CIESM Congress Session : Alien records
Moderator : Sergej Olenin, Klapeida Univ., Lithuania

Moderator's Synthesis

Seven papers were presented in this session, co-authored by researchers from 10 countries. The thematic of the presentations ranged from the records of alien species (an ascidian in Malta, the lion fish in Cyprus, coastal plant in Romania, red alga in Tunisia) and regional overviews of non-indigenous biota (status of invasive marine species in Libya, exotic fishes in Mediterranean) to public participation in invasive species detection through social networks. The following discussion was centered on three main questions: 1) What are the best methods for early detection and correct identification of alien species; 2) How to increase the level of certainty about the pathway/vector of introduction; and 3) What are the objective methods to measure losses and gains caused by introduction of alien species?

The participants expressed their opinion that in spite of rapid advent of molecular methods, it is important to support and develop the traditional taxonomic knowledge for proper identification of new non-indigenous species (NIS). Appropriately supervised 'citizen science' can provide through social networks important data on exotic species status (established, not established, rare, common, etc.), their secondary spread and impacts. Provided that data are scientifically validated and standardized, such method is especially useful for relatively large conspicuous species, such as fish. Community involvement is also an important instrument to raise public awareness on the problem of marine invasive species.

There are clear gaps in the knowledge on pathways and vectors of NIS introductions, which may impact the science advice to management. Especially it is vital to distinguish between the "Lesseptian migration" involving physical movement of species through the Suez Canal and introduction of aliens by ships (ballast water, hull fouling, etc), which are passing the Canal. Management options for these two pathways are different, involving different legal instruments and technological solutions.

Another important knowledge gap is the lack of data on losses and gains caused by introduction of alien species. It is not enough to record new and new NIS entering the Mediterranean Sea, it also is important to investigate that is their impact on biodiversity, environment, economy and human health. The solid evidence base on the bioinvasion impacts is needed for prioritization of environmental remediation measures, especially than funds for such remediation are limited.

It was agreed also that data on new species records, pathways and vectors of their spread, their biological traits and environmental tolerance limits as well as impacts, should be publically available through the scientifically verified and constantly updated open source databases. Ideally, such database(s) should cover not only the Mediterranean Sea, but also other regions of the world to make it possible interregional comparisons and exchange of data needed for management decisions.

THE CURRENT STATUS OF THE ALIEN ASCIDIAN *HERDMANIA MOMUS* IN MALTA

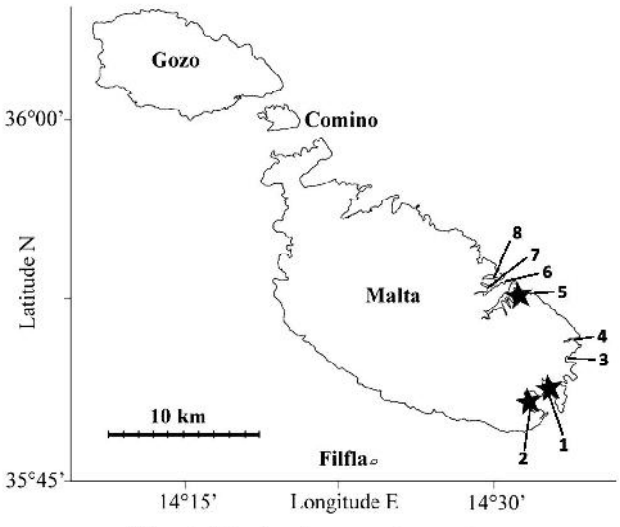
Sofia Afoncheva [1], Julian Evans [2]* and Patrick J. Schembri [2]
[1] University of Bremen, Bremen 28359, Germany
[2] Department of Biology, University of Malta, Msida MSD2080, Malta - julian.evans@um.edu.mt

Abstract
The non-indigenous ascidian *Herdmania momus* was first recorded from the southeast coast of Malta at Marsaxlokk in 2013. Surveys at eight sites along the east coast of Malta revealed that it has since spread to another two sites, one of which is located *ca* 10 km north of Marsaxlokk. The ascidians remain largely restricted to artificial substrata in areas under anthropogenic influence, although a few individuals were observed on natural rock. The size distributions of the three populations reflect the likely propagation of the tunicates from the site of introduction. Four taxa of commensal crustaceans inhabiting Maltese *H. momus* were found, with the highest abundance of ascidicolous crustaceans recorded from the Marsaxlokk population.

Keywords: Alien species, Species introduction, Tunicata, Sicily Channel

Introduction
The solitary ascidian *Herdmania momus* is an Erythraean immigrant that was restricted to the eastern Mediterranean until 2013, when it was recorded from Marsaxlokk Bay on the southeastern coast of Malta [1]. The Marsaxlokk population was restricted to artificial substrata, but this ascidian can also colonise natural rocky bottoms [2], while its planktonic larval stage increases its potential for range expansion along the Maltese coast. The present study was undertaken to assess the current distribution and status of *H. momus* along the eastern coast of Malta.

Material and Methods
Field surveys were carried out at eight sites along the eastern coast of Malta in September-November 2015 (Fig. 1). At each site 2-4 stations with either a concrete or a natural substratum were sampled. At each station, 25 m of coastline were surveyed from 0 m to a depth of 1 m and the abundance of *H. momus* was recorded. Up to 25 individuals were collected at random from each station, narcotized and fixed. Body length of these individuals was measured from the base of the oral siphon to the base of atrial siphon along the mid-ventral line. The specimens were then dissected and the branchial sac was examined for the presence of commensals.



Mean (±SD) abundance per transect

	Artificial substratum	Natural substratum
Site 1 (Marsaxlokk)	42.5 ± 23.3	4.0 ± 5.6
Site 2 (Birzebbuga)	69.0 ± 26.9	12.5 ± 14.8
Site 5 (Rinella)	2	4

Fig. 1. Map of the Maltese Islands showing the location of sites surveyed for *Herdmania momus* (numbered 1-8). The mean abundances of *H. momus* (as individuals per 1 m x 25 m belt transect) from artificial and natural substrata at the three sites where populations were found (black stars) are also shown.

Results and Discussion
Herdmania momus was found at three of the eight sites investigated: in Marsaxlokk Bay (site 1), where the first record of *H. momus* in Maltese waters was originally made, at Birzebbuga (site 2) and in Rinella Bay (site 5), with the highest abundances recorded from artificial substrata at Birzebbuga (Fig. 1). The present data show that *H. momus* tends to establish populations in areas under anthropogenic impact, since all three sites are located in harbours characterised by intense human activities. It has been suggested that non-indigenous ascidians thrive particularly well on artificial surfaces but often fail to establish on natural substrata [3]. The present results show that in Malta *H. momus* remains largely restricted to artificial substrata, but a few individuals were also recorded from natural rocky bottoms indicating that it has the ability to also colonise natural substrata, as reported previously in Israel [2].

The size structure of the ascidian populations varied between sites. The Marsaxlokk population had the broadest size distribution with body lengths ranging from 18 mm to 129 mm, whereas no individuals larger than 102 mm were recorded from Birzebbuga or Rinella, suggesting that Marsaxlokk was colonized first. This pattern of size distribution likely reflects the propagation of the species from Marsaxlokk Bay to other sites along the coast. From the 145 ascidians dissected and examined for commensals, four different crustacean taxa were recorded: two copepod taxa (not identified further), one amphipod (*Leucothoe* sp.) and one tanaid (*Leptochelia savignyi*), with copepods accounting for more than 99% of all individuals. Commensal crustaceans were found in around half of the ascidians collected from artificial substrata in Marsaxlokk and Birzebbuga, while no commensals were observed in specimens from Rinella. The abundance of commensals was correlated with the mean size of the ascidian host and the probable 'settlement age', which is the time since the population was first established.

These results suggest that the *H. momus* populations are well established and this species may continue to spread along the coast of Malta, possibly invading communities on natural shores. Continued monitoring of the status of such immigrants is of high importance as interspecific interactions between alien and native biota can lead to niche limitation, displacement or local extinction [4].

Acknowledgements: We are grateful to Veronica Farrugia Drakard for assistance with field sampling.

References
1 - Evans J., Borg J.A. and Schembri P.J., 2013. First record of *Herdmania momus* (Ascidiacea: Pyuridae) from the central Mediterranean Sea. *Mar. Biodivers. Rec.*, 6: e134.
2 - Gewing M.T., Rothman S.B.S., Nagar L.R. and Shenkar N., 2014. Early stages of establishment of the non-indigenous ascidian *Herdmania momus* (Savigny, 1816) in shallow and deep water environments on natural substrates in the Mediterranean Sea. *BioInvasions Rec.*, 3(2): 77-81.
3 - Lambert G., 2002. Non-indigenous ascidians in tropical waters. *Pac. Sci.*, 56: 291-298.
4 - Galil B.S., 2007. Loss or gain? Invasive aliens and biodiversity in the Mediterranean Sea. *Mar. Poll. Bull.*, 55: 314-322.

ENHANCING EARLY DETECTION THROUGH SOCIAL NETWORKS: A FACEBOOK EXPERIMENT

Michel Bariche [1]* and Ernesto Azzurro [2]
[1] American University of Beirut, Biology Department - michel.bariche@aub.edu.lb
[2] ISPRA, Piazzale dei Marmi 2, 57123 Livorno, Italy

Abstract
The emergence of internet-based social media has made it possible for one person to communicate with a large number of people. Here we show that social media groups can spontaneously provide sound information on marine invaders and be used as powerful systems for early detection.

Keywords: Invasive species, Mediterranean Sea, Lessepsian migration

Introduction
Public participation in invasive species detection is a widely used tool for both scientific research and monitoring worldwide. It may be used alone or in combination with traditional (and often expensive) scientific surveys. Information gained through the public has just started to be considered by Mediterranean scientists, which are interested in expanding detection and monitoring of exotic species (Azzurro et al., 2013). Yet, the online social media, where internet users can connect with others and share information with a wide audience, have rapidly become an essential digital skill worldwide. Facebook is currently the most used social network where people can post and share comments, photos, videos and interact with them. This can be done at the individual level (friends) or through user groups that share common interest to a specific topic. Here we tested the potentiality of Facebook in detecting the occurrence and distribution of exotic marine species.

Materials and Methods
A public group on Facebook was created in October 2012 under the name of "Sea Lebanon". It has been described as dedicated to the marine world and presented a forum for people to share pictures, information and curiosities on anything related to marine organisms in Lebanon. This group allowed anyone to ask questions or upload pictures taken on the beach, on the market or while scuba diving, angling, spearfishing, boating or any other marine related activity. A first, a bunch of members were encouraged to join by sending them an invitation by email. Once the posting started, more people were able to join by sending a simple click join requests. Sea Lebanon was administered by one of the authors (M.B.), who evaluated subscription requests, commented the posts, provided identifications, validated records and engaged people encouraging discussion. A testing period of two calendar years (2013-2015) was initially planned.

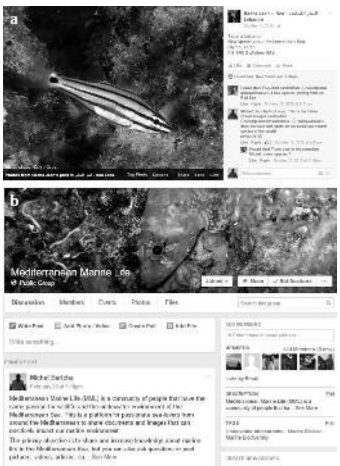


Fig. 1. Screenshots from Facebook groups (a) "Sea Lebanon", showing a sample post and discussion (b) "Mediterranean Marine Life", showing its cover page. Photo credits J. Bacha; V. Gerovasileiou.

Results and discussion
Since 2013, a total of 521 person joined "Sea Lebanon". They are mostly scuba divers, spearfishers, anglers, fishermen or simply sea lovers. Overall, several hundreds of posts were received during the testing exercise (Fig. 1). They covered a wide array of pictures, videos, comments and discussion and included photos of animals, landscapes, and threats. Among the animal photos, records of exotic species were common and spanned a variety of organisms, mainly schyphozoans, molluscs, decapods and teleosts (Fig. 2). Other posts included rare or unfamiliar species (e.g. *Calappa granulata*, *Isurus oxyrinchus*, *Peristedion cataphractum*, *Dermochelys coriacea*, *Monachus monachus*). Remarkably the most interesting posts encouraged other members to upload their pictures on the same species or topic. That particularly applied to the exotic Lionfish (*Pterois miles*), firstly recorded in Lebanon in autumn 2012 (Bariche et al., 2013). In two years (2013-2014), a number of 107 pictures and 3 videos of Lionfish were posted, providing information on 47 individuals spotted across the entire Lebanese coast. This information, gained through Facebook, highlighted that a relatively large population of the Lionfish existed in the waters of Lebanon. Building upon the 'Sea Lebanon' success, a new public group "Mediterranean Marine Life" (414 members so far) was created in January 2015 (Fig. 1). It aims at covering the entire Mediterranean Sea and is currently accepting members. To increase its audience among Mediterranean countries, it gives the option to post in any of the common Mediterranean languages (Spanish, French, Italian, Greek, Arabic, and Turkish) in addition to English. These results provide a remarkable example of the potentialities of social media for exotic species monitoring and early detection. Mobile phones and internet technologies will soon have a role in Mediterranean research or elsewhere. They allow to collect large scale biodiversity data while trading ideas, sharing knowledge and promoting awareness for a wide audience.

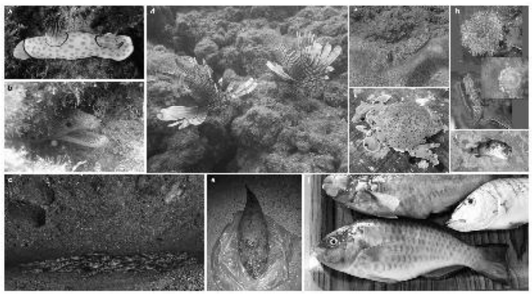


Fig. 2. Sample of exotic species that have been uploaded to "Sea Lebanon". (a) *Goniobranchus annulatus* (b) *Enchelycore anatina* (c) *Plotosus lineatus* (d) *Pterois miles* (e) *Platycephalus indicus* (f) *Torquigener flavimaculosus* (g) *Matuta victor* (h) *Cassiopea andromeda* (i) *Apogon nigripinnis* (j) *Scarus ghobban*.

References
1 - Azzurro E., Broglio E., Maynou F. & Bariche M. (2013). Citizen science detects the undetected: the case of Abudefduf saxatilis from the Mediterranean Sea. Management of Biological Invasions, 4: 167-170.
2 - Bariche M., Torres M., Azzurro E., 2013. The presence of the invasive Lionfish Pterois miles in the Mediterranean Sea. Mediterranean Marine Science, 14: 292-294.

THE RED SEA MACROALGA *PALISADA MARIS-RUBRI* (RHODOBIONTA, ARCHAEPLASTIDA): FIRST RECORD IN TUNISIA

Charles-François Boudouresque [1], Jamila Ben Souissi [2], Michele Perret-Boudouresque [1]* and Marc Verlaque [1]
[1] Mediterranean Institute of Oceanography (MIO) Aix-Marseille University - charles.boudouresque@univ-amu.fr
[2] University Tunis El Manar, Institut National Agronomique de Tunisie (INAT), Laboratoire National de Biodiversité, Biotechnologie et Changements Climatiques, Tunis, Tunisia

Abstract
The Red Sea macroalga *Palisada maris-rubri* has already been reported from the Mediterranean Sea: Mar Minor Lagoon (Murcia, Spain) and Lachea Island (Italy). Here, we describe a specimen from a third locality, the hypersaline El-Biban Lagoon (Tunisia) and confirm its occurrence in the Mediterranean.

Keywords: Alien species, Algae, Tunisian Plateau, Lagoons, Lessepsian migration

The red macroalga *Palisada maris-rubri* (K.W. Nam et Saito) K.W. Nam (Florideophyceae, Rhodobionta, kingdom Archaeplastida) has been described from the northern Red Sea (Ras Muhammed, Sinai, Egypt), as *Laurencia maris-rubri* K.W. Nam et Saito [1, 2]. Subsequently, *P. maris-rubris* has been reported from 2 localities in the Mediterranean Sea: the hypersaline lagoon of Mar Menor (Spain) and Lachea Island (Italy) [3]. Red Sea species that entered the Mediterranean via the Suez Canal are called 'Lessepsian species' or 'Lessepsian migrants' [4, 5].

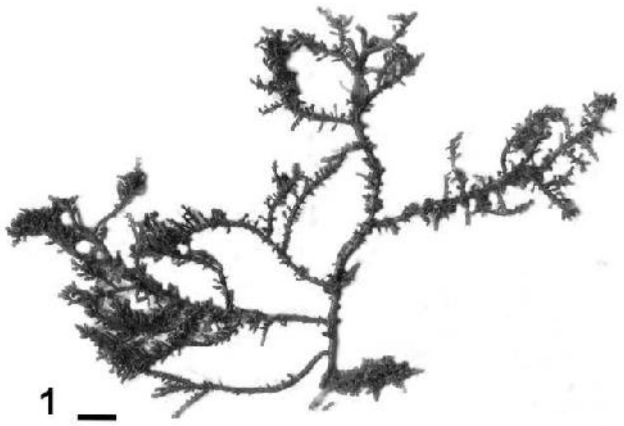


Fig. 1. Habit of the specimen of *Palisada maris-rubri* collected at Jdaria (El-Biban Lagoon, Tunisia). Preserved (H8310) in the Herbarium Verlaque (HCOM) at Aix-Marseille University. Scale bar = 1 cm.

On December 2015, we (CFB, JBS) collected a large specimen (~10 cm in diameter) of *P. maris-rubris* at Jdaria, in El-Biban Lagoon (southern Tunisia) (Fig. 1). El-Biban Lagoon is a hypersaline lagoon [6]. The collected specimen was dwelling on a rope, along a fishing pier, just below sea-level. The distinguishing characters of the species, which are exhibited by the collected specimen, are as follows:
- Axes cylindrical, up to 10-15 cm high, robust, rigid, cartilaginous, dark in color, attached to the substratum by a discoid holdfast;
- Main axes percurrent, 1–3 mm broad in the median parts, irregularly ramified, denuded in the proximal region but often with fascicles of young branches;
- Branching sparse, up to 3 to 4 orders of branches, irregularly alternate, subopposite, frequently subverticillate in medium parts, with the branches of a third order often unilateral;
- Ultimate branchlets cylindrical with truncate apices, (1) 2–3 mm long and 0.6–1 mm broad;
- Cortical cells palisade-like in transverse section and without secondary pit connections;
- Medullary cells in transverse section rounded without lenticular thickening.

