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Collective Article A

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Abstract

This Collective article reports 17 introduced species and 22 new locations for these species in the Mediterranean Sea. The reports are from three different Marine Strategy Framework Directive (MSFD) subregions (Aegean-Levantine Sea, Adriatic Sea and Western Mediterranean Sea) and the Sea of Marmara and cover ten different countries. The goal of consistent and detailed reporting of introduced species is to complement the existing species inventories and serve as a basis for establishing monitoring strategies and other conservation measures. Some of the reports from this article are the first species records for the Mediterranean Sea, namely the green alga *Udotea flabellum* from the Aegean Sea (Turkey) and the deepbody boarfish *Antigonia capros* from the Balearic Sea (Spain). In addition, new records of introduced species are included for different seas, namely the moon crab *Matuta victor* for the Aegean Sea (Greece), the whale shark *Rhincodon typus* and the lionfish *Pterois miles* for the Alboran Sea (Spain), the almaco jack *Seriola rivoliana* for the Tyrrhenian Sea (Italy), and the hound needlefish *Tylosurus crocodilus* for the Adriatic Sea (Italy). Furthermore, reports on first country records are included: the red alga *Colaconema codicola* from Slovenia, the nudibranch *Melibe viridis* from Bosnia and Herzegovina, the lionfish *Pterois miles* from Montenegro, and the goldstripe sardinella *Sardinella gibbosa* from Syria, which also represents a second record for the Mediterranean Sea. Furthermore, the occurrence of the scleractinian coral *Oculina patagonica* was noted in Gulf of Lion (France). Four polychaete species, namely *Leodice antennata*, *Timarete punctata* and *Branchiomma bairdi*, are reported from the vermetid reef habitat and two of them (*L. antennata* and *B. bairdi*) are also recorded for the first time in Lebanon. Evidence for established populations of the Asian date mussel *Arcuatula senhousia* in the Sea of Marmara (Turkey) and the rayed pearl oyster *Pinctada radiata* around the island of Sardinia (Italy) is provided.

Introduction

Bioinvasion, especially alien invasive species, is one of the greatest threats to marine biodiversity (Molnar *et al.*, 2008). The problem of bioinvasion seems to be particularly pronounced in the Mediterranean Sea, which hosts the highest number of introduced species of all European seas (Galil *et al.*, 2014). Although geographically uniform, the Mediterranean Sea is enclosed by 22 countries, both EU members and non-EU members, leading to different policy approaches and monitoring efforts. Unfortunately, an increase in both introduced and established alien species is constantly being observed in the Mediterranean Sea (Zenetos & Galanidi, 2020; Zenetos *et al.*, 2022).

The Mediterranean Sea is one of the busiest seas in the world due to intense maritime traffic, fishing, and tourism. These are all pressures associated with the main introduction pathways for alien species, namely shipping, the Suez Canal, and mariculture (Zenetos *et al.*, 2012). Natural dispersal from neighbouring areas is also important for the secondary spread of alien species across the Mediterranean basin, which is accelerated by ocean warming (Zenetos & Galanidi, 2020). The increase in seawater temperature is another threat to biodiversity in the Mediterranean, which has been identified as one of the most vulnerable areas to climate change (Ali *et al.*, 2022). Although bioinvasion and climate-change driven range expansions of the species differ in important processes (Essl *et al.*, 2019), it is essential to monitor them all as part of a holistic approach to identify changes in Mediterranean biodiversity. Moreover, range expansion may be the result of synergistic effects between human-assisted dispersal and human-induced environmental changes (Wilson, 2020). In this context, this paper reports new information on introduced species, defined here as in Gerovasileiou *et al.* (2022) in a broad sense, i.e., including alien, cryptogenic, crypto-expanding, and species whose status remains questionable.

Careful recording of new and already introduced species is an important contribution to the sometimes unclear introduction pathways. It is very difficult to determine the exact vector of introduction for introduced species, so they are usually inferred from life history, habitat, and dispersal patterns (Galil, 2012). In addition, consistent and detailed reporting of alien species and reassessment of existing species inventories will help to establish monitoring systems and take further action to achieve good environmental status under the Marine Strategy Framework Directive (MSFD) (Tsiamis *et al.*, 2019). For this reason, the Collective Article A' series of the scientific journal *Mediterranean Marine Science* is dedicated to collecting new distribution data on introduced species.

This collective paper reports 17 introduced species and 22 new locations for these species in the Mediterranean Sea. The records include new occurrences for the

Table 1. Species records are listed in the order in which they appear in the subsections (SC) of this paper. Information on the phylum, country of the record, subregion (MAD - Adriatic Sea, MAL - Aegean-Levantine Sea, MARM - Sea of Marmara, MWE - Western Mediterranean Sea) and location number (LN; same as in Figure 1) is given.

Species	Phylum	Country	Subregions	SC	LN
Udotea flabellum	Chlorophyta	Turkey	MAL	1.1	19
Colaconema codicola	Rhodophyta	Slovenia	MAD	2.1	14
Oculina patagonica	Cnidaria	France	MWE	3.1	4 – 6
Melibe viridis	Mollusca	Bosnia and Herzegovina	MAD	4.1	16
Arcuatula senhousia	Mollusca	Turkey	MARM	4.2	20
Pinctada radiata	Mollusca	Italy	MWE	4.3	7 – 12
Branchiomma bairdi	Annelida	Lebanon	MAL	5.1	21
Leodice antennata	Annelida	Lebanon	MAL	5.1	21
Pseudonereis anomala	Annelida	Lebanon	MAL	5.1	21
Timarete punctata	Annelida	Lebanon	MAL	5.1	21
Matuta victor	Arthropoda	Greece	MAL	6.1	18
Antigonia capros	Chordata	Spain	MWE	7.1	3
Pterois miles	Chordata	Spain	MWE	7.2	2
Pterois miles	Chordata	Montenegro	MAD	7.3	17
Rhincodon typus	Chordata	Spain	MWE	7.4	1
Sardinella gibbosa	Chordata	Syria	MAL	7.5	22
Seriola rivoliana	Chordata	Italy	MWE	7.6	15
Tylosurus crocodilus	Chordata	Italy	MAD	7.7	13

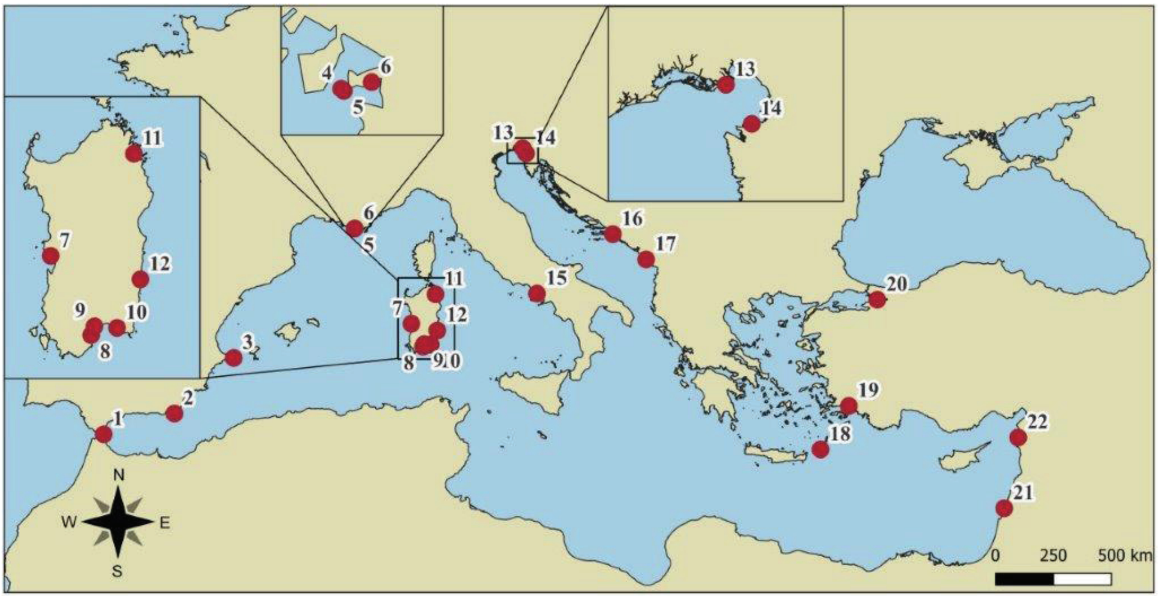

Fig. 1: Map of the Mediterranean Sea showing the species occurrences presented in this paper, marked with ● and the location numbers (LN) as they appear in Table 1. The areas of Sardinia, the harbour of Toulon (Gulf of Lion) and the Gulf of Trieste (northern Adriatic) are enlarged for better representation.

Mediterranean Sea, some cases of establishment of old invaders, as well as accounts of introduced species found in new habitats. The first species records for the entire Mediterranean Sea are reported here, namely the green alga *Udotea flabellum* from the Aegean Sea (Turkey) and the deepbody boarfish *Antigonia capros* from the Balearic Sea (Spain). In addition, new records of introduced species are included for different seas, namely the moon crab *Matuta victor* for the Aegean Sea (Greece), the whale shark *Rhincodon typus* and the lionfish *Pterois miles* for the Alboran Sea (Spain), the almaco jack *Seriola rivoliana* for the Tyrrhenian Sea (Italy), and the hound needlefish *Tylosurus crocodilus* for the Adriatic Sea (Italy). Moreover, information on first country records is added: the red alga *Colaconema codicola* from Slovenia, the nudibranch *Melibe viridis* from Bosnia and Herzegovina, the polychaetes *Leodice antennata* and *Branchiomma bairdi* from Lebanon, the lionfish *Pterois miles* from Montenegro, and the goldstripe sardinella *Sardinella gibbosa* from Syria, which also represents a second record for the Mediterranean Sea. Furthermore, the occurrence of the scleractinian coral *Oculina patagonica* was noted in Gulf of Lion (France), 50 years after transplantation experiments in this region. Evidence is also reported for established populations of the Asian date mussel *Arcuatula senhousia* in the Sea of Marmara (Turkey) and the rayed pearl oyster *Pinctada radiata* on the island of Sardinia (Italy). Three polychaete species, namely *Leodice antennata*, *Timarete punctata* and *Branchiomma bairdi*, were newly reported from the vermetid reef habitat. The information about the introduced species is given in Table 1, while the map with the exact locations of the findings is shown in Figure 1.

