



A contribution to the North Atlantic polychaete diversity: new records from Morocco

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Abstract: Polychaetes are the most diversified class of segmented worms under the phylum Annelida found in marine ecosystem. These worms play a crucial role in the food web of the trophic system and serve as the primary link between sediment and higher predators. They are demonstrating a wide range of functional diversity as well as apprehension of various environmental conditions also they are one of the best indicators of environmental disturbance among benthic groups. The study on the diversity of polychaetes (Annelida) in Morocco started at the beginning of the 20th century, more recently, there has been some additional studies as a result, 326 species have been reported from Moroccan coasts, which was underestimate of the true diversity of marine polychaete in the country. The current study is aimed to identify the diversity of polychetes and their distribution from two ecosystems Oualidia lagoon and Dakhla bay. As a result of multiple surveys carried out in Oualidia Lagoon and Dakhla Bay between March 2013 and February 2014, twenty-seven species annelid polychaetes were collected. Among them seven are new records for Morocco, namely *Axiiothella constricta*, *Eteone barbata*, *Maldane sarsi*, *Nephtys kersivalensis*, *Ophelia rathkei*, *Pistella lornensis* and *Schistomeringos neglecta*. Accordingly, the total polychaete species diversity in the country is increased to 333.

1. Introduction

Benthic organisms play a key role in marine ecosystem functioning (Lefrere *et al.*, 2015, Touhami *et al.*, 2017, Chaouti and Bayed, 2017). Particularly, the polychaetes are a basal group in any study on marine benthic communities (Kies *et al.*, 2020, Ali *et al.*, 2023). They dominate the macrofaunal assemblages in terms of abundance, biomass, and diversity at practically all depths and benthic habitats (Jumars *et al.*, 2015, Chouikh *et al.*, 2020). They are well known by their adaptability to a wide variety of environmental conditions, thus playing a key role in ecosystem functioning. Furthermore, they have been used successfully as surrogates to estimate the diversity, spatial-temporal dynamics, and functional roles of benthic communities (Quirós-Rodríguez *et al.*, 2023).

The study on the diversity of polychaetes (Annelida) in Morocco started at the beginning of the 20th century, with the first list being published by Charrier (1921). Thereafter, numerous works have been conducted, particularly dealing with bays, lagoons and estuaries, and including checklists and

ecological approaches (e.g., polychaetes as bioindicators), as shown in the recent compilation by Gillet (2017). More recently, there has been some additional studies on the composition and spatial distribution of polychaetes from protected coastal areas (see Chouikh *et al.*, 2019). As a result, 326 species, 181 genera and 44 families have been reported from Moroccan coasts.

This quantity turns to be relatively low when compared with those of nearby regions (e.g. from more than 370 in Tunisia to more than 1000 in the Iberian Peninsula) (Zaabi *et al.*, 2012; Parapar, 2018). Therefore, we expected more species to be discovered in different Moroccan coasts. Accordingly, the present study was carried out to study the diversity of polychaetes in the Oualidia lagoon and the Dakhla bay and report the presence of seven new species with the systematic account of each species and their distribution.

2. Methodology

Sampling was carried out in forty-two stations in the Oualidia lagoon (between March and July 2013) and in Dakhla Bay (between May 2013 and February 2014). Samples were collected with a Van Veen grab and sieved in situ through a 1 mm pore size mesh. The material retained on the mesh was transferred to individual plastic containers and fixed in a 10% formalin solution. All macroinvertebrates were sorted under a binocular microscope and the polychaetes were isolated and identified at the lowest taxonomic level and counted. Selected specimens of the most relevant species have been deposited in the collections of the Centre d'Estudis Avançats de Blanes (CEAB). Full information on the methodological sampling and collection procedures are included in El Asri *et al.* (2018, 2019).

Light microscopy pictures of the newly reported species have been obtained with a compound microscope (Zeiss Stemi 2000-c), linked to a digital camera (CMEX 5, Euromex). Polychaete identifications are based on the keys included in Gil (2011), checked for the most updated terminology at the online World Polychaeta Database (Read and Fauchald, 2019) and validated through the most recently published papers on the respective families.

