

CLIMATE CHANGE WHAT CAN WE DO?

According to leading climate scientists worldwide, human activities are contributing to an increase in the concentration of greenhouse gases in the atmosphere, and the increase may be causing the Earth's average surface temperature to rise. Carbon dioxide, methane, and nitrous oxide are common heat-trapping "greenhouse gases." Methane is emitted from landfills, nitrous oxide is emitted from agricultural and industrial processes, and large quantities of carbon dioxide are released into the atmosphere when fossil fuels are burned to power motorized vehicles, utilities, factories, and appliances.

Although there is uncertainty about exactly how and when the Earth's climate will respond to higher concentrations of greenhouse gases, observations indicate that detectable changes are underway. Surface air temperatures will most likely rise by an average of 2.5 to 10.4° F (1.4-5.8° C) over the next century, along with measurable changes in precipitation, soil moisture, and sea level. These changes could have adverse effects on many ecological systems in addition to coral reefs by altering vegetation patterns, species migration routes, and disease prevalence.

Dramatic statistics on coral mortality prompted the United States to develop an appropriate management strategy to protect our nation's coral reefs. In a major collaborative effort, more than 10 federal agencies, in cooperation with organizations in American Samoa, Commonwealth of the Northern Mariana Islands, Florida, Guam, Hawaii, Puerto Rico, and the U.S. Virgin Islands, formed the Coral Reef Task Force. The task force maps and monitors U.S. coral reefs and researches the causes and solutions to coral reef depletion. One way the United States could have an impact on coral reefs on an international scale would be to help slow global warming.

Here are some ways for you to help slow climate change:

- Inform yourself and others. For more information on climate change, visit EPA's Global Warming Site at www.epa.gov/globalwarming.
- Encourage more research and efforts to protect our nation's coral reefs. If you work for an organization that carries out related scientific studies, suggest including a climate change component to the research.
- Reduce greenhouse gases. Use a more fuel-efficient (or non-motorized) mode of transportation, carpool, purchase electronic devices and appliances with the ENERGY STAR® label, and plant trees.



Photo courtesy of Marj Awei



Photo courtesy of Lillian Becker and Thomas Howe

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Information about climate change presented in this brochure was taken from studies conducted by the U.S. Environmental Protection Agency (EPA), Intergovernmental Panel on Climate Change, and the U.S. Global Change Research Program. Information about coral reefs and coral bleaching was taken from studies conducted by the World Conservation Union (IUCN), National Oceanic and Atmospheric Administration (NOAA), and the National Wildlife Federation (NWF).

FOR MORE INFORMATION ON CLIMATE CHANGE AND CORAL REEFS, VISIT:

EPA's Coral Reef Protection Web Site
<http://www.epa.gov/owow/oceans/coral/>

Coral Reef Task Force
<http://coralreef.gov/>

NWF's "Coral Reefs and Climate Change: Last Straw for a Threatened Ecosystem"
http://www.nwf.org/climate/coral_index.html

The IUCN, World Wide Fund for Nature, U.S. Agency for International Development, Convention on Biological Diversity's booklet, "Management of Bleached and Severely Damaged Coral Reefs"
<http://www.iucn.org/places/usa/literature.html>

NOAA's Coral Reef Web Site
<http://www.coralreef.noaa.gov>



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Climate Change and CORAL REEFS

Sea Ecosystems at Risk



CORAL REEFS AND CLIMATE CHANGE

Vibrantly colored coral reefs are complex and fragile ecosystems that inhabit shallow tropical waters around the world. In the United States, reefs can be found off the coasts of Florida, Georgia, Hawaii, and the Louisiana/Texas border. Reefs also are extensive in U.S. waters off Puerto Rico, the U.S. Virgin Islands, American Samoa, Guam, and the Northern Mariana Islands.

