A massive update of non-indigenous species records in Mediterranean marinas

Aylin Ulman[1,2,3], Jasmine Ferrario[1], Anna Occhpinti-Ambrogi[1], Christos Arvanitidis[3], Ada Bandi[1], Marco Bertolino[4], Cesare Bogi[5], Giorgos Chatzigeorgiou[3], Burak Ali Çiçek[6], Alan Deidun[7], Alfonso Ramos-Esplá[8], Cengiz Koçak[9], Maurizio Lorenti[10], Gemma Martinez-Laiz[11], Guenda Merlo[1], Elisa Princisgh[1], Giovanni Scribano[1] and Agnese Marchini[1]

[1] Department of Earth and Environmental Sciences, University of Pavia, Pavia, Italy
[2] Laboratoire d'Ecogéochimie des Environnements Benthiques, Université Pierre et Marie-Curie, Banyuls-sur-Mer, France
[3] Institute of Marine Biology, Biotechnology and Aquaculture, Hellenic Center of Marine Research, Heraklion, Crete, Greece
[4] Dipartimento di Scienze della Terra dell'Ambiente e della Vita (DISTAV), Università degli Studi di Genova, Genova, Italy
[5] Gruppo Malacologico Livornese, Livrono, Italy
[6] Department of Biological Sciences, Eastern Mediterranean University, Famagusta, Cyprus
[7] Department of Geosciences, University of Malta, Msida, Malta
[8] Marine Research Centre (CIMAR), University of Alicante, Alicante, Spain
[9] Department of Hydrobiology, Faculty of Fisheries, Ege University, Izmir, Turkey
[10] Center of Villa Dohrn-Benthic Ecology, Stazione Zoologica Anton Dohrn, Ischia, Italy
[11] Department of Zoology, University of Seville, Seville, Spain

Corresponding author
Aylin Ulman, aylinh.ulman@unipv.it

ABSTRACT

The Mediterranean Sea is home to over 2/3 of the world's charter boat traffic and hosts an estimated 1.5 million recreational boats. Studies elsewhere have demonstrated marinas as important hubs for the stepping-stone transfer of non-indigenous species (NIS), but these unique anthropogenic, and typically artificial habitats have largely gone overlooked in the Mediterranean as sources of NIS hot-spots. From April 2015 to November 2016, 34 marinas were sampled across the following Mediterranean countries: Spain, France, Italy, Malta, Greece, Turkey and Cyprus to investigate the NIS presence and richness in the specialized hard substrate material of these marina habitats. All macroinvertebrate taxa were collected and identified. Additionally, fouling samples were collected from approximately 600 boat-hulls from 25 of these marinas to determine if boats host diverse NIS not present in the marina. Here, we present data revealing that Mediterranean marinas indeed act as major hubs for the transfer of marine NIS, and we also provide evidence that recreational boats act as effective vectors of spread. From this wide-ranging geographical study, we report here numerous new NIS records at the basin, subregional, country and locality level. At the basin level, we report three NIS new to the Mediterranean Sea (*Achelia sawayai sensu lato*, *Aorides longimerus*, *Cymodoce* aff. *fuscina*), and the re-appearance of two NIS previously known but currently considered extinct in the Mediterranean (*Bemlos leptocheirus*, *Saccostrea glomerata*). We also compellingly update the distributions of many NIS in the Mediterranean Sea showing some recent spreading; we provide details for 11 new subregional records for NIS (*Watersipora arcuata*, *Hydroides*

brachyacantha sensu lato and *Saccostrea glomerata* now present in the Western Mediterranean; *Symplegma brakenhielmi*, *Stenothoe georgiana*, *Spirobranchus tertaceros sensu lato*, *Dendostrea folium sensu lato* and *Parasmittina egyptiaca* now present in the Central Mediterranean, and *W. arcuata*, *Bemlos leptocheirus* and *Dyspanopeus sayi* in the Eastern Mediterranean). We also report 51 new NIS country records from recreational marinas: 12 for Malta, 10 for Cyprus, nine for Greece, six for Spain and France, five for Turkey and three for Italy, representing 32 species. Finally, we report 20 new NIS records (representing 17 species) found on recreational boat-hulls (mobile habitats), not yet found in the same marina, or in most cases, even the country. For each new NIS record, their native origin and global and Mediterranean distributions are provided, along with details of the new record. Additionally, taxonomic characters used for identification and photos of the specimens are also provided. These new NIS records should now be added to the relevant NIS databases compiled by several entities. Records of uncertain identity are also discussed, to assess the probability of valid non-indigenous status.

INTRODUCTION

The seas are being rapidly being tainted by many harmful stressors such as climate change, overfishing, pollution and non-indigenous species (NIS) (*Occhipinti-Ambrogi, 2007*). The Mediterranean recreational boating fleet is estimated to contain approximately 1.5 million vessels and hosts over 70% of global charter boating traffic (*Cappato, 2011*). It is also the world's most invaded sea, hosting over 700 NIS (*Galil et al., 2017*), over half of which have Indo-Pacific origins and have probably arrived via the Suez Canal (*Galil, Marchini & Occhipinti-Ambrogi, in press*). The human-mediated transport of species across boundaries is dramatically altering the natural distribution of marine biota, impacting biodiversity as well as human well-being (*Carlton, 1989*; *Occhipinti-Ambrogi, 2007*).

Biological invasions are not only important to understand due to their associated ecological and economic impacts; but they also provide an opportunity to understand other important biogeographic processes such as long-distance dispersal, rapid adaptation and range-expansion processes (*Viard, David & Darling, 2016*). To properly assess the bioinvasion process and understand the scale of the associated threats, it is first necessary to have the most up-to-date information regarding species distributions, which are used to feed the many databases such as the European Alien Species Information Network (*Katsanevakis et al., 2015*), the World Register of Introduced Alien Species (*Pagad et al., 2017*) and AquaNIS-Information system on aquatic NIS and cryptogenic species (*Olenin et al., 2014*). These databases are highly utilized by scientists and legislators wishing to assess the breadth of the ecological and socio-economic consequences of

biological invasions by understanding species' distributions, measuring trends, and generating ecological models.

Most records of NIS in the Mediterranean Sea originate from occasional or casual findings, while only a few monitoring programs thus far have specifically targeted Mediterranean marine NIS, mainly addressing Marine Protected Areas (MPAs, *Mannino et al., 2017*), commercial harbors (*López-Legentil et al., 2015*), or aquaculture sites (*Verlaque, 2001*). Recreational marinas have not yet been systematically surveyed in the Mediterranean, despite the recent international literature indicating they are important hubs for new species introduction and secondary spreading events (*Acosta & Forrest, 2009*; *Floerl et al., 2009*; *Clarke-Murray, Pakhamov & Therriault, 2011*; *Ashton, Davidson & Ruiz, 2014*). Furthermore, several recent records of marine NIS in the Mediterranean come from marina habitats (*Ros et al., 2013*; *Marchini, Ferrario & Minchin, 2015*; *Marić et al., 2016*; *Ferrario et al., 2017*; *Steen et al., 2017*), suggesting that marinas are part of the stepping-stone invasion process.

The definition of NIS adopted here is: "An organism introduced outside its natural past or present distribution range by direct or indirect human activity (*European Environment Agency, 2012*)." This definition implies an anthropogenic-assisted transport via various pathways, albeit intentional or unintentional. The route that a new species is transported through to a recipient region is treated as a "pathway." In the Mediterranean Sea, in addition to shipping and aquaculture (together considered the principal pathways of global NIS introductions), the Suez Canal is frequently referenced as another relevant pathway for the migration of Indo-Pacific species (*Galil et al., 2017*), and references therein). Each of these "pathways" can have several "vectors" attributed to them, which is the means by which they were transported (*Minchin et al., 2009*; *Olenin et al., 2014*). For example, the "shipping" pathway can have the following associated transport vectors: hull-fouling, ballast water and sea chests. There is a high level of uncertainty associated with many of these pathways and vectors since it is rather impossible to prove how a species had been transported, although inferential reasoning on the locality, and proximity to known hubs for NIS introductions such as major ports, aquaculture farms or the Suez Canal make it possible to put forth scientifically sound hypotheses. For this reason, a NIS is often defined as "polyvectic species" *sensu Carlton & Ruiz (2005*, see definitions*)*, because it could have been introduced by a certain combination of pathways or vectors.

This contribution presents new records from the first large-scale survey of Mediterranean marinas for NIS. From April 2015 to November 2016, 34 marinas were sampled for NIS across the Mediterranean spanning from Spain, France, Italy, Malta, Greece, Turkey and Cyprus. Additionally, when permitted, boat-hulls were also inspected for NIS and their captains interviewed about the boats recent travel history since its last hull-cleaning to investigate if recreational boats indeed do seed new NIS propagules to marinas they are visiting, i.e., to verify the role that recreational boating plays as a vector of spread of NIS. Here, we present new NIS records either for the Mediterranean basin, sub-region, country or locality. The new records are presented by taxa, with information on the native origin of the species, their global and Mediterranean

distributions, and details of the present record. Here, new records are provided for 32 macroinvertebrate species in Mediterranean marinas and an additional six species found on boat-hulls but not in the marina.

MATERIALS AND METHODS

The criteria used for marina selection initially included the sub-region to which they belong, the number of berths (marina size) and popularity as a tourist locality, and in addition, the possibility of obtaining permissions and feasibility. The number of visiting vessels to each marina per annum and staying at least one night was also meant to be used as a proxy for marina selection, however these data were only available for 20 marinas (Table S1). A total of 34 marinas were sampled in seven countries, along with a subset of recreational boat-hulls from 25 of the marinas (Table 1; Fig. 1).

When reporting new sub-regional records for the Mediterranean, the sub-regions included the following sampled countries: Western Mediterranean (Spain and France); Central Mediterranean (Italy and Malta); and Eastern Mediterranean (Greece, Turkey, and Cyprus).

Marina substrate sampling

We adopted a rapid assessment protocol (Pedersen et al., 2003; Cohen, 2005; Ashton et al., 2006) targeting all fouling macroinvertebrate taxa. These "rapid assessments" typically target a predefined list of species, involve an onsite team of experts, and generally last an hour. Since our strategy also targeted any unknown invertebrate species for collection, and generally had one or two collectors at most, we increased the typical sampling time to approximately eight hours per marina to allow for the careful collection and sorting of all unknown taxa to ensure no new species could additionally be collected. Samples were taken from each of the central, outer and inner portions of the marinas to guarantee representative samples. For the larger marinas (i.e., Port Camargue, Cap d'Agde), the management authorities provided the use of an inflatable boat with a captain to access hard-to-reach areas, and to ensure the substrate sampling could be completed in one day. Photos were taken of the non-indigenous biota using either a SONY RXIII (with a Nauticam housing) camera, or the Olympus Tough TG-3 or TG-4.

A specialized hand-held rigid net with one sharpened edge was built for the marina substrate sampling (1 mm mesh size, surface 25 × 20 cm), which extended to a depth of 1.5 m from the pier to scrape the submerged areas of the pontoons and marina walls over an area of approximately 0.23 m^2. Ladders, tires and buoys were also scraped using a 6.35 cm (diameter) paint scraper or manually. Next, the biota were placed in a plastic tray and immediately sorted to major taxonomic groups into smaller bottles containing a 75–90% ethanol solution (such as crustaceans, molluscs, polychaetes, etc.) for further laboratory analysis. The smaller-sized taxa were filtered and collected using a sieve with a 1 mm mesh size. The only exception were the ascidians, which were immediately preserved in seawater, then later placed in a freezer for 30–90 min (with care taken not to freeze the sample), then transferred to a 4% formalin/seawater solution for 48 h for fixing, and lastly preserved in a 90% ethanol solution; this procedure is necessary for maintaining some rigidity in the specimens structure, necessary for dissection.
Table 1 List of marinas sampled, with corresponding number, geographical coordinates, sampling dates and boat hulls sampled or not (Y, Yes; N, No).

Country	#	Locality name	Marina name	Latitude and longitude	Sampling dates	Boats sampled
Spain	1	Alicante	Marina de Alicante	38.339°N; 0.4799°E	14/11/2016	N
	2	Barcelona	One Ocean Port Vell	41.376°N; 2.187°E	22/11/2016	N
France	3	Agde	Port Principal du Cap d'Agde	43.281°N; 3.501°E	5–18/06/2015	Y
	4	La Grande-Motte	Port de la Grande-Motte	43.557°N; 4.082°E	02/11/2016	N
	5	Le Grau-du-Roi	Port du Plaisance du Port Camargue	43.515°N; 4.132°E	16–28/05/2015	Y
	6	Saint-Tropez	Port de Saint-Tropez	43.278°N; 6.637°E	1–30/04/2016	Y
	7	Cogolin	Marines de Cogolin	43.065°N; 6.586°E	1–30/04/2016	Y
	8	Sainte-Maxime	Port Privé de Sainte-Maxime	43.307°N; 6.638°E	1–30/04/2016	Y
	9	Cannes	Cannes Le Vieux Port	43.540°N; 7.032°E	19–28/04/2015	Y
	10	Antibes	Port Vauban	43.585°N; 7.127°E	1–12/05/2015	Y
	11	Villefranche-sur-Mer	Port de Villefranche	43.698°N; 7.307°E	22–30/11/2016	N
Italy	12	Lido di Ostia	Porto Turistico di Roma	41.737°N; 12.250°E	12–19/07/2015	Y
	13	Ischia Island	Marina di Casamicciola; Marina di Sant'Angelo; Porto d'Ischia	40.748°N; 13.906°E 40.695°N; 13.893°E 40.743°N; 13.939°E	1–11/08/2015	Y
	14	Sorrento	Porto Turistico Marina Piccola Sorrento	40.629°N; 14.375°E	22–29/07/2015	Y
	15	Palermo	Marina Villa Igiea	38.142°N; 13.370°E	26–29/07/2016	Y
	16	Palermo	Porto La Cala	38.120°N; 13.368°E	2–3/08/2016	N
	17	Riposto	Porto dell'Etna	37.732°N; 15.208°E	17–28/09/2016	Y
	18	Siracusa	Porto Grande (Marina Yachting)	37.063°N; 15.284°E	15-16/08/2016	N
	19	Marzamemi	Marina di Marzamemi	36.733°N; 15.119°E	08/10/2016	N
	20	Marina di Ragusa	Porto Turistico Marina di Ragusa	36.781°N; 14.546°E	1–7/09/2016	Y
	21	Licata	Marina di Cala del Sole	37.097°N; 13.943°E	5–10/08/2016	Y
Malta	22	Msida	Msida Yacht Marina	35.896°N; 14.493°E	1–8/07/2016	Y
	23	Valletta	Grand Harbor Marina	35.890°N; 14.523°E	11–18/07/2016	Y
Greece	24	Heraklion	Old Venetian Harbor	35.343°N; 25.136°E	1–15/11/2015	Y
	25	Agios Nikolaos	Agios Nikolaos Marina	35.187°N; 25.136°E	18–25/11/2015	Y
	26	Rhodes	Mandraki Port	36.449°N; 28.226°E	2–11/06/2016	Y
Turkey	27	Istanbul	Setur Kalamış Marinas	40.976°N; 29.039°E	28/08/2015	Y
	28	Bodrum	Milta Bodrum Marina	37.034°N; 27.425°E	9–11/09/2015	Y
	29	Datça	Datça Marina	26.722°N; 27.689°E	10/10/2015; 13/05/2016	N
	30	Marmaris	Setur Marmaris Netsel Marina	36.852°N; 28.276°E	14–18/09/2015	Y
	31	Fethiye	Eçe Marina	36.623°N; 29.101°E	19–24/09/2015	Y
	32	Finike	Setur Finike Marina	36.294°N; 30.149°E	18–27/05/2016	Y
Cyprus	33	Karpaz	Karpaz Gate Marina	35.558°N; 34.232°E	21–27/06/2016	Y
	34	Famagusta	Famagusta Port	35.123°N; 33.952°E	13–19/06/2016	Y
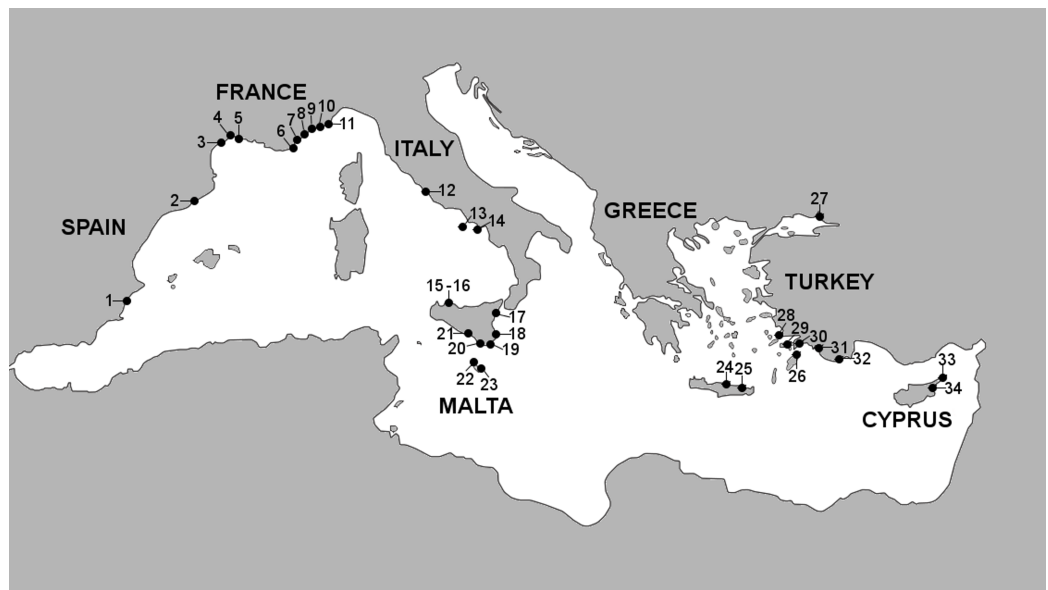
Figure 1 Marinas sampled in this study. Marina numbers correspond to marinas listed in Table 1.

Boat-hull sampling

A preliminary screening was first completed with boat captains/owners before selection to ensure that their boat had travelled outside the marina in the past 12 months for a minimum of one night, so that the vessel posed some risk of spreading NIS. Next, and only with permission from the boat owners/captains, fouling samples were collected from the boat-hulls and a short survey was completed with the boat owners/captains on the vessel's characteristics, hull-cleaning and painting details, and recent 12 months of travel history. The fouling samples were collected from the boat-hulls using one of three approaches (which were dependent on authorizations and feasibility): The first approach involved inspecting the boat-hulls immediately as they were hoisted from the water at the *carénage* (haul-out station) for their maintenance routines (cleaning/painting/repairs). This approach was mainly used in France: Cannes, Antibes, Marines de Cogolin, Saint Maxime, Saint Tropez and Cap d'Agde as the sampling season provided the optimal opportunity to use this approach as these routine maintenance procedures normally occur before the onset of the tourist season, and was used sporadically in other marinas only when the opportunity presented itself. The boat-hull including niche areas such as the propeller, propeller shaft, water vents, rudders and ladders were closely inspected and fouling samples were collected using a paint scraper and aquarium fishing net wherever fouling biota were found, and quickly transferred to a bottle containing 90% ethanol. Photographs were also taken from each boat-hull to crosscheck the results and reduce likelihood of mistakes. The remaining boat-hulls were sampled via snorkeling or, on a few occasions, by scuba diving but using the same methods as described above. Care was taken to ensure the sampling strategy did not release NIS propagules into the marina's waters by scraping the samples collected in-water directly into small, finely meshed

aquarium nets. All fouling samples were collected by the first author, with the exception of the boats in Porto Turistico di Roma which were collected by the ports professional scuba diver, with careful instructions from the first author on what to collect after reviewing underwater detailed photos of the hulls.

Taxonomic identification

This study focused on fouling invertebrates; plants and algae were not examined. All macronivertebrate taxa were collected for identification, and samples requiring expert identification were sent to appropriate experts.

The preserved specimens were observed under a dissecting microscope and, where needed, taxonomic slides were prepared and analyzed under an optical microscope. Photographs of magnified specimens or morphological parts were taken directly from the microscopes using the Olympus TG-4 camera (i.e., for serpulids and crustaceans), or with the Tescan Field Emission Scanning Electron Microscope series Mira 3XMU for SEM pictures, with increasing magnification, at 6–19 mm working distance, using an accelerating voltage of 10 kV, with graphite metallization and detection by secondary electrons (i.e., for bryozoans). Bryozoan specimens used for SEM pictures were cleaned beforehand using a combination of bleach and hydrogen peroxide to remove organic residues. Ascidians were stained with Masson's haemalum for dissection.

Some of our records refer to species completely new to the Mediterranean Sea, whose taxonomic identity has been verified morphologically, but still requiring further genetic confirmation, since they pertain to taxonomically challenging taxa which have often revealed complexes of cryptic species. Moreover, a couple of our findings include species not yet properly described scientifically; thus it is not possible to assign a certain identification until formal descriptions are completed. These records are discussed in detail to verify the likeliness of representing introduced populations of NIS. To assign a NIS status for such species, the *Chapman & Carlton (1991)* criteria were followed taking into account factors such as: "appearance in local regions where not found previously;" "association with human mechanisms of dispersal;" "prevalence or restrictions to artificial environments;" "insufficient active or passive dispersal capability" and "exotic evolutionary origin." Records of species found only on boat-hulls but not in marinas should only be considered as new NIS country records if certain that the boat did not leave that country's waters, since boats represent mobile habitats and are hence affected by an "uncertain occurrence" (see *Marchini, Galil & Occhipinti, 2015*).

Non-indigenous species status is dependent on their establishment success in a new locality, and can be defined as either: not established (a single specimen reported in one or two localities, rare, uncommon), or established (evidence of a reproducing population in one or more localities, common or abundant). Additionally, a couple of cases are presented here for "pseudoindigenous species" (see definitions).

RESULTS

Within the framework of this study, a total of 76 NIS were collectively identified from 34 marinas from the seven countries; however, only new country records and interesting
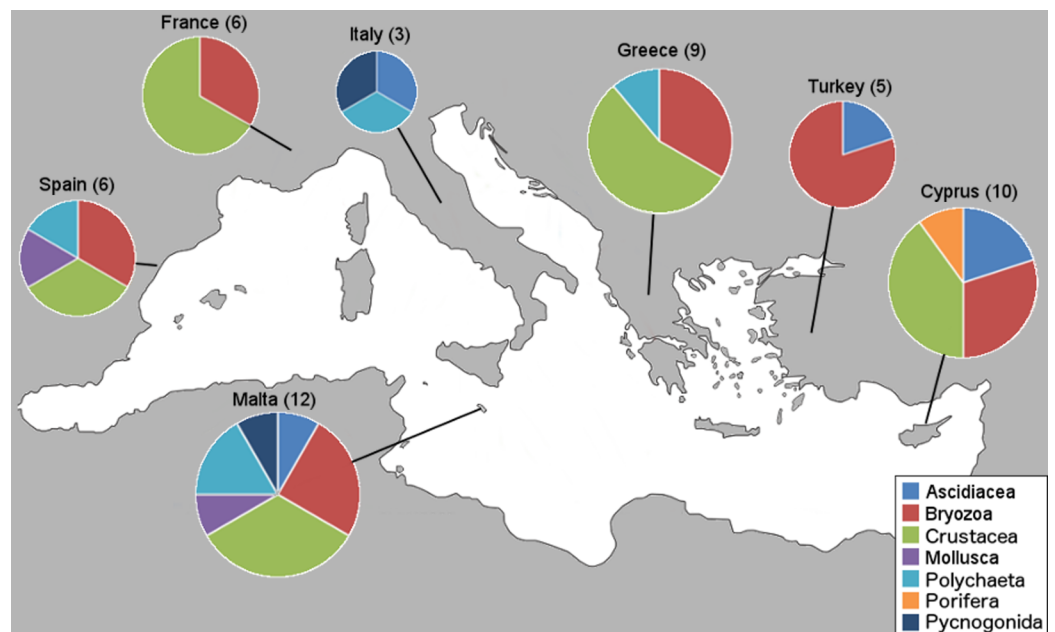
Figure 2 Number of new NIS records per country by taxonomic group. Sampled countries are shown with their number of new NIS records found in this study (in brackets), and pie graphs show the new records represented proportionally by taxa.

new locality records are presented here. First, we present the number of new NIS found in this study per country and by taxa (Fig. 2).

