Mediterranean Marine Science

Vol 25, No 2 (2024)

Mediterranean Marine Science

New records of introduced species in the Mediterranean (August 2024)

GEORGIOS CHRISTIDIS, IZDIHAR ALI AMMAR, MOUNA ANTIT, YOUNES MUNIF BARHOUM, GIANNI BRUNDU, ALBERTO COLLETTI, FABIO CROCETTA, ANDREA DESIDERATO, MARKOS DIGENIS, MEHMET GÖKOĞLU, DANIELE GRECH, PERIKLIS KLEITOU, GERASIMOS KONDYLATOS, IOANNIS KOSOGLOU, MARIJA KVESIĆ IVANKOVIĆ, GIORGOS LAZARAKIS, MARCO LEZZI, CRISTINA MAZZIOTTI , MANOLIS METAXAKIS , CHRISTINA MICHAIL, SERENA MUCCIOLO, JELENA NEJAŠMIĆ, EMINE SUKRAN OKUDAN, FIKRET ÖNDES, ADNAN ÇAĞLAR ORUÇ, PANAGIOTA PERISTERAKI, JULIEN P. RENOULT, VALENTINA TANDUO, INCI TUNEY, MESUT YILMAZ, ANTE ŽULJEVIĆ, VASILIS GEROVASILEIOU

doi: 10.12681/mms.34474

To cite this article:

CHRISTIDIS, G., AMMAR, I. A., ANTIT, M., BARHOUM, Y. M., BRUNDU, G., COLLETTI, A., CROCETTA, F., DESIDERATO, A., DIGENIS, M., GÖKOĞLU, M., GRECH, D., KLEITOU, P., KONDYLATOS, G., KOSOGLOU, I., KVESIĆ IVANKOVIĆ, M., LAZARAKIS, G., LEZZI, M., MAZZIOTTI , C., METAXAKIS , M., MICHAIL, C., MUCCIOLO, S., NEJAŠMIĆ, J., OKUDAN, E. S., ÖNDES, F., ÇAĞLAR ORUÇ, A., PERISTERAKI, P., RENOULT, J. P., TANDUO, V., TUNEY, I., YILMAZ, M., ŽULJEVIĆ, A., & GEROVASILEIOU, V. (2024). New records of introduced species in the Mediterranean (August 2024). *Mediterranean Marine Science*, *25*(2), 453–479. https://doi.org/10.12681/mms.34474

Collective Article A

Mediterranean Marine Science
Indexed in WoS (Web of Science, ISI Thomson) and SCOPUS
www.hcmr.gr
DOI: https://doi.org/10.12681/mms.34474

New records of introduced species in the Mediterranean (August 2024)

Georgios CHRISTIDIS[1,2], Izdihar Ali AMMAR[3], Mouna ANTIT[4], Younes Munif BARHOUM[5], Gianni BRUNDU[6], Alberto COLLETTI[7], Fabio CROCETTA[8], Andrea DESIDERATO[9], Markos DIGENIS[10], Mehmet GÖKOĞLU[11], Daniele GRECH[6], Periklis KLEITOU[12], Gerasimos KONDYLATOS [13], Ioannis KOSOGLOU[1], Marija KVESIĆ IVANKOVIĆ[14], Giorgos LAZARAKIS[1], Marco LEZZI[15], Cristina MAZZIOTTI[15], Manolis METAXAKIS[1], Christina MICHAIL[12], Serena MUCCIOLO[9], Jelena NEJAŠMIĆ[14], Emine Sukran OKUDAN[11], Fikret ÖNDES[16], Adnan Çağlar ORUÇ[16], Panagiota PERISTERAKI[1], Julien P. RENOULT[17], Valentina TANDUO[8], Inci TUNEY[18], Mesut YILMAZ[11], Ante ŽULJEVIĆ[14] and Vasilis GEROVASILEIOU[10,19]

[1] Hellenic Centre for Marine Research (HCMR), Institute of Marine Biological Resources and Inland Waters (IMBRIW),
71500, Heraklion, Greece
[2] Department of Biology, University of Crete, 70013, Heraklion, Greece
[3] Marine Biology Department, High Institute of Marine Research, Tishreen University, Latakia, Syria
[4] Université de Tunis El Manar, Faculté des Sciences de Tunis, LR18ES41 Ecologie,
Biologie et Physiologie des Organismes Aquatiques, 2092, Tunis, Tunisia
[5] Department of Zoology, Faculty of Science, Tishreen University, Latakia, Syria
[6] IMC - International Marine Centre, Loc. Sa Mardini, Torregrande - 09170 Oristano, Italy
[7] Department of Biology, University of Naples Federico II, Naples, Italy
[8] Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Villa Comunale, 80121 Naples, Italy
[9] Department of Invertebrate Zoology and Hydrobiology, Faculty of Biology and Environmental Protection, University of Lodz,
Banacha 12/16, 90 237 Lodz, Poland
[10] Department of Environment, Faculty of Environment, Ionian University, 29100 Zakynthos, Greece
[11] Faculty of Fisheries, Akdeniz University, Antalya, Türkiye
[12] Marine and Environmental Research (MER) Lab Ltd., 202 Amathountos Av.,
Marina Gardens, Block B, Offices # 13-14, Parekklisia, Limassol, Cyprus
[13] Hydrobiological Station of Rhodes, Hellenic Centre for Marine Research, Cos Street, 85131 Rhodes, Greece
[14] Institute of Oceanography and Fisheries, Šetalište I. Meštrovića 63, 21 000 Split, Croatia
[15] ARPAE, Regional Agency for Environmental Protection and Energy of Emilia Romagna,
Oceanographic Unit Daphne,47042 Cesenatico (FC), Italy
[16] Faculty of Fisheries, Izmir Katip Çelebi University, Cigli, Izmir 35620, Türkiye
[17] CEFE – University of Montpellier, CNRS, EPHE, IRD, Montpellier, France
[18] Ege University, Faculty of Science, Department of Biology, Izmir, Türkiye
[19] Hellenic Centre for Marine Research (HCMR), Institute of Marine Biology, Biotechnology and Aquaculture (IMBBC),
Thalassocosmos, Gournes, Crete, Greece

Abstract

This Collective article presents 18 introduced taxa in the Mediterranean Sea, belonging to seven phyla and documented at 22 new locations and seven countries spanning from the Levantine to the western Mediterranean. These records include the first country records of the African mussel *Perna perna* (Syria), the sea slug species complex *Elysia* cf. *marginata-grandifolia* (Cyprus), the green algae *Acetabularia caliculus* and the parasitic amphipod *Brachyscelus rapacoides* (Türkiye), the lizardfish *Synodus randalli* (Greece), the red algae *Chondria coerulescens* (Croatia) and the gastropod *Pyrgulina maiae* (Tunisia). Moreover, the cardinalfish *Cheilodipterus novemstriatus* is recorded for the first time from the Aegean Sea (Greece), the shrimp *Urocaridella pulchella* from the Ionian Sea (Greece) and the colonial ascidian *Aplidium accarense* and the polychaete *Laonome triangularis* from the Adriatic Sea (Italy). Regarding the expansion of non-indigenous species, this article documents the southernmost occurrence of the cornetfish *Fistularia petimba* in the Aegean Sea (Greece) and the westernmost occurrence of the lizardfish *Saurida lessepsianus* in the Mediterranean (Greece). Moreover, it includes information on the continued spread of the zooxanthellate coral *Oculina patagonica* in Türkiye, as well as the further expansion of the crab *Dyspanopeus sayi* and the colonial ascidian *Polyandrocarpa zorritensis* in Italy. Finally, the first Mediterranean record of the sea slug *Tubulophilinopsis reticulata* (Tunisia), and the northernmost global record of the snapping/pistol shrimp *Synalpheus africanus* (Italy) are reported.

Introduction

Marine bioinvasions result from the introduction of marine species into new areas beyond their native range, either through human activities or natural processes (Canning-Clode, 2015). In the 21st century, bioinvasions are a leading cause of global biodiversity loss and can significantly impact marine ecosystems through altering their structure and function (e.g., Bax *et al.*, 2003; Galil, 2007; Katsanevakis *et al.*, 2014). A non-indigenous species (NIS) is considered as successful invader when it establishes self-sustaining populations and expands its range in the recipient environment (Lockwood *et al.*, 2013). Some established NIS become invasive, posing significant ecological, economic and human-health threats (Occhipinti-Ambrogi & Galil, 2009). During the last decades, the rate of marine bioinvasions has increased due to the globalization and intensification of human activities such as trade, shipping and aquaculture (Hulme, 2009; Seebens *et al*., 2013). Studies conducted in different regions around the world have documented this increasing trend (i.e., Wonham & Carlton, 2005; Chan *et al*., 2018; Zenetos *et al*., 2022a), while others predict that the global invasion risk will significantly escalate in the future (Sardain *et al*., 2019; Seebens *et al*., 2021).

The Mediterranean Sea is an area of particular interest as it is the most invaded sea worldwide, currently hosting approximately 1000 NIS (Zenetos *et al*., 2022b). The main vectors of NIS' introductions in the Mediterranean are sea corridors (the Strait of Gibraltar and the Suez Canal), shipping activity (ballast waters and hull fouling) and aquaculture (escapes and contaminants of cultured species) (Zenetos *et al*., 2012). The eastern Mediterranean is the most impacted subregion, due to its proximity to the Suez Canal, resulting in a higher influx of NIS from the Red Sea (Galil *et al*., 2018). Tracking the spatio-temporal trends of NIS is crucial to adopt management measures in order to prevent further expansion and mitigate potential impacts. Regularly updating inventories of NIS at global, regional and national levels offers a fundamental baseline to manage these species effectively (Tsiamis *et al*., 2019). Since 2011, the scientific journal "Mediterranean Marine Science" has been publishing the series Collective Article A', providing a consistent overview of new introductions in the Mediterranean basin and the expansion status of already introduced species. In the latest series, the term "introduced species" is used according to Gerovasileiou *et al*. (2022) and includes non-indigenous, cryptogenic (species with unclear native or introduced origin), crypto-expanding (species with unclear natural or human-mediated expansion), and species with questionable status.

This collective article presents new information on 18 introduced taxa in the Mediterranean Sea belonging to seven phyla: Chlorophyta (one species), Rhodophyta (one species), Cnidaria (one species), Mollusca (three species and one species complex), Annelida (one species), Arthropoda (four species) and Chordata (two species of Ascidiacea and four species of Osteichthyes) (Table 1, Fig. 1). The majority of records encompasses non-indigenous taxa from the eastern and central basins, with the exception of the African mussel *Perna perna* and the red algae *Chondria coerulescens* which are considered cryptogenic species (Verlaque *et al*., 2015; Fofonoff *et al*., 2018). All but one of these taxa have previously been recorded in the Mediterranean, with this study documenting new distribution sites, thereby providing further information on their ongoing expansion within the basin. The taxa presented here originate from the Indian and Indo-Pacific Oceans (seven species and one species complex), others naturally distribute in the Atlantic Ocean (five species) and the Australian waters (one species), while two species exhibit a broader native range (e.g., they occur in the Atlantic, Indian and Pacific Oceans). Notably, most of the records are in the vicinity or inside ports and one species in a lagoon, locations known as introduction hotspots requiring consistent monitoring (Hewitt, 2003; Rilov & Galil, 2009; Ojaveer *et al*., 2014).

The new records are organized into seven country-based subsections and presented geographically from the eastern to the western Mediterranean. They include the first occurrence of the sea slug *Tubulophilinopsis reticulata* in the Mediterranean Sea and several first country records, namely the African mussel *Perna perna* from Syria, the sea slug species complex *Elysia* cf. *marginata-grandifolia* from Cyprus, the green algae *Acetabularia caliculus* and the parasitic amphipod *Brachyscelus rapacoides* from Türkiye, the lizardfish *Synodus randalli* from Greece, the red algae *Chondria coerulescens* from Croatia and the gastropod *Pyrgulina maiae* from Tunisia. Additionally, the cardinalfish *Cheilodipterus novemstriatus* is reported for the first time in the Aegean Sea (Greece), the shrimp *Urocaridella pulchella* in the Ionian Sea, as well as the colonial ascidian *Aplidium accarense* and the polychaete *Laonome triangularis* in the Adriatic Sea. Records documenting the further spreading of introduced species include the mud crab *Dyspanopeus sayi* and the colonial ascidian *Polyandrocarpa zorritensis* from Italy, the zooxanthellate coral *Oculina patagonica* from Türkiye, and those of the cornetfish *Fistularia petimba* and lizardfish *Saurida lessepsianus* from Crete (Greece). Finally, the record of snapping/pistol shrimp *Synalpheus africanus* from Italy is the northmost record of this species worldwide.

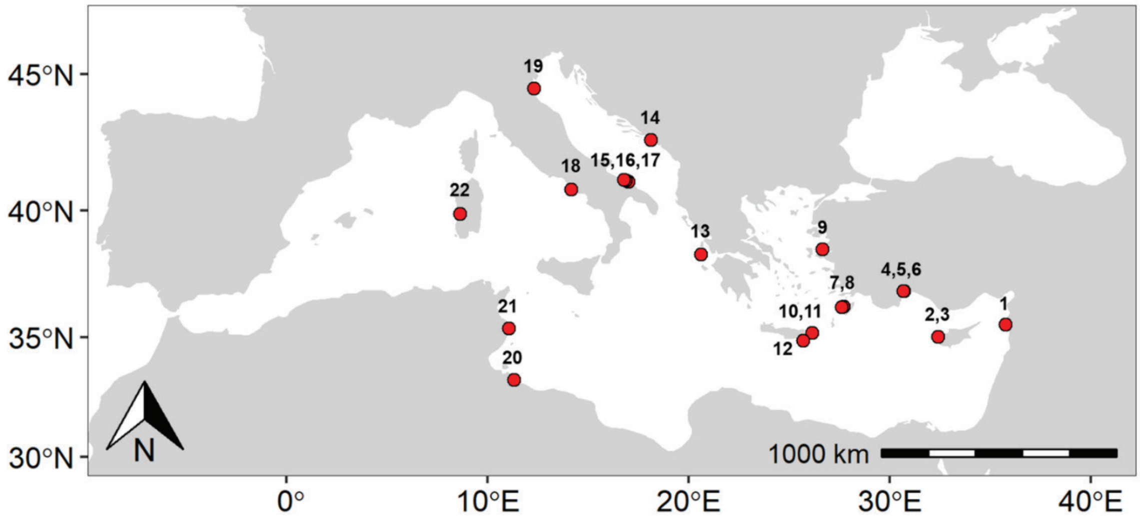

Fig. 1: Map of the Mediterranean Sea showing the locations (red dots) of the introduced species presented in this Collective article. Location numbers correspond to those of the LN column of Table 1.

Table 1. Species records included in the present article by phylum, basin (EMED: Eastern Mediterranean, CMED: Central Mediterranean, ADRIA: Adriatic Sea, WMED: Western Mediterranean), ecoregion, country and location. SC: the subsection of this article in which the species' record appears, LN: location numbers as they appear in Figure 1.

Taxon	Basin	Region	Country	Location	SC	LN
Phylum Chlorophyta						
Acetabularia caliculus J.V.Lamouroux, 1824	EMED	Levantine Sea	Türkiye	Antalya Gulf	3.2	6
Phylum Rhodophyta						
Chondria coerulescens (J.Agardh) Sauvageau 1897	ADRIA	Adriatic Sea	Croatia	Lokrum Island	5.1	14
Phylum Cnidaria						
Oculina patagonica de Angelis, 1908	EMED	Aegean Sea	Türkiye	Mordoğan	3.3	9
Phylum Mollusca						
Elysia cf. *marginata-grandifolia*	EMED	Levantine Sea	Cyprus	Latsi	2.1	2,3
Perna perna (Linnaeus, 1758)	EMED	Levantine Sea	Syria	Afamia	1.1	1
Pyrgulina maiae Hornung & Mermod, 1924	CMED	Tunisian Plateau	Tunisia	Hammamet Gulf	7.2	21
Tubulophilinopsis reticulata (Eliot, 1903)	CMED	Tunisian Plateau	Tunisia	El Biban lagoon	7.1	20
Phylum Annelida						
Laonome triangularis Hutchings & Murray, 1984	ADRIA	Adriatic Sea	Italy	Ravenna Port	6.2	19
Phylum Arthropoda						
Brachyscelus rapacoides Stephensen, 1925	EMED	Levantine Sea	Türkiye	Antalya Gulf	3.1	4,5
Dyspanopeus sayi (Smith, 1869)	WMED	Sardinia	Italy	Santa Giusta lagoon	6.4	22
Synalpheus africanus Crosnier & Forest, 1965	WMED	Tyrrhenian Sea	Italy	Bagnoli-Coroglio	6.3	18
Urocaridella pulchella Yokeş & Galil, 2006	CMED	Ionian Sea	Greece	Kefalonia Island	4.5	13
Phylum Chordata						
Aplidium accarense (Millar, 1953)	ADRIA	Adriatic Sea	Italy	Bari	6.1	16
Cheilodipterus novemstriatus (Rüppell, 1838)	EMED	Aegean Sea	Greece	Alimia and Chalki Islands	4.1	7,8
Fistularia petimba Lacepède, 1803	EMED	Crete	Greece	Sitia Gulf	4.3	11
Polyandrocarpa zorritensis (Van Name, 1931)	ADRIA	Adriatic Sea	Italy	Torre a mare and Santo Spirito	6.1	15,17
Saurida lessepsianus Russell, Golani & Tikochinski, 2015	EMED	Crete	Greece	Sitia Gulf	4.2	10
Synodus randalli Cressey, 1981	EMED	Crete	Greece	Chrysi Island	4.4	12

SYRIA

1.1 First record of *Perna perna* (Linnaeus, 1758) from Syria

Izdihar Ali AMMAR and Younes Munif BARHOUM

This note reports the first record of *Perna perna* (Linnaeus, 1758) on the Syrian coast. This species is a subtropical filter feeding bivalve (Bivalvia, Mollusca) belonging to the family Mytilidae. For the first time, two live individuals of *P. perna* were collected by hand from Afamia site next to the fishing port northwest of Latakia, Syria (35.544026° N, 35.756649° E).

The first individual was collected in 27 October 2020 from a small rocky substrate covered with a colony of the invasive mussel *Brachidontes pharaonis* (P. Fischer, 1870) and algae at a depth of 0.5 m. The second individual was collected on 10 November 2020 from a depth of almost 0.00 m, on a rocky substrate covered with *B. pharaonis* (Fig. 2), associated with the limpets *Fissurella nubecula* (Linnaeus, 1758) and *Patella caerulea* Linnaeus, 1758. The site was constantly exposed to wave movement and sea currents. Seawater temperature ranged between 25.6 and 28.7° C, salinity ranged between 37.9 and 38.4 ‰, and the dissolved oxygen concentration ranged between 6.4 and 7.7 mg/L.

