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Preliminary Results On Marine Algae Of Madagascar Reef, Yucatan, México: a Functional Group approach.

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Abstract. The abundance and distribution of marine algae was recorded for the first time in Madagascar Reef, a site that may be part of the connection between the Caribbean and the Gulf of Mexico algal communities. The objective of this study is to generate the base-line information on macroalgal functional forms (MFGs) distribution and abundances that can serve to develop a monitoring program for this community. We used the Steneck and Dethier (1994) functional-form system modified. MFGs were examined on 4 sites with three different substrates. The abundance of MFGs and taxa was recorded using a modification of the Braun-Blanquet method. Community differences were analyzed with regard to MFGs and algal taxa distribution. The macroalgal assemblages were found to be variable at the MFG level and widely distributed, except for some of the more complex ones, which tended to be absent in the more continuous rocky substrate. While community analysis at both, MFG and taxa levels revealed similar trends in relation to the type of substrate, we were able to detect important differences in the number of genera that constitute these MFGs. The most diverse site concerning taxa and MFGs composition is probably associated with a more heterogeneous substrate.

Key words: Macroalgae, Functional Forms, Gulf of México.

Introduction

The functional form model is generally used to understand ecological patterns in the diversity of the macroalgal flora. This model is based on the idea that a form-function relationship can be used to interpret distributional patterns in relation to different environmental factors (Littler and Littler 1984). Different models of functional-form groups have been proposed (Littler and Littler 1980; Steneck and Watling 1982; Steneck and Dethier 1994). For this study we used the Steneck and Dethier (1994) system but separated the green calcareous from the coenocytic, as proposed by Collado-Vides et al. (2005) and Phillips et al. (1997), to distinguish conspicuous algae such as *Caulerpa*, *Codium* from *Halimeda* and other cenocytic algae, taking into consideration the local flora composition and morphology.

Madagascar Reef is located between the more structurally complex communities of both the Caribbean and the Gulf of México, therefore the study of this site could help answer questions about connectivity in the flora of the two biogeographical regions. The objective of this study is to generate the base- line information on taxa and macroalgal functional forms distribution and abundances that can serve to develop a monitoring program for this peculiar community.

Material and Methods

Study Area

Madagascar Reef is located at the Northwest of the Yucatan Península, north of the port of Sisal (Fig.1). It forms part of the Inner Campeche Bank Reefs. It is an underwater extension of the Yucatan Peninsula that slopes gradually northwards for about 200 km and descends abruptly into the Sigsby Deep.

Four sites were selected. Site 1 was located at 21°26´26.1´´N and 90°16´55.2´´W, had 24ºC, was 15-17.5m deep and had a sandy substrate; Site 2 was located at 21°26´19.2´´N and 90°16´56.5´´W, had 26ºC, was 7-11m deep and had a mixed rocky-sandy substrate; Site 3 was located at 21°26´19.2´´ N and 90°16´42.3´´W, had 27 ºC, was 7-12m deep and had a rocky substrate; Site 4 was located at 21°26´29.6´´N and 90°17´36´´W, had 24ºC, was 15-17.5m deep and had a rocky substrate.

Field techniques

Between August and September of 2007 four sites were collected along the reef. Two 10m transects marked at 2m intervals were used at each site, with a 25 x 25 cm quadrant placed every two meters (to the

right, center and left of the transect, alternatively) to record the composition and abundance of each MFG (macroalgae functional group). In the field, the abundance of MFGs was recorded using the Braun-Blanquet method, assigning a "relative abundance score" between 0 and 5 in each quadrant (0=absent, 1=few to numerous individuals covering <5%, 2=5-25% cover, 3=25-50% cover, 4=50-75% cover, and 5=75-100% cover). Specimens were collected and taken to the laboratory to determinate taxonomic unit (species or genus) and confirm MFGs.

