

A new species of *Parameiropsis* Becker, 1974 (Copepoda: Harpacticoida) from the Porcupine Seabight (North-East Atlantic Ocean)

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Abstract A new species of *Parameiropsis* Becker, 1974 is described from the Porcupine Seabight and questions about the position of this genus within Harpacticoida are briefly addressed. The new species is the smallest representative of the genus and extends the depth and distribution range of *Parameiropsis* to 880 m and 51°25.9'N. *Parameiropsis antennafortis* sp. n. differs from the known species (viz. *P. rapiens* Becker, 1974, *P. peruanus* Becker, 1974 and *P. magnus* Itô, 1983) basically in total body size, shape of labrum, robustness of A2, armature of mouthparts and P1-P5, shape of P5 and shape of copulatory pore and tube. Additionally, the new species has the apical elements of P1 enp-3 transformed into a unipinnate spine, a spiniform outer terminal seta and a miniaturized inner terminal seta. This condition is not homologous to the Podogennonta pattern. *Parameiropsis* do not show any decisive character supporting the inclusion of this genus within Ameiridae and is considered here an *incertae sedis* taxon within Harpacticoida.

Keywords Boxcorer · Deep-sea · New species · Morphological taxonomy

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Introduction

Samples containing one or few individuals are a typical situation for the deep-sea benthos and is related to the relatively high evenness in the distribution of species' abundances (e.g. Thistle 1978; Boucher and Lambshead 1995; Gage 1996). Therefore, more extensive samplings are necessary to collect more specimens of each species for the assessment of intraspecific variability. Nevertheless, the description of new species based on single specimens can supply substantial phylogenetical information (e.g. Seifried and Schminke 2003).

The species composition and diversity of harpacticoid copepods associated with dead cold-water coral substrates in the Porcupine Seabight (NE Atlantic) has recently been investigated (H. Gheerardyn, M. De Troch, M. Vincx and A. Vanreusel, manuscript submitted). In total, 860 adult harpacticoids (157 species belonging to 62 genera and 19 families) were identified from the coral degradation zone of *Lophelia pertusa* (Linnaeus, 1758) reefs in the Belgica Mound Province. Deep-sea harpacticoids are characterised by high species diversity and low species dominance (Seifried 2004; Rose et al. 2005), and the assemblage in the Porcupine Seabight is not an exception to this. Overall, 131 species each occurred with less than 1% of relative abundance and 52 species were present as singletons. The two most common species, new representatives of *Sigmatidium* Giesbrecht, 1881 (Ectinosomatidae) and *Pseudomesochra* T. Scott, 1902 (Pseudotachidiidae), each accounted for 5% of the total of adult individuals.

A single individual of a new species of the genus *Parameiropsis* Becker, 1974 was found in sediment samples from the Porcupine Seabight. Three species of *Parameiropsis* have been described so far and the description of each of them was based on single female specimens. These three

species were found in distant locations [Peru Trench, North-African deep sea (on the Atlantic coast) and southeast off Mindanao Island, in the Philippines] at depths between 3,900 and 5,000 m (Becker 1974; Itô 1983). The new species herein described is the smallest representative of the genus and extends the depth range of *Parameiropsis* to 880 m.

Material and methods

The single specimen described in this paper was collected during expedition RV Belgica 01/12 to the Belgica Mound Province in the Porcupine Seabight (NE Atlantic Ocean), in May 2001. The sample was taken with a boxcorer in the coral degradation zone of *Lophelia pertusa* reefs, at a depth of 880 m. The surface of the sediment was covered with several dead fragments of the cold-water coral *L. pertusa*. After collecting the coral fragments, meiofauna of underlying sediment was sampled with three sediment cores (surface area 10 cm²). All material was fixed in 4% buffered formaldehyde.

In the laboratory, each coral sample was rinsed thoroughly over 1-mm and 32- μ m sieves to collect macro- and meiofauna, respectively. Meiofauna from the sediment was extracted by density gradient centrifugation, using Ludox HS40 (specific density 1.18) as a flotation medium (Heip et al. 1985; Vincx 1996). Harpacticoid copepods were sorted and counted using a Wild M5 binocular microscope. Dissected parts of the specimens were mounted in lactophenol. Drawings were made with the aid of a drawing tube on a Leica DMR microscope equipped with differential interference contrast (DIC) at 1,000 \times magnification. Specimens have been deposited in the invertebrate collection of the Forschungsinstitut und Naturmuseum Senckenberg. Scale bars in figures are indicated in micrometres (μ m).

Comparisons with other described species are based uniquely on original descriptions, since the type material of these species is lost.

The following abbreviations are used in the text: *A1* antennule, *A2* antenna, *aes* aesthetasc, *benp* basoendopod, *enp* endopod, *enp-1 (2,3)* proximal (middle, distal) segment of endopod, *exp* exopod, *exp-1 (2,3)* proximal (middle, distal) segment of exopod, *Md* mandible, *Mx1* maxillule, *Mx2* maxilla, *Mxp* maxilliped, *P1-P6* first to sixth thoracopod.

Results

Parameiropsis antennafortis sp. n.

Etymology The name of the species is a combination of the latin noun *antenna* and the latin adjective *fortis* (= robust) and refers to strong antenna of the new species, bearing many modified spines.

