

## A new species of *Quinquelaophonte* (Crustacea: Copepoda: Harpacticoida: Laophontidae) from Port Phillip Bay, Victoria, Australia

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### Abstract

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A new species of *Quinquelaophonte* Wells, Hicks and Coull, 1982 from Port Phillip Bay, is separated from its congeners by the presence of five elongate setae on P1 exopod-2. The P1 exopod-2 of all other species of *Quinquelaophonte* has two long setae and three shorter spines. In addition, the P1 endopod-2 of the new species has an accessory seta that is longer than the terminal claw. This condition is also present in *Q. wellsi*, the only other species of *Quinquelaophonte* described from Australia. The new species brings the total number of species of *Quinquelaophonte* to ten.

### Keywords

*Quinquelaophonte*, Laophontidae, Harpacticoida, marine Copepoda, Port Phillip Bay, Victoria, Australia

### Introduction

Australia's harpacticoid fauna is diverse. In a recent survey of harpacticoids from Port Phillip Bay more than 50 species were identified from the shallow subtidal seagrass and surrounding sandy areas (Walker-Smith, 2003). It is estimated that only a small percentage of Australian harpacticoid species has been described; 94 species have been described from marine, estuarine and brackish water ecosystems, although worldwide there are in excess of 3000 species (Giere, 1993; Huys et al., 1996). Sixty-four of the species found in Australia are considered endemic.

Nine species of *Quinquelaophonte* Wells, Hicks and Coull, 1982 have been described from around the world (Lee, 2003), including *Q. wellsi* (Hamond, 1973), which was described from a saline lake in South Australia. During a survey of Harpacticoida in Port Phillip Bay, a new species of *Quinquelaophonte* common on the surface of the unvegetated sediment adjacent to the subtidal seagrass, *Heterozostera tasmanica* (Martens ex Ascherson) den Hartog, was discovered. This new species was rarely found among the seagrass itself (Walker-Smith, 2003). Several other species of *Quinquelaophonte* are considered to be sediment-surface dwellers; *Q. wellsi*, *Q. candelabrum* Wells, Hicks and Coull, 1982 and *Q. longifurcata* (Lang, 1965) (Hamond, 1973; Wells et al., 1982; Lang, 1965).

Seagrass and sediment samples were collected by hand (Walker-Smith, 2003) and fixed in 4% buffered formalin in sea-water. After (at least) 48 hours samples were washed over a 63- $\mu$ m mesh sieve and retained material was transferred to 70% ethanol. Samples were examined under a Zeiss Stemi SV 11 or a Wild M8 stereomicroscope and harpacticoids were extracted using fine forceps. Harpacticoids were dissected in a drop of glycerol on a microslide, using electrolytically-sharpened tungsten needles. Appendages were mounted in glycerol. Microslides were examined using three microscopes (Olympus BX50 and Leica DMR compound microscopes with Nomarski interference contrast, Leitz Dialux 22 compound microscope). Illustrations were made with the aid of a camera lucida. Once appendages were illustrated, they were permanently mounted in Gurr's Aquamount and coverslips were sealed with clear nail varnish. Scanning electron micrographs were taken using a Philips XL20 scanning electron microscope (KV=10, spot size 3).

Terminology used follows that of Huys and Boxshall (1991). Abbreviations used are: A1, antennules or first antennae; A2, antennae or second antennae; Mx1, maxillules; Mx, maxillae; P1–P4, swimming legs 1–4. Individual segments of P1–P4 rami are written (for example) as P1 exopod-3, which refers to the third or terminal segment of the P1 exopod. P5 and P6 refer to the fifth and sixth legs. Total length measurements are from the base of the rostrum to the posterior margin of the caudal rami (caudal setae are excluded). Armature formulae (also known as the setal formulae) for swimming legs are constructed following the methods of Lang (1934) (also see Huys and Boxshall, 1991: 29). The term "armature" is used to refer collectively to setae and spines. Type material is held in Museum Victoria (NMV) and the South Australian Museum (SAM).

Table 1. Distribution of *Quinquelaophonte* species

Species	Distribution	Reference
<i>Q. brevicornis</i> (T. Scott, 1894)	Ghana	T. Scott, 1894
<i>Q. quinquespinosa</i> (Sewell, 1924)	India: Chilka Lake, Orissa	Sewell, 1924
	Egypt: Lake Menzaleh	Gurney, 1927
	Bermuda	Willey, 1930; Lang, 1948
	Tunisia: Goulette	Monard, 1935
	Réunion	Chappuis et al., 1956
	Angola: Benguela	Candeias, 1959
	USA: Puget Sound, Seattle, Washington State	Wieser, 1959
	France: Marseilles	Bodin, 1964; Hamond, 1973
	Mozambique: Inhaca Island	Wells, 1967
	Seychelles: Aldabra	Wells and McKenzie, 1973
	Andaman Islands	Wells and Rao, 1987
<i>Q. capillata</i> (Wilson, 1932)	USA: Katama Bay, Marthas Vineyard, Massachusetts;	Wilson, 1932; Coull, 1976, 1986
	North Inlet, Georgetown, South Carolina	Coull, 1986
	Bahamas: Eleuthera; Crooked Island	Fiers, 1986
<i>Q. longifurcata</i> (Lang, 1965)	USA: California	Lang, 1965
<i>Q. parasigmoides</i> (Božić, 1969)	Réunion: St Phillippe	Božić, 1969
<i>Q. wellsi</i> (Hamond, 1973)	Australia: Robe and Beachport, South Australia	Hamond, 1973
<i>Q. candelabrum</i> Wells, Hicks and Coull, 1982	New Zealand: Raion Point, Pauatahanui Inlet, Porirua Harbour, Wellington; Papanui Inlet, Otago Peninsula; Whangateau Harbour, Northland; Avon-Heathcote Estuary, Christchurch; Hobson's Bay, Waitemata Harbour, Auckland	Wells, Hicks and Coull, 1982
<i>Q. bunakenensis</i> Mielke, 1997	Indonesia: Sulawesi	Mielke, 1997
<i>Q. koreana</i> Lee, 2003	Korea: Taean	Lee, 2003
<i>Q. prolixasetae</i> sp. nov.	Australia: Port Phillip Bay, Victoria	present study

***Quinquelaophonte*** Wells, Hicks and Coull, 1982

*Quinquelaophonte* Wells, Hicks and Coull, 1982: 178–179.

