

NATIONAL PARKS IN PERIL

THE THREATS OF CLIMATE DISRUPTION

State Fact Sheet: Florida

Human disruption of the climate is the greatest threat ever to our national parks.

At risk are nearly every resource and value that make our national parks so special. In *National Parks in Peril*, the Rocky Mountain Climate Organization and the Natural Resources Defense Council identify 25 national parks as having the greatest vulnerabilities to human-caused climate change. In Florida, Biscayne, Dry Tortugas, and Everglades national parks are on the list of most endangered parks. Biscayne is vulnerable to higher seas and more storms, more downpours and floods, a loss of plant communities, a loss of wildlife, a loss of cultural resources, intolerable heat, more crowding, and a loss of fishing. Dry Tortugas is vulnerable to higher seas and more storms, more downpours and floods, a loss of plant communities, a loss of wildlife, a loss of cultural resources, and a loss of fishing. Everglades is vulnerable to higher seas and more storms, more downpours and floods, a loss of plant communities, a loss of wildlife, intolerable heat, and a loss of fishing. Other parks in Florida, including Big Cypress National Preserve, Cape Canaveral National Seashore, and Gulf Islands National Seashore, face similar vulnerabilities.

Many of these impacts are already happening, as human activities—the emission of heat-trapping gases—are now changing the climate. To preserve our national parks for ourselves and future generations, we need to both stop changing the climate and take actions to preserve the resources and values that make our parks special. For detailed recommendations, see the full report, *National Parks in Peril*.

Higher Seas and Stronger Storms

A hotter climate raises sea levels by melting ice from land-based glaciers and ice sheets, which adds more water to the oceans, and by heating water so that it expands in volume, which also pushes sea levels higher. Current estimates are that with a high-emissions future sea level will rise three to four more feet by the end of the century; under a lower-emissions future, the seas are expected to rise about 2.3 feet. A second major risk to coasts and coastal parks comes from stronger coastal storms, including hurricanes. According to a recent U.S. government report, climate models project that further warming of ocean waters will lead to stronger tropical storms.

Dry Tortugas is in danger of being our first national park to be completely lost. Our most remote national park, 70 miles west of Key West and reachable only by boat or seaplane, it is made up of seven islands—all of which are mostly less than three feet above the current sea level, and so at risk of being submerged in this century. Every terrestrial park resource is vulnerable to being lost—from Fort Jefferson, boat anchorages, and a beach with easy access to a spectacular coral reef, to important nesting grounds for endangered sea turtles and for seabirds that breed nowhere else in the United States.

Everglades has the largest expanse of land vulnerable to sea-level rise in the national park system. The highest spot in the park is only 11 feet above



To read the full report on the impacts of global warming on national parks, visit www.nrdc.org/policy or www.rockymountainclimate.org

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mean sea level. Most of the park would be inundated by a rise of only 23 inches in sea level. Virtually all of it would be submerged if the sea were to rise six feet. What is at stake is a unique resource of great national and international significance. It is the first national park to be established as a biologic marvel, not a scenic showplace, with the largest freshwater sawgrass prairie in North America, the largest protected mangrove ecosystem in the Western Hemisphere, the most significant breeding and feeding grounds for tropical wading birds in the country, and habitat for a wide variety of endangered species. Its worldwide value has been recognized with designations as a World Heritage Site, an International Biosphere Reserve, and a Wetland of International Importance.

Neighboring Biscayne is similarly at risk of being submerged. The average elevation of its land is about two feet above the sea, and 90 percent of the park's land is less than five feet high. Well before portions of Everglades, Biscayne, and nearby Big Cypress National Preserve might be inundated by the sea, their freshwater ecosystems could be irrevocably changed by recurring intrusions of salt water.

Stronger coastal storms also put these parks at risk. In Everglades, back-to-back hurricanes Wilma and Katrina in 2005 damaged or destroyed the structures in the one developed area inside the park, the Flamingo area, including the only lodging inside the park. Not surprisingly, the number of visitors to the park has since declined; in the three full years since Wilma and Katrina, visitation has averaged 23 percent below the 2005 level. The NPS has approved a long-term vision for an environmentally sensitive redevelopment of the area, including new lodging, but it could cost \$50 million, and it is not clear how it will be funded.

