

Inventory of Crustacea Decapoda and Stomatopoda from Rhodes island (Eastern Mediterranean Sea), with emphasis on rare and newly recorded species

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The list of decapod and stomatopod crustacean fauna of Rhodes island (SE Aegean Sea, Eastern Mediterranean Sea) is updated, with the addition of 14 decapods and one stomatopod collected during the last six years. The occurrence of the pelagic crab *Planes minutus* is recorded for the first time in the Hellenic waters, while the finding of the species *Parasquilla ferussaci*, *Paractaea monodi*, *Paragalene longicrura* and *Spinolambrus macrochelos*, rarely captured in the Mediterranean Sea, is documented in detail, with notes on their geographical distribution. The crustaceans recorded around the island number today 109 decapod and 4 stomatopod species. About 16% of them is composed of alien species, mostly entered the South Aegean during the last two decades. A comparison between the decapod fauna of Rhodes and neighboring areas is also presented.

Key words: Decapoda, Stomatopoda, distribution, alien species, Eastern Mediterranean Sea.

INTRODUCTION

The island of Rhodes, located in the SE Aegean Sea and very close to the NW Levantine Sea, is influenced by intense hydrological phenomena. The Rhodes gyre, south-east of the island, and the Asia Minor Current (AMC) are the major hydrological features affecting the area, which is characterized by a sub-tropical open-sea environment. Surface salinity ranges from 39.0‰ to 39.6‰ and temperature from 16.4°C to 28.5°C in winter and summer, respectively (Corsini-Foka, 2010; Pancucci-Papadopoulou *et al.*, 2011, 2012). Due to these characteristics, similar to the Levantine Basin (Mavruk & Avsar, 2008), the island and the nearby region were classified as part of the biogeographic “Lessepsian Province” of the Mediterranean Sea (Por, 1990), since it offers suitable environmental conditions for the establishment of thermophilous organisms, including tropical or sub-tropical species from the Red

Sea and the Indo-Pacific ocean introduced via the Suez Canal (the so-called Lessepsian immigrants).

Moreover, the evolution of the Eastern Mediterranean Transient (EMT) (Theocharis & Lascaratos, 2000; Galil & Kevrekidis, 2002), the global warming and the tropicalization of the Mediterranean Sea (Bianchi, 2007; Occhipinti-Ambrogi, 2007), together with the probable existence of vacant niches, contribute to enhance the rate of introduction in the area and the opportunities for introduced warm-water alien species to establish viable populations (Raitsos *et al.*, 2010; Pancucci-Papadopoulou *et al.*, 2011). The term “alien species” is used here following the definition of the Convention on Biological Diversity (<http://www.cbd.int/invasive/terms.shtml>).

There is no doubt that the marine region around Rhodes presents a great zoogeographical significance for the whole Mediterranean, as it is the first Aegean area which Lessepsian immigrants meet in their way from the Levantine following the Asia Minor coasts and the main pathway of their further spreading (Corsini-Foka, 2010; Pancucci-Papado-

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poulou *et al.*, 2012). Thus, improvement of the knowledge on the biodiversity of this region contributes to assess possible rearrangements of its composition which could lead to loss of native biota and alteration of ecosystem functioning and productivity.

Decapods are an important benthic group, represented in the Mediterranean Sea by 384 species (Coll *et al.*, 2010). Although prevalently Atlanto-Mediterranean, with a minority of endemic species, the Mediterranean decapod fauna includes today a large number of alien species (20% of the total decapod fauna, see Zenetos *et al.*, 2010), showing a fast establishment and spreading into the basin; the majority of them are of Red Sea/Indo-Pacific origin and occur in the Eastern Mediterranean Sea introduced via the Suez Canal (Galil, 2006, 2011; Kourouras *et al.*, 2010; Zenetos *et al.*, 2010).

It is also worth mentioning that, in contradiction to the total of alien invertebrates in Greece, where molluscs are the leading group (Zenetos *et al.*, 2009), in the study area crustaceans are dominant, followed by molluscs, polychaetes and echinoderms (Pancucci-Papadopoulou *et al.*, 2012).

Twelve stomatopod species are known in the Mediterranean Sea, including three aliens of Indo-Pacific origin (Colmenero *et al.*, 2009; Frogli, 2010; Zenetos *et al.*, 2010).

Knowledge on the decapod and stomatopod crustacean diversity along the coasts of Rhodes Island has increased in the last years, mostly due to the finding of alien species introduced via the Suez Canal and the Gibraltar Strait.

In the review conducted by Kevrekidis & Galil (2003), 83 Decapoda (8 Dendrobranchiata, 11 Caridea, 8 Thalassinidea, 4 Palinura, 16 Anomura, 36 Brachyura) and 3 Stomatopoda Crustacea were recorded from Rhodes Island, including alien species of Red Sea/Indo-Pacific (4 Dendrobranchiata, 2 Brachyura and 1 Stomatopoda) and Atlantic origin (1 Brachyura). Two native species were later added to the local fauna, *Bathynectes longipes* (Risso, 1816) (Corsini-Foka *et al.*, 2004) and *Herbstia condyliata* (Fabricius, 1787) (Corsini & Kondilatos, 2006), while a noticeable number of alien brachyurans were recorded (1 species introduced from the Atlantic, 9 from the Indo-Pacific ocean) (Corsini-Foka *et al.*, 2010 and references therein), increasing the decapod species known from the island to 95.

The aim of this work is to update the list of the decapod and stomatopod crustacean species occurring in the shallow and deep waters around the

island and to provide new information on their distribution in the Eastern Mediterranean Sea. Furthermore, decapod species diversity of the Aegean waters, Cyprus and Levantine coasts of Turkey is briefly discussed.

MATERIALS AND METHODS

The present work is based on the information available to date from the scientific literature, after careful verification and reference cross-checking. Additional records of species collected from various localities along the northwestern and eastern coasts of the island (Fig. 1) in the period 2006-2011 are also included. Various sampling methods were used, namely fishing nets, boat seining, crayfish traps, snorkeling and hand-nets, while a specimen was found in a prefilter of the public Aquarium installations, supplied by seawater pumped at depth of 32 m.

The main sources for specimens' identification were Holthuis (1987), Noël (1992) and Falciai & Minervini (1992). In particular cases, Manning (1977), Tan & Ng (2007) and Mavidis *et al.* (2009) were used. The sites "European Register of Marine Species" (<http://www.marbef.org/data/erms.php>) and "World Register of Marine Species" (<http://www.marinespecies.org>) were consulted for scientific nomenclature and the site "Greek biodiversity" (<http://greek-biodiversity.web.auth.gr>) for biogeographic information.

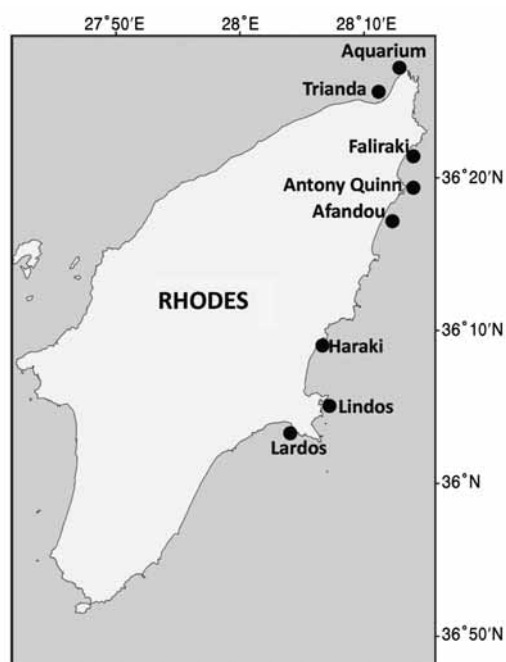


FIG. 1. Map of Rhodes island showing the sampling localities.

