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The echinoderm (Deuterostomia) fauna of the Aegean Sea, and comparison with those of the neighbouring seas

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Earlier and recent sampling carried out in the Aegean Sea revealed the presence of 20 asteroid, 14 ophiuroid, 21 echinoid, and 1 holothuroid species. The ophiuroid *Monaphiura apicula*, and the echinoids *Arbaciella elegans*, *Echinus melo* and *Hemiaster expergitus* are recorded for the first time in the Eastern Mediterranean; the latter has previously been known only from the Western Mediterranean. The ophiuroid *Amphiura (Acrocnida) brachiata* is recorded for the first time in the Aegean Sea. For all species, information on their distribution and habitat is given. A checklist of the Mediterranean and Black Sea echinoderms, as well as their distribution in the Mediterranean territorial areas and the Black Sea are also presented. Furthermore, the faunas of the Mediterranean territorial areas are compared. According to the considered data, the number of species decreases as follows: Western Mediterranean, Aegean Sea, Adriatic Sea, Central Mediterranean, Levantine Sea and Black Sea. Species with an Atlanto-Mediterranean distribution dominate in all areas and are followed in numbers by the Mediterranean endemics and cosmopolitans. Four species of Indo-Pacific origin are located in the Levantine and SE Aegean seas.

Key words: Echinodermata, Mediterranean Sea, Aegean Sea.

INTRODUCTION

Specific or scattered information on the echinoderm fauna of the Aegean Sea is mainly included in: Spratt & Forbes (1842), Forbes (1844, 1845), Raulin (1870), Carus (1885), Steindachner (1891), Marenzeller (1893, 1895), Ostroumoff (1896), Marion (1898), Panagiotopoulos (1916), Athanassopoulos (1917, 1921), Issel (1928), Tortonese (1946, 1947, 1965), Belloc (1948), Pérès & Picard (1958), Laborel (1960), Tortonese & Demir (1960), Jacquotte (1962), Kisseleva (1963, 1983), Makkavieva (1963), Caspers (1968), Vamvakas (1971), Geldiay & Koçatas (1972), Chardy *et al*. (1973), Koukouras & Sinis (1981), Bianchi & Morri (1983), Ünsal (1985), Pancucci & Zenetos (1990), Fiege & Yulin (1994) and Pancucci (1994).

Pancucci-Papadopoulou (1996), mainly based on a survey of the literature, recorded the presence of 103 echinoderm species (2 crinoids, 33 holothuroids, 25 asteroids, 23 ophiuroids and 20 echinoids) in the Aegean Sea. More recent information on the Aegean echinoderm fauna has been provided only by Özaydin *et al*. (1995).

According to the information included in the above papers, the echinoderm fauna of the Aegean Sea (including the Sea of Marmara) consists of 103 species (2 crinoids, 33 holothuroids, 25 asteroids, 22 ophiuroids and 21 echinoids).

The present paper focuses on: i) the new information on the echinoderm fauna of the Aegean Sea and, ii) the comparison of the Aegean fauna with the faunas of the neighbouring seas.

MATERIALS AND METHODS

A total of 6725 echinoderm specimens, collected from 181 stations located in the Aegean Sea (Fig. 1) were examined. Information on the characteristics of the sampling stations is given in the presentation of the species found. The samples were obtained using fishing nets, various types of dredges and grabs and by free or SCUBA diving at depths up to 1250 m. The specimens have been deposited at the Museum of the

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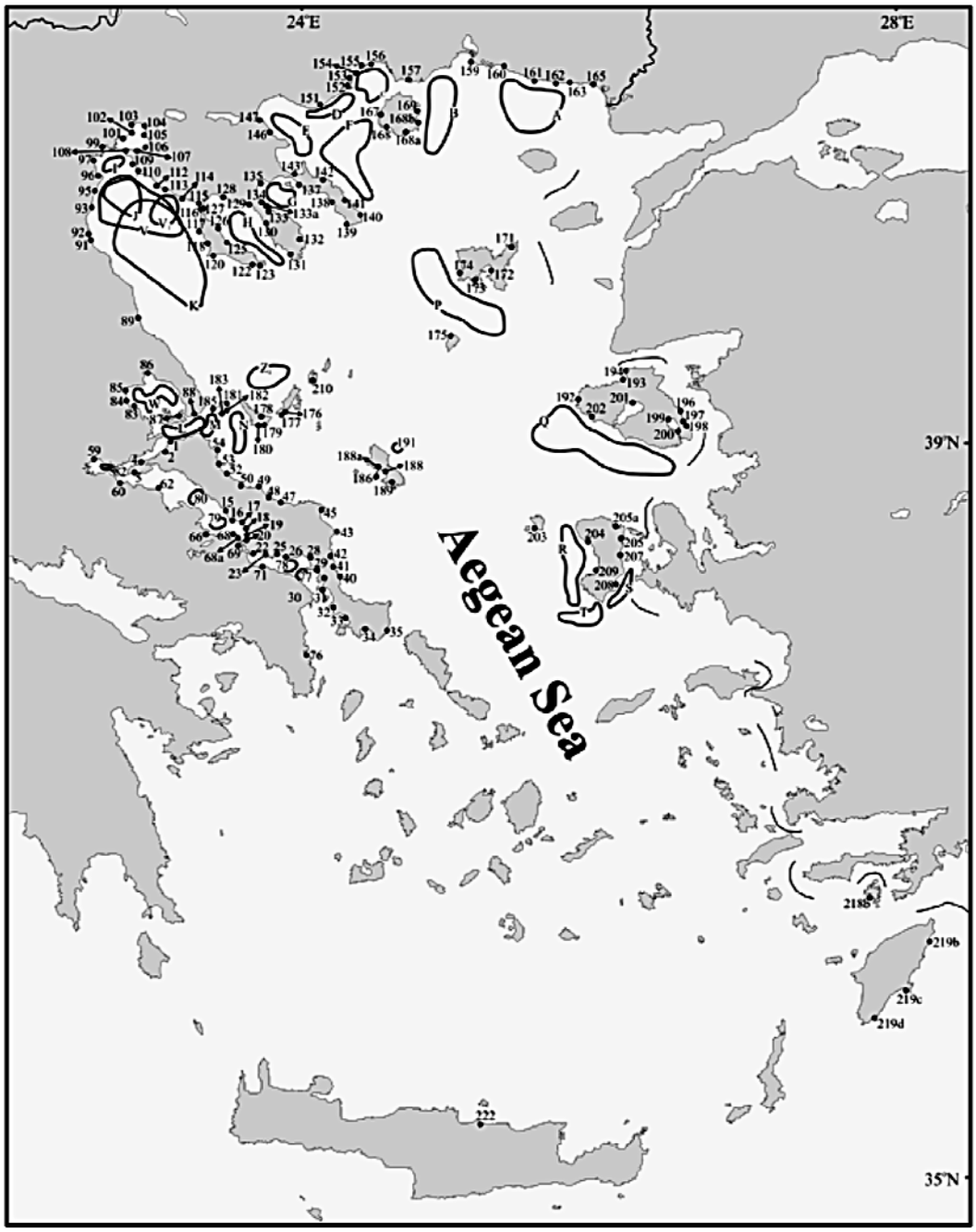

FIG. 1. Map of the Aegean Sea, indicating the sampling stations.

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RESULTS AND DISCUSSION

Taxonomic list

1. Eleutherozoa – Asteroidea

The following 20 species were found in the Aegean Sea during the present study.

Anseropoda placenta (Pennant, 1777)

Material: 31 specimens; stas 2, 16, 85, 104, C, E, I, J, M, V and W; depth 5-190 m; on rocks, biogenic detritus, and sandy, sandy silt and silty bottoms; Dmax. (maximum diameter) = 145.6 mm.

Distribution: A species known from various localities of the Aegean Sea (Forbes, 1844 as *Palmipes membranaceus*; Tortonese, 1947 as *Palmipes placenta*; Pérès & Picard, 1958 as *Anseropoda membrana-*

cea; Vamvakas, 1971; Geldiay & Koçatas, 1972).

An Atlanto-Mediterranean species (Table 1), known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Cherbonnier, 1958; Zavodnik, 1960; Tortonese, 1965; Kaspiris & Tortonese, 1982; Özaydin *et al*., 1995).

Asterina gibbosa (Pennant, 1777)

Material: 152 specimens; stas 20, 25, 29, 42, 102, 105, 123, 127, 129, 130, 135, 140, 142, 146, 147, 151, 159, 162, 163, 168, 172, 173, 174, 186, 192, 194, 199, 200, 203, 205, 208 and 209; depth 0-27 m; on rocks, boulders, cobbles, and meadows of *Zostera* and *Posidonia*; Dmax. = 43.3 mm.

Distribution: Known from many localities of the Aegean Sea (Athanassopoulos, 1917; Tortonese, 1947; Pancucci & Zenetos, 1990).

An Atlanto-Mediterranean species (Table 1), known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Mortensen & Steuer, 1937; Tortonese, 1961, 1965; Zavodnik, 1976; Pancucci & Zenetos, 1989).

Astropecten aranciacus (Linnaeus, 1758)

Material: 54 specimens; stas 20, 50, 78, 80, 85, 87, 89, 99, 104, 105, 108, 109, 110, 127, 130, 134, 147, 153, 156, 162, 176, 189, 191, 193, 196, 201, A, C, D and E; depth 1-110 m; on biogenic detritus, sandy and sandy silt bottoms, and meadows of *Zostera* and *Posidonia*; Dmax. = 289.2 mm.

Distribution: Known from various localities of the Aegean Sea (Tortonese, 1947; Tortonese & Demir, 1960; Pancucci & Zenetos, 1990).

An Atlanto-Mediterranean species (Table 1), known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Tortonese, 1965; Kaspiris & Tortonese, 1982; Özaydin *et al*., 1995).

Astropecten bispinosus (Otto, 1823)

Material: 63 specimens; stas 97, 104, 105, 109, 115, 152, 159, 161, 162, 168, 192, A, C, D, E, V and W; depth 1-105 m; on sandy, sandy silt and silty bottoms, and meadows of *Posidonia*; Dmax. = 212.0 mm.

Distribution: This species has been known in the Aegean Sea, from the Sea of Marmara (Ostroumoff, 1896; Tortonese & Demir, 1960), Rhodos island (Tortonese, 1946) and the Izmir gulf (Geldiay & Koçatas, 1972).

An Atlanto-Mediterranean species (Table 1), known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Mortensen & Steuer, 1937; Tortonese, 1965; Zavodnik, 1981; Pancucci & Zenetos, 1989; Özaydin *et al*., 1995).

Astropecten irregularis pentacanthus (Delle Chiaje, 1825)

Material: 632 specimens; stas 33, 40, 41, 43, 49, 79, 85, 89, 95, 103, 105, 109, 110, 112, 129, 133a, 155, 162, A, C, D, E, F, G, J, L, M, N, Q, R, S and W; depth 1-460 m; on biogenic detritus, sandy, sandy silt and silty bottoms, and meadows of *Zostera* and *Posidonia*; Dmax. = 197.6 mm.

Distribution: Known in the Aegean Sea, from Antimilos islet (Marenzeller, 1893 as *A. pentacanthus*), the Sea of Marmara (Ostroumoff, 1896; Tortonese & Demir, 1960) and the Izmir gulf (Geldiay & Koçatas, 1972; Ünsal, 1985).

An Atlanto-Mediterranean species (Table 1), known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Mortensen & Steuer, 1937; Zavodnik, 1977; Pancucci & Zenetos, 1989).

