Acta Oceanol. Sin., 2012, Vol. 31, No. 1, P. 98-105
DOI: 10.1007/s13131-012-0181-4
http://www.hyxb.org.cn
E-mail: hyxbe@263.net

Macrofaunal communities of threatened subtidal maërl seabeds on Tenerife (Canary Islands, north-east Atlantic Ocean) in summer

Rodrigo Riera[1*], Juan Domingo Delgado[2], Myriam Rodríguez[1], Óscar Monterroso[1], Eva Ramos[1]

[1] Centro de Investigaciones Medioambientales del Atlántico (CIMA SL), C/Arzobispo Elías Yanes, 44, 38206 La Laguna, Tenerife, Canary Islands, Spain

[2] Área de Ecología, Departamento de Sistemas Físicos, Químicos y Naturales. Facultad de Ciencias Experimentales, Universidad Pablo de Olavide, Ctra. de Utrera km. 1, 41013 Sevilla, Spain

Received 9 October 2010; accepted 18 April 2011

Abstract
This study contributes with the first data on physical and taxonomical structure of macrofaunal assemblages of maërl beds from the Canary Islands. Maërl beds and *Cymodocea nodosa* meadows of the Canary Islands are considered biodiversity hot-spots in terms of taxonomic and functional biodiversity with a broad geographical and depth ranges. The authors have studied the structure of the macrofaunal assemblages on different habitat types (*Cymodocea, Caulerpa*, sabellid field, garden eel and maërl beds). Samples were taken at a range of depths between 14 and 46 m. Correlations were performed among abiotic variables (granulometry, organic matter, nitrogen and phosphates) and the most abundant taxa. Similarity analysis was performed to explore the patchiness of seabeds at a local scale. Significant differences were found in macrofaunal assemblages among seabed types, with highest abundances and lowest biodiversity in sabellid fields, where the sabellid *Bispira viola* dominated. The polychaetes *Aponuphis bilineata* and *Chone filicauda* and the mollusc *Turritella brochii* were the most abundant taxa on maërl beds. The mosaic of granulometric conditions would explain the associated macroinfaunal community structure and contribute to the creation of diversity on these relatively well preserved seabeds at a local scale.

Key words: Macrofauna, Polychaetes, Amphipods, Molluscs, soft-bottoms, subtidal, Tenerife, Canary Islands

1 Introduction

Maërl beds are, along with the *Cymodocea nodosa* meadows (a habitat type which is known locally as "sebadales"), threatened by several anthropogenic disturbances including dredging, eutrophication, fishing, harbour construction and mariculture (Ballesteros, 2006; Barberá et al., 2003). Loss of maërl habitat is exacerbated by its slow growth rate (Blake and Maggs, 2003). The conservation value of maërl seabeds in European waters is recognized under EU legislation (*Habitats Directive* 92/43/EEC, 1992, Annex V) and conventions (Convention for the protection of the Mediterranean Sea against pollution, 1976; Bern Convention, 1996; OSPAR convention, 1998) (Airoldi and Beck, 2007). Moreover, a special plan for the protection of Mediterranean coralligenous and maërl assemblages has been recently adopted within the framework of the United Nations Environment Programme's Mediterranean Action Plan (UNEP-MAP) (Agnesi et al., 2009), since these ecosystems have been recognized as habitats that support a particularly high biodiversity of flora and fauna (Sciberras et al., 2009).

Maërl beds cover large areas in the Canarian archipelago at depths of ca. 40 m to 150 m deep (pers. obs. and ecocartographic studies). However, there is no currently any plan or specific regional legislation related to their environmental protection in the Canary Islands, and as far as we know, no studies concerning basic questions of their actual community structure and conservation. Thus, for effective environmental monitoring assessment and management of maërl habitats in this archipelago, in-depth studies on the distribution, biodiversity and macrofaunal community structure were urgently required.

In this study, we have compared the macrofaunal

*Corresponding author, E-mail: rodrigo@cimacanarias.com

community structure from different sedimentary habitats [*Cymodocea* meadows, *Caulerpa* meadows, *Caulerpa* and sabellids, maërl bottoms and seabeds colonized by garden eels, *Heteroconger longissimus* Günther (Pisces: Anguilliformes, Congridae)]. The study area may serve as a relatively well-preserved reference for this habitat mosaic. It is still characterized by the absence of periodical anthropogenic disturbances, although the installation of several finfish farms is envisaged for the near future. The aim of the present study is to characterize the macrobenthic assemblages of the subtidal seabed habitats on the south coast of the Tenerife Island, by examining composition, community structure and biodiversity of these sedimentary bottoms at a local scale, with a special interest in maërl bottoms of high conservation value.