This study revealed three species new to the Mediterranean basin (*Achelia sawayai sensu lato*, *Aoroides longimerus*, and *Cymodoce* aff. *fuscina*), 11 new subregional records (*W. arcuata*, *H. brachyacantha sensu lato* and *Saccostrea glomerata* now present in the Western Mediterranean; *Symplegma brakenhielmi*, *Stenothoe georgiana*, *Spirobranchus tertaceros sensu lato*, *Dendostrea folium sensu lato* and *Parasmittina egyptiaca* now present in the Central Mediterranean, and *W. arcuata*, *Bemlos leptocheirus* and *Dyspanopeus sayi* in the Eastern Mediterranean), for an overall number of 51 new country records and a few new locality records exhibiting distribution expansions. These new Mediterranean basin and country records are presented (Table 2) with the corresponding marina numbers in which they were found from Table 1. Additionally, NIS found on boat-hulls but not in the respective marina, locality or country, are presented as a warning signal for future monitoring (Table 3). The numbers of new NIS found per marina are shown (Table 4), and also the new NIS records are presented by country, specifically 12 for Malta, 10 for Cyprus, nine for Greece, six for Spain and France, five for Turkey and three for Italy (Table 5). Subsequently, all new NIS records are discussed by species (first ordered by class and family, and then alphabetically by species, see "New NIS records: notes on individual species" below). The key taxonomic characters used to identify these species are accompanied as "Supplementary Data," along with identification photos taken of our specimens. Comprehensive reviews of global and Mediterranean distributions for all NIS listed in Tables 2 and 3 are presented below, along with details on the new record type and if they were found in the marina, on a boat-hull or both.

Table 2 New NIS record table by species, with numbers in locality corresponding to marina details from Table 1.

Family	Species	Country and Marina #	Record type
Ascidea	*Clavelina oblonga*	Cyprus (#34)	*
	Clavelina oblonga	Turkey (#29)	*
	Phallusia nigra	Cyprus (#33, #34)	*
	Styela plicata	Malta (#22, #23)	*
	Symplegma brakenhielmi	Italy (#15)	*, CM
Bryozoa	*Amathia verticillata*	Malta (#22, #23)	*
	Amathia verticillata	Cyprus (#34)	*
	Amathia verticillata	Turkey (#28, #30)	*
	Celleporaria brunnea	Spain (#1)	*
	Celleporaria brunnea	France (#4, #5, #6, #8)	*
	Celleporaria brunnea	Malta (#22, #23)	*
	Celleporaria brunnea	Greece (#24)	*
	Celleporaria vermiformis	Greece (#24, #25, #26)	*
	Celleporaria vermiformis	Cyprus (#33, #34)	*
	Hippopodina sp. A	Turkey (#32)	*
	Parasmittina egyptiaca	Turkey (#32)	*
	Parasmittina egyptiaca	Cyprus (#33)	*
	Tricellaria inopinata	France (#3, #5)	*
	Tricellaria inopinata	Greece (#24)	*
	Watersipora arcuata	Spain (#1, #2)	*
	Watersipora arcuata	Malta (#22)	*, CM
	Watersipora arcuata	Turkey (#28, #32)	*, EM
Crustacea	*Ampithoe bizseli*	Cyprus (#33, #34)	*
	Aorides longimerus	France (#5)	**
	Bemlos leptocheirus	Greece (#24, #25)	*, EM
	Charybdis (*Gonioinfradens*) *paucidentatus*	Cyprus (#34)	*
	Cymodoce cf. *fuscina*	Greece (#24)	**
	Dyspanopeus sayi	Greece (#24)	*, EM
	Erichthonius cf. *pugnax*	France (#5)	*
	Ianiropsis serricaudis	France (#3, #5)	*
	Mesanthura cf. *romulea*	Spain (#1)	*
	Mesanthura cf. *romulea*	Malta (#22)	*
	Mesanthura cf. *romulea*	Greece (#26)	*
	Mesanthura cf. *romulea*	Cyprus (#33, #34)	*
	Paracerceis sculpta	Malta (#22, #23)	*
	Paracerceis sculpta	Cyprus (#34)	*
	Paranthura japonica	Spain (#1, #2)	*
	Paranthura japonica	Malta (#23)	*
	Sphaeroma walkeri	Greece (#24)	*
	Stenothoe georgiana	France (#5)	*
	Stenothoe georgiana	Malta (#23)	*, CM

(Continued)

Family	Species	Country and Marina #	Record type
Mollusca	*Arcuatula senhousia*	Spain (#2)	*
	Dendostrea folium s.l.	Malta (#22, #23)	*, CM
Polychaeta	*Hydroides brachyacantha s.l.*	Spain (#2)	*, WM
	Hydroides brachyacantha s.l.	Greece (#24)	*
	Hydroides dirampha	Malta (#22, #23)	*
	Hydroides elegans	Malta (#22)	*
	Spirobranchus tetraceros s.l.	Italy (#18)	*, CM
Porifera	*Paraleucilla magna*	Cyprus (#34)	*
	Achelia sawayai s.l.	Malta (#23)	**
Pycnogonida	*Achelia sawayai s.l.*	Italy (#17, #18)	**

Note:
Record type: *New country record, **New Mediterranean record; Letters indicate a new subregional record (WM, Western Med.; CM, Central Med.; EM, Eastern Med.).

NEW NIS RECORDS: NOTES ON INDIVIDUAL SPECIES

Please note that the numbers used in describing the locality of the new records correspond to the marinas listed in Table 1.

Class: Ascidiacea

Some ascidians whose likely origin is the Northeast Atlantic (i.e., *Clavelina lepadiformis, Ciona intestinalis, Ascidella aspersa* and *Botryllus schlosseri*) have been excluded from this study which focuses exclusively on NIS. Genetic studies have shown that these species include different clades in the Mediterranean, some which can be considered non-native, and in some cases native (*Turon et al., 2003*; *Perez-Portela et al., 2013*; *Bouchemousse, Bishop & Viard, 2016*; *Nydam, Giesbrecht & Stephenson, 2017*). These cryptogenic species (*Carlton, 1996*), their origins and status require additional genetic analyses, which exceeds the breadth of the present study, which is based on morphological characters.

Family: Ascidiidae

Phallusia nigra *Savigny, 1816*

Potential native origin: Uncertain, could be from the Red Sea, Indo-Pacific, or Western Atlantic Ocean.

Distribution: First recorded and described from the Red Sea (*Savigny, 1816*), then in the Gulf of Guinea and Angola (*Millar, 1965*), the Arabian Gulf (*Monniot & Monniot, 1997*), the Pacific Ocean (*Lambert, 2003*), Indian Ocean (*Abdul Jaffar, Sivakumar & Tamilselvi, 2009*), and the Western Atlantic and Caribbean (*Van Name, 1945*; *Bonnet & Rocha, 2011*; *Vandepas et al., 2015*).

In the Mediterranean, it has only been reported in the Eastern Mediterranean from Israel, Lebanon and the Turkish Levantine coast (*Çinar et al., 2006*; *Shenkar, 2008*; *Izquierdo-Muñoz, Díaz-Valdés & Ramos-Esplá, 2009*), and most recently from Greece,

Table 3 NIS found on boat hulls but not found in the marina or country.

Family	Species	Country and Marina #	Record type
Ascidiacea	*Clavelina oblonga*	Cyprus (#33)	Λ
Bryozoa	*Amathia verticillata*	Turkey (#31)	Λ
	Celleporaria brunnea	France (#3, #7, #9, #10)	Λ
	Celleporaria brunnea	Greece (#25, #26)	*
	Tricellaria inopinata	Turkey (#27)	*
	Parasmittina egyptiaca	Italy (#21)	*, CM
	Parasmittina egyptiaca	Greece (#25)	*
	Watersipora arcuata	France (#7)	*
Crustacea	*Amphibalanus improvisus*	France (#5)	*
	Balanus trigonus	Cyprus (#33)	*
	Cymodoce cf. *fuscina*	Greece (#25)	Λ
	Ericthonius cf. *pugnax*	France (#3)	Λ
	Paracerceis sculpta	Turkey (#31)	*
	Paradella dianae	Italy (#20)	Λ
	Paradella dianae	Greece (#24)	*
	Sphaeroma walkeri	Greece (#25)	Λ
	Stenothoe georgiana	France (#3, #10)	Λ
Mollusca	*Dendostrea folium s.l.*	Italy (#17)	*
	Saccostrea glomerata	France (#10)	*, WM
Polychaeta	*Hydroides homoceros*	Cyprus (#33)	*

Note:
Λ = Not previously known from the locality, * = Not previously known from the country. Letters indicate a new subregional record (WM, Western Med.; CM, Central Med.; EM, Eastern Med.).

specifically from Chalkidiki and Rhodes (*Kondilatos, Corsini-Foka & Pancucci-Papadopoulou, 2010*; *Thessalou-Legaki et al., 2012*).

New records: This finding represents the first country record for Cyprus (#33 and #34: Fig. S1A).

Boat-hull records: Found on one boat-hull moored in Cyprus (#34).

Notes: Although its native origin is uncertain, it is considered a NIS in the Mediterranean (*Çinar et al., 2006*; *Shenkar, 2008*). *Vandepas et al. (2015)* highlighted some uncertainty regarding some *Phallusia nigra* Mediterranean records due to resemblances to the also dark, native congeneric tunicate *Phallusia fumigata* (Gruber, 1864), and confirmed the presence of the introduced *Phallusia nigra* in the Eastern Mediterranean basin. For this reason, the morphology of the *Phallusia* specimens collected from Cyprus were carefully compared to specimens of the native *Phallusia fumigata* (found in our own samples from Port Vell, Barcelona).

Family: Clavelinidae

Clavelina oblonga Herdman, 1880

Native origin: Western Atlantic US coast and Caribbean Sea.

Table 4 Number of NIS per sampled marina, using marina numbers given in Table 1.

#. Marina locality and country	# NIS	#. Marina locality and country	# NIS
1. Alicante, Spain	10	18. Siracusa, Italy	16
2. Barcelona, Spain	11	19. Marzememi, Italy	11
3. Cap d'Agde, France	8	20. Ragusa, Italy	14
4. La Grand-Motte, France	7	21. Licata, Italy	11
5. Port Camargue, France	17	22. Msida, Malta	14
6. Saint-Tropez, France	4	23. Grand Harbor, Malta	13
7. Cogolin, France	6	24. Heraklion, Greece	27
8. Saint-Maxime, France	3	25. Agios Nikolaos, Greece	12
9. Cannes, France	5	26. Rhodes, Greece	16
10. Antibes, France	5	27. Istanbul, Turkey	4
11. Villefranche-sur-Mer, France	2	28. Bodrum, Turkey	12
12. Rome, Italy	9	29. Datça, Turkey	9
13. Ischia, Italy	5	30. Marmaris, Turkey	6
14. Sorrento, Italy	8	31. Fethiye, Turkey	10
15. Villa Igiea, Italy	20	32. Finike, Turkey	14
16. La Cala, Italy	16	33. Karpaz, Cyprus	17
17. Riposto, Italy	13	34. Famagusta, Cyprus	18

Distribution: Its initial record is from Bermuda (*Van Name, 1945*). It is hypothesized to be an introduced species to Brazil, first sighted there in 1925 (*Rocha, Kremer & Fehlauer-Ale, 2012*). In the Eastern Atlantic, it has been reported as NIS in Cape Verde (*Hartmeyer, 1912*), Senegal (*Pérès, 1951*), and the Azores (*Monniot & Monniot, 1994*). It was described in the Mediterranean half a century after its initial record as *Clavelina phlegraea* from southern Italy and Corsica (*Salfi, 1929*). It was also found in natural habitats on the Iberian Coast, about 100 km west of Gibraltar (*Ordóñez et al., 2016*).

New records: This finding represents a first country record for Turkey (Marina #29) and Cyprus (#34: Fig. S1B), and two new locality records for mainland France (#5, #7).

Boat-hull records: Found on boat-hulls moored in Cyprus (#33 and #34).

Notes: The species identified earlier as *Clavelina phlegraea* (*Salfi, 1929*) in the Mediterranean was thought to be a native species, but recent genetic analysis confirmed it as the introduced *Clavelina oblonga* (*Ordóñez et al., 2016*). In France, it had only previously been reported in Corsica, so these new records from the French mainland indicate its possible expansion along the coast.

Family: Didemnidae

Diplosoma listerianum (Milne-Edwards 1841)

Native origin: Northern Sea.

Distribution: This species was first described from England but is well known from marinas and harbors worldwide including the Pacific Northwest, Panama, Chile, Japan, Tahiti, Guam, South Africa and Australia (*Rocha & Kremer, 2005*; Pérez-Portela et al.,

Table 5 New NIS records by country, with countries ordered from west to east.

Country	Species	Country	Species
Spain	*Celleporaria brunnea*	Greece	*Celleporaria brunnea*
Spain	*Watersipora arcuata*	Greece	*Celleporaria vermiformis*
Spain	*Mesanthura* cf. *romulea*	Greece	*Tricellaria inopinata*
Spain	*Paranthura japonica*	Greece	*Bemlos leptocheirus*
Spain	*Arcuatula senhousia*	Greece	*Cymodoce* cf. *fuscina*
Spain	*Hydroides brachyacantha s.l.*	Greece	*Dyspanopeus sayi*
France	*Celleporaria brunnea*	Greece	*Mesanthura* cf. *romulea*
France	*Tricellaria inopinata*	Greece	*Sphaeroma walkeri*
France	*Aorides longimerus*	Greece	*Hydroides brachyacantha s.l.*
France	*Erichthonius* cf. *pugnax*	Turkey	*Clavelina oblonga*
France	*Ianiropsis serricaudis*	Turkey	*Amathia verticillata*
France	*Stenothoe georgiana*	Turkey	*Hippopodina* sp. A
Italy	*Symplegma brakenhielmi*	Turkey	*Parasmittina egyptiaca*
Italy	*Spirobranchus tetraceros s.l.*	Turkey	*Watersipora arcuata*
Italy	*Achelia sawayai s.l.*	Cyprus	*Clavelina oblonga*
Malta	*Styela plicata*	Cyprus	*Phallusia nigra*
Malta	*Amathia verticillata*	Cyprus	*Amathia verticillata*
Malta	*Celleporaria brunnea*	Cyprus	*Celloporaria vermiformis*
Malta	*Watersipora arcuata*	Cyprus	*Parasmittina egyptiaca*
Malta	*Mesanthura* cf. *romulea*	Cyprus	*Mesanthura* cf. *romulea*
Malta	*Paracerceis sculpta*	Cyprus	*Ampithoe bizseli*
Malta	*Paranthura japonica*	Cyprus	*Charybdis (Gonioinfradens) paucidentatus*
Malta	*Stenothoe georgiana*	Cyprus	*Paracerceis sculpta*
Malta	*Dendostrea folium s.l.*	Cyprus	*Paraleucilla magna*
Malta	*Hydroides dirampha*		
Malta	*Hydroides elegans*		
Malta	*Achelia sawayai s.l.*		

2013). In the Mediterranean, its first record was from Italy in 1975 (*Lafargue, 1975*), and is now widespread throughout European and Mediterranean waters (*Millar, 1969*; *Ramos-Esplá, 1988*; *Koukouras et al., 1995*; *Çinar, 2014*).

New records: This study presents a new locality record for the Turkish Levantine Sea/Mediterranean coast (#31, #32). During this study, it was also found in France (#5), Malta (#23: Fig. S1C), Turkey (#28) and Greece (#24 and #26).

Family: Pyuridae

***Microcosmus exasperatus* Heller 1878**

Potential native origin: Unknown.

This species has a broad global distribution from all continental waters, including remote localities such as Hawaii and the Mariana Islands, but does not occur in Antarctica (*Nagar & Shenkar, 2016*).

In the Mediterranean, it was first reported from south-eastern Tunisia in 1998 (*Meliane, 2002*; *Ramos-Esplá, Izquierdo-Muñoz & Çinar, 2013*), then from Lebanon (*Bitar, Ocana & Ramos-Esplá, 2007*), Israel (*Shenkar, 2008*), around the Lebanese coast in 2009 (*Ramos-Esplá, Izquierdo-Muñoz & Çinar, 2013*), the Aegean Sea of Turkey (*Ramos-Esplá, Izquierdo-Muñoz & Çinar, 2013*), and North-Western Cyprus (*Gewing et al., 2016*).

New records: This study presents a new locality record for Turkey (#29) as the southernmost record for Turkey, and a new locality for Cyprus (#33), illustrating its ongoing expansion.

Notes: *Microcosmus exasperatus* and *Microcosmus squamiger* are both present in the Mediterranean, however, they do not overlap in distributions: *Microcosmus squamiger* is present in the Western and Central Mediterranean whereas *Microcosmus exasperatus* is only present in the Eastern Mediterranean (*Ramos-Esplá, Izquierdo-Muñoz & Çinar, 2013*). Thus, it has been hypothesized these two species invaded via different entrances to the basin: *Microcosmus squamiger* via the Strait of Gibraltar and *Microcosmus exasperatus* via the Suez Canal (*Turón, Nishikawa & Rius, 2007*; *Ramos-Esplá, Izquierdo-Muñoz & Çinar, 2013*). Noteworthy is that *Microcosmus exasperatus* was not found in late 2014 in Karpaz Marina, Cyprus (#33) by *Gewing et al. (2016)* when specifically looking for this species; however, we found it present there in 2016.

Microcosmus squamiger Michaelsen, 1927

Potential native origin: Australia.

Distribution: Globally, this species is found in the waters of California, South Africa, Hawaii, and the Western Indian Ocean (*Mastrototaro & Dappiano, 2008*).

In the Mediterranean, it was first reported from Tunisia in 1967 (*Monniot, 1981*), and is now found throughout the Western Mediterranean (*Monniot, 1981*; *Ramos-Esplá, 1988*; *Mastrototaro & Dappiano, 2008*; *Turón, Nishikawa & Rius, 2007*) and from the Central Mediterranean: Taranto, Italy and Grand Harbor, Malta (*Izquierdo-Muñoz, Díaz-Valdés & Ramos-Esplá, 2009*).

New records: This finding represents a new locality for Italy around Sicily (#15, #17, #19, #20: Fig. S1D). From this study, it was also found in Spain (#2).

Family: Styelidae

Styela plicata (Lesueur, 1823)

Potential native origin: Unknown, cosmopolitan species.

Distribution: This species has been reported worldwide (*Harant & Vernières, 1933*; *Van Name, 1945*; *Pérès, 1951*; *Tokioka, 1963*; *Ramos-Esplá, 1988*). It is considered a NIS in California (*Lambert & Lambert, 2003*), Gulf of Mexico (*Lambert, 2005*), Brazil (*Rocha & Kremer, 2005*) and the Mediterranean Sea (*Maltagliati et al., 2016*).

New records: This finding represents a new country record for Malta (#22 and #23). From this study, *Styela plicata* is extremely widespread and was found in all sampled marinas aside from #6, #9, #11, #29 and #33.

Boat-hull records: Found on boat-hulls moored in the following marinas: France (#3, #5, #7, #10), Italy (#12, #14: Fig. S1E, #15, #21), Malta (#22), Greece (#24, #26), and Turkey (#31, #32).

Notes: This is a well-known cosmopolitan hull-fouling species found from many localities across the Atlantic Ocean from Philadelphia (*Van Name, 1945*) to Senegal (*Pérès, 1951*). Recent genetic analysis suggests that its wide geographic distribution is attributed to many introductions stemming from human-mediated hull fouling, triggering multiple introduction events (*Barros, Rocha & Pie, 2009*). Additionally, most records are from artificial substrates or harbours, also supporting the hypothesis of an ongoing invasion (*Barros, Rocha & Pie, 2009*).

Symplegma brakenhielmi (Michaelson, 1904)

Potential native origin: Unknown

Distribution: It has been found in Australian waters (*Kott, 2004*), the Pacific Panamanian coast (*Carman et al., 2011*), and from the Atlantic in French Guianese waters (*Monniot, 2016*). In the Mediterranean, it was reported from Israel in the 1950s (as *Symplegma viride* Herdman, 1886), then from Lebanon (*Bitar & Kouli-Bitar, 2001*; *Bitar, Ocana & Ramos-Esplá, 2007*), Israel (*Shenkar, 2008*) and Turkey (*Çinar et al., 2006*).

New records: This study presents a new country record for Italy (#15), and a new Central Mediterranean subregional record. During this study, it was also found in Turkey (#31 and #32: Fig. S1F).

Boat-hull records: Found on one boat-hull moored in Turkey (#31).

Notes: It is likely that *Pérès (1958)* is referring to this species under the name *Symplegma viride*. *Antoniadou, Gerovasileiou & Bailly (2016)*, in their recent update of ascidians found in Greek waters, warned of a high-likelihood of a Greek invasion due to its proximity to the Turkish Levantine coast. This study confirms its spread to the Central Mediterranean. Soon after this finding in Cyprus from June 2016, it was also reported from Cyprus in Larnaca Bay in November 2016 by *Gerovasileiou et al. (2017)*.

Bryozoa
Family: Candidae

Tricellaria inopinata D'Hondt & Occhipinti-Ambrogi, 1985

Potential native origin: Indo-Pacific Ocean.

Distribution: It is considered a NIS in New Zealand and cryptogenic elsewhere in the Pacific, from Japan to Taiwan, Australia and the Northeast Pacific (*Dyrynda et al., 2000*). It was also reported from the Northeast Atlantic coasts of Great Britain, Ireland, Belgium, France, the Netherlands, Spain, Portugal and Germany (*Dyrynda et al., 2000*;

Arenas et al., 2006; *Cook et al., 2013*). This species has also been transported via aquaculture and in association with marine debris stemming from the 2011 Japanese tsunami which landed in Oregon (*Calder et al., 2014*).

In the Mediterranean, *Tricellaria inopinata* was first described in the Lagoon of Venice in 1982 (*D'Hondt & Occhipinti-Ambrogi, 1985*) and is considered a NIS in the Mediterranean Sea because the genus *Tricellaria*, typical of the Indo-Pacific Ocean, was previously absent from the basin. After its initial Venetian record, it was reported from Tunisia (*Ben Souissi, Ben Salem & Zaouali, 2006*), and from several other Italian localities (*Lodola, Savini & Occhipinti-Ambrogi, 2012*; *Ferrario et al., 2017*).

New records: This finding represents new country records for France (#3 and #5: Fig. S2A) and Greece (#24).

Boat-hull records: Found on boat-hulls moored in Italy (#14), France (#3 and #5), and Turkey (#27).

Notes: In Europe, it was found on various types of artificial substrates, e.g., boat-hulls, ropes, docks and also natural substrates (*Dyrynda et al., 2000*; *De Blauwe & Faasse, 2001*). Generally, *Tricellaria inopinata* is known to establish successfully in marinas lacking strong freshwater inputs (*Occhipinti-Ambrogi, 1991*; *Johnson, Winston & Woollacott, 2012*; *Cook et al., 2013*). If it establishes from boat to marina in Turkey, it would then present a new country record.

Family: Hippopodinidae

***Hippopodina* sp. A**

Potential native origin: Indo-Pacific Ocean.

