WHAT DOES CORAL POPULATION SIZE STRUCTURE TELL US?

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What can coral population size structure tell us?

Corals are colonial organisms in which processes like fragmentation and fussion, increase the complexity of their population dynamics. Additionally the variation of environmental parameters associated with changes in depth can affect their size frequency distribution. These aspects represent a difficulty in demographical analysis, an indispensable tool to plan conservation and management programs for coral reefs.

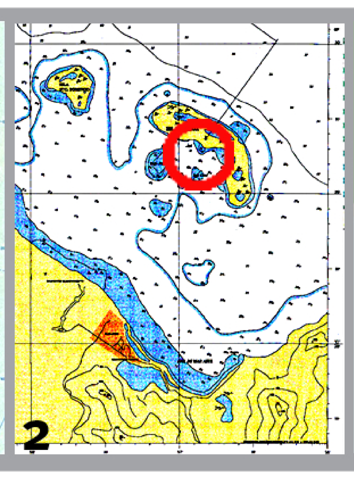
In colonial organisms, biotic and abiotic processes appear to be much more related to size rather than age (Szmant 1991). Consequently, size is a better descriptor of population structure. Also, shape parameters of frequency distributions as a measure of population structure can provide useful information about ecological processes and their effects on populations. Previous studies made by Bak & Meesters (1998) and Meesters *et al.* (2001) suggest that the analysis of size distribution structure can be a useful method to evaluate the health state of a reef. These studies found that reefs under the influence of environmental degradation would show discernible patterns in coral population structure caused by reduced recruitment and/or increased partial or whole mortality. Distributions of coral populations under these conditions will become more skewed to the left in comparison with populations in a "pristine" environment.

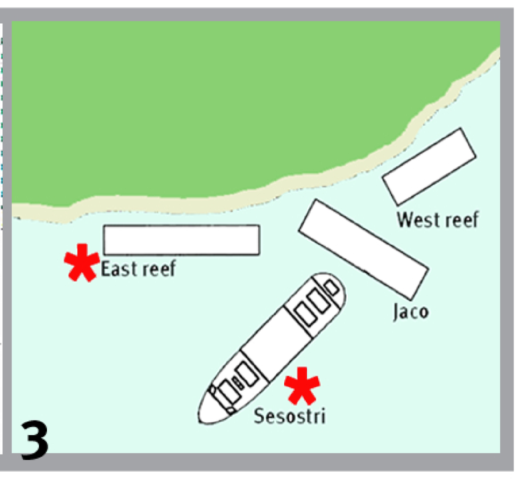
Objective:

The aim of this project was to know the effects of environmental parameters of size distribution frequencies of three coral species (*Agaricia agaricites*, *Porites astreoides* and *Diploria strigosa*), and generate information to evaluate the strength of this method for monitoring the health state of a reef.

Study area:

The study was made in the central coast of Venezuela (1), in "Isla Larga" (2). In the south coast of this island is a fringe reef interrupted by two shipwrecks: "Jaco" and "Sesostri" submerged since 1941 (3). Measurements were made at the east side of the natural reef and over the horizontal platforms of "Sesostri". At both reefs measurements were made between 1-3 m of depth (shallow) and 8-10 m of depth (deep).





Materials and methods:

1. Six environmental parameters were measured at least twice both in the natural reef and the shipwreck at different depths (3 and 9 meters):

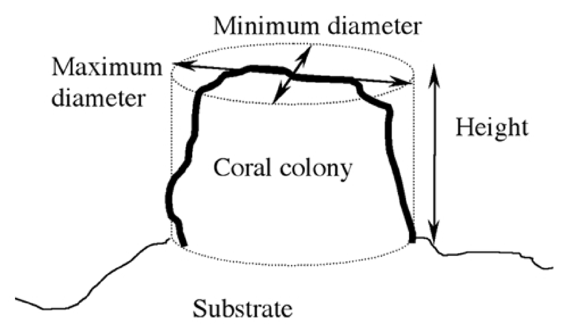
1.Sedimentation rate
2.Resuspension rate
3. Grain size

4.Light intensity
5.Temperature

6.Water movement (Doty 1971)

Temporal comparison of environmental parameters using Kruskal-Wallis tests (α: 0,05) were made. Size frequency distributions were compared within and between reefs with U-Mann Whitney tests (α: 0,05).

