Factors affecting community dynamics of scleractinian corals: Competition, succession, keystone species and history.

Thesis submitted by

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Abstract

A major focus of ecology is to determine the causes of community structure. In this thesis, I examine the role of interactions between sessile organisms, primarily scleractinian corals and algae, in structuring the benthic assemblage of a coral reef. Specifically, I look at four main factors: competition, succession, keystone species, and the role of history or ecological memory. While competition among corals has received a certain amount of attention to date, its consequences for the individuals involved, and for the community, have not yet been ascertained. The other three processes that I investigate have all been virtually ignored on coral reefs, with very few exceptions. This is the first time that the effect of competition on the fitness of scleractinian corals has been examined, and is also the first detailed investigation of succession, keystone species and the effects of history in coral reef benthic assemblages.

There have been few reports on the intensity of competition experienced by coral colonies in their natural habitat. I examined the frequency with which competitive encounters occurred between corals, and between corals and algae, at three sites around Heron Island and Wistari reefs. Intensity of competition was found to be linearly related to coral cover, with a mean encounter rate of 1 per colony once cover reached approximately 50%.

Competition was found to have a significant negative impact on the fitness of competing colonies. Colonies engaged in competition with other scleractinian corals experienced a decreased growth rate compared to non-competing controls, and a localised decrease in fecundity. Mortality rates of corals were not affected by competition however. Competition with macroalgae was also found to cause a decrease in growth rate, and caused a decline in whole colony fecundity by approximately 50%. Again, survivorship was not affected to any significant extent.

Patterns of succession and community dynamics of three reef crest coral assemblages were further investigated by the use of matrix models. The pattern of succession observed most closely fits the tolerance model. Interactions between species groups almost always occurred in a reciprocal

fashion, with no species clearly dominating the rest. It was found that the model community structure took greater than 20 years to equilibrate, much longer than the time between cyclones, supporting the non-equilibrium nature of coral reefs. Sensitivity analysis of the model communities failed to show up any keystone species, although this technique is likely to be a powerful means for identifying the presence of such species in complex communities.

To examine the role of history in determining the structure of these coral assemblages, the models were extended to incorporate a knowledge of the communities past. I found no evidence that history was having any effect at the community level, although the probabilities of transition between different species did show a marked effect of history. The lack of an effect of history at the community level is likely to be due to the highly disturbed nature of the reef crest at Heron Island, with other more sheltered areas possibly not showing the same results.

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