



## A new species of *Halophytophilus* Brian, 1919 (Copepoda: Harpacticoida: Ectinosomatidae) from cold-water corals in the Porcupine Seabight (NE Atlantic)

HENDRIK GHEERARDYN<sup>1</sup>, SYBILLE SEIFRIED<sup>2</sup> & ANN VANREUSEL<sup>1</sup>

<sup>1</sup>Marine Biology Section, Biology Department, Ghent University, Campus Sterre – Building S8, Krijgslaan 281, B-9000 Ghent, Belgium. E-mail: hendrik.gheerardyn@ugent.be

<sup>2</sup>Faculty 5, Institute of Biology and Environmental Sciences, AG Zoosystematics and Morphology, University of Oldenburg, D-26111 Oldenburg, Germany

### Abstract

The first deep-sea representative of *Halophytophilus* Brian, 1919 is described from samples of dead cold-water coral fragments, glass sponge skeletons and underlying sediment collected from the Porcupine Seabight (NE Atlantic). *Halophytophilus lopheliae* sp. nov. can be distinguished from its congeners by the dimensions of the P1 endopod and the position of the inner seta on its proximal segment. Moreover, we present the first description of a male in this genus. The occurrence of *Halophytophilus* and three other ectinosomatid genera with prehensile first legs is remarkable in the deep sea and an indication that the hard substrates of the coral degradation zone may provide an exceptional habitat. A key to the five species of *Halophytophilus* is included.

**Key words:** Ectinosomatidae, *Halophytophilus lopheliae*, systematics, deep sea, *Lophelia pertusa*

### Introduction

The assemblage structure and species diversity of Copepoda Harpacticoida associated with cold-water coral substrates in the Porcupine Seabight (NE Atlantic) has recently been investigated by Gheerardyn *et al.* (submitted). In the coral degradation zone of *Lophelia pertusa* (Linnaeus, 1758) reefs, Ectinosomatidae Sars, 1903 was found to be the most dominant family on dead coral fragments and in the underlying sediment. Generally, this is an abundant family in the deep-sea benthos with species mostly belonging to the genera *Bradya* Boeck, 1873, *Pseudobradya* Sars, 1904, *Ectinosoma* Boeck, 1865 and *Halectinosoma* Lang, 1944 (e.g. Martínez Arbizu *et al.* 1998; Seifried 2004; Shimanaga *et al.* 2004). In the Porcupine Seabight, twelve genera were identified and four of these were characterised by prehensile first legs (i.e. *Bradyellopsis* Brian, 1924, *Halophytophilus* Brian, 1919, *Klieosoma* Hicks & Schriever, 1985 and *Peltobradya* Médioni & Soyer, 1968). Known species of the first three genera are mostly reported from the washings of littoral algae, suggesting a shift to the phytal environment from the sedimentary benthic substrates more commonly inhabited by Ectinosomatidae (Lang, 1948; Noodt 1971; Hicks & Coull 1983; Hicks & Schriever 1983, 1985; Watkins 1987). The occurrence of these genera in the deep sea is remarkable and an indication that the coral degradation zone may provide an exceptional habitat. A new species of *Halophytophilus* will be described here.

## Material and methods

The material studied in this paper was collected during expeditions RV Belgica 00/16 and RV Belgica 01/12 in the Belgica Mound Province of the Porcupine Seabight (NE Atlantic Ocean), in June 2000 and May 2001, respectively. Samples were taken with a boxcorer in the coral degradation zone of *Lophelia pertusa* reefs, at depths between 880 and 1005 m. In each case, the surface of the sediment was partly or entirely covered with several dead fragments of the cold-water coral *L. pertusa* and skeletons of the glass sponge *Aphrocallistes beatrix* Gray, 1858. After collecting the coral fragments and sponge skeletons separately, meiofauna of underlying sediment was sampled with three sediment cores (surface area 10 cm<sup>2</sup>). One additional male of the new *Halophytophilus* species was sampled during Belgica Cruise 03/13 in May 2003, from a boxcore sample taken in coral-free sediments to the east of the Belgica Mounds. All material was fixed in 4% buffered formaldehyde.

In the laboratory, each coral or sponge sample was rinsed thoroughly over 1 mm and 32 µm sieves to collect macro- and meiofauna, respectively. Meiofauna from the sediment was extracted by density gradient centrifugation, using Ludox HS40 (specific density 1.18) as a flotation medium (Heip *et al.* 1985; Vincx 1996). Details of sediment granulometry are described by Gheerardyn *et al.* (submitted). Harpacticoid copepods were sorted and counted using a Wild M5 binocular microscope. Dissected parts of the specimens were mounted in glycerine and preparations were sealed with insulating varnish. Drawings were made with the aid of a drawing tube on a Leica DMR microscope equipped with differential interference contrast (DIC) at 1000x magnification. Whole specimens were stored in 75% ethanol. Specimens have been deposited in the Invertebrate Collections of the Royal Belgian Institute of Natural Sciences (KBIN) (Brussels, labelled COP) and in the first author's collection at the Marine Biology Section of Ghent University (Ghent). Scale bars in figures are indicated in µm.

The following abbreviations are used in the text: P1-P6 = first to sixth thoracopod; enp = endopod; exp = exopod; enp-1 (2,3) = proximal (middle, distal) segment of endopod; exp-1 (2,3) = proximal (middle, distal) segment of exopod; aes = aesthetasc; baseoendopod = benp; incl. = including; excl. = excluding.

## Results

In total, 860 adult harpacticoids were identified from the coral degradation zone in the Belgica Mound Province. This yielded 235 specimens of Ectinosomatidae, belonging to 36 species in 13 genera (2 of the 36 species could not be assigned unequivocally to a known genus). Thirty species were considered new to science and two species, *Klieosoma triarticulatum* (Klie, 1949) and *Microsetella norvegica* (Boeck, 1865), were known. Four species have been identified with reserves (*Pseudobradya* cf. *banyulensis* Soyer, 1974, *P.* cf. *peresi* Soyer, 1974, *Sigmatidium* cf. *parvulum* Mielke, 1974 and *S.* cf. *triariculatum* Mielke, 1979).

List of identified genera, with identified species and number of new species in parentheses:

*Bradya* Boeck, 1873 (2 new spp.)

*Bradyellopsis* Brian, 1924 (1 new sp.)

*Ectinosoma* Boeck, 1865 (3 new spp.)

*Halectinosoma* Lang, 1944 (2 new spp.)

*Halophytophilus* Brian, 1919 (3 new spp.)

*Hastigerella* Nicholls, 1935 (1 new sp.)

*Klieosoma* Hicks & Schriever, 1985 (*Klieosoma triarticulatum* (Klie, 1949) and 2 new spp.)

*Lineosoma* Wells, 1965 (1 new sp.)

*Microsetella* Brady & Robertson, 1873 (*Microsetella norvegica* (Boeck, 1865))  
*Parabradya* Lang, 1944 (2 new spp.)  
*Peltobradya* Médioni & Soyer, 1968 (1 new sp.)  
*Pseudobradya* Sars, 1904 (*P.* cf. *banyulensis* Soyer, 1974, *P.* cf. *peresi* Soyer, 1974 and 5 new spp.)  
*Sigmatidium* Giesbrecht, 1881 (*S.* cf. *parvulum* Mielke, 1974, *S.* cf. *triarticulatum* Mielke, 1979 and 5 new spp.)  
Ectinosomatidae (2 new spp.)

## Description

### Ectinosomatidae Sars, 1903

#### *Halophytophilus* Brian, 1919

##### *Halophytophilus lopheliae* sp. nov.

**Type locality:** North-East Atlantic Ocean, Porcupine Seabight, Boxcore Bbc01-1205 (Belgica Cruise 01/12), 51°25.9290'N 11°46.2717'W, 880 m, collected on 7 May 2001.

**Type material:** (a) From type locality (sample of underlying sediment): holotype female, dissected on 12 slides (COP 7013); allotype male, dissected on 9 slides (COP 7014); paratype 1 is one female dissected on 6 slides (COP 7015); paratype 2 is one female dissected on 8 slides (COP 7016); 2 female paratypes preserved in 75% alcohol (COP 7017).

