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Contribution to the Knowledge of Keratose Sponges (Dictyoceratida, Dendroceratida, Verongida: Demospongiae, Porifera) of the Aegean Sea

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With 5 figures

Abstract. Samplings carried out in the North Aegean Sea revealed the presence of 24 Keratose sponge species belonging to the orders Dictyoceratida, Dendroceratida and Verongida. Eight of these species are new records for the Eastern Mediterranean, 1 for the Aegean Sea and 5 for the North Aegean Sea. For the 24 species found, geographical distribution, as well as ecological and other information is given. A check list of the Keratose species found up to the present in the Eastern Mediterranean is presented and discussed. Finally, the Keratose fauna of the Aegean is compared to that of other Mediterranean areas on the basis of their common species.

Key words: Porifera, Dictyoceratida, Dendroceratida, Verongida; Zoogeography; Systematics; Ecology; Aegean Sea

Introduction

The Aegean Sea is one of the less studied Mediterranean areas as far as its benthic fauna is concerned. Sponges are included among the benthic animal groups for which there is relatively few information.

Our knowledge of the sponge fauna of the Western Mediterranean is fairly satisfactory (SCHMIDT 1862, 1864; TOPSENT 1925b, 1928; SARA 1958a, 1961b; VACELET 1959, 1969; PULITZER-FINALI 1970, 1978; etc.). However, there is very restricted information on the sponge fauna of the Eastern Mediterranean as has been pointed out by various authors (EKMAN 1967, VACELET 1980, etc.). This information is included in a small number (12) of publications, namely those by LEVI (1957) and TSURNAMAL (1968, 1969b) which refer to the demosponges of the coasts of Israel; BURTON (1936) for the coasts of Alexandria; SZYMANSKY (1904) who studied a very small sponge collection (7 species) from Aegina Island in the South Aegean Sea; SARITAS (1972, 1973) including 38 sponge species from the Turkish coast of the Aegean; RÜTZLER & BROOMLEY (1981) describing a new species from the coasts of Rhodes Island; VOULTSIADOU-KOUKOURA (1987) who commented on the genus *Aplysina* in the Mediterranean; and VOULTSIADOU-KOUKOURA et al. (1991) describing a new species from the North Aegean Sea.

Occasionally informations on the presence of some sponge species are included in a restricted number of papers (PERES & PICARD 1958; GRIESSINGER 1971, LABOREL 1980, PULITZER-FINALI & PRONZATO 1981, etc.). Some other papers (KOUKOURAS et al. 1979, KOUKOURAS et al. 1985, VOULTSIADOU-KOUKOURA et al. 1987) give information on the macrofauna associated with sponge species in the North Aegean Sea.

Concerning the sponges of the orders Dictyoceratida, Dendroceratida and Verongida, formerly referred to as the order Keratosa (BERGQUIST 1980), in which the commercial

species are included, the review of the relevant literature showed that from a total of 48 Mediterranean species only 21 had been reported from the Eastern Mediterranean, 17 from the Aegean Sea (including the Sea of Marmara).

The main objectives of this paper are (i) to give new information on the Keratose sponges of the North Aegean Sea; (ii) to present, for the first time, a check list of the Keratose fauna of the Eastern Mediterranean; (iii) to give a comparison of the Keratose fauna of the Aegean Sea with those of other Mediterranean areas.

Material and Methods

A total of 355 specimens were examined, collected from 115 stations scattered over the North Aegean Sea, excluding the Turkish coasts (Fig. 1. Folded card loosely enclosed). These stations are part of a sampling program started in 1970, aiming to study the benthic macrofauna of the North Aegean Sea. This program includes a total of 236 sampling stations.

Sampling was made by fishing nets (stations marked with a line and capital letter), by free or scuba diving, dredges and grabs (stations marked with a triangle and a number), at depths to approximately 1000 m.

A part of the specimens is deposited in the Museum of the Department of Zoology, University of Thessaloniki, and another part in the Museum of Natural History of the Humboldt University, in Berlin.

Results and Discussion

I. Annotated list of Keratose species found in the North Aegean Sea

From the 48 Keratose species known from the Mediterranean (see below), the following 24 were found in the North Aegean Sea, by the present study.