Astropecten jonstoni (Delle Chiaje, 1825)

Material: 24 specimens; stas 20, 54, 95, 104, 125, 132, 146, 160, 163, 168, 196 and F; depth 1-90 m; on biogenic detritus, sandy and sandy silt bottoms, and meadows of *Zostera* and *Posidonia*; Dmax. = 75.2 mm.

Distribution: This species has been known from the Sea of Marmara (Tortonese & Demir, 1960), the Izmir gulf (Geldiay & Koçatas, 1972) and Kos island (Bianchi & Morri, 1983).

A Mediterranean endemic species (Table 1), known from all over the Mediterranean region (Mortensen & Steuer, 1937; Tortonese, 1965; Zavodnik, 1972; Pancucci & Zenetos, 1989).

Astropecten platyacanthus (Philippi, 1837)

Material: 7 specimens; stas 76, 104, 130, 157, 188 and 199; depth 1-16 m; on sandy and sandy silt bottoms, and meadows of *Zostera* and *Posidonia*; Dmax. = 160.0 mm.

Distribution: This species has been known in the Aegean Sea only from the Sea of Marmara (Ostroumoff, 1896; Tortonese & Demir, 1960), Antiparos islet (Tortonese, 1965), and the Izmir gulf (Ünsal, 1985).

A Mediterranean endemic species (Table 1) known from all over the Mediterranean region (Zavodnik, 1972; Demetropoulos & Hadjichristophorou, 1976; Rodríguez, 1979; Pancucci & Zenetos, 1989).

Astropecten spinulosus (Philippi, 1837)

Material: 7 specimens; stas 20, 127, 156 and 157; depth 1-28 m; on sandy and sandy silt bottoms, and meadows of *Zostera* and *Posidonia*; Dmax. = 98.5 mm.

Distribution: This species has been known in the area only from the Sea of Marmara (Demir, 1952/1954) and the Izmir gulf (Geldiay & Koçatas, 1972; Ünsal, 1985).

A Mediterranean endemic species (Table 1) known from all over the Mediterranean region (Mortensen & Steuer, 1937; Cherbonnier, 1958; Tortonese, 1961; Zavodnik, 1967; Kaspiris & Tortonese, 1982).

Brisingella coronata (O. Sars, 1871)

Material: 2 specimens; stas Q and R; depth 120-320 m; on sandy silt and silty bottoms; LAmax. (maximum arm length) = 310.0 mm.

Distribution: Known from various localities of the Aegean Sea (Steindachner, 1891; Marenzeller, 1893, 1895; Özaydin *et al*., 1995).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Marenzeller, 1893, 1895; Mortensen, 1927; Cherbonnier, 1958; Zavodnik, 1972; Demetropoulos & Hadjichristophorou, 1976).

Chaetaster longipes (Retzious, 1805)

Material: 1 specimen; sta 79; depth 40-50 m; on sandy silt bottoms; D = 240.0 mm.

Distribution: This species has been known in the Aegean Sea only from the SW coast of Turkey (Özaydin *et al*., 1995).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Ludwig, 1897; Mortensen, 1927; Cherbonnier, 1958; Zavodnik, 1972; Demetropoulos & Hadjichristophorou, 1976; Gjiknuri, 1981; Kaspiris & Tortonese, 1982).

Coscinasterias tenuispina (Lamarck, 1816)

Material: 49 specimens; stas 5, 15, 19, 20, 30, 68, 71, 89, 123, 138, 162, 175, 179, 181, 202, 205, 207, D and E; depth 0-50 m; on rocks, biogenic detritus, sandy and silty sand bottoms, and meadows of *Zostera* and *Posidonia*; Dmax. = 165.0 mm.

Distribution: Known in the Aegean from Rhodos island (Tortonese, 1946), the Tainaron cape (Pérès & Picard, 1958), the Izmir gulf (Geldiay & Koçatas, 1972; Ünsal, 1985) and the Güllük gulf (Özaydin *et al*., 1995).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Ludwig, 1897; Mortensen, 1927; Mortensen & Steuer, 1937; Cherbonnier, 1958; Tortonese, 1961; Zavodnik, 1972; Kaspiris & Tortonese, 1982).

Echinaster (Echinaster) sepositus sepositus (Retzius, 1783)

Material: 100 specimens; stas 20, 30, 40, 79, 89, 110, 112, 129, 132, 134, 156, 168, 174, 183, 191, 194, 196, A, D, E, I, K, M, P, T, V and W; depth 0-210 m; on rocks, biogenic detritus and sandy, silty sand and sandy silt substrata and meadows of *Zostera* and *Posidonia*; Dmax. = 260.5 mm.

Distribution: Known from various localities of the Aegean Sea and the Sea of Marmara (Forbes, 1844; Ostroumoff, 1896; Tortonese, 1947; Pérès & Picard, 1958; Tortonese & Demir, 1960; Jacquotte, 1962; Vamvakas, 1971; Geldiay & Koçatas, 1972; Ünsal, 1985; Pancucci & Zenetos, 1990).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Koehler, 1924; Cherbonnier, 1958; Tortonese, 1961; Zavodnik, 1972; Kaspiris & Tortonese, 1982; Pancucci & Zenetos, 1989; Özaydin *et al*., 1995).

Hacelia attenuata (Gray, 1840)

Material: 6 specimens; stas 175, 176, 177, 186 and M; depth 1-190 m; on rocks, biogenic detritus, and sandy, silty sand and sandy silt substrata; Dmax. = 120.5 mm.

Distribution: Known from various localities of the Aegean Sea (Marenzeller, 1895; Pérès & Picard, 1958; Tortonese & Demir, 1960; Vamvakas, 1971; Geldiay & Koçatas, 1972; Kisseleva, 1983; Özaydin *et al*., 1995).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Ludwig, 1897; Mortensen, 1927; Cherbonnier, 1958; Zavodnik, 1972, 1981; Kaspiris & Tortonese, 1982).

Luidia ciliaris (Philippi, 1837)

Material: 6 specimens; stas 185, 189, 191, 192, A and T; depth 1-90 m; on rocks, biogenic detritus and sandy, silty sand and sandy silt substrata; Dmax. = 545.5 mm.

Distribution: Known in the Aegean Sea from the Sea of Marmara (Demir, 1952/1954; Tortonese & Demir, 1960), from Rhodos island (Tortonese, 1946, 1947) from the south of Santorini (Jacquotte, 1962), and from the SE of Limnos island and the Edremit gulf (Özaydin *et al*., 1995).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Ludwig, 1897; Mortensen, 1927; Cherbonnier, 1958; Zavodnik, 1972; Demetropoulos & Hadjichristophorou, 1976; Gjiknuri, 1981; Kaspiris & Tortonese, 1982).

Luidia sarsi sarsi Düben & Koren, in Düben, 1845

Material: 6 specimens; stas 79, Q, S and V; depth 20-190 m; on sandy, silty sand and sandy silt substrata; Dmax. = 290.5 mm.

Distribution: This species has been known in the Aegean Sea only from the SE of the cape Maleas and between the cape Maleas and Milos (Marenzeller, 1893, 1895; as *L. paucispina*), from between Paros and Naxos islands (Pérès & Picard, 1958) and from the NE of Samothraki island (Jacquotte, 1962).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Marenzeller, 1893; Mortensen, 1927; Tortonese, 1957; Cherbonnier, 1958; Zavodnik, 1972; Gjiknuri, 1981).

Marthasterias glacialis (Linnaeus, 1758)

Material: 96 specimens; stas 18, 62, 78, 79, 85, 87, 109, 116, 125, 129, 133, 137, 146, 152, 153, 156, 162, 167, 174, 177, 168b, 179, 180, 183, 192, 193, 203, 205, A, C, L, Q, V and W; depth 1-105 m; on rocks, biogenic detritus and sandy, silty sand and sandy silt substrata, and meadows of *Zostera* and *Posidonia*; Dmax. = 360.6 mm.

Distribution: Known from various localities of the Aegean Sea (Forbes, 1844, as *Uraster glacialis*; Ostroumoff, 1896, as *Asterias glacialis*; Athanassopoulos, 1917; Pérès & Picard, 1958; Tortonese & Demir, 1960; Geldiay & Koçatas, 1972; Özaydin *et al*., 1995).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Cherbonnier, 1958; Tortonese, 1965; Zavodnik, 1972, 1981; Özaydin *et al*., 1995) as well as from the Black Sea – the Bosporus and off the Bosporus (Marion, 1898, as *Asterias glacialis*; Tortonese & Demir, 1960).

*Odontaster mediterraneu*s (Marenzeller, 1893)

Material: 2 specimens; stas S and T; depth 80-250 m; on sandy silt and silty substrata; Dmax. = 80.5 mm.

Distribution: This species has been known in the Aegean Sea only from the west of Milos island (Marenzeller, 1893, as *Gnathaster mediterraneus*), between Serifos and Milos islands (Marenzeller, 1895) and from the west of Lesvos island, the SW of Skyros island, the north of Samos island and the north of Rhodos island (Özaydin *et al*., 1995).

An Atlanto-Mediterranean species (Table 1) known from the European Atlantic coast (Mortensen, 1927), the western Mediterranean (Ludwig, 1897; Piras, 1972; Sibuet, 1974), the Adriatic Sea (Zavodnik, 1972) and the Levantine Basin; south coast of Turkey (Özaydin *et al*., 1995). It is not known from the Central Mediterranean.

Ophidiaster ophidianus (Lamarck, 1816)

Material: 1 specimen; sta R; depth 40 m; on silty sand substratum; D = 205.0 mm.

Distribution: This species has been known in the Aegean (Forbes, 1844, as *O. laevigata*) only from Rhodos island (Tortonese, 1946, 1947), Kos island (Bianchi & Morri, 1983), the south of Limnos island and the SE of Chios island (Özaydin *et al*., 1995).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Cherbonnier, 1958; Tortonese, 1965; Zavodnik, 1972, 1981; Özaydin *et al*., 1995; Pancucci-Papadopoulou, 1996).

Peltaster placenta (J. Müller & Troschel, 1842)

Material: 5 specimens; stas A, C, G and S; depth 40-180 m; on sandy and silty sand substrata; Dmax. = 90.7 mm.

Distribution: Known from various localities of the Aegean Sea (Marenzeller, 1895, as *Pentagonaster placenta*; Tortonese, 1946, 1947, as *Ceramaster placenta*; Pérès & Picard, 1958, as *Ceramaster placenta*; Tortonese & Demir, 1960, as *Sphaeriodiscus placenta*; Özaydin *et al*., 1995, as *Sphaeriodiscus placenta*).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Ludwig, 1897; Mortensen, 1927; Cherbonnier, 1958; Tortonese, 1961; Zavodnik, 1972; Demetropoulos & Hadjichristophorou, 1976; Kaspiris & Tortonese, 1982; Özaydin *et al*., 1995).

Tethyaster subinermis (Philippi, 1837)

Material: 3 specimens; stas 79, R and S; depth 40-320 m; on silty sand and sandy silt substrata; Dmax. = 360.2 mm.

Distribution: This species has been known in the Aegean Sea only from Rhodos island (Tortonese, 1946, 1947), the S and SE of Limnos island, the SW and S of Lesvos island and the Gökova gulf (Özaydin *et al*., 1995).

