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## New amphipods of hydrothermal vent environments on the Mid-Atlantic Ridge, Azores Triple junction zone

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### Abstract

This work is the third publication on the new amphipod species collected from the Azores Triple junction zone by the cruises ATOS, DIVA 2, MARVEL, PICO and SEAHMA 1. Seven new species and a new genus are described belonging to six families, Eusiridae, Leucothoidae, Oedicerotidae, Phoxocephalidae, Pleustidae, and Podoceridae. They were sampled in four sites, Menez Gwen, Lucky Strike, Saldanha and Rainbow.

**Keywords:** *Amphipoda, new species, mid-Atlantic Ridge, hydrothermal vent*

### Introduction

While we possess a lot of data on Atlantic bathyal amphipods, this is not true for amphipods that live on the Mid-Atlantic Ridge. Amphipods are not especially abundant at most locales on the Mid-Atlantic Ridge and sampling is difficult; we thus have had little material to study from each cruise. It was necessary to wait for the development of multiple programmes to obtain sufficient specimens for proper study.

During the diving cruises of IFREMER (Brest, France), sometimes in collaboration with English or Portuguese teams, on the Mid-Atlantic Ridge in the Azores Triple junction zone, some specimens of Amphipods were sampled: Stenothoidae (Bellan-Santini 2005) from DIVA 1 and 2, PICO, MARVEL and ATOS cruises, *Rhachotropis* (Bellan-Santini 2006) from DIVA 2, MARVEL and FLAME 2 cruises. Seven new species belonging to six families from ATOS, DIVA 2, MARVEL, PICO and SEAHMA 1 cruises come from the same zone. The seven new species belong to six families, Eusiridae, Leucothoidae, Oedicerotidae, Phoxocephalidae, Pleustidae, and Podoceridae.

In each cruise, observations and sampling were conducted by a Remotely Operated Vehicle (ROV), Nautile or Victor shipped on an oceanographic ship Atalante or Nadir.

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## Material and methods

Specimens studied here come from five cruises on Azores Triple Junction zone: ATOS, DS Victor/RV Atalante, July 2001 (chief scientist Pierre Marie Sarradin), MAR, Menez Gwen (850 m); DIVA 2, DS Nautille/RV Atalante, June–July 1994 (chief scientists Daniel Desbruyères, Anne Marie Alayse), MAR, Lucky Strike (1686 m); MARVEL, DS Nautille/RV Atalante, August 1997 (chief scientist Daniel Desbruyères), MAR, Rainbow zone (2295 m); PICO, RV Nadir, June–July 1998 (chief scientist Daniel Desbruyères), MAR, Rainbow (2296 m); SEAHMA 1, DS Victor/RV Atalante, July–August 2002 (chief scientist F. Barriga), MAR, Lucky Strike (1680 m), Menez Hom (2298 m), Saldanha (2223 m). In the ATOS and SEAHMA 1 cruises, the amphipods were collected by a slurp gun handled from the submarine Victor. In DIVA 2 cruise *Oediceropsis bicornuta* was captured in a particle trap deposited at the foot of a black smoker. In MARVEL and PICO cruises, specimens come from baskets of vacuum handled from the submarine Nautille.

List of the new species in the different hydrothermal sites (Figure 1) from North to South:

Menez Gwen:

*Leucothoe atosi*, 37°50.52'N–31°32.23'W, 850 m.

Lucky Strike:

*Podosirus vaderi*, 37°17.398'N–32°16.642'W, 1680 m;

*Oediceropsis bicornuta*, 37°17.32'N–32°16.51'W, 1686 m;

*Monoculodes anophthlma*, 37°8'N, 2200 m.

Saldanha:

*Xenodice portuguesi*, 36°33.60'N–33°73'W, 2223 m.

Rainbow:

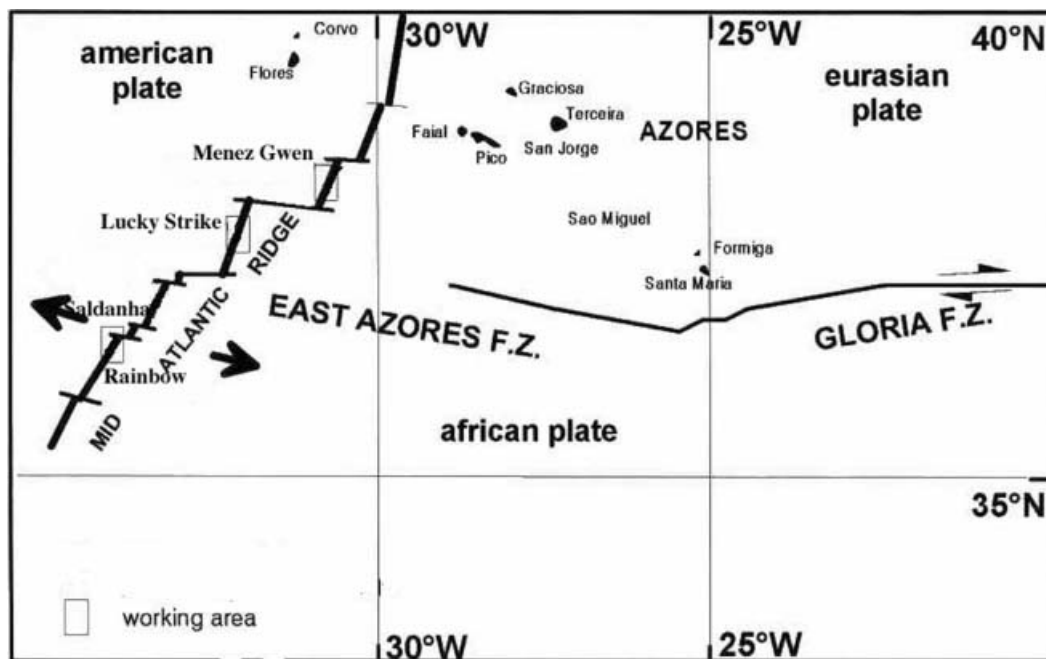


Figure 1. Map of the different hydrothermal sites.

*Harpinia pico*, 36°13.44'N–33°54.10'W, 2296 m;

*Stenopleustes rainbowi*, 36°13.78'N–33°54.14'W, 2295 m.

The specimens are deposited in the Muséum National d'Histoire Naturelle, Paris.

## Taxonomy

Family **EUSIRIDAE**, Stebbing, 1888

Genus ***Podosirus*** n. gen.

(Figures 2, 3)

*Type locality.* Mid-Atlantic Ridge, 37°17.398'N, 32°16.642'W, Lucky Strike site, 1680 m.

*Material examined.* SEAHMA 1, PL 187-09, 12 August 2002, slurp gun 5, Lucky Strike site, 1680m.

*Type species.* *Podosirus spinosa*

*Diagnosis.* Body slender, compressed, weakly toothed. Rostrum moderate, lateral cephalic lobes ordinary. Eyes absent. Antenna 1 with article 1 slightly shorter than the head, toothed at the upper distal corner, article 2 as long as article 1, article 3 short, accessory flagellum absent. Antenna 2 slender. Labrum entire. Mandible molar tritulative, article 2 of palm not lobed, article 3 as long as 2. Maxilla 1 inner plate small, outer plate with large terminal spines. Maxilla 2 inner plate no broader than outer and shorter. Maxilliped inner plate shorter than outer, palp of four articles, elongate, not lobed, article 4 longer than 3, not spinose.

Coxae 1–4 acuminate, less high than broad. Gnathopods diverse, subchelate, not eusirid, carpus not lobate. Pereopods 3–7 simple, basis not lobate, propodus incurved. Epimeral plate 3 rounded. Urosomite 1 longer than 2+3, each one with a dorsal tooth. Uropods 1 and 2 ordinary. Uropod 3 with peduncle as long as rami. Telson entire, oval with sub-terminal spinules.

This new genus with an urosomite 1 elongate, a basis of P3–5 rectilinear, resembles a Podoceridae, but with an accessory flagellum absent, mouthparts basic, coxae medium, gnathopods subchelate, rami of uropod 3 broadly lanceolate, telson entire, will be attributed to the family Eusiridae.

*Etymology.* *Podosirus* in reference to the two families Podoceridae and Eusiridae.

*Relationship.* The Eusiridae family is a complex family with more than 60 genera more or less well defined. *Podosirus* which possesses the various characters of the family differs from the other genera by:

- eyes absent,
- the presence of a distal process on the first article of antenna 1,
- accessory flagellum absent,
- gnathopods diverse, subchelate, not eusirid,
- the shape of pereopods 3–7, with basis rectilinear, merus longer than propodus, propodus curved in claw-shaped and proximally humped.

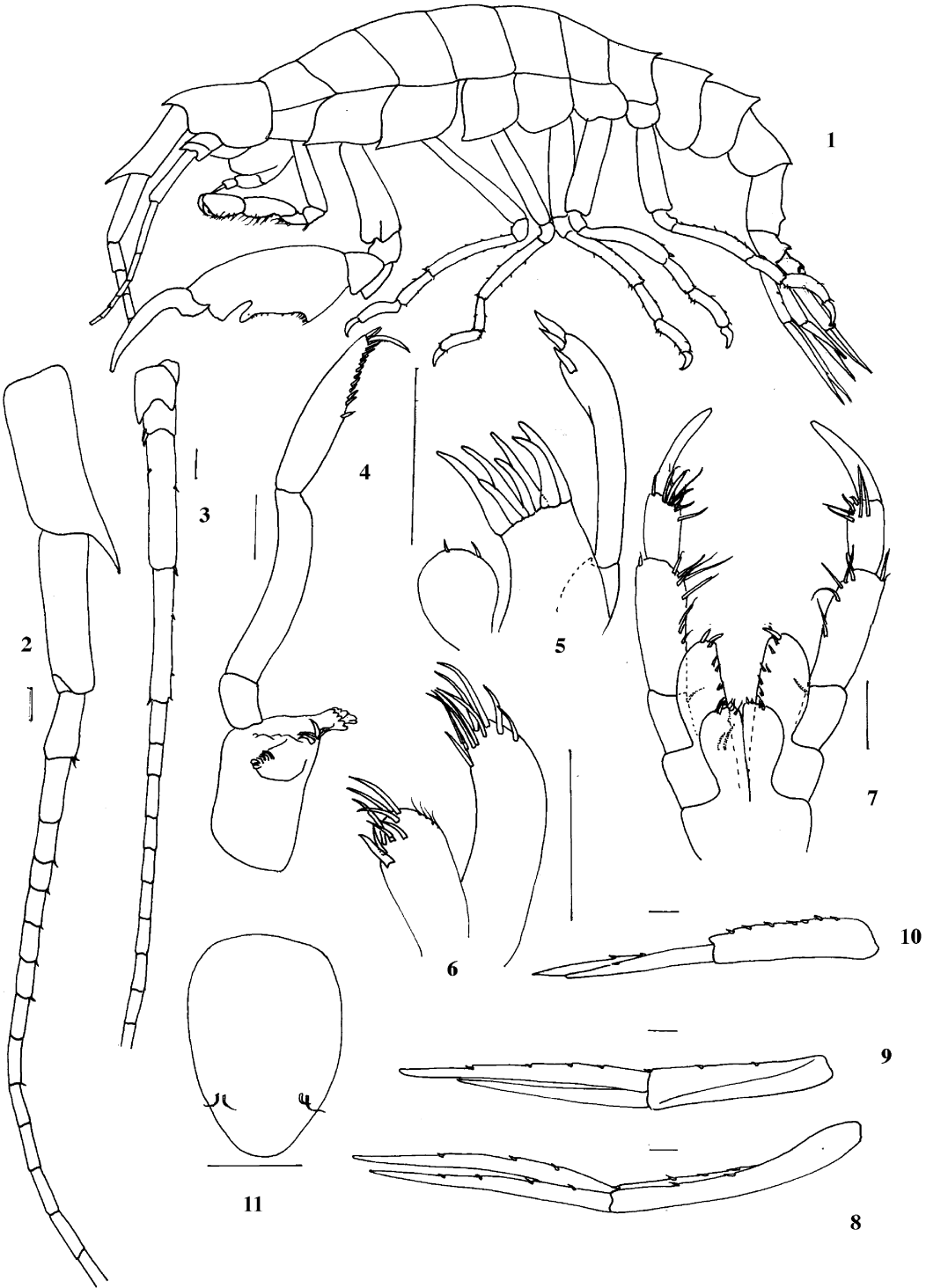


Figure 2. *Podosirus vaderi*, SEAHMA 1 PIL 187-09, holotype female. (1) habitus; (2) antenna 1; (3) antenna 2; (4) mandible; (5) maxilla 1; (6) maxilla 2; (7) maxilliped; (8) uropod 1; (9) uropod 2; (10) uropod 3; (11) telson. Scale bar 100  $\mu$ m.

