Mediterranean Marine Science

Vol 9, No 1 (2008)

Additions to the annotated list of marine alien biota in the Mediterranean with special emphasis on Foraminifera and Parasites

A. ZENETOS, E. MERIC, M. VERLAQUE, P. GALLI, C.F. BOUDOURESQUE, A. GIANGRANDE, M.E. CINAR, M. BILECENOGLU

doi: 10.12681/mms.146

Mediterranean Marine Science
Volume 9/1, 2008, 119-165

Additions to the annotated list of marine alien biota in the Mediterranean with special emphasis on Foraminifera and Parasites

A. ZENETOS[1], E. MERİÇ[2], M. VERLAQUE[3], P. GALLI[4], C.-F. BOUDOURESQUE[3], A. GIANGRANDE[5], M. E. ÇINAR[6] and M. BILECENOĞLU[7]

[1] Hellenic Centre for Marine Research, Institute of Marine Biological Resources,
P.O. Box 712, 19013, Anavissos, Attica, Hellas
[2] Moda, Hüseyin Bey Sokak, 15/4, 34710 Kadıköy, İstanbul, Turkey
[3]UMR 6540, DIMAR, COM, CNRS, Université de la Méditerranée,
F13288 Marseille France
[4] Wet Lab, Department of Biotechnology and Biosciences, University of Milano Bicocca,
Piazza della Scienza 2, 20126 Milano, Italy
[5]Department of Biological and Environmental Sciences and Technologies,
University of Lecce, Complesso Ecotekne, Via Prov. le Lecce-Monteroni,
73100 Lecce, Italy
[6]Ege University, Faculty of Fisheries, Department of Hydrobiology,
35100 Bornova, Izmir, Turkey
[7]Adnan Menderes University, Faculty of Arts & Sciences, Department of Biology,
09010 Aydin, Turkey

e-mail: zenetos@ath.hcmr.gr

Abstract

The present work is an update of the annotated list (ZENETOS et al., 2006) based on literature up to April 2008. Emphasis is given to ecofunctional/taxonomic groups poorly addressed in the annotated list, such as the foraminiferan and parasites, while macrophytes are critically reviewed following the CIESM Atlas (VERLAQUE et al., in press). Moreover, in this update the bio-geographic area addressed includes the Sea of Marmara.

The update yields a further 175 alien species in the Mediterranean bringing the total to 903. As evidenced by recent findings, more and more previously known 'casual' aliens, are becoming established. Approximately 100 more species have become well established in the region, raising the number of established species to 496 versus 385 until 2005. In the period from January 2006 to April 2008 more than 80 published papers have resulted in the recording of 94 new aliens, which is interpreted as a new introduction every 9 days, a rate beyond the worst scenario.

Introduction

Biological invasions have become a hot issue in recent decades. An increasing trend towards aquatic invasions has been documented for all European Large Marine Ecosystems but is most pronounced in the Mediterranean Sea (STREFTARIS *et al.,* 2005; EEA, 2007a).

A compilation of the available information on the alien marine biota in the Mediterranean resulted in an annotated list that includes 745 alien species (ZENETOS *et al.,* 2006). This covered the groups: fish, zoobenthos (Polychaeta, Crustacea, Mollusca, Echinodermata, Sipuncula, Bryozoa and Ascidiacea) comparatively fully, and less so phytobenthos, phytoplankton and zooplankton. Little information was provided for taxa such as Foraminifera and Isopoda that have not been well studied in the Mediterranean. A gap in information was also noticeable as regards parasites.

Since then, new publications have: a) confirmed the establishment and further geographic expansion of rare species; b) reported on the occurrence of new alien species; c) enlightened on the introduction of little studied groups such as parasites, foraminiferans and d) critically reviewed higher taxa such as macrophytes. In parallel, publications based on molecular studies reconsider the status of species excluded in the annotated list, while publications on taxonomy have significantly changed the nomenclature of certain species.

The aim of the present work is to update the annotated list by reporting on species presumably omitted in ZENETOS *et al.* (2006) and on the new species recorded in the 2006-2008 period and possible changes in their establishment success. Emphasis is put on foraminiferan and parasites, through collaboration with regional experts.

Methodology

The basis for the present work is the annotated list of marine alien species in the Mediterranean (ZENETOS *et al.,* 2006), called here after 'annotated list'. The list has been updated to incorporate species recorded up to April 2008. The species updates are presented in 10 units, which are ecofunctional/taxonomic groups, namely: 1: Phytoplankton, 2: Zooplankton, 3: Phytobenthos, 4: Zoobenthos/Polychaeta, 5: Zoobenthos/Crustacea, 6: Zoobenthos/Mollusca, 7: Zoobenthos/Foraminifera, 8: Zoobenthos /Miscellanea, 9: Parasites and 10: Fish.

Data have been mostly extracted from a simple information system, structured in ACCESS, which has been developed at the Hellenic Centre for Marine Research (internal use only). The database is updated on a monthly basis and results are reported to UNEP/MAP and the European Environment Agency (EEA) (UNEP/MAP, 2004; EEA, 2006). One of the main uses of the aforementioned system is the development of a trend indicator for marine and estuarine species in Europe for the SEBI2010[1] program (EEA, 2007a, b) and the Mediterranean (UNEP/MAP, 2007).

[1]SEBI2010 Streamlining European Biodiverity Indicators: Framework of biodiversity indicators to assess progress towards the 2010 biodiversity target). Expert group on 'trends in invasive alien species': http://biodiversity-chm.eea.eu.int/information/indicator/F1090245995

A major difference with the 'annotated list' is the geographic coverage of the Mediterranean. The alien biota of the Sea of Marmara (KAMINSKI *et al.,* 2002; ÇINAR *et al.,* 2006a), which were omitted in the first compilation of data, are included in this work.

Concerning their establishment success, alien species are grouped into six broad categories, namely established, casual, questionable, cryptogenic, excluded and invasive, as defined in the 'annotated list', For foraminifera a finer distinction of the established category includes the rare species (those observed more than twice in several different localities but always few in number: one or two individuals) and the frequent ones (those species recorded many times in large quantities and showing a wide range of distribution patterns).

Besides the presentation of new species (i.e. species missing in ZENETOS *et al.,* 2006 and those recorded in the 2006-2008 period) with notes on the country of their occurrence, special attention is given to those species whose establishment success has altered compared to the 'annotated list'. For example, in the light of molecular and/or detailed taxonomic studies, some previously assumed questionable or excluded species have been now moved to the cryptogenic or established category.

Nomenclature changes are presented under 'name changes'. These are the result of the latest taxonomic studies (e.g. VAN AARTSEN 2004; 2006); group review papers (GOMEZ, 2008); molecular studies (e.g VERLAQUE *et al.,* 2005) and web databases (GUIRY & GUIRY, 2008).

Thanks to collaboration with regional experts, emphasis has been placed on foraminiferan and parasites, two groups poorly addressed in the 'annotated list', yet with many representatives among aliens. A full list of the experts per taxonomic group who contributed in various ways is provided in the acknowledgements.

Results

1. Phytoplankton

The validity of categorizing the diatoms and dinoflagellates reported in STREFTARIS *et al.* (2005) as alien phytoplankton in the European Seas was investigated by GOMEZ (2008) who concluded that the number of alien phytoplankton species in European Seas has been excessively inflated. Most of the discrepancies noted in GOMEZ (2008) had already been rectified in the 'annotated list'. Exceptions were the cosmopolitan *Protoceratium reticulatum* reported as *Gonyaulax grindleyi,* and *Gyrodinium falcatum* also reported as *Gymnodinium fusus*/*Pseliodinium vaubanii* which are now excluded from the Mediterranean aliens. In addition, the benthic/epiphytic dinoflagellates that were included among phytoplankton in the 'annotated list' are now moved to phytobenthos.

Warm-water species expand their geographical ranges or increase their abundances to detectable levels during warming periods. *Alexandrium tamarense, Chaetoceros coarctatus, Proboscia indica* and *Pyrodinium bahamense* are a few examples of marginal dispersal associated with climatic events rather than species introductions from remote areas. Again, these introductions are considered important even if only to document the impact of climatic changes, and are kept on our list. As a result four (4) *new* phytoplankton species have been added to the list ((Tables 1.1, 1.2).

Table 1.1
***New* alien phytoplanktonic species and changes in establishment success.**

***species excluded in the 'annotated list'**
Establishment success: C=casual; E=established; Q=questionable; CR=cryptogenic

New species	Establishment success	Source
Alexandrium concavum (K.R. Gaarder) E. Balech	C	Tunisia: DALY YAHIA-KEFI *et al.,* 2001
Alexandrium kutnerae (E. Balech) E. Balech	C	Tunisia: DALY YAHIA-KEFI *et al.,* 2001
**Proboscia indica* (Peragallo) Hernández-Becerril *[1]	CR/E	GOMEZ, 2008
Pseudosolenia calcar-avis Schultze, 1858	E	Sea of Marmara: ÇINAR *et al.,* 2006a
Change in establishment success		
Karenia mikimotoi (Miyake & Kominami ex Oda) G. Hansen & Ø. Moestrup	From Q to CR/E	GOMEZ, 2008
Prorocentrum mexicanum Osorio-Tafall	From C to CR/E	GOMEZ, 2008

[1] *Proboscia indica* (H. Peragallo) D.U. Hernandez-Becerril (= *Rhizosolenia indica*) was found previously in the Indian Ocean more than in the Mediterranean or Atlantic. It was historically considered as a variety of the cosmopolitan *Rhizolenia alata* Brightwell.

Table 1.2
Name changes in phytoplankton.

NEW NAME	OLD NAME	Source
Protoceratium reticulatum (Claparède & Lachmann) Butschli	*Gonyaulax grindleyi* Reinecke	GOMEZ, 2008
Karenia brevis (C.C. Davis) G. Hansen & Ø. Moestrup	*Gymnodinium breve* C.C. Davis	GOMEZ, 2008
Karenia mikimotoi (Miyake & Kominami ex Oda) G. Hansen & Ø. Moestrup	*Gymnodinium mikimotoi* Miyake & Kominami ex Oda	GOMEZ, 2008
Gymnodinium aureolum (E. M. Hulburt) G. Hansen	*Gyrodinium aureolum* E.M. Hulburt	GOMEZ, 2008
Gyrodinium falcatum Kofoid & Swezy	*Gymnodinium fusus* Schütt	GOMEZ, 2008
Proboscia indica (H. Peragallo) D. U. Hernández-Becerril	*Rhizosolenia indica* H. Peragallo	GOMEZ, 2008

2. Zooplankton

The number of alien zooplanktonic species in the 'annotated list' has been reduced by six since the benthic copepod species *(Canuellina insignis, Enhydrosoma hopkinsi, Robertsonia salsa, Scottolana longipes, Stenhelia inopinata, Stenhelia min-*

uta) reported by POR (1964; 1972) were erroneously placed among zooplankton. Eight (8) *new* alien species (Table 2) are added to the 'annotated list'. Five of these species occur on the Mediterranean coast of Egypt: *Abyla trigona, Sulculeolaria angusta, Olindias singularis, Rhabdosoma whitei, Aidanosagitta neglecta* (ZAKARIA 2004; 2006), one in South Turkey: *Ferosagitta galerita* (ÜNAL *et al.,* 2002; TERBIYIK *et al.,* 2007) and one in Tunisia: *Stomolophus meleagris* (DALY YAHIA *et al.,* 2003). It is interesting to note the finding of *Beroe ovata,* one of the worst Invasive Alien Species (IAS) in the Black Sea, now having been recorded from the South Aegean Sea (SHIGANOVA *et al.,* 2007). The three copepods species, namely *Acartia hasanii, Paracartia ioannae* and *Paracartia janetae* (ÜNAL *et al.,* 2002) that were excluded from the 'annotated list', as unsupported records, retain their excluded status. After examination of specimens from the area, it was concluded that all specimens were copepodites (future females) of *Acartia clausi* and *Acartia tonsa* (A. Gubanova, pers. commun.).

The geographic expansion of reported species such as *Phyllorhiza punctata* (Ionian Sea: NAVANDI & KIKINGER, 2007), and the documented burst of alien zooplanktonic species in general, presum-

Table 2
***New* alien zooplanktonic species in the Mediterranean and changes in establishment success.**

***species excluded in the 'annotated list'**
Taxon: AMPH=Amphipoda; CHA=Chaetognatha; CTE=Ctenophora; SIPH=Siphonophora; SCY=Scyphozoa
Establishment success: C=casual; E=established; Q=questionable

Taxon	New species	Establishment success	Source
SIPH	*Abyla trigona* Quoy & Gaimard, 1827	C	Egypt: ZAKARIA, 2004
CHA	**Aidanosagitta neglecta*[1]	E	Egypt: H. ZAKARIA, pers. commun
CTE	*Beroe ovata* Mayer, 1912	C	Greece: SHIGANOVA *et al.,* 2007
CHA	*Ferosagitta galerita* (Dallot, 1971)	E	Turkey: TERBIYIK *et al.,* 2007
SCY	*Olindias singularis* Browne, 1905	E	Egypt: ZAKARIA, 2004
AMPH	*Rhabdosoma whitei* Bate, 1862	C	Egypt: ZAKARIA, 2006
SIPH	*Stomolophus meleagris* (L. Agassiz, 1862)	C	Tunisia: DALY YAHIA *et al.,* 2003
SIPH	*Sulculeolaria angusta* Totton, 1954	E	Egypt: ZAKARIA, 2004
Change in establishment success			
SCY	*Phyllorhiza punctata* von Lendenfeld, 1884	From C to E	Greece: NAVANDI & KIKINGER, 2007

[1] Reported as *Sagitta neglecta.*

ably reflect the sensitivity of zooplankton to climatic changes.

3. Phytobenthos

A total of 110 species (22 Chromobionta, 71 Rhodobionta, 16 Chlorobionta and 1 Plantae) constitute the main core of the CIESM Atlas of exotic macrophytes of the Mediterranean Sea (VERLAQUE *et al.,* in press). Comparing this information to the 'annotated list' has led to the addition to the new list of six cryptogenic species that were reported before the Suez Canal opening and assumed to be native by ZENETOS *et al.* (2006) (e.g.: *Asparagopsis taxiformis, Desmarestia viridis*) (Table 3.1); recent rapid changes in their Mediterranean distribution give evidence of a recent introduction of either a cryptic species similar to the Mediterranean one or an alien genotype from a remote population. In addition, seven species recently identified as new for the whole or a part of the Mediterranean Sea are also listed in Table 3.1. These include *Dictyota ciliolata* Sonder *ex* Kützing (reported from Catalonia: RULL LLUCH *et al.,* 2007); *Batophora* sp (reported from Italy: BOTTALICO *et al.,* 2006); and 5 species namely, *Microspongium tenuissimum* (Hauck) A.F. Peters; *Lomentaria flaccida* Tanaka; *Grateloupia minima* P.L. Crouan & H.M. Crouan; *Polysiphonia stricta* (Dillwyn) Greville and *Cladophora hutchinsioides* Hoek & Womersley, all collected in the Thau

Table 3.1

***New* alien phytobenthic species in the Mediterranean and changes in establishment success.**

***excluded in the 'annotated list'. Countries of first observation concerned the populations assumed to be introduced.**

Taxon: RHO=Rhodobionta, CHL=Chlorobionta, CHR=Chromobionta
Establishment success: C=casual; E=established; Q=questionable; CRf=cryptogenic frequent; CRr=cryptogenic rare

Taxon	New species	Establishment success	Source
RHO	*Acanthophora naydaformis* (Delile) Papenfuss	CRf/F	Egypt: VERLAQUE *et al.,* 2005
RHO	*Antithamnionella boergesenii* (Cormaci & G. Furnari) Athanasiadis	E	Algeria: Verlaque *et al.,* in press
RHO	**Antithamnionella elegans* (Berthold) J.H. Price & D.M. John	CRf/Q	Italy : VERLAQUE *et al.,* in press
RHO	**Antithamnionella spirographidis* (Schiffner) E.M. Wollaston	CRf/Q	Italy : VERLAQUE *et al.,* in press
RHO	**Asparagopsis taxiformis* (Delile) Trevisan de Saint-Léon	CRf	Egypt: VERLAQUE *et al.,* 2005
RHO	**Acrochaetium spathoglossi* Børgesen	Q	Egypt: VERLAQUE *et al.,* in press
RHO	*Anotrichium okamurae* Baldock	E	VERLAQUE *et al.,* in press
CHL	*Caulerpa racemosa* var. *cylindracea* (Sonder) Verlaque, Huisman & Boudouresque	E	Libya: VERLAQUE *et al.,* in press

(continued)

Table 3.1 (continued)

Taxon	New species	Establishment success	Source
CHL	*Caulerpa racemosa var lamourouxi f. requienii* (Montagne) Weber-van Bosse	E	Israel: VERLAQUE *et al.,* in press
CHL	*Caulerpa racemosa* var. *turbinata* (J. Agardh) Eubank - *uvifera* (C. Agardh) J. Agardh	E	Tunisia: VERLAQUE *et al.,* in press
RHO	*Chondria coerulescens* (J. Agardh) Falkenberg[1]	E	France: VERLAQUE *et al.,* in press
RHO	**Ceramium bisporum* D.L. Ballantine[2]	Q	Greece: SARTONI & BODDI, 2002
CHL	*Cladophora hutchinsioides* Hoek & Womersley[3]	Q	France: VERLAQUE *et al.,* 2007
CHR	**Cladosiphon zosterae* (J. Agardh) Kylin	E	France: VERLAQUE *et al.,* in press
CHR	**Desmarestia viridis* (O.F. Müller) J.V. Lamouroux	CRf	France: VERLAQUE *et al.,* in press
CHR	*Dictyota ciliolata* Sonder ex Kützing	E	Spain: RULL LLUCH *et al.,* 2007
CHR	*Dictyota okamurae* (E.Y. Dawson) I. Hörnig, R. Schnetter & W.F.	E	France: VERLAQUE *et al.,* in press
CHR	**Ectocarpus siliculosus* var. *hiemalis* (P.L. Crouan & H.M. Crouan) Foslie	CRr/Q	Italy: VERLAQUE *et al.,* in press
RHO	*Feldmannophycus okamurae* (Yamada) Mineur, Maggs & Verlaque	E	France: VERLAQUE *et al.,* in press
RHO	**Ganonema farinosum* (J.V. Lamouroux) K.C. Fan & Yung C. Wang	CRf	Egypt: VERLAQUE *et al.,*in press
RHO	**Gracilaria arcuata* Zanardini	Q	Turkey: TASKIN *et al.,* 2008
RHO	*Grateloupia minima* P.L. Crouan & H.M. Crouan[4]	Q	France: VERLAQUE *et al.,* 2007
RHO	*Lomentaria flaccida* Tanaka	C	France: VERLAQUE *et al.,* 2007
CHR	*Microspongium tenuissimum* (Hauck) A.F. Peters[5]	Q	France: VERLAQUE *et al.,* 2007
RHO	*Nemalion vermiculare* Suringar	E	France: VERLAQUE *et al.,* in press
CHR	**Pilayella littoralis* (Linnaeus) Kjellman	C	Italy: VERLAQUE *et al.,* in press

