

THE IMPACTS OF CLIMATE CHANGE ON AMERICA'S NATIONAL PARKS

OVERSIGHT FIELD HEARING

BEFORE THE

SUBCOMMITTEE ON NATIONAL PARKS, FORESTS
AND PUBLIC LANDS

OF THE

COMMITTEE ON NATURAL RESOURCES

U.S. HOUSE OF REPRESENTATIVES

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OVERSIGHT FIELD HEARING ON “THE IM- PACTS OF CLIMATE CHANGE ON AMERICA’S NATIONAL PARKS”

**Tuesday, April 7, 2009
U.S. House of Representatives
Subcommittee on National Parks, Forests and Public Lands
Committee on Natural Resources
Twentynine Palms, California**

The Subcommittee met, pursuant to call, at 10 a.m., City Council Chambers, 6134 Adobe Road, Twentynine Palms, California, Hon. Raúl Grijalva [Chairman of the Subcommittee] presiding.

Present: Representatives Grijalva and Napolitano.

STATEMENT OF THE HON. RAÚL GRIJALVA, A REPRESENTA- TIVE IN CONGRESS FROM THE STATE OF ARIZONA

Mr. GRIJALVA. Thank you very much. And let me call the Subcommittee on National Parks, Forests and Public Lands to order. This is an oversight hearing on the impact of climate change on America’s national parks.

Today our Subcommittee will be conducting the second in a series of oversight hearings to explore the role of Federal lands in combating climate change. Our focus today will be on the effects on our treasured national parks, some of which face serious threats to characteristic resources. It’s really difficult to imagine Glacier National Park without glaciers, Joshua Tree National Park without these trees. Yet the evidence is clear that we may be facing just that kind of future. The impacts of climate change on our Federal lands are staggering. Science shows that climate change will cause the spread of invasive species, threaten native species, endanger watersheds, cause habitat loss, and increase the intensity and length of the fire season on our public lands.

Today we will be hearing more about these impacts and suggested policy solutions by reputable scientists, such as Dr. Swetnam from the University of Arizona and Rebecca Shaw of The Nature Conservancy.

There are two potential climate change solutions which the Subcommittee is exploring today, as we did at a previous hearing in March that focused on the national forests and lands owned by the Bureau of Land Management. The first is climate change adaptation. Jon Jarvis of the National Park Service will be talking about some of the steps the agency is starting to take in this regard, from

scenario planning to improving what many call resilience—the ability of natural systems to respond to changing conditions.

Mr. John Harja from the Western Governor’s Association and some of our other witnesses will be talking about connecting habitat in order for wildlife to adapt to the impacts of climate change.

The second solution we are exploring is whether some of the key laws under the jurisdiction of the Committee on National Resources adequately reflect the reality of climate change. These laws include the National Environmental Policy Act, or NEPA, as well as various organic acts from the land management agencies.

Today we’ll be hearing from Bob Keiter of the University of Utah who has been studying such questions for several years.

President Obama has made climate change a top issue in his agenda, and climate change and Federal lands will be a key agenda item for this Subcommittee in this Congress.

I feel strongly that while our public lands are threatened by climate change, they are also critical in finding solutions to combat climate change. As Congress goes about developing climate change legislation, I will work to ensure that there is a role for Federal lands.

I look forward to hearing from our witnesses today. And let me take the time to thank the Park Service staff for their courtesy and generosity of time and schedule. I also want to thank the Mayor and City Council for the use of these fine facilities, It is very much appreciated. I appreciate it very much.

[The prepared statement of Mr. Grijalva follows:]

**Statement of The Honorable Raúl M. Grijalva, Chairman,
Subcommittee on National Parks, Forests and Public Lands**

Today our Subcommittee will be conducting the second in a series of oversight hearings to explore the role of federal lands in combating climate change. Our focus today will be the effects on our treasured national parks, some of which face serious threats to characteristic resources. It’s hard to imagine Glacier National Park without glaciers, or Joshua Tree National Park without those trees. Yet the evidence is clear that we may be facing just such a future.

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goes about developing climate change legislation, I will work to ensure that there is a role for federal lands.

I look forward to hearing from all of our witnesses today. I would now like to turn to my colleague Mrs. Napolitano for any opening statement she may have.

Mr. GRIJALVA. Now let me turn to my colleague on the Committee on Natural Resources, the Chair of the Subcommittee on Water and Power, Mrs. Napolitano, for any opening statement she may have.

Madame Chair.

STATEMENT OF THE HON. GRACE F. NAPOLITANO, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF CALIFORNIA

Mrs. NAPOLITANO. Thank you, Chairman Grijalva, for the hearing on public lands' service to the whole area of the United States, especially in California.

To the witnesses, thank you for your cooperation and your being transparent in telling us some of the things that are happening and we don't normally hear in Washington nor, if we don't live in the area, we certainly are not affected by them. But we know that there are things that will affect the rest of the country, and we must work together to preserve the wilderness and the water management on our public lands.

In the Subcommittee on Water and Power that I chair, we're very concerned about the drought in the whole Western States, especially in California. And the fact that if we do continue to have more evaporation, we need to find the ability to store underground in aquifers. We need to be able to understand how we can capture and maintain more water in the watershed areas.

I know we need to invest more than has been invested in the last eight years in the research on what impact the water drought and climate change have on our public lands and its environment. The need to protect our plants and wildlife is something that we have overlooked. And it is critical for us to understand the role it plays in preservation of our air, our water, and certainly our environment and, of course, to that end, the economy. Because it does affect our economy.

We must work with the National Park Service on combating climate change and implementing conservation strategies goes without question. It's something that even local communities, local councils are aware of. This need must be included when bringing forth testimony on how they also want to be part of finding workable solutions.

Thank you, Chairman Grijalva. It's good to be here in this beautiful area, and I trust that you'll come back and see us more often.

Mr. GRIJALVA. Thank you, very much.

Mr. GRIJALVA. Thank you. I'd like to thank the gentlelady from California for giving me permission to visit this beautiful state.

Again, let me thank the witnesses for traveling to be here with us today. We look forward to your testimony. It is going to be vital in shaping the legislation that we hope to propose in the very near future.

Let me remind the witnesses that your written statements and any other extraneous information you wish to submit to the Committee will be made part of the record. And if you could limit your oral remarks to five minutes or so. I'm not a real stern time-keeper, but when Dom tells me that I've become too lax, I will have to ask you to wrap up. And that will allow Mrs. Napolitano and me some time to ask some questions.

Let me now start with Mr. Jon Jarvis, Regional Director, National Park Service Pacific West region.

Thank you, sir. And welcome. I look forward to your comments.

**STATEMENT OF JONATHAN B. JARVIS, REGIONAL DIRECTOR,
PACIFIC WEST REGION, NATIONAL PARK SERVICE,
OAKLAND, CALIFORNIA**

Mr. JARVIS. Thank you, Mr. Chairman. And thank you for giving us this opportunity.

Congresswoman Napolitano, thank you also for joining us here today.

We are very pleased that you have chosen Joshua Tree National Park and Twentynine Palms as the site for the field hearing because this park has been a leader in addressing climate change and becoming an environmental sustainability leader as well.

Secretary Salazar has made the issue of climate change a top priority within the Department of the Interior, and as such has called upon all of the bureaus to work together in an unprecedented manner to address this concern, the National Park Service being just one of those. The BIA, U.S. Geological Survey, U.S. Fish and Wildlife Service, Bureau of Land Management, Bureau of Reclamation, and Minerals Management Service are all working together on this issue.

Climate change is potentially the most far-reaching and consequential challenge to our mission than any other previous challenge in the entire history of the National Park Service. It challenges the very foundation of the National Park System and our ability to leave America's national and cultural heritage unimpaired for future generations.

As your stewards of America's natural and cultural heritage, we have an obligation to act now. There are serious consequences if we delay action.

But I want to focus on what we are seeing now in the national parks, what programs do we already have underway, the actions that are involving mitigation, adaptation, and communication, and then the role that research and monitoring play in ecosystem resilience.

Already we are seeing glaciers melting in our mountain parks. We are seeing species moving up in elevation. We are seeing higher mortality in forests from beetle infestations. Our fire seasons are longer and more intense. We are seeing archeological sites damaged by fire and potentially by sea level rise.

As you know, our coastal systems are the most productive systems in the country in terms of shellfish and recreational fishing and commercial fishing. All of those will be challenged by sea level rises.

We are already seeing coral bleaching in the Virgin Islands. And as you've mentioned yourself, the Joshua trees here, the namesake of this national park, based on the predictive models of warmer winters and increased rain, the Joshua tree itself may be threatened to no longer exist in this park.

In Alaska where I worked for five years in the bush, subsistence resources that are heavily relied on by rural residents and native Alaskans are being threatened by climate change as well.

As I mentioned, this will require an unprecedented level of co-operation across the landscape of the Department of the Interior and all of our partner land management organizations as well.

We have, the National Park Service, created a strategic framework to begin to address some of these things, working with other agencies such as the Environmental Protection Agency as well. We have a Climate Friendly Parks program, of which now 60 parks are participating.

The first and foremost aspect of that is leading by example. And that is reducing our own carbon footprint. Of course our big natural areas are already sequestering carbon, but we are really looking at how our operations can be changed so that we reduce our own footprint. So emissions, inventories, climate action planning, looking at energy conservation, and looking at opportunities for renewable energy through the Energy SmartPARKS Program are all ways that we can reduce our carbon footprint and become a visible leader in environmental sustainability.

Our region is also already well in advance of this. This park, for instance, already generates 40 percent of its energy from renewable resources.

We need to begin adaptation in terms of our planning and really look to maintaining ecosystem integrity. The key to that is long-term monitoring and good research as well. We have a tremendous opportunity to communicate that information to the public as well.

As we observe the changes in climate, our visitation is over 275 million visitors to parks, and it's a great opportunity to educate them about what we are seeing and what actions they can take at home.

We are in the process of looking at multiple-working futures for our parks. With the variety of scientific scenarios in the future we have to be thinking about different planning regimes for our parks as well.

Joshua Tree has been, again, one of those places that this work has been a model for the rest of the Mojave Desert. So, we are really into scenario and adaptation planning as the major goal for the National Park Service over the next ten years.

As I mentioned, the National Park Service is ideally positioned to bring climate awareness to the American public and to the rest of the world. As we seek solutions and as we see problems, we want to engage the public. So looking forward, the National Park Service has a goal that every national park will have some form of exhibit providing information through brochures, waysides, interpretive programs, handouts, and websites to talk about climate change, and also how we ourselves are addressing those issues.

Again, we are looking at this as not just affecting natural resources. I want to emphasize that cultural resources are both at

risk and an opportunity as well. Through historic preservation of existing structures we are able to preserve the embedded energy in carbon in these structures and interpret them as well.

We are currently developing a Visitor Do Your Part program which will allow visitors to voluntarily measure their own carbon footprint as they travel to parks. Alternative transportation activities with our gateway communities and our partners are also one of the ways that we will be addressing climate change and reducing our carbon footprint.

Clearly we know that boundaries of national parks are inadequate to address the issues of climate change. Working with our neighbor, land management agencies, with the establishment of corridors and opportunities for migratory wildlife to move between protected areas is absolutely essential to climate change as well.

So, in conclusion, the key components to the National Park Service program are to monitor the change and report that out; to use our parks as the canaries in the mine for research; to lead in sustainability, both in reducing our own carbon footprint but also being a beacon for the American public in terms of our own sustainability; and educate the public about climate change. Sixty-five percent of our park visitors are repeat visitors. They provide extraordinary opportunities to demonstrate the changes that have occurred to the parks from climate change. And to cooperate across borders with all of our partners in addressing climate change.

Thank you for this opportunity. And I am open to any questions.

Mr. GRIJALVA. Thank you very much, Mr. Jarvis.

[The prepared statement of Mr. Jarvis follows:]

**Statement of Jonathan B. Jarvis, Regional Director,, Pacific West Region,
National Park Service, U.S. Department of the Interior**

Mr. Chairman and members of the subcommittee, thank you for the opportunity to present testimony on the role of the Department of the Interior (DOI) and the National Park Service (NPS) in addressing climate change impacts on America's greatest treasures—units of the National Park System.

Secretary Salazar has prioritized the issue of climate change within the Department of the Interior. He is in the process of designing a climate change strategy to integrate the work of each Bureau to mitigate and adapt to the effects of climate change in the pursuit of each Bureau's mission—this includes the National Park Service, Fish and Wildlife Service, U.S. Geological Survey, Bureau of Land Management, Bureau of Indian Affairs, Bureau of Reclamation, and Minerals Management Service. In 2008 the Department of the Interior had a multi-agency taskforce that put forth a number of recommendations relating to climate change adaptation and mitigation activities. The Department works closely on many levels with NOAA and the U.S. Forest Service in coordinating activities relating to climate change.

An integration of science, adaptive management tools, and other resources across the Federal Government is essential to the DOI's mission to address climate change across all federal lands, wildlife, and cultural and natural resources (including mitigation, adaptation, and communication/engagement strategies) and to the NPS' mission to do the same. We are pleased that you chose Joshua Tree National Park as the site of this field hearing since this is a good example of a desert park whose resources are being impacted by climate change.