2 Material and methods

The seabeds of Las Galletas, a fishing and touristic village on the south coast of Tenerife, are heterogeneous, with a mosaic of differentiated habitats occupying small patches. Eight stations were sampled in September 2005, selected to represent the five major sedimentary habitat types observed in the area: Maërl bottoms, *Cymodocea* meadows, *Caulerpa* meadows, *Caulerpa* and sabellids, and bottoms colonized by garden eels (Table 1, Fig. 1).

Three replicates were taken at each station, using

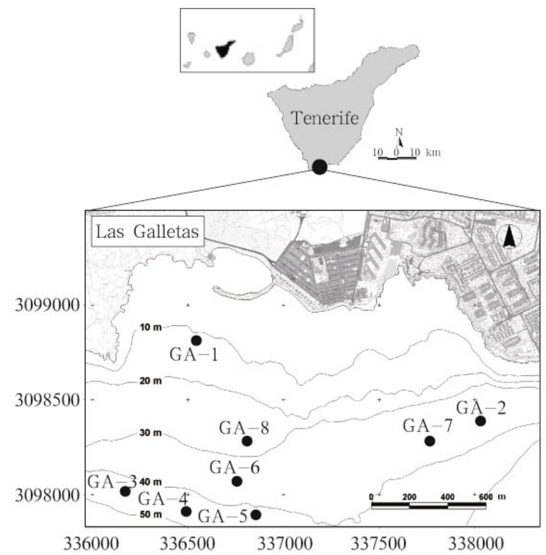

Fig.1. Map of the location of the Canarian archipelago (upper map), Tenerife Island and the study area at Las Galletas coast (South Tenerife) showing sampling stations (GA-1 to GA-8).

Table 1. Locations and depths of sampling stations

Station	UTM X	UTM Y	Depth/m	Community
GA1	336396	3098838	14	*Cymodocea* meadows
GA2	336230	3098275	38	*Caulerpa* meadows
GA3	337335	3097611	45	Maërl
GA4	337588	3097794	46	Maërl
GA5	337821	3098026	46	Maërl
GA6	338336	3098425	38	Maërl
GA7	338084	3098401	39	*Caulerpa* and Sabellids
GA8	337979	3098590	29.8	Garden eel

a 20 cm diameter core (area: 0.06 m^2), inserted to a maximum depth of 20 cm. Each sample was sieved through a 0.5 mm sieve, fixed in 4% formalin and latter transferred to 70% alcohol before sorting under a dissection microscope for macrofaunal identification. All macrofaunal specimens were determined to the lowest taxonomical level whenever possible.

Sedimentary samples were taken for abiotic factors (granulometry, organic matter, nitrogen and phosphates). These samples were taken by means of a 4.5 cm diameter core to a depth of 20 cm. Granulometry samples were dried, sieved on a stack of graded sieves ranging from 63 to 2.000 μm mesh, and the residue on each weighed (Buchanan and Kain, 1971). Organic carbon was determined by oxidizing carbon with $KMnO_4$ (Walkley and Black, 1934). Total nitrogen content was determined by the Kjeldahl method (Kimberly and Roberts, 1905). Phosphates were determined by the direct UV measurement of the phosphomolybdate complex (Rubino et al., 1989).

Statistical analysis

Differences in the density of macrofauna between stations and habitats were examined using the non-parametric Kruskal-Wallis (H) test. Spatial patterns in the macrofauna distribution were analysed using the PRIMER software package (Clarke and Warwick, 2001). To detect significant differences among macrofaunal assemblage composition (abundances, Shannon's diversity and Pielou's evenness) between habitats, multivariate analyses were carried out on untransformed and transformed (square root) abundance data. Correlations among the seven most abundant macrofaunal species and the relevant abiotic factors derived from the multivariate ordination were calculated with Spearman correlation coefficients. We have compared the mean values of the univariate descriptors (richness, abundance, evenness and diversity) among different bottom types by two-sided Student's t tests, adjusted for pairwise comparisons with the Bonferroni correction at α=0.05. To find patterns of similarity among different sedimentary types in macrofaunal community structure, a hierarchical cluster analysis was performed with stations, using species composition and abundance per species. The Bray-Curtis similarity index with average linkage between groups was applied.

3 Results and discussion

3.1 *Abiotic variables*

Sedimentary fractions were in accordance with the sedimentary habitat variety and patchiness at a local scale (Fig. 2). Four sedimentary fractions characterized the sampling stations: fine sands in *Cymodocea nodosa* meadows (Sta. GA-1), medium sands in *Caulerpa* meadows (GA-2), *Caulerpa* and sabellids assemblages (GA-7) and garden eel bottoms (GA-8). Mäerl seabeds were characterised by coarse sands (GA-3, GA-4 and GA-5) and medium-coarse sands (GA-6). Organic matter content and nitrogen concentration of the sediment presented low values in sampling stations (OM: 0.05%–0.25%; N:<1–3.0 mg/kg). Phosphates showed low concentrations (<20 mg/kg), with the exception of Sta. GA-8 (45.3 mg/kg) (Table 2). However, this value could be considered to be intermediate in subtidal sandy seabeds of the Canarian archipelago (Riera R, pers. obs.).

