New Mexico Climate Change Ecology and Adaptation Workshop – REPORT

Albuquerque, New Mexico – October 22, 2007

Summary

The Nature Conservancy in New Mexico worked with Climate Assessment for the Southwest (CLIMAS) and the Institute for the Study of Planet Earth (both associated with the University of Arizona) to organize a forum in which New Mexico's most influential natural resource managers would:

- Develop a shared understanding of the known and likely future effects of climate change on New Mexico's natural resources.
- Learn about concrete steps that land and water managers are taking now to help ecosystems cope with climate change.
- Identify common goals for climate change adaptation, and agree to work toward these goals collaboratively.
- Develop a framework for coordinated responses to the climate change challenge.
- Identify partnership and information-sharing opportunities.

The group, which included eleven scientists, nineteen public agency resource managers, and nine representatives of non-profit conservation organizations, recommended **four key strategies** for buffering natural ecosystems from climate change:

1. Develop a small number (two to four) of intensive **landscape-scale climate change adaptation pilot projects**, including at least one in a forested landscape and another in a landscape dominated by grassland and/or shrubland.
2. Identify a suite of **practical climate change adaptation options for natural resource managers**. Share, apply and test these ideas collaboratively across US southwest and northern Mexico.
3. Develop a **regional climate change adaptation network and training program** for information sharing, networking, professional development, and capacity building.
4. Develop a **regional monitoring and data management framework** that facilitates development and sharing of scientific information about climate change and its ecological effects.

The participants identified several other needs, including community outreach and education; policy and administrative reform (particularly with respect to environmental regulation), and addressing the root cause of climate change by reducing emissions of greenhouse gas both within and outside New Mexico.

Description

This workshop was designed to take a first step toward building capacity within natural resource management agencies to lessen the negative outcomes of climate change through information sharing, brainstorming, consensus building and collaborative action. The workshop brought together key local, state, tribal and federal natural resource managers with agency and academic scientists to review the

science, articulate management concerns, share management strategies and other pertinent information, and identify opportunities to address climate change adaptation challenges in a coordinated way. Invited speakers provided science and management perspectives to provide a foundation for problem-solving. Then participants devised and discussed a wide variety of options, ultimately identifying a suite of priority strategies for follow-up.

Key Science Findings

Climate Change in the Southwestern US: Mechanisms, Evidence and Projections. Jonathan Overpeck, Director of the Institute for the Study of Planet Earth at the University of Arizona, provided an overview of global and regional climate change science, stating that global warming is *unequivocal* and that it is *very likely* caused by humans. Dr. Overpeck emphasized several key points:

- Observed warming has been greater over land than oceans, and at high elevations and latitudes, and this trend is projected to continue. Within the continental US, warming will be greatest in the West with summer temperatures increasing more than winter ones. Scientists are very confident in continental temperature change predictions: the West could warm by as much as 10.8^{o} F in the next 100 years, depending on the level of greenhouse gas (GHG) emissions.
- Scientists are less confident about precipitation change predictions; most models predict less winter precipitation in the Southwest but disagree about changes in summer precipitation because of difficulties in simulating the summer monsoon. However, winter storm tracks are expected to continue moving northward, as they have since the late 1970s, which may decrease winter precipitation in the Southwest.
- Continued temperature increases will exacerbate drought in the Southwest, because they will diminish snowpack, accelerate spring snow melt, enhance drought in the face of diminished precipitation, and likely counteract the positive influence of any increase in rainfall. The long-term climate record indicates that the Southwest can experience extended megadroughts (150+ yr long) with rapid onset and interspersed periodically by wet years; higher Southwest temperatures will increase the likelihood of extended drought.
- Reducing GHG emissions now may keep impacts from becoming unmanageable; in 10 to 20 years it may be too late to avoid "dangerous climate change," in the words of the Intergovernmental Panel on Climate Change.

Comment by Dr. David Gutzler, Professor of Earth and Planetary Sciences, University of New Mexico: In addition to long-term drying and warming, we can anticipate greater decadal and inter-annual *variability* in temperature and precipitation which may have as much influence on ecosystems as the long-term average trend in these variables.

Vegetation Dieback, Fire, and Erosion as Climate-Driven Ecological Disturbances: Thresholds and Interactions Across Spatial Scales. Dr. Craig Allen, an ecologist with the US Geological Survey's Jemez Mountains Field Station, reported on recent findings from his own and others' research regarding climate-driven changes in some of the Southwest's characteristic ecological processes, including fire, erosion and insect outbreaks.