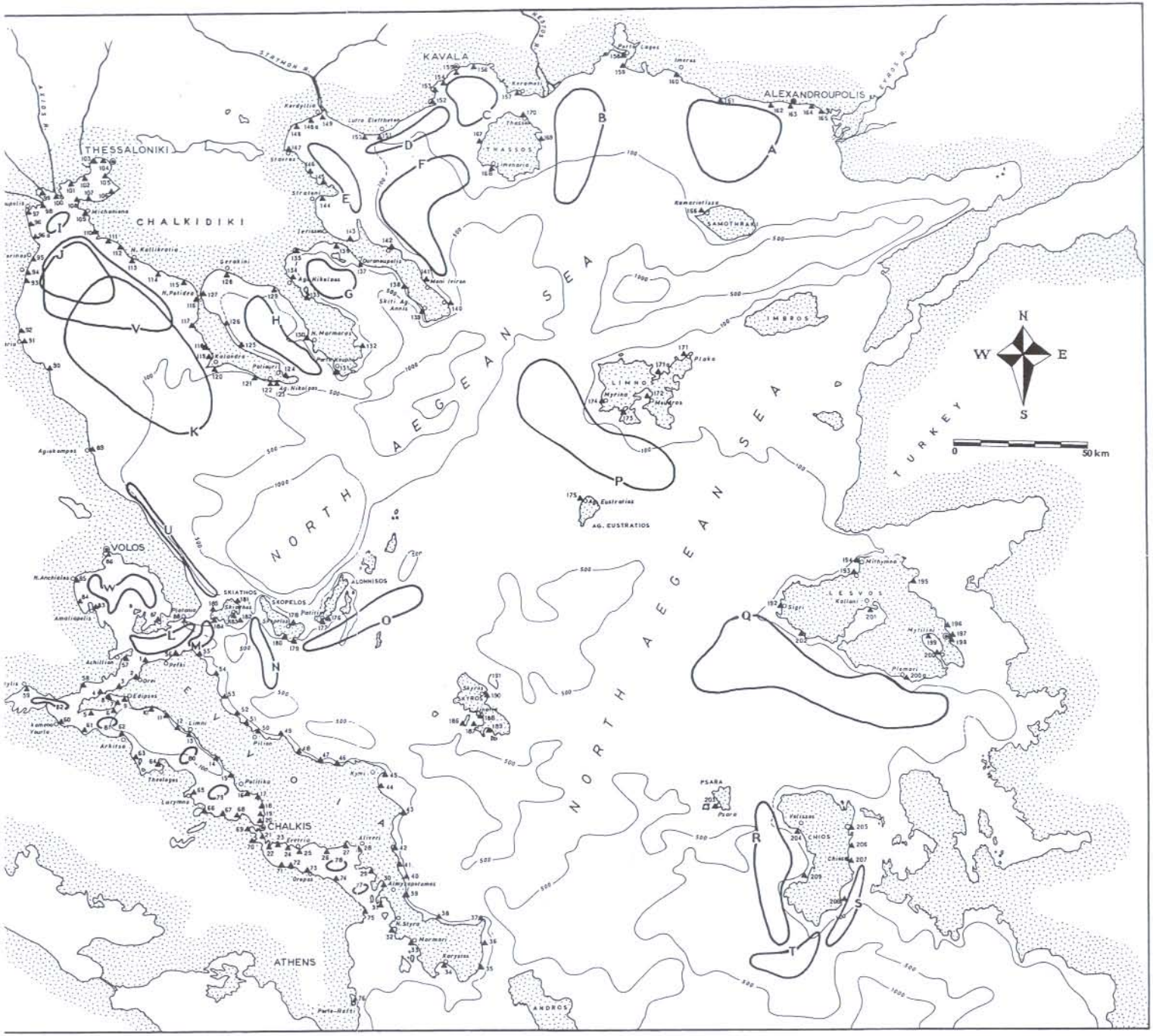
Order DICTYOCERATIDA

Family SPONGIIDAE

Spongia officinalis LINNAEUS, 1759

Spongia adriatica SCHMIDT, 1862, p. 20, taf. II, fig. 1.
Spongia officinalis LAUBENFELS, 1948, p. 4, fig. 1, pl. I, II.

Material: 20 specimens (stations: 34, 37, 109, 112, 117, 120, 128, 129, 130, 132, 135, 152, 189, 194, 196, 202, K, W).
Ecology: Found at depths of 1 – 70 m, on rocks and coralligenous bottoms. More than 90 animal species were found associated with this sponge species (KOUKOURAS et al. 1985).
Distribution: Aegean Sea (SZYMANSKI 1904, PERES & PICARD 1958, KOUKOURAS et al. 1985), remaining areas of the Eastern Mediterranean (BURTON 1936, LEVI 1957), Western Mediterranean-Adriatic (SZYMANSKI 1904; RÜTZLER 1965, 1976; VACELET 1976; PULITZER-FINALI & PRONZATO 1977; URIZ 1984; etc.). Indian Ocean, Australia, Northwest coast of America (LAUBENFELS 1948, etc.). Cosmopolitan species.



Iap showing the location of sampled areas, in the North Aegean Sea

Remarks. The distribution of this commercial species, especially in the Eastern Mediterranean, is much more extended than it seems to be. Information obtained from sponge fishermen (personal communication) show that it exists along the coasts of Tunisia, Lybia, Egypt and Cyprus (although there are no published records of its presence in these areas).

Spongia agaricina (PALLAS, 1766)

Euspongia officinalis var. *lamella* SCHULZE, 1879, p. 617, tab. 35, fig. 4.
Spongia agaricina VACELET, 1959, p. 77.

Material: 3 specimens (stations: 146, 213, C).
Ecology: Found in depths around 20 m, on rocky substrates.
Distribution: Aegean Sea (no exact location is given), Eastern Mediterranean (LENDENFELD 1889). Western Mediterranean (BOURY-ESNAULT 1971, OLIVELLA 1977, RÜTZLER 1976, etc.), Australia (LENDENFELD 1889, LAUBENFELS 1948). Cosmopolitan species.

Spongia nitens (SCHMIDT, 1862)

Ditella nitens SCHMIDT, 1862, p. 24, taf. II, fig. 6.
Spongia nitens VACELET, 1959, p. 74, fig. 11.

Material: 2 specimens (stations: 112, 175).
Ecology: Specimen from station 175 on coralligenous bottom (40 m) and that from station 112 on a rock, among the alga *Cystoseira* (0.9 m).
Distribution: First record of this species from the Eastern Mediterranean. Western Mediterranean-Adriatic (TOPSENT 1934, RÜTZLER 1965, etc.). East Atlantic coast (LOPES & BOURY-ESNAULT 1981, etc.).

Spongia virgultosa SCHMIDT, 1868

Spongia virgultosa SCHMIDT, 1868, p. 4. – VACELET, 1959, p. 78, fig. 13, 14, 15.

Material: 16 specimens (stations: 20, 29, 42, 117, 122, 134, 142, 173, 176, 180, 188, 189, 203, 205, 207, 211).
Ecology: On rocks and stones, at depths of 1–8 m.
Distribution: First record from the Eastern Mediterranean. Western Mediterranean-Adriatic (SCHMIDT 1868, SARA 1960, RÜTZLER 1965, BENITO 1981, etc.), Atlantic coast of South America (BOURY-ESNAULT 1973), etc. Cosmopolitan species.
Remarks: On the surface of the specimen from station 29 many coral fragments and small pebbles were found. In the ectosome of the specimen from station 189 numerous spicules (anchors, oxeas, stereasters, anisochelae, etc.) belonging to different sponge species were incorporated.

