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**A new species of *Catinia* Bocquet & Stock, 1957 (Copepoda, Catiniidae) associated with mud shrimps, *Axianassa australis* Rodrigues & Shimizu, 1992 (Decapoda, Thalassinidea, Laomediidae), from Brazil**

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**Abstract**

*Catinia aiso* sp. n. was found in association with the mud shrimp, *Axianassa australis* Rodrigues & Shimizu, 1992 collected in the intertidal zone of Araçá Beach, state of São Paulo, Brazil (23°48'50''S, 45°23'48''W). The new species shares with *Catinia plana* Bocquet & Stock, 1957 the structure of the oral appendages, the setal formula of the swimming legs, the robust pedunculate sucker on the antenna, and the absence of the maxilliped in adult females. However, the two species can be separated by the rostrum shape, the presence or absence of an inner coxal seta on leg 4, and the structure of leg 5 in both sexes. *Catinia aiso* also differs from *C. plana* in the depressed ovoid body shape, the ornamentation of the maxilla in the female and in the modified claw of the maxilliped of the male. The sexual dimorphism expressed in the armature of the antennule and the endopodal segments of the swimming legs in *C. plana*, is absent in *C. aiso*. This is the first record of *Catinia* since the genus was established on the basis of material from the Baie de Morgat, France, in 1957.

**Key words:** Crustacea, associated Copepoda, Catiniidae, *Catinia*, *Axianassa*, Brazil, mud shrimp

**Introduction**

Bocquet & Stock (1957) established the family Catiniidae to accommodate *Catinia plana* Bocquet & Stock, 1957, a marine cyclopid externally associated with *Sipunculus nudus* Linnaeus, 1766, from the Atlantic coast of France. Clearly a member of the nereicoliform group (Gooding, 1963), in the opinion of Ho (1984) the development of a strong pedunculate sucker on the second endopodal segment of the antenna and the reduction of the maxilliped in females placed *Catinia* together with the genera *Myzomolgus* Bocquet & Stock, 1957, *Cotylomolgus* Humes & Ho, 1967, *Cotylemyzon* Stock, 1982, and *Goidelia* Emble-

ton, 1901 in the catiniid complex. Kim (2001) redescribed *C. plana* and tentatively assigned these five genera to the family Catiniidae. Based on apomorphies for the Catiniidae, such as a pedunculate sucker on the antenna, the reduction or absence of the female maxilliped, the presence of spinulate areas proximally to the maxilla, an inner seta on the second endopodal segment of legs 1–4, and the incised anal somite, Boxshall (in Boxshall & Halsey, 2004) transferred *Goidelia* to the family Echiurophilidae and provided a revised key to the four genera remaining in Catiniidae and their species.

Catiniids have been found in Madagascan, Indonesian, French and Korean waters as external associates of sipunculids and polychaetes (Bocquet & Stock, 1957; Humes & Ho, 1967; Stock, 1982; Ho, 1984; Kim, 2001). This is the first record of *Catinia* since the genus was established.

### Material and methods

The copepods were collected from the external surface of the carapace and uropods of the mud shrimp *Axianassa australis* Rodrigues & Shimizu, 1992 from the intertidal zone of Araçá Beach, state of São Paulo, Brazil (23°48'50''S, 45°23'48''W).

Whole specimens were examined in temporary lactic-acid mounts. Chips of cover slip were used to support the cover glass of the preparation. After examination, the material was returned to and preserved in 70% ethanol.

Dissections were made in glycerin, and the dissected parts were placed on slides and sealed with Glyceel®.

A Zeiss Axioskop 2 Plus® compound microscope equipped with differential interference contrast, a Nikon Coolpix 995® digital camera, and a drawing tube were used to examine and prepare illustrations of the specimens.

The terminology applied to segmentation and setation of body appendages was adopted from Huys & Boxshall (1991).

### Taxonomy

#### *Catinia aiso* sp. n.

(Figs. 1–11)

**Material examined.** São Sebastião, Araçá Beach (23°48'50''S, 45°23'48''W): 2 females, Sep. 19 1997; 11 females and 1 male, 22 Jan. 2000, and 2 females and 1 male, 11 Mar. 2001. All specimens from external surface of carapace and uropods of *Axianassa australis* in the intertidal zone; Cynthia Santos coll. Holotype (registration number: MZUSP 16462) and undissected paratypes (MZUSP 16463) deposited in Museu de Zoologia, Universidade de São Paulo. Dissected paratypes in collection of Carlos E. F. Rocha (Departamento de Zoologia, Instituto de Biociências, Universidade de São Paulo).

**Female** (Figs. 1–5, 6A–C, 10). Total length, excluding setae on caudal rami, 0.7–0.8 mm (N=15). Body broadly ovoid (Figs. 1A, 10A–B), dorsoventrally compressed. Prosoma longer than urosome (3.17:1). Cephalosome and free prosomites pitted (Figs. 1B, 10C), with sensilla pattern as shown in Fig. 1A, and posterior borders smooth. Epimera of third and fourth pedigerous somites expanded posteriorly, lateral margins of epimera deeply serrate. Posterior margin of fourth pedigerous somite clearly incised medially. Urosome (Figs. 1C, 2A, 10D) 5-segmented, comprising fifth pedigerous somite, genital double-somite and 3 free abdominal somites. Hyaline frills of second to fourth urosomites deeply indented. Somite bearing leg 5 (Figs. 1C, 2A) about 2.5 times wider than long in dorsal view, with 4 transverse rows of spinules on ventral surface and leg 5 arising ventrolaterally. Genital double-somite (Figs. 1C, 2A) slightly longer than broad, with 2 transverse rows of minute spinules and few sensilla on dorsal surface; densely covered with rows of spinules ventrally. Genital area (Fig. 1C) located dorsolaterally on each side. Anal somite (Figs. 1C, 2A–C) cleft medially, twice as wide as long, with pairs of setules and spinules on dorsal surface and row of strong spinules along posterior edge, both ventrally and laterally.

Caudal ramus (Figs. 2A–C) slightly longer than wide and armed with 7 setae. Setae I and III bipinnate; setae IV and V strongly developed and bipinnate, seta V 3 times longer than seta IV; seta VI shortest; seta VII biarticulate at base and arising from minute dorsal pedestal, near inner posterior margin. Ramus with tiny spinules on inner margin and row of strong spinules along posterior margin ventrally.

Rostrum (Figs. 3A, 10F) conspicuous only in ventral view, quadrangular.

