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ARTICLE

Redescription of the fish-parasitic isopod *Cymothoa ianuarii* Schioedte & Meinert, 1884 and further records of *C. excisa* Perty, 1833 and *C. oestrum* (Linnaeus, 1758) (Isopoda: Cymothoida: Cymothoidae) from Brazil

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Abstract. *Cymothoa ianuarii* Schioedte & Meinert, 1884 is rediscovered almost 136 years after its original description and redescribed from specimens collected in the state of São Paulo. This species is mainly characterized by adult females with cephalon with conspicuous eyes and not deeply immersed in pereonite 1, pereonites 5-6 much wider than 4, pleotelson twice as wide as long and pleopods 1-5 decreasing in size; *Cymothoa excisa* Perty, 1833 and *C. oestrum* (Linnaeus, 1758) are recorded from the state of Bahia. Illustrations and an updated distribution map for these species in Brazil are provided.

Keywords. Distribution; Parasitic crustaceans; Taxonomy; Fishes; Cymothoid.

INTRODUCTION

Species of Cymothoidae Leach, 1818 are distributed worldwide, except in polar waters, and are known to be obligate fish parasites (Trilles, 1994; Smit *et al.,* 2014; Hata *et al.,* 2017). Cymothoids are represented by 42 genera and about 366 species and are characterized by the hematophagous life-style and protandry (Boyko *et al.,* 2008; Poore & Bruce, 2012; Smit *et al.,* 2014). The genus *Cymothoa* Fabricius, 1793 comprises 51 species usually found infesting the tongue of the host fish (Smit *et al.,* 2014). In Brazil, nine species of *Cymothoa* have been recorded (Thatcher, 2000; Thatcher *et al.,* 2003; Thatcher & Fonseca, 2005; Thatcher *et al.,* 2007; Luque *et al.,* 2013). In a comparative study, Thatcher *et al.* (2003) analyzed all these species, providing the redescription of *Cymothoa excisa* Perty, 1833 and *C. oestrum* (Linnaeus, 1758). However, for *C. ianuarii* Schioedte & Meinert, 1884, Thatcher *et al.* (2003) pointed that no records were found since its original description and the type-material could be apparently lost, but the authors have no evidence as to why they concluded it. Consequently, the redescription of the species was not possible due to the absence of any material. Taxonomic studies of cymothoid isopods can be complicated given past mistake identifications, poor descriptions and redescriptions and lack of type-material. In addition, the intra-specific variation can be confounded with interspecific differences (Smit *et al.,* 2014). In the present contribution, we provide new records of three species of *Cymothoa* from Brazilian waters and the redescription of *C. ianuarii* based on material collected in past years. New illustrations and an updated distribution map for these species in Brazil are also provided.

MATERIAL AND METHODS

The material examined is stored in ethanol 70% and deposited in the Carcinological Collection of the Departamento de Zoologia of the Universidade Federal do Rio Grande do Sul (UFRGS) and in the Museu de Ciências e Tecnologia of the Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, state of Rio Grande do Sul, Brazil (MCP). Specimens were examined under a stereomicroscope Nikon SMZ800 and the illustrations were obtained with the aid of a camera lucida. Distribution map in Brazil was elaborated using the software Arcview 9.3 pro-

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gram (ESRI, 2009). Morphological description and terminology follows Thatcher *et al.* (2003) and Hadfield *et al.* (2013). For each specimen, we measured the total length and width and the pleotelson length and width. For a complete list of synonyms consult Trilles (1994).

RESULTS

Taxonomy

Order Isopoda Latreille, 1817
Suborder Cymothoida Wägele, 1989
Family Cymothoidae Leach, 1818
Genus *Cymothoa* Fabricius, 1793

Cymothoa Fabricius, 1793: 503. Milne Edwards, 1840: 264. Schioedte & Meinert, 1884: 223. Kussakin, 1979: 289. Brusca, 1981: 185. Brusca & Iverson, 1985: 45. Trilles, 1994: 137. Thatcher *et al.,* 2003: 342. Hadfield *et al.,* 2011: 58. Hadfield *et al.,* 2013: 153. Martin *et al.,* 2016: 5.

Type species: *Oniscus oestrum* Fabricius, 1793; by subsequent designation (Kussakin, 1979).

Diagnosis: Hadfield *et al.* (2011, 2013).

Remarks: In Brazil, this genus encompass nine species distributed along the coast: *Cymothoa brasiliensis* Schioedte & Meinert, 1884, *C. catarinensis* Thatcher, Loyola e Silva, Jost & Souza-Conceição, 2003, *C. excisa, C. exigua* Schioedte & Meinert, 1884, *C. gerris* Schioedte & Meinert, 1884, *C. ianuarii, C. liannae* Sartor & Pires, 1988, *C. oestrum* and *C. spinipalpa* Thatcher, de Araujo, de Lima & Chellapa, 2007 (Thatcher, 2000; Thatcher *et al.,* 2003; Thatcher & Fonseca, 2005; Thatcher *et al.,* 2007; Luque *et al.,* 2013).

Cymothoa excisa Perty, 1833
(Figs. 1, 6; Table 1)

Restricted synonymy: *Cymothoa excisa* Perty, 1833: 211, tab. 40, fig. 11. Coelho & Koenig, 1972: 1976, table 1. Trilles 1994: 141. Thatcher *et al.,* 2003: 545, figs. 27-51. Luque *et al.,* 2013: 1454.

Material examined: BRAZIL: Bahia: one ovigerous female, Candeias, coll. J. Pezzi da Silva, 11/V/2010 (MCP 2996); two ovigerous females, Candeias, coll. J. Pezzi da Silva, 11/V/2010 (MCP 2997) [illustrated].

