



White "bathtub rings" show the pre-drought water level of Lake Powell in Arizona.

## Hotter and Drier: The West's Changed Climate

Human activities are already changing the climate of the American West. A new report by the Rocky Mountain Climate Organization (RMCO) and the Natural Resources Defense Council (NRDC), drawn from 50 scientific studies, 125 other government and scientific sources, and our own new analyses, documents that the West is being affected more by a changed climate than any other part of the United States outside of Alaska. When compared to the 20th century average, the West has experienced an increase in average temperature during the last five years that is 70 percent greater than the world as a whole. Responding quickly at all levels of government by embracing available solutions is critical to minimizing further disruption of this region's climate and economy.

### The West Is Getting Hotter

The planetary warming that scientists predict will result from human emissions of heat-trapping gases is already underway. In February 2007, the Intergovernmental Panel on Climate Change (IPCC) declared, "Warming of the climate system is unequivocal," and it is "very likely" that most of the warming since the middle of the 20th century is the result of human pollutants.

The American West has heated up even more than the world as a whole. For the last five years (2003 through 2007), the global climate has averaged 1.0 degree Fahrenheit warmer than its 20th century average. RMCO found that during the 2003 through 2007 period, the 11 western states averaged 1.7 degrees Fahrenheit warmer than the region's 20th century average—which represents 70 percent more warming than for the world as a whole. The West has also experienced more frequent and severe **heat waves**, with the number of extremely hot days increasing by up to four days per decade since 1950.

### More Rapid Warming in the West

2003 to 2007 5-Year Average Temperatures Compared to 20<sup>th</sup> Century Averages

Planet	+1.0°F
Western United States	+1.7°F
Colorado River Basin	+2.2°F
Arizona	+2.2°F
California	+1.1°F
Colorado	+1.9°F
Idaho	+1.8°F
Montana	+2.1°F
Nevada	+1.7°F
New Mexico	+1.3°F
Oregon	+1.4°F
Utah	+2.1°F
Washington	+1.4°F
Wyoming	+2.0°F

To read the full report on the impacts of global warming in the West, visit [www.nrdc.org/policy](http://www.nrdc.org/policy).

For more information, please contact:  
**Theo Spencer** at NRDC  
(212) 727-2700

**Stephen Saunders** at RMCO  
(303) 880-4598

the  
**ROCKY MOUNTAIN CLIMATE**  
Organization



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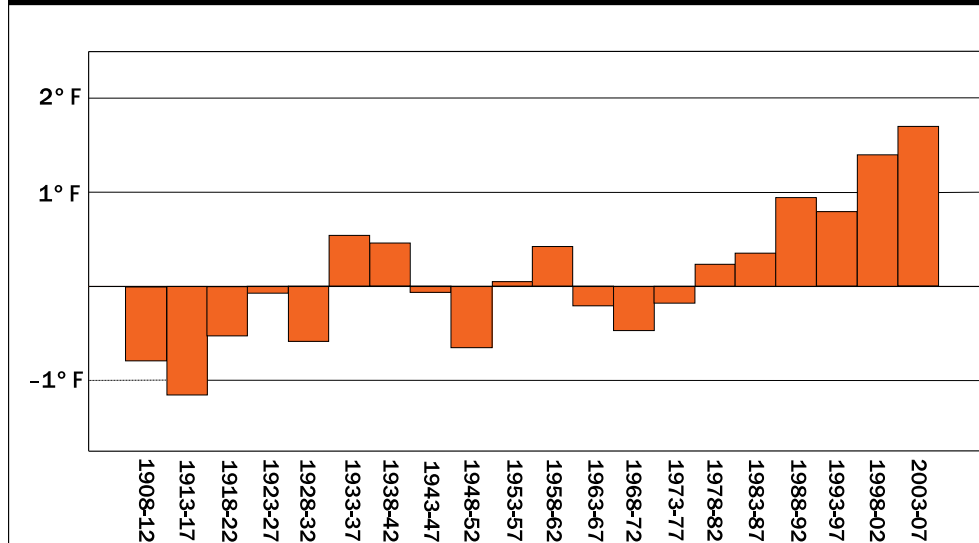
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*“The West is warming dramatically. Things are just going to get hotter. You can bet the farm on it.”*

DR. JONATHAN OVERPECK,  
UNIVERSITY OF ARIZONA (2006)<sup>1</sup>

**A Warmer West: Five-year Average Temperatures in 11 Western States Compared to 20<sup>th</sup> Century Average**



Data from the National Oceanic and Atmospheric Administration's climate division series. Analysis by the Rocky Mountain Climate Organization.

