Patterns of the Benthic Community Structure in Coral Reefs of the North Western Caribbean

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ABSTRACT

Data on the benthic community structure of six coral reefs of the Mexican portion of the Mesoamerican Barrier Reef System using the photographic-transect method, aimed to describe the structural patterns in each reef, and comparing differences between shallow and deep reefs. In the shallow stratum (Colombia 6-7m, Chankanaab 6m, Majahual 1-6m and Akumal 8m) hexacorals, sponges and algae dominated, with 38%, 34.6% and 14.5% of abundance, respectively. The species most commonly found were: *Montastrea annularis, Agaricia agaricites, Agaricia tenuifolia, Siderastrea siderea, Diploria strigosa, Agelus sp, Pandarus acanthifolium, Haliclona hogarthi, Neofibularia nolitangere, Cliona delitrix, Dictyota dicthiota, Penicillus dumetosus and Halimeda opuntia*. Hexacorals and sponges dominated in the deep stratum (Chankanaab 30m, Chemuyil 20-27m, and Palancar 16-20, 17, 22 and 27m), with 38% and 29% of total abundance, respectively. The species most commonly found were: *Montastrea annularis, Acropora cervicornis, Agaricia agaricites, Montastrea cavernosa, Goreauiella auriculata, Agelus sp, Cliona lampa and Chondilla nucula*. The Mexican Caribbean reefs display some differences in the benthic community structure and composition, which are determined by depth. It is likely that the differences detected in the community structure also depend on other unidentified extrinsic and intrinsic factors, which may be regulating the benthic community dynamics of these coral reefs.

KEY WORDS. Structure, diversity, benthic community, coral reef, Mesoamerican Barrier Reef System

Patrones Estructurales De La Comunidad Bentonica En Arrecifes Del Caribe

Se obtuvieron datos de abundancia a través de transectos fotográficos en 1989 y 1990, entre 1-15m y 15-30m de profundidad en los arrecifes Colombia, Chankanaab, Palancar, Chemuyil, Akumal y Majahual, con la finalidad de determinar los patrones estructurales de cada arrecife y comparar las diferencias entre arrecifes someros y profundos. En el estrato somero (Colombia 6-7m, Chankanaab 6m, Majahual 1-6m y Akumal 8m) dominaron los hexacorales, esponjas y algas, con el 38%, 34.6% y 14.5% de la abundancia total respectivamente. Las especies más comunes encontradas son: *Montastrea annularis, Agaricia agaricites, Agaricia tenuifolia, Siderastrea siderea, Diploria strigosa, Agelus sp, Pandarus acanthifolium, Haliclona hogarthi, Neofibularia nolitangere, Cliona delitrix, Dictyota dicthiota, Penicillus dumetosus y Halimeda opuntia*. En el estrato profundo (Chankanaab 30m, Chemuyil 20-27m, y Palancar 16-20, 17-22 y 27m) están dominados por hexacorales y esponjas con el 38% y 29% de la abundancia total respectivamente. Las especies más comunes encontradas son: *Montastrea annularis, Acropora cervicornis, Agaricia agaricites, Montastrea cavernosa, Goreauiella auriculata, Agelus sp, Cliona lampa y Chondilla nucula*. Los arrecifes del Caribe Mexicano presentan algunas diferencias en la estructura y composición de la comunidad bentónica, las cuales están determinadas por la profundidad. Es muy probable que las diferencias encontradas en la estructura de la comunidad bentónica también dependan de otros aspectos extrínsecos e intrínsecos no identificados, los cuales estén regulando la dinámica de la comunidad bentónica en los arrecifes coralinos del Caribe Mexicano.

PALABRAS CLAVES. Estructura, diversidad, comunidad bentónica, arrecife coralino, arrecife mesoamericano.

INTRODUCTION

Coral reefs are an expression of a strong interdependence between the physical environment and organic activity. Physical factors are driving forces of their specific composition (Jones y Endean 1977). Wave action, tides and currents affect benthic life at the coastal zone shaping the structure and composition of the coral reef community and particularly on the benthic ecology. In shallow reefs, there is a strong control of coral growth by the tides, currents, light, depth, as main factors (Glynn 1976); by contrast in deep reefs, the light and biological factors play a very significant role in the community structure (Liddell 1987). Therefore, the light, sediment deposition rate, and wave action are the main environmental variables responsible for the zoning of the coral reef community.

Along the eastern coast of Yucatán, some fringing reefs are forming a discontinuous windward barrier, where the coral reefs Akumal, Majahual, and Chemuyil are found. These reefs are characterized by profuse patches of *Acropora palmata* and *Millepora complanata*; other important components of the community are octocorals and algae (Jordan 1989). On the south west coast of Cozumel, a series of leeward reef formations with different degree of development are found like in the reefs Chankanaab, Palancar, and Colombia; these reefs are characterized by a high density of its components, and where stony corals are not dominant, but sponges and algae are the dominant elements of the benthic community (Jordan 1988).

