

***Myzomolgus sipunculensis* sp. nov. (Cyclopoida, Catiniidae), a new copepod associated with sipunculan worms from Brazil**

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ABSTRACT. Catiniid copepods are characterized by the presence of a pedunculate sucker on the antenna. Four genera are currently included in the family Catiniidae: *Catinia*, *Cotylemyzon*, *Cotylemolgus* and *Myzomolgus*, the most speciose. Within the framework of the Special Research Program "Conservation and Sustainable Use of the Biodiversity of the State of São Paulo – Biota/FAPESP", a new species of *Myzomolgus* was found as an external associate of *Sipunculus nudus* and *S. phalloides phalloides*. The sipunculan worms were collected during the low tide in Araçá Beach, State of São Paulo, Brazil (23°49'02"S, 45°24'19"W). The new species differs from its three congeners, namely *M. stupendus* from France and *M. tenuis* and *M. orientalis* from Korea, by the peculiar ornamentation of the third antennal segment, morphology of mandible and leg 6 and presence of denticulate area between maxillipeds. The description of this new species raises to four the number of catiniid species (one of *Catinia* and two of *Myzomolgus*) associated with the widely distributed *S. nudus*. In Brazil, this is the first record of *Myzomolgus* and the second species associated with sipunculan worms (a new species of *Catinia* found on *S. phalloides phalloides* is under description).

KEY WORDS. Marine parasite; *Sipunculus*; taxonomy.

RESUMO. *Myzomolgus sipunculensis* sp. nov. (Cyclopoida, Catiniidae), um novo copépode associado a sipuncúlidos do Brasil. Os copépodes catiniídeos se caracterizam pela presença de uma ventosa pedunculada na antena. Atualmente, quatro gêneros estão incluídos na família Catiniidae: *Catinia*, *Cotylemyzon*, *Cotylemolgus* e *Myzomolgus*, o mais especioso. Como parte de um programa especial de pesquisa "Conservação e Uso Sustentável da Biodiversidade do Estado de São Paulo – Biota/FAPESP", uma nova espécie de *Myzomolgus* foi encontrada associada à superfície externa de *Sipunculus nudus* e *S. phalloides phalloides*. Os sipuncúlidos foram coletados na Praia do Araçá, Estado de São Paulo, Brasil (23°49'02"S, 45°24'19"W), durante a maré baixa. A nova espécie difere de *M. stupendus*, da França, e *M. tenuis* e *M. orientalis*, ambos da Coréia do Sul, pela ornamentação peculiar do terceiro artigo da antena, morfologia da mandíbula e perna 6, e presença de área denticulada entre os maxilípedes. A descrição desta nova espécie eleva para quatro o número de catiniídeos (uma espécie de *Catinia* e duas de *Myzomolgus*) associados a *S. nudus*, um táxon de larga distribuição. No Brasil, este é o primeiro relato de *Myzomolgus*, e o registro da segunda espécie associada a sipuncúlidos (uma nova espécie de *Catinia* associada a *S. phalloides phalloides* encontra-se em descrição).

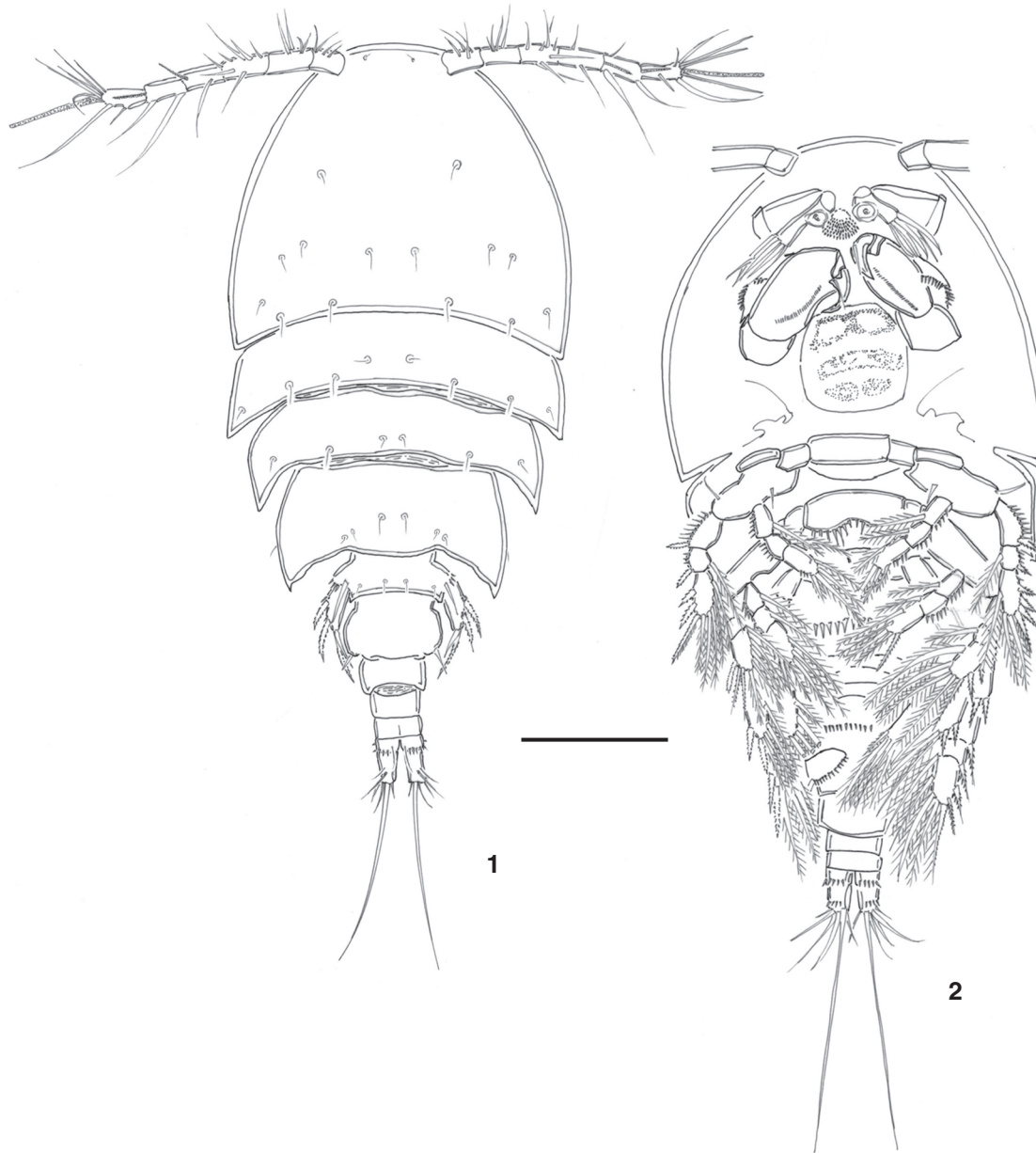
PALAVRAS-CHAVE. Parasita marinho; *Sipunculus*; taxonomia.

