

Summary Report from NPS I&M Arid Lands Climate Change Response Workshop

*April 6-7, 2010
Tucson, Arizona*



Overview.....	2
Workshop Goals and Objectives	2
Goals	2
Objectives.....	2
Organization Attendees	2
Background	3
Impetus	3
Connection to Landscape Conservation Cooperatives	3
National Park Service Strategy.....	3
Planned 2010 Efforts.....	3
Products from Workshop.....	4
Product 1: Current Understanding of Climate Change Impacts	4
Product 2: On-going Monitoring Efforts of Participating Agencies	5
Product 3: Updated Conceptual Diagrams for Climate Change Impacts to Key Arid Lands Systems	6
Product 4: Criteria for Prioritizing Climate Response Monitoring Indicators.....	13
Product 5: Strategy for Partnerships within the Desert LCC	22
Product 6: Draft Priorities for Long-term Monitoring of Ecological Response to Climate Change in Arid Land Parks	22
Next Steps.....	22
Appendix.....	23

Overview

The following report presents highlights from a National Park Service (NPS) Inventory & Monitoring (I&M) workshop titled, “Monitoring Ecological Response to Climate Change in Arid Land Parks in the Desert Landscape Conservation Cooperative.” The two-day workshop was designed to explore ecological response to climate change, develop criteria and preliminary monitoring priorities, and explore opportunities to expand monitoring partnerships. The workshop sought to engage participants with workshop goals and objectives (see below). Following the workshop, there was a working day for the National Park Service planning group to draft a strategy and work plan for the I&M networks.

The workshop was held at the Hilton East, Tucson, Arizona from April 6-7, 2010.

Workshop Goals and Objectives

GOALS

The goal of this workshop was to engage parks, Inventory and Monitoring (I&M) networks, and key partners in gaining critical input for developing multi-year strategies for long-term monitoring of ecological response to climate change relevant to the conservation and management of park natural resources.

OBJECTIVES

- 1) Enhance participant’s understanding of projected changes in climate and related effects on ecosystem components (e.g., communities, disturbance regimes, ecological processes, and species).
- 2) Engage parks, networks and other key staff in developing multi-year strategies and work plans for implementing long-term monitoring of ecological response to climate change.
- 3) Work collaboratively across parks, networks, and regions. Engage potential partners to discuss opportunities for collaboration on enhancing and leveraging existing resources for monitoring indicators of climate change on federal lands.
- 4) Develop and describe a planning process and products that can serve as a prototype for other arid lands parks and protected areas.

Organization Attendees

The primary focus of the workshop was the 24 arid land park units in and near the Desert Landscape Conservation Cooperative, including parks within the Chihuahuan Desert, Mojave Desert, and Sonoran Desert Networks. Arid land park units include Amistad National Recreation Area, Big Bend National Park, Carlsbad Caverns National Park, Casa Grande Ruins National Monument, Chiricahua National Monument, Coronado National Memorial, Death Valley National Park, Fort Bowie National Historic Site, Fort Davis National Historic Site, Gila Cliff Dwellings National Monument, Grand Canyon-Parashant National Monument, Great Basin National Park, Guadalupe Mountains National Park, Joshua Tree National Park, Lake Mead National Recreation Area, Manzanar National Historic Site, Mojave National Preserve, Montezuma Castle National Monument, Organ Pipe Cactus National Monument, Rio Grande

Wild and Scenic River, Saguaro National Park, Tonto National Monument, Tumacácori National Historical Park, Tuzigoot National Monument, and White Sands National Monument.

Key partners included the Bureau of Land Management, Department of Defense, US Geological Survey, US Fish and Wildlife Service, Pima County (Arizona), the Southern Nevada Agency Partnership, and the Desert Managers Group.

Background

IMPETUS

Secretarial Order No. 3289 of September 14, 2009, established a climate change strategy to integrate the work of each Department of Interior (DOI) bureau to mitigate and adapt to the effects of climate change in the pursuit of their respective missions (Senate hearing on climate change, October 28, 2009). Given the broad impacts of climate change, management responses to such impacts are expected to be coordinated on a landscape-level basis.

CONNECTION TO LANDSCAPE CONSERVATION COOPERATIVES

Agencies within DOI have proposed use of the U.S. Fish and Wildlife Service (USFWS) twenty-two geographic areas, referred to as Landscape Conservation Cooperatives (LCCs), as an organizing framework for cooperation to address climate change impacts. The USFWS describes LCCs as “conservation-science partnerships between the USFWS, U.S. Geological Survey (USGS), and other federal agencies, states, tribes, NGOs, universities and stakeholders within a geographically defined area.”

NATIONAL PARK SERVICE STRATEGY

The NPS expects to fully participate with each of the DOI-proposed LCCs. In fiscal year 2010, the NPS anticipates receiving up to \$10M service-wide to address climate change impacts to park resources with an integrated strategy that includes planning, adaptation, mitigation and monitoring. The NPS Inventory and Monitoring (I&M) program strategy includes monitoring indicators of climate change impacts within four thematic natural resource areas that include park units at: high-elevation, high-latitude, arid-lands, and coastal locations on the Pacific (including Hawaii), Atlantic, and Gulf coasts. In fiscal year 2010 the Washington Support Office (WASO) I&M program will receive initial funding to begin developing work plans for monitoring ecological impacts of climate change within a subset of NPS units across these four thematic areas. The USFWS Refuge System is receiving new funding in 2010 to begin developing an inventory and monitoring program for refuge lands. The NPS and USFWS expect to collaborate closely on ecological monitoring.

PLANNED 2010 EFFORTS

During this fiscal year, the Intermountain (IMR) and Pacific West Regions (PWR) will cooperate on developing work plans for monitoring indicators of climate change within two LCCs: the Desert LCC and the Great Northern LCC. This year the IMR and PWR I&M programs will focus their planning on arid-lands park units (Desert LCC) and high-elevation

park units (Great Northern LCC). Planning for monitoring in parks outside of these two LCCs is expected in subsequent years. To secure future funding for I&M monitoring of climate change indicators, I&M planning efforts require working closely with park managers to set monitoring priorities, establishing collaborative partnerships within and outside DOI to develop and accomplish monitoring, and producing collaborative multi-year work plans to implement high priority monitoring in parks.