3.2 *General faunal analysis*

A total of 1 498 specimens belonging to 125 taxa were collected. The most abundant taxonomic group was Polychaeta with 1 109 specimens (74% of the overall abundance). The remaining taxonomic groups were represented by less than 150 individuals. Cumaceans and mysids were extremely rare (1 and 2 specimens, respectively). The most diverse taxonomic groups were polychaetes (40 species) and decapods (21 species). Cumaceans, stomatopods, isopods, mysids and nemerteans were represented by one taxon (Table 3). The most abundant species was the polychaete sabellid *Bispira viola* with 509 individuals (~34% of all individuals), followed by the polychaete onuphid *Aponuphis bilineata* with 258 individuals (~17% of the total). The rest of species were represented by less than 70 specimens, with 43 species were represented by only one specimen (Table 3).

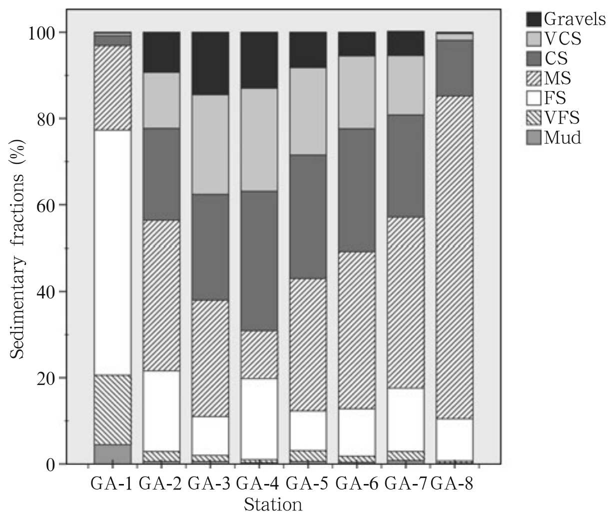

Fig.2. Sedimentary fractions of the sampling stations. VCS represents very coarse sands, CS coarse sands, MS medium sands, FS fine sands, and VFS very fine sands.

Table 2. Abiotic variables of the sampling stations (OM represents organic matter, N nitrogen, and P phosphates)

Station	OM (%)	N/mg·kg^{-1}	P/mg·kg^{-1}
GA-1	0.14	<1	19.6
GA-2	0.10	2.4	14.7
GA-3	0.16	2.2	12.7
GA-4	0.20	<1	6.8
GA-5	0.21	3.0	10.8
GA-6	0.05	2.4	13.3
GA-7	0.15	2.8	15.6
GA-8	0.25	2.2	45.3

3.3 *Univariate indices*

Sampling stations were divided into five groups depending on habitat type: *Cymodocea* meadows, represented by Sta. GA-1; *Caulerpa* meadows (Sta. GA-2); Maërl (Stas GA-3, GA-4, GA-5 and GA-6); *Caulerpa* and sabellids (Sta. GA-7); Garden eels (Sta. GA-8).

The species richness ranged from ca. 11 species in *Caulerpa* meadows to 22 species in *Caulerpa* and sabellids. The differences in species richness among sedimentary habitats were not significant (H=7.77; p=0.10). The overall abundance varied greatly among sedimentary habitats, with maximum densities in the *Caulerpa* and sabellids with a mean of 204.33 specimens. The lowest densities were recorded in maërl bottoms with a mean of 35.8 individuals (Fig. 3). The differences in overall abundance among sedimentary habitats were significant (H=11.04; p=0.02). The Shannon's diversity (H') showed important variations among sedimentary habitats, with maximum values in garden eel bottoms and *Cymodocea* meadows with 2.47 and 2.45, respectively. Contrarily, the lowest diversity values were recorded in *Caulerpa* and sabellid bottoms