Palisada maris-rubri has not been included in the CIESM Atlas of exotic species in the Mediterranean [7], because of minor differences in vegetative features between the Mediterranean material and the type material [3]. Here, we confirm the presence of this Lessepsian migrant within the Mediterranean Sea.

Because of the recent enlargement of the Suez Canal, the flow of Red Sea species (Lessepsian migrants) to the Mediterranean is expected to dramatically intensify [8].

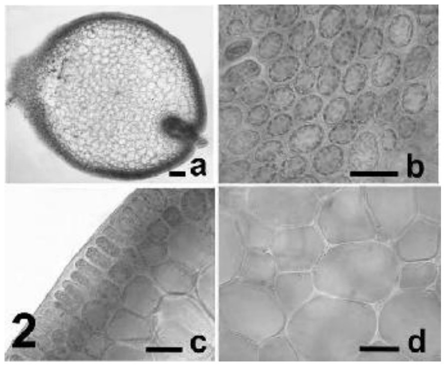


Fig. 2. A: Transverse section. b. Cortex in surface view. c: Transverse section, detail of palisade-like cortical cells. d: Transverse section, detail of medullary cells. Scale bars. a = 100 µm; b-d = 50 µm.

References
1 - Nam K.W. and Saito Y., 1995. Vegetative and reproductive anatomy of some *Laurencia* (Ceramiales, Rhodophyta) species with a description of *L. maris rubri* sp. nov. from the Red Sea. *Phycologia*, 34: 157-165.
2 - Nam K.W., 2007. Validation of the generic name *Palisada* (Rhodomelaceae, Rhodophyta). *Algae*, 22(2) : 53-55.
3 - Serio D., Cormaci M., Furnari G. and Boisset F., 2010. First record of *Palisada maris-rubris* (Ceramiales, Rhodophyta) from the Mediterranean Sea along with three proposed transfers to the genus *Palisada*. *Phycol. Res.*, 58 : 9-16.
4 - Por F.D., 1978. *Lessepsian migrations. The influx of Red Sea biota into the Mediterranean by way of the Suez canal.* Springer publ., Berlin: i-viii + 1-228.
5 - Boudouresque C.F. and Verlaque M., 2002. Biological pollution in the Mediterranean Sea: invasive versus introduced macrophytes. *Mar. Poll. Bull.*, 44: 32-38.
6 - Pergent G., Bessibes M., Djellouli A., El Abed A., Langar H., Mrabet R. and Pergent-Martini C., 2009. Le récif à *Neogoniolithon brassica-florida* de la lagune des Bibans (Tunisie). *Proceedings of the 1st symposium on the coralligenous and other calcareous bio-concretions of the Mediterranean Sea*, Tabarka, 15-16 January 2009, Pergent-Marini C., Brichet M (édits.), RAC/SPA publ., Tunis: 117-122.
7 - Verlaque M., Ruitton S., Mineur F. and Boudouresque C.F., 2015. CIESM Atlas of exotic species. 4. Macrophytes. Briand F. (edit.), CIESM Publisher, Monaco: 1-362.
8 - Galil B.S., Boero F., Campbell M.L., Carlton J.T., Cook E., Fraschetti S., Gollasch S., Hewitt C.L., Jelmert A., Macpherson E., Marchini A., Mckenzie C., Minchin D., Occhipinti-Ambrogi A., Ojaveer H., Olenin S., Piraino S. and Ruiz G.M., 2015. 'Double trouble': the expansion of the Suez Canal and marine bioinvasions in the Mediterranean Sea. *Biol. Inv*, 17(4): 973-976.

XANTHIUM STRUMARIUM SUBSP. *ITALICUM* (MORETTI) D.LOVE, AN INVASIVE ALIEN PLANT ON THE ROMANIAN BLACK SEA COAST

Marius Fagaras [1]*
[1] Ovidius University of Constanta - marius_fagaras@yahoo.com

Abstract
Native to North America, *Xanthium strumarium* subsp. *italicum* is an invasive plant with a high risk for environment in Eastern and Central Europe, inclusive on the Romanian Black Sea coast. Its spiny fruits are dispersed in many ways, but especially clinging to fur of animals or on the shoes and clothing of humans. Grazing cows and horses in the Danube Delta Biosphere Reserve, has facilitated the widespread of the rough cocklebur on the sand dunes where it replaces gradually the native psammophilous plants of the beaches. On the southern coast of Romania, this species is abundant in the disturbed habitats of the harbours of Midia and Constanta and on the sand dunes between Mamaia and Navodari.

Keywords: Coastal systems, Invasive species, Beach, Black Sea

The spread of invasive alien species poses a serious threat to the conservation of natural and semi-natural habitats (Weber, 2005). The invasive plants change the character, form or nature of ecosystems and they have a tremedous impact on the native floral communities. IUCN defines alien invasive species as "an alien species which becomes established in natural or semi-natural ecosystems or habitats, is an agent of change and threatens native biological diversity" (McNeely et al., 2001).
Xanthium strumarium subsp. *italicum (X. orientale subsp. italicum* (Moretti) Greuter; *X. italicum* Moretti) known as rough cocklebur is an annual plant native to North America, belonging to *Asteraceae* family. From America, it has been extensively naturalized elsewhere, including the Eastern and Central Europe. The burry fruits cling to the fur of animals and the clothing of humans, and are easily dispersed in this way. It has become invasive especially in disturbed habitats but also on the roadsides, along the riverbanks and on the sandy beaches (Fig. 1), where it replaces, gradually, the typical psammophilous species, some of which are rare plants.

Fig. 1. *Xanthium italicum* on the sand dunes between Mamaia and Navodari

In the Danube Delta Biosphere Reserve, *Xanthium italicum* is abundant within the plant communities *Elymetum gigantei* Morariu 1957 and *Cakilo euxinae-Salsoletum ruthenicae* Vicherek 1971, in the frame of the habitat types 2110 – Embryonic shifting dunes and 1210 - Annual vegetation of drift-lines. Large local populations with *Xanthium italicum* were observed on the beaches of Sulina, Sfantu Gheorghe, on Saraturile sandbank (between Sulina and Sf. Gheorghe), in Sacalin area, between Portita and Periteasca. Grazing cows and horses is a frequent activity in the Danube Delta Biosphere Reserve, especially close to villages and farms, and this fact facilitates the spreading of the spiny fruits of rough cocklebur on the sand dunes. Here, *Xanthium italicum* often develops large colonies, having a negative influence upon the floristic composition of the psammophilous plant communities, a typical behaviour of an invasive plant. South of Cape Midia, on the southern coast of Romania, *Xanthium italicum* is locally abundant in the area of the Midia and Constanta harbours (Fig. 2) and between Mamaia and Navodari (at approximately 5 km south from Midia harbour).

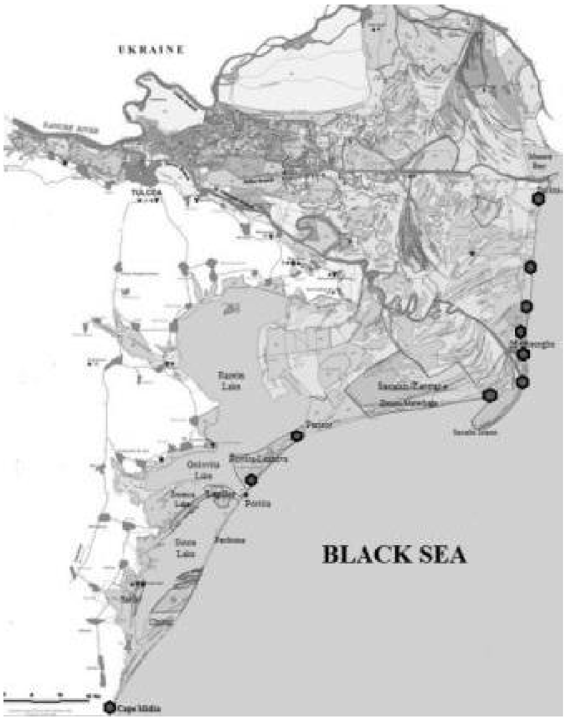


Fig. 2. Locations with large local populations of *Xanthium italicum* in the Danube Delta Biosphere Reserve

The harbours could be the main gate for the introduction of this taxa in the coastal area. In other locations, i.e. Constanta, Eforie Nord, Eforie Sud, Tuzla, Costinesti, Saturn, Mangalia, 2 Mai, Vama Veche, *Xanthium italicum* has been noticed only as a sporadic plant. On the northern coast of Bulgaria, *Xanthium italicum* grows abundantly on the sand dunes and has become co-dominant within the plant community *Xanthio italici-Leymetum sabulosi* Tzonev et al. 2005.
Field surveys were supported by the grant PN-II-PT-PCCA-2011-3.2-1427 of UEFISCDI, contract no. 69/2012 (project acronym ECOMAGIS).

References

1 - Weber E., 2005. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds, CABI Publishing, Oxon, UK.
2 - McNeely J.A., Mooney H.A., Neville L.E., Schei P.J., Waage J.K., 2001. Global Strategy on Invasive Alien Species. IUCN, Gland, Switzerland and Cambridge, UK.

EXOTIC FISHES IN THE MEDITERRANEAN – UPDATE, REAPPRAISAL AND TRENDS

D. Golani [1]*, L. Orsi-Relini [2], E. Massutí [3], J. Quignard [4], J. Dulcic [5] and E. Azzurro [6]
[1] Department of Evolution, Systematics and Ecology, The Hebrew University of Jerusalem, 91904 Jerusalem, Israel - dani.golani@mail.huji.ac.il
[2] Department of Earth, Environment and Life Sciences (DISTAV), Univ. of Genoa, Italy
[3] Instituto Español de Oceanografía Centre Oceanografic de les Balears, Palma de Mallorca, Spain
[4] Laboratoire d'Ichthyologie méditerranéenne, Université Montpellier II, France
[5] Institute of Oceanography and Fisheries, Split, Croatia
[6] High Institute of Environmental Protection and Research (ISPRA), Livorno, Italy

Abstract
As a quasi enclosed sea, the Mediterranean is particularly susceptible to the influence of exotic species. Since the last update of the CIESM Fish Atlas, in 2013, twenty exotic species were recorded. Many (13) of the newly reported taxa occur in the Red Sea and therefore can be considered as Lessepsian migrants.

Keywords: Alien species, Fishes, Lessepsian migrants, Eastern Mediterranean, Western Mediterranean

The phenomenon of alien species entering the Mediterranean continues without any sign of ceasing [1]. Since the last update [2], 20 new alien species have been recorded, including 13 recent Lessepsian (Red Sea origin) migrants which are: *Sardinella gibbosa* (Bleeker, 1849), *Encrasicolina gloria* Hata and Motomura, 2016, *Stolephorus indicus* (van Hasselt, 1823), *Bregmaceros nectabanus* Whitley, 1941, *Epinephelus areolatus* (Forsskåll, 1775), *Epinephelus geoffroyi* (Klunzinger, 1870), *Lutjanus fulviflamma* (Forsskål, 1775), *Plectorhinchus gaterinus* (Forsskål, 1775), *Parablennius thysanius* (Jordan and Seale, 1907), *Cryptocentrus caeruleopunctatus* (Rüppell, 1830), *Synchirops sechellensis* Regan, 1908, *Acanthurus chirurgus* (Bloch, 1787), *Zebrasoma xanthurum* (Blyth, 1852). The addition of these species brings the total number of Lessepsian fish migrants to over 100 [3].

The three other additions are recent migrants from the eastern Atlantic that have entered the Mediterranean via Gibraltar: *Taractes rubescens* (Jordan & Evermann, 1887), *Abudefduf hoefleri* Steindachner, 1881, *Zebrasoma flavescens* Bennett, (1828). Four species recently recorded in the Mediterranean are due to human intervention (e.g., aquarium or aquaculture escapees or from ballast water): *Chrysiptera cyanea* (Quoy & Gaimard, 1825), *Stegastes variabilis* (Castelnau, 1855), *Acanthurus coeruleus* Bloch and Schneider, 1801, *Balistoides conspicillium* (Bloch and Schneider, 1801). Unlike other marine taxa, fish species of alien origin in the Mediterranean rarely arrive via ballast water; if ballast water was a significant vector of alien fish, we would see in the Mediterranean many more species from non-adjacent regions.

The unprecedented influx of new fish species into the Mediterranean is clearly one of the major drivers of biodiversity change in this essential marine region.

References
1 - Golani, D. and B. Appelbaum-Golani, 2012. Red Sea fishes in the Mediterranean Sea – history and recent developments. In: *Life in the Mediterranean Sea: A look at habitat changes*. Stambler, N, (ed.). Nova Science Publishers, New York. 295-308 pp.
2 - CIESM, 2013. CIESM Atlas of Exotic Fishes in the Mediterranean Sea. Online website http://www.ciesm.org/atlas/appendix1.html (retrieved 18/11/2016).
3 - Seyhan, D., Irmak, E. and Fricke, R. (in press). *Diplogrammus* sp. (Pisces: Callionymidae), a new Lessepsian migrant recorded from the Mediterranean Sea. *Mediterranean Marine Science*.

VENI, VIDI, VICI: THE SUCCESSFUL ESTABLISHMENT OF THE LIONFISH *PTEROIS MILES* IN CYPRUS (LEVANTINE SEA)

C. Jimenez [1]*, A. Petrou [1], V. Andreou [1], L. Hadjioannou [1], W. Wolf [2], N. Koutsoloukas [3] and R. Abu Alhaija [4]
[1] Enalia Physis Environmental Research Centre, Cyprus - c.jimenez@enaliaphysis.org.cy
[2] QDivers, Agia Napa
[3] Ocean Aquarium, Protaras, Cyprus
[4] Energy, Environment and Water Research Center, Cyprus Institute, Cyprus

Abstract
A network of information set up in Cyprus in 2011 to monitor coral communities allowed for the establishment of the chronology of dispersion and abundance of the lionfish *Pterois miles*. Since localized first records in Autumn 2012, *P. miles* has successfully expanded to the rest of the island, except upstream, towards the eastern coast. Initially, solitary individuals were observed throughout the year at different stages of gonad maturation; during 2015, groups of up to five lionfish were frequently observed. There is an incipient consumption of lionfish flesh by locals.

Keywords: Alien species, Lessepsian migration, Levantine Basin, Suez Canal

Introduction
The Levantine Sea is among the Mediterranean basins mostly affected by exotic marine species. Not surprisingly, a large percentage of those are of Red Sea and Indo-Pacific origin, and their dispersion (as larvae or adults) is essentially through the Suez Canal. The dispersal and establishment of the emblematic lionfish (*Pterois miles* and *Pterois volitans*) in the Western Atlantic and Caribbean Sea during the last two decades have illustrated the capacity of exotic species to produce complex effects on local ecology. In the Mediterranean Sea, one single *P. miles* was observed in the early 1990s and only during the last three to four years its occurrence and abundance in the Levantine Basin has rapidly increased in what appears to be a "recent wave" [1] of very successful propagules.

Methods
By means of an island-wide network of collaborators in Cyprus (professional and recreational divers and fishermen, port and governmental authorities, volunteers and observers of opportunity) set up in 2011 initially to monitor coral communities and more recently lionfish, it was possible to acquire records of sightings, specimens and what is usually more difficult, a chronology of the dispersal and development of *P. miles* populations. Observers were asked to record or provide (by formulated interviews) a set of standard observations, such as number of individuals, estimated size, substrate, depth, locality, and, when possible, to capture specimens for taxonomic, morphometric, sexing (MEDITS protocol), genetic and stomach content analyses. Whenever possible, live specimens were kept in aquaria for observation.

Results
The taxonomy of nine specimens (14-29.4cm max. length; five males, stages 2 and 4; three females, stages 1 to 3; one not sexed) from different locations was resolved based on fin (dorsal and anal) ray meristics confirming that *P. miles* was found along the coast of Cyprus. Earliest records (Autumn 2012) were from the Southwestern area of Limassol (Fig. 1) of solitary juveniles (n=3, 5-10cm max. length) associated with rocky and coralligenous substrates between 20 and 35m depth. During the Winter 2012/13, other specimens (n=5, 10-25cm max. length, 15-20m depth) were observed at other rocky-coralligenous or artificial substrate locations of the Limassol and Cape Pyla areas (Fig. 1); two additional specimens were reported by local authorities in the national press. Sightings for the rest of 2013 (n=6, 15-20cm max. length, 10-30m depth) were restricted to those same areas. It is during 2014 that the number of lionfish specimens increased significantly (n=13, 8-30cm max. length, 10-25m depth) as well as the number of locations along the coast (Fig. 1). Noteworthy is the fact that until 2015 only solitary individuals were observed. In 2015, numerous reports (n=52, 8-30cm max. length, 2-35m depth) were made all over Cyprus except from the easternmost coast (Fig. 1); groups of 2 to 5 fish were observed. There are four independent reports of lionfish consumption by local fishermen. Spines and skin were carefully removed and the flesh grilled.

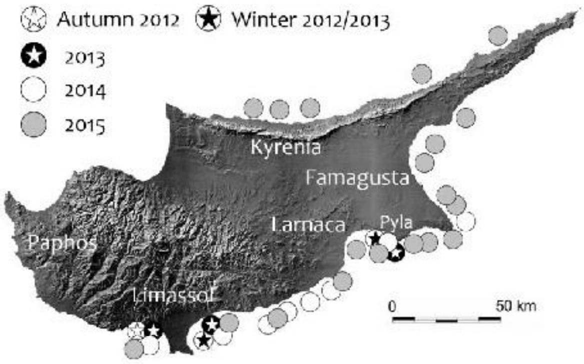


Fig. 1. Chronological distribution of lionfish reports in Cyprus.