Spongia zimocca SCHMIDT, 1862

Spongia zimocca SCHMIDT, 1862, p. 23, taf. II, fig. 3, 4.

Material: One specimen from station P.
Ecology: On a small rock at a depth of about 30 m.
Distribution: Aegean Sea (Turkish coast), remaining areas of Eastern Mediterranean (LENDENFELD 1889). Sea of Marmara (ARNDT 1947). Western Mediterranean-Adriatic (SARA 1958b, RÜTZLER 1976, etc.).

Hippospongia communis (LAMARCK, 1813)

Spongia equina SCHMIDT, 1862, p. 23, taf. II, fig. 5.
Hippospongia communis LAUBENFELS, 1948, p. 30.

Material: 6 specimens (stations: 106, 131, 162, 193, 196, J).
Ecology: On rocks, at depths from 1 to 40 m.
Distribution: Aegean Sea (PERES & PICARD 1958; LABOREL 1960, 1980). Sea of Marmara (ARNDT 1947). Western Mediterranean-Adriatic (SARA 1958b; RÜTZLER 1965, 1976; BOURY-ESNAULT 1971; etc.). Caribean Sea, Australia (LENDENFELD 1889). Cosmopolitan species.

Family THORECTIDAE

Cacospongia scalaris SCHMIDT, 1862

Cacospongia scalaris SCHMIDT, 1862, p. 27, taf. II, fig. 4.

Material: 18 specimens (stations: 77, 78, 79, 85, 87, 125, 128, 146, 151, 210, D, E, G, J, K, M).
Ecology: On rocks and coralligenous bottoms, at depths of 4–350 m. On the specimen of station K, the decapod *Pilumnus spinifer* H. MILNE-EDWARDS was found, while in the choanosome of the specimen from station 77 the barnacle *Acasta spongites* (POLI).
Distribution: Aegean Sea (SZYMANSKI 1904, DIAPOULIS & BOGDANOS 1983), remaining areas of Eastern Mediterranean (BURTON 1936), Western Mediterranean-Adriatic (SARA 1958a, POULIQUEN 1972, RÜTZLER 1976, etc.), East Atlantic coast (LOPES & BOURY-ESNAULT 1981), Japan (HOSHINO 1977), etc. Cosmopolitan species.

Cacospongia mollior SCHMIDT, 1862

Cacospongia mollior SCHMIDT, 1862, p. 27.

Material: 3 specimens (stations: 122, I, V).
Ecology: On rocks and *Posidonia* rhizomes, from 4 to 36 m.
Distribution: First record of this species from the North Aegean Sea. South Aegean Sea (SZYMANSKI 1904), remaining areas of Eastern Mediterranean (BURTON 1936), Sea of Marmara (ARNDT 1947), Western Mediterranean-Adriatic (TOPSENT 1934, BOURY-ESNAULT 1971, OLIVELLA 1977, PULITZER-FINALI & PRONZATO 1977, etc.).

Ircinia variabilis (SCHMIDT, 1862)

Hircinia variabilis SCHMIDT, 1862, p. 34, taf. III, fig. 15.
Ircinia fasciculata VACELET, 1959, p. 89.
Ircinia typica PULITZER-FINALI & PRONZATO, 1977, p. 93.

Material: 96 specimens (stations: 7, 12, 15, 20, 22, 23, 24, 25, 27, 29, 30, 34, 37, 42, 53, 54, 62, 68, 69, 77, 79, 108, 112, 117, 120, 123, 125, 126, 128, 129, 131, 132, 135, 137, 138, 139, 140, 141, 142, 143, 146, 151, 153, 159, 167, 168, 170, 172, 173, 176, 178, 179, 180, 183, 188, 193, 199, 202, 203, 205, 207, 208, 209, 211, 212, 213, C, J, L, M).
Ecology: In various types of hard substrates, from 0 to 200 m. Specimens from stations 30 and 53 were found on the gastropod *Phyllonotus trunculus* (LINNAEUS) and the sponge *Geodia cydonium* (JAMESON) correspondingly. More than 150 animal species were found to be associated with this sponge (KOUKOURAS et al. 1985).

Distribution: Aegean Sea (SZYMANSKI 1904, PULITZER-FINALI & PRONZATO 1981, KOUKOURAS et al. 1985), remaining areas of Eastern Mediterranean (BURTON 1936, LEVI 1957), Western Mediterranean-Adriatic (SARA 1958a, 1961b; VACELET 1961a; OLIVELLA 1977; etc.), Atlantic coast (LAUBENFELS 1948, etc.), Pacific Ocean (HOSHINO 1981), N USSR coast (KOLTUN 1959), etc. Cosmopolitan species.
Remarks: The material examined confirms that *I. variabilis* is a species showing a very wide morphological variability. It was found to have a thickly encrusting to irregularly massive form. The color of its ectosome varied greately between yellowish-gray to black. No remarkable differences were found in the structure of the skeleton among the various specimens.

Ircinia dendroides (SCHMIDT, 1862)

Hircinia dendroides SCHMIDT, 1862, p. 32, taf. III, fig. 10.

