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Benthic assemblages in two Mediterranean caves: species diversity and coverage as a function of abiotic parameters and geographic distance

Ruth Martí*[‡], Maria J. Uriz*, Enric Ballesteros* and Xavier Turon[†]

*Centre d'Estudis Avançats de Blanes, CSIC, Accés Cala Sant Francesc, 14, 17300 Blanes (Girona), Spain. [†]Department of Animal Biology, Faculty of Biology, University of Barcelona, Diagonal Ave. 645, 08028 Barcelona, Spain. [‡]Corresponding author, e-mail: ruth@ceab.csic.es

Benthic assemblages of two Mediterranean submarine caves were compared. Species coverage and number of species were lower in internal (dark) communities than external. This feature was specially marked in the less illuminated cave. Ordination analyses performed on species coverage per community for each cave separately, distinguished several benthic communities from the outermost to the innermost zone of each cave. Cluster analyses on species coverage, taking into account all communities in both the caves, established similarities among communities: algal-dominated communities clustered according to the level of light received independently of the cave they inhabited, while animal-dominated communities were more similar within each cave than between the caves. Moreover, among the abiotic parameters measured irradiance was the only factor that clearly diminished from the entrance to the innermost zone in both the caves. In contrast, water movement and particulate organic matter varied differently in each cave. Results indicate that the different topography, depth and geographic location of the two caves determine water movement, light penetration and nutrient availability along the caves. These factors are responsible for determining species abundance and diversity, as well as species growth habit in each community.

INTRODUCTION

Submarine caves show patterns comparable worldwide in structure and type of communities. A common feature is a decrease in species richness, biomass and coverage of benthic organisms from the outermost to the innermost part of the cave (see Harmelin, 1985 and references therein). The usual explanation for this gradient is a reduced water turnover towards the inner part (Fichez, 1991), although experiments comparing the dissolution of plaster balls failed to substantiate this hypothesis (Balduzzi et al., 1989; Zabala et al., 1989). Likewise, no stagnation of water in microlayers over wall boundaries has been detected by dye diffusion (Zabala et al., 1989). Other physico-chemical gradients (salinity, temperature, density, dissolved oxygen and chlorophyll) that could explain this zonation were not detected either (Gili et al., 1986; Zabala et al., 1989). Light is, in all cases, the factor that clearly decreases from the external to the innermost zone of all the caves. For planktonic organisms, a strong decrease in the number of individuals from external to internal zones reported in a Mediterranean cave (Palau et al., 1991) may be explained by simple diffusionsedimentation processes (Garrabou & Flos, 1995). However, this result is inconsistent with the lack of decrease in particulate organic matter (POM) reported for the same cave (Gili et al., 1986; Zabala et al., 1989), although it might be explained by the importance of the tripton part of the seston (not considered in planktonic studies) (Palau et al., 1991). Moreover, it has been suggested that the organic content of the particles inside

the caves is lower than that of the particles outside them, so the quality of the food supply potentially available to suspension-feeders would be higher in the external zones of the caves (Fichez, 1991).

Here we attempt to compare species coverage and richness of the flora and fauna in the different communities established in two Mediterranean caves. Using photography we were able to study large areas in the caves and to encompass spatial heterogeneity. Moreover, values of abiotic parameters (irradiance, water movement and POM) were obtained for comparative purposes. Samples were collected in spring and autumn to allow for possible seasonal variation in species presence and/or abundance.

From the comparison of these two caves with contrasting topographical and trophic conditions we aimed to identify the factors determining community structure and variation along the caves, and establish whether the seasonality reported in open littoral communities of the Mediterranean also applies to the inner communities of the caves.

MATERIALS AND METHODS

Study sites

The caves are located in the north-western Mediterranean (Iberian Peninsula): the Cabrera Archipelago (Balearic Islands, oligotrophic sea) and the Medes Islands (Catalan coast, a relatively eutrophic zone). The two caves (Figure 1) have in common the limestone nature of the substrate and the mainly rocky nature





of the floor, with low amounts of sediment, in contrast to what is commonly found in the caves. They differ in topography and trophic characteristics.

Assemblage assessment

A longitudinal, 2 m wide transect was set up from the cave entrance to the innermost zone in both the caves. The species inventories and the measurement of physical parameters were performed by SCUBA diving along each transect. In the Cabrera cave the transect was located at 6 m depth and in the Medes cave at about ~ 10 m depth, which represented the mean depth of the respective caves. The study was performed in June and November 1996.

A semi-quantitative inventory of the benthic species was drawn up according to the method described in Braun Blanquet (1979). Species abundance was assessed *in situ*, and samples were collected when necessary for later taxonomic identification in the laboratory.

The semi-quantitative inventories distinguished several communities throughout the caves. Once the main communities (zones) had been established, the physical and biological parameters of each zone were studied.

Physical parameters

Irradiance

Light in each zone was measured in June and November using a SPQA Li-Cor provided with a data-logger Li-Cor LI-1000. The values are referred to the subsurface light.

Water motion and temperature

Water motion in the established zones of both the caves was derived from measurement of weight losses of calcium sulphate balls (1.5 cm in diameter) (Muus, 1968). A wire was passed through each ball and the wires were included in a flexible resin, which was attached to the walls. In a variety of sea conditions, four sets of five balls were maintained for two days on the walls of each zone, in June and November. Five additional balls were left underwater in the cave in a closed container for the same period, as a control for CaSO₄ dissolution in static conditions. Balls were dried for 24 h at 100°C after collection and then weighed. Losses of CaSO₄ in control balls were subtracted from losses measured in the balls placed on the walls. The results are expressed in mg of CaSO₄ lost per hour.

Water temperature was measured in each zone in both seasons.

Particulate organic matter (POM)

Seawater was collected with a Niskins sampler in each zone of both the caves, in June and November. Two litres of water were filtered on precombusted GF/F glass fibre filters of 0.22- μ m pore diameter. Afterwards, filters were exposed to hydrochloric acid vapour for 48 h to eliminate the inorganic material, dried and analysed with a C:H:N Autoanalyser Eager 200. Final concentrations are expressed in μ g/litre.

Community structure

Sampling

To assess seasonal coverage of the most abundant species, 20 pictures were taken at random in each zone in both the caves, in June and November 1996. The pictures, covering $\sim 310 \text{ cm}^2$ each, were taken with a Nikonos-V camera and a 28 mm objective provided with a Nikonos close-up lens.

All seaweeds and animals in each picture were outlined and identified to the species level (whenever possible). The outlines were later digitalized and analysed with Sigma Scan Image software (Jandel) to measure the total area and number of individuals of each species (which corresponds to the number of patches for sponges and other encrusting organisms).

Coverage and number of species

The percentage cover of each species in the 20 pictures taken per zone and season was calculated. The values were added to obtain the percentage cover of each species in the whole area sampled per zone (6200 cm²). A log-linear model comparing the number of species per taxon in each zone was performed for each cave.

Ordination

Detrended correspondence analyses (DCAs) were performed on species coverage to study the spatial distribution of the benthic species in each of the four zones previously defined in both the caves. This analysis provided a graph of the distance(s) between the zones on the basis of differences in species composition and abundance. The percentage cover per species was the variable analysed. The percentage of bare rock was also taken into account, since it varied strongly between zones.

The analyses used the software program PC-ORD version 4 (McCune & Mefford, 1999). Outliers were

previously eliminated using the Sorensen (Bray-Curtis) distance. The down weighting of rare species option was selected to avoid their possible influence on ordination.

Because species coverage varied from June to November, especially in the most external zones dominated by seaweeds, the ordination analyses were carried out separately for each sampling season. However, as the general pattern was similar in both seasons, only the analyses from June are shown here.

An analysis was first performed for all samples of each cave separately (80 samples, 20 pictures per zone). A second analysis was performed for the animal-dominated zones (Zones 3 and 4 of the Cabrera cave and Zones 2, 3 and 4 of the Medes cave) of each cave separately since they appeared clumped in the first analysis.

Classification

Cluster analyses were conducted on percentage cover per taxonomic group to assess the relationships between zones of the two caves in the two seasons. Bare rock was not considered for these analyses.

Hierarchical clustering with group-average linking, based on similarity matrices (Bray-Curtis coefficient) was used. Data were previously transformed to double root (4th root), which down weights the importance of the very abundant species so that the less dominant, and even the rare species, contribute to similarity between samples. The PRIMER (Plymouth Routines in Multivariate Ecological Research) package for the analyses (Clarke & Warwick, 1994) was used.

A preliminary analysis was done using the percentage cover per high taxonomic entity (from Phylum to Class depending on the group) as the variable. Using the groups found in this analysis, more accurate analyses were carried out on the percentage cover per species.

RESULTS

Assemblage assessment

Species composition and abundance (semi-quantitative inventories) as well as changes in growth habit of the same species (for example massive forms at the cave entrance becoming thinly encrusting forms at the innermost parts), allowed us to distinguish four differentiated zones in each cave, which corresponded to four different communities (Pérès & Picard, 1964).

In the Cabrera cave (Figure 1A), Zone 1 corresponded to a photophilic seaweed community, and Zone 2 to a sciaphilic seaweed community. The former, facing west, was located just outside the cave. The sciaphilic community faced north-west and was located at the cave entrance. Zone 3 corresponded to a semi-dark cave community and Zone 4 represented a dark community in several aspects (see Discussion) (terminology according to Pérès & Picard, 1964).

The narrow shape of the Medes (Figure IB) cave and its deeper location as compared to the Cabrera cave results in a darker nature of its communities. Zone I faced south-east out of the cave and had a hemisciaphilic seaweed community. The communities inhabiting Zones 2 and 3 corresponded to a semi-dark cave community. Although Zone

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3 was darker, both zones had similar species composition, although the species showed different growth habits. The assemblage dwelling on Zone 4 represented a dark-cave community. The cave ended with a zone almost free of macroinvertebrates.

The three communities of seaweeds in the two caves can be therefore positioned along a gradient of light: photophilic, hemisciaphilic and sciaphilic.

Physical parameters

Irradiance

The irradiance values in each zone of both the caves are reported in Table 1. In the Cabrera cave, Zone 1 (located outside the cave) was well illuminated (Table 1). Zone 2 received nearly 3% of the subsurface light. In the two innermost zones no light was detected at 11 a.m. At sunset some light was detected in Zone 4 due to the west facing of the cave.

The two innermost zones of the Medes cave were dark throughout the day (Table 1). Zone 2 received some light from a pit that opens to the outside just above it and from the entrance to the cave. Zone 1, although it was placed outside the cave (as in the Cabrera cave), received less light than Zone 1 in the Cabrera cave, since it was deeper.

Water motion and temperature

In the Cabrera cave, Zone 3 had the lowest water motion in both seasons while Zone 2 showed the highest

Table 1. Irradiance in each zone of both the caves. The mean values are referred to the subsurface light (0 m depth). There were no appreciable differences between seasons.

		% of irradiance					
Season	Zone	Cabrera cave	Medes cave				
June	1	42.8	19.5				
and	2	2.7	0.076				
November	3	0.0036	0				
	4	0	0				

Table 2.	Water motio	n expressed i	in mg CaS	0 ₄ lost per	hour.
The values	correspond to	means and st	tandard erro	ors of four	sets of
measures pe	r season inclu	ding differen	et sea condit	ions.	

	mg $CaSO_4/h$								
Season and zone	Cabrera cave	Medes cave							
Iune									
1	$125.6 (\pm 38.6)$	$293.5(\pm 8.9)$							
2	$175.2(\pm 75.5)$	$101.0(\pm 17.1)$							
3	$90.2(\pm 31.4)$	$116.0(\pm 20.1)$							
4	$117.5(\pm 56.1)$	$160.3 (\pm 27.3)$							
November		· · · · ·							
1	$129.2 (\pm 46.3)$	$145.4 (\pm 49.5)$							
2	$184.9(\pm 75.1)$	$35.0(\pm 21.2)$							
3	$70.0(\pm 31.5)$	$40.3(\pm 27.0)$							
4	$151.3(\pm 45.5)$	$50.6(\pm 31.8)$							

Table 3. Particulate organic carbon and nitrogen $(\mu g/l)$ in the water in the four zones of the two caves and in the two seasons.

