Mediterranean Marine Science

Vol 23, No 3 (2022)

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doi: 10.12681/mms.27798

Research Article

Mediterranean Marine Science
Indexed in WoS (Web of Science, ISI Thomson) and SCOPUS
The journal is available on line at http://www.medit-mar-sc.net
www.hcmr.gr
DOI: http://doi.org/10.12681/mms.27798

Polychaete diversity in Tunisian waters as of 2021: an update with special emphasis on Non-Indigenous species

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Contributing Editor: Joachim LANGENECK

Received: 11 August 2021; Accepted: 11 April 2022; Published online: 29 July 2022

Abstract

The last inventory of Tunisian polychaetes diversity by Ayari *et al*. (2009) is updated. New records were acquired from the literature and from the current study concerning species collected in the tidal channels of the Gulf of Gabès (2016-2017) and the re-examination of some species deposited in the collection of the Tunisian National Institute of Marine Sciences and Technologies. This inventory, reviewing the taxonomy, nomenclature and biogeographic distribution of the Tunisian polychaetes, includes 390 species belonging to 52 families, among which the Serpulidae (41 species) and Syllidae (36 species) are the most diverse. In total, 37 species previously reported are currently removed from the Tunisian polychaetes list. An additional 121 new species are added, including 23 species collected in the tidal channels and 6 species in the reference collection previously misidentified as their congeners. Morphological differences between the latter are briefly discussed and figured. Among these species, *Laonice bahusiensis*, *Laonice norgensis* and *Scolelepis neglecta* are extending their Mediterranean distribution, while *Sternaspis thalassemoides* and *Caulleriella mediterranea* are probably reported for the first time after their original description. In addition, this current inventory allows us to discuss the establishment status of 17 Non-Indigenous polychaete species (14 established, 1 casual and 2 cryptogenic) found in Tunisian waters.

Keywords: Polychaetes; inventory; non-indigenous species; new records; Tunisia.

Introduction

According to Coll *et al*. (2010), the number of polychaete species in the Mediterranean Sea exceeds 1,000; these authors show that, despite this richness, further efforts are required to fill gaps in our knowledge about deeper waters and the southern coasts of the Mediterranean. Subsequently, inventories of polychaetes have been drawn up for the southern coasts of the western Mediterranean corresponding to North Africa (Gillet 2017; Bakalem *et al*., 2020). The first inventories of polychaetes in Tunisian waters were published by Zghal & Ben Amor (1980), and Zghal & Bouaziz-Azzouna (1984), while a complete inventory of Tunisian polychaetes was revised by Ayari *et al*. (2009) and then updated by Zaâbi *et al*. (2012).

For Moroccan waters including the Atlantic and Mediterranean coasts, polychaete species have been inventoried by Gillet (2017), but without any information on the diversity on either of these coastlines. More recently, Bakalem *et al*. (2020) identified a total of 534 species on the Algerian coasts, eight of which are non-indigenous species. However, it is difficult to compare the diversity of polychaetes between the northern and the southern sides of the Mediterranean Sea due to insufficient data for the southern part: i.e., a scarcity of data from the Libyan coasts, as well as fragmentary and incomplete data from the Egyptian coasts (Abd-Elnaby, 2009; Dorgham *et al*., 2014).

Faced with environmental changes, a detailed knowledge of biodiversity appears necessary, in particular by targeting non-indigenous species (NIS). In recent

years, research on NIS has increased, reflecting the scientific interest in these species due to their ecological and economic impact on ecosystems (Zenetos *et al*., 2005, 2010, 2012). The European Union's Marine Strategy Framework Directive (MSFD) and the Commission for the Scientific Exploration of the Mediterranean recommend the monitoring and creation of a database on NIS to improve updating of our knowledge of biodiversity in the Mediterranean Sea (Zenetos *et al*., 2010, 2012).

The MSFD approach was adopted to protect the marine environment and is based on geographical and ecological criteria. Four sub-regions were subsequently defined: 1) the Western Mediterranean Sea (WMED); 2) the Central Mediterranean Sea (CMED); 3) the Adriatic Sea (ADRIA); and 4) the Eastern Mediterranean Sea (EMED) (Zenetos *et al*., 2010).

The Tunisian coasts make up a hinge or transition zone between the WMED and CMED regions. Therefore, a knowledge of their biodiversity in general and their NIS in particular would represent a significant contribution to the understanding of biological exchanges, in particular the pathways of introduction and spread of NIS between these two regions of the Mediterranean.

Complete inventories of polychaete species in the Mediterranean have been carried out mainly by Dauvin *et al*. (2006) for the Mediterranean coast of France, Campoy (1982) for the Mediterranean coast of Spain, Castelli *et al*. (2008) for Italy, Çınar *et al*. (2014a) for Turkey, Mikac (2015) for the Adriatic Sea, Faulwetter *et al*. (2017) for Greece and Bakalem *et al*. (2020) for Algeria. Since the first inventory by Zibrowius (1992), many articles have been published on Mediterranean introduced species not only in regional terms (Occhipinti-Ambrogi *et al*., 2011; Simboura *et al*., 2010) but also at the scale of the whole Mediterranean Sea (Galil, 2009; Galil *et al*., 2018; Zenetos *et al*., 2005, 2008, 2010, 2012, 2017, 2022).

In their inventory of polychaetes for Tunisian waters, Ayari *et al*. (2009) recorded 289 species, but considered that this diversity was probably underestimated due to a lack of prospecting in certain regions, in particular the southern region of Tunisia, where this diversity is made up of only 105 species. Zaâbi *et al*. (2012) inventoried 86 new polychaete species from the North-east Tunisian coast, increasing the total number to 375 species. A new species was described from this same sector of the Tunisian coast and a new species was reported for the Mediterranean Sea (Chaibi *et al*., 2019 and 2021, respectively). Other taxonomic and especially ecological studies have been conducted over the last decade in the Gulf of Gabès (Pérez-Domingo *et al*., 2008; Aloui-Bejaoui & Afli, 2012; Khedhri *et al*., 2014, 2016a, b, 2017a, b; Mosbahi *et al*., 2015a, b, 2016, 2017; Boudaya *et al*., 2019); these studies have led to the recording of several new polychaete species compared to the inventory of Ayari *et al*. (2009).

The main objectives of our present study are: 1) to update our knowledge of the current diversity of polychaetes on the Tunisian coasts a decade after the inventory of Ayari *et al*. (2009); 2) to provide taxonomic revisions of doubtful or poorly identified species; 3) to review and validate the NIS based on their establishment success; 4) to record the polychaete diversity of tidal channels in the Gulf of Gabès; and 5) to study and revise the polychaete specimens in the reference collection of the National Institute of Marine Science and Technology (Tunis).

Materials and Methods

Study area

The present study covers the entire Tunisian coastline, which borders two marine sub-regions: the Western Mediterranean Sea and the Central Mediterranean Sea. The boundary between these two Mediterranean sub-regions is defined as the line joining Ras Kapoudia (Tunisia) to the southern tip of Sicily (Italy) (Fig. 1).

Data sources

1- Study of tidal channels in the Gulf of Gabès (Southern Tunisia)
Tidal channels in the Gulf of Gabès were investigated in the framework of A. Fersi's PhD thesis with the aim of establishing the organization of its benthic communities. Four tidal channels were chosen: the Mimoun Channel (CM), the Kneiss Channel (CK), the Maltine Channel (CML) and the Ben Khelaf Channel (CP) (Fig. 1). Other details of the sampling procedure and location are given elsewhere in Fersi *et al*. (2018) and Dauvin *et al.* (2021). For each polychaete species identified, the total number of individuals was counted for the whole sampling year and given as results for all tidal channels in Table 1.

2- Polychaete collection: Based on some recent work dealing with the taxonomic identification of pseudo-cryptic species (morphologically very similar), we examined some polychaete species lodged at the collection of the National Institute of Marine Science and Technology (INSTM) (Tunisia). The species in question belong to the collection of Ayari and Zaâbi (RF in Table 1).

3- Research on polychaetes and studies dealing with macrobenthic fauna, which were published after the last complete inventory of Tunisian polychaetes due to Ayari *et al*. (2009), are revised and collated here, especially the data of Diawara *et al*. (2008), Pérez-Domingo *et al*. (2008), Ayari *et al.* (2009), Zaâbi *et al*. (2009, 2010, 2012), Khedhri *et al*. (2014, 2016 a, b, 2017 a, b), Mosbahi *et al*. (2015 a, b, 2017), Ounifi-Ben Amor *et al*. (2015), Boudaya *et al*. (2019), and Chaibi *et al*. (2019, 2021).

Other papers were consulted to check the distribution of species in other regions of the Mediterranean (e.g., Castelli *et al*., 2008; Çinar *et al*., 2014a, b; Mikac, 2015; Faulwetter *et al*., 2017; Bakalem *et al*., 2020). The records and status of the NIS are reported and discussed in the wider context of the Mediterranean Sea and worldwide biogeography, with reference to the studies of Zenetos *et al*. (2010, 2012), Tsiamis *et al*. (2018), and Zenetos & Galanidi (2020).

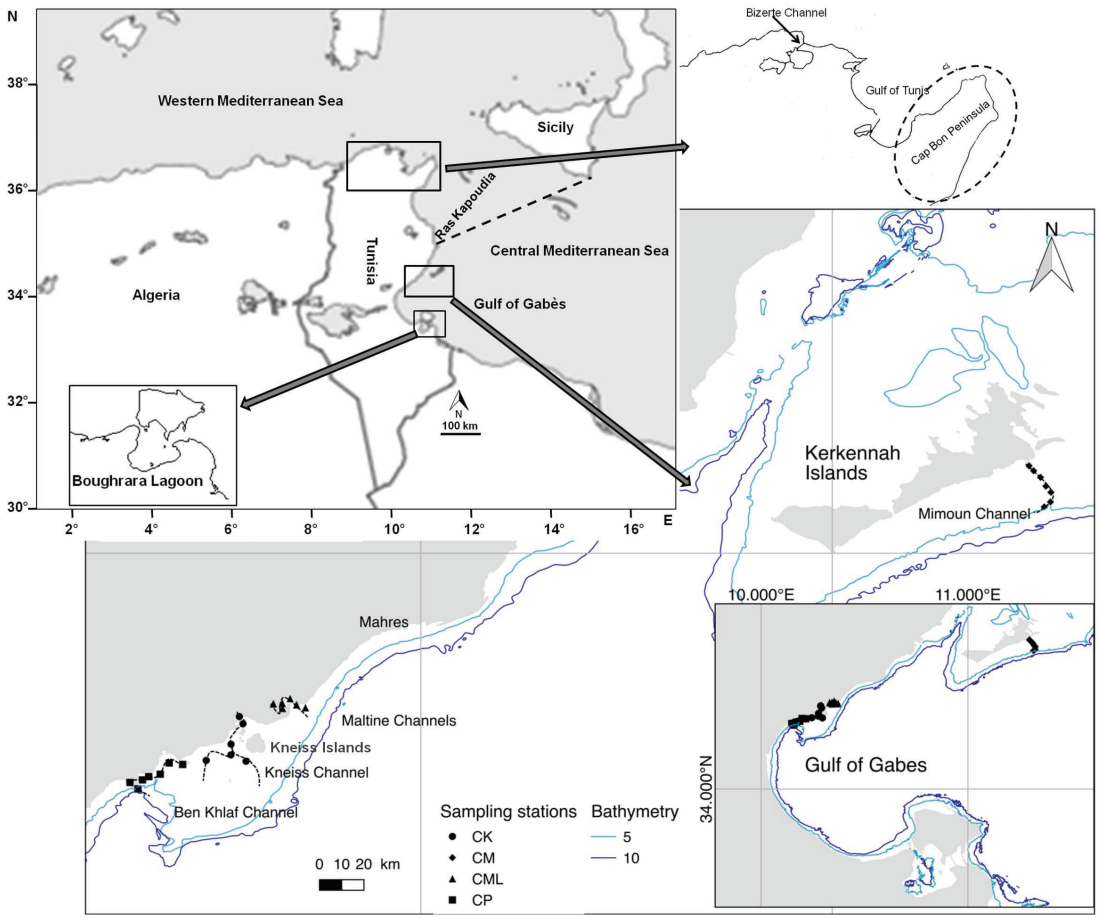

Fig. 1: Tunisian coasts with polychaete study areas including stations in the tidal channels of the Gulf of Gabès (Fersi *et al.,* 2018 modified).