3. Results and Discussion

Ampharetidae Malmgren, 1866

Alkmaria Horst, 1919

Alkmaria romijni Horst, 1919

Material examined

Oualidia Lagoon (32°46'45, 84''N, 8°58'37, 56''W) date. July 2013, one specimen.

Distribution

Baltic Sea; North Sea; French Atlantic coasts; Northwestern Iberian coasts; Southern and western coastal of Portugal; Morocco (Atlantic and Mediterranean coasts).

Cirratulidae Ryckholt, 1851

Cirriiformia Hartman, 1936

Cirriiformia tentaculata (Montagu, 1808)

Material examined

Dakhla Bay (23°48'57.6''N, 15°43'12''W) date. May 2013 and February 2014, two specimens (CEAB.AP875).

Distribution

Pacific and Indian Oceans; Atlantic, from Norway to the Mediterranean Sea; British Isles; Madeira; Canary Islands; Morocco; Adriatic Sea; Aegean Sea; Black Sea.

Dorvilleidae Chamberlin, 1919

Schistomeringos Jumars, 1974

Schistomeringos neglecta (Fauvel, 1923)

[Figure 1i](#)

Material examined

Dakhla Bay (23° 44' 34.512''W, 15° 47' 8.267 W; 23° 38' 13.164''N, 15° 53' 25.404''W) date: May 2013 and February 2014, two specimens (CEAB.AP.888).

Distribution:

Eastern part of the Atlantic; between Great Britain and South Africa; Mediterranean Sea; Adriatic Sea; Aegean Sea; and Black Sea.

Remark:

First record for Morocco

Eunicidae Berthold, 1827

Eunice Cuvier, 1817

Eunice vittata (Delle Chiaje, 1828)

Material examined

Dakhla Bay (23° 48' 0''N, 15° 44' 24''W) date. May 2013 and February 2014, two specimens (CEAB.AP.881).

Distribution

Cosmopolite species, which occur worldwide.

Lysidice Lamarck, 1818

Lysidice unicornis (Grube, 1840)

Material examined

Dakhla Bay (23° 42' 10.548''N, 15° 48' 29.015''W; 23° 46' 31.944''N, 15° 53' 36.419''W) date. May 2013 and February 2014, two specimens (CEAB.AP.894).

Distribution

Considered as cosmopolitan in warm-temperate waters: Northeastern Atlantic, from the English Channel to Morocco; Mediterranean Sea; Adriatic Sea; Aegean Sea; Black Sea; Suez Canal; tropical Indo-west-Pacific.

Remark

Lysidice unicornis was cited for Morocco as *Nematonereis unicornis* (Grube, 1840).

Glyceridae Grube, 1850

Glycera Lamarck, 1818

Glycera alba (O.F. Müller, 1776)

Material examined

Dakhla Bay (23° 52' 32.124''N, 15° 46' 33.779''W) date. May 2013 and February 2014, two specimens (CEAB.AP.883 A-D).

Distribution

Norway Atlantic coasts of Europe; Mediterranean Sea; Morocco, Tyrrhenian Sea; Adriatic Sea; Aegean Sea; Black Sea; China.

Glycera cf. tridactyla Schmarda, 1861

Material examined

Dakhla Bay (23°52'11.82''N, 15°46'5.664''W) date. May 2013 and February 2014, two specimens (CEAB.AP.889).

Distribution

From the North Sea to the Mediterranean Sea; Morocco; Turkey; Tyrrhenian Sea; Ionian Sea; Adriatic Sea; Gulf of Patras; Israel; Aegean Sea; Black Sea; coasts of South Africa; Red Sea; Arabian Sea; Bay of Bengal; Japan; East and South China Sea; New Guinea; Australia.

