

## Mediterranean Marine Science

Vol 14, No 1 (2013)



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doi: [10.12681/mms.322](https://doi.org/10.12681/mms.322)

#### To cite this article:

RADASHEVSKY, V. I., & SIMBOURA, N. (2013). First record of *Dipolydora blakei* (Annelida: Spionidae) from Europe: Greece, Mediterranean Sea. *Mediterranean Marine Science*, 14(1), 19–23. <https://doi.org/10.12681/mms.322>

## First record of *Dipolydora blakei* (Annelida: Spionidae) from Europe: Greece, Mediterranean Sea

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Received: 25 April 2012; Accepted: 3 August 2012; Published on line: 19 February 2013

### Abstract

The spionid polychaete *Dipolydora blakei* is identified from benthic samples collected in the Aegean Sea off Chalkis and the Ionian Sea off Kalamitsi, both on the coast of Greece. Adults of *D. blakei* are characterized by having the falcate spines of chaetiger 5 with a large lateral tooth and bristles on the convex side of a long and pointed main fang, awl-like spines in posterior notopodia, branchiae beginning from chaetiger 7 and a pygidium with two lateral lobes. This is the first report of the species from the Mediterranean Sea and European waters and the second record (after one from Brazil) outside its type locality in deep-water off New England, north-west Atlantic Ocean. The morphology of the Greek specimens is described and illustrated and diagnostic characters of the species are discussed. The origin of these specimens in the coastal waters of Greece is uncertain and the species is considered as cryptogenic in the Mediterranean Sea. An identification key to *Dipolydora* species with bristle-topped falcate spines in chaetiger 5 known from the Mediterranean Sea and European waters is provided.

**Keywords:** polychaete, morphology, Aegean Sea, Ionian Sea, Mediterranean, cryptogenic species.

### Introduction

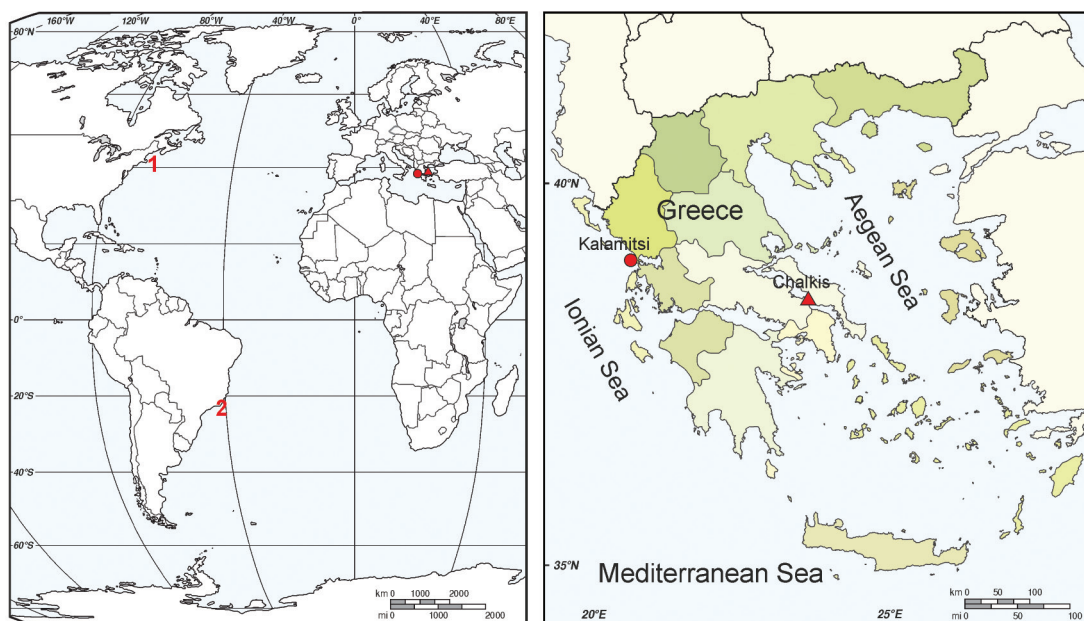
In total, 398 species of polychaetes were identified in samples collected from 188 stations in the Aegean and Ionian Seas during ecological surveys along the coast of Greece (Simboura *et al.*, 2000). One sample from the Ionian Sea, off Kalamitsi on the western coast of Greece (Fig. 1), yielded small immature spionid polychaetes which were reported by Zenetos *et al.* (1997) as *Polydora caulleryi* Mesnil, 1897. One specimen of the same species was also collected from the Aegean Sea, Evvoikos Gulf, off Chalkis on the eastern coast of Greece. These specimens are here described and re-identified as *Dipolydora blakei* (Maciolek, 1984). This is the first report of the species from the Mediterranean Sea and European waters.