Material: 8 specimens (stations: 55a, 117, 118, 122, 171, 186, 188, 210).
Ecology: On rocks. The specimen from station 186 was attached on the sponge *S. spinosulus* (SCHMIDT) and that from station 55a on the coral *Corallium rubrum* (LINNAEUS). All specimens were found at depths between 2 and 4 m, with the exeption of that from station 55a which was found at a depth of about 75 m.
Distribution: The presence of this species in the North Aegean Sea is reported for the first time. South Aegean (SZYMANSKI 1904, PULITZER-FINALI & PRONZATO 1981), Western Mediterranean-Adriatic (SCHMIDT 1862, SARA 1958a, VACELET 1961a, OLIVELLA 1977, etc.), East Atlantic coast (LOPES & BOURY-ESNAULT 1981).

Ircinia oros (SCHMIDT, 1864)

Hircinia oros SCHMIDT, 1864, p. 29, taf. III, fig. 5.

Material: 8 specimens (stations: 85, 89, 131, 188, 207, C, I).
Ecology: On rocks, between 3 and 25 m. The specimen from station 131 was attached on the bivalve *Pinna nobilis* LINNAEUS. The polychaete *C. costae* and the bivalve *Hiatella arctica* were found in the canals of this sponge.
Distribution: First record of this species from the Aegean Sea. Remaining areas of the Eastern Mediterranean (BURTON 1936), Western Mediterranean-Adriatic (SARA 1960, RÜTZLER 1965, POULIQUEN 1972, OLIVELLA 1977, etc.).

Ircinia pausifilamentosa VACELET, 1961
(fig. 2, 3)

Ircinia pausifilamentosa VACELET, 1961b, p. 354, fig. 3.

Material: 2 specimens from stations 131 and 213.
Description: Both individuals are massive (fig. 2). The color of the ectosome is brownish-yellow, while that of the choanosome white-yellowish. Surface connules of variable size and in variable distance from one another.

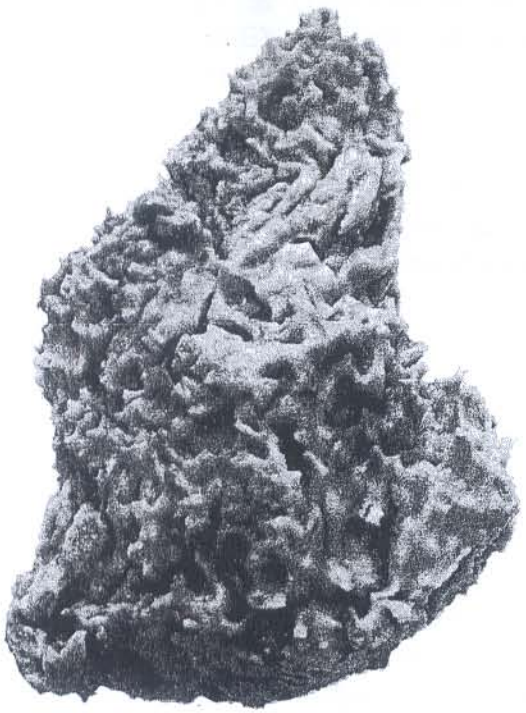


Fig. 2. *Ircinia pausifilamentosa* VACELET

Primary fibers with a mean diameter of 40 μm are full of foreign material. The network formed by the secondary fibers has the form of a perforated plate. The mean diameter of the filaments is 10 μm. Flattenings, refoldings and twistings appear all along them. Their knots are of varying and peculiar form which has been characterized as "pathologic" by VACELET (1961b). Some forms of filament knots are given in fig. 3.

Ecology: Both specimens were found on the walls of submarine caves located at depths of 10 and 15 m. VACELET (1961b) found it also in a submarine cave a few meters deep.

Distribution: It has been recorded up to date only from Kasterorizo Island (South Aegean Sea) by VACELET (1961b), who described it as new species.

Sarcotragus spinosulus SCHMIDT, 1862

Sarcotragus spinosulus SCHMIDT, 1862, p. 35, taf. III, fig. 18.

Material: 14 specimens (stations: 20, 25, 68, 108, 112, 122, 134, 146, 151, 180, 186, 188, 211).

Ecology: On rocks, 1–4 m. Various unidentified species of polychaetes, sipunculans, decapods and amphipods were found living in its canals.

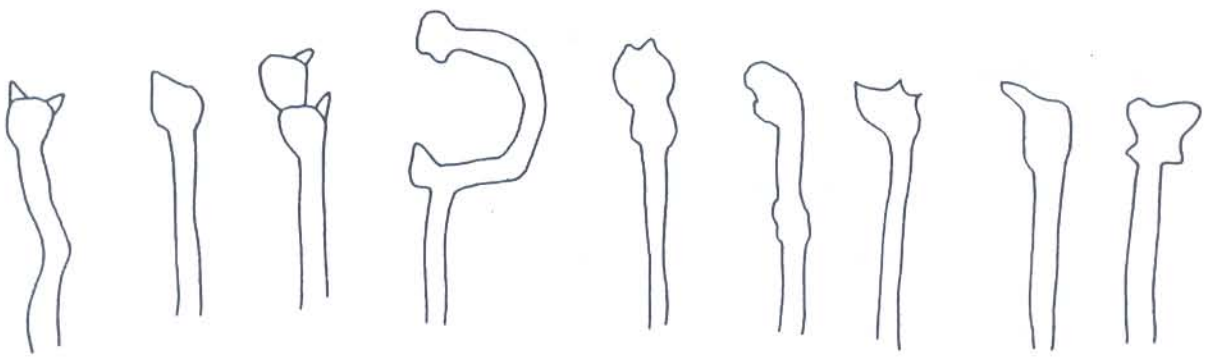


Fig. 3. Filaments of *Ircinia pausifilamentosa* VACELET

Distribution: It has not been previously reported from the Eastern Meditteranean. Western Mediterranean-Adriatic (POULIQUEN 1972, RÜTZLER 1976, BENITO 1981, etc.), East coast of Atlantic, Australia (LOPES & BOURY-ESNAULT, 1981, etc.). Cosmopolitan species.