		Cabre	ra cave	Medes cave			
Season and zone		Carbon	Nitrogen	Carbon	Nitrogen		
Iune							
0	1	834	76	1175	67		
	2	818	88	1206	151		
	3	1226	87	1614	104		
	4	1251	81	1313	113		
November							
	1	896	93	2102	210		
	2	870	89	2250	256		
	3	1282	101	2495	317		
	4	1336	99	2284	286		

(Table 2). Zones 1 and 4 were always within the range of values of Zones 2 and 3. However, while water movement in Zone 1 was comparable in both seasons, water motion in Zone 4 was higher ($\sim 30\%$) in November than in June.

In the Medes cave, comparison between seasons was precluded due to very different sea conditions (much rougher in June). The zone outside the cave (Zone 1) always had the highest water motion, followed by the innermost zone. Zones 3 and 2 had similar water motion, in both cases lower than Zones 1 and 4.

The temperature values registered indicated that there were no differences between zones or seasons within each cave. The average temperature was 19°C in the Cabrera cave and 17°C in the Medes cave.

Particulate organic matter (POM)

The results shown in Table 3 for POM content are merely illustrative, since water samples were taken only once per season. The values, however, are useful for assessing within-cave trends.

In the Cabrera cave, the organic matter concentration was similar in both seasons for all zones. Nitrogen concentration, as expected, was lower in absolute values than carbon concentration. Carbon concentration was higher in the two innermost zones of the cave than in the two external ones.

In the Medes cave, a gradient of POM along the cave was evident. Zone 3 had the highest concentration of carbon, followed by Zone 4, Zone 2 and finally Zone 1. Nitrogen concentration was also lower outside the cave (Zone 1), while inside the cave Zone 2 showed the highest value. Concentrations were higher in November than in June.

Community structure Coverage

The coverage of all species from the two caves is listed in Table 4 (see Appendix for list of species and authorities).

In the Cabrera cave there were no outstanding differences in species coverage between seasons in any zone (Figure 2). Zone l was clearly dominated by seaweeds and the substratum was totally covered. In Zone 2, although seaweeds were still the dominant group and the substratum was also totally covered, other taxonomic groups (sponges, cnidarians and bryozoans) represented 12–18% of the total coverage. Zones 3 and 4 lacked seaweeds and were dominated by filter- and suspension-feeders. In both zones a large amount of bare rock was present, being more abundant in Zone 4.

The differences between Zones 3 and 4 were mainly due to the faunal composition. While in Zone 3, bryozoans, cnidarians and sponges were abundant, the last group was the most important in terms of coverage. In Zone 4 sponges clearly dominated and cnidarians and bryozoans were poorly represented.

In the Medes cave (Figure 2) there were large differences in taxon abundance with respect to the Cabrera cave. Only the external zone (1) was dominated by seaweeds. The remaining zones inside the cave were dominated by animals. The traits common to the internal Zones (2, 3, and 4) were the dominance of sponges and the high proportion of bare rock (up to 73% in June in Zone 4), although their respective percentages varied among zones.

When comparing the caves, differences became evident. First, Zones 1 and 2 in the Cabrera cave were dominated by seaweeds while only Zone 1 was in the Medes cave.

Zones 2, 3, and 4 of the Cabrera cave were roughly equivalent in composition to Zones 1, 2, and 3 of the Medes cave, respectively. Finally, the equivalent of Zone 4 from the Medes cave was not present in the Cabrera cave. The low animal cover of Zone 4 in the Medes cave was an indicator of its extreme confinement.

Number of species

In the Cabrera cave (Figure 3) the differences in the number of species between the two external zones (1 and 2) and the similarity in this parameter in the two internal zones (3 and 4) are noteworthy. This pattern was not observed for the percentage cover (Figure 2). A log-linear model comparing the number of species per taxon in each zone detected significant (P < 0.001) differences in species composition between zones. In Zone 1 the number of seaweed species was higher in both seasons than that of the remaining taxonomic groups. Moreover, in November there were ten more seaweed species than in June. In Zone 2 seaweeds were also the dominant group in number of species but the sum of animal species was higher than in Zone 1. In November the number of seaweed species decreased with respect to June. Zones 3 and 4 were similar with the dominant groups, ranked from the richest to the poorest, being: sponges, bryozoans, cnidarians and polychaetes. The number of sponge species in Zone 4 was the highest but no noticeable differences were found for other taxonomic groups.

In the Medes cave (Figure 3), the similarity of the three internal zones (2, 3 and 4), which clearly differ from the external zone (1), is evident. As in the Cabrera cave, a log-linear model comparing the number of species per taxon in each zone revealed a significant (P < 0.001) difference between zones. In Zone 1, the number of seaweed species equalled the sum of the species of the other taxonomic groups; in both seasons algae were the dominant group followed by sponges. In Zones 2, 3 and 4, sponges were the group with the highest number of species and Zone 2 had the highest value. Bryozoans, cnidarians and

Table 4.	Species coverage	ge (%) fr	om 20 pictu	res taken d	at random	per zone	e in the	Cabrera	cave a	nd in the	Medes	cave in	June and
November.													

Species		Ju	ne			Nove	ember	
Cabrera cave	Zone 1	Zone 2	Zone 3	Zone 4	Zone 1	Zone 2	Zone 3	Zone 4
Chlorophyta								
Acetabularia acetabulum	0.01							
Acetabularia parvula					0.01			
Anadyomene stellata	0.15				0.35			
Cladophora pellucida		0.09						
Cladophora sp.					0.15	0.08		
Codium bursa	0.04				0.25			
Flabellia petiolata	0.09	5.39			0.54	8.34		
Halimeda tuna	0.03	0.02			0.05			
Palmophyllum crassum		6.16				5.78		
Pseudochlorodesmis furcellata	0.12	1.09			0.01			
Valonia utricularis		0.06			0.01	0.03		
Phaeophyta								
Aglaozonia sp.		0.02						
Cystoseira balearica	10.63				2.06			
Cystoseira compressa	0.65				0.01			
Dictyopteris polypodioides	2.73				2.94	0.002		
Dictyota dichotoma	0.20	0.03			0.14			
Dictyota dichotoma var. intricata	23.81				2.51			
Halopteris filicina		3.74				1.03		
Halopteris scoparia	15.38				1.30			
Lobophora variegata	0.18	0.38			5.48	3.34		
Padina pavonica	22.89				6.47			
Sphacelaria cirrosa					0.45			
Taonia atomaria	0.93	0.05						
Unid. filamentous brown algae		0.12						
Rhodophyta								
Amphiroa cryptarthrodia		0.06			0.14	0.10		
Amphiroa rigida	0.91				2.88			
Boergeseniella fruticulosa	0.10				0.11			
Botryocladia boergesenii		0.004				0.01		
Botryocladia botryoides		0.004			0.09			
Contarinia squamariae		0.12				0.07		
Corallina elongata	0.40				0.43	0.003		
Cryptonemia lomation					0.004			
Delesseriaceae unid.		0.12				0.53		
Falkenbergia sp.	0.61	0.09			0.22			
Gloiocladia furcata		0.10			0.004	0.31		
Haliptilon virgatum	9.19	0.25			36.95	0.46		
Hydrolithon farinosum		1.83	0.004			3.77	0.004	
Laurencia gr. obtusa					0.002			
Lithophyllum cabiochae		0.27						
Melobesiae unid.			0.64			0.24	0.89	
Mesophyllum alternans	0.49	7.95			2.11	3.08		
Neogoniolithon brassica-florida	7.44				28.59			
Peyssonnelia rosa-marina		32.31				44.90		
Peyssonnelia squamaria	0.30	13.38			0.30	9.47		
Plocamium cartilagineum		0.19				0.02		
Polystrata fosliei					1.80	0.05		
Rhodymenia ardissonei						0.004		
Tricleocarpa sp.		0.001			0.08	0.01		
Unid. filamentous red algae		2.37						
Wurdermannia miniata					1.86			
Granuloreticulosa								
Miniacina miniacea		0.04	0.08	0.47			0.12	0.12
Porifera								
Acanthella acuta		0.20	0.06			0.15	0.10	
* Agelas oroides			1.29	1.61			0.98	1.61
* Axinella damicornis		0.60	1.49	1.39		0.48	2.63	1.39
Cacospongia mollior		0.08						
Chondrosia reniformis		0.03	1.92	0.001			1.51	0.004
								(Continued)

Table 4. (Continued).