Remarks: *Cymothoa excisa* was most recently diagnosed by Thatcher *et al.* (2003). The species had already been recorded from northeastern Brazil, in the states of Maranhão, Pernambuco and Sergipe by Coelho & Koenig (1972). These authors also raised the possibility of the occurrence in the states of Piauí, Ceará, Rio Grande do Norte, Paraíba, Alagoas, Bahia and Espírito Santo, the latter in the southeastern Brazil. In addition, the occurrence of this species was also recorded in the states of Pará (Monod, 1969) and Rio de Janeiro (Richardson, 1901). This is the first record for the state of Bahia, particularly in the northern portion (12°44′49″S 38°29′38″W). The southernmost record of *C. excisa* in western South Atlantic is La Plata (Argentina) (Gerstaecker, 1901). *Cymothoa excisa* was redescribed by Thatcher *et al.* (2003) based on material from the Florianopolis Island, state of Santa Catarina, southern Brazil. Females are distinguished mainly by the acute anterolateral angles of pereonite 1 reaching or surpassing the eyes; the truncate cephalon, deeply immersed in pereonite 1; eyes present but inconspicuous; pereonites 4-6 subequal in width; pleon deeply immersed in pereonite 7 (Fig. 1); and pleopods trilaminate (Thatcher *et al.,* 2003). Males are similar to females, but smaller and with pleopod 2 lacking an appendix masculinum (Thatcher *et al.,* 2003).

Table 1. Measurements (mm) of analyzed female specimens of *Cymothoa* spp.

Species	Measurements				Collection Number
	Body		Pleotelson		
	Length	Width	Length	Width	
Cymothoa excisa	23.4	9.8	4.1	8.3	MCP 2996
	12.1	5.7	2.8	4.5	MCP 2997
	9.5	4.6	2.2	3.2	MCP 2997
Cymothoa ianuarii	11.6	6.1	1.9	4.8	UFRGS 6515
	10.6	5.9	1.8	3.9	UFRGS 6515
	11.7	6.0	1.9	4.1	UFRGS 6515
	17.7	9.3	2.9	6.8	UFRGS 6516
.	14.4	8.5	2.4	5.6	UFRGS 6517
	12.2	6.9	2.0	4.0	UFRGS 6518
	11.4	6.2	2.3	3.9	UFRGS 6520
Cymothoa oestrum	22.8	10.9	4.6	7.4	MCP 2999

Hosts: The host of present specimens is unknown. However, *C. excisa* was already found parasitizing fishes of the families Gerreidae, Haemulidae, Lutjanidae, Priacanthidae, Sciaenidae and Synodontidae (Joca *et al.,* 2015).

Distribution: USA (Massachusetts to Florida), Antilles, Venezuela, Brazil (Pará, Maranhão, Pernambuco, Bahia, Sergipe, Rio de Janeiro and Santa Catarina) and Argentina (Trilles, 1994; Thatcher *et al.,* 2003) (Fig. 6).

Cymothoa ianuarii Schioedte & Meinert, 1884
(Figs. 2-4, 6; Table 1)

Cymothoa Ianuarii Schioedte & Meinert, 1884: 246-248, tab. VI (Cym. XXIV), figs. 19-20.
Cymothoa ianuarii Trilles, 1994: Thatcher *et al.,* 2003: 551, fig. 80. Luque *et al.,* 2013: 1454.
Cymothoa januarii Sartor & Pires, 1988: 146-156. [erroneus spelling].

Material examined: BRAZIL: São Paulo: three ovigerous females, Enseada de Ubatuba, 03/V/2007 (UFRGS 6515); one ovigerous female, Enseada de Ubatuba, coll. F. Mantelatto, 02/VI/2008 (UFRGS 6516) [illustrated];

