Dire warming scenarios for world's reefs

Experts predict 'crumbling frameworks' if CO2 emissions continue to grow

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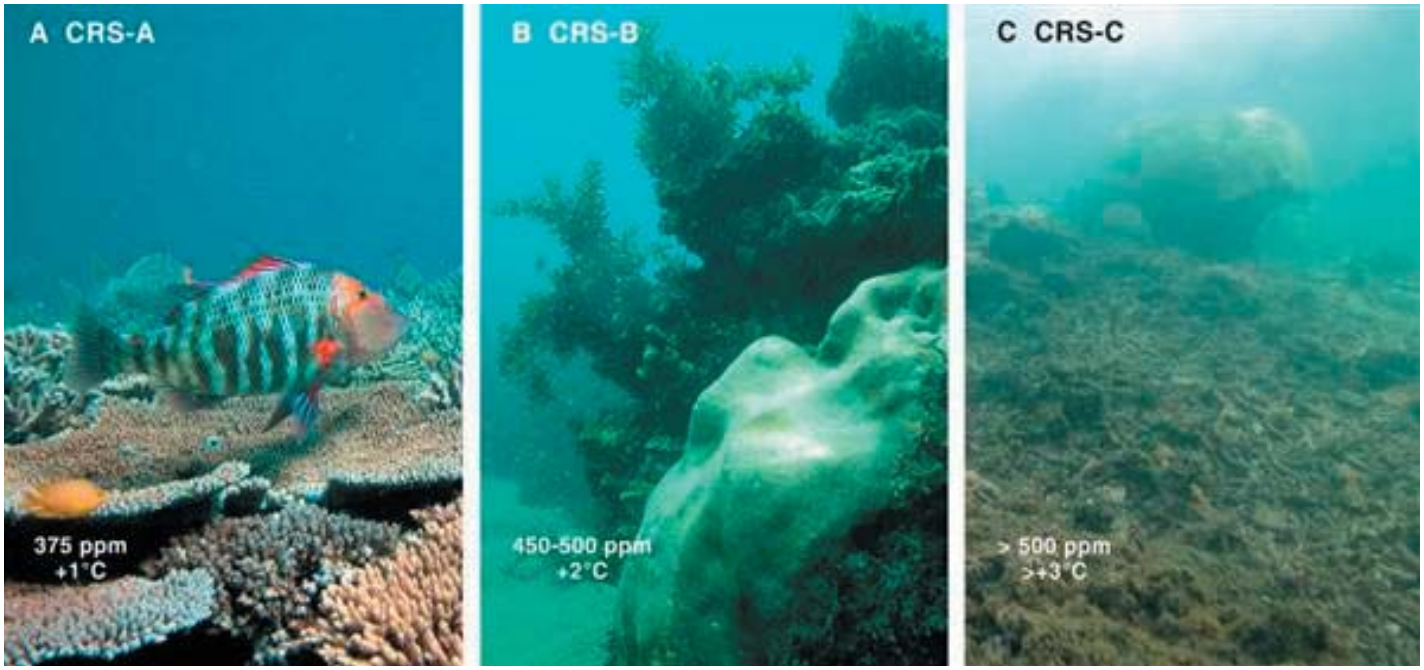

Ove Hoegh-Guldberg

These images published with a coral acidification study in the journal Science reflect scenarios of carbon dioxide's impact on reef ecosystems. The left image represents an intact system at current CO2 levels; the center image shows coral decay with increased CO2; and the right image shows a devastated system with even higher CO2 emissions.

By Miguel Llanos
MSNBC Reporter

They get blown up by fishermen, trampled on by tourists and suffer diseases exacerbated by warming seas. The victims here are the world's coral reefs, and if all that's not enough to do them in, there's an even bigger threat on the horizon: oceans becoming more acidic as carbon dioxide emissions increase.

"Rapid increases in the atmospheric carbon dioxide concentration, by driving global warming and ocean acidification, may be the final insult to these ecosystems," 17 scientists reported in a peer-reviewed study published in the journal Science on Friday.

Oceans soak up about a quarter of all CO2 emissions. Absorbing the CO2 reduces warming's atmospheric impact but literally changes the oceans' chemistry. That's because the absorbed CO2 produces carbonic acid — the same stuff that puts the fizz in soft drinks — and that dissolves the minerals used by corals to grow.

"The warmer and more acidic oceans caused by the rise of carbon dioxide from the burning of fossil fuels threaten to destroy coral reef ecosystems, exposing people to flooding, coastal erosion and the loss of food and income from reef-based fisheries and tourism," lead author Ove Hoegh-Guldberg said in a statement issued with the study.

