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Three new species of Artotrogidae (Copepoda, Siphonostomatoida) from the southeastern coast of Pernambuco State, Brazil

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Abstract

Three new copepod species, *Bradypontius ancistronus* sp. nov., *Cryptopontius aesthetascus* sp. nov. and *Cryptopontius expletus* sp. nov., of the siphonostomatoid family Artotrogidae are described based on specimens from sponge and algal hosts collected along the Brazilian coast. These findings represent the first records of artotrogid copepods from Brazil. Male *Bradypontius ancistronus* sp. nov. was found in association with sponges, and is characterized by having an unarmed P4 endopod that bears a distal hook-like projection on the third segment. Male *Cryptopontius aesthetascus* sp. nov., also recorded from sponges, differs from its congeners by a combination of characters that include a 12-segmented antennule, 2 setae on the inner lobe of the maxillule, 7 elements on the third exopodal segment of P1 and 9 elements on the third exopodal segment of P4. Female *Cryptopontius expletus* sp. nov. was recorded on algae, and can be distinguished from its congeners by having an 8-segmented antennule, 6 elements on the third endopodal segment of P1, 9 elements on the third exopodal segment of P4 and 3 setae on P5 exopod.

Key words: Artotrogidae, Siphonostomatoida, *Cryptopontius*, *Bradypontius*, new species, Copepoda, Brazil

Introduction

Recent taxonomic studies on siphonostomatoid copepods associated with coral reef communities of the Abrolhos region and Todos os Santos Bay in Brazil (Fig. 1) revealed 14 new species of the family Asterocheridae and one new member of the family Entomolepididae collected from sponges, echinoderms, bryozoans and cnidarians (Johnsson 1997, 1998a–b, 1999, 2000, 2002; Bispo *et al.* 2006). This handful of studies confirmed our belief that many siphonostomatoid copepods exist in association with an array of invertebrate groups within this region and, more importantly, suggest that additional copepod-invertebrate associations await discovery along the Brazilian coast.

The present paper describes two new species of *Cryptopontius* Giesbrecht, 1899 and a new species of *Bradypontius* Giesbrecht, 1895 collected along the northeastern coast of Brazil. One of the two *Cryptopontius* species was found associated with algae, while the remaining two new taxa were found in association with sponges. These findings represent the first records of the copepod family Artotrogidae from the Brazilian coast.

Material and methods

One sample each of sponges and algae, respectively, were collected at a depth of 10–15 m off Santo Aleixo Island (8°36'44"S, 35°01'21"W), a volcanic island located about 5 km east from the northeastern coast of Pernambuco State, Brazil (Fig. 1), and then processed following the methods given in Humes (1996) to recover

copepod associates.

Copepods were cleared in lactic acid prior to taking body and appendage measurements with an ocular micrometer. Each holotype was stained in Black Chlorazol E, dissected, and mounted permanently in CMC-9® (Masters Chemical Company, Inc.) mounting media. All drawings were made with the aid of a drawing tube fitted on an Olympus CH30 microscope. The length of each antennular segment was measured along the posterior, non-setiferous margins. For the armature formula of legs 1–4, Roman numerals represent spines and Arabic numerals indicate setae. Abbreviations P1–P6 refer to legs 1–6. Type material are deposited in the Museu Nacional / Universidade Federal do Rio de Janeiro (UFRJ).

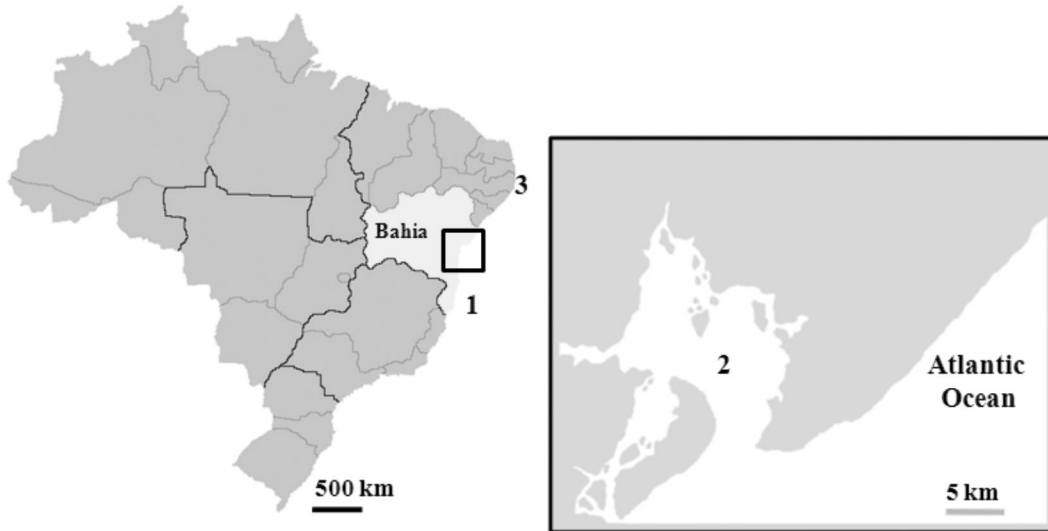


FIGURE 1. Location of collection sites in Brazil: (1) Abrolhos region; (2) Todos os Santos Bay; (3) Santo Aleixo Island.

Results

Bradypontius ancistronus sp. nov.

(Figs 2–4)

Material examined. Holotype ♂ (MNRJ 12910) and 5 ♂ paratypes (MNRJ 12916), ex sponges, Santo Aleixo Island, Serinhaem, Pernambuco, Brazil, leg. P.S. Young, 15 March, 1995.

Description of male. Mean body length (excluding caudal setae) 933 μm (925–941 μm), mean body width 416 μm (402–425 μm) (based on 6 specimens). Body (Fig. 2a) cycloform, dorsoventrally flattened, with moderately enlarged prosome, and cylindrical urosome. Pedigerous somite 1 completely fused with cephalosome; cephalothorax with rounded epimera. Pedigerous somites 2–4 with pointed epimera. Pedigerous somite 3 extends over two succeeding pedigers and proximal one-third of genital somite. Prosome length:width ratio 1.8:1. Urosome (Fig. 2b) composed of 6 somites. Genital somite 171 μm long, length:width ratio 0.5:1, rounded anterolaterally. Four postgenital somites each wider than long (61 \times 102 μm , 48 \times 87 μm , 39 \times 80 μm , 59 \times 87 μm , respectively). Prosome:urosome length ratio 2.2:1. Caudal rami subrectangular, 42 \times 37 μm , armed with 6 setae (seta I absent). Setae II–VII 29, 120, 354, 566, 186, and 32 μm long, respectively; setae III to VI plumose, setae II and VII naked.

Antennule (Fig. 2c) 258 μm long (not including setae), comprised of 9 segments. Length of segments: 67, 48, 13, 11, 9, 13, 38, 15, and 43 μm , respectively. Setation as follows: 1, 5, 1, 2, 2, 6, 2+spine, 1, 9+ae. Aes-thetasc 191 μm long. Antenna (Fig. 2d) 153 μm long (including distal claw); basis 35 μm long. Exopod 1-seg-mented, 7 μm long, with 2 apical naked setae. Endopod 2-segmented; first segment 27 μm long, unarmed; second segment 31 μm long, with 3 naked elements (proximomedial seta, apical seta and straight terminal

claw).

