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The mollusc community associated with maerl beds of Ustica Island (Tyrrhenian Sea)

Luca CASTRIOTA[1], Franco AGAMENNONE[2] and Giuseppe SUNSERI[1]
(1) *ICRAM via Emerico Amari 124, 90139 Palermo – Italy. Fax: +39 91 6114060.*
E-mail: castriotaluca@hotmail.com
(2) *Via Quarto dei Mille 15, 65122 Pescara - Italy*

Abstract: Living molluscs associated with circalittoral maerl have been studied at Ustica Island (southern Tyrrhenian Sea). Five sediment samples from two sites were collected in November 1996 and July 1997 using a van Veen grab (0.1 m^2), at 50 m depth. Two-way crossed PERMANOVA revealed non-significant temporal and spatial differences in abundance. The molluscan community was composed of both hard bottom and soft bottom species typical of circalittoral coastal detritic and to coarse sands and fine gravels under bottom currents assemblages. Suspension feeders dominated these communities, followed by herbivores and carnivores in similar percentages. *Haminoea hydatis, Gibberula jansseni* and *Modiolula phaseolina* were the most abundant species followed by *Acantochitona fascicularis, Hiatella arctica* and *Limatula subauriculata*. *Ischnochiton usticensis* may be an exclusive maerl associated species. The low richness and high evenness values recorded let us consider this community as well structured.

Résumé : *La communauté de Mollusques associée aux bancs de maërl de l'île d'Ustica (Mer Tyrrhénienne).* La communauté de mollusques vivants associée au maërl circalittoral de l'île d'Ustica (sud de la Mer Tyrrhénienne) a été étudiée. Cinq échantillons de sédiment ont été récoltés à deux stations en novembre 1996 et juillet 1997 avec une benne van Veen (0.1 m^2), à 50 m de profondeur. Aucune différence significative entre les stations n'a été mise en évidence, ni en nombre d'individus ni entre les périodes d'étude avec la PERMANOVA orthogonale à deux facteurs. La communauté est composée à la fois d'espèces de substrat dur et d'espèces de substrat meuble, appartenant respectivement à la biocœnose des fonds détritiques côtiers circalittoraux et à celle des sables grossiers et fins graviers sous influence des courants de fond. Cette communauté est nettement dominée par les suspensivores suivis des herbivores et des carnivores dans les mêmes proportions. *Haminoea hydatis, Gibberula jansseni* et *Modiolula phaseolina* sont les espèces les plus nombreuses, suivies par *Acantochitona fascicularis, Hiatella arctica* et *Limatula subauriculata*. *Ischnochiton usticensis* semble pouvoir être considérée comme une espèce exclusive du maërl. Les faibles valeurs de richesse spécifique et les fortes valeurs de l'équitabilité de Pielou mesurées nous font considérer cette communauté comme bien structurée.

Keywords: Circalittoral, Coastal detritic, Maerl, Molluscs, Tyrrhenian, Ustica

Introduction

Maerl beds are mainly composed of free-living non-geniculate coralline algae (Corallinaceae: Rhodophyta), that have an algal core or a core of sandy granules or shells with a more or less regular and concentric growth around them. These structures, referred to as "rhodoliths", develop and accumulate on soft bottoms influenced by laminar currents, producing characteristic calcareous deposits which constitute major sources of carbonate sediment. They are usually found in shallow subtidal waters and are widely dis-

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tributed from the Arctic to the Tropics (Hall-Spencer, 1998). *Phymatolithon calcareum* (Pallas) W.H. Adey & D.L. McKibbin and *Lithothamnion corallioides* (P. L. & H. M. Crouan) P. L. & H. M. Crouan are the main European maerl forming species. In the western Mediterranean this community, so called "Free Melobesie", colonizes both infra- and circalittoral bottoms and represents an important fraction of the coastal detritic (DC) biocoenosis, with its high degree of biodiversity and biomass and ability to provide habitats for numerous rare or endemic species of flora and fauna, also providing food and shelter for a large number of invertebrates (Cabioch, 1969; Grall & Glémarec, 1997; Castriota et al., 1998; Castriota et al., 2003). Maerl beds are legally protected, listed in European Community Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (1992) with the inclusion of both the aforementioned species listed under Annex V. Despite the recognized importance of maerl, few faunal investigations have been carried out in the Mediterranean. In the framework of research on the effects of a hyperhaline discharge from a desalination plant on benthic communities around Ustica Island (Castriota et al., 2001), we collected sediment samples from a maerl ground. We focused on the associated living molluscs as they are considered to be efficient descriptors of benthic communities, due to their linkage with the sediment (Gambi et al., 1982). While there is a detailed literature on molluscs from various biocoenoses around Ustica Island (Chemello, 1986; Milazzo et al., 2000; Milazzo et al., 2001), the molluscan assemblage of maerl has not yet been investigated.

