



Mediterranean Marine Science

Vol 12, No 1 (2011)



Marine alien species in Greek Seas: Additions and amendments by 2010

A. ZENETOS, S. KATSANEVAKIS, D. POURSANIDIS, F. CROCETTA, D. DAMALAS, G. APOSTOLOPOULOS, C. GRAVILI, E. VARDALA-THEODOROU, M. MALAQUIAS

doi: 10.12681/mms.55

To cite this article:

ZENETOS, A., KATSANEVAKIS, S., POURSANIDIS, D., CROCETTA, F., DAMALAS, D., APOSTOLOPOULOS, G., GRAVILI, C., VARDALA-THEODOROU, E., & MALAQUIAS, M. (2011). Marine alien species in Greek Seas: Additions and amendments by 2010. *Mediterranean Marine Science*, *12*(1), 95–120. https://doi.org/10.12681/mms.55

Research Article

Marine alien species in Greek Seas: Additions and amendments by 2010

A. ZENETOS¹, S. KATSANEVAKIS¹, D. POURSANIDIS², F. CROCETTA³, D. DAMALAS¹, G. APOSTOLOPOULOS⁴, C. GRAVILI⁵, E. VARDALA-THEODOROU⁶ and M. MALAQUIAS⁷

¹ Institute of Marine Biological Resources, Hellenic Centre for Marine Research, P.O. Box 712, 19013 Anavissos, Hellas

² Department of Marine Sciences, University of the Aegean, 81100, Mytilene, Hellas

³ Laboratory of Cellular and Developmental Biology, Stazione Zoologica Anton Dohrn Viale Antonio Dhorn, 80121 Napoli

⁴ Law school, University of Athens, Ippokratus 33, 10680, Hellas

⁵ Dipartimento di Scienze e Tecnologie Biologiche ed Ambientali, Università del Salento, Lecce, Italy

⁶ Department of Hydrobiology, Goulandris Natural History Museum – Gaia Center, 100 Othonos Str., Kifissia, 14562, Hellas

⁷ Phylogenetics, Systematics and Evolution Research Group, The Natural History Collections, Bergen Museum, University of Bergen, 5020-Bergen, Norway

Corresponding author: zenetos@ath.hcmr.gr

Received: 09 December 2010; Accepted: 13 January 2011; Published on line: 11 March 2011

Abstract

An update of the inventory of alien marine species from the coastal and offshore waters of Greece is presented. Records were compiled based on the existing scientific and grey literature, including the HCMR database of Greek alien species (ELNAIS), technical reports, scientific congresses, academic dissertations, websites, and unpublished/personal observations. 47 species were added to the inventory, including 34 invertebrates, one vertebrate (fish), three plants, eight protozoa, and one cyanobacterium. With the new records, the inventory of alien marine species of Greece now includes a total of 237 species (33 macrophytes, 131 invertebrates, 42 vertebrates, two bacteria and 29 protozoans). Among these, the presence of the gastropod Hypselodoris infucata, the bivalves Dendrostrea frons and Septifer forskali and the chondrichthyan Rhizoprionodon acutus is reported here for the first time. Based on molecular analysis, the occurrence of Bulla arabica in Greek waters is confirmed, and the suggestion that previous records of Bulla ampulla in the Mediterranean should be considered as misidentification of B. arabica is further supported. The acclimitization status of earlier records was revised in the light of new data, and thus the fish Enchelycore anatina, Seriola fasciata and Tylerius spinosissimus, the red algae Hypnea cornuta and Sarconema scinaioides, the scyphomedusa Cassiopea andromeda, the cephalopod Sepioteuthis lessoniana, the nudibranch Chromodoris annulata and the bivalves Gastrochaena cymbium and Pseudochama corbieri were upgraded from casual records to established populations. The increased rate of introductions of warm water species confirms previous findings, which link the rate of introduction in the eastern Mediterranean to climate change.

Keywords: Marine aliens; Greece; *Hypselodoris infucata; Rhizoprionodon acutus; Dendrostrea frons; Septifer forskali; Bulla arabica.*

Introduction

The eastern Mediterranean is especially susceptible to biological invasions because of its crossroads location between the Ponto-Caspian and the Indian Sea/Red Sea regions, the maritime traffic through the Dardanelles, Gibraltar and Suez, and the existence of many fish and shellfish farms. Hence, Greek waters may function as a gateway to the dispersal of marine alien species, either from the Levantine to the Adriatic and/or to the western Mediterranean or from the Black Sea to the eastern Mediterranean.

The rate of introductions of alien marine species in the Mediterranean Sea is increasing (ZENETOS, 2010) as is the spread of alien species initially established in the Levantine, to other biogeographic areas such as the Aegean. In addition, the scientific community has intensified its efforts to study alien invasions in coastal ecosystems. While new studies are being added to the list, careful examination of historical data on little studied taxa such as hydroids, polychaetes and foraminiferan further expands the Mediterranean aliens' list.

Following a series of scattered publications dealing with single species or groups, a summary of marine alien biota in Greek waters was prepared by PANCUCCI-PAPADOPOULOU et al. (2005a) and updated by PANCUCCI-PAPADOPOULOU et al. (2005b). ZENETOS et al. (2007), provided some additions to the alien marine fauna of Greece. CORSINI-FOKA & ECONOMIDIS (2007) focused on the marine and estuarine fish fauna, while TSIAMIS et al. (2008, 2010) reviewed the alien marine flora. The most up-to-date inventory of the alien aquatic species of Greece, with comments on the sources and patterns of their introduction is given by ZENETOS et al. (2009a). For Greek waters, the Hellenic Centre for Marine Research maintains and continuously updates an online database of alien marine species, with records of their presence in Greek localities and distribution maps (ZENETOS et al., 2009b; ELNAIS, 2010). Systematic study of Foraminifera in the Greek Aegean Sea has provided additional data on the distributional range of alien Foraminifera in the Eastern Mediterranean (KOUKOUSIOURA et al., 2010). SIMBOURA et al. (2010) reported cases of alien Polychaeta species that were previously collected but had not been identified until recently, or species not classified as aliens (ZENETOS et al., 2009a) although they were present in Greek check lists.

Recently, MALAQUIAS & REID (2008) described a new species of the genus Bulla (Mollusca: Opisthobranchia) from the Red Sea and Arabian Peninsula, that they named Bulla arabica; the authors hypothesized that the records of Bulla ampulla in the Mediterranean Sea for the coasts of Israel, Greece, Cyprus and Turkey (BARASH & DANIN, 1982; ZENETOS et al., 2004; MIENIS, 2004), would probably belong to B. arabica. Both B. ampulla and B. arabica have similar shells that can be misidentified; however their anatomy is distinct and molecular phylogenetics clearly separates these two species (MALAQUIAS & REID, 2008). Furthermore, these species do not occur sympatrically; whereas B. arabica is restricted to the Red Sea and Arabian Peninsula, the species B. ampulla is not present in these areas but has a broader Indo-West Pacific distribution.

The aim of this work is to update the ZENETOS *et al.* (2009a) list of marine alien species by a) adding all new records reported in the literature or observed by the authors up to December 2010; b) amending collection dates based on literature; c) clarifying the nomenclature of *Bulla ampulla*; and

d) revising the establishment success of earlier casual records in the light of new data.

Materials and Methods

Records of marine alien species from coastal and offshore waters of Greece are compiled based on the existing scientific and grey literature, including ELNAIS (2010), technical reports, scientific congresses, academic dissertations, and websites/online forums (e.g. http://www.scubadive.gr, http://www.seaslugforum.net), as well as on unpublished/personal observations. Records from grey literature or personal observations are included provided they are supported by physical evidence such as specimens or photographs. Additional records of species found in the period July 2009-December 2010 or previous findings reported within 2010 are discussed. The updated list also includes some records reported before June 2009 but missed by ZENETOS et al. (2009a).

Determination of establishment success follows terminology provided in ZENETOS *et al.* (2009a) and KATSANE-VAKIS *et al.* (2009).

Established: Introduced or feral population of species settled in the wild with freeliving, self maintaining and self-perpetuating populations unsupported by and independent of humans. Species with at least two records in Greece spread over time and space (at least three records for fishes) are also classified as established, in the sense of the CIESM atlas series.

Casual: Casual species are those, which have been recorded only once (no more than twice for fish) in the scientific and grey literature and are presumed to be non-established in Greece. In this paper 'casual' is used in the same sense as 'alien' in the CIESM atlas series.

Questionable: Species with insufficient information – 'suspects'. This also includes new entries not verified by experts or species with taxonomic status unresolved.

Cryptogenic: Species with no definite evidence of their native or introduced status according to CARLTON (1996) and species whose probable introduction occurred in 'early times' and has not been witnessed, e.g. prior to 1800.

Invasive: Species defined as established aliens that have overcome biotic and abiotic barriers and are able to disseminate away from their area of initial introduction through the production of fertile offspring with noticeable impact, such as threat to the diversity or abundance of native species, the ecological stability of infested ecosystems, economic activities dependent on these ecosystems, and human health.

For some species reported as casual in ZENETOS *et al.* (2009a) there was evidence of further expansion, which led us to change the status of their establishment success. Nomenclature adopted in this paper follows the World Register of Marine Species (WoRMS <www.marinespecies.org>) and contributing databases (AlgaeBase, CLEMAM, FishBase).

To clarify the nomenclature of *Bulla ampulla*, living specimens that provided the material for DNA analysis were collected in May 2006, in Psili Ammos on Salamis Island of Saronikos Gulf and preserved in ethanol. The taxonomic identification of this material was assessed by molecular methods.

The results are structured in six units. A. The new species with a brief text on their findings; B. Species to be excluded; C. Change in establishment success with comments; D. Misidentifications and Nomenclatural changes; E. Change in introduction dates; and F. Spread of reported aliens and current distribution of marine aliens in the Greek Seas.