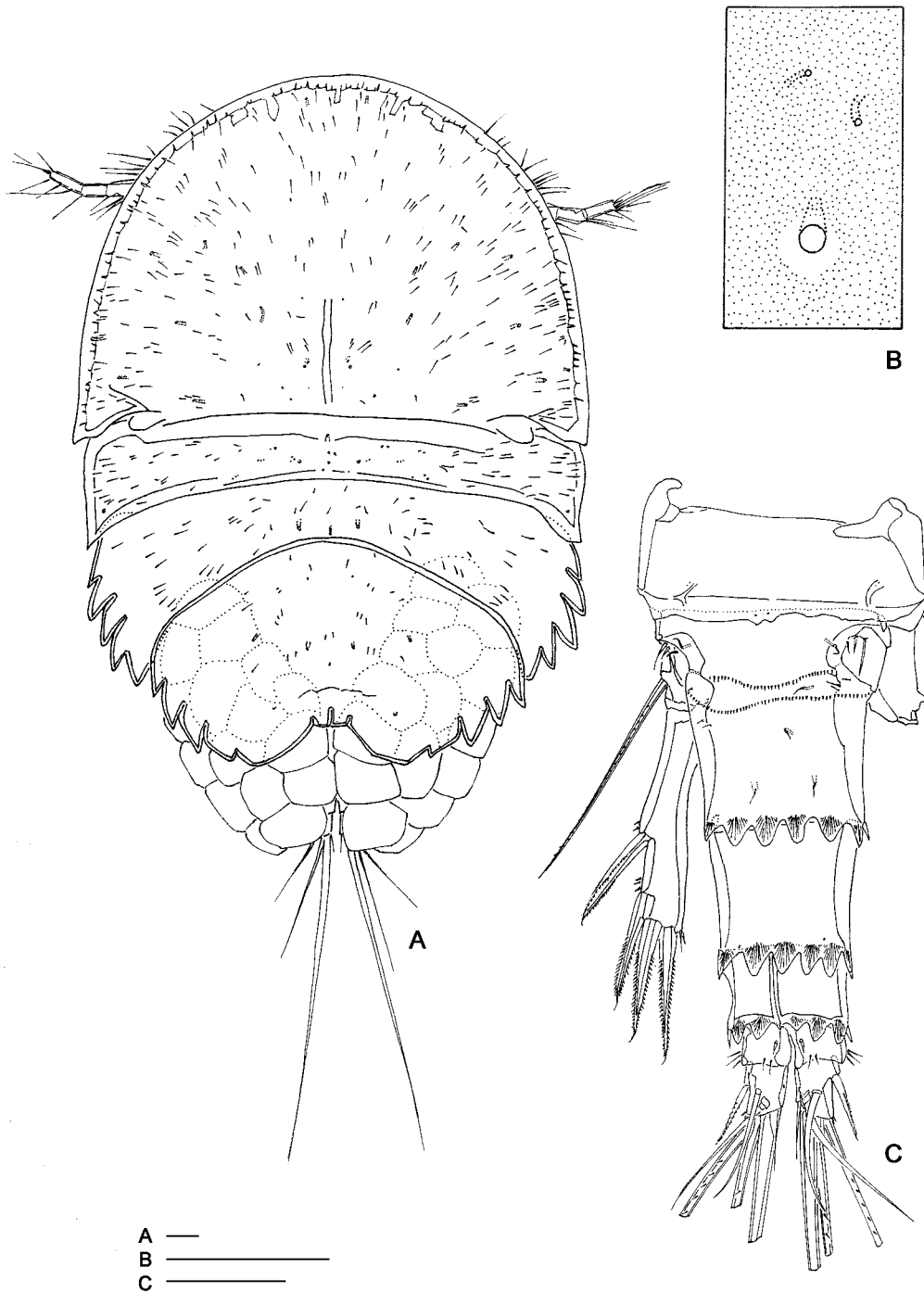
Antennule (Figs. 3A–C) 6-segmented. Segment 1 with spiniform, serrate, upward-curved seta inserted on pedestal near posteroventral edge (arrowed in Figs. 3B–C, 10E). Segment 2 longest. Segment 5 with aesthetasc fused basally to seta. Segment 6 with apical acrothek consisting of aesthetasc and 2 slender setae. Armature formula: 5, 13, 9, 4 + 1 aesthetasc, 2 + 1 aesthetasc, 7 + 1 aesthetasc.

Antenna (Figs. 3D, 10F–G) 4-segmented. Segment 1 longest, with rows of setules along inner and outer margins; plumose seta and massive corrugated process (Fig. 10H, arrowed in Figs. 3D, 10G) on distal corner. Segment 2 unarmed, segment 3 with pinnate seta, large pedunculate sucker (Fig. 10I), and flattened pinnate seta on distal edge. Segment 4 with row of fine spinules on outer corner; 4 geniculate setae at apex, two of them with setules terminally; 2 unipinnate subterminal outer setae, inner seta twice as long as outer.

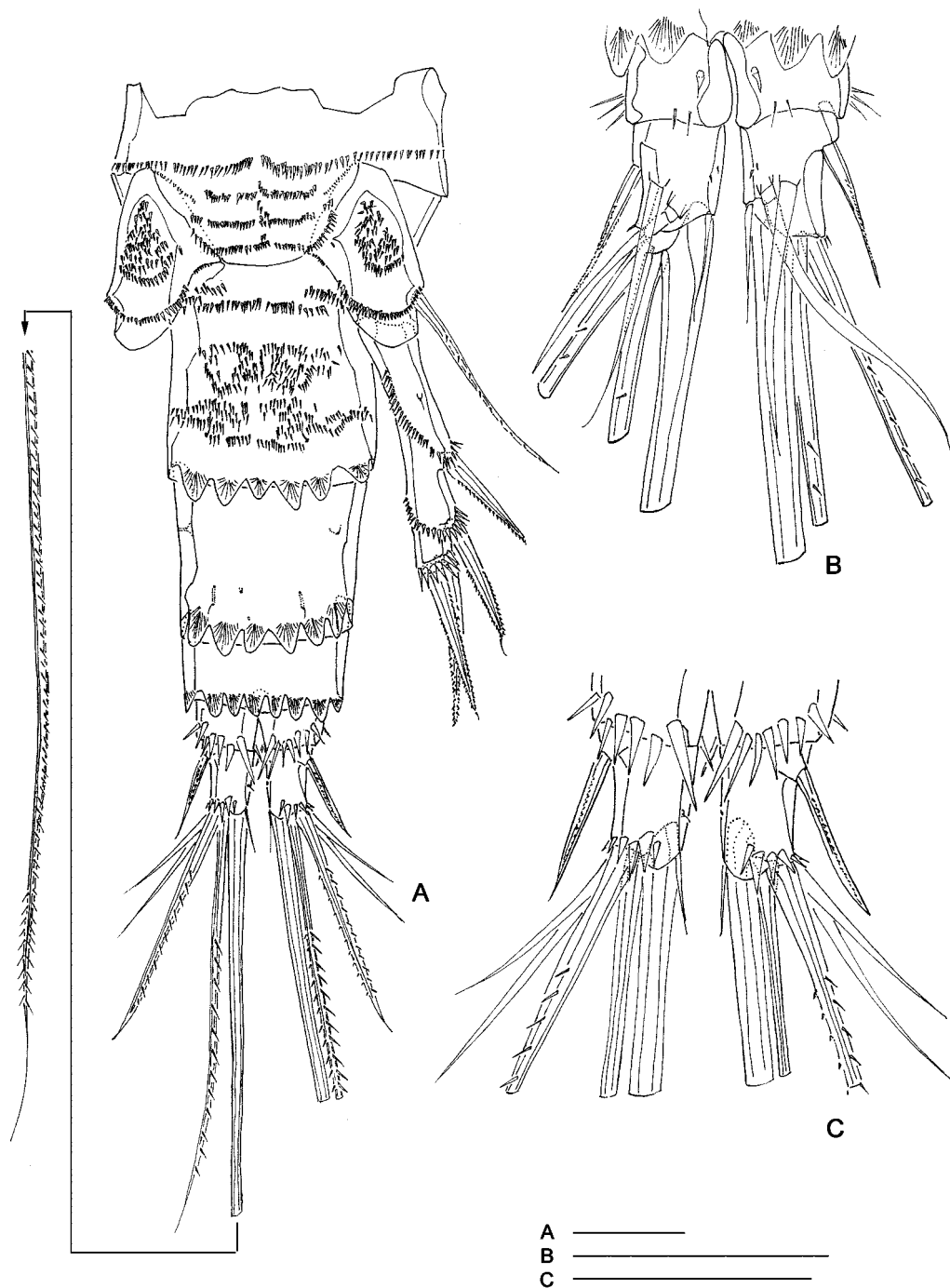
Labrum (Fig. 4A) conical, partly covering mandibles; rounded part with row of spinules.