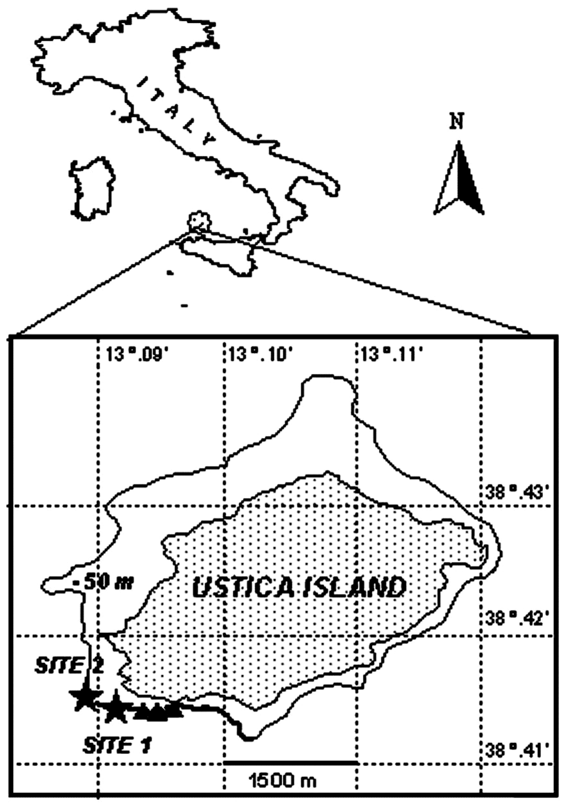

Figure 1. Map of the study area and location of the sampling sites (stars and triangles for quantitative and qualitative sampling respectively).

Figure 1. Carte du secteur étudié et localisation des sites d'échantillonnage (étoiles et triangles pour l'échantillonnage quantitatif et qualitatif respectivement).

Material and Methods

Study site

Ustica Island (Southern Tyrrhenian Sea, 38° 42' N, 13° 10' E, Fig. 1) is located 67 km north of Sicily; it was designated as a Natural Marine Reserve by Ministerial Decree on 12 November 1986. Ustica Island has a volcanic origin, rising to more than 2000 m from the Tyrrhenian seabed. Western currents have anticlockwise circulation around the island, which is surrounded by very clear waters. The island lies on a short continental shelf extending for the maximum distance of 1800 m in its northern area. This area is almost entirely colonised by seagrass *Posidonia oceanica* (L.) Delile reaching depths of 40-45 m. The southern coast, in contrast, is characterized by a shorter continental shelf with a steep rocky seabed where algal communities occur to depths of 35 m. From 35 to around 40-50 m short *P. oceanica* meadows occur. At a depth of 40-50 m *P. oceanica* is replaced by heterogeneous sandy substratum characterized by the presence of organogenic detritus and calcareous Rhodophyceae. This soft substratum has been investigated in the present study, since no recent background information exists on its associated mollusc community.

This bottom is mainly composed of medium sand (ϕ = 2.0, 50.3% to 58.2%), biogenic and volcanic particles together with a significant red calcareous algae of *prâlines* structure (i.e. irregular nodules, a few centimetres in diameter, formed by the superposition of layers of a calcareous alga that is living over the whole of the nodule surface (Pérès, 1967)). *Lithophyllum*, *Neogoniolithon*, *Lithothamnion*, *Phymatolithon* and *Spongites* are the dominant genera (Mannino et al., 2002). Maerl from this bottom is alive and structurally pristine, not affected by fishery exploitation. The floristic assemblage is typical of that described in western Mediterranean maerl beds of coastal detritic bottoms, characterized by the high occurrence of red algae. The presence of rhodoliths allows the settlement of species normally confined to hard substrata. The whole community has a subtropical character and it represents a *facies* of the

DC biocoenosis (Mannino et al., 2002). The zoobenthic community is characterized by species typical of the DC biocoenosis (the echinoderm *Genocidaris maculata* A. Agassiz, 1869) together with species of coarse sediments affected by strong currents (the polychaete *Glycera lapidum* Quatrefages, 1865, the echinoderm *Spatangus purpureus* O.F. Muller, 1776) (Castriota et al., 1998 & 2001). This area is subject to strong currents; temperature ranges from 13 °C in winter to 17 °C in summer and salinity from 36.9 to 37.9‰.