For this year's efforts within , the Great Northern and Desert LCCs , the I&M program will establish the framework for these work plans that must be approved by the WASO to secure the funding necessary to support future NPS climate change monitoring in park units within these two LCCs. Two workshops in the spring of 2010 were scoped to (a) provide critical input from park managers needed for setting priorities, and (b) initiate collaboration among potential partners for developing and implementing climate change monitoring. The current workshop brought together park managers and partners from three I&M networks within the Desert LCC: Chihuahuan Desert and Sonoran Desert (both in the IMR), and the Mojave Desert (PWR). Methods and results from this workshop, focused on park units in the Desert LCC, will be used to modify design of a similar planning workshop scoped in early May for park units in the Great Northern LCC.

Products from Workshop

Four products resulted from the efforts of this workshop, described below and available online at <http://www.southwestlearning.org/getinvolved/outreach/workshops/climate/aridlands>. These products will be used by networks following the workshop for work plan development in response to Secretarial Order No. 3289 of September 14, 2009. This order established a climate change strategy that integrates the efforts of individual Department of Interior (DOI) bureaus to mitigate and adapt to the effects of climate change. Detailed notes from the workshop are available upon request from the Sonoran Institute (aberry@sonoraninstitute.org).

PRODUCT 1: CURRENT UNDERSTANDING OF CLIMATE CHANGE IMPACTS

Summaries of our current understanding of climate change impacts to key resources within the LCC were detailed in the plenary presentation by Dr. Lisa Graumlich, and also in discussions of terrestrial and aquatic systems within I&M Networks in the Desert LCC. Brief notes from Dr. Graumlich's presentation are below and the presentation can be found at the workshop website—

<http://www.southwestlearning.org/getinvolved/outreach/workshops/climate/aridlands>.

Dr. Graumlich focused on three areas for adapting to a warmer, drier, and more crowded landscape in the Southwest: anticipating climate change and uncertainty, choosing among tools for forecasting impacts, and prioritizing conservation targets at landscape scales. Dr. Graumlich pointed out that while there are various predictions about how the climate will change over the coming century, it is most useful to focus on the next few decades. In addition, there is more certainty about a 1 degree Celsius increase in

temperature over the coming decades. Declines in snowpack, increases in wildfire, and Pinyon-juniper dieback are ecosystem changes that are attributable to climate change and are occurring now. Dr. Graumlich described a suite of tools that can be used to forecast ecological impacts of climate change including paleoecological data, 20th century observations, bioclimatic envelope models, mechanistic species distribution models, and species vulnerability indices. Uncertainty varies with each tool, and Dr. Graumlich advised the participants to choose wisely. She introduced a new concept for prioritizing conservation targets at landscape scales: “climate space.” Because Southwestern ecosystems are constrained by water and temperature, “climate space” can be mapped or graphed as the amount of precipitation versus temperature or potential evapotranspiration. When land management is mapped onto climate space in the Southwest, protected areas tend to occupy the hottest and driest space or the cool and moderately wet climate spaces. To fill in the climate space gaps, collaboration across jurisdictions is key.

PRODUCT 2: ON-GOING MONITORING EFFORTS OF PARTICIPATING AGENCIES

On-going monitoring efforts of ten groups potentially participating in the Desert LCC were presented. These groups included NPS, the U.S. Fish & Wildlife Service, USFWS National Wildlife Refuge I&M program, Bureau of Land Management, Department of Defense, U.S. Geological Survey, California Desert Managers Group, Southern Nevada Agency Partnership, Pima County (Arizona), and Big Bend Conservation Cooperative. Brief notes from the presentations are below. Links to the PowerPoint presentations and contact information for the presenters can be found at the workshop website—see <http://www.southwestlearning.org/getinvolved/outreach/workshops/climate/aridlands> .

Bureau of Land Management (Elroy Masters) – At the national level, the Bureau of Land Management (BLM) is developing a set of core indicators that complements ongoing work at the local level to provide information on the health of public lands across the nation. The BLM is focusing on three attributes: biotic integrity, soil and site stability, and hydrologic function. Indicators identified to date are non-native invasive plants, bare ground, special status (plant) species, vegetation composition by cover, vegetation height, proportion of soil surface in large inter-canopy gaps, soil aggregate stability, and stand density index. Potential future indicators include fragmentation, soil compaction, area with significant soil erosion, and soil carbon. Additionally, to address riparian/aquatic management the BLM is developing a core set of aquatic indicators.

Department of Defense (Fon Duke) – Major Department of Defense (DoD) operations within the Desert LCC include six Army (Camp Navajo, Fort Bliss, Fort Huachuca, Fort Irwin, White Sands Missile Range, and Yuma Proving Ground), eight Air Force (Barry M. Goldwater Range, Creech & Nevada Test and Training Range, Davis-Monthan, Edwards, Holloman, Laughlin, and Luke) , three Navy (Chocolate Mountains Gunnery Range, Naval Air Facility el Centro, and Naval Air Warfare Center

China Lake), and three Marine Corps (Marine Corps Logistic Base Barstow, Marine Corps Air Station Yuma, and Twentynine Palms Marine Corps Base). The largest military bases for the US are located within the Desert LCC. Each base has environmental managers who guide conservation efforts and partner with other agencies.

National Park Service (Steve Fancy) – The National Park Service Inventory & Monitoring program works to provide knowledge on the status and trend in condition for key resources in each park so the information about resource condition is used in management decision-making, planning, interpretation, and other management activities. As such, the core duties of I&M staff are to determine status and trends in the condition of a few key natural resources for each park, and effectively deliver information to park managers, planners, interpreters, scientists, and other key audiences. A recent achievement of the I&M program was the release of data, standard operating procedures and interpretative materials from the NPScape program which addresses landscape dynamics. The NPScape team developed six measures (conservation status, housing, landcover, pattern, population, and roads) and associated metrics. The data are available and broadly applicable across the Desert LCC.