Oral cone (Fig. 2a) 366 μm , reaching insertion of P1. Mandibular palp absent; mandibular stylet (Fig. 3a) long, stout, armed with 6 distal teeth. Maxillule (Fig. 3b) bilobed; both lobes stout. Inner lobe 51 μm long, with setules along inner margin and 3 distal setae (1 naked, 1 plumose, 1 unipinnate). Outer lobe 45 μm long, with 2 apical naked setae. Maxilla (Fig. 3c) with 180 μm long syncoxa and 307 μm long claw; claw distally curved, with seta and patches of setules subapically. Maxilliped (Fig. 3d) 4-segmented, 540 μm long; syncoxa

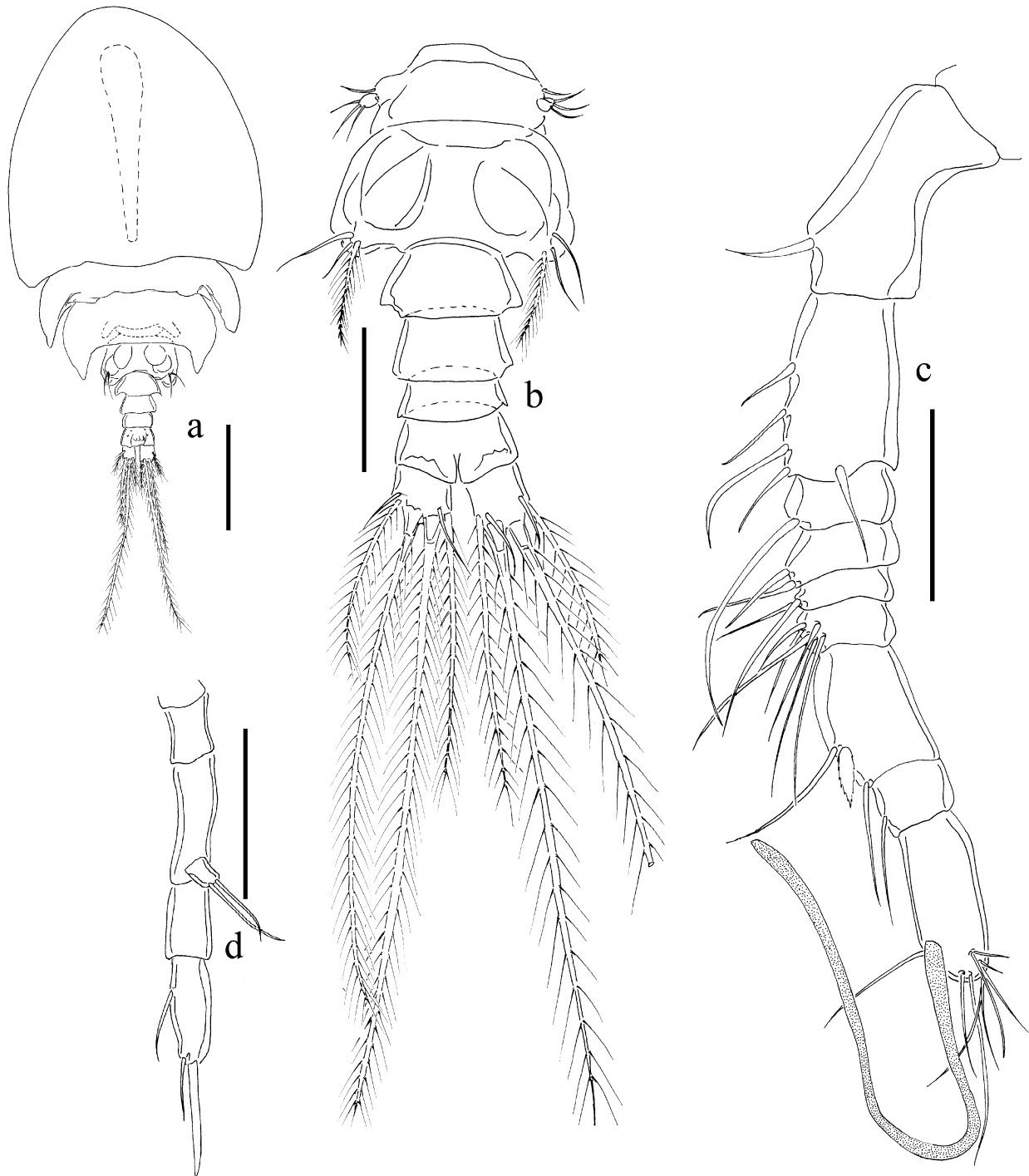


FIGURE 2. *Bradypontius ancistronus* sp. nov., male holotype (MNRJ 12910). (a) habitus, dorsal view; (b) urosome, dorsal; (c) antennule; (d) antenna. Scale bars: a = 250 μm ; b = 100 μm ; c–d = 50 μm .