2. Belt transects of known areas were established to determine the size distributions of *Agaricia agaricites*, *Porites astreoides* and *Diploria strigosa* in the natural reef and the shipwreck at the 2 depths intervals (brief and deep). At each depth between 69-130 colonies of each species were measured (d). The size of each coral was considered the total surface of the colony geometric form (spheric, hemispheric, ellipsoid). To analyze the size frequencies log transformation of the size data was made (Linear size = ln (size)/ln (base); Vermeij & Bak 2000). For each distribution skewness (g_1), kurtosis (g_2), and coefficient of variation were calculated and the significances were estimated with a t Student (α: 0,05) (Meesters *et al.* 2001). The normality of the curves was tested with a Kolmogorov-Smirnov test (α: 0,05). For the intra and interspecific comparison a 2-samples Kolmogorov-Smirnov (α: 0,05) was used.



Results:

1. Environmental parameters comparisons

Temporal comparisons:

No temporal variation was found in any of the variables evaluated (Kruskal-Wallis; p > 0.05)

Spatial comparisons:

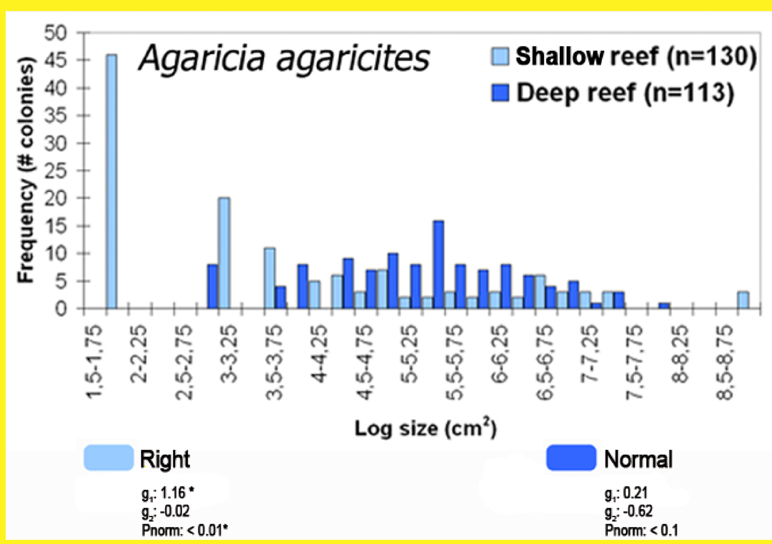
Differences were found only in (U-Mann Whitney; p < 0.05):

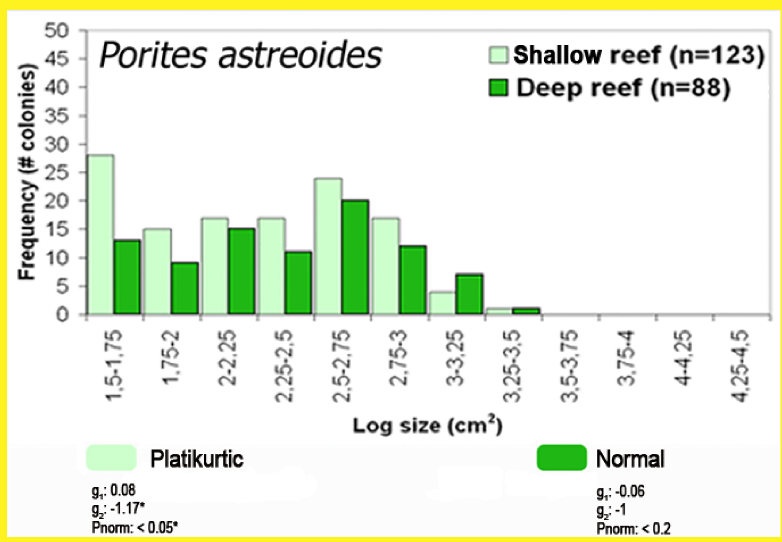
	Reef	Shipwreck	Shallow	Deep
Water movement	higher	lower	higher	lower
Sedimentation rate	higher	lower		
Grain size	fine	medium,large		
Light intensity			higher	lower
Temperature			higher	lower