Data collection

Sediment samples were collected in November 1996 and July 1997 with a van Veen grab (0.1 m^2), at a depth of around 50 m, along a transect of around 2 km, parallel to the south-west coast of Ustica Island (Fig. 1), to assess temporal changes in mollusc assemblage structure. In order to investigate within bed variability, two stations were sampled in each period; five replicate samples were taken at each station; samples retained after washing on a 0.5 mm sieve were preserved in 5% formalin. Organisms were sorted under a stereomicroscope, identified to species level and counted.

Data analysis

In order to identify the dominant species in the mollusc communities examined, a mean dominance index (dm ± standard error) was calculated: dm = n/N.100 where n is the number of specimens of a species and N is the total number of individuals collected (Martin et al., 1990). The mean values (± standard error) of abundance (N), richness (S), Shannon–Wiener diversity index (H'), Pielou's Evenness (J), and Margalef's index (D) were calculated (Magurran, 1996) in order to allow comparisons with other studies on the same subject. Two-way crossed non-parametric multivariate analysis of variance (PERMANOVA) was used to detect differences in abundance between periods and sites (Anderson, 2001 & 2005, McArdle & Anderson, 2001). Data were transformed to Ln (x + 1); the analysis is based on Gower distances excluding double zeros. After no significant differences were found ($p > 0.05$), principal coordinate analysis (PCO) (Anderson, 2003) based on Gower distances was carried out to graphically represent the distribution of the mollusc species in relation to their abundance values. PERMANOVA was also used to analyse indices between periods and sites; the analysis was based on Euclidean distances with untransformed data standardized to z-scores, as they vary on different scales. Pair-wise *a posteriori* comparisons were made after significant differences were found.

Trophic guild analysis was also performed to assess the contribution in abundance given by groups of species using similar resources within the maerl community. This analysis was carried out grouping the individuals as suspension feeders, herbivores, carnivores, and others (comprising deposit feeders, omnivores and parasites) and their % total abundance calculated.

Complementary sediment samples (n = 24) collected at different periods (November 1997, January 1998, June 1998) and at different sites (Fig. 1) were also examined in order to enhance the list of mollusc species associated with maerl, but they were not considered in any quantitative analyses.

Information on the ecology of the observed species was mainly drawn from Picard (1965), Pérès (1967), Tebble (1976), Graham (1988), Thompson (1988) and Dell'Angelo & Smriglio (1999).

Results

Qualitative analysis

A total of 57 species was found in all the sediment samples examined, of which 18 species were only recorded in the complementary samples and were represented by one or few individuals. 32 species are newly reported for the Ustica molluscan maerl fauna, although most of them are commonly reported in the Tyrrhenian Sea. Table 1 presents the total list of mollusc species collected and the biocoenosis where they were found in previous studies at Ustica Island (Chemello, 1986; Milazzo et al., 2000; Milazzo et al., 2001, Covazzi et al., 2002).

Quantitative analysis

220 mollusc specimens belonging to 39 species were collected during our survey. Bivalvia were the dominant group in abundance (103 individuals; 16 species), followed by Gastropoda (77 individuals; 17 species), Polyplacophora (39 individuals; 5 species) and Scaphopoda (1 individual; 1 specie). 18 species were common to both studied periods. Mollusc species collected within the two circalittoral maerl stations of Ustica Island and their mean abundances in both study periods are shown in table 2; their life mode is also reported.

Haminoea hydatis (dm = 17.2 ± 5.1), *Gibberula jansseni* (dm = 13.4 ± 4.3), and *Modiolula phaseolina* (dm = 11.7 ± 3.9) were the species with the highest dominance indexes, followed by *Acantochitona fascicularis* (dm = 6.5 ± 2.1), *Hiatella arctica* (dm = 5.3 ± 2.5) and *Limatula subauriculata* (dm = 4.6 ± 2.6). *M. phaseolina* was particularly abundant in the summer period when it represented the 24.6 % of the total number of molluscs recorded in this season.

The mean number of individual molluscs sampled with the van Veen grab was 11.0 ± 1.3 per 0.1 m^2; the mean number of mollusc species sampled was 6.4 ± 0.6 per 0.1 m^2.