Goniadidae Kinberg, 1866

Glycinde Müller, 1858

Glycinde nordmanni (Malmgren, 1866)

Material examined

Dakhla Bay (23°48'0''N, 15°44'24''W) date. May 2013 and February 2014, two specimens (CEAB.AP.877).

Distribution

West Atlantic and Gulf of Mexico; Northeast Atlantic, from Iceland to Morocco; English Channel; Skagerrak; Kattegat; Mediterranean Sea; Adriatic Sea; Aegean Sea.

Lumbrineridae Schmarda, 1861

Lumbrineris Blainville, 1828

Lumbrineris coccinea (Renier, 1804)

Material examined

Oualidia Lagoon (32°44'48.12''N, 9°1'30''W) date. July 2013, one specimen (CEAB.AP.863).

Distribution

From the North Sea and English Channel to the Mediterranean Sea, Morocco and Canary Islands.

Maldanidae Malmgren, 1867

Axiothella Verrill, 1900

Axiothella constricta (Claparède, 1868)

[Figure 1a](#)

Material examined

Dakhla Bay (23°41'16.476''N, 15°55'37.739''W; 23°48'22.32''N, 15°50'40.632''W) date. May 2013 and February 2014 tow specimens (CEAB.AP892).

Distribution

Mediterranean Sea; Adriatic Sea.

Remark

This finding represents the first record of the species for the Atlantic coasts of Morocco.

Maldane Grube, 1860

Maldane sarsi Malmgren, 1865

[Figure 1c](#)

Material examined

Dakhla Bay (23° 49'8.4'' N, 15°43'1.2''W; 23°48'57.6''N, 15°43'12''W) date. May 2013 and February 2014, two specimens (CEAB.AP.879).

Distribution

Arctic Ocean; Greenland; Kara Sea; western European coast, from Norway to Portugal; Adriatic Sea; Aegean Sea; west coast of Africa to South Africa; Indian Ocean; Japan; Western Canada; California; Antarctica.

Remark

First record for Morocco.

Nereididae Blainville, 1818

Hediste Malmgren, 1867

Hediste diversicolor (O.F. Müller, 1776)

Material examined

Oualidia Lagoon (32°46'32.52''N, 8°58'55.56''W) date. March and July 2013, two specimens (CEAB.AP.860).

Distribution

From the Gulf of St. Lawrence to Massachusetts; Greenland; Northeast Atlantic, from Iceland to the Mediterranean Sea; Morocco; Baltic Sea; Adriatic Sea; Aegean Sea; Black Sea; Caspian Sea.

Platynereis Kinberg, 1865

Platynereis dumerilii (Audouin & Milne Edwards, 1833)

Material examined

Dakhla Bay (23°48'36''N, 15°44'2.4''W) date: May 2013 and February 2014, two specimens (CEAB.AP.890).

Distribution

North Sea; North Atlantic from North America to Brazil; Madeira; Azores; Canary Islands; Morocco; Cape Verde; Mediterranean; Persian Gulf; Red Sea; Indian Ocean; Pacific; West and South Africa.

Oeononidae Kinberg, 1865

Arabella Grube, 1850

Arabella iricolor (Montagu, 1804)

Material examined

Dakhla Bay (23°48'0''N, 15°44'24''W) date. May 2013 and February 2014 specimens (CEAB.AP.887).

Distribution

English Channel to France; Mediterranean Sea; Adriatic Sea; Aegean Sea; Azores; Morocco; Red Sea; Persian Gulf; Indian Ocean; Strait of Magellan; West and South Africa; West Coast of USA; Bermuda;

Gulf of Mexico; West Indies; Vancouver Island to California; Mexico; Argentina; north Japan Sea to Japan; China.

Onuphidae Kinberg, 1865

Diopatra Audouin & Milne Edwards, 1833

Diopatra marocensis Paxton, Fadlaoui & Lechapt, 1995

Material examined

Dakhla Bay (23°52'11.8244''N, 15°46'5.664 W) date. May 2013 and February 2014, two specimens (CEAB.AP878).