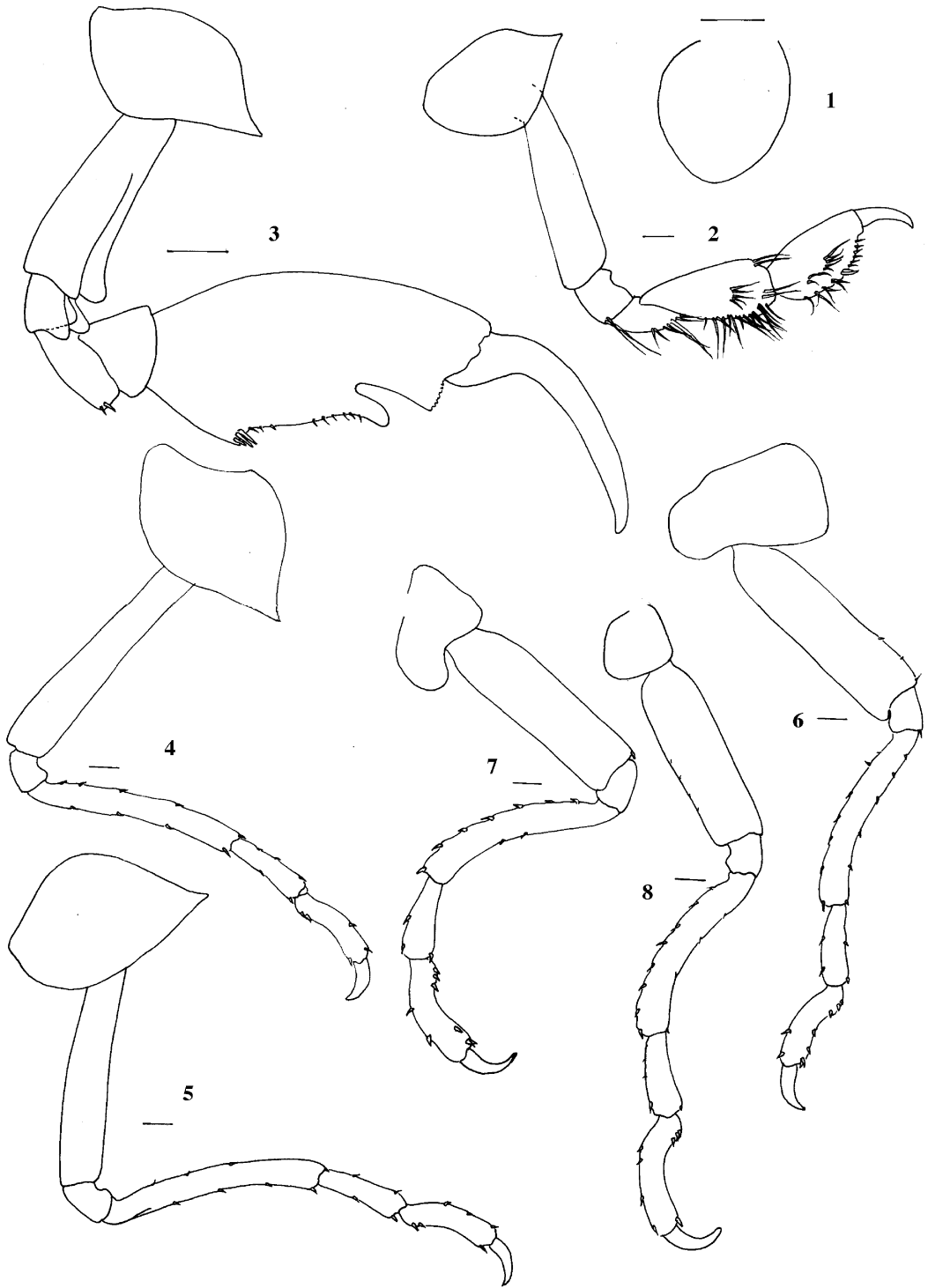


Figure 3. *Podosirus vaderi*, SEAHMA 1 PIL 187-09, holotype female. (1) labrum; (2) gnathopod 1; (3) gnathopod 2; (4) pereopod 3; (5) pereopod 4; (6) pereopod 5; (7) pereopod 6; (8) pereopod 7. Scale bar 100  $\mu$ m

***Podosirus vaderi* n. sp.**

(Figures 1, 2)

*Type locality.* Mid-Atlantic Ridge, 37°17.398'N, 32°16.642'W, Lucky Strike site, 1680 m.

*Material examined.* SEAHMA 1, PL 187-09, 12 August 2002, slurp gun 5, Lucky Strike site, 1680 m, 4 specimens: 1 female with oostegites, holotype MNHN Am-7463; 3 exemplaries of 6, 4 and 4 mm, paratypes MNHN Am-7464.

*Description.* Holotype female 5 mm, with oostegites. Body slender, compressed, last segment of mesosome with a small dorsal process. Segments 1–3 of metasome with a small dorsal process. Segments of urosome each one with a dorsal process small and triangular. Rostrum moderate, lateral cephalic lobe ordinary. Eyes not visible. Antennae flagellum broken. Antenna 1, peduncle articles 1 and 2 of equal length; article 1 with a long dorso-distal process, article 3 small, primary flagellum more than 13-articulate, accessory flagellum absent. Antenna 2 slender, articles 4 and 5 equal, flagellum more than 10-articulate. Labrum entire, rounded.

Mandible with normal triturative molar, incisor sharply dentate, palp long, article 1 short, articles 2 and 3 equal in length, article 3 fringed with small spines on the distal half of the inner side, long sub-terminal spine. Maxilla 1 inner plate small with two small terminal spines, outer plate with seven broad spines. Maxilla 2 inner plate shorter than outer, eight terminal and sub-terminal setae, outer plate with nine terminal setae. Maxilliped inner plate short with two terminal triangular spines and two or three setae, outer plate with small facial spines, two terminal setae, palp with four articles, second longer than 1 and 3, article 4 longer than 3 and smooth.

Coxae 1–4 small, anteriorly produced as a sharp process. Gnathopod 1 smaller than gnathopod 2, subchelate, basis long, ischium and merus short, carpus as long as propodus, fringed with setae, propodus ovate, palmar fringed with small spines and defined by a larger spine, dactylus half of propodus. Gnathopod 2 large, basis long with two anterior crests ending distally with a small rounded process, ischium crested, merus produced, carpus triangular, propodus longer than broad, palm indented in a finger shape, proximal part with small spines and defined by three larger spines, dactylus long as two-thirds of the propodus.

Pereopods 3 and 4 similar, basis straight and long, ischium short, merus long as basis, fringed on both sides by small spines, carpus shorter than merus and propodus, propodus curved and humped in the proximal part, dactylus half length of propodus, claw-shaped.

Pereopods 5–7 similar, basis not lobate but little more broad than pereopods 3 and 4, other articles similar to pereopods 3 and 4.

Epimeral plates 1–3 similar, rounded.

Uropod 1, peduncle equal to sub-equal rami, each ramus fringed with scarce small spines. Uropod 2, outer ramus scarcely shorter than inner. Uropod 3 not expanded beyond uropods 1 and 2, rami lanceolate equal to peduncle, peduncle fringed with small spines. Telson entire, ovate, two pairs of sub-terminal spinules.

*Etymology.* The species is named in honour of Wim Vader for his important and friendly contribution to “amphipodology”.

Family **LEUCOTHOIDAE**, Dana, 1852

***Leucothoe atosi*** n. sp.

(Figures 4, 5)

*Type locality.* Mid-Atlantic Ridge, Menez Gwen site, 37°50.52'N, 31°32.23'W, 850 m.

*Material examined.* ATOS cruise, 22 June–22 July 2001, 850 m. 113–15, vacuum 3, 5 specimens, 1 female of 5 mm, holotype, MNHN Am-7465, four other specimens, paratypes MNHN Am-7466.

*Diagnosis.* Rostrum short and rounded, eyes absent. Gnathopod 1 narrow, propodus two-thirds length of carpus, dactylus short, one-quarter length of propodus. Pereopods 3 and 4 similar, linear. Pereopods 5–7 basis narrow. Telson triangular elongate, more than two times long as broad.

*Description.* Holotype female, 5 mm. Rostrum short and rounded, antero-ventral margin of the head truncate. Eyes absent. Antennae short, equal in length. Antenna 1 equal to the head and three first segments of pereon together, articles 1/2/3 ratio 4:4:1, flagellum of four articles. Antenna 2 with flagellum five-articulate. Mandible, raker row with eight spines, incisor toothed, palp article 1 short, article 3 half of article 2. Inner plate of maxilla 1 bearing a single apical seta, outer plate with five spines and four setae, palp biarticulate. Maxilla 2 inner plate bearing four setae, outer plate with three apical setae. Maxilliped, inner plate with three or four apical setae, outer plate reaching one-quarter along inner margin of palp article 1, inner margin straight with one apical spine and one seta, palp four-articulate.

Coxa 1 slightly smaller than 2–4, rounded anteriorly. Coxae 3 and 4 subquadrate.

Gnathopod 1 narrow, carpus long and narrow, propodus two-thirds length of carpus, dactylus short, one-quarter length of propodus. Gnathopod 2 carpus lobate, lobe exceeding one-quarter length of propodus, propodus with palm rounded, dactylus three-quarter length of propodus. Pereopods 3 and 4 linear. Pereopods 5–7 basis narrow.

Epimeral plate 2 quadrate. Epimeral plate 3 with a small postero-distal point. Uropod 1 outer ramus slightly shorter than inner. Uropod 2 outer ramus three-quarter length of inner. Uropod 3 missing. Telson triangular elongate, more than twice as long as broad.

*Etymology.* Named for the cruise ATOS.

*Relationship.* Thomas and Klebba (2006) give 84 species for the “leucothoid clade”, after the revision of the family in Lowry et al. (2000). In the Atlantic genus *Leucothoe* only two species are blind, *L. rostrata* Chevreux, 1908 and *L. uschakovi* Gurjanova, 1951. *Leucothoe rostrata* was sampled from Azores near Menez Gwen site, at 1360 m deep. It has a rostrum very long and pointed, as long as three-quarters of the first article of antenna 1; telson heart-shaped, a little longer than broad. *Leucothoe ushakovi*, sampled from Greenland at 3000 m, is a very large species (34 mm) with a rostrum well developed, inner lobe of maxilla 2 with many small setae, coxa 1 hardly directed anteriorly, epimeral plate 2 with a postero-distal point. Elsewhere two other species are blind or with eyes very poorly developed, *Leucothoe pacifica* Nagata, 1963, with an epimeral plate sinuate at lower posterior corner and pereopods 5–7 with lobed basis and *Leucothoe panpulco* Barnard, 1961, with “epimeral





Figure 4. *Leucothoe atosi*, ATOS 113-15, holotype. (1) habitus; (2) head; (3) mandible; (4) maxilla 1; (5) maxilla 2; (6) maxilliped; (7) gnathopod 1; (8) gnathopod 2; (9) epimeral plates 1-3; (10) telson. Scale bar 100 µm.