Specimens were preserved in 70% alcohol, while the large-sized were dried; they have been deposited in the collection of the Hydrobiological Station of Rhodes (HSR) of the Hellenic Centre for Marine Research (HCMR) or in the HCMR collection.

The following abbreviations were used throughout the text: CL, carapace length; CW, carapace width; TL, total body length.

RESULTS

A total of 109 decapods and 4 stomatopods are listed in the present study (Table 1), including one stomatopod and 14 decapod species (1 Dendrobranchiata, 2

Caridea, 3 Anomura and 8 Brachyura) new to the marine fauna of Rhodes Island. Six of them were collected on coarse substrate (biogenic detritus mixed with mud), at depths between 100 m and 200 m (Haraki and Lindos, Fig. 1). Specimens of the remaining nine species were collected mainly in shallow waters down to 30 m depth, on sandy, rocky or sandy muddy substrate covered with vegetation.

Data on the collected material, sampling sites, methods, habitat, along with body measurements and detailed information on the distribution of the six most interesting species are given below, while data on the remaining species newly reported from Rhodes are given in Table 2.

TABLE 1. Updated list of Stomatopoda and Decapoda Crustacea from Rhodes island

Stomatopoda		Thalassinidea	
Parasquillidae	<i>Parasquilla ferussaci</i> (Roux, 1830)*	Callianassidae	<i>Callianassa candida</i> (Olivi, 1792) <i>Callianassa subterranea</i> (Montagu, 1808) <i>Callianassa tyrrhena</i> (Petagna, 1792) <i>Gourettia denticulata</i> (Lütze, 1837)
Squillidae	<i>Erugosquilla massavensis</i> (Kossmann, 1880) <i>Rissoides pallidus</i> (Giesbrecht, 1910) <i>Squilla mantis</i> (Linnaeus, 1758)	Upogebiidae	<i>Upogebia pusilla</i> (Petagna, 1792) <i>Upogebia stellata</i> (Montagu, 1808) <i>Upogebia talismani</i> (Bouvier, 1915) <i>Upogebia tipica</i> (Nardo, 1869)
Decapoda		Palinura	
Dendrobranchiata		Palinuridae	<i>Palinurus elephas</i> (Fabricius, 1787)
Penaecidae	<i>Marsupenaeus japonicus</i> (Bate, 1888) <i>Melicertus kerathurus</i> (Forskål, 1775) <i>Metapenaepsis aegyptia</i> Galil & Golani, 1990 <i>Metapenaepsis mogiensis consobrina</i> (Nobili, 1904) <i>Parapenaeus longirostris</i> (Lucas, 1846) <i>Trachysalambria palaestinensis</i> Steinitz, 1932 <i>Sicyonia carinata</i> (Brünnich, 1768)	Scyllaridae	<i>Scyllarides latus</i> (Latreille, 1803) <i>Scyllarus arctus</i> (Linnaeus, 1758) <i>Scyllarus pygmaeus</i> (Bate, 1888)
Solenoceridae	<i>Solenocera membranacea</i> (Risso, 1816)	Anomura	
Stenopodidae	<i>Stenopus spinosus</i> Risso, 1827*	Diogenidae	<i>Calcinus tubularis</i> (Linnaeus, 1767) <i>Clibanarius erythropus</i> (Latreille, 1818) <i>Dardanus arrosor</i> (Herbst, 1796) <i>Dardanus calidus</i> (Risso, 1827) <i>Diogenes pugilator</i> (Roux, 1829) <i>Paguristes eremita</i> (Linnaeus, 1767)
Caridea		Paguridae	<i>Anapagurus bicorniger</i> A. Milne-Edwards & Bouvier, 1892* <i>Anapagurus laevis</i> (Bell, 1846) <i>Anapagurus petiti</i> Dechancé & Forest, 1962* <i>Cestopagurus timidus</i> (Roux, 1830) <i>Pagurus anachoretus</i> Risso, 1827 <i>Pagurus pridaeux</i> Leach, 1815
Alpheidae	<i>Alpheus dentipes</i> Guérin-Méneville, 1832 <i>Synalpheus gambarelloides</i> (Nardo, 1847)	Galatheidae	<i>Galathea intermedia</i> Lilljeborg, 1851 <i>Galathea machadoi</i> Barrois, 1888 <i>Galathea squamifera</i> Leach, 1814 <i>Galathea strigosa</i> (Linnaeus, 1767) <i>Munida curvimana</i> A. Milne-Edwards & Bouvier, 1894*
Crangonidae	<i>Aegaeon cataphractus</i> (Olivi, 1792)	Porcellanidae	<i>Pisidia bluteli</i> (Risso, 1816) <i>Porcellana platycheles</i> (Pennant, 1777)
Gnathophyllidae	<i>Gnathophyllum elegans</i> (Risso, 1816)*		
Hippolytidae	<i>Lysmata seticaudata</i> (Risso, 1816)*		
Palaemonidae	<i>Palaemon elegans</i> Rathke, 1837 <i>Palaemon xiphias</i> Risso, 1816 <i>Palaemonetes antennarius</i> (H. Milne-Edwards, 1837) <i>Pontonia pinnophylax</i> (Otto, 1821)		
Pandalidae	<i>Plesionika edwardsii</i> (Brandt, 1851) <i>Plesionika narval</i> (Fabricius, 1787)		
Processidae	<i>Processa acutirostris</i> Nouvel & Holthuis, 1957 <i>Processa macrophthalma</i> Nouvel & Holthuis, 1957		

Brachyura									
Calappidae	<i>Calappa granulata</i> (Linnaeus, 1758)	Ocypodidae							<i>Maja squinado</i> (Herbst, 1788)
Dromiidae	<i>Dromia personata</i> (Linnaeus, 1758)	Palicidae							<i>Ocypode cursor</i> (Linnaeus, 1758)
Epiplatidae	<i>Acanthonyx lunulatus</i> (Risso, 1816)	Parthenopidae							<i>Palicus caronii</i> (Roux, 1830)
	<i>Herbstia condyliata</i> (Fabricius, 1787)								<i>Derilambrus angulifrons</i> (Latreille, 1825)*
	<i>Lissa chiragra</i> (Fabricius, 1775)*								<i>Spinolambrus macrochelous</i> (Herbst, 1790)*
	<i>Pisa armata</i> (Latreille, 1803)	Pilumnidae							<i>Pilumnus hirtellus</i> (Linnaeus, 1761)
	<i>Pisa corallina</i> (Risso, 1816)								<i>Pilumnus villosissimus</i> (Rafinesque, 1814)*
	<i>Pisa muscosa</i> (Linnaeus, 1758)	Plagusiidae							<i>Percnon gibbesi</i> (H. Milne Edwards, 1853)
	<i>Pisa tetraodon</i> (Pennant, 1777)	Polybiidae							<i>Liocarcinus navigator</i> (Herbst, 1794)
Eriphiidae	<i>Eriphia verrucosa</i> (Forskål, 1775)								<i>Liocarcinus corrugatus</i> (Pennant, 1777)
Ethusidae	<i>Ethusa mascarone</i> (Herbst, 1785)								<i>Liocarcinus depurator</i> (Linnaeus, 1758)
Goneplacidae	<i>Goneplax rhomboides</i> (Linnaeus, 1758)								<i>Liocarcinus zariquieyi</i> (Gordon, 1968)
Grapsidae	<i>Pachygrapsus marmoratus</i> (Fabricius, 1787)	Portunidae							<i>Bathynectes longipes</i> (Risso, 1816)
	<i>Planes minutus</i> (Linnaeus, 1758)*								<i>Callinectes sapidus</i> Rathbun, 1896
Homolidae	<i>Homola barbata</i> (Fabricius, 1793)								<i>Carupa tenuipes</i> Dana, 1851
Inachidae	<i>Inachus communissimus</i> (Rizza, 1839)								<i>Charybdis hellerii</i> (A. Milne-Edwards, 1867)
	<i>Inachus dorsettensis</i> (Pennant, 1777)								<i>Charybdis longicollis</i> Leene, 1938
	<i>Inachus leptochirus</i> (Leach, 1817)								<i>Gonioinfradens paucidentatus</i> (A. Milne Edwards, 1861)
	<i>Inachus thoracicus</i> (Roux, 1830)								<i>Portunus hastatus</i> (Linnaeus, 1767)
	<i>Macropodia rostrata</i> (Linnaeus, 1761)								<i>Portunus segnis</i> (Linnaeus, 1758)
Latreilliidae	<i>Latreillia elegans elegans</i> (Roux, 1830)								<i>Thalamita poissonii</i> (Audouin, 1826)
Leucosiidae	<i>Coleusia signata</i> Paulson, 1875								<i>Paragalene longicrura</i> (Nardo, 1869)*
	<i>Ilia nucleus</i> (Linnaeus, 1758)								<i>Atergatis roseus</i> (Rüppell, 1830)
	<i>Ixa monodi</i> Holthuis & Göttlieb, 1956	Progeryonidae							<i>Monodaeus guinotae</i> Forest, 1976
	<i>Myra subgralunata</i> Kossmann, 1877	Xanthidae							<i>Paractaea monodi</i> Guinot, 1969*
Macrophthalmidae	<i>Macrophthalmus graeffei</i> A. Milne-Edwards, 1873								<i>Xantho granulicarpus</i> Forest, 1953
									<i>Xantho poressa</i> (Olivi, 1792)
Majidae	<i>Eurynome aspera</i> (Pennant, 1777)								
	<i>Maja crispata</i> (Risso, 1827)								
	<i>Maja goltziana</i> d'Oliveira, 1888*								