*Type species.* *Laophonte quinquespinosa* Sewell, 1924.

*Diagnosis.* A1 of female with 5 or 6 segments; A2 exopod reduced, 1-segmented; P2–P4 exopods of male strongly modified; P2 endopod of male not modified (same as for female); P5 of male reduced to 4–5 setae arising from the somite margin; caudal rami with 3 terminal setae, only one of which is well developed (seta V).

*Species.* *Quinquelaophonte brevicornis* (T. Scott, 1894); *Q. quinquespinosa* (Sewell, 1924); *Q. capillata* (Wilson, 1932); *Q. longifurcata* (Lang, 1965); *Q. parasigmoides* (Božić, 1969); *Q. wellsi* (Hamond, 1973); *Q. candelabrum* Wells, Hicks and Coull, 1982; *Q. bunakenensis* Mielke, 1997; *Q. koreana* Lee, 2003; *Q. prolixasetae* sp. nov.

*Distribution.* See Table 1.

*Habitat.* Marine, intertidal and shallow subtidal; in saline lakes; sand and mud. Frequently recorded in detritus-rich habitats.

*Remarks.* Fiers (1986) discovered specimens of *Q. quinquespinosa* (from the West Indies) and noted the specimens had an “interesting feature”: the inner distal edge of P3 endopod-1 with a few “long and fragile hairs” (Fiers, 1986: 142). Because Fiers (1986) believed these “hairs” resembled the inner seta of *Q. parasigmoides*, he suggested *Q. parasigmoides* was within the range of variability of *Q. quinquespinosa* and therefore

should be considered synonymous with it. However, Lee (2003) rejected this, instead believing confirmation of the synonymy required examination of more specimens, from more localities and I agree.

In his catalogue of marine harpacticoids, Bodin (1997) listed *Paronychocamptus wilsoni* Coull, 1976 as a junior synonym of *Q. capillata* but Lee and Huys (1999) recognized *P. wilsoni* as a valid species and I support this. Inspection of Coull's (1976) illustrations of *P. wilsoni* revealed distinct differences between this species and *Q. capillata*. Firstly, the P3 endopod-2 of male *P. wilsoni* is modified and has a spine-like distal outgrowth and this modification does not occur in *Q. capillata*. Secondly, the P5 exopod of the male is well developed and has four setae in *P. wilsoni* but is reduced and represented by five setae in *Q. capillata*. For all other species of *Quinquelaophonte* the P5 exopod of male is reduced. The P5 of female *P. wilsoni* has only four setae on the baseoendopod and five setae on the exopod, while in *Q. capillata* there are five setae on the baseoendopod and six setae on the exopod. The caudal setae of the two species also differ; *P. wilsoni* has two well developed terminal setae but *Q. capillata* has only one well developed terminal seta (seta V) — the possession of only one well developed caudal seta is a character state defining *Quinquelaophonte*. The setal formula for the swimming legs also varies between these species (Table 2). Lastly, when Coull (1986) re-examined Wilson's type material he discovered the A2 exopod of *Q. capillata* had three setae, and not two as originally reported. The A2 exopod of *P. wilsoni* has only two setae.

Table 2. Comparison of the setal formulae of *Quinquelaophonte capillata* and *Paronychocamptus wilsoni*. Endp = endopod; exp = exopod.

	Segments of swimming legs				
	P2 endp-2	P3 exp-3	P3 endp-3	P4 exp-3	P4 endp-2
<i>Q. capillata</i>	1.2.0	1.2.3	2.2.1	1.2.3	1.1.1
<i>P. wilsoni</i>	2.2.0	2.2.3	3.2.1	1.2.2	1.2.0

***Quinquelaophonte prolixasetae* sp. nov.**

Figures 1–8

**Material examined.** Holotype. NMV J52388 (ovigerous female, on 8 slides). Australia, Victoria, Port Phillip Bay: at the end of Grand Scenic Drive, in front of the Sands Caravan Park, Moolap (38°09.92'S 144°28.42'E). Collected from the surface of unvegetated sediments, adjacent to subtidal seagrass beds of *Heterozostera tasmanica* (water depth approximately 1 m), G. K. Walker-Smith, 17 Nov 1997.

Paratypes. NMV J52389 (1 male, allotype, on 6 slides), NMV J53020 (1 female on 5 slides), NMV J53110 (1 female on 5 slides), NMV J53111 (1 female on 1 slide), NMV J53112 (1 male on 1 slide), NMV J53021 (20 adult females and 2 juveniles), NMV J53022 (9 males), SAM C6096 (20 females, including 2 ovigerous and 4 juveniles), SAM C6097 (9 males), SAM C6098 (8 females on a SEM stub), SAM C6099 (4 males on an SEM stub). All paratypes collected with the holotype.

Other material. NMV J48528 (13 specimens), NMV J48529 (3 specimens), NMV 48530 (5 specimens), NMV J48531 (12 specimens), NMV J48532 (29 specimens), NMV J48533 (3 specimens), NMV J48535 (103 specimens). Collection data as for holotype.

**Diagnosis.** A1 of female 6-segmented; A2 exopod with 3 setae; P1 exopod-2 with 5 thin, elongate setae; P1 endopod-2 accessory setae longer than terminal claw; P3 exopod-3 of female with 1 inner seta; P3 endopod-2 of female with 5 setae; P4 exopod-3 of female without inner seta; P4 endopod-2 with 3 setae; P5 exopod of female with 6 setae; P5 of male with 5 setae.

