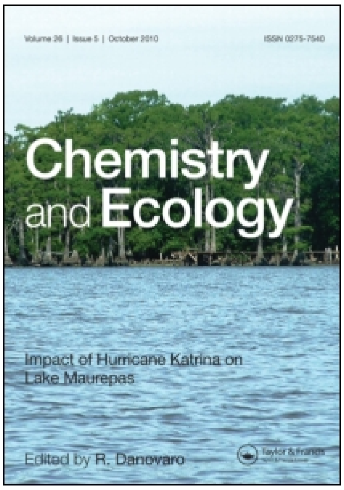

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Biodiversity of the white coral reefs in the Ionian Sea (Central Mediterranean)

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BIODIVERSITY OF THE WHITE CORAL REEFS IN THE IONIAN SEA (CENTRAL MEDITERRANEAN)

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Three surveys were carried out off Cape Santa Maria di Leuca (Southern Italy). Samples were taken using an 'ingegno', trawl net and traps at 630–1100 m depth.

The white coral biocoenosis in this area of the Ionian Sea consists of living corals mainly represented by the framework builders *Lophelia pertusa* and *Madrepora oculata*. The solitary corals *Desmophyllum cristagalli* and *Stenocyathus vermiformis* were also obtained alive. The polychaete *Eunice norvegica* is another characteristic species.

A list of 58 species were compiled, indicating the Atlantic character of this biocoenosis and confirming Mediterranean biodiversity to be lower than that of ocean.

Keywords: Deep-water coral reef; Deep-water fauna; Biodiversity; Ionian Sea; Mediterranean

1 INTRODUCTION

Deep-sea coral reefs have been recorded in several areas of the Atlantic Ocean and Mediterranean Sea (Le Danois, 1948; Pérès and Picard, 1964; Zibrowius, 1980; Fosså *et al.*, 2002; Hovland *et al.*, 2002). This formation has a patch distribution (Wilson, 1979) and its predominant species are the colonial *Lophelia pertusa* (Linnaeus, 1758) and *Madrepora oculata* to which the solitary *Desmophyllum cristagalli* is generally associated (Le Danois, 1948; Pérès and Picard, 1964; Pérès, 1967). *L. pertusa* and *M. oculata* may grow on each other. Such mixed colonies are the result of epibiotic settling (Rogers, 1999). These branched scleractinians form a complex three dimensional structure providing ecological niches and substrate for a multitude of other species (Rogers, 1999).

The Mediterranean deep-water coral biocoenosis resembles that of the Atlantic (Zibrowius, 1980) but has been much less investigated (Pérès, 1967).

Generally, most deep-water scleractinians collected in the Mediterranean are dead and covered by Fe–Mn oxides. Living corals have only seldom been recovered, whereas in the Atlantic, these deep-water coral association are still thriving. Delibrias and Taviani (1985) suggested that the rarity of these coral banks in the Mediterranean was due to the homeothermic conditions in the deep waters (12.7–14.5 °C, salinity 38.4–39.0‰).

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Moreover, in the last twenty years human activity has begun to have an impact on the deep-sea biocoenosis, this impact is mainly due to deep-sea fishing, oil exploration and illegal dumping.

An early well documented record of a deep coral reef in the Eastern Mediterranean dates back to the Pola expedition in 1891 and regards the Northern Ionian Sea (Marenzeller, 1893). This site has only recently been revisited during a trawl survey and corals have been found at depths of 550–1100 m (Mastrototaro *et al.*, 2002).

The aim of the present paper is to describe the fauna associated with these deep-water coral structures contributing to a better knowledge of Mediterranean biodiversity and to understanding changes in the faunal composition that occurred during the last geological eras (Bouchet and Taviani, 1992; Corselli, 2001).

2 MATERIALS AND METHODS

Data on the deep-water coral reef biocoenosis of the Ionian Sea were collected during three cruises. Those of August 2000 and February 2001 were carried out using a fishing vessel, that of August 2002 on board the oceanographic Italian vessel ‘Urania’. The sampling area was about 20–25 miles off Cape of Santa Maria di Leuca (LE), Southern Italy, as shown in Figure 1.