(continued)

[1] Introduced in the Thau Lagoon
[2] probably confused with *C. codii*
[3] the taxonomy of the genus *Cladophora* Kützing is so complicated that the confirmation of the identity of this macrophyte requires further investigation.
[4] The determination of the alien or native status of Mediterranean populations requires further investigations.
[5] The determination of the Atlantic or Mediterranean origin of the Thau populations requires further investigations

Table 3.1 (continued)

Taxon	New species	Establishment success	Source
RHO	**Polysiphonia fucoides* (Hudson) Greville	E	France: VERLAQUE *et al.,* in press
RHO	*Polysiphonia stricta* (Dillwyn) Greville[6]	Q	France: VERLAQUE *et al.,* 2007
CHR	**Punctaria tenuissima* (C. Agardh Greville	E	France: VERLAQUE *et al.,* in press
CHR	**Spatoglossum variabile* Figari & De Notaris	Q	Israel: VERLAQUE *et al.,* in press
CHL	**Ulva fasciata* Delile	E	Egypt: VERLAQUE *et al.,* in press
Change in establishment success			
RHO	*Antithamnionella sublittoralis* (Setchell & Gardner) Athanasiadis	From Q to E	VERLAQUE *et al.,* in press
RHO	*Antithamnionella ternifolia* (J.D. Hooker & Harvey) Lyle	From C to E	VERLAQUE *et al.,* in press
CHL	*Caulerpa mexicana* Sonder *ex* Kützing	From C to E	VERLAQUE *et al.,* in press
CHL	*Ceramium strobiliforme* G.W. Lawson & D.M. John	From C to E	VERLAQUE *et al.,* in press
CHL	*Cladophora patentiramea* (Montagne) Kützing	From Q to E	VERLAQUE *et al.,* in press
RHO	*Dasya sessilis* Yamada	From C to E	VERLAQUE *et al.,* in press
RHO	*Dasysiphonia* sp.	From C to E	VERLAQUE *et al.,* in press
RHO	*Goniotrichiopsis sublittoralis* G.M. Smith	From Q to E	VERLAQUE *et al.,* in press
RHO	*Grateloupia patens* (Okamura) Kawaguchi & Wang	From E to C	VERLAQUE *et al.,* in press
RHO	*Laurencia caduciramulosa* Masuda & Kawaguchi	From Q to E	VERLAQUE *et al.,* in press
CHR	*Padina boryana* Thivy *in* W.R. Taylor	From C to E	VERLAQUE *et al.,* in press
RHO	*Plocamium secundatum* (Kützing) Kützing	From C to E	Spain: RODRÍGUEZ PRIETO, unpublished
RHO	*Polysiphonia atlantica* Kapraun & J.N. Norris	From Q to E	VERLAQUE *et al.,* in press
RHO	*Porphyra yezoensis* Ueda	From C to E	VERLAQUE *et al.,* in press
RHO	*Solieria dura* (Zanardini) F. Schmitz	From E to C	VERLAQUE *et al.,* in press
CHR	*Sphaerotrichia firma* (Gepp) A.D.Zinova	From C to E	Occurrence in Levantine, Aegean, Marmara, France
RHO	*Symphyocladia marchantioides* (Harvey) Falkenberg	From C to E	VERLAQUE *et al.,* in press

[6] The determination of the Atlantic or Mediterranean origin of the Thau populations requires further investigation

Lagoon (VERLAQUE *et al.,* 2007). *Ulva ohnoi,* recorded in ballast water (Italy: FLAGELLA *et al.,* 2007) is not included in the CIESM atlas.

Concerning micro-phytobenthos, there have been few studies of the benthic/epiphytic species such as *Ostreopsis lenticularis, O. siamensis, O. ovata* in the Mediterranean compared to other regions and these species have simply been recorded when studies were carried out (i.e. MONTI *et al.,* 2007). According to GOMEZ (2008) these new entries should not be considered as recent species introductions in the Mediterranean Sea. However, in the absence of evidence we maintain them as aliens.

With the addition of the three aforementioned species, thirty four (34) *new* phytobenthos species have been added to the 'annotated list'.

In the light of new data, changes have occurred in establishment success. Eleven of the previous casual records such as *Plocamium secundatum* (RODRÍGUEZ PRIETO, unpublished) are now classified as established (Table 3.1). On the other hand, eight (8) of the questionable species reported in the 'annotated list'and two of the 'established' are excluded in this work (Table 3.2). Additional species that are considered as non-aliens in the CIESM Atlas (VERLAQUE *et al.,* in press) are listed in Table 3.2. Name changes are presented in Table 3.3.

Table 3.2
Taxa excluded compared to the 'annotated list'.

[+] reported as questionable in the 'annotated list'
[++] reported as established in the 'annotated list'

Taxon	Species	Reasoning
RHO	[+]*Acanthophora muscoides* (Linnaeus) Bory de Saint-Vincent	Unsupported records
RHO	*Acrochaetium balticum* (Rosenvinge) Aleem & Schulz	Mistake
RHO	*Antithamnion densum* (Suhr) M.A. Howe	Mistake
RHO	*Antithamnion ogdeniae* Abbott	Indigenous species *(A. decipiens)*
RHO	[++]*Chondria collinsiana* M.A. Howe	Unsupported records
RHO	[++]*Chondria polyrhiza* F.S. Collins & Hervey	Unsupported records
RHO	*Ceramium giacconei* Cormaci & G. Furnari	Indigenous species
RHO	*Ceramium graecum* Lazaridou & Boudouresque	Indigenous species
RHO	*Chondrus crispus* Stackhouse	Misidentification
RHO	*Gracilaria armata* (C. Agardh) Greville	Indigenous species
RHO	[+]*Hypnea variabilis* Okamura	Unsupported records
RHO	[+]*Laurencia chondrioides* Boergesen	Indigenous species
RHO	[+]*Laurencia intricata* J.V. Lamouroux	Indigenous species
RHO	*Laurencia japonica* Yamada	Mistake
RHO	[+]*Laurencia majuscula* (Harvey) A.H.S. Lucas	Indigenous species
RHO	*Laurencia microcladia* Kützing	Indigenous species
CHL	[+]*Parvocaulis parvulus* (Solms-Laubach) S. Berger, U. Fettweiss, S. Gleissberg, L. B. Liddle, U. Richter, H. Sawitsky & G.C. Zuccarello	Indigenous species

(continued)

Table 3.2 (continued)

Taxon	Species	Reasoning
RHO	+*Polysiphonia kampsaxii* Boergesen	Unsupported records
RHO	*Polystrata fosliei* (Weber-van Bosse) Denizot	Indigenous species
RHO	*Pterothamnion simile* (J.D. Hooker & Harvey) Nägeli	Mistake
CHR	*Rosenvingea intricata* (J. Agardh) Børgesen	Indigenous species
CHR	+*Sargassum latifolium* (Turner) C. Agardh	Unsupported records

Table 3.3
Name changes in macroalgae.

New name	Old name	Source
Acrochaetium robustum Børgesen	*Audouinella robusta;* reported as *Acrochaetium sargassicola*	VERLAQUE *et al.,* in press
Acrochaetium spathoglossi Børgesen	*Audouinella spathoglossi,* reported as *Kylinia spathoglossi*	VERLAQUE *et al.,* in press
Acrochaetium subseriatum Børgesen	*Audouinella subseriata*	VERLAQUE *et al.,* in press
Anotrichium okamurae Baldock	*Anotrichium furcellatum* (J. Agardh) Baldock)	VERLAQUE *et al.,* in press
Antithamnion nipponicum Yamada & Inagak	misreported to *A. pectinatum*	VERLAQUE *et al.,* in press
Botryella parva (Takamatsu) Kim	*Sorocarpus* sp	VERLAQUE *et al.,* in press
Dasysiphonia sp.	reported as *Heterosiphonia japonica*	VERLAQUE *et al.,* in press
Feldmannophycus okamurae (Yamada) Mineur, Maggs & Verlaque	reported as *F. rayssiae*	VERLAQUE *et al.,* in press
Grateloupia subpectinata	*G. luxurians*	VERLAQUE *et al.,* 2005
Hypnea flagelliformis Greville ex J. Agardh	misidentified as *Hypnea spicifera* (Suhr) Harvey	VERLAQUE *et al.,* in press
Neosiphonia harveyi (J. Bailey) M.-S. Kim, H.-G. Choi, Guiry & G.W. Saunders	*Polysiphonia harveyi* J. Bailey	VERLAQUE *et al.,* in press
Cladophora herpestica (Montagne) Kützing	*Cladophoropsis javanica* (Kützing) P.C. Silva	VERLAQUE *et al.,* in press
Ulvaria obscura (Kützing) Gayral	*Monostroma obscurum* (Kützing) J. Agardh	VERLAQUE *et al.,* in press
Saccharina japonica (Areschoug) C.E. Lane, C. Mayes, Druehl & G.W. Saunders	*Laminaria japonica* Areschoug	VERLAQUE *et al.,* in press

4. Zoobenthos/Polychaeta

After the publication by ZENETOS *et al.* (2006), 10 additional alien polychaete species were reported from the Mediterranean (Table 4). *Chaetozone corona, Pseudopolydora paucibranchiata* and *Timarete punctata* were found along the Aegean and Levantine coasts of Turkey (ÇINAR & ERGEN, 2007; ÇINAR, 2007; DAGLI & ÇINAR, 2008); *Syllis bella, Exogone breviantennata* and *Syllis* cf. *mayeri* from the Lebanon coast (Levantine Sea) (AGUADO & SANMARTÌN, 2007); *Novafabricia infratorquata* from the Mediterranean coast of Spain and Italy (BICK, 2005; LICCIANO & GIANGRANDE 2006); *Hesionura serrata* and *Erinaceusyllis serratosetosa* from Spain (CARDELL & MENDEZ, 1996; SAN MARTİN, 2003) and *Megalomma claparedei* from Italy (GIANGRANDE & LICCIANO, 2008). Among the species, only *T. punctata, E. breviantennata* and *Megalomma claparedei* are Lessepsian immigrants; the others have probably been introduced into the area by shipping. The spionid worm, *Pseudopolydora paucibranchiata,* which was previously misidentified as *P. antennata* (ÇINAR *et al.,* 2006c), invaded the polluted soft bottom of the inner part of Izmir Bay, reaching to a population density of 6180 ind.m^{-2} in June 2004 (DAGLI & ÇINAR, 2008).

Table 4
***New* alien polychaeta species in the Mediterranean and changes in establishment success.**

Establishment success: C=casual; E=established; Q=questionable; CRf=cryptogenic frequent

New species	Establishment success	Source
Chaetozone corona Berkeley & Berkeley 1941	CRf	Turkey: ÇINAR & ERGEN, 2007
Pseudopolydora paucibranchiata Okuda 1937	E	Turkey: DAGLI & ÇINAR, 2008
Syllis bella (Chamberlin, 1919)	E	Lebanon: AGUADO & SAN MARTIN, 2007
Hesionura serrata (Hartmann-Schröder, 1960)	C	Spain: CARDELL & MENDEZ, 1996
Timarete punctata (Grube, 1859)	E	Turkey: ÇINAR, 2007
Exogone breviantennata Hartmann-Schröder, 1959	E	Lebanon: AGUADO & SAN MARTIN, 2007
Erinaceusyllis serratosetosa (Hartmann-Schröder, 1982)	C	Spain: SAN MARTİN, 2003
Megalomma claparedei Gravier, 1908	C	Italy: GIANGRANDE & LICCIANO, 2008
Novafabricia infratorquata (Fitzhugh, 1983)	E	Spain: BICK, 2005
Syllis cf. *mayeri* Musco et Giangrande, 2005[1]	Q	Lebanon: AGUADO & SAN MARTIN, 2007
Change in establishment success		
Epidiopatra hupferiana Augener, 1918	From Q to C	Italy: Cantone pers. commu
Isolda pulchella Müller, 1858	From Q to C	Italy: Cantone pers. commu

[1] First description of species. Taxonomic posision is questionable

According to ÇINAR (2007), the previous report of *Cirriformia semicincta* (Ehlers, 1905) from the Levantine coast by LAUBIER (1966), might in fact belong to *Timarete punctata. Linopherus incarunculata* (Peters, 1858) reported by GALIL, (2007) is excluded as it is considered as misspelling of *Linopherus acarunculata,* (BEN ELIAHU, 1976).

Although there have been many attempts, the Mediterranean polychaete fauna is largely unknown. Therefore, the species that are distributed in the mid-eastern Atlantic cannot be considered as alien species, as they might have been previously overlooked or misidentified in the region. The minute syllid species are a good example. The recent great efforts to understand the syllid fauna in the Mediterranean have doubled the number of species that we had known in the region. For example, *Erinaceusyllis belizensis* and *Syllides bansei,* both of Caribbean Atlantic origin, were first reported from the Mediterranean coast of Spain (OLANO *et al.,* 1998; ALOS, 1984) and then subsequently from the other coasts of the Mediterranean, including the Aegean Sea (ÇINAR & ERGEN, 2002; ÇINAR, 2003). Similarly, representatives of other families of tropical Atlantic origin, such as *Neanthes agulhana,* were recorded on the Cadiz Coast and Malaga (SARDA, 1985) and recently found along the Italian Coast (Ionian Sea GIANGRANDE unpublished data), and *Paranaitis wahlbergi,* of north Atlantic origin, were recorded in Ibiza (VIETEZ *et al.,* 2004).

5. Zoobenthos/Crustacea

Based on CORBERA (1994), who cast doubt on the origin of *Iphinoe crassipes haifae* because the species was present off the north-eastern coast of the Iberian Peninsula, this questionable species has been excluded from our list. On the other hand, *Penaeopsis serrata,* excluded in the 'annotated list', is added here. It is argued that it had probably not been discovered earlier due to its deep-water habitat (MURA *et al.,* 2003). Six benthic copepods *(Canuellina insignis, Enhydrosoma hopkinsi, Robertsonia salsa, Scottolana longipes, Stenhelia inopinata, Stenhelia minuta)* reported in the Bardawil Lagoon (POR, 1964; 1972) that were erroneously placed among zooplankton in the 'annotated list' are also added to the zoobenthos.

Altogether, research has a) brought to light 10 *new* alien species (Table 5), belonging mostly to Decapoda and b) expanded the distribution of some species considered as casual so far, thus leading to their classification as established. Two of these new species, namely *Eocuma rosea* and *Urocaridella pulchella* are new to science (CORBERA & GALIL, 2007; YOKEŞ & GALIL, 2006b). However, diagnostic characters place them with other species of the same genera known from the Indo-Pacific Ocean and it is thus suggested that they entered the Mediterranean through the Suez Canal (CORBERA & GALIL, 2007; YOKEŞ & GALIL, 2006b).

6. Zoobenthos /Mollusca

Mollusca is one of the best studied groups (ZENETOS *et al.,* 2004) with significant contribution among alien biota in the Mediterranean (ZENETOS, 2008). The number of molluscan alien species recorded by December 2005 was estimated to be 196 (ZENETOS *et al.,* 2006). The rate of increase, compared to the 139 reported by GOFAS & ZENETOS (2003), was attributed to the increased

Table 5

New alien crustacean species in the Mediterranean and changes in establishment success.

*** species excluded in the 'annotated list'.**
Taxon: AMP=Amphipoda; CIR=Cirripedia; CUM=Cumacea; DEC=Decapoda; ISO=Isopoda; STO=Stomatopoda.
Establishment success: C=casual; E=established; Q=questionable

Taxon	New species	Establishment success	Source
DEC	*Charybdis feriata* (Linnaeus, 1758)	C	Spain: ABELLÓ & HISPANO, 2006
STO	*Clorida albolitura* Ahyong & Naiyanetr, 2000	C	Israel: AHYONG & GALIL, 2006
CUM	*Eocuma rosae* Corbera & Galil, 2007[1]	Q	Israel: CORBERA & GALIL, 2007
DEC	*Fenneropenaeus merguiensis* (De Man, 1888)	C	Turkey: ÖZCAN *et al.,* 2006
DEC	*Grapsus granulosus* H. Milne-Edwards, 1853	C	Tunisia: ZAOUALI *et al.,* 2007a
DEC	**Penaeopsis serrata* Bate, 1881	Q	Sardinian Channel: MURA *et al.,* 2003
CUM	*Scherocumella gurneyi* (Calman, 1927)	C	Israel: CORBERA & GALIL, 2007
DEC	*Sirpus monodi* Gordon, 1953	C	Greece: PANCUCCI-PAPADOPOULOU & NALETAKI, 2007
CIR	*Tetraclita squamosa* Pilsbry, 1916	C	Tunisia: ZAOUALI *et al.,* 2007b
DEC	*Urocaridella pulchella* Yokeş & Galil, 2006[2]	E	Turkey: YOKEŞ & GALIL, 2006b
Change in establishment success			
ISO	*Apanthura sandalensis* Stebbing, 1900	From C to E	Israel: NEGOESCU, 1981
DEC	*Dorippe quadridens* (Fabricius, 1793)	From E to C	Record based on a single animal: GALIL, 2005.
AMP	*Gammaropsis togoensis* (Schellenberg, 1925)	From C to E	Turkey: BAKIR *et al.,* 2007
ISO	*Paradella dianae* Menzies, 1962	From C to E	Turkey: ÇINAR *et al.,* 2008
DEC	*Plagusia squamosa* (Herbst, 1790)	From C to E	Tunisia: ZAOUALI *et al.,* 2007a

[1] First description of the species
[2] First description of the species

interest of malacologists and the relatively easy collection/identification of mollusca. However, 31 species were classified as questionable. The questionable taxa were reported mostly from the Israeli coast; the records were based on a single specimen or a few empty shells. In the 2006-2007 period, nine of them (Table 6.1) were reported as casual in other areas or even as having become established, such as *Chama aspera* (MIFSUD & OVALIS, 2007; OVALIS & ZENETOS, 2007) or *Nanostrea exigua* (MIENIS, 2008). The fact is that some of these species are present in collec-