1. CHLOROPHYTA

1.1. First record of the Indo-Pacific green algae *Udotea flabellum* (J. Ellis & Solander) M. Howe in the Mediterranean Sea

Emine Sukran OKUDAN and Inci TUNEY KIZILKAYA

The genus *Udotea* J.V.Lamouroux, with over 43 species, is currently accepted as the largest of the family Halimedaceae (Chlorophyta). In the Mediterranean Sea, there is only one species belonging to this genus: *Udotea petiolata* (Turra) Børgesen (as *Flabellia petiolata* (Turra) Nizamuddin) (Guiry & Guiry, 2022). In this study, we report the presence of *Udotea flabellum* (J. Ellis & Solander) M. Howe for the first time in the Mediterranean Sea.

U. flabellum is widely distributed in the Indo-Pacific Ocean, from New Zealand to the east coasts of Africa, the Red Sea, and the tropical Atlantic Ocean (Guiry & Guiry, 2022).

We conducted scientific dives in 21 different sites along the coast of Gökova Bay Marine Protected Area (MPA) (Aegean Sea) in October 2022. *Udotea flabellum* was collected only in one diving site (36.996944° N 28.207778° E), at a depth range of 3-11 m, with 70-100% coverage (Fig. 2a).

U. flabellum is erect, 5-30 cm tall; the blades are fan-shaped with many overlapping lobes that are mostly calcified. Its colour ranges from dark to pale green (Fig. 2b). The blades are smooth, leathery, calcified, multilayered,

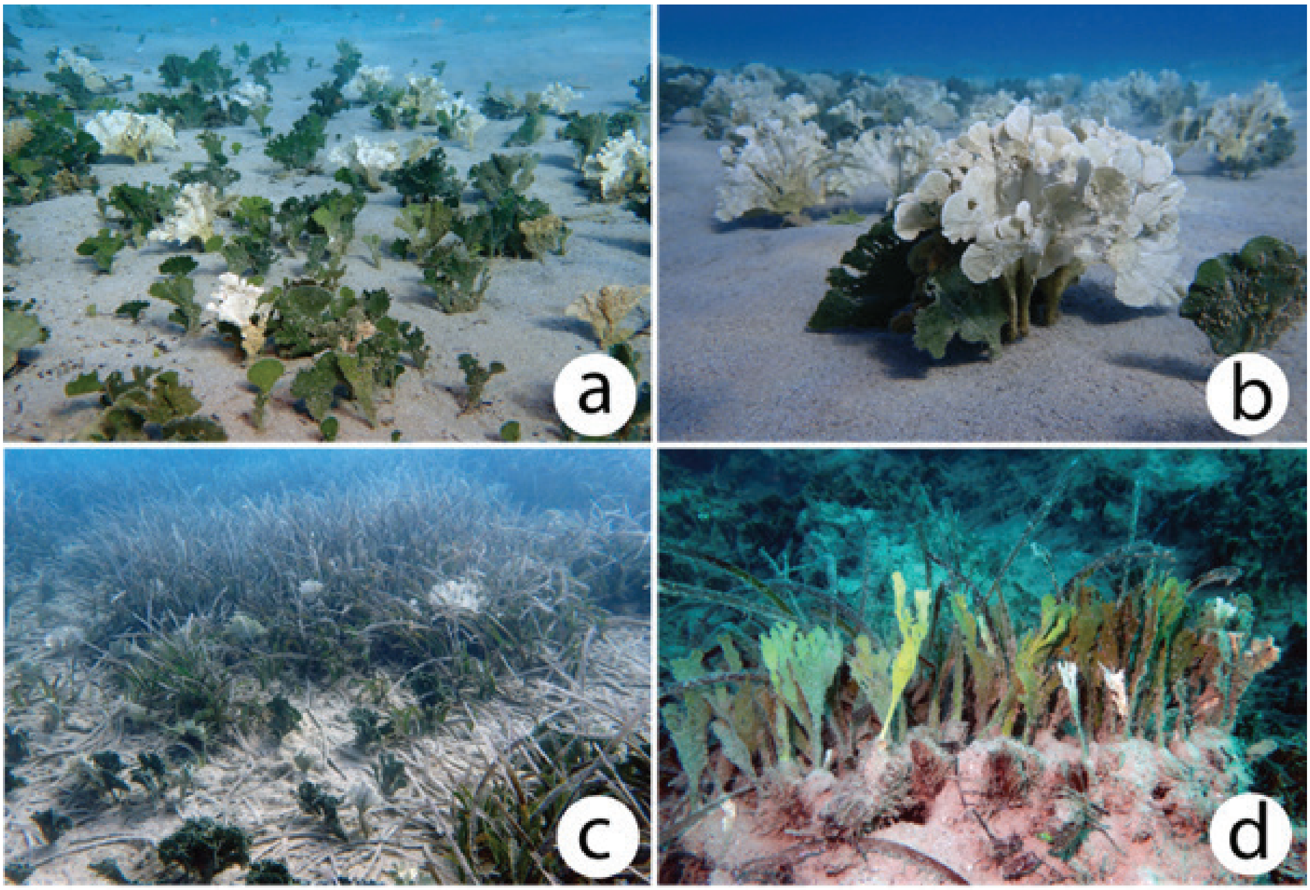

Fig. 2: a): General view of *Udotea flabellum* in Gökova Bay MPA. b): A closer view of *U. flabellum* thallus in calcified white and green colour. c), d): Growing *U. flabellum* on the anchoring damaged roots of *Posidonia oceanica*.

rigid, and have significant zonal bands, while older blades have overlapping lobes. Stipes are anchored in soft substrata by massive rhizoidal bases and commonly occur in sandy areas to a depth of 11 m (Fig. 2b). In Gökova Bay, it was found firmly attached to the ground, in degraded parts of *P. oceanica* beds and competed for its habitat (Fig. 2c and 2d). The morphological difference between *U. flabellum* and *Udotea petiolata*, which is native to the Mediterranean, is shown in Figure 3.

After sequencing the ITS region of the sample we collected, the Blast results showed 100% similarity with the *U. flabellum* ITS regions of the GenBank. The complete ITS region sequence was deposited in the GenBank under Accession #OQ268228. Both morphological and molecular results have proven that the sample collected from Gökova Bay is *U. flabellum*.

Gökova Bay is declared a biodiversity hotspot within the 200 ecoregions by WWF Global (Olson & Dinerstein, 2002). Besides its importance in terms of biodiversity, the area is under the pressure of human activities, mainly tourism, fisheries, and alien invasive species. The high coverage rate of *U. flabellum* in only one location within Gökova Bay should be investigated, and its possible establishment in other areas should be monitored in future studies.

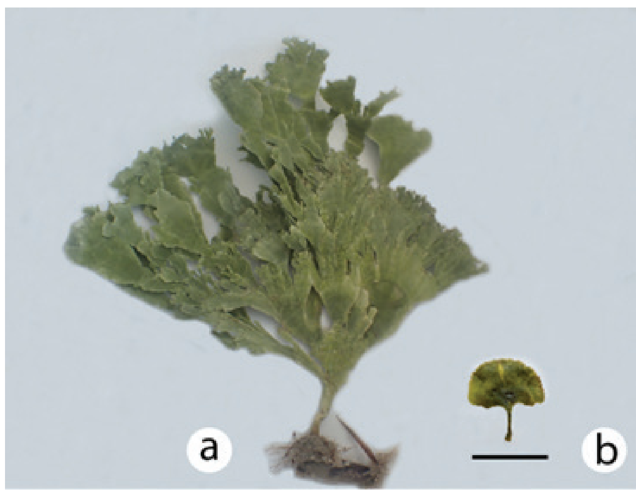

Fig. 3: Difference between a) *Udotea flabellum* and native Mediterranean species b) *Udotea petiolata* (the scale length is 4 cm).

2. RHODOPHYTA

2.1. First record of *Colaconema codicola* (Rhodophyta, Colaconematales) in Slovenian coastal waters (northern Adriatic)

Ana FORTIČ and Martina ORLANDO-BONACA

Colaconema codicola (Børgesen) Stegenga, J.J. Bolton & R.J. Anderson is a red filamentous alga probably native to the Atlantic Ocean and considered an alien species in the Mediterranean Sea (Ribera & Boudouresque, 1995). In the Mediterranean basin it was first recorded in France (Banyuls-sur-mer) in 1950 as *Rhodothamniella codii* (Bidoux & Magne, 1989). The species was then found in 1978 in the Venice Lagoon (Italy), where it is now established but not very abundant (Sfriso *et al.*, 2020). The most recent record is from the Thessaloniki Gulf (Greece) in the North Aegean Sea (Orfanidis *et al.*, 2021). The species seems to be well established in the Mediterranean Sea, but due to taxonomic uncertainties, some records are yet to be confirmed (Bideoux & Magne, 1989; Cormaci *et al.*, 2017).

Here we report the first occurrence of this species in the Slovenian coastal sea. We found *C. codicola* as an epiphyte on another alien macroalga, *Codium fragile* (Suringar) Hariot, during alien species monitoring on 14 September 2022 (Fig. 4). The thallus of *C. fragile* with *C. codicola* grew on a boulder in the upper infralittoral belt, near the Marina Izola (45.539386° N, 13.656258° E) (Fig. 4a, b). We collected the algae with the sampling net and brought them to the laboratory of the Marine Biology