Results and Discussion

A. New species

Table 1 presents the new species along with some information on their origin, speculated mode of introduction, year of first sighting, and literature. Among the new species 34 are invertebrates, 1 vertebrate (fish), 3 macroalgae, 8 protozoa, and 1 cyanobacterium (Table 1). By adding these 47 species, and excluding three species (see section B), the inventory of alien marine species of Greece now includes a total of 237 species of which 33 are macrophytes, 131 invertebrates, 42 vertebrates, 2 bacteria, and 29 protozoans (Fig. 1). All the new records of invertebrates are zoobenthic species belonging to the taxa investigated the most intensively, i.e. Polychaeta, Mollusca and Crustacea. Fifteen of the records appear to have established viable populations already. With the exception of two species [Anotrichium okamurae Baldock and Chattonella verruculosa Y. Hara & M. Chihara], originating in the North Pacific, all the new introductions are warm water species. Examination of the presumed modes of introduction, leads to the inference that some of the well established Lessepsian immigrants in the Levantine Sea are spreading northwards to the Aegean. However, the role of shipping bears equal responsibility for the transfer of warm water species to the Aegean Sea, either via Suez or via Gibraltar. It is also worth noticing that with the addition of the 47 species reported here, the number of alien species has increased by 24.4% since the last compilation (June 2009). Overall, 84 new marine alien species have been collected/sighted since 2000, this high rate of introduction being significantly correlated to climate change (RAITSOS *et al.*, 2010). More details for each species are provided in the text that follows.

CYANOPHYCEA

The cyanobacterium *Trichodesmium* erythraeum is known from nutrient-poor tropical and subtropical ocean waters (particularly around Australia). It has been reported from the Turkish Aegean, in Sicily (BARRONE, 2004), and in the Gulf of Gabes, Tunisia (DRIRA et al., 2009). In Greek waters it was found in Chalkida (Evvoikos Gulf) by METAXATOS et al. (2003), while blooms have been reported from Rodos island (S Aegean) and Lesvos island (NE Aegean) [Spatharis, pers. obs].

PROTOZOA

Marteilia refringens is a parasite which affects the digestive system of several bivalve species, inducing physiological disorders and eventually results in death. The first report in Greece dates back to 1997 from oyster beds in Thermaikos Gulf (ANGELIDIS *et al.*, 2001). According to the Directorate General of Veterinary Services in Athens there have been five outbreaks of the disease in farmed mussels across Greece until November 2010.

KOUKOUSIOURA et al. (2010) reported six cryptogenic foraminiferan species namely: Amphistegina lobifera Larsen, Sorites orbiculus (Forsskål), Cymbaloporetta plana (Cushman), Triloculina fichteliana d'Orbigny, Planogypsina acervalis (Brady) and Coscinospira hemprichii Ehrenberg from Greek coastal areas. Their distribution can be associated with several pathways, via the Atlantic during the interglacial warm

| First | Sighting | 1997 | | 1997 | | 1998 | | 2000 | | 1955-64 | | 2001 | | 2001 | | 2006 | | 1955-64 | | 1973 | | 2009 | | unknown | | . |
|---------------|----------|--------------------------|----------------------|----------------------|----------------------|-------------------------|----------------------|-------------------------|----------------------|-------------------------|-----------------|----------------------|----------------------|------------------------|----------------------|-------------------------|----------------------|-------------------------------|------------------|----------------------|----------------|----------------------|--------------------------|------------------|------------------------|---|
| source | | METAXATOS | <i>et al.</i> , 2003 | ANGELIDIS | <i>et al.</i> , 2001 | NIKOLAIDIS | <i>et al.</i> , 2005 | NIKOLAIDIS | <i>et al.</i> , 2005 | BLANK VERNET, | 1969 | KOUKOUSIOURA | <i>et al.</i> , 2010 | KOUKOUSIOURA | <i>et al.</i> , 2010 | KOUKOUSIOURA | <i>et al.</i> , 2010 | BLANC-VERNET, | 1969 | GERLOFF & | GEISSLER, 1974 | XIMMIS & | BELLOU, 2010 | TSIAMIS | <i>et al.</i> , 2010 | |
| Origin | | tropical | | umenown | | N Pacific | | umknown | | unknown | | unknown | | unknown | | unknown | | Indian Ocean/ | Red Sea | NW Pacific | | Pacific | | Indo-Pacific | | |
| Vector | | unknown | | aquaculture | | unknown | | shipping | | unknown | | via Suez / | shipping | via Suez / | spreading | via Suez / | shipping | via Suez | | shipping | | shipping | | via Suez / | shipping | |
| Establishment | success | unknown | | established | | cryptogenic/ | questionable | unknown | | cryptogenic/ | established | cryptogenic/ | established | cryptogenic/ | established | cryptogenic/ | established | established | | questionable | | established | | questionable | | |
| Taxon | | Cyanophycea | | undefined | | Dinophyceae | | Dinophyceae | | Foraminifera | | Foraminifera | | Foraminifera | | Foraminifera | | Foraminifera | | Rhodophyta | | Rhodophyta | | Rhodophyta | | |
| Species | | Trichodesmium erythraeum | Ehrenberg | Marteilia refringens | Cavalier-Smith, 2002 | Chattonella verruculosa | Y. Hara & M. Chihara | Prorocentrum triestinum | J. Schiller, 1918 | Coscinospira hemprichii | Ehrenberg, 1839 | Cymbaloporetta plana | (Cushman, 1924) | Planogypsina acervalis | (Brady, 1884) | Triloculina fichteliana | D'Orbigny, 1838 | Amphistegina madagascariensis | D' Orbigny, 1903 | Anotrichium okamurae | Baldock | Apoglossum gregarium | (E.Y. Dawson) M.J. Wynne | Chondria pygmaea | Garbary & Vandermeulen | |
| Kingdom | | Bacteria | | Protista | | Protista | | Protista | | Protista | | Protista | | Protista | | Protista | | Protista | | Plantae | | Plantae | | Plantae | | |

Table 1 Additional alien species in Greek Seas to those reported in ZENETOS *et al.* (2009a). ver=Vertebrates, inv=Invertebrates.

| Kingdom | Species | Taxon | Establishment | Vector | Origin | source | First |
|----------|-------------------------------------|----------------|---------------|---------------|----------------|---------------------------|-----------|
| | | | success | | | | Sighting |
| Animalia | Rhizoprionodon acutus | Fish/ | casual | via Gibraltar | circumtropical | This work | 2004 |
| (ver) | (Rüppell, 1837) | Chondrichthyes | | | | | |
| Animalia | Naineris quadraticeps | | | | | | |
| (inv) | Day, 1965 | Polychaeta | questionable | Via Suez | Indian Ocean | HARMELIN, 1969 | 1964 |
| Animalia | Capitellethus dispar (Ehlers, 1907) | Polychaeta | questionable | unknown | Indo-Pacific / | ARVANITIDIS , 2000 | |
| (inv) | | | | | Red Sea | | |
| Animalia | Chaetozone corona | Polychaeta | cryptogenic | shipping | unknown | SIMBOURA | 1982 |
| (inv) | Berkeley & Berkeley, 1941 | | | | | et al., 2010 | |
| Animalia | Dasybranchus cameus | Polychaeta | questionable | unknown | Red Sea | ARVANITIDIS, | unknown |
| (inv) | Grube, 1870 | | | | | 2000 | |
| Animalia | Dispio magnus | Polychaeta | questionable | unknown | Indian Ocean | SIMBOURA, 1996 | 1981 |
| (inv) | (Day, 1955) | | | | | | |
| Animalia | Dodecaceria capensis Day, 1961 | Polychaeta | questionable | unknown | Indo-Pacific / | BODGANOS & | 1975 |
| (inv) | | | | | Red Sea | SATSMADJIS, 1983 | |
| Animalia | Hyboscolex longiseta | Polychaeta | questionable | unknown | cosmopolitan | FASSARI, 1982 | 1977 |
| (inv) | (Schmarda, 1861) | | | | | | |
| Animalia | Leocrates chinensis Kinberg, 1866 | Polychaeta | questionable | unknown | Pacific | ARVANITIDIS & | |
| (inv) | | | | | | KOUKOURAS, 1994 | 1987 |
| Animalia | Loimia medusa Savigny, 1818 | Polychaeta | questionable | unknown | cosmopolitan | BOGDANOS & | 1976 |
| (inv) | | | | | | SATSMADJIS, 1983 | |
| Animalia | Lumbrineris perkinsi | Polychaeta | established | shipping | Indo-Pacific | ARVANITIDIS, | 1990s |
| (inv) | Carrera-Parra, 2001 | | | | | 1994 | |
| Animalia | Marphysa disjuncta Hartman, 1961 | Polychaeta | established | shipping | Pacific | SIMBOURA | 1983 |
| (inv) | | | | | | et al., 2010 | |
| Animalia | Neopseudocapitella brasiliensis | Polychaeta | established | shipping | W Atlantic / | SIMBOURA & | 1991 |
| (inv) | Rullier & Amoureux, 1979 | | | | Red Sea | NICOLAIDOU, 2001 | |
| | | | | | | | continued |

| 0 |
|------------|
| - a |
| H |
| = |
| |
| •= |
| Ξ |
| - |
| - |
| |
| 0 |
| ల |
| <u> </u> |
| 1 (c |
| e 1 (c |
| le 1 (c |
| ble 1 (c |
| able 1 (c |
| able 1 (c |
| Table 1 (c |

