

Pindamoraria boraceiae, a new genus and species of freshwater Canthocamptidae (Copepoda, Harpacticoida) from Brazil

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Members of a new genus and species of harpacticoid copepod crustacean appeared in samples from semi-terrestrial (moist arboreal mosses, wet soil) and aquatic (bromeliad tanks, *Sphagnum* moss, rock pools, stream) habitats in a remnant of the Atlantic Forest in south-eastern Brazil. The new taxon, for which we propose the name *Pindamoraria boraceiae* sp. nov., is distinguished by a unique combination of characters, in particular the segmentation and setation pattern of legs 1–4 in both sexes, the structure of leg 5 in the female, and the strongly modified claw of the maxilliped in the male. It most resembles the canthocamptid genera *Moraria*, *Pseudomoraria*, *Morariopsis* and *Paramorariopsis*. Both previous records of species of *Moraria* from South America refer to members of *Antarctobiotus*, which is not considered a member of the *Moraria* group: *Moraria* (*Kuehneliella*) *neotropica* Löffler has previously been transferred to *Antarctobiotus*; and we propose herein the transfer of *Moraria kummeroworum* Ebert & Noodt to *Antarctobiotus* as well. In the New World, the genus *Moraria* extends only as far south as Honduras; and *Pseudomoraria*, *Morariopsis* and *Paramorariopsis* are Old World genera. The new species from Brazil is therefore the only member of the *Moraria* group known from South America. © 2003 The Linnean Society of London, *Zoological Journal of the Linnean Society*, 2003, 139, 81–92.

ADDITIONAL KEYWORDS: Atlantic Forest – Crustacea – semi-terrestrial – South America – taxonomy.

INTRODUCTION

Semi-terrestrial, groundwater-related, and karstic habitats worldwide harbour a wide diversity of copepod crustaceans, particularly cyclopoids and harpacticoids (Brancelj, 2000; Reid, 2001). The numbers of new species, genera, and even families of copepods are increasing steadily as collectors gain increased access to these habitats. As part of the statewide biological survey program on Conservation and Sustainable Use of Biodiversity of the State of São Paulo, Brazil, named BIOTA-SP, The Virtual Institute of Biodiversity, supported by FAPESP, we sampled extensively in a cloud forest within the Boracéia Biological Station in the eastern part of the state. This is a protected remnant

of the original Atlantic Forest biome. Adults and copepodids belonging to a previously unknown species and genus of canthocamptid harpacticoid copepod crustacean occurred in several of the samples, and are described herein.

MATERIAL AND METHODS

The Boracéia Biological Station is located in the coastal range (Serra do Mar), in the Municipality of Salesópolis, 110 km east of the city of São Paulo and 14 km from the coast. The biological station covers an area of about 14 520 ha, at an altitude of about 850 m (some 50 m below the maritime divide). For 49 years it has been managed as a protected reserve by the Museum of Zoology of the University of São Paulo. The reserve includes the headwaters of two rivers. One, the Rio Claro, runs inland as a tributary of the Rio

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Tietê, which flows into the Rio Paraná-Paraguay. The other, the Rio Guaratuba, is a short mountain stream that runs directly to the Atlantic Ocean between the municipalities of São Sebastião and Bertioga (Travassos-Filho & Camargo, 1958). We sampled in surface waters ranging from a cliff-base pool and marshes, to tiny riverside rock pools and the tanks of bromeliads; in semi-terrestrial microhabitats including moist arboreal and terrestrial mosses, leaf litter, and moist soil; and also in the sandy streambeds, over a two-day period in August 1999.

The substrate materials were placed in plastic bags and transported on ice in an insulated container to the laboratory, where they were stored under refrigeration prior to sorting. Copepods and other microcrustaceans were sorted live from the substrate by means of a stereomicroscope, and fixed and preserved in 70% ethanol. For taxonomic description, the specimens were transferred to a solution of 70% ethanol–10% glycerin which was allowed to evaporate to nearly pure glycerin, and were then transferred to lactic acid. The specimens were drawn in temporary lactic acid mounts under a cover slip supported by glass fragments; some were then dissected and the parts permanently mounted in commercial CMC-9 medium with rose Bengal stain added. Undissected specimens were returned to ethanol. Drawings of dissected cephalic appendages were made from the permanent mounts, and details of all structures were also verified from these mounts. An Olympus BX51 compound microscope equipped with differential interference contrast illumination and a drawing tube was used to prepare the drawings, which were made at 400× or 1000×, the latter using an oil immersion objective.

The specimens were deposited in the Museu de Zoologia da Universidade de São Paulo, Brazil (MZUSP); the Natural History Museum, London, UK (NHM); and the Virginia Museum of Natural History, Martinsville, USA (VMNH).

SYSTEMATICS

HARPACTICOIDA SARS, 1903

CANTHOCAMPTIDAE BRADY, 1880

PINDAMORARIA GEN. NOV.

Diagnosis: Canthocamptidae. Body small, slender. Posterior margins of urosomites ventrally with spines. Anal operculum produced posteriorly, free margin hyaline and crenate. Caudal ramus long-ovate, with longitudinal dorsal keel; sexually dimorphic with additional medial spine row in female. Antennule 8-segmented in female. Antennal exopodite 1-segmented, with 3 terminal setae. Mandibular palp 1-segmented, with 3 terminal setae. Maxilliped dimorphic, claw greatly enlarged in male. Legs 1–4

all with 3-segmented exopodites and 2-segmented endopodites; except leg 3 endopodite of male 3-segmented. Leg 1 exopodite segment 2 without, legs 2–4 exopodite segment 2 each with medial seta. Legs 1–4 exopodite segment 3 each with 4 lateral and terminal setae. Leg 1 endopodite not prehensile. Legs 2–4 endopodites sexually dimorphic. Leg 5, baseoendopodite and exopodite distinct. Leg 5 of male, baseoendopodite medial expansion with 1, exopodite with 5 setae; leg 5 of female, baseoendopodites partly fused medially, medial expansion of each with 4 setae and expanded crenate distomedial margin covering insertions of 2 medial setae; exopodite with 4 setae.

Type species: ***Pindamoraria boraceiae* sp. nov.** (by monotypy).

Etymology: The name derives from the Guarani Indian word 'pindá', hook or claw, describing the modified claw of the maxilliped in the male; joined to the genus *Moraria*. The gender is feminine.