An even more powerful example of how hurricanes can affect national parks is what happened when Biscayne took a direct hit in 1992 from Hurricane Andrew, when it became only the third Category 5 (most powerful) storm to make landfall in the United States since the beginning of the 20th century. The park was essentially put out of business for two years. The number of visitors to the park, averaging over half a million a year before Andrew, plummeted to about 20,000 the year after the storm and about 25,000 the next year.

Gulf Islands National Seashore in Florida and Mississippi was hit hard in a little more than a year by four hurricanes and two other tropical storms. In 2004, Hurricane Ivan caused \$30 million in damage to the Florida units. Several miles of roads were washed out; the road to the Fort Pickens unit, near Pensacola, was not reopened until May 2009. The following year, Katrina produced a storm surge 35 feet high over the Mississippi units, slicing one barrier island in half and eroding others. A lighthouse was destroyed, and a visitor center still has not reopened.

Similar risks are faced by many other coastal parks, including Canaveral National Seashore in Florida.

More Downpours and Floods

With a changed climate, more precipitation now comes in downpours. The amount of rain falling in heavy storms increased by 20 percent over the past century, while there has been little change in the amount from light and moderate storms. In its recent report, the U.S. Global Change Research Program says there is at least a 90 percent likelihood that heavy downpours will become even more frequent and intense. With an increase in downpours, flooding also is likely to increase. Virtually all national parks in Florida and elsewhere are at risk, as the forecast is for more downpours everywhere.

Loss of Plant Communities

An altered climate can lead to fundamental changes in the natural plant communities of parks. In coastal parks, the plant communities of wetlands, intertidal areas, and near-shore ecosystems could be lost to the effects of sea-level rise, stronger coastal storms, storm surges, and saltwater intrusion, all of which are projected to result from a human-changed climate.

The current plant communities of Biscayne, Dry Tortugas, and Everglades are particularly threatened. In Biscayne and Everglades, coastal mangrove forests protect inland areas from storm surges and flooding, and prevent saltwater incursion into the freshwater marshes behind them. If the sea level were to rise very slowly—perhaps no more than one additional foot in this century—the mangroves may be able to maintain themselves by regenerating farther inland. But if the sea level rises even at the rate predicted for a low-emissions future, scientists warn that the mangroves may not be able to disperse inland rapidly enough to stay ahead of the rising sea. Then they would no longer serve as a dam holding out salt water, and the freshwater resources behind them would be quickly lost. The current ecosystem and 27 rare plant species could disappear. In Everglades, if the sea level were to rise even as little as two feet, the park's pinelands, one of the rarest ecosystems in South Florida, would be submerged, and half of the park's signature freshwater marsh would be transformed by salt water pushed landward.

Loss of Wildlife

For many Americans, the highlight of a trip to a national park is the wildlife they see. But a changed climate could mean less of the wildlife species now in the parks. Some species may go completely extinct, and, local populations in particular parks may be eliminated or decline sharply.

The Florida panther, found in Everglades and Big Cypress National Preserve, is one of the most critically endangered mammals in the world, with only about 100 individuals. Like other south Florida species, it could be affected because of the likely disruption of the region's ecosystems. An even larger risk for the Florida panther could be its lack of a key advantage for any species—enough genetic variation in its population to give some individual animals different traits that would help them survive in profoundly different conditions. With a tiny population and a history of inbreeding, the Florida panther could fall short.

Sea-level rise could pose problems for some bird populations. With a three-foot sea-level rise, Dry Tortugas could be completely submerged, eliminating a key mid-Gulf resting stop for migrating birds and the only significant breeding colony in the United States of sooty terns. In Everglades, rising seas and stronger coastal storms could destroy habitat for the endangered Cape Sable Seaside Sparrow, roseate spoonbills, wood storks, snail kites, and other species not found in many other places in the country.

In Dry Tortugas, a study of nesting endangered loggerhead and green sea turtles from 1995 through 2006 showed that in years of strong coastal storms the hatching success of both species declines, as high, storm-driven waves flood or expose turtle nests in beaches. These turtle species doubtless have always lost nests to coastal storms. Previously, though, larger populations and more widely spread nesting areas helped sustain the species. Now, nesting sites have been lost to human developments and population levels have dropped to 10 percent or less of those before European settlement. As a result, they now have little remaining margin of safety in the face of any further stresses, such as the projected increase in coastal storm strength.