This work presented here was made with the purpose of examining the effects of differential expression of the environmental driving forces on the structure of the coral reef community on six coral reefs along the coast of eastern Yucatán, trying to find some patterns of response expressed as common characteristics of the composition of the coral reef community.

METHODS

Six coral reefs of the northern part of the Mesoamerican barrier Reef System (MBRS) were examined: *Chankanaab, Chemuyil, Colombia, Akumal, Majahual* and *Palancar* (Fig. 1). Data on the species composition and density of the main components of coral community were obtained by means of scuba diving and using the photographic transect in depths comprised between one and 30 meters. Each transect contained nearly 30 pictures taken at about the same depth and perpendicularly to the ground and to a constant distance of 0.80 m, determined by a stick attached to the camera. Distance between every two samples was 2 m approximately. The area covered by each photographic sample was about 1 m^2. For the analysis of data, the method used by Olhorst *et al.* 1988 was adopted; it consists in the projection of each slide on a screen with 31 points randomly distributed on it, then each species under each point was recorded. The analysis of data was conducted by depth strata and results of each reef were compared to those obtained at other reefs.

The composition of the community was analyzed by using the spectrum of diversity, measured by using the Shannon and Weaner formula: $H=-Sp_i(\log_2 p_i)$ (Ludwig y Reynolds, 1988). Equitability J´ (J'=H'/H'max) by (Pielou, 1966) was also used. Sanders´ Index of Biological Value was also applied to all of the species recorded proving an indication of total dominance, based in ranks and points (Loya-Salinas, *et al.* 1990). Finally, some tests of multivariate statistics, like cluster analysis and principal components were applied with the purpose of exploring the possible existence of common patterns of organization of the community as consequence of under different expression of driving factors (Margalef, 1974).

RESULTS

Abundance of the main species in the six reefs mentioned was analyzed including 45 families, 75 genera, and 127 species (Table 1). The methods described in above paragraphs were applied to each reef.

Species Composition

Colombia reef Samples were collected between 6 and 7 meters. A total of 70 species was recorded, 26 of which correspond to hexacorals, 28 to sponges, 5 to octocorals, 7 to algae, and 4 to other organisms. Abundant group in the reef consisted of sponges with 28 species and 354 colonies, accounting for 53.6 % of total abundance, followed by 26 hexacorals species with 151 colonies, accounting for 22.9%. (Fig.1).

Chemuyil reef was recorded in only one depth stratum, 20-27 meters. A total of 70 species was recorded, 24 of which belong to hexacorals, 15 to octocorals, 13 to algae, 12 to sponges and 6 to other benthic organisms. The hexacorals with 21 species and 126 colonies represent 52.1% of total abundance and 14 octocorals species with 81 colonies representing 33.5% of abundance. (Fig.1).

Chankanaab reef samples were obtained in two strata, 6 and 30 meters. *6 m stratum*: A total of 32 species was

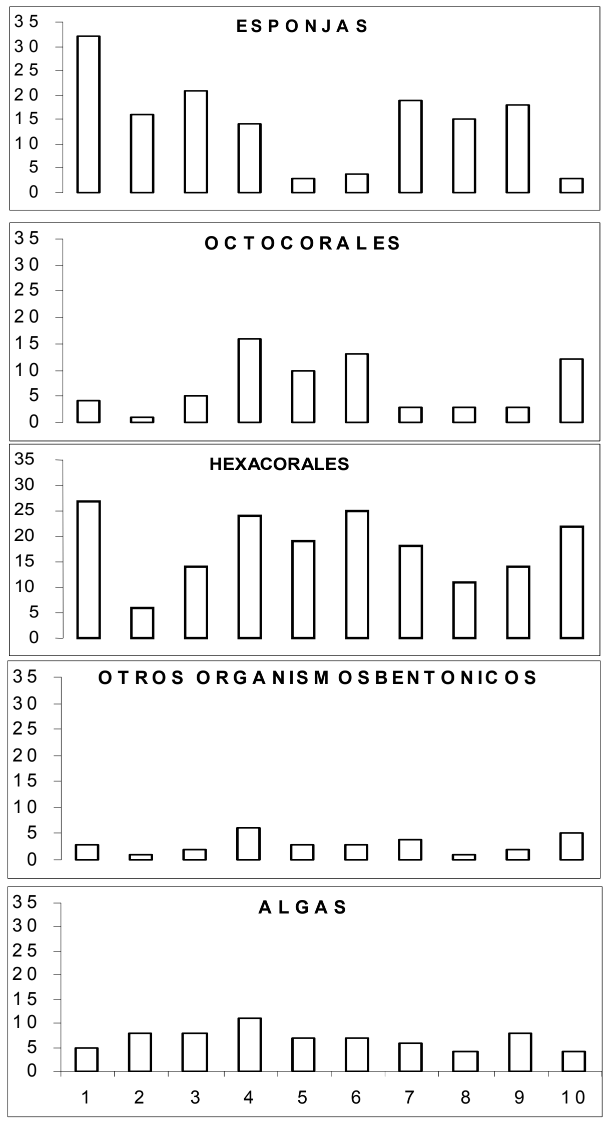

Figure 1. Species riqueza each taxonomic group in the north western Caribbean coral reefs. 1. Colombia 6-7 m, 2. Chankanaab 6 m, 3. Chankanaab 30 m, 4. Chemuyil 20-27 m, 5. Majahual 1-6 m, 6. Majahual 6-7 m, 7. Palancar 16-20 m, 8. Palancar 17-22 m,9. Palancar 27 m y 10. Akumal 8 m