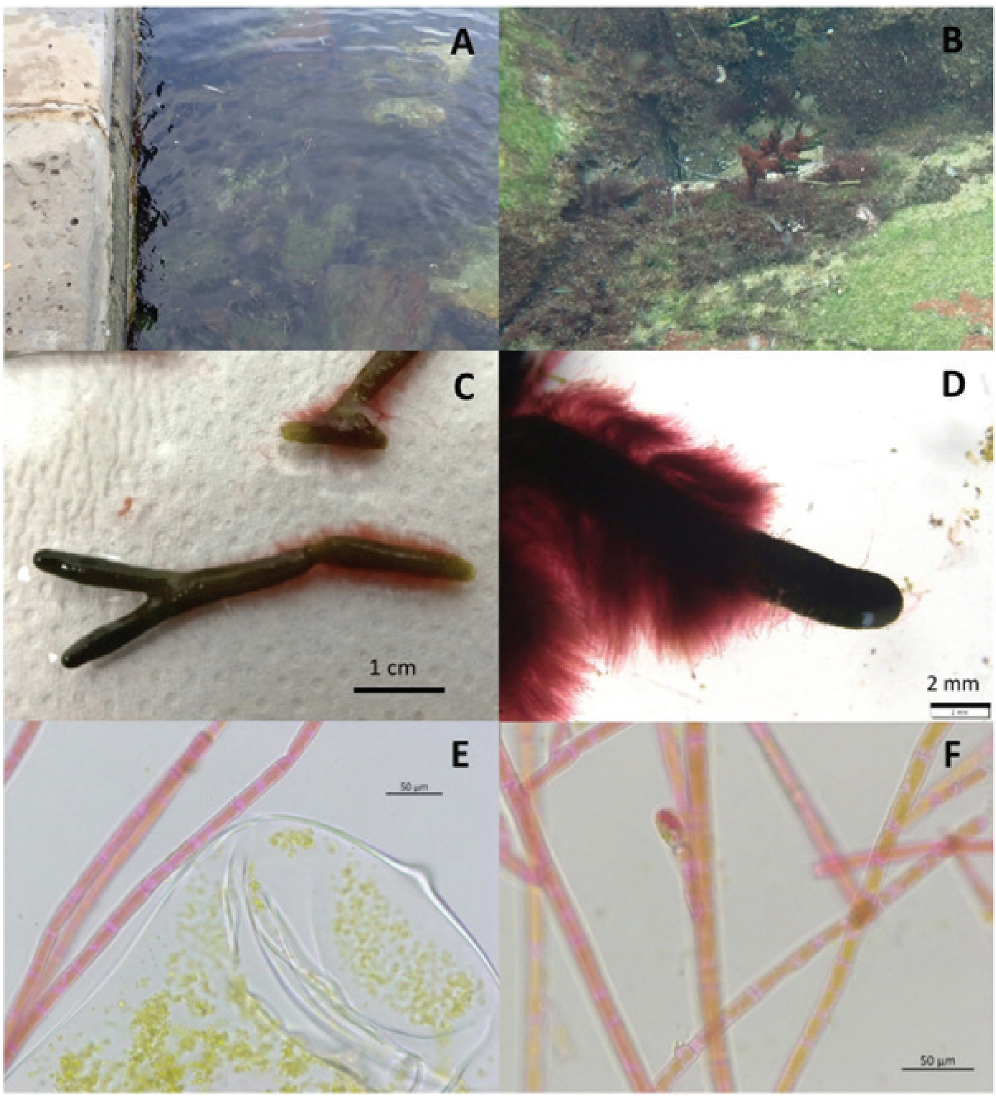

Fig. 4: *Colaconema codicola* from Slovenia: A) and B) the alga was found on boulders in the infralittoral belt; C) and D) it grew on a thallus of *C. fragile*, seen on the photos as 2-4 mm high filaments. Bigger magnifications revealed E) that the cells are 2-4 times longer than wide and F) some ovoid, peduncolate monosporangia. Photo credits: Ana Fortič (A, B), Martina Orlando-Bonaca (C, D) and Janja Francé (E, F).

Station in Piran. At the time of sampling, we measured some abiotic parameters, such as temperature (24.5 °C), salinity (38.1), and dissolved oxygen (7.72 mg/l).

In the laboratory, we examined the algae under a stereomicroscope and an inverted microscope. The thalli of *C. codicola* agree well with the description of Tsioli & Orfanidis (Orfanidis *et al.*, 2021) and the unpublished material of A. Sfriso (pers. comm.). They consist of a prostrate, caespitose part composed of a mass of intertwined filaments and an erect part formed by straight, weakly branched filaments, 2-4 mm high (Fig. 4c, d). The cells are 2-4 times longer than wide (Fig. 4e). Some ovoid, peduncolate monosporangia were also found, emerging laterally from the filaments (Fig. 4f).

Colaconema codicola is usually found as an epiphyte on *C. fragile* (Orfanidis *et al.*, 2021). Therefore, we can assume that the two algae were likely introduced and spread together in the Mediterranean region. The proposed pathways of introduction for both species are aquaculture and maritime transport (Ribera & Boudouresque, 1995). Since we found it near a marina, it might be introduced to this area by vessels.

3. CNIDARIA

3.1. New record of the invasive coral *Oculina patagonica* de Angelis, 1908 (Cnidaria, Scleractinia) on the French Mediterranean coast

Stéphane SARTORETTO

The genus *Oculina* Lamarck, 1816 includes ten species mostly located in the Gulf of Mexico and the Caribbean Sea. Among them, *Oculina patagonica* De Angelis, 1908 is a zooxanthellate encrusting coral with an invasive character. In Mediterranean Sea, it was first discovered in 1966 on the Ligurian coasts of Italy, about 1 km from the port of Savona (Zibrowius, 1974). Shortly afterwards, it was reported from the port of Alicante (Spain), 1000 km away (Serrano *et al.*, 2023). This species was originally described from fossils from the southeast coast of South America. However, no records of live specimens have been registered in this region. A recent survey of fouling communities in Argentinian ports failed to find any evidence of this species. Nevertheless, *O. patagonica* is thought to have been introduced via shipping, from South America to the western Mediterranean. Since it was first reported, this coral has been observed in other areas of the western and eastern Mediterranean basins (Alboran sea, Balearic Islands area, Algeria, Tunisia, Greece, Malta, Croatia, Turkey, Lebanon, Israel) (Serrano *et al.*, 2023). This expansion to invasive levels could be a result of environmental changes (Leydet & Hellberg, 2015).

In France, this species was experimentally transplanted near Marseille in 1972 (Zibrowius, 1974). In 2020 and

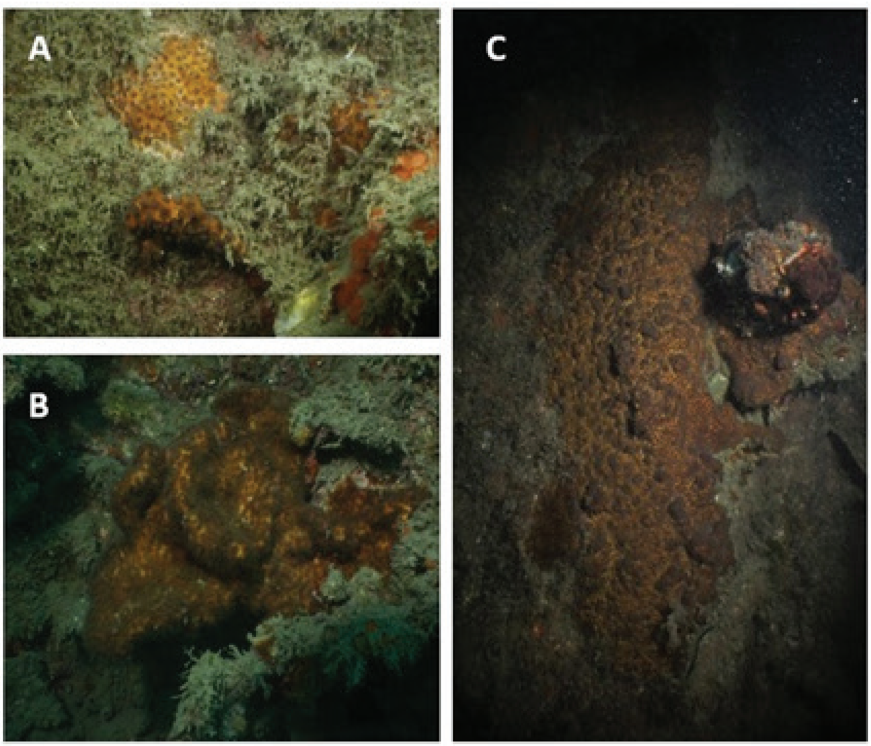

Fig. 5: *Oculina patagonica* colonies found along three wharfs in the harbour of Toulon: A) Wharf of the Corse, B) Minerve's wharf, C) Fournel's wharf. Photo credits: Stéphane Sartoretto.

2021, *Oculina patagonica* was observed in the harbour of Toulon. These records constitute a new signal on the French Mediterranean coast. The species was directly identified *in situ* and confirmed in laboratory on samples. A total of three colonies were found on the docks of ferries bound for the Balearic Islands and Corsica. The GPS locations are respectively: 43.116017° N, 5.930000° E (Fournel wharf, 3 m depth), 43.116233° N, 5.929633° E (Minerve wharf, 5.4 m depth) and 43.116900° N, 5.933850° E (Corsica wharf, 6 m depth) (Fig. 5). The surface area of the observed colonies reaches 2400 cm², 400 cm² and 600 cm². According to the knowledge of growth rate values (Rodolpho-Metalpa *et al.*, 2014; Rubio-Portillon *et al.*, 2014), the smallest colony could be aged 11 years and the largest 30 years. This period of time corresponds to the extension of the activity of the Toulon harbour. Their presence on ferry docks reinforces the idea that ports are a major gateway for the introduction of the invasive species *O. patagonica*. The travel of coral populations by shipping (fouling the hull and metal crevices) could contribute to the long-distance dispersal of this species (Massé *et al.*, 2023; Serrano *et al.*, 2023).

4. MOLLUSCA

4.1. The first record of nudibranch species *Melibe viridis* (Kelaart, 1858) in Bosnia and Herzegovina

Adla KAHRIĆ and Dejan KULIJER

Melibe viridis (Kelaart, 1858) is a nudibranch gastropod that naturally occurs in the Indo-Pacific region (Gosliner & Smith, 2003). In the Mediterranean it was recorded for the first time in Greece in 1982 as *Melibe fimbriata* (Thompson & Crampton, 1984). According to Zenetos *et al.* (2016) and Lipej & Mavrič (2017) from the Adriatic Sea this species has been known from Slovenia, Croatia, and Montenegro. Here we report the first observation of this species in Bosnia and Herzegovina and give further data on the species spreading in the Adriatic Sea.