Type locality North-East Atlantic Ocean, Porcupine Seabight, 51°25.9290'N 11°46.2717'W.

Type material Female holotype dissected on seven slides (SMF 32176); Boxcorer Bbc01 1205 (RV Belgica Cruise 01/12); 880 m depth; collected on May 7 2001.

Description

Habitus almost cylindrical (Fig. 1a, b), body length 625 μ m (measured from tip of rostrum to posterior end of telson); cephalothorax with weakly chitinized areas posteriorly and laterally. Free prosomites and urosomites with posterior hyaline frill. Sensilla and cuticular pores as in Fig. 1a, b. Telson elongated and tapering posteriorly, about 2.5-times as long as penultimate somite (Fig. 1a, b); anal operculum concave on dorsal view (Figs. 1b, 2a), not reaching the posterior margin of telson. Furca (Figs. 1a, b, 2a, b) with convex inner margin and straight outer margin, about two-times as long as wide, with seven setae; seta I reduced. Rostrum (Fig. 3a) not fused to cephalothorax, bell-shaped, with two sensilla apically inserted. A1 (Fig. 3d-h) short, gradually tapering distally, four-segmented, with a preantennular sclerite (marked with *); armature from proximal to distal segment 1/6/5 + (1 + aes)/11 + (2 + aes). A2 with indistinctly separated allobasis (Fig. 3b-c), fused on the anterior margin, without abexopodal seta; free endopodal segment shorter than allobasis, with strong spinules on anterior surface, with seven robust spines (two subdistal, Fig. 3b6-b7 and five distal, Fig. 3b1-b5) and three setae (two subdistal, inserted on the inner margin and one distal, fused to the outermost spine); outermost spine piriform (Fig. 3b1), with a row of very prominent spinules, the innermost distal spine also strongly ornamented (Fig. 3b5); exp unisegmented (Fig. 3b), with one subdistal seta (distal seta probably broken). Labrum (Fig. 4g) represented by a triangular plate, with bifid tip, fringed by a hyaline membrane around apex, with papilliform ornamentation at its distal margin. Mouthparts well developed, forming an oral cone. Md (Fig. 4a-b) with elongated corpus mandibularis (Fig. 4a) and strong gnathobasis with a sharp cutting edge, armed with three strong denticulate teeth (aboral and medial teeth multicuspidate) and one stout subdistal seta on the oral surface; mandibular palp (Fig. 4b) with unarmed basis; exp unisegmented, with two distal setae; enp unisegmented with four distal setae fused to the segment, two subdistal setae, two strong outer spinules and a row of spinules adjacent to it. Mx1 (Fig. 4c) with elongated praecoxal arthrite armed with four slender, apical setae, apparently fused to the arthrite, two aboral setae subapically and two setae closely inserted next to each other on the oral margin; coxal endite with three slender setae; basal endite with five setae; enp fused to