Table 1. Species list of polychaetes from Tunisia. Aera: TWMED, Tunisian West Mediterranean and TCMED, Tunisian Central Mediterranean; RF (number of individuals): referring to species from the INSTM collection; Sc: Species complex; NIS (species highlighted): Non-Indigenous Species; status: EST Established, CAS Casual, CRY Cryptogenic; Tidal Channel of Gulf of Gabès: TCh (number of individuals). *Species new for Tunisia from published data after inventory of Ayari *et al*. (2009); **Species new for Tunisia (present study); ***Species new for Central and Western Mediterranean or for the whole Mediterranean Sea. Authors-Reference: A1: Ayari *et al*. (2009); B1: Boudaya *et al*. (2019); Ca1: Cantone *et al*. (1978); Ch1, Ch2: Chaibi *et al*. (2019 ; 2021); Crocetta et al. (2021); D1: Diawara *et al*. (2008); G1: Gaillande (1970); K1, K2, K3, K4: Khedhri *et al.* (2014; 2016a; 2017a; 2017b); M1, M2, M3: Mosbahi *et al*. (2015a and b, 2017); O1: Ounifi-Ben Amor *et al*. (2015); P1: Pérez-Domingo *et al*. (2008); V1: Vuillemin (1965); Za1, Za2, Za3: Zaâbi *et al*. (2009, 2010, 2012); Zi1: Zibrowius (1978).

	TWMED	TCMED	NIS	Notes
SCOLECIDA				
Arenicolidae Johnston, 1835				
Abarenicola claparedi (Levinsen, 1883)	+	+		
Arenicola cristata Stimpson, 1855	+	+		
Arenicola marina (Linnaeus, 1758)*		M2		
Branchiomaldane vincenti Langerhans, 1881	+			
Capitellidae Grube, 1862				
Capitella capitata (Fabricius, 1780)	+	+		Sc
Dasybranchus caducus Grube, 1846	+	+		
Dasybranchus gajolae Eisig, 1887	+	+		
Heteromastus filiformis (Claparède, 1864)	+	+		
Mastobranchus trinchesii Eisig, 1887*	Za3			
Mediomastus fragilis Rasmussen, 1973*		M3		

Continued

Table 1 continued

	TWMED	TCMED	NIS	Notes
Notomastus aberans Day, 1963		G1	EST	
Notomastus latericeus Sars, 1851	+	+		
Notomastus profundus Eisig, 1887	+			
Pseudocapitella incerta Fauvel 1913	+			
Pseudoleiocapitella fauveli Harmelin, 1964	+			
Maldanidae Malmgren, 1867				
Axiothella constricta (Claparède, 1868)**		TCh (1)		TCh (1)
Euclymene collaris (Claparède, 1869)**		TCh (7)		TCh (7)
Euclymene lombricoides (Quatrefages, 1866)	+	+		+
Euclymene oerstedii (Claparède 1863)	+	+		+
Euclymene palermitana (Grube, 1840)	+	+		+
Heteroclymene robusta Arwidsson, 1906		+		+
Johnstonia clymenoides Quatrefages, 1866	+	+		+
Leiochone leiopygos (Grube, 1860)	+	+		+
Macroclymene santanderensis (Rioja, 1917)	+	+		+
Maldane glebifex Grube, 1860	+			
Maldane sarsi Malmgren, 1865	+			
Microclymene tricirrata Arwidsson, 1906*		K3		K3
Nicomache trispinata Arwidsson, 1906*		M3		M3
Petaloproctus terricolus Quatrefages, 1866	+			
Praxillella affinis (M. Sars in G.O. Sars, 1872)	+	+		+
Praxillella gracilis (M. Sars, 1862)	+	+		+
Praxillella praetermissa (Malmgren, 1865)	+	+		+
Cossuridae Day, 1963				
Cossura soyeri Laubier, 1963	+			
Opheliidae Malmgren, 1867				
Armandia polyophthalma Kükenthal, 1887	+			
Ophelia amoureuxi Bellan & Costa, 1987***		TCh (10)		TCh (10)
Ophelia barquii Fauvel, 1927	+			
Ophelia bicornis Savigny in Lamarck, 1818	+			
Ophelia limacina (Rathke, 1843)*	Za3			
Ophelina acuminata Örsted, 1843**		TCh (10)		Sc
Polyophthalmus pictus (Dujardin, 1839)	+	+		
Scalibregmatidae Malmgren, 1867				
Scalibregma inflatum Rathke, 1843*	Za3			Sc
Orbiniidae Hartman, 1942				
Naineris laevigata (Grube, 1855)	+			
Naineris setosa (Verrill, 1900)***		K1	EST	
Orbinia latreillii (Audouin & Milne Edwards, 1833)*		M3		
Orbinia sertulata (Savigny, 1822)	+	+		
Phylo foetida (Claparède, 1869)	+	+		
Protoaricia oerstedii (Claparède, 1864)	+			
Scoloplos (*Leodamas*) *chevalieri candiensis* Harmelin, 1969*	Za2			
Scoloplos armiger (Müller, 1776)	+	+		Sc
Scoloplos typicus (Eisig, 1914)	+			

Continued

Table 1 continued

	TWMED	TCMED	NIS	Notes
Paraonidae Cerruti, 1909				
Aricidea (*Acmira*) *assimilis* (Tebble, 1959)	+			N_3
Aricidea (*Acmira*) *catherinae* Laubier, 1967*	Za3			Sc
Aricidea (*Acmira*) *cerrutii* Laubier, 1966	+	+		Sc
Aricidea (Acmira) simonae (Laubier & Ramos, 1974)	+			
Aricidea (Acmira) simplex Day, 1963*	Za1			
Aricidea (Aricidea) *bansei* Laubier & Ramos, 1974*	Za3			
Aricidea (Aricidea) *pseudoarticulata* Hobson, 1972*	Za1			
Cirrophorus branchiatus Ehlers, 1908*	Za3			
Levinsenia gracilis (Tauber, 1879)	+			
Paradoneis armata Glémarec, 1966*	Za1			N_4
Paradoneis harpagonea (Storch, 1967)*	Za1			
Paradoneis lyra (Southern, 1914)*	Za1	+		N_5
Paraonis fulgens (Levinsen, 1883)	+			
PALPATA Rouse & Fauchald, 1997				
ACICULATA Rouse & Fauchald, 1997				
AMPHINOMIDA				
Amphinomidae Lamarck, 1818				
Chloeia venusta Quatrefages, 1866	+			
Euphrosinidae Williams, 1851				
Euphrosine foliosa Audouin & Milne-Edwards, 1833	+	+		
EUNICIDA				
Dorvilleidae Chamberlin, 1919				
Protodorvillea kefersteini (McIntosh, 1869)	+	+		
Schistomeringos rudolphii (Delle Chiaje, 1828)	+			
Eunicidae Savigny, 1818				
Eunice pennata (Müller, 1776)	+	+		
Eunice schizobranchia Claparède, 1870*	Za1			
Eunice vittata (Delle Chiaje, 1829)	+	+		
Leodice antennata (Savigny, 1820)*		O1	EST	
Leodice harassii (Audouin & Milne-Edwards, 1833)	+			
Leodice torquata (Quatrefages, 1866)	+	+		
Lysidice collaris Grube, 1870*		O1	EST	
Lysidice ninetta Audouin & Milne-Edwards, 1833	+	+		Sc
Lysidice unicornis (Grube, 1840)	+	+		
Marphysa bellii (Audouin & M-Edwards, 1833)	+	+		
Marphysa chirigota Martin, Gil & Zanol in Martin *et al*. 2020***	Ch2			
Marphysa fallax Marion & Bobretzky, 1875	+	+		
Marphysa sanguinea (Montagu, 1815)	+	+		Sc
Palola siciliensis (Grube, 1840)	+	+		
Lumbrineridae Schmarda, 1861				
Hilbigneris gracilis (Ehlers, 1868)	+	+		
Lumbricalus adriatica (Fauvel, 1940)		+		
Lumbrineriopsis paradoxa (Saint-Joseph, 1888)	+	+		
Lumbrineris coccinea (Renier, 1804)	+			
Lumbrineris latreilli Audouin & Milne-Edwards, 1833	+	+		

Continued

Table 1 continued

	TWMED	TCMED	NIS	Notes
Scoletoma fragilis (Müller, 1776)	+			
Scoletoma funchalensis (Kinberg, 1865)	+			
Scoletoma impatiens (Claparède, 1868)	+	+		
Oenonidae Kinberg, 1865				
Arabella geniculata (Claparède, 1868)*	Za2			
Arabella iricolor (Montagu, 1804)	+	+		Sc
Drilonereis filum (Claparède, 1868)	+	+		
Notocirrus scoticus McIntosh, 1869**		TCh (1)		
Onuphidae Kinberg, 1865				
Aponuphis bilineata (Baird, 1870)	+			Sc
Aponuphis brementi (Fauvel, 1916)	+			Sc
Diopatra marocensis Paxton, Fadlaoui & Lechapt, 1995	A1	+	CRY	
Diopatra neapolitana Delle Chiaje, 1841	+	+		
Hyalinoecia tubicola (Müller, 1776)	+			Sc
Nothria conchylega (Sars, 1835)	+			Sc
Onuphis eremita Audouin & Milne Edwards, 1833**		TCh (86)		Sc
PHYLLODOCIDA				
Acoetidae Kinberg, 1856				
Euarche tubifex Ehlers, 1887	+			
Panthalis oerstedi Kinberg, 1856*	Za3			
Polyodontes maxillosus (Ranzani, 1817)	+			
Aphroditidae Malmgren, 1867				
Laetmonice hystrix (Savigny *in* Lamarck, 1818)	+	+		
Pontogenia chrysocoma (Baird, 1865)	+	+		
Chrysopetalidae Ehlers, 1864 *	Za3			
Chrysopetalum debile (Grube, 1855)*	Za3			
Glyceridae Grube, 1850				
Glycera alba (Müller, 1776)	+	+		
Glycera fallax Quatrefages, 1850		+		
Glycera lapidum Quatrefages, 1865*	Za1			Sc
Glycera tesselata Grube, 1863	+	+		
Glycera tridactyla Schmarda, 1861	+	+		
Glycera unicornis Savigny in Lamarck, 1818	+	+		
Goniadidae Kinberg, 1866				
Goniada emerita Audouin & Milne-Edwards, 1833		+		
Goniada maculata Örsted, 1843	+			
Goniada norvegica Örsted, 1845*	Za2			
Hesionidae Grube, 1850				
Hesione splendida Lamark, 1818*	Za3	+		Sc
Hesionides arenaria Friedrich, 1937	+	+		
Hesionides gohari Hartmann-Schröder, 1960	+			Sc
Microphthalmus sczelkowii Metschnikow, 1865*	Za3			
Microphthalmus similis Bobretzky, 1870	+			
Oxydromus agilis (Ehlers, 1864)	+			
Oxydromus flexuosus (Delle Chiaje, 1827)*	Za3			
Psamathe fusca Johnston, 1836	+	+		