Catarra cave Zone 1 Zone 2 Zone 3 Zone 4 Zone 4 <thzon 4<="" th=""> <thzon 4<="" th=""> Zone4</thzon></thzon>	Species		Ju	ne		November			
Clabrina clashras 0.01 0.003 0.004 Clinan exp. 0.03 0.01 0.03 Clinan sp. 0.01 0.18 0.02 1.05 Clinan sp. 0.04 1.13 0.01 0.03 0.18 0.01 * Demixed lesp. 0.14 1.37 5.59 0.01 3.59 * Dipisardi sp. 0.44 6.66 0.27 6.666 * Dipisardi sp. 0.14 3.84 1.24 0.20 0.91 2.38 * Dipisardi scatteria 0.14 3.84 1.24 0.20 0.91 2.38 * Dipisardi scatteria 0.03 0.41 0.04 0.06 1.07 * Dipisardi scatteria 0.03 0.41 0.08 1.01 0.18 1.01 * Hynodecanics sp. 0.14 1.75 0.33 1.75 1.75 1.75 * Hynodecanics sp. 4 0.42 0.45 0.44 0.33 1.30 * Christia factoria factoria factoria factoria factoria factoria factoria factoria f	Cabrera cave	Zone 1	Zone 2	Zone 3	Zone 4	Zone 1	Zone 2	Zone 3	Zone 4
Gladiniasp. 0.01 0.03 Cliona sp. 0.01 0.18 * Combic cranhe 0.46 1.13 0.01 1.05 * Darakinel Sp. 0.01 1.05 0.03 0.18 0.01 * Darakinel Sp. 0.01 1.05 0.03 0.18 0.01 0.01 * Darakinel Sp. 0.04 6.66 0.27 6.56 0.57 0.53 0.71 5.39 * Diplastrich bistlata 0.44 3.84 1.24 0.20 0.91 2.78 * Diplastrich bistlata 0.14 3.84 1.24 0.20 0.92 2.85 * Diplastrich bistlata 0.13 0.13 0.28 0.32 0.77 0.63 Hypode partic sp. 0.14 3.84 1.24 0.20 0.92 2.83 Hypode partic sp. 0.14 1.75 0.75 0.53 0.75 0.53 Hypode partic sp. 0.14 1.75 0.75 0.75 0.75 0.75 0.75	Clathrina clathrus		0.01		0.003		0.004		
Clina sp. 0.01 0.18 US Clina sp. 0.01 0.11 0.01 0.01 0.01 * Came crambe 0.16 1.3 0.01 0.01 0.01 * Dardnace lairs 0.16 0.13 0.01 0.01 0.01 * Dardnace lairs 0.40 6.66 0.75 5.59 * Disignalita sp. 2.49 0.63 0.07 0.63 * Disignalita sp. 0.14 3.84 1.24 0.28 0.23 Feysher samma 0.14 0.17 0.43 0.00 0.18 0.01 * Upmidensins sp. 1 0.089 1.01 0.18 1.01 0.18 * Upmidensins sp. 1 0.682 0.33 0.64 0.06 0.001 * Upmidensins sp. 1 0.14 1.75 1.75 1.75 * Upmidensins sp. 1 0.62 0.30 0.26 0.001 Microsons of ascendars 0.001 0.01 0.021 0.021 * Upmidensing sp. 1	<i>Clathrina</i> sp.				0.01				
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Chone viridis 0.01	Cliona sp.	0.01	0.18						
* Consider cambe 0.46 1.13 0.01 1.03 0.03 0.18 0.02 1.03 * Darwind sap. 0.01 0.01 0.01 0.01 0.01 * Diplarend histelta 0.40 6.66 0.27 5.59 * Diplarend histelta 0.40 6.66 0.27 6.66 * Diplarend histelta 0.40 6.66 0.27 0.63 Keypen sp. 0.14 3.44 1.24 0.20 0.01 2.78 Hymed constants 0.11 0.13 0.14 0.43 0.20 0.10 0.18 *Hymed constants 0.01 0.14 1.75 1.75 1.75 Hymed constants 0.01 0.14 1.75 1.052 10.62 Teriais area 0.42 0.53 0.04 4.88 1.30 Hymed constant 0.001 0.01 0.001 0.001 Microsion is avaiobilis 1.26 0.45 0.46 0.22 0.21 Hymed constants	Cliona viridis	0.01							
* Dardwald sp. 0.01 0.01 0.01 * Dedraval his 1.37 5.59 0.71 6.66 * Didysall sp. 2.19 0.63 0.07 0.63 * Dylide atom 0.09 0.63 0.07 0.63 * Dylide atom 0.14 3.84 1.24 0.28 0.22 Enrylow ap. 0.17 0.43 0.00 0.18 0.01 0.18 * Handeld proofit 0.03 0.64 0.06 1.07 Hight sp. 1.65 1.75 * Hymodemia sp. 1 0.89 1.01 0.18 1.01 1.75 * Hymodemia sp. 4 1.26 0.45 0.04 4.88 1.30 * Enviso atriabilis 0.01 0.01 0.001 0.001 0.001 * Microsions 4.1 0.27 0.66 0.66 0.66 0.66 0.66 0.66 0.66 0.66 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0	* Crambe crambe	0.46	1.13	0.01	1.05	0.03	0.18	0.02	1.05
* Defativity 1.57 5.39 0.11 5.39 * Dipitarity 0.40 6.66 0.27 6.66 * Dipitarity 0.09 0.63 0.07 0.63 * Dipitarity 0.14 3.84 1.24 0.20 0.91 2.78 Earypen sp. 0.17 0.43 0.064 0.06 1.07 Hepschafts pronti 0.01 0.18 1.01 0.18 1.01 Hyperschafts 0.01 0.18 1.01 1.75 1.73 *Hymediamia sp. 1 0.14 1.75 1.052 1.052 Ircsin ares 0.82 0.33 1.01 1.03 Hyperschaft protocol and sold is 0.001 0.01 0.001 0.001 Microcionic sold is 0.001 0.01 0.021 0.021 *Microcionic sold is conders 0.01 0.04 0.30 0.26 Orarell to thereadus 0.01 0.04 0.04 0.04 Protoco sofitis sold is conders 0.01	* Darwinella sp.				0.01				0.01
* 0.40 6.66 0.27 6.66 * Diciponita suca 0.49 0.63 0.07 0.63 * Diciponita suca 0.09 0.63 0.07 0.63 Erryins caractram 0.14 3.84 1.24 0.20 0.31 2.78 Euryon sp. 0.13 0.41 0.43 0.64 0.06 1.07 Headedin presonia 0.01 0.01 0.01 0.18 1.01 *Hymodesmia sp. 1 0.89 1.01 0.18 1.01 *Hymodesmia sp. 4 1.25 1.75 1.75 Ircinia arcsicilata 0.14 1.75 0.62 Ircinia arcsicilata 0.02 0.33 Ircinia arcsicilata 0.01 0.001 Microciona Ci accredary 0.01 0.46 0.46 0.46 Microciona Ci accredary 0.01 0.46 0.46 0.46 Microciona Ci accredary 0.01 0.22 0.21 1.72 * Persons fighermis 0.07 0.07 0.22	* Dendroxea lenis			1.37	5.59			0.71	5.59
* Drivid asya 0.249 0.83 0.75 0.85 * Dyrid aswa 0.09 0.63 0.07 0.53 Erybes trastrum 0.14 3.84 1.24 0.20 0.91 2.78 Eurypes sp. 0.17 0.43 0.28 0.32 0.32 0.32 Hexeddal prozofi 0.03 0.64 0.06 1.01 1.18 1.01 0.18 1.01 1.18 1.01 1.18 1.01 1.18 1.01 1.18 1.01 1.18 1.01 1.18 1.01 1.18 1.01 1.18 1.01 1.18 1.01 1.16 1.15 1.15 1.15 1.15 1.15 1.15 1.15 1.15 1.15 1.15 1.15 1.15 1.15 1.15 1.15 1.15 1.15 1.15 1.15 1.16 1.16 1.16 1.16 1.16 1.16 1.16 1.16 1.16 1.16 1.16 1.16 1.16 1.16 1.16 1.16 <td>* Diplastrella bistellata</td> <td></td> <td></td> <td>0.40</td> <td>6.66</td> <td></td> <td></td> <td>0.27</td> <td>6.66</td>	* Diplastrella bistellata			0.40	6.66			0.27	6.66
* Instance 0.09 0.63 0.07 0.03 Expluse assum 0.14 3.84 1.24 0.20 0.91 2.78 Eurypon sp. 0.17 0.43 0.64 0.06 1.07 Headela preorii 0.03 0.64 0.06 1.07 Hypodenins sp. 0.14 1.75 1.73 Hymodennia sp. 2 0.14 1.75 1.02 Terinia fascitata 0.89 1.00 0.84 1.30 Terinia fascitata 0.82 0.33 1.022 1.022 Terinia fascitata 0.82 0.33 1.02 0.01 Microsiona C, accredras 0.01 0.01 0.01 0.01 *Microsiona Sp. 0.46 0.46 0.46 0.46 Myceisopagia araesea 0.14 0.40 0.09 2.21 *Microsiona Sp. 0.06 2.34 1.43 2.21 3.22 Photas fighrais 0.07 0.22 0.09 0.04 Photas fi	* Dictyonella sp.			2.49	0.85		-	0.75	0.85
Leytes exastram 0.14 3.84 1.24 0.20 0.91 2.78 Everyon sp. 0.17 0.43 0.628 0.32 Hexaddala provoti 0.03 0.64 0.06 1.07 Hippospongic communis 0.01 0.18 1.01 0.18 *Hynodesmia sp. 1 0.89 1.01 0.18 1.05 Hixadismia sp. 4 1.75 1.75 1.062 Ircinia variabilis 0.22 0.33 1.062 1.062 Ircinia variabilis 0.26 0.45 0.04 4.88 1.30 Microsina variabilis 0.001 0.001 0.001 0.001 .0.001 Microsing variabilis 0.07 0.27 0.29 0.21 Processing variabilis 0.07 0.07 0.22 0.09 Pharbas transor 0.06 2.34 1.43 2.21 Processing variabilis 0.02 0.02 0.02 0.02 Processing variabilis 0.01 0.21 0.22	* Dysidea avara		0.09	2.04	0.63		0.07	0.01	0.63
baryon sp. 0.17 0.43 0.23 0.32 Hexadela pravati 0.01 0.64 0.06 1.07 Hippospongia communis 0.01 0.18 1.01 *Hymodesmia sp. 2 0.14 1.75 1.75 Ircinia fasciculata 0.62 0.63 1.662 Ircinia arsiculata 0.01 0.01 0.01 0.01 Microsciona ci. accendens 0.01 0.01 0.001 0.001 Microsciona ci. accendens 0.01 0.001 0.001 0.001 Microsciona ci. accendens 0.046 0.46 0.46 Occarelta thebrenata 0.87 0.04 0.04 Occarelta thebrenata 0.07 0.22 0.09 Phorbas ficformis 0.06 2.34 1.43 2.21 3.22 Piora satifica 0.001 0.46 0.01 0.25 3.22 Piora satifica 0.001 0.48 0.21 0.26 3.12 6.44 Sprainting figari 0.22	Erylus euastrum		0.14	3.84	1.24		0.20	0.91	2.78
Hexadia provin 0.03 0.04 0.06 1.07 Hippospengia communis 0.01 0.18 1.01 0.18 */Lynnedsmia sp. 1 0.89 1.01 0.18 1.01 */Lynnedsmia sp. 2 0.14 1.75 1.75 */Lynnedsmia sp. 4 10.62 10.62 10.62 Irrinia variabilis 0.81 0.01 0.001 Microciana striabilis 0.001 0.01 0.001 Microciana sp. 0.46 0.46 0.46 Mylicrociana sp. 0.44 0.40 0.30 0.221 Phorbas ficitius 0.07 0.22 0.09 Phorbas ficitius 0.07 0.22 0.09 Phorbas ficitius 0.01 0.02 0.02 Phorbas ficitius 0.01 0.22 0.09 Phorbas ficitius 0.02 0.02 0.02 Phorbas ficitius 0.02 0.02 0.02 Phorbas ficitius 0.01 0.22 0.09 Phorbas ficitius 0.02 0.002 0.02 Resize ficita 0.32 1.47 0.34 0.20 Resize ficita 0.19 0.03 0.01 Resize ficita ubcratizi x 4.6	Eurypon sp.			0.17	0.43			0.28	0.32
Philpsiling communits 0.01 0.01 0.18 * Hymedsmin sp. 1 0.14 1.75 1.75 * Hymedsmin sp. 2 0.14 1.75 1.75 Irrinia aros 0.82 0.33 1.61 Irrinia aros 0.82 0.53 0.62 Irrinia aros 0.82 0.53 0.64 0.60 Microciona sp. 0.46 0.46 0.62 Oscardla taberalata 0.87 0.11 0.92 0.09 Pharbas fictilius 0.07 0.22 0.09 0.94 Pharbas fictilius 0.07 0.22 0.09 0.94 Pharbas fictilius 0.07 0.22 0.09 0.94 0.85 0.46 Piarous fictilius 0.07 0.7 0.22 0.09 9 Pharbas fictilius 0.06 2.34 1.43 2.21 3.22 Raice a mucosa 0.19 0.03 0.01 0.23 0.25 Raice a mucosa 0.19 0.03	Hexadella pruvotn			0.03	0.64			0.06	1.07
"Hymetessine sp. 1 0.89 1.01 0.18 1.01 "Hymetessine sp. 2 0.14 1.75 1.75 "Hymetessine sp. 4 10.62 0.21 Irrinia ariabilis 0.82 0.53 Irrinia ariabilis 0.001 0.01 8.83 Irrinia ariabilis 0.01 0.01 0.001 Microciona cf. ascenders 0.01 0.46 0.46 0.001 Microciona sp. 0.46 0.46 0.46 0.46 0.04 Patriasi fiftins 0.07 0.22 0.09 0.46 Pharbas transcar 0.01 0.11 0.92 0.21 Pharbas transcar 0.07 0.22 0.09 0.46 Pharbas transcar 0.07 0.22 0.09 0.25 Pharbas transcar 0.001 0.20 2.30 0.25 Restarias acculata 0.48 0.21 0.85 0.44 Restarias acculata 0.40 0.01 0.20 0.01 Spriastrella spl	Hippospongia communis			0.01	1.01			0.01	0.18
"Primeters is p. 2 0.14 1.73 1.73 "Hymedismis sp. 4 10.62 0.10 0.62 Ircinia rors 0.82 0.53 10.62 Ircinia rors ariabilis 1.26 0.45 0.04 4.88 1.30 Leucosolenia variabilis 0.001 0.01 0.001 0.01 0.001 Microciona sp. 0.46 0.46 0.46 0.46 0.46 0.46 0.46 0.40 0.02 0.02 0.02 0.02 0.02 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.02 0.001 0.05 0.32 1.47 0.34 0.20 0.23 0.25 Raspacinon aculata 0.02 0.001 0.01 0.02 0.01 0.14 0.48 0.21 0.85 0.46 0.11 0.20 0.01 0.35 0.34 0.13 0.14 0.12 0.13 0.14 0.12 0.14 0.12 0.11 <td< td=""><td>*Hymedesmia sp. 1</td><td>0.14</td><td></td><td>0.89</td><td>1.01</td><td></td><td></td><td>0.18</td><td>1.01</td></td<>	*Hymedesmia sp. 1	0.14		0.89	1.01			0.18	1.01
"Lymacssnic sp. 4 10.02 0.11 Ircinia avasi Ircinia varsibilis 0.82 0.33 Ircinia varsibilis 0.001 0.01 Microciona cl. ascendens 0.01 0.001 Microciona sp. 0.46 0.48 Occarella bivervaluta 0.87 0.46 0.46 Microciona sp. 0.46 0.46 0.46 Occarella bivervaluta 0.87 0.11 0.92 0.21 * Microciona sp. 0.07 0.22 0.09 0.46 0.46 Orcarella bivervaluta 0.87 0.04 0.04 0.04 0.04 Phorbas fielifismis 0.07 0.22 0.09 Phorbas fielifismis 0.02 0.02 0.25 Raspaciona acultata 0.48 0.21 0.85 0.46 Renicra mucosa 0.19 0.03 0.01 * forpia singla arutosa 0.19 0.03 0.01 * forpia singla arutosa 0.19 0.03 0.32 0.44 Spongia virgulosa <	*Hymedesmia sp. 2	0.14			1.75				1.75
Irrinia priscitata 0.21 Irrinia variabilis 0.82 0.53 Irrinia variabilis 0.001 0.01 0.001 Leucasolenia variabilis 0.01 0.01 0.001 *Microciona cf. ascenders 0.01 0.46 0.46 0.46 Myceliospognia ranesa 0.14 0.40 0.30 0.26 Oxarrella tuberculata 0.87 0.11 0.92 0.21 * Pertosia ficiformis 0.07 0.02 0.09 0.04 Phorbas infifa 0.007 0.22 0.09 0.04 0.001 0.02 0.001 0.02 0.01 0.02 0.01 0.01 0.02 0.01 0.01	*Hymedesmia sp. 4				10.62			0.01	10.62
Irrina aras 0.82 0.33 Irrina arashifis 1.26 0.45 0.04 4.88 1.30 Iacasalenia variabilis 0.01 0.01 0.01 0.01 Microciona cf. ascendens 0.01 0.04 0.92 0.26 Systems 0.04 0.40 0.30 0.26 Oxarrella tuberculata 0.87 0.11 0.92 0.21 * Petrosia ficiformis 0.06 2.44 0.43 2.21 3.22 Pharbas factitus 0.07 0.02 0.09 Pharbas factitus 0.23 0.23 0.25 Raspaciona acidenta 0.82 1.47 0.34 0.20 2.30 0.25 Raspaciona acidenta 0.20 0.002 0.01 0.46 0.21 0.85 0.46 Remiera mucosa 0.19 0.03 0.01 0.44 0.20 2.30 0.25 Raspaciona acidenta 0.20 0.02 0.01 0.44 3.12 6.44 Sporigi virgulasa 0.16 0.01 0.22 0.01 0.35 0.34	Ircinia fasciculata			0.00				0.21	
Irrent variabilis 1.20 0.43 0.04 4.88 1.30 Microciona C. ascendeus 0.01 0.01 0.01 *Microciona Sp. 0.46 0.46 Myceliospongia araneosa 0.14 0.40 0.30 0.26 Oscarella tuberculata 0.87 0.11 0.92 0.21 * Petrosia ficiformis 0.06 2.34 1.43 2.21 3.22 Piorbas ficitius 0.07 0.07 0.22 0.09 Phorbas tenacior 0.06 2.34 1.43 2.21 3.22 Pione vasifica 0.01 0.02 0.32 1.47 0.34 0.20 2.30 0.25 Raspaciona acuteata 0.19 0.02 0.002 0.01 0.85 0.46 Reniera muosa 0.19 0.03 0.01 0.01 0.03 0.31 Spirastella cunctatrix 4.62 6.44 3.12 6.44 Spirastella cunctatrix 0.60 0.24 0.10 0.35 0.34 Chidaria 0.11 0.20 0.01 0.35	Ircinia oros			0.82	0.45		0.04	0.53	1.00
Latessienda variabils 0.001 0.01 0.01 *Microciona sp. 0.04 0.46 Myceliospongia araneosa 0.14 0.40 0.30 0.26 Oscarella tuberculata 0.87 0.11 0.92 0.21 * Petrosia ficiformis 0.07 0.22 0.09 Phorbas ficifiums 0.04 0.04 Phorbas ficifiums 0.06 2.34 1.43 2.21 3.22 Piore vastifica 0.001 0.25 2.30 0.25 Respaciona aculeata 0.48 0.21 0.85 0.46 Reniera nucosa 0.19 0.03 0.01 0.01 * Spirastrella cunctatrix 4.62 6.44 3.12 6.44 Spongia virgulosa 0.16 0.01 0.02 0.01 0.03 Terpios figuax 0.01 0.24 0.10 0.35 0.34 Chidaria 0.20 0.003 0.17 0.26 0.01 Carapolybilia curopaca 0.11 0.26 0.	Ircinia variabilis			1.20	0.45		0.04	4.88	1.30
Microiona sp. 0.01 * Microiona sp. 0.46 0.46 Mycelisspongia armeosa 0.14 0.40 0.30 0.26 Osarella tuberculata 0.87 0.11 0.92 0.21 * Petrosia ficiformis 0.07 0.07 0.22 0.09 Phorbas ficitius 0.07 0.07 0.22 0.09 Phorbas tenacior 0.06 2.34 1.43 2.21 3.22 Pione vasifica 0.01 0.48 0.20 2.30 0.25 Raspaciona acuteata 0.48 0.21 0.85 0.46 Reniera fulva 0.02 0.002	Leucosolenia variabilis			0.001	0.01				0.001
* Arrectional sp. 0.49 0.40 0.30 0.26 Mycelisopagia aranesa 0.14 0.40 0.30 0.226 Oscarella tuberculata 0.87 0.11 0.92 0.21 * Petrosia ficiformis 0.06 2.34 1.43 2.21 3.22 Piorbas fencior 0.06 2.34 1.43 2.21 3.22 Piore vastifica 0.001 0.02 0.002 0.85 0.46 Reniera fulva 0.48 0.21 0.85 0.46 Reniera mucosa 0.19 0.03 0.01 0.02 0.002 * Spirastrella cunctatrix 4.62 6.44 3.12 6.44 Sporgia arguinguasa 0.11 0.02 0.01 0.03 0.01 Terpios fugax 0.01 0.04 0.01 0.02 0.01 0.03 Cardaphylitia europaea 0.11 0.20 0.01 0.03 0.14 Cardaphylitia europaea 0.11 0.22 0.02 0.01 Cardaphylitia europaea 0.01 0.25 0.047 0.01	Microciona cf. ascendens			0.01	0.40				0.40
Myceticsponga armedsa 0.14 0.40 0.30 0.20 Oscarella tuberculata 0.87 0.11 0.92 0.21 * Petrosia ficiformis 0.07 0.07 0.22 0.09 Phorbas ficitius 0.06 2.34 1.43 2.21 3.22 Pione sensifica 0.001 0.20 2.30 0.25 Respaciona caluata 0.48 0.21 0.085 0.46 Reniera fulva 0.19 0.002 0.002 0.01 * Spinstella cunclatrix 4.62 6.44 3.12 6.44 Spongia virgultosa 0.16 0.01 0.02 0.01 0.03 Topisetin garciae 0.20 0.003 0.11 0.20 0.01 0.35 0.34 Cnidaria 0.20 0.003 0.17 0.01 0.025 0.01 0.43 Granularia consucojae 0.11 0.20 0.01 0.25 0.00 0.01 0.01 0.17 0.01 0.02 0.01 0.17 0.01 0.01 0.17 0.01 0.01 0.17	* Microciona sp.			0.14	0.46			0.20	0.46
Observice inducer contracts 0.67 0.11 0.92 0.21 * Petrosia fréformis 0.06 2.34 1.43 2.21 3.22 Pione sastifica 0.001 0.04 0.04 0.04 Pleraphysilla spinifera 0.001 0.32 1.47 0.34 0.20 2.30 0.25 Reniera fulva 0.48 0.21 0.03 0.01 Reniera fulva 0.19 0.03 0.01 * Spinsitella cunctatrix 4.62 6.44 3.12 6.44 Spinsitella cunctatrix 4.62 6.44 3.12 6.44 Spinsitella cunctatrix 4.62 6.44 3.12 6.44 Spinsitella cunctatrix 4.62 0.01 0.03 0.01 * Teriosi figax 0.01 0.04 0.01 0.02 0.01 0.35 0.34 Chidaria 0.20 0.003 0.17 0.25 0.16 0.12 0.43 0.21 0.06 Carularia cornucopiae 0.11 0.20 0.01 0.25 0.17 0.11 0.25 0.17	Myceiiospongia araneosa			0.14	0.40			0.30	0.20
* Perosta fielformis 0.07 0.04 0.04 0.04 Phorbas fielitius 0.07 0.07 0.22 0.09 - Phorbas tenacior 0.06 2.34 1.43 2.21 3.22 Pine astifica 0.001 - - - - - Pieraphysilla spinifera 0.001 - 0.85 0.46 Reniera mucosa 0.19 0.03 0.01 - - Reniera mucosa 0.19 0.03 0.01 - - Spirastrella cunctatrix 4.62 6.44 3.12 6.44 Sporgia virgulasa 0.01 0.04 0.01 0.02 0.01 Topsentia garciae 0.20 0.02 0.01 0.35 0.34 Chidaria 0.20 0.003 0.17 0.20 0.01 Caroularia consucopiae 0.11 0.20 0.01 0.25 0.01 Caruularia consucopiae 0.01 0.25 0.06 0.27 0	Scarella tuberculata			0.87	0.11			0.92	0.21