(b) From type locality (sample of dead coral fragment): paratype 3 is one female dissected on 12 slides (COP 7018); paratype 4 is one female dissected on 7 slides (COP 7019); paratype 5 is one female dissected on 9 slides (COP 7020); paratype 6 is one male dissected on 5 slides (COP 7021); 1 male and 3 female paratypes preserved in 75% alcohol (COP 7022).

**Additional material:** (a) North-East Atlantic Ocean, Porcupine Seabight, Boxcore Bbc00-1605 (Belgica Cruise 00/16), 51°24.824'N 11°45.932'W, 1000 m, collected on 17 June 2000: one male dissected on 5 slides (COP 7023) and 4 females and 4 males preserved in 75% alcohol (COP 7024), sampled from dead coral fragment; one male preserved in 75% alcohol (COP 7025), sampled from underlying sediment.

(b) North-East Atlantic Ocean, Porcupine Seabight, Boxcore Bbc00-1604 (Belgica Cruise 00/16), 51°24.802'N 11°45.924'W, 1005 m, glass sponge skeleton, collected on 17 June 2000: 2 males preserved in 75% alcohol (COP 7026).

(c) North-East Atlantic Ocean, Porcupine Seabight, Boxcore Bbc01-1205 (Belgica Cruise 01/12), 51°25.9290'N 11°46.2717'W, 880 m, sample of dead coral fragment, collected on 7 May 2001: 2 females and 1 male preserved in 75% alcohol (first author's collection).

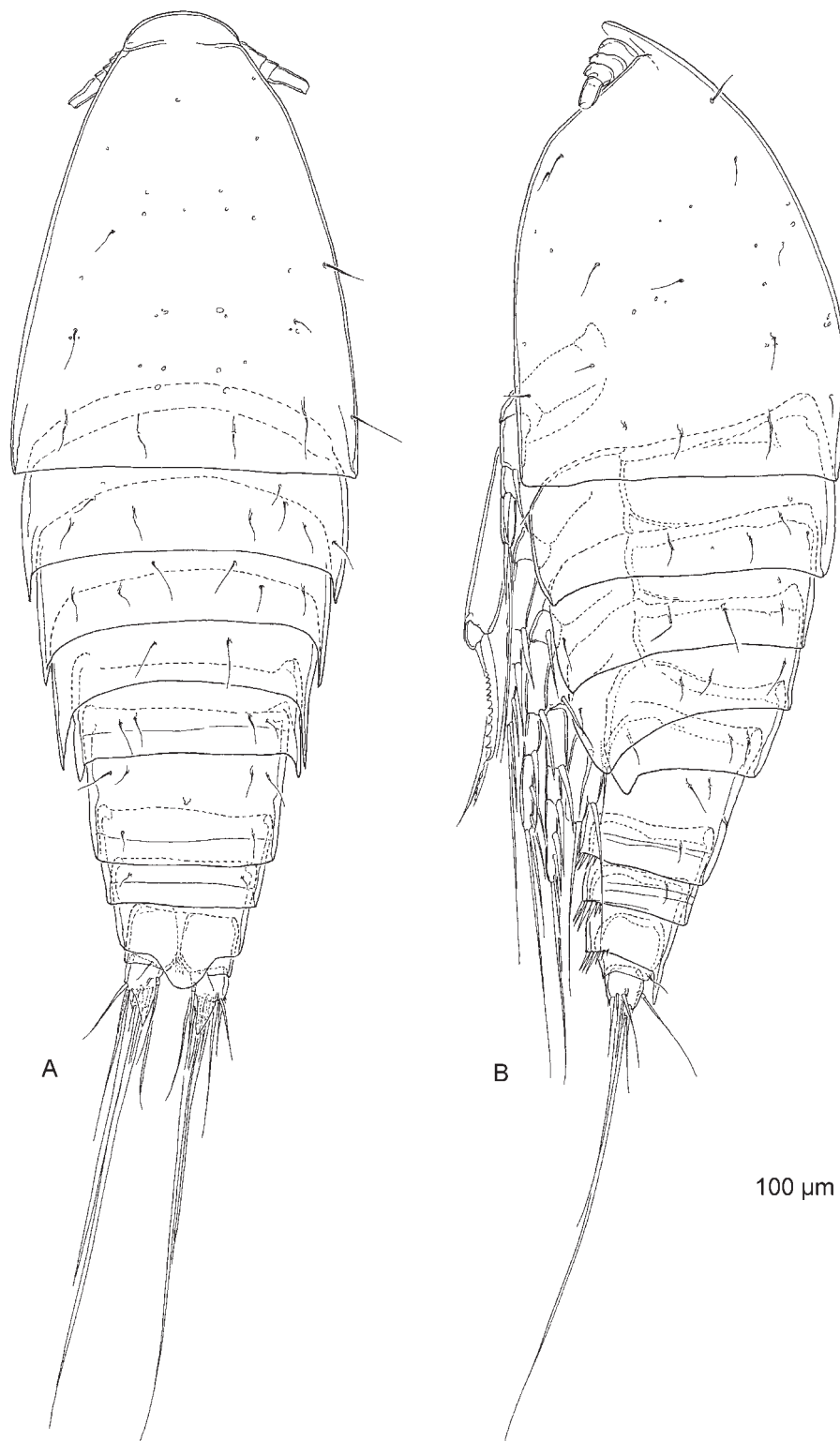
(d) North-East Atlantic Ocean, Porcupine Seabight, Boxcore Bbc03-1304b (Belgica Cruise 03/13), 51°23.454'N 11°39.901'W, 646 m, sediment sample of upper first centimetre (from boxcore without coral fragments), collected on 25 May 2003: 1 male preserved in 75% alcohol (first author's collection).

**Etymology:** The specific name refers to the peculiar substrate on which the species was found, namely dead fragments of the cold-water coral *Lophelia pertusa* (Linnaeus, 1758).

##### *Description of the female holotype.*

All drawings based on holotype except gnathobase of mandible (Fig. 3C and 3D from paratype 1 and 3, respectively), maxillule (Fig. 3E from paratype 2) and maxilla (Figs 3F–H from paratype 5).

**Body length** (incl. rostrum and caudal rami): 306 µm. Caudal rami: 8 µm. Maximum body width: 110 µm. Rostrum: 18 µm. Cephalothorax length (excl. rostrum): 131 µm.