Sarcotragus foetidus SCHMIDT, 1862

Sarcotragus foetidus SCHMIDT, 1862, p. 36, taf. III, fig. 19.
Sarcotragus muscarum SCHMIDT, 1864, p. 29.

Material: 52 specimens (stations: 5, 20, 23, 25, 27, 29, 38, 42, 45, 53, 55a, 69, 78, 83, 85, 89, 122, 126, 131, 132, 137, 138, 139, 140, 141, 142, 143, 146, 166, 175, 178, 186, 193, 196, 199, 205, 208, 211, 213, 214, B, K, S, V).
Ecology: On rocks, from 0.5 to 300 m. At station 213 it was found in a semidark cave, in a depth of 3 m. On the surface and inside the canals of the sponge many animal species were living (KOUKOURAS et al. 1985).
Distribution: Aegean Sea (SZYMANSKI 1904, VAMVAKAS 1971, PULITZER-FINALI & PRONZATO 1981, BIANCHI & MORI 1982, KOUKOURAS et al. 1985), Western Mediterranean-Adriatic (SARA 1958b, etc.), Eastern Atlantic coast (DURAN & RODRIGUEZ 1982, etc.), Australia (LENDENFELD 1889). Cosmopolitan species.

Fasciospongia cavernosa (SCHMIDT, 1862)

Cacospongia cavernosa SCHMIDT, 1862, p. 28.
Fasciospongia cavernosa VACELET, 1959, p. 93, fig. 22, 23.

Material: 23 specimens (stations: 13, 24, 34, 42, 79, 80, 85, 115, 128, 146, 176, 200, 213, C, V).
Ecology: On rocks, coralligenous bottoms and *Posidonia* rhizomes, at depths between 1 and 85 m. In station 213 it was found in a semidark cave, at 10 m.

In many cases *F. cavernosa* served as a substratum for other organisms, among which sponges. In station 79, the sponges *Cacospongia scalaris*, *Chondrilla nucula* (SCHMIDT) and *Gellius dubius* (BABIC) as well as various algae and mollusc shells were attached. The sponge *Batzella inops* (TOPSENT) covered as an incrustation the specimen from station C. Many algae and the sponges *Timea geministellata* PULITZER-FINALI and *Crella sigmata* TOPSENT were found on the specimen from station E. *T. geministellata* was also found on the specimen from station V, while in station 115 the anemone *Aiptasia mutabilis* (GRAVENHORST) was settled on the surface of *F. cavernosa*. The sipunculan *Phascolosoma granulatum* LEUCKART was living in the canals of the specimen from station 182. Finally, in two occasions *F. cavernosa* used *I. variabilis* as a substrate.
Distribution: This is the first record of this species from the North Aegean Sea. South Aegean (SZYMANSKI 1904). Remaining areas of Eastern Mediterranean (BURTON 1936, LEVI 1957), Sea of Marmara (ARNDT 1947), Western Mediterranean (TOPSENT 1925b; RÜTZLER 1965, 1976; etc.).

Family DYSIDAEIDAE

Dysidea fragilis (MONTAGU, 1818)

Spongelia elegans SCHMIDT, 1862, p. 28, taf. III, fig. 5.

Material: 16 specimens (stations: 30, 37, 70, 77, 145, 151, 188, 201, 207, A, C, D, K, V).
Ecology: In depths of 1–84 m, on hard substrates (rocks, coralligenous bottoms, *Mytilus* shells). Specimens from stations 30 and K were found associated with the ophiuran *O. fragilis* (ABILDGAARD), the decapod *Galathea intermedia* LILLGEBORG, the amphipod *Aristias neglectus* HANSEN, and the bivalve *Anomia ephippium* LINNAEUS.
Distribution: The species is reported for the first time from the North Aegean Sea. South Aegean Sea (VAMVAKAS 1971). Remaining areas of Eastern Mediterranean (BURTON 1936), Black Sea, Bosphorus (ARNDT 1947, GOMOIU 1963), Western Mediterranean-Adriatic (RÜTZLER 1967, VACELET 1967, OLIVELLA 1977, PULITZER-FINALI & PRONZATO 1977, etc.). Eastern and Western Atlantic coasts (BURTON 1956, BOURY-ESNAULT 1973). Cosmopolitan species.

Dysidea tupha (MARTENS, 1824)

Dysidea tupha BENITO, 1981, p. 96, fig. 1. – PULITZER-FINALI & PRONZATO, 1981, p. 129, fig. 1.

Material: 1 specimen from station 174.
Ecology: It was found on the lower surface of a rock, in a depth of about 4 m.
Distribution: The species has not been previously reported from the Eastern Mediterranean. Western Mediterranean-Adriatic (VACELET 1961a, BENITO 1981; etc.).

Dysidea avara (SCHMIDT, 1862)

Spongelia avara SCHMIDT, 1862, p. 29, taf. III, fig. 6.
Dysidea avara VACELET, 1959, p. 68, pl. 1, fig. 7.

Material: 8 specimens (stations: 131, 173a, 188, 205, 211, 212, 213).
Ecology: On rocks between 3 and 30 m.
Distribution: North Aegean Sea: Sea of Marmara (ARNDT 1947), Western Mediterranean-Adriatic (VACELET 1961a, RÜTZLER 1965, PULITZER-FINALI & PRONZATO 1981, etc.).

Dysidea incrustans (SCHMIDT, 1862)

Spongelia incrustans SCHMIDT, 1862, p. 29, taf. III, fig. 7.
Dysidea incrustans PULITZER-FINALI & PRONZATO, 1977, p. 88–1981, p. 130.

