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ARTICLE

New records of two species of parasitic isopods (Isopoda: Cymothoida: Bopyridae: Athelginae) associated with hermit crabs from the south Atlantic

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Abstract. Two species of bopyrid isopods from the subfamily Athelginae are recorded from new localities in northeastern Brazil. *Parathelges foliatus* Markham, 1972 was recorded for the first time from Brazil, in the state of Ceará, parasitising the hermit crab *Clibanarius symmetricus* (Randall, 1840). *Pseudostegias atlantica* Lemos de Castro, 1965 is recorded from the state of Ceará, parasitising *Clibanarius antillensis* Stimpson, 1859. Illustrations, species diagnosis and an updated distribution map are given for each species.

Key-Words. *Bopyrids; Parathelges; Pseudostegias;* Taxonomy; Western Atlantic.

INTRODUCTION

Bopyridae Rafinesque, 1815 is one of the most diverse families within Isopoda, comprising more than 600 species distributed in nine subfamilies: Argeiinae Markham, 1977a, Athelginae Codreanu & Codreanu, 1956, Bathygyginae Markham, 2016, Bopyrinae Rafinesque, 1815, Hemiarthrinae Markham, 1972a, Keponinae Boyko *et al.,* 2013, Orbioninae Codreanu, 1967, Phyllodurinae Markham, 1977b and Pseudioninae Codreanu, 1967 (Markham, 1972a; Boyko *et al.,* 2008 onwards).

Athelginae comprises 44 species distributed in nine genera, all dorsopleonal parasites of paguroids (Markham, 2003; Boyko *et al.,* 2008 onwards; Williams & Boyko, 2016). The genus *Parathelges* Bonnier, 1900 has pantropical distribution and it is composed of ten species, of which only four are recorded from Western Atlantic: *Parathelges occidentalis* Markham, 1972 from Florida (USA), Berry Islands, Bahamas, and Margarita Island, Venezuela; *P. tumidipes* Markham, 1972 from Jamaica, *P. piriformis* Markham, 1972 from North Rock Reef, Bermuda, and *P. foliatus* Markham, 1972 from Port of Spain, Trinidad (Markham, 1972b). However, none of these species have been recorded for the south Atlantic. The genus *Pseudostegias* Shiino, 1933 is composed of seven species, and only *P. atlantica* Lemos de Castro, 1965 has been recorded from Brazil.

The present paper aims to provide the first record of *P. foliatus* for the south portion of the Atlantic Ocean, and an additional record of *P. atlantica* from northeastern Brazil, expanding its distribution. In addition, illustrations, species diagnosis and an updated distribution map are given.

MATERIAL AND METHODS

The material examined is deposited in the Carcinological Collection of the Departamento de Zoologia, Universidade Federal do Rio Grande do Sul, Porto Alegre, Rio Grande do Sul, Brazil (UFRGS) and the Carcinological Collection of the Laboratório de Invertebrados Marinhos do Ceará, Departamento de Biologia, Universidade Federal do Ceará, Fortaleza, Ceará, Brazil (UFC). Specimens are stored in 75% ethanol and identifications are based on morphological characters

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according Lemos de Castro (1965) and Markham (1972b). The appendages were dissected and were mounted as micropreparations. The illustrations were obtained with the aid of *camera lucida* mounted on a stereomicroscope and compound microscope. The references are provided for the taxonomic authorities of all parasitic taxa, but not for those of hosts.

Abbreviation

TL = total length
SL = shield length

RESULTS

Taxonomy
Order Isopoda Latreille, 1817
Suborder Cymothoida Wägele, 1989
Family Bopyridae Rafinesque, 1815
Subfamily Athelginae Codreanu & Codreanu, 1956
Genus *Parathelges* Bonnier, 1900

Type species: *Athelges aniculi* Whitelegge, 1897 (by original designation). Gender: masculine.

Parathelges foliatus Markham, 1972b (Figs. 1, 4)

Parathelges foliatus Markham, 1972b: 73, figs. 14, 15. Markham, 2003: 74.

