

FIRST RECORD OF THE GENUS *PERICLIMENAEUS* BORRADAILE, 1815
(DECAPODA: PALAEMONIIDAE: PONTONIINAE) IN THE NORTHEASTERN ATLANTIC,
WITH THE DESCRIPTION OF A NEW SPECIES, *PERICLIMENAEUS AURAE*

Antonina dos Santos, Ricardo Calado, and Ricardo Araújo

(AdS, correspondence) Instituto Nacional de Investigação Agrária e Pescas, IPIMAR,
Av. de Brasília, s/n. 1449-006 Lisboa, Portugal (antonina@ipimar.pt);

(RC) CCMAR, Universidade do Algarve, Campus de Gambelas, 8005-139 Faro,
Portugal (rjcalado@hotmail.com);

(RA) Estação de Biologia Marinha do Funchal, Cais do Carvão, Promenade da Orla Marítima do Funchal,
Gorgulho, 9000-107 Funchal, Madeira, Portugal (ricardo.araujo@mail.cm-funchal.pt)

A B S T R A C T

A new species of *Periclimenaeus* is described from Madeira Island, in the northeastern Atlantic Ocean. It is closest to *P. pearsei* Holthuis, 1951 from the western Atlantic, but it can be distinguished by the shape of rostrum, the size of exopod in relation to endopod in third maxilliped, the relation between the carpus and the chela of pereopod 1, the relative size of second pereopod minor chela, and the number of setae on appendix masculina. This is the first record of the genus *Periclimenaeus* in the eastern Atlantic.

KEY WORDS: Decapoda, Palaemonidae, *Periclimenaeus*, taxonomy

INTRODUCTION

The genus *Periclimenaeus* Borradaile, 1915 is the second most speciose genus within Pontoniinae with most of its members occurring in tropical waters (Bruce, 2001). Abele and Kim (1986) listed the occurrence of ten species of *Periclimenaeus* in the tropical northwestern Atlantic: *Periclimenaeus ascidiarum* Holthuis, 1951, *P. atlanticus* (Rathbun, 1901), *P. bermudensis* (Armstrong, 1940), *P. bredini* Chace, 1972, *P. caraibicus* Holthuis, 1951, *P. chacei* Abele, 1971, *P. maxillulidens* (Schmitt, 1936), *P. pearsei* (Schmitt, 1932), *P. perlatus* (Boone, 1930), *P. schmitti* Holthuis, 1951 and *P. wilsoni* (Hay, 1917). Although several caridean shrimp genera are known to be amphi-Atlantic, occurring in western Atlantic tropical waters and the Macaronesian Islands (*Cinetorhynchus* Holthuis, 1995, *Janicea* Manning & Hart, 1984, *Tulearicaris* Hipeau-Jacquotte, 1965 and *Thor* Kingsley, 1878) (d'Udekem d'Acoz, 1999, 2001), the genus *Periclimenaeus* has not been previously recorded in the eastern Atlantic.

In order to update the current checklist of decapod crustaceans occurring in the Madeira Archipelago, a review of the Museu Municipal do Funchal (MMF) (Madeira Island, Portugal) Crustacea Decapoda collection was carried out. During the examination of this material, a specimen labelled as *Typton spongicola* O.G. Costa, 1844 caught our attention due to its distinctive morphological features. Based on a more in depth examination, we concluded that this specimen was erroneously identified and represented an undescribed species of *Periclimenaeus*.

The present work reports the first record of the genus *Periclimenaeus* in the eastern Atlantic, provides a detailed morphological description of a new species in the genus, *Periclimenaeus aurae* and a re-description of the closest species, *P. pearsei* Holthuis, 1951, based on the observation of the holotype from the National Museum of Natural History, Smithsonian Institution, Washington DC, USA.

MATERIAL AND METHODS

The examined specimen from Madeira waters was stored in 80% ethanol and in perfect morphological condition. *Periclimenaeus pearsei* specimens where presented with all appendices separated from the body parts and the female holotype was damaged in a way that prevented us to measure total length. Drawings and measurements were made with a camera lucida on a Wild M8 dissecting stereomicroscope, and on a Zeiss microscope for setae observation. Since only single specimens were available for study, the preparation of slides with appendages was temporary. Total length (TL) was measured from the tip of the rostrum to the posterior end of the telson. Carapace length (CL) was measured from the posterior orbital margin to the posterior margin of carapace. The described new species is deposited in the Museu Municipal do Funchal, Madeira (MMF13705).

SYSTEMATICS

Order Decapoda Latreille, 1802
Suborder Pleocyemata Burkenroad, 1963
Palaemonidae Rafinesque, 1815
Periclimenaeus Borradaile, 1915
Periclimenaeus aurae n. sp.
(Figs. 1-4, 5C, 5K)

Holotype.—Adult male 4.25 mm CL (13.77 mm TL; 1.08 mm rostrum) [MMF13705]. The specimen has been collected on the 5th of April 1958 at Garajau, South of Madeira Island, Eastern Atlantic (32.63°N/16.85°W), at a depth of 6-7 m.

Diagnosis.—The body is small and subcylindrical. Carapace smooth and glabrous, with antennal spine; epigastric and hepatic spines absent. Rostrum small, well developed with dorsal carina dentate. Pleon smooth, glabrous and pleura with posterior margins rounded. Telson with two pairs of dorsal spines and three pairs of posterior spines. Antennule normal with upper flagellum with short ramus reduced. Antenna with basicerite unarmed. Eye normal, with globular cornea. Epistome unarmed. Mandible without palp and fourth thoracic sternite without median process. Second pereopods well developed, chelae unequal, dissimilar, one

