BioInvasions Records (2014) Volume 3, Issue 2: 83–88
doi: http://dx.doi.org/10.3391/bir.2014.3.2.05

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Rapid Communication

First record of *Naineris setosa* (Verrill, 1900) (Annelida: Polychaeta: Orbiniidae) in the Western Mediterranean Sea

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Received: 6 March 2014 / Accepted: 22 April 2014 / Published online: 12 May 2014

Handling editor: Philippe Goulletquer

Abstract

The Polychaeta *Naineris setosa* (Verrill, 1900) is reported for the first time in the Western Mediterranen Sea. Several specimens were collected in 2012 and 2013 in Boughrara Lagoon (Tunisia). The vector of introduction of *N. setosa* likely commercial shipping because Gabes is an international harbour with dense shipping traffic. A detailed description of specimens from Boughrara Lagoon is provided in this paper.

Key words: alien species, polychaete, Tunisia, Lagoon of Boughrara

Introduction

Introduction of new species is one the major factor affecting biodiversity in the Mediterranean Sea in the past few decades. At least 986 alien species are known in the Mediterranean, 775 in the eastern basin, 308 in the western basin, 249 in the central basin, and 190 in the Adriatic Sea. These alien species represent 5.9% of the total biodiversity (Zenetos et al. 2010, 2011, 2012). In the light of its geographic position, between western and eastern basins, the coasts of Tunisia appear to be very sensitive to colonization by exotic species. To date, 124 marine invasive alien species have been recorded along the Tunisian coastline, of which 11 are polychaetes (UNEP-MAP-RAC/SPA 2013).

Six species of Orbiniidae (Polychaeta) are known to occur in the coastal waters of Tunisia. *Naineris laevigata* (Grube, 1855) was reported for the first time in 1978 in the Gulf of Tunis (Cantone et al. 1978) and in the lagoon of Monastir (Mortier, 1978). *Phylo foetida* (Claparède, 1869) was reported in 1924 in Boughrara Lagoon (Fauvel, 1924). *Orbinia sertulata* (Savigny, 1822) and *Protoaricia oerstedii* (Claparède, 1864) were found in 1978 in the Gulf of Tunis (Cantone et al. 1978). *Scoloplos (Scoloplos) armiger* (Müller, 1776) was found in the Gulf of Gabes in 1934 (Seurat 1934), and finally *Scolaricia typica* (Eisig, 1914) was described for the first time in Tunis Bay in 2003 (Ayari and Afli 2003, 2008).

The orbiniid Polychaete *Naineris setosa* (Verrill, 1900) is considered to be a subtropical-tropical American species (Blake and Giangrande 2011). The species described as *Aricia setosa* by Verrill (1900) from an intertidal beach in Bermuda is distributed in Puerto Rico (Treadwell 1901), Florida (Hartman 1951) and the Gulf of Mexico (Rioja 1960; Perkins and Savage 1975; Hernandez-Alcantara and Solis-Weiss 1989). The first Eastern Pacific record was from Acapulco (Mexico) (Hartman 1957). *N. setosa* is also present in Costa Rica, Ecuador (Galapagos Islands) (Blake and Giangrande 2011), Belize (Solis-Weiss and Fauchald 1989) and Brazil (Rizzo and Amaral 2001). Recently, *N. setosa* was reported for the first time outside its native area, in aquaculture facility near Brindisi (Adriatic Sea, Italy) (Black and Giangrande 2011). However, this species was not included in the updated list of alien species for the Mediterranean Sea