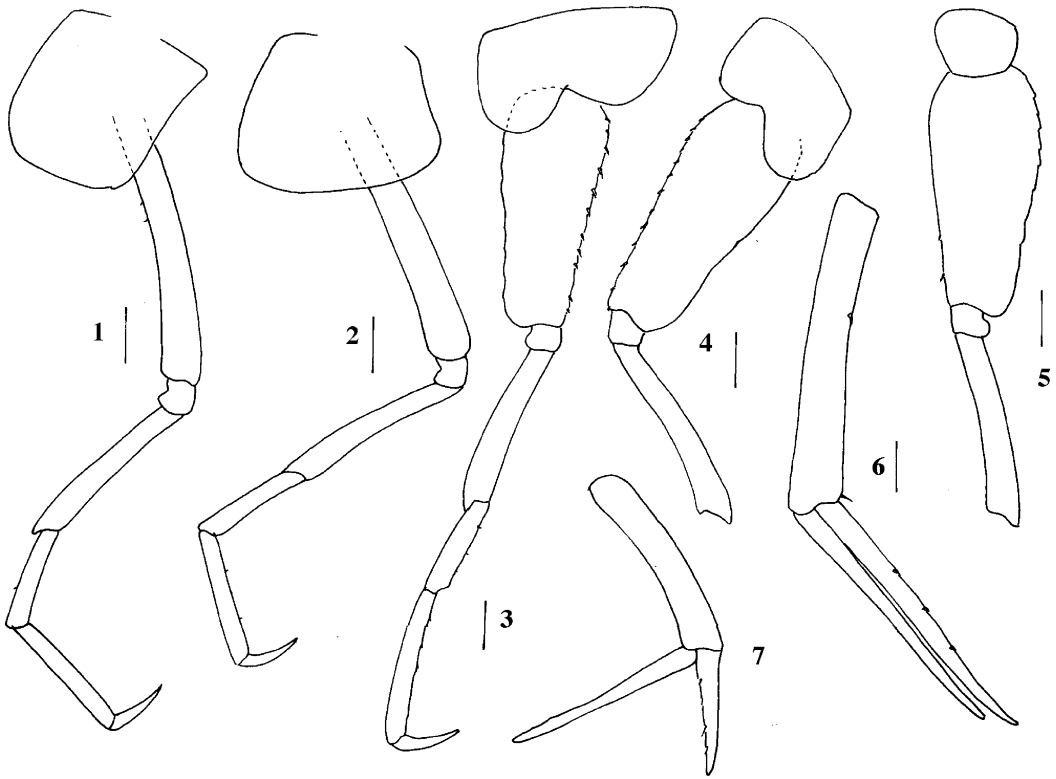


Figure 5. *Leucothoe atosi*, ATOS 113-15, holotype. (1) pereopod 3; (2) pereopod 4; (3) pereopod 5; (4) pereopod 6; (5) pereopod 7; (6) uropod 1; (7) uropod 2. Scale bar 100  $\mu$ m.

plate behind sinuous, lower corner quadrate” and “third palp article of mandible more than half as long as second article”.

Family **OEDICEROTIDAE** Lilljeborg, 1865

***Monoculodes anophthalma*** n. sp.

(Figures 6–8)

*Type locality.* Mid-Atlantic Ridge, Lucky Strike (Menez Hom), 37°8'N, 2200 m.

*Material examined.* SEAHMA 1 cruise, PL 186-04, slurp gun, 7 August 2002, 2200 m, 12 specimens: 1 female holotype MNHN-Am 7467, 11 specimens paratypes MNHN Am-7468.

*Diagnosis.* Rostrum shorter than article 1 of antenna 1 peduncle. Eyes absent. Antennae equal and short. Gnathopods 1 and 2 similar, subchelate, without long lobate carpus.

*Description.* Holotype female, 4 mm. Rostrum longer than lateral cephalic lobe and shorter than article 1 of antenna 1. Eyes absent. Antennae equal, shorter than half body length. Antenna 1, articles 1/2/3 ratio 5:5.7:2.9, no accessory flagellum visible, flagellum 11-articulate. Antenna 2, article 5 slightly shorter than 4, flagellum 12-articulate. Mandible

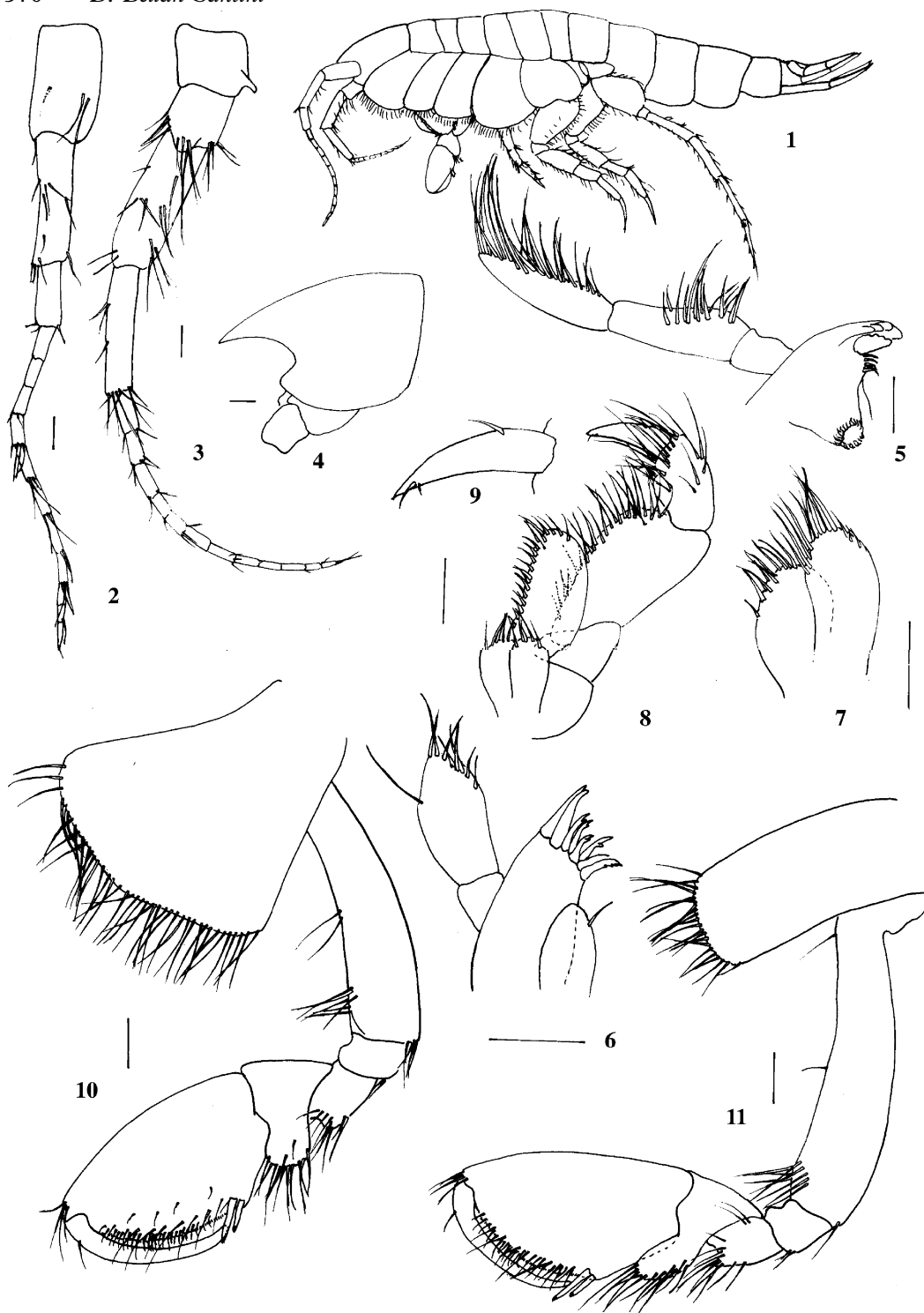


Figure 6. *Monoculodes anophthalma*, SEAHMA 1, PL 186-04, holotype female. (1) habitus; (2) antenna 1; (3) antenna 2; (4) rostrum; (5) mandible; (6) maxilla 1; (7) maxilla 2; (8) maxilliped; (9) dactylus of article 3 of maxillipedal palp; (10) gnathopod 1; (11) gnathopod 2. Scale bar 100  $\mu$ m.

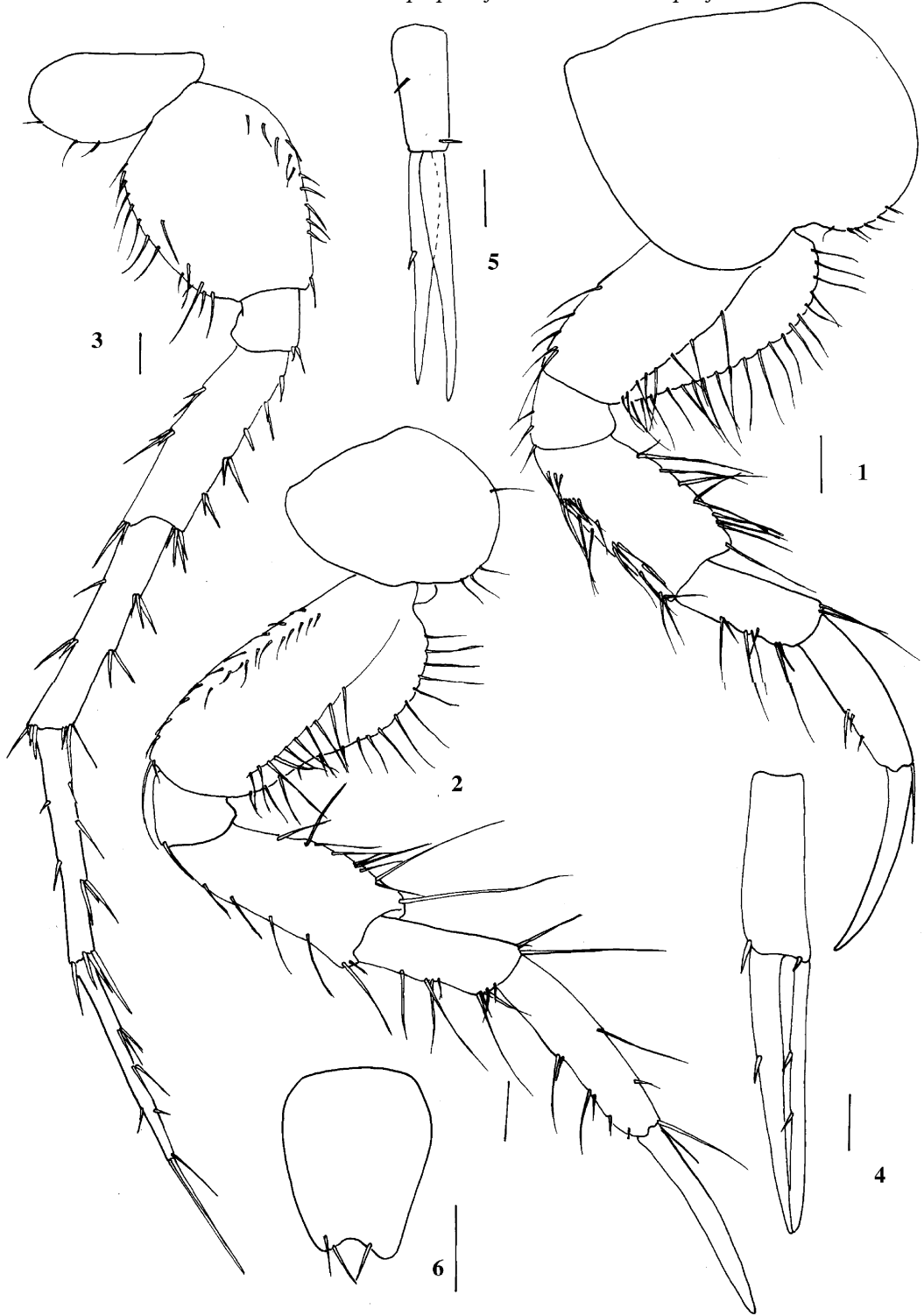


Figure 7. *Monoculodes anophthalma*, SEAHMA 1, PL 186-04, holotype female. (1) pereopod 5; (2) pereopod 6; (3) pereopod 7; (4) uropod 2; (5) uropod 3; (6) telson. Scale bar 100  $\mu$ m.