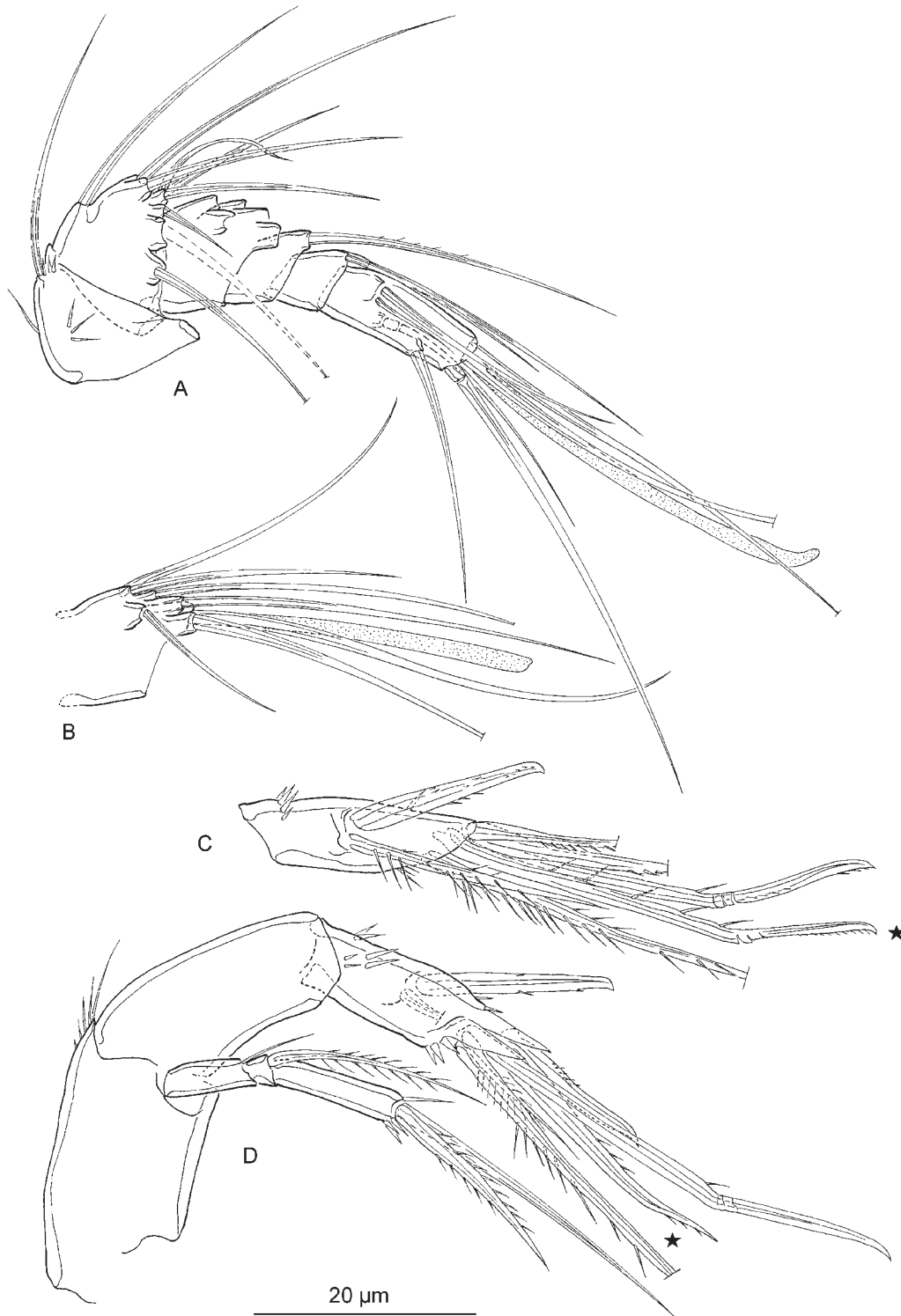


**FIGURE 1.** *Halophytophilus lopheliae* sp. nov. (female, COP 7013). A, habitus, dorsal; B habitus, lateral.

**Body** (Figs 1A–B) with distinction between prosome and urosome; prosome consisting of cephalothorax and 3 free pedigerous somites; first pedigerous somite completely fused to cephalosome; urosome 5-segmented, comprising somite bearing P5, genital double-somite, 2 free abdominal somites, and the anal somite. Cephalothorax longer than wide and wider than urosome. Cephalothorax and body somites with sensilla and

pores. Whole body surface smooth, without cuticular ornamentation. Posterodorsal margin of cephalothorax and body somites without spinules. Penultimate segment with smooth, convex pseudoperculum. Anal somite divided medially.

**Rostrum** (Fig. 1A) fused medially with cephalothorax; nearly twice broader than long; without sensilla or pores.

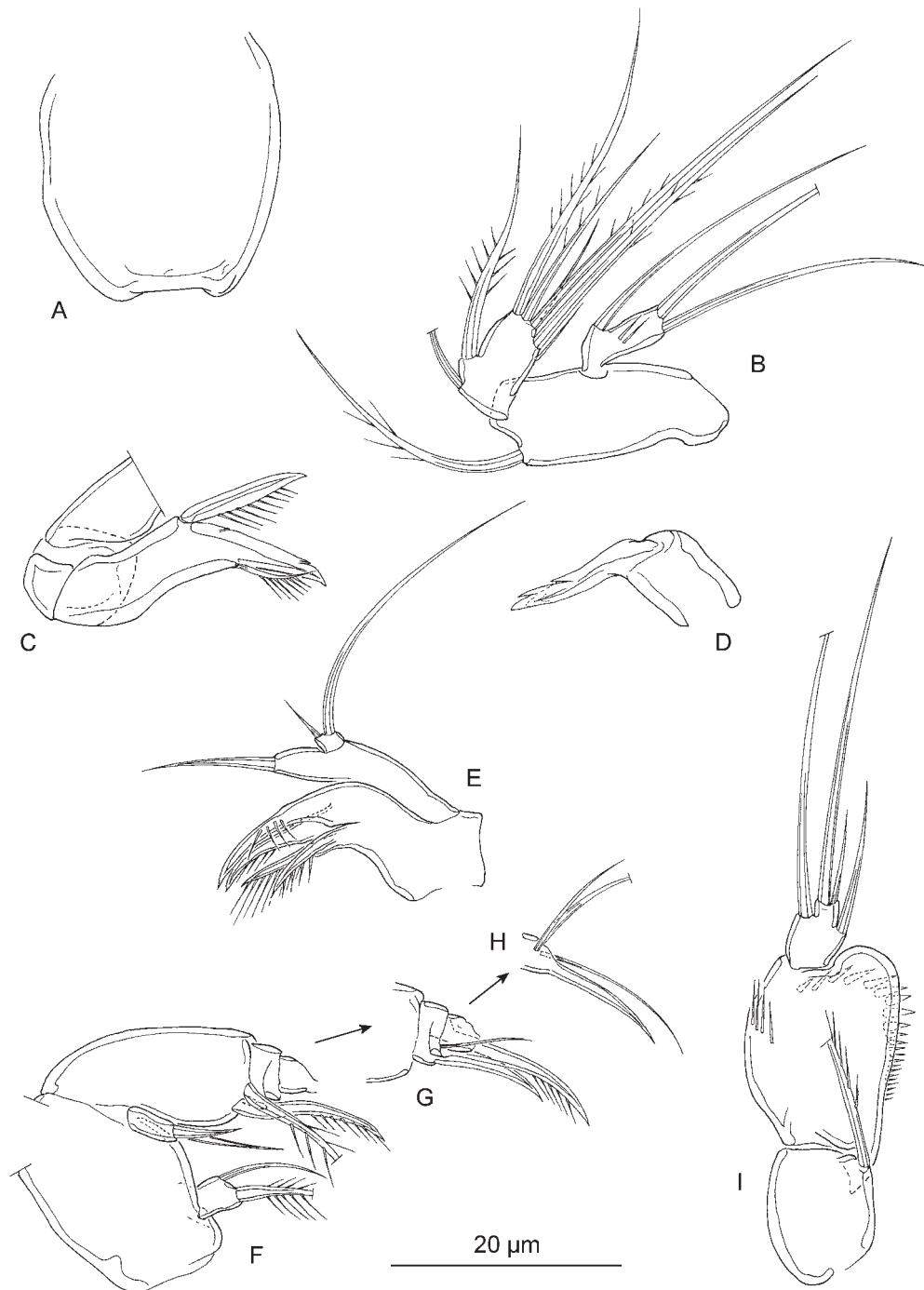


**FIGURE 2.** *Halophytophilus lopheliae* sp. nov. (female, COP 7013). A, antennule, dorsal; B, segment 3 of antennule, dorsal; C, enp-2 of antenna; D, antenna (asterisk indicating position of missing seta, drawn in C).

**Genital field** (Fig. 6A) with median copulatory pore and 4 integumental pores.

**Caudal rami** (Figs 6C–E) slightly wider than long, with 7 setae; with few spinules along outer distal border; posterior edge of rami produced ventrally and dorsally into acuminate lappet.

**Antennule** (Figs 2A–B) 6-segmented and rather slender; armature formula: 1, 9, 6+(1+aes), 1, 2, 5+(2+aes); first segment with few spinules along anterior margin; last segment 2.5 times longer than wide; 1 seta on segment 4 pinnate, all other antennular setae naked.