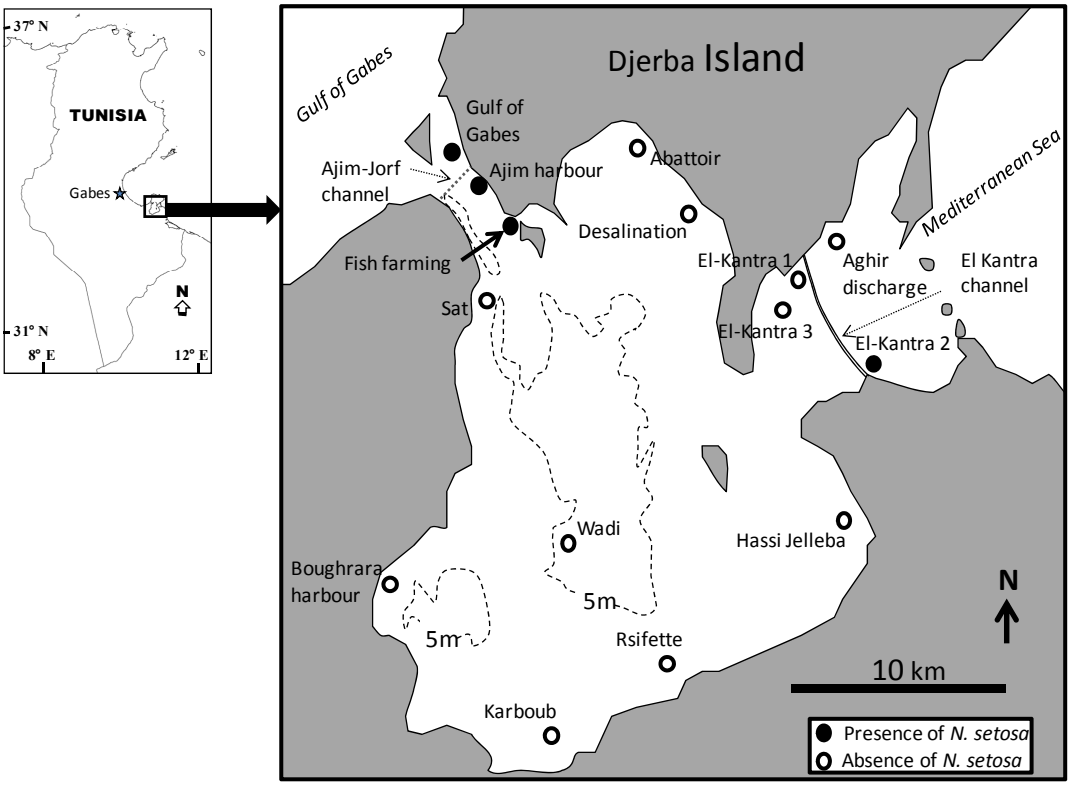

Figure 1. Presence and absence of *Naineris setosa* in Boughrara lagoon.

because, after being one of the most abundant polychaetes (500 ind.m^{-2}), this species disappeared from the area (Zenetos et al. 2012). The present paper reports the first record of *N. setosa* along the Tunisian coasts.

Material and methods

Study area

The Lagoon of Boughrara is located on the south-eastern coast of Tunisia. This small bay (about 500 km^2) is bounded on the north by the Djerba Island and on the south by the mainland. The bay connects with the Gulf of Gabes by the Ajim-Jorf channel (2.2 km wide) and by the El Kantra Channel (160 m wide) (Figure 1). The average depth is about 4 m with a maximum of 16 m in the center of the lagoon. The salinity is very high especially in summer with an average value up to 42 (Ben Aoun et al. 2007). Boughrara Lagoon is a vulnerable environment with limited access to open sea and is submitted to negative effects of aquaculture activities, fishing ports, sewage outfalls, and industrial wastes (organic matter, fluorides, cadmium, acids, etc.) (Ben Aoun et al. 2007).

This study was conducted within the framework of a National Institute of the Sciences and the Technologies of the Sea (INSTM) project and aimed to evaluate the general ecological status of the Lagoon of Boughrara.

Material examined

Benthic macrofauna was sampled from 15 stations in Boughrara Lagoon between 2012 and 2013 during summer (August) and winter (January) seasons (Figure 1, Appendix 1). Samples were collected by scuba divers with a quadrat (1 m², 10 cm depth) and sieved through 1 mm mesh. The remaining fraction was fixed in 7% formalin and later transferred into 70% ethanol. All specimens were examined under a Nikon SMZ1500 stereo-microscope and one specimen photographed with a Nikon DS-Fi 2 camera. Specimens were measured with the NIS-Elements Analysis software (Nikon Instruments Inc., Melville, New York, USA).

