

## Rapid Communication

## First records of seven marine organisms of different origins from Libya (Mediterranean Sea)

Esmail A. Shakman<sup>1</sup>, Abdalha Ben Abdalha<sup>1</sup>, Fathe Talha<sup>1</sup>, Ali Al-Faturi<sup>2</sup> and Michel Bariche<sup>3,\*</sup>

<sup>1</sup>Zoology Department, Tripoli University, Tripoli, Libya

<sup>2</sup>Marine Biology Research Center, Tripoli, Libya

<sup>3</sup>American University of Beirut, FAS, Department of Biology, Beirut, Lebanon

\*Corresponding author

E-mail: [michel.bariche@aub.edu.lb](mailto:michel.bariche@aub.edu.lb)

Received: 24 September 2017 / Accepted: 4 November 2017 / Published online: 15 November 2017

Handling editor: Fabio Crocetta

### Abstract

Seven first records of species of various origins are reported from the Libyan marine environment. These are the Longfin yellowtail *Seriola rivoliana*, Lesser amberjack *Seriola fasciata*, Blunthead puffer *Sphoeroides pachygaster*, Golani round herring *Etrumeus golanii*, Blue swimmer crab *Portunus segnis*, Bigfin reef squid *Sepioteuthis lessoniana*, and the green alga *Caulerpa taxifolia*. The first three species are widely distributed fish seemingly expanding their range in the Mediterranean Sea, while the others are alien species, introduced in the Mediterranean through various pathways. While some were recently captured, others were identified from old collections, with dates of capture ranging between 1993 and 2017. In addition to updating the list of marine fauna and flora from Libya, the respective dates of these records represent vital information for future studies aiming at reconstructing range expansion histories and assessing spread rates in the Mediterranean Sea.

**Key words:** *Seriola rivoliana*, *Seriola fasciata*, *Sphoeroides pachygaster*, *Etrumeus golanii*, *Sepioteuthis lessoniana*, *Portunus segnis*, *Caulerpa taxifolia*

### Introduction

The presence of non-indigenous species (NIS) in the Mediterranean Sea is nowadays gaining a lot of scientific attention (e.g. Katsanevakis et al. 2016; Galil et al. 2017; Zenetos et al. 2017). In fact, the Mediterranean is highly impacted by marine bio-invasions, and introduction rates seem to have increased at an alarming rate (Golani 2010; Edelist et al. 2013; Samaha et al. 2016). A relatively large number of marine species of various origins have been reported in the last few decades. NIS have entered the Mediterranean following the opening of the Suez Canal or have arrived from more distant locations, through other modes of introductions (Galil 2016; Zenetos et al. 2017). Other species, previously recorded in the tropical Atlantic but not in the Mediterranean, seem to have expanded their biogeographical ranges over the years (range-expanding

species). However, for many of them direct evidence of their native or alien status in the Mediterranean is lacking, and they have been labelled as “cryptogenic” (Carlton 1996).

The seashore of Libya represents 2000 km of coastline and is characterized by a wide continental shelf that encompasses various habitats and topography (Shakman 2008; Shakman and Kinzelbach 2007a). The geographic location of Libya, in the central and “warm” part of the Mediterranean Sea is interesting, as it can host thermophilic organisms arriving from the east (Indo-Pacific origin) or expanding from the west (Tropical Atlantic origin). Scientific investigations on the Libyan marine fauna and flora started in the 1880s (reviewed in Al-Hassan and El-Silini 1999; Shakman and Kinzelbach 2007b) but information available on these species remains rare, incomplete, and fragmented (e.g. Stirn 1970; Al-Hassan and Silini 1999; Shakman and Kinzelbach 2007a; Bazairi et al.

2013). There is a serious lack of comprehensive studies on marine organisms occurring in the area and this part of the Mediterranean remains among the least known to scientists (Shakman 2008).

In the present paper, we report seven first records of marine organisms, some of which are invasive, from the coastal zone of Libya. These include four fish species, a decapod, a cephalopod, and a seaweed. All seven organisms represent first records for Libyan waters and some are among the first individuals to be recorded in the Mediterranean Sea. They are all catalogued and deposited in the collections of the Tripoli University (ZMT: Zoological Museum of Tripoli; HPTA: Herbarium Plant department of Tripoli, Algae).

