

# **EVALUATING OUR CAPACITY:**

## **A Discussion of Capability for Ongoing Climate Assessment in the Colorado River Basin**

**Authors:** T. Wall, G. Garfin, and J. Galayda

**Workshop Report**

**Boulder, Colorado, June 6-8, 2011**



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## EXECUTIVE SUMMARY

The workshop, *Evaluating Our Capacity: A Discussion of Capability for Ongoing Climate Assessment in the Colorado River Basin*, was held in Boulder, CO, June 6-8, 2011. Sponsored by the Climate Assessment for the Southwest, the Western Water Assessment, and the California Nevada Applications Program, the workshop brought together a diverse group of professionals working in the Colorado River Basin. Participants tried to answer two main questions during the workshop: *What is our capacity for conducting ongoing assessments of climate vulnerabilities, impacts, and adaptive capacity? What is our capacity to evaluate the efficacy of our efforts to adapt to regional climate changes and their impacts?* Workshop participants assessed capacity by identifying current adaptation initiatives. They applied eight metrics to current assessment and adaptation efforts in the region: institutions; communication; attitudes, culture & framing; leadership; resources; monitoring; science capacity; and legal. The following workshop summary provides a roadmap for considering how to move forward with climate change assessment and adaptation efforts in the Colorado River Basin. This report focuses on the authors' key observations from the workshop and suggests a synthesized set of recommendations:

1. **Activities and actions.** Design and implement on-the-ground pilot projects that build partnerships across sectors and disciplines.
2. **Communication and coordination.** Foster learning networks across the region as well as communities of practice where lessons learned, data, and project information can be shared efficiently and effectively.
3. **Capacity building.** Allocate resources and dedicate personnel to 1) develop science translation between scientists and nonscientists, 2) tie science into decision-maker timeframes and needs, and 3) promote education and outreach to society.

Workshop participants pointed to the critical need for incentives and mandates to motivate collaboration and coordination for effective ongoing assessment. Without such incentives, participants believe that capacity for integration will dissipate. This would likely revert to business as usual—efforts focused on narrowly defined interests, lack of multi-sectoral communication, and increased likelihood of maladaptation through lack of coordinated assessment and planning. We need to connect the science of climate change directly to societal values and decision-making parameters. If we do not begin to consistently make this connection between scientific knowledge and affected constituencies, we risk losing critical buy-in and engagement from decision makers. By making these connections, we frame a basis for action.

# INTRODUCTION AND MOTIVATION FOR THE WORKSHOP

## Workshop Structure: How the workshop was organized

The workshop involved a series of four alternating plenary and breakout sessions, with key experts from the region giving talks during the plenary sessions that focused discussion for the breakout session that followed. In three facilitated breakout groups of approximately 20 people, participants responded to prepared questions on topics related to assessment capacity.

*The breakout topics included* (1) monitoring, (2) communication and assessment networks, (3) climate change assessments (e.g., vulnerability, risk, economic valuation) and adaptation initiatives, and (4) metrics for evaluating assessment capacity.

The workshop, *Evaluating Our Capacity: A Discussion of Capability for Ongoing Climate Assessment in the Colorado River Basin*, was held at the University of Colorado campus in Boulder on June 6-8, 2011. Three members of the western Regional Integrated Sciences and Assessments network (RISAs) organized and convened the workshop. The lead RISA was the Climate Assessment for the Southwest (CLIMAS), in collaboration with the Western Water Assessment (WWA) and the California Nevada Applications Program (CNAP). The workshop focus was on 1) understanding the current assessment capacity in the Colorado River Basin for evaluating and adapting to climate change, and 2) identifying how to develop long-term assessment capacity and avoid maladaptation to climate change.

With a focus on water, CLIMAS, WWA, and CNAP brought together participants from all seven Colorado River Basin states and tributary watersheds. These included federal, state, and private sector professionals in the water, agricultural, and ecosystem management sectors, as well as university and agency researchers. Dur-

ing the workshop, participants discussed regional coordination, communication, and knowledge gaps that pose challenges to meeting the National Climate Assessment's (NCA) objective to create an ongoing, sustainable regional assessment process. This workshop was convened to support the NCA objectives by broadening the scope of discussions about regional climate change and improving coordination throughout the Colorado River Basin.