**Adult dimensions.** Females: mean length 0.85 mm ± 0.05 mm (n = 22). Males: mean length 0.82 mm ± 0.03 mm (n = 21).

**Description of female.** Body tapering posteriorly (Fig. 1A–B). Rostrum fused to cephalothorax, with 2 sensillae. Clear delineation of body somites. Somite margins with setules. Hyaline frill present on somite preceding anal somite. Anal somite with anal operculum (Figs 3D, 8D). Caudal rami length 3 times width (Fig. 3D); 3 setae on lateral margin (Figs 3D, 8C), seta I minute (difficult to see under compound microscope), seta IV reduced, seta V well developed and covered with minute spinules (only visible via SEM) (Figs 3D, 8C), terminal accessory seta (VI) on inner subdistal corner, dorsal seta (VII) triarticulate at the base.

Antennule 6-segmented (Fig. 2A), aesthetasc fused basally to seta on segment 4, terminal segment with smaller aesthetasc fused basally to 2 setae (i.e. tritheck). Antenna with allobasis (Fig. 2B), abexopodal seta reduced to a small spine no different from the surrounding spines, exopod reduced to single segment with 3 setae. Endopod with 2 pinnate spines

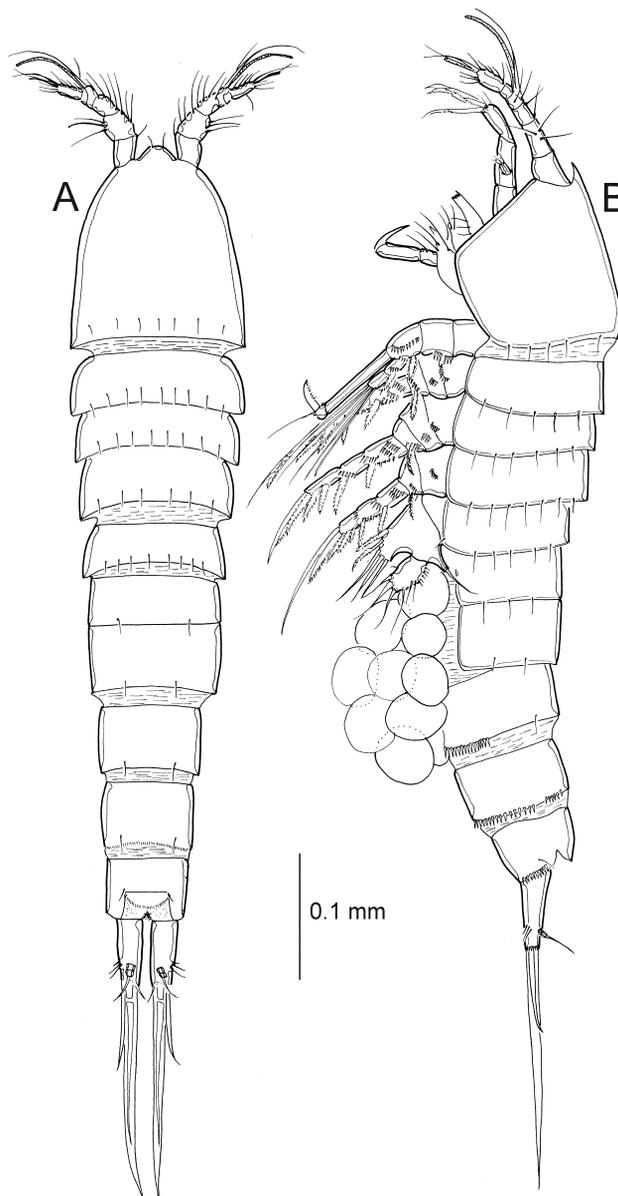


Figure 1. *Quinquelaophonte prolixasetae* sp. nov., female, paratype (NMV J53020): A, habitus, dorsal view; B, habitus, lateral view.

laterally and 3 geniculate setae and 2 pinnate spines terminally. Endopod also with spinules laterally and a subapical hyaline frill.

Mouthparts. Labrum with setules along anterior margin (Figs 2G, 7A). Paragnaths as in figures 2H and 7A. Mandible with well developed gnathobase (Fig. 2C), palp 1-segmented and with 4 setae (endopod and exopod fused to basis), endopod represented by 3 setae, exopod represent by 1 seta, basal armature represent by a larger pinnate seta. Maxillule (Figs 2D, 7A) arthrite with 6 spines and a row of setae on the posterior surface, also with 1 seta on lateral margin; coxa with 1 smooth seta, 1 long spine and a row of spinules on upper surface; endopod and basis fused, endopod represented by

