

Synergistic impacts of global warming on the resilience of coral reefs

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Recent epizootics have removed important functional species from Caribbean coral reefs and left communities vulnerable to alternative attractors. Global warming will impact reefs further through two mechanisms. A chronic mechanism reduces coral calcification, which can result in depressed somatic growth. An acute mechanism, coral bleaching, causes extreme mortality when sea temperatures become anomalously high. We ask how these two mechanisms interact in driving future reef state (coral cover) and resilience (the probability of a reef remaining within a coral attractor). We find that acute mechanisms have the greatest impact overall, but the nature of the interaction with chronic stress depends on the metric considered. Chronic and acute stress act additively on reef state but form a strong synergy when influencing resilience by intensifying a regime shift. Chronic stress increases the size of the algal basin of attraction (at the expense of the coral basin), whereas coral bleaching pushes the system closer to the algal attractor. Resilience can change faster—and earlier—than a change in reef state. Therefore, we caution against basing management solely on measures of reef state because a loss of resilience can go unnoticed for many years and then become disproportionately more difficult to restore.

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