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Sponge fauna associated with a Mediterranean deep-sea coral bank

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Thirty species of sponges (29 Demospongiae, 1 Hexactinellida) have been recorded in association with a white coral bank situated off Cape S. Maria di Leuca (southern Italy) at depths ranging from 430 to 1160 metres. Notwithstanding the occurrence of clearly eurybathic species, two depth-dependent sponge groups can be identified along the bathymetric gradient. Two species, *Geodia nodastrella* and *Plocamiopsis signata*, are reported for the first time from the Mediterranean Sea. The sponge assemblage shows a higher affinity with the fauna from the Boreal region, with very low number of Mediterranean endemic species. Systematic notes concerning the poorly known and intriguing species, studied using scanning electron microscopy analysis, are reported.

INTRODUCTION

Deep-water corals are present globally, from coastal Antarctica to the Arctic Circle (Rogers, 1999; Tursi et al., 2003). These organisms may build structures several hundred metres in diameter and extending several metres above the sea-floor of bathyal environments with a patch distribution (Jensen & Frederiksen, 1992; Rogers, 1999). These biogenic reefs have a complex three dimensional structure which provides ecological niches for a multitude of other species (Rogers, 1999), constituting islands of hard substrate for the deep benthic fauna (Beaulieu, 2001).

In the Mediterranean Sea, white coral banks consist of sub-fossil deposits and living colonies mainly belonging to the genus *Lophelia* Milne-Edwards & Haime, 1849 and *Madrepora* Linnaeus, 1758.

Sponges represent one of the most remarkable components of the fauna which colonizes deep white corals (Jensen & Frederiksen, 1992; Rogers, 1999 for a review) with a total of 184 species recorded (Vacelet, 1969; Pulitzer-Finali, 1983; Magnino et al., 1999; Rogers, 1999). Among them, 75 species were reported for the Mediterranean Sea (Vacelet, 1969; Pulitzer-Finali, 1983; Magnino et al., 1999), even though such records mainly refer to the French coast (Marseille). Thereafter, knowledge of the taxonomic composition, as well as the geographic and bathymetric distribution of the sponge fauna associated with Mediterranean white coral biocoenosis, is far from exhaustive.

The aim of the present paper is to study the taxonomy and the distribution of the sponge fauna associated with a white coral reef situated about 25 miles south of Cape S. Maria di Leuca (southern Italy–Ionian coast of Apulia, central Mediterranean Sea) (Tursi et al., 2003). This bank, located from 430 to 1160 m in depth, shows the characteristic patch distribution. It consists of living and dead colonies of *Lophelia pertusa* (Linnaeus, 1758) and *Madrepora oculata* Linnaeus, 1758 (Cnidaria, Anthozoa) which have a thick calcareous texture, colonized by several specimens of the solitary anthozoan *Desmophyllum cristagalli* Milne-Edwards & Haime, 1848 (Tursi et al., 2003).

MATERIALS AND METHODS

The material studied was collected during the winter of 2001 from nine sampling stations (Figure 1). Table 1 indicates their geographical coordinates and depths. Sampling was made using a sort of dredge drawn by a boat ('ingegno'). It consisted of an iron bar of 1 m in length and 60 cm in diameter, with pieces of old fishing net attached (Tursi et al., 2003).

The coral samples were immediately fixed with 5% formaldehyde in seawater and taken to the laboratory. For each sampling station about 1.5 kg (in damp weight) of coral colonies was selected and analysed by stereomicroscope to detect sponges. For species identification, slides of dissociated spicules and transversal sections of paraffin wax embedded sponges were prepared and observed with an optical microscope. For each type of spicule 25 dimensional measures were taken using an optical microscope with a micrometric eyepiece. In addition, some species were observed using a Philips SEM 515 scanning electron microscope.

The classification was mainly made according to the updated nomenclature reported in Hooper & van Soest (2002).

Sponge distribution was analysed by multivariate statistical methodologies; the analysis was performed on presence–absence data, using the Bray–Curtis similarity coefficients and group average clustering technique according to the program Primer 5 (Clarke & Warwick, 2001). Analysis of similarities (ANOSIM) was applied to test the differences among and between groups of species-station identified by multivariate analysis. Individual species contributions (up to about 90%) to average