An Atlanto-Mediterranean species (Table 1) known in the Atlantic Ocean from the Bay of Biscay to Morocco and Liberia (Mortensen, 1927). Also known from the western Mediterranean (Cherbonnier, 1958), the Adriatic (Zavodnik, 1972), the central Mediterranean, the Taranto gulf (Tortonese, 1961), Peloponnisos (Kaspiris & Tortonese, 1982), the Levantine basin, Cyprus (Demetropoulos & Hadjichristophorou, 1976), and the south coast of Turkey (Özaydin *et al*., 1995).

2. Eleutherozoa – Cryptosyringida – Ophiuroidea

The following 14 species were found in the Aegean Sea during the present study.

Amphipholis squamata (Delle Chiaje, 1828)

Material: 31 specimens; stas 16, 115, 120, 123, 141, 175, 188, 203, C, Q and V1; depth 0-210 m; on rocks, organic detritus, sandy and sandy silt substrata, as well as associated with sponges. Ddmax. (Maximum disc diameter) = 3.4 mm.

Distribution: Known from many localities of the Aegean Sea (Forbes, 1844, as *Amphiura neglecta*; Ostroumoff, 1896, as *Amphiura squamata*; Tortonese, 1947; Pérès & Picard, 1958; Tortonese & Demir, 1960; Caspers, 1968; Vamvakas, 1971; Pancucci & Zenetos, 1990; Özaydin *et al*., 1995).

A cosmopolitan species (Table 1) known from all the Mediterranean areas (Mortensen & Steuer, 1937; Tortonese, 1956, 1961, 1966; Cherbonnier, 1958; Zavodnik, 1972; Pancucci & Zenetos, 1989) and the Black Sea – the Bosporus (Tortonese & Demir, 1960), the Atlantic Ocean (Mortensen, 1927) and the Pacific Ocean (Clark & Rowe, 1971).

Amphiura (Acrocnida) brachiata (Montagu, 1804)

Material: 1 specimen; sta 96; depth 5.3 m; on sandy substratum; Ddmax. = 8.5 mm.

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

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Tortonese, 1965; Cherbonnier & Guille, 1967; Zavodnik, 1972; Demetropoulos & Hadjichristophorou, 1976; Pancucci & Zenetos, 1989; Özaydin *et al*., 1995).

Amphiura chiajei Forbes, 1843

Material: 2815 specimens; stas 77, 78, 84, 96, 97, 101, 106, 107, 112, 113, 152, 156, 198, 209, C, D, I and V1; depth 2-250 m; on sandy, silty sand and sandy silt substrata; Ddmax. = 9.7 mm.

Distribution: Known from many localities of the Aegean Sea (Forbes, 1844, 1845, as *A. florifera*; Marenzeller, 1895; Ostroumoff, 1896; Pérès & Picard, 1958; Tortonese & Demir, 1960; Caspers, 1968; Pancucci & Zenetos, 1990; Özaydin *et al*., 1995).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Spratt & Forbes, 1842; Mortensen, 1927; Mortensen & Steuer, 1937; Tortonese, 1952, 1956, 1961; Cherbonnier, 1958; Zavodnik, 1972, 1981; Demetropoulos & Hadjichristophorou, 1976; Pancucci & Zenetos, 1990) as well as from the Black Sea – off the Bosporus (Tortonese & Demir, 1960).

Amphiura filiformis (O. F. Müller, 1776)

Material: 132 specimens; stas 77, 78, 153, A, C, E, H, I, J, R and W; depth 22-42 m; on sandy and silty sand substrata; Ddmax. = 8.4 mm.

Distribution: Also known from many localities of the Aegean Sea (Forbes, 1844; Raulin, 1870; Marenzeller, 1893, 1895; Ostroumoff, 1896; Tortonese & Demir, 1960; Caspers, 1968; Pancucci & Zenetos, 1990; Özaydin *et al*., 1995).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Mortensen & Steuer, 1937; Tortonese, 1956, 1965; Cherbonnier, 1958, 1969; Zavodnik, 1972, 1981; Pancucci & Zenetos, 1989).

Amphiura mediterranea Lyman, 1882

Material: 4 specimens; stas 96 and C; depth 0-25 m; on sandy and silty sand substrata; Ddmax. = 6.2 mm.

Distribution: This species has been known in the Aegean Sea only from the SW of Lesvos island, the SW of Limnos island and off the SE coast of Evvoia island (Kisseleva, 1963) and from Lesvos island – Geras gulf (Pancucci & Zenetos, 1990).

A Mediterranean endemic species (Table 1) known from all over the Mediterranean regions (Mortensen & Steuer, 1937; Tortonese, 1956, 1961, 1965; Cherbonnier, 1958; Zavodnik, 1972; Pancucci & Zenetos, 1989).

Monamphiura apicula (Cherbonnier, 1957)

Material: 6 specimens; stas 33 and 207; depth 2-8 m; on sandy substrata with cobbles and meadows of *Zostera*; Ddmax. = 2.4 mm.

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

A Mediterranean endemic species (Table 1) known until now only from the western Mediterranean (Cherbonnier, 1957, 1958, as *Amphiura apicula*; Tortonese, 1959, 1965, as *A. apicula*), and the Adriatic Sea (Zavodnik, 1995).

Ophiacantha setosa (Retzius, 1805)

Material: 114 specimens; stas 1, 45, 87, L and S; depth 5-255 m; on sandy, silty sand and sandy silt substrata; Ddmax. = 8.5 mm.

Distribution: This species has been known in the Aegean Sea only from the Sea of Marmara (Ostroumoff, 1896) and Syros island (Pérès & Picard, 1958).

An Atlanto-Mediterranean species (Table 1) known from the Atlantic – Bay of Biscay to the south of the Canaries (Mortensen, 1927), the western Mediterranean (Cherbonnier, 1956, 1958; Tortonese, 1956, 1965; Cherbonnier & Guille, 1967), the central Mediterranean (Marenzeller, 1893; Kaspiris & Tortonese, 1982), and the Adriatic (Zavodnik, 1972). It is not known in the Levantine basin.

Ophioderma longicaudum (Retzius, 1805)

Material: 147 specimens; stas 2, 17, 20, 22, 29, 68, 83, 107, 110, 116, 125, 126, 131, 137, 142, 146, 154, 167, 169, 174, 188a, 192, 205, 209, 219b, C and I; depth 0-30 m; on rocks, biogenic detritus, and sandy and silty sand substrata, and meadows of *Zostera* and *Posidonia*; Ddmax. = 28.8 mm.

Distribution: Known from various localities of the Aegean Sea (Forbes, 1844, 1845, as *O. lacertosa*; Tortonese, 1946, 1947; Tortonese & Demir, 1960).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Mortensen & Steuer, 1937; Tortonese, 1956, 1961, 1966; Cherbonnier, 1958; Zavodnik, 1972, 1981; Demetropoulos & Hadjichristophorou, 1976; Kaspiris & Tortonese, 1982; Pancucci & Zenetos,1989).

Ophiomyxa pentagona (Lamarck, 1816)

Material: 50 specimens; stas 92, 101, 102, 128, 131, 135, 155, 196, 203, 209, A, C, E, I, R and V; depth 0-260 m; on rocks, biogenic detritus, and sandy, silty sand and sandy silt substrata; Ddmax. = 24.2 mm.

Distribution: Known from various localities of the Aegean Sea (Forbes, 1844, 1845, as *O. lubrica*; Tortonese, 1946, 1947; Pérès & Picard, 1958; Tortonese & Demir, 1960; Jacquotte, 1962).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Mortensen & Steuer, 1937; Cherbonnier, 1958; Tortonese, 1961, 1966; Zavodnik, 1972; Kaspiris & Tortonese, 1982; Pancucci & Zenetos, 1989).

Ophiopsila aranea Forbes, 1843

Material: 2 specimens; stas C, and I; depth 16-25 m; on silty sand substratum; Ddmax. = 7.4 mm.

Distribution: Known from certain localities of the Aegean Sea (Forbes, 1844, 1845; Ostroumoff, 1896; Pérès & Picard, 1958; Tortonese & Demir, 1960; Jacquotte, 1962; Pancucci & Zenetos, 1990).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Marenzeller, 1895; Mortensen, 1927; Mortensen & Steuer, 1937; Tortonese, 1956, 1961, 1965; Cherbonnier, 1958; Zavodnik, 1967).

Ophiothrix fragilis (Abildgaard, in O.F. Müller, 1789)

Material: 1102 specimens; stas 1, 2, 15, 18, 20, 25, 26, 42, 45, 52, 54, 66, 68, 85, 87, 89, 108, 112, 117, 120, 123, 126, 127, 128, 129, 130, 131, 132, 134, 135, 137, 138, 139, 140, 141, 142, 143, 146, 147, 151, 153, 155, 157, 165, 168a, 168b, 171, 175, 178, 179, 180, 181, 182, 192, 194, 200, 203, 204, 205, 205a, 207, 208, 209, 219b, A, C, D, E, H, I, R, S, V, V1 and W; depth 0-380 m; on sandy, silty sand and sandy silt substrata, and associated with algae and sponges; Ddmax. = 17.2 mm.

Distribution: Known from certain localities of the Aegean Sea, under the names *O. rosula*, *O. fragilis, O.*

TABLE 1. Check list of the Mediterranean Echinodermata and their distribution in certain geographical areas of the Mediterranean and the Black Seas, with reference to their presence in the Atlantic and the Indo-Pacific Oceans. WM = Western Mediterranean, CM = Central Mediterranean, AD = Adriatic Sea, AS = Aegean Sea (including the Sea of Marmara), LB = Levantine Basin, BS = Black Sea, AO = Atlantic Ocean, IP = Indo-Pacific Ocean (the Red Sea). Zoogeographical characterization (ZC): AM, Atlanto-Mediterranean; C, Cosmopolitan; E, Possibly endemic; LM, Lessepsian migrants. VD = Vertical distribution. Species marked with * were found in the present study. Species marked with + are reported for the first time from the Aegean Sea. Species marked with ++ are reported for the first time from the Eastern Mediterranean (Aegean Sea and Levantine Basin)

Mediterranean species	WM	CM	AD	AS	LB	BS	AO	IP	ZC	VD (m) (literature)	VD (m) (present data)
Crinoidea											
Antedon bifida (Pennant, 1777)	+						+		AM	5-200	
Antedon mediterranea (Lamarck, 1816)	+	+	+	+	+				E	1-420	
Leptometra celtica (Barrett & McAndrew, 1858)	+						+		AM	46-1279	
Leptometra phalangium (J. Müller, 1841)	+	+	+	+					E	40-1300	
Neocomatella europaea (A.H. Clark, 1931)	+						+		AM	400-1710	
Eleutherozoa											
Asteroidea											
Anseropoda lobiancoi (Ludwig, 1897)	+								E	40-100	
* *Anseropoda placenta* (Pennant, 1777)	+	+	+	+	+		+		AM	10-600	5-190
Aquilonastra burtoni (Gray, 1840)					+			+	LM	8-10	
* *Asterina gibbosa* (Pennant, 1777)	+	+	+	+	+		+		AM	0-126	0-27
Asterina ocellifera (Gray, 1847)	+	+					+		AM	6-200	
Asterina panceri (Gasco, 1870)	+	+	+	+	+				E	0-40	
Asterina phylactica Emson & Crump, 1979	+		+				+		AM	0-2	
* *Astropecten aranciacus* (Linnaeus, 1758)	+	+	+	+	+		+		AM	1-80	1-110
* *Astropecten bispinosus* (Otto, 1823)	+	+	+	+	+		+		AM	1-245	1-105
* *Astropecten irregularis pentacanthus* (Delle Chiaje, 1825)	+	+	+	+	+		+		AM	3-1829	1-460
Astropecten irregularis irregularis (Pennant, 1777)	+						+		AM	3-900	
* *Astropecten jonstoni* (Delle Chiaje, 1825)	+	+	+	+	+				E	2-12	1-90
* *Astropecten platyacanthus* (Philippi, 1837)	+	+	+	+	+				E	2-64	1-16
* *Astropecten spinulosus* (Philippi, 1837)	+	+	+	+	+				E	3-55	1-28
* *Brisingella coronata* (O. Sars, 1871)	+	+	+	+	+		+		AM	100-2904	120-320
Ceramaster grenadensis grenadensis (Perrier, 1881)	+	+		+			+		AM	200-2210	
* *Chaetaster longipes* (Retzius, 1805)	+	+	+	+	+		+		AM	30-1139	40
* *Coscinasterias tenuispina* (Lamarck, 1816)	+	+	+	+	+		+		AM	0-79	0-50
* *Echinaster (Echinaster) sepositus sepositus* (Retzius, 1783)	+	+	+	+	+		+		AM	0-250	0-210
* *Hacelia attenuata* (Gray, 1840)	+	+	+	+	+		+		AM	1-150	1-190
Henricia cylindrella (Sladen, 1883)	+						+		AM	530-1400	

