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TITLE: Coral Reef Ecosystems under Climate Change and Ocean Acidification

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ABSTRACT:

Coral reefs are found in a wide range of environments, where they provide food and habitat to a large range of organisms as well as other ecological goods and services. Warm-water coral reefs, for example, occupy shallow sunlit, warm and alkaline waters in order to grow and calcify at the high rates necessary to build and maintain their calcium carbonate structures. At deeper locations (40 ? 150 m), ?mesophotic? (low light) coral reefs accumulate calcium carbonate at much lower rates (if at all in some cases) yet remain important as habitat for a wide range of organisms, including those important for fisheries. Finally, even deeper, down to 2000 m or more, the so-called ?cold-water? coral reefs are found in the dark depths. Despite their importance, coral reefs are facing significant challenges from human activities including pollution, over-harvesting, physical destruction, and climate change. In the latter case, even lower greenhouse gas emission scenarios (such as Representative Concentration Pathway RCP 4.5) are likely drive the elimination of most warm-water coral reefs by 2040-2050. Cold-water corals are also threatened by warming temperatures and ocean acidification although evidence of the direct effect of climate change is less clear. Evidence that coral reefs can adapt at rates which are sufficient for them to keep up with rapid ocean warming and acidification is minimal, especially given that corals are long-lived and hence have slow rates of evolution. Conclusions that coral reefs will migrate to higher latitudes as they warm are equally unfounded, with the observations of tropical species appearing at high latitudes ?necessary but not sufficient? evidence that entire coral reef ecosystems are shifting. On the contrary, coral reefs are likely to degrade rapidly over the next 20 years, presenting fundamental challenges for the 500 million people who derive food, income, coastal protection, and a range of other services from coral reefs. Unless rapid advances to the goals of the Paris Climate Change Agreement occur over the next decade, hundreds of millions of people are likely to face increasing amounts of poverty and social disruption, and, in some cases, regional insecurity.

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