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Contribution to the study of deep coastal detritic bottoms: the algal communities of the continental shelf off the Balearic Islands, Western Mediterranean

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Abstract

Three main algal-dominated coastal detritic communities from the continental shelf off Mallorca and Menorca (Balearic Islands, Western Mediterranean) are described herein: maërl beds dominated by *Spongites fruticulosus* and forests of *Laminaria rodriguezii* located in the Menorca channel, and *Peyssonnelia inamoena* beds found along the Southern coast of Menorca. There seems to be a gradient of disturbance from the highly disturbed *Peyssonnelia* beds to the almost undisturbed *L. rodriguezii* forests. Whether this gradient is the result of current and past anthropogenic pressure (e.g. trawling intensity) or is driven by natural environmental factors needs further assessment. Finally, the location of the target communities by means of ROV dives combined with the use of a Box-Corer dredge and beam trawl proved to be a good methodology in the study of the composition and structure of these deep water detritic communities.

Keywords: detritic bottoms, *Laminaria rodriguezii*, macroalgae, sampling methods, Mediterranean Sea, *Peyssonnelia inamoena*, *Spongites fruticulosus.*

Introduction

Mediterranean algal-dominated coastal detritic bottoms usually develop at depths between 25 and 130 m (Pérès, 1985; Giaccone *et al.*, 1994). They are composed of silt, sand, gravels, and calcareous skeletons of benthic organisms such as molluscs, bryozoans, cnidarians, echinoderms and macroalgae. Free-living members of the orders Corallinales and Peyssonneliales (Pérès, 1985; Klein & Verlaque, 2009) are usually the major components of these bottoms. Both the skeletons and the calcareous algae allow the settlement and growth of organisms usually found on rocky bottoms (Bianchi, 2001), creating a special habitat harbouring animals and plants of both soft and hard bottoms (Laborel, 1987).

Different assemblages have been recognized in Mediterranean algal-dominated coastal detritic bottoms, each one characterized by either one or a reduced number of more or less exclusive species (e.g. see Dieuzede, 1940; Huvé, 1954, 1956; Jacquotte, 1962; Pérès & Picard, 1964; Picard, 1965; Giaccone, 1967; Bourcier, 1968; Augier & Boudouresque, 1978; Ballesteros, 1988, 1994; Giaccone *et al.*, 1994). The Balearic Islands harbour extensive areas of these kinds of bottoms and different seascapes have been described between 52 and 93 m, using bottom trawls (Joher *et al.*, 2012): maërl beds dominated by *Spongites fruticulosus*, deep water forests of *Laminaria rodriguezii*, two types of *Peyssonnelia* beds (one dominated by *P. inamoena* and the other one by *P. rubra,* both species presenting hypobasal calcification, and the last one presenting some cystolists too), and red algae meadows dominated by *Osmundaria volubilis* and *Phyllophora crispa*.

However, although bottom trawling was effective for the characterization of underwater landscapes, descriptions at community level require the use of smaller sampling areas. Several ROV dives were performed in 2009 in the Menorca channel and along the Southern coast of Menorca (Barberá *et al.*, 2009, 2012) in order to locate certain homogeneous areas harbouring the communities that characterized the seascapes found by Joher *et al.* (2012). Three of these areas were located: one with maërl beds of *S. fruticulosus*, another with forests of *L. rodriguezii*, and a last one with *P. inamoena* beds. In contrast, extensive areas covered by the assemblage dominated by *Osmundaria volubilis* and *Phyllophora crispa* were found, with a patchy distribution.

Maërl beds dominated by *S. fruticulosus* have seldom been reported from the Balearic Islands (Barberá *et al.*, 2012), and their composition and structure have only been studied from Tossa de Mar (Northwestern Mediterranean, Spain) (Ballesteros, 1988), where the maërl bed grows in reduced light levels (around 0.3 % of surface PAR irradiance) and moderate temperature range conditions (12.5 to 21.5ºC). Forests of *L. rodriguezii* develop under low light intensities (usually at depths between 50 and 120 m, being more abundant below 70 m), low temperature (less than 14ºC), and unidirectional current conditions (Feldmann, 1934; Huvé, 1955; Molinier, 1960; Pérès & Picard, 1964; Giaccone, 1967, 1971; Lüning, 1990; Giaccone & Di Martino, 1997). Most information available about these rarefied kelp forests focuses on species composition although there are no quantified lists of species (Huvé, 1955; Molinier, 1956; Gautier & Picard, 1957). Finally, several authors have reported *Peyssonnelia* beds developing on circalittoral bottoms, mainly along the coasts of Marseille, the Tyrrhenian Sea and the Balearic Islands (e.g. Huvé, 1954; Carpine, 1958; Parenzan, 1960; Augier & Boudouresque, 1978; Basso, 1990; Ballesteros, 1994; Joher *et al*., 2012), highlighting the variety of the dominant *Peyssonnelia* species. These beds also develop under low light conditions but they seem to need pulsing current conditions, which prevent the burial of living *Peyssonnelia* spp. (Bourcier, 1968; Basso, 1990). Two kinds of *Peyssonnelia* beds, one dominated by *P. rosa-marina* and the other by an unidentified *Peyssonnelia* have been reported previously from the Balearic Islands (Ballesteros, 1994), but there is no published information on the beds dominated by *P. inamoena*.

The purpose of this paper is to describe the species composition and abundance of three specific communities from the detritic bottoms off the Balearic Islands (*S. fruticulosus, L. rodriguezii* and *P. inamoena*), which characterized three of the landscapes described previously in Joher *et al.* (2012). Another objective was to check whether Box-Corer dredging and beam trawling, combined with ROV images, are suitable methodologies to characterize deep-water coastal detritic communities.

Materials and Methods

The sampling area was located in the Menorca channel and along the Southern coast of Menorca (the Balearic Islands, Western Mediterranean; Fig. 1). The continental shelf bottoms of this area are characterized by sediments of biogenic origin (Canals & Ballesteros, 1997; Fornós & Ahr, 1997) with a high percentage of carbonates (Acosta *et al*., 2002), and the water column presents a high light transmittance (Ballesteros & Zabala, 1993; Canals & Ballesteros, 1997).

Sampling was performed in May 2009, during the MEDITS_ES05_09 campaign organized by the Centre Oceanogràfic de Balears (Instituto Español de Oceanografía). Target communities had been located previously by ROV during the CANAL0209 research survey (February-March 2009): large areas were occupied by the communities with *Spongites fruticulosus* and *Laminaria rodriguezii* in the Menorca channel at depths between 50 and 62 m, while the community dominated by *Peyssonnelia inamoena* was found on the Southern coast of Menorca, at depths of around 65 m.

Because of the deep-water distribution of these communities, we did not sample them by SCUBA diving but used other sampling methods: dredges (e.g. see Dieuzede, 1940; Huvé, 1956; Costa, 1960; Bourcier, 1968; Blunden *et al.,* 1977; Bordehore *et al.,* 2003; Peña, 2010) and beam trawls (Barberá *et al*., 2012; Ellis *et al*., 2013). Images obtained by ROV, together with previous results (Joher *et al*., 2012), showed that the community dominated by *S. fruticulosus* was very homogeneous, and composed mainly of small maërl-forming species (*S. fruticulosus* and *Phymatolithon calcareum*). There, samples were collected using a Box-Corer dredge (sampling area: 200 cm^2). In contrast, communities with *L. rodriguezii* and *P. inamoena* were more heterogenous because of the size of the algae and the aggregation in clusters of the thalli of the characteristic species. There, the use of a Box-Core was disregarded, and samples were collected using a beam trawl (horizontal and vertical openings: 1.30 and 0.88 m, respectively; mesh size: 10 mm), at speeds of 2.5-3.0 knots. Trawling time ranged from 5 to 12 seconds and was controlled by a SCANMAR system (Scanmar Maritime Services Inc., Makati City, Philippines) in order to calculate the trawled area, which ranged from 6 to 16 m^2.