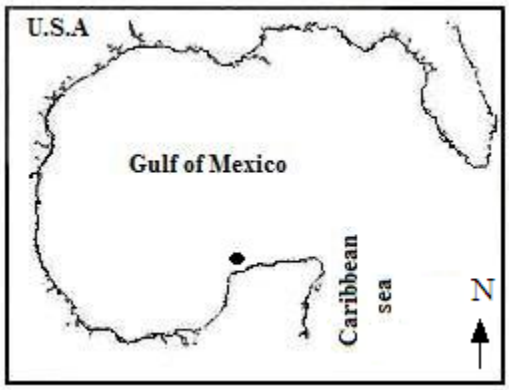

Figure 1: Geographical position of Madagascar Reef.

We used the Steneck and Dethier (1994) system, separating the coenocytic from the calcareous green. For purposes of analyses, data from these quadrates were averaged. Shannon´s diversity index was calculated and matrices with both species and MFGs were built. A percentage of similarity cluster analysis with UPGMA linkage procedure was applied in order to identify similarities in trends between sites, and a PCA was used to determine correlations between sites and species and MFGs using the MVSP 3.1

Results and Discussion

Composition

A total of 55 taxa (visible growth) was recorded (Table 1). At site 1, the most abundant taxa were *Gracilaria* spp, *Halymenia* sp, articulated calcareous algae and Cyanophyta whereas at site 2 the most abundant were *Asparagopsis* and *Dictyopteris* spp. At sites 3 and 4 the Rhodophyta had the highest number of taxa, but *Dictyota* spp and *Dictyopteris* spp (Phaeophyta) had the highest abundance. The least abundant group was the leathery macrophyte constituted by *Sargassum* (Fig. 2).

The 55 taxa were unevenly distributed across the 10 MFGs. The most diversified MFGs were the filaments, corticated polysiphonic filaments and corticated macrophytes, comprising over 50% of the taxa; and the least species-rich group were the foliose and leathery macrophyte, with only one taxon each (Fig.3-4).

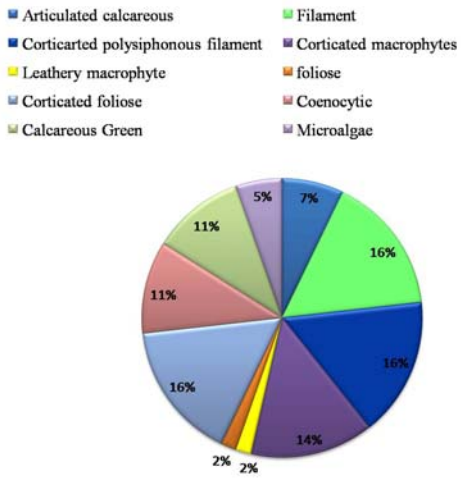

Figure 2: Abundance of different MFG at Madagascar reef.

Macroalgae Functional Groups

Ten MFGs were considered and their generic composition and distribution among sites was as seen in Table 1:

Concerning the abundance of MFGs per site, we found that sites 1 and 2 have eight and nine respectively; corticated macrophytes and the microalgae were the two most abundant at site 1, whereas at site 2 the most abundant were the microalgae, calcareous articulated and filamentous algae. Sites 3 and 4 both have six MFGs, the most abundant being the corticated foliose, the microalgae and the articulated calcareous (Fig. 3).

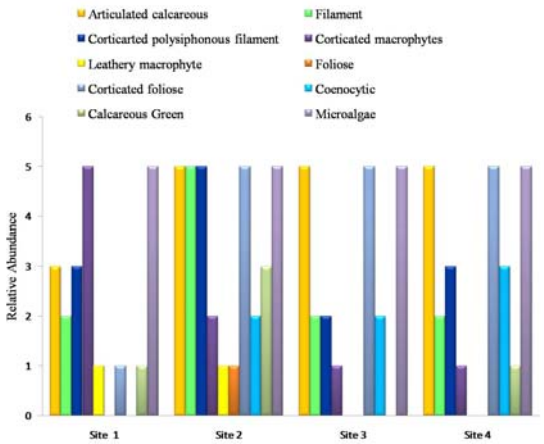

Figure 3: Relative abundance of MFGs per site.

The highest diversity was present at Site 2, both at taxa and MFGs levels, where all except the corticated

foliose group were found. Rocky bottom sites 3 and 4 showed a reduction of both taxa and MFGs, with very few calcareous greens and no corticated foliose algae, foliose and leathery macrophyte (Fig. 4).

