

First record of the polychaetous annelid *Diopatra micrura* Pires *et al.*, 2010 in the Mediterranean Sea

A. ARIAS¹ and H. PAXTON^{2,3}

¹ Departamento de Biología de Organismos y Sistemas (Zoología), Universidad de Oviedo, Oviedo 33071, Spain

² Department of Biological Sciences, Macquarie University, Sydney, NSW 2109, Australia

³ Australian Museum, 6 College Street, Sydney, NSW 2010, Australia

Corresponding author: ariasandres.uo@uniovi.es

Handling Editor: Carlo Nike Bianchi

Received: 3 March 2013; Accepted: 25 June 2013; Published on line: 29 July 2013

Abstract

Until now the only recognised species of the onuphid genus *Diopatra* in the Mediterranean Sea was *D. neapolitana*. This paper reports on the presence of another species, *D. micrura*, in the western Mediterranean, occurring in shallow waters along the coasts of south-eastern Spain.

Keywords: Onuphidae, Iberian Peninsula, biodiversity, western Mediterranean.

Introduction

Until very recently, the onuphid polychaete genus *Diopatra* Audouin & Milne-Edwards, 1833 was thought to be represented in Europe by only one species, *D. neapolitana* Delle Chiaje, 1841. These large worms are valued as fish bait (Pires *et al.*, 2012a) and have become an exploited natural resource (Arias & Anadón, 2012), stimulating a tremendous increase in biological research. *Diopatra* species are ecosystem engineers, thought to undergo range shifts in Western Europe (Wethy & Woodin, 2008; Berke *et al.*, 2010). *Diopatra marocensis* Paxton *et al.*, 1995, previously only known from the Moroccan Atlantic coast, was reported from the coasts of Portugal (Rodrigues *et al.*, 2009; Berke *et al.*, 2010) and northern Spain (Arias *et al.*, 2010). The reproductive biology of *D. neapolitana* and *D. marocensis* was studied by Pires *et al.* (2012b; 2012c respectively) and Arias *et al.* (2013) who demonstrated that the Spanish Villaviciosa population of the brooding *D. marocensis* was a simultaneous hermaphrodite. With all this research activity, new species were discovered. *Diopatra micrura* Pires *et al.*, 2010 was described from the western and southern coast of Portugal (Pires *et al.*, 2010), while *D. biscayensis* Fauchald *et al.* (2012) was described from western France and *D. cryptornata* Fauchald *et al.* (2012) from the south-western Iberian Peninsula, increasing the number of European *Diopatra* species to five (Fauchald *et al.*, 2012).

Despite the recent increase of *Diopatra* species in Europe, *D. neapolitana* is the only Mediterranean representative, as *D. baeri* Grube, 1840 and *D. iridicolor*

Costa in Clarapède, 1868, previously described species for the Mediterranean, are considered subjective synonyms of *D. neapolitana* (Read & Fauchald, 2013).

Here we are reporting on the presence of *D. micrura* in the Mediterranean Sea, constituting the easternmost distribution for this species. We are presenting a diagnosis of *D. micrura*, its relative abundance at the new locality and compare the depths and substrate preferences of its original Portuguese habitat and the new Mediterranean sites. Furthermore, we discuss and tabulate the distinguishing characteristics between *D. micrura* and *D. neapolitana*.

Materials and Methods

In March 2012, a series of surveys were carried out at an intertidal sandy cove near Cape Gata (36°57'N 01°53'W), SE Spain, Mediterranean Sea (Fig. 1). Collected specimens were transported alive to the laboratory, anaesthetized in a 7.5% MgCl₂ solution isotonic with seawater and extracted from their tubes (Fig. 2B); then, they were pre-fixed in 10% buffered formalin and preserved in 70% ethanol for later taxonomical analysis. All specimens were measured (body length and width of the 10th chaetiger) with callipers. Voucher specimens of *D. micrura* from these collections have been deposited at the Invertebrate Collection of the Department of Biology of Organisms and Systems at the University of Oviedo (Spain) (BOS-EUN 21; BOS-EUN 22).