During the first cruise, the coral build-ups were found on the occasion of three trawl hauls carried out at depths between 630 and 1100 m (Tab. I). During the second cruise they were sampled using the ‘ingegno’, a tool consisting of an iron bar (1 m long, Ø 60 cm) with pieces of old fishing net attached. This second cruise comprised 16 sampling stations at depths between 280 and 1146 m (Tab. I).

During the third cruise, after Side Scan Sonar exploration of the area, 12 sampling stations were investigated using the ‘ingegno’, depth 307–1150 m. Four additional stations were investigated using a group of six traps, depth 632–788 m (Tab. I).

All biological samples were preserved on board in 5% formaldehyde solution with sea water and sorted to species in the laboratory. Considering that four main types of habitat can be distinguished within the deep-water coral biocoenosis (surface, detritus, cavities and free space around) (Mortensen *et al.*, 1995; Rogers, 1999), the species collected during this study have been listed in the following four main categories: characteristic species – those living strictly in this biocoenosis; associated species – those that live on or inside the coral branches; accompanying species – those that live in the three dimensional net formed by the coral branches; and co-occurrent species – those that live in the free space around the coral reef.

3 RESULTS

The deep-water coral association rediscovered off Cape of Santa Maria di Leuca is dominated by two colonial scleractinians, *L. pertusa* and *M. oculata.* Living and dead branches were sampled. The living branches were white without any epibionts and with yellowish polyps. The dead branches varied in colour from yellow to black and they were often covered with Fe–Mn oxides and different epibiotic species. All four scleractinian corals were collected alive: *L. pertusa*, *M. oculata*, *D. cristagalli* and *Stenocyathus vermiformis* (Cnidaria, Anthozoa). A total of 58 taxa (1 Foraminifera, 4 Porifera, 9 Cnidaria, 1 Brachiopoda, 5 Mollusca, 7 Anellida, 12 Crustacea, 2 Echinodermata, 5 Chondroichthyes and 12 Osteichthyes) were identified and classed as characteristic species, associated species, accompanying species and co-occurent species (Tab. II).