U.S. Fish & Wildlife Service (Mark Chase) – The U.S Fish & Wildlife Service National Wildlife Refuge System has been funded to create an Inventory & Monitoring program, which is based in Ft. Collins, Colorado near the NPS I&M program. The plan is to build a scientifically credible program across the Wildlife Refuge System that is seamless with the NPS I&M program. The USFWS is receiving \$12 million to monitor a variety of fish, wildlife, and plant resources including climate change indicators. USFWS is committed to providing real data to the wildlife refuge managers using the same relationship model as the NPS I&M networks have with individual parks. The underpinning foundation for this new program is sound credible scientific information at the local, state, and federal levels.

U.S. Geological Survey (Charles van Riper) – The U.S. Geological Survey (USGS) conducts activities at broad- and small-scales across the Desert LCC. Large scale activities include the National Coordinating Office, and National Phenology Network. There are several large scale projects such as forecasting climate impacts on wildlife in the Southwest and the consequences of the U.S./Mexico border fence. Small scale projects include reptile and amphibian research and monitoring, the Border Environmental Health Initiative, the Santa Cruz Watershed Ecosystem Portfolio Model, developing assessments for the distribution of disturbances within Border Parks, and evaluating buffelgrass fuel loads and fire danger at Saguaro National Park.

Big Bend Conservation Cooperative (Jeff Bennett) – Due to a changing landscape, the Big Bend Conservation Cooperative (BBCC) was established. The goals of the BBCC are

to promote collaborative relationships to advance monitoring and science-based conservation, further scientific understanding of the effects of climate change and flow regime on the Rio Grande and its watersheds, active conservation and restoration of Chihuahuan Desert resources – Rio Grande watershed, groundwater, and uplands, and develop a watershed planning and restoration toolbox for public and private landowners and resource managers. Initial cooperative projects focused on saltcedar management. Cooperative agreements with non-governmental organizations (NGOs) have helped to coordinate cross-border efforts. Examples of BBCC science, monitoring, and management activities include the Pine Canyon Watershed, recognition by Texas of springs as “Ecologically Significant” as recommended by BBCC, spring inventory and geochemical tracers (partners: NPS, Sul Ross State University, Texas State University, USGS), grasslands restoration and outreach, and coordination with Mexican partners.

California Desert Managers Group (Russell Scofield) – The California Desert Managers Group works together to conserve and enhance the California deserts for current and future generations by developing coordinated and complementary management practices and programs. Participants in the Desert Managers Group come from the Department of Interior, Department of Defense, Department of Agriculture, State of California, and county governments. The Mojave region is expected to have significant impacts from climate change. Research is taking place now to address climate change adaptability. Projects include landscape genetic modeling, niche modeling, and downscale climate impact modeling.

Pima County (Brian Powell) – In 2004, the Sonoran Institute and NPS Sonoran Desert Inventory & Monitoring Network established the Sonoran Desert Regional Monitoring Partnership, which included numerous federal, state, non-profit, and university partners. The group met to discuss monitoring of birds, border impacts, invasive plants, invasive animals, riparian systems and other topics. Currently, the group is not active. Pima County, Arizona is developing a monitoring program to complement the Sonoran Desert Conservation Plan. Current efforts focus on the county’s ranches purchased through a bond initiative. While Pima County is doing some monitoring, they need the bigger picture that they don’t have the resources to track. Brian made a plea for local governments to be included in the work of the Desert LCC.

Southern Nevada Agency Partnership (Kent Turner) – The Southern Nevada Agency Partnership (SNAP) includes the NPS, BLM, USFS, and USFWS in southern Nevada and is a chartered framework for the management of over seven million acres of land. SNAP’s Science and Research Team works to provide clear understanding of the health and trends of the southern Nevada ecosystem for uniform, informed management decisions regarding natural resources, cultural resources, and human use of public lands. The three goals of SNAP’s Science and Research Strategy are to (1) restore, sustain, and enhance southern Nevada ecosystems, (2) provide for

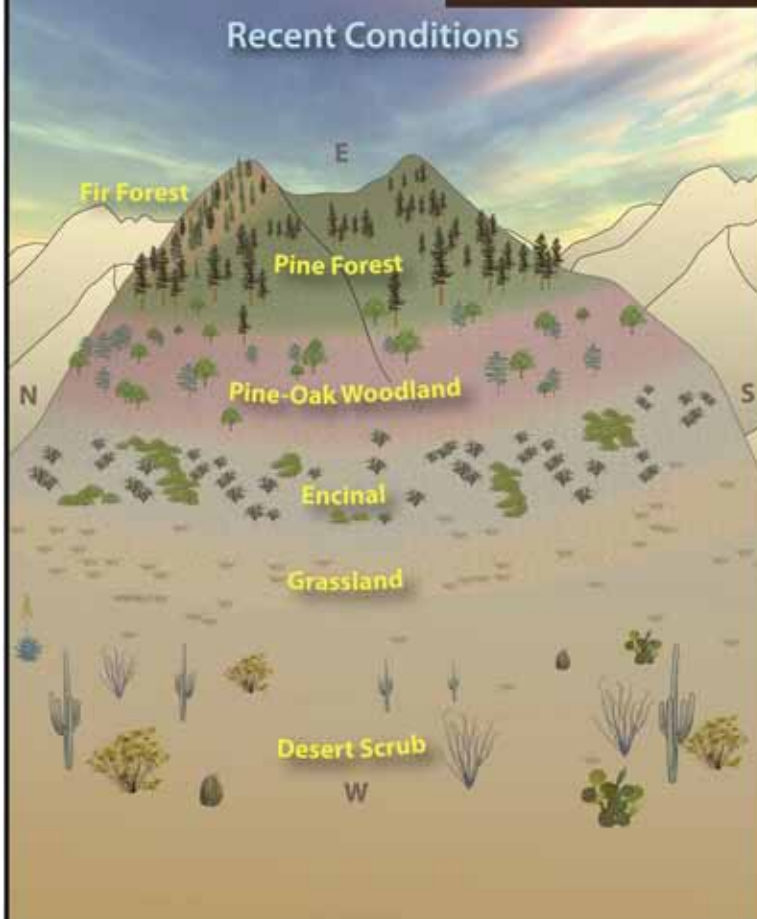
responsible use of southern Nevada lands in a manner that preserves the heritage resources and promotes an understanding of human interaction with the landscape, and (3) promote scientifically informed and integrated approaches to effective, efficient, and adaptive management. There are three projects with information relevant to climate change monitoring: (1) characterizing local climate and soils within the ecological zones of the Spring and Sheep Mountains, (2) fire history, fire effects and post fire seeding in Southern Nevada, (3) ecosystem health monitoring in Lake Mead NRA.