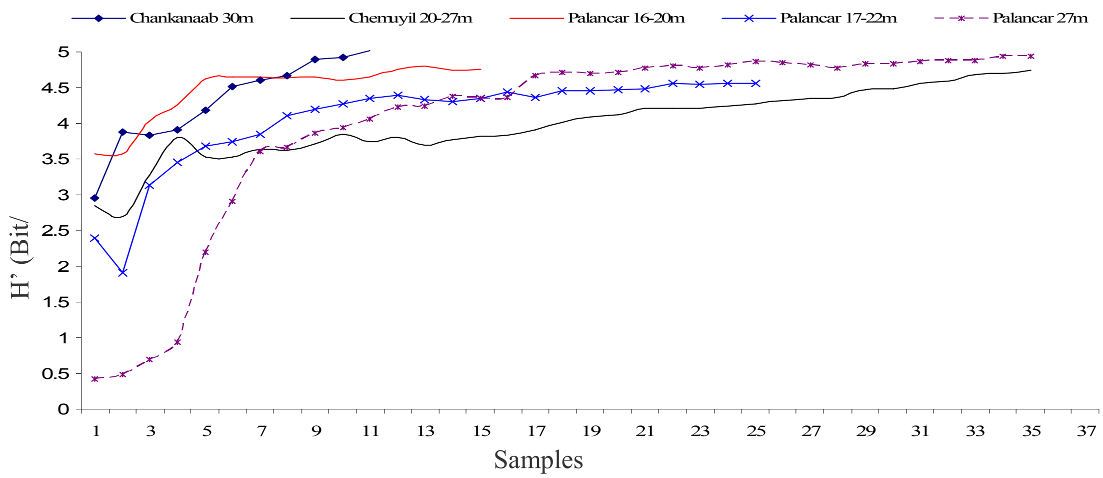

Figure 2. Diversity spectrum for deep reefs.

recorded, 15 of which corresponded to sponges, 9 to algae, 5 to hexacorals, 2 to octocorals and 1 to other benthic organisms. Sponges with 15 species and 45 colonies, represents 23.8% of total abundance; although sponges included the highest number of species, these were not the most abundant ones. Algae with 9 species and 74 colonies, accounted for 39.2% of total abundance, being the most abundant group; hexacorals with 5 species and 58 colonies contributed to 30.7%. *30 m stratum*: A total of 50 species was recorded, 20 of which corresponded to sponges, 14 to hexacorals, 9 to algae, 6 to octocorals and 1 to other benthic organisms. The sponges with 20 species and 77 colonies, represents 34.8% of total abundance; although sponges were the group with the highest number of species, these were not the most abundance ones. Hexacorals, with 14 species and 86 colonies, accounted for 38.9% of total abundance. (Fig.1).

Palancar reef was divided into three substrates: 16-20, 17-22 y 27 meters depth, respectively. *16-20 m stratum*: A total of 50 species was recorded, 18 of which belong to hexacorals, 17 to sponges, 9 to algae, 4 to other benthic organisms and 2 to octocorals. The hexacorals with 17 species and 112 colonies, accounting for 40.8% of total abundance, followed by algae with 9 species and 84 colonies, representing 30.6% of total abundance. *17-22 m stratum*: A total of 33 species was recorded, 12 of which belong to sponges, 11 to hexacorals, 7 to algae, 3 to octocorals and 1 to other benthic organisms. The sponges with 12 species and 202 colonies representing 37.4% of total abundance followed by hexacorals with 14 species and 163 colonies represents 30.3% of total abundance. *27-m stratum*: A total of 45 species were recorded, 15 of which belong to sponges, 14 to hexacorals, 10 to algae, 4 to octocorals and 2 to other benthic organisms. The sponge with 18 species and 259 colonies, accounted for 38.48% of total abundance, followed by hexacorals with 18 species and 230 colonies, representing 34.18% of total abundance. (Fig.1).