People in a wide variety of government, academic, and private entities throughout the basin are engaged in climate change assessment, adaptation planning, and implementation. *A key motivation for this engagement is the evidence of climate-induced changes in the Colorado River Basin*, such as observed increases in temperature that far exceed global temperature trends and large-scale ecological effects (e.g., uncharacteristically severe wildfire, forest dieback, seasonal stream dewatering, and regional drought). The participants in this workshop applied a diverse array of experiences, skills, research interests, and professional responsibilities to answer two central questions: *What is our capacity for conducting ongoing assessments of climate vulnerabilities, impacts, and adaptive capacity? What is our capacity to evaluate the efficacy of our efforts to adapt to regional climate changes and their impacts?*

The following workshop summary provides a roadmap for considering how to move forward with climate change assessment and adaptation efforts in the Colorado River Basin. This report focuses on the authors' key observations from the workshop and suggests a synthesized set of recommendations. Workshop participants assessed capacity in the region by identifying current adaptation initiatives and applying eight metrics to current assessment and adaptation efforts in the region: institutions; communication; attitudes, culture & framing; leadership; resources; monitoring; science capacity; and legal. These metrics frame the following report and are described in more detail in the following section.

# METRICS FOR ASSESSMENT

Several months before the workshop, a small group of experts<sup>1</sup> collaborated with CLIMAS staff to recommend metrics for evaluating the Colorado River Basin's ability to assess impacts from climate change (Figure 1). Workshop participants used these metrics to get the measure of assessment activities that support adaptation to climate change in the region. Each metric was rated on a scale of one to five, with low values corresponding to low capacity.

## Metrics Description

**Institutions.** Captures the degree to which institutional mandates, missions, and goals align with ongoing assessment capacity. Strong institutional norms, if not well aligned, can lock assessment activities into path dependency, while more flexible norms can improve responses to climate change.

**Communication.** Covers the flow of information, including the extent of communication between institutions working on assessments and adaptation planning in the Colorado River Basin.

**Attitudes, Culture & Framing.** Evaluates the degree to which the framing of climate change issues in both public discourse and in institutional settings hinders or helps assessment activities at local, state, and regional scales.

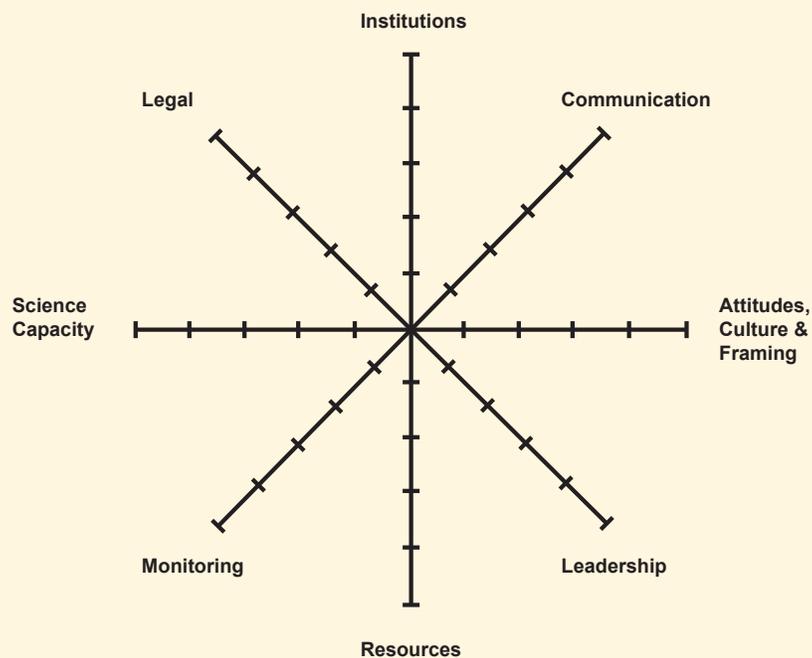
**Leadership.** Assesses leadership capability in the region. Leaders' actions often have large impacts and are able to attract the support of people and resources.

**Resources.** Includes social and economic capital.

**Monitoring.** Quantifies the extent to which there is adequate monitoring of both climate change trends and impacts. It also places a value on whether we are sufficiently monitoring aspects of the assessment processes to determine if the region is meeting climate change challenges.

**Science Capacity.** Captures the amount of scientific understanding in the assessment community, identifies knowledge gaps that constrain assessment and adaptation planning, and identifies science manpower available for ongoing assessment.

