

A new species of *Leptophoxoides* Barnard, 1962 (Amphipoda, Phoxocephalidae) from the Brazilian northeastern continental slope

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Abstract. A new species of *Leptophoxoides* Barnard, 1962 is described with material from the continental slope of Rio Grande do Norte state, northeastern Brazil at three different depths: 150, 400 and 2,500 meters. *Leptophoxoides longisetae* **sp. nov.** can be diagnosed and distinguished from the other two species of the genus, *L. molaris* Barnard, 1962 and *L. marina* Senna, 2010, by the following characters: antenna 1 peduncular article 1 ventral apex weakly ensiform; maxilla 1 inner plate longer than outer; maxilliped palp article 3 with blunt and extremely protuberant apex; gnathopods 1-2 carpus almost cryptic; gnathopod 2 palm defined by a large and sharply produced palmar hump; pereopod 6 basis posterodistal corner produced as a blunt lobe; and telson with two dorsal long plumose setae on each side. This is the first record of the genus for northeastern Brazilian waters, uncovering a higher biodiversity in deep waters.

Keywords. Amphilochidea; Peracarida; Taxonomy; Rio Grande do Norte; Deep sea.

INTRODUCTION

Phoxocephalidae G.O. Sars, 1891 is a pan-oceanic benthic family, comprising nearly 380 species. In general, these amphipods have up to 10 millimeters length and are active predators of meio- and macroinfauna feeding on small invertebrates, organic matter, and sediment particles (Oliver *et al.*, 1982). When compared to its knowledge worldwide, little is known about their diversity in southwestern tropical Atlantic waters, with recent studies focused on southeast and southern Brazil (Andrade & Senna, 2020a).

Among the 27 species of the family recorded from Brazilian waters, *Leptophoxoides* Barnard, 1962 is a rare deep-sea genus known from the southern hemisphere with a strict distribution. To date, there are two described species, being *L. molaris* Barnard, 1962 the type species of the genus recorded from Cape Basin, off South Africa, and Weddell Sea. Also, *L. marina* Senna, 2010, known from Campos Basin, off southeastern Brazil (Barnard, 1962; Gutt *et al.*, 2000; Senna, 2010). *Leptophoxoides molaris* has been recorded between 2,315 and 4,961 meters depth (Alonso

de Pina *et al.*, 2008), while *L. marina* is known from shallower waters ranging from 750 to 1,950 meters.

Here, we present *L. longisetae* **sp. nov.**, morphologically described from Potiguar Basin, Rio Grande do Norte State at depths ranging from 150 to 2,500 meters. This is the northernmost record of the genus and the first record of *Leptophoxoides* from northeastern Brazil.

MATERIAL AND METHODS

The material was collected by Van Veen grabs at depths of 150, 400 and 2,500 meters, off Potiguar Basin, Rio Grande do Norte state, within the project "Avaliação da Biota Bentônica e Planctônica da Bacia Potiguar e Ceará" (BPOT) developed by the Brazilian Oil Company "Petróleo Brasileiro S/A (Petrobras)" onboard the R/V Seward Johnson.

For the taxonomic study, appendages and mouthparts from the right side of the holotype were dissected and mounted in glycerine gel slides. The holotype was selected due to its larg-

er length and good preservation status. The appendages were illustrated under an optical microscope with camera lucida, Leica DM E, and digitally prepared with CorelDRAW 2018. The setal/spine classification used in this work follows Watling (1989). The nomenclature of gnathopod palm morphology is based on Poore & Lowry (1997). The type-material is deposited in the Crustacea Collection of the *Museu de Oceanografia Prof. Petrônio Alves Coelho da Universidade Federal de Pernambuco* (MOUFPE), Brazil.

RESULTS

Taxonomic analysis

Order Amphipoda Latreille, 1816

Suborder Amphilochidea Boeck, 1871

Family Phoxocephalidae G.O. Sars, 1891

Subfamily Phoxocephalinae G.O. Sars, 1891

Genus *Leptophoxoides* Barnard, 1962

Type species: *Leptophoxoides molaris* Barnard, 1962.

Amended diagnosis (after Senna, 2010): Rostrum well developed, constricted, sharp, and deflexed. Cephalic dorsal keel present. Antenna 1 peduncular article 2 short, ventral setae confined distally. Antenna 2 peduncular article 1 not ensiform, article 4 with one row of facial setae. Mandible incisor with three to five teeth, right lacinia mobilis bifid, molar triturative; palp hump small, article 3 apex truncate. Maxilla 1 inner plate naked, palp 1-articulate. Maxilla 2 weakly setose, inner plate wider than outer. Maxilliped inner and outer plates small, poorly armed, palp article 3 with apex strongly protuberant, article 4 elongated, apical nail distinct. Coxa 1 expanded anteriorly, anterior margin slightly concave. Gnathopods 1 and 2 dissimilar, carpus with eusirid attachment, palm acute; gnathopod 2 stronger than

gnathopod 1, propodus broadened. Epimeral plate 3 posteroventral corner rounded. Urosomite 3 smooth. Uropod 1 peduncle without inter-ramal spine, rami not continuously with robust setae to apex. Uropod 3 outer ramus longer than peduncle, article 2 elongated, bearing up to two apical setae. Telson elongated and deeply cleft.

Composition: The genus is composed by 2 species + 1 new species: *Leptophoxoides longisetae* **sp. nov.**; *Leptophoxoides marina* Senna, 2010; and *Leptophoxoides molaris* Barnard, 1962.

