

THE PELAGIC SHRIMPS (DECAPODA, NATANTIA) OF THE AEGEAN SEA, WITH AN ACCOUNT OF THE MEDITERRANEAN SPECIES

BY

A. KOUKOURAS

Department of Zoology, Aristoteleio University of Thessaloniki, GR-540 06 Thessaloniki, Greece

ABSTRACT

Recent sampling carried out in the Aegean with the use of a mid-water trawl, yielded 12 species of pelagic shrimps, 6 of which (*Acantheephyra eximia*, *A. pelagica*, *Pasiphaea multidentata*, *Sergestes arcticus*, *S. atlanticus*, and *S. sargassi*) are reported for the first time from the Aegean. For all the above species as well as for 6 other so far known from the Mediterranean, information is given on their distribution in certain geographical areas of the Mediterranean and the adjacent oceans.

RÉSUMÉ

Des échantillonnages récents effectués en mer Egée, à l'aide d'une chalut de demiprofondeur, ont fourni 12 espèces de crevettes pélagiques, dont six (*Acantheephyra eximia*, *A. pelagica*, *Pasiphaea multidentata*, *Sergestes arcticus*, *S. atlanticus*, et *S. sargassi*) sont signalées pour la première fois en mer Egée. Pour toutes les espèces ci-dessus comme pour six autres connues jusqu'à présent de Méditerranée, des informations sont données sur leur répartition dans les différentes aires géographiques de cette mer et des océans voisins.

INTRODUCTION

A review of the relevant literature shows that the Mediterranean pelagic shrimps are poorly known, especially the genera *Sergestes* and *Sergia*. Most records of these species from the various Mediterranean areas are based on a small number of adult individuals or larval stages, the identification of which was problematic because of the confused descriptions of these species. As a result, these records are in part doubtful. Most problems were elucidated after the review by Crosnier & Forest (1973) and later after those by Vereshchaka (1994) and Pérez Farfante & Kensley (1997). However, the absence of Mediterranean material in these papers leaves certain records from the Mediterranean still uncertain.

Koukouras et al. (1992), listing the decapod fauna of the Aegean Sea, pointed out the lack of information concerning the pelagic shrimps. The limited information existing on the pelagic shrimps of the Aegean (including the Sea of Marmara)

is included in older papers, i.e., those of Guérin (1832), König (1895), Ostroumoff (1896), Adensamer (1898), and Stephensen (1923), and in the more recent ones by Drensky (1951), Bacescu & Mayer (1961), Vamvakas (1970), Koukouras & Kattoulas (1974), Kaspiris (1990), and Koukouras et al. (1992), which report the presence of a total of 7 species from this area. The record of *Acantheephyra purpurea* A. Milne-Edwards, 1881 (possibly *A. pelagica* (Risso, 1816)) by Katagan et al. (1988) from the SW coast of Turkey should be considered an erroneous identification.

MATERIAL AND METHODS

In the framework of a broader study of the pelagic fauna in the northern Aegean Sea, one fishing cruise was performed in summer 1993, from 17 to 28 July. A grid of 9 stations (fig. 1) was designed, all over the study area. At each station, samples were taken at depths of 250, 500, 750, and 1000 m, during daytime. A METHOD mid-water trawl with a mouth aperture of 2.2 m, fitted with a net of 3.0 mm mesh at the cod end, was used for sampling. Next to the decapod samples from the above tows, some additional specimens of pelagic shrimps, which were collected from six other areas of the Aegean Sea (off the SW coast of Chios Island, station 10; off the SE coast of Athos Peninsula, sta. 11; north Evoikos Gulf, sta. 12; off the north coast of Crete, sta. 13; off Crete, 35° 54' 96" N 25° 10' 04" E, sta. 14; and off the SW coast of Simi Island, sta. 15) were also examined.

RESULTS

Examination of the material collected gave new information concerning various pelagic shrimps of the Aegean Sea. The abbreviation Cl = carapace length: measured from the posterior margin of the orbit to the terminal border of the carapace.

OPLOPHORIDAE

Acantheephyra eximia Smith, 1884

Acantheephyra eximia. — Crosnier & Forest, 1973: 34, fig. 7c-d.

Material examined. — 5 juv., sta. 4, depth 250 m, water column; 2 juv., sta. 7, depth 500 m, water column; 24 ♂♂, 13 ♀♀, sta. 14, depth 1830 m, silty substratum, 18.i.1998, baited traps. Max. Cl ♂ = 32.0 mm; max. Cl ♀ = 32.0 mm.

This nektobenthic (Chace, 1940; Cartes, 1993) species has been reported in this area only off the western (35° 36' N 23° 18' E) and southern coast (34° 45' N 24° 23' E;