In Everglades, alligators, crocodiles, sea turtles, and mangrove terrapins have an unusual vulnerability to hotter temperatures: The gender of offspring is determined by temperatures during embryo incubation, so unnaturally high temperatures could disrupt the gender balance of new generations.

Marine fish populations may also suffer from an altered climate, in part because of the destructive impacts on coral reefs. Corals, which are marine animals, and the astonishingly rich ecosystems of the reefs they build are represented in our national parks more than many people realize. Biscayne and Dry Tortugas are among the 12 parks containing coral reefs. Coral reefs are among the ecosystems most affected by human emissions of heat-trapping gases. The primary reef building corals in Atlantic waters, elkhorn and staghorn corals, have already declined by more than 97 percent since the 1970s along the Florida Keys, in Dry Tortugas, and in the U.S. Virgin Islands; disease, heat-driven bleaching, and damage from hurricanes are the principal culprits. As a result, they were given federal protection under the Endangered Species Act in 2006.

Coral bleaching is a particular threat clearly linked to hotter temperatures. The often brilliant colors of corals actually come from algae that the corals host; when stressed enough, though, corals eject the algae and lose their color. Since the 1980s, this coral bleaching has greatly increased. On a small scale, bleaching can be caused by a variety of factors, but large-scale, mass bleaching has been conclusively linked to a single cause—unusually high water temperatures. The most extensive episodes of coral bleaching have been in 1998-99 and 2005, the world's hottest years on record. A well-studied example was in the waters of Virgin Islands National Park in 2005, where researchers documented the loss of half of the park's corals from high water temperatures. Other parks have experienced losses of coral reefs, too; during the late 1990's, Biscayne, like much of the Florida Keys, lost approximately 40 percent of its corals

When corals die, not just the coral reef ecosystem but also the larger marine environment is affected. As one example, reefs are important feeding grounds for wide-ranging marine fish species. In the Caribbean, the loss of coral reefs has been associated with an overall decline in fish populations since the mid-1990s.

Loss of Historical and Cultural Resources

By preserving some of the best of our historical and cultural resources—buildings, landscapes, archaeological sites, and artifacts—America's national parks provide information about the past and provide important links to the present. Many of these resources are at risk from the possible effects of a climate disrupted by human activities.

Dry Tortugas could be entirely lost to higher seas. One cultural resource of the park that is at risk of destruction is Fort Jefferson, the Western Hemisphere's largest brick fort, which covers most of the park's largest island.

Other cultural resources at risk from higher seas and stronger storms include Biscayne, where a lighthouse and other historic structures on Boca Chita Key are threatened.

Intolerable Heat

As the world continues to heat up, heat itself will become a real problem in areas that are already hot to begin with and could get much hotter. People visiting national parks in these areas will particularly feel the heat, since they typically are outdoors, not in air-conditioned buildings. These parks may simply become intolerably hot for long stretches of the year for many people.

In Biscayne and Everglades, high temperatures average nearly 90°F from June through September, hot enough that it would not take much more heat to make them intolerably hot for significant stretches. Climate models project that in Biscayne and Everglades national parks and Big Cypress National Preserve temperatures are projected to average 90°F or hotter for half or more of the entire year.

More Overcrowding

As temperatures soar with a changed climate, to escape oppressive heat enough people may flock to cooler coastal parks and national seashores to overcrowd them. In these parks, the impacts of additional visitation could include less visitor enjoyment and damage to park resources.

Overcrowding could be a significant problem particularly for those parks that offer a break from heat and are close to major population centers, including Biscayne.

Loss of Fishing

Fishing is a popular pastime in national parks. But now a changed climate threatens to reduce fish populations and recreational fishing opportunities in the parks. In the nation's coastal parks, fishing for marine species could be affected. In the bays of Everglades and Biscayne national parks, sea-level rise could disrupt or eliminate most of the tidal flats, saltmarshes, and estuarine beaches that support local fisheries. Climate change impacts on coral reefs (important breeding grounds for many sport fish) and other marine ecosystems could affect fishing in Biscayne and Dry Tortugas.

For documentation of the sources used for this fact sheet, please see the full report, *National Parks in Peril: The Threats of Climate Disruption*, at www.nrdc.org/policy or www.rockymountainclimate.org.