Phorbas letitus 0.07 0.07 0.02 0.09 Phorbas tenacior 0.06 2.34 1.43 2.21 3.22 Pione vastifica 0.001 0.32 1.47 0.34 0.20 2.30 0.25 Pione vastifica 0.01 0.32 1.47 0.34 0.20 2.30 0.25 Respication aculeata 0.02 0.002 0.002 0.03 0.01 Reniera nucosa 0.19 0.03 0.01 0.04 0.01 0.02 0.01 Spongia virgullosa 0.16 0.01 0.02 0.01 0.03 0.01 Spongia virgullosa 0.16 0.01 0.02 0.01 0.03 0.01 Spongia virgullosa 0.11 0.20 0.01 0.03 0.03 0.01 Caladophenia sp. 0.12 0.03 0.17 0.01 0.01 0.02 0.01 Aglaophenia sp. 0.12 0.03 0.17 0.01 0.25 0.01 0.02 0.01 Hydrozoan unid. 0.25 0.06 0.42	* Petrosia ficiformis		0.07	0.07	0.04	0.99		0.00	0.04
Primous tendation 0.00 2.34 1.43 2.21 3.22 Pione vasifica 0.001 0.32 1.47 0.34 0.20 2.30 0.25 Reprint a spinifera 0.32 1.47 0.34 0.20 2.30 0.25 Reniera futva 0.48 0.21 0.85 0.46 Reniera futva 0.02 0.002 0.01 0.85 0.46 Spirastrella cunctatrix 4.62 6.44 3.12 6.44 Spinga virgulosa 0.16 0.01 0.02 0.01 0.03 Terpios fugax 0.01 0.02 0.01 0.03 0.35 0.34 Chidaria 0.20 0.03 0.17 0.01 0.20 0.01 Aglaophenia sp. 0.12 0.03 0.17 0.01 0.25 Eudendrium sp. 0.47 0.01 0.27 0.06 0.27 Hydrozoan unid. 0.27 0.06 0.27 0.06 Leptopsammia privoti 1.78 0.06 0.42 0.00 Parazoanthus axinellae	Phorbas julillus Phorbas tempsion		0.07	0.07	1 4 2	0.22		0.09	2 99
Pieraphysilia spinifera 0.001 Pieraphysilia spinifera 0.32 1.47 0.34 0.20 2.30 0.25 Raspaciona aculeata 0.48 0.21 0.85 0.46 Reniera mucosa 0.19 0.03 0.01 * Spirastrella cunctatrix 4.62 6.44 3.12 6.44 Spongia virgultosa 0.16 0.01 0.02 0.01 0.03 Topsenia garciae 0.16 0.01 0.02 0.01 0.03 0.35 0.34 Cniclarria 0.20 0.003 0.17 0.35 0.34 Caryophylia inornata 0.20 0.003 0.17 0.01 0.25 0.01 Carwahylia durotrix 0.66 0.42 0.01 0.25 0.06 0.27 Hoplangia durotrix 0.06 0.42 0.01 0.17 0.06 0.17 0.06 0.17 0.06 0.17 0.06 0.24 0.06 0.24 0.06 0.24 0.06 0.24 0.06 0.24 0.06 0.24 0.06 0.27 0.06 0	Photoas lenacior Bismo mostifica	0.001	0.00	2.34	1.45			2.21	3.22
Preterptyskild spinitera 0.32 1.47 0.34 0.20 2.30 0.23 Raspaciona cauleata 0.44 0.21 0.85 0.46 Reniera fulva 0.02 0.002 0.002 0.01 * Spirastrella cunctatrix 4.62 6.44 3.12 6.44 Spongia virgultosa 0.16 0.01 0.02 0.01 0.03 Terpios fugax 0.01 0.04 0.01 0.02 0.01 0.03 Terpios fugax 0.01 0.04 0.01 0.02 0.01 0.03 Terpios fugax 0.12 0.04 0.01 0.02 0.01 0.03 Terpios fugax 0.12 0.24 0.10 0.35 0.34 Chidaria 0.20 0.003 0.17 0.01 0.25 Aglaophenia sp. 0.12 0.43 0.21 0.43 0.21 0.43 Cornularia corsucopiae 0.01 0.22 0.27 0.06 0.22 0.06 Leptosammia pruvoti 1.78 0.06 0.42 0.00 0.00 0	Pione vasujica Planet lucille etimi fane	0.001	0.20	1 47	0.24		0.90	0.20	0.95
Reviera futoa 0.40 0.21 0.33 0.40 Reviera futoa 0.02 0.002 0.01 Reviera futosa 0.19 0.03 0.01 * Spirastrella cunctatrix 4.62 6.44 3.12 6.44 Spongia virgultosa 0.16 0.01 0.02 0.03 0.01 Terpios fugax 0.01 0.04 0.01 0.02 0.01 0.03 Topsentia garciae 0.24 0.10 0.35 0.34 0.35 0.34 Chidaria 0.24 0.10 0.02 0.01 0.35 0.34 Caryophyllia europaea 0.11 0.20 0.01 0.25 0.01 0.25 Eudendrium sp. 0.47 0.01 0.27 0.06 0.27 0.06 Hoplangia durotrix 0.06 0.42 0.06 0.07 0.00 Paresythropodium coralolides 9.33 1.21 13.85 2.57 Polycyathus axinellae 9.33 1.21 13.85 2.57 Polycyathus axinellae 9.33 1.21 13.85	Pierapiysilla spinijera Bashasiona anyloata		0.32	1.47	0.34		0.20	2.30	0.25
Reniera jula 0.02 0.002 0.002 Reniera mucosa 0.19 0.03 0.01 * Spirastrella cunctatrix 4.62 6.44 3.12 6.44 Spongia virgultosa 0.16 0.01 0.02 0.01 0.03 Tepios fugax 0.01 0.04 0.01 0.02 0.01 0.03 Topsenia garciae 0.24 0.10 0.05 0.34 Aglaophenia sp. 0.12 0.03 0.01 0.02 0.01 Caryophyllia inornata 0.20 0.003 0.17 0.01 0.25 0.01 0.27 0.01 0.27 0.01 0.12 0.43 0.27 0.06 0.27 0.06 0.27 0.06 0.27 0.06 0.27 0.06 0.27 0.06 0.06 0.27 0.06 0.27 0.06 0.27 0.06 0.27 0.06 0.27 0.06 0.27 0.06 0.26 0.33 0.21 0.35 2.57 0.06 0.26 0.33 0.21 0.35 2.57 0.06 0.06 0.25 <t< td=""><td>Raspaciona acuteata Roming fulng</td><td></td><td></td><td>0.40</td><td>0.21</td><td></td><td></td><td>0.65</td><td>0.40</td></t<>	Raspaciona acuteata Roming fulng			0.40	0.21			0.65	0.40
* Spirastrella cunctatrix 0.19 0.03 0.01 0.01 $*$ Spirastrella cunctatrix 4.62 6.44 3.12 6.44 Spongia virgultosa 0.16 0.01 0.02 0.01 0.03 Terpios fugax 0.01 0.04 0.01 0.02 0.01 0.03 Terpios fugax 0.01 0.04 0.01 0.02 0.01 0.03 Chidaria 0.20 0.003 0.17 0.01 0.20 0.01 Aglaophenia sp. 0.12 0.43 0.25 0.01 0.25 Cornularia cornucopiae 0.01 0.27 0.06 0.42 0.06 Cornularia cornucopiae 0.06 0.42 0.06 0.66 0.66 0.66 Leptosammia pruvoti 1.78 0.06 0.61 0.17 0.06 Parezythropodium coralloides 0.06 0.42 0.00 0.00 Parazoanthus axinellae 9.33 1.21 13.85 2.57 Polycyattus muellerae	Rentera jutoa Pomiora mucosa		0.10	0.02	0.002				0.01
Spindiversation 1.12 0.14 0.11 0.14 0.11 0.11 0.11 0.11 0.02 0.01 0.03 Terpios fugax 0.01 0.04 0.01 0.02 0.01 0.03 Topsentia garciae 0.24 0.10 0.35 0.34 Chidaria 0.24 0.10 0.02 0.01 Aglaophenia sp. 0.12 0.08 0.17 Cavyophyllia europaea 0.11 0.20 0.01 Caryophyllia europaea 0.11 0.20 0.01 Carwalaria cornucopiae 0.01 0.25 Eudendrium sp. 0.17 Hydrozoan unid. 0.17 0.027 0.06 0.27 Hoplangia durotrix 0.06 0.42 0.00 0.01 Parezylthropodium coralloides 0.06 0.06 0.01 0.17 Massella edwardsi 0.06 0.26 0.03 0.61 0.10 0.17 Parezylthropodium coralloides 0.00 0.06 0.00 0.00 0.00 0.00 0.00 Protula sp. 0.40 0.	Kentera macosa * Shiractrella cunctatrix		0.19	4.69	6.44			2 1 9	6.44
Spingli linguidadi 0.10 0.01 0.01 0.02 0.01 0.03 Terpios fugax 0.01 0.04 0.01 0.02 0.01 0.03 Topsentia garciae 0.24 0.10 0.35 0.34 Cnidaria 2.24 0.10 0.08 0.35 0.34 Aglaophenia sp. 0.12 0.003 0.17 0.01 0.20 0.01 Caryophyllia inornata 0.20 0.003 0.17 0.17 0.12 0.03 Caryophyllia inornata 0.20 0.003 0.17 0.25 0.01 0.25 Eudendrium sp. 0.47 0.01 0.27 0.06 0.27 0.06 Hydrozoan unid. 0.27 0.06 0.42 0.06 0.17 0.06 Hoplangia durotrix 0.06 0.42 0.06 0.17 0.06 Parerythropodium coralloides 0.36 0.06 0.27 0.06 Parazoanthus axinellae 9.33 1.21 13.85 2.57 Polycytahus muellerae 9.55 0.10 0.43 0.14 0.73 Polychacta $Protula sp.$ 0.09 0.87 0.003 0.03 0.07 Salmacina dysteri 0.40 0.01 0.002 0.68 Serpulidae sp. 1 0.43 0.24 0.21 0.08 Serpulidae sp. 3 0.05 1.09 0.73	Spirasireita tantiairix			4.02	0.44	0.01		5.12	0.44
Topion Jugax 0.01 0.04 0.01 0.02 0.01 0.03 Topsentia garciae 0.24 0.10 0.35 0.34 Cnidaria 0.24 0.10 0.35 0.34 Aglaophenia sp. 0.12 0.08 0.01 0.35 0.34 Balanophyllia europaea 0.11 0.20 0.01 0.01 0.01 Caryophyllia inornata 0.20 0.003 0.17 0.01 0.25 0.01 0.25 0.06 0.27 0.06 0.27 0.06 0.27 0.06 0.02 0.00 0.07 0.06 0.02 0.00 0.01 0.17 0.06 0.02 0.06 0.01 0.17 0.01 0.17 0.01 0.17 0.01 0.02 0.06 0.25 0.01 0.02 0.06 0.02 0.06 0.02 0.06 0.02 0.06 0.02 0.06 0.02 0.06 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.01 0.02 <td>Terbios fugar</td> <td></td> <td>0.01</td> <td>0.10</td> <td>0.01</td> <td>0.01</td> <td>0.02</td> <td>0.01</td> <td>0.03</td>	Terbios fugar		0.01	0.10	0.01	0.01	0.02	0.01	0.03
Cnidaria 0.12 0.10 0.33 0.31 Aglaophenia sp. 0.12 0.08 0.01 Balanophyllia europaea 0.11 0.20 0.01 Caryophyllia inornata 0.20 0.003 0.17 Clavularia crassa 0.36 0.12 0.43 Cornularia cornucopiae 0.01 0.25 0.01 Eudendrium sp. 0.47 0.01 0.27 Hoplangia durotrix 0.06 0.42 0.06 Leptopsammia pruvoti 1.78 0.06 0.24 0.06 Parezythropodium coralloides 0.06 0.42 0.06 0.01 Parazoanthus axinellae 9.33 1.21 13.85 2.57 Polychateta 3.55 0.10 0.43 3.14 0.73 1.11 Polychaeta 0.09 0.87 0.003 0.07 57 Polychaeta 0.09 0.87 0.003 0.07 58 Serpulidae sp. 1 0.40 0.01 0.02 0.68 58 Serpulidae sp. 2 0.43 0.24 0.21 </td <td>Topsentia garciae</td> <td></td> <td>0.01</td> <td>0.04</td> <td>0.01</td> <td></td> <td>0.02</td> <td>0.01</td> <td>0.05</td>	Topsentia garciae		0.01	0.04	0.01		0.02	0.01	0.05
Aglaophenia sp. 0.12 0.08 Balanophyllia europaea 0.11 0.20 0.01 Caryophyllia inornata 0.20 0.03 0.17 Clavularia crassa 0.36 0.12 0.43 Cornularia cornucopiae 0.01 0.25 0.01 Eudendrium sp. 0.47 0.01 0.27 Hydrozoan unid. 0.27 0.06 0.42 0.06 Hydrozoan unid. 0.27 0.06 0.42 0.06 Parenythropodium coralloides 0.06 0.42 0.06 Parenythropodium coralloides 0.06 0.26 0.03 0.61 0.01 Polychaeta 9.33 1.21 13.85 2.57 Polychaeta 0.09 0.87 0.003 0.03 0.07 Serpulidae sp. 0.40 0.01 0.02 0.02 0.02 Serpulidae sp. 0.43 0.24 0.21 0.08 0.68 0.01 0.21 0.08 0.73	Cnidaria			0.21	0.10			0.55	0.51
Ingrespinal sp. 0.11 0.00 0.01 Balanophyllia inornata 0.20 0.003 0.17 Caryophyllia inornata 0.20 0.003 0.17 Clavularia crassa 0.36 0.12 0.43 Cornularia cornucopiae 0.01 0.25 Eudendrium sp. 0.47 0.01 Hydrozoan unid. 0.27 Hoplangia durotrix 0.06 0.42 0.06 Leptopsammia pruvoti 1.78 0.06 0.26 0.03 0.61 0.01 Masella edwardsi 0.06 0.42 0.006 0.006 0.006 Parezythropodium coralloides 0.03 0.61 0.01 0.17 Polycyathus muellerae 3.55 0.10 0.43 3.14 0.73 1.11 Polychaeta 0.09 0.87 0.003 0.03 0.07 0.68 Serpulidae sp. 1 0.43 0.24 0.21 0.08 Serpulidae sp. 3 0.05 0.05 0.05 0.73	Aglaophenia sp	0.12				0.08			
Caryophyllia inornata 0.20 0.003 0.17 Caryophyllia inornata 0.36 0.12 0.43 Cornularia cornucopiae 0.01 0.25 Eudendrium sp. 0.47 0.01 Hydrozoan unid. 0.27 0.06 Hoplangia durotrix 0.06 0.42 0.06 Leptopsammia pruvoti 1.78 0.06 0.26 0.03 0.61 0.01 0.17 Maasella edivardsi 0.06 0.26 0.03 0.61 0.01 0.17 Parerythropodium coralloides 9.33 1.21 13.85 2.57 Polycyathus muellerae 3.55 0.10 0.43 3.14 0.73 1.11 Polychaeta 9.33 0.21 0.03 0.07 0.02 0.68 Serpulidae sp. 1 0.40 0.01 0.02 0.68 0.61 0.21 0.08 Serpulidae sp. 2 0.43 0.24 0.21 0.08 0.73	Ralanophvilia europaea	0.12				0.00			0.01
Clavularia crassa 0.36 0.12 0.43 Cornularia conucopiae 0.01 0.25 Eudendrium sp. 0.47 0.01 Hydrozoan unid. 0.27 Hoplangia durotrix 0.06 0.42 Leptopsammia pruvoti 1.78 0.06 0.61 Maasella edwardsi 0.06 0.06 0.00 Parezythropodium coralloides 0.00 0.00 0.00 Parazoanthus axinellae 9.33 1.21 13.85 2.57 Polycyathus muellerae 3.55 0.10 0.43 3.14 0.73 1.11 Polycyathus muellerae 0.09 0.87 0.003 0.07 0.68 Serpulidae sp. 1 0.40 0.01 0.002 0.68 Serpulidae sp. 2 0.43 0.24 0.21 0.08 Serpulidae sp. 3 0.05 1.09 0.73	Carvophyllia inornata	0.11	0.20	0.003		0.20	0.17		0.01
Cornularia cornucopiae 0.01 0.25 Eudendrium sp. 0.47 0.01 Hydrozoan unid. 0.27 Hoplangia durotrix 0.06 0.42 Massella edwardsi 0.06 0.06 Parerythropodium coralloides 0.00 0.06 Parazoanthus axinellae 9.33 1.21 13.85 2.57 Polycyathus muellerae 3.55 0.10 0.43 3.14 0.73 1.11 Polychaeta 9.33 1.21 13.85 2.57 0.00 0.03 0.07 0.00 Serpula vermicularis 0.40 0.01 0.43 3.14 0.73 1.11 Polychaeta 9.33 0.02 0.68 0.02 0.68 Serpula vermicularis 0.40 0.01 0.002 0.68 0.68 Serpulidae sp. 1 0.43 0.24 0.21 0.08 Serpulidae sp. 3 0.05 1.09 0.73	Clavularia crassa		0.20	0.000		0.12	0.43		
Eudendrium sp. 0.47 0.01 Hydrozoan unid. 0.27 Hoplangia durotrix 0.06 0.42 0.06 Leptopsammia pruvoti 1.78 0.06 0.26 0.03 0.61 0.01 Maasella edwardsi 0.06 0.26 0.03 0.61 0.01 0.17 Maasella edwardsi 0.06 0.06 0.06 0.06 0.06 0.00 Parerythropodium coralloides 9.33 1.21 13.85 2.57 Polycyathus axinellae 9.33 1.21 13.85 2.57 Polycyathus muellerae 3.55 0.10 0.43 3.14 0.73 1.11 Polychaeta 0.09 0.87 0.003 0.03 0.07 0.68 0.01 0.002 0.68 Serpulidae sp. 1 0.43 0.24 0.21 0.08 0.73 Serpulidae sp. 3 0.05 1.09 0.73 0.73	Cornularia cornucopiae		0.01			0.12	0.25		
Hydrozoan unid. 0.17 0.27 Hoplangia durotrix 0.06 0.42 0.06 Leptopsammia pruvoti 1.78 0.06 0.26 0.03 0.61 0.01 0.17 Maasella edwardsi 0.06 0.26 0.03 0.61 0.01 0.17 Maasella edwardsi 0.06 0.06 0.06 0.00 0.06 0.00 Parerythropodium coralloides 9.33 1.21 13.85 2.57 Polycyathus muellerae 3.55 0.10 0.43 3.14 0.73 1.11 Polychaeta 0.09 0.87 0.003 0.07 0.68 Serpula vermicularis 0.40 0.01 0.002 0.68 Serpulidae sp. 1 0.43 0.24 0.21 0.08 Serpulidae sp. 3 0.05 1.09 0.73	Eudendrium sp		0.47				0.01		
Hoplangia durotrix 0.06 0.42 0.06 Leptopsammia pruvoti 1.78 0.06 0.26 0.03 0.61 0.01 0.17 Maasella edwardsi 0.06 0.06 0.06 0.06 0.06 0.00 Parerythropodium coralloides 0.06 0.06 0.00 0.00 0.00 Parazoanthus axinellae 9.33 1.21 13.85 2.57 Polycyathus muellerae 3.55 0.10 0.43 3.14 0.73 1.11 Polychaeta 0.02 0.02 0.03 0.07 5almacina dysteri 0.00 0.01 0.002 0.68 Serpulidae sp. 1 0.40 0.01 0.002 0.68 0.01 0.21 0.08 Serpulidae sp. 3 0.43 0.24 0.21 0.08	Hydrozoan unid		0.17				0.27		
Leptopsammia pruvoti 1.78 0.06 0.26 0.03 0.61 0.01 0.17 Maasella edwardsi 0.06 0.06 0.06 0.00 0.00 0.00 Parerythropodium coralloides 9.33 1.21 13.85 2.57 Polycyathus muellerae 3.55 0.10 0.43 3.14 0.73 1.11 Polychaeta 0.09 0.87 0.003 0.03 0.07 0.02 Serpula vermicularis 0.40 0.01 0.002 0.68 0.01 Serpulidae sp. 1 0.43 0.24 0.21 0.08 Serpulidae sp. 3 0.05 1.09 0.73	Hoplangia durotrix		0.06		0.42				0.06
Masella edwardsi 0.06 Parerythropodium coralloides 0.06 Parazoanthus axinellae 9.33 1.21 13.85 2.57 Polycyathus muellerae 3.55 0.10 0.43 3.14 0.73 1.11 Polychaeta 0.09 0.87 0.003 0.03 0.07 0.02 Serpula vermicularis 0.40 0.01 0.002 0.68 0.01 Serpulidae sp. 1 0.43 0.24 0.21 0.08 Serpulidae sp. 3 0.05 1.09 0.73	Leptopsammia pruvoti		1.78	0.06	0.26	0.03	0.61	0.01	0.17
Parerythropodium coralloides 0.00 Parazoanthus axinellae 9.33 1.21 13.85 2.57 Polycyathus muellerae 3.55 0.10 0.43 3.14 0.73 1.11 Polychaeta 0.09 0.87 0.003 0.03 0.07 Salmacina dysteri 0.40 0.01 0.002 0.68 Serpulidae sp. 1 0.43 0.24 0.21 0.08 Serpulidae sp. 3 0.05 1.09 0.73 0.73	Maasella edwardsi		1170	0.000	0.20	0.06	0.01	0.01	0117
Parazoanthus axinellae 9.33 1.21 13.85 2.57 Polycyathus muellerae 3.55 0.10 0.43 3.14 0.73 1.11 Polychaeta 0.09 0.87 0.003 0.03 0.07 Salmacina dysteri 0.40 0.01 0.002 0.68 Serpulidae sp. 1 0.43 0.24 0.21 0.08 Serpulidae sp. 3 0.05 1.09 0.73 0.73	Parerythropodium coralloides								0.00
Polycyathus muellerae 3.55 0.10 0.43 3.14 0.73 1.11 Polycyathus muellerae 3.55 0.10 0.43 3.14 0.73 1.11 Polychaeta 0.09 0.87 0.003 0.03 0.07 Salmacina dysteri 0.02 0.02 0.68 Serpulidae sp. 1 0.01 0.002 0.68 Serpulidae sp. 2 0.43 0.24 0.21 0.08 Serpulidae sp. 3 0.05 1.09 0.73	Parazoanthus axinellae			9.33	1.21			13.85	2.57
Polychaeta Protula sp. 0.09 0.87 0.003 0.03 0.07 Salmacina dysteri 0.02 0.02 0.02 0.68 Serpula vermicularis 0.40 0.01 0.002 0.68 Serpulidae sp. 1 0.01 0.01 0.01 0.01 Serpulidae sp. 2 0.43 0.24 0.21 0.08 Serpulidae sp. 3 0.05 1.09 0.73	Polycyathus muellerae		3.55	0.10	0.43		3.14	0.73	1.11
Protula sp. 0.09 0.87 0.003 0.03 0.07 Salmacina dysteri 0.02 0.02 0.02 0.68 Serpula vermicularis 0.40 0.01 0.002 0.68 Serpulidae sp. 1 0.01 0.01 0.01 0.01 Serpulidae sp. 2 0.43 0.24 0.21 0.08 Serpulidae sp. 3 0.05 1.09 0.73	Polychaeta								
Salmacina dysteri 0.02 Serpula vermicularis 0.40 Serpulidae sp. 1 0.01 Serpulidae sp. 2 0.43 Serpulidae sp. 3 0.05	Protula sp.		0.09	0.87	0.003		0.03	0.07	
Serpula vermicularis 0.40 0.01 0.002 0.68 Serpulidae sp. 1 0.01 0.01 0.01 0.01 Serpulidae sp. 2 0.43 0.24 0.21 0.08 Serpulidae sp. 3 0.05 1.09 0.73	Salmacina dvsteri				0.02				
Serpulidae sp. 1 0.01 Serpulidae sp. 2 0.43 0.24 0.21 0.08 Serpulidae sp. 3 0.05 1.09 0.73	Serpula vermicularis	0.40		0.01	0.002				0.68
Serpulidae sp. 2 0.43 0.24 0.21 0.08 Serpulidae sp. 3 0.05 1.09 0.73	Serpulidae sp. 1				0.01				
<i>Serpulidae</i> sp. 3 0.05 1.09 0.73	Serpulidae sp. 2			0.43	0.24			0.21	0.08
	Serpulidae sp. 3			0.05	1.09				0.73
<i>Serpulidae</i> sp. 4 0.02 0.20 0.01	Serpulidae sp. 4			0.02	0.20			0.01	