### The West Is Getting Drier

In the arid and semi-arid West, global warming is already having serious consequences for the region's scarce water supplies, particularly the snow that makes up most of the region's precipitation and, when melted, provides 70 percent of its water. Already, **decreases in snowpack, less snowfall, earlier snow melt, more winter rain events, increased peak winter flows, and reduced summer flows** have been

documented. Scientists have recently attributed more than half of these changes in the West between 1950 and 1999 to the effects of heat-trapping pollutants.

As global warming continues, the IPCC predicts **more intense and longer droughts**, and characterized the severe drought that began in the western United States in 1999 and continues today as a "notable extreme climate event."

### The Colorado River Basin: Hotter and Drier

The Colorado River is the major source of water for the driest part of the country. Upwards of 30 million Americans across seven states now depend on it for agricultural, municipal, industrial, and hydroelectric needs—and the basin is among the fastest growing areas in the country.

The Colorado River Basin, which stretches from Wyoming to Mexico and includes parts of Arizona, California, Colorado, Nevada, New Mexico, and Utah, is the epicenter of the hotter and drier climate changes underway

in the West. Since the late 1970s, the basin has warmed more than any other region in the contiguous United States, and the river basin's snowpacks are now melting faster than before, as recent spring snowpacks have shrunk more quickly than they used to.

These changes have contributed to reductions in what matters most in this basin: the volume of water in the Colorado River. The years 2000 through 2004 were the first five consecutive years of below-average flow since the start of modern records. The Colorado River's two

main reservoirs, Lake Powell and Lake Mead, are now only 45 and 50 percent full, respectively. It could take 15 to 20 consecutive years of what used to be normal inflow to refill them to capacity.

Several studies have concluded that these changes are likely the result of human emissions of heat-trapping gases. Even if the recent drought is "just" an illustration of what scientists are predicting for the Colorado River basin in the future, there still is reason for great concern in the region.

## Global Warming Is Disrupting Ecosystems

According to the IPCC, recent warming is strongly affecting ecosystems and wildlife. One study found that warmer spring and summer temperatures are responsible for **increases in wildfire** in the West, including increases in the length of the fire season, number of fires, time needed to put out the average wildfire, and area being burned.

Global warming is leading to other major disturbances in western forests, including the **proliferation of mountain pine beetles**, which kill their host trees to reproduce. Without the extreme cold temperatures that normally hold their populations in check, beetle outbreaks are now widespread across the West. Foresters predict that in Colorado and southern Wyoming mountain pine beetles will likely kill the majority of the mature lodgepole pine forests within the next three to five years. The rapid mortality of aspen trees in Colorado that scientists call “**sudden aspen decline**” has recently been linked to the hotter and drier conditions that represent an altered climate in the interior West.

Another effect of global warming is **increased melting of glaciers** across the West. U.S. Geological Survey researchers projected in 2003 that all glaciers in Glacier National Park could be completely melted by 2030, but they actually are melting so fast they are likely to be gone by 2022. In Washington’s North Cascades Mountains, 47 glaciers monitored since 1984 have lost, on average, 20 to 40 percent of their volume, with five having melted entirely away.

The warming of the West is also **disrupting the natural timing of seasons** and leading to **loss of wildlife**. Species of wildlife are adapting to an altered climate by changing where they live—and in some cases are being eliminated from areas where they used to live. In Yosemite National Park, 14 of 50 studied animal species can no longer be found in lower-elevation portions of the range they occupied early in the 20th century.



A forest fire smolders in Montana in 2007, part of an unusually severe fire season in the state.

## Realities of Global Warming in the 11 Western States

**Deadly Heat Waves:** In **California**, a heat wave in July 2006 led to an initial official count of at least 143 deaths—a total being reviewed by the state government following a press analysis that the real death toll may have been 466.

**Diminishing Reserves:** The volume of water in Lake Powell—a man-made Colorado River reservoir in **Arizona**—dropped by two-thirds between 2000 and 2005. This draining of the reservoir was more rapid and severe than thought possible. It is currently less than half full.

**No Snow:** On the date the snowpack at Snoqualmie Pass in **Washington** normally reaches its peak of 92 inches, in 2005 there was no measurable snow at all.

**Charred Habitat:** Destructive wildfires in northern **Nevada** in 2006 charred pronghorn antelope habitat and forced the relocation of half the regional herd.

**Grizzly Bears at Risk:** Warmer temperatures in **Wyoming** have allowed mountain pine beetles to invade high-elevations in the Yellowstone area, where they may eliminate whitebark pines, whose nuts are the most important food source for the area’s grizzlies.