TABLE 1. continued

Mediterranean species	WM	CM	AD	AS	LB	BS	AO	IP	ZC	VD (m) (literature)	VD (m) (present data)
* *Luidia ciliaris* (Philippi, 1837)	+	+	+	+	+		+		AM	4-400	1-90
* *Luidia sarsi sarsi* Düben & Koren, in Düben, 1845	+	+	+	+	+		+		AM	10-1292	20-190
Marginaster capreensis (Gasco, 1876)	+			+			+		AM	49-2487	
* *Marthasterias glacialis* (Linnaeus, 1758)	+	+	+	+	+	+	+		AM	0-180	1-105
Nymphaster arenatus (Perrier, 1881)	+						+		AM	225-2790	
* *Odontaster mediterraneus* (Marenzeller, 1893)	+		+	+	+		+		AM	24-1804	80-250
* *Ophidiaster ophidianus* (Lamarck, 1816)	+	+	+	+	+		+		AM	0-100	40
* *Peltaster placenta* (J. Müller & Troschel, 1842)	+	+	+	+	+		+		AM	10-500	40-180
Plutonaster bifrons (W. Thompson, 1873)	+	+					+		AM	106-2525	
Sclerasterias neglecta (Perrier, 1891)	+		+	+			+		AM	160-485	
Sclerasterias richardi (Perrier, 1882)	+	+		+			+		AM	100-710	
* *Tethyaster subinermis* (Philippi, 1837)	+	+	+	+	+		+		AM	50-1400	40-320
Cryptosyringida											
Ophiuroidea											
Amphilepis norvegica (Ljungman, 1865)	+		+	+			+		AM	70-2940	
Amphioplus (Lymanella) laevis (Lyman, 1874)					+			+	LM	0-40	
* *Amphipholis squamata* (Delle Chiaje, 1828)	+	+	+	+	+	+	+	+	C	0-740	0-210
*+ *Amphiura (Acrocnida) brachiata* (Montagu, 1804)	+	+	+	+	+		+		AM	5-40	5.3
Amphiura cherbonnieri Guille, 1972	+	+	+	+					E	12-130	
* *Amphiura chiajei* Forbes, 1843	+	+	+	+	+	+	+		AM	9-1200	2-250
Amphiura delamarei Cherbonnier, 1958	+								E	43-200	
* *Amphiura filiformis* (O. F. Müller, 1776)	+	+	+	+	+		+		AM	5-1200	22-42
Amphiura incana Lyman, 1879	+						+		AM	18-58	
Amphiura lacazei Guille, 1976	+	+		+					E	20-175	
* *Amphiura mediterranea* Lyman, 1882	+	+	+	+	+				E	9-90	0-25
Amphiura (Ophiopeltis) securigera (Düben & Koren, 1846)	+		+				+		AM	40-600	
Amphiura stepanovi D'yakonov, 1954						+			E	70-205	
Astrospartus mediterraneus (Risso, 1826)	+		+	+			+		AM	50-188	
Cryptopelta brevispina (Ludwig, 1879)	+								E	20-145	
*+ + *Monamphiura apicula* (Cherbonnier, 1957)	+		+	+					E	15-170	2-8
* *Ophiacantha setosa* (Retzius, 1805)	+	+	+	+			+		AM	50-1480	5-255

TABLE 1. continued

Mediterranean species	WM	CM	AD	AS	LB	BS	AO	IP	ZC	VD (m) (literature)	VD (m) (present data)
Ophiactis balli (W. Thompson, 1840)	+						+		AM	50-1765	
Ophiactis macrolepidota Marktanner-Turneretscher, 1887					+			+	LM	0-200	
Ophiactis savignyi (J. Müller & Troschel, 1842)	+			+	+		+	+	C	2-518	
Ophiactis virens (M. Sars, 1857)	+	+	+		+		+		AM	0-90	
Ophiocomina nigra (Abildgaard, in O. F. Müller, 1789)	+						+		AM	0-400	
Ophioconis forbesi (Heller, 1863)	+	+	+	+			+		AM	20-200	
Ophiocten abyssicolum Marenzeller, 1893	+	+	+	+			+		AM	40-620	
* *Ophioderma longicaudum* (Retzius, 1805)	+	+	+	+	+		+		AM	0-70	0-30
* *Ophiomyxa pentagona* (Lamarck, 1816)	+	+	+	+	+		+		AM	0-250	0-260
Ophiopsila annulosa (M. Sars, 1857)	+	+	+	+			+		AM	10-100	
* *Ophiopsila aranea* Forbes, 1843	+	+	+	+	+		+		AM	9-185	16-25
Ophiopsila aff. guineensis Koehler, 1914	+		+				+		AM	27-175	
* *Ophiothrix fragilis* (Abildgaard, in O. F. Müller, 1789)	+	+	+	+	+	+	+		AM	0-1244	0-380
Ophiura africana (Koehler, 1923)	+						+		AM	20-60	
* *Ophiura albida* Forbes, 1839	+	+	+	+	+		+		AM	4-850	2-26
Ophiura (Dictenophiura) carnea Lütken, 1858 ex M. Sars MS	+			+			+		AM	30-1260	
* *Ophiura grubei* Heller, 1863	+	+	+	+	+		+		AM	10-187	1-30
* *Ophiura ophiura* (Linnaeus, 1758)	+	+	+	+	+		+		AM	0-685	0-350
Pectinura vestita Forbes, 1843				+					E	160	
Echinozoa											
Echinoidea											
* *Arbacia lixula* (Linnaeus, 1758)	+	+	+	+	+		+		AM	0-40	0-50
*+ +*Arbaciella elegans* Mortensen, 1910	+	+		+			+		AM	3-40	1-15
* *Brissopsis lyrifera* (Forbes, 1841)	+	+	+	+	+		+		AM	5-1500	4-20
* *Brissopsis atlantica mediterranea* Mortensen, 1913	+		+	+			+		AM	100-3200	2-105
* *Brissus unicolor* (Leske, 1778)	+	+	+	+	+		+		AM	0-250	1-12
* *Centrostephanus longispinus* (Philippi, 1845)	+	+	+	+	+		+		AM	40-208	40-60
* *Cidaris cidaris* (Linnaeus, 1758)	+	+	+	+	+		+		AM	50-2000	20-250
* *Echinocardium cordatum* (Pennant, 1777)	+	+	+	+	+		+	+	C	0-230	1-70
Echinocardium fenauxi Péquignat, 1963	+	+		+					E	20-50	
Echinocardium flavescens (O. F. Müller, 1776)	+	+	+	+			+		AM	5-360	
* *Echinocardium mediterraneum* (Forbes, 1843)	+	+	+	+	+		+		AM	3-40	2-35

TABLE 1. continued

Mediterranean species	WM	CM	AD	AS	LB	BS	AO	IP	ZC	VD (m) (literature)	VD (m) (present data)
Echinocardium mortenseni Thiéry, 1909	+								E	10-70	
* *Echinocyamus pusillus* (O. F. Müller, 1776)	+	+	+	+	+		+		AM	0-1250	1-70
* *Echinus acutus* Lamarck, 1816	+	+	+	+	+		+		AM	20-1280	3-350
*+ +*Echinus melo* Olivi, 1792	+	+	+	+			+		AM	25-1100	20-350
* *Genocidaris maculata* A. Agassiz, 1869	+	+	+	+	+		+		AM	12-500	20-22
*+ +*Hemiaster expergitus* Lovén, 1874	+			+			+		AM	400-3120	1230-1249
Neolampas rostellata A. Agassiz, 1869	+						+		AM	95-1260	
* *Paracentrotus lividus* (Lamarck, 1816)	+	+	+	+	+		+		AM	0-80	0-90
* *Plagiobrissus costai* (Gasco, 1876)	+	+		+	+		+		AM	25-200	20
* *Psammechinus microtuberculatus* (Blainville, 1825) Heller, 1868	+	+	+	+	+				E	4-685	1-110
* *Schizaster canaliferus* (Lamarck, 1816)	+	+	+	+	+				E	9-100	10-105
Spatangus inermis Mortensen, 1913	+			+					E	20-350	
* *Spatangus purpureus* (O. F. Müller, 1776)	+	+	+	+	+		+		AM	15-969	18-50
* *Sphaerechinus granularis* (Lamarck, 1816)	+	+	+	+	+		+		AM	3-100	2-120
* *Stylocidaris affinis* (Philippi, 1845)	+	+	+	+	+		+		AM	30-1000	5-180
Holothuroidea											
Aslia lefevrei (Barrois, 1882)	+						+		AM	6-20	
Havelockia inermis (Heller, 1868)	+	+	+	+			+		AM	6-180	
Hedingia mediterranea (Bartolini-Baldelli, 1914) Tortonese, 1965	+								E	800-1005	
Holothuria (Panningothuria) forskali Delle Chiaje, 1823	+	+	+	+	+		+		AM	1-100	
Holothuria (Holothuria) helleri Marenzeller, 1878	+	+	+	+					E	0-80	
Holothuria (Thymiosycia) *impatiens* (Forskål, 1775)	+	+	+	+	+		+	+	C	0-30	
Holothuria (Roweothuria) lentiginosa Marenzeller, 1893	+						+		AM	100-250	
Holothuria (Holothuria) mammata Grube, 1840	+	+	+	+			+		AM	1-77	
Holothuria (Lessonothuria) polii Delle Chiaje, 1823	+	+	+	+	+		+		AM	0-250	
Holothuria (Platyperona) sanctori Delle Chiaje, 1823	+		+	+	+		+		AM	2-30	
Holothuria (Holothuria) stellati Delle Chiaje, 1823	+		+	+					E	3-65	
Holothuria (Holothuria) tubulosa Gmelin, 1788	+	+	+	+	+		+		AM	0-100	
Labidoplax buskii (M'Intosh, 1866)	+	+	+	+			+		AM	10-540	
Labidoplax digitata (Montagu, 1815)	+	+	+	+	+	+	+		AM	0-268	
Labidoplax media Östergren, 1905	+		+	+			+		AM	5-95	
Labidoplax thomsoni (Herapath, 1865)	+	+	+	+					E	7-70	