	Ustica Island	Literature
Polyplacophora		
+*Acanthochitona fascicularis* (Linnaeus, 1767)	AP	AP, hb
+*Lepidopleurus africanus* Nierstrasz, 1906	DC	DC
**Lepidopleurus cimicoides* (Monterosato, 1879)		HP, DC
**Lepidopleurus geronensis* (Kaas &Van Belle, 1985)		C, DC
*+*Callochiton calcatus* Dell'Angelo & Palazzi, 1994		C, DC
Callochiton septemvalvis (Montagu, 1803)	AP	DC
Ischnochiton rissoi (Payraudeau, 1826)	AP	hb
**Ischnochiton usticensis* Dell'Angelo & Castriota, 1999		
Lepidochitona monterosatoi Kaas & Van Belle, 1981	AP	C, DC
Gastropoda		
+*Tectura virginea* (Mueller O.F., 1776)	AP, SGCF	hb
+*Diodora graeca* (Linnaeus, 1758)	AP, RMI, HP, SGCF	LR (hb)
**Emarginula punctulum* Piani, 1980		hb
Scissurella costata D'Orbigny, 1824	AP, C, HP, SGCF	LR
Pisinna glabrata (Von Muehlfeldt, 1824)	AP	AP, HP
**Caecum auriculatum* De Folin, 1868		sb
**Caecum trachea* (Montagu, 1803)		sb
**Calyptraea chinensis* (Linnaeus, 1758)		LR (hb)
Neosimnia spelta (Linnaeus, 1758)	C	C
**Erato voluta* (Montagu, 1803)		LR
**Euspira pulchella* (Risso, 1826)		LR (sb)
*+*Vitreolina philippi* (Rayneval & Ponzi, 1854)		LR
Mitrella scripta (Linnaeus, 1758)	AP, HP, SGCF	LR
**Gibberula jansseni* Van Aartsen, Menkhorst & Gittemberger, 1984		DC
**Granulina occulta* (Monterosato, 1869)		DC
**Volvarina mitrella* (Risso, 1826)		DC
Rissoella inflata Locard, 1892	AP	AP, HP
+*Ammonicera rota* (Forbes & Hanley, 1850)	AP, C, HP, SGCF	LR
Haminoea hydatis (Linnaeus, 1758)	AP, C, SGCF	LR
+*Retusa truncatula* (Bruguière, 1792)	AP	LR
**Aplysia parvula* Guilding in Morch, 1863		AP
**Aegires punctilucens* (D'Orbigny, 1837)		hb
*+*Embletonia pulchra* Alder & Hancock, 1851		SGCF
Bivalvia		
**Solemya togata* (Poli, 1795)		HP
Arca noae Linnaeus, 1758	AP	LR (hb)
Barbata barbata Linnaeus, 1758	AP	LR (hb)
**Gregariella semigranata* (Reeve, 1858)		hb
**Modiolarca subpicta* (Cantraine, 1835)		hb
+*Modiolula phaseolina* (Philippi, 1844)	DC	DC
*†*Modiolus barbatus* (Linnaeus, 1758)		HP, hb
+*Limatula subauriculata* (Montagu, 1808)	AP	LR (sb)
**Chlamys flexuosa* (Poli, 1795)		DC
*+*Anomia ephippium* (Linnaeus, 1758)		LR (hb)
*+*Pododesmus patelliformis* (Linnaeus, 1761)		LR (hb)
Ctena decussata (Costa O.G., 1829)	AP	LR (SGCF)
Neolepton sulcatulum (Jeffreys, 1859)	AP	AP, HP
Glans trapezia (Linnaeus, 1758)	AP	LR (HP)
Chama gryphoides (Linnaeus, 1758)	AP	LR (hb)
*+*Plagiocardium papillosum* (Poli, 1795)		LR (DC)
*+*Tellina donacina* (Linnaeus, 1758)		DC
*+*Tellina pygmaea* Lovèn, 1846		SGCF
**Psammobia costulata* Turton, 1822		SGCF
+*Gouldia minima* (Montagu, 1803)	AP	SGCF, DC
*+*Timoclea ovata* (Pennant, 1777)		LR (sb)
**Gastrochaena dubia* (Pennant, 1777)		LR (hb)
+*Hiatella arctica* (Linnaeus, 1767)	AP	LR (hb)
*+*Thracia villosiuscula* (Mc Gillivray, 1827)		SGCF
Scaphopoda		
**Antalis vulgaris* Da Costa, 1778		SGCF

