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***Mychophilus palmatus*, a new species (Copepoda: Cyclopoida: Ascidicolidae) associated with the compound ascidian *Botryllus leachi* Savigny, with remarks on congeneric species and related genera**

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Abstract

Presently two species of the genus *Mychophilus* Hesse, 1865 are known: *Mychophilus roseus* Hesse, 1865 and *Mychophilus fallax* Stock, 1967. A hitherto unknown species is described herein as *Microphilus palmatus* n. sp. The new species is characterized by its urosome much exceeding the cephalosome-metasome in length, the ornamentation of the labrum, the shape of the palp of the first maxilla, the ornamentation of the legs 1–4 and shape of the caudal rami. These and other features of the genus *Mychophilus* are compared with those from other related genera of the family Ascidicolidae Thorell, 1859.

Introduction

The family Ascidicolidae Thorell, 1859 includes seven subfamilies; subfamily Enteropsinae Aurivillius, 1885 has two described genera, *Mychophilus* Hesse, 1865 and *Enteropsis* Aurivillius, 1885 (Illg & Dudley, 1980; Ooishi, 1991).

Two species have been recognized in *Mychophilus*: *M. roseus* Hesse, 1865 and *M. fallax* Stock, 1967. Incomplete descriptions and anatomical observations resulted in several other specific names, but most of them have been referred to the type-species of the genus, *M. roseus* (Gotto, 1954; Illg & Dudley, 1980). A complete account of references and synonyms may be found in Illg & Dudley (1980). *M. roseus* is a European west coast species while the second species, *M. fallax*, was described from the Red Sea, based on a single specimen.

In this paper *Mychophilus palmatus* n. sp. is described and compared with its congeners. Furthermore, the affinities with other related genera within the family Ascidicolidae are discussed.

Material and methods

The compound ascidian *Botryllus leachi* Savigny was collected on stones from the infralittoral zone (12 m

deep). The ascidians were relaxed with menthol and preserved in formalin (4% in seawater). The copepods were removed by dissection under a stereomicroscope from the matrix of the host and preserved in a 70% ethyl alcohol in seawater. The specimens were stained with chlorazol black and dissected under a stereomicroscope. Permanent mounts were made in lactophenol and sealed using Entellan. All figures were drawn with the aid of a camera lucida. The letter after explanation of each figure refers to the scale at which it was drawn.

Family Ascidicolidae Thorell, 1859
Subfamily Enteropsinae Aurivillius, 1885
Genus *Mychophilus* Hesse, 1865

Mychophilus palmatus, new species (Figures 1, 2)

Type material: 7 females from the compound ascidian *Botryllus leachi* Savigny at San García, Algeciras Bay, Cádiz, Spain, September 1992. The holotype and one paratype have been deposited in the Museo Nacional de Ciencias Naturales of Madrid, Spain (MNCN 20.04/788). Remaining paratypes (two dissected) in the collection of the authors.

Description: Female. Body vermiform (Figure 1a), mean length of relaxed specimens 2 mm (based on 4

specimens in lactophenol, range: 1.78 and 2.46 mm). Ratio of cephalosome: metasome: urosome, 1:4.3:7.3 (range 1:3.5–5.3:4.5–10.8). Uncontracted specimens have urosome curved upward. Separation of pedigers weakly defined. Anus placed dorsally. Rostrum not delimited.

Cephalic appendages placed as shown in Figures 1b and 1c. First antenna (Figure 1f) unimerous, narrowing apically suggesting two possible segments. Distal portion with 3(4) setae and 3(4) smaller setae. Second antenna (Figure 1g) unimerous and more sclerotized than first antenna, typically conical with spines and spinules apically. Labrum (Figure 2a) more or less elliptical, ornamented with 5–6 pubescent setose elements. First maxilla (Figure 2b) bilobed with a row of spinules at basis, basal prolongation with 2 elongated pubescent setiferous lobes, palp carrying 3 elongated pubescent setiferous lobes. Second maxilla (Figure 2c) bimerous, basal segment massive with 2 rows of spinules, distal segment short and square with a long terminal claw.

Legs 1–4 (Figures 2d–g) bimerous, surface smooth, without fine protuberances, sclerotizations not obvious. Basal segment cylindrical to conical, with 3 rows of spinules on anterior side. Distal segment conical, with distal spine and lobe looking like a third segment, which in some cases appears bilobed.