| | | E | | TT TT | | | |
|-------------------|---|------------------------|---------------|-------------------------|---------------------------|-------------------------------|--------------------|
| monguin | Species | 1 4 X 0 H | Establishment | vector | Origin | source | FII'St Sighting |
| Animalia (inv) | Paraprionospio coora Wilson, 1990 | Polychaeta | cryptogenic | shipping | Pacific | SIMBOURA et al., 2010 | 1982 |
| Animalia (inv) | Polydora spongicola Berkelev & Berkelev, 1950 | Polychaeta | questionable | unknown | Pacific | ARVANITIDIS, 2000 | unknown |
| Animalia (inv) | Polycirrus twisti Potts, 1928 | Polychaeta | cryptogenic | via Suez / spreading | Red Sea | SIMBOURA, 2011 | 1983-84 |
| Animalia (inv) | Protodorvillea biarticulata Day, 1963 | Polychaeta | questionable | unknown | Indian Ocean | BODGANOS & SATMATDIS, 1985 | 1975 |
| Animalia (inv) | Pseudopołydora paucibranchiata (Okuda, 1937) | Polychaeta | established | shipping | Pacific | SIMBOURA et al., 2010 | 2005 |
| Animalia (inv) | Scoletoma debilis (Grube, 1878) | Polychaeta | questionable | unknown | Indo-Pacific | ARVANITIDIS, 2000 | unknown |
| Animalia (inv) | Sigambra constricta (Southern, 1921) | Polychaeta | questionable | unknown | Indo-Pacific | ARVANITIDIS, 2000 | unknown |
| Animalia (inv) | Syllis schulzi (Hartmann-Schröder, 1962) | Polychaeta | questionable | unknown | Red Sea / Indian Ocean | ARVANITIDIS, 1994 | unknown |
| Animalia (inv) | <i>Timarete dasylophius</i> (Marenzeller, 1879) | Polychaeta | questionable | unknown | Indo-Pacific | ARVANITIDIS, 2000 | unknown |
| Animalia (inv) | Phallusia nigra Savignyi 1816 | Ascidiacea | established | via Suez / spreading | pantropical | KONDILATOS et al., 2010 | 2009 |
| Animalia (inv) | Clytia linearis (Thornely, 1900) | Cnidaria/ Hydrozoa | established | via Suez / spreading | Indo-Pacific | MARINOPOULOS, 1979 | 1977 |
| Animalia (inv) | Synalpheus tumidomanus africanus (Crosnier & Forest, 1965) | Crustacea/ Decapoda | cryptogenic | Via Suez? | unknown | KOUKOURAS, 1978 | unknown |

Table 1 (continued)

101

continued

| | | | - | - | | - | |
|----------|------------------------------------|-----------------|---------------|------------|----------------|----------------------|----------|
| Kingdom | Species | Taxon | Establishment | Vector | Origin | source | First |
| | | | success | | | | Sighting |
| Animalia | Atergatis roseus (Rüppell, 1830) | Crustacea/ | established | via Suez / | Indo-Pacific | CORSINI-FOKA & | 2009 |
| (inv) | | Decapoda | | spreading | | PANCUCCI-PAPA- | |
| | | I | | | | DOPOULOU, 2010 | |
| Animalia | Gonioinfradens paucidentatus | Crustacea/ | casual | unknown | Indo-Pacific | CORSINI-FOKA | 2010 |
| (inv) | (A. Milne Edwards, 1861) | Decapoda | | | | et al., 2010a | |
| Animalia | Macrophthalmus graeffei | Crustacea/ | casual | via Suez / | Indo-Pacific | PANCUCCI-PAPA- | 2009 |
| (inv) | A. Milne Ewdards, 1873 | Decapoda | | spreading | | DOPOULOU | |
| | | | | | | et al., 2010 | |
| Animalia | Cardites akabana (Sturany, 1899) | Mollusca/ | casual | via Suez / | Red Sea | MANOUSIS | 2008 |
| (inv) | | Bivalvia | | shipping | | <i>et al</i> , 2010 | |
| Animalia | Chama pacifica Broderip, 1834 | Mollusca/ | questionable | via Suez / | Indo-Pacific | MANOUSIS | 2008 |
| (inv) | | Bivalvia | | spreading | | et al., 2010 | |
| Animalia | Septifer forskali (Dunker, 1855) | Mollusca/ | established | via Suez / | Indo-Pacific / | This work | 2010 |
| (inv) | | Bivalvia | | spreading | Red Sea | | |
| Animalia | Dendrostrea frons | Mollusca/ | established | via Suez / | Indo-Pacific / | This work | 2010 |
| (inv) | (Linnaeus, 1758) | Bivalvia | | spreading | Red Sea | | |
| Animalia | Diplodonta bogii van Aartsen, 2004 | Mollusca/ | casual | via Suez / | Red Sea | MANOUSIS | 2008 |
| (inv) | | Bivalvia | | spreading | | <i>et al.</i> , 2010 | |
| Animalia | Dosinia erythraea Roemer, 1860 | Mollusca/ | casual | via Suez / | Red Sea | MANOUSIS | 2007 |
| (inv) | | Bivalvia | | spreading | | et al., 2010 | |
| Animalia | Hypselodoris infucata | Mollusca/ | established | via Suez / | Indo-Pacific / | This work | 2007 |
| (inv) | (Rüppell & Leuckart, 1828) | Opisthobranchia | | spreading | Red Sea | | |

Table 1 (continued)



Fig. 1: Breakdown of marine alien species in Greek Seas per taxonomic group.

periods of the Pleistocene-Holocene or fairly recent invasions, now well established, most probably via the Suez Canal (KOUKOUSIOURA *et al.*, 2010). Of these, *Amphistegina lobifera* and *Sorites orbiculus* were included in the compiled list of ZENETOS *et al.* (2009a). *Coscinospira hemprichii* and *Amphistegina madagascariensis* are missing from the list although they have been known since the 1950s (BLANC-VERNET, 1969). *Amphistegina madagascariensis* was reported in the infralittoral zone of Peloponnesos, Kastellorizo, Kriti and Saronikos in *Halophila* meadows (BLANC-VERNET, 1969).

Coscinispira hemprichii is a symbiontbearing foraminiferan exhibiting a global tropical distribution. It is reported from the Indo-Pacific and the Red Sea. Widely distributed in the Mediterranean, it is known from the coasts of Turkey under the synonym *Peneroplis arietinus* (MERIC *et al.*, 2008). In Greece *C. hemprichii* was reported from Kriti (HOLLAUS & HOTTINGER, 1997), and from the Aegean Sea under the name *Spirolina arietina* (BLANC-VERNET, 1969). KOUKOUSIOURA *et al.* (2010) found *C. hemprichii* mainly in the central and northern Aegean sites, yet in very low abundances.

Cymbaloporetta plana thrives in the shallow water environments of the Pacific Ocean. KOUKOUSIOURA *et al.* (2010) found *C. plana* mainly at the northern and central Aegean sites displaying a peak in relative abundance at the site of Mavro Lithari (Saronikos Gulf).

Planogypsina acervalis seems to be common in the Atlantic, Indian and Red Seas. BLANC-VERNET (1969) described this species from the coasts of Provence, France. KOUKOUSIOURA *et al.* (2010) reported *P. acervalis* as rare at the central Aegean and always in very low abundances. *Triloculina fichteliana* thrives in the shallow water environments of the Atlantic Ocean, Pacific Ocean and Red Sea. In the Mediterranean Sea, MERIC *et al.* (2008) reported it from the coasts of Turkey. KOUKOUSIOURA *et al.* (2010) reported it as rare at the southern and central Aegean and always found in very low abundances.

DINOFLAGELLATA

The species *Chattonella veruculosa* appeared in Amvrakikos in 1998, causing mass finfish mortality (NIKOLAIDIS *et al.*, 2005). However, its presence has not been confirmed by later findings and even its identification is problematic (K. Aligizaki, pers. comm.). Blooms of *Prorocentrum triestinum* were reported in Thermaikos Gulf during 2000 and 2001 and were considered responsible for water discoloration (NIKOLAIDIS *et al.*, 2005 reported as *Prorocentrum redfeldii*).

MACROALGAE

TSIAMIS & BELLOU (2010) reported a first finding of the red macroalgae Apoglossum gregarium in Greece, which is also the first record in the eastern Mediterranean basin. It was found on artificial substrata (in experimental frames, after one year of deployment) at 50 m depth near Sapientza Island, southeastern Ionian Sea, Greece (Lat 360 44'33.6"N, Lon 210 42'32.5"E), on 2 April 2009. The Greek specimens were identical to the previous Mediterranean descriptions and were epiphytic on a bryozoan. Moreover, the Greek habitat is the deepest ever recorded for the species. The surrounding natural habitat was sandy mud, and the invasive alga Caulerpa racemosa var. cylindracea was the predominant species (TSIAMIS & BELLOU, 2010).

Two taxa have probably been confused under the name of Anotrichium furcellatum: the native taxon described from Naples and a species (Anotrichium okamurae) originally described from Japan, probably introduced from the Pacific at an unknown time and exhibiting invasive behaviour. In Greece, where A. furcellatum has frequently been recorded in the Ionian and Aegean Seas, three hypotheses have to be considered: either we have the native taxon, or the introduced species, or both taxa. Pending new information, the Greek records of A. furcellatum are provisionally attributed to A. okamurae as a debatable case (TSIAMIS et al., 2010).

In the Mediterranean Sea, *Chondria pygmaea* was found among the epiflora of the introduced *Halophila stipulacea* every time that it was studied. Considering the wide distribution of the introduced seagrass in Greece, the occurrence of *C. pygmaea* is highly probable. Pending confirmation, *C. pygmaea* was provisionally included in the questionable category by TSIAMIS *et al.* (2010).

ASCIDIACEA

The ascidian *Phallusia nigra* is among the established alien species of the Levantine basin. Its presence in Greek waters was first noted in 2009. Established populations were observed by SCUBA diving offshore the beach 'Stegna' and in one of the harbours of Rodos Island (KONDILATOS *et al.*, 2010).