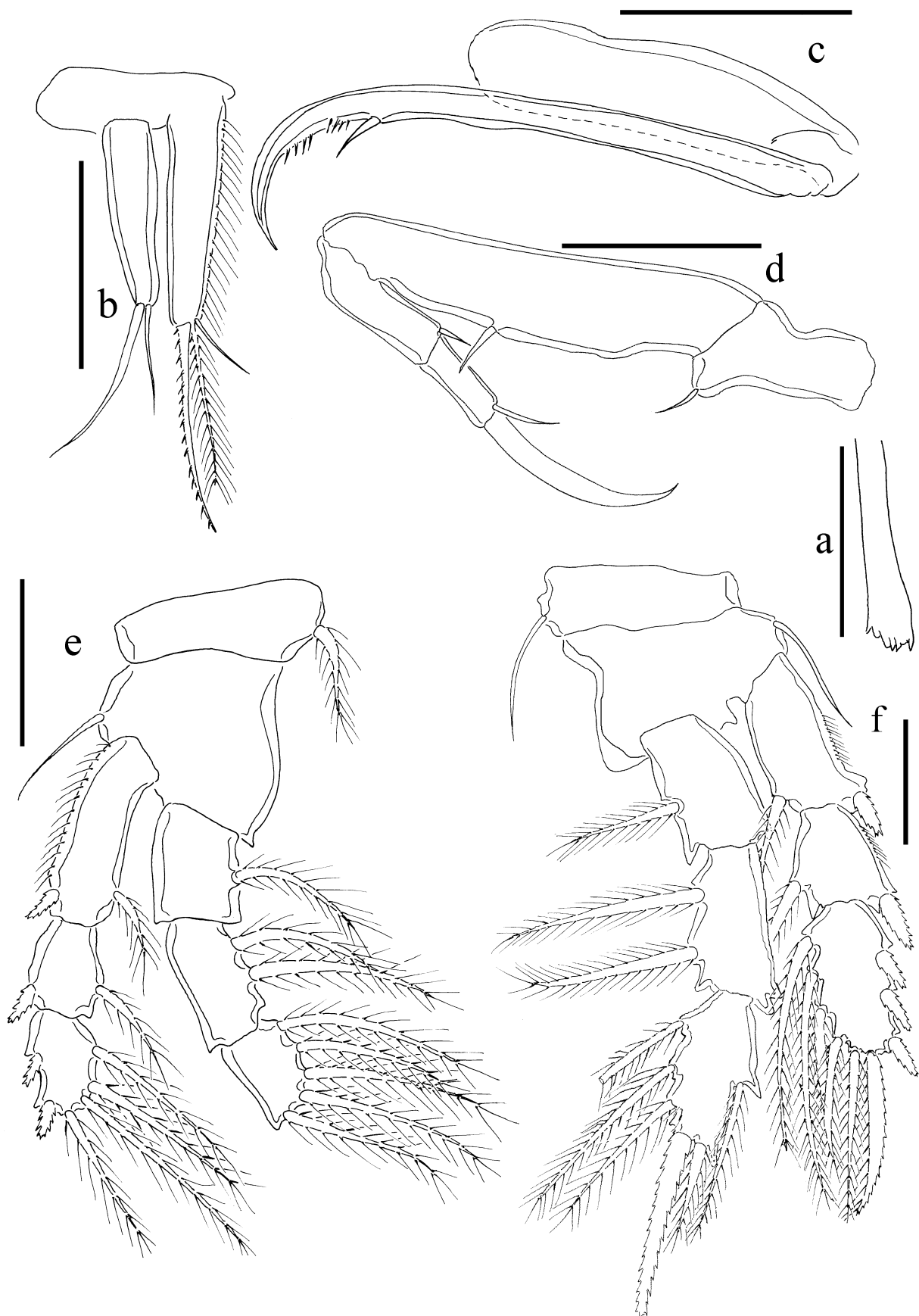


FIGURE 3. *Bradypontius ancistronus* sp. nov., male holotype (MNRJ 12910). (a) distal end of mandibular stylet; (b) maxillule; (c) maxilla; (d) maxilliped; (e) P1; (f) P2. Scale bars: a, d–f = 50 μ m; b–c = 100 μ m.

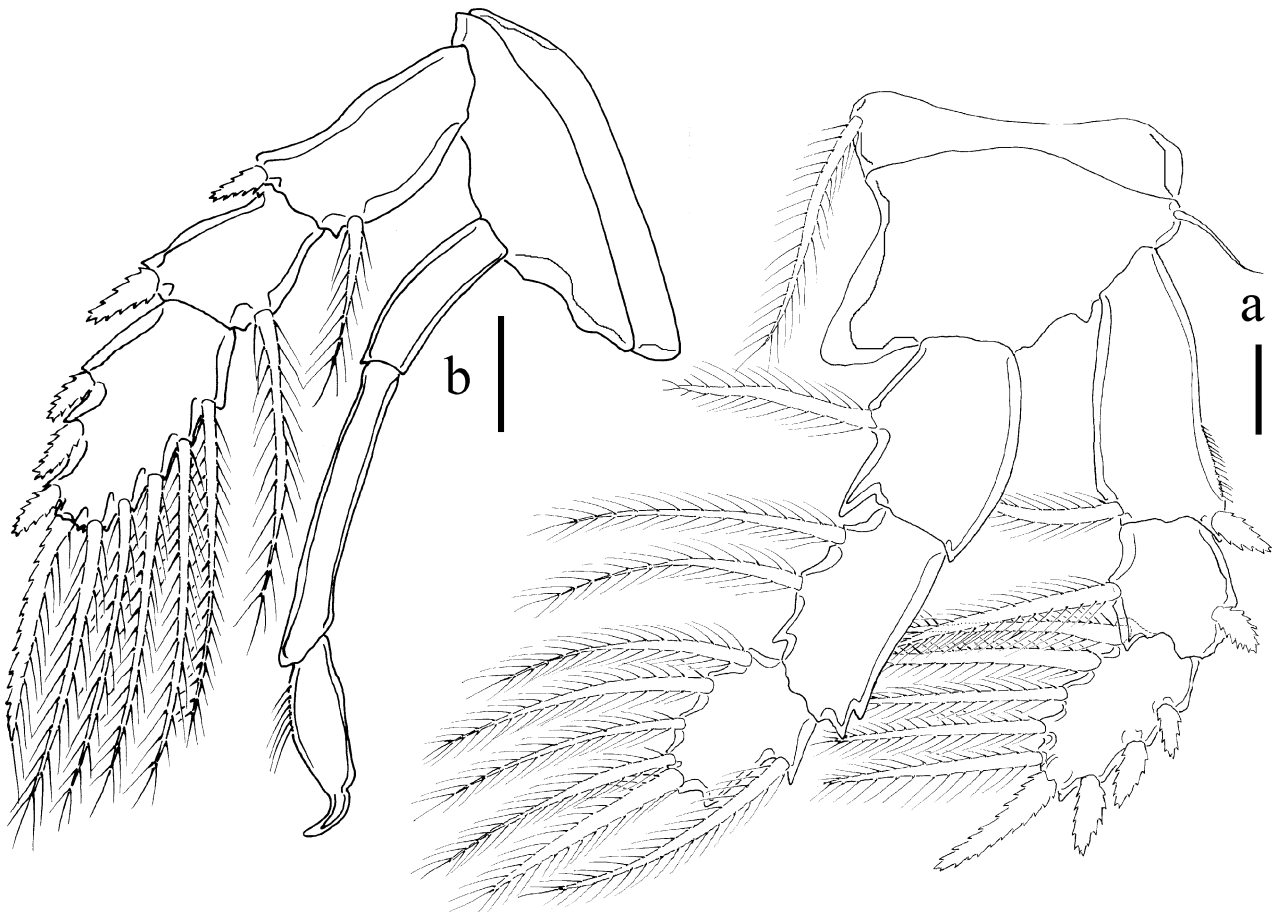


FIGURE 4. *Bradypontius ancistronus* sp. nov. male holotype (MNRJ 12910). (a) P3; (b) P4. Scale bars: all 25 μ m.

78 μ m long, with small inner seta; basis 222 μ m long, with short subdistal seta on inner margin. Endopod 2-segmented, 76 and 47 μ m long, respectively; first segment with naked distal seta; second segment bears naked distal seta and 116 μ m long, distally curved, claw-like element.

P1-P4 (Figs 3e-f, 4a-b) biramous, 3-segmented. Armature formula of P1-P4 as follows:

	Coxa	Basis	Exopod	Endopod
P1	0-1	1-0	I-1; I-1; II,4	0-1; 0-2; 0,2,3
P2	0-1	1-0	I-1; I-1; III,I,5	0-1; 0-2; 1,1+I,3
P3	0-1	1-0	I-1; I-1; III,I,5	0-1; 0-2; 1,2,3
P4	0-0	0-0	I-1; I-1; III,I,5	0-0; 0-0; 0-0

Distal exopodal spine of P2 and P4 heterogeneously ornamented, with serrate outer margin and setulate inner margin. Coxal seta of P1 and P3 plumose; basal seta of P1-P3 naked. Exopodal spines of P1 smaller than those of P2-P4. Outer margin of first exopodal segment of P1-P3 and second exopodal segment of P2 covered with setules. P4 with unarmed endopod; third segment with distal hook-like projection.

P5 (Fig. 2b) comprised of protopodal segment fused to somite and free exopodal segment. Protopod with seta near insertion of exopod. Exopod small, 16 μ m long, with 3 distal naked setae. P6 (Fig. 2b) represented by 1 plumose and 2 naked setae on posterolateral margin of genital somite.

Female. Unknown.

Etymology. The specific name refers to the the Greek word “*ankistron*” which means fish hook, alluding to the hook-like projection on the third endopodal segment of P4.

Remarks. *Bradypontius ancistronus* sp. nov. possesses two apomorphic characteristics not found in any other known male congener. Firstly, the third exopodal segment of P1 in *B. ancistronus* sp. nov. has 2 outer spines rather than 3 as in all other species of the genus. Secondly, the P4 endopod of the new species is totally unarmed, with the third segment bearing a distal hook-like process. Only *B. serratipes* Nicholls, 1944, *B. ova-tus* Nicholls, 1944, *B. inermis* Nicholls, 1944 and *B. pichoni* Stock, 1966 have the first two endopodal segments of P4 unarmed as in the new species; however, the third segment bears at least 1 seta in these four nominal species (Nicholls 1944; Stock 1966). Although it seems reasonable to erect a new genus for this Brazilian species based on the two aforementioned apomorphic features, we believe it is more appropriate to retain the new species in *Bradypontius* pending the collection of female specimens of the new taxon.