Climate change is potentially the most far-reaching and consequential challenge to our mission than any previously encountered in the entire history of the NPS. In setting aside Yellowstone National Park in 1872, Congress stated that the purpose of the park was:

preservation, from injury or spoliation, of all timber, mineral deposits, natural curiosities, or wonders, within the park, and their retention in their natural condition.

This concept of “retention in their natural condition” became the cornerstone of our National Park System when Congress passed the National Park Service Organic Act, which states that the mission of the NPS is:

...to promote and regulate the use of the...national parks...which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.

Climate change challenges the very foundation of the National Park System and our ability to leave America’s natural and cultural heritage unimpaired for future generations. Our national park units can serve as the proverbial canary in the coal mine, a place where we can monitor and document ecosystem change without many of the stressors that are found on other public lands.

DOI and the NPS are rising to this challenge, and today my testimony will focus on four major areas. First, our observations of the effects and potential future changes related to climate change in national park units. Second, the actions and programs we have underway to prepare for the current and anticipated changes from climate change. Third, some of the actions the NPS plans to undertake in the coming years. And fourth, some other considerations related to climate change.

The Effects of Climate Change in National Park Units

Parks are already experiencing some dramatic impacts that may be resulting from climate change. Warming temperatures may be accelerating melting of mountain glaciers in national parks such as Glacier and North Cascades while perennial snowfields throughout Alaska are disappearing. Reduced snowpack and changes in the timing and amount of stream flow affect aquatic communities. Alaskan parks are seeing some of the earliest impacts of possible climate change—melting sea ice threatens marine mammals as well as coastal communities, while thawing permafrost can destabilize buildings, roads, and facilities and disrupt the structural basis of large regions of interior lands. In Yosemite and Great Basin National Parks, we have documented high-elevation species, such as the pika and alpine chipmunk, moving upslope, thereby reducing the effective area for their survival; this upslope migration may be attributable to changes in climate. In Bandelier and Rocky Mountain National Parks, higher temperatures and drought have brought high mortality to pine forests as infestations of bark and pine beetles have expanded to higher elevations and new ranges that may also be occurring because of climate change. (Parmesan 2006, Marcogliese 2001)

Fire frequency and intensity may also be related to climate change. NPS data indicates that fire ignitions are occurring both earlier and later in the season now and the average duration of time that a wildfire burns has increased from less than 10 days to more than a month. Fires in some places may be increasing in frequency and intensity, threatening native plant communities and contributing to the spread of invasive exotic species. Wildland fire frequency and intensity can have a significant impact on cultural resources, as hotter fires and our efforts to fight them directly damage buried archeological sites. At Mesa Verde National Park, fires have damaged historic structures and threatened the loss of archeological sites according to NPS data. (Westerling 2006)

Coastal parks are extremely vulnerable to climate change. The NPS manages 74 coastal units encompassing more than 5,100 miles of coast and three million acres of submerged resources including beaches, wetlands, estuaries, coral reefs, and kelp forests. These parks attract more than 75 million visitors every year, and generate over \$2.5 billion in economic benefits to local communities. The U.S. Climate Change Science Program Synthesis and Assessment Product on Coastal Sensitivity to Sea Level Rise (2009) states:

Critical coastal ecosystems such as wetlands, estuaries, and coral reefs are particularly vulnerable to climate change. Such ecosystems are among the most biologically productive environments in the world.

These coastal ecosystems are significant habitats for the production and health of recreationally and commercially valuable fish and shellfish, they provide important environmental services, and offer beautiful landscapes for marine recreation and wildlife watching. These ecosystems are predicted to change as sea level, ocean acidity, and water temperatures rise. Shorelines and park boundaries will change as sea level rises resulting in a net loss where parks cannot migrate inland. At Everglades National Park, rising seas may overwhelm the mangrove communities that filter out saltwater and maintain the freshwater wetlands. Indeed, changes have already been observed as coral bleaching and disease caused by increased sea surface temperatures led to the loss of more than 50 percent of reef-building corals in the Virgin Islands park units since 2005. (IPPC 2001, Hoegh-Guldberg 1999, Buddemeier 2004)

Increasing the resilience and adaptive capacity of coastal ecosystems will be critical to maintaining their enormous biological value and ecological services to the nation and local communities. NPS's Organic Act uniquely positions us to work cooperatively with states, local agencies and the public to address the cumulative impacts of overfishing, pollution, and coastal development that aggravate and accelerate the effects of climate change on these valuable ecosystems.

While some impacts from climate change are already measurable, the long-range effects of climate disruption on park natural and cultural resources, infrastructure, and visitor experience are just beginning to be understood. Here at Joshua Tree, the park may lose its namesake species as warmer winters cause the freezing temperatures required for the trees' reproduction to occur less frequently. The policy implications for protecting species in a rapidly changing climate are complex and without precedent.

Cultural resources will also be significantly affected by climate change, primarily due to increased erosion from rising seas and more intense storm (and hurricane) surge. Rising sea levels are already damaging archeological sites, historic structures, and cultural landscapes such as Fort Jefferson in the Dry Tortugas and Jamestown. Sea level rise and storms threaten the tangible remains of some of the earliest human occupation sites, dating back over 10,000 years, along the west coast, as well as associated Native American burial grounds at places like Channel Islands National Park and shell middens on the Gulf Coast of Everglades National Park. Alternately, decreasing lake levels expose vulnerable archeological resources and critical park infrastructure in places like Lake Mead National Recreation Area. Our nation's maritime history, including lighthouses from Massachusetts to Oregon, historic forts including Fort Jefferson and Fort Sumter, and historic coastal communities also face threats from rising seas and more intense storm surges.

The 1980 Alaska National Interest Lands Conservation Act (ANILCA) created 10 Alaskan parks and expanded parklands by 43 million acres. It also recognized the critical importance of access to subsistence resources found in parks, including fish, game, and plants, to both Native and non-Native residents of rural Alaska, and directly linked this access to their continued physical, economic, social, traditional, and cultural existence. While the threats that climate change poses to salmon, caribou, and seals may be viewed as threats to natural resources, they also clearly challenge our ability to provide appropriate subsistence opportunities to local rural residents around our units in Alaska.

Many questions exist regarding how physical processes, species populations, and ecosystems will respond to a changing climate. The science of predicting the complexities of these interactions over relatively long periods of time is highly uncertain, yet the NPS is committed to understanding and monitoring the effects of climate change on park resources and ecosystems. The focus of the climate change discussion has largely shifted from the evidence to what we can do about it. As stewards of our nation's natural and cultural heritage, we have an obligation to act now.

Current Climate Change Actions and Programs

To effectively respond to the challenges of climate change, the DOI is undertaking a collective and coordinated strategy that builds upon and expands existing partnerships such as those between NPS, other bureaus, parks, regions, and national program offices. Building the capacity to respond to climate change will involve identifying, linking, prioritizing, and implementing a range of short and long-term activities. The complex and cross-cutting nature of this issue will require an unprecedented level of cooperation across the DOI Bureaus, other federal and state agencies, the entire NPS, and our partner organizations.

Because climate change has been identified as one of highest priorities for the NPS, many actions and activities have already been undertaken at parks and within regions. The NPS is now in the process of developing a strategic framework for action that will detail short and long-term actions in three major areas: mitigation, adaptation, and communication. The NPS has hired a Climate Change Coordinator and created six working groups—Legal & Policy; Planning; Science; Resource Stewardship; Greenhouse Gas Emission & Sustainable Operations, and Communication. We will use the information from these groups to develop a strategic framework for action that will address park, regional, and national-level needs and concerns.

Over the past three years, the NPS has hosted or participated in a series of regional and interagency workshops to explore climate change impacts and coping strategies. In conjunction with the Environmental Protection Agency in 2003, the NPS initiated the Climate Friendly Parks Program to promote sustainable operations in parks and create climate action plans to reduce greenhouse gas emissions; almost 60 parks now participate. The NPS also requires Environmental Manage-

ment System Plans that help parks track and reduce their environmental impacts and set targets for sustainable park operations. The NPS adopted an Ocean Park Stewardship Action Plan in 2006 to guide actions to reduce ocean-related climate change impacts. Finally, NPS formed a service-wide Climate Change Response Steering Committee to foster communications, provide recommendations, and serve as an advisory body to NPS leadership.

Successful approaches to mitigating climate change impacts require the very best science, not only in physical and biological disciplines, but also in social, and cultural sciences. Since 1999, the Cooperative Ecosystem Studies Units (CESU) Network has provided the NPS with a mechanism to collaborate with leading research institutions, including universities, NGO's and State and federal partners to provide the necessary science for sustainable adaptive management of NPS resources. Since 1999, 17 CESUs have been established covering all regions of the country, with a total of 250 partners including 13 federal agencies. The program has been highly successful in funding cutting edge collaborative research and providing technical assistance and capacity building to the NPS, as well as State and local agencies and other federal partners.

Looking to the Future—Mitigation, Adaptation, Communication

While efforts to date are significant, much work lies ahead. The NPS must position itself to respond to the effects of climate change on park resources and to prescribe management actions that are suitable for parks. Building an effective response to the threats posed by climate change will require action in three inter-related areas: mitigation, adaptation, and communication. These efforts will necessarily involve strong intra- and interagency cooperation and leadership. We need to build on the collective knowledge that is available to create new solutions for protecting resources and resource values.

Mitigation-Leading by Example

Our collective carbon footprint must be understood to be managed responsibly. In the area of mitigation, the NPS is leading by example in reducing our carbon footprint and promoting sustainable operational practices. The Climate Friendly Parks Program and the Energy SmartPARKS Program are two of the key ways that NPS is mitigating GHGs through these areas of emphasis:

Emissions Inventories: Parks quantify and track their emissions and identify specific areas where reductions can be most readily achieved. An online tool—the Climate Leadership in Parks (CLIP) Tool created in 2005, allows parks a new and simplified way to do this assessment and to guide them through the process.

Climate Action Planning: Parks use the CLIP tool to identify carbon reduction goals and actions to follow through on these goals. Sixty parks are now in the process of completing these plans.

Energy Conservation: Significant portions of GHG emissions in parks come from transportation, building energy consumption, and waste management. Mitigation solutions include sustainable design and construction, adaptive “green” reuse of historic structures, use of high-mileage and alternative-fuel vehicles, solid waste reduction, and alternative transportation systems that integrate all modes of travel within a park, including land and water-based vehicles.

Renewable Energy: An increasing number of parks are generating and using clean renewable energy such as photovoltaic systems and geothermal heat exchange. The Energy SmartPARKS program is a partnership with the Department of Energy that is focusing on generating renewable energy and showcasing sustainable energy practices in parks. Currently, NPS-wide, 3.8% of energy in parks comes from renewable sources.

Regions are also moving forward with their own climate change initiatives. For example, the Pacific West Region (PWR) of the NPS has a very ambitious Climate Change Leadership Initiative that promotes Climate Friendly Parks. The overall objective is to support Executive Order 13423, Strengthening Federal Environmental, Energy, and Transportation Management, by setting GHG targets. The 58 parks in the region have set a target of carbon neutral for park operations by 2016 and now generate over 4% of their energy from renewable sources. For example, Joshua Tree National Park generates 40% of its energy from renewable sources.

The NPS has made carbon management, energy conservation, and renewable energy a major focus for our future. Accordingly, we have set a goal to significantly exceed the federal requirements for reducing total energy use in NPS operations and having some of our energy come from renewables by 2016, the 100th year anniversary of the establishment of the National Park System. Additionally, the NPS has

set a goal of having all parks identify their carbon footprint and have climate action plans in place before 2016.

Safeguarding and Protecting Park Resources—Adaptation Planning

While mitigating the cause of climate change is essential, scientific evidence demonstrates that even if we stopped emitting greenhouse gases today, our past actions have already committed the planet to some degree of change. Because of processes in the atmosphere and oceans, it will take carbon dioxide and temperature on the order of centuries to stabilize once GHG emissions are under control. Other responses, such as sea level rise, can take millennia. We have to start planning for adaptation options now—while we simultaneously work to stabilize emissions.

For adaptation planning and implementation, our highest priority is to support ecosystem integrity and the resilience of species and communities to respond to changing conditions. As climate change causes shifts in weather, we will see changes in water availability, fire, and community structure and composition. Park vegetation and wildlife will need to adapt to these new regimes or have the ability to migrate. By building resilience and reducing other ecosystem stressors, the NPS will help to reduce the extent of some of the most deleterious impacts on park resources from climate change. For example, the NPS needs to be aggressive in its actions to prevent the intrusion of invasive species, eradicate where feasible, and control the spread when prevention and eradication efforts fail. The NPS also will undertake measures to restore natural ecosystems, making them healthier and more resilient to the effects of climate change. Examples include our on-going efforts to restore major ecosystems such as the Everglades, and the establishment of marine reserves in units of the National Park System.

A critical component for adaptation planning and implementation involves building our science information and ecosystem monitoring capacity for sound decision-making by park managers. National park units represent a wide range of ecosystems scattered across the nation, embracing a broad spectrum of diverse and natural environments of North America. Parks present a tremendous opportunity to observe the effects of climate change on resource conditions that scientists and managers have documented over decades. Begun almost nine years ago, the NPS Natural Resources Challenge Initiative has funded parks across the nation to conduct inventories and initiate vital signs monitoring of natural resources under the NPS's jurisdiction.

