

# National parks are getting hotter and drier. What's the outlook for 2100?

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Bureau

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America's national parks are warming up and drying out faster than other U.S. landscapes, threatening iconic ecosystems from the Everglades in Florida to Joshua Tree in California to Denali in Alaska.

That's the conclusion of a new [climate change](#) study published Monday, the first to examine rainfall and temperatures in all 417 national parks sites. The study also forecasts the degree that parks could become hotter and more drought-stricken by century's end, depending on whether nations undertake efforts to reduce greenhouse gas emissions, or continue with business as usual.

"U.S. national parks protect some of the most irreplaceable ecosystems in the world," said the study, published in *Environmental Research Letters*, a peer-reviewed scientific journal. Reductions in industrial emissions could "substantially reduce the magnitude" of expected impacts, the study added, "offering hope for the future of the U.S. national parks."

It is hardly news that [climate](#) change is challenging numerous national parks. In the Everglades, rising sea levels and saltwater intrusion threaten habitat and wildlife that depend upon fresh flows of water. Catastrophic wildfires threaten Yosemite and other national parks in California. In Montana, there is online debate about whether Glacier National Park should soon rename itself, or face accusations of false advertising.

Yet Monday's study is the first to analyze how a warming climate affects the entire 85 million-acre [national park](#) system, a collection of particularly dynamic landscapes.

"A higher fraction of national parks are in extreme environments," said Patrick Gonzalez, a forest ecologist at the University of California, Berkeley who authored the study with UC Berkeley colleagues and scientists at the University of Wisconsin, Madison.

National parks tend to be relatively high in elevation, where warming occurs more quickly because of the thinner atmosphere, Gonzalez said. In addition, a large proportion of park land is located in the desert

Southwest and Alaska—regions feeling the strongest impacts of climate change.

The study found that, between 1885 and the year 2010, areas that are now national parks warmed by 1.8 degrees Fahrenheit, twice the U.S. rate. It also found that annual precipitation in national parks declined 12 percent, compared to 3 percent drop in the United States overall, during that same period.

At current rates of greenhouse gas emissions, temperatures in the most exposed national parks—particularly in Alaska—could rise by as much as 16 degrees Fahrenheit by 2100, according to the study.

With that level of increase, arctic permafrost could further melt, trees will replace tundra and wildfires will be more common and damaging. Many rare species would be unable to migrate to more comfortable climes, bringing some to the brink of extinction.

Individual parks face varying threats, according to Monday's study and other research it cites:

- In Yellowstone National Park, outbreaks of bark beetle due to climate change have killed half the park's whitebark pine in areas that increased 3.4 degrees since the 1950s.
- In Joshua Tree National Park, managers are concerned that climate change could eventually make the park too warm for the park's namesake Joshua trees. This form of yucca was spread around the Southwest in the dung of giant sloth that went extinct 13,000 years ago, and have adapted to certain elevations and temperatures. While it might be able survive at higher elevations outside the park, that would require human intervention to disperse seeds as the extinct sloth once did.
- In Glacier National Park, average temperatures have risen nearly

4 degrees Fahrenheit since 1950, one cause of the park's shrinking glacial fields. According to Monday's study, temperatures in the park could rise as much as 9 degrees by 2100. "At this point, it is likely that the glaciers in Glacier National [park](#) will ultimately disappear," said John Williams, a University of Wisconsin geography professor who contributed to the study.

National parks face the largest expected increases in temperatures in northern Alaska, which, similar to other arctic regions, is warming faster than the rest of the world. Yet efforts to reduce emissions worldwide could forestall some of those impacts, according to the study's authors. They project that temperatures in Noatak National Preserve, which protects Alaska's Noatak River above the Arctic Circle, could rise 15 degrees by century's end without climate action, but only 2.7 degrees if worldwide emissions were reduced.

"That's the hopeful message here," said Gonzalez. "Reducing [greenhouse gas emissions](#) can save our parks from the most extreme heat."

Monday's study, funded partly by the National Park Service, did not analyze all potential impacts of climate change on parks, such as sea level rise. But significant computing time was required to provide projections on temperatures and rainfall.

To conduct the research, scientists collected historical rainfall and temperature data, and then created maps for each of the parks and the United States as a whole. One major challenge was taking climate models—generally used to forecast impacts over broad geographic regions—and downscale them to estimate impacts for each of the 417 parks.

The research team then produced estimates for average annual

[temperature](#) and rainfall changes under four scenarios developed by the Intergovernmental Panel on Climate Change, ranging from "no action" being taken to reducing emissions to various levels of reduction.

**More information:** Patrick Gonzalez et al. Disproportionate magnitude of climate change in United States national parks, *Environmental Research Letters* (2018). [DOI: 10.1088/1748-9326/aade09](https://doi.org/10.1088/1748-9326/aade09)

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