Genital apertures (Figures 1a, e) on lateral surface, posterior to the level of the anus, unornamented.

Caudal rami (Figures 1a, d) unimerous, unornamented, conical and swollen, narrowing at the middle suggesting two possible segments, the distal portion tapering gradually.

Male unknown.

Etymology: The specific name *palmatum* refers to the shape of the palp of the first maxilla.

Key to species of the genus *Mychophilus* (based on females)

1. Urosome and cephalosome-metasome roughly subequal; terminal claw of second maxilla short *M. roseus* Hesse, 1865
Urosome usually much exceeding the cephalosome-metasome; terminal claw of second maxilla elongate 2
2. Distal segment of legs 1–4 unarmed; basal segment of legs 1–4 with 4–5 groups of spinules along distal margin; leg 1 not displaced laterally

..... *M. fallax* Stoch, 1967
Distal segment of legs 1–4 with a spine; basal segment of legs 1–4 with 3 parallel and well-developed rows of spinules on anterior side; leg 1 displaced laterally *M. palmatum*, new species

Discussion

Including *Mychophilus palmatum*, three species of the genus are known. *Mychophilus roseus* Hesse, 1865 from the European west coast and Mediterranean, *M. fallax* Stock, 1967 from the Red sea, and *M. palmatum*, described in this paper, from the Straits of Gibraltar. All species of *Mychophilus* are associated with compound ascidians, mainly with the genera *Botryllus* Gaertner and *Botrylloides* Milne Edwards. *Botryllus schlosseri* (Pallas), *B. smaragdii* Milne Edwards, *B. violaceus* Milne Edwards (both synonyms of *B. schlosseri*), *Botryllus leachi* Savigny and *Polycyclus renieri* Lamarck are hosts for *M. roseus*; *Botrylloides nigrum* Herdman is known for *M. fallax*; and *Botryllus leachi* for *M. palmatum*. At present, *Botrylloides* is considered a synonym of *Botryllus*, and part of the specimens studies as *B. nigrum* are *B. leachi* (Monniot & Monniot, 1987).

The precise localization of the *Mychophilus* species in its ascidian hosts is not clear. *M. roseus*, the best known species, has been found in the branchial cavity (Scott, 1901; Illg & Dudley, 1980), cloacal cavity (Schellenberg, 1922) and matrix (Chatton & Brément, 1909; Gray, 1933; Illg & Dudley, 1980). *M. palmatum* was found in the matrix, and no data are available about *M. fallax*.

Mychophilus roseus has been redescribed by Illg & Dudley (1980), including synonyms and variability of the different appendages. As pointed out Lang (1948) and Gotto (1954), several specific names have been proposed in the genus *Mychophilus* but all of them must be referred to *M. roseus*; excluding the second valid species described by Stock (1967) as *M. fallax* (see Illg & Dudley, 1980). Some aspects of the anatomy and biology of *M. roseus* have been treated by Chatton & Brément (1909, as *M. curvatus*), Gray (1933, as *M. rosavula*), Lang (1948), Gotto (1952, 1954, 1984) and Illg & Dudley (1980). According to Illg & Dudley, the diagnostic characters of *M. roseus* are: urosome and cephalosome-metasome subequal in length; labrum unornamented; palp of the first maxilla as a lobe, sometimes slightly bilobed; distal spine of the second maxilliped moderately short; first legs