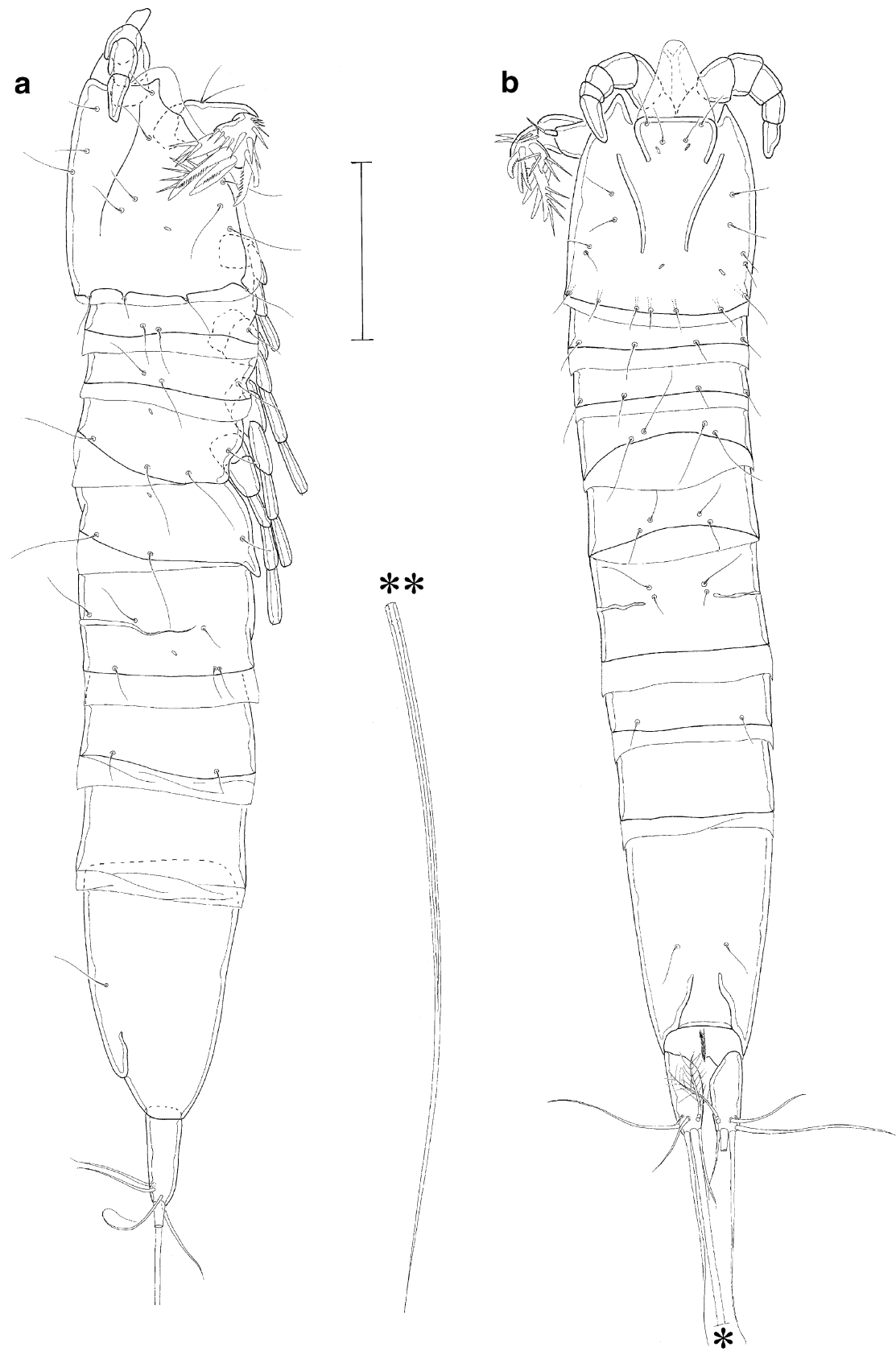


Fig. 1 *Parameiopsis antennafortis* sp. n., holotype, female, SMF 32176: **a** lateral habitus; **b** dorsal habitus; *partial view of seta V; **complete view of seta V. Scale 100 μ m

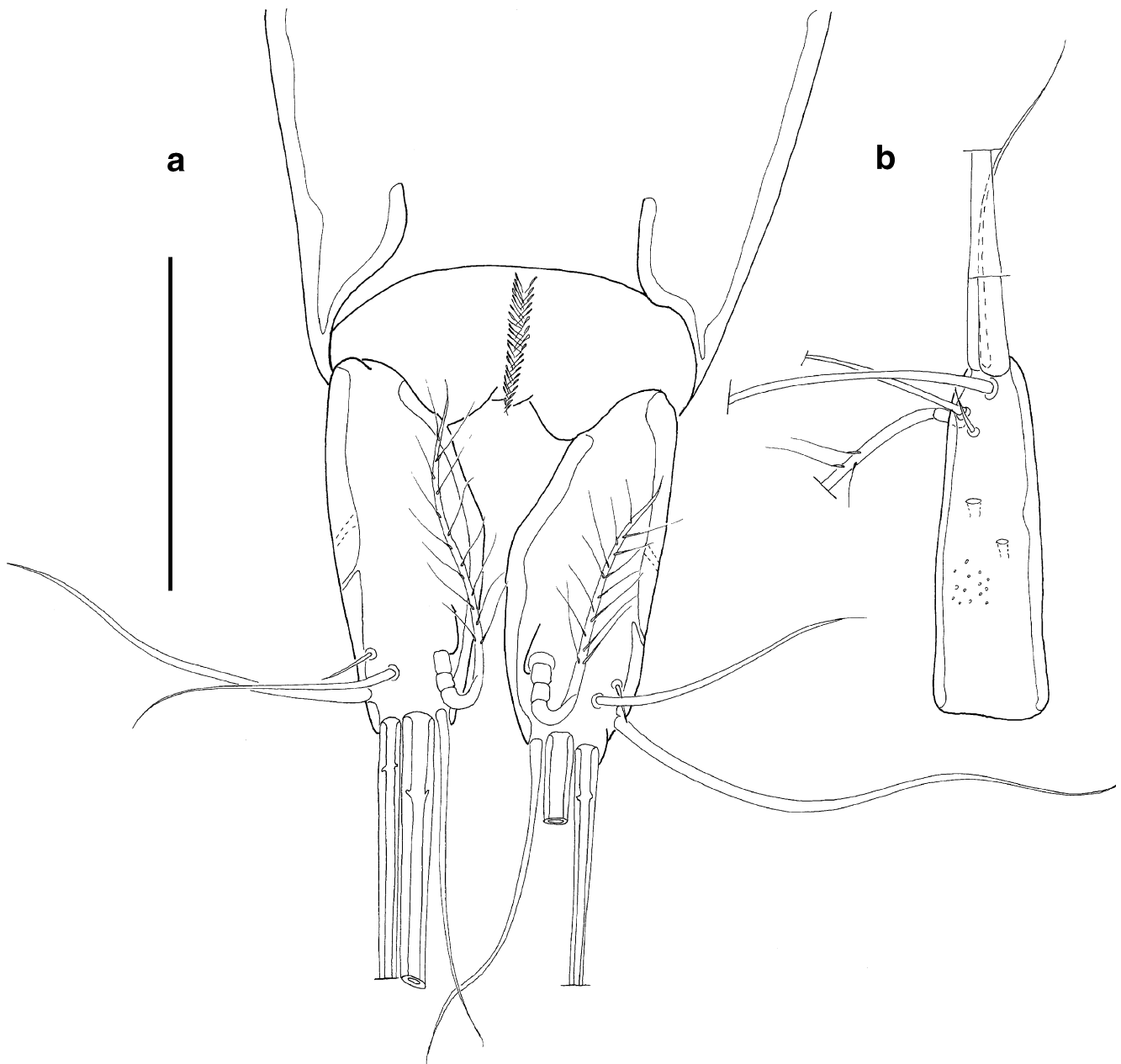


Fig. 2 *Parameiopsis antennafortis* sp. n., holotype, female, SMF 32176: **a** dorsal view of telson with anal operculum and furcal rami; **b** lateral view of left furcal ramus. Scale 50 μ m

