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How to Protect Coral Reefs from the Ravages of Climate Change

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Coral reefs are some of the most biodiverse and beautiful ecosystems on the planet – but they are more than natural wonders. Reefs provide vital shoreline protection and secure coastal communities from storm damage; and they are a major source of revenue for millions of people. One-third of the global population relies on reefs as a source of protein-dense food. Sadly, all of these benefits are in jeopardy due to rising carbon emissions. Although recent research on coral resiliency provides reasons for hope, swift and deliberate action must be taken to reduce harmful emissions globally in order to preserve coral reefs and their bounty for future generations.

The Role of Man-Made Climate Change

Coral reefs are suffering from widespread decline due to climate change caused by human activities, and at the same time are harmed by increased sedimentation and runoff from development, untreated waste dumping, and destructive fishing practices. Warming seas are causing increases in the frequency and severity of mass coral bleaching events, during which corals lose their vital symbiotic algae, turn white, and often die off at a large scale. Meanwhile, local overfishing, pollution, and ocean acidification are causing reef breakdowns. Roughly half of the living coral on the Great Barrier Reef has been lost over the past 20 years and coral cover in the Caribbean has declined almost 70 percent since the 1970s. Overall, the world's coral reefs are at a tipping point.

Resilience of Some Corals Provides Hope

Not all the news about reefs is bad. Recent research shows that certain types of coral are better than others at adapting over many generations and even acclimatizing to new or stressful conditions during one lifetime. This means that scientists can use such adaptive types of reefs to develop additional resilient reef systems.

- Researchers have learned that corals growing in environments exposed to greater degrees of thermal variation are often better suited to survive in warming conditions. Such corals are more likely to survive, as reefs are expected to see in the future warmer summers, cooler winters, and greater temperature variability over daily and annual cycles.

- In addition, certain corals close to land have shown signs of resiliency. In the Mesoamerican Barrier Reef System in Belize, where my colleagues and I conducted research, nearshore corals are exposed to greater annual temperature variation and higher land-based stressors. Temperature variation – rather than nutrient pollution – causes these areas to have less coral cover and diversity than more pristine and stable offshore environments. Though nearshore sites are less diverse, the corals that live there grow *faster* than their offshore counterparts. Historical growth records have shown that these

nearshore corals have grown faster than offshore corals since the early to mid-1900s. And even though their growth rates have been in decline over the past decade – likely due to additive stresses of increased coastal development and increased warming – these nearshore corals are able to grow faster in conditions that are considered less ideal. In short, these nearshore corals may be better able to adapt or acclimatize to some of the effects of climate change.

Scientists and conservationists from around the world are attempting to harness resilient traits in order to help coral reefs survive climate change. A massive research project co-led by Australian and U.S. scientists is developing resilient corals through selective breeding programs. The Belize-based organization Fragments of Hope LTD is monitoring local reefs in search of endangered coral individuals that are resilient to bleaching. These resilient corals are then fragmented and planted at reefs around the country. The aim is to increase the quantity of live corals and to promote sexual recombination of these resilient individuals with other wild populations, making the species more resilient. Researchers, advocates, and grantmakers concerned with preserving coral reefs should learn from these programs, which could prove vital to ensuring that the world's reefs are not lost for good.

Emissions Reductions are Vital for Any of These Possibilities to Work

As scientists work to preserve coral reefs, any solution, however innovative, will not be enough to save coral reefs unless emissions are curbed on a global scale. Without swift and significant action on emissions reduction, coral reefs will change forever, leaving millions of people hungry and in need of new livelihoods. Because large corporations and developed nations such as the United States and China are the biggest emitters of carbon dioxide into the atmosphere, changes in the world energy economy are necessary to protect the environment and public health.

The Paris Climate Agreement, should it survive, can be a significant step forward, because it aims to limit warming to 2°C above pre-industrial levels by reducing carbon emissions – and the ultimate goal is to keep warming at or below 1.5°C above pre-industrial limits. This half of a degree would make a critical difference. Scientists from the Intergovernmental Panel on Climate Change report that two degrees would usher the breakdown of modern coral reef ecosystems but 1.5 degrees warming would be less catastrophic. In other words, limiting emissions can save modern coral reefs and ensure that future generations have the beauty, bounty, and economic prosperity provided by these ecosystems for years to come.

Unfortunately, most of the large nations that signed the Paris document have made little progress on emissions reductions – and the United States under the Trump administration is attempting to pull out of the deal, which may cause other large polluting nations to leave. However, many individual U.S. states and cities have pledged to stay in the agreement, demonstrating a strong desire on the part of many Americans to act on climate change at the state and local level. Such efforts will prove vitally important to achieving emissions reduction success, and advocates should turn renewed attention to promoting state and local climate change legislation.

Although the Paris Agreement is crucial, even its full implementation would not be enough. Additional reduction campaigns will be essential. Yet if emissions could be successfully reduced, efforts to restore coral reefs could take off. Techniques developed by scientists could be used to *rebuild* reefs rather than just as stop gaps to keep them from disappearing entirely.

Read more in Steven Levas, Verena Schoepf, Mark E. Warner, Matthew Aschaffenburg, Justin H. Baumann, and Andréa G. Grottolit, "Long-Term Recovery of Caribbean Corals from Bleaching." Journal of Experimental Marine Biology and Ecology, 506 (2018): 124-134.