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Effect of Global Warming on Coral Reef

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Abstract—*Global warming and Climate change impacts have been identified as one of the greatest global threats to coral reef ecosystems. A sudden rise in temperature, mass bleaching, and infectious disease outbreaks are likely to become more frequent. Carbon dioxide (CO_2) absorbed into the ocean from the atmosphere reduces calcification rates in reef-building and reef-associated organisms by altering sea water chemistry through decreases in pH (ocean acidification). The present article is emphasis on the effect of climate change on coral reef, possible effect of global warming along with some remedies to reduce its effect.*
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Keywords: *Global warming, coral reef, climate change*

1. INTRODUCTION

Coral reefs, and the organisms and communities that build and live on them, are widely distributed in shallow tropical and subtropical waters of the world. Coral reefs are unique ecosystems in that they are defined by both biological ("coral" community) and geological ("reef" structure) components. The reef is constructed of limestone (calcium carbonate) secreted as skeletal material by corals and calcareous algae. Reef-building corals are colonial animals that house single-celled micro algae, called zooxanthellae, within their body tissues. This symbiotic relationship benefits both partners. The coral obtains food from the plant photosynthesis, the micro algae benefit from nutrients released as waste by the coral, and the two have complementary effects on carbon dioxide (CO_2) exchange that is believed to account for the rapid rates of skeletal growth.

2. CLIMATE AND ENVIRONMENTAL CHANGE

The Earth's climate system consists of natural processes that redistribute the sun's energy that is absorbed and re-emitted by the planet. The Third Intergovernmental Panel on Climate Change (IPCC) found that the average temperature of the earth has risen 0.4–0.8°C (approximately 1°F) since the late 19^{th} century, and attributed a substantial part of that change to the concurrent increase in greenhouse gas concentrations (Houghton *et al*. 2001).

3. CLIMATIC CHANGE STRESSES TO CORAL REEFS

Global climate change imposes interactive chronic and acute stresses, occurring at scales ranging from global to local, on coral reef ecosystems. Gas bubbles preserved in polar ice caps show that atmospheric CO_2 concentrations over the past 400,000 years have oscillated between about 180 and 310 parts per million volumes or ppmv (Petit *et al*. 1999). Temperature and sea-level variations in the past mimic the CO_2 fluctuations, with relatively constant minimum (glacial period) and maximum (interglacial) values. The has been an increase in atmospheric CO_2 due to the activities of man, which is responsible for the increase the temperature and decrease in pH of the surface waters of ocean (Caldeira & Wickett 2003).

4. CORAL BLEACHING

The atmosphere and the ocean have warmed since the end of 19^{th} century and will continue to warm into the foreseeable future, largely as a result of increasing greenhouse gas concentrations (Levitus *et al*., 2001). Bleaching is the extreme case of natural variation in algal population density that occurs in many corals (Fitt *et al*. 2000, 2001).

5. GLOBAL WARMING AND REEF DISTRIBUTION

The global distribution of reef-building corals is limited by annual minimum temperatures of ~18°C (i.e., 64°F; Kleypas *et al*. 1999). Although global warming might extend the range of corals into areas that are now too cold (Precht & Aronson 2003), the new area made available by warming will be very much limited. The countervailing effects of other changes suggest that any geographic expansion of coral reefs will be very minor.

6. REDUCED CALCIFICATION POTENTIAL

The oceans currently absorb about a third of the anthropogenic CO_2 inputs to the atmosphere, resulting in significant changes in seawater chemistry affecting the ability of reef organisms to calcify (Houghton *et al*. 2001). Changes in the CO_2

concentration of seawater through well-known processes of air sea gas exchange alter the pH and the concentrations of carbonate and bicarbonate ions. Projected increases in atmospheric CO_2 may drive a reduction in ocean pH to levels not seen for millions of years (Caldeira & Wickett 2003).

7. SEA LEVEL

The predicted rise of sea level due to the combined effects of thermal expansion of ocean water and the addition of water from melting icecaps and glaciers is between 0.1 and 0.9 meter (4-36 inches) by the end of this century (Houghton *et al*. 2001).

8. EL NIÑO-SOUTHERN OSCILLATION (ENSO)

Mass bleaching of corals in the past two decades has been clearly linked to El Niño events (Glynn 2000).

9. OCEAN CIRCULATION CHANGES

Circulation, from local (wind-driven upwelling) to global (thermohaline) scales, is likely to change with global climate. Virtually all coral reefs at high latitudes occur where boundary currents deliver warm waters from tropical regions.

10. PRECIPITATION AND STORM PATTERNS

Tropical precipitation has increased over the past century by 0.2–0.3 % per decade in the 10ºS-10ºN region, and the frequency of intense rainfall events is “very likely” (90–99 % chance) to increase over most areas (Houghton *et al*. 2001).