Within the framework of the Special Research Program "Conservation and Sustainable Use of the Biodiversity of the State of São Paulo – Biota/FAPESP", a new Catiniidae was found as an external associate of sipunculan worms. Although the concept of the family Catiniidae was not well established by BOUQUET & STOCK (1957), HO (1984) separated Catiniidae from Clausidiidae and Clausiidae, considering the large sucker on the antenna and the reduction of the female maxilliped.

Recent papers included *Cotylemyzon* Stock, 1982,

Cotylemolgus, Humes & Ho, 1967 and *Myzomolgus* Bocquet & Stock, 1957 with *Catinia* Bocquet & Stock, 1957 in Catiniidae (KIM 2001, BOXSHALL & HALSEY 2004) and transferred *Goidelia* Embleton, 1901 to Echiurophilidae (BOXSHALL & HALSEY 2004).

The genus *Myzomolgus* has important apomorphies as terminal armature of maxilla with one pointed process and female maxilliped extremely reduced (HO 1984). This genus comprises 3 known species: *M. stupendus* Bocquet and Stock, 1957, *M. tenuis* Kim, 2001 and *M. orientalis* Kim, 2001.



Figures 1-2. *Myzomolgus sipunculensis* sp. nov., male: (1) habitus, dorsal; (2) habitus, ventral. Scale bar 100 μ m.

Myzomolgus was found before in the Channel, coast of France (BOCQUET & STOCK 1957), and in Korea (KIM 2001), associated with sipunculan worms. *M. stupendus* and *M. tenuis* attached to *Sipunculus nudus* L. and *M. orientalis* to *Siphonosoma cumanense* (Keferstein).

In Brazil, this is the first record of *Myzomolgus* and the second species associated with sipunculan worms (a new species of *Catinia* found on *S. phalloides phalloides* is under description elsewhere).

MATERIAL AND METHODS

The six male copepods studied were found attached to the external surface of sipunculan worms. *Sipunculus nudus* and *S. phalloides phalloides*, were collected by digging in the substrate during the low tide in Araçá Beach, State of São Paulo, Brazil (23°49'02"S, 45°24'19"W). The copepods were relaxed with drops of propylenephenoxyethol 0.2% added in the sea water and separated from the host. They were fixed in 4% formalin.

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 glycerine and the dissected parts were placed on slides and sealed with Glyceel^o.

Nikon Labophot[®] and Zeiss Axioskop 2 Plus[®] compound microscope equipped with differential interference contrast, digital camera Nikon Coolpix 995[®] and camera lucida were used to examine and prepare the illustrations of the specimens.

The terminology applied to the segmentation and setation of body appendages was adopted from BOXSHALL & HALSEY (2004).

Myzomolgus sipunculensis sp. nov.

Figs 1-29

Material examined. São Sebastião, Araçá Beach (23°49'02"S, 45°24'19"W): six males, 09.X.2003. Three specimens on *Sipunculus nudus*, and three on *S. phalloides phalloides* in the intertidal zone; Kawachi, G.Y. leg. Holotype (registration number: MZUSP 16461) deposited in Museu de Zoologia, Universidade de São Paulo. Dissected paratypes in collections of Dr Carlos E.F. da Rocha (Departamento de Zoologia, Instituto de Biociências, Universidade de São Paulo) and Dr Tagea K.S. Björnberg (Centro de Biologia Marinha, Universidade de São Paulo).

Description. Male. Body (Figs 1, 2): cycloform, slightly flattened. Total length, excluding setae on caudal rami, 0.435-0.530 mm (n = 6). Prosome longer than urosome (2.8:1). Largest width (0.242 mm) measured at posterior margin of second prosomite. Prosome (Figs 1 and 2): cephalosome fused to first pedigerous somite and 3 free prosomites. Cephalosome and free prosomites with sensilla pattern as shown in figure 1. Epimera of second to fourth prosomites expanded posteriorly and with pointed posterior corners. Fourth prosomite wider than preceding free somites. Urosome (Figs 1-4): 6-segmented, about four times narrower than prosome, slightly tapering posteriorly. First urosomite bearing leg 5, with two pairs of dorsal sensilla (Fig. 3) and ventrally ornamented with two rows of spinules (Fig. 4). Genital somite (Figs 3 and 4) nearly rectangular, rounded laterally, with row of pre-marginal minute denticles on ventral aspect and naked seta on each posterior corner. Third urosomite (Fig. 4) with row of spinules on lateral corners. Fifth urosomite dorsal shape as in figure 3. Anal somite (Figs 3-6) deeply cleft, shorter than 1/3 length of caudal ramus, with row of spinules along dorsal and ventral posterior margins; a naked seta inserted dorsally, near inner corner.