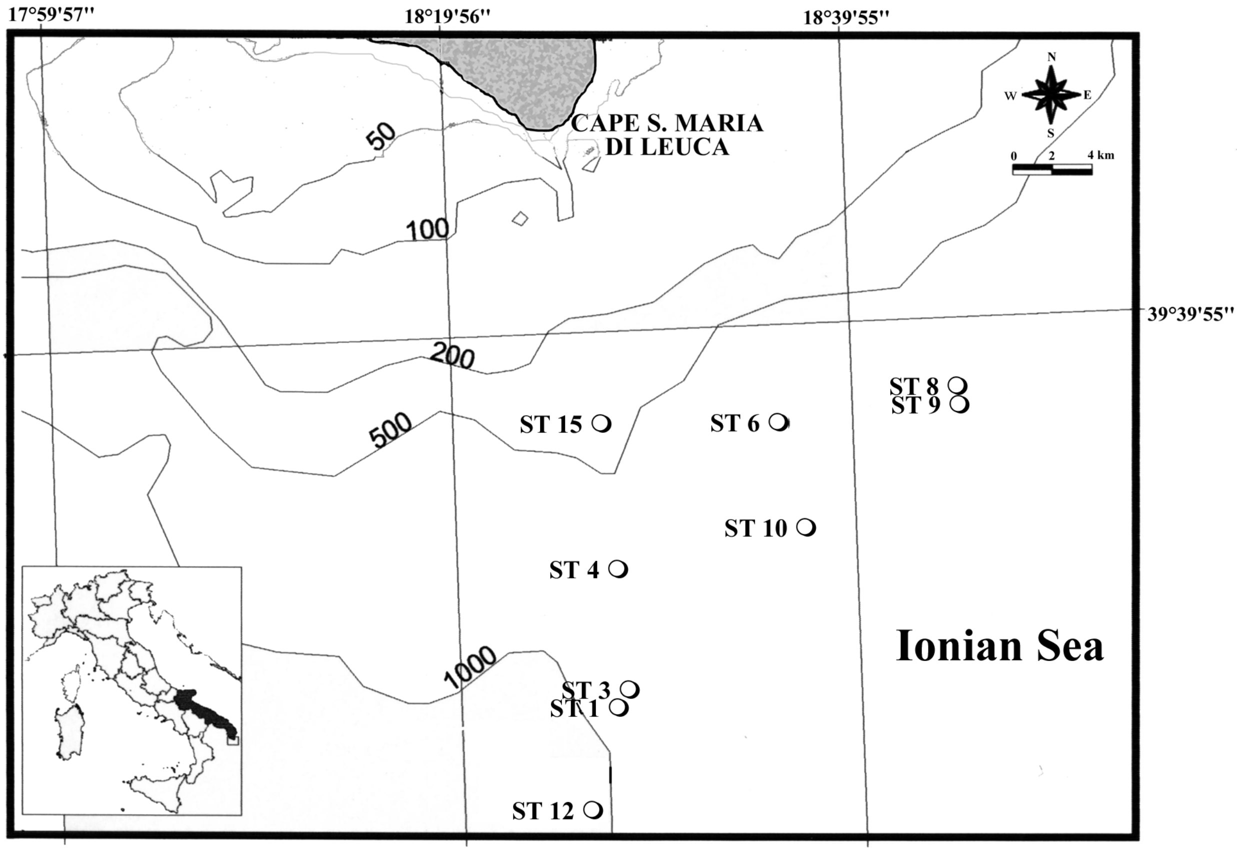

Figure 1. Location of the sampling stations.

Table 1. *List of the sampling stations with geographical coordinates and depths.*

		Beginning haul			End haul			Mean depth
Station	Date	Latitude	Longitude	m	Latitude	Longitude	m	m
1	14/02/2001	39°27.18′N	18°23.62′E	807	39°27.51′N	18°24.01′E	780	793.5
3	14/02/2001	39°27.75′N	18°24.11′E	738	39°27.59′N	18°23.23′E	809	773.5
4	14/02/2001	39°31.93′N	18°23.86′E	647	39°31.81′N	18°25.92′E	631	639
6	14/02/2001	39°36.74′N	18°31.11′E	640	39°36.86′N	18°31.39′E	662	651
8	16/02/2001	39°37.78′N	18°39.07′E	634	39°37.42′N	18°38.80′E	665	649.5
9	16/02/2001	39°37.17′N	18°39.15′E	664	39°37.15′N	18°39.37′E	681	672.5
10	16/02/2001	39°33.10′N	18°32.09′E	780	39°32.70′N	18°32.01′E	789	784.5
12	16/02/2001	39°23.70′N	18°22.32′E	1100	39°23.60′N	18°23.56′E	1160	1130
15	16/02/2001	39°36.98′N	18°23.14′E	430	39°37.34′N	18°23.61′E	469	449.5

similarity within each group were examined using the SIMPER procedure (Clarke & Warwick, 2001).

RESULTS

Systematics

Thirty species of sponges (29 Demospongiae, 1 Hexactinellida) were detected, two of which (*Geodia nodastrella* Carter, 1876, *Plocamiopsis signata* Topsent, 1904) are new records for the Mediterranean Sea. Moreover, *Jaspis incrustans* (Topsent, 1890), *Isops anceps* (Vosmaer, 1894), *Leiodermatium* cf. *lynceus* Schmidt, 1870, and *Haliclona (Gellius) flagellifer* (Ridley & Dendy, 1886) are new records for the Ionian Sea (Table 2).

The single Hexactinellida specimen belongs to the order Hexactinosida Schrammen, 1903, family Tretodictyidae Schulze, 1886. As regards the Demospongiae, the subclasses Tetractinomorpha Lévi, 1953 and Ceractinomorpha Lévi, 1953 are the most represented. Among Tetractinomorpha, the order Astrophorida Sollas, 1888 is the most represented with five families (Ancorinidae Schmidt, 1870,

Table 2. *List of the Porifera found associated with the white coral bank and distribution among the sampling stations.*

	Station 1	Station 3	Station 4	Station 6	Station 8	Station 9	Station 12	Station 15
1 *Tretodictyum* cf. *tubulosum* Schulze, 1886		+						
2 *Plakortis simplex* Schulze, 1880			+					+
3 *Jaspis incrustans* (Topsent, 1890)**		+	+	+				
4 *Pachastrissa pathologica* (Schmidt, 1868)					+			
5 *Erylus papulifer* Pulitzer-Finali, 1983		+	+		+	+		
6 *Geodia nodastrella* Carter, 1876*					+	+		
7 *Isops anceps* (Vosmaer, 1894)**		+						
8 *Pachastrella monilifera* Schmidt, 1868								+
9 *Poecillastra compressa* (Bowerbank, 1866)	+	+	+	+		+		
10 *Vulcanella (Vulcanella) gracilis* (Sollas, 1888)	+							
11 *Thrombus abyssi* (Carter, 1873)		+	+		+	+		+
12 *Cliona* sp.				+				
13 *Timea chondrilloides* (Topsent, 1904)			+					
14 *Spiroxya heteroclita* Topsent, 1896				+				
15 *Spiroxya levispira* (Topsent, 1898)		+			+			
16 *Siphonidium ramosum* (Schmidt, 1870)			+	+	+	+		
17 *Leiodermatium* cf. *lynceus* Schmidt, 1870**								+
18 *Plocamiopsis signata* Topsent, 1904*	+							
19 *Antho* sp.	+	+		+				
20 *Crellastrina alecto* (Topsent, 1898)		+		+				
21 *Hymedesmia mutabilis* (Topsent, 1904)		+	+	+				
22 *Desmacella annexa* (Schmidt, 1870)			+					
23 *Desmacella inornata* (Bowerbank, 1866)	+	+	+	+	+	+	+	+
24 *Hamacantha (Hamacantha) implicans* Lundbeck, 1902	+			+			+	
25 *Hamacantha (Hamacantha) johnsoni* (Bowerbank, 1864)			+	+				+
26 *Sceptrella insignis* (Topsent, 1892)	+	+	+	+	+	+		+
27 *Axinella cannabina* (Esper, 1794)					+			
28 *Bubaris* sp.			+					
29 *Haliclona (Gellius) flagellifer* (Ridley & Dendy, 1886)**		+						
30 *Hexadella detritifera* Topsent, 1913					+			

*, new record for Mediterranean Sea; **, new record for Ionian Sea.

Calthropellidae Lendenfeld, 1907, Geodiidae Gray, 1867, Pachastrellidae Carter, 1875, Thrombidae Sollas, 1888) and nine species. Among the Ceractinomorpha, the most represented order is Poecilosclerida Topsent, 1928, with six families (Microcionidae Carter, 1875 Crellidae Dendy, 1922, Hymedesmiidae Topsent, 1928, Desmacellidae Ridley & Dendy, 1886, Hamacanthidae Gray, 1872, Latrunculiidae Topsent, 1922) and nine species. The third subclass, Homoscleromorpha Bergquist, 1978, is present with one species only, belonging to the family Plakinidae Schulze, 1880.

