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Skeletal morphologic variation in *Montastrea cavernosa* (Cnidaria: Scleractinia) at Isla Verde Coral Reef, Veracruz, Mexico

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Abstract: Samples of *Montastrea cavernosa* were collected from three depth classes: 3-6, 9-12, and 15-18 m, in the leeward slope of Isla Verde Reef, Veracruz, Mexico. The number of centers per 5 cm², diameter of corallite, total number of septa per cup, and distance between corallites were determined for each colony. The observed differences between the studied characters as a function of depth class seem to be indicative of a phenotypic plasticity induced by the environment instead of genetic plasticity.

Key words: Corals, genetic, phenotypic, plasticity, skeletal.

The intraspecific morphological variability presented by scleractinian corals has been explained as a phenotypic and/or genetic response to environmental conditions (Veron 1981). Since light is linked directly to coral skeleton calcification acting upon the symbiotic zooxanthellae (Goreau 1959, 1961, 1963, Barnes 1973), it has been considered as the major ecological factor that influences the vertical distribution of scleractinian corals (Muscatine 1973). This calcification can be expressed as number of septa and corallites per area (Wijsman-Best 1974): light is possibly the most important physical factor that causes morphological variation in these organisms.

The present paper is concerned with morphological variability in *Montastrea cavernosa* (Linnaeus, 1767). This hermatypic species was chosen, because of it's ecological importance (in area covered and abundance) in front of the Port of Veracruz (Bravo-Ruíz *et al.* 1989).

MATERIAL AND METHODS

Samples of *M. cavernosa* were collected with hammer and chisel between March and May, 1990, in three depth classes: 3-6 m, 9-12 m, and 15-18 m, from the site known by villagers as "Las Catedrales" in the leeward slope of Isla Verde Reef, (19° 12' N, 96° 04' W), in front of the Port of Veracruz, Mexico (Fig. 1).

Twenty-four samples with ten polips, when possible of physiological separated colonies (Loya 1978) were collected in each depth class. The surface area of the skeleton of each coral sample was determined using the aluminium foil method (Marsh 1970); other measurements appear in Table 1 (each: n=10).

The specimens are deposited in the coral collection of the Instituto de Investigaciones Oceanográficas del Golfo y Mar Caribe de México (DGON-SECMAR).

RESULTS

Averages of each studied character by depth class are presented in Table 1. One-way ANOVA's after outlier rejection showed differences in total number of septa per corallite and diameter of corallite among depth classes (P=0.03 and P=0.01, respectively). Further analysis using the least significant difference