* Species recorded in the present work

TABLE 2. Additional decapod crustacean species new to the Rhodes island fauna, along with collection data

	Date	Method	Location	Substrate	Depth (m)	Specimens number/sex	Catalogue Number
Dendrobranchiata							
<i>Stenopus spinosus</i> Risso, 1827	November 2006	Boat seining	Trianda	Sandy mud, vegetation	5-30	1 ♀	HSR61
Caridea							
<i>Gnathophyllum elegans</i> (Risso, 1816)	7/2/2007	Boat seining	Trianda	Sandy mud, vegetation	5-30	1 ♀	HSR62
<i>Lysmata seticaudata</i> (Risso, 1816)	5/5/2008	Aquarium prefilter	Aquarium	Sand, gravel	32	1 ♂	HSR63
Anomura							
<i>Anapagurus bicorniger</i> A. Milne-Edwards & Bouvier, 1892	22/7/2009	Grab Ponar	Antony Quinn	Sand	6	1 ♀	C103
<i>Anapagurus petiti</i> Dechancé & Forest, 1962	22/7/2009	Grab Ponar	Faliraki	Sand	6	1 ♀	C104
<i>Munida curvimana</i> A. Milne-Edwards & Bouvier, 1894	May 2010	Crayfish trap	Haraki	Biogenic detritus, rocks	200	2 ♂	HSR64 HSR65
Brachyura							
<i>Lissa chiragra</i> (Fabricius, 1775)	28/6/2010	Crayfish trap	Haraki	Biogenic detritus, rocks	200	1 ♂	HSR66
<i>Derilambrus angulifrons</i> (Latreille, 1825)	2009			<i>Lagocephalus sceleratus</i> stomach		1 ♂	HSR72
<i>Pilumnus villosissimus</i> (Rafinesque, 1814)	22/2/2010	Hand-net	Lindos	Rocky	2	1 ♂	HSR75
	20/6/2010	Hand-net	Faliraki	Rocky	5	1 ♂	HSR76

PARASQUILLIDAE

Parasquilla ferussaci (Roux, 1830)

Material

1 ♂; CL (excluding rostrum): 23.1 mm, TL: 92.7 mm; station Haraki; crayfish trap; depth 150 m; biogenic detritus mixed to mud, rocks present; 18 May 2010; Catalogue number HSR60.

Remarks

Parasquilla ferussaci (Fig. 2) is considered a rare species (Özcan *et al.*, 2008a). Its usual habitat appears to be the muddy and lightly sandy substrates (Abelló *et al.*, 1993), at depths between 175 and 700 m, but also on the continental shelf (Colmenero *et al.*, 2009). The known distribution of *P. ferussaci* comprises the Eastern Central Atlantic and the Mediterranean Sea, mainly its western part (Colmenero *et al.*, 2009 and references therein). The occurrence of the species in the Eastern Mediterranean was firstly reported from Rethymnon Bay, northern coast of Crete, at 50 m of depth on soft bottom (Dounas & Steudel, 1994) and more recently in the Turkish waters of the NE Aegean Sea, near Babakale, at depth between 150 and 200 m, on sandy-silt bottom (Özcan *et al.*, 2008a).



FIG. 2. Male specimen of *Parasquilla ferussaci*, TL 92.7 mm (Photo: G. Kondylatos).

MAJIDAE

Maja goltziana d'Oliveira, 1888

Material

1 ♂; CL: 71.6 mm, CW: 50.0 mm; station Trianda; boat seining; depth 5-30 m; sandy mud with vegetation; 20 June 2007; Catalogue number HSR67. 1 ♂; CL: 83.2 mm, CW: 57.3 mm; station Trianda; boat seining; depth 5-30 m; sandy mud with vegetation; 17 August 2008; Catalogue number HSR68.

Remarks

According to Udekem d'Acoz (1999), *M. goltziana* is distributed in the Eastern Atlantic Ocean and the Mediterranean Sea. The species was first recorded from the Mediterranean Sea off the coast of Israel in the late 1950's (Holthuis & Gottlieb, 1958). Later, it was recorded in the Levantine basin and the Aegean Sea (Ramadan & Dowidar, 1972; Koukouras, 1979; Kocataş, 1981; Koukouras *et al.*, 1992), the Ionian Sea (Pastore, 1983), the strait of Sicily (Pipitone & Tumbiolo, 1993), the Adriatic (Pallaoro & Dulčić, 2004) and the Tyrrhenian Sea (Vignoli *et al.*, 2004; Soppelsa *et al.*, 2005). Recently, it was found in the North Aegean Sea (Artüz, 2006).

Although considered by far the rarest species of the Majidae family (Zariquiey Alvarez, 1968), recent studies conducted in Lebanese and Syrian coasts confirmed its frequent occurrence in the Levantine basin (Hasan *et al.*, 2008; Lelli *et al.*, 2008).

XANTHIDAE

Paractaea monodi Guinot, 1969

Material

1 ♂; CL: 20.5 mm, CW: 28.9 mm; station Faliraki; fishing nets, depth 8 m; sand and rocks with vegetation; 24 June 2011; Catalogue number HSR69.

Remarks

Paractaea monodi (Fig. 3) lives in shallow waters up to 150 m depth on sand or gravel and in areas with *Posidonia oceanica* meadows (Falciai & Minervini, 1992). It inhabits the Eastern Atlantic Ocean, the Azores, Madeira, Ilhas Desertas, the Canary Islands, the Cape Verde Islands and the Mediterranean Sea (Manning & Holthuis, 1981). It has been reported from the western Mediterranean (Zariquiey Alvarez, 1968; Castelló *et al.*, 1987; Noël, 1993), the Adriatic Sea (Števcic, 1990; Kljajo & Števcic, 2000), and the central basin (Udekem d'Acoz, 1999). In the Eastern Mediterranean Sea, *P. monodi* is known from the Egyptian and Turkish Levantine waters (Balss, 1936; Holthuis & Gottlieb, 1956; Udekem d'Acoz, 1994; Ateş *et al.*, 2010) and the Aegean Sea, where it was firstly recorded in 1955, in the Gulf of Kalamata (Peloponnese), 38-40 m deep, on biogenic detritus and later at Milos Island (Koukouras *et al.*, 1992, 1993; Mavidis *et al.*, 2008). *Paractaea monodi* is generally considered a rare species in the Mediterranean Sea (Vignoli *et al.*, 2004).