**Legal.** Pertains to the role of existing laws either requiring or constraining assessment activities or building future capacity.



**Figure 1:** Metrics for evaluating capacity for assessment and adaptation in the Colorado River Basin

<sup>1</sup>Netra Chhetri (Arizona State University), Lisa Dilling (University of Colorado), Leslie Ethen (City of Tucson Office of Conservation and Sustainable Development), Susanne Moser (Susanne Moser Research and Consulting), Joel Smith (Stratus Consulting)

# OBSERVATIONS, SYNTHESIS, AND RECOMMENDATIONS

Overall, workshop participants noted moderate capacity for assessment in the Colorado River Basin, with strengths spread unevenly across the evaluation metrics and across the region. Across the three breakout groups, science capacity was generally rated the highest, with many participants rating the capacity at four or higher. The lowest rated metric was attitudes, culture & framing, which was rated near the bottom for most of the participants. *A common thread across the eight evaluation metrics was the need for increased communication and coordination that supported integration across water, energy, and agricultural sectors.*



## 1.0 Institutions

In the discussion of institutional capacity, one of the common themes in all of the groups was the strength of individual institutions working in the Colorado River Basin. Recent high points among Colorado River Basin institutions include the emergence of coherent efforts and leadership from the Water Utility Climate Alliance ([www.wucaonline.org/html](http://www.wucaonline.org/html)) and WestFAST, a collaboration of federal agencies initiated by the Western States Water Council ([www.westgov.org/wswc/WestFAST.htm](http://www.westgov.org/wswc/WestFAST.htm)).

However, workshop participants also commented on the need for increasing cross-institutional communication and organization. Specific issues they have observed:

- inefficiency and possible duplication of work between institutions
- competition and “awkward” memorandums of understanding between different institutions in the Colorado River Basin
- overlapping organizational goals and missions that compete for financial and personnel resources
- a business-as-usual approach and a reluctance to change (so-called path dependency)
- difficulty in finding or accessing data held by an institution.

An opportunity for institutions within the Colorado River Basin to build assessment capacity and move forward with adaptation efforts is to lead with efforts to implement pilot projects at regional and local scales. These pilot projects should emphasize 1) *developing partnerships* between public and private institutions in the region, and 2) design projects that *integrate assessment and adaptation efforts across sectors and disciplines*.

## Bureau of Reclamation Colorado River Basin Water Supply and Demand Study

Unlike many other studies of this scope, this study focuses on the quantification of climate change and other risks. The Bureau of Reclamation collaborated with the seven Colorado River Basin states to develop a set of scenarios that include climate, growth, and water demand to provide different projections for water demand and supply. This approach will provide decision makers in the CRB states with a basis for thinking about future water infrastructure and challenges to urban, agriculture, and environmental water supplies.

[www.usbr.gov/lc/region/programs/crbstudy.html](http://www.usbr.gov/lc/region/programs/crbstudy.html)  
[www.usbr.gov/lc/region/programs/crbstudy/report1.html](http://www.usbr.gov/lc/region/programs/crbstudy/report1.html)

## Southwest Climate Change Initiative

The Nature Conservancy, in collaboration with the Climate Assessment for the Southwest, National Center for Atmospheric Research, Western Water Assessment, Wildlife Conservation Society, USDA-Forest Service, and the University of Washington, formed the Southwest Climate Change Initiative (SWCCI). Unlike many assessments, the project's focus is on the assessment and implementation of adaptation measures and advances our knowledge about climate change impacts on the ground and our ability to adapt in locally relevant ways. SWCCI has four demonstration projects located in the Bear River Basin in Utah, the Four Forest Restoration Initiative area in Arizona, the Gunnison Basin in Colorado, and the Jemez Mountains in New Mexico. Goals of the project include:

- developing science-based vulnerability assessments and adaptation strategies
- creating local partnerships that promote, facilitate, and help raise funds for adaptation action
- developing and promoting on-the-ground adaptation projects that will build resilience to rapid environmental change.

[www.nmconservation.org/dl/SWCCI%20Fact%20Sheet%20October%202010.pdf](http://www.nmconservation.org/dl/SWCCI%20Fact%20Sheet%20October%202010.pdf)

## 2.0 Communication

Participants identified a need for communication that supports integrated multi-sector climate assessment, adaptation, and action at the local, state, and federal levels. Currently, efforts such as the Joint Front Range Climate Change Vulnerability Study, the Bureau of Reclamation's Colorado River Basin Water Supply and Demand Study, the National Oceanic and Atmospheric Administration's (NOAA) National Integrated Drought Information System (NIDIS) program, and Carpe Diem's Healthy Headwaters project are all steps in the right direction.