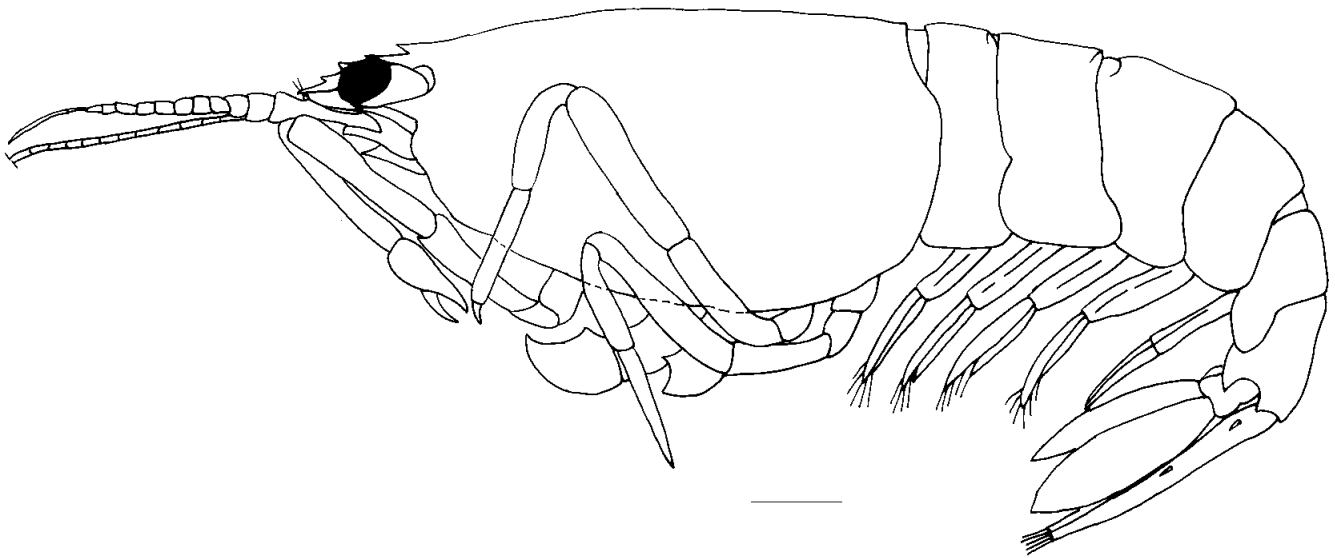


Fig. 1. *Periclimenaeus aurae*, sp. nov., male holotype, 4.25 mm CL. Lateral view. Scale bar: 1.0 mm.

greatly enlarged, dactylus bearing molar process, fixed finger with opposing fossa.

Description.—A small robust built shrimp (Fig. 1), sub-cylindrical, body form slightly compressed. Carapace smooth, glabrous, with anterolateral margin broadly rounded and anteriorly slightly produced. Rostrum short (Fig. 5C), slender, acute, 0.25 the carapace length, directed downwards, making a 110° angle, with tip reaching about level of distal margin of first article of antennular peduncle and over-reaching the eyes; 4 acute dorsal teeth, the first anterior to the posterior orbital margin, ventral margin straight without teeth. Obsolescent inferior orbital angle present, postorbital ridge and supraorbital tubercles lacking. Antennal spine present and strong, placed close to lower angle of orbit. Pterygostomial angle obtusely rounded, not produced.

Eyes (Fig. 2A) with rounded and oblique pigmented cornea, corneal diameter about 1/10 length of carapace, slightly narrower than the eyestalk.

Pleon smooth, first segment without anterodorsal lobe, with pleura of first five segments broadly rounded. The sixth pleomere is longest, about half as long as telson, with acute spine on posterior end of pleura. Sixth segment with posterolateral angle small, acute, posteroventral angle large, broadly acute.

Telson (Fig. 5K) as long as uropods, slender, with lateral margins feebly convergent distally, with 2 pairs of dorsal spines, proximal ones situated close to anterior margin of telson; distal spines halfway between first pair and posterior margin of telson. Posterior margin rounded, and truncate, with row of 3 pairs of spines, lateral distal spines short and about the size of dorsal spines, and intermediate and inner spines longer and subequal in size.

Antennular peduncle (Fig. 2B) with basal article having a short and broad stylocerite, not reaching the middle of this segment; lateral margin of basal article forming a blunt angle at the level of stylocerite tip, ending in a small but distinct anterolateral tooth, with plumose seta on inner margin; articles 2 and 3 nearly equal in size. Inner flagellum

with 21 articles, outer flagellum with the two rami fused for first 7 articles, rami broken.

Antenna (Fig. 2C) with robust proximal article, article 2 smaller with 7 simple setae on distal margin, article 3 longest, reaching to the end of scaphocerite. Scaphocerite short, twice as long as broad, rounded distally, reaching end of antennular peduncle, with 34 plumose setae on medial margin; lateral margin straight, with well-developed distal tooth, shorter than lamella; flagella apparently very long, broken.

Mandible (Fig. 2D) small, without palp; molar process with 3 blunt tubercles, bearing dense rows of simple spines; incisor process reduced, distally acute, medial margin with minute tooth.

Maxillula (Fig. 2E) with slender, curved, simple palp having single, terminal, simple seta; upper lacinia broad with 6 stout, dentate, marginal spines, and submarginal row of 3 more slender, serrulate setae, and 8 serrulate setae on inner margin; lower lacinia slender, with 13 long, simple setae along dorsal margin.

Maxilla (Fig. 2F) with elongated palp lacking seta; inner lacinia simple, with 13 simple setae on distal margin, scaphognathite well developed, with 94 setae along margin, lower lobe slender.

First maxilliped (Fig. 2G) with small simple palp with one simple seta subdistally on the medial margin; basal endite broad with 3 rows of dense setulose setae; exopod with caridean lobe longer than broad, with 22 sparsely plumose marginal setae, flagellum slender, with several plumose setae distally; epipod bilobed.

Second maxilliped (Fig. 3A) with endopod stout, dactyl article terminal, distally elongated, with rows of long marginal setae; propodus broader than long, with 8 sparsely distributed setae; carpus short, unarmed; merus longer than ischium; ischium and basis fused and unarmed; exopod long and slender with plumose setae distally; coxa medially rounded, with rounded and large epipod laterally.

Third maxilliped (Fig. 3B) with slender endopod; proximal article of endopod longer than 2 distal articles