Length of the studied specimens ranged between 3.52 and 3.75 cm, their width was 2.11-2.42 cm, and their height was 1.30-1.40 cm. The wet weight of the specimens was 3.025 and 4.183 g. *Perna perna* (Fig. 3A) has roughly oval shells in the ventral half, but in the dorsal half, they taper to a triangular shape with an apex at the hinge and an obtuse angle at the anterior edge. The shells have irregular areas of light brown-green, also ranging from brown to brick-red (Rajagopal *et al*., 2006). Erosion has worn away the periostracum, leaving white or pink spots. The interior of its valves is pearly, pinkish-white, and the mantle margin has more prominent papillae (Fig. 3B).

Perna perna, formerly known as *Perna picta* or *Perna indica*, is called “African mussel”, and is native to the western Indian Ocean (from the Bay of Bengal and the Red Sea to the tip of South Africa), and the west coast of Africa, northwards to the western Mediterranean on the coasts of Morocco, Algeria, and Tunisia. Shipping may have increased its prevalence in earlier centuries, but the Brazilian *P. perna* populations are now assumed to be native (Pierri *et al*., 2016). It has recently reached the eastern Mediterranean (Douek *et al*., 2021; Ragkousis *et al*., 2023). An outbreak of this mussel is reported by Douek *et al*. (2021), where dense beds of *P. perna* are present on intertidal rocks of Haifa Bay. The new report of this bivalve on the Syrian tidal zone is most probably a local progression of this outbreak and not a new introduction from the core range of *P. perna*.

Fig. 2: *Perna perna* in Afamia area, northwest of Latakia (Syria), among a cluster of *Brachidontes pharaonis*.

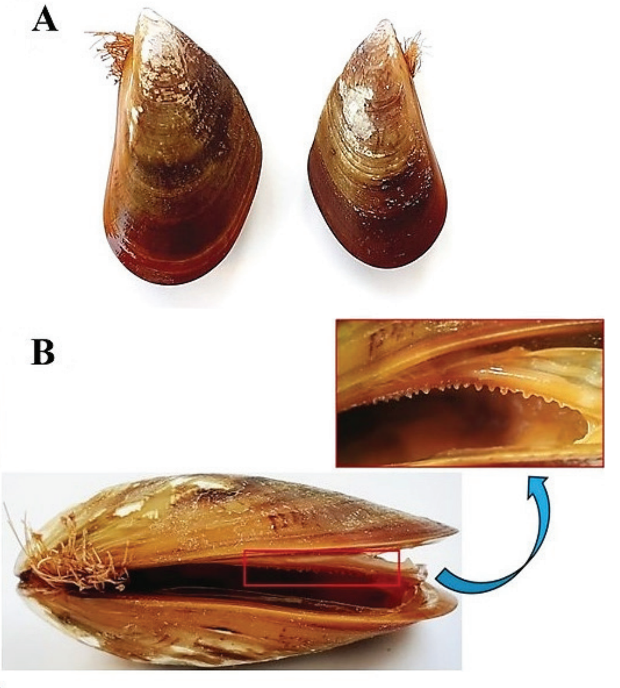

Fig. 3: A) General shape of the collected *Perna perna* specimen from Syrian coast. B) Prominent papillae at the mantle margin of *P. perna*.

CYPRUS

2.1 First records of the Lessepsian heterobranch *Elysia* cf. *marginata-grandifolia* in Cyprus

Christina MICHAIL and Periklis KLEITOU

Elysia (Mollusca: Gastropoda: Elysiidae) is the largest genus within sacoglossans, presenting intricate systematics and several species complexes such as *Elysia marginata-grandifolia* (Martín-Hervás *et al*., 2023). Until recently, the *E. marginata-grandifolia* complex has been synonymised with *E. ornata* but recent integrative taxonomic studies by Krug *et al*. (2013) have shed light on this complexity, revealing four distinct candidate species within the *E. marginata-grandifolia* complex in the Indo-Pacific region, and distinguishing them from *E. ornata*, which is confined in the Caribbean. In the Mediterranean Sea, *E. marginata-grandifolia* was first detected in Türkiye in 2001, and subsequently in Israel, Lebanon (see Crocetta *et al*., 2013 and references therein as *E. grandifolia*), and Syria (Ammar *et al*., 2022 as *E. ornata*).

During field sampling conducted in Cyprus from 19 to 20 January 2024, two live specimens (Fig. 4) were observed on artificial structures, specifically wave breakers, on consecutive days. The sightings occurred in Latsi village, located in the northwest region of the island. Interestingly, one specimen was found on the outer side (35.040550° N, 32.401888° E), while the other was on the inner side (35.040366° N, 32.400379° E) of the wave breakers. Both were observed at a shallow depth ranging from 1 to 2 m, associated with macroalgae (Fig. 4).

This report confirms the presence of *E. marginata-grandifolia* species complex in Cyprus, thereby filling a gap in our understanding of its distribution in the eastern Mediterranean. Our findings are consistent with all sightings of the species in the Mediterranean Sea, which were recorded at shallow depths of less than 10 m. Our data indicate a delayed arrival or detection of this alien species in Cyprus compared to other eastern Mediterranean countries. This delay is likely due to a lack of targeted research, underscoring the importance of continuous monitoring and research efforts to detect and address geographical gaps in our knowledge (Kleitou *et al*., 2019). Future targeted research is necessary for precise species delineation within the complex and for uncovering potential additional species.

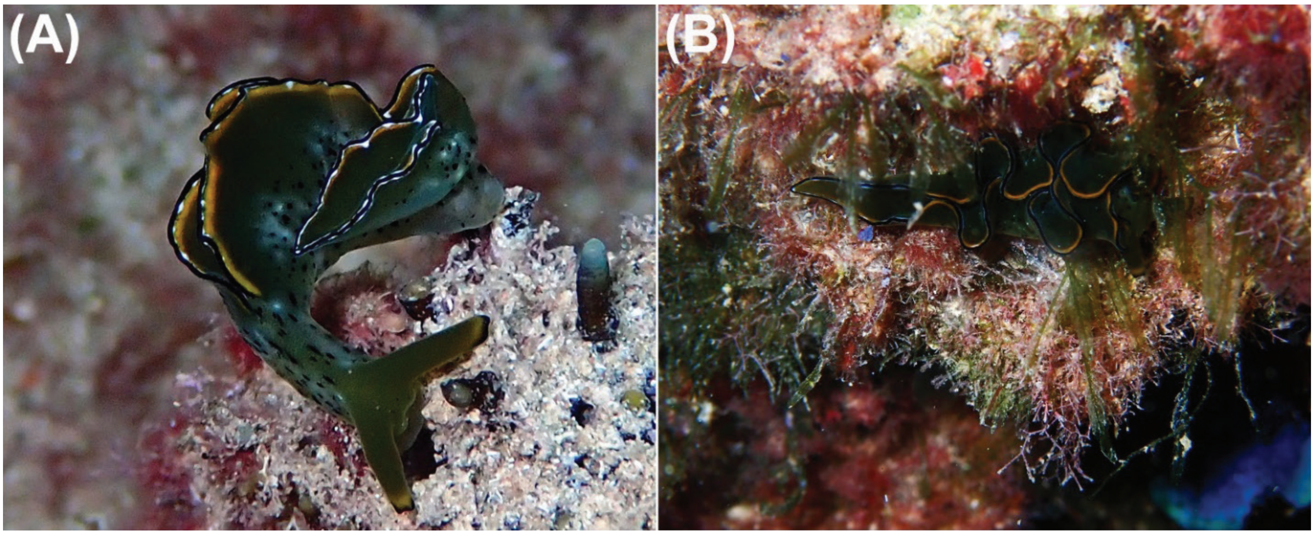

Fig. 4: *Elysia* cf. *grandifolia-marginata* observed on the wave breakers of Latsi area (Cyprus) on (A) 19/01/2024, attached to *Cystoseira montagnei* var. *tenuior* and (B) 20/01/2024, associated with brown algae (e.g., *Dictyota* sp., *Sphacelaria* sp., *Halopteris* sp., *Stypopodium schimperi*) and red algae (*Jania* sp., *Dasya* sp., *Polysiphonia* sp.).

TÜRKIYE

3.1 First record of *Brachyscelus rapacoides* Stephensen, 1925 on the southern coast of Türkiye

Mesut YILMAZ and Mehmet GÖKOĞLU

The jellyfish *Rhopilema nomadica* (Galil, Spanier & Ferguson, 1990), which originates from the western Indian Ocean, was first reported from the Mediterranean Sea in Israel in 1976 (Galil *et al*., 1990). It creates huge populations in Israel, Lebanon, Syria and the Gulf of Iskenderun in Türkiye (Galil & Goren, 2014) and has spread across the Mediterranean (Galanidi *et al*., 2023). *Brachyscelus rapacoides* Stephensen, 1925 belongs to the hyperiidean amphipod family Brachyscelidae (Crustacea: Amphipoda: Hyperiidea) and has been recorded recently as a parasite of the scyphozoan *R. nomadica* (Zeidler *et al*., 2018).

We conducted scientific dives in two different sites (36.882777° N, 30.679166° E and 36.884166° N, 30.699722° E) in the Gulf of Antalya in April 2022. During the dives, we observed brownish spots (Fig. 5) in many jellyfish potentially infested by *B. rapacoides*. Five specimens of infested *R. nomadica* individuals were collected for examination in the laboratory.

Upon microscopic examination, the spots were determined to belong to the amphipod family Brachyscelidae. Diagnostic features of this relatively small species can briefly be listed as: distinctly longer telson than wide, more pointed apex, slightly shorter exopod than endopod, rami of all uropoda with serrated margins and much wider double urosomite than long. The diagnostic features of *B. rapacoides* are well described by Zeidler *et al*. (2018). To support morphological identification, molecular identification was performed. After isolating the amphipods' DNA, the Cytochrome Oxidase Subunit I (COXI) was amplified by using PCR as described by Zeidler *et al*. (2018) and sequence analysis was performed. The amplified 597 bp of the species' COXI sequence (GenBank Accession Number: PP315903) was compared with the GenBank database by using the BLASTN at NCBI (2024). The algorithm yielded perfect matches (100%) with the three reported sequences (GenBank Accession Numbers: MG807264, MG807265 and MG807266) of *B. rapacoides* species. According to our results, the sampled individuals can be ascribed with certainty to *B. rapacoides*.

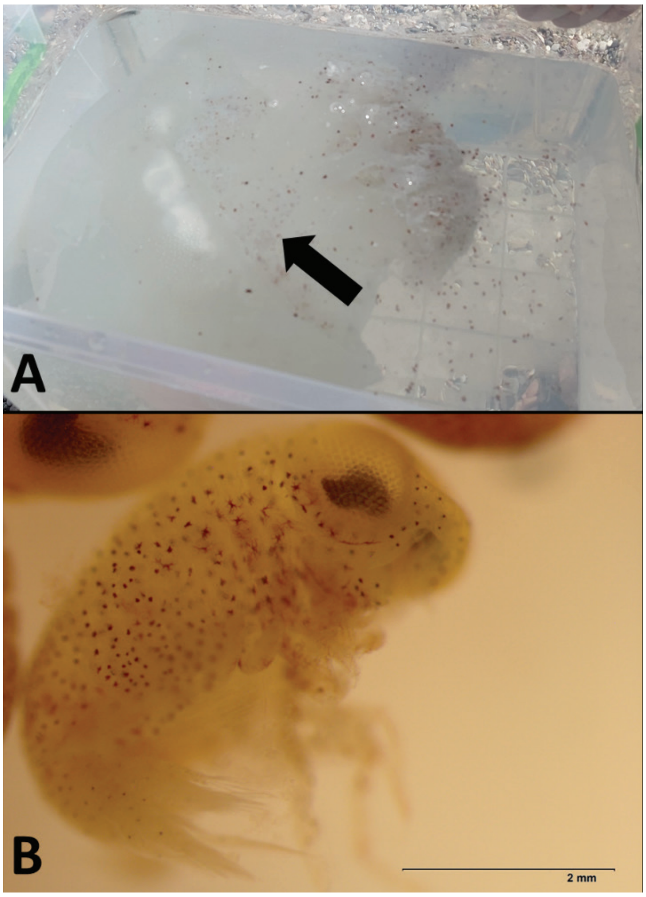

Fig. 5: A: Sampled *Rhopilema nomadica* with *Brachyscelus rapacoides* (arrowed) and B: Identified *B. rapacoides*.

Our literature search indicates that this species has not yet been recorded from Turkish coasts, although one might expect to find *B. rapacoides* associated with *R. nomadica* wherever this scyphozoan occurs in the Mediterranean Sea. Thus, this is the second record of this amphipod species in the Mediterranean Sea after Zeidler *et al*. (2018) and the first record from Türkiye.

3.2 First record of the green algae *Acetabularia caliculus* J.V.Lamouroux 1824 in Turkish Coasts

Emine Sukran OKUDAN and Inci TUNEY

The genus *Acetabularia* J.V.Lamouroux consists of 14 globally recognized species and two varieties (Guiry & Guiry, 2024). In Turkish coastal regions, *Acetabularia acetabulum* (Linnaeus) P.C.Silva is the only previously identified species documented by Taskin *et al.* (2019). This study enhances the knowledge on Turkish marine algae flora by introducing the presence of *Acetabularia caliculus* J.V.Lamouroux 1824.

Acetabularia caliculus, a unicellular marine green alga, is widely distributed in temperate and tropical waters across the Indian, Pacific, and Atlantic Oceans (Cormaci *et al*., 2004). Prior records indicate its occurrence along the Mediterranean Coasts in Greece, Spain, Morocco, Egypt, and Israel (Yokeş *et al*., 2018).

Samples were collected at a depth of 10 m in Antalya Bay (Mediterranean Sea) in September 2023 (36.881011° N, 30.674394° E) (Fig. 6). The thallus of *A. caliculus* is slender, measuring approximately 2.0-4.0 cm long, with delicate features and a lightly calcified structure. It forms clusters of cylindrical stalks, each terminating in light-green gametangial rays, and is anchored to the substrate by a small, lobed holdfast. The peduncles exhibit slight nodulation, lack branching, and appear whitish due to calcification. Scars from shed hairs are noticeable near the apex, close to the gametangial ray disc. The gametangial ray discs, solitary, assume a cup-like shape upon maturation and consist of 28-36 elongated transparent rays laterally united by calcifications as explained in Moura *et al.* (2014). The voucher sample was deposited at Personal Herbarum of ES. OKUDAN under the code # ESOac01.

In addition to morphological characteristics, the Small Subunit ribosamoal RNA (SSU rRNA) region assessed to confirm the species. DNA was extracted with Norgen Plant/Fungi DNA Isolation Kit (Norgen Biotek Corp, Canada) according to manufacturer instructions. PCR amplification was performed in 25 µL total volume PCR mix with 10x reaction buffer, 10 µM forward primer AcF: 5'-GCTTCTGGGCTTGATTGCTC-3' and reverse primer ITS4: 5'- TCCTCCGCTTA TTGATATGC -3' each, 2.5 mM dNTP, 0.5 U Taq DNA Polymerase (DreamTaq, Thermofisher, USA) and 3 ng DNA. The PCR reaction started with 95° C for 1 min initial denaturation followed by 35 cycles of denaturation at 95°C for 1 min, annealing at 58° C for 30s and extension at 72° C for 1 min. The reaction completed with final extension at 72° C for 10 min. The amplicons were purified and sequenced by authorized company (LetgenBio Labs, Izmir, Türkiye).

The sequenced SSU rRNA gene region of the sample exhibited 99.72 % similarity with the *A. calyculus* ITS regions in GenBank records. The sequenced SSU rRNA region sequence has been deposited in GenBank under Accession # PP670034.

Although *A. caliculus* is not declared an invasive species, its inclusion in biodiversity surveys is crucial for comprehensive assessments.

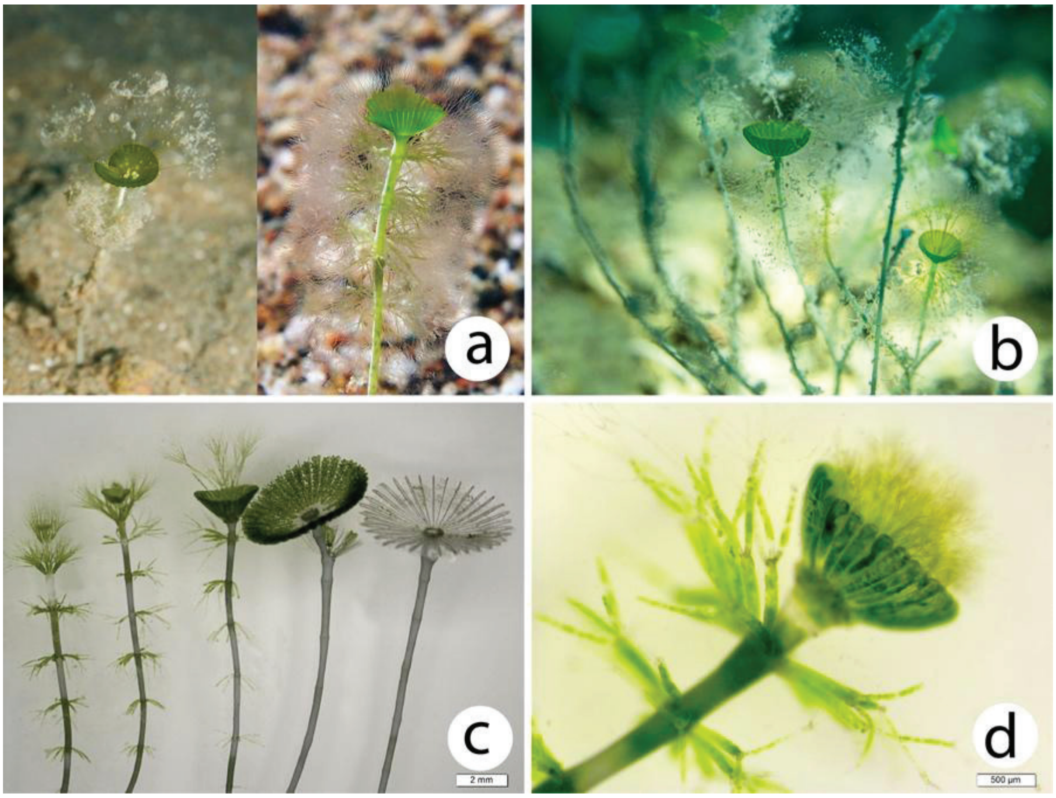

Fig. 6: Underwater view of *Acetabularia caliculus* (a and b). Light microscope (c) and stereo microscope (d) appearance of the specimen.