The sponge assemblage mainly consists of small or thin encrusting specimens with the exception of some Astrophorida (*Pachastrissa pathologica* (Schmidt, 1868), *Erylus papulifer* Pulitzer-Finali, 1983, *I. anceps*, *Poecillastra compressa* (Bowerbank, 1866)) and a Lithistid (*L.* cf. *lynceus*) up to about 10 cm in diameter.

The presence of boring sponges was rather scarce with only three species recorded in all (*Cliona* sp., *Spiroxya heteroclita* Topsent, 1896, *S. levispira* (Topsent, 1898)).

The following, the descriptions of the 11 poorly known and most intriguing species are reported with their characteristics. The range of variations in length, thickness or diameter are reported for each spicule type, with the mean values and standard deviations in parentheses.

Class HEXACTINELLIDA Schmidt, 1870
Order HEXACTINOSIDA Schrammen, 1903
Family TRETODICTYIDAE Schulze, 1886
Genus *Tretodictyum* Schulze, 1886

Tretodictyum cf. *tubulosum* Schulze, 1886
Tretodictyum tubulosum Schulze, 1886: 78

Material

Station 3 no. 5 (738–809 m).

Description

A small whitish and finely bristly specimen with no definable shape was found and entirely used for the spicule preparation.

Spicules

— rugose pentactins or hexactins, the latter with atrophic proximal actin: distal actins 280–600×10–12 μm (434 ±114.8×11.4 ±0.9 μm), proximal actins 40–80×10–12 μm (53.6 ±15.3×11.7 ±1.1 μm), pair actins 160–300×10–12 μm (241 ±50.9×11.5 ±0.8 μm);
— fine spiny scopules with 4–5 rays provided with light swelling at the ends: 350–750×2–4 μm (478 ±157.2 ×3 ±1 μm);
— spiny uncinates: 350–520×1–4 μm (434 ±66.9×2.4 ±1.1 μm);

— rugose oxyhexactins: 75–95 μm (85 ±9.3 μm);
— oxyhexasters with smooth and dichotomous actins: 60–92 μm (68.4 ±13.9 μm).

Ecology and distribution

The species is distributed in the Atlantic and Pacific Oceans (Hooper & van Soest, 2002) and recorded in the Mediterranean Sea from 90–1645 m in depth (Vacelet, 1969; Boury-Esnault et al., 1994).

Remarks

The spiculation of this specimen is close to that of *Tretodictyum tubulosum* reported for the Mediterranean Sea by Vacelet (1969) and Boury-Esnault et al. (1994). However, Reiswig (in Hooper & van Soest, 2002: 1353) doubts such records, proposing the distribution area of the species to be limited to the coasts of Japan and China.

Class DEMOSPONGIAE Sollas, 1885
Subclass TETRACTINOMORPHA Lévi, 1953
Order ASTROPHORIDA Sollas, 1888
Family ANCORINIDAE Schmidt, 1870
Genus *Jaspis* Gray, 1867

Jaspis incrustans (Topsent, 1890)
Epallax incrustans Topsent, 1890: 68

Material

Station 3 no. 4 (738–809 m); Station 4 no. 31 (631–647 m); Station 6 no. 31 (640–662 m).

Description

This species consists of thin encrustations of a few millimetres in thickness and 1 cm in diameter. It has long oxeas which protrude from the surface. It is beige in colour and soft in consistency.

Skeleton

The large oxeas are perpendicular to the surface and they emerge from it. In addition, they are also confusedly scattered in the inner portion of the sponge. The small oxeas are tangential to the surface. The oxyasters are scattered in the sponge tissue.

Spicules

— large oxeas: 1200–1600×8–16 μm (1425.2 ±35.8 ×11 ±2.5 μm);
— small oxeas: 130–480×3–8 μm (370.4 ±96.89 ×6.6 ±1.64 μm);
— oxyasters with finely spiny actins: 12–24 μm (16.8 ±3.79 μm).

Ecology and distribution

This species has been reported in association with red coral colonies between depths of 70 and 120 m in the Alboran Sea (Maldonado, 1992). In addition it is also recorded from the western Mediterranean Sea (France, Morocco, Tunisia) (Vacelet, 1969 as *Jaspis johnstonii* (Schmidt, 1862) var. *incrustans* Topsent, 1898) and from the Atlantic Ocean (Azores; Gulf of Mexico) (Topsent, 1892 as *Dorypleres incrustans* Topsent, 1892). This is the first record for the Ionian Sea.

Family GEODIIDAE Gray, 1867
Genus *Geodia* Lamarck, 1815

Geodia nodastrella Carter, 1876
Geodia nodastrella Carter, 1876: 397
(Figure 2)

Material

Station 8 no. 27 (634–665 m); Station 9 no. 16, 18, 21 (664–681 m).

Description

Specimens are massive and cushion-shaped with a diameter ranging from 1 to 5 cm. Their cortex, white-cream in colour, is hard and friable and might reach about 500 μm in thickness. The surface is smooth, without a different inhalant or exhalant region. The choanosomal portion is pinkish white and fleshy. Some clearly evident parts of the aquiferous system are recognizable: sieve openings, about 100 μm in diameter; large surface canals (0.9–1.6 mm in diameter); small deep canals (0.3 mm).

Skeleton

The cortex is about 1.5 mm in thickness, and consists of an external layer of oxyasters and spherasters positioned over strictly abreast sterrasters. The oxeas are arranged perpendicularly and cross toward the cortical layer. In the choanosome there are oxeas, dichotriaenes, promesotriaenes and anatriaenes that form radial bundles oriented towards the inner part of the sponge.

Spicules

— choanosomal oxeas, bend toward one end: 1900–4000×24–40 μm (some broken oxeas might have been longer) (2325 ±706.6×26 ±5.7 μm);
— dichotriaenes: length of rhabdome 1400–2200 μm (1775 ±386.2 μm), width of cladome 600–700 μm (635 ±47.2 μm);
— promesotriaenes: rhabdome longer than 2000 μm, width of cladome 120–200 μm (153.3 ±41.6 μm);
— anatriaenes: rhabdome longer than 2000 μm, width of cladome 110–150 μm (130 ±14.1 μm);
— cortical oxeas: 320–400×4–8 μm (324 ±39.8×6 ±0.9 μm);
— roundish and spherical sterrasters: 72–80 μm (76.6 ±4.1 μm);
— spherasters with a large centrum and short actins with a terminal swelling: 14–20 μm (17.4 ±2.3 μm);
— strongylasters: 8–12 μm (9 ±1.3 μm);
— oxyasters with conical actins: 14–22 μm (18 ±2.8 μm).