PINDAMORARIA BORACEIAE SP. NOV.

(FIGS 1–35)

Material examined: Male holotype (MZUSP 15370) and female allotype (MZUSP 15371), each dissected on slide, and 13 males, 13 females, and four copepodids, paratypes (MZUSP 15379), all from sample SP99-5-6, along the Trilha da Clareira ('Clearing Trail'), beside last of three unnamed streamlets before clearing at end of trail (23°40'08.5"S, 045°53'54.2"W; UTM 23K0408370/7382086), damp moss growing on tree trunks at heights of 5 cm to 1 m above the ground, 24.viii.1999. Additional paratypes: one female and one male (MZUSP 15372), sample SP99-1-5, combined water from tanks of two arboreal bromeliads along shaded trail leading to Poço Verde waterfall on Rio Claro (23°38'56.3"S, 045°52'49.5"W; UTM 23K0410050/7384157), 23.viii.1999. One female and one male (MZUSP 15373), sample SP99-1-11, tank of large bromeliad at base of tree trunk, same locality and date as SP99-1-5. One male (MZUSP 15374), sample 99-1-17, in *Sphagnum* moss in small puddle near base of waterfall, same locality and date as SP99-1-5. One male (MZUSP 15375), sample SP99-3-1, saturated moss on small rocks by riverside, bank of stream Ribeirão do Campo, just downstream from waterfall (23°38'10.3"S, 045°49'56.6"W; UTM 23K 0415023/7385808), 23.viii.1999. One female (MZUSP 15376), sample SP99-3-2, shallow shaded pool containing decomposing leaves and sand, on large rock beside stream, same locality and date as SP99-3-1. Four females, six males, and one copepodid (NHM reg. no. 2002.1095–2005), sample SP99-3-3, among roots of small plant on rock at base of waterfall, same locality

and date as SP99-3-1. Two females (MZUSP 15377), sample SP99-5-1, sand from bed of first tiny unnamed creek after clearing, same locality and date as SP99-5-6. One female and One male (MZUSP 15378), sample SP99-5-4, wet moss and plant roots on bank of tiny creek, same locality and date as SP99-5-6. 6 females and one copepodid (MZUSP 15380), sample SP99-5-8, in organic detritus at base of large arboreal bromeliad, same locality and date as SP99-5-6. Three females, five males, and one copepodid (VMNH Crustacea Catalogue no. 440), sample SP99-6-2, in decaying leaves in small debris dam in creek, same locality and date as SP99-5-6. One female (MZUSP 15381), sample SP99-9-1, Trilha da Clareira, head of trail about 10 m from SABESP (Companhia de Saneamento Básico do Estado de São Paulo) pipe (23°40'07.8"S, 045°53'57.6"W; UTM23K 0408315/7382105), saturated sandy-muddy soil with odour of sulphide, 24.viii.1999. Collectors C. E. F. Rocha and J. W. Reid.

Description of male

Length of holotype 490 µm; lengths of four paratypes from Sample SP99-5-6, 455–483, mean 473 µm. Body (Figs 1–3) slender. Cephalosome (Figs 1,2) with dorso-medial integumental window, ovoid and slightly constricted at midlength; no lateral window present. Hyaline frills of all somites smooth. Posterior margins of urosomites 2–4 each with ventral row of spines. Urosomite 5 (Figs 1–6) with ventrolateral row of spines, and dorsal row of tiny hyaline spines along posterior margin. Anal operculum (Fig. 5) produced posteriorly, free margin hyaline, rounded and crenate.

Caudal ramus (Figs 1–6) long-ovate, with longitudinal dorsal keel ending in acute prominence near distal end of ramus. Rows of large spines present at insertions of lateral setae and along posteroventral margin of ramus; medial surface bare. Inner terminal seta slightly longer than half length of ramus, slender and hyaline. Middle and outer terminal setae stout, without breaking planes, set with strong spinules along approximately middle third.

Rostrum (Fig. 2) subtriangular, reaching distal end of antennule segment 1, bearing two subapical sensilla.

Antennule (Figs 1,2,7,8) about 2/3 length of cephalosome, 9-segmented with well-developed basal prominence, geniculate, with long aesthetasc on segment 4 and short aesthetasc on segment 9, and bifurcate spiniform seta on segment 4.

Antenna (Fig. 9) with allobasis; exopodite 1-segmented, with three terminal setae.

Labrum (Fig. 10) diamond-shaped in ventral view, thickly set with spines.

Mandible (Fig. 11), gnathobase with one large conical tooth, three bifid to multicuspidate spines, and one

finely serrate seta; palp 1-segmented, with three terminal setae.

Maxillule (Figs 12,13), precoxal arthrite with four stout spines fused to arthrite and five spinulose setae along inner margin, and pair of smooth setae on distal margin. Coxal endite with two terminal setae. Palp bearing stout spinulose spine and two setae at apex; outer margin with four setae. Epipodite represented by two short setae.