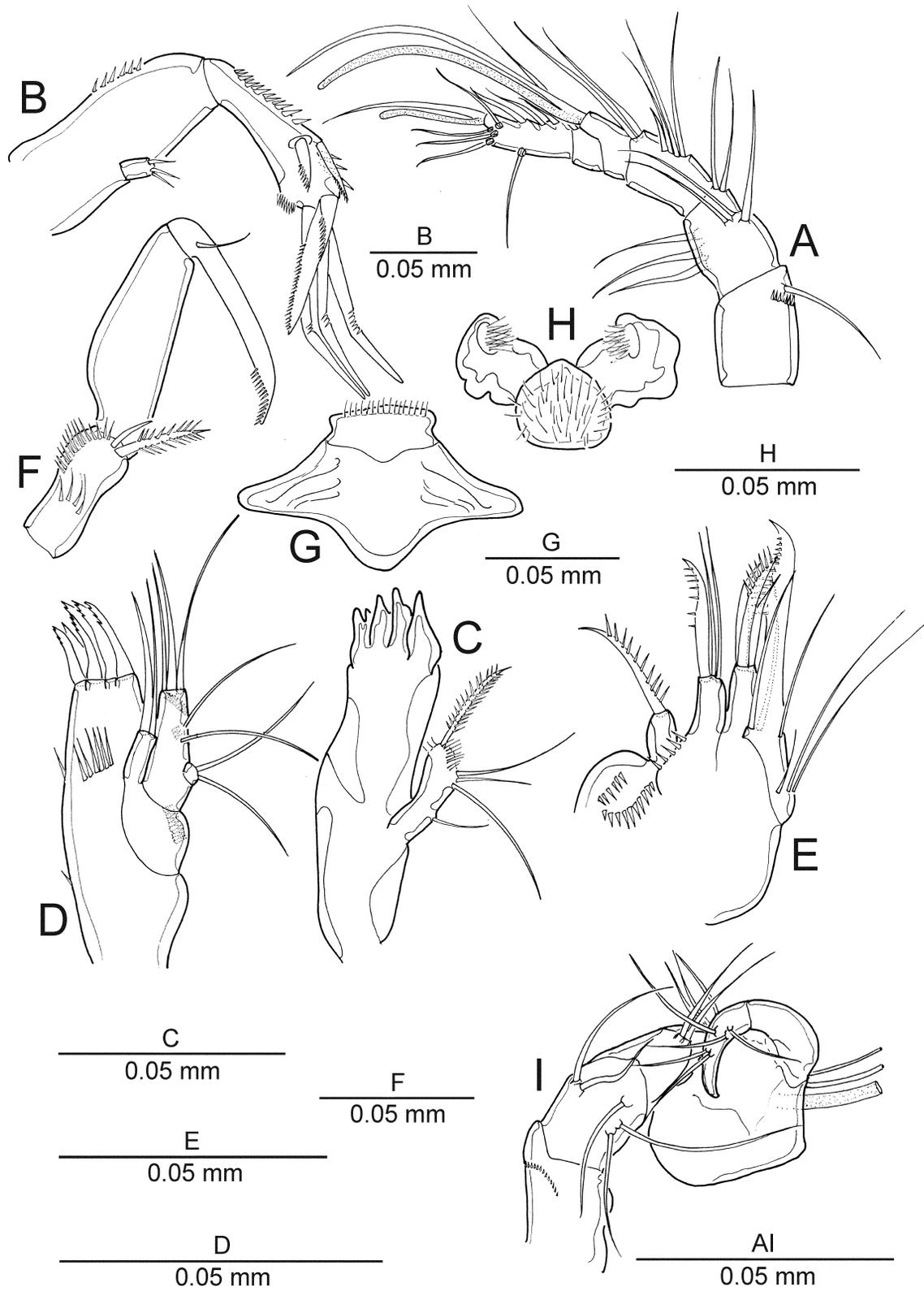


Figure 2. *Quinquelaophonte prolixasetae* sp. nov., female, holotype (NMV J52388): A, A1, ventral view; B, A2. Female, paratype (NMV J53110); C, mandible; D, maxillule. Female, paratype (NMV J53020): E, maxilla; F, maxilliped; G, labrum; H, paragnaths. Male, paratype (NMV J52389): I, A1, dorsal view.

