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Title: Paleoecology of The Great Barrier Reef: projections of coral diversity and disparity between edge zones and central zones of coral colonies with increasing global temperatures

Introduction (999 of 1000 characters) (10 points)

Coral reefs are in danger of extinction as a result of global warming. Knowing the magnitude of diversity change, calculated as amount of change in the number of unique species, and disparity change, calculated as amount of change in morphological features, of coral species over time can encourage more effective conservation efforts. Edge zones of a coral colony will have limited flow of genes and ecological support and can be a spot for high rates of adaptation (Budd and Pandolfi, 2010). Higher temperatures can introduce new species into edge zones as a result of migration, but may also lead to morphological changes. My objective is to study the magnitude of diversity and disparity of corals between the Pleistocene and the modern. Two types of areas will be examined: the center and the edge of the Great Barrier Reef. I hypothesize that edge zones will have higher disparity and diversity change over this time interval while center zones will have lower disparity and diversity change.

Justification: (1998 of 2500 characters) (10 points)

This study is significant because it shows how much the center and edge zones of the Great Barrier Reef coral colonies are changing between the Pleistocene and the modern. Coral reefs do not only serve as an inhabitant of the coral reef ecosystem, but also provide critical habitat and food for many other marine species hence its preservation is important for the continuous survival of the Great Barrier Reef ecosystem. Changes in disparity and

diversity are vital to the survival of the coral reef because a homogenous assemblage will not be able to fulfill the needs of the variety of species living in the coral reef ecosystem. For example, specialized fishes such as the chevron butterflyfish (*Chaetodon trifascialis*) feed almost exclusively on a single coral species *Acropora hyacinthus* (Pratchett, 2005). It only takes weeks or months for the effects of coral loss on fishes to become evident such as reduced physiological condition and reproductive activity (Pratchett et al., 2004). Over a span of a few years, this may lead to lower abundance and diversity of fishes (Wilson et al., 2006). The lineages at well-connected central locations of coral colonies remain the same but the lineages at edge zones fuse together or split into smaller phylogenetic branches where gene flow is limited (Budd and Pandolfi, 2010). This is interesting because it would mean that different areas of the colony would react differently to changes in the environment. In particular interest, I will assess the contrast between the two areas in relation to increasing ocean temperatures. This study will determine the degree of change in diversity and disparity over increasing global temperatures of the corals at the edge zones and the corals at the central zone. The analysis will be helpful determining rate of these changes and allow scientists to identify areas of the coral colony that need more focus in conservation efforts for more successful survival of the corals in the increasingly warm future.

Research Plan: (1492 of 2500 characters) (8 points)

In choosing the data, I will first have to clearly define the center and edge of the coral colony in order to distinguish between different areas to make it a repeatable experiment. I will make use of the Great Barrier Reef Marine Park Province database for the bulk of the sources for modern colony conditions and species. I think that this data is appropriate because it is the most comprehensive one for the Great Barrier Reef region. Then, I will compare the diversity and disparity of the species in the Pleistocene data with the modern data because

there were lower global temperatures during this time compared to today. The diversity change is calculated as the amount of change in the number of unique species, so I will count the number of unique species in each collected sample. The disparity change will be calculated as the amount of change in morphological features. Each unique species present in both time intervals would be compared qualitatively based on their morphological features. The Pleistocene is also chosen because of the availability of collected data. In calculating the diversity, I will need to ensure sample evenness before applying richness metrics to avoid the species-area effect. Besides that, I will be using foraminifera oxygen isotope values as a temperature proxy. Another important step is also to account for time-averaging. I will need to assess the evidence for post-mortem modification of elements as well as any signs of movement in the strata.

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