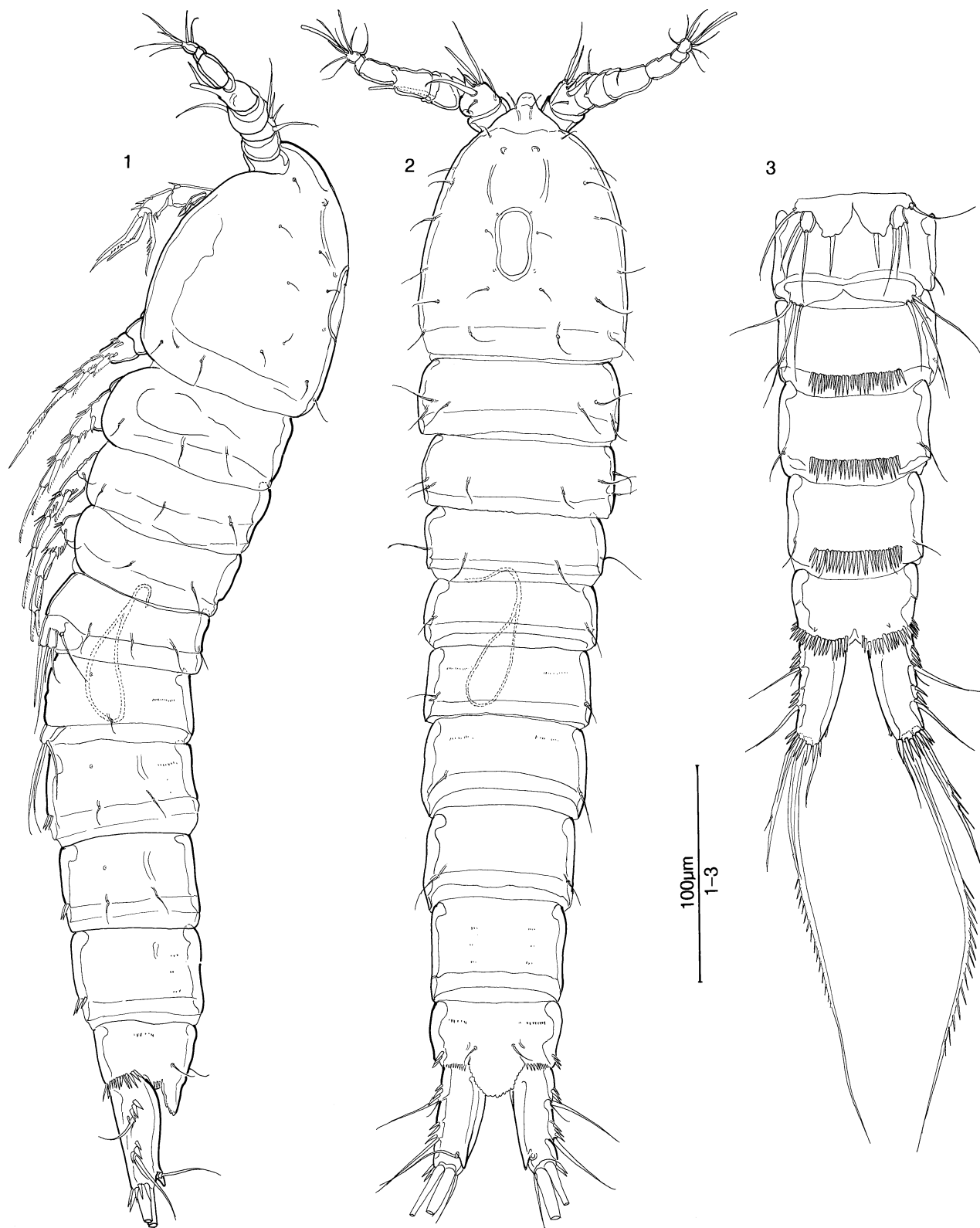
Maxilla as in female (Fig. 29).

Maxilliped (Figs 10,14,15), syncoxa with crescentic row of spines, and stout spinulose distal seta with several spines at its base; basis with two groups of spines on outer margin, and inner margin with wide, deeply crenate hyaline flange; endopodite lacking seta, with claw enormously enlarged and sclerotized, recurved, with rounded inner subterminal expansion and blunt recurved tip.

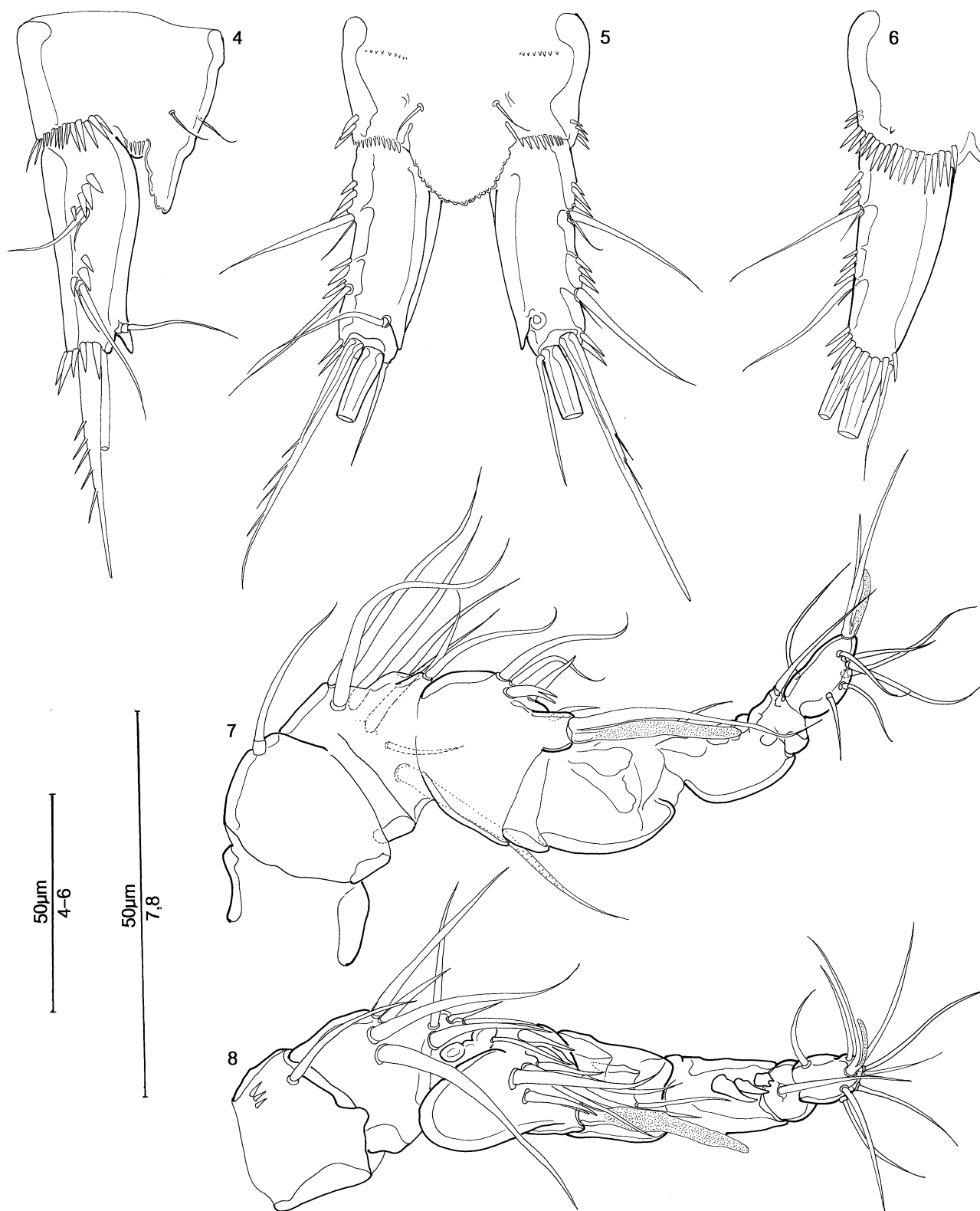
Legs 1–4 (Figs 16–23) with 3-segmented exopodites and 2-segmented endopodites, except leg 3 endopodite 3-segmented. Couplers (intercoxal sclerites) bare. Leg 1 basis with spiniform seta on medio-distal corner. Leg 1 exopodite segment 2 without, legs 2–4 exopodite segment 2 each with medial seta. Legs 1–4 exopodite 3 each with four lateral and terminal setae, lateral setae inserted near apex of exopodite. Leg 1 endopodite not prehensile, segment 1 broad. Leg 2 endopodite (Fig. 18), segment 1 short and broad with large, stout, medially curved spine on laterodistal corner, flanked medially by two slightly smaller stout spines, and with two tiny spines on medial surface; segment 2 narrower and shorter, with two long terminal spinulose setae and tiny spine on medial surface. Leg 3 basis (Fig. 19) with two spines on medial surface. Leg 3 endopodite (Fig. 20) 3-segmented, segment 1 bare, segment 2 with stout medial apophysis having slender, simple tip, and segment 3 with stout apical seta flanked by longer, medial subapical plumed seta and two more proximal, short smooth hyaline setae on medial margin. Leg 4 endopodite (Figs 22,23) 2-segmented; segment 1 with stout seta on mediolateral corner; segment 2 with two slender apical setae and one short stout apical spine, and at about midlength, one slender smooth seta, two stout denticulate setae, and two stout spines.

