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First record of *Boccardia polybranchia* (Haswell, 1885) (Polychaeta: Spionidae) from the Atlantic coast of Morocco

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Abstract

The polychaete *Boccardia polybranchia* (Haswell, 1885), Spionidae, was found for the first time in Atlantic Moroccan coasts. This species was collected from a rocky intertidal habitat in the region of Safi located in Western Morocco (32°15'23.52" N and 9°15'42.36" W). This new occurrence from this rocky shore extends the known geographical distribution range of the species both in Morocco (as the southern limit of the North Atlantic) and in North Africa. It contributes to the growing body of knowledge of the biogeography of this species found, to date, on many coastal geographical regions between the North (the Manche and the English Channel) and the South (South Africa and Southern America) including the Indian Ocean. Some data on the spatial distribution, relationship with sewage organic enrichment, morphology and ecology of the species are discussed.

1. Introduction

Boccardia polybranchia (Haswell, 1885) is a burrowing spionid worm that currently belongs to the sedentary polychaete annelids. This species, originally described from the oyster farms (mud-blisters) along the Hunter River, New South Wales, Australia, by Haswell [1] as *Polydora polybranchia*, was later renamed by Carrazzi [2] as *Boccardia polybranchia* while reviewing the genus from Italian coasts (Naples). Referring to the description of Soderström [3] and Fauvel [4], Monro [5] reported *B. polybranchia* in the deepest part of the Gulf of Morbihan ("Baie de l'observatoire") on the east coast of the Subantarctic Kerguelen islands.

Afterward, the species was widely recorded along the south coast of South Africa without any information about its habitat, and in Namibia where it was recorded from shallow dredgings [6] [7]. *B. polybranchia* was again described by Blake & Kudenov [8] from the New South Wales, Tasmania and Macquarie Island in the Indian Ocean. Subsequently, records of the species were done from the Southern America (Brazil, Argentina, Straits of Magellan, Tierra del Fuego, Peru) [9] [10] and Japan [11]. Later, data on its biology in the Gulf of Morbihan Kerguelen islands were reported by Duchêne [12] and recently Simon *et al.* [13] made a revision of *B. polybranchia* with two other species (*B. pseudonatrix* and *B. proboscidea*) in areas along the south and south-east coasts of South Africa where they were associated with both wild and cultured mollusks and Williams *et al.*

[14] compared the population genetic structures of *B. polybranchia* and *P. hoplura* to provide novel insights into the factors that contribute to their dispersal and implications for aquaculture

The species has been described as alien associated with wild and cultured molluscs [14] [15] and it is considered as cosmopolitan [16] [17] [13] with a wide geographic distribution range extending from Northern latitudes (e.g. [4] [5] [11] [18-22]) to southern latitudes [4] [23-33] [9] [12] [10] [13] (Figure 1).

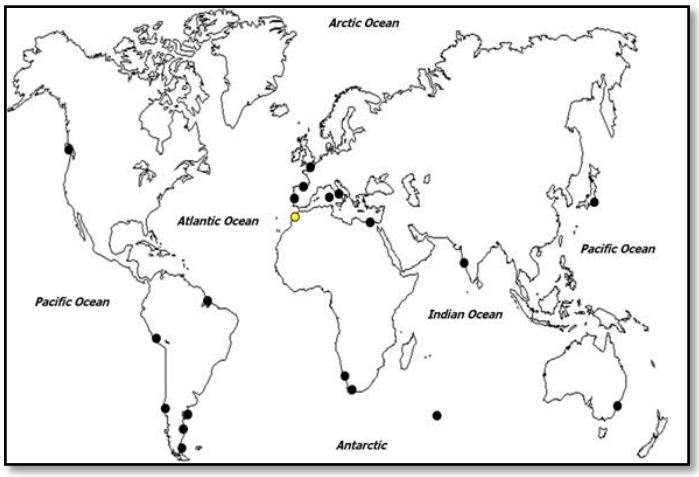

Figure 1: Geographical distribution of *Boccardia polybranchia*, indicating its new record from Morocco (grey dot) and previous literature records around the world (black dots).

The genus *Boccardia* contains about 26 valid species [8] [33-35] [13] and members of this genus and the genus *Boccardiella* have branchiae on setiger anterior to setiger five. These two genera (*Boccardia* and *Boccardiella*) differ in the kinds of modified setae on the fifth setiger, *Boccardiella* species have one (simple and falcate) while *Boccardia* have two (one simple and falcate and the second expanded and club-like) [16].

In the present paper, the first record of *Boccardia polybranchia* (Haswell, 1885) from the Atlantic coast of Morocco is highlighted.