Leptophoxoides longisetae sp. nov. (Figs. 1-5)

Material examined: Holotype, female, 3.7 mm length, dissected and illustrated, off Rio Grande do Norte state, 04°34'24.26"S, 36°54'24.68"W, Station BPOT MT55 R3, 150 m isobath, Van Veen Grab, 2011 (MOUFPE 20039). Paratypes: 1 female, off Rio Grande do Norte state, 04°25'48.43"S, 36°38'15.64"W, Station BPOT MT84 R2, 2,500 m isobath Van Veen Grab, 2011 (MOUFPE 15960); 1 female, off Rio Grande do Norte state, 04°34'24.26"S, 36°54'24.68"W, Station BPOT MT55 R2, 150 m isobath, Van Veen Grab, 2011 (MOUFPE 20040); 1 female, off Rio Grande do Norte state, 04°34'24.26"S, 36°54'24.68"W, Station BPOT MT55 R3, 150 m isobath, Van Veen Grab, 2011 (MOUFPE 20041); 1 female, off Rio Grande do Norte state, 04°36'38.20"S, 36°44'21.89"W, Station BPOT MT64 R1, 400 m isobath, Van Veen Grab, 2011 (MOUFPE 20042). All material is stored in 70% ethanol.

Etymology: The specific epithet is related to the long dorsal setae present on the telson of the new species.

Type locality: Continental slope of Rio Grande do Norte state, Brazil (04°34'24.26"S, 36°54'24.68"W).

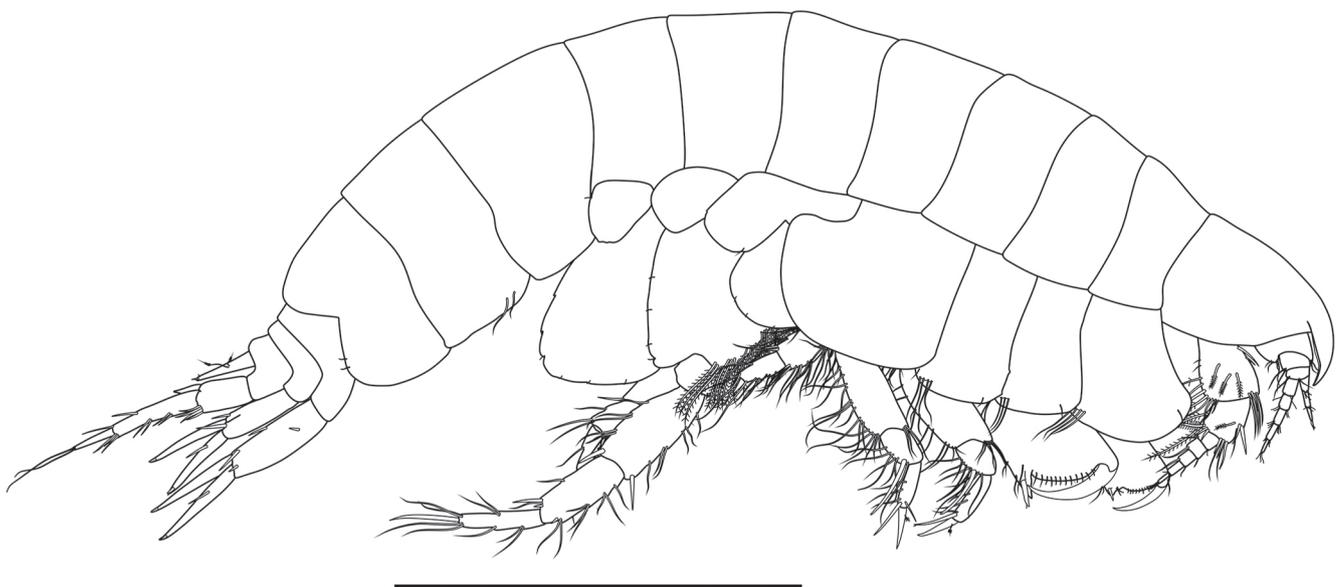


Figure 1. *Leptophoxoides longisetae* sp. nov., female holotype (MOUFPE 20039). Habitus. Scale bar: 1.0 mm.