Leg 5 (Fig. 24), baseoendopodites partly fused medially; baseoendopodite and exopodite distinct, with bare surfaces. Medial expansion of baseoendopodite broadly triangular, with one simple subapical seta and tiny papilla lateral to insertion of seta. Exopodite subquadrate, shorter than baseoendopodite, with five setae of which middle seta is longest. Medialmost seta curved toward median line.

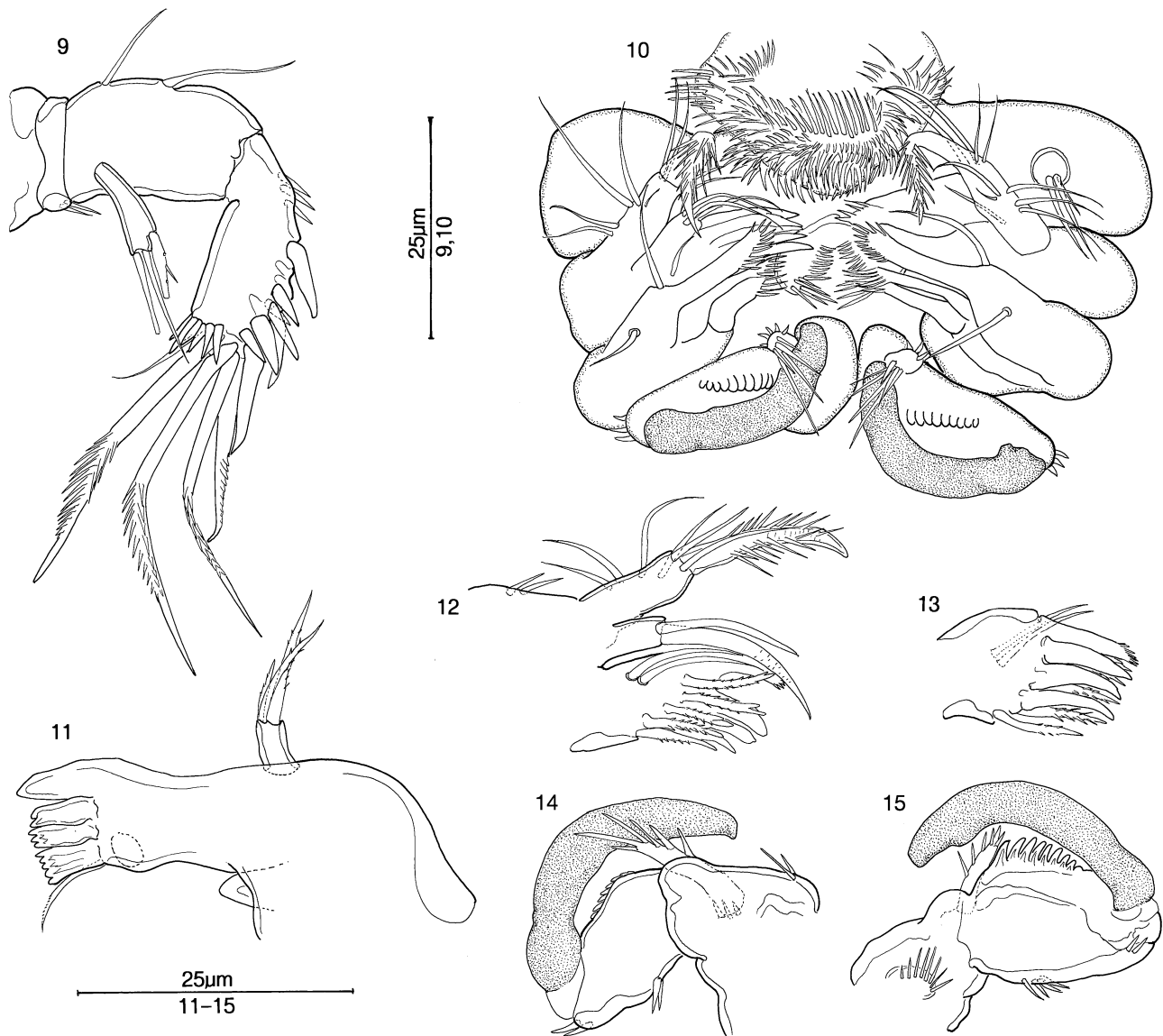
Leg 6 (Fig. 3) a simple broad plate bearing three long setae.



Figures 1–3. *Pindamoraria boraceiae* gen. & sp. nov., male holotype. Fig. 1. Habitus, lateral view. Fig. 2. Habitus, dorsal view. Fig. 3. Urosome, ventral view. Scale as indicated in figure.