CRUSTACEA/DECAPODA

A single specimen of the crab *Macrophthalmus* graeffei, was collected in 2009 by PANCUCCI et al. (2010) in the Gulf of Trianta (W. Rodos Island). The xanthid Atergatis roseus firstly recorded in 2009 at Plimmiris Bay (SE Rodos) at 6-8 m depth on sandy bottom with rocks covered by vegetation (CORSINI-FOKA & PANCUCCI-PAPADOPOULOU, 2010) is now considered established (CORSINI-FOKA et al., 2010). Both aforementioned species are well established in the Levantine Basin.

CORSINI-FOKA *et al.* (2010a) documented the first record for the Mediterranean Sea of the red swimming crab *Gonioinfradens paucidentatus*, from specimens collected at Rodos Island (southeastern Aegean Sea), giving a detailed description of samples and biotopes.

The Alboran populations of Synalpheus tumidomanus africanus may represent a natural expansion of the biogeographic distribution range of the species from the Atlantic. However, the references of Synalpheus tumidomanus africanus from Greece (KOUKOURAS and Turkey & KATTOULAS 1974; KOCATAS, 1981) could indicate a separate advance in the eastern Mediterranean littoral from the Israel populations. Recently it has been captured in Sicily (BACCI et al., 2010). The unresolved question is whether the eastern Mediterranean populations are 'alien' or not. Following ZENETOS et al. (2010) we have classified it as cryptogenic.

MOLLUSCA

Dosinia erythraea is reported from two live specimens with length of 35 mm and 44 mm respectively, collected at a depth of 5-8 m, during 2007 at Aggelochori, Thermaikos Gulf (MANOUSIS *et al.*, 2010). The record of *Diplodonta bogii* is based on one live specimen of 7 mm, found at 5m in Palioura, Epanomi, Thermaikos Gulf in March 2008 (MANOUSIS *et al.*, 2010). *Cardites akabana* was collected from sandy-muddy bottoms of the sublittoral zone of the southern Thessaloniki Gulf and eastern Thermaikos Gulf. Following the first finding at 0.5 m depth in Cape, Epanomi in April 2008, seven live specimens and two shells (some bearing their periostracum) were found with their lengths ranging from 1.6 mm to 7.6 mm (MANOUSIS *et al.*, 2010).

Two established populations of Dendrostrea frons were discovered in June 2010 in northern Kriti and in June 2010 in Astypalaia Island. The species, initially reported from southern Turkey (CEVIKER, 2001), appears to have spread eastwards and become established in Vai Bay, Astypalaia Island (36°35'13.75"N 26°24'10.52"E), where thousands of live specimens were found on a big metallic cage brought by the sea to a sandy-muddy bottom with Posidonia patches at 5-6 m of depth (cages in use were situated 1.5 km away, just at the end of the bay) (R. Villa, pers. comm.) and in Kriti, as evidenced by the finding of ci 25 mature individuals in Agia Pelagia (D. Poursanidis, A. Zenetos, pers. obs).

About ten live *Septifer forskali* specimens were found byssed on *Dendrostrea frons* at Astypalaia Island, together with *Pinctada radiata* and *Brachidontes pharaonis*, constituting the first record of this species for Greece. The species was sighted again in Agia Pelagia, Kriti in December 2010 (Poursanidis, pers. obs.) and in Alimos, Saronikos Gulf, attached on *Acanthocardia spinosa* (P. Ovalis, pers. obs).

Hypselodoris infucata is very common in the Levantine Sea where it can be found all year round. This work reports the first finding of the species in Greek waters. A single specimen of *Hypselodoris infucata* (Ruppell & Leuckart, 1830) was photographed on a rocky bottom at a depth of 0.5 m in the west side of the port of Kastellorizo Island, on 28 August 2007. This species was sighted again at the same site in September 2009.

The record of *Chama pacifica* is based on one specimen (6.7 mm in length) found in 2008 as epibiont of *Pinna nobilis* shell collected at Aggelochori, Thessaloniki Bay (MANOUSIS *et al.*, 2010). However, the picture shown in Fig. 2d of MANOUSIS *et al.* (2010) is not convincing. The specimen is too small to be accurately identified as *C. pacifica* and the record is based on a single individual. It is speculated here that the specimen corresponds to *Chama aspersa*.

POLYCHAETA

The presence of *Chaetozone* corona in the Mediterranean Sea was first reported by ÇINAR & ERGEN (2007) from Izmir Bay who postulated that this species might be a cryptogenic species. According to SIMBOURA *et al.* (2010), earlier records designated as *Chaetozone* sp. B are currently identified as *C. corona*. Thus, *C. corona* shows a wide distribution in North Evvoikos Gulf, Thermaikos Gulf, Kyklades and Kriti in disturbed and undisturbed sites (SIMBOURA *et al.*, 2010).

Marphysa disjuncta is a species first recorded in the Mediterranean Sea from Fethiye Bay (Levantine Sea, Turkey) by KURT ŞAHIN & ÇINAR (2009), presumably introduced from the Pacific Ocean through ballast waters. In Greece *Marphysa disjuncta* was found in North Evvoikos Gulf (Aegean Sea) at 80 m depth on mud mixed with metalliferous waste (slag), in the caldera of Santorini island (Kyklades, Aegean Sea) at 316 m depth on muddy gravel of volcanic material, and in Saronikos Gulf at 60-70 m depth in muddy sandy sediments (SIMBOURA *et al.*, 2010). Pseudopolydora paucibranchiata was originally described from Japan and the Pacific Ocean and its establishment in the Mediterranean was attributed to ballast waters (DAGLI & ÇINAR, 2008). In Greece *P. paucibranchiata* was found in Larymna Bay (Evvoikos Gulf, Aegean Sea). It was also found casually among the endofauna of a *Zostera* meadow in Geras Gulf (Lesvos Island) and in Elefsis Bay (Saronikos Gulf) (SIMBOURA et al., 2010).

Neopseudocapitella brasiliensis has been known since 1991 in the Evvoikos Gulf (from Chalkis to Larymna) and in Kriti (SIMBOURA, 1996). The species is also known in the Levantine Sea (Cyprus, Turkey), Adriatic, Central and west Mediterranean (ZENETOS *et al.*, 2010).

Lumbrineris perkinsi was first reported as L. inflata by GIANGRANDE et al. (1981), who collected it from the Ischia Harbour (Tyrrhenian Sea, western Mediterranean). In Greece (as L. inflata), it was found in Evvoikos and Thermaikos Gulfs in the 1990s (ARVANITIDIS, 1994). Dense populations of L. perkinsi on the southern coast of Turkey (CINAR, 2009), Egypt (ABD-ELNABY, 2009) and Greece (ARVANITIDIS, 1994) and the single record from the western Mediterranean might indicate that this species could have been introduced to the Mediterranean from the Suez Canal. However, its occurrence in the Indo-Pacific area should be checked.

The terebellid species *Polycirrus twisti* Potts, 1928 had been confused with *Polycirrus plumosus* Wollebaeck, 1912 because of incomplete or unclear descriptions and its presence in Greek Seas had been overlooked. SIMBOURA (2011) reports on its occurrence in Korinthiakos Gulf and discusses previous findings in the Aegean Sea since the eighties.

A total of 14 questionable alien poly-

chaetes (Capitellethus dispar, Dasybranchus carneus, Dispio magnus, Dodecaceria capensis, Hyboscolex longiseta, Leocrates chinensis, Loimia medusa, Naineris quadraticeps, Polydora spongicola, Protodorvillea biarticulata, Scoletoma debilis, Sigambra constricta, Syllis schulzi and Timarete dasylophius) was reported by SIMBOURA & NICO-LAIDOU (2001) and ZENETOS et al. (2010) but they had not previously been classified as aliens.

CNIDARIA

Clytia linearis was found on algae, Posidonia oceanica, sponges, hydroids, bryozoans and on polychaete tubes, in shallow warm waters (BOERO & FRESI, 1986). In the Mediterranean, it has been recorded from the French coast, Ligurian Sea, Tyrrhenian Sea, Adriatic and Ionian Sea, Spanish waters, Alboran Sea off the coast of Morocco, Greek waters, and Lebanese waters. In Greece, C. linearis was recorded from Aspra (Korinthiakos Spitia Gulf) bv MARINOPOULOS (1979) (as Clytia gravieri) (collection date: 1977) and from Kos Island (Aegean Sea) by MORRI & BIANCHI (1999) (collection date 1981).

FISH

The milk shark *Rhizoprionodon acutus* has a circumtropical distribution (Tropical Atlantic and Indian Ocean, Red Sea and Japan). To date it has been considered as a vagrant fish in the Mediterranean, its record based on a single specimen captured in the Gulf of Taranto, Italian Ionian Sea (PASTORE & TORTONESE, 1984). The present work reports a second sighting of the species in the Greek SW Ionian Sea (Lat 36° 52' N, Lon 20° 32' E). The individual, captured on 16 July 2004 by D. Damalas,

was measured and weighed. It was a male with a total length 162cm, a fork length 130cm, pectoral length 102cm and a round weight of 21.5 Kg. A tissue sample was kept for DNA analysis (code No 42), preserved in the Ichthyology Laboratory of the University of Athens.

B. Species to be excluded

The alga Neosiphonia sphaerocarpa (Borgesen) M.S. Kim & I.K. Lee was first recorded in the Mediterranean Sea from Tunisia and successively from Corsica, the Balearic Islands and Milos Island in Greece. CORMACI et al. (2004) considered N. sphaerocarpa as an alien species. However, the species is distributed worldwide and molecular data are needed to locate its place of origin. Moreover, the identification of the species is not easy. Consequently the absence of N. sphaerocarpa in the Mediterranean prior to 1970 could simply mean that it was overlooked or mistaken for another Polysiphonia species. Pending further investigations, TSIAMIS et al. (2010) provisionally consider this species as native in the Mediterranean Sea.