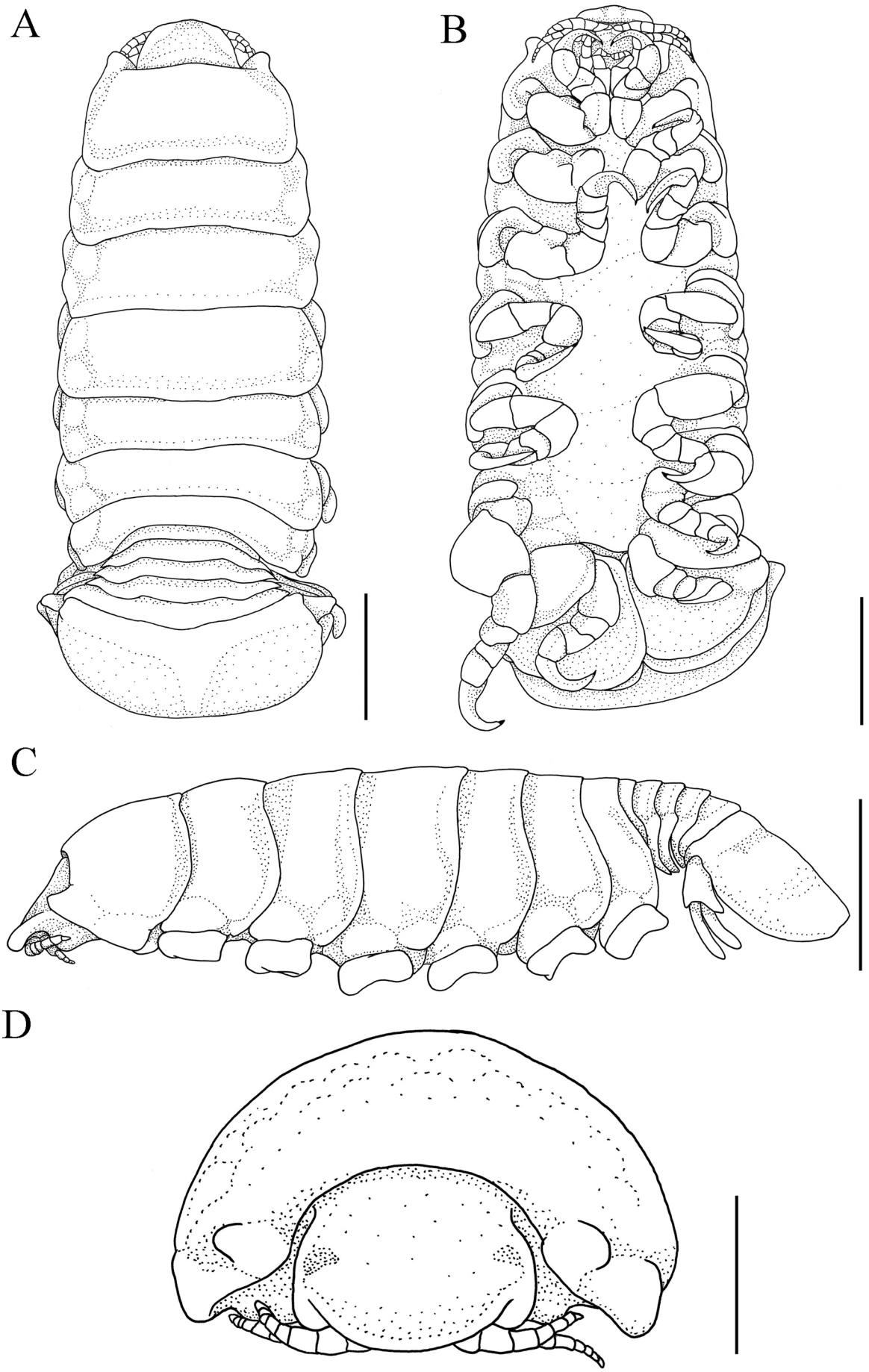

Figure 1. *Cymothoa excisa* Perty, 1833 (MCP 2996): (A) habitus dorsal view; (B) habitus ventral view; (C) habitus lateral view; (D) cephalon frontal view. Scale bar: A-C = 5 mm; D = 2.5 mm.

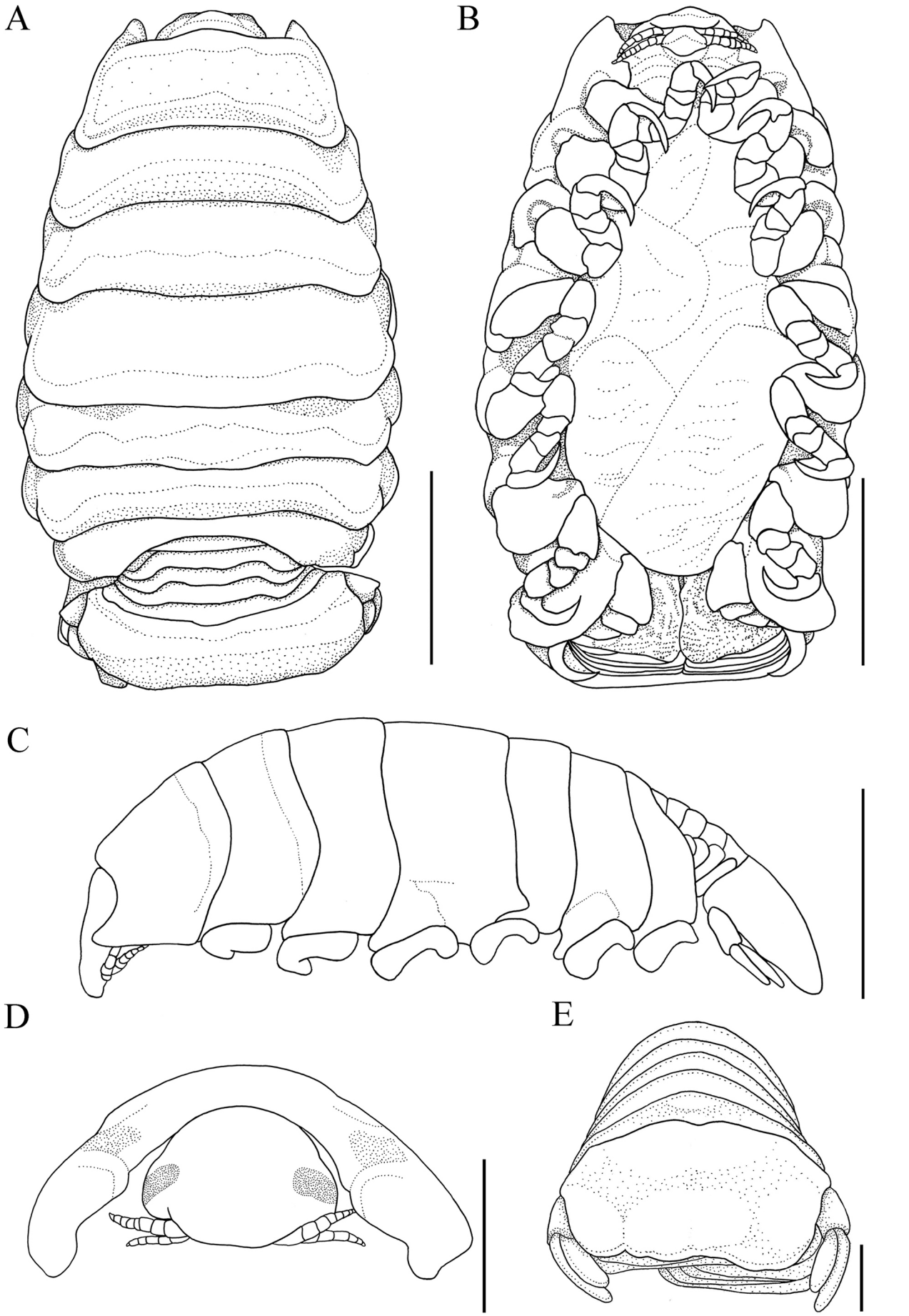

Figure 2. *Cymothoa ianuarii* Schioedte & Meinert, 1884 (UFRGS 6516): (A) habitus dorsal view (UFRGS 6516); (B) habitus ventral view (UFRGS 6516); (C) habitus lateral view (UFRGS 6516); (D) cephalon frontal view (UFRGS 6516); (E) pleotelson dorsal view (UFRGS 6520). Scale bar: A-C = 5 mm; D = 2.5 mm; E = 1 mm.

one ovigerous female, Enseada de Ubatuba, 15/VI/2003 (UFRGS 6517); one female, Enseada de Ubatuba, 15/VI/2003 (UFRGS 6518); one ovigerous female, Enseada de Ubatuba, X/2002 (UFRGS 6520) [illustrated].

Redescription (based on seven females)

Body 1.8 times as long than wide (Table 1), widest at pereonite 5, narrowest at pereonite 1 (Fig. 2A).

Cephalon: longer than wide, frons transversely truncated, visible in dorsal view, immersed on pereonite 1; eyes visible (Figs. 2A, C, D).