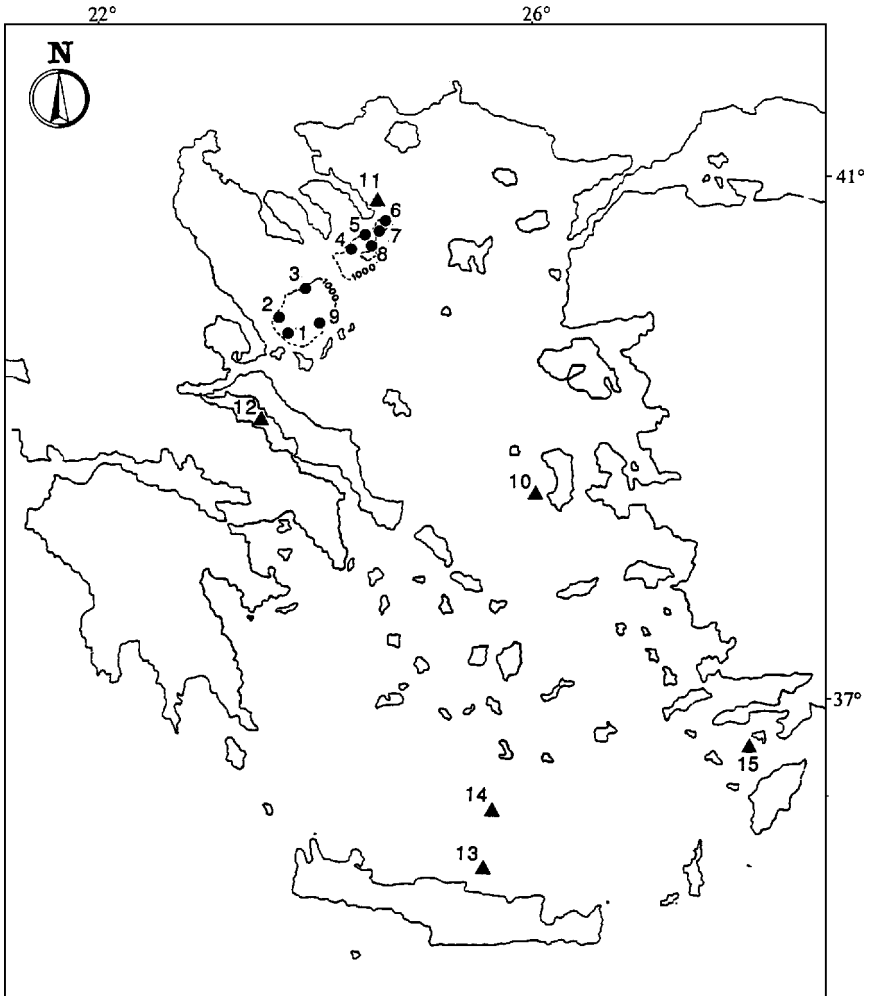


Fig. 1. Map of the Aegean Sea, indicating the sampling stations.

$33^{\circ}4'N$ $24^{\circ}17'E$) of Crete (Adensamer, 1898, as *A. pulchra* A. Milne-Edwards, 1890). Thus, its presence in the Aegean is here reported for the first time.

This cosmopolitan species (Crosnier & Forest, 1973) has been known in the Mediterranean (table I) from the western basin (e.g., Zariquiey Alvarez, 1968), the central Mediterranean (e.g., Adensamer, 1898), and the Levantine Basin (e.g., Galil & Goren, 1994).

***Acanthephyra pelagica* (Risso, 1816)**

Acanthephyra pelagica. — Sivertsen & Holthuis, 1956: 7, figs. 3-7.

Material examined. — 21 juv., 10 ♂♂, 4 ♀♀, sta. 1, depths 750 and 1000 m, water column; 42 juv., 9 ♂♂, 3 ♀♀, sta. 2, depths 750 and 1000 m, water column; 54 juv., 2 ♂♂, sta. 3, depth 750 m, water column; 10 juv., 6 ♂♂, 2 ♀♀, sta. 4, depth 750 m, water column; 11 juv., 6 ♂♂, 1 ovig ♀, sta. 5, depth 500 m, water column; 32 juv., 1 ♂, sta. 6, depth 750 m, water column; 33 juv., 4 ♂♂, 2 ♀♀, sta. 7, depth 750 m, water column; 18 juv., 3 ♂♂, sta. 8, depths 750 and 1000 m, water column; 12 juv., 3 ♂♂, 3 ♀♀, sta. 9, depths 750 and 1000 m, water column; 1 ♂, sta. 13, in the stomach of the fish *Nettastoma melanurum* Rafinesque, 1810, fished at a depth of 850 m, 15.v.1994. Max. Cl ♂ = 22.0 mm; max. Cl ♀ (ovig.) = 19.5 mm.

This bathypelagic shrimp was known in this area only from off the SE coast of Rodos Island (Stephensen, 1923; as *A. multispina* Coutière, 1905) and SE of Crete (Christiansen, 1989). Consequently, it is now reported for the first time from the Aegean.

An ampho-Atlantic species (Crosnier & Forest, 1973), known in the Mediterranean (table I) from the western basin (e.g., Sardá & Palomera, 1981), the central Mediterranean (Stephensen, 1923, as *A. multispina*), the Adriatic (Frogliia & Gianini, 1984), and the Levantine Basin (Stephensen, 1923; Christiansen, 1989; Galil & Goren, 1994).

PASIPHAEIDAE

***Pasiphaea multidentata* Esmark, 1866**

Pasiphaea multidentata. — Zariquiey Alvarez, 1957: 16, figs. 5-6, pls. 4-9.

Material examined. — 4 juv., sta. 1, depth 750 m, water column; 9 juv., 2 ♂♂, sta. 2, depths 500, 750 and 1000 m, water column; 6 juv., sta. 4, depths 500 and 750 m, water column; 2 juv., sta. 5, depths 500 and 1000 m, water column; 2 juv., sta. 6, depth 750 m, water column; 2 juv., sta. 7, depth 750 m, water column; 2 juv., sta. 9, depths 750 and 1000 m, water column. Max. Cl ♂ = 30.6 mm.

Remark. — Figueira (1957) first observed that the numbers of spines on the ventral margin of the merus of the first and second pereopods and on the ventral margin of the basis of the second pereopod increase with age. In the specimens examined, the number of spines on the ventral margins of the basis and merus of the second pereopods increased with carapace length as follows: Cl = 6.0 mm, 1+0; Cl = 8.5 mm, 3+1; Cl = 10.5 mm, 5+2; Cl = 14.5 mm, 8+2; Cl = 30.6 mm, 17+2. In Iwasaki's (1990) collection, the largest specimen (Cl = 35.2 mm) had 12-13 spines on the basis of the second pair of pereopods and 25-28 on the merus of the second pair. Consequently, it is obvious that the number of spines increases with age but that in large individuals these numbers may vary substantially.