## Records

### CARANGIDAE Rafinesque, 1815

#### *Seriola rivoliana* Valenciennes, 1833

The Longfin yellowtail *Seriola rivoliana*, also known as Almaco Jack, is a circumglobal marine fish living in tropical and temperate regions, but with an unclear distribution in the eastern Atlantic (Froese and Pauly 2017). The first individual was reported from the Mediterranean Sea in year 2000 and several additional records have later been published from other locations (e.g. Castriota et al. 2002; Castriota et al. 2004; Mansour et al. 2011; Valls et al. 2011).

On 12<sup>th</sup> February 2004, a single individual of *Seriola rivoliana* (Figure 1) of 221 mm SL was captured off the coast of Tripoli along the Libyan shore (32°54'51.39"N; 13°14'18.76"E). The fish was caught in a trammel net at a depth of about 40–50 m over a rocky bottom covered by seaweeds. All descriptive characters, measurements and counts followed those given for *S. rivoliana* (Castriota et al. 2002, 2004). The specimen is fixed in formalin and catalogued (ZMT, FISH0126).

### CARANGIDAE Rafinesque, 1815

#### *Seriola fasciata* (Bloch, 1793)

The Lesser amberjack *Seriola fasciata* is a carangid living on both sides of the Atlantic Ocean (Eschmeyer et al. 2017). It was first recorded in 1989 and quickly reported in large numbers in the central Mediterranean (Massutí and Stefanescu 1993; Andaloro and Potoschi 1997; Andaloro et al. 2005). It has also been found in several parts of the Mediterranean Sea, and has reached the easternmost coasts (e.g. Sonin et al. 2009; Crocetta et al. 2015; Jawad et al. 2015).

On 18<sup>th</sup> July 2003, a single individual of *Seriola fasciata* (Figure 2) of 128 mm SL was captured off the



**Figure 1.** *Seriola rivoliana*, 221 mm standard length (ZST, FISH0126). Photograph by: A. Ben Abdalha.



**Figure 2.** *Seriola fasciata*, 128 mm standard length (ZST, FISH0127). Photograph by: A. Ben Abdalha.

coast of Tripoli along the Libyan shore (32°54'51.39"N; 13°14'18.76"E). The fish was caught in a trammel net at a depth of about 30–40 m over a rocky bottom covered by seaweeds. All descriptive characters, measurements and counts followed those given for *S. fasciata* in Fischer et al. (1981). The specimen is fixed in formalin and catalogued (ZMT, FISH0127).

### TETRAODONTIDAE Bonaparte, 1831

#### *Sphoeroides pachygaster* (Müller and Troschel, 1848)

The Blunthead puffer *Sphoeroides pachygaster* is a circumglobal marine fish living in tropical and temperate regions (Froese and Pauly 2017). The first individual reported from the Mediterranean Sea dates back to 1979, as *Sphoeroides cutaneus* (see Oliver 1981). The species has since established a population and colonized most of the Mediterranean basin (Dulčić 2002; Lipej et al. 2013; Gerovasileiou et al. 2017).

On 13<sup>th</sup> June 1993, a single individual of *Sphoeroides pachygaster* (Figure 3) of 325 mm SL was captured west of the city of Misrata, along the Libyan shore (32°26'29.85"N 14°54'26.35"E). The fish was caught with a commercial trawler operating over a muddy bottom at a depth ranging between 60

and 80 m. The identification has been made following Tortonese (1986). The specimen is fixed in formalin and catalogued (ZST, FISH0128).

CLUPEIDAE Cuvier, 1816

*Etrumeus golanii* DiBattista, Randall and Bowen, 2012

The Golani round herring *Etrumeus golanii* is an Indo-Pacific marine fish native to the northern Red Sea (DiBattista et al. 2012). The species also occurs in the Mediterranean as a NIS since 1961 (Whitehead 1963) with an important population established in the eastern Mediterranean (El-Sayed 1994; Golani 2000; Corsini et al. 2005). It recently spread to the central Mediterranean and has quickly appeared in large quantities in Tunisia (Falautano et al. 2006; Boussellaa et al. 2016; Rafrafi-Nouira et al. 2017).