Five paratypes of *D. micrura* from Portugal, depos-



Fig. 1: *Diopatra micrura* - current distribution along the Iberian Peninsula. Portuguese sites: A: Aveiro estuary; B: Nazaré; C: Tagus estuary; D Guadiana estuary (Pires *et al.*, 2010). Spanish sites: E: Gata Cape; F: Valencia Harbour.

ited at the National Museum of Natural Sciences, Madrid, Spain (MNCN 16.01/11627-16.01/11631) were examined to confirm identification of the Cape Gata specimens.

Preserved specimens in the collections of the MNCN (MNCN16.01/1942-MNCN16.01/1961; MNCN16.01/2045-MNCN16.01/2056; MNCN16.01/2641; MNCN16.01/2665; MNCN16.01/2671; MNCN16.01/4339; MNCN16.01/5942), previously identified as *Diopatra neapolitana* from the Spanish Mediterranean coast, between San Antonio Cape (38°48'N 00°08'W) and Valencia Harbour (39°27'N 00°19'W), collected on soft substrata (from muddy to fine sands) from 5 m to 50 m depth (Redondo & San Martín, 1997), were re-examined and identified as *Diopatra micrura*.

Results

Diopatra micrura Pires *et al.*, 2010 (Fig. 2A, B; Table 1)

Diopatra neapolitana – Rendondo & San Martín, 1997; not Delle Chiaje, 1841

Diagnosis: Small species; living specimens of green-

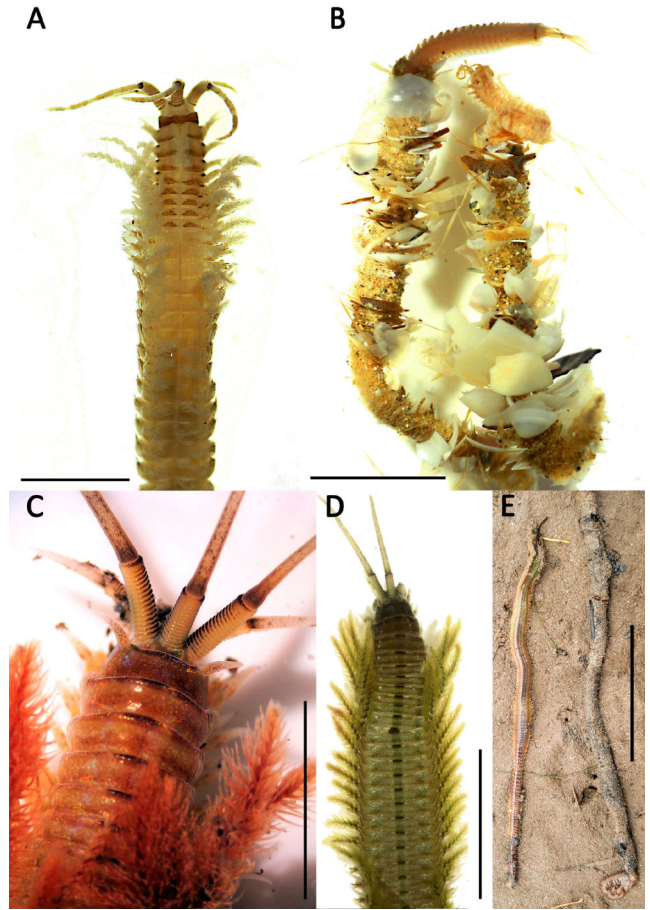


Fig. 2: (A) Anterior end of *Diopatra micrura*, dorsal view. (B) General view of *D. micrura* tubes, with attached shell fragments and vegetal material. (C) Anterior end of live *Diopatra neapolitana*, dorsal view; (D) Dorsal colour pattern of anterior chaetigers of *D. neapolitana*. (E) *D. neapolitana* with its tube. Scale bars: A: 2 mm; B: 5 mm; C-D: 10 mm; E: 10 cm.

ish colour; antennostyles and palpostyles with conspicuous transverse iridescent white and brown bands, 12–15 brown ceratophoral rings; nuchal organs crescentic; subulate to ovate ventral parapodial lobes on setigers 5 to 14–20; four pairs of modified parapodia with bidentate

Table 1. Comparison of diagnostic features between *Diopatra micrura* and *D. neapolitana*.