***Cryptopontius aesthetascus* sp. nov.**

(Figs 5–7)

Material examined. Holotype ♂ (MNRJ 12909) and 3 ♂ paratypes (MNRJ 12920), ex sponges, Santo Aleixo Island, Serinhaem, Pernambuco, Brazil, leg. P.S. Young, 15 March, 1995.

Description of male. Mean body length (excluding caudal setae) 890 µm (875–904 µm), mean body width 460 µm (452–475 µm) (based on 4 specimens). Body (Fig. 5a) cyclopiform, dorsoventrally flattened with moderately enlarged prosome, and cylindrical urosome. Pedigerous somite 1 totally fused with cephalosome; epimera of cephalothorax moderately pointed. Pedigerous somites 2 and 3 with pointed epimera. Pedigerous somites 4 and 5 concealed by third pedigerous somite. Prosome length:width ratio 1.4:1. Urosome composed of 6 somites (first urosomite excluded in Fig. 5b). Genital somite 170 µm long, length:width ratio 0.6:1, rounded posteriorly. Four postgenital somites each wider than long (43 × 104 µm, 39 × 93 µm, 32 × 82 µm, 50 × 80 µm, respectively). Anal somite (Fig. 6a) with small lateral setule and spinules dorsally. Length ratio of prosome to urosome 2.7:1. Caudal rami (Figs 5b, 6a) elongate, 54 × 36 µm, armed with 6 setae (seta I absent); furnished with minute spinules on dorsal surface. Length of setae II–VII 32, 75, 237, 383, 105, and 62 µm, respectively; setae III–VI plumose, setae II and VII naked.

Antennule (Fig. 5c) slender, 269 µm long (not including setae), consisting of 12 segments, with ancestral segments III and IV partially fused. Length of segments: 82, 15, 28, 9, 8, 15, 13, 15, 13, 40, 23, and 52 µm, respectively. Setation as follows: 1, 1+ae, 4+2ae, 1+ae, 1+ae, 1+ae, 2+ae, 7+ae, 1+spine+ae, 4+2ae, 2+ae, 12+ae. Antenna (Fig. 5d) 123 µm long (including distal claw-like seta); basis 40 µm long. Exopod 1-segmented, 7 µm long, with 2 naked apical setae. Endopod 2-segmented; first segment 24 µm long, unarmed; second segment 35 µm long, furnished with 2 rows of setules and armed with proximomedial seta and 3 apical elements.

Oral cone (Fig. 5a) 320 µm long, reaching insertion of maxilliped. Mandibular palp absent; stylet (Fig. 6b) bears 7 subdistal teeth. Maxillule (Fig. 6c) bilobed; both lobes slender. Inner lobe 79 µm long, with setules along outer margin and 2 distal setae (1 unipinnate, 1 naked). Outer lobe 57 µm long, with short row of setules distally along inner margin and 2 long barbed setae. Maxilla (Fig. 6d) with 160 µm long syncoxa and 258 µm long claw; claw distally curved and armed with 2 setae, one medially and other subdistally near short row of setules. Maxilliped (Fig. 6e) 299 µm long, 5-segmented; syncoxa 28 µm long, with seta on inner margin; basis 159 µm long, with short seta on inner margin. Endopod 3-segmented; segments 55, 12 and 37 µm long, respectively. First segment armed with outer seta; second segment with distal seta; third segment with distal seta and slightly curved, 93 µm long claw. All maxillipedal setae naked.

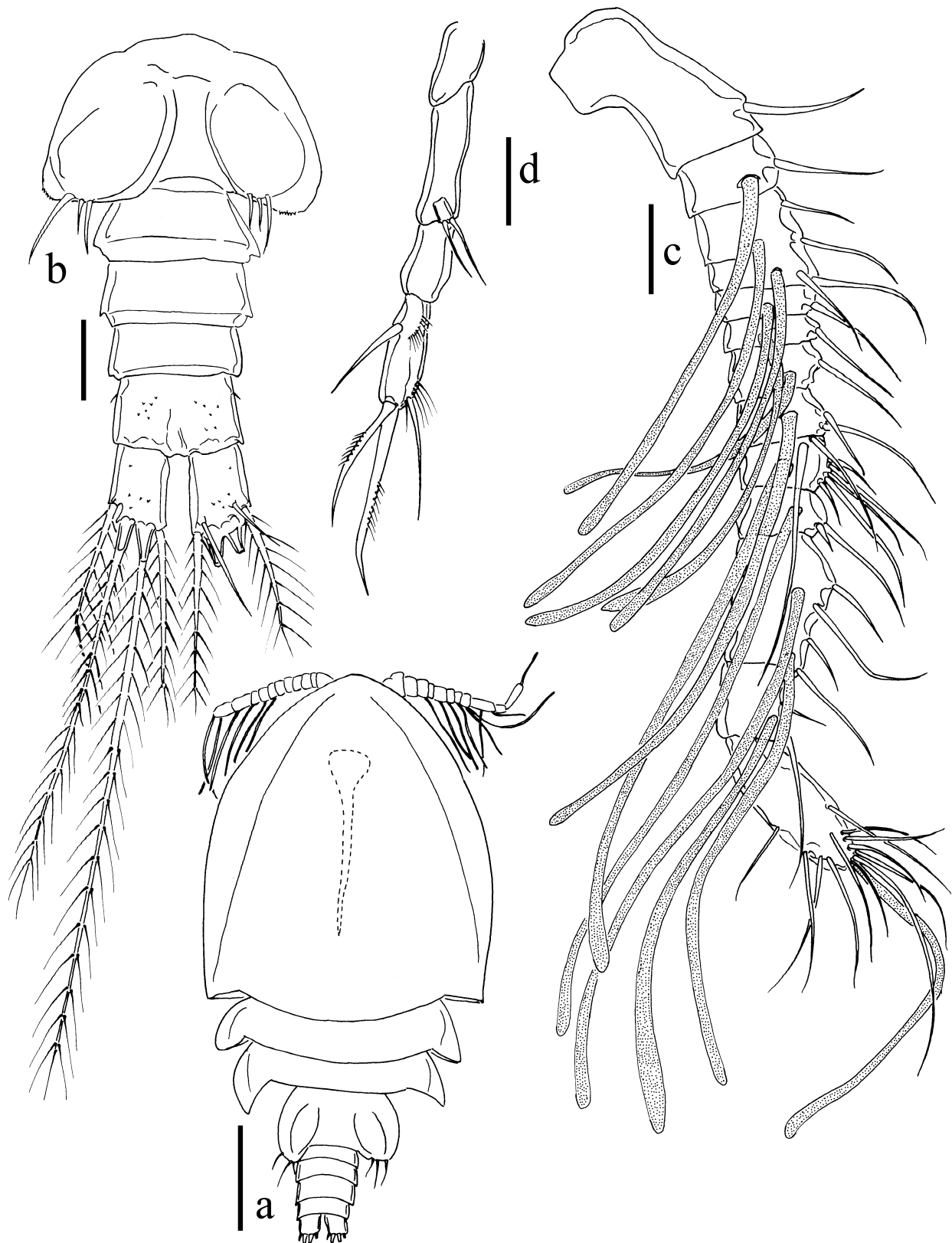


FIGURE 5. *Cryptopontius aesthetascus* sp. nov., male holotype (MNRJ 12909). (a) habitus, dorsal; (b) urosomites 2–6, dorsal; (c) antennule; (d) antenna. Scale bars: a = 150 μ m; b = 50 μ m; c–d = 25 μ m.