The combination of these sources of information, long-term legacy monitoring data, and new inventories has provided timely examples of the possible effects of climate change now visible in parks. The NPS Inventorying and Monitoring (I&M) Program's primary goal is to collect, organize, and make available natural resource data. This program includes 32 networks serving more than 270 parks. The Vital Signs Program, which is part of the I&M Program, is strategically positioned to help parks acquire the information they need to make informed decisions and to employ adaptive management so that we can be flexible in the face of change. In addition, NPS has also been funding baseline documentation, including condition assessments of its cultural resources and ethnographic studies that include data on natural resources utilized and monitored by native groups. This data provides critical information for evaluating the potential and real impacts of climate change on cultural resources. Information from these programs also informs state policymakers and assists scientists in looking at regional and national trends.

Planning for climate change presents a major challenge for park superintendents, their staff, and NPS programs. Resource management decisions must be based on future expectations. However, in an era of climate change, the future will be characterized by highly consequential and unprecedented changes that cannot be predicted with as much accuracy and precision as we would like. Consequently, the NPS is utilizing a scenario planning approach that uses the best available science to explore a range of plausible "multiple working futures" and consider appropriate actions within them. Currently the NPS and USGS are working on a scenario planning workshop that will be held the end of this month to look at case studies at Assateague Island National Seashore and Wind Cave National Park. Adaptation also involves rethinking infrastructure and preparing people for those changes that are inevitable. To respond to climate change, park infrastructure may need to be adapted to better perform or maintain functionality. This also includes rethinking park planning issues such as zoning and the design or location of buildings and roads. Scenario planning is being specifically designed to help managers identify policies and actions that will be most effective across a range of potential futures and to promote tactical adaptation responses that are compatible with the NPS mission.

Joshua Tree served as a case study for developing climate change scenarios through a workshop held at the park in November 2007. Some of the issues that were common across all scenarios were the loss of Mojave Desert habitat in the park due to warming and increased invasion by non-native grasses, which in turn is likely to bring more frequent and larger fires to the park. As the park begins its general management plan this year, these scenarios—forecasts of potential landscapes of the future—will help guide that park in identifying appropriate management actions for the future.

The NPS has made scenario and adaptation planning a major goal for the next ten years to ensure parks are prepared for building resilience into ecosystems and ensuring future visitor facilities are sited in appropriate locations.

Parks Serve as Models of Sustainability and Places to Communicate Climate Change Information

There is a great need at this time for messages that communicate the complexities of climate change and the actions that can be taken. With 275 million visitors annually, the parks can serve as models of sustainability and platforms to effectively communicate information about climate change. Parks can thus be the catalyst for visitors to do their part for climate friendly parks. The NPS's interpretive and education programs strive to connect people to the parks, with opportunities for all visitors to form their own intellectual, emotional, and physical connections to the meanings and values found in the parks' stories. Effective interpretive and educational programs encourage the development of a personal stewardship ethic and broaden public support for preserving and protecting park resources so that they may be enjoyed by present and future generations. The public has come to expect high-quality and up-to-date resource information when they visit parks.

The NPS is ideally positioned to raise awareness on climate change and provide information about solutions that are being implemented across the NPS and the Department. A number of efforts are underway to tell the story about climate change and impacts to national parks. These efforts include a monthly web-based seminar series featuring climate change experts on science, communication, and management topics and interpretive training using a decision-tree for developing knowledge around aspects of climate change. The information will be used to frame interpretive programs and answer visitor questions. The NPS has developed a "Climate Change, Wildlife and Wildlands Toolkit" (in conjunction with other federal agencies) to be used by interpreters in parks, zoos, aquariums, and science centers and by outdoor and classroom educators across the country. In addition, summaries of climate change knowledge for specific bioregions—a series of 11 bioregional documents—are being created in partnership with the U.S. Fish and Wildlife Service that summarize the current state of knowledge about climate change and impacts to protected areas, with a focus on national parks and refuges.

Looking forward, the NPS has a goal of every NPS park having climate change information available through brochures, wayside exhibits, interpretive programs and handouts, and park websites. The Climate Friendly Parks Program has encouraged this and currently, there are many examples such as Point Reyes National Seashore, Glacier National Park, Apostle Islands National Lakeshore, Everglades National Park, Dry Tortugas National Park, and Kenai Fjords National Park where climate change information is readily available to the public. The NPS is currently developing and supporting a new and exciting "Visitor—Do Your Part Program" which will have visitors voluntarily measure and reduce their carbon footprint.

The NPS may also utilize the national preservation programs, such as Preservation Assistance and the National Center for Preservation Technology, to develop and disseminate information on sustainability, historic preservation, guidance for adaptive reuse of historic buildings and addition of renewable energy sources into historic areas.

Other Considerations

In the future, collaboration with gateway communities, private partners and state, local and federal agencies will be a key element to successful mitigation, adaptation, and communication measures. Much of our carbon footprint results from visitor services and movement in and around parks. Thus, our ability to mitigate GHGs is uniquely tied to our gateway communities and the transportation decisions we make. The NPS will need to complement natural mechanisms that mitigate and adapt to climate change through strategic approaches including: ensuring wildlife and stream corridors are established to enable wildlife to migrate if necessary; promoting and protecting healthy reefs, mangroves and coastal wetlands that can minimize damage to coastal communities; and protecting and restoring forests that can

reduce soil erosion and mudslides brought on by changing weather patterns and catastrophic events.

At present, the Vital Signs Monitoring Program is well-established as a key source and supplier of reliable, organized, and retrievable information about parks. Climate change monitoring efforts by other DOI bureaus, such as the U.S. Geological Survey, will also be a valuable tool in understanding climate change effects on NPS landscapes. By building on the successful network approach of these programs, the NPS will likely gain additional capability to collect, analyze, and report data on the condition of key natural and cultural resources in parks and how they are changing or may change as a result of climate change.

Coastal and riverine parks are extremely vulnerable to climate change impacts, especially sea level rise and storm surges, and these are high priority areas for developing and implementing adaptation actions. For example, shallow estuaries are significant for the long-term production and health of many commercial species of fish, including salmon and steelhead trout. The survival of these natural resources are also critical to maintaining viable cultures that depend on them such as the salmon and shellfish critical to Northwest tribes and the reefs that support Pacific Island cultures. These important habitats could dramatically change as sea level continues to rise. The impacts of rising sea level also reach surprisingly far inland. The Hudson River, for example, is tidal more than 100 miles inland, at Albany, New York. Implementation of adaptation plans will be critical to ensure facilities and coastal systems such as estuaries and tidal rivers continue to function.

Conclusion

Our national park units are environmental baselines to track change, and they stand as some of the last vestiges where ecological components function naturally. To succeed in its mission in the face of climate change, the DOI and NPS must lead by example in minimizing our carbon footprint and promoting sustainable operational practices. We must take responsibility for understanding how climate change will impact the national parks and take appropriate steps to protect these national treasures. An unprecedented level of collaboration and cooperation with other agencies and partners will be required to acquire needed scientific information, protect resources, and effectively expand the teaching of the benefits and necessity of natural and cultural resource conservation across the nation and the world.

Thank you for the opportunity to present this testimony. I will be pleased to answer any questions you and other members of the subcommittee might have.

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Mr. GRIJALVA. One of the questions that comes to mind is should the National Park Service have set renewable energy goals as part of that effort in sustainability, and how to downsize the agency's carbon footprint. Should there be a goal?

Mr. JARVIS. Yes, sir, I do believe that goals are essential to achieving this. We have already in the Pacific West begun to research whether or not we can be carbon neutral by 2016. We are already at about four percent in terms of our use of renewables. And the rest of the Service is about 3.8 percent. I think measurable goals for reducing our footprint would be very good.

Mr. GRIJALVA. And the NPS 2006 management policies, they say very little about the subject that we're talking about today, very little about climate change, adaptation, sustainability, some of the issues that you mentioned in your testimony. Do you believe that document needs to be updated to the issues that we're dealing with now?

Mr. JARVIS. Sir, I think actually no. I think that the management policies provide at the moment an excellent framework upon which to address this. I think the way I would suggest that it might be addressed from a policy standpoint would be a director's order which tiers off of management policies and can be very specific to the actions required under climate change.

We are not yet prepared, I would suggest, to address in management policies concerns about the specific changes to natural resources from climate change. We have a foundation that the national parks—the natural areas of our National Park System—be managed, quote, unquote, to be natural. That we know is changing, but we are not yet, let's say, sophisticated enough to understand what the new model will be.

I served on a panel at a science conference just a few months ago on this particular issue. And we are looking for what will be the new model in terms of ecosystem, ecological integrity, while we address climate change.

So, my suggestion at this time would be that we address it through a director's order as well.

Mr. GRIJALVA. And a director's order would be more flexible?

Mr. JARVIS. I think it would, sir. What it provides is that it can be revised more easily than management policies at this—as we address this, I think we're going to need some flexibility.

Mr. GRIJALVA. OK.

NPS, the public lands, the Park Service's role in cap and trade, how do you see that role?

Mr. JARVIS. I think that there is a role for the National Park System in a carbon market. We are beginning to research how that would work. We do restoration. For instance, in Redwood National Park, an area that we—I was brought into the National Park System after most of the large redwood trees had been logged. We are in active restoration there, and those trees will obviously sequester carbon. And understanding how we could market that in a carbon market would be important.

We do restoration here in the desert. We do restoration work in the islands. And all of those, I think, would be ideal to play on a carbon market.

Mr. GRIJALVA. Again, one of the advantages of having a closed ecosystem over dealing with an unlimited number of owners is that it's a tremendous advantage in the strategy that one puts in place. How do you envision multiple boundaries and the need for adaptation, the restoration process to be initiated when we're dealing with

something other than a closed ecosystem, when we're dealing with something other than one or two participating owners, when we're dealing with multiboundaries, be they public, be they private?

Mr. JARVIS. I think that climate change may be the unifying principle that brings us together to begin to really address at a landscape scale the changes that we are seeing. As you well know, this country was divided up into a variety of Federal, state, and private land ownerships, and has resulted in a checkerboard landscape. In order for us to retain long-term ecological sustainability and at the same time develop renewables and other energy sources and to move it across the country in corridors, we really are going to have to begin discussing this at a landscape scale, at an ecosystem scale. And there are some models in this country where we've done that. And there are some models in Canada where they have done that as well, where private, public land managers come together and say, these are the most important ecological corridors for, let's say, here in the desert.

The desert is a perfect example of that where we are addressing right now the planning for large deployment of solar energy in the desert and thinking about how do you connect and provide for the mule deer and the desert bighorn and the desert tortoise and other species in the desert while providing solar development and recreation and all of that.

So, connectivity is the key. And it doesn't necessarily mean it all has to be National Park Service or all wilderness. It's just that it needs to be managed in such a manner that ecological integrity is maintained and connectivity is maintained as well.

Mr. GRIJALVA. So, the urgency becomes the unifier.

Mr. JARVIS. That's the way I see it, sir.

Mr. GRIJALVA. Tell me a little more about climate change and the threat to cultural resources on our National Park System.

Mr. JARVIS. I'll start first with our coastal areas. The coasts of this country have been occupied for tens of thousands of years, obviously because of their productivity and they're great places to live. And as a result there are archeological sites all along the Pacific Coast and the Atlantic Coast, in the Pacific Islands. And predicted sea level rise of a meter or more could or will inundate many of these archeological sites, former home sites, and in some cases sites that are still occupied with Native American reservations such as along the Olympic Peninsula.

It has caused us in the National Park Service to begin to shift our priorities in terms of inventory and monitoring of those sites, if they are to be inundated by a sea level rise or storm surge. Or like in the case of in the Northwest where we're getting changes in storm regimes where much more flooding in the falls that can wipe out these big alluvial fans where, again, there are archeological sites, we are shifting our priorities to inventory these sites before we lose them.

Mr. GRIJALVA. Thank you.

Mrs. Napolitano, questions?

Mrs. NAPOLITANO. Where do I start?

I have great interest in all the work that you're doing and what you're reporting. And I think one of the first questions I'd like to ask—because I know this was an issue with us in the Bureau of

Reclamation, is the amount of funding of your staffing levels. What is it going to take to be able to do a job that you need to do? That's one question.

If you want to address that, I have a whole bunch of others.

Mr. JARVIS. Well, I always like that question. And the bottom line is, first of all, the Congress in over the last ten years has frankly been very good to the National Park Service in investing in the national resources challenge. About 80 million dollars was invested over about eight years of recurring funding that allowed us to build a network of vital signs, and cooperative ecosystem study units of the universities across the country. We have one here in the University of California. And those have really been the bedrock of monitoring of our park resources. And we are—so we are better prepared today from that kind of investment than we would have been if that investment had not occurred.

Now we're sort of moving to the next phase of this. And certainly an investment I would suggest in two areas, one is to build our research capacity to really begin to understand the changes that we are seeing. We have sort of a baseline of monitoring, but we need to also do a significant amount of research as these—as these systems really change much more rapidly than we had originally expected.