3.3 First record of the zooxanthellate coral *Oculina patagonica* de Angelis, 1908 (Cnidaria, Scleractinia) in the Aegean coast of Türkiye

Fikret ÖNDES and Adnan Çağlar ORUÇ

The zooxanthellate scleractinian coral *Oculina patagonica* de Agelis, 1908, which generally lives in shallow areas (less than 6 m), reaches sexual maturity within 1-2 years and is characterized by rapid growth (1-2 cm year^{-1}) (Martinez *et al.*, 2021). This coral species, which can adapt to very different temperature and salinity conditions, has been known to exist in Mediterranean since 1966 (Martinez *et al.*, 2021; Serrano *et al.*, 2023). It is thought that this species, which originates from Atlantic-South America, was transported to the Mediterranean by shipping (Çinar *et al*., 2006). After its first record in the Savona harbour, Gulf of Genoa, in the Mediterranean, over the years this species has been reported from Gulf of Lion, Balearic Sea, Levant Sea, Greek coasts of Aegean Sea, Alboran Sea, Algerian and Tunisian waters, Adriatic Sea and Ionian Sea (Serrano *et al*., 2023). There is less information about the distribution of this species in the eastern Mediterranean, with more records reported in the western Mediterranean (Serrano *et al*., 2023). The last record of this species from the western Aegean was given in January 2020 (Ragkousis *et al*., 2023). However, to date, it has not been reported from the Aegean coast of Türkiye.

In this study, *O. patagonica* colony was found at 2 m depth in Mordoğan (Aegean coasts of Türkiye) (38.52756° N, 26.62465° E) in July 2021. The colony represented with a relatively small size; the major axis (D1) was 16 cm, whilst the minor axis (D2) was measured as 13 cm and coverage area was calculated as 125.9 cm^2 (Fig. 7) and the water temperature was recorded as 24° C. Previous studies in the Mediterranean have reported larger colony sizes for this species (Çinar *et al*., 2006; Serrano *et al*., 2023). One colony of *O. patagonica* has been reported only once from Türkiye to date; it was observed from the Levantine coast in 2005 (Çinar *et al*., 2006). Recently Serrano *et al*. (2023) highlighted that it can be dispersed to large areas in Mediterranean as a fouling organism by recreational boats and it is considered that increasing water temperatures globally can accelerate the spread of this species in some regions. Additionally, it is thought that the distribution of the species might expand since it is invasive in the Aegean Sea (Salomidi *et al*., 2013). On the other hand, as with many coral species, bleaching has been observed in this species as the water temperature increases (Martinez *et al*., 2021). Thus, information about the spatial distribution along with monitoring studies are important to better understand the ecology of these corals.

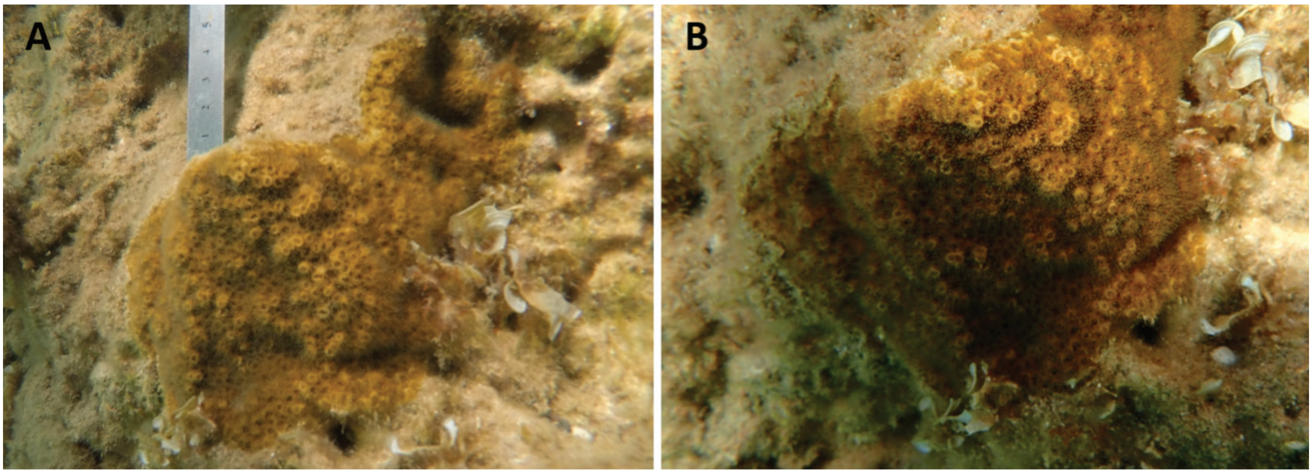

Fig. 7: Different aspects of the zooxanthellate coral *Oculina patagonica* colony from the Aegean Sea coast of Türkiye. Photo credits: Fikret Öndes and A. Çağlar Oruç.

GREECE

4.1 First record of *Cheilodipterus novemstriatus* (Rüppell, 1838) (Actinopterygii: Apogonidae) in Aegean Sea, Greece

Gerasimos KONDYLATOS

Cheilodipterus novemstriatus (Rüppell, 1838) is a marine, mouthbrooding species, common in shallow waters that uses the spines of *Diadema* sea-urchins as shelter (Golani *et al*., 2021). It can be easily distinguished by the four black stripes over a silvery gray overall body coloration and a fifth stripe which runs along the anal-fin base, reaches the pelvic-fin base and continues upward to the anterior of pectoral-fin base. Two black spots are present, one at middle of caudal peduncle and one on the dorsal surface of the latter. A white mark is distinct between the two black spots, anteriorly (Gon & Randall, 2003). The species exhibits a confined distribution range within the western Indian Ocean which includes the Red Sea, Gulf of Oman, and the Persian Gulf (Froese & Pauly, 2024). In the Mediterranean Sea, *C. novemstriatus* was first reported in 2010 from Israeli marine waters and consequent records were from Lebanon, Türkiye, Cyprus, Syria and the Levantine waters of Rhodes, Greece (Ragkousis *et al*., 2020 and references therein). The species has been reported in the Turkish coasts of the Aegean Sea (2013 in Bodrum: Gülşahin & Yapici in Langeneck *et al*., 2023). The present work backdates its presence in the Aegean Sea and constitutes its first record in the region.

On July 17th 2022, during a citizen science snorkeling survey in the coastal waters of Alimia Island, Aegean Sea, Greece, more than 20 individuals of *C. novemstriatus* were filmed with an underwater camera within the largest gulf of the island (Tigani Gulf, southern Alimia Island, 36.2552222° N, 27.6995000° E), at less than 2 m depth. The substrate was rocky, almost depleted of algae and all individuals were moving among the spines of approximately 10 individuals of *Diadema setosum* (Leske, 1778). On May 29th 2023, during a field survey in the coastal waters of Chalki Island, Aegean Sea, Greece, a follow up documentation of *C. novemstriatus* (Fig. 8) took place in the Port of Chalki (Emborio Port, southeastern Chalki Island, 36.2230555° N, 27.6130278° E), at approximately 2 m depth. One individual was photographed with an underwater Nikon AW111 camera, over rocky substrate, almost depleted of algae, among individuals of *D. setosum*. The latter species was recorded to live along with individuals of *Arbacia lixula* (Linnaeus, 1758), *Paracentrotus lividus* (Lamarck, 1816) and *Sphaerechinus granularis* (Lamarck, 1816) in the same vicinity. The simultaneous presence of the four sea-urchin species in the same area is herein documented for the first time.

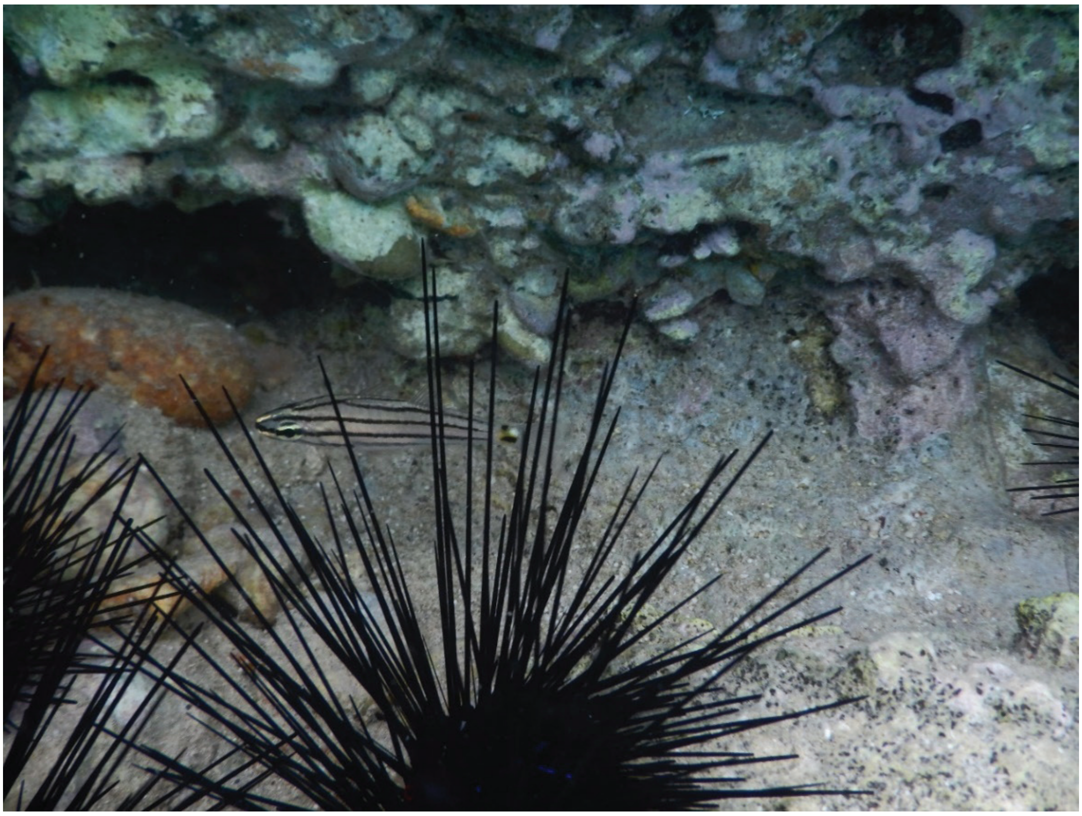

Fig. 8: *Cheilodipterus novemstriatus* from Emborio Port (Chalki Island, Greece). Photo credits: Gerasimos Kondylatos.

4.2 First record of *Saurida lessepsianus* Russell, Golani & Tikochinski, 2015 in the Cretan Sea

Giorgos LAZARAKIS and Panagiota PERISTERAKI

The Lessepsian lizardfish, *Saurida lessepsianus* (Aulopiformes: Synodontidae) is a natively common species of the lizardfishes in the Red Sea and Western Indian described by Russell *et al*. (2015) and now it is widely distributed in the eastern Mediterranean. The Lessepsian lizardfish *S. lessepsianus*, is a marine demersal species found mainly on sandy or muddy substrates up to 100 m, feeding mostly on small fish.

In the Mediterranean Sea, this species has been originally reported by Ben-Tuvia (1953), in Haifa coastal waters as *Saurida undosquamis*. In the next years, this fish continued to be reported as *S. undosquamis* from southeast Türkiye (Ben-Tuvia, 1978) and from Greece, where it was recorded in Rhodes Island (Papaconstantinou, 1990). Later, Katsanevakis *et al.* (2020) reported the species as *S. lessepsianus* from Kalymnos Island.

The present study presents the first record of *S. lessepsianus* ever caught in the waters of Crete, which is also the westernmost confirmed presence of the species in the Mediterranean Sea. The species was caught in 13 October 2023 during experimental fishing with boat-seine in the Gulf of Sitia (Northeast Crete). The haul was deployed by a commercial fishing vessel (vessel length 12.10 m, engine power 74.6 kW). The depth of trawling ranged from 10.5 to 23.5 m (trawl start: 35.202717° N, 26.116017° E; trawl end to 35.207267° N, 26.11895° E). One of the caught individuals was examined in the HCMR fisheries laboratory. Its total length was 22.7 cm, standard length 195 cm and total weight 74.96 g. The species was identified and distinguished from similar species, according to

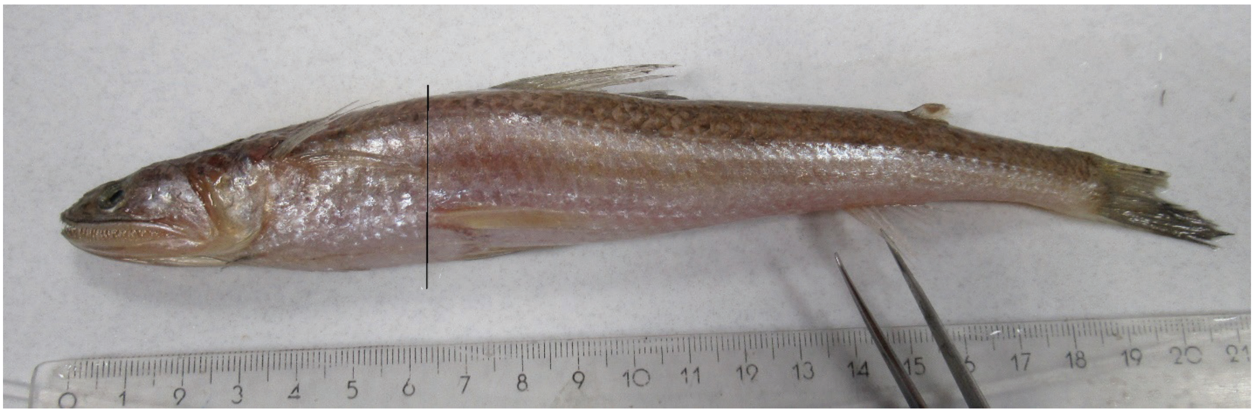

Fig. 9: First specimen of *Saurida lessepsianus* caught in the area of Crete. The black line shows the end of pectoral fin in regard with the beginning of pelvic fin.

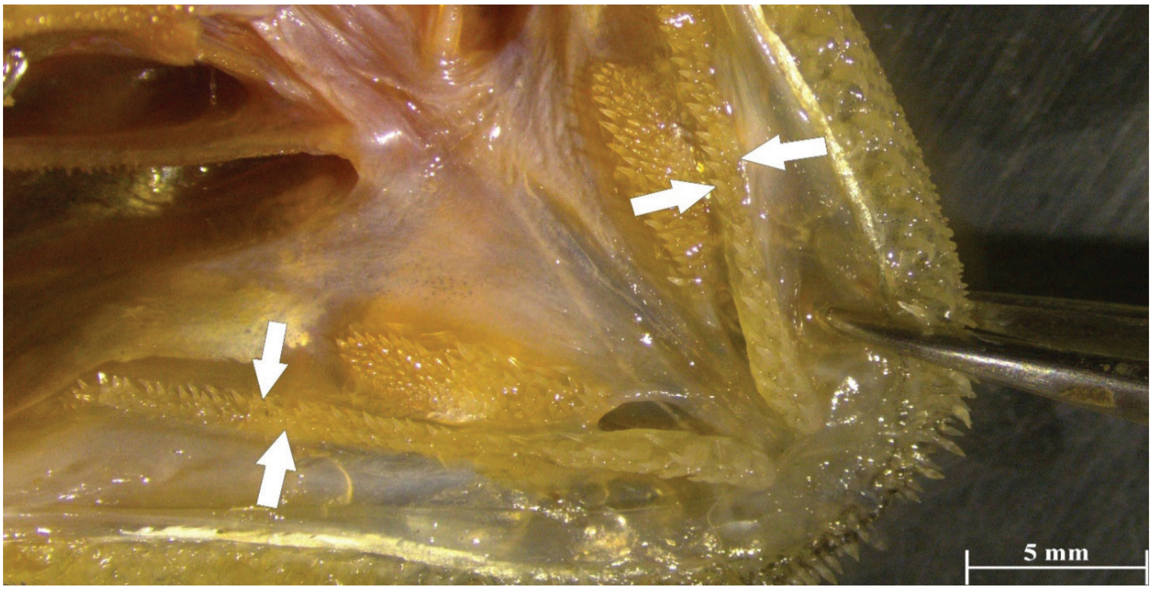

Fig. 10: Upper jaw of the first specimen of *Saurida lessepsianus* caught in the area of Crete. Arrows indicate the two double rows of teeth on the outer anterior palatines.

the *Saurida* species Key (Russell *et al*., 2015). The distinguishing characteristics were: i) the longest ray of dorsal fin was more than three times longer than the last dorsal ray and the measured lengths of the corresponding rays were 34.55 and 7.08 mm; ii) the pectoral fin was not extending or reaching beyond the pelvic fin's base (Fig. 9); iii) two rows of teeth were present on the outer anterior palatines (Fig. 10). The sampled specimen was deposited in the Natural History Museum of Crete (University of Crete) by the code number NHMC80.1.105.2. The present record constitutes the first occurrence of the species in the Cretan Sea (GSA 23).

The gap of information in the Greek seas from 1990 till 2020, may indicate that the species had not been successfully established in the area. However, in the recent years it has been reported in Kalymnos (Katsanevakis *et al*., 2020), in Crete (present study) and had also been caught in Pserimos Island (Dodecanese) during the MEDITS research surveys of 2022 and 2023 (unpublished data). These findings may indicate a new recent expansion of the species in the area.