basis and represented by a lobe armed with two setae; exp represented by a distinct segment armed with one seta. Mx2 (Fig. 4d) syncoxa with short spinules on the inner margin; proximal endite probably absent; distal endite armed with one seta; basis drawn into a strong, sclerotized and serrated claw, with a strong accompanying spine inserted on its proximal oral margin; enp fused to basis and armed with two slender setae apically. Mxp (Fig. 4e-f) syncoxa unarmed and ornamented with row of strong inner spinules; basis as long as syncoxa, bare; enp represented by a strong claw, proximally with a long, slender seta. P1 intercoxal sclerite transversally elongated (Fig. 5a). P2-P4 intercoxal sclerites rostrocaudally

elongated (Figs. 5b, 6a, b). P1-P4 (Figs. 5a, b, 6a, b) with three-segmented exps and enps; rami slender and slightly tapering towards distally; enp and exp of P1 subequal in length; enps of P2-P4 slightly shorter than corresponding exps. P1 (Fig. 5a) praecoxa with short row of spinules on anterior surface; coxa with diagonal row of spinules on anterior surface, distal spinules larger than proximal ones; basis with strong spine inserted on the inner margin, not reaching beyond the distal margin of enp-1, with row of strong spinules inserted distally, bordering the insertion of enp, with outer row of strong spinules subjacent to the outer seta and a proximal row of strong spinules, adjacent to the pore. P1

