

LEVINEBALIA MARIA, A NEW GENUS AND NEW SPECIES OF LEPTOSTRACA
(CRUSTACEA) FROM AUSTRALIA

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Abstract

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The genus *Paranebalia* historically contained three species but with the discovery of a new species from southeastern Australia a new genus, *Levinebalia*, has been erected for *Paranebalia fortunata* Wakabara, 1976 and *L. maria* sp. nov. (type species). Species of *Levinebalia* differ from *Paranebalia* in: having the surface of their eyes smooth; lacking a setal brush on the mandible incisor; having smooth pleopod peduncle margins and having crenellations on the margin of pleonites 5, 6, and 7. The margin of pleonite 5 is smooth in *Paranebalia*. Of significance is antenna 2 of *Levinebalia*. It has several rows of small and medium-sized spines and patches of tiny spines on the third peduncular article and flagellum. In addition, there are conical sensory structures proximally on the third peduncle article. The conical sensory structures and spines on antenna 2 have not been observed in any other genus of Leptostraca.

Introduction

Historically there are six genera in the leptostracan family Nebaliidae Samouelle, 1819: *Nebalia* Leach, 1814; *Paranebalia* Claus, 1880; *Nebaliella* Thiele, 1904; *Dahlella* Hessler, 1984; *Sarsinebalia* Dahl, 1985; and *Speonebalia* Bowman, Yager and Iliffe, 1985. *Paranebalia* was recognised by Claus (1880) as being distinct from *Nebalia*, having thoracopods that extend beyond the ventral margin of the carapace, a greatly reduced epipod on the thoracopods and a rostrum without a keel but with a subterminal spine. *Paranebalia* contains three species, *P. longipes* (Willemoes-Suhm, 1875), *P. fortunata* Wakabara, 1976, and *P. belizensis* Modlin, 1991.

Paranebalia longipes and *P. belizensis* are most similar to one another having denticulate eyes, denticles or crenellations on the pleopod peduncles, and crenellations only on the dorsal margin of pleonites 6 and 7. They also share the presence of a setal brush on the mandible incisor. The setal brush is unique to *P. longipes* and *P. belizensis*.

Paranebalia fortunata and a new similar Australian species do not have denticulate eyes or crenellations on the pleopod peduncles and the dorsal margin of pleonite 5 and pleonites 6 and 7 have very small crenellations. The new species, here described as *Levinebalia maria* gen. et sp. nov., and *Paranebalia fortunata* have the unique structures on antenna 2 (Fig. 4a). Both species have several rows of small and medium spines, and patches of tiny spines, on the third peduncle article and the flagellum (Figs 5c, d, e) as well as conical structures proximally on the third peduncular article (Figs 5a, b). These may be chemosensory organs as vents can be seen around the base (Fig. 5b). Wakabara (1976: 300) observed spines on the third article of antenna 2 and the flagellum of *P. fortunata* and described them as “short, strong spines”. She did not however, mention any conical structures on antenna 2, but my examination of a paratype revealed their existence. The conical sensory structures and spines on antenna 2 have not been observed in any other genus of Leptostraca. For these reasons the two species are placed in a new genus, *Levinebalia*.

Methods

All specimens examined came from the collections of Museum Victoria (NMV). Specimens were dissected and mounted in glycerol and slides were viewed under an Olympus BH-2 or BX-50 compound microscope. Whole specimens and body parts were drawn with the aid of a camera lucida. Plumose setae are numerous on many body parts, but in most cases they have been figured without their setules so as not to obscure other details. Abbreviations used in figures are: RO, rostrum; A1, antenna 1; A2, antenna 2; MD, mandible; MX1, maxilla 1; MX2, maxilla 2; T1, T3, T8, thoracopods 1, 3, and 8; P1–P6, pleopods 1–6; and CR caudal rami or furca. Scale bars are 1 mm.

Terminology. I follow the usage of Watling (1989) for setal classification. *Spine* has been used for a non-articulating cuticular process, *seta* for an articulating cuticular process and *setule* for a flexible extension of the shaft of a seta. A *plumose seta* is a seta with a regular row of long setules on each side (Watling, 1989: Fig. 4g). The *comb-row* consists of a row of bi-pectinate setae (Fig. 6b) and is equivalent to the spine-row of other authors (e.g., Dahl, 1985: Fig. 155). The term *bi-pectinate* setae refers to setae that have a comb-like row of projections along each side of the central shaft of the seta.

Scanning electron microscopy (SEM). Leptostracan specimens examined under the scanning electron microscope (SEM) were dehydrated in an ethanol series (70%–absolute EtOH, with 10% increments). Specimens were left in each alcohol concentration for 30 minutes. Specimens were then placed in a 50:50 mixture of absolute ethanol and hexamethyldisilazane (HMDS), followed by a 25:75 solution of absolute ethanol and HMDS, then placed in 100% HMDS before being air-dried. Specimens were left in each HMDS solution for 10 minutes. Specimens were mounted on SEM stubs with double-sided Scotch™ tape. Stubs were sputter-coated with gold and examined under a Phillips 505 (tungsten filament) scanning electron microscope at 20 and 20.1 kv. The SEM was linked to a computer and the program Spectrum was used to capture the images.

Levinebalia gen. nov.

Type species. *Levinebalia maria* sp. nov.