Majahual reef was divided in two substrates: 1-6 and 6-7 meters deep, respectively. *1-6 m stratum*: A total of 33 species was recorded, 16 of which belong to hexacorals, 6 to octocorals, 4 to sponges, 5 to algae and 2 to other benthic organisms. The hexacorals with 19 species and 272 colonies represents 55.2% of total abundance, followed by octocorals with 8 species and 101 colonies. *6-7 m stratum*: A total of 43 species was recorded, 20 of which belong to hexacorals, 12 to octocorals, 4 to sponges, 4 to algae and 3 to other benthic organisms. The hexacorals with 20 species and 85 colonies, accounting for 52% of total abundance, followed by octocorals with 12 species and 48 colonies, accounting for 29.2% of total abundance. (Fig.1).

Akumal reef recorded only at 8 meters depth: A total of 47 species was recorded, 24 of which belong to hexacorals, 11 to octocorals, 2 to sponges, 4 to algae and 5 to other benthic organisms. The hexacorals with 24 species and 119 colonies account for 56.2% of total abundance and 11 octocorals species with 51 colonies, representing 24.3% of total abundance. (Fig.1).

Diversity spectrum, dominance and evenness

Colombia reef *6-7 meters stratum*. The dominant group in the community was sponges with *Pandaros acanthifolium* is the most important species in the community, followed by *Agelus sp.* The diversity index of this reef was 5.257 bits/ind, with an evenness of J = 0.855. (Fig. 3).

Chankanaab reef *6 meters stratum*. The dominant group was algae with *Penicillus dumetosus*, being the most important species in the community, followed by *Agelus sp.* The diversity index for the 6 meters stratum in Chankanaab reef was 4.264 bits/ind, with a mean evenness of 0.853. (Fig. 3). At the *30 meters stratum*, the dominant group in the community was the sponges with *Agelus sp.* representing the most important species in the community, followed by *Agaricia agaricities.* The total diversity of this stratum at Chankannab reef was 5.022 bits/ind, with a mean evenness of J = 0.890. (Fig. 2).

Majahual reef *1-6 meters stratum*. The dominant

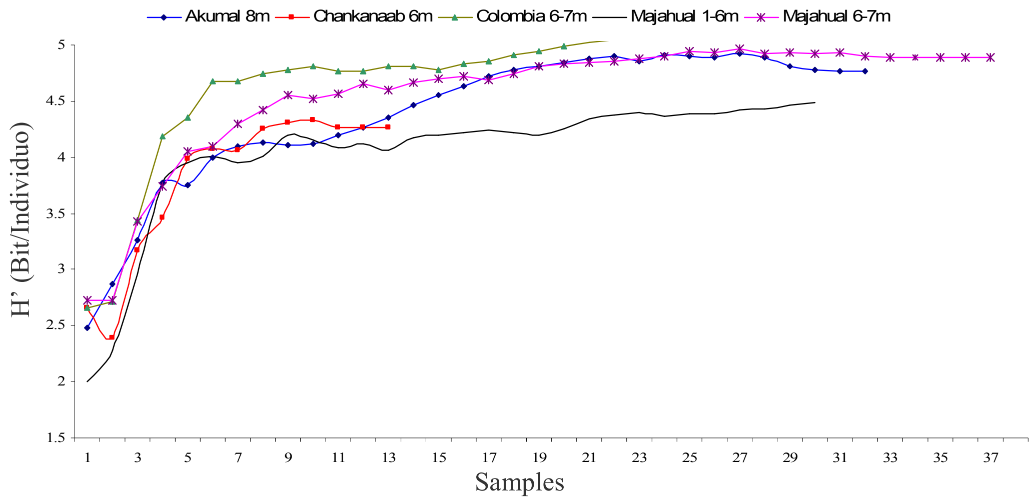

Figure 3. Diversity spectrum for shallow coral reefs

group corresponded to hexacorals, although the *Gorgonia flabellum* from the octocorals group is the most important species in the community, followed by *Jania sp.* The diversity index for the 1-6 meters stratum in this reef was 4.488 bits/ind, with a mean evenness value of 0.859. At the *6-7 meters stratum* of this reef, the dominant group is hexacorals, where *Diploria strigosa* is the most important species in the community, followed by the algae *Dictyota dicthiota.* The diversity index for the 6-7 meters stratum in this reef is 4.888 bits/ind, with a mean evenness value of 0.857. At the *8 meter- stratum*, the most dominant group corresponds to hexacorals, where *Montastrea annularis* is the most important species in the community, followed by the algae *Dictyota dicthiota.* (Fig. 3).

Chemuyil reef *20-27 meters stratum*. The most dominant group was hexacorals with *Montastrea anularis*, being the most important species in the community, followed by *Acropora cervicornis.* The diversity index for the Chemuyil reef was 4.735 bits/ind., with a mean evenness of 0.772. (Fig. 2).