Continued

Table 1 continued

	TWMED	TCMED	NIS	Notes
Syllidia armata Quatrefages, 1865	+			
Iphionidae Kinberg, 1856*				
Iphione muricata (Savigny *in* Lamark, 1818)*		B1	EST	
Nephtyidae Grube, 1850				
Aglaophamus agilis (Langerhans, 1880)	+			
Nephtys assimilis Öersted, 1843*		P1		
Nephtys caeca (Fabricius, 1780)	+	+		
Nephtys cirrosa Ehlers, 1868*		P1		
Nephtys hombergii (Savigny *in* Lamarck, 1818)	+	+		
Nephtys hystricis McIntosh, 1900	+	+		
Nephtys incisa Malmgren, 1865	+			
Nephtys kersivalensis McIntosh, 1908*		P1		
Nereididae Johnston, 1865				
Alitta succinea (Frey & Leuckart, 1847)		+		
Ceratonereis (*Composetia*) *costae* (Grube, 1840)	+	+		
Ceratonereis (*Composetia*) *hircinicola* (Eisig, 1870)	+	+		
Hediste diversicolor (Müller, 1776)	+	+		Sc
Micronereis variegata Claparède, 1863*		K3		
Neanthes acuminata (Ehlers, 1868)	+	+		Sc
Neanthes fucata (Savigny, 1822)**		TCh (6)		
Neanthes kerguelensis (McIntosh, 1885)**		TCh (4)		
Neanthes nubila (Savigny, 1822)*		M3		
*Nereis falsa Q*uatrefages, 1866	+			
Nereis pelagica Linnaeus, 1758	+	+		Sc
Nereis perivisceralis Claparède, 1868**		TCh (1)		
Nereis pulsatoria (Savigny, 1822)	+	+		
Nereis rava Ehlers, 1868*	Za2	+		
Perinereis cultrifera (Grube, 1840)	+	+		Sc
Perinereis macropus (Claparède, 1870)	+			
Perinereis macropus var. *conodonta* Fauvel, 1924		+		
Perinereis oliveirae (Horst, 1889)**		TCh (9)		
Perinereis tenuisetis (Fauvel, 1915)**		TCh (2)		
Platynereis coccinea (Delle Chiaje, 1841)	+	+		
Platynereis dumerilii (Audouin & Milne-Edwards, 1832)	+	+		Sc
Websterinereis glauca (Claparède, 1870)	+			
Paralacydoniidae Pettibone, 1963				
Paralacydonia paradoxa Fauvel, 1913	+			
Phyllodocidae Örsted, 1843				
Eteone longa (Fabricius, 1780)*	Za1			Sc
Eulalia viridis (Linnaeus, 1767)	+	+		N_6
Eumida punctifera (Grube, 1860)*	Za2			
Eumida sanguinea (Örsted, 1843)	+	+		Sc
Hesionura coineaui (Laubier, 1962)	+			
Hesionura elongata (Southern, 1914)	+			
Mysta picta (Quatrefages, 1866)*	Za2	+		
Nereiphylla rubiginosa (Saint-Joseph, 1888)	+			

Continued

Table 1 continued

	TWMED	TCMED	NIS	Notes
Phyllodoce laminosa Savigny *in* Lamarck, 1818	+	+		
Phyllodoce lineata (Claparède, 1870)		+		
Phyllodoce madeirensis Langerhans, 1880*	Za2	+		Sc
Phyllodoce mucosa Örsted, 1843	+			
Protomystides bidentata (Langerhans, 1880)*	Za3			
Pseudomystides limbata (Saint-Joseph, 1888)*	Za2	+		
Pterocirrus macroceros (Grube, 1860)	+	+		
Pilargidae de Saint-Joseph, 1899*	Za2			
Ancistrosyllis groenlandica McIntosh, 1879*	Za2			
Pilargis verrucosa Saint-Joseph, 1899**		TCh (2)		
Sigambra tentaculata (Treadwell, 1941)*	Za3	+		Sc
Polynoidae Malmgren, 1867				
Harmothoe antilopes McIntosh, 1876*	Za3			
Harmothoe areolata (Grube, 1860)	+			
Harmothoe extenuata (Grube, 1840)*		M3		
Harmothoe imbricata (Linnaeus, 1767)	+			Sc
Harmothoe impar (Johnston, 1839)	+			N_7
Harmothoe spinifera (Ehlers, 1864)	+	+		
Lepidasthenia brunnea Day, 1960	+			
Lepidasthenia elegans (Grube, 1840)	+			
Lepidonotus clava (Montagu, 1808)	+	+		
Lepidonotus squamatus (Linnaeus, 1758)	+			Sc
Malmgrenia castanea McIntosh, 1876**		TCh (4)		
Malmgrenia darbouxi (Pettibone, 1993)**				
Malmgrenia ljungmani (Malmgren, 1867)				
Malmgrenia lunulata (Delle Chiaje, 1830)				
Malmgrenia polypapillata (Barnich & Fiege, 2001)				
Subadyte pellucida (Ehlers, 1864)*				
Sigalionidae Malmgren, 1867				
Euthalenessa oculata (Peters, 1854)				
Fimbriosthenelais minor (Pruvot & Racovitza, 1895) *				
Pelogenia arenosa (Delle Chiaje, 1830)				
Pholoe inornata Johnston, 1839				
Pisione remota (Southern, 1914)				
Sigalion mathildae Audouin & Edwards 1834				
Sthenelais boa (Johnston, 1833)				
Sthenelais limicola (Ehlers, 1864)**		TCh (9)		
Syllidae Grube, 1850				
Amblyosyllis spectabilis (Claparède, 1863)	+			
Branchiosyllis exilis (Gravier, 1900)	+			Sc
Brania pusilla (Dujardin, 1851)	+			
Eurysyllis tuberculata Ehlers, 1864*	Za2			
Eusyllis blomstrandi Malmgren, 1867	+			
Eusyllis lamelligera Marion & Bobretzky, 1875**		TCh (1)		
Exogone dispar (Webster, 1879)	+			
Exogone verugera (Claparède, 1864)	+	+		

Continued

Table 1 continued

	TWMED	TCMED	NIS	Notes
Haplosyllis spongicola (Grube, 1855)	+			Sc
Myrianida prolifera (Müller, 1788)	+			
Neopetitia amphophthalma (Siewing, 1956)	+			Sc
Odontosyllis ctenostoma Claparède, 1868	+			
Paraehlersia ferrugina (Langerhans, 1881)*	Za3			
Parapionosyllis cf. gestans (Pierantoni, 1903)*	Za1			
Parapionosyllis labronica Cognetti, 1965*	Za3			
Parapionosyllis minuta (Pierantoni, 1903)*	Za1			
Parapionosyllis papillosa (Pierantoni, 1903)*	Za1			
Pseudosyllis brevipennis Grube, 1863	+			
Salvatoria clavata (Claparède, 1863)	+	+		
Salvatoria limbata (Claparède, 1868)*	Za1			
Sphaerosyllis bulbosa Southern, 1914*	Za2			
Sphaerosyllis hystrix Claparède, 1863	+			
Sphaerosyllis pirifera Claparède, 1868*	Za2			
Sphaerosyllis taylori Perkins, 1981*	Za3			
Streptosyllis bidentata Southern, 1914*	Za3			
Syllis amica Quatrefages, 1866	+	+		
Syllis armillaris (Müller, 1776)	+	+		
Syllis garciai (Campoy, 1982)*	Za3	+		
Syllis gracilis Grube, 1840	+	+		Sc
Syllis hyalina Grube, 1863	+	+		
Syllis hyllebergi (Licher, 1999)*		O1	EST	
Syllis krohnii Ehlers, 1864	+	+		
Syllis prolifera Krohn, 1852	+			
Syllis variegata Grube, 1860	+	+		
Syllis vittata Grube, 1840	+			
Trypanosyllis zebra (Grube, 1860)	+	+		Sc
CANALIPALPATA Rouse & Fauchald, 1997				
SABELLIDA sensu Rouse & Fauchald, 1997				
Oweniidae Rioja, 1917				
Galathowenia oculata (Zachs, 1923)*	Za3			
Owenia fusiformis Delle Chiaje, 1844		+		Sc
Sabellariidae Johnston, 1865				
Lygdamis muratus (Allen, 1904)**		TCh (4)		
Sabellaria alveolata (Linnaeus, 1767)		+		
Sabellaria spinulosa Leuckart, 1849	+	+		
Sabellidae Latreille, 1825				
Acromegalomma claparedei (Gravier, 1906)***		K3	EST	
Acromegalomma lanigerum (Grube, 1846)	+	+		N_9
Amphiglena mediterranea (Leydig, 1851)	+	+		Sc
Branchiomma bairdi McIntosh, 1885***		K4	EST	
Branchiomma bombyx (Dalyell, 1853)	+	+		
Branchiomma luctuosum (Grube, 1870)*	CR		EST	
Chone filicaudata Southern, 1914	+			N_{10}
Desdemona ornata Banse, 1957*		M3	EST	

Continued

Table 1 continued

	TWMED	TCMED	NIS	Notes
Dialychone acustica Claparède, 1868*	Za3			
Dialychone collaris (Langerhans, 1881)	+			
Dialychone dunerificta Tovar-Hernández, L & Giangrande, 2007	+	+		
Euchone rosea Langerhans, 1884**		TCh (2)		
Euchone rubrocincta (Sars, 1862)*	Za2			
Euratella salmacidis (Claparède, 1870)		+		
Hypsicomus stichophthalmos (Grube, 1863)*	Za3			
Jasmineira caudata Langerhans, 1880*	Za2			
Laonome kroyeri Malmgren, 1866*	Za3	+		
Sabella discifera Grube, 1874*	Za3			
Sabella pavonina Savigny, 1820	+	+		
Sabella spallanzanii (Gmelin, 1791)	+	+		
Serpulidae Johnston, 1865				
Ditrupa arietina (Müller, 1776)		+		
Ficopomatus enigmaticus (Fauvel, 1923)	V1	+	EST	Sc
Filograna implexa Berkeley, 1827		+		
Filogranula annulata (Costa, 1861)	+			
Filogranula calyculata (Costa, 1861)		+		
Filogranula gracilis Langerhans, 1884		+		
Hydroides dianthus (Verrill, 1873)	+	+		Sc
Hydroides dirampha Morch, 1863	Zi1		EST	
Hydroides elegans (Haswell, 1883)	Zi1	+	EST	Sc
Hydroides helmata (Iroso, 1921)	+			
Hydroides nigra Zibrowius, 1971	+	+		
Hydroides norvegica Gunnerus, 1768	+	+		
Hydroides operculata (Treadwell 1929)*	O1		EST	
Hydroides pseudouncinata Zibrowius, 1968	+	+		
Janita fimbriata (Delle Chiaje, 1828)	+	+		
Janua heterostropha (Montagu, 1803)	+	+		
Josephella marenzelleri Caullery & Mesnil, 1896	+	+		
Metavermilia multicristata (Philippi, 1844)	+			
Neodexiospira pseudocorrugata (Bush, 1905)	+			
Pileolaria heteropoma (Zibrowius, 1968)	+	+		
Pileolaria militaris Claparède, 1870	+	+		
Placostegus crystallinus sensu Zibrowius, 1968		+		
Protolaeospira striata (Quiévreux, 1963)	+			
Protula intestinum (Lamarck, 1818)		+		
Protula tubularia (Montagu, 1803)		+		
Salmacina incrustans Claparède, 1870		+		
Semivermilia agglutinata (Marenzeller, 1893)		+		
Semivermilia crenata (Costa, 1861)	+	+		
Semivermilia cribrata (Costa, 1861)		+		
Semivermilia pomatostegoides (Zibrowius, 1969)		+		
Serpula concharum Langerhans, 1880	+	+		
Serpula lobiancoi Rioja, 1917	+			
Serpula vermicularis Linnaeus, 1767	+	+		

