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## Ancient Corals Provide Insight on the Future of Caribbean Reefs

*Climate change is already widely recognized to be negatively affecting coral reef ecosystems around the world, yet the long-term effects are difficult to predict. University of Miami (UM) scientists are using the geologic record of Caribbean corals to understand how reef ecosystems might respond to climate change expected for this century.*

The findings are published in the current issue of the journal *Geology*.

The Pliocene epoch—more than 2.5 million years ago—can provide some insight into what coral reefs in the future may look like. Estimates of carbon dioxide and global mean temperatures of the period are similar to environmental conditions expected in the next 100 years, explains James Klaus, assistant professor in the Department of Geological Sciences, College of Arts and Sciences, at UM and lead investigator of this project.

“If the coming century truly is a return to the Pliocene conditions, corals will likely survive, while well-developed reefs may not,” says Klaus, who has a secondary appointment in the Rosenstiel School of Marine and Atmospheric Science (RSMAS), at UM. “This could be detrimental to the fish and marine species that rely on the reef structure for their habitat.”

The study looks at the fossil records of coral communities from nine countries around the Caribbean region to better understand the nature of these ecosystems during the Pliocene. Today, fossil reefs are often found far from the sea, exposed in road cuts, quarry excavations, or river canyons due to uplift and higher ancient sea levels.

In studying the fossil reefs, the researchers uncovered a striking difference between modern and Pliocene coral communities. The Pliocene epoch was characterized by a great diversity of free-living corals. Unlike most reef corals, these corals lived unattached to the sea floor. Free-living corals were well suited to warm, nutrient-rich seas of the Pliocene. Between eight and four million years ago the origination of new free-living coral species approximately doubled that of other corals. However, free-living corals experienced abrupt extinction as seawater cooled, nutrient levels decreased, and suitable habitat was eliminated in the Caribbean. Of the 26 species of free-living corals that existed during the Pliocene, only two remain in the Caribbean today. The modern Caribbean coral fauna is

composed of those coral species that survived this extinction event.

The scientists argue that the effects of ongoing climate change are reminiscent of conditions present during the Pliocene and opposite to the environmental factors that caused the extinction and gave rise to modern Caribbean corals. So, how might the Caribbean coral fauna respond to a predicted return to Pliocene-like conditions within this century? The free-living corals of the Pliocene would have been well suited to ocean conditions projected for this century. However, the modern reef-building coral fauna may not, explains Donald McNeill, senior scientist in the Division of Marine Geology and Geophysics at UM and co-author of the study.

“Like the Pliocene, we might expect shallow reefs to be increasingly patchy with lower topographic relief,” says McNeill. “Rising levels of carbon dioxide will lower the pH in the oceans, a process known as ocean acidification, and will make it difficult for corals to build their limestone skeletons.”

Climate change may also increase nutrients in the oceans, boosting populations of marine life that degrade the coral into fine white sand, a process called bioerosion. Reefs built by corals in areas with high bioerosion will be affected the most. Mesophotic reefs, those growing in depths between 30 and 150 meters, have reduced rates of both calcification and bioerosion and thus may be affected less.

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**Journal Reference:** 1. J. S. Klaus, B. P. Lutz, D. F. McNeill, A. F. Budd, K. G. Johnson, S. E. Ishman. Rise and fall of Pliocene free-living corals in the Caribbean. *Geology*, 2011; 39 (4): 375 DOI: 10.1130/G31704.1