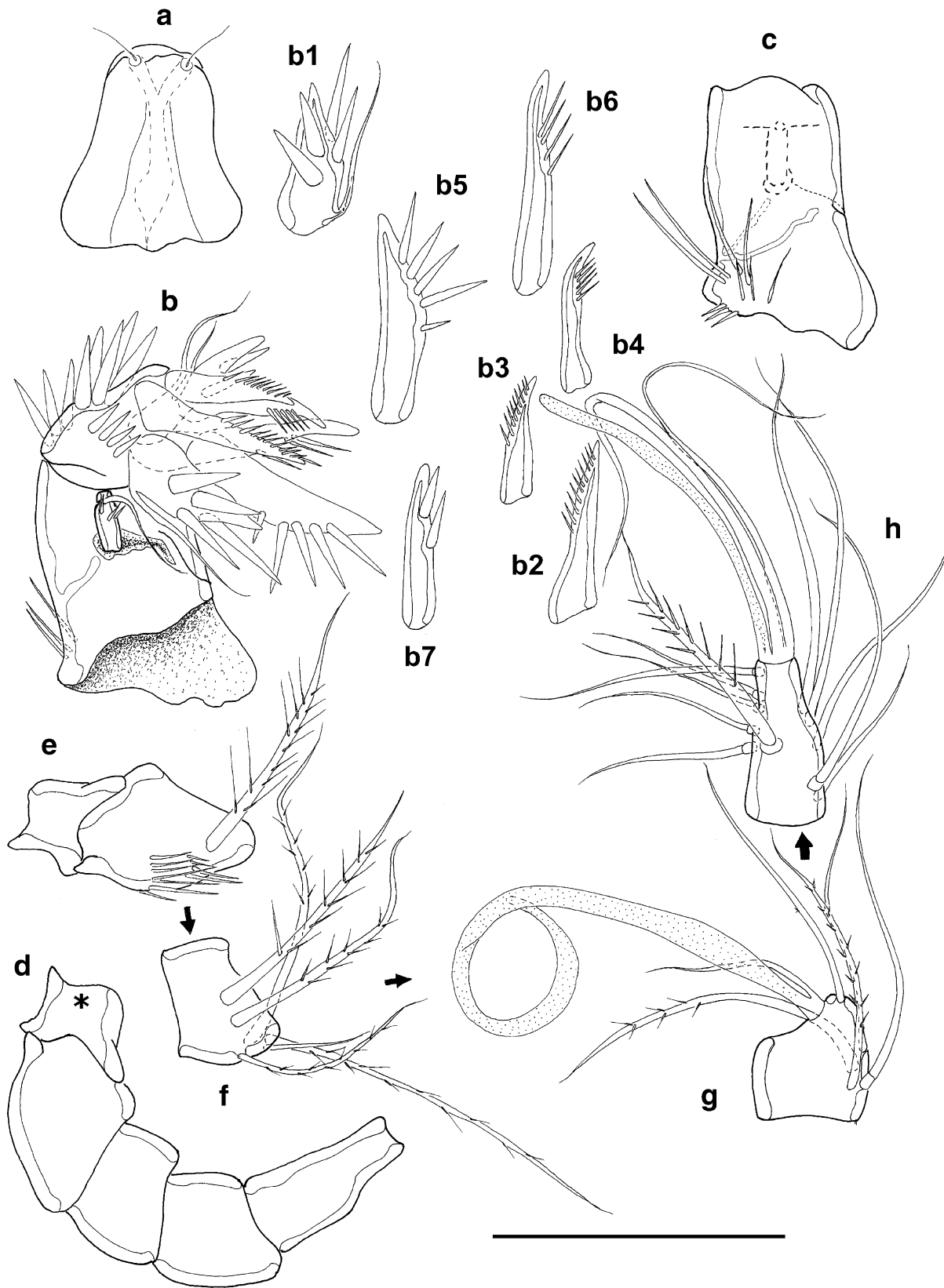


Fig. 3 *Parameiropsis antennafortis* sp. n., holotype, female, SMF 32176: **a** rostrum; **b** antenna (A2); **b1–b7** innermost to outermost spine of A2 enp-2; **c** A2 allobasis; **d** unarmed view of antennule (A1);

e A1 preantennular sclerite and first segment; **f** second segment of A1; **g** third segment of A1; **h** fourth segment of A1. Scale 50 μ m

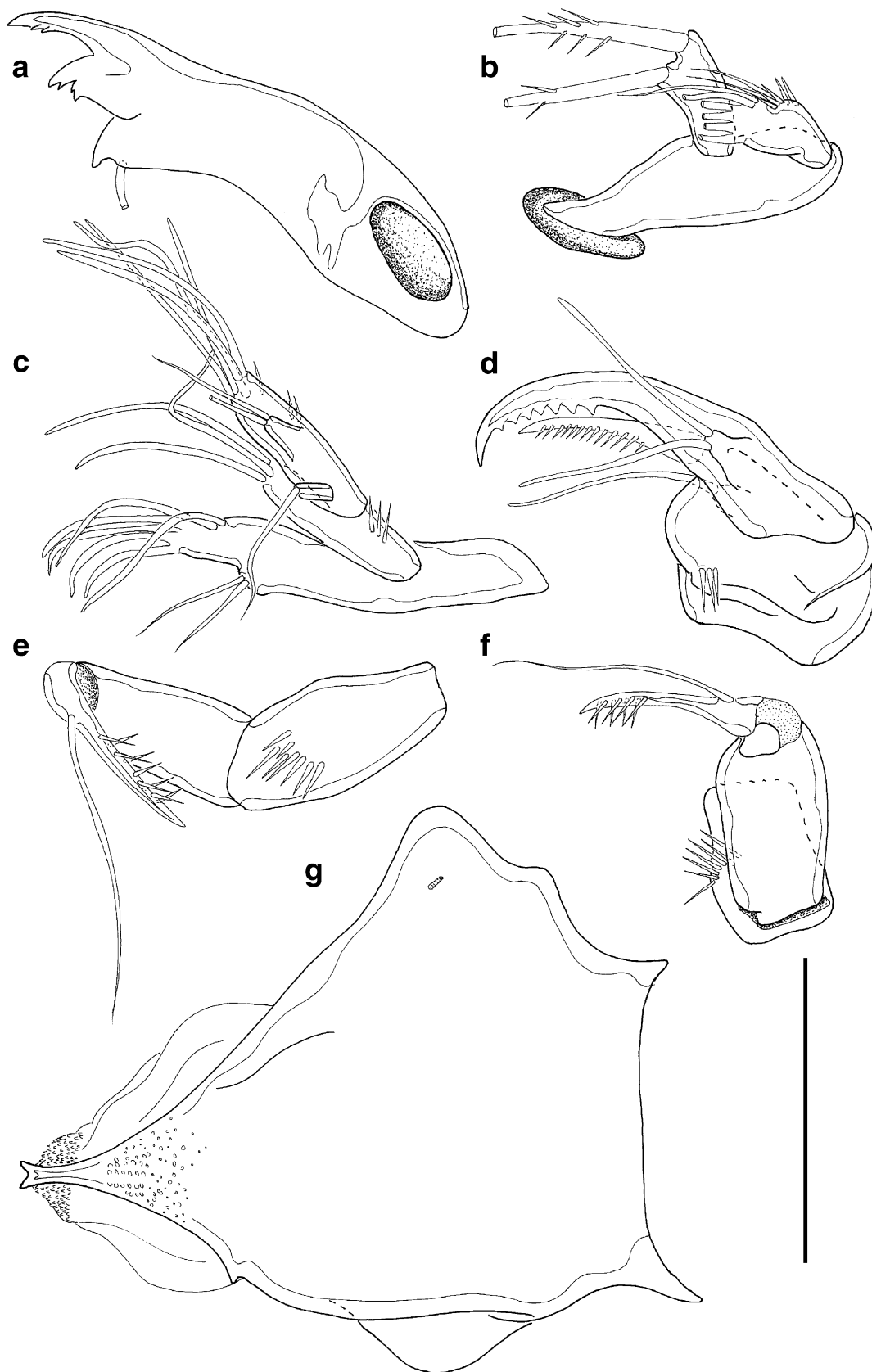


Fig. 4 *Parameiopsis antennafortis* sp. n., holotype, female, SMF 32176: **a** mandible (Md) corpus mandibularis and gnathobasis; **b** detached Md palp with exp and enp; **c** Mx1; **d** Mx2; **e-f** Mxp; **g** labrum. Scale 50 μ m