Table 6.1

***New* alien molluscan species in the Mediterranean and changes in establishment success.**

***Species excluded in the 'annotated list'**
Establishment success: C=casual; E=established; Q=questionable;

New species	Establishment success	Source
Acanthopleura gemmata (de Blainville, 1825)	Q	Libya: ZAOUALI *et al.,* 2007b
Anadara granosa (Linnaeus, 1758)	C	Greece: YOUNG *et al.,* 2007
Atys angustatus Smith, 1872	E	Turkey: VAN AARTSEN & GOUD, 2006a
Bractechlamys vexillum (Reeve, 1853)	C	France: WGITMO, 2006
Cerithidium perparvulum (Watson 1886)	E	Israel: BOGI & GALIL, 2006
Chrysallida micronana Öztürk & van Aartsen, 2006	C	Turkey: ÖZTÜRK & VAN AARTSEN, 2006
Circe scripta (Linnaeus, 1758)	C	Greece: YOUNG *et al.,* 2007
**Conus arenatus arenatus* Hwass, 1792	C	Israel: MIENIS,2008
Conus inscriptus Reeve, 1843	C	Greece: YOUNG *et al.,* 2007
Conus rattus Hwass, 1792	C	Israel: MIENIS,2008
Mytilopsis sallei Recluz, 1849	C	Egypt: HOFFMAN *et al.,* 2006
Nassa situla (Reeve, 1846)	C	Israel: MIENIS,2008
Nassarius concinnus (Powys, 1835)	C	Israel: MIENIS,2008
Nassarius stolatus (Gmelin, 1791)	C	Greece: YOUNG *et al.,* 2007
Parviturbo dibellai Buzzurro & Celalupo, 2006	C	Turkey: BUZZURRO & CELALUPO, 2006
**Petricola hemprichi* (Issel, 1869)	C	Turkey: CEVIKER & ALBAYRAK S., 2006
Sepia gibba Ehrenberg, 1831	C	Israel: MIENIS, 2008
Sepia pharaonis Ehrenberg, 1831	Q	Known only from cuttlebones: MIENIS 2003a
Strombus vittatus vittatus Linnaeus, 1758	C	Turkey: KABASAKAL *et al.,* 2005
Trivirostra triticum Schilder, 1932	C	Israel: MIENIS, 2008
Change in establishment success		
Acteocina crithodes Melvill & Standen, 1907	From Q to C	Turkey: MIENIS, 2004
Angulus flacca (Roemer, 1871)	From Q to C	Israel: MIENIS, 2004
Atys cylindricus (Helbling, 1779)	From Q to C	Israel: MIENIS, 2004
Chama aspera Reeve, 1846	From C to E	Turkey: MIFSUD & OVALIS, 2007
Chama asperella Lamarck, 1819	From Q to E	Greece: OVALIS & ZENETOS, 2007
Chromodoris quadricolor	From C to E	Turkey: ÖZTÜRK & CAN, 2006.
(Rüppell & Leuckart, 1828)		
Ergalatax contracta (Reeve, 1846)	From E to C	R. HOUART, pers. Commun.
Ethminolia hemprichi (Issel, 1869)	From Q to C	MIENIS, 2004 Great Bitter Lake, HOFFMAN *et al.,* 2006

(continued)

Table 6.1 (continued)

New species	Establishment success	Source
Nanostrea exigua Harry, 1985	From Q to E	Israel: MIENIS,2008
Nerita sanguinolenta Menke, 1829	From C to E	Turkey: MUTAF *et al.,* 2007
Pinctada margaritifera (Linnaeus, 1758)	From E to C	MIENIS, 2004
Rhinoclavis sinensis (Gmelin, 1791)	From Q to C	MIENIS, 2004
Rissoina ambigua (Gould, 1849)	From Q to C	MIENIS, 2004
Septifer bilocularis (Linnaeus, 1758)	From Q to C	Turkey: ALBAYRAK & CALGAR, 2006

tions from the Mediterranean and are frequently reported in periodicals of Malacological Societies (*ARION, BASTERIA, GLORIA MARIS, HALIOTIS, LEVANTINA, NAUTILUS, NEPTUNEA, NOVAPEX, SPIRULA, TRITON,* etc.).

The 'annotated list' has been updated based on contributions that include summaries of findings of invasive molluscs in the Mediterranean, such as MIENIS (2004; 2008) and DELONGUEVILLE & SCAILLET (2007), or just sparse records of new alien species (MIENIS, 2003a, 2003b, 2005). From the latest publications it appears that the centre of bio-invasions, which used to be the Israeli coast, is spreading northward. Most of the new records refer to the Levantine coast of Turkey (Table 6.1) where more alien mollusca are met, including species excluded in the CIESM Atlas (ZENETOS *et al.,* 2004) such as *Petricola hemprichi* (CEVIKER & ALBAYRAK, 2006) and *Conus arenatus arenatus* (MIENIS, 2008). Newly-established species in areas along the coast of Turkey include *Chromodoris quadricolor* (CAN, 2006) and *Nerita sanguinolenta* (MUTAF *et al.,* 2007). Eight new species are reported as occasional new visitors along the Mediterranean coast of Israel (Table 6.1) including a variation of the well established gastropod *Rhinoclavis kochi* var. *recurva* and the rare *Planaxis griseum* (MIENIS, 2008). Another hotspot area for alien biota is the Saronikos Gulf. The presence of four alien molluscan species (shells only), new to the Mediterranean, is attributed to shipping in combination with climatic change (YOUNG *et al.,* 2007).

Meanwhile taxonomic studies have led to nomenclature changes of several species (Table 6.2). There are now approximately 216 alien mollusca in the Mediterranean - twenty (20) *new* molluscs since the 'annotated list'.

7. Zoobenthos /Miscellanea

Twenty (20) *new* species are added to the 'annotated list'; the main invading groups are echinodermata, ascidia and bryozoa (Table 7). Most of the new species are fouling organisms reported from port areas.

Echinodermata: The number of alien echinodermata has doubled with the present records from 5 to 11. Four of the newcomers were reported in the 2006-2007 period while *Prionocidaris babulosa* and *Asterias rubens* were reported earlier (Table 7). *Asterias rubens* is a well-established species in the Sea of Marmara, known since 1990 (YUCE & SADLER,

Table 6.2
Name changes in mollusca.

New name	Old name	Source
Cerithidium diplax (Watson, 1886)	*Clathrofenella ferruginea* (A. Adams, 1860)	VAN AARTSEN, 2006
Cyrnola lendix (A. Adams 1863)	*Styloptygma beatrix* Melvill, 1911	VAN AARTSEN & GOUD, 2006b
Diplodonta bogii Van Aartsen, 2004	*Diplodonta subrotunda* Issel, 1869	VAN AARTSEN, 2004
Ergalatax junionae Houart, 2008	*Ergalatax obscura* Houart, 1996	HOUART, 2008
Melibe viridis (Kelaart, 1858)	*Melibe fimbriata* Alder & Hancock, 1864	GOSLINER & SMITH, 2003
Monotigma lauta (A. Adams, 1853)	*Adelacteon fulvus* (A. Adams, 1851)	VAN AARTSEN & HORI, 2006
Leucotina natalensis Smith, 1910	*Adelacteon amoenus* (A. Adams, 1851)	VAN AARTSEN & HORI, 2006
Timoclea marica (Linnaeus, 1758)	*Timoclea maurica*	Spelling mistake in ZENETOS *et al.,* 2006

2000). MORTENSEN (1927) reported that it was found accidentally in the Mediterranean but did not specify a locality. ALBAYRAK, (1996) reports it from the Bosphorus Straits. The suggestion that *A. rubens* was introduced by shipping (ZIBROWIUS, 2002) is reasonable. Its planktotrophic larvae may have been transferred in the ballast waters on ships. Other ship-mediated introductions include *Eucidaris tribuloides* (TANTI & SCHEMBRI, 2006), *Prionocidaris babulosa* (SCHEMBRI, 1978), while there remain the introductions of *Diadema setosum,* and *Ophiocoma scolopendrina* (YOKEŞ & GALIL, 2006a; ZAOUALI *et al.,* 2007b) presumably via the Suez Canal.

Bryozoa: Three new bryozoan species are reported, all three presumably ship-transfered and reported close to harbour areas. *Bowerbankia gracillima* of Atlantic origin, reported from Lazio, Italy (D'HONDT & CHIMENZ GUSSO, 2006); *Celleporaria brunnea* and *Cellepo-raria pilaefera,* of Indo-Pacific origin, reported near Alsancak Harbour, Aegean Turkey and Rinella, Malta, respectively (KOCAK, 2007; AGIUS *et al.,* 1977).

Hydrozoa: Two species are added to the 'annotated list' namely: *Eudendrium carneum,* which has been recorded from the western Mediterranean in recent years (GILI, 1986; BAVESTRELLO & PIRAINO, 1991) and *Sertularia marginata* found in the eastern Mediterranean (PICARD, 1958).

Ascidiacea: Six new ascidians are reported. Of them, *Styela clava* is classified among the top worst invasive IAS in Europe (EEA, 2007b). The proximity of commercial shell fisheries to the discovered populations in S. France, and the absence of *S. clava* from other harbours and marinas along the coast, suggests that the species may have been introduced by shellfish transfer (DAVIS & DAVIS, 2008). Several colonies of *Distaplia bermudensis* were observed from the Taranto Seas (Mar Pic-

Table 7
***New* alien zoobenthic species (Miscellanea taxa) in the Mediterranean and changes in establishment success.**

Taxon: ECH=Echinodermata; BRY=Bryozoa; HYD=Hydrozoa; ASC=Ascidiacea; SIP=Sipuncula; PLA=Platyelminthes.
Establishment success: C=casual; E=established; Q=questionable; CR=Cryptogenic

Taxon	New species	Establishment success	Source
ECH	*Acanthaster planci* (Linnaeus, 1758)	C	France: WGITMO, 2006
ECH	*Asterias rubens* Linnaeus, 1755	E	Turkey: YUCE & SADLER, 2000
ECH	*Diadema setosum* (Leske, 1778)	C	Turkey: YOKE_ & GALIL, 2006a
ECH	*Eucidaris tribuloides* (Lamarck, 1816)	E	Malta:TANTI & SCHEMBRI, 2006
ECH	*Ophiocoma scolopendrina* (Lamarck, 1816)	C	Libya: ZAOUALI *et al.,* 2007b
ECH	*Prionocidaris babulosa* (Lamarck, 1816)	C	Malta: SCHEMBRI, 1978
BRY	*Bowerbankia gracillima* Hinks, 1880	C	Italy: D'HONDT & CHIMENZ GUSSO, 2006
BRY	*Celleporaria brunnea* (Hincks, 1884)	C	Turkey: KOCAK, 2007
BRY	*Celleporaria pilaefera* (Canu & Bassler, 1929)	Q	Malta: AGIUS *et al.,* 1977
HYD	*Eudendrium carneum* Clarke, 1882	E	Spain: GILI, 1986
HYD	*Sertularia marginata* (Kirchenpauer, 1864)	C	Lebanon: PICARD, 1958
ASC	*Botrylloides violaceus* Oka,1927	E	Italy: ZANIOLO *et al* .,1998
ASC	*Cystodytes philippinensis* Herdman 1886	CR	MELIANE, 2002
ASC	*Distaplia bermudensis* Van Name, 1902	E	Spain: PERES, 1957 Italy: MASTROTOTARO & BRUNETTI, 2006
ASC	*Ecteinscidia styeloides* (Traustedt, 1882)	E	MASTROTOTARO & TURSI, 2006
ASC	*Perophora multiclathrata* (Sluiter,1904)	E	MONNIOT, 1983
ASC	*Styela clava* Herdman, 1882	E	France: DAVIS & DAVIS, 2008
ASC	*Botrylloides violaceus* Oka, 1927	E	Italy: ZANIOLO *et al.,* 1998
POR	*Paraleucilla magna* Klautau *et al.,* 2004	E	Italy: LONGO *et al.,* 2007
SIP	*Apionsoma misakianum* Ikeda, 1904[1]	Q	Turkey: AÇIK, 2007
PLA	*Boninia neotethydis* Curini-Galletti & Campus, 2007	E	Israel: CURINI-GALLETTI & CAMPUS, 2007

(continued)

[1] Origin uncertain

Table 7 (continued)

Taxon	New species	Establishment success	Source
Change in establishment success			
SIP	*Aspidosiphon elegans* (Chamisso & Eysenhardt, 1821)	From Q to E	Turkey: AÇIK, 2008
ASC	*Microcosmus squamifer* Michaelsen, 1927	From Q to E	TURON *et al.,* 2007
ASC	*Eusynstyela hartmeyeri* Michaelsen, 1904	From C to Q	IZQUIERDO-MUNOZ *et al.,* in press
ASC	*Ascidia cannelata* Oken,1820	From C to E	IZQUIERDO-MUNOZ *et al.,* in press

colo and Mar Grande) since 2000 (MASTROTOTARO & BRUNETTI, 2006). *Botryllus schlosseri,* a cosmopolitan species normally present in the Mediterranean Sea, was erroneously cited as established in the 'annotated list'. In contrast, *Botrylloides violaceus,* native to Northwest Pacific, is recorded from the Venice Lagoon in Italy (ZANIOLO *et al.,* 1998). *Perophora multiclathrata* and *Ecteinascidia styeloides* have only been found in harbours (MONNIOT, 1983, MASTROTOTARO & TURSI 2006) while Cystodytes philippinensis is a cryptogenic species probably confused with *C. dellechiajei* (MELIANE, 2002). Symplegma viride, a casual species in the 'annotated list' is excluded as synonym of *Symplegma brakenhielmi* (IZQUIERDO-MUNOZ *et al.,* in press). Ascidia savigny is also excluded as a misidentification of Ascidia cannelata (A. Ramos-Espla, pers. commun.).

Porifera: Current research on the Lebanese coast has brought to life five species that are new for the Mediterranean but which are widely distributed in the tropics. However, these species do not appear to be Lessepsian immigrants, but are interpreted as remnants of an ancient thermophilous fauna that survived in the easternmost part of the Mediterranean (VACELET *et al.,* 2007). On the other hand, the calcareous sponge *Paraleucilla magna* has been detected at different Mediterranean sites (Taranto, Porto Cesareo, Brindisi and Naples). Its record in well-studied areas where several benthic surveys have previously been carried out suggests a recent introduction of the species into the Mediterranean Sea (LONGO *et al.,* 2007).

Sipuncula: *Aspidosiphon elegans,* a rare species to date, has recently established viable populations on the Levantine coast of Turkey (AÇIK, 2008). The status of a second *Apionsoma species A. (A.) misakianum,* though widely distributed in the Aegean Sea (not confined to a recipient area such as harbours or near canals) was most probably previously confused with the other *Apionsoma* species in the Mediterranean Sea. The previous reports of *Apionsoma* species should be re-examined to determine the real distributional boundary of *A. (A.) misakianum* within the Mediterranean basins (AÇIK, 2007).

Platyelminthes: Based on specimens

collected in the Mediterranean and the Red Sea coasts of Israel, a new Lessepsian flatworm *(Boninia neotethydis)* was described (CURINI-GALLETTI & CAMPUS, 2007). An Indo-Pacific origin of the species is supported by the history of its records. In 1998 the species was common in the Mediterranean, particularly in shelly, very coarse sediments at the bottom of rocky pools, and among clumps of the mussel *Brachidontes pharaonis.*

8. Zoobenthos /Foraminifera

In the Mediterranean, very little attention was paid to alien foraminifera until the early 1990s. Since then, they have been reported from many localities such as the Adriatic Sea (CIMERMAN & LANGER, 1991), Italy: the Tyrrhenian Sea (SGARRELLA & MONCHARMONT-ZEI, 1993), Israel (HYAMS *et al.,* 2002), Egypt (SAMIR *et al.,* 2003), Greece (DEBENAY *et al.,* 2005; TRIANTAPHYLLOU *et al.,* 2005) and the Maltese Islands (YOKEŞ *et al.,* 2007). The greatest amount of information however, comes from the Turkish coast. Recent studies have revealed the presence of many alien benthic foraminifera species on the southern and western Mediterranean coasts of Turkey (MERIÇ & AVŞAR, 2001; MERIÇ *et al.,* 2002 a, b, c; 2003 a, b; 2004 a, b), and in the Dardanelles (MERIÇ *et al.,* 2008a) and the Sea of Marmara (KAMINSKI *et al.,* 2002; MERIÇ *et al.,* 2005, 2007). In the 'annotated list' only seven species have been reported with the authors acknowledging the difficulty in properly documenting the records of foraminiferans in the area and identifying the need for an update. Table 8 summarizes information on alien foraminifera recorded in the Mediterranean, also providing the geographic range they have been reported from at country level.

A summary of the Turkish alien foraminifera is provided in MERIÇ *et al,* 2008d. Most of the alien foraminifer species observed in the Mediterranean Sea are of Indo-Pacific origin presumably introduced via the Suez Canal. The most abundant species are *Sorites orbiculus* and *Amphistegina lobifera.* Some researchers reported the presence of *Amphistegina* in Haifa-Israel, Greece and the Gulf of Gabes without indicating a specific species (LANGER & HOTTINGER, 2000). *Iridia diaphana,* which is rarely observed in the Northern Aegean Sea, is suggested as being of Atlantic origin and widely distributed in the Mediterranean (LOEBLICH & TAPAN, 1988). The species *Pulleniatina obliquiloculata* occurs both in the Atlantic and Indo-Pacific; however, its absence from the Red Sea fauna suggests that it has been introduced and has spread into the Mediterranean from the Atlantic via Gibraltar. In contrast, the species *Cushmanina striatopunctata,* also known to have a wide distribution in the Atlantic and in the Indo-Pacific (HOTTINGER *et al.,* 1993; LOEBLICH & TAPAN, 1994), is absent from the western Mediterranean, which suggests that the eastern Mediterranean population has an Indo-Pacific origin. Thus, it might have been introduced from the Red Sea and settled in the Dardanelles Straits. Like *Agglutinella* and *Amphistegina* spp., it may also establish a population in the Sea of Marmara.

In total, 45 alien foraminiferan species (49 including 4 identified at the genera level) are found in the Mediterranean. 32 genera and 42 species are suggested to have an Indo-Pacific origin, whereas, only 2 genera and 2 species are of Atlantic origin.

Table 8
Alien Foraminiferan species in the Mediterranean.