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Bryozoa								
Annectocyma indistincta		0.10						
Annectocyma sp.			0.002			0.01	0.004	
Bryozoan sp.1			0.08	0.05		0.02	0.02	0.02
Bryozoan sp.2			0.05					
Bryozoan sp.3			0.01			0.33		
Bryozoan sp.4			0.01	0.99			0.01	0.10
Bryozoan sp.5				0.55			0.01	0.19
Bryozoan sp.o		0.12		0.01				0.01
Bryozoan sp. 9		1 10		0.01				
Bryozoan sp.o Rugula calathus		0.01		0.36				0.18
Cellaria sp		0.01		0.001	0.01			0.10
Celleboring sp				0.001	0.01	0.02		
Chlidonia byriformis				0.01		0.04		
Crisia sp.1		0.39						
Crisia sp.2						0.07		
Crisia sp.3						1.48		
Crisia sp.4		0.16						
Crisia sp.5		0.32						
Crisia sp.6	0.003							
Frondipora verrucosa		0.03	0.39	0.58		0.01	0.64	0.71
Lichenopora radiata			0.03	0.04			0.05	0.02
Margaretta cereoides			0.12				0.02	
Myriapora truncata		4.74			0.01	3.16		
Puellina gattyae		0.09						
Reptadeonella violacea		0.12			0.30			
Rynchozoon sp.						0.12		
Schizomavella sp.1				0.31				0.05
Schizomavella sp.2		0.01	5.37	1.94	0.00		5.41	3.01
Schizomavella sp.3		0.01	0.89	0.34	0.06		1.12	0.10
Scrupocellaria sp.		1.01	3.41	0.42		0.05	3.80	0.10
Sertella sp.		1.21	0.56	0.55		0.25	0.84	0.45
Smillina cervicornis Mollusco		0.10	0.56				0.44	
Rittium raticulatum		0.003						
Calliostoma sp		0.005	0.03					
Lima hians		0.01	0.05					
Lithophaga lithophaga		0.03	0.00	0.01		0.03	0.14	0.03
Patella sp		0.00		0.01	0.01	0.00	0.11	0.00
Brachiopoda					0.01			
Argyrotheca cordata				0.01				0.01
Echinodermata								
Paracentrotus lividus					0.14			
Tunicata								
Ascidia mentula				0.01				
Botrylloides leachii							0.01	
Didemnum sp. 1			0.02			0.04	0.02	
Didemnum sp. 2				0.03				0.01
Lissoclinum perforatum	0.01	0.04		0.11	0.08			0.07
Pyura dura							0.13	
Unidentified	1.48	5.27	7.66	0.95	0.20	6.43	10.42	0.74
Bare rock		0.06	37.23	46.05			30.81	40.34
Species		June				Nove	ember	
Medes cave	Zone 1	Zone 2	Zone 3	Zone 4	Zone 1	Zone 2	Zone 3	Zone 4
Chlorophyta								_
Cladophora pellucida	0.02				0.04			
Cladophora sp.	0.11				1.33			
Flabellia petiolata	0.56				2.27			
Halicystis parvula	0.001	0.001						
Halimeda tuna	0.07				0.06			
Pseudochlorodesmis furcellata	0.003							