Discussion and conclusions
Similar pattern of rapid increase in lionfish abundance and distribution has been observed elsewhere (e.g. Caribbean coast of Costa Rica). In Cyprus, initial reports were restricted mainly to two areas and in about three years *P. miles* started being observed along almost all coastal areas of the island. Currently, pairs or small groups of lionfish are known among local divers/fishers to be recruited to specific substrates (rocky and shipwrecks) in spite of high abundance of a known *P. miles* predator, the bluespotted cornetfish (*Fistularia commersoni*) [2]. The pattern of dispersal and abundance described here is not considered an artefact of sampling since lionfish are very conspicuous and hard to go unnoticed. Additionally, the same sampling effort occurs since 2011. These considerations suggest that for the lionfish in Cyprus, a "recent wave" of dispersal was followed by successful recruitment and survivorship is effectively in motion.

Acknowledgements
We thank the Cypriot community of fishermen and divers for reporting catches and sightings of lionfish from all around the island. Thanks are also due to the Department of Fisheries and Marine Research of Cyprus for their support to this study.

References
1 - Bariche, M., Torres and M., Azzurro, E., 2013. The presence of the invasive Lionfish *Pterois miles* in the Mediterranean Sea. *Mediterranean Mar. Sci.* 14: 292-294.
2 - Bernadsky, G. and Goulet, D., 1991. A natural predator of the Lion fish, *Pterois miles*. *COPEIA* 1: 230–231.

STATUS OF INVASIVE MARINE SPECIES IN THE LIBYAN COAST

Esmail A Shakman [1]*, Khaled S Etayeb [1] and Abdalha R Ben-abdallah [1]
[1] Zoology Department, Tripoli University, Libya - shugmanism@yahoo.com

Abstract
Thirty five marine species have invaded the Libyan coast from the red sea and Atlantic Ocean. More than 71% are fishes, 17.14% Mollusca and 11.43% Crustaceans. Three fish species have recorded for first time in the Libyan coast (*Sphoeroides pachygaster*, *Seriola fasciata* and *Seriola rivoliana*). Many of these species are successfully adapted to the different topography and environments of Libyan coast. However, some of these species become commercially valuable.

Keywords: Invasive species, Lessepsian migration, Libyan Sea

Introduction
Invasive species increased regional marine biodiversity in Mediterranean Sea, however, may alter the evolutionary pathway of native species by competitive exclusion, niche displacement, predation and other ecological and genetic mechanisms [5]. According to [7], bathymetrically speaking three areas may be distinguished along the coast of Libya; all are closely associated with major structural features of the African continent. Migrant invasive marine species have had an enormous impact on the eastern Mediterranean ecosystem; there has been no thorough study to assess this impact [4]. Many invasive marine species have been recorded in Libyan waters [1,6]. The objectives of this study are to present the status, distribution and characterization of invasive marine species along the entire Libyan coast.

Results and Discussion
This study documented thirty five marine invasive species in the Libyan waters, fishes represent the highest percentage (71%) followed by Mollusca, and crustaceans 17.14%, and 11.43 % respectively (Fig. 1).

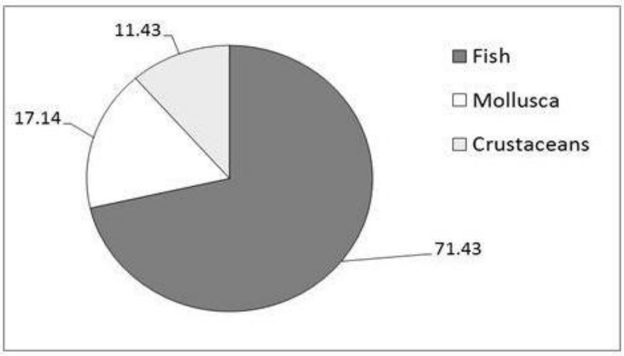


Fig. 1. Percentage of the invasive marine species in the Libyan coast.

Three fish species have been recorded for the first time in the Libyan waters: *Seriola rivoliana*, *Seriola fasciata* and *Sphoeroides pachygaster*. Most of the invasive migrants have been successfully adapted to the different topography and environments of Libyan coast [5]. As many invasive species, *Siganus luridus*, *S. rivulatus*, *Sphyraena chrysotaenia*, *S. flavicauda*, *Hemiramphus far* and *Fistularia commersonii* have become common along this coast, while other species such as: *Alepes djedaba*, *Upeneus pori*, *Upeneus maluccensis*, *Liza carinata*, *Sargocentron rubrum* and *Crenidens crenidens* were rare. The abundance of the invasive species differ according to the coastal main regions (Eastern, Sirt gulf and western), which may be due to a relation between the species' early arrival and the species abundance. [3] Suggested that there is a correlation between species that arrived earlier in the Mediterranean and their greater abundance. Most invasive migrant species are found in the coastal area and usually at depths of 1-50 m. As far as the distribution, most of the invasive species are concentrated in the eastern Libyan coast. For a better understanding of invasive immigration, additional taxonomic and biological investigations are required [2]. This study has shown that some of the invasive migrants have successfully adapted to the different topography and environments of Libyan coast and many species have become widespread along this coast, which means that they are contributing to the commercial fish catch in Libya.

Acknowledgements
We would like to thank the fishermen and the fishermen's union for their collaboration with us. Our thanks to the National Agency for Scientific Research (NASR) for support this project.

References
1 - Ben-Abdallah R., Alturky A., Fituri A. (2005) Records of exotic fishes in the Libyan coast. Libyan Journal of Marine Science 10: 1-8.
2 - Ben-Tuvia A. (1978) Immigration of fishes through the Suez Canal. Fishery Bulletin 76 (1): 249-255.
3 - Golani D. 1998. Impact of Red Sea fish migrants through the Suez Canal on the aquatic environment of the eastern Mediterranean. Bulletin of the Yale School of Forestry and Environmental Studies 103: 375-387.
4 - Golani D. 2002. Lessepsian fish migration-Characterization and impact on the Eastern Mediterranean. Pp. 1-9. In: Bayram Öztürk and Nuri Basusta (eds). Workshop on Lessepsian migration, 20-21 July 2002 Gökceada- Turkey.
5 - Mooney HA, Cleland EE (2001) The evolutionary impact of invasive species. Proceedings of the National Academy of Sciences of the United States of America, 98 , 5446 – 5451.
6 - Shakman E.A., Kinzelbach R. (2007). First record of the Sweeper fish *Pempheris vanicolensis* Cuvier, 1821 in the eastern part of the Libyan coast. Rostocker Meereskundliche Beiträge 18: 1-3.
7 - Sogreah E. (1977) Trawl fishing ground survey off the Tripolitania coast. Final Report. Part V: 1-44, and final report: Introduction and General Conclusions: 1-30.

CIESM Congress Session : Biogeography of aliens

Moderator's Synthesis

Not available

OCCURRENCE OF THE BLUE CRAB *CALLINECTES SAPIDUS*, RATHBUN, 1896, AND ITS FISHERIES BIOLOGY IN BARDAWIL LAGOON, SINAI PENINSULA, EGYPT

Fatma AbdelRazek [1]*, Marwa Ismaiel [1] and Mousa Ameran [2]
[1] National Institute of Oceanography and Fisheries, Alexandria, Egypt. - fatma_abdelrazek@hotmail.com
[2] General Authority for Fish Resources Development (GAFRD), Egypt.

Abstract
Callinectes sapidus, Rath. was firstly recorded in Bardawil Lagoon (BL) during the present study in 2015. It constitutes about 15% of the total catch while *Portunus pelagicus* is considered the major part in crab fishery in (BL). The size range of *C. sapidus* was from 65 mm to 155 mm (CW). The regression of width length relationship showed a marked deviation from isometric growth. Length–width and body weight regressions have also deviation from the isometric growth and the analysis of the covariance indicates that there is a significant difference between sexes with respect to length weight relationship.

Keywords: Crustacea, Levantine Basin, Fisheries, Lagoons

Introduction
The ecosystem of Bardawil Lagoon (BL) differs from the other Northern Delta Lakes of Egypt, as it is hypersaline and shallow in depth (Fig. 1).

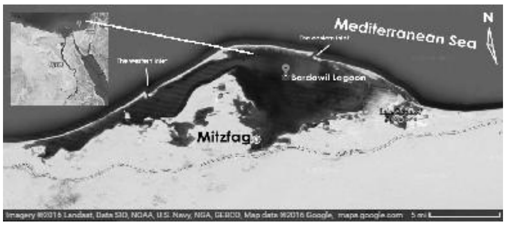


Fig. 1. A map showing the location of Bardawil Lagoon and the selected fishing area.

Crabs and shrimps are considered recently as one of the most important crustacean fishery resources in (BL) (Ameran, 2004; Ameran et al., 2009; Abdelrazek et al., 2006 & 2008; Mohamed and El-Aiatt, 2012). The increasing of crab production continued from 2000 to 2009 to reach about 38% of the total lagoon fisheries. By 2014 this production decreased to be 19% after fisheries regulations done during 2015 by preventing the use of the fishing trawl (Kalsa). Thus, crab catch increased to be 42% of the total lagoon production (Fig. 2) (GAFRD, 2015).

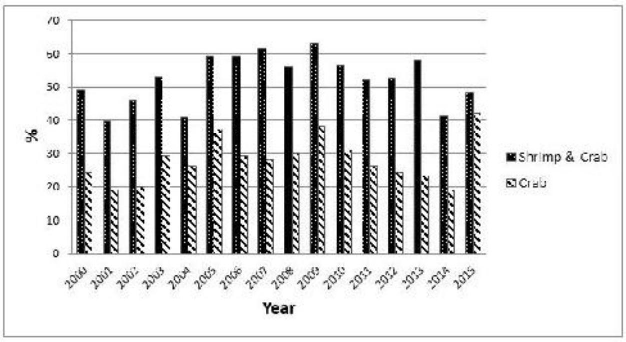


Fig. 2. Crustacean Fisheries in Bardawil Lagoon between the years 2000 - 2015.

Callinectes sapidus (Rath.) was firstly recorded in Lake Manzala, Egypt in 1940 and then in Lake Edku (Banoub, 1963). Ramadan and Dowidar (1972) mentioned that *C. sapidus* production was greatly affected by the high dam construction and decreased completely in the northern lakes as well as in the Mediterranean marine catch. In the present study, *C. sapidus* was recorded in (BL) from May to December (2015). The catch of *C. sapidus* is about 15% of total crab production while the remaining 85% is of the *Portunus pelagicus*. Materials and Methods: During the fishing season 2015 from May to December a monthly sample of crab catch from (BL) was collected from Mitzfag (Fig. 1). The sample was frozen and transported to NIOF laboratory. 140 individuals of *C. sapidus* were isolated and sexed, then, their carapace width, length and weight were measured using Vernier Caliper (0.05 mm accuracy). Regression equations were derived. Results and Discussion: The results showed that *C. sapidus* ranged from 65 mm to 159 mm in carapace width (CW) and from 52-303 g in weight (Wt). 105 mm CW is considered the main size group observed in its catch, smaller and larger sizes were represented with few individuals. The regression relationship of width length of *C. sapidus* were done. The (b) values were 0.9838, 0.9566 and 0.9267, respectively for males, females and combined sexes. The regression equations for the length- weight relationships were Wt = 0.004 CL3.133, WT = 0.008 CL2.931 and Wt = 0.004 CL3.1234 for males, females and combined sexes, respectively. The exponential values showed a marked deviation from the isometric growth. (r) values of for males, females and combined sexes were 0.9579, 0.9256 and 0.9512 respectively. The (b) values for the carapace width CW and body weight body Wt of males, females and combined sexes were 2.7693, 2.396 and 2.545 respectively, which represents a deviation from isometric growth pattern. The (r) values were 0.9838, 0.9566 and 0.9267 respectively. The analysis of covariance indicates that there is a significant difference between sexes with respect to length-weight relationship. The interrelationship between CW/Length and propodus length/depth for males and with abdomen width /length for females were done which suggested in most cases the positive relationship and the highly significant case. The ratio of females in *C. sapidus* population in Bardawil lagoon was in favor of males. In Turkish waters, the reverse was recorded in Beymelek lagoon *C. sapidus* population as the females were more than males (Sumer et al., 2013). In Brazil, a similar pattern was obtained for Babitonga Bay, with females dominating in most samples, while in the bay of Santos, Sao Paulo state, males dominated in samples. Thus, ratio may be related to the longevity and growth of crabs population, also to different migration pattern in the lagoon system and all these parameters seem to affect their relative occurrence.
Further studies on the population of *C. sapidus* and on the potential dispersal of this species in adjacent areas would be of interest to provide rich information on population structure and dynamics of the blue crab in Bardawil Lagoon.

References
1 - Abdel Razek,F.A. 1987. Crab fishery of the Egyptian waters with notes on the bionomics of *Portunus pelagicus* (L). Acta Adriatica, 28(1-2): 143-154.
2 - Abdel-Razek, F.A., Taha, S.M., Ameran, M.A., 2006. Population biology of the edible crab *Portunus pelagicus* (Linnaeus) from Bardawil Lagoon, northern Sinai, Egypt. Egypt. J. Aquat. Res. 32, 401–418.
3 - Ameran, M.A., 2004. Studies on the Crustacean Fishery in Bardawil Lagoon (Ph.D. thesis). Faculty of Environmental Agricultural Science, Al-Arish, Suez Canal University.
4 - Banoub, M.W. 1963. Survey of the Blue-Crab *Callinectes sapidus* (Rath.), in Lake Edku in 1960. Alexandria Institute of Hydrobiology, Notes and Memoirs 69: 1-20.
5 - GAFRD, 2015. Annual report of Bardawil Lagoon, The general authority for the development of fish resources (in press).
6 - Sumer, C., Teksam, I., Karatas,H., Beyhan, T., and Aydin, C.M., 2013. Growth and Reproduction Biology of the Blue Crab, *Callinectes sapidus*, Rathbun, 1896, in the Beymelek Lagoon (Southwestern Coast of Turkey). 13, 675-84.

BRACHYURAN CRABS ASSOCIATED WITH MARINE FOULING FROM EGYPTIAN MEDITERRANEAN HARBORS

Khaled M. Abdelsalam Ibrahim [1]* and Sherif E. Ramadan [1]
[1] National Institute of Oceanography and Fisheries, Egypt - kh.abdelsalam@gmail.com

Abstract
The present study deals with the brachyuran decapods associated with marine fouling in Egyptian Mediterranean harbors. Nine species of 9 genera affiliating to 5 families were recorded. Remarks on the species recorded are provided.

Keywords: Fouling, Decapoda, South-Eastern Mediterranean, Nile Delta

Introduction
Fouling is the growth of marine biota on submerged objects. Its investigation in Egypt dates back to 1960 [1]. Fouling harbors different organisms including brachyuran crabs.

Material and methods
Brachyuran crabs associated with marine fouling in 7 Egyptian Mediterranean harbors (Figure 1) collected between the years 1977 and 2015, were identified.

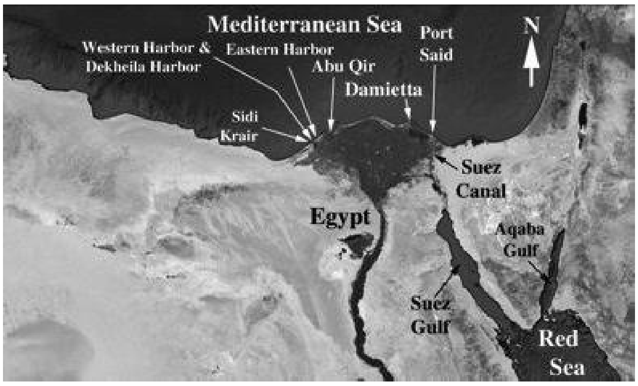


Fig. 1. Sampling localities.

Results and discussion
Through the present work 9 brachyuran crabs affiliating to 9 genera of 5 families were recorded, 5 of them (*i.e.* more than 55% of the total recorded species) are of Indo-Pacific origin (Table 1). These are *Coleusia signata*, *Hyastenus hilgendorfi*, *Charybdis hellerii*, *Pilumnopeus vauquelini*, and *Sphaerozius nitidus*. The other four species (*Liocarcinus depurator*, *Eriphia verrucosa*, *Pachygrapsus marmoratus*, and *Brachynotus sexdentatus*) are Atlanto-mediterranean in origin.

Tab. 1. Distribution of the recorded species in the studied harbors.

Harbor / Species	S.	DK.	W.	E.	A.	D.	P.	O.
C. signata							+	I
H. hilgendorfi							+	I
C. hellerii	+			+				I
L. depurator				+				A
E. verrucosa		+		+				A
P. vauquelini						+	+	I
S. nitidus							+	I
P. marmoratus						+	+	A
B. sexdentatus		+	+	+	+		+	A

S. = Sidi Krair (31° 03'N, 29° 40'E), DK. = Dekheila (31°08'N, 29°47'E), W. = Western (31° 11'N, 29° 52'E), E. = Eastern (31° 12'N, 29° 53'E), A.= Abu Qir (31° 19'N, 30° 04'E), D.= Dameitta (31° 28'N, 31° 45'E), and P.= Port Said (31° 16'N, 32° 19'E). O. = Origin, I= Indo-Pacific, A= Atlanto-Mediterranean.

Coleusia signata inhabits the entire Red Sea on muddy and sandy gravel bottoms from subtidal to 22 m deep. Its first appearance in the Mediterranean dates back to 1953 [2] and in Egypt dates back to 1969 [3]. *Hyastenus hilgendorfi* inhabits Indo-West Pacific region at 0-93 m on coarse and soft bottoms. In Mediterranean it exists since 1960 [4] and in Egyptian Mediterranean since 1969 [3].*Charybdis hellerii* inhabits Indo-West Pacific region and invaded the Western Atlantic [5]. Its depth range is 3-162 m on different types of bottoms [3]. It inhabits the Mediterranean since (1924-25) [5] and in the Egyptian Mediterranean since 1936 [6]. *Pilumnopeus vauquelini* inhabits Red Sea to Arabic Gulf; found in fouling, sandy mud and coarse bottoms at 0-3 m deep. Its first record in the Mediterranean was from Egypt in 1924 [7]. *Sphaerosius nitidus* inhabits Red Sea to japan in fouling and at 50 fathoms deep. Its record in Egypt and Mediterranean dates back to 1969 [3]. The presence of these 5 alien species associated to fouling may define the fouling attached to ship hulls as a mean of introducing these species to the Mediterranean Sea. The number of Indo-Pacific species recorded in the present study equals 1/3 of the total Indo-Pacific species procured in the Egyptian Mediterranean waters. More investigation may reveal more crab species associated to fouling in the Mediterranean.