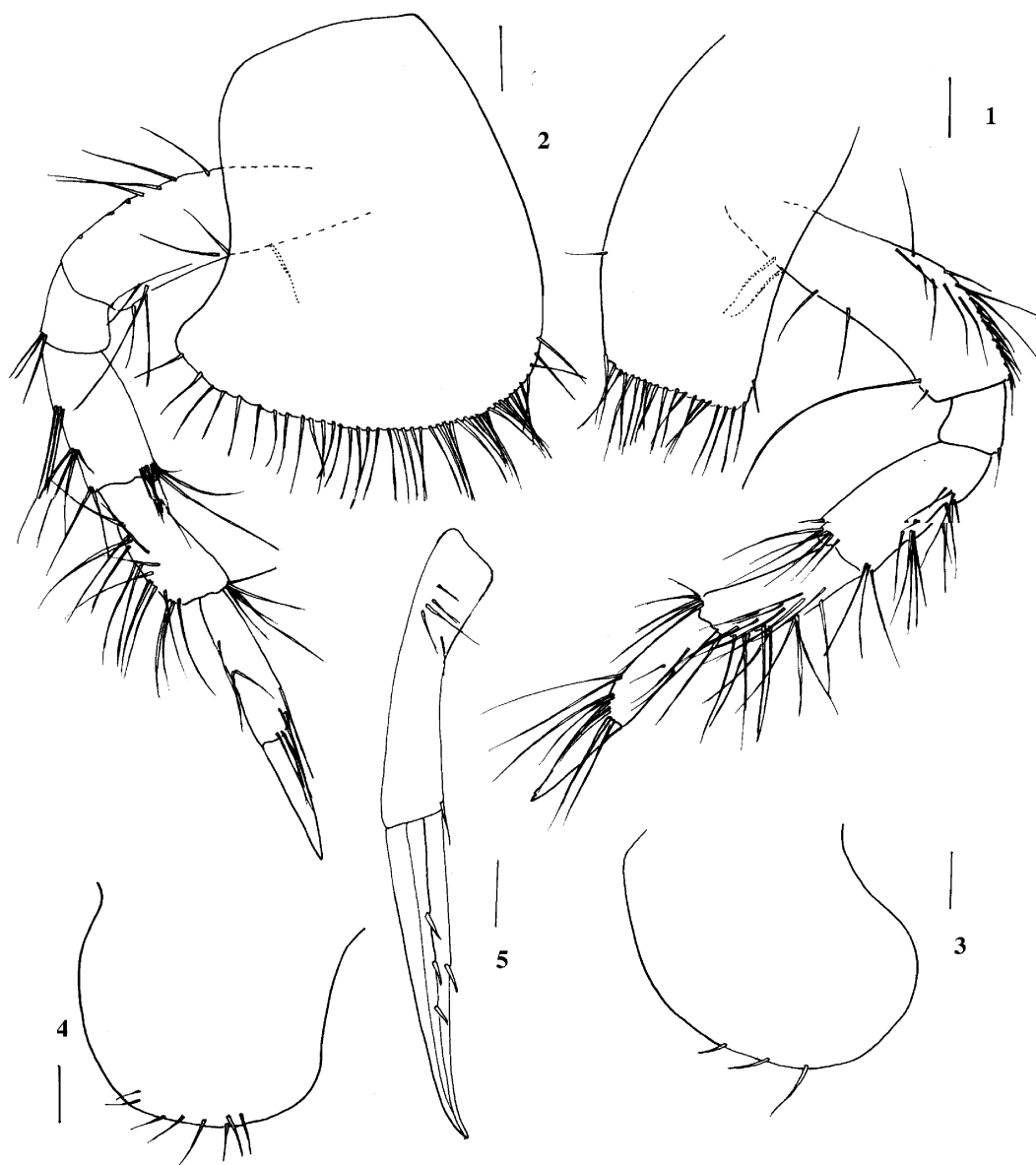


Figure 8. *Monoculodes anophthalma*, SEAHMA 1, PL 186-04, holotype female. (1) pereopod 3; (2) pereopod 4; (3) epimeral plate 2; (4) epimeral plate 3; (5) uropod 1. Scale bar 100  $\mu$ m.

with incisor process hardly denticulate, molar process columnar denticulate, palp triarticulate, first article smooth, article 2 setose on the proximal part, article 3 strongly setose. Maxilla 1, inner lobe with one single subterminal seta, outer lobe eight-denticulate, palp biarticulate, and distal article enlarged. Maxilla 2 classical, inner lobe shorter than outer. Maxilliped strongly setose, palp four-articulate, third article enlarged, distally falcate.

Coxa 1 distally enlarged, strongly setose on the distal margin. Coxae 2 and 3 subrectangular, distal margin strongly setose. Coxa 4 enlarged, posteriorly excavate, distally strongly setose. Gnathopod 1 subchelate; merus distally setose; carpus slightly

lobate and setose; propodus length/width ratio 14:8.5, palm defined by a pair of bifid spines, fringed with small indentations, numerous small setae and seven long setae; dactylus as long as palm, smooth except for a proximal seta on the external margin. Gnathopod 2 a little longer than gnathopod 1, but similar; carpus with distal lobe a little longer than for gnathopod 1; propodus oval, palm defined by a pair of bifid spines, length/width ratio 14.5:8, palm fringed by numerous small setae and five long setae; dactylus slightly shorter than palm, smooth except for a proximal seta on the external margin.

Pereopods 3 and 4 elongate, basis, merus, carpus, propodus with long setae, dactylus slightly shorter than propodus, smooth. Coxa 5 bilobate, posteriorly setose. Pereopod 5 basis lobate posteriorly, lobe large proximally, edge indented and fringed with long setae, middle of the lobe with a row of long setae, anterior edge with long setae, dactylus smooth, longer than propodus, dactylus/propodus ratio 8:7. Coxa 6 rounded with few long setae. Pereopod 6 similar to pereopod 5. Coxa 7 small, oval, pereopod 7, basis enlarged, posteriorly regularly lobate, fringed with long setae; pereopod very elongate; dactylus slightly shorter than propodus, dactylus/propodus ratio 15.5:16.5, prolonged distally by two long setae.

Epimeral plate 3 rounded, fringed distally by long setae. Uropod 1, rami equal, longer than peduncle. Uropods 2 and 3 rami equal and longer than peduncle. Telson entire longer than wide, discreetly excavated with two terminal setae and one subterminale.

*Etymology.* Name refers to the fact that species is blind.

*Relationship.* The genus *Monoculodes* has been defined in the Oedicerotidae with antenna 2 short, subchelate gnathopods with the carpal lobes more or less enlarged. Jo (1990) has given a good diagnosis of the genus; Bousfield and Chevrier (1996) considered *Monoculodes* to be a complex and gave a “formal rediagnosis”. They consider that in this large group a subgeneric division is required.

Only four *Monoculodes* are blind with gnathopods 1 and 2 similar, without long lobate carpus and with a rostrum longer than lateral cephalic lobes: *M. abacus* Barnard, 1961, *M. latissimanus* Stephensen, 1931, *M. rostratus* Stephensen, 1931 and *M. sudor* Barnard, 1967. *Monoculodes abacus* has the rostrum reaching the end of the first peduncular article of antenna 1, propodus of gnathopods 1 and 2 are triangular. *Monoculodes latissimanus* has the propodus of the gnathopod 1 “extremely broad, nearly as broad as long”, pereopods 3–7 have the dactyli long “nearly as long as the two preceding joints together”; the lateral lobe is quadrate. *Monoculodes rostratus* has a rostrum “as long as the head behind the process”; gnathopods 1 and 2 have the carpus with a long process. *Monoculodes sudor* has the rostrum “reaching to apex of article 1 of antenna 1”; lateral cephalic lobe with subacute apex; dactyli of pereopods 3 and 4 slightly longer than propodus; telson rounded apically. With *Monoculodes anophthalma*, only *M. latissimanus* has been found in the Atlantic, in Greenland.

*Distribution and habitat.* Mid-Atlantic Ridge, central Atlantic Ocean.

***Oediceropsis bicornuta* n. sp.**  
(Figures 9–12)

*Type locality.* Mid-Atlantic Ridge, Lucky Strike (Tour Eiffel), 37°17.32'N, 32°16.51'W, 1686 m.

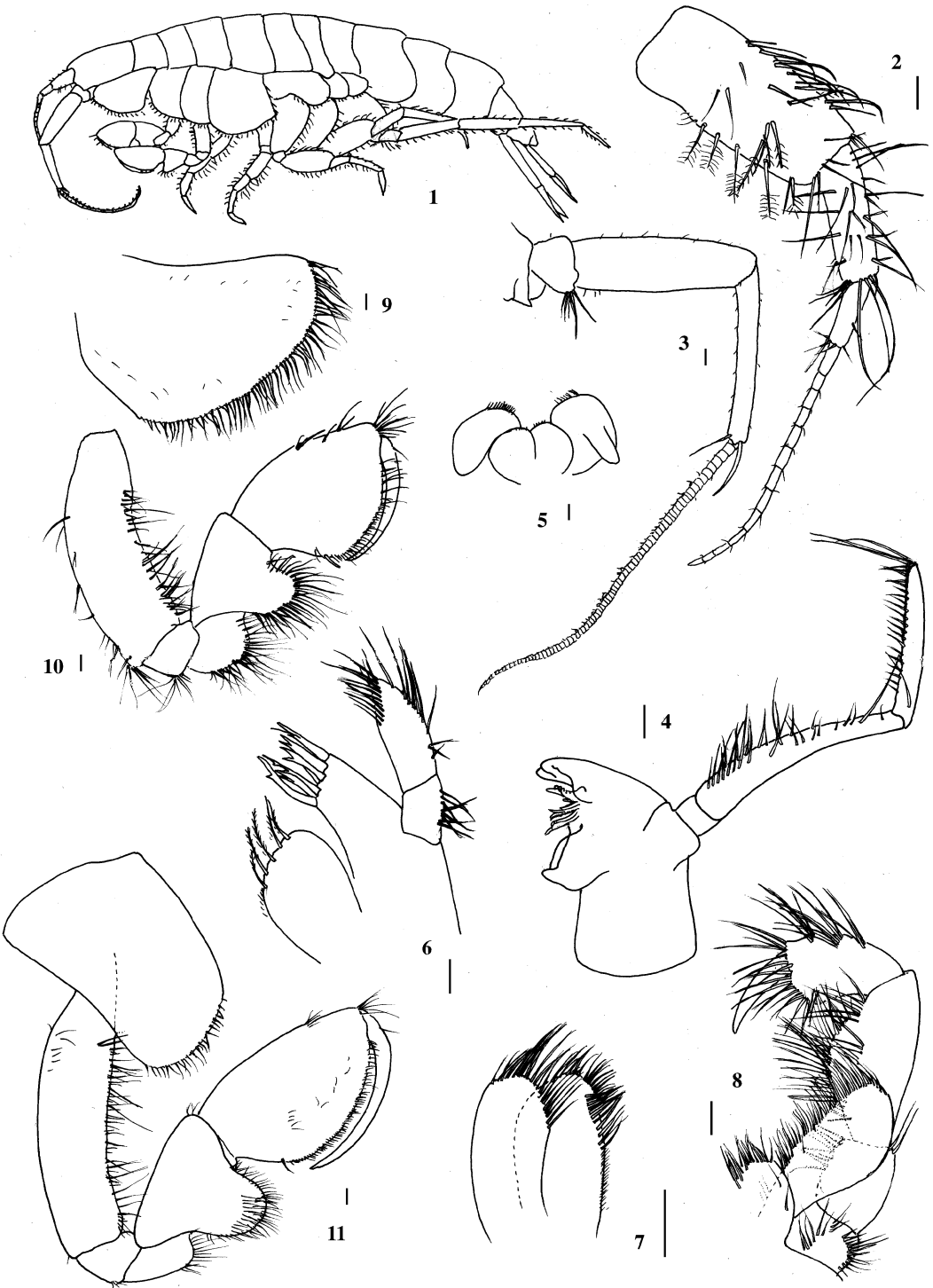


Figure 9. *Oediceropsis bicornuta*, Diva 2. Holotype female. (1) habitus; (2) antenna 1; (3) antenna 2; (4) mandible; (5) labium; (6) maxilla 1; (7) maxilla 2; (8) maxilliped; (9) coxa 1; (10) gnathopod 1; (11) gnathopod 2. Scale bar 100 µm.