Diagnosis. Carapace emarginate, not sculptured. Rostrum with subterminal spine, keel absent. Surface of eyes smooth, without denticles or

cuticular outgrowths. Eyes elongate and with ommatidia. Antenna 1 4-articulate, article 4 without robust setae but with a variable number of teeth along anterior margin. Male flagellum modified, either swollen (in juveniles) or transformed into a callynophore. Antenna 2 with 2 rounded cuticular outgrowths on peduncle article 3 and conical sensory organs (Fig. 4a), surface of peduncle article 3 and flagellum with patches of spines (Fig. 4a), dorsal spine absent. Mandible incisor without setal brush. Maxilla 1 palp long, well developed. Maxilla 2 endopod uni-articulate. Thoracopods closely spaced, long and tapering, extending beyond ventral margin of carapace; epipod small, shorter than exopod; endopods showing some articulation. Pleopods 1–4 peduncle margins smooth. Pleopod 1 exopod with or without comb-row of bi-pectinate setae (Fig. 6a). Pleonites 5, 6, and 7 margins with tiny crenellations. Pleonites 5, 6, and 7 all approximately equal in size. Pleopod 5 longer than pleopod 6. Caudal furca short and stout.

Composition. *Levinebalia maria* sp. nov.; *Levinebalia fortunata* (Wakabara, 1976) comb. nov.

Etymology. *Levi* (Latin) means smooth, referring to the absence of denticles on the surface of the eyes.

Remarks. *Levinebalia* differs from *Paranebalia* in a number of ways. Species of *Paranebalia* have denticulate eyes, distinctive crenellate margins only on pleonites 6 and 7 and crenellate pleopod peduncles. They also have a setal brush on the mandibular incisor. *Levinebalia* species have none of these characters. The unique characters of *Levinebalia* are the rows of small and medium spines and patches of tiny spines on the third peduncle article and flagellum of antenna 2 (Figs 5c, d, e) and the conical structures proximally on the third peduncle article (Figs 5a, b). These may be chemosensory organs as vents can be seen around the base (Fig. 5b).

Claus (1880) used the absence of a rostral keel and the presence of a rostral spine as characters defining *Paranebalia*. Both species of *Levinebalia* also have these characters. However, *Dahlella* and *Speonebalia* also lack a rostral keel and *Sarsinebalia* has a rostral spine. Their presence in species of *Paranebalia* and the two species assigned to *Levinebalia* suggests all are probably related but it is likely that these characters have arisen more than once. Indeed, *Paranebalia* and *Levinebalia* do share three unique synapomorphies: the elongate thoracopod;

reduced epipod; and rounded cuticular outgrowths on article 3 of antenna 2 (Figs 4a, b). However, the differences between *Paranebalia* and *Levinebalia* described above, especially the unique armature of antenna 2 which is not present in any other Leptostraca, suggest more strongly that the new genus *Levinebalia* should be erected for *Paranebalia fortunata* and the new Australian species.

Unfortunately, Wakabara (1976) did not mention the comb-row on the exopod of pleopod 1. Her illustration (Fig. 2f) indicates only one type of seta on the lateral margin of the pleopod 1 exopod. However my examination of a paratype of *Paranebalia fortunata* revealed the presence of a comb-row, half as long as the exopod. The finely bi-pinnate setae are approximately equal in length to the smooth setae found distally on the lateral margin of the exopod. I have also examined several other undescribed species of *Levinebalia* from the collection of Museum Victoria and all have comb-rows on the exopod of pleopod 1.

The most recent key to extant families and genera of Leptostraca (Martin et al., 1996) needs to be emended and a new key to the genera of the Leptostraca is in preparation (Walker-Smith and Poore).

Levinebalia is represented by *L. maria* from Tasmania, Australia and *L. fortunata* from New Zealand. Examination of material from Museum Victoria collections reveals *Levinebalia* is found throughout Australia; in New South Wales, Queensland, north Western Australia, South Australia, and Victoria but these specimens may not belong to the new species described here. *Paranebalia* has two described species: *P. longipes* originally identified from the Atlantic but also recorded from Bermuda (Willemoes-Suhm, 1975; Sars, 1887; Verrill, 1923; Clark, 1932), Virgin Islands (Thiele, 1904), southern Florida (Brattegard, 1970), West Indies (Thiele, 1905), Japan (Thiele, 1905), Gulf of Siam (Thiele, 1905) and Torres Strait (Thiele, 1905); and *P. belizensis*, from Belize, Central America. The first record of *Paranebalia* in Australia was by Hale (1929: 367) as *P. longipes* "or a closely allied species" from the coast of South Australia. Dahl (1985: 135) suggested *Nebalia* and *Paranebalia* which were originally "assumed to be composed of a small number of highly variable species, with more or less cosmopolitan distribution" actually contained a considerable number of species. The existence of many undescribed species of leptostracans in Australian museum collections (Dahl's and own unpublished obser-

vations in litt.; Walker-Smith, 1998) suggest that records of *Paranebalia longipes* remote from the type locality are dubious.

Levinebalia maria sp. nov.

Figures 1–6

Material examined. Holotype. Tasman Sea, 15 km E of Maria I., Tasmania (42°37'S, 148°20'E), 102 m, WHOI epibenthic sled, R.S. Wilson, on RV *Soela*, 9 Oct 1984 (stn SO5/84/1), NMV J34661 (1 female).