A challenge singled out by workshop participants is the need for individuals from different sectors to develop and maintain communication networks. *The lack of long-term institutional support for these types of communication networks is a serious barrier to building capacity for effective assessment and avoiding maladaptation to climate change.*

These networks can create *communities of practice* that share information, projects, lessons learned, and data. This is a crucial component to developing support at the local level and among decision makers in all sectors and levels of government. An example of this type of program is the Colorado Climate Preparedness Project, an outreach effort that aims to coordinate research, data, and projects associated with climate change and adaptation.

The importance of communication underlies a key recommendation from the workshop, which is to *expand the translation of climate science to stakeholders, decision makers, and the general public*. Workshop participants agreed that training scientists in communicating science to nonscientists and mentoring a new generation of scientists who routinely have such training would enhance and accelerate the translation of climate science. Creating dedicated science translator and coordinator positions at institutions will be instrumental in increasing the use of climate science by decision makers. This in turn will encourage engaging communities in increasing their adaptation capacity (Behar, 2009).

## 3.0 Attitudes, Culture & Framing

Workshop participants said many people they encounter find the implications and impacts of climate change overwhelming, making it difficult to engage stakeholders, decision makers, and the public. It was challenging to work on problem-solving or engage in discussions about preparedness and adaptations to changes in climate. This was often compounded by the polarization of public sentiment on climate change. Participants

## Colorado Climate Preparedness Project

The Colorado Climate Preparedness Project was undertaken by the Western Water Assessment to help coordinate state efforts to prepare for climate variability and change. The primary product is a database that aims to encourage coordination and communication about climate preparedness in the state. Currently, the database holds almost 500 entries on people, organizations, projects, and products focused on increasing climate preparedness in Colorado.

[www.coloadaptationprofile.org](http://www.coloadaptationprofile.org)

## Natural and Human Dynamics of Acequia Systems Innovation Working Group

A consortium of universities and community water management groups led by New Mexico State University have initiated a multi-year integrated assessment to examine relationships between traditional water management systems, communities, and landscapes. The consortium is examining the effects of population growth and climate change on traditional community water management collaboratives, known as acequia associations. Population growth accelerates the change from agricultural to residential land and water uses; climate change threatens water supply reliability through enhanced evaporation and earlier spring snowmelt.

Acequias consist of gravity-fed earthen canals that divert stream water flow for irrigation. These systems, used for hundreds of years in northern New Mexico, lie at the center of a set of complex social interactions that maintain community cohesion, economic sustainability, floodplain hydrologic functions, and wildlife habitat.

[watersolutions.nmsu.edu](http://watersolutions.nmsu.edu)

[www.youtube.com/watch?v=zvuJHig00vo](http://www.youtube.com/watch?v=zvuJHig00vo)

[southwestfarmpress.com/management/nmsu-hosts-acequia-hydrology-symposium](http://southwestfarmpress.com/management/nmsu-hosts-acequia-hydrology-symposium)

in the workshop saw this inability or unwillingness to engage in capacity assessment, adaptation planning, and implementation efforts as a serious barrier to the region's ability to increase adaptive capacity. They noted that outside factors such as the "Climategate" episode have impacted public discourse on climate change (Maibach et al., 2010).

In the Colorado River Basin, several programs have been proactive in addressing barriers to adaptation by attempting to reframe the discussion on climate change and engage decision makers and the public in climate adaptation. These public institutions and private groups are reflective of a trend noted by several participants, namely the increasingly prominent leadership role played by NGOs in building assessment and adaptive capacity in the region.

Suggested approaches for solving this problem of engagement at the workshop were diffuse, but outreach and communication to decision makers and communities was a common thread across the three discussion groups. *As one participant voiced during a post-workshop discussion, all climate adaptation is local.* People who care about and manage ecosystems and work in natural resource-dependent businesses are only too ready to dive into the scientific details and work out practical solutions to climate-related threats. An opportunity exists for institutions in the Colorado River Basin to organize and support more local, landscape-scale adaptation working groups/communities of practice beyond the small handful of places where groups are currently working at climate adaptation.