PRODUCT 3: UPDATED CONCEPTUAL DIAGRAMS FOR CLIMATE CHANGE IMPACTS TO KEY ARID LANDS SYSTEMS

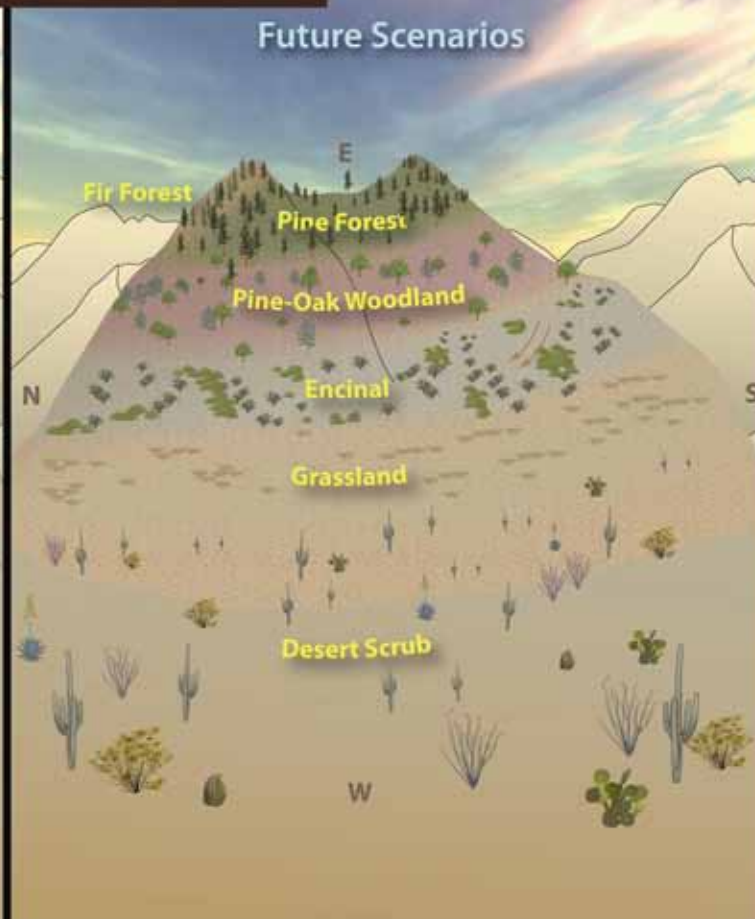
Conceptual diagrams were presented at the workshop to illustrate climate change impacts in key arid lands systems. Those diagrams were presented on the morning of Day 2 of the workshop, and used to aid in discussion and understanding of ecological impacts of climate change on the arid lands of the Desert LCC. The four conceptual models—arid land biomes, upland environments, riparian environments, and tinaja environments—are presented in the following pages and are available on the workshop website <http://www.southwestlearning.org/getinvolved/outreach/workshops/climate/aridlands>.

Aridland Biomes

Recent Conditions



Future Scenarios



Predicted Climate Changes in Aridland Biomes

Temperature



Precipitation

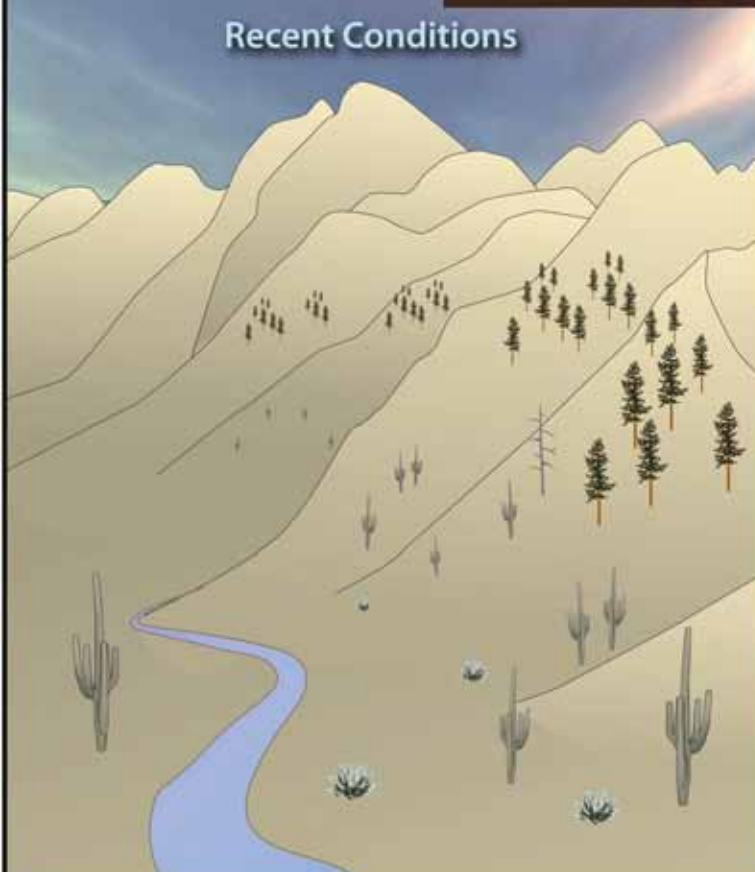


Some of the Predicted Responses to Climate Change in Aridland Biomes

There is expected to be a general upward shift in all desert biomes in this region

Aridland Upland Environments

Recent Conditions



Future Scenarios



Predicted Climate Changes
in Aridland Upland Environments

Temperature



Precipitation



Some of the Predicted Responses to Climate Change in Aridland Upland Environments



Increased frequency and extent of fires.