Palancar reef *16-20 meters stratum*. The most dominant group corresponded to sponges, with *Goreauiella auriculata* was the most important species in the community, followed by *Udotea cyathiformis.* The diversity index for the 16-20 meters stratum in this reef was 4.941 bits/ind, with a mean evenness value of 0.832. *17-22 meters stratum* the most dominant group was sponges, with *Goreauiella auriculata* being the most important species in the community, followed by *Agelus sp.* The diversity index for the 17-22 m stratum in this reef was 4.569 bits/ind, with an evenness value of 0.832. At the *27 meters stratum*, the most dominant group was Hexacorals, although *Goreauiella auriculata* species of the sponges group was the most important species in the community, followed by *Agaricia agaricites.* The diversity index for the 27 m stratum in the Palancar Reef was 4.69 bits/ind, with an evenness value of 0.855. (Fig. 2).

DISCUSSION

Sampling: Among the inconveniencies encountered during the course of the study, there is the period to which data correspond, and the assumption that results reflecting the current characteristics in the study area could be questioned. However, it is worth remembering that the complexity in these communities, both in ecological and evolutionary terms, favors slow changes in the community structure. The photograph-transect method used for this study allowed to conduct a detailed analysis of the data obtained. Olhorst *et al.* (1988), compared this method with several others used for studying benthic communities, and found that the former was the most convincing one, given that it enables to obtain a larger sample size, conduct a detailed analysis, and invest less time in sampling. Nonetheless, it is worth noting that a shortcoming that might bias results obtained with this method is that it may underestimate the number of species or colonies recorded in up to 30%. (Olhorst *et al.* 1988).

Another aspect worth to mention, is in reference to diversity. In most studies, diversity is just a useful value for comparing communities. A method used in this study is the calculation of diversity through its spectrum, which depends on sample size. The notion of a spectrum leads to consider the use of diversity as an excellent method for comparing different samples: if diversity increases after pooling samples, this demonstrates their heterogeneity, but if it remains unchanged, this means that both communities include either the same species or species with the same role in the ecosystem (Margalef, 1974). This method's usefulness allows detecting fluctuations in diversity across the study area, providing a better insight on the spatial hetero-

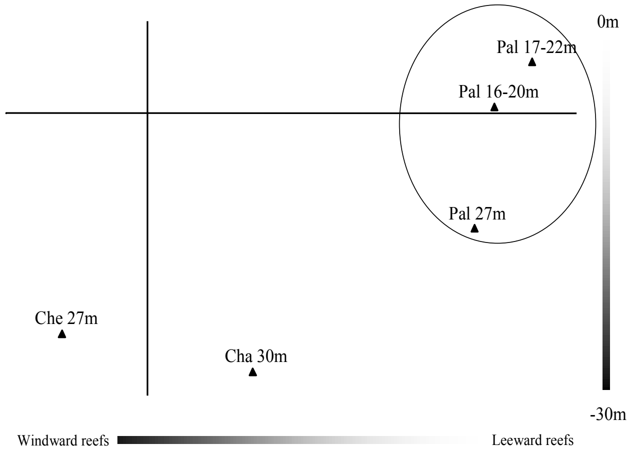

Figure 4. Principal component analysis for deep reefs.

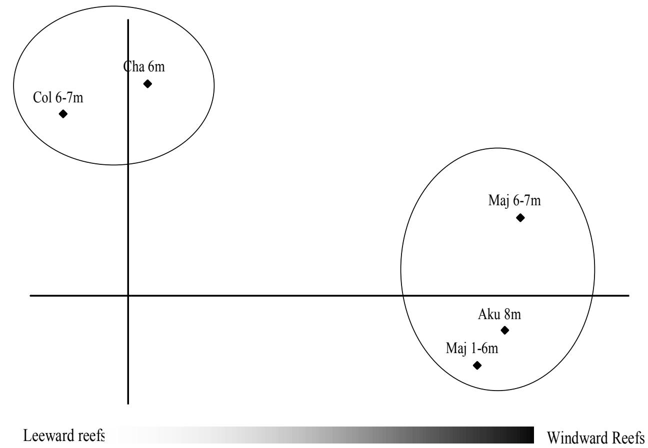

Figure 5. Principal component analysis for shallow reefs.

geneity and differences between similar communities. The samples analyzed did not correspond to the same sampling effort, so that these had to be standardized in order to make the abundance width equal and thus avoid any bias when comparing sampling areas with one another.

Zoning: Glynn (1976) y Liddell *et al.* (1987), state that factors determining the structure of the benthic community of coral reefs are driven by physical forces imposing clear patterns in their structure, more evident at shallow reef areas, but well expressed in deeper levels; in the shallow portions, wave action and strong light intensity allow the establishment of branching and fragile corals, whilst in deeper levels massive species with slow growth rates are more successful. Here, reef shape imposes two basic patterns of environment, one windward where octocorals and round stony corals are dominant and on the lee side, where water column is more stable, massive sponges characterize the physiognomy of the reef community. The species zoning observed also has some exceptions, in those shallow areas protected from the wave action. The expression of these patterns does not mean that biological forces are not important, non the less, being the habitat basically constant, allowing the establishment of very stable communities, this characteristic allows the expression of strong competition among reef dwellers in favor of adaptive radiation expressed over time as a very high species diversity.