We collected seven samples of the *S. fruticulosus* community, which were integrally quantified, and two from the *L. rodriguezii* and *P. inamoena* communities. All samples were preserved on board in 4% formalin:seawater. Samples of *L. rodriguezii* and *P. inamoena* were homogeneously extended occupying the corresponding sampled surface, and we took two replicates of 1.2x1.2 m^2 per sample. Samples and replicates were named *C s-r*, where *C* corresponds to each community, *s* to each sample, and *r* to each replicate. Then, they were sorted and identified to the minimum taxonomic level, and each taxon was quantified measuring its algal surface (Sa_i, in cm^2) and biomass (B_i, as dry weight in g) (Ballesteros, 1992). Skeletons of dead Corallinales were rejected because we only wanted to quantify live specimens.

Several synthetic parameters were calculated for each sample/replicate: a) the number of species, total algal surface (Sa_T) and total biomass (B_T); b) the Index of Floral Originality (IFO = $(\sum 1/M_i)/n$), where M_i is the number of samples in which the species i occurred and n the number of species in the sample; c) the total algal surface and biomass of the maërl-forming species (MFS_{Sa}, MFS_B); d) Shannon's diversity index ($H' = -\sum p_i \log_2 p_i$), where p_i corresponds to the proportion of the measured parameter (Sa_i/Sa_T or B_i/B_T) for each species; and e) Pielou's evenness index ($J' = H'/\log_2 S$), where H' was based both on algal surface and biomass.

In order to verify the grouping of the samples, cluster analysis accompanied by the SIMPROF test (Clarke *et*

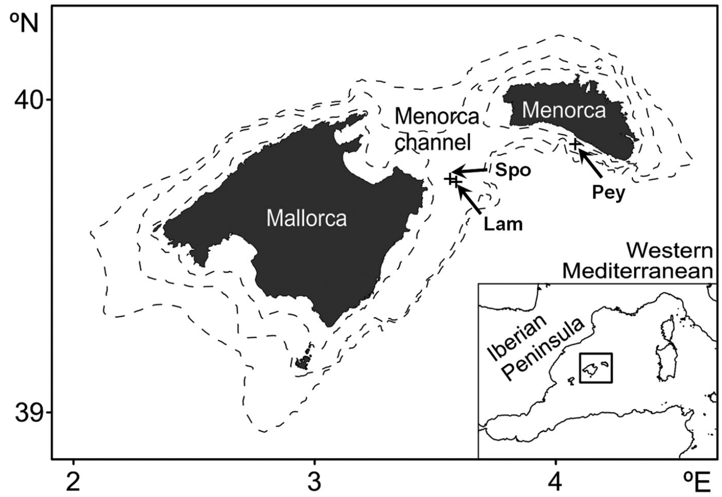

Fig. 1: Sampling locations of the three communities studied in the Menorca Channel and the Southern coast of Menorca. Isobaths of -50, -100 and -200 m are shown. Abbreviations: Spo, *Spongites fruticulosus* beds; Lam, forests of *Laminaria rodriguezii*; Pey, *Peyssonnelia inamoena* beds.

al., 2008) adjusted to 9999 permutations and a 0.1% significance level according to Potter *et al*. (2001), based on Sørensen and Bray-Curtis similarity matrices, were performed for each community. Finally, SIMPER tests were used to calculate species contribution to the similarities within each of the three studied communities and their characteristic species. These analyses were performed with PRIMER version 6 software (Clarke & Warwick, 2001).

Results

We identified up to 143 algal taxa at specific and infraspecific level (below named species for convenience) (Table 1), although some of them could not be identified to species level because either we had only small fragments of the specimens, they were sterile (e.g. *Aglaothamnion* sp., *Peyssonnelia* sp., *Polysiphonia* sp., unidentified Rhodophyta), or they are probably undescribed species (e.g. *Halymenia* sp., *Rhodymenia* sp.).

A total of 57 algal species were identified on the *Spongites fruticulosus* beds (Table 2), with a dominance (84.2%) of Rhodophyta (Fig. 2). The number of species per sample was 16±5; the Sa_T per sample 3965±2838 cm^2 m^{-2}; and the B_T per sample 351±270 g dw m^{-2}. Maërl-forming species represented 76.8±21.5% of total Sa_T per sample, and 94.5±3.7% of B_T (Fig. 3). The characteristic species of these maërl beds were *S. fruticulosus* and *Phymatolithon calcareum* (SIMPER test, Fig. 4), which accounted for 80% of Sa_T and 82.6% of B_T. It should be noted that despite statistical analyses (cluster + SIMPROF), based both on qualitative and algal surface data, indicated that the samples belonged to a single significant group;

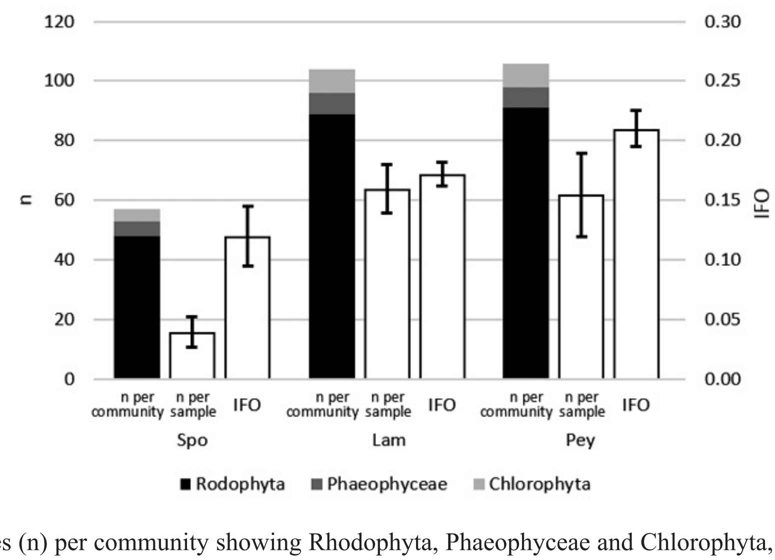

Fig. 2: Number of species (n) per community showing Rhodophyta, Phaeophyceae and Chlorophyta, and number of species and Index of Floral Originality (IFO) per sample (mean and standard deviation). Abbreviations: Spo, *Spongites fruticulosus* beds; Lam, *Laminaria rodriguezii* forests; Pey, *Peyssonnelia inamoena* beds.

Table 1. Species composition of the collected samples/replicates. For each taxon, the upper value corresponds to the algal surface (Sa, in $cm^2 m^{-2}$) in the sample or replicate, and the lower value, the biomass as dry weight (B, in $g\ dw\ m^{-2}$). The introduced species are marked with an asterisk (*), and the maërl-forming species, with a hashtag (#). Abbreviations: Spo, *Spongites fruticulosus* beds; Lam, *Laminaria rodriguezii* forests; Pey, *Peyssonnelia inamoena* beds; MC, Menorca Channel; SM, Southern Menorca.