Material examined: BRAZIL: **Ceará:** one female, Camocim, Estuário do Rio Coreaú (02°53'42"S, 40°51'31"W), coll. F.B. Ribeiro, 13/X/2008, identified by D. Roccatagliata and F.B. Ribeiro, 13/X/2008, (UFRGS 5970), infesting pleon of an ovigerous female of *Clibanarius symmetricus* (Randall, 1840) (5 mm CL; UFC 230).

Diagnosis: *Female:* cephalon spade-shaped in outline, eyes absent, barbula with three sharp projections on each side, pereopods all alike and with prominent coxal segments, pleon with distinct segments, exopodites of pleopods long and rounded at ends, pleotelson not set off. Males are unknown.

Remarks: *Parathelges foliatus* was described based on a female (TL 8.33 mm) from Trinidad, being reported only from the type-locality (Markham, 1972b). The specimen examined here is morphologically similar to the material described by Markham (1972b), showing the pereon with all segments well distinguished dorsally, marsupium closed ventrally, pleopodal exopodites on peduncles and with distal margins rounded (Fig. 1A, B). Additional morphological characters not mentioned in previous descriptions include: antennule with three articles and antenna with four articles (Fig. 1C, D), and pereopod 7 with dactylus embedded in the propodus (Fig. 1I). This is the first record of this species from Brazilian waters and second for the western Atlantic Ocean. In addition, this is the third genus of Athelginae recorded from Brazil; the genera *Anathelges* Bonnier, 1900 from the state of Santa Catarina and *Pseudostegias* are known from the states of Ceará and Alagoas, respectively (Brasil Lima, 1998).

Representatives of the genus *Parathelges* infest diogenid hermit crabs of the genera *Allodardanus* Haig & Provenzano, 1965, *Calcinus* Dana, 1851, *Clibanarius* Dana, 1852 and *Dardanus* Paul'son, 1875 (Markham, 2003). *Parathelges foliatus* was described infesting the same host of our specimen, the hermit crab *Clibanarus vittatus* (Bosc, 1802). However, Negri *et al.* (2014) established that populations of *C. vittatus* should be restricted to the southeastern coast of the United States and Gulf of Mexico. Specimens from the Caribbean to southern Brazil should be classified as *Clibanarius symmetricus* (Randall, 1840), which is therefore the identity of the host of *P. foliatus.* According to Markham (1972b), species of *Parathelges* are usually found associated with shallow-water hosts, which agrees with our specimen collected attached to a hermit crab in the intertidal zone of an estuarine area.

Distribution: Western Atlantic: Trinidad and Brazil (state of Ceará) (Fig. 4).

Genus *Pseudostegias* Shiino, 1933

Type species: *Pseudostegias setoensis* Shiino, 1933 (by monotypy). Gender: masculine.

Pseudostegias atlantica Lemos de Castro, 1965 (Figs. 2-3, 4)

Pseudostegias atlantica Lemos de Castro, 1965: 105, figs. 1-8. Brasil Lima, 1965: 640.

Material examined: BRAZIL: **Ceará:** one female and one male, Paracuru, Pedra Rachada Beach (02°53'42"S, 40°51'31"W), coll. F.B. Ribeiro, identified by D. Roccatagliata and F.B. Ribeiro, 13/X/2008, (UFRGS 6669), infesting pleon of a male of *Clibanarius antillensis* Stimpson, 1859 (2.7 mm CL; UFC 506).

Diagnosis: *Female:* cephalon deeply inset in pereomere I and about two times as long as wide, eyes present, all pereomeres distinct, all pereopods similar in size, all pleomeres distinct and tapering posteriorly, lateral plates on pleomere V absent. *Male:* eyes present, pereon broadest at pereomere 6, all pleomeres fused, pleopods and uropods absent.