Paratypes. Collected with holotype, NMV J34663 (1 immature male, allotype). Australia, Tasmania, Maria I., 5 km NE of Mistaken Cape (42°37'S, 148°12.5'E), 100 m, fine muddy bryozoan sand, WHOI epibenthic sled, R.S. Wilson on RV *Challenger*, 23 Apr 1985 (stn TAS 31), NMV J34256 (10 females and 1 male). 15 km E of Maria I., (42°37'S, 148°20'E), 102 m, WHOI epibenthic sled, R.S. Wilson, on RV *Soela*, 9 Oct 1984, (stn SO5/84/1), NMV J34574 (19 immature males); NMV J13282 (40 specimens; mean carapace length, 3.19±0.43 mm); NMV J34573 (1 specimen; carapace length, 3.7 mm). 20 km E of Falmouth (41°32.9'S, 148°35.0'E), 122 m, WHOI epibenthic sled, R.S. Wilson, on RV *Soela*, 10 Oct 1984 (stn S05/84/05), NMV J13283 (4 specimens; mean carapace length, 3.15±0.03 mm). Off Freycinet Peninsula (42°2.20'S, 148°38.70'E), 800 m, coarse shelly sand, WHOI epibenthic sled, M.F. Gomon et al. on RV *Franklin*, 27 Jul 1986 (stn SLOPE 45), NMV J34576 (3 specimens; mean carapace length, 3.37±0.18 mm). Off Freycinet Peninsula (41°56.50'S, 148°37.90'E), 200 m, coarse bryozoan sand, WHOI epibenthic sled, M.F. Gomon M.F. et al. on RV *Franklin*, 27 Jul 1986 (stn SLOPE 49), NMV J34580 (4 specimens).

Description of holotype. Female (Fig. 1) with 3 embryos, entire length 4.8 mm. Carapace length 3.0 mm, depth 2.0 mm, emarginate, dorsally convex, anterior and posterior margin rounded, 3.6 times length of rostrum, posterior margin reaching pleonite 4, surface not sculptured.

Rostrum (Fig. 1) length 2.79 times width, greatest depth 0.23 times length, subterminal spine present, keel absent.

Eyestalks (Fig. 1) pigmented, ommatidial region 0.51 times length of eye, 0.69 times length of rostrum, width 0.41 times length, dorsal margin slightly convex, without denticles, dorsal papilla absent, tapering, rounded distally, supraocular scale absent.

Antenna 1 (Fig. 1) article 2 length 2.8 times width, 9 mesiodistal plumose setae; article 3 0.64 times length of article 2, with 10 distomedial plumose setae; article 4 medial flange with 19 teeth, each tooth with denticulate surface, numerous plumose setae over lateral and medial surface;

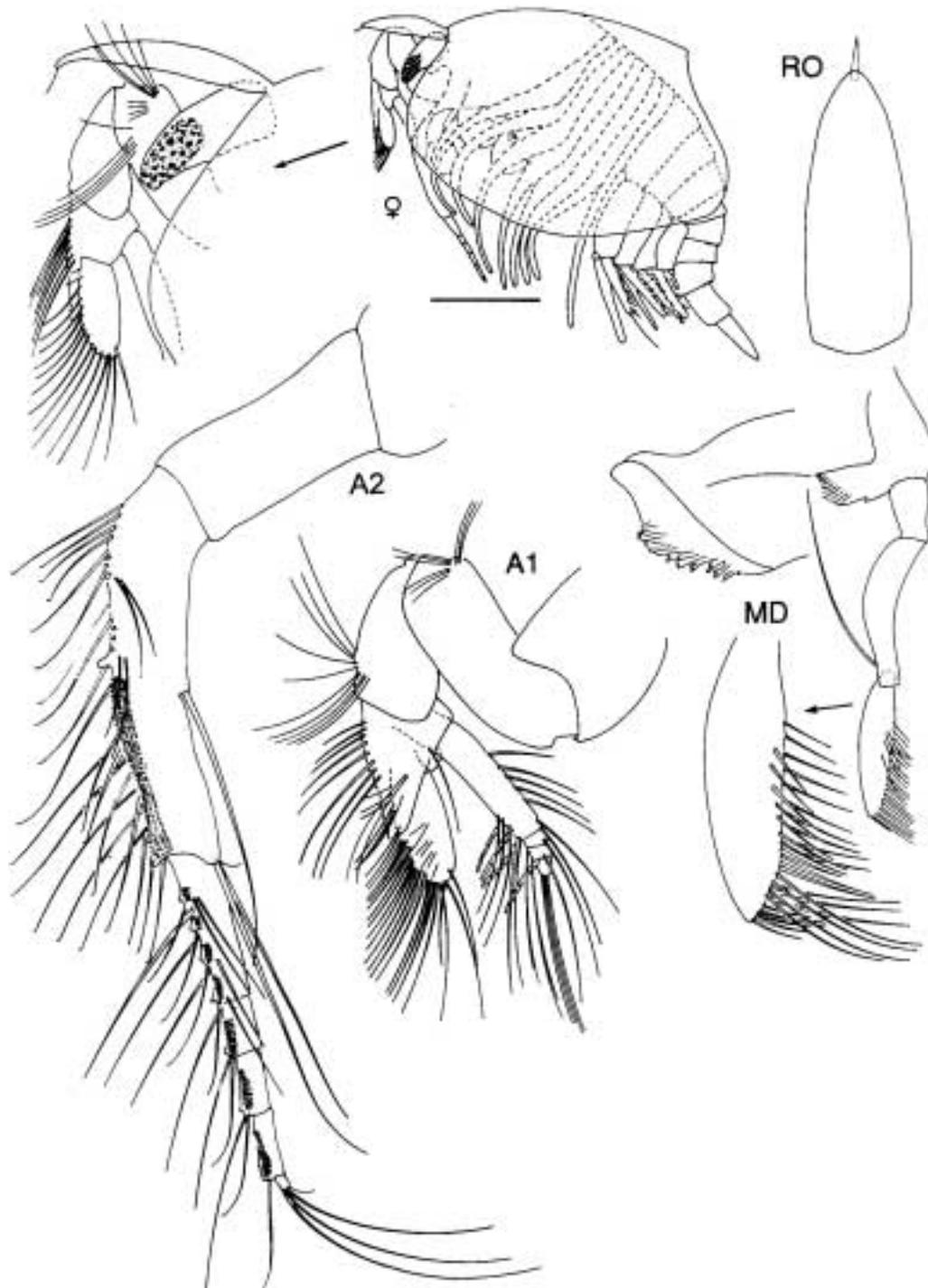


Figure 1. *Levinebalia maria*. Female holotype J34661: dorsal view of rostrum; medial view of antenna 1; lateral view of antenna 2; lateral view of mandible palp.