	Spo I	Spo II	Spo III	Spo IV	Spo V	Spo VI	Spo VII	Lam I-1	Lam I-2	Lam II-1	Lam II-2	Pey I-1	Pey I-2	Pey II-1	Pey II-2
Location	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**SM**	**SM**	**SM**	**SM**
Depth (m)	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-61**	**-61**	**-62**	**-62**	**-64**	**-64**	**-65**	**-65**
Date of collection	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**15/05/09**	**15/05/09**	**15/05/09**	**15/05/09**	**19/05/09**	**19/05/09**	**19/05/09**	**19/05/09**
Rhodophyta															
Acrochaetium sp.					10.0			0.4	0.1	0.1	0.1	0.1	0.1		0.1
					0.100			0.004	0.001	0.001	0.001	0.001	0.001		0.001
Acrosorium ciliolatum (Harvey) Kylin												0.1			
												0.001			
'Acrosymphytonema breemaniae' (stadium) Boudouresque, Perret-Boudouresque & Knoepffler-Peguy *nom. inval.*												0.1			
												0.001			
Acrothamnion preissii (Sonder) E.M. Wollaston*								2.8	5.2	2.8	3.3	7.2	5.4	1.7	2.0
								0.028	0.031	0.028	0.022	0.036	0.021	0.007	0.016
Aglaothamnion tenuissimum (Bonnemaison) Feldmann-Mazoyer					5.0			0.2	9.8			0.1	0.1		
					0.050			0.002	0.099			0.001	0.001		
Aglaothamnion tripinnatum (C. Agardh) Feldmann-Mazoyer								29.1		0.1					
								0.292		0.001					
Aglaothamnion sp.										0.1		0.1			
										0.001		0.001			
Antithamnion sp.					5.0								0.1		
					0.050								0.001		
Apoglossum ruscifolium (Turner) J. Agardh				5.0				2.2	0.8	3.1	0.1		0.1		0.1
				0.050				0.001	0.028	0.016	0.001		0.001		0.001
Bonnemaisonia asparagoides (Woodward) C. Agardh												0.4			1.3
												0.073			0.013
Bonnemaisonia sp.				5.0									0.1		
				0.050									0.001		
Botryocladia botryoides (Wufen) Feldmann									0.1						
									0.001						

(continued)

Table 1 (continued)

	Spo I	Spo II	Spo III	Spo IV	Spo V	Spo VI	Spo VII	Lam I-1	Lam I-2	Lam II-1	Lam II-2	Pey I-1	Pey I-2	Pey II-1	Pey II-2
Location	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**SM**	**SM**	**SM**	**SM**
Depth (m)	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-61**	**-61**	**-62**	**-62**	**-64**	**-64**	**-65**	**-65**
Date of collection	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**15/05/09**	**15/05/09**	**15/05/09**	**15/05/09**	**19/05/09**	**19/05/09**	**19/05/09**	**19/05/09**
Botryocladia chiajeana (Meneghini) Kylin								0.4	0.6	0.3		0.3	0.5		
								0.014	0.007	0.007		0.001	0.005		
Brongniartella byssoides (Goodenough & Woodward) F. Schmitz												0.1		0.1	
												0.001		0.001	
Callophyllis laciniata (Hudson) Kützing												0.2	0.8	5.3	
												0.002	0.004	0.023	
Ceramium bertholdii Funk					5.0			0.1							0.1
					0.050			0.001							0.001
Ceramium codii (H. Richards) Mazoyer												0.1	0.1	0.1	0.1
												0.001	0.001	0.001	0.001
Champia parvula (C. Agardh) Harvey									0.2						
									0.007						
Chrysymenia ventricosa (J.V. Lamouroux) J. Agardh											0.1				
											0.001				
Chylocladia verticillata (Lightfoot) Bliding								0.6	0.1				0.1		
								0.014	0.001				0.001		
Contarinia peyssonneliaeformis Zanardini	207.5							0.3	0.3			4.3			
	1.038							0.002	0.001			0.021			
Cordylecladia erecta (Greville) J. Agardh cf			5.0												
			0.050												
Cryptonemia lomation (Bertoloni) J. Agardh									7.8	3.0			0.1		0.1
									0.049	0.015			0.001		0.001
Cryptonemia longiarticulata Funk species inquirendum										0.9		1.9			
										0.005		0.007			
Cryptonemia tuniformis (A. Bertoloni) Zanardini	9.0		40.0	120.0	48.0	5.0	15.0	8.4	0.5	0.6	1.6	26.1	25.0	2.5	0.5
	0.050		0.245	1.075	0.410	0.050	0.065	0.043	0.007	0.028	0.007	0.127	0.136	0.015	0.003
Cryptopleura ramosa (Hudson) L. Newton			5.0					2.4	0.1			4.7	6.6	6.7	4.1
			0.050					0.014	0.001			0.023	0.027	0.021	0.020
Dasya corymbifera J. Agardh			10.0												
			0.100												

(continued)

Table 1 (continued)

	Spo I	Spo II	Spo III	Spo IV	Spo V	Spo VI	Spo VII	Lam I-1	Lam I-2	Lam II-1	Lam II-2	Pey I-1	Pey I-2	Pey II-1	Pey II-2
Location	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**SM**	**SM**	**SM**	**SM**
Depth (m)	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-61**	**-61**	**-62**	**-62**	**-64**	**-64**	**-65**	**-65**
Date of collection	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**15/05/09**	**15/05/09**	**15/05/09**	**15/05/09**	**19/05/09**	**19/05/09**	**19/05/09**	**19/05/09**
Dasya penicillata Zanardini							5.0						0.1	0.1	0.1
							0.050						0.001	0.001	0.001
Dermatolithon sp.										0.1					
										0.001					
Erythroglossum balearicum J. Agardh *ex* Kylin	13.0	5.0	5.0					1.3	0.9		0.5		0.1		0.1
	0.100	0.050	0.050					0.001	0.007		0.007		0.001		0.001
Erythroglossum sandrianum (Kützing) Kylin									0.1						
									0.001						
Erythrotrichia carnea (Dillwyn) J. Agardh								0.1	0.1						
								0.001	0.001						
Eupogodon planus (C. Agardh) Kützing				5.0								1.5	0.9	0.4	0.1
				0.050								0.006	0.005	0.003	0.001
Felicinia marginata (Roussel) Manghisi, Le Gall, Ribera, Gargiulo et M. Morabito								6.9	78.1			2.4	1.6		
								0.069	0.781			0.014	0.008		
Gloiocladia furcata (C. Agardh) J. Agardh						5.0		0.3			0.1	0.5	0.8	0.7	0.9
						0.050		0.001			0.001	0.003	0.005	0.005	0.004
Gloiocladia microspora (Bornet ex J.J. Rodríguez y Femenías) Berecibar, M.J.Wynne, Barbara & R.Santos								0.3	50.0	58.3	59.9	1.9		0.6	0.2
								0.001	0.340	0.292	0.285	0.017		0.002	0.002
Gloiocladia repens (C. Agardh) Sánchez & Rodríguez-Prieto								2.2	52.4	63.7	11.5				
								0.035	0.594	0.465	0.076				
Gracilaria corallicola Zanardini					12.0			1.5	1.8	10.8	0.2	11,1	23,3		0,7
					0.105			0,014	0,018	0,039	0,002	0,066	0,085		0,006
Halymenia sp.										0.6				0.3	
										0.003				0.001	
Haraldia lenormandii (Derbès & Solier) Feldmann									0.1						
									0.001						

(continued)

Table 1 (continued)