Table 1. Mollusc species from maerl around Ustica Island. Biocoenoses where species have been observed in previous studies around the Island and those indicated in the literature are reported: AP = photophilic algae, C = coralligenous, DC = coastal detritic, GI = infralittoral pebbles, LR = wide range of habitat preferences, HP = *Posidonia oceanica* meadows, RMI = lowest mediolittoral rock, SGCF = coarse sands and fine gravels under bottom currents, hb = hard bottom, sb = soft bottom. The preferred habitat is indicated in brackets. * new records for Ustica Island, + occurrence in other maërl beds.

Tableau 1. Liste des mollusques du maërl de l'île d'Ustica et des biocœnoses où ces espèces ont déjà été signalées dans l'île et celles indiquées dans la littérature. AP = biocœnose des algues photophiles, C = biocœnose coralligène, DC = biocœnose des fonds détritiques côtiers, GI = galets infralittoraux, LR = espèce à large répartition écologique, HP = herbier de *Posidonia oceanica*, RMI = roche médiolittorale inférieure, SGCF = sables grossiers et fins graviers sous influence des courants de fond, hb = substrat dur, sb = substrat meuble. Entre parenthèses est indiqué l'habitat préféré. * = nouveau signalement pour l'île d'Ustica. + = présence dans d'autres fonds de maërl.

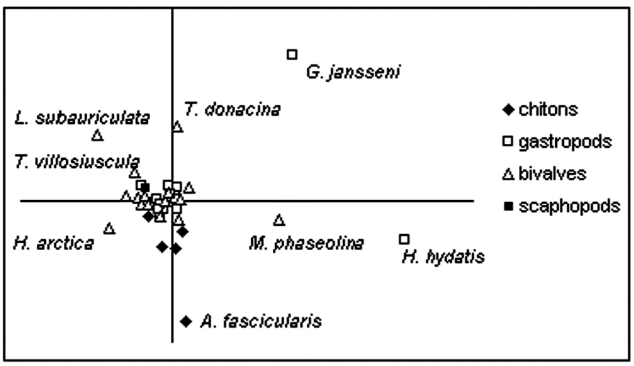

Figure 2. Principal Coordinate Analysis with the principal species indicated.

Figure 2. Analyse en Coordonnées Principales avec indication des espèces principales.

Table 3 reports the mean values (± standard error) of N, S, H', J and D per site and per period; they are graphically represented in Fig. 3.

Results of PERMANOVA showed no significant difference in abundance between sites ($F_{1,16} = 0.854$, $p > 0.05$.), between periods ($F_{1,16} = 1.584$, $p > 0.05$.) nor in interaction term ($F_{1,16} = 1.389$, $p > 0.05$). Results of PCO are shown in Fig. 2, indicating the classes to which each species belongs; the first two axes explained 63.24% of the variation.

PERMANOVA performed on indices showed no significant difference between sites ($F_{1,16} = 3.365$, $p > 0.05$) nor between periods ($F_{1,16} = 0.618$, $p > 0.05$), but highly significant differences ($F_{1,16} = 6.992$, $p < 0.01$) in interaction term. Pair-wise *a posteriori* comparisons resulted in significant differences between periods in site 2 ($t = 2.87$, $p < 0.05$) and highly significant differences between sites in July 1997 ($t = 3.35$, $p < 0.01$).

The trophic analysis showed the dominance of suspension feeders (45.2%) followed by herbivores (27.3%), carnivores (21.1%) and others (6.4%).

Discussion

The mollusc community of the maerl around Ustica Island is composed of species with different habitat preferences. In addition to the bivalves *M. phaseolina* and *Tellina donacina*, which are characteristic of the circalittoral coastal detritic biocoenosis (Pérès, 1967), we observed species belonging to the non-climatic biocoenosis of the coarse sands and fine gravels under bottom currents (SGCF) (the scaphopod *Antalis vulgaris*, the bivalves *Psammobia costulata* and *Thracia villosiuscula*) together with species with a wide range of habitat preferences. Such an assemblage, composed of both hard substratum and soft substratum species, reflects the habitat heterogeneity. Similar results were also obtained analysing the epiflora composition of this maerl bed, which showed a high percentage of infralittoral species together with those characteristic of the circalittoral coralligenous biocoenosis (Mannino et al., 2002). Falconetti (1970) described an analogous settlement for the maerl of Castiglione (Algeria), pointing out the coexistence of the maerl *facies* with the biocoenosis of the coastal detritic plus that of SGCF. Basso & Brusoni (2004) reported the dominance of current-loving /SGCF mollusc species in the maerl of Elba Island in the Tuscan Archipelago, although they examined a very small sample that was probably unrepresentative of the entire community. Benthic assemblages characteristic of heterogeneous substrates were also found by Grall & Glémarec (1997) in Breton maerl beds.