Increased erosion from uplands after fires.



Evapotranspiration is amplified



Increase in thunderstorms



Increased insects and pathogens resulting in vegetation stress and mortality



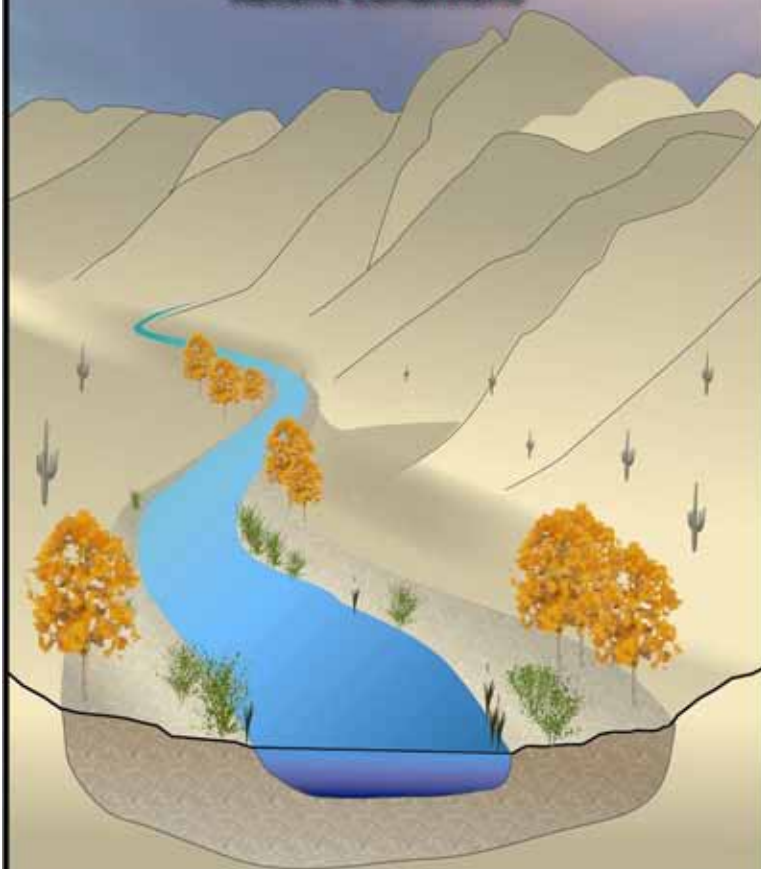
Increase in non-native species (e.g., buffelgrass)



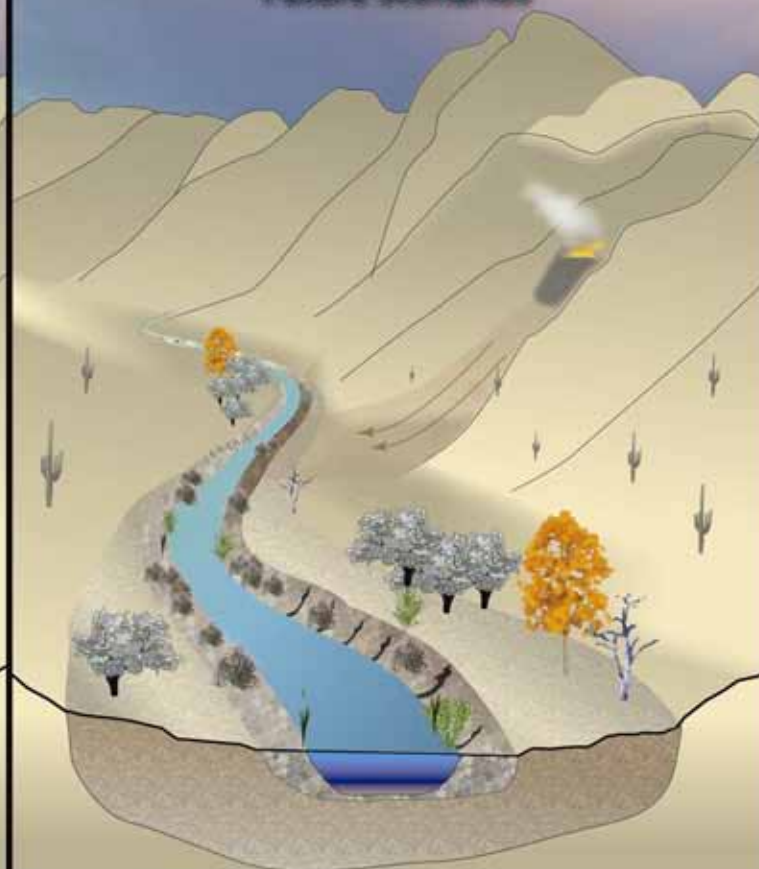
Decreased tolerance to environmental change by native species (e.g., Saguaro)

Aridland Riparian Environments

Recent Conditions



Future Scenarios



Predicted Climate Changes in Aquatic Environments & Hydrology

Temperature



Precipitation



Some of the Predicted Responses to Climate Change in Aquatic Environments & Hydrology

Hydrology

Reduced stream flow and changes in timing.



Physical Environment



Increased stream channel erosion.
Increased runoff and sedimentation from uplands (e.g., after fires).