4.3 First record of *Fistularia petimba* Lacepède, 1803 in the Cretan Sea

Manolis METAXAKIS and Ioannis KOSOGLOU

Fistularia petimba Lacepède, 1803, a member of the cornetfish family Fistulariidae, is widely distributed across the Atlantic, Pacific and Indian Oceans, including the Red Sea (Froese & Pauly, 2024). It is a carnivorous, sublittoral species, primarily found along soft substrates at depths ranging from 18 to 57 m (Froese & Pauly, 2024). Along with its congeneric species, *Fistularia commersonii* Rüppel, 1838, they represent the two members of the

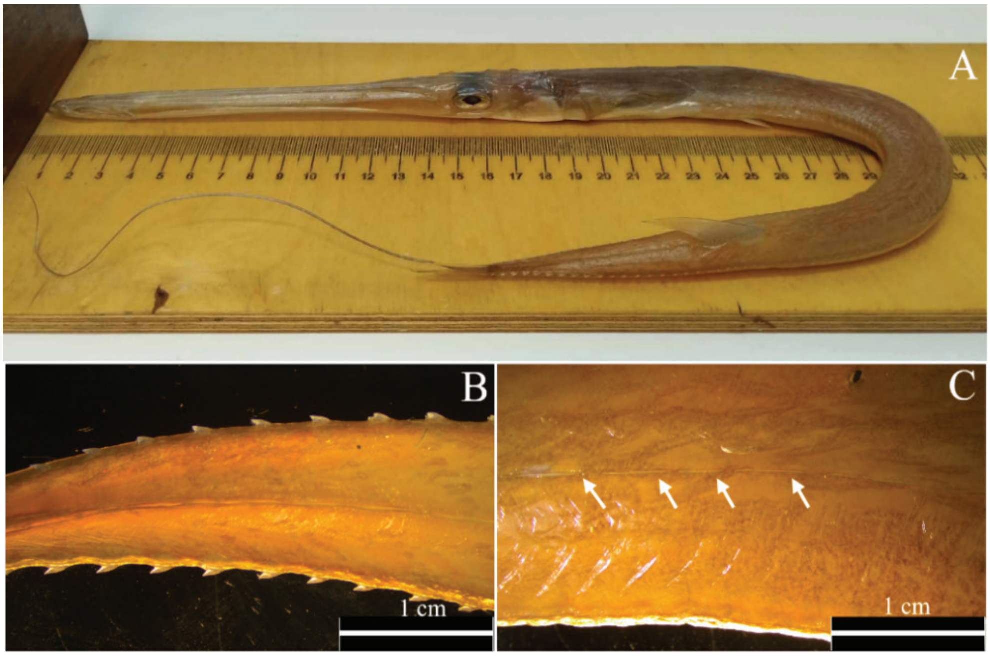

Fig. 11: *Fistularia petimba* individual caught in the Gulf of Sitia, Crete during experimental boat seining (A), distinctive characteristics of sharp spines on lateral line (B) and elongated dorsal bony plates (C).

genus that have entered the Mediterranean Sea, posing a potential threat to the native ecosystem and fisheries by predating on commercial fish (Çiftçi *et al*., 2019). In the Mediterranean, *F. petimba* was initially recorded in the Gulf of Cadiz, Spain in 1996 (Cárdenas *et al*., 1997), though this introduction was considered unsuccessful. It was later collected in Antalya Bay, Türkiye in 2016 (Ünlüoğlu *et al*., 2018), marking the beginning of a second introduction originating from the Red Sea. Since then, it has rapidly expanded its range in many regions of eastern Mediterranean, recently reaching the Marmara Sea, which is the northernmost record in the Mediterranean Sea (Papageorgiou *et al*., 2023 and references herein). In Greece, the species was first recorded in Samos Island in 2021 with no subsequent publication from the Greek waters (Papageorgiou *et al*., 2023 and references within).

On 7 December 2022 one *F. petimba* individual was caught in the Gulf of Sitia, Crete, during an experimental fishing trip with the commercial boat seine Taxiarchis (Length: 12.1 m, Gross tonnage: 6.97, Horsepower: 74.6, Mesh size in the cod-end: 10 mm). The haul was deployed at depths ranging from 4 to 20 m in the location from 35.202167° N, 26.116000° E to 35.207250° N, 26.118717° E. The total length of the individual was 61.0 cm, the standard length 49.2 cm and total weight 190.54 g. The species was distinguished from its congeneric *F. commersonii*, based on its reddish orange coloration, the presence of backwards pointing sharp bony spines along the lateral line, and the presence of elongated bony plates predorsally (Fig. 11). The sample was deposited in the Natural History Museum of Crete of the University of Crete (code number NHMC80.1.104.1). The present record constitutes the first occurrence of the species in the Cretan Sea (GSA 23) and the southernmost record in Greek seas.

4.4 First record of the non-indigenous Randall's lizardfish *Synodus randalli* Cressey, 1981 in Greece

Georgios CHRISTIDIS and Ioannis KOSOGLOU

Randall's lizardfish *Synodus randalli* Cressey, 1981, belongs to the Synodontidae family and is native in the Red Sea and the western Indian Ocean (Fricke *et al*., 2024). In the Mediterranean Sea, this species was first recorded off the coast of Türkiye (Iskenderun Bay) in June 2023 (Turan & Doğdu, 2023). Up to now, the only other non-indigenous synodontids in the Mediterranean are *Saurida gracilis* and *Saurida lessepsianus*, recorded in Tunisia (Khamassi *et al*., 2023) and in many coastal areas of the eastern Mediterranean (Russell *et al*., 2015), respectively. *Synodus randalli* is the only non-indigenous representative of the genus *Synodus* in the Mediterranean. The present record is the first for *S. randalli* in Greece and the second in the Mediterranean Sea.

On November 17th, 2023, a specimen of *S. randalli* was caught off the southeastern coasts of Crete (GSA 23: 34.871944° N, 25.667778° E) onboard a small-scale fishing boat using gillnets. It was collected at a depth of 33 meters on sandy bottom with patches of *Posidonia oceanica*. The specimen was preserved at −20° C until identification and was subsequently deposited in the Natural History Museum of Crete (Code number: NHMC80.1.105.1).

The collected specimen measured 246 mm in total length and weighed 133.33 g. It was a mature female with ovaries occupying 2/3 of the body cavity and eggs visi-

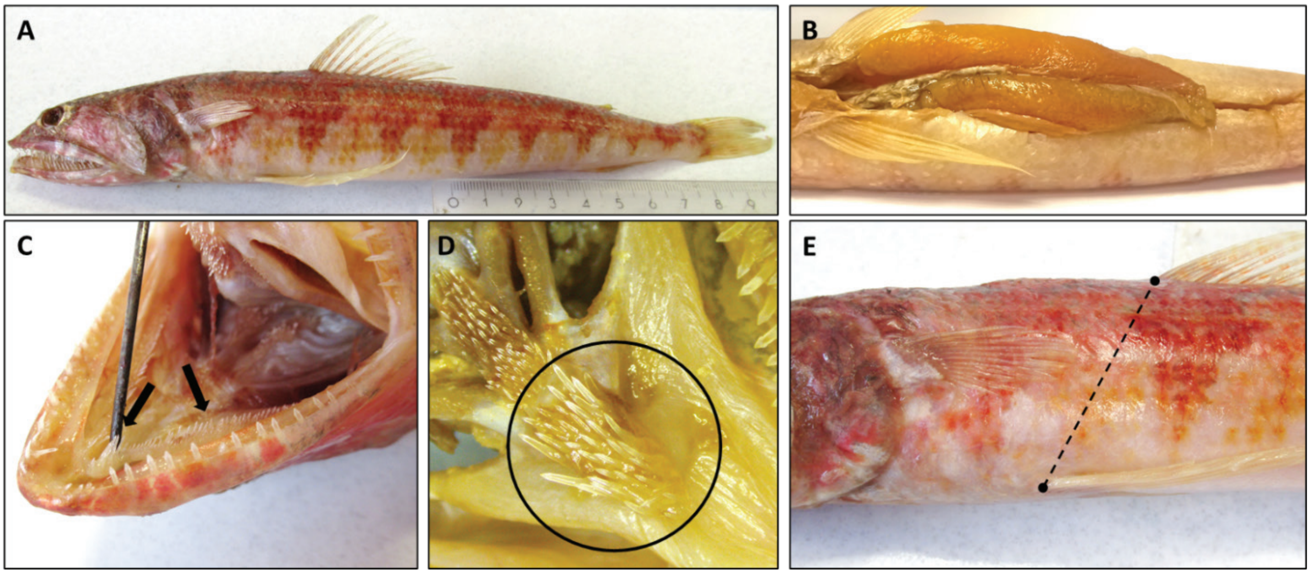

Fig. 12: A) Lateral view of *Synodus randalli* specimen caught off the southeastern coasts of Crete (total length 246 mm); B) Ovaries of the specimen; C) View of the oral cavity revealing that the anterior palatine teeth are longer and arranged in a discrete group compared to the posterior teeth; D) Teeth on the free end of the tongue; E) Side view of the specimen demonstrating that the pectoral fin does not extend beyond a line from the origin of dorsal fin to the origin of pelvic fin.

Table 2. Morphometric measurements and meristic counts of the *Synodus randalli* specimen caught in Crete and comparison with previous records.

Morphometrics (mm)	**Present study**	**Turan & Doğdu (2023)**	**Cressey (1981)**
Total length	246	187	-
Fork length	235	173	-
Standard length	218	161	113
Head length	59.27	45.56	31.97
Snout length	15.16	11.21	8.13
Upper jaw length	37.44	28.81	20.22
Diameter of bony orbit	13.62	11.02	7.68
Least width of bony interorbital	8.59	7.39	3.95
Pre-dorsal fin origin	92.40	66.91	49.72
Pre-adipose origin	182.13	133.79	93.90
Pre-anal fin origin	173.09	133.62	92.88
Pre-pelvic fin origin	74.04	55.80	43.61
Pre-pectoral fin origin	58.88	41.80	40.11
Eye diameter	8.61	6.22	-
Meristic counts			
Dorsal fin rays	13	13	13
Anal fin rays	8	8	8
Pectoral fin rays	12	12	12
Ventral fin rays	8	8	8
Pored lateral-line scales	56	58	55
Scales above lateral line to dorsal fin	3.5	-	3.5
Scales below lateral line to anal fin	4	-	4
Number of teeth on free end of tongue	40	-	40
Peritoneal spots	12	-	14
Weight	133.33	51.89	-

ble to the naked eye (Fig. 12B). The meristic counts and morphometrics of the specimen are presented in Table 2 along with those from previous studies. Key identification characters, including count of fins rays, anterior palatine teeth (Fig. 12C), scale rows above and below the lateral line and count of teeth at the free end of the tongue (Fig. 12D), matched the species description by Cressey (1981). However, in contrast with Cressey's description, the pectoral fin of the examined specimen did not extend beyond a line from the origin of the pelvic to the origin of the dorsal fin (Fig. 12E). Given that the pectoral fin length, as a percentage of body length, may decrease with size in some *Synodus* species (Cressey, 1981), this discrepancy may be attributed to the fact that only one small-sized specimen of *S. randalli* was examined by Cressey.

The present record shows a westward expansion of *S. randalli* and provides further evidence of its potential establishment in the eastern Mediterranean. Additionally, the discovery of a mature female specimen suggests the presence of a reproducing population in Crete.

4.5 The non-indigenous shrimp *Urocaridella pulchella* in a marine cave of the Ionian Sea

Markos DIGENIS and Vasilis GEROVASILEIOU

According to Gerovasileiou *et al*. (2022), 126 introduced species have been recorded in Mediterranean marine caves, 16 of which are crustaceans, mostly decapods (9 species). Among those is the palaemonid cleaner-shrimp *Urocaridella pulchella* Yokeş & Galil, 2006, a highly overlooked decapod which was first described from the southwestern coasts of Türkiye, in the eastern Mediterranean Sea in 2006 (Yokeş & Galil, 2006) and then recorded in Saudi Arabia and Jordan (Red Sea) proving its Indo-Pacific origin (Ďuriš, 2017). In the Mediterranean Sea, the nocturnal *U. pulchella* has also been recorded in Israel (Katsanevakis *et al*., 2020), Greece (Digenis *et al*., 2021) and Cyprus (Crocetta *et al*., 2021) in cryptic habitats (e.g., marine caves and crevices).

In July 2024, three individuals of *U. pulchella* (including one ovigerous female) were observed while SCUBA diving in a small and shallow marine cave of Kefalonia Island, Greece (38.30839° N, 20.61042° E). The individuals were sighted on the sedimentary bottom of a cavity covered by serpulids in the semidark zone of the cave, at a depth of 3 m and approximately 7 m from the cave entrance (Fig. 13A-B). They presented a laterally compressed, transparent and smooth carapace with small red spots at its abdomen and a red bar across the third abdominal segment. The uropodal exopods were striped with red and white colour and subterminally banded with red. The pereopods were white, banded with red while the chelae of the first two pereopods presented bright-red palms and white fingers (Fig. 13) (Yokeş & Galil, 2006; Digenis *et al*., 2021).

Urocaridella pulchella is the only representative of its genus in the Mediterranean Sea. The scattered and few reports of the species can be attributed to its small and mostly transparent body as well as to its preference for cryptic habitats (Digenis *et al*., 2021). It has been recorded in crevices, amphorae (artificial substrate), rocky overhangs, *Posidonia* and *Cymodocea* meadows and rocky bottoms, while in marine caves the species seems to prefer sedimentary bottoms. Although it is commonly sighted in small groups of 5-6 individuals (Yokeş & Galil, 2006) it has been recorded to reach up to 40 individuals in the semidark zone of some surveyed caves in Karpathos and Crete Islands in Greece (authors' personal observations). The current record describes the first sighting of *U. pulchella* in the Ionian Sea indicating a westward expansion (probably unaided) of this cryptobenthic species.

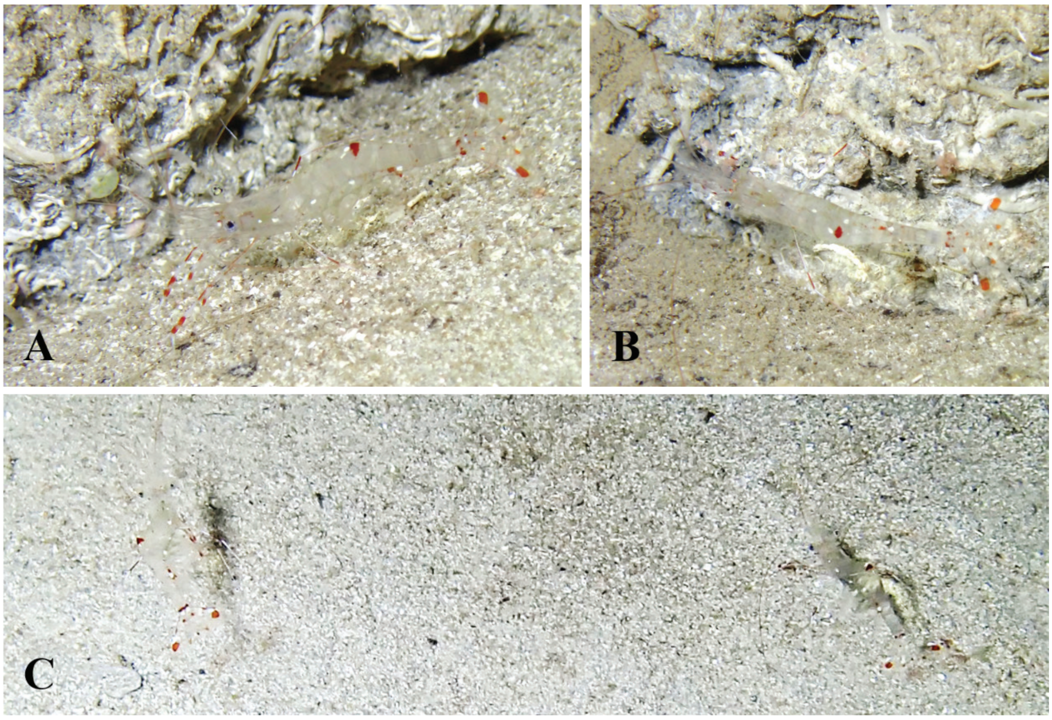

Fig. 13: *Urocaridella pulchella* from a marine cave in Kefalonia Island, eastern Ionian Sea. A: lateral and B: dorsal view of the recorded individuals. C: Two individuals on the soft cave bottom. Photo credits: Markos Digenis.

CROATIA

5.1 Red alga *Chondria coerulescens* (Rhodophyta, Rhodomelaceae) in Croatia

Ante ŽULJEVIĆ, Jelena NEJAŠMIĆ and Marija KVESIĆ IVANKOVIĆ

The rhodophyte *Chondria coerulescens* (J.Agardh) Sauvageau is considered a cryptogenic species in the Mediterranean Sea, potentially existing as both a native and non-native strain (Verlaque *et al.*, 2015). The introduced population likely originated from the northeastern Atlantic, from England to Morocco, where this alga has a native geographic range.

Chondria coerulescens has been recorded in several Mediterranean areas as a native species (Gómez Garreta *et al.*, 2001). In Croatian marine waters, it was first recorded in 1997 near Rijeka in the North Adriatic (Battelli & Arko Pijevac, 2005). It was abundant on rocky and sandy substrates at depths between 5 and 15 m, forming part of the turf algae and considered native. However, there is no detailed description or herbarium specimens to validate this record. To the best of our knowledge, this study is the only detailed published report of *C. coerulescens* in Croatia making it the first record of this species as non-native with cryptic status.

In July 2005, we recorded *C. coerulescens* on the northern side of Lokrum Island (South Adriatic) (42.6333° N, 18.1179° E). It was found in a protected, partially shaded rocky bottom area between 0 and 10 cm depth. Since then, we have surveyed that area more than ten times and through different seasons and was distributed always on a maximum of 1 m^2. Despite its easy recognizability due to specific turquoise iridescence, we have not recorded its presence elsewhere in Croatian waters.

Morphological and molecular analyses were conducted on samples collected in June 2022. The morphological features matched previous descriptions (Maggs & Hommersand, 1993; Díaz-Tapia & Bárbara, 2013; Verlaque *et al.*, 2015): cylindrical, erect or decumbent axes with striking turquoise iridescence (Fig. 14A), up to 3 cm long, obtuse apices with circular depression, in middle part diameter of 400-500 µm, branching in a spiral pattern of development in 1-3 orders irregularly and sparsely. The branches are markedly constricted at the base and form stolon-like crawling axes when attached to the substrate with secondary rhizoids. In cross-section: a rounded axial cell and 5 pericentral cells, surrounded by 1 (2) layers of subcortical cells and a layer of cortical cells that are elongated towards apics in surface view, mostly 3-5 times long as broad in the middle part (Fig. 14B-D). Reproductive organs not observed.

Genomic DNA was extracted using a DNeasy® Plant Mini Kit, and the chloroplast rbcL gene was amplified by PCR (Fig. 15A) and subsequently sequenced. BLAST analysis revealed >92% identity with sequence annotated as *Chondria* sp. on GenBank (KF672851). Phylogenetic analyses, exhibiting identical topologies in both trees, positioned our isolate within the same clade as *C. coerulescens* collected from the Atlantic Coast of France (MF094043) (Fig. 15B).

Further morphological, ecological and molecular studies are necessary to determine if *C. coerulescens* in the Mediterranean comprises native populations only, or if there is sympatry of introduced and native strains as was previously suggested (Verlaque *et al.*, 2015).