A short field study has been conducted from 1 to 3 October 2021 in a small bay at the outskirts of Opuće village located on Klek Peninsula at the entrance to the Neum Bay. Neum Bay represents the major part of the sea territory that belongs to Bosnia and Herzegovina, located in central part of Eastern Adriatic Sea coast, completely enclosed by Croatian waters. It is approximately six km long, 1.2 km wide and up to 30 m deep. It is characterized by muddy and sandy bottom with rocky intertidal zone. We conducted visual inspection on algal habitats in the littoral zone up to 1 m depth and the rocky coastal zone was inspected by snorkelling to up to 4 m depth along the 300 m stretch of the northern and eastern part of the Opuće Bay. The alien heterobranch species *M. viridis* (Fig. 6) was recorded at the rocky shore on the northern part of Opuće Bay (42.930958° N, 17.567731° E) on 2 October 2021. One specimen was found slowly moving during daytime on the bottom below a vertical rocky surface covered with algae, at 3 m depth, approximately 50 m from a fish farm. The species was identified based on elongated brownish body with white dots covered with rounded tubercles, well developed oval hood with numerous tentacles and the presence of large cylindrical cerata on dorsal surface, flattened at their ends, and located along the edge of the mantle. The observed

Fig. 6: *Melibe viridis* (Kelaart, 1858) photographed in Bosnia and Herzegovina, Neum Bay. Photo credits: Dejan Kulijer.

individual was approximately 25 cm long. The specimen was photographed on site, preserved in 70 % ethanol and deposited in the invertebrate collection of National Museum of Bosnia and Herzegovina. Investigations of the distribution of alien and invasive species in the Bosnia and Herzegovina are scarce and their discovery is mainly accidental. Furthermore, the marine heterobranch fauna of Bosnia and Herzegovina has never been investigated in detail and therefore only seven species have been reported for the country until now (Kahrić *et al.*, 2022). Systematic research of marine ecosystems in Bosnia and Herzegovina is necessary in order to achieve better understanding of marine biodiversity and potential negative impact of alien species.

4.2. *Arcuatula senhousia* (W. H. Benson, 1842) has become established in the Sea of Marmara

Alper DOĞAN and Gizem GÜNDEĞER

The Asian date mussel *Arcuatula senhousia* (W. H. Benson, 1842) is a small thin shelled filter feeding species belonging to the family Mytilidae. It was first reported from the Turkish seas from the Levantine coasts of Turkey by Uysal *et al.* (2008). Many juvenile specimens of *A. senhousia* were also reported by Eleftheriou *et al.* (2011) from Iskenderun Bay. Doğan *et al.* (2014) reported *A. senhousia* for the first time from the Aegean Sea. By 2012 it was reported for the first time from the Sea of Marmara (west area) by Öztürk *et al.* (2017) (see Table 2). Here we report the finding of an established population in the Marmara Sea. A total of 313 specimens of *A. senhousia* (Fig. 7) were found in the eastern Marmara Sea (40.726433° N, 29.490989° E) at a shipyard area. The specimens were collected in November 2022 with a Van Veen Grab (0.1 m^2) from muddy bottom at a depth of 8 meters. Consequently, the *A. senhousia* population density was estimated to >3,000 ind./m^2.

Arcuatula senhousia, is considered as an opportunistic species with a great reproductive capacity and a fast growth ability, can create intense populations with over than 10,000 ind/m^2, and which may change the nature of the sediment where it occurs (Morton, 1973). Doğan *et al.* (2014) documented a population of 50 ind./m^2 in the polluted inner part of Izmir Bay in April 2012. In another study conducted at Izmir Bay in mussel beds (*Mytilus galloprovincialis*), the density of *A. senhousia* was estimated to be 150 ind./m^2 and 50 ind./m^2 respectively at two different stations (Doğan, 2016). Our results confirm an eastward expansion of *A. senhousia* in the Sea of Marmara (Fig. 8) and document a well-established population in the area within a 10 year-period (2012 to 2022).

Since the first sampling locations (Öztürk *et al.*, 2017) were close to Bandırma port and was close to the Çanakkale Strait (both characterized by intense shipping transport activities), the pathway of introduction of *A. senhousia* into the Sea of Marmara is assumed to be shipping.

Fig. 7: *Arcuatula senhousia* specimens from a Van Veen Grab (0.1 m^2) sample the study area.

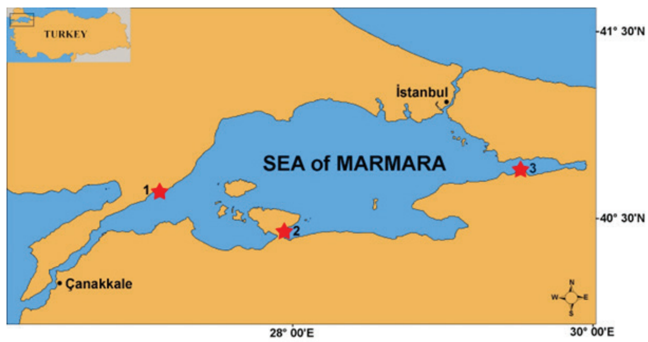

Fig. 8: 1, 2: Previous records by Öztürk *et al.* (2017); 3: this study.

Table 2. Distribution of *Arcuatula senhousia* along the Turkish coasts.

Source	Area	Collection date	Latitude (N)	Longitude (E)	Abundance (ind.m^{-2})	Depth (m)
Uysal *et al*., 2008	Levantine	2005-2007	~36.700000°	~34.500000°	Not reported	Not reported
Çevik *et al*. in Eleftheriou *et al*., 2011	Levantine Sea	2.07.2010	36.800556°	35.862500°	Many	10
Doğan *et al*., 2014	Aegean Sea Izmir Bay	10.04.2012	38.419722°	27.047500°	40	10
Doğan *et al*., 2014	Aegean Sea Izmir Bay	23.04.2009	38.409167°	27.075000°	20	12
Doğan *et al*., 2014	Aegean Sea Izmir Bay	10.04.2012	38.454444°	27.148611°	50	8
Doğan, 2016	Aegean Sea Izmir May	27.11.2014	38.427500°	27.132222°	150	0.1
Öztürk *et al*., 2017	Sea of Marmara	29.09.012	40.402778°	27.909722°	360	0.5
Öztürk *et al*., 2017	Sea of Marmara	5.10.2012	40.608333°	27.096944°	30	0.5
This study	Sea of Marmara	26.11.2022	40.726433°	29.490989°	3130	8

4.3. First record of an established population of *Pinctada radiata* (Leach, 1814) in Sardinian waters with possible ecological implications

Daniele GRECH and Daniela CARACCIOLO

This note reports the first record of an established and overlooked population of *Pinctada radiata* (Leach, 1814) in Sardinian waters during the validation of a citizen scientist sighting of misidentified *Pinna nobilis* juveniles. The northernmost examined specimens were collected in autumn 2022, first from Olbia Bay (Cala Prosecco, North Sardinia) 2.5 m deep, and in five additional sites for a total of 15 investigated sites (Table 3) by Rapid Assessment Surveys (RAS, *sensu* Png-Gonzalez *et al.*, 2021) along Sardinian coastline. The collected specimens have been identified according to Scuderi *et al.* (2007) and Png-Gonzalez *et al.* (2021) (Fig. 9A-B). The Sardinian specimens have been measured and the population size structure was represented in Figure 9C.

The rayed pearl oyster *Pinctada radiata* (Leach, 1814), originated in the Indo-Pacific, and is the oldest reported Lessepsian migrant in the Mediterranean. This bivalve has successfully spread along the eastern and central Mediterranean basins as well as in the Adriatic (Gavrilović *et al.*, 2017); nonetheless, records in the north-western sectors are still scarce. The unique first citation in Sardinia dates from 2012, from a single specimen collected *in situ* in the south area (Stasolla *et al.*, 2014). Sporadic records have been reported in the north-western Mediterranean, until the first known population was described by López Soriano & Quiñonero Salgado (2019) for the Iberian Peninsula.

In Sardinia, the species has been present for some time with scattered individuals and has recently expanded its distribution, probably taking advantage of the niche vacated by the Mass Mortality Event (MME) of *Pinna nobilis* (Scarpa *et al.*, 2020), considering the same trophic traits and habitats. For these ecological implications, the species should be worth of in-depth monitoring, also by the involvement of citizen science initiatives (https://www.lifepinna.eu/citizen-science/). Considering the recorded sites (close to mussel farms, pontoon of artificial structures, marinas and sheltered bays) aquaculture and maritime transport are the most probable combined pathway for the introduction in the study area (Gavrilović *et al.*, 2017; Png-Gonzalez *et al.*, 2021).

Table 3. GPS coordinates (WGS84) of 6 Sardinian sites where *Pinctada radiata* has been recorded in 2022.

Site	Lat (DD)	Long (DD)
Cala Prosecco, Olbia	40.91391	9.57467
Sarrala, Nuoro	39.66691	9.65828
Cala Regina, Cagliari	39.17857	9.35458
Sarroch, Cagliari	39.10519	9.01683
Giorgino, Cagliari	39.19413	9.06254
Torregrande, Oristano	39.90216	8.49037

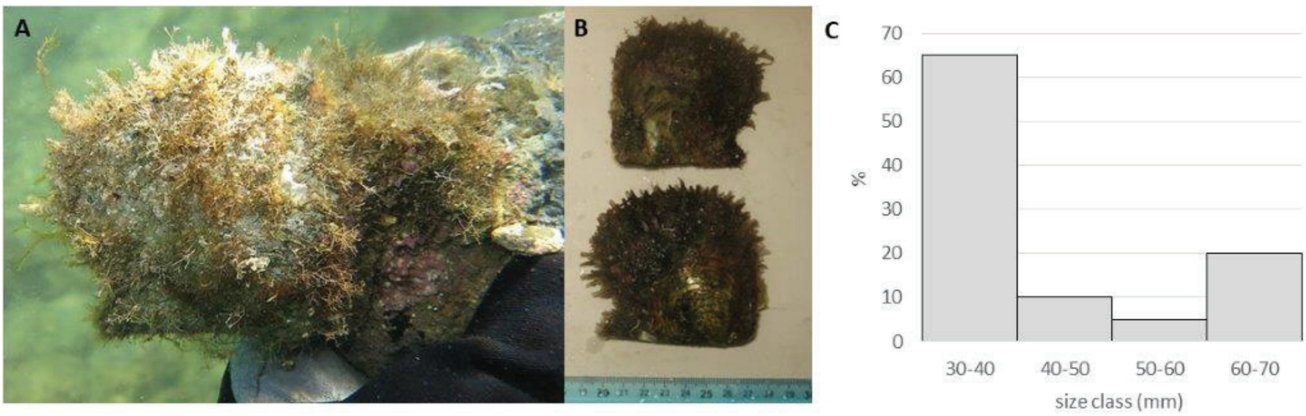

Fig. 9: *Pinctada radiata* in Sardinian waters. A) Underwater specimen. B) Collected sample. C) Sardinian population size structure of the hinge length (N=36).