Results obtained after the application of multivariate statistics, like cluster and principal components analysis, provide evidence confirming the empirical observations described in the above paragraph, finding four scenarios: a) shallow reefs, b) deep reefs, c) leeward reefs, and d) windward reefs; all of them presented a clear separation as a result of the relative importance of the light intensity (or depth) and the exposure to wave action. In reefs located leeward like Colombia, Chankanaab, and Palancar dominant elements of the community are sponges and stony corals, where species like Agelus *sp, Pandarus acanthifolium, Agaricia agaricites, Montastrea annularis, Haliclona hogarthi, Neofibularia nolitangere, Cliona delitrix, Hemectyon ferox, Verongia longissima, Plexaurella dichotoma, and Plexaurella grisea* are dominant.

By contrast, dominant elements at windward reefs (Chemuyil, Majahual y Akumal) are stony corals, soft corals and algae. Among these, *Agaricia agaricites, Dictyota dicthiota, Gorgonia ventaliva, Pseudopterogorgia americana, Pseudopterogorgia acerosa, Acropora palmata, Gorgonia flabellum, Plexaurella dichotoma, Pseudopterogorgia bipinata, Halimeda opuntia, and Diploria strigosa* are dominant in the coral reef community.

In shallow reefs: Colombia 6-7 m, Chankanaab 6 m, Majahual 1-6 m, 6-7 m, and Akumal 8 m. (Fig.5), dominant species are *Montastrea annularis, Agaricia agaricites, Agaricia tenuifolia, Siderastrea siderea, Diploria strigosa, Agelus sp, Pandarus acanthifolium, Haliclona hogarthi, Neofibularia nolitangere, Cliona delitrix, Dictyota dicthiota, Penicillus dumetosus, Halimeda opuntia, Plexaurella dichotoma,* and *Plexaurella grisea,* some of them are characteristically small and fast-growing species well adapted to strong turbulence of water and high light intensity.

By contrast, dominant species at deep reefs: Chankanaab 30m, Palancar 16-20 m, 17-22 m, 27 m y Chemuyil 27 m (Fig. 4), are *Montastrea annularis, Acropora cervicornis, Agaricia agaricites, Montastrea cavernosa, Goreauiella auriculata, Agelus sp, Cliona lampa, Plexaurella dichotoma, Pseudopterogorgia bipinata, Halimeda Incrassata, Chondilla nucula,* and *Halimeda copiosa*, some of them are characteristically slow-growing species well adapted to low water movement and dim light.

Reef maturity is an indicator of environmental stability in the region, which has allowed to reach such complexity levels that evolutionary pressures are oriented towards the formation of new niches, an increase in species diversity and, consequently, a progressively more complex trophic network, contrasting with more extreme environments, where environmental variability constrains the formation of new niches and, hence, of new species, tending to maintain a less mature trophic network.

It is hoped that studies like the present one may be useful as a baseline helping in the process of decision-making for informed management dealing with the management and preservation of coral communities. Nowadays, tourist development has become a major threaten to coral reef conservation for the MBRS; in this study area, hugh tourist development has reached high levels in Cancún and along the Riviera Maya route, where huge investments are being undertaken impelling this development and threatening the persistence of :shallow fringing reefs along this corridor. Economic development brings some economic benefits, creating more employment, but this well being is just apparent, and it seems to be more like a mirage, because most investments belong to capital, most of the labors they create are low level jobs and most profits leave the Country. But the new immigrants demand resources that the locality is not able to support and provide for long time; so, the pressure leads local environment and its resources to depletion, as occurred in the Cancun area, where the fisheries attained their maximum production level in 1985, falling into a complete collapse short time afterwards.

LITERATURA CITADA.

Pielou, E.C. 1966. The measurement of diversity in different types of biological collections. *J Theoret. Biol.* **13:** 131-144.

Margalef, R. 1974. Ecología. Ed. Omega S.A. Barcelona, España.

Glynn, P. 1976. Some Physical and Biological Determinats of Coral Community Structure in the Eastern Pacific. *Ecol. Monogr.* **46**:431-456.

Jones, A. O. and R. Endean. 1977. Biology and Geology of Coral Reef. Vol. IV. Geology 2. Academic Press. USA. p.377.

Liddell W.D., Ohlhorst S. 1987. *Patterns of community structure, north Jamaica*. *Bull. Mar. Sci*. **40(2)**: 311-329.

Jordán, D. E. 1988. Arrecifes Profundos de Isla Cozumel, México. An. Cienc. del Mar y Limnol. UNAM. 15(2): 195-208.

Ludwig, J.A. and Reynolds, J.F. 1988. Ecological community data In: Statistical Ecology. A Primer on Methods and Computing. John Wiley & Sons, New York, 337p.