Remarks: *Pseudostegias atlantica* was described based on one mature female (TL 5.5 mm) and male (3 mm) from Mucuripe beach, Fortaleza, state of Ceará, and one immature female and male from Garça Torta beach, Maceió, state of Alagoas (Lemos de Castro, 1965). The specimen

examined here is morphologically similar to the material described by Lemos de Castro (1965), showing the cephalon with anterior margin straight, dorsal region of *cephalon* concave with pereomeres 1-5 directed laterally forewards, all pereopods are similar in size, pleomeres distinct, lateral plates present in pleomeres 1-5 and pleopods with leaf-like endopodites and exopodites (Fig. 2). Regarding the male specimen, it is similar to the allotype of *P. atlantica* in having the cephalon of approximately two times as wide as long with rounded anterior margin and all pleomeres fused (Fig. 3); however, it differs in the absence of the dorsal carina on the pleotelson. It is very likely that the specimen analyzed by Lemos de Castro (1965) showed an artifact of preservation for this character. Additional morphological characters not mentioned in previous descriptions for the female include: antennule of three articles and antenna of six articles (Fig. 2C, D), oostegite 1 bilobed with anterior lobe subtriangular, posterior lobe with inner margin concave, oostegites 2-3 subrectangular and oostegites 4-5 subtri-

