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First record of the sipunculan worm *Phascolion (Phascolion) caupo* Hendrix, 1975 in the Mediterranean Sea

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Abstract

Specimens of the sipunculan worm *Phascolion (Phascolion) caupo* Hendrix, 1975 have been collected for the first time in the Mediterranean Sea, thus increasing the number of known sipunculan species up to 36 in this area. They were encountered on soft bottoms from the coast of San Pedro del Pinatar (Western Mediterranean). Thirty specimens were collected at a depth ranging from 32.6 to 37.2 m, mainly in sandy substrata with high load of silt and clays. 80% of the individuals were found inhabiting empty shells of gastropods or empty tubes of serpulid polychaetes.

Keywords: Sipuncula, *Phascolion caupo*, Mediterranean.

Introduction

To date, after recent contributions (Açik, 2007, 2011), a total of 35 sipunculan species are known in the Mediterranean Sea. A detailed list can be consulted in Coll *et al*. (2010). Three of these species belong to the genus *Phascolion: Phascolion (Isomya) convestitum* (Sluiter, 1902), *Phascolion (Isomya) tuberculosum* Théel, 1875 and *Phascolion (Phascolion) strombus* (Montagu, 1804) (Pancucci-Papadopoulou *et al.*, 1999; Coll *et al*., 2010). In this work, it is reported an addition to the list of known species of sipunculan worms in the Mediterranean Sea.

Phascolion (Phascolion) caupo Hendrix, 1975 (Fig. 1) is relatively a recent species, with only a few records around the world. Originally, it was collected from shallow waters, among rhizomes and roots of the seagrass *Thalassia testudinum*, from the southeastern coast of the United States in the Western Atlantic (Hendrix, 1975). Later, it was recorded in the eastern side of the Atlantic Ocean, in the Ibero-Moroccan bay, at a depth ranging between 544-1378 m, in bottoms formed by fragments of mollusc shells (Saiz-Salinas & Villafranca-Urchegui, 1990). Three years later, it was recorded for the first time in the Indian Ocean (Saiz-Salinas, 1993a).

Phascolion caupo shows a similar morphology to *P. strombus,* a species widely recorded along the European Mediterranean shoreline (Pancucci-Papadopoulou *et al.*, 1999). Probably the presence of *P. caupo* has been overlooked in the Mediterranean Sea due to the lack of specialists in the identification of sipunculan species (Pancucci-Papadopoulou *et al*., 1999). When identifying sipunculans of the genus *Phascolion*, the confusion between *P. caupo* and *P. strombus* might be easy for marine biologists who are not habituated to their identification. *Phascolion strombus* presents a high phenotypic plasticity (Cutler, 1973), with variability between individuals in body shape, skin colour, body size or number and shape of papillae (Saiz-Salinas, 1984). The objectives of this study are: (1) to report the presence of *P. caupo* in the Mediterranean Sea; and (2) to select reliable characters for the distinction of closely related species.

Materials and Methods

Specimens of *P. caupo* were collected near San Pedro del Pinatar (Spanish Mediterranean), at depths ranging from 32.6 to 37.2 m (Fig. 2). The sediment was a mixture of muddy sand, with different grain size and even gravel and coralline algae at location C1 (Table 1).

A total of 144 samples were collected every June from 2007 to 2010 by using a Van Veen grab with a sur-

Fig. 1: Specimen of *Phascolion caupo* from San Pedro del Pinatar (Western Mediterranean). Scale bar = 1 mm.

face area of 0.04 m^2. To separate the macrofauna from sediment, the samples were sieved through a 0.5 mm mesh screen. Afterwards, the macrofauna was fixed in 10% buffered formalin and preserved in 70% ethanol. Depth and sediment type were recorded at each station (Buchanan, 1984). Sipunculans were dissected to study their internal anatomy using a binocular microscope and fine scissors with a 3 mm blade (Moria MC19). Small structures with high taxonomic value, such as papillae and hooks, were observed under the microscope. To identify the species, we examined the introvert hooks, a distinctive characteristic between *P. caupo* and *P. strombus* (Cutler, 1994). *Phascolion strombus* presented claw-like hooks (type I hooks) (Fig. 3A), while *P. caupo* presented scattered broad-based hooks, with the tip rounded (type III hooks) (Fig. 3B).