Material: 4 specimens from stations 146, 175 and 205.
Ecology: Found on the lower surface of rocks, from 2 to 4 m.
Distribution: First record from the Eastern Mediterranean. Western Mediterranean-Adriatic (SCHMIDT 1862, PULITZER-FINALI & PRONZATO 1977, etc.).

Spongiella pulchella (SOWERBY, 1806)

Spongionella pulchella VACELET, 1959, p. 52, figs. 8, 9, 10.

Material: 1 specimen from station 213.
Ecology: Found on the lower surface of a rock, at depth of 3 m.

Distribution: First record from the Eastern Mediterranean. Western Mediterranean-Adriatic (POULIQUEN 1972, OLIVELLA 1977, etc.), East Atlantic coast (ARNDT 1935, LAUBENFELS 1948).

Order DENDROCERATIDA

Family APLYSILLIDAE

Aplysilla rosea (BARROIS, 1876)

Aplysilla sulfurea VACELET, 1959, p. 62, fig. 1, 2.
Aplysilla rosea PULITZER-FINALI & PRONZATO, 1977, p. 98, fig. 10.

Material: One single specimen from station 109.
Ecology: It was found as an incrustation on the bivalve *Mytilus galloprovincialis* in a depth of 1 m.
Distribution: This is the first record of this species from the Eastern Mediterranean. Western Mediterranean-Adriatic (TOPSENT & OLIVIER 1943, VACELET 1961a, etc.), Red Sea (LEVI 1958), Atlantic coast (ARNDT 1935, BOROJEVIC et al., 1968), New Zealand, Australia (BERGQUIST 1980). Cosmopolitan species.

Pleraplysilla spinifera (SCHULZE, 1878)

Pleraplysilla spinifera VACELET, 1959, p. 64, fig. 4, 5.

Material: One single specimen from station K.
Ecology: It was an incrustation on a small rock, at a depth of about 110 m.
Distribution: The species is reported for the first time from the Eastern Mediterranean. Western Mediterranean-Adriatic (VACELET 1959, BOURY-ESNAULT 1971, etc.).

Family HALISARCIDAE

Halisarca dujardini JOHNSTON, 1842

Dendoryx dujardini TOPSENT, 1888, p. 115, fig. VI.
Halisarca dujardini ARNDT, 1935, p. 109, fig. 234.

Material: 2 specimens from stations 48 and 188.
Ecology: Found as an incrustation in semidark sites, at depths of about 3 m. At station 188 it was almost entirely covered by the sponge *Spirastrella cunctatrix* SCHMIDT. In the choanosome of the other specimen a large number of diatoms was observed.
Distribution: Aegean Sea: Sea of Marmara (ARNDT 1947), Black Sea (KAMINSKAYA 1967), Western Mediterranean-Adriatic (SARA & SIRIBELLI 1962, OLIVELLA 1977, URIZ 1984, etc.), Atlantic coast (ARNDT 1935, DESCATOIRE 1969, etc.).

Order VERONGIDA

Family APLYSINIDAE

Aplysina aerophoba SCHMIDT, 1862

Aplysina aerophoba SCHMIDT, 1862, p. 25, taf. III, fig. 2.

Material: 49 specimens (stations: 12, 15, 20, 24, 42, 55a, 68, 69, 77, 87, 112, 122, 129, 130, 131, 134, 135, 137, 138, 140, 143, 146, 153, 166, 171, 199, 201, B, C, E, I, K, S, U, V).

Ecology: It was found on hard substrates (rocks, coralligenous bottoms), but also in *Posidonia* meadows, at depths down to 150 m. At station 77 it was attached to the carapace of the decapod *Pisa armata* (LATREILLE), while at station 15 it covered entirely the decapod *Dromia personata* (LINNAEUS), which was probably unable to move because the sponge was fixed on a rock.
Distribution: Aegean Sea (SZYMANSKI 1904, PERES & PICARD 1958, HOTTINGER 1974, LABOREL 1980, PULITZER-FINALI & PRONZATO 1981, KOUKOURAS et al. 1985, VOULTSIADOU-KOUKOURA 1987, VOULTSIADOU-KOUKOURA et al. 1987), Western Mediterranean-Adriatic (TOPSENT & OLIVIER 1943, SARA 1958a, RÜTZLER 1965, OLIVELLA 1977, etc.), West coast of Africa (BURTON 1956).
Remarks: According to our oppinion the species described by VACELET (1959) as *Verongia cavernicola* is not separate from *A. aerophoba*. They rather seem to be ecological forms of the same species, as supported by VOULTSIADOU-KOUKOURA (1987).

As it appears from the review of the literature, from the 24 species found during this research, 10 are cosmopolitan (*Spongia oficinallis*, *S. agaricina*, *S. virgultosa*, *Hippospongia communis*, *Ircinia variabilis*, *Sarcotragus*, *foetidus*, *S. spinosulus*, *Cacospongia scalaris*, *Dysidea fragilis* and *Aplysilla rosea*), 5 have been found in the Mediterranean and the Eastern coast of Atlantic (*Spongia nitens*, *Ircinia dendroides*, *Spongionella pulchella*, *Halisarca dujardini* and *Aplysina aerophoba*) and 9 have been found up till now exclusively in the Mediterranean (*Spongia zimocca*, *Cacospongia mollior*, *Ircinia oros*, *I. pausifilamentosa*, *Fasciospongia cavernosa*, *Dysidea tupha*, *D. avara*, *D. incrustans* and *Pleraplysilla spinifera*).

Four of these species, namely *Spongia officinalis*, *S. agaricina*, *S. zimocca* and *Hippospongia communis*, are commercial being collected by the sponge fishermen in the Eastern Mediterranean. These species are also collected in some areas of the North Aegean Sea (Limnos and Samothraki Islands, Cape Trikeri, coast of Mount Athos, etc.). It should be mentioned here that in the years 1986–1987 the comercial sponge populations in Greek and Egyptian waters were almost entirely damaged by a disease. Although the real agent of the disease is unknown, it is worthwhile mentioning that the choanosome and the skeleton of these sponges were infected by a fungi species (personal observations).