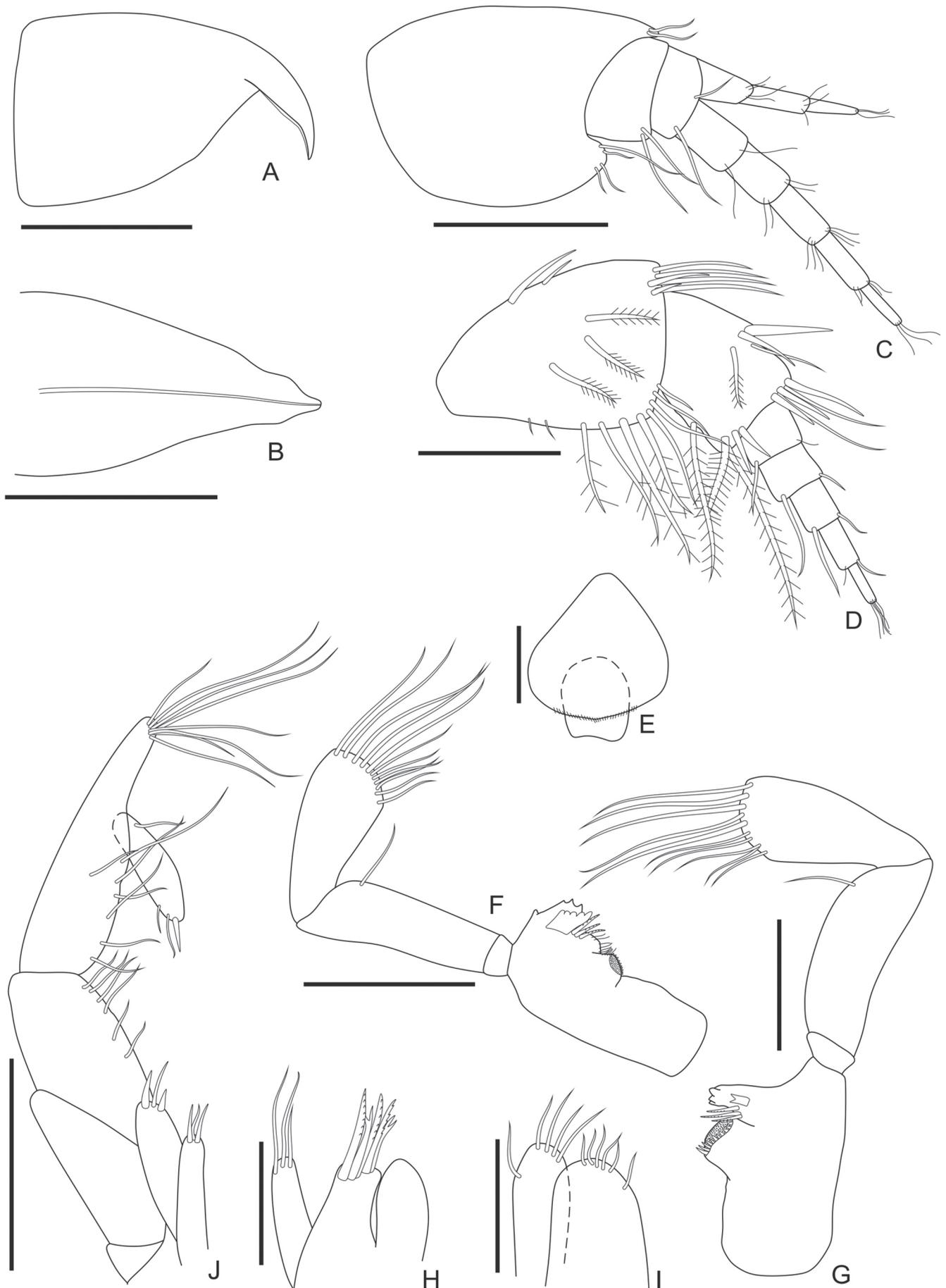


Figure 2. *Leptophoxoides longisetae* sp. nov., female holotype (MOUFPE 20039). (A) Head in lateral view. (B) Head in dorsal view. (C) Antenna 1. (D) Antenna 2. (E) Upper lip. (F) Left mandible. (G) Right mandible. (H) Maxilla 1. (I) Maxilla 2. (J) Maxilliped. Scale bars: A-B = 0.2 mm; C-D, F-G and J = 0.1 mm; E, H-I = 0.05 mm.