Figures 4–8. *Pindamoraria boraceiae*, male holotype. Fig. 4. Anal somite and caudal ramus, lateral view. Fig. 5. Anal somite and caudal ramus, dorsal view. Fig. 6. Anal somite and caudal ramus, ventral view. Fig. 7. Antennule, ventral view (flattened in permanent mount). Fig. 8. Antennule, anteroventral view (supported mount). Scales as indicated in figure.



Figures 9–15. *Pindamoraria boraceiae*, male holotype: Fig. 9. Antenna. Fig. 10. Labrum and mouthparts, ventral view. Fig. 11. Mandible. Fig. 12. Maxillule. Fig. 13. Detail of gnathobase of maxillule. Fig. 14. Maxilliped, oblique-caudal view. Fig. 15. Maxilliped, caudal view. Scales as indicated in figure.

Observed variation: Leg 2 endopodite segment 1 may have 1–3 large spines along the outer distal corner; two is the most usual number. The usual number of setae on the leg 5 exopodite is 5; the holotype has three setae on the right exopodite and five on the left; of the males in Sample SP99-5-6, 2 specimens had three or four setae on one exopodite.

Description of female

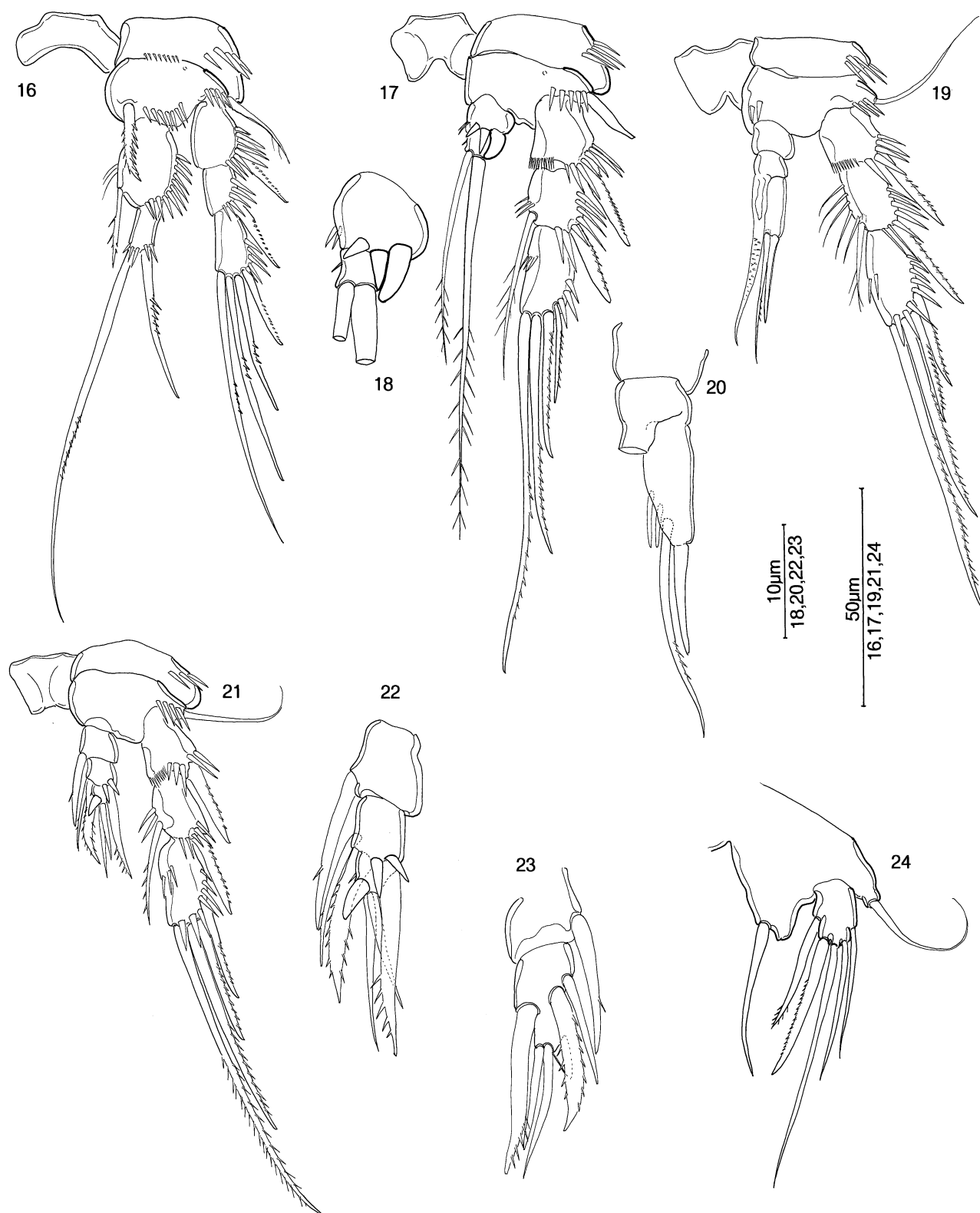
Length of allotype 510 µm; lengths of nine paratypes in Sample SP99-5-6, 460–508, mean 489 µm. Habitus

and ornamentation of urosome as in male, except for fused genital double-somite (Fig. 25). Genital field (Fig. 25) occupying anterior half of genital double-somite, with short wide funnel leading to genital pore, and large paired dorsal receptacula seminis.