**Ruinous Wildfire:** **Colorado** suffered the largest wildfire in its history in 2002. Nine firefighters died, nearly 1,000 structures were destroyed, 915,000 acres burned, and \$1.7 billion were lost in tourism revenue.

**Disastrous Drought:** Drought hit **Utah** so hard in 2002 that every county in the state qualified for disaster relief. 2,600 Utahans lost their agricultural jobs and the dryland harvest shrank 30 percent.

**Livestock Loss:** **New Mexico** lost \$279 million in income from livestock production due to the 2002 drought. In Montana, drought forced ranchers to cull 150,000 cattle from their herds in three years, bringing the state’s cattle population to a 40-year low in 2004.

**Lost Revenue:** **Idaho** was forced to cancel sage grouse hunting season after wildfires destroyed much of the bird’s habitat in 2007.

**Dead Zone:** An area of ocean waters with too little oxygen to support sea life off the **Oregon** coast, caused by changed weather patterns, has grown in four years to cover an area the size of Rhode Island.

## Hotter and Drier: The West's Changed Climate

### Warmer Temperatures Affect Business, Recreation, and Tourism

In the first few years of the 21st century, western farmers and ranchers have suffered significantly from the combination of **above-normal heat and drought**. Across the country, four of the five top years for crop loss claims due to drought have been since 2000.

Warming temperatures and other manifestations of a changing climate are already **diminishing fishing and hunting** opportunities in the West. Sea-run salmon stocks are in steep decline throughout much of North America. In Montana, in eight out of the last 10 years, drought and higher temperatures have led to the shutdown of fishing in nationally acclaimed angling rivers. Hotter and drier conditions have also led to fewer opportunities for hunting.

In the West, ski areas at lower elevations have recently suffered from **less snow**, with the Northwest and the Southwest taking turns having very bad years.

### Conclusion and Recommendations

The West is being affected by a changed climate more than any other part of the United States outside Alaska—and the economic damages stemming from this disrupted climate are being felt across the region. The good news is this is a problem residents of the West can help solve.

This challenge can be met through improvements in building, vehicle, and industrial efficiency; increased investment in renewable energy and low carbon fuel; and deployment of technologies to capture and store carbon emissions. Enacting mandatory federal greenhouse gas limits will stimulate investment in cleaner energy technologies. Additionally, policies that reform perverse regulatory incentives and help overcome the significant barriers to investment in energy and transportation



Warming of their alpine habitat has led to a decline of white-tailed ptarmigan in Rocky Mountain National Park.

efficiency—allowing investment in energy efficiency to compete on a level playing field with expenditures on electric and gas supply—must be adopted.

There are several ways of achieving these goals. One is regional. To date, seven western states (Arizona, California, Montana, New Mexico, Oregon, Utah, and Washington) have entered into a regional agreement to limit global warming pollution. As members of the Western Regional Climate Initiative (WCI), governors of these states have agreed to a goal of reducing their aggregate greenhouse gas emissions 15 percent below 2005 levels by 2020. These states, and others that join them, should ensure that a suite of comprehensive policies achieves these targets either on or ahead of schedule. Additionally, the WCI states should agree to the firm target of reducing emissions of global warming pollution at least 80 percent below current levels by mid-century.

We also need leadership at the federal level, where the U.S. Senate is working on a major bill that would get the United States started on addressing global warming. We urge western state Senators to support and strengthen S. 2191, the Lieberman-Warner bill (“America’s Climate Security Act”) on global warming.

The sooner and the more decisively we act to usher in the next generations of buildings, vehicles, fuels and energy, the greater our chances will be of avoiding the most dangerous effects of human-caused global warming and preserving the West we know and love.

*“We’ve known for decades that the hydrology of the West is changing, but for much of that time people said it was because of Mother Nature and that she would return to the old patterns in the future. But we have found very clearly that global warming has done it, that it is the mechanism that explains the change and that things will be getting worse.”*

TIM BARNETT, SCRIPPS  
INSTITUTION OF OCEANOGRAPHY  
(2008)<sup>2</sup>

<sup>1</sup> E. Draper, “West is warming epicenter: Experts say region outpaces rest of globe in temperature rise,” *Denver Post*, October 12, 2006, [http://www.denverpost.com/news/ci\\_4484760](http://www.denverpost.com/news/ci_4484760).

<sup>2</sup> M. Kaufman, “Decline in snowpack is blamed on warming,” *Washington Post*, February 1, 2008, <http://www.washingtonpost.com/wp-dyn/content/article/2008/01/31/AR2008013101868.html>.