	Spo I	Spo II	Spo III	Spo IV	Spo V	Spo VI	Spo VII	Lam I-1	Lam I-2	Lam II-1	Lam II-2	Pey I-1	Pey I-2	Pey II-1	Pey II-2
Location	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**SM**	**SM**	**SM**	**SM**
Depth (m)	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-61**	**-61**	**-62**	**-62**	**-64**	**-64**	**-65**	**-65**
Date of collection	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**15/05/09**	**15/05/09**	**15/05/09**	**15/05/09**	**19/05/09**	**19/05/09**	**19/05/09**	**19/05/09**
Hydrolithon farinosum (J.V. Lamouroux) D. Penrose & Y.M. Chamberlain								7.4	0.3	0.1	0.1	0.1			
								0.699	0.003	0.001	0.006	0.001			
Hypoglossum hypoglossoides (Stackhouse) F.S. Collins & Hervey		9.0	5.0	56.0	154.0		5.0	1.8	0.8	0.1	0.5	0.0		0.2	0.1
		0.070	0.050	0.125	0.250		0.050	0.015	0.008	0.001	0.007	0.000		0.001	0.001
Irvinea boergesenii (Feldmann) R.J. Wilkes, L.M. McIvor & Guiry		5.0	5.0	6.0	5.0		5.0	0.4	0.6	0.1	0.1	0.2	0.1	0.2	0.3
		0.050	0.050	0.050	0.050		0.050	0.014	0.007	0.001	0.007	0.002	0.002	0.002	0.001
Jania virgata (Zanardini) Montagne								0.1							
								0.007							
Kallymenia feldmannii Codomier								0.7	5.9	0.7		0.1			
								0.014	0.015	0.003		0.001			
Kallymenia patens (J. Agardh) Codomier *ex* P.G. Parkinson								588.3	31.5	67.4	46.7	2.4	3.3	0.1	0.6
								3.266	0.190	0.674	0.203	0.015	0.016	0.001	0.004
Kallymenia requienii (J. Agardh) J. Agardh	20.0	130.0	14.0	19.5	14.0	30.0	5.0	18.0	8.4	9.9	27.3	4.0	2.2	4.4	0.3
	0.200	0.710	0.050	0.095	0.050	0.135	0.050	0.067	0.035	0.057	0.090	0.023	0.014	0.018	0.002
Kallymenia sp.								5.6	1.2	8.1		1.7			
								0.028	0.007	0.042		0.009			
Lejolisia mediterranea Bornet					5.0							0.3	0.1	0.1	
					0.050							0.003	0.001	0.001	
Leptofauchea coralligena Rodríguez-Prieto & De Clerk			2.0		5.0		18.0	2.2	1.0	0.7	0.4	2.0	3.5	1.9	0.4
			0.050		0.050		0.125	0.001	0.007	0.005	0.007	0.013	0.014	0.009	0.002
Lithophyllum racemus (Lamarck) Foslie#								27.8							
								2.778							
Lithophyllum stictaeforme (Areschoug) Hauck#								11.8	0.4	16.0		0.5	0.8	1.4	3.0
								1.181	0.042	1.604		0.049	0.083	0.139	0.257
Lithophyllum sp. #															0.7
															0.069
Lithothamnion corallioides (P.L. Crouan & H.M. Crouan) P.L. Crouan & H.M. Crouan#		100.0								25.1	27.8	29.3	18.6	6.9	4.5
		10.000								2.449	2.778	2.931	1.861	0.694	0.451

(continued)

Table 1 (continued)

	Spo I	Spo II	Spo III	Spo IV	Spo V	Spo VI	Spo VII	Lam I-1	Lam I-2	Lam II-1	Lam II-2	Pey I-1	Pey I-2	Pey II-1	Pey II-2
Location	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**SM**	**SM**	**SM**	**SM**
Depth (m)	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-61**	**-61**	**-62**	**-62**	**-64**	**-64**	**-65**	**-65**
Date of collection	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**15/05/09**	**15/05/09**	**15/05/09**	**15/05/09**	**19/05/09**	**19/05/09**	**19/05/09**	**19/05/09**
Lithothamnion valens Foslie#	375.0 37.500	900.0 90.000		1300.0 130.000	250.0 25.000	250.0 25.000	200.0 20.000	196.4 19.462	190.3 19.028	24.8 2.483	31.3 3.125	2.1 0.208	5.2 0.521	2.8 0.278	
Lomentaria clavellosa (Lightfoot ex Turner) Gaillon											0.8 0.008				
Lomentaria ercegovicii Verlaque, Boudouresque, Meinesz, Giraud & Marcot-Coqueugniot														0.1 0.001	
Lomentaria subdichotoma Ercegovic			20.0 0.120									0.1 0.001	0.1 0.002		0.1 0.001
Lophosiphonia obscura (C. Agardh) Falkenberg												0.1 0.001			
Melobesia membranacea (Esper) J.V. Lamouroux#									0.1 0.001			0.2 0.002	0.1 0.001		0.1 0.001
Meredithia microphylla (J. Agardh) J. Agardh									42.1 0.272	17.2 0.118	3.5 0.014				
Mesophyllum alternans (Foslie) Cabioch & M.L. Mendoza#	25.0 2.500								2.4 0.243						
Mesophyllum expansum (Philippi) Cabioch & M.L. Mendoza#								0.2 0.021				5.9 1.381			
Monosporus pedicellatus (Smith) Solier									0.1 0.001						
Myriogramme carnea (J.J. Rodríguez y Femenías) Kylin								1.6 0.001				0.8 0.006		1.1 0.008	0.3 0.002
Myriogramme tristromatica (J.J. Rodríguez y Femenías) Boudouresque								0.3 0.014	0.7 0.014	1.3 0.001	0.3 0.007	19.7 0.072	20.8 0.079	9.9 0.042	4.3 0.015
Neogoniolithon mamillosum (Hauck) Setchell & L.R. Mason#							300.0 30.000	32.2 3.215				2.8 0.278			
Neurocaulon foliosum (Meneghini) Zanardini												0.3 0.004	3.5 0.031	0.2 0.004	

(continued)

Table 1 (continued)

	Spo I	Spo II	Spo III	Spo IV	Spo V	Spo VI	Spo VII	Lam I-1	Lam I-2	Lam II-1	Lam II-2	Pey I-1	Pey I-2	Pey II-1	Pey II-2
Location	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**SM**	**SM**	**SM**	**SM**
Depth (m)	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-61**	**-61**	**-62**	**-62**	**-64**	**-64**	**-65**	**-65**
Date of collection	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**15/05/09**	**15/05/09**	**15/05/09**	**15/05/09**	**19/05/09**	**19/05/09**	**19/05/09**	**19/05/09**
Nitophyllum micropunctatum Funk								0.1 0.001							
Nitophyllum punctatum (Stackhouse) Greville											0.1 0.007				
Osmundaria volubilis (Linnaeus) R.E. Norris				720.0 5.245				137.8 1.107	166.7 1.385	40.1 0.333	30.6 0.194	0.6 0.005	0.8 0.009		0.7 0.004
Osmundea pelagosae (Schiffner) K.W. Nam						5.0 0.050						0.3 0.003			
Peyssonnelia armorica (P.L. Crouan & H.M. Crouan) Weber-van Bosse								9.7 0.049	24.0 0.120	6.3 0.031	8.3 0.042		2.0 0.010		
Peyssonnelia bornetii Boudouresque & Denizot								81.8 0.486	111.6 1.166		2.6 0.007				83.3 0.903
Peyssonnelia coriacea Feldmann								427.4 2.801	477.5 3.108	62.0 0.285	346.4 2.215	1.2 0.044	0.1 0.002		
Peyssonnelia dubyi P.L. Crouan & H.M. Crouan		5.0 0.050	5.0 0.050									0.1 0.001		6.1 0.007	0.1 0.001
Peyssonnelia harveyana P.L. Crouan & H.M. Crouan ex J. Agardh			3.0 0.050					6.6 0.165	8.5 0.213	2.8 0.070	0.7 0.018	177.4 4.435	760.4 19.010	60.5 1.513	6.9 0.173
Peyssonnelia inamoena Pilger	94.0 0.725		17.5 0.113				0.150 0.105	1.444 1.270	0.177 0.205	1.485 1.454	3.535 1.944	14.653 27.226	8.392 11.222	3.366 2.207	2.339 3.676
Peyssonnelia rosa-marina Boudouresque & Denizot#								21.9 1.874	12.5 1.486	15.0 1.276	18.4 1.424	161.8 15.142	116.0 9.123	15.3 0.965	1.4 0.198
Peyssonnelia rubra (Greville) J. Agardh								400.6 3.745	542.2 3.518	208.3 1.938	23.5 0.240	760.4 5.826	322.9 2.201		505.8 4.535
Peyssonnelia squamaria (S.G. Gmelin) Decaisne										458.2 3.431					5.6 0.042
Peyssonnelia stoechas Boudouresque & Denizot										2.3 0.012					
Peyssonnelia sp.					5.0 0.050				0.4 0.001	9.6 0.048		0.2 0.001			
Phyllophora crispa (Hudson) P.S. Dixon		337.5 2.400						486.1 4.321	569.3 4.867	758.3 6.507	433.9 3.354	24.8 0.149	42.3 0.285	34.7 0.232	20.2 0.150