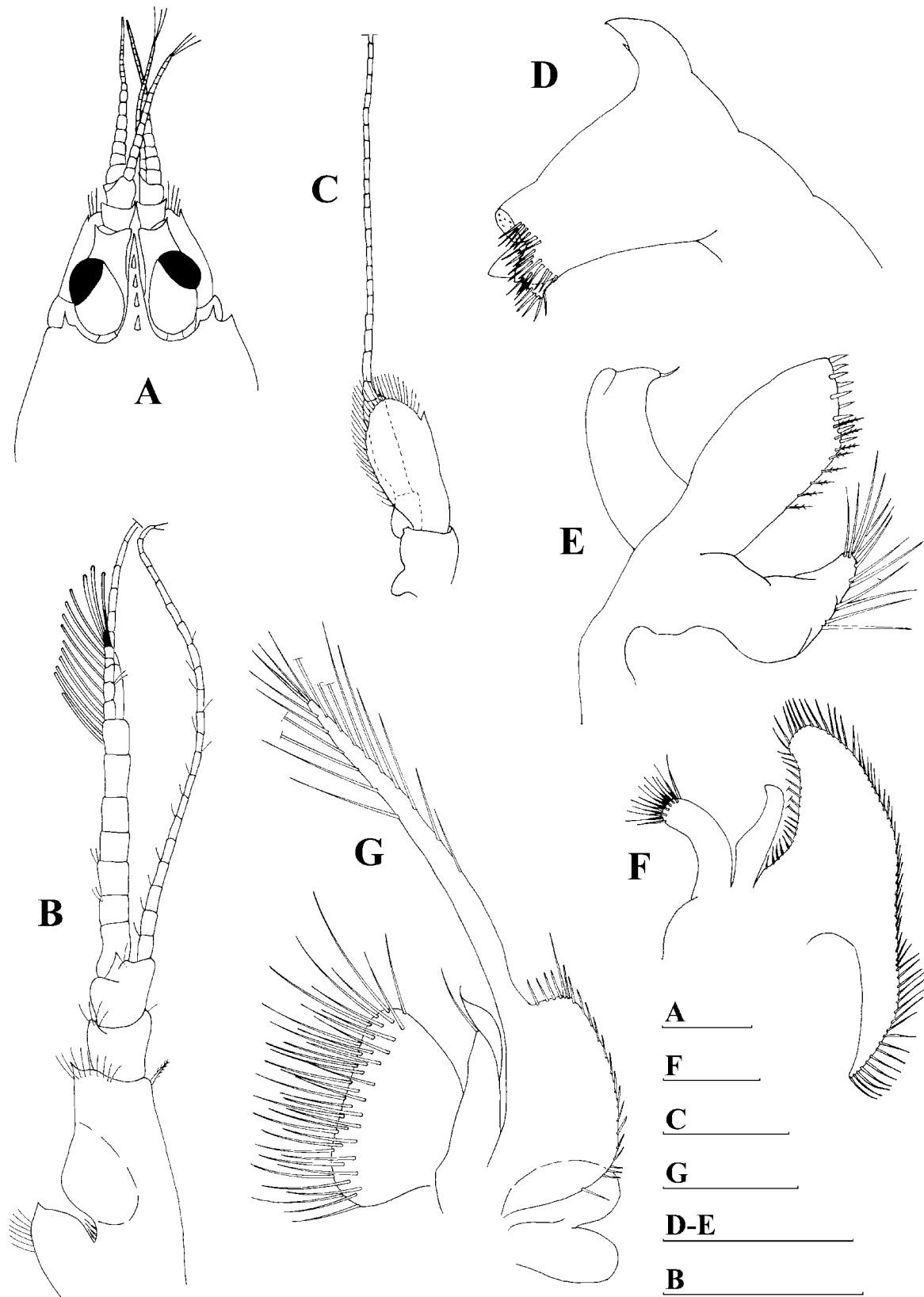


Fig. 2. *Periclimenaeus aurae*, sp. nov., male holotype. A, anterior portion of cephalothorax, dorsal view; B, antennule; C, antenna; D, mandible; E, maxillula; F, maxilla; G, first maxilliped. Scale bars: 1.0 mm (A-C); 0.5 mm (D-G).

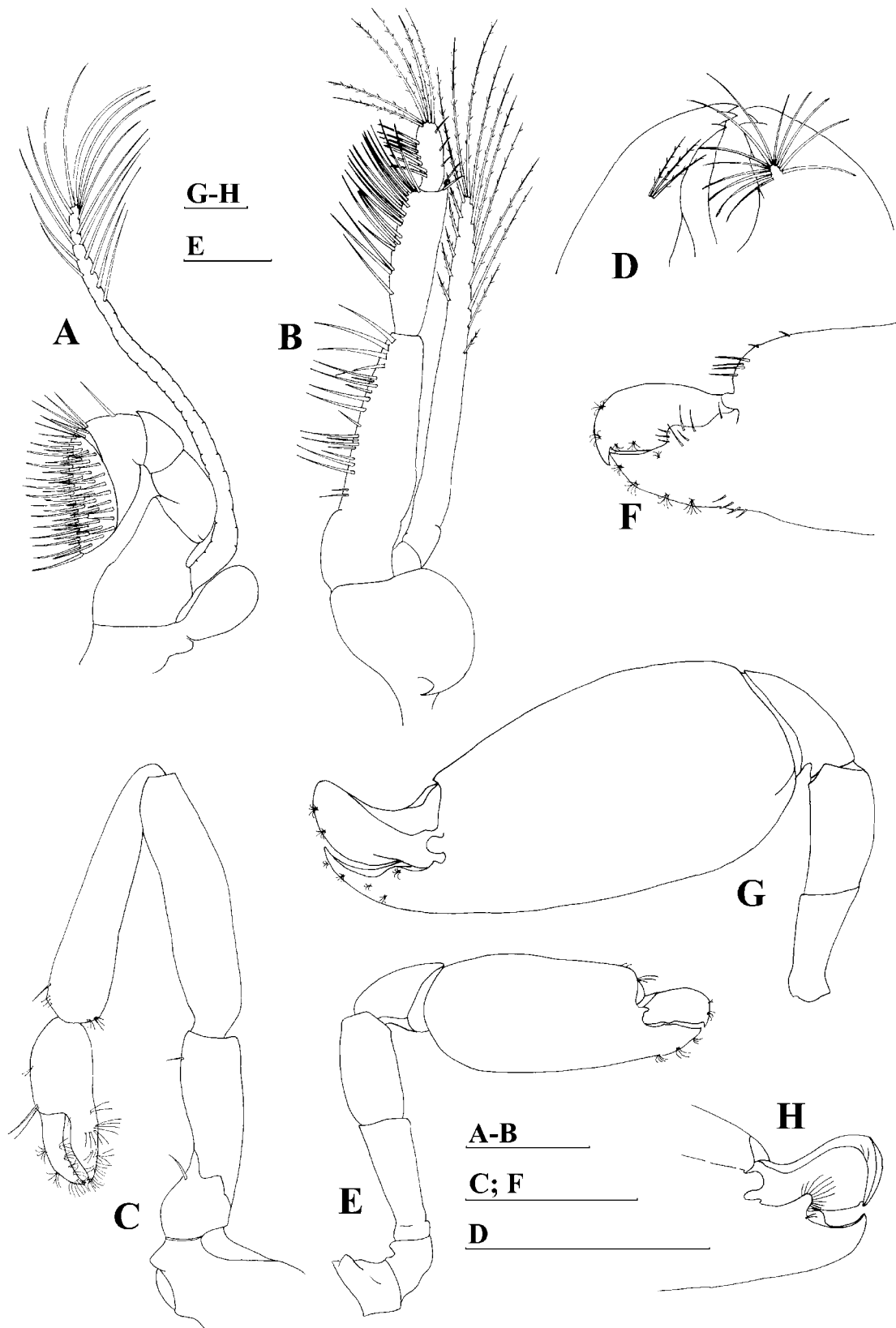


Fig. 3. *Periclimenaeus aurae*, sp. nov., male holotype. A, second maxilliped; B, third maxilliped; C, first pereiopod; D, detail of the chela of first pereiopod; E, minor second pereiopod, dorsal view; F, detail of the chela of the minor second pereiopod, ventral view; G, major second pereiopod, dorsal view; H, detail of the chela of the major second pereiopod, ventral view. Scale bars: 1.0 mm (C; E-H); 0.5 mm (A-B; D).