The record of Circenita callipyga (Born 1778) is based on one shell measuring 8.6 mm in length, found in the Gulf of Thessaloniki, Mikro Emvolo, at 5m in 2008 (MANOUSIS et al., 2010). However, the picture of the shell figured in MANOUSIS et al. (2010) is not convincing in our opinion as it does not match the species description (size, outline, sculpture). The ovate rather than trigonal outline and the radial sculpture are diagnostic features for the species. This is not clear from Figure 3a of MANOUSIS et al. (2010) where a whole bivalved specimen is depicted, presumably belonging to a juvenile Gouldia minima (Montagu, 1803). After consideration of the

Mediterranean distribution of the species which is restricted to Israel (ZENETOS *et al.*, 2004), this record has been excluded from our list.

Two of the Atlantic invaders (*Alopias superciliosus* and *Gaidropsarus granti*) are excluded from the list of Greek alien species following ZENETOS *et al.* (2010), who consider them Atlanto-Mediterranean species.

C. Change in establishment success

The species listed in Table 2 have been reported from more than one site, and hence they are now considered to be established in Greek waters. Details on their distribution are provided below.

The establishment of the fangtooth moray eel *Enchelycore anatina* in the south Aegean is confirmed by the finding of a specimen in Rodos Island in 2010 (KALO-GIROU, 2010) and another one in Karpathos Island (CORSINI-FOKA, 2010, pers. comm.) As an indication of its establishment, local fishermen state that they catch approximately 4-5 individuals per vessel with gillnets during the summer period along Rodos Island's rocky bottoms and even in Kastellorizo Island (KALOGIROU, 2010).

A second record of the small Indo-Pacific fish *Tylerius spinosissimus* (Tetraodontidae) (known as spiny blaasop) was documented at the beginning of 2009 in the waters of Rodos Island (south-eastern Aegean Sea, Greece). The finding shows the putative establishment of a population of this alien fish in the Mediterranean around the Dodekanisos islands (CORSINI-FOKA *et al.*, 2010b).

Seriola fasciata (Bloch, 1793) is a species of amphi-Atlantic origin, which made its first appearance in Rodos in 2004. Consequent findings in Rodos (2009) and Lesvos (2010) [ELNAIS, 2010] confirm its establishment success in Greek waters.

The Lessepsian immigrant *Hypnea cornuta*, found only twice in the Aegean Sea [in 1894 in Rodos Island (as *H. valentiae*) and one century later, in 2007], was found again in the Saronikos Gulf (TSIAMIS *et al.*, 2008) in August 2009; hence it appears to have become established in the area (TSIAMIS *et al.*, 2010).

The red alga *Sarconema scinaioides*, which was reported from Greece only in the

| Species | Taxon | Source |
|---|----------------------|----------------------------|
| Enchelycore anatina (Lowe, 1839) | Fish/Osteichthyes | KALOGIROU, 2010 |
| Tylerius spinosissimus (Regan, 1908) | Fish/Osteichthyes | CORSINI-FOKA et al., 2010b |
| Seriola fasciata (Bloch, 1793) | Fish/Osteichthyes | ELNAIS, 2010 |
| Hypnea cornuta (Kützing) J. Agardh 1851 | Rhodophyta | TSIAMIS et al., 2010 |
| Sarconema scinaioides Børgesen, 1934 | Rhodophyta | TSIAMIS et al., 2010 |
| Cassiopea andromeda (Forsskål, 1775) | Cnidaria/Scyphozoa | This work |
| Gastrochaena cymbium Spengler 1783 | Mollusca/Bivalvia | MANOUSIS et al., 2010 |
| Pseudochama corbieri (Jonas, 1846) | Mollusca/Bivalvia | MANOUSIS et al., 2010 |
| Chromodoris annulata (Eliot, 1904) | Mollusca /Gastropoda | This work |
| Sepioteuthis lessoniana Lesson, 1830 | Mollusca/Cephalopoda | This work |

 Table 2

 Alien marine species in Greece classified as established.

Saronikos Gulf in the early 1980's, was found again at the same location after about 30 years (see TSIAMIS *et al.*, 2009); thus, revealing an established population in the area still surviving after three decades (TSIAMIS *et al.*, 2010).

Cassiopea andromeda, which occurs along the Levantine coastline, was recently reported from Malta (SCHEMBRI et al., 2010). SCHÄFER (1955) reported the occurrence of very young specimens (2-30 mm) on Neokameni, a small volcanic island near Santorini, Aegean Sea, where the medusae flourished in rocky pools with water temperatures reaching up to 36° C due to volcanic activity. The present work reports on the finding of >15 alive individuals of C. andromeda in Paros Island at depths between 2-10 m (June 2010: S. Katsanevakis pers. obs.) and in S. Evvoikos, (Chalkoutsi, September 2010: A. Zenetos pers. obs.).

From six stations of the sublittoral zone of eastern Thermaikos Gulf, Thessaloniki Gulf and Thessaloniki Bay, more than 30 live specimens of *Gastrochaena cymbium*, 5.4-5.7 mm in length, were dissected out of their calcareous capsules (MANOUSIS *et al.*, 2010). Empty shells of *G. cymbium* were extracted from *Ostrea* sp. shells collected in Elefsis Bay, Saronikos Gulf (S. Katsanevakis, pers. obs.).

Two live specimens of *Pseudochama corbieri* (Jonas 1846) measuring 13.1 mm and 19.1 mm, were found in April 2006 in Epanomi, Thermaikos Gulf, North Aegean at 2 m depth (MANOUSIS *et al.*, 2010).

The presence of *Chromodoris annulata* (Eliot, 1904) in Greece was documented from a single sighting of the species in Saronikos Gulf. The species was observed again in September 2010 in Madraki, Kastellorizo at a depth of 0.5 m (G. Apostolopoulos, pers. obs.). Sepioteuthis lessoniana Lesson, 1830 is one of the most commercially important squid species for inshore fisheries throughout its distributional range. It is common in the Levantine basin and first appeared in Greek waters at Dodekanisos in 2009 (LEFKADITOU *et al.*, 2009). Ever since, occasional reports e.g. in Kastellorizo (G. Apostolopoulos pers. obs.) and elsewhere (ELNAIS, 2010) testify to its establishment success and eastward spread.

The presence of Alepes djedaba (Forsskål, 1775) in Greek water has to be downgraded to questionable. The species was not reported in PANAGIOTOPOULOS (1916), as mentioned in ZENETOS et al. (2009a). However, under its synonym Caranx gallus it was reported by MALDURA (1938) in Rodos, a citation that was later corrected by LASKARIDIS (1948) as the native Alectis alexandrinus. It appears that PAPACONSTANTINOU (1988) cites A. djedaba as questionable based on TORTONESE (1952) who has repeated MALDURA (1938). Although it is established in the Levantine Sea and eastern Aegean Sea, its occurrence in Greek waters, based only on BINI (1960), remains to be confirmed.

D. Misidentifications and Nomenclatural changes

Attention was paid to recent nomenclatural updates (Table 3). These are the result of the latest taxonomic and/or molecular studies. Such is the case for the commercially important swimming crab *Portunus pelagicus* (Linnaeus, 1758) and the gastropod *Bulla ampulla* (Linnaeus, 1958). Based on morphological and DNA characters as well as biogeographical considerations *P. pelagicus* is in fact *Portunus segnis*, a species confined to the western Indian

New name Old name Source Equulites klunzingeri (Steindachner, 1898) Leiognathus klunzingeri FISHBASE (Steindachner, 1898) Portunus segnis (Forsskål, 1775) Portunus pelagicus LAI et al., 2010 (Linnaeus, 1758) Conomurex persicus (Swainson, 1821) Strombus persicus WoRMS (Swainson, 1821) Bulla arabica Malaquias & Reid, 2008 Bulla ampulla This work (Linnaeus, 1758)

 Table 3

 Misidentifications and nomenclature changes.

Ocean from Pakistan to South Africa (LAI *et al.*, 2010).

With regard to *Bulla ampulla*, DNA was extracted and amplified for the mitochondrial genes cytochrome *c* oxidase subunit I (COI) and 16S rRNA. COI amplification was not successful but the 16S yielded good quality sequences. Those were blasted in GenBank and results retrieve maximum similarity with the two sequences of *Bulla arabica* available in this database, including with the holotype of the species (BMNH 20060103/1, United Arab Emirates; GenBank accession number: DQ986575.1). The results of molecular analysis confirm the occurrence of *Bulla arabica* in the Mediterranean Sea and support the suggestion by MALAQUIAS & REID (2008) that previous records of *Bulla ampulla* in this basin should be considered misidentifications of *B. arabica*.

E. Change in introduction dates

Recent literature and/or re-examination of other sources make it clear that the collection date of species listed in Table 4 needs to be corrected.

F. Distribution of reported aliens

Besides those species considered as casual and reported in other locations, which reveals their establishment success, many

| Species | Correct collection | Source |
|---------------------------------------|--------------------|---------------------------|
| | date | |
| Alepes djedaba (Forsskål, 1775) | 1960 not 1916 | BINI, 1960 |
| Siganus rivulatus Forsskål, 1775 | 1925 not 1932 | ZACHARIOU MAMALINGA, 1990 |
| Apogon pharaonis Bellotti, 1874 | 1982 not 2002 | ZACHARIOU-MAMALINGA, 1990 |
| Pempheris vanicolensis Cuvier, 1831 | 1983 not 1985 | ZACHARIOU-MAMALINGA, 1990 |
| Amphistegina lessonii d'Orbigny, 1826 | 1974 not 1997 | Hottinger pers. comm. |
| Conomurex persicus (Swainson, 1821) | 1983 not 1986 | VERHECKEN, 1984 |

 Table 4

 Correction of collection dates reported in ZENETOS et al. (2009a).

of the established species have expanded their geographic distribution range northwards or have spread rapidly within the same area, revealing an invasive character. Examples are presented below:

The recent records of *Lagocephalus sceleratus* (Gmelin, 1788) verify that the species is now very common along the central, southern and southeastern coasts of the Aegean Sea. Recent captures confirm the spreading of the species in the NW Aegean Sea, increasing the number of its northern records in the whole Mediterranean (MINOS *et al.*, 2010) (Fig. 2a).

