Managing for Change in the Jemez Mountains
Building Resilience in a Singular Mountain Range

Climate change is well underway in the southwestern U.S. Warmer temperatures and more erratic rainfall are already affecting native plants, animals and habitats in ways we can see and measure. Any action we take now to build ecosystem resilience to rapid climate change will help us protect our natural areas and the clean water, clean air, and wildlife habitat they provide in the decades to come. The Nature Conservancy has joined with the Climate Assessment for the Southwest, the Wildlife Conservation Society, USDA Forest Service, the National Center for Atmospheric Research, the Western Water Assessment, and the University of Washington to form the Southwest Climate Change Initiative (SWCCI), whose aim is to provide climate adaptation information and tools to conservation practitioners in vulnerable landscapes of Arizona, Colorado, New Mexico and Utah.

The Jemez Mountains: A Remarkable Landscape At Risk

The Jemez Mountains of north-central New Mexico grew warmer, faster, in the 20th century than any other place in the state. The Jemez is one of four vulnerable landscapes selected by the SWCCI to develop and test ways to help natural areas cope with climate change.

A Million-Acre Storehouse of Biological Diversity

As the southern tip of the Rocky Mountains, the Jemez Mountains provide an outpost for northern species such as the ermine and the bog birch. This volcanic mountain range’s isolation from other montane environments allowed unique species such as the Jemez Mountains salamander and the Goat Peak pika to evolve.

People Are Part of the Jemez

This landscape provides water, livelihoods and recreation for thousands in surrounding communities. People have been part of the Jemez for centuries. This mountain range has the highest density of archaeological sites in the U.S. The people of Jemez and Santa Clara pueblos still make their homes here.

The Jemez Mountains Are Showing Stress From a Changing Climate

In the last three and a half decades, this landscape has suffered a series of large destructive forest fires, a severe drought that killed nearly all mature piñon pines, and a measurable reduction in the flows of important streams. The challenge to the conservation community is to manage the Jemez Mountains to avoid the most adverse impacts of climate change.
Creating Practical Climate Adaptation Strategies

In April 2009, the Conservancy and our partners brought together local scientists and managers to share information about the known and projected local impacts of climate change—and to start developing practical strategies to reduce its adverse effects. Fifty land managers and scientists representing 22 federal, state and tribal agencies participated. The focus on the workshop was on two critical ecological processes that shape the Jemez Mountains: fire and stream flow.

Participants reviewed two likely climate change scenarios for the landscape given the current rate of greenhouse gas emissions:

1. Within 10-30 years, mean annual temperature is expected to rise 2-4°C with increased drying. There will be sporadic extreme events in the first half of the century, with precipitation reduced overall but coming in the form of less frequent, but larger, storms.

2. After 30 years, mean annual temperature will rise 2-6°C with increased drying and increased frequency of extreme events, (for example, extremely deep droughts) occurring by mid-century.

Managers and scientists also identified actual and potential effects of past and projected climate change on two critical ecological processes that shape the Jemez Mountains: fire and stream flow. These impacts include:

- Increased frequency and severity of drought
- Reduced snow, more rain than snow, earlier peak stream flows, and more frequent and intense floods
- Longer fire seasons and increased fire frequency, size and severity
- Extreme post-fire erosion post due to decreased surface cover and infiltration
- Increased stream temperatures and post-fire ash deposition
- Large-scale forest dieback and increased frequency of bark beetle outbreaks
- Intensified browsing by elk as vegetation is stressed by drought, and as less snow cover makes aspen and shrubs available year round

After agreeing upon likely impacts on forests, fire, streams and springs, workshop participants identified strategies to help these habitats remain viable in a changing world. Examples of climate change impacts and strategies to address them are shown in the table (right).

**CLIMATE CHANGE IMPACT**

- Increased fire frequency, intensity and size.
- Increased insect/disease outbreaks and tree mortality.
- Reduced frequency of flooding, reduced groundwater recharge and dropping water tables resulting in degradation of streamside ecosystems.
- Reduced snowpack and greater variability in precipitation, reduced stream base flows.