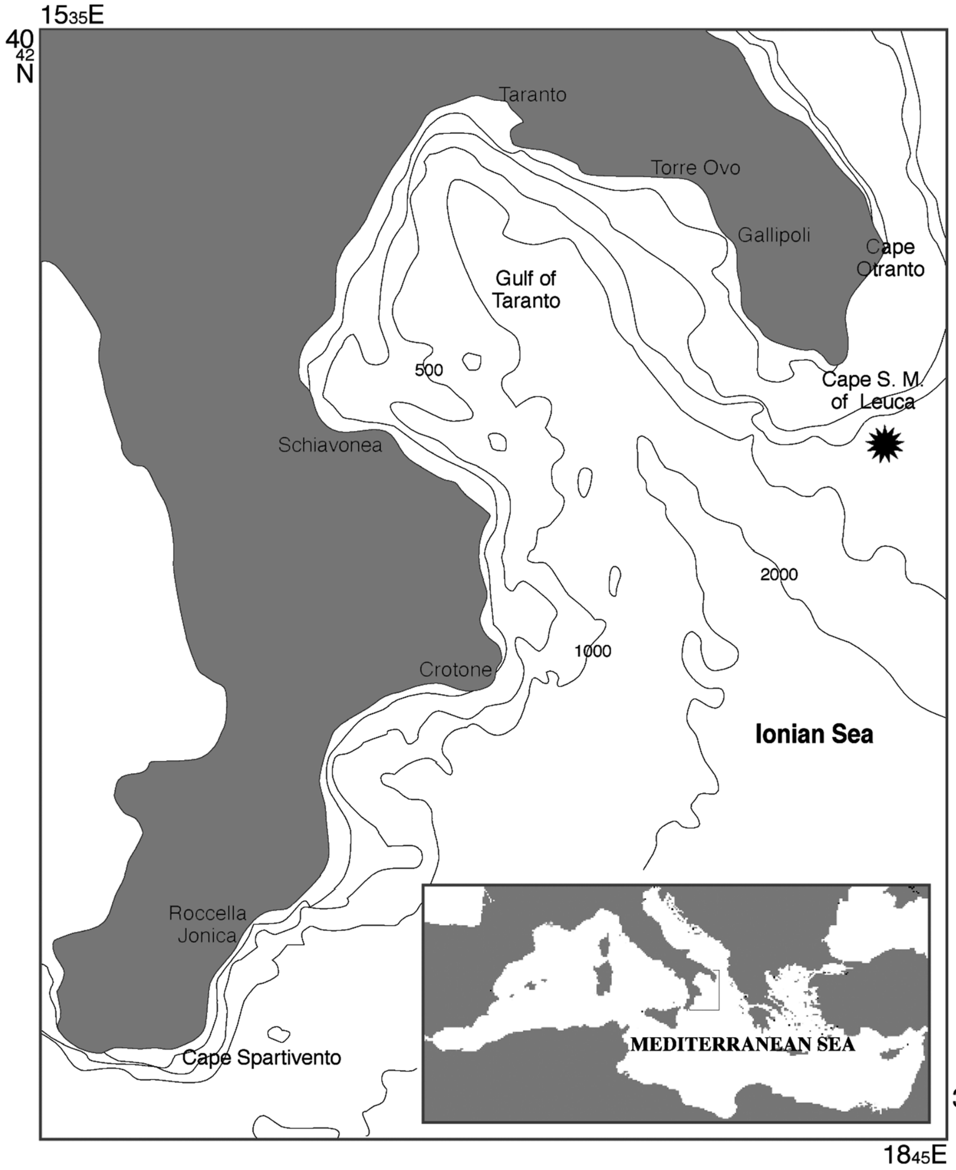

FIGURE 1 Sampling area (✹) in the Ionian Sea and its location in the Mediterranean Sea.

3.1 Characteristic Species

The branched cnidaria *L. pertusa* and *M. oculata* are the most important characteristic species (*sensu* Pérès and Picard, 1964).

Lophelia pertusa

L. pertusa is a deep water scleractinian coral with a wide geographical distribution. This species is distributed throughout the North Atlantic, in both the East and West, including some areas of the Mediterranean Sea, along the coast of West Africa, United States and Brazil.

TABLE I List of the Hauls Carried Out During the Three Research Cruises with Indication of Date, Sampling Station, Type of Gear, Beginning and End of Haul Coordinates with Depth (m).

