

# Mobile epifaunal community in marine caves in comparison to open habitats

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**ABSTRACT:** Mobile epifauna is an essential component of rocky reef ecosystems. In spite of this and the great scientific interest that the study of marine caves has aroused in the last decades, little research has been conducted on the macrofauna associated with animal substrates in submarine caves. This study explores the main differences between marine caves and open habitats in terms of species composition and diversity patterns of epifaunal communities in 4 different shallow marine caves in southern Spain. Colonies of *Eudendrium* sp., a marine hydroid widely distributed in the Mediterranean Sea, were taken from inside and outside each cave, and all associated mobile fauna were sorted and identified. More than 90% of organisms were crustaceans, with Amphipoda as the dominant group. Although the main species did not vary significantly in abundance between open and cave habitats, multivariate analysis carried out for the entire amphipod community showed significant differences between these 2 habitats. nMDS analysis showed that marine cave assemblages were also characterized by a higher degree of individuality, and univariate analysis showed a decrease in Shannon diversity and species richness with distance into the caves, a consistent pattern for all caves studied. Although the possible role of predation pressure in the structure of such assemblages was also discussed, we propose that the absence of plant substrates inside the caves, in conjunction with oligotrophic conditions and low siltation, are the main factors responsible for the impoverishment of the epifaunal community. The near lack of photosynthetic activity reduced the presence of herbivorous species, while the rich detritus-feeder community supported by the animal substrates was limited by the low rate of sedimentation.

**KEY WORDS:** Epifauna · Marine caves · Amphipods · Hydroids · Mediterranean Sea

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## INTRODUCTION

Marine caves constitute a typical feature of the Mediterranean coastline. Because of their high vulnerability and important role as a biodiversity reservoir (Gerovasileiou & Voultsiadou 2012), marine cave habitats are protected by the European Community (Habitat Directive 92/43 EEC). Darkness is not the only peculiarity of this ecosystem; because of their isolation, lack of photosynthetic production, long-

term stability, similarity to the bathyal zone and presence of strong environmental gradients on spatial scales of only a few meters, marine caves have long been considered as environments of great taxonomic and ecologic interest (Vacelet et al. 1994, Benedetti-Cecchi et al. 1997, Hiscock & Breckels 2007). Several comparative studies have been done to explore the differences in distribution of organisms inside marine caves versus open habitats (e.g. Zabala et al. 1989, Harmelin 1997, Martí et al. 2004, Bussotti & Guidetti

2009, Janssen et al. 2013). However, only a few of these studies have taken into account the epifaunal community inhabiting animal or plant substrates (Ledoyer 1966, True 1970, Scipione et al. 1981). Thus, this type of assemblage remains poorly known, although it is essential to consider this part of the marine cave community in order to understand the behavior of these systems. Epifauna associated with hard-bottom substrates are major contributors to the flux of materials in rocky habitats, providing up to 99% of total secondary productivity, and acting as a prey source for the majority and most productive demersal fishes (Taylor 1998a, Edgar & Aoki 1993). However, they have usually been excluded in trophic models (Taylor 1997).

Although a decrease in species richness, diversity and coverage of benthic organisms is a well-known phenomenon in the inner part of marine caves (Zabala et al. 1989, Bussotti et al. 2006), the existence of the same pattern for the epifaunal community has not been tested. The presence of sessile species has a positive effect on the diversity of associated assemblages, which is evident when we compare them to bare rock and sedimentary environments (Chapman et al. 2005, Birdsey et al. 2012). Thus, one could expect that because of the oligotrophic conditions and high percentage of bare substrate in these habitats, caves might support a poor assemblage of mobile organisms. However, the decline in competition for substrate by algae in the semi-dark areas of marine caves often allows for the development of a rich and heterogeneous community dominated by sessile invertebrates (Bussotti et al. 2006).

With respect to differences in species composition, obviously if the benthic community is different between marine caves and open habitats, the associated epifauna will likely also differ (Birdsey et al. 2012). Previous studies have highlighted how macroinfauna associated with soft sediments inside marine caves was different from those present outside them (Bamber et al. 2008, Navarro-Barranco et al. 2013). However, it is difficult to establish how many of those differences in community are due to habitat, because of the presence of confounding factors such as changes in the granulometry or the chemical properties of the sediment. Thus, in the present study we explore the mobile organisms associated with *Eudendrium* sp. (Cnidaria, Hydrozoa), a substrate present in both habitats (semi-dark and open). By using the same substrate, we can identify the extent the environment (and not the change of substrate) plays in determining changes in epifaunal composition and biodiversity patterns.