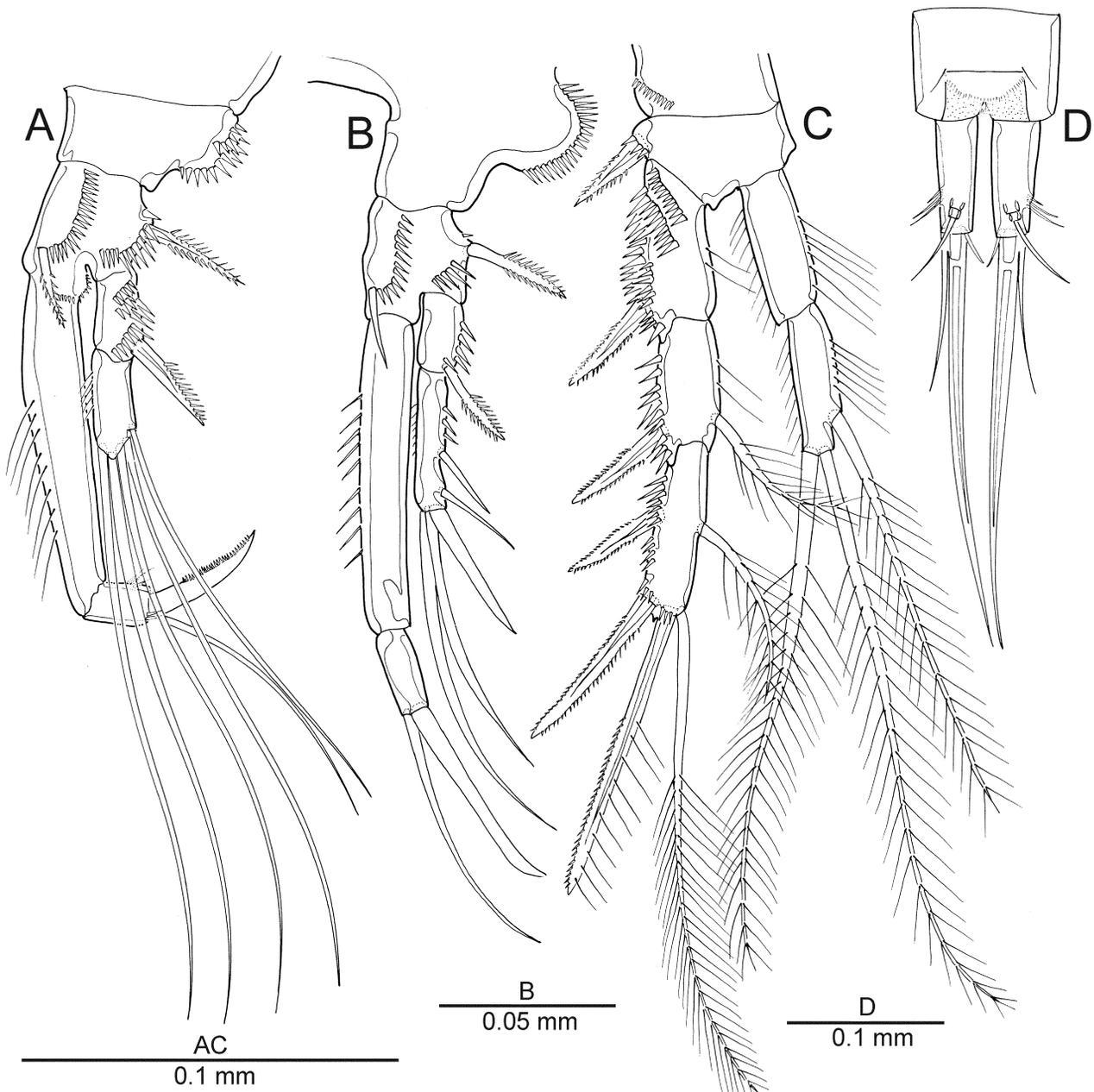


Figure 3. *Quinquelaophonte prolixasetae* sp. nov., female, holotype (NMV J52388): A, P1; C, P2. B, P2 *Q. wellsi* (redrawn from Hamond, 1973). Female, paratype (NMV J53020): D, caudal rami and anal somite.

2 setae, basis endite with 2 smooth setae and 1 long spine; exopod 1-segmented and with 2 smooth setae. Maxilla (Figs 2E, 7B) syncoxa with 3 endites, first endite with 1 spinose seta, middle endite with 2 setae and 1 pinnate spine, distal endite with 1 pinnate spine and 2 setae; allobasis with a pinnate claw and 2 smooth setae inserted at the base of the claw, also with 3 lateral setae that are remnants of the endopod. Maxilliped (Fig. 2F), prehensile, syncoxa with 2 setae, basis without ornamentation, endopod represented by terminal claw with 1 seta and some distal spinules.

P1 (Figs 3A, 8A–B) coxa with spinules on outer margin.

Basis with 2 rows of spinules and 2 spinulose spines. Exopod 2-segmented, exopod-1 with 3 rows of spinules and 1 unipinnate spine, exopod-2 with 5 elongate, smooth setae. Endopod 2-segmented, endopod-1 with fine setules along inner margin, endopod-2 with 1 spinulose claw, 3 setae on lateral margin and 2 short setae at the base of the claw, terminal accessory seta is more than twice the length of the claw.

P2–P4 exopod 3-segmented, endopod 2-segmented (Figs 3C, 4A–B). P2 endopod reaching just beyond distal margin of P2 exopod-2 (Fig. 3C). P3 endopod not reaching beyond distal margin of P3 exopod-2 (Fig. 4A). P4 endopod not reaching

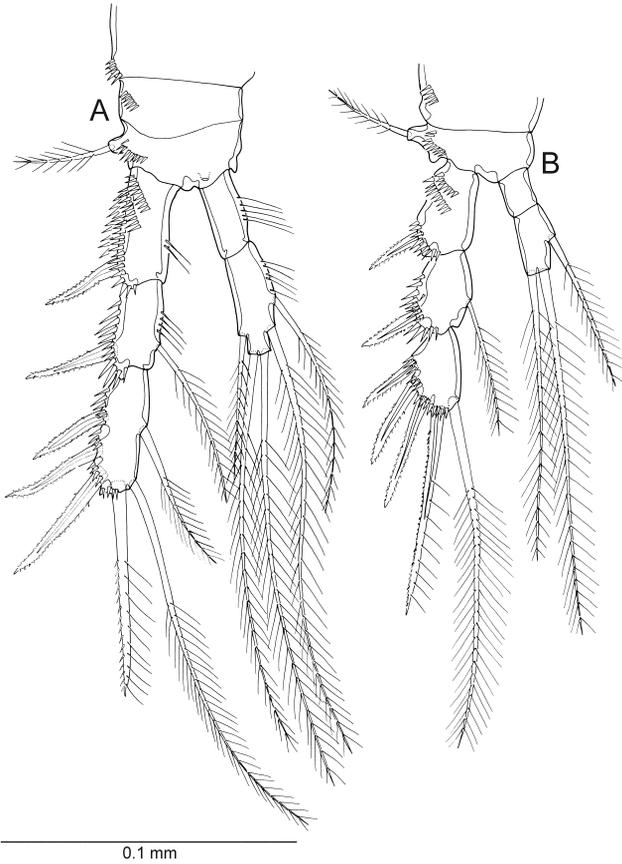


Figure 4. *Quinquelaophonte prolixasetae* sp. nov., female, holotype (NMV J52388): A, P3; B, P4.

beyond distal margin of P4 exopod-2 (Fig. 4B). P3 and P4 endopod-2 without tube pore.

Armature formulae for swimming legs:

Exopod	Endopod	
P2	0.1.123	0.120
P3	0.1.123	0.221
P4	0.1.023	0.120

P5 baseoendopod (Fig. 5C), outer setophore with 1 seta, endopodal lobe with 2 serrate spines and 3 smooth setae, endopodal lobe not reaching to distal margin on exopod. Exopod longer than wide, with 3 pinnate setae and 3 smooth setae, as well as some spinules.

**Description of male.** Male same as for female except for the following: A1 subchirocer and without seta on segment-1 (Figs 2I, 7C–F); P2–P4 larger and more chitinised (Figs 5B, 6A–B), lateral spines longer, exopod-3 almost at right angles to exopod-2. P4 endopod-2 more than 2 times length of endopod-1. P5 reduced to 5 setae (Fig. 5D).

**Etymology.** *Prolixus* (Latin): stretched out, long; plus *setae* (Latin): bristles; referring to the five elongate setae on P1 exopod-2.