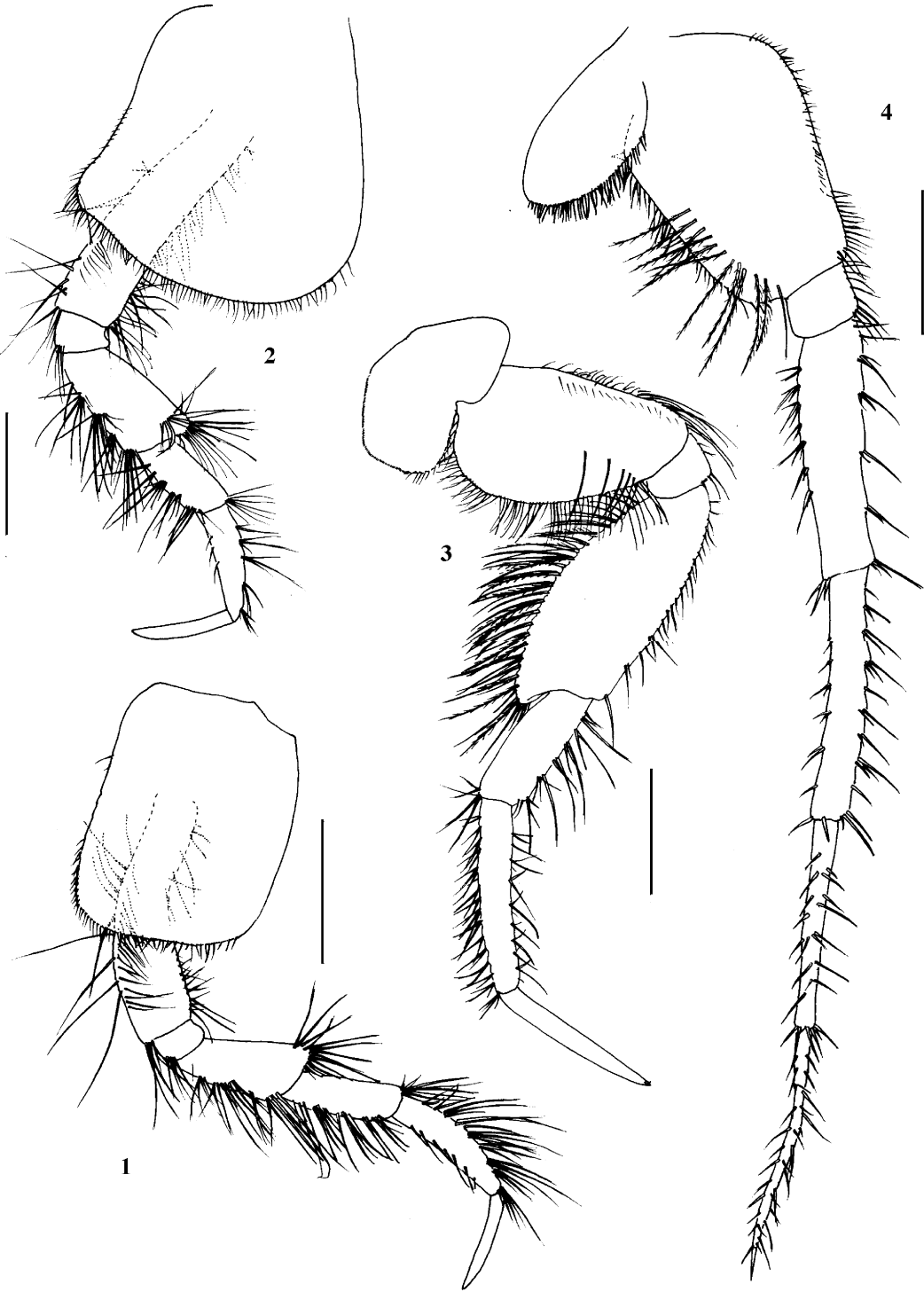


Figure 10 *Oediceropsis bicornuta*, Diva 2. Holotype female. (1) pereopod 3; (2) pereopod 4; (3) pereopod 6; (4) pereopod 7. Scale bar 1000 µm.



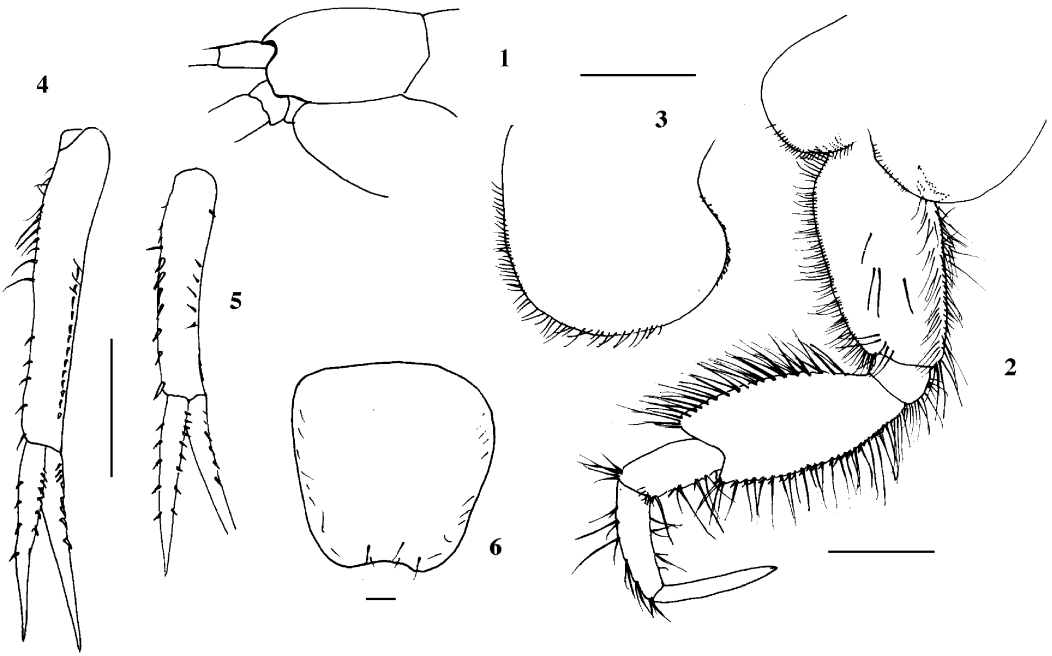
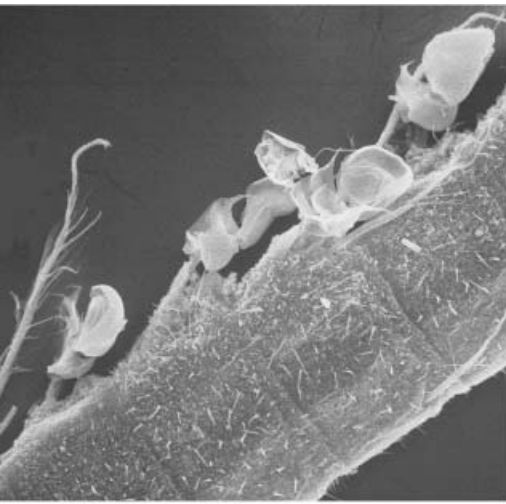


Figure 11. *Oediceropsis bicornuta*, Diva 2. Holotype female. (1) head; (2) pereopod 5, (3) epimeral plate 3; (4) uropod 1; (5) uropod 2; (6) telson. Scale bar 6 100µm; 2, 3, 4, 5: 1000µm.

*Material examined.* DIVA 2 cruise (particle trap triple 4 June 1994–1 July 1994, 1.5 m of the bottom), foot of black smoker. Tour Eiffel, 1686 m, 1 female holotype MNHN-Am 7469.



1



2

Figure 12. *Oediceropsis bicornuta*, Diva 2. Holotype female. (1) antenna 2 flagellum with calceoli et setose seta; (2) Antenna 2, calceolus. Scale bar 1: 100µm; 2: 10µm.

*Diagnosis.* Antenna 1 short, accessory flagellum absent. Antenna 2 shorter than half of body length, peduncle article 5 with a long antero-distal curved spine, each article of the flagellum with a plumose seta and a calceolus. Eyes absent. Telson normal.

*Description.* Holotype female with oostegites, 16 mm. Head is equal to the two first segments of the mesosome. Body smooth. Eyes absent. Rostrum short, as long as lateral cephalic lobe. Lateral cephalic lobe quadrate. Antenna 1 reaching the end of article 4 of the peduncle of antenna 2; article 1 robust with single setae on the superior edge and plumose setae at the inferior edge; article 2 equal to 0.6 of article 1, setose; article 3 equal to half of article 2; accessory flagellum absent, flagellum 13-articulate. Antenna 2 shorter than half of body length, peduncle article 5 with a long curved antero-distal spine, as long as the eight first articles of the flagellum, and a posterior spine less long and straight; flagellum 67-articulate bearing at the inferior edge of each article a plumose seta and a calceolus. Mandible with incisor process denticulate, molar columnar, palp triarticulate, first article short and smooth; article 2 slightly curved and fringed with many short setae, one long subterminal seta; article 3 fringed with a single row of short setae, three long distal setae. Maxilla 1 inner plate rounded, fringed on the inner edge by five plumose setae, outer plate with seven bidentate spines, palp biarticulate, article 1 setose on the external edge, article 2 setose on the external edge and at the distal part of the inner edge. Maxilla 2 both plates equal and hardly setose. Maxilliped inner and outer plates setose on the inner edge, palp four-articulate, article 2 enlarged in the medial part, article 3 wide distally, article 4 falcate.

Coxa 1 enlarged distally, distal edge fringed with numerous setae. Coxa 2, subrectangular, distal edge slightly shorter, rounded and fringed with numerous setae. Coxa 3 rectangular, distal edge setose, coxa 4 not excavate posteriorly, only concave, distal edge and half posterior edge setose.

Gnathopods subchelate. Gnathopod 1 basis fringed on both edges, ischium and merus short; carpus lobate, as long as wide, lobe not extending along the propodus; propodus enlarged length/breadth ratio 7:5, palm rounded, fringed with numerous short setae, delimited by a spine; dactylus curved, as long as palm. Gnathopod 2 basis fringed on the anterior edge; ischium and merus short; carpus lobate, lobe setose; propodus ovate, palm rounded, delimited by a spine, dactylus curved, long as palm. Pereopods 3 and 4 basis setose on both edges, merus distally enlarged, dactylus long. Pereopod 5 basis slightly lobate, strongly setose on both edges, merus ovate, fringed by long plumose setae on posterior edge and distal anterior one, dactylus long and blade shaped. Pereopod 6 basis proximally lobate, fringed on both edges by long setae; merus ovate, fringed with long setose seta on the posterior edge and simple setae on the anterior edge; dactylus seven-eighths length of propodus and blade-shaped. Pereopod 7 elongate, basis slightly lobate, fringed on both edges by long setae, plumose setae on the lobe; ischium short, merus/carpus/propodus/dactylus ratio 10:12:9.5:10, all articles fringed on both edges by robust setae.

Epimeral plate 3 rounded, fringed with short setae. Uropod 1 peduncle long and spinose, equal rami spinose, peduncle/rami ratio 13:8. Uropod 2 peduncle long and spinose, peduncle/rami ratio 9:8. Uropod 3 lost. Telson entire, as long as wide, distally excavated, fringed with small setae on the sides, two pairs of little distal setae.

*Remarks.* The calceoli of antenna 2 of this species have an original shape. Lincoln and Hurley (1981) have given good descriptions of the different types of calceoli. They describe nine structural types for different families. They consider that for eusirid, gammarellid and

oedicerotid types, the calceoli are “immediately distinguished ... from other calceoli” by “the distinct separation of the proximal and distal elements and the remarkable cup-shaped configuration of the former”. In *Oediceropsis bicornuta*, a membrane with two acute tips envelops the fluted proximal parabolic element, the distal element is saucer shaped with a ridged plate interiorly.

*Relationship.* In the Oedicerotidae, the genus *Oediceropsis* is characterized by the buccal structure; rostrum small or absent; gnathopods similar to one another, subchelate; articles 4 and 5 of antenna 2 with several very large or elongated and curved spines. Three species of *Oediceropsis* have been described; *O. brevicornis* Lilljeborg, 1865; *O. elsula* Barnard, 1966 and *O. proxima* Chevreux, 1908. *Oediceropsis bicornuta* is distinguished from *O. brevicornis* by absence of eyes, size of antenna 1 reaching the end of article 4 of antenna 2, absence of hump in the coxa 4 and the telson distally excavated; from *O. elsula* by size of rostrum, shape of gnathopod 1 carpus and propodus, absence of posterior hump in the coxa 4, shape of telson. *Oediceropsis proxima* considered as very near to *O. brevicornis* has a short description, but coxa 4 is expanded posteriorly with a sharp upturned point; in *Oediceropsis bicornuta* the posterior edge of coxa 4 has only a small distal hump without point; the propodus of gnathopod 1 in *O. proxima* is longer than wide as gnathopod 2, in *O. bicornuta* the propodus of gnathopod 1 is as long as wide; the first two pereopods of *O. proxima* have the dactylus longer than propodus, in *O. bicornuta* dactylus/propodus have a ratio 2:2.6 in pereopod 3 and 2:2.3 in pereopod 4. The telson of *Oediceropsis proxima* has a crenulated distal margin not excavated as in *O. bicornuta*; *O. proxima* has no calceoli on antenna 2.

*Distribution and habitat.* Mid-Atlantic Ridge, central Atlantic Ocean.

*Etymology.* The name is suggested by the special shape of the membrane enveloping the proximal element of the calceoli.