### 4.0 Leadership

Participants noted that the tendency for leadership to fluctuate with new political appointments undermines long-term progress at promoting assessment and increasing adaptive capacity in the region. The issue of leadership fluctuating with political appointments is reminiscent of a well-documented challenge in Mexican water management, where turnover of municipal water provider leadership coincides with three-year election cycles in municipal governments. The upshot is that priorities change, short-term initiatives find favor, and continual innovation is required of a parade of new actors in the process (Wilder, 2010). In addition, participants noted that at the national level, the stagnation in leadership to develop national energy, climate, and water policies constrains long-term monitoring and observation programs in the Colorado River Basin and nationally.

An opportunity exists with new institutions that are regionally-based but create a national network. These

## San Juan Climate Initiative

The San Juan Climate Initiative is a grassroots stakeholder- and scientist-driven effort in the San Juan Mountain region of southwest Colorado. The goals of the initiative are to assess existing and potential threats caused by climate change and develop strategies to plan for, adapt to, and reduce the effects of climate change on ecosystems and society.

The initiative started in 2006 as a conference to discuss climate variability and change in the region, a dynamic transition zone between the deserts of northwest Arizona and New Mexico and the southern Rocky Mountains of southwest Colorado.

The Mountain Studies Institute is coordinating a vast network of partners, including citizens, local officials, researchers, and regional and federal agencies to develop assessments, tools, and adaptation strategies for the region. The success of the SJCI may be attributed to the active involvement of a wide range of stakeholders, including concerned individuals, community organizations, businesses and industries, land managers, local governments and government agencies, existing regional task forces and work groups, university and college faculty and students, and others.

[www.mountainstudies.org/index.php?q=content/san-juan-climate-initiative](http://www.mountainstudies.org/index.php?q=content/san-juan-climate-initiative)

## USRCRN

NOAA's U.S. Regional Climate Reference Network (USRCRN) will consist of 538 automated climate observing stations across the United States. To assist with implementation of the National Integrated Drought Information System (NIDIS) implementation, USRCRN pilot activities were begun in the Four Corners states (New Mexico, Colorado, Utah, and Arizona), which include much of the Upper Colorado River Basin. The stations will be spaced about 80 miles apart on average, and telemeter five-minute data each hour to [www.ncdc.noaa.gov/crn/observations.htm?network=usrcrn](http://www.ncdc.noaa.gov/crn/observations.htm?network=usrcrn). The data will be available at the Western Regional Climate Center and via MesoWest, a data portal developed and administered by the University of Utah Department of Atmospheric Sciences ([mesowest.utah.edu/index.html](http://mesowest.utah.edu/index.html)).

institutions may provide an important element of stability at the regional and national level in the integration of climate science with assessment and adaptation planning. These new institutions include the Landscape Conservation Cooperatives and the Department of the Interior Climate Science Centers, and augment ongoing work of existing institutions like the Western Governors' Association, NGOs, and the RISA network.

## 5.0 Resources

The workshop participants noted that resources for biophysical research have been used extensively in the Colorado River Basin, but questioned the evenness of the resources. At the local community and county level, resources are less available than they are at the state and federal levels.

A challenge to building capacity is identifying and moving resources in ways that are responsive to local perceptions of problems and needs. Assessing local perceptions and needs would help advance efforts to engage communities and decision makers in local adaptation responses to climate change. One assessment that is attempting to work at the local level is the Natural and Human Dynamics of Acequia Systems Innovation Working Group led by New Mexico State University.

## 6.0 Monitoring

Participants assessed the current state of monitoring in discussions that focused on monitoring strengths and weaknesses, coordination, resources, and capacity. They also identified organizations capable of contributing to monitoring for ongoing assessment in the region. The workshop participants noted that biophysical research is conducted extensively in the Colorado River Basin. Key strengths included interagency efforts, particularly in the Upper Basin, such as those led by the USGS, NIDIS, and Reclamation. Participants also noted strong ecosystem monitoring of megafauna and holistic monitoring in some riparian areas, but gaps in other ecosystems. The National Phenology Network ([www.usanpn.org](http://www.usanpn.org)) was identified as an example of well-coordinated ecosystem change monitoring. A landscape-level monitoring network that is currently being deployed is the NOAA-sponsored USRCRN network.