Cnidarian colonies can support a highly diverse epifaunal community, as has been shown in gorgonian gardens and scleractinian reefs (Stella et al. 2010, Carvalho et al. 2014). Hydroids are also considered to be a foundation species of littoral communities in temperate habitats (Bavestrello et al. 1996). Simkina (1980) pointed out that hydroid colonies can constitute the major regulators of zooplankton in some areas, playing an important role in the mass development of copepod species. They also act as a food supply for many species, such as nudibranchs and amphipods (Bavestrello et al. 1996). Moreover, specific studies have highlighted the biodiversity increase of epifauna in rocky habitats when hydroid colonies were present (Bradshaw et al. 2003). *Eudendrium* is a common and widely distributed hydroid genus in both natural and polluted Mediterranean environments, forming large arborescent colonies which support a rich community of sessile and mobile epibiotic organisms (Bavestrello et al. 1996, Romagnoli et al. 2007, Di Camillo et al. 2008). Among its mobile epifauna, crustaceans (mainly copepods and amphipods) comprise more than 90% of individuals (Bavestrello et al. 1996); a common feature in most benthic substrates and habitats (and also inside marine caves) (Martin-Smith 1993, Taylor 1997, Fredriksen et al. 2005, Guerra-García et al. 2011, Navarro-Barranco et al. 2012). Because of their abundance, ubiquity, importance in the structure of benthic assemblages and sensitivity to environmental changes, amphipod crustaceans are often used as a model group in ecological studies (Sánchez-Moyano & García-Gómez 1998, Duffy & Hay 2000, Guerra-García & García-Gómez 2001).

The main objective of this study was to explore the ecological patterns that characterize mobile epifaunal communities in marine caves. For that, we used the amphipod community associated with *Eudendrium* sp. as a model, studying the possible existence of differences in the abundance, number of species, diversity and species composition in the epifauna associated with hard-bottom communities between marine caves and open habitats.

## MATERIALS AND METHODS

### Study site and sampling collection

Four shallow marine caves were selected and sampled between 20 and 28 August 2012 in La Heradura (southern Spain): 'Cueva de la Punta del Vapor' (36°43'22"N, 3°42'35"W), 'Cueva del Jarro'

(36°43'11"N, 3°43'48"W), 'Cueva de los Gigantes' (36°43'20"N, 3°44'08"W), and 'Cueva de Cerro-Gordo' (33°43'46"N, 3°45'56"W). All of these caves are shallow (samples were taken between 6 and 12 m deep) and showed a similar topography in their semi-dark areas. Two sampling stations were selected in each location: one in the exterior area (approximately 5 m outside the cave mouth) and another inside the cave. The abundance of *Eudendrium* sp. decreases in the inner part of the caves, being absent in the completely dark areas. Therefore, the cave samples were taken in the semi-dark area (approximately 10 m from the entrance), where the abundance of *Eudendrium* sp. remains similar to that present outside the caves. Although the distance between the 2 stations in each cave was only ca. 15 m, the caves showed marked gradients in many factors, such as light and hydrodynamism. Therefore, changes between both communities were very evident, with an algae-dominated community on one side and an invertebrate-dominated community on the other. Four replicate samples of *Eudendrium* sp. were collected at each station by divers using SCUBA equipment. Each colony was enveloped in a plastic bag before detachment to avoid the loss of organisms, and preserved in 70% ethanol. In the laboratory, each colony was washed through a 0.1 mm mesh sieve with fresh water to collect all mobile organisms, and the volume of each colony was measured by the displacement of a known volume of water when the hydroid was introduced. The organisms were sorted into higher taxa and counted. Additionally, all amphipods were identified to species level using a binocular microscope.