Table 3. Species list of the sampling stations

Group	Species	GA-1	GA-2	GA-3	GA-4	GA-5	GA-6	GA-7	GA-8	Total
Amphipoda	*Amphilochus neapolitanus*	0	0	0	0	1	0	0	0	1
Amphipoda	*Ampithoe rubricata*	1	0	0	0	0	1	0	0	2
Amphipoda	*Corophium* sp.	1	0	0	0	0	0	0	1	2
Amphipoda	*Corophium* sp.1	0	0	0	0	0	1	0	0	1
Amphipoda	*Dexamine spinosa*	0	0	0	0	0	0	1	0	1
Amphipoda	*Gammaropsis maculata*	0	0	0	1	0	0	0	0	1
Amphipoda	*Harpinia antennaria*	3	0	0	0	0	0	0	0	3
Amphipoda	*Megaluropus agilis*	2	0	0	0	0	0	0	0	2
Amphipoda	*Pariambus typicus*	4	0	0	0	0	0	0	0	4
Amphipoda	*Photis longicaudata*	5	1	1	1	0	3	0	1	12
Amphipoda	*Pseudoprotella phasma*	0	0	0	1	0	0	1	0	2
Amphipoda	*Tryphosites longipes*	0	0	0	0	0	0	0	1	1
Amphipoda	*Urothoe marina*	1	0	0	0	2	1	0	3	7
Amphipoda	*Urothoe pulchella*	1	0	0	0	1	0	0	1	3
Cumacea	*Iphinoe canariensis*	0	0	0	0	0	0	0	1	1
Decapoda	*Alpheus dentipes*	0	0	0	4	0	0	0	0	4
Decapoda	*Alpheus macrocheles*	0	0	0	2	0	0	7	0	9
Decapoda	*Anapagurus laevis*	0	0	1	1	1	2	0	1	6
Decapoda	*Atharas nitescens*	0	0	0	1	0	0	2	0	3
Decapoda	*Calcinus tubularis*	0	0	1	3	0	0	3	0	7
Decapoda	*Dardanus calidus*	0	0	0	0	0	0	2	0	2
Decapoda	*Galathea intermedia*	0	0	1	5	0	0	5	0	11
Decapoda	*Hippolyte longirostris*	0	0	0	0	0	0	1	0	1
Decapoda	*Hippolyte varians*	0	0	1	0	0	0	2	0	3
Decapoda	*Macropodia* sp.	0	0	0	0	0	0	1	0	1
Decapoda	*Palaemus longirostris*	0	0	0	2	0	0	0	0	2
Decapoda	*Palicus caronii*	0	0	0	0	0	0	1	0	1
Decapoda	*Paractea monodi*	0	0	0	1	0	0	0	0	1
Decapoda	*Parthenope massena*	0	0	1	0	0	1	0	0	2
Decapoda	*Philocheras sculpus*	0	2	0	0	0	0	1	0	3
Decapoda	*Philocheras trispinosus*	1	0	0	0	0	1	0	2	4
Decapoda	*Pilumnus spirifes*	0	1	0	0	0	0	1	0	2
Decapoda	*Pisa nodipes*	0	0	3	5	0	0	7	0	15
Decapoda	*Polybius zariquieyi*	0	0	1	0	0	0	0	0	1
Decapoda	*Processa canaliculata*	0	0	1	0	0	0	1	0	2
Decapoda	*Nanocassiope melanodactyla*	0	0	0	0	0	0	3	0	3
Echinoidea	*Ophiothrix fragilis*	1	0	0	1	0	3	0	0	5
Echinoidea	*Ophiura texturata*	0	0	0	0	1	0	0	0	1
Echinoidea	*Sphaerechinus granularis*	0	0	1	0	0	0	0	0	1
Echinoidea	*Amplipholis squamata*	0	0	1	0	1	0	2	0	4
Echinoidea	*Brissus unicolor*	3	0	0	0	0	0	0	1	4
Echinoidea	*Echynociamus pusillus*	0	0	0	0	2	0	0	1	3
Holothuroidea	*Holothuria fonskali*	0	0	0	1	0	0	0	0	1
Stomatopoda	Stomatopoda sp.1	0	0	0	0	0	1	2	0	3
Isopoda	*Eurydice pulchra*	0	0	2	0	0	1	0	0	3
Misidacea	*Gastrosaccus sanctus*	1	0	0	0	0	0	0	1	2
Nemertea	Nemertea sp.1	1	1	0	0	1	0	0	0	3
Ostracoda	*Cypridina mediterranea*	2	0	0	0	0	0	1	0	3
Ostracoda	*Cypridina norvergica*	2	0	0	0	0	0	0	2	4
Polychaeta	*Aponuphis bilineata*	23	65	29	16	14	86	17	8	258
Polychaeta	*Armandia polyophthalma*	0	1	0	0	0	0	0	0	1
Polychaeta	*Aricidea assimilis*	0	0	1	0	0	0	1	0	2
Polychaeta	*Armandia cirrosa*	0	0	0	0	0	0	0	3	3
Polychaeta	*Bispira viola*	0	0	0	0	0	0	509	0	509
Polychaeta	*Chone collaris*	0	0	0	3	0	1	3	0	7
Polychaeta	*Chone filicaudata*	0	0	21	3	11	18	4	7	64