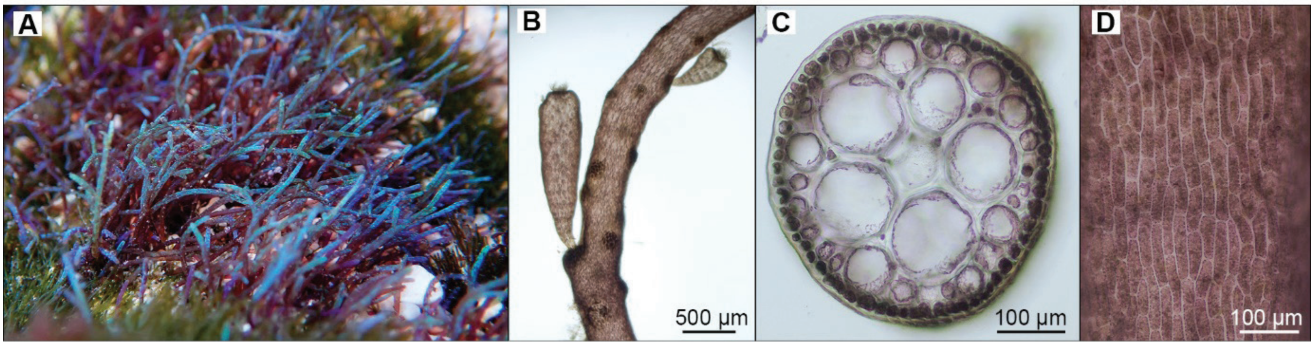

Fig. 14: *Chondria coerulescens* from Croatia. A: Settlements on 10 cm depth with turquoise iridescence of thalli; B: a higher part of thalli with secondary rhizoids and branchlets in a spiral pattern of development; C: transverse section and D: cortical cells in the middle part. Microscopic photos are made on the thalli from formaldehyde.

A

Region	Forward primer (F753)	Reverse primer (RbcL-Rev)	PCR conditions
rbcL	GGAAGATATGTATGAAAGAGC	ACATTTGCTGTTGGAGTCTC	95°C for 2 min; 35 cycles of: 93°C for 1 min, 47°C for 1min, 72°C for 2 min and 72°C for 2 min

B

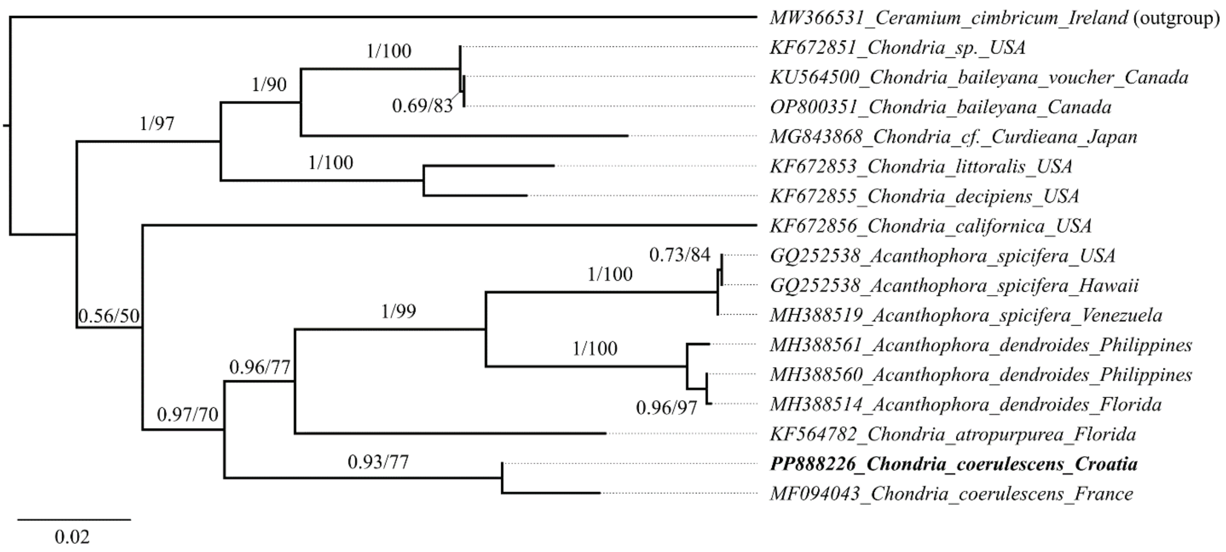

Fig. 15: A: Primers and polymerase chain reaction (PCR) conditions used for rbcL amplification. B: Phylogenetic tree derived from Bayesian and Maximum Likelihood (ML) analyses based on rbcL gene data. Bayesian posterior probabilities and ML bootstrap probabilities are placed on each node, separated by a slash.

ITALY

6.1 New record of the colonial ascidians *Aplidium accarense* and *Polyandrocarpa zorritensis* along the Adriatic coast confirmed with integrative taxonomy

Serena MUCCIOLO and Andrea DESIDERATO

Ascidians represent one of the main sessile biofouling taxa thanks to both their ability to tolerate a wide range of stresses and to quickly grow with high densities (Montesanto *et al*., 2021). An increasing number of non-indigenous species (NIS) has been recorded for the Mediterranean Sea, also because of the attention given to fouling organisms in the late years. Among the NIS ascidians reported in the Mediterranean Sea, *Aplidium accarense* (Millar, 1953), first described from the western African coast, and *Polyandrocarpa zorritensis* (Van Name, 1931), originally from the southeastern American coast, have a cosmopolitan distribution. The former species has been found in the western Mediterranean (Catalan and Tyrrhenian coasts) and the Ionian Sea (López-Legentil *et al*., 2015; Montesanto *et al*., 2021), while the latter has also been reported in the southern Adriatic Sea (Stabili *et al*., 2015). In August 2022, during a sampling campaign of fouling communities along the Apulian coasts (Italy, Adriatic Sea), *A. accarense* was found in a marina in the port of Bari (41.134° N, 16.85° E), and *P. zorritensis* (Fig. 16A) in two other small marinas in Torre a mare (41.0891° N, 16.999° E) and Santo Spirito (41.1648° N, 16.752° E), nearby. Colonies were fixed in 96% ethanol, and, in the laboratory, total DNA was extracted adapting the protocol from Casquet *et al*. (2012), using either a small group of zooids or a small piece of tissue of the body wall of each colony (i.e., 7 colonies). Then, the cytochrome oxidase subunit 1 (CO1) barcode was amplified according to Lobo *et al*. (2013) and sequenced (respectively: 625 bp, and between 623 and 676bp long fragments). The identity of both species was confirmed through Identification Engine in BOLD (www.boldsystems.org) and the sequences deposited in the BOLD datasets DS-ADAAC and DS-ADPZO respectively for *A. accarense* and *P. zorritensis* (dx.doi.org/10.5883/DS-ADAAC; dx.doi.org/10.5883/DS-ADPZO) together with other public sequences used as reference. A median-joining haplotype network was done for *A. accarense* with Pop-Art. This represents the first record in the Adriatic Sea for *A. accarense*. Furthermore, the haplotype found in Bari, seems

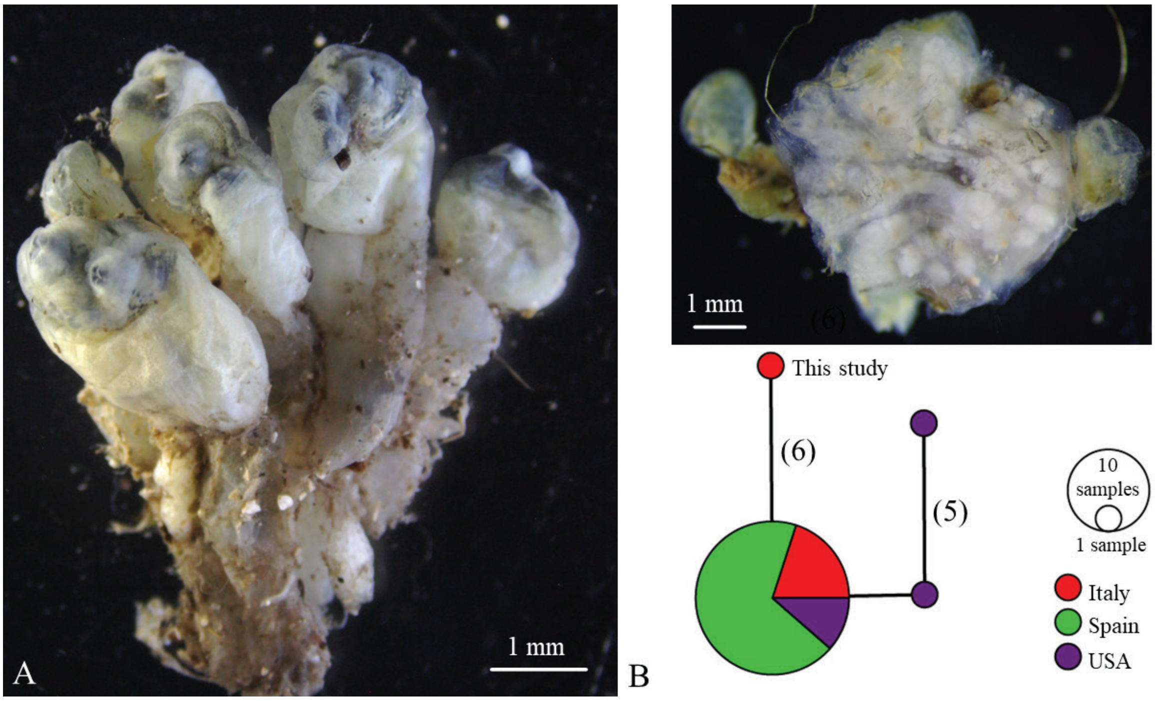

Fig. 16: A) Colony of *Polyandrocarpa zorritensis* from the port of Bari; B) The colony of *Aplidium accarense* from this study, and the CO1 median-joining haplotype network and the publicly available sequences (625bp). Numbers in brackets representing the mutations between haplotypes.

considerably different from those found before in the Mediterranean Sea (i.e., 6 mutations ~0.01% of Kimura 2-parameters distance, Fig. 16B), suggesting a possible different introduction compared to the western Mediterranean and requiring further investigations. The closest record (non-molecularly confirmed) of *P. zorritensis* in Apulia was in Brindisi (~90 km southward; Stabili *et al.*, 2015) confirming its expansion and possibly its presence in further marinas between these two areas (Bari-Brindisi). Also, *P. zorritensi*s showed 6 haplotypes (out of 7 specimens) being one the same of other Mediterranean specimens publicly available, suggesting connectivity among populations. These findings highlight the importance of recurrent surveys of ports for early detection to possibly take counter measures against the spread of NIS.

6.2 Spreading of the invasive Polychaete *Laonome triangularis* Hutchings & Murray, 1984 (Annelida, Sabellidae) in the Adriatic Sea

Marco LEZZI and Cristina MAZZIOTTI

The polychaete *Laonome triangularis* Hutchings & Murray, 1984, is a sabellid native to Australian waters (Hutchings & Murray, 1984). Redescribed by Capa (2007), it has become established as an invasive alien species in the Eastern Mediterranean (Çinar, 2009; Bonifazi *et al*., 2023). The first documented sighting in the Mediterranean Sea was in 2005, near the Port of İskenderun and Mersin Bays in Türkiye (Çinar, 2009). In Italian waters, *L. triangularis* was reported only once in 2023 from Civitavecchia in the Tyrrhenian Sea (Bonifazi *et al*., 2023).

A field sampling campaign was conducted in October 2023 as part of a dredging monitoring program within the Port of Ravenna, located in the North Adriatic Sea, Italy (Fig. 17). The target species was *L. triangularis*, and a total of 200 specimens were collected from the soft bottom substrate. Samples were collected on muddy sand at a depth of 4 m (44.493889° N, 12.299833° E).

Based on morphological traits, the collected specimens were identified as *L. triangularis*, in agreement with the descriptions provided by Hutchings & Murray (1984), Capa (2007), Çinar (2009), and Bonifazi *et al.* (2023). *Laonome triangularis* is identifiable by several key morphological features, including transverse rows of pigment at the base of some crown pinnules (Fig. 17A), a triangular pygidium (Fig. 17C), and triangular collar lobes (Fig. 17D). The species constructs large, fragile tubes composed of agglutinated mud particles (Fig. 17B).

Across its geographic range, *L. triangularis* exhibits a consistent preference for similar environments. Specimens have been collected from muddy and sandy substrates at depths between 7 and 30 m in both its native Australian waters and introduced localities, like the Turkish coast and the Tyrrhenian Sea (e.g., Hutchings & Murray, 1984; Çinar, 2009; Bonifazi *et al.*, 2023).

Çinar (2009) suggested that the presence of *L. triangularis* near commercial ports might be due to introduction via ship ballast water. He further attributed the

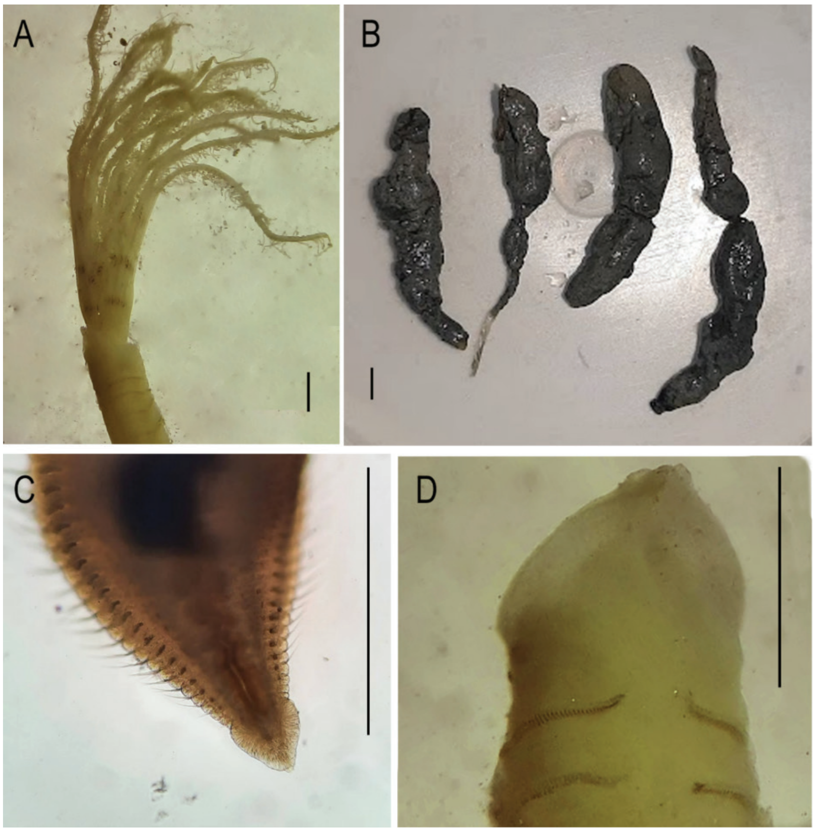

Fig. 17: *Laonome triangularis:* (A) Anterior end with transverse rows of pigment on radioles; (B) Tubes composed of agglutinated mud particles; (C) Triangular pygidium; (D) Collar lobes. Scale bar: 1 mm.

successful establishment of this species to its euryhaline nature, allowing adaptation to various environmental conditions. The current record, along with the finding of Bonifazi *et al.* (2023), strengthens this hypothesis. The Port of Ravenna, despite limited research on its alien biota, is known for its abundance of alien and invasive species. This finding highlights the potential of commercial ports like Ravenna to act as hotspots for biological invasions, serving as initial introduction points for alien and invasive species. Given the comparable substrate composition, predominantly muddy and similar to adjacent non-port areas, continued monitoring is crucial to assess the potential for future range expansion of *L. triangularis* into neighbouring environments.

6.3 The northernmost record of *Synalpheus africanus* Crosnier & Forest, 1965 (Decapoda: Alpheidae)

Valentina TANDUO, Alberto COLLETTI and Fabio CROCETTA

Snapping/pistol shrimps of the family Alpheidae Rafinesque, 1815 (Arthropoda: Malacostraca) are one of the most diversified groups of decapods, living nearly worldwide and often possessing enlarged or modified chelipeds with a snapping mechanism, used to produce a typical underwater sound (Anker *et al.*, 2006). About ten alpheid native taxa live in the Mediterranean Sea, of which *Alpheus dentipes* Guérin, 1832 and *Athanas nitescens* (Leach, 1814) are quite common and almost ubiquitous in shallow waters, whereas the remaining species are generally rarer all over the basin, with few exceptions, such as *Synalpheus gambarelloides* (Nardo, 1847) in the Levant Sea.

Within the ABBaCo project, aiming to evaluate the biodiversity of the National Interest Priority Site (NIPS) of Bagnoli-Coroglio (Naples, Tyrrhenian Sea, central-western Mediterranean Sea), scraping activities were carried out on the 23rd of July 2020 (~40.8102º N, 14.1625º E), at about 4-5 metres depth. Soon after the material was sorted out, nine snapping shrimps (carapace length measured with a Vernier calliper of 0.01 mm accuracy – from the base of the rostrum to the posterior margin of the carapace: 3.38–5.93 mm) were noticed among the two above mentioned commonest Mediterranean species. They differed from the other samples by a stout appearance and a greenish body colour (Fig. 18A), without additional whitish colour patches on the carapace and the chelipeds or whitish longitudinal bands on the carapace, as respectively usual in *A. dentipes* and *A. nitescens*.

Specimens were quickly photographed and fixed in 99.9% ethanol and soon after screened with a Zeiss Axio Zoom.V16 microscope for the main morphological features characterizing Mediterranean alpheid genera. They showed: (i) eyes completely covered by an orbital hood in dorsal and lateral views (Fig. 18B-C, black arrowheads) and a tooth cavity system on the claw fingers (snapping mechanism) (Fig. 18D, red arrowheads), which excludes the genera *Athanas* Leach, 1814, *Automate* De Man, 1888, and *Salmoneus* Holthuis, 1955, which have exposed or partially exposed eyes (with orbital teeth in *Athanas* and *Salmoneus*) and lack the snapping mechanism system (Lagardère, 1973; Anker *et al.*, 2006) and (ii) an acute pterygostomial angle (Fig. 18C, blue arrowhead), which excludes the genus *Alpheus* Fabricius, 1798, which have a rounded pterygostomial area (Lagardère, 1973). On the other hand, these characters well matched those of the genus *Synalpheus* Spence Bate, 1888, known from the Mediterranean Sea by *S. gambarelloides* and *Synalpheus africanus* Crosnier & Forest, 1965. Between them, the investigated samples fitted with the latter one, as they showed sharp ocular spines (Fig. 18E, light blue arrowhead) (*vs* blunt in *S. gambarelloides*), a stylocerite (Fig. 18E, brown arrowhead) extending behind the middle of the second segment of the antennular peduncle (Fig. 18E, brown rectangle) (*vs* reaching the base of it in *S. gambarelloides*), two spines on the antennal basicerite, with the outer one (Fig. 18E, dark green arrowhead) being longer than the inner one (Fig. 18E, light green arrowhead) (*vs* one in *S. gambarelloides*), a well-evident lamina of the scaphocerite (Fig. 18E, red quare) (*vs* barely present in *S. gambarelloides*), and a blunt tooth on the anterior dorsal margin of the propodus of the chelipeds (Fig. 18E, dark blue arrowhead) (*vs* one strongly pointed spine in *S. gambarelloides*) (Lewinsohn & Holthuis, 1964; Lagardère, 1973; Bacci *et al.*, 2010).