(continued)

Table 1 (continued)

	Spo I	Spo II	Spo III	Spo IV	Spo V	Spo VI	Spo VII	Lam I-1	Lam I-2	Lam II-1	Lam II-2	Pey I-1	Pey I-2	Pey II-1	Pey II-2
Location	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**SM**	**SM**	**SM**	**SM**
Depth (m)	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-61**	**-61**	**-62**	**-62**	**-64**	**-64**	**-65**	**-65**
Date of collection	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**15/05/09**	**15/05/09**	**15/05/09**	**15/05/09**	**19/05/09**	**19/05/09**	**19/05/09**	**19/05/09**
Phyllophora herediae (Clemente) J. Agardh												0.3 0.004	0.6 0.006	1.1 0.010	
Phymatolithon calcareum (Pallas) W.H. Adey & D.L. McKibbin#	2100.0 210.000	2475.0 247.500	50.0 5.000	550.0 55.000	155.0 15.500	2075.0 207.500	700.0 70.000	35.9 3.594	219.2 21.877	55.4 5.366	99.3 9.931	4.5 0.451			
Plocamium cartilagineum (Linnaeus) P.S. Dixon								1.4 0.021	0.3 0.014			1.4 0.009	0.8 0.007	0.9 0.004	0.4 0.002
Polysiphonia ornata J. Agardh						5.0 0.050		0.1 0.001							
Polysiphonia perforans Cormaci, G. Furnari, Pizzuto & Serio								2.9 0.191							
Polysiphonia subulifera (C. Agardh) Harvey					46.0 0.220			0.1 0.001	2.4 0.024	3.2 0.032	0.2 0.001	0.7 0.006	0.1 0.001		0.1 0.001
Polysiphonia sp.					5.0 0.050			262.0 2.618	7.1 0.072	0.1 0.001	8.5 0.085			1.6 0.016	
Pterothamnion crispum (Ducluzeau) Nägeli					5.0 0.050							0.1 0.001	0.1 0.001		0.1 0.001
Pterothamnion plumula (J. Ellis) Nägeli				5.0 0.050											
Ptilocladiopsis horrida Berthold								0.1 0.001	0.1 0.001			0.1 0.001			
Ptilothamnion pluma (Dillwyn) Thuret				5.0 0.050	5.0 0.050				13.8 0.138		8.5 0.085	0.1 0.001			
Ptilothamnion sp.													0.1 0.001		
Radicilingua thysanorhizans (Holmes) Papenfuss								0.1 0.014	2.1 0.007	1.7 0.007	0.1 0.007				
Radicilingua sp.											0.7 0.007				
Rhodophyllis divaricata (Stackhouse) Papenfuss										0.5 0.005					
Rhodophyllis strafforelloi Ardissone					4.5 0.050					1.6 0.008	1.4 0.011	9.9 0.047	0.1 0.001	0.9 0.007	0.7 0.007

(continued)

Table 1 (continued)

	Spo I	Spo II	Spo III	Spo IV	Spo V	Spo VI	Spo VII	Lam I-1	Lam I-2	Lam II-1	Lam II-2	Pey I-1	Pey I-2	Pey II-1	Pey II-2
Location	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**SM**	**SM**	**SM**	**SM**
Depth (m)	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-61**	**-61**	**-62**	**-62**	**-64**	**-64**	**-65**	**-65**
Date of collection	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**15/05/09**	**15/05/09**	**15/05/09**	**15/05/09**	**19/05/09**	**19/05/09**	**19/05/09**	**19/05/09**
Rhodymenia sp.								0.5 0.001	0.4 0.004	10.8 0.108	0.2 0.002	30.7 0.104	1.2 0.007		2.0 0.010
Rodriguezella bornetii (J.J. Rodríguez y Femenías) F. Schmitz ex J.J. Rodríguez y Femenías															2.3 0.014
Rodriguezella pinnata (Kützing) F. Schmitz ex Falkenberg												0.1 0.001			
Rodriguezella strafforelloi F. Schmitz ex J.J. Rodríguez y Femenías													6.9 0.026		
Rytiphlaea tinctoria (Clemente) C. Agardh														0.2 0.003	
Sahlingia subintegra (Rosenvinge) Kornmann											0.6 0.015	0.4 0.004	0.3 0.003		0.1 0.001
Sebdenia rodrigueziana (Feldmann) Athanasiadis												0.1 0.000	0.1 0.001		
Sphaerococcus coronopifolius Stackhouse								4.7 0.022				14.2 0.064	8.9 0.048	4.0 0.017	2.6 0.014
Sphaerococcus rhizophylloides J.J. Rodríguez y Femenías	21.0 0.095							36.8 0.257	64.9 0.315	109.4 0.528	58.4 0.272	1.5 0.014	0.1 0.001		0.3 0.001
Spongites fruticulosus Kützing[#]	3475.0 347.500	3825.0 382.500	50.0 5.000	1500.0 150.000	585.0 58.500	850.0 85.000	1285.0 128.500	899.0 89.896	620.8 62.083	444.8 44.479	271.2 27.118	58.7 5.868	41.7 4.167	11.5 1.146	
Stylonema alsidii (Zanardini) K.M. Drew													0.1 0.001		0.1 0.001
Titanoderma pustulatum (J.V. Lamouroux) Nägeli								0.2 0.017	0.1 0.001						
Titanoderma sp.		5.0 0.050						0.3 0.022				0.2 0.002	0.1 0.001	0.1 0.001	
Womersleyella setacea (Hollenberg) R.E. Norris*					5.0 0.050							0.1 0.001			

(continued)

Table 1 (continued)