- Gradual climate change may trigger large, abrupt ecological change as illustrated locally by the piñon pine dieback in the Jemez Mountains (and over 2.5 million acres in the Four Corners).
- The precipitation deficit during the recent drought was no greater than during the 1950s drought but, because of warmer temperatures, pines could not survive.
- Climate change is increasingly a driver of large-scale, insect-induced forest dieback; recent diebacks have occurred globally in Australia, the Amazon, Canada, Spain and Switzerland.

- Interactions between drought, ground cover and erosion can lead to desertification, such as during the 1930s "Dust Bowl" drought. Interconnected grass cover is an important component of southwestern ecosystems. Drought-caused decreases in grass cover and coalescence of bare soil patches can push landscapes beyond a threshold where runoff and soil erosion increase rapidly, leading to desertification. In the Southwest, systems normally hover around this erosion/runoff threshold.
- There are some beneficial aspects of recent drought and warming. Natural thinning by a combination drought and insects reduces competition between trees for limited resources, such as water, and increases resilience. Resetting of woodland/forest systems by vegetation dieback, following a century of fire exclusion, may allow managers to safely reintroduce fire in dense forested areas, further enhancing resilience.
- Mechanical thinning and prescribed burning are important strategies for climate change adaptation.

Climate Change: Projected Effects on New Mexico Stream and River Ecosystems. Dr. Manuel Molles, Professor Emeritus of Biology at the University of New Mexico, was unable to travel to the workshop due to an early-season snowstorm at his southern Colorado home. Carolyn Enquist of The Nature Conservancy presented Dr. Molles' slides, highlighting the following:

- The El Niño Southern Oscillation climate pattern has a great influence on stream flow in New Mexico and the Southwest.
- In drier environments, streams become "flashier," responding in a more extreme manner (*e.g.* greater peak flow) to small increases in precipitation; this is so because in drier environments there is less vegetation to buffer the effects of increased runoff.
- Fish and non-flying invertebrates are predicted to be at greatest risk from climate change, especially at high-elevations.
- Warmer temperatures and drought conditions will result in more variable stream flows due to New Mexico's complex geography.

Applying Climate Change Science to Natural Resources Management: A National Perspective. Dr. *Allen Solomon,* National Program Leader for Global Change Research for the USDA Forest Service (USFS), presented an overview of his agency's response to global climate change, providing a link between science, policy and practice.

- Climate change figures prominently in USFS Chief Kimball's three strategic themes for the USFS including climate change as an increasing disturbance. The USFS is considering changes in land management based on climate change research.
- USFS climate change research strategy is focused on: (1) adaptation (*e.g.,* increase diversity, decrease density of forests); (2) mitigation (*e.g.,* increase CO_2 sequestration from atmosphere by decreasing emissions from wildfires and increasing forest growth); (3) bioproducts (*e.g.,* increased biomass removal from forests to long term carbon pools, biofuels); and (4) decision support tools (*e.g.,* for incorporating climate change into planning and land management).
- Recommendations for responding to climate change include: (1) develop formal training for USFS land managers; (2) establish action priorities under resource limits; (3) develop early detection and rapid response systems for post-disturbance management; (4) educate stakeholders on the role of climate change in management; (5) integrate climate change across planning levels within USFS; (6) increase collaboration across federal and private ownership; and (7) reframe the role of uncertainty by learning to manage for change.

- The US Climate Change Science Program's soon-to-be-published *Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources* includes key findings and adaptation strategies. Parts of a draft version of this document were provided in the workshop background materials.

Challenges of Adapting to a Changing Climate. Dr. Brian Hurd, Professor of Agricultural Economics at New Mexico State University, presented a conceptual framework for climate change adaptation by institutions and individuals, including definitions of adaptation, adaptive capacity, and resilience.

- Adaptation is a deliberate change in the system design, function or behavior in response to or in anticipation of external events or changing conditions. There are two paradigms: reactive adaptation and proactive (anticipatory) adaptation.
- Managers can build adaptive capacity by adjusting to realized and potential changes and disturbance events; taking advantage of existing and emerging opportunities; successfully cope with adverse consequences, mitigating damages, and/or recovering from system failures.
- How and where to begin adapting: Identify vulnerable systems where interventions can be effective. Identify "no regret" and "win-win" opportunities. For example: (1) Improve science and information development, integration, and dissemination; (2) Develop appropriate risk management institutions and policies; (3) Increase the use of resource markets and incentive-based policy designs; (4) Add flexibility and safety to infrastructure design and assessment; and (5) Consider climatic factors in land use planning and building codes.
- Tactics and strategies: see the "5R's + 1" conceptual adaptation framework developed by Linda Joyce and Connie Millar of the USDA Forest Service (see Table 3 in the workshop background materials).

Round Table Discussion

The three panelists—Secretary Joanna Prukop, Director Bruce Thompson, and Supervisor Daniel Jiron—answered questions about their agency's responses to climate change. Their responses are summarized below.