Date	*Station*	*Gear*	*Beginning Lat./Long.*	*Depth, m*	*End Lat./Long.*	*Depth, m*
24/08/2000	1	Trawl net	39°38.69′/18°38.89′	630	39°37.16′/18°38.98′	678
23/08/2000	2	Trawl net	39°27.28′/18°23.95′	800	39°26.68′/18°24.84′	800
23/08/2000	3	Trawl net	39°23.99′/18°21.60′	1100	39°24.93′/18°19.92′	1100
14/02/2001	4	Ingegno	39°27.18′/18°23.62′	807	39°27.51′/18°24.01′	780
14/02/2001	5	Ingegno	39°26.87′/18°25.32′	784	39°26.39′/18°25.60′	810
14/02/2001	6	Ingegno	39°27.75′/18°24.11′	760	39°27.59′/18°23.23′	809
14/02/2001	7	Ingegno	39°31.93′/18°23.86′	647	39°31.81′/18°25.92′	631
14/02/2001	8	Ingegno	39°34.37′/18°25.71′	550	39°34.82′/18°25.93′	577
14/02/2001	9	Ingegno	39°36.74′/18°31.11′	640	39°36.86′/18°31.39′	662
15/02/2001	10	Ingegno	39°26.40′/18°19.22′	1041	39°25.54′/18°19.05′	1146
16/02/2001	11	Ingegno	39°37.78′/18°39.07′	642	39°37.42′/18°38.80′	665
16/02/2001	12	Ingegno	39°37.17′/18°39.15′	664	39°37.15′/18°39.37′	674
16/02/2001	13	Ingegno	39°33.10′/18°32.09′	785	39°32.70′/18°32.01′	789
16/02/2001	14	Ingegno	39°24.31′/18°20.97′	1116	39°23.98′/18°21.60′	1112
16/02/2001	15	Ingegno	39°23.70′/18°22.32′	1100	39°23.60′/18°23.56′	1121
16/02/2001	16	Ingegno	39°25.01′/18°24.64′	910	39°25.13′/18°24.39′	895
16/02/2001	17	Ingegno	39°24.82′/18°23.42′	1045	39°25.61′/18°22.88′	1000
16/02/2001	18	Ingegno	39°36.98′/18°23.14′	425	39°37.34′/18°23.61′	469
16/02/2001	19	Ingegno	39°38.90′/18°24.42′	374	39°39.51′/18°24.92′	280
21/08/2002	20	Ingegno	39°27.51′/18°24.00′	780	39°27.72′/18°24.23′	780
22/08/2002	21	Ingegno	39°27.30′/18°23.98′	813	39°26.84′/18°24.88′	807
22/08/2002	22	Trap	39°27.08′/18°24.42′	788	39°27.28′/18°24.30′	780
22/08/2002	23	Ingegno	39°27.10′/18°24.10′	818	39°26.18′/18°25.39′	828
23/08/2002	24	Ingegno	39°28.79′/18°22.66′	784	39°29.00′/18°23.32′	756
23/08/2002	25	Trap	39°29.08′/18°21.50′	767	39°29.31′/18°21.05′	758
23/08/2002	26	Ingegno	39°27.72′/18°24.80′	750	39°28.33′/18°23.39′	779
24/08/2002	27	Ingegno	39°24.12′/18°21.32′	1108	39°24.80′/18°19.73′	1150
25/08/2002	28	Trap	39°31.65′/18°25.79′	632	39°31.82′/18°25.76′	627
25/08/2002	29	Trap	39°31.44′/18°25.50′	643	39°31.52′/18°25.46′	640
25/08/2002	30	Ingegno	39°37.05′/18°23.22′	424	39°38.45′/18°25.04′	408
25/08/2002	31	Ingegno	39°34.68′/18°22.92′	528	39°36.40′/18°22.97′	464
26/08/2002	32	Ingegno	39°34.94′/18°23.54′	501	39°36.42′/18°23.13′	451
26/08/2002	33	Ingegno	39°34.77′/18°22.94′	518	39°35.54′/18°22.96′	486
27/08/2002	34	Ingegno	39°37.53′/18°23.51′	465	39°38.29′/18°22.17′	307
27/08/2002	35	Ingegno	39°36.03′/18°23.17′	473	39°36.67′/18°23.42′	447

It also occurs extensively in the Gulf of Mexico and the Caribbean Sea. A few records have been reported for the Pacific and Indian Oceans and South of New Zealand (Zibrowius, 1980; Rogers, 1999).

The occurrence of *L. pertusa* often refers to dead or sub-fossil specimens, thus its living distribution could be overestimated (Rogers, 1999). In the Mediterranean Sea, there is a high number of sub-fossil remains, while living branches of *L. pertusa* in the Mediterranean are extremely rare (Zibrowius, 1980). Living colonies of this species were found in the study area between depths of 425 and 1100 m in nine sampling stations (Tab. II).