The mollusc community from Ustica Island did not differ spatially or temporally over the range considered, as demonstrated by the PERMANOVA. The abundance values recorded were very low when compared with those of molluscs communities living in the shallower waters. Mollusc densities recorded in the photophilic algae assemblage of the same area (Milazzo et al., 2000) were around twenty times higher than that found associated with the maerl and the diversity indices were also higher in the former. However, the high evenness values recorded and the low

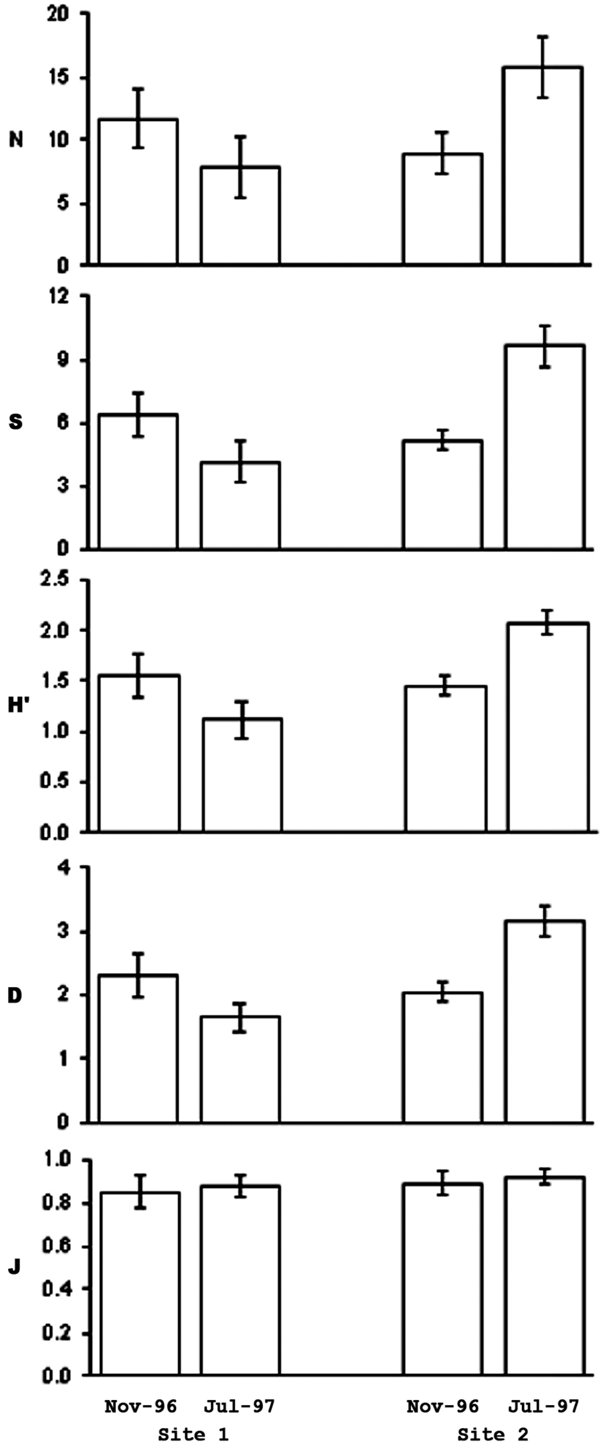

Figure 3. Number of individuals (N), number of species (S), Shannon-Wiener diversity index (H'), Pielou's evenness (J) and Margalef's diversity index (D) calculated for both sites and periods (mean ± standard error).