Q: What are the top three priorities for your agency?

Secretary Prukop (JP): Top 3 priorities for NM Energy, Minerals and Natural Resources Dept. are: (1) GHG reduction; (2) implementation of the Forest and Watershed Health Plan; and (3) implementation of the Lead by Example program. State government can and should be bold in reducing GHG emissions and influencing regional energy policy and production. She cited numerous examples of Administration initiatives to mitigate GHG emissions, including establishing incentives for both emission reduction and sequestration.

Director Thompson (BT): NM Dept. of Game and Fish priorities are: (1) conserve fish and wildlife resources for the full spectrum of human uses; (2) provide opportunities for sustainable resource use; and (3) deliver effective outreach in support of the above priorities. Director Thompson gave several examples of how the department is advancing each of these priorities including programs or actions that foster an outdoor connection with children; maintain healthy populations of sensitive species; diminish the effects of non-native species; and focus additional attention on conservation areas that will be important for climate change.

Supervisor Jiron (DJ): Priorities for the Santa Fe National Forest are: (1) restoring fire-adapted ecosystems; (2) protecting open space adjacent to USFS lands from subdivision and development; (3) encouraging climate change research to understand its effects; and (4) finding new ways to reach out to people in a changing, diverse America. Climate change is becoming a greater priority and Supervisor

Jiron gave several examples of how the USFS is responding including: funding climate change research; reducing the agency's carbon footprint; and figuring out how to include climate change into different USFS planning timelines.

Q: What are the chief barriers & opportunities to the adoption of climate change adaptation strategies by your agency?

JP: The oil and gas industry has a strong influence on the legislature, which requires that climate change be addressed through administrative rather than legislative channels; our challenge is to realign the thinking of the legislature so that capital outlays are used strategically to address climate change problems.

BT: The single greatest barrier and opportunity is to manage ecosystems across jurisdictional boundaries.

DJ: The greatest barrier and opportunity is to interpret science results and apply them to local areas; also need to integrate climate-induced vegetation changes and local science into USFS planning.

Q: How should fire and water flows be managed differently in a warmer, drier climate?

JP: Water conservation is the key issue; we would have greater flexibility in allocating water if we used water more wisely.

BT: Integrate conservation assessments, plans and activities comprehensively, across organizations (*e.g.,* Comprehensive Wildlife Conservation Strategy, New Mexico Forest and Watershed Health and Restoration Plan).

DJ: Need to do more thinning and other treatments to enable more "wildland fire use;" need to value water as an ecological service.

Q: Given $10M to build capacity and implement climate change adaptation strategies, where would you put your money?

JP: $1.5M to build capacity for integrating climate change and adaptation strategies into all the work we do; $2.5M to develop good climate change adaptation models and decision support tools; and $6M for habitat conservation and restoration projects at sites that are resilient (or can be made resilient), using the Land, Wildlife and Clean Energy program framework.

BT: $9M for leveraged, collaborative on-the-ground projects; $0.5M for interpretation/outreach to increase knowledge of climate change effects and adaptation strategies (for agency staff and public); and $0.5M to monitor the effects of climate change on wildlife resources.

DJ: Would invest the money in: inventory, monitoring and research which is critical to making the right management adaptations; restoration of fire-adapted ecosystems; and studies that evaluate environmental services and programs integrating these services into what we do.

Group Discussion

The remainder of the workshop's afternoon session was taken up by a wide-ranging, full-group discussion of how the New Mexico natural resource management community can help preserve ecosystem services, land-based livelihoods, and biological diversity as the region's climate becomes warmer, drier and more

variable. The group acknowledged that climate change adaptation presents new and sometimes confounding challenges that add complexity to the many issues that land, water and wildlife managers already face; these include exurban development, fire, insects, invasive species, forest dieback, and overallocation of water. Paradoxically, climate change not only exacerbates these problems, it also ties many of them together. Some members of the group suggested that climate change presents an opportunity—perhaps even an urgent requirement—for natural resource managers to work closely together, across ownership boundaries, to tackle this tangled suite of issues.

Some of the group's key observations and suggestions:

- The group agreed that **we must address the root cause of climate change—greenhouse gas emissions—if dangerous regional warming and drying are to be avoided**. But there was no clear consensus as to whether the New Mexico natural resource management and conservation community can make a critical difference. Rather, the group agreed that, whether or not emissions can be significantly reduced through our actions in New Mexico, **managers and leaders must begin taking action now to help natural ecosystems adapt** to the regional warming and drying that is in progress and will only become greater over the next several decades.