On 22<sup>th</sup> April 2017, a school of *Etrumeus golanii* was captured west of the city of Misrata, along the Libyan shore (32°54'51.39"N; 13°14'18.76"E). The school was landed by a purse seine operating at around 30 m, over a soft bottom. A single individual (156 mm SL, Figure 4) was collected and preserved. All descriptive characters, measurements and counts followed those given for *E. golanii* by DiBattista et al. (2012). The specimen is fixed in formalin and catalogued (ZMT, FISH0129).

PORTUNIDAE Rafinesque, 1815

*Portunus segnis* (Forskål, 1775)

The Blue swimmer crab *Portunus segnis*, previously recorded in the Mediterranean Sea as *P. pelagicus* (Linnaeus, 1758), is a decapod native to the western Indian Ocean (Lai et al. 2010). It is among the very first species to be reported from the Mediterranean Sea following the opening of the Suez Canal and had already a large population established in the Levant in the 1920s (Galil 2011). It started to spread recently and has been recorded in various areas in the Mediterranean, including Italian and Tunisian waters (Crocetta 2006; Rabaoui et al. 2015).

On 25<sup>th</sup> April 2017, a female specimen of *Portunus segnis* of 68 mm (Figure 5) carapace length (CL) was captured west of the city of Tubruk, along the Libyan shore (32°4'36.70"N; 24°0'21.51"E). It was accidentally captured by a trammel net set at 30 m depth over a seagrass meadow. The specimen is fixed in formalin and catalogued (ZMT, CRS0032).

LOLIGINIDAE Lesueur, 1821

*Sepioteuthis lessoniana* Férussac, 1831

The Bigfin reef squid *Sepioteuthis lessoniana* is a squid occurring in the Indo-West Pacific realm, including the Red Sea (Jereb and Roper 2006; Lefkaditou et al.



Figure 3. *Sphoeroides pachygaster*, 325 mm standard length (ZST, FISH0128). Photograph by: A. Ben Abdalha.



Figure 4. *Etrumeus golanii*, 156 mm standard length (ZST, FISH0129). Photograph by: A. Al-Faturi.



Figure 5. *Portunus segnis*, 68 mm carapace length (ZST, CRS0032). Photograph by: A. Al-Faturi.

2009). It has been first recorded in the Mediterranean in 2002 and then subsequently in several other parts, including a single specimen from Tunisia in 2011 (Crocetta et al. 2014, 2017).

On 3<sup>rd</sup> December 2015, one individual of *Sepioteuthis lessoniana* (Figure 6) of 170 mm mantle length (ML) was captured off the coast of Tripoli, along the Libyan shore (32°54'43.51"N; 13°14'12.29"E). It was accidentally captured by an angler who was jigging for squids and octopus at about 10 m depth over a gravel bottom, with boulders and seaweeds. The specimen is fixed in formalin and catalogued (ZST, CEPH08).

## CAULERPACEAE Kützing, 1843

*Caulerpa taxifolia* var. *distichophylla* (Sonder)  
Verlaque, Huisman and Procaccini

*Caulerpa taxifolia* (M. Vahl) C. Agardh, 1817, is a well-known macrophyte (Chlorophyta: Caulerpaceae) aquarium strain that has been introduced to the Mediterranean in the 1980s, rapidly spread and generated a lot of public interest in the northwestern and central Mediterranean (Meinesz and Hesse 1991; Jousson et al. 1998; Meinesz et al. 2001). A different strain, *Caulerpa taxifolia* var. *distichophylla*, was recorded from Syria in 2003 and from various places of the eastern and central Mediterranean afterwards, including Sicily and Malta (reviewed in Bitar et al. 2017).

On 10<sup>th</sup> March 2017, a specimen of *Caulerpa taxifolia* var. *distichophylla* (Figure 7) was captured off the coast of Tripoli, along the Libyan shore (32°54'37.77"N; 13°14'35.11"E). It was collected over a sandy bottom with a seagrass meadow, probably growing on some hard structure. The specimen is fixed in formalin and catalogued (HPTA279).