Ecology and distribution

Atlantic Ocean (Scotland, Azores, Cap St. Vincent, Ibero-moroccan Gulf), between depths of 200 and 2165 m (Carter, 1876; Boury-Esnault et al., 1994). This is the first record for the Mediterranean Sea.

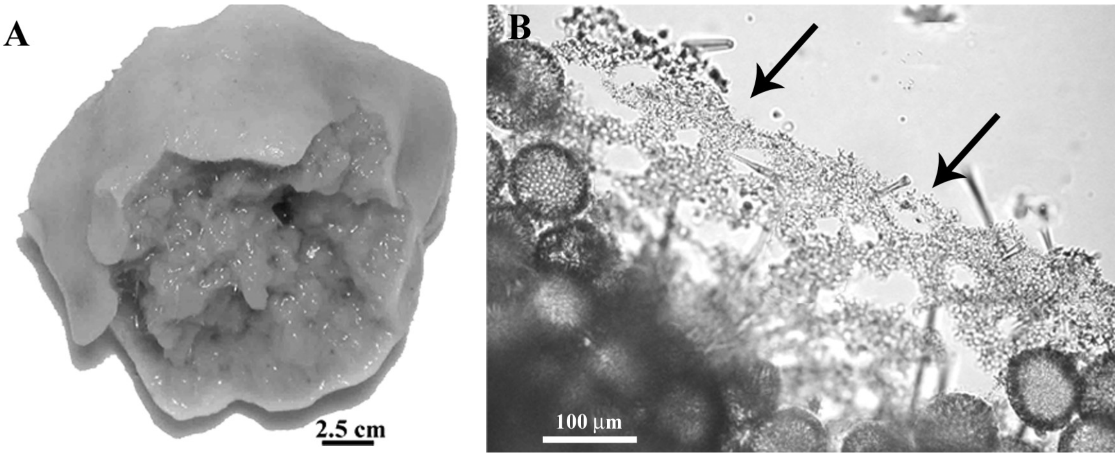

Figure 2. *Geodia nodastrella* Carter, 1876: (A) specimen no 18 collected in ST 9; (B) cross-section of the cortical region with the sieve area (arrows).

Genus *Isops* Sollas, 1880

Isops anceps (Vosmaer, 1894)
Synops anceps Vosmaer, 1894: 275

Material
Station 3 no. 15 (738–809 m).

Description
The specimen found is cushion-shaped measuring 9 cm in diameter. The cortex is dark beige, smooth and crusty with uniformly distributed oscules measuring between 150 and 400 μm in diameter. The choanosome is darker than the cortex, and is tough.

Skeleton
The cortex, about 650 μm in thickness, shows an external layer of oxyspherasters and a lower layer of sterrasters. The clads of the triaenes occupy the inner cortical layer and their rhabdomes are arranged radially towards the choanosome. The oxeas are organized in bundles that are arranged radially together with rhabdomes. The oxyasters are scattered in the choanosome.

Spicules
— oxeas slightly curved: 1200–2000×20–40 μm (1592.2 ±344.21×26 ±6.58 μm);
— orthotriaenes often anomalous: length of rhabdome 540–960 μm (778 ±147.42 μm), width of cladome 180–520 μm (media 348 ±92.95 μm);
— dichotriaenes: length of rhabdome 620–1120 μm (963 ±188.33 μm), width of cladome 250–640 μm (408 ±134.9 μm);
— anatriaenes: rhabdome slightly curved 1100–2500×4–10 μm (1900 ±135.2×8 ±3.7 μm), cladome with short and curved clads sometimes ill-formed: width 45–70 μm (58 ±15.1 μm);
— sterrasters: 88–106 μm (99.2 ±6.87 μm);
— oxyasters with 4–6 conic actins: 40–68 μm (56.4 ±10.23 μm) length of ray 18–32 μm (25.8 ±4.84 μm);
— oxyasters with numerous long and thin actins: 34–66 μm (47.8 ±9.49 μm) length of ray 15–33 μm (21.5 ±5.25 μm);
— oxyspherasters: 10–16 μm (13.5 ±1.71 μm).

Ecology and distribution
This is a deep Mediterranean species, previously reported in the Alboran Sea (70–120 m) (Maldonado, 1992), in association with *Corallium rubrum* (Linnaeus, 1758) and in the Gulf of Naples (120–200 m) (Vosmaer, 1894). This is the first record for the Ionian Sea.

Order HADROMERIDA Topsent, 1894
Family CLIONAIDAE D'Orbigny, 1851
Genus *Cliona* Grant, 1826

Cliona sp.

Material
Station 6 no. 2 (640–662 m).

Description
The presence of the sponge is shown by circular brown papillae 0.9–1.8 mm (1.4 ±0.3 mm) in diameter, emerging from the scleraxis of *Lophelia pertusa* (Linnaeus, 1758). The specimen was very small and was entirely used for spicule preparations. It formed chambers no more than 3 mm in diameter. Despite several skeletal preparations being made, no microscleres were found.

Spicules
— tylostyles slightly curved, sometimes with a subterminal tyle: 304–368×3–6 μm (325.6 ±19.2 ×4.3 ±1.1 μm).

Remarks
The systematic position of boring sponges lacking microscleres and presenting only tylostyles is problematic. Many authors consider sponges with this character synonymous with *Cliona celata* Grant, 1826. However, the