Feature	<i>Diopatra micrura</i> (Figure 2A, B)	<i>Diopatra neapolitana</i> (Figure 2C-E)
Maximum length of complete preserved specimens	5 cm	60 cm
Maximum width at chaetiger 10	4.5 mm	10 mm
Colour pattern of palps and antennae	styles with transverse iridescent white and brown bands	styles with brown spots
Colour pattern of peristomium	darker than subsequent segments	same colour as other segments
Colour pattern of anterior chaetigers	with two dorsal lateral brown patches each	with one median brown bar
Shape of nuchal grooves	crescentic	almost circular
Appearance of subacicular hooks	8–13	19–25
Level of emergence of tube from sediments	several cm above sediment	sediment level
Ornamentation of tube	shell fragments and seaweed incorporated into tube	smooth silty, sandy tube

pseudocompound hooks with moderately long pointed appendages; pectinate chaetae with 5–10 long teeth; lower limbate chaetae replaced by two bidentate subacicular hooks from chaetiger 8–13. Tube typical of genus.

Remarks: Specimens identified as *D. neapolitana* in the collections of the MNCN (registration numbers listed above) have been examined and re-identified as *Diopatra micrura*, thus demonstrating that the species has been present in the Mediterranean since at least 1996, the collection date.

The material sampled in March 2012 near Cape Gata was from an intertidal-shallow subtidal (2 m depth) fine to medium sand community, where *D. micrura* reached a density of ca. 4 individuals/m². The size range of complete specimens varied from 29 to 44 mm, and the average length was 35.9 mm (N= 10; SD= 4.41); average width of 10th chaetiger (without parapodia) was 1.58 mm (N=10; SD= 0.16).

A key to the five European *Diopatra* species can be found in Fauchald *et al.* (2012). Here we are focusing on the distinguishing characteristics between *D. micrura* and *D. neapolitana* (Table 1). The two species are closely related and thus share a number of diagnostic parapodial and chaetal characteristics. However, they can easily be distinguished in that *Diopatra micrura* is a much smaller, slenderer species than *D. neapolitana*, which can reach at maximum size of 68 cm length (authors' pers. obs.), and in that their colour patterns are strikingly different. *Diopatra micrura* has antennae with iridescent white and brown bands, a brown peristomium that differs sharply from the immediate segments and two dorsal lateral brown patches on each of the anterior chaetigers (Figure 2A), while *D. neapolitana* has antennae with brown spots, a peristomium of the same colour as the subsequent segments, and anterior chaetigers with one short transverse mid-dorsal brown bar (Figure 2C-D). Other differences concern the construction and ornamentation of their tubes, and the level of emergence from the sediment. *Diopatra micrura* tubes stand out a few centimetres from the sediment (with tube-cap) and are highly ornamented with foreign material, mainly shells, shell-fragments and seaweeds, for most of the length of the tube (Fig. 2B). On the other hand, *D. neapolitana* builds its tubes at sediment level (without tube-cap) with scarcely any ornamentation and they consist mostly of silt and fine sand, but may include some larger foreign material near the opening (Fig. 2E).

Discussion

Diopatra micrura occurs along the western and southern Portuguese coasts, commonly in shallow waters of mouths of major estuaries (Pires *et al.*, 2010) (Fig. 1). The Portuguese population seems to have a preference for fine sand and shallow waters and the same seems to hold true

for the Mediterranean representatives. In the intertidal region of the Aveiro estuary, *D. micrura* occurs sympatrically with *D. marocensis* and *D. neapolitana* (Pires *et al.*, 2010), whereas in the Mediterranean study sites *D. micrura* was not found with other *Diopatra* species.

The presence of *D. micrura* in south-eastern Spain brings the number of identified Mediterranean *Diopatra* species to two. However, Çinar *et al.* (2012) reported an unidentified *Diopatra* sp. from Mersin Harbour and Seyhan estuary (Turkey), where it reaches high densities (ca. 90 specimens /m²). We expect that *D. micrura* is more widely distributed in the Mediterranean Sea and has at times been misidentified as young specimens of *D. neapolitana*. A widespread sampling campaign and examination of museum holdings would be required in order to document the real distribution of this species in the Mediterranean Sea.

