Monitoring Ecological Responses to Climate Change in the Rocky Mountain Network

HOT TOPIC BRIEF

The Earth is currently experiencing a period of rapid climate change where global temperatures are rising and the extent of mountain glaciers and snowpack is decreasing. The Rocky Mountain Inventory and Monitoring Network (ROMN) includes a wide range of environments, from mountain peaks down through evergreen and deciduous forests to Western grasslands. The six units of the network include Glacier National Park (NP), Grant-Kohrs Ranch National Historic Site, Little Bighorn Battlefield National Monument (NM), Florissant Fossil Beds NM, Great Sand Dunes NP and Preserve, and Rocky Mountain NP. While the environments may differ among the parks, all the units in the ROMN are experiencing similar trends in climate. The western United States has seen average temperatures increase over the past century and the ratio of snowfall to rainfall is decreasing.

In order to meet the challenge of managing national parks in the face of global climate change, it is critical that the National Park Service has high-quality, natural resource monitoring and inventory data to track changes as they occur.

NPS/I. ASHTON

Rachel Lazcano, a network volunteer and SCEP employee at the Denver Service Center, takes a soil sample at the highest monitoring peak in Rocky Mountain National Park, August 2009.

Linking Monitoring to Climate Change Research

The ROMN's monitoring protocols will document changes in the status and trends of priority vital signs. In the following sections, we describe these protocols and report on some of the changes that the Intergovernmental Panel on Climate Change[1] (IPCC) believes to be likely for our vital signs.

NPS/B. SCHWEIGER

Monitoring an alpine wet meadow in Rocky Mountain National Park, August 2008.

Alpine Vegetation and Soils

ROMN is part of the Global Observation Research Initiative in Alpine Environments (GLORIA), an international effort to monitor climate and vegetation changes at high elevations. GLORIA sites have been established at Glacier, Great Sand Dunes, and Rocky Mountain. Glacier became one of the first sites in North America to examine five years worth of changes in alpine vegetation by revisiting sites in 2009 that were established in 2003–04. According to the IPCC, the length of the growing season has increased an average of two days per decade since 1950, with most of the increase resulting from earlier spring warming. Earlier snowmelt and warmer temperatures are expected to cause shifts in alpine vegetation communities.

Wetlands Ecological Integrity

Changes in precipitation, snowpack, and monsoon seasons may decrease surface and groundwater availability. If so, wetlands and their associated flora and fauna will likely diminish in number and extent. ROMN is monitoring wetlands in Rocky Mountain and Florrisant Fossil Beds. We will begin monitoring wetlands in the Great Sand Dunes in the summer of 2010. We are examining status and trends in wetland type and extent, water table, water chemistry, soils, herbivory, and vegetation composition.

1. Field et al. 2007. North America. *Climate Change 2007: Impacts, Adaptation, and Vulnerability: Contribution of Working group II to the Forth Assessment Report of the Intergovernmental Panel on Climate Change.* Pary et al. Eds., Cambridge U Press, Cambridge, UK, 617–652.

NPS/B. SCHWEIGER

The Rocky Mountain Network monitoring stream ecological integrity at Reynolds Creek, an alpine sentinel site in Glacier National Park, July 2009.

Stream Ecological Integrity

ROMN is monitoring stream ecological integrity in Glacier, Little Bighorn Battlefield, and Grant-Kohrs Ranch. At every stream site, we collect data on water quality, streamflow, stream morphology, riparian vegetation, and macroinvertebrate and periphyton (algae and associated microorganisms) communities. According to the IPCC, climate change is likely to make it more difficult to achieve existing water quality goals. Coldwater fish habitat, aquatic insects, and other invertebrates living in streams will likely be reduced.

Vegetation and Soils in Small Parks

Disturbances such as wildfire and insect outbreaks are increasing and are likely to intensify in a warmer future with drier soils and longer growing seasons. The Vegetation Composition, Structure, and Soils Protocol for Small Parks was completed in 2009. We are monitoring many aspects of vegetation including plant diversity, invasive species cover, and tree health in Florissant Fossil Beds, Grant-Kohrs Ranch, and Little Bighorn Battlefield.

NPS/D. SHORROCK

View of Grant-Kohrs Ranch National Historic Site while monitoring vegetation, June 2008.

NPS/M. BRITTEN

Chief Ranger Rick Wilson sampling soils in Florrisant Fossil Beds National Monument, September 2008.

Rocky Mountain Climate Protocol

In collaboration with the Greater Yellowstone Network, the ROMN developed a protocol to monitor the status and trend in climate at our parks focusing on temperature, precipitation, streamflow, drought, and snowpack. Warming and changes in the form, timing, and amount of precipitation will very likely lead to earlier melting and significant reductions in snowpack in the western mountains by the middle of the 21st century. We will monitor such changes by analyzing and reporting on climate data from national climate networks. Baseline trend reports will be used to examine long-term changes in historical climate patterns, and annual or three-year reports will be produced to document the current status of climate.

Snow Chemistry and Deposition

The goal of the ROMN Snow Chemistry protocol is to monitor changes in snow chemistry and snow water equivalent at locations in Glacier, Great Sand Dunes, and Rocky Mountain. Snowmelt in the alpine areas of the Rocky Mountains is critical to both the quality and quantity of water in freshwater lakes, streams, and wetlands and is expected to be reduced in the near future. In addition to climate change, atmospheric pollutants, such as sulfate and nitrate, are present in the snowpack and can pose a threat to alpine ecosystems. In collaboration with the U.S. Geological Survey, ROMN monitors trends in snow chemistry and snow water equivalent at six sites in the parks and these are compared to numerous other sites throughout the Rocky Mountains.

NPS/I. ASHTON

George Ingersoll of the USGS taking a snow samples at Loch Vale Meadow Site in Rocky Mountain National Park, April 2009.