	Spo I	Spo II	Spo III	Spo IV	Spo V	Spo VI	Spo VII	Lam I-1	Lam I-2	Lam II-1	Lam II-2	Pey I-1	Pey I-2	Pey II-1	Pey II-2
Location	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**SM**	**SM**	**SM**	**SM**
Depth (m)	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-61**	**-61**	**-62**	**-62**	**-64**	**-64**	**-65**	**-65**
Date of collection	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**15/05/09**	**15/05/09**	**15/05/09**	**15/05/09**	**19/05/09**	**19/05/09**	**19/05/09**	**19/05/09**
Unidentified Ceramiaceae				0.5					4.7						
				0.050					0.047						
Unidentified Corallinaceae	400.0	250.0		205.0	5.0		150.0	29.1	86.3	64.8	18.4	9.6	10.2	5.3	3.0
	40.000	25.000		20.500	0.050		15.000	0.991	7.010	1.106	1.840	0.924	1.006	0.522	0.299
Unidentified Delesseriaceae										0.3	0.1				
										0.002	0.001				
Unidentified Halymeniaceae								0.2							
								0.001							
Unidentified Rhodomelaceae				5.0					0.1						
				0.050					0.001						
Unidentified Rhodophyta 1												2.8	3.5	1.0	
												0.014	0.017	0.005	
Unidentified Rhodophyta 2								0.2		0.2					
								0.002		0.006					
Phaeophyceae (Ochrophyta)															
Asperococcus bullosus J.V. Lamouroux												0.3			
												0.015			
Carpomitra costata (Stackhouse) Batters											93.9				
											0.939				
Cutleria chilosa (Falkenberg) P.C. Silva									1.4	0.3	0.1			0.4	
									0.001	0.003	0.007			0.004	
Dictyopteris lucida M.A. Ribera Siguán, A. Gómez Garreta, Pérez Ruzafa, Barceló Martí & Rull Lluch			10.0							0.2		3.5	0.1		0.6
			0.050							0.001		0.011	0.001		0.002
Dictyota dichotoma (Hudson) J.V. Lamouroux		3.5	14.0		98.0	12.5	5.0	47.2	15.8	21.5	8.7	0.1	2.7	0.5	0.6
		0.050	0.120		0.350	0.070	0.050	0.146	0.069	0.076	0.028	0.002	0.010	0.003	0.004
Halopteris filicina (Grateloup) Kützing		5.0	8.0		4.0		4.0	2.8	3.0	9.3	3.1	11.0	5.6	4.5	3.0
		0.050	0.050		0.050		0.050	0.014	0.014	0.028	0.007	0.033	0.021	0.010	0.019
Laminaria rodriguezii Bornet								121.5	88.0	593.2	359.0				
								0.826	0.472	3.285	2.368				

(continued)

Table 1 (continued)

	Spo I	Spo II	Spo III	Spo IV	Spo V	Spo VI	Spo VII	Lam I-1	Lam I-2	Lam II-1	Lam II-2	Pey I-1	Pey I-2	Pey II-1	Pey II-2
Location	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**SM**	**SM**	**SM**	**SM**
Depth (m)	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-61**	**-61**	**-62**	**-62**	**-64**	**-64**	**-65**	**-65**
Date of collection	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**15/05/09**	**15/05/09**	**15/05/09**	**15/05/09**	**19/05/09**	**19/05/09**	**19/05/09**	**19/05/09**
Sphacelaria plumula Zanardini					5.0 0.050	10.0 0.100									
Zanardinia typus (Nardo) P.C. Silva								7.8 0.097	16.7 0.153	12.2 0.138	20.4 0.215				
Zonaria tournefortii (J.V. Lamouroux) Montagne	36.0 0.125											0.6 0.008	0.6 0.004		0.5 0.005
Unidentified encrusting Phaeophyceae													2.1 0.021		
Chlorophyta															
Cladophora sp.									0.1 0.001						0.1 0.001
Derbesia tenuissima (Moris & De Notaris) P.L. Crouan & H.M. Crouan															0.1 0.001
Flabellia petiolata (Turra) Nizamuddin				725.0 3.650				264.0 1.473	342.7 2.319	145.8 1.090	95.8 0.646	4.1 0.028	7.6 0.048	7.2 0.036	3.5 0.030
Halimeda tuna (J. Ellis & Solander) J.V. Lamouroux								0.6 0.021							
Microdictyon umbilicatum (Velley) Zanardini												0.2 0.002	0.5 0.008	0.1 0.001	
Palmophyllum crassum (Naccari) Rabenhorst								25.7 0.340	31.1 0.396	66.0 0.896	51.0 0.646				
Pseudochlorodesmis furcellata (Zanardini) Børgesen				5.5 0.195					33.0 0.330	0.1 0.001	0.1 0.001		7.6 0.076		1.2 0.012
Ulvella scutata (Reinke) R. Nielsen, C.J. O'Kelly & B. Wysor									0.1 0.001						
Umbraulva dangeardii M.J. Wynne et G. Furnari												0.1 0.001		0.2 0.001	
Uronema marinum Womersley					5.0 0.050				65.9 0.659			0.2 0.002	0.1 0.001		1.2 0.012
Valonia macrophysa Kützing				4.0 0.065			6.0 0.050	12.2 0.222	19.8 0.377	7.8 0.146	11.1 0.125	2.4 0.034	1.0 0.014		0.2 0.006

sample Spo III grouped separately from the other samples in the analysis based on biomass because it presented an extremely low biomass compared to the rest of the samples.

A total of 104 species were identified in samples collected from *Laminaria rodriguezii* forests (Table 2), with Rhodophyta accounting for 85.6% of the species (Fig. 2). This community presented a mean of 64±8 species per replicate, a Sa_T of 3653±817 cm^2 m^{-2} and a B_T of 106±42 g dw m^{-2} (Fig. 3). The species *Phyllophora crispa*, *Spongites fruticulosus*, *Peyssonnelia coriacea*, *Laminaria rodriguezii*, *Flabellia petiolata* and *Peyssonnelia rubra*, in this order, were found to be the main characterizing species in terms of algal surface, according to the SIMPER test (Fig. 4). Maërl-forming species represented 21.8±5.7% of Sa_T but 76.3±5.0% of B_T, and consequently, as regards biomass, the SIMPER test indicated that the main species were the Corallinales *Spongites fruticulosus*, *Phymatolithon calcareum* and *Lithothamnion valens* (Fig. 4). Statistical analyses based on both qualitative and quantitative data showed no significative differences between replicates of both samples.

A total of 106 species were identified in the community with *Peyssonnelia inamoena* (Table 2), with Rhodophyta accounting for 85.8% of the species (Fig. 2). The number of species per replicate was 62±14; Sa_T was 1661±1118 cm^2 m^{-2}; and B_T 34±29 g dw m^{-2} (Fig. 3). While the SIMPER test for algal surface indicated that *P. inamoena* and *P. rubra* were the most characteristic species, the analysis performed with the biomass data revealed four *Peyssonnelia* species: *P. inamoena*, *P. rosa-marina*, *P. harveyana* and *P. rubra* (Fig. 4). In this community, maërl-forming species accounted for 6.3±3.6% of Sa_T and 30.6±15.0% of B_T (Fig. 3). According to the statistical analyses, replicates of both samples did not present significant differences in quantitative and qualitative species composition.

Discussion

Spongites fruticulosus beds presented a very low number of species, H'_B and J'_B, which could also be a sampling artifact due to the small sampling areas. Besides, our results show that they were mostly characterized by the calcareous species of the basal stratum (mainly *Spongites fruticulosus* and *Phymatolithon calcareum*), which accounted for 76.8±21.5% of Sa_T and 94.5±3.3% of B_T, erect algae being irrelevant. This relatively low development of fleshy species was also been observed previously in Tossa de Mar (Spain, Northwestern Mediterranean) and although it might be caused by low irradiance levels (Ballesteros, 1988), we still do not have the clues to explain this situation as the other communities studied here thrive at the same irradiance levels.