[+] species reported in the 'annotated list'.
Establishment success: C=casual; R=Established/Rare; F=Established/Frequent

Species	Establishment success	Source
Acervulina inhaerens Schultze	R	Turkey: MERIÇ *et al.,* 2004 a
Agglutinella arenata (Said)	C	Turkey: KAMINSKI *et al.,* 2002
Agglutinella compressa El-Nakhal	R	Egypt: SAMIR *et al.,* 2003
Agglutinella robusta El-Nakhal	R	Egypt: SAMIR *et al.,* 2003
Agglutinella soriformis El-Nakhal	R	Egypt: SAMIR *et al.,* 2003
[+]*Amphisorus hemprichii* Ehrenberg	F	YANKO, 1995; Egypt: SAMIR *et al.,* 2003; Turkey: MERIÇ *et al.,* 2008c
Amphistegina lessonii D'Orbigny	R	Greece: HOLLAUS & HOTTINGER, 1997; Israel: HYAMS *et al.,* 2002
[+]*Amphistegina lobifera* Larsen	F	Israel: YANKO *et al.,* 1993; Turkey: MERIÇ & AVŞAR, 2001; Malta: YOKEŞ *et al.,* 2007
Amphistegina madagascariensis (D'Orbigny)	C	Egypt: SAMIR *et al.,* 2003
Articulina alticostata Cushman	C	Turkey: MERIÇ *et al.,* 2004a
[+]*Astacolus insolithus* (Schwager)	C	Turkey: MERIÇ *et al.,* 2004a
[+]*Astacolus sublegumen* (Parr)	C	Turkey: MERIÇ *et al.,* 2004a
Borelis sp	R	Israel: HYAMS *et al.,* 2002
Clavulina angularis D'Orbigny	R	Israel: YANKO *et al.,* 1993; Turkey: AVŞAR *et al.,* 2001
Clavulina cf. *multicamerata* Chapman	R	Turkey: MERIÇ *et al.,* 2008c
Cushmanina striatopunctata (Parker & Jones)	R	Turkey: MERIÇ *et al.,* 2008b
Cyclorbiculina compressa (D'Orbigny)	C	Turkey: MERIÇ *et al.,* 2008c
Cymbaloporetta plana (Cushman)	R	Turkey: MERIÇ *et al.,* 2008c
Cymbaloporetta squammosa (D'Orbigny)	R	Turkey: MERIÇ *et al.,* 2008c
Edentostomina cultrata (Brady)	R	Israel: YANKO *et al.,* 1993; Turkey: MERIÇ *et al.,* 2004a
Elphidium cf. *charlottense* (Vella)	R	Turkey: MERIÇ *et al.,* 2008c
Elphidium striatopunctatum (Fichtel & Moll)	R	Israel: YANKO *et al.,* 1993; Turkey: AVŞAR *et al.*, 2001
Entosigmomorphina sp	R	Turkey: MERIÇ *et al.,* 2008c
Euuvigerina sp	R	Turkey: MERIÇ *et al.,* 2004b
Haddonia sp	F	Turkey: MERIÇ *et al.,* 2008c
Hauerina diversa Cushman	F	Israel: YANKO *et al.,* 1993; Turkey: AVŞAR *et al.,* 2001;
Heterocyclina tuberculata (Mobius)	R	Israel: YANKO, 1995; Turkey: AVŞAR *et al.,* 2001

(continued)

Table 8 (continued)

Species	Establishment success	Source
+*Heterostegina depressa* D'Orbigny	F	Italy: MONCHARMONT-ZEİ, 1968; Greece: MORARIU & HOTTINGER, 1988; Israel: YANKO *et al.,* 1993; Turkey: AVŞAR *et al.*, 2001
Iridia diaphana Heron-Allen & Earland	F	Turkey: MERIÇ *et al.,* 2008a
Miliolinella cf. *hybrida* (Terquem)	R	Turkey: MERIÇ *et al.,* 2008c
Nodopthalmidium antillarum (Cushman)	F	Israel: YANKO, 1995; Turkey: MERIÇ *et al.,* 2008c
Operculina ammonoides (Gronovius)	C	Israel: YANKO, 1995
Peneroplis antillarum D'Orbigny	C	Israel: HYAMS *et al.,* 2002
Peneroplis arietinus (Batsch)	F	Turkey: MERIÇ *et al.,* 2008c
+*Planogypsina acervalis* (Brady)	R	Turkey: MERIÇ *et al.,* 2004a
+*Planogypsina squamiformis* (Chapman)	R	Turkey: MERIÇ *et al.,* 2004a
Planorbulinella larvata (Parker & Jones)	C	Israel: YANKO, 1995
Pseudomassilina reticulata (Heron-Allen & Earland)	R	Israel: YANKO *et al.,* 1993; Turkey: AVŞAR *et al.,* 2001
Pulleniatina obliquiloculata (Parker & Jones)	R	Turkey: MERIÇ *et al.,* 2004b
Pyramidulina catesbyi (D'Orbigny)	R	Israel: YANKO *et al.,* 1993; Turkey: AVŞAR *et al.,* 2001
Pyramidulina perversa (Schwager)	R	Turkey: MERIÇ *et al.,* 2008c
Pyrgo denticulata (Brady)	R	Israel : YANKO *et al.,* 1993; Egypt: SAMIR *et al.,* 2003; Turkey: MERIÇ *et al.,* 2008c
Quinqueloculina cf. *mosharrafai* Said	R	Turkey: MERIÇ *et al.,* 2008c
Schlumbergerina alveoliniformis (Brady)	R	Turkey: MERIÇ *et al.,* 2008c
Sorites orbiculus Ehrenberg	F	Italy: HOFKER, 1930, Greece: CHERIF, 1970; France: BLANC VERNET *et al.,* 1979; Italy: CRAPON-DE CAPRONA & BENIER, 1985; Adriatic: CIMERMAN & LANGER, 1991; Israel: YANKO, 1995; Turkey: AVŞAR *et al.,* 2001; Egypt: SAMIR *et al.,* 2003
Sorites variabilis Lacroix	F	Israel: YANKO *et al.,* 1993; Turkey: MERIÇ *et al.,* 2008c
Spiroloculina angulata Cushman	F	Israel: YANKO *et al.,* 1993; Turkey: AVŞAR *et al.,* 2001
Spiroloculina antillarum D'Orbigny	F	Israel: YANKO *et al.,* 1993; Turkey: AVŞAR *et al.,* 2001; Egypt: SAMIR *et al.,* 2003; Greece: DEBENAY *et al.,* 2005
Triloculina cf. *fichteliana* D'Orbigny	R	Turkey: MERIÇ *et al.,* 2004a

9. Parasites

Unlike the recent increase in reports of introduced free-living marine species, reports of parasites invading marine environments are relatively uncommon. When species are introduced into a new territory their parasites may also follow, forming a biotic unit called 'symbiota' (GALLI *et al.,* 2005). Parasites are potentially able to control host populations and reduce host density by affecting their growth, reproduction, and survival (TORCHIN & MITCHELL, 2004). They can also affect community structure by indirectly acting on predation or competition (MOURITSEN & POULIN, 2006).

A recent study examining all parasites from different groups of animals (molluscs, crustaceans, fish, birds, mammals, amphibians and reptiles) showed that the number of parasite species found in exotic populations is roughly half the number found in native populations (TORCHIN *et al.* 2003). In the same study, it was shown that introduced populations were less heavily parasitized in terms of average prevalence (percentage of hosts infected with one or more individuals of a parasite species (BUSH *et al.,* 1997). The parasites with a lower probability of colonizing new areas tended to be those that were less prevalent in native populations. The success of establishment of parasites (both in new geographical areas and new hosts) has been described in detail by PASTERNAK *et al.* (2007) and PAIS *et al.* (2007) who illustrated that it may depend on: 1) how often the host population has been introduced into the new area; 2) the complexity of the parasite life-cycle; 3) the age of the host (according to BAUER (1991) younger fish, fry or fingerlings, are less infected than adults) and 4) global climatic change.

Few scientists have been only looking for parasitological aspects in the wild, while investigations have focused mostly on the micro- and macro- parasites of Indo-Pacific immigrants, the most popular hosts being *Siganus luridus* and *S. rivulatus* and more recently *Fistularia commersoni.* As knowledge concerning the original distribution of parasites is not complete, we propose cross-comparison of parasitological data regarding both native and alien hosts. We consider as alien the parasites detected only on alien hosts, or recognized as aliens from the authors of the research. Parasites recorded from both native and alien fish are regarded as of unknown origin. In particular, we consider of unknown origin the genera *Ceratomyxa, Entamoeba, Hexamita* (syn *Octomitus*) and *Ortholinea,* which in fact were found on both Red Sea and Mediterranean hosts.

To date, 14 species of parasites have been recoqnized as Lessepsian (BARICHE & TRILLES, 2006; TRILLES & BARICHE, 2006; GALIL & LÜTZEN 1995; PAIS *et al.,* 2007; PASTERNAK *et al.,* 2007; PAPERNA, 1972; DIAMANT *et al.,* 1999). The most representative group belongs to the class Monogenoidea (Table 9.1). In the Red Sea, monogenoids have been studied principally by PAPERNA (1965, 1972a,b,c), PAPERNA *et al.* (1984), DIAMANT & PAPERNA (1986), and DIAMANT (1989), and more recently by KRITSKY *et al.* (2007) and KRITSKY & GALLI (2007); In Mediterranean Sea Monogenoidea were investigated by DIAMANT (1989) and PASTERNAK *et al.* (2007).

The first documented case of a monogenoidean invading a new biogeographical region by 'natural' extension of its host range is that of the gill ectoparasite *Polylabris* cf. *mamaevi* infecting rabbitfish,

Table 9.1
Alien parasite species in the Mediterranean.

[+] species reported in the 'annotated list'.
Taxon: CRU=Crustacea; MON=Monogenoidea/Platyelminthes; DIG= Digenea/ Platyelminthes; PRO=Protozoa. Establishment success: C=casual; E=established; Q=questionable

Taxon	Species	Establishment success	Source
CRU	*Anilocra pilchardi* Bariche & Trilles, 2006	C	Lebanon: BARICHE & TRILLES, 2006
CRU	*Cymothoa indica* (Schiodte. & Meinert, 1884)	C	Lebanon: TRILLES & BARICHE, 2006
CRU	[+]*Heterosaccus dollfusi* Boschma, 1960	E	Israel: GALIL & LÜTZEN 1995
CRU	[+]*Mytilicola orientalis* Mori, 1935	E	France: HIS, 1977
CRU	[+]*Myicola ostrea* Hoshina & Sigiura, 1953	E	France: POLLIO, 1981
DIG	*Allolepidapedon fistulariae* Yamaguti, 1940	C	Italy: PAIS *et al.,* 2007
DIG	[+] *Hysterolecitha sigani* Manter, 1969	Q	Israel: FISCHTHAL 1980
MON	*Polylabris* cf *mamaevi* Ogawa & Egusa, 1980	E	Israel: DIAMANT, 1989 Paperna, 1972
MON	*Tetrancistrum polymorphus* (Paperna, 1972)	E	Israel: PAPERNA, 1972d
MON	*Tetrancistrum suezicum* (Paperna, 1972)	E	Israel: PAPERNA, 1972d
MON	*Tetrancistrum strophosolenum* Kritsky, Galli & Tingbao 2007	E	Israel: DIAMANT *et al.,* 1999
MON	*Lecithochirium magnicaudatum* Fischthal & Kuntz, 1963	C	Israel: FISCHTHAL 1980
MON	*Monilicaecum ventricosum* Yamaguti, 1942	C	Israel: FISCHTHAL 1980
MON	*Glyphidohaptor plectocirra* (Paperna, 1972)	E	Israel: PAPERNA, 1972d
MON	*Lecithochirium magnicaudatum* Fischthal &Kuntz,1963	C	Israel: FISCHTHAL 1980
MON	*Monilicaecum ventricosum* Yamaguti,1942	C	Israel: FISCHTHAL 1980
MON	[+]*Neothoracocotyle acanthocybii* (Meserve, 1938)	C	Italy: ROMEO *et al.,* 2005
PRO	[+]*Hirudinella ventricosa* (Pallas, 1774)	C	Italy: ROMEO *et al.,* 2005
PRO	*Balantidium sigani* Diamant & Wilbert, 1985	Q	Israel: DIAMANT *et al.,* 1999
PRO	*Nosema ceratomyxa* Diamant & Paperna, 1985	Q	Israel: DIAMANT *et al.,* 1999
PRO	[+]*Bonamia ostrea* (Pichot *et al.,* 1979)	C	Spain: MONTES & LAMA, 1993
PRO	*Perkinsus atlanticus* (Levine 1978)	E	Spain: SANTMARTİ *et al.,* 1995
PRO	*Marteilia refringens* Cavalier-Smith, 2002	C	Spain: RIERA *et al.,* 1995

Siganus rivulatus. The prevalence levels of *P. cf. mamaevi* in the Israeli Mediterranean rabbitfish populations were very high, approximately three times greater than those found in the native populations of the northern Red Sea. The subfamily Protomicrocotylinae, to which *Polylabris* belongs, is almost entirely restricted to warmer waters of the Indo-west Pacific Ocean. Both host and parasite are Lessepsian immigrants that have co-invaded the Mediterranean Sea via the Suez Canal. The greater abundance of *P.* cf. *mamaevi* in the invading (Mediterranean) populations is probably due to the changed, new environment, possibly impacting on host resistance to the parasite and encouraging heavier infections (PASTERNAK *et al.,* 2007).

One Red Sea Digenea, *Allolepidapedon fistulariae,* was found by PAIS *et al.* (2007). *A. fistulariae* was reported for the first time from the Mediterranean Sea, parasitizing the bluespotted cornetfish *Fistularia commersonii.* The finding of this Indo-Pacific digenean, acquired by juvenile or adult fish predating on second intermediate hosts, would suggest that *F. commersonii* colonized the Mediterranean by actively swimming individuals and not by passive planktonic larvae (PAIS *et al.,* 2007).

Cymothoids (Isopoda) are a group of crustaceans typically parasitic of teleost fish. However, they are poorly studied animals and some groups remain completely undescribed. Studies of parasitic isopods from Lebanon have revealed the occurrence of two introduced species *Anilocra pilchardi* and *Cymothoa indica* (BARICHE & TRILLES, 2006; TRILLES & BARICHE, 2006) from the Indo-Pacific region parasitizing mainly barracudas (Sphyraenidae).

The global transport of marine bivalves for aquaculture has lead to widespread introductions of parasitic copepods. Some parasitic copepods that infect shellfish have been widely introduced with the transport and culture of bivalves. *Mytilicola orientalis* and *Myicola ostrae* are both parasitic copepods of the Pacific oyster, *Crassostrea gigas* in Asia, where they are native. Both species infect native bivalves and *M. orientalis* is considered a serious pest (STREFTARIS & ZENETOS, 2006).

Protistan parasites have often caused significant and widespread effects in marine systems and aquaculture operations. Some of these pathogens are likely to be introduced species. However, for other pathogens there is limited evidence of an exotic source. The protistan reported as aliens in the Mediterranean are the species *Bonamia ostrea, Perkinsus atlanticus* and *Marteilia refringens,* all introduced accidentally with aquaculture.

Bonamia ostreae is an intracellular haplosporidian parasite in European flat oysters *Ostrea edulis* that occurs on both coasts of the United States and causes significant mortality in Europe (MARTY *et al.,* 2006); since 1990 *Perkinsus atlanticus* has been responsible for abnormal mortalities of *Ruditapes decussatus* in Spain (SANTMARTÍ *et al.,* 1995; SAGRISTÀ *et al,* 1996); *Marteilia refringens* is a haplosporidium protozoan parasite affecting the digestive system of the flat oyster. In Europe this disease is commonly known as Aber disease, digestive gland disease of the European oyster, or marteiliosis. Infection with *Marteilia refringens* produces high mortality, associated with sporulation in the epithelial cells of the digestive tubules. An intermediate host or a free-living stage is thought to be required in the lifecycle of this parasite. *Marteilia refrin-*

gens can occur in some oysters without causing disease.

Table 9.1 summarizes the information known to the authors where fourteen (14) additions have been made to the 'annotated list'. In the absence of further evidence, one of the crustaceans rated as casual in the 'annotated list', namely the cirripedia *Loxothylacus texanus* known to parasitise on *Callinectes sapidus* is excluded in this work as an unsupported record. This brings the number total of known alien parasites in the Mediterranean to 21. Undoubtedly, more introduced marine parasites exist than are reported (TORCHIN & KURIS, 2005). Partly, this may be because, unlike their introduced hosts, parasites are often difficult to observe and thus some alien parasites go unreported.

The hosts analysed are illustrated in Table 9.2 while the most recent nomenclature changes are presented in Table 9.3.

Table 9.2
Alien parasites with their hosts.

Taxon: CRU=Crustacea; MON=Monogenoidea/Platyelminthes; DIG= Digenea /Platyelminthes; PRO=Protozoa

Taxon	Species	host
CRU	*Anilocra pilchardi*	*Sardina pilchardus* *Boops boops* *Pagellus acarne* *Pagellus erythrinus* *Engraulis encrasicolus*
CRU	*Cymothoa indica*	*Sphyraena chrysotaenia*
CRU	*Heterosaccus dollfusi*	*Charybdis longicollis*
CRU	*Mytilicola orientalis*	Oyster beds
CRU	*Myicola ostrea*	Oyster beds
DIG	*Allolepidapedon fistulariae*	*Fistularia commersonii*
MON	*Polylabris cf mamaevi*	*Siganus rivulatus*
MON	*Tetrancistrum polymorphus*	*Siganus rivulatus* *Siganus luridus*
MON	*Tetrancistrum suezicum*	*Siganus rivulatus*
MON	*Tetrancistrum strophosolenum*	*Siganus rivulatus*
MON	*Glyphidohaptor plectocirra*	*Siganus rivulatus* *Siganus luridus*
MON	*Hysterolecitha sigani*	Siganidae
PRO	*Balantidium sigani*	*Siganus rivulatus*
PRO	*Nosema ceratomyxae*	*Siganus rivulatus*
PRO	*Bonamia ostrea*	Oyster beds
PRO	*Perkinsus atlanticus*	*Ruditapes philippinarum* *Tapes decussatus* *Tapes semidecussatus*
PRO	*Marteilia refringens*	Oyster beds

Table 9.3
Name changes in parasites.

New name	Old name	Source
Tetrancistrum polymorphus (Paperna, 1972)	*Pseudohaliotrematoides polymorphus eilaticus:* Paperna, 1972 *Pseudohaliotrematodides polymorphus eilaticus:* KTARI & KTARI (1974)	KRITSKY *et al.* 2007
Tetrancistrum suezicum (Paperna, 1972)	*Pseudohaliotrematoides polymorphus suezicus:* Paperna, 1972 *Pseudohaliotrematodides polymorphus suezicus:* KTARI & KTARI (1974) (misspelling); *Pseudohaliotrematoides suezicus* Paperna, 1972	KRITSKY *et al.* 2007
Tetrancistrum strophosolenum Kritsky, Galli & Tingbao, 2007	*Pseudohaliotrematoides nagatyi* Diamant, 1985 (nomen nudum) *Pseudohaliotrematoides polymorphus* ssp.: DIAMANT & PAPERNA (1986); *P. nagatyi*: Diamant (1989) *(nomen nudum)* *Pseudohaliotrematoides polymorphus* "*nagatyi*" of DIAMANT *et al.* (1999)	KRITSKY *et al.* 2007
Glyphidohaptor plectocirra (Paperna, 1972)	*Synonyms. Pseudohaliotrema plectocirra* Paperna, 1972; *Tetrancistrum plectocirra:* Lim, 2002	KRITSKY & GALLI 2007

10. Fish

To the 110 species in the 'annotated list' sixteen (16) records have been added in the 2006-April 2008 period (Table 10) and one is excluded in this work. The established aliens increased from 63 to 69, the casual aliens from 42 to 50 and the number of questionable aliens (5) remaining the same, thus bringing the total number of alien fish to 125 species.