II. The Keratose fauna of the Eastern Mediterranean: Comparisons and affinities

The review of the relevant literature, combined with the results of our research in the North Aegean Sea, showed that 29 species belonging to the orders Dictyoceratida, Dendroceratida and Verongida are known from the Eastern Mediterranean and they are listed in table 1. Only four of them are not included in our collections: (1) *Heteronema erecta* KELLER, reported from the coast of Israel (Yarne, Akko) by TSURNAMAL (1969b); this species according to POR (1978) is a Lessepsian immigrant and has been found in the Suez Canal and the Red Sea (LEVI 1965). (2) *Chelonaplysilla erecta* TSURNAMAL known also from the coast of Israel (TSURNAMAL 1967). (3) *Dendrilla acantha* VACELET from Santorini Island (South Aegean Sea), collected by "Calypso" (VACELET 1959) and (4) *Hexadella racovitzai* TOPSENT from the coasts of Israel (LEVI 1957). *Coscinoderma sporadense* was recently described by VOULTSIADOU-KOUKOURA et al. (1991) but no further material has been found yet. As can be seen in Table 1, this research added 8 new species to the Eastern Mediterranean fauna, 1 species to the Aegean Sea fauna and five to the fauna of the North Aegean.

Table 1
Check list of the Eastern Mediterranean Keratosa. The presence of a species in a certain area according to the literature is marked with an * instead of × in case it is reported for the first time by the present study.

Species	E. Med.	Aeg.	N. Aeg.
Dictyoceratida			
Spongiidae			
Spongia officinalis LINNAEUS	×	×	×
Spongia agaricina (PALLAS)	×	×	×
Spongia nitens (SCHMIDT)	*	*	*
Spongia zimocca (SCHMIDT)	×	×	×
Spongia virgultosa (SCHMIDT)	*	*	*
Hippospongia communis (LAMARCK)	×	×	×
Coscinoderma sporadense VOULTSIADOU-KOUKOURA, VAN SOEST & KOUKOURAS			
Thorectidae			
Cacospongia scalaris SCHMIDT	×	×	×
Cacospongia mollior SCHMIDT	×	×	*
Ircinia variabilis (SCHMIDT)	×	×	×
Ircinia dendroides (SCHMIDT)	×	×	*
Ircinia oros (SCHMIDT)	×	*	*
Ircinia pausifilamentosa VACELET	×	×	*
Sarcotragus foetidus SCHMIDT	×	×	×
Sarcotragus spinulosus SCHMIDT	*	*	*
Fasciospongia cavernosa (SCHMIDT)	×	×	*
Heteronema erecta KELLER	×	—	—
Dysideidae			
Dysidea fragilis (MONTAGU)	×	×	*
Dysidea tupha (MARTENS)	*	*	*
Dysidea avara (SCHMIDT)	*	*	*
Dysidea incrustans (SCHMIDT)	*	*	*
Spongionella pulchella (SOWERBY)	*	*	*
Dendroceratida			
Aplysillidae			
Aplysilla rosea (BARROIS)	*	*	*
Chelonaplysilla erecta TSURNAMAL	×	—	—
Pleraplysilla spinifera (SCHULZE)	*	*	*
Dendrilla acantha VACELET	×	×	—
Halisarcidae			
Halisarca dujardini JOHNSON	*	*	*
Hexadella racovitzai TOPSENT	×	—	—
Verongida			
Aplysinidae	×	×	×
Aplysina aerophoba (SCHMIDT)			

The number of Keratose species known at present from the Mediterranean is about 48 as it appears from the review of the relevant literature (VACELET 1959, PULITZER-FINALI 1983, URIZ 1984, etc.). The number of species known from the Eastern Mediterranean (29) represents 60.4% of the total Mediterranean Keratose species. Five of these species, namely

