



The Impacts of Climate Change on Coral Reef Ecosystems

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Introduction

Among the global scientific community, disagreement exists with regards to the direction and rate of climate change likely to be experienced in the future. There is however, very little disagreement that climate change is a scientific reality. It is now apparent that increasing sea temperatures and increasing ocean acidity are having severely detrimental effects on the world's coral reef ecosystems. These two physical manifestations of climate change are primarily the result of increased concentrations of atmospheric CO₂. The loss or degradation of these ecosystems is a major cause for concern due to the extraordinary amount of the marine biodiversity that is reliant upon coral reef ecosystems. Coral reefs also provide ecosystem services such as fisheries opportunities, the protection of coastal areas, and support for local economies through their significance as tourism centers. For these reasons and many more it is a critical that the global community decisively acts to alleviate the human caused stresses on coral reef ecosystems.



Conclusions

- ❖ In order to successfully conserve coral reefs, there must be an expenditure of resources aimed at addressing the current gaps in our knowledge with regards to the ecological, social, and economic impacts of coral bleaching, ocean acidification, and mortality.
- ❖ Studies based on the IPCC's lower range emissions scenarios conclude that even under these lower scenarios we should expect devastating impacts for coral reef ecosystems and the life that depends upon them .
- ❖ Ultimately, without coordinated global action which successfully reduces greenhouse gas emissions, in particular CO₂, local conservation strategies are unlikely to be successful over the long-term. These local strategies must be seen as stop-gap solutions while the world musters the political will to seriously address global climate change.

Background

❖ Corals are colonial marine polyps (animals) of the class Anthozoa. The reef building corals have a symbiotic relationship with zooxanthellae (algae) which through photosynthesis produce organic nutrients that are critical to the coral. This provision of nutrients is vital because most coral inhabit nutrient deficient waters.

❖ Coral bleaching occurs when an external factor such as increased temperature physiologically stresses the coral colony. This may result in a breakdown of the symbiotic relationship and the eventual expulsion of the algae, with a resulting "bleached" appearance. If the stress is prolonged the result is often the mortality of the coral colony.

❖ The major building block of coral reefs is Calcium Carbonate (CaCO₃), which is secreted by each individual coral polyp. When the oceans absorb CO₂, it reacts with water to produce Carbonic Acid. A free proton (H⁺) is then released which combines with available Carbonate ions (CO₃²⁻), thus reducing the concentration of Carbonate and impeding the ability of corals to produce Calcium Carbonate (Fig 1).

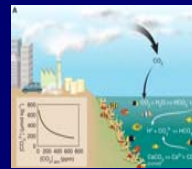


Fig. 1. Linkages between the buildup of atmospheric CO₂ and the slowing of coral calcification due to ocean acidification. Photo: O. Hoegh-Guldberg et. al. 2007

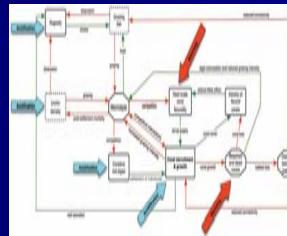


Fig. 2. Ecological feedback processes on a coral reef showing pathways of disturbance caused by climate change. Photo: O. Hoegh-Guldberg et. al. 2007



Fig. 3. Time-series of bleached coral (*Colpophyllia natans*) at Coral Gardens, Florida Reef Tract. Photo: www.rsmas.miami.edu/pressreleases/imag/es/bleached-coral.jpg

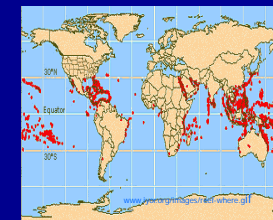


Fig. 4. Global distribution of tropical and Sub-tropical coral reefs

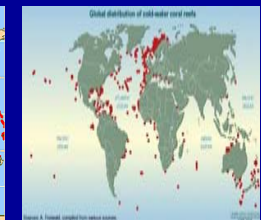


Fig. 5. Global distribution of cold water coral reefs.

Conservation Strategies

❖ Reduction of secondary stressor could dramatically increase the likelihood that corals can survive bleaching events. Some of these stressors include pollution (excess nitrogen, industrial pollutants), sedimentation, overexploitation of fish, etc.

❖ Many direct intervention strategies are potentially difficult logistically, are generally unproven, but may ultimately be of use. These include such practices as direct shading, polyp feeding, symbiont inoculation, and wave-powered artificial upwelling.

❖ There is a need to develop marine protected areas where coral resilience is high. The protection of these areas will be critical to seed areas that become severely degraded or have died.

References

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