References
1 - Banoub M.W., 1960. Notes on the fouling of glass plates submerged in the Eastern Harbour. Alexandria, 1958. Alex. Inst. Hydrobiol. Not. and Mem. 64: 1-17.
2 - Holthuis L.B., 1956. Notes on a collection of Crustacea Decapoda known from the Suez Canal. Zool. Meded. Leiden 34: 301-330.
3 - Ramadan Sh. E., 1976. Studies on Bottom Crustacea (Decpoda-Brachyura) in the region between Port Said and Alexandria , M.Sc. Thesis, Fac. of Sci., Alex.Univ., 258 pp.
4 - Lewinsohn C., Holthuis L. B., 1964. New records of decapod Crustacea from the Mediterranean coast of Israel and the eastern Mediterranean. Zoologische Mededelingen, 40: 45-63.
5 - CIESM, 2004. Atlas of Exotic Crustacea.
6 - Balss H., 1936. The fishery grounds near Alexandria, VII- Decapoda, *Note Mem. Fish. Res. Direct.* Egypt 15: 1-67.
7 - Calman W.T., 1927. Report on the Crustacea decapoda (Brachyura). Zoological Results of the Cambridge Expedition to the Suez Canal, 1924. XIII, *Trans. Zool. Soc. Lond.*, 22:211-217.

SPATIAL DISTRIBUTION AND MORPHOMETRIC CHARACTERIZATION OF THE INVASIVE SPECIES *CERITHIUM SCABRIDUM* PHILIPPE (1848) IN THE TUNISIAN COASTS

Nadia Ben Akkez [1], Wafa Boulajfene [2], Lotfi Rabaoui [3] and Sabiha Tlig Zouari [1]*
[1] Unité de Biologie intégrative et d'écologie évolutive et fonctionnelle des milieux aquatiques - s.zouaritlig@gmail.com
[2] Université Tunis El Manar Faculté des Sciences de Tunis, Unité de Biologie intégrative et écologie évolutive et fonctionnelle des milieux aquatiques
[3] Université Tunis El Manar Faculté des Sciences de Tunis, Unité de Biologie intégrative et écologie évolutive et fonctionnelle des milieux aquatiques

Abstract
This work is a contribution to the study of the spatial distribution and the morphology of the invasive species *Cerithium scabridum* along the coasts of Tunisia. Among the surveyed stations (18), only four situated in the Gulf of Gabes, revealed the presence of this Cerithe with a relatively large density values. The application of the Factorial Discriminant analysis (FDA) to the metric variables tmesured on specimens sampled from the Gulf of Gabes and the Persian Gulf, divided the stations into two groups significantly different. The isolation of the stations of Jerba seems to be related to environmental conditions favorable to the development of this species. <\/div>

Keywords: Gastropods, Lessepsian migration, Invasive species, Tunisian Plateau

Introduction
The invasive species *Cerithium scabridum* Philippi, 1848 is a prosobranch gastropod subservient to the infralittoral, It is among the first indo-pacific molluscan species recorded in the Suez Canal and then in the Mediterranean Sea. It was recently reported on the Tunisian coasts ([1]). The deficience of researchs on the eco-biology of this Cerithe led us to study its current distribution along the Tunisian coasts and to compare the shell morphology of the introduced specimens with that of individuals from their original environment (Persian Gulf).

Materials and methods
A total of 18 stations were surveyed along the coasts of Tunisia, in spring 2015. At each station containing *C. scabridum*, the density was evaluated using a quadrat of 0.25m² of surface at the rate of 5 replicates at each station and a sample of 30 individuals was collected. In addition, a sample of 30 individuals was brought from the Manifah station (Arabian Gulf). On each shell, metric variables were measured using an electronic caliper (1/100 mm) : Shell length (L), shell width (l), shell thickness (E), last whorl length (LDS), siphonal canal length (Ls), siphonal canal width (ls), aperture length (Lo), aperture width (lo). A factorial discriminant analysis (FDA) has been performed and Wilks test was applied to verify the significance of the difference between the groups obtained by FDA. In addition, the estimated percentages PCS was used to assign individuals into their original samples.

Results and Discussion
The study of the spatial distribution showed that the species was encountered alive only at four stations in the Gulf of Gabes namely: Zarzis a, Zarzis b, Jerba El Borj and Jerba Sidi Jmour. The density values were relatively important varying between 7 and 11 ind / m². The application of Kruskal-Wallis test on the measured variables revealed a highly significant difference between them at the limit of 1% reflecting a clear morphological variability between the studied samples. The results of the FDA performed on the metric variables showed that the two first axes explain 93% of the total variation (Fig. 1).

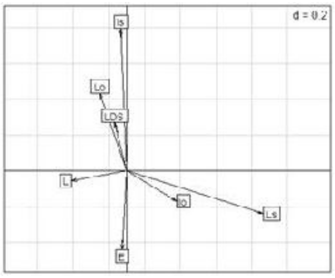


Fig. 1. Contribution of the variables in the formation of the two first discriminant functions

The barycentric representation of the factorial plan FDA (Fig 2) suggested the presence of two main groups: the first is the two stations of Jerba (Jerba El Borj, Jerba Sidi Jmour). The second includes the Zarzis stations and that of Manifah (Arabian Gulf). The Wilks test confirmed the significance of this difference (Wilks lambda = 0.036109, F = 27,143, $p < 0.05$). The calculated percentages of PCS are varying between 95% in Arabian Gulf and 98% in Jerba El Borj reflecting an intra-sample similarity.

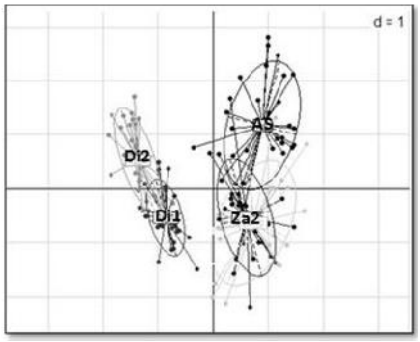


Fig. 2. Factorial Discriminant Analysis (FDA) of studied populations

The absence of *C scabridum* in the Gulf of Tunis despite its signalisation in previous works, seems revealing that the species wasn'i installed in abundance at this level and didn't yet constitute stable populations ([2]). Furthermore, the segregation of Jerba stations may be related to environmental conditions such as the availability of foods and space that appears to be suitable to the prosperity of this invasive species.

References
1 - 1- Enzenross L., Enzenross R. 2001. Untersuchungen uber das Vorkommen mariner Mollusken in tunesischen Gewasser. *Shriften sur malakozoologie*, 17: 45-62.
2 - 2- Antit M., Daoulatli A., Rueda J.L and Salas C. 2013. Temporal variation of the algae associated molluscan assemblage of artificial substrata in the Bay of Tunis (Tunisia). *Medeterranean Marine Science*, 14 (2):390-402.

ABUNDANCE OF INVASIVE ALIEN SPECIES (IAS) CAUGHT BY SMALL-SCALE FISHERIES OF LIPSI ISLAND, GREECE.

V. Buchet [1], M. Panagiotou [1]*, M. Drakulic [1], N. Rios [1] and A. Miliou [1]
[1] Archipelagos, Institute of Marine Conservation - mar.panagiotou@hotmail.com

Abstract
Recorded landings from artisanal fishermen of the Lipsi island complex, Greece, were analysed for abundance of IAS ichthyofauna. *Seriola fasciata*, *Siganus rivulatus*, *Siganus luridus, Sargocentron rubrum* and *Etrumeus teres* were landed. *Siganidae* sp. comprised 18% of the total catch biomass.The current study confirmed the presence of these IAS at a local scale.

Keywords: Invasive species, Aegean Sea, Fisheries, Alien species

The Aegean Sea, which poses many different anthropogenic influences, provides an opportunity to survey the presence of IAS. Landings from the local, small-scale fisheries gave precise data on IAS presence and abundance, on a local scale. This study was carried out in collaboration with Lipsi Island complex fishermen in order to map IAS distribution and calculate abundance. This is a baseline study to increase the understanding of the local distribution of IAS.

The study took place between April and October 2014 alongside small-scale Lipsi island fishermen. Of fishermen catch, species were identified and the length of each individual was measured and recorded on a daily basis. Gear characteristics, fishing techniques and the substrate type was also recorded. Data analysis was based on 144 landing surveys using long-line, trammel and gill nets. Using the formula $W = aL^b$, length was converted to weight (kg) and biomass per individual (kg) was estimated.

Throughout the sampling period, the majority of the IAS were landed in June and July 2014 whereas the lowest landings were recorded in September and October 2014 (Figure 1). Additionally, shallow waters that are less than 30 m depth had the highest landing rate of IAS.

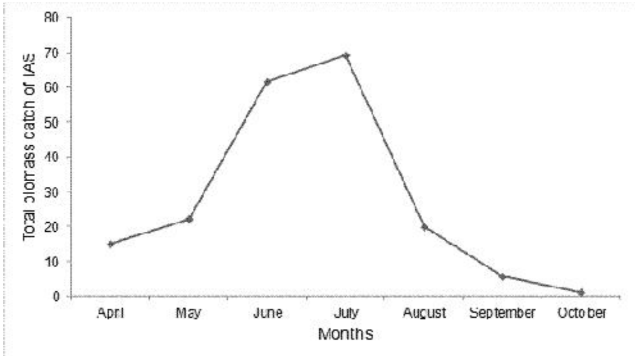


Fig. 1. Figure 1 Total biomass catch of monthly IAS landings in Lipsi island complex, 2014

70 species were identified during the landings, including 5 IAS with a total of 135 individuals: *Siganus luridus* (107), *Siganus rivulatus* (17), *Sargocentron rubrum* (6), *Seriola fasciata* (4) and *Etrumeus teres* (1). *S. luridus* had the second largest biomass caught in the total biomass of species landed in 2014 (Figure 2); this species contributed to 97.6 % of the IAS total biomass. The large presence of Siganidae sp. can be interpreted that the IAS could be dominant over many native biota of Lipsi. These IAS species have previously been recorded in Greek territorial waters, but not as far north as Lipsi island [1, 2].

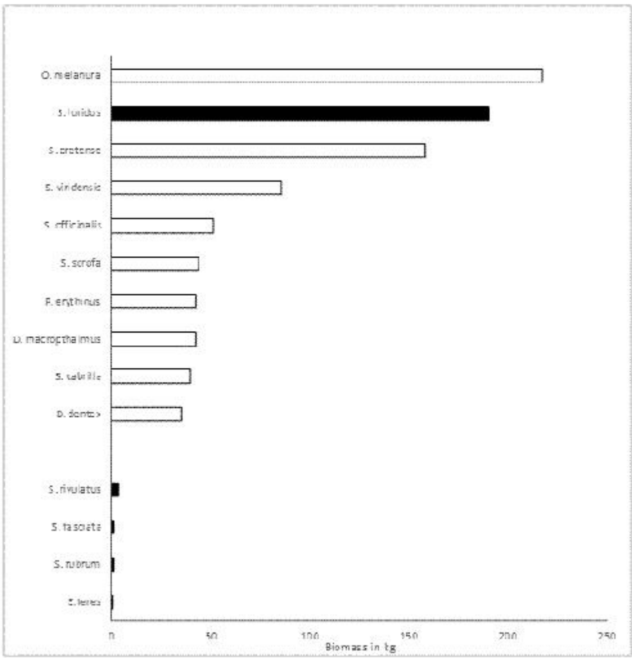


Fig. 2. Figure 2 – Total biomass of 14 caught species landed during the 2014 season – IAS in black, native species in white.

Close co-operation with artisanal fishermen is of great importance, allowing an efficient method to gather data on IAS abundance. However, only information on catchable species would be presented. Siganidae sp. contributed to a high proportion of the biomass caught of IAS whereas only four other IAS were reported, each with a low catch number. It is important to note that most of the IAS were caught in shallow waters; this could be linked to the species habitat preference or higher anthropogenic influences in these areas.

References
1 - ELNAIS. 2016. Elnais – DataBase | ELNAIS BY HCMR. [Online] Available at: http://elnais.hcmr.gr/elnais-database-2/ [Accessed 09 March 2016]
2 - Golani, D., Orsi-Relini, L., Massuti, E., Quingnard, J.P. 2002. CIESM Atlas of Exotic Species in the Mediterranean. Vol.1 Fishes, CIESM Publishers, *Monaco*; 254

NEWCOMER SPECIES FROM MALTESE WATERS: ADDITIONS AND AMENDMENTS

Julian Evans [1] and Patrick J. Schembri [1]*
[1] Department of Biology, University of Malta, Msida MSD2080, Malta - patrick.j.schembri@um.edu.mt

Abstract
The inventory of newcomers in Maltese waters is updated with the addition of 7 alien and 1 range-expanding species, while one previous entry in the inventory is omitted. Thus, a total of 72 alien and 8 range-expanding species have been recorded by February 2016. Half of these species have established populations in Maltese waters while a further 10% are considered to be invasive. The main modes of introduction for alien species in Maltese waters are 'Shipping' and 'Secondary dispersal' from elsewhere in the Mediterranean. More than half of these newcomer species were recorded since the year 2000.

Keywords: Species introduction, Alien species, Phytobenthos, Sicily Channel, Zoobenthos

Introduction

Timely updates to inventories of non-native species are essential to provide information on the distribution, introduction and dispersal pathways, and on impacts of such species. A total of 66 alien and 7 range-expanding species were confirmed from Maltese waters by December 2014 [1], but there have been a number of new records or changes in the status of previously recorded species since then, which are presented here (updated to February 2016). Definitions of establishment status and origin are as given in Evans *et al.*, 2015 [1].

Results and Discussion

New or updated records of newcomer species to be added to the Maltese inventory are listed in Table 1. The 2013 record of *Acanthurus monroviae* [2] was considered questionable [3], but is actually substantiated by a photo (J. Langenack, *pers. comm.*), while a second individual of this species was caught and photographed in November 2015. On the other hand, *Monticellina dorsobranchialis,* recently reported as a non-indigenous species in Maltese waters [4], is not included because it is known to be an Atlanto-Mediterranean species. A specimen of *Kyphosus* sp. was recorded from Malta in January 2016, but its specific identity could not be determined on the basis of photographs and this record was omitted from the inventory. Furthermore, *Stenothoe gallensis* should be removed from the inventory since this record was likely based on a misidentification of the native *S. cattai* [5].

Tab. 1. Additions (filled circles) or updates (empty circles) to the inventory of alien and range-expanding species from Maltese waters. *Vector*: A: aquarium trade, D: dispersal, RE: range expansion, S: shipping, U: unknown; *Status*: C: casual; E: established; *Origin*: A: alien; RE: range expansion.

Species	Date	Vector	Status	Origin	Ref
● *Apionsoma misakianum*	2005	U	E	A	[6]
● *Marittigrella fuscopunctata*	2015	S / D	E	A	[7]
○ *Ondina michaelae*	2009	S	C	A	[8]
○ *Portunus segnis*	1972	U	C	A	[7]
● *Acanthurus coeruleus*	2013	U	C	A	[3]
● *Acanthurus monroviae*	2013	U	C	A	[2]
● *Heniochus intermedius*	2014	U	C	A	[3]
● *Pomacanthus maculosus*	2012	S / A	C	A	*
● *Sargocentron hastatum*	2016	U	C	A?	**
Stegastes variabilis	○2013	U	○C	A	[9]
● *Enchelycore anatina*	2015	RE	C	RE	[10]

* Present authors, unpublished record
** Based on images published on social media

These updates bring the total number of newcomer species recorded from Maltese waters to 80, of which 72 are alien species with the remaining 8 having arrived via natural range expansion. Half of these species have established populations and a further 10% are considered invasive (Fig. 1a). Overall, 'Shipping' and 'Secondary dispersal' from elsewhere in the Mediterranean Sea are the most common introduction pathways for alien species into Maltese waters (Fig. 1b). More than half of the newcomer species were recorded since the year 2000, which is indicative of the accelerated rate of arrivals of new species in the last two decades.

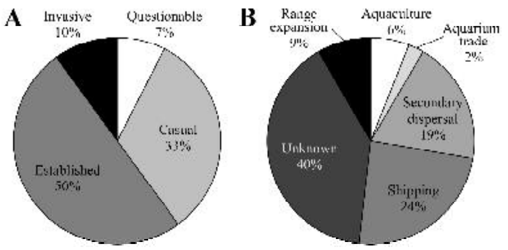


Fig. 1. Newcomer species recorded from Maltese waters by February 2016, grouped according to their (A) establishment success and (B) introduction pathway. All 80 newcomers were included in the analysis of establishment status, while species with a 'Questionable' status were excluded from the analysis of introduction pathways.