Glaucostegus halavi, which was previously excluded from the list of alien fish by GOLANI *et al.* (2002 and whose vector of introduction was stated to be evidently from the Red Sea (BEN SOUISSI *et al.,* 2007), has recently been found off southern Tunisia. Among questionable species in the 'annotated list', *Torpedo sinuspersici* was recently evaluated by some authors as a casual Lessepsian species (i.e. SERENA, 2005; GALIL, 2008). However, the single specimen reported from Syria (SAAD *et al.,* 2004) was not supported by any taxonomical information to confirm species identification, thus retaining its questionable occurrence until substantiated by further studies. The status of the bigeye thresher shark *(Alopias superciliosus)*, that was classified as questionable due to uncertainty regarding its origin, is still not clear despite recent records from the Mediterranean Sea. Some morphological characters of the species (i.e. very large eyes reaching the dorsal surface of head; the v-shaped ridge on the head; long snout etc.) clearly distin-

Table 10
***New* alien fish species and changes in establishment success.**

*** species excluded in the 'annotated list'**
Establishment success: C=casual, E=established, Q= questionable

New species	Establishment success	Source
Apogon queketti Gilchrist, 1903	C	Turkey: ERYILMAZ & DALYAN, 2006
Apogon smithi (Kotthaus, 1970)	E	Israel: GOLANI *et al.,* 2008
Bregmaceros atlanticus Goode & Bean, 1886	E	Turkey: YILMAZ, *et al.,* 2004; FILIZ *et al.,* 2007 Israel: GOREN & GALIL, 2006
Cephalopolis taeniops (Valenciennes, 1828)	C	Libya: BEN ABDALLAH *et al.,* 2007
Cyclopterus lumpus Linnaeus, 1758	C	Croatia: DULČIĆ & GOLANI, 2006
Dasyatis marmorata (Steindachner, 1892)	Q	Israel: GOLANI & CAPAPÉ, 2004
Decapterus russelli (Rüppell, 1830)	E	Israel: GOLANI, 2006
**Glaucostegus halavi*[1]	C	Tunisia: BEN SOUSSI *et al.,* 2007
Monotaxis grandoculis (Forsskål, 1775)	C	Turkey: BILECENOĞLU, 2007
Nemipterus randalii Russell, 1986[2]	E	Israel: GOLANI & SONIN, 2006 Turkey: BILECENOĞLU & RUSSELL, in press
Pagrus major (Temminck & Schlegel, 1843)	C	Croatia: DULČIĆ & KRALJEVIC, 2007, Greece: CORSINI-FOKA & ECONOMIDIS, 2007
Papillogobius melanobranchus (Fowler, 1934)	C	Egypt: KOVAČIĆ & GOLANI, 2007
Parupeneus forsskali (Fourmanoir and Guézé, 1976)	C	Turkey: ÇINAR *et al.,* 2006b Malta (?): SCIBERRAS & SCHEMBRI, 2007
Platax teira (Forsskål, 1775)	C	Turkey: BILECENOĞLU & KAYA, 2006
Sciaenops ocellatus (Linnaeus, 1766)	C	Israel: GOLANI & MIRES, 2000
Zenopsis conchifera (Lowe, 1852)	C	Tunisia: RAGONESE & GIUSTO, 2007
Change in establishment success		
Coryogalops ochetica (Norman, 1927)	From C to E	Egypt: KOVAČIĆ & GOLANI, 2007
Hippocampus fuscus Rüppell, 1838	From C to E	Turkey: BILECENOĞLU, pers.obs.
Torquigener flavimaculosus Hardy & Randall, 1983	From C to E	Greece: CORSINI-FOKA *et al.,* 2006

[1] Recorded as *Rhinobatos halavi* by BEN SOUISSI *et al* .(2007)
[2] Recorded as *N.japonicus* by GOLANI &SONIN (2006)

guish *A. superciliosus* from its Mediterranean congeneric *A. vulpinus,* so the probability that it was previously overlooked is not justified. TORTONESE (1956) stated that the bigeye thresher shark is a typical species of the tropical Atlantic, and its

absence in the Mediterranean (at least until the 1980's) was indicated in two monumental works (HUREAU & MONOD, 1973; WHITEHEAD *et al.,* 1984). Although a range expansion of *A. superciliosus* during the last two decades from western and central basin to eastwards is evident (see CLO *et al.,* 2008), a probable introduction via the Gibraltar Strait requires verification.

Tortonese's stingray (*Dasyatis tortonesei*) was listed among questionable fish in the 'annotated list', but should be excluded due to its distribution being restricted to the Mediterranean (WHITEHEAD *et al.,* 1984). The validity of the species is still a matter of dispute (COMPAGNO, 1999). On the other hand, the eastern Atlantic originated *Dasyatis marmorata* is now included on our list as a questionable alien species. Its first record from Gulf of Gabès in southern Tunisia (MAURIN & BONNET, 1970) was followed by specimens captured along Israeli coasts (GOLANI & CAPAPÉ, 2004). Although *D.marmorata* has never been evaluated as an alien fish (GOLANI *et al.,* 2002; SERENA, 2005), its pattern of zoogeographical distribution is similar to other tropical Atlantic originated fishes such as *Enchelycore anatina, Arius parkii* and *Acanthurus monroviae* (GOLANI & CAPAPÉ, 2004). The taxonomy of the species, which was previously mentioned under the names of *Dasyatis pastinaca* marmorata and *D. chrysonota,* is currently not clear.

The antenna codlet (*Bregmaceros atlanticus*) finding from Turkey (YILMAZ *et al.,* 2004) did not put forward the possible origin of the species, but GOREN & GALIL (2006) evaluated the species as alien, which is likely to have arrived in the Mediterranean with discharged ballast water. The antenna codlet is currently quite abundant at the northeastern Mediterranean and several specimens may be observed during bottom trawl catch compositions. The species has recently been found in the Aegean Sea (FILIZ *et al.,* 2007).

The record of *Nemipterus japonicus* (Bloch, 1791) of GOLANI & SONIN (2006) is invalid as it is considered a misidentification of *N. randalli* Russell, 1986 (for a full account, see BILECENOĞLU & RUSSELL, in press; LELLI *et al.,* in press).

Even though *Decapturus russelli* and *Apogon smithi* are known by single records from the Mediterranean Sea, they were rated as established following GOLANI (2006) and GOLANI *et al.* (2008), respectively. According to a recent review of alien fish from the Maltese islands, SCIBERRAS & SCHEMBRI (2007) noted the possible occurrence of *Parupeneus forsskali,* which was hitherto known by a single report from Turkey (ÇINAR *et al.,* 2006b). However, the relevant record from Malta should be evaluated as questionable due to lack of preserved material and information.

Aphanius dispar was considered as a Lessepsian immigrant for many years. It is one of the worst alien fish in the eastern Mediterranean according to some authors (i.e. GOREN & GALIL, 2005; GALIL, 2008), since the species and its hybrids have replaced the native killifish, *A. fasciatus,* along the Mediterranean coast of Israel. On the other hand, GOLANI *et al.* (2002) excluded *A. dispar* from the list of exotic species, based on a comparative electrophoretic study by KORNFIELD & NEVO (1976) who suggested that the species was a permanent Mediterranean resident. Based on evidence presented by the latter authors that the occurrence of *A. dispar* in the Mediterranean precedes the opening of Suez Canal, we are retaining the species within excluded taxa in the 'annotated list'.

Discussion

Biological invasions have been recognised as one of the priority issues of concern to the health of marine ecosystems in the Mediterranean (EEA, 2006). ZENETOS *et al.* (2006) reported approximately 745 alien species in an annotated list, up to December 2005. The figures presented in ZENETOS *et al.* (2006) were criticised by Prof D.F. Por (pers. Commun.) who argues that they present an artificial inflation because the Lessepsian immigrants are mixed with aliens introduced in other ways. In his opinion, the tropical immigrants fit in well in the impoverished and sub-tropical Levantine basin. GALIL (2008) claims a total of 558 alien metazoan species in the Mediterranean Sea, ignoring the 745 that were already assembled in the 'annotated list'. The latest figures documented in this work reveal an even more spectacular increase in the number of marine alien species in the Mediterranean.

In addition to the 94 new species, reported in the period 2006-2008, the 'annotated list' is further enriched with 81 records reported before 2005, which had either escaped the author's attention, and thus are missing from the 'annotated list': or had been rated as excluded but have to be reinstated as aliens according to recent taxonomic/molecular studies. On the other hand, a few species (17 in all) included in the 'annotated list'are excluded in this work as cosmopolitan taxa/ unsupported records/ indigenous species. To sum up, a total of 903 alien species are to date present in the Mediterranean; their breakdown per eco-functional/taxonomic group is presented in Figure 1. To these, we could add a few fresh/brackish water species that occasionally occur in estuarine/coastal areas. In the latter category, some mollusca and fish are included. Among mollusca, we refer to the bivalvia *Dreissena polymorpha* and *Anodonta woodiana* and the gastropoda *Potamopyrgus antipodarum, Congeria leucophaeta* and *Ferrissia wautieri,* all cryptogenic species well established in the Mediterranean. Among fish, *Micropterus salmoides, Acipenser baeri, Acipenser gueldenstaedtii* have been reported from coastal areas in Greece (CORSINI-FOKA & ECONOMIDIS, 2007) and France (WGITMO, 2006). Worth noting is that the planktonic alien species appear to be underestimated. According to Prof. S. Lakkis (Lebanon) approximately two hundred alien phyto- and zooplanktonic species have been collected from the Lebanese coast between 1970 and 2005. However, a critical evaluation is needed based on voucher specimens before these species can be rated as aliens in the Mediterranean.

Excluding the parasites and foraminiferans that are treated in detail in this work, hence the increase is 3- fold to 6-fold respectively, an increase of approximately 10-25% is observed in the other groups. Thus, the rate of biological invasions is highest in phytobenthos (24%) followed by zooplankton (16%), fish (13%) and zoobenthos (13%). These newcomers are mostly of tropical and subtropical origin, which presumably indicates the 'tropicalization' of the Mediterranean. Indeed, it has been argued that present-day warming ultimately favours the spread of warm-water species through direct and indirect effects, and especially by changing water circulation. It is impossible at present to foresee to what extent the exuberance of warm-water species will affect the trophic web and the functioning of marine ecosystems in the Mediterranean Sea of tomorrow (BIANCHI, 2007). The eastern Mediterranean is still the favourite destina-

tion for alien species, but the centre of introduction seems to have spread from Israel to Turkey. This observation suggests a shift from Lessepsian migration to ship-mediated transfer, a further argument towards the 'tropicalisation' hypothesis for the Mediterranean.

Besides the *new* species presented in this work, changes in their establishment success are also indicated. The state of establishment success, as in April 2008, is presented in Figure 1. On considering the overall increase, the percentage of the established species to the total alien species has remained stable (about 55% vs 52% reported by December 2005. However, the fact that more than 30 species have changed their establishment status to 'established' indicates that alien species are becoming all the more permanent inhabitants in the Mediterranean. In contrast to the 'annotated list' (385 established species), there are to date 496 established alien species, an increase of 29%.

GALIL (2008) reports approximately 80 species in the 2000-2007 period. This seems an underestimate. Based on the publications of the recent 28 months (Jan 2006-April 2008), it is here demonstrated that there are 94 new records (14 fish, 1 phytoplankton, 3 zooplankton, 59 zoobenthos, 13 macrophytes and 4 parasites), indicating a rate of 1 new entry every 9 days (1.3 weeks). This rate of introduction is in agreement with STREFTARIS *et al.* (2005) who noticed an increasing pattern in the rate of introduction over the years 1998-2003. In particular, they calculated the time span for alien species' introduction in the Mediterranean to be 5.2 weeks in 1998 vs 2.9 weeks in 2003.

The increasing trend in bio-invasions

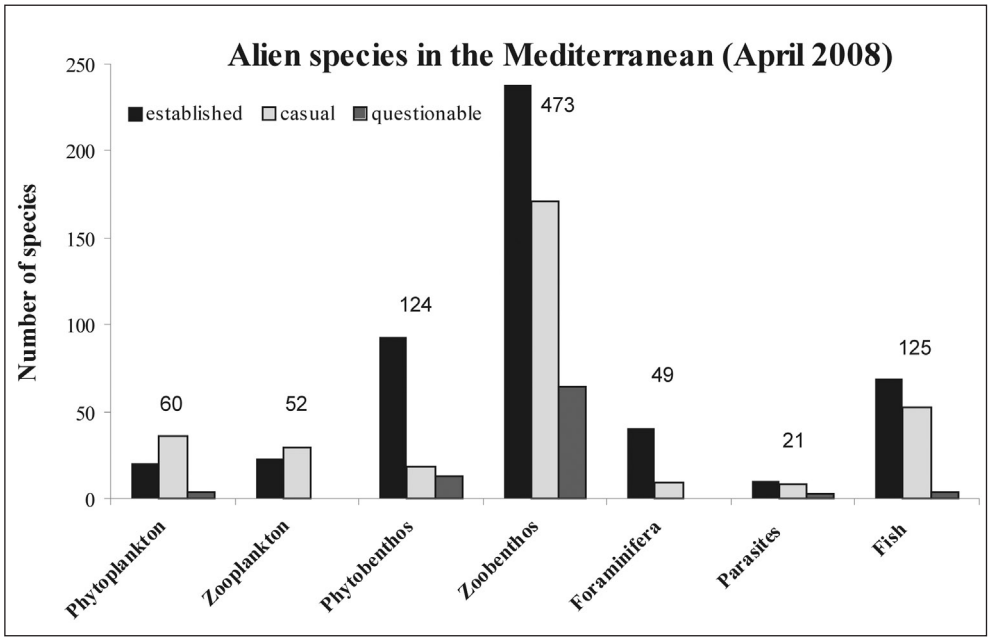

Fig. 1: Number of marine alien biota in the Mediterranean and their establishment success . Numbers indicate totals per group.

that has been mostly attributed to climatic change worldwide is partly due to the awareness and response of the scientific community on the issue, resulting in: a) taxonomic competence and multinational collaboration on projects and/or publications - tracing/identifying aliens has never been an easy task; and b) the development of electronic scientific journals that promote prompt publication of findings related to alien species. One good example is the new electronic journal *Aquatic Invasions AI:* an important part of the developing. European early warning system on aquatic invasive species. Fourteen out of the 94 new marine alien species in the Mediterranean were first recorded in the 2006-2007 volumes of AI.

Conclusions

- A total of 903 alien species by April 2008 in the Mediterranean.
- The rate of biological invasions in the Mediterranean not only has not paused but is increases astronomically. 94 species within 28 months means 1 new species entry every 9 days!
- The newcomers are becoming all the more permanent inhabitants. 496 established species in 2008 versus 385 in 2005 means a 29% increase in the number of permanent visitors!

Acknowledgements

We gratefully acknowledge the following individuals for generous contributions to this project, including the provision of the latest publications and comments at various stages.

Fish: Jamila BEN SOUISSI (Tunisia); Jakov DULČIĆ (Croatia); Daniel GOLANI (Israel)
Mollusca: Serhat ALBAYRAK (Turkey); Ghazi BITAR (Lebanon); Fabio CROCETTA (Italy); Henk DEKKER (The Netherlands); Jeroen GOUD (The Netherlands); Christiane DELONGUEVILLE (Belgium); Alper DOGAN (Turkey); Roland HOUART (Belgium); Henk MIENIS (Israel); Jose TEMPLADO (Spain); Jacobus J. VAN AARTSEN (The Netherlands)
Polychaeta: Guillermo SAN MARTIN (Spain); Maria Teresa AGUADO (Spain)
Crustacea: Cedric D' UDEKEM D' ACOZ (Belgium); Gianna INNOCENTI (Italy)
Echinodermata: Patrick SCHEMBRI (Malta)
Foraminifera: Baki YOKEŞ (Turkey)
Ascidia: Francesco MASTROTOTARO (Italy), Alfonso RAMOS-ESPLA (Spain)
Bryozoa: Jean-Loup D'HONDT (France)
Zooplankton: Alexandra GUBANOVA (Russia); Sami LAKKIS (Lebanon); Ioanna SIOKOU-FRANGOU (Greece); Nejib DALY YAHIA (Tunisia); Howaida ZAKARIA (Egypt)
Phytobenthos: Enric BALLESTEROS (Spain)

This work was supported by the SESAME project, EC Contract No GOCE-036949, funded by the European Commission's Sixth Framework Programme under the priority 'Sustainable Development, Global Change and Ecosystems'. The publication reflects only the views of the authors and the EC is not liable for any use that may be made of the information contained herein.

References

ABELLÓ, P. & HISPANO, C., 2006. The capture of the Indo-Pacific crab *Charybdis feriata* (Linnaeus, 1758)

(Brachyura: Portunidae) in the Mediterranean Sea. *Aquatic Invasions,* 1/1: 13–16.

AÇIK, S., 2007. Observations on the population characteristics of *Apionsoma (Apionsoma) misakianum* (Sipuncula: Phascolosomatidae), a new species for the Mediterranean fauna. *Scientia Marina,* 71: 571–577.

AÇIK, S., 2008. Occurrence of the alien Species *Aspidosiphon (Aspidosiphon) elegans* (Sipuncula) on the Levantine and Aegean Coasts of Turkey. *Turkish Journal of Zoology,* 32: in press.

AGIUS, C., SCHEMBRI, P.J. & JACCARINI, V., 1977. A preliminary report on organisms fouling oyster cultures in Malta. *Memorie di Biologia Marina e di Oceanografia,* 7/ 3–4: 51–59.

AGUADO, M.T. & SAN MARTÍN, G., 2007. Syllidae (Polychaeta) from Lebanon with two new reports for the Mediterranean Sea. *Cahiers de Biologie Marine,* 48: 207–224.

AHYONG, S.T. & GALIL, B.S., 2006. First Mediterranean record of the Indo-West Pacific mantis shrimp, *Clorida albolitura* Ahyong & Naiyanetr, 2000 (Stomatopoda, Squillidae). *Aquatic Invasions,* 1/3: 191–193.

ALBAYRAK, S., 1996. Echinoderm fauna of the Bosphorus (Turkey). *Oebalia,* 22: 25–32.

ALBAYRAK, S. & CALGAR, S., 2006. On the presence of *Siphonaria belcheri* Hanley, 1858 [Gastropoda: Siphonariidae] and *Septifer bilocularis* (Linnaeus, 1758) [Bivalvia: Mytilidae] in the Iskenderun Bay (SE Turkey). *Aquatic Ivnasions,* 1/4: 292–294.