Results

Fifty specimens of *Naineris setosa* were collected in 2012–2013 from four different sites in the Boughrara Lagoon (Figure 1, Appendix 1). This species displayed highest abundances in summer at stations "Ajim Harbour" and "Gulf of Gabes" with 21 and 19 individuals m^{-2}, respectively. Abundances were lower in winter (max 6 ind.m^{-2}). *N. setosa* was always collected from in muddy sediments.

Systematics

ORBINIIDAE Hartman, 1942
Orbiniinae Hartman, 1957
Naineris Blainville, 1828
Naineris setosa (Verrill, 1900)
Figure 2

Aricia setosa Verrill, 1900: 651-653
Anthostoma latacapitata Treadwell, 1901: 203–205, figs 61–65.

Naineris setosa Hartman, 1942: 61, figs 116–118; 1951: 67–70, pl. 17, figs 1–6; Hartman 1957: 305, pl. 41, figs 1–6; Solis-Weiss and Fauchald 1989: 774–778, fig 2; Blake and Giangrande 2011: 21, figs. 1–2.

Material examined

Western Mediterranean Sea: Tunisia: lagoon of Boughrara (10°40' to 10°57' E; 33°28' to 33°45' N; station Gulf of Gabes; 12 August 2012; 1.1 m depth; 5 specimens).

Description

Incomplete specimens with 40–87 setigers and 3.6–4.7mm width. Prostomium short, broadly truncate and T-shaped (Figure 2); few eyespots, concentrated in two comma groups forming Y-shaped. Everted proboscis large and saclike. Peristomium broad and asetigerous.

Branchiae from setigers 6 in all specimens; basally broader and gradually tapering to pointed tip; anteriorly, branchiae and notopodial postsetal lobes are similar in length but posteriorly the branchiae are longer than notopodial lobes. External borders highly ciliated with blood sinus clearly visible.

Two sensory organs present from setigers 8, small, oval-shaped, located in antero margin of setiger; very close to the branchiae in anterior setigers.

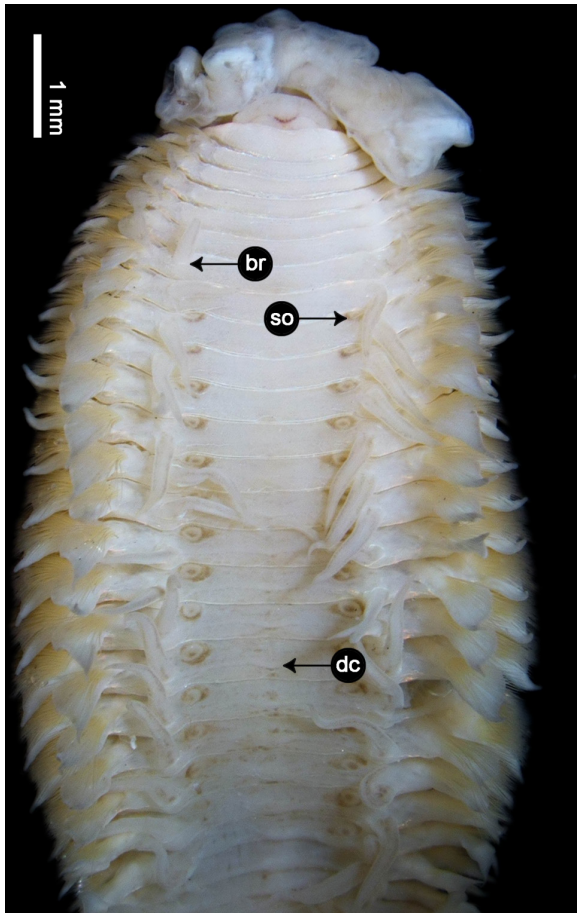

Figure 2. *Naineris setosa*: dorsal view of a specimen from Boughrara lagoon. Abbreviations: br: branchia; so: sensory organ; dc: dorsal crest. Photograph by P. Bonifácio.

