



## Impacts of Warming on the Heartland



### The Science Is In

Recent reports by the U.S. Global Change Research Program, the National Academy of Sciences, and the United Nations Intergovernmental Panel on Climate Change, give a clear indication of a warming world and related changes in our global climate system. The climate is changing, and there is little scientific doubt that most of the temperature increases since the mid 20th century are due to greenhouse gases produced by human activities. Taking action now will diminish the risks associated with climate change, and reduce the likelihood of catastrophic and far more expensive consequences.

### A Changing Climate

Change has always been a powerful force of nature. National parks help us understand how much change influences our lives by illustrating how interconnected we are with our environment.

In the last 100 years, the Earth's surface temperatures have risen an average 1.33°F (0.74°C). More than 20% of this change has occurred since 1996, with eleven of the last twelve years ranking among the twelve warmest years on record.

Current warming is occurring in most regions across the globe and is largest at high latitudes in the Northern Hemisphere.

James Hansen, NASA's chief climate scientist has said "We are getting close to a tipping point...Several degrees of temperature rise are unavoidable. The changes will be substantial, but something to which we can probably adapt. However, if we stay on a business as usual path for another decade, the impacts will be dire."

### Temperature and Precipitation

Climate models project that by the end of the 21st century average temperatures will increase throughout the Midwest by as much as 5° to 10°F (3° to 6°C). While average maximum temperatures will rise, average minimums will increase by as much as 1° to 2 °F (0.5° to 1 °C) more.

Annual precipitation is predicted to increase by 10 to 30% across much of the Midwest. Increases in the proportion of precipitation coming from heavy storms are very likely. Extreme weather events such as heat waves, droughts, tornadoes, and thunderstorms will also become more frequent.



Climate models predict that extreme weather events like heat waves, droughts, tornadoes, and thunderstorms may become more frequent.

Despite the increases in precipitation, increases in temperature and other meteorological factors are likely to lead to a substantial increase in evaporation, causing a soil moisture deficit, reduction in lake and river levels, and more drought-like conditions in much of the region.

Two-thirds of the winters between 1988 and 2003 in the Midwest had temperatures above the long-term average. Winters are getting shorter in the region. The last spring frost has come earlier and the first autumn frost has come later. Snow cover in the northern hemisphere has declined about 5% since 1975.

**\* The "Heartland" includes 15 inland National Park Service units within the states of Arkansas, Indiana, Iowa, Kansas, Minnesota, Missouri, Nebraska, and Ohio.**

## The Ecological Effects



Scientists have begun to note changes in plant communities related to warming temperatures.

Warmer weather, with increased carbon dioxide, is likely to lead to an increase in plant growth rates, particularly for plants currently limited by cold temperatures. Midwest species favoring cool climates are shifting their ranges to higher elevations and to the north. Plant and animal communities adapted to warm climates are expanding. Southern pines could replace the oak and hickory trees currently prevalent in the Ozarks. It is likely that temperate tree species will expand their range at the expense of boreal tree species.

Warming temperatures increase problems related to insects and disease. Because insects and pathogens have shorter life spans than most forest vegetation, they can respond more rapidly to climate change. A longer growing season may mean that more generations of pests could attack vegetation, while shorter and warmer winters would allow more pests to survive. If vegetation has been stressed by drought or fire, it is also more susceptible to disease and infestation.

Changes in seasonal temperature patterns will affect plant community composition. The slight warming of nighttime temperatures seen in the last 20 years, for example, has been linked to the decline of blue grama grass, the dominant grass of short-grass prairies.

Changes in precipitation, temperature, and the hydrological cycle are likely to affect the abundance, size, and distribution of wetlands. Warmer water temperatures could reduce fish habitat at areas like Ozark National Scenic Riverways and Buffalo National River, causing declines in popular species such as smallmouth bass and rainbow trout

The coordination in timing between life cycles of predators and prey may be the greatest impact on wildlife species attributable to climate change. Changes in climate are having significant effects on breeding range, winter distribution, and the timing of migration for many bird species in North America. Changes in the nutritional value of plants or changes in the timing of insect emergence could contribute to a decline in some bird populations. At the same time, longer growing seasons and the possibility of increased plant productivity could also increase the region's attractiveness for other bird species. The net effects are still unknown.

Storm water runoff is likely to increase as heavy precipitation events carry soil and excess nutrients into rivers and lakes. This, coupled with warmer temperatures, is likely to stimulate the growth of algae, depleting the oxygen in the water to the detriment of fish and other aquatic animals.

## New Faces In New Places

Some native species will not adapt fast enough to the changing climate regimes. This will most likely result in new, and often harmful, infestations by invasive plants and animals.

Potential impacts include shifts in the relative abundance and distribution of native species, significant changes in species richness and communities, and local extinctions of native species.

Researchers tell us that climate warming will cause changes in the types of tree species that grow in midwest forests. Increased average temperature and annual precipitation could make it possible for invasive plants, such as kudzu and Johnson grass, to migrate north. The fire ant, an invasive insect that has a painful sting and negatively impacts many native species, could expand its range into the southern portions of the Heartland area.

## Recreation, Health and Safety

Climate change will create longer seasons for popular warm weather activities like swimming, camping, boating, and hiking. The season for winter recreational activities, however, will get progressively shorter as snow and ice decreases.



Storms and floods pose threats to campgrounds, roads, and historic structures as well as to park visitors.

Although periods of drought will exist, researchers also predict an increase in intense short-duration rain storms characterized by violent winds, lightning, and/or flash floods creating hazardous conditions for visitors to National Park Service areas. Severe storms may also pose threats to historic structures, campgrounds, roads and trails, archeological sites, administrative facilities, and other national park resources and infrastructure.

As spring arrives earlier, mosquitoes and other insects will begin hatching earlier in the season and last longer into the fall. This will be a nuisance to visitors and may increase the risk of mosquito transmitted diseases to visitors.

Changes in fish communities will change the recreational fishing experience. Increased summer temperatures may lead to more heat related illnesses. Increasing carbon dioxide levels may cause the poison ivy that is present in many Heartland parks to grow faster and become more potent.

Rising temperatures, greater evaporation leading to reduced soil moisture, and earlier springs are likely to increase forest fire potential, increase the length of the fire season, and contribute to larger fires. Climate and ecological models suggest that the seasonal severity of fire is likely to increase by 10% over much of the US.



## What Difference Can We Make?

- Become knowledgeable about climate change and how individual actions can make a difference. Share this bulletin with a friend.
- Use public transportation at home, to and around parks, forests and wildlife refuges. Walk, use mass transit, carpool with friends, or ride a bike whenever possible.
- Purchase solar and wind generated power and "carbon credits" to help offset your emissions.
- When it is time to replace the family vehicle, consider one that gets more miles per gallon than your present vehicle.
- Convert home and office lighting to compact fluorescent bulbs. Turn off unnecessary lights.
- When buying an appliance, look for the Energy Star® label identifying energy-efficient models.
- Buy products that feature reusable, recyclable, or reduced packaging to save the energy required to manufacture new containers and reduce greenhouse gas emissions from landfills.
- Educate others. Let friends and family know about these practical, energy-saving steps they can take to save money while protecting the environment. Calculate your carbon contribution at: <https://www.greentagsusa.org>
- Encourage your company to join Waste Wi\$e recycling programs, and sustainable practices programs.
- Encourage scientific research and public discussion on global warming and solutions such as energy efficiency and alternative energy.

For more information go to: <http://www.nps.gov/climatefriendlyparks/> Version 10/11/07