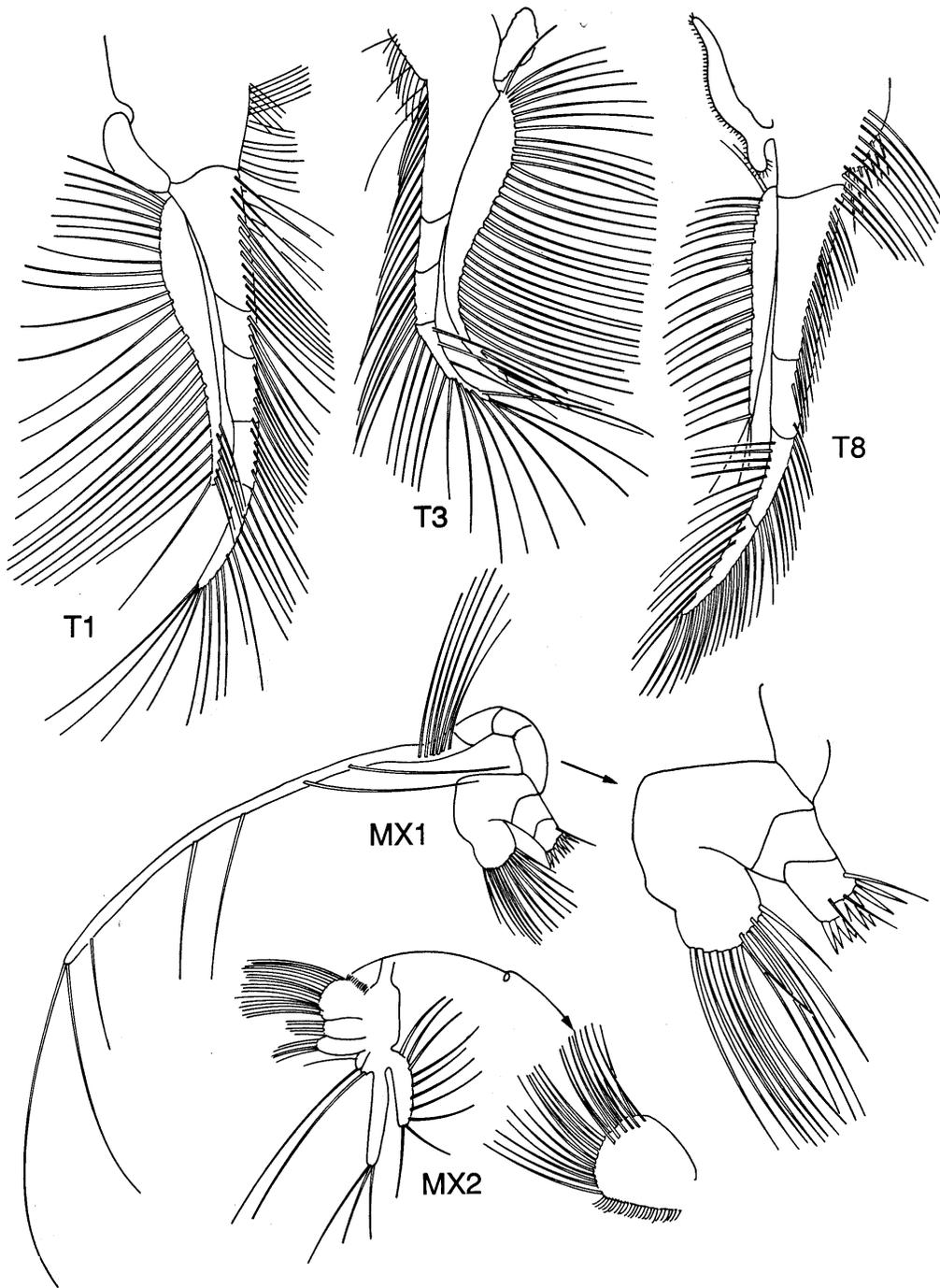


Figure 2. *Levinebalia maria*. Female holotype J34661: thoracopod 1 anterior view; thoracopod 3 posterior view; thoracopod 8 anterior view; maxillae 1 and 2.