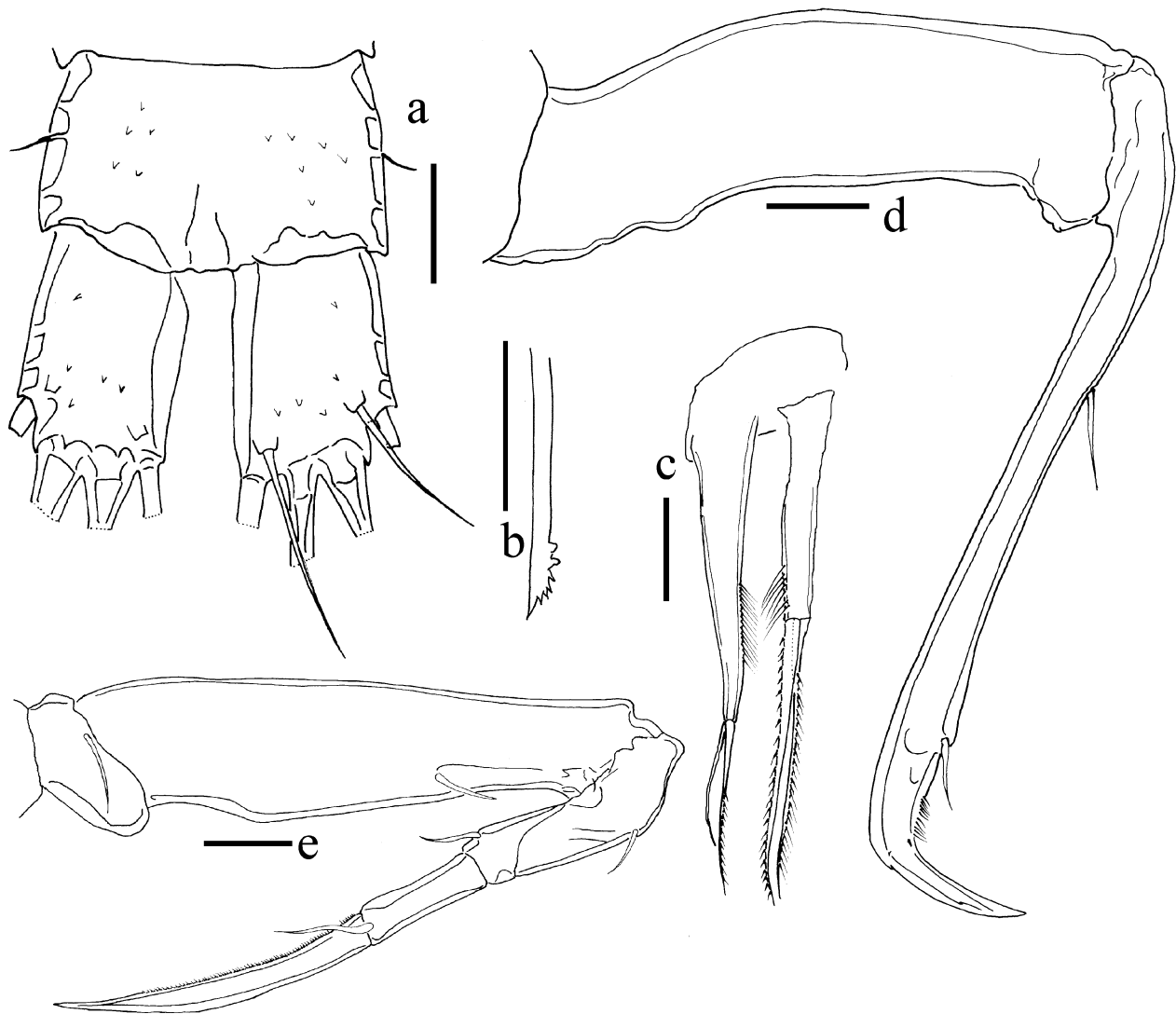


FIGURE 6. *Cryptopontius aesthetascus* sp. nov., male holotype (MNRJ 12909). (a) anal somite and caudal rami, dorsal; (b) distal end of mandibular stylet; (c) maxillule; (d) maxilla; (e) maxilliped. Scale bars: a, c–e = 25 μ m; b = 50 μ m.

P1–P3 (Figs 7a–c) biramous and trimerous. P4 (Fig. 7d) uniramous, without endopod. Armature formula for P1–P4 as follows:

	Coxa	Basis	Exopod	Endopod
P1	0-1	1-1	I-1; I-1; III,4	0-1; 0-2; 1,2,3
P2	0-1	1-0	I-1; I-1; III,I,5	0-1; 0-2; 1,1+I,3
P3	0-1	1-0	I-1; I-1; III,I,5	0-1; 0-2; 1,2,3
P4	0-0	0-0	I-1; I-1; III,I,5	Absent

Coxal seta and basis setae of P1 plumose; seta on coxa and basis of P2 and P3 naked; setae on rami plumose. Outer margin of P2–P4 exopod serrated. Distal spine on terminal exopodal segment of P2–P4 serrated along outer margin and setulate along inner margin.

P5 (Fig. 7e) comprised of protopodal segment fused to somite and free exopodal segment. Protopod with lateral naked seta. Exopod small, 21 μ m long, with 3 distal naked setae. P6 (Fig. 5b) represented by 3 naked setae on posterior margin of genital somite.