ALOS, C., 1984. Anélidos poliquetos del Cabo de Creus. I. Rizomas de *Posidonia oceanica. Cuadernos Marisqueros. Publicacion Tecnica,* 7: 89–101.

AVŞAR, N., MERİÇ, E. & ERGİN, M., 2001. İskenderun Körfezi bentojenik sedimentlerinin foraminifer içeriği. *H. Ü. Yerbilimleri,* 24: 97–112, Ankara.

BAKIR, K., SEZGIN, M. & KATAĞAN, T., 2007. Contribution to the knowledge of alien amphipods off the Turkish coast: *Gammaropsis togoensis* (Schellenberg, 1925). *Aquatic Invasions,* 2/1: 80–82.

BARICHE, M. & TRILLES, J.P., 2006. *Anilocra pilchardi* n.sp., a new parasitic cymothoid isopod from off Lebanon (Eastern Mediterranean). *Systematic Parasitology,* 64: 203–214.

BAVESTRELLO, G. & PIRAINO, S., 1991. On two *Eudendrium* (Cnidaria, Hydrozoa) species from the Mediterranean Sea. *Oebalia,* 17: 197–207.

BAUER, O.N., PUGACHEV, N.O. & VORONIN, V.N., 1991. Study of parasites and diseases of sturgeons in Russia: a review. *Journal of Applied Ichthyology.* 18: 420–429.

BEN ABDALLAH, A., BEN SOUISSI J., MÉJRI H., CAPAPÉ C. & GOLANI, D., 2007. First record of *Cephalopholis taeniops* (Valenciennes) in the Mediterranean Sea. *Journal of Fish Biology,* 71: 61–614.

BEN ELIAHU, N.M., 1976. Errant polychaete cryptofauna (excluding Syllidae and Nereidae) from rims of similar intertidal vermetid reefs on the Mediterranean coast of Israel and in the Gulf of Elat. *Israel Journal of Zoology,* 25: 156–177.

BEN SOUISSI, J., GOLANI, D., MÉJRI, H., BEN SALEM, M. & CAPAPÉ, C., 2007. First confirmed record of the Halave's Guitarfish, *Rhinobatos halavi* (Forsskal, 1775) (Chondrichthyes: Rhinobatidae) in the Mediterranean Sea with description of a new case of

albinism in Elasmobranch. *Cahiers de Biologie Marine,* 48/1: 67–75.

BIANCHI, C.N., 2007. Biodiversity issues for the forthcoming tropical Mediterranean Sea. *Hydrobiologia,* 580:7–21.

BICK, A., 2005. Redescription of *Fabriciola tonerella* Banse, 1959, and a new record of *Novafabricia infratorquata* (Fitzhugh, 1983) from the Mediterranean Sea, with a key for the Fabriciinae (Annelida: Polychaeta) of the Mediterranean Sea and the north-east Atlantic. *Zoologischer Anzeiger,* 244: 137–152.

BILECENOĞLU, M., 2007.The first record of *Monotaxis grandoculis* (Forsskål, 1775) (Osteichthyes, Lethrinidae) in the Mediterranean Sea. *Aquatic Invasions,* 2/4: 466–467.

BILECENOĞLU, M. & KAYA, M., 2006. A new alien fish in the Mediterranean Sea – *Platax teira* (Forsskål, 1775) (Osteichthyes: Ephippidae). *Aquatic Invasions,* 1/2: 80–83.

BILECENOĞLU, M. & RUSSELL B.C., in press. Record of N*emipterus randalii* Russell 1986 (Osteichthys: Nemipteridae) from the Cevlik coast of Iskenderun Bay, Turkey. *Cybium.*

BLANC-VERNET, L., CLAIREFOND, P. & ORSOLINI, P., 1979. Les foraminiferes. *Annales de l'Universite de Provence,* 6: 171–209.

BOGI, C & GALIL, BS, 2006. Nuovi ritrovamenti lungo le coste Israeliane. *Notizario S.I.M.* 24/5–8: 16–18.

BOTTALICO, A., DELLE FOGLIE, C.I. & PERRONE, C., 2006. New records along the Apulian coasts. *In:* UNEP-MAP-RAC/SPA (Eds), *Proceedings of the Second Mediterranean Symposium on Marine Vegetation,* Athens, 12–13 December 2003, pp. 77–82, Tunis.

BUSH, A. O., LAFFERTY, K. D.M. LOTZ J. M. & SHOSTAK, A. W., 1997. Parasitology meets ecology on its own terms: Margolis *et al.* revisited. *Journal of Parasitology,* 83: 575–583.

BUZZURRO, G. & CELALUPO, A., 2006. I molluschi lessepsiani di Tasuçu (Turchia sud-orientale): descrizione di *Parviturbo dibellai* n. sp.(Gastropoda: Trochoidea: Skeneidae). *Bolletino Malacologico,* 42/1–4: 27–32.

CARDELL, M.J. & MENDEZ, N., 1996. First record of *Hesioniura serrata* (Polychaeta, Phyllodocidae) in the Mediterranean Sea (littoral zone of Barcelona, NE Spain). *Scientia Marina,* 60/2–3: 423–426.

CEVIKER, D. & ALBAYRAK S., 2006. Three alien molluscs from Iskenderun Bay (SE Turkey). *Aquatic Invasions* 1/2: 76–79.

CHERIF, O.H., 1970. *Die Miliolacea der West-Küste von Naxos (Griechenland) und ihre Lebensbereiche.* Ph.D Thesis, University of Clausthal, Germany, 175 pp.

CIMERMAN, F. & LANGER, M.R., 1991. *Mediterranean foraminifera.* Slovenska Akademija Znanosti in Umetnosti, Akademia Scientiarum et Artium Slovenica. 118 pp., 93 plts., Ljubljana.

ÇINAR, M.E., 2003. Ecological features of Syllidae (Polychaeta) from shallow-water benthic environments of the Aegean Sea, eastern Mediterranean. *Journal of the Marine Biological Associations of the United Kingdom,* 83: 737–745.

ÇINAR, M.E., 2007. Re-description of *Timarete punctata* (Polychaeta: Cirratulidae) and its occurrence in the Mediterranean Sea. *Scientia Marina,* 71: 755–764.

ÇINAR, M.E. & ERGEN, Z., 2002. Faunistic analysis of Syllidae (Annelida:

Polychaeta) from the Aegean Sea. *Cahiers de Biologie Marine,* 43: 171–178.

ÇINAR, M.E. & ERGEN, Z., 2007. The presence of *Chaetozone corona* (Polychaeta: Cirratulidae) in the Mediterranean Sea: an alien or a native species? *Cahiers de Biologie Marine,* 48: 339–346.

ÇINAR, M.E., BILECENOĞLU, M., OZTURK, B., KATAGAN, T. & AYSEL, V., 2006a. Alien species on the coasts of Turkey. *Mediterranean Marine Science,* 6/2: 119–146 [2005].

ÇINAR, M.E., BILECENOĞLU, M., ÖZTÜRK, B. & CAN, A., 2006b. New records of alien species on the Levantine coast of Turkey. *Aquatic Invasions,* 1/2: 84–90.

ÇINAR, M.E., KATAĞAN, T., ÖZTÜRK, B., EGEMEN, Ö., ERGEN, Z., KOÇATAS, A., ÖNEN, M., KIRKIM, F., BAKIR, K., KURT, G., DAGLI, E., KAYMAKÇI, A., AÇIK, S., DOGAN, A. & ÖZCAN, T., 2006c. Temporal changes of soft bottom zoobenthic communities in and around Alsancak Harbor (Izmir Bay, Aegean Sea), with special attention to the autoecology of exotic species. *Marine Ecology,* 27: 229–246.

ÇINAR, M.E., KATAĞAN, T., ÖZTÜRK, B., EGEMEN, Ö., ERGEN, E., KOCATAS, A., ÖNEN, M., KIRKIM, F., BAKIR, K., KURT, G., DAĞLI, E., KAYMAKÇI, A., AÇIK, S., DOGAN, A. & ÖZCAN, T., 2008. Faunal assemblages of the mussel *Mytilus galloprovincialis* in and around Alsancak Harbour (Izmir Bay, eastern Mediterranean) with special emphasis on alien species. *Journal of Marine Systems,* 71: 1–17.

CLO, S., BONFIL, R. & DE SABATA, E., 2008. Additional records of the bigeye thresher shark, *Alopias superciliosus* from the central and eastern Mediterranean Sea. *JMBA2, Biodiversity Records* 6168.

COMPAGNO, L.J.V., 1999. Checklist of living elasmobranchs. p. 471–498. In W.C. Hamlett (Ed.) *Sharks, skates, and rays: the biology of elasmobranch fishes.* John Hopkins University Press, Maryland.

CORBERA, J., 1994. A new record of *Iphinoe crassipes* Hansen, 1895 (Cumacea, Bodotriidae) from Catalonian coast. *Scientia Marina,* 58/3: 273–276.

CORBERA, J. & GALIL, B.S., 2007. Colonisation of the eastern Mediterranean by Red Sea cumaceans, with the description of a new species. *Scientia Marina,* 71/1: 29–36.

CORSINI-FOKA, M. & ECONOMIDIS, P.S., 2007. Allochthonous and vagrant ichthyofauna in Hellenic marine and estuarine waters. *Mediterranean Marine Science,* 8/1: 67–89.

CORSINI-FOKA, M., MARGIES, P., KONDILATOS, G. & ECONOMIDIS, P. S., 2006. *Torquigener flavimaculosus* Hardy and Randall, 1983 (Pisces: Tetraodontidae) off Rhodes island marine area: a new alien fish in the Hellenic waters. *Mediterranean Marine Science,* 7/2: 73–76.

KOVAČIĆ, M. & GOLANI, D., 2007. First record of *Papillogobius melanobranchus* in the Mediterranean Sea and new data on geographic distributions, bathymetric ranges and morphology of several small benthic fishes in the Levant. *Cybium,* 31/4: 417-425.

CRAPON-DE CAPRONA, D'E. A. & BENIER, C., 1985. Contribution a l'etude des Soritidae Actuels (Foraminiferes). III, Sousfamilles des Archaiasinae, Meandropsininae et

Soritinae et conclusions generales. *Revue de Paleobiologie,* 4: 437–490.

CURINI–GALLETTI M. & CAMPUS, P., 2007. *Boninia neotethydis* sp. nov. (Platyhelminthes: Polycladida: Cotylea) –the first lessepsian flatworm. *Journal of the Marine Biological Association of the United Kingdom,* 87: 435–442.

DAGLI, E. & ÇINAR, M.E., 2008. Invasion of polluted soft substratum of Izmir Bay (Aegean Sea, eastern Mediterranean) by the spionid polychaete worm, *Pseudopolydora paucibranchiata* (Polychaeta: Spionidae). *Cahiers de Biologie Marine,* 49: 87–96.

DALY YAHIA–KEFI, O., NEZAN E. & DALY YAHIA, M.N., 2001. On the presence of the genus *Alexandrium* Halim (dinoflagellates) in the bay of Tunis (Tunisia), *Oceanologica Acta,* 24: 17–25.

DALY YAHIA, M.N., J. GOY, J. & DALY YAHIA–KEFI, O., 2003. Distribution et écologie des Méduses (Cnidaria) du golfe de Tunis (Méditerranée occidentale). *Oceanologica Acta,* 26: 645–655.

DAVIS, M.H. & DAVIS, M.E., 2008. First record of *Styela clava* (Tunicata, Ascidiacea) in the Mediterranean region. *Aquatic Invasions,* 3/2: 125–132.

DEBENAY, J.P., MILLET, B. & ANGELIDIS, M.O., 2005. Relationships between foraminiferal assemblages and hydrodynamics in the Gulf of Kalloni, Greece. *Journal of Foraminiferal Research,* 35/4: 327–343.

DELONGUEVILLE, C. & SCAILLET, R., 2007. Les especes invasives de mollusques en Mediterranee. *Novapex,* 8/2: 47–70.

DIAMANT, A., 1989. Lessepsian migrants as hosts: a parasitological assessment of rabbitfish *Siganus luridus* and *Siganus rivulatus* (Siganidae) in their original and new zoogeographical regions. p. 187–194. In: SPANIER E., STEINBERGER, Y. & LURIA, M., (Eds), *Environmental quality and ecosystem stability,* Vol. IVB., Environmental Quality ISEEQS Pub. Jerusalem, Israel.

DIAMANT, A. & PAPERNA, I. 1986: The parasites of wild Red-Sea rabbitfish (*Siganus* spp.) (Teleostei: Perciformes) as potential pathogens in mariculture. (In) Pathology in Marine Aquaculture, Vivarès, C. P., Bonomi, J.-R. & E. Jaspers (Eds), *European Aquaculture Society,* Special Publication No. 9, Bredene, Belgium : 71–83.

DIAMANT, A., BANET, A., PAPERNA, I., WESTERNHAGEN, H. V., BROEG K., KRUENER, G., KOERTING, W. & ZANDER, S., 1999. The use of fish metabolic, pathological and parasitological indices in pollution monitoring II. The Red Sea and Mediterranean. *Helgoland Marine Research,* 53: 195–208.

DULČIĆ, J. & GOLANI, D., 2006. First record of *Cyclopterus lumpus* L., 1758 (Osteichthyes: Cyclopteridae) in the Mediterranean Sea. *Journal of Fish Biology,* 69: 300–303.

DULČIĆ, J. & KRALJEVIC, 2007. On the record of red seabream *Pagrus major* (Temminck and Schlegel, 1843) (Osteichthyes: Sparidae) in the Adriatic Sea. *Scientia Marina,* 71/1: 15–17.

EEA, 2006. Priority issues in the Mediterranean Sea (Papathanassiou, E., Wlodarczyk, E. & Zenetos, A.). European Environment Agency Report, 88pp http://reports.eea.eu.int/eea_report_2006_4/en

EEA, 2007a. Europe's environment _ The

fourth assessment. State of the environment report No 1/2007. http://reports.eea.europa.eu/state_of_environment_report_2007_1/en/

EEA, 2007b. Halting the loss of biodiversity by 2010: proposal for a first set of indicators to monitor progress in Europe, EEA Technical report No 11/2007, 182pp, http://reports.eea.europa.eu/technical_report_2007_11/en/Tech_report_11_2007_SEBI.pdf

ERYILMAZ, L. & DALYAN,C., 2006. First record of *Apogon queketti* Gilchrist (Osteichthyes: Apogonidae) in the Mediterranean Sea. *Journal of Fish Biology,* 69: 1251–1254.

FILIZ, H., AKÇINAR, S.C., ULUTÜRK, E., BAYHAN, B., TASKAVAK, E., SEVER, T.M., BILGE, G. & IRMAK, E., 2007. First records of the *Echiodon dentatus* (Carapidae) and *Bregmaceros atlanticus* (Bregmacerotidae) from the Aegean Sea: with a second record of *Nemichthys scolopaceus* (Nemichthyidae). *Acta Ichthyologica et Piscatoria,* 37: 107–112.

FISCHTHAL, J.H., 1980. Some digenetic trematodes of marine fishes from Israel's Mediterranean coast and their zoogeography, especially those from Red Sea immigrant fishes. *Zoologica Scripta,* 9: 11–23.

FLAGELLA, M.M., VERLAQUE, M., SORIA, A. & BUIA, M.C., 2007. Macroalgal survival in ballast water tanks. *Marine Pollution Bulletin,* 54: 1395–1401.

GALIL, B.S., 2005. *Dorippe quadridens* (Crustacea: Decapoda: Dorippidae) – first record of an alien dorippid in the Mediterranean Sea. *Crustaceana,* 78/4: 497–498.

GALIL, B.S., 2007. Seeing Red: Alien species along the Mediterranean coast of Israel. *Aquatic Invasions,* 2/4: 281–312.

GALIL, B.S. 2008. Alien species in the Mediterranean Sea. Which, when, where,why? *Hydrobiologia,* 606: 105–116.

GALIL, B.S. & LÜTZEN, J., 1995. Biological observations on *Heterosaccus dollfusi* Boschma (Cirripedia, Rhizocephala), a parasite of *Charybdis longicollis* Leene (Decapoda: Brachyura), a lessepsian migrant to the Mediterranean. *Journal of Crustacean Biology* 15/4: 659–670.

GALLI, P., STEFANI, F., BENZONI, F. & ZULLINI, A., 2005. Introduction of alien host–parasite complexes in a natural environment and the symbiota concept. *Hydrobiologia,* 548: 293–299.

GIANGRANDE, A. & LICCIANO, M., 2008. Revision of the species of *Megalomma* (Polychaeta: Sabellidae) from the Mediterranean Sea, with the description of *M. messapicum* n. sp., *Italian Journal of Zoology,* 75/2: 207–217.

GILI, J.M., 1986. *Estudio sistematico y faunistico de los Cnidarios de la costa Catalana.* PhD Thesis, University of Barcelona.

GOFAS, S. & ZENETOS, A., 2003. Exotic molluscs in the Mediterranean basin: Current status and perspectives. *Oceanography and Marine Biology: An annual Review,* 41: 237–277.

GOLANI, D., 2006. The section of Fishes. pp. 17–20 In: *A Newsletter of the biological collections of the Hebrew University. Hasiana,* 3, 91 pp.

GOLANI, D. & CAPAPÉ, C. 2004. First record of the blue stingray, *Dasyatis chrysonota* (Smith, 1828) (Chondrichthyes: Dasyatidae) off the coast of Israel (Eastern Mediterranean).

Acta Adriatica, 45/1: 107–113.

GOLANI, D. & MIRES, D., 2000. Introduction of fishes to the freshwater system of Israel. *Israel Journal of Aquaculture,* 152/2: 47–60.

GOLANI, D. & SONIN, O., 2006. The Japanese threadfin beam *Nemipterus japonicus,* a new Indo-Pacific fish in the Mediterranean Sea. *Journal of Fish Biology,* 68: 940–943.

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 pp.

GOLANI, D., APPELBAUM-GOLANI, B. & GON O., 2008. *Apogon smithi* (Kotthaus, 1970) (Teleostei: Apogonidae), a Red Sea cardinalfish colonizing the Mediterranean Sea. *Journal of Fish Biology,* 72: 1534–1538.

GÓMEZ, F., 2008. Phytoplankton invasions: Comments on the validity of categorizing the non-indigenous dinoflagellates and diatoms in European Seas. *Marine Pollution Bulletin,* 56: 620–628.

GOREN, M., GALIL, B.S., 2005. A review of changes in the fish assemblages of Levantine inland and marine ecosystems following the introduction of non-native fishes. *Journal of Applied Ichthyology,* 21: 364–370.

GOREN, M. & GALIL, B.S., 2006. Additional records of *Bregmaceros atlanticus* in the eastern Mediterranean 'V an invasion through the Suez Canal or in ballast water? *JMBA2, Biodiversity Records,* 5549.