Pereon: Convex. Pereonite 1 with anterolateral angles surpassing eyes; pereonites 1 and 4 largest; pereonites 2 and 3 subequal; pereonites 5 and 6 subequal; pereonite 7 shorter and narrower than pereonite 6. Coxae 2 and 3 morphologically similar and bent downwards; 4-7 morphologically similar to each other and falciform (Fig. 2A, C).

Pleon: Immersed in pereonite 7; pleonites similar in length with posterolateral margins not overlapped by lateral margins of the subsequent pleonite (Figs. 2A, E). Pleotelson sub-rectangular and 0.46 times as long as wide; posterior margin sinuous; dorsal surface smooth; lateral margins convex (Fig. 2A, E).

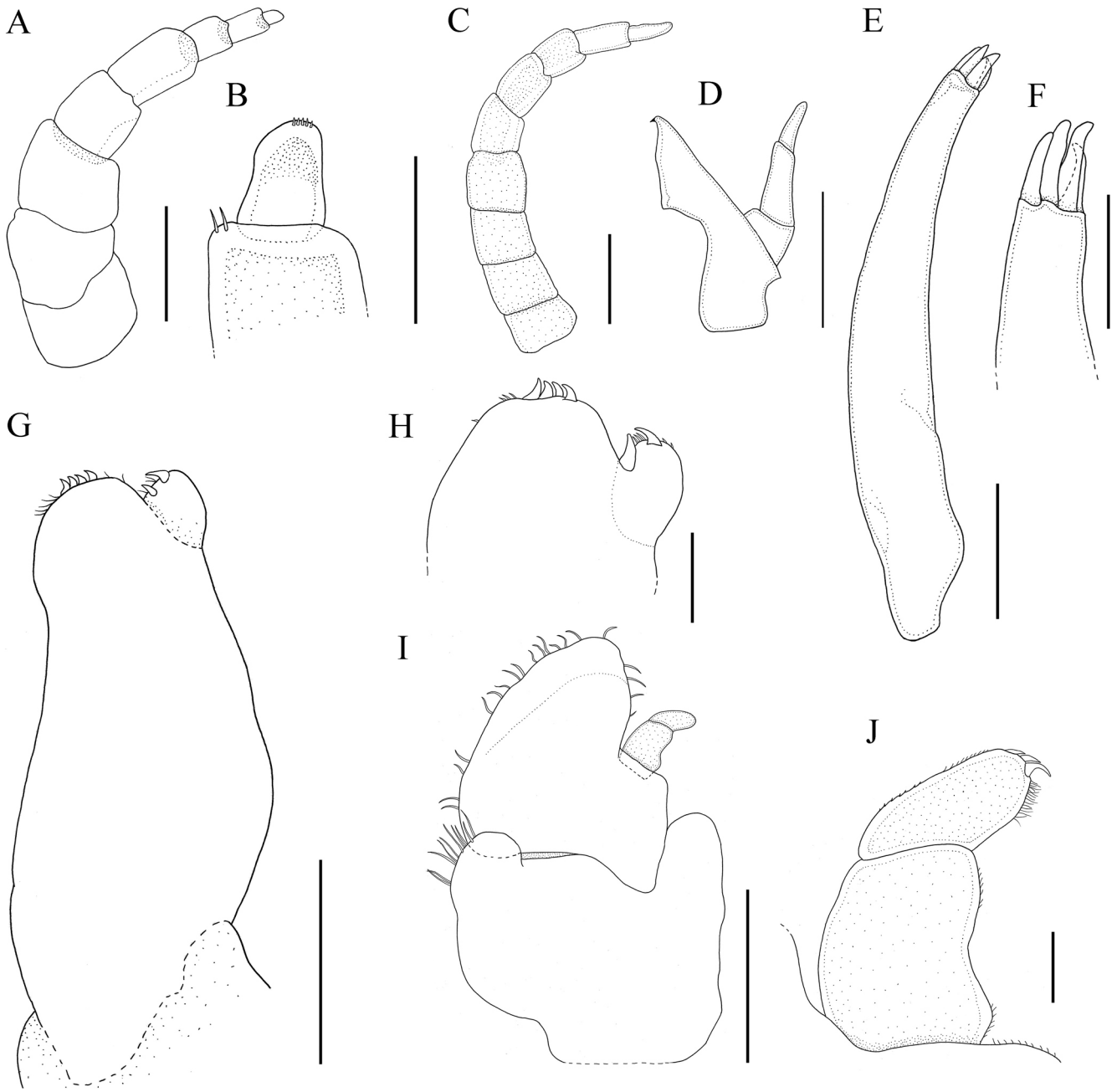

Figure 3. *Cymothoa ianuarii* Schioedte & Meinert, 1884: (A) antennule (UFRGS 6516); (B) apical article of antennule (UFRGS 6516); (C) antenna (UFRGS 6516); (D) mandible (UFRGS 6515); (E) maxilulle (UFRGS 6520); (F) apex of maxillula (UFRGS 6520); (G) maxilla (UFRGS 6515); (H) maxilla distal portion (UFRGS 6515); (I) maxilliped with oostegite (UFRGS 6515); (J) maxilliped articles 2 and 3 (UFRGS 6515). Scale bar: A, C and D = 0.5 mm; E and G = 0.3 mm; B = 0.125 mm; F, H and J = 0.1 mm; I = 1 mm.