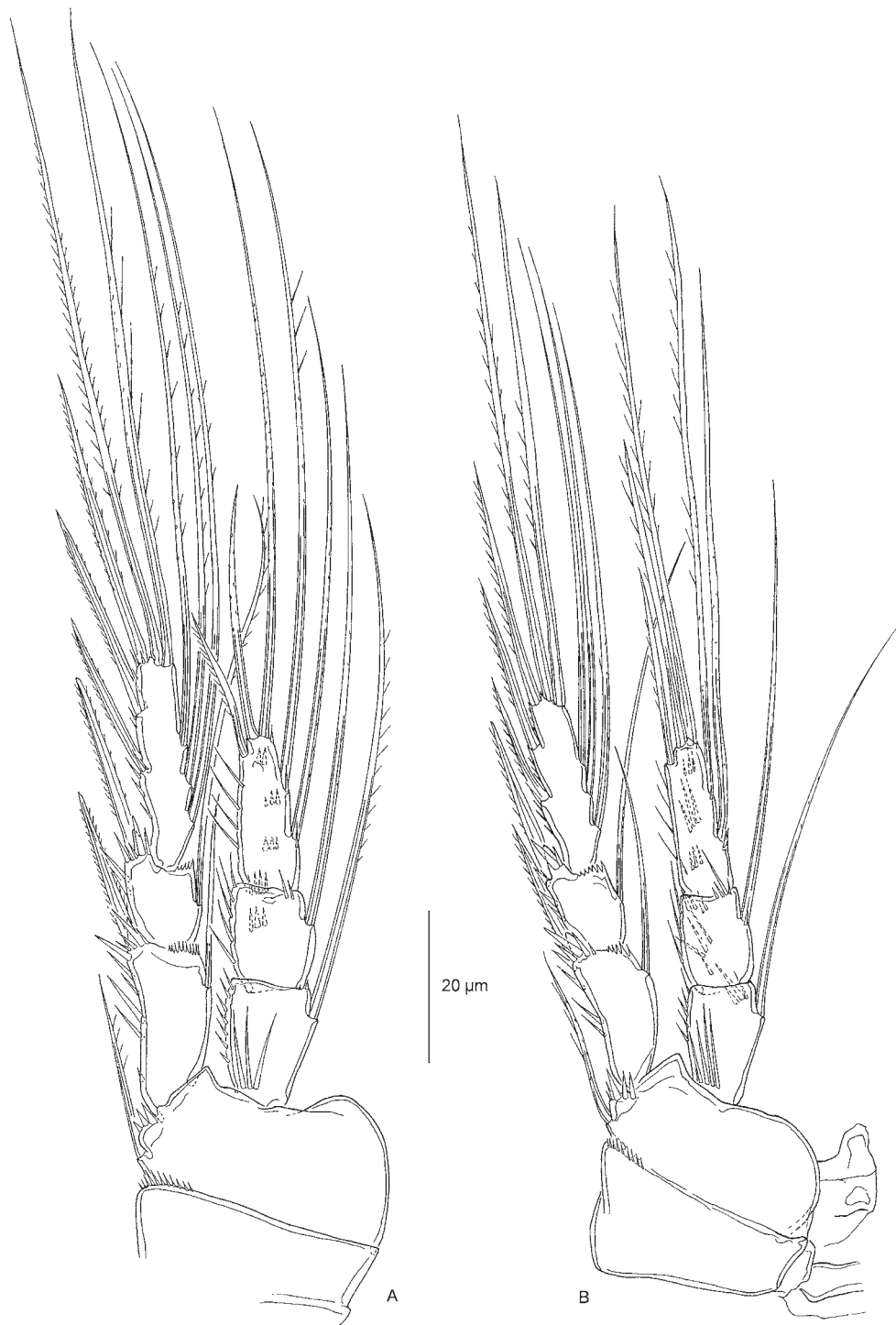
**FIGURE 3.** *Halophytophilus lopheliae* sp. nov. A–B, I (female, COP 7013); C (female, COP 7015); D (female, COP 7018); E (female, COP 7016); F–H (female, COP 7020). A, labrum; B, palp of mandible; C–D, gnathobase of mandible; E, maxillule, posterior; F, maxilla, posterior (armature of endopod omitted); G, endopod of maxilla, posterior (armature of enp-3 omitted); H, enp-3 of maxilla, posterior; I, maxilliped, posterior.

**Antenna** (Figs 2C–D): Basis with few long spinules along distal abexopodal edge; enp-1 without setae; enp-2 with few spinules along lateral side, subapical armature consisting of 1 pinnate spine and 1 pinnate seta, apically with 6 setae: 2 pinnate spines, 2 geniculate pinnate setae and 1 well developed, pinnate seta which is fused to a minute, pinnate seta; exp 3-segmented with 1, 1, 2 setae; seta on exp-1 minute; exp slender and shorter than enp; middle segment shortest; exp-3 with some spinules around apical margin.

**Labrum** (Fig. 3A) not prominent, without spinules.



**FIGURE 4.** *Halophytophilus lopheliae* sp. nov. (female, COP 7013). A, P1; B, P2.

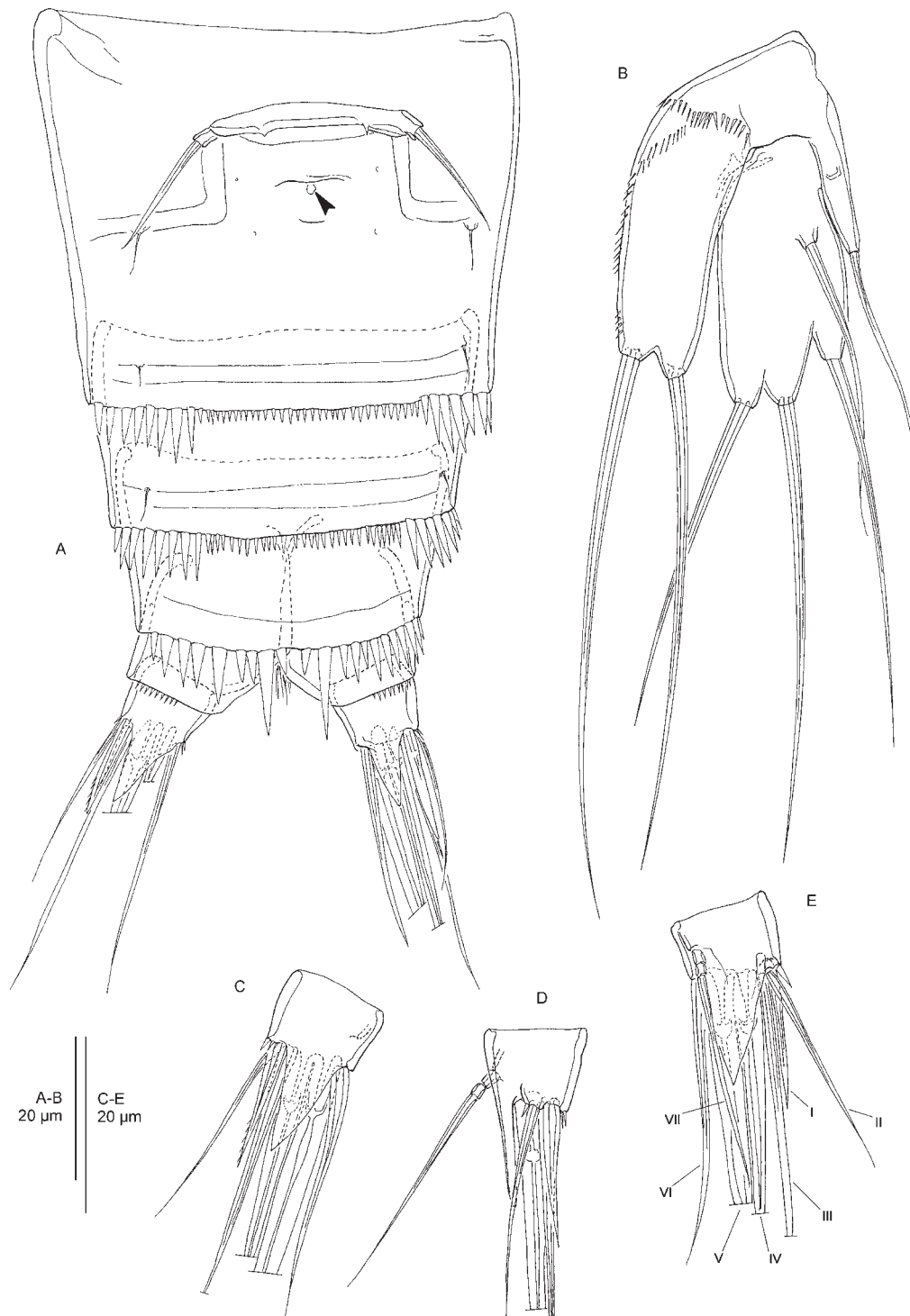


**FIGURE 5.** *Halophytophilus lopheliae* sp. nov. (female, COP 7013). A, P3; B, P4.

**Mandible** (Figs 3B–D): Gnathobase slender; cutting edge with one big tooth and 4 small processes fused to it; 1 slender, unipinnate seta at dorsal and 1 strong, unipinnate spine at ventral corner; basis with 1 plumose seta; enp 1-segmented with 2 lateral and 5 distal setae, with slender spinule at distal edge; exp 1-segmented, smaller than enp, with 1 lateral and 2 distal setae, with few spinules on surface.