However, workshop participants questioned the evenness of monitoring distribution and how well this monitoring is coordinated between institutions. They identified substantial gaps in monitoring of the following parameters: soil moisture, evapotranspiration, wind, salinity, precipitation in rural and mountainous areas, snow, groundwater, and agricultural water use; these parameters have been identified in previous assessments (*e.g.*, Brekke *et al.*, 2009; Jacobs *et al.*, 2009; NRC, 2010).

Impacts monitoring was singled out as a significant area of need for climate change assessment monitoring, especially in conjunction with early warning for drought and other climate hazards (e.g., *NIDIS, 2007*). Sectors lacking sufficient hydroclimatic and impact monitoring include ranching, human health and disease, recreation, ecosystem services, and food supply. Areas that need additional resources include socioeconomic and demographic monitoring. Increasing comprehensive region-wide monitoring should include observations at finer scales to understand micro-scale response to shifts in climate.

To improve monitoring in the Colorado River Basin and develop capacity for ongoing assessment, participants suggested basin and landscape-scale monitoring and systems-based approaches; these frameworks will help integrate parameters (including species and human activities) that are currently monitored individually. To improve coordination, participants recommended *monitoring communities of practice* and the development of data interpretation tools. The latter would help stakeholder organizations in the use of climate change science.

## Science Capacity

The CRB and the surrounding region encompasses a wide array of federal, state, and NGO resources that broadly support science capacity in atmospheric research, climatology, hydrology, ecology, earth systems, paleoclimatology, and the application of science and research to stakeholders. Some workshop participants noted that the region has a wealth of capacity in the physical sciences, but less obvious capacity in social and economic sciences. Workshop participants identified a sampling of institutions that demonstrate science capacity in the region (in alphabetical order):

**Denver Federal Center.** This center serves as a western U.S. center for federal agency communication and operations and policy formulation. There are 26 different federal agencies on site—the largest concentration of federal agencies outside of Washington, D.C.

**Department of the Interior Southwest Climate Science Center.** This recently established center is a collaboration between universities, federal agencies, and non-governmental research institutions. It will serve as a center for scientific assessment, research, synthesis, and decision support to inform and build capacity for addressing climate change challenges to natural resource management.

**National Center for Atmospheric Research (NCAR)** in Boulder, CO, is a leader in global climate modeling and improving understanding of the atmospheric mechanisms that drive the Earth's climate. NCAR also hosts a variety of research and outreach efforts, including a division focusing on science-society interactions.

**National Oceanic and Atmospheric Administration (NOAA) Earth System Research Laboratory (ESRL)**, in Boulder, CO, provides substantial expertise in climate, weather, and hydrometeorological research and prediction. NOAA ESRL hosts many scientists associated with the Western Water Assessment.

**National Oceanic and Atmospheric Administration (NOAA) Regional Integrated Sciences and Assessments (RISA).** The Colorado River Basin hosts three NOAA RISA programs: the California Nevada Applications Program, the Climate Assessment for the Southwest, and the Western Water Assessment. These university-based centers develop and provide experimental climate services, with a strong focus on use-inspired multi-disciplinary research to address decision-making needs that require climate knowledge.

**National Science Foundation Long-Term Environmental Research (LTER) Network.** The CRB hosts five LTER sites. Researchers at these network sites monitor and analyze environmental changes in areas as diverse as urban centers, mountain meadows, rangelands, and deserts.

**U.S. Department of Agriculture (USDA) Agricultural Research Service (ARS).** The CRB hosts several ARS facilities, which include laboratories, experimental watersheds, and agricultural and rangeland experiment stations, some of which explicitly focus on climate change research.

**U.S. Geological Survey (USGS) Water Sciences Centers.** Each CRB state hosts a Water Science Center. These centers provide hydrological monitoring and research, data collection, quality control and archiving, and service to state agencies and communities.

**Western Regional Climate Center (WRCC; Reno, NV)** is a center for climate data and information for the western United States. WRCC develops experimental and operational climate information products, and its staff have a strong orientation toward applied climate projects that meet diverse stakeholder needs.

## 7.0 Science Capacity

Participants rated science capacity in the Colorado River Basin the highest of the eight metrics evaluated in the workshop. They felt that the caliber of available scientists and labs was high, although the number of scientists at the federal level who were available for field research in specific geographical areas and in sensitive ecosystems could be increased. While they expressed a general sense that good scientific information was available, participants also noted that information and data could be difficult to find, not easily accessible, and too technical.