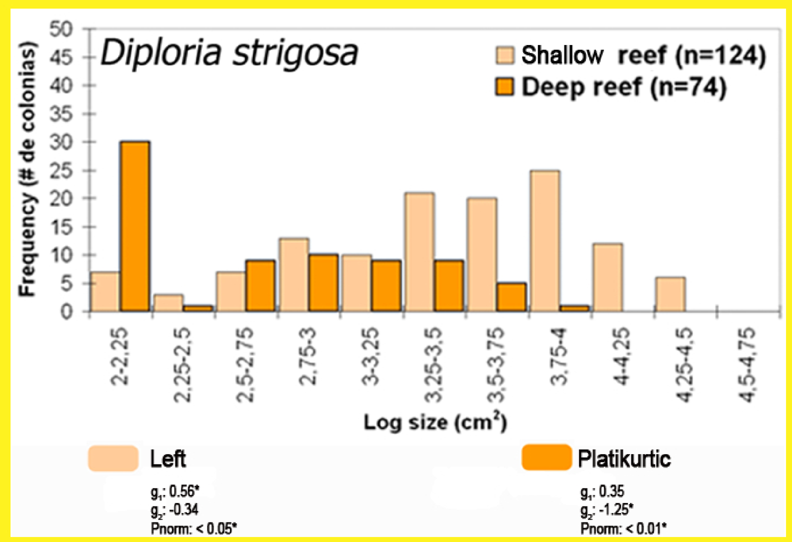
2. Size distribution frequencies

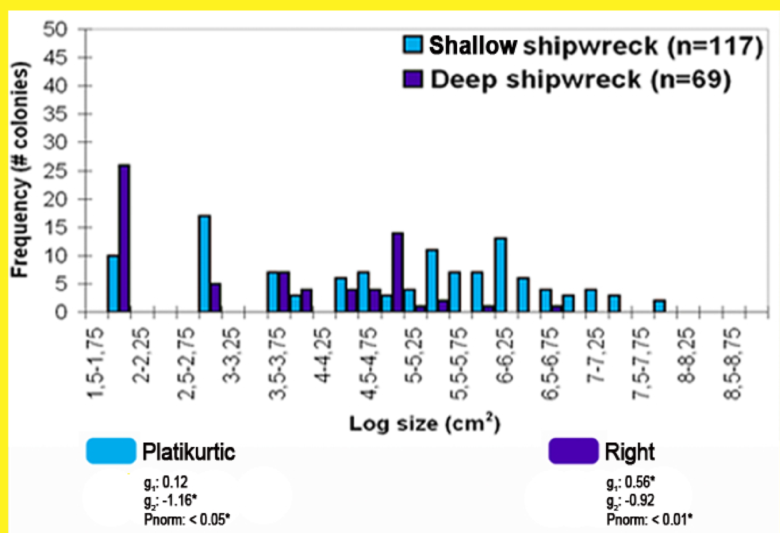
Intraspecific similarities were found only in *P. astreoides* in the shipwreck.