**Maxillule** (Fig. 3E) reduced; praecoxa with 4 unipinnate spines apically; coxa fused to praecoxa or basis; basis with 1 seta; one small segment (representing enp or exp) with 2 setae.

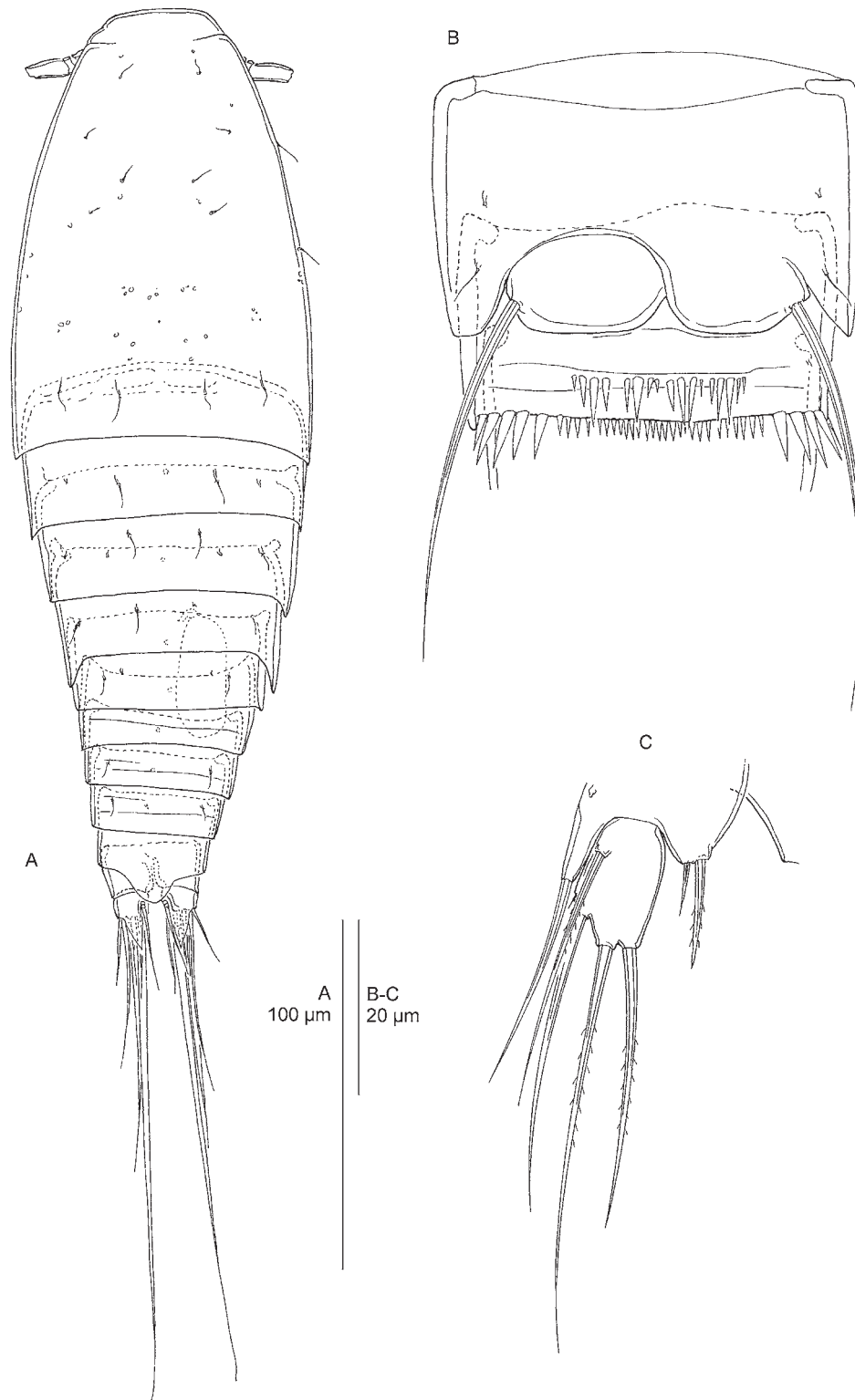




**FIGURE 6.** *Halophytophilus lopheliae* sp. nov. (female, COP 7013). A, urosome (copulatory pore arrowed), ventral; B, P5; C, caudal ramus, ventral; D, caudal ramus, lateral; E, caudal ramus, dorsal.

Armature formula P1-P4:

	coxa	basis	exopod	endopod
P1	0-0	1-1	I-0; I-1; III-2-1	0-1; III
P2	0-0	1-0	I-1; I-1; III-2-2	0-1; 0-1; I-2-2
P3	0-0	1-0	I-1; I-1; III-2-3	0-1; 0-1; I-2-2
P4	0-0	1-0	I-1; I-1; III-2-3	0-1; 0-1; I-2-2



**FIGURE 7.** *Halophytophilus lopheliae* sp. nov. (male, COP 7014). A, habitus, dorsal; B, second and third urosomite, ventral; C, P5.

**Maxilla** (Figs 3F–H) small; syncoxa with 2 endites, each with 2 setae; allobasis with 2 spines at distal edge; remaining enp indistinctly 3-segmented; the two proximal segments fused anteriorly; armature formula: I, I+1, I+3.

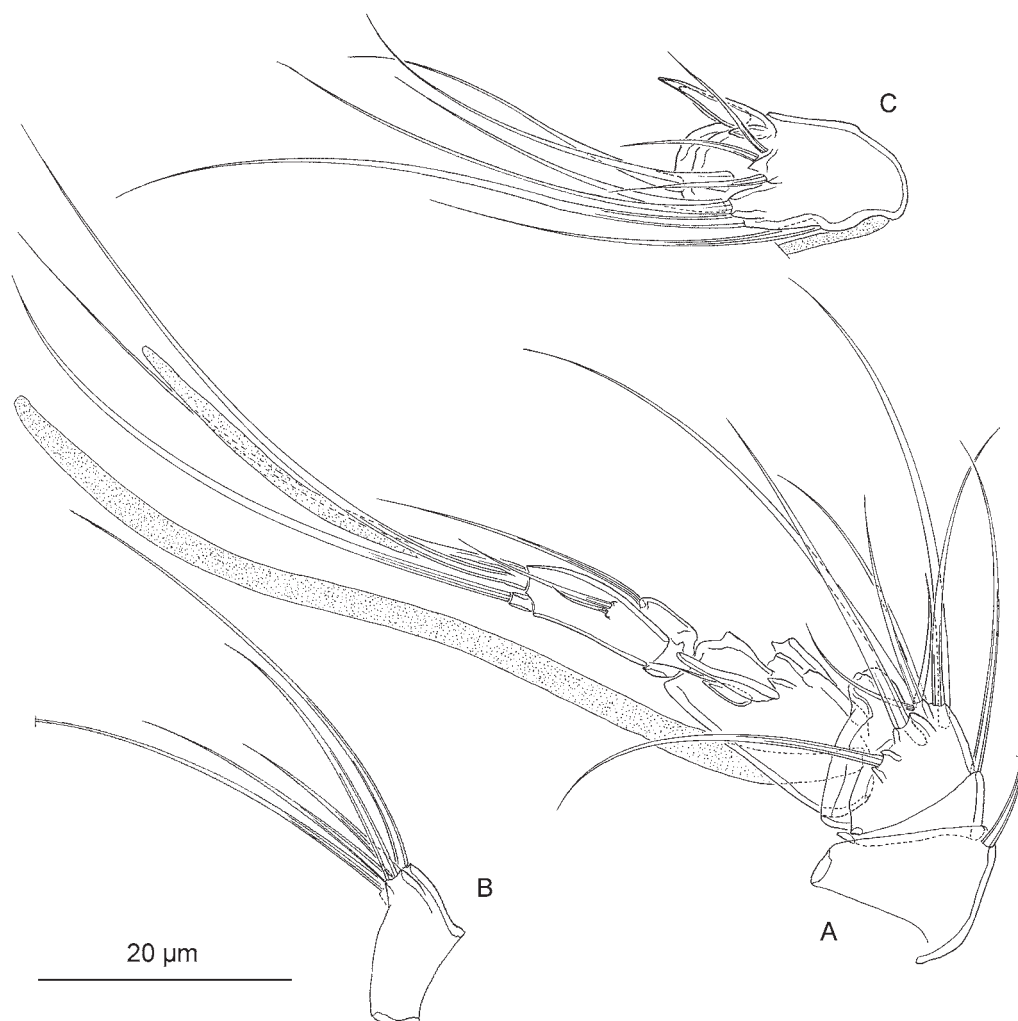
**Maxilliped** (Fig. 3I): Syncoxa with 1 pinnate seta at inner distal corner; basis without setae but with semi-circular row of spinules on anterior surface and few slender spinules on outer edge; enp 1-segmented with 2 lateral and 2 distal setae.