2. Material and methods

2.1. Study area

Five rocky shore intertidal stations: Beddouza beach (S1); Marissa III beach(S2); Jorf Lihoudi beach (S3); Oulad Salmane beach (S4) and Souiria beach (S5) (Figure 2), are located about 70 km in the region of Safi on the Atlantic coast (32°15’23.52"N, 9°15’42.36’’W) in the Western Morocco. The choice of the sampling stations was designed for a pollution screening purpose at five locations along the region of Safi:

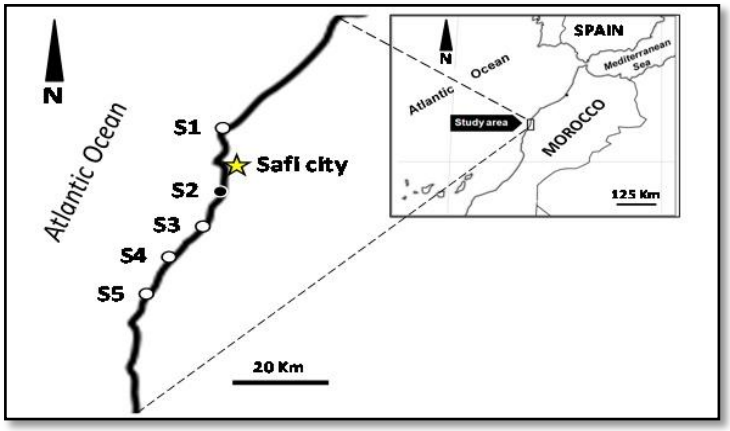

Figure 2: Geographical position of the study area and sampling site locations along the coast of Safi, NW Morocco. The black dot indicates the presence of *Boccardia polybranchia* (Site 2), whereas white dots represent its absence (other surveyed sites). S1: Beddouza beach; S2: Marissa III beach; S3: Jorf Lihoudi beach; S4: Oulad Salmane beach; S5: Souiria beach.

Beddouza beach (34km from the Safi city), (32°55’36.14"N, 9°27’12.88’’W), is characterized by absence of industrial activity. Marissa III Beach (S2) (2km south of Safi city) (32°24’42.76"N, 9°26’25.08’’W), is the main effluent outlet from the city with domestic sewage and industrial discharge waste waters (Figure 3).
Jarf Lihoudi (S3) (5 km south of Safi city) (32°20’52.85"N, 9°25’25.52’’W), is a point of discharge of the three industrial complexes of chemistry and phosphorous. Oulad Salmane beach (S4), (32°13’45.57"N, 9°30’00.16’’W) (16 km south of Safi city) is characterised by absence of industrial activity. Souiria beach (S5), (32°05’09.35"N, 9°34’18.16’’W) (30km south of Safi city) characterized by the smalls fishing boats.

Figure 3: Photo showing the study area, Marissa III beach, sewage discharges from the adjacent food industry.

Seawater temperature ranges between 16 and 26 ºC and conductivity between 43 and 45 ms/cm. The pH varies between 8.1 and 8.6, and dissolved oxygen between 6.5 and 6.8 mg/l. The tide is semi-diurnal and tidal excursions ranges between 0.40 and 1.55 m for neap tides and from 2.35 to 3.95 m at spring tides.

2.2. Sample collection

Sampling was carried out during two years (from Juin 2012 to July 2014), bimestrial, using a 0.25 m² quadrat. The contents of quadrat were carefully scraped and removed with a knife and a spatula. They were placed in plastic bowl and fixed in 10% saline formaldehyde solution. In the laboratory, the macrofauna was sieved through a 1mm mesh size; the polychaetes were sorted and preserved in 70% alcohol solution. All specimens were identified to species level whenever possible.
Some specimen was deposited in the Polytheque collection of the UCO, Angers, France.

3. **Results and discussion**

3.1. Results

3.1.1. Systematics

Family Spionidae Grube, 1850
Genus *Boccardia* Carazzi, 1893
Boccardia polybranchia (Haswell, 1885)
(Figure 4)

3.1.2. Material examined

Morocco: Atlantic coast of Safi, Marissa III Beach, (32°24’42.76"N, 9°26’25.08"W, June 2012-july 2014, boring into rock. Number of specimens observed, varied from 50 to 200 individuals. Three specimens are deposited in the Polytheque collection of the UCO, Angers, France (Registration number UCO T SPI 51). The specimens here assigned to *B. polybranchia*. It were found only boring into rock, it probably due to their tubes and their mucus secretions and to the vegetation cover [12].

3.1.3. Description

Medium-sized species, with 6,5 to 14 mm leng for 45 to 75 chaetigers, color green to reddish-yellow. Prostomium bifid anteriorly, caruncle extends to the posterior margin of the second chaetiger; absence of

occipital tentacle (antenna) and presence of two pairs of eyes. Caruncle extends to the posterior margin of the second chaetiger,two kinds of setae on chaetiger five (one simple and falcate and the second expanded and club-like).