Continued

Table 1 continued

	TWMED	TCMED	NIS	Notes
Spiraserpula massiliensis (Zibrowius, 1968)	+	+		
Spirobranchus lamarcki (Quatrefages, 1865)	+			
Spirobranchus polytrema (Philippi, 1844)	+			
Vermiliopsis infundibulum (Philippi, 1844)	+	+		
Vermiliopsis labiata (Costa, 1861)	+	+		
Vermiliopsis striaticeps (Grube, 1862)	+			
Vinearia endoumensis (Zibrowius, 1968)	+			
Vinearia koehleri (Caullery & Mesnil, 1897)	+	+		
SPIONIDA *sensu* Rouse & Fauchald, 1997				
Chaetopteridae Audouin & Milne-Edwards, 1833				
Chaetopterus variopedatus (Renier, 1804)		+		
Phyllochaetopterus socialis Claparède, 1868	+	+		
Spiochaetopterus costarum (Claparède, 1868)		+		
Magelonidae Cunningham & Ramage, 1833				
Magelona equilamellae Harmelin 1964		+		
Magelona filiformis Wilson, 1959**		TCh (2)		
Magelona johnstoni Fiege, Licher & Mackie, 2000**		TCh (3)		
Magelona minuta Eliason, 1962**		TCh (36)		
Magelona mirabilis (Johnston, 1865)	+	+		
Poecilochaetidae Hannerz, 1866				
Poecilochaetus serpens Allen, 1905		+		
Spionidae Grube, 1850				
Aonides oxycephala (Sars, 1862)	+			
Aonides paucibranchiata Southern, 1914	+			
Boccardia polybranchia (Haswell, 1885)	+			
Dipolydora armata (Langerhans, 1880)*		M3		
Dipolydora coeca (Örsted, 1843)	+			
Laonice bahusiensis Söderström 1920**	RF (3)			
Laonice norgensis Sikorski, 2003***	RF (3)		CAS	
Malacoceros fuliginosus Claparède, 1868	+			
Paraprionospio coora Wilson, 1990*	Za3		CRYP	
Polydora ciliata (Johnston, 1838)	+			
Polydora hoplura Claparède, 1870	+			
Prionospio caspersi Laubier, 1962**		TCh (21)		
Prionospio ehlersi Fauvel, 1928	+			
Prionospio fallax Söderström, 1920	+			
Prionospio steenstrupi Malmgren, 1867	+			
Pseudopolydora antennata (Claparède, 1869)	+	+		
Pygospio elegans Claparède, 1863		+		
Scolelepis (*Parascolelepis*) *tridentata* (Southern, 1914)**	RF (1)			
Scolelepis (*Scolelepis*) *cantabra* (Rioja, 1918)*	Za3			
Scolelepis (*Scolelepis*) *squamata* (Müller, 1806)	+			
Scolelepis neglecta Surugiu, 2016**	RF(1)			
Spio decoratus Bobretzky, 1870*		M3		
Spio multioculata (Rioja, 1918)	+			
Spiophanes bombyx Claparède, 1870	+			

Continued

Table 1 continued

	TWMED	TCMED	NIS	Notes
TEREBELLIDA *sensu* Rouse & Fauchald, 1997				
Acrocirridae Banse, 1969				
Macrochaeta clavicornis (Sars, 1835)	+			
Ampharetidae Malmgren, 1866				
Amage adspersa (Grube, 1863)	+			
Amage gallasii Marion, 1875	+	+		
Ampharete baltica Eliason, 1962	+			
Amphicteis gunneri (Sars, 1835)	+	+		
Anobothrus gracilis (Malmgren, 1866)	+	+		
Melinnidae Chamberlin, 1919				
Melinna palmata Grube 1870	+	+		
Cirratulidae Carus, 1863				
Aphelochaeta filiformis (Keferstein, 1862)	+	+		
Aphelochaeta marioni (Saint-Joseph, 1894)	+	+		
Aphelochaeta multibranchis (Grube, 1863)*	Za3			
Caulleriella alata (Southern, 1914)	+			
Caulleriella bioculata (Keferstein, 1862)	+			
Caulleriella mediterranea Lezzi, 2017**	RF (5)			
Chaetozone caputesocis (Saint-Joseph, 1894)*	Za1			
Chaetozone cf. *setosa* Malmgren, 1867	+			Sc
Chaetozone gibber Woodham & Chamberlin, 1994*	Za1			
Chaetozone zetlandica McIntosh, 1911*	Za3			N_{13}
Cirratulus cirratus (Müller, 1776)	+	+		Sc
Cirriformia tentaculata (Montagu, 1808)	+	+		
Dodecaceria concharum Örsted, 1843	+			N_{14}
Protocirrineris chrysoderma (Claparède, 1869)	+	+		Sc
Tharyx killariensis (Southern, 1914)*	Za1			
Timarete filigera (Delle Chiaje, 1828)	+	+		
Ctenodrilidae Kennell, 1882				
Ctenodrilus serratus (Schmidt, 1857)	+			
Flabelligeridae de Saint-Joseph, 1894				
Bradabyssa villosa (Rathke, 1843)*	Za1			Sc
Flabelligera diplochaitus (Otto, 1821)	+			
Piromis eruca (Claparède, 1870)	+	+		
Pherusa plumosa (Müller, 1776)	+	+		N_{15}
Stylarioides moniliferus Delle Chiaje, 1841	+	+		N_{16}
Trophoniella radesiensis (Chaibi *et al*., 2019)*	Ch1			
Pectinariidae Quatrefages, 1866				
Amphictene auricoma (Müller, 1776)		+		
Lagis koreni Malmgren, 1866		+		
Petta pusilla Malmgren, 1866*	Za3			
Sternaspidae Carus, 1863				
Sternaspis scutata (Ranzani, 1817)	+	+		
Sternaspis thalassemoides Otto, 1821**	RF (7)			
Terebellidae Malmgren, 1867				
Amaeana trilobata (Sars, 1863)		+		

Continued

Table 1 continued

	TWMED	TCMED	NIS	Notes
Amphitrite cirrata Müller, 1776*	Za3			
Amphitrite rubra (Risso, 1828)	+	+		
Amphitritides gracilis (Grube, 1860)	+	+		
Axionice maculata (Dalyell 1853)	+			
Eupolymnia nebulosa (Montagu, 1818)	+	+		Sc
Eupolymnia nesidensis (Delle Chiaje, 1828)	+	+		
Lanice conchilega (Pallas, 1766)		+		
Neoamphitrite edwardsii (Quatrefages, 1865)**		TCh (2)		
Neoamphitrite figulus (Dalyell, 1853)	+			
Nicolea venustula (Montagu, 1818)	+	+		
Parathelepus cf. collaris (Southern, 1914)*	Za1			
Pista cretacea (Grube, 1860)	+	+		
Pista cristata (Müller, 1776)	+	+		
Polycirrus aurantiacus Grube, 1860	+			
Polycirrus haematodes (Claparède, 1864)*	Za1			N_{17}
Terebella lapidaria Linnaeus, 1767	+	+		
Thelepus cincinnatus (Fabricius, 1780)*	Za3			
Trichobranchiidae Malmgren, 1866				
Terebellides stroemii Sars, 1835	+	+		Sc
POLYCHAETA incertae sedis				
Protodrilidae Czerniavsky, 1881				
Megadrilus purpureus (Schneider, 1868)*	Za1			
Saccocirridae Czerniavsky, 1881				
Saccocirrus papillocercus Bobretzky, 1872*	Za1			
Apharyngtidae Worsaae *et al*., 2021				
Apharyngtus punicus Westheide, 1971	+			
Parergodrilidae Reisinger, 1925				
Stygocapitella subterranea Knöllner, 1934	+			

Taxonomic section and Nomenclature

The most recent phylogenetic classification of Annelida Polychaeta is given in Weigert & Bleidorn (2016). To be compatible and comparable with other checklists from the Mediterranean Sea, we only use phylogenetic studies concerning certain families e.g. the recent work of Norlinder *et al*. (2012) and Gonzalez *et al*. (2018). Generally, we follow the traditional cladistic classification proposed by Rouse & Fauchald (1997) and the phylogenetic tree of Polychaeta modified by Rouse & Pleijel (2001). Families within orders are assigned according to the Linnean rank used by Viéitez *et al*. (2004) and by Castelli *et al*. (2008), except for Melinninae, traditionally a subfamily of Ampharetidae, now becoming Melinnidae (Stiller *et al*., 2020). According to these same authors, Polycirrinae and Thelepodinae stay within the Terebellidae despite the ideas of Nogueira *et al*. (2013). Many authors agree that the Terebellidae genera need more revision (e.g., Jirkov & Leontovich, 2017, Hutchings *et al*., 2017). Awaiting further research on the generic affinities of Terebellidae species, we do not make use of the latest nomenclature proposed by Jirkov & Leontovich (2017).

In addition, despite recent molecular phylogenies which assume that all ctenodrilids are progenetic members of the Cirratulidae [Weidhase *et al*. (2015); Magalhães *et al*. (2016)], we maintain the current attributions to the Cirratulidae until more revision of the family.

Species names were checked using the World Register of Marine Species (WoRMS) list (http://www.marinespecies.org) on Februry 2021. Thus, we also consider some new taxonomic studies dealing with synonymies based on phylogenetic analysis. Genera and species are listed in alphabetic order within families (Table 1). Taxa identified only at the genus level are removed from the checklist whether or not they have ever been differentiated to species level.

Species complex ("Sc" in Table 1) indicates species with unresolved status, which means the species belongs to a complex of cryptic or pseudo-cryptic species: i.e., morphologically similar or very similar but genetically different species, respectively.

Native status

The NIS polychaetes of Tunisian waters are studied here according to their establishment success and classified according to categories (casual, established, questionable or cryptogenic) defined by Zenetos *et al.* (2005, 2011, 2017); these categories have been taken up by many authors such as Faulwetter *et al.* (2017), and Bakalem *et al.* (2020).

The original status of the NIS and any changes, as well as their geographical distribution, are presented and discussed based on the available data on these species in the Mediterranean (Castelli *et al*., 2008; Çinar *et al*., 2014a, b; Mikac 2015; Zenetos *et al*., 2005, 2011, 2017; Faulwetter *et al*., 2017; López & Richter, 2017; Langeneck *et al*., 2020; Zenetos & Galanidi, 2020; Zenetos *et al*., 2022).

Other necessary information to read the final checklist

Table 1 presents the first occurrence of species in Tunisian waters, but only for non-native species and native species newly reported after the last inventory by Ayari *et al*. (2009). The presence of other species is indicated by "+".

For native species, the section on "Additional notes to Table 1" contains further taxonomic and biogeographic information when this is necessary.

Results

In total, 52 families containing 390 species were counted, of which 49 species belong to a complex of cryptic or pseudo-cryptic species; this means it is not known whether specimens belong to the concerned species *sensu stricto* or to a different species of the same genus.

A total of 29 new species are added based on the present study, including 23 species reported from the tidal channels of the Gulf of Gabès from March 2016 to January 2017 and six species newly recorded after examination of polychaete species lodged in the collections of the INSTM. Revision of the available data from research conducted over the past decade allowed us to list 92 new species. Among them, only 21 were reported from the