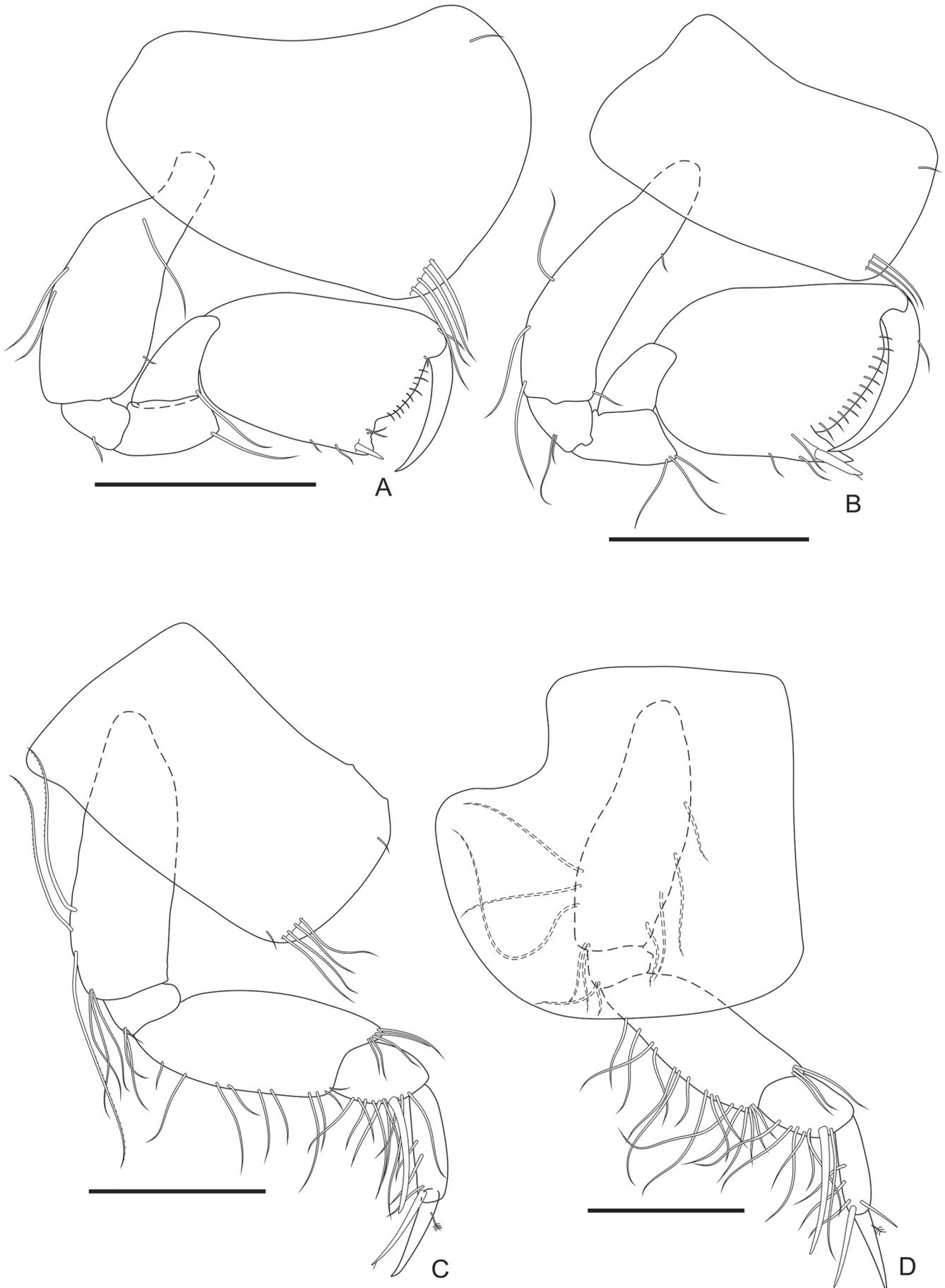


Figure 3. *Leptophoxoides longisetae* sp. nov., female holotype (MOUFPE 20039). (A) Gnathopod 1. (B) Gnathopod 2. (C) Pereopod 3. (D) Pereopod 4. Scale bars: 0.2 mm.

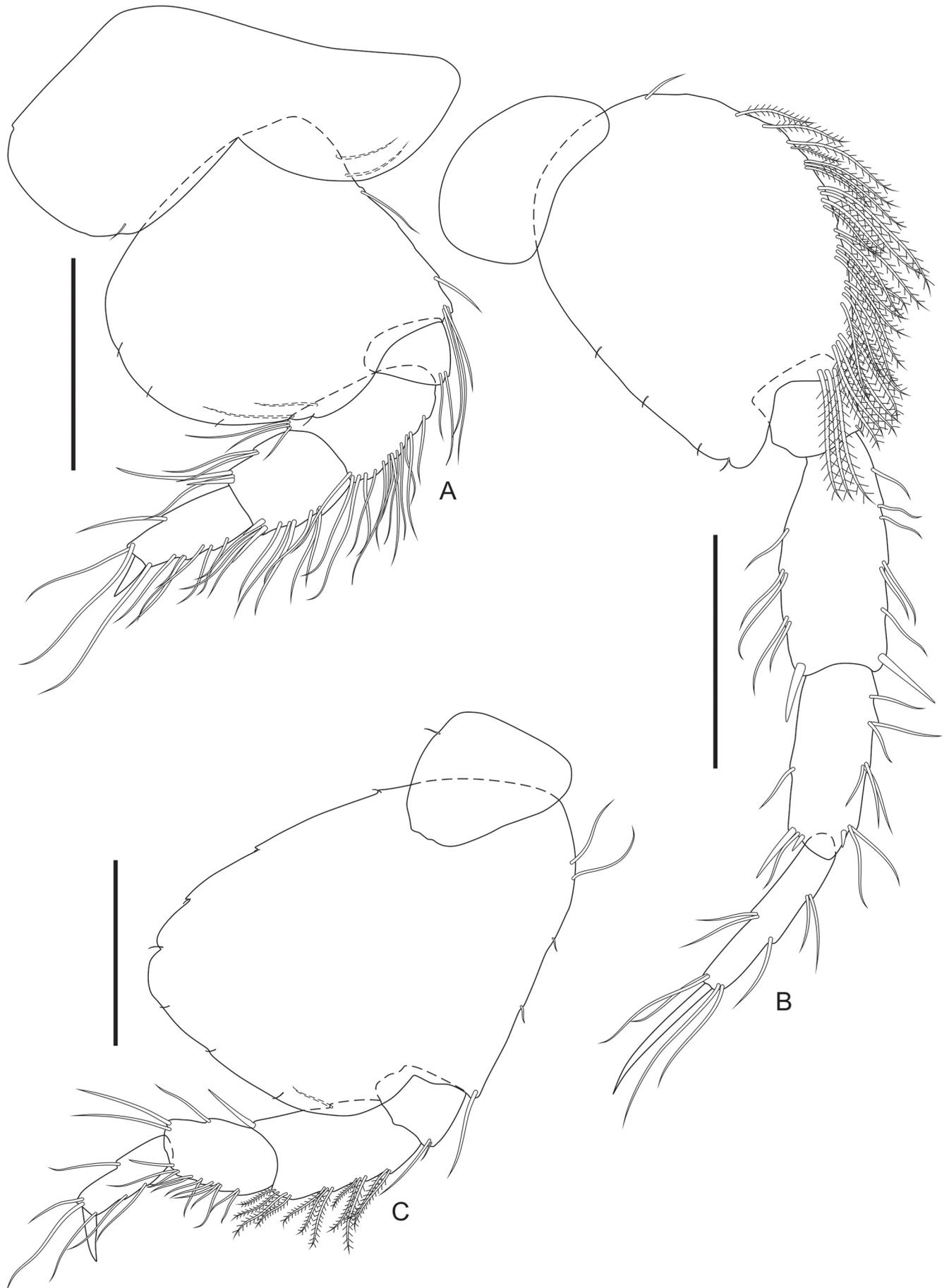


Figure 4. *Leptophoxoides longisetae* sp. nov., female holotype (MOUFPE 20039). (A) Pereopod 5. (B) Pereopod 6. (C) Pereopod 7. Scale bars: A and C = 0.2 mm; B = 0.3 mm.