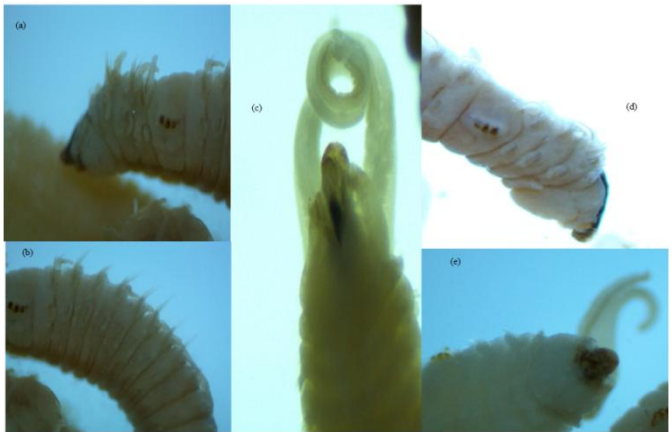

Figure 4: *Boccardia polybranchia*, adult morphology.(a) lateral view anterior shows lateral organ on first chaetiger to chaetiger 5.(b) lateral view anterior of chaetiger 5 to chaetiger 17.(c) Dorsal view head showing dorsal ciliary organs. (d) Lateral view (e) ventral view of ciliary bands and dorsal ciliary organs.

Chaetiger 1 reduced, with small notopodia, lacking notochaetae (Figure 4). Hooded hooks from chaetiger 7, with11 hooks per ramus. Modified spines of chaetiger 5 include dorsal row of 2 or 3 falcate spines, and ventral row of 3 or 4 bristle-topped spines. Older falcate spines not strongly curved. Branchiae on chaetigers 2-4 and posteriorly from chaetiger 6 for 70-80% of chaetigers. Short, broad and connected to notopodia on chaetigers 6-16, then filiform and longer. Paired glands composed of a few large sacs observed on chaetigers 7-9.
The pygidium, small disc and thick ring and fleshy shows a dorsal notch (sometimes a ventral notch).

3.2. Discussion

The intertidal area around sewage discharges of Safi shore is characterized by the presence of the non-indigenous spionid *B. polybranchia*, a gregarious polychaete species that uses sand to build its tubes (tube-dwelling spionid), which develop into biogenic structures. Spionid species often form extensive assemblages in areas with high contents of organic matter [36] and are recognized to be indicators of organically enriched environments [27].
As in the case of the southwestern Atlantic shore [26-28] [10] and the Gulf of Morbihan, Kerguelen [12] [25], *B. polybranchia* co-occurred with *Capitella capitata* in the organically enriched (organic polluted) shore. The presence and abundance of these indicator species (*B. polybranchia* with *C. capitata*) in the hard substrate community is regarded as the classic response of "opportunistic species" (in terms of organic enrichment, as suggested by Pearson & Rosenberg, [36]) when large amounts of organic matter are available [26] [29]. In fact, the sampled site is exposed to industrial sewage discharges from the city of Safi and is characterized by organically polluted sediments [37] associated to the mussel *Mytilus galloprovincialis*, which provides microhabitats (shelter) for small-sized polychaetes abundant in the sampling area. Thus, *B. polybranchia* and *C. capitata* were dominant and subdominant in the impacted point (site 2: Marissa III beach) from this Moroccan Atlantic shore. The species is also frequently mentioned as being in or around sewage outfalls in the Southern Hemisphere, like *Boccardia* spp. or *B. proboscidea* in an Australian sewage [24] and also in the intertidal zone of an outfall area in California [38]. In the Southwestern Atlantic, *B. polybranchia* with *C. capitata* near the outfall depicted positive and significant correlation for total organic carbon respectively [26].
In this study, *B. polybranchia* was among the dominant infaunal polychaete taxa, accounting generally for 12% of the total polycheaete number found during the whole study period on the coast of Safi and pointed out 10% to 25% of the total polycheaete abundance. The species disappeared from areas far from the outfall to less than 50

m south to the sewage effluent. in contrast to López Gappa *et al.* [39] have found high densities of *Boccardia* sp. (up to 500,000 ind. m-²) between mussels and in sandy substrates at lower intertidal and subtidal areas at 50 to 100 m from sewage.

The species was firstly assigned into sensitive species group (Ecological group I) [18] and because of its high polluo-sensitivity degree to the organic enrichment, it is currently classified as 2nd order opportunistic species (Ecological Group IV) according to the list available in the AMBI program (AZTI's Website 2015: http://www.azti.es).

Considering all of the samples collected during this study, it was clear that this species preferentially lives in the exposed-wave action rocky intertidal areas with moderate hydrodynamics inside consolidated sandy bloks or sand banks [39] in the rocky platforms containing bivalves (slight mussel beds, *Mytilus galloprovincialis* in our case) and other intertidal flora or fauna with a lower ranges of salinity and temperature. The species preferencially develops around the sewage discharges resulting in a high organic enrichment and pollution. In such constraining conditions and due to its highly effective reproduction plus high growing rate [25], this worm can cover the entire surface of rocks and exclude any other intertidal flora or fauna.

Conclusion

The new occurrence of *B. polybranchia* from the coast of Safi (Northwestern Morocco) on one hand, and its record from Moroccan Atlantic coasts on the other, confirm the distribution of the species and therefore, significantly extends its distributional range on Eastern Atlantic and North African coasts.

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