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How Effective are Marine Protected Areas (MPAs) for Coral Reefs?

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Introduction

Coral reefs throughout the world are under severe challenges from acute and chronic environmental factors; these include high Sea Surface Temperatures (SSTs) that induce coral bleaching, ocean acidification, destructive fishing practices and overfishing, run off of pollutants from agriculture, rising sea levels, blooms of algae, increasing development of coastal resorts and fish farms, oil pollution, and cyclone and hurricane damage. Small modifications to environmental parameters (e.g. a change in temperature of just a few degrees) can cause significant (up to 50%) changes in coral growth rates. Often, environmental parameters influencing growth can be multifactorial, and result in complex cellular changes so that high energy and high sedimentation together can reduce growth, while changes in temperature, salinity, and sedimentation can influence not only growth but also diversity and abundance of corals.

Sea surface temperatures across the tropics have increased significantly - about 0.4° to 1°C - since the mid-1970s. A parallel increase in the frequency and extent of coral bleaching and mortality has fuelled concern that climate change poses a major threat to the survival of coral reef ecosystems worldwide. Steadily rising SSTs are already driving dramatic changes in the growth of important reef-building scleractinian corals.

Atmospheric carbon dioxide concentration is expected to exceed 500 parts per million by the second half of the current century. That means global temperatures rising by 2°C or more, a level exceeding that during the nearly half a million years when the majority of most extant marine organisms evolved. One possibility is that reefs will contain fewer coral species; potentially more like the most northern reefs around the island of Bermuda, where there are few species made up almost entirely of massive brain-type corals. A changing climate means that scaling up interventions in the marine world will be required, as well as concerted action on global greenhouse gas emissions, if we are not to loose scleractinian coral reefs forever.

So how can we intervene? Geoengineering is one possibility, although coral reefs have their own particular needs [1]. Marine parks and protected areas have long been in use, although their efficiency has often been questioned. A recent paper by Edgar and colleagues [2] on global conservation outcomes and marine protected areas found that the conservation benefits of 87 MPAs investigated worldwide increased exponentially with the accumulation of five key features: no take, well enforced, old (>10 years), large (>100 km^2) and isolated by deep water or sand. They concluded that global conservation targets based on area alone will not optimize protection of marine biodiversity. One way forward to protect coral reefs is to take these key criteria very seriously, and have well designed networks of MPAs based on conservation priorities [3], that could be planned effectively in conjunction with other management enforcement strategies, such as fisheries regulations and reductions of nutrients and other forms of land-based pollution [4]. It may be prudent and timely to introduce large-scale MPAs as part of an overall climate change mitigation policy for one or more countries. This may help future integration of climate change mitigation into MPA planning, management, and evaluation.

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