Madrepora oculata

M. oculata is an Oculinidae widespread in the North Atlantic, mostly along the Norwegian coast, but its occurrence is known from the Azores to the Gulf of Guinea, Georgia and the Brazilian coast as well as in the Indian and Pacific Oceans (Zibrowius, 1980). It is widespread in the Mediterranean Sea, even though many records of this species concern dead and sub-fossil colonies. The presence of living colonies of *M. oculata* in the Mediterranean is

TABLE II List of the Species Collected Alive on the White Coral Reef in the Ionian Sea During the Three Research Cruises (August 2000, February 2001 and August 2002).

Types of species	*Type*	*Sampling station*
Characteristic species		
Lophelia pertusa (Linnaeus, 1758)	Cn	1-2-3-4-6-7-9-13-18
Madrepora oculata (Linnaeus, 1758)	Cn	1-2-3-4-6-7-9-13-18-20-23-31-32-33
Desmophyllum cristagalli (Milne-Edwards & Haime, 1848)	Cn	1-2-3-4-6-7-9-13-17-18-31-35
Eunice norvegica (Linnaeus, 1767)	An	1-2-3-4-6-7-9-13-20-26-32
Associated species		
Planopulvinulina sp.	Fr	31
Poecillastra compressa (Bowerbank, 1866)	Pr	4-6-7-8-12
Cliona levispira (Topsent, 1898)	Pr	6-9
Latrunculia insignis (Topsent, 1892)	Pr	4-6-7-9-11-12
Desmacella inornata (Bowerbank, 1866)	Pr	6-7-9-11-12-15-18
Placogorgia sp.	Cn	6-20-21-23-26
Leiopathes glaberrima (Esper, 1792)	Cn	11-12-33
Stenocyathus vermiformis (Pourtalès, 1868)	Cn	11-31
Filograna implexa (Berkeley, 1828)	An	1-4
Filogranula gracilis (Langerhans, 1884)	An	1-4-9-13
Filogranula stellata (Southward, 1936)	An	1
Metavermilia multistriata (Philippi, 1844)	An	4
Serpula vermicularis (Linnaeus, 1767)	An	11
Vermiliopsis eliasoni (Zibrowius, 1970)	An	1-4-9-10
Megerlia truncata (Linnaeus, 1767)	Br	31
Emarginula adriatica (O. G. Costa, 1829)	Ml	20
Asperarca nodulosa (O. F. Müller, 1776)	Ml	1-2-3-4-6-9-11-13-15-16-20-21-23-27-31
Bathyarca philippiana (Nyst, 1848)	Ml	1-2-3-4-6-9-13-27
Delectopecten vitreus (Gmelin, 1791)	Ml	1-3-5-13-20-21-32
Spondylus gussonii (O. G. Costa, 1829)	Ml	21-31
Accompanying species		
Callogorgia verticillata (Pallas, 1766)	Cn	16-18
Acanthogorgia hirsuta (Gray, 1857)	Cn	6
Dendrophyllia cornigera (Lamarck, 1816)	Cn	32-35
Polycheles typhlops (Heller, 1862)	Cr	1-2-3-19-20-21-26-27-31
Munida intermedia (A. Milne Edwards and Bouvier, 1899)	Cr	31-35
Munida tenuimana (G. O. Sars, 1872)	Cr	23-26
Bathynectes maravigna (Prestandrea, 1839)	Cr	25-28
Ebalia nux (A. Milne Edwards, 1883)	Cr	26-31
Monodaeus couchii (Couch, 1851)	Cr	21-26-31-35
Stichopus regalis (Brandt, 1835)	Ec	30
Cidaris cidaris (Linnaeus, 1758)	Ec	6-7-14-15-20-27-31
Co-occurrent species		
Aristaeomorpha foliacea (Risso, 1827)	Cr	1
Aristeus antennatus (Risso, 1816)	Cr	2-3
Acanthephyra eximia (S. I. Smith, 1884)	Cr	3-25
Plesionika acanthonotus (S. I. Smith, 1882)	Cr	1-3
Plesionika heterocarpus (A. Costa, 1871)	Cr	25
Plesionika martia (A. Milne Edwards, 1883)	Cr	1-2-3
Chimaera monstrosa (Linnaeus, 1758)	Ch	1
Galeus melastomus (Rafinesque, 1810)	Ch	1-2-3
Dalathias licha (Bonnaterre, 1788)	Ch	25
Etmopterus spinax (Linnaeus, 1758)	Ch	2-3-22-25
Raja oxirhynchus (Linnaeus, 1758)	Ch	3
Notacanthus bonapartei (Risso, 1840)	Os	2-3
Conger conger (Linnaeus, 1758)	Os	25
Bathypterois mediterraneus (Bauchot, 1962)	Os	3
Lepidion lepidion (Risso, 1810)	Os	3
Mora moro (Risso, 1810)	Os	2-3