### Data analysis

Abundance per taxon was calculated for each station (mean  $\pm$  SD). For amphipod crustaceans, the number of species (mean  $\pm$  SD) and Shannon-Wiener diversity index (Shannon & Weaver 1963) were also calculated. The spatial variation in these parameters for the amphipod community was explored using ANCOVA with 2 factors: habitat (Ha) and location (Lo). Habitat was a fixed factor with 2 levels (internal vs. external stations). Location was a fixed factor, orthogonal with habitat, with 4 levels (one for each marine cave). Four samples were considered for each station ( $n = 4$ ). Volume was included as a covariate. It has been proven that the inclusion of factors that cannot be controlled experimentally as covariates increases

the power of the statistical analysis (Huitema 2011, Quinn & Keough 2002). Heterogeneity of variance was checked using Cochran's test, and transformations were applied when necessary (Underwood 1997). When variances remained heterogeneous, untransformed data were analyzed, as ANOVA is robust enough to support conclusions based on this assumption—particularly in a balanced design with sufficient replicates (Underwood 1997). In such cases, special care was taken in the interpretation of results, and in order to reduce Type I errors, the level of significance was reduced to 0.01. Prior to analysis, heterogeneity of slopes was also tested by crossing the covariate with the interaction of the other 2 factors and checking for significant interactions (Engqvist 2005). Taking into account that colony volume was not a significant covariate in any analysis, the same general design was tested with an ordinary ANOVA (Quinn & Keough 2002, Martins et al. 2007), with 2 factors. When ANOVA indicated a significant difference for a given factor, the source of difference was identified using the Student-Newman-Keuls (SNK) tests.

Multivariate analyses were conducted using the abundances of amphipod species per replicate. Data were previously square-root transformed to reduce the importance of extreme values, and a similarity matrix was generated using the Bray-Curtis similarity index. In order to test differences in amphipod species compositions, a distance-based permutational multivariate analysis of variance (PERMANOVA) was carried out using the previous 2-factor design. Terms found to be significant in the analyses were examined individually using appropriate pair-wise comparisons. A non-parametric multidimensional scaling (nMDS) using the mean values per station was carried out to explore differences in species composition between habitats and locations. A permutational analysis of multivariate dispersions (PERMDISP) was carried out to test differences in the variation of the amphipod community between cave and external habitats. SIMPER was used to calculate the contribution of each species to the observed dissimilarity between internal and external stations. ANOVA was used for those species with higher contribution, to test whether their abundance was different across habitats.

ANOVA analyses were performed using the GMAV5 program (Underwood et al. 2002) and ANCOVA using SPSS.15. Multivariate analyses were carried out using the PRIMER v.6 + PERMANOVA package (Clarke & Gorley 2001).

RESULTS

A total of 2877 organisms were collected in the study. Arthropods made up the most abundant group in all stations (Fig. 1), and with the exception of a few pycnogonids, all of the arthropods were crustaceans. Molluscs (mainly nudibranchs and bivalves) represented 3.8% of organisms, 2.5% were annelids (polychaetes) and 1% were echinoderms. Within crustaceans, 98.6% were amphipods while the rest were comprised of tanaids, isopods, decapods and cumaceans. Nineteen different amphipod species (17 gammarids and 2 caprellids) were found on *Eudendrium* sp. (Table 1). The caprellid *Pseudoprotella phasma* var. *minor* was the most abundant species, constituting 58% of the organisms, and reaching densities higher than 50 ind. cm<sup>-3</sup> in some colonies. The gammarids *Ischyrocerus inexpectatus*, *Lembos websteri* and *Stenothoe* sp. were also very abundant, while other species such as *Amphilocheus neapolitanus*, *Liljeborgia* sp. or *Ampithoe ramondi* were only represented by a few organisms. According to the univariate analyses, the diversity of amphipod communities associated with *Eudendrium* sp. was significantly lower inside the caves (Table 2). No differences were detected among locations, and the absence of a significant interaction between factors (Ha × Lo) allows us to consider that the diversity decrease inside caves was a constant pattern in all