The bathypelagic *P. multidentata* has been reported in this area only off the SE coast of Rodos (Stephensen, 1923). Its presence in the Aegean is now reported for the first time.

An ampho-Atlantic species (Sivertsen & Holthuis, 1956; Burukovskii, 1976) known in the Mediterranean (table I) from several areas of the western basin (e.g., Stephensen, 1923; Zariquiey Alvarez, 1968), the central Mediterranean (e.g., Arena & Li Greci, 1973; Pipitone & Tubiolo, 1993), the Adriatic (e.g., Pesta, 1918; Frogliia & Giannini, 1984), and the Levantine Basin (Stephensen, 1923; Galil & Goren, 1994).

***Pasiphaea sivado* (Risso, 1816)**

Pasiphaea sivado. — Zariquiey Alvarez, 1968: 70, figs. 6a, 30.

Material examined. — 3 ♂♂, 1 ovig. ♀ (Cl = 20.1 mm, bearing 63 eggs, diameter = 1.2 mm), sta. 1, depth 500 m, water column; 1 juv., sta. 7, depth 500 m, water column; 1 ♂, sta. 10, depth 500 m, water column, 16.v.1997; 1 ♂, sta. 11, depth 400 m, water column, 14.vi.1995; 11 ♂♂, 9 ♀♀ (2 ovig.: Cl = 17.2 mm, with 55 eyed eggs, diameter = 1.5 mm; and Cl = 21.2 mm, with 88 eyed eggs, diameter = 1.8 mm), sta. 12, depth 100-400 m, water column, 10.xii.1993. Max. Cl ♂ = 25.2 mm; max. Cl ♀ = 21.2 mm.

Remark. — There are ovigerous females of the species throughout the year (Zariquiey Alvarez, 1968; Frogliia & Giannini, 1984; Pipitone & Tubiolo, 1993).

This pelagic species was known in the Aegean from: Sapienza (Kithyra) Island, the coast of Peloponnisos, Naxos Island (Guérin, 1832); Korinthiakos Gulf, the Sporades Islands, the Sea of Marmara (Stephensen, 1923); Thasos Island (Drensky, 1951); Evoikos Gulf (Koukouras & Kattoulas, 1974); Saronikos Gulf (Vamvakas, 1970); Korinthiakos Gulf (Kaspiris, 1990).

An Atlanto-Mediterranean species (Kensley, 1981; Iwasaki, 1990) known in the Mediterranean (table I) from several areas of the western basin (e.g., Heller, 1863; Zariquiey Alvarez, 1957; Relini Orsi, 1974), the central Mediterranean (Arena & Li Greci, 1973; Pipitone & Tubiolo, 1993), the Adriatic (e.g., Pesta, 1918; Frogliia, 1972; Bombace & Frogliia, 1973), and the Levantine Basin (Galil & Goren, 1994).

BENTHESICYMIDAE

***Gennadas elegans* (Smith, 1882)**

Amalopenaeus elegans Smith, 1882: 87, pl. 14 figs. 8-14, pl. 15 figs. 1-5.

Gennadas elegans. — Bouvier, 1908: 35, pl. 7 figs. 1-24.

Material examined. — 681 juv., 140 ♂♂, 85 ♀♀, stas. 1-9, depths 250, 500, 750 and 1000 m, water column; 6 ♂♂, 4 ♀♀, sta. 11, depth 500 m, water column, 14.vi.1995. Max. Cl ♂ = 9.5 mm; max. Cl ♀ = 10.5 mm.

This bathypelagic species, was known in the Aegean only from the Sea of Marmara, 4° 48' N 27° 59' E; the Gulf of Korinthos, 38° 10' N 22° 33' E; and the Sporades Islands, 37° 52' N 26° 22' E (Stephensen, 1923).

An amphi-Atlantic species (Pérez Farfante & Kensley, 1997) known all over the Mediterranean (table I) (e.g., Pesta, 1918; Stephensen, 1923; Forest, 1965; Zariquiey Alvarez, 1968).

SERGESTIDAE

***Sergestes arachnipodus* (Cocco, 1832)**

Sergestes corniculum. — Köning, 1895: 13, pl. 2 fig. 12, pl. 3 fig. 15, pl. 5 fig. 24.

Sergestes rubroguttatus. — Pesta, 1918: 54, fig. 15.

Sergestes (Sergestes) henseni. — Crosnier & Forest, 1973: 310, figs. 105a-c, 106a, b, e.

Material examined. — 1 ♀, sta. 10, depth 300 m, water column, 16.v.1997; 1 ♀, sta. 11, depth 500 m, water column, 14.vi.1995. Max. Cl ♂ = 8.2 and ♀ = 13.5 mm.

This pelagic species was known in the Aegean only from the southern part, by the presence of a juvenile individual (Bacescu & Mayer, 1961; as *S. corniculum* Krøyer, 1855), and the Sea of Marmara (Ostroumoff, 1896, as *Sergestes arachnipodus* De Natale, 1850).

An amphi-Atlantic species (D'Udekem d'Acoz, 1999) known from certain areas all over the Mediterranean (table I) under the names *S. arachnipodus* (Cocco, 1832), *S. corniculum* Krøyer, 1855, *S. rubroguttatus* Wood Mason, 1891, and *S. henseni* (Ortmann, 1893) (e.g., Senna, 1902; Lo Bianco, 1903; Pesta, 1918; Hansen, 1922; Sardá & Palomera, 1981; Vaso & Gjiknuri, 1993; Galil & Goren, 1994).