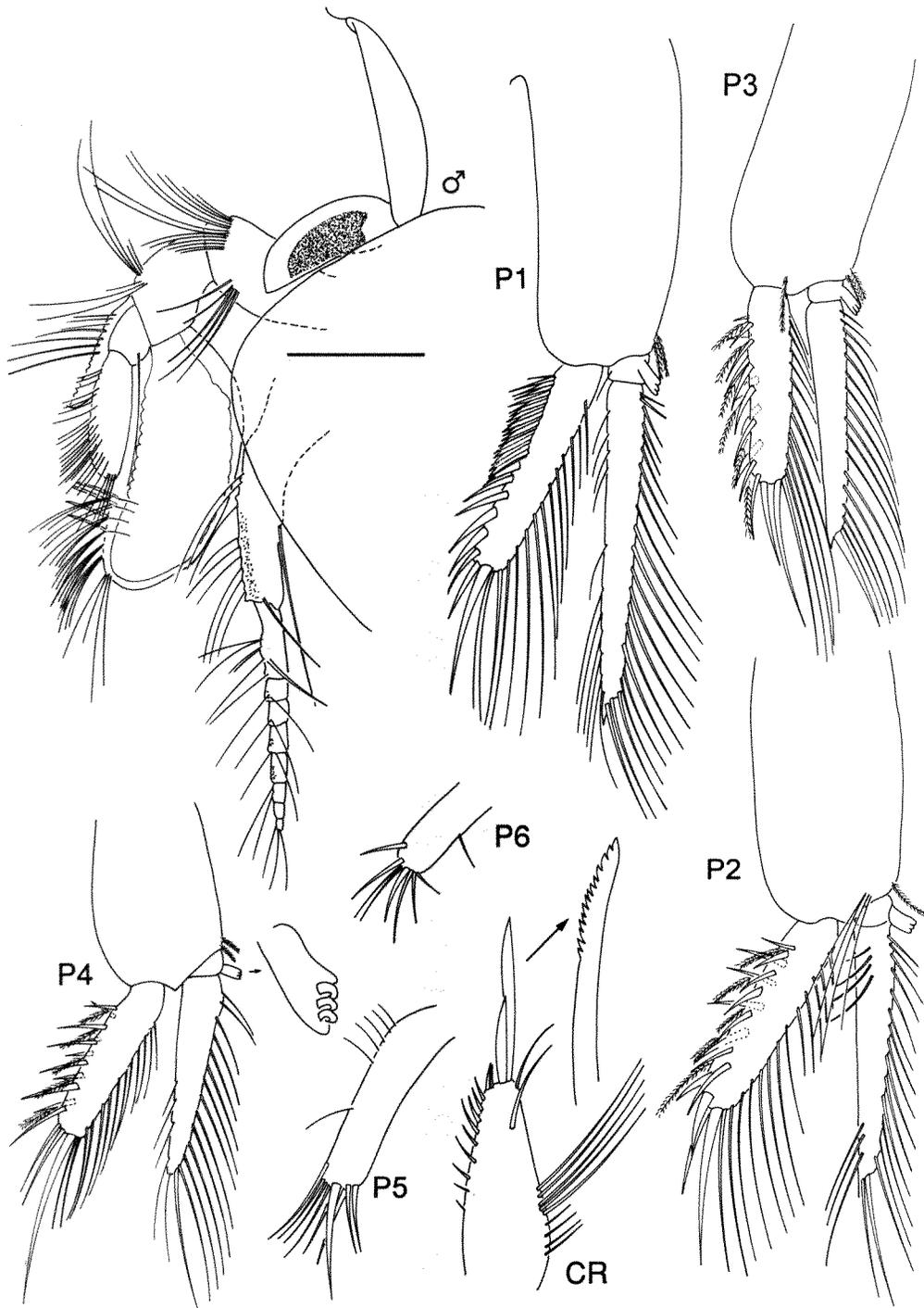


Figure 3. *Levinebalia maria*. Anterior section of male allotype J34663. Female holotype J34661: pleopods 1-4 anterior view; dorsal view of caudal furca.

swollen scale length 2.7 times width, heavily setose, with plumose setae; flagellum with 4 articles, article 1 0.8 times length of flagellum, 4 aesthetascs anteriorly.

Antenna 2 (Figs 1, 4a, 5) article 2 length 1.52 times width, without dorsal spine; articles 3 and 4 fused, combined length 2.19 times length of article 2, heavily setose on anterior surface, with 2 rounded cuticular outgrowths and a row of conical sensory organs, 1 row of spines, several rows of smaller spines and patches of tiny spines on the outer (lateral) surface of articles 3 and 4 and flagellum; flagellum with 6 articles, approximately 3 plumose setae per article.

Mandibular palp (Fig. 1) of 3 articles; article 2 with long medial seta; article 3 approximately equal in length to article 2, margins tapering, 3 rows of plumose setae along posterior and distal margin, increasing in length distally, terminal row of short setae; well developed molar process, without setal brush; mandible incisor with 1 tooth.

Maxilla 1 (Fig. 2) endite 1 rounded with 1 row of plumose marginal setae; endite 2 rectangular with 2 rows of simple robust setae and 3 plumose setae; palp long, well developed, with 12 lateral setae and 2 terminal setae.

Maxilla 2 (Fig. 2) with 5 endites; endite 1 expanded distally, margin with 3 rows of plumose setae, fine setae along proximal margin; endite 2 rectangular with 3 rows of plumose supracuticular setae; endite 3 approximately equal to endite 2, with 2 rows of plumose setae; endite 4 0.4 times length of endite 3, with 2 plumose setae; endite 5 same size as endite 4 with 1 long smooth seta; endopod 1.16 times the length of exopod, tapering distally, of 1 article, 3 plumose setae terminally; exopod with plumose setae along lateral and terminal margins.