5. ANNELIDA

5.1. On some alien polychaete species from a vermetid reef on the coast of Lebanon (eastern Mediterranean)

Ali BADREDDINE and Melih Ertan ÇINAR

On the 13 November 2021, one of us (AB) performed a fieldwork to collect fauna associated with a vermetid reef [*Dendropoma anguliferum* (Monterosato, 1884)] in the Marine Protected Area Tyre (location: Ras-Al-Ain), Lebanon, east Levantine Sea (33.226272° N, 35.210275° E). The vermetid reef of Ras-Al-Ain is characterized by its outer edge wide and flattened, with some crevices, and inner edge irregular with many tidal pools. The samples were collected randomly in the reef, passed through a 0.5 mm mesh and fixed with 5% formaldehyde. After sorting material under a stereomicroscope, polychaete specimens were preserved in 70% ethanol, and identified and counted by MEÇ. The material included five polychaete species, *Pseudonereis anomala* Gravier, 1899, *Leodice antennata* Savigny in Lamarck, 1818, *Polyophthalmus pictus* (Dujardin, 1839), *Timarete punctata* (Grube, 1859) and *Branchiomma bairdi* (McIntosh, 1885), of which only *P. pictus* is native, the others are alien species for the Mediterranean Sea. All these species were known from the Levantine Sea (Laubier, 1966, Çinar *et al.*, 2021), but *Leodice antennata* and *Branchiomma bairdi* are new records for the Lebanon fauna. Three species, namely *L. antennata*, *T. punctata* and *B. bairdi* are being newly reported from the vermetid reef habitat. A brief description of these alien species is given below and the photographs of the specimens are seen in Figure 10.

Pseudonereis anomala Gravier, 1899

Five specimens, largest incomplete, with anterior fragment, 19 mm long, 2.5 mm wide, for 43 chaetigers. Body cylindrical, pale brownish, with a dark brownish colour pattern on dorsum. Posterior parapodia with greatly expanded dorsal ligule, extending far beyond parapodial lobe. Pharynx with a pair of black jaws, maxillary and oral rings with conical black paragnaths; area V without paragnath, VI= 5 paragnaths in a transverse row, VII-VIII= 12 paragnaths in a transverse row.

Leodice antennata Savigny in Lamarck, 1818

One specimen, incomplete, with anterior fragment, 23 mm long, 1.8 mm wide, with 44 chaetigers. Body cylindrical, poorly preserved, pale yellowish in colour with a broad white band on dorsum of chaetiger 1 and a white spherical spot on dorso-median region of each anterior segment. Antennae placed in a horse shoe-shaped arrangement; ceratostyles moniliform with 10-20 articles. Peristomium distinct with a pair of moniliform cirri. One pair of black, rounded eyes placed at base of anterior antennae. Branchiae from chaetiger 6, longer than dorsal cirri, numbering 3 filaments on chaetiger 15. Parapodia with limbate, pectinate, falciger chaetae, tridentate subacicular hooks, and distally blunt acicula.

Timarete punctata (Grube, 1859)

One specimen, complete, 1.4 mm long, 1 mm wide, with 95 chaetigers. Body enlarged in middle region, pale brownish with irregular black spots on body surface, and black spots and stripes on branchiae and tentacular cirri. Prostomium broadly triangular, biannulated, without eyes, peristomium distinct. Tentacular filaments thick, emerging on chaetiger 3 and 4; branchiae starting on chaetiger 1, just dorsal to notopodia, gradually moving to dorsal midline of body in middle chaetigers. Chaetae of two types, capillaries and acicular spines; notopodial acicular spines first occurring on chaetiger 13, neuropodial acicular spines first occurring on chaetiger 10, associated with capillary chaetae.

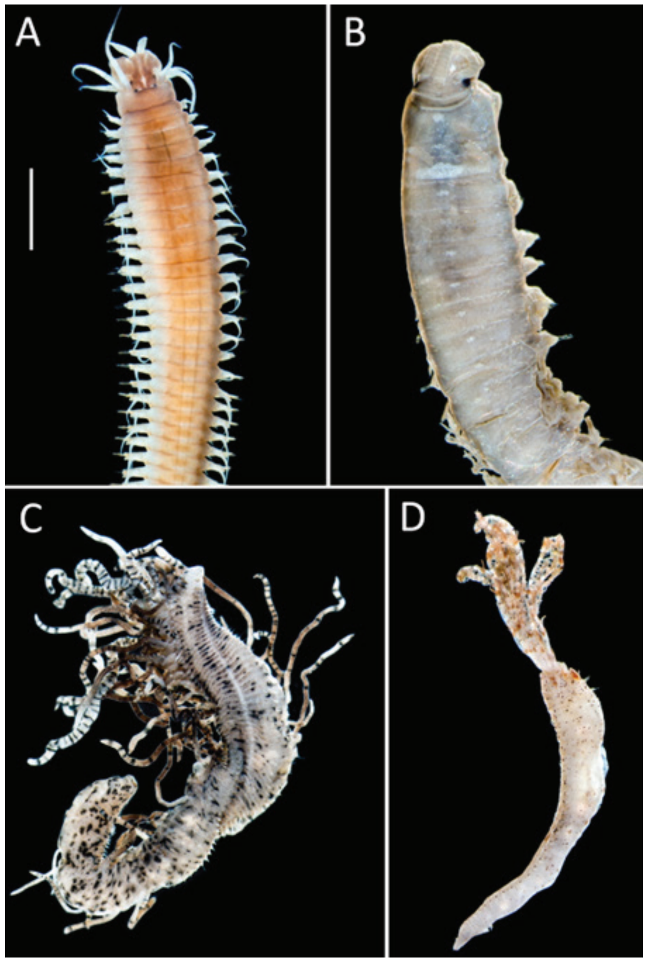

Fig. 10: Alien polychaete species from a vermetid reef on the Lebanon coast. A) *Pseudonereis anomala*, B) *Leodice antennata*, C) *Timarete punctata*, D) *Branchiomma bairdi*. Scale bar: A=2.8 mm, B=1 mm, C=1.12 mm, D=0.4 mm.

Branchiomma bairdi (McIntosh, 1885)

One small specimen, complete, 8.9 mm long (radiolar crown 3 mm, thorax 1.4 mm, abdomen 4.5 mm), 0.9 mm wide (on chaetiger 4), thorax with 8 chaetigers, abdomen with 25 chaetigers. Body pale brownish with small dark brownish spots. Radioles numbering 6 on left and 3 on right, with brown bands, eyes and long stylodes. Basal stylode long, unpaired, digitiform. Macrostylodes strap-like, longer than width of radioles. Thoracic and abdominal uncini with two rows of teeth above main fang.

The Lebanese specimen was identified based on the paper by Del Pasqua *et al.* (2018), who listed a set of characters (the shape of macrostylode, radiolar eyes, body size, the size of first pair of stylodes and the number of teeth over the main fang of thoracic and abdominal uncini) that distinguishes *B. bairdi* from *B. boholense* (Grube, 1878). In our specimen, the macrostylodes were strap-like, the first pair of stylodes were long, the body size was short and the radiolar eyes are large. These characters fit well with the re-description of *B. bairdi* by Pasqua *et al.* (2018).

6. ARTHROPODA

6.1. *Matuta victor* (Fabricius, 1781): moving westwards in the Mediterranean

Paraskevi K. KARACHLE and Elsa MARTÍNEZ JIMÉNEZ

The moon crab *Matuta victor* (Fabricius, 1781) was first recorded in the Mediterranean from the Israeli coasts in 2012, by Galil & Mendelson (2013). The species seems to spread quite fast in the Mediterranean Sea, yet its presence to date is restricted to the south-eastern parts of the basin. Innocenti *et al.* (2017) characterise the species as "aggressive, omnivorous and invasive", reflecting in this way the characteristics that make the species a successful invader. The feeding habits and foraging characteristics of *M. victor* might affect the structure of benthic invertebrate populations, if it becomes well established and abundant (Galil & Mendelson, 2013).

Karachle *et al.* (2017) have included it in the billboard of marine invasive species expected to invade Greek waters. Indeed, in 2018 it was detected along the Levantine coast of Rodos Island (Kondylatos *et al.*, 2018). Yet, by 2020 it was still unreported from the Aegean Sea (Zenetos *et al.*, 2020).

In August (20-27 August 2022), an unusual crab was spotted in Emporios beach (35.417361°N, 26.932762°E), Kasos Island, by one of the authors (Elsa Martínez Jiménez), while snorkelling, at a depth of 2 m. The morphological characteristics and colour of the observed specimen fully agreed with the description of *M. victor* given by Galil & Mendelson (2013) (Fig. 11). The individual was seen in multiple occasions, either solitary or with a Spotted weever *Trachinus araneus* Cuvier, 1829 and a Wide-eyed flounder *Bothus podas* (Delaroche, 1809) (Fig. 11). This finding further expands the known distribution of the species in a new Marine Strategy Framework Directive (MSFD) area in the Greek waters and is the westernmost for the species in the Mediterranean.

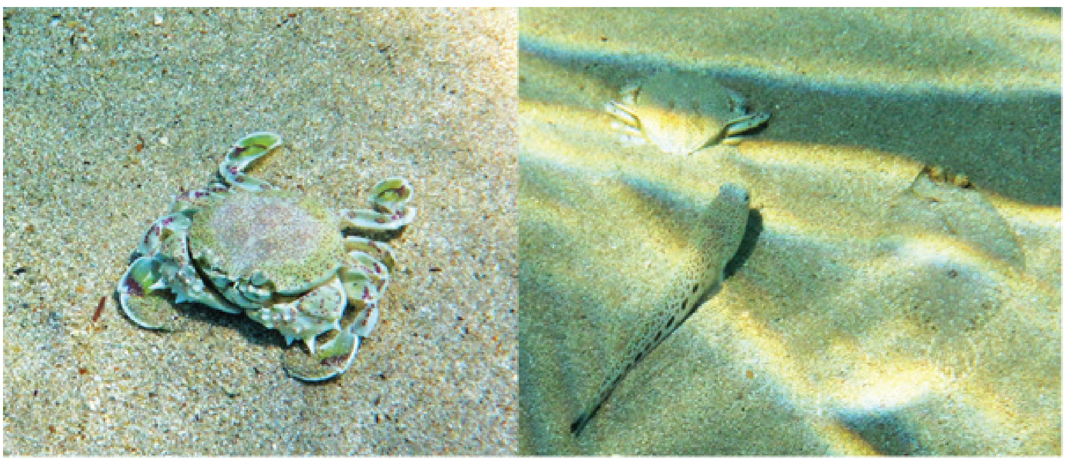

Fig. 11: *Matuta victor* in Kasos Island, solitary (left) and in the presence of the fish species *Trachinus araneus* and *Bothus podas* in the area (right).