### Discussion

The three fish species, *Seriola rivoliana*, *Seriola fasciata*, and *Sphoeroides pachygaster* are all widely distributed fishes and are mostly considered as naturally expanding their distributional range in the Mediterranean Sea (Zenetos et al. 2012). Besides the first records for the coast of Libya, the individual of *S. rivoliana*, which was collected as early as 2004, constitutes the third (out of six records) in the Mediterranean Sea. Similarly, the importance of the records of both *S. fasciata* and *S. pachygaster* lies in the fact that they were also among the early individuals that have ever been reported from the Mediterranean Sea. Both species are nowadays present in various parts of the Mediterranean Sea (Lipej et al. 2013; Crocetta et al. 2015). The record of the Indo-Pacific fish *Etrumeus golanii* and the decapod *Portunus segnis* are also interesting because they have recently reached the central Mediterranean region and their populations are currently blooming in nearby Tunisian waters and also gaining commercial importance (Crocetta et al. 2015; Ben Souissi, pers. comm.). The Indo-Pacific squid *Sepioteuthis lessoniana* has already been reported from several locations in the eastern Mediterranean, but the current record constitutes the second for the central Mediterranean Sea (Crocetta et al. 2014). Finally, we hereby report the presence of *Caulerpa taxifolia* in Libyan waters, identified as *Caulerpa taxifolia* var. *distichophylla*. This record is the seventh record of this variety from

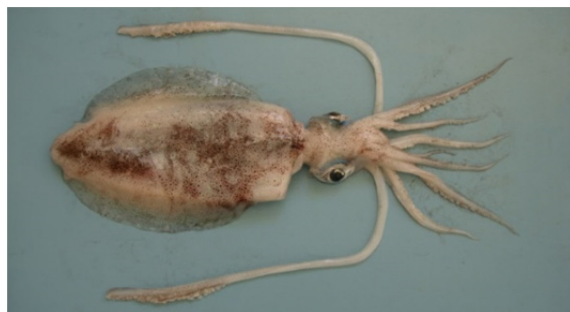


Figure 6. *Sepioteuthis lessoniana*, 173 mm ML (ZST, CEPH08). Photograph by: E.A. Shakman.



Figure 7. *Caulerpa taxifolia* var. *distichophylla* (HPTA279). Photograph by: E.A. Shakman.

the Mediterranean Sea. However, we are highly cautious on the proper identification of this particular species since the two strains, both occur in the central Mediterranean (Jongma et al. 2013; Schembri et al. 2015; Mannino et al. 2017). The taxonomy of Caulerpaceae being relatively complex with variable morphologies is determined by environmental conditions. It is imperative that further samples are collected and carefully examined using genetics.

There is often a detection lag between the real arrival time and the first published record of a new species (Costello and Solow 2003). Despite that lag, documenting the arrival to a new region is crucial since it is the only measure in time and space available to scientists. Libya is among those Mediterranean countries that generally lack updated faunal and floral studies (Shakman 2008). The recorded species update the checklist of species from this country, but the respective dates of records for these species also show that an “exotic” species is often recognised but not always reported to the scientific community.

This is particularly the case for the three cryptogenic fishes, which were simply kept in collection (since 1993 for *S. pachygaster*, 2003 for *S. fasciata*, and 2004 for *S. rivoliiana*). These records remain of key importance for studying the early stages of presence of such organisms as well as their spread in the Mediterranean Sea.

## Acknowledgements

The authors are very grateful to the fishermen who provided some specimens. This work was partly funded by the National Agency for Scientific Research of Libya and partly by the American University of Beirut (AUB 513071).