Results and Discussion

A total of 30 specimens of *P. caupo* were collected. Most of them inhabited inside a calcareous shelter (80.0%), such as gastropod empty shells (65.7%), *Ditrupa arietina* (Polychaeta: Serpulidae) empty tubes (11.4%) or calcareous debris (2.9%). It is well known that *P. caupo* is usually an empty shells dweller (Hendrix, 1975; Saiz-Salinas & Villafranca-Urchegui, 1990;

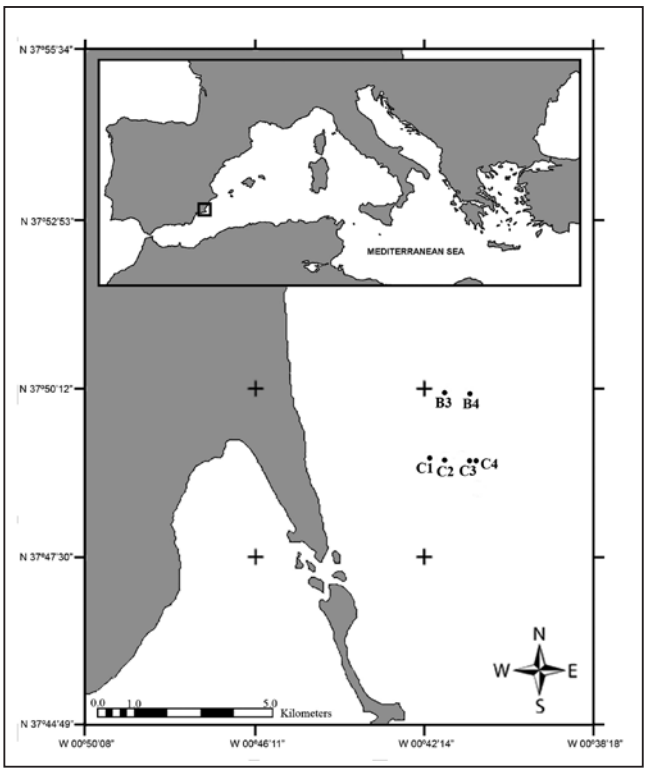

Fig. 2: Map of the study area showing the sampling stations.

Saiz-Salinas, 1993a,b). In a few cases, sipunculans were found sharing their shelter with polychaetes or bivalves. The average trunk length of the specimens was 3.27 ± 0.46 mm long (mean ± SE), with a maximum size of 12 mm. The length of the introvert when fully everted was around 1-3 times longer than the trunk length. Lemon-shaped papillae (Fig. 3C) were present in the anterior and posterior part of the trunk, and blister-shaped papillae (Fig. 3D) scattered along the trunk. A few cone-shaped holdfasts papillae (Fig. 3E) were found in the middle of the trunk. These papillae were difficult to find due to their low abundance and they were detected only in some of the specimens. Dissected individuals had the standard characters of the genus: the presence of one nephridium

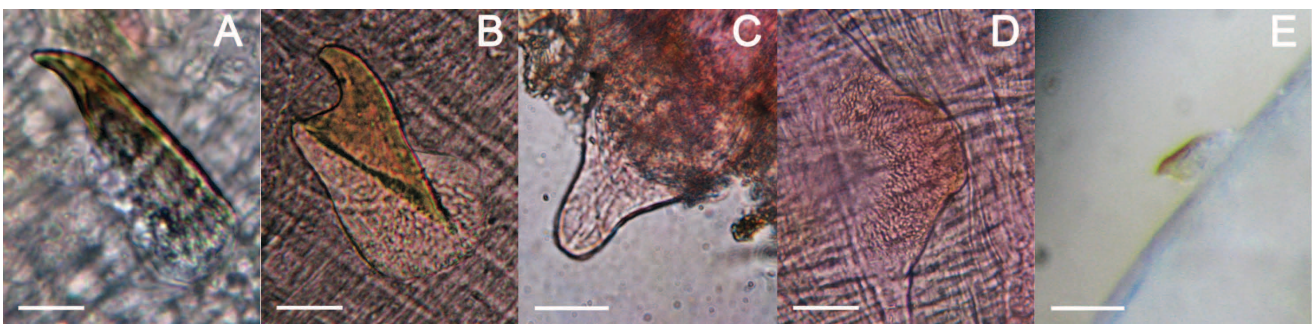

Fig. 3: (A) Claw-like hook from the introvert of *Phascolion strombus*. (B) Tip-rounded hook from the introvert of *Phascolion caupo*. (C) Lemon-shaped papilla from the anterior part of the trunk of *P. caupo*. (D) Blister-shaped papilla from the mid-trunk of *P. caupo*. (E) Holdfast papilla from mid-trunk of *P. caupo*. Scale bars: A,B = 10 µm; C = 100 µm; D,E = 50 µm.

Table 1. Data collection of the material examined showing year, station, latitude, longitude, depth (m), bottom substrate, shelter and trunk length (TL) for each specimen. Substrate = main fraction of the sediment (Buchanan, 1984).