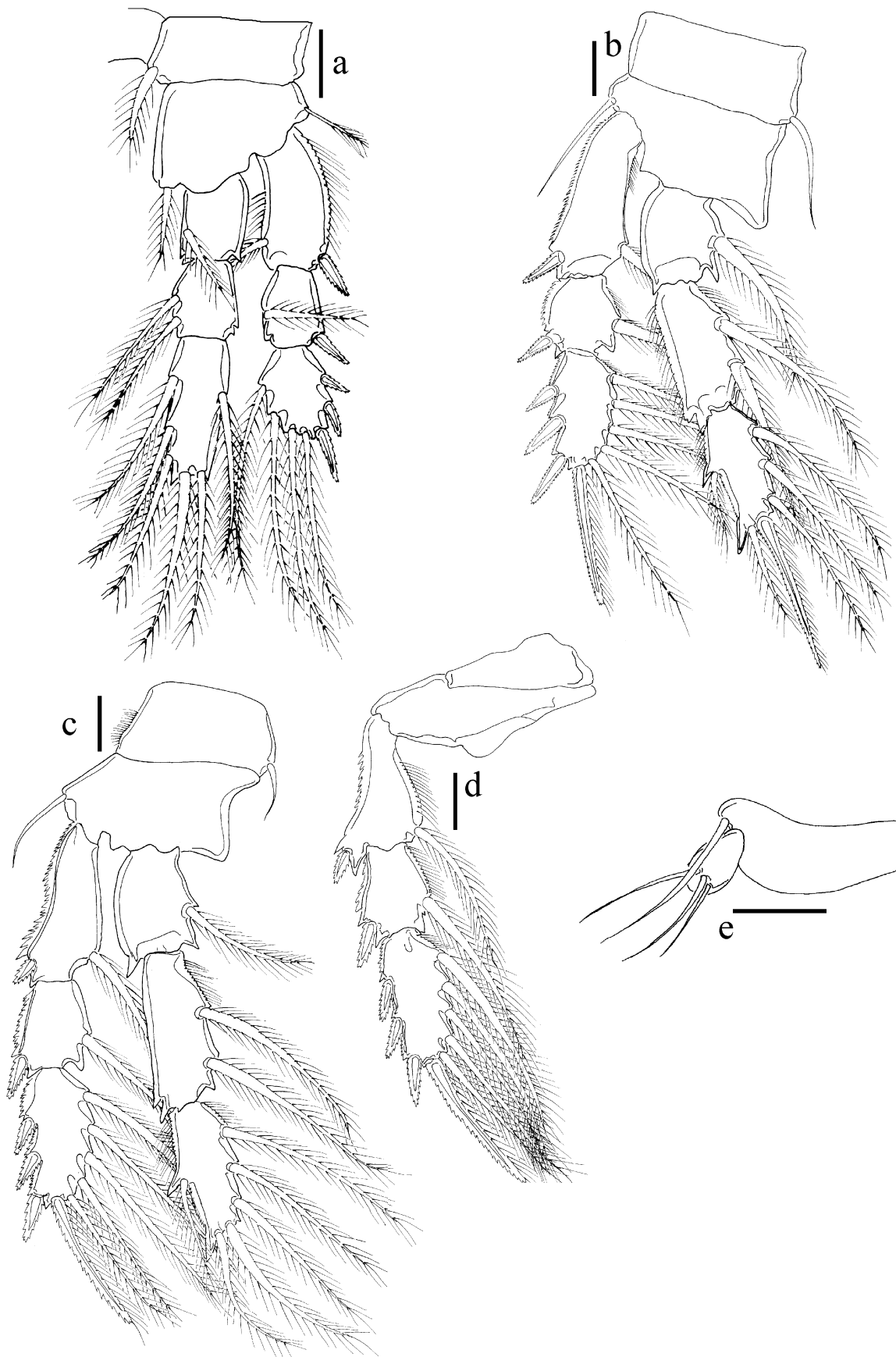


FIGURE 7. *Cryptopontius aesthetascus* sp. nov., male holotype (MNRJ 12909). (a) P1; (b) P2; (c) P3; (d) P4; (e) P5. Scale bars: all 25 μ m.

Female. Unknown.

Etymology. The specific name “*aesthetascus*” alludes to the relatively high number of aesthetascs on the antennule.

Remarks. To date, all known *Cryptopontius* species have been described based on female specimens. The male sex, however, has also been described for all *Cryptopontius* species, except *C. ricinius* Malt, 1991, *C. graciloides* Ummerkutty, 1961, *C. brevicaudatus* (Brady, 1899), *C. proximus* Nicholls, 1944 and *C. paracapitalis* (Nicholls, 1944). Nevertheless, the newly discovered male *Cryptopontius* species from Brazil is deemed to be an independent taxon, as it does not share a suite of important, non-sexually dimorphic features (i.e. segmentation of the antennule proximal to ancestral segments IX–XII, structure of the antenna and maxillary endopod, and leg setation) with any known female congener.

Cryptopontius aesthetascus **sp. nov.** has an armature of III;4 on the third exopodal segment of P1, 2 inner setae and a total of 6 setae, respectively, on the second and third endopodal segments of P1, a total of 9 elements on the third exopodal segment of P4 and a uniramous P4 in common with *C. madeirensis* Johnsson, 2001, *C. paracapitalis* Nicholls, 1944, *C. capitalis* (Giesbrecht, 1895) and *C. thorelli* (Giesbrecht, 1895) (Giesbrecht 1899; Nicholls 1944; Johnsson 2001). However, *C. aesthetascus* **sp. nov.** can be easily distinguished from these four related taxa by having 7 expressed antennular segments, rather than 3 (*C. madeirensis* and *C. paracapitalis*) or 4 (*C. capitalis* and *C. thorelli*), proximal to fused ancestral segments IX–XII (= expressed segment 8 in the new taxon).

***Cryptopontius expletus* sp. nov.**

(Figs 8–10)

Material examined. Holotype ♀ (MNRJ 12912) and 7 ♀ paratypes (MNRJ 12923), ex algae, Santo Aleixo Island, Serinhaem, Pernambuco, leg. P.S. Young, 15 March, 1995.

Description of female. Mean body length (excluding caudal setae) 1.19 mm (1.17–1.20 mm), mean body width 670 µm (661–682 µm) (based on 8 specimens). Body (Fig. 8a) cycloform, dorsoventrally flattened with moderately enlarged prosome and cylindrical urosome. Pedigerous somite 1 totally fused with cephalosome. Cephalothorax and pedigerous somites 2–4 with pointed epimera. Pedigerous somite 4 partially conceals pedigerous somite 5 and genital double-somite. Prosome length:width ratio 1.3:1. Urosome composed of 5 somites (first urosomite excluded in Fig. 8b). Genital double-somite 155 µm long, length:width ratio 0.7:1, with well developed posterolateral expansions and serrated posterior margin. Three postgenital somites wider than long (48 × 107 µm, 34 × 100 µm, 72 × 97 µm, respectively). First and second postgenital somites with serrated posterior margin. Ratio of prosome length to urosome 2.7:1. Caudal rami (Fig. 8b) elongate, 66 × 41 µm, armed with 6 setae (seta I absent). Length of setae II–VII 34, 114, 335, 462, 190, and 90 µm, respectively; setae III–VI plumose, setae II and VII naked.

Antennule (Fig. 8c) slender, 327 µm long (not including setae), consisting of 8 segments. Length of segments: 62, 23, 73, 36, 11, 29, 37, and 55 µm, respectively. Setation as follows: 1, 2, 8, 4, 2, 2, 3, 8+ae. All setae simple; aesthetasc 148 µm long. Antenna (Fig. 8d) 151 µm long (including distal claw-like seta); basis 53 µm long. Exopod 1-segmented, 8 µm long, with 2 distal setae; plumose seta extends beyond first endopodal segment. Endopod 2-segmented; first segment 25 µm long, unarmed; second segment 36 µm long, terminally covered with setules, and armed with proximomedial plumose seta and 3 apical setae (2 spiniform, 1 plumose).

Oral cone (Fig. 8a) 420 µm long, reaching insertion of P1. Mandibular stylet (Fig. 8e) with 8 distal teeth; mandibular palp absent. Maxillule (Fig. 9a) bilobed; both lobes elongated. Inner lobe 101 µm long, with 1 plumose and 1 naked setae and row of setules along inner margin. Outer lobe 70 µm long, with 2 long setae distally and row of setules along lateral margin. Maxilla (Fig. 9b) with 286 µm long syncoxa and 262 µm

long, distally curved claw; claw unarmed. Maxilliped (Fig. 9c) 512 μm long, 4-segmented; syncoxa 68 μm long, with short distomedial seta; basis 171 μm long, with short distomedial seta and setules along outer margin. Endopod 2-segmented; segments 104 and 59 μm long, respectively. First endopodal segment armed with outer and inner setae. Second endopodal segment with 2 setae and 111 μm long, recurved claw.