A contrasting case is displayed by the kelp forest of *Laminaria rodriguezii,* which showed a well-developed erect stratum, composed of dispersed clusters of thalli of *L. rodriguezii*, interspersed with free-living corallines and sand patches. Free-living corallines *S. fruticulosus* and *P. calcareum* were far less abundant (21.8±5.7% of Sa_T and 76.3±4.9% of B_T) than on *Spongites fruticulosus* beds. As expected, the forest presented higher values of H' and J' when compared to *Spongites fruticulosus* beds (Table 2), due to higher complexity. Diversity values based on algal surface are amongst the highest in Mediterranean algal communities, and similar to those found on free-living *Peyssonnelia* beds (Ballesteros, 1994) or other deep-water communities along the Northeastern coast of Spain (*Cystoseira zosteroides, Halimeda tuna, Lithophyllum stictaeforme* and *Phymatolithon calcareum*) (Ballesteros, 1988, 1992). The kelp forest of *L. rodriguezii* studied here was very similar in species composition to that found in Hyères Islands (France, Northwestern Mediterranean) (Gautier & Picard, 1957), and even to that found growing over coralligenous concretions at Ustica (Tyrrhenian Sea, Italy) (Giaccone, 1967), suggesting a high homogeneity of these forests in the Western Mediterranean Sea.

Peyssonnelia inamoena beds were quite diverse because soft erect algae and prostrate species were relatively abundant. These beds were as rich in species as the *L. rodriguezii* forests but showed lower values of H' and J' (Table 2). They displayed the lowest percentage of free living corallines of the three communities (6.3±3.6% of Sa_T and 30.6±15.0% of B_T) and, in addition, 45% of MFS_{Sa} and 41% of MFS_B belonged to the calcified species *Peyssonnelia rosa-marina*. Similar low abundances of members of the order Corallinales (<2%) have been found on other *Peyssonnelia* beds dominated by *P. rosa-marina* or *Peyssonnelia* sp. in the Balearic Islands (Ballesteros, 1994), which has been explained by the burial of corallines in bottoms with a high sedimentation rate, while *Peyssonnelia* and other fleshy species accumulate in ripple mark depressions (Ballesteros, 1994; Bordehore *et al*., 2003). Values of H' and J' in relation to algal surface were similar to values found on *S. fruticulosus* beds, but in relation to biomass, the *P. inamoena* community presented higher values of H'_B and J'_B (Fig. 3). *Peyssonnelia* beds seem to be abundant and diverse on the continental shelf of the Balearic Islands. In this regard, besides the *P. inamoena* and *P. rubra* identified here and in a previous work (Joher *et al.,* 2012), some bottoms dominated by different *Peyssonnelia* species have been identified previously in the Balearic Islands (Ballesteros, 1994) as well as in other areas of the Western Mediterranean Sea (Huvé, 1954; Carpine, 1958; Parenzan, 1960; Bourcier, 1968; Augier & Boudouresque, 1978; Basso, 1990). In addition, the *P. inamoena* beds studied here also show a great abundance of other congeneric species (*P. rosa-marina*, *P. harveyana*, *P. rubra*), suggesting that all *Peysonnelia* beds could constitute a single habitat, where the different species could become dominant as a response to slightly different environmental conditions. However, further studies are required on this issue.

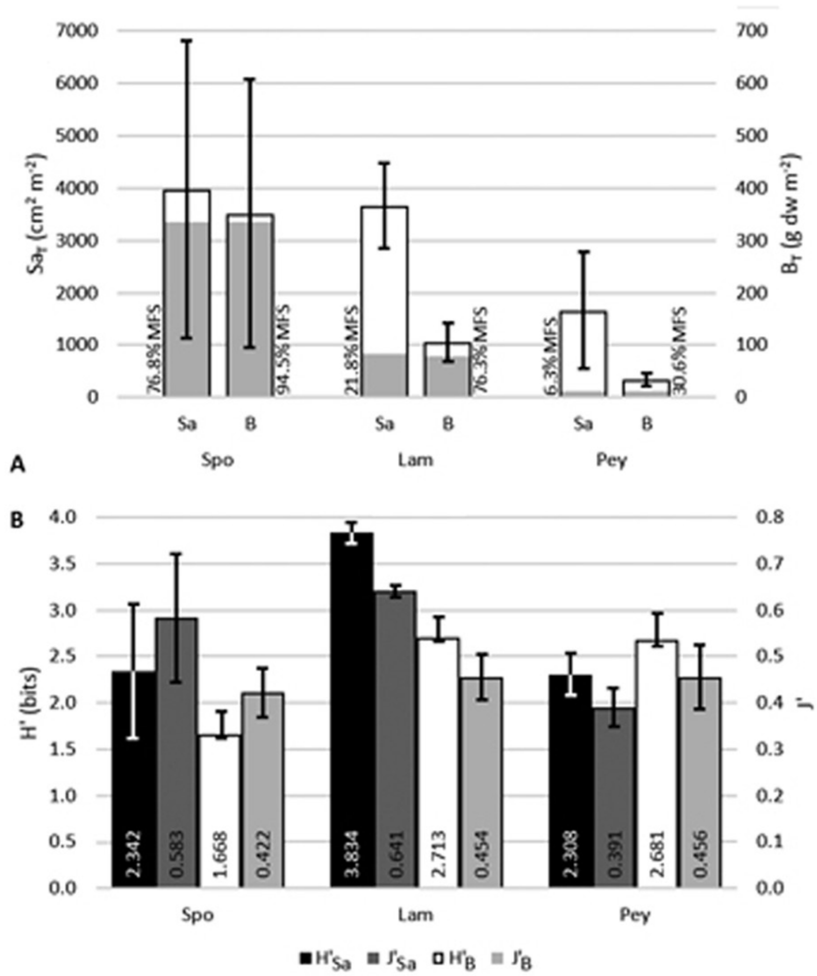

Fig. 3: Characteristics of the three studied communities (mean and standard deviation). A) Total algal surface (Sa_T) and total biomass (B_T). The percentage of the maërl-forming species is given for both parameters. B) Shannon's diversity (H') and Pielou's evenness (J') both based on algal surface (Sa) and biomass (B). Abbreviations: Spo, *Spongites fruticulosus* beds; Lam, *Laminaria rodriguezii* forests; Pey, *Peyssonnelia inamoena* beds.

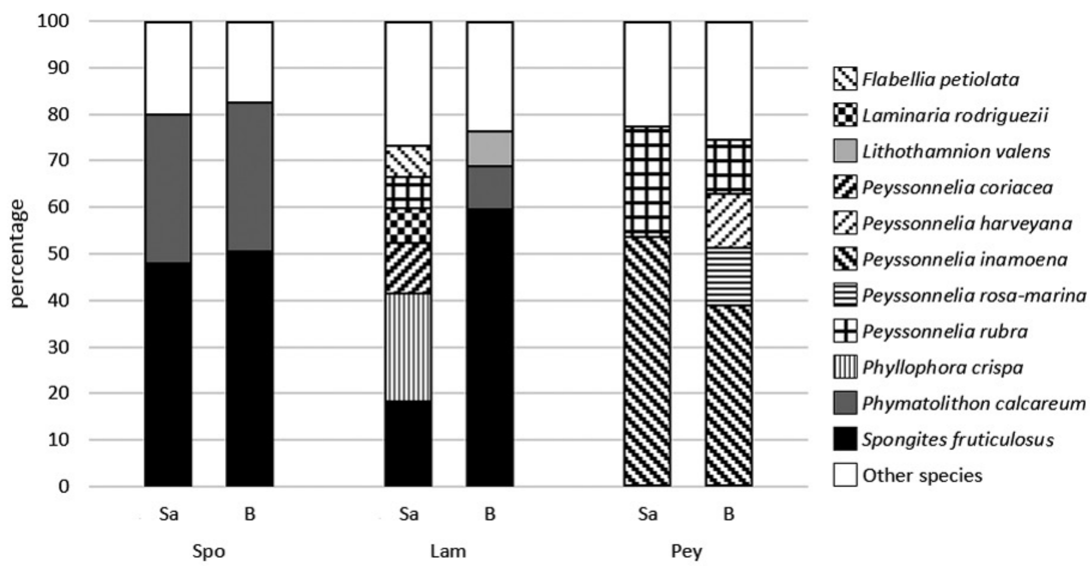

Fig. 4: Results of the SIMPER test based on algal surface (Sa) and biomass (B) for the three communities. The species summarizing 70% of total contribution to the similarity of the samples are given. Abbreviations: Spo, *Spongites fruticulosus* beds; Lam, *Laminaria rodriguezii* forests; Pey, *Peyssonnelia inamoena* beds.