- Managers need to make a transition between **managing using the past as guide to managing for future conditions that have no past analog**. We are managing in a changing and uncertain world. This will require information sharing, adaptive management and triage.

- Setting management goals in a changing environment is challenging. Managers should consider developing a **common approach to assessing condition and developing objectives, such as ecosystem services, sustainability or ecological functionality**.

- Both private and public lands must be included when devising and testing adaptation strategies. The scope of the challenge requires **cross-institutional, landscape-scale thinking and management**, in order to have a long enough reach to make a difference ecologically.

- Thinking and working on a large scale, through **landscape-scale, cross-boundary analysis and management**, is needed to successfully maintain local and regional biodiversity and other ecosystem values.
- The natural resource management community needs **to share information about climate change and its effects seamlessly across organizations**. Our management—including inventory, monitoring, research and restoration—will be more effective if we form a network to bring communicate about climate change and its effects, and about new strategies to build ecological resilience.

- Ecosystems are changing in ways we don't yet understand. The community needs **integrative, large-scale, interdisciplinary science** as it never has before. **Information management, including standardization of research and monitoring protocols, is extremely important to understanding climate change effects at large and small scales**. Several existing programs, such as CIRMOUNT (www.fs.fed.us/psw/cirmount/), SAHRA (www.sahra.arizona.edu/) and EPSCoR (www.nmepscor.org/), have been established to meet the need for regional science integration and application to management. But we need stronger efforts to integrate science and management. An important next step is to use global and regional climate change science to form hypotheses that we can test through on-the-ground experiments and case studies.

Priorities and Next Steps

Priorities for action are the **four key climate change adaptation strategies** that emerged from the day's discussions. The workshop organizers, The Nature Conservancy (TNC) and the Climate Assessment for the Southwest (CLIMAS) and Institute for the Study of Planet Earth (ISPE), suggest a series of next steps below, organized by strategy. **We welcome additional ideas and request that participants send them to Patrick McCarthy or Gregg Garfin**. We will compile and distribute your ideas to the group. We also plan to contact workshop participants to gauge individuals' and agencies' interest in following up on specific suggestions.

1. Develop a small number (two to four) of intensive **landscape-scale climate change adaptation pilot projects**, including at least one in a forested landscape and another in a landscape dominated by grassland and/or shrubland.

    - ✓ Convene a small, focused group to develop a pilot climate change adaptation project for the Jemez Mountains (which meets several of the project selection criteria suggested during the afternoon discussion) and perhaps a second project centered on a grassland/shrubland site in southern or eastern New Mexico.

2. Identify a suite of **practical adaptation options and best management practices for natural resource managers**, using local, regional and national examples as starting points. Share, apply and test these ideas collaboratively across US southwest and northern Mexico.

    - ✓ Develop a New Mexico climate change adaptation working group that includes scientists and managers, and that is charged with documenting tangible, specific adaptation options and best management practices, complete with real-world case studies, within a specific time frame.

3. Develop a **regional climate change adaptation network and training program** for information sharing, networking, professional development, and capacity building.

    - ✓ Develop a southwestern regional climate change adaptation learning network for natural resource managers. Products of the network might include science and adaptation strategy workshops, technical workbooks, and adaptation plans for specific landscapes (such as the Malpai Borderlands, Sangre de Cristo Mountains or Upper San Juan River Watershed).

    - ✓ Develop an interagency federal/state climate change training program for managers and administrators that would build capacity for understanding and responding to the effects of climate change on New Mexico landscapes, rivers and streams.

4. Develop a **regional monitoring and data management framework** that facilitates development and sharing of scientific information about climate change and its ecological effects.

    - ✓ Develop a regional climate change monitoring and data management working group that includes scientists and managers, and that is charged with developing standards for monitoring project design and data management, including protocols for databases and data sharing.

- ✓ Implement these standards in the design of a monitoring and data management system for the pilot adaptation sites to track project results as well as climate change effects, thereby facilitating an adaptive management approach.

Speakers

Jonathan Overpeck, Director, Institute for the Study of Planet Earth, University of Arizona
Craig Allen, Ecologist, US Geological Survey, Jemez Mountains Field Station
Manuel Molles, Professor Emeritus, University of New Mexico (*in absentia*)
Allen Solomon, Director of Global Change Research, USDA Forest Service
Brian Hurd, Associate Professor of Agricultural Economics, New Mexico State University

Panelists

Daniel Jiron, Supervisor, Santa Fe National Forest
Joanna Prukop, Secretary, New Mexico Energy, Minerals and Natural Resources Department
Bruce Thompson, Director, New Mexico Department of Game and Fish

Additional Information

Click here for additional information about the workshop (including a full participant list) and for links to climate change ecology and adaptation resources on the web.