TABLE II *Continued.*

Types of species	*Type*	*Sampling station*
Phycis blennoides (Brünnich, 1768)	Os	2
Caelorhynchus caelorhynchus (Risso, 1810)	Os	1-3
Hymenocephalus italicus (Giglioli, 1884)	Os	1
Nezumia sclerorhynchus (Valenciennes, 1838)	Os	1-2-3
Benthocometes robustus (Goode and Bean, 1886)	Os	1-3-1
Hoplostethus mediterraneus (Cuvier, 1829)	Os	1-2
Helicolenus dactylopterus (Delaroche, 1809)	Os	1

Note: Foraminifera (Fr), porifera (Pr), cnidaria (Cn), brachiopoda (Br), mollusca (Ml), anellida (An), crustacea (Cr), echinodermata (Ec), chondroichthyes (Ch) and osteichthyes (Os).

confirmed only for the following areas: the Straits of Gibraltar, the Alboran Sea, along the French coast of Banyuls and Marseille, in the Gulf of Genoa, Corsica, Sardinia and North of Sicily (Zibrowius, 1980; Tunesi and Diviacco, 1997; Tunesi *et al.*, 2001; Tunesi and Diviacco, 2002) and off Cape of Santa Maria di Leuca (LE) (Mastrototaro *et al.*, 2002). Although this bathyal species is considered characteristic of a *facies* of deep-sea biocoenosis (*sensu* Pérès and Picard, 1964), living colonies of this oculinid have been found in the Marseille area from 200 m down to 1000 m (Zibrowius, 1980). In the Atlantic, its bathymetric range is wider, from 80 to 1500 m (Zibrowius, 1980). This species contributes to the building of deep-water reefs mostly made up of the other coral species (Rogers, 1999). In our sampling area, living colonies of *M. oculata* were found from 425 to 1100 m in 14 sampling stations (Tab. II).

Desmophyllum cristagalli

D. cristagalli is a solitary coral with big polyps with protruding primary septa. The size and the morphology of this species are very variable (Le Danois, 1948; Zibrowius, 1980). *D. cristagalli* is widespread in the Mediterranean (Zibrowius, 1980). Living corals have been found off Cape of Gata (South of Spain), in the regions of Banyuls and Marseille (Zibrowius, 1980) and off Cape of Santa Maria di Leuca (Mastrototaro *et al.*, 2002). This species is usually associated with the colonies of *M. oculata* and *L. pertusa*; however it can also colonize other hard substrata: either natural, such as cliffs and small rocks, or artificial such as submarine cables etc.

Living polyps of *D. cristagalli* in our study area were collected both on the colonies of *M. oculata* and *L. pertusa*, mostly at the base of the colonies (Tab. II).

Eunice norvegica

E. norvegica is a large eunicid polychaete that lives on the white coral reef. Its ecological role is somewhat controversial. In fact, on one hand, it seems to weaken the coral skeleton with its jaws (Glynn, 1996). On the other hand, the presence of *E. norvegica* seems to stimulate the thickening of the coral framework (Freiwald *et al.*, 1997). The parchment tube of *E. norvegica* is overgrown by the coral *coenosteum* and incorporated into the calcareous colony (Le Danois, 1948; Zibrowius, 1980). Such a structure characterizes all the colonies sampled off Cape of Santa Maria di Leuca. Different sized specimens were found in both the living and dead colonies (Tab. II).