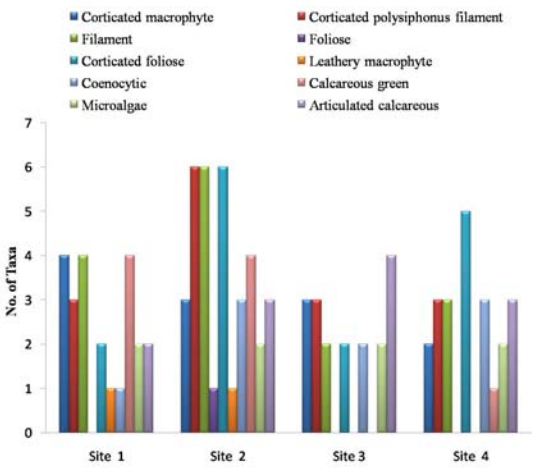

Figure 4: Diversity of Taxa/MGF and MFGs per site.

The PCA data indicate that axis 2 has 98% of the MFG abundance variability. For axis 2, the main component (MFG) that characterized site 1 were corticated macrophytes where *Gracilaria* had the highest abundance. In addition, for site 2 the main component were calcareous green (*Halimeda spp)*, corticated polysiphonous filaments (*Neosiphonia* spp), microalgae (*Lyngbya majuscula*), and filamentous algae (*Asparagopsis* spp.). For axis 1, the main component that differentiates sites 3 and 4 were corticated foliose (*Dictyota* spp), articulated calcareous (*Amphiroa* and *Jania* spp) and coenocytic algae (*Caulerpa* spp) (Fig. 5).

Analysis by MFG

The cluster analysis of similarity percentages indicates that site 3 and 4 had a 94 % similarity, grouping sites with rocky substratum and separating them from sandy and sandy-rocky substrata (Fig. 6).

An algal distribution and abundance pattern was found using MFGs: The macroalgal assemblages were found to be variable at the MFG level and widely distributed, specially regarding the more simple groups such as the filaments and corticated polysiphonous filaments that constitute the turfs, whereas some of the more complex ones, such as foliose and leathery macrophytes, tend to be absent in the more continuous rocky substrate.

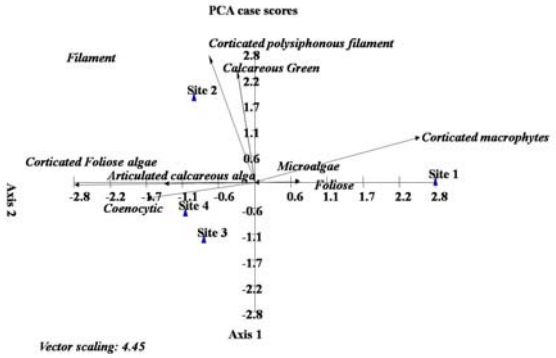

Figure.5: PCA analysis.

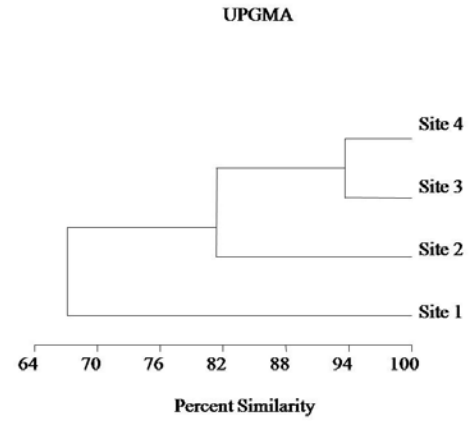

Figure 6: Classification dendrogram of Madagascar reef sites.

The most abundant MFGs at site 1 also belonged to the most abundant taxa (*Gracilaria, Halymenia* and *Lyngbya majuscula*), and the "corticated macrophyte" were the MFGs that covered the most area of the bottom. At site 2, a mixed substrate (sandy-rocky) allowed the presence of more MFGs with high abundance. Sites 3 and 4 had the same three groups with the highest abundance: coralline articulated, corticated foliose and the microalgae, the first two covering almost all the bottom forming a turf composed also in minor proportions by the other MFGs.