In addition, a partial sequence of the 16S rRNA gene, for which molecular data are available for most of the species of the group, was amplified from one specimen as described in Tanduo *et al.* (2021). The DNA barcoding approach gave ambiguous results. In fact, BLASTn queries of the obtained sequence (432 base pairs, bp) against the NCBI database showed a 98.84% similarity, thus within the range of conspecificity, with the sequence KU312992, deposited as *Synalpheus tenuispina* Coutière, 1909 (taxid: 1837161) and based on a specimen originating from the Western Atlantic Ocean (Ubatuba, São Paulo, Brazil). All the other sequences, including the sequence KJ595185 attributed to *Synalpheus* cf. *africanus* (taxid: 1503832), showed a similarity ≤93.86%, thus excluding conspecificity. Nevertheless, once the BLASTn query was limited to "*Synalpheus africanus*" (taxid: 1503751), a similarity within the potential range of con-

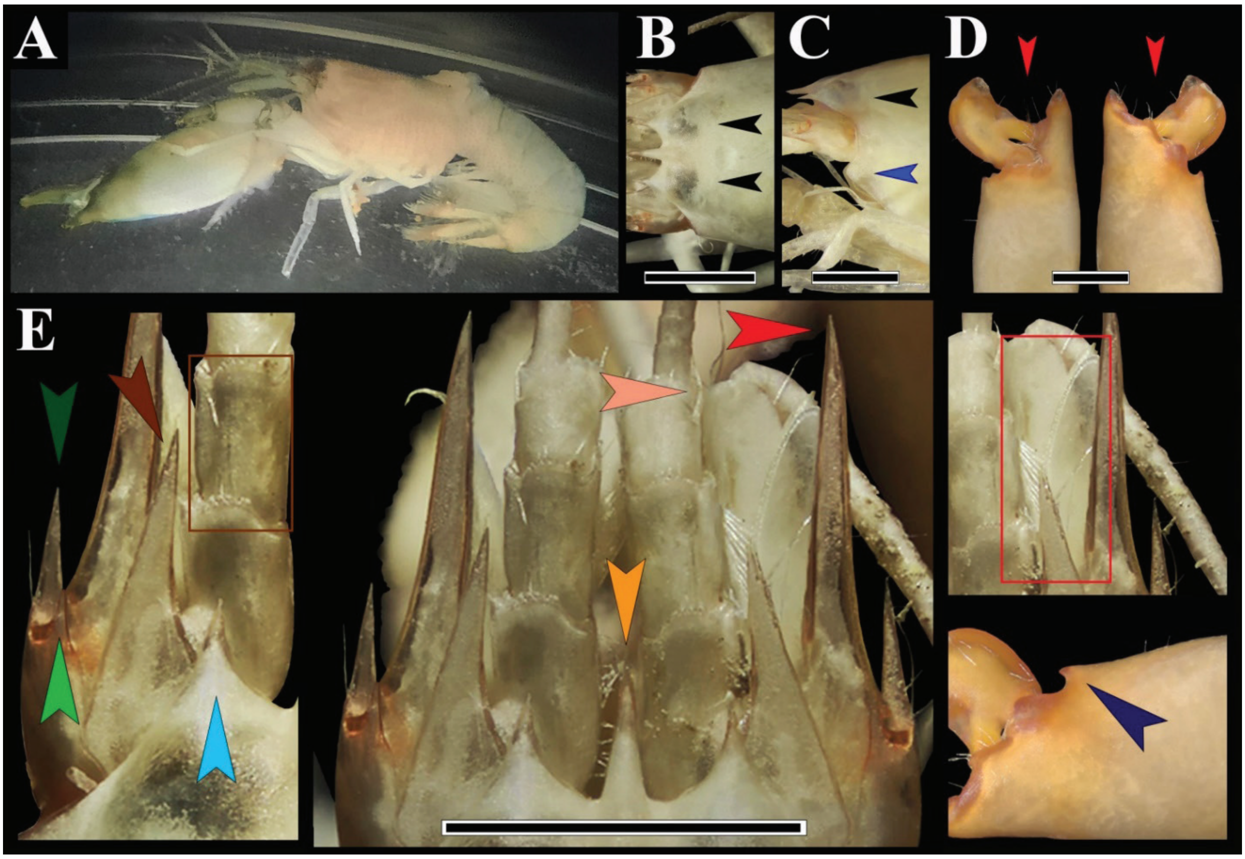

Fig. 18: *Synalpheus africanus* from the NIPS of Bagnoli-Coroglio (Naples, Tyrrhenian Sea, central-western Mediterranean Sea). A. Specimen photographed soon after collection showing a greenish body colour. B-E. One of the specimens found (♀, carapace length: 5.93 mm). B-C. Dorsal and lateral views, highlighting the eyes completely covered by the orbital hood (black arrowheads) and the acute pterygostomial angle (blue arrowhead). D. Internal and external view of the major cheliped, highlighting the snapping mechanism system (red arrowheads). E. Magnifications of the diagnostic parts mentioned in the text (ocular spine: light blue arrowhead; stylocerite: brown arrowhead; second segment of the antennular peduncle: brown rectangle; outer and inner spine on the antennal basicerite: dark and light green arrowheads; lamina of the scaphocerite: red rectangle; tooth on the propodus of the cheliped: dark blue arrowhead; rostrum: orange arrowhead; distolateral tooth of the scaphocerite: red arrowhead; carpocerite: pink arrowhead). Scale bars: 2 mm.

specificity (96.70%) was also retrieved with a shorter (182 bp) sequence (KJ625020) ascribed to this latter taxon and based on a specimen originating from the Eastern Atlantic Ocean (São Tomé). Sequencing of another molecular marker also yielded values within the range of conspecificity with additional sequences of *S. africanus* and excluded conspecificity with *S.* cf. *africanus* (Tanduo *et al.*, in preparation). No molecular data are available at this gene for *S. tenuispina*, which prevented us from performing additional comparisons.

Unfortunately, *S. tenuispina* and *S. africanus* are very similar and their status as different species was never investigated through molecular approaches. Anker *et al.* (2012) summarized their differences, laying in the shape of the rostrum (very slender and spiniform in *S. tenuispina vs* wider and stouter in *S. africanus*) and the length of the distolateral tooth of the scaphocerite (overreaching the end of the carpocerite in *S. tenuispina vs* falling short of it in *S. africanus*). In our specimens, the rostrum is wide and quite stout (Fig. 18E, orange arrowhead), but the distolateral tooth of the scaphocerite (Fig. 18E, red arrowhead) almost equals in length the end of the carpocerite (Fig. 18D, pink arrowhead), sometimes overreaching it. This observation is apparently in agreement with other specimens from the Eastern Atlantic and the Mediterranean Sea (e.g., Lagardère, 1973; Bacci *et al.*, 2010).

For the sake of biogeographic stability, we keep the identification of the investigated samples as *S. africanus*, in agreement with the recent literature from the Mediterranean Sea. Therefore, the 16S rRNA sequence was deposited as such in GenBank (accession number OR450015), and the same holds true for the specimen, deposited in the collection of the Laboratory of Benthos-Napoli (Stazione Zoologica Anton Dohrn, Naples) (code SZN-B-946CR70A). However, it might be possible that all this would require an update once the taxonomy of the species of the group will be settled. The present results account for the first molecular data obtained from specimens from the Mediterranean basin, confirm the taxonomic uncertainties reported in the literature, and also first highlight through molecular evidences a potential conspecificity between samples sequenced from the Mediterranean Sea and both the Eastern and the Western Atlantic Ocean.

Synalpheus africanus is a species described from the tropical Eastern Atlantic Ocean. Since ~1960, it was first recorded from Israel (Lewinsohn & Holthuis, 1964) and then from additional Mediterranean countries, although the species is still known from the entire basin by few and scattered occurrences (see Bacci *et al.*, 2010). The present sighting first testifies the presence of *S. africanus* in the widely studied area of the Gulf of Naples, with the NIPS of Bagnoli-Coroglio representing the northernmost locality known for the distribution of *S. africanus* worldwide, and accounts for the second record for Italy (Bacci *et al.*, 2010). No certainties occur on whether the species has been always present in the Mediterranean Sea, but went overlooked until recently, or if it entered the basin only in the last century, facilitated by either natural currents or anthropogenic vectors. Similar doubts also occur regarding its present distribution in the Mediterranean. The very recent first records of this taxon in some countries that are generally under-studied (e.g., Egypt, Libya) might suggest that its distribution in the basin is still presumably hindered by lack of field studies and absence of taxonomic specialists. However, it is also possible that *S. africanus* is truly spreading further within the basin in the recent decades. This again might have happened due to anthropogenic vectors (secondary spread) or the increasing seawater temperatures. In the latter case, the species might be thermophilic.

6.4 Further spreading of the mud crab *Dyspanopeus sayi* in Sardinia: insights from a west coast lagoon

Daniele GRECH and Gianni BRUNDU

Beach monitoring can be of valuable importance to public society which benefits of ecosystem services (Cabana *et al*., 2024), as well as to scientific research, mainly when unusual stranded specimens are reported to the scientific community, contributing to conservation and biodiversity inventories (Grech *et al*., 2020). During May 2024, dozens of little brachyuran specimens stranded (Fig. 19A-B) along the eastern shore of Santa Giusta lagoon (Center Western Sardinia, 39.872356° N, 8.608842° E). Specimens were identified as *Dyspanopeus sayi* (Smith, 1869) according to literature (Froglia & Speranza, 1993; Cabiddu *et al*., 2020 and references therein): oval, arcuate carapace, small median notch on front and minutely granular; 5 teeth on each anterolateral margin, of which the first 2 coalescent and near the ocular lobe margin, the last 3 prominent and variable in shape; the first male pleopod with a low medial lobe broadly rounded; fingers of chelae variable in colour, from ivory to black (Fig. 19C-D).

Subsequently to the finding, 60 specimens were collected, brought to the laboratory, and the gender and the carapace width (CW) and length (CL) were assessed. The sex ratio of the animals resulted in 0.15 (females/(females+males)). CW ranged from 12 to 28 mm, in particular 20.2±0.5 (mean ± SD, N=51) for males and 22.4±0.2 (N=9) for females. CL ranged from 8 to 21 mm, 14.9±0.3 (N=51) for males and 16.6±0.3 (N=9) for females. Our results agree with most of the previous studies, reporting similar mean size (male+female) and sex ratio dominated by males. The mean size of females was bigger than males, similarly to those reported by Cabiddu *et al*. (2020) from a locality nearby (Cagliari, Santa Gilla lagoon) and differently from most of the available literature. These results could be attributable to an underestimation of the smaller size due to the stranding phenomena or opportunistic collection, despite other performed surveys did

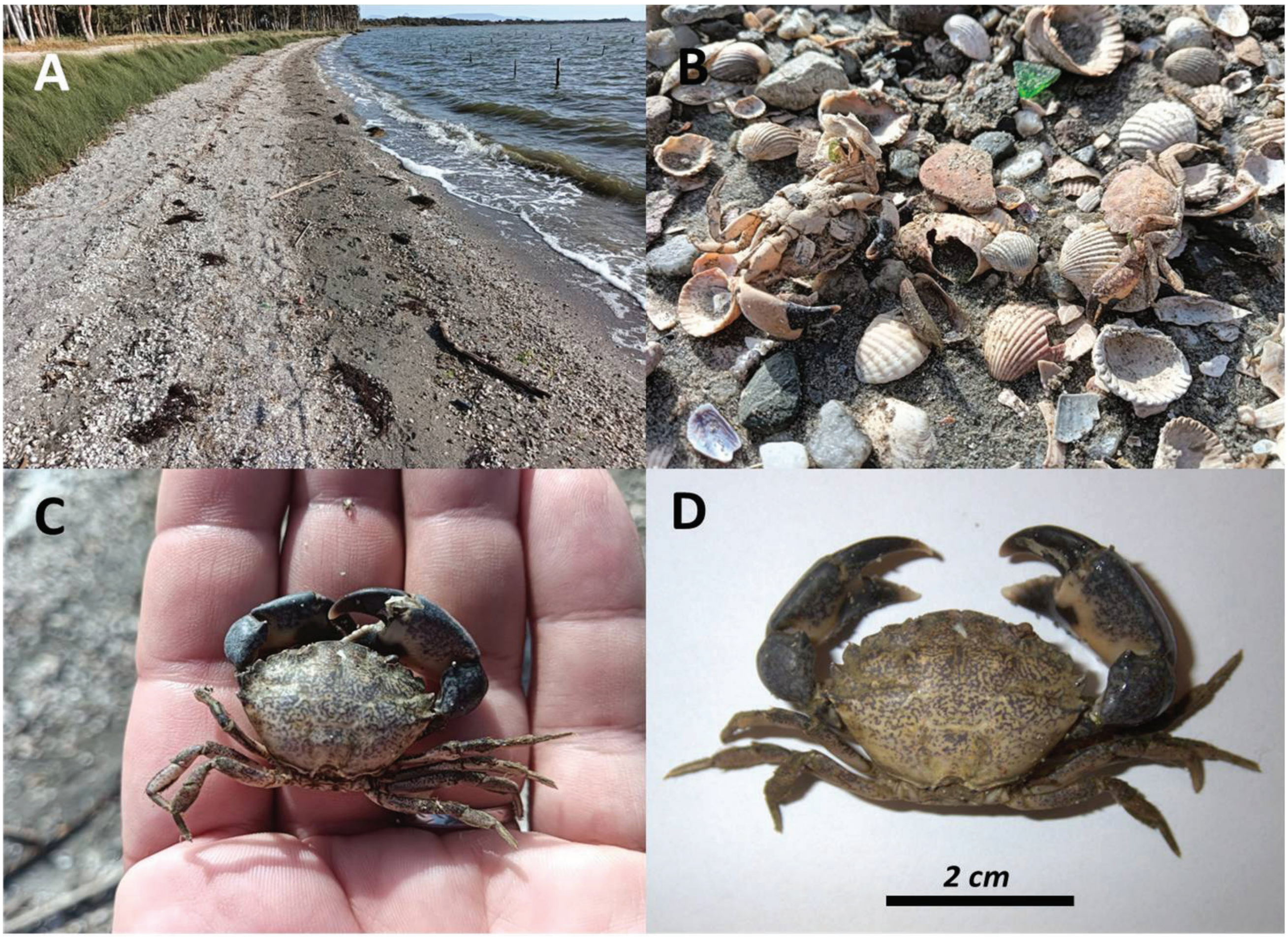

Fig. 19: Specimens of *Dyspanopeus sayi* in Sardinia. A: Santa Giusta eastern shore. B: stranded specimens with seashells. C: collected specimen. D: a male complete specimen with scalebar.

not allow to collect smaller specimens, especially for females. Though we could not assess the relative importance of alive and reproducing specimens, their massive stranding in a portion of the lagoon supports the possibility of a self-sustaining population residing in the Santa Giusta lagoon. Since the benthic macrofauna of this area was periodically investigated, we can hypothesize that the introduction of the species can be subsequent to 2012 (i.e., Brundu & Magni, 2021). *Dyspanopeus sayi* is a euryhaline alien species native of the NW Atlantic coast, reported in the Mediterranean Sea for the first time by Froglia & Speranza (1993). It deserves particular attention because it is reported as a common predator of bivalve species and is potentially able to drastically decrease the abundance of natural populations of the bivalves *Mytilus galloprovincialis* Lamarck, 1819, *Mytilaster lineatus* (Gmelin, 1791), *Ostrea edulis* Linnaeus, 1758 and *Magallana gigas* (Thunberg, 1793).

TUNISIA

7.1 First record of *Tubulophilinopsis reticulata* (Eliot, 1903) for the Mediterranean region

Julien P. RENOULT

Tubulophilinopsis reticulata (Eliot, 1903) is an aglajid sea slug (Heterobranchia: Cephalaspidea) originating from the Indo-Pacific region and the Red Sea. On 8 April 2024, an individual of *T. reticulata* was photographed at 0.3 m depth on a red algae *Ceramium* sp. during a snorkelling session in El Biban lagoon, Tunisia (33.277445° N, 11.293719° E). The individual was approximately 25 mm long, brown and yellow-spotted in colouration, and had tiny but visible eyes (Fig. 20). The presence of parapodia partially covering the body and separated into a cephalic and a posterior shield terminated by two caudal lobes points toward the Aglajidae family. Within this family, the following combination of characters excludes all genera except *Tubulophilinopsis* and *Spinoaglaja*: body with smooth dorsal surface, and with elongated and cylindrical shape, posterior and cephalic shields of ap-

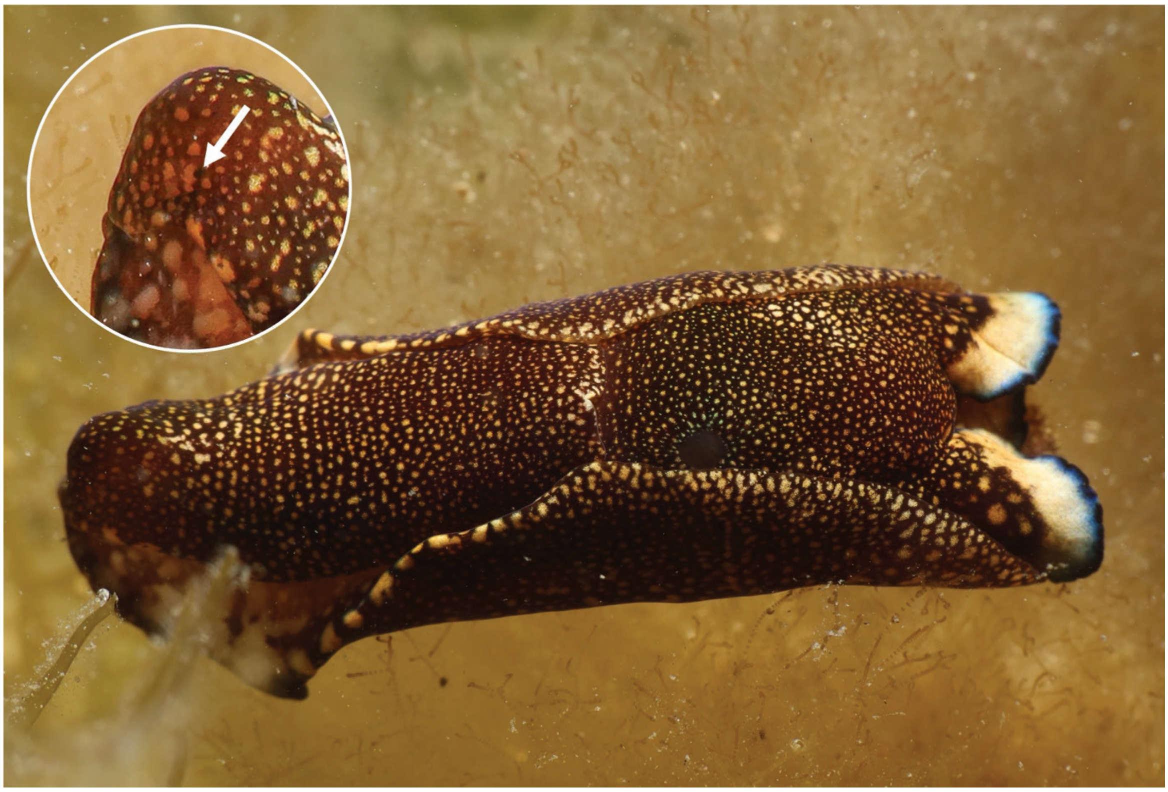

Fig. 20: *Tubulophilinopsis reticulata* in El Bibane lagoon, Tunisia. The arrow in the inset points to the eye.

proximately equal lengths, anterior edge of the cephalic shield angular and elevated, posterior edge lying over the posterior shield, posterior shield with two short, symmetrical, and rounded caudal lobes, parapodia reduced (Zamora-Silva & Malaquias, 2018). The three recognised species of *Spinoaglaja* can be excluded based on their appearance, characterised by conspicuously coloured anterior and posterior edges of the cephalic shield, and by the lack of visible eyes. Among the four currently recognised species of *Tubulophilinopsis,* only *T. reticulata* shows a spotted pattern. The Tunisian specimen matches in all respects to the individual of *T. reticulata* illustrated in the recent description of the genus (see Fig. 4B in Zamora-Silva & Malaquias, 2018).