Caudal ramus (Figs 5 and 6) with parallel lateral margins slightly tapering posteriorly and armed with six setae. Seta I absent; setae II and IV dorsally implanted, the last one biarticulate; posterolateral seta III on outer distal corner; terminal setae IV and VI naked and weak; seta V well developed and about as long as urosome. Ramus expanded into rounded projection and with posterior row of spinules ventrally.

Rostrum: incorporated to cephalothorax.

Antennule (Fig. 7): 6-segmented, with setal formula: 4, 11, 9, 4+1 aesthetasc, 2+1 aesthetasc, 7+1 aesthetasc.

Antenna (Figs 8-12): 4-segmented. First segment (Figs 8 and 9) about as long as lengths of three segments summed together, with patches of minute spinules on ventral surface (Fig. 8), and three rows of spinules along dorsal distal corner (Fig. 9). Second segment (Fig. 8) small, with row of spinules along inner margin. Third segment (Figs 8 and 10) with pedunculate cup-like sucker, flattened sharply pointed inner spine, and two setae; short seta denticulate at tip; long seta more than two times longer than last segment and bearing row of spinules curved backwards; last segment (Figs 8 and 11) with four distal setae denticulate apically, two lateral setae pinnate distally, and dorsal patch of spinules on posterior side, as in figure 11.

Labrum (Figs 12 and 13): short, bell-shaped and strongly spinulate.

Mandible (Figs 14 and 15): prolonged into digitiform process bearing a pointed foliaceous element with one pinnate margin and 2 naked setae.

Paragnaths (Figs 15 and 16): racket-like structures, with rows of spinules on distal margin.

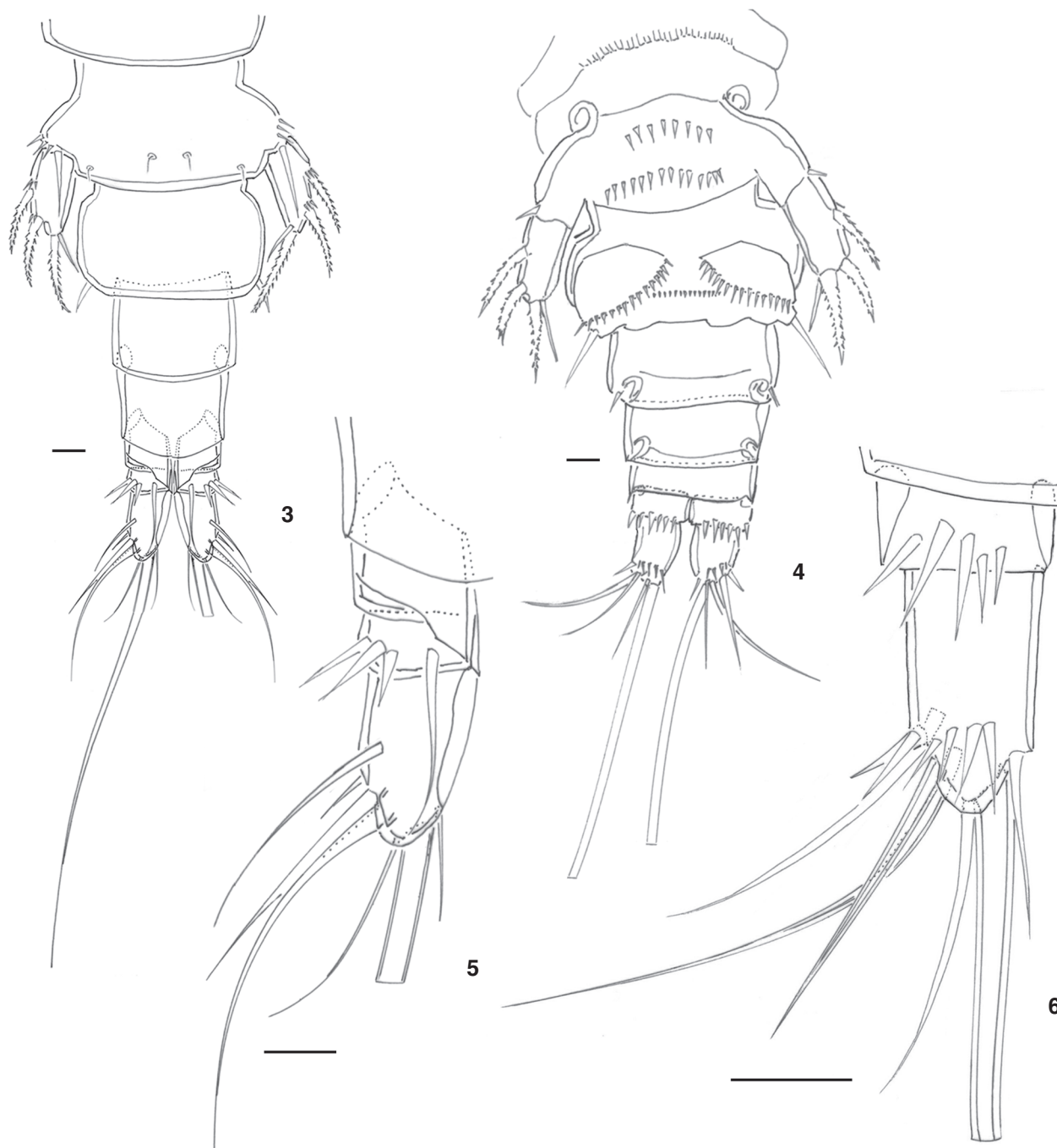
Maxillule (Fig. 17): 1-segmented, with four setae.