TABLE 1. continued

Mediterranean species	WM	CM	AD	AS	LB	BS	AO	IP	ZC	VD (m) (literature)	VD (m) (present data)
Leptopentacta elongata (Düben & Koren, 1844)	+	+	+	+	+		+		AM	0-150	
Leptopentacta tergestina (M. Sars, 1857)	+	+	+	+			+		AM	8-170	
Leptosynapta decaria (Östergren, 1905)			+				+		AM	2-70	
Leptosynapta galliennii (Herapath, 1865)		+	+				+		AM	5-30	
Leptosynapta inhaerens (O. F. Müller, 1776)	+	+	+	+	+	+	+		AM	2-173	
Leptosynapta makrankyra (Ludwig, 1898)	+	+	+	+	+				E	1-36	
Leptosynapta minuta (Becher, 1906)	+			+			+		AM	3-50	
Mesothuria intestinalis (Ascanius, 1805) Östergren, 1896	+	+	+	+	+		+		AM	18-4255	
Mesothuria verrilli (Théel, 1886)	+						+		AM	280-2520	
Molpadia musculus Risso, 1826	+	+					+		AM	25-2098	
Myriotrochus geminiradiatus Salvini-Plawen, 1972			+						E	70-225	
Neocnus incubans Cherbonnier, 1972	+								E	1-?	
Neocucumis atlantica (Ludwig & Heding, 1935)	+						+		AM	50-300	
Neocucumis marioni (Marenzeller, 1878)	+		+	+			+		AM	25-560	
Ocnus grubei (Marenzeller, 1874)	+		+		+				E	3-40	
Ocnus koellikeri (Semper, 1867)	+			+			+		AM	50-685	
Ocnus lacteus (Forbes & Goodsir, 1839)	+		+				+		AM	0-100	
Ocnus petiti (Cherbonnier, 1958)	+								E	30-35	
Ocnus planci (Brandt, 1835)	+	+	+	+		+	+		AM	5-250	
Ocnus syracusanus (Grube, 1840) Panning, 1949	+	+	+	+	+				E	7-100	
Panningia hyndmanni (W. Thompson, 1840)	+		+	+		+	+		AM	7-1152	
Parastichopus regalis (Cuvier, 1817)	+	+	+	+	+		+		AM	5-1200	
Pawsonia saxicola (Brady & Robertson, 1871)	+						+		AM	0-130	
Penilpidia ludwigi (Marenzeller, 1893)		+		+	+				E	755-4766	
Phyllophorus drachi Cherbonnier & Guille, 1968	+								E	?-90	
Phyllophorus granulatus (Grube, 1840)	+	+		+					E	3-15	
Phyllophorus (Phyllophorus) urna Grube, 1840	+		+	+					E	2-150	
Prototrochus meridionalis (Salvini-Plawen, 1977)	+								E	?-540	
Pseudostichopus occultatus Marenzeller, 1893	+	+		+			+	+	C	232-5300	
Pseudothyone raphanus (Düben & Koren, 1846)	+						+		AM	7-1050	
Pseudothyone sculponea Cherbonnier, 1958	+		+						E	25-120	
Stereoderma kirschbergi (Heller, 1868)	+	+	+	+		+	+		AM	30-80	

TABLE 1. continued

Mediterranean species	WM	CM	AD	AS	LB	BS	AO	IP	ZC	VD (m) (literature)	VD (m) (present data)
**Synaptula reciprocans* (Forskål, 1775)				+	+			+	LM	1-20	0-4
Thyone cherbonnieri Reys, 1960	+		+	+					E	3-63	
Thyone fusus mediterranea Madsen, 1941	+	+	+	+	+				E	20-150	
Thyone gadeana R. Perrier, 1902	+						+		AM	562-1045	
Trochodota furcipraedita Salvini-Plawen, 1972	+								E	4-5	
Trochodota venusta (Semon, 1887)	+								E	1-13	
Total number of species: 154	144	91	100	108	72	10	110	9			

fragilis echinata and *O. quinquemaculata* (Forbes, 1844; Ostroumoff, 1896; Panagiotopoulos, 1916; Athanassopoulos, 1917; Pérès & Picard, 1958; Tortonese & Demir, 1960; Jacquotte, 1962; Caspers, 1968; Vamvakas, 1971; Özaydin *et al*., 1995).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Mortensen & Steuer, 1937; Tortonese, 1956, 1961, 1966; Cherbonnier, 1958; Zavodnik, 1972; Pancucci & Zenetos, 1989), as well as from the Black Sea (D'yakonov, 1954; Tortonese & Demir, 1960).

Ophiura albida Forbes, 1839

Material: 16 specimens; stas 97, 109, 113, 154, 156, 157, and I; depth 2-26 m; on sandy and silty sand substrata; Ddmax. = 8.3 mm.

Distribution: Known from many localities of the Aegean Sea, (Forbes, 1844, 1845; Ostroumoff, 1896; Pérès & Picard, 1958; Tortonese & Demir, 1960; Jacquotte, 1962; Kisseleva, 1963; Makkavieva, 1963; Vamvakas, 1971; Pancucci & Zenetos, 1990; Özaydin *et al*., 1995).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Tortonese, 1956, 1961; Cherbonnier, 1958; Zavodnik, 1972; Kaspiris & Tortonese, 1982; Özaydin *et al*., 1995).

Ophiura grubei Heller, 1863

Material: 15 specimens; stas 154, C, I and J; depth 1-30 m; on sandy and silty sand substrata; Ddmax. = 5.2 mm.

Distribution: This species has been known in the Aegean Sea only from the Sea of Marmara (Tortonese & Demir, 1960), the Saronikos gulf (Vamvakas, 1971) and Lesvos island (Pancucci & Zenetos, 1990).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean region (Tortonese, 1956, 1965; Zavodnik, 1972; Pancucci-Papadopoulou, 1996) as well as from the Atlantic coasts of Morocco (Mortensen, 1927).

Ophiura ophiura (Linnaeus, 1758)

Material: 46 specimens; stas 78, 87, 107, 201, 222, A, E, F and W; depth 0-350 m; on rocks, organic detritus, sandy and sandy silt substrata, and meadows of *Zostera* and *Posidonia*; Ddmax. = 27.6 mm.

Distribution: Known from various localities of the Aegean Sea under the name *O. lacertosa*, *O. texturata* and *O. ophiura* (Forbes, 1844, 1845; Ostroumoff, 1896; Tortonese, 1946; Pérès & Picard, 1958; Tortonese & Demir, 1960, Kisseleva, 1961; Jacquotte, 1962; Vamvakas, 1971; Pancucci & Zenetos, 1990; Özaydin *et al*., 1995).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Mortensen & Steuer, 1937; Cherbonnier, 1956, 1958; Tortonese, 1956, 1961, 1965; Zavodnik, 1972; Kaspiris & Tortonese, 1982; Pancucci & Zenetos, 1989; Özaydin *et al*., 1995).

3. Eleutherozoa – Cryptosyringida – Echinozoa – Echinoidea

The following 21 species were found in the Aegean Sea during the present study.

Arbacia lixula (Linnaeus, 1758)

Material: 115 specimens; stas 15, 25, 29, 32, 42, 45, 76, 83, 85, 86, 88, 89, 109, 110, 114, 115, 117, 120, 122, 128, 133, 135, 137, 138, 139, 140, 141, 146, 159, 165, 169, 172, 173, 174, 175, 177, 178, 179, 188, 189, 196, 203, 208, 209 and C; depth 0-50 m; on rocks, organic detritus, as well as on live leaves of *Posidonia*; Dmax. = 56.5 mm.

Distribution: Known from various localities of the Aegean Sea under the name *A. aequituberculata*, *A. pustulosa* and *A. lixula* (Ostroumoff, 1896; Issel, 1928; Tortonese, 1946; Pérès & Picard, 1958; Geldiay & Koçatas, 1972; Pancucci & Zenetos, 1990).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Cherbonnier, 1958; Zavodnik, 1972; Demetropoulos & Hadjichristophorou, 1976; Kaspiris & Tortonese, 1982).

Arbaciella elegans Mortensen, 1910

Material: 20 specimens; stas 15, 20, 41, 130, 142, 147, 172, 173, 188a, 203, 205, and 208; depth 1-15 m; under rocks and on organic detritus; Dmax. = 7.6 mm.

Distribution: This species is reported for the first time from the Eastern Mediterranean (Aegean Sea and Levantine Basin). Not known from the Adriatic Sea.

An Atlanto-Mediterranean species (Table 1). In the Atlantic it occurs on the African west coast, but it is not known to the north of Cape Blanc (Mortensen, 1927). It is known from a few localities of the

Western Mediterranean (Gautier-Michaz, 1958; Tortonese, 1965; Galán-Novella & López-Ibor Alíño, 1981) and from Marsaxlokk Bay, Malta, in the Central Mediterranean (Schembri, 1978).

Brissopsis lyrifera (Forbes, 1841)

Material: 4 specimens; stas 45, 109 and 210; depth 4-20 m; in sandy substrata; Dmax. = 76.2 mm.

Distribution: Known from various localities of the Aegean Sea (Marenzeller, 1895; Ostroumoff, 1896; Pérès & Picard, 1958; Tortonese & Demir, 1960; Özaydin *et al*., 1995).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Mortensen & Steuer, 1937; Cherbonnier, 1958; Pérès & Picard, 1958; Tortonese, 1958, 1965; Zavodnik, 1972).

Brissopsis atlantica mediterranea Mortensen, 1913

Material: 17 specimens; stas 23, 109, C, D, E, J, and M; depth 2-105 m; in sandy, silty sand and sandy silt substrata; Dmax. = 72.0 mm.

Distribution: The presence of this species in the Aegean Sea has been documented only from the north of Lesvos island (Özaydin *et al*., 1995).

An Atlanto-Mediterranean species (Table 1) known from the Atlantic (Mortensen, 1927; Tortonese, 1965), the western Mediterranean (Tortonese, 1965; Rodríguez, 1979) and the Adriatic (Zavodnik, 1980). It is not known from the central Mediterranean and the Levantine basin.

Brissus unicolor (Leske, 1778)

Material: 20 specimens; stas 15, 34, 68a, 110 and 171; depth 1-12 m; in sandy substrata; Dmax. = 102.0 mm.

Distribution: This species has been known in the Aegean Sea only from the Messiniakos gulf-Kalamata and the Kyklades islands – Nata (Pérès & Picard, 1958).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Mortensen & Steuer, 1937; Cherbonnier, 1956, 1958; Tortonese, 1965; Zavodnik, 1972; Schembri, 1978; Rodríguez, 1979; Kaspiris & Tortonese, 1982).

Centrostephanus longispinus (Philippi, 1845)

Material: 3 specimens; sta 77; depth 40-60 m; on biogenic detritus on silty sand substratum; Dmax. = 35.4 mm.

Distribution: This species has been known in the Aegean Sea from various localities (Tortonese, 1946, 1947; Pérès & Picard, 1958; Laborel, 1960; Tortonese & Demir, 1960; Özaydin *et al*., 1995).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Cherbonnier, 1956; Tortonese, 1965; Zavodnik, 1972; Schembri, 1978; Rodríguez, 1979; Kaspiris & Tortonese, 1982; Özaydin *et al*., 1995).

Cidaris cidaris (Linnaeus, 1758)

Material: 30 specimens; stas 77, 175, M, Q and S; depth 20-250 m; on rocks, biogenic detritus, and silty sand and sandy silt substrata; Dmax. = 38.8 mm.