Vegetation



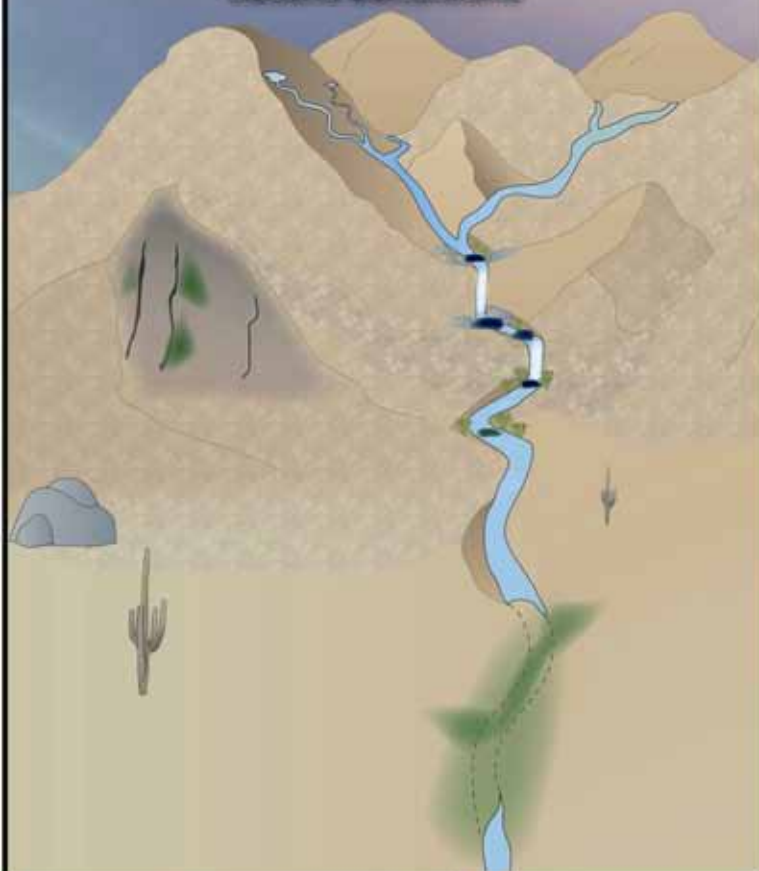
Decrease in native riparian vegetation



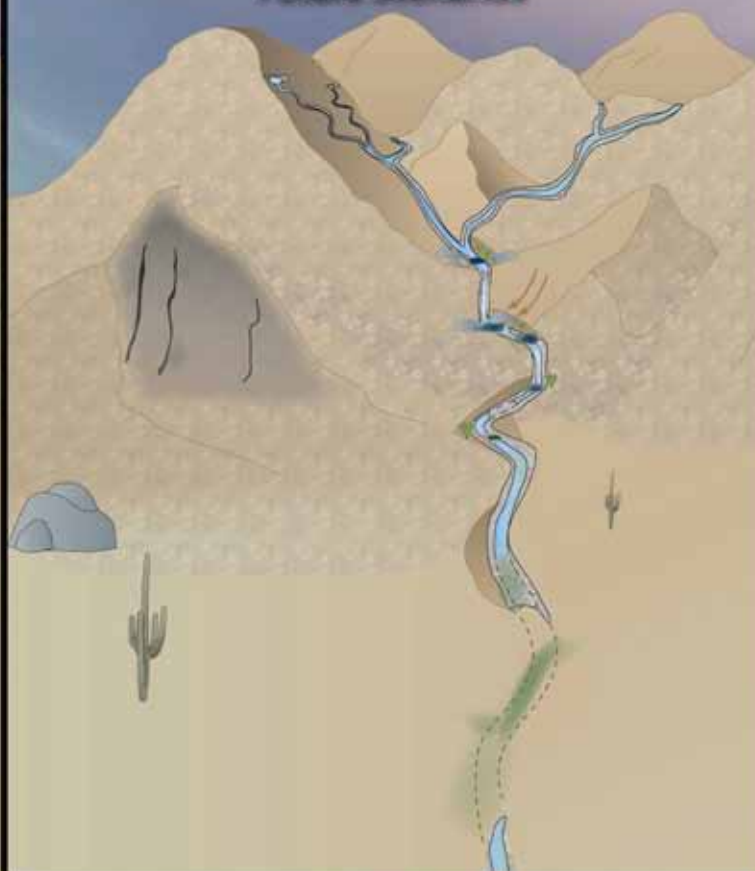
Increase in exotic riparian vegetation (e.g., Russian olive and Tamarisk)

Aridland Tinaja Environments

Recent Conditions



Future Scenarios



Predicted Climate Changes in Aridland Tinaja Environments

Temperature



Precipitation



Some of the Predicted Responses to Climate Change in Aridland Tinaja Environments

Hydrology

- Reduced stream flow.
- Reduced Seeps & Spring.

Physical Environment

- Increased stream channel erosion.
- Increased filling of tinajas from erosion and sedimentation from uplands (e.g., after fires).

Vegetation

- Decrease in native riparian vegetation.

PRODUCT 4: PRIORITIZATION OF CLIMATE RESPONSE MONITORING INDICATORS

During the second day of the workshop, participants broke out into work groups focused on terrestrial systems, rivers and streams, and springs, tinajas, and oases. Each work group was tasked with developing a coarse-filtered prioritized list of monitoring recommendations associated with monitoring ecological response to climate change. The prioritized lists were compiled to inform NPS decision making and planning.

Each work group was provided a table of vital signs and monitoring protocols relevant to climate change. During the development of each Network's monitoring plan, teams created vital sign lists utilizing conceptual models, expert input that underwent rigorous review. The initial list of vital signs for each Network was prioritized to meet the overall program goal of monitoring conditions of natural resources in parks. The NPS Network and regional managers reviewed the current lists for vital signs and identified vital signs relevant to climate change and made initial monitoring recommendations. In their initial screen they eliminated vital signs that appeared not to be climate change related, plus organized the vital signs based on protocols (since one protocol might cover many vital signs). Their lumping resulted in the columns of spreadsheet being projected called "protocols/vital sign," "management issues" and "monitoring recommendations". The work groups reviewed the initial lists, identified gaps, and added, deleted and modified the recommendations. Participants rated each recommendation using a scale of 1-5 for a subset of prioritization criteria. The combined results of the breakout groups are presented in the table below (Table 1).