### Materials and Methods

Field collections were made in the Aegean and Ionian Seas, Greece, eastern Mediterranean, on soft substrata at depths ranging from 3 to 380 m between 1982 and 1993 (see Simboura *et al.*, 2000). Sediment samples were collected using grabs and screened using a 1 mm

mesh sieve. The residue was fixed in 10% formaldehyde solution, rinsed in fresh water, and then transferred to 70% ethanol. Polychaetes were removed from the residue under a stereomicroscope at the Hellenic Centre for Marine Research, Hellas, Greece. Photographs were taken using a Zeiss Axio Imager 7.2 microscope equipped with a digital camera; before photography, specimens were stained with a solution of methylene green in alcohol. The examined material was deposited at the Museum of the Institute of Marine Biology (MIMB), Vladivostok, Russia. Information about the samples is given below along with description of the specimens. The number of specimens in each sample is given in parentheses after the museum abbreviation and registration number.

Type specimens of *Polydora blakei* from off New England, U.S.A. deposited in the Allan Hancock Foundation Polychaete collection of the Natural History Museum of Los Angeles County, Los Angeles, U.S.A. (LACM-AHF), and specimens of *D. blakei* from off the states of Rio de Janeiro and São Paulo, Brazil deposited in the E.F. Nonato Polychaete Collection of the Institute of Biology of the Federal University of Rio de Janeiro, Rio de Janeiro, Brazil (IBUFRJ), Museum of Zoology of the University of São Paulo, São Paulo, Brazil (MZUSP),



**Fig. 1:** Map showing world-wide records of *Dipolydora blakei* and collecting sites off Greece. 1 – continental slope off New England, U.S.A. (Maciolek, 1984); 2 – continental platform and slope off the states of São Paulo and Rio de Janeiro, Brazil (Radashevsky & Paiva, 2010); filled triangle – Aegean Sea, off Chalkis; filled circle – Ionian Sea, off Kalamitsi (present study).

and the Museum of Zoology of the State University of Campinas, Campinas, Brazil (ZUEC) were also examined.

## Taxonomic Account

### Spionidae Grube, 1850

#### *Dipolydora blakei* (Maciolek, 1984)

*Polydora blakei* Maciolek, 1984: 124–127, figs 1, 2.

*Dipolydora blakei*: Blake, 1996: 194. Radashevsky & Paiva, 2010: 44–45, textfig. 44.

*Polydora caulleryi*: Zenetos *et al.*, 1997: 445, 449. Not Mesnil, 1897.

### Material

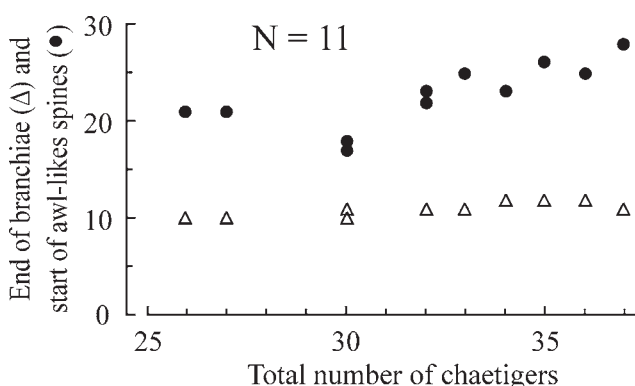
Greece: Mediterranean, **Aegean Sea**, Evvoikos Gulf, off Chalkis, sta. XA1, 38°28.9'N, 23°35.9'E, 18 m, muddy sand with coral debris, coll. N. Simbora, 8 Mar 1991, MIMB 27141 (1). **Ionian Sea**, off Kalamitsi, sta. C4b, 38°58.155'N, 20°42.264'E, 63 m, sand with shell debris, coll. N. Simbora, 26 Apr 1991, MIMB 27123 (11).