"These changes come at a time when reefs are already stressed by climate change, overfishing and other types of pollution," added co-author Ken Caldeira of the Carnegie Institution

of Washington at Stanford University. The stress includes the practice in some waters of blasting reefs to stun and then retrieve fish for the aquarium trade.

"Unless we take action soon," Caldeira said, "there is a very real possibility that coral reefs — and everything that depends on them — will not survive this century."

Those dependents include humans. "The deterioration of coral reef ecosystems is a visually poignant reminder that climate change is not just an environmental issue but a development issue," said Katherine Sierra of the World Bank's sustainable development program. "Coral reefs are much more than a pretty picture, they're an important asset."

Three scenarios

The researchers plotted three scenarios using the low-end of CO2 projections by the U.N. Intergovernmental Panel on Climate Change, or IPCC. Emissions are measured in parts per million of atmosphere, and the global rate is now around 380 ppm.

The projections were combined with computer simulations of how ocean chemistry changes when CO2 levels range from 280 ppm to more than 500 ppm.

In scenario A, where emissions stabilize at around 380 ppm, corals would be affected but still survive, the experts calculated.

Scenario B, where emissions continue growing at the present pace to 450-500 ppm, "reef erosion will exceed calcification," they found. "The density and diversity of corals on reefs are likely to decline, leading to vastly reduced habitat complexity and loss of biodiversity, including losses of coral associated fish and invertebrates."

Scenario C, looking at 500-600 ppm, was even more dramatic. "These changes will reduce coral reef ecosystems to crumbling frameworks," the authors wrote.

"Under these conditions, reefs will become rapidly eroding rubble banks such as those seen in some inshore regions of the Great Barrier Reef, where dense populations of corals have vanished over the past 50 to 100 years," they added. "Rapid changes in sea level, coupled with slow or nonexistent reef growth, may also lead to 'drowned' reefs in which corals and the reefs they build fail to keep up with rising sea level."

Hoegh-Guldberg, a researcher at the University of Queensland in Australia, emphasized that "under these conditions coral reefs are likely to dwindle into insignificance; they'll be reduced to rubble."

The experts noted that while some species have shown an ability to adapt to climate shifts, corals do not appear to be that agile.

"Given that recent and future rates of change dwarf even those of the ice age transitions, when biology at specific locations changed dramatically, it is likely that these changes will exceed the capacity of most organisms to adapt," the authors wrote.

"Evidence that corals and their symbionts can adapt rapidly to coral bleaching is equivocal or nonexistent," they added. "Reef-building corals have relatively long generation times and low genetic diversity, making for slow rates of adaptation."

The experts concluded by noting that their scenarios were conservative, falling within the lower range of emissions projected by the Intergovernmental Panel on Climate Change.

"It is sobering to think that we have used the lower range of IPCC scenarios in our analysis yet still envisage serious if not devastating ramifications for coral reefs," they wrote. "Equally important is the fact that IPCC scenarios are likely to be cautious given scientific reticence and the inherently conservative nature of consensus seeking within the IPCC process."

John Bruno, a coral researcher who was not part of the study team, shared the authors' concerns.

"So far we haven't see these effects in the field, presumably because ocean acidification is just beginning," he said.

"The acidification of the world's oceans has truly profound implications for coral reefs and many other types of habitats," said Bruno, an associate professor at the University of North Carolina at Chapel Hill. "The trouble is that coral growth could slow substantially, and if acidification is profound enough, coral skeletons could literally dissolve.

"Most other types of creatures that deposit similar skeletons, like oysters, clams and plankton, could also be severely affected," he added.

Clean Water Act strategy

In the United States, the Center for Biological Diversity has petitioned 10 coastal states to declare their ocean waters impaired under the Clean Water Act due to acidification.

"Ocean acidification is the most serious water-quality threat to our oceans," center attorney Miyoko Sakashita said in announcing the petitions. "The Clean Water Act is the nation's strongest law protecting water quality and it provides tools that states should use to address this problem."

The center also noted that the Senate is weighing a bill, introduced by Sen. Frank Lautenberg, D-N.J., to monitor carbon dioxide's effect on oceans.

"Ocean acidification is quietly altering the fundamental chemistry of the world's oceans and additional research is just the beginning of the measures needed to prevent the harms it will bring," said Sakashita. "We must act now to prevent global warming's evil twin, ocean acidification, from destroying our ocean ecosystems."