Table 1. Benthic community abundance identify in north western Caribbean coral reef. *Species present in all coral reef survey. (Col-Colombia, Che-Chemuyil, Cha-Chankanaab, Pal-Palancar, Maj-Majahual y Aku-Akumal).

Species	Col 1-6m	Che 27m	Cha 6m	Cha 30m	Pal 16-17m	Pal 17-22m	Pal 27m	Maj 1-6m	Maj 6-7m	Aku 8m
Acropora cervicornis	-	178	-	2	-	-	-	2	-	11
Acropora palmata	1	1	-	-	-	-	-	44	-	19
Adocia carbonaria	3	7	-	1	3	14	23	-	-	8
*Agaricia agaricites**	37	44	3	12	9	14	31	13	10	63
Agaricia fragilis	4	4	-	1	2	7	10	-	-	3
Agaricia lamarcki	3	6	-	-	-	34	10	-	-	9
*Agaricia tenuifolia**	12	15	4	4	4	8	21	23	51	14
Agaricia undata	-	-	-	-	1	-	-	-	-	-
Agelus sp.	66	-	5	20	10	47	13	-	-	-
Amphimedon viridis	-	1	-	-	8	-	4	-	2	-
Amphiroa sp.	-	-	-	-	1	-	-	2	-	-
Anthipates sp.	2	4	-	-	-	-	-	-	1	2
Anthosigmella varians	-	-	-	-	12	7	18	-	-	-
Aplysina fistularis	-	-	-	-	1	6	-	-	-	-
Avrainvillea nigricans	-	-	1	-	-	-	-	2	-	-
Briareum asbestinum	2	25	-	3	-	-	14	-	-	3
Begula neritina	-	1	-	-	-	-	-	-	1	-
Callyspongia plicifera	1	-	-	1	-	-	-	-	-	-
Ceratoporella nicholsoni	16	4	-	-	8	-	-	7	2	-
Cinachyra sp.	3	-	-	-	1	-	-	-	-	-
Cliona delitrix	27	-	2	-	-	-	-	-	-	-
Cliona lampa	5	-	-	5	10	7	19	-	-	-
Cliona langa	-	-	-	-	-	9	9	-	-	-
Codium decorticatum	-	-	-	-	-	-	4	-	-	-
Colpophyllia breviserialis	3	-	-	-	-	10	-	-	10	2
Colpophyllia natans	8	-	-	-	-	4	2	1	3	-
Condylactis gigantea	-	-	-	-	2	-	-	-	-	-
Chondrilla nucula	18	3	8	4	7	31	18	-	-	-
Dasychalina cyathina	10	-	1	1	-	-	-	-	-	-
Dendrogyra cylindrus	-	3	-	-	-	-	-	43	-	-
Diadema antillarum	-	-	-	-	-	-	-	2	-	-
Dictyota dicthiota	2	5	-	5	1	2	-	31	22	64
Dichocoenia stokesi	6	-	-	2	-	-	-	1	9	5
Didiscus sp.	-	-	-	-	-	-	2	-	-	-
Diplora strigosa	-	12	-	16	-	-	-	22	54	16
Diploria clivosa	4	2	-	-	-	-	-	-	1	3
Diploria labyrinthiformis	-	-	-	-	-	-	-	-	5	12
Eunicea mammosa	-	8	-	-	-	-	-	1	15	-
Eusmilia fastigiata	8	-	-	2	2	-	2	-	3	-
Favia fragum	-	-	-	-	2	-	-	1	-	-
Golloides ramosa	9	-	-	-	4	-	-	-	3	-
Goreauiella auriculata	-	4	2	11	32	54	95	-	-	-
Gorgonia flabellum	-	26	-	1	-	-	-	63	15	17
Gorgonia ventalina	-	6	1	-	-	-	-	-	-	33
Haliclona hogarthi	31	12	3	7	3	-	19	-	-	-
Haliclona rubens	-	-	-	-	2	-	-	-	-	-

Table 1. Continued.