***Sergestes arcticus* Krøyer, 1855**

Sergestes arcticus. — Krøyer, 1859: 240, 276, 285, pl. 3 fig. 7a-g, pl. 5 fig. 16. — Hansen, 1922: 62, pl. 1 figs. 1-2, pl. 3 figs. 3-5, pl. 4 fig. 1.

Material examined. — 163 juv., 460 ♂♂, 303 ♀♀, stas. 1-9, depths 250, 500, 750 and 1000 m, water column; 3 ♀♀, sta. 13, depth 500 m, water column, 15.v.1994. Max. Cl ♂ = 14.0 mm; max. ♀ Cl ♀ = 14.5 mm (♀, sta. 1, depth 750 m).

Remark. — 1% of the individuals collected did not bear any supra-orbital spine and 0.5% had such a spine on one side only.

This is a bathypelagic species reported from the Aegean for the first time here.

A cosmopolitan species (Pérez Farfante & Kensley, 1997) known in the Mediterranean (table I) from several areas of the western basin (e.g., García Raso, 1982), the central Mediterranean (e.g., Arena & Li Greci, 1973) and the Adriatic (e.g., Pesta, 1918; Froglija & Giannini, 1984).

TABLE I
Species of pelagic shrimps found in the Aegean Sea (present study) and in the Mediterranean (according to the literature)

Species	Aegean Sea (present study)		Mediterranean Sea (literature)		General distribution	
	Stations	Depth range (m)	Areas	Depth range (m)	Oceans	Depth range (m)
Ophiophoridae						
* <i>Acanthephyra eximia</i> Smith, 1884	4,7,14	250-1830	WM, CM, LB	400-2200	A, IP	200-3700
* <i>Acanthephyra pelagica</i> (Risso, 1816)	1-9,13	500-1000	WM, CM, AD, LB	150-2000	A	350-4700
Pasiphaeidae						
* <i>Pasiphaea multidentata</i> Esmark, 1866	1,2,4-7,9	500-1000	WM, CM, AD, LB	300-1500	A	10-2000
* <i>Pasiphaea sivado</i> (Risso, 1816)	1,7,10-12	100-500	WM, CM, AD, LB, AS	50-1527	A	0-2000
Benthescymidae						
<i>Gennadas elegans</i> (Smith, 1882)	1-9,11	250-1000	WM, CM, AD, LB, AS	250-2200	A	150-3000
<i>Gennadas valens</i> (Smith, 1884)			WM	900?	A	50-2000
Penaeidae						
<i>Funchalia villosa</i> (Bouvier, 1905)			WM	?	A, IP	50-2600
<i>Funchalia woodwardii</i> Johnson, 1867			WM, CM	300-3000	A, IP	27-3000
Sergestidae						
<i>Sergestes arachnipodus</i> (Cocco, 1832)	10,11	300-500	WM, CM, AD, LB, AS	0-2500	A	0-3500
* <i>Sergestes arcticus</i> Krøyer, 1855	1-9,13	250-1000	WM, CM, AD	80-2100	A, IP	80-2100
* <i>Sergestes atlanticus</i> H. Milne Edwards, 1830	5	500	WM	900	A, IP	0-3000
* <i>Sergestes sargassi</i> Ortmann, 1893	7,10	300-500	WM, AD, LB	200-1470	A, IP	100-2050
<i>Sergestes vigilax</i> Stimpson, 1860	10,11,13	400-500	WM, CM, AD, LB, AS	0-900	A, IP	0-1000
<i>Sergia japonica</i> (Bate, 1881)			WM	900?	A, IP	500-5590
<i>Sergia robusta</i> (Smith, 1882)	1-9	500-1000	WM, CM, AD, LB, AS	250-2200	A	100-4700
<i>Sergia splendens</i> (Sund, 1920)			WM	?	A	0-1000
<i>Sergia tenuiremis</i> (Krøyer, 1855)	15	600		?	A, IP	100-4000
Luciferidae						
<i>Lucifer typus</i> H. Milne Edwards, 1837			WM, CM, AD, LB, AS	0-100	A, IP	0-100
Total number of species:	12		17 11 10 10 7			
	13					18

WM, Western Mediterranean; CM, Central Mediterranean; AD, Adriatic Sea; LB, Levantine Basin; AS, Aegean Sea (including the Sea of Marmara and Korinthiakos Gulf); A, Atlantic Ocean; IP, Indo-Pacific Ocean; *, first record from the Aegean Sea. For further explanations, see text.

Sergestes atlanticus H. Milne Edwards, 1830

Sergestes atlanticus. — Bate, 1888: 389, pls. 68-69. — Pérez Farfante & Kensley, 1997: 196, figs. 137-139.

Material examined. — 1 ♀, sta. 5, depth 500 m, water column. Cl = 9 mm.

A bathypelagic species reported here for the first time from the Aegean.

A cosmopolitan species (Pérez Farfante & Kensley, 1997), so far known in the Mediterranean (table I) only from the western basin, near Gibraltar (Sund, 1920). Seridji (1971) recorded the occurrence of larvae in the Bay of Algiers, at depths between 40 and 80 m during January, March, and October till December, and Carli & Pessani (1973) found larvae near the water surface in the western coast of Sicily. Thus, the discovery of this species in the Aegean Sea, constitutes the second record of an adult, for the Mediterranean. This species should be considered very rare in the Mediterranean, given that Foxtton (1970) in his extensive samplings in the NE Atlantic only found one individual. It seems to be much more abundant in the Gulf of Mexico (Flock & Hopkins, 1992).