Mandible (Figs. 4A–B) consisting of elongate process bent 90° downward, with short subterminal spinules.

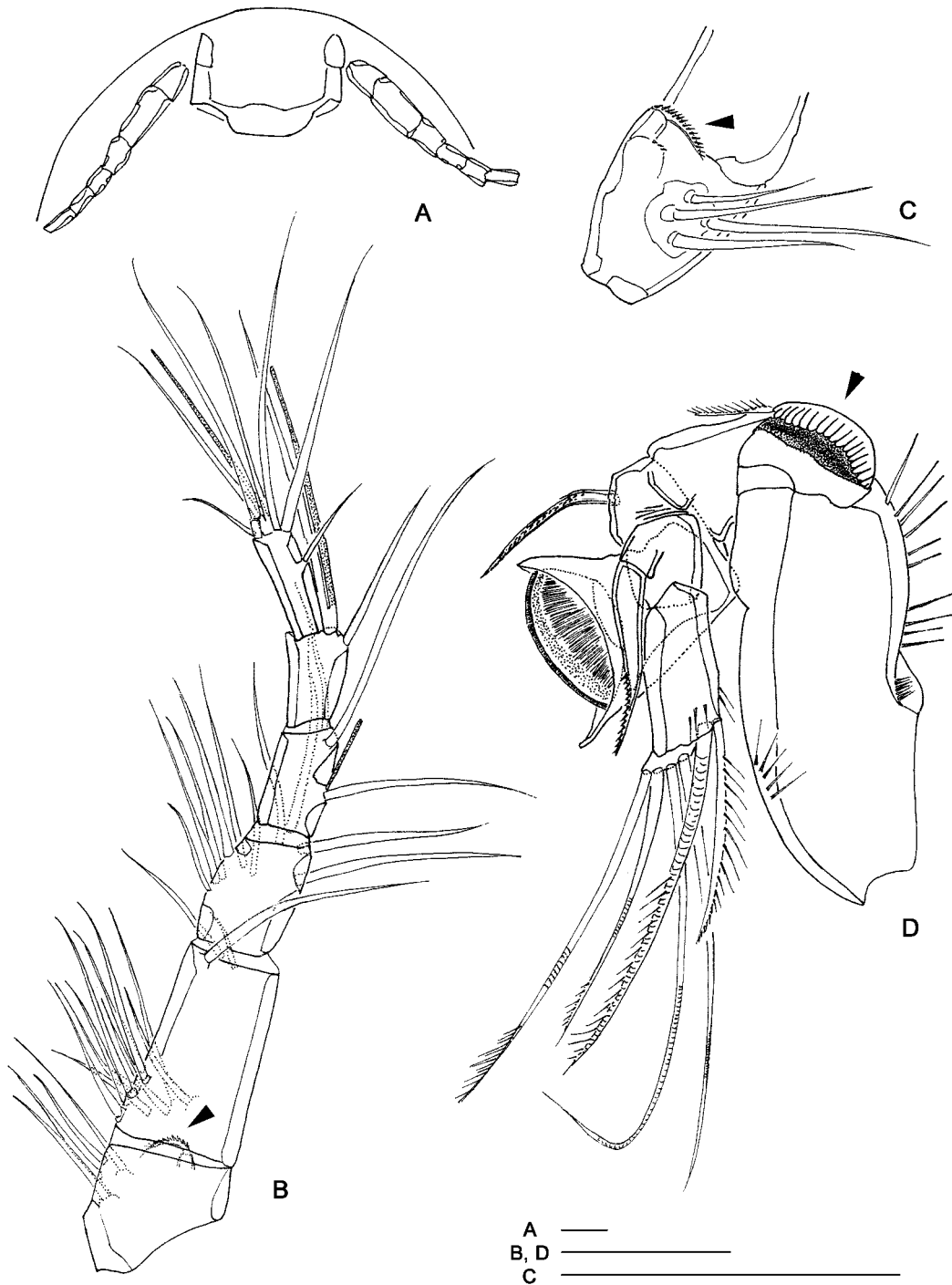
Maxillule (Figs. 4A, 4C) 1-segmented, implanted on reinforced integumental area; armed with 1 lateral and 4 apical setae.



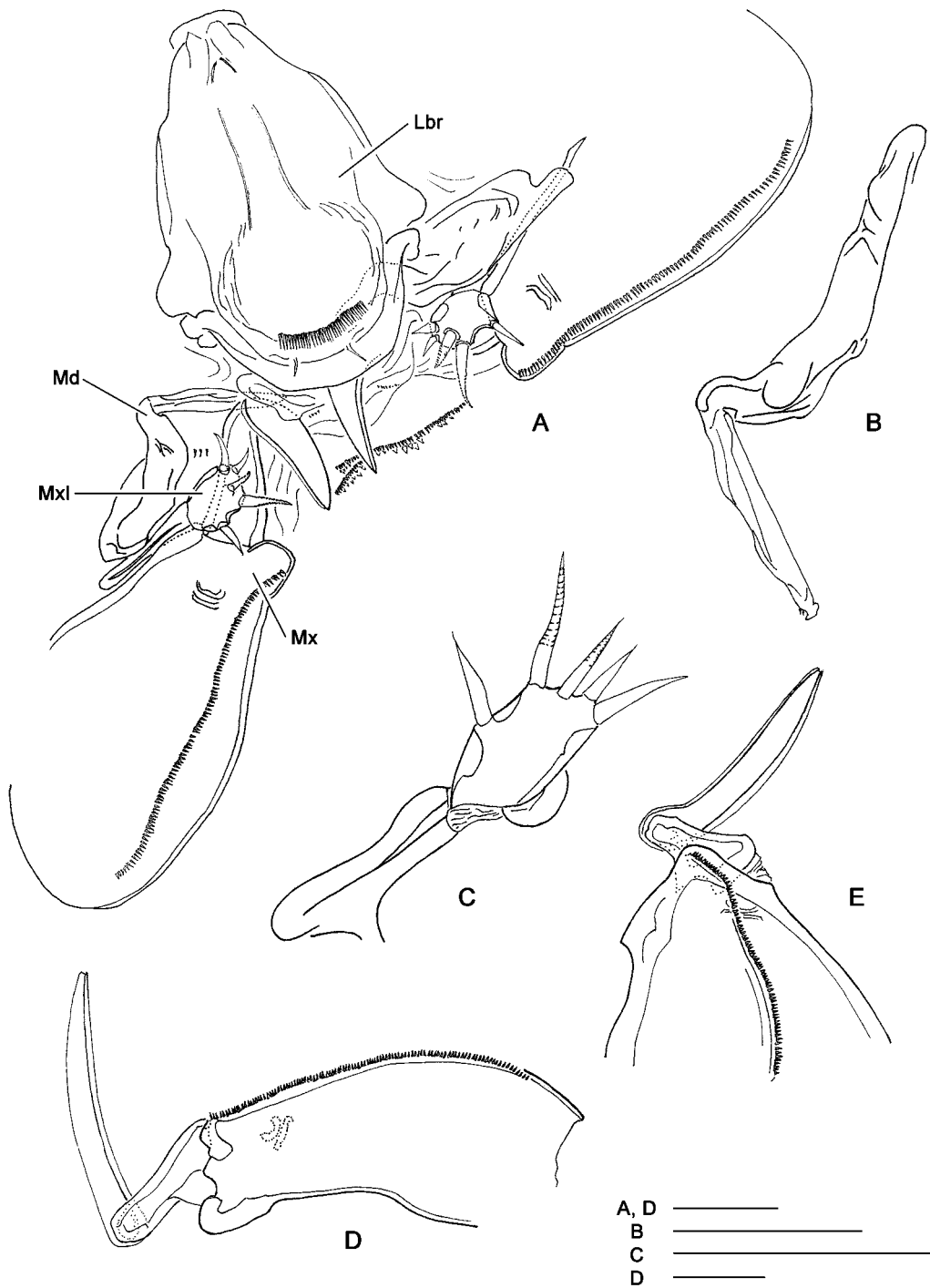
**FIGURE 1.** *Catinia aiso* sp. n. Female: A. habitus, dorsal; B. detail of cephalosome ornamentation, showing pits and tegumental glandular pores, dorsal; C. urosome, dorsal (scale bars 50  $\mu$ m).