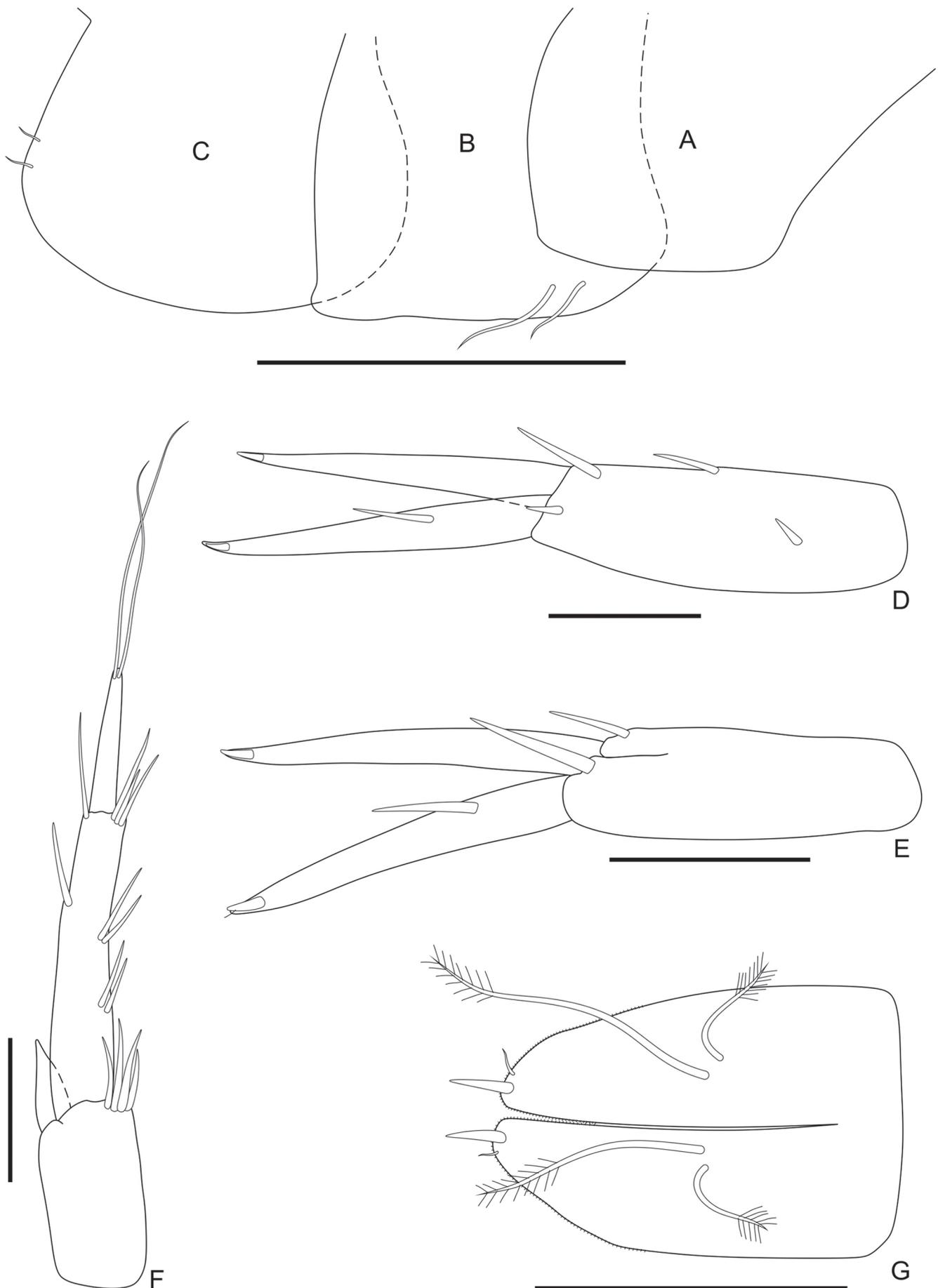


Figure 5. *Leptophoxoides longisetae* sp. nov., female holotype (MOUFPE 20039). (A) Epimeral plate 1. (B) Epimeral plate 2. (C) Epimeral plate 3. (D) Uropod 1. (E) Uropod 2. (F) Uropod 3. (G) Telson. Scale bars: A-C = 0.3 mm; D-G = 0.1 mm.

Diagnosis: Eyes absent. Antenna 1 peduncular article 1 ventral apex weakly ensiform. Antenna 2 peduncular article 4 with facial plumose setae. Left mandible *lacinia mobilis* with five teeth. Right mandible *lacinia mobilis* bifid. Maxilla 1 inner plate longer than outer. Maxilliped palp article 3 with blunt and extremely protuberant apex. Gnathopods 1-2 carpus almost cryptic; propodus with one robust seta near palmar corner. Pereopod 5 basis slightly wider than long. Pereopod 6 basis anterior margin setose with plumose setae, posterodistal corner produced as a blunt lobe. Pereopod 7 merus, carpus and propodus broad; dactylus short. Uropod 3 outer ramus article 2 with two long apical setae; inner ramus short, about 0.2× the length of outer. Telson deeply cleft, apically with one slender and one robust seta, dorsally with two long plumose setae on each side.

Description: Based on 3.7 mm length female holotype (MOUFPE 20039).