Dorsal crests small, started in the thoracic region until posterior setigers, more conspicuous in abdominal region.

Thoracic region with 20–21 biramous setigers, with foliaceous and broad notopodial postsetal lobes; neuropodial postsetal shorter, broader and rounder than corresponding notopodial lobes. Neuropodial postsetal lobes with an upper digitiform papilla more evident in anterior setigers. Transitional setigers between 21 and 24.

Abdomen from setiger 25 with narrow notopodial postsetal lobes, becoming short in the posterior abdomen. In parallel, size of neuropodial postsetal lobe sharply reduced and finally tapering to narrow tips.

Thoracic notopodia with long crenulated capillaries setae arranged in 3 rows. Neuropodial thoracic setae are all crenulated capillaries arranged in two bundles: one, with about 8 rows; and two, the lower group, about 4 rows.

In abdomen, the number of setae is more reduced than in the thorax. The notopodia have crenulated capillaries and 1–2 furcate setae (hard to see). The neuropodia with crenulated capillaries and 2–3 straight, bluntly pointed uncini more posteriorly.

Distribution

North-western Atlantic: Gulf of Mexico (Perkins and Savage 1975; Hernandez-Alcantara and Solis-Weiss 1991); Puerto Rico (Treadwell 1901), Acapulco, Mexico (Hartman 1957); Belize (Solis-Weiss and Fauchald, 1989), south-eastern Brazil (Rizzo and Amaral 2001). Mediterranean: Adriatic Sea, Italy (Blake and Giangrande 2011) and western Mediterranean, lagoon of Boughrara, Tunisia (this study).

Type locality

Bermuda

Remarks:

In Mediterranean Sea, only two species of *Naineris* are recorded: *N. laevigata* (Grube, 1855) distributed apparently from Italy to south of France (Fauvel, 1927), and *N. setosa* (Verrill, 1900) from the Adriatic Sea, Italy (Blake and Giangrande, 2011). The main difference between the two species is that *N. laevigata* presents subuluncini in thoracic neuropodia, whereas *N. setosa* presents only crenulated capillaries (Fauvel 1927; Blake 1996; Solis-Weiss and Fauchald 1989; Blake and Giangrande 2011). Furthermore, the prostomium of *N. laevigata* is rounded and the branchiae appears often from setigers 7 or 8 (Fauvel, 1927). Specimens found in this study agree with description of *N. setosa* from Solis-Weiss and Fauchald (1989) and Blake and Giangrande (2011) with presence of prostomium broadly truncated, branchiae appearing on setiger 6 and presence of crenulated capillaries only in thoracic neuropodia.

Among the material examined by Solis-Weiss and Fauchald (1989), variations were found: prostomium rounded or T-shaped; eyesposts scattered or ranged in two or four sickles; 13 or 23 thoracic setigers; and thoracic neurosetae ranged in one or two bundles. All these characteristics appear to be correlated with animal age (Solis-Weiss and Fauchald 1989; Blake and Giangrande 2011). In accordance with these characteristics, animals found in this study are adults: prostomium T-shaped, few eyespots ranged in two sickles, 21 thoracic setigers and thoracic neurosetae ranged in two bundles.