**FIGURE 2.** *Catinia aiso* sp. n. Female: A. urosome, ventral; B. anal somite and caudal rami, dorsal; C. posterior margin of anal somite and caudal rami, ventral (scale bars 50  $\mu$ m).

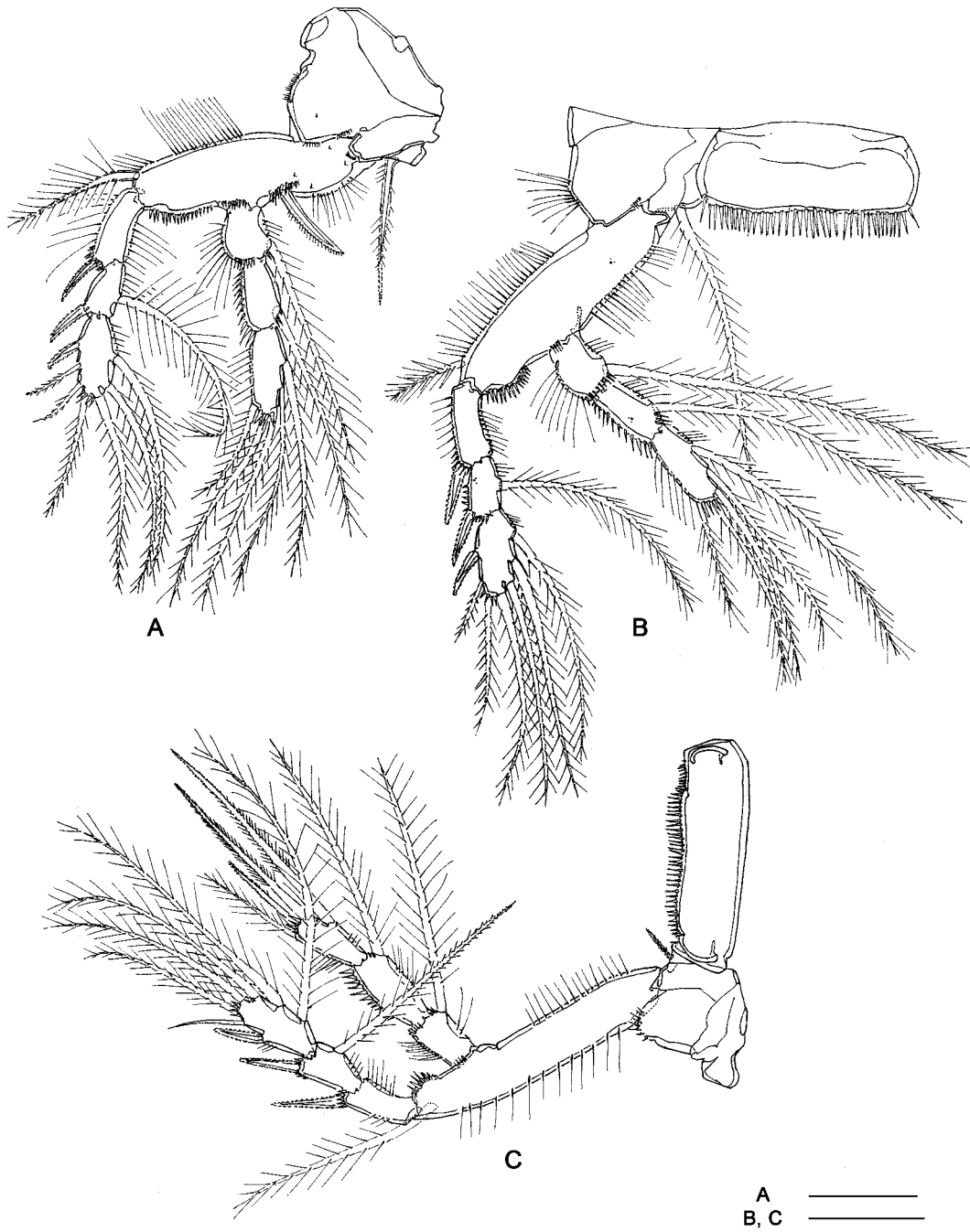


**FIGURE 3.** *Catinia aiso* sp. n. Female: A. frontal part of cephalosome showing rostral area and pair of antennules (armature not represented), ventral; B. antennule (arrow indicating spiniform seta); C. antennule segment 1 (arrow indicating spiniform seta), posterior; D. antenna (arrow indicating massive process) (scale bars 50  $\mu$ m).