Table 2. Main characteristics of the collected samples/replicates. Abbreviations: Spo, *Spongites fruticulosus* beds; Lam, *Laminaria rodriguezii* forests; Pey, *Peyssonnelia inamoena* beds; MC, Menorca Channel; SM, Southern Menorca; n, number of species; IFO, Index of Floral Originality; Sa_T, total algal surface; B_T, total biomass; MSF_{Sa} and MSF_B, maërl-forming species according to total algal surface and biomass; H'_{Sa} and H'_B, Shannon's diversity based on algal surface and biomass; J'_{Sa} and J'_B, Pielou's evenness based on algal surface and biomass.

	Spo I	Spo II	Spo III	Spo IV	Spo V	Spo VI	Spo VII	Lam I-1	Lam I-2	Lam II-1	Lam II-2	Pey I-1	Pey I-2	Pey II-1	Pey II-2
Location	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**MC**	**SM**	**SM**	**SM**	**SM**
Depth (m)	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-50-60**	**-61**	**-61**	**-62**	**-62**	**-64**	**-64**	**-65**	**-65**
Date of collection	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**13/05/09**	**15/05/09**	**15/05/09**	**15/05/09**	**15/05/09**	**19/05/09**	**19/05/09**	**19/05/09**	**19/05/09**
n	12	14	18	19	26	10	15	70	71	60	54	77	67	45	57
IFO	0.107	0.087	0.139	0.142	0.134	0.142	0.088	0.182	0.178	0.168	0.159	0.230	0.203	0.214	0.194
Sa_T (cm^2 m^{-2})	6776	8055	269	5242	1451	3248	2718	4426	4065	3577	2545	2886	2311	541	906
MFS_{Sa} (cm^2 m^{-2})	5975	7300	100	3350	990	3175	2485	1225	1046	581	448	266	182	38	10
H'_{Sa} (bits)	1.880	1.957	3.564	2.641	2.853	1.380	2.121	3.832	3.989	3.755	3.760	2.326	2.534	2.370	2.004
J'_{Sa}	0.524	0.514	0.855	0.622	0.607	0.416	0.543	0.625	0.649	0.636	0.653	0.371	0.418	0.431	0.344
B_T (g dw m^{-2})	640	758	11	366	101	318	264	148	134	81	60	68	48	8	11
MFS_B (g dw m^{-2})	598	730	10	335	99	318	249	122	105	58	44	26	16	3	1
H'_B (bits)	1.564	1.677	1.809	1.909	1.583	1.218	1.916	2.425	2.718	2.766	2.944	2.635	2.594	3.074	2.419
J'_B	0.436	0.441	0.434	0.449	0.337	0.367	0.490	0.396	0.442	0.468	0.512	0.421	0.428	0.560	0.415

Although the spatial structure of the communities studied here was different, differences in species composition were small, as reflected in the low values of IFO calculated for each of the studied communities (Fig. 1). In this sense, previous reports of bottoms dominated by the kelp *L. rodriguezii* as 'fonds à prâlines et *Laminaria rodriguezii*' (Molinier, 1956; Gautier & Picard, 1957; Pérès & Picard, 1964), together with the high similarities between *S. fruticulosus* beds and *L. rodriguezii* forests highlighted in this study, suggest the existence of a gradient moving from the *S. fruticulosus* beds to the *L. rodriguezii* forests. Whether this is driven by natural environmental factors or by anthropogenic pressures would require further work. However, in this sense, recent studies pointed out that the abundances of this endemic kelp on detritic bottoms geographically differ depending on commercial trawling pressure, since well-developed *L. rodriguezii* kelps are only found in specific areas of the Menorca channel with low trawling pressure (Joher *et al.*, 2012). Finally, the development of *Peyssonnelia* spp. communities could also be favoured by adverse local environmental conditions for the development of maërl beds. Thus, the natural presence of high sedimentation rates and/or changes induced by trawling, such as turbidity, could enhance the abundance of Peyssonneliaceae over Corallinales, as previously observed in Alicante (Spain) and Malta (Bordehore *et al.*, 2000).

ROV dives have been extremely useful for finding extensive beds of the three targeted communities and, in fact, this is the most advisable method to localize specific communities in deep-water, highly patchy detritic landscapes, rather than using destructive dredges or Scuba-diving. Regarding the sampling method, the number of species reported for each community in this work is significantly higher than the values found in corresponding assemblages sampled by bottom trawling (Fig. 5) (Joher *et al.*, 2012). This was unexpected since the sampled surface was much larger in the collections made by bottom trawling. Bottom trawls have a larger mesh size than beam trawls (20 mm *vs* 10 mm), which could explain this increase in the *L. rodriguezi* and *P. inamoena* communities, even when sampling much smaller surfaces. In the case of the *S. fruticulosus* community, Box-Corer dredges completely prevented any loss of sample and probably this is the reason explaining the increase. Thus, Box-Corer dredges or beam trawls seem to be good sampling methods for studying the composition and structure of deep-water detritic communities, although bottom trawls are equally effective if the main assemblages have to be identified in large areas.

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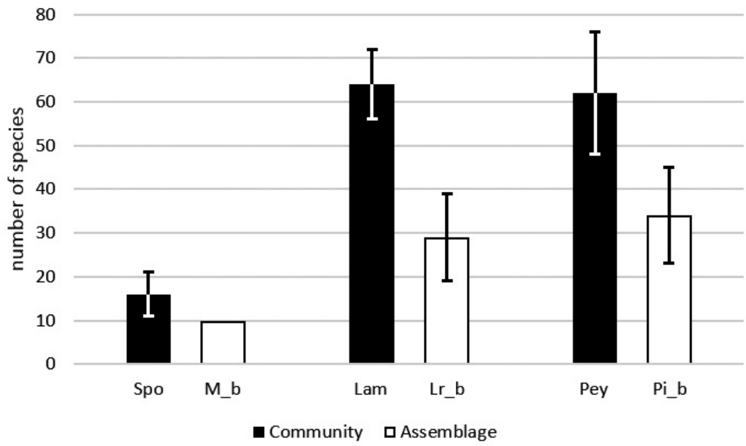

Fig. 5: Comparison of the number of species (mean and standard deviation) of the communities studied here and the corresponding assemblages described in Joher *et al.* (2012). Abbreviations: Spo, *Spongites fruticulosus* beds; M_b, maërl beds in Joher *et al*. (2012); Lam, *Laminaria rodriguezii* forests; Lr_b, *Laminaria rodriguezii* beds in Joher *et al*. (2012); Pey, *Peyssonnelia inamoena* beds; Pi_b, *P. inamoena* beds in Joher *et al*. (2012).

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