FIG. 3. *Paractaea monodi*, male, CL: 20.5 mm, dorsal and ventral view.

PROGERYONIDAE

Paragalene longicrura (Nardo, 1869)

Material

1 ♂; CL: 36.7 mm, CW: 48.9 mm; station Trianda; fishing net; depth 5-30 m; sand and rocks with vegetation; June 2007; Catalogue number HSR70. 1 ♀; CL: 32.9 mm, CW: 43.2 mm; station Haraki; crayfish trap; depth 150 m; biogenic detritus and rocks; 17 June 2010; Catalogue number HSR71.

Remarks

Today, the genus *Paragalene* comprehends two species, the recently described *P. danielleae* (Tavares & De Melo, 2010) from the Western Atlantic and *P. longicrura* (Nardo, 1869). *Paragalene longicrura* (Fig. 4) is a rare species known from the Mediterranean Sea and the Eastern Atlantic Ocean (Madeira and Canary Islands) (Udekem d'Acoz, 1999; Castro & Ng, 2008).

Concerning the Mediterranean Sea, *P. longicrura* has been recorded from Malta and mainly the western basin, namely Balearic Islands area, Naples Bay, Algerian waters, Tuscany islands, and Adriatic (Pallaoro, 2005). In the eastern part of the basin, it has been reported from the island of Skyros in the Aegean Sea (Türkey, 1976), while in the Levantine basin the species has been recorded for the first time at Kastelorizo Island, only in 2004 (Mavidis *et al.*, 2008). The collection of two more specimens of *P. longicrura* from Rhodes increases significantly the knowledge on its distribution in the Eastern Mediterranean Sea.

According to Udekem d'Acoz (1999), *P. longicrura* occurs in dark caves and on hard bottoms with algal growth and shells, at depths between 30 and 160 m, as confirmed by the species finding in Rhodes.



FIG. 4. A live female of *Paragalene longicrura*, CL: 32.9, dorsal and ventral view.

PARTHENOPIDAE

Spinolambrus macrochelos (Herbst, 1790)

Material

1 ♂; CL: 28.5, CW: 32.0; station Faliraki; fishing nets; depth 20-25 m; sandy; 5 September 2011; Catalogue number HSR73. 1 ♂; CL: 42.5 mm, CW: 50.4 mm; station Haraki; crayfish trap; depth 180 m; biogenic detritus and rocks; 10 October 2011; Catalogue number HSR74.

Remarks

Spinolambrus macrochelos is considered a rare species (Falciai & Minervini, 1992) distributed over the Mediterranean Sea on sandy-muddy bottoms at depths between 18 and 370 m (Guerao & Abelló, 1999; Politou *et al.*, 2003; Fanelli *et al.*, 2007), but also down to 750 m (Mura & Cau, 1994), sometimes shallower than 5 m, and exceptionally at great depths (Hasan *et al.*, 2008). In the Eastern Mediterranean Sea *S. macrochelos* is known from the Aegean Sea up to the Turkish Straits (Koukouras *et al.*, 1992; Kocataş *et al.*, 2004; Ateş *et al.*, 2010), the coasts of Israel (18-97 m) (Holthuis & Gottlieb, 1958; Fishelson, 2000), Cyprus (37-70 m) (Kocataş *et al.*, 2001), along the Syrian coasts (30 m) (Hasan *et al.*, 2008) and the Mediterranean coasts of Turkey (Ateş *et al.*, 2010). It was recently collected in the eastern Aegean Sea (200-300 m) (Özcan & Katağan, 2009).

GRAPSIDAE

Planes minutus (Linnaeus, 1758)

Material

1 ♀; CL: 18.9 mm, CW: 19.4mm; station Lindos; crayfish trap; depth 150 m; biogenic detritus and rocks; 12 June 2010; Catalogue number HSR77.

Remarks

The species, considered rare, occurs in the Atlantic waters up to the North Sea and in the Mediterranean Sea (Falciai & Minervini, 1992). In the Eastern Mediterranean Sea, it has been recorded in Israel (Lewinsohn & Holthuis, 1964) and Cyprus (Kocataş *et al.*, 2001). The present record of *Planes minutus* (Fig. 5) is the first for the Aegean Sea.

The species is characteristically associated with non-living and living floating objects like branches, algae and pelagic marine animals such as sea turtles (Raso, 1984; Falciai & Minervini, 1992; Cuesta *et al.*, 1997; Casale *et al.*, 2004; Frick *et al.*, 2011). The present finding of this pelagic crab in a trap lift from deep waters contrasts with the usual observations. However, the possibility that the specimen entered the trap near the surface, attached to a floating object during the lifting up, is not to be excluded.

DISCUSSION

After a review of the available literature (Türkay *et al.*, 1987; Koukouras *et al.*, 1992, 1998; Udekem d'Acoz, 1994, 1995, 1999; Koukouras, 2000; Koukouras & Dounas, 2000; Kirmizoglou *et al.*, 2006; Zenetos *et al.*, 2009, 2011; Corsini-Foka *et al.*, 2010; Ateş *et al.*, 2010; Çinar *et al.*, 2011) and taking into account the occurrence of *P. minutus* recorded in the present work, the overall decapod fauna of the Aegean Sea numbers 281 species (73% of the total Mediterranean decapod fauna) and it is the richest in species compared to other region of the Eastern Mediterranean Sea, as assessed in the comprehensive study of Koukouras *et al.* (1992) (Table 3).

The results of the present study increase the



FIG. 5. *Planes minutus*, female, CL: 18.9 mm, dorsal and ventral view.

TABLE 3. Comparison of decapod fauna between Rhodes island and neighboring areas (IP: Red Sea/Indo-Pacific Ocean origin, AT: Atlantic Ocean origin)

	Origin	Dendro-branchiata	Caridea	Astacidea	Thalassinidea	Palinura	Anomura	Brachyura	Total
Rhodes island	Native	5	13		8	4	19	43	92
	IP aliens	4						11	15
	AT aliens							2	2
	Total	9	13		8	4	19	56	109
Levantine Sea (Turkey)	Native	7	41		7	4	28	61	148
	IP aliens	9	8					18	35
	AT aliens	1	1					2	4
	Total	17	50		7	4	28	81	187
Cyprus	Native	7	36		7	5	22	66	143
	IP aliens	3						5	8
	AT aliens							2	2
	Total	10	36		7	5	22	73	153
Aegean Sea	Native	23	67	2	16	6	39	101	254
	IP aliens	6	2					13	21
	AT aliens		2					4	6
	Total	29	71	2	16	6	39	118	281

number of decapod species known for Rhodes island from 95 to 109, accounting for 38.8% of the whole Aegean Sea decapod fauna.

According to Dounas & Steudel (1994), Kocataş & Katağan (1995) and to the recent review of Bakir & Cevirgen (2012), the stomatopod fauna of the Aegean Sea lists eight species. Along the Mediterranean coasts of Turkey, the Indo-Pacific alien *Clorida albolitura* Ahyong & Naiyanetr, 2000 was recently added (Galil *et al.*, 2009) to the previously recorded *Erugosquilla massavensis* (Kossmann, 1880) and *Squilla mantis* (Linnaeus, 1758) (Kocataş & Katağan, 1995; Bakir & Cevirgen, 2012), while *Rissoides desmaresti* (Risso, 1816), *Rissoides pallidus* (Giesbrecht, 1910) and *E. massavensis* occur in Cyprus (Kocataş *et al.*, 2001; Katsavenakis *et al.*, 2009).