GOSLINER, T.M, & SMITH, V.G., 2003. Systematic review and phylogenetic analysis of the nudibranch genus *Melibe* (Opistobranchia: Dendronotacea) with descriptions of three new species. *Proceedings of the California Academy of Sciences,* 54: 302–355.

GUIRY, M.D. & GUIRY, G.M., 2008. *AlgaeBase.* World-wide electronic publication, National University of Ireland, Galway. http://www.algaebase.org; accessed on 26 May 2008.

HOUART, R., 2008. Rehabilitation of *Ergalatax martensi* (Schepman, 1892) (Gastropoda: Muricidae), senior synonym of *Ergalatax obscura* Houart, 1996, and description of *Ergalatax junionae,* new name for *Morula martensi* Dall, 1923. *The Nautilus* 122(2): 99–106.

HIS, E., TIGE, G. & RABOUIN, M.A., 1977. *Mytilicola orientalis* Mori: son action sur les huitres du bassin d'Arcachon au cours de l'ete et de l'automne 1977. ICES Council Meeting 1978. International Council for the Exploration of the Sea [collected papers] 12 p.

HOFFMAN, L., VAN HEUGTEN, B. & DEKKER, H., 2006. Marine mollusca collected during a journey to the Great Bitter Lake (Suez Canal) and Nile Delta, Egypt. *Gloria Maris,* 45/1–2: 184–200.

HOFKER, J. 1930. Notizen über die Foraminiferen des Golfes von Neapel. *Pubblicazioni della Stazione Zoologica di Napoli,* 10/3: 366–406.

HOLLAUS, S. S. & HOTTINGER, L., 1997. Temperature dependance of endosymbiotic relationships? Evidence from the depth range of Mediterranean *Amphistegina lessonii* (Foraminiferida) truncated by the thermocline. *Ecologae Helvetiae,* 90: 591–597.

HONDT, D' J.L. & CHIMENZ GUSSO, C., 2006. Note sur quelques Bryozoaires Ctenostomes des cotes Italiennes et Turques. *Bulletin de la Societe Zoologique de France,* 131/2: 107–116.

HOTTINGER, L., HALICZ, E. & REISS, Z., 1993. Recent foraminiferida from the Gulf of Aqaba, Red Sea. *Slovenska Akademija Znanosti in Umetnosti, Academia Scientiarum et Artium Slovenica.* 179 p., 230 plts, Ljubljana.

HUREAU, J.C. & MONOD, T. (Eds), 1973. *Check-list of the fishes of the north-eastern Atlantic and of the Mediterranean.* Volume I, Unesco, Paris, 683 pp.

HYAMS, O., ALMOGI-LABIN, A. & BENJAMINI, C., 2002. Larger foraminifera of the southeastern Mediterranean shallow continental shelf of Israel. *Israel Journal of Earth Science,* 51: 169–179.

IZQUIERDO-MUÑOZ, A., DÍAZ-VALDÉS, M. & RAMOS-ESPLÁ A., 2008. Recent non-indigenous ascidians in the Mediterranean Sea. *Aquatic Invasions,* in press.

KABASAKAL, H., KARHAN, S.U., KABASAKAL, E., KALKAN, E. & BUZZURO, G., 2005. First Record of *Strombus (Doxander) vittatus vittatus* LINNAEUS, 1758 from the Mediterranean Sea, with a Brief Review of Strombids in the Levant Basin. *Nachrichtenblatt der Ersten Vorarlberger Malakologischen Gesellschaft,* 13: 63–66.

KAMINSKI, M.A., AKSU, A., BOX, M., HISCOTT, R.N., FILIPESCU, S. & AL-SALAMEEN, M., 2002. Late Glacial to Holocene benthic foraminifera in the Marmara Sea. implications for Black Sea-Mediterranean Sea connections following the Last deglaciation. *Marine Geology,* 190: 165–202.

KOÇAK, F., 2007. A new alien bryozoan *Celleporaria brunnea* (Hincks, 1884) in the Aegean Sea (eastern Mediterranean). *Scientia Marina,* 71/1: 191–195.

KORNFIELD, I.L., & NEVO, E. 1976. Likely pre-Suez occurrence of a Red Sea fish *Aphanius dispar* in the Mediterranean. *Nature,* 264: 289–291.

KOVACIC, M. & GOLANI, D., 2007. First record of *Papillogobius melanobranchus* in the Mediterranean Sea and new data on geographic distributions, bathymetric ranges and morphology of several small benthic fishes in the Levant. *Cybium,* 31/4: 417-425.

KRITSKY, D.C. & GALLI, P., 2007. Dactylogyrids (Monogenoidea) Parasitizing the Gills of Spinefoots (Teleostei: Siganidae): Revision of *Pseudohaliotrema,* with Redescriptions of *P. sphincteroporus* and *P. molnari* from the Great Barrier Reef, Australia. *Comparative Parasitology,* 74/1: 9–22.

KRITSKY, D.C., GALLI, P. & TINGBAO, Y., 2007. Dactylogyrids (Monogenoidea) Parasitizing the Gills of Spinefoots (Teleostei, Siganidae): Proposal of *Glyphidohaptor* n. gen., with Description of Two New Species from the Great Barrier Reef, Australia, and Redescription of *G. plectocirra* (Paperna, 1972) comb. n. from Ras Mohammed National Park, Egypt. *Journal of Parasitology,* 93: 39–46.

KTARI, F. & KTARI, MH., 1974. Presence dans le Golfe de Gabes de *Siganus luridus* (Rüppel, 1829) et de *Siganus rivulatus* (Forsskal, 1775) (poissons, siganides) parasites par *Pseudohaliotrematodides polymorphus. Bulletin de l'Institut National Scientifique et Technique d'Océanographique et de Peche, Salammbô* 3: 95–98.

LANGER, M. R. & HOTTINGER, L., 2000. Biogeography of selected "larger" foraminifera. *Micropaleontology,*

46, Supplement 1: 105–126.

LAUBIER, L., 1966. Sur quelques Annélides polychètes de la règion de Beyrouth. *Miscellaneous Papers in the Natural Sciences, American University of Beirut,* 5: 9–23.

LELLI, S., COLLOCA, F., CARPENTIERI, P. & RUSSELL B.C. (in press). The threadfin bream *Nemipterus randalii* Russell, 1986. (Perciformes: Nemipteridae) in the Eastern Mediterranean Sea. *Journal of Fish Biology.*

LICCIANO, M. & GIANGRANDE, A., 2006. The genus *Novafabricia* Fitzhugh, 1990 (Polychaeta: Sabellidae: Fabriciinae) along the Italian coast (Mediterranean Sea) with a description of *N. posidoniae* n. sp. *Scientia Marina,* 70/4: 673–678.

LOEBLICH, JR. A.R. & TAPPAN, H., 1988. Foraminiferal genera and their classification. *Van Nostrand Reinhold Company,* 970 p., 842 plts., New York.

LOEBLICH, JR. A. R. & TAPPAN, H., 1994. Foraminifera of the Sahul Shelf and Timor Sea. *Cushman Foundation for Foraminiferal Research, Special Publication,* No: 31, 663 pp., 630 plts.

LONGO, C., MASTROTOTARO, F. & CORRIERO, G., 2007. Occurrence of *Paraleucilla magna* (Porifera: Calcarea) in the Mediterranean Sea. *Journal of the Marine Biological Association of the United Kingdom,* 87: 1749–1755.

MARTY, G.D., BOWER, S.M., CLARKE, K.R., MEYER G., LOWE, G., OSBORN, A.L., CHOW, E. P., HANNAH, H., BYRNE, S., SOJONKY, K., & ROBINSON, J. H., 2006. Histopathology and a real-time PCR assay for detection of *Bonamia ostreae* in *Ostrea edulis* cultured in western Canada. *Aquaculture,* 261: 33–42.

MASTROTOTARO, F. & BRUNETTI, R., 2006. The non-indigenous aplosobranch ascidian *Distaplia bermudensis* in the Mediterranean: comparison with the native species *Distaplia magnilarva* and *Distaplia lucillae* n. sp. *Journal of the Marine Biological Association of the United Kingdom,* 86: 181–185.

MASTROTOTARO, M. & TURSI, A., 2006. Ascidiacea. In: Revisione della Cheklist della fauna marina italiana. HYPERLINK. "http://www.sibm. unige. it/CHECKLIST/principalechecklist.htm" www.sibm.unige.it/CHECKLIST/ principalechecklist.htm

MAURIN, C. & BONNET, M., 1970. Poissons des côtes nord-ouest Africaines (campagnes de la Thalassa), (1962 et 1968). *Revue des Travaux de l'Office Scientifique et Technique des Peches Maritimes,* 34: 125–170.

MÉLIANE, I., 2002. Contribution to the knowledge of the ascidian fauna in the south east of Tunisia. MSc Thesis. *University of Alicante,* Spain. 65 pp.

MERİÇ, E. & AVŞAR, N., 2001. Benthic foraminiferal fauna of Gökçeada Island (Northern Aegean Sea) and its local variations. *Acta Adriatica,* 42/1: 125–149.

MERİÇ, E., AVŞAR, N. & NAZİK, A., 2002a. Bozcaada (Kuzey Ege Denizi) bentik foraminifer ve ostrakod faunası ile bu toplulukta gözlenen yerel değişimler. *Ç. Ü. Yerbilimleri (Geosound),* 40–41: 97–119, Adana.

MERİÇ, E., AVŞAR, N. & BERGİN, F., 2002b. Midilli Adası (Yunanistan-Kuzeydoğu Ege Denizi) bentik foraminifer faunası ve bu toplulukta gözlenen yerel değişimler. *Ç. Ü. Yerbilimleri (Geosound),* 40–41: 177–193, Adana.

MERİÇ, E., AVŞAR, N., BERGİN, F.

& YOKEŞ, B., 2002c. The proliferation of *Amphistegina* (Lessepsian migrants) population in the Three-Islands (Üçadalar, Antalya), a new observation from the Turkish Coast. p. 27–34, In: *Workshop on Lessepsian Migration Proceedings, No 9,* edited by B. Öztürk and N. Başusta. Türkish Marine Research Foundation, İstanbul, Turkey.

MERİÇ, E., AVŞAR, N., BERGİN, F. & BARUT, İ.F., 2003a. Edremit Körfezi (Kuzey Ege Denizi) güncel çökellerindeki bentik foraminifer topluluğu ile ekolojik koşulların incelenmesi. *Ç. Ü. Yerbilimleri (Geosound),* 43: 169–182, Adana.

MERİÇ, E., AVŞAR, N., BERGİN, F. & BARUT, İ.F., 2003b. Dikili Körfezi'nde (Kuzey- doğu Ege Denizi) bulunan üç anormal bentik foraminifer örneği: *Peneroplis planatus* (Fichtel ve Moll), *Rosalina* sp. ve *Elphidium crispum* (Linné) hakkında. *M. T. A. Dergisi,* 127: 67–81, Ankara.

MERİÇ, E., AVŞAR, N. & BERGİN, F., 2004a. Benthic foraminifera of Eastern Aegean Sea (Turkey) Systematics and Autoecology. Chamber of Geological Engineers of Turkey and Turkish Marine Research Foundation, Publication No: 18, 306 p., 33 plts, Istanbul.

MERİÇ, E., AVŞAR, N., NAZİK, A., ERYILMAZ, M. & YÜCESOY-ERYILMAZ, F., 2004b. Saros Körfezi'nin (Kuzey Ege Denizi) güncel bentik ve planktik foraminifer toplulukları ile çökel dağılımı. *Ç. Ü. Yerbilimleri (Geosound),* 44–45: 1–44, Adana.

MERİÇ, E., AVŞAR, N., NAZİK, A., ALPAR, B., YOKEŞ, B., BARUT, İ. F. & ÜNLÜ, S., 2005. Gemlik Körfezi'nin yüzey çökellerinin foraminifer, ostrakod ve mollusk faunası, foraminifer kavkılarında gözlenen morfolojik amnomaliler ile sedimentolojik, hidro-kimyasal ve biokimyasal özellikleri. *M. T. A. Dergisi,* 131: 21–48, Ankara.

MERİÇ, E., GÖRMÜŞ, M. & AVŞAR, N., 2007. Holocene geologic history of the Golden Horn (İstanbul, NW Turkey) based on foraminiferal data. *Journal of Asian Earth Sciences,* 30: 353–363.

MERİÇ, E., AVŞAR, N., NAZİK, A., YOKEŞ, M., ERGİN, M., ERYILMAZ, M., ERYILMAZ-YÜCESOY, F., GÖKAŞAN, E., TUR, H., AYDIN, Ş. & DİNÇER, F., 2008a. Çanakkale Boğazı'nın güncel bentik foraminifer, ostrakod ve mollusk topluluğu ile çökel dağılımı. (in press).

MERİÇ, E., AVŞAR, N., YOKEŞ, B. & DİNÇER, F., 2008b. Alibey ve Maden adaları (Ayvalık-Balıkesir) yakın çevresi bentik foraminiferelerinin taksonomik dağılımı. (in press).

MERİÇ, E., AVŞAR, N., NAZİK, A., YOKEŞ, M. B. & DİNÇER, F., 2008c Benthic foraminifer and ostracod faunas along the Kalkan. Kaş, Kekova, Beş Adalar and Üç Adalar (SW Antalya) coastline *Micropaleontology* (in press).

MERİÇ, E., AVŞAR, N. & YOKEŞ, M.B., 2008d. Some alien foraminifers along the Aegean and southwestern coasts of Turkey. *Micropaleontology* (in press).

MIENIS, H., 2003a. Marine mollusks from the Eastern Mediterranean 15. Invasion of cuttlebones of *Sepia pharaonis* along the coast of Israel. *Spirula* 335: 127–129.

MIENIS, H., 2003b. Marine molluscs from the eastern Mediterranean. 12. Not *Timoclea roemeriana* but *Timoclea marica. Spirula,* 331: p42

MIENIS, H. K., 2004. New data concerning the presence of Lessepsian and other Indo-Pacific migrants among the molluscs in the Mediterranean Sea with emphasis on the situation in Israel. pp. 117–131. In: Öztürk, B. & Salman, A. (Eds). *1st National malacology Proceedings,* 1–3 September 2004, Izmir. Turkish Marine Research Foundation. Istanbul. pp. i–ix, 1–259.

MIENIS, H. K., 2005. An overlooked record of *Callista florida* from Port Said, Egypt (Bivalvia, Veneridae). *Triton,* 11: 5.

MIENIS, H.K., 2008. Monitoring the invasion of the Eastern Mediterranean by Lessepsian Migrants and other Indo-Pacific Molluscs. *Haasiana,* 4: 69-70.

MIFSUD, C. & OVALIS, P., 2007. *Chama aspersa* Reeve, 1846 (Bivalvia: Chamidae) another established Lessepsian invader in the Mediterranean Sea. *Novapex,* 8/1: 27–28.

MONCHARMONT-ZEI, M., 1968. I foraminiferi di alcuni campioni di fondo prelevati lungo la costa di Beirut (Libano). *Bolletino della Società dei Naturalisti in Napoli,* 77: 3–34.

MONNIOT, C., 1983. Ascidies littorales de Guadeloupe II: Phlebobranches, *Bulletin du Muséum national d' Histoire naturelle de Paris,* 4e sér., 5A(1): 51-71.

MONTES, J. & LAMA, A., 1993. Status of Bonamiasis in the Spanish coast. Centro De *Investigaciones Marinas,* Pontevedra (Spain):. 557–561.

MONTI, M., MINOCCI, M., BERAN, A., IVES˘A, L., 2007. First record of *Ostreopsis* cfr. *ovata* on macroalgae in the Northern Adriatic Sea. *Marine Pollution Bulletin,* 54: 598–601.

MORARIU, A. & HOTTINGER, L., 1988. Amphisteginids, specific identifications, dimorphism, coiling direction and provincialism. *Revue de Paleobiologie, Special Volume,* 2: 695–698.

MORTENSEN, T.H., 1927. *Handbook of the echinoderms of the British Isles.* London: Humphrey Milford, Oxford University Press.

MOURITSEN, KM. & POULIN, R., 2006. A parasite indirectly impacts both abundance of primary producers and biomass of secondary producers in an intertidal benthic community. *Journal of the Marine Biological Association of the United Kingdom,* 86: 221–226.

MURA, M., MURENU, M. & CAU, A., 2003. The occurrence of *Penaeopsis serrata* Bate, 1881 (Decapoda, Penaeidae) in the middle-west Mediterranean Sea. *Crustaceana,* 75/10: 1263–1269.

MUTAF, B.F, AKŞIT, D. & GÖKOĞLU, M., 2007. Some marine gastropods first recorded from Antalya Bay, Turkey (the Mediterranean Sea). *JMBA2, Biodiversity Records* 5151.

NAVANDI, D.A. & KIKINGER,R., 2007. First record of the tropical scyphomedusa *Phyllorhiza punctata* von Lendenfeld, 1884 (Cnidaria: Rhizostomeae) in the Central Mediterranean Sea. *Aquatic Invasions,* 2/4: 391–394.

NEGOESCU, I., 1981. Contribution à l'étude des Isopodes Anthuridés (Isopoda, Anthuridae) de la Mer Méditerranée. *Rapports de la Commission Internationale pour l'Exploration Scientifique de la Mer Méditerranée,* 27/2: 219–220.

OLANO, M. L., LOPEZ, E. & SAN MARTIN, G., 1998. Dos especies del Silidos (Polychaeta: Syllidae, Exogoninae) para el litoral ibérico: *Sphaerosyl-*

lis belizensis Russell, 1989 y *Exogone (Parexogone) cognettii* Castelli, Badalamenti et Lardicci, 1987. *Boletin de la Real Sociedad Espanola de Historia Natural,* 94/ 1–2: 83–88.

OVALIS, P. & ZENETOS, A., 2007. The establishment of two more alien mollusca *(Chama aspersa* and *Chama asperella)* in the eastern Mediterranean. *Mediterranean Marine Science,* 8/ 2: 97–100.

OZCAN, T., GALIL, B.S., BAKR, K. & KATAGAN, T., 2006. The first record of the banana prawn *Fenneropenaeus merguiensis* (De Man, 1888) (Crustacea, Decapoda: Penaeidae) frm the Mediterranean Sea. *Aquatic Invasions,* 1/4: 286–288.

ÖZTÜRK, B. & CAN, A., 2006. Indo-Pacific gastropod species in the Levantine and Aegean Seas. *Aquatic Invasions,* 1/3: 124–129.

ÖZTÜRK, B. & VAN AARTSEN, J. J. 2006. Indo-Pacific species in the Mediterranean. 5. *Chrysallida micronana* nom. nov. for *Chrysallida nana* (Hornung and Mermod, 1924) Gastropoda: Pyramidellidae). *Aquatic Invasions* 1/4: 241–244.