Table 4. (Continued).

Species		Ju	ne		November			
Medes cave	Zone 1	Zone 2	Zone 3	Zone 4	Zone 1	Zone 2	Zone 3	Zone 4
Phaeophyta								
Aglaozonia sp.	0.28				0.24			
Colpomenia sinuosa	0.12							
Dictyopteris polypodioides					0.02			
Dictyota dichotoma	1.05				0.06			
Dictyota dichotoma v. intricata	5.27							
Dictyota fasciola	1.81				0.04			
Halopteris filicina	1.36				3.41			
Halopteris scoparia	1.35							
Padina pavonica	0.01							
Taonia atomaria	24.57							
Rhodophyta								
Amphiroa beauvoisii					0.05			
Amphiroa cryptarthrodia	0.01				0.14			
Asparagopsis armata	3.57							
Bornetia secundiflora	0.01							
Corallina elongata	2.37				11.27			
Falkenbergia rufolanosa	33.35				45.20			
Hydrolithon farinosum	0.25							
Jania rubens	0.08				0.09			
Lithophyllum dentatum	0.13							
Lithophyllum incrustans	1.78				1.47			
Melobesiae unid.		0.03				0.02		
Mesophyllum alternans	2.65				11.35			
Peyssonnelia rosa-marina	0.20				1.47			
Peyssonnelia squamaria	0.81				3.34			
Plocamium cartilagineum	0.52				0.44			
Rhodophyllis divaricata	0.003							
Rhodymenia ardissonei		0.20						
Unid. filamentous red algae					8.65			
Granuloreticulosa								
Miniacina miniacea		0.001						0.14
Porifera								
Aaptos aaptos		0.04	0.72	0.01		0.41	0.12	0.45
Acanthella acuta		0.38				0.07		
Agelas oroides		1.67	0.20	0.04		2.50	1.54	0.03
Aplysina cavernicola		0.05	1.62	0.53		0.41	2.06	0.75
Axinella damicornis		0.01				0.30		0.03
Cacospongia mollior					0.01			
Chelanoplysilla noevus		0.004	0.001			0.14	0.004	
Chondrosia reniformis		0.003		0.01			0.01	0.03
Clathrina sp. 1	0.001	0.06	0.29	0.90	0.05	0.09	0.40	1.02
Clathrina clathrus		2.48	2.40	0.57	0.001	1.90	1.28	0.70
Clathrina sp. 2				0.01				
Cliona schmidti				0.01			0.001	0.001
Clionia celata	0.01				0.01			
Clionia viridis	0.01	0.003			0.01		0.06	
Crambe crambe	0.98				1.90	0.001		
Crella mollior		0.05	0.18	0.08		0.10	0.11	0.22
Dendroxea lenis	0.01	11.49	15.71	7.70	0.01	7.49	11.48	12.52
Diplastrella bistellata		8.57	9.34	0.89		10.14	10.70	3.30
Dictyonella sp.		0.23				1.09		0.07
Dysidea avara		1.05	0.75			1.76	0.46	0.003
Ērylus euastrum		0.07	0.20	0.92		0.15	1.31	2.38
Eurypon sp.1		0.28			0.26	0.09		
Eurypon sp.2			0.03					
Hemimycale columella					0.01			
Hexadella pruvotii		0.002	0.01	0.02		0.39	0.002	
Hymedesmia sp. 1		0.07	0.06	0.85		0.27	0.11	2.46
Hymedesmia sp. 2		· · · ·	0.13	0.06			0.06	
Hymedesmia sp. 4			0.70	0.003		0.24	-	0.01
- 1							0.32	