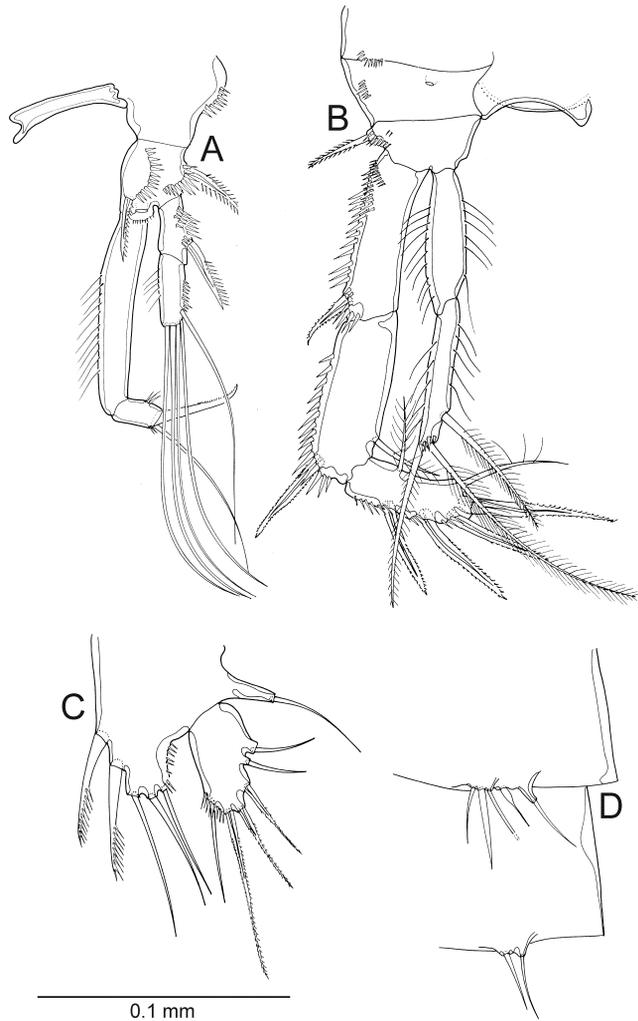


Figure 5. *Quinquelaophonte prolixasetae* sp. nov. male, paratype (NMV J52389): A, P1 and intercoxal sclerite; B, P2 and intercoxal sclerite; D, section of urosome, ventral view showing P5 and P6. Female, holotype (NMV J52388): C, P5.

**Distribution.** Australia, Victoria, Port Phillip Bay, specifically: Blairgowrie, St Leonards, Grassy Point, Point Richards, Clifton Springs and Moolap.

**Remarks.** Although all appendages of the holotype have been mounted on microscope slides, the orientation of the mouthparts did not allow for clear illustration, thus mouthparts have been illustrated using paratypes. Careful comparison of the holotype and paratypes were made.

**Discussion**

*Quinquelaophonte prolixasetae* is the second species of the genus described from Australia and is distinguished from its congeners by the presence of five elongate setae on the P1 exopod-2. All other species of *Quinquelaophonte* have two long setae and three spines on P1 exopod-2 (Fig. 3B).