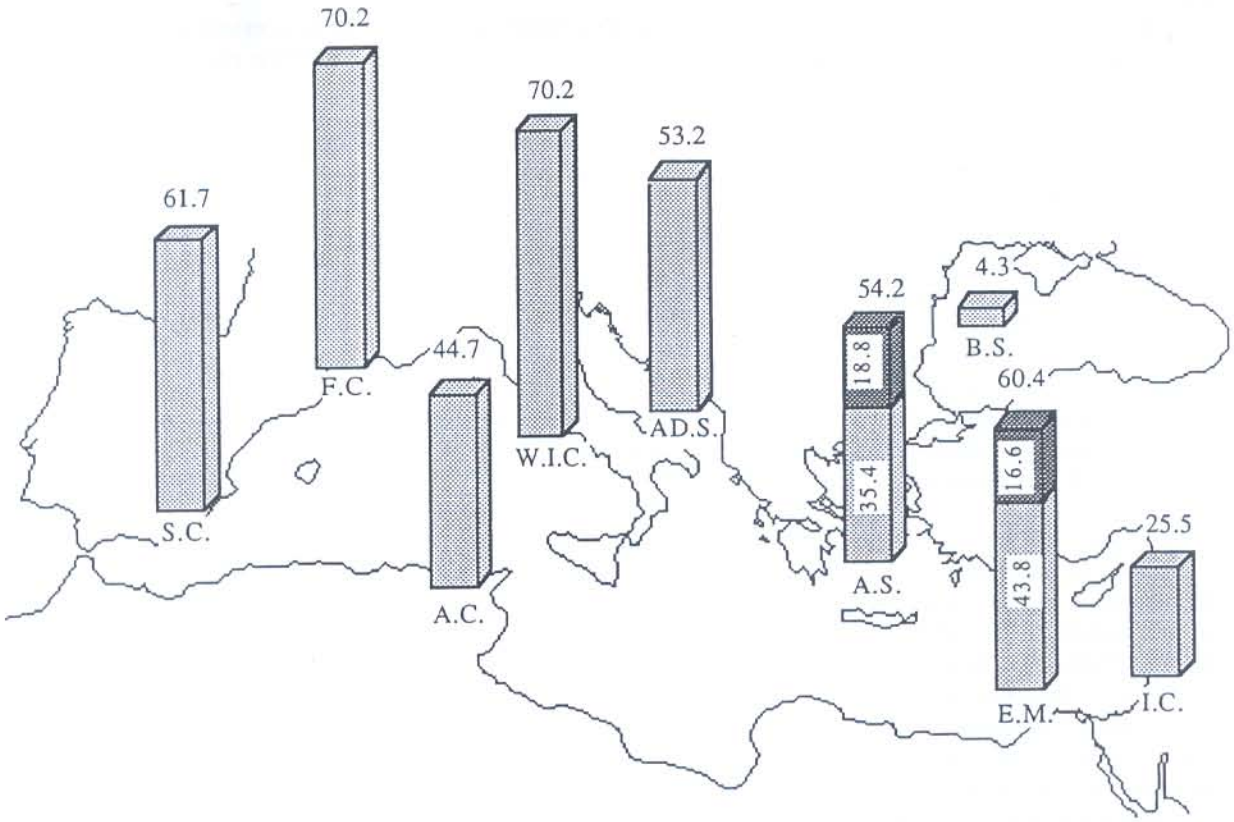


Fig. 4. Distribution of Keratosa in various areas of the Mediterranean and the Black Sea as percentages of the total Mediterranean species. The dark parts of the columns show the percentages added by the present study. S.C. = Spanish coasts, F.C. = French coasts, W.I.C. = Western Italian coasts, AD.S. = Adriatic Sea, T.C. = Tunisian and Algerian coasts, I.C. = Israel and Egyptian coasts, B.S. = Black Sea, A.S. = Aegean Sea, E.M. = Eastern Mediterranean

Heteronema erecta, *Chelonaplysilla erecta*, *Dendrilla acantha*, *Ircinia pausifilamentosa* and *Coscinoderma sporadense*, have been found exclusively in the Eastern Mediterranean, at least for the moment. The percentages corresponding to the Aegean Sea, other Mediterranean areas and the Black Sea are given in figure 4.

The number of species reported from each one of these areas was estimated on the basis of the relevant literature. From Spanish coast 29 species have been recorded up to the present, representing 61.7% of the total Mediterranean Keratose species, according to URIZ 1984. From the Mediterranean French coast (including the coast of Monaco) 33 species (70.2%) have been reported, according to TOPSENT (1893, 1925a), TOPSENT & OLIVER (1943), VACELET (1959, 1969), BOURY-ESNAULT (1971) and PANSINI (1982). The same number of species (33) is known from the West coast of Italy (TOPSENT 1925b; SARA 1958b; PULITZER-FINALI & PRONZATO 1977, 1981). According to SCHMIDT (1862, 1864), SCHULZE (1880), RÜTZLER (1965, 1967), PRONZATO (1975), and PULITZER-FINALI & PRONZATO (1981), the species known from the Adriatic coast are 25 (53.2%). Along the West Mediterranean coast of Africa (coast of Algeria and Tunisia) 21 keratose species (44.7%) have been found (SCHMIDT 1868, FERRER-HERNANDEZ 1916, VACELET 1959, RÜTZLER 1976 and PULITZER-FINALI 1977). On the other hand, from the East Mediterranean coast of Africa (Israel and Egyptian coast) 12 species (25.5%) have been reported according to LENDENFELD (1889), BURTON (1936), (LEVI 1957) and TSURNAMAL (1968). Finally, in the Black Sea, only 2 keratose species were found (4.3%) according to ARNDT (1947) and KAMINSKAYA (1967).

	S.C.	F.C.	W.I.C.	AD.S.	AF.C.	I.C.	A.S.
B.S.	2	2	2	1	1	1	2
A.S.	20	22	23	19	17	9	
I.C.	9	9	9	10	9		
AF.C.	16	17	20	18			
AD.S.	19	21	22				
W.I.C.	23	26					
F.C.	29						
N.S.	29	33	33	25	21	12	26

Fig. 5. Numbers of species common among various Mediterranean areas. The numbers under the table (N.S.) represent the species known in each area (for abbreviations see fig. 4)

Figure 4 shows that the richest faunas are those of the French and West Italian coasts, followed by the fauna of the Spanish coast. The percentages for the Adriatic and the Aegean Sea are approximately equal, but lower than those of the above areas. Still lower are the percentages of the remaining Mediterranean areas and the Black Sea.

The above distribution of Keratose sponges known from the Mediterranean could be a result of the combination of two factors. The first is that some species of Atlantic origin found in the western basin have not yet extended their distribution to (or entered) the eastern basin. The second is that in the former basin much more research has been carried out (as can be seen from the relevant literature and the number of the new records in the latter during the present study). The fact that the number of species known from the West Mediterranean coast of Africa is lower than that of the other areas of the Western Mediterranean may be attributed to the restricted research carried out in this area. The very small number of species found in the Black Sea may be explained by the very peculiar oceanographic conditions prevailing there, especially the low salinity values.

Because some biotopes, such as the very rich in sponge species submarine caves, have not been sufficiently studied throughout the Mediterranean, and also because the various Mediterranean areas are not equally studied with reference to Keratosa, an estimation and discussion of the affinities among them can not be made. However, we considered it useful to present the numbers of species common among them (fig. 5).

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