Distribution: Known from various localities of the Aegean Sea, under the names C. *hystrix, Dorocidaris papillata* and *C. cidaris* (Spratt & Forbes, 1842; Forbes, 1844; Steindachner, 1891; Marenzeller, 1893, 1895; Ostroumoff, 1896; Pérès & Picard, 1958; Kisseleva, 1983; Özaydin *et al*., 1995).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Marenzeller, 1893; Mortensen, 1927; Cherbonnier, 1956, 1958; Tortonese, 1965; Zavodnik, 1972; Demetropoulos & Hadjichristophorou, 1976; Schembri, 1978; Özaydin *et al*., 1995).

Echinocardium cordatum (Pennant, 1777)

Material: 59 specimens; stas 23, 68a, 92, 95, 147, 159, 163, 171, J and K; depth 1-70 m; in sandy and silty sand substrata; Dmax. = 48.5 mm.

Distribution: This species has been known in the Aegean Sea from the Sea of Marmara (Ostroumoff, 1896), Syros island (Marion, 1898), the Izmir gulf (Geldiay & Koçatas, 1972), and Lesvos island (Pancucci & Zenetos, 1990).

A cosmopolitan species (Table 1) known from all the Mediterranean areas (Mortensen & Steuer, 1937; Tortonese, 1956, 1965; Cherbonnier, 1958; Pérès & Picard, 1958; Zavodnik, 1972; Rodríguez, 1979; Kaspiris & Tortonese, 1982; Pancucci & Zenetos, 1989), the Atlantic (Mortensen, 1927; Tortonese, 1965) and the Pacific Oceans (Mortensen, 1927; Tortonese, 1965).

Echinocardium mediterraneum (Forbes, 1843)

Material: 24 specimens; stas 125, 147, 207 and K; depth 2-35 m; in sandy and silty sand substrata; Dmax. = 42.5 mm.

Distribution: This species has been known in the Aegean Sea only from Poros island (Forbes, 1844) and the Sea of Marmara (Tortonese & Demir, 1960).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Tortonese, 1956, 1965; Cherbonnier, 1958; Zavodnik, 1972; Rodríguez, 1979; Pancucci & Zenetos, 1989).

Echinocyamus pusillus (O.F. Müller, 1776)

Material: 21 specimens; stas 107, 108, J and V; depth 1-70 m; in sandy and silty sand substrata; Dmax. = 8.6 mm.

Distribution: Known from many localities of the Aegean Sea (Forbes, 1844; Ostroumoff, 1896; Marion, 1898; Tortonese, 1946; Pérès & Picard, 1958; Tortonese & Demir, 1960; Jacquotte, 1962; Vamvakas, 1971; Kisseleva, 1983; Pancucci & Zenetos, 1990; Özaydin *et al*., 1995).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Raulin, 1870, as *E. tarentinus*; Mortensen, 1927; Mortensen & Steuer, 1937; Cherbonnier, 1956, 1958, 1969; Tortonese, 1956, 1965; Zavodnik, 1972, 1981; Pancucci & Zenetos, 1989).

Echinus acutus Lamarck, 1816

Material: 53 specimens; stas 79, 130, B, E, G, H, K, Q, R, S and V; depth 3-350 m; on organic detritus, sandy and sandy silt substrata; Dmax. = 152.0 mm.

Distribution: Known from certain localities of the Aegean Sea under the names *E. norvegicus*, *E. melo* and *E. acutus* (Steindachner, 1891; Marenzeller, 1893, 1895; Tortonese & Demir, 1960; Makkavieva, 1963).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Marenzeller, 1893; Mortensen, 1927; Cherbonnier, 1956, 1958; Tortonese, 1958; Zavodnik, 1972; Demetropoulos & Hadjichristophorou, 1976; Schembri, 1978; Rodríguez, 1979; Kaspiris & Tortonese, 1982).

Echinus melo Olivi, 1792

Material: 52 specimens; stas 71, 79, 109, B, E, G, H, K, M, Q, S and V; depth 20-350 m; on rocks, organic detritus and silty sand substrata; Dmax. = 130.4 mm.

Distribution: This species is reported for the first time from the Eastern Mediterranean (Aegean Sea and Levantine basin).

An Atlanto-Mediterranean species (Table 1) also known from the European Atlantic coasts (Mortensen, 1927), the western Mediterranean (Cherbonnier, 1958; Tortonese, 1965; Rodríguez, 1979), the central Mediterranean (Marenzeller, 1893; Schembri, 1978) and the Adriatic (Zavodnik, 1972).

Genocidaris maculata A. Agassiz, 1869

Material: 1 specimen; sta 197; depth 20-22 m; on calcareous algae; D = 8.0 mm.

Distribution: Known from various localities of the Aegean Sea (Pérès & Picard, 1958; Tortonese & Demir, 1960; Jacquotte, 1962; Vamvakas, 1971).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Mortensen & Steuer, 1937; Tortonese, 1956; Cherbonnier, 1958; Zavodnik, 1972; Pancucci & Zenetos, 1989).

Hemiaster expergitus Lovén, 1874

Material: 3 specimens; sta Z1, 39° 16.58′ N, 23° 42.49′ E & 39° 15.51′ N, 23° 42.51′ E; depths 1249 m & 1230 m; in silty substratum; Dmax. = 32.6 mm.

Distribution: This species is reported for the first time from the Eastern Mediterranean (Aegean Sea and Levantine basin).

An Atlanto-Mediterranean species (Table 1) known in the Atlantic from the Norwegian coast and the south of Iceland to the Azores and the Cape Verde island an from the Davies Strait to the West Indies (Mortensen, 1927). It has been known in the Mediterranean only from Mallorca – Baleares (Cherbonnier, 1958) and the gulf of Genova (Tortonese, 1972).

Paracentrotus lividus (Lamarck, 1816)

Material: 331 specimens; stas 4, 15, 16, 20, 23, 25, 28, 29, 31, 34, 35, 42, 45, 47, 48, 49, 53, 59, 60, 68, 76, 85, 88, 89, 91, 93, 95, 102, 104, 108, 109, 110, 112, 115, 118, 122, 123, 127, 128, 130, 131, 135, 138, 140, 141, 142, 146, 147, 151, 156, 157, 159, 161, 162, 163, 168a, 169, 171, 172, 173, 174, 175, 177, 178, 179, 188, 189, 192, 193, 196, 199, 200, 203, 205, 207, 208, 209, C, I and K; depth 0-90 m; on rocks, organic detritus and silty sand substrata, as well as on live leaves of *Posidonia* (personal observation); Dmax. = 62.4 mm.

Distribution: Known from many localities of the Aegean Sea, under the names *Echinus (Toxopneustes) lividus*, *Strongylocentrotus lividus* and *P. lividus* (Spratt & Forbes, 1842; Forbes, 1844; Raulin, 1870; Ostrou-

moff, 1896; Panagiotopoulos, 1916; Issel, 1928; Tortonese, 1946, 1947; Pérès & Picard, 1958; Tortonese & Demir, 1960; Vamvakas, 1971; Pancucci & Zenetos, 1990).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Mortensen & Steuer, 1937; Cherbonnier, 1958; Tortonese, 1965; Zavodnik, 1972; Schembri, 1978; Pastore, 1981; Pancucci & Zenetos, 1989).

Plagiobrissus costai (Gasco, 1876)

Material: 1 specimen; sta 109; depth 20 m; in silty sand substratum; D = 80.2 mm.

Distribution: This species has been known in the Aegean Sea only from the Messiniakos gulf-Kalamata (Jacquotte, 1962; as *Metalia costae*) and the west of Karavi islet, close to Kythira island (Pérès & Picard, 1958; as *Melita costae*).

An Atlanto-Mediterranean species (Table 1) known from the eastern Atlantic (Tortonese, 1965), the western Mediterranean (Tortonese, 1965), the central Mediterranean (Cherbonnier, 1956; Tortonese, 1961), and the Levantine basin (Mortensen & Steuer, 1937; Tortonese, 1956).

Psammechinus microtuberculatus (Blainville, 1825) Heller, 1868

Material: 131 specimens; stas 20, 22, 77, 79, 93, 95, 96, 105, 106, 109, 110, 128, 156, 194, 196, 199, 200, 201, 207, 208, C, E, V and V1; depth 1-110 m; on organic detritus, silty sand and sandy silt substrata, as well as on leaves of *Posidonia* and algae; Dmax. = 29.8 mm.

Distribution: Known from certain localities of the Aegean Sea, under the names *Echinus microtuberculatus* and *Psammechinus microturberculatus* (Ostroumoff, 1896; Marion, 1898; Tortonese & Demir, 1960; Kisseleva, 1983; Pancucci & Zenetos, 1990; Özaydin *et al*., 1995).

A Mediterranean endemic species (Table 1) known from all over the Mediterranean region (Cherbonnier, 1956, 1958; Tortonese, 1961; Zavodnik, 1972; Demetropoulos & Hadjichristophorou, 1976; Kaspiris & Tortonese, 1982; El-Beshbeeshy, 1995).

Schizaster canaliferus (Lamarck, 1816)

Material: 10 specimens; stas 15, 108, C, E and I; depth 10-105 m; in sandy and silty sand substrata; Dmax. = 63.2 mm.

Distribution: Known from certain localities of the Aegean Sea (Forbes, 1844, as *Brissus atropos*; Ostroumoff, 1896; Marion, 1898; Pérès & Picard, 1958; Tortonese & Demir, 1960; Jacquotte, 1962; Pancucci & Zenetos, 1990; Özaydin *et al*., 1995).

A Mediterranean endemic species (Table 1) known from all the Mediterranean regions (Mortensen & Steuer, 1937; Cherbonnier, 1956, 1958; Tortonese, 1956, 1965; Zavodnik, 1972; Schembri, 1978; Kaspiris & Tortonese, 1982).

Spatangus purpureus (O.F. Müller, 1776)

Material: 2 specimens; stas 80 and 175; depth 18-50 m; in silty sand and sandy silt substrata; Dmax. = 108.5 mm.

Distribution: Known from certain localities of the Aegean Sea (Forbes, 1844; Marenzeller, 1893, 1895; Ostroumoff, 1896; Pérès & Picard, 1958; Tortonese & Demir, 1960; Jacquotte, 1962; Vamvakas, 1971; Özaydin *et al*., 1995).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Marenzeller, 1893; Mortensen, 1927; Cherbonnier, 1956, 1958; Zavodnik, 1972; Demetropoulos & Hadjichristopohorou, 1976; Schembri, 1978; Kaspiris & Tortonese, 1982).

Sphaerechinus granularis (Lamarck, 1816)

Material: 47 specimens; stas 40, 60, 82, 83, 85, 92, 105, 109, 110, 180, 191, 196, 200, 201, 203, C, M and T; depth 2-120 m; on rocks and organic detritus, as well as on sandy (meadows of *Posidonia*) and silty sand substrata; Dmax. = 79.6 mm.

Distribution: Known from various localities of the Aegean Sea (Ostroumoff, 1896; Athanassopoulos, 1921; Tortonese, 1946, 1947; Pérès & Picard, 1958; Tortonese & Demir, 1960; Jacquotte, 1962; Vamvakas, 1971; Pancucci & Zenetos, 1990; Özaydin *et al*., 1995).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Cherbonnier, 1956, 1958; Tortonese, 1965; Zavodnik, 1972; Demetropoulos & Hadjichristopohorou, 1976; Schembri, 1978; Kaspiris & Tortonese, 1982; Özaydin *et al*., 1995).

Stylocidaris affinis (Philippi, 1845)

Material: 43 specimens; stas 45, 77, 78, 130, 175, H, S and T; depth 5-180 m; on organic detritus, calcareous

algae, and silty sand and sandy silt substrata; Dmax. = 46.8 mm.