## References

- Al-Hassan LAJ, El-Silini OA (1999) Check-list of bony fishes collected from the Mediterranean coast of Benghazi, Libya. *Revista de Biología Marina y Oceanografía* 34(2): 291–301
- Andaloro F, Falautano M, Sinopoli M, Passarelli FM, Pipitone C, Addis P, Cau A, Castriota L (2005) The lesser amberjack *Seriola fasciata* (Perciformes: Carangidae) in the Mediterranean: a recent colonist? *Cybium* 29(2): 141–145
- Andaloro F, Potoschi A (1997) Ichthyofauna associated to fish aggregation devices in the southern Tyrrhenian Sea. In: Massuti E, Morales-Nin B (eds), Proceedings of a Workshop on the biology and fishery of dolphin-fish and related species, Palma de Mallorca, October 1997, pp 475
- Bazairi H, Sghaier YR, Benamer I, Langar H, Pergent G, Bourass EM, Verlaque M, Ben Soussi J, Zenetos A (2013) Alien marine species of Libya: first inventory and new records in El-Kouf National Park (Cyrenaica) and the neighbouring areas. *Mediterranean Marine Science* 14: 451–462, <https://doi.org/10.12681/mms.351>
- Bitar G, Ramos-Esplá A, Ocaña O, Sghaier YR, Forcada A, Valle C, El Shaer H, Verlaque M (2017) The introduced marine macroflora of Lebanon and its distribution on the Levantine coast. *Mediterranean Marine Science* 18, 138–155, <https://doi.org/10.12681/mms.1993>
- Boussellaa W, Boudaya L, Derbel H, Neifar L (2016) A new record of the Lessepsian fish *Etrumeus golanii* (Teleostei: Clupeidae) in the Gulf of Gabes, Tunisia, with notes on its parasites. *Cahier de Biologie Marine* 57: 389–395
- Carlton JT (1996) Biological invasions and cryptogenic species. *Ecology* 77: 1653–1655, <https://doi.org/10.2307/2265767>
- Castriota L, Falautano M, Greco S, Andaloro F (2004) Second record of *Seriola rivoliiana* (Carangidae) in the Mediterranean. *Cybium* 28(3): 265–266
- Castriota L, Greco S, Marino G, Andaloro F (2002) First record of *Seriola rivoliiana* Cuvier, 1833 in the Mediterranean. *Journal of Fish Biology* 60: 486–488, <https://doi.org/10.1006/jfbi.2001.1838>
- Corsini M, Margies P, Kondilatos G, Economidis PS (2005) Lessepsian migration of fishes to the Aegean Sea: First record of *Tylerius spinosissimus* (Tetraodontidae) from the Mediterranean and six more fish records from Rhodes. *Cybium* 29: 347–354
- Costello CJ, Solow AR (2003) On the pattern of discovery of introduced species. *Proceedings of the National Academy of Sciences of the USA* 100: 3321–3323, <https://doi.org/10.1073/pnas.0636536100>
- Crocetta F (2006) First record of *Portunus pelagicus* (Linnaeus, 1758) (Decapoda, Brachyura, Portunidae) in the northern Tyrrhenian Sea. *Crustaceana* 79: 1145–1148, <https://doi.org/10.1163/156854006778859632>
- Crocetta F, Agius D, Balistreri P, Bariche M, Bayhan Y, Çakir M, Ciriaco S, Corsini-Foka M, Deidun A, Zrelli R, Ergüden D, Evans J, Ghelia M, Giavasi M, Kleitou P, Kondylatos G, Lipej L, Mifsud C, Özvarol Y, Pagano A, Portelli P, Poursanidis D, Rabaoui L, Schembri P, Taşkin E, Tiralongo F, Zenetos A (2015) New Mediterranean Biodiversity Records (October 2015). *Mediterranean Marine Science* 16: 682–702, <https://doi.org/10.12681/mms.1477>
- Crocetta F, Bitar G, Zibrowius H, Capua D, Dell'Angelo B, Oliverio M (2014) Biogeographical homogeneity in the eastern Mediterranean Sea - III. New records and a state of the art of Polyplacophora, Scaphopoda and Cephalopoda from Lebanon. *Spixiana* 37(2): 183–206