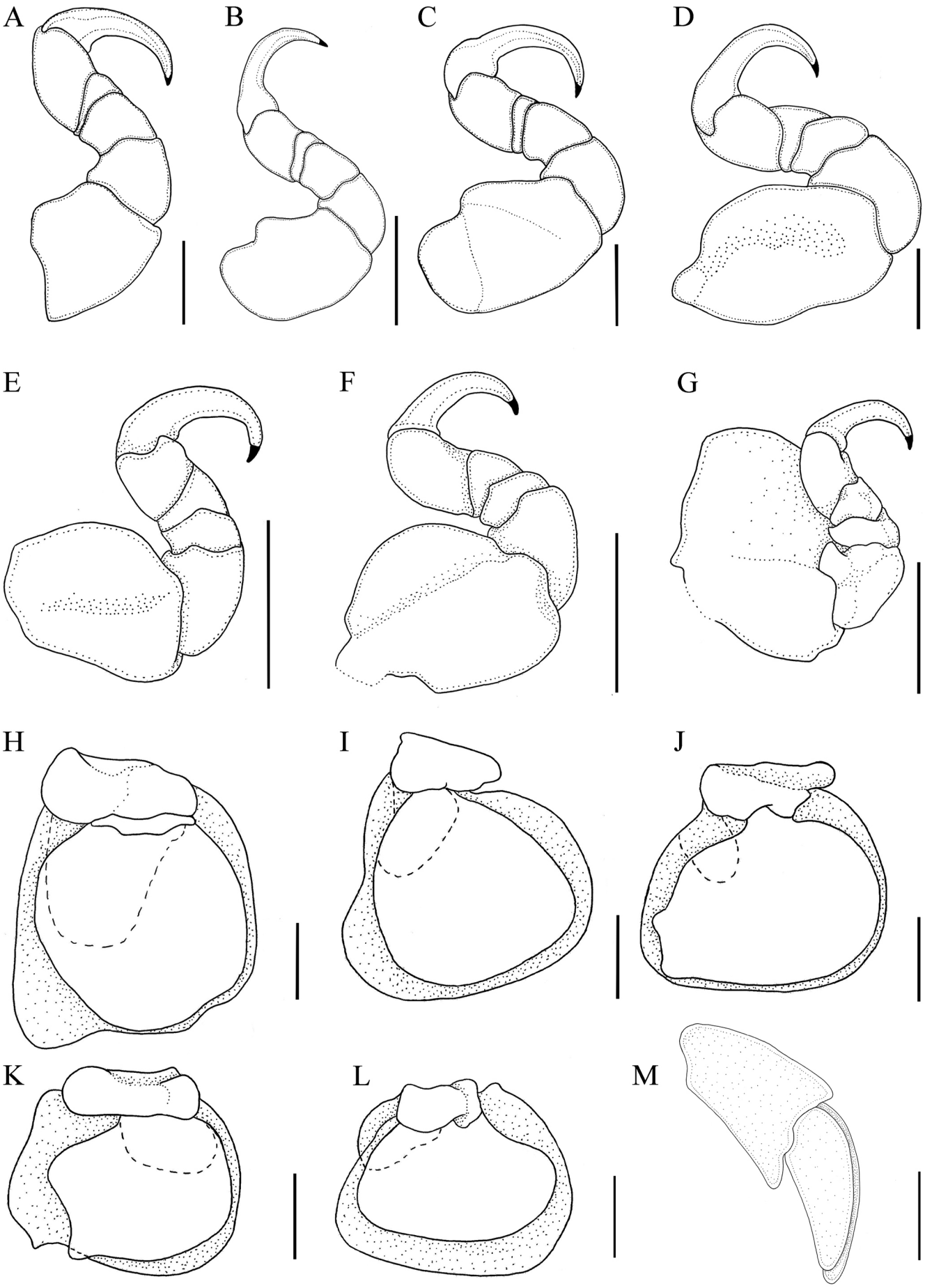

Figure 4. *Cymothoa ianuarii* Schioedte & Meinert, 1884 (UFRGS 6516): (A-G) pereopods 1-7; (H-J) pleopods 1-5 dorsal view; (M) uropod. Scale bar: E-G = 2 mm; A-D, H-J = 1 mm; D = 2.5 mm; M = 0.5 mm.

Antennula: with eight articles, the first two being stouter, distal article with five small apical setae (Figs. 2B, 3A).

Antenna: comprised of nine articles, terminal article without setae; extending to posterior margin of cephalon. Labrum lateral margins concave, without median point (Figs. 2B, 3C).

Mandible: with chitinous and acute incisor and straight molar process. Palp shorter than mandible (Fig. 3D).

Maxillula: bilobed with four apical stout robust setae (Figs. 3E, F).

Maxilla: mesial lobe with four recurved robust setae, partly fused to lateral lobe with two recurved robust setae (Fig. 3G, H).

Maxilliped: Maxilliped article 3 with three recurved robust setae (Figs. 3I, J).

Oostegite: smooth, with marginal setae (not illustrated) (Fig. 2B).

Pereopods: 1-3 smaller than 4-7, which gradually increase in size and with carina on basis. Pereopod 1 basis 1.1 times as long as greatest width; ischium 0.7 times as long as basis; merus proximal margin without bulbous protrusion; carpus with straight proximal margin; propodus 1.6 times as long as wide; dactylus slender, 1.3 as long as propodus, 3.2 times as long as basal width. Pereopod 2 propodus 1.4 times as long as wide; dactylus 1.7 times as long as propodus; Pereopod 3 basis 1.5 times as long as greatest width; ischium 0.5 times as long as basis; propodus 1.2 times as long as wide; dactylus slender, 1.7 as long as propodus, 2.4 times as long as basal width. Pereopod 4 basis 1.67 times as long as greatest width; ischium 0.5 times as long as basis; propodus 1.4 times as long as wide; dactylus slender, 1.43 as long as propodus, 2.1 times as long as basal width. Pereopod 5 basis 1.3 times as long as greatest width; ischium 0.6 times as long as basis; propodus 1.07 times as long as wide; dactylus slender, 2.03 as long as propodus, 2.18 times as long as basal width. Pereopod 6 basis 1.3 times as long as greatest width; ischium 0.6 times as long as basis; propodus 1.6 as long as wide; dactylus 1.2 times as long as propodus. Pereopod 7 basis 1.5 times as long as greatest width; ischium 0.4 times as long as basis, with large proximal bulbous protrusion; merus proximal margin with slight protrusion, 0.3 times as long as ischium, 0.4 times as long as wide; carpus without bulbous protrusion; propodus 0.8 times as long as ischium, 1.6 times as long as wide; dactylus slender, 1.8 times as long as propodus, 2.6 times as long as basal width.

Pleopods: without setae, lobes decreasing in size from pleonites 1 to 5, exopod larger than endopod. Pleopod 1 exopod 1.1 times as long as greatest width, lateral margin straight, distal margin sinuous, mesial margin straight; endopod as long as wide, lateral margin convex, distally narrowly rounded, mesial margin convex; peduncle 2.75 times as wide as long. Pleopods 1-3 endopod proximal borders decreasing in size and increasing in size in pleopods 4-5; with fleshy folds absent and medial lobes present and decreasing in size (Figs. 4H-L).