Corals are tiny animals called *polyps* that live in colonies and build massive skeletons that form reefs. Their colors come from plant-like organisms called “zooxanthellae” that live inside the corals and provide them with energy from photosynthesis. The reef structure serves as habitat and provides food for nearly a million species of fish and other forms of marine life, such as sponges, soft corals, urchins, snails, and turtles—making coral reefs one of the world’s most diverse ecosystems.

Coral reefs also support multi-billion dollar fishing and tourism industries worldwide and protect coasts from storm damage. Today, these colorful underwater colonies face severe risks from a variety of threats ranging from pollution to global warming.

Global warming and associated climate changes are threatening coral reefs by increasing average ocean temperatures, causing a rise in sea level, changing carbon dioxide levels in the ocean, and altering ocean circulation patterns. In addition, continued climate change may result in more frequent and severe storms.

Warmer average seawater temperature. Coral reefs generally thrive in shallow, clear water between 77 and 84°F (25-29°C). Scientists project that global warming could cause average sea surface temperature to rise by 1.8-3.6°F (1-2°C) by 2100. Even a slight change (0.5°F or 0.25°C) in average temperature could exceed the tolerance level of some coral species and lead to an increase in bleaching events.

Higher sea level. According to the Intergovernmental Panel on Climate Change, global warming will cause sea level to rise as much as 34 inches by 2100. Although the growth rates of healthy corals will most likely keep up with this rise in sea level, reefs weakened by bleaching or other factors may be unable to grow at a rate that enables them to continue protecting low-lying islands and the coast.

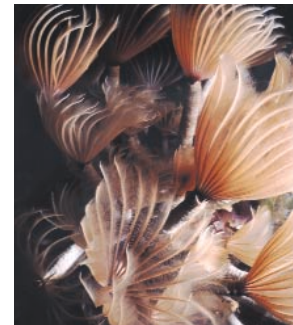


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CORAL REEFS AND BLEACHING

More carbon dioxide in the atmosphere. As levels of carbon dioxide in the atmosphere rise, some of the excess carbon dioxide is absorbed by the oceans, making surface waters less alkaline. Recent studies suggest that this change in ocean chemistry is reducing the ability of corals to build up calcium carbonate, the substance that forms their protective skeletons, further weakening coral reefs and stunting their growth.

More severe weather events. Global warming may result in an increase in the frequency and intensity of storms and storm runoff into coastal waters, affecting the cloudiness of coastal seawater and the nutrients that support coral reefs. Wave action from storms also can damage reefs through breakage and pounding of corals and other organisms.

Changes in ocean circulation. Global warming could change patterns in ocean circulation that affect the dispersal and transport of coral larvae and nutrients. These changes may alter the development and distribution of reefs.

One of the threats to coral reefs is a phenomenon called *coral bleaching*, which is caused in part by prolonged exposure to warmer-than-normal water temperatures, a potential consequence of climate change. Although corals usually rely on warm water for their survival, water that is too warm can cause them to expel the zooxanthellae that they host. Without the colorful zooxanthellae, the corals appear white or “bleached.” Since zooxanthellae provide corals with nutrients, their loss also can cause the corals to starve. Sometimes corals can recover from bleaching and regain their zooxanthellae populations. However, if the stress is extreme or prolonged, the corals will die. Without the complex coral structure, loss of other reef organisms soon follows.

To date, the reefs most severely affected by coral bleaching are outside the United States. From 1995 to 2000, unprecedented catastrophic bleaching occurred in some areas, with deaths of nearly 95 percent of reefs observed in Bahrain, the Maldives, Singapore, Sri Lanka, and Tanzania. During the same period, severe bleaching with 50 to 70 percent mortality occurred in Belize, Japan, Kenya, the Seychelles, Thailand, and Vietnam. Severe bleaching also has taken place, although to a lesser extent, in the Bahamas, Bermuda, Brazil, Easter Island, Fiji, Florida, the Great Barrier Reef, Mexico, Palau, Panama, and the Philippines.



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