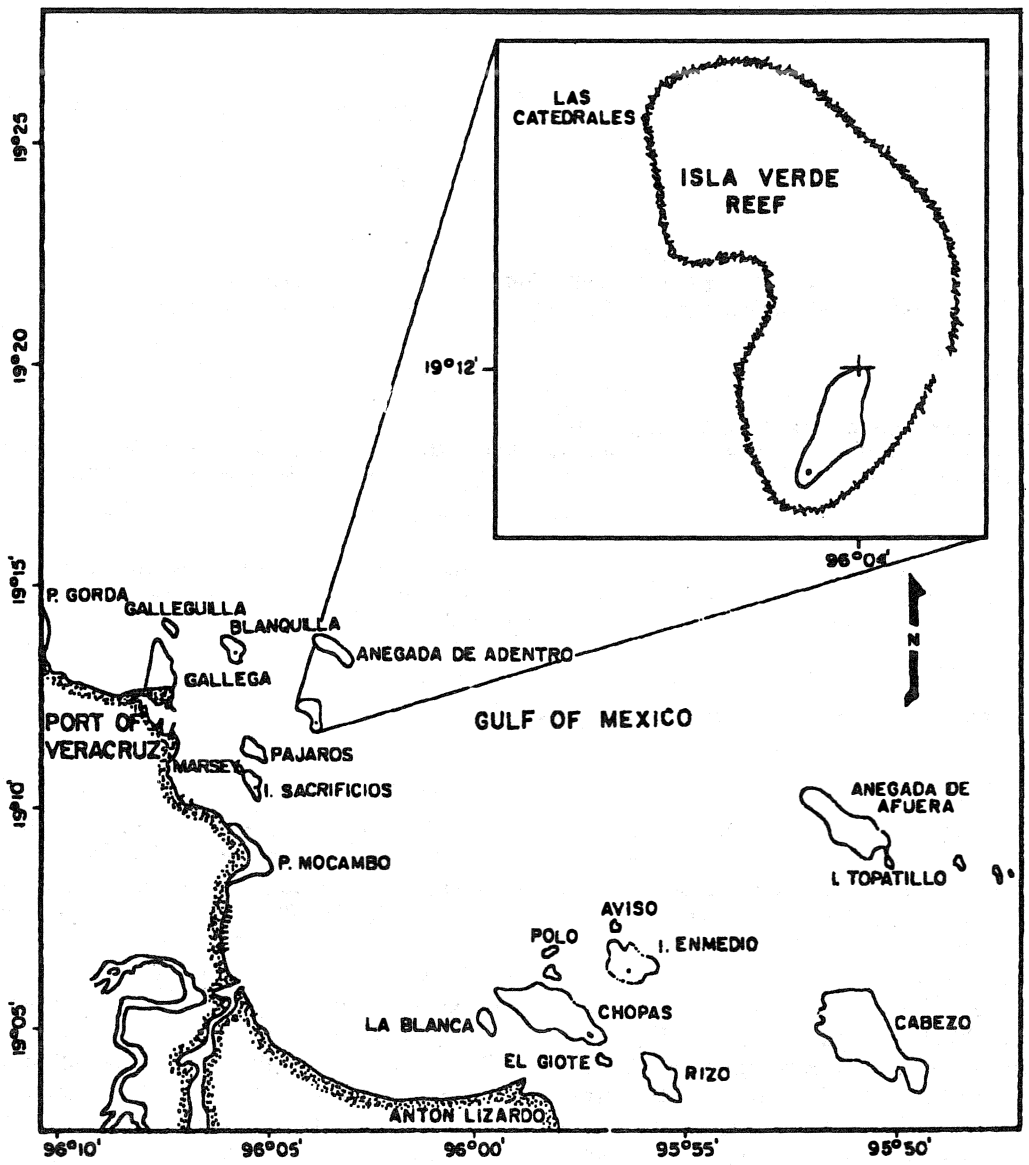

Fig. 1. Location of Isla Verde Reef.

(LSD) multiple range analysis with intervals at 95% (Tukey 1977) revealed, for these two characters, two homogeneous groups interconected by 9-12 m depth class with values at 3-6 m depth class higher than at 15-18 m depth class. The number of corallites per 5 cm² and the distance between cups did not differ significantly among depth classes (P=0.37 and P=0.23, respectively).

A simple regression analysis showed that total number of septa per cup and diameter of corallite as a function of depth class have negative trends, with low correlation values (r=-0.29 and r=-0.34, respectively).

DISCUSSION

Light intensity decreases with depth, thus the phenotypic plasticity that scleractinian corals present in response to light will be directly controled by depth; this situation was observed by Wijsman-Best (1974) with some species of *Favia*, and by Lasker (1977) for *M. cavernosa*.

TABLE 1

Means ± standard erros of means of Montastrea cavernosa *in Mexico; n= sample size*

Depth class (m)		Corallite diameter (mm)	Septa per corallite	Distance between corallites	Corallite per 5 cm²
3-6	mean	7.21	40.60	2.56	5.73
	s.e.m.	0.79	3.46	0.83	1.25
	n	24	24.00	24	24
9-12	mean	6.77	39.93	2.91	5.77
	s.e.m.	0.89	3.32	1.15	1.51
	n	24	24	24	24
15-18	mean	6.48	38.10	3.02	6.27
	s.e.m.	0.85	3.34	0.90	1.64
	n	24	24	24	24

Results in the present research show that *M . cavernosa* has intraspecific variability: the total number of septa per corallite and the diameter of corallites showed plasticity since they differed significantly among depth classes. The low correlations of these characters with depth could be indicative of typical genetic variation of the species, Amaral (1990, 1991) reported great phenotypic and genetic plasticity.

