

Southern Colorado Plateau Network

Climate Change Resource Brief

Intermountain Region
Inventory and Monitoring
National Park Service
U.S. Department of the Interior



Climate change impacts on the Colorado Plateau

The combination of high elevation and a semi-arid climate makes the Colorado Plateau particularly vulnerable to climate change. Climate models predict that over the next 100 years, the Southwest will become warmer and even more arid, with more extreme droughts than the region has experienced in the recent past.

These changes will affect both the montane and lower-elevation ecosystems. Because mountain plant species have narrow habitat tolerances and only marginal habitats are available for some species, climate change is likely to result in higher rates of species loss at higher elevations than at lower elevations. At lower elevations, the slow-growing vegetation of semi-arid grasslands, shrublands, and woodlands may not be as resilient as more productive ecosystems to climate-related disturbance, such as severe droughts and increased fire frequency.

Vegetation and soils

A warmer and more arid climate has the potential to affect vegetation by altering the relative dominance of species, shifting the elevational distribution of some species, and decreasing overall vegetative cover. Decreases in vegetative cover may increase soil erosion, which can cause further dramatic changes in vegetation structure and composition. Climate change can also result in altered fire regimes and increased vulnerability to exotic species invasion. Drought-induced pinyon pine (*Pinus edulis*) die-off has recently been documented across the Southwest, with 90% mortality recorded in high-elevation sites near Bandelier National Monument and Mesa Verde National Park. The Southern Colorado Plateau Network is monitoring vegetation and soils, which are reliable indicators of upland ecosystem integrity. To date, we have established 148 monitoring plots in 12 ecosystems in 9 parks, and we have plans to expand our monitoring to additional ecosystems and parks.

Vegetation phenology

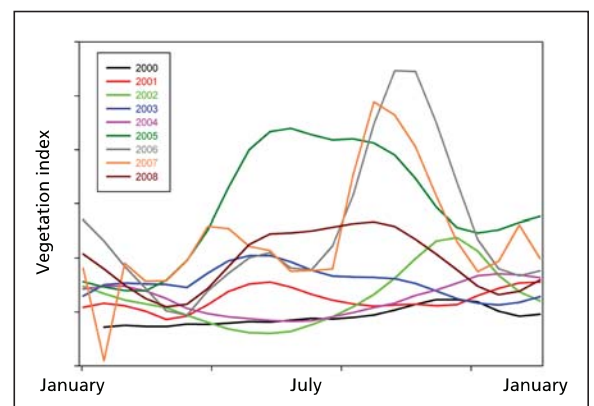
Growing seasons are expected to lengthen as a result of climate change and this can have complex ecological consequences. In the American Southwest, increases in temperature may result in a prolonged dry period between the winter months and the onset of the summer monsoon. The Southern Colorado Plateau Network is using Moderate Resolution Spectroradiometer (MODIS) satellite data to monitor growing season patterns and trends for major vegetation types occurring in our parks. This data provides us with a measure of vegetation growth at 16-day intervals throughout the year, enabling us to track the onset, duration, and magnitude of the growing season for the major vegetation types.



The high-elevation, mixed-conifer forests on the North Rim of Grand Canyon National Park may experience rapid changes in forest structure and composition.



Pinyon-juniper woodlands on the Colorado Plateau, such as this one at Navajo National Monument, are experiencing mortality from recent drought.



Preliminary MODIS data showing the variation in the annual growth cycles of vegetation from 2000 to 2008 at Petrified Forest National Park.

Aquatic macroinvertebrates

Climate change is predicted to have multiple effects on aquatic ecosystems, such as the disruption of natural flood regimes, alteration of natural temperature cycles, and increased risk for invasion and persistence of non-native aquatic organisms. All are likely to have profound consequences for aquatic communities. Aquatic macroinvertebrates are an essential component of healthy aquatic ecosystems and are sensitive to environmental changes. By monitoring aquatic macroinvertebrate populations in streams we can monitor the overall health of stream ecosystems in our parks. The data we collect will enable us to observe changes in macroinvertebrate community structure and function and in abiotic stream components, such as water quality and habitat availability.

Spring ecosystems

Springs are the most productive and biologically diverse ecosystems in the arid Southwest, and, in some areas serve as the only reliable water source for wildlife. Climate change could lead to changes in the amount, timing, and distribution of rain and snowfall, potentially affecting aquifer recharge rates, diminishing spring flow, and causing changes in the composition and structure of aquatic and riparian plant and animal communities. On the Colorado Plateau, springs provide vital habitat for both endemic and regionally rare species, including several types of orchids and the declining populations of leopard frogs. The Southern Colorado Plateau Network plans to monitor the hydrology and biologic communities at springs in network parks.

Riparian ecosystems

Many streams and rivers in Southern Colorado Plateau Network parks are intermittent or ephemeral, flowing only during spring runoff or following monsoon rainfall events. On the Colorado Plateau, the precipitation regime is the most important climatic factor influencing the characteristics of riparian ecosystems—shaping stream channels and supporting water-limited ecological processes, such as primary production, nutrient cycling, and plant reproduction. The timing (seasonality) of precipitation and runoff is particularly important because it strongly controls the hydrologic regime—evaporation, transpiration, runoff, soil-water storage, and streamflow. The Southern Colorado Plateau Network monitors the hydrology, riparian vegetation, and fluvial geomorphology of streams and rivers in network parks.

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Changing hydrologic regimes, increased water temperatures, and altered riparian vegetation may affect aquatic macroinvertebrate communities.



Reduced precipitation due to climate change threatens sensitive spring ecosystems such as Vasey's Paradise at Grand Canyon National Park.



One consequence of climate change may be an increase in the number and magnitude of floods, such as this 2006 flash flood on the Escalante River in Glen Canyon National Recreation Area.