Associated Species

Concerning the associated species, the colonial foraminifera belonging to the genus *Planopulvinulina* was sampled.

The following porifera species were identified: *Poecillastra compressa*, *Cliona levispira*, *Latrunculia insignis* and *Desmacella inornata* (Longo *et al.*, 2002a, b). These species are typical of deep hard substrata and deep coral biocoenosis (Le Danois, 1948). The sponges belonging to the genus *Cliona*, living inside the coral colony, have a key role in the bioerosion and dynamics of the biocoenosis (Calcinai *et al.*, 2001).

Three species of Cnidaria were collected: an Octocorallia belonging to the genus *Placogorgia*; the Hexacorallia *Leiopathes glaberrima*, a species of Mediterranean black coral, and a solitary coral *Stenocyathus vermiformis*. These species are often associated with colonies of *M. oculata* and *L. pertusa* and show a wide distribution both in the Western and in the Eastern Mediterranean (Rogers, 1999).

Six serpulid species were found: *Filograna implexa*, *Filogranula gracilis*, *Filogranula stellata*, *Metavermilia multistriata*, *Serpula vermicularis*, *Vermiliopsis eliasoni*.

Two specimens of the Brachiopoda *Megerlia truncata* were found on a dead colony.

Concerning the molluscs, a gastropod Fissurellidae *Emarginula adriatica* and four bivalves, two Arcidae *Asperarca nodulosa* and *Bathyarca philippiana*, a Pectinidae *Delectopecten vitreus* and a Spondylidae *Spondylus gussoni* were sampled (Tab. II).

Accompanying Species

Three species of Cnidaria were found as accompanying species: two Octocorallia *Acanthogorgia hirsuta* and *Callogorgia verticillata* and the Hexacorallia *Dendrophyllia cornigera*. *A. hirsuta* was recovered on the bottom close to the bank at a depth of 760 m, *C. verticillata* at depths of 425 and 910 m while *D. cornigera*, with a few living polyps, was found at depths of 473 and 501 m.

The crustacean Decapoda collected in the study area were: *Polycheles typhlops*, *Munida intermedia*, *Munida tenuimana*, *Bathynectes maravigna*, *Ebalia nux* and *Monodaeus couchii*. The echinoderms *Cidaris cidaris* and *Stichopus regalis* were found in the coral net (Tab. II).

Co-occurrent Species

Close to the coral biocoenosis, some typical bathyal species were collected using the trawl net and traps: 6 crustacean Decapoda, 5 Chondroichthyes and 12 Ostheychthyes species (Tab. II).

4 DISCUSSION

Knowledge of the biodiversity in the deep water ecosystem of the Mediterranean Sea mostly concerns the benthic and benthopelagic fauna of muddy bottoms (*e.g.* Fredj and Laubier, 1983; Fredj and Maurin, 1987; Laubier and Emig, 1993), while the biodiversity of hard bottoms and deep-water coral habitats is still little explored. In addition to the usual difficulties and limitations inherent to deep-sea exploration, deep-water coral biocoenosis is difficult to sample with traditional gear. The rarity of the deep-water coral banks in the Mediterranean due to hydrological changes (Delibrias and Taviani, 1985) may be only one aspect. The fact that few studies have been carried out using suitable sampling gear should also be considered. In the Ionian Sea, the framework builders are *L. pertusa* and *M. oculata*. The number and type of the species sampled during this study show a high diversity level similar to that in the Western Mediterranean (Pérès and Picard, 1964; Pérès, 1967; Tunesi *et al.*, 2001). Nevertheless, this fauna is less diversified than in similar habitats in the Atlantic (Le Danois, 1948; Jensen and Frederiksen, 1992; Rogers, 1999; Freiwald *et al.*, 2002).