To detect any change within a community we first need to understand the spatio-temporal patterns. We still do not know whether the functional form group model provides the correct resolution to detect temporal and spatial changes in community structure, but it helps to provide a first insight on the way the algal community is structured. At this moment the similarity of results of using MFG and "genera" support its use as a rapid and efficient tool to study the spatio-temporal macroalgal distribution and abundance patterns in this type of communities.

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References

Collado-Vides L, Rutten M, Fourqurean J (2005) Spatiotemporal variation of the abundance of calcareous green macroalgae in the Florida keys: a study of synchrony within a macroalgal functional-form group. J Phycol 41: 742–752

Littler MM (1980) Morphological form and photosynthetic perfomances of marine macroalgae: tests of a functional/form hypothesis. Bot Mar 22:161-165

Littler MM, Littler DS (1984) Relationships between macroalgal functional form groups and substrata stability in a subtropical rocky-intertidal system. J Exp Mar Biol Ecol 74: 13-34

Phillips JC, Kendrick GA, Lavery PS (1997) A test of a functional group approach to detecting shifts in macroalgal communities along a disturbance gradient. Mar Ecol Progr Ser 153: 125-138

Steneck RS, Dethier MN (1994) A functional group approach to the structure of algal-dominated communities. Oikos 69: 476-498

Steneck RS, Watling L (1982) Feeding capabilities and limitation of herbivorous molluscs: a functional group approach. Mar Biol 68: 299_319

Table 1: Composition and distribution of algal taxa per MFG.

Taxa per MFGs per Site	Site 1	Site 2	Site 3	Site 4
Corticated macrophyte				
Agardiella sp				1
Chondria sp		1		
Coelothrix sp		1		
Gelidiopsis sp			1	
Gelidiopsis variabilis	1			
Gracilaria dominguensis	1			
Hypnea spinella	1	1	1	1
Chondrophycus poiteaui	1		1	
Corticated polysiphonus filament				
Ceramium cimbricum		1	1	1
Ceramium cruciatum		1	1	1
Gayliella flaccida	1	1		
Heterosiphonia gibessi		1		
Neosiphonia sphaerocarpa		1		
Polysiphonia binneyi				1
Polysiphonia howey			1	
Polysiphonia sp	1	1		
Spyridia filamentosa	1		1	1
Filament				
Asparagopsis taxiformis		1	1	1
Ptilothamnion speluncarum	1			
Boodleopsis pusilla		1		
Chaetomorpha sp.		1		
Cladophora laetevirens		1	1	1
Cladophora sp	1			1
Rhizoclonium riparium		1		
Sphacelaria rigidula	1	1		
Corticated foliose				
Halymenia floresia	1			
Foliose				
Colpomenia sinuosa		1		
Corticated foliose				
Canistrocarpus cervicornis	1	1	1	1
Canistrocarpus crispatus				1
Dictyota menstrualis		1		1
Dictyota mertensii				1
Dictyopteris delicatula	1	1	1	1
Dictyopteris plagiograma		1		
Dictyopteris polipodioides		1		
Padina sancte-crucis		1		
Leathery macrophyte				
Sargassum hystrix	1	1		
Coenocytic				
Caulerpa brachypus				1
Caulerpa racemosa		1	1	1
Caulerpa verticillata			1	
Caulerpella ambigua				1
Caulerpa webbiana		1		
Codium isthmocladum	1	1		
Calcareous green				
Halimeda discoidea	1	1		
Halimeda incrassata		1		
Halimeda scabra	1			
Halimeda tuna	1	1		1
Penicillus dumetosus	1			
Udotea cyathiformis		1		
Microalgae				
Scytonema sp	1	1		
Oscillatoria sp		1	1	1
Lyngbya majuscula	1		1	1
Articulated calcareous				
Amphiroa fragilisima		1	1	1
Jania adhaerens			1	1
Jania capillacea	1	1	1	
Jania pumilla	1	1	1	1