Distribution: The species *Hippopodina feegeensis* (Busk, 1884) from the Indo-Pacific and the Red Sea, was reported as NIS in the Eastern Mediterranean Sea (*Powell, 1969*; *Morri et al., 1999*; *Corsini-Foka et al., 2015*). However, *Tilbrook (1999)* had observed strong morphological variations within *Hippopodina feegeensis* colonies from different geographical regions, and some species were later designated to be new species (*Tilbrook, 2006*). Particularly, *Tilbrook (2006)* recognised that the true *Hippopodina feegeensis* is restricted to the Philippines Islands, South China Sea and Australia, while two other *Hippopodina* spp. were left undescribed (named as *Hippopodina* "*feegeensis*," Holothuria Bank and *Hippopodina* "*feegeensis*," Ethiopia (*sic*) in *Tilbrook, 2006*). The material presented here is most likely conspecific with the still undescribed *Hippopodina* sp. collected by *Tilbrook (2006)* from Massawa Harbor, Erythraea (K. J. Tilbrook, 2017, personal communication), and is indicated here as *Hippopodina* sp. A.

New records: This study presents a new country record for Turkey (#32). It was also found in Rhodes, Greece (#26: Fig. S2B). Recently, *Corsini-Foka et al. (2015)* recorded *Hippopodina feegeensis* from Mandraki Harbor in Rhodes, in the same locality where it was also collected during this study (at the Three Windmills wall), and those specimens will likely be re-assigned to *Hipppodina* sp. A, after a more comprehensive and detailed taxonomic comparison is undertaken.

Boat-hull records: Found on two boat-hulls moored in Turkey (#32: Fig. S2C).

Notes: This species is morphologically similar to *Hippopodina feegeensis*, with only a few varying characters (see Supplementary Data). Further morphological and genetic comparisons are necessitated to compare the Mediterranean specimens thus far identified as *Hippopodina feegeensis* (*Powell, 1969*; *Morri et al., 1999*; *Corsini-Foka et al., 2015*) with samples from the Red Sea, which will then lead to a proper taxonomic description for these *Hippopodina* samples.

Family: Lepraliellidae
Celleporaria brunnea (Hincks, 1884)

Native origin: Northeast Pacific Ocean.

Distribution: It is widely distributed in the Pacific Ocean (British Columbia, Ecuador, Gulf of California, Hawaiin Islands, Korea and Panama Canal: see *Soule, Soule & Chaney, 1995*; *Seo & Min, 2009*). Recorded as a NIS along the North-eastern Atlantic (Portugal and France: *Canning-Clode, Souto & McCann, 2013*; *Harmelin, 2014*) and Mediterranean Sea (from Croatia, Italy, Lebanon, Turkey: *Koçak, 2007*; *Harmelin, Bitar & Zibrowius, 2009*; *Harmelin, 2014*; *Lezzi, Pierri & Cardone, 2015*; *Lodola, Ferrario & Occhipinti-Ambrogi, 2015*; *Ferrario et al., 2016*; *Marić et al., 2016*).

New records: These findings represent first country records for Spain (#1), France (#4, #5: Figs. S2D–S2F, #6, #8), Malta (#22 and #23), and Greece (#24). In Turkey, *Celleporaria brunnea* was previously found in Izmir Bay by *Koçak (2007)*, and during this study, three additional localities are added to its previously known Turkish distribution (#28, #30 and #31), illustrating its wider expansion along the Turkish south-western and southern coasts. During this study, it was also present all around Sicily (#15, #16, #17, #19, #20, #21).

Boat-hull records: Found on boat-hulls moored in France (#3, #7, #9, #10) and Greece (#25, #26), but was not found from the artificial substrates of those same marinas.

Notes: Many species of the genus *Celleporaria* are tolerant and opportunistic, and may exhibit invasive attributes (*Dunstan & Johnson, 2004*). *Celleporaria brunnea* was reported as a fouling organism from different substrates, both natural and artificial (*Koçak, 2007*; *Canning-Clode, Souto & McCann, 2013*; *Lezzi, Pierri & Cardone, 2015*). Furthermore, it can be easily spread via hull-fouling, but its introduction via the aquaculture trade cannot be ruled out, as some of the Mediterranean findings refer to sites in close proximity to shellfish farms (*Lezzi, Pierri & Cardone, 2015*; *Lodola, Ferrario & Occhipinti-Ambrogi, 2015*).

Family: Lepraliellidae
Celleporaria vermiformis (Waters, 1909)

Native origin: Red Sea.

Distribution: Apart from the Red Sea, its distribution is not well known (*Vine, 1986*; *Ostrovsky et al., 2011*). However, it has recently been found in the Gulf of Oman

(*Dobretsov, 2015*). Its first and only Mediterranean record (prior to our new records listed below) is from Tripoli, Lebanon (*Harmelin, 2014*).

New records: This study presents new country records for both Greece (#24, #25, #26) and Cyprus (#33: Figs. S2G–S2I, and #34).

Boat-hull records: Found on boat-hulls moored in Greece (#25 and #26), and Cyprus (#33 and #34).

Notes: Since *Celleporaria vermiformis* was previously recorded from only a single record from a single site in Lebanon, it was not previously considered as an established species (*Harmelin, 2014*). However, these five new locality records presented here now qualify it as an established NIS in the Mediterranean, and signifies its likely spreading in the eastern portion of the basin.

Family: Smittinidae

Parasmittina egyptiaca (Waters, 1909)

Native origin: Red Sea and Indo-Pacific Ocean.

Distribution: *Parasmittina egyptiaca* was reported along the Suez Canal (*Hastings, 1927*; *Harmelin, Bitar & Zibrowius, 2009*), in the Red Sea (*Ostrovsky et al., 2011*), and from the Indo-Pacific region (*Menon, 1972*). In the Mediterranean Sea, it has only been reported from Lebanon (*Harmelin, Bitar & Zibrowius, 2009*) and Israel (*Sokolover, Taylor & Ilan, 2016*).

New records: This finding represents two new country records for Turkey (#32) and Cyprus (#33).

Boat-hull records: Found on boat-hulls moored in Greece (#25: Figs. S3A and S3B), and Italy (#21). The Italian finding presents a new Central Mediterranean record for this species.

Notes: In our samples, *Parasmittina egyptiaca* was mostly found growing on *Amphibalanus amphitrite* (*Darwin, 1854*) specimens and oysters. The captain of the boat hosting this species in Italy explained that his home marina was Finike, Turkey (#32), and he had just recently travelled from there, through Greece to Sicily. Interestingly, one could expect many similar examples of new country records for Greece as several dozens of liveaboard recreational sailboats that used to winter in the Finike marina in Turkey explained to the first author that since 2014, many had collectively relocated their vessels to now winter in Agios Nikolaos, Crete (#25). Despite thorough sampling procedures in Agios Nikolaos, this species was not found present in the marina.

Family: Vesiculariidae

Amathia verticillata (*Delle Chiaje, 1822*)

Native origin: Caribbean Sea.

Distribution: It has a cosmopolitan distribution from tropical to subtropical regions in the Atlantic and Indo-Pacific Oceans, the Mediterranean Sea and Macaronesia

(*Amat & Tempera, 2009*; *Wirtz & Canning-Clode, 2009*; *Minchin, 2012*; *Ferrario, Marchini & Lodola, 2014*; *Marchini, Ferrario & Minchin, 2015*).

In the Mediterranean, it was first recorded in the Gulf of Naples (*Delle Chiaje, 1822*) and is well-known from the following countries: Algeria, Croatia, Egypt, France, Greece, Israel, Spain, Syria and Tunisia (*Marchini, Ferrario & Minchin, 2015*).

New records: This finding represents new country records for Malta (#22, #23), Turkey (#28 and #30: Fig. S3E) and Cyprus (#34). During this study, it was also found in Spain (#2), France (#4, #5, #6, #11), the Tyrrhenian coast of Italy (#12 and #14), the Ionian Sea (around Sicily, #15–21), and Greece (#24 and #26).

Boat-hull records: Found on boat-hulls moored in France (#10), Italy (#12: Fig. S3F, #13, #14, #15, #17, #20, #21), Malta (#22, #23), Greece (#24–26), Turkey (#28, #30, #31), and Cyprus (#34).

Notes: It was recently confirmed to originate from the Caribbean (see *Galil & Gevili, 2014*). Due to its rapid growth rate, it can pose ecological and economic impacts by forming extensive and resistant colonies on many types of artificial substrates (*Ferrario et al., 2016*), and can also facilitate introductions of additional fouling species (*Marchini, Ferrario & Minchin, 2015*), such as *Caprella scaura*, which was found to be intertwined with it in large abundances in La Grand-Motte, France when we sampled there.

Family: Watersiporidae

Watersipora arcuata *Banta, 1969*

Potential native origin: Tropical Eastern Pacific.

Distribution: It is a widespread species distributed from the tropical Pacific such as the Mexican Pacific coast, California and Hawaii, extending down to Australasia (*Wisley, 1958*; *Skerman, 1960*; *Banta, 1969*; *Coles, DeFelice & Eldredge, 1999*). In the Mediterranean, it had only been reported from Porto Santa Margherita Ligure in NW Italy and Porto Rotondo Marina in Sardinia (*Ferrario et al., 2015*, *2017*).

New records: This finding represents new country records for Spain (#1 and #2), Malta (#22: Fig. S3I) and Turkey (#28 and #32). This also represents an additional Italian locality record for Sicily (#18: Figs. S3G and S3H, and #20). Therefore, this study shows this species is now present in all regions of the Mediterranean, presenting here two new subregional records for the Western and Eastern Mediterranean.

Boat-hull records: Found on a boat-hull moored in France (#7), but not found from the marina substrate.

Notes: In this study, *W. arcuata* was especially abundant in Siracusa, Sicily. The captain of the boat in Cogolin, France (#7) hosting this species had recently travelled from Barcelona, where it was also found in the marina from this study. If it does establish in France, it would then present a new country record.

Crustacea

Cirripedia

Family: Balanidae

Amphibalanus improvisus (*Darwin, 1854*)

Potential native origin: Western Atlantic Ocean.

Distribution: It is considered NIS in the Pacific Northwest, and is also present in the Sea of Japan, New Zealand and northern Europe (*Foster & Willan, 1979*; *Zullo, 1979*; *Furman, 1989*; *Iwasaki, 2006*).

In the Mediterranean region, it was first reported from the Black Sea in 1844 (*Gomoiu et al., 2002*). Next, it was found in the Bosphorus Strait, Turkey (*Neu, 1935*), which connects the Black Sea to the Aegean Sea. By the late 1940s it was also reported in Barcelona (Spain), Catania (Italy), and Alexandria and Abukir (Egypt; *Kolosvary, 1949*).

Marina records: This finding represents a new locality record for Italy (#12). It was also found in Turkey (#27).

Boat-hull records: Found on boat-hulls moored in France (#5: Figs. S4A and S4B) and Turkey (#28).

Notes: If *Amphibalanus improvisus* happens to establish in Port Camargue marina, this would then present a new country record for France. The captain of a boat hosting *Amphibalanus improvisus* in Port Camargue (France #5) had recently travelled from Barcelona (where it was recorded long ago), as well as the Balearic Islands. Another captain from Port Camargue also hosting this species had recently only travelled to the Balearic Islands, so it is likely that *Amphibalanus improvisus* is present there. The captain hosting this species from Bodrum, Turkey (#28) had recently travelled to Istanbul, where this species has long been present, in addition to travelling through Italy and Greece.

Balanus trigonus *Darwin, 1854*

Native origin: Indo-Pacific.

Distribution: It was first described from the Pacific Ocean (*Darwin, 1854*), and has a wide Indo-Pacific distribution extending to the Red Sea. It is considered NIS in the Atlantic Ocean and Mediterranean Sea, its first Atlantic record coming from Brazil in the 1860s (*Zullo, 1992*). It was introduced to the Atlantic coast of North America around the 1950s to the 1960s (*Moore & McPherson, 1963*; *Gittings, 1985*), and has also been reported from the Eastern Atlantic from the Azores to South Africa.

Its first Mediterranean record was from the Gulf of Catania, Italy in 1927 (*Patane, 1927*). It was abundant in the Italian Tyrrhenian, Ionian and Adriatic Seas in the 1960s (*Relini, 1968*). It is also reported from Egypt (*Ghobashy, 1976*), Lebanon (*Bitar & Kouli-Bitar, 2001*), Turkey (*Koçak, Ergen & Çinar, 1999*), Greece (*Koukouras & Matsa, 1998*), Croatia (*Igić, 2007*) and Slovenia (*Mavrič et al., 2010*).

Boat-hull records: Found on boat-hulls moored in Italy (#14 and #15), Turkey (#32), Greece (#24 and #26), and Cyprus (#33: Figs. S4C and S4D).

Notes: Although reported on boat-hulls in north-western Europe, it has not established in that region (*Hayward & Ryland, 1995*). *Relini (1968)* questioned a lack of other Mediterranean records for this species despite its earlier abundance in the Italian Ionian, Tyrrhenian and Adriatic Seas. In Cyprus, *Balanus trigonus* has not yet been reported for the country, and the boat captain in Cyprus hosting this species explained that he had just travelled along Turkey's Mediterranean coast and also through Rhodes, Greece since his last hull-cleaning. If this species establishes itself in Karpaz Marina, Cyprus, where it was found on boats, it would then present a new country record for Cyprus. This species can also be transported via both the aquaculture or "Live Fish Food Trade" pathways due to its custom of gluing itself onto other marine species such as shellfish and crabs (*Zullo, 1992*).

Decapoda

Family: Portunidae

Charybdis (Gonioinfradens) paucidentatus (A. Milne-Edwards, 1861)

Native origin: Indo-Pacific.

Distribution: This species has a wide Indo-Pacific distribution, including the Red Sea, eastern Africa, Australia, New Caledonia, Japan (*Poupin, 1994*, *1996*; *Apel & Spiridinov, 1998*; *Apel, 2001*), Madagascar (*Crosnier, 1962*), the Persian Gulf (*Naderloo & Sari, 2007*) and Hawaii (*Davie, 1998*).

Its first Mediterranean record was in Turkey in 2009 from the Kaş-Kekova specially protected area from the Turkish Levantine coast (*Karhan & Yokeş, 2012*). A 2010 record from Rhodes, Greece provided the second Mediterranean record (*Corsini-Foka et al., 2010*), which is only about 140 km from Kaş, Turkey.

New records: This finding represents a new country record for Cyprus (#34: Fig. S5A).

Notes: It may have been introduced to the Eastern Mediterranean via ballast water (*Corsini-Foka et al., 2010*).

Dyspanopeus sayi (Smith, 1969)

Native origin: Western Atlantic, from Canada to Florida.

Distribution: It spread from the Western Atlantic to the Northeastern Atlantic and also to the North Sea: Great Britain, France and Netherlands (*Ingle, 1980*; *Clark, 1986*). Its first Mediterranean record was from the Lagoon of Venice in 1991 (*Froglia & Speranza, 1993*), then next a little south in the Adriatic Sea in the Po River Delta (*Turolla, 1999*). In 2009, it was found in a Romanian harbor in the Black Sea (*Micu, Niţă & Todorova, 2010*), and in 2010 from the Ebro Delta of the Iberian Peninsula, providing the first Western Mediterranean record (*Schubart, Guerao & Abelló, 2012*). In 2011, it was collected from the central-southern Adriatic Sea lagoon of Varano (*Ungaro, Pastorelli & Di Festa, 2012*), and in 2011 it was reported in Mar Piccolo, Gulf of Taranto (Ionian Sea, *Kapiris et al., 2014*) another known hotspot for NIS, and then in Lago Fusaro (a brackish lagoon north of Naples), where it was the most abundant crab (*Thessalou-Legaki et al., 2012*).

New records: This finding represents a first subregional record for the Eastern Mediterranean and additionally a new country record for Greece (#24: Figs. S5B and S5C). It was also found in Sicily (#18) from this study.

Notes: Its first Mediterranean record from Venice is hypothesized to have arrived either via the ballast water or aquaculture vector (*Froglia & Speranza, 1993*).

Peracarida—Amphipoda
Family: Ampithoidae
Ampithoe bizseli *Özaydinli & Coleman, 2012*

Potential native origin: Red Sea and Indian Ocean.

Distribution: To date, the species has only been reported from Tanzania and Turkey (Izmir Bay, *Özaydinli & Coleman, 2012*). Its distribution may be much wider than currently known, but this species could have been misidentified as *Ampithoe ramondi* Audouin, 1826, following *Schellenberg's (1928)* record of "*Ampithoe ramondi*" (see notes below).

New records: This finding represents a new country record for Cyprus (#33 and #34: Figs. S6A and S6B).

Boat hull records: Found on boat-hulls moored in Cyprus (#33 and #34).

Notes: According to *Özaydinli & Coleman (2012)*, specimens from Tanzania identified as *Ampithoe ramondi* by *Schellenberg (1928)* display ischium lobes identical to *Ampithoe bizseli*. For this reason, the native origin of *Ampithoe bizseli* is hypothesized to be the Indian Ocean, from where it could have been transferred to the Mediterranean via hull-fouling. Its current presence in two marinas and also on boat-hulls in those marinas supports the hypothesis of biofouling as a vector for its wider spread.

Family: Aoridae
Aoroides longimerus *Ren & Zheng, 1996*

Native origin: Northwest Pacific Ocean.

Distribution: It has been reported from Daya Bay, China (*Ren & Zheng, 1996*) and from Osaka and Wakayama, Japan (*Ariyama, 2004*). It has also been recorded from the Northeastern French Atlantic coast where it is considered NIS (*Gouillieux et al., 2016*).

New records: This finding represents a new Mediterranean record (#5: Figs. S6C and S6D), and a new regional record for the French Mediterranean.

Boat-hull records: Found on boat-hulls in France (#5).

Notes: Port Camargue, France, is situated in close proximity to Thau lagoon, the most important Mediterranean locality for aquaculture farming of Japanese oysters (*Boudouresque et al., 2011*). This information and our new record from boat-hulls suggests that both aquaculture and shipping are possible vectors of introduction, similarly to what has been indicated for the French Atlantic record (*Gouillieux et al., 2016*).

Bemlos leptocheirus (*Walker, 1909*)

Native origin: Red Sea, Indian Ocean.

Distribution: Aside from early records from its native region: Kenya, Tanzania, South Africa, Suez Canal (*Walker, 1909*; *Schellenberg, 1928*; *Sivaprakasam, 1968*; *Myers, 1975*), its first and only Mediterranean record was from Egyptian coast from Port Said, Alexandria, and Abu Kir in the early 20th century (*Schellenberg, 1928*; *Bellan-Santini et al., 1998*). However, it was considered to be as absent from the Mediterranean, as it had not been reported since (*Zenetos et al., 2017*).

New records: This finding represents a new country record for Greece (#24: Figs. S6E and S6F, and #25), and confirms its presence and reappearance in the Eastern Mediterranean.

Notes: Previous findings of *Bemlos leptocheirus* in the Suez Canal and from the Egyptian Mediterranean coast, near the canals entrance, suggest it to have a "Lessepsian migrant" vector status (*Bellan-Santini et al., 1998*), especially since it was also recorded from buoys and boats (*Schellenberg, 1928*). Our findings support that it should rather be assigned to the "biofouling or hull-fouling" vector.

Family: Ischyroceridae

Ericthonius* cf. *pugnax (Dana 1852)

Potential native origin: Indonesia.

Distribution: *Ericthonius pugnax* has a wide Indo-Pacific distribution including Australia (Great Barrier Reef, New Caledonia and New South Wales), Papua New Guinea, Singapore, Japan, Korea, Malaysia, India, Sri Lanka, Madagascar and Mauritius (*Marchini & Cardeccia, 2017* and references therein). It was reported from New Zealand as a NIS (*Ahyong & Wilkens, 2011*). Records of *Ericthonius pugnax* from South Africa on mussel rafts (*Milne & Griffiths, 2013*) may also represent an introduction event. In the Mediterranean Sea, a record of *Ericthonius dydimos* from the Adriatic Sea (*Krapp-Schickel, 2013*) may refer to this species.

New records: This finding represents a new subregional record for the Western Mediterranean and a new country record for France (#5: Figs. S6G and S6H).

Boat-hull records: Found on boat-hulls moored in France (#3 and #5).

Notes: An *Ericthonius* species strikingly similar to *Ericthonius pugnax* was described by *Krapp-Schickel (2013)* from the Lagoon of Venice (and to date, has not been reported from other localities): *Ericthonius didymus*. The latter presents a strongly posteriorly lobate pereopod 5 basis, identical to *Ericthonius pugnax*. *Krapp-Schickel (2013)* justifies the establishment of the new species *Ericthonius didymus* on the basis of differences in pereopod 5 postero-distal lobe (in *Ericthonius didymus* only visible in adult males; in *Ericthonius pugnax*, visible in both adult and juvenile males), in shape of gnathopod 2 carpus (bearing two teeth in *Ericthonius didymus*, versus only one tooth in *Ericthonius pugnax*), shape of pereopods 3 and 4 basis, as well as body size. However, a re-examination of *Ericthonius* material collected in 2012 from the Lagoon of Venice
(A. Marchini, 2012, private collection), together with a cross-comparison of descriptions and drawings of both *Ericthonius didymus*, provided by *Krapp-Schickel (2013)*, and *Ericthonius pugnax*, provided by *Moore (1988)*, *Just (2009)* and *Azman & Othman (2013)*, shows that the differences pointed out by *Krapp-Schickel (2013)* may not support the separation between the two species. With regards to gnathopod 2 carpus, *Azman & Othman (2013)* showed that the number of teeth in male *Ericthonius pugnax* varies with maturity. Furthermore, we observed some males from Venice having a single-toothed gnathopod 2 carpus, consistent with the description of *Ericthonius pugnax* hyperadult males of *Moore (1988)*. The basis of pereopods 3, 4 is bottle-shaped, and distally expanded in both species. Furthermore, body length is largely variable (*Ericthonius didymus* described from Venice is 4.5 mm; *Ericthonius pugnax* described from Australia by *Moore (1988)* and *Just (2009)* is 3.0–3.7 mm, from Malaysia by *Azman & Othman (2013)* is 3.8 mm, from Japan by *Nagata (1965)* is up to 7.5 mm.

Therefore, we hereby suggest that the "endemic" *Ericthonius didymus* in Venice may be an introduced population of the Indo-Pacific *Ericthonius pugnax*, and therefore may be a pseudoindigenous species (see definitions). However, it is also possible that the global populations of *Ericthonius* with a posteriorly lobated pereopod 5 basis represent a complex of cryptic species. We consider that in this case the hypothesis of the valid introduced status is supported by the following facts:

1. *Ericthonius pugnax* has a notably wide distribution in the Indo-Pacific region, which supports a human-mediated dispersal hypothesis, and is already known as a NIS from New Zealand (and possibly, South Africa);

2. In the Lagoon of Venice, it has developed populations with high densities (A. Marchini, personal observation), which is consistent with "invasive" behaviour; and

3. The Lagoon of Venice is a well-known hotspot of introductions, where over 70 NIS have already been recorded, many with Pacific/Indo-Pacific origins, which were introduced to Venice *via* oyster imports (*Marchini, Galil & Occhipinti, 2015*). The present records from Cap d'Agde and Port Camargue are both nearby another popular hotspot for oyster introductions, the Thau lagoon (*Boudouresque et al., 2011*). This further supports the hypothesis of introduction from the Indo-Pacific region, with aquaculture being the main pathway of primary introduction.

Family: Stenothoidae

Stenothoe georgiana Bynum & Fox 1977

Native origin: Western Atlantic.

Distribution: Its first record outside its native range was reported just recently in 2010, in association with fouling communities of offshore fish farms (about 10 km from shore) in Alicante and Murcia, Spain (*Fernández-González & Sánchez-Jerez, 2017*). Its subsequent Mediterranean records were from the Ligurian Sea and from Sardinia, Italy (*Ferrario et al., 2017*).

New records: These findings represent new country records for France (#5) and Malta (#23). This study increases its known Italian distribution by incorporating Sicily (#14: Figs. S6I and S6J, #15, #18, #21). The Maltese and Sicilian findings from this study represent a new Central Mediterranean subregional record.

Boat-hull records: Found on boat-hulls moored in France (#3, and #10), and Italy (#14, #15, #17, and #21).