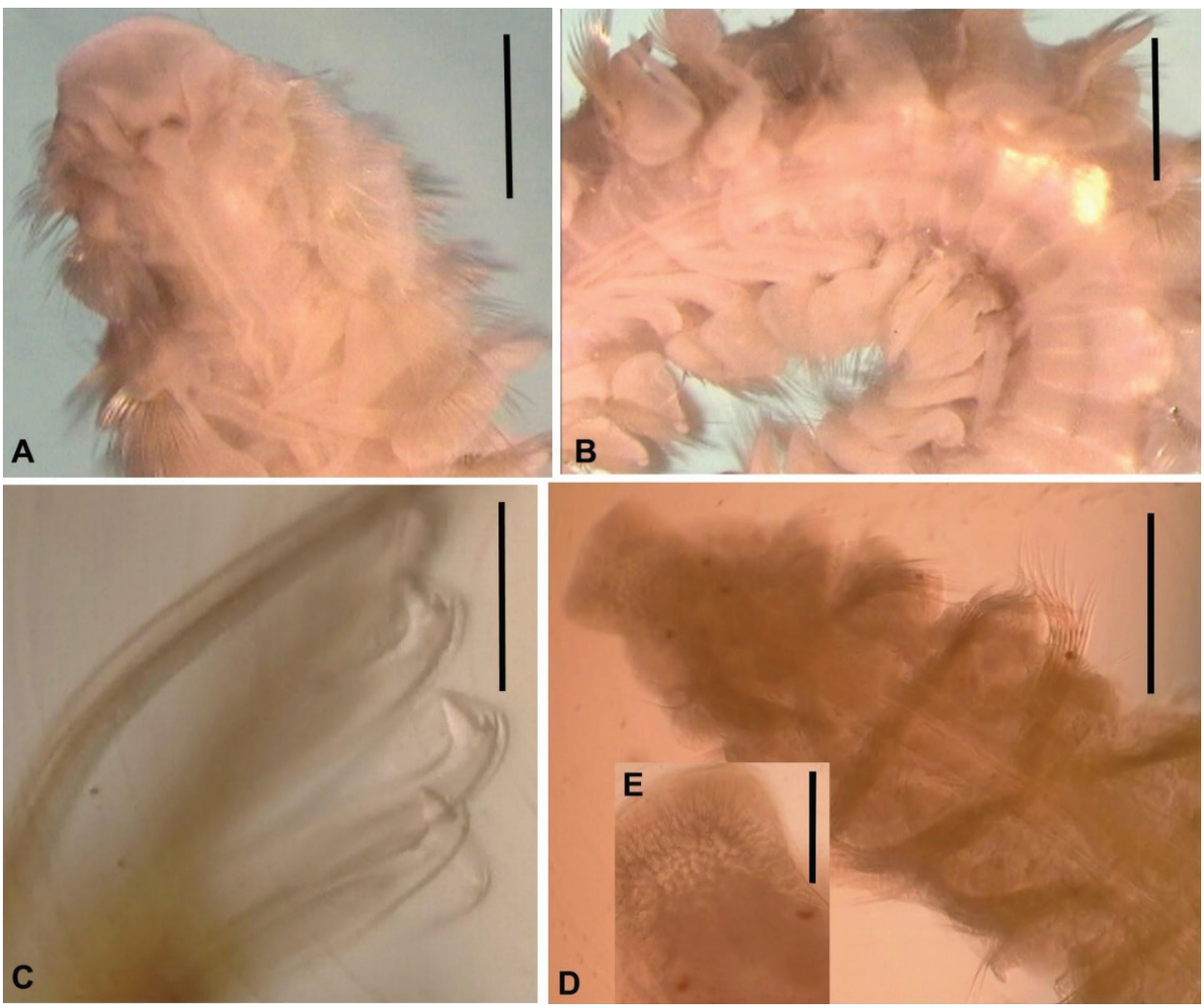

Fig. 2: *Laonice bahusiensis* Söderström, 1920: A. Anterior end, dorsal view. B. Chaetigers anterior and posterior to dorsal sense organ. C. Hooded hooks, chaetiger 38. *Laonice norgensis* Sikorski, 2003: D. Anterior end, dorsal view. E. Posterior crescent-shaped eyes. Scales (mm): A, D = 0.25, B = 0.3, C, E = 0.075.

southern part of the region (CMED). In total, 37 species previously recorded are excluded from the final list of Tunisian polychaetes because they are in fact absent from the area but were misidentified as valid present species. In addition, to be compatible with other checklists from the Mediterranean Sea, taxa identified to genus level are also removed. 17 NIS (14 established, 1 casual and 2 cryptogenic) are inventoried here and their establishment status is discussed. The polychaete diversity comprises 311 species for the Tunisian West Mediterranean (TWMED) and 215 species for the Tunisian Central Mediterranean (TCMED). Serpulidae (41 species) and Syllidae (36 species) are the most diverse polychaete families, followed by Spionidae (24 species) and Sabellidae (20 species).

Polychaete species newly reported from the tidal channels of the Gulf of Gabès

A total of 116 polychaetes species were collected from the tidal channels of the Gulf of Gabès, including 23 species new for Tunisian waters. Among them, the endemic species *Ophelia amoureuxi* Bellan & Costa, 1987 and the NIS *Diopatra marocensis* Paxton, Fadlaoui & Lechapt, 1995 are newly recorded for the Central Mediterranean Sea.

Diopatra marocensis is herein reported from tidal channels around the Gulf of Gabès. It was recorded throughout the sampling period (2016 to 2017) between 3 and 15 m depth and in sediments varying from silty to gravely sand. Separately, a single individual of *D. marocensis* was previously reported in 2004 from the Gulf of Tunis (Ayari *et al*., 2009). Çinar *et al*. (2014b) described specimens from the Aegean and Levantine Seas. The species was recently described from the Atlantic coast of Morocco and then reported from the North Atlantic coast (Arias *et al*., 2010; Rodrigues *et al*., 2009). It is difficult to assess whether its distribution represents a natural expansion range or whether it might have been introduced. Thus, we assign a cryptogenic status as classified by López & Richter (2017) until genetic analyses and more surveys are undertaken, despite the fact that Çinar *et al*. 2021 & Zenetos *et al*., 2022 still consider *D. marocensis* as an alien established species.

New species reported from the Polychaete collection lodged at the **INSTM**

Specimens of *Laonice cirrata* (Sars, 1851) (deposit number: INSTM 2006.10.31.02) recorded by Zaâbi *et al*. (2012) from Cap Bon Peninsula and occurring in silty to sandy sediments at depths ranging from 5 to 61 m, actually belong to two other species of the genus.

1- *Laonice bahusiensis* (two incomplete individuals) is the closest species to *L. cirrata*, differing mainly in having hooded hooks with two side-by-side apical teeth visible in lateral view under a light microscope (Fig. 2. C). The prostomium is truncated to slightly incurved (Fig. 2. A). Following the study recently carried out by Sikorski *et al*. (2021) on the *L. bahusiensis* complex, which reveals the presence of three other new species in North European waters, a reexamination of our material confirms the identity of our specimen as *L. bahusiensis*. Branchiae present on chaetigers posterior to nuchal organs until chaetiger 22 (Fig. 2. B) are up to twice as long as notopodial postchaetal lamellae (Fig. 2A, B). The specimen shown here also reaches a width of 1.4 mm as mentioned in the key for the *L. bahusiensis* species complex (Sikorski *et al*., 2021). *L. bahusiensis* was originally described from the Atlantic Ocean and subsequently from the Western (Sikorski, 2003) and the Eastern Mediterranean (Dagli *et al*., 2011). Its depth of occurrence ranges from 10 to 200 m in the Northeastern Atlantic Ocean and Western Mediterranean Sea (Sikorski, 2003) and from 10 to 71 m in the Aegean Sea (Dagli *et al*., 2011). *L. bahusiensis* could be underreported in the studied area as well as from Greece (Faulwetter *et al*. (2017), since it may have been confused in previous studies with *Laonice cirrata*.

2 - *Laonice norgensis* Sikorski, 2003. One complete individual of 68 chaetigers, up to 0.3 mm wide and 11 mm long. It has a bell-shaped prostomium anteriorly truncated and not fused with the peristomium at the anterior margin (Fig. 2D). No wings rising above prostomium. More than two rows of capillaries in the parapodia of anterior chaetigers are present giving the appearance of a tuft of capillaries (Fig. 2D).It has two pairs of brown eyes, anterior pair point being shaped in the middle of the prostomium and a posterior pair of crescent-shaped eyes (Fig. 2E), as described by Meißner *et al.* (2014). For more morphological details of the species, see Sikorski (2003) and Meibner *et al*. (2014). *L. norgensis* is known from its type locality in the North Sea (Sikorski, 2003), but was subsequently recorded and re-described from the Eastern Mediterranean (Dagli *et al*., 2011). This species is new to the Western Mediterranean; its bathymetric distribution ranges from 106 to 300 m in the North Sea and from 109 to 113 m in the Aegean Sea, but decreases to 61 m at Cap Bon Peninsula. *L. norgensis* was described by Sikorski (2003) from samples (Arctic and North Atlantic) collected from 1998 to 1999, but has only been recorded once - far from its type locality - during sampling carried out in 2000 in the Aegean Sea (Dagli *et al*., 2011). The status of *Laonice norgensis* has been confirmed as casual (Zenetos *et al*., 2022).

Sternaspis thalassemoides Otto, 1821

Based on the recent revision of the genus *Sternaspis* Otto, 1821 (Sendall & Salazar-Vallejo, 2013), we re-examined four individuals identified as *Sternaspis scutata* Ranzani, 1817 by Ayari (2010). Two of these species, recorded in muddy sediments of the Gulf of Tunis at water depths of 57 m and 100 m, actually belong to *Sternaspis thalassemoides* Otto, 1821. The five individuals of *Sternaspis* (deposit number: INSTM 2006.10.34.01) report-

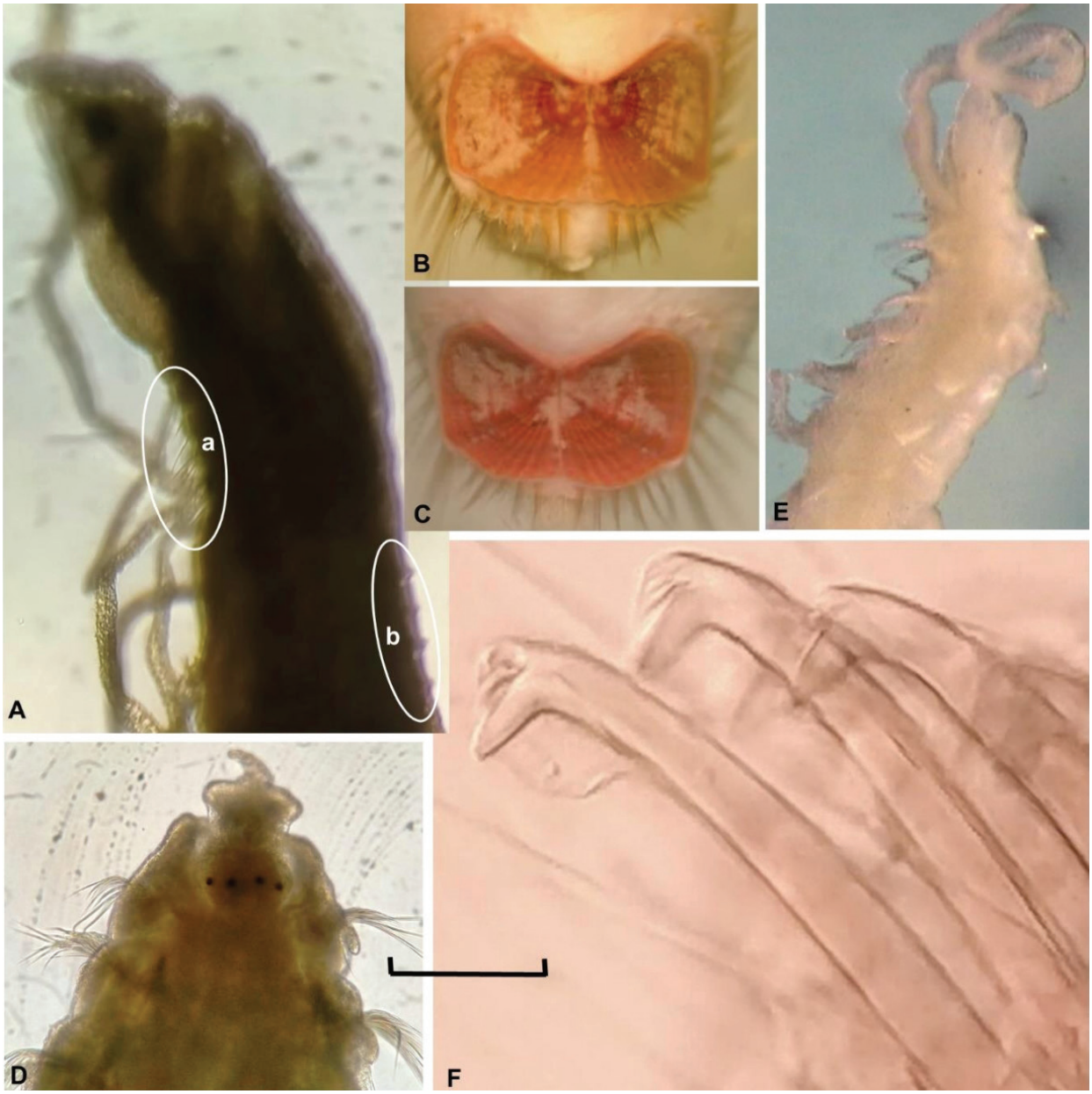

Fig. 3: *Caulleriella mediterranea* Lezzi, 2017: A. Anterior end, lateral view; (a) capillaries in anterior notopodial chaetigers; (b) anterior neuropodia with hooks. *Sternaspis thalassemoides* Otto, 1821: B. Ventro-caudal shield. *Sternaspis scutata* Ranzani, 1817: C. Ventro-caudal shield. *Scolelepis neglecta* Surugiu, 2016: D Anterior dorsal end. *Scolelepis* (*Parascolelepis*) *tridentata* (Southern, 1914): E. Anterior lateral view; F. Tridentate hooks of middle chaetiger. Scales (mm): A = 0.25, B = 2, C =1.6, D = 0.25, E = 0.4, F = 0.021.

ed at depth range of 25-66 m from the Cap Bon Peninsula (Zaâbi *et al*., 2012) were also identified wrongly as *Sternaspis scutata*. Other records of *Sternaspis scutata* from Tunisian waters could be attributed to either of the two species, which differ clearly by their shield features especially those of the fan (Fig. 3B, C). See Sendall & Salazar-Vallejo (2013) for more details. *Sternaspis thalassemoides*, originally described from the Tyrrhenian Sea (Naples), is distributed in the Mediterranean Sea and the Northeastern Atlantic Ocean (Sendall & Salazar-Vallejo, 2013).