The genus *Tubulophilinopsis* has been previously recorded once in the Mediterranean region, based on a shell collected at 40-100 m depth in Greece (Galinou-Mitsoudi *et al.*, 2023). However, this shell does not precisely match any known species and thus the identification, even at the genus level, remains uncertain. *Tubulophilinopsis reticulata* has therefore never been recorded in the Mediterranean region thus far. The arrival of this Lessepsian species in Tunisia is of uncertain origin; possible explanations include ship traffic or aquaculture. Regardless, Mediterranean lagoons are hotspots of invasive marine species (Mghili *et al.*, 2024), and in Tunisia 16% of the country's alien fauna have been recorded for the first time in a lagoon (Amor *et al.*, 2016). Considering the geographic position of Tunisia at the crossroads between the western and the eastern Mediterranean, monitoring the alien fauna of these lagoons is of crucial importance for understanding the dynamics of marine bioinvasions in the region.

7.2 The alien pyramidellid gastropod *Pyrgulina maiae* Hornung & Mermod, 1924 has reached Tunisia

Mouna ANTIT

The gastropod family Pyramidellidae comprises numerous species characterized by a mostly small size and a mode of life as ectoparasites of other invertebrates, mainly polychaetes and other molluscs. Despite the difficulty for finding an appropriate host in a newly invaded area, this family ranks first among Mollusca as for the number of Indo-Pacific alien species recorded in the Mediterranean Sea, with currently 22 species, plus three of the allied family Amathinidae. At least in one documented case (Oliverio, 1994), an alien pyramidellid of Indo-Pacific origin shifted to a native Mediterranean molluscan host.

Pyrgulina maiae Hornung & Mermod, 1924 is the earliest recorded alien pyramidellid in the Mediterranean, traced back to 1935 in Israel. It was originally described from Massaua, Eritrea, and is common in the Red Sea in shallow water (Peñas *et al.*, 2020). By the end of the 20th century, it had become extremely common in some parts of the Eastern Mediterranean, particularly Türkiye (Zenetos *et al.*, 2004 and references therein) and Cyprus but records further west are few [Saronikos Gulf, Aegean part of Greece: Manousis *et al*., 2020, as *Pyrgulina pupaeformis* (Souverbie, 1865); Malta: Nappo *et al*., 2024]. The species is relatively easy to identify (see details below), because of its relatively large size for a pyramidellid (up to 4 mm in the Mediterranean, Zenetos *et al.*, 2004), and does not resemble any of the native species in that family. *Pyrgulina pupaeformis*, originally described from New Caledonia, was at one time considered as an older name for *P. maiae* but Peñas *et al*. (2020: 54) considered them as distinct and resumed usage of the name *maiae* for the Mediterranean records.

Here we report for the first time the occurrence of this species in the Tunisian part of the Eastern Mediterranean, in the Gulf of Hammamet.

Our study site (Fig. 21) is near the harbour of Salakta al Marsa in the Gulf of Hammamet (35.39060° N, 11.04521° E). We began with a qualitative sample in July 2023, then resumed with also a quantitative sampling on April 22, 2024. Samples were taken at depths of 1 to 3 m on an artificial pier of the harbour, built perpendicular to the coastline (Fig. 21). The quantitative samples were taken from four quadrats of 0.25 x 0.25 m (totalizing 0.25 m^2), first collecting the algal cover in a fine mesh bag, then using a brush to collect all the fauna from the substrate within the perimeter of the frame. The qualitative sample was sorted in seawater so that the living specimens, among which *P. maiae*, could be photographed. For the remaining samples, the algae were washed in a bucket of fresh water so that the small animals came off, then the total residue (brushing and algae washing) was sifted through a series of meshes down to 0.5 mm and each fraction sorted by species under a binocular microscope. The volume and biomass of the algae were recorded.

The four replicates of the quantitative sample collected on the pier yielded altogether 2666 live collected specimens of molluscs, representing 121 species. The assemblage was dominated by gastropods (109 species, 90%), followed by bivalves (12 species, 10%) and by only one polyplacophoran species. The most dominant species were, in this order, *Bittium reticulatum* (da Costa, 1778) (1762 individuals), the alien *Cerithium scabridum* Philippi, 1848 (260 individuals), *Mytilaster minimus* (Poli, 1795) (132 individuals), *Musculus subpictus* (Cantraine, 1835) (52 individuals), *Tricolia pullus* (Linnaeus,

Fig. 21: Aerial view of our collection site (arrow). Image from Google Earth.

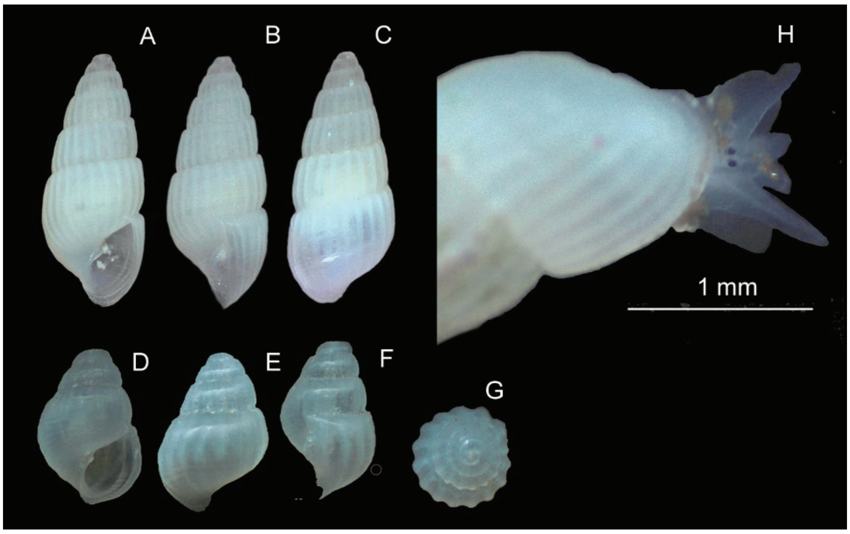

Fig. 22: Specimens of *Pyrgulina maiae* from Salakta, collected in July 2023. A-C: Adult specimen (height 3.7 mm). D-G: juvenile (height 1.1 mm). H: living animal, same specimen as A-C.

1758) (42 individuals) and *Pyrgulina maiae* (22 individuals). This fauna is currently under study and details will be published elsewhere.

Our specimens (Fig. 22) show the characteristic features of *P. maiae*: pupoid, quite solid shell reaching ca. 4 mm in height, type C protoconch (i.e., with coiling axis tilted 180° with respect to the teleoconch axis) smooth and clearly demarcated from teleoconch, sculpture of strong axial ribs (ca. 18 per whorl) and very fine spiral cordlets between the ribs. In adult shells, the last whorl is somewhat constricted with respect to the previous ones. The living animal has a typical pyramidellid head-foot with small black eyes embedded close together, a markedly bifid snout (contrary to most native Mediterranean pyramidellids which have a rectangular snout), quite large cephalic tentacles, foliaceous and triangular in shape, and a broad, squarish propodium.

This work also allows us to update the faunistic data compiled by the Ministère de l'Environnement et du Développement Durable which report only 10 species of molluscs in the Gulf of Hammamet, a very low figure compared to the better studied Gulf of Gabès and Gulf of Tunis where hundreds of species are reported. This reflects a gap of knowledge in this area where the expected richness is no less than other parts of the Tunisian coast. Taking this into account, *P. maiae* may have been overlooked for some time, but was not found in an earlier qualitative sampling by the author in August 2008.

The distance of over 2000 km separating our finding from the established populations in Türkiye may be an artefact, because the Mediterranean coast of Egypt and that of Libya have hardly been studied for small molluscs. The modalities of larval development and dispersal are poorly known in Pyramidellidae, especially in species with a C-type protoconch, but at least some members of this family have planktonic larvae which could mediate the extension of the range within the Mediterranean.

Acknowledgements

Gerasimos Kondylatos would like to thank Mrs Minna Puhakka for providing the video of the species from Alimia Island. Markos Digenis acknowledges that his research was supported by the Hellenic Foundation for Research and Innovation (HFRI) under the 4th Call for HFRI PhD Fellowships (Fellowship Number: 10597). Vasilis Gerovasileiou was supported by the project "SponBIODIV - Marine sponge biodiversity from genes to ecosystems: delivering knowledge and tools for sustainable management and conservation", funded by Biodiversa+, the European Biodiversity Partnership under the 2021-2022 BiodivProtect joint call for research proposals, co-funded by the European Commission (GA N°101052342) and the funding organisation General Secretariat for Research and Innovation (GSRI) under the Hellenic Ministry of Development. Ante Žuljević, Jelena Nejašmić and Marija Kvesić Ivanković acknowledge that their work was supported by the Croatian Science Foundation under the project Benthic NIS (IP-2019-04-6702). Serena Mucciolo and Andrea Desiderato would like to state that the expedition was carried out under the IDUB project B2211001000118.07 of the University of Lodz. The work of Valentina Tanduo, Alberto Colletti and Fabio Crocetta was partially funded by the ABBaCo project (C62F16000170001). This article is part of the Ph.D. project "DARING" (Tackling diversity through DNA barcoding and integrative taxonomy: **D**ecapod **A**ssemblages **R**evealed **IN** the **G**ulf of Naples) of Valentina Tanduo. Daniele Grech would like to thank Alessandra Bellucci and Francesco Grech for helping in the sampling collection. Daniele Grech's work was funded by "ALIEM VIGIL - Actions de limitation, de gestion et de vigilance liées à l'introduction d'espèces exotiques envahissantes dans les zones de transports en Méditerranée", progetto finanziato nell'ambito dell'asse 2 di Interreg Italia – Francia Marittimo 2021-2027 (https://www.aliem-network.eu/)

References

Ammar, I., Khalifa, F., Mhanna, H., Halhal, M., 2022. First record of four species of Nudibranchia molluscs from Chromodorididae and Plakobranchidae families in Syria. *Species*, 23 (71), 14-19.

Amor, K.O.B., Rifi, M., Ghanem, R., Draeif, I., Zaouali, J. *et al.*, 2016. Update of alien fauna and new records from Tunisian marine waters. *Mediterranean Marine Science*, 17 (1), 124-143.

Anker, A., Ahyong, S.T., Noel, P.Y., Palmer, A.R., 2006. Morphological phylogeny of alpheid shrimps: parallel preadaptation and the origin of a key morphological innovation, the snapping claw. *Evolution*, 60 (12), 2507-2528.

Anker, A., Pachelle, P.P., De Grave, S., Hultgren, K.M., 2012. Taxonomic and biological notes on some Atlantic species of the snapping shrimp genus *Synalpheus* Spence Bate, 1888 (Decapoda, Alpheidae). *Zootaxa*, 3598 (1), 1-96.

Bacci, T., Trabucco, B., Magaletti, E., 2010. First record of *Synalpheus tumidomanus africanus* (Crosnier & Forest, 1965) (Caridea, Alpheidae) in Italian waters. *Crustaceana*, 83 (7), 821-827.

Battelli, C., Arko Pijevac, M., 2005. Development of the invasive turf-forming red algae *Womersleyella setacea* (Hollenberg) R. E. Norris on subtidal shores of Rijeka Bay (northern Adriatic sea). *Annales. Series historia naturalis*, 15 (2), 215-222.

Bax, N., Williamson, A., Aguero, M., Gonzalez, E., Geeves, W., 2003. Marine invasive alien species: a threat to global biodiversity. *Marine Policy*, 27, 313-323.

Ben-Tuvia, A., 1953. New Erythrean fishes from the Mediterranean coast of Israel. *Nature*, 172, 464-465.

Ben-Tuvia, A., 1978. Immigration of fishes through the Suez Canal. *Fishery Bulletin*, 76 (1), 249-255.

Bonifazi, A., Lombardo, M.F., De Bonis, S., Caprioli, R., Fustolo, M. *et al.*, 2023. First Record of the Alien and Invasive Polychaete *Laonome triangularis* Hutchings & Murray, 1984 (Annelida, Sabellidae) in Italian Waters. *Diversity*, 15 (6), 771.

Brundu, G., Magni, P., 2021. Context-dependent effect of serpulid reefs on the variability of soft-bottom macrobenthic assemblages in three Mediterranean lagoons (Sardinia, Italy). *Estuarine, Coastal and Shelf Science*, 262, 107589.

Cabana, D., Pinna, S., Farina, S. Grech D., Barbieri, N. *et al.*, 2024. Coastal cultural ecosystem services and adolescents' subjective well-being. *Ambio*, https://doi.org/10.1007/s13280-024-02043-2.

Cabiddu, S., Addis, P., Palmas, F., Pusceddu, A., 2020. First record of *Dyspanopeus sayi* (Smith, 1869) (Decapoda: Brachyura: Panopeidae) in a Sardinian coastal lagoon (western Mediterranean, Italy). *BioInvasions Records*, 9 (1), 74-82.

Canning-Clode, J., 2015. General Introduction – Aquatic and Terrestrial Biological Invasions in the 21st Century. p. 13-19. In: *Biological invasions in changing ecosystems: vectors, ecological impacts, management and predictions*. Canning-Clode, J., Michalczyk, K., Vainikka, A., Turner, B. (Eds). De Gruyter, Berlin.

Capa, M., 2007. Redescription of *Laonome triangularis* Hutchings & Murray, 1984 (Polychaeta: Sabellidae) from Australia, with a new record from the eastern Mediterranean. *Journal of the Marine Biological Association of the United Kingdom*, 87 (2), 421-426.

Cárdenas, S., Berastegui, D.A., Ortiz, J., 1997. First record of *Fistularia petimba* Lacepéde, 1803 (Pisces, Fistulariidae) off the coast of Cadiz (southern Iberian Peninsula). *Boletín del Instituto Español de Oceanografía*, 13 (1), 83-86.

Casquet, J., Thebaud, C., Gillespie, R.G., 2012. Chelex without boiling, a rapid and easy technique to obtain stable amplifiable DNA from small amounts of ethanol-stored spiders. *Molecular Ecology Resources*, 12, 136-141.

Chan, F.T., Stanislawczyk, K., Sneekes, A.C., Dvoretsky, A., Gollasch, S. *et al.*, 2019. Climate change opens new frontiers for marine species in the Arctic: Current trends and future invasion risks. *Global change biology*, 25 (1), 25-38.

Çiftçi, N., Ayas, D., Doğangün, M., 2019. New locality record for *Fistularia petimba* Lacepède, 1803 from the northeastern Mediterranean Sea (Mersin Bay). *Mediterranean Fisheries and Aquaculture Research*, 2 (2), 42-48.

Çinar, M.N., 2009. Alien polychaetes (Annelida) in the Aegean, Marmara, and Black Seas: with checklists for the alien and native species. *Aquatic Invasions*, 4 (1), 115-122.

Çinar, M.E., Bilecenoglu, M., Öztürk, B., Can, A., 2006. New records of alien species on the Levantine coast of Turkey. *Aquatic invasions*, 1 (2), 84-90.

Cormaci, M., Furnari, G., Giaccone, G., Serio, D., 2004. Alien macrophytes in the Mediterranean Sea: a review. *Recent Research Developments in Environmental Biology*, 1, 153-202.

Cressey, R.F., 1981. Revision of Indo-West Pacific lizardfishes of the genus *Synodus* (Pisces: Synodontidae). *Smithsonian Contributions to Zoology*, 342, 1-53.

Crocetta, F., Zibrowius, H., Bitar, G., Templado, J., Oliverio, M., 2013. Biogeographical homogeneity in the eastern Mediterranean Sea - I: The opisthobranchs (Mollusca: Gastropoda) from Lebanon. *Mediterranean Marine Science*, 14 (2), 403-408.

Crocetta, F., Al Mabruk, S.A., Azzurro, E., Bakiu, R., Bariche, M. *et al.*, 2021. New Alien Mediterranean Biodiversity Records (November 2021). *Mediterranean Marine Science*, 22 (3), 724-746.

Díaz-Tapia, P., Bárbara, I., 2013. Seaweeds from sand-covered rocks of the Atlantic Iberian Peninsula. Part 1. The Rhodomelaceae (Ceramiales, Rhodophyta). *Cryptogamie, Algologie*, 34 (4), 325-422.

Digenis, M., Ragkousis, M., Vasileiadou, K., Gerovasileiou, V., Katsanevakis, S., 2021. New records of the Indo-Pacific shrimp *Urocaridella pulchella* Yokeş & Galil, 2006 from the Eastern Mediterranean Sea. *BioInvasions Records*, 10 (2), 295-303.