- Crocetta F, Gofas S, Salas C, Tringali LP, Zenetos A (2017) Local ecological knowledge versus published literature: a review of non-indigenous mollusca in Greek marine waters. *Aquatic Invasions* 12: 415–434, <https://doi.org/10.3391/ai.2017.12.4.01>
- DiBattista JD, Randall DJ, Bowen BW (2012) Review of the round herrings of the genus *Etrumeus* (Clupeidae: Dussumierinae) of Africa, with descriptions of two new species. *Cybium* 36(3): 447–460
- Dulčić J (2002) Northernmost occurrence of *Sphoeroides pachygaster* (Tetraodontidae) in the Adriatic Sea. *Bulletin of Marine Science* 70(1): 133–139
- Edelist D, Rilov G, Golani D, Carlton JT, Spanier E (2013) Restructuring the sea: profound shifts in the world's most invaded marine ecosystem. *Diversity and Distributions* 19: 69–77, <https://doi.org/10.1111/ddi.12002>
- El-Sayed RS (1994) Check-list of Egyptian Mediterranean fishes. National Institute of Oceanography and Fisheries, Alexandria, Egypt, 77 + IX pp
- Eschmeyer WN, Fricke R, van der Laan R (2017) Catalog of Fishes: Genera, Species, References. Electronic version. <https://researcharchivve.calacademy.org/research/ichthyology/catalog/fishcatmain.asp> (accessed 25 July 2017)
- Falautano M, Castriota L, Andaloro F (2006) First record of *Etrumeus teres* (Clupeidae) in the Central Mediterranean Sea. *Cybium* 30(3): 287–288
- Fischer W, Bianchi G, Scott WB (1981) FAO species identification sheets for fishery purposes. Eastern Central Atlantic; fishing areas 34, 47 (in part). Volume 1, Canada Funds-in-Trust. Ottawa, Department of Fisheries and Oceans Canada, by arrangement with the Food and Agriculture Organization of the United Nations, 324 pp
- Froese R, Pauly D (2017) FishBase. World Wide Web electronic publication. [www.fishbase.org](http://www.fishbase.org). version (06/2017)
- Galil BS, Marchini A, Occhipinti-Ambrogi A (2016) East is east and West is west? Management of marine bioinvasions in the Mediterranean Sea. *Estuarine, Coastal and Shelf Science*, <https://doi.org/10.1016/j.ecss.2015.12.021>
- Galil B, Marchini A, Occhipinti Ambrogi A, Ojaveer H (2017) The enlargement of the Suez Canal - Erythraean introductions and management challenges. *Management of Biological Invasions* 8: 141–152, <https://doi.org/10.3391/mbi.2017.8.2.02>
- Galil BS (2011) The alien Crustaceans in the Mediterranean Sea: An historical review. In: Galil BS, Clark PF, Carlton JT (eds), In the Wrong Place - Alien Marine Crustaceans: Distribution, Biology and Impacts. Springer, Netherlands, pp 377–401, [https://doi.org/10.1007/978-94-007-0591-3\\_13](https://doi.org/10.1007/978-94-007-0591-3_13)
- Gerovasileiou V, Akel EH, Akyol O, Alongi G, Azevedos F, Babali N, Bakiu R, Bariche M, Bennoui A, Castriota L, Chintiroglou CC, Crocetta F, Deidun A, Galinou-Mitsoudi S, Giovos I, Gököglu M, Golemaj A, Hadjioannou L, Hartingerova J, In sacco G, Katsanevakis S, Kleitou P, Korun J, Lipej L, Malueg M, Michailidis N, Mouzai Tifoura A, Ovalis P, Petrović S, Piraino S, Rizkalla SI, Rousou M, Savva I, Şen H, Spinelli A, Vougioukalou KG, Xarahi E, Zava B, Zenetos A (2017) New Mediterranean Biodiversity Records (July 2017).