Distribution

East Atlantic (near Gibraltar; Morocco, Spain and Portugal) and the eastern Mediterranean.

Remark

This species might be introduced in the Eastern Mediterranean, through ballast waters from the East Atlantic (near Gibraltar) (Çinar et al. 2014).

Orbiniidae Hartman, 1942

Naineris Blainville, 1828

Naineris laevigata (Grube, 1855)

Material examined

Dakhla Bay (23° 48'0''N, 15°44'24''W) date. May 2013 and February 2014, two specimens (CEAB.AP.895).

Distribution

Cantabria Sea; Morocco; Western Mediterranean Sea; Adriatic Sea; Aegean Sea; Black Sea; Antillean Islands; Gulf of Mexico; Bermuda; Jamaica; Brazil; South Africa; Persian Gulf; Sri Lanka; Pacific Ocean; Hawaiian Islands; California.

Nephtys hombergii Savigny in Lamarck, 1818

Material examined

Oualidia Lagoon (32°44'40.56''N, 9°1'45.84''W) date. March and July 2013, two specimens (CEAB.AP.865).

Distribution

Northeastern Atlantic, from the Barents Sea to the Mediterranean Sea, including the North Sea, Skagerrak, Kattegat and outer Baltic Sea; Adriatic Sea; Aegean Sea; Black Sea; South Africa.

Nephtys kersivalensis McIntosh, 1908

[Figure 1d](#)

Material examined

Oualidia Lagoon (32°44'48.12''N, 9°1'30''W; 32°44'24''N, 9°2'2.76''W) date. July 2013, one specimen (CEAB.AP.868).

Distribution

North-eastern Atlantic; Ireland; North Sea; English Channel; Western France; Portugal; Mediterranean Sea.

Remark

First record for Morocco.

Opheliidae Malmgren, 1867

Ophelia Savigny, 1822

Ophelia rathkei McIntosh, 1908

[Figure 1e-f](#)

Material examined

Dakhla Bay (23°48'7.2''N, 15°44'16.799 W; 23°50'46.356''N, 15°49'48.359''W) date May 2013 and February 2014, two specimens (CEAB.AP.893).

Distribution

British Islands; English Channel; North Sea; western Baltic Sea to Kieler Bight.

Remark

First record for Morocco

Pectinariidae Quatrefages, 1866

Lagis Malmgren, 1866

Lagis koreni Malmgren, 1866

Material examined

Oualidia Lagoon (32°44'46.32''N, 9°1'28.919''W) date. July 2013, one specimen.

Distribution

Eastern North Atlantic, from the Barents Sea to Namibia; Iceland; Norway; English Channel; North Sea; western Baltic Sea; Portugal; Morocco; Mediterranean Sea; Adriatic Sea; Aegean Sea; Black Sea.

Phyllodocidae Örsted, 1843

Eteone Savigny, 1822

Eteone barbata Malmgren, 1865

[Figure 1b](#)

Material examined

Dakhla Bay (23°50'46.356''N, 15°49'48.395''W; 23°48'46.8''N, 15°43'48''W) date. May 2013 and February 2014, two specimens (CEAB.AP880).

Distribution

Iceland; Denmark; Swedish; Norway; Ireland; eastern part of English Channel; Spain; Japan.

Remark

First record for Morocco.

Eumida Malmgren, 1865

Eumida cf. sanguinea (Örsted, 1843)

Material examined

Dakhla Bay (23°40'8.4''N, 15°51'9.18''W) date. May 2013 and February 2014, two specimens (CEAB.AP870 A-C).

Distribution

Eumida sanguinea is in fact a complex of sibling species, which can be distinguished basically by a molecular approach and key color patterns of living individuals (Nygren and Pleijel, 2011). The specimens from Dakhla Bay agrees with the morphological description of the preserved materials, but further samples are required to check the morphology of living animals, as well as to analyze them with molecular tools, to be able to confirm the species. At present, the only valid records of *E. sanguinea* are restricted to Kattegat, Skagerrak, and south coast of England (Nygren and Pleijel, 2011).