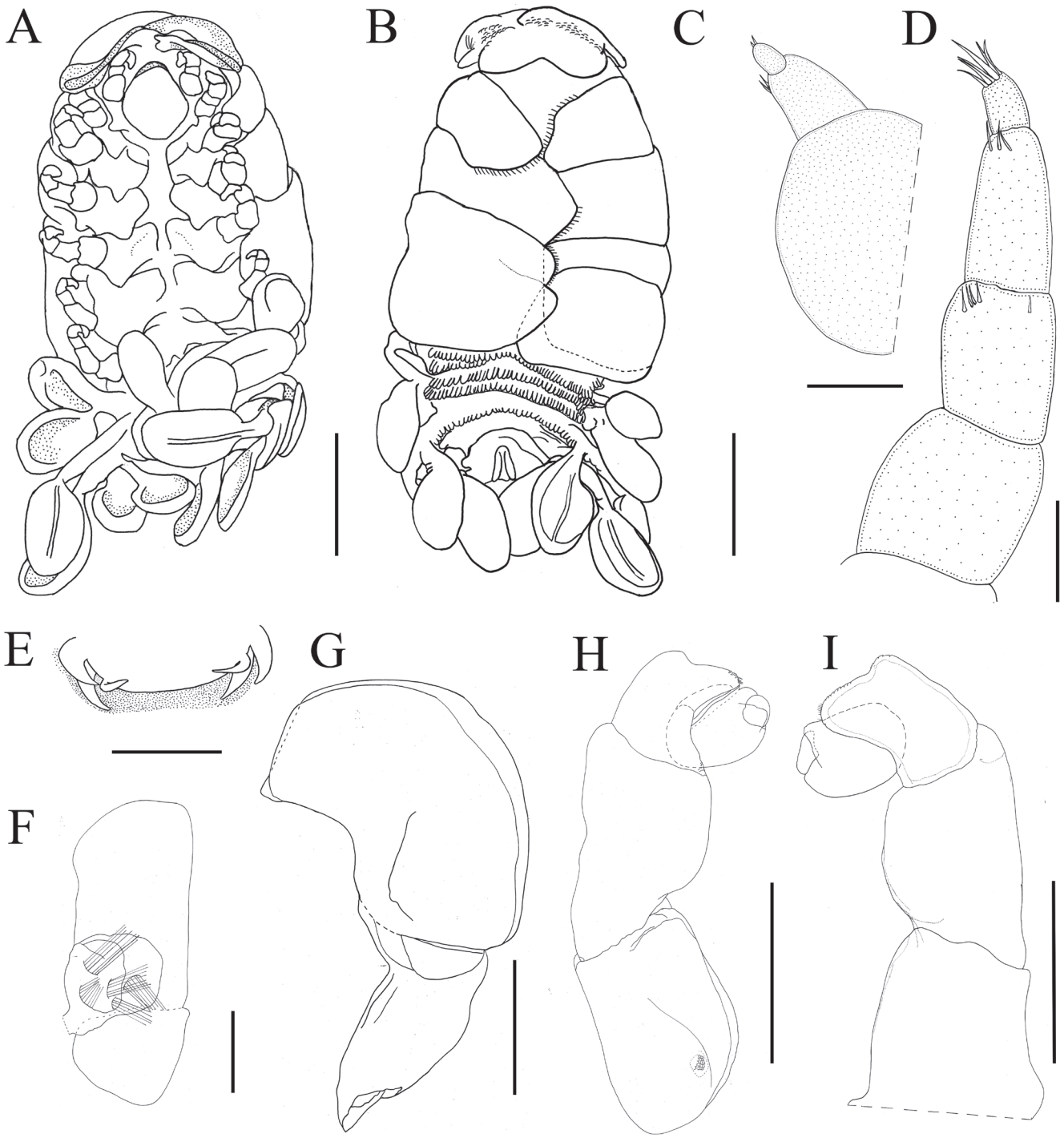

Figure 1. *Parathelges foliatus* Markham, 1972 (UFRGS 5970): (A) habitus dorsal view; (B) habitus ventral view; (C) antennula; (D) antenna; (E) barbula; (F) maxilliped; (G) oostegite 1; (H) pereopod 1; (I) pereopod 7. Scale bars: A and B = 5 mm; C = 0.1 mm; D and G = 0.5 mm; E = 0.1 mm; F, K and L = 1.00 mm; H = 0.3 mm; I = 1.5 mm.