**P1** (Fig. 4A). Basis with 1 row of spinules at base of exp and 1 row of long spinules on anterior surface; enp-1 almost twice as long as exp; inner seta of enp-1 inserted at one third of inner margin; outer edge of enp-1 proximally with spinules, few setules along inner edge; top of enp-1 with hyaline frill; enp-2 small, slightly wider than long, enclosed by distal end of enp-1, bearing three strong setae (two of which broad, flattened and strongly serrate); exp-1 and exp-3 equal in length and longer than exp-2; outer edge of exp spinulose and anterior surface of exp-1 and exp-2 with rows of spinules; inner margin of exp-2 and exp-3 with few setules.

**P2-P4** (Figs 4B, 5A–B). Coxa and basis with row of spinules along outer margin; enp slightly shorter than exp; enp-3 slightly longer than enp-1 and enp-2; anterior surface of enp-1 with 1 row of long spinules; outer edge of each endopodal segment with row of spinules; posterior surface of most endopodal segments with short rows of spinules; exp-1 and exp-3 equal in length and longer than exp-2; outer edge of all exopodal segments with spinules.

**P5** (Fig. 6B) left and right P5 separated; exp slightly longer than benp; exp with 3 terminal setae and 1 surface seta; benp with 2 setae, of equal length; benp with rows of spinules along inner margin and on anterior surface, and with 1 pore proximally on setophore of basal seta.

**P6** (Fig. 6A) with 1 seta.



**FIGURE 8.** *Halophytophilus lopheliae* sp. nov. (male, COP 7014). A, left antennule, dorsal; B, segment 4 of left antennule, dorsal; C, segment 5 of right antennule.

### **Description of the male allotype.**

All drawings based on allotype. Antenna, mouthparts, P1–P4, and caudal rami as in female.

**Body length** (incl. rostrum and caudal rami): 260  $\mu\text{m}$ . Caudal rami: 8  $\mu\text{m}$ . Maximum body width: 85  $\mu\text{m}$ . Cephalothorax length (excl. rostrum): 113  $\mu\text{m}$ . Spermatophore: 35  $\mu\text{m}$ .

**Body** (Figs 7A–B) as in female, but slightly more slender; urosome 6-segmented; third urosomite with ventral row of irregular spines; 1 spermatophore.

**Antennule** (Figs 8A–C) 7-segmented, with geniculation between segments 5 and 6; armature formula: 1, 1, 9, 5, 10+aes, 1, 3+(2+aes); aesthetasc on segment 5 inserting proximally; the cuticular cone of Ectinosomatidae on the 5th segment comprises a slender seta (drawn in Fig. 8A) and 3 cuticular conical apophyses; last segment 2.5 times longer than wide.

**P5** (Fig. 7C). Left and right P5 not clearly fused; exp with 3 terminal setae and 1 surface seta; benp short with 2 setae, innermost seta longest; 1 pore proximally on setophore of basal seta.

Sixth pair of legs (**P6**) (Fig. 7B) asymmetrical; one member functional; one member fused to somite; both bearing 1 seta.

**Variability:** Body length (incl. rostrum and caudal rami) of females varies between 306 and 354  $\mu\text{m}$  (average = 329  $\mu\text{m}$ ; n = 10). Body length (incl. rostrum and caudal rami) of males varies between 260 and 300  $\mu\text{m}$  (average = 283  $\mu\text{m}$ ; n = 10).

### **Key to the species of *Halophytophilus* Brian, 1919**

1. Enp-1 of P1 almost twice as long as exopod ..... *Halophytophilus lopheliae* **sp. nov.**
- Enp-1 of P1 about as long as exopod, or shorter ..... 2
2. Caudal rami 1.5 times as long as wide ..... 3
- Caudal rami wider than long ..... 4
3. Inner seta on enp-1 of P1 inserted near middle of margin; enp-2 of P1 twice as long as wide .....  
..... *Halophytophilus similis* Lang, 1948
- Inner seta on enp-1 of P1 inserted near distal end of margin; enp-2 of P1 three times as long as wide .....  
..... *Halophytophilus spinicornis* Sars, 1921
4. Exp-3 of P3–P4 each with three outer spines; enp-3 of P3–P4 each with two inner setae .....  
..... *Halophytophilus fusiformis* Brian, 1919
- Exp-3 of P3–P4 each with two outer spines; enp-3 of P3–P4 each with one inner seta .....  
..... *Halophytophilus simplex* Wells & Rao, 1987

### **Discussion**

#### Systematic discussion

The structure of the first swimming leg shows that the new species belongs to *Halophytophilus*. At present, this genus includes five species: *Halophytophilus fusiformis* Brian, 1919, *H. spinicornis* Sars, 1921, *H. similis* Lang, 1948, *H. simplex* Wells & Rao, 1987 and *H. lopheliae* **sp. nov.** The male of the present new species is the first described within *Halophytophilus* and shows the typical sexual dimorphism of Ectinosomatidae, in body size, genital segmentation, antennule, P5 and P6. Moreover, the fifth segment of the male antennule bears the characteristic cuticular cone, which is one apomorphy of the family (Seifried 2003). All members of the genus have a two-segmented, prehensile P1 endopod with an elongated proximal segment. In *H. lopheliae* **sp. nov.**, the proximal endopodal segment of P1 is almost twice as long as the exopod, but in the other species, it is only as long as the exopod, slightly longer or shorter or the enp-1 is as long as exp-1 and

exp-2 combined. In Huys *et al.* (1996), the diagnosis of *Halophytophilus* states that the syncoxa of the maxilla bears only one endite. However, *H. simplex* and *H. lopheliae* **sp. nov.** each have two. Also, there are no endites drawn on the maxilla in the original description of *H. fusiformis* by Brian (1919). Neither for *H. similis* is the structure of the mouthparts completely clear. Although Lang (1948) states that the mouthparts of this species are exactly as in *H. spinicornis*, the form of the maxilla is different and the single endite on its syncoxa is inserted more proximally in the drawing of *H. similis* by Huys *et al.* (1996). In all described *Halophytophilus* species the allobasis of the maxilla is elongate, but not in *H. lopheliae* **sp. nov.** and *H. similis* (in Huys *et al.* 1996). Since most older descriptions are incomplete (especially with respect to the mouthparts), it is at present difficult to compare the species and assess whether they truly belong to a monophyletic group.