Maxilla (Figs 12, 18 and 19): foliaceous, with two pointed articulations posteriorly, usually covered by the maxilliped in entire specimens (Fig. 12); row of spinules along outer margin; anterior cap-like flap with 2 rows of spinules, one along posterior margin and one more anteriorly placed; inner margin with strong claw-like spine, bearing two small setae on dorsal view (Fig. 19).

Maxilliped (Figs 12, 20-22): robust, 4-segmented. First segment triangular, with inner pinnate spine. Second segment with rows of minute spinules along outer and inner margins, ventral face with long row of spinules covering a complex ornamentation as in figure 21; dorsal surface (Fig. 22) with two rows of long spinules and patch of smaller spinules. Third segment short and unarmed; distal segment, a very strong claw, with two bipinnate and one small glabrous seta on ventral side.

Labium (Figs 12 and 23): consisting of a triangular protuberance directed backwards and covered by minute spinules. Posteriorly to labium and between maxilliped bases, a rounded cushion-like area is covered by patches of spinules as arrowed in figure 12.

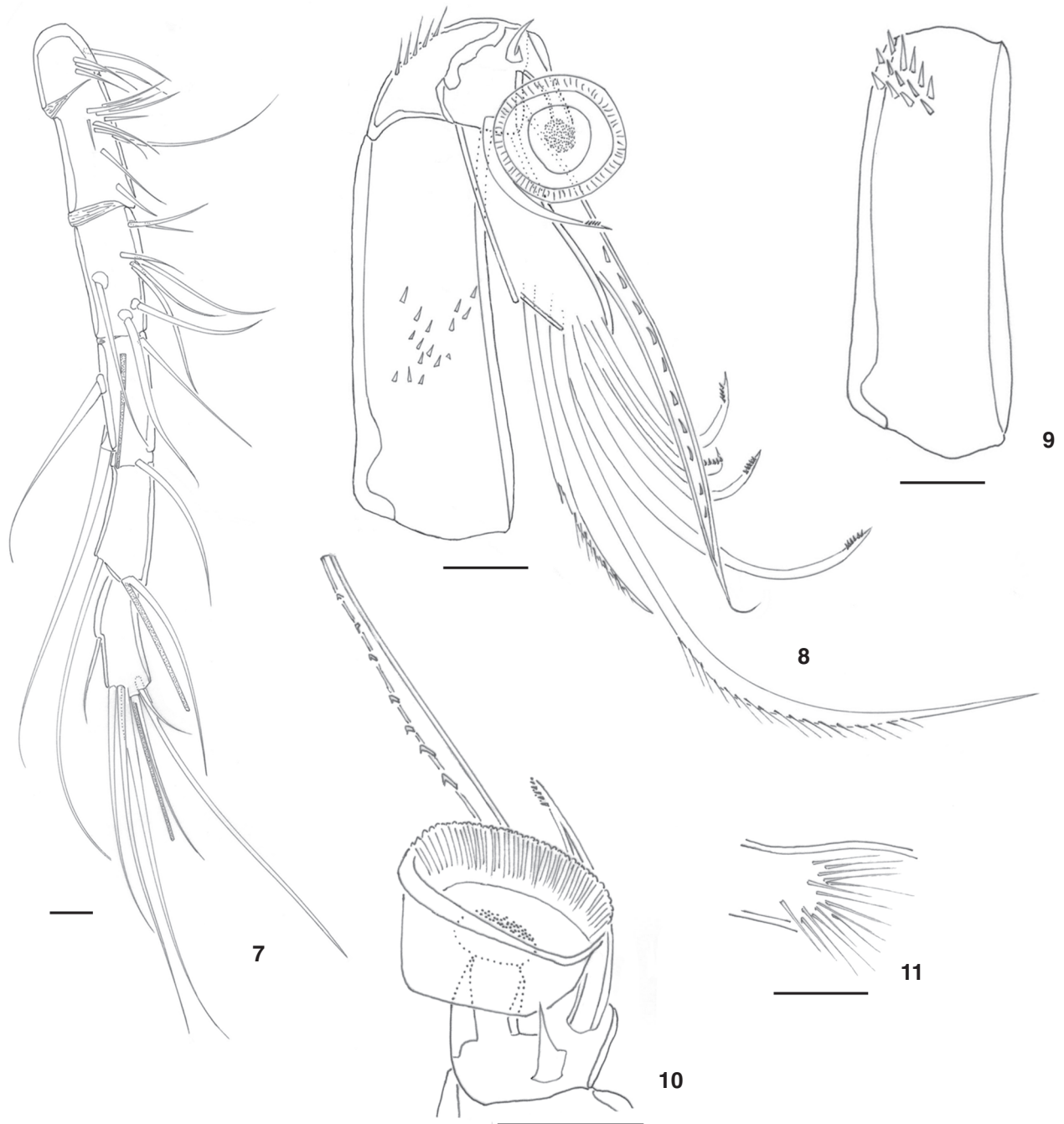
Legs 1-4 (Figs 24-26): biramous, with both rami 3-segmented. Legs 2 and 3 similar. Intercoxal plate of leg 1 with row of minute spinules along posterior margin; those of legs 2-4 with strong spinules along convex edges. Pre-coxa ornamented with row of spinules along posterior margin of leg 1. Coxa of legs 1-4 with row of spinules at outer corner, leg 1 also with row of minute spinules along posterior margin. Basis of legs 1-4 with bipinnate setae on distal outer corner, and row of spinules along distal rim between exopod and endopod; leg 1 inner margin with row of minute spinules near endopod insertion and with row of spinules at insertion of bipinnate spine; legs 2 and 3 with row of setules



