



## Climate Change

### A Warming Climate

“Deadly Heat,” “Devastating Hurricanes,” “Rising Sea Level,” “Vanishing Glaciers”—headlines like these bombard many of us on a daily basis. Climate change is no longer just a phenomenon discussed among scientists. It is a pressing issue, one that permeates many aspects of our lives.

Over the last 100 years, the earth’s average temperature rose by 1.5° F. By the end of this century, it is predicted to rise by an additional 2–7° F. This

rapid temperature increase parallels an increasing level of carbon dioxide found in our atmosphere. Carbon dioxide, along with other gases, such as methane and nitrous oxide, is called a “greenhouse gas” because it traps heat in the atmosphere. While these gases are essential to all life on Earth, high concentrations lead to a warmer planet. Scientists link this build-up of greenhouse gases in the earth’s atmosphere, due largely to human activities, to the rapid rise in temperature.

Although the earth has experienced cooler and warmer periods throughout its past, current warming is occurring at an unprecedented rate. A 2° F additional change in Earth’s temperature might not seem drastic, but even this increase could bring major changes to our water cycle and to many people, plants, and animals adapted to the current climate.

### Melting Ice

Although Earth’s overall temperature is steadily rising, climate change affects areas around the globe in different ways. Mountain ecosystems in the western United States and, in particular, the Northern Rockies, are highly sensitive to climate change. Northwest Montana experiences the same general global warming pattern, but at a faster rate (1.8 times the global average). At elevations above 6,000 feet, temperatures are warming even faster—three times the global average.

What does this mean for the park’s snow and ice? At the end of a cooler period in Earth’s history, known as the Little Ice Age (circa 1850), an estimated 150 glaciers existed within the present boundaries of the park. Today, due to a rapidly warming climate, only 25 glaciers remain—and the largest have lost roughly 75% of their size since 1850. If the current rate of melting continues, climate models predict the park’s glaciers will disappear by 2030, if not earlier.

Ice patches and perennial snowfields are also melting. Along with glaciers, these sources contribute essential cold water to streams during late summer and early fall, when little seasonal snowfall remains. The loss of glacial and other ice could create many changes for species that depend on a continuous, cold water supply.

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Grinnell Glacier, August 1926. Photo: Morton J. Elrod, Mansfield Library, University of Montana.



Grinnell Glacier, August 2008. Photo: Lisa McKeon, USGS.

### Water Towers of the World

Often referred to as “water towers of the world,” mountains provide life-giving fresh water. More than 50% of the world’s freshwater supply comes from mountain run-off in the form of rain and melting snow and ice. In the American West, humans depend on mountains for the majority of their water supply; in western Montana, snow accounts for 60–80% of annual run-off.

As temperatures increase, snowpack

levels decrease. With warmer temperatures, more winter precipitation will fall as rain, reducing the amount of snow stored in the mountains and the reservoir of water it holds. Earlier spring run-off also occurs as the region experiences warmer spring temperatures. Less snowpack, earlier snowmelt, and less glacial melt lower the flow of water in downstream rivers and increase water temperature during the late summer and fall months.

This change is critical for many species, such as bull trout, that rely on cold, connected streams for survival.

Humans are not immune to these changes. Mountains supply us with the water we need for irrigation, drinking water, power generation, and recreation. Changes in precipitation patterns may alter how we live and recreate on the landscape.

## Move, Adapt, or Die

If given enough time, many species can adapt to changes in climate. But a rapidly changing climate poses great threats for certain plants and animals. Some species may move upslope to get to cooler temperatures, while others might follow their temperature range northward in order to survive. Less mobile species, or those already living at the end of their range, may be less fortunate.

Earlier spring thaws and later fall frosts, caused by warmer temperatures, create a longer growing season for plants. As temperatures warm and growing seasons lengthen, trees spread upslope. In some places in Glacier, trees 80 years or younger now invade once treeless alpine meadows. This loss of alpine habitat

could not only impact the survival of certain alpine plant species, but also limit the availability of nutrient-rich plants needed by mountain goats, grizzly bears, pikas, and other high-country inhabitants.

While some animals, such as the grizzly bear, are fairly adaptable, others, like the pika, are not. These small mammals make their homes near mountaintops. Equipped with thick, furry coats and high metabolisms, these creatures specialize in cold climates, surviving all winter long under snow-laden talus slopes. Increasing temperatures could reduce the amount of suitable pika habitat. Pikas do not hibernate, relying instead on the insulating effect of ample snow to endure harsh winter temperatures.

Reduced snowpack or earlier snow-melt may limit their habitat range and ability to survive. Pikas currently remain abundant in Glacier, but predicted warming may have drastic consequences for these alpine survivalists.



North American pika – Chris Peterson Photo

## Fires Heat Up

Fire is part of the western landscape. Over thousands of years, plants, animals, and even people adapted to fire-altered ecosystems. Today, similar fire patterns exist as in the past, but warmer temperatures and changing precipitation patterns have intensified them. Less snowfall, earlier snow-melt, longer growing seasons, a three-fold increase in extremely hot days over 90° F—all of these factors add up to bigger, more frequent fires and longer fire seasons.

What does this mean for Glacier and the surrounding area? Although a natural process, large, hot fires can scorch the soil so intensely that it takes plants longer to grow back. Noxious weeds take the opportunity to settle in and spread. Fish and other aquatic life can suffer. Without trees and other vegetation to provide shade, streams heat up. Plant roots also keep the soil in place. Their loss increases erosion, dumping heavy sediment in the water. Both of these factors affect

native fish and aquatic insects that need cold, clear water to survive.

Wildfire affects people too. Heavy fire seasons destroy buildings and homes, create health problems and risks, and hinder our ability to recreate. Current and predicted large, frequent fires also stretch monetary resources and it may take new, innovative methods to manage them.

## Management Strategies

In 2010, the National Park Service released a Climate Change Response Strategy to address climate change and provide direction for the agency and its employees. This strategy describes goals and objectives to guide park service staff in four areas of emphasis: science, adaptation, mitigation, and communication.

At Glacier, nearly half of the research conducted in the park addresses climate change either directly or indirectly. The results of this research help park managers to make effective management decisions. Additionally, park leaders partner with other agencies and groups to develop adaptive strategies for managing natural and cultural resources and infrastructure under a changing



Going-to-the-Sun Road shuttle bus – NPS Photo

climate. These strategies are flexible and designed to help managers in an uncertain future.

Many park programs are also geared toward mitigating climate change. Glacier offers free shuttle buses for visitors to the park, provides recycling opportunities for staff and visitors, manages a fleet of bikes for employees to use for work purposes, and works with contractors and park facility crews to implement green building practices.

The park shares its management efforts as well as communicates climate change impacts and research findings with the public through a variety of ways. Interpretive programs, exhibits, and media include information about climate change and provide visitors with the tools they need to understand this dynamic, and often complicated, topic.

## What Can We Do?

While tackling climate change is a difficult task, each of us can take meaningful action. By lowering our collective carbon footprint, we can minimize extensive, rapid changes to the planet. Take a moment while you're here to reflect on climate change impacts happening in Glacier. What do these changes mean to

you . . . to your family . . . to the plants and animals that live here?

Find out how climate change affects where you live. Perhaps there is a nearby national park or protected area where you can examine those impacts. Think about your home, work, school, or community. Are

there ways to reduce carbon emissions and create more sustainable places to live and work? We can't go back in time and change our current warming trajectory, but we can minimize how much change Earth experiences in the future. Step by step, we can work toward shaping that future. It's up to all of us.