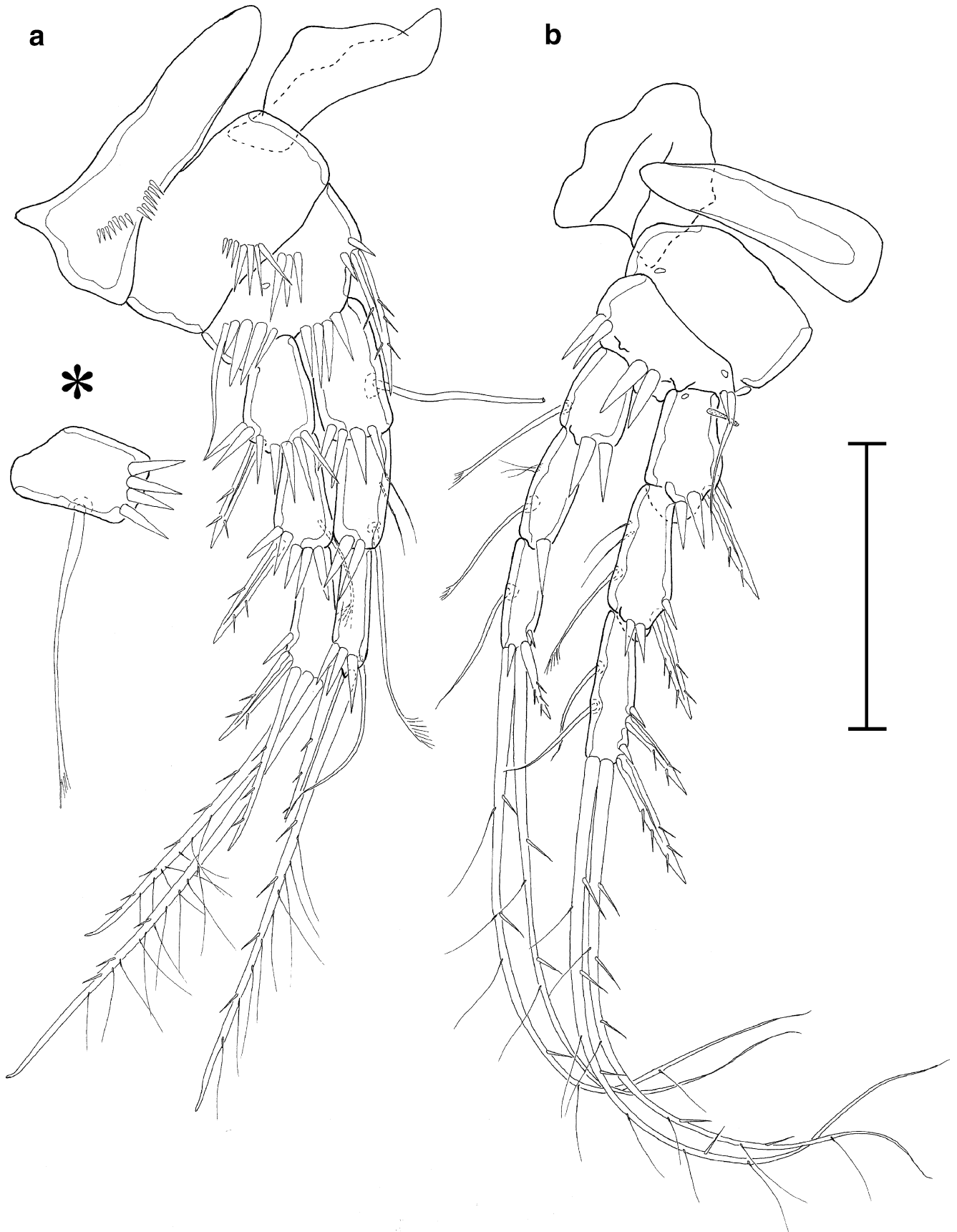


Fig. 5 *Parameiopsis antennafortis* sp. n., holotype, female, SMF 32176: **a** thoracopod 1 (P1); **b** thoracopod 2 (P2); *left P1 enp-1. Scale 50 μ m



Fig. 6 *Parameiropsis antennafortis* sp. n., holotype, female, SMF 32176: **a** thoracopod 3 (P3); **b** thoracopod 4 (P4). Scale 50 μ m

exp-1 (Fig. 5a) approximately of the same size as enp-1; exp-1, exp-2 and enp-1 to enp-3 with strong spinules inserted distally; exp-2 with a short and slender inner seta (not reaching to the distal margin of exp-3) with plumose tip; exp-3 armed with two outer spines and two apically inserted spiniform setae; enp-1, enp-2 and enp-3 subequal in length; enp-1 (Fig. 5*) and enp-2 each with inner seta with plumose tip; enp-3 with outer unipinnate spine, spiniform outer terminal seta and a small and slender inner terminal seta. P2-P4 bases (Figs. 5b, 6a, b) ornamented with strong spinules inserted on the inner margin and between exp and enp; a smaller spinule inserts just next to and distally from the outer setae; a cuticular pore is present near the insertion of the outer seta. Exp-1 of P2-P4 (Figs. 5b, 6a, b) proximally with anterior cuticular pore and a tube pore located proximally on the outer margin; exp-1, exp-2, enp-1 and enp-2 of P2-P4 with strong spinules on the distal outer margin only; exp-2 and enp-2 of P2-P4 ornamented with inner setules. Exp-1 of P2-P4 without inner seta; exp-2, exp-3, and enp-1 to enp-3 of P2-P4 with short and slender inner setae, generally with a plumose tip

(Figs. 5b, 6a, b); not-plumose setae present on exp-3 of P2-P4 and enp-3 of P2 and P4.