Sabellidae Latreille, 1825

Panousea Rullier & Amoureux, 1970

Panousea africana Rullier & Amoureux, 1969

Material examined

Dakhla Bay (23°48'57.6''N, 15°43'12''W) date. May 2013 and February 2014, two specimens (CEAB.AP.869).

Distribution

Morocco; South Portugal.

Sigalionidae Kinberg, 1856

Sthenelais Kinberg, 1856

Sthenelais boa (Johnston, 1833)

Material examined

Dakhla Bay (23°48'46.8''N, 15°43'48''W) date: May 2013 and February 2014, two specimens (CEAB.AP.891).

Distribution

British Islands; from Norway to the Mediterranean Sea; Adriatic Sea; Aegean Sea; Black Sea; Atlantic and Indo-Pacific areas; from Massachusetts coast to Brazil; West and South Africa; Indian Ocean; Red Sea; Persian Gulf; China; Japan.

Spionidae Grube, 1850

Paraprionospio Caullery, 1914

Paraprionospio cf. pinnata (Ehlers, 1901)

Material examined

Dakhla Bay (23°51'37.152''N, 15°45'18.755''W) date: May 2013 and February 2014, two specimens (CEAB.AP.882).

Distribution

This species was originally reported from Chile and later mentioned in the Indo-Pacific, Western Atlantic and Mediterranean, however, recent studies seems tp confirm that there are at least 13 valid species in the genus (Delgado-Blas and Carrera-Parra, 2018). Thus, further materials are required to validate the presence of this species in Moroccan coasts.

Terebellidae Johnston, 1846

Amaeana Hartman, 1959

Amaeana trilobata (Sars, 1863)

Material examined

Dakhla Bay (23°52'32,124''N, 15°46'33,779''W) date. February 2014, one specimen (CEAB.AP.874).

Distribution

Iceland; Faroes Island; Norway; North Sea; Swedish west coast; British Islands; Morocco; Mediterranean Sea; Adriatic Sea; Aegean Sea; New England; North Carolina; North Pacific; Japan; Solomon Islands; South Africa; Tasmania; Australia.

Pistella Hartmann-Schröder, 1996

Pistella lornensis (Pearson, 1969)

Figure 1 g-h

Material examined

Dakhla Bay (23°48'57.6''N, 15°43'12''W; 23°51'37.152''N, 15°45'18.755''W) date: May 2013 and February 2014, two specimens (CEAB.AP.896).

Distribution

Norwegian south coast, Swedish west coast, north coast of Jutland, West coast of Scotland.

Remark

First record for Morocco.