7. CHORDATA

7.1. First record of *Antigonia capros* Lowe, 1843 (Teleostei, Caproidae) in the Mediterranean Sea

Javier GUALLART and Antoni LOMBARTE

The deepbody boarfish *Antigonia capros* Lowe, 1843 is a small demersal species that has worldwide distribution in subtropical and tropical oceans, including both the Atlantic and the Indo-Pacific regions. In the Eastern Atlantic it has been reported from France to Namibia, including Azores and Madeira whereas in the Western Atlantic has been found in southern USA to Uruguay, including the Gulf of Mexico. Its presence in temperate waters of the Europe is restricted to a few recent records in the north of the Iberian Peninsula (Spain) and in the Bay of Biscay (France) (Quéro & Duron, 1980; Bañón *et al.*, 2019). The species had never been cited in the Mediterranean Sea.

On April 28, 2022 a specimen was caught by a trawling fishing vessel in the Balearic Sea (Spain) in the western Mediterranean. Data of the fishing haul are: mean coordinates 38.7060° N 0.4798° E; depth range 185-210 m. After examination, the right otolith sagitta was extracted and the specimen was deposited in the CBMR collection (reference marine biological collections, ICM-CSIC) with the code ICMP001933.

The specimen (Fig. 12A) measured 116.3 mm TL (Total Length) and weighed 51.05 g. Morphometrics (in mm) of the specimen are: Standard Length (SL) = 97.5; Pre-Dorsal Length (PDL) = 61.1; Preorbital Length (POL) = 10.9; Interorbital Length (IOL) = 11.2; Body Height (BH) = 99.3; Caudal peduncle Height (CPH) = 13.7; Eye Diameter (ED) = 12.5. Fin ray formula is: dorsal: VIII + 34; anal: III + 32; pelvics: I + 6; pectorals: 13. These data allow to clearly identify the species, in particular with respect to the other Caproidae present in the Atlantic and very common in the Mediterranean, *Capros aper* Lacepède, 1802 (Quéro, 1986).

The otolith sagitta (Fig. 12B) shows the characters previously described in *Antigonia capros* by Stinton (1967) and Tuset *et al.* (2008) and it is well differentiated from *Capros aper* sagitta (Tuset *et al.*, 2008). The morphological traits are a tall rhomboidal general shape with ventral area more developed than dorsal. The anterior region is double-peaked with a short and broad rostrum and presence of antirostrum. The sulcus acusticus is heterosulcoid ostial, with ostium wider and shorter than a tubular and straight cauda. Otolith measurements (in mm) are: Otolith length (OL) = 5.88; Otolith width (OW) 6.81.

The present finding constitutes the first record of this species for the Mediterranean Sea. Recent citations (Quéro & Duron, 1980; Bañón *et al.*, 2019) and the current paper suggest that it is a species that can be considered range expanding. Their presence in the Balearic Sea seems to coincide with the trend towards the entry of numerous species with tropical and subtropical affinities through the Strait of Gibraltar over the last few decades, probably due to climate change (Golani *et al.*, 2021).

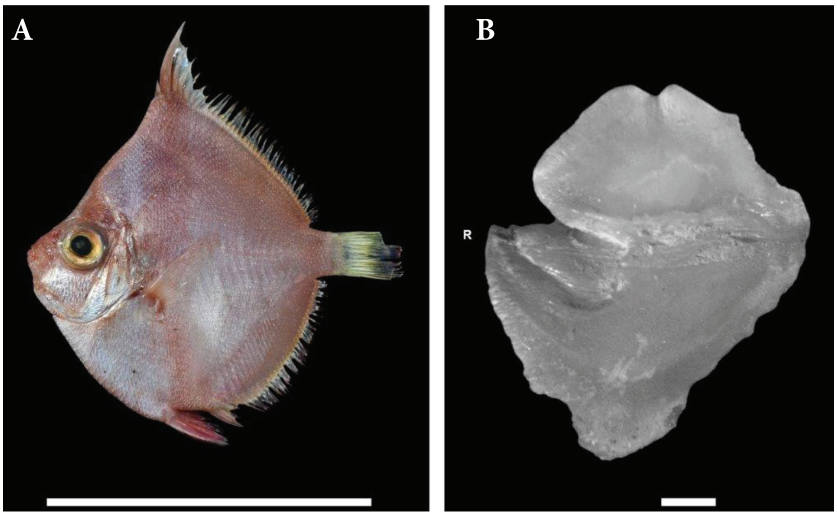

Fig. 12: *Antigonia capros* from the Balearic Sea (Western Mediterranean). A) The specimen in lateral view. B) Right otolith sagitta of the specimen, R mean rostrum. Scale bars: 100 mm in A), 1 mm in B).

7.2. First record of the lionfish *Pterois miles* (J. W. Bennett, 1828) (Scorpaenidae) from the Alboran Sea

Ángel BELMONTE-GALLEGOS and José Carlos BÁEZ

This work reports on the first confirmed record of a lionfish *Pterois miles* (J. W. Bennett, 1828) (Scorpaenidae) from the Alboran Sea. The fish was filmed with a Go-pro on 15 August 2022 on a sandy bed near the *Posidonia oceanica* seagrass meadow at 5 m depth (Fig. 13). *Pterois miles* was filmed by ABG, an expert diver during a recreational dive, at Corralete beach, near the Cabo de Gata lighthouse (36.7233°N, 2.1933°W).

Fig. 13: Lionfish filmed from the Alboran Sea on a sand bed near the *Posidonea oceanica* seagrass meadow.

The lionfish is considered an alien species in the Mediterranean Sea which arrived in Eastern Mediterranean waters in 1991 from the Red Sea, and progressively it has been spreading towards the Western Mediterranean. The last confirmed sightings placed the species in the Adriatic Sea (Dragičević *et al.*, 2021) and north Tunisia (Ounifi Ben Amor *et al.*, 2022). However, predictive models based on sea warming predicted that it could reach the Alboran Sea, via North Africa (Dimitriadis *et al.*, 2020).

In recent years the Alboran Sea due to global warming has shown maximum peaks in sea surface temperature, accompanied by anomalous biological events, such as the first confirmed nesting of the loggerhead turtle *Caretta caretta* (Linnaeus, 1758) in the Northern Alboran Sea (Báez *et al*., 2020).

There are more examples of tropical fish that have been recorded in the Alboran Sea, such as bigeye tuna *Thunnus obesus* (Lowe, 1839), recorded by Pérez Bielsa *et al*. (2021), but in these cases their origin is from the Atlantic Ocean. We believe that the most likely route of introduction of lionfish to Cabo de Gata (Alboran Sea) is from Tunisia via North Africa, so it is very likely that there are established populations in Morocco or Algeria yet to be discovered.

7.3. First record of lionfish, *Pterois miles* (Bennett, 1828) (Scorpaenidae) from the Montenegrin waters (south-eastern Adriatic Sea)

Olivera MARKOVIĆ and Ilija ĆETKOVIĆ

The lionfish *Pterois miles* (Bennett, 1828) is considered among the most invasive species in the Mediterranean Sea (Tsirintanis *et al.*, 2022). Dimitriadis *et al.* (2020) that reviewed its distribution in the Mediterranean by October 2019 stated that "*even the most moderate of the scenarios examined, i.e. RCP4.5 by 2050, indicates a risk of considerable expansion towards the middle Adriatic and the Western Mediterranean*". Indeed, the first occurrences of this species in the Adriatic Sea were near Lecce in Italy and beach Dhermi in Albania in July 2019 (Di Martino & Stancanelli, 2021). Subsequently the species was reported in Torre Canne near Brindisi in August 2020 (Di Martino & Stancanelli, 2021) and in Croatian waters near island Vis in August 2021 (Dragičević *et al.*, 2021).

A single specimen of lionish, *P. miles* was observed in the southern Adriatic Sea (Montenegrin territorial waters) at the end of October 2022 (Fig. 14). It was observed near Cape Volujica on a rocky bottom at a depth of approximately 15 m (42.089190° N, 19.069170° E). The video footage was provided by the local spear-fisher). This new record confirms the hypothesis that this species is capable of expanding and establishing in the Adriatic Sea as Karachle *et al.* (2017) had predicted by including *P. miles* among the species expected to spread in ESENIAS countries (i.e., Albania and Montenegro).

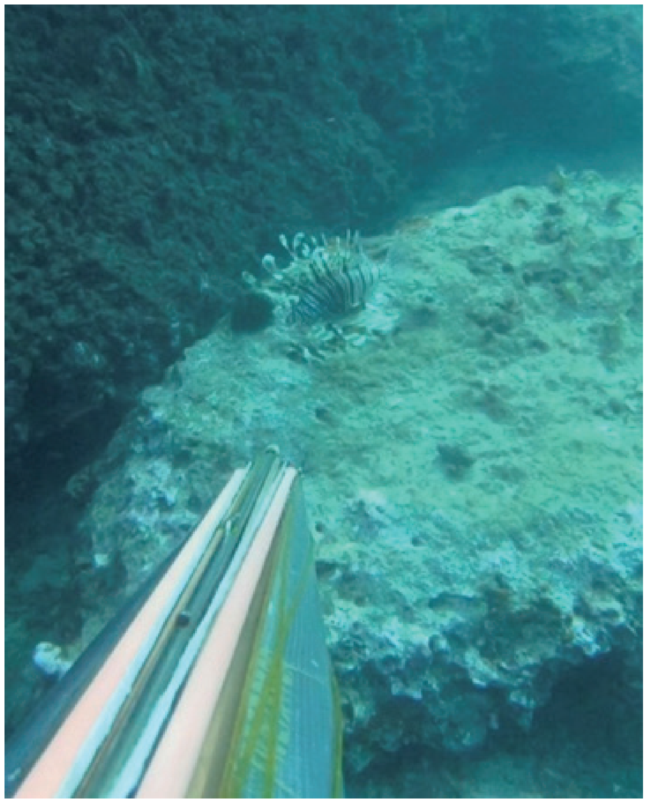

Fig. 14: The lionfish, *Pterois miles* in the Montenegrin waters (southeastern Adriatic Sea). Photo credits: Andrej Samardžić.