Discussion

The vector of introduction of *Naineris setosa* in the Lagoon of Boughrara cannot be easily determined. According to the Mediterranean Action Plan for Invasive species (UNEP-MAP-RAC/SPA 2005) and in agreement with recent evaluation of pathways at Pan European Level (Katsanevakis et al. 2013), shipping (ballast water and sediments, anchoring, and fouling) is the second main vector of species introduction into the Mediterranean Sea after migration across the Suez Canal. *N. setosa* is probably not a Lesseptian species as this polychaeta is *a priori* not present in the Indo-Pacific region. Blake and Giangrande (2011) suggested that *N. setosa* was introduced in Italy via aquaculture. Despite the presence of two fish farms in the Boughrara Lagoon, this way of introduction may be dismissed because of the origin of the cultivated fishes: Tunisia, Republic of the Philippines, and France. As *N. setosa* was collected in four sites directly connected to the Gulf of Gabes, transport via ship hulls or ballast waters has been hypothesized. Indeed, Gabes is an international harbour with a favoured place in the middle of the Mediterranean Sea, between the oriental and occidental basins. It receives a great deal of traffic from Europe (mainly from Italy), Asia, the USA, and Mexico and is classified among the main harbours for ships carrying crude oil in the Mediterranean Sea. Indeed, there is extensive traffic of crude oil between Italy and Tunisia frequent contact between Brindisi in Italy (where *N. setosa* occurs; Blake and Giangrande 2011) and Skrika in the Gulf of Gabes. Even if maritime transport seems to be the most likely vector of introduction of this species in the Lagoon of Boughrara, it is difficult to identify the exact origin of *N. setosa* which could arrive either directly from the western Atlantic (USA, Mexico) or as a result of secondary spread from Italy.

Naineris setosa is clearly tolerant to severely degraded environmental conditions. During this study, specimens were found in four sites classified as polluted: Ajim Harbour supports many fishing activities; the Gulf of Gabes receives industrial waters charged in phosphate; the fish farming site has a heavy aquaculture influence; and El Kantra 2 is perturbed by extension of the pass of El Kantra. These four stations are characterized by high salinity (between 38.5 and 43.1) for both winter and summer seasons, muddy sediments, some areas of anoxic mud (e.g., the Ajim Harbour and fish farming stations), and by polluted waters. Blake and Giangrande (2011) indicated that the

existence of the dorsal crests on the abdomen of *N. setosa* is atypical and is perhaps an adaptation, with the very vascularised branchiae, to low oxygen levels in the sediments.

With the extensive levels of intra-Mediterranean shipping traffic, *Naineris setosa* might be present in other Mediterranean harbours. As the Mediterranean Sea connects naturally with the Atlantic Ocean through the Strait of Gibraltar and with the Black Sea by the straits of Bosphorus and the Dardanelles, the presence of this species in other adjacent areas should be watched closely. Finally, the impact of non-indigenous species on the native ecosystem can be significant and may be extremely damaging to native species, local environment, and human activities (Lavesque et al. 2010). Further studies will be necessary to evaluate the major factors driving the spread of *N. setosa* in the Gulf of Gabes and to understand the consequences of its presence on the structure of benthic communities.

Acknowledgements

The authors wish to thank C. Jbelai (scuba diver), M.D. Aoudi (Captain of the boat), people involved in the sampling campaigns in the lagoon of Boughrara, and anonymous reviewers for useful comments on the manuscript. First author is very grateful to X. de Montaudouin and G. Bachelet to welcome her on the Biodiversity Platform (EPOC laboratory, Arcachon Marine Station, France), the Ministry of the Higher Education of Tunisia and the National Institute of the Sciences and the Technologies of the Sea (INSTM) - Tunis to finance of her stay in France.

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Appendix 1. Records of *Naineris setosa* in the lagoon of Boughrara. N: number of individuals collected. Sites: see Figure 1.

Sites	Date	Tidal level (m)	Habitat	Latitude	Longitude	Salinity (PSU)	N
Gulf of Gabes	August 2012	1.1	Mud	33°43'N	10°44'E	41.5	19
	January 2013	1.1	Mud	33°43'N	10°44'E	41.1	1
Ajim Harbour	August 2012	1	Anoxic mud	33°42'N	10°44'E	42.3	21
	January 2013	1	Anoxic mud	33°42'N	10°44'E	41.9	1
Fish Farming	August 2012	1.5	Anoxic mud	33°41'N	10°45'E	43.1	2
El Kantra 2	January 2013	0.3	Mud	33°37'N	10°56'E	38.5	6