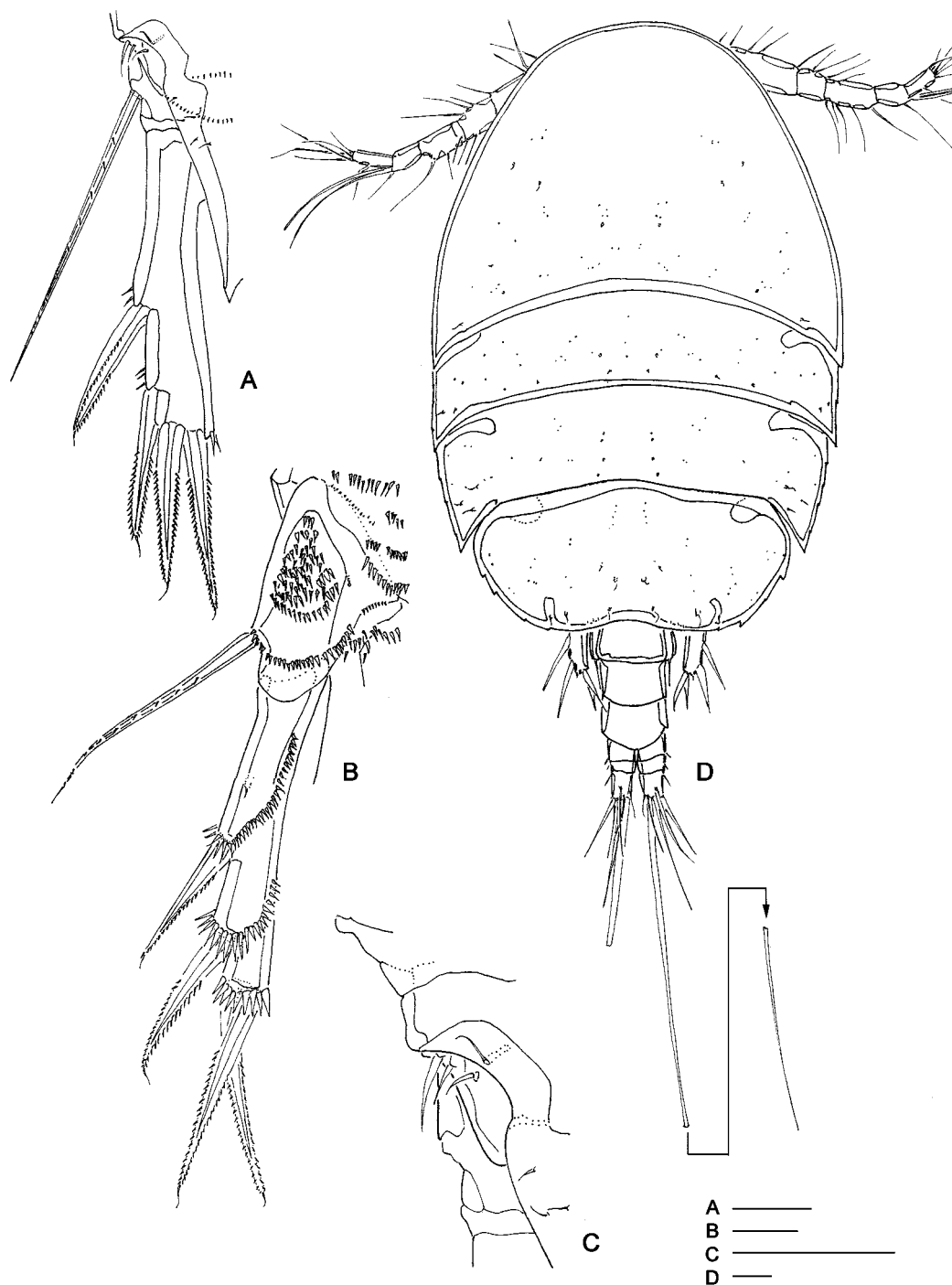


**FIGURE 4.** *Catinia aiso* sp. n. Female: A. oral area with labrum (Lbr), mandible (Md), maxillule (Mxl) and maxilla (Mx); B. mandible; C. maxillule articulating on reinforced integumental area; D. maxilla, anterior; E. maxilla, ventral (scale bars 25  $\mu$ m).





**FIGURE 5.** *Catinia aiso* sp. n. Female: A. leg 1; B. leg 2, with intercoxal sclerite; C. leg 4, with intercoxal sclerite (scale bars 50  $\mu$ m).



**FIGURE 6.** *Catinia aiso* sp. n. Female: A. leg 5, posterior; B. leg. 5, anterior; C. leg 6. Male: D. habitus, dorsal (scale bars 25  $\mu$ m).

Maxilla (Figs. 4A, 4D–E) 2-segmented. Segment 1 elongate, slightly narrower distally and with row of spinules posteriorly along crest. Segment 2 forming an elongate process directed towards mouth, distal part folded and lamellar.

Maxilliped absent.

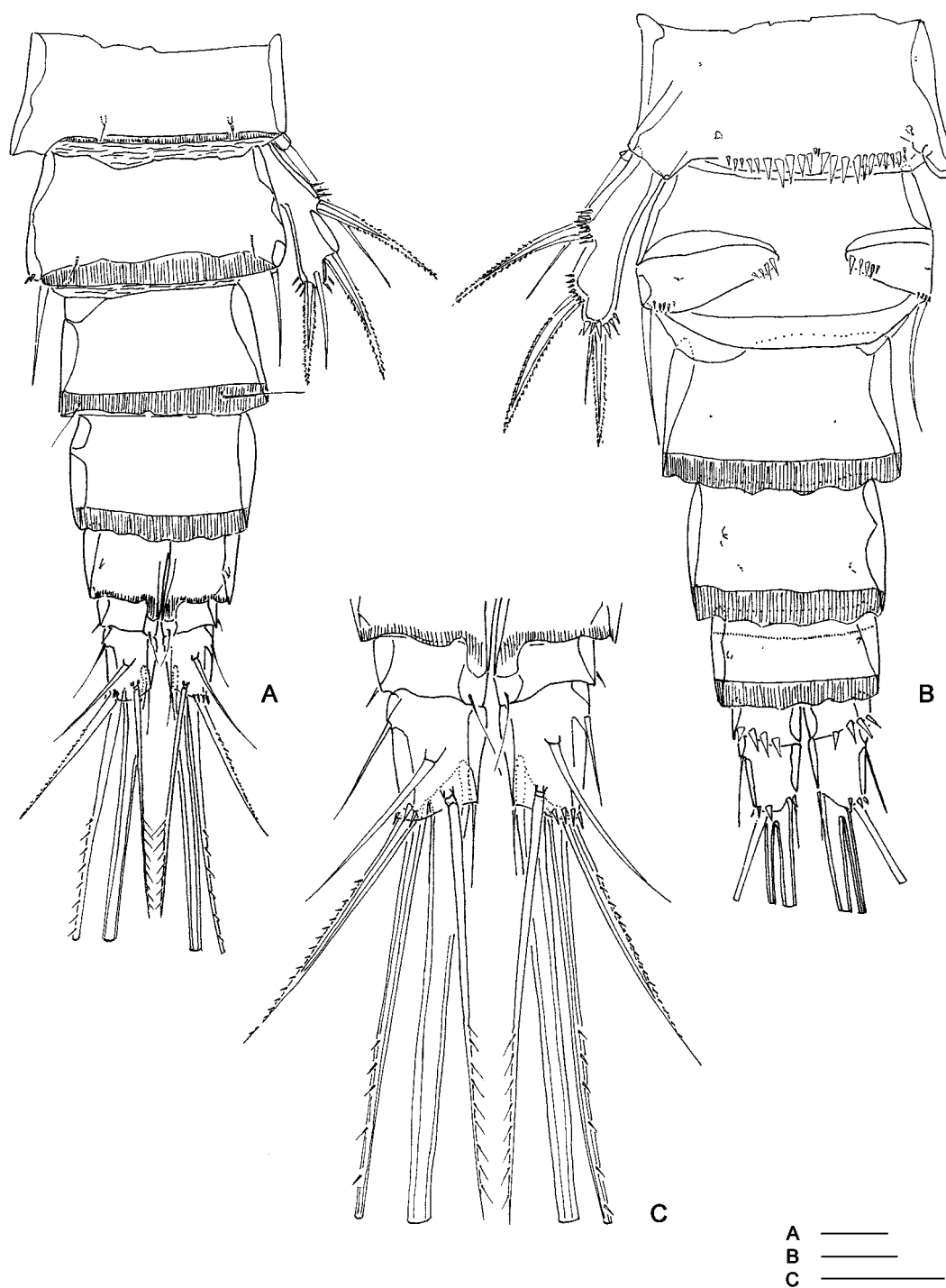
Legs 1–4 (Fig. 5) biramous, with 3-segmented rami. Legs 2 and 3 differing only in size. Elements on coxa of legs 1–4 very variable; leg 1 (Fig. 5A) with stiff bipinnate seta; legs 2 and 3 (Fig. 5B) each with long plumose seta; leg 4 (Fig. 5C) with short pinnate seta. Basis of legs 1–4 elongate, inserted on coxa at angle of about 45°, with plumose seta at outer distal corner, and row of spinules along distal rim between exopod and endopod; outer and inner margins each with row of sparse setules. Leg 1 basis with slightly curved inner spine, this spine serrate along its outer margin. Inner and outer margins of exopods and endopods of legs 1–4 ornamented with setules and spines as shown in Figs. 5A–C. Leg 4 endopod segment 3 with 2 thick inner setae ornamented with stiff setules on distal 2/3, proximal seta about 1.25 times longer than distal seta; apical seta stiff, serrate and reaching midlength of inner distal seta. Armature formula as follows (Roman numerals representing spines, Arabic numerals representing setae):