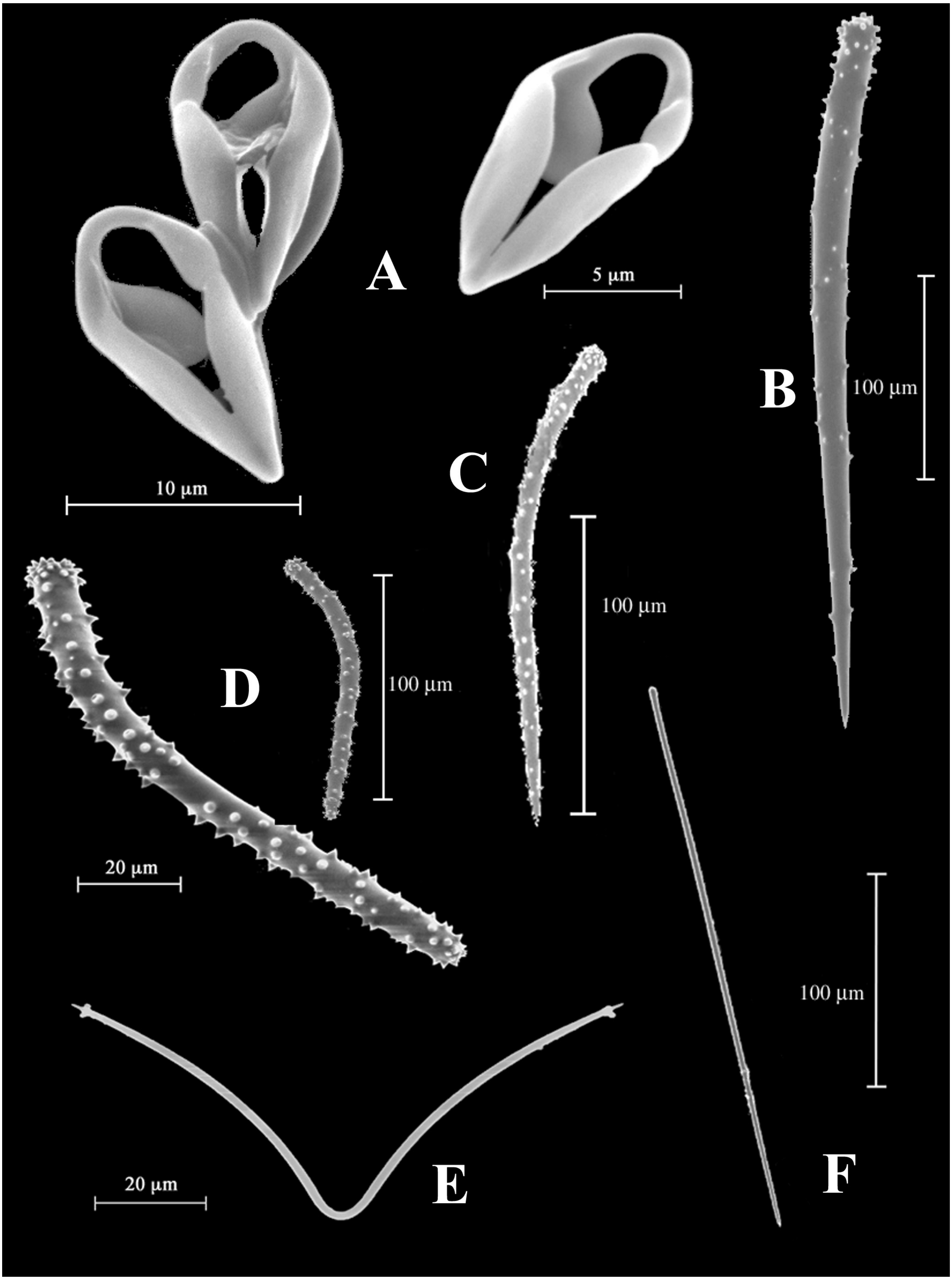

Figure 3. Spicules of *Plocamiopsis signata* Topsent, 1904: (A) anisochelae; (B) principal acanthostyle; (C) auxilar acanthostyle; (D) acanthostrongyles; (E) wing-shaped toxa; (F) subtylostyle.

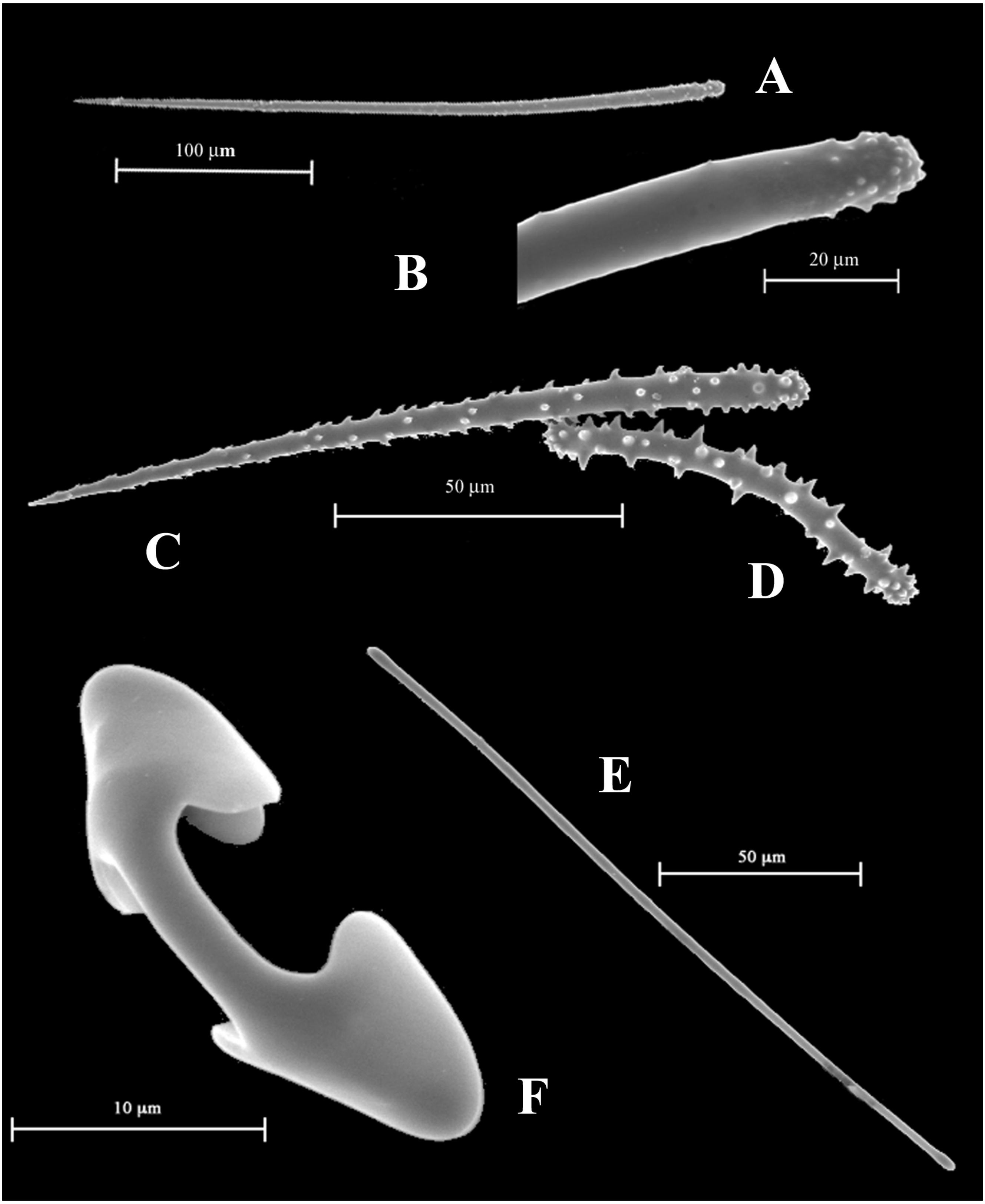

Figure 4. Spicules of *Antho* sp.: (A) principal acanthostyle and (B) detail of its base; (C) auxiliar acanthostyle; (D) acanthostrongyle; (E) tylote; (F) isochelae.