And the second piece is the education side, that frankly our education side of our organization has gone into decline over recent years and our reinvestment in our staff that do frontline interpretation, education, exhibits, brochures, web, all of that new technology that will allow us to get this information out. Those were two areas.

Mrs. NAPOLITANO. And I'm assuming that you do not have the access to a lot of that technology.

Mr. JARVIS. That's correct, we do not.

Mrs. NAPOLITANO. And just as an aside, I was in Puerto Rico during the days of Aníbal Acevedo Vilá, being a resident commissioner. And we visited the reserve. And some of the Park Service people there advised us that they were very shorthanded in being able to maintain that park. And that's one of the most beautiful places I've seen.

How closely does the Park Service work with the USGS, with the Bureau of Reclamation, with the Army Corps of Engineers? And the reason I'm asking is, given my area of water in the rivers, the dams, the canals, I worked heavily with all three of them, mostly the first two, USGS and Bureau of Reclamation, but somehow we haven't built the nexus to be able to determine what your role, the Park Service, is with the role of conservation, of watershed management, of all those other things that can be part of what you're talking about.

Mr. JARVIS. That's a great question. And you're absolutely right. Those are sister agencies within the Department of the Interior, except for Army Corps of Engineers, but Bureau of Reclamation and USGS are sister agencies to the National Park System.

And it is very clear to me in discussions with the new secretary, Secretary Salazar, and his staff, that the expectation is that our bureaus will be working together much more closely than in the past.

I think it has been in some ways—I mean, each of these agencies have somewhat in some cases competing mandates. And the expectation of the new secretary is that we will get together, particularly on climate change and water demands.

I mean, as you well know, Congresswoman, the challenges we are having here in California from drought and water needs, water availability, water quality, all of those kinds of things. And in many cases the National Park Service and the BLM and the U.S. Forest Service are at the headwaters in terms of these sites. In some cases there are entitlements. And we play a very vital role in protecting that watershed as to serve the downstream needs. And we are really working together in a much more robust way.

Mrs. NAPOLITANO. Well, that really helps the quality of water.

Mr. JARVIS. Yes, it does.

Mrs. NAPOLITANO. Which brings me to a point of recycling. How much recycling of any of its water does the Park Service do?

Mr. JARVIS. It's again—in many cases it's the individual initiative of a local superintendent has created some system to provide that. But there has not been a holistic approach to this at the National Park Service.

Mrs. NAPOLITANO. Why not?

Mr. JARVIS. Because there hasn't been, as you've indicated, Chairman, sort of direction from the top that the National Park Service should be an environmental leader.

Mrs. NAPOLITANO. Well, I guess I push that because we need to start looking at conservation storage, recycling it. And as you talk about education, I hope that as you receive some assistance in funding for education of the public and the visitors that you incorporate water conservation into that.

Mr. JARVIS. Absolutely.

Mrs. NAPOLITANO. That is key.

How about the tribal issues? Are they part and parcel of what the Park Service is doing? Many tribal lands are adjoining park units, and when you're talking about establishing—what would I say—corridors of energy that traverse public, private, and tribal lands, that's going to be a big issue in being able to resolve without impacting the wildlife in those areas.

Mr. JARVIS. Absolutely. And this has been certainly one of my personal interests over my 30 years in the National Park Service, is to reach out to affiliated tribes. In many cases the tribes have—our national park units were their traditional hunting grounds or they are adjacent to reservations or in some cases the reservations are actually inside units of the National Park System. And to maintain an open and robust relationship requires individual personal attention from the park superintendents. And I encourage all of my superintendents—I did it as a superintendent as well—to sit down and discuss these issues. Because they too, tribes, have a very strong vested interest in wildlife corridors, in energy development, in maintaining their lifeways, all of those things, cultural resources in particular that are threatened by this. And I think it's going to require us to work very, very closely with tribes as we address this.

Mrs. NAPOLITANO. And is the Park Service looking at the possibility of adding areas adjacent to the parks, the national parks, for purposes of preservation?

Mr. JARVIS. In some cases I believe so. You know, there is a process for adding units, for adding significant lands. And it comes by Congress authorizing the study of additional units and additional park lands. Our new secretary, Secretary Salazar, has indicated that he has an interest in expanding the National Park System for a variety of reasons to reflect all of the American stories but as well to preserve additional habitat.

Mrs. NAPOLITANO. I'm glad to hear that because if not, we'll ask his brother to bend his ear. His brother serves in our caucus, and we are very much proud of the work he's doing.

You indicated you're behind in the strategy and you're trying to set up the model that you just attended a conference where they're looking at being able to bring it all together. How long do you think that's going to take? And if you were the director, if you were given the authority by Congress by the—whether it's by the secretary's mandate or legislation, what would be the scenario that you think would be in place to be able to progress more than we have in the last decade or so?

Mr. JARVIS. Well, in 2016 will be the centennial, the hundredth birthday of the National Park System. And I think 2016 provides an extraordinary opportunity and target point for us as an agency and, frankly, for the country.

If you look at the National Park System in aggregate, we—as Wallace Stegner said, we are America at its best. We are, as in Ken Burns' film that's coming out this fall, America's best idea.

Climate change is going to be a challenge to all of us. And the National Park Service can play a significant leadership role in this, first setting very specific goals to reduce our carbon footprint by 2016 so that we can really demonstrate to the American public that this institution is a leader.

And I can give you a perfect example here in California, At Lassen Volcanic National Park we've built a brand new visitor center up there that is certified under the Green Building Council as Lead Platinum, which is the highest level that you can get. So when you enter that building, you can pick up a brochure on volcano, and you can pick up a brochure on the in-floor heating system that is driven by geothermal. So, you really get both stories.

And I think that setting specific goals for the National Park Service to be an environmental leader in this case, to set up a way of reporting to the American public on the condition of these park resources, the ecological integrity as well that has been threatened, and to inspire the American public to take action themselves in terms of energy conservation, water conservation, all of those things to what they learn within our national parks, I would set all of those as very specific goals leading up to 2016.

Mrs. NAPOLITANO. OK. Hopefully part of that will be the solar panel, especially in areas where there's a lot of sun.

Chair, I have other questions, but I think I'll submit them in writing.

Thank you very much.

Mr. GRIJALVA. Thank you, Mrs. Napolitano.

If I can, Mr. Jarvis, let me follow up on a question that Mrs. Napolitano asked.

One of our later witnesses is going to suggest that we should also consider adding areas to the National Park System that are damaged but restorable. Any thoughts on that concept?

Mr. JARVIS. The National Park Service has, I believe, one of the best restoration programs in the country. We have inherited damaged landscapes in the past. Shenandoah National Park in the East was significant—was homesteaded. It was significantly cut-over forest. And as I mentioned, Redwood National Park as well. Restoration is an absolute key. And it's—actually I think it's an exportable activity as well, as there are damaged landscapes around the world that we can contribute to as well. I think it's a very valid idea.

Mr. GRIJALVA. Thank you. Let me thank you, Mr. Jarvis. I think that was—as the development of the legislation goes forward, I think you made some good points that need to be considered, in response to a question about education, how vital that needs to be as part of the overall strategy to deal with the climate change and the public lands, and the fact that we touch so many people, so many visitors, and how powerful too that could be.

Research and development is another point you made, and human resource development as well. And so thank you very much for your testimony, and I appreciate your suggestions very much. Thank you.

Mr. JARVIS. Thank you, Mr. Chairman.

Mr. GRIJALVA. Call the next panel of witnesses. If the next panel would join us, please. Thank you.

Let me begin. Mr. John Harja, Co-Chair Western Governors' Association Wildlife Corridors Initiative Steering Committee, welcome. And we look forward to your comments.

STATEMENT OF JOHN HARJA, CO-CHAIR, WESTERN GOVERNORS' ASSOCIATION WILDLIFE CORRIDORS INITIATIVE STEERING COMMITTEE, SALT LAKE CITY, UTAH

Mr. HARJA. Thank you. Thank you for the opportunity to come, Mr. Chairman, Mrs. Napolitano.

My name is John Harja. I am Public Lands Policy Coordinator for Governor Jon Huntsman of Utah. And as a coincidence, Governor Huntsman is the Chair of the Western Governors' Association this year.

Last summer at their annual meeting, the Governors established a working group called the Western Governors' Wildlife Council. The reason for this is the Governors recognized that wildlife issues were important to the West as a whole.

The Western Governors' Association is composed of the 19 Western states. And the board of directors are the Governors. So, it's an organization that directly reports to the Governors and face these regional issues. They don't always agree, of course. And if not, then that issue is left with Governors to deal with on their own. So when they do agree on an issue, it's very important. And this is one of the issues they agreed on, that wildlife crucial habitat and wildlife corridors, connectivity of wildlife, was something that as a region we should focus on.

And by connectivity, they didn't necessarily mean just movement of big game. They meant connectivity in terms of genetics and the flow of plants and all that sort of thing. So, it is an important issue that they decided to move forward with.

They recognized, as we stated, that intact and functioning ecosystems, resilience as the previous speaker mentioned, are important, and asked a group to start looking at it. That group convened last summer. And in one of those be-careful-what-you-ask-for tasks, I was elected chair. So, that's why I'm here today. In meeting the council has focused on a couple of issues. There have been a couple of important examples of corridors that we're looking at, protection of corridors. The first wasn't the Western Governors' Association that caused it to happen, it was a partnership of lots of groups. It's a corridor south of Grand Teton National Park, the Path of the Pronghorn, was established by the Forest Service and the BLM last summer. And that's the kind of example of movement that we were mentioning.

I want to mention that not only because it's there now, but it was true partnership. And that's one of the things that the Governors understand, that it's going to take Federal lands and state lands and private lands to accomplish many of these goals.

But in meeting we've discovered a number of things. A lot of information is simply not there. The Western Governors' Association is also, at the same time, working on a Western Renewable Energy Zone Process. And they're trying to establish areas where wind, geothermal, solar are appropriate—or best sited—let me put it that way. And wildlife is one of the issues. Another of course is transmission corridors and power lines and all of that. But wildlife is very important.

In examining our group was asked to provide them information on wildlife corridors and crucial habitats, and discovered much information is simply not yet there. And what information is there is not necessarily designed for this purpose. For example, in Arizona a lot of antelope information simply doesn't exist. So, how to proceed?

Crucial habitat are defined differently in different states. My state, Utah, has one definition. Right across the border, Wyoming, might have a different definition. Neither is wrong, they're just established for different purposes. And so trying to coordinate across state boundaries is a key point for us.

We do need a credible set of tools. We need things like GIS. We do need to understand how to map them. But in mapping you have to understand the basis of the information. It has to be accurate.

And then it comes down to funds. A lot of states, of course, are suffering just now. There's a need for funding. There's a need for GIS funding. There's a need for essentially more information. Most of the states get their wildlife funding through sale of permits for hunting. That's sufficient for what we're doing, but a lot of the states are maxed out. It's hard to proceed any further. And so some sort of coordinated effort is needed.

We're pleased to partner with most of these groups that are sitting next to me and behind me as partnering their efforts and their funding. And that's an important way to proceed.

We are looking primarily at what we call a Decision Support System. And that is a method of gathering information, making it available to the public on the web, for example, to anybody who needs it, and then making it available to decision makers, whether those decision makers are local government, state government folks, or the Federal agencies. Just providing it to them, and then asking that they use it.

In Utah in the last few years we have been taking advantage of cooperating agency status a great deal. That's one of my primary functions with Governor Huntsman. This is a way to get into the process, bring that kind of information to the Federal agencies that work on environmental impact statements and ask them to consider it. That's one way. There are many others. The State of Wyoming has got a GIS system on their web that has all of the information that they have to date. And they're asking agencies to look at it. So, there are many ways to approach it.

The effects of climate change are part of our effort. Corridors may change as the climate adjusts, as things get warmer and plants move north or up. So, that's a difficult one, though, for the agencies. There isn't a lot of knowledge yet. Some of their predicted models vary in their certainty. They're very complex. So, just trying to get a handle on that is going to be a major challenge in and of itself.

But the state agency—I want to emphasize this—the state agencies are willing to accept all those challenges. They take very seriously their responsibilities as the public trust for natural resources. Outside the Endangered Species Act, for example, the states are the managers of habitat and wildlife. They don't own the habitat, but they are the managers of the wildlife issues. They take that seriously and they see it as an opportunity to improve things and protect corridors that are essential to the way of life in the West for wildlife.

So, with that, Mr. Chairman, I pass the opportunity along.

Mr. GRIJALVA. Thank you, very much.

[The prepared statement of Mr. Harja follows:]

**Statement of John Harja, Director, Public Lands Policy Coordination,
Office of Utah Governor Jon M. Huntsman Jr., Speaking on behalf of the
Western Governors' Wildlife Council**

Chairman Grijalva, Ranking Member Bishop and members of the Committee, my name is John Harja. I am the Director of Public Lands Policy Coordination in the Office of Utah Governor Jon M. Huntsman, Jr. I also serve as Chair of the Western Governors' Wildlife Council, an organization formed by the Western Governors' Association. The WGA addresses important policy and governance issues in the West, advances the role of the Western states in the federal system, and strengthens the social and economic fabric of the region. Thank you for the invitation to testify today on behalf of WGA concerning the Wildlife Corridors Initiative and the work of the Western Governors' Wildlife Council¹.