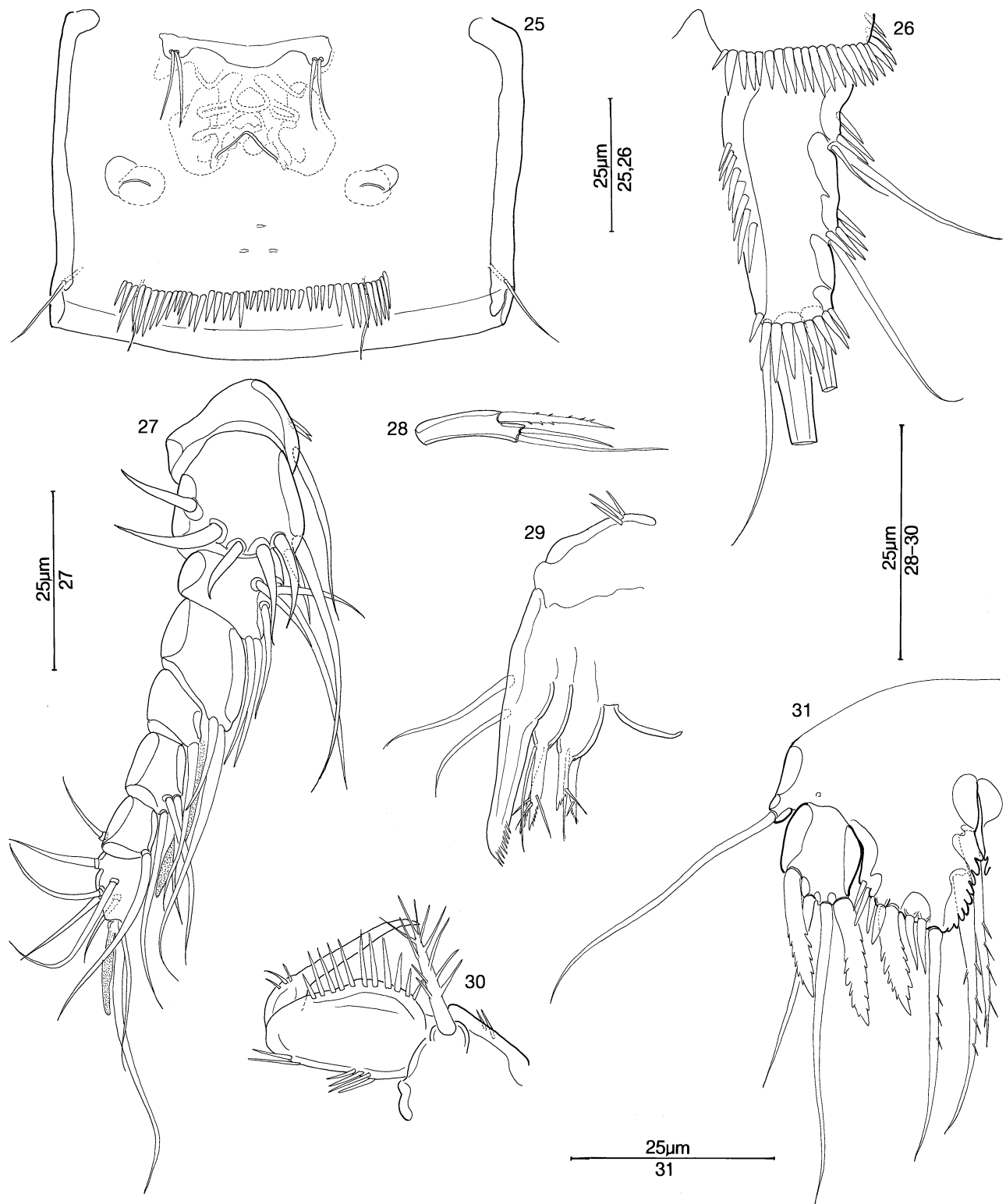
Caudal ramus (Fig. 26) as in male, except with additional row of spines along middle third of medial surface. Caudal setae as in male.

Antennule (Fig. 27) 8-segmented, with long slender aesthetasc on segment 4, and short slender aesthetasc on segment 8.

Antennal exopodite (Fig. 28) as in male.



Figures 16–24. *Pindamoraria boraceiae*, male holotype. Fig. 16. Leg 1 and coupler. Fig. 17. Leg 2 and coupler. Fig. 18. Left leg 2 endopodite, frontal view. Fig. 19. Leg 3 and coupler. Fig. 20. Left leg 3 endopodite, frontal view with detail of segment 3. Fig. 21. Leg 4 and coupler. Fig. 22. Left leg 4 endopodite, frontal view. Fig. 23. Left leg 4 endopodite, caudal view. Fig. 24. Leg 5. Scales as indicated in figure.



Figures 25–31. *Pindamoraria boraceiae*, female allotype. Fig. 25. Genital double-somite, ventral view. Fig. 26. Caudal ramus, ventral view. Fig. 27. Antennule. Fig. 28. Antennal exopodite. Fig. 29. Maxilla. Fig. 30. Maxilliped. Fig. 31. Leg 5. Scales as indicated in figure.

Maxilla (Fig. 29), syncoxa with two endites, each with three apical setae; basis with two setae and stout claw ending in broad, deeply serrated, spatulate tip.

Maxilliped (Fig. 30), syncoxa with group of spines, and stout spinulose distal seta; basis with two groups of spines on outer margin, and inner margin produced, bearing row of strong spines; endopodite with tiny seta and few spines, claw slender, tapering, acute, slightly recurved near tip.

Leg 5 (Fig. 31), baseoendopodites partly fused medially. Medial expansion of baseoendopodite with four setae, lateralmost seta spatulate and serrate, three medial setae slender, with stiff setules; mediodistal margin deeply crenate and expanded, covering insertions of two medial setae. Exopodite quadrate, shorter than baseoendopodite, with four setae of which two outer setae are spatulate and serrate, and two middle setae are slender and smooth.

Legs 1–4 basipodites, exopodites, leg 1 endopodite, spiniform seta on distomedial corner of leg 1 basipodite, and couplers all as in male. Leg 2 endopodite (Fig. 32), segment 1 with three or four spines on distal margin, outer one or two spines very stout; segment 2 with three terminal and subterminal setae, and two subterminal spines. Leg 3 endopodite (Fig. 33), segment 1 with seta on mediodistal corner; segment 2 with three apical and subapical setae of which apical seta is longest, and subapical spine. Leg 4 endopodite (Figs 34,35), segment 1 with seta on distomedial corner; segment 2 with three apical and subapical setae, apical seta longest, and subapical spine; in allotype, right segment 2 with, left segment 2 without medial seta.

Leg 6 (Fig. 25) consisting of tiny plate bearing two setae.

Observed variation: Of the female paratype specimens in Sample SP99-5-6, all had leg 4 endopodite segment 2 bearing three setae.

Etymology: The species name is given for the collection locality, with profound appreciation for the long efforts of staff members of the Museum of Zoology to maintain the Boracéia preserve.