Sergestes sargassi Ortmann, 1893

Sergestes (Sergestes) sargassi. — Kensley, 1971: 241, fig. 14.

Material examined. — 1 ♀, sta. 7, depth 500 m, water column; 2 ♀♀, 1 ♂, sta. 10, depth 300 m, water column, 16.v.1997. Max. Cl ♂ = 8.1 mm; max. Cl ♀ = 10.0 mm.

This bathypelagic species is reported for the first time from the Aegean Sea.

A cosmopolitan species (Pérez Farfante & Kensley, 1997) known in the Mediterranean (table I) from the western basin (e.g., Hansen, 1922; Cartes et al., 1993), the Adriatic (Froglia & Giannini, 1984), and the Levantine Basin (Galil & Goren, 1994).

Sergestes vigilax Stimpson, 1860

Sergestes vigilax. — Hansen, 1922: 159, pl. 1 fig. 8, pl. 9 fig. 4a-m, pl. 10 fig. 1a-c.

Material examined. — 1 ♂, sta. 10, depth 400 m, water column, 16.v.1997; 4 ♀♀, sta. 11, depth 500 m, water column, 14.vi.1995; 2 ♀♀, sta. 13, depth 400 m, water column, 15.v.1994. Max. Cl ♂ = 8.2 mm; max. Cl ♀ = 11.6 mm.

This bathypelagic species has been reported from the southern Aegean Sea (König, 1895, as *Sergia clausi* König, 1895, and as *Sergestes oculatus* Krøyer, 1855).

A cosmopolitan species (Pérez Farfante & Kensley, 1997) known in the Mediterranean (table I) from certain areas of the western basin (e.g., Hansen, 1922;

Zariquiey Alvarez, 1946), the Adriatic (Pesta, 1918; Froglija & Giannini, 1984), and certain areas of the central Mediterranean and the Levantine Basin (König, 1895, as *Sergia clausi* König, 1895, and as *Sergestes oculatus* Krøyer, 1859).

***Sergia robusta* (Smith, 1882)**

Sergestes robustus Smith, 1882: 97, pl. 16 figs. 5-8b.

Sergia robusta. — Pérez Farfante & Kensley, 1997: 200, figs. 140-141.

Material examined. — 234 juv., 40 ♂♂, 9 ♀♀, stas. 1-9, depths 500, 700, and 1000 m, water column. Max. Cl ♂ = 19.5 mm; max. Cl ♀ = 20.5 mm (2 females at depths of 500 and 1000 m).

A bathypelagic species known in the Aegean only from its southern part (Bacescu & Mayer, 1961; Kaspiris, 1990).

An amphi-Atlantic species (Vereshchaka, 1994) known in the Mediterranean (table I) from several areas of the western basin (e.g., Lo Bianco, 1903; García Raso, 1982), the central Mediterranean (Arena & Li Greci, 1973), the Adriatic (e.g., Pesta, 1918; Pipitone & Tumbiolo, 1992), and the Levantine Basin (e.g., Adensamer, 1898; Galil & Goren, 1994).

***Sergia tenuiremis* (Krøyer, 1855)**

Sergestes tenuiremis. — Illig, 1927: 283, figs. 6-10.

Sergestes krøyeri. — Illig, 1927: 289, figs. 18-25.

Material examined. — 1 ♀, sta. 15, depth 600 m, water column, 6.x.1997. Cl = 9.2 mm.

The only previous records of the species in the Mediterranean is that by Ostroumoff (1896) from the eastern basin of the Sea of Marmara (table I), (which was indirectly questioned by Holthuis & Gottlieb (1958) reporting that Hansen (1922) does not mention this species from the Mediterranean) and that by Müller (1986), also from the Sea of Marmara.

This cosmopolitan, rare and deep-living species occurs throughout tropical and temperate zones of all oceans (Vereshchaka, 1994).

OTHER PELAGIC SHRIMPS FROM THE AEGEAN AND THE MEDITERRANEAN SEA

BENTHESICYMIDAE

Gennadas valens (Smith, 1884) (table I). This amphi-Atlantic species (Pérez Farfante & Kensley, 1997) is known in the Mediterranean only from the Alboran Sea, near Gibraltar (Sund, 1920).

PENAEIDAE

Funchalia villosa (Bouvier, 1905) (table I). A bathypelagic, cosmopolitan species (Pérez Farfante & Kensley, 1997) known in the Mediterranean only from certain areas of the western basin (Grippa, 1987).

Funchalia woodwardi Johnson, 1867 (table I). A bathypelagic cosmopolitan species (Pérez Farfante & Kensley, 1997), known in the Mediterranean only from the central part, near Messina (Grippa, 1976), and certain areas of the western basin (Stephensen, 1923; Zariquiey Alvarez, 1968; Relini-Orsi & Costa, 1975; Grippa, 1987).

SERGESTIDAE

Sergia japonica (Bate, 1881) (table I). Bathypelagic cosmopolitan species (Vereshchaka, 1994; Pérez Farfante & Kensley, 1997), known in the Mediterranean only from the western basin, near Gibraltar (Sund, 1920; as *Sergestes mollis* Smith, 1882).

Sergia splendens (Sund, 1920) (table I). A mesopelagic ampho-Atlantic species (Vereshchaka, 1994; Pérez Farfante & Kensley, 1997), known in the Mediterranean only from the western basin, off Monaco (Hansen, 1922, as *Sergestes crassus*: Synonymized by Hansen, 1922; Kensley, 1971).