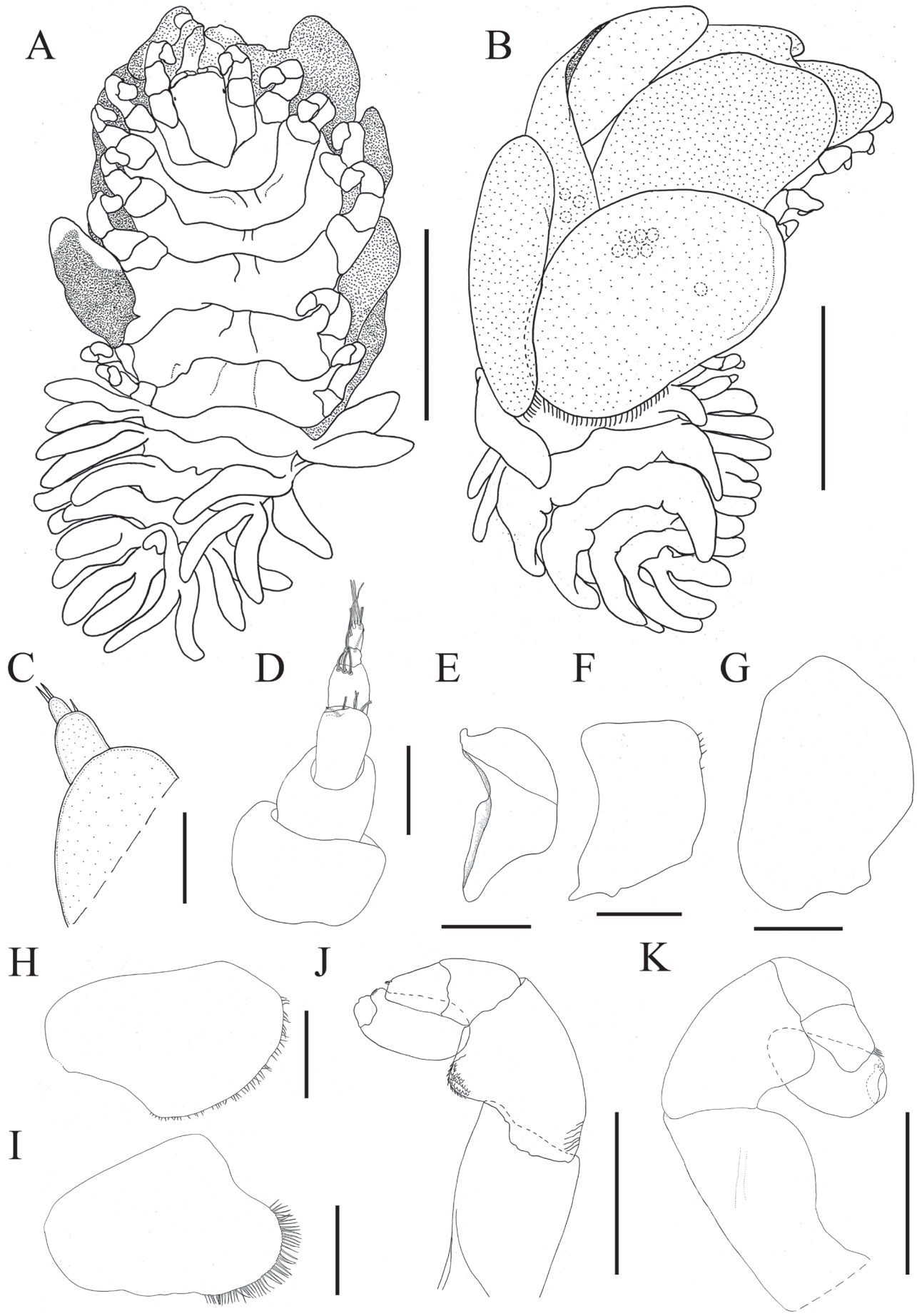

Figure 2. *Pseudostegias atlantica* Lemos de Castro, 1965, female (UFRGS 6669): (A) habitus dorsal view; (B) habitus ventral view; (C) antennule; (D) antenna; (E) oostegite 1; (G) oostegite 2; (G) oostegite 3; (H) oostegite 4; (I) oostegite 5; (J) pereopod 1; (K) pereopod 7. Scale bars: A and B = 2 mm; C and D = 0.125 mm; E-I = 1 mm.

