

Avoiding Coral Reef Functional Collapse Requires Local and Global Action

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Coral reefs face multiple anthropogenic threats, from pollution and overfishing to the dual effects of greenhouse gas emissions: rising sea temperature and ocean acidification [1]. While the abundance of coral has declined in recent decades [2, 3], the implications for humanity are difficult to quantify because they depend on ecosystem function rather than the corals themselves. Most reef functions and ecosystem services are founded on the ability of reefs to maintain their three-dimensional structure through net carbonate accumulation [4]. Coral growth only constitutes part of a reef's carbonate budget; bioerosion processes are influential in determining the balance between net structural growth and disintegration [5, 6]. Here, we combine ecological models with carbonate budgets and drive the dynamics of Caribbean reefs with the latest generation of climate models. Budget reconstructions using documented ecological perturbations drive shallow (6–10 m) Caribbean forereefs toward an increasingly fragile carbonate balance. We then projected carbonate budgets toward 2080 and contrasted the benefits of local conservation and global action on climate change. Local management of fisheries (specifically, no-take marine reserves) and the watershed can delay reef loss by at least a decade under “business-as-usual” rises in greenhouse gas emissions. However, local action must be combined with a low-carbon economy to prevent degradation of reef structures and associated ecosystem services.

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