Background

In February 2007, the Western Governors' Association unanimously approved policy resolution 07-01, Protecting Wildlife Migration Corridors and Crucial Wildlife Habitat in the West². This resolution asked the Western states, in partnership with important stakeholders, to identify key wildlife corridors and crucial wildlife habitats in the West and make recommendations on needed policy options and tools for

¹ www.westgov.org

² <http://www.westgov.org/wga/policy/07/wildlife-corridors07-01.pdf>

preserving those landscapes. WGA did this through the Wildlife Corridors Initiative, a multi-state, collaborative effort to assess current data for wildlife corridors and crucial habitat in the 19 Western states. In June 2008, the governors adopted the report³, Wildlife Corridors Initiative, which included recommendations on data needs and conservation tools developed through a stakeholder-based process.

The Governors acknowledged that large, intact and functioning ecosystems, healthy fish and wildlife populations, and public access to natural landscapes contribute to the West's quality of life and economic well-being. Unfortunately, human activity occurring in important wildlife corridors and crucial wildlife habitats can affect the integrity of these ecosystems around the nation and in the Western States.

Western Governors' Wildlife Council

In June 2008 the Western Governors established the Western Governors' Wildlife Council to implement recommendations in the report. The primary task is to identify key wildlife corridors and crucial wildlife habitats in the West, and to coordinate implementation of needed policy options and tools for preserving those landscapes.

The Council is generally tasked to address the following needs identified in the development of the report:

- Much information is missing, or more detailed information is desirable, concerning wildlife corridors and crucial habitats.
- Crucial habitat and wildlife corridors are defined differently, and used for different purposes, in the various states. These issues need to be examined and reconciled, to meet the common goal of aiding wildlife conservation efforts
- States must have a credible set of tools and models for incorporating wildlife values into planning and decision-making processes.
- There must be coordination across all levels of government for conservation of wildlife corridors and crucial habitat.
- States require long-term, sustained funding for wildlife conservation objectives that support current and future decision-making in a dynamic landscape. State wildlife agencies are funded primarily by revenues from fishing and hunting, federal distributions and lottery dollars; these revenues limit their capacity to engage actively in conserving wildlife habitat and corridors. Several existing programs provide a foundation of information that can be built upon with a modest infusion of funds.

A key product of the Western Governors' Wildlife Council is the development of a spatially explicit Decisions Support System (DSS) that each state can use to make more informed decisions on protecting wildlife corridors and crucial habitats. This tool will build upon existing information and fill data gaps. The DSS will include GIS mapping data to bring consistency in the way corridors are mapped and crucial habitats identified across the West. It will also increase the integration of wildlife data into decision processes early on, by fostering more proactive planning and promoting research on adaptive resource management.

The DSS will be dynamic. There will be regular updates of data as landscapes and wildlife populations change as a result of the influence of population growth, energy development and climate change. Through this effort the DSS will support research to understand climate change impacts on wildlife corridors and crucial habitats and climate-change related adaptation.

For the last six months the Western Governors' Wildlife Council has been working on a pilot project to collect available wildlife data from relevant states, federal agencies and nongovernmental organizations to apply crucial habitat information to the identification of developable renewable energy zones within WGA's Western Renewable Energy Zones initiative. Plans are also underway within the Western Governors' Wildlife Council to establish two standing committees to move forward on developing an integrated fish and wildlife DSS within each state and to achieve a coordinated understanding of wildlife corridors and connectivity issues.

Federal Partnerships

The WGA, through the Western Governors' Wildlife Council, is poised to coordinate efforts between the 16 state members of the Council to develop DSSs, while integrating federal partners and stakeholders into these efforts. Integrated DSSs in each state in the West will include all public lands, and consider current and future uses of adjoining lands. Early and frequent coordination between state and federal land managers and other agencies and stakeholders will create the likelihood of positive results. Given the amount of public lands in the West, it will be critical for states to partner with federal agencies in developing DSSs to ensure data sharing

³ <http://www.westgov.org/wga/publicat/wildlife08.pdf>

and the ability for federal agencies to utilize the information in their own decision-making processes.

One wildlife corridor has already been designated on public lands as a result of data sharing between states, federal agencies and additional stakeholders. The Bridger-Teton National Forest amended its Land and Resource Management Plan to identify a wildlife corridor, known as the Path of the Pronghorn, and a management standard to ensure that no new projects or activities impede the migration corridor. This is one of the longest remaining land-based wildlife migrations in North America, and it is the longest in the lower 48 United States. A portion of this corridor also crosses Bureau of Land Management lands in Wyoming. A recent revision of the Pinedale District Resource Management Plan protected a portion of the pronghorn migration on their lands by approving the designation of an Area of Critical Environmental Concern, designated Trappers Point.

State Needs

Each state will require funding to coordinate the development of their DSSs on a regional scale and fill data gaps within their state. Many states have begun this process, but they are in different stages of development. The Western Governors' Wildlife Council will soon be developing a framework for a coordinated DSS that will give each state the ability to create a scorecard, identifying their specific and individual needs. A portion of that money will also be needed to help states modify their wildlife management goals and plans as wildlife respond to impacts from climate change. Resources directed toward the federal agencies that would maximize their participation and support of the Western Governors' Wildlife Council should also be considered.

The Effects of Climate Change

The Wildlife Corridors Initiative report provided recommendations for identifying and maintaining wildlife corridors in the face of climate change. These recommendations include:

- Establish a Wildlife Adaptation Advisory Council among state and federal agencies, academics, and science-based NGOs to facilitate regional and state climate-impact assessments on the effects of climate change upon wildlife and wildlife habitat.
- Establish a regional climate change adaptation information clearinghouse relevant to wildlife corridors and crucial habitat.
- Implement flexible approaches to addressing habitat fragmentation on public lands and utilize incentives to encourage voluntary protection and management of key crucial habitats and wildlife corridors by private owners.
- Recommend coordination among western states, tribes and federal natural resource agencies in planning and implementing adaptation activities.
- Consider collaboration within hydrologic strategic planning, hydrologic climate modeling, water storage capacity and state invasive species strategies.

The Wildlife Corridors Initiative additionally suggests that the Western Governors should consider supporting the establishment of new revenue streams to support wildlife adaptation to climate change in any relevant climate change legislation, such as carbon cap and trade or carbon tax legislation that may be enacted by the U.S. Congress.

Conclusion

In closing, the WGWC is moving ahead quickly with establishing a dynamic DSS in each state. Each DSS will be designed to coordinate the collection of information concerning crucial habitat and wildlife corridors, and design a process within each state which provides this information to state, local and federal decision makers. Our effort is to encourage early consideration of wildlife data in planning decisions and to help assist decision-makers to better manage wildlife resources. It is this last step which is vital. Wildlife and plant species live on private, state and federal land, and any process to protect them must involve partnerships. No one entity can accomplish the task alone. We would appreciate any support this committee and Congress is able to offer through funding or by encouraging federal agency participation in this effort.

Thank you for the opportunity to speak with you about the work WGA and the Western Governors' Wildlife Council are doing to map wildlife corridors and crucial habitat on public and private lands.

Mr. GRIJALVA. Ms. Rebecca Shaw, Director of Conservation Science, The Nature Conservancy of California. Welcome and thank you.

STATEMENT OF REBECCA SHAW, DIRECTOR OF CONSERVATION SCIENCE, THE NATURE CONSERVANCY OF CALIFORNIA, SAN FRANCISCO, CALIFORNIA

Ms. SHAW. Thank you very much, Chairman Grijalva and Congresswoman Napolitano, for the opportunity to offer testimony regarding the impacts of climate change on the National Parks, and the opportunities that exist for implementing adaptation strategies to protect these resources.

My name is Rebecca Shaw. I work for The Nature Conservancy. I oversee The Nature Conservancy's conservation in California. And I conduct research on the climate change impacts and adaptation strategies to develop scientific methods and information for use in the field by managers and by policy makers. I'm here today to talk to you about the adaptation of our national lands and waters, especially those in our national parks in the face of a rapidly changing climate.

Just to be clear, adaptation refers to human actions to maintain important human and natural systems in the face of change. But adapting nature to the impacts of climate change will help ensure the health of our valuable resources in our national parks as well as the forests and waters on people—upon which people depend.

In many parts of the world, including here in the California desert, impacts of climate change can already be seen and measured with just the observed rise in global mean temperature of 1.3 degrees Fahrenheit. An explosion of studies in the last five years has documented the observed climate impacts on species distribution, wildfire frequency and intensity.

With or without social interventions in curbing greenhouse gas emissions, we are committed to impacts in the future. In California in this century the average annual statewide temperature is projected to rise anywhere between 6.8 and 10.4 degrees Fahrenheit under the greenhouse gas emissions trajectory on which we now find ourselves. To put this into context, San Francisco could have the climate of Los Angeles. That means that there will be considerable impacts in the desert as well as here at Joshua Tree National Park. Climate change will result in increased rates of plant mortality, including the charismatic Joshua Tree, which is the emblematic symbol of this park. These changes will affect the viability of the investments we have made in public lands in California and the resources those investments were designed to protect.

While it is important to implement meaningful greenhouse gas reductions, it's also important to come to terms with the degree of the climate change to which we have already committed ourselves, and to act on the funding, planning and implementation to facilitate adaptation of our important protects areas.

Current adaptation responses to climate change are focusing heavily on defensive infrastructure, such as reinforcing seawalls, relocating communities and roads, and building dams and levies and channels to control flooding. Such infrastructure responses will be necessary, but they will not be sufficient to address the full

scope of climate change impacts. Done right and under the right conditions, adaptation can protect us from climate change threats such as increased fire, flooding, and pest outbreaks more cost-effectively than by deploying additional infrastructure. And this is ecosystem-based adaptation, what we term as ecosystem-based adaptation.

In practice, ecosystem-based adaptation includes strategies such as insuring that natural lands remain intact, and not fragmented, and connected to allow for plants, animals, and people to adjust to environmental conditions. It also includes the restoration of fragmented or degraded ecosystems. And it can include the use of natural infrastructure such as wetlands, flood plains, and mangrove trees to buffer settlements from flood waters or storms.

The national parks, as you know, are not viable as islands. And ecosystem-based adaptation strategies will be needed to protect their resources in the future.

As the climate shifts and plants and animals no longer will be able to survive in the current location, the ability to move will be essential to the survival of all species.

One analysis of impacts of climate change here at Joshua Tree show that the future range will be reduced and shifted northward, and unfortunately the Joshua tree lacks the sufficient dispersing capability to follow that shifting climate. The Nature Conservancy is facing similar challenges with our investments in natural resource protection. And like the Federal government, we are working diligently to develop information to support those solutions.

It is for this reason that The Nature Conservancy is developing information tools such as the Climate Wizard, which is referenced in my written testimony, and the Climate Stress Index, that allow resource managers to interpret climate impacts data for decision making. Using these tools and others, we are working to determine where species will migrate and to develop ecosystem-based adaptation strategies to facilitate their movement.

This includes, of course, as others have mentioned, establishing connectivity to future habitat and insuring corridors are free of barriers to movement.

Here at Joshua Tree National Park such a strategy will require coordination among Federal agencies like the National Park Service and the Bureau of Land Management, as well partnerships with nonFederal entities including private landowners.

And to say that these kinds of efforts aren't unique, they would just be needed to be more prevalent in the future. An excellent example of this is available right here in the vicinity of the Coachella Valley Multiple Species Habitat Conservation Plan, which maintains links between Joshua Tree National Park and other protected areas, even as urban development moves forward.

Moving forward then, it would be important to carefully explore what will be needed to implement adaptation strategies, ecosystem-based adaptation strategies to protect these resources on a scale that will be meaningful for protecting natural and human communities.

I encourage you to consider the inclusion of the following key elements in any policy context: There will need to be significant funding and sustained funding to implement ecosystem-based adapta-

tion. But it will be cost-effective in the long-run. But there is a need for a revenue stream.

I encourage the development of a national climate change adaptation program with a nationally prioritized list of ecosystem-based adaptation strategies to address climate change impacts, guidelines for how they should be accomplished, and guidance on whether infrastructure solutions are necessary and appropriate.

I also encourage climate change adaptation partnerships to facilitate the cooperation among all levels of government and the private sector, and the appropriate incentives to allow this to happen.

I also encourage guidance on the avoidance of impacts counter to adaptation goals. While Federal and state agencies should ensure adaptive infrastructure avoids damage to natural systems to the maximum extent practical, and should look for opportunities to use restoration of natural systems as a way to protect human communities.

And last, the national parks could serve as climate change adaptation centers with key national parks identified to develop the information and tools needed, design and pilot adaptation approaches and strategies, monitor outcomes, and to facilitate adaptation learning.

Thank you very much for the opportunity to appear today and to offer testimony.

As the Subcommittee contemplates legislation for adaptation of our valued national parks, the conservancy has very practical solutions for advancing adaptation to climate change. And on behalf of the conservancy, I would like to extend an offer to work with the committee as you explore practical solutions for assisting the Nation in adapting to our future climate.

Mr. GRIJALVA. Thank you very much.