7.4. First record of *Rhincodon typus* (Orectolobiformes: Rhincodontidae) from the western Mediterranean Sea

Andrea SPINELLI and Álvaro GARCÍA DE LOS RÍOS Y LOS HUERTOS

The whale shark *Rhincodon typus* Smith, 1828 (Orectolobiformes: Rhincodontidae) is the largest living fish in the world's oceans, a pelagic filter feeder, living singly or in schools, from coastal to oceanic waters (Stewart & Wilson, 2005; Compagno, 2001). It commonly occurs in tropical and temperate waters, with seasonal aggregations in tropical and subtropical waters from the Atlantic to the Pacific and Indian Oceans (Stewart & Wilson, 2005). In the Mediterranean Sea, the species is not included in the most recent checklist of elasmobranchs (Serena *et al.*, 2020). Nevertheless, a single record has recently been reported off Samandağ, Hatay, Turkey, in the eastern Mediterranean Sea, representing the first species record in the basin (Turan *et al.*, 2021). On 6th December 2022, at 12:00 a.m., one adult female specimen of *R. typus* was observed during a SCUBA dive inside a pound net for tuna fishing off Ceuta, a Spanish autonomous territory in the north coast of Africa, northwestern Mediterranean Sea (35.970945° N, 5.378601° W). The leader of pound net was oriented to the south-east. The specimen was alive and in good condition, initially swimming near the fishing net close to the sandy bottom, at a depth of 20 m. Divers from the CECAM (Center for Studies and Conservation of Marine Animals of Ceuta) were able to accompany the animal out of the pound net leader. The observed specimen (Fig. 15) was recorded by a diver of CECAM

(Juan Carlos Rivas) who shot a short video clip (publicly accessible on Facebook). It measured approximately 10 m of total length. Some individuals of the pilotfish *Naucrates ductor* (Linnaeus, 1758), remoras *Remora* spp. and five short-beaked common dolphins (*Delphinus delphis* Linnaeus, 1758) were swimming close to the whale shark. Unique body markings represented by white and yellow spots between vertical and horizontal stripes that form a checkerboard-pattern agree with the description of *R. typus* in Stewart & Wilson (2005) and clearly distinguish this species from other members of Orectolobiformes. The presence of *R. typus* in the south-eastern Spanish waters represents the first species record in the western Mediterranean Sea and the second species record at Mediterranean scale. In accordance with Turan *et al.*, (2021), it is currently difficult to hypothesize the causes of the migration of the whale shark in the Mediterranean Sea. However, its presence in the southern Portugese waters (Rodrigues *et al.*, 2012) could suggest that the present individual may have migrated to the western Mediterranean through the Gibraltar Channel, however, without excluding the hypothesis that it may have entered the Mediterranean Sea through the Suez Channel to finally reach the western part of the basin.

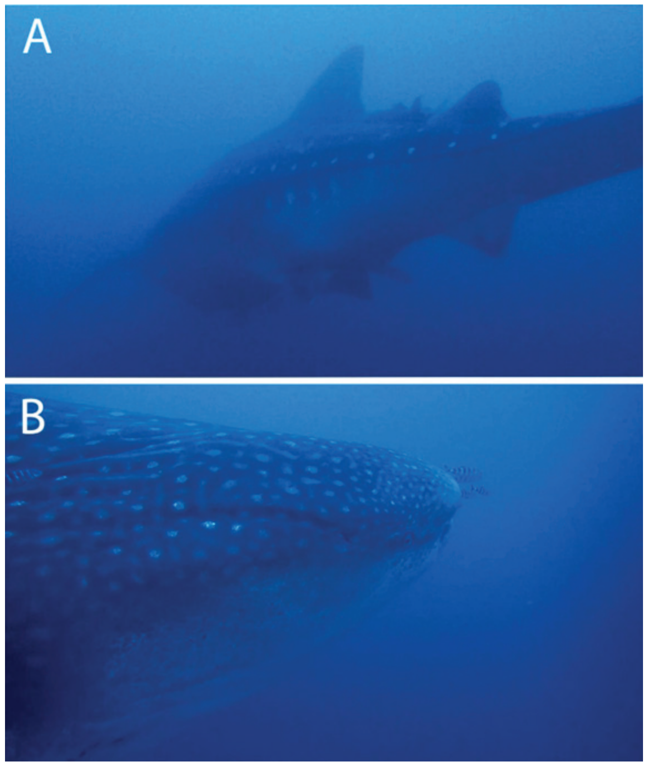

Fig. 15: A) Specimen of *Rhincodon typus* filmed at Ceuta (Spain) on 6 December 2022. B) Closer view to the specimen's unique body markings forming a checkerboard-pattern.

7.5. First record of *Sardinella gibbosa* (Bleeker, 1849) in the Syrian marine waters (eastern Mediterranean)

Reem AL-SHEIKH RASHEED, Mohamad GALIYA and Zouhair ALMAJID

The Clupeidae family constitutes an important economic source as food for humans and bait for fish in the eastern Mediterranean. Six species of this family have been recorded so far in Syrian marine waters. This study is the first record of *Sardinella gibbosa* (Bleeker, 1849) in Syrian marine waters and the second in the Mediterranean Sea. *Sardinella gibbosa* is common on the coasts of India, the western Pacific Ocean, eastern Africa, Madagascar, northern Australia, and the Red Sea (Dor, 1984). It was first recorded in the Mediterranean Sea as a non-native species in 2015 from the Israeli Levantine coast (Stern *et al.*, 2015). One of the most important outcomes of the opening of the Suez Canal was the Lessepsian migration between the Red Sea and the Mediterranean Sea, as more than 104 fish species migrated through it to the Mediterranean Sea (Golani *et al.*, 2020). The *S. gibbo-*

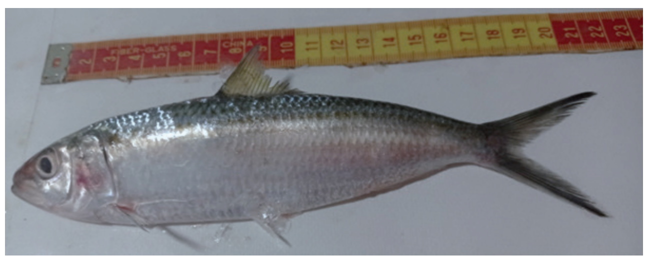

Fig. 16: *Sardinella gibbosa* caught from Syrian marine waters with a weight of 72.82 g and a length of 21 cm.

Table 4. Morphometric measurements of the two specimens of *Sardinella gibbosa* caught from the marine waters of Syria.

Morphometric measurements	Specimen 1	Specimen 2
Weight (g)	53.48	72.82
Length (cm)	18	21
Standard Length (cm)	14.5	17
Maximum body depth (cm)	3.5	3.9
Number of rakers on the first-gill arch	49	56

sa specimens of this study were caught on 30 July 2022 from Ras al-Bassit (35.8524°N, 35.8378°E), north of the Syrian coast, as part of a periodic sampling of Clupeidae fish, with the aim of identifying the species of the Syrian coast. Morphometric measurements of the samples were taken in the lab (Table 4). *Sardinella gibbosa* is characterized by a slender body, compressed sides, and depth that usually ranges from 24 to 30% of the standard length (Fig. 16). The caudal fin is divided into two equal parts. The dorsal and caudal fins are dark-edged with a black spot at the beginning of the dorsal fin. It has 32 to 34 scutes and 45 to 59 lower gillrakers (Whitehead, 1985).

7.6. The neonative *Seriola rivoliana* in the Tyrrhenian Sea (central-western Mediterranean)

Riccardo VIRGILI and Fabio CROCETTA

The genus *Seriola* Cuvier, 1816 (family Carangidae) includes four taxa in the Mediterranean Sea. These are the greater amberjack *S. dumerili* (Risso, 1810), a native and widespread fish, and three species only recorded in the basin since the last decades, namely the Guinean amberjack *S. carpenteri* Mather, 1971 and the almaco jack *S. rivoliana* Valenciennes, 1833, only known so far from scattered occurrences, and the lesser amberjack *S. fasciata* (Bloch, 1793), that in about 30 years already colonized the entire Mediterranean basin (Louisy, 2020; Golani *et al.*, 2021).

On the 16 June 2022, a single specimen of the genus *Seriola* was spearfished below a floating object in the Gulf of Pozzuoli (Gulf of Naples, Tyrrhenian Sea, central-western Mediterranean Sea, ~40.9363° N, 14.1497° E) (Fig. 17A). Although gills and viscera were removed soon after for food consumption, the general shape and colour of the fish led the fisherman to contact one of the authors (F.C.) as to verify whether the specimen belonged to the common *S. dumerili* or not. Upon request, it was frozen and brought in the next days to the Laboratory of Benthos-Napoli (Stazione Zoologica Anton Dohrn, Naples, Italy). Once thawed, the fish was weighed to the nearest 0.1 g, pinned, measured to the nearest mm with a measuring tape and a digital caliper, and photographed (Fig. 17B). The specimen was silvery violet to grey-olive in colour with a paler ventral part, and a dark bar was present from the eye to the dorsal fin origin (Fig. 17A). It showed a moderately elongated and compressed body (Fig. 17B), being 2.56 times longer than broad in standard length (SL), the lobes of the second dorsal fin (Fig. 17B, purple arrow) and of the anal fin (Fig. 17B, green arrow) were long and pointed, and it had a broad posterior end of the upper jaw (supramaxilla) reaching the orbit level (Fig. 17A–B, red arrow). Measurements and meristic traits were recorded according to Holden & Raitt (1974) and are reported in Table 5. Morphological characters reported above suggested its identification as *S. rivoliana*, as the second dorsal fin in three other species reported in the Mediterranean is shorter. Moreover, *S. dumerili* and *S. carpenteri* have a slenderer body (2.8–3.1 times longer than broad), whereas *S. fasciata* has a thin posterior end of the supramaxilla (Smith-Vaniz, 2002; Louisy, 2015; Golani *et al.*, 2021). These three latter species are also very different in colour with respect to *S. rivoliana* (see Smith-Vaniz, 2002; Louisy, 2020; Golani *et al.*, 2021).

As a further support, DNA barcoding of a partial portion (646 base pairs) of the *cytochrome c oxidase I* (COI) gene was performed following the methods described in Osca *et al.* (2020). The BLASTn hits produced a 98.7–100% similarity with 44 COI sequences deposited in GenBank as *S. rivoliana*, whereas all the other taxa showed lower similarities (≤94.5%). This result falls within the accepted barcode gap for teleosts and confirms the preliminary morphological identification. With regards the other three above-mentioned species, *S. dumerili* scored 93.67–94.5%, *S. carpenteri* 88.58%, and *S. fasciata* 88.33–89.60%, thus excluding conspecificity. The obtained sequence was deposited in GenBank with the accession number OP692478, whereas the specimen was fixed in 99.9% ethanol and deposited in the collection of the Laboratory of Benthos-Napoli (SZN_B_3522FS-C7A).