Within Ectinosomatidae, the proximal endopodal segment of P1 is also elongated in *Bradyellopsis*, *Klieosoma*, *Lineosoma* Wells, 1965, *Noodtiella* Wells, 1965, *Peltobradya*, *Pseudectinosoma* Kunz, 1935 and *Sigmatidium* Giesbrecht, 1881. Furthermore, species of *Lineosoma*, *Noodtiella* and *Pseudectinosoma* have elongated proximal endopodal segments in the swimming legs P2 to P4. The form of the P1 endopod in *H. lopheliae* **sp. nov.** (with enp-1 almost twice as long as the exopod and enp-2 small, slightly wider than long) is unique and different from that in species belonging to the genera *Lineosoma*, *Noodtiella*, *Pseudectinosoma* and *Sigmatidium*. In the latter four genera, enp-1 of P1 is either as long as the (similarly elongated) exp-1 (most *Pseudectinosoma* species), as long as the entire exopod (some *Noodtiella* species) or in between these two conditions (*Lineosoma*, *Sigmatidium*, most *Noodtiella* species, some *Pseudectinosoma* species). Additionally, enp-2 is about as long as enp-1 or only slightly shorter (except in *Sigmatidium parvulum* Mielke, 1974 where enp-2 is distinctly smaller and less than twice as long as wide). Further, species of *Lineosoma* and *Noodtiella* have a cylindrical body shape, and species of *Lineosoma*, *Pseudectinosoma* and *Sigmatidium* have a modified P5 with the exopod fused to the baseoendopod in female and/or male. As in *Halophytophilus*, the endopod of the first swimming leg is prehensile in *Bradyellopsis*, *Klieosoma*, *Peltobradya* and some species of *Sigmatidium*. Although *Bradyellopsis* and *Halophytophilus* have a similar P1, *H. lopheliae* **sp. nov.** cannot be assigned to the former genus because it lacks a cuticular cone on the third segment of the antennule in male and female, a one-segmented antennary exopod, a P5 exopod with four distal spines or setae and no surface seta, and a produced outer distal corner on the caudal rami. Species of the genus *Klieosoma* have a three-segmented P1 endopod and the monotypic *Peltobradya* is characterised by the dorsoventrally depressed body shape and short, broad segments in the swimming legs P1 to P4. At present, the new species is best placed within the genus *Halophytophilus* because it agrees with the generic diagnosis in the combination of characters such as the fusiform body shape, a two-segmented and prehensile P1 endopod (with the distal segment much shorter), exp-3 of P1 and P2 with three outer spines, P1-P4 rami with slender segments and a distinct baseoendopod and exopod in P5. *Halophytophilus lopheliae* **sp. nov.** can be distinguished from its congeners by the relative length of the P1 endopod (with enp-1 almost twice longer than exp) and the insertion site of the seta on enp-1 (at one third of the inner margin). Furthermore, the setae on the distal endopodal segment of P1 are strongly serrate and flattened, while being of the normal form in the other known species.

#### Ecological discussion

Although Ectinosomatidae is an abundant family in the deep-sea benthos (Vincx *et al.* 1994; Martínez Arbizu *et al.* 1998; Ahnert & Schriever 2001; George & Schminke 2002; Seifried 2004; Shimanaga *et al.* 2004; Rose *et al.* 2005; Baguley *et al.* 2006), information on its generic or specific composition is scarce. Most deep-sea studies are conducted at higher taxon level and, especially in the family Ectinosomatidae, identification down to generic/species level remains quite problematic. From the literature, it appears that in the soft sediments of the deep sea ectinosomatid species mostly belong to *Bradya*, *Pseudobradya*, *Ectinosoma* and *Halectinosoma* (e.g. Martínez Arbizu *et al.* 1998; Seifried 2004; Shimanaga *et al.* 2004). Moreover, none of the 97 species of Ectinosomatidae found in the deep sea of the Angola Basin on silt and clay sediment (DIVA 1 project) had a prehensile first leg (Seifried *et al.* 2007; Seifried & Martínez Arbizu in press). In the

coral degradation zone of *Lophelia pertusa* reefs in the Porcupine Seabight (NE Atlantic), twelve genera of Ectinosomatidae were identified, with *Sigmatidium*, *Pseudobradya* and *Halophytophilus* being the most abundant. The occurrence of four genera with prehensile first legs (i.e. *Bradyellopsis*, *Halophytophilus*, *Klieosoma* and *Peltobradya*) is remarkable, because known species of the first three genera are mostly reported from the washings of littoral algae (Lang 1948; Klie 1949; Hicks & Schriever 1983, 1985; Watkins 1987). The single described species of *Peltobradya* occurs as an associate of a bryozoan host in the Mediterranean Sea (Médioni & Soyer 1968). Phytal associates generally possess a modified P1 which is strongly prehensile and facilitates clinging on algal surfaces (Bell *et al.* 1987). It is conceivable that the prehensile first legs in these taxa also permit an epifaunal lifestyle on the hard substrates of the coral degradation zone.

*Halophytophilus lopheliae* **sp. nov.** is the first deep-sea representative of the genus. All specimens, except one, were collected in the coral degradation zone of *Lophelia pertusa* reefs. The other species of the genus were described and reported from the littoral and shallow subtidal (Lang 1948; Vervoort 1964; Pallares 1975; Wells & Rao 1987). Only the type species *H. fusiformis* seems to have a clear preference for algal substrates (Lang 1948; Vervoort 1964; Pallares 1975). *Halophytophilus spinicornis*, *H. similis* and *H. simplex* have all been collected, though in low numbers, from muddy bottoms (Sars 1921; Lang 1948; Wells & Rao 1987) and Huys *et al.* (1996) also reported *H. similis* from maerl. The genus occurs worldwide, with reports from Norway and Sweden (Sars 1921; Lang 1948), the western coast of Scotland (Huys *et al.* 1996), the Mediterranean Sea (Lang 1948), the Caroline Islands (SW Pacific) (Vervoort 1964), Isla de los Estados, Argentina (SW Atlantic) (Pallares 1975) and South Andaman (Indian Ocean) (Wells & Rao 1987). Although the known species are restricted to the littoral and shallow subtidal, a recent report of *Halophytophilus* from the deep sea of the northern Gulf of Mexico (Baguley 2004) together with this study indicate a much wider occurrence, especially in the deep sea. Nevertheless, our reports of *Halophytophilus* and the three other ectinosomatid genera with prehensile first legs are an indication that the hard substrates of the coral degradation zone may provide an exceptional habitat in the deep sea.

## Acknowledgements

The first author acknowledges a postdoctoral research grant from the Special Research Fund (Ghent University, BOF). This research was conducted within the framework of the HERMES project (EC Sixth Framework Research Programme under the priority ‘Sustainable Development, Global Change and Ecosystems’), the national FWO Research Project G.0199.03 ‘A Comparative Study of the Meio-Epifauna Associated with Tropical and Cold-Water Coral Reefs’, the UGent-BOF-GOA research project 01GZ0705 ‘Biogeography and Biodiversity of the Sea’ and the MarBEF Network of Excellence ‘Marine Biodiversity and Ecosystem Functioning’, which is funded by the Sustainable Development, Global Change and Ecosystems Programme of the European Community’s Sixth Framework Programme (contract no. GOCE-CT-2003-505446). The present study was supported by a small grant from the Taxonomy Clearing System (MarBEF). This publication is contribution number MPS-08013 of MarBEF. Prof. Dr. Jean-Pierre Henriot and co-workers from the Renard Centre of Marine Geology, as well as the crew of the R.V. Belgica, are acknowledged for a successful collaboration. Dr. T. Karanovic and two anonymous reviewers are kindly thanked for critically reading the manuscript and providing constructive remarks.

## References

- Ahnert, A. & Schriever, G. (2001) Response of abyssal Copepoda Harpacticoida (Crustacea) and other meiobenthos to an artificial disturbance and its bearing on future mining for polymetallic nodules. *Deep-Sea Research II*, 48, 3779–3794.