Notes: Since this species has only very recently been reported in the Mediterranean, we hypothesize that it may have gone previously overlooked, since it is already present in at least four countries. It may soon establish in Cap d'Agde Marina or Port Vauban, Antibes, and this should serve as a warning for future monitoring of those marinas. This study demonstrates that this species is likely polyvectic (see definitions): in addition to its likely transfer via aquaculture (*Fernández-González & Sánchez-Jerez, 2017*), recreational boating is also facilitating its spread.

Peracarida—Isopoda

Family: Anthuridae

Mesanthura* cf. *romulea *Poore & Lew-Ton, 1986*

Potential native origin: Tropical to sub-tropical southern seas.

Distribution: *Mesanthura* specimens belonging to the same species and sharing major diagnostic characters with *Mesanthura romulea* described from Australia (*Poore & Lew-Ton, 1986*) were subsequently (2000) collected from the harbors of Salerno and Taranto (Italy), where they were well established (*Lorenti, Dappiano & Gambi, 2009*), and also from Ischia Island (*Kroeker et al., 2011*). More recently, this species has been reported by *Ferrario et al. (2017)* from marinas in Northern Italy (Liguria).

New records: This finding represents new country records for Spain (#1: Fig. S7A), Malta (#22: Fig. S7A), Greece (#26) and Cyprus (#33 and #34), the latter two records also confirming the presence of *Mesanthura* cf. *romulea* in the Eastern Mediterranean. From this study, we additionally report specimens from Italy (#14, #15, #16: Fig. S7A, and #18).

Notes: The earliest mention of the presence of the genus *Mesanthura* in the Mediterranean region was from Lake Burullus, Egypt (*Samaan, Ghobashy & Aboul Ezz, 1989*); however, the record was not supported with taxonomic details and needs confirmation. *Castelló (2017)* recently described a new *Mesanthura* species from both the Lebanese coast and Cyprus (*Mesanthura pacoi, Castelló, 2017*), whose females vary from those of the present species in the dorsal colour pattern and in other subtle morphological features. As mentioned above, the species found by *Lorenti, Dappiano & Gambi (2009)* and reported here is comparable and most probably conspecific (G. Poore, 2017, personal communication) with *Mesanthura romulea* described by *Poore & Lew-Ton (1986)*, which is based only on two specimens collected from Sydney Harbor and Port Stephens, New South Wales, Australia. No other records of this species have been published.

The fact that the extant description of the Australian *Mesanthura romulea* lacks a number of taxonomic characters and is based on only two specimens prevents from

determining if features observed in all Mediterranean specimens lie within the natural range of morphological variation of the species, or allow for the determination of a different species.

As long as these cases of taxonomic identity are unsolved, and no new material of *Mesanthura romulea* is found from its putative native range, the origin of populations occurring in the Mediterranean remains obscure. However, the Mediterranean finding of the present species of *Mesanthura* shows strong indications of a human-mediated introduction. Following *Chapman & Carlton's (1991)* criteria, the lack of previous records of the genus *Mesanthura* on a basin scale (except for the recent discovery of *Mesanthura pacoi* from the Levantine Sea), the mentioned occurrences from confined areas such as lagoons and harbors, the notably poor capabilities of active or passive spreading by natural means of the genus, and its likely exotic evolutionary origin, cumulatively support the hypothesis of a human-mediated introduction.

Family: Janiridae

Ianiropsis serricaudis Gurjanova, 1936

Native origin: Sea of Okhotsk to the Sea of Japan.

Distribution: In addition to its native range, it has been reported from the Northeastern Pacific (from Puget Sound to Monterey Bay), the Northwestern Atlantic (from Maine to New Jersey) and the Eastern Atlantic and North Sea (England and the Netherlands) (*Hobbs et al., 2015*).

Its first Mediterranean record was in 2012 from the Lagoon of Venice (*Marchini, Ferrario & Occhipinti-Ambrogi, 2016a*), and soon after from Olbia, Sardinia in 2014 (*Marchini, Ferrario & Occhipinti-Ambrogi, 2016b*).

New records: This finding represents a new country record for France (#3 and #5: Fig. S7B).

Notes: In North America, this species is now known as a common fouling species. It was hypothesized that this species is likely more established along North America and the European coasts than what is known, but may go undetected due to its minuscule size (<3 mm) and the taxonomic complexity of the genus (*Hobbs et al., 2015*). All the Mediterranean findings (Venice, Olbia, Port Camargue) refer to sites in close proximity to aquaculture sites.

Family: Paranthuridae

Paranthura japonica Richardson 1909

Native origin: Northwest Pacific Ocean.

Distribution: It was first reported from Muroran, northern Japan and from eastern Russia (*Nunomura, 1977*). It was reported as a NIS for San Francisco Bay in 1993, then from southern California in 2000 (*Cohen & Carlton, 1995*; *Cohen, 2005*). Between 2007 and 2010 it was first recorded in European waters from the Bay of Biscay, France, most likely via the aquaculture vector (*Lavesque et al., 2013*).

Its first Mediterranean records occurred only recently; between 2010 and 2012 it was found in numerous localities around Italy: the Lagoon of Venice, La Spezia and Olbia harbors (*Marchini et al., 2014*), and Taranto (*Lorenti et al., 2015*). Next, it was found in La Grande-Motte, France (*Marchini, Ferrario & Minchin, 2015*) and then in Tunisia and Greece (*Tempesti, Langeneck & Castelli, 2016*).

New records: These findings represent new country records for Spain (#1: Fig. S7C, and #2) and Malta (#23). Furthermore, *Paranthura japonica* was found in countries where it was already reported from, extending its known distribution to new localities in France (#3, #4 and #9), Italy (#12, #13, #16–21: (#21) Fig. S7C), and Greece (#24 and #26). These new Sicilian records (#16–21), and Maltese record (#23) show it is already well-established in the Central Mediterranean.

Boat-hull records: Found on boat-hulls moored in France (#3, #5, #9 and #10), Italy (#12, #17, #20 and #21) and Greece (#24).

Notes: The current findings dramatically increase the known distribution of *Paranthura japonica*, revealing it as one of the most widespread NIS in the Mediterranean Sea. While the initial findings of *Paranthura japonica* had suggested an association with aquaculture transfers, these new records show that it most likely is a polyvectic species (see definitions) species, which complicates the possibility of reconstructing its invasion trajectory.

Family: Sphaeromatidae

Cymodoce* aff. *fuscina *Schotte & Kensley, 2005*

Native origin: Persian Gulf.

Distribution: *Cymodoce fuscina* was first described in 2005 from seagrass beds in Saudi Arabia, the Persian Gulf by *Schotte & Kensley (2005)*. Until now, this isopod had not been reported outside the Persian Gulf.

New records: This finding represents a new record for the Mediterranean basin, and a new country record for Greece (#24: Figs. S7D and S7E).

Boat-hull records: Found on boat-hulls moored in Greece (#24 and #25).

Notes: Our specimens show very strong affinity to *Cymodoce fuscina* from the Persian Gulf (V. Khalaji-Pirbalouty, 2016, personal communication), and they certainly differ from all other known *Cymodoce* species reported in the Mediterranean Sea in several characters of the pleotelsonic region, while also being similar to other species described from the Western Indian Ocean (*Khalaji-Pirbalouty & Raupach, 2014*). Its association with marina structures and hull-fouling further supports the hypothesis of a human-mediated introduction, possibly from boats travelling from the Red Sea through the Suez Canal. However, slight differences between our material and the original description of *Cymodoce fuscina* by *Schotte & Kensley (2005)* should be noted, for example the pleotelsonic apex of *Cymodoce fuscina* has the three apical lobes subequal in length and rounded apically, while in our material the central lobe is slightly longer than the lateral ones, and ends in a tiny bifid spike. We stress the

fact that not all Indo-Pacific species within this genus may be known (many new species have been described in the recent decade), and a complex of species is also a possibility. Therefore, we recommend that genetic analyses should be undertaken to compare the Mediterranean material with specimens from the native range, to confirm the identity of these samples from Heraklion, Greece.

Paracerceis sculpta (Holmes 1904)

Native origin: California.

Distribution: This is a widely distributed species naturally found along the North American Pacific coast from California to Mexico, and has also been reported from Hawaii, Hong Kong, Australia, Brazil and the Azores (*Marchini et al., in press* and references therein).

   In the Mediterranean Sea, it was first reported from the Lake of Tunis, Tunisia (*Rezig, 1978*); and next from several Italian localities (*Forniz & Sconfietti, 1983*; *Forniz & Maggiore, 1985*; *Savini et al., 2006*; *Ferrario et al., 2017*), and the Strait of Gibraltar (*Castelló & Carballo, 2001*). Most recently, it was reported in Thermaikos and Toroneos Gulf in Greece (*Katsanevakis et al., 2014*) and La Grande-Motte in France (*Marchini, Ferrario & Minchin, 2015*).

New records: This finding represents new country records for both Malta (#22: Fig. S7F, and #23) and Cyprus (#34). It was also found in France (#4), Greece (#24 and #26) and Italy (#13, #15–21).

Boat-hull records: Found on boat-hulls from Sicily (#17, #20 and #21), Greece (#24) and Turkey (#31).

Notes: This species has often been reported from marinas, indicating that recreational boating plays an important role in the spread of this global invader. In Fethiye (#31), it was found on a boat-hull but not in the marina and so far was unknown from Turkey; When interviewed, the boat captain hosting this species explained he had just travelled from Rhodes (#26), where it was found in the marina. Attention should be paid to see if it spreads to the marina in Fethiye, Turkey, where it would then constitute a new country record.

Paradella dianae (Menzies, 1962)

Native origin: Eastern Pacific Ocean.

Distribution: The first description of this species was from the Bay of San Quintin, Baja California (*Menzies, 1962*).

   Its first Mediterranean record was from Civitavecchia, Italy (*Forniz & Maggiore, 1985*), followed by a series of findings in Egypt (*Atta, 1991*), Spain (*Castelló & Carballo, 2001*), Turkey (*Çinar et al., 2006*), Cyprus (*Kırkım et al., 2010*), Libya (*Zgozi, Haddoud & Rough, 2002*) and Sardinia, Italy (*Ferrario et al., 2017*).

New records: This finding represents a new locality record for Sicily, Italy (#15: Fig. S7G), and an additional record for Turkey from the same locality (Fethiye) it had previously been reported in (#31).

Boat-hull records: Found on boat-hulls moored in Greece (#24), and Italy (#20).

Notes: This species has not yet been reported in Greece, so this finding on a boat-hull in Heraklion, Crete, which had only travelled through Greek islands since its last cleaning alludes to its presence in Greek waters. Interestingly, the boat-hull it was found on in Sicily had just travelled from Fethiye, Turkey, where it is known from. It is assumed that this sphaeromatid isopod arrived to the Mediterranean via hull-fouling on vessels from the Northeast Pacific, its alleged original native range (*Galil, Occhipinti-Ambrogi & Gollasch, 2008*).

Sphaeroma walkeri Stebbing 1905

Native origin: Indian Ocean.

Distribution: This species is commonly found in intertidal fouling communities and has been widely reported from ports in warm and warm-temperate waters worldwide, including the Pacific coast of North America (*Carlton & Iverson, 1981*).

Its first Mediterranean record is from Port Said, Egypt in 1924, where it was found on boat-hulls (*Omer-Cooper, 1927*). Half a century later (in 1977), it was reported from Toulon, France (*Zibrowius, 1992*), then from Turkey (*Kocatas, 1978*), and Alicante, Spain in 1981 (*Jacobs, 1987*). Decades later it was found once again on boat-hulls in Haifa Harbor, Israel (*Galil, Occhipinti-Ambrogi & Gollasch, 2008*), and also found to be well-established in Tunisian harbors and lagoons (*Ounifi-Ben Amor, Ben Salem & Ben Souissi, 2010*). In 2010 it was first spotted in Italy in the harbor of La Spezia (*Lodola et al., 2012*).

New records: This finding represents a new country record for Greece (#24: Fig. S7H). It was also found in Turkey (#31).

Boat-hull records: Found in Greece (#24 and #25), and Turkey (#31). This presents a new locality record for Greece (#25) in addition to the new country record presented above.

Mollusca
Family: Chamidae
Pseudochama cf. *corbierei* (Jonas 1846)

Native origin: Red Sea, Gulf of Aqaba and Suez Canal.

Distribution: It is considered endemic to the Red Sea and Suez Canal (*Barash & Danin, 1972*). Its first Mediterranean record is from Greece (*Ralli-Tzelepi, 1946*), and it has also been reported from Turkey (*Cachia & Mifsud, 2017*). The latest record from Malta represents its first Central Mediterranean record (*Cachia & Mifsud, 2017*).

New records: One juvenile specimen was found in Italy (#20: Fig. S8F).

Notes: This species was formerly known as *Chama corbieri,* while *Pseudochama cornucopia* (Reeve, 1846) and *Pseudochama ruppelli* (Reeve, 1847) are both considered common synonyms. An additional record from Israel (*Barash & Danin, 1972*) as *Chama cornucopiae* Reeve, 1846 was excluded since the record was based on an empty shell. The

present finding in Ragusa, Sicily (Italy) of a single young specimen remains dubious about its exact determination. Hence, we classify this finding as uncertain since the defining characters for this species were not yet fully developed in our juvenile specimen and suggest that the occurrence of *Pseudochama corbierei* awaits further confirmation before considering the species introduced to Italy.

Family: Mytilidae
Arcuatula senhousia (Benson 1842)

Native origin: Siberian Peninsula to Indo-Pacific.

Distribution: It has been reported from Great Bitter Lake, the Suez Canal, the Red Sea, Mauritius, Zanzibar, and several Indo-Pacific and Indian Ocean countries including Thailand, Malaysia and New Caledonia (*Barash & Danin, 1972*).

Its first Mediterranean record was from Israel in 1960, and then from Lake Bardawil on the Egyptian Sinai Peninsula in 1982 (*Barash & Danin, 1971*). It was also found in Thau Lagoon, France in 1982, a popular oyster aquaculture locality (*Hoenselaar & Hoenselaar, 1989*) and then spread to the surrounding area including the Leucate Lagoon. Next, it was recorded in Ravenna, the Italian Adriatic coast in 1986 (*Lazzari & Rinaldi, 1994*). In this century, it was found in the Gulf of Olbia, Tyrrhenian Sea (*Savarino & Turolla, 2000*), then in 2001 it was established in the Gulf of Taranto, the Ionian Sea, from an area involving both mussel aquaculture and intense shipping (*Mastrototaro, Matarrese & D'Onghia, 2003*). Next, it was reported again along the Adriatic Italian coast (*Solustri, Morello & Froglia, 2003*), and the following year it had dense populations inside the dams of the Port of Leghorn (Livorno, Italy) (*Campani et al., 2004*; *Margelli et al. 2004*). It was also found in Tunisia (*Ben Souissi et al., 2005*), then, between 2006 and 2009, in Siracusa's Porto Grande Marina, Sicily (*Brancato & Reitano, 2009*). In 2010, it was found in the Eastern Adriatic from the Neretva River Delta growing on serpulid tubes of the polychaete *Ficopomatus enigmaticus* (Fauvel, 1923) (*Despalatović et al., 2013*). In Spain, it was reported from the Ebro River Delta in 2014 (*Soriano & Salgado, 2014*); however, that record was based on four empty shells, therefore, its presence in Spain still awaits confirmation from live specimens.

New records: This finding represents the first confirmed country record for Spain (#2: Figs. S8B and S8C). It was also found in France (#5 and #9), and Sicily (#15, #16 and #21).

Family: Ostreidae
Dendostrea folium sensu lato (Linneaus 1758)

Native origin: Indo-Pacific.

Distribution: Its first Mediterranean record is from Iskenderun Bay, Turkey in 1998 (*Çeviker, 2001*), then from Cyprus (*Zenetos, Konstantinou & Konstantinou, 2009*), and next from the Greek islands of Astypalaia, Rhodes and Kastellerizo (*Karachle et al., 2016*). It has also recently been reported from Panama (*Lohan et al., 2015*).

New records: This finding represents a new subregional record for the Central Mediterranean, and a new country record for Malta (#22 and #23). It was also found in Greece (#24 and #26), Turkey (#29, #30 and #32) and Cyprus (#33: Fig. S8I), where it was previously known.

Boat-hull records: Found on boat-hulls moored in Italy (#17), Greece (#26), Turkey (#31 and #32) and Cyprus (#33).

Notes: If it establishes in the marina in Italy, where it was found on a boat-hull, it would then present a new country record; the boat which was hosting *Dendostrea folium* in Italy had just returned from a long trip back from southern Turkey and the Greek Islands. *Dendostrea frons* (Linnaeus, 1758) and *Dendostrea folium* are very similar species. *Huber (2010)* rejects the possible presence of *Dendostrea frons* in the Mediterranean Sea, despite many reports of this species there. Based on genetic results, *Crocetta et al. (2015)* demonstrated that the Greek and Turkish material belongs to a single, morphologically highly variable species: *Dendostrea folium*, most likely representing a complex of species in need of revision (M. Oliverio, 2017, personal communication).

Saccostrea cf. *cucullata* (Born 1778)

Native origin: Indo-Pacific.

Distribution: It is found from the Red Sea, East Africa down to South Africa including Madagascar, and West Africa up to Angola (*Branch et al., 2002*).

Its first Mediterranean record is from south-eastern Turkey in 1998–1999 from Erdemli, and later from Yumurtalik and Tasuçu (slightly west and east of Erdemli, respectively), where it is well-established with large populations (*Çevik, Öztürk & Buzzuro, 2001*), followed by a record from El-Faham, Egypt (*Gofas & Zenetos, 2003*). An additional record from Tunisia remains questionable (*Ounifi-Ben Amor et al., 2016*).

New records: This finding represents a possible new country record for Greece (#24). From this study, it was also found in Turkey (#31), presenting the most south-western record for the country.

Notes: The only specimen collected in Heraklion (Greece) was a juvenile (20 mm) and the crenulations along the margin (a key identification character) were only partially visible (Figs. S8G and S8H), but were not well developed as in matured specimens. Therefore, we regard this finding as uncertain and suggest the occurrence of *Saccostrea cucullata* needs further confirmation before officially presenting this as a new country record in Greece.

Saccostrea glomerata (Gould 1850)

Native origin: Australasia.

Distribution: Its native distribution extends from eastern Australia to New Zealand. In the Mediterranean, it was intentionally introduced to the Adriatic Sea in 1984 for aquaculture (*Cesari & Pellizzato, 1985*), but has not been found there since 1990 (*Mizzan, 1998*), and is thus currently considered as locally extinct. In 1998 it was reported

in Turkey, which was the first Eastern Mediterranean record (*Çevik, Öztürk & Buzzuro, 2001*), but this record is considered a case of misidentification with either *Saccostrea cucullata* (according to *Gofas, 2011*) or *Dendostrea frons* (acccording to *Albayrak, 2011*), so this record remains questionable.

Boat-hull records: This species was found on one boat-hull moored in France (#10: Figs. S8D and S8E), which had only travelled locally around the French Riviera (from Nice to Golfe-Juan) for the past 1.5 years since its last hull-painting.

New Mediterranean records: This finding confirms its presence in French waters and also presents a new subregional record for the Western Mediterranean.

Notes: This species was formerly known as *Saccostrea commercialis* (Iredale & Roughley, 1933), and is distinct from *Saccostrea cucullata* in terms of DNA 16S sequences (*Lam & Morton, 2006*; *Salvi, Macali & Mariottini, 2014*).

Polychaeta
Family: Serpulidae
H. brachyacantha sensu lato Rioja 1941

Potential native origin: Mexican Pacific.

Distribution: Since its initial Mexican record, it has been reported globally, from Hawaii (*Straughan, 1969*), Brazil (*Zibrowius, 1970*), Micronesia (*Imajima, 1982*), Japan (*Imajima, 1987*), Venezuala (*Díaz Díaz & Liñero-Arana, 2001*), California (*Bastida-Zavala & ten Hove, 2003*) and India (*Pati, Rao & Balaji, 2015*).

Its first Mediterranean record was from Israel in 1933 (*Ben-Eliahu, 1991*), and its second from Turkey (*Çinar, 2006*).

New Mediterranean records: This finding represents new country records for both Greece (#24) and Spain (#2: Figs. S9A–S9C), the latter also presenting a new subregional record for the Western Mediterranean.

Boat-hull records: Found on boat-hulls moored in Greece (#24).

Notes: The recent paper by *Sun et al. (2016)* re-described *H. brachyacantha* as a complex of species, which renders the identity of the Mediterranean populations as unknown, until genetic analyses are performed and the status of the species within the complex is clarified. Consequently, the native origin of the Mediterranean populations is also unknown, and this serpulid should therefore be classified as "cryptogenic." However, the possibility that *H. brachyacantha* is a native Mediterranean species having long escaped detection is not fully supported; it first appeared in the Mediterranean as early as in 1933 and so far has only two records in the Levantine Sea (Israel and Turkey). According to *Chapman & Carlton's (1991)* criteria, these characteristics, combined with the fact that the species of *H. brachyacantha* complex are more widely distributed elsewhere (*Sun et al., 2016*), support a likely introduced status for the *H. brachyacantha* complex in the Mediterranean Sea.

The new records of this complex of species presented from this study in Greece and Spain demonstrate its ongoing spread, and additionally provide an important reference

for future genetic analyses. Due to the uncertainty surrounding the real identity of any Mediterranean *H. brachyacantha* material, we here use the open nomenclature qualifier "*sensu lato.*"

Hydroides dirampha Mörch, 1863

Potential native origin: Tropical Western Atlantic.

Distribution: Circumtropical (*Bastida-Zavala & ten Hove, 2003*), originally described from the US Virgin Islands (*Zibrowius, 1971*). It was reported in the Red Sea (*Zibrowius, 1971*), the Western Atlantic (*Bastida-Zavala & ten Hove, 2002*), the Eastern Pacific (*Bastida-Zavala & ten Hove, 2003*), Australia (*Hayes & Sliwa, 2003*; *Sun et al., 2015*), and Hawaii (*Bastida-Zavala, 2008*).

In the Mediterranean, it was first reported in Italy in 1870 as *Eupomatus lunifer* (*Claparède, 1870*). It has since spread all over the basin, being next reported in Spain in 1923, Egypt in 1924 (for both records: *Zibrowius, 1973*), Israel in 1937 (*Ben-Eliahu & ten Hove, 1992*), Tunisia in 1969 (*Zibrowius, 1978*), Lebanon in 1978 (*Zibrowius & Bitar, 1981*), Turkey in 2005 (*Çinar, 2006*) and Greece in 2014 (*Corsini-Foka et al., 2015*).

New records: This finding represents a new country record for Malta (#22 and #23: Figs. S9D and S9E).

Boat-hull records: Found on boat-hulls moored in marinas in France (#7), Italy (#12, #15, #17, #20, #21), Malta (#22 and #23), Greece (#24 and #25), Turkey (#31 and #32) and Cyprus (#33).

Notes: It is a NIS in the Mediterranean believed to be arrived by the shipping pathway from the tropical Western Atlantic (*Zibrowius, 1992*).

Hydroides elegans (Haswell, 1883)

Native origin: Australasia and Indian Ocean.

Distribution: Circumtropical: Pacific Ocean, Caribbean, Atlantic and Northern Europe. In the Mediterranean Sea, it has been reported since the 19th century (*Claparède, 1870*), and has since spread to most countries in the basin (*Galil & Gevili, 2014*).

New records: This finding represents a new country record for Malta (#22). This species was found in all marinas, except for #8, #13, #14, #20, #23, #29-31, #33, #34, #35. Figs. S9F and S9G are from #18.

Boat-hull records: Found on boat-hulls from all marinas which had boats sampled.

Notes: It is considered the main fouling organism in the Mediterranean Sea (*Koçak, Ergen & Çinar, 1999*); our study confirms that it is the most widespread fouling species found here in terms of distribution.

Hydroides homoceros Pixell, 1913

Potential native origin: Indo-Pacific.

Distribution: It was originally described from the Cape Verde Islands, in the Eastern Atlantic (*Pixell, 1913*). Also reported from the Red Sea, Suez Canal, Arabian Gulf, Zanzibar and Maldives (*Ben-Eliahu & ten Hove, 2011*).

