

The Relationship of Polyp Contraction Systems to Fish Grazing in Scleractinian Corals: An Evolutionary Study

Abstract

The relationship of polyp contraction systems (local and widespread) to fish grazing in Scleractinian corals was studied. A census of coral species and their types of polyp contraction was done. Palatability studies with polyp tissue ~~was~~ ^{were} performed. The results were inconclusive as to whether fish grazing pressure helps determine the ~~co~~ type of contraction system. The evolutionary significance of the data is discussed.

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the production of toxins. Compounds toxic to fish have been found in some gorgonians (Bakus 1981). The possibility also exists that some corals could use their nematocysts as a form of defense.

One type of defense which does not immediately come to mind in the Cnidarians is behavioral defense. The example Neudecker gives of behavioral defense is nocturnal polyp extension in many corals. It has been shown that predators on benthic organisms tends to have diurnal activity patterns (Robson 1975). Therefore those corals which extend their polyps only at night effectively avoid their predators.

My own field observations have shown that coral polyps' response to a mechanical stimulus can be divided into two classes. The first class, which I will call local contraction, refers to the contraction of polyps at and immediately surrounding the site of the stimulus. The second class, widespread contraction, refers to the contraction of all the polyps in the colony, or a significant portion thereof. These definitions are purposely flexible, in order that they may be useful for a study at this level.

I hypothesize that the widespread contraction of coral polyps is a behavior pattern adapted as a defense of piscine corallivores. A coral

the Discovery Bay Marine Laboratory, Discovery Bay, Jamaica. The site for the censusing ~~was~~ was the area known as Mooring 1, on the west fore-reef of Discovery Bay. This area is made up of several coral reefs separated by wide sand channels. The depth range was about 40-90 feet. The area is ~~a~~ a good one to study corals, in that they are both diverse and abundant there.

All censusing was done by means of SCUBA diving. The daytime census consisted of roughly five dives, all occurring between 8 AM and 3 PM. I did not make any effort to randomize my sampling. Instead, I merely searched for any coral I could find with its polyps extended. Having found such a coral, I identified it, often with the help of the Greenberg's (1977) ~~g~~ underwater guide. I then produced a stimulus by simply touching the highest point on the colony gently with a fingertip. Then I recorded the degree of coral retraction. When the polyps had re-extended, I repeated the stimulus. I also tried to sample two or more colonies of each species, to establish the consistency of the reaction.

The nighttime census consisted of two dives, both at about 8 PM. My sampling technique was exactly the same as above.

water column near fish, and the behavior of the fish towards the samples was recorded.

Results

species	Census of Contraction Types			polyp contraction
	extended during day	extended at night	inter- or intratentacular division	
<u>Madracis mirabilis</u>	yes	yes	inter	local
<u>Porites porites</u>	yes	yes	inter	local
<u>Porites astreoides</u>	no	yes	inter	local
<u>Acropora cervicornis</u>	yes	?	inter	local
<u>Mussa angulosa</u>	no	yes	inter	local
<u>Montastrea cavernosa</u>	no	yes	inter	widespread
<u>Meandrina meandrites</u>	no	yes	intra	widespread
<u>Pendrogya cylindrus</u>	yes	yes	intra	widespread
<u>Colpophyllia natans</u>	no	yes	intra	widespread
<u>Diploria labyrinthiformis</u>	no	yes	intra	widespread
<u>Diploria strigosa</u>	no	yes	intra	widespread
<u>Millepora alcicornis</u> *	yes	?	inter	widespread/branch

* Millepora is not a coral, but a hydrozoan. All the polyps on the stimulated branch contract, but those on other branches do not.

The results of this census show that there is no apparent relationship between diel activity and type of polyp contraction. Therefore, the hypothesis

Discussion

The results of this study were far less useful in the study of coral polyp contraction and its evolution than expected. Before trying to assess the reasons why, I would like to discuss briefly what is known about these polyp contractions.

One reason that it is interesting to study these interactions is that corals are in the phylum Coelenterata, and Coelenterates are the most primitive of the Metazoa which have a nervous system (Mackie 1976). Thus a study of a coral nervous system can provide insight into the development of nervous systems in higher animals.

A fair amount of work has been done with the nerve net found in Anthozoans, but the majority of this work has been done with sea anemones and very little with corals. It is well established that polyp contraction in Anthozoans is controlled by the nerve net (Ross 1965, Robson and Josephson, 1967). Shelton and McFarlane (1976) speak of a "slow conduction system" in Anthozoa, and state that stimulation above a certain threshold value of any part of the animal evokes a response. So we have at the least a ~~good~~ base to work from; coral polyps will respond to mechanical stimuli, and the polyps are interconnected through a nerve net.

reproductive scheme (intertentacular division or intratentacular division), with type of polyp contraction. In all but one case, the corals with intratentacular division (or brain corals) exhibited widespread contraction and the non-brain corals exhibited local contraction. This phenomenon can be explained in terms of the fish grazing hypothesis. The physical presence of the polyp cup in non-brain corals could be a deterrent to grazers, because the polyps would be more difficult to reach. Therefore, brain corals would be more subject to fish grazing, and have more selective pressure to develop other defensive methods, such as widespread polyp contraction. With a minor stretch of the imagination we can even explain the one coral that doesn't fit, Montastrea cavernosa. Montastrea has large polyps which protrude very far from the polyp cups. So in this case the defensive benefits of the polyp cup are reduced, increasing the grazing pressure.

There were several problems with the methods and scope of this project. The major problem was the qualitative approach to sampling. To do a study of this type properly, a specific and reproducible stimulus should be used. Also, the reaction of the colony should be quantitatively measured, instead of using a subjective, yes-or-no type criterion.

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