DISCUSSION AND COMPARISONS

Pindamoraria boraceiae gen. & sp. nov. most resembles a group of canthocamptid genera including *Moraria* T. & A. Scott, 1893; *Pseudomoraria* Brancelj, 1994; *Morariopsis* Borutsky, 1931; and *Paramorariopsis* Brancelj, 1991. These have in common short swimming legs with reduced setation, especially of the exopodite segment 3, which bears only four or five (four in most cases) setae and spiniform setae grouped apically or nearly apically. Most of these genera also show advanced sexual dimorphism, with modifications of legs 2–5 in the males. Table 1, modified and updated

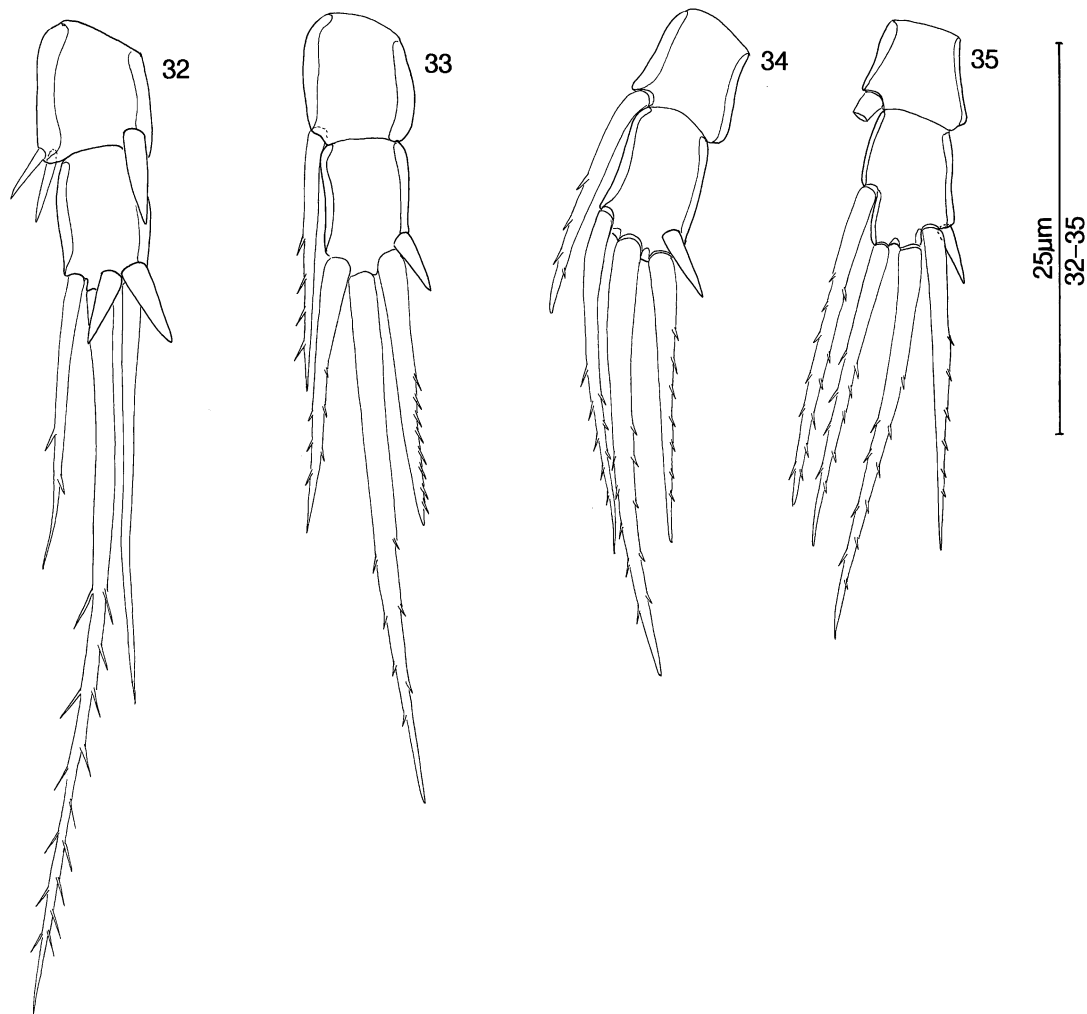
from a similar table provided by Brancelj (1994, 2000), lists the differences among the genera in regard to the setation of legs 1–5, and the presence or absence of sexual dimorphism in the caudal rami and of modified spiniform setae on the swimming legs in males.

Two genera found in austral and Andean South America, *Antarctobiotus* Chappuis, 1930 and *Loefflerella* Rouch, 1962, have been successful in similar, strictly benthic and semi-terrestrial habitats as the members of the *Moraria* group. Like these, they have small slender bodies, with the endopodites of the swimming legs 2-segmented and showing reduced setation and advanced sexual dimorphism. However, neither *Antarctobiotus* nor *Loefflerella* can be considered a member of the *Moraria* group as defined above, in particular because of their less reduced setation of legs 3 and 4. As seen in Table 1, both differ from *P. boraceiae* in this as well as other characters.

Pindamoraria boraceiae is further distinguished by two characters that are unusual not only within the genus-group, but within the family. The crenate flange on the baseoendopodite of the fifth leg of the female may protect the insertions of the bordering setae. Females of some species of *Loefflerella* have a similar flange, but with a smooth margin (cf. Ebert, 1976). The modified, blunt heavy claw of the maxilliped in the male has, to our knowledge, no parallel in the family; it may serve to assist in clasping the female during precopulatory mate guarding.

Most species of the *Moraria* group are Palearctic or Nearctic (cf. Dussart & Defaye, 1990). The genus *Moraria* includes both Palearctic and Nearctic species; these were last generally reviewed by Lang (1948), and for North America by Reid & Lesko (2003). Members of *Moraria* are widely distributed and rather common in the Nearctic as far south as the south-eastern USA. Outlying (unnamed) species were reported from high-altitude montane lakes in southern Mexico and in Guatemala by Löffler (1972). A species from a cloud forest in the Cerro Uyuca of Honduras, reported and described by Ebert (1976, in an unpublished thesis), represents the southernmost known occurrence of a member of *Moraria*.