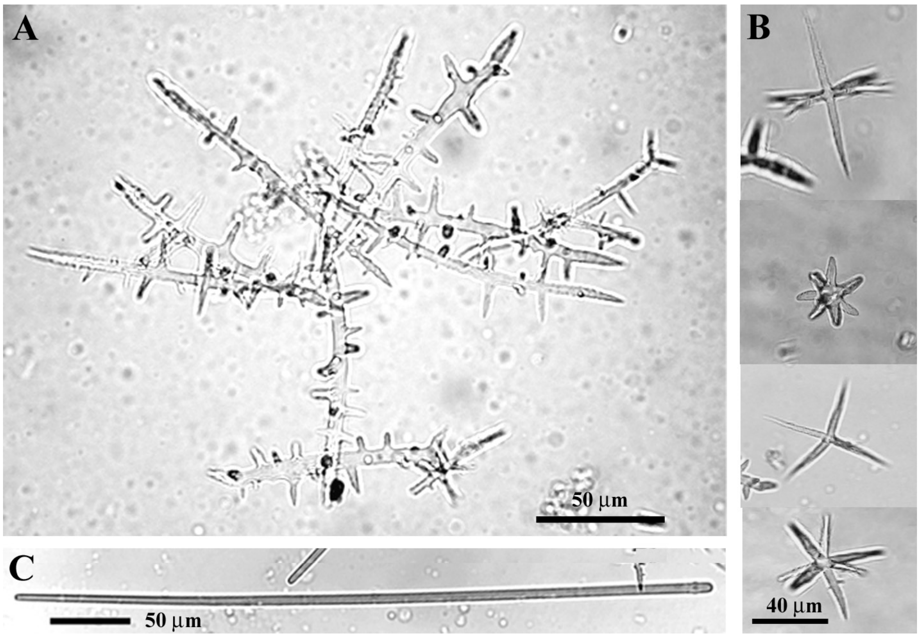

Figure 5. *Crellastrina alecto* (Topsent, 1898) spicules: (A) acanthoxeas; (B) asters; (C) subtylostrongyle.

brown colour of our sponge and the small size of its perforating chambers are not compatible with the diagnostic characters of this species.

Informal group LITHISTID Pisera & Lévi, 2002
Family AZORICIDAE Sollas, 1888
Genus *Leiodermatium* Schmidt, 1870

Leiodermatium cf. *lynceus* Schmidt, 1870
Leiodermatium lynceus Schmidt, 1870: 22

Material
Station 15 no. 6, 7 (430–469 m).

Description
Foliaceous specimens measuring 10–15 cm in length and 0.5 cm in thickness, with several deep undulations. The colour in life is blue, which turns beige after preservation. The consistency is stony and firm. Evenly spaced oscules (diameter: 340 μm), located at the top of small flat elevations, are distributed on the outer sponge surface. A dense net of inhalant pores (diameter: 120 μm) is also recognizable on the inner surface.

Spicules
— rhizoclone desmas: width 100–350 μm (249.5 ±81.3 μm);
— oxeas (rare): the largest measuring 700–850×3–5 μm (788.3 ±52.7×4.3 ±1 μm), the smallest measuring 150–450×2 μm (275 ±112.9 μm).

Ecology and distribution
This is a deep species previously recorded in the Atlantic Ocean, at 355–1530 m in depth (Topsent, 1928; Boury-Esnault et al., 1994), in the Indian Ocean, at 216 m in depth (van Soest & Stentoft, 1988) and in the Mediterranean Sea, at 700 m in depth (Magnino et al., 1999). This latter record is referred to both bathyal muds and white coral biocoenosis of a Tyrrhenian station.

Remarks
We disagree with Pisera (in Hooper & van Soest, 2002: 354) who maintains that the Mediterranean records of *Leiodermatium lynceus* are not assignable to this species, suggesting it might be a different and probably new species. This is the first record for the Ionian Sea.

Subclass CERACTINOMORPHA Lévi, 1953
Order POECILOSCLERIDA Topsent, 1928
Suborder MICROCIONINA Hajdu, van Soest & Hooper, 1994
Family MICROCIONIDAE Carter, 1875
Subfamily OPHLITASPONGIINAE De Laubenfels, 1936
Genus *Plocamiopsis* Topsent, 1904

Plocamiopsis signata Topsent, 1904
Plocamiopsis signata Topsent, 1904: 155
(Figure 3)

Material
Station 1 no. 3, 5 (780–807 m); Station 6 no. 18 (640–662 m).

Description
This species is in the form of small thin cushion-shaped encrustations of 3–4 mm in diameter, which are rough and greyish in colour.

Skeleton
The principal and auxiliary acanthostyles protrude through the surface. The underlying portion consists of acanthostrongyles with a confused organization ascribable to a renieroid skeleton, according to Hooper, 1996. The principal megascleres are in contact with the substrate and perpendicular to it.

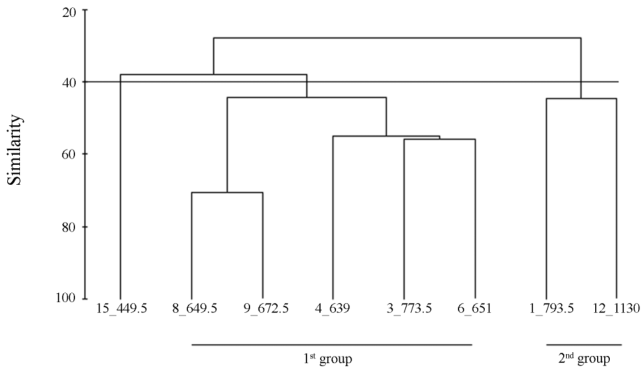

Figure 6. Bray–Curtis cluster analysis between the sampling stations. Numbers refer to each sampling station and mean depths.