Figures 3-6. *Myzomolgus sipunculensis* sp. nov., male: (3) urossome, dorsal; (4) urossome, ventral; (5) terminal portion of urossome showing the left parts of pre-anal and anal somites, as well as the left caudal ramus, dorsal; (6) right portion of anal somite and respective caudal ramus, ventral. Scale bars 10 μ m.

along inner margin. Inner and outer margins of exopods and endopods of legs 1-4 ornamented with setules and spines. Armature formula as follows (Roman numerals representing spines,

Arabic numerals representing setae): exopod – leg 1: I-0; I-1; III,1,3; leg 2: I-0; I-1; II,1,4; leg 3: I-0; I-1; II,1,4; leg 4: I-0; I-1; II,1,4; endopod – leg 1: 0-1; 0-1; I+1,1,3; leg 2: 0-1; 0-1; I+1,1,3;

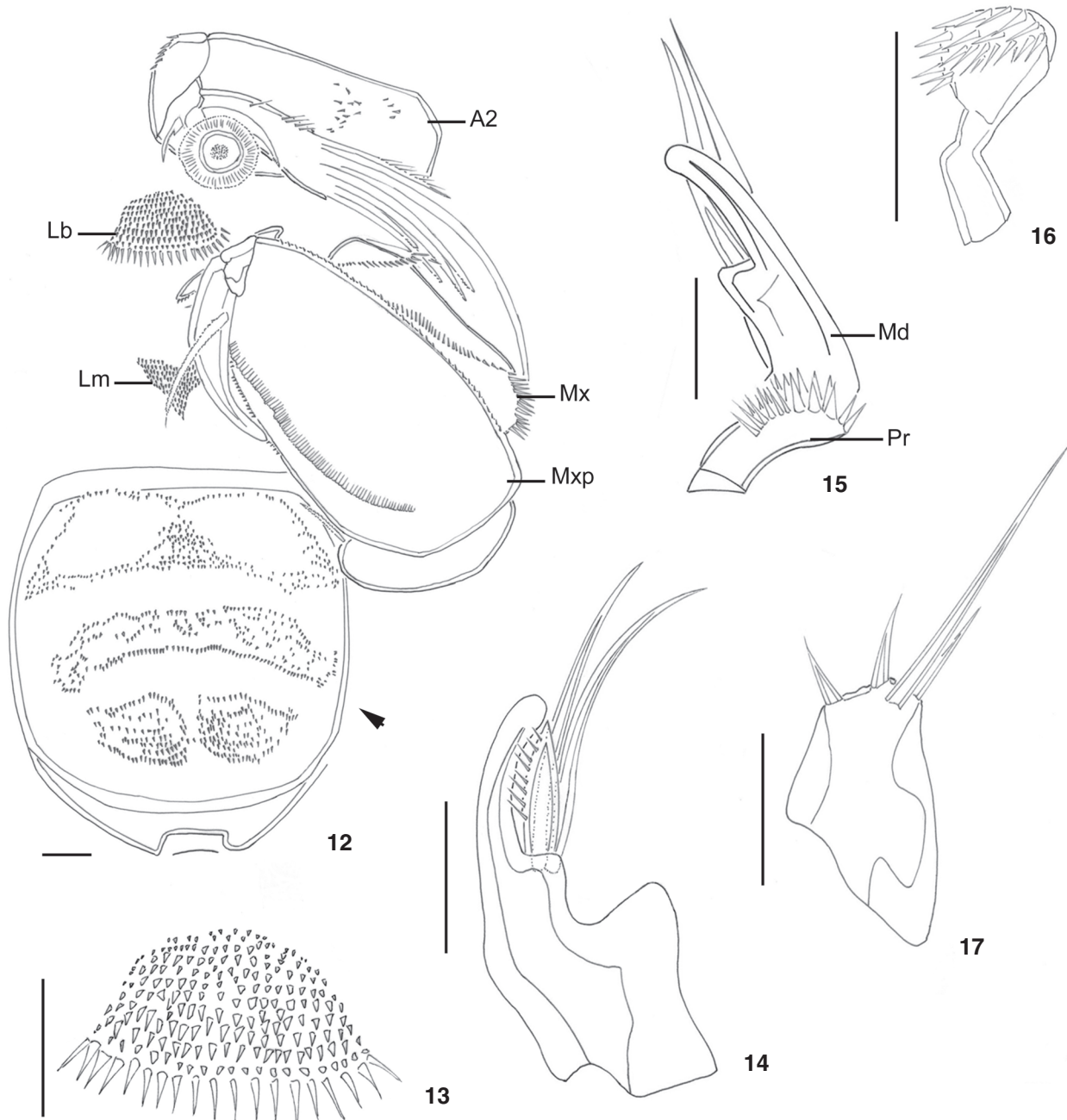


Figures 7-11. *Myzomolgus sipunculensis* sp. nov., male: (7) antennule; (8) antenna; (9) first antennal segment, dorsal; (10) third antennal segment, ventral; (11) distal area of the fourth antennal segment, dorsal. Scale bars 10 μ m.

leg 3: 0-1; 0-1; I+1,1,3; leg 4: 0-1; 0-1; 1,1,2.