LUCIFERIDAE

Lucifer typus H. Milne Edwards, 1837 (table I). An epipelagic cosmopolitan species (Pérez Farfante & Kensley, 1997), known all over the western Mediterranean (e.g., Hansen, 1922; García Raso, 1982), the central Mediterranean (Hansen, 1922; Bacescu & Mayer, 1961), the Adriatic (e.g., Pesta, 1918; Frogliia & Giannini, 1984), the Levantine Basin (e.g., Adensamer, 1898; Holthuis & Gottlieb, 1958), and the Aegean Sea, between Chalkidiki Peninsula and Limnos Island (Adensamer, 1898, as *Leucifer Reynaudii*).

DISCUSSION

As shown in table I, the presence of 18 pelagic species, including the nektobenthic species *Acanthephyra eximia*, has been reported from the Mediterranean.

None of these species has been recorded from the Black Sea due to the special conditions (mainly the reduced salinity) prevailing there (Caspers, 1957). Seventeen species (94.5%) are known from the western basin of the Mediterranean, which is due to the fact that the invasion of the Atlantic species is initially limited to this basin, and also due to the more intensive sampling carried out in that area.

Eleven species (61.1%) are known from the central Mediterranean, mainly due to the restricted sampling effort in this area. Ten species (55.5%) have been reported from the Adriatic, possibly because of its significantly restricted communication with the western basin (Ovchinnikov, 1966) and of its shallow waters. Only 10 species (55.5%) have been reported from the Levantine Basin, possibly because of its impoverished fauna (Por & Dimentman, 1989) and of the reduced sampling effort. Thirteen species (72.2%) have been reported from the Aegean (7 of them were previously known, while 6 are recorded for the first time in the present study), possibly due to the more direct communication with the western basin (e.g., Ovchinnikov, 1996) and to the increased sampling effort in this area.

According to the relevant literature, 10 out of the 18 Mediterranean species (55.5%), are cosmopolitan, since they are distributed both in the Atlantic and in the Indo-Pacific (table I). The remaining 8 (44.5%) have an Atlanto-Mediterranean distribution.

REFERENCES

- ADENSAMER, T., 1898. Decapoden gesammelt auf S. M. Schiff "Pola" in den Jahren 1890-1894. Berichte der Commission für Erforschung des östlichen Mittelmeeres. XXII. Zoologische Ergebnisse. XI. Denkschr. Akad. Wiss. Wien, **65**: 597-628.
- ARENA, P. & F. LI GREGI, 1973. Indagine sulle condizioni faunistiche e sui rendimenti di pesca dei fondali batiali della Sicilia occidentale e della bordura settentrionale dei banchi della soglia Siculo - Tunisina. Quad. Lab. Tecnol. Pesca, **1** (5): 157-201.
- BACESCU, M. & R. MAYER, 1961. Malacostracés (Mysidacea, Euphausiacea, Decapoda, Stomatopoda) du plancton diurne de la Méditerranée. Etude basée sur le matériel du Lamont Geological Observatory, Washington. Rapp. Comm. int. Mer Méditerranée, **16** (2): 183-202.
- BATE, C. S., 1888. Report on the Crustacea Macrura collected by H. M. S. "Challenger" during the years 1873-76. Rep. Voy. Challenger, (Zool.) **24**: i-xc, 1-942.
- BOMBACE, G. & C. FROGLIA, 1973. Premières remarques sur les peuplements de l'étage bathyal de Basse Adriatique. Rapp. Comm. int. Mer Méditerranée, **22** (4): 93-94.
- BOUVIER, E. L., 1908. Crustacés Décapodes (Pénéides) provenant des campagnes de l'Hirondelle et de la Princesse Alice (1886-1907). Résultats des Campagnes scientifiques accomplies par le Prince Albert I de Monaco, **33**: 1-112, pls. 1-16.
- BURUKOVSKII, R. N., 1976. A new species of shrimp, *Pasiphaea grandicula* sp. n. (Decapoda, Crustacea) and a short outline of the genus' species. Biol. Morya, **4**: 17-28.
- CARLI, A. & D. PESSANI, 1973. Studio delle larve di Crostacei Decapodi (Natantia e Reptantia) raccolte durante la campagna di pesca del Giugno 1968 alle Isole Egadi (Sicilia). Boll. Pesca Piscic. Idrobiol., **28** (2): 319-329.
- CARTES, J. E., 1993. Day-night feeding by decapod crustaceans in a deep-water bottom community in the western Mediterranean. Journ. mar. biol. Assoc. U.K., **73**: 795-811.
- CARTES, J. E., E. SARDÁ & P. ABELLO, 1993. Decapod crustaceans collected by deep-water trawls (between 1000 and 2200 m) in the Catalan Area (North-Western Mediterranean). Bios, **1** (1): 206-221.
- CASPERS, H., 1957. Black Sea and Sea of Azov. Geol. Soc. America Mem., **67** (1): 801-890.
- CHACE, F. A., 1940. The bathypelagic caridean Crustacea. Plankton of the Bermuda Oceanographic Expedition. IX. Zoologica, New York, **25** (11): 117-209.