Participants also noted the importance of scale in assessing science capacity. Science capacity at the state level seems uneven and lags that of federal and academic science capacity.

*Workshop participants noted that the challenge in this metric connects back to the communication metric and getting the right information in the right format to the right people at the right time.*

Critical to this effort are dedicated positions within institutions that are focused on bringing scientists, decision makers, and information together in ways that are both effective and efficient.

## Law of the River

A divergence in viewpoints over the approach to renegotiating use of Colorado River water has intensified as a string of dry years at the turn of the century reduced the average annual flow and caused Lake Mead to fall to its lowest recorded level in 2010. The Law of the River is a series of complex documents based on the 1922 Colorado River Compact. Proponents of altering the compact suggest the original agreement is fatally flawed for several reasons: it was based on short-term hydrological records and the principle of stationarity, it excludes Mexico and Native American tribes, and it does not consider environmental needs for in-stream flows and the surrounding ecosystem (Alder, 2008). Other proponents point to the long-standing history and legal weight surrounding the Law of the River, and suggest it would be a waste of effort and resources to attempt altering this legal framework. Instead, they suggest working within the existing framework and using it as a foundation to build new agreements for managing the Colorado River (Kenney, 2011). Regardless, both sides agree on several points—a lot has changed in the West since the Colorado River Compact was signed, and we need to start thinking big and implementing those ideas sooner rather than later.

## 8.0 Legal

At the state level, laws and legal regulations related to climate change and the environment are highly variable across the region. There are some federal initiatives to coordinate between legal mandates (the Secure Water Act, USDA National Institute of Food and Agriculture (NIFA), the National Park Service Climate Change Response Program, the U.S. Fish and Wildlife Service Landscape Conservation Cooperatives, and DOI Climate Science Centers). Discussions of existing laws brought up several points concerning the efficacy of existing legal structures. Some participants suggested that working within the confines of existing laws has greater efficacy than attempting to revamp well-established legal systems, whereas others questioned if older laws had the flexibility needed to handle rapidly evolving management situations and climate conditions. Other participants felt that legal drivers often focused on one specific sector, while assuming other sectors remained static. This lack of integration between sectors made it difficult to tackle climate issues that require solutions that address ramifications across multiple sectors.

# RECOMMENDATIONS

The observations of workshop participants' current assessment capacity ranged from moderate to low in the eight metrics. To build capacity for assessment and adaptation, the workshop participants placed the strongest emphasis on the need for improvement and effort in three areas:

1. Activities and actions. Design and implement on-the-ground pilot projects that build partnerships across sectors and disciplines.
2. Communication and coordination. Foster learning networks across the region as well as communities of practice where lessons learned, data, and project information can be shared efficiently and effectively.
3. Capacity building. Allocate resources and dedicate positions to 1) develop science translation between scientists and non-scientists, 2) tie science into decision-maker timeframes and needs, and 3) promote education and outreach to society.

## SUMMARY

One of the most salient needs identified by workshop participants is the need to foster further capacity in science translation, including improved integration between science, values, and policy. Development of new institutions can bridge leadership gaps and build capacity for overcoming the observed barriers raised by anti-climate change attitudes and framing. Examples of actions that can address these issues include pilot projects and knowledge exchange through communities of practice. However, these science translation initiatives cannot be conducted in isolation.

*Communication and collaboration across sectors in the Colorado River Basin are essential to engender further success. Fostering capabilities for assessment and implementation of initiatives is needed to keep ahead of climate vulnerabilities and risks.* The absence of collaboration, coordination, continued fragmentation, or isolation of some sectors and groups (e.g., agriculture, tribes), will impede assessment progress. This will render ineffective the capacity built through existing and new initiatives to keep up with climate challenges.

Participants pointed to the critical need for incentives and mandates to motivate the collaboration and coordination efforts for effective ongoing assessment. Without such incentives, participants believe that capacity for integration will dissipate. This would likely revert to business as usual – efforts focused on narrowly defined interests, lack of multi-sectoral communication, and *increased likelihood of maladaptation through the lack of coordinated assessment and planning*. Leadership, a somewhat intangible quality, must be more continuous across the region and is essential in facilitating strength to transform mere capacity into sustained and effective action.