Distribution: Known from various localities of the Aegean Sea (Tortonese, 1946, 1947; Pérès & Picard, 1958; Tortonese & Demir, 1960; Jacquotte, 1962; Makkavieva, 1963; Vamvakas, 1971; Özaydin *et al*., 1995).

An Atlanto-Mediterranean species (Table 1) known from all over the Mediterranean and the Atlantic regions (Mortensen, 1927; Mortensen & Steuer, 1937; Cherbonnier, 1956; Tortonese, 1956, 1961, 1965; Zavodnik, 1972; Schembri, 1978; Kaspiris & Tortonese, 1982).

4. Eleutherozoa – Cryptosyringida – Echinozoa – Holothuroidea

The results of intensive samplings in the Aegean concerning crinoids and holothuroids have been presented by Koukouras & Sinis (1981) and are included in Table 1.

Pancucci-Papadopoulou (1996) when listing the Echinodermata of Greece, included among the holothuroids the species *Echinocucumis hispida* (Barrett, 1857) (as *E. typical*, Sars, 1861), based on a record from the gulf of Kavala, at a depth of 40 m (Papazacharias, 1991). However, the specimen by Papazacharias (1991) which is mentioned as deposited at the Zoological Museum of the Department of Zoology, Aristotle University of Thessaloniki has been lost. Furthermore, this species is known only from the Central Skagerrak; Norway, between Arendal and N Finnmark; off SW Faeroes; off S and W Iceland; off W Ireland and the Biscay gulf; at depths 50-1430 m (Mortensen, 1927; Hansson, 1999). Fredj (1974) included *E. hispida* (as *E. typica*) in his list of the western Mediterranean benthic invertebrates, but without any documentation. For the above reasons, the record of *E. hispida* from the gulf of Kavala has to be considered as erroneous.

During recent sampling, the following holothuroid species was found in the Aegean Sea, at the coast of Megisti island (Kastellorizo) and the coasts of Cyprus.

Synaptula reciprocans (Forskål, 1775)

Material: 10 specimens; stas 218b, 219b, 219c, 239 (Megisti Island) and Cyprus – Lemesos – Zigi; depth 0-4 m; on sandy substrata; Dmax. = 450.0 mm.

Distribution: This species was known from the Red Sea and the SE Arabia (Clark & Rowe, 1971). Tortonese (1947) reported *Synaptula reciprocans* from the Suez Canal (Lake Timsah). Later, Tortonese (1979) noted "*In Antalya (South Anatolia) I was recently told that dark and rather large synaptids were seen near the shore but unfortunately were not collected: they might be Synaptula reciprocans, a Red Sea species quite recently observed along the Israelian shores*". However, Cherbonnier (1986) reported for the first time its presence in the Mediterranean (two specimens from the Akrotiri gulf, Cyprus, and two more from Nachsholin and Dor, Israel), although he did not attribute it to Lessepsian migration, as Zibrowius (1991) noted. Recently, this species was reported from the coast of Lebanon (Zibrowius & Bitar, 2003), the SW coast of Turkey (Çinar *et al*., 2006) and the SE Aegean Sea (Zaitsev & Öztürk, 2001).

In any case, the specimens collected from the area Zigi – Lemesos confirm the presence of *S. reciprocans* in the south coasts of Cyprus.

According to Koukouras & Sinis (1981) two species of Crinoidea are known from the Aegean Sea (Table 1).

Concerning Asteroidea, five more species are known from the Aegean Sea (Table 1): *Asterina panceri* (Tortonese & Demir, 1960), *Ceramaster grenadensis grenadensis* (Marenzeller, 1893, 1895; as *Pentagonaster hystricis*), *Marginaster capreensis* (Marenzeller, 1893, 1895), *Sclerasterias neglecta* (Marenzeller, 1895; as *Stolasterias neglecta*) and *Sclerasterias richardi* (Marenzeller, 1893, 1895; as *Asterias richardi*). Including the above five species, the number of the known Asteroidea from the Aegean Sea is 25.

In respect of Ophiuroidea, ten more species are known from the area (Table 1): *Amphilepis norvegica* (Forbes, 1845; as *Amphiura florifera*), *Amphiura cherbonnieri* (Pancucci & Zenetos, 1990), *Amphiura lacazei* (Pancucci-Papadopoulou, 1996), *Astrospartus mediterraneus* (Belloc, 1948), *Ophiactis savignyi* (Pancucci-Papadopoulou, 1996), *Ophioconis forbesi* (Pérès & Picard, 1958), *Ophiocten abyssicolum* (Forbes, 1845, as *Ophiura abyssicola*; Marenzeller, 1893), *Ophiopsila annulosa* (Pérès & Picard, 1958), *Ophiura (Dictenophiura) carnea* (Marenzeller, 1893; as *Ophioglypha carnea*), and *Pectinura vestita* (Forbes, 1844). Including the above ten species, the number of the known Ophiuroidea from the Aegean Sea is 24.

Concerning Echinoidea, three more species are known from the Aegean Sea (Table 1): *Echinocardium fenauxi* (Borghi, 1994), *Echinocardium flavescens* (Pérès & Picard, 1958) and *Spatangus inermis* (Özaydin *et al*., 1995). Thus, with these three species, the number of the known Echinoidea from the Aegean

Sea is 24.

Koukouras & Sinis (1981) showed the presence of 30 Holothuroidea species in the Aegean Sea. Pancucci & Zenetos (1990) reported *Neocucumis marioni* and Pancucci (1994), *Leptosynapta minuta* from this area. In this study, *Synaptula reciprocans* is also reported (Table 1). Thus, the total number of the known Holothuroidea species from the Aegean Sea rises to 33.

Comparison of the Aegean fauna with the faunas of other neighbouring seas

Tortonese (1979) has numbered 143 Mediterranean echinoderm species (5 Crinoidea, 30 Asteroidea, 34 Ophiuroidea, 26 Echinoidea, 48 Holothuroidea). The review of the relevant literature showed that, up to day, 154 valid species (5 Crinoidea, 33 Asteroidea, 36 Ophiuroidea, 26 Echinoidea, 54 Holothuroidea) have been known from the Mediterranean and the Black Seas. Their distribution over the geographical areas of the Mediterranean and their presence in the Black and Red Seas, and the Atlantic Ocean, as well as their depth range according to the literature and present data, are given in Table 1. The distribution of the known echinoderm species in the main geographical areas of the Mediterranean Sea and the Black Sea (as real numbers and percentages of the total Mediterranean species) as it results from the present study, is given in Table 2 and Fig. 2. Taking into account Tables 1 and 2, Fig. 2, data on the Mediterranean water masses and circulation (Ovchinnikov, 1966; The POEM Group, 1992; Perivoliotis *et al*., 1997) along with data on temperature and salinity variations (Lacombe *et al*., 1958; Özsoy *et al*., 1993) and geographical aspects (Bianchi & Morri, 2000; Pinardi & Masetti, 2000), the following considerations can be made:

Western Mediterranean (WM): 144 species, 93.5% of the known Mediterranean fauna (Ludwig, 1897; Koehler, 1927; Bartolini-Baldelli, 1914; Clark, 1931; Panning, 1949; Tortonese, 1952, 1965; Cherbonnier, 1956, 1958, 1968, 1972; Cherbonnier & Guille, 1967, 1968; Salvini-Plawen, 1972, 1977; Lopez-Ibor Aliño & Galan-Novella, 1982; Guille *et al*., 1983; Pérez-Ruzafa & López-Ibor, 1986; Burke *et al*., 1988). In the western Mediterranean, only ten Mediterranean species have not been found: *Aquilonastra burtoni* (asteroid, Lessepsian migrant), *Amphioplus (Lymanella) laevis* (ophiuroid, Lessepsian migrant), *Amphiura stepanovi* (ophiuroid, Black Sea endemic), *Ophiactis macrolepidota* (ophiuroid, Lessepsian migrant), *Pect-*

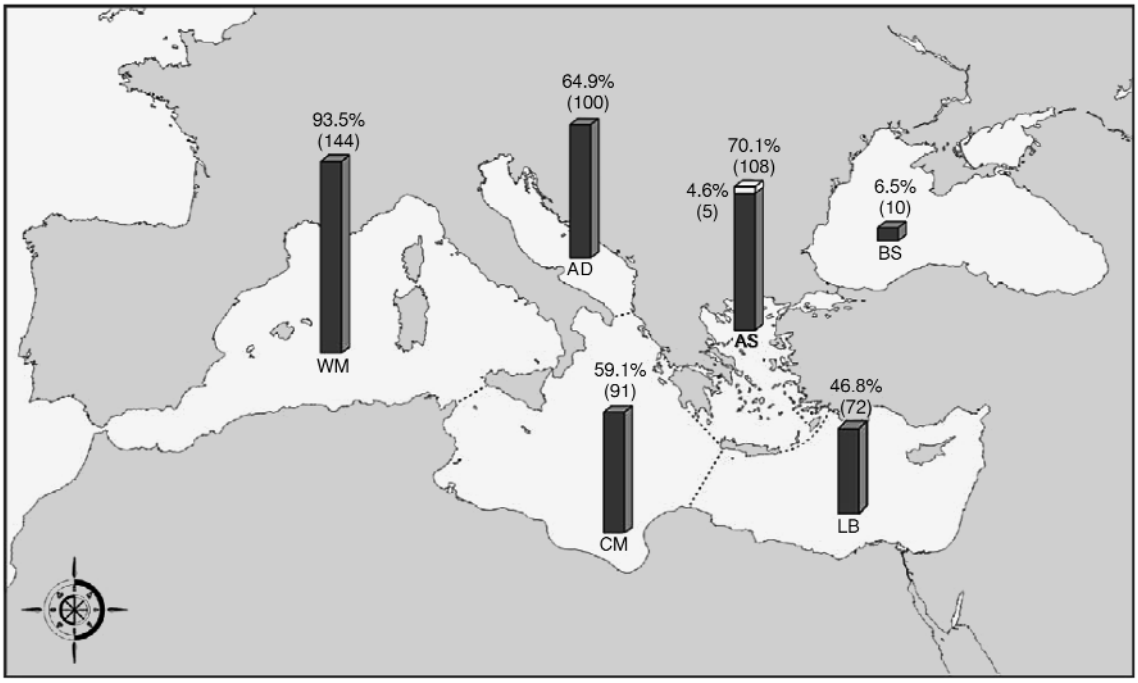

FIG. 2. Distribution of the known species of echinoderms in the main geographical areas of the Mediterranean and the Black Seas, as real numbers and percentages of the total Mediterranean species. Concerning the Aegean Sea, the blank part of the column shows the number of species added by the present study (abbreviations as in Table 1).

TABLE 2. Species number for each one of the five echinoderm taxa separately, as well as total echinoderm species number and Mediterranean species percentage for each one of the geographical areas (abbreviations as in Table 1)

	Geographical areas and species numbers					
	WM	CM	AD	AS	LB	BS
Crinoidea	5	2	2	2	1	0
Asteroidea	32	24	23	25	22	1
Ophiuroidea	32	19	23	24	16	4
Echinoidea	26	21	19	24	17	0
Holothuroidea	49	25	33	33	16	5
Total number	144	91	100	108	72	10
(%)	(93.5)	(59.1)	(64.9)	(70.1)	(46.8)	(6.5)

inura vestita (ophiuroid, Aegean Sea endemic), *Synaptula reciprocans* (holothuroid, Lessepsian migrant), and *Leptosynapta decaria*, *L. galliennii*, *Myriotrochus geminiradiatus*, *Penilpidia ludwigi* (holothuroid, known from other Mediterranean areas). The highest species number of the echinoderm fauna in the western basin of the Mediterranean (Fig. 2, Table 2) could be attributed to the fact that the influx of Atlantic species is initially limited in this large basin, which, having a wide range of physicochemical parameters, permits the settlement of both cold and warm water species in its northern and southern parts, respectively. This general trend does not seem to be strongly based on the more intensive sampling carried out in this area.