Both of the existing records of *Moraria* from South America actually refer to species of *Antarctobiotus*. Cicchino & Ringuelet (1977) revised the South American species of *Antarctobiotus* and transferred *Moraria* (*Kuehneliella*) *neotropica* Löffler, 1962, to *Antarctobiotus*, incidentally invalidating the subgenus *Kuehneliella* which Löffler (1962) had proposed for that species. Cicchino & Ringuelet (1977) were apparently unaware of the article by Ebert & Noodt (1975) describing *Moraria kummeroworum* from Chile. The chaetotaxy of the swimming legs, especially legs 3 and 4 exopodite segment 3, of the single female described by Ebert & Noodt (1975) clearly corresponds



Figures 32–35. *Pindamoraria boraceiae*, female allotype. Fig. 32. Right leg 2 endopodite, frontal view. Fig. 33. Left leg 3 endopodite, frontal view. Fig. 34. Left leg 4 endopodite, frontal view. Fig. 35. Right leg 4 endopodite, caudal view. Scales as indicated in figure.

to that of the 'koenigi–ringueleti-group' proposed by Cicchino & Ringuelet (1977). We therefore propose the transfer of *Moraria kummeroworum* to the genus *Antarctobiotus*. The South American species of *Antarctobiotus* occur in Tierra del Fuego, Argentina, the Falkland Islands (Malvinas), and Chile.

The remaining genera of the *Moraria* group are all palaeartic. *Morariopsis* has a disjunct distribution, in Lake Baikal and in south-eastern Europe (Lang, 1948; Brancelj, 2000). The genera *Pseudomoraria* and *Paramorariopsis* were recently described from Slovenia (Brancelj, 1994, 2000, respectively). The discovery of *P. boraceiae* in south-eastern Brazil therefore greatly expanded the known geographical range of members of this group.

The Boracéia cloud forest affords a wide array of aquatic and moist semi-terrestrial microhabitats such

as the rivers and tiny tributary streams, marshes, pools, the tanks of terrestrial and arboreal bromeliads and other phytotelms, damp arboreal and terrestrial mosses and leaf litter, and the humid soil itself. The constantly humid conditions have fostered the growth of a nearly continuous moist organic substrate composed of interlaced plant roots, fungi, and decaying organic matter, which not only covers much of the sandy soil but extends over the tree boles and even up the tree trunks. The collection data indicated that *P. boraceiae* exploits all parts of this substrate, preferring moist arboreal mosses and the organic detritus collected at the base of bromeliads, but enters fully aquatic microhabitats including the tanks of bromeliads and tiny streams and rock pools. The species was not found in the more-disturbed, less-shaded woods and marshes near the reserve headquarters. Nor has

Table 1. Some distinguishing characters of *Moraria* and related genera, *Antarctobiotus*, *Loefflerella*, and *Pindamoraria boraceiae* gen. & sp. nov. Abbreviations: benp, baseoendopodite; CR, caudal ramus; enp, endopodite; exp, exopodite; Md, mandible; P1–5, legs 1–5; seg, number of segments; setae, number of setae

	<i>Moraria</i>	<i>Morariopsis</i>	<i>Pseudomoraria</i>	<i>Paramorariopsis</i>	<i>Antarctobiotus</i>	<i>Loefflerella</i>	<i>Pindamoraria boraceiae</i>
Male and female							
P1–4 exp 2, seta	0,0,0,0	0,0,0,0	0,0,0,0	1,1,1,1	0,0,0,0 or 0,0,0,1	1,1,1,1	0,1,1,1
P1–4 exp 3, setae and spines	4,4,4,5	4,4,4,5	5,4,4,5	4,5,5,5	4,4,5,6	4,6,7,6	4,4,4,4
Md palp, seg: setae	2:5	2:3	2:4	?	1:2–3	2:4–5	1:3
CR longitudinal dorsal crest	Present	Present	Absent	Absent	Present or absent	Present	Present
CR sexually dimorphic	No	No	Yes	No	Yes or no	No	Yes
Female							
P1–4 exp seg	3,3,3,3	3,3,3,3	2,2,3,3	3,3,3,3	3,3,3,3	3,3,3,3	3,3,3,3
P1–4 enp seg	2,2,2,2	2,1,1,1	2,2,2,2	2,1,1,2	2,2,2,2	2,2,2,2	2,2,2,2
P5 benp setae	5–7	3–6	6	3	5–6	4–5	4
P5 exp setae	5	3–4	5	2	4	5–6	4
Male							
P1–4 exp seg	3,3,3,3	3,3,3,3	2,2,2,2	3,3,3,3	3,3,3,3	3,3,3,3	3,3,3,3
P1–4 enp seg	2,2,2,2	2,2,2,2	2,2,2,1	2,2,3,2	2,2,2,2	2,2,2,2	2,2,3,2
P2, enp1 with short stout lateral spine	Yes	Yes	No	No	No	No	Yes
P4, enp with modified apical spine	Yes	Yes	No	Yes	No	No	Yes
P3 or 4, exp with modified lateral spine	No	No	No	Yes	No	Yes	No
P5 benp setae	1–2	2	1–2	0	2	1	1
P5 exp setae	5	4–5	2	2	4–5 (usually 5)	4–5	5

it been found in any other of several localities in the state of São Paulo which have been sampled as part of the BIOTA-SP survey program.

Certain species of harpacticoid and cyclopoid copepods are normal components of the cryptozoic microfauna living in moist organic epigeal substrates. Of these substrates, humid leaf litter in temperate forests has been most investigated, but other habitats such as a sedge meadow, the Colombian Páramo, and a Brazilian wet campo which afford constantly moist substrates may also support dense copepod populations (reviewed by Fiers & Ghenne, 2000; Reid, 2001). Fiers & Ghenne (2000) suggested that the extensive 'leaf carpet' in temperate forests may provide a route for microinvertebrates to disperse into uncolonized aquifers, as well as for genetic exchange among populations. Frey (1980) reported two closely related species of chydorid cladocerans, *Bryospilus repens* and *Bryospilus bifidus*, with astonishingly discontinuous distributions in Puerto Rico, Venezuela and New Zealand; and in New Zealand, respectively. He conceived of the thin water film and tiny water bodies in humid forests as a truly aquatic habitat, continuous in space over large areas and continual over long periods of time, allowing for the evolution of endemic or uniquely adapted species. The moist organic substrate developed in tropical cloud and rain forests may function similarly to the temperate leaf carpet as a pathway, as well as a distinct and continuous habitat. The pattern of distribution of *P. boraceiae* in the Boracéia reserve hints that even modest habitat modification may be sufficient to interrupt this route and fracture the microinvertebrate populations.

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