**ADAPTATION STRATEGY**

- Use forest thinning and controlled burns to restore forest structure and natural surface fires. Increase use of natural ignitions. Prepare for the inevitable large crownfires.
- Apply forest thinning strategically to reduce moisture stress and tree dieback and increase tree and shrub species and genetic diversity, thereby reducing vulnerability to insect and disease outbreaks.
- Reduce competition from non-native invasive plants, restore native vegetation, and manage grazing by elk and livestock such that the groundwater table remains high enough to support native streamside vegetation.
- Apply forest thinning and controlled burning methods that maximize moisture infiltration into the soil. Maximize snowpack retention while providing optimal shade to minimize sublimation and evaporation losses.

- Monitor, monitor, monitor...

**THOUGHTS ON ADAPTATION PLANNING**

Todd Ringler, Los Alamos National Laboratory

- This is a century-long exercise.
- Think 10 by 10: Adaption plans with 10-year milestones, revisited 10 times.
- Manage toward the high-end estimate of change: +5°C, -25% precipitation, +episodic drought.
- Look for win-win scenarios, i.e. climate adaption practices that meet additional objectives.
- Our understanding of climate change will evolve, build flexible adaptation plans.
- Monitor, monitor, monitor...

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CRAIG ALLEN
U.S. Geological Survey

"Managers must recognize that changes are occurring and anticipate future changes. As Wayne Gretzky put it, we need to ‘skate to where the puck is going to be.’"

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**RELATIVE INCREASE IN MOISTURE STRESS 1970-2006 IN NEW MEXICO**

Legend

Watershed (9-digit HUC)

High-increasing

Low -decreasing

Trend in moisture stress or drying over 37 yrs.

Regularly monitoring stream and fish community health, and expanding prescribed fire are two practical climate adaptation strategies.
resources will be needed to prevent erosion and exotic weed invasion after these crownfires and natural tree reestablishment will be extremely slow. The more severe climate scenario will require new strategies entirely. This includes managing large expanses of the landscape as it transforms from forest to woodland or grassland. The remaining refugia for native fish will require active protection as water temperatures rise, and yearly streamflows become more variable.

The good news to emerge from the workshop is that many of the restoration strategies already being planned or implemented in the Jemez Mountains can be used to prepare for climate change. But we don’t have all the answers. What we do know is that we must accelerate and expand work that improves the health of forests and streams in order to make them more resilient to rising temperatures and deeper droughts – and we have enough information to act now.

**Taking Action to Build Resilience**

The Conservancy and our land management partners are following up on the adaptation workshop by engaging in several projects that will help species and habitats of the Jemez Mountains cope with climate change.

- **The Southwest Jemez Restoration Strategy** will help restore 210,000 acres of forest, woodland and streams in the Santa Fe National Forest and the Valles Caldera National Preserve. The project includes a robust monitoring program that integrates climate data into management decisions.

- **Climate-smart Conservation Strategies for the Jemez Mountains Salamander** is an applied research project that will integrate restoration guidelines for mixed conifer forests with habitat conservation for a unique and declining salamander.

- **Outreach and Capacity Building for Addressing Climate Change on the Santa Fe and Carson National Forests**: The Conservancy is helping to build climate literacy and promote adaptation action among the professionals who manage three million acres of at-risk public land.

**Lessons from SWCCCI Landscape Workshops**

Our climate adaptation workshops at four landscapes in the Southwest have yielded valuable lessons that can be applied to other important natural areas:

- **We know enough about climate change to take local action**: Though the pace of climate change is uncertain, we have enough information to act now to reduce the most likely adverse impacts.

- **Conservation organizations are already doing a lot to restore and maintain ecosystems—but climate change means we must do more and do it smarter.**

- **“Climate-smart conservation” means adjusting the pace, scope and sequencing of management activities, and coordinating our work regionally, across multiple ownerships.**

- **Some management objectives may become unattainable; we must be agile and adjust our sights**, perhaps aiming to conserve processes (such as stream flow) and functions (such as water supply) as much as species and habitats.

- **More than ever, conservation success will require that monitoring be tightly integrated into planning and management** as landscapes are transformed by climate change.

- **Workshops, while productive, represent only the beginning of a long-term process for understanding and responding to the challenge of climate adaptation for species, habitats and ecosystems. Building resilience requires on-the-ground action.**

**For more information about the Southwest Climate Change Initiative and its work in the Jemez Mountains:**

Visit [http://nmconservation.org/projects/new_mexico_climate_change](http://nmconservation.org/projects/new_mexico_climate_change) or contact project director Anne Bradley at (505) 988-1542 ext. 218 or abradley@tnc.org.

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