Its first Mediterranean record was from Israel in 1955 (*Ben-Eliahu, 1991*), then in late 1970s from an aircraft carrier moored in Toulon, France (*Ben-Eliahu & ten Hove, 2011*). Next it was reported from the south-eastern Turkey (*Çinar, 2006*).

Boat-hull records: Found on boat-hulls moored in Cyprus (#33: Figs. S9H and S9I), but was not found in the same marina. The captain of one boat hosting this species in Cyprus had recently travelled to the Turkish Levantine coast, where it is known from. If it does establish in Cyprus, it would then present a new country record.

Spirobranchus tetraceros sensu lato (Schmarda 1961)

Native origin: Indo-Pacific.

Distribution: First described from Australia, it has a circumtropical distribution that includes the Suez Canal, Indian Ocean, South Africa, Australia, Malaysia, Japan, China and the Caribbean (*Ben-Eliahu & ten Hove, 1992*; *Fiege & Sun, 1999*).

Its first Mediterranean record was from Lebanon in 1965 (*Laubier, 1966*) as *Spirobranchus giganteus coutierei* Gravier, 1908 (which is now understood as a sub-species of *Spirobranchus tetraceros*; E. Kupriyanova, 2017, personal communication), followed by Rhodes, Greece (*Dumont & Werger, 1989*), Abu Kir Bay, the Egyptian Mediterranean (*Selim et al., 2005*), and the Turkish Levantine Sea (*Çinar et al., 2006*).

New records: This finding presents a new subregional record for the Central Mediterranean and a new country record for Italy (#18: Fig. S9J). It was also found in Greece (#24).

Notes: *Spirobranchus tetraceros* has been treated as a complex of species since 1994 (*Fiege & Sun, 1999*; *Ben-Eliahu & ten Hove, 2011*) in need of taxonomic revision, hence, here it is referred to as *Spirobranchus tetraceros sensu lato*.

Porifera
Family: Amphoriscidae
Paraleucilla magna Klautau, Monteiro & Borojevic, 2004

Potential native origin: Indo-Pacific and Australia.

Distribution: First described from the Western Atlantic in Rio de Janeiro, Brazil, and was also found from the Azores, Madeira and Portugal (*Bertolino et al., 2014*; *Guardiola, Frotscher & Uriz, 2016*).

Its first Mediterranean records were from multiple Italian localities, first in the Ionian then in the Tyrrhenian and Adriatic Seas, followed by the Ligurian Sea and Sicily (*Longo et al., 2004*, *2012*; *Longo, Mastrototaro & Corriero, 2007*; *Bertolino et al., 2014*; *Marra et al., 2016*). It was also reported from multiple localites in the Costa Brava region in Spain (*Guardiola, Frotscher & Uriz, 2012*, *2016*), as well as Malta (*Zammit, Longo & Schembri, 2009*), and Croatia (*Cvitković et al., 2013*). Its first Eastern Mediterranean record is from

the Gulf of Thessaloniki, Greece, where it was first observed in 2014 in a mussel farm (*Gerovasileiou et al., 2017*). It has also emerged in the Sea of Marmara, Turkey in 2012 (*Topaloğlu, Evcen & Çınar, 2016*).

New records: This finding represents a new country record for Cyprus (#34), and new locality records for both Greece (#24: Fig. S10A, and #26) and Sicily. Specifically, it was present at all seven sampled Sicilian marinas (#15–21), and was also found in Malta (#23).

Boat-hull records: Found on boat-hulls in France (#5), Malta (#22), Greece (#26) and Cyprus (#34).

Notes: Prior to the recent 2004 description of *Paraleucilla magna*, this genus was only known from the Indo-Pacific region and Red Sea. As it was initially described from Rio de Janeiro in 2004, where it is considered cryptogenic (*Cavalcanti et al., 2013*), it was likely already present in several Mediterranean locations. For instance, the species had already been recorded (preceding its formal description) in 2001 from Mar Piccolo of Taranto (*Longo et al., 2004*), and according to local mussel farmers was present there as long as 20–30 years earlier (*Longo, Mastrototaro & Corriero, 2007*). The opportunistic behavior of *Paraleucilla magna*, with proliferation only close to either aquaculture facilities or harbours, may be the reason behind its late detection in the Mediterranean (*Guardiola, Frotscher & Uriz, 2012*). Moreover, as several introductions probably occurred in a short period of time, the phylogeographic signal could be weak or even lost, making the determination of the introduction pathway a challenge (*Pineda, López-Legentil & Turon, 2011*). Aquaculture and shipping are the most probable vectors for its recent expansion along the Western Mediterranean coast (*Longo, Mastrototaro & Corriero, 2007*). This study shows that *Paraleucilla magna* is now both a common and established species around Sicily and Malta. Noteworthy is the record on boat-hulls reported here from France (but not in the marina), which may represent the first step of subsequent spreading in the Western Mediterranean and recreational boating as another vector of spread.

Pycnogonida

Family: Ammotheidae

Achelia sawayai sensu lato Marcus, 1940

Native origin: Western Atlantic.

Distribution: Extremely common in the tropical shallow waters of the Western Atlantic. It is distributed from Georgia to the Gulf of Mexico and throughout the Caribbean Sea to Brazil (*Müller & Krapp 2009*). It has also been reported in Western Africa, Madagascar and in the southern Pacific in French Polynesia, Indonesia, Fiji and Papua New Guinea, although some of these records are still awaiting confirmation (*Child, 1992, 2004*).

New records: This finding represents a new record for the Mediterranean Sea, and new country records for both Malta (#23: Figs. S11A and S11B) and Italy (#17, #18).

Notes: Recent molecular studies suggest that the Atlantic and Pacific populations may belong to different entities within a complex of species (*Sabroux et al., 2017*). Therefore, it is referred to here as *Achelia sawayai sensu lato*. Since the origin of the Mediterranean
material is unknown, further molecular studies are necessary to understand the invasion route taken by this pycnogonid. The local reproductive success of this species exhibiting paternal care was demonstrated by the finding of two ovigerous male specimens.

DISCUSSION

This wide-scale study spanning the Mediterranean Sea provides a massive update of new NIS records, and in many cases their regional or local expansions, providing a warning for subsequent spreading. The 51 new country records presented in this study clearly indicate how inadequate our knowledge on Mediterranean marine NIS still is. There was a prevalence of new findings for bryozoans and crustaceans in almost all countries (Fig. 2). This is because these are both poorly studied taxa in the Mediterranean owing to a lack of taxonomic expertise/focused studies. Additionally, typical rapid assessment surveys or citizen science initiatives searching for NIS usually target larger and eye-catching taxa (*Zenetos et al., 2013*; *Mannino et al., 2017*), so these minuscule or less charismatic components of fouling biota may have gone previously overlooked or not have had the applicable expertise available.

It is not uncommon for marine NIS to go overlooked for long periods of time (*Carlton, 2009*), as in the case of *Paraleucilla magna* in the Mediterranean (*Longo, Mastrototaro & Corriero, 2007*). Actually, for most "first country records" documented in this study, the year of first introduction may have been much earlier than the first year of discovery presented here, as these NIS may have gone unnoticed due to a lack of taxonomic expertise or lack of focused study. Some probable examples of this include: *Paranthura japonica*, *Watersipora arcuata* and *Celleporaria brunnea*, whose current widespread Mediterranean distributions indicate they have likely been hitching rides around the basin for quite some time. Another example of this is the sea spider *Achelia sawayai sensu lato*, first reported here for the Mediterranean basin, and specimens were already found in three marinas: two in Sicily and one in Malta. An exception to this is our finding of *Microcosmus exasperatus* in Karpaz Gate Marina, Cyprus, as this species was specifically sought two years prior to our sampling of the same marina, but was not found then (*Gewing et al., 2016*). Also, *Celleporaria brunnea* was not found to be present in Grand-Motte, France in 2014 (*Marchini, Ferrario & Minchin, 2015*), but was present there when we sampled in 2016.

In addition to the records presented here, *Percnon gibbesi* (H. Milne Edwards, 1853) was sighted in Port Vauban, France, presenting a new country record for this species of western Atlantic origin, and already known from several other Mediterranean countries as a very successful invader (*Katsanevakis et al., 2010*, *2011*). The non-indigenous status of *Percnon gibbesi* in the Mediterranean Sea is uncertain, because its long-lived planktonic larvae could have entered the Gibraltar Strait facilitated by natural means, i.e. the Atlantic Current, rather than human vectors, such as ballast water (*Mannino et al., 2017* and references therein). Due to its questionable status regarding its mode of introduction, we have cautiously separated this species from the other NIS records. However, it is noteworthy that *Percnon gibbesi* was sighted feasting on a fouling community on a

boat-hull in Greece (#25), suggesting hull-fouling as another possible vector for its ongoing spread.

This study focusing exclusively on marina habitats indicates that recreational boating represents the most plausible vector of introductions for the NIS we found, aside from the few marinas situated in very close proximity to either aquaculture facilities or shipping ports, as in Port Camargue, France and Heraklion, Greece. Hence, most of these new records suggest the pivotal role of recreational boating in facilitating both first introduction events to a given country and secondary spread.

Furthermore, some species reported here are likely polyvectic, but it is clear that recreational boating plays a determinant role in accelerating/facilitating the spread of many species, especially those having only a very short and lecithotrophic larval stage. The presence of such species lacking the ability for natural long-distance dispersal found on boat-hulls and in marinas can confirm that the hull-fouling vector is instrumental in expediting primary introductions as well as facilitating secondary transfer for many ascidians, bryozoans and peracarids such as *Ampithoe bizseli*, *Bemlos leptocheirus*, *Celleporaria brunnea*, *Clavelina oblonga*, *Paraleucilla magna*, *Paracerceis sculpta*, *Paranthura japonica*, *Phallusia nigra*, *Styela plicata* and *Tricelleria inopinata*. The ongoing nature of the invasion process is further demonstrated by the observation of the same set of NIS on boat-hulls and in the same marinas, clearly showing the exchange of organisms from marina to mobile habitats and *vice versa*.

The species which are not yet present in a country, but found only on boats obviously cannot formally be recorded as new country records, unless we are certain that the boat has not left that country since its last hull-painting/cleaning, e.g., as in our finding of *Paradella dianae* on boat-hulls in Greece. Some other interesting cases of NIS found on boats but not yet in the country are (see Table 3 for details) the barnacle *Amphibalanus improvisus* and the bryozoan *Watersipora arcuata* both found on hulls in France, yet the boats which they were found on had only travelled to the Balearic Islands, alluding to the assumption that those NIS are likely present in the Balearic Islands. Also noteworthy is the finding of the oyster *Saccostrea glomerata* from a boat-hull in France, representing a new record for the Western Mediterranean, and of the bryozoan *Parasmittina egyptica* from a boat-hull in Italy, representing the first Central Mediterranean record for this species. Overall, the 20 records presented in this study of NIS attached to boats but not yet recorded in the respective marina illustrates the potential of the biofouling vector in seeding a new area with propagules.

In synthesis, a pool of NIS is circulating among Mediterranean marinas, linked by a dense network of boat voyages ensuring their dissemination by a steady multiplication of the number of occasions. It is also of interest to point out that nearly all marinas have a rule prohibiting the in-water cleaning of vessels, but this rule is genuinely not enforced, and in-water cleaning was commonly witnessed within marinas during this study, likely facilitating the 'stepping stone' invasion process by dislodging and exacerbating the resettlement of NIS propagules.

Recently, *Ferrario et al. (2017)* showed that marinas can host as many NIS as larger commercial harbors. This massive contribution of new NIS records confirms their result

and reveals that Mediterranean marinas so far have been inadequately explored for NIS, despite the Mediterranean Sea being both the global hotspot for boating traffic, and for level of NIS invasions. We strongly recommend that major attention should soon be dedicated to recreational marinas as hotspots of introduction, and to pleasure boats as a vector of introduction and spreading. Management actions to combat NIS in the Mediterranean Sea need to also incorporate the recreational boating vector.

DEFINITIONS

Non-indigenous species An organism introduced outside its natural past or present distribution range by human agency, either directly or indirectly (*European Environment Agency, 2012*).

Polyvectic species May have been introduced by a certain combination of vectors and pathways (*Carlton & Ruiz, 2005*).

Pseudoindigenous species A species described as new to an area where it was in fact introduced by human action (*Carlton, 2009*).

ACKNOWLEDGEMENTS

We thank all the marina personnel for granting permission for this study; please see Supplementary Material for a detailed list of those who facilitated this study. We are also incredibly indebted to the boat owners/captains for their cooperation. For helping to obtain marina permissions we thank Giulio Franzitta, Paola Gianguzza and Stefanos Kalogirou. For collection of samples, we thank Alessandro Bolis, Gina Donnarumma, Ali Murat Elagoz, Andres Izquierdo-Muñoz, Alberto Orengo, Francesco Saracino, the late Arif Sipahi and Tevfik Yilmaz. For taxonomic advice, we would like to thank (in alphabetical order) Michel Bariche, Ferdinando Boero, Şermin Açik Çinar, Melih Ertan Çinar, Victoria Fernandez-Gonzalez, Bella S. Galil, Jean-Georges Harmelin, Valiallah Khalaji-Pirbalouty, Traudl Krapp-Schickel, Elena Kupriyanova, Gretchen Lambert, Carlos Navarro-Barranco, Gary Poore, Rosanna Rocha, Jean-Claude Sorbe, Yanan Sun and Kevin J. Tilbrook. We are also grateful to Francis Kerckhof and Giuseppe de Paolis for their help in obtaining copies of publications of difficult access.

Funding

This work was funded by a PhD Scholarship awarded to Aylin Ulman from the MARES-Erasmus Mundus Joint Doctoral Fellowship Program in Marine Ecosystem Health and Conservation. A COST Action #1209 grant was provided to Aylin Ulman to facilitate ascidian taxonomic identification in the University of Alicante, Spain. MARES is a Joint Doctorate programme selected under Erasmus Mundus coordinated by Ghent University (FPA 2011-0016). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Grant Disclosures

The following grant information was disclosed by the authors:

Aylin Ulman from the MARES-Erasmus Mundus Joint Doctoral Fellowship Program in Marine Ecosystem Health and Conservation.

Ghent University: FPA 2011-0016.

Competing Interests

The authors declare that there are no competing interests.

Author Contributions

- Aylin Ulman conceived and designed the experiments, performed the experiments, analyzed the data, contributed reagents/materials/analysis tools, wrote the paper, prepared figures and/or tables, reviewed drafts of the paper.
- Jasmine Ferrario performed the experiments, analyzed the data, contributed reagents/materials/analysis tools, wrote the paper, prepared figures and/or tables, reviewed drafts of the paper.
- Anna Occhpinti-Ambrogi conceived and designed the experiments, contributed reagents/materials/analysis tools, reviewed drafts of the paper.
- Christos Arvanitidis performed the experiments, analyzed the data, contributed reagents/materials/analysis tools, reviewed drafts of the paper.
- Ada Bandi performed the experiments, analyzed the data.
- Marco Bertolino analyzed the data, contributed reagents/materials/analysis tools, wrote the paper, prepared figures and/or tables, reviewed drafts of the paper.
- Cesare Bogi analyzed the data, contributed reagents/materials/analysis tools, wrote the paper, prepared figures and/or tables, reviewed drafts of the paper.
- Giorgos Chatzigeorgiou analyzed the data, contributed reagents/materials/analysis tools, reviewed drafts of the paper.
- Burak Ali Çiçek contributed reagents/materials/analysis tools, reviewed drafts of the paper, helped with logistics and permissions.
- Alan Deidun contributed reagents/materials/analysis tools, reviewed drafts of the paper, helped with logistics and permissions.
- Alfonso Ramos-Esplà analyzed the data, contributed reagents/materials/analysis tools, wrote the paper, reviewed drafts of the paper.
- Cengiz Koçak analyzed the data, contributed reagents/materials/analysis tools, wrote the paper, prepared figures and/or tables, reviewed drafts of the paper.
- Maurizio Lorenti analyzed the data, contributed reagents/materials/analysis tools, wrote the paper, reviewed drafts of the paper.
- Gemma Martinez-Laiz performed the experiments, analyzed the data, prepared figures and/or tables, reviewed drafts of the paper.
- Guenda Merlo performed the experiments, analyzed the data.
- Elisa Princisgh performed the experiments, analyzed the data.
- Giovanni Scribano performed the experiments, analyzed the data, prepared figures and/or tables.

- Agnese Marchini conceived and designed the experiments, performed the experiments, analyzed the data, contributed reagents/materials/analysis tools, wrote the paper, prepared figures and/or tables, reviewed drafts of the paper.

Field Study Permissions

The following information was supplied relating to field study approvals (i.e., approving body and any reference numbers):

The following people (including their position) authorised the field sampling permissions for this study:

Spain

Marina de Alicante: Seaman chief—Marìn

One Ocean Port Vell Barcelona: Communications Officer—Regina Sorreno

France

Cap d'Agde: Marina Director—Pierre Weiss

La Grand-Motte: Marina Director—Eric Pallier

Port Camargue: Marina Director—Michele Cavalais

Saint-Tropez: Marina Director—Jean-Francois Tourret

Marines du Cogolin: Marina Director—Claude Robert

Saint-Maxime: Marina Manager—Mr. Ellul

Cannes Le Vieux Port: Marina Director—Francois Gillet

Antibes Port Vauban: Marina manager—Emilie Pluenet

Villefranche-sur-Mer: Chef d'Exploitation—Sarah Castanie

Italy

Porto Turistico di Roma/Lido di Ostia: Marina Manager—Daniele Cossu

Ischia Marina di Sant'Angelo: Giulio Lauro; Porto d'Ischia: Mr. Di Maio

Sorrento Marina Piccola: Italian Coast Guard/Sorrento Location

Marina Villa Igiea Palermo: Marina Owner—Gioacchino Guccione

Porto La Cala Palermo: Marina Manager—Nicola Rossa

Porto Grande Siracusa: The Italian Coast Guard/Siracusa granted verbal permission.

Marina di Marzamemi: Marina Director—Salvatore Gurrieri

Marina di Ragusa: Marina Manager—Enza Di Ramondo

Marina di Cale del Sole (Licata): Marina Manager—Maria Sitibondo

Porto dell'Etna/Marina di Riposto: Marina Manager—Emiliano Indelicato

Malta

Msida Yacht Marina: Marina Director—George Mercieca

Grand Harbour Marina Valletta: Marina Director—Gordon Vassolo

Greece

Old Venetian Harbour (Heraklion): Marina Director—Dr. Bras Ioannis

Agios Nikolaos Marina: Marina Manager—Mikhalis Farsaris and Marina Director—Garefallakis Michalis.

Rhodes Mandraki Port: Chief of the Port Police—Mr Moustakopoulos Ioannis

Turkey

Istanbul Atakoy Marina: Marina Manager—Asli Ebru Erkoc

Istanbul Setur Kalamiş Marina: Marina Manager—Kerem Cesmebasi

Milta Bodrum Marina: Marina Communications Director—Ayşe Mine Aykutluğ

Setur Marmaris Netsel Marina: Marina Director—Erkan Ozatag & Marina manager—Onur Kunduz

Datça Marina: Marina Manager—Ali Gök

Ece Fethiye Marina: Marina communications officer—Mrs. Yelena

Setur Finike Marina: Marina Manager—Zia Dal

Cyprus

Karpaz Gate Marina: Marina Director—Deniz Akaltan

Famagusta Port: The Turkish Coast Guard granted verbal permission with Erol Adelier's and Burak Çiçek's assistance.

Data Availability

The data that this output produced is all detailed in Tables 2, 3 and 5, with details of each species in the Results.

Supplemental Information

Supplemental information for this article can be found online at http://dx.doi.org/10.7717/peerj.3954#supplemental-information.

REFERENCES

Abdul Jaffar A, Sivakumar V, Tamilselvi M. 2009. Distribution of alien and cryptogenic ascidians along the Southern Coasts of Indian Peninsula. *World Journal of Fish and Marine Science* **1**:305–312.

Acosta H, Forrest B. 2009. The spread of marine non-indigenous species via recreational boating: a conceptual model for risk assessment based on fault tree analysis. *Ecological Modelling* **220(13–14)**:1586–1598 DOI 10.1016/j.ecolmodel.2009.03.026.

Ahyong ST, Wilkens SL. 2011. Aliens in the Antipodes: non-indigenous marine crustaceans of New Zealand and Australia. In: Galil BS, ed. *In the Wrong Place–Alien Marine Crustaceans: Distribution, Biology and Impacts. Invading Nature, Springer Series in Invasion Ecology*. Vol. 6. Netherlands: Springer, 451–485.

Albayrak S. 2011. Alien marine bivalve species reported from Turkish seas. *Cahiers de Biologie Marine* **52**:107–118.

Amat JN, Tempera F. 2009. *Zoobotryon verticillatum* Delle Chiaje, 1822 (Bryozoa), a new occurrence in the archipelago of the Azores (North-eastern Atlantic). *Marine Pollution Bulletin* **58(5)**:761–764 DOI 10.1016/j.marpolbul.2009.02.019.

Antoniadou C, Gerovasileiou V, Bailly N. 2016. Ascidiacea (Chordata: Tunicata) of Greece: an updated checklist. *Biodiversity Data Journal* **4**:e9273.

Apel M. 2001. Taxonomie und Zoogeographie der Brachyura, Paguridea und Porcellanidae (Crustacea: Decapoda) des Persisch-Arabischen Golfes. PhD thesis, Frankfurt, Germany: Johann Wolfgang Goethe Universität, 68.

Apel M, Spiridinov VA. 1998. Taxonomy and zoogeography of the portunid crabs (Crustacea: Decapoda: Brachyura: Portunidae) of the Arabian Gulf and the adjacent waters. *Fauna of Arabia* **17**:159–331.

Arenas F, Bishop JDD, Carlton JT, Dyrynda PJ, Farnham WF, Gonzalez DJ, Jacobs MW, Lambert C, Lambert G, Nielsen SE, Pederson JA, Porter JS, Ward S, Wood CA. 2006. Alien species and other notable records from a rapid assessment survey of marinas on the south coast of England. *Journal of the Marine Biological Association of the United Kingdom* **86(6)**:1329–1337 DOI 10.1017/s0025315406014354.

Ariyama H. 2004. Nine species of the genus Aoroides (Crustacea: Amphipoda: Aoridae) from Osaka Bay, Central Japan. *Publications of the Seto Marine Biological Laboratory* **40(1–2)**:1–66 DOI 10.5134/176318.

Ashton G, Boos K, Shucksmith R, Cook E. 2006. Rapid assessment of the distribution of marine non-native species in marinas in Scotland. *Aquatic Invasions* **1(4)**:209–213 DOI 10.3391/ai.2006.1.4.3.

Ashton G, Davidson I, Ruiz G. 2014. Transient small boats as a long-distance coastal vector for dispersal of biofouling organisms. *Estuaries and Coasts* **37(6)**:1572–1581 DOI 10.1007/s12237-014-9782-9.

Atta M. 1991. The occurrence of *Paradella dianae* (Menzies, 1962) (Isopoda, Flabellifera, Sphaeromatidae) in Mediterranean waters of Alexandria. *Crustaceana* **60(2)**:213–218 DOI 10.1163/156854091x00416.

Azman B, Othman B. 2013. Shallow water marine gammaridean amphipods of Pulau Tioman, Malaysia, with the description of a new species. *Zookeys* **335**:1–31 DOI 10.3897/zookeys.335.5567.

Banta WC. 1969. The recent introduction of *Watersipora arcuata* Banta (Bryozoa, Cheilostomata). *Bulletin of the Southern California Academy of Science* **68**:248–251.

Barash A, Danin Z. 1971. Mollusca from the stomach of *Sparus auratus* fished in the lagoon of Bardawil. *Argamon* **2**:97–104.

Barash A, Danin Z. 1972. The Indo-Pacific species of Mollusca in the Mediterranean and notes on a collection from the Suez Canal. *Israeli Journal of Zoology* **21**:301–374.