News & Highlights

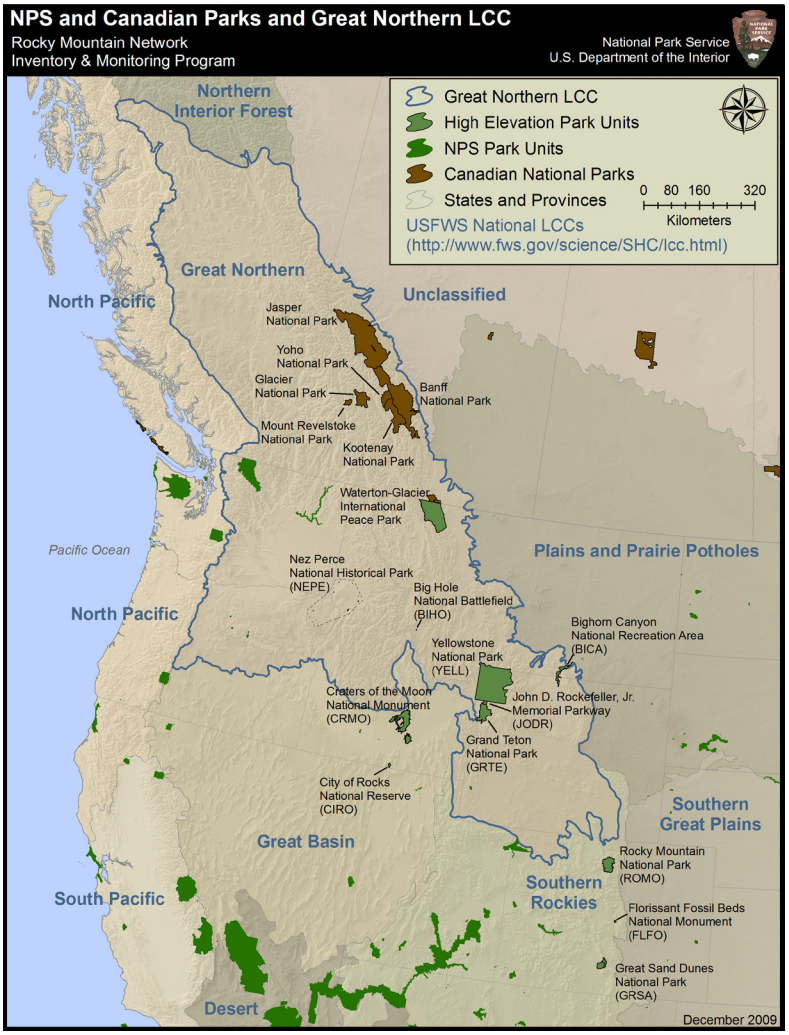
The ROMN is collaborating with the Upper Columbia Basin (UCBN) and Greater Yellowstone (GRYN) networks to join 12 high-elevation parks (below) to focus on monitoring responses to climate change. The networks will hold a workshop in Bozeman, MT, May 4–6, 2010, to develop a long-term climate change monitoring workplan, which will be completed September 2010.

In preparation for the workshop, the networks are preparing a synthesis titled *Climate and Ecological Responses to Climate Change in the Rocky Mountains and Upper Columbia Basin: A Synthesis of the Best Available Science*.

The ROMN, in collaboration with UCBN, GRYN, and Grand Teton NP, is developing plans for climate change projects relevant to its network parks including: using pika as an indicator of climate change, improving baseline climate data within the parks to produce long-term trend reports, and investigating the links between Didymo (an native but invasive nuisance algae) growth and climate change.

Phyllis Pineda Bovin, a biologist at Great Sand Dunes, won the NPS National Resource Program Center Olympus 2009 Photo Contest for a photograph of ROMN's efforts to monitor alpine vegetation and climate change. See: http://www.nature.nps.gov/PhotoContest/Winners.

Landscape Conservation Cooperatives are conservation-science partnerships between the U.S. Fish and Wildlife Service, USGS, and other federal agencies, states, tribes, non-governmental organizations, universities, and stakeholders within a geographically defined area. The Great Northern LCC will form in 2010 and includes Glacier National Park and Grant-Kohrs Ranch.



Park-specific Monitoring

As of 2010, the following protocols will be active in each park:

Florissant Fossil Beds NM
Weather and Climate
Vegetation Composition, Structure, and Soils (VCSS): Grassland, Shrubland, and Woodlands
Wetlands Ecological Integrity

Glacier NP
Weather and Climate
Stream Ecological Integrity
VCSS: Alpine Tundra
Snow Chemistry

Grant-Kohrs Ranch NHS
Weather and Climate
VCSS: Grassland, Shrubland, and Woodlands
Stream Ecological Integrity

Great Sand Dunes NP and Pr
Weather and Climate
Wetlands Ecological Integrity
VCSS: Alpine Tundra
Snow Chemistry

Little Bighorn Battlefield NM
Weather and Climate
VCSS: Grassland, Shrubland, and Woodlands
Stream Ecological Integrity

Rocky Mountain NP
Weather and Climate Protocol
Wetland Ecological Integrity
VCSS: Alpine Tundra
Snow Chemistry

Rocky Mountain Inventory and Monitoring Network
1201 Oakridge Drive, Suite 200
Fort Collins, CO 80525

Mike Britten, Program Manager
(970-267-2150, mike_britten@nps.gov)
Billy Schweiger, Ecologist
(970-267-2147, billy_schweiger@nps.gov)
Isabel Ashton, Ecologist/Crew Leader
(970-267-2155, isabel_ashton@nps.gov)
Donna Shorrock, Ecologist/Crew Leader
(970-225-3583, donna_shorrock@nps.gov)

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