Caulleriella mediterranea Lezzi, 2017

This species was recently described on the Northwest Italian coast in fine sand at around 8 m depth (Lezzi, 2017). This latter author pointed out that most of the identified *Caulleriella alata* (Southern, 1914) from fine sand at other Mediterranean localities such as Tunisia (Zaâbi *et al*., 2012) may be referred to *C. mediterranea*. A re-examination of Tunisian specimens collected by Zaâbi *et al*. (2012) (deposit number: INSTM 2006.10.32.02) and referred to *C. alata* reveals the existence of *Caulleriella mediterranea* Lezzi, 2017. Samples were collected during 2006 from Cap Bon Peninsula in fine and coarse sand between 2 and 45 m. *C. mediterranea* and may have been underreported and confused with the congeneric *C. alata*

because both are characterized by the presence of winged hooded hooks. However, *C. mediterranea* is easily distinguished by its weakly biannulate peristomium and the absence of capillaries in anterior neuropodial chaetigers (Fig. 3A). The appearance of notopodial hooks from 10° chaetiger is the mean difference between *C. mediterranea* and the other *Caulleriella* species with winged hooks from the Atlantic and Mediterranean region; *C. acicula* Day, 1961 (Lezzi, 2017). This probably represents the first report of *C. mediterranea* after its original description.

Scolelepis neglecta Surugiu, 2016 was described recently after reexamination of Mediterranean specimens previously confused with *Scolelepis squamata* (O.F. Müller, 1806) and *Scolelepis cantabra* (Rioja, 1918) (Surugiu 2016). Based on this latter study, we carried out a re-examination that confirms the identification of *Scolelepis cantabra* specimens recorded from Cap Bon Peninsula by Zaâbi *et al*. (2012) and lodged at INSTM collection (deposit number: INSTM 2006. 10. 31. 09). But, for specimens labelled *Scolelepis cantabra* without a deposit number, three species of the genus can be identified:

1) *Scolelepis* (*Scolelepis*) *squamata* (Müller, 1806), already reported from Tunisian waters and elsewhere in the Mediterranean;
2) *Scolelepis* (*Parascolelepis*) *tridentata* (Southern, 1914), one incomplete individual clearly recognized by neuropodial hooded hooks with three very sharp accessory teeth (Fig. 3E, F); and
3) *Scolelepis neglecta* Surugiu, 2016, one incomplete individual easily distinguished from *Scolelepis cantabra* by a distinct groove between peristomium and prostomium forming dorso-lateral developed wings. The anterior shape of the prostomium is trilobate with anterolateral lobes rounded and median lobe pointed; 4 dark eyes in a trapezoidal arrangement as re-described recently by Surugiu *et al*. (2020) (Fig 3D).

NIS of polychaetes reported by Ayari et al. *(2009) and Zaâbi* et al. (2012)

Six species previously stated as NIS have been reported by Ayari *et al*. (2009) in Tunisian coastal waters: *Diopatra marocensis* Paxton, Fadlaoui & Lechapt, 1995, *Ficopomatus enigmaticus* (Fauvel 1923), *Hydroides dirampha* Mörch 1863, *Hydroides elegans* (Haswell 1883), *Diopatra hupferiana monroi* Day 1957 and *Notomastus aberans* Day 1963. In addition, four species previously stated as NIS were reported from the Cap Bon Peninsula by Zaâbi *et al*. (2012): *Metasychis gotoi* (Izuka 1902), *Paraprionospio coora* Wilson, 1990, *Isolda pulchella* Müller in Grube 1858 and *Pista unibranchia* Day, 1963.

The establishment status of these NIS is discussed below in the light of recent molecular and morphological studies, as well as their distribution ranges.

Hydroides dianthus (Verrill 1873), also listed in the inventory of Ayari *et al*. (2009), was considered firstly as a cryptogenic species and subsequently as an established NIS in the Mediterranean Sea (Zenetos *et al*., 2005; Zaâbi *et al*., 2012). The molecular study of Sun *et al.* (2017) revealed the presence of putative cryptic species and showed that *H. dianthus* has a high genetic diversity in the Mediterranean; thus, *Hydroides dianthus* is no longer considered as an alien species (Zenetos *et al*., 2017; Langeneck *et al*., 2020; Zenetos & Galanidi 2020).

Ficopomatus enigmaticus (Fauvel 1923) is an established species that is well known as invasive. Seurat (1927), Vuillemin (1965), and Zibrowius (1978) already found this species along the Tunisian coasts. Recently, it was also found in the South Kerkennah harbour (Aloui-Bejaoui & Afli, 2012) and near the Kneiss Islands (Mosbahi *et al*., 2017). It was considered by Faulwetter *et al*. (2017) to be a complex species; the molecular analyses of Styan *et al*., (2017) have revealed three putative cryptic species of *Ficopomatus enigmaticus* from Australia. Grosse *et al*. (2021) also detected three molecular species of the *F. enigmaticus* species complex in Majorca.

Hydroides dirampha Mörch 1863 was originally described as occurring in the Caribbean, but has since established itself throughout the Mediterranean Sea (Zibrowius, 1973). However, this species has been reported only once in Tunisia at the level of the Bizerte Channel (Zibrowius, 1978) and has since been collected recently in Greece (Faulwetter *et al*., 2017), Turkey (Çinar *et al*., 2014a) and Algeria (Bakalem *et al*., 2020). It was considered by Zenetos (2010) as an established NIS in the WMED and the CMED.

Hydroides elegans (Haswell 1883) was considered as a cryptogenic species whose introduction occurred many years ago (Zenetos *et al*., 2005). Its presence in Tunisia also dates back to reported findings along the northern coast between 1978 and 2004 (Ayari *et al*., 2009), and then subsequent reports from the Kneiss Islands by Mosbahi *et al*. (2017). This species was also collected in Turkey (Çinar *et al*., 2014a), Greece (Faulwetter *et al*., 2017) and Algeria (Bakalem *et al*., 2020). Thus, it is well established and widespread over the whole Mediterranean Sea (Zenetos, 2010). Grosse *et al*., (2021) detected two species of the *H. elegans* species complex.

Diopatra hupferiana monroi Day, 1957 has only been collected in the Gulf of Tunis (Cantone *et al*., 1978). It was considered as a casual NIS in CMED according to Zenetos *et al.* (2010) and Servello *et al*. (2019) then has been recently excluded (Zenetos *et al*., 2022).

Notomastus aberans Day, 1963 was originally distributed along the coasts of East Africa and in the Red Sea, before becoming widespread throughout the Mediterranean Sea and being considered as an established NIS (Zenetos *et al.*, 2010). The only Tunisian record of the species is due to Gaillande (1970 a, b) in the Gulf of Gabès.

Metasychis gotoi (Izuka, 1902) had an Indo-Pacific origin; it was considered to be an established NIS since reported findings are spread over different times and regions. Found earlier in the northern Adriatic (Fauvel, 1940), it has since been reported from the same area (Alefi *et al*., 2003) and throughout the Mediterranean: Greece (Simboura & Zenetos, 2005), Italy (Castelli *et al*., 2008), Turkey (Çinar *et al*., 2014a) and Algeria (Bakalem *et*

al., 2020). *M. gotoi* was classified recently by Zenetos & Galanidi (2020) as "data deficient", thus replacing the term "questionable" proposed by Tsiamis *et al*. (2019).

Paraprionospio coora Wilson, 1990 was considered as a cryptogenic species, being originally described from the Pacific Ocean and Southern Australia (Faulwetter *et al*., 2017). It has been reported more recently in Greece (Simboura *et al*., 2010; Katsiaras & Simboura, 2015), Turkey (Yokoyama *et al*., 2010) and the Adriatic Sea (Mikac, 2015). It was reported by Zaâbi *et al*., (2012) from the Cap Bon Peninsula in the Western Mediterranean Sea.

Isolda pulchella Müller in Grube, 1858 is an Indo-Pacific species that has been reported once in the CMED on the south-eastern coast of Sicily (Cantone, 2001). Despite a second record of the same species in the WMED, it was considered as questionable species by Langeneck *et al*. (2020) then by Zenetos *et al*., 2022.

Pista unibranchia Day, 1963 was reported in Tunisian waters by Zaâbi *et al*. (2012); although originally a species from South African waters, it is also known to be present in the Eastern Region of the Mediterranean Sea (Occhipinti-Ambrogi *et al*., 2011). Zenetos *et al.* (2005) classified it as an established NIS. It was reported in Italy by Cantone (1981) as a new species in the Mediterranean Sea, but has subsequently been reported in other Mediterranean regions especially in the Aegean and Levantine Seas (Çinar *et al*., 2014a). Examination of specimens of *P. unibranchia* from the National Museum of Natural History in Madrid led Jirkov & Leontovich (2017) to conclude that this species was absent from the North Sea. Mikac & Hutchings (2017) have proposed a revision of the genus *Pista*, which would result in the transfer of many species of the genus *Pista*, especially *P. unibranchia*, to the genus *Pistella* Hartmann-Schröder, 1996. Subsequently, Langeneck *et al.* (2020) doubted the presence of *P. unibranchia* as a non-indigenous species. Recently, Lavesque *et al*. (2021) described a new species *P. labruneae* and stressed that it has probably been confused and misidentified in the Mediterranean Sea as *P. unibranchia*. These latter authors show that this species is characterized by the absence of long-handled uncini on segment number five and it should be transferred to the genus *Pistella* as already proposed by Mikac & Hutchings (2017). Thus, *P. unibranchia* is herein removed from the final list.

NIS of polychaetes reported by Khedhri et al. *(2014, 2017a, b)*

Naineris setosa (Verrill, 1900) was originally found in Bermuda and is widely distributed in the North-Western Atlantic. *N. setosa* had been frequently found in the channel of the Agroittica Aquaculture facility at Brindisi (Italy) (Blake & Giangrande, 2011). This species has been excluded from the catalogue of NIS (Zenetos *et al*., 2012) since worms are no longer present in the area. *N. setosa* was found for the second time in the Mediterranean Sea in the Boughrara Lagoon, where fifty specimens were collected on a soft substratum (Khedhri *et al*., 2014). The description of Tunisian specimens had led to its reinstatement in the catalogue of alien species with an established status in the Central Mediterranean. This has been confirmed by the report and description of *N. setosa* from a lagoon located on the southern coast of Sardinia (Tyrrhenian Sea) (Atzori *et al*., 2016).

Acromegalomma claparedei (Gravier, 1906) is a Lessepsian migrant originally found in the Red Sea, but other specimens from the Adriatic Sea have now been re-described by Giangrande & Licciano (2008). It was recorded from South Tunisia in the Boughrara Lagoon as *Megalomma claparedei* (Gravier, 1906) (Khedhri *et al.*, 2017a). *A. claparedei* is omitted in the latest review of marine alien species of Italy (Servello *et al*., 2019) despite it was reported from Faro Lake (Rizzo *et al*., 2015). Zenetos *et al*. (2022) changed its status from casual to established.