The record of the stomatopod *Parasquilla ferusaci* reported here is the second one for the Hellenic waters and the third one for the Eastern Mediterranean Sea (Aegean Sea) (Dounas & Steudel, 1994; Özcan *et al.*, 2008a). It adds a new stomatopod to the three species previously known from the island, the native *R. pallidus*, *S. mantis*, and the Lessepsian *E. massavensis* (Kevrekidis & Galil, 2003). *Erugosquilla massavensis*, a successful colonizer with a wide distribution range in the Aegean waters (Özcan *et al.*, 2008b), seems to increase its population around Rhodes (10 to 180 m depth, pers. observation).

The total number of Aegean decapods includes 27 alien species, which constitute approximately 10% of the total recorded species (Table 3) (Zenetos *et*

al., 2009, 2010, 2011; Ateş *et al.*, 2010; Koukouras *et al.*, 2010; Çınar *et al.*, 2011; Galil, 2011). In the waters around Rhodes island, 17 (63%) of the above Aegean alien decapods species occur, 15 of Indo-Pacific and two of Atlantic origin, representing 15.7% of the 109 decapod species currently known. Apart from the portunid *Callinectes sapidus* Rathbun, 1896, the remaining alien decapods are warm-water species. All species of Indo-Pacific origin are Lessepsian immigrants, including *Gonioinfradens paucidentatus* (A. Milne Edwards, 1861), firstly recorded for the Mediterranean in the waters of Rhodes island (Corsini-Foka *et al.*, 2010), and also occurring eastward along the Mediterranean coasts of Turkey (Karhan & Yokes, 2012).

It is worth mentioning that, apart from few cases of northward spreading, mainly along the Aegean coast of Asia Minor, up to date most Indo-Pacific decapod species introduced into the Aegean waters, are concentrated along the coasts of the southeastern corner of the basin, from Rhodes island up to Gökova Bay (see Koukouras *et al.*, 2010), a marine environment particularly suitable to the establishment of warm-water alien species.

Comparing native and alien decapods of Rhodes island and its neighbouring areas (Cyprus, Aegean Sea, Turkish Levantine waters), on the base of the present knowledge the majority of species recorded in Cyprus (97%) are in common with the Aegean Sea, while a lower percentage (80%) is in common with the Levantine coasts of Turkey. As for Rhodes

island, 75% of the known decapod fauna results in common with Cyprus and 80% with the Turkish Levantine waters. Only ten alien decapods have been reported from Cyprus, out of a total 153 species (Table 3) (Lewinsohn & Holthuis, 1986; Kocataş *et al.*, 2001; Kirmizoglou *et al.*, 2006; Tzomos *et al.*, 2007; Dogan *et al.*, 2008; Christodoulou *et al.*, 2009; Katsavenakis *et al.*, 2009, 2011). This strong difference between the two islands could be attributed to the isolation of Cyprus and the lack of a strong connecting current with the Levant coast (Ben Eliahu & Payatas, 1999), but also to the limited research effort devoted to this area (see Christodoulou *et al.*, 2009).

The Levantine coasts of Turkey, although inhabited by a lower number of decapod species compared to the whole Aegean, have been significantly enriched by a high number of alien decapods (39 species), which constitute 21% of the total species listed (Table 3) (Ateş *et al.*, 2010; Özcan *et al.*, 2010; Çinar *et al.*, 2011; Galil, 2011; Karhan & Yokes, 2012). In this area, 88% of decapod species is in common with the Aegean fauna, while the remaining species, the majority Red Sea/Indo-Pacific aliens, have not been recorded up to date in the Aegean Sea.

As already remarked above, five of the newly reported species from Rhodes, namely *Parasquilla ferussaci*, *Paractaea monodi*, *Paragalene longicrura*, *Spinolambrus macrochelos* and *Planes minutus*, are generally considered rare species in the Mediterranean Sea. The occurrence of the brachyuran *Planes minutus* represents the first record for the Aegean Sea, while the remaining 13 decapods signaled in the present study have already been listed (Koukouras *et al.*, 1992; Ateş *et al.*, 2010). Limited sampling effort performed in the deep waters around the island allowed to report the presence of *Parasquilla ferussaci* and *Planes minutus* and to collect a second specimen of *Paragalene longicrura*, showing that these species are rarely captured probably because they inhabit areas difficult to be reached by sampling devices. The first findings of *Paractaea monodi* in the shallow waters of Faliraki, an area of Rhodes where fishing activities and underwater observations are intense all over the year, could indicate that its population is represented by a scarce number of individuals. *Spinolambrus macrochelos*, although considered a rare species, was collected in a short period of time both from shallow and deep waters. Consequently, it is more probable that the occurrence of the species was undetected or disregarded

until now along the coasts of the island. A well establishment of *Maja goltziana* in the Levantine Basin has been recently ascertained (Hasan *et al.*, 2008; Lelli *et al.*, 2008). Along the last few years, the species is often captured in the shallow waters of Rhodes and live specimens are regularly displayed in the Aquarium of the Hydrobiological Station. This fact may suggest that the species is today rather common also in the southeastern Aegean Sea.

Up to date, a total of one hundred alien species occur in Rhodes area, of which 98 are warm-water, the majority entered during the last two decades via the Suez Canal, some showing abundant populations along the coasts (cf. Pancucci-Papadopoulou *et al.*, 2011, 2012; Corsini-Foka *et al.*, 2012).

The introduction rate of Lessepsian biota is increasing (Tzomos, 2007; Belmaker *et al.*, 2010; Koukouras *et al.*, 2010; Tzomos *et al.*, 2012) and evidence is accumulating that the entry of tropical species into the Mediterranean Sea is linked to global climate changes and warming of the basin (Ben Rais Lasram & Mouillot, 2009; Raitzos *et al.*, 2010; Pancucci-Papadopoulou *et al.*, 2011, 2012). The phenomenon of warm-water aliens introductions, in particular of Indo-Pacific origin in the Eastern Mediterranean Sea, amplified by climatic changes (Raitzos *et al.*, 2010), and accomplished to the rapid integration and often population explosion of this new biota, conduces to an accelerated alteration of the native marine communities into mixed Red Sea-Mediterranean Sea ones (Fishelson, 2000). Although consequences of this process are largely unknown (Philippart *et al.*, 2011), the magnitude of its impact at environmental and socio-economic level begins to appear manifest (EASTMED, 2010; Zenetos *et al.*, 2010; Galil, 2011; Pancucci-Papadopoulou *et al.*, 2011, 2012).

Monitoring of the benthic biota in Rhodes area, a geographically crucial region subjected to invasions and already considered biopolluted (Pancucci-Papadopoulou *et al.*, 2011), is therefore imperative.