Uropods: shorter than pleotelson. Peduncle 0.8 times as long as rami; lateral margins without setae. Endopod apically rounded, 2.8 times as long as greatest width, lateral margin weakly convex, mesial margin weakly convex. Exopod 0.9 times as long as endopod, 2.5 times as long as greatest width and without setae (Figs. 2A, C, E; 4M).

Remarks: Adult females of *Cymothoa ianuarii* can be distinguished mainly by the cephalon with conspicuous eyes and not deeply immersed in pereonite 1, anterolateral angles of pereonites 1 surpassing eyes, pereonites 5-6 much wider than 4, pleotelson twice wide as long and pleopods 1-5 decreasing in size. Males are unknown (Thatcher *et al.,* 2003). This is the first record from the state of São Paulo, particularly in the northern portion of the coast (23°29′38.72″S, 45°05′16.0″W). This new record represents the rediscovery of this species after a hiatus of approximately 136 years since its original description from material collected in Rio de Janeiro in the 1880's. We provided the redescription of this species based on the analyzed specimens.

Hosts: The host of present specimens is unknown. However, *C. ianuarii* was already found parasitizing fishes of the families Priacanthidae and Pleuronectidae (Schioedte & Meinert, 1884).

Distribution: Rio de Janeiro (Schioedte & Meinert, 1884) and São Paulo, Brazil (Fig. 6).

Cymothoa oestrum (Linnaeus, 1758) (Figs. 5-6; Table 1)

Oniscus oestrum Linnaeus, 1758: 636.
Asellus oestrum Olivier, 1789: 253.
Cymothoa oestrum Fabricius, 1793: 505. Thatcher *et al.,* 2003: 546, figs. 52-76. Luque *et al.,* 2013: 1454.

Material examined: BRAZIL: Bahia: one ovigerous female, Candeias, coll. J. Pezzi da Silva, 11/V/2010 (MCP 2999) [illustrated].

Remarks: This is the first record of this species from Bahia, particularly in the northern portion (12°44′49″S, 38°29′38″W), and it is the second record from Brazil. This species was redescribed by Thatcher *et al.* (2003) based on material from Camboriú, state of Santa Catarina, southern Brazil. Females can be distinguished by the truncate cephalon deeply immersed in the pereonite 1, eyes absent, anterolateral margins of pereonite 1 blunt and bilaminate pleopods with folding on the fifth endopod (Fig. 5). Males are unknown (Thatcher *et al.,* 2003).

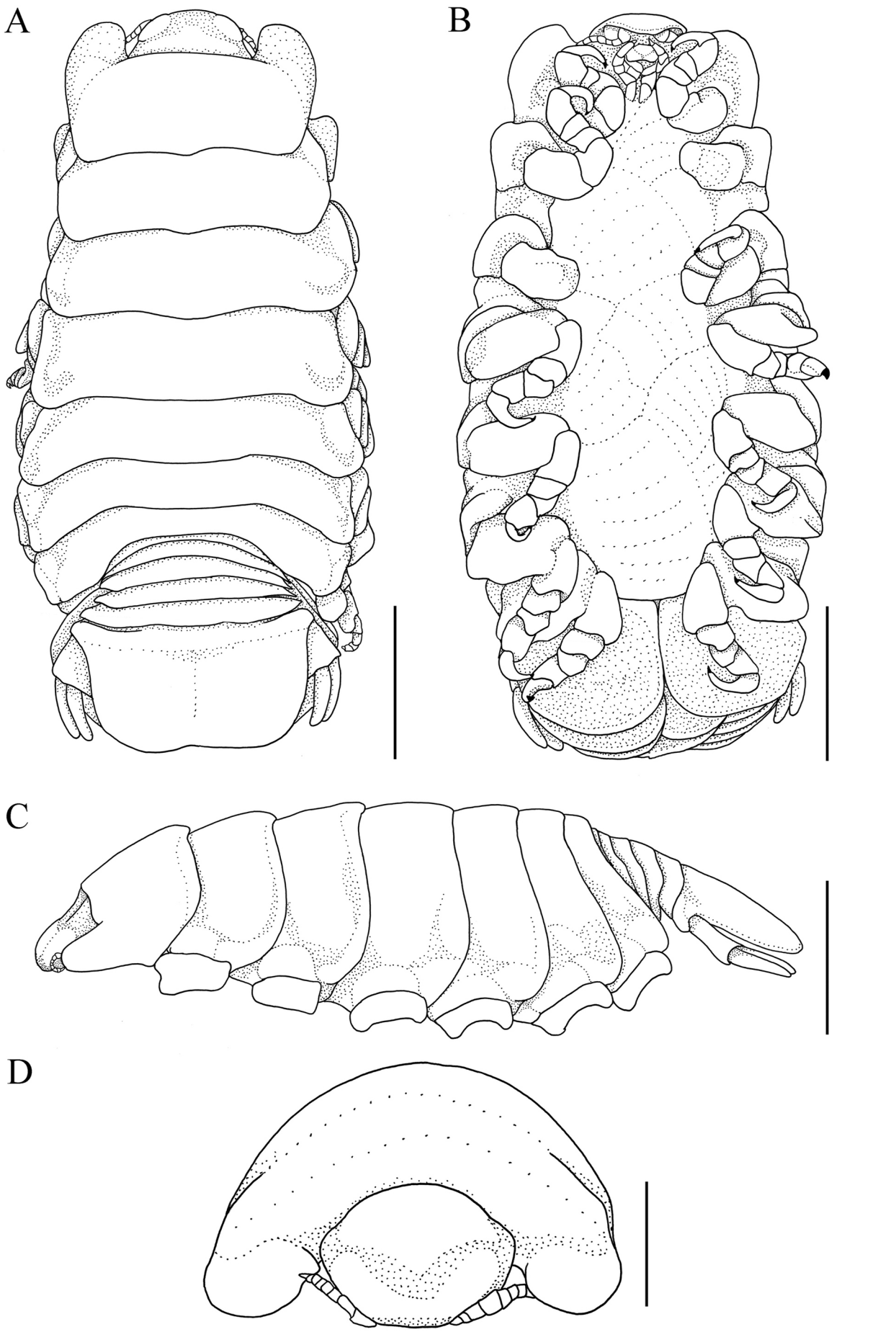

Figure 5. *Cymothoa oestrum* (Linnaeus, 1758) (MCP 2999): (A) habitus dorsal view; (B) habitus ventral view; (C) habitus lateral view; (D) cephalon frontal view. Scale bar: A-C = 5 mm; D = 2.5 mm.