Armature of P1-P4 as follows:

	Coxa	Basis	Exp	Enp
P1	0-0	1-1	I-0; I-1; II, 2, 0	0-1; 0-1; I,2,0
P2	0-0	1-0	I-0; I-1; II,2,2	0-1; 0-1; I,2,1
P3	0-0	1-0	I-0; I-1; II,2,3	0-1; 0-1; I,2,2
P4	0-0	1-0	I-0; I-1; II,2,3	0-1; 0-1; I,2,2

P5 not fused medially (Fig. 7a); exp fused to benp and represented by two outer setae and one long apical spine with an inner tube pore; benp with an outer basal seta and two endopodal spines inserted apically (inner spine bipinnate and two-times longer than outer spine). P6 (Fig. 7a, b) formed by a fused plate with one small process on each side. Genital apertures fused; a single copulatory pore represented by a wide semi-lunar aperture, followed by a rectangular copulatory tube; seminal receptacles paired and medially displaced.

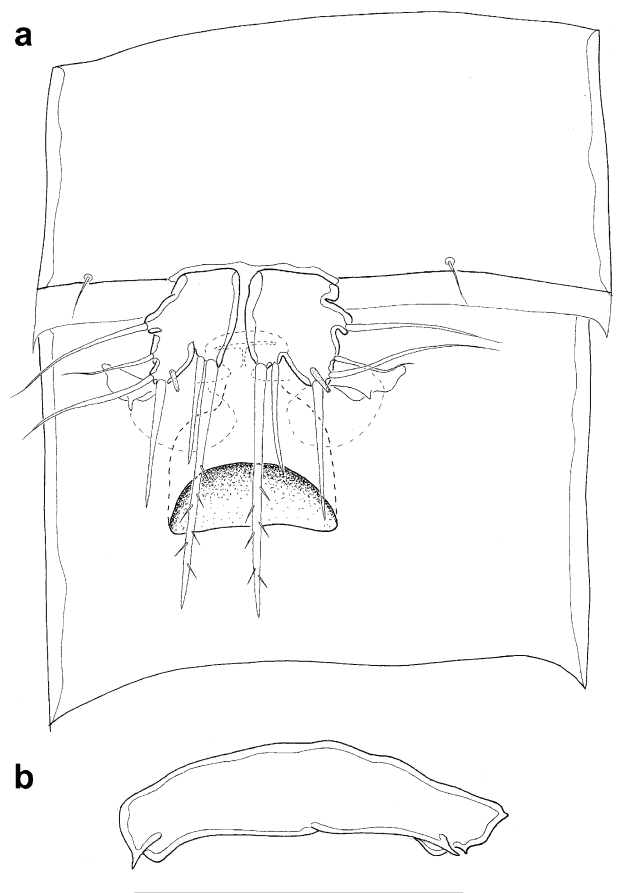


Fig. 7 *Parameiopsis antennafortis* sp. n., holotype, female, SMF 32176: **a** ventral view of first and second urosomites, with thoracopods 5 (P5), 6 (P6) and genital aperture; **b** detail of P6. Vertical scale 50 μ m; horizontal scale 50 μ m

Discussion

The genus *Parameiopsis* was created by Becker (1974), to group the species *Parameiopsis rapiens* Becker, 1974 from an Atlantic deep-sea site at the Northern African coast and *P. peruanus* Becker, 1974 from the Peru Trench. Later, Itô (1983) described a third species, *P. magnus* Itô, 1983 from a deep-sea site off Mindanao in the western Pacific Ocean. The genus seems to be monophyletic and its species are typically collected from deep-sea sites. Each species (including the one described in this paper) has been described from a single female specimen, which is an indication of the rareness of this taxon.

The inclusion of the new species within *Parameiopsis* is supported by the following characters that we consider autapomorphic for the genus: aes on the third segment of the female A1; A2 dorsally bent with outermost spine on enp strongly modified, bearing a row of strong spinules; labrum triangular; Md with elongated pars mandibularis, mandibular palp without armature; praecoxal arthritis of Mx1 elongate, bearing long spines; Mx2 basis forming a strong, much chitinized claw, denticulate along the oral margin, with a very strong spine inserting on its proximal dorsal edge; and elongated and tapering telson, with anal operculum not reaching beyond its posterior margin.