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REFERENCES

- Abelló P, Pretus JL, Corbera J, 1993. Occurrence and distribution of some stomatopod crustaceans in the western Mediterranean. *Miscellanea Zoologica*, 17: 107-113.
- Artüz ML, 2006. First record of *Maja goletziana* Oliveira, 1888 in Saros Bay, north Aegeis. *Zoonatantia*, 33-34.
- Ateş AS, Kocataş A, Katağan T, Özcan T, 2010. An updated list of decapod crustaceans on the Turkish coast with a new record of the Mediterranean shrimp, *Processa acutirostris* Nouvel and Holthuis 1957 (Caridea, Processidae). *North-Western Journal of Zoology*, 6: 209-217.
- Bakir K, Cevirgen F, 2012. Stomatopods on the Turkish coasts with a new record *Allosquilla africana* (Manning, 1970) (Stomatopoda, Tetrasquillidae). *Crustaceana*, 85: 349-358.
- Balss H, 1936. Decapoda with an appendix: Schizopoda, by C. Zimmer, In *The Fishery Grounds near Alexandria. Fisheries Research Directorate Notes and Memoirs, Cairo*, 15: 1-67.
- Belmaker J, Brokovich E, China V, Golani D, Kiflawi M, 2010. Introduction rate of Lessepsian fishes into the Mediterranean. In: Golani D, Appelbaum-Golani B, eds. *Fish invasions of the Mediterranean Sea: change and renewal*. Pensoft Publishers, Sofia-Moscow: 57-69.
- Ben-Eliahu MN, Payiatas G, 1999. Searching for Lessepsian migrant serpulids (Annelida: Polychaeta) on Cyprus – some results of a recent expedition. *Israel Journal of Zoology*, 45: 101-119.
- Ben Rais Lasram F, Mouillot D, 2009. Increasing southern invasion enhances congruence between endemic and exotic Mediterranean fish fauna. *Biological Invasions*, 11: 697-711.
- Bianchi CN, 2007. Biodiversity issues for the forthcoming tropical Mediterranean Sea. *Hydrobiologia*, 580: 7-21.
- Casale P, Freggi D, Basso R, Argano R, 2004. Epibiotic barnacles and crabs as indicators of *Caretta caretta* distribution and movements in the Mediterranean Sea. *Journal of the Marine Biological Association of the United Kingdom*, 84: 1005-1006.
- Castelló J, Portas F, Isern-Arús J, 1987. Contribución al conocimiento de los Crustáceos Decápodos algúcolas de las islas Baleares. *Investigación Pesquera*, 51: 293-300.
- Castro P, Ng PKL, 2008. *Rhadinoplax*, a new genus of Progeryonidae Števičić, 2005, for *Carcinoplax microphthalmus* Guinot & Richer de Forges, 1981, and a redescription of *Paragalene longicrura* (Nardo, 1868) (Crustacea: Decapoda: Brachyura: Goneplacoidea). *Zootaxa*, 1777: 53-68.
- Christodoulou M, Tzomos Th, Chartosia N, Kitsos MS, 2009. Decapod crustaceans new to the fauna of Cyprus. *Marine Biodiversity Records*, 2: e168.
- Çinar ME, Bilecenoğlu M, Öztürk B, Katağan T, Yokeş MB, Aysel V, Dağlı E, Açıç S, Özcan T, Erdoğan H, 2011. An updated review of alien species on the coasts of Turkey. *Mediterranean Marine Science*, 12: 257-315.
- Coll M, Piroddi C, Steenbeek J, Kaschner K, Ben Rais Lasram F, Aguzzi J, Ballesteros E, Bianchi CN, Corbera J, Dailianis T, et al., 2010. The biodiversity of the Mediterranean Sea: estimates, patterns, and threats. *PLoS ONE*, 5: e11842.
- Colmenero AI, García Raso JE, Abelló P, 2009. New records of *Parasquilla ferussaci* (Roux, 1830) (Crustacea, Stomatopoda) from the Eastern Atlantic and Western Mediterranean. *Arxius de Miscellània Zoològica*, 7: 72-77.
- Corsini M, Kondilatos G, 2006. On the occurrence of two brachyurans, *Myra subgranulata* and *Herbstia condyliata*, on Rhodes Island (SE Aegean Sea). *Crustaceana*, 79: 167-174.
- Corsini-Foka M, 2010. Current status of alien fishes in Greek seas. In: Golani D, Appelbaum-Golani B, eds. *Fish invasions of the Mediterranean Sea: change and renewal*. Pensoft Publishers, Sofia-Moscow: 219-253.
- Corsini-Foka M, Kondilatos G, Economidis PS, 2004. Occurrence of the lessepsian species *Portunus pelagicus* (Crustacea) and *Apogon pharaonis* (Pisces) in the marine area of Rhodes Island. *Mediterranean Marine Science*, 5: 83-89.
- Corsini-Foka M, Pancucci-Papadopoulou MA, Kondilatos G, Kalogirou S, 2010. *Gonioinfradens paucidentatus* (A. Milne Edwards, 1861) (Crustacea, Decapoda, Portunidae): a new alien crab in the Mediterranean Sea. *Mediterranean Marine Science*, 11: 331-340.
- Corsini-Foka M, Kondilatos G, Santorinos E, 2012. Alien species at the Aquarium of Rhodes (Greece): a long-term experience. *Proceedings of the 10th Pan-Hellenic Symposium on Oceanography and Fishery, Athens Greece*: 139.
- Cuesta JA, González-Gordillo JI, Rodríguez A, 1997. First zoeal stages of *Grapsus adscensionis* (Osbeck) and *Planes minutus* (Linnaeus) (Brachyura: Grapsidae) described from laboratory hatched material, with notes on larval characters of the Grapsinae. *Journal of Natural History*, 31: 887-900.
- Dogan A, Özcan T, Kirkim F, Katağan T, 2008. Decapod crustaceans new to the fauna of Cyprus. *Crustaceana*, 81: 759-762.
- Dounas C, Steudel C, 1994. Stomatopod Crustacea from the island of Crete. *Crustaceana*, 66: 252-254.
- EASTMED, 2010. Report of the Sub-Regional Technical meeting on the Lessepsian migration and its impact on Eastern Mediterranean fishery. GCP/INT/041/EC – GRE – ITA/TD-04.
- Falciai L, Minervini R, 1992. *Guida dei crostacei decapodi d'Europa*. Franco Muzzio Editore, Padova.
- Fanelli E, Colloca F, Ardizzone G, 2007. Decapod crustacean assemblages off the West coast of central Italy (western Mediterranean). *Scientia Marina*, 71: 19-28.
- Fishelson L, 2000. Marine animal assemblages along the