Key of *Oediceropsis* species

- 1. Eyes present . . . . . *O. brevicornis*  
– Eyes absent . . . . . 2
- 2. Coxa 4 posteriorly acutely produced . . . . . *O. proxima*  
– Coxa 4 posteriorly bluntly, not acutely produced . . . . . 3
- 3. Gnathopod 1, posterior lobe of carpus short and blunt, propodus ovate . . . . . *O. elsula*  
– Gnathopod 1, posterior lobe of carpus projecting and rounded, propodus as long as wide . . . . . *O. bicornuta*

Family **PHOXOCEPHALIDAE** Sars, 1895  
***Harpinia pico*** n. sp.  
(Figures 13–15)

*Type locality.* Mid-Atlantic Ridge, site Rainbow, 36°13.44'N–33°54.10'W, 2296 m.

*Material examined.* PICO, PL1266, 2 July 1998, basket, 2296 m, 2 specimens, 1 female 9 mm, holotype, MNHN Am-7470, 1 individual 4 mm. SEAHMA 1, PL 186-04, Lucky

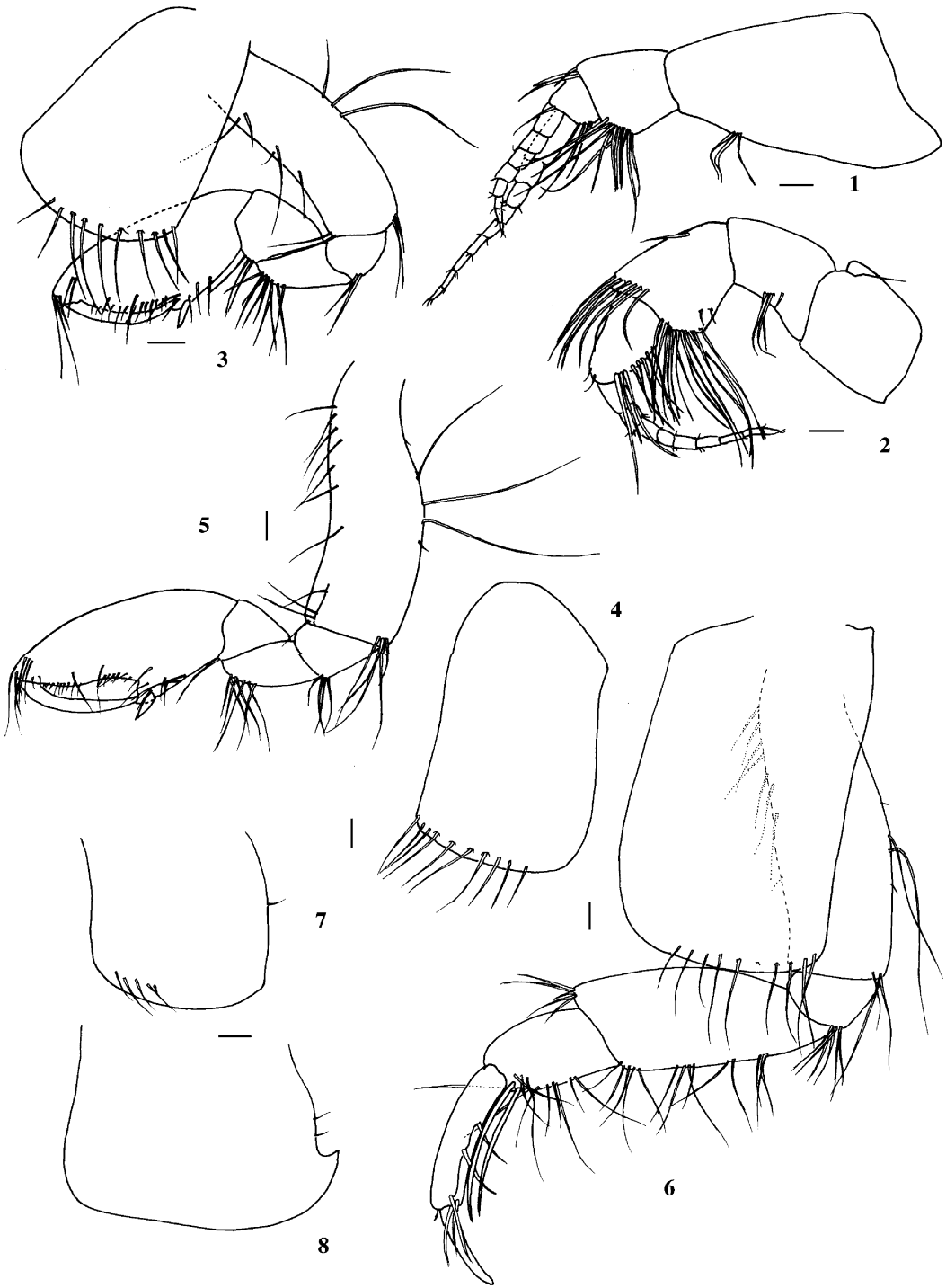


Figure 13. *Harpinia pico*, PICO PL1266. Holotype female. (1) antenna 1; (2) antenna 2; (3) gnathopod 1; (4) coxa 2; (5) gnathopod 2; (6) pereopod 3; (7) epimeral plate 2; (8) epimeral plate 3. Scale bar 100 μm.



Figure 14. *Harpinia pico*, PICO PL1266. Holotype female. (1) pereopod 4; (2) pereopod 5; (3) pereopod 6; (4) maxilliped. Scale bar 100  $\mu$ m.

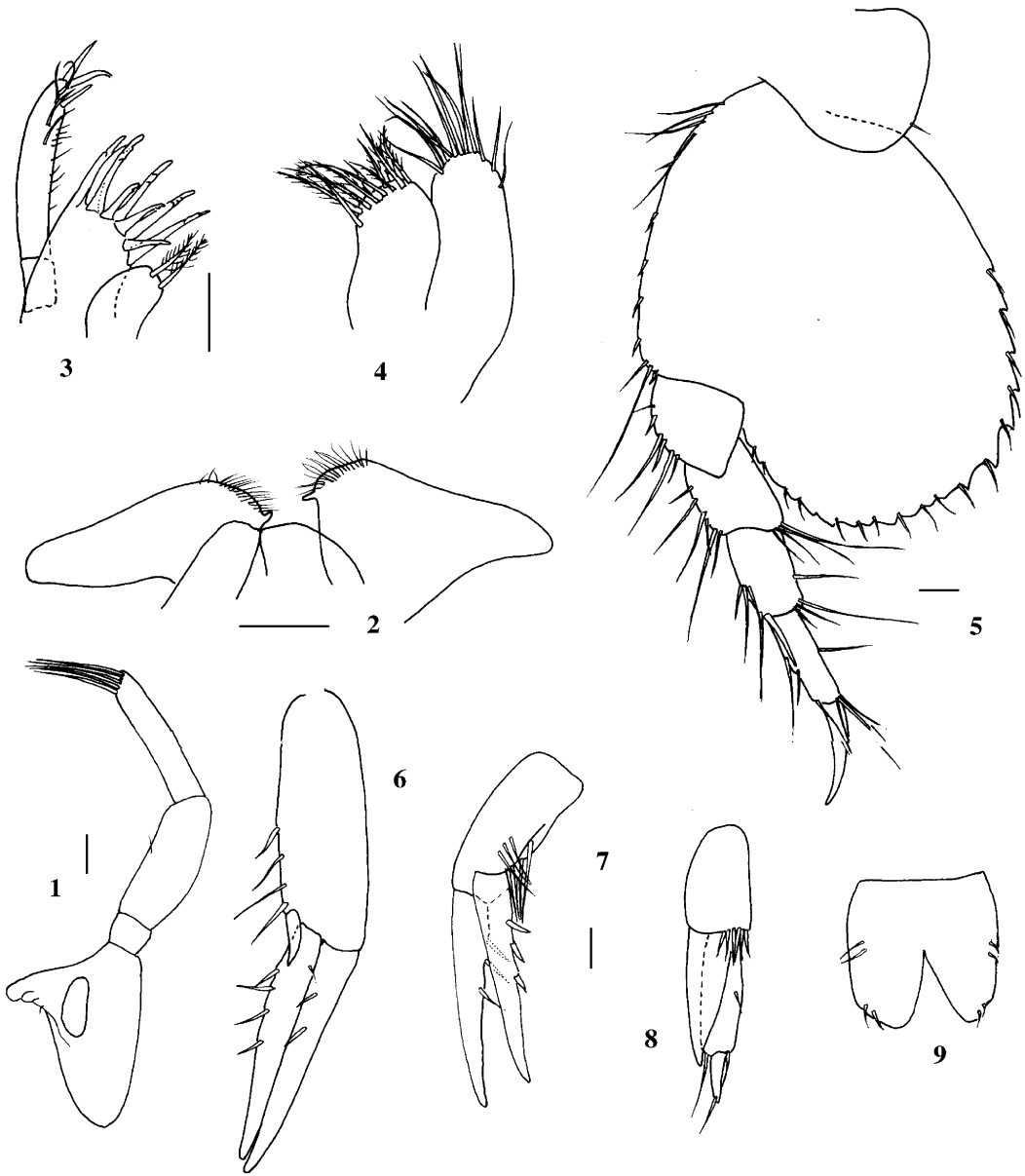


Figure 15. *Harpinia pico*, PICO PL1266. Holotype female. (1) mandible; (2) labium; (3) maxilla 1; (4) maxilla 2; (5) pereopod 7; (6) uropod 1; (7) uropod 2; (8) uropod 3; (9) telson. Scale bar 100  $\mu$ m.

Strike (Menez Hom), 2298 m, vacuum 2, 7 August 2002, 4 specimens, 5 paratypes MNHN Am-7471

**Diagnosis.** Pleon segments 1–3 without setae. Antenna 2 peduncle without ensiform process. Epimeral plate 3 with a postero-distal corner in hook shape. Pereopod 7, basis serrate posteriorly, lobe reaching end of merus.

*Description.* Holotype female with oostegites, 9 mm. Pleon segments 1–3 each without setae. Head relatively short. Antenna 1 flagellum nine-articulate, accessory flagellum eight-articulate. Antenna 2 peduncle without ensiform process, flagellum nine-articulate. Maxilla 1 inner plate with two plumose setae, palp with two distal spine-like setae, one subterminal and three lateral setae, and numerous small hair-like setae on the surface. Maxilla 2 inner plate shorter than outer, with ten plumose setae, outer plate with 12 setae. Maxilliped inner plate short with five plumose setae, palp article 4 long with a nail as long as article 4.

Coxae 1–3 with distal margin entire, without tooth, the distal margin fringed with long setae. Gnathopods similar. Gnathopod 2 propodus narrower than gnathopod 1, palm more excavate, defined by a prominence with a spine. Pereopods 3 and 4 carpus with two strong and long spine-like setae on postero-distal corner; propodus with two setae on posterior margin and two or three distal setae; dactylus half length of propodus. Pereopod 6 with long dactylus, dactylus/propodus ratio 5:6. Pereopod 7, basis serrate posteriorly, lobe reaching end of merus.

Epimeral plate 2 with postero-distal corner angular bearing five setae on the proximal part of the distal margin. Epimeral plate 3 with a postero-distal corner in hook shape. Uropod 1 peduncle with four marginal setae and a stout distal spine, rami equal with respectively three and four setae. Uropod 2 rami subequal with three spines each. Uropod 3 peduncle short with six distal setae, inner ramus exceeding first article of outer ramus, without distal seta, outer ramus biarticulate, article 1 with two terminal setae, article 2 with a long distal seta. Telson as broad as long, each lobe with two short subdistal and two lateral setae.

*Etymology.* The name of the species is derived from the name of the PICO cruise.

*Relationship.* Barnard and Karaman (1991) list 17 species in the genus *Harpinia*, three new species were described subsequently, *Harpinia agna* Karaman, 1987, *H. ala* Karaman, 1987 and *H. zavodniki* Karaman, 1987. Only two species also have an epimera 3 with a hooked corner: *H. agna* and *H. crenulata*. *Harpinia pico* differs from *H. agna* by the shape of epimera 3, the size of the antennae, the shape of article 4 of the maxilliped palp, the shape of pereopod 7 basis and by the pilosity. *Harpinia pico* differs from *H. crenulata* by the shape of epimera 3, size of flagellum of antennae, article 4 of maxilliped palp, basipodite of pereopod 7 and uropod 1.

*Distribution and habitat.* Mid-Atlantic Ridge, central Atlantic Ocean on the sites Rainbow and Menez Hom.