Douek, J., Paz, G., Gayer, K., Mendelson, M., Rinkevich, B. *et al.*, 2021. An outbreak of *Perna perna* (Linnaeus, 1758) (Mollusca, Bivalvia, Mytilidae) in the Eastern Mediterranean. *BioInvasions Records*, 10 (1), 136-148.

Ďuriš, Z., 2017. Palaemonid shrimps (Crustacea: Decapoda) of Saudi Arabia from the 'Red Sea biodiversity survey' 2011-2013, with 11 new records for the Red Sea. *Marine Biodiversity*, 47 (4), 1147-1161.

Fofonoff, P.W., Ruiz, G.M., Steves, B., Simkanin, C., Carlton, J.T., 2018. *National Exotic Marine and Estuarine Species Information System*. http://invasions.si.edu (Accessed 11 July 2024).

Fricke, R., Eschmeyer, W.N., Van der Laan, R., 2024. *Eschmeyer's Catalog of Fishes: Genera, Species, References.* http://researcharchive.calacademy.org/research/ichthyology/ catalog/fishcatmain.asp (Accessed 22 April 2024).

Froese, F., Pauly, D., 2024. *Fish Base*. http://www.fishbase.org (Accessed 11 March 2024).

Froglia C., Speranza S., 1993. First record of *Dyspanopeus sayi* (Smith, 1869) in the Mediterranean Sea (Crustacea, Decapoda, Xanthidae). *Quaderni dell'Istituto Ricerche Pesca Marittima*, 5 (2), 163-166.

Galanidi, M., Aissi, M., Ali, M., Bakalem, A., Bariche, M. *et al.*, 2023. Validated Inventories of Non-Indigenous Species (NIS) for the Mediterranean Sea as Tools for Regional Policy and Patterns of NIS Spread. *Diversity*, 15 (9), 962.

Galil, B.S., 2007. Loss or gain? Invasive aliens and biodiversity in the Mediterranean Sea. *Marine Pollution Bulletin*, 55, 314-322.

Galil, B.S, Goren, M., 2014. Metamorphoses: bioinvasions in the Mediterranean Sea. p. 463-478. In: *The Mediterranean Sea: Its History and Present Challenges*. Goffredo, S., Dubinsky, Z. (Eds.), Springer Verlag, Dordrecht.

Galil, B.S., Marchini, A., Occhipinti-Ambrogi, A., 2018. East is east and West is west? Management of marine bioinvasions in the Mediterranean Sea. *Estuarine, Coastal and Shelf Science*, 201, 7-16.

Galil, B.S, Spanier, E., Ferguson, W.W., 1990. The Scyphomedusae of the Mediterranean coast of Israel, including two lessepsian migrants new to the Mediterranean. *Zoologische Mededelingen, Leiden*, 64, 95-106.

Galinou-Mitsoudi, S., Zaminos, G., Manousis, T., Kontadakis, C., Stasinos, S. *et al.*, 2023. Mediterranean and Hellenic Seas: New records and distributional status of marine molluscs (by December 2022). *Xenophora Taxonomy*, 39, 57-67.

Gerovasileiou, V., Bancila, R.I., Katsanevakis, S., Zenetos, A., 2022. Introduced species in Mediterranean marine caves: an increasing but neglected threat. *Mediterranean Marine Science*, 23 (4), 995-1005.

Golani, D., Azurro, E., Dulčić, J., Massutí, E., Orsi-Relini, L., 2021. *CIESM atlas of exotic fishes in the Mediterranean Sea*. Vol. 2. CIESM Publisher, F. Briand (Ed.), Paris, Monaco, 365 pp.

Gómez Garreta, A., Gallardo, T., Ribera, M.A., Cormaci, M., Furnari, G. *et al.*, 2001. Checklist of Mediterranean Seaweeds. III. Rhodophyceae Rabenh. 1. Ceramiales Oltm. *Botanica Marina*, 44 (5), 425-460.

Gon, O., Randall, J.E., 2003. A review of the cardinalfishes (Perciformes: Apogonidae) of the Rea Sea. *Smithiana Bulletin*, 1, 1-47.

Grech, D., van de Poll, B., Bertolino, M., Rosso, A., Guala, I., 2020. Massive stranding event revealed the occurrence of an overlooked and ecosystem engineer sponge. *Marine Biodiversity*, 50 (5), 82.

Guiry, M.D., Guiry, G.M., 2024. *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. https://www.algaebase.org (Accessed 11 June 2024).

Hewitt, C.L, 2003. Marine biosecurity issues in the world oceans: global activities and Australian directions. *Ocean Yearbook Online*, 17, 193-212.

Hulme, P.E., 2009. Trade, transport and trouble: managing invasive species pathways in an era of globalization. *Journal of applied ecology*, 46 (1), 10-18.

Hutchings, P.A., Murray, A., 1984. A vaucheriacean symbiosis in a new species of *Laonome* (Polychaeta: Sabellidae) from New South Wales. *Proceedings of the Linnean Society of New South Wales*, 107 (4), 349-359.

Katsanevakis, S., Wallentinus, I., Zenetos, A., Leppäkoski, E., Çinar, M.E. *et al.*, 2014. Impacts of invasive alien marine species on ecosystem services and biodiversity: a pan-European review. *Aquatic Invasions*, 9, 391-423.

Katsanevakis, S., Poursanidis, D., Hoffman, R., Rizgalla, J., Rothman, S.B. *et al.*, 2020. Unpublished Mediterranean records of marine alien and cryptogenic species. *BioInvasions Records*, 9 (2), 165-182.

Khamassi, F., Ghanem, R., Hassan, B., Karray, S., El Bour, M. *et al.*, 2022. First record of the Gracile lizardfish *Saurida gracilis* (Quoy & Gaimard, 1824) in Mediterranean waters. *Mediterranean Marine Science*, 23 (1), 25-29.

Kleitou, P., Giovos, I., Wolf, W., Crocetta, F., 2019. On the importance of citizen-science: the first record of *Goniobranchus obsoletus* (Rüppell & Leuckart, 1830) from Cyprus (Mollusca: Gastropoda: Nudibranchia). *BioInvasions Records*, 8 (2), 252-257.

Krug, P.J., Vendetti, J.E., Rodriguez, A.K., Retana, J.N., Hirano, Y.M. *et al.*, 2013. Integrative species delimitation in photosynthetic sea slugs reveals twenty candidate species in three nominal taxa studied for drug discovery, plastid symbiosis or biological control. *Molecular Phylogenetics and Evolution*, 69 (3), 1101-1119.

Lagardère, J.P., 1973. Les crevettes des côtes du Maroc. *Travaux de l'Institut scientifique cherifien et de la Faculte des Sciences – Serie Zoologie*, 36, 1-140.

Langeneck, J., Bakiu, R., Chalari, N., Chatzigeorgiou, G., Crocetta, F. *et al.*, 2023. New records of introduced species in the Mediterranean Sea (November 2023). *Mediterranean Marine Science*, 24 (3), 610-632.

Lewinsohn, C.H., Holthuis, L.B., 1964. New records of Decapoda Crustacea from the Mediterranean coast of Israel and the eastern Mediterranean. *Zoologische Mededelingen*, 40 (8), 45-63.

Lobo, J., Costa, P.M., Teixeira, M.A., Ferreira, M.S.G., Costa, M.H. *et al.*, 2013. Enhanced primers for amplification of DNA barcodes from a broad range of marine metazoans. *BMC Ecology*, 13 (34).

Lockwood, J.L., Hoopes, M.F., Marchetti, M.P., 2013. *Invasion ecology. Second edition*. Wiley-Blackwell, Malden, Massachusetts, 464 pp.

López-Legentil, S., Legentil, M.L., Erwin, P.M., Turon, X., 2015. Harbor networks as introduction gateways: contrasting distribution patterns of native and introduced ascidians. *Biological Invasions*, 17, 1623-1638.

Maggs, C., Hommersand, M.H., 1993. *Seaweeds of the British Isles. Vol. 1. Rhodophyta, Part 3A Ceramiales*. The Natural History Museum, London, 464 pp.

Manousis, T., Kontadakis, C., Mbazios, G., 2020. New records of Cimidae, Murchisonellidae and Pyramidellidae (Mollusca: Gastropoda: Heterobranchia) for the Mediterranean Sea and the Hellenic Waters. *Xenophora Taxonomy*, 28, 1-27.

Martinez, S., Bellworthy, J., Ferrier-Pagès, C., Mass, T., 2021. Selection of mesophotic habitats by *Oculina patagonica* in the Eastern Mediterranean Sea following global warming. *Scientific Reports*, 11 (1), 18134.

Martín-Hervás, M.R., Carmona, L., Jensen, K.R., Krug, P.J., Vitale, F. *et al.*, 2023. A global phylogeny of *Elysia* Risso, 1818 (Gastropoda: Heterobranchia): molecular systematic insights focusing on European taxa and description of a new species. *Zoological Journal of the Linnean Society*, 1-20.

Mghili, B., Lamine, I., Laamraoui, M.R., Aksissou, M., Galanidi, M., 2024. Updating the national list of marine alien species in Morocco. *Mediterranean Marine Science*, 25 (1), 231-249.

Montesanto, F., Chimienti, G., Gissi, C., Mastrototaro, F., 2021. Spread of the non-indigenous ascidian *Aplidium accarense* (Millar, 1953) in the Eastern Mediterranean Sea: morphological and molecular tools for an accurate identification. *Mediterranean Marine Science*, 22 (2), 246-254.

Moura, C.W.D.N., Almeida, W.R.D., Santos, A.A.D., Andrade Junior, J.C.D., Alves, A.M. e*t al.*, 2014. Polyphysaceae (Dasycladales, Chlorophyta) in Todos os Santos Bay, Bahia, Brazil. *Acta Botanica Brasilica*, 28, 147-164.

Nappo, A., Cilia, D.P., Cardona, S., 2024. Additions to the marine mollusc fauna of the Maltese Archipelago, with observations on the nomenclature and biogeography of rare or poorly known Central Mediterranean species. *Bollettino Malacologico*, 60, 46-79.

NCBI, 2024. *BlastN algorithm*. https://blast.ncbi.nlm.nih.gov/Blast.cgi (Accessed 22 January 2024).

Occhipinti-Ambrogi, A., Galil, B.S., 2004. A uniform terminology on bioinvasions: a chimera or an operative tool? *Marine Pollution Bulletin*, 49 (9-10), 688-694.

Ojaveer, H., Galil, B.S., Minchin, D., Olenin, S., Amorim, A. *et* *al*., 2014. Ten recommendations for advancing the assessment and management of non-indigenous species in marine ecosystems. *Marine Policy*, 44, 160-165.

Oliverio, M., 1994. On the record of a living lessepsian pyramidellid from Turkey (Heterobranchia, Heterostropha). *Notiziario del C.I.S.MA.* [Centro Italiano di Studi Malacologici, Roma], 15, 79-82.

Papaconstantinou, C., 1990. The spreading of Lessepsian fish migrants into the Aegean Sea (Greece). *Scientia Marina*, 54 (4), 313-316.

Papageorgiou, M., Resaikos, V., Petrou A., 2023. A preliminary assessment of *Fistularia petimba* (Lacepède, 1803) migration in the Mediterranean Sea: historical and new data from Cyprus (Levantine Sea) with biological notes. *Mediterranean Marine Science*, 24 (2), 446-453.

Peñas, A., Rolán, E., Sabelli, B., 2020. The family Pyramidellidae in the Red Sea. I. The tribe Chrysallidini. *Iberus*, 38 (supplement 8), 1-93.

Pierri, B., Fossari, T., Magalhães, A., 2016. O mexilhão Pernaperna no Brasil: nativo ou exótico? *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*, 68 (2), 404-414.

Ragkousis, M., Abdelali, N., Azzurro, E., Badreddine, A., Bariche, M. *et al*., 2020. New Alien Mediterranean Biodiversity Records (October 2020). *Mediterranean Marine Science*, 21 (3), 631-652.

Ragkousis, M., Zenetos, A., Ben Souissi, J., Hoffman, R., Ghanem, R. *et al.*, 2023. Unpublished Mediterranean and Black Sea records of marine alien, cryptogenic, and neonative species. *BioInvasions Records*, 12 (2), 339-369.

Rajagopal, S., Venugopalan, V., Van der Velde, G., Jenner, H., 2006. Greening of the coasts: A review of the Perna viridis success story. *Aquatic Ecology*, 40, 273-297.

Rilov, G., Galil, B., 2009. Marine Bioinvasions in the Mediterranean Sea – History, Distribution and Ecology. p. 549-570. In: *Biological invasions in marine ecosystems*. Rilov, G., Crooks, J.A. (Eds). Springer, Berlin.

Russell, B.C., Golani, D., Tikochinski, Y., 2015. *Saurida lessepsianus* a new species of lizardfish (Pisces: Synodontidae) from the Red Sea and Mediterranean Sea, with a key to *Saurida* species in the Red Sea. *Zootaxa*, 3956 (4), 559-568.

Salomidi, M., Katsanevakis, S., Issaris, Y., Tsiamis, K., Katsiaras, N., 2013. Anthropogenic disturbance of coastal habitats promotes the spread of the introduced scleractinian coral *Oculina patagonica* in the Mediterranean Sea. *Biological Invasions*, 15, 1961-1971.

Sardain, A., Sardain, E., Leung, B., 2019. Global forecasts of shipping traffic and biological invasions to 2050. *Nature Sustainability*, 2 (4), 274-282.

Seebens, H., Gastner, M.T., Blasius, B., 2013. The risk of marine bioinvasion caused by global shipping. *Ecology letters*, 16 (6), 782-790.

Seebens, H., Bacher, S., Blackburn, T.M., Capinha, C., Dawson, W. *et al*., 2021. Projecting the continental accumulation of alien species through to 2050. *Global Change Biology*, 27 (5), 970-982.

Serrano, E., Ribes, M., Bolivar, M., Coma, R., 2023. Fouling of a boat hull by the invasive zooxanthellate coral *Oculina patagonica*-could shipping be enhancing its unique large-scale spread? *Mediterranean Marine Science*, 24 (1), 76-86.

Stabili, L., Licciano, M., Longo, C., Lezzi, M., Giangrande, A., 2015. The Mediterranean non-indigenous ascidian *Polyandrocarpa zorritensis*: Microbiological accumulation capability and environmental implications. *Marine Pollution Bulletin*, 101 (1), 146-152.

Tanduo, V., Osca, D., Crocetta, F., 2021. A bycatch surprise: *Scyllarus subarctus* Crosnier, 1970 (Decapoda: Achelata: Scyllaridae) in the Mediterranean Sea. *Journal of Crustacean Biology*, 41 (2), ruab010.

Taskin, E., Akbulut, A., Yildiz, A., Sahin, B., Sen, B. *et al.* (Eds.), 2019. *Türkiye Suyosunlar Listesi*. Ali Nihat Gökyigit Vakfi Yayini, Istanbul, 804 pp.

Tsiamis, K., Palialexis, A., Stefanova, K., Gladan, Ž.N., Skejić, S. *et al*., 2019. Non-indigenous species refined national baseline inventories: A synthesis in the context of the European Union's Marine Strategy Framework Directive. *Marine Pollution Bulletin*, 145, 429-435.

Turan, C., Doğdu, S.A., 2023. First record of the non-indigenous Randall's lizardfish *Synodus randalli* Cressey,1981 in the Mediterranean Sea. p. 624-626. In: *New records of introduced species in the Mediterranean Sea (November, 2023)*, Langeneck, J., Bakiu, R., Chalari, N., Chatzigeorgiou, G., Crocetta, F. *et al*., *Mediterranean Marine Science*, 24 (3).

Ünlüoğlu, A., Akalin, S., Dal, İ., Tıraşın, E.M., Aydin, C.M., 2018. First record of red cornetfish *Fistularia petimba* (Syngnathiformes:Fistulariidae) from Antalya and İskenderun Bays along Turkish Coasts of the Mediterranean Sea. *Journal of Applied Icthyology*, 34, 977-980.

Verlaque, M., Ruitton, S., Mineur, F., Boudouresque, C.F., 2015. *CIESM atlas of exotic species in the Mediterranean. Vol.4. Macrophytes*, CIESM Publishers, Monaco, 364 pp.

Wonham, M.J., Carlton, J.T., 2005. Trends in marine biological invasions at local and regional scales: the Northeast Pacific Ocean as a model system. *Biological invasions*, 7, 369-392.

Yokeş, B., Galil, B.S., 2006. New records of alien decapods (Crustacea) from the Mediterranean coast of Turkey, with a description of a new palaemonid species. *Zoosystema*, 28 (3), 747-755.

Yokeş, M., Andreou, V., Bakiu, R., Bonanomi, S., Camps, J. *et al.*, 2018. New Mediterranean Biodiversity Records (November 2018). *Mediterranean Marine Science*, 19 (3), 673-689.

Zamora-Silva, A., Malaquias, M.A.E., 2018. Molecular phylogeny of the Aglajidae head-shield sea slugs (Heterobranchia: Cephalaspidea): new evolutionary lineages revealed and proposal of a new classification. *Zoological Journal of the Linnean Society*, 183 (1), 1-51.

Zeidler, W., Douek, J., Rinkevich, B., Gevili, R., Goren, M. *et al*., 2018. Validation and redescription of the hyperiidean amphipod *Brachyscelus rapacoides* Stephensen, 1925 (Crustacea: Amphipoda: Hyperiidea: Brachyscelidae), a new record of association with the scyphozoan jellyfish *Rhopilema nomadica* Galil, 1990 (Scyphozoa: Rhizostomeae: Rhizostomatidae) in the Mediterranean Sea. *Zootaxa*, 4471 (3), 523-534.

Zenetos, A., Gofas, S., Russo, G., Templado, J., 2004. *CIESM atlas of exotic species in the Mediterranean*. *Vol. 3. Molluscs*. CIESM Publishers, Monaco, 376 pp.

Zenetos, A., Gofas, S., Verlaque, M., Çinar, M.E., García Raso, J.E. *et al*., 2012. Alien species in the Mediterranean Sea by 2010. A contribution to the application of European Union's

Marine Strategy Framework Directive (MSFD). Part 2. Introduction trends and pathways. *Mediterranean Marine Science*, 13 (2), 328-352.

Zenetos, A., Tsiamis, K., Galanidi, M., Carvalho, N., Bartilotti, C. *et al*, 2022a. Status and trends in the rate of introduction of marine non-indigenous species in European seas. *Diversity*, 14 (12), 1077.

Zenetos, A., Albano, P.G., López Garcia, E., Stern, N., Tsiamis, K. *et al*., 2022b. Established non-indigenous species increased by 40% in 11 years in the Mediterranean Sea. *Mediterranean Marine Science*, 23 (1), 196-212.