### Supplementary material

U.S.A.: **New England Continental Slope**, Gay Head-Bermuda Transect, R/V *Atlantis*, cruise 283, sta. slope 2, 40°1.8'N, 70°42'W, 200 m, anchor dredge, coll. H.L. Sanders, 28 Aug 1962, LACM-AHF POLY 1387 (holotype), 1388 (600 paratypes).

Brazil: **Rio de Janeiro Continental Slope**, northern Bacia de Campos, Oceano Profundo II Project: sta. 50A, 22°02.847'S, 39°52.402'W, box core layer 2–5 cm, 1048 m, 29 Jun 2003, IBUFRJ 1284 (1); sta. 50,

22°04.567'S, 39°52.083'W, box core layer 5–10 cm, 1030 m, 30 Jun 2003, IBUFRJ 822 (1). **São Paulo Continental Platform**, REVIZEE/Score Sul - Benthos Project, sta. 6661, 24°07.637'S, 45°51.895'W, 147 m, 9 Jan 1998, ZUEC POL 669 (11); sta. 6665, 24°20.844'S, 44°09.913'W, 258 m, 10 Jan 1998, ZUEC POL 670 (4); sta. 6686, 25°36.988'S, 45°13.571'W, 380 m, 13 Jan 1998, ZUEC POL 668 (1); REVIZEE/Score Central - Benthos Project, sta. Y1-4, 22°19.083'S, 40°48.7'W, 60 m, 11 Jun 2002, MZUSP 81 (1).



**Fig. 2:** *Dipolydora blakei* adult morphology (Aegean and Ionian Seas, Greece, MIMB 27123, 27141). Relationship between distribution of branchiae (number of the last branchiate chaetiger) and total number of chaetigers in worm (empty triangles), and anterior position of awl-like spines in notopodia (number of the first spine-bearing chaetiger) and total number of chaetigers in worm (filled circles).

### Adult morphology (Greek specimens)

Up to 4 mm long and 0.2 mm wide for 37 chaetigers. Pigmentation absent. Prostomium anteriorly bilobed, posteriorly extending to end of chaetiger 2 as a low caruncle. Occipital antenna and eyes absent. Nuchal organs as wide ciliary bands on sides of caruncle. Palps as long as 10–15 chaetigers, with frontal longitudinal groove lined with fine cilia.

Chaetiger 1 with short capillaries and small postchaetal lamellae in both rami. Posterior notopodia from chaetigers 17–28 to the end of the body with up to 15 awl-like spines gathered in cone-shaped bundles and 10 slender capillaries (Fig. 3F); spines gradually lost with age from anterior notopodia and starting in more posterior chaetigers in bigger individuals (Fig. 2). Spines with distal tips pointed and basal parts blunt, conspicuously protruding out of the body, slightly thinner and fewer at first appearance than in posterior chaetigers; old spines thinner and shorter than new spines in same bundle.

Chaetiger 5 twice as long as chaetigers 4 and 6, with up to 5 dorsal superior winged geniculate capillaries (Fig. 3C), 4 heavy falcate spines alternating with 1–2 thin companion capillaries (Fig. 3D), and 6 winged ventral capillaries (Fig. 3B); postchaetal lamellae absent. Dorsal superior capillaries fewer and shorter than those on chaetigers 4 and 6; ventral capillaries fewer but similar in size to those on chaetigers 4 and 6; companion chaetae alimbate or with narrow wing, situated between newly developed falcate spines in posterior part of row. Falcate spines each with long, distally pointed main fang and large lateral tooth; convex side of main fang, except tip, covered with fine bristles (Fig. 3E).

Hooded hooks in neuropodia from chaetiger 7, up to 5 in a series, accompanied by 1–2 inferior capillaries throughout and 1–2 alternating capillaries in 5–10 posterior chaetigers (Fig. 3A). Hooks bidentate; shaft slightly curved, without constriction; newly developed hooks bigger, situated in upper part of hook row (Fig. 3A, *ho*). Inferior capillaries winged in anterior neuropodia, very thin and alimbate in posterior neuropodia (Fig. 3A, *ic*). Alternating capillaries hair-like, alimbate, situated between upper hooks in row (Fig. 3A, *ac*).