Thoracopod endopods and exopods tapering distally (Fig. 2); epipods reduced. Thoracopod 1, exopod lateral and distomedial margins setose, 0.52 times length of endopod; endopod anterior margin with 2 rows of plumose setae; epipod 0.31 times length of exopod. Thoracopod 3, exopod lateral margin setose, 0.65 times length of endopod; endopod anterior margin with 2 rows of plumose setae, posterior margin with several plumose setae distally; epipod 0.3 times length of exopod, dorsal lobe longer than ventral lobe, dorsal lobe tapering distally, ventral lobe rounded, margin with fine hair-like setae. Thoracopod 8 exopod lateral margin setose, 0.41 times length of endopod; endopod anterior margin with 2 rows of plumose setae, posterior margin with single row

of setae distally; epipod 0.73 times length of exopod, dorsal lobe narrow and elongate, longer than ventral lobe, ventral lobe distally rounded, margin of epipod with thin hair-like setae.

Pleonites with tiny pointed denticles along dorsal margin of pleonites 5, 6, and 7; pleonite 7 0.67 times length of telson, 1.20 times length of pleonite 6, equal to pleonite 5, 1.20 times length of pleonite 4.

Pleopod 1 (Figs 3, 6) exopod 0.71 times length of peduncle, 0.67 times length of endopod, lateral margin with comb-row of bi-pectinate setae, comb-row 0.38 times length of exopod, 6 robust simple setae distally along lateral margin, 2 smooth robust setae terminally, medial margin with numerous long, fine plumose setae; endopod with long fine plumose setae on lateral and medial margins, 1 smooth seta and one short, stout spine terminally.

Pleopod 2 (Fig. 3) peduncle with 5 distal plumose setae, posterior margin not denticulate; exopod 0.82 times length of peduncle, 0.82 times length of endopod, lateral margin with 5 pairs of smooth setae, medial margin with long, fine plumose setae; endopod lateral and medial margins with long, fine plumose setae, robust smooth seta and stout spine terminally; reticulum present.

Pleopod 3 (Fig. 3) posterior margin of peduncle not serrate; exopod 0.73 times length of peduncle, 0.79 times length of endopod, 6 pairs of smooth setae, longer plumose setae between each pair, 3 terminal smooth setae, medial margin with long, fine plumose setae; endopod lateral and medial margins with long, fine, plumose setae, robust smooth setae and stout spine terminally; reticulum present above endopod.

Pleopod 4 (Fig. 3) peduncle without serrate posterior margin; exopod approximately equal to length of peduncle, 0.86 times length of endopod, lateral margin with 5 pairs of simple setae, longer plumose setae between smooth setae in each pair, 3 smooth setae terminally, medial margin with long, fine plumose setae; endopod lateral and medial margins with long, fine plumose setae, smooth robust seta and stout lateral spine terminally; reticulum present.

Pleopod 5 (Fig. 3) length 4.5 times width, with 8 simple setae terminally, fine plumose setae on lateral margin.

Pleopod 6 (Fig. 3) length 2.5 times width, with 9 simple setae on terminal margin, fine plumose setae on lateral margin.

Caudal furca (Fig. 3) 2.36 times long as wide, 1.44 times as long as telson, 0.17 times as long as carapace; with 9 short, subcuticular smooth setae