Habitus as in Fig. 1, color unknown due to preservation. **Head** (Figs. 2A, B) rostrum well-developed, constricted, sharp and deflexed; dorsal keel present. **Antenna 1** (Fig. 2C) peduncular article 1 about 1.4× longer than wide, dorsal apex produced, with two setae, article 2 about 1.6× wider than long, ventral margin with two distal setae, article 3 about 1.8× wider than long, with two facial setae; primary flagellum 5-articulate; accessory flagellum 3-articulate. **Antenna 2** (Fig. 2D) peduncular article 4 about 1.4× longer than wide, with three facial plumose setae, dorsal margin with two robust setae medially and a distal row of six robust setae, ventral margin with eight distal setae, being four pappose, article 5 about 1.2× longer than wide, with one facial plumose seta, dorsal margin with one slender and two robust setae medially and a distal row of three robust and two slender setae, ventral margin with three plumose setae, distally bearing two facial short robust setae; flagellum 5-articulate. **Upper lip** (Fig. 2E) subtriangular, apically setulose. **Left mandible** (Fig. 2F) incisor with four teeth, *lacinia mobilis* with five teeth, accessory setal row with three multicuspidate setae and few setules, molar triturative; palp article 1 short, article 2 about 3× longer than wide, slightly longer than article 3, mesial margin with one distal seta, article 3 about 2.3× longer than wide, broadening distally, with 11 apical setae. **Right mandible** (Fig. 2G) incisor with four teeth, *lacinia mobilis* bifid, accessory setal row with three multicuspidate setae, molar triturative; palp article 1 short, article 2 about 3× longer than wide, slightly longer than article 3, mesial margin with one distal seta, article 3 about 2.3× longer than wide, broadening distally, with 10 apical setae. **Maxilla 1** (Fig. 2H) inner plate naked and slightly longer than outer, outer plate with five apical setae, being two bifid and three serrated; palp 1-articulate, with three apical setae. **Maxilla 2** (Fig. 2I) inner plate 1.6× longer than wide, about 1.8× broader than outer, with six apical setae; outer plate 2.8× longer than wide, with four apical setae and one distolateral seta. **Maxilliped** (Fig. 2J) inner plate slender, with three apical setae; outer plate reduced, with

one simple and two apical robust setae; palp article 2 mesial margin weakly setose, article 3 about 1.2× longer than article 2, blunt, with eight apical long setae, article 4 elongated, bearing one distinct apical nail.

Gnathopod 1 (Fig. 3A) coxa expanded anteriorly, ventral margin with a row of four posteroventral setae and one anteroventral setule; basis about 2.4× longer than wide, weakly setose; ischium short and subrectangular, posterior margin with one seta; merus subrectangular, posterior margin with one distal seta; carpus almost cryptic, posterior margin with one seta; propodus about 1.6× longer than wide, with one robust seta near palmar corner, anterior margin with one distal seta, palmar hump small; palm acute, with setules and a distal concavity near corner; dactylus reaching the palmar corner. **Gnathopod 2** (Fig. 3B) coxa subrectangular, ventral margin with three posteroventral setae and one anteroventral setule; basis about 3.4× longer than wide, weakly setose; ischium short and subtriangular, posterior margin with two setae; merus subrectangular, posterior margin with three distal setae; carpus almost cryptic; propodus robust, about 1.4× longer than wide, weakly setose, with one robust seta near palmar corner, palmar hump large and sharply produced, defining palm; palm acute, with setules, with a distal "v-shaped" excavation; dactylus reaching the palmar corner, outer margin with one proximal seta. **Pereopod 3** (Fig. 3C) coxa subrectangular, ventral margin with one setule and four setae posteroventrally and two anteroventral setules; basis about 2.9× longer than wide, posterior margin with three serrulate setae, posterodistal corner with three setae; ischium short and subrectangular, posterodistal corner with three setae; merus about 2.4× longer than wide, dorsal apex with five setae, posterior margin weakly setose; carpus ventral margin moderately setose, with one distal robust seta exceeding the apex of propodus; propodus posterior margin with three setae and one distal robust seta with accessory seta reaching the apex of dactylus; dactylus about 85% the length of propodus, outer margin with one proximal plumose setule. **Pereopod 4** (Fig. 3D) coxa as long as wide, posterodorsal margin strongly excavated, posteroventral corner; basis about 2.6× longer than wide, anterior margin with four setae, posterior margin with three setae, posterodistal corner with two setae; ischium short and subrectangular, posterodistal corner with two setae; merus about 2.3× longer than wide, dorsal apex with three setae, ventral margin moderately setose; carpus ventral margin weakly setose, with one distal robust seta exceeding the apex of propodus and reaching half of dactylus; propodus with one distal facial seta, ventral margin with three setae and one distal robust seta reaching the apex of dactylus; dactylus about 85% the length of propodus, outer margin with one proximal plumose setule. **Pereopod 5** (Fig. 4A) coxa bilobated, posterior lobe with one ventral setule; basis posteriorly expanded, anterior margin with four setae, anterodistal corner with three setae, posterior margin with four setules; ischium short and subrectangular, anterodistal corner with two setae; merus anterior margin

setose, posterior margin weakly setose; carpus anterior and posterior margins with few setae and two distal robust setae each; propodus weakly setose, anterior margin with one distal long seta, posterior margin with two distal long setae; dactylus short, about 35% the length of propodus. **Pereopod 6** (Fig. 4B) coxa subrectangular, naked; basis about 1.3× longer than wide, posterior margin with few setules, posterodistal corner produced as a blunt lobe, with a notch and one setule; ischium subquadrate, anterodistal corner with one seta; merus 2.1× longer than wide, anterior and posterior margins weakly setose, with one distal robust seta each; carpus 2.4× longer than wide, weakly setose, anterior margin with one distal short robust seta, posterior margin with one distal slender and two robust setae; propodus 5.2× longer than wide, weakly setose, anterior and posterior margin with two distal long setae; dactylus elongated, about 75% the length of propodus. **Pereopod 7** (Fig. 4C) coxa subtrapezoidal, posterior margin with one setule; basis about 1.2× longer than wide, posteroventrally expanded, anterior margin with two proximal setae, two setules medially and one distal seta; posterior margin weakly crenulated, bearing few setules; ischium short and subrectangular, anterodistal corner with two setae; merus anterior margin with plumose setae, posterior margin with one distal robust seta; carpus anterior margin moderately setose, posterior margin weakly setose; propodus weakly setose, anterior and posterior margin with one and two distal setae, respectively; dactylus about 45% the length of propodus.