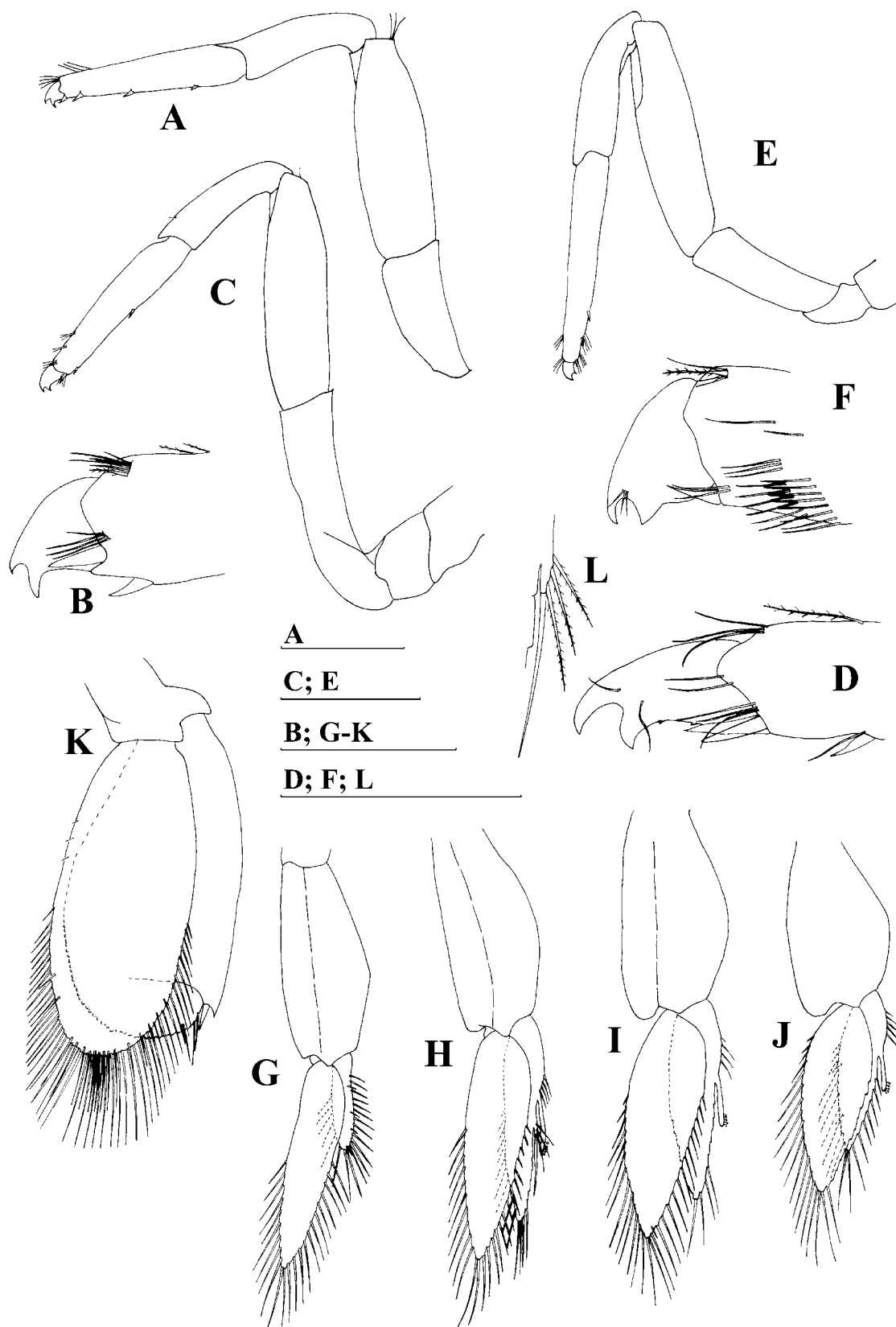


Fig. 4. *Periclimanaeus aurae*, sp. nov., male holotype. A, third pereiopod; B, detail of the dactyl of the third pereiopod; C, fourth pereiopod; D, detail of the dactyl of the fourth pereiopod; E, fifth pereiopod; F, detail of the dactyl of the fifth pereiopod; G, first pleopod; H, second pleopod; I, fourth pleopod; J, fifth pleopod; K, uropods; L, appendix masculina. Scale bars: 1.0 mm (A; C; E; G-K); 0.5 mm (B; D; F; L).