- CHRISTIANSEN, B., 1989. *Acanthephyra* sp. (Crustacea: Decapoda) in the eastern Mediterranean Sea captured by baited traps. *Senckenbergiana marit.*, **20** (5/6): 187-193.
- CROSNIER, A. & J. FOREST, 1973. Les crevettes profondes de l'Atlantique oriental tropical. *Faune tropicale*, **19**: 1-409. (O.R.S.T.O.M., Paris).
- DRENSKY, P., 1951. Über Entomostraca und Malacostraca (Cr.) aus dem Agäischen Meer. *Ann. Univ. Sofia, (Biol.)* **46** (3): 235-250.
- FIGUEIRA, A. J. G., 1957. Madeiran decapod crustaceans in the collection of the Museum Municipal do Funchal. I. On some interesting deep-sea prawns of the families Pasiphaeidae, Oplophoridae and Pandalidae. *Bol. Mus. municipal Funchal*, **10** (26): 22-51.
- FLOCK, M. E. & T. L. HOPKINS, 1992. Species composition, vertical distribution, and food habits of the sergestid shrimp assemblage in the eastern Gulf of Mexico. *Journ. Crust. Biol.*, **12** (2): 210-223.
- FOREST, J., 1965. Campagnes du "Professeur Lacaze-Duthiers" aux Baléares: Juin 1953 et Août 1954. *Crustacés Décapodes. Vie Milieu*, **16** (1-B): 325-413.
- FOXTON, P., 1970. The vertical distribution of pelagic decapods (Crustacea Natantia) collected on the Sond cruise 1965. II. The Penaeidea and general discussion. *Journ. mar. biol. Assoc. U.K.*, **50**: 961-1000.
- FROGLIA, C., 1972. Preliminary report on the Crustacea Decapoda of Adriatic deep waters. *Thalassia Jugoslavica*, **8** (1): 75-79.
- FROGLIA, C. & S. GIANNINI, 1984. Pelagic shrimps of the Adriatic Sea. *Atti Soc. Italiana Sci. nat. Museo civ. Stor. nat. Milano*, **125** (1-2): 49-60.
- GALIL, B. S. & M. GOREN, 1994. The deep sea Levantine fauna. New records and rare occurrences. *Senckenbergiana marit.*, **25** (1/3): 41-52.
- GARCÍA RASO, J. E., 1982. Penaeidea y Caridea de las costas de Malaga (Region Sur-Mediterranea Españaola). *Graellsia*, **38**: 85-115.
- GRIPPA, G., 1976. *Funchalia woodwardi* Johnson, 1867 nelle acque di Sicilia, con osservazioni sul genere. *Atti Soc. Italiana Sci. nat. Museo civ. Stor. nat. Milano*, **117** (3-4): 117-136, pl. 6.
- —, 1987. A revision of gen. *Pelagopenaeus* Burkenroad, 1934 and *Funchalia* Johnson, 1867 (Crustacea, Decapoda, Penaeidea). *Inv. Pesq., Barcelona*, **51** (Suppl. 1): 73-85.
- GUÉRIN-MÉNEVILLE, F. E., 1832. Ire Classe. Crustacés. In: A. BRULLÉ, *Des animaux articulés. Expédition scientifique de Morée. Section des sciences physiques*, **3** (1), (Zool.) (2): 30-50.
- HANSEN, H. J., 1922. Crustacés décapodes (Sergestides) provenant des campagnes des yachts "Hirondelle" et "Princesse Alice" (1885-1915). *Rés. Camp. scient. Monaco*, **64**: 1-232, pls. 1-11.
- HELLER, C., 1863. Die Crustaceen des südlichen Europa. *Crustacea Podophthalmia. Mit einer Übersicht über die horizontale Verbreitung sämtlicher europäischer Arten*: i-xi, 1-336, pls. 1-10.
- HOLTHUIS, L. B. & E. GOTTLIEB, 1958. An annotated list of the decapod Crustacea of the Mediterranean coast of Israel with an appendix listing the Decapoda of the eastern Mediterranean. *Bull. Res. Counc. Israel*, **7B**: 1-126.
- ILLIG, G., 1927. Die Sergestiden der Deutschen Tiefsee-Expedition. *Wiss. Ergebn. Valdivia Exped.*, **23**: 279-354, figs. 1-131.
- IWASAKI, N., 1990. Pasiphaeid shrimps from the eastern North Atlantic and the Carribean sea, with the description of a new species of *Pasiphaea* (Crustacea: Decapoda: Pasiphaeidae). *Zool. Meded., Leiden*, **63** (15): 187-203.
- KASPIRIS, P., 1990. Deep-water Crustacea (Decapoda, Natantia) from the Korinthiakos Gulf, Greece. *Ann. Musei Goulandris*, **8**: 263-267.
- KATAGAN, T., A. KOÇATAS & H. BENLI, 1988. Note préliminaire sur les Décapodes bathyaux de la c te Turque de la mer Egée. *Rapp. Comm. int. Mer Méditerranée*, **31** (2): 23.
- KENSLEY, B., 1971. The family Sergestidae in the waters around southern Africa (Crustacea, Decapoda, Natantia). *Ann. South African Mus.*, **57** (10): 215-264.