Epimeral plate 1 (Fig. 5A) naked, anterior margin slightly concave, ventral margin almost straight, posterior margin convex. **Epimeral plate 2** (Fig. 5B) with two facial setae, anterior margin concave, posteroventral corner weakly produced in a blunt lobe, posterior margin weakly convex. **Epimeral plate 3** (Fig. 5C) anterior margin, ventral and posterior margins convex, posterior margin with two setae. **Uropod 1** (Fig. 5D) peduncle slightly longer than both rami, dorsomesial and dorsolateral margins with two robust setae each; outer ramus slightly longer than inner, with one dorsal robust seta, bearing one subapical nail; inner ramus dorsally naked, bearing one subapical seta, slightly exceeding the apex of ramus. **Uropod 2** (Fig. 5E) peduncle slightly shorter than both rami, dorsomesial and dorsolateral apex with one distal robust seta each; outer ramus slightly longer than inner, with one dorsal robust seta, bearing one subapical nail with accessory seta, slightly exceeding the apex of ramus; inner ramus dorsally naked, bearing one subapical seta, slightly exceeding the apex of ramus. **Uropod 3** (Fig. 5F) peduncle about 1.9× longer than wide; outer ramus about 4.9× longer than inner, article 1 ventral margin with three groups of setae (2-2-3), dorsal margin with one seta, dorsoapical corner with one seta, article 2 slender, about 0.3× the length of article 1, with two apical long setae; inner ramus short, about 0.2× the length of outer. **Telson** (Fig. 5G) deeply cleft, about 85% its length, 1.4× longer than wide, apically with one slender and one robust seta on each side, dorsally with two long plumose

setae, distal half of lateral and apical margins minutely setulose.

Distribution: The species is known from the continental slope of Rio Grande do Norte state (Fig. 6) at the following geographic coordinates and respective depths: 04°34'24.26"S, 36°54'24.68"W (150 m); 04°36'38.20"S, 36°44'21.89"W (400 m); and 04°25'48.43"S, 36°38'15.64"W (2,500 m).

Remarks: The genus is composed by only two species, and *L. longisetae* **sp. nov.** presents some importantly similar morphological characters with both, such as: sharp and deflexed rostrum; antennae 1-2 flagellum with reduced number of articles; mandible molar triturative, palp article 2 slightly longer than article 3; maxilla 1 inner plate naked, palp 1-articulate; gnathopods 1-2 propodus with one robust seta near palmar corner, palm acute; pereopod 4 coxa posterodorsal margin strongly excavated; epimeral plate 3 with rounded margins; and telson deeply cleft.

However, *L. longisetae* **sp. nov.** can be distinguished from *L. marina*, by the following characters (characters of *L. marina* in parenthesis): antenna 1 peduncular article 1 with setae, ventral apex rounded and weakly ensiform (without setae, ventral apex truncated); antenna 2 article 4 with three facial plumose setae (without facial setae), dorsal apex with six setae (three setae); left mandible incisor with four sharp teeth (three blunt teeth), palp article 2 medial margin with one distal slender seta (with one proximal and one distal plumose seta); maxilla 1 inner plate longer than outer (inner plate strongly shorter than outer); maxilliped palp article 3 apex extremely protuberant, with eight apical long setae (strongly protuberant, with three apical long setae); gnathopod 1 carpus almost cryptic (regular), propodus about 1.6× longer than wide (about 1.9×); pereopod 6 basis without facial setae (with three facial plumose setae), posterodistal corner produced as a blunt lobe (not produced); pereopod 7 basis anterior margin straight (convex), dactylus short, about 45% the length of propodus (elongated, as long as propodus); epimeral plate 3 posterior margin with two setae (naked); uropod 1 peduncle slightly longer than rami (peduncle slightly shorter than rami), inner ramus without dorsal setae (with one dorsal seta); uropod 2 rami with subapical nail (without subapical nail); uropod 3 inner ramus about 0.2× the length of outer (about 0.5×); telson apex with one short and one robust seta (with two long and one or two short setae), dorsally with two long plumose setae (without dorsal setae).

Leptophoxoides marina was described by Senna (2010) with a male holotype and there are few drawings of a female individual. However, as often noticed in phoxocephalids, males exhibit stronger secondary sexual characters, especially regarding the enlargement of gnathopods 1-2, elongation of antenna 2 and uropod 3 with more setae (Bousfield, 1978). Considering all the observed characters in the new species, a male of *L. longisetae* **sp. nov.** would present even larger gnathopods 1-2,