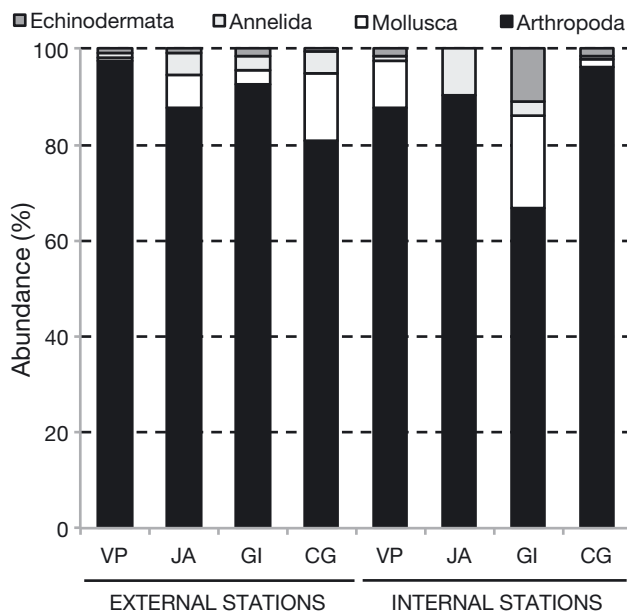


Fig. 1. Abundance (%) of each phylum collected per station. External stations were located approximately 5 m outside the mouth of the cave; internal stations were in the semi-dark area approximately 10 m from the cave entrance

Table 1. Mean (±SD) abundances (ind. 1000 cm<sup>-3</sup>) of the amphipod species associated with *Eudendrium* sp. in each station. Ext = external stations; int = internal stations, -: species not found

Species	Punta del Vapor		Jarro		Gigantes		Cerro Gordo	
	Ext	Int	Ext	Int	Ext	Int	Ext	Int
<i>Amphilocheus neapolitanus</i>	-	-	-	-	-	-	62 ± 62	-
<i>Ampithoe ramondi</i>	187 ± 71	-	-	-	-	-	-	-
<i>Apocorophium acutum</i>	250 ± 160	-	-	-	-	-	267 ± 155	-
<i>Dexamine spiniventris</i>	327 ± 227	-	87 ± 59	363 ± 223	-	-	83 ± 83	-
<i>Dexamine spinosa</i>	187 ± 187	-	87 ± 59	227 ± 227	305 ± 270	-	-	-
<i>Elasmopus vachoni</i>	562 ± 483	-	-	-	355 ± 169	-	250 ± 250	-
<i>Erichthonius punctatus</i>	83 ± 83	-	1666 ± 1453	3090 ± 2912	-	-	-	-
<i>Gammaropsis maculata</i>	1684 ± 1131	375 ± 375	1600 ± 299	681 ± 682	555 ± 555	1875 ± 1875	562 ± 483	125 ± 125
<i>Ischyrocerus inexpectatus</i>	3107 ± 939	-	2138 ± 790	3480 ± 1409	2716 ± 1092	1250 ± 722	3866 ± 2730	4500 ± 3304
<i>Lembos websteri</i>	5693 ± 2376	177 ± 118	3005 ± 714	4818 ± 3032	1350 ± 662	680 ± 609	1657 ± 317	-
<i>Liljeborgia</i> sp.	-	92 ± 92	-	-	-	-	-	-
<i>Lysianassa</i> sp.	321 ± 236	-	-	-	-	-	-	-
<i>Maera inaequipes</i>	416 ± 416	-	-	-	-	-	-	-
<i>Microjassa cumbrensis</i>	4833 ± 1383	250 ± 250	291 ± 172	45 ± 45	55 ± 55	-	720 ± 397	-
<i>Perionotus testudo</i>	386 ± 179	-	-	-	-	-	-	-
<i>Phitsica marina</i>	1223 ± 1037	956 ± 543	62 ± 62	-	227 ± 193	-	41 ± 41	604 ± 258
<i>Pseudoprotella phasma</i>	38592 ± 8488	11674 ± 6025	5925 ± 1305	5111 ± 3242	10411 ± 2743	5055 ± 3510	10354 ± 4529	43031 ± 26474
<i>Stenothoe dulfossi</i>	836 ± 316	698 ± 466	622 ± 242	-	977 ± 661	-	702 ± 366	-
<i>Stenothoe</i> sp.	7470 ± 2638	355 ± 230	819 ± 270	1327 ± 1077	255 ± 189	-	979 ± 425	125 ± 125

Table 2. Results of 2-way ANOVA for Shannon-Wiener diversity, species richness and abundance of individuals for the amphipod community. No transformations were necessary for diversity and richness values, while abundance data were log transformed. \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$