Central Mediterranean (CM): 91 species, 59.1% of the known Mediterranean fauna (Marenzeller, 1893; Cherbonnier, 1956; Pérès & Picard, 1956; Gautier-Michaz, 1958; Tortonese, 1965; Schembri, 1978; Kaspiris & Tortonese, 1982; Pancucci & Zenetos, 1989; Fiege & Liao, 1996). Central Mediterranean comes fourth in echinoderm species number (Fig. 2, Table 2), although it should have a higher species number compared with the Aegean and Adriatic Seas, due to its direct neighbouring with the western Mediterranean. This lower number of species should be attributed to the limited sampling effort carried out in this area.

Adriatic Sea (AD): 100 species, 64.9% of the known Mediterranean fauna (Mayer, 1937; Tortonese, 1956, 1965; Zavodnik, 1960, 1972, 1979, 1980, 1995; Salvini-Plawen, 1972, 1977). The Adriatic Sea (Fig. 2, Table 2), although intensively sampled, displays a relatively low species number. This should mainly be attributed to a) its considerably restricted communication with the western basin (Ovchinnikov, 1966; Theocharis *et al*., 1993), b) the larger amplitude of temperature variations (Delépine *et al*., 1987), and c) the shallow waters of its northern part with relatively low winter temperatures and low salinity (Lacombe & Tchernia, 1960).

Aegean Sea (AS): 108 species, 70.1% of the known Mediterranean fauna (Forbes, 1844, 1845; Marenzeller, 1893, 1895; Ostroumoff, 1896; Tortonese, 1946, 1947; Pérès & Picard, 1958; Tortonese & Demir, 1960; Koukouras & Sinis, 1981; Pancucci & Zenetos, 1990; Özaydin *et al*., 1995; present study). Although the Aegean Sea is more distant from Gibraltar (the main pathway of enrichment for the Mediterranean fauna) (Ekman, 1967) than the Adriatic, the Aegean is inhabited by a larger number of species (Fig. 2, Table 2). The main reasons for the presence of a higher species number in the Aegean could be a) its more direct communication with the western basin (Ovchinnikov, 1996) and b) its higher habitat variability (Pérès, 1967; Koukouras *et al*., 2001).

Levantine Basin (LB): 72 species, 46.8% of the known Mediterranean fauna (Forbes, 1845; Mortensen & Steuer, 1937; Tortonese, 1956, 1965, 1966, 1979; Achituv, 1969, 1973; Demetropoulos & Hadjichristophorou, 1976; Por, 1978; Cherbonnier, 1986; Achituv & Sheer, 1991; Zibrowius, 1991; Özaydin *et al*., 1995; Zaitsev & Öztürk, 2001; Zibrowius & Bitar, 2003). The lowest species numbers of the Levantin basin in comparison with those of other Mediterranean areas (Fig. 2, Table 2) should mainly be attributed to its impoverished fauna, a fact that is without doubt a result of the fluctuations resulting from the last glacial cycle, and much less of the present restricting circumstances, as for example the oligotro-

phic conditions (Por & Dimentman, 1989), as well as to the less intensive sampling effort carried out in the area. Moreover, from the Atlantic species inflowing in the Mediterranean through the Gibraltar Straits, few species are able to reach and settle in the Levantine Sea, where particularly unfavourable conditions prevail (Por & Dimentman, 1989; Koukouras & Russo, 1991; Koukouras *et al*., 2001; Arvanitidis *et al*., 2002). Conversely, the fauna of the eastern part of the Levantine Basin became enriched with four Lessepsian migrants, one of which, *Synaptula reciprocans*, has extended its distribution up to SE Aegean Sea (present study).

Black Sea (BS): 10 species, 6.5% of the known Mediterranean fauna (Caspers, 1968; Tortonese & Demir, 1960; Tortonese, 1979). The extremely low species number of the Black Sea fauna is a result of the very peculiar oceanographic conditions prevailing in the area, especially the low salinities and temperatures (Caspers, 1957; Tortonese & Demir, 1960; Longhurst, 1998).

The total of the 154 Mediterranean echinoderm species is distributed within the five taxa as it is shown in Fig. 3 and Table 3. In Fig. 4 (based on Tables 1 and 3), the participation of the four zoogeographical categories as percentages of the total Mediterranean species is given. As it is demonstrated, most species (68.2%) have an Atlanto-Mediterranean distribution, while 26% are possibly Mediterranean endemics and only five species (3.2%) are cosmopolitan. Four species (2.6%) are Lessepsian immigrants in the Mediterranean Sea. Only one of them, *Synaptula recipro-*

TABLE 3. Species number for each one of the five echinoderm taxa separately, as well as total echinoderm species number and percentage for each zoogeographical category. The number and percentage of Mediterranean species per taxon is also given (abbreviations as in Table 1)

	Zoogeographical categories				All Mediterranean species and (%)
	AM	E	C	LM (IP)	
Crinoidea	3	2	0	0	5 (3.2)
Asteroidea	27	5	0	1	33 (21.4)
Ophiuroidea	24	8	2	2	36 (23.4)
Echinoidea	20	5	1	0	26 (16.9)
Holothuroidea	31	20	2	1	54 (35.1)
Total number	105	40	5	4	154
(%)	(68.2)	(26.0)	(3.2)	(2.6)	

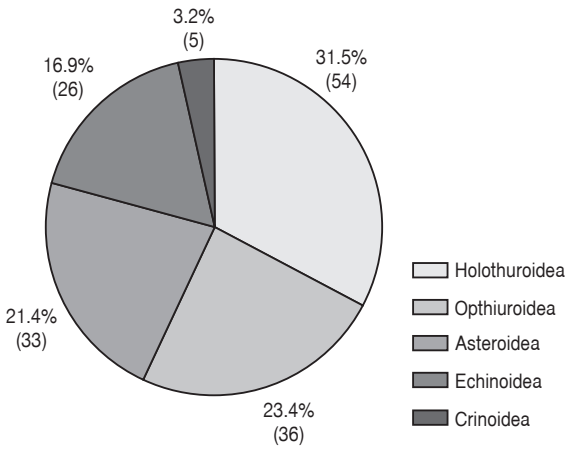

FIG. 3. Echinoderm fauna composition in the Mediterranean and the Black Seas (percentages and real numbers) regarding the contribution of the five taxa.

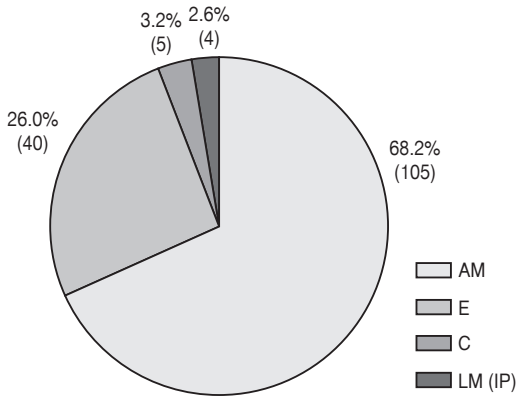

FIG. 4. Echinoderm fauna composition in the Mediterranean and the Black Seas (percentages and real numbers), regarding the zoogeographical characterization of the species (abbreviations as in Table 1).

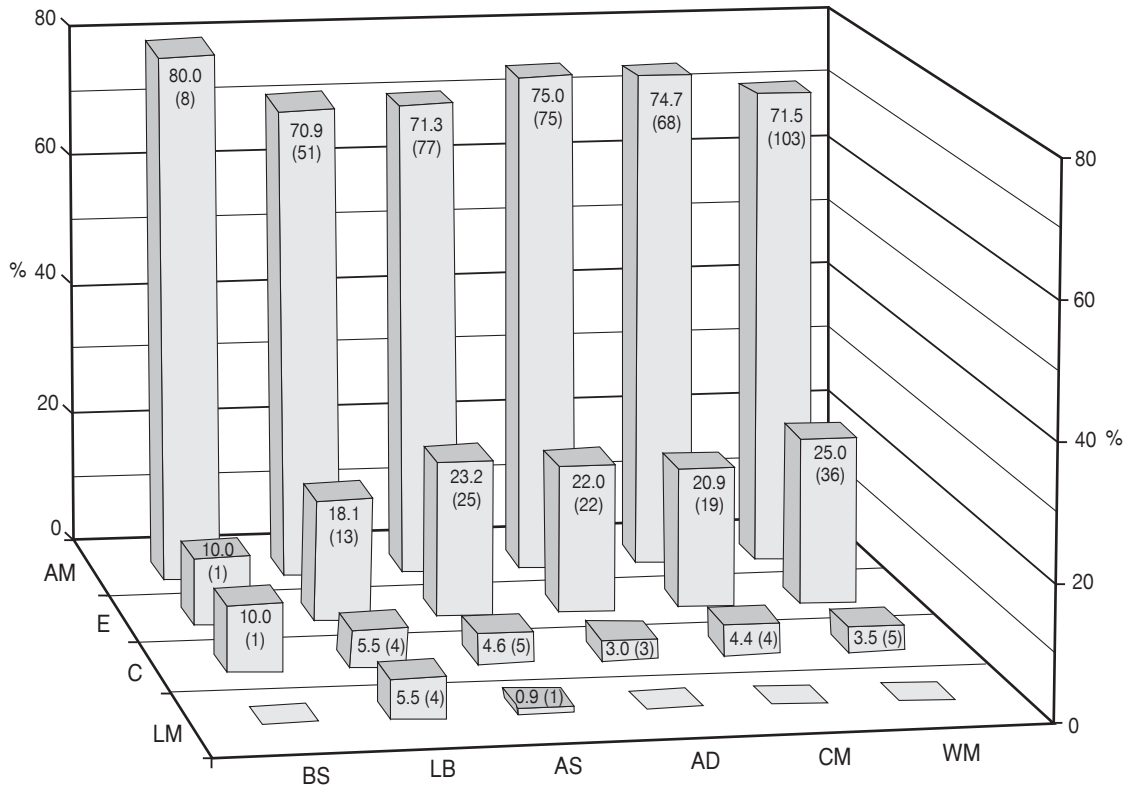

FIG. 5. Percentages of the four zoogeographical categories in the Mediterranean territorial areas and the Black Sea; calculations were made for the total of species found from each area (abbreviations as in Table 1).

cans has extended its distribution beyond the Levantine Basin to the SE Aegean Sea. The percentage of endemic species (26%) is relatively very high probably due to the sluggish locomotion of echinoderms and their relatively short pelagic stage of development. Tortonese (1985) has listed 144 Mediterranean species, 35 of which (24.3%) were characterized as endemic.

In Fig. 5 (based also on Tables 1 and 3), the percentages of the four zoogeographical categories, for the total of species known from each Mediterranean area and the Black Sea, are shown. From this Figure it is obvious that in each Mediterranean area, Atlanto-Mediterranean species dominate followed by endemic and cosmopolitan species. Furthermore, the species number (and percentage) of each zoogeographical category seems to decline from west to east, as it also applies to the total known species numbers from each Mediterranean area. The above considerations are supported by those of Koukouras *et al*. (2001) and Koukouras & Karachle (2005).

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