- —, 1981. On the zoogeography of southern African decapod Crustacea, with a distributional checklist of the species. *Smithsonian Contr. Zool.*, **338**: 1-64.
- KÖNIG, A., 1895. Die Sergestiden des östlichen Mittelmeeres, gesammelt 1890-93. *Berichte der Commission für Erforschung des östlichen Mittelmeeres*, 13. Denkschr. Akad. Wiss. Wien, (math.-naturw. Kl.) **62**: 1-18.
- KOUKOURAS, A., K. DOUNAS, M. TÜRKAY & E. VOULTSIADOU-KOUKOURA, 1992. Decapod crustacean fauna of the Aegean Sea. New information, check list, affinities. *Senckenbergiana marit.*, **22** (3/6): 217-244.
- KOUKOURAS, A. & M. KATTOULAS, 1974. Benthic fauna of the Evvoia coast and Evvoia Gulf. III. Natantia (Crustacea: Decapoda). *Sci. Ann. Fac. Phys. Mathem. Univ. Thessaloniki*, **14**: 369-382.
- KRØYER, H., 1859. Forsøg til en monographisk Fremstilling af Kraebdyrslægten *Sergestes*. Med Bemaerkninger om Dekapodernes Höreredskaaber. *K. Danske Vidensk. Selsk. Skr.*, (5) **4**: 217-303, pls. 1-5.
- LO BIANCO, S., 1903. Le pesche abissali eseguite da F. A. Krupp col yacht "Puritan" nelle adiacenze di Capri ed in altre località del Mediterraneo. *Mitt. zool. Stat. Neapel.*, **16**: 109-279, pls. 7-9.
- MÜLLER, G. J., 1986. Review of the hitherto recorded species of Crustacea Decapoda from the Bosphorus, the Sea of Marmara and the Dardanelles. *Cercetari Marine, I.R.C.M. Constanta*, **19**: 109-130.
- OSTROUMOFF, A., 1896. Comptes-rendus des dragages et du plancton de l'expédition de "Selianik". *Bull. Acad. Imp. Sci. St. Petersbourg*, **5**: 33-92. [In Russian.]
- OVCHINNIKOV, I. M., 1966. Circulation in the surface and intermediate layer of the Mediterranean. *Oceanology*, **6**: 48-59.
- PÉREZ FARFANTE, I. & B. F. KENSLEY, 1997. Penaeoid and sergestoid shrimps and prawns of the world. Keys and diagnoses for the families and genera. *Mém. Mus. natn. Hist. nat., Paris*, **175**: 1-233.
- PESTA, O., 1918. Die Decapodenfauna der Adria: i-x, 1-500. (Franz Deuticke, Leipzig und Wien).
- PIPITONE, C. & M. L. TUMBILOLO, 1993. Decapod and stomatopod crustaceans from the trawlable bottoms of the Sicilian channel (central Mediterranean Sea). *Crustaceana*, **65** (3): 358-364.
- POR, F. D. & C. DIMENTMAN, 1989. The legacy of Tethys: an aquatic biogeography of the Levant. In: H. J. DUMONT & M. J. A. WERGEL (eds.), *Monographiae biologicae*, **63**: i-xi, 1-214. (Kluwer Academic Publishers, Dordrecht).
- RELINI ORSI, L., 1974. Un ambiente marino di grande interesse naturalistico: i fondi batiali al largo del Promontorio di Portofino. *Atti del IV Simp. Nazionale sulla conservazione della Natura, Bari*, **1**: 141-148.
- RELINI ORSI, L. & M. R. COSTA, 1975. Segnalazione di *Funchalia woodwardi* Johnson in Mar Ligure (Crustacea, Decapoda, Penaeidae). *Boll. Mus. Ist. Univ. Genova*, **43**: 33-39.
- SARDÀ, F. & I. PALOMERA, 1981. Crustáceos Decápodos capturados durante la campaña "Mediterraneo II" (Marzo, 1977) en el mar catalán. *Res. Exp. Cient. (Supl. Inv. Pesq., Barcelona)*, **9**: 143-150.
- SENN, A., 1902. Nota sui crostacei. Le esplorazioni abissali nel Mediterraneo del R. Piroscampo "Washington" nel 1881. II. *Bull. Soc. Ent. Italiana*, **24**: 235-367.
- SERIDJI, R., 1971. Contribution à l'étude des larves crustacés décapodes en baie d'Alger. *Pélagos*, **3** (2): 1-107.
- SIVERTSEN, E. & L. B. HOLTHUIS, 1956. Crustacea Decapoda (the Penaeidae and Stenopodidea excepted). *Rep. scient. Res. "Michael Sars" North Atlantic deep-sea Exped. 1910*, **5** (12): 1-54.
- SMITH, S. I., 1882. Report on Crustacea. Part I. Decapoda. Reports on the results of dredging under the supervision of Alexander Agassiz, on the east coast of the United States, during the summer of 1880, by the U.S. coast survey steamer "Blake", commander J. R. Bartlett, U.S.N., commanding. *Bull. Mus. comp. Zool., Harvard*, **10**: 1-108, pls. 1-16.

- STEPHENSEN, K., 1923. Decapoda — Macrura excluding Sergestidae. Rep. Danish oceanogr. Exped. Mediterranean, **2** (3): 1-85, figs. 1-27.
- SUND, O., 1920. Pénéidés et Sténopidés. Rep. scient. Res. "Michael Sars" North Atlantic deep-sea Exped. 1910, **3** (7): 1-36.
- 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. Patrimoines naturels (M.N.H.N./S.P.N.), **40**: 1-383. (Muséum National d'Histoire Naturelle, Paris).
- VAMVAKAS, C., 1970. Peuplements benthiques des substrats meubles du sud de la mer Egée. Téthys, **2** (1): 89-129.
- VASO, A. & L. GJIKNURI, 1993. Decapod crustaceans of the Albanian coast. Crustaceana, **65** (3): 390-407.
- VERESHCHAKA, A. L., 1994. North Atlantic and Caribbean species of *Sergia* (Crustacea, Decapoda, Sergestidae) and their horizontal and vertical distribution. Steenstrupia, **20** (3): 73-95.
- ZARIQUIEY ALVAREZ, R., 1946. Crustáceos Decápodos Mediterráneos. Pubbl. Biol. Mediterraneo, Barcelona, **2**: 1-183, pls. 1-26.
- —, 1957. Decápodos españoles XI. La *Acanthephyra eximia* S. I. Smith, 1884 (Crust. Dec. Nat.) en las costas mediterráneas españolas. Inv. Pesq., Barcelona, **10**: 3-15.
- —, 1968. Crustáceos Decápodos Ibéricos. Inv. Pesq., Barcelona, **32**: 1-510.

First received 16 August 1999.

Final version accepted 31 December 1999.