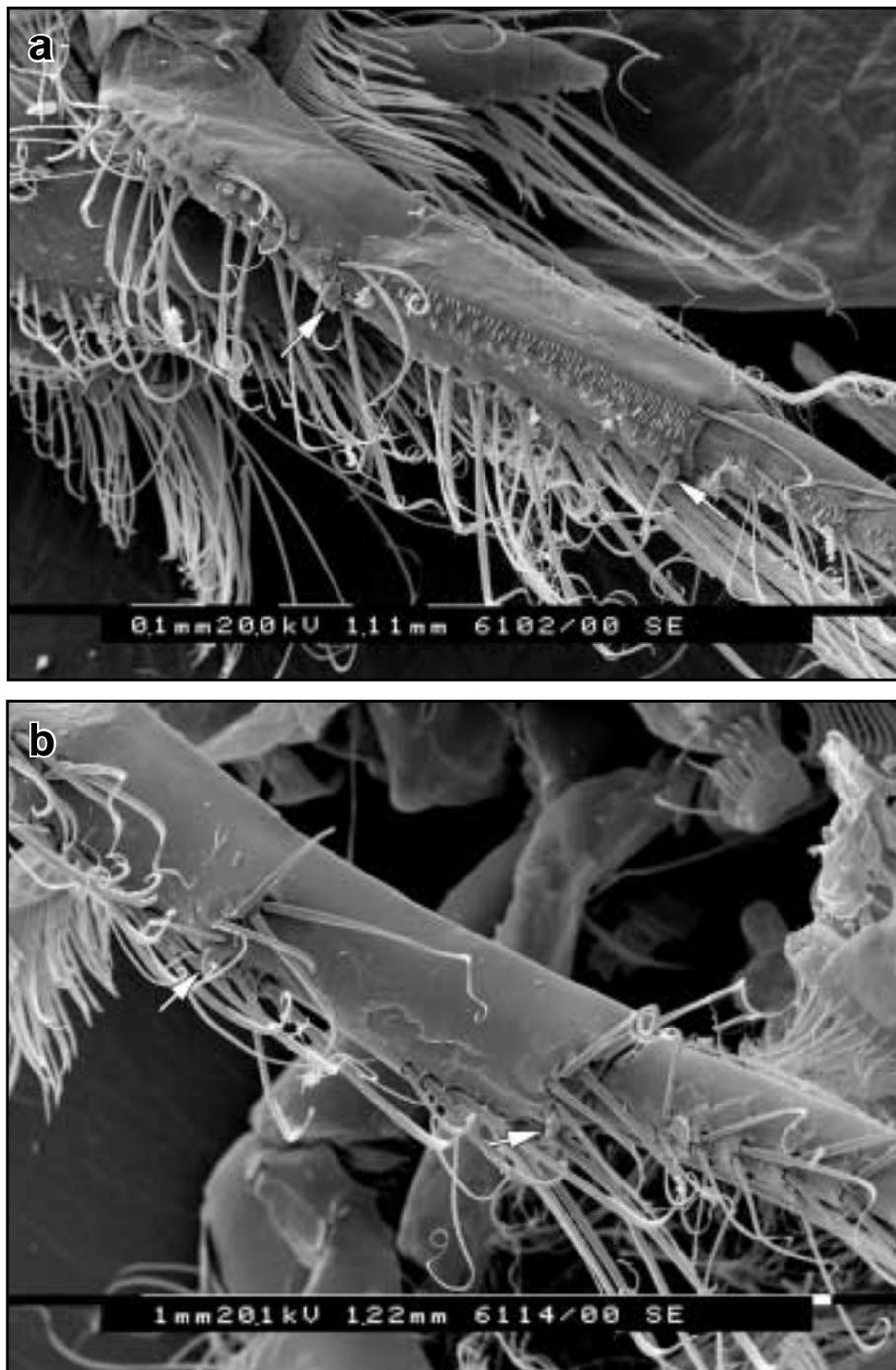


Figure 4. Antenna 2 in situ (left), peduncle article 3 and first article of flagellum. **a**, *Levinebalia maria* paratype J13282, note rows of small, spines. Arrows point to conical sensor organs and large cuticular projections. **b**, *Paranebalia* sp. J13278, note absence of small, spines. Arrows indicate large cuticular projections.

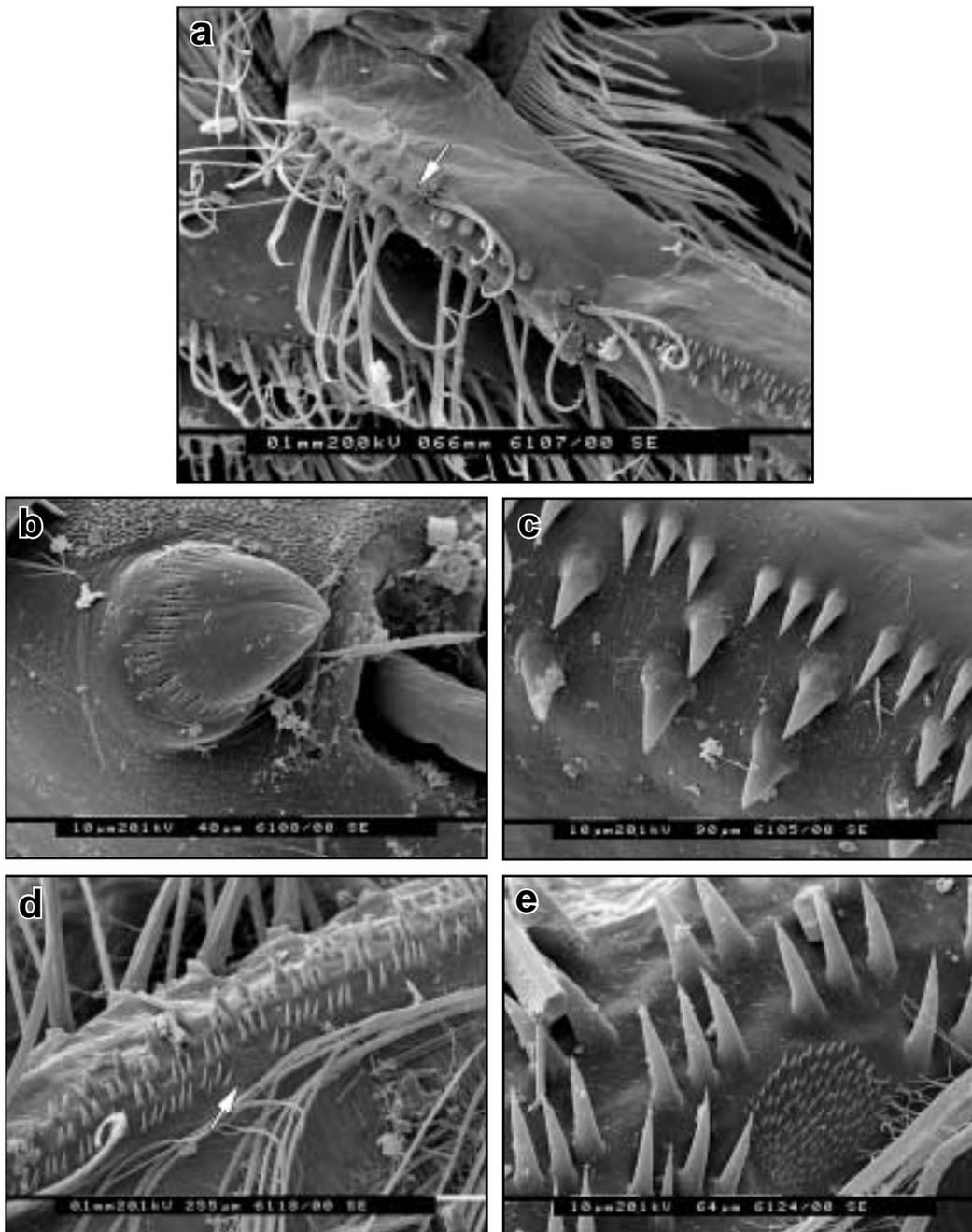


Figure 5. **a–c**, *Levinebalia maria* paratype J13282. **a**, antenna 2 (left) in situ. Arrows indicate conical sensory organs and large cuticular outgrowths. **b**, conical sensory organ. **c**, spines on article 3 of antenna 2. **d–e**, *Levinebalia maria* paratype, J34256. **d**, antenna 2 (right) in situ (proximal end of antenna at bottom of photo). **e**, area of spines, including patch of tiny spines.