[The prepared statement of Dr. Shaw follows:]

**Statement of M. Rebecca Shaw, Ph.D., Director of Conservation Programs,
The Nature Conservancy of California**

I. Background on Dr. Rebecca Shaw

I am Rebecca Shaw, the Director of Conservation for the California Chapter of The Nature Conservancy. It is my job to provide the technical guidance and leadership necessary for the Conservancy to make smart decisions regarding the conservation and management of nature. Prior to taking a position at The Conservancy, I was a researcher at the Carnegie Institution's Department of Global Ecology at Stanford University and pursuing a career in climate change science. At the Conservancy, I have continued research on climate change impacts and adaptation, developing scientific methods and information for use by field managers of natural resources and policy makers that creates an explicit link between climate science information and its users. I have dedicated my scientific career to using rigorous, practical analysis and synthesis of science data for management and use our lands and waters. I am here today to talk explicitly about adapting our natural lands and waters, especially those in our National Parks, to a rapidly changing climate.

II. Background on The Nature Conservancy

For the past 50 years, the Conservancy has integrated science, policy and on-the-ground conservation to protect more than 117 million acres of land and 5,000 miles of river around the world. We work in all 50 states and 32 countries, and are supported by approximately one million individual members. Our work also includes more than 100 marine conservation projects in 21 countries and in 22 U.S. states. The Conservancy owns and manages approximately 1,400 reserves throughout the United States—the largest private system of nature sanctuaries in the world. The Conservancy recognizes that successful conservation is the underpinning of human health and prosperity and uses science and its strategic application to protect bio-

logical diversity and meet human needs. To achieve our goals we routinely partner with government agencies, non-profit organizations, academic institutions, and business enterprises. However, climate change impacts on the Earth's lands and waters are real and tangible, and we have found that protecting our natural systems has become increasingly challenging.

III. Context for Ecosystem-based Adaptation to Climate Change

In many parts of the world, including right here in Joshua Tree National Park, impacts are already observable and measureable. Forests from Canada to Brazil are more susceptible to pest outbreaks and catastrophic fires. Species like polar bears in the Arctic are struggling to survive as suitable habitat shrinks. As climate continues to change, water supplies will be threatened as some regions experience more flooding and others more drought. Agricultural productivity will shift. Low-lying coastal communities may be inundated by sea-level rise. In fact, with or without societal interventions, we are committed to continued human-driven climatic change and additional impacts in the future (Kerr 2004, 2005) and it is important to develop concrete approaches for helping communities and ecosystems deal with the climate change that is unavoidable.

Nature can play a powerful role the solutions. Adapting nature to the impacts of climate change will help ensure the health of valuable resources, such as forests and fisheries, upon which people depend for their well-being and livelihoods. However, there is emerging evidence that adaptive responses to climate change are focusing heavily on defensive infrastructure, such as reinforcing seawalls, relocating communities or roads, and building dams, levees, and channels to control flooding. Such infrastructure responses will often be necessary, but they will not be sufficient to address the full scope of climate change impacts. Also needed are strategies to ensure that the ecosystems that support biodiversity and that provide people with water, food, and other natural resources and services continue to function despite the changing conditions. Done right and under the right conditions, we can also harness nature to protect us from climate change threats, such as increased flooding, more cost-effectively than by deploying additional infrastructure.

While the testimony provided today will focus on adaptation in order to lessen climate change impacts, action to address the causes of climate change is essential if adaptation efforts are to be effective. To that end, implementation of policy that explicitly links three concepts is essential to success adaptation success:

1. A strong cost-effective cap on emissions and a market-based program compatible with other international efforts. Meaningful emission reductions are needed to stabilize atmospheric greenhouse gas concentrations at a level that ensures the well-being of human communities and ecosystems worldwide. The Conservancy supports caps that would establish emissions reductions of 20% below 2005 levels by 2020 and an 80% reduction by 2050.
2. Reduction of emissions from forest and land-use practices through a comprehensive framework including incorporation of verified credits from these practices in a cap-and-trade program, and
3. Strong support for ecosystem-based adaptation programs designed to protect human and natural communities from the impacts of climate change.

III. Climate Change Impacts in California and at Joshua Tree National Park

Our terrestrial, freshwater, and marine habitats, including the already dry and hot California desert in which we find ourselves today, face an uncertain climatic future. Climate change projections forecast significant ecological and economic impacts as a result of rising temperatures, changing rainfall patterns and extreme weather events. Although climate has changed repeatedly over past millennia, for a variety of reasons (Houghton et al. 2001), anticipated human-driven changes are likely to be unusually fast and large. Many of the species and ecosystems here are particularly vulnerable to future climatic change because their current ranges are limited and their potential ranges are bounded by the coast, mountains and other geographic features (Snyder et al. 2003). California's unique climate, under which its ecological systems evolved, is projected to change dramatically. Mean annual temperatures in California have already increased by 1 degree Celsius (1.8°F) between 1950 and 2000. The contemporary climatic changes have already had a demonstrable impact on California's natural resources. Droughts have become more severe, especially in the southern part of the state, and this trend is projected to continue over the next 100 years (Christensen et al. 2007; Seager et al. 2007; Trenberth et al. 2007). In addition, movement of species in response to climate warming is already resulting in shifts of species ranges north and upward along elevational gradients (Parmesan, 2006) and have begun to explore the implications

of these changes for the provisions of ecosystem services (*sensu* Millennium Ecosystem Assessment 2005). Indeed, an explosion of studies in the last five years document observed climate impacts on species distributions. In one such study in Southern California's Santa Rosa Mountains, researchers documented plants shifting upslope by 65 m over the 30 year period from 1970 to 2007 (Kelly and Goulden, 2008). The altitudinal shift is attributable to increases in surface temperature and in the precipitation due to climate change. In another, researchers discovered that 70% of butterfly species studied advanced the date of first spring flights by an average 24 days over the period from 1972 to 2002 (Forister and Shapiro 2003).

In California this century, the average annual statewide temperature is projected to rise 1.7-3.0°C (3.0-5.4°F) under low emission scenarios and 3.8-5.8°C (6.8-10.4°F) under higher emissions scenarios; the current trend is the higher than the high emissions scenario (Hayhoe et al. 2004; Cayan et al. 2006, Rapauch 2007). The projections for statewide annual average precipitation change varies in both direction and magnitude from a decrease of 157 mm to an increase of 38 mm (Hayhoe et al. 2004; Cayan et al. 2006), with significant variation in projections among Global Circulation Models (GCMs) and emissions scenarios (Metz et al. 2001; Salathe 2003; Wood et al. 2004).

The projections for the California deserts, including Joshua Tree National Park, are even more severe, with the typical summer maximum temperatures by the end of the century reaching levels that are hotter than the most extreme year we have seen in the last 100 years. The majority of climate models also predict these deserts will become even more arid, losing an average of 1.6 inches of precious rain each year. Additional stresses to species and ecological systems are also likely to come from increased invasions from non-native species, more frequent high-intensity fires, unforeseen interactions between species as the climate shifts, and natural and non-natural barriers to wildlife migration (Suttle et al. 2007). Under pressure from climate change and the full array of stressors, these ecosystems, including the distinctive species associated with these places, will necessarily respond and change.

Indeed, here in the Mojave Desert at Joshua Tree National Park, there will likely be increased rates of plant mortality, including the charismatic Joshua Tree, which will accelerate rates of erosion, create opportunities for exotic plant invasions and promote fire. The increased frequency of fire will further reduce abundance of native plants. The climate-driven dynamics of the fire cycle are likely to become the single most important feature controlling future plant distributions in these deserts. Thus it is likely that California's desert species and ecosystems, and the direct value we derive from them via ecosystem services (e.g., to sustain biodiversity, promote clean water, and sequester carbon), will also be altered dramatically.

As we are now able to measure ecological signals for a temperature increase of just 1.0° C (1.8°F), the expected impacts on species and ecosystems of the temperature expected by 2099 are sure to be dramatic and we need to develop approaches for securing our past investment in our federal, state and private protected areas through a comprehensive adaptation strategy that takes into account the likely impacts of climate change, analyzes the vulnerability of species and ecosystems to those impacts and develops adaptation strategies for building resilience into natural systems.

IV. Ecosystem-based Adaptation Approach—Strategies and Benefits

While a world of rapidly changing climate is not desirable, it is now inevitable. To alter course of impact of climate change, it is essential to implement meaningful greenhouse gas reduction targets; but it is also important to come to terms with degree of climate change to which we have committed ourselves, both through our past emissions and through emissions that will occur between now and in the future. It is therefore vital to act now to begin to take steps to fund, plan and implement strategies to protect our important protected areas and the services they provide to our nation's people in the face of anticipated changes in climate. These last strategies are commonly referred to as ecosystem-based adaptation strategies.

In practice, ecosystem-based adaptation includes practices such as ensuring that ecosystems remain intact and interconnected to allow for biodiversity and people to adjust to changing environmental conditions. It can also include restoration of fragmented or degraded ecosystems, or simulation of missing ecosystem processes such as migration or pollination. It can include the use of natural infrastructure such as wetlands or fringing mangrove communities to buffer human settlements from floodwaters or storms. These interventions are not without costs—all will demand adaptation of management, governance and institutional settings—but they are necessary to safeguard ecosystems and the essential services that natural systems provide to people such as clean water, clean air and recreations. Protecting, restoring, and managing key ecosystems yields significant sustained benefits in a world of

climate change for both humans and nature. These benefits include cost-effective protection against storms and flooding and reinforcing mitigation efforts.

Ecosystem-based adaptation encompasses a range of strategies whereby ecosystem management, restoration and uses are modified or diversified to confer greater resilience of natural ecosystems, production landscapes, human populations and livelihoods in the face of accelerated climate change. Ecosystem-based strategies include, but are not limited to:

- Integrating climate change into local and regional plans
- Protecting large areas with buffer zone, increase reserve size and increase number of reserves
- Increasing connectivity between reserves through design of corridors, removal of barriers for dispersal, reforestation
- Minimizing and mitigate synergistic threats including invasive species, fragmentation, and fire
- Practicing intensive management to secure populations including relocating species
- Improving interagency regional coordination
- Providing private land stewardship incentives

Early lessons from existing ecosystem-based adaptation projects suggest some principles for developing effective ecosystem-based adaptation strategies:

- Ecosystem-based adaptation should be based on robust predictive modeling of climate, biodiversity and social/economic responses to climate change.
- Ecosystem-based adaptation strategies should include a focus on minimizing other anthropogenic stresses that have degraded the condition of critical ecosystems, as healthy ecosystems will be more resilient to climate change.
- Existing management practices and governance infrastructure should be the basis for adaptation efforts, although these may have to be substantially altered in order to achieve management objectives.
- The development of adaptation strategies and their implementation should involve diverse stakeholders in government, the private sector and civil society.

Ecosystem-based adaptation complements other climate change responses in two ways. First, it helps to make ecosystems more resistant and resilient in the face of climate change so that they can continue to provide the full suite of services that nature provides. Such strategies are especially important for sustaining natural resources like water, timber and fisheries that people depend on for their well-being and livelihoods. Second, ecosystem-based adaptation protects and restores ecosystems that can provide cost-effective protection against some of the threats that result from climate change. For example, wetlands, mangroves, coral reefs, oyster reefs, and beaches all provide shoreline protection from storms and flooding that can reinforce and enhance engineered solutions while sustaining biodiversity at the same time.

Protecting, restoring, and managing key ecosystems yields the following significant sustained benefits in a world of climate change for both humans and biodiversity:

- Cost-effective protection against storms and flooding: protecting and restoring “green infrastructure” like healthy riparian corridors and wetlands could be a more cost-effective means for protecting large coastal areas, and require less maintenance since they are living systems
- Maintenance of connectivity across temperature and moisture gradients will allow plants and wildlife to adapt naturally to some degree of climate change
- Maintenance of essential ecosystem services, such as water purification, will ensure continued availability and access to natural resources so that communities can maintain and adapt livelihoods to the conditions that are projected in a changing climate.
- Reinforcement of mitigation efforts through, for example, “working forest” easements can sequester carbon by improving overall forest health, and simultaneously sustain functioning ecosystems that provide food, fiber and water resources on which people depend.
- Consolidation and expansion of parks and other protected areas in carbon-rich habitats can increase carbon storage, thereby reducing greenhouse gas emissions, and involve a wide range of people in mitigation and adaptation efforts.