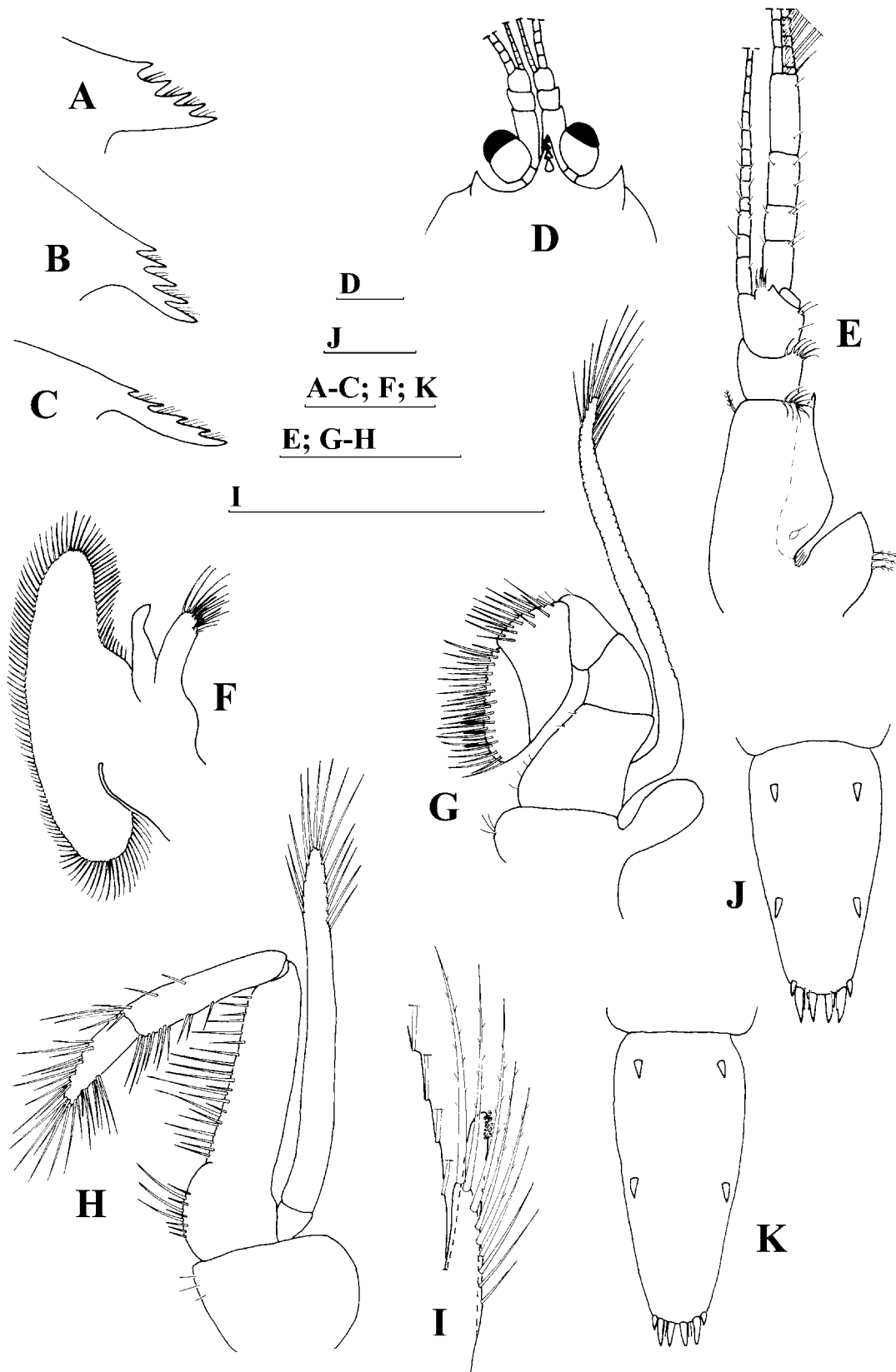


Fig. 5. *Periclimenaeus pearsei*, female holotype. A, rostrum. *Periclimenaeus pearsei*, male holotype. B, rostrum. *Periclimenaeus aurae*, sp. nov., male holotype. C, rostrum. *Periclimenaeus pearsei*, male holotype. D, anterior portion of cephalothorax, dorsal view; E, antennule; F, maxilla; G, second maxilliped; H, third maxilliped; I, appendix masculina; J, telson. *Periclimenaeus aurae*, sp. nov., male holotype. K, telson. Scale bars: 1.0 mm (A-H; J-K); 0.5 mm (I).

combined, all strongly setose on mesial border, distal article narrow, short, almost half length of penultimate segment, sparsely setose, with 6 long plumose setae distally; exopod well developed, slender, reaching tip of penultimate endopodal segment, with 16 plumose setae distally; coxa robust without setae and displaying a small flattened hemispherical plate-like epipod dorsolaterally.

First pereopod (Fig. 3C, D) moderately robust, with well-developed chela, with merus reaching beyond the scaphocerite; palm smooth, longer than deep, sparsely setose; fingers subspatulate, about 0.8 times the palm with 3 teeth at the tip; dactylus with transverse rows of numerous, short curved setae, forming dense brush; fixed finger with five transverse rows of few long simple setae; carpus about 1.7 times length of chela and about as long as merus, with small sparsely distributed simple setae on distal margin; merus unarmed; ischium about 0.5 of merus length with 1 very small simple seta on distal margin, obliquely articulated with basis; basis short, with 1 simple small setae distally; coxa as usual for genus, with a rounded dorsolateral protuberance.

Second pereopods (Fig. 3E-3H) well developed, robust, chelae large, unequal; major chela about 1.3 of CL, with glabrous and smooth palm, 1.8 times longer than wide, oval in section, distally tapering slightly, with fingers strongly twisted medially; dactylus robust and compressed, slightly exceeding fixed finger, with dorsal margin strongly convex, distally carinate, with stout blunt hooked tip, cutting edge distally sharp, entire, with concave ventral surface and molar process; fixed finger proximally stout and ventrally carinate, with stout blunt hooked tip, distal half of cutting edge sharp, entire, proximal half with deep fossa, proximal dorsal margin with rounded protuberance, ventral margin with small tooth; carpus about 0.2 length of propodus length, distally expanded; merus about 1.7 length of carpus; ischium about 0.6 length of merus, tapering strongly proximally; basis and coxa normal, robust, without special features; minor chela about 0.3 of CL and about 0.4 of major chela length, 1.8 times longer than wide, oval in section, tapering slightly distally, cutting edges unarmed throughout their length; dactylus robust and compressed, slightly exceeding fixed finger, with stout blunt strongly hooked tip, and dorsal margin proximally concave; fixed finger proximally stout, with stout blunt hooked tip, sharp cutting edge, entire, proximal dorsal margin with round protuberance at base, and ventral margin with small protuberance; carpus, merus and ischium of same basic shape as in larger second pereopod; basis and coxa normal, robust, without special features.

Third pereopod (Fig. 4A, B) with propodus about 1/3 length of pereopod reaching beyond scaphocerite; dactylus short and stout, biunguiculate; propodus about 9 times as long as dactylus, narrowing distally, with short stout distoventral spine, flexor border with three similar spines; carpus slender and about 2/3 of the propodus length; merus robust, 1.5 length of carpus, with 3 disto-dorsal setae; ischium about 0.5 length of merus; basis and coxa robust, without special features.

Fourth pereopod (Fig. 4C, D) long and slender; dactylus biunguiculate, with dorsal margin convex and ventral

margin sinuous with 4 very small spines; propodus long, 7 times longer than dactylus, with pair of short stout distoventral spines, flexor border with two similar spines, one at 0.4 and one at 0.9, and several groups of setae distoventrally; carpus slender, about 2/3 of propodus length; merus robust and long, 2.5 times length of carpus; ischium about the same length of merus; basis and coxa without special features.

Fifth pereopod (Fig. 4E, F) long, slender; dactylus biunguiculate; propodus long, slightly tapering distally, 11 times longer than dactylus, with 3 spines on flexor border, one at 0.8, one at 0.9 and one on the tip, and several groups of setae distoventrally; carpus and merus unarmed, merus longer than carpus; ischium about 0.5 length of merus.

First pleopod (Fig. 4G) with basipodite unarmed; exopod more than twice as long as endopod with 23 plumose setae; endopod almost triangular in shape with 20 marginal plumose setae and 4 simple small supra-marginal setae.

Second pleopod (Fig. 4H) with exopod having 25 plumose setae; endopod about 4/5 length of exopod with 21 plumose marginal setae; appendix masculina (Fig. 4L) much shorter than appendix interna, with 1 strong terminal spine, and 3 plumose setae on anterior lateral margin.

Other pleopods (Fig. 4I, J) with endopod slightly smaller than exopod, and displaying 28-29 plumose setae on exopod and 21-22 plumose setae on endopod.

Uropods (Fig. 4K) broadly ovate; protopod short and unarmed; exopod sub-equal to telson length, with convex unarmed lateral margin, acute distolateral tooth not reaching the distal border of exopod, larger medially mobile spine present, and numerous plumose marginal setae on inner and distal margins; endopod subequal to exopod length, with 53 plumose marginal setae and 13 simple dorsal setae.

Colour.—No data available.

Etymology.—This species is named after Dr. Aura Ribeiro-Cascalho in recognition of her dedicated work on the biology of decapod crustacean communities in Portugal and Africa.

Remarks.—*Periclimenaeus aurae* displays all the morphological characters used by Bruce (1994) for the diagnosis of the genera *Periclimenaeus*.