#### Family **PLEUSTIDAE** Buchholz, 1874

##### ***Stenopleustes rainbowi*** n. sp.

(Figures 16, 17)

*Type locality.* Mid-Atlantic Ridge, Rainbow site 36°13.78'N, 33°54.14'W, 2295 m.

*Material examined.* MARVEL cruise, PL1199, 26 August 1997, basket, MAR, Rainbow site, 2295 m, 4 specimens: one adult female of 8 mm, holotype MNHN Am-7472, one female which has lost the head, of 10.5 mm (entire probably 12 mm), one female of 9 mm, one young of 6 mm, paratypes MNHN Am-7473.

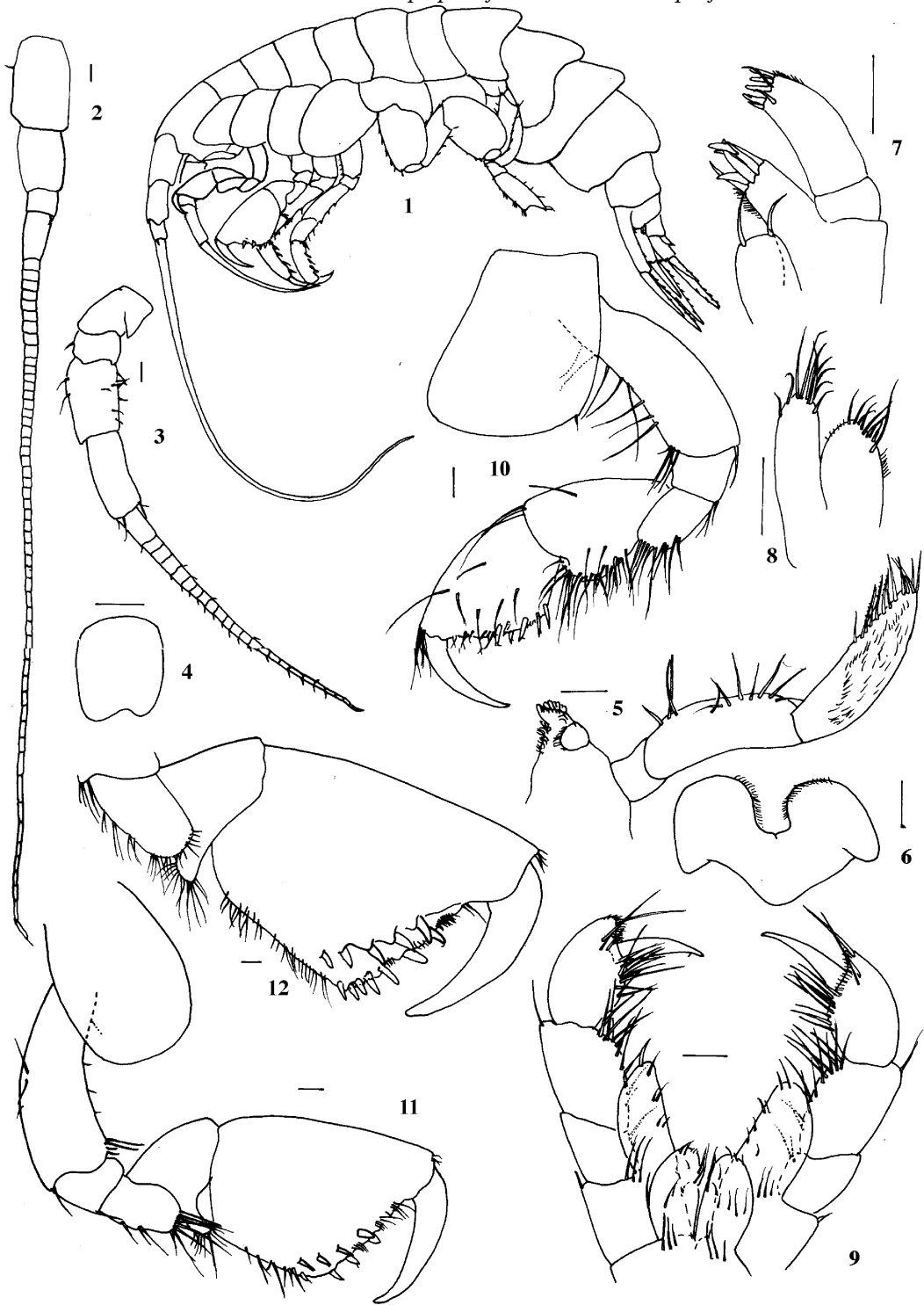


Figure 16. *Stenopleustes rainbowi*, MARVEL PL1199. Holotype female. (1) habitus; (2) antenna 1; (3) antenna 2; (4) labrum; (5) mandible; (6) labium; (7) maxilla 1; (8) maxilla 2; (9) maxilliped; (10) gnathopod 1; (11) gnathopod 2; (12) gnathopod (2<sup>nd</sup> exemplary). Scale bar 100 μm.



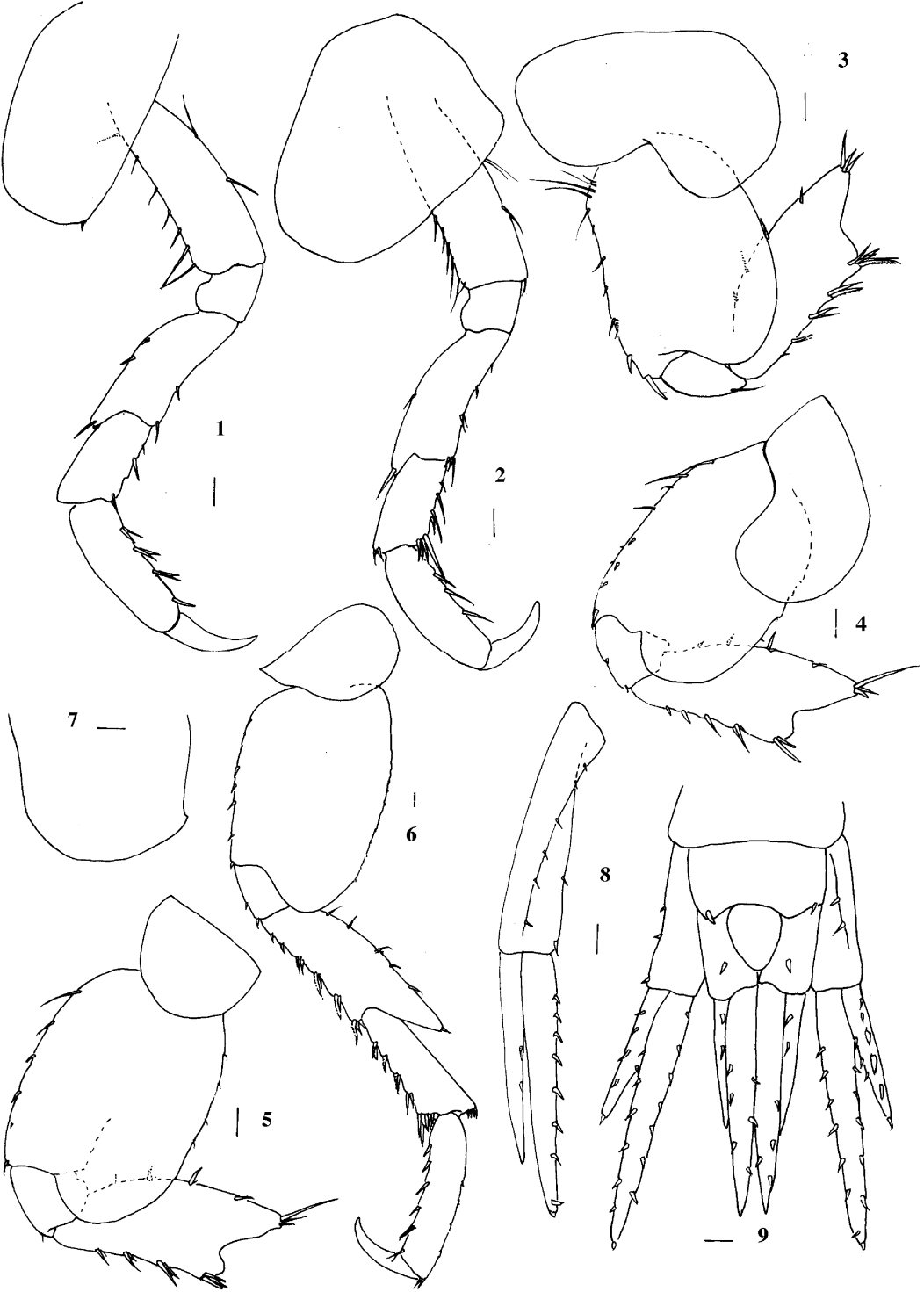


Figure 17. *Stenopleustes rainbowi*, MARVEL PL1199. Holotype female. (1) pereopod 3; (2) pereopod 4; (3) pereopod 5; (4) pereopod 6; (5) pereopod 7; (6) pereopod 7 (2<sup>nd</sup> exemplary); (7) epimeral plate 3; (8) uropod 1; (9) uropods 2–3, telson. Scale bar 100 μm.

*Diagnosis.* Body strongly built, last segment of mesosome and segments of metasome dorsally gibbous. Eyes not visible, rostrum short. Antenna 1 half length of body.

*Description.* Holotype female, 8 mm. Body strongly built, last segment of mesosome and segments of metasome dorsally gibbous. Head as long as the two first segments of the mesosome, rostrum short. Eyes not visible. Antenna 1 half length of body, article 1/2/3 ratio 8:5:2, accessory flagellum as a scale, flagellum 54-articulate. Antenna 2 half as long as antenna 1, flagellum 24-articulate. Mandible with incisor process denticulate, molar large, palp triarticulate, article 1 short, 2 and 3 long and setose. Maxilla 1 inner plate rounded with two terminal setae, outer plate with five distal spines and a row of fine setae on the inner margin. Maxilla 2 ordinary, inner plate shorter than outer. Maxilliped palp four-articulate, article 3 produced distally, article 4 well developed.

Coxae increasing in size, coxa 1 anteriorly rounded, coxa 4 not projecting at the infero-posterior corner. Gnathopods subchelate. Gnathopod 1 small, merus not produced more than one-third length of carpus; carpus as long as propodus, propodus pyriform with the palm setose and spinose, defined by an angle and a spine. Gnathopod 2 large, carpus less than half length of propodus, with a small lobe; propodus very large, distally expanded, palm transverse, delimited by a spine, armed with setae and two rows of strong spines; dactylus as long as palm. Pereopods 3 and 4 basis posteriorly setose, ischium short, merus, carpus and propodus bearing marginal spines, dactylus smooth. Pereopods 5–7 basis posteriorly lobate, anteriorly armed with spines, merus, carpus, propodus spinose, dactylus smooth. Epimeral plate 3 with posterior and distal edges rounded with a very small process in the distal corner. Uropod 1, rami unequal, inner as long as peduncle, outer shorter. Uropod 2 outer ramus as long as half of inner, armed by spines on both sides. Uropod 3 outer ramus slightly longer than half of inner. Telson entire, oval.

The mature female without head has a gnathopod 2 with the palm of the propodus bearing on each side of the central edge five and seven spines. The holotype of 8 mm has four spines on each side.

*Etymology.* This species is named after the Rainbow site.

*Relationship.* This species is referable to the *Stenopleustes*. In the eight species cited in Barnard and Karaman (1991), none is blind and only two, *Stenopleustes eldingi* Gurjanova, 1930 and *S. latipes* (Sars, 1858), have a large gnathopod 2. *Stenopleustes eldingi* has three setae on the inner plate of maxilla 1, and gnathopod 2 has an oval propodus, not expanded distally. *Stenopleustes latipes*, according to the description of Sars (1893) and redraw by Hendrycks and Bousfield (2004), differs from *S. rainbowi* by the presence of eyes “rather large, oblong, reniform” and “dark red”, a coxa 1 “with the anterior corner angularly produced”, the propodus of gnathopod 1 with edge “smooth bearing a few small spinules besides fine hairs”. Gnathopod 2 propodus is variable with maturity, according to Sexton (1909) Sars (1893) reported a “small projection above the middle, and having below on the outer side a somewhat projecting, broadly-truncated lobe armed with five strong spines within the latter there is a groove, defined above by a ridge bearing a similar row of spines”, “the telson is very small and distinctly navicular in form, tip evenly rounded”.