Spicules

— principal acanthostyles straight, few basal spines and a sort of sub-terminal narrowing: 420–640×12–20 μm (532 ±66.9×15.5 ±3.13 μm);

— auxiliary acanthostyles slightly curved, with spines distributed along the shaft but more concentrated at the base: 160–250×8–12 μm (190.6 ±30.1×10.2 ±1.48 μm);

— smooth subtylostyles, with a slightly swelling base and asymmetric conical points: 272–312×4 μm (291.4 ±18.5 μm);

— acanthostrongyles entirely spiny, with irregular curves and slightly swelling points: 116–140×6–10 μm (125.6 ±8.53×8.4 ±1.25 μm);

— smooth wing-shaped toxas, with a terminal swelling: length 20–200 μm (77.33 ±52.5 μm);

— anisochelae with one remarkably developed ala that meets the other shorter one along the medial margin: length 14–16 μm (14.6 ±0.97 μm).

Ecology and distribution

This is rare and deep species, recorded only from the Atlantic Ocean (Azores), at 1360 m in depth (Topsent, 1904). This is the first record for the Mediterranean Sea.

Remarks

The studied specimens are close to the original description of Topsent (1904) with the exception of the polytylote subtylostyles with a few basal spines mentioned by the author, here substituted by smooth subtylostyles, with a slightly swelling base and asymmetric conical points. Systema Porifera (Hooper & van Soest, 2002) considers the genus *Plocamiopsis* Topsent, 1904 synonymous with *Antho* (*Acarnia*) Gray, 1867 which, however, has isochelae instead of anisochelae. The occurrence of anisochelae in our samples is not consistent with the hypothesis of a synonymous species, thus suggesting to consider the genus *Antho* separated from *Plocamiopsis*.

Genus *Antho* Gray, 1867
Antho sp.
(Figure 4)

Material

Station 1 no. 8 (780–807 m); Station 3 no. 21 (738–809 m).

Description

The small cushion-shaped specimens found were 3–4 mm in diameter, white or almost transparent and bristly. They were entirely used for dissociated spicule preparations.

Spicules

— principal acanthostyles slightly curved with rare low developed spines and distributed only at the base, they have a sub-terminal narrowing: 560–735×8–14 μm (652 ±61.9×10.8 ±1.9 μm);

— auxiliary acanthostyles, straight, entirely spined with a sub-terminal narrowing: 100–240×4–6 μm (134.5 ±41.9×4.5 ±0.8 μm);

— curved acanthostrongyles with well pronounced spines, perpendicular to the shaft and uniformly distributed. They often have a slight sub-terminal narrowing at both the extremities: 80–92×4–8 μm (86.4 ±4.9×5.4 ±1.3 μm);

— tylotes with slightly swelling ends: 190–230×2 μm (208.1 ±10.8 μm);

— isochelae with slightly widened alae: major axis 24–30 μm (27.4 ±2.1 μm).

Remarks

The spiculation of this specimen is consistent with that reported for the genus *Antho*, apart from the lack of toxas (Hooper & van Soest, 2002). It could be a new species, but the lack of any information on the skeletal arrangement does not allow any attribution to specific level.

Suborder MYXILLINA Hajdu, van Soest & Hooper, 1994
Family CRELLIDAE Dendy, 1922
Genus *Crellastrina* Topsent, 1927

Crellastrina alecto (Topsent, 1898)
Yvesia alecto Topsent, 1898: 248
(Figure 5)

Material

Station 3 no. 6, 7 (738–809 m); Station 6 no. 37 (640–662 m).

Description

This species consists of a thin whitish film on *Lophelia pertusa* (Linnaeus, 1758) scleraxis.

Spicules

— slightly curved acanthoxeas entirely covered by conical spines more pronounced along the shaft, smaller at both ends: 80–130×4–6 μm (102.2 ±16.4×4.7 ±1 μm);

— subtylostrongyle with one end rounded with a sub-terminal slightly swollen, the other one irregularly rounded: 320–544×6–10 μm (399 ±78.3×6.6 ±1.3 μm);

— asters of various forms: 40–64 μm (47.8 ±8.1 μm).

Ecology and distribution

This is a rare deep species which was previously recorded from the Atlantic Ocean (Azores) at 600 m in depth (Topsent, 1898).

Remarks

The spiculation of this species closely corresponds to the description by original author (Topsent, 1898).

Order HALICHONDRIDA Gray, 1867
Family BUBARIDAE Topsent, 1894
Genus *Bubaris* Gray, 1867

Bubaris sp.

Material

Station 4 no. 14 (631–647 m).

Description

This small encrusting specimen was white-cream in colour, with long spicules protruding through the surface. It was entirely used for dissociated spicule preparations.

Spicules

— straight styles: 800–3000×18–34 μm (1746.7 ±1131.6 ×27.3 ±8.3 μm);
— curved or flexuous strongyles with sharpened ends: 280–1000×10–16 μm (434.4 ±228.4×13.3 ±2 μm).

Remarks

This specimen had a spiculation comparable with *Bubaris* sp. 2 found by Vacelet (1969) in the western Mediterranean Sea.

Order HAPLOSCLERIDA Topsent, 1928
Suborder HAPLOSCLERINA Topsent, 1928
Family CHALINIDAE Gray, 1867
Genus *Haliclona* Grant, 1836
Subgenus *Gellius* Gray, 1867

Haliclona (Gellius) flagellifer (Ridley & Dendy, 1886)
Gellius flagellifer Ridley & Dendy, 1886: 333

Material

Station 3 no. 25 (738–809 m).

Description

The very small specimen consisted of a thin encrustation which was light brown in colour and bristly. It was entirely used for dissociated spicule preparations.

Spicules

— oxeas slightly curved with symmetrical and sharpened ends: 280–368×5–12 μm (333.2 ±29.8×10.4 ±2.1 μm);
— sigma flagellate, with long ends bending inside: major axis 66–100 μm (88.1 ±11.2 μm);
— sigma 'C' shaped: major axis 24–56 μm (47.2 ±9.1 μm).

Ecology and distribution

This species was previously recorded from the Atlantic Ocean (Azores) at 1378 m in depth (Topsent, 1928 as *Gellius vagabundus* (Schmidt, 1870)) and from the Mediterranean Sea, between 20 and 270 m in depth (Lion Gulf, Ligurian Sea, Corsica Sea) (Pulitzer-Finali, 1983; Topsent, 1928; Vacelet, 1969 as *Sigmadocia flagellifer* (Ridley & Dendy)). This is the first record for the Ionian Sea.