The relative poverty of the deep-water coral biocoenosis in the Mediterranean can be explained by factors already suggested for the paucity of the deep benthic and benthopelagic fauna, namely the recent origin of the deep-sea fauna, the impediment posed by the shallow sill of Gibraltar, the high temperature and oligotrophy, and the climatic fluctuations during the Quaternary (Fredj and Laubier, 1983; Fredj and Maurin, 1987; Bouchet and Taviani, 1992). Furthermore, in the Atlantic, the coral banks occur over a wider depth range than in the Mediterranean (Zibrowius, 1980; Frederiksen *et al.*, 1992).

With the exception of the gastropod *E. adriatica*, all the characteristic and associated species are suspension-feeders that can be expected to depend on bottom currents and reduced mud sedimentation (Genin *et al.*, 1986). Most of the accompanying and co-occurrent species are typical of the bathyal muddy bottoms of the Northern Ionian Sea (D'Onghia *et al.*, 2003).

The complexity of the coral community and the presence of many suspension feeder species are most probably linked to the energetic trophic system regarding the study area. In fact, the total vertical flux of particulate matter recorded on the slope barely northwards is similar to that observed in coastal areas of the Western Mediterranean and Northern Adriatic and even greater than those reported for open areas, such as the Ligurian Sea and the Sargasso Sea (De Lazzari *et al.*, 1999). An important coupling between the water column production process and the transfer of suspended matter to the depth occurs in the study area (De Lazzari *et al.*, 1999). As suggested by Frederiksen *et al.* (1992), the particle flux to the bottom mixed layer is a crucial factor for suspension feeders like the corals. As reported by Hovland *et al.* (2002), deep-sea coral reefs establish themselves at locations on the seafloor where there is a continuous and regular supply of concentrated food and nutrients due to the flow of a relatively strong current. With this regard, the coral community described in this paper is markedly affected by the cold and dense water masses of the Adriatic flowing into the Northern Ionian Sea (Lacombe and Tchernia, 1972).

The biocoenosis of deep-water coral in the Mediterranean Sea is a little known habitat which acts like an oasis in the desert. In fact, the coral build-up consists of a complex three-dimensional structure providing ecological niches for a large diversity of associated species (Rogers, 1999), including crustacea and fish species of economic interest, such as *Aristaeomorpha foliacea* and *Helicolenus dactylopterus* (Tunesi *et al.*, 2001; present results). It is hypothesised that coral reefs may function as centres of spreading for associated fauna (Fosså *et al.*, 2002). Since it has long been a deterrent to trawling, it can have positive 'spill-over' effects on the deep-water demersal resources intensively fished on neighbouring muddy bottoms.

Man's deep-sea activities are increasing in intensity particularly in the fishing industry. The obvious impact of trawling on the coral banks is mechanical damage caused by otter boards and nets that destroy the three-dimensional structure of coral reefs (Hall-Spencer, 2001). Furthermore, bottom trawl activity alters the hydrodynamic and sedimentary conditions. Members of the associated fauna also suffer. The scale of these effects depends on the frequency of the disturbance from trawling. Video surveys carried out off West Norway show that these deep-water coral banks are especially fragile and easily reduced to rubble by towed fishing gear (Hall-Spencer, 2001). In an area with a high fishing pressure off Southern Tasmania, the coral reef community was replaced by a low diversity community (Koslow and Gowlett-Jones, 1998). Other fishing gears, such as longlines, can also cause damage to this biocoenosis since they cause breakage. On the other hand, a low fishing intensity may have an effect on spreading the species forming new coral patches. In fact, living branches broken off may continue to grow on the seabed. However, the proportion of the coral fragments that survive to form new colonies is unknown (Rogers, 1999).

Another impact of trawling activity on the white coral reef is due to the suspension of sediments; in fact, coral species, like all suspension feeders, are particularly vulnerable to the effects of increased sedimentation (Rogers, 1999). Considering that all fishing gears can also be very damaging for this biocoenosis there is an evident need for further investigation in order to improve the knowledge on this biocoenosis and to protect its relevant biodiversity.

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