- Mediterranean Marine Science* 18: 355–384, <https://doi.org/10.12681/mms.13771>
- Golani D (2000) The Lessepsian migrant, the Red-eye round herring *Etrumeus teres* (DeKay, 1842), a new record from Cyprus. *Zoology in the Middle East* 20: 61–64, <https://doi.org/10.1080/09397140.2000.106637813>
- Golani D (2010) Colonization of the Mediterranean by Red Sea fishes via the Suez Canal – Lessepsian migration. In: Golani D, Appelbaum-Golani B (eds), Fish invasions of the Mediterranean Sea: Change and renewal. Pensoft Publishers, Sofia, pp 145–188
- Jawad L, Mtawej A, Ibrahim A, Hassan M (2015) First record of the lesser amberjack *Seriola fasciata* (Teleostei: Carangidae) in Syrian coasts. *Cahiers de Biologie Marine* 56(1): 81–84
- Jereb P, Roper CFE (2006) Cephalopods of the Indian Ocean. A review. Part I. Inshore squids (Loliginidae) collected during the International Indian Ocean Expedition. *Proceedings of the Biological Society of Washington* 119: 91–136, [https://doi.org/10.2988/0006-324X\(2006\)119\[91:COTIOA\]2.0.CO;2](https://doi.org/10.2988/0006-324X(2006)119[91:COTIOA]2.0.CO;2)
- Jongma DN, Campo D, Dattolo E, D’Esposito D, Duchi A, Grewe P, Huisman J, Verlaque M, Yokes Mehmet B, Procaccini G (2013) Identity and origin of a slender *Caulerpa taxifolia* strain introduced into the Mediterranean Sea. *Botanica Marina* 56: 27–39, <https://doi.org/10.1515/bot-2012-0175>
- Jousson O, Pawlowski J, Zaninetti L, Meinesz A, Boudouresque CF (1998) Molecular evidence for the aquarium origin of the green alga *Caulerpa taxifolia* introduced to the Mediterranean Sea. *Marine Ecology Progress Series* 172: 275–280, <https://doi.org/10.3354/meps172275>
- Katsanevakis S, Tempera F, Teixeira H (2016) Mapping the impact of alien species on marine ecosystems: The Mediterranean Sea case study. *Diversity and Distributions* 2: 694–707, <https://doi.org/10.1111/ddi.12429>
- Lai JCY, Ng PKL, Davie PJF (2010) A revision of the *Portunus pelagicus* (Linnaeus, 1758) species complex (Crustacea: Brachyura: Portunidae), with the recognition of four species. *The Raffles Bulletin of Zoology* 58(2): 199–237
- Lefkaditou E, Corsini-Foka M, Kondilatos G (2009) Description of the first Lessepsian squid migrant, *Septoteuthis lessoniana* (Cephalopoda: Loliginidae), in the Aegean Sea (Eastern Mediterranean). *Mediterranean Marine Science* 10: 87–97, <https://doi.org/10.12681/mms.110>
- Lipej L, Mavrič B, Paliska D (2013) New northernmost record of the blunthead pufferfish, *Sphoeroides pachygaster* (Osteichthyes: Tetraodontidae) in the Mediterranean Sea. In: Scientific and Research Center of the Republic of Slovenia, *Annales - Series Historia Naturalis* 23(2): 103–114
- Mannino AM, Paraspuro M, Crocetta F, Balistreri P (2017) An updated overview of the marine alien and cryptogenic species from the Egadi Islands Marine Protected Area (Italy). *Marine Biodiversity* 47: 469–480, <https://dx.doi.org/10.1007/s12526-016-0496-z>
- Mansour S, Azzouz K, Boumaiza M, Ben Amor MM, Capapé C (2011) First record of a rare carangid species, the Almaco Jack, *Seriola rivoliana* (Osteichthyes: Carangidae) in Tunisian marine waters (central Mediterranean). *Cahier de Biologie Marine* 52(2): 187–192
- Massuti E, Stefanescu C (1993) First record of *Seriola fasciata* (Bloch, 1793) (Osteichthyes: Carangidae) in the Mediterranean. *Journal of Fish Biology* 42: 143–144, <https://doi.org/10.1006/jfbi.1993.1012>