Induite for dealers	0.10				0.20			
	0.16	0.94	0.00	0.00	0.50	0.50	0.17	0.00
		0.34	0.03	0.26	0.001	0.50	0.17	0.08
Ircinia variabilis		0.36	1.46	1.51		0.45	1.00	1.78
Leucosolenia variabilis	0.001					0.002		
Microciona sp.		0.08				0.04	0.02	
Mycale sp.		0.04	0.01			0.35	0.12	
Myceliospongia araneosa		0.04	2.05	0.03		0.12	1.08	1.82
Oscarella sp.								0.001
Oscarella tuberculata		0.26				0.02		
Petrosia ficiformis		6.19	2.57	0.02		6.57	3.29	0.57
Phorbas fictitius	0.04				0.03			
Phorbas tenacior	0.02	0.59	2.32		0.02	2.85	1.80	0.14
Pione vastifica	0.01							
Pleraplysilla spinifera		2.13	0.89	0.04		1.00	0.39	0.09
Reniera mucosa		6.21	3 77	0.84		3 71	3 75	2.02
Reniera sarai		0.21	0.77	0.01		0.003	0.19	2.02
Reniera sp		0.05				0.005	0.15	
Shirastralla sunctatria		5.60				5 52	0.004	
Spirasireita cunciatrix	0.01	1.09	0.59	0.07	0.009	2.55	1.05	0.16
Spongia origuitosa	0.01	1.00	0.36	0.07	0.002	2.00	1.05	0.10
Sycon elegans		0.005		0.01			0.001	0.01
Sycon sp.		0.01		0.01		0.00	0.001	0.01
Terpios fugax		0.01				0.02	0.001	0.01
Topsentia garciae		0.02		0.01		0.13		
Cnidaria								
Aglaophenia kirchenpaueri	0.01				0.03			
Alcyonium acaule					0.01			
Balanophyllia regia		0.02	0.02	0.00	0.03	0.01	0.01	
Caryophyllia inornata			0.002				0.003	
Corallium rubrum	0.06	0.47				0.19	0.01	0.07
Cornularia cornucopiae	0.01				0.09			
Eudendrium sp.	0.04				0.01			
Eunicella singularis					0.02			
Hydrozoan unid		0.003						
Hoplangia durotrix		0.02	0.09	0.02		0.09	0.06	0.17
I eptopsammia pruvoti		1 73	0.03	0.004		2.12	0.89	0.17
Polycyathus mullerae		0.10	0.12	0.001		0.00	0.05	0.57
Sertularella ellisi	0.01	0.10			0.04	0.00		
Sertularella an	0.01				0.04			
Delevel e etc					0.02			
Polychaeta			0.01	0.02		0.01	0.001	0.00
Myxicola aestnetica		0.07	0.01	0.03	0.07	0.01	0.001	0.02
Protula sp.	0.00	0.07	1.02		0.07	0.03	0.33	0.05
Salmacina dysteri	0.03	0.34				0.37		
Serpula vermicularis	0.01	0.06			0.03	0.02	0.02	0.01
Serpulidae sp. 1		0.16	0.03	0.14		0.09		0.16
Serpulidae sp. 2				0.01				
Serpulidae sp. 3				0.11				0.05
Serpulidae sp. 4		0.01	0.47				0.21	0.003
Serpulidae sp. 5							0.01	
<i>Spirorbis</i> sp.		0.02	0.32	4.35		0.003	0.40	0.73
Bryozoa								
Bryozoan sp. 1		0.01						
Bryozoan sp. 2		1.43		3.63			0.20	3.05
Bryozoan sp. 3	0.05							
Bryozoan sp. 4	0.00	0.06	0.01					
Celleboring sp		0.00	0.01	0.01		0.001		0.001
Chlidonia huriformic			0.01	0.01		0.001		0.001
Crisia an	0.02		0.01		0.15			
Distantly histoide	0.05	0.06			0.15	0.07		
Disporeita nispiaa		0.06				0.07		
Frondipora verrucosa		0.04						
Idmidronea atlantica		0.04						
Lichenopora radiata	-		0.002	0.01		0.01	0.002	0.002
Myriapora truncata	0.001							
Parasmittina tropica		0.14				0.03		
Schizomavella cuspidata		0.73				1.07		
Schizomavella linearis		0.06				1.23		
Schizomavella sp. 1			0.01					
Schizomavella sp. 2			0.01				0.70	
-								

Table 4. (Continued).

Species		Ju	ne		November				
Medes cave	Zone 1	Zone 2	Zone 3	Zone 4	Zone 1	Zone 2	Zone 3	Zone 4	
Bryozoa (continued)									
Schizomavella sp. 3			0.04				0.10		
Scrupocellaria sp.		5.35	1.31	0.04		0.60	0.22	0.05	
Sertella sp.	0.02				0.02	0.01			
Smittina cervicornis		0.59				0.31			
Smittoidea reticulata		0.20				0.01			
Spiralaria gregaria		0.09				0.85		0.40	
Mollusca									
Bittium reticulatum								0.001	
Bivalvia unid.			0.003						
Coralliophila sp.			0.001				0.003		
Lithophaga lithophaga	2.35		0.01		0.03		0.01		
Brachiopoda									
Argyrotheca cordata							0.002	0.001	
<i>Terebratulina</i> sp.			0.01	0.02			0.04		
Crania anomala			0.15	2.31			0.12	0.91	
Megerlia truncata			0.001	0.01		0.003	0.001	0.02	
Echinodermata									
Paracentrotus lividus	0.42					0.01			
Tunicata									
Clavelina lepadiformis	0.10				0.54				
Cystodytes dellechiajei	0.08	0.12	0.01		0.11	0.42	0.001		
Didemnum sp. 1	0.01	0.05	0.36	0.61		0.04	0.18	0.94	
Didemnum sp. 2	0.01								
Didemnum sp. 3			0.03				0.004	0.33	
Didemnum sp. 4							0.004		
Diplosoma spongiforme			0.04						
Pyura dura		0.02							
Unidentified	13.21	2.35	1.26	0.12	5.23	0.39	1.95	1.18	
Bare rock		35.84	48.28	73.20		40.56	51.55	60.69	

Note that in Zone 4 of the Cabrera cave some sponge species (*) have exactly the same coverage in June and November. Although these species in fact decreased in coverage, we consider this decrease an artefact due to the small size of the zone and the intensive sampling for toxicity analyses carried out in June. Some sponge specimens that remained untouched showed an increment in coverage from June to November. We have kept the coverage values of these species for June, as we think that this is the more conservative correction we can apply.

polychaetes were the groups best represented after the sponges.

There were marked seasonal differences in species richness (Figure 3). In the Cabrera cave there was a noticeable increase in the number of species in Zone 1 from June to November, and a decrease in Zones 2, 3 and 4 during the same period. In the Medes cave there was a decrease in the number of species from June to November in Zones 1 and 2, while Zones 3 and 4 showed an increase in the number of species in the same period.

Ordination

The ordination analysis of the samples from the Cabrera cave is graphically represented in Figure 4A,B. The first axis was interpreted as representing the horizontal gradient across the cave from the most external zone (left in the graph) to the innermost zone (right in the graph). Forty-seven per cent of the variation of our pictures was explained by the two first axes. However, almost all the variance (77.6%) was explained by axis I. Notice that the r^2 for axis II is low in all the graphs (Figure 4).

The 20 pictures taken at the most external part of the cave (zone 1), appeared in the analysis as a compact group on the left part of the graph. Clearly separated from the first group, another cluster of 20 samples, which belonged to Zone 2, were represented.

The set of samples on the right of the graph belonged to Zones 3 and 4. These two zones were situated inside the cave, with low levels of light, so the dominant benthic organisms there were invertebrates. No spatial separation of the two zones was obtained in this analysis.

In order to assess whether the lack of resolution between the two internal zones (Zones 3 and 4) was an artefact due to the presence of the other, markedly different zones, another analysis was carried out with only the 40 pictures of these two zones (Figure 4B). After the elimination of the outliers, axis I represented the gradient from Zone 3 to the innermost part of the cave (Zone 4). Most of the samples of Zone 4 can be found on the right part of the graph. Axis I explained 37% of the variance in the samples.

Most of the samples from Zone 3 were grouped on the left. However, the separation of the two zones was not clear cut. This was expected since the species found were



Figure 2. Coverage per high-level taxonomic group in the four zones of the Cabrera cave and the Medes cave in both seasons.



Figure 3. Number of species per high-level taxonomic group in the four zones of the Cabrera cave and the Medes cave in both seasons. Bold values indicate species richness.



Figure 4. Detrended correspondence analyses (DCAs) representation of all samples (A) and samples of Zones 3 and 4, exclusively (B), from the Cabrera cave and DCAs representation of all samples (C) and samples of Zones 2, 3 and 4, exclusively (D) from the Medes cave. Data represent coverage values in June.

similar in both zones. Axis II distributed samples according to species abundance and amount of bare rock.

The representation of ordination analyses for the Medes cave in June is shown in Figure 4C,D. When all zones were included (Figure 4C), the first axis, which explained 41% of the total variance, again represented the horizontal gradient along the cave.

The 20 pictures taken in Zone 1 appeared in the analysis in a compact group on the left part of the graph. Clearly



Figure 5. Cluster analysis of zones from both the caves using the percentage cover per high-level taxonomic group (A). Cluster analysis of the algal-dominated zones (B) and animal-dominated zones (C), using the percentage cover per species. Data were transformed to 4th root. C, the Cabrera cave; M, the Medes cave; J, June; N, November. Numbers denote cave zones.

separated from Zone l, there was a group composed of all the remaining 60 pictures, all of them taken inside the cave.

When the analysis was only performed on the three internal zones (2, 3 and 4) (Figure 4D), axis I again represented the horizontal gradient from the external to the internal zones of the cave, explaining 38% of the variance.

The three zones appeared separated along this axis, although with some overlap. This overlap was expected because, as in the Cabrera cave internal zones, the three zones shared the same species. Species abundance and the increment of bare rock were the two factors that clearly varied among zones. Axis II discriminated samples according to the coverage of the most abundant species and bare rock.