Habitat and Ecology.—The single specimen was collected clinging to a small rock at a depth of 6 to 7 m. Apart from this vague observation there is no further information on habitat or ecology. Nevertheless, since most *Periclimenaeus* species have been known to occur in close association with sponges (Bruce, 1988), and the present specimen was erroneously classified as *Typton spongicola*, it may be possible that *P. aurae* also displays this type of associative behavior.

Periclimenaeus pearsei Holthuis, 1951
(Fig. 5A-B, D-J)

Material.—Holotype, (USNM 65080) 2 specimens: 1 female, 1 male. The specimens are in a fragmentary state. The container have the following information: Pontonid from soft black sponge, Tortugas, Florida, USA, 18 June

1931, collected by A. S. Pearce and examined by L. Holthuis, 1948.

Dimensions.—Female damaged: 7.04 mm CL, TL impossible to measure. Male: 5.36 mm CL, 17.52 mm TL, 0.808 mm rostrum. Although the re-examined material presents an indication that it had been previously observed by Holthuis in 1948, it is curious to note that in *P. pearsei* description of *P. pearsei* (Holthuis, 1951) the largest male observed displayed a TL of 15 mm, being smaller than the male specimen now re-examined.

Description.—Small pontonid shrimp with sub-cylindrical and slightly compressed body form. Carapace smooth and glabrous. Male rostrum short (Fig. 5B), with triangular shape, large at base and acute at posterior end, 0.15 the carapace length, directed downwards, making a 133.5° angle, with 4 acute dorsal teeth, with tip reaching about halfway first article of antennular peduncle and not reaching beyond eyes, ventral margin straight without teeth. Female rostrum also short and triangular shaped, with 4 dorsal teeth, although not as downwards directed, in a more forward position, making a 103° angle (Fig. 5A). Strong antennal spine present, placed close to lower angle of orbit. Distinct postorbital ridge present, descending into antennal spine.

Eyes with rounded, oblique, pigmented cornea, corneal diameter about 0.08 times length of carapace, slightly narrower than eyestalk (Fig. 5D).

Pleon smooth (as described in Holthuis, 1951). Telson as long as uropods, slender, with lateral margins feebly convergent distally, with 2 pairs of dorsal spines, proximal spines situated close to anterior margin of telson; distal spines placed at almost 2/3 of telson length (Fig. 5J). Posterior margin rounded, truncate, with row of 3 pairs of spines, lateral distal spines shorter, about size of dorsal spines, intermediate and inner spines longer, subequal in size.

Antennular peduncle with basal article having a short and broad stylocerite, not reaching the middle of this segment; lateral margin of basal article forming a blunt angle at the level of the stylocerite's tip, and ending in a distinct anterolateral tooth, almost reaching the middle of the second segment and with plumose seta on inner margin; articles 2 and 3 nearly equal in size. Inner flagellum broken at the 13th article. Outer flagellum with the two rami fused for first 6 articles in the male and first 4 articles in the female, rami broken (Fig. 5E).

Antenna as described in Holthuis (1951), male specimen with 28 plumose setae on medial margin of scaphocerite. Mandible and maxillula as described in Holthuis (1951).

Maxilla (Fig. 5F) with elongated palp lacking seta; inner lacinia simple, with 19 simple setae on distal margin, scaphognathite well developed and large, with 133 setae along margin and lower lobe very broad.

First maxilliped with small simple palp with 3 simple setae distomedially; basal endite broad with 3 rows of dense setulose setae; exopod with caridean lobe longer than broad, with sparsely plumose marginal setae, flagellum slender, with several plumose setae on the third distal end; epipod bilobed.

Second maxilliped (Fig. 5G) with endopod stout, dactyl article terminal, distally elongated, with rows of long

marginal setae; propodus broader than long, with 17 sparsely distributed setae; carpus short, unarmed; merus longer than ischium; basis unarmed; exopod long and slender with plumose setae distally; coxa medially rounded, with rounded and large epipod laterally.

Third maxilliped (Fig. 5H) with slender endopod; proximal article of endopod almost the same size than the two distal articles combined, all strongly setose on mesial border, distal article narrow, almost 2/3 as long as penultimate segment, sparsely setose; exopod well developed, slender, not reaching tip of penultimate endopodal segment, with 14 plumose setae distally; coxa robust with 3 small simple setae and displaying a small flattened hemispherical plate-like epipod dorsolaterally.

Pereiopods as described in Holthuis (1951), except that in the male first pereiopod the carpus is about 1.4 times length of chela and shorter than merus and ischium about 0.5 of merus length. The second pereiopod with major chela about 1.5 of CL and about 2 times longer than wide and minor chela about 0.7 of CL, about 0.5 of major chela length and 2.4 times longer than wide.

First pleopod of male with basipod unarmed; exopod more than twice as long as endopod with marginal plumose setae; endopod ovate in shape with marginal plumose setae.

Second pleopod of the male with exopod having 23 plumose setae; endopod about 4/5 length of exopod with 20 plumose marginal setae; appendix masculina (Fig. 5I) much shorter than appendix interna, with 1 terminal spine and 8 plumose setae on interior lateral margin.

Other pleopods with endopod slightly smaller than exopod, marginal setae plumose.

Uropods as described in Holthuis (1951).

Remarks.—This species was described by Holthuis (1951, p. 93-96, Pl. 28, figs. a-r), but given the similar morphological features of the two species considered here a re-examination of the specimens was performed. A detailed description and illustration of the male appendages, which had been only briefly described in the previous work, is presented here.

DISCUSSION

Morphological Remarks

The main morphological differences among the species of *Periclimenaeus* occurring in the northern Atlantic are presented in Table 1. *Periclimenaeus aurae* is the first species of the genus to be recorded in the northeastern Atlantic. Eleven species were previously known to occur in the northwestern Atlantic (see Table 1), all of them present in the Caribbean Sea. Although *Periclimenaeus wilsoni* and *P. schmitti* (both also occurring off North Carolina (USA)) and *P. bermudensis* (present in the Bermudas) are geographically closer to *P. aurae* than other members of the genus, they do not appear to be closely related due to the differences among their morphological characters. These three species differ from *P. aurae* in the 1) number of dorsal rostral teeth, 2) number of teeth of the incisor process of the mandible, 3) the relation between the carpus and the chela of the first pereiopod, and 4) the arrangement of telson distal spines (see Table 1 for additional differences).

Table 1. Geographic distribution, and comparative presentation of morphological characters of the North Atlantic species of *Periclimenaeus*.