- littoral of the Israeli Mediterranean seashore: The Red-Mediterranean Seas communities of species. *Italian Journal of Zoology*, 67: 393-415.
- Frick MG, Kopitsky K, Bolten AB, Bjorndal KA, Martins HR, 2011. Sympatry in grapsoid crabs (genera *Planes* and *Plagusia*) from olive ridley sea turtles (*Lepidochelys olivacea*), with descriptions of crab diets and masticatory structures. *Marine Biology*, 158: 1699-1708.
- Frogliola C, 2010. Crustacea, Hoplocarida, Stomatopoda. *Biologia Marina Mediterranea*, 17: 472-473.
- Galil BS, 2006. The marine Caravan-The Suez Canal and the Erythrean invasion. In: Gollasch S, Galil BS, Cohen AN, eds. *Bridging dividers. Maritime canals as invasion corridors*. Springer, Dordrecht: 207-300.
- Galil BS, 2011. The alien Crustaceans in the Mediterranean Sea: an historical review. In: Galil BS, Clark PF, Carlton JT, eds. *In the wrong place - alien marine Crustaceans: distribution, biology and impacts*. Springer, London: 377-401.
- Galil BS, Kevrekidis K, 2002. Exotic decapods and a stomatopod off Rhodes Island (Greece) and the eastern Mediterranean Transient. *Crustaceana*, 75: 925-930.
- Galil BS, Yokes MB, Goren M, Diamant A, 2009. First record of the Indo-West Pacific mantis shrimp, *Clorida albolitura* Ahyong & Naiyanetr, 2000 (Stomatopoda, Squillidae) in Turkey. *Aquatic Invasions*, 4: 701-702.
- Guerao G, Abelló P, 1999. The first zoal stage of *Parthenope macrochelos* (Herbst, 1790) hatched in the laboratory (Crustacea: Brachyura: Parthenopidae). *Scientia Marina*, 63: 9-14.
- Hasan H, Zeini A, Noël PY, 2008. The marine decapod Crustacea of the area of Lattakia, Syria. *Crustaceana*, 81: 513-536.
- Holthuis LB, 1987. Stomatopodes. Crevettes. Vrais crabes. In: Fischer W, Bauchot M-L, Schneider M, eds. *Fiches FAO d'identification des espèces pour les besoins de la pêche. (Révision 1). Méditerranée et mer Noire. Végétaux et Invertébrés*. FAO, Rome, 1: 179-367.
- Holthuis LB, Gottlieb E, 1956. Two interesting crabs (Crustacea Decapoda Brachyura) from Mersin Bay, S.E. Turkey. *Zoologische Mededelingen Leiden*, 34: 287-299.
- Holthuis LB, Gottlieb E, 1958. An annotated list of the decapod Crustacea of the Mediterranean coast of Israel, with an appendix listing the Decapoda of the eastern Mediterranean. *Bulletin of the Research Council of Israel*, 7B: 1-126.
- Karhan SÜ, Yokes MB, 2012. An earlier record of the Indo-Pacific swimming crab, *Gonioinfradens paucidentatus* (A. Milne-Edwards, 1861) (Decapoda, Brachyura, Portunidae) off the Mediterranean coast of Turkey. *Crustaceana*, 85: 117-121.
- Katsanevakis S, Tsiamis K, Ioannou G, Michailidis N, Zenetos A, 2009. Inventory of alien marine species of Cyprus (2009). *Mediterranean Marine Science*, 10: 109-133.
- Katsanevakis S, Poursanidis D, Yokes MB, Mačić V, Beqiraj S, Kashta L, Sghaier YR, Zakhama-Sraieb R, Benamer I, Bitar G, et al., 2011. Twelve years after the first report of the crab *Percnon gibbesi* (H. Milne Edwards, 1853) in the Mediterranean: current distribution and invasion rates. *Journal of Biological Research-Thessaloniki*, 16: 224-236.
- Kevrekidis K, Galil BS, 2003. Decapoda and Stomatopoda (Crustacea) of Rodos island (Greece) and the Erythrean expansion NW of the Levantine Sea. *Mediterranean Marine Science*, 4: 57-66.
- Kirmizozglou I, Kitsos M-S, Thessalou-Legaki M, Tselepidis A, Koukouras A, 2006. Investigation of the progress and possible expansion of the limits of the Lessepsian migratory current regarding Decapoda (Crustacea). In: *Book of Abstracts of the 10th International Conference on Zoogeography and Ecology of Greece and Adjacent Regions, Patras, Greece*: 51.
- Kljajic B, Števcic Z, 2000. The occurrence of *Paractaea monodi* Guinot, 1969 (Decapoda, Brachyura, Xanthidae) in the Adriatic Sea. *Crustaceana*, 73: 1301-1305.
- Kocataş A, 1981. Liste préliminaire et répartition des Crustacés Décapodes des eaux turques. *Rapport de la Commission internationale pour l'Exploration Scientifique de la Mer Méditerranée*, 27 : 161-162.
- Kocataş A, Katağan T, 1995. On Stomatopoda from Turkey with first record of *Rissoides pallidus* for the Turkish Fauna. *Crustaceana*, 68: 649-652.
- Kocataş A, Katağan T, Benli HA, 2001. Contribution to the knowledge of the Crustacean fauna of Cyprus. *Israel Journal of Zoology*, 47: 147-160.
- Kocataş A, Katağan T, Ateş AS, 2004. Atlanto-Mediterranean originated Decapod Crustaceans in the Turkish seas. *Pakistan Journal of Biological Sciences*, 7: 1827-1830.
- Koukouras A, 1979. Some interesting zoogeographical notes on some species of the benthic fauna of the north Aegean Sea. *Biologia Gallo-Hellenica*, 8: 49-53.
- Koukouras A, 2000. The pelagic shrimps (Decapoda, Natantia) of the Aegean Sea, with an account of the Mediterranean species. *Crustaceana*, 73: 801-814.
- Koukouras A, Dounas C, 2000. Decapod crustaceans new to the fauna of the Aegean Sea. *Crustaceana*, 73: 497-502.
- Koukouras A, Dounas C, Türkay M, Voultziadou-Koukoura E, 1992. Decapod crustacean fauna of the Aegean Sea: new information, check list, affinities. *Senckenbergiana Maritima*, 22: 217-244.
- Koukouras A, Dounas C, Eleftheriou A, 1993. Crustacea Decapoda from the cruises of "Calypso" 1955, 1960, in the Greek waters. *Bios (Macedonia, Greece), Scientific Annals of the School of Biology*, 1: 193-200.
- Koukouras A, Kallianiotis A, Vafidis D, 1998. The Decapod crustacean genera *Plesionika* Bate (Natantia) and *Munida* Leach (Anomura) in the Aegean Sea. *Crustaceana*, 71: 714-720.