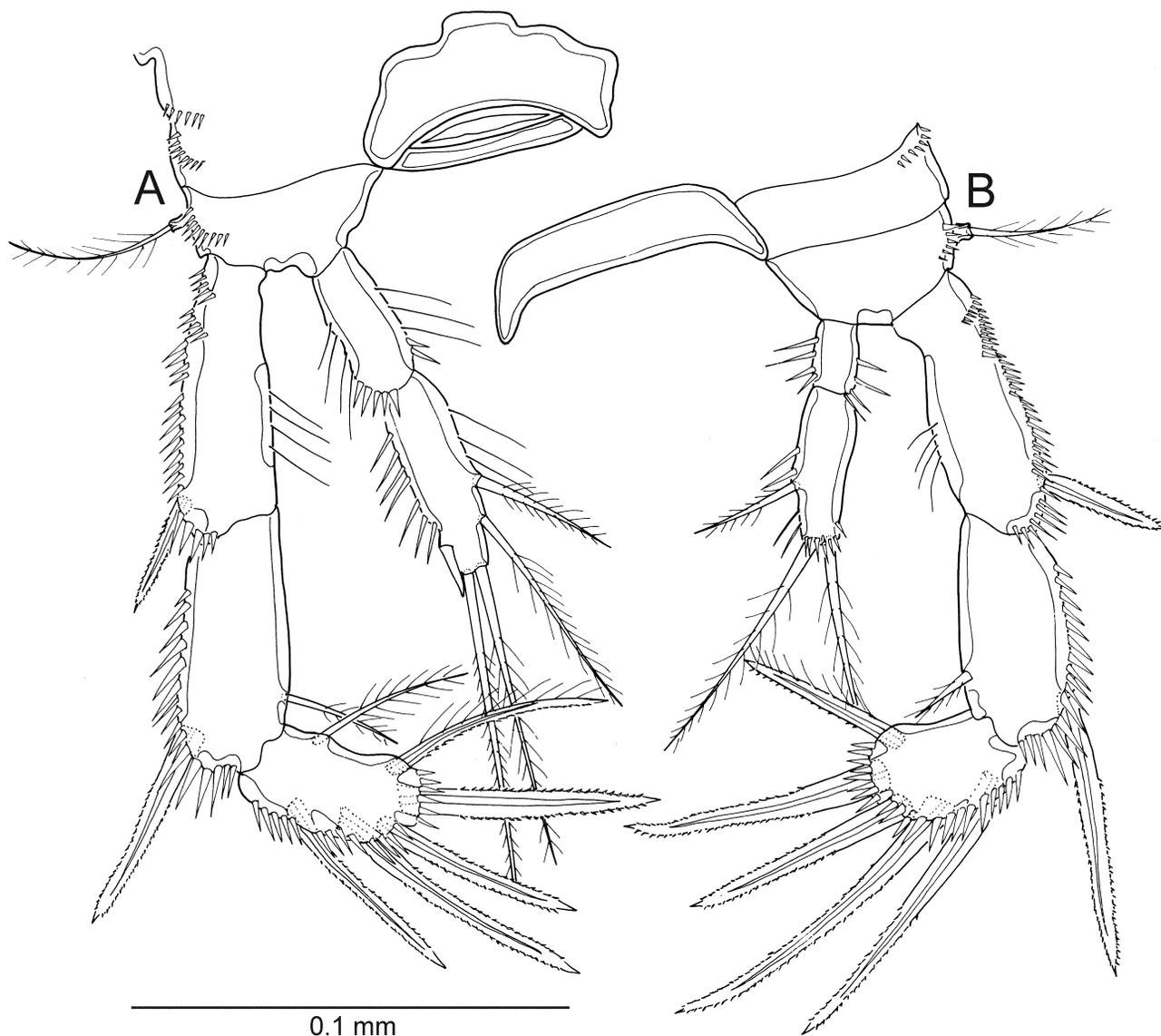


Figure 6. *Quinquelaophonte prolixasetae* sp. nov. male, paratype (NMV J52389): A, P3 and intercoxal sclerite; B, P4 and intercoxal sclerite.

*Quinquelaophonte prolixasetae* is most closely related to *Q. wellsi* (the other Australian species) sharing the unusual character of the P1 endopod-2 accessory seta longer than the terminal claw. Character states separating *Q. prolixasetae* from *Q. wellsi* are: P3 exopod-3 with one inner seta (two in *Q. wellsi*), P4 exopod-3 without an inner seta (with one in *Q. wellsi*) and the setation of P1 exopod-2 as mentioned above.

Many illustrations of species of *Quinquelaophonte* lack fine detail, however, in a recent paper (Lee, 2003) several smaller features, possibly omitted by previous authors, were illustrated. Lee (2003) noted the abexopodal seta on the A2 of *Q. koreana* was a "tiny . . . pinnate seta". In most illustrations of the A2 (of other *Quinquelaophonte* species) no distinction has been made between the abexopodal seta and the other spinules on the allobasis. This lack of distinction may be because the difference went unnoticed or it may simply be that the abexopodal seta

appears exactly like the other allobasis spinules. I was unable to distinguish the abexopodal seta of *Q. prolixasetae* from the other spinules on the ventral margin of the allobasis. The abexopodal seta of *Q. bunakenensis*, *Q. candelabrum* and *Q. wellsi* is longer than the neighbouring allobasis spinules (Mielke, 1997; Wells et al., 1982; Hamond, 1973). The maxillule of *Q. prolixasetae* also differed from that of *Q. koreana* having a short lateral seta on the lateral margin of the arthrite instead of a long one, as found in *Q. koreana*. The illustration of the maxillule arthrite of *Q. wellsi* did not include a lateral seta (Hamond, 1973). *Quinquelaophonte bunakenensis* and *Q. parasigmoides* both have a long seta on the distal end of the maxillule arthrite (Mielke, 1997; Božić, 1969). Lee (2003) noted P3 and P4 endopod-2 of *Q. koreana* possessed a tube pore. This character state was not observed in *Q. prolixasetae* and has not been illustrated for any other species of