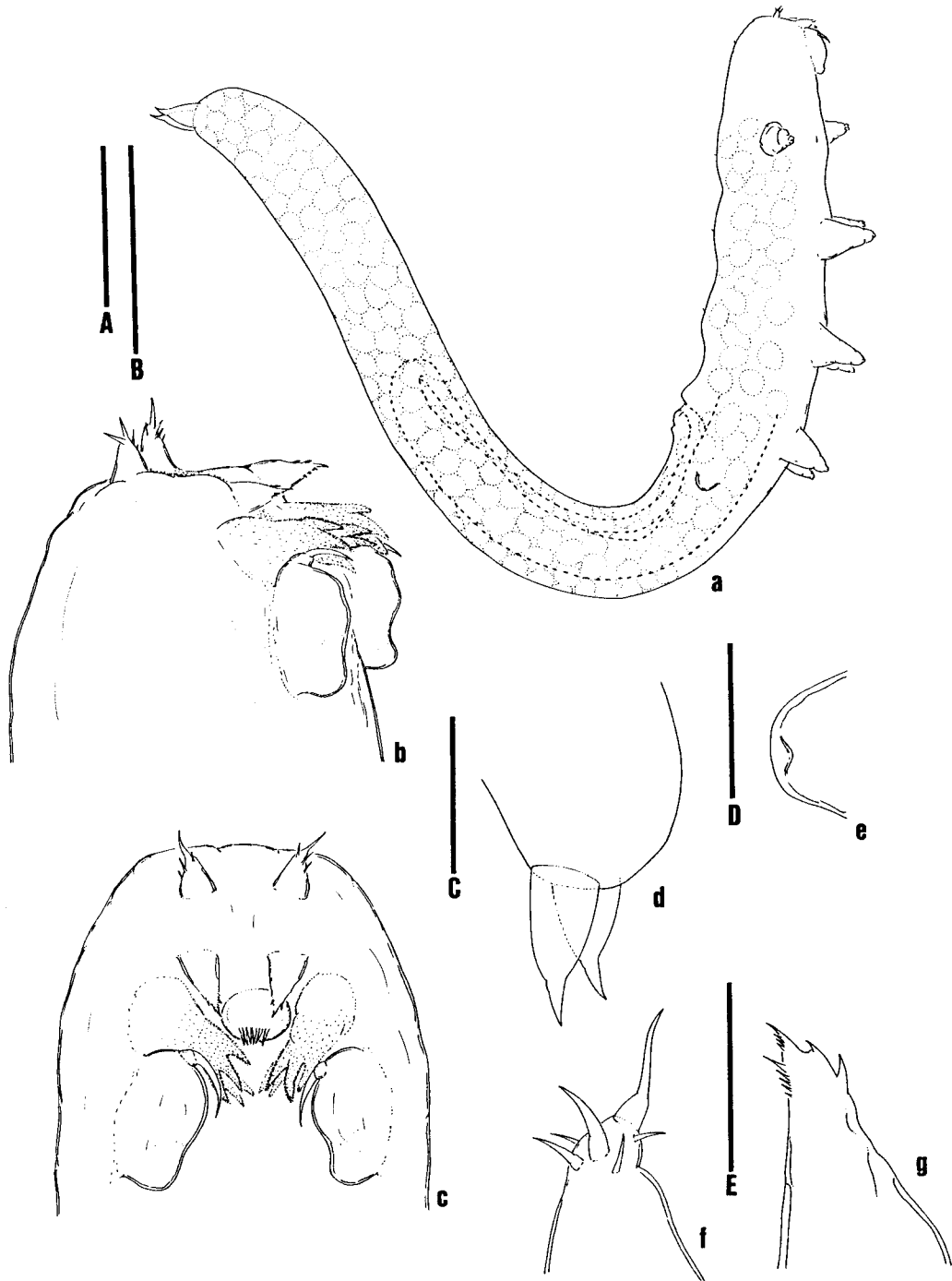


Figure 1. *Mychophilus palmatus*, female (paratype): a, habitus, lateral (A); b, cephalic region, lateral (B); c, oral region (B); d, caudal rami, lateral, right side must be considered as dorsal (C); e, genital aperture (D); f, first antenna (E); g, second antenna (E). Scale bars, A: 300 μm ; B: 100 μm ; C: 100 μm ; D: 50 μm ; E: 25 μm .