The almaco jack *S. rivoliana* has a wide tropical and subtropical distribution, occurring in the Indo-Pacific as well as in the western and eastern Atlantic Ocean

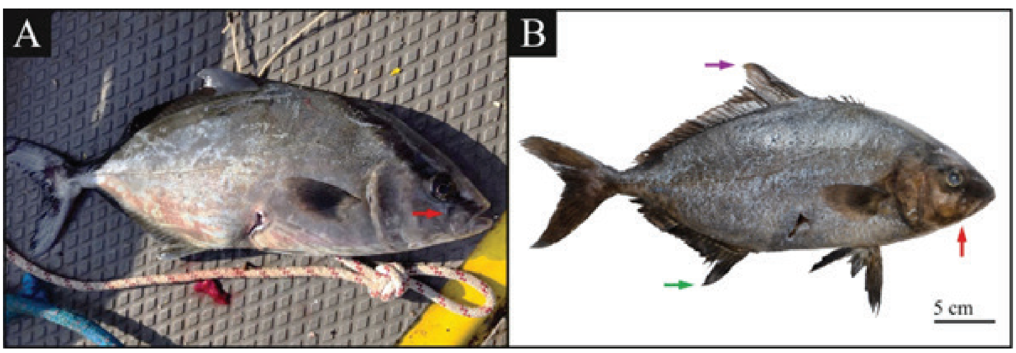

Fig. 17: *Seriola rivoliana* (SZN_B_3522FSC7A) from the Gulf of Pozzuoli (Tyrrhenian Sea). A) Lateral views of the specimen fresh spearfished and B) pinned after thawing. Purple arrow highlighting the lobe of the second dorsal fin. Green arrow highlighting the lobe of the anal fin. Red arrow highlighting the posterior end of the supramaxilla.

Table 5. Morphometric measurements of the *Seriola rivoliana* specimen reported as absolute (mm) and standardized to the standard length (% SL). Meristic measurements are reported as hard rays with roman numerals and soft rays with Arabic numerals. Abbreviations used: SL - Standard length; L - length; D - distance; DI - diameter.

Morphometry	Absolute	% SL		Absolute	% SL
Total L	376	124	Caudal peduncle L	122	40
Fork L	349	115	Dorsal fin base L	182	60
Standard length (SL)	303	–	Dorsal fin L	50	17
Greatest depth	118	39	Dorsal fin height	31	10
Greatest breadth	47	16	Pectoral fin L	42	15
Upper head L	72	24	Ventral fin L	50	17
Head depth	64	21	Anal fin base L	50	17
Preanterior dorsal D	97	32	Dorsal caudal fin L	87	29
Snout L	28	9	Ventral caudal fin L	60	20
Mandibular L	56	18	Spread caudal D	65	21
Perpendicular iris DI	8	3	Mass (g)	748*	
Longitudinal iris DI	10	3	**Meristic**		
Orbital DI	14	5	Dorsal fin	VII + I+29	
Postorbital D	36	12	Pectoral fin	24	
Interorbital D	30	10	Ventral fin	I + 5	
Preanal D	195	64	Anal fin	II + I+19	
Caudal peduncle depth	20	7	Caudal fin	26	

* Weight of the specimen without gills and viscera.

(Smith-Vaniz, 2002). Since 2000, it also enlarged its range to the Mediterranean Sea, where it was so far known from seven sightings located in the western and central-southern parts of the basin, namely Lampedusa Island (Italy), northern Tunisia, Balearic Islands (Spain), and Libya (Golani *et al.*, 2021 and references therein). The present record therefore first testifies its spreading in the Tyrrhenian Sea and in general along the Italian mainland waters. In addition, it also accounts for the northernmost finding in the Mediterranean Sea. Although the occurrence of this species in the basin is still considered a rare event, reasons for its expansion may be attributed to the growing sea surface temperatures and the general tropicalization of the Mediterranean Sea, which are increasingly contributing to the establishment of exotic and thermophilic species (Golani *et al.*, 2021). Absence of further detection in the basin may has been hindered by the pelagic lifestyle of the species coupled with the similarity with young specimens of *S. dumerili*.

7.7. First record of *Tylosurus crocodilus* (Péron & Lesueur, 1821) in the northern Adriatic Sea

Diego BORME, Federica CAMISA and Nicola BETTOSO

The family Belonidae comprises 10 genera and 47 species found in all tropical and warm temperate seas (Froese & Pauly, 2022). Only *Belone belone* (Linnaeus, 1760) is truly native to the Mediterranean Sea, but four other species are reported as occasional (Froese & Pauly, 2022): *Belone svetovidovi* Collette & Parin, 1970, *Tylosurus acus imperialis* (Rafinesque, 1810), *T. choram* (Rüppell, 1837) and *T. crocodilus* (Péron & Lesueur, 1821). The hound needlefish *T. crocodilus* is a tropical marine species found in coral reefs and lagoons at depths above 13 m. This pelagic fish usually swims alone or in small groups near the surface and feeds on small fish. The eggs are large and covered with well-developed sticky chorionic filaments that allow them to cling to floating objects. The species is distributed in the tropical waters of the Indo-West Pacific, from the Red Sea to French Polynesia, north to Japan, south to New South Wales, Australia (Froese & Pauly, 2022). In the eastern Atlantic, it is known only from a few specimens caught in the Gulf of Guinea and on Ascension Island (Collette, 2016).

On 16 June 2022, an adult male specimen of *T. crocodilus*, with total length 887 mm and weighing 793.0 g, was caught on a sandy bottom at a depth of 10 m off Grado (45.7015° N, 13.5030° E) in the Gulf of Trieste, the northernmost part of the Mediterranean Sea. The specimen was caught with a trammel net targeting cuttlefish. After being recognized at the fish market, the specimen was taken to the laboratory, measured and freshly dissected. After dissection gonads were observed and recognized thanks to emission of sperm. The main diagnostic characters were: absence of vertical bars (Fig. 18A), absence of gill-rakers, presence of black caudal peduncle

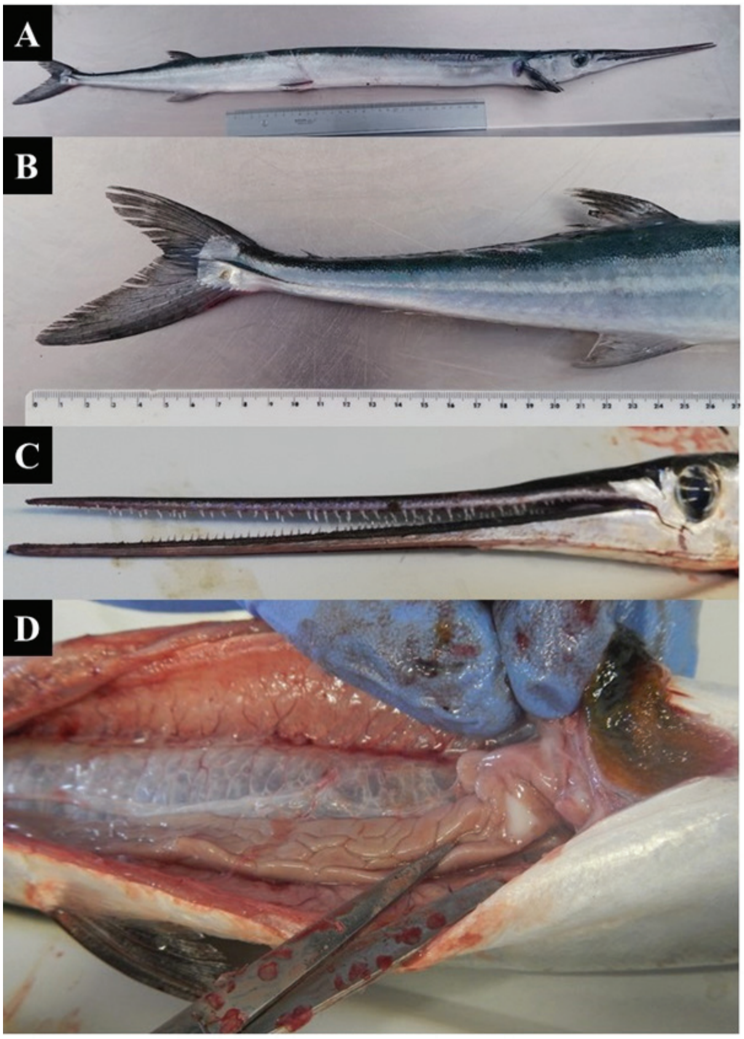

Fig. 18: View of the entire body A), caudal fin B), mouth and teeth C), right gonad with emission of sperm D) of a male specimen of *Tylosurus crocodilus* caught in the northern Adriatic Sea on 16 June 2022; notches on the ruler are in centimetres (Photo credits: D. Borme and F. Camisa).

Table 6. Meristic counts and morphometric measurements (expressed as % of standard length - SL) of *Tylosurus crocodilus* caught in coastal waters off Grado (northern Adriatic Sea) compared with specimens from the northern Aegean Sea (Sinis, 2005), the north-eastern Indian Ocean (Barik *et al.*, 2018; Roul *et al.*, 2019) and with Collette (2016).

Meristic counts	Adriatic	N Aegean	NE Indian Ocean	Collette (2016)
Dorsal fin rays	22	24	18-23	21-23
Anal fin rays	22	23	20-21	18-22
Pectoral fin rays	14	14	14-15	13-15
Pelvic fin rays	6	6	6	
Caudal fin rays	11 (sup); 14 (low)			
Pre-dorsal scales	328		271-340	240-290
Vertebrae	85		82-86	79-84
Teeth on upper jaw	124			
Teeth on lower jaw	106			
Morphometric measurements	**Adriatic (%SL)**		**NE Indian Ocean (%SL)**	
Head length	29.7		31.2-32.2	
Pre-dorsal length	79.0		77.7-80.0	
Pre-pectoral length	30.7		31.9-33.0	
Pre-Pelvic length	61.8		60.4-63.0	
Pre-anal length	77.2		76.5-79.6	

keel (Fig. 18B), prominent lower lobe of the caudal fin (Fig. 18B), teeth of similar size (Fig. 18C) and left gonad shorter than the right (Fig. 18D). Meristic counts and morphometric measurements were compared with the description of *T. crocodilus* made by Collette (2016), Sinis (2005), Barik *et al.* (2018) and Roul *et al.* (2019) (Table 6). To our knowledge, this is the first record for the Adriatic Sea and the second for the Mediterranean (Sinis, 2005), representing a case of Lessepsian introduction. The specimen is currently frozen in the laboratory and some muscle samples were preserved in 96% ethanol for further genetic analyses.

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