Distribution

Sponges were found at eight out of nine sampling stations. *Sceptrella insignis* (Topsent, 1892) and *Desmacella inornata* (Bowerbank, 1866) occurring at almost all the examined stations. *Poecillastra compressa* (Bowerbank, 1866) and *Thrombus abyssi* (Carter, 1873) were found at five stations, whereas a large number of the remaining species (15/24) were only found at one station (Table 2).

The highest number of species (between 12 and 13) occurs at Stations 3, 4 and 6 located at depths from 631 to 809 m. Only two species occur at Station 12, located at depths between 1100 and 1160 m (Table 2).

The dendrogram obtained from cluster analysis, applied on presence–absence data (Figure 6), encompasses the presence of two main groups (40% similarity), clearly separated on the basis of the depth range. The first group consists of five sampling stations, located at a mean depth ranging from 639 to 773.5 m. The second included the two stations at the greatest depths (793.5 m and 1130 m). The ANOSIM confirmed that these species–station groups were significantly different (global $R=0.759$; $P<0.006$). The first group showed an average similarity (SIMPER) of 50.28%, and was mainly represented by *D. inornata* and *S. insignis*. The other one presented the lowest average similarity (44.44%) and was characterized by *D. inornata* and *Hamacantha (Hamacantha) implicans* Lundbeck, 1902. The shallowest station (Station 15, mean depth 449.5 m), characterized by *D. inornata*, *Pachastrella monilifera* Schmidt, 1868 and *Leiodermatium* cf. *lynceus* Schmidt, 1870 was separated from the main groups.

DISCUSSION

In a recent study performed on the same white coral bank here exploited, Tursi et al. (2003) discovered 54 zoobenthic species (both sessile and vagile) belonging to many systematic groups, apart from sponges. The results of our study, with 30 sponge species detected, indicate that poriferans constitute the group with the highest values of species richness among the benthic fauna associated with this coral bank. This is in agreement with literature data referring to the North Atlantic Ocean (Jensen & Frederiksen, 1992).

The sponge assemblage here described is characterized by the presence of rather scarce boring sponges, with only three species recorded in all, and little evidence of boring activity. This feature is consistent with previous observations (Vacelet, 1969) referring to white corals from the French Mediterranean coast, but strongly disagrees with Jensen & Frederiksen's (1992) data, indicating heavy excavations in the scleraxis of Atlantic *Lophelia* banks. In addition, high values of abundance and species richness of boring sponges are usually reported for red coral communities (Bavestrello et al., 1996; Corriero et al., 1997) underlying the ease of excavation by boring sponges on anthozoan scleraxis. Thereafter, the differences in species richness of boring species between different banks of white corals could be related to the difficulties in larval dispersion among insular habitats surrounded by vast areas of unavailable soft bottoms (Beaulieu, 2001).

The sponge assemblage here described mainly consists (about 75%) of species already reported for this biocoenosis (Vacelet, 1969; Pulitzer-Finali, 1983; Magnino et al., 1999; Rogers, 1999); however, seven species (*Erylus papulifer* Pulitzer-Finali, 1983, *Isops anceps* (Vosmaer, 1894), *Spiroxya heteroclita* Topsent, 1896, *Plocamiopsis signata* Topsent, 1904, *Crellastrina alecto* (Topsent, 1898), *Axinella cannabina* (Esper, 1794), *Hexadella detritifera* Topsent, 1913), are here found for the first time in association with white coral banks.

Eleven of the species here detected (*Plakortis simplex* Schulze, 1880, *Jaspis incrustans* (Topsent, 1890), *Pachastrissa pathologica* (Schmidt, 1868), *E. papulifer*, *I. anceps*, *Pachastrella monilifera* Schmidt, 1868, *Poecillastra compressa* (Bowerbank, 1866), *S. heteroclita*, *Desmacella annexa* (Schmidt, 1870), *D. inornata* (Bowerbank, 1866), *Sceptrella insignis* (Topsent, 1892)), are also reported in the literature in association with shallower Mediterranean red coral bottoms (within 100 m of depth) (Maldonado, 1992; Bavestrello et al., 1996; Corriero et al., 1997). In contrast, the affinity between the sponge assemblage here described and that from Mediterranean muddy bathyal bottoms (Pansini & Musso, 1991; Magnino et al., 1999), is very low, with only five species in common (*P. compressa*, *Siphonidium ramosum* (Schmidt, 1870), *Leiodermation* cf. *lynceus* Schmidt, 1870, *D. annexa*, *Haliclona (Gellius) flagellifer* (Ridley & Dendy, 1886)). This confirms the strong taxonomic differences in the composition of the deep sponge fauna inhabiting soft or hard substrates (Vacelet, 1969; Pansini & Musso, 1991; Boury-Esnault et al., 1994). Deep sponges, conversely, seem to exhibit low preferentiality among different hard substrates.

The trend in the bathymetric distribution of the whole sponge assemblage here recorded, with a remarkable decrease in species richness at greater depths, is in agreement with Mediterranean literature data (Pansini & Musso, 1991). Notwithstanding the occurrence of clearly eurybathic species (*Thrombus abyssi* (Carter, 1873), *D. inornata*, *S. insignis*), two depth-dependent sponge groups can be identified. One, characterized by *D. inornata* and *S. insignis*, preferentially distributed at depths from 600 to 800 m. The other one, including *D. inornata* and *Hamacantha (Hamacantha) implicans* Lundbeck, 1902, is found at greater depths (from 800 to 1100 m). This species differentiation contrasts with the pattern observed for Mediterranean muddy bottoms, where sponges show a more homogeneous distribution along the bathymetric gradient (Pansini & Musso, 1991).

Most of the sponge species recorded during the present study show an Atlantic–Mediterranean repartition; among them, *Geodia nodastrella* Carter, 1876 and *P. signata* are also recorded and are new records for the Mediterranean basin. According to current sponge biogeographic literature (Pansini & Longo, 2003), the sponges here detected show a higher affinity with the fauna from the Boreal region (40.7%), than that from the Mauritanian and Senegalese ones (25.9%). The percentage of Mediterranean endemic species is very low (13.3%), in disagreement with the value of 48.2% reported by Pansini & Longo (2003) for the Mediterranean sponge fauna.

Our value, however, is slightly nearer to the 22 and 25.8% respectively indicated by Vacelet (1969) for the Mediterranean white coral banks, and Maldonado (1992) for the sponge assemblage associated with a Mediterranean red coral bank, thus suggesting a decrease in endemics in Mediterranean deep sponges from hard bottom communities.

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