	Coxa	Basis	Exopod	Endopod
Leg 1	0-1	1-I	I-0; I-1; I,2,1,3	0-1; 0-1; 1,4
Leg 2	0-1	1-0	I-0; I-1; I,1,1,4	0-1; 0-1; 1,4
Leg 3	0-1	1-0	I-0; I-1; I,1,1,4	0-1; 0-1; 1,4
Leg 4	0-1	1-0	I-0; I-1; I,1,1,4	0-1; 0-1; 1,3

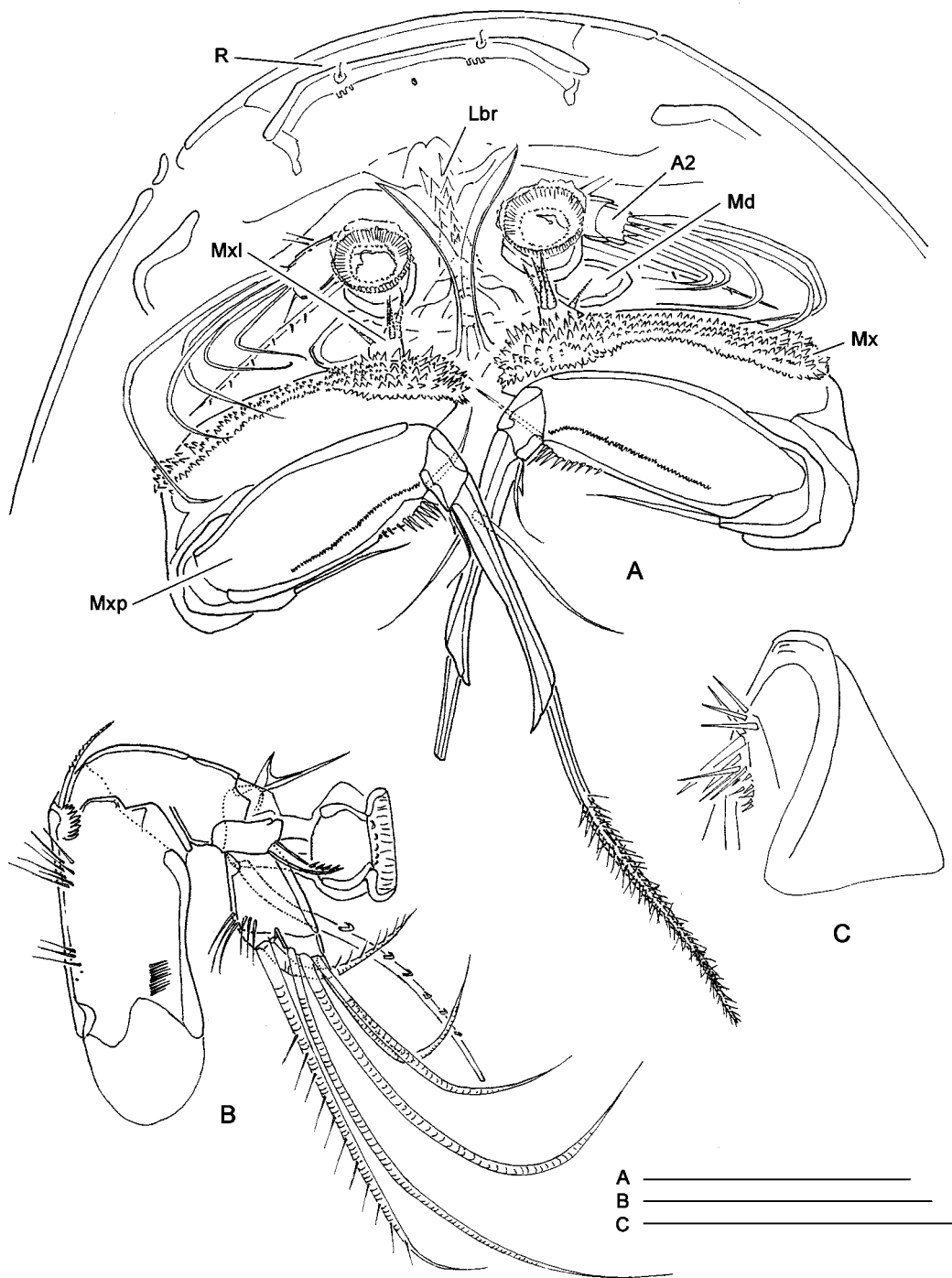
Leg 5 (Figs. 6A–B, 10D) 2-segmented. Basal segment with long seta armed with minute sparse spinules; ventral surface spinulose and with subterminal row of spinules ending at base of seta. Terminal segment 10 times longer than wide, with oblique rows of spinules on ventral surface running toward insertion sites of outer spines, plus row of spinules at apex. Armature consisting of 4 bipinnate spines, each with terminal flagellum.

Leg 6 (Fig. 6C) consisting of 3 small setae.