Source of variation	df	Shannon diversity			Species richness			Abundance of organisms		
		MS	F	p	MS	F	p	MS	F	p
Habitat = (Ha)	1	3.07	16.55	0.000***	190.13	43.25	0.000***	22.78	20.83	0.000***
Location = (Lo)	3	0.49	2.66	0.071	28.54	6.49	0.002**	3.1	3.66	0.027*
Ha × Lo	3	0.2	1.08	0.377	8.21	1.87	0.162	3.45	3.16	0.043*
Residual	24	0.19			4.4			1.09		

locations. Habitat was also a significant factor in species richness (Table 2). Colonies of *Eudendrium* sp. situated inside the caves hosted less than half of the number of species compared to colonies inhabiting open habitats (Fig. 2). All species in the study were present in external stations, but only 12 were present in the colonies inside the caves. Location was also a significant factor, but the patterns were still constant (Ha × Lo not significant). Concerning abundance analysis, there were significant differences between habitats and locations, but these differences were not constant (Table 2). For example, external colonies in Punta del Vapor contained 10 times more individuals than internal ones, while in Cerro-Gordo the abundances were higher inside the cave (Fig. 2). The abundance increase inside Cerro-Gordo cave was due to an unusual rise in the number of *Pseudoprotella phasma*.

PERMANOVA results showed significant differences in the amphipod community between habitats and among locations (Table 3), with no interaction between them. A clear separation between internal and external communities was not found in the nMDS (Fig. 3), although a higher variability of internal stations among caves in comparison with external ones can be observed. PERMDISP results indicated that cave habitats showed a significantly greater variation than external habitats ( $p < 0.05$ ). The uni-

variate analyses carried out for each of the main species separating habitats (according to SIMPER results) did not show any significant differences between internal and external areas.

## DISCUSSION

### Mobile epifaunal community associated with *Eudendrium* sp.

The dominance of crustaceans observed in the present study agrees with most of the studies carried out for epifaunal communities associated with hard substrates (see references in the 'Introduction'). Polychaetes were also established as the dominant epifaunal group in some areas, but this is usually due to the highly polluted conditions of these environments (Dean 2008). All amphipod species found in the study had been previously recorded as inhabiting multiple hosts (Bellan-Santini et al. 1982, 1989, 1993). Although some amphipod species have shown strong host specificity (Poore et al. 2000, Gestoso et al. 2013), hard substrate epifaunal taxa (amphipods included) generally do not show habitat specialization (Taylor 1997). Moreover, *Eudendrium* sp. and most benthic hydroids in temperate waters are subjected to sharp seasonal variations in abundance

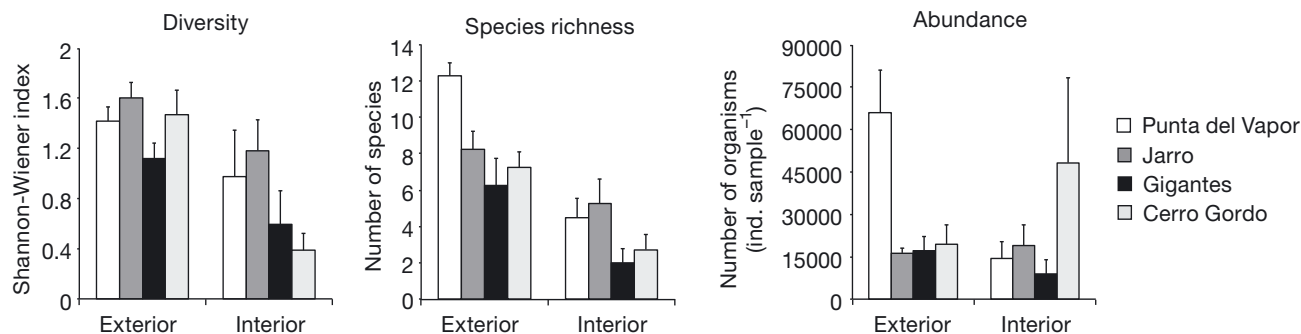


Fig. 2. Mean values ( $\pm$ SD) of Shannon-Wiener diversity index, number of species and abundance of organisms (ind. sample<sup>-1</sup>) inside and outside the caves

Table 3. Results of the multivariate PERMANOVA for amphipod assemblages, based on Bray-Curtis dissimilarities of square-root transformed data. \*\* $p < 0.01$

Source of variation	df	MS	F	p
Habitat = (Ha)	1	4926.4	3.224	0.003**
Location = (Lo)	3	3203.5	2.096	0.007**
Ha × Lo	3	2364.7	1.548	0.078
Residual	24	1528.1		