References
1 - Evans J., Barbara J. and Schembri P.J., 2015. Updated review of marine alien species and other 'newcomers' recorded from the Maltese Islands (Central Mediterranean). *Medit. Mar. Sci.*, 16(1): 225-244.
2 - Langeneck J., Boyer M., De Cecco P.G., Luciani C., Marcelli M. and Vacchi M., 2015. First record of *Acanthurus chirurgus* (Perciformes: Acanthuridae) from the Mediterranean Sea, with some distributional notes on Mediterranean Acanthuridae. *Medit. Mar. Sci.*,16(2): 427-431.
3 - Evans J., Tonna R. and Schembri P.J., 2015. Portent or accident? Two new records of thermophilic fish from the central Mediterranean. *BioInvasions Rec.*, 4(4): 299-304.
4 - Romeo T., D'Alessandro M., Esposito V., Scotti G., Berto D., *et al.*, 2015. Environmental quality assessment of Grand Harbour (Valletta, Maltese Islands): a case study of a busy harbour in the Central Mediterranean Sea. *Environ. Monit. Assess.*, 187: 747.
5 - Krapp-Schickel T., 2013. New or amended data on Mediterranean Amphipoda: genera *Dexamine*, *Ericthonius* and *Stenothoe*. *Zootaxa*, 3613(2): 125-145.
6 - Mifsud C. and Saiz Salinas J.I., 2012. A contribution to the knowledge of the phylum Sipuncula in the Maltese Islands (central Mediterranean). *The Central Mediterranean Naturalist* [Malta], 5(3-4): 20-25.
7 - Crocetta F., Agius D., Balistreri P., Bariche M., Bayhan Y.K., *et al.*, 2015. New Mediterranean biodiversity records (October 2015). *Medit. Mar. Sci.*, 16 (3): 682-702.
8 - Cachia C. and Mifsud C., 2015. Considerations about *Leucotina eva* Thiele, 1925 with description of *Ondina michaelae* n. sp. (Heterobranchia: Pyramidellidae). *Triton*, 31: 3-5.
9 - Vella A., Agius Darmanin S. and Vella N., 2015. Morphological and genetic barcoding study confirming the first *Stegastes variabilis* (Castelnau, 1855) report in the Mediterranean Sea. *Medit. Mar. Sci.*, 16(3): 609-612.
10 - Deidun A., Watson D., Castriota L., Mazza G. and Pasolli L., 2015. First record of the fangtooth moray, *Enchelycore anatine* (Actinopterygii: Anguilliformes: Muraenidae), from Maltese waters, Central Mediterranean. *Acta Ichthyol. Piscat.*, 45(3): 315-317.

CIESM Congress Session : Exotic species - fluxes and vectors across seas

Moderator : Henn Ojaveer, Marine Inst., Tartu Univ., Estonia

Moderator's Synthesis

One of the most pressing issues relative to management of new species introductions is uncertainty in our knowledge to assign individual introductions not only to vectors, but even to responsible pathways. Such an uncertainty is also relevant for Mediterranean Sea introductions, and relates to invasions though the Suez Canal (is the invasion vector the canal itself or shipping occurring via the canal).

Although prevention should be in focus in reducing the risk of new introductions in the marine realm, and so the management focus should be invasion vectors, knowing the source of the species is of vital importance. This knowledge may help to better identify the habitat requirements / tolerance limits, suggest the likely invasion vector(s), and design more appropriate mitigation measures. But the deeper we look in the past, the less we know on the origin of non-native species. Therefore, knowing the species origin will play a crucial role for more recent and also future introductions.

The International Convention for the Control and Management of Ships' Ballast Water and Sediments will enter into force in September 2017. Thus, one of the vectors for major species introductions globally will be managed very soon. However, although ship hull fouling has been proven to be an essential invasion vector, no regulation or voluntary guidelines exist for it. This should be considered as an important gap in reducing the risk for new species introductions currently.

DONOR AND RECIPIENT REGIONS FOR EXOTIC SPECIES OF MARINE MACROPHYTES: A CASE OF UNIDIRECTIONAL FLOW, THE MEDITERRANEAN SEA

Charles F. Boudouresque [1], Michele Perret-Boudouresque [1]* and Marc Verlaque [1]
[1] Mediterranean Institute of Oceanography (MIO) Aix-Marseille University - charles.boudouresque@univ-amu.fr

Abstract

The Mediterranean Sea is the recipient area for two major flows, at a world scale, of exotic macrophytes: (i) the Lessepsian pathway, based upon the Suez Canal, with the Red Sea as the donor area; (ii) the Japan pathway, based upon the transfer of molluscs. The flows in the opposite direction, stemming from the Mediterranean, are null or negligible, making this sea a kind of sink for species diversity.

Keywords: Phytobenthos, Algae, Mediterranean Sea, Biodiversity

An exotic species (= NIS, Non Indigenous Species), in a recipient area, is a species that has been transported by Man from a distant donor region (i.e. an area non-contiguous to the recipient area). Within exotic species, introduced species are species that can self-reproduce without human assistance (= established species, naturalized species). Within introduced species, invasive species are harmful species, either for other species and ecosystem functioning, the economy and/or human health. Within invasive species, transformer species are species that are autogenic ecosystem engineers and therefore build a new ecosystem, completely distinct from the native one [1-3]. The notion of 'biological invasions' encompasses the full range of these degrees. A biological invasion involves a donor area, a recipient area, a vector (e.g. a ship), a corridor (e.g. the pathway sailed by a ship) and of course a candidate species [3].

The Mediterranean is the area most impacted worldwide by biological invasions. ~1 000 exotic taxa have been recorded [4-7]. The main vectors are fouling and clinging on ship hulls, the species accompanying oyster culture, ballast waters, the aquarium trade and the Suez Canal [4, 7].

The flow of Red Sea species into the Mediterranean Sea, via the man-made Suez Canal ('Lessepsian migration'), is often considered as the major modern biogeographical event, at the Holocene scale [10]. Hundreds of Red Sea species, including 39 species of macrophytes (e.g. the Rhodobionta *Chondria pygmaea*, *Galaxaura rugosa* and *Hypnea anastomosans*, the Magnoliophyta *Halophila stipulacea*, the stramenopile *Stypopodium shimperi*), have entered the Mediterranean through this waterway since the 19th century [7,9]. Because of the recent enlargement of the Suez Canal, this flow is expected to dramatically intensify [10]. The flow is unidirectional. The migration in the opposite direction, i.e. from the Mediterranean to the Red Sea ('anti-Lessepsian migration'), is negligible, because of the mainly unidirectional water flow (Red Sea towards the Mediterranean) [8,9]. No Mediterranean macrophytes have been found to occur in the Red Sea.

Perhaps equivalent, in worldwide magnitude, is the flow of north-western Pacific macrophytes, from Japan, Korea and adjacent areas, towards other regions such as the North American Pacific, Australia, Atlantic European coasts and the Mediterranean Sea. This global bioinvasion event is due to the transfer of oysters (*Crassostrea gigas*, adults and spat) and Manila clams (*Ruditapes philippinarum*) from the north-western Pacific to other areas. The Mediterranean is probably the hardest-hit region worldwide. Between 40 and 50 species of macrophytes have been directly or indirectly (mainly via the North American Pacific coast and the north-eastern Atlantic coasts) introduced into the Mediterranean from the north-western Pacific Ocean. The most invasive species are *Sargassum muticum*, *Undaria pinnatifida* and *Codium fragile*. Their effect on native ecosystems is dramatic. Like the Red Sea-Mediterranean flow, the 'Japan path' is unidirectional: no seaweed species, or just a very few, have taken the opposite path.

The Mediterranean Sea can constitute a kind of 'hub' for Red Sea and 'Japanese' species. For instance, the Red Sea Magnoliophyta *Halophila stipulacea*, once introduced into the Mediterranean, was exported to the Caribbean Sea. The Japanese stramenopile *Undaria pinnatifida*, once introduced into the Mediterranean Thau Lagoon (southern France), has been exported to the north-eastern Atlantic Ocean (Brittany and Galicia).

Overall, the Mediterranean constitutes a sink for exotic marine macrophytes: incomings are massive, whereas outgoings are null or negligible. Could a similar mechanism, at the geological timescale, account for its very high species diversity, making the Mediterranean Sea the main hotspot worldwide for macrophytes species diversity?

References

1 - Boudouresque C.F. and Verlaque M., 2002. Biological pollution in the Mediterranean Sea: invasive versus introduced macrophytes. *Mar. Poll. Bull.,* 44: 32-38.
2 - Boudouresque C.F. and Verlaque M., 2012. An overview of species introduction and invasion processes in marine and coastal lagoon habitats. *Cah. Biol. Mar*., 53(3): 309-317.
3 - Boudouresque C.F., 1999. Introduced species in the Mediterranean : routes, kinetics and consequences. *Proceedings of the workshop on invasive Caulerpa in the Mediterranean.* Heraklion, Crete, Greece, 18-20 March 1998. UNEP publ., Athens, Greece : 51-72.
4 - Ribera M.A. and Boudouresque C.F., 1995. Introduced marine plants, with special reference to macroalgae: mechanisms and impact. *Progress in Phycological Research*, Round F.E. and Chapman D.J. (eds), Biopress Ltd publ., UK , 11: 187-268.
5 - Galil B.S., 2000. A sea under siege – alien species in the Mediterranean. *Biol. Inv.,* 2: 177-186.
6 - Zenetos A., Gofas S., Verlaque M., Cinar M.E., García Raso J.E., Bianchi C.N., Morri C., Azzurro E., Bilecenoglu M., Froglia C.,Siokou S., Violanti D., Sfriso A., San Martín G., Giangrande A., Katagan T., Ramos-Esplá A., Mastrototaro F., Ocaña O., Zingone A., Gambi M.C. and Streftaris N., 2010. Alien species in the Mediterranean Sea by 2010. A contribution to the application of European Union's Marine Strategy Framework Directive (MSFD). Part I. Spatial distribution. *Mediterr. Mar. Sci.,*11(2): 381-493.
7 - M., Ruitton S., Mineur F. and Boudouresque C.F., 2015. CIESM Atlas of exotic species. 4. Macrophytes. Briand F. (ed.), CIESM Publisher, Monaco: 1-362.
8 - Por F.D., 1978. Lessepsian migrations. The influx of Red Sea biota into the Mediterranean by way of the Suez Canal. Springer publ., Berlin: i-viii + 1-228.
9 - Boudouresque C.F., 1999. The Red Sea - Mediterranean link: unwanted effects of canals. *Invasive species and biodiversity management*, Sandlund O.T., Schei P.J., Viken A. (eds.), Kluwer Academic publ.: 213-228.
10 - Galil B., Boero F., Fraschetti S., Piraino S., Campbell M., Hewitt C., Carlton J., Cook E., Jelmert A., Macpherson E., Marchini A., Occhipinti-Ambrogi A., Mckenzie C., Minchin D., Ojaveer H., Olenin S. and Ruiz G., 2015. The enlargement of the Suez Canal and introduction of non-indigenous species to the Mediterranean Sea. *Limnol. Oceanogr. Bull.*, 24(2): 43–45.

TEMPERATURE TOLERANCE OF TWO AMPHIPOD SPECIES UNDER KIEL FJORD CONDITIONS: BALTIC *VS.* CASPIAN SEA SPECIES

Isabel Casties [1]* and Elizabeta Briski [1]
[1] GEOMAR Helmholtz Centre for Ocean Research Kiel - icasties@geomar.de

Abstract
In this study, we tested temperature tolerance of two amphipod species, one originating from the Baltic Sea (*Gammarus oceanicus*) and another from the Ponto-Caspian region (*Pontogammarus maeoticus*) to determine their performance under current and future global warming scenarios. Both amphipod species perform rather similar in temperatures from 6 to 22°C. However, above 24°C, only *P. maeoticus* survived, indicating that in the case of global warming *P. maeoticus* that evolved under higher temperatures of the Caspian Sea might outcompete *G. oceanicus*, which evolved under lower temperatures of the Baltic Sea.

Keywords: NIS, Temperature, Baltic Sea, Caspian Sea

New non-indigenous species are constantly arriving to the Baltic Sea, most likely via ballast water, hull fouling and/or aquaculture [1,2]. A relatively high number of those species originate from the Ponto-Caspian region (*i.e.*, Black, Azov and Caspian Seas) [3], with some of them, such as the amphipod *Echinogammarus ischnus*, known to have high impact on local communities and ecosystem functioning [1]. In addition, future global warming may open new environmental and niche opportunities for continuously arriving species [4]. Here, we tested temperature tolerance of two amphipod species, one originating from the Baltic Sea (*Gammarus oceanicus*) and another from the Ponto-Caspian region (*Pontogammarus maeoticus*) to determine their performance under current and future temperature conditions. *P. maeoticus* has been chosen due to its invasion history in freshwater areas of Turkey, but not in the Baltic Sea [1,2,5].

Specimens of *P. maeoticus* and *G. oceanicus* were collected in October 2014 in South Caspian Sea (Iran) and in May 2015 in Kiel Fjord (Germany), respectively. The species were kept at their natural salinity and temperature until the common garden experiment started (*i.e.*, 18°C, 10 ppt and 16°C, 16 ppt, respectively). The experiment was performed in Kiel in November and December 2015, and consisted of a control, a warm (increasing temperature) and a cold (decreasing temperature) treatment. Each treatment was replicated three times with ten individuals of each species per replicate. Two 1-l beakers with mesh on the sides, each containing one species, were submerged in a tank allowing water exchange, but preventing direct contact between species (*i.e.*, one replicate). The salinity during the whole experiment was 16 (±0.2) ppt, light/dark cycle was 12:12 hours, and the starting temperature was 16°C. During the experiment, temperature was decreased/increased by 2°C every three days until reaching 6 or 28°C. Animals were fed ad libitum with a mixture of algae flakes. Water was exchanged every three days by replacing half of the volume. Temperature and salinity were monitored every day, while survival was checked every three days during the water exchange.

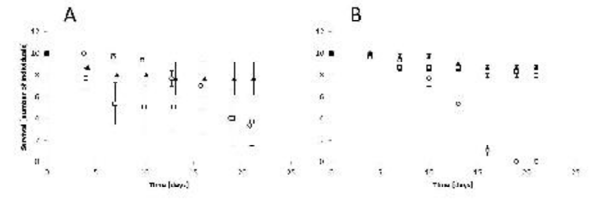


Fig. 1. Survival rates (abundance: mean ± SE, N=3 each) for *Pontogammarus maeoticus* (**A**) and *Gammarus oceanicus* (**B**) at three different temperature treatments (control (white square), warm (white circle) and cold (black triangle)). In (**A**) data points of the same day were slightly shifted to better distinguish the error bars of the different treatments.

At the end of the experiment, survival of *P. maeoticus* was between 0 and 90%, 30 and 40%, and 40 and 100% in the control, warm, and cold treatment, respectively (Fig. 1A). In the warm treatment, survival was rather high until 22° C (90 to 100%; Fig. 1A). In the case of *G. oceanicus*, survival was between 70 and 90%, 0%, and 80 and 100% in the control, warm, and cold treatment, respectively (Fig. 1B). In the warm treatment, all *G. oceanicus* died at 26°C (Fig. 1B).

The present study revealed that both amphipod species perform rather similar in temperatures from 6 to 22°C. Survival rates of *P. maeoticus* varied in the control treatment, which might be due to the salinity change that the species experienced during the experiments. Nevertheless, *P. maeoticus* survived relatively well in the warm treatment, while all *G. oceanicus* died up to 26°C. Our study predicts that in the case of global warming *G. oceanicus*, which evolved under lower temperatures of the Baltic Sea, would not be able to compete with *P. maeoticus* that evolved under higher temperatures of the Caspian Sea. Salinity stress and chemical composition of the Baltic Sea water had less effect on *P. maeoticus* than temperature stress on *G. oceanicus* which indicates that *P. maeoticus* have potential to become a non-indigenous species in Kiel Fjord and probably the Baltic Sea.

References
1 - Leppäkoski E., Gollasch S., Gruszka P., Ojaveer H., Olenin S., and Panov V. 2002. The Baltic - a sea of invaders. *Can. J. Fish. Aquat. Sci.* 59: 1175-1188. (doi: 10.1139/f02-089)
2 - Molnar J.L., Gamboa R.L., Revenga, C. and Spalding M.D. 2008. Assessing the global threat of invasive species to marine biodiversity. *Front. Ecol. Environ.*6: 485-492. (doi: 10.1890/070064)
3 - Casties I., Seebens H. and Briski E. submitted. Importance of geographic origin for invasion success: a case study of the North and Baltic Seas *versus* the Great Lakes-St. Lawrence River region. *Ecol. Evol.*
4 - Hellmann J.J., Byers J.E., Bierwagen B.G. and Dukes J.S. 2008. Five potential consequences of climate change for invasive species. *Conserv. Biol*. 22: 534-543. (doi: 10.1111/j.1523-1739.2008.00951.x)
5 - Ozbek M. 2011. Distribution of the Ponto-Caspian Amphipods in Turkish Fresh Waters: An Overview. *Mediterr. Mar. Sci.* 12: 447-453. (doi: 10.12681/mms.44)

LIVE SEAFOOD IMPORTATION AS A POTENTIAL VECTOR FOR ALIEN INTRODUCTION IN THE TARANTO SEAS (SOUTHERN ITALY, MEDITERRANEAN SEA)

E. Cecere [1], M. Belmonte [1], G. Portacci [1], F. Rubino [1]* and A. Petrocelli [1]
[1] CNR-IAMC - rubino@iamc.cnr.it

Abstract

Importation of edible molluscs represents one of the main cause of introduction of alien species throughout the world. Intervalvar water and shells of mollusc imported to the Taranto market were investigated to assess the presence of alien micro- and macroalgae. Up to now, only one alien species was found, and this confirms that the risk of possible future introduction is still lurking.

Keywords: Alien species, Bivalves, Mediterranean Sea, Algae, Ionian Sea

Introduction

The use of exotic seafood in the human diet, mainly bivalve molluscs, is well-established throughout the world nowadays, and has historical basis [1]. Generally, it was started to cover some shortage of the local aquaculture production or even to diversify market supply. However, up to the second half of the last century, there was no idea of the possible damages caused by such an activity [1]. That way, the translocation of these organisms led to the introduction of several alien species, which caused environmental and health harms of different extent [2]. Therefore, localities where seafood importation is massive, are particularly exposed to this hazard. At Taranto, in 2014, about 1,200 tons of molluscs were imported [3]. Here we report the results of a research carried out on molluscs imported to the Taranto market for consumption, to detect possible alien hitchhikers.

Materials and methods

Three specimens of: *Crassostrea gigas* Thunberg, 1793 from France and Spain, respectively, *Venerupis phillippinarum* A. Adams & Reeve, 1850 from the Venice Lagoon, *Mytilus galloprovincialis* (Lamarck, 1819) from Spain and *Modiolus barbatus* Linnaeus, 1758 from Greece, were collected directly from trucks, before arriving to distribution centres. Once in the laboratory, firstly, the intervalvar water was removed from the molluscs, and analysed. Successively, three shells for each batch were put into culture cells, and maintained in seawater for three months with plain air bubbling, in order to assess the presence of epibionts. Periodically, the culture medium was completely and warily changed. At the end of the culture time, each shell was observed under a stereomicroscope to detect all the possible developed epibionts.