Leg 5 (Figs 27-29): 2-segmented; articulation of first segment of leg 5 and genital somite not discernible. First segment with spinules on outer distal corner and a naked seta on dorsal

surface. Second segment with oblique row of spinules reaching distal end, two outer bipinnate spines with rows of spinules at insertion, a terminal bipinnate spine, and a subterminal naked seta.



Figures 12-17. *Myzomolgus sipunculensis* sp. nov., male: (12) oral region; (13) labrum; (14) mandible; (15) mandible (Md) and paragnath (Pr); (16) paragnath; (17) maxillule. (A2) Antenna, (Lb) labrum, (Lm) labium, (Mx) maxilla, (Mxp) maxilliped, arrow head indicating the rounded cushion-like area covered by patches of spinules. Scale bars 10 μ m.

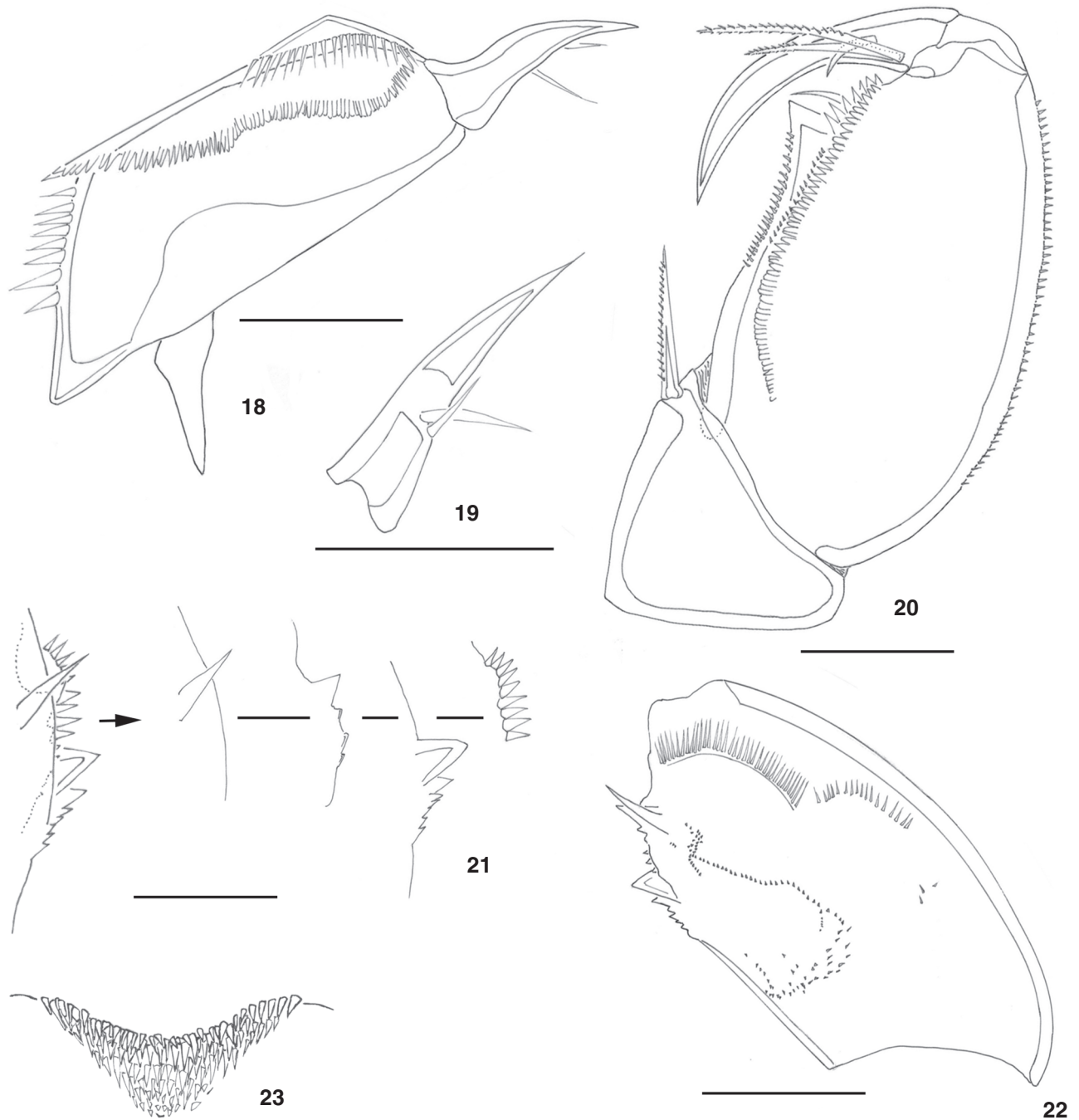
Leg 6 (Fig. 29): represented by genital flaps with row of spinules along distal margin.

DISCUSSION

According to the key provided by KIM (2001), in which

characters refer to both sexes, unless otherwise specified, and comparing with descriptions and re-descriptions of Catiniidae genera (BOCQUET & STOCK 1957, HUMES & HO 1967, STOCK 1982, KIM 2001), only *Myzomolgus* can accommodate our species.