*Distribution and habitat.* Mid-Atlantic Ridge, central Atlantic Ocean. The specimens coming from the vent site Rainbow (2295 m).

Family **PODOCERIDAE** Leach, 1814***Xenodice portuguesi*** n. sp.

(Figures 18, 19)

*Type locality.* Mid-Atlantic Ridge, 36°33.600'N, 33°24.730'W, 2223 m.*Material examined.* SEAHMA 1, PL181-03, 4 August 2002, slurp gun 6, MAR, Saldanha site, 2223 m, 1 specimen female with oostegites, holotype, MNHN Am-7474.*Diagnosis.* Body cylindrical, smooth. Eyes not visible. Antennae long, equal in length. Gnathopod 2 slightly shorter than gnathopod 1. Pereopods 3–7 long and with slender basis. Uropods 1 and 2 biramus, rami shorter than peduncle. Telson entire triangular.*Description.* Holotype female with oostegites, 12 mm. Body cylindrical, smooth, mesosome segments free, urosomites free, urosomite 1 elongate. No rostrum, ocular lobes short. Eyes not visible.

Antennae long, equal in length. Antenna 1 peduncular articles 1/2/3 ratio 3.5:7.5:4.5, accessory flagellum seven-articulate. Antenna 2 articles 4 and 5 longest and equal. Labrum broad, bilobed.

Mandible normal, palp article 2 longest, articles 2 and 3 setose. Labium with well-developed inner lobes. Maxilla 1 inner plate with three distal setae, and four small medial setae, outer plate with seven spines, palp biarticulate, distal article long with five distal spines and 13 setae. Maxilla 2 normal, inner plate slightly shorter than outer. Maxilliped inner plate with distal part straight, with four spines and numerous setae; outer plate normal, not reaching apex of palp article 2, with strong spines on medial margin; palp with four articles, second long, article 3 not lobate.

Coxae very small, discontinuous. Gnathopods 1 and 2 not very different, subchelate, gnathopod 2 slightly shorter than gnathopod 1, densely setose. Gnathopod 1 carpus lobate, equal to propodus, propodus triangular, palm crenulated and not defined, dactylus longer than propodus palm. Gnathopod 2 carpus shorter than propodus, propodus dilated, with palm defined by an angle, dactylus ordinary, as long as palm. Pereopods 3–7 long with basis slender. Pereopods 3 and 4 alike. Pereopods 5–7 progressively longer, 5 short and 7 very long, dactylus of pereopods 6 and 7 long.

Uropod 1 biramous, rami subequal, shorter than peduncle. Uropod 2 shorter than uropod 1, rami slightly unequal, shorter than peduncle. Uropod 3 forming a tiny leaf shape lacking rami.

Telson entire, triangular.

Oostegites present on segments 2–5, small on 2 and 5, and large on 3 and 4.

*Etymology.* This species is dedicated to the Portuguese teams, which have continued to work in the Mid-Atlantic Ridge, after the death of our friend Professor Luiz Vieira Caldas Saldanha.*Relationship.* According to Myers and Lowry (2003) among corophiidean amphipods, the family Podoceridae is characterized by head rectangular, mandibular present, pereopods fully developed, urosomites 1 and 2 not coalescent. *Xenodice*, a monotypic genus characterized by well-developed accessory flagellum and strongly setose inner plate of maxilla 1, is considered to be part of this family. The only other species in this genus is *X.*

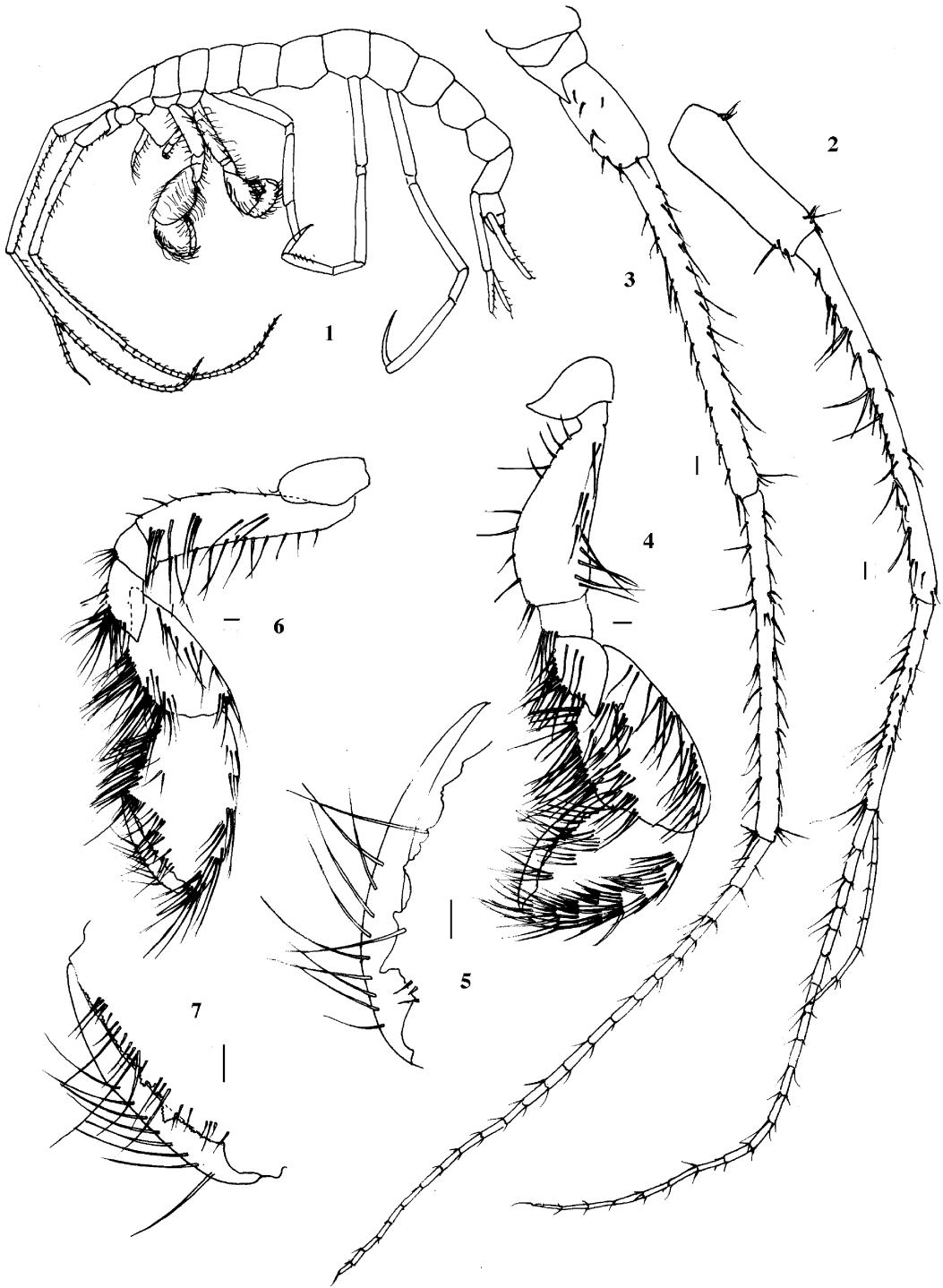


Figure 18. *Xenodice portuguesi*, SEAHMA 1 PL 181-03. Holotype female. (1) habitus; (2) antenna 1; (3) antenna 2; (4) gnathopod 1; (5) palm of gnathopod 1; (6) gnathopod 2; (7) palm of gnathopod 2. Scale bar 100  $\mu$ m.

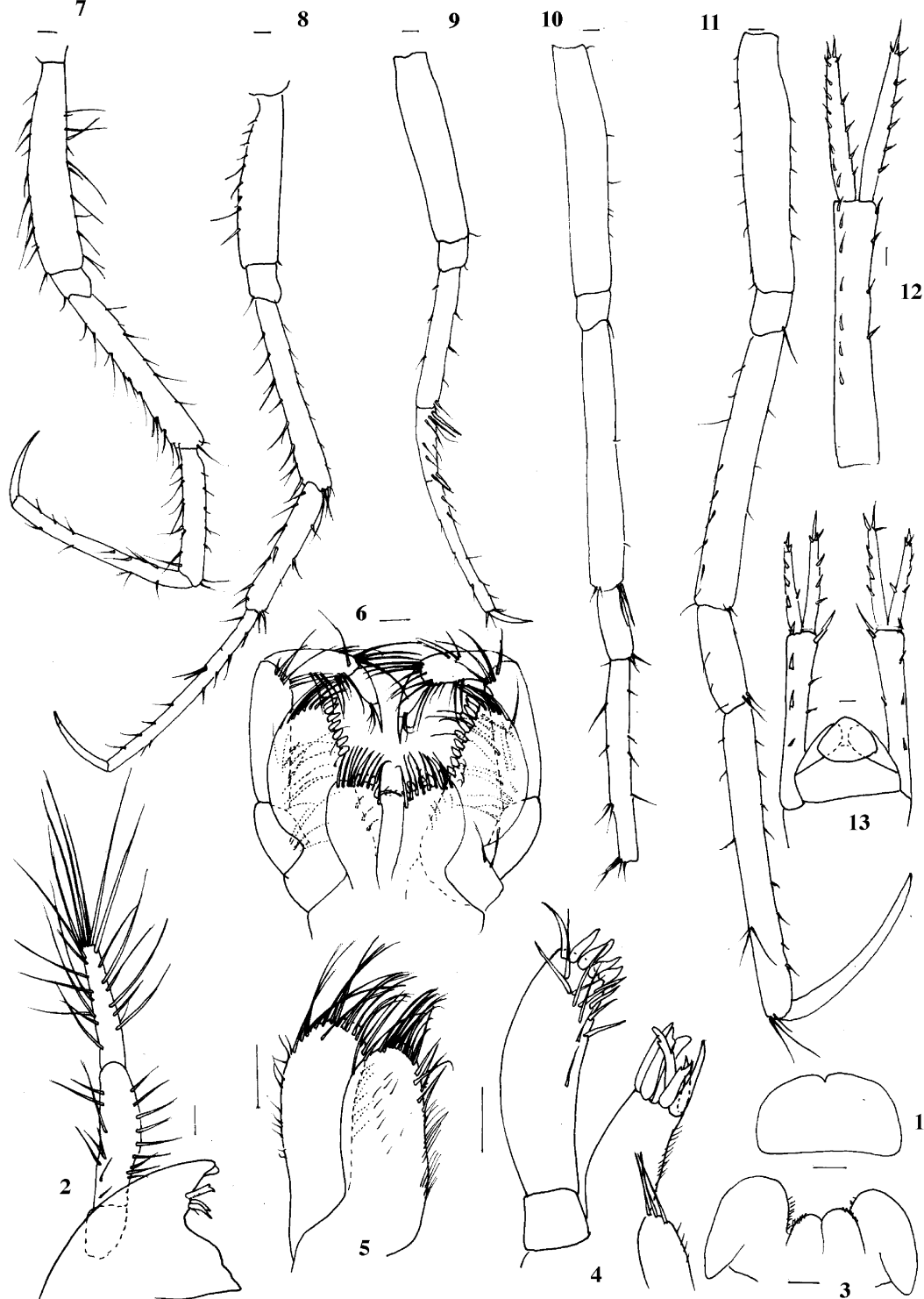


Figure 19. *Xenodice portuguesi*, SEAHMA 1 PL 181-03. Holotype female. (1) labrum; (2) mandible; (3) labium; (4) maxilla 1; (5) maxilla 2; (6) maxilliped; (7) pereopod 3; (8) pereopod 4; (9) pereopod 5; (10) pereopod 6; (11) pereopod 7; (12) uropod 1; (13) uropods 2-3, telson. Scale bar 100  $\mu$ m.

*frauenfeldti* Boeck, 1871; *X. macrophthalma* Schiecke 1976, was moved to *Parunciola seurati*, Chevreux, 1911 (Bellan-Santini et al. 1993).

*Xenodice portuguesi* differs from *X. frauenfeldti* by the size of the accessory flagellum with seven articles, the different sizes of the two gnathopods (gnathopod 1 is larger than gnathopod 2), the dactyli of pereopods 5–7 are long, and uropods 1 and 2 have the rami shorter than peduncle.

**Distribution and habitat.** *Xenodice frauenfeldti* was collected in the Arctic ocean, North Atlantic and North sea between 150 and 565 m. *Xenodice portuguesi* was collected at the Saldanha site from 2223 m depth where an evolutive hydrothermal field of low activity was described.

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