Results and Discussion

The analysis of the intervalvar water showed the presence of six different taxa (Tab. 1). Cells of the diatom *Gyrosigma* sp. and the adult of an unidentified copepod were found in *C. gigas* from France. Cells of the potentially toxic dinoflagellate *Prorocentrum* cf. *micans*, cysts of *Alexandrium* sp. and an unidentified ciliate were found in the intervalvar water of *M. barbatus*. Cells of the diatom *Licmophora* sp. and an unidentified ciliate were observed in the intervalvar water of M. galloprovincialis.

Tab. 1. List of micro-and macroalgae found in and on analysed bivalves, respectively. F= France, S=Spain. * alien species

	C. gigas F	*C. gigas* S	*V. philippinarum*	*M. galloprovincialis*	*M. barbatus*
Microalgae					
Alexandrium sp. (cyst)					–
Gyrosigma sp.	+	-	-	-	-
Licmophora sp.					
Prorocentrum cf. *micans* Ehrenberg	-	-	-	-	–
Macroalgae					
**Asparagopsis taxiformis* (Delile) Trevisan de Saint-Léon	-	-	-	-	–
Bryopsis sp.	+	-	-	-	-
Chaetomorpha sp.	+	-	-	-	-
Cladophora sp.	-	+	-	-	-
Dictyota sp.	+	-	-	-	-
Ectocarpus sp.			+		
Hincksia ovata (Kjellman) P.C.Silva	+	-	-	-	-
Lomentaria clavaeformis Ercegovic	+	-	-	-	-
Polysiphonia subulata (Ducluzeau) Kützing	-	+	-	-	-
Pterothamnion plumula (J. Ellis) Nägeli	+	-	-	-	-
[illegible] Reinsch	+	-	-	-	-
Ulva sp.	+	+			
Total	8	3	1	1	3

Concerning shell analysis, they appeared uncolonised to the naked eye, but at the end of the culture period, eight thalli of macroalgae were detected developed on *C. gigas* from France, three on *C. gigas* from Spain, one on *V. philippinarum* and one on *M. barbatus.* No epibionts were found on *M. galloprovincialis.* All the thalli were very small, and in most cases sterile, so that their taxonomical identification was performed only to the genus level. In case of fertile thalli, species identification was possible (Tab. 1). From those observations, *C. gigas* confirms to be the mollusc *par excellence* for the settlement of macroalgae on its shells. Indeed, as already observed in previous studies in other Transitional Water Systems in Italy [4], and elsewhere [5], its rough surface holds sediment particles and propagules, favouring the species settlement. Concerning aliens, in our study, only one species, i.e. the tetrasporic phase of *Asparagopsis taxiformis* (Delile) Trevisan de Saint-Léon, was detected on bivalve shells. This phase, previously known as a distinct species, i.e. *Falkenbergia hillebrandii* (Bornet) Falkenberg, was recently reported in the Mar Piccolo of Taranto, but no hypothesis about the vector of introduction was formulated [6]. Since in Taranto, notwithstanding the rules in force, imported molluscs are often improperly stored into the sea up to the sale, and their shells are jettisoned after consumption onto the bottom [3], it is most likely that *A. taxiformis* was introduced through live seafood. Therefore, it is necessary to be always vigilant. Indeed, even though in intervalvar water and on the other mollusc surfaces no alien was detected, the continuous importation of live seafood, the presence of viable microalgal cells in the intervalvar water and of macroalgal propagules on shell surface, and the capacity of the developed thalli to form reproductive structure, are all factors predisposing to the introduction of aliens.

Research carried out within the framework of the Flagship Project RITMARE

References

1 - Wolff W.J. and Reise K., 2002. Oyster imports as a vector for the introduction of alien species into northern and western European coastal waters. *In*: Leppäkoski E., Gollasch S., Olenin S. (eds), Invasive aquatic species of Europe. Distribution, impacts and management, Kluwer Academic Publishers, Dordrecht, pp. 193-205.

2 - Mineur F., Le Roux A., Maggs C.A. and Verlaque M., 2014. Positive feedback loop between introductions of non-native marine species and cultivation of oysters in Europe. *Conserv. Biol*., 28: 1667-1676.

3 - Cecere E., Petrocelli A., Belmonte M., Portacci G. and Rubino F., 2015. Activities and vectors responsible for the biological pollution in the Taranto seas (Mediterranean Sea, southern Italy): a review. *Environ. Sci. Pollut. Res.*: DOI 10.1007/s11356-015-5056-8

4 - Manghisi A., Morabito M., Bertuccio C., Le Gall L., Couloux A., Cruaud C. and Genovese G., 2010. Is routine DNA barcoding an efficient tool to reveal introductions of alien macroalgae? A case study of *Agardhiella subulata* (Solieriaceae, Rhodophyta) in Cape Peloro lagoon (Sicily, Italy). *Cryptogamie, Algol.*, 31: 423-433.

5 - Verlaque M., Boudouresque C.F. and Mineur F., 2007. Oyster transfers as a vector for marine species introductions: a realistic approach based on the macrophytes. *CIESM Workshop Monographs*, 32: 39-47.

6 - Bottalico A., Russo C., Pati R., 2015. Sulla presenza del genere *Asparagopsis* Montagne (*Bonnemaisoniales*, *Rhodophyta*) in Puglia (Italia meridionale). *Informatore Botanico Italiano*, 47: 291-313.

ASSESSING THE POTENTIAL OF SUEZ CANAL SHIPPING TRAFFIC AS AN INVASION PATHWAY FOR NON-INDIGENOUS SPECIES IN CENTRAL MEDITERRANEAN HARBOURS

A. Deidun [1], F. Andaloro [2], C. Berti [2], P. Consoli [2], M. D'Alessandro [3], V. Esposito [2], G. Scotti [2], G. Galofaro [4], T. Romeo [2] and K. Agius [1]*
[1] Physical Oceanography Research Group, University of Malta - karl.agius.05@um.edu.mt
[2] Institute for Environmental Protection and Research
[3] University of Messina
[4] University of Catania

Abstract
The shipping traffic visiting seven Central Mediterranean ports within Sicily and Malta over a period of one year (2013) and the ballast water volumes it transported was quantified and classified according to port of origin in order to assess the influence of traffic navigating through the Suez Canal on the marine biota of the same geographical area. Scraping and benthic sediment collection exercises were also conducted within the same ports and a list of non-indigenous species is reported.

Keywords: Alien species, Mediterranean Sea, Suez Canal

Introduction

Shipping is the leading vector for trade in the world and alone is currently responsible for moving round over 80% of the world commodities (UNCTAD/RMT, 2014). Concurrently, the global shipping sector moves around approximately three to five billion tons of ballast water internationally every year (GLOBALLAST, 2015). Although ballast water operation is essential for any type of vessel to carry out safe and efficient cargo operations, such a process also constitutes a serious threat to ecological, economic and human health systems due to the inadvertent introduction of invasive aquatic species within new marine regions. In the Mediterranean Sea, these dynamics and concerns are even more pronounced due to its status as a biodiversity hotspot and its' simultaneous importance as a shipping transit route, crystallized within the recent expansion of the Suez Canal, completed on the 6th of August 2015, which should double vessel traffic within the Canal, with the current average of 49 transits per day expected to increase to 97 passages per day (SCA, 2015).This paper aims to makes a preliminary consideration of the real potential of Suez Canal shipping traffic as an invasion pathway for non-indigenous marine species to a number of Central Mediterranean ports.

Materials & Methods

A total of 5 harbours in Sicily (Catania, Siracusa, Lampedusa, Augusta, Porto Empedocle) and 2 in Malta (La Valletta, Marsaxlokk) in the Central Mediterranean have been investigated in the current study. Maritime traffic data has been gathered from the harbour masters in Sicily and from the Transport Authority ofMalta during 2013 and organized in a database. From the total cohort of vessels within the database, only the data for the vessel category 'Tankers' was extracted since this was recognized as the main vector for the spread of alien species, by virtue of the enormous amount of ballast water that couldpotentially betransported by such vessels. Two extremes (7% and 54% of Gross Registered Tonnage [GRT]) have been adopted by different authors for measuring the minimum and maximum volumes of ballast water that could potentially be discharged within destination ports. For each individual port, the total volume of ballast water coming in, as well as the fraction of ballast hailing directly from ports beyond the Suez Canal, was calculated. Within the framework of the BIODIVALUE project (www.biodivalue.com), four of the Central Mediterranean ports (Valletta, Marsaxlokk, Augusta, Siracusa) under investigation were chosen for sediment and hard bottom (fouling assemblage) pilot sampling. The origin of all identified marine species was classified as Suez, Black Sea, Atlantic and Mediterranean. Fouling assemblages settled on jetties and wharves falling within a 0.5m x 0.5m quadrat were scraped off and collected underwater within a fine-mesh bag. Soft bottom sediments were sampled by means of a van Veen grab (15 litres).

Results

For 2013, the fraction of tankers hailing directly from the Suez Canal (i.e. not making prior stops before reaching the ports under investigation) ranges from 0% for the ports of Catania, Porto Empedocle, Lampedusa and Valletta, to 2% for Augusta and Siracusa and 3% for Marsaxlokk. Applying the 7%-54% of GRT criterion, this traffic was responsible for transporting between 24 and 191 tons of ballast water at the Siracusa port, between 50 and 385 tons at Augusta and between 30 and 218 tons at Marsaxlokk. A total of 13 non-indigenous macrozoobenthic species belonging to the Mollusca and to the Polychaeta were recorded from the four ports at which scraping exercises were conducted. The highest (9) number of such species was recorded at Marsaxlokk, where the only introduction attributed to aquaculture (*Crassostrea gigas*) from the total of 13 non-indigenous species was recorded. No species was recorded from all the four ports, although a number (*Brachidontes pharaonis, Notomastus aberans*, *Branchiomma bairdi, Pista unibranchia* and *Monticellina dorsobranchialis)* were recorded from three of the same ports. The highest (3109) number of such individuals was recorded from Augusta, although this total was dominated by collections of *B. pharaonis*, which made up for 96% of total non-indigenous individual abundance recorded at this port.

Discussion

The investigated ports, being visited the most by tankers in general and by those hailing directly from the Suez Canal, exhibited the highest rates of colonisation by non-indigenous macrozoobenthic species. The total (including indirect) influence of tankers transiting through the Suez Canal on the Central Mediterranean ports under investigation was probably under-estimated in the current study. This is because tankers hailing from other Mediterranean ports before visiting the ports under investigation (representing the majority of all recorded tankers) probably transited through the Canal at a preceding stage, thus contributing to the discharge of ballast water into the Mediterranean Sea. The current study makes the case for an urgent entry into force of agreements such as the IMO's Ballast Water Management Convention so as to stem the incessant flow of exotic species within busy waterways as the Mediterranean and strengthens the call made by the international biological community for a renewed monitoring effort of the real impact of the enlarged Suez Canal on the marine biota of the Mediterranean.

References

1 - BWMC, 2004. International convention for the control and management of ship's ballast water and sediment. *IMO pubblications*, London.
2 - EQUASIS, 2014. The world Merchant fleet. Equasis statistics. *Equasis publications*. Fearnleys, 2002;
3 - GLOBALLAST, action programme, 2015. Available at: http://globallastlearning.com/login/index.php (accessed 23 August 2015).
4 - SCA, Suez Canal Authority, 2015. available at: http://www.suezcanal.gov.eg/
5 - UNCTAD/RMT, 2014. Review of Maritime Transport 2014. *United Nations pubblications*. New York and Geneva.

THE RELATIVE IMPORTANCE OF AQUACULTURE AND SHIPPING AS VECTORS OF INTRODUCTION OF MARINE ALIEN SPECIES: THE CASE OF OLBIA (SARDINIA)

Agnese Marchini [1]*, Jasmine Ferrario [1] and Anna Occhipinti-Ambrogi [1]
[1] Dept. of Earth and Environmental Sciences University of Pavia - agnese.marchini@unipv.it

Abstract
The macroinvertebrate assemblage in Olbia (Sardinia, Italy) was analysed for occurrence of marine alien species. Two main vectors of introduction operate in this area: vessels and aquaculture. The comparison with alien species assemblages of other three Italian localities connected to Olbia by different pathways (vessels: Genoa, Leghorn; aquaculture: Venice) suggests that shellfish stocking is a major vector operating in Olbia.

Keywords: Alien species, Aquaculture, Tyrrhenian Sea, Zoobenthos

Introduction
The assessment of marine alien species distribution, the areas at high risk of introduction, the main pathways and vectors of introduction are essential elements in designing an effective management and conservation program [1]. We present the results of a study on alien macroinvertebrate assemblages in the harbour of Olbia, a coastal town in North-East Sardinia (Italy) affected by two main pathways of introductions: vessels and aquaculture. Olbia is one of the most important passenger seaports in the Mediterranean Sea (2 million passengers per year), as well as an important trading harbour (4 million tons of traffic volume every year). Ferries and cruises connect Olbia with other Mediterranean harbours on the western coast of Italy (www.olbiagolfoaranci.it/indexen_GB.php?carattere=p, Accessed Feb. 2016). Olbia is also a major site for mussel farming; about 15% of mussels grown in Olbia are imported from the other sites of mussel cultivation in Italy [2]. In this work, we compare the marine alien species assemblages of Olbia with those of other three Italian localities (Fig. 1): Venice (Adriatic Sea), Genoa and Leghorn (Western Mediterranean Sea), in order to assess the relative importance of shipping and aquaculture as pathways of introduction.

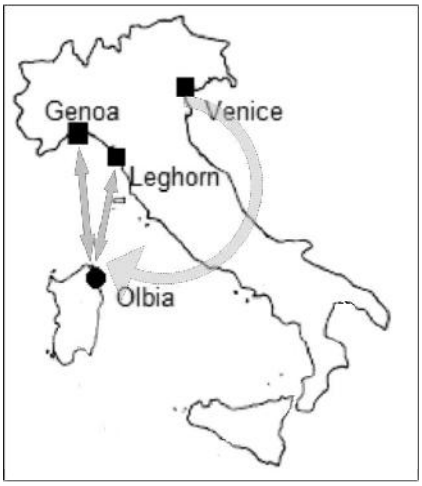


Fig. 1. The harbour of Olbia (Sardinia) is connected with Genoa and Leghorn by ferries and commercial ships (straight arrows). Moreover, Olbia receives stocks of mussels for cultivation from the North Adriatic region (round arrows).

Methods
In summer 2014 we collected 12 samples from 4 distinct areas in the harbour of Olbia; artificial hard substrates (*e.g.* docks, floating pontoons) were scraped and macroinvertebrates removed for further laboratory identification. Data from other localities, to be used for comparisons, were obtained from samples collected with similar methodology from our research team in the years 2012-2013. A similarity analysis was conducted to compare alien species assemblages in the 4 localities, using the software PRIMER 6.1.13.

Results
A total of 24 marine alien species were identified: 13 in Olbia, 19 in Venice, 13 in Genoa and 11 in Leghorn. Olbia displays an alien species pool more similar to Venice (average similarity: 52.3%) and Leghorn (53.0%) than to Genoa (43.9%). Olbia shared with Venice two alien crustaceans not recorded in the other localities: *Ianiropisis serricaudis* Gurjanova, 1936 and *Rhithropanopeus harrisii* (Gould, 1841). On the other hand, the bryozoan *Celleporaria brunnea* (Hincks, 1884) was present in the three Western Mediterranen localities but did not occur in Venice samples.

Discussions and Conclusion
Our results show that the alien species pool of Olbia strongly depends on importation of mussels for restocking: the alien invertebrates of Olbia have a high similarity with those of Venice, and there are species shared by the two localities, such as *I. serricaudis*, that have not been recorded anywhere else so far. Globally, the role of aquaculture in introducing and spreading marine alien species is perceived as declining, compared to shipping and boating. However, we have shown that in the Mediterranean region the transfer and restocking of cultured species, including native mussels, is still contributing to the spread of marine alien species, especially when stocks originate from hotspots of introduction such as Venice [3]. Movement of vessels from and to Olbia can then support the further spread of these aquaculture hitchhikers. The combined effects of these human activities are increasingly homogenizing the Mediterranean marine fouling communities; for this reason, programmes of awareness raising and biosecurity control are urgently needed, in order to reach an effective management plan of marine alien species in the region.

References
1 - McGeoch M.A., Genovesi P., Bellingham P.J., Costello M.J., McGrannachan C. and Sheppard A. (2016). Prioritizing species, pathways, and sites to achieve conservation targets for biological invasion. *Biol. Inv.*, 18 (2): 299-314.
2 - Navone A. and Del Vecchio C., 2008. Nuovo Piano Regolatore Portuale di Olbia e Golfo Aranci – Studio del comparto mitilicoltura nel Golfo di Olbia. (Technical Report SIR_2). Studio Navone, Olbia, pp.55.
3 - Marchini A., Ferrario J., Sfriso A. and Occhipinti-Ambrogi A. (2015). Current status and trends of biological invasions in the Lagoon of Venice, a hotspot of marine NIS introductions in the Mediterranean Sea. *Biol. Inv.*, 17 (10): 2943-2962.

ROLE OF THE BLACK SEA AS A DONOR AREA FOR THE CASPIAN SEA

Tamara A Shiganova [1]*, Larisa A Pautova [1] and Andrey M Kamakin [2]
[1] P.P.Shirshov Institute of oceanology of RAS, Moscow, Russia - shiganov@ocean.ru
[2] Caspian Scientific–Research Fishery Institute, Astrakhan, Russia

Abstract
The Black Sea has become an important international shipping destination during second part of twenty century. High shipping intensity has facilitated species invasions into the Black Sea. Many species have successfully established because of Black Sea disturbances in 1970s. Consequently the Black Sea serves as a hub for species that then spread further to adjacent seas: the Sea of Azov, Marmara, Mediterranean and were brought in different ways in the Caspian Sea. This process facilitated after the Volga-Don Canal construction which connected the Black, Azov and Caspian seas. As a result of invasions of the Black Sea native and non-native species greatly increased in the Caspian Sea they replaced the Caspian species and became predominant in communities and in some cases in entire ecosystem.