The new species shows some resemblance with *M.*

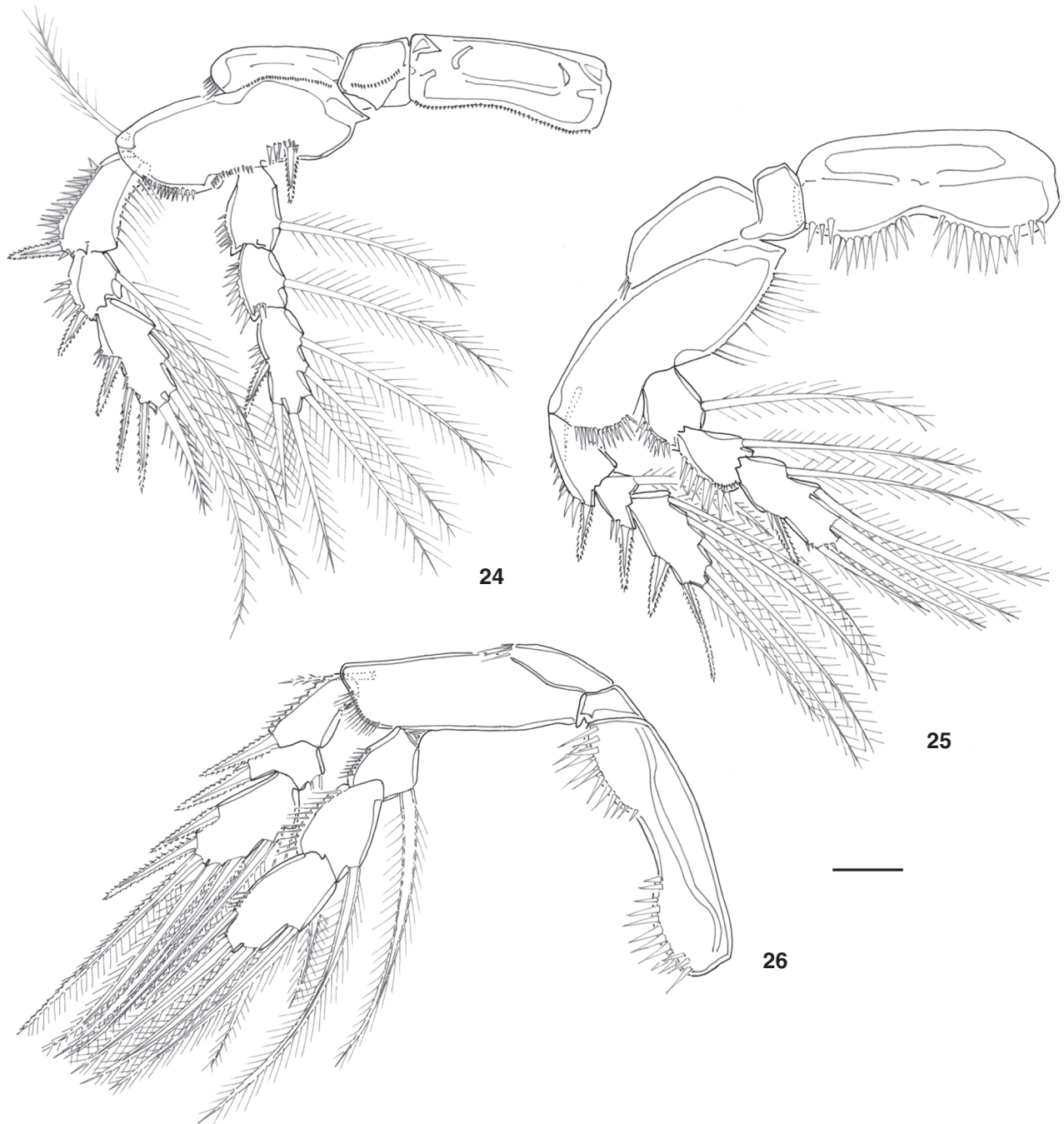


Figures 18-23. *Myzomolgus sipunculensis* sp. nov., male: (18) maxilla; (19) detail of the maxillary terminal spine; (20) maxilliped; (21) maxilliped second segment, dorsal; (22) detail of the second segment maxilliped ornamentation on inner distal area, and the same ornamentation separated in dorsal to ventral layers; (23) labium. Scale bars 20 μ m.

orientalis in body shape, armature of the segments 3 and 4 of the antenna, shape of the labrum, general aspect of maxilliped, and setal formulae of legs 1-4. Differences between the two spe-

cies are in the length of caudal ramus, ornamentation of the antennule, maxilla and maxilliped.