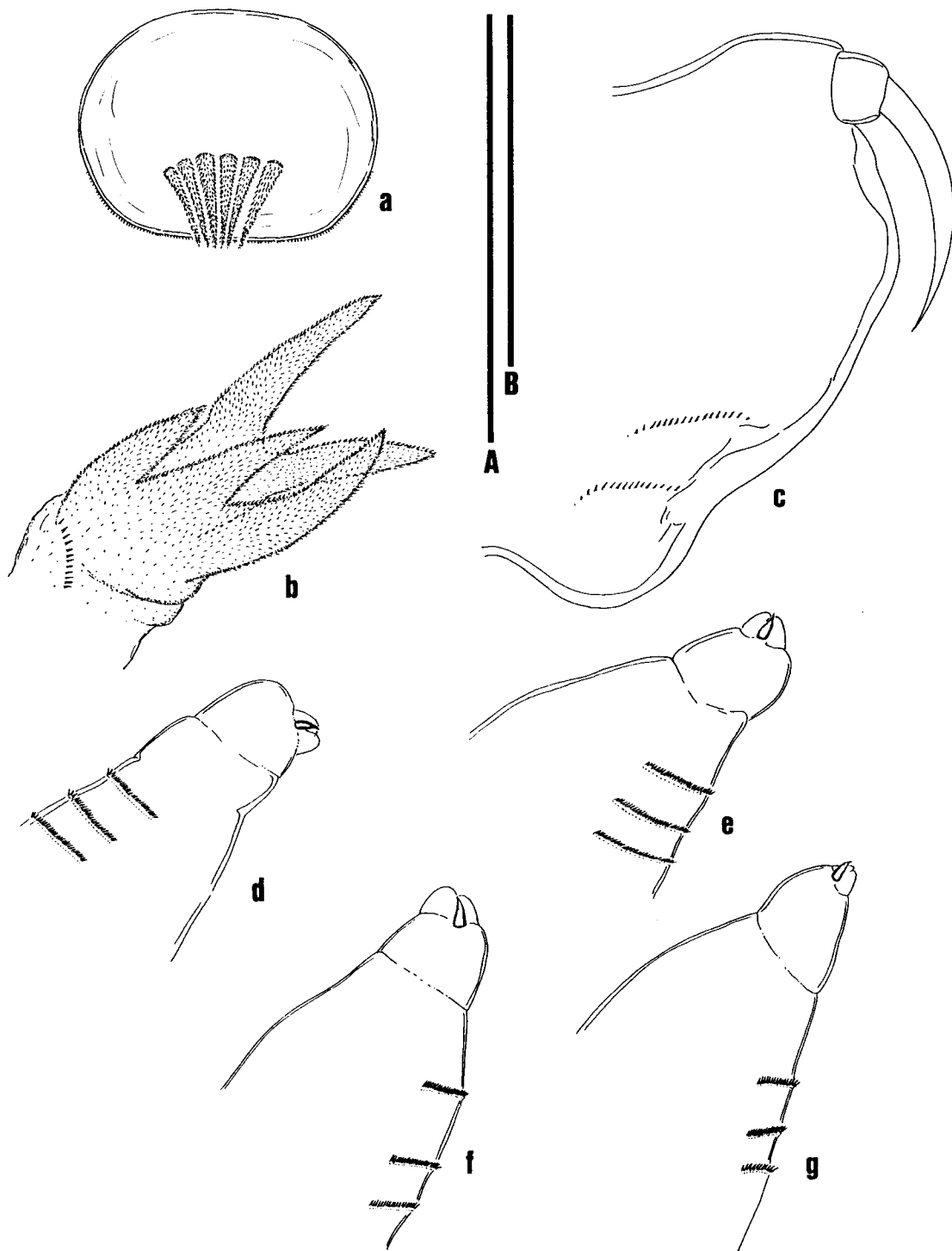


Figure 2. *Mychophilus palmatus*, female (paratype): a, labrum (A); b, first maxilla (A); c, second maxilla (A); d, first leg (B); e, second leg (B); f, third leg (B); g, fourth leg (B). Scale bars, A: 50 μm; B: 100 μm.

displaced laterally; distal segment of legs 1–4 with a spine; and caudal rami small, seta-like.

Mychophilus fallax is known from a single specimen, and some features (the possible presence of a 5th leg, and the structure of second antenna, first and second maxilla) from the original description are interesting. Stock (1967) points out that this species possesses a 'small, unadorned, triangular projection, which might represent the 5th leg' that has not been observed in the other two species. The shape of the second antenna, prehensile with a long and slender claw, used by Illg & Dudley (1980) in their key to the species, reminds strongly of the structure of the second maxilla observed in *M. palmatus*. Moreover, the shape of the second maxilla is reminiscent of the second antenna present in *M. roseus* and *M. palmatus*. The structure of the first maxilla is difficult to compare with the same structure in the two other species due to the presence of a 'coxopod' not observed in *M. roseus* nor *M. palmatus*. The 'presumed basipodite' with two long shortly pubescent setae should correspond with the two inner long setae present in *M. palmatus*, and the palp 'finger-shaped, and distally armed with some minute spinules or teeth' should correspond with the palp illustrated in Illg & Dudley's monograph (p. 99, fig. 38f–h) for *M. roseus*. This palp may be bilobed in the latter species too, or appearing to be provided with three long pubescent setae, similar to those of the basal portion in *M. palmatus*. The absence of a spine on the distal segment of legs 1–4 and the position of the leg 1, not displaced laterally, are diagnostic features for *M. fallax*. For the present work, we propose the following modification from Stock (1967): the 'maxilla' and the 'posterior antenna' must be considered as the second antenna and the second maxilla, respectively. This misinterpretation is probably due, as pointed out Stock, to the extremely small appendages and the difficulty of dissection and examination.