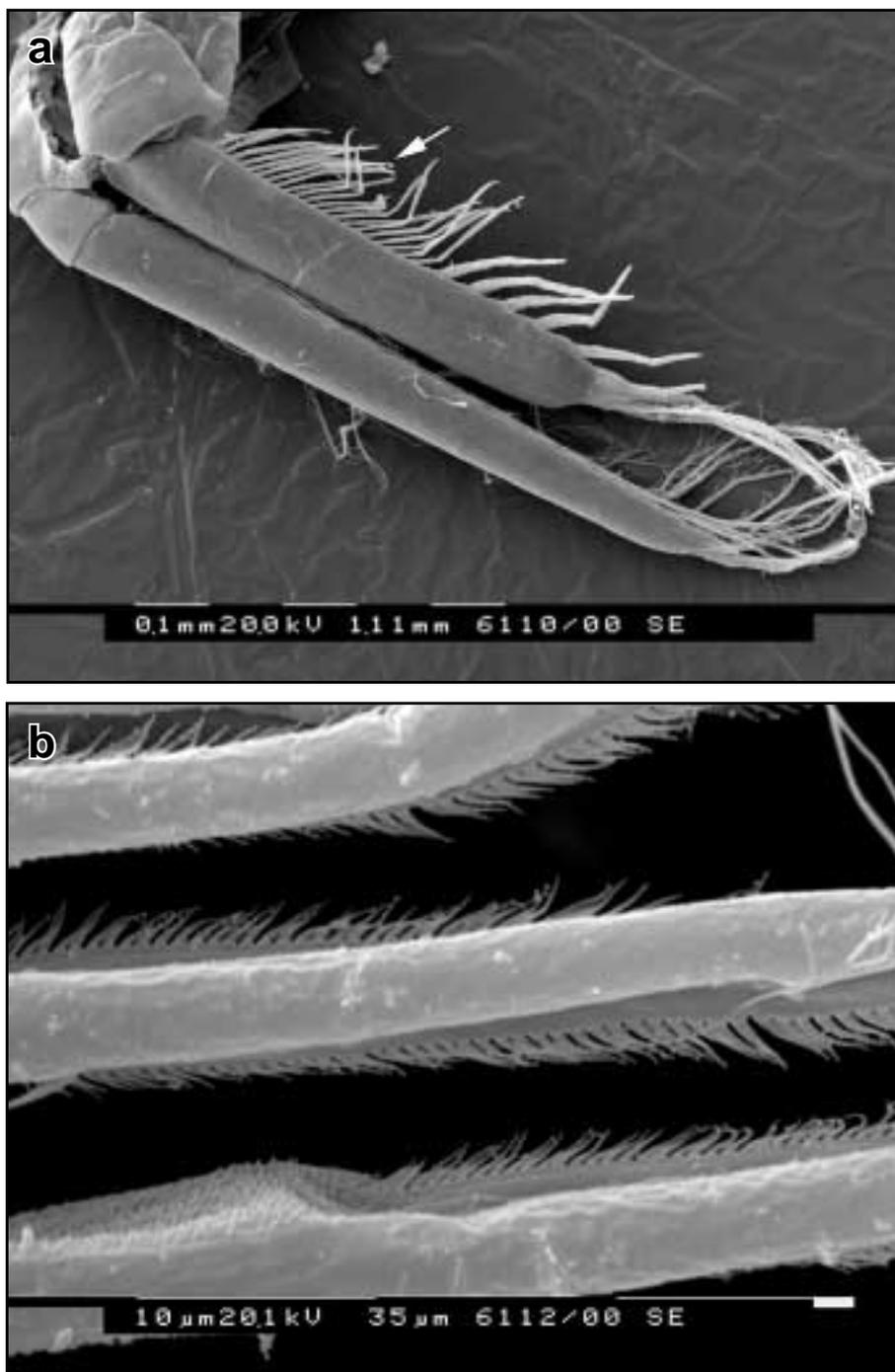


Figure 6. **a–b**, *Levinebalia maria* paratype J13282. **a**, pleopod 1, exopod and endopod. Exopod with two types of marginal setae. **b**, proximal marginal setae, forming the comb-row (arrow in **a**).

on lateral margin; numerous plumose setae on medial margin and terminally, 4 denticulate setae terminally.

Description of allotype. Juvenile male. Entire length 4.41 mm. Carapace length 2.84 mm, depth 1.85 mm. Antenna 1 (Fig. 3) flagellum swollen, articles fused, numerous aesthetascs, article 4 as for female. Antenna 2 with small cuticular outgrowth on anteroproximal margin. All other characters same as for female.

Etymology. For Maria Island, Tasmania, type locality (noun in apposition).

Remarks. The posterior margin of the carapace of *Levinebalia maria* is rounded. Wakabara (1976) illustrated the carapace of *Paranebalia fortunata* with a straight posterior margin but my examination of a paratype of *P. fortunata* reveals the carapace is a similar shape to that of *Levinebalia maria*. The lateral margin of the exopod of pleopod 2 of *L. maria* possesses pairs of smooth setae and this is the setal arrangement found in *P. fortunata* (paratype examined). Wakabara's (1976) illustration of pleopod 2 suggested the setae occur singly along the lateral margin. No fully mature male of *L. maria* has been found.

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