Halimeda copiosa	-	11	3	3	-	35	24	1	-	-
Halimeda discoidea	-	3	-	-	-	-	-	-	-	-
Halimeda goreaui	18	3	6	2	7	2	5	-	3	8
Halimeda incrassata	12	16	12	2	15	28	13	-	-	-
*Halimeda opuntia**	14	8	-	7	4	2	17	5	22	16
Helioseris cuculata	2	-	-	-	1	-	-	-	2	-
Hemectyon ferox	25	3	-	4	-	-	3	-	-	-
Homotrema rubrum	-	4	-	3	-	-	4	-	-	3
Iciligorgia schrammi	3	1	-	-	-	-	27	-	-	-
Iotrochota birotulata	1	-	-	-	-	21	-	-	-	-
Ircina campana	1	-	1	1	-	-	-	-	-	-
Ircina fasciculata	-	-	-	1	-	-	-	-	-	-
Ircina strobilina	13	1	-	1	-	-	3	-	-	-
Isophyllia sinuosa	-	-	-	-	-	-	-	2	4	-
Isophyllastrea rigida	-	-	-	-	-	-	-	-	1	-
Jania sp.	-	-	-	-	-	-	-	37	7	-
Leucosolenia canariensis	1	-	-	-	1	-	-	-	-	-
Lobophora variegata	-	2	7	-	-	-	-	-	1	-
Madracis decactis	2	-	-	-	1	-	-	4	-	-
Madracis mirabilis	-	8	-	-	-	-	-	-	1	-
Manicina areolata	-	-	-	-	1	-	-	-	-	-
Meandrina meandrites	2	1	-	1	1	-	-	-	1	-
Millepora alcicornis	1	10	-	-	-	-	-	6	18	16
Millepora complanata	6	2	-	-	-	-	-	3	8	9
*Montastrea annularis**	8	109	26	20	3	4	47	25	28	118
Montastrea cavernosa	-	5	12	10	23	-	43	-	3	-
Muricea muricata	1	9	-	-	-	-	-	6	13	-
Mussa angulosa	1	-	-	-	-	-	-	-	-	-
Muriceopsis flavida	-	-	11	1	-	-	-	2	22	7
*Mycale laevis**	5	12	2	8	1	2	12	1	-	6
Mycale sp.	4	-	1	2	1	-	-	-	-	-
Mycetophyllia aliciae	3	1	-	-	1	4	-	-	-	-
Mycetophyllia danaana	3	2	-	-	1	-	-	-	1	-
Mycetophyllia ferox	2	-	-	-	-	-	-	-	-	8

Table 1. Continued.

M. lamarckiana	1	5	-	-	1	3	2	-	-	-
Nemaster rubiginosa	-	2	-	-	-	-	-	-	-	-
Neofibularia nolitangere	28	-	5	2	11	7	-	-	-	-
Palythoa caribaeorum	3	2	-	-	1	-	-	9	29	4
Pandaros acanthifolium	63	-	-	-	-	-	-	-	-	2
Panulirus guttatus	-	-	-	-	-	-	-	-	-	9
Penicillus capitatus	-	-	3	1	-	-	-	1	-	-
Penicillus dumetosus	-	1	33	10	-	-	6	1	4	-
Plexaura flexuosa	-	14	-	-	-	-	-	5	17	12
Plexaura homomalla	-	9	-	-	-	-	-	7	4	7
Plexaurella dichotoma	20	36	8	8	5	3	3	-	18	17
Plexaurella grisea	19	10	-	-	-	-	-	-	3	4
Plexaurella porosa	4	4	-	-	-	-	-	5	-	-
Porites astreoides	1	8	-	-	-	-	7	40	10	12
Porites divaricata	-	4	-	-	2	-	-	8	6	3
Porites furcata	-	3	-	-	-	5	-	-	-	2
Porites porites	4	8	-	3	-	-	-	26	2	9
Pseudoplexaurella porosa	-	34	-	6	-	-	6	-	8	4
P. acerosa	-	18	-	-	-	-	-	10	34	26
P. americana	-	17	-	-	-	-	-	7	3	29
P. bipinnata	-	67	-	1	1	-	-	9	5	17
Rhipocephalus phoenix	-	-	-	1	-	-	-	-	-	-
Sargassum sp	-	-	-	-	-	-	-	-	3	-
Sertulariella speciosa	-	-	-	-	4	9	21	-	-	-
Siderastrea radians	11	-	-	5	-	-	22	-	16	8
Siderastrea siderea	12	5	13	6	-	-	2	5	31	14
S. coralliphagum	14	2	-	4	6	7	7	-	-	-
*Solenastrea bournoni**	6	11	-	2	2	7	24	3	7	3
Spinosella vaginalis	5	-	-	-	-	-	-	-	-	-
S. michelinii	-	-	-	-	3	-	3	-	-	5
Stromatospongia norae	-	1	-	-	-	-	9	-	-	-
Tedania ignis	4	-	-	1	-	-	-	-	-	-
Tethya sp.	3	1	1	1	-	-	-	-	-	-
Turbinaria turbinata	-	-	-	-	-	-	-	7	-	-
Udotea cyathiformis	-	-	-	-	44	38	-	-	-	-
Udotea spinulosa	-	1	1	-	-	-	-	-	1	-
Ulosa hispida	2	-	1	1	-	7	28	-	-	-
Valonia macrophysa	-	-	-	-	-	-	2	-	-	-
Valonia ventricosa	4	2	-	-	-	-	4	-	-	-
Verongia fistularis	-	-	2	-	-	-	-	-	-	-
Verongia longissima	23	1	3	3	2	9	15	-	-	-
Verongia sp.	3	2	-	-	-	-	-	-	-	-
Xestospongia muta	18	-	-	-	-	-	-	-	-	-
Xestospongia sp.	1	-	5	2	1	-	-	-	-	-
Zoanthus sociatus	1	8	3	-	5	-	-	-	4	4