National Park Service
U.S. Department of the Interior

Rocky Mountain National Park
Continental Divide Research Learning Center

Temperature Trends

The Question: What are the long-term temperature trends in the park's three altitudinal zones: montane, subalpine, and alpine?

Rocky Mountain National Park is composed of a variety of unique ecosystems defined by altitudinal zones: the montane forests, less than 9,500 ft elevation, containing ponderosa pine forests and shrubs; the subalpine forests, between 9,500 and 11,000 ft, dominated by Engelmann spruce and subalpine fir; and the alpine tundra's unique, dwarfed communities of sedges and flowering plants, situated above tree line at 11,000 ft. These varied ecosystems are created by the drastic change in temperature and precipitation due to change in elevation; as you go up 1,000 ft in elevation the temperature decreases about 3.5 degrees Fahrenheit and precipitation increases. Each altitudinal zone can thus be said to have its own climate. Because organisms are specialized to live in their environment they are sensitive to change. One environmental change that poses a threat to park ecosystems is climate change.

The Project: Using a location near the park, analyze temperature trends in records collected along an altitudinal transect over a 45 year period.

Between 1952 and 1997 the Mountain Research Station at the University of Colorado (Boulder) collected temperature records at 5 stations on a 19 mile altitudinal gradient over three ecotones (montane, subalpine, and alpine), along the Colorado Front Range. Elevations ranged from 4,950 ft (Longmont) to 12,300 ft (Niwot Ridge). Though this study took place 20 miles south of the park, scientists collected data in the same ecotones as those found in the park, and thus results are broadly applicable to the park. The Mountain Research Station data set represents one of the best long-term records of temperature along an altitudinal transect in the world, and monitors the highest continuously operating weather station in North America.

The Results: Temperature trends warmed at mid-elevation sites and cooled at high-elevation sites.

Temperature results (1952-1997) from Mountain Research Station study applied to RMNP.

Ecosystem	Elevation	Results	RMNP Examples	Plant Communities
Montane	Less than 9,500 ft	Overall warming	Moraine Park, Cow Creek	Ponderosa pines
Subalpine	Between 9,500 and 11,000 ft	Higher daily maxima and lower daily minima temperatures	Bear Lake, Hidden Valley	Englemann spruce and subalpine fir
Alpine	Above 11,000 ft (tree line)	Cooling	Alpine Visitor Center, Rock Cut	Communities of alpine meadows, fellfields and shrubs

At the montane study site (similar elevation to Moraine Park) there was an overall warming trend. The results from the subalpine elevation site (comparable to Bear Lake) show an increase in daily maxima (hotter days) and decrease in daily minima temperatures (cooler nights) creating a larger than average range in daily temperatures. At the alpine study site (similar ecosystem seen at the Alpine Visitor Center) opposite results were found: a consistent slight trend in cooling. In general, at zones in mid-range elevations (i.e., montane and subalpine), there was consistent warming where zones at higher elevations, at the alpine site, there was absolute cooling. Because the montane and subalpine environments are naturally warmer than the alpine environment, these results indicate a steepening of the temperature gradient between the montane and the alpine over the course of the study. This analysis acts as a model to understand some of the possible effects of climate change on the park's unique ecosystems. It illustrates the inconsistencies in temperature trends and complexities of climate change.

This summary is based on published, peer-reviewed and/or unpublished reports available at the time of writing. It is not intended as a statement of park policy or as a definitive account of research results.
For more information on the park's research program, see www.nps.gov/romo Written by: Andrea Gohl Date: August 2007 Photo credit: NPS-RMNP
Pepin N. 2000. Twentieth-Century Change in the Record for the Front Range, Colorado, USA. Arctic, Antarctic, and Alpine Research. *v. 32, n. 2, p. 135-146.*