Barros R, Rocha R, Pie M. 2009. Human-mediated global dispersal of *Styela plicata* (Tunicata, Ascidiacea). *Aquatic Invasions* **4(1)**:45–57 DOI 10.3391/ai.2009.4.1.4.

Bastida-Zavala JR. 2008. Serpulids (Annelida: Polychaeta) from the Eastern Pacific, including a short mention of Hawaiian serpulids. *Zootaxa* **1722**:1–61.

Bastida-Zavala JR, ten Hove HA. 2002. Revision of *Hydroides* Gunnerus, 1768 (Polychaeta: Serpulidae) from the western Atlantic region. *Beaufortia* **52**:103–178.

Bastida-Zavala JR, ten Hove HA. 2003. Revision of *Hydroides* Gunnerus, 1768 (Polychaeta: Serpulidae) from the eastern Pacific region and Hawaii. *Beaufortia* **53**:67–110.

Bellan-Santini D, Karaman G, Ledoyer M, Myers A, Ruffo S, Vader W. 1998. *The Amphipoda of the Mediterranean. Part 4: Localities and Map,* Mémoires de l'Institut océanographique. Monaco: Institut Océanographique.

Ben Souissi J, Ben Salem M, Zaouali J. 2006. *Tricellaria inopinata* (Bryozoa, Cheilostome), recolte pour la premiere fois en Tunisie (Lagune sud de Tunis: Tunisie septentrionale) [Tricellaria inopinata (Bryozoa, Cheilostome), harvest for the first time in Tunisia (Southern Lagoon of Tunis: northern Tunisia)]. In: *Actes de la 8'eme Conference Internationale des Limnologues d'Expression Francaise 17–21 Mars 2006*, Vol. Abstract, Hammamet, (Tunisie), 1.

Ben Souissi J, Trigui EMN, Mahjoub M, Mejri H, Quignard J, Capapé C, Zaouali J. 2005. On the recent occurrences of marine exotic species in the Tunisian waters. In: *Proceedings of the Seventh*

International Conference on the Mediterranean Coastal Environment, MEDCOAST05, 25–29, Kusadasi: Turkey, 529–540.

Ben-Eliahu M. 1991. Red Sea serpulids (Polychaeta) in the eastern Mediterranean. In: Petersen ME, Kirkegaard JB, eds. *Proceedings of 2nd International Polychaeta Conference, Copenhagen, 1986 Systematics, Biology and Morphology of World Polychaeta*, Ophelia Supplement. Copenhagen: Ophelia Publications, 515–528.

Ben-Eliahu M, ten Hove H. 1992. Serpulids (Annelida: Polychaeta) along the Mediterranean coast of Israel-New population build-ups of Lessepsian migrants. *Israel Journal of Zoology* **38**:35–53.

Ben-Eliahu M, ten Hove H. 2011. Serpulidae (Annelida: Polychaeta) from the Suez Canal—from a Lessepsian migration perspective. *Zootaxa* **2848**:1–147.

Bertolino M, Longo C, Marra MV, Correiro G, Pansini M. 2014. *Paraleucilla magna* Klatau et al., 2004 (Porifera, Calcarea), an alien species extending its range in the Mediterranean Sea. *Biologia Marina Mediterranea* **21**:109–110.

Bitar G, Kouli-Bitar S. 2001. Nouvelles données sur la faune et la flore benthiques de la cote Libanaise. Migration Lessepsienne [New data on benthic fauna and flora on the coast Lebanese. Lessepsian migration]. *Thalassia Salentina* **25**:71–74.

Bitar G, Ocana O, Ramos-Esplá AA. 2007. Contribution of the Red Sea alien species to structuring some benthic biocenosis in the Lebanon coast (Eastern Mediterranean). *Rapports de la Commission International pour l'Exploration de la Mer Méditerranée* **38**:437.

Bonnet N, Rocha R. 2011. The Ascidiidae (Ascidiacea: Tunicata) of Coastal Brazil. *Zoological Studies* **50**:809–825.

Bouchemousse S, Bishop J, Viard F. 2016. Contrasting global genetic patterns in two biologically similar, widespread and invasive Ciona species (Tunicata, Ascidiacea). *Scientific Reports* **6(1)**:24875 DOI 10.1038/srep24875.

Boudouresque CF, Klein J, Ruitton S, Verlaque M. 2011. Biological invasion: the Thau Lagoon, a Japanese biological island in the Mediterranean Sea. In: Ceccaldi H-J, Dekeyser I, Girault M, Stora G, eds. *Global Change: Mankind-Marine Environment Interactions.* Netherlands: Springer, 151–156.

Brancato A, Reitano A. 2009. Segnalazione di *Fulvia fragilis* (Forskål, 1775) e *Musculista senhousia* (Benson In Cantor, 1842) nelle acque del Porto Grande di Siracusa (Sicilia sud-orientale) (Mollusca Bivalvia) [Reporting of Fulvia fragilis (Forska°l, 1775) and musculus senhousia (Benson In Cantor, 1842) in the waters of the Great Harbor of Syracuse (south-eastern Sicily) (Mollusca Bivalvia)]. Il. *Naturalista Siciliano* **IV**:207–212.

Branch GM, Griffiths CL, Branch M, Beckley L. 2002. *Two Oceans: A Guide to the Marine Life of South Africa.* Johannesburg: Struik Publishers.

Cachia C, Mifsud C. 2017. A third *Chama* species in Maltese waters. *Triton* **35**:5–6.

Calder D, Choong H, Carlton J, Chapman J, Miller J, Geller J. 2014. Hydroids (Cnidaria: Hydrozoa) from Japanese tsunami marine debris washing ashore in the northwestern United States. *Aquatic Invasions* **9(4)**:225–240 DOI 10.3391/ai.2014.9.4.02.

Campani E, Coppini M, Cuneo F, Margelli A. 2004. Bivalvi "alieni" nelle acque del porto di Livorno: *Theora (Endopleura) lubrica* Gould, 1861 e *Musculista senhousia* (Benson in Cantor, 1842) [Bivalve "alien" in the waters of the port of Livorno: Theora (Endopleura) lubrication Gould, 1861 and musculus senhousia (Benson in Cantor, 1842)]. *Atti della Società Toscana di Scienze Naturali Memorie Serie B* **111**:1–5.

Canning-Clode J, Souto J, McCann L. 2013. First record of *Celleporaria brunnea* (Bryozoa: Lepraliellidae) in Portugal and in the East Atlantic. *Marine Biodiversity Records* **6**:1–5.

Cappato A. 2011. *Cruises and Recreational Boating in the Mediterranean.* Sophia Antipolis: Plan Bleu/UNEP MAP Regional Activity Centre.

Carlton JT. 1989. Man's role in changing the face of the ocean: biological invasions and implications for conservation of near-shore environments. *Conservation Biology* **3(3)**:265–273 DOI 10.1111/j.1523-1739.1989.tb00086.x.

Carlton JT. 1996. Biological invasions and cryptogenic species. *Ecology* **77(6)**:1653–1655 DOI 10.2307/2265767.

Carlton JT. 2009. Deep invasion ecology and the assembly of communities in historical time. In: Rilov G, Crooks JA, eds. *Biological Invasions in Marine Ecosystems.* Berlin Heidelberg: Springer-Verlag, 13–56.

Carlton JT, Iverson EW. 1981. Biogeography and natural history of *Sphaeroma walkeri* Stebbing (Crustacea: Isopoda) and its introduction to San Diego Bay, California. *Journal of Natural History* **15**:31–48.

Carlton JT, Ruiz G. 2005. Vector science and integrated vector management in bioinvasion ecology: conceptual frameworks. In: Mooney HA, ed. *Invasive Alien Species: A New Synthesis SCOPE 63.* Washington, D.C.: Island Press, 36–58.

Carman MR, Bullard SG, Rocha RM, Lambert G, Dijkstra JA, Roper JJ, Goodwin A, Carman MM, Vail EM. 2011. Ascidians at the Pacific and Atlantic entrances to the Panama Canal. *Aquatic Invasions* **6(4)**:371–380 DOI 10.3391/ai.2011.6.4.02.

Castelló J. 2017. New and little-known species of isopods (Crustacea, Isopoda) from the eastern Mediterranean. *Zootaxa* **4311(2)**:151–182 DOI 10.11646/zootaxa.4311.2.2.

Castelló J, Carballo J. 2001. Isopod fauna, excluding Epicaridea, from the Strait of Gibraltar and nearby areas (Southern Iberian Peninsula). *Scientia Marina* **65(3)**:221–241 DOI 10.3989/scimar.2001.65n3221.

Cavalcanti FF, Skinner LF, Klautau M. 2013. Population dynamics of cryptogenic calcarean sponges (Porifera, Calcarea) in Southeastern Brazil. *Marine Ecology* **34**:280–288 DOI 10.1111/maec.12013.

Cesari P, Pellizzato M. 1985. Molluschi pervenuti in Laguna di Venezia per apporti volontari o casuali. Acclimazione di *Saccostrea commercialis* (Iredale and Roughley, 1933) e di *Tapes philippinarum* (Adams and Reeve, 1850) [Molluscs recorded in Venice Lagoon as a result of deliberate or accidental introductions. Acclimatisation of Saccostrea commercialis (Iredale and Roughley, 1933) and of Tapes philippinarum (Adams and Reeve, 1850)]. *Bollettino Malacologico* **21**:237–274.

Çevik C, Öztürk B, Buzzuro G. 2001. The presence of *Crassostrea virginica* (Gmelin, 1791) and *Saccostrea commercialis* (Iredale and Roughley, 1933) in the Eastern Mediterranean Sea. *La Conchiglia* **298**:25–28.

Çeviker D. 2001. Recent immigrant bivalves in the Northeastern Mediterranean off Iskenderun. *La Conchiglia* **298**:39–46.

Chapman JW, Carlton JT. 1991. A test of criteria for introduced species: the global invasion by the isopod *Synidotea laevidorsalis* (Miers, 1881). *Journal of Crustacean Biology* **11(3)**:386–400 DOI 10.2307/1548465.

Child C. 1992. *Shallow-water Pycnogonida of the Gulf of Mexico. Part 1. Memoirs of the Hourglass Cruises.* Vol. IX. St. Petersburg: Marine Research Institute, 86.

Child CA. 2004. Some Pycnogonida from the western Caribbean with descriptions of three new species. *Bulletin of Marine Science* **74**:143–161.

Çinar M. 2006. Serpulid species (Polychaeta: Serpulidae) from the Levantine coast of Turkey (eastern Mediterranean), with special emphasis on alien species. *Aquatic Invasions* **1(4)**:223–240 DOI 10.3391/ai.2006.1.4.6.

Çinar M, Bilecenoglu M, Öztürk B, Can A. 2006. New record of alien species on the Levantine coast of Turkey. *Aquatic Invasions* **1(2)**:84–90 DOI 10.3391/ai.2006.1.2.6.

Claparède É. 1870. Les annélides chétopodes du Golfe de Naples [The chetopod annelids of the Gulf of Naples]. In: *Supplément Mémoires de la Société de physique et d'histoire naturelle de Genève*. Vol. 20. Genève, 365–542.

Clark PF. 1986. *North-east Atlantic Crabs: An Atlas of Distribution.* Rosson-Wye: Marine Conservation Society, 252.

Clarke-Murray C, Pakhamov EA, Therriault TW. 2011. Recreational boating: a large unregulated vector transporting marine invasive species. *Diversity and Distributions* **17(6)**:1161–1172 DOI 10.1111/j.1472-4642.2011.00798.x.

Cohen AN. 2005. Guide to the exotic species of San Francisco Bay. Oakland: San Francisco Estuary Institute. *Available at* http://www.exoticsguide.org (accessed 16 January 2017).

Cohen AN, Carlton JT. 1995. *Biological Study. Non Indigenous Aquatic Species in a United States Estuary: A Case Study of the Biological Invasions of the San Francisco Bay and Delta.* Washington, D.C.: US Fish and Wildlife Service, 11.

Coles S, DeFelice R, Eldredge L. 1999. Non-indigenous marine species introductions in the harbour of the south and west shores of Oahu, Hawaii. In: *Bernice Pauahi Bishop Museum Technical Report.* Vol. 15. Honolulu, Hawaii: Hawaii State Museum of Natural and Cultural History, 212.

Cook EJ, Stehlíková J, Beveridge C, Burrows M, De Blauwe H, Faasse M. 2013. Distribution of the invasive bryozoan *Tricellaria inopinata* in Scotland and a review of its European expansion. *Aquatic Invasions* **8(3)**:281–288 DOI 10.3391/ai.2013.8.3.04.

Corsini-Foka M, Pancucci-Papadoulou MA, Kondilatos G, Kalogirou S. 2010. *Gonioinfradens paucidentatus* (A. Milne Edwards, 1861) (Crustacea, Decapoda, Portunidae): a new alien crab in the Mediterranean Sea. *Mediterranean Marine Science* **11(2)**:331–340 DOI 10.12681/mms.80.

Corsini-Foka M, Zenetos A, Crocetta F, Çinar ME, Koçak F, Golani D, Katsanevakis S, Tsiamis K, Cook E, Froglia C, Triandaphyllou M, Lakkis S, Kondylatos G, Tricarico E, Zuljevic A, Almeida M, Cardigos F, Caglar S, Durucan F, Fernandes A, Ferrario J, Haberle I, Louizidou P, Makris J, Maric M, Mici D, Mifsud C, Nall C, Kytonou E, Poursanidis D, Spigoli D, Stasolla G, Yapici S, Roy HE. 2015. Inventory of alien and cryptogenic species of the Dodecanese (Aegean Sea, Greece): collaboration through COST action training school. *Management of Biological Invasions* **6(4)**:351–366 DOI 10.3391/mbi.2015.6.4.04.

Crocetta F, Agius D, Balistreri P, Bariche M, Bayhan YK, 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.

Crosnier A. 1962. Crustacés Décapodes Portunidae. *Faune de Madagascar* **16**:1–154.

Cvitković I, Despalatović M, Grubelić I, Nikolić V, Pleše B, Žuljecić A. 2013. Occurrence of *Paraleucilla magna* (Porifera: Calcarea) in the Eastern Adriatic Sea. *Acta Adriatica* **54**:93–99.

Çinar ME. 2014. Checklist of the phyla Platyhelminthes, Xenacoelomorpha, Nematoda, Acanthocephala, Myxozoa, Tardigrada, Cephalorhyncha, Nemertea, Echiura, Brachiopoda,

Phoronida, Chaetognatha, and Chordata (Tunicata, Cephalochordata, and Hemichordata) from the coasts of Turkey. *Turkish Journal of Zoology* **38**:698–722 DOI 10.3906/zoo-1405-70.

Darwin C. 1854. *A Monograph of the Sub-Class Cirripedia.* London: Royal Society, 770.

Davie PJF. 1998. New records of crabs in Hawaii (Crustacea: Decapoda: Brachyura). In: Evenhuis NL, Miller S, eds. *Records of the Hawaii Biological Survey for 1997—Part 2: Notes.* Vol. 56. Honolulu: Bishop Museum Occasional Papers, 63–64.

De Blauwe H, Faasse M. 2001. Extension of the range of the bryozoans *Tricellaria inopinata* and *Bugula simplex* in the North-East Atlantic Ocean (Bryozoa: Cheilostomatida). *Nederlandse Faunistische Mededelingen* **141**:112.

Delle Chiaje S. 1822. Memorie sulla storia e notomia degli animali senza vertebre del Regno di Napoli [On the history and anatomy of animals without vertebra in the Kingdom of Naples]. *Stamperia de 'Fratelli Fernandes'.* Naples: Stamperia de 'Fratelli Fernandes', 232.

Despalatović M, Cukrov M, Cvitković I, Cukrov N, Žuljević A. 2013. Occurrence of non-indigenous invasive bivalve *Arcuatula senhousia* in aggregations of non-indigenous invasive polychaete *Ficopomatus enigmaticus* in Neretva River Delta on the Eastern Adriatic coast. *Acta Adriatica* **54**:213–220.

D'Hondt JL, Occhipinti-Ambrogi A. 1985. Tricellaria inopinata, n. sp., un nouveau Bryozoaire Cheilostome de la faune Méditerranéenne. *Marine Ecology* **6(1)**:35–46 DOI 10.1111/j.1439-0485.1985.tb00319.x.

Díaz Díaz O, Liñero-Arana L. 2001. Poliquetos asociados a substratos artificiales sumergidos en la costa nororiental de Venezuela. II: Serpulidae y Spirorbidae [Polychaeta associated with artificial substrates submerged in the northeastern coast of Venezuela. II: Serpulidae and Spirorbidae]. *Boletín del Instituto Oceanográfico de Venezuela, Universidad de Oriente* **40**:9–20.

Dobretsov S. 2015. Biofouling on artificial substrata in Muscat waters. *Journal of Agricultural and Marine Science* **20**:24–29.

Dumont HJ, Werger MGA. 1989. *The Legacy of Tethys: An Aquatic Biogeography of the Levant.* Dordrecht, Netherlands: Kluwer Academic Publishers.

Dunstan PK, Johnson CR. 2004. Invasion rates increase with species richness in a marine epibenthic community by two mechanisms. *Oecologia* **138(2)**:285–292 DOI 10.1007/s00442-003-1400-7.

Dyrynda PEJ, Fairall VR, Occhipinti Ambrogi A, d'Hondt JL. 2000. The distribution, origins and taxonomy of *Tricellaria inopinata* d'Hondt and Occhipinti Ambrogi, 1985, an invasive bryozoan new to the Atlantic. *Journal of Natural History* **34(10)**:1993–2006 DOI 10.1080/00222930050144828.

European Environment Agency. 2012. The impacts of invasive alien species in Europe. Technical Report 16. Publications Office of the European Union. Luxembourg: EEA, 114.

Fernández-González V, Sánchez-Jerez P. 2017. Fouling assemblages associated with off-coast aquaculture facilities: an overall assessment of the Mediterranean Sea. *Mediterranean Marine Science* **18(1)**:87–96 DOI 10.12681/mms.1806.

Ferrario J, d'Hondt JL, Marchini A, Occhipinti-Ambrogi A. 2015. From the Pacific Ocean to the Mediterranean Sea: *Watersipora arcuata*, a new non-indigenous bryozoan in Europe. *Marine Biology Research* **11(9)**:909–919 DOI 10.1080/17451000.2015.1041531.

Ferrario J, Marchini A, Caronni S, Occhipinti-Ambrogi A. 2017. Role of commercial harbours and recreational marinas for the spread of fouling non-indigenous species. *Biofouling* **33(8)**:651–660 DOI 10.1080/08927014.2017.1351958.

Ferrario J, Marchini A, Lodola A. 2014. The pseudoindigenous bryozoan *Zoobotryon verticillatum* along the Mediterranean and Atlantic European coasts. *Biologia Marina Mediterranea* **21**:117–118.

Ferrario J, Ulman A, Marchini A, Saracino F, Occhipinti-Ambrogi A. 2016. Non-indigenous fouling species in the marina of Rome. *Biologia Marina Mediterranea* **23**:224–225.

Fiege D, Sun R. 1999. Polychaeta from Hainan Island, South China Sea. Part I: Serpulidae (Annelida, Polychaeta, Serpulidae). *Senckenbergiana Biologica* **79**:109–141.

Floerl O, Inglis GJ, Dey K, Smith A. 2009. The importance of transport hubs in stepping-stone invasions. *Journal of Applied Ecology* **46(1)**:37–45 DOI 10.1111/j.1365-2664.2008.01540.x.

Forniz C, Maggiore F. 1985. New records of Sphaeromatidae from the Mediterranean Sea (Crstacea, Isopoda). *Oebalia* **9**:779–783.

Forniz C, Sconfietti R. 1983. Ritrovamento di *Paracerceis sculpta* (Holmes, 1904) (Isopoda, Flabellifera, Sphaeromatidae) nella Laguna di Venezia [Finding Paracerceis sculpta (Holmes, 1904) (Isopoda, Flabellifera, Sphaeromatidae) in the Lagoon of Venice]. *Bolletino del Museo Civico di storia naturale di Venezia* **34**:197–203.

Foster BA, Willan RC. 1979. Foreign barnacles transported to New Zealand on an oil platform, New Zealand. *Journal of Marine and Freshwater Research* **13(1)**:143–149 DOI 10.1080/00288330.1979.9515788.

Froglia C, Speranza S. 1993. First record of *Dyspanopeus sayi* (Smith 1869) in the Mediterranean Sea (Crustacea: Decapoda: Xanthidae). *Quaderni Istituto Ricerca Pesca Marittima* **5**:163–166.

Furman E. 1989. Enzyme genetic variation in *Balanus improvisus* Darwin (Crustacea, Cirripedia) in the Baltic Sea. *Ophelia* **30(1)**:35–45 DOI 10.1080/00785326.1989.10430834.

Galil BS, Gevili R. 2014. *Zoobotryon verticillatum* (Bryozoa: Ctenostomatida: Vesiculariidae), a new occurrence on the Mediterranean coast of Israel. *Marine Biodiversity Records* **7**:e17 DOI 10.1017/s1755267214000086.

Galil B, Marchini A, Occhipinti-Ambrogi A. East is east and West is west? Management of marine bioinvasions in the Mediterranean Sea. *Estuarine and Coastal Marine Science* (in press) DOI 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(2)**:141–152.

Galil BS, Occhipinti-Ambrogi A, Gollasch S. 2008. Biodiversity impacts of species introductions via marine vessels. In: Abdulla A, Linden O, eds. *Maritime Traffic Effects on Biodiversity in the Mediterranean Sea: Review of İmpacts, Priority Areas and Mitigation Measures.* Malaga, Spain: IUCN Centre for Mediterranean Cooperation, 118–150.

Gerovasileiou V, Ehkh EH, Akyol O, Alongi G, Azevedo F, Babali N, Bakiu R, Bariche M, Bennoui A, Castriota L, Chintiroglou CC, Crocetta F, Deidun A, Galinou-Mitsoudi S, Giovos I, Gökoğlu M, Golemaj A, Hadjioannou L, Hartingerova J, Insacco G, Katsanevakis S, Kleitou P, Korun J, Lipej L, Malegue M, Michailidis N, Mouzai Tifoura A, Ovalis P, Petović S, Piraino S, Rizkalla SI, Rousou M, Savva I, Şen H, Spinelli A, Vougioukalou KG, Xharahi E, Zava B, Zenetos A. 2017. New Mediterranean Biodiversity Records (July, 2017). *Mediterranean Marine Science* **18**:355–384.

Gewing M-T, Bronstein O, Nagar L, Granot I, Frid O, Shenkar N. 2016. First record of the non-indigenous ascidian *Microcosmus exasperatus*, Heller 1878, in Cyprus. *Marine Biodiversity* **46(4)**:937–941 DOI 10.1007/s12526-015-0442-5.

Ghobashy AFA. 1976. Seasonal variation and settlement behavior of the principal fouling organisms in the Eastern harbour of Alexandria. In: *Proceedings of the 4th International Congress on Marine Corrosion & Fouling*, Antibes: Juan-Les-Pins, 213–220.

Gittings SR. 1985. Notes on barnacles (Cirripedia: Thoracica) from the Gulf of Mexico. *Gulf Research Reports* **8**:35–41.

Gofas S. 2011. Familias Siphonariidae y Trimusculidae [Families Siphonariidae and Trimusculidae]. In: Gofas S, Moreno D, Salas C, eds. *Moluscos marinos de Andalucía Volumen II.* Malaga: Servicio de Publicaciones e Intercambio Científico, Universidad de Malaga, 534–535.

Gofas S, Zenetos A. 2003. Exotic molluscs in the Mediterranean Basin: current status and perspectives. *Oceanography and Marine Biology: Annual Review* **41**:237–277.

Gomoiu MT, Alexandrov B, Shadrin N, Zaitsev Y. 2002. The Black Sea—a recipient, donor and transit area for alien species. In: Leppäkoski E, Gollasch S, Olenin S, eds. *Invasive Aquatic Species of Europe Distribution, Impacts and Management.* Dordrecht, Netherlands: Kluwer Academic Publishers, 341–350.