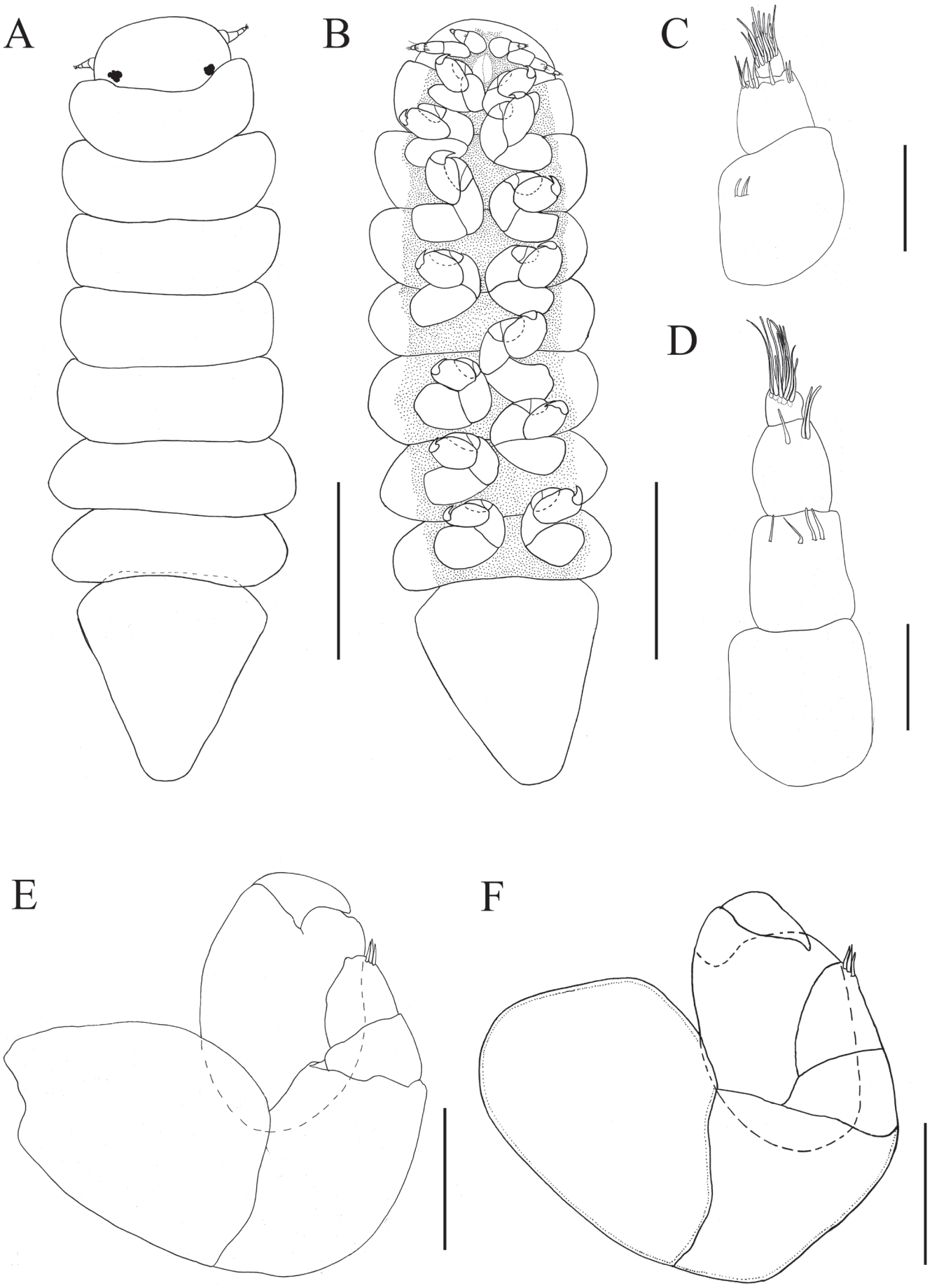

Figure 3. *Pseudostegias atlantica* Lemos de Castro, 1965, male (UFRGS 6669): (A) habitus dorsal view; (B) habitus ventral view; (C) antennula; (D) antenna; (E) left pereopod 1; (F) left pereopod 7. Scale bars: A and B = 0.5 mm; C and D = 0.025 mm; E and F = 0.05 mm.

Figure 4. Distribution map of parasites (*Parathelges foliatus* and *Pseudostegias atlantica*) (circles and squares) and associated hosts (hermit crabs) (stars). Black circles and squares represent previous records and white circles and squares new records for parasites. White and black stars represent the distribution of *Clibanarius antillensis* and *C. symmetricus* respectively from Venezuela to Brazil according to Coelho *et al.* (2007), Negri et al. (2014), Nucci & Melo (2015) and Lemaitre & Tavares (2015).

angular (Fig. 2E-I); and for the male, antennule of three articles and antenna of four articles (Fig. 3C, D), all pereopods subequal in size and shape (Fig. 3B), and pereopods 1 and 7 bears three setae in the distal margin of carpus (Fig. 3E, F). The barbula and maxilliped were not illustrated due to the condition of the material.

Pseudostegias is a genus of by pleonal parasites of diogenid hermit crabs of the genera *Calcinus* Dana, 1851, *Clibanarius* Dana, 1852, *Diogenes* Dana, 1851, *Paguristes* Dana, 1851; pagurid hermit crabs of the genus *Strigopagurus* Forest, 1995; and lithodid anomurans of the genus *Hapalogaster* Brandt, 1850 (Markham, 2003). All specimens used in the original description of *P. atlantica* were found associated to a host identified as *Clibanarius* sp. (Lemos de Castro, 1965). The specimens in our study were found infesting the hermit crab *Clibanarius antillensis* Stimpson, 1859 from Pedra Rachada Beach, Paracuru, state of Ceará. This new record is about 100 km from the previous record in this state.

Distribution: Western Atlantic: Brazil (states of Ceará and Alagoas) (Fig. 4).

CONCLUSION

The broad distribution of the host species on the Brazilian coast suggest the likelihood that their bopyrid parasites can also have a much wider distribution than currently reported in Brazil (Fig. 4). In addition, considering the current diversity of the Athelginae, three known species, and the Brazillian coastal extension, probably the diversity of the subfamily is still underestimated. Future surveys, in order to obtain more material, will allow the accurate identification of already known species and possible discovery of new taxonomic entities.

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