Acknowledgements

We thank the two reviewers for their constructive criticism. A. A. is supported by a Severo Ochoa fellowship from the FICYT Foundation (Principado de Asturias, Spain).

References

- Arias, A., Anadón, N., 2012. First record of *Mercenaria mercenaria* (Bivalvia: Veneridae) and *Ensis directus* (Bivalvia: Pharidae) on Bay of Biscay, Iberian Peninsula. *Journal of Shellfish Research*, 31, 57-60.
- Arias, A., Anadón, N., Paxton, H., 2010. New records of *Diopatra marocensis* (Annelida: Onuphidae) from northern Spain. *Zootaxa*, 2691, 67-68.
- Arias, A., Richter, A., Anadón, N., Paxton, H., 2013. Evidence of simultaneous hermaphroditism in the brooding *Diopatra marocensis* (Annelida: Onuphidae) from northern Spain. *Journal of the Marine Biological Association of the United Kingdom*. In press. <http://dx.doi.org/10.1017/S002531541300012X>
- Berke, S.K., Mahon, A.R., Lima, F.P., Halanych, K.M., Wethey, D.S. *et al.*, 2010. Range shifts and species diversity in marine ecosystem engineers: patterns and predictions for European sedimentary habitats. *Global Ecology and Biogeography*, 19, 223-232.
- Çinar, M.E., Katagan, T., Öztürk, B., Dagli, E., Açik, S. *et al.*, 2012. Spatio-temporal distributions of zoobenthos in Mersin Bay (Levantine Sea, eastern Mediterranean) and the importance of alien species in benthic communities. *Marine Biology Research*, 8(10), 954-968.
- Fauchald, K., Berke S.K., Woodin S.A. 2012. *Diopatra* (Onuphidae: Polychaeta) from intertidal sediments in south-western Europe. *Zootaxa*, 3395, 47-58.
- Pires, A., Freitas R., Quintino, V., Rodrigues, A.M., 2012a. Can *Diopatra neapolitana* (Annelida: Onuphidae) regenerate body damage caused by bait digging or predation. *Estuarine, Coastal and Shelf Science*, 110, 36-42.
- Pires, A., Gentil, F., Quintino, V., Rodrigues, A.M., 2012b. Re-

- productive biology of *Diopatra neapolitana* (Annelida, Onuphidae), an exploited natural resource in Riade Aveiro (Northwestern Portugal). *Marine Ecology*, 33, 56-65.
- Pires, A., Paxton, H., Quintino, V., Rodrigues, A.M., 2010. *Diopatra* (Annelida: Onuphidae) diversity in European waters with the description of *Diopatra micrura*, new species. *Zootaxa*, 2395, 17-33.
- Pires, A., Quintino V., Gentil F., Freitas R., Rodrigues, A.M., 2012c. Reproductive biology of a brooding *Diopatra* species: *Diopatra marocensis* Paxton et al., 1995. *Estuarine, Coastal and Shelf Science*, 110, 85-92.
- Read, G., Fauchald, K., 2013. *World Polychaeta database*. <http://www.marinespecies.org/polychaeta> (Accessed 27 February 2013)
- Redondo, M. S., San Martín, G., 1997. Anélidos Poliquetos de la costa comprendida entre el cabo de San Antonio y el Puerto de Valencia. *Publicaciones Especiales del Instituto Español de Oceanografía*, 23, 225-233.
- Rodrigues, A.M., Pires, A., Mendo, S., Quintino, V., 2009. *Diopatra neapolitana* and *Diopatra marocensis* from the Portuguese coast: morphological and genetic comparison. *Estuarine, Coastal and Shelf Science*, 85, 609-617.
- Wetthey, D.S., Woodin, S.A., 2008. Ecological hindcasting of biogeographic responses to climate change in the European intertidal zone. *Hydrobiologia*, 606, 139-151.