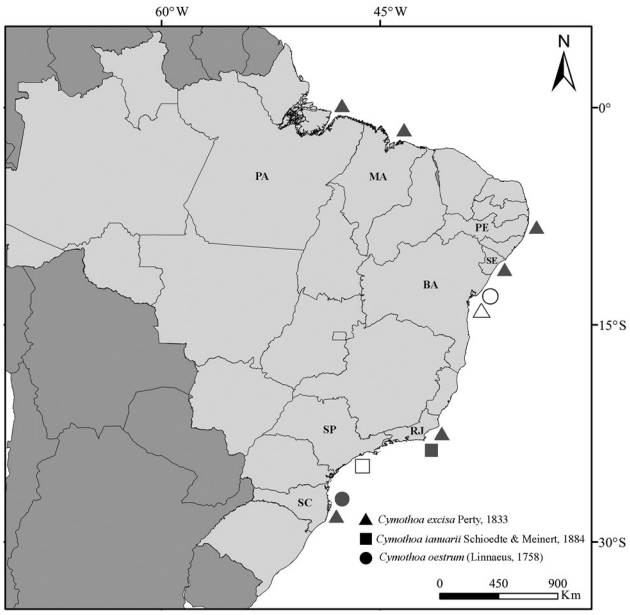

Figure 6. Map with the records of *Cymothoa* excisa (▲), *C. ianuarii* (■) and *C. oestrum* (●) in Brazil. Symbols in dark gray indicate literature records and white indicates new records. Abbreviations: PA = Pará; MA = Maranhão; PE = Pernambuco; SE = Sergipe; BA = Bahia; RJ = Rio de Janeiro; SP = São Paulo; SC = Santa Catarina.

Hosts: The host of the present specimen is unknown. However, *C. ianuarii* was already found parasitizing fishes of the families Carangidae and Priacanthidae (Trilles, 1994).

Distribution: United States of America (Massachusetts to Florida), Antilles, Venezuela and Brazil (Bahia and Santa Catarina) (Fig. 6) (Thatcher *et al.,* 2003).

CONCLUSION

This study deepen the knowledge on the distribution of three species of *Cymothoa* from Brazil. The rediscovery of *C. ianuarii* after a gap of almost 136 years of its original description and its redescription with the inclusion of new illustrations and description of the mouth parts are particularly important once the type material was lost and past descriptions were incomplete. We believe that these new data will help researchers to better identify the species and, therefore, further the understanding of distribution of these species in the southwestern Atlantic.

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AUTHORS' CONTRIBUTIONS

F.B.R. identified all specimens; F.B.R. and A.F.H. worked on illustrations and pictures; F.B.R., A.F.H., and P.B.A. wrote and reviewed the manuscript. All authors read and approved the final manuscript and consent to publication.

REFERENCES

Boyko, C.B.; Bruce, N.L.; Hadfield, K.A.; Merrin, K.L.; Ota, Y.; Poore, G.C.B.; Taiti, S.; Schotte, M. & Wilson, G.D.F. (Eds.). 2008. *World marine, freshwater and terrestrial Isopod Crustaceans database. Cymothoidae Leach, 1818.* Available: http://www.marinespecies.org/aphia.php?p=taxdetails&id=118274. Access: 23/07/2020.

Brusca, R.C. 1981. A monograph on the Isopoda Cymothoidae (Crustacea) of the eastern Pacific. *Zoological Journal of the Linnean Society,* 73: 117-199. DOI

Brusca, R.C. & Iverson, E.W. 1985. A guide to the marine isopod Crustacea of Pacific Costa Rica. *Revista de Biologia Tropical,* 33: 1-77.

Coelho, P.A. & Koenig, M.L. 1972. A distribuição dos crustáceos pertencentes as ordens Stomatopoda, Tanaidacea e Isopoda no Norte e Nordeste de Brasil. *Trabalhos do Instituto Oceanográfico da Universidade Federal de Pernambuco,* Recife, 13: 245-260.

Environmental Systems Research Institute (ESRI). 2009. *ArcGIS Desktop: Release 9.3.* Environmental Systems, Research Institute Redlands, CA.

Fabricius, J.C. 1793. *Entomologica systemica emendata et acuta, Secundum classes, ordines, genera, species, adjectis synonymis, locis, observationibus, descriptionibus.* Hafniae, C.G. Proft. v. 2, viii. 519p.

Gerstaecker, A. 1901. Isopoda. *In:* Bronn, H.C.G. (Ed.). *Die Klassen und Ordnungen der Arthropoden wissenschaftlich dargestellt in Wort und Bild., Fünfter Band. II Abtheilung. Crustacea. Isopoda.* Leipzig, C.F. *Winter'sche verlagshadlung.* p. 8-278.

Hadfield, K.A.; Bruce, N.L. & Smit, N.J. 2011. *Cymothoa hermani* sp. nov. (Isopoda, Cymothoidae, Crustacea), a parasitic isopod, collected off the Zanzibar coast, Tanzania from the mouth of a parrotfish (Scaridae). *Zootaxa,* 2876: 57-68.

Hadfield, K.A.; Bruce, N.L. & Smit, N.J. 2013. Review of the fish-parasitic genus *Cymothoa* Fabricius, 1793 (Isopoda, Cymothoidae, Crustacea) from the southwestern Indian Ocean, including a new species from South Africa. *Zootaxa,* 3640(2): 152-176.

Hata, H.; Sogabe, A.; Tada, S.; Nishimoto, R.; Nakano, R.; Khogya, N.; Takeshima, H. & Kawanishi, R. 2017. Molecular phylogeny of the family Cymothoidae (Isopoda, Crustacea): Evolution of the attachment mode to host fish and the habitat shift from saline water to freshwater. *Marine Biology,* 164(105): 1-15. DOI

Joca, L.K.; Leray, V.L.; Zigler, K.S. & Brusca, R.C. 2015. A new host and reproduction at a small size for the "snapper-choking isopod" *Cymothoa excisa* (Isopoda: Cymothoidae). *Journal of Crustacean Biology,* 35(2): 292-294.