Branchiomma bairdi McIntosh, 1885 was collected (43 individuals) from four different sites around the Boughrara Lagoon by Khedhri *et al*. (2017b). Originally, it was found in the Caribbean Sea, but has since spread its distribution to Australia and the Pacific Ocean, as well as the Canaries and Madeira (North Atlantic) (Khedhri *et al.*, 2017b). In the Mediterranean Sea, it has been described from the Italian coasts (Giangrande *et al*., 2012) and Malta (Arias *et al*., 2013). Khedhri *et al*. (2017b) pointed out the morphological resemblance between *B. bairdi* and another alien species: *B. boholense* (Grube, 1878). Keppel *et al*. (2015) discussed this similarity and showed that the main morphological difference is the shape of macrostyle. In addition to this feature, Del Pasqua *et al*. (2018), suggested that the development of microstyles and radiolar eyes, coupled with body size, are the main discrete morphological differences. *B. bairdi* has a high invasive capacity, which is not only due to the pattern of introduction but also to its reproductive features (Lezzi *et al*., 2016). For these reasons, it is considered as an invasive NIS.

Additional non-indigenous species

Desdemona ornata Banse, 1957 was considered by Zenetos *et al*. (2010) as an established species in the WMED, the Adriatic and in the EMED. It has been recorded in the Kneiss Islands by Mosbahi *et al*. (2017) then by Boudaya *et al*., 2019. Zenetos & Galanidi (2020) confirm its expansion into the CMED and it was classified as established (Zenetos *et al*., 2022).

Iphione muricata (Savigny in Lamark, 1818) is an established NIS (Zenetos & Galanidi, 2020; Zenetos *et al*., 2022). Distributed from the Suez Canal and the Red Sea to Japan, *I. muricata* is considered a Lessepsian migrant by Goren *et al*. (2017) who described it morphologically. Its finding in Skhira Bay by Boudaya *et al*. (2019) demonstrates that it is spreading rapidly from the Eastern to the Central Mediterranean.

Ounifi-Ben Amor *et al*. (2015) confirmed the establishment of five species on the Tunisian coasts: *Leodice antennata* Savigny in Lamarck, 1818, *Lysidice collaris* Grube, 1870 and *Syllis hyllebergi* (Licher, 1999) in the

Gulf of Gabès (CMED); *Hydroides operculata* (Treadwell, 1929) and *Neopseudocapitella brasiliensis* Rullier & Amoureux, 1979 in the Gulf of Tunis. The latter species is removed from the final list given it was classified as data deficient (Zenetos & Galanidi, 2020).

In October 2020, the non-indigenous polychaete species *Branchiomma luctuosum* (Grube, 1870) was reported from Bizerte Lagoon. Since that date, many other prospections have been conducted which prove its establishment in the area (Crocetta *et al*., 2021). *B. luctuosum* represents a possible Lessepsian migrant from the Red Sea (Licciano & Giangrande, 2008). It has been reported in many localities in the Mediterranean Sea (Mabrouki *et al*., 2021) and has been missed in the list by Zenetos *et al*., 2022.

Additional notes to Table 1

N_1: *Heteroclymene robusta* Arwidsson, 1906 is a North-Atlantic species reported along the Algerian coast (Bakalem *et al*., 2020) and in the Eastern Mediterranean (Faulwetter *et al*., 2017).

N_2: *Microclymene tricirrata* Arwidsson, 1906 has also been found along the Algerian coast (Bakalem *et al*., 2020), on the Atlantic and Mediterranean coasts of France (Bellan & Reyss, 1967) and the Mediterranean coasts of Spain (Campoy, 1982; Viéitez *et al*., 2004).

N_3: *Aricidea assimilis* (Tebble, 1959) is the most morphologically similar species to the newly described *A. pseudoassimilis* (Erdoğan-Dereli & Çinar, 2020), and both are distributed in the same type of habitats. Thus, *A. pseudoassimilis* could be underreported in the Mediterranean in the same way as *A. assimilis*.

N_4: Erdogan-Dereli & Çinar (2019) compared the morphology of *Paradoneis armata* from the Sea of Marmara with specimens of the holotype (Atlantic) and paratypes, showing that the descriptions are compliant with a single species.

N_5: Erdogan-Dereli & Çinar (2019) studied the genus *Paradoneis* from the Sea of Marmara and discussed its morphological resemblances with *Paradoneis lyra* (Southern, 1914) and *Paradoneis longifurcata* Erdoğan-Dereli & Çinar, 2019. These authors showed that the morphology of *P. lyra* coincides to some extent with *P. longifurcata*. The number of prebranchial chaetigers is always three in both species and the number of branchial pairs is not very different (7 to 11 pairs in *P. longifurcata* and 8 to 14 pairs *in P. lyra*). Thus, *P. longifurcata* could be overlooked and specimens of *P. lyra* from the Mediterranean might contain *P. longifurcata*.

N_6: *Eulalia viridis* reported from Tunisian coasts (Vuillemin, 1965; Zghal & Ben Amor, 1980; Zaâbi *et al*., 2012) could probably correspond to *Eulalia clavigera* (Audouin & Milne Edwards, 1833) (Bonse *et al*., 1996).

N_7: *Harmothoe impar* (Johnston, 1839), reported only in Tunisian waters by Bellan (1961), could belong to either *Harmothoe pagenstecheri* Michaelsen, 1896 or some other species [Barnich & Fiege (2000)].

N_8: Based on morphological and molecular criteria, *Pholoe inornata* and all species previously assigned to Pholoidae were placed within the Sigalionidae by Gonzalez *et al*. (2018).

N_9: All records of *Megalomma vesiculosum* (Montagu, 1815) from Tunisian waters should be assigned to *Acromegalomma lanigerum* (Grube, 1846). In fact, all specimens recorded in the Mediterranean Sea belong to *Megalomma lanigera* (Grube, 1846) (Giangrande & Licciano, 2008), which was later synonymized to *Acromegalomma lanigerum* (Grube, 1846) (Gil & Nishi, 2017).

N_{10}: Mediterranean specimens of *Chone filicaudata* Southern, 1914 likely belong to *Dialychone usticensis* (Giangrande *et al*., 2006).

N_{11}: All Mediterranean records of *Prionospio malmgreni* should be assigned to *Prionospio fallax* Söderström, 1920 (Faulwetter *et al*., 2017).

N_{12}: According to Surugiu (2016), Mediterranean records of *Scolelepis squamata* (Müller, 1806) could also be assigned to *Scolelepis neglecta* Surugiu, 2016.

N_{13}: According to Chambers *et al*. (2011), the reports of *Chaetozone zetlandica* McIntosh, 1911 in the Mediterranean Sea are doubtful.

N_{14}: *Dodecaceria concharum* Örsted, 1843 is a Northern Atlantic species whose taxonomic status in the Mediterranean Sea is yet unresolved (Faulwetter *et al*., 2017). The indication of its occurrence by Zghal & Azzouna (1984) is probably due to misidentification.

N_{15}: *Pherusa plumosa* (Müller, 1776) was absent from the Mediterranean Sea, and all previous records correspond certainly to *Pherusa obscura* Quatrefages, 1849 or *Pherusa incrustans* (Salazar-Vallejo, 2014).

N_{16}: For Salazar-Vallejo (2011), the records of *Stylarioides monilifer* Delle Chiaje, 1841 in the Mediterranean Sea correspond to specimens of *Stylarioides hirsutus* Lo Bianco, 1893.

N_{17}: Glasby & Hutchings (2014) suggest that the specimens attributed to *Polycirrus haematodes* (Claparède, 1864) could belong to other species of the genus because the original description is insufficient to differentiate the specimens.

Species previously reported from Tunisia and deleted from the present inventory

In addition to *Diopatra hupferiana monroi*, *Isolda pulchella*, *Metasychis gotoi*, *Pista unibranchia* and *Neopseudocapitella brasiliensis*, some other species whether indigenous or non-indigenous previously reported as present in various studies, are in fact absent from Tunisia and should be deleted from the present inventory (Table 1). Their taxonomic status is unresolved (questionable species), being either wrongly identified or not described from Mediterranean specimens (doubtful species). Species that have been reported so far only once from Tunisian waters are not deleted from the inventory when their type locality is Mediterranean.

We give a list below of the studies previously reporting species from Tunisian waters that are now deleted from the present inventory:

I. Ayari & Afli, 2003: *Potamilla torelli* (Malmgren, 1866), *Paradiopatra quadricuspis* (M. Sars in G.O.Sars, 1872), *Phyllodoce macrophthalma* Schmarda, 1861), *Eunice norvegica* (Linnaeus, 1767);
II. Bellan, 1961: *Eunice oerstedi* Stimpson, 1854;
III. Boudaya *et al*. (2019): *Eunice floridana* (Pourtalès, 1869);
IV. Cantone *et al*. (1978): *Hyboscolex longiseta* Schmarda 186, *Spio filicornis* (Müller, 1776); *Pholoe minuta* (Fabricius, 1780);
V. Gaillande, 1970a : *Laonice cirrata* (Sars, 1851);
VI. Khedhri *et al*. (2016a, b, 2017a): *Euclymene droebachiensis* (Sars, 1872), *Lumbrineris japonica* (Marenzeller 1879 and *Travisia forbesii* Johnston, 1840);
VII. Mosbahi *et al*. (2015a, 2017): *Notomastus abyssalis* Fauchald, 1972, *Eunice aphroditois* (Pallas, 1788), *Syllis* (*Typosyllis*) *punctulata* Haswell 1920, *Stylomma palmatum* (Quatrefages 1866);
VIII. Vuillemin, 1965: *Circeis spirillum* (Linnaeus, 1758);
IX. Zaâbi *et al*. (2009, 2010, 2012): *Ampharete acutifrons* Malmgren, 1865, *Aricidea* (*Acmira*) *lopezi* Berkeley & Berkely, 1956, *Eunice tubifex* Crossland, 1904, *Bhawania goodei* Webster, 1884, *Glycera capitata* Örsted, 1843, *Harmothoe johnstoni* (McIntosh, 1876), *Lugia pterophora* (Ehlers, 1864), *Magelona rosea* Moore, 1907, *Therochaeta flabellata* (Sars in Sars 1872), *Protodorvillea atlantica* (McIntosh, 1885), *Pista cf. brevibranchiata* Moore, 1923 and *Prionospio cirrifera* Wirén, 1883;
X. Zghal & Ben Amor (1980): *Pseudopotamilla reniformis* Malmgren, 1867; *Syllis cornuta* Rathke, 1843.

Circeis spirillum (Linnaeus, 1758) is known mainly from the Arctic Ocean (*Rzhavsky et al*., 2018), the North East Atlantic, California and the Gulf of Mexico (Knight-Jones & Knight-Jones 1977). It has probably never been found in the Mediterranean. Thus, the single report of *C. spirillum* from the Lake of Tunis is doubtful since this specimen was identified by Vuillemin (1965) as *Spirorbis spirillum* (Linnaeus, 1758), which is a superseded synonym of *C. spirillum*.

Ampharete acutifrons (Grube, 1860) could be confused with *Ampharete lindstroemi* Hessle 1917 (Faulwetter *et al*., 2017).

Hyboscolex longiseta Schmarda, 1861, whose presence is considered as questionable (Simboura *et al*., 2010; Faulwetter *et al*., 2017).

Eunice tubifex Crossland, 1904 reported in the tropical zones of India and the Western Pacific but considered a questionable NIS in the Mediterranean Sea (Zenetos *et al*., 2010).

Eunice floridana (Pourtalès, 1869), known from the Greater Caribbean (Fauchald *et al*., 2009), is a NIS considered as having questionable status in the Mediterranean (Zenetos *et al*., 2010; Faulwetter *et al*., 2017). The presence of *E. floridana* in Tunisia remains to be confirmed, especially since no Mediterranean specimen has been described so far.

Bhawania goodei Webster, 1884 was described from specimens collected in Bermuda and South Africa, and showed a wide distribution in the Atlantic, Indian and Pacific oceans before being described in South Africa by Day (1967). *B. goodei* was found by Bitar & Kouli-Bitar (2001) on the Lebanon coast but is excluded from the NIS list for the Mediterranean Sea (Zenetos, 2005).