Otherwise, Mayal and Amaral (1990) reported no light-linked factors induce this plasticity; nevertheless the number of centers per 5 cm² and the distance between corallites remain relatively constant in the three depth classes. This suggest that the corals collected in the three depth classes belong to the same population, and we assume that the observed morphologic variability is caused by environmentally induced phenotypic plasticity.

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RESUMEN

En el talud de sotavento del Arrecife de Isla Verde, Veracruz, México, se recolectaron muestras de *Montastrea cavernosa* en tres clases de profundidad: 3-6, 9-12 y 15-18 m. A cada colonia recolectada se le determinó el número de centros por 5 cm², el diámetro de los coralitos, el número total de septos por copa y la distancia entre coralitos. La diferencias observadas en los caracteres estudiados en función de la clase de profundidad parecen ser indicativas de una plasticidad fenotípica inducida por el ambiente y no de plasticidad genética.

REFERENCES

Amaral, F. 1990. Morphologic variation within the reef corals *Montastrea cavernosa* (Linnaeus, 1766) and *Favia gravida* Verrill, 1868 (Cnidaria, Anthozoa, Scleractinia) from Brazil. II Congreso de Ciencias del Mar. 23a. Reunión de la Asoc. Lab. Mar. Carib. Programa/Resúmenes. Palacio de las Convenciones, La Habana, Cuba.

Amaral, F. 1991. Plasticidade morfológica de *Montastre a cavernosa* (Linnaeus, 1766) (Cnidaria, Anthozoa, Scleractinia) do Brasil (Abrolhos e Tamandaré) e México (Puerto Morelos). XVIII Congresso Brasileiro de Zoologia Resumos: 15. Universidade Federal da Bahia, Istituto de Biologia, Departamento de Zoologia. Salvador, Bahia.

Barnes, D.J. 1973. Growth in colonial scleractinians. Bull. Mar. Sci. 23: 280-298.

Bravo-Ruíz, J., J. Camacho-Ruíz & J.P. Carricart-Ganivet. 1989. Composición de especies y zonación de corales escleractinios en el Arrecife "La Blanquilla", Veracruz. X Congreso Nacional de Zoología. Programa y resúmenes: 24. México, D.F.

Goreau, T.F. 1959. The physiology of skeleton formation in corals. I. A method for measuring the rate of calcium deposition by corals under different conditions. Biol. Bull. Mar. Biol. Lab., Woods Hole 116: 59-75.

Goreau, T.F. 1961. Recent investigations on the growth of coral reefs in Jamaica. Bull. Cient. Res. Coun., Jamaica 2: 41-44.

Goreau, T.F. 1963. Calcium carbonate deposition by coralline algae and corals in relation to their roles as reef-builders. Ann. N.Y. Acad. Sci. 109: 127-167.

Lasker, H.R. 1977. Patterns of zooxanthellae distribution and polyp expansion in the reef coral *Montastrea cavernosa*. Proc. Third Internal. Coral Reef Symp. Miami, Florida 2: 607-613.

Loya, Y. 1978. Plotless and transect methods, p. 197-217. *In:* D.R. Stoddart & R.E. Johannes (eds.). Coral reefs: research methods. UNESCO, París.

Marsh, J.A. 1970. Primary productivity of reef building calcareus red algae. Ecology 51: 255-263.

Mayal, E. & F. Amaral. 1990. Ecomorfose em alguns escleractínios da Costa Pemambucana. Trab. Oceanog. Univ. Fed. PE. Recife 1: 239-251.

Muscatine, L. 1973. Nutrition of corals, p. 77-115. *In:* O.A. Jones & R. Endean (eds.). Biology and Geology of Coral Reefs. Vol. II, Biology 1. Academic, New York.

Tukey, J.W. 1977. Exploratory data analysis. Princeton University, New Jersey 448 p.

Veron, J.E.N. 1981. The species concept in Scleractinia of Eastern Australia. Proc. Fourth Internal. Coral Reef Symp. Manila 2: 183-186.

Wijsman-Best, M. 1974. Habitat-induced modification of reef corals (Faviidae) and its consequences for taxonomy. Proc. Second Internal. Coral Reef Symp. Great Barrier Reef Commitee. Brisbane, Australia 2:217-228.