11. RESOURCES AT RISK

11.1 Socioeconomic Impacts

Coral reefs benefit human society in many ways, but placing an economic value on the goods and services provided by reefs is difficult. While estimating the direct economic benefits from fishing and tourism is relatively straightforward, estimating values of services such as shoreline protection, biodiversity, and aesthetic value is not (Costanza *et al*. 1997), and these services are often omitted from reef valuations.

11.2 Biological and Ecological Impacts

Coral reefs, which support more biodiversity than any other marine ecosystem, also alter water energy and circulation in many near shore environments. This shapes other habitats and protects them from wave impact and coastal erosion.

11.3 Protection and Conservation

Growing concerns with human impacts on oceanic ecosystems in general have focused attention on the use of marine protected areas (MPAs) as potentially important practical management tools (Lubchenco *et al*. 2003).

12. WHAT CAN WE DO TO PROTECT CORAL REEFS FROM CLIMATE CHANGE?

12.1 Create effective marine protected areas (MPAs)

Create MPAs in areas that are less prone to bleaching events because of local cold-water currents or upwelling

12.2 Lessen other pressures on coral reefs

Reefs with fewer stresses will be more likely to recover from coral bleaching and adapt to increased temperatures. Countries and communities need to enforce laws against coral destruction, as well as control pollutants, and promote sources of construction material other than coral. Controlling coastal development through an Integrated Coastal Zone Management (ICZM) strategy can help protect reefs from long-term stresses strategy.

12.3 Identify ways to adapt

Governments, especially those of island nations, need to assess ways to adapt to these changes in coral reefs and develop a national strategy to deal with these impacts in consultation with local communities and the private sector.

12.4 Adopt policies and treaties

The reduction of greenhouse gases will decrease the severity of global climate change. All countries are encouraged to support, ratify and implement the Kyoto Climate Change Convention. All countries are also encouraged to participate in the work of the UN Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on climate change (IPCC).

12.5 Protect and enhance ecosystems

The loss of some ecosystems, especially forests and wetlands, contributes a significant amount of carbon dioxide and other greenhouse gases to the atmosphere. Governments can mitigate the severity of climate change by protecting and enhancing these ecosystems, a strategy known as natural carbon sequestration. Natural carbon sequestration is the process of removing carbon dioxide from the atmosphere by enhancing ecosystems, such as forests, that absorb greenhouse gases. Carbon sequestration should be considered as a primary management strategy.

13. CONCLUSION

Global climate change poses a broad range of challenges, both acute and chronic. We have emphasized the ways in which the various types of stresses interact, as well as the geographic and temporal diversity of reefs, reef organisms, reef habitats, and environments. Future changes in coral reef condition will reflect this diversity of stresses, present conditions, and biota, but will almost certainly be in the direction of further loss and degradation.

REFERENCES

[1] Caldeira, K., and Wickett, M . E. 2003. Nature. **425**: 365.
[2] Costanza, R.; d'Arge, R.; de Groot, R.; Farber S.; Grasso, M.; Hannon, B.; Limburg, K.; Naeem, S.; O'Neill, R.V.; Paruelo, J.; Raskin, R. G.; Sutton, P. and van den Belt, M. 1997. Nature. **387**: 253-260.
[3] Fitt, W. K.; Brown, B. E.; Warner, M. E. and Dunne, R. P. 2001. Coral Reefs. **20**: 51-65.
[4] Fitt, W. K.; Mc Farland, F. K.; Warner, M. E. and Chilcoat, G. C. 2000. Limnology and Oceanography. **45**: 677-685.
[5] Glynn, P. W. 2000. In: Carbonate Platform Systems: Geological Society of London, Special Publications. **178**: 117-133.
[6] Houghton, J. T.; Ding, Y.; Griggs, D. J.; Noguer, M.; van der Linden, P. J. and Xiaosu D. 2001.The Scientific Basis, Cambridge, UK. p. 944.
[7] Kleypas, J. A.; McManus, J. W and Menez, L. A. B. 1999. American Zoologist. **39**: 146-159.
[8] Lubchenco, J.; Palumbi, S. R.; Gaines, S. D. and Andelman, S. 2003. Ecological Applications. **13**: S3-S7.
[9] Levitus, S.; Antonov, J. I.; Wang, J.; Delworth, T. L.; Dixon, K. W. and Broccoli, A. J. 2001. Science. **292**:267-270.
[10] Precht, W. F., and Aronson, R. B. 2003. Geological Society of America Abstracts with Programs. **35**: 84.
[11] Petit, J. R.; Jouzel, J.; Raynaud, D.; Barkov, N. I.; Barnola, J. M.; Basile, I.; Bender, M.; Chappellaz, J.; Davis, M.; Delaygue, G.; Delmotte, M.; Kotlyakov, V. M.; Legrand, M.; Lipenkov, V. Y.; Lorius, C.; Pepin, L.; Ritz, C.; Saltzman E. and Stievenard, M. 1999. Nature. **399**: 429-436.