented exopodite with two elongate plumose setae, one on each distal corner; thoracopod 7 coxa with one large, tubular epipodite; thoracopod 7 basis with one large, tubular exopodite; thoracopod 8 with no epipodites or exopodites; dactylus with four claws consisting of one longest, two moderately long and one short claw; dactylus with four claws; pleopods- pleopods 3-4 reduced to single segments with three to four short, simple setae and one short and one elongate plumose setae; pleopod 5 without appendages.

Male pleopod 1 with three segments; protopod short, length to width ratio 0.56, with one simple seta on the subdistal lateral margin; pleopod 1 exopodite multisegmented with seven segments, each with two elongate plumose setae, one on each distal corner; pleopod 1 endopodite single segment, folded to produce a medial groove along the length of the segment; medial margins with mid rounded extension; dorsal medial margin extension with row of seven coupling hook setae and tapered distally; ventral margin extension with row of approximately 20 minute dentate spines followed with rectangular distal tip.

Male pleopod 2 consisting of five segments; protopod segment 1 with two simple setae and one elongate, plumose setae on posterior margin; protopod segment 2 with simple, medial setae; endopodite segment one elongate, medially curved, length to width ratio 3.0 with circular group of coupling hook setae on subproximal medial margin; coupling hooks setae appear two segmented with two digitate extensions; endopodite segment 2 elongate, narrow, length to width ratio 2.4 with one row of five dentate, distally directed spines on the lateral and medial margins; endopodite segment 3 stylet shaped, medially curved with fine rounded tip; length to width ratio 16.5 with a narrow lateral extension extending from mid length to the tip.

Uropod protopod length to total length of exopodite 0.65; protopod robust and elongate, length to width ratio 1.65; protopod dorsolateral margin with 17 robust, dentate setae; protopod ventromedial margin with

two elongate, plumose setae; exopodite 2 subequal segmented rami; proximal segment length to width ratio 3.0; lateral margin with 16 robust, dentate setae of variable lengths; medial margin with 10 robust, dentate setae of variable lengths; distal segment length to width ratio 3.3; lateral margin with seven robust, dentate setae of increasing lengths distally; medial margin with six robust, dentate setae of increasing lengths distally; distal margin with four robust, dentate setae of subequal lengths; dorsal surface with one subdistal, robust, dentate seta; endopodite 2 subequal segmented rami; proximal segment length to width ratio 2.7; lateral margin with 11 robust, dentate setae of subequal lengths; medial margin with 12 robust, dentate setae with lengths increasing distally; dorsal surface with two large and four small plumose setae on lateral side and one subdistal, robust, dentate setae; distal segment length to width ratio 2.9; lateral margin with five robust, dentate setae of subequal length medial margin with four robust, dentate setae of subequal and one minute simple seta; distal margin with four robust, dentate setae of subequal lengths; dorsal surface with one subdistal, robust, dentate seta; pleonite 6 posterior margin with 11 elongate spines extending 0.55 length of telson; the spine arrangement is one long lateral spine, two short, one long and two short medial spines.

Habitat

The hyporheic zone of a coarse sand and gravel stream.

Distribution

Restricted to type locality in the mid sections of Halls Creek, south east of Manilla, to the north west of Tamworth, North West New South Wales, Australia. The stream drains the granite regolith of the southern New England Tablelands within the Namoi River catchment.