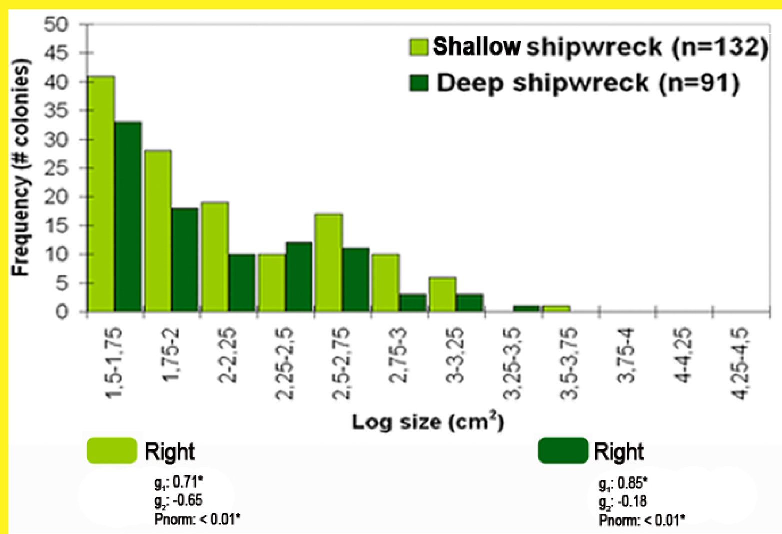
Interspecific similarities were found only between *P. astreoides* in the deep reef and *D. strigosa* in the shallow shipwreck.

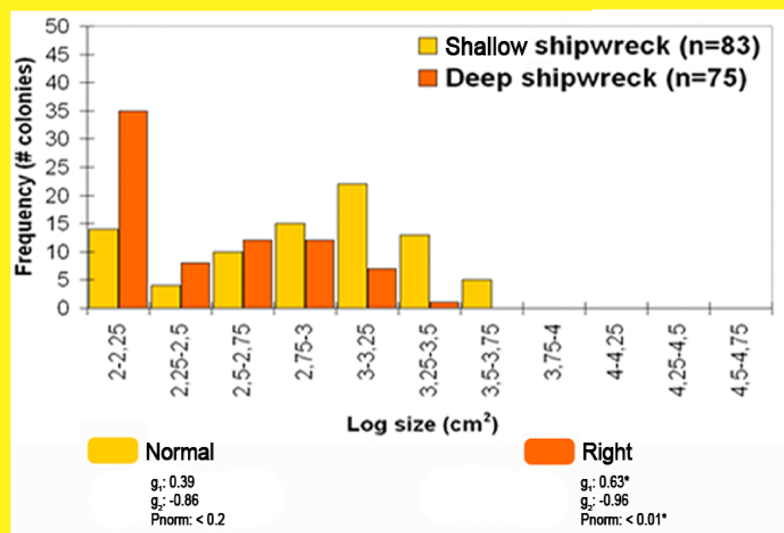












Discussion:

Highest contrast differences of environmental parameters were found between reefs. The most stressful conditions seem to happen in the natural reef, where organisms are under a higher abundance of fine sediments and water movement.

The populations of the 3 species evaluated differ in their structure, having intra and interspecific differences within and between reefs. The intraspecific differences might be associated to environmental parameters (rate of sedimentation, water movement, etc.) that might affect recruitment and survival rates. The interspecific differences might be related to the intrinsic differences of each species (demographic rates, reproductive mode, phenotypic plasticity). However, in both cases, there might be a simultaneous effect of the genetic component and of the environmental conditions.

Inter and intraspecific differences suggest that the environmental variables might have a great influence over size distributions. Special care must be taken when determining the health state of a reef with this method. Delimitation of depth intervals and the use of alternative methods (total coral cover, algal cover, recent mortality, etc.) are recommendable in order to understand ecological processes that can be determining the population structure.

Conclusions:

The 3 coral species presented intra and interspecific variations in the structure of their size frequency distributions.

Apparently the effect of the environmental parameters over the 3 species is species-specific and can be causing the variations of the populations between reefs and depth gradient.

When using size structure to determine the health state of a reef the delimitation of depth intervals is highly recommended as well as the use of alternative methods.

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Project Aware

Idea Wild