V. Effective Adaptation—Information and Tools

As we work to curb greenhouse gas emissions, it is important that the adaptation go beyond the systematic identification of potential future impacts to produce a much more comprehensive analysis of vulnerability and pathway for modifying that vulnerability through implementable strategies. The goal of adaptation should be increasing the long-term resilience of natural and managed systems by increasing the

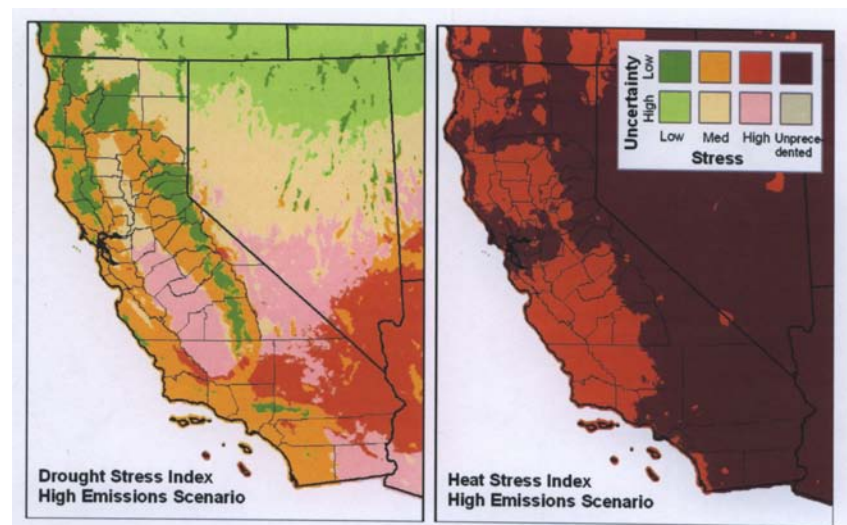
adaptive capacity of the managing institutions. There are four important features are necessary for such an adaptation approach:

1. Tools that identify the range of potential future climate changes, the uncertainties associated with those ranges, the degree of vulnerability of particular species or systems to the full range of climatic change
2. An assessment the synergistic impacts of other factors that might alter vulnerability to climatic changes (e.g., land use change, fragmentation, pollution, proximity to other protected areas, etc.)
3. An assessment of the adaptive capacity for existing resource management institutions to respond to and reduce vulnerability given current goals and resources constraints; and
4. Development of an adaptive framework for reassessing goals and policies that promotes cross-institutional collaboration for ensuring the persistence of the nation's ecosystem and parks.

This adaptation approach will allow for a systematic analysis of the institutions that manage natural resources, the factors that make species and natural resources vulnerable to impending climate change and the identification of institutional changes to enhance resilience. Proactive measures to address climate change impacts have proven to be more cost-effective and efficient than reactive measures (e.g., Schneider et al. 2000; Easterling et al. 2004). With concerted planning for adaptation, adaptation measures can be implemented in the course of short-term operational and longer-term strategic planning and management decisions (Paavola and Adger 2002; Luers and Moser 2006). I will focus in this testimony on concrete examples of tools and approaches that represent The Conservancy's experience at developing decision support tools for climate adaptation and the development and implementation of action plans for an adaptive approach.

Decision-Support Tools for Climate Change Impacts

There is so much climate change information that managers and decision-makers can easily become overwhelmed. Information on climate change and its uncertainty, past and future, is not readily accessible to managers and decision makers and distilled in an applicable form. It is for this reason that Conservancy scientists have developed decision-support tools such the "Climate Wizard" (see www.climatewiz.org) that allow users choose any place and get records of past temperature and precipitation trends as well as future projections under different scenarios and the "Climate Stress Index" which interprets that climate impacts data relative to the climate under which management now occurs and at scales relevant for decision-making.



Climate Stress Index: Figure shows how different the future climate (precipitation on the left and temperature on the right) will be relative the past climate under which resource managers have come accustom. The Drought Stress Index (left) indicates whether the change in precipitation will be low, medium, high or unprece-

mented relative to the last 100 years and whether there is low or high uncertainty associated with the change. The Heat Stress Index (right) indicates whether the change in temperature will be low, medium, high or unprecedented relative to the last 100 years and whether there is low or high uncertainty associated with the change.

Cost-Impact Study for Reality Check on What Adaptation Strategies are Cost-Effective

With impacts of climate change, new land protection and species management strategies may needed to maintain and achieve current conservation goals but we will have to be smart about the use of limited resources. In an analysis of a 780,000 acre (320,000 ha) Conservancy project area around San Jose, California, we found 43% of the endemic, highly-restricted species at high risk of local extinction requiring the establishment of corridors and the implementation of assisted migration strategies to new suitable areas; and 41% of the wide-ranging species in need of new climate-adaptive conservation strategies, such as new land use, land acquisition and land management contracts, in order to persist in the future. The total cost of sustaining the biodiversity and ecosystem function of this landscape under a current climate would likely exceed \$300M during the next 40 years. Under a changing climate, the total cost could exceed \$750 million, or a 2.5 times increase. With considerable emphasis on the adoption of new policies to incentivize implementation of lower-cost climate-adapted strategies in place of traditional, resource-intensive strategies such as land acquisition, the costs can be reduced considerably. Methodologies and tools developed in this study should be made widely-available to all natural lands managers.

Cost-Impact Studies for Reality Check of What Is at Stake to Lose

In a California Energy Commission—funded study on the impacts of climate change on ecosystem service production and value, the Conservancy values the economic impact of climate change on our natural resources in the state of California and the ecosystem services they provide (Shaw et al. 2009). In this study, we show that California's famous grasslands and forests will likely shrink in area and generally become more shrubby and scrubby. Less grassland habitat means mean fewer opportunities for ranchers to graze cows on natural forage. The loss of natural forage not only deprives consumers of naturally fed beef, but results in a loss of profits for ranchers who must raise fewer cows or pay more to feed these cattle using grain and other sources of feed. By 2070, we estimate the annual loss in net income to ranchers could be between \$22 million and \$312 million annually. Likewise, the economic effects of climate change on forests will be substantial. A change in the ability of California forests to store carbon will affect the state's ability to meet greenhouse gas emission goals and will result in broader impacts on society as a whole. The market cost of changes in carbon storage by estimating how much it would cost to buy carbon offsets in a carbon trading market could be as high as \$22 billion annually by 2070. Lost carbon storage also will contribute to global climate change and have an impact on economies around the world. This "social cost" of the lost carbon storage could result in impact that could cost society more than \$62 billion annually. However, the sooner we act, the less likely we will be forced to incur this full cost.

VI. Examples of Implementation of Adaptation Implementation: Learning By Doing

The Nature Conservancy does not have all the answer but has developed tools for understanding climate impacts, has begun to develop a series of adaptation strategies—ecosystem by ecosystem—and we have begun to implement these tools and strategies to better understand what will work best. Below are two examples of our adaptation approach:

Example One—Coastlines:

Coastlines have always been dynamic, but are now more so than ever because of changing storm patterns and sea level rise, placing human and natural communities at greater risk. The costs of these hazards to human and natural communities are increasing as coastal development continues and natural buffers, such as coastal wetlands, dunes, and mangroves are lost. Despite a growing awareness of the reality of these hazards, communities and local decision makers still have little access to information on likely changes in storm and flooding risk or tools to visualize the potential impacts and identify alternative scenarios. As a consequence, communities are unable to integrate sea level rise and coastal hazard risk into decision-making regarding natural resource protection and land use management. This information is needed to protect human communities from the dramatic changes that are underway. The Conservancy has contributed to the development of two different examples

of tools and approaches that can help address these services and objectives jointly in the Florida panhandle (www.marineebm.org/32.htm) and a more advanced and developing decision support tool for the southern shores of Long Island (<http://www.coastalresilience.org>).

The salt marshes, sea-grass beds and oyster reefs of Florida's Gulf Coast harbor manatees, sea turtles, piping plovers and many other threatened species, as well as serving as nurseries for economically important shrimp, crab and red snapper. These habitats also provide protection from storm surges that accompany hurricanes. Yet strategies to defend and restore coastal ecosystems—which could simultaneously assist people and expand habitats for threatened and economically valuable species—have largely been ignored in favor of engineering projects (diking, building levees, and hardening the coastline) that accelerate erosion and habitat loss. Working with scientists from the National Oceanic and Atmospheric Administration, the Conservancy recently combined maps of critical habitats and threatened species in the Florida Panhandle with maps of anticipated storm surges and of human communities most physically and socio-economically vulnerable to storm damage. By overlaying these data sets, we were able to identify areas in which restoration should simultaneously protect the most vulnerable human populations as well as many of the area's most important species.

Example Two—California Grasslands:

In the Mount Hamilton range, south of San Francisco, The Conservancy is implementing a conservation plan called the Mount Hamilton Project. The Conservancy developing a climate-adapted conservation plan using information about temperature and precipitation changes and employing climate adaptation strategies to ensure the persistence of a full array of species and ecosystems important to California's biodiversity. An example of one important species found at the site is the Bay Checkerspot Butterfly (*Euphydryas editha bayensis*). The federally-threatened butterfly relies on a native plant that was once widespread, but now persists only on rare serpentine soil patches. Current conservation plans, identify for protection the areas where the species is currently found but not where the future habitats are. The areas of suitable climate for the butterfly and its host plants are projected to shift upslope, but the distribution of suitable soils is too limited to support their gradual migration to higher elevations. In this case, the butterfly, and other sensitive species, would go locally extinct without climate adaptation strategies including (1) the drafting of a climate-sensitive conservation plan that identifies for protection those areas where the butterfly can persist in the future and (2) the relocation populations to those climate-safe areas. We are currently updating our methodology to create site specific conservation plans to take current and future habitat needs into consideration, in addition

VII. Closing Recommendations

Moving forward, it will be important to carefully explore what will be needed to implement adaptation strategies on a scale that will be meaningful for protecting on natural and human communities. I encourage you to consider the inclusion of the following key elements in a policy context:

1. *Dedicated Funding:* While in the long run ecosystem-based adaptation will be cost effective, there is an immediate and long-term need for a dedicated revenue stream to support the data collection and synthesis, the development of a robust adaptation approach and its implementation.
2. *National Climate Change Adaptation Plan:* Implementation of comprehensive adaptation approach will not be easy. I encourage the development of National Climate Change Adaptation Program with a nationally prioritized list of ecosystem-based adaptation strategies and action to address climate change impacts, guidelines for how that is to be accomplished, and guidance on when infrastructure solutions such as raising roads and building sea-walls are necessary.
3. *Climate Change Adaptation Partnership:* The National Climate Change Adaptation Plan should be designed to facilitate partnerships among all levels of government and the private sector.
4. *Avoiding Impacts Counter to Adaptation Goals:* Federal and State agencies taking action to prevent damage to roads and property from sea level rise or flooding should avoid damage to natural systems to the maximum extent practicable.
5. *Facilitate Land Acquisition for Adaptation:* Federal, state and local agencies will need funding for land, easements and cooperative management agreements to facilitate ecosystem-based adaptation and connectivity.

As this Subcommittee contemplates legislation for the adaptation of our valued National Parks, it is faced with the daunting task of simultaneously configuring our policies and economy to reduce greenhouse gas emissions and support our natural and human communities to adapt to climate change. We do have very practical solutions for advancing both to great success. I would like to extend an offer to work with the Committee as you explore policy options for assisting the nation in adapting to our future climate.

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Mr. GRIJALVA. Professor Thomas Swetnam, Director, Tree Ring Laboratory, from the great University of Arizona. I say that, I'm alumna. I'm allowed one perk every once in a while.
Professor Swetnam.

STATEMENT OF THOMAS W. SWETNAM, DIRECTOR, TREE RING LABORATORY, UNIVERSITY OF ARIZONA, TUCSON, ARIZONA

Mr. SWETNAM. I appreciate the opportunity to be here. Thank you for inviting me. And thank you to Congresswoman Napolitano for being here.

For the benefit of everyone else, I am a Professor of Dendrochronology, which is tree rings sciences. And I use tree rings to study forest ecosystems. And I have had the great pleasure and honor to work in national parks and national forests across this country for the last 30 years. My research has mainly focused on the use of the tree rings to study forest fires, insect outbreaks, and also the role of climate variability and climate change on driving disturbances in our national landscapes.

My written testimony has three main points. The first one, which we've heard quite a bit about already, is the need for better coordination and collaboration among Federal, state, county, and private entities.

The second point—which we've already heard—is that there's a need to maintain the parks as canaries in the coal mine, if you will. They are really some of our best places to understand climate change, to track it, to monitor it, to know how it's occurring, and also to educate the public on the impacts of climate change.

The last point is about the need for science infrastructure for building our capacity to do better and more science to deal with the climate change problems that we're facing.

On the first point, better coordination and collaboration, I was very encouraged to hear Jon Jarvis' comments about the Parks Service's intention and indeed their work already in coordinating among the multiple agencies. In my written testimony I provide a couple of examples from Southern Arizona, in Chairman Grijalva's district, in fact, that exemplify the problems that we're facing, the climate change problems we're facing.

Climate change is operating at regional and landscape scales. And by landscapes I mean whole mountain ranges, entire watersheds, multiple state. And of course at these scales we must better

coordinate and interact among the different jurisdictions, different Federal agencies and state agencies and the county agencies.

The examples I give from Southern Arizona include invasive species, the problem of buffelgrass in invading the Sonoran Desert. But this is a problem recurring elsewhere in the American deserts. Here in Joshua Tree and the great basin there are other invasive species occurring. And these are leading to extraordinary wildfires that are changing the ecosystems.

Climate change is most likely involved in promoting some growth of these invasives, but also through the droughts which promote fire.

In Southern Arizona there's a very dynamic group engaged now in dealing with the buffelgrass problem, the Southern Arizona Buffelgrass Coordination Center. This is a Federal, state, and county and private enterprise to really begin to deal with it. And I think it's a good example of this coordination that needs to take place.