Keywords: Alien species, Invasive species, Black Sea, Caspian Sea

Introduction
The Black, Azov, and Caspian seas (Ponto-Caspian) were united as a single basin several times in the past, most recently in the Pliocene. The Black and Azov seas were reconnected again with the Caspian Sea by the Volga–Don Canal in 1952. Owing to accelerating human activities such as shipping, deliberate stocking, unintentional releases many non-native species have arrived and established in the Black Sea. From the Black Sea some of them were introduced in the adjacent seas and with the ship via the Volga –Don Canal the Black Sea native and non-native species arrived and established with the ship fouling and ballast waters in the Caspian Sea.

Results
The Caspian Sea is an inland brackish water basin with the vulnerable ecosystem to invaders because of its long isolation and high species endemism therefore appearance eurybiontic non-native species easily suppressed native species in occupied community and some affected the total ecosystem.
The appearance of non-native species may be divided into three phases in the Caspian Sea (Fig.1). The first deliberate large-scale introductions since 1930s were aimed at enlarging the resources of commercial fishes or their food organisms. However only two finfish (the mullets *Liza saliens* and *L. aurata*) from the Black Sea and two benthic species (the polychaete *Hediste diversicolor* and the bivalve *Abra segmentum*) from the Sea of Azov achieved significance. The second phase started when the Volga--Don Canal opened in 1952. First species were carried from the Black Sea by ships as fouling organisms. Among them zoobenthic animals and macrophytes dominated. The third phase began in the early 1980s when mainly phyto- and zooplanktonic species began to arrive in ballast water after ballast tank constructions on the ships from the Black Sea [1].Among non-native phytoplankton species *Pseudo-nitzschia seriata, Pseudo-nitzschia pseudodelicatissima, Chaetoceros peruvianus*, *Tropidoneis lepidoptera* became widely distributed. Globally significant coccolithophore alga *Emiliania huxleyi* regular developed now in the Caspian Sea [2,3]. In the Middle Caspian, the cold-water community with non-native *Pseudo-nitzschia seriata*, *Cerataulina pelagica*, *Chaetoceros peruvianus* below the thermocline form by the remnants of winter–spring bloom at the end of February-March [2]. Most of these species play now important role in the Caspian ecosystem [3]. Among zooplankton species also the Black Sea species and Black Sea invaders became abundant in the Caspian Sea. The most abundant became the Black Sea Cladocera *Pleopis polyphemoides* widely distributed around the Caspian and comprised more than 50 % Cladocera abundance and the Black Sea non-native Copepoda *Acartia tonsa*, which makes up more than 90% of zooplankton in summer in the most areas of the Caspian, replacing native copepods [1]. Meroplanktonic larvae of non-native *Balanus improvisus* comprised often more than 70%. All these planktonic species although replaced native species became food items for all kilka species [1].
In 1999 the Black Sea invader *Mnemiopsis leidyi* and Black Sea medusa *Aurelia aurita* were recorded [1].
Among benthic species, the mussel *Mytilaster lineatus* was the first accidental invader; it came from the Black Sea with fouling of boats. It replaced Caspian endemic species but became a food resource for roach, bream, zander, sturgeon and stellate sturgeon.Its planktonic larvae are food for planktivorous fish[1].
Two Black Sea prawns, *Palaemon adspersus* and *P. elegans*, were released during mullets introduction, spread all over the Caspian Sea and became a food source for benthic-feeding fishes including sturgeons and seal. In addition they have commercial value [1]. The polychaete *Hediste diversicolor* and the bivalve *Abra segmentum* have become food resources for fish stocks, first of all sturgeons [1].
The crab *Rhithropanopeus harrisi tridentata* arrived in the Caspian Sea together with fouling from the Black Sea where it was introduced from the North America. The crab became a food for sturgeons.
At present among all non-natives *M. leidyi* is the most aggressive invader that affected all levels of the Caspian ecosystem. Its abundance increases in the Middle and Northern Caspian and area of seasonal spreading increase in the Northern Caspian during last years.

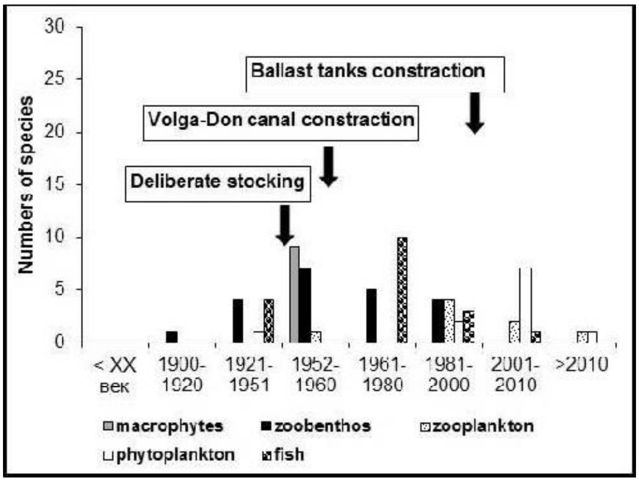


Fig. 1. Chronology of species invasions in the Caspian Sea.

Conclusion
Summarizing this review we may conclude that species invaded from the Black Sea although not numerous in numbers (about 50 species) became predominated in occupied community, replacing native species and therefore recognized as one of the leading treats to biodiversity in the Caspian Sea among them *M.leidyi* imposes enormous economic damage on biodiversity and the Caspian fisheries. Although we may conclude that some of the species became valuable food items for fish when native species almost disappeared after *M.leidyi* invasion.

References
1 - Shiganova T.A. Pautova L.A., Kamakin A.M. 2016. Role invasive species in the Caspian Sea ecosystem. Marine biology (in press).
2 - Pautova L.A., Kravchishina M.D., Vostokov S.V., Zernova V.V.,Silkin V.A.,2015. Pattern of vertical structure of summer phytoplankton of dep regions of the Caspian Sea. Doklady of Academy of sciences.T.462, N 4:479-483.

SUEZ CANAL EXPANSION PROJECT BETWEEN GLOBALIZATION NECESSITY AND ENVIRONMENTAL IMPLICATIONS

Tarek A Temraz [1]*
[1] Marine Science Department, Suez Canal University - ttemraz@yahoo.com

Abstract

Since the inauguration of the Suez Canal Expansion project an agitated sea of newsletters and articles hit the project with assumptions. The main potential impacts alleged was the dramatic increase in the introduced number of alien species. Water hydrodynamic study by RMA-II model indicated that changes in the water volume, current speed and directions may have insignificant impacts on increasing the potential number of migrated species. This mainly was attributed to restriction of expansion works to the middle sector and preserving the canal inlet and outlet without any alterations or deepening. Mitigation measures were identified and evaluated to be implemented. Environmental Monitoring program is currently in place for early warning of potential migrant species, risk assessment and control/eradication of invasive species.

Keywords: Alien species, Suez Canal

Introduction

The Suez Canal is directly linking the Mediterranean Sea to the Red Sea. It is the longest canal without a lock in the world. Opened for shipping in 1869, it abridged the distance between the Eastern and the Western parts of the world. With the increase of globalization in term of international trade, the Suez Canal went through many development stages to increase its size in order to accommodate larger vessels. The Suez Canal expansion project created a new bypass in two areas of the existing canals with total length of 35 km and dredged and expanded the existing pass (at Bitter Lakes) with a total length of 37km (Figure 1). The project aims to increase the navigational capacity and to improve the shipping traffic by eliminating the convoy system and to achieve the non-stop direct crossing for 45 ships in both directions, as well as reducing the crossing and transit time to a maximum of 3 hours instead of 8 to 11 hours. Species migration is a global phenomenon took place all over the word, the drivers behind migration process are often of global nature despite the impacts being observed on local scale. For instance, San Francisco Bay receives a new aquatic species every 14 week (Before 1960, the rate was approximately once every 55 weeks.) This acceleration is likely because of a rise in propagules pressure as a result of increased shipping traffic and aquaculture activities. Humans have also changed aquatic system through eutrophication (the increase of nutrients such as nitrogen and phosphorus), the removal of top predators, and other modifications including Global warming. Rising sea temperature, in response to increased atmospheric carbon dioxide, causes a shift in the geographical distribution of marine species. Increasing temperature in the Mediterranean Sea may result in more favorable conditions for the majority of migrant organisms with Indo pacific origin. This species thrive at relatively high temperature thus will likely favor their reproduction, growth and survival at elevated temperature (1). During 1955 sea temperature rose In the Mediterranean by 1.0 to 1.5 °C in the winter months allowing species such as *Saurida undosquamis, Sargocentron rubrum* and *Upeneus moluccensis* to establish population in the Mediterranean as the higher temperature favored their reproduction compared to the native species. The Mediterranean Sea acidification in a changing climate project, 2014 indicate that changes in the CO_2 concentration of the Mediterranean could indirectly result in vacant niches which increase vulnerability of being colonized by invasive predators.

Results and Discussion

The Mediterranean support an ever growing suit of migrating alien species, not only driven through Suez canal but from various vectors, of them (Atlantic-Mediterranean route; Shipping including fouling organisms and ballast water; Aquaculture and marine curio-trade; as well as global warming phenomena). The migration through the Suez Canal depends on many factors of them, the removal of the salinity barrier of the bitter lake, the elevation of salinity in the eastern Mediterranean as a result of reduction of fresh water inflow from the High dam. As mandatory requested by Environment Law 4 in 1994 amended by Law 9 in 2009 and its Executive Regulations Suez Canal Authority (SCA) submitted a preliminary EIA study of the project on the 29th of July 2014. The Egyptian Environmental Affair Agency (EEAA) studied the submitted document and approved in principle, with an emphasis on the need to prepare a strategic environmental assessment study. In June 2015 the final EIA study was submitted for revision and appraisal. The EIA elaborated the proposed impacts to be on changing the hydrodynamic system of the Suez Canal, increasing of turbidity levels and the movement of tracer materials. The tidal level will change slightly in the central part of Suez Canal with maximum increase of 10 cm while the tidal current will decrease in the central and northern parts at (Deversoir and Ferdan). Moreover the change in discharge flow rate to the Mediterranean is nearly zero. Turbidity was within the permissible level which is less than 60 mg/L except in the area that extends about 1 km north and 1 km south of a spot where dredging occurs. Simulation models of the movement of a tracer from Bitter Lakes to Timsah showed that the new expansion has minor effects on the spread of the tracer material. Feasible mitigation measures were studied and ranked, on top of the list came the salinity barrier (higher or lower than ambient salinity) in combination with other solutions like bubble curtain to deter migration of different planktonic stages. These options raised the need for mesocosm studies to adopt the most suitable solution. Studying the effectiveness of mitigation measures applied on the expansion project will doubtless expand our understanding to apply the proper measure for the entire Suez Canal to control and eliminate the threat of invasive species (2). The study suggested multible vectors mangment approach to manage (ballast water, ship hull fouling and restoration of the natural salinity barrier. The expansion project give us a unique opportunity to study the settlement and succession that took place 150 years ago in Suez Canal. Moreover studies will reveal species traits, time lag in species introduction, settlement and adaptation, as well as the risk assessment of exotic species(3).

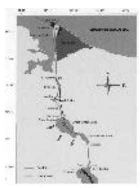


Fig. 1. Suez canal Map showing location of extension project

References

1 - Bellard, J., W. Thuilier, B. Leroy., P. Genoves.,Balkkenes, M. (2013). Will climate change promote future invasion. Global Change Biology, 1 – 9

2 - CBD (2002). Guiding principles for the prevention, introduction and mitigation of impacts of alien species that threaten ecosystems, habitats or species: Annex to CBD Decision V1/23

3 - UNEP/MAP-RAC/SPA (2008). Guide for Risk Analysis assessing the impacts of the Introduction of Non-indigenous species. Ed. RAC/SPA, Tunis. 30 pp

CIESM Congress Session : Aliens biology and adaptations
Moderator : Anders Jelmert, Inst. of Marine Research, Flødevigen, Norway

Moderator's Synthesis

The introductory presentation made a very generic outline of how incomplete knowledge of biological traits and adaptation in NIS lowers our ability to predict the effects of NIS in the recipient ecosystems. The concept adaptation was broken done in three different meanings: A species adaptation to a shifting or a new environment (plasticity and evolution), the ecosystems response to a new (NIS) species, and finally, the human response (how to manage NIS). The introduction also pointed to the fact that issues related to biodiversity (and thus NIS) are partly normative - both for the scientific and the general community.

To stimulate debate after the presentations, and taking into account the session presentation of the concept "tropicalization" of the Mediterranean, one question was put to the audience: "We conventionally regard the effects of a NIS as negative: How are we evaluate NIS in a situation where indigenous species (having key ecosystems functions) no longer can deliver these ecosystem services, whereas a NIS can? "

The question stimulated a fairly lively debate, although some misunderstandings regarding the example of herbivory (macro-algae grazing fishes vs zooplankton) needed to being sorted out. Other issues were commented: the time-span for functional and numerical response (many NIS have been shown to have a rapid growth and impact, but later to become less prominent in effects). This was contrasted to the risk of overlooking NIS that have long lag-phases; both issues call for long-term studies of the presence and effects of NIS.

DO NOT EAT *LAGOCEPHALUS SCELERATUS*: A TRANSNATIONAL ALERT THROUGH THE WESTERN MEDITERRANEAN

E. Azzurro [1]*, M. Allué [2], F. Amato [3], F. Andaloro [4], M. Bariche [5], E. Broglio [6], L. Castriota [4], V. del Rio [7], M. Falautano [4] and A. Lombarte [6]
[1] ISPRA - eazzurr@gmail.com
[2] Conselleria d'agricultura, ramadaria i pesca, Generalitat de Catalunya, Barcelona, Catalonia, Spain
[3] Reparto Pesca Marittima del Corpo delle Capitanerie di Porto, Rome
[4] ISPRA, sts Palermo, Italy
[5] American University of Beirut, Beirut, Lebanon
[6] ICM-CSIC Barcelona, Spain
[7] IRTA Sant Carles de la Ràpita, Catalonia, Spain

Abstract
A key action in the process of effectively managing the risks posed by an invasive species is to engage and communicate with the public. Here we illustrate the initial stages of a joint alert campaign launched by ISPRA in Italy and by the ICM-CSIC in Spain, aimed to warn about the spread of the toxic silver-cheeked toadfish through the western Mediterranean.

Keywords: Alien species, Fishes, North-Western Mediterranean

Introduction
Public awareness and health surveillance, aiming at preventing the consumption of pufferfishes has assumed increasing relevance in the Mediterranean Sea due to the rapid expansion of the highly toxic *Lagocephalus sceleratus* (Gmelin, 1789), one of the "worst" biological invaders of this basin. Eating this fish may provoke severe intoxications, even lethal, and this renders crucial a rapid dissemination of information. Yet, various initiatives in countries such as Egypt, Turkey, Greece, Cyprus and Tunisia have raised awareness on this issue. In October 2013 the species was firstly found in Italian waters and in July 2014 an individual was recorded in Spain [2].

Materials and Methods
Informative campaigns were launched in Italy and Spain soon after the first occurrences of *L. sceleratus* in these countries, and in 2015 these two separate actions were extended to the national territory and interconnected on the principles of mutual benefit and public biosecurity. The campaigns were mainly based on posters (Fig 1) and divulgated by a variety of different media. Institutional emails and cell phones were dedicated to receive sightings of pufferfishes (from both fishermen and the general public). Both the Spanish and Italian campaigns were promoted by the interactive web platform SEAWATCHERS www.seawatchers.org under the action 'invasive fishes'. The social impact of the alert campaigns was estimated by searching the number of internet pages related to *L. sceleratus* according to the year and country of publication.

Results and discussion
The cumulative number of web pages (Fig 2) shows an abrupt breakpoint in correspondence of the year 2015. In Spain, the number of web pages bearing information on *L. sceleratus* jumped from 73in 2015, to 1220 in 2016. In Italy, 902 pages were available in 2015 and 2070 in 2016. Since November 2013 (beginning of Italian the campaigns), ISPRA registered 5 new records of *L. sceleratus* in Sicily waters and 3 captures of *L. lagocephalus*. In Catalunia - Spain, since August 2014, the Agriculture department of the Catalan Government, together with fishermen associations and the platform SEAWATCHERS registered 22 sightings of pufferfish. Of them, 6 were record of *Sphoeroides pachygaster* and 16 of *L. lagocephalus*. In conclusion, the two campaigns are being useful tools to both inform the general public and to retrieve information related to the occurrence of pufferfish. Because of the risks associated to *L. sceleratus*, it would be advisable to extend this practice to neighboring countries.

Fig. 1. Images of the posters being used for the alert campaigns in Catalonia (left) and Italy (right).

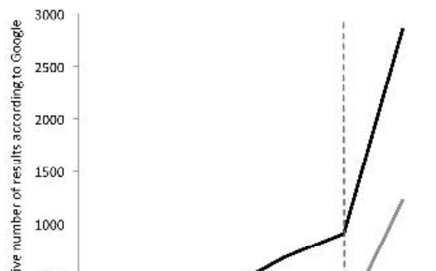


Fig. 2. Cumulative number of results according to the search engine Google and the keyword "*Lagocephalus sceleratus*": Black line = results from Italian web pages; Grey line = results from spanish web pages. The dotted vertical line indicates the beginning of the join awareness campaign in Italy and Spain.

References
1 - Azzurro E, Castriota L, Falautano M, Giardina F, Andaloro F (2014) The silver-cheeked toadfish *Lagocephalus sceleratus* (Gmelin, 1789) reaches Italian waters. Journal of Applied Ichthyology DOI 10.1111/jai.12471
2 - Izquierdo-Munoz A., Izquierdo-Gomez D (2014). First Record of *Lagocephalus sceleratus* (Gmelin, 1789) (Actinopterygii, Tetraodontidae) on the Mediterranean Spanish Coast, pp. 686e687. In: Katsanevakis S. et al. 2014. New Mediterranean. Biodiversity Records (October, 2014).