Findings of the recently recorded *Petroscirtes ancylodon* Rüppell, 1838, *Callionymus filamentosus* Valenciennes, 1837, *Torquigener flavimaculosus* Hardy & Randall, 1983 and *Scomberomorus commerson* Lacepède, 1800 from Rodos in summer 2008, confirm their quick establishment (CORSINI-FOKA, 2010). *Torquigener flavimaculosus* and *P. ancylodon* were also spotted in Kastellorizo (G. Apostolopoulos, pers. obs.).

Stephanolepis diaspros Fraser-Brunner, 1940, well established in the south Aegean Sea (CORSINI-FOKA & ECONOMIDIS, 2007; CORSINI-FOKA, 2010), was captured in boat seine hauls carried out in the period 2008-2009 in the Aegean Sea, occurring in up to 60% of the hauls (LEFKADITOU *et al.*, 2010). Its current distribution is illustrated in Fig. 2b.

KOUKOUSIOURA *et al.* (2010) postulated that *Amphistegina lobifera*, is the dominant foraminifer species at the southern and central Aegean usually comprising more than 30% of total specimens of the foraminiferal assemblages. In the northern site (N. Kallikratia) *A. lobifera* was present at very low abundances.

Sorites orbiculus was regularly found at the central Aegean and southern Aegean

sites with somewhat higher percentages at Falasarna (7.5% of the foraminiferal fauna) (KOUKOUSIOURA *et al.*, 2010).

Two bivalvia species of the Chamidae family were collected from rocky bottoms of Thermaikos Gulf: *Chama asperella* Lamarck 1819 (four live specimens with length ranging from 8.2 mm to 17.6 mm) at 5m Paralia, Epanomi, in October 2008, on *Pinna nobilis*, and at Palioura, Epanomi, in December 2008, and *Chama aspersa* Reeve 1846 (two live specimens 15 mm and 26 mm in length, respectively), in 2008, from the sea shore at Paralia, Epanomi, Thermaikos Gulf (MANOUSIS *et al.*, 2010). *Chama aspersa* was also collected in September 2010 from Elefsis Bay, Saronikos Gulf (S. Katsanevakis, pers. obs.).

Brachidontes pharaonis (Fischer P., 1870), previously known only from Rodos and Saronikos Gulf, was also observed in SE Kriti (P. Ovalis, ELNAIS, 2010) and Astypalaia Island in June 2010. *Pinctada radiata* (Leach, 1814), known as north as the Evvoikos Gulf, was collected at Palioura, Epanomi, in March 2005, at Cape, Epanomi in August 2010 (S. Mitsoudi, pers. comm.) and at Astypalaia Island in June 2010 (F. Crocetta, pers. obs.).

Trochus erithraeus Brocchi, 1821 previously known from Kriti, (COSENZA & FASULO, 1997) has been spotted in 2010 in central Aegean Sea. One shell was collected on the coast of Syros Island and deposited in the collection of the Goulandris Natural History Museum.

An established population of *Synaptula reciprocans* (Forsskål, 1775) measuring 20-100 cm in length was found at Loutro, SW Kriti (35°12' 1.68"N 24° 4' 53.70"E) at depths more than 5 m (D. Poursanidis, ELNAIS, 2010) (Fig. 2c).

Further to its spread in the North Aegean and Ionian Sea (KATSANEVAKIS &

TSIAMIS, 2009; KATSANEVAKIS *et al.*, 2011), and its population explosion along the coasts of Rodos in 2010 (M. Corsini-Foka, pers. obs.), *Percnon gibbesi* (H. Milne Edwards, 1853) was found at 10 sites in SW, W,

and NW Kriti during summer and autumn 2010 (D. Poursanidis, pers. obs.) and may thus be considered as established along the entire Cretan coastline; it was also found in Pesada, S. Kefallonia Island, Ionian Sea in



Fig. 2 (a-d): Distribution of some of the most invasive species. Asterisks indicate findings after ZENETOS et al. (2009).

July 2010 (A. Panou, pers. comm,). One of us (G. Apostolopoulos) has observed and photographed *P. gibbesi* along the north Kastellorizo coast repeatedly since 2004 (Fig. 2d).

Figure 3 shows aliens' zoogeographical patterns in Greek waters. The highest number (93 species) was reported in the Dodekanisos area, SE Aegean, which testifies to the importance of the area as the entrance point of Lessepsian immigrants spreading towards the Aegean Sea. Particular notice should be given to the 86 species reported in the wider area of the Saronikos Gulf, a hotspot area for bioinvasions in Greek waters, closely related to the route of ships towards Peiraias, the biggest Greek port. Relatively high (40 species) is also the number of alien species in the Thermaikos Gulf (related to the port of Thessaloniki). Many of the species encountered in Saronikos and/or Thermaikos Gulfs present a limited distribution in the aforementioned areas.

Conclusions

- ▶ Following the review by ZENETOS *et al.* (2009a) on marine alien species in Greek Seas, 47 additional species are reported herewith, bringing the total to 237, which is a 24.4% increase. Twenty one of the listed species were reported for the first time in 2009-2010, whereas 21 species (mostly Polychaeta) although they existed in the literature, had never been classified as aliens previously.
- The species Hypselodoris infucata, Dendrostrea frons, Septifer forskali and Rhizoprionodon acutus are reported in this work for the first time in Greek waters.



Fig. 3: Pattern of alien species distribution in Greek waters.

- Four species reported in previous lists are now excluded. These are: the rhodophyte Neosiphonia sphaerocarpa, the bivalve Circenita callipyga, and the fish Alopias superciliosus and Gaidropsarus granti.
- ► Based on molecular analysis, we confirm the occurrence of *Bulla arabica* in the Mediterranean Sea and support the suggestion by MALAQUIAS & REID (2008) that previous records of *Bulla ampulla* in the Mediterranean should be considered as a misidentification of *B. arabica*.
- ► In 2010, ten species previously known as casual and/or questionable immigrants, have established viable populations and spread to many localities in the Greek coasts. To-date, of the 237 alien species reported in Greek waters, 127 are established; 59 are casual records; 20 are cryptogenic and 31 are questionable records.
- The majority of alien species belong to Mollusca (47 species: 19.8%), followed by fish (41 species: 17.3%), Polychaeta (38 species: 16.0%), macroalgae (33 species: 13.9%), and Crustacea (31 species: 13.1%).
- Most of the newly introduced and/or reported species originate in tropical subtropical areas of the Pacific, Indian or Atlantic Oceans.
- The increased rate of introductions of warm water species confirms the previous findings linking the rate of introduction in the eastern Mediterranean to climate change.
- Although many of the newly reported species are Lessepsian immigrants spreading in the Aegean Sea, the role of shipping is gaining significance as a vector of alien species' transfer in the Aegean Sea.

Ackowledgements

The authors would like to express their thanks to all ELNAIS contributors. Special

thanks are due to Sofia Galinou-Mitsoudi (Alexander Technological Educational Institute of Thessaloniki); Nomiki Simboura (HCMR, Anavissos); Antonella Pancucci-Papadopoulou (HCMR, Anavissos); Eugenia Lefkaditou (HCMR, Agios Kosmas); Yiannis Issaris (HCMR, Agios Kosmas); Mariolina Corsini-Foka (HCMR, Rodos) and Panayotis Ovalis (Athens) for providing collection details for some of the new species. We also thank Kimon Moschandreou, Katerina Aligizaki (Aristotle University of Thessaloniki), Sofia Spatharis (University of the Aegean, Mytilene, Greece), Raimondo Villa (Italy) and Francis Kerckhof (Royal Belgian Institute of Natural Sciences) for profitable correspondence and exchange of information. Sincere thanks are due to Tassos Eleftheriou (Kriti) for helpful and useful comments that improved significantly the manuscript.

References

- ABD-ELNABY, F.A., 2009. Polychaete study in Northeastern Mediterranean coast of Egypt. *World Journal of Fish & Marine Sciences*, 1 (2): 85-93.
- ANGELIDIS, P., VIRVILIS, C., PHOTIS, G., CHOLLET, B. & BERTHE, F., 2001. First report of *Marteilia* disease of the flat oyster *Ostrea edulis*, in the gulf of Thessaloniki, Greece. 10th International Conference of the E.A.F.P., 10-14 September 2001, Dublin.
- ARVANITIDIS, C., 1994. Systematic and bionomic study of the macrobenthic Polychaeta of the Northern Aegean.
 PhD Thesis, Aristotelian University of Thessaloniki, 512 pp. (in Greek)
- ARVANITIDIS, C., 2000. Polychaete fauna of the Aegean Sea: inventory and new information. *Bulletin of Marine Science*, 66 (1): 73-96.