Classification

Two distinct groups were clearly separated in the preliminary cluster analysis performed on high-level taxonomic groups (Figure 5A). The first one comprised all the zones dominated by seaweeds irrespective of cave or season. The second group included all the zones inside the caves (i.e. the darker communities dominated by suspension-feeders). However, relationships within each group were not clear.

A separate analysis on the group comprising the algal-dominated zones (Figure 5B) performed at the species level, showed that Zone 2 of the Cabrera cave was more similar to zone 1 of the Medes cave than to Zone 1 of the Cabrera cave. Thus, two zones belonging to two geographically separated archipelagos were more similar than two zones with spatial continuity. This result highlighted the importance of the amount of light in establishing affinities between different algal communities. Seasonal variation was less important, as the sample of both seasons in each zone clustered together in all cases.

When the animal-dominated communities were analysed at the species level (Figure 5C), the differences in species composition between the two caves became manifest, and the Cabrera and the Medes caves appeared as separate clusters. Again, similarity was higher between seasons for the same zone than between zones.

DISCUSSION

A clear although different pattern of zonation was found in both the caves. In the Cabrera cave the decrease in coverage and number of species and the corresponding increase in bare rock towards the internal zone is less marked than in the Medes cave (also reported by Gili et al., 1986) possibly due to the higher water flow inside. A diminished larval supply might explain the poor colonization of the substratum at the most internal zones of the caves, since larvae of the main benthic taxa living inside the caves (sponges, bryozoans and ascidians) have not been found in the corresponding planktonic compartment (Palau et al., 1991). However, the difficulty in larval identification of several Phyla (mainly sponges, Mariani et al., 2003) casts some doubt on the absence of larvae in these caves.

Sponges were the dominant group in the animal-dominated communities of both the caves. Bryozoans and cnidarians were also relevant in the Cabrera cave. In contrast, cnidarians were scarce and even absent from the innermost zone in the Medes cave, a finding consistent with the progressive disappearance of cnidarians from semi-dark communities to dark communities previously reported (Harmelin, 1985, 1997).

The adaptation of the organisms from different taxonomic groups to life inside the caves relies mainly on their trophic requirements (Harmelin, 1985). Sponges (active filter-feeders) appear to be well adapted to this kind of environment due to their high efficiency in retention of small organic particulates (Simpson, 1984). As a result, they are highly competitive organisms in submarine caves (Harmelin et al., 1985) and clearly dominate semi-dark communities (Vacelet, 1979). Our data confirmed the reported dominance of sponges in the caves, in terms of both species richness and coverage, from the cave entrance to the innermost zone. However, the pattern of sponge abundance was different in the two caves. While the number of sponge species and their coverage clearly decreased from the external to the internal zone in the Medes cave, both descriptors reached the highest values in the innermost zone (Zone 4) of the Cabrera cave. The differences in species composition (only 38 species out of 62 were present in both the caves) may be due to the geographical isolation of both the caves, and the low dispersal capacity of sponges (Harmelin, 1985; Mariani et al., 2003). When we compare the sponge species composition of the caves studied with that of other Mediterranean caves (e.g. Marseilles caves, Pouliquen, 1972; Harmelin & Vacelet, 1997; and Migtigliano cave, Balduzzi et al., 1989), we find that the number of species in common is generally low, and decreases with increasing geographic distance, as previously reported (Alcover et al., 1993).

Detrended correspondence analyses revealed differences between the two caves. In all cases the axis with the highest coefficient of determination was the one that represented the horizontal gradient across the cave, from the most external zone to the innermost one.

The cluster analysis on percentage cover per high taxonomic groups allowed us to differentiate those organisms from the external and internal zones of both the caves. The analysis of the external zones (phytobenthic communities) using species percentage cover clustered the zones on the basis of light availability and not by geographic proximity. The internal zones (animal-dominated communities), on the other hand, were grouped according to the cave they belonged to.

All the results presented here show that light is determinant in explaining differences among algal-dominated communities, but not among the animal-dominated communities. The algal communities are similar between the caves, varying as a function of irradiance. In contrast, animal-dominated communities are more similar within than between the caves, and more intrinsic factors, such as cave typology, that determines water flows and hence differences in food and larval supply, may be more relevant to explain differences among animal-dominated benthic communities from the caves. Although seasonal differences in species abundance and coverage are much less important than differences linked to the caves and zones, there is nevertheless significant seasonal variation even in the innermost zones of the caves, especially with respect to coverage figures.

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Appendix. List of species and authorities

Div. CHLOROPHYTA

Acetabularia acetabulum (Linnaeus) Silva Acetabularia parvula Solms-Laubach Anadyomene stellata (Wulfen) C. Agardh Cladophora pellucida (Hudson) Kützing Codium bursa J. Agardh Flabellia petiolata (Turra) Nizamuddin Halimeda tuna (Ellis & Solander) Lamouroux Halicystis parvula Schmitz Palmophyllum crassum (Naccari) Rabenhorst Pseudochlorodesmis furcellata (Zanardini) Børgesen Valonia utricularis (Roth) C. Agardh

Div. PHAEOPHYTA

- Colpomenia sinuosa (Mertens ex Roth) Derbès & Solier in Castagne
- Cystoseira balearica Sauvageau
- *Cystoseira compressa* (Esper) Gerloff & Nizamuddin v. *pustulata* Ercegovic
- Dictyopteris polypodioides (Stackhouse) Batters
- Dictyota dichotoma (Hudson) Lamouroux
- Dictyota dichotoma (Hudson) Lamouroux v. intricata (C. Agardh) Greville
- Dictyota fasciola (Roth) Howe
- Halopteris filicina (Grateloup) Kützing
- Halopteris scoparia (Linnaeus) Sauvageau
- Lobophora variegata (Lamouroux) Womersley
- Padina pavonica (Linnaeus) Thivy
- Sphacelaria cirrosa (Roth) C. Agardh
- Taonia atomaria (Woodward) J. Agardh

Div. RHODOPHYTA

Amphiroa beauvoisii Lamouroux

- Amphiroa cryptarthrodia Zanardini
- Amphiroa rigida Lamouroux
- Asparagopsis armata Harvey
- Boergeseniella fruticulosa (Wulfen) Sprengel
- Bornetia secundiflora (J. Agardh) Thuret
- Botryocladia boergesenii J. Feldmann
- Botryocladia botryoides (Wulfen) J. Feldmann
- Contarinia squamariae (Meneghini) Denizot
- Corallina elongata Ellis & Solander
- Cryptomenia lomation (Bertoloni) J. Agardh
- Falkenbergia rufolanosa (Harvey) Scmitz (life-history phase)
- Gloiocladia furcata (C. Agardh) J. Agardh
- Haliptilon virgatum Ellis & Solander
- Hydrolithon farinosum (Lamouroux) Howe
- Jania rubens (Linnaeus) Lamouroux
- Laurencia obtusa (Hudson) Lamouroux
- Lithophyllum cabiochae (Dufour) Furnari, Cormaci & Alongi
- Lithophyllum dentatum (Kützing) Foslie sensu Hamel & Lemoine
- Lithophyllum incrustans Philippi
- Mesophyllum alternans (Foslie) Cabioch & Mendoza
- Neogonolithion brassica-florida (Harvey) Setchell & Mason
- Peyssonnelia rosa-marina Boudouresque & Denizot
- Peyssonnelia squamaria (Gmelin) Decaisne
- Plocamium cartilagineum (Linnaeus) Dixon
- Polystrata fosliei (Weber van Bosse) Denizot
- Rhodophyllis divaricata (Stackhouse) Papenfuss

Rhodymenia ardissonei J. Feldmann Wurdermannia miniata (Sprengel) J. Feldmann & Hamel

Phylum GRANULORETICULOSA Miniacina miniacena (Pallas, 1766)

Phylum PORIFERA Aaptos aaptos (Schmidt, 1864) Acanthella acuta Schmidt, 1862 Agelas oroides (Schmidt, 1864) Aplysina cavernicola (Vacelet, 1959) Axinella damicornis (Esper, 1794) Cacospongia mollior Schmidt, 1862 Chelanoplysilla noevus (Carter,1876) Chondrosia reniformis Nardo, 1833 Clathrina clathrus (Schmidt, 1864) Cliona celata Grant, 1826 Cliona schmidti (Ridley, 1881) Cliona viridis (Schmidt, 1862) Crambe crambe (Schmidt, 1862) Crella mollior Topsent, 1925 Dendroxea lenis (Topsent, 1892) Diplastrella bistellata (Schmidt, 1862) Dysidea avara (Schmidt, 1862) Erylus euastrum (Schmidt, 1870) Hemimycale columella (Bowerbank, 1874) Hexadella pruvotii Topsent, 1905 Hippospongia communis (Lamarck, 1813) Ircinia fasciculata (Pallas, 1766) Ircinia oros (Schmidt, 1864) Ircinia variabilis (Schmidt, 1862) Leucosolenia variabilis Haeckel, 1870 Myceliospongia araneosa Vacelet & Perez, 1998 Oscarella tuberculata (Schmidt, 1868) Petrosia ficiformis (Poiret, 1879) Phorbas fictitius (Bowerbank, 1866) Phorbas tenacior (Topsent, 1925) Pione vastifica (Hanckock, 1849) Pleraplysilla spinifera (Schulze, 1879) Raspaciona aculeata (Johnston, 1842) Reniera fulva Topsent, 1893 Reniera mucosa Griessinger, 1971 Reniera sarai (Pulitzer-Finali) Spirastrella cunctatrix Schmidt, 1868 Spongia virgultosa (Schmidt, 1868) Sycon elegans (Bowerbank, 1866) Terpios fugax Duchassaing & Michelotti, 1864 Topsentia garciae Bibiloni, Uriz & Gili, 1989

Phylum CNIDARIA

Aglaophenia kirchenpaueri (Heller, 1868) Alcyonium acaule Marion, 1878 Balanophyllia europaea (Risso, 1826) Balanophyllia regia (Gosse, 1860) Caryophyllia inornata (Duncan, 1878) Cladocora caespitosa (Linnaeus, 1767) Clavularia crassa (Milne-Edwards, 1848) Corallium rubrum (Linnaeus, 1758) Cornularia cornucopiae (Pallas, 1766) Eunicella singularis (Esper, 1791) Hoplangia durotrix Gosse, 1860 Leptopsammia pruvoti Lacaze-Duthiers, 1897 Maasella edwardsi (Lacaze-Duthiers, 1888) Parerythropodium coralloides (Pallas, 1766) Parazoanthus axinellae (Schmidt, 1862) Polycyathus muellerae (Abel, 1959) Sertularella ellisi (Milne-Edwards, 1836)

Phylum ANNELIDA Myxicola aesthetica Koch in Renier, 1847 Salmacina dysteri (Huxley, 1855) Serpula vermicularis Linnaeus, 1767

Phylum MOLLUSCA Bittium reticulatum (Da Costa, 1778) Lima hians (Gmelin, 1790) Lithophaga lithophaga (Linnaeus, 1758)

Phylum ECTOPROCTA

Annectocyma indistincta (Canu & Bassler, 1929) Bugula calathus (Norman 1868) Chlidonia pyriformis (Bertoloni, 1810) Disporella hispida (Fleming, 1828) Frondipora verrucosa (Lamouroux, 1821) Idmidronea atlantica (Canu & Bassler, 1928) Lichenopora radiata (Audouin, 1826) Margaretta cereoides (Ellis & Solander, 1786) Myriapora truncata (Pallas, 1766) Parasmittina tropica (Waters, 1909) Puellina gattyae (Landsborough, 1852) Reptadeonella violacea Johnston, 1847 Schizomavella cuspidata (Hincks, 1880) Schizomavella linearis (Hassall, 1841) Smittina cervicornis (Pallas, 1766) Smittoidea reticulata (MacGillivray, 1842) Spiralaria gregaria (Heller, 1867)

Phylum BRACHIOPODA

Argyrotheca cordata (Risso, 1826) Crania anomala (Müller, 1776) Megerlia truncata (Linnaeus, 1767)

Phylum ECHINODERMATA Paracentrotus lividus (Lamarck, 1816)

Phylum CHORDATA Ascidia mentula Müller, 1776 Botrylloides leachi (De Savigny, 1816) Clavelina lepadiformis (Müller, 1776) Cystodytes dellechiajei (Della Valle, 1877) Diplosoma spongiforme (Giard, 1872) Lissoclinum perforatum (Giard, 1872) Pyura dura (Heller, 1877)