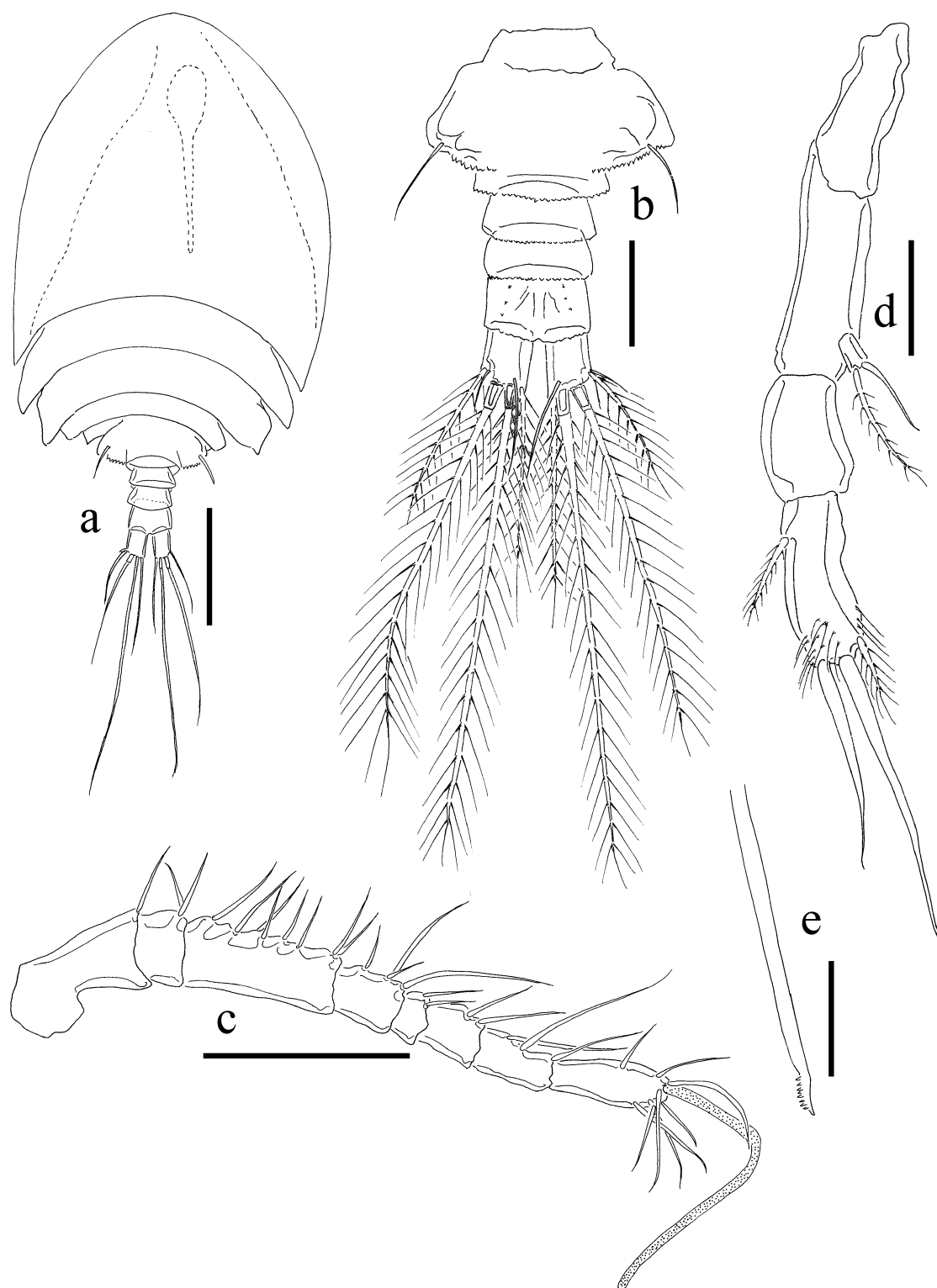


FIGURE 8. *Cryptopontius expletus* sp. nov., female holotype (MNRJ 12912). (a) habitus, dorsal view; (b) urosomites 2–5, dorsal; (c) antennule; (d) antenna; (e) distal end of mandibular stylet. Scale bars: a = 250 μm ; b–c = 100 μm ; d–e = 25 μm .

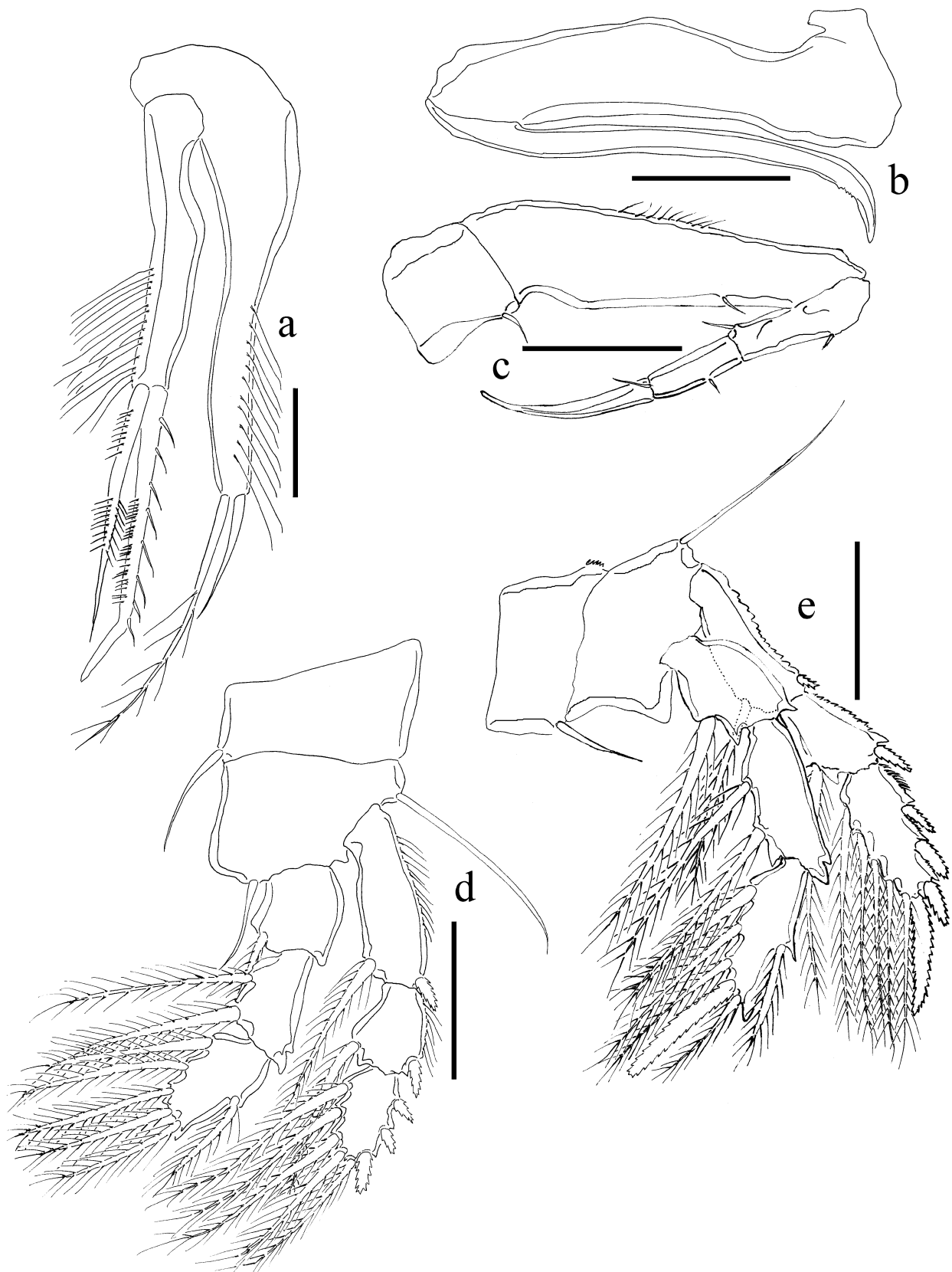


FIGURE 9. *Cryptopontius expletus* sp. nov., female holotype (MNRJ 12912). (a) maxillule; (b) maxilla; (c) maxilliped; (d) P1; (e) P2. Scale bars: a = 25 µm; b–e = 100 µm.