To be continued

Continued from Table 3

Group	Species	GA-1	GA-2	GA-3	GA-4	GA-5	GA-6	GA-7	GA-8	Total
Polychaeta	*Chone* sp.	4	2	1	1	3	5	0	2	18
Polychaeta	*Capitomastus minimus*	1	0	0	0	0	0	0	0	1
Polychaeta	*Ditrupa arietina*	1	0	0	1	3	0	0	29	34
Polychaeta	*Demonax brachychona*	0	58	0	0	0	1	0	0	59
Polychaeta	*Glycera alba*	0	4	0	0	0	0	0	0	4
Polychaeta	*Glycera* sp.	0	0	4	0	3	2	1	8	18
Polychaeta	*Glycera* sp.1	0	0	1	0	0	0	1	0	2
Polychaeta	*Goniadides* sp.	0	0	0	1	0	1	0	0	2
Polychaeta	*Harmothoe* sp.	0	0	0	0	0	0	1	0	1
Polychaeta	*Harmothoe* sp.1	0	0	1	2	0	1	2	0	6
Polychaeta	*Hermione histryx*	0	0	0	2	0	0	0	0	2
Polychaeta	*Hermodice carunculata*	0	0	0	4	0	1	5	0	10
Polychaeta	*Hesione pantherina*	0	0	0	0	0	0	1	0	1
Polychaeta	*Kefersteinia cirrata*	0	0	0	0	1	0	0	0	1
Polychaeta	*Lumbrineriopsis paradoxa*	1	0	0	0	0	0	0	0	1
Polychaeta	*Lumbrineris cingulata*	0	0	1	0	0	1	1	2	5
Polychaeta	*Lumbrineris* sp.	0	2	0	0	0	0	0	0	2
Polychaeta	*Malacoceros fuliginosus*	0	0	1	0	2	0	0	0	3
Polychaeta	*Neanthes rubicunda*	0	0	3	3	0	0	1	0	7
Polychaeta	*Nematonereis unicomis*	0	0	2	0	0	0	0	0	2
Polychaeta	*Nephthys cirrosa*	4	0	0	0	0	0	0	7	11
Polychaeta	*Petaloproctus terricola*	4	0	0	0	0	0	1	0	5
Polychaeta	*Phyllodoce maculata*	0	1	0	0	0	0	0	0	1
Polychaeta	*Phyllodoce* sp.	0	0	0	1	0	1	1	0	3
Polychaeta	*Pista cristata*	0	1	0	0	0	0	0	0	1
Polychaeta	*Poecilochaetus serpens*	0	1	1	1	0	2	0	3	8
Polychaeta	*Prionospio steenstrupii*	0	10	0	2	2	0	0	25	39
Polychaeta	*Rhynchospio glutaea*	0	1	0	0	0	0	0	0	1
Polychaeta	*Scolelepis tridentata*	0	0	0	1	4	1	0	1	7
Polychaeta	*Scoloplos (Leodamas)* sp.	0	3	1	0	0	0	6	1	11
Polychaeta	*Scoloplos armiger*	0	0	1	1	0	2	2	4	10
Polychaeta	*Sigalion squamatum*	15	1	3	2	4	1	0	4	30
Polychaeta	*Syllis* sp.	0	0	0	1	0	0	0	0	1
Sipuncula	*Aspidosiphon muelleri*	1	0	1	2	5	2	0	16	27
Sipuncula	*Aspidosiphon* sp.	0	1	0	0	0	0	1	0	2
Sipuncula	Sipuncula sp.	0	0	0	0	16	3	2	0	21
Sipuncula	*Sipunculus nudus*	0	0	2	0	2	4	0	0	8
Tanaidacea	*Apseudes talpa*	28	0	0	0	0	0	0	19	47
Tanaidacea	*Leptochelia dubia*	2	0	1	0	0	1	2	0	6
Bivalvia	*Callista chione*	0	0	0	0	0	0	1	1	2
Bivalvia	*Chlamys corallinoides*	0	0	0	0	0	0	1	0	1
Bivalvia	*Ervilia castanea*	0	0	1	0	0	0	0	0	1
Bivalvia	*Gastrochaena dubia*	0	0	0	2	0	0	0	0	2
Bivalvia	*Gregariella subclavata*	0	0	0	1	0	0	0	0	1
Bivalvia	*Lima hians*	0	0	0	1	0	0	0	0	1
Bivalvia	*Linga adansoni*	6	0	0	0	0	0	0	0	6
Bivalvia	*Lucinella divaricata*	1	0	0	0	1	0	0	0	2
Bivalvia	*Pandora pinna*	0	0	0	1	0	0	0	0	1
Bivalvia	*Plagiocardium papillosum*	0	0	0	0	0	0	0	1	1
Bivalvia	*Solemya togata*	5	0	0	0	0	1	1	0	7
Bivalvia	*Tellina donacina*	0	0	0	0	0	1	0	0	1
Bivalvia	*Thracia papyracea*	1	0	0	0	0	0	0	0	1
Gastropoda	*Atys macandrewi*	0	0	1	0	0	0	0	0	1
Gastropoda	*Bela ornata*	1	0	0	0	0	0	0	0	1
Gastropoda	*Bittium incile*	0	0	0	0	0	1	0	0	1
Gastropoda	*Bittium latreillii*	2	0	2	0	0	2	2	0	8
Gastropoda	*Bulla mabillei*	0	0	1	2	1	0	0	0	4