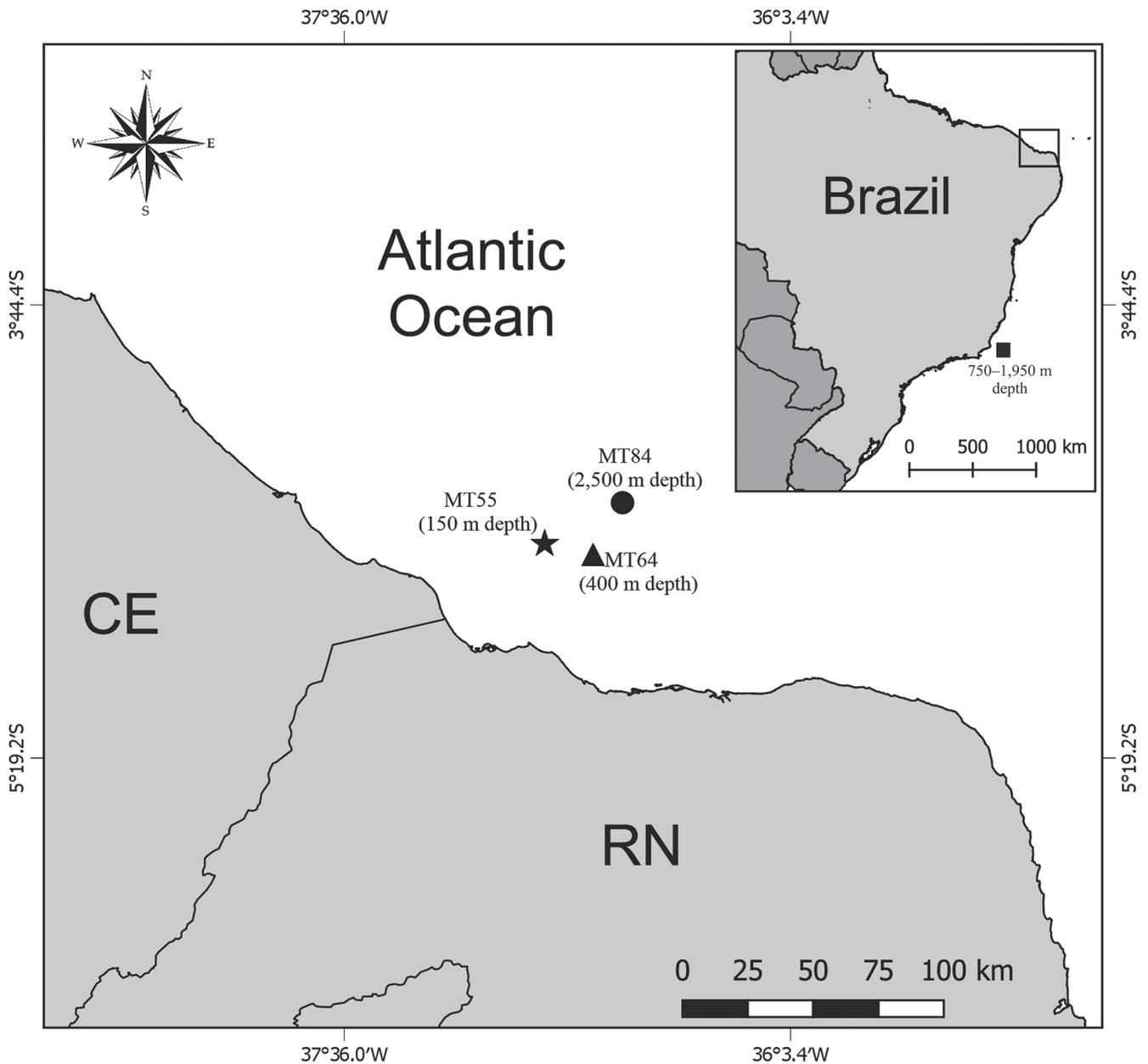


Figure 6. Distribution of *Leptophoxoides longisetae* **sp. nov.** Star. Station BPOT MT55, Type-locality, 04°34'24.26"S, 36°54'24.68"W. Triangle. Station BPOT MT64, 04°36'38.20"S, 36°44'21.89"W. Circle. Station BPOT MT84, 04°25'48.43"S, 36°38'15.64"W. Square. Distribution of *L. marina* Senna, 2010. Empty square. Potiguar Basin. CE. Ceará state. RN. Rio Grande do Norte state.

which is not the case when comparing it with *L. marina*. In addition, other important diagnostic characters of the new species would be reflected on male individuals, such as: article 1 of antenna 1 with rounded and weakly ensiform ventral apex; extremely produced apex of maxilliped article 3; propodus of gnathopod 2 with palmar hump large and sharply produced; basis of pereopod 6 with posterodistal corner produced as a blunt lobe; pereopod 7 not much shorter in length in relation to pereopod 6; and telson with dorsal long plumose setae.

Also, *L. longisetae* **sp. nov.** can be distinguished by *L. molaris* by the following characters (characters of *L. molaris* in parenthesis): maxilliped palp article 3 apex blunt and extremely protuberant (sharp and strongly protuberant); pereopod 5 basis very broad in relation to other articles (not so broad); pereopod 6 basis anterior

margin setose (weakly setose), posterodistal corner produced as a blunt lobe (not produced); epimeral plate 3 posterior margin with two setae (naked); uropods 1-2 rami bearing subapical nail (without subapical nail); telson apex without long seta (with long seta), dorsally with two long plumose setae (with one long slender seta).

CONCLUSION

Leptophoxoides is considered a bathyal/abyssal genus, however, *L. longisetae* **sp. nov.** was collected in shallower environments from 150 to 2,500 meters depth. This finding extends the minimum depth range of the genus to 150 meters. Given that, it is possible to say that *Leptophoxoides* is a well-adapted group, tolerating shifts

on abiotic conditions associated to its wide bathymetrical range.

The new finding presented here demonstrates that the knowledge about the phoxocephalid biodiversity in Brazilian waters is just blooming. Former studies on the family have shown that species previously thought to have a restricted distribution are far more widespread in southwestern Atlantic coast (Andrade & Senna, 2020b, c). The presence of *L. marina* and *L. longisetae* **sp. nov.** off southeastern and northeastern Brazilian waters, respectively, is an indication that the genus may have a broad geographical distribution. This gap in knowledge tends to be filled as new taxonomic efforts are implemented in order to unravel an overlooked amphipod diversity, especially in the Brazilian deep-sea.

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CONFLICTS OF INTEREST: Authors declare there are no conflicts of interest.

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