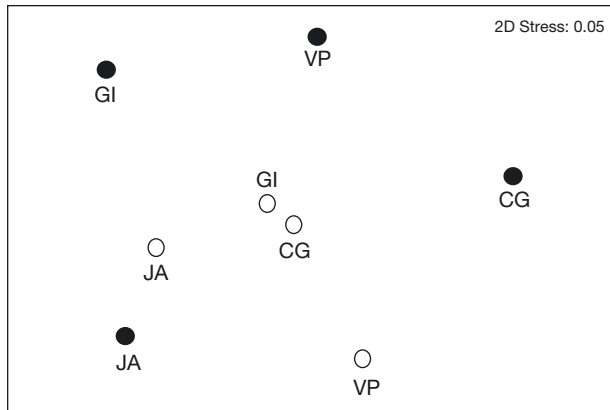


Fig. 3. Two-dimensional non-parametric multidimensional scaling (nMDS) plot for species composition inside and outside the marine caves. Data were square-root transformed. Black circles represent internal stations; white circles represent external ones. VP = Cueva del Vapor; JA = Cueva del Jarro; GI = Cueva de los Gigantes; CG = Cueva de Cerro Gordo

(Bavestrello et al. 2006, Di Camillo et al. 2012), which might promote lower rates of specialization (Duffy & Hay 1991, Chemello & Milazzo 2002). For example, stenothoids are predominantly found on cnidarians, but also occur on algae, tunicates, sponges, etc. (Bellan-Santini et al. 1993, Vader & Krapp-Schickel 1996). *Ischyrocerus inexpectatus*, the second most abundant species found in our study, is also present in other substrates such as algae and bryozoans, and was only reported to occur occasionally on *Eudendrium glomeratum* (Bellan-Santini et al. 1989, Bavestrello et al. 1996, Conradi et al. 2000). Only *Pseudoprotella phasma*, the most abundant species in the study, seemed to show a clear preference for hydroids (J. M. Guerra-García unpubl. data), which could be due to the close kleptocommensalism relationship that has been reported between *P. phasma* and *Eudendrium* sp. (Bavestrello et al. 1996).

The diverse epifaunal community hosted by *Eudendrium* sp. is usually explained by its role as a small ecosystem engineer (Bavestrello et al. 1996).

Since *Eudendrium* sp. is among the few erect and ramified organisms living inside marine caves, it could be expected that the role of this hydroid in terms of epifaunal diversity is especially important in this habitat.

### Differences between marine caves and open habitats

The high variability observed in the internal samples is a common feature reported in marine caves. Several factors (e.g. depth, cave topography, size and orientation of entrance) can influence environmental conditions inside caves, which creates a high degree of individuality in these habitats (Bussotti et al. 2006, Navarro-Barranco et al. 2013).

Regarding amphipod distribution, no species were exclusive of cave environments. That was to be expected, since the samples were not taken in the inner and most isolated part of the caves, and the vast majority of the species recorded in marine caves are stygophilic (not specialized in subterranean life, found in other similar habitats as well) or stygoxenes (sheltering in caves but feeding outside) (Scipione et al. 1981, Gerovasileiou & Voultsiadou 2012). The absence of significant differences between internal and external areas of the caves in terms of the main species separating habitats is remarkable, since some of them, such as *Lembos websteri* or *Ischyrocerus inexpectatus*, are often related to exposed environments.

In spite of the absence of significant differences between habitats with respect to specific species, the analysis for the whole community showed clear differences between external and internal habitats, with a decrease in species richness and diversity in the latter. What factor(s) could be responsible for these differences? Unfortunately, little effort has been made to test the extent to which differences in the environment might promote changes in the epifauna associated with a given substrate. As mentioned above, most of the species considered here are generalists, so this epifaunal community presumably responds to factors other than just variations in *Eudendrium* sp. properties and abundances. Tanner (2006) highlighted the importance of landscape ecology for the mobile epifauna associated with seagrasses. A factor frequently used to explain the diversity decrease of sessile animals in marine caves is the difficulty involved in reaching and colonizing this semi-enclosed environment (Harmelin 1997, Denitto et al. 2007). Nevertheless, this does not seem to be a

plausible explanation for mobile epifaunal community, since movement of the major mobile groups associated with hard-bottom substrates is mainly accomplished by crawling from one substrate to another, rather than swimming in the water column (Taylor 1998b). Moreover, amphipods lack planktonic larvae, and there is no discontinuity between internal and external stations in the presence of *Eudendrium* sp. in the caves we studied.