To be continued

Continued from Table 3

Group	Species	GA-1	GA-2	GA-3	GA-4	GA-5	GA-6	GA-7	GA-8	Total
Gastropoda	*Bursa marginata*	0	0	0	1	0	0	0	0	1
Gastropoda	*Cylichna propecylindracea*	0	0	0	0	0	1	0	0	1
Gastropoda	*Gibbula magus*	0	0	1	0	0	0	0	0	1
Gastropoda	*Jujubinus exasperatus*	3	0	0	0	0	0	0	0	3
Gastropoda	*Nassarius cuvierii*	3	0	0	0	0	0	0	0	3
Gastropoda	*Natica furva*	0	1	0	0	0	0	0	0	1
Gastropoda	*Natica livida*	0	1	0	0	0	0	0	0	1
Gastropoda	*Polynices lacteus*	0	0	0	0	1	0	0	0	1
Gastropoda	*Raphitoma linearis*	0	0	0	1	0	0	0	0	1
Gastropoda	*Smaragdia viridis*	4	0	0	0	0	0	0	0	4
Gastropoda	*Turritella brocchii*	0	1	2	2	4	2	2	0	13
Gastropoda	*Vexillum (Pusia) zebrinum*	0	0	1	0	0	0	0	0	1
	Total	139	159	99	87	87	157	613	157	1 498

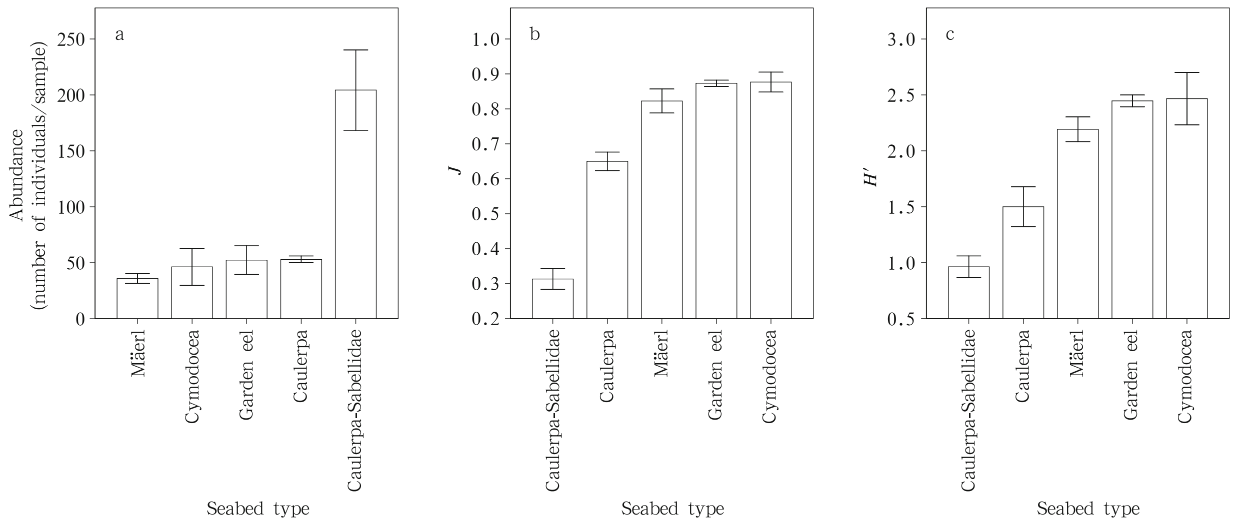

Fig.3. Patterns of variation in abundance and diversity measures for the studied seabeds. a. Relative abundance (number of individuals), b. evenness (J), and c. Shannon's diversity (H'). Bars represent means ±1 S.E.

and *Caulerpa* meadows, with a mean value of 0.96 and 1.5, respectively (Fig. 3). Shannon's diversity presented significant differences among sedimentary habitats (H=13.02; p=0.01).

3.4 *Multivariate analysis*

The eight sampling stations presented low overall similarity. Station GA-7 was separated at the 18.1% of similarity, being dominated by *Bispira viola*, naming the sabellid bottom of this sampling area. Station GA-2 was separated at 24.1% of similarity, with high abundances of the polychaetes *Aponuphis bilineata* and *Demonax brachychona*. Stations GA-1 and GA-8 were separated at the level of 29.7% of similarity, due to the presence of high densities of the tanaid *Apseudes talpa* and intermediate abundances of *A. bilineata*. The remaining sampling stations (GA-3, GA-4, GA-5 and GA-6) presented a similarity of 38.6% and were characterized by the presence of the polychaetes *A. bilineata* and *Chone filicauda*, as well as the mollusc *Turritella brocchii* (Fig. 4).