Mychophilus palmatus is close to *M. roseus* by the structure of first and second antenna, presence of a spine on the terminal segment of legs 1–4, and the lateral displacement of leg 1; it differs from *M. roseus* by the ratio urosome to cephalosome-metasome, presence of five to six setiform elements on the labrum, structure of the palp in the first maxilla, proportions of the terminal claw in the second maxilla, presence of three rows of spinules on the basal segment of the legs 1–4, and general aspect of the caudal rami, much more reduced in *M. roseus* than those of *M. palmatus*.

Mychophilus palmatus is close to *M. fallax* by the vermiform appearance of the body, the long distal claw

on the second maxilla, proportions of the caudal rami, and shape of the second antenna. *M. palmatus* may be distinguished from *M. fallax* by the presence of a spine on the terminal segment of legs 1–4, lateral displacement of leg 1, presence of three rows of spinules on the anterior side of the basal segment of legs 1–4, palp of first maxilla with three pubescent setiform processes, first antenna with more than two distal elements, and caudal rami not completely tapering gradually, swollen basally and differentiated into two regions. No data are available on the structure of the labrum in *M. fallax*.

The diagnostic features of *M. palmatus* are: ornamentation of the labrum, shape of the palp of the first maxilla, the ornamentation of the basal segment of the legs 1–4, and shape of the caudal rami.

The importance of the elongation of the urosome with respect to the cephalosome-metasome for specific differentiation is relative, depending on maturity of the female, and must be used with caution. The high number of females of *Mychophilus roseus* collected by different authors demonstrates a subequal dimension of the urosome in mature females (range based in Gotto's and Illg & Dudley's illustrations, 1:3–3.3:3.2–3.8). In *M. fallax* (1:2.8:9) and *M. palmatus* (range 1:3.5–5.3:4.5–10.8), there is probably a progressive elongation of the urosome with maturation of the females. In these two species the maximum length of the urosome exceeds the cephalosome-metasome. This character may be considered as a first feature to distinguish between two artificial but practical groups, as in the key in this paper.

The male of *Mychophilus* is only known for *M. roseus*. Lang (1948), Gotto (1954) and Illg & Dudley (1980) studied some copepodite stages. The adult male was found and described for the first time by Gotto et al. (1984). These authors pointed out the rarity of males in *M. roseus*. The males of *M. fallax* and *M. palmatus* remain unknown.

Some features of *M. palmatus* relate it to *Enteropsis* Aurivillius, 1885, the other genus of the Enteropsinae. The labrum of *M. palmatus* shows affinity with that of *Enteropsis roscoffensis* Chatton & Brément, 1990, *E. sphinx* Aurivillius, 1887, *E. capitulatus* Illg & Dudley, 1980 and *E. georgianus* Schellenberg, 1922, all of them illustrated in Illg & Dudley (1980). The palp of the first maxilla of *M. palmatus* resembles that of *E. roscoffensis*, *E. sphinx* and *E. capitulatus*. However, the structure of the second maxilla, dorsal displacement of the anus to the anterior end of the urosome and, in the last place, an elongate urosome are diagnostic of *Mychophilus*.

Besides, this subfamily shows close affinity with Enterocolinae Della Valle, 1883 (Illg & Dudley, 1980). Species of both subfamilies have in common an eruciform habitus of the body of females, a labrum often ornamented with setose elements, a similar palp of the first maxilla and a massive basis of second maxilla, with more or less developed spiniform processes. There are also striking differences, e.g. the structure of a setose and well-developed second antenna, biramous legs 1–4, and presence of leg 5 as a pedigerous projection, all characteristics of the Enterocolinae.

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