Branchiae from chaetiger 7 to chaetiger 12, fewer in small individuals (Fig. 2); flattened, with surfaces oriented parallel to body axis, basally fused to notopodial postchaetal lamellae.

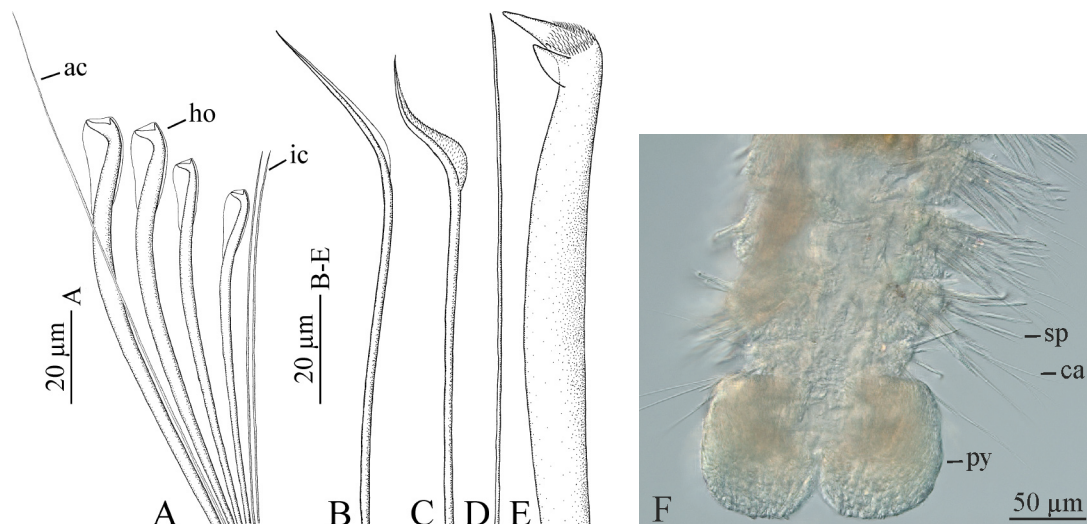
Pygidium small and fleshy, bilobed, divided by dorsal gap and ventral furrow into two rounded lateral lobes, whitish due to numerous spindle-shaped glandular cells with striated contents (Fig. 3F).

Glandular pouches in neuropodia from chaetiger 6, large in chaetigers 7 and 8 and then gradually diminishing in size.

Digestive tract without gizzard-like structure.

### Habitat

In the Ionian Sea, adults of *D. blakei* were found off the Kalamitsi coast, inhabiting silty tubes in clusters of empty calcareous serpulid tubes on a sandy seabed with shell debris, at a depth of 63 m. In total, 313 specimens were found in two Ponar grab samples, each with a sampling surface area of 0.045 m<sup>2</sup>. In the Aegean Sea, the only individual of *D. blakei* was found off the Chalkis



**Fig. 3:** *Dipolydora blakei* adult morphology (Ionian Sea, Greece, MIMB 27123). A – chaetae from a posterior neuropodium, left lateral view, dorsal side is to the left and the posterior end is up, showing alimbate capillary chaeta (*ac*) alternating upper (bigger, newly developed) hooks in a row, four bidentate hooded hooks (*ho*), and alimbate inferior capillary chaeta (*ic*). B–E – chaetae from notopodium of chaetiger 5: B, ventral capillary chaeta, C, short geniculate dorsal superior capillary chaeta, D, slender companion capillary chaeta (anterior-row notochoeta), E, heavy falcate spine with large lateral tooth and fine bristles on convex side of main fang (posterior-row notochoeta). F – posterior end, dorsal view, showing awl-like spines (*sp*) and capillary chaetae (*ca*) in notopodia, and pygidium (*py*) composed by two lateral lobes containing large glandular cells.



coast, on a muddy sand seabed with fragments of a stony coral *Cladocora caespitosa* (Linnaeus, 1767).

### Distribution

West Atlantic Ocean, off North America (USA) and South America (Brazil); first record from European waters, Mediterranean, Greece, presented here (Fig. 1).