Also during the break out session on the second day of the workshop, a fourth work group focused on partnership opportunities within the Desert LCC. The group discussed how partners could work together to enhance monitoring efforts across the deserts. The group started with a discussion of goals—why partnerships could be helpful; then identified a strategy for building a partnership; and identified next steps. Notes and results from the discussions are included in the appendix.

Table 1. Combined list of ranked management issues, recommendations, and vital signs

Management Issue	Protocol / vital signs	Recommendation	Responsiveness to Climate Change (1-5)	Common to Parks or within LCC (1-5)	Cost-effectiveness (1-5)	Relevance to Management (1-5)	Sum of Scores
Changes in species composition due to salinity levels	Streams & Springs	Changes in riparian soil salinity	4	5	1	5	15
Changes in species composition due to salinity levels	Streams	Riparian aquifer water quality (salinity)	3	5	2	3	13
Changes in the watershed, including land use and impervious surfaces, affect runoff characteristics	Land cover/land use	Monitor land use and impervious surfaces in watershed	5	5	1	4	15

Management Issue	Protocol / vital signs	Recommendation	Responsiveness to Climate Change (1-5)	Common to Parks or within LCC (1-5)	Cost-effectiveness (1-5)	Relevance to Management (1-5)	Sum of Scores
Changing climate will affect <i>iconic/charismatic species</i> (plants and animals) composition such that there will be "winners" (resistant or invasive) and "losers" (highly-sensitive, intolerant) with consequences for ecosystems	NEW	Add vertebrates - species that people like. Collect additional condition and demography measures on susceptible and resistant indicator species; resume measurements from legacy research studies	3	5	3	5	16
Changing climate will affect plant species composition such that there will be "winners" (resistant or invasive) and "losers" (highly-sensitive, intolerant) with consequences for ecosystems	Terrestrial Vegetation and Soils	Collect additional condition and demography measures on susceptible and resistant indicator species; resume measurements from legacy research studies.	3	5	5	5	18

Management Issue	Protocol / vital signs	Recommendation	Responsiveness to Climate Change (1-5)	Common to Parks or within LCC (1-5)	Cost-effectiveness (1-5)	Relevance to Management (1-5)	Sum of Scores
Changing climate will affect vertebrate species composition such that there will be "winners" (resistant or invasive) and "losers" (highly-sensitive, intolerant) with consequences for ecosystems	NEW	Collect additional condition and demography measures on susceptible and resistant indicator species; resume measurements from legacy research studies.	5	5	3	5	18
Changing Climate will shift the distributions of terrestrial species	Terrestrial Vegetation and Soils	Add additional monitoring plots along gradients.	3	5	5	3	16
Climate	Weather and Climate (from Terrestrial)	Collaborate with NOAA and others. Fill-in the gaps to capture small-scale variations? Fill-in the gaps to have enough data for the Network/LCC.	5	5	5	5	20

Management Issue	Protocol / vital signs	Recommendation	Responsiveness to Climate Change (1-5)	Common to Parks or within LCC (1-5)	Cost-effectiveness (1-5)	Relevance to Management (1-5)	Sum of Scores
Climatic change will affect phenology and snow pack over time	Land cover/land use	use remote sensing data (MODIS, LandSat, no development) to determine spring green up, snow extent and productivity using existing adjacent network protocols	5	5	4	3	17
Concentration of metals in water & soils	Water quality		1-2 (depends on why levels are changing)	2	2-3 (could be higher depending on lab costs)	3-5 (depends on how accessible/important the contaminated source is)	10
Disappearance of springs (individual springs going dry)	Water quantity		3 (if related to development) or 5 (if related to increased temperatures)	5	5	5	19
Ground water levels	Ground water quantity	Focus on those most likely to change	1-2	5	1-2	3-5	12
Increased erosion from uplands and deserts	Terrestrial Vegetation and Soils	Add additional measures of actual and potential soil erosion; resume measurements from legacy research studies.	2	5	3	5	15
Increased exotic plant invasions in uplands and deserts	Exotic Plants - Early Detection (Streams)	Investigate remote sensing applications. Improve data management and data sharing across agencies.	5	5	3	5	18

Management Issue	Protocol / vital signs	Recommendation	Responsiveness to Climate Change (1-5)	Common to Parks or within LCC (1-5)	Cost-effectiveness (1-5)	Relevance to Management (1-5)	Sum of Scores
Increased exotic plant invasions in uplands and deserts	Exotic Plants - Early Detection (Terrestrial)	Increase the spatial extent and temporal frequency of existing sampling; resume measurements from legacy research studies.	2	5	3	5	15
Increased fire occurrence, extent, intensity in uplands and deserts	Disturbance Database (from Streams)	Collaborative effort with other agencies. Expand spatial and thematic scope of SODN Disturbance Database; accelerate population of database	5	5	5	5	20
Increased fire occurrence, extent, intensity in uplands and deserts	Disturbance Database (from Terrestrial)	Expand spatial and thematic scope of SODN Disturbance Database; accelerate population of database; resume measurements from legacy research studies.	4	5	5	5	19
Increased fire occurrence, extent, intensity in uplands and deserts	Terrestrial Vegetation and Soils	Collect additional information on fuel loading, continuity, and other fire ecology parameters; improve programmatic integration with fire (READ/BAER/FEMO) per CHDN and SOPN; resume measurements from legacy research studies.	4	5	4	5	18
Increased sedimentation	Streams	Sediment transport and dynamics. Understand flux, sources, etc.	5	5	3	5	18