- Koukouras A, Kitsos M-S, Tzomos Th, Tselepides A, 2010. Evolution of the entrance rate and of the spatio-temporal distribution of lessepsian crustacean Decapoda in the Mediterranean Sea. *Crustaceana*, 83: 1409-1430.
- Lelli S, Carpentieri P, Colloca F, Ardizzone GD, 2008. The spiny spider crab *Maja goltziana* (Crustacea: Majidae) in south Lebanese waters. *Marine Biodiversity Records*, 1: e83.
- Lewinsohn Ch, Holthuis LB, 1964. New records of Decapod Crustacea from the Mediterranean coast of Israel and the Eastern Mediterranean. *Zoologische Mededelingen*, 40: 45-63.
- Lewinsohn Ch, Holthuis LB, 1986. The Crustacea Decapoda of Cyprus. *Zoologische Verhandelingen Leiden*, 230: 1-64.
- Manning RB, 1977. A Monograph of the West African Stomatopod Crustacea. *Atlantide Report*, 12: 25-181.
- Manning RB, Holthuis LB, 1981. West African brachyuran crabs (Crustacea: Decapoda). *Smithsonian Contributions to Zoology*, 306: 1-379.
- Mavidis M, Türkay M, Koukouras A, 2008. The genera *Atergatis*, *Microcassiope*, *Monodaeus*, *Paractea*, *Paragalene*, and *Xantho* (Decapoda, Xanthidae) in the Mediterranean Sea. *Crustaceana*, 81: 1035-1053.
- Mavidis M, Kitsos M-S, Türkay M, Koukouras A, 2009. The taxonomical status of the genus *Pilumnus* Leach, 1815 (Pilumnidae, Decapoda, Crustacea) in the Mediterranean Sea, focusing on three species in the Aegean Sea. *Journal of Biological Research-Thessaloniki*, 11: 13-20.
- Mavruk S, Avsar D, 2008. Non-native fishes in the Mediterranean from the Red Sea, by way of the Suez Canal. *Reviews in Fish Biology and Fisheries*, 18: 251-262.
- Mura M, Cau A, 1994. Community structure of the Decapod Crustaceans in the middle bathyal zone of the Sardinian Channel. *Crustaceana*, 67: 259-266.
- Noël PY, 1992. *Clé préliminaire d'identification des Crustacea Decapoda de France et de principales autres espèces d'Europe*. Collection Patrimoines Naturels 9, Muséum National d'Histoire Naturelle, Paris.
- Noël PY, 1993. *Atlas des crustacés décapodes de France (espèces marines et d'eaux saumâtres), état d'avancement au 28-06-1993*. Muséum National d'Histoire Naturelle, Paris.
- Occhipinti-Ambrogi A, 2007. Global change and marine communities: Alien species and climate change. *Marine Pollution Bulletin*, 55: 342-352.
- Özcan T, Katağan T, 2009. Deep-water decapod crustacean fauna of the Sigacık Bay, Aegean Sea coast of Turkey. *E.U. Journal of Fisheries and Aquatic Sciences*, 26: 149-151.
- Özcan T, Katağan T, Irmak E, 2008a. First record of the *Parasquilla ferussaci* (Roux, 1830) (Stomatopoda, Parasquillidae) from the Turkish coasts. *Crustaceana*, 81: 1254-1257.
- Özcan T, Ateş AS, Katağan T, 2008b. Expanding distribution and occurrence of the Indo-Pacific Stomatopod, *Erugosquilla massavensis* (Kossmann, 1880) on the Aegean coast of Turkey. *Mediterranean Marine Science*, 9: 115-118.
- Özcan T, Katağan T, Ng PKL, 2010. First record of *Eurycarcinus integrifrons* De Man, 1879 (Decapoda, Pilumnidae) from the Mediterranean Sea. *Crustaceana*, 83: 507-510.
- Pallaoro A, 2005. The rediscovery of the crab, *Paragalene longicrura* (Nardo, 1868) (Decapoda, Brachyura, Xanthidae) in the Adriatic Sea. *Crustaceana*, 78: 749-753.
- Pallaoro A, Dulčić J, 2004. On the occurrence of the spider crab *Maja goltziana* (Crustacea: Majidae) an alien species in the Adriatic Sea. *Journal of the Marine Biological Association of the United Kingdom*, 84: 1007-1008.
- Pancucci-Papadopoulou MA, Corsini-Foka M, Raitzos DE, 2011. Alien invasions and climatic changes: the southeastern Aegean experience. *Proceedings of the 12th International Conference on Environmental Science and Technology, Rhodes, Greece*: A1376-A1383.
- Pancucci-Papadopoulou MA, Raitzos DE, Corsini-Foka M, 2012. Biological invasions and climatic warming: implications for southeastern Aegean ecosystem functioning. *Journal of the Marine Biological Association of the United Kingdom*, 92: 777-789.
- Pastore M, 1983. An oxyrhynch crab new to the Ionian Sea, *Maja goltziana* D'Oliveira, 1888 (Decapoda, Brachyura). *Crustaceana*, 45: 232-237.
- Philippart CJM, Anadón R, Danovaro R, Dippner JW, Drinkwater KF, Hawkins SJ, Oguz T, O'Sullivan G, Reid PC, 2011. Impacts of climate change on European marine ecosystems: Observations, expectations and indicators. *Journal of Experimental Marine Biology and Ecology*, 400: 52-69.
- Pipitone C, Tumbiolo ML, 1993. Decapod and stomatopod crustaceans from the trawlable bottoms of the Sicilian Channel (central Mediterranean Sea). *Crustaceana*, 65: 358-364.
- Politou CY, Kavadas S, Mytilineou Ch, Tursi A, Carlucci R, Lembo G, 2003. Fisheries resources in the deep waters of the eastern Mediterranean (Greek Ionian Sea). *Journal of Northwest Atlantic Fishery Science*, 31: 35-46.
- Por FD, 1990. Lessepsian migration. An appraisal and new data. *Bulletin de l'Institut Océanographique, Monaco*, 7: 1-10.
- Raitzos DE, Beaugrand G, Georgopoulos D, Zenetos A, Pancucci-Papadopoulou MA, Theocharis A, Papatthanassiou E, 2010. Global climate change amplifies the entry of tropical species into the Mediterranean Sea. *Limnology and Oceanography*, 55: 1478-1484.
- Ramadan ShE, Dowidar NM, 1972. Brachyura (Decapoda Crustacea) from the Mediterranean waters of Egypt. *Thalassia Jugoslavica*, 8: 127-139.
- Raso JEG, 1984. Brachyura of the coast of Southern Spain. *Spixiana*, 7: 105-113.
- Soppelsa O, Crocetta F, Pipitone C, 2005. *Maja goltziana*

- D'Oliveira, 1888 (Decapoda, Brachyura, Majidae) in the southern Tyrrhenian Sea. *Crustaceana*, 78: 121-124.
- Štević Z, 1990. Check-list of the Adriatic decapod Crustacea. *Acta Adriatica*, 31: 183-274.
- Tan SH, Ng PKL, 2007. Descriptions of new genera from the subfamily Parthenopinae (Crustacea: Decapoda: Brachyura: Parthenopidae). *The Raffles Bulletin of Zoology*, 16: 95-119.
- Tavares M, De Melo GAS, 2010. First species of *Paragalene* Kossmann, 1878 (Decapoda, Brachyura, Progeyonidae) from the Western Atlantic. In: Castro P, Davie PJF, Ng PKL, eds. *Studies on Brachyura: a homage to Danièle Guinot (Crustaceana Monographs 11)*. Brill, Leiden: 335-343.
- Theocharis A, Lascaratos A, 2000. Possible causes, origin, evolution and some consequences of the Eastern Mediterranean Transient during the period 1987-1999. In: Briand F, ed. *The eastern Mediterranean climatic transient, its origin, evolution and impact on the eco-system. CIESM Workshop Series 10*. CIESM, Monaco: 41-44.
- Türkyay M, 1976. Ein Fund von *Paragalene longicrura* in der Ägäis (Decapoda Brachyura). *Crustaceana*, 30: 108.
- Türkyay M, Fischer G, Neumann V, 1987. List of the marine Crustacea Decapoda of the Northern Sporades (Aegean Sea) with systematic and zoogeographic remarks. *Investigación Pesquera*, 51: 87-109.
- Tzomos T, 2007. Investigation of the progress of the Lessepsian immigratory current, in respect of Mollusca and Pisces. M.Sc. Thesis, Aristotle University of Thessaloniki.
- Tzomos T, Kirmitzoglou I, Chartosia N, Mavidis M, Kitsos MS, Ateş AS, Özcan T, Sezgin M, Katağan T, 2007. Decapoda crustacea fauna gradient from Cyprus and the south Turkish coast to the Black Sea. *Rapport de la Commission Internationale pour l'Exploration Scientifique de la Mer Méditerranée*, 38: 625-625.
- Tzomos T, Kitsos MS, Koutsoubas D, Koukouras A, 2012. Evolution of the entrance rate and of the spatio-temporal distribution of Lessepsian Mollusca in the Mediterranean Sea. *Journal of Biological Research-Thessaloniki*, 17: 81-96.
- Udekem d'Acoz C d', 1994. Contribution à la connaissance des crustacés décapodes Helléniques I: Brachyura. *Bios (Macedonia, Greece), Scientific Annals of the School of Biology*, 1: 9-47.
- Udekem d'Acoz C d', 1995. Contribution à la connaissance des crustacés décapodes Helléniques II: Penaeidea, Stenopodidea, Palinuridea, Homaridea, Thalassinidea, Anomura, et note sur le Stomatopodes. *Bios (Macedonia, Greece), Scientific Annals of the School of Biology*, 3: 51-77.
- Udekem d'Acoz C d', 1999. *Inventaire et distribution des crustacés décapodes de l'Atlantique nord-oriental, de la Méditerranée et des eaux continentales adjacentes au nord de 25°N. Collection Patrimoines Naturels, 40*. Muséum National d'Histoire Naturelle, Paris.
- Vignoli V, Caruso T, Falciai L, 2004. Decapoda Brachyura from Monte Argentario (Mediterranean Sea, central Tyrrhenian). *Crustaceana*, 77: 177-186.
- Zariquiey Alvarez R, 1968. Crustáceos Decápodos Ibéricos. *Investigación Pesquera*, 32: 1-510.
- Zenetos A, Pancucci-Papadopoulou MA, Zogaris S, Papastergiadou E, Vardakas AL, Aligizaki K, Economou AN, 2009. Aquatic alien species in Greece (2009): tracking sources, patterns and effects on the ecosystem. *Journal of Biological Research-Thessaloniki*, 12: 135-172.
- Zenetos A, Gofas S, Verlaque M, Cinar ME, García Raso JE, Bianchi CN, Morri C, Azzurro E, Bilecenoglu M, Froglija C, 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: 381-493.
- 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: 95-120.