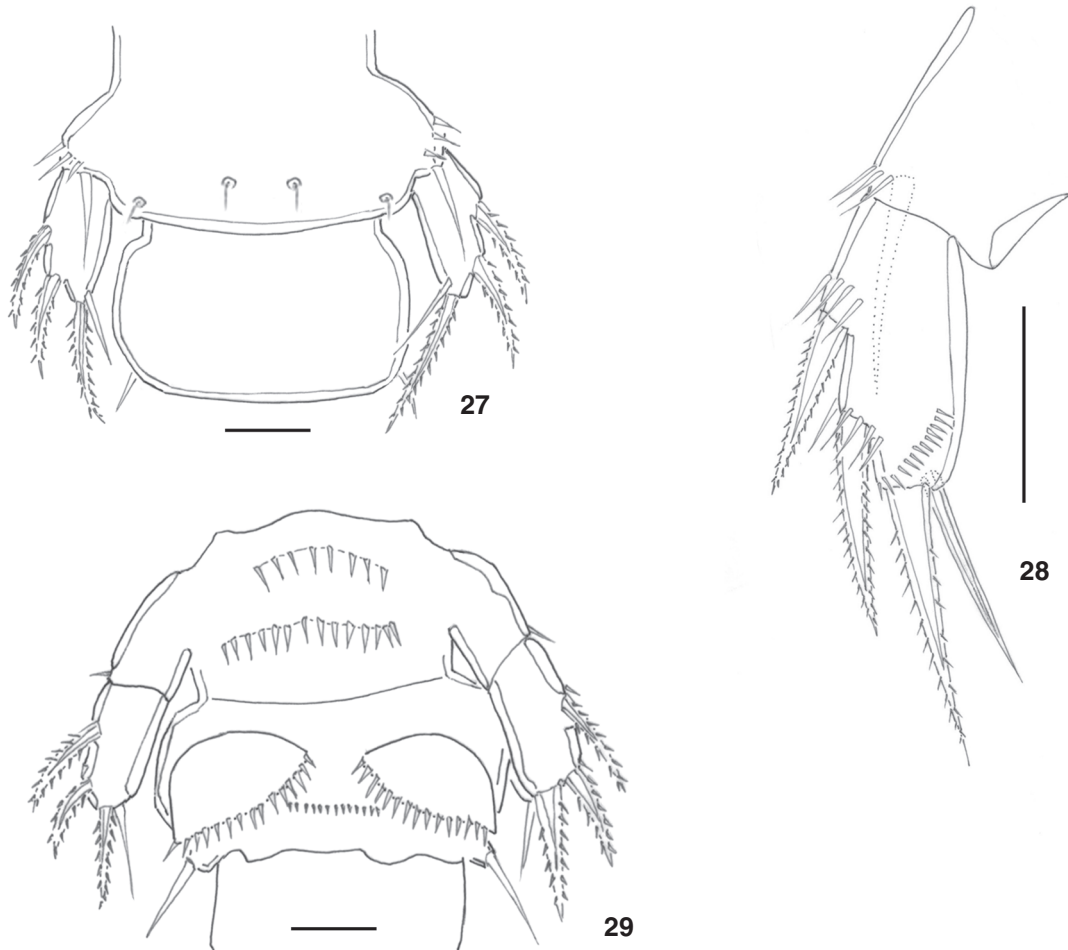
Myzomolgus sipunculensis can be easily distinguished from



Figures 24-26. *Myzomolgus sipunculensis* sp. nov., male: (24) leg 1; (25) legs 2 and 3; (26) leg 4. Scale bar 20 μ m.

its congeners by the peculiar ornamentation of the third antennal segment with a pedunculate cup-like sucker, a flattened spine, one small seta with a denticulate tip, and a long seta bearing claw like spinules. Other differential characteristics are the presence of one digitiform projection, 2 setae and one fo-

liaceous element compounding the mandible, and the morphology of leg 6. In the new species, the denticulate area between the maxillipeds, the expanded epimera of second to fourth prosomites pointed posteriorly, and the spinulose labrum and labium are other remarkable features.



Figures 27-29. *Myzomolgus sipunculensis* sp. nov., male: (27) segment bearing leg 5 and genital segment, dorsal; (28) leg 5, ventral; (29) segment bearing leg 5 and genital segment with leg 6. Scale bars 20 µm.

Previously found in France and Korea (Tab. I), this is the first record of the genus *Myzomolgus* in Brazil. The host list for Catinidae is being enlarged by adding *S. phalloides phalloides* (Tab. I). Similar to BOUCQUET & STOCK (1957) who found *M. stupendus* and *Catinia plana* Boucquet & Stock, 1957 attached to *S. nudus*, the new species also occurs together with *Catinia* on *S. phalloides phalloides* (G.Y. KAWAUCHI, personal obs.)

Although the key provided herein considered only male characters, it could be used as a supplement to the key published by BOXSHALL & HALSEY (2004) to identify *Myzomolgus* species, and will serve as a basis for future investigations.

Key to the species of *Myzomolgus* (males)

- 1. Limit between prosome and urosome indistinct; maxillae roundish; distal segment of antenna with very short setae (about as long as segment); endopod-3 of legs 1-3 with four elements *M. tenuis*
- 1'. Prosome distinctly separate from urosome, much narrower

- than prosome; maxillae not roundish; distal segment of antenna with long setae (at least twice as long as segment); endopod-3 of legs 1-3 with six elements 2
- 2. Second to fourth prosomites with pointed margins; mandible without spine *M. sipunculensis*
- 2'. Second to fourth prosomites with rounded margins; mandible with spine 3
- 3. Outer margin of maxilliped claw smooth; antennule with plumose setae *M. orientalis*
- 3'. Outer margin of maxilliped claw denticulate; antennule without plumose setae *M. stupendus*

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Table I. Geographic distribution and list of hosts of the known species of *Myzomolgus*.

Species	Local	Host
<i>M. stupendus</i>	Mortag Bay in la Manche, France	<i>Sipunculus nudus</i> Linnaeus
<i>M. orientalis</i>	Sinhung-ri, Jeju Island, Korea	<i>Siphonosoma cumanense</i> (Keferstein)
<i>M. tenuis</i>	Sinhung-ri, Jeju Island, Korea	<i>Sipunculus nudus</i> Linnaeus
<i>M. sipunculensis</i>	Ponta do Araçá, São Sebastião, Brazil	<i>Sipunculus nudus</i> Linnaeus <i>Sipunculus phalloides phalloides</i> (Pallas)

the Instituto de Biociências of the Universidade de São Paulo, for the equipment and laboratory space.

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