Kussakin, O.G. 1979. *Marine and brackishwater like-footed Crustacea (Isopoda) from the cold and temperate waters of the Northern Hemisphere. Suborder Flabellifera.* Leningrad, Opredeliteli po Faune SSSR, Izdavaemye Zoologicheskim Institutom Akademii Nauk SSSR, Izdatel'stvo Nauka.472p.

Latreille, P.A. 1817. *Nouveau dictionnaire d' histoire naturelle appliqué aux arts à l'agriculture, à l'economie rural et domestique, à la medicine, etc… nouvelle edition presqu'entierement refundue et considérablement augmentée, avec des figures tirées des trios règnes de la nature.* Paris. v. 25, p. 610.

Leach, W.E. 1818. Cymothoadées, Cymothoadæ. (Crust.). *In:* Cuvier, F. (Ed.). *Dictionnaire des Sciences Naturelles, dans lequel on traite Méthodiquement des Différens étres de la Nature, considérés soit en eux-mêmes, d'après l'état actuel de nos connaissances, soit relativement à l'utilité qu'en peuvent retirer la Médecine, l'Agriculture, le Commerce et les Arts. Suivi d'une biographie des plus Célèbres Naturalistes. Ouvrage destiné aux médecins, aux agriculteurs, aux commerçans, aux artistes, aux manufacturiers, et à tous ceux qui ont intérêt à connaître les productions de la nature, leurs caractères génériques et spécifiques, leur lieu natal, leurs propiétés et leurs usages.* Strasbourg et Paris, Levrault et Le Normant. v. 12- F.G. p. 337-354.

Linnaeus, C. 1758. *Systema Naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis.* Editio decima, reformata. Holmiae. Laurentius Salvius. ii, 824p.

Luque, J.L.; Vieira, F.M.; Takemoto, R.M.; Pavanelli, G.C. & Eiras, J.V. 2013. Checklist of Crustacea parasitizing fishes from Brazil. *Check List,* 9(6): 1449-1470.

Martin, M.B.; Bruce, N.L. & Nowak, B.F. 2016. Review of the fish-parasitic genus *Cymothoa* Fabricius, 1793 (Crustacea: Isopoda: Cymothoidae) from Australia. *Zootaxa,* 4119(1): 1-072. DOI

Milne Edwards, H. 1840. *Histoire naturelle des crustacés comprenent l'anatomie, la physiologie et la classification de ces animaux.* Paris, Roret. 638p.

Monod, T. 1969. Sur trois crustacés isopodes marins de la région Guyane-Amazone. *Cahiers ORSTOM, Série Océanographie,* 7(3): 47-68.

Olivier, M. 1789. Histoire naturelle des Insectes. *Encyclopédie Méthodique.* Paris, Panckoucke. v. 4, p. 246-256.

Perty, M. 1833. Delectus animalium articulatorum, quae in itinere per Brasiliam annis 1817-1820, jussu et auspiciis Maximiliani Josephi I. Bavariae regis augustissimi peracto, collegerunt Dr. J.B. Spix et Dr. C.F. Ph. de Martius. Monachii, Imprensis Editoris.

Poore, G.C.B. & Bruce, N.L. 2012. Global diversity of marine isopods (except Asellota and crustacean symbionts). *PLoS ONE,* 7(8): e43529.

Richardson, H. 1901. Key to the Isopods of the Atlantic coast of North America, with description of new and little-known species. *Proceedings of the United States Natural History Museum,* 23(1222): 493-579.

Sartor, S.M. & Pires, A.M. 1988. The occurrence of *Cymothoa liannae,* a new species of Cymothoid Isopod from Brazil, with a comparative study of its post-marsupial development. *Crustaceana,* 55(2): 147-156.

Schioedte, J.C. & Meinert, F.W. 1884. Symbolae ad Monographiam Cymothoarum Isopodum Familiae 4. Cymothoidae. Trib. II. Cymothoinae. Trib. III. Livonecinae. *Naturhistorisk Tidsskrift,* 3(14): 221-454.

Smit, N.J.; Bruce, N.L. & Hadfield, K.A. 2014. Global diversity of fish parasitic isopod crustaceans of the family Cymothoidae. *International Journal for Parasitology: Parasites and Wildlife,* 3: 188-197.

Thatcher, V.E. 2000. The isopods parasites of South American Fishes. *In:* Salgado-Maldonado, G.; Garcia-Aldrete, A.N. & Vidal-Martinez, V.M. (Eds.). *Metazoan Parasites in the Neotropics.* México, D.F., Universidad Nacional Autónoma de México. p. 193-270.

Thatcher, V.E. & Fonseca, F.T. 2005. *Cymothoa recifea* sp. nov. (Isopoda, Cymothoidae) from the mouths of marine fishes of Pernambuco State, Brazil. *Revista Brasileira de Zoologia,* 22(3): 517-521.

Thatcher, V.E.; de Araujo, G.S.; de Lima, J.T.A.X. & Chellappa, S. 2007. *Cymothoa spinipalpa* sp. nov. (Isopoda, Cymothoidae) a buccal cavity parasite of the marine fish, *Oligoplites saurus* (Bloch & Schneider) (Osteichthyes, Carangidae) of Rio Grande do Norte State, Brazil. *Revista Brasileira de Zoologia,* 24(1): 238-245.

Thatcher, V.E.; Loyola e Silva, J.; Jost, G.F. & Souza-Conceição, J.M. 2003. Comparative morphology of *Cymothoa* spp. (Isopoda, Cymothoidae) from Brazilian fishes, with the description of *Cymothoa catarinensis* sp. nov. and redescriptions of *C. excisa* Perty and *C. oestrum* (Linnaeus). *Revista Brasileira de Zoologia,* 20(3): 541-552.

Trilles, J.P. 1994. Catalogue mondial des Cymothoidae. Prodrome pour une faune. *Studia Marina,* 21/22(1-2): 5-288.

Wägele, J.W. 1989. Evolution und phylogenetisches System der Isopoda. *Zoologica,* 140: 1-262.

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