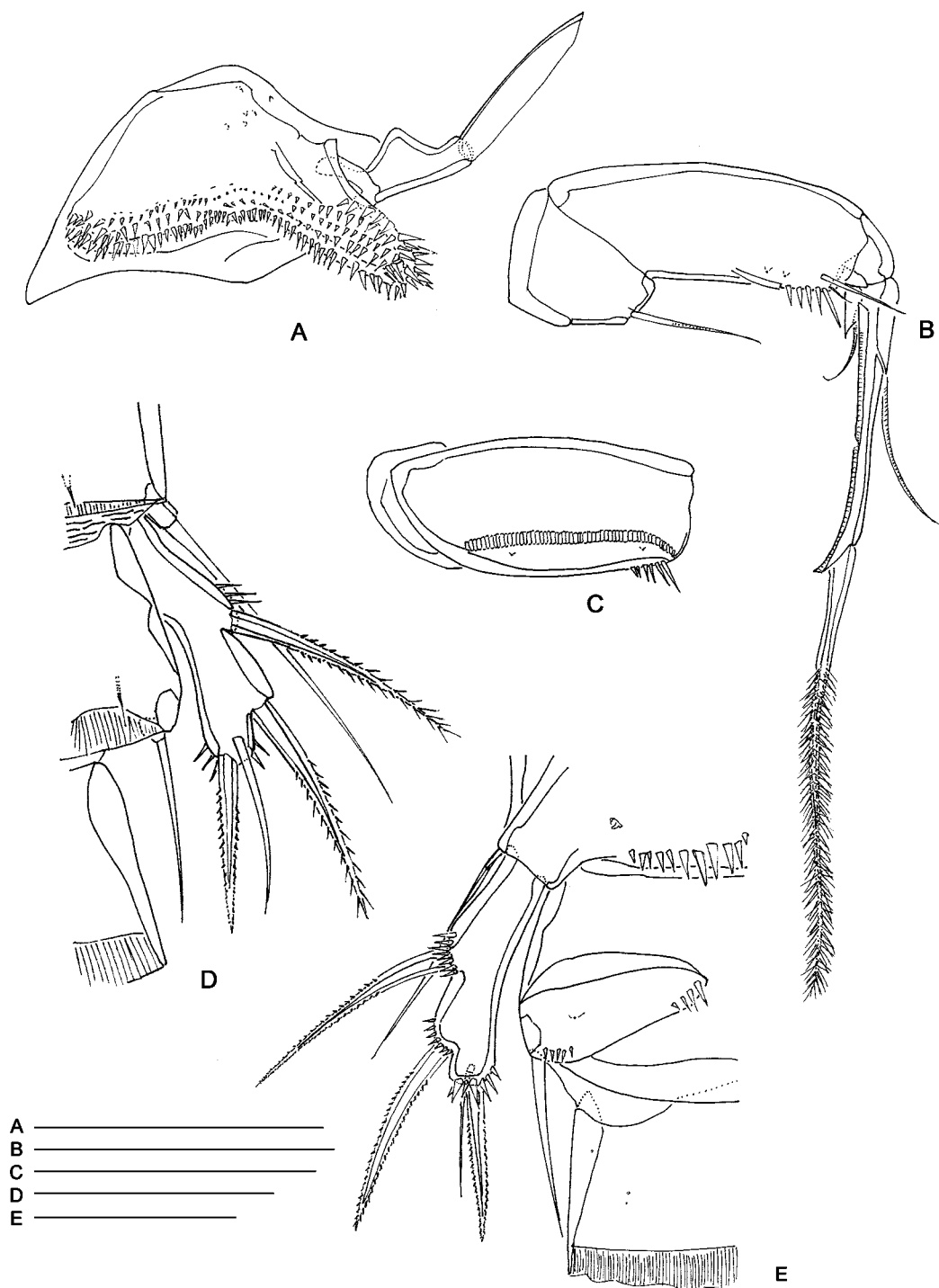
**Male** (Figs. 6D, 7–9, 11). Total length, excluding setae on caudal rami, 0.4 and 0.5 mm (N=2). Body cyclopiform (Figs. 6D, 11A). Prosoma longer than urosome (2.28:1). Cephalosome and free prosomites with smooth posterior borders; integumental pores and sensilla as shown in Fig. 6D. Epimera of second to fourth pedigerous somites weakly indented on lateral margin. Urosome (Figs. 7A–B) 6-segmented. Hyaline frills of second to fourth urosomites finely striated. Somite bearing leg 5 (Figs. 7A–B) with row of spinules on ventral surface; fifth legs arising ventrolaterally. Anal somite (Figs. 7A–B) with pair of sensilla on inner dorsolateral area and row of few thick spinules along posterior margin ventrally and laterally.



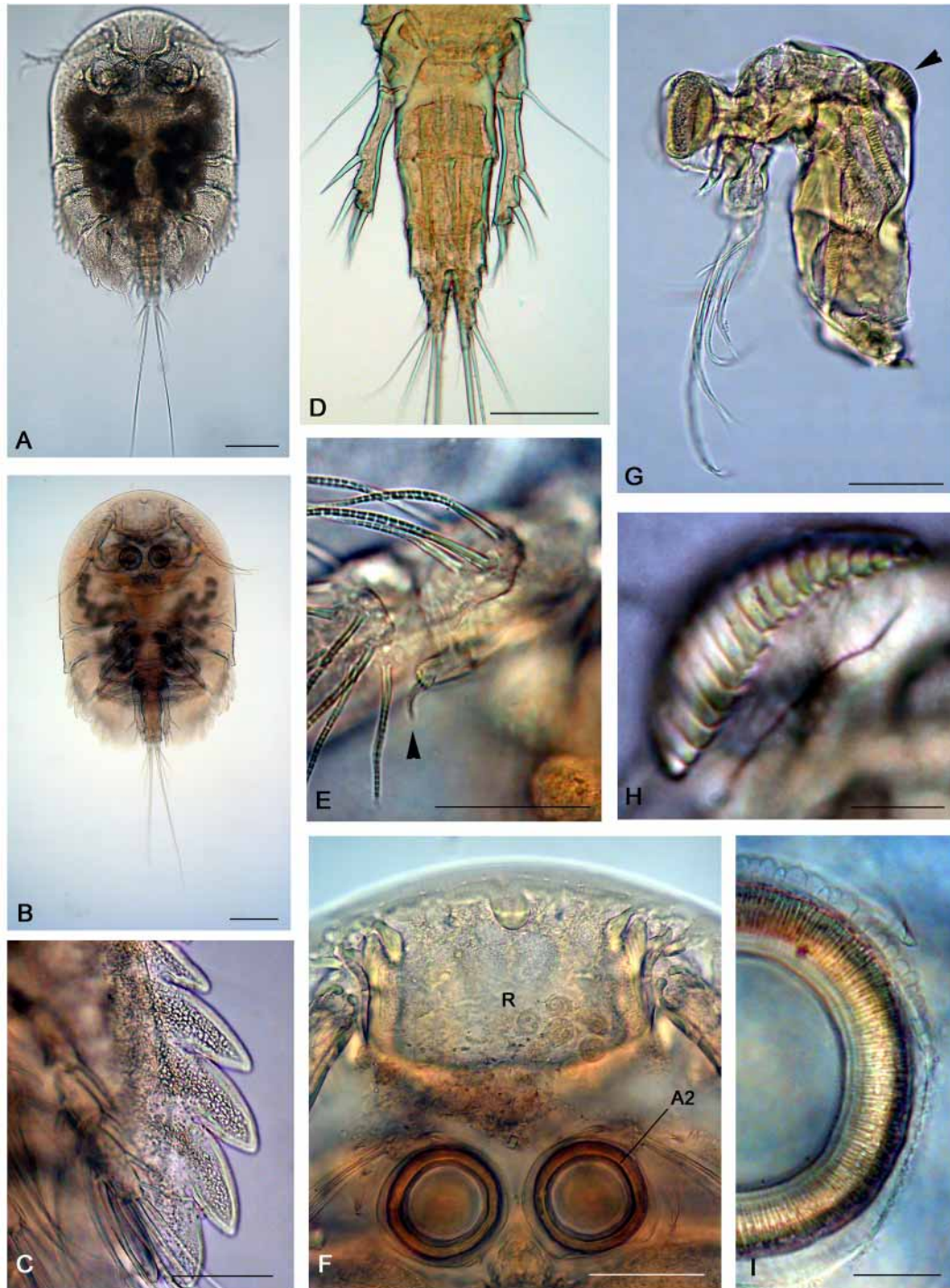
**FIGURE 7.** *Catinia aiso* sp. n. Male: A. urosome, dorsal; B. urosome, ventral; C. anal somite and caudal rami, dorsal (scale bars 25  $\mu$ m).



**FIGURE 8.** *Catinia aiso* sp. n. Male: A. cephalosome in ventral view, with rostrum (R), antennae (A2), labrum (Lbr), mandible (Md), maxillule (Mxl), maxilla (Mx), and maxilliped (Mxp) (antennules not shown); B. antenna; C. labrum (scale bars 50  $\mu$ m).



**FIGURE 9.** *Catinia aiso* sp. n. Male: A. maxilla, anterior; B. maxilliped, posterior; C. maxilliped segment 2, anterior; D. leg 5, dorsal; E. legs 5 and 6, ventral (scale bars 50  $\mu$ m).