Glycera capitata Örsted, 1843 has a distribution limited to the Arctic, Antarctic, Pacific and South West Atlantic oceans (Böggemann, 2002). *G. capitata* is morphologically similar to *Glycera lapidum* Quatrefages, 1866 and has been reported by Castelli *et al*. (2008) and Çinar *et al*. (2014a) in the Mediterranean Sea. However, its presence remains doubtful until a description of a Mediterranean specimen is forthcoming.

Magelona rosea Moore, 1907 is reported from Italy (Castelli *et al*., 2008) and Turkey (Çinar *et al*., 2014a); this species is not present on European coasts, and Mediterranean specimens of this species should be assigned to *Magelona filiformis* (Fiege *et al*., 2000).

Therochaeta flabellata (Sars *in* Sars 1872) is restricted to the North-East Atlantic and Arctic waters (Salazar-Vallejo, 2013).

Protodorvillea atlantica (McIntosh, 1885), originally described from deep Atlantic waters off the Azores, has been reported twice from the Mediterranean: Algeria (Bakalem *et al*., 2020) and the Adriatic Sea (Mikac, 2015) but not figured.

Euclymene droebachiensis (Sars, 1872), originating from the North Atlantic, was reported recently in Boughrara Lagoon (Tunisia) (Khedhri *et al*., 2016a, b, 2017a). This represents a single non-figured report of its presence in the Mediterranean Sea.

Travisia forbesii (Johnston, 1840) was originally found in British waters and in other coastal areas bordering the North Atlantic Ocean including Canada and Spain. The species was reported but non-figured by Khedhri *et al*. (2017a) in the Boughrara Lagoon. Thus, this single report from the Central Mediterranean is considered doubtful even if the species was reported by Bakalem *et al*., 2020.

Lumbrineris japonica (Marenzeller, 1879) has an Indo-Pacific origin and has recently been found in the Persian Gulf and the Red Sea (Wehe & Fiege, 2002).

Notomastus abyssalis Fauchald, 1972 has been reported from deep waters in the Gulf of California (Fauchald, 1972) and the Gulf of Mexico (García-Garza & León-González, 2015); its presence in the Mediterranean Sea (Mosbahi *et al*., 2015a) is doubtful, more precisely in shallow waters off South Tunisia.

Eunice aphroditois (Pallas, 1788) has a questionable status in the Mediterranean Sea (Faulwetter *et al*., 2017). Some Mediterranean specimens of *Eunice aphroditois* have been identified as *Eunice roussaei* Quatrefages, 1866 by Zanol & Bettoso (2006); Çinar *et al*. (2014a) considered that the reports of *Eunice aphroditois* correspond in fact to those of *Eunice roussaei*.

The presence of both Pacific species *Syllis* (*Typosyllis*) *punctulata* Haswell, 1920 and *Stylomma palmatum* (Quatrefages, 1866) in Tunisian waters is yet to be con-

firmed

In the Mediterranean Sea, *Syllis cornuta* Rathke, 1843 has a questionable status, and the presence of *Prionospio cirrifera* Wirén, 1883 and *Paradiopatra quadricuspis* (M. Sars in G.O. Sars, 1872) is doubtful (Faulwetter *et al*., 2017).

Records of *Potamilla torelli* from the Mediterranean are doubtful and specimens belong probably to *Potamilla saxicola* (Malmgren, 1866) (Faulwetter *et al*., 2017).

Meißner *et al*. (2011) limited the distribution of *Spio filicornis* (Müller, 1776) to Greenland; its presence in the Mediterranean is questioned (Simboura, 1996; Faulwetter *et al*., 2017).

Using Mar Bef Data System, Ayari *et al*. (2009) synonymized *Phyllodoce macrophthalma* Schmarda, 1861 with *Phyllodoce schmardaei* Day, 1963. Both of them are wrongly applied names (Pleijel, 1991).

Eunice oerstedi Stimpson, 1854 has not been found in six decades, it was reported from Tunisia by Bellan, 1961 and Vuillemin, 1965. Given that European specimens could belong to *Eunice dubitata* Fauchald, 1974 (Wisnens, 1989), Ayari *et al*. (2009) placed them wrongly as synonyms despite the status of *E. oerstedi* being considered indeterminable by Fauchald (1992) and was not listed in the Eunicidae key by Carrera-Parra & Salazar-Vallejo (1998).

Pseudopotamilla reniformis Malmgren, 1867 recorded in the Mediterranean Sea probably corresponds to *Pseudopotamilla saxicava* (Quatrefages, 1866), while its distribution is reduced to Iceland, northern Norway, Nova Scotia and Newfoundland (Knight-Jones *et al*. (2017).

Eunice norvegica (Linnaeus, 1767) was listed by Day (1967) as a synonym of *Eunice Floridana* (Pourtalès, 1869) sensu Fauvel (1923). Thus, *E. norvegica* was wrongly listed by Ayari *et al*. (2009) as a synonym of *Eunice floridana* (Pourtalès, 1869). In fact, specimens were sampled from silty bottoms and identified by Ayari & Afli (2003, 2008) using Fauvel's key. *E. norvegica* is often found in coralligenous habitats (Tursi *et al*., 2004; Gravina *et al*., 2021). Its confusion with *E. floridana* has already been discussed by Fauchald (1992) and by Carrera-Parra & Salazar-Vallejo (1998). The systematic position of *E. norvegica* was recently clarified by Gravina *et al*. (2021). However, this species has been reported elsewhere from the Mediterranean, and the single report from Tunisian waters, ten years ago, is considered questionable on the basis of habitat and the use of outdated keys.

Lugia pterophora (Ehlers, 1864) is a doubtful nomination based probably on juveniles and since the type material is lost, it is considered indeterminable by Pleijel (1991). Thus, the species is herein excluded from the final list.

Harmothoe johnstoni (McIntosh, 1876) was considered indeterminable by Tebble & Chambers (1982) and by Barnich & Fiege (2000, 2009) as the holotype is incomplete and insufficient to characterize the taxon.

The old report of *Pholoe minuta* (Fabricius, 1780) from the Gulf of Tunis by Cantone *et al*. (1978) is deleted from the final list given that its presence in the Mediterranean is doubtful (Barnich & Fiege, 2003; Mikac, 2015).

Aricidea (*Acmira*) *lopezi*, known from Pacific coasts of America, has only been reported from Greece with a questionable status (Faulwetter *et al*., 2017).

Pista brevibranchiata Moore, 1923 known from North Pacific Ocean has never been described; more correctly, it should be attributed to *Axionice agassizi* (Hilbig, 2000) following the taxonomic explanation given in Jirkov & Leontovich (2017).

The identity of *Laonice cirrata* reported by Zaabi *et al*. (2012) was checked in this study and individuals were assigned to *L. bahusiensis* and *L. norgensis*. *L. cirrata* is not present in the Mediterranean but distributed in the Arctic, Atlantic and Pacific Oceans (Sikorski, 2003). Its report from the Adriatic probably refers to *L. bahusiensis* (Mikac, 2015). Faulwetter *et al*. (2017) doubt the presence of this species in Greek waters and refer it also to the very similar taxon *L. bahusiensis*. Previous reports of *L. cirrata* from Tunisian waters are not taken into account.

Discussion

The current list comprising 390 species increases the polychaete diversity by adding 105 species to the last inventory by Ayari *et al*. (2009) and by deleting more than 37 taxa previously reported. Ayari *et al.* (2009) pointed out that the number of polychaete species from southern Tunisian coastal waters has been under-estimated and that this region needs to be more fully investigated. This under-estimation is highlighted by the increase in the number of polychaete species collected in the framework of studies performed since 2008 in South Tunisia. Since that date, the polychaete diversity in this area, which amounted to only 105 species (Ayari *et al*., 2009), has now doubled to reach 215 species. Among species added for the Gulf of Gabès, 43 species are new for Tunisian fauna: 21 species are reported from recent investigations in the shallow Gulf of Gabès, mainly around the Boughrara Lagoon (Khedhri *et al*. 2014, 2016a, b, 2017a, b), the intertidal zone of the Kneiss Islands (Mosbahi, 2017) and 23 species from the tidal channels (present study). Despite the increasing research effort in South Tunisian waters, this area is still impoverished when compared with the North Tunisian coasts. This might be due to the higher diversity of habitats in the North compared to the South.

Generally, the Tunisian polychaete diversity is still far less well known than for other Mediterranean regions. For Tunisia, the polychaete diversity (390 species, without counting the deleted questionable species) represents 35% or 36% of the Mediterranean diversity of polychaetes, which is estimated at 1122 (Coll *et al*., 2010) or 1105 species (Faulwetter *et al*., 2017). Even when deleted questionable species are taken into account, the polychaete diversity of Tunisian waters (427 species) is nevertheless lower than that of the Algerian coasts (534 species) (Bakalem *et al*., 2020).

For Tunisia, Ounifi-Ben Amor *et al*. (2015) identified 18 NIS of polychaetes (14 established, 3 casual and 1 questionable). After revision of their establishment status, the present study identifies almost the same number

of polychaetes non-indegenous species (14 established, 1 casual and 2 cryptogenic) but after the removal of 6 NIS among them *Metasychis gotoi*, Neop*seudocapitella brasiliensis* and *Eunice tubifex* previously considered established but now excluded.

Eight NIS have been reported in the TWMED and eleven NIS in the TCMED (Gulf of Gabès). Established NIS in the two subregions (TWMED and TCMED) originates from the subtropical or tropical parts of the Indo-Pacific region. This implies that the main introduction pathway of NIS to Tunisian coastal waters is probably shipping (fouling and ballast water) arriving via the straits of Gibraltar or the Suez Canal.

The diversity of polychaete NIS in Tunisian waters is under-estimated compared with other Mediterranean areas: 47 NIS for Greece (Simboura *et al*., 2010; Faulwetter *et al*., 2017), 46 NIS (86 when considering questionable species) for Italian waters (Langeneck *et al*., 2020) and 21 NIS Iberian Mediterranean seaboard (López & Richter, 2017). This is because the problem of questionable status or poorly identified species remains unresolved, while there are also cases of particular or original specimens that have not been studied. However, it is remarkable that the number of NIS (17 species) in Tunisian waters is higher than that observed (8 species) in Algerian waters (Bakalem *et al*., 2020); this could be explained by the fact that the Southern Tunisian coasts are much more subject to the influence of the Eastern basin which is characterized by the strong presence of NIS of Lessepsian origin.

The increase in the observed diversity of polychaetes from the Tunisian coasts over the last decade is the consequence of the numerous studies carried out in Tunisian waters, mainly in the Northern part where 77 new species are added to the Tunisian fauna. This inventory of Tunisian polychaetes in general and NIS in particular forms a new base of information, in particular concerning the distribution of certain Mediterranean species and species new to the region.

Despite these recent research efforts, the diversity of polychaetes from the Southern coasts of Western Mediterranean basin appears to remain much lower than that noted on the Northern coasts of the Western basin. In the future, additional research is needed to ensure a better knowledge and estimation of the diversity on the Southern Mediterranean coasts in general and Tunisian coasts in particular. For a better knowledge of the Tunisian polychaetes, it will be necessary to extend surveys to deep soft bottoms (more than 100 m) and to hard substrates that have so far been rarely studied in shallow as well as deep waters. The re-examination of only four species from the INSTM reference collection, using recent keys and taxonomic research, has provided six further new species. Thus, we are led to give more weight to the recent taxonomic revision especially in the Mediterranean. In addition, molecular studies and taxonomic revisions would also be necessary to improve the estimation of the diversity of polychaetes from the Tunisian coasts.

Acknowledgements

The authors acknowledge financial support from Sfax University (Tunisia) and UMR M2C (Normandy University, France) for Abir Fersi four-month stay in Caen from September to December 2017. Dr M.S.N. Carpenter post-edited the English style and grammar. We are also thankful to two referees and editors of *Mediterranean Marine Science* (Dr. Langeneck Joachim and Dr. Argyro Zenetos) for their helpful suggestions and comments.

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