Gouillieux B, Lavesque N, Leclerc JC, Le Garrec V, Bachelet G. 2016. Three nonindigenous species of Aoroides (Crustacea: Amphipoda: Aoridae) from the French Atlantic coast. *Journal of the Marine Biological Association of the United Kingdom* **96**:1651–1659.

Guardiola M, Frotscher J, Uriz MJ. 2012. Genetic structure and differentiation at a short-time scale of the introduced calcarean sponge *Paraleucilla magna* to the western Mediterranean. *Hydrobiologia* **687(1)**:71–84 DOI 10.1007/s10750-011-0948-1.

Guardiola M, Frotscher J, Uriz MJ. 2016. High genetic diversity, phenotypic plasticity, and invasive potential of a recently introduced calcareous sponge, fast spreading across the Atlanto-Mediterranean basin. *Marine Biology* **163(5)**:123 DOI 10.1007/s00227-016-2862-6.

Harant H, Vernières P. 1933. *Fascicule 1: Ascidies. Faune de Francesuniciers [Issue 1: Ascidians. Wildlife of Francesuniciers].* Vol. 27. Paris, France: Office Central de Faunistique, 101.

Harmelin JG. 2014. Alien bryozoans in the eastern Mediterranean Sea—new records from the coast of Lebanon. *Zootaxa* **3893(3)**:301–338 DOI 10.11646/zootaxa.3893.3.1.

Harmelin JG, Bitar G, Zibrowius H. 2009. Smittinidae (Bryozoa, Cheilostomata) from coastal habitats of Lebanon (Mediterranean Sea), including new and non-indigenous species. *Zoosystema* **31(1)**:163–187 DOI 10.5252/z2009n1a9.

Hartmeyer R. 1912. Die ascidien der Deutschen Tiefsee Expedition [The ascidia of the German Deep Sea Expedition]. *Deutschen Tiefsee-Expedition* **16**:225–392.

Hastings AB. 1927. Cambridge expedition to the Suez Canal, 1924. Pt. 20. Report on the Polyzoa. In: *Transactions of the Zoological Society of London.* Vol. 22, 331–353.

Hayes KR, Sliwa C. 2003. Identifying potential marine pests—a deductive approach applied to Australia. *Marine Pollution Bulletin* **46(1)**:91–98 DOI 10.1016/s0025-326x(02)00321-1.

Hayward P, Ryland JS. 1995. *Handbook of the Marine Fauna of North-West Europe.* New York: Oxford University Press, 800.

Hobbs NV, Lazo-Wasem E, Faasse M, Cordell J, Chapman JW, Smith C, Prezant R, Shell R, Carlton JT. 2015. Going global: the introduction of the Asian isopod *Ianiropsis serricaudis* Gurjanova (Crustacea: Peracarida) to North America and Europe. *Aquatic Invasions* **10(2)**:177–187 DOI 10.3391/ai.2015.10.2.06.

Hoenselaar HJ, Hoenselaar J. 1989. *Musculista senhousia* (Benson in Cantor, 1842) in the western Mediterranean (Bivalvia, Mytilidae). *Basteria* **53**:73–76.

Huber M. 2010. *Compendium of Bivalves. A Full-Color Guide to 3,300 of the World's Marine Bivalves. A Status on Bivalvia After 250 Years of Research.* Hackenheim: ConchBooks.

Igić L. 2007. Cirripedia of Adriatic. *Studia Marina* **24**:168.

Imajima M. 1982. Serpulinae (Polychaetous annelids) from the Palau and Yap islands, Micronesia. *Proceedings of the Japanese Society of Systematic Zoology* **23**:37–55.

Imajima M. 1987. Serpulidae (Annelida, Polychaeta) collected around Sesoko Island and Bise, Okinawa. *Galaxea* **6**:75–82.

Ingle RW. 1980. *British Crabs.* London: Oxford University Press, 222.

Iwasaki K. 2006. Human-mediated introduction of marine organisms in Japan: a review. In: Koike F, Clout MN, Kawamichi M, De Poorter M, Kunio Iwatsuki K, eds. *Assessment and control of biological invasion risks.* In: Kyoto and Gland: IUCN, Shoukadoh Book Sellers, 104–112.

Izquierdo-Muñoz A, Díaz-Valdés M, Ramos-Esplá A. 2009. Recent non-indigenous ascidians in the Mediterranean Sea. *Aquatic Invasions* **4(1)**:59–64 DOI 10.3391/ai.2009.4.1.5.

Jacobs BJM. 1987. *A Taxonomic Revision of the European, Mediterranean and NW. African Species Generally Placed in Sphaeroma Bosc, 1802 (Isopoda, Flabellifera, Sphaeromatidae).* Amsterdam, Netherlands: Rijks Museum van Natuurlijke Historie, 69.

Johnson CH, Winston JE, Woollacott RM. 2012. Western Atlantic introduction and persistence of the marine bryozoan *Tricellaria inopinata. Aquatic Invasions* **7(3)**:295–303 DOI 10.3391/ai.2012.7.3.001.

Just J. 2009. Ischyroceridae. Benthic Amphipoda (Crustacea: Peracarida) of the Great Barrier Reef, Australia. *Zootaxa* **2260**:463–486.

Kapiris K, Apostolidis C, Baldacconi R, Başusta N, Bilecenoglu M, Bitar G, Bobori DC, Boyaci YÖ, Dimitriadis C, Djurović M, Dulčić J, Durucan F, Gerovasileiou V, Gökoğlu M, Koutsoubas D, Lefkaditou E, Lipej L, Marković O, Mavrič B, Özvarol Y, Pesic V, Petriki O, Siapatis A, Sini M, Tibullo D, Tiralongo F. 2014. New Mediterranean biodiversity records (April, 2014). *Mediterranean Marine Science* **15(1)**:198–212 DOI 10.12681/mms.737.

Karachle PK, Angelidis A, Apostolopoulos G, Ayas D, Ballesteros M, Bonnici C, Brodersen MM, Castriota L, Chalari N, Cottalorda JM, Crocetta F, Deidun A, Dodo Z, Dogrammazi A, Dulčić J, Florentino F. 2016. New Mediterranean biodiversity records (2016). *Mediterranean Marine Science* **17**:230–252.

Karhan SÜ, Yokeş MB. 2012. An earlier record of the Indo-Pacific swimming crab, *Gonioinfradens paucidentatus* (A. Milne-Edwards, 1861) (Decapoda, Brachyura, Portunidae) off the Mediterranean coast of Turkey. *Crustaceana* **85**:117–121.

Katsanevakis S, Coll M, Piroddi C, Steenbeek J, Ben Rais Lasram F, Zenetos A, Cardoso AC. 2014. Invading the Mediterranean Sea: biodiversity patterns shaped by human activities. *Frontiers in Marine Science* **1**:11 DOI 10.3389/fmars.2014.00032.

Katsanevakis S, Deriu I, D'Amico F, Nunes AL, Pelaez Sanchez S, Crocetta F, Arianoutsou M, Bazos I, Christopoulou A, Curto G, Delipetrou P, Kokkoris Y, Panov V, Rabitsch W, Roques A, Scalera R, Shirley S, Tricarico E, Vannini A, Zenetos A, Zervou S, Zikos A, Cardoso C. 2015. European alien species information network (EASIN): supporting European policies and scientific research. *Management of Biological Invasions* **6(2)**:147–157 DOI 10.3391/mbi.2015.6.2.05.

Katsanevakis S, Poursanidis D, Issaris Y, Tsiamis K, Salomidi M, Maroulakis M, Kytinou E, Thessalou-Legaki M, Zenetos A. 2010. The invasive crab *Percnon gibbesi* (Crustacea: Decapoda: Plagusiidae) is spreading in the Aegean and Ionian Seas. *Marine Biodiversity Records* **3**:1–5 DOI 10.1017/s1755267210000163.

Katsanevakis S, Poursanidis D, Yokes MB, Macic V, Beqiraj S, Kashta L, Shaier YR, Zakhama-Sraieb R, Benamer I, Bitar G, Bouzaza Z, Magni P, Bianchi CN, Tsiakkiros L, Zenetos A. 2011. Twelve years after the first report of the crab *Percnon gibbesi* (H. Milne Edwards, 1853) in the Mediterranean: current distribution and invasion rates. *Journal of Biological Research* **16**:224–236.

Khalaji-Pirbalouty V, Raupach MJ. 2014. A new species of *Cymodoce* Leach, 1814 (Crustacea: Isopoda: Sphaeromatidae) based on morphological and molecular data, with a key to the Northern Indian Ocean species. *Zootaxa* **3826(1)**:230–254 DOI 10.11646/zootaxa.3826.1.7.

Kırkım F, Özcan T, Katağan T, Bakir K. 2010. First record of five free-living isopod species from the coast of Cyprus. *Acta Adriatica* **51**:101–105.

Koçak F. 2007. A new alien bryozoan *Celleporaria brunnea* (Hincks, 1884) in the Aegean Sea (eastern Mediterranean). *Scientia Marina* **71**:191–195.

Koçak F, Ergen Z, Çinar M. 1999. Fouling organisms and their developments in a polluted and an unpolluted marina in the Aegean Sea (Turkey). *Ophelia* **50(1)**:1–20 DOI 10.1080/00785326.1999.10409385.

Kocatas A. 1978. Izmir Körfezi kayalik sahillerinin bentik formlarüzerinde kalitatif ve kantitatif arafltrmala. [A quantitative and qualitative analysis of the benthic substrate in Izmir Bay]. *Ege University Faculty of Science Monograph Series* **12**:93.

Kondilatos G, Corsini-Foka M, Pancucci-Papadopoulou MA. 2010. Occurrence of the first non-indigenous ascidian *Phallusia nigra* Savigny, 1816 (Tunicata: Ascidiacea) in Greek waters. *Aquatic Invasions* **5(2)**:181–184 DOI 10.3391/ai.2010.5.2.08.

Kolosvary G. 1949. Ujbalanidak a hazai harmadkorból. *Földtani Közlöny* **79(1–4)**:1–8.

Kott P. 2004. Ascidiacea (Tunicata) in Australian waters of the Timor and Arafura. *Beagle, Records of the Museum and Art Galleries of the Northern Territory* **20**:37–81.

Koukouras A, Voultsiadou-Koukoura E, Kevrekidis T, Vafidis D. 1995. Ascidian fauna of the Aegean Sea with a check list of the eastern Mediterranean and Black Sea species. *Annales de l'Institut Océanographique* **71**:19–34.

Koukouras A, Matsa A. 1998. The thoracican cirriped fauna of the Aegean Sea: new information, check list of the Mediterranean species, faunal comparisons. *Marine Biodiversity* **28(4–6)**:133–142 DOI 10.1007/bf03043144.

Krapp-Schickel T. 2013. New or amended data on Mediterranean Amphipoda: genera Dexamine, Ericthonius and Stenothoe. *Zootaxa* **3613(2)**:125–145 DOI 10.11646/zootaxa.3613.2.2.

Kroeker K, Micheli F, Gambi M, Martz T. 2011. Divergent ecosystem responses within a benthic marine community to ocean acidification. *PNAS* **108**:14515–14520.

Lafargue F. 1975. Révision taxonomique des *Didemnidae* des côtes de France (Ascidie Composées). Description des espèces de Banyuls-sur-Mer. Genre *Lissoclinum* Genre *Diplosoma*. *Vie Milieu* **25**:289–309.

Lam K, Morton B. 2006. Morphological and mitochondrial-DNA analysis of the Indo-West Pacific rock oysters (Ostreidae: Saccostrea species). *Journal of Molluscan Studies* **72(3)**:235–245 DOI 10.1093/mollus/eyl002.

Lambert G. 2003. Marine biodiversity in Guam: the Ascidiacea. *Micronesica* **35–36**:584–593.

Lambert C, Lambert G. 2003. Persistence and differential distribution of nonindigenous ascidians in harbors of the Southern California Bight. *Marine Ecology Progress Series* **259**:145–161 DOI 10.3354/meps259145.

Lambert G. 2005. Ecology and natural history of the protochordates. *Canadian Journal of Zoology* **83(1)**:34–50 DOI 10.1139/z04-156.

Laubier L. 1966. Sur quelques Annélides Polychètes de la région de Beyrouth. *American University of Beirut Miscellaneous Papers in Natural Sciences* **5**:9–22.

Lavesque N, Sorbe JC, Bachelet G, Gouillieux B, de Montaudouin X, Bonifacio P. 2013. Blanchet H, Dubois S. 2013. Recent discovery of *Paranthura japonica* Richardson, 1909

(Crustacea: Isopoda: Paranthuridae) in European marine waters (Arcachon Bay, Bay of Biscay). *Bioinvasions Records* **2(3)**:215–219 DOI 10.3391/bir.2013.2.3.07.

Lazzari G, Rinaldi E. 1994. Alcune considerazioni sulla presenza di specie extra mediterranee nelle Lagune Salmasre di Ravenna. *Bolletino Malacologico* **30**:195–202.

Lezzi M, Pierri C, Cardone F. 2015. Presence of *Celleporaria brunnea* (Bryozoa: Lepraliellidae) in the Central Mediterranean: first occurrence in the Gulf of Taranto. *Marine Biodiversity Records* **8**:e137 DOI 10.1017/s1755267215001116.

Lodola A, Dos Santos TR, Paganelli D, Marchini A, Savini D, Occhipinti-Ambrogi A. 2012. Native and alien peracarids in Italian harbours (La Spezia, Olbia and Lampedusa) and neighbouring Marine Protected Areas (Cinque Terre, Tavolara Punta Coda Cavallo and Linosa island). In: Baistrocchi E, Zaccaroni M, eds. *73rd Congresso Nazionale dell'Unione Zoologica Italiana (UZI), Firenze, Book of Abstracts*. Florence: Firenze University Press, 154.

Lodola A, Ferrario J, Occhipinti-Ambrogi A. 2015. Further Mediterranean expansion of the non-indigenous bryozoan *Celleporaria brunnea*: multiple records along the Italian coasts. *Scientia Marina* **79(2)**:263–274 DOI 10.3989/scimar.04174.31a.

Lodola A, Savini D, Occhipinti-Ambrogi A. 2012. First record of *Tricellaria inopinata* (Bryozoa: Candidae) in the harbours of La Spezia and Olbia, Western Mediterranean Sea (Italy). *Marine Biodiversity Records* **5**:e41 DOI 10.1017/s1755267212000309.

Lohan KMP, Hill-Spanik KM, Torchin ME, Strong EE, Fleishcher RC, Ruiz GM. 2015. Molecular phylogenetics reveals first record and invasion of *Saccostrea* species in the Caribbean. *Marine Biology* **162(5)**:957–968 DOI 10.1007/s00227-015-2637-5.

Longo C, Liaci L, Manuel M, Correiro G. 2004. Note sui poriferi del Mar Grande e del Mar Piccolo do Taranto (Mar Ionio). *Biologia Marina Mediterranea* **11**:440–443.

Longo C, Mastrototaro F, Corriero G. 2007. Occurrence of *Paraleucilla magna* (Porifera: Calcarea) in the Mediterranean Sea. *Journal of the Marine Biological Association of the United Kingdom* **87(6)**:1749–1755 DOI 10.1017/s0025315407057748.

Longo C, Pontassuglia C, Corriero G, Gaino E. 2012. Life-cycle traits of *Paraleucilla magna*, a calcareous sponge invasive in a coastal Mediterranean Basin. *PLOS ONE* **7(8)**:e42392 DOI 10.1371/journal.pone.0042392.

López-Legentil S, Legentil ML, Erwin PM, Turon X. 2015. Harbor networks as introduction gateways: contrasting distribution patterns of native and introduced ascidians. *Biological Invasions* **17(6)**:1623–1638 DOI 10.1007/s10530-014-0821-z.

Lorenti M, Dappiano M, Gambi MC. 2009. Ocurrence and ecology of *Mesanthura* (Crustacea: Isopoda: Anthuridea) in two Italian harbours. *Marine Biodiversity Records* **2**:e48 DOI 10.1017/s1755267209000542.

Lorenti M, Keppel E, Petrocelli A, Sigovini M, Tagliapietra D. 2015. The non-indigenous *Paranthura japonica* Richardson, 1909 (Isopoda: Anthuroidea: Paranthuridae) from the Mar Piccolo lagoon, Taranto (Italy, Mediterranean Sea). *Environmental Science and Pollution Research* **23(13)**:12791–12796 DOI 10.1007/s11356-015-4994-5.

Maltagliati F, Lupi L, Castelli A, Pannacciulli FG. 2016. The genetic structure of the exotic ascidian *Styela plicata* (Tunicata) from Italian ports, with a re-appraisal of its worldwide genetic pattern. *Marine Ecology* **37(3)**:492–502 DOI 10.1111/maec.12261.

Mannino AM, Parasporo 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(2)**:469–480 DOI 10.1007/s12526-016-0496-z.

Marchini A, Cardeccia A. 2017. Alien amphipods in a sea of troubles: cryptogenic species, unresolved taxonomy and overlooked introductions. *Marine Biology* **164(4)**:164–169 DOI 10.1007/s00227-017-3093-1.

Marchini A, Costa AC, Ferrario J, Micael J. The global invader *Paracerceis sculpta* (Isopoda: Sphaeromatidae) has extended its range to the Azores Archipelago. *Marine Biodiversity* (in press) DOI 10.1007/s12526-017-0674-7.

Marchini A, Ferrario J, Minchin D. 2015. Marinas may act as hubs for the spread of the pseudo-indigenous bryozoan *Amathia verticillata* (Delle Chiaje, 1822) and its associates. *Scientia Marina* **79(3)**:355–365 DOI 10.3989/scimar.04238.03a.

Marchini A, Ferrario J, Occhipinti-Ambrogi A. 2016a. Confirming predictions: the invasive isopod *Ianiropsis serricaudis* Gurjanova, 1936 (Crustacea: Peracarida) is abundant in the Lagoon of Venice (Italy). *Acta Adriatica* **57**:331–335.

Marchini A, Ferrario J, Occhipinti-Ambrogi A. 2016b. The relative importance of aquaculture and shipping as vectors of introduction of marine alien species: the case of Olbia (Sardinia). *Rapport Commission Internationale Mer Méditeranee* **411**:430.

Marchini A, Galil BS, Occhipinti A. 2015. Recommendations on standardizing lists of marine alien species: lessons from the Mediterranean Sea. *Marine Pollution Bulletin* **101(1)**:267–273 DOI 10.1016/j.marpolbul.2015.09.054.

Marchini A, Sorbe JC, Torelli F, Lodola A, Occhipinti-Ambrogi A. 2014. The non-indigenous *Paranthura japonica* Richardson, 1909 in the Mediterranean Sea: travelling with shellfish? *Mediterranean Marine Science* **15(3)**:545–553 DOI 10.12681/mms.779.

Margelli A, Cuneo F, Coppini M, Campani E. 2004. Bivalvi esotici nel Porto di Livorno. *Notiziario SIM* **22**:13–24.

Marić M, Ferrario J, Marchini A, Occhipinti-Ambrogi A, Minchin D. 2016. Rapid assessment of marine non-indigenous species on mooring lines of leisure craft: new records in Croatia (eastern Adriatic Sea). *Marine Biodiversity* **47(3)**:949–956 DOI 10.1007/s12526-016-0541-y.

Marra MV, Bertolino M, Pansini M, Giacobbe S, Manconi R, Pronzato R. 2016. Long-term turnover of the sponge fauna in Faro Lake (North-East Sicily, Mediterranean Sea). *Italian Journal of Zoology* **83(4)**:579–588 DOI 10.1080/11250003.2016.1251981.

Mastrototaro F, Dappiano M. 2008. New record of the non-indigenous species *Microcosmus squamiger* (Ascidiacea: Stolidobranchia) in the harbour of Salerno (Tyrrhenian Sea, Italy). *Marine Biodiversity Records* **1**:e12 DOI 10.1017/s1755267205001247.

Mastrototaro F, Matarrese A, D'Onghia G. 2003. Occurrence of *Musculista senhousia* (Mollusca: Bivalvia) in the Taranto seas (eastern-central Mediterranean Sea). *Journal of the Marine Biological Association of the United Kingdom* **83(6)**:1279–1280 DOI 10.1017/s002531540300866x.

Mavrič B, Bonaca O, Bettoso M, Lipej L. 2010. Soft-bottom macrozoobenthos of the southern part of the Gulf of Trieste: faunistic, biocoenotic and ecological survey. *Acta Adriatica* **51**:203–216.

Meliane I. 2002. Contribution to the knowledge of the ascidian fauna in the south-east of Tunisia. MSc thesis, Spain: University of Alicante, 268.

Menon NR. 1972. Species of the genus *Parasmittina* (Bryozoa, Ascophora) from Indian waters. *Marine Biology* **14(1)**:72–84 DOI 10.1007/bf00365784.

Menzies RJ. 1962. The marine isopod fauna of Bahia de San Quintin, Baja California, Mexico. *Pacific Naturalist* **3(11)**:337–348.

Micu D, Niță V, Todorova V. 2010. First record of Say's mud crab *Dyspanopeus sayi* (Brachyura: Xanthoidea: Panopeidae) from the Black Sea. *Marine Biodiversity Records* **3**:1–6 DOI 10.1017/s1755267210000308.

Millar RH. 1965. Ascidians from the tropical coast of west Africa. *Atantic Reports* **8**:247–255.

Millar RH. 1969. Ascidians of European waters. In: *Catalogue of main marine fouling organisms.* Vol. 4. Paris: Organisation for Economic Co-Operation and Development, 1–34.

Milne R, Griffiths C. 2013. Additions to and revisions of the amphipod (Crustacea: Amphipoda) fauna of South Africa, with a list of currently known species from the region. *African Natural History* **9**:61–90.

Minchin D. 2012. Rapid assessment of the bryozoan, *Zoobotryon verticillatum* (Delle Chiaje, 1822) in marinas, Canary Islands. *Marine Pollution Bulletin* **64(10)**:2146–2150 DOI 10.1016/j.marpolbul.2012.07.041.

Minchin D, Gollasch S, Cohen AN, Hewitt CL, Olenin S. 2009. Characterizing vectors of marine invasions. In: Rilov G, Crooks J, eds. *Biological Invasions in Marine Ecosystems: Ecological, Management and Geographic Perspectives Ecological Studies.* Vol. 204. Heidelberg: Springer.

Mizzan L. 1998. Le species alloctone del macrozoobenthos della Laguna di Venezia: il punto della situazione. *Bollettino del Museo Civico di Storia Naturale di Venezia* **49**:145–177.

Monniot C. 1981. Apparition de l'ascidie *Microcosmus exasperatus* dans les ports Méditerranéens. *Tethys* **10**:59–61.

Monniot C, Monniot F. 1994. Additions to the inventory of eastern tropical Atlantic ascidians: arrival of cosmopolitan species. *Bulletin of Marine Science* **54**:71–93.

Monniot C, Monniot F. 1997. Records of ascidians from Bahrain Arabian Gulf with three new species. *Journal of Natural History* **31(11)**:1623–1643 DOI 10.1080/00222939700770871.

Monniot F. 2016. Ascidians (Tunicata) of the French Guiana expedition. *Zootaxa* **4114(3)**:201–245 DOI 10.11646/zootaxa.4114.3.1.

Moore PG. 1988. Taxonomic observations on the genera *Xenocheira* Haswell and *Ericthonius* Milne Edwards (Crustacea: Amphipoda) from Australian coastal waters. *Journal of Natural History* **22(3)**:705–732 DOI 10.1080/00222938800770461.

Moore HB, McPherson FB. 1963. Colonization of the Miami area by the barnacle *Balanus trigonus*, Darwin and a note on its occurrence on the test of an echinoid. *Bulletin of Marine Science* **13**:418–421.