### Discussion

*Dipolydora blakei* was originally described by Maciolek (1984, as *Polydora blakei*) based on material collected at depths of 140–200 m along the east coast of the United States, off New England, in the north-west Atlantic Ocean. After its original description, the species was reported from off the coast of the state of Rio de Janeiro, Brazil, south-west Atlantic Ocean, at depths of 1030–1048 m (Radashevsky & Paiva, 2010) (Fig. 1). It has not been reported from the east Atlantic Ocean or the Mediterranean Sea despite intensive studies around Europe. Type specimens of *P. blakei* from the continental slope off New England, U.S.A. and specimens of *D. blakei* from the continental slope and platform off the states of Rio de Janeiro and São Paulo, Brazil were examined and no morphological difference was found between them and specimens from Greece. Both Brazilian and Greek specimens are therefore referred to *D. blakei*. The origin of the specimens in coastal waters around Greece remains uncertain and the species is considered as cryptogenic in the Mediterranean Sea.

*Dipolydora blakei* is a small gonochoristic species up to 7 mm long and 0.5 mm wide for 40 chaetigers; females produce small number of oocytes each at least 241 µm in diameter (Maciolek, 1984). Worms occur rarely but may form local dense aggregations as a result of asexual reproduction; specimens with signs of architomy were found off the Brazilian coast (Radashevsky V.I., unpublished data). The details of the reproduction and larval development of *D. blakei* are unknown.

With the present study, four *Dipolydora* species with bristle-topped falcate spines in chaetiger 5 have been reported from the Mediterranean Sea and European waters. These are *D. armata* (Langerhans, 1880), *D. blakei*, *D. caulleryi* (Mesnil, 1897), and *D. quadrilobata* (Jacobi, 1883). Adults of these species are characterized by having the prostomium incised to bilobed on the anterior margin, branchiae beginning from chaetiger 7 and basally fused to notopodial postchaetal lamellae, and awl-like spines in posterior notopodia. *Dipolydora armata* adults bore into various calcareous substrata while adults of the other species inhabit tubes on soft substrata. A key for their identification is provided below.

Adults of *D. blakei* appear similar to those of *D. caulleryi* in that the heavy falcate spines of chaetiger 5 have dense bristles on the convex side of the long, pointed

main fang. They differ, however, in having the falcate spines of chaetiger 5 with a large lateral tooth, rather than a main fang only and in having a bilobed pygidium with two lateral lobes, rather than a quadrilobate pygidium with one pair of dorsal and one pair of ventral lobes (see Blake, 1971). *Dipolydora caulleryi* is a common inhabitant of soft bottom communities in the Mediterranean Sea and European waters, thus *D. blakei* might have been confused with this species. Reassessment of *Dipolydora* specimens with bristle-topped falcate spines in chaetiger 5 from European waters would clarify the origin of *D. blakei* in the Mediterranean Sea.

### Key to *Dipolydora* species with bristle-topped falcate spines in chaetiger 5 from the Mediterranean Sea and European waters

1. Boring into shells, corals and coralline algae. Falcate spines of chaetiger 5 each with large lateral tooth and an apical transverse flange on the convex side of the main fang. Pygidium cup-shaped to bilobed *armata*  
- Inhabiting tubes on soft sediments. Falcate spines of chaetiger 5 without apical transverse flange; lateral tooth present or absent. Pygidium with two or four lobes 2
2. Falcate spines of chaetiger 5 distally bifurcated, each with two short massive unequal teeth and fine bristles between them. Pygidium with four lobes *quadrilobata*  
- Falcate spines of chaetiger 5 each with a long pointed main fang bearing dense bristles on the convex side. Pygidium with two or four lobes 3
3. Falcate spines of chaetiger 5 without lateral teeth. Pygidium four-lobed, with one pair of dorsal lobes and one pair of ventral lobes *caulleryi*  
- Falcate spines of chaetiger 5 each with large lateral tooth. Pygidium bilobed, with one pair of lateral lobes *blakei*

### Acknowledgements

Our sincere thanks are to Leslie Harris, Tim Worsfold and anonymous reviewers for valuable comments and edits to the manuscript. Financial support was provided by the Russian Foundation for Basic Research (Project 12-04-00609) through the A.V. Zhirmunsky Institute of Marine Biology, and the Government of the Russian Federation (Project 11.G34.31.0010) through the Far Eastern Federal University.

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