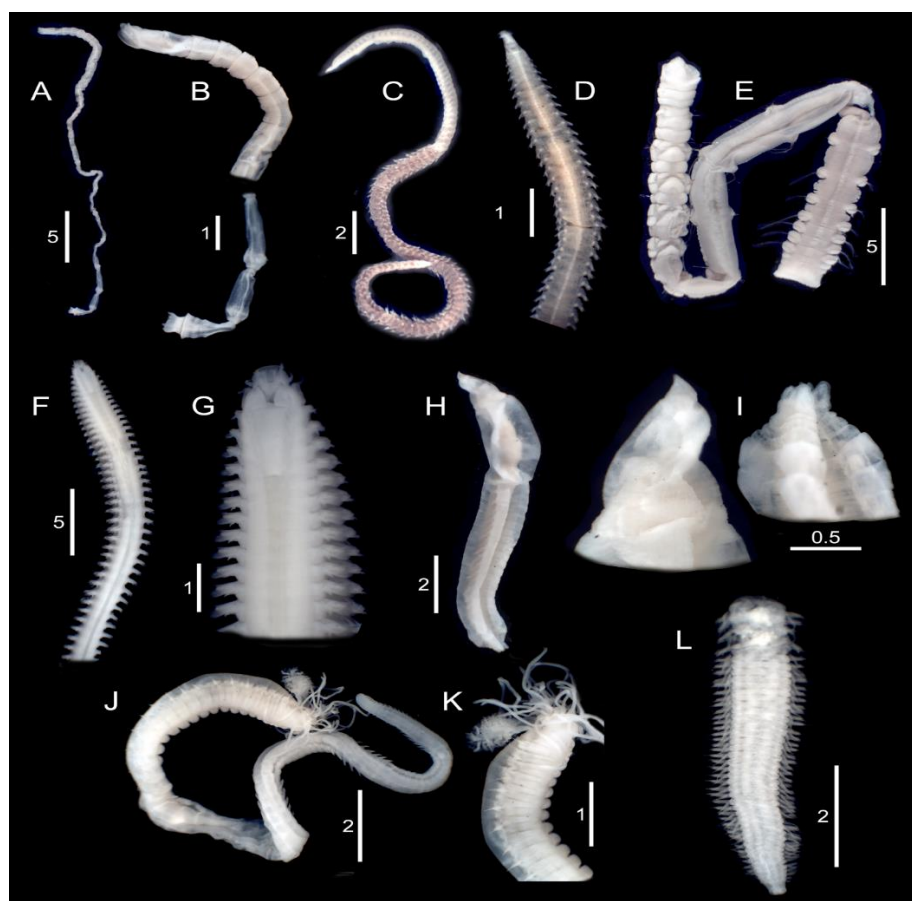


Figure. 1: A. Whole body of *Axiothella constricta*. B. Detail of anterior and posterior ends of *A. constricta*. C. Whole body of *Eteone barbata*. D. Detail of anterior end of *E. barbata*. E. Whole body of *Maldane sarsi*. F. Whole body of *Nephtys kersivalensis*. G. Detail of anterior end of *N. kersivalensis*. H. Whole body of *Ophelia rathkei*. I. Detail of anterior and posterior ends of *O. rathkei*. J. Whole body of *Pistella lornensis*. K. Detail of anterior end of *P. lornensis*. L. Posterior end of *Schistomeringos neglecta*. Scale bars are mm.

The present study updates the number of polychaete species known from Morocco to 333 species. However, we strongly suggest that this number certainly represents an underestimate of the true diversity of marine polychaete in the country, as it occurs in nearby regions, where the 56 species of Mauritania (Gillet, 2017) or the 168 species of Açores (Cordeiro *et al.*, 2019) are likely due to the lack of information rather than to a real low diversity. Two factors support the existence of a higher diversity in Morocco. First, the extent of its coasts (more than 3500 Km) and its high habitat diversity (Gillet, 2017). Second, the higher species diversity recorded in better studied nearby regions which range from 390 in Tunisia (Ayari *et al.*, 2009) to 683 Canary Islands (Freitas *et al.*, 2019), 253 species in the Gulf of Guinea (Sobczyk *et al.*, 2023), 605 in Portugal (Gil, 2011), 934 in France (including British Channel, Atlantic and Mediterranean Sea) (Gillet, 2017) and 1055 in the Iberian Peninsula and the Balearic Islands (including Myzostomida and Siboglinidae and excluding Clitellata and Sipuncula) (Parapar, 2018). Accordingly, we agree with Gillet (2017) in that further studies must be addressed to improve the knowledge on the fauna of annelids of Morocco.

Conclusion

This study revealed the presence of seven new species: *Axiothella constricta*, *Eteone barbata*, *Maldane sarsi*, *Nephtys kersivalensis*, *Ophelia rathkei*, *Pistella lornensis* and *Schistomeringos neglecta*. Accordingly, the total polychaete species diversity in the country is increased from 326 species to 333.

The study constitutes a baseline for future monitoring and coastal management in Dakhla Bay and Oualidia lagoon. However, further investigations are needed to obtain a whole picture on the overall biodiversity on the fauna of annelids of Morocco.

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Compliance with Ethical Standards: This article does not contain any studies involving human subjects.

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