PAIS, A., MERELLA, P., FOLLESA, M. C. & GARIPPA, G. 2007. Westward range expansion of the Lessepsian migrant *Fistularia commersonii* (Fistulariidae) in the Mediterranean Sea, with notes on its parasites. *Journal of Fish Biology,* 70: 269–277.

PANCUCCI-PAPADOPOULOU, M.A. & NALETAKI, M., 2007. A new alien species in the Mediterranean? On the presence of *Sirpus monodi* Gordon, 1953 (Brachyura, Pirimelidae) in Greece. *Mediterranean Marine Science,* 8/2: 91–96.

PAPERNA, I., 1965: Contributions to the knowledge of the Red Sea. No. 32. Monogenetic trematodes from the gills of Red Sea fishes. *Bulletin of the Sea Fisheries Research Station of Israel,* Haifa 39: 1–10.

PAPERNA, I., 1972a. Monogenea of Red Sea fishes. III Dactylogyridae from littoral and reef fishes. *Journal of Helminthology,* 46: 47–62.

PAPERNA, I., 1972b. Monogenea from Red Sea fishes. I. Monogenea of fish of the genus *Siganus. Proceedings of the Helminthological Society of Washington,* 39: 33–39.

PAPERNA, I., 1972c. Monogenea from Red Sea fishes. II Monogenea of Mullidae. *Proceedings of The Helminthological Society of Washington,* 39: 39–45.

PAPERNA, I., 1972d. Parasitiological implications of fish migration through interoceanic canals. *17e Congrès International de Zoologie* (Monte-Carlo 25–27 Septembre 1972). Thème N° 3: Les conséquences biologiques des canaux inter-océans. 9 pp.

PAPERNA, I., DIAMANT, A. & OVERSTREET, R. M. 1984. Monogenean infestations and mortality in wild and cultured Red Sea fishes. *Helgolander Meeresuntersuchungen,* 37: 445–462.

PASTERNAK, Z., DIAMANT, A. & ABELSON, A., 2007. Co-invasion of a Red Sea fish and its ectoparasitic monogenean, *Polylabris* cf. *mamaevi* into the Mediterranean: observations on oncomiracidium behavior and infection levels in both seas. *Parasitology Research,* 100: 721–727.

PERES, JM., 1957. Ascidies récoltées dans les parages des Baléares par le 'Professeur Lacaze-Duthiers' (2e. partie): Iviza et San Antonio. *Vie Milieu,* suppl. 6: 223-234.

PICARD, J., 1958. Notes sur une collec-

tion d'hydroïdes provenant des côtes méditerranéennes d'Israel. *Bulletin of the Sea Fisheries Research Station of Haifa* 15: 1–3.

POR, F.D., 1964. A study of the Levantine and Pontic Harpacticoida (Crustacea, Copepoda). *Zoologische Verhandelingen,* 64: 1–128.

POR, F.D., 1972. Hydrobiological notes on the high-salinity waters of the Sinai Peninsula. *Marine Biology,* 14: 111–119.

RAGONESE, S & GIUSTO, G. B., 2007. *Zenopsis conchifera* (Lowe, 1852) (Pisces, Actinopterygii, Zeidae): a new alien fish in the Mediterranean Sea. *Journal of Fish Biology,* 71: 1853–1857.

RIERA, V., BIGAS. M., SANTMARTÍ, M., & DURFORT, M., 1995. Prevalencia del protozoo parásito *Marteilia refringens* en las poblaciones de ostra plana (*Ostrea edulis* L.) del Maresme (NE Barcelona). *Actas del V Congreso Nacional de Acuicultura:* 242–247.

ROMEO T., AZZURRO E. & MOSTARDA E., 2005. Record of *Acanthocybium solandri* in the central Mediterranean Sea, with notes on parasites. *Journal of the Marine biological Association of the United Kindom,* 85: 1295–1296.

RULL LLUCH, J., BALLESTEROS, E., BARCELÓ, M.C., GÓMEZ GARRETA, A. & RIBERA SIGUAN, M.A., 2007. *Dictyota ciliolata Sonder ex* Kützing (Phaeophyceae, Dictyotales) in the Mediterranean Sea. *Cryptogamie, Algologie,* 28: 89–97.

SAAD, A., SÉRET, B. & ALI, M., 2004. Liste commentée des chondrichtyens de Syrie (Méditerranée Orientale). p.240 In: *Abstracts of the 37th Congress of the Mediterranean Science Commission,* edited by J. Masscle *et al.,* CIESM, Monaco.

SAGRISTÀ, E., DURFORT, M., & AZEVEDO, C. 1996. Ultrastuctutral data on the life cycle of the parasite *Perkinsus atlanticus* (Apicomplexa) on the clam *Ruditapes philippinarum* in the Mediterranean. *Scientia Marina,* 60: 283–288.

SAMIR, A. M., ABDOU, H. F., ZAZOU. S. M. & EL-MENHAWEY, W. H., 2003. Cluster analysis of recent benthic foraminifera from the Northwestern Mediterranean coast of Egypt. *Revue de micropaleontologie,* 46: 111–130.

SANTMARTÍ, M., GARCIA VALERO, M.J., MONTES, J., PECH, A. & DURFORT, M., 1995. Seguimiento del protozoo *Perkinsus* sp. En las poblaciones de *Tapes decussatus* y *Tapes semidecussatus* del delta del Ebro. In: Castelló, F. & Calderer, A. (Eds), Actas del V Congreso Nacional de Acuicultura, May 10–13, 1995, S. Carlos de la Rápita, Spain, Universidad de Barcelona, Barcelona, Spain, pp. 260–265.

SAN MARTIN, G., 2003. *Fauna Iberica vol 21 Annelida Polychaeta II, Syllidae.* Museo Nacional de Ciencias Naturales Consejo superior de Investigaciones cientificas. 554 pp.

SARDÀ, R., 1985. Fauna de Anélidos poliquetos del estrecho de Gibratar. I. Sphinterida y Phyllodocida. *Miscellania Zoologica* 9: 65–78.

SARTONI, G. & BODDI, S., 2002. *Ceramium bisporum* (Ceramiaceae, Rhodophyta), a New Record for the Mediterranean Algal Flora. *Botanica Marina,* 45/6: 566–570.

SCHEMBRI, P.J., 1978. Recent echinoids (Echinodermata: Echinoidea) from the Maltese Islands and surrounding waters. *Animalia,* 5: 123–132.

SCIBERRAS, M. & SCHEMBRI, P.J., 2007. A critical review of records of alien marine species from the Maltese Islands and surrounding waters (Central Mediterranean). *Mediterranean Marine Science,* 8: 41–66.

SERENA, F., 2005. *Field identification guide to the sharks and rays of the Mediterranean and Black Sea.* FAO Species Identification Guide for Fishery Purposes, Rome, FAO, 97 pp.

SGARRELLA, F. & MONCHARMONT--ZEI, M., 1993. Benthic foraminifera of the Gulf of Naples (Italy), systematic and autoecology. *Bolletino della Societa Paleontologica Italiana,* 32/2: 145–264.

SHIGANOVA, T.A., CHRISTOU, E.D. & SIOKOU- FRANGOU, I., 2007. First recording of the non-native species *Beroe ovata* Mayer 1912 in the Aegean Sea. *Mediterranean Marine Science,* 8/1: 5–14.

STREFTARIS, N. & ZENETOS, A., 2006. Alien marine species in the Mediterranean – the 100 'worst invasives' and their impacts. *Mediterranean Marine Science,* 7/1: 87–118.

STREFTARIS, N., ZENETOS, A. & PAPATHANASSIOU, E., 2005. Globalisation in marine ecosystems - The story of non indigenous marine species across European Seas. *Oceanography and Marine Biology: An annual Review,* 43: 419–453.

TANTI, C.M. & SCHEMBRI, P.J., 2006. A synthesis of the echinoderm fauna of the Maltese islands. *Journal of the Marine Biological Associationof the United Kingdom,* 86: 163–165.

TASKIN, E., ÖZTÜRK, M., KURT, O. & ÖZTÜRK, M. , 2008. *The check-list of the marine algae of Turkey.* pp. [i-ii]-[1]-87. Manisa, Turkey: Ecem Kirtasiye.

TERBIYIK, T., CEVIK, C., TOKLU-ALICLI, B & SARIHAN, E., 2007. First record of *Ferosagitta galerita* (Dallot, 1971) [Chaetognatha] in the Mediterranean Sea. *Journal of Plankton Research,* 29/ 8: 721–726.

TORCHIN, M.E. & KURIS, A. M., 2005. Introduced marine parasites. In: *Nonequilibrium Ecology:* K. Rhode, ed. Cambridge University Press. pp 358–366.

TORCHIN, M.E. & MITCHELL, C.E.. 2004. Parasites, pathogens and invasions by plants and animals. *Frontiers in Ecology and the Environment* 2: 183–190.

TORCHIN, M.E., LAFFERTY, K.D., DOBSON, A. P., MCKENZIE, V. J. & KURIS, A. M., 2003. Introduced species and their missing parasites, *Nature,* 421: 628–629.

TORTONESE, E., 1956. *Leptocardia, Ciclostomata, Selachii.* Fauna D' Italia, Edizioni Calderini Bologna, 334 pp.

TRIANTAPHYLLOU, M.V., TSOUROU, T., KOUKOUSIOURA, O. & DERMITZAKIS, M.D., 2005. Foraminiferal and ostracod ecological patterns in coastal environments of SE Andros Island (Middle Aegean Sea, Greece). *Revue de Micropaleontologie,* 48: 279– 302.

TRILLES, J.P. & BARICHE, M., 2006. First record of the Indo-Pacific *Cymothoa indica* (Crustacea, Isopoda, Cymothoidae), a Lessepsian species in the Mediterranean Sea. *Acta Parasitologica,* 51/3: 223–230.

TURON, X., NISHIKAWA, T. & RIUS, M., 2007. Spread of *Microcosmus squamiger* (Ascidiacea: Pyuridae) in the Mediterranean Sea and adjacent waters, *Journal of Experimental Marine Biology and Ecology* 342: 185–188.

ÜNAL, E., SHMELEVA, A.A. & KIDEYS, A.E., 2002. Three new species of *Acartia* (Copepoda, Calanoida) from the northeastern Levantine Basin. p.35–39. In: *Proceedings of Workshop on Lessepsian Migration,* 20–21 July 2002, Gökceada, Turkey, edited by B.Öztürk and N.Basusta. Turkish Marine Research Foundation (TÜDAV), Vol. 9.

UNEP/MAP, 2004. Marine pollution indicators Fact sheets. Document UNEP(DEC) MEDWG.264/Inf.14

UNEP/MAP, 2007. Report On Marine Pollution Indicators In Mediterranean Countries. Review Meeting of MED POL monitoring activities and the use of indicators Athens, 12–14 December 2007, UNEP(DEPI)/MED WG.321/Inf.7.

VACELET, J., BITAR, G., CARTERON, S., ZIBROWIUS, H. & PEREZ,T., 2007. Five new sponge species of subtropical or tropical affinities from the coast of Lebanon (eastern Mediterranean). *Journal of the Marine Biological Association of the United Kingdom* 87/6: 1539–1552.

VAN AARTSEN, J.J., 2004. *Diplodonta bogii* spec. nov.: a new species from the Red Sea, living along the Mediterranean coast of Israel (Bivalvia, Diplodontidae). *Basteria,* 68: 73–76.

VAN AARTSEN, J.J., 2006. Indo-Pacific migrants into the Mediterranean. 4. *Cerithidium diplax* (Watson 1886) and *Cerithidium perparvulum* (Watson 1886) (Gastropoda, Caenogastropoda). *Basteria,* 70: 33–39.

VAN AARTSEN, J.J. & GOUD, J., 2006a. Indo-Pacific migrants into the Mediterranean. 3.1. *Atys angustatus* Smith, 1872 (Gastropoda, Opisthobranchia). *Basteria,* 70: 29–31.

VAN AARTSEN, J.J. & GOUD, J., 2006b. Indo-Pacific migrants into the Mediterranean. 6.1. *Syrnola lendix* (A. Adams, 1863) (Gastropoda, Pyramidellidae. *Basteria,* 70: 164–166.

VAN AARTSEN, J.J & HORI, S., 2006. Indo-Pacific migrants into the Mediterranean. 2. *Monotigma lauta* (A.Adams 1853) and *Leucotina natalensis* Smith 1910 (Gastropoda, Pyramidellidae). *Basteria,* 70: 1–6.

VERLAQUE, M., BRANNOCK P.M., KOMATSU T., MARTINE VILLALARD-BOHNSACK M., & MARSTON, M., 2005. The genus *Grateloupia C.* Agardh (Halymeniaceae, Rhodophyta) in the Thau Lagoon (France, Mediterranean): a case study of marine plurispecific introductions. *Phycologia,* 44/5: 477–496.

VERLAQUE, M., BOUDOURESQUE C.F. & MINEUR F., 2007. Oyster transfers as a vector for marine species introductions: a realistic approach based on the macrophytes. *CIESM Workshop Monographs, Monaco,* 32: 39–48.

VERLAQUE, M., RUITTON S., MINEUR F. & BOUDOURESQUE C.F., in press. 4. Macrophytes. *In:* Briand F. (Ed.), *CIESM Atlas of Exotic Species in the Mediterranean.* CIESM Publishers, Monaco.

VIETEZ, J.M., ALOS C, PARAPAR, J., BESTEIRO, C., NUNEZ, J., LABORD, A.J. & SAN MARTIN, G., 2004. Annelida Polychaeta I En: *Fauna Iberica* vol 25 (Ramos, M.A. *et al.,* Eds) Museo National de Ciencias Naturales CICS Madrid. 530 pp.

YANKO, V., 1995. Benthic foraminifera as indicators of heavy metals pollution along Ísraeli coast (Cruise AVI-1, May 1993). *Benthic foraminifera as indicator of heavy metal pollution- A*

new kind of biological monitoring for the Mediterranean, Task 5.

YANKO, V., AVŞAR, N., SANVOISIN, R., SPEZZAFERRI, S., MERİÇ, E. & BASSO, D., 1993. Foraminiferal study: Taxonomy, distribution, density and diversity. *Benthic foraminifera as indicator of heavy metal pollution-A new kind of biological monitoring for the Mediterranean,* Task 9.

YILMAZ, R., BILECENOĞLU, M. & HOŞSUCU, B., 2004. First record of the antenna codlet, *Bregmaceros atlanticus* Good & Bean, 1886 (Osteichthys: Bregmacerotidae), from the eastern Mediterranean. *Zoology in the Middle East,* 31: 111–112.

YOKEŞ, B. & GALIL, B.S., 2006a. The first record of the needle-spined urchin *Diadema setosum* (Leske, 1778) (Echinodermata: Echinoidea: Diadematidae) from the Mediterranean Sea. *Aquatic Invasions,* 1/3: 188–190.

YOKEŞ, B. & GALIL, B.S., 2006b. New records of alien decapods Crustacea) from the Mediterranean coast of Turkey, with a description of a new palaemonid species. *Zoosystema,* 28/3: 747–755.

YOKEŞ, B., MERİÇ, E. & AVŞAR, N., 2007. On the presence of alien foraminifera *Amphistegina lobifera* Larsen on the coasts of the Maltese Islands. *Aquatic Invasions,* 2/4: 439–441.

YOUNG, L., POLYCHRONIDIS, L. & ZENETOS, A., 2007. Saronikos Gulf: Hot spot for alien mollusca. Communication presented at 1st *Pan-Hellenic Meeting on Aquatic Invasive Species in the eastern Mediterranean.* Irakleio, Kriti, 5–6/11/2007.

YÜCE, Ö. & SADLER, K.C., 2000. Determination of the reproduction periods of two dominant starfish in the Straits and the Sea of Marmara. In *Proceedings of SBT 2000 – 4th National Meeting of Underwater Science and Technology, Istanbul, 2–3 November 2000,* S. Hamarat & V. Evrin (Eds), pp. 45–49. [In Turkish.]

WGITMO, 2006. Report of the ICES Working Group on Introductions and Transfers of Marine Organisms (WGITMO), Oostende Meeting, Belgium. ICES CM 2006/ACME: 05, 330 pp.

WHITEHEAD, P.J.P., BAUCHOT, M.-L., HUREAU, J.-C., NIELSEN, J. & TORTONESE, E. (Eds), 1984. *Fishes of the North-eastern Atlantic and the Mediterranean.* Volume I, UNESCO, Paris, 510 pp.

ZAKARIA, H.Y., 2004. Pelagic coelenterates in the waters of the western part of the Egyptian Mediterranean Coast during summer and winter. *Oceanologia,* 46/2: 253–268.

ZAKARIA, H.Y., 2006. The zooplankton community in Egyptian Mediterranean Waters: A review. *Acta Adriatica,* 47/2: 195–206.

ZANIOLO, G., MANNI, L., BRUNETTI, R. & BURIGHEL, P., 1998. Brood pouch differentiation in *Botrylloides violaceus,* a viviparous ascidian (Tunicata). *Invertebrate Reproduction & Development,* 33:11–24

ZAOUALI, J., BEN SOUISSI, J, GALIL, B.S., D'UDEKEM D'ACOZ, C. & BEN ABDALLAH, A., 2007a. Grapsoid crabs (Crustacea: Decapoda: Brachyura) new to the Sirte Basin, southern Mediterranean Sea – the roles of vessel traffic and climate change. *JMBA2, Biodiversity Records* 5770.

ZAOUALI, J., BEN SOUISSI, J., STOHR, S. D'UDEKEM D'ACOZ, C. & BEN ABDALLAH, A. 2007b. Contribution à l'étude des peuple-

ments actuels des substrats solides de l'étage médiolittoral de la Méditerranée méridionale. *Rapports de la Commission Internationale pour l'Exploration Scientifique de la Mer Méditerranée,* 38: 639.

ZENETOS, A., 2008. Alien species in European Seas with focus in the Mediterranean. Presentation communicated at: *European Conference on Invasive Alien Species,* Madrid 15–16 January, 2008.

ZENETOS, A., GOFAS, S., RUSSO, G. & TEMPLADO, J. 2004. *CIESM Atlas of Exotic Species in the Mediterranean, Volume 3: Molluscs* F. Briand (Ed.), 376 pp, CIESM Publishers Monaco.

ZENETOS, A., ÇINAR, M.E., PANCUCCI-PAPADOPOULOU, M.A., HARMELIN, J.G., FURNARI, G., ANDALORO, F., BELLOU, N., STREFTARIS, N. & ZIBROWIUS, H., 2006. Annotated list of marine alien species in the Mediterranean with records of the worst invasive species. *Mediterranean Marine Science,* 6/2: 63–118 [2005].

ZIBROWIUS, H., 2002. Assessing scale and impact of ship transported alien fauna in the Mediterranean *CIESM Workshop Monographs,* 20: 62–68.

Published on line: June 2008