Species richness was not significantly different amongst habitats (Table 4). The seabeds formed by *Caulerpa* with sabellids, however, presented significantly lower diversity and evenness, and higher macrofaunal abundance when compared with all the other habitat types, including *Caulerpa* meadows (Table 4). *Caulerpa* meadows were statistically similar in terms of abundance to the remaining habitats, but differed regarding diversity and evenness, which were by far lower than in the other habitats.

The organic matter content was inversely correlated with the polychaete *Aponuphis bilineata*, whilst the polychaete *Ditrupa arietina* showed an inverse cor-

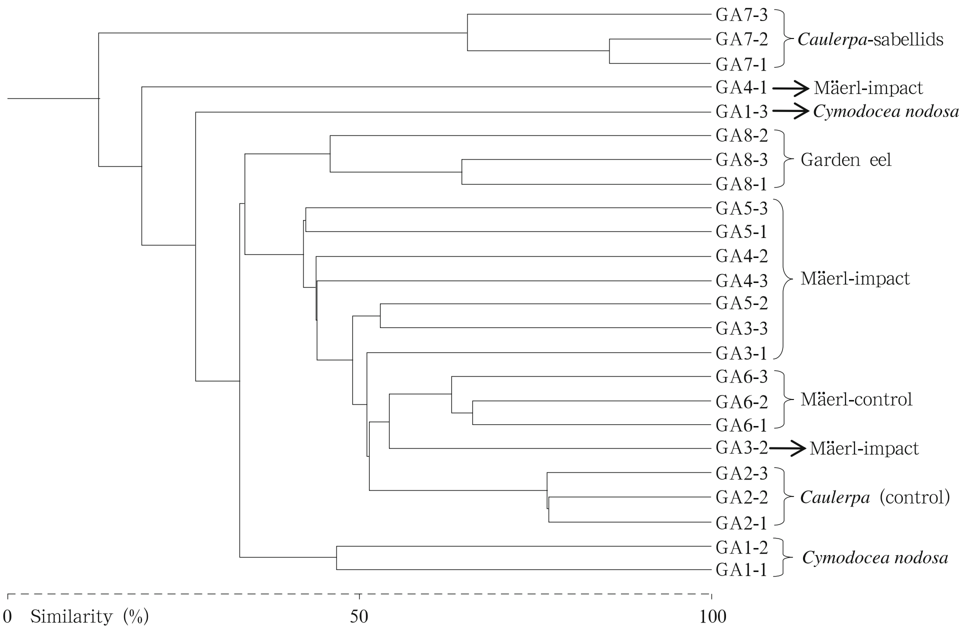

Fig.4. Bray-Curtis cluster analysis of sampling stations based on species composition and abundance per species.

Table 4. Comparison of mean abundance and diversity measures between seabed types by a two-sided Student's t test (tests adjusted for pairwise comparisons with Bonferroni correction; $\alpha = 0.05$). Capital letters indicate significant pairwise differences between habitats for each index [e.g., Evenness (J) was significantly higher in *Caulerpa* bottoms than in habitats formed by Caulerpa plus sabellids]

	Habitat				
	Garden eel (A)	*Caulerpa* + sabellids (B)	*Caulerpa* (C)	Maërl (D)	*Cymodocea nodosa* (E)
Abundance (n° ind.)		A C D E			
Richness (n° spp.)					
Evenness (J)	B		B	B	B
Shannon's Diversity (H')	B C			B	B C

Table 5. Correlations between the seven most abundant macrofaunal species and the most important abiotic factors[1)]

Species	OM	P	Gravel	VCS	CS	MS	FS	VFS	Silt/clay
Aponuphis bilineata	–0.906**								
Ditrupa arietina		–0.936**			0.849**				
Prionospio steenstrupii	0.871**				0.830**				
Apseudes talpa			–0.782*	–0.883**	–0.934**		0.727**	0.745*	0.744*

Notes: [1)] * $p < 0.05$; ** $p < 0.01$. OM represents organic matter, P phosphates, VCS very coarse sands, CS coarse sands, MS medium sands, FS fine sands, and VFS very fine sands.

relation with the content of phosphates and a positive correlation with coarse sands. The polychaete *Prionospio steenstrupii* presented a positive correlation with phosphates and medium sands. The tanaid *Apseudes talpa* showed the highest correlations with abiotic variables, and it was inversely correlated with coarser sedimentary fractions (gravels, very coarse sands and coarse sands) and positively correlated with the finer sedimentary types (fine sands, very fine sands and silt/clay) (Table 5).

