



Hawksbill Turtle finning over coral reef © Richard Carey/iStockphoto

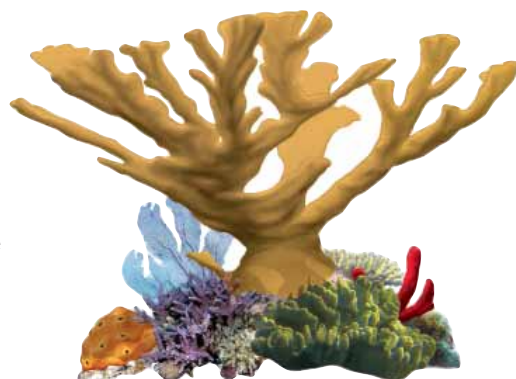
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Coral Reefs

of Southern Florida and the Caribbean

Neon-hued parrotfish. Graceful angelfish the size of dinner platters. Delicate sponges that sway in the currents. Coral communities teeming with colorful marine life. Our fascination with the oceans and their denizens has led Congress to include within the National Park System some of the nation's most incredible and beautiful marine ecosystems.

Ninety-five percent of **Biscayne** National Park, for instance, is underwater. Venture beneath the surface and you'll encounter a rich, vibrant ecosystem that contains fanciful sea life ranging from sharks and sea cows to the only living tropical coral reef in the continental United States. Known as the Florida Reef Tract, it is the world's third-largest reef and wraps from Biscayne on Florida's eastern shore all the way to **Dry Tortugas** National Park off the state's southwestern tip. Within Dry Tortugas you will find a seascape similar to that of Biscayne, with a wide variety of marine life protected within the park's borders. You will also find a 46-square-mile research natural area that offers an added layer of protection by prohibiting anchoring of boats and fishing which can physically damage coral reefs, while providing an area for unfettered marine ecosystem research. Park managers hope that threatened staghorn corals, which have declined by 99 percent in the park's waters since 1977, will benefit from these additional protections and expanded research opportunities.



In recent decades there have been significant changes in the coral reef communities of Florida and the Caribbean.



Unfortunately, multiple problems confront coral reefs. Over-fishing can reduce fish species that are critical to coral reef health. In addition, water quality issues and physical disturbances have been long-standing problems. Now climate change threatens to exacerbate these stressors.

Both staghorn and elkhorn corals were listed as threatened species under the Endangered Species Act in May 2006, partly due to the threats posed by climate change. Two years later, in November 2008, the National Marine Fisheries Service designated part of Florida's waters and those in the U.S. Virgin Islands, including **Virgin Islands National Park**, as critical habitat for these two corals. Designations of critical habitat are

important steps in protecting corals, but the human-caused stressors, as well as global stressors such as climate change, must also be addressed.

In recent decades there have been significant changes in the coral reef communities of Florida and the Caribbean. More potent and numerous hurricanes and coral "bleaching" — a phenomenon in which corals stressed by too-warm water or other stressors turn white as they expel their resident algae — are damaging, if not outright destroying, these valuable ecosystems. The most significant bleaching episode to date in the Florida Keys occurred in 1997-98. Compounding that event were Hurricane Georges and Tropical Storm Mitch, which added to the

reef damage. The extent of damage varies from year to year, but declines in many coral reef habitats have been recorded throughout the Florida Keys in the last two decades. Warming ocean temperatures and disease may have been primary contributing factors to these declines. In **Virgin Islands National Park**, three months of abnormally elevated water temperatures led to extensive bleaching followed by disease outbreaks that resulted in an average decline in hard coral cover of more than 51 percent during 2005. The future seems bleak, as scientists expect bleaching episodes to become a more frequent calling card of climate change.

The latest climate-related threat to coral reef ecosystems is ocean

acidification. While the oceans' capacity to absorb atmospheric carbon dioxide makes them great "carbon sinks," they are absorbing so much that their pH is decreasing and ocean waters are becoming more acidic. If left unchecked, this acidification threatens to deprive corals of their ability to create and maintain their calcium carbonate skeletons (acid dissolves calcium carbonate). And it is these skeletons, when assembled in mass, which create the reefs.

Along with global stressors such as warming waters and hurricanes are localized man-made stressors, including overuse, sedimentation, water pollution, physical disturbance (i.e., boat groundings), and disease — all of which affect the reefs. Over-fishing takes a toll by culling beneficial fish and invertebrate species that help control algal growth on corals.

The impacts of weakened and dying corals go beyond the somewhat monochromatic and crumbling skeletons left behind by bleaching and other damage. Not only are coral reef ecosystems some of the most diverse and species-rich ecosystems on Earth, but they are huge economic drivers for nearby communities. **Biscayne National Park** alone generates more than \$23 million a year in economic activity thanks to its visitors, and the entire south Florida region profits \$4.4 billion annually, along with more than 70,000 full- and part-time jobs, thanks to business associated with these ecosystems. Marinas, charter boats, fishing guides, dive shops, grocery stores, motels, restaurants, and gift shops all benefit from the reefs.

SOLUTIONS

How can we help protect coral reefs, the myriad species that depend on corals, and the economies of coastal communities? Stop contributing to global warming and work to alleviate the local human-generated stressors

that may be hurting our reefs' chances of recovery from bleaching and other adverse effects of global warming. This will not be simple. Some say that even if greenhouse gas emissions dropped back to pre-Industrial levels (below 300 parts per million) in the atmosphere tomorrow, it could take as long as 40 years for a return to normal temperature regimes.

While impacts of climate change, such as warmer waters and more potent storms, can't be eased overnight, working to reduce the human-related impacts can help lessen the reefs' vulnerability to climate change. Studies have shown that reef ecosystems with a rich diversity of plants, invertebrates, and fish are more resilient to bleaching and rebound more quickly after bleaching episodes. Helping maintain such diversity are healthy mangrove forests, which serve as nurseries for fish fry that later inhabit reefs as adults. Human-produced stressors include the fertilizers, pesticides, and toxic substances that stormy weather flushes from coastal areas into the oceans, where the pollution can harm reefs. Through managing healthy populations of fish and combating human impacts the resilience of coral reefs to climate change actually can be heightened.

Understanding the interconnectedness of marine systems and managing them to promote species diversity, as well as minimizing or limiting human-caused impacts (e.g., sedimentation, over-fishing, pollution, physical disturbances), could help coral reef communities cope with the effects of climate change. Altering human impacts by getting stakeholders to realize the problems and work proactively to overcome them can start to pay off almost immediately. Such an approach will require National Park Service managers to work with other governmental agencies and bring together all stakeholders to develop and implement a comprehensive strategy to protect the reefs.

We Can Safeguard Coral Reefs from Climate Change

Stop contributing to climate change

Coral reefs might not survive if we fail to reduce carbon dioxide pollution that is warming the waters and acidifying the ocean.

Reduce and eliminate existing harms that make coral more vulnerable to climate change

Reducing pollution runoff, sedimentation, over-fishing, and physical disturbances will help corals become healthier and better able to withstand climate change impacts.

Adopt "climate smart" management practices

National Park Service managers can bring together all stakeholders to develop and implement strategies that strengthen coral reef systems, such as restoring mangrove forests that shelter fish that help keep corals healthy, and minimizing human-caused impacts. These strategies should help coral reef communities become more resilient in the face of climate change.