	<i>P. aurae</i> present work	<i>P. pearsei</i> (Schmitt, 1932)	<i>P. perlanus</i> (Boone, 1930)	<i>P. ascidiarum</i> Holthuis, 1951	<i>P. wilsoni</i> (Hay, 1917)	<i>P. chacei</i> Abele, 1971	<i>P. bermudensis</i> (Armstrong, 1940)	<i>P. maillidensis</i> (Schmitt, 1936)	<i>P. atlanticus</i> (Raabun, 1901)	<i>P. carabicus</i> Holthuis, 1951	<i>P. schmitti</i> Holthuis, 1951	<i>P. bredini</i> Chace, 1972
Geographical distribution	Madeira, Portugal	Tortugas, Florida	Tortugas (Florida), Haiti, Panama	Tortugas (Florida), Dominica, Colombia	North Carolina, Florida	Gulf of Mexico	Tortugas (Florida), Bahamas, Bermudas	Florida, Netherlands West Indies	Florida, Virgin Islands	British West Indies	North Carolina, Tortugas (Florida)	Territorio Quintana Roo, Mexico
Number of rostrum dorsal teeth	4	3-5	7-9	3	10-12	4	7-8	2	4	6	1-2	7
Rostrum ventral teeth	no	no	no	no	no	no	no	no	no	1	no	no
Supra-orbital spines	absent	absent	absent	absent	absent	absent	absent	absent	absent	present	absent	absent
Number of joints fused in upper antennular flagellum	7	3-4	9	4	6-9	5	4-5	6-8	3	5	3	4
Mandible incisor process	very short, 1 tooth	very short, 1-2 teeth	well developed, 1 tooth	7 teeth	2 teeth	4 teeth	very short, without teeth	6 teeth	7 teeth	10 teeth	3 teeth	2 minute teeth
Maxilla inner lacinia	simple	simple	simple	simple	simple	simple	bilobed	simple	simple	simple	simple	simple
Scaphocerite anterolateral tooth	yes	yes, short	yes	yes, short	yes	yes	yes	yes	yes, ?	yes, long	no	yes
Third maxilliped distal segments	slender	slender	slender	broad	slender	slender	slender	broad	broad	broad	broad	slender
First pereopods relation carpus longer than chela	1.7	1.5	about 2.0	1.3	1.3	slightly longer	slightly longer	slightly longer	slightly longer	1.4	slightly longer	slightly longer
Second pereopod fingers relation with palm	shorter	shorter	shorter	shorter	shorter	shorter	longer	shorter	shorter	shorter	shorter	shorter
Movable finger of second pereopods	not extending beyond tip of fixed finger	not extending beyond tip of fixed finger	not extending beyond tip of fixed finger	not extending beyond tip of fixed finger	not extending beyond tip of fixed finger	extending beyond tip of fixed finger	extending beyond tip of fixed finger	not extending beyond tip of fixed finger	not extending beyond tip of fixed finger	extending beyond tip of fixed finger	not extending beyond tip of fixed finger	not extending beyond tip of fixed finger
Third pereopods bifid dactyl	yes	yes	yes	yes	yes	no	yes	no	no	yes	yes	yes
Telson distal spines arranged in one row	yes	yes	no	yes	no	yes	no	no	no	yes	no	yes
Position of anterior pair of telson dorsal spines	anterior fourth of segment	anterior fourth of segment	anterior fourth of segment	anterior fourth of segment	anterior fourth of segment	anterior fourth of segment	anterior fourth of segment	anterior third of segment	anterior third of segment	anterior fourth of segment	anterior third of segment	anterior fourth of segment

Periclimenaeus aurae seems closely related to *P. pearsei*. They share the following characters: rostrum with 4 dorsal teeth and without ventral teeth, carapace without supraorbital spines or tubercles, inferior orbital angle obsolete, mandible incisor process highly reduced, third maxilliped with last two segments very slender, major second pereopod with well developed molar process and fossa, dactyl of minor second pereopod exceeding fixed finger, fingers of first legs with cutting edge entire, dactyls of first pereopod short with upper margin strongly convex, dactyls of ambulatory legs biunguiculate.

Periclimenaeus aurae differs from *P. pearsei* in the following characters: rostrum slender, projected downward in a 110° angle (versus rostrum triangular shaped, projected downward in a 133.5° angle); upper antennular flagellum with 7 fused joints (versus 6); scaphocerite with 34 plumose setae (versus 28); scaphognathite with 94 setae along margin and a lower slender lobe (versus 133 and very broad lower lobe); first maxilliped flagellum with plumose setae on the 1/2 distal part (versus 1/3 distal part); second maxilliped propodus with 8 setae (versus 17); third maxilliped endopod posterior segment is about 1/2 the length of the middle one and exopod reaches the posterior end of endopod middle segment (versus 2/3 and exopod proportionally shorter); carpus of first pereopod about 1.7 times length of chela and about as long as merus (versus carpus about 1.4 times length of chela and shorter than merus); second pereopod minor chela about 0.3 of CL and 1.8 times longer than wide (versus minor chela about 0.7 of CL and 2.4 times longer than wide); appendix masculina with 1 terminal spine and 3 plumose setae on lateral margin (versus 1 terminal setae and 8 plumose setae on lateral margin). Despite the consistent differences recorded, it will be important to sample and examine further specimens of *P. aurae*, particularly females, in order to have a better indication of the features that characterize this new species.

Furthermore, Holthuis (1951) considered *P. pearsei* to be closely related to *P. hancocki*, species from the eastern Pacific Ocean. As pointed out by this author, those species can be distinguished by the shape of dactylus upper margin of the first pereopod, the thickness of the last two segments of the third maxilliped, the shape and size of the basal segment of antennular peduncle anterolateral tooth and the shape of the rostrum. Although *P. aurae* has a slender rostrum, like *P. hancocki*, all the characters pointed above are more similar to those of *P. pearsei*.

Bruce (1988) indicated that little information is available regarding the presence or absence of appendix masculina in *Periclimenaeus* species. However, since then, more *Periclimenaeus* species had been described and re-examined and all males possess an appendix masculina (Bruce, 1980, 2005, 2006; Ríos, 1986). All appendicis masculinae of the species of *Periclimenaeus* described until now are of the same type as described here for *P. aurae*, i.e., a short appendix masculina, at least half the size of the appendix interna, and presenting from 1 (in the case of *Periclimenaeus* sp., Bruce, 2005) to 9 long setae on exterior margin (*P. pearsei*, present re-description) that can be simple or plumose. The male specimen of *P. aurae* presents the same number of setae as *P. hancocki* (see Ríos, 1986), but it only

has 1 apical setae and this late species presents 2 apical and 2 lateral setae on the appendix masculina.

Biogeographical Remarks

As previously mentioned, *Periclimenaeus* is a highly speciose genus with representatives occurring in all oceans, particularly in tropical waters (Chace & Bruce, 1993). Since the genus is represented by at least 11 species in the northwestern Atlantic, its occurrence in the northeastern Atlantic is not unexpected. Despite the biogeographical interest of Madeira Island, only recently has study of the decapod fauna of shallow waters been addressed, with new and puzzling species being recently discovered (Calado et al., 2004). The small size of most of these organisms and their associative behaviour with other invertebrates present additional problems for their collection and correct identification, e.g., the new species described may have been for long mistaken with *Typton spongicola*. These new occurrences reinforce the need and importance of more biodiversity surveys in Macaronesia waters.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the insightful comments of A. J. Bruce. We would also like to express our sincere gratitude to André Simões from the University of Lisbon for his assistance on Latin language.