- ARVANITIDIS, C. & KOUKOURAS, A., 1994. Polychaete fauna associated with the coral *Cladocora caespitosa* (L.) in the eastern Mediterranean. *Mémoires du Muséum National d'Histoire Naturelle (Zoologie)*, 162: 347-353.
- BACCI, T., MARUSSO, V., TRA-BUCCO, B. & MAGALETTI, E., 2010. First record of Synalpheus tumidomanus africanus (Crosnier & Forest, 1965) (Caridea, Alpheidae) in Italian waters. Crustaceana, 83 (7): 821-827.
- BARASH, A. & DANIN, Z., 1982. Mediterranean molluscs of Israel and Sinai: composition and distribution. *Israel Journal of Zoology*, 31 (3-4): 86-118.
- BARONE, R., 2004. Asparagopsis taxiformis (Delile) Trevisan (Rhodophyta) e Trichodesmium erythreum Ehrenberg (Cyanobacteria), due taxa algali tropicali identificati nelle acque costiere della Sicilia. Naturalista siciliano S. IV, 28 (1): 183-203.
- BINI, G., 1960. *Catalogue of the names of fishes of commercial importance in the Mediterranean*. FAO, Rome, 250 pp.
- BLANC-VERNET, L., 1969. Contribution à l'étude des foraminifères de Méditerranée. *Recueil des travaux de la Station Marine d'Endoume*, 64: 1-281.
- BOERO, F. & FRESI, E., 1986. Zonation and evolution of a rocky bottom hydroid community. Pubblicazioni della Stazione zoologica di Napoli I, *Marine Ecology*, 7: 123-150.
- BOGDANOS, C. & SATSMADJIS, J., 1983. The macrozoobenthos of an Aegean embayment. *Thalassographica*, 6: 77-105.
- BODGANOS, C. & SATMATDIS, J., 1985. The benthic fauna of different soft substrata in the Pagassitikos Gulf

(Greece). Thalassographica, 8: 43-69.

- BODGANOS, C. & SATSMATDIS, J., 1987. The Patraikos Gulf bottom fauna. *Thalassographica*, 10 (1): 37-71.
- CARLTON, J.T., 1996. Biological invasions and cryptogenic species. *Ecology*, 77 (6): 1653-1655.
- ÇEVIKER, D., 2001. Recent immigrant bivalves in the northeastern Mediterranean off Iskenderun. *La Conchiglia*, 298: 39-46.
- ÇINAR, M.E., 2009. Alien polychaete species Annelida: Polychaeta) on the southern coast of Turkey (Levantine Sea, eastern Mediterranean), with 13 new records for the Mediterranean Sea. *Journal of Natural History*, 43 (37-38): 2283-2328.
- 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 (4): 339-346.
- CORMACI, M., FURNARI, G., GIACCONE, G. & SERIO, D., 2004. Alien macrophytes in the Mediterranean Sea: a review. *Recent Research Development in Environmental Biology*, 1: 153-202.
- CORSINI-FOKA, M., 2010. Current status of alien fishes in Greek seas. p.35-56. In: *Fish invasions of the Mediterranean Sea: change and renewal.* Golani D., Appelbaum-Golani B. (Eds). Pensoft Publishers, Sofia-Moscow.
- CORSINI-FOKA, M. & ECONOMIDIS, P.S., 2007. Allochthonous and vagrant ichthyofauna in Hellenic marine and estuarine waters. *Mediterranean Marine Science*, 8 (1): 79-101.
- CORSINI-FOKA, M. & PANCUCCI-PAPADOPOULOU, M.A., 2010. Erythrean alien brachyurans in the south-

eastern Aegean Sea: record of *Atergatis roseus* in Rhodes. *Marine Biodiversity Records*, 3 (e76): 1-3. DOI:10.1017/S1755267210000667 (Published online)

- CORSINI-FOKA, M., MARGIES, P., KONDILATOS, G. & ECONOMI-DIS, P.S., 2010b. Tetraodontid colonizers in the Aegean Sea; second record of the spiny blaasop, *Tylerius spinosissimus* (Actinopterygii: Tetraodontiformes: Tetraodontidae). *Acta Ichthyologica et Piscatoria*, 40 (1): 71-74.
- CORSINI-FOKA, M., PANCUCCI-PAPADOPOULOU, M.A., KONDI-LATOS, G. & KALOGIROU, S., 2010a. *Gonioinfradens paucidentatus* (A. Milne Edwards, 1861) (Crustacea, Decapoda, Portunidae): a new alien crab in the Mediterranean Sea. *Mediterranean Marine Science*, 11 (2): 331-340.
- COSENZA, G. & FASULO, G., 1997. The littoral shelled molluscs of the Island of Crete. *La Conchiglia*, 284: 51-58.
- DAGLI, E. & ÇINAR, M.E., 2008. Invasion of polluted soft substrate of Izmir Bay (Aegean Sea, eastern Mediterranean) by the Spionid polychaete worm, *Pseudopolydora paucibranchiata* (Polychaeta: Spionidae). *Cahiers de Biologie Marine*, 49 (1): 87-96.
- DRIRA, Z., BEL HASSEN, M., HAMZA, A., REBAI, A., BOUAIN, A., AYADI, H., & ALEYA L., 2009.
 Spatial and temporal variations of microphytoplankton composition related to hydrographic conditions in the Gulf of Gabes. *Journal of the Marine Biological Association of the United Kingdom*, 89 (8): 1559-1569.
 DOI:10.1017/S002531540900023X
- ELNAIS, 2010. Ellenic Network of Aquatic Invasive Species. https://serv-

ices.ath.hcmr.gr/ visited on 5th October 2010.

- FASSARI, G., 1982. Annelidi policheti del mar Egeo. *Animalia*, 9 (1-3): 109-121.
- GERLOFF, J. & GEISSLER, U., 1974. Eine revidierte Liste der Meeresalgen Griechenlands. *Nova Hedwigia*, 22: 721-793.
- GIANGRANDE, A., GAMBI, M.C. & FRESI, E., 1981. Two species of polychaetes new to the Mediterranean fauna. *Bollettino di Zoologia*, 48: 311-317.
- HARMELIN, J.G., 1969. Contribution a l'étude de l'endofaune des prairies d' *Halophila stipulacea* de Méditerranée orientale. *Recueil des Travaux de la Station marine Endoume*, 45 (61): 305-316.
- HOLLAUS, S.S. & HOTTINGER, L., 1997. Temperature dependence of endosymbiotic relationships? Evidence from the depth range of Mediterranean *Amphistegina lessonii* (Foraminiferida) truncated by the thermocline. *Eclogae geologicae Helvetiae*, 90: 591-597.
- KALOGIROU, S., 2010. First confirmed record of the non-indigenous fangtooth moray *Enchelycore anatina* in an area of south eastern Aegean Sea. *Mediterranean Marine Science*, 11 (2): 357-360.
- KATSANEVAKIS, S. & TSIAMIS, K., 2009. Records of alien marine species in the shallow coastal waters of Chios Island (2009). *Mediterranean Marine Science*, 10 (2): 99-107.
- KATSANEVAKIS, S., TSIAMIS, K., IOANNOU, G., MICHAILIDIS, N., ZENETOS, A., 2009. Inventory of alien marine species of Cyprus (2009). *Mediterranean Marine Science*, 10 (2): 109-133.
- KATSANEVAKIS, S., POURSANIDIS, D., YOKES, M.B., MACIC, V.,

BEQIRAJ, S., *et al.*, 2011. Twelve years after the introduction of the crab *Percnon gibbesi* (H. Milne Edwards, 1853) in the Mediterranean: current distribution and invasion rates. *Journal of Biological Research-Thessaloniki*.

- KOCATAŞ, A., 1981. Liste préliminaire et répartition des Crustacés Décapodes des eaux Turques. *Rapports de la Commission Internationale pour l'Exploration Scientifique de la Mer Méditerranée*, 27 (2): 161-162.
- KONDILATOS, G., CORSINI-FOKA, M. & PANCUCCI-PAPADOPOU-LOU, M.A., 2010. Occurrence of the first non-indigenous ascidian *Phallusia nigra* Savigny, 1816 (Tunicata: Ascidiacea) in Greek waters. *Aquatic Invasions*, 5 (2): 181-184.
- KOUKOURAS, A. & KATTOULAS, M., 1974. Benthic Fauna of the Evvoia Coast and Evvoia Gulf. III. Natantia (Crustacea, Decapoda). Scientific Annals, Faculty of Physics & Mathematics, University of Thessaloniki, 14: 369-382.
- KOUKOUSIOURA, O., DIMIZA, M.D. & TRIANTAPHYLLOU, M.V., 2010. Alien foraminifers from Greek coastal areas (Aegean Sea, Eastern Mediterranean). *Mediterranean Marine Science*, 11 (1): 155-172.
- KURT SAHIN, G. & ÇINAR, M.E., 2009. Presence of *Marphysa disjuncta* (Polychaeta: Eunicidae) in the Mediterranean Sea. *Mediterranean Marine Science*, 10 (2): 145-150.
- LAI, J.C.Y., NG, P.K.L. & DAVIE, P.J.F., 2010. A revision of the *Portunus pelagicus* (Linnaeus, 1758) species complex (Crustacea: Brachyura: Portunidae), with the recognition of four species. *The Raffles Bulletin of Zoology* 58 (2): 199-237.