- Baguley, J.G. (2004) *Meiofauna community structure and function in the northern Gulf of Mexico deep sea*. Ph.D. dissertation, The University of Texas at Austin, USA, 201 pp.
- Baguley, J.G., Montagna, P.A., Lee, W., Hyde, L.J. & Rowe, G.T. (2006) Spatial and bathymetric trends in Harpacticoida (Copepoda) community structure in the northern Gulf of Mexico deep-sea. *Journal of Experimental Marine Biology and Ecology*, 330, 327–341.
- Bell, S.S., Walters, K. & Hall, M.O. (1987) Habitat utilization by harpacticoid copepods: a morphometric approach. *Marine Ecology Progress Series*, 35, 59–64.
- Boeck, A. (1865) Oversigt over de ved Norges Kyster iagttagne Copepoder henhørende til Calanidernes, Cyclopidernes og Harpacticidernes Familier. *Forhandlinger i Videnskabs-Selskabet i Christiania*, 1864, 226–282.
- Boeck, A. (1873) Nye Slaegter og Arter af Saltvands-Copepoder. *Forhandlinger i Videnskabs-Selskabet i Christiania*, 1872, 35–60.
- Brady, G. & Robertson, D. (1873) Contributions to the study of entomostraca. 8. On marine copepoda taken in the west of Ireland. *Annals and Magazine of Natural History*, 4, 126–142.
- Brian, A. (1919) Descrizione de una nuova forma di copepodo neritico della famiglia Ectinosomatidae Sars, vivente tra le alghe del litorale di Quarto dei Mille. *Atti della Società Ligustica di Scienze Naturali e Geografiche*, 29, 71–78.
- Brian, A. (1924) Descrizione di un nuove genere di copepodo arpacticoidi dell' Adriatico. *Atti della Società Ligustica di Scienze Naturali e Geografiche*, 4, 116–122.
- George, K.H. & Schminke, H.K. (2002) Harpacticoida (Crustacea, Copepoda) of the Great Meteor Seamount, with first conclusions as to the origin of the plateau fauna. *Marine Biology*, 144, 887–895.
- Gheerardyn, H., De Troch, M., Vincx, M. & Vanreusel, A. (Submitted) Biodiversity of harpacticoid copepods associated with cold-water coral substrates in the Porcupine Seabight (North-East Atlantic). *Deep-Sea Research I*.
- Giesbrecht, W. (1881) Vorläufige Mitteilung aus einer Arbeit über die freilebenden Copepoden des Kieler Hafens. *Zoologischer Anzeiger*, 4, 254–258.
- Gray, J.E. (1858) On *Aphrocallistes*, a new genus of Spongiadae from Malacca. *Proceedings of the Zoological Society of London*, 26, 114–115.
- Heip, C., Vincx, M. & Vranken, G. (1985) The ecology of marine nematodes. *Oceanography and Marine Biology. An Annual Review*, 23, 399–489.
- Hicks, G.R.F. & Coull, B.C. (1983) The ecology of marine meiobenthic harpacticoid copepods. *Oceanography and Marine Biology. An Annual Review*, 21, 67–175.
- Hicks, G.R.F. & Schriever, G. (1983) A new genus and species of Ectinosomatidae (Copepoda, Harpacticoida) based on the original material of Dr. h.c. Walter Klie. *Mitteilungen aus dem Zoologischen Museum zu Kiel*, 2, 1–7.
- Hicks, G.R.F. & Schriever, G. (1985) *Klieosoma* nom. nov., a replacement name for *Kliella* Hicks & Schriever, 1983 (Copepoda, Harpacticoida, Ectinosomatidae). *Crustaceana*, 49, 100–101.
- Huys, R., Gee, J.M., Moore, C.G. & Hamond, R. (1996) *Marine and brackish water harpacticoid copepods. Part 1*. In: Kermack, D.M., Barnes, R.S.K. & Crothers, J.H. (Eds). *Synopses of the British Fauna (New Series)*, London, 352 pp.
- Klie, W. (1949) Harpacticoida (Cop.) aus dem Bereich von Helgoland und der Kieler Bucht. I. *Kieler Meeresforschungen*, 6, 90–128.
- Kunz, H. (1935) Zur Ökologie der Copepoden Schleswig-Holsteins und der Kieler Bucht. *Schriften des Naturwissenschaftlichen Vereins für Schleswig-Holstein*, 21, 84–132.
- Lang, K. (1944) *Monographie der Harpacticiden (Vorläufige Mitteilung)*. Almqvist & Wiksells Boktryckeri, Uppsala, 39 pp.
- Lang, K. (1948) *Monographie der Harpacticiden, I & II*. Håkan Ohlssons Boktryckeri, Lund, 1683 pp.
- Linnaeus, C. (1758) *Systema Naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis (Holmiae: Laurentii Salvii). Tomus 1: Regnum animale*. Tenth Edition, Stockholm, 824 pp.
- Martínez Arbizu, P., Vanaverbeke, J., Schminke, H.K. & Dahms, H.-U. (1998) The meiobenthos in the Arctic Laptev Sea. *Berichte zur Polarforschung*, 277, 79–80.
- Médioni, A. & Soyer, J. (1968) Copépodes Harpacticoides de Banyuls-sur-Mer: Quelques formes récoltées sur des Bryozoaires. *Vie et Milieu*, 18, 317–343.
- Mielke, W. (1974) Eulitorale Harpacticoida (Copepoda) von Spitzbergen. *Mikrofauna Meeresbodens*, 37, 1–52.
- Mielke, W. (1979) Interstitielle Fauna von Galapagos. XXV. Longipediidae, Canuellidae, Ectinosomatidae (Harpacticoida). *Mikrofauna Meeresbodens*, 77, 1–107.
- Nicholls, A.G. (1935) Copepods from the Interstitial Fauna of a Sandy Beach. *Journal of the Marine Biological Association of the United Kingdom*, 20, 379–405.
- Noodt, W. (1971) Ecology of the Copepoda. *Smithsonian Contributions to Zoology*, 76, 97–102.
- Pallares, R.E. (1975) Copepodos Harpacticoides marinos de Tierra del Fuego (Argentina). I. Isla de los Estados. *Contribuciones Científicas del Centro de Investigaciones de Biología Marina*, 122, 1–34.
- Rose, A., Seifried, S., Willen, E., George, K.H., Veit-Köhler, G., Bröhdick, K., Drewes, J., Moura, G., Martínez Arbizu,

- P. & Schminke, H.K. (2005) A method for comparing within-core alpha diversity values from repeated multicorer samplings, shown for abyssal Harpacticoida (Crustacea: Copepoda) from the Angola Basin. *Organisms Diversity and Evolution*, 5, Suppl. 1, 3–17.
- Sars, G.O. (1903) An account of the Crustacea of Norway with short descriptions and figures of all the species. Copepoda Harpacticoida, 5, 1–28.
- Sars, G.O. (1904) An account of the Crustacea of Norway with short descriptions and figures of all the species. Copepoda Harpacticoida, 5, 29–80.
- Sars, G.O. (1921) An account of the Crustacea of Norway with short descriptions and figures of all the species. Copepoda supplement, 7, 93–121.
- Seifried, S. (2003) *Phylogeny of Harpacticoida (Copepoda): Revision of "Maxillipedasphalea" and Exanechentera*. Cuvillier Verlag, Göttingen, 259 pp.
- Seifried, S. (2004) The importance of a phylogenetic system for the study of deep-sea harpacticoid diversity. *Zoological Studies*, 43, 435–445.
- Seifried, S. & Martínez Arbizu P. (in press) A new and exceptional species of *Bradya* Boeck, 1873 (Copepoda: Harpacticoida: Ectinosomatidae) from the abyssal plain of the Angola Basin and the variability of deep-sea Harpacticoida. *Zootaxa*.
- Seifried, S., Plum, C. & Schulz, M. (2007) A new species of *Parabradya* Lang, 1944 (Copepoda: Harpacticoida: Ectinosomatidae) from the abyssal plain of the Angola Basin. *Zootaxa*, 1432, 1–21.
- Shimanaga, M., Kitazato, H. & Shirayama, Y. (2004) Temporal patterns in diversity and species composition of deep-sea benthic copepods in bathyal Sagami Bay, central Japan. *Marine Biology*, 144, 1097–1110.
- Soyer, J. (1974) Contribution à l'étude des Copépodes Harpacticoides de Méditerranée occidentale. 8. Le genre *Pseudobradya* Sars. Systématique, écologie. *Vie et Milieu*, 24, 127–154.
- Vervoort, W. (1964) Free-living Copepoda from Ifaluk Atoll in the Caroline Islands with notes on related species. *Bulletin of the United States National Museum*, 236, 1–431.
- Vincx, M. (1996) Meiofauna in marine and freshwater sediments. In: Hall, G.S. (Ed), *Methods for Examination of Organismal Diversity in Soils and Sediments*. CAB International, Wallingford, pp. 187–195.
- Vincx, M., Bett, B.J., Dinet, A., Ferrero, T., Gooday, A.J., Lamshead, P.J.D., Pfannkuche, O., Soltwedel, T. & Vanreusel, A. (1994) Meiobenthos of the deep Northeast Atlantic. *Advances in Marine Biology*, 30, 1–88.
- Watkins, R.L. (1987) Descriptions of new species of *Bradyellopsis* and *Perissocope* (Copepoda, Harpacticoida) from the California coast with revised keys to the genus. *Journal of Crustacean Biology*, 7, 380–395.
- Wells, J.B.J. (1965) Two new genera of harpacticoid copepods of the family Ectinosomidae. *Revista de Biologia*, 5, 30–35.
- Wells, J.B.J. & Rao, G.C. (1987) Littoral Harpacticoida (Crustacea: Copepoda) from Andaman and Nicobar Islands. *Memoirs of the Zoological Survey of India*, 16, 1–385.