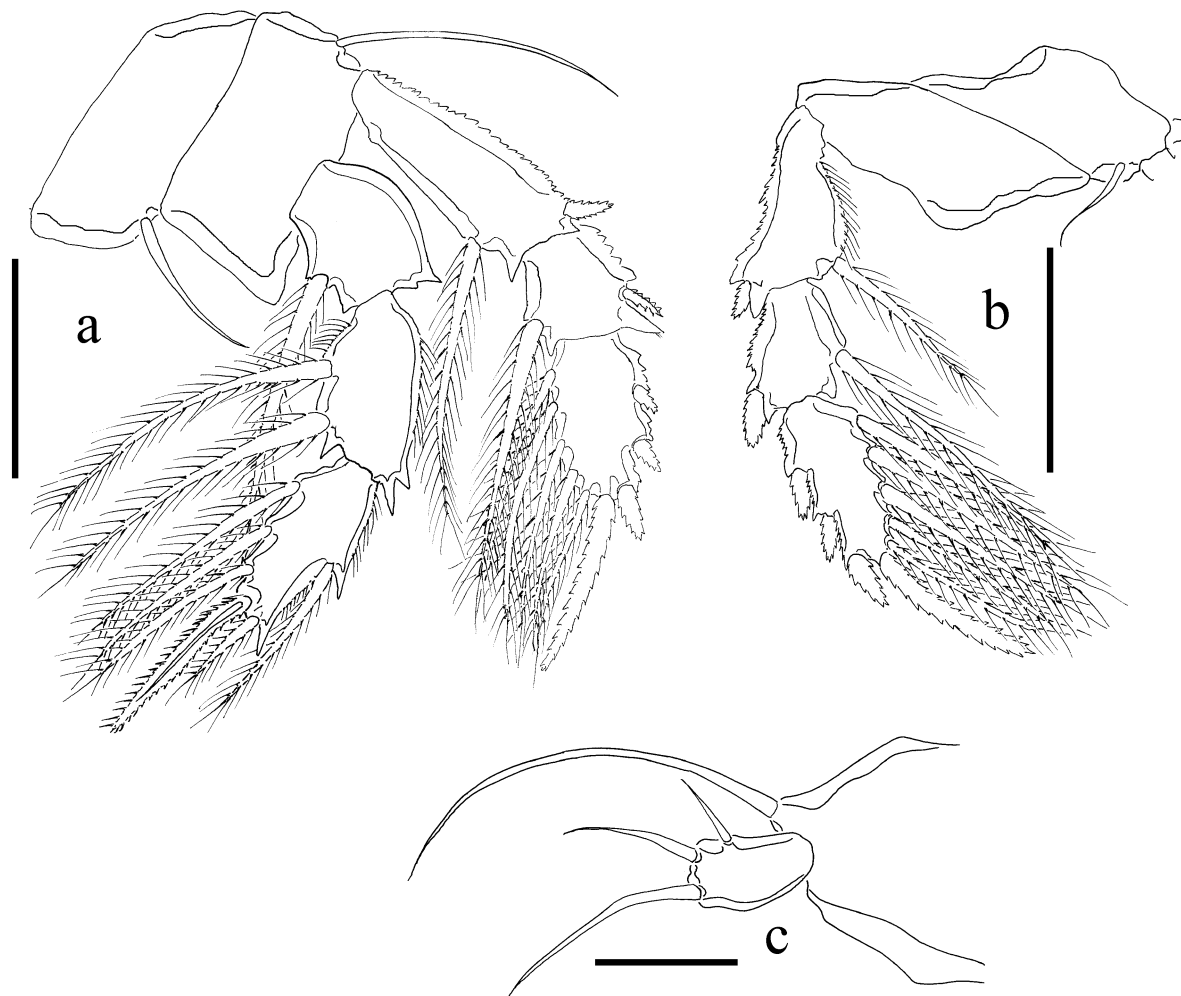


FIGURE 10. *Cryptopontius expletus* sp. nov., female holotype (MNRJ 12912). (a) P3; (b) P4; (c) P5. Scale bars: a–b = 100 μ m; c = 25 μ m.

P1–P3 (Figs 9d–e, 10a) biramous and trimerous. P4 (Fig. 10b) without endopod. Armature formula for P1–P4 as follows:

	Coxa	Basis	Exopod	Endopod
P1	0–1	1–1	I–1; I–1; III,5	0–1; 0–2; 1,2,3
P2	0–1	1–0	I–1; I–1; III,I,5	0–1; 0–2; 1,1+I,3
P3	0–1	1–0	I–1; I–1; III,I,5	0–1; 0–2; 1,1+I,3
P4	0–1	0–0	I–1; I–1; III,I,5	Absent

All coxal and basal setae naked. Outer margin of P2–P4 exopods serrated.

P5 (Fig. 10c) composed of protopodal segment fused to somite and free exopodal segment. Protopod with lateral naked seta. Exopod small, 23 μ m long, with 3 distal naked setae. P6 (Fig. 8b) represented by naked seta on posterior margin of genital-double somite.

Male. Unknown.

Etymology. The specific name refers to the Latin word “*expletus*” which means complete and perfect, alluding to the fact that the new species possesses more elements on its legs than any known congener.

Remarks. Although *C. expletus* sp. nov. and *C. aesthetascus* sp. nov. were found in the same locality, they are not conspecific because: 1) each species occupies a different microhabitat (algae vs. sponge); 2) the number of antennular segments proximal to fused ancestral segments IX–XII in *C. aesthetascus* sp. nov. and

C. expletus **sp. nov.** is 7 and 3, respectively; 3) the relative lengths of the exopod and distal endopodal segment of the antenna between these two taxa are not congruent; 4) the mandibular stylet of *C. aesthetascus* **sp. nov.** and *C. expletus* **sp. nov.** bears 7 and 8 teeth, respectively; 5) the curved maxillary claw of *C. aesthetascus* **sp. nov.** is armed with 2 small setae instead of unarmed as in *C. expletus* **sp. nov.**; 6) the endopod of the maxilliped is composed of 3 segments in *C. aesthetascus* **sp. nov.** instead of 2 as in *C. expletus* **sp. nov.**; 7) the armature of the third exopodal segment of P1 differs between them (5 inner setae in *C. expletus* **sp. nov.** vs. 4 in *C. aesthetascus* **sp. nov.**); and 8) an inner coxal seta is present on P4 in *C. expletus* **sp. nov.** but absent in *C. aesthetascus* **sp. nov.** None of these features can be attributed to sexual dimorphism.

The 8-segmented female antennule of *C. expletus* **sp. nov.** is a characteristic shared with *C. ignotus* (Brady, 1910), *C. latus* Nicholls, 1944, *C. minor* Stock, 1965, *C. ricinius* Malt, 1991, *C. donghaensis* Kim, 1996, *C. quinquesetus* Kim, 1996 and *C. digitatus* Kim, 1996. The new species can be distinguished from *C. digitatus* by the absence of P4 endopod (Kim 1996). *Cryptopontius expletus* **sp. nov.** differs from *C. quinquesetus*, *C. minor*, *C. ignotus*, *C. latus* and *C. ricinius* by having 8 rather than 7 elements on the third exopodal segment of P1 (Nicholls 1944; Eisele 1961; Stock 1965; Kim 1996). *Cryptopontius expletus* **sp. nov.** differs from *C. donghaensis* by having 6 rather than 5 elements on the third endopodal segment of P1 and 3 rather than 2 setae on the free exopodal segment of P5 (Kim 1996).

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