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# PARTICIPANTS

**Jeffrey Arnold**

Army Corps of Engineers, Institute for Water Resources,  
Climate & Global Change Program

**Kristen Averyt**

Western Water Assessment

**Tim Bardsley**

Western Water Assessment

**John Berggren**

Western Water Assessment

**Keely Brooks**

Southern Nevada Water Authority, Environmental  
Monitoring and Management

**Tom Brown**

USFS, Rocky Mountain Research Station

**Bret Bruce**

USGS Rocky Mountain Regional Executive's Office

**DeWayne Cecil**

NOAA NCDC

**Netra Chhetri**

Arizona State University, School of Geographical Sciences  
and Urban Planning

**Kelsey Cody**

Western Water Assessment

**Mike Cohen**

Pacific Institute

**Lisa Dilling**

University of Colorado, Environmental Studies

**Jim Dyer**

Southwest Marketing Network and Healthy Community  
Food Systems

**Tom Easley**

Rocky Mountain Climate Organization

**Leslie Ethen**

City of Tucson, Office of Conservation and Sustainable  
Development

**Karl Ford**

Bureau of Land Management, National Operations Center,  
Division of Resource

**Jaimie Galayda**

University of Arizona / CLIMAS

**Gregg Garfin**

University of Arizona / CLIMAS

**Rob Gillies**

Utah Climate Center

**Heather Glenn**

Western Water Assessment

**Eric Gordon**

Western Water Assessment

**Ben Harding**

AMEC Earth & Environmental

**Holly Hartmann**

University of Arizona / Arid Lands Information Center

**Cat Hawkins Hoffman**

National Park Service

**Margaret Hiza Redsteer**

USGS

**Paul Houser**

Bureau of Reclamation

**Tom Iseman**

Western Governors Association

**Bill Jackson**

National Park Service

**Kathy Jacobs**

National Climate Assessment, Office of Science and  
Technology Policy

**Carly Jerla**

Bureau of Reclamation

**Linda Joyce**

USFS, Rocky Mountain Research Station

**Lurna Kaatz**

Denver Water

**Brian Kahn**

International Research Institute for Climate & Society /  
NOAA Climate Societal Interactions

**David Kanzer**

Colorado River District

# PARTICIPANTS

**Trudy Kareus**

USDA / Farm Service Agency

**Bobbie Klein**

University of Colorado, Center for Science and Technology  
Policy Research

**Sonja Kokos**

Bureau of Reclamation, Lower Colorado River Multi-Species  
Conservation Program

**Jeff Lukas**

Western Water Assessment

**Glen MacDonald**

UCLA Institute of the Environment and Sustainability  
(Department of Interior, Climate Science Center)

**Patrick McCarthy**

The Nature Conservancy, Southwest Climate Change  
Initiative

**Louise Misztal**

Sky Island Alliance

**Jack Morgan**

USDA, ARS, Rangeland Resources Research

**Avra Morgan**

Desert and Southern Rockies Landscape Conservation  
Cooperatives (Bureau of Reclamation)

**Armin Munevar**

CH2M Hill

**Betsy Neely**

The Nature Conservancy

**David Nix**

USDA / Farm Service Agency

**Bel Pachhai**

Navajo Nation, Department of Water Resources, Water  
Management Branch

**Tom Piechota**

University of Nevada, Las Vegas

**Jim Prairie**

Bureau of Reclamation / Lower and Upper Colorado

**David Raff**

Bureau of Reclamation

**Andrea Ray**

NOAA, Earth System Research Laboratory

**Kelly Redmond**

Western Regional Climate Center, Desert Research Institute

**Claudia Regan**

USDA Forest Service, Rocky Mountain Region

**Frank Riggle**

USDA NRCS

**Daniel Alfredo Rodriguez**

Aurora Water

**Dennis Rule**

Central Arizona Project

**Steven Saunders**

The Rocky Mountain Climate Organization

**Stephanie Smith**

City of Flagstaff

**Joel Smith**

Stratus Consulting

**Bill Travis**

University of Colorado, Department of Geography

**Jim Verdin**

USGS, National Integrated Drought Information System

**Christina Vojta**

Desert Landscape Conservation Cooperative (US Fish and  
Wildlife Service)

**Tamara Wall**

Desert Research Institute

**Reagan Waskom**

Colorado State University, Colorado Water Institute

**Ben Webster**

Environmental Defense Fund

**Kevin Wheeler**

Water Balance Consulting

**Myra Wilensky**

National Wildlife Federation

**Olga Wilhelmi**

National Center for Atmospheric Research

**Kimery Wiltshire**

Carpe Diem West



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