The new species differs from the known described species (viz. *P. rapiens*, *P. peruanus* and *P. magnus*) basically in the following characters (the condition found in the other known *Parameiopsis* species is described within brackets): A1 four-segmented (eight-segmented), labrum with bifid tip, with the bordering hyaline membrane distally ornamented with a series of papilliform outgrowths (labrum with single tip and without papilliform ornamentation on the bordering hyaline membrane); Md with shorter corpus mandibularis and gnathobasis with shorter cutting edge, without distinct spines apically (very long gnathobasis and distinct spines on the cutting edge); Mx2 apparently without proximal endite and distal endite armed with a single seta [proximal endite with one seta, distal with three setae; the description of three endites by Becker (1974) and Itô (1983) is not supported by the observation of other undescribed species of *Parameiopsis*]; Mxp without syncoxal seta (also absent in *P. peruanus*, but present in the other species); robust A2, with strongly modified and piriform-shaped outermost spine (A2 less robust and ornamented, outermost spine strongly developed, but not piriform, much longer than broad); strong reduction of the inner terminal seta of P1 enp-3 (much longer in the other species); absence of inner seta on exp-1 of P2-P4 (inner seta present); exp-2, exp-3, enp-2 and enp-3 of P2-P4 with short inner seta(e), generally with plumose tip (much longer and bipinnate); reduction of the outer armature of P1-P4 exp-3, with the proximal spine

missing (proximal spine present); reduction of armature of P2-P3 enp-3, with loss of the proximal seta (proximal seta present); P5 not fused medially, formed by two separate plates each with fused benp and exp and without intercoxal sclerite (not fused medially and with intercoxal sclerite in *P. rapiens* and *P. peruanus*; fused medially in *P. magnus*; benp fused to exp in *P. rapiens* and *P. magnus*, unisegmented in *P. peruanus*); P5 benp with two endopodal spines (three endopodal spines); and total body length, being *P. antennafortis* sp. n. much smaller than the other known species. Although not illustrated or detailed enough in the original drawings of the known species, the following differences can be additionally mentioned. In *P. antennafortis* sp. n., the genital field has a single copulatory pore represented by a wide semi-lunar aperture, followed by a rectangular copulatory tube. Our observation of other undescribed species, as well as the description of *P. magnus*, revealed that the most common pattern is of a circular or ellipsoid copulatory pore and a cuneiform copulatory tube. In addition, the description of *P. magnus* reveals that the apical armature of exp-3 of P2-P4 consists of an outer rigid and spiniform seta, ornamented with outer spinules and inner setules, whereas the inner seta is a long, flexible and bipinnate. In *P. antennafortis* sp. n., exp-3 of P2-P4 are armed with long and flexible apical setae only. The condition present in *P. magnus* cannot be confirmed for the two species described by Becker (1974), but is present in several other species of *Parameiopsis* studied by us and in several other Harpacticoida groups outside *Parameiopsis*. Therefore, it could be credited as plesiomorphic at least for the genus under question. Taking this into consideration, it seems quite probable that *P. antennafortis* sp. n. is the most derived species of *Parameiopsis* known until now, showing an uncommon reduction of armature on the mouthparts and locomotory limbs within the genus.

Finally, a striking character of *P. antennafortis* sp. n. concerns the armature of P1 enp-3. In this species, the outer spine is transformed into a unipinnate spine, ornamented only along the outer margin, the outer terminal seta is transformed into a rigid spiniform seta and the inner terminal seta is naked and much reduced in size. In addition, the three elements are slightly “superimposed”, with the outer spine appearing in the anterior plane, successively followed by the long spiniform seta and the short slender seta. A similar condition seems to appear at least in *P. magnus*, with the inner terminal seta not so reduced and an unclear superimposition of the armature. In the other known *Parameiopsis* species and most of the undescribed species observed by us, the outer spine is bipinnate and the two terminal setae are long and flexible, the condition that we consider plesiomorphic for the genus.

In literature, special attention has been given to the P1 autapomorphies for Podogenmonta (e.g. Martínez Arbizu

and Moura 1994, Willen 2000 and Seifried 2003). It is hypothesized that in the groundpattern of Podogennonta the enp would have the following autapomorphies (e.g. Willen 2000; p. 133): enp-1 at least as long as exp-1 and exp-2 together, enp-2 and enp-3 short, enp-3 with an outer claw-like seta superimposing a geniculate outer terminal seta and a miniaturized inner terminal seta.

We do not endorse here that the P1 enp-3 condition of *P. antennafortis* sp. n. is homologous to the Podogennonta condition described by Martínez Arbizu and Moura (1994) or Willen (2000). Instead, we would like to call attention to the superficial similarity of P1 enp-3 morphology of *P. antennafortis* sp. n. and Podogennonta. As mentioned above, there is evidence indicating a more derived position of *P. antennafortis* sp. n. within *Parameiopsis*, what would make the hypothesis of a Podogennonta P1 at the groundpattern of the genus *Parameiopsis* at least low parsimonious and the inclusion of *Parameiopsis* within Podogennonta at least doubtful.

Parameiopsis was included within the family Ameiridae Monard, 1927 (a typical Podogennonta taxon) by Becker (1974) and this taxonomic scheme has traditionally been adopted even in recent works (e.g. Boxshall and Halsey 2004; Wells 2007). However, the *Parameiopsis* species known until now do not show any decisive character supporting the inclusion of this genus within Ameiridae (a discussion about the position of *Parameiopsis* within Harpacticoida will be offered in a forthcoming paper). Therefore, here we consider *Parameiopsis* an incertae sedis taxon within Harpacticoida.

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