- LASKARIDIS, K., 1948. Contribution to the biology of the fish *Mulloides auriflamma* (Forsk.). *Praktika of the Hellenic Hydrobiological Institute*, 2: 103-118.
- LEFKADITOU, E., CORSINI-FOKA, M., KONDYLATOS, G., 2009. Description of the first Lessepsian squid migrant, *Sepioteuthis lessoniana* (CEPHALOPODA: Loliginidae), from the Aegean Sea (Eastern Mediterranean). *Mediterranean Marine Science*, 10 (2): 87-97.
- LEFKADITOU, E., SEGOVIA, M., PETRAKIS, G., KAVADAS, S. & CHRISTIDIS, G., 2010. Lessepsian fish migrants in the Hellenic Seas: spatial variation of their occurrence in boat-seine catches. *Rapports et Procès-Verbaux des Réunions Commission Internationale pour l'Exploration Scientifique de la Mer Méditerranée, Monaco*, 39: 569.
- LICHER, F., 1999. Revision der Gattung *Typosyllis* Langerhans, 1879 (Polychaeta: Syllidae). Morphologie, Taxonomie und Phylogenie. *Abhandlungen der Senckenbergische Naturforschende Gesellschaft*, 551: 1-336.
- MALAQUIAS, M. & REID, D.G., 2008 Systematic revision of the living species of Bullidae (Mollusca: Gastropoda: Cephalaspidea), with a molecular phylogenetic analysis. *Zoological Journal of the Linnean Society*, 153 (3): 453-543.
- MALDURA, C.M., 1938. La pesca nelle Isole Italiane dell'Egeo. *Bollettino di Pesca, Piscicoltura e Idrobiologia,* 4: 1-24.
- MANOUSIS, T.H., MPARDAKIS, G., PARASKEVOPOULOS, C. & GALINOU-MITSOUDI, S., 2010. The Bivalvia Mollusca of Thessaloniki & Thermaikos Gulfs (North Aegean Sea, Greece) with emphasis on new

species for Hellenic waters. *Journal of Biological Research-Thessaloniki*, 14: 161-179.

- MARINOPOULOS, J., 1979. Biological survey of the eastern Mediterranean Sea: Hydroids (preliminary study). *Rapports et Procès-Verbaux des Réunions Commission Internationale pour l'Exploration Scientifique de la Mer Méditer ranée, Monaco*, 25/26 (4): 119-120.
- MERIC, E., AVCAR, N. & YOKES, M.B., 2008. Some alien foraminifers along the Aegean and southwestern coasts of Turkey. *Micropaleontology*, 54 (3-4): 307-349.
- METAXATOS, A., PANAGIOTOPOU-LOS, C. & IGNATIADES, L., 2003. Monosaccharide and aminoacid composition of mucilage material produced from a mixture of four phytoplanktonic taxa. *Journal of Experimental Marine Biology & Ecology*, 294: 203-217.
- MIENIS, H.K., 2004. Marine molluscs from the eastern Mediterranean 18. Finds of *Bulla ampulla* Linnaeus, 1758. *Spirula*, 337: 33-34.
- MINOS, G., KARIDAS, TH., CORSINI-FOKA, M. & ECONOMIDIS, P.S., 2010. New data on the geographical distribution of the invasive Lagocephalus sceleratus (Gmelin, 1789) in North Aegean. p.283-286. In: Proceedings of the 14th Panhellenic Conference of Ichthyologists, 6-9 May 2010, Piraeus, Greece. (In Greek)
- MORRI, C. & BIANCHI, C.N., 1999. Hydroids (Cnidaria: Hydrozoa) from the Aegean Sea, mostly epiphytic on algae. *Cahiers de Biologie Marine*, 40: 283-291.
- NIKOLAIDIS, G., KOUKARAS, K., ALIGIZAKI, K., HERACLEOUS, A., KALOPESA, E., *et al.*, 2005.

Harmful microalgal episodes in Greek coastal waters. *Journal of Biological Research-Thessaloniki*, 3: 77-85.

- PANAGIOTOPOULOS, P., 1916. Fish culture and fishes of the Messolonghi lagune. *Bulletin of the Hydrobiological Station (Greece)*, 1: 329-448.
- PANCUCCI-PAPADOPOULOU, M.A., KEVREKIDIS, K., CORSINI-FOKA, M. & SIMBOURA, N., 2005a. Changes in species: invasion of exotic species. p.336-342. In: *State of the Hellenic Marine Environment*. Papathanassiou E. & Zenetos A. (Eds). Athens, HCMR Publications.
- PANCUCCI-PAPADOPOULOU, M.A., ZENETOS, A., CORSINI-FOKA, M. & POLITOU, C.Y., 2005b. Update of marine alien species in Hellenic waters. *Mediterranean Marine Science*, 6 (2): 147-158.
- PANCUCCI-PAPADOPOULOU, M.A., CORSINI-FOKA, M. & NALETAKI, M., 2010. Macrophthalmus graeffei A. Milne Edwards, 1873 (Crustacea: Brachyura: Macrophthalmidae): a new Indo-Pacific guest off Rhodes Island (SE Aegean Sea, Greece). Mediterranean Marine Science, 11 (1): 195-200.
- PAPACONSTANTINOU, K., 1988. Check-List of Marine Fishes of Greece. Fauna Graeciae IV, National Center for Marine Research, Hellenic Zoological Society, Athens, 257pp.
- PASTORE, M. & TORTONESE E., 1984. Prima segnalazione in Mediterraneo dello squalo *Rhizoprionodon acutus* (Ruppel). *Thalassia Salentina*, 14: 11-15.
- RAITSOS, D.E., BEAUGRAND, G., GEORGOPOULOS, D., ZENETOS, A., PANCUCCI-PAPADOPOULOU, M.A., et al., 2010. Global climate change amplifies the entry of tropical

species into the Mediterranean Sea. *Limnology & Oceanography*, 55 (4): 1478-1484.

- SCHÄFER, W., 1955. Eine Qualle aus dem Indischen Ozean in der Agais. *Natur und Volk*, 85: 241-245.
- SCHEMBRI, P.J., DEIDUN, A. & VELLA, P.J., 2010. First record of *Cassiopea andromeda* (Scyphozoa: Rhizostomeae: Cassiopeidae) from the central Mediterranean Sea. *Marine Biodiversity Records*, 3 (e6). DOI:10.1017/S1755267209990625
- SIMBOURA, N., 1996. Marine macrobenthic Polychaetes (Annelida, Polychaeta) of Greece: Taxonomy, Ecology, Zoogeography. PhD thesis, University of Athens, 241pp. (In Greek)
- SIMBOURA, N., 2011. An overlooked alien species present on the coasts of Greece (eastern Mediterranean): the polychaete *Polycirrus twisti* Potts (Polychaeta: Terebellidae). *Mediterranean Marine Science*, 12 (1): 239-246.
- SIMBOURA, N. & NICOLAIDOU, A., 2001. The Polychaetes (Annelida: Polychaeta) of Greece: checklist, distribution and ecological characteristics. Monographs on Marine Sciences, Vol. 4, 115 pp.
- SIMBOURA, N., KURT SAHIN, G., PANAGOULIA, A. & KATSIARAS, N., 2010. Four new alien species on the coasts of Greece (Eastern Mediterranean). *Mediterranean Marine Science*, 11 (2): 341-352.
- TORTONESE, E., 1952. Monografia dei carangidi viventi nel Mediterraneo. *Annali del Museo di Storia Naturale di Genova*, 65: 259-324.
- TSIAMIS, K. & BELLOU, N., 2010. *Apoglossum gregarium* (Delesseriaceae, Rhodophyta) from Greece: a new record for the eastern Mediter-

ranean Sea. *Botanica Marina*, 53 (4): 313-317.

- TSIAMIS, K., DIAPOULIS, A. & PANAYOTIDIS, P., 2009. On the enigmatic occurrence of the alien alga *Sarconema scinaioides* Borgesen (Gigartinales, Rhodophyta) in the Mediterranean Sea. *Phycologia*, 48 (Suppl.): 26.
- TSIAMIS, K., MONTESANTO, B., PANAYOTIDIS, P., KATSAROS, C. & VERLAQUE, M., 2010. Updated records and range expansion of alien marine macrophytes in Greece (2009). *Mediterranean Marine Science*, 11 (1): 61-79.
- TSIAMIS, K., PANAYOTIDIS, P. & ZENETOS, A., 2008. Alien marine macrophytes in Greece: a review. *Botanica Marina*, 51 (4): 237-246.
- VERHECKEN, A., 1984. *Strombus decorus raybaudii* in de Middellandse Zee. *Gloria Maris*, 23: 79-88.
- ZACHARIOU-MAMALINGA, H., 1990. The fishes of Symi, Dodecanese. Their scientific, vernacular, common, modern Greek and ancient Greek names. *Annales dei Musei Goulandris*, 8: 309-416.
- ZENETOS, A., 2010. Trend in aliens species in the Mediterranean. An answer to Galil, 2010 «Taking stock: inventory of alien species in the Mediterranean Sea» *Biological invasions*, 12: 3379-3381.
- ZENETOS, A., GOFAS, S., RUSSO, G. & TEMPLADO, J., 2004. *CIESM Atlas of Exotic Species in the Mediterranean Sea*. Vol. 3. Molluscs. CIESM, Monaco, 376 pp.
- ZENETOS A., VASSILOPOULOU, V., SALOMIDI, M. & POURSANIDIS, D., 2007. Additions to the marine alien fauna of Greek Waters (2007 update).

Journal of the Marine Biological Association of the UK 2 - Biodiversity records 5928 (Published on line)

- ZENETOS, A., PANCUCCI-PAPADO-POULOU, M.A., ZOGARIS, S., PAPASTERGIADOU, E., VARDA-KAS, L., et al., 2009a. Aquatic alien species in Greece: tracking sources, patterns and effects on the ecosystem. Journal of Biological Research-Thessaloniki, 12: 135-172.
- ZENETOS, A., POURSANIDIS, D., PANCUCCI-PAPADOPOULOU, M.A., CORSINI-FOKA, M., FRA-GOS, G. & TRACHALAKIS, P., 2009b. ELNAIS: Hellenic Network for

Aquatic Alien Species - A tool for scientists (database) and policy makers. p.687-691. In: Proceedings of the 9th Pan-Hellenic Symposium of Oceanography and Fisheries, 13-16 May 2009, Patra, Greece.

ZENETOS, A., GOFAS, S., VERLAQUE, M., ÇINAR, M.E., GARCIA RASO E., *et al.*, 2010. Alien species in the Mediterranean Sea by 2010. A contribution to the application of European Union's Marine Strategy Framework Directive (MSFD). Part I. Spatial distribution. *Mediterranean Marine Science*, 11 (2): 381-493.