Figure 3. Nombre d'individus (N), nombre d'espèces (S), indice de diversité de Shannon-Wiener (H'), équitabilité de Pielou (J) et indice de diversité de Margalef (D) calculés pour chaque station et période d'échantillonnage (moyenne ± erreur standard).

richness found let us consider the maerl community as well structured, as one would expect in heterogeneous sediments (Gray, 1974). In terms of trophic guilds, suspension feeders, mainly represented by bivalves, were dominant, as expected in coarse sediments (Gray, 1974); they were followed by herbivores and carnivores in similar proportions. The importance of bivalves, and particularly of suspension feeders, is also reported for Breton maerl beds (Grall & Glémarec, 1997). Together with bivalves, chitons were also well represented (Fig. 2); they represented 65% in number of herbivores and their occurrence is probably related to that of rhodoliths they graze on (Dell'Angelo & Smriglio, 1999). In terms of species abundance, three molluscs dominated this community: the opisthobranch *H. hydatis*, the gastropod *G. jansseni* and the bivalve *M. phaseolina*, which were also the species with the highest frequency of occurrence. The importance of *G. jansseni* in the DC around Ustica Island confirms its preference for coastal detritic bottoms, as suggested by Micali & Quadri (2001) who found a high number of living individuals of this species in the DC of Lampedusa Island (Strait of Sicily). Other abundant members of the examined community are mainly species found on a wide range of habitats, such as the chiton *A. fascicularis* and the bivalves *H. arctica* and *L. subauriculata.* Some species, such as *Tectura virginea*, *T. donacina, Tellina pygmaea, Modiolus barbatus, M. phaseolina, T. villosiuscula*, *L. subauriculata*, *H. arctica, Timoclea ovata, Anomia ephippium*, are also found in Atlantic maerl bed mollusc assemblages (Nunn, 1993; Hall-Spencer, 1998; Jackson et al., 2004), nevertheless they are not exclusively found on maerl habitat. Similar results were also obtained for infaunal crustacean communities of Irish maerl beds (De Grave, 1999). By contrast, the chiton *Ischnochiton usticensis*, a new species from the maerl of Ustica Island (Dell'Angelo & Castriota, 1999), could be characteristic of maerl, since it has not been found in any other biocoenoses in Ustica Island. Occurrence of rhodolith-specific cryptofaunal chitons was also reported in rhodolith beds of the Gulf of California by Steller et al. (2003). These observations suggest that chitons, among molluscs, may establish specific association with maerl, although their ecological interactions with the substrate need further investigation.

Indices analysis showed variability between periods in site 2 and between sites in July 1997. This variability is attributable to differences in rhodolith density and type over the study area. Live maerl is known to have high structural heterogeneity and to support high biodiversity, providing refuge and food supply for several species (Grall & Glémarec, 1997; De Grave, 1999; Kamenos et al., 2004). The occurrence, in the maerl bed studied, of rhodoliths with different branch shape (from cylindrical to knobby), branch density and arrangement (from sparse and open to dense and crowded) as well as growth-form variation (from fruti-

Table 2. Mean abundance (0.1 m^2) ± standard error of molluscs associated with maerl of Ustica Island, calculated for two sites and two periods. C = Carnivore, D = Detritivore, H = Herbivore, M = Mucous feeder, O = Omnivorous, P = Parasite, S = Suspension feeder.

Tableau 2. Abondance moyenne (0.1 m^2) ± erreur standard des mollusques associés au maërl de l'île d'Ustica, calculée pour deux stations et deux périodes d'échantillonnage. C = Carnivore, D = Détritivore, H = Herbivore, M = Collecteur de mucus, O = Omnivore, P = Parasite, S = Suspensivores.