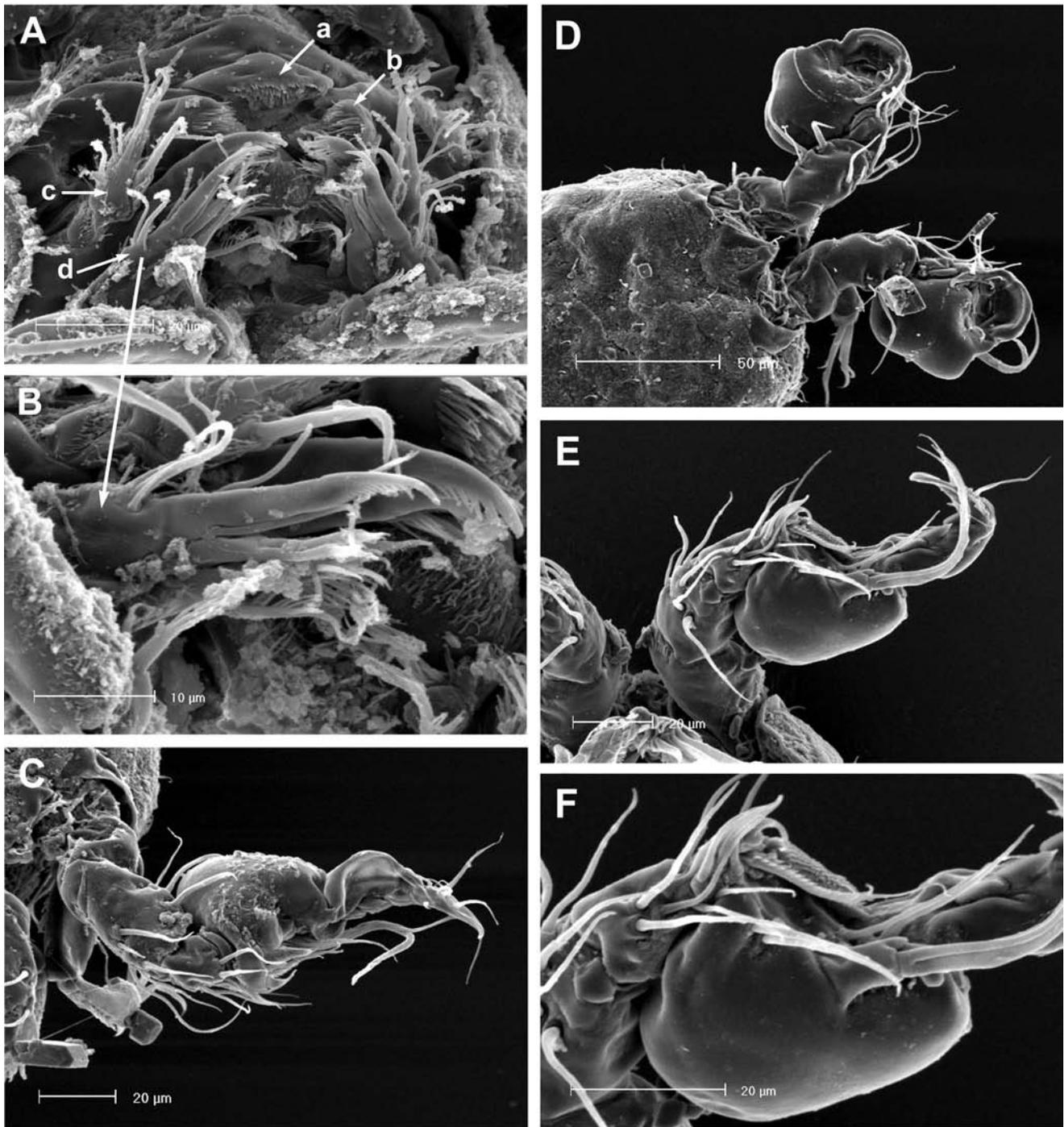


Figure 7. *Quinquelaophonte prolixasetae* sp. nov. Female (SAM C6098): A, mouthparts: a, labrum; b, paragnath; c, Mxl; Mx; B, Mx. Male (SAM C6099): C, A1 (open) dorsal view; D, A1 dorsal view; E, A1 ventral view; F, A1 ventral view close up.

*Quinquelaophonte*. The possession a single well developed terminal seta (V) on the caudal rami is a diagnostic feature of *Quinquelaophonte*. Seta V and seta IV are fused basally in *Q. koreana* but are not fused in *Q. prolixasetae*. The distal half of seta V of *Q. koreana* has tiny spinules covering the surface but the entire length of seta V of *Q. prolixasetae*, is covered with minute spinules.

Some of the character states distinguishing *Q. prolixasetae* from all other species of *Quinquelaophonte* are listed in table 3.

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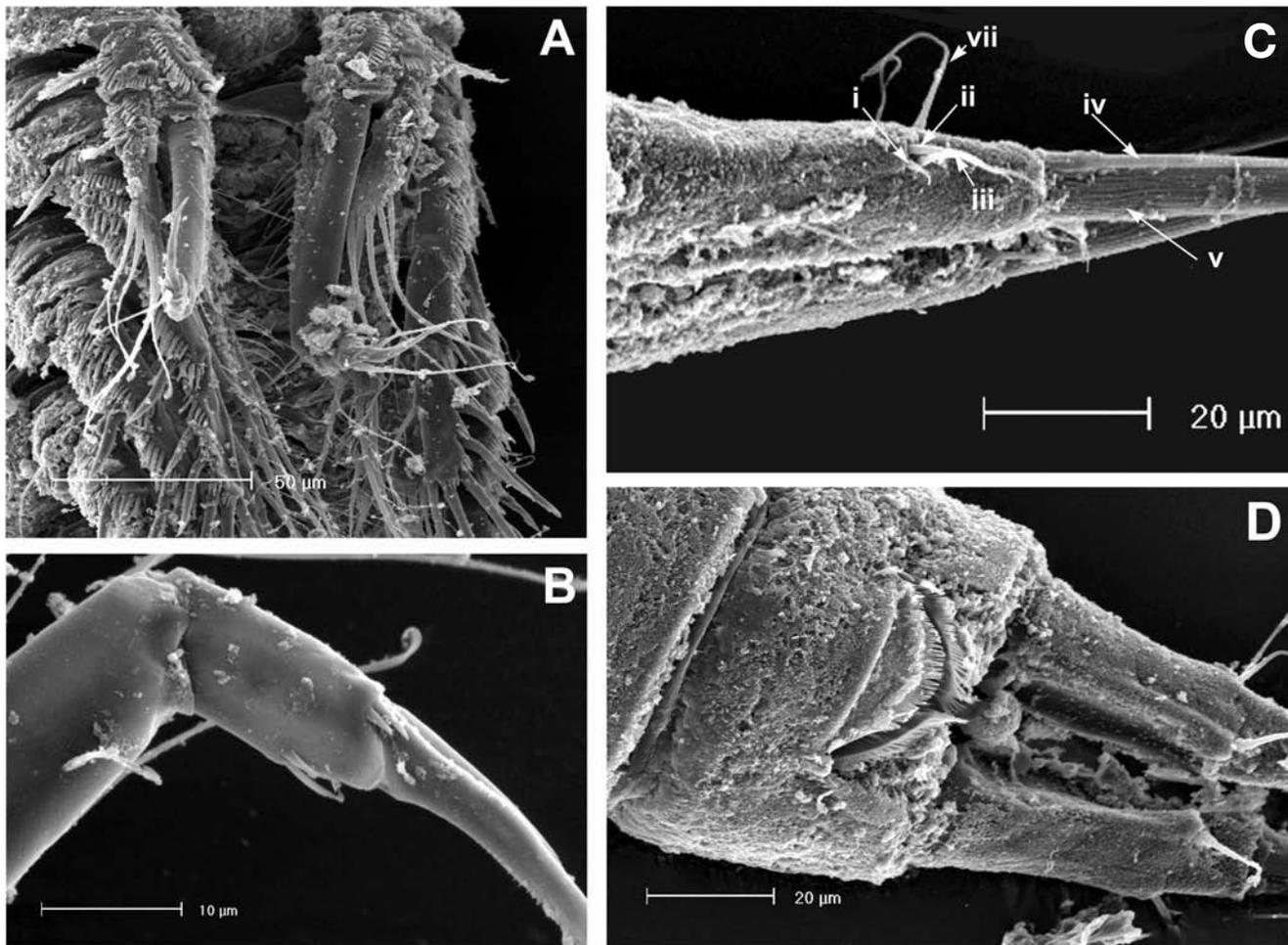


Figure 8. *Quinquelaophonte prolixasetae* sp. nov. female (SAM C6098): A, P1 dorsal view; B, P1 endopod-2 and claw; C, caudal rami, ventro-lateral view; D, anal operculum and caudal rami, dorsal view.

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