**FIGURE 10.** *Catinia aiso* sp. n. Female: A. habitus, dorsal; B. habitus, ventral; C. Epimera of third pedigerous somite, showing deeply indented lateral margin, dorsal; D. urosome, dorsal; E. antennule segment 1 (arrow indicating spiniform seta), posterior; F. rostrum (R) and pedunculate suckers of antennae (A2), ventral; G. antenna (arrow indicating massive process); H. antenna, detail of the massive process; I. antenna, detail of the pedunculate sucker (scale bars: A–B, 200  $\mu\text{m}$ ; C, 25  $\mu\text{m}$ ; D, 100  $\mu\text{m}$ ; E, 25  $\mu\text{m}$ ; F–G, 50  $\mu\text{m}$ ; H–I, 10  $\mu\text{m}$ ).

Caudal ramus (Figs. 6D, 7C) bearing 7 setae. Setae I, II and VI naked; seta V 4 times longer than seta IV; seta VII bipinnate. Ramus with spinules along lateral posterior edge.

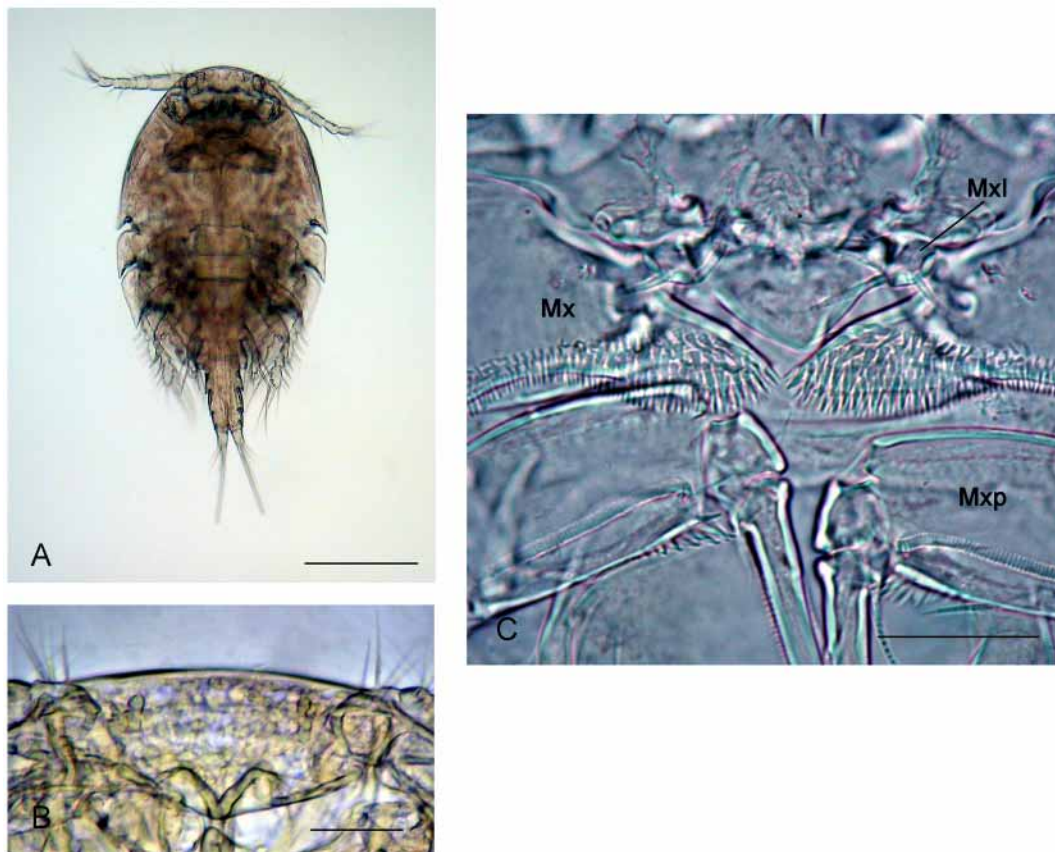
Rostrum (Fig. 11B) with rounded posterior margin.

Antenna (Figs. 8A–B) with process on first segment less conspicuous than in female. Segment 3 with sucker, 1 bifid spine, 1 unipinnate seta and 1 long seta with small backwards-curved spinules.

Labrum (Figs. 8A, 8C) with 2 rows of stiff spinules medially.

Maxilla (Figs. 8A, 9A, 11C) produced into crest and ornamented with rows of spinules along posterior and distal margin of segment 1. Segment 2 as in female.

Maxilliped (Figs. 8A, 9B–C, 11C) 4-segmented. Segment 1 with seta on inner margin. Segment 2 with row of denticles along anterior surface; seta and row of spinules on inner distal margin, and 1 lateral seta on posterior surface. Segment 3 reduced and unarmed. Segment 4 long and narrow, claw-like with plumose apical seta and 2 proximal short setae.



**FIGURE 11.** *Catinia aiso* sp. n. Male: A. habitus, dorsal; B. rostrum, ventral; C. oral area with maxillule (Mxl), maxilla (Mx) and part of maxilliped (Mxp) (scale bars: A, 200  $\mu$ m; B–C, 25  $\mu$ m).



Leg 5 (Figs. 9D–E) 2-segmented. Segment 1 partly fused to base, with 1 seta arising from pedestal. Terminal segment having 3 spiniform setae and 1 slender seta; and with rows of spinules ventrally at setal insertions.

Leg 6 (Fig. 9E) represented by membranous opercular flaps, with spinules and 1 long seta.

**Etymology.** — The specific name is derived from the Tupi-Guarani word *aisó*, meaning comely.

### Differential diagnosis

The new species shares with *C. plana* the structure of the oral appendages, the setal formula of the swimming legs, the presence of a robust pedunculate sucker on the antenna, and the absence of the maxilliped in the adult female. However, the two species can be easily differentiated by, among other features, the rostrum shape, the presence of a seta on the inner corner of leg 4 coxa (only in *C. aiso*) and the structure of leg 5 in both sexes. *Catania aiso* also differs from *C. plana* in the ovoid depressed body shape, and in the shape and armature of the maxilla in the female.

The males can also be distinguished by the structure of the maxilla and maxilliped. The protrusion on the maxilla in *C. aiso* is strongly curved outward, and the spinules on it are stouter than in *C. plana*. The maxilliped of the new species is characteristic in having an elongate claw-like distal segment with a serrate hyaline frill along the inner margin, and an apical brush seta.

Sexual dimorphism in the armature of the antennule and the endopodal segments of the swimming legs is exhibited by *C. plana*, but is absent in *C. aiso*.

According to Kim (2001), *C. plana* has a broad spinulate process at the posteroventral corner of the first segment of the antennule. Ho (1984) used this structure as one of the apomorphies for the Catiniidae in his cladistic analysis of nereicoliform families. The existence of a seta inserted on a pedestal in *C. aiso* demonstrates the interspecific variation in this character, and therefore the significance of this structure in defining the genus *Catania* should be reviewed.

This genus is not associated with *Sipunculus nudus* in Korea (Kim, 2001) or Brazil.

### Acknowledgments

The authors gratefully acknowledge Dr. Janet W. Reid and Prof. Geoffrey A. Boxshall for reviewing the manuscript, and Gisele Y. Kawauchi for providing us with bibliographic references for sipunculids.

This research was carried out under the BIOTA/FAPESP program — Bentos Marinho, a study made possible through support from FAPESP (Proc. N<sup>o</sup> 1998/07090-3).

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