TAXA	Station 1		Station 2		Trophic guild
	nov-96	jul-97	nov-96	jul-97	
Acanthochitona fascicularis	1.40 ± 0.75	0.20 ± 0.20	0.40 ± 0.24	1.80 ± 0.80	H grazer
Callochiton septemvalvis	0.40 ± 0.24			0.60 ± 0.24	H grazer
Ischnochiton usticensis	0.40 ± 0.40		0.20 ± 0.20	0.40 ± 0.24	H grazer
Lepidochitona monterosatoi	0.40 ± 0.24		0.20 ± 0.20	0.80 ± 0.37	H grazer
Lepidopleurus geronensis	0.20 ± 0.20			0.40 ± 0.40	H grazer
Aegires punctilucens			0.20 ± 0.20		C (sponges)
Aplysia parvula	0.60 ± 0.24				H
Caecum auriculatum				0.20 ± 0.20	H micrograzer
Caecum trachea	0.20 ± 0.20				H micrograzer
Calyptraea chinensis			0.20 ± 0.20	0.40 ± 0.24	M
Diodora graeca				0.20 ± 0.20	C (sponges)
Emarginula punctulum				0.20 ± 0.20	C (sponges), D
Embletonia pulchra				0.20 ± 0.20	C (hydroids)
Euspira pulchella	0.20 ± 0.20	0.20 ± 0.20	0.20 ± 0.20	0.40 ± 0.24	C (bivalves)
Gibberula jansseni	0.40 ± 0.24	1.80 ± 0.80	1.00 ± 0.63	0.60 ± 0.24	C ?
Haminoea hydatis	2.40 ± 1.69	0.80 ± 0.20	1.60 ± 1.60	1.60 ± 0.60	H, C (bivalves)
Neosimnia spelta		0.20 ± 0.20			C (anthozoans)
Pisinna glabrata	0.20 ± 0.20		0.20 ± 0.20		unknown
Retusa truncatula		0.20 ± 0.20			C (foraminifers, molluscs)
Scissurella costata		0.20 ± 0.20		0.20 ± 0.20	D ?
Vitreolina philippi				0.40 ± 0.40	P (on echinoderms)
Volvarina mitrella			0.20 ± 0.20		C ?
Anomia ephippium	0.20 ± 0.20	0.20 ± 0.20	0.20 ± 0.20	0.40 ± 0.40	S
Arca noae	0.80 ± 0.80				S
Chama gryphoides	0.40 ± 0.24	0.20 ± 0.20			S
Gastrochaena dubia	0.20 ± 0.20	0.20 ± 0.20	0.20 ± 0.20	0.20 ± 0.20	S
Glans trapezia			0.20 ± 0.20		S
Gregariella semigranata		0.20 ± 0.20	0.40 ± 0.40	0.60 ± 0.24	S
Hiatella arctica	0.60 ± 0.40		1.00 ± 1.00	1.40 ± 0.87	S
Limatula subauriculata	1.80 ± 1.80	0.40 ± 0.40	0.40 ± 0.24		S
Modiolarca subpicta				0.20 ± 0.20	S
Modiolula phaseolina	0.20 ± 0.20	2.80 ± 1.71	0.20 ± 0.20	3.00 ± 1.52	S
Modiolus barbatus	0.20 ± 0.20				S
Neolepton sulcatulum				0.60 ± 0.40	S
Psammobia costulata				0.40 ± 0.40	S
Tellina donacina		0.20 ± 0.20	0.80 ± 0.58	0.40 ± 0.24	S, D
Tellina pygmaea				0.20 ± 0.20	S
Thracia villosiuscula	0.40 ± 0.24		0.80 ± 0.37		S
Antalis vulgaris			0.20 ± 0.20		O

cose to lumpy to partially encrusting) (Mannino et al., 2002), may affect species abundance, richness and diversity. According to Hinojosa-Arango & Riosmena-Rodríguez (2004), branch density, and secondarily rhodolith density, affect the fauna community associated with rhodolith beds in the Gulf of California, while rhodolith growth-form would be less important than rhodolith species in determining abundance and richness of the associated fauna. These observations would be a stimulus for future research in Mediterranean maerl beds.

In conclusion, it appears to be no particular molluscan assemblage specifically associated with maerl around Ustica Island and most species reflect the nature of the substratum on which the maerl lies.

Table 3. Number of individuals (N), number of species (S), Shannon-Wiener diversity index (H'), Pielou's evenness (J) and Margalef's diversity index (D) calculated for both sites and periods (mean ± standard error).

Tableau 3. Nombre d'individus (N), nombre d'espèces (S), indice de diversité de Shannon-Wiener (H'), équitabilité de Pielou (J) et indice de diversité de Margalef (D) calculés pour chaque station et période d'échantillonnage (moyenne ± erreur standard).

		N	S	H'	J	D
Site 1	Nov '96	11.6 ± 2.4	6.4 ± 1.0	1.55 ± 0.22	0.86 ± 0.07	2.30 ± 0.34
	Jul '97	7.8 ± 2.4	4.2 ± 1.0	1.11 ± 0.18	0.88 ± 0.05	1.63 ± 0.22
Site 2	Nov '96	8.8 ± 1.6	5.2 ± 0.5	1.45 ± 0.10	0.89 ± 0.06	2.03 ± 0.15
	Jul '97	15.8 ± 2.4	9.6 ± 1.0	2.08 ± 0.12	0.93 ± 0.03	3.16 ± 0.23

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