Trophic requirement is another main factor affecting the distribution and composition of the amphipod community (Conradi & López-González 2001 and references therein), and the decrease in trophic supply is the most common explanation for impoverishment of cave faunas (Zabala et al. 1989). With the exception of some carnivorous (*Amphilochus neapolitanus*, *Liljeborgia* sp., and stenothoids), and herbivorous species (*Elasmopus vachoni*, *Amphitoe ramondi*, *Perionotus testudo* and *Lysianassa costae*) the rest of amphipods inhabiting *Eudendrium* sp. were detritivorous (Scipione 1989, Guerra-García et al. 2014). This association is favored by mucus secretion in the colonies, which retains large amounts of sediment from the water column (Bavestrello et al. 1994). Experimental studies in vegetated habitats revealed that species richness and abundance of amphipods were highly and positively related to the detritus content (Vázquez-Luis et al. 2009). However, while in most cases (e.g. harbours) low hydrodynamism conditions are related to higher sedimentation rates, marine caves often represent an exception. Due to the highly stable conditions in the caverns, protected from the influence of currents and storms, the amount of suspended particles in the water is very low (Fichez 1991). Because of this low siltation, food supply could be a limiting factor for the detritus-feeding community supported by cave substrates. The near absence of photosynthetic activity inside the cavity contributes to this low diversity as well, as it confines the presence of herbivorous species to illuminated areas (Harmelin et al. 1985, Parker et al. 2001). All herbivorous species found in this study were only present in the external stations.

Lastly, the structure and dynamics of marine epifauna can also be affected by predation pressure by fishes (Nelson 1979, Vázquez-Luis et al. 2010). Mobile epifauna constitute the most important trophic resource for the majority of demersal fishes, and the most productive fishes in rocky reef ecosystems (Taylor 1998a, Edgar & Aoki 1993). Epifauna associated with hard-bottom substrates (mainly crustaceans) appear to be the most abundant food item for several species of the genus *Diplodus*, one of the

dominant groups in shallow rocky habitats of the Mediterranean (Sala & Ballesteros 1997). There are differences in the fish assemblages associated with marine caves and rocky cliffs, with a decrease in species richness and abundance toward the innermost sections of the caves (Bussotti et al. 2002, Bussotti & Guidetti 2009). Therefore, a decrease in predation pressure would be expected inside marine caves. Nevertheless, it is not clear which is the primary controlling factor in these systems; prey availability (bottom-up regulation) or predation pressure (top-down regulation). In this sense, Taylor (1998a) found that these fishes only consumed approximately 20% of epifaunal production, although this work was carried out in New Zealand and his results are difficult to extrapolate to our environments. Edgar & Aoki (1993) also suggested that fish predation affects size structure and composition (preferentially eliminating the largest animals), rather than epifaunal production.

In conclusion, we suggest that the oligotrophic conditions inside the caves, in conjunction with the absence of algae, were the main factors influencing the diversity and species composition in epifaunal communities of marine cave ecosystems. Further studies will be necessary to clarify the role of predation over epifaunal ecology, and vice versa. In that sense, marine caves represent an ideal environment in which to conduct ecological and experimental investigations because of their impoverished communities, isolated conditions and the strong gradients in predation pressure and epifaunal abundance present in these habitats.

*Acknowledgements.* Financial support of this work was provided by the Ministerio de Economía y Competitividad (Project CGL 2011-22474, internal reference 2011-707) co-financed by FEDER funds of the European Union, and by the Consejería de Economía, Innovación, Ciencia y Empleo, Junta de Andalucía (Project P11-RNM-7041). Special thanks to Dr. E. Baeza-Rojano for help with amphipod identifications. Constructive comments on the manuscript from 3 anonymous reviewers were much appreciated. We are also grateful to K. Gavira and E. Hendrycks, who conducted the English revision of the manuscript, and to I. Ferreira for help in sorting the samples. This work forms part of C.N-B.'s PhD thesis, supported by the University of Seville (PIF Grant).

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