REFERENCES

- Abele, L. G. 1971. A new species of *Periclimenaeus* Borradaile, 1915 (Crustacea: Decapoda: Palaemonidae) from the Northeastern Gulf of Mexico. *Tulane Studies in Zoology and Botany* 17: 38-40.
- , and W. Kim. 1986. An illustrated guide to the Marine decapod crustaceans of Florida. Part 1. State of Florida Department of environmental Regulation, Technical Series 8: 1-326.
- Armstrong, J. C. 1940. New species of Caridea from the Bermudas. *American Museum Novitates* 1096: 1-10.
- Boone, L. 1930. New Decapod and Isopod Crustaceans from Gonave Bay, Haiti. *Zoologica* 12: 41-53.
- Borradaile, L. A. 1915. Notes on Caridea. *Annals and Magazine of Natural History* 15: 205-213.
- Bruce, A. J. 1980. Notes on some Indo-Pacific Pontoniinae, XXXIII. *Periclimenaeus diplosomatis* sp. nov., an ascidian associate from Heron Island, Australia. *Crustaceana* 39: 30-51.
- . 1988. A redescription of *Periclimenaeus fimbriatus* Borradaile, 1815, with the designation of a new genus (Crustacea: Decapoda: Palaemonidae). *Zoological Journal of the Linnean Society* 94: 219-232.
- . 1994. A synopsis of the Indo-West Pacific genera of the Pontoniinae (Crustacea: Decapoda: Palaemonidae). *Theses Zoologicae* 25: 1-172.
- . 2001. A re-examination of *Periclimenaeus trispinosus* Bruce and *P. orbitospinatus* Bruce (Crustacea: Decapoda: Pontoniinae). *Zoologische Mededelingen, Leiden* 75: 147-158.
- . 2005. A re-description of *Periclimenaeus robustus* Borradaile, the type species of the genus *Periclimenaeus* Borradaile, 1915 (Crustacea: Decapoda: Pontoniinae). *Cahiers de Biologie Marine* 46: 389-398.
- . 2006. *Periclimenaeus nielbrucei* sp. nov. (Crustacea: Decapoda: Pontoniinae), a new sponge associate from the Capricorn Islands, Queensland, with notes on related *Periclimenaeus* species. *Zootaxa* 1224: 1-22.
- Burkenroad, M. D. 1963. The evolution of the Eucarida (Crustacea, Eumalacostraca) in relation to the fossil record. *Tulane Studies in Geology* 2: 3-16.
- Calado, R., P. Chevaldonné, and A. dos Santos. 2004. A new species of the deep-sea genus *Bresilia* (Crustacea: Decapoda: Bresiliidae) discovered from a shallow-water cave in Madeira. *Journal of the Marine Biological Association of the United Kingdom* 84: 191-199.
- Chace, F. A., Jr. 1972. The shrimps of the Smithsonian-Bredin Caribbean Expeditions with a summary of the West Indian shallow-water species (Crustacea: Decapoda: Natantia). *Smithsonian Contributions to Zoology* 98: 1-179.

- , and A. J. Bruce. 1993. The Caridean shrimps (Crustacea: Decapoda) of the Albatross Philippine Expedition 1907-1910, Part 6: Superfamily Palaemonoidea. *Smithsonian Contributions to Zoology* 543: 1-152.
- Costa, O. G. 1844. Su dei nuovi generi di Crostacei decapodi Macrourini Nota. *Annali delle Accademia degli Aspiranti Naturalisti, Napoli* 2: 285-290.
- Hay, W. P. 1917. Preliminary descriptions of five new species of Crustaceans from the coast of North Carolina. *Proceedings of the Biological Society of Washington* 30: 71-73.
- Hipeau-Jacquotte, R. 1965. Notes de faunistique et de biologie marines de Madagascar, III: Un nouveau Décapode gageur (Pontoniinae) associé aux oursins dans la région de Tuléar: *Tuleariocaris holthuisi* nov. gen. et nov. sp. *Recueil des Travaux de la Station Marine d'Endoume* 53 (37): 247-259.
- Holthuis, L. B. 1951. A general revision of the Palaemonidae (Crustacea Decapoda Natantia) of the Americas. I. The subfamilies Euryrhynchinae and Pontoniinae. *Allan Hancock Foundation Publications, Occasional Papers* 11: 1-332.
- . 1995. Notes on Indo-West Pacific Crustacea Decapoda III to IX. *Zoologische Mededelingen, Leiden* 69 (13): 139-151.
- Kingsley, J. S. 1978. Notes on the North American Caridea in the Museum of the Peabody Academy of Science at Salem, Mass. *Proceedings of the Academy of Natural Sciences, Philadelphia* 1878: 89-98.
- Latreille, P. A. 1802. *Histoire naturelle générale et particulière des Crustacés et des Insectes*. 3: 1-467.
- Manning, R. B., and C. W. Hart. 1984. The status of the hippolytid shrimp genera *Barbouria* and *Ligur* (Crustacea: Decapoda) a reevaluation. *Proceedings of the Biological Society of Washington* 97: 655-665.
- Rafinesque, C. S. 1815. *Analyse de la nature ou tableau de l'univers et des corps organisés*. Palermo, 224 pp.
- Rathbun, M. J. 1901. The Brachyura and Macrura of Porto Rico. *Bulletin of the United States Fisheries Commission* 2: 1-127.
- Rios, R. 1986. Caridean shrimps of the Gulf of California. V. New Records of species belonging to the subfamily Pontoniinae (Crustacea: Decapoda: Palaemonidae). *Proceedings of the Biological Society of Washington* 93: 429-434.
- Schmitt, W. L. 1932. *Coralliocaris pearsei*. In, Pearse, Inhabitants of certain sponges at Dry Tortugas. *Carnegie Institution of Washington Publication* 435: 123-124.
- . 1936. Macruran and Anomuran Crustacea from Bonaire, Curaçao and Aruba. *Zoologische Ergebnisse einer Reise nach Bonaire, Curaçao and Aruba im Jahre 1930*. N° 16. *Zoologische Jahrbücher, Systematik, Ökologie und Geographie der Tiere* 67: 363-378.
- Udekem d'Acoz, C.d'. 1999. Inventaire et distribution des crustacés décapodes de l'Atlantique nord-oriental, de la Méditerranée et des eaux continentales adjacentes au nord de 25°N. *Patrimoines naturels (M.N.H.N./S.P.N.)* 40: 1-383.
- . 2001. First record of *Janicea antiguensis* (Chace, 1972) from the Cape Verde Islands and in the eastern Atlantic (Decapoda, Caridea, Hippolytidae). *Crustaceana* 73: 1163-1166.

RECEIVED: 27 February 2007.

ACCEPTED: 9 May 2007.