Year	Station	Latitude	Longitude	Depth (m)	Substrate	Shelter	TL (mm)
2007	B3	N 37º49'54"	W 0º42'20"	33.7	Coarse sand	—	2.0
2007	C2	N 37º48'49"	W 0º42'21"	33.4	Medium sand	*D. arietina* tube	2.0
2007	C3	N 37º48'49"	W 0º41'50"	34.9	Coarse sand	—	8.0
2007	C3	N 37º48'49"	W 0º41'50"	34.9	Coarse sand	Gastropod shell	2.0
2007	C3	N 37º48'49"	W 0º41'50"	34.9	Coarse sand	Gastropod shell	6.0
2007	C3	N 37º48'49"	W 0º41'50"	34.9	Coarse sand	Gastropod shell	7.0
2007	C3	N 37º48'49"	W 0º41'50"	34.9	Coarse sand		1.0
2007	C3	N 37º48'49"	W 0º41'50"	34.9	Coarse sand	Gastropod shell	5.0
2007	C3	N 37º48'49"	W 0º41'50"	34.9	Coarse sand	—	2.0
2007	C3	N 37º48'49"	W 0º41'50"	34.9	Coarse sand	—	2.0
2007	C3	N 37º48'49"	W 0º41'50"	34.9	Coarse sand	Gastropod shell	1.5
2008	B4	N 37º49'53"	W 0º41'49"	37.2	Mud	Gastropod shell	1.0
2008	C1	N 37º48'51"	W 0º42'41"	32.6	Gravel	Gastropod shell	1.0
2008	C2	N 37º48'49"	W 0º42'21"	33.4	Medium sand	Gastropod shell	5.0
2008	C2	N 37º48'49"	W 0º42'21"	33.4	Medium sand	*D. arietina* tube	3.0
2008	C2	N 37º48'49"	W 0º42'21"	33.4	Medium sand	Gastropod shell	2.0
2008	C2	N 37º48'49"	W 0º42'21"	33.4	Medium sand	*D. arietina* tube	4.0
2008	C3	N 37º48'49"	W 0º41'50"	34.9	Fine sand	Calcareous debris	7.0
2008	C3	N 37º48'49"	W 0º41'50"	34.9	Fine sand	Gastropod shell	0.5
2008	C3	N 37º48'49"	W 0º41'50"	34.9	Fine sand	Gastropod shell	1.5
2008	C3	N 37º48'49"	W 0º41'50"	34.9	Fine sand	Gastropod shell	2.5
2008	C3	N 37º48'49"	W 0º41'50"	34.9	Fine sand	Gastropod shell	2.0
2008	C3	N 37º48'49"	W 0º41'50"	34.9	Fine sand	Gastropod shell	1.0
2008	C3	N 37º48'49"	W 0º41'50"	34.9	Fine sand	Gastropod shell	12.0
2008	C4	N 37º48'49"	W 0º41'47"	35.6	Medium sand	Gastropod shell	2.0
2008	C4	N 37º48'49"	W 0º41'47"	35.6	Medium sand	Gastropod shell	2.0
2008	C4	N 37º48'49"	W 0º41'47"	35.6	Medium sand	Gastropod shell	2.5
2008	C4	N 37º48'49"	W 0º41'47"	35.6	Medium sand	Gastropod shell	2.5
2008	C4	N 37º48'49"	W 0º41'47"	35.6	Medium sand	Gastropod shell	4.0
2008	C4	N 37º48'49"	W 0º41'47"	35.6	Medium sand	Gastropod shell	2.5
2010	C3	N 37º48'49"	W 0º41'50"	34.9	Medium sand	Gastropod shell	5.0

and two retractor muscles are partially fused. Both the ventral and the dorsal retractor muscles are attached at the same level, just at the posterior part of the trunk. The ventral retractor muscle showed a slight division at the base and was 3-6 times thinner than the dorsal one. This thinner ventral muscle was overlooked in the original description by Hendrix (1975).

Historically, the high plasticity of this genus led to the description of numerous species during the first half of the twentieth century, many of which were later synonymised through different revisions (Hendrix, 1975; Cutler & Cutler, 1985; Gibbs, 1985), decreasing notably the number of species belonging to the genus *Phascolion*. The species *P. caupo* was not described by Hendrix until 1975, making clear the anatomic differences between *P. caupo* and other species of the genus. It is likely that the presence of *P. caupo* in the Mediterranean Sea has been overlooked for many years, possibly being misidentified as *P. strombus*. Nonetheless, the possibility of a recent entrance of *P. caupo* to the Mediterranean Sea through the Strait of Gibraltar should be analysed by a genetic study of individuals from different Atlantic and Mediterranean locations. Also, the genetic divergence should be studied, both among varieties of different localities and different species of the genus *Phascolion*.

KEY TO THE GENUS *PHASCOLION* FROM THE MEDITERRANEAN SEA

1a. Ventral retractor muscle much thinner than dorsal (less than one-half). 2
1b. Dorsal and ventral retractors of equal size; epidermal holdfast of trunk weakly proteinised or absent. 3
2a. Claw-like hooks (type I) (Figure 2A) . . . . . *Phascolion (Phascolion) strombus*
2b. Scattered broad-based hooks, with rounded tip (type III) (Figure 2B). . . . . *Phascolion (Phascolion) caupo*
3a. Large holdfast papillae without chitinised borders. . . . . *Phascolion (Isomya) tuberculosum*
3b. Holdfast papillae with weak borders of hardened proteins . . . . . *Phascolion (Isomya) convestitum*

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