Management Issue	Protocol / vital signs	Recommendation	Responsiveness to Climate Change (1-5)	Common to Parks or within LCC (1-5)	Cost-effectiveness (1-5)	Relevance to Management (1-5)	Sum of Scores
Invasion of exotic species	Plant and non plant species		2	4	4	3-5 (depending on the species)	14
Loss of habitat due to reduced streamflow	Streams	Backwaters (extent) - sedimentation, invasive species, water quality	5	2	2	5	14
Retrospective studies of climate change effects	NEW	Identify extent long-term datasets from prior research or monitoring in LCC parks, and (using some tight criteria). Good initial project.	5	5	4	5	19
Rare and endemic species	Vegetation; invertebrates; fish; water quality; birds		3-5 (depends on how vulnerable the species is)	4	4 (depends on if data exists)	5	17
Reduced streamflow (SODN& CHDN)	Riparian/Alluvial groundwater	Monitor depth to groundwater in riparian area. Riparian aquifer characteristics	5	5	4	5	19
Spatial/temporal distribution of springs	Water quantity; Ground water		3 (if related to development) or 5 (if related to increased temperatures)	5	1-2	5	15.5

Management Issue	Protocol / vital signs	Recommendation	Responsiveness to Climate Change (1-5)	Common to Parks or within LCC (1-5)	Cost-effectiveness (1-5)	Relevance to Management (1-5)	Sum of Scores
Water recharge zone characterization (baseline inventory)	Ground water; land cover/use; vegetation; disturbance; aquifer characterization		1-2	5	1 (if no data exists) – 3 (if USGS data exists)	3	11.5
Water recharge zone condition (monitor long term)	Ground water; land cover/use; vegetation; disturbance;		1-2	5	4	4	14.5

Next Steps

The attendees assembled for this workshop helped create a set of draft priorities (Product 4) for monitoring ecological response to climate change in high elevation parks. This table served as input to the Intermountain and Pacific West Regions I&M programs for a workshop follow-up effort scoped at developing work plan and long-term strategies in response to Secretarial Order No. 3289. This follow up effort occurred April 8, 2010 and included a subset of the attendees to the workshop To meet this desired outcome, workshop participants, under leadership from Bruce Bingham, decided to slot monitoring priorities into shorter term (work plan) and longer term (strategic) categories. Notes and results from the discussions are available upon request to Bruce Bingham (Bruce_Bingham@nps.gov).

The products described above will be used by the NPS I&M Networks following for the development of a work plan and long-term strategy in response to Secretarial Order No. 3289 of September 14, 2009. The workshop planning team greatly appreciates the input from participants during the workshop and feels that the NPS planning group gained critical input for developing multi-year strategies for long-term monitoring of ecological response to climate change relevant to the conservation and management of park natural resources. The planning team wishes to thank all participants for their time and effort.

APPENDIX: NOTES AND RESULTS FROM PARTNERSHIPS DISCUSSION

The group discussed how partners could work together to enhance monitoring efforts across the deserts. The group started with a discussion of goals—why partnerships could be helpful; then identified a strategy for building a partnership; and identified next steps.

Goals—why partnerships would be beneficial

- Link groups across the desert LCC; engage the full range of partners and roles
- Link scales of monitoring to see effects across the landscape
- There is great potential for landscape connection and conservation through collective efforts (overall, the desert LCC is dominated by federal lands that are in good condition and protected)
- Share information: consistent data collection, share data management
- Identify research needs with partners to support monitoring efforts
- Create synergy for mutual benefit and to institutionalize collaborative monitoring across the landscape
- Pool and coordinate resources for monitoring (funding, staffing, skill sets) to understand condition and trends and inform management decisions across a larger landscape
- Share systems; create cross-cutting multi-agency projects
- We want to be successful—working together will increase our collective success

EXAMPLE: Pacific Islands

Steve Fancy described an example from the Pacific Islands for how an interagency partnership resulted in meaningful outcomes on the landscape. The main components of their success included:

- Forming an interagency steering committee
- An alliance of partners helped set priorities
- Shared resources and coordinated staff—each partner was committed to the partnership and dedicated resources toward it
- Cross-border thinking allows partners to see the bigger picture, and to be more nimble in adaptive management
- A common database, data collected together
- Shared recognition for products and results

Structure for building a regional partnership

- Agreed upon objectives, and strategies for accomplishing goals
- Identify local priorities—come to identify a small set of common priorities (identify the key audiences and their needs—not the whole laundry list of “wants”—identify a hierarchical framework)

- Share information widely, make it accessible; access existing information; standardize as much as you can as soon as you can
- Coordinate monitoring to maximize effectiveness—identify what is most important and why; compare efforts and adapt for effectiveness; coordinate efforts to collect information across landscapes, share resources, agree on methods

How to move forward

1. Define a partnership—start with a core group of people to build momentum, build relationships, define roles, get the right mix of skills
2. Distill, explain existing efforts in the region
3. Build a conceptual framework—climate change adaptation strategy at the landscape scale
4. Start: identify a smaller focus, a manageable issue of high priority, start there and build on success
5. Produce tangible product or benefit, share success

Next steps

- Form an interagency group
- Share prioritized list to find common interests
- Agree on a small set of issues to start with
- Pool resources and start implementation to test
- Leverage success to expand
- Grant will organize a call by early May
- A group will meet during the BLM NLCS meeting in Albuquerque May 24th to start planning initial actions

Participants

Kristen Beaupre
NPS-Sonoran Desert Network
kristen_beaupre@nps.gov

Dave Busch
USGS-Pacific Southwest Area
dave_busch@usgs.gov

Steve Fancy
NPS-I&M Division
steven_fancy@nps.gov

Grant Harris
USFWS
Grant_Harris@fws.gov

Kate Kitchell
USGS-SW Biological Science Center
kkitchell@usgs.gov

Penny Latham
NPS-I&M Division – Pacific West Region
Penny_Latham@nps.gov

Erika Rowland
University of Arizona
rowland.el@gmail.com

Kevin Schneider
NPS-White Sands NM
kevin_schneider@nps.gov

Russell Scofield
BLM-Desert Managers Group
russell_scofield@ca.blm.gov

Darla Sidles
NPS-Saguaro National Park
darla_sidles@nps.gov

Mark Sturm
NPS-Organ Pipe Cactus NM
mark_sturm@nps.gov

Kent Turner
NPS-Lake Mead NRA
kent_turner@nps.gov

Jake Weltzin
USGS- Nat'l Phenology Network
jweltzin@usgs.gov