As compared with sites in the Mediterranean Sea, Tenerife seabeds are characterized by low macrofaunal abundances and intermediate species diversity (Sciberras et al., 2009). This is mainly due to differences in grain size, since mäerl beds in the Mediterranean seabeds are characterized mainly by gravels (> 2 mm diameter) that harbour an important number of crevicular spaces where inhabit a rich faunal community adapted to this environment (Barberá et al., 2003). Moreover, the Canarian archipelago is characterized to be an oligotrophic region (Barton et al., 1998), with low contents of particulate organic matter that implies the presence of low benthic abundances in all faunal components, mainly mega- ($>$ 1 mm) and macrofauna ($>$ 0.5 mm). Sedimentary habitats determined the macrofaunal community structure, with different granulometric fractions characterizing different habitats. There is a mosaic of seabed habitats determined mainly by granulometric variation, which enhances local habitat diversity without a large influence on taxonomic diversity. *Cymodocea* meadows are present in finer sediments whilst *Caulerpa* meadows and Maërl bottoms are on medium or coarse sands. In the habitat of *Caulerpa* and sabellids, *Bispira viola* clearly dominates the macrofaunal community structure, and the remaining species are comparatively scarcer. In *Cymodocea* meadows, *Caulerpa* meadows, mäerl seabeds and garden eel assemblages, the onuphid polychaete *Aponuphis bilineata* was dominant. This species was accompanied by the tanaid *Apseudes talpa* (*Cymodocea nodosa* meadows and Garden eel assemblages), the sabellid polychaete *Demonax brachychona* (*Caulerpa* meadows) and the sabellid polychaete *Chone filicauda* and the mollusc *Turritella brochii* (Mäerl seabeds).

This ecological study constitutes the first attempt to describe macrofaunal diversity in mäerl seabeds in the Canary islands. More detailed studies are necessary to understand ecosystem functioning of this fragile marine ecosystem. Moreover, this study can be used as a baseline for future conservation studies of mäerl seabeds that are subjected to anthropogenic stressors (pipelines, harbours, atificial beaches, spills, among others) or naturally-induced changes (e.g., climate change).

Acknowledgements

The authors acknowledge Humberto Aguirre for his help during sampling campaign. We are also grateful for all the hospitality provided by the company Parque Mar Paraso SL for financial support and also to the fishermen association from Las Galletas for logistic facilities.

References

Agnesi S, Annunziatellis A, Casese M L, et al. 2009. Analysis on the coralligenous assemblages in the Mediterranean Sea: a review of the current state of knowledge in support of future investigations. In: Pergent-Martini C, Brichet M, eds. UNEP-MAP-RAC/SPA (2009) Proceedings of the 1st Mediterranean symposium on the conservation of the coralligenous and other calcareous bio-concretions (Tabarka, 15-16 January 2009). Tunis: RAC/SPA publication

Airoldi L, Beck M W. 2007. Loss, status and trends for coastal marine habitats of Europe. Oceanography and Marine Biological Annual Review, 45: 345–405

Ballesteros E. 2006. Mediterranean coralligenous assemblages: a synthesis of present knowledge. Oceanography and Marine Biology Annual Review, 44: 123–195

Barberá C, Bordehore C, Borg J A, et al. 2003. Conservation and management of northeast Atlantic and Mediterranean maërl beds. Aquatic Conservation of Marine and Freswater Ecosystem, 13(S1): S65–S76

Barton E D, Arístegui J, Tett P, et al. 1998. The transition zone of the Canary Current upwelling region. Prog Ocean, 41: 455–504

Blake C, Maggs C A. 2003. Comparative growth rates and internal banding periodicity of maërl species (Corallinales, Rhodophyta) from northern Europe. Phycology, 42: 606–612

Buchanan J B, Kain M. 1971. Measurements of the physical and chemical environment. In: McIntyre A D, ed. Methods for the study of marine benthos. Oxford & Edinburgh: Blackwell Scientific Publications, 30–58

Clarke K R, Warwick R M. 2001. Changes in marine communities: an approach to statistical analysis and interpretation. Plymouth, UK: PRIMER-E

Kimberly A E, Roberts M G. 1905. A method for the direct determination of organic nitrogen by the Kjeldahl process. Public Health Pap Rep, 31(2): 109–122

Rubino L, Catapano V, Guerra G. 1989. Determination of inorganic phosphorus in serum: Evaluation of three methods applied to the Technicon RA-1000 analyzer. Journal of Automatic Chemistry, 11(4): 164–167

Sciberras M, Rizzo M, Mifsud J R, et al. 2009. Habitat structure and biological characteristics of a maërl bed off the northeastern coast of the Maltese Islands (central Mediterranean). Marine Biodiversity, 39: 251–264

Walkley A, Black J A. 1934. An examination of the Degtjareff method for determining soil organic matter and a proposed modification of the chromic titration method. Soil Science, 37: 29–38