SEARCHING FOR BIOLOGICAL CHARACTERISTICS OF BENTHIC MEDITERRANEAN EXOTIC SPECIES: PRELIMINARY RESULTS

Antonios Geropoulos [1]* and Ioannis Karakassis [1]
[1] Biology Department, University of Crete, Heraklion, Greece. - bio2822@hotmail.com

Abstract

A large number of metazoan organisms have arrived in the Mediterranean basin during the past decades and most of these species are benthic. The biological characteristics of 489 benthic macro-faunal invasive species were collected from the scientific literature and databases. The analysis of these results indicated that the more species are represented in each family, the more biological characteristics are recorded. Results on the biology of a small proportion of exotic species is shown.

Keywords: Invasive species, Mediterranean Sea, Zoobenthos, NIS, Life cycles

The introduction of alien species in the Mediterranean has been thoroughly investigated and the results of new invasive species are recorded in various databases[1]. The available species-lists include information on the impact of invasive species, the date and vectors of introduction in the Mediterranean, the degree of interaction with native species and the status of establishment success [2]. However, the biological characteristics for most of these species are poorly known. Exceptions to this rule are species used in aquaculture or of other economic importance. The biology of species is a useful information source in order to assess the potential for introduction and spread of invasive alien species[3] and to manage wildlife and habitats, according to European legislation [4]. The biological characteristics of 489 benthic invasive species were collected from 980 scientific literature sources and 25 databases. The information on most characteristics was obtained between 1970 and 2016, and include papers reporting new records of species in the Mediterranean. The traits collected, covered various aspects of biology (morphological, behavioural, reproductive and larval traits) of the benthic invasive species in the Mediterranean. A total of 52 traits where collected, subdivided into 278 sub-categories, called modalities. This group of species belong to six phyla (Annelida, Arthropoda, Echinodermata, Mollusca, Porifera and Sipuncula), the most abundant being Mollusca with 209 species, followed by Annelida-Polychaeta (138 species) and Crustacea (110 species). In total species from 195 families have been registered. Data on the total number of modalities for 25 of these families are shown in Figure 1. Families including more than four invasive species have numerous known biological traits recorded in the scientific literature.

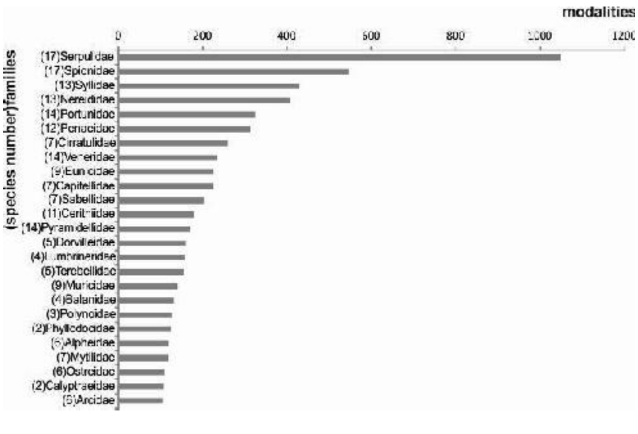


Fig. 1. Number of modalities collected, for 25 families (in parentheses the number of species per family).

Biological characteristics have been collected and stored in a data base. These continuous numerical traits are grouped into different number of range-classes, as shown in figure 2. Published information has been registered for lifespan (36 species), fecundity (80 species), egg size (90 species), age at first maturity (95 species) and maximum body-size (324 species). Body size and age at first maturity showed a maximum in the middle of the modality classes. On the other hand, species tend to have more variable egg sizes, fecundity and lifespan.

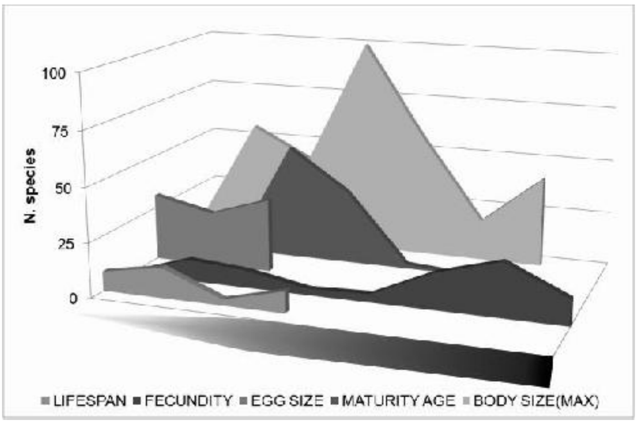


Fig. 2. Number of species per selected trait and range-class. As arrow gradually darkens, the modality values in the range-class increases.

Conclusively, invaders are characterized by mixed biological characteristics according to the published literature. Although aggregating the biological characteristics of so different taxa with a high phenotypic plasticity is risky, it could be a useful approach to detect patterns related to different life strategies of benthic invasive species[5]. At the same time the review of this scattered information is a tool for identifying gaps in the knowledge on the biology of these species which largely determines their dispersal ability.

References

1 - Marchini A., Galil B.S. and Occhipinti-Ambrogi A., 2015. Recommendations on standardizing lists of marine alien species: Lessons from the Mediterranean Sea. *Mar. Pollut. Bull.,* 101: 267–273.
2 - Streftaris N., Zenetos A. and Papathanassiou E., 2005. Globalization in marine ecosystems: the story of non-indigenous marine species across European seas. In: Gibson R., Atkinson R., Gordon J., (eds.). Oceanography and Marine Biology: An Annual Review. CRC Press, pp 419–453.
3 - EU, 2014. Regulation on the prevention and management of the introduction and spread of invasive alien species. PE-CONS 70/14. European Parliament and Council, Brussels.
4 - Genovesi P. and Shine C., 2004. European strategy on invasive alien species: Convention on the Conservation of European Wildlife and Habitats (Bern Convention). Council of Europe Publishing, 68 pp.
5 - Usseglio-Polatera, P., Bournard, M., Richoux, P. and Tachet, H., 2000. Biological and ecological traits of benthic freshwater macroinvertebrates: relationships and definition of groups with similar traits. *Freshwater Biol.*, 43: 175–205

CONTRIBUTION OF LESSEPSIAN INTRUSIONS TO THE ALTERATION OF COASTAL FISH ASSEMBLAGES IN ISKENDERUN BAY (NORTHEASTERN MEDITERRANEAN)

S. Mavruk [1]*, H. Yeldan [1], M. Manasirli [1], F. Bengil [2] and D. Avsar [1]
[1] Cukurova University, Fisheries Faculty - smavruk@cu.edu.tr
[2] Girne American University, Marine School

Abstract

The seasonal bottom trawl surveys those were conducted between 2004 and 2015, revealed that the composition of shallow-soft bottom habitats in Iskenderun Bay significantly changed because of the establishment and progress of lessepsian fishes after 2010. The recent invaders such as *Nemipterus randalli* and *Pomadasys stridens* were found to be responsible on this alteration. A significant parallelism was also observed among the variations of ichthyofaunal composition, temperature and chlorophyll concentration. These arguments were considered as supporting the tropicalization hypothesis in Eastern Mediterranean.

Keywords: Alien species, Iskenderun Bay, Biodiversity, Temperature, Teleostei

Introduction

Due to ongoing introductions of lessepsian species, the structure of coastal fish assemblages reveals apparent inter-annual variations in Levant Basin. Recently, more than 100 Indo-Pacific fish taxa have been recorded in Eastern Mediterranean by the way of this migration [1]. The introduction rate has particularly increased within the last two decades [2]. This circumstance gives a perfect opportunity to evaluate the alterations of ichthyofaunal structure resulting from the invasive species. In this study, the inter-annual changes of the composition of teleost fish assemblages were investigated in a shallow-soft bottom habitat in northwestern coasts of Iskenderun Bay.

Material and Method

A total of 90 bottom trawl operations within 45 expeditions were conducted at 10 and 20m depth contours. The positions of transects were as follows; 35. 87° E, 36. 82°N to 35. 91°E, 36. 86°N and 35. 89°E, 36. 80°N to 35. 93°E, 36. 84° N. The expeditions were performed from 2004 to 2015 with regular seasonal intervals. During the expeditions, commercial bottom trawlers were used with the approximately same fishing effort which was about 700HP engine power and one-hour towing duration. Abundance based CPUE (individual per hour) values and remotely sensed temperature and chlorophyll [3] were used for the statistical analyses. In the first step of analyses, the significant clusters were determined with a Simprof procedure applied to the Bray-Curtis distance matrix. Then, non-metric multi-dimensional scaling (NMDS) combined with indirect gradient analysis was conducted.

Results and Discussion

During the study period we observed a total of 120 teleost fish species. The overall mean of CPUE was 102kg h^{-1} and 7762 individual h^{-1} in biomass and abundance respectively. However, the 73% of total richness was composed of Atlantic-Mediterranean species, 32 Indo-Pacific taxa dramatically dominated the catch. The proportion of lessepsians was determined as 62% of total biomass, and 85% of total abundance. Lessepsian fishes, *Equulites klunzingeri* (17.2%), *Upeneus pori* (16.8%) and *Saurida lessepsianus* (10.8%) constituted the most dominant three species in the study area. Two native fishes, *Pagellus erythrinus* and *Mullus barbatus*, followed them by forming 7.6% and 5.2% of total abundance respectively.

According to Simprof results, the sampling years formed three significant clusters in respect of species composition (Figure 1). Between-group Simper revealed that the first two groups which were 2004-2005 and 2006-2009, were slightly separated from each other with the variations of several native species such as *Arnoglossus laterna* and *Boops boops*. However, the composition of the third group (2010-2015) apparently differed from those of the both, particularly with the contributions of recently recorded lessepsians such as *Nemipterus randalli*, *Pomadasys stridens* and *Apogon smithi.* Mentioned lessepsians were firstly recognized after 2008 in Iskenderun Bay [4]. Apparently, they managed to establish consistent populations and even become the dominant component of the catch (Figure 1). This circumstance eventually resulted with the raise the dominance of lessepsian species in fish assemblages after 2010.

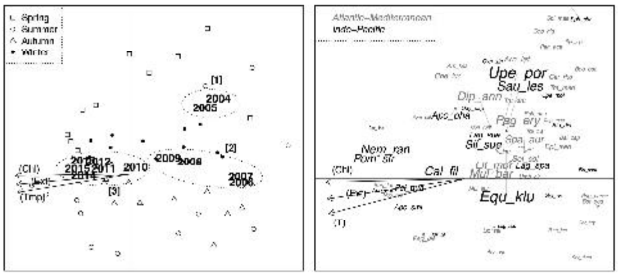


Fig. 1. NMDS ordination by sampling units (left panel) and species (right panel). The numbers in square brackets indicate the significant clusters. (Chl) and (Tmp) indicate the trend components of temperature and chlorophyll. (Ext) shows the approximate positions of annual minimum and maximum chlorophyll and annual minimum temperature. The font size is proportional to the maximum contribution of species to the within group similarity.

The variation of the species composition was significantly parallel with the increment of the annual average temperature and chlorophyll as well as annual minimum and maximum chlorophyll and annual minimum temperature ($p<0.01$). The increasing importance of warm water biota corresponding to the rising temperature and production may be considered as providing further support for the Bianchi and Morri's "tropicalization" concept [5] in Eastern Mediterranean.

Acknowledgements

This study was supported by the Cukurova University, Scientific Research Projects Coordination Unit with the grant number SUF2013-BAP7.

References

1 - Rothman, S.B.S., Stern, N. and Goren, M., 2016. First record of the Indo-Pacific areolate grouper Epinephelus areolatus (Forsskål, 1775) (Perciformes: Epinephelidae) in the Mediterranean Sea. Zootaxa 4067: 479. doi:10.11646/zootaxa.4067.4.7

2 - Lasram, F.B.R., Guilhaumon, F. and Mouillot, D., 2010. Global warming and exotic fi shes in the Mediterranean Sea: introduction dynamic, range expansion and spatial congruence with endemic species, in: Golani, D., Appelbaum-Golani, B. (Eds.), Fish Invasions of the Mediterranean Sea Change and Renewal. pp. 35–56.

3 - Acker, J.G. and Leptoukh, G., 2007. Online Analysis Enhances Use of NASA Earth Science Data. Eos, Trans. Am. Geophys. Union 88: 14. doi:10.1029/2007EO020003

4 - Bilecenoglu, M., Kaya, M., Cihangir, B. and Cicek, E., 2014. An updated checklist of the marine fishes of Turkey. Turkish J. Zool. 38: 901–929. doi:10.3906/zoo-1405-60

5 - Bianchi, C.N. and Morri, C., 2003. Global sea warming and “‘tropicalization’” of the Mediterranean Sea: biogeographic and ecological aspects. Biogeographia 24, 319–327.

THE PROXIMATE, AMINO ACID AND FATTY ACID COMPOSITIONS OF *EQUULITES KLUNZINGERI* FROM ISKENDERUN BAY, NORTHEAST MEDITERRANEAN SEA

Gülsün Özyurt [1], Ali S. Özkütük [2]* and Caner E. Özyurt [1]
[1] University of Cukurova, Faculty of Fisheries
[2] University of Cukurova Yumurtalik Vocational School - aliserhat@cu.edu.tr

Abstract
Equulites klunzingeri which is a lessepsian fish species Mediterranean Sea recognised as discard fish because of its small size. For evaluating nutritional value of *E. klunzingeri*, proximate composition, fatty acid and amino acid composition were investigated in this study.

Keywords: Invasive species, Iskenderun Bay, Lessepsian migration, Nutrients, Mediterranean Sea

Introduction

Equulites klunzingeri (Klunzinger's ponyfish) which was migrated from the Red Sea to the Mediterranean Sea by the Suez Channel is a lessepsian fish species. These fish are called as pony fishes due to their highly protractible mouth, which protract either dorsally, rostrally, or ventrorostrally. The general morphological characters of *E. klunzingeri* are silver coloration, small sized and laterally compressed. *E. klunzingeri*, which is found in large quantities in the Mediterranean Sea, is rejected by Mediterranean countries because of its small size. Because discard fish has a potential as a high quality feed source and a valuable food source for humans as functional ingredients and nutritional supplements, it is important to establish of their components.

Materials ans Methods

E. klunzingeri were captured by academic staff of Fisheries Faculty in Iskenderun Bay. The mean weights and lengths of fish were measured as 5.89±2.56 g and 7.55±1.75cm, respectively. Moisture content and crude ash of the samples were determined in an oven at 103 °C and 550 °C respectively until the weight became constant. Lipid content was analyzed according to procedure of Bligh and Dyer [1] and crude protein was determined by Kjeldahl's method [2]. Amino acid composition was determined by the TUBITAK MAM (Scientific and Technological Research Council of Turkey, Food Institute of Marmara Research Centre). Lipid samples were converted to their constituent fatty acid methyl esters by the method of Ichihara [3]. The fatty acids methyl esters were separated and quantified with a gas chromatograph.

Results and Discussions

The moisture, ash, crude protein and lipid content of *E. klunzingeri* were 74.84±0.45 %, 4.06±0.04 %, 16.45±0.54 % and 3.78±0.06 %, respectively. This proximate composition's data reveals that *E. klunzingeri* caught from the Iskenderun Bay had reasonably high protein and low fat contents. Marine oils are rich sources of polyunsaturated fatty acids (PUFA), especially EPA and DHA. Palmitic and stearic acids are the major constituents of saturated fatty acids (SFAs) in marine lipids. For the monounsaturated fatty acids (MUFA), palmitoleic and oleic acids are the major ones. In the presented study, the obtained data of the main fatty acids from *E. klunzingeri* were also had the same results. The total SFAs, MUFAs and PUFAs of *E. klunzingeri* were determined as 35.31±0.63%, 31.39±1.23% and 18.92±1.07%, respectively. Palmitic acid, stearic acid and myristic acid were found as 23.96±0.42%, 5.81±0.13% and 5.09±0.31%, respectively. Palmitoleic acid and oleic acid were the major MUFA and determined as 13.12±0.77% and 10.32±0.29%, respectively. Among the PUFA, EPA and DHA were also the main fatty acids and they were found as 4.97±0.52% and 10.37±0.54%, respectively. Most researchers have reported that the main amino acids in fish are glutamic acid, aspartic acid, lysine and leucine. In this study, the main amino acids in *E. klunzingeri* were lysine, glutamic acid, leucine, alanine and aspartic acid which constituted in the range of 1131 and 2051 mg/100 g sample. It was determined that the remaining amino acids were in range of 322 and 854 mg/100g sample. The ratio of essential amino acids (E) / nonessential amino acids (NE) was determined as 0.88 for *E. klunzingeri*. For many fish species, the reported range of E/NE ratio was 0.69 to 1.00 [4-5].The results shown that *E. klunzingeri* have well-balanced and high quality protein source in respect to E/NE ratio. It can be concluded that *E. klunzingeri* has valuable nutritional compounds as a result of this study. Therefore, utilisation of this discard fish may have some advantages in terms of environmental pollution and gaining value-added products.

References

1 - Bligh, E.G. and Dyer, W.J., 1959. A rapid method of total lipit extraction and proficiation, *Can. J.Biochem. Physiol*.37: 911-917.
2 - AOAC, 1998. Official methods of analysis of AOAC International. In: *Official methods of analysis*, 16th Eds., Chapter 39 (edited by D.L. Soderberg and P. Cunniff), Gaithersburg, MD.
3 - Ichihara, K., Shibahara, A., Yamamoto, K., and Nakayama, T., 1996. An Improved Method for Rapid Analysis of the Fatty Acids of Glycerolipids. *Lipids*, 31: 535-539.
4 - Özyurt, G. and Polat, A., 2006. Amino acid and fatty acid composition of wild sea bass (*Dicentrarchus labrax*): a seasonal differentiation. *European Food Research and Technology*, 222(3-4): 316-320.
5 - Tokur, B., Çakli, S. and Polat, A., 2006.The Quality Changes of Trout (*Oncorhynchus mykiss* W., 1792) with a Vegetable Topping During Frozen Storage (-18° C)." *Su Ürünleri Dergisi* 23.3.