- Meinesz A, Belsher T, Thibaut T, Antolic B, Mustapha KB, Boudouresque CF, Chiaverini D, Cinelli F, Cottalorda JM, Djellouli A, El Abed A, Orestano C, Grau AM, Ivesa L, Jaklin A, Langar H, Massuti-Pascual E, Peirano A, Tunesi L, De Vaugelas J, Zavodnik N, Zuljevic A (2001) The introduced green alga *Caulerpa taxifolia* continues to spread in the Mediterranean. *Biological Invasions* 3: 201–210, <https://doi.org/10.1023/A:1014549500678>
- Meinesz A, Hesse B (1991) Introduction et invasion de l’algue tropicale *Caulerpa taxifolia* en Méditerranée Nord occidentale. *Oceanologica Acta* 14(4): 415–426
- Oliver P (1981) Sobre la aparición de algunos peces raros en las Islas Baleares. *Boletino Del Instituto Espanol De Oceanographia* 6: 59–64
- Rabaoui L, Arculeo M, Mansour L, Tlig-Zouari S (2015) Occurrence of the lessepsian species *Portunus segnis* (Crustacea: Decapoda) in the Gulf of Gabes (Tunisia): first record and new information on its biology and ecology. *Cahiers de Biologie Marine* 56(2): 169–175
- Rafrafi-Nouira S, Ounifi-Ben Amor K, Ben Amor MM (2017) Abundant records of Red-Eye round herring *Etrumeus golanii* (Osteichthyes: Clupeidae) from the Tunisian coast (Central Mediterranean). *Annales Series Historia Naturalis* 27: 65–68, <https://dx.doi.org/10.19233/ASHN.2017.09>
- Samaha C, zu Dohna H, Bariche M (2016) Analysis of Red Sea fish species’ introductions into the Mediterranean reveals shifts in introduction patterns. *Journal of Biogeography* 43: 1797–1807, <https://doi.org/10.1111/jbi.12793>
- Schembri P, Barbara J, Deidun A, Lanfranco E, Lanfranco S (2015) It was only a matter of time: occurrence of *Caulerpa taxifolia* (Vahl) C. Agardh var. *distichophylla* (Sonder) Verlaque, Huisman and Procaccini in the Maltese Islands (Chlorophyta, Ulvophyceae, Caulerpaceae). *BiolInvasions Records* 4: 9–16, <https://doi.org/10.3391/bir.2015.4.1.02>
- Shakman EA (2008) Lessepsian Migrant fish species of the coastal waters of Libya: Status, Biology, Ecology. PhD Thesis, Rostock University, Rostock, Germany, 125 pp
- Shakman E, Kinzelbach R (2007a) Distribution and characterization of Lessepsian migrant fishes along the coast of Libya. *Acta Ichthyologica et Piscatoria* 37: 7–15, <https://doi.org/10.3750/AIP2007.37.1.02>
- Shakman E, Kinzelbach R (2007b) Commercial fishery and fish species composition in the coastal waters of Libya. *Rostocker Meeresbiologische Beiträge* 18(S): 65–80
- Sonin O, Salameh P, Golani D (2009) First record of the lesser amberjack, *Seriola fasciata* (Actinopterygii: Perciformes: Carangidae), in the Levant. *Acta Ichthyologica et Piscatoria* 39: 71–73, <https://doi.org/10.3750/AIP2009.39.1.15>
- Stirn J (1970) Some notes on western trends of Lessepsian migrations. *Journées ichthyologiques, CIESM, Rome*, 30: 187–190
- Tortonese E (1986) Tetraodontidae. In: Whitehead PJP, Bauchot M-L, Hureau J-C, Nielsen J, Tortonese E (eds), Fishes of the North-Eastern Atlantic and the Mediterranean, Volume 3, UNESCO, Paris, pp 1341–1347
- Valls M, Grau AM, Massuti E, Tobaruela A, Riera F (2011) First record of *Seriola rivoliana* (Osteichthyes: Carangidae) in the western Mediterranean. *Marine Biodiversity Records* 4: e91, <https://doi.org/10.1017/S1755267211000753>
- Whitehead PJP (1963) A revision of the recent round herrings (Pisces: Dussumieriidae). *Bulletin of the British Museum of Natural History (Zoology)* 10: 305–380, <https://doi.org/10.5962/bhl.part.20529>
- Zenetos A, Çinar ME, Crocetta F, Golani D, Rosso A, Servello G, Shenkar N, Turon X, Verlaque M (2017) Uncertainties and validation of alien species catalogues: The Mediterranean as an example. *Estuarine, Coastal and Shelf Science* 191: 171–187, <https://doi.org/10.1016/j.ecss.2017.03.031>