Morri C, Bianchi CN, Cocito S, Peirano A, Biase AMD, Aliani S, Pansini M, Boyer M, Ferdeghini F, Pestarino M, Dando P. 1999. Biodiversity of marine sessile epifauna at an Aegean island subject to hydrothermal activity: Milos, eastern Mediterranean Sea. *Marine Biology* **135(4)**:729–739 DOI 10.1007/s002270050674.

Müller H-G, Krapp F. 2009. The pycnogonid fauna (Pycnogonida, Arthropoda) of the Tayrona National Park and adjoining areas on the Caribbean coast of Colombia. *Zootaxa* **2319**:138.

Myers AA. 1975. Studies on the genus Lembos Bate. III. Indo-Pacific species: *L. kidoli* sp. nov., *L. ruffoi* sp. nov., *L. excavatus* sp. nov., *L. leptocheirus* Walker. *Bollettino del Museo civico di Storia Naturale, Verona* **2**:13–50.

Naderloo R, Sari A. 2007. Subtidal crabs of the Iranian coast of the Persian Gulf: new collections and biogeographic considerations. *Aquatic Ecosystem Health & Management* **10(3)**:341–349 DOI 10.1080/14634980701514620.

Nagar LR, Shenkar N. 2016. Temperature and salinity sensitivity of the invasive ascidian *Microcosmus exasperatus* Heller, 1878. *Aqautic Invasions* **11(1)**:33–43 DOI 10.3391/ai.2016.11.1.04.

Nagata K. 1965. *Studies on Marine Gammaridean Ampipoda of the Seto Inland Sea.* Vol. 13. Hiroshima: Seto Marine Biology Lab, 291–326.

Neu W. 1935. *Balanus eburneus* Gould und *Balanus improvisus* Darwin als Bewuchs ausgehängter Platten im Goldenen Horn von Istanbul. *Zoologischer Anzeiger* **112**:92–95.

Nunomura N. 1977. Marine Isopoda from Amakusa, Kyushu. *Publications of the Amakusa Marine Biological Laboratory* **4**:71–90.

Nydam M, Giesbrecht K, Stephenson E. 2017. Origin and dispersal history of two colonial ascidian clades in the *Botryllus schlosseri* species complex. *PLOS ONE* **12(1)**:e0169944 DOI 10.1371/journal.pone.0169944.

Occhipinti-Ambrogi A. 1991. The spread of *Tricellaria inopinata* into the lagoon of Venice: an ecological hypothesis. *Bulletin Societé Sciences Naturels Ouest France Mémoires Hors Série* **1**:139–144.

Occhipinti-Ambrogi A. 2007. Global change and marine communities: alien species and climate change. *Marine Pollution Bulletin* **55(7–9)**:342–352 DOI 10.1016/j.marpolbul.2006.11.014.

Olenin S, Narščius A, Minchin D, David M, Galil B, Gollasch S, Marchini A, Occhipinti-Ambrogi A, Ojaveer H, Zaiko A. 2014. Making non-indigenous species information systems practical for management and useful for research: an aquatic perspective. *Biological Conservation* **173**:98–107 DOI 10.1016/j.biocon.2013.07.040.

Omer-Cooper WT. 1927. Report on the Crustacea Tanaidacea and Isopoda. Zoological results of the Cambridge expedition to the Suez Canal II. *Transactions of the Zoological Society of London* **22**:201–209.

Ordóñez V, Pascual M, Fernández-Tejedor M, Turon X. 2016. When invasion biology meets taxonomy: *Clavelina oblonga* (Ascidiacea) is an old invader in the Mediterranean Sea. *Biological Invasions* **18(4)**:1203–1215 DOI 10.1007/s10530-016-1062-0.

Ostrovsky A, Cáceres-Chamizo JP, Vávra N, Berning B. 2011. Bryozoa of the Red Sea: history and current state of research. *Annals of Bryozoology* **3l**:67–97.

Ounifi-Ben Amor K, Ben Salem M, Ben Souissi J. 2010. *Sphaeroma walkeri* Stebbing, 1905 (Crustacea, Isopoda, Sphaeromatidae) introduced and established in Tunisia waters: CIESM proceedings. *Rapport Commission internationale Mer Méditerenee* **39**:615.

Ounifi-Ben Amor K, Rifi M, Ghanem R, Draief I, Zaouali J, Ben Souissi J. 2016. Update of alien fauna and new records from Tunisian marine waters. *Mediterranean Marine Scencei* **17(1)**:124–143.

Özaydinli M, Coleman O. 2012. *Ampithoe bizseli* n. sp. (Crustacea, Amphipoda) from the west coast of Turkey. *Zootaxa* **3378**:17–28.

Pagad S, Hayes K, Katsanevakis S, Costello MJ. 2017. World Register of Introduced Marine Species (WRIMS). *Available at http://www.marinespecies.org/introduced* (accessed 1 February 2017).

Patane L. 1927. Sullo strato peritoneale del mesenterio dei Balanidi. *Memorie della Classe di scienze fisiche, matematiche e naturali/Reale Accademia dei Lincei* **6**:124–130.

Pati SK, Rao MV, Balaji M. 2015. Spatial and temporal changes in biofouling community structure at Visakhapatnam harbour, east coast of India. *Tropical Ecology* **56**:139–154.

Pedersen J, Bullock R, Carlton J, Dijkstra J, Dobrroski N, Dyrynda P, Fisher R, Harris L, Hobbs N, Lambert G, Lazo-Wasem EA, Mathieson AC, Miglietta MP, Smith J, Smith J, Tyrrell M. 2003. *Marine Invaders in the Northeast. Rapid Assessment Survey of Non-native and Native Marine Species of Floating Dock Communities.* Vols. 5–3. Cambridge: MIT Sea Grant College Program Publication, 41.

Pérès J. 1951. Nouvelle contribution à l'étude des ascidies de la Cote occidentale d'Afrique [New contribution to the study of Western Africa's ascidians]. *Bulletin de l'Institut Français d'Afrique Noire* **13**:1051–1071.

Pérès JM. 1958. Ascidies récoltées sur les côtes méditerranéennes d'Israel [Ascidia harvested from Israel's Mediterranean coasts]. *Bulletin Research Council of Israel* **7B**:143–150.

Perez-Portela R, Arranz V, Rius M, Turon X. 2013. Cryptic speciation or global spread? The case of a cosmopolitan marine invertebrate with limited dispersal capabilities. *Scientific Reports* **3**:10 DOI 10.1038/srep03197.

Pineda MC, López-Legentil S, Turon X. 2011. The whereabouts of an ancient wanderer: Global phylogeography of the solitary ascidian *Styela plicata*. *PLOS ONE* **6(9)**:e25495 DOI 10.1371/journal.pone.0025495.

Pixell H. 1913. Polychaeta of the Indian Ocean, together with some species from the Cape Verde Islands. The Serpulidae, with a classification of the genera *Hydroides* and *Eupomatus. Transactions of the Linnean Society of London Series* **2l**:6992.

Poore G, Lew-Ton H. 1986. *Mesanthura* (Crustacea: Isopoda: Anthurida) from south-eastern Australia. *Memoirs of the Museum of Victoria* **47(1)**:87–104 DOI 10.24199/j.mmv.1986.47.04.

Poupin J. 1994. Quelques crustacés décapodes communs de Polynésie Française. In: *Rapport Scientifique et Technique du Service Mixte de Surveillance Radiologique et Biologique de l'homme et de l'environnement*, Montlhéry: Ministère de la Défense, Service Mixte de Surveillance Radiologique et Biologique, de l'homme et de l'environnement, 108.

Poupin J. 1996. Atlas des Crustacés marins profonds de Polynésie Française. Récoltes du navire Marara (1986/1996). *Service Mixte de Surveillance Radiologique et Biologique.* Editions Louis Jean, Gap: Publications du SMSRB, 56.

Powell N. 1969. Indo-Pacific Bryozoa new to the Mediterranean coast of Israel. *Israel Journal of Zoology* **18**:157–168.

Ralli-Tzelepi ZN. 1946. Contribution à l'étude conchyliologique du littoral de l'Attique (Grèce). In: *Première partie: Nuculidae, Arcidae, Carditidae, Chamidae, Erycinidae, Cardiidae, Solenidae, Mactridae, Thraciidae, Saxicavidae, Gastrochaenidae, Corbulidae, Pholadidae, Solenomyidae, Scrobiculariidae, Tellinidae, Lucinidae.* PhD thesis, Athens: University of Athens, 1.

Ramos-Esplá A. 1988. Ascidias litorales del Mediterráneo Ibérico: Faunística, ecología y biogeografía. Doctoral thesis, Barcelona: University of Barcelona, 423.

Ramos-Esplá A, Izquierdo-Muñoz A, Çinar M. 2013. *Microcosmus exasperatus* (Ascidiacea: Pyuridae), current distribution in the Mediterranean Sea. *Marine Biodiversity Records* **6**:e89 DOI 10.1017/s1755267213000663.

Relini G. 1968. Segnalazione di due Cirripedi nuovi per l'Adriatico. *Bolletino Societa Adriatica Scienze Naturale* **56**:218–225.

Ren X, Zheng C. 1996. Fouling Amphipoda (Crustacea) from Dayawan, Guangdong province, China (South China sea). *Institute of Oceanology, China Academy of Sciences* **1**:58–78.

Rezig M. 1978. Sur la présence de *Paracerceis sculpta* (Crustacé, Isopode, Flabellifère) dans le Lac de Tunis. *Bulletin Office National Pêches, Tunisie* **2**:175–191.

Rocha RM, Kremer LP. 2005. Introduced ascidians in Paranaguá Bay, Paraná, southern Brazil. *Revista Brasileira de Zoologia* **22**:1170–1184.

Rocha RM, Kremer L, Fehlauer-Ale K. 2012. Lack of COI variation for *Clavelina oblonga* (Tunicata, Ascidiacea) in Brazil: evidence for its human-mediated transportation? *Aquatic Invasions* **7**:419–424.

Ros M, Guerra-García JM, González-Macías M, Saavedra Á, López-Fe CM. 2013. Influence of fouling communities on the establishment success of alien caprellids (Crustacea: Amphipoda) in Southern Spain. *Marine Biology Research* **9**:293–305.

Sabroux R, Corbari L, Krapp F, Bonillo C, le Prieur S, Hassanin A. 2017. Biodiversity and phylogeny of Ammotheidae (Arthropoda: Pycnogonida). *European Journal of Taxonomy* **286**:1–33 DOI 10.5852/ejt.2017.286.

Salfi M. 1929. Sulla blastogenesi in *Clavelina* e su una nuova specie del genere [On blastogenesis in Clavelina and on a new species of the genus]. *Pubblicazioni della Stazione Zoologica di Napoli* **9**:195–201.

Salvi D, Macali A, Mariottini P. 2014. Molecular phylogenetics and systematics of the bivalve family ostreidae based on rRNA sequence-structure models and multilocus species tree. *PLOS ONE* **9(9)**:e108696 DOI 10.1371/journal.pone.0108696.

Samaan AA, Ghobashy AFA, Aboul Ezz SM. 1989. The benthic fauna of Lake Burollus 1-Community composition and distribution of the total fauna. *Bulletin of Natural Intitute of Oceanography and Fish* **15**:217–224.

Savarino R, Turolla E. 2000. Un ospite indesiderato sbarca ad Olbia [An unwanted guest landed at Olbia]. *Informare* **9**:2–3.

Savigny JC. 1816. *Memoires sur les animaux sans vertebres.* Vol. 2. Paris: Membre de l'institut d'Ègypte et de l'ordre royal de la legion d'honneur, de l'académie de Marseille, de la Société Wenerienne d'Èdimbourg, 1–239.

Savini D, Marchini A, Forni G, Castellazzi M. 2006. Touristic harbours and secondary spread of alien species. *Biologia Marina Mediterranea* **13**:760–763.

Schellenberg A. 1928. Report on the amphipoda. Cambridge expedition to the Suez Canal, 1924. *Transactions of the Zoologial Society, London* **22**:635–692.

Schotte M, Kensley B. 2005. New species and records of Flabellifera from the Indian Ocean (Crustacea: Peracarida: Isopoda). *Journal of Natural History* **39(16)**:1211–1282 DOI 10.1080/00222930400005757.

Schubart CD, Guerao G, Abelló P. 2012. First record and evidence of an established population of the North American mud crab *Dyspanopeus sayi* (Brachyura: Heterotremata: Panopeidae) in the western Mediterranean. *Scientia Marina* **76(1)**:79–85 DOI 10.3989/scimar.03361.16a.

Selim SA, Abdel Naby F, Gab-Alla AA, Ghobashy A. 2005. Gametogenesis and spawning of *Spirobranchus tetraceros* (Polychaeta, Serpulidae) in Abu Kir Bay, Egypt. *Mediterranean Marine Science* **6(1)**:89–98 DOI 10.12681/mms.195.

Seo JE, Min BS. 2009. A faunistic study on Cheilostomatous Bryozoans from the shoreline of South Korea, with two new species. *Animal Systematics, Evolution and Diversity* **25(1)**:19–40 DOI 10.5635/kjsz.2009.25.1.019.

Shenkar N. 2008. Ecological aspects of the ascidian community along the Israeli coasts. PhD thesis, Israel: Tel Aviv University, Tel Aviv.

Sivaprakasam TE. 1968. Amphipoda from the east coast of India. Part I. Gammaridea. *Journal of the Marine Biological Association of India* **8**:82–122.

Skerman TM. 1960. The recent establishment of the polyzoan *Watersipora cucullata* in Auckland Harbour, New Zealand. *New Zealand Journal of Science* **3**:615–619.

Sokolover N, Taylor PD, Ilan M. 2016. Bryozoa from the Mediterranean coast of Israel. *Mediterranean Marine Science* **17(2)**:440–458 DOI 10.12681/mms.1390.

Solustri C, Morello E, Froglia C. 2003. *Musculista senhousia* (Benson in Cantor, 1842) (Bivalvia: Mytilidae) in the costal waters of the Adriatic Sea (Italy). *Atti della Società Italiana di Scienze Naturali e del Museo Civico di Storia* **144**:231–240.

Soriano JL, Salgado SQ. 2014. Primeras citas de diversos moluscos marinos alóctonos en el Delta del Ebro (Cataluña, España). *Spira* **5**:149–151.

Soule DF, Soule JD, Chaney HW. 1995. *The Bryozoa.* In: Blake JA, Chaney W, Scott PH, Lissner AL, eds. *Taxonomic Atlas of the Santa Maria Basin and Western Santa Barbara Channel 13.* Camarillo: Southern California University Press, Hancock Institute of Marine Studies.

Steen F, Aragay J, Zuljevic A, Verbruggen H, Mancuso FP, Bunker F, Vitales D, Garretta A, De Clerck O. 2017. Tracing the introduction history of the brown seaweed *Dictyota cyanoloma* (Phaeophyceae, Dictyotales) in Europe. *European Journal of Phycology* **52(1)**:31–42 DOI 10.1080/09670262.2016.1212998.

Straughan D. 1969. Serpulidae (Annelida, Polychaeta) from Oahu, Hawaii. *Bulletin of the Southern California Academy of Sciences* **68**:229–240.

Sun Y, Wong E, Hove H, Hutchings PA, Williamson JE, Kupriyanova EK. 2015. Revision of the genus *Hydroides* (Annelida: Serpulidae) from Australia. *Zootaxa* **4009(1)**:99 DOI 10.11646/zootaxa.4009.1.1.

Sun Y, Wong E, Tovar-Hernández MA, Williamson J, Kupriyanova E. 2016. Is *Hydroides brachyacantha* (Serpulidae: Annelida) a widespread species? *Invertebrate Systematics* **30**:41–59 DOI 10.1071/is15015.

Tempesti J, Langeneck J, Castelli A. 2016. Further record of *Paranthura japonica* (Richardson, 1909) (Anthuridea, isopoda) from a Mediterranean commercial harbour. Management of bioinvasions in the Mediterranean Sea. In: *Euromarine Workshop*, Book of Abstracts, 15.

Thessalou-Legaki M, Aydogan O, Bekas P, Bilge G, Boyaci YO, Brunelli E, Circosta V, Crocetta F, Durucan F, Erdem M, Ergolavou A, Filiz H, Fois F, Gouva E, Kapiris K, Katsanevakis S, Kljajic Z, Konstantinidis E, Konstantinou G, Koutsogiannopoulos D, Lamon S, Mačić V, Mazzette R, Meloni D, Mureddu A, Paschos I, Perdikaris C, Piras F, Poursanidis D, Ramos-Esplá AA, Rosso A, Sordino P, Sperone E, Sterioti A, Taşkin E, Toscano F, Tripepi S, Tsiakkiros L, Zenetos A. 2012. New Mediterranean Biodiversity Records (December 2012). *Mediterranean Marine Science* **13(2)**:312–327 DOI 10.12681/mms.313.

Tilbrook KJ. 1999. Description of *Hippopodina feegeensis* and three other species of *Hippopodina* Levinsen, 1909 (Bryozoa: Cheilostomatida). *Journal of Zoology* **247(4)**:449–456 DOI 10.1017/s0952836999004045.

Tilbrook KJ. 2006. Cheilostomatous Bryozoa from the Solomon Islands. In: Chaney HW, ed. *Santa Barbara Museum of Natural History Monograph Number 4–Studies in Biodiversity.* Vol. 3. Santa Barbara: Santa Barbara Museum of Natural History.

Tokioka T. 1963. Contributions to Japanese ascidian fauna XX. The out-line of Japanese ascidian fauna as compared with that of the Pacific coast of North America. *Seto Marine Biological Laboratory* **11(1)**:131–156 DOI 10.5134/175319.

Topaloğlu B, Evcen A, Çınar M. 2016. Sponge fauna in the Sea of Marmara. *Turkish Journal of Fisheries and Aquatic Sciences* **16**:51–59.

Turolla E. 1999. Nuovi ospiti per la sacca di Goro. Due bivalvi e un granchio si aggiungono alla già ricca comunità di specie alloctone pervenute nell'area del delta del Po negli ultimi

quaranta annii [New guests for the Goro bag. Two bivalves and a crab are added to the game rich aloft community species that came to the Po Delta area for the last forty years]. *Laguna* **4**:32–35.

Turon X, Tarjuelo I, Duran S, Pascual M. 2003. Characterising invasion processes with genetic data: an Atlantic clade of *Clavelina lepadiformis* (Ascidiacea) introduced into Mediterranean harbours. In: *Migrations and Dispersal of Marine Organisms.* Dordrecht: Springer, 29–35.

Turón X, Nishikawa T, Rius M. 2007. Spread of *Microcosmus squamiger* (Ascidiacea: Pyuridae) in the Mediterranean Sea and adjacent waters. *Journal of Experimental Marine Biology and Ecology* **342(1)**:185–188 DOI 10.1016/j.jembe.2006.10.040.

Ungaro N, Pastorelli AM, Di Festa T. 2012. *Dyspanopeus sayi* (Smith, 1869)–Crustacea, Panopeidae–una nuova presenza nella laguna costiera di Varano (Adriatico Centro-Meridionale). *Biologia Marina Mediterranea* **19**:194–195.

Van Name W. 1945. The North and South American Ascidians. *Bulletin of the American Museum of Natural History* **84**:476.

Vandepas LE, Oliveira LM, Lee SSC, Hirose E, Rocha RM, Swalla BJ. 2015. Biogeography of *Phallusia nigra*: is it really black and white? *Biological Bulletin* **228(1)**:52–64 DOI 10.1086/bblv228n1p52.

Verlaque M. 2001. Checklist of the macroalgae of Thau Lagoon (Herrault, France), a hot spot of marine species introduction in Europe. *Oceanologica Acta* **24(1)**:29–49 DOI 10.1016/s0399-1784(00)01127-0.

Viard F, David P, Darling J. 2016. Marine invasions enter the genomic era: three lessons from the past, and the way forward. *Current Zoology* **62(6)**:629–642 DOI 10.1093/cz/zow053.

Vine P. 1986. *Red Sea Invertebrates.* London: Immel Publishing.

Walker K. 1909. Amphipoda Gammaridea from the Indian Ocean, British East Africa, and the Red Sea. *Transactions of the Linnean Society of London* **12(4)**:323–344 DOI 10.1111/j.1096-3642.1909.tb00145.x.

Wirtz P, Canning-Clode J. 2009. The invasive bryozoan *Zoobotryon verticillatum* has arrived at Madeira Island. *Aquatic Invasions* **4(4)**:669–670 DOI 10.3391/ai.2009.4.4.11.

Wisley B. 1958. The settling and some experimental reactions of a bryozoan larva, *Watersipora cucullata* (Busk). *Australian Journal of Marine & Freshwater Research* **9(3)**:362–371 DOI 10.1071/mf9580362.

Zammit PP, Longo C, Schembri P. 2009. Occurrence of *Paraleucilla magna* Klautau et al., 2004 (Porifera: Calcarea) in Malta. *Mediterranean Marine Science* **10(2)**:135–138 DOI 10.12681/mms.114.

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 and Coastal Shelf Science* **191**:171–187 DOI 10.1016/j.ecss.2017.03.031.

Zenetos A, Konstantinou F, Konstantinou G. 2009. Towards homogenization of the Levantine alien biota: additions to the alien molluscan fauna along the Cypriot coast. *Marine Biodiversity Records* **2l**:e156.

Zenetos A, Koutsogiannopoulos D, Ovalis P, Poursanidis D. 2013. The role played by citizen scientists in monitoring marine alien species in Greece. *Cahiers de Biologie Marine* **54**:419–426.

Zgozi SW, Haddoud DA, Rough A. 2002. Influence of environmental factors on distribution and abundance of macrobenthic organisms at Al Gazala Lagoon (Libya). In: *Technical Report of Marine Research Center of Tajura.* Tajura, 23–27.

Zibrowius H. 1970. Contribution à l'etude des Serpulidae (Polychaeta Sedentaria) du Brésil. *Boletim do Instituto Oceanográfico de São Paulo* **19**:1–32 DOI 10.1590/s0373-55241970000100001.

Zibrowius H. 1971. Les espèces Méditerranéennes du genre *Hydroides* (Polychaeta, Serpulidae). Remarques sur le prétendu polymorphisme de *Hydroides uncinata [Mediterranean species of the genus Hydroides (Polychaeta, Serpulidae). Remarks on the pretentious polymorphism of Hydroides uncinata]. Téthys* **2**:691–746.

Zibrowius H. 1973. Remarques sur trois espèces de Serpulidae acclimatées en Méditerranée: *Hydroides dianthus* (Verrill, 1873), *Hydroides dirampha* Mörch, 1863, et *Hydroides elegans* (Haswell, 1883) [Remarks on three species of Serpulidae acclimated in the Mediterranean: Hydroides dianthus (Verrill, 1873), Hydroides dirampha Mörch, 1863, and Hydroides elegans (Haswell, 1883)]. *Rapport de la Commission Internationale de la Mer Méditerranée* **21**:683–686.

Zibrowius H. 1978. Quelques récoltes de Serpulidae (Annelida Polychaeta) sur les côtes Nord de la Tunisie [Some Serpulidae (Annelida Polychaeta) crops on the northern coasts of Tunisia]. *Bulletin de l'Office National de Pêche. Tunisie* **2**:211–222.

Zibrowius H. 1992. Ongoing modification of the Mediterranean marine fauna and flora by the establishment of exotic species. *Mésogée* **51**:83–107.

Zibrowius H, Bitar G. 1981. Serpulidae (Annelida Polychaeta) indo-pacifiques établis dans la région de Beyrouth, Liban [Serpulidae (Annelida Polychaeta) Indo-Pacific settlements in the Beirut area, Lebanon]. *Rapports Commission Intérnationale Mer Méditerranée* **27**:159–160.

Zullo V. 1992. *Balanus trigonus* Darwin (Cirripedia, Balaninae) in the Atlantic basin: An Introduced Species? *Bulletin of Marine Science* **50**:66–74.

Zullo V. 1979. *Marine flora and fauna of the Northeastern United States. Arthropoda: Cirripedia, NOAA Technical Report NMFS Circular.* Vol. 425. Washington, D.C.: NOAA. US Department of Commerce, National Marine Fisheries Service, U.S. Government Printing Office, 29.