The second example I describe in my written testimony is the Firescape Initiative. And this is working up at the tops of the mountains. Our Sky Islands of Southern Arizona and New Mexico have forests at the top, and they're burning. We recently had more than a hundred thousand acres burn in the Santa Catalina Mountains in 2002 and 2003, burned up 300 homes. These kinds of things are happening all across the West and elsewhere in the country as we know.

To deal with these problems we need to have coordination among multiple agencies. And so restoration, work of dealing with the fuels problems, and dealing with the invasives also on these higher elevations is necessary.

In this regard I want to actually thank Chairman Grijalva for his leadership on the recent passage of the Forest Landscape Restoration Act. This is precisely the kind of Federal support that's needed to really move to the landscape scales in terms of dealing with these broad scale problems.

The second point is that the parks and the forests are really essential locations for tracking climate change and monitoring climate change. I give a couple of examples there of recent studies published. I was involved in one of these looking at wildfire occurrence across the whole Western United States.

Tony Westerling, Professor at the University of California at Merced, and his colleagues at Scripps Institute in San Diego, we pulled together a record of forest fires across all of the Western U.S. And we published this in *Science* two years ago. We show almost seven times increase in area burned in the last two decades relative to the previous two decades, more large fires. This increase is well correlated with the rise in temperatures across the Western United States.

Further, there's been many more early springs. Spring is occurring early, the snow melt is coming off the mountains, and the fuels are drying out earlier. There's been more early springs in recent decades.

The second paper I describe in my written testimony—and I do have a couple of graphics at the end of testimony that show some of the results—a recent paper published in January in the *Journal*

of Science by USGS scientists and their colleagues across the West showing rising tree mortality rates across the whole Western United States. And they very carefully analyze these data and show that these trends are regardless of elevation, of forest type, of land use history, the forest fire history. We're getting increasing rates of tree mortality. And they concluded that this is likely related to the warming temperatures across the West, because all of the other factors have been controlled for in this case. My examples there are that we would not have been able to do these large-scale studies of fire and tree mortality if it had not been for the monitoring data available from national parks and national forests. So, we really need to maintain these monitoring of data generating networks of our parks and forests, and improve them, expand them.

The third and final point is that we need to build our capacity, our science capacity, within the parks and within and among the agencies. I give an example of one of the most effective types of—we call translational science, moving science to management and operations.

Place-based scientists, these are scientists that are located at the national parks. And there's relatively few of these. USGS, through some legacy, has a number of scientists located at the national parks. And these folks have been very productive. The Parks Services Research Learning Centers is another great opportunity for science to be done in the parks and right adjacent to the parks. There are other kinds of science mechanisms that we need to build, including the CESU's and the interaction with the NOAA RISAs, the regional impact centers that NOAA funds.

So, one thing I see here is a need for better coordination and institutional linkages, more explicit linkages to be made between the USGS scientists, the Park Service scientists and NOAA scientists and the other agencies that are involved in providing science support for the parks. We need to build the science capacity.

Finally, one of the things we saw from the New Deal, which has been very valuable as I travel through parks, as anybody who travels through parks, they see the bridges and the roads and the trails and the great rock and timber structures that were built during the 1930s. And so the parks, we've seen a really big boost from the New Deal in terms of infrastructure. But we also had a science boost during that time frame. As I go back through the old records, the old documentary records, I see that a lot of the original mapping and the original species inventories and the original science work was also funded at that time. And we need this same sort of kind of investment now in the parks, both for the real infrastructure, the solid infrastructure, but also the science infrastructure, to deal with climate change as it is now.

Mr. GRIJALVA. Thank you.

[The prepared statement of Mr. Swetnam follows:]

Statement of Thomas W. Swetnam, Professor of Dendrochronology & Watershed Management, Director of the Laboratory of Tree-Ring Research, University of Arizona

Mr. Chairman and members of the Subcommittee, thank you for inviting me today to discuss the importance of America's National Parks in understanding

climate change impacts, and the need to mitigate and adapt to these coming impacts on the “crown jewels” of our public lands system.

I am a scientist with more than 30 years of research and applications experience in National Parks, primarily in the western United States. My expertise is in the areas of forest ecosystems, fire history, insect outbreaks, and the effects of climate change. Although my research has basic aspects, it has largely focused on applications to management, such as the use of fire and forest history knowledge to guide ecological restoration of forest ecosystems. This work has been particularly useful in places like the giant sequoia groves in Sequoia, Kings Canyon and Yosemite National Parks in California and the ponderosa pine forests of the Rincon Mountain Wilderness in Saguaro National Park, near Tucson. In recent years, my research has focused primarily on climate change and its past and current effects on fires and insect outbreaks.

The main points of my statement are as follows:

- The coming climate-caused changes require landscape to regional-scale perspectives and management. These broad scales require much more effective collaboration among federal, state and private entities than has occurred before. Management challenges also require increased translational science capacity and partnerships between universities and federal agencies. I will briefly describe a landscape-scale collaboration in southern Arizona to illustrate some of the issues, needs, and potential.
- The National Parks are critically important areas for tracking and understanding climate change impacts on ecosystems and watersheds. The Parks include many of the least human-altered ecosystems on the planet. As such they provide a unique and valuable perspective on climate-caused changes that have occurred in the past and are occurring now. Moreover, because the Parks contain our most cherished biota and landscapes, the climate change effects on these living things and places are naturally of great concern to the American people.
- To carry out the needed science support for mitigation of and adaptation to climate change impacts in the National Parks, federal agencies and their science collaborators in the universities need to build basic science and translational science capacity. A very effective mechanism of science support within and for the National Parks is “place-based” science. I will describe examples of this model, and I recommend that it be broadly replicated and institutionally strengthened. Additional science capacity building is needed that will involve other approaches, including the National Park Service’s Monitoring Networks and Research Learning Centers, and coordination with the National Oceanic and Atmospheric Administration’s Regional Integrated Science and Assessment centers (RISAs).

Landscape-Scale Management—Collaboration and Science Needed to Support It

A common observation, as reflected in statements by witnesses who have testified earlier this year to this committee, is the need for better coordination and cooperation among the multiple federal and state agencies involved in managing our ecosystems and watersheds. This need arises because the impacts of climate change are broad scale; they do not follow administrative boundaries, and neither will effective mitigation and adaptation solutions. As temperatures continue to rise and droughts of greater severity occur in coming years and decades we may be challenged to assist re-location of plants and animals via migration corridors or direct translocation to more suitable habitats.

Most of the necessary science, mapping, planning, and prioritization for adaptation is yet to be done. An approach that will be highly valuable is the development of climate change scenarios at the scale of bio-regions that can be used for planning and prioritizing in coordination among multiple agencies. I am encouraged to know that the National Park Service (NPS) is developing a strategic framework for action that has adaptation as a major component (Leigh Welling, NPS Climate Change Coordinator, personal communication). As part of this framework, NPS has already begun to develop a scenario-based approach for planning at the Park level. The first prototype workshop took place in Joshua Tree National Park in November 2007 and involved scientists, natural and cultural resource managers, and educators. Several other scenario workshops are being planned for 2009 and 2010, involving Assateague Island in the northeast, Wind Cave in the northern Prairies, and Yellowstone and Glacier National Parks in the Rocky Mountains. These efforts need to become more widespread and coordinated.

As we work to adapt or restore ecosystems to conditions that are more resilient to climate changes and related disturbances—such as wildfires and insect out-

breaks—we will need to implement treatments (e.g., mechanical thinning of forests, eradication/control of invasive species, and prescribed fire) at landscape scales. By “landscape scales”, I mean entire watersheds and mountain ranges, typically extending over tens to hundreds of thousands of acres, i.e., the scales of National Parks, or networks of Parks. Examples from the landscapes where I live and work in southern Arizona (including Congressman Grijalva’s district) serve to illustrate some of the issues and needs here:

The mountains and desert basins of southern Arizona are often referred to as the “Sky Islands”. The mountains rise as “islands” of oak woodlands and conifer forests above a sea of grasslands and cactus-shrub deserts. Ecosystems that span these elevational gradients range from the low Sonoran deserts to the high montane forests. Most of these ecosystems are increasingly at risk of irreversible damage from a climate change-related disturbance: unnatural and uncharacteristic wildfire.

In the lowlands, the chief culprit is buffelgrass (*Pennisetum cilare*), an invasive species introduced into the Sonoran desert originally as forage for livestock. Buffelgrass has now spread widely throughout the Tucson Basin, including into Saguaro National Park. Buffelgrass is extremely flammable. The spreading clumps of buffelgrass are forming continuous patches hundreds of acres in size in some places, and they are carrying extraordinarily hot, running fires through the Sonoran desert. These fires kill most of the cactus and other native species because they are not adapted to such fires, which have never occurred with this severity or extent in these ecosystems before. Buffelgrass, in contrast, is highly adapted to fire and it re-sprouts prolifically.

This problem of widespread invasive species promoting unnatural wildfires is increasingly common in the American deserts and our National Parks. In addition to buffelgrass invasion in the Sonoran Desert, red brome, cheat grass and other invasive species are spreading prolifically in the Southwest and elsewhere, including National Parks in the Mohave and Great Basin deserts. In summer of 2005, invasive grasses fueled desert wildfires that approached a quarter of a million acres in central Arizona (the Cave Creek Fire Complex) and three-quarters of a million acres in southern Nevada.

The impacts of grass invasions and altered fire regimes in the deserts are many, looming and costly. They include threats to life and property in urban and exurban areas, significant economic losses (i.e., decreased property value, lost tourism revenues, and escalating weed control and fire suppression budgets), and compromises to biodiversity, protected lands and conservation initiatives. These fast-evolving threats are catching communities and fire departments off guard and ill prepared.

The connection with climate change is not entirely clear, but we know that higher CO₂ levels will favor cheatgrass and red brome at the expense of native species, and that warmer winters will push buffelgrass higher in elevation and farther north. Our National Parks and Monuments are especially in peril, and save for a few valiant, grassroots efforts we seem to be losing this battle. One day, we may not only face a Glacier National Park without glaciers, but also a Joshua Tree National Park without Joshua trees and a Saguaro National Park without its iconic saguaro.

A growing concern is the potential spread of wildfires from the lowlands to the highlands, and vice versa. The mountain tops of the Sky Islands have already experienced several damaging wildfires. The 2002 Bullock Fire and the 2003 Aspen Fire in the Santa Catalina Mountains, for example, collectively burned more than 115,000 acres and destroyed about 300 homes and businesses in the town of Summerhaven. Similar events have occurred across the western U.S. in recent years, and it is increasingly evident that this rising trend in “megafire” occurrence is partly associated with warming temperatures, earlier arrival of spring, and drought conditions (Westerling et al. 2006).

Forest changes (e.g., fuel accumulations) due to a century of fire suppression and land uses (e.g., livestock grazing, logging, etc.) are also involved in this problem in many but not all forests. More than 35% of the area of the Bullock and Aspen Fires resulted in total or substantial canopy kill of the forest, leaving very large “canopy holes” which promote erosion of forest soils, and severe downstream watershed impacts. Although frequent, low severity, “surface fires” were a common and natural ecological process in our Southwestern ponderosa pine and mixed conifer forests in the past, these recent fires are burning uncharacteristically (and unnaturally) hot as “crown fires. The result is conversion of forest stands to shrublands or grasslands, and damaging effects on soils, habitats, and watershed values.

Landscape-scale collaborative efforts are underway in the Sky Islands, focusing on forest restoration that aims to mitigate and adapt to the climate change-related “shocks” of megafires. The “FireScape” collaborative is an approach that has been particularly effective at working at landscape scales in the multi-agency context. FireScape is a collaboration of the Coronado National Forest, The Nature Conser-

vancy, Saguaro National Park, The University of Arizona and other partners to provide an umbrella for safe, ecologically sound, broad-scale, multi-party fire management. The first FireScape project was developed for the Huachuca Mountains of southeastern Arizona. This project is nearing the implementation phase.

A developing FireScape project for the Santa Catalina and Rincon Mountains surrounding Tucson has a focus on utilizing the mosaic of fuel conditions left by the recent Bullock and Aspen fires. The idea here is that the mosaic of low, moderate and high severity burned areas in the Bullock and Aspen Fires can be used as effective fuel breaks and opportunities for reintroducing prescribed fire and thinning treatments at landscape scales. This approach is likely to be safer, more cost effective, and ecologically sensitive than such treatments in unburned landscapes. In some areas the recent wildfires have effectively begun the restoration process of reducing fuel accumulations and forest stand densities. It is necessary, however, to follow up with treatments within the next decade or less, otherwise it is likely that the beneficial effects of the mosaic will be lost.

Both the buffelgrass and forest wildfire problems of southern Arizona, like similar climate change-related problems elsewhere in U.S., require landscape-scale thinking, effective translational science partnerships, and sustained implementation with follow through using science-based adaptive management. The buffelgrass efforts are exemplary of highly effective multi-jurisdictional coordination and planning to deal with a landscape-scale problem affected by climate, and analogous to many of the climate change problems we will be facing in years ahead. Space is limiting here to describe in detail the collaborative efforts that have gone into planning southern Arizona buffelgrass control and the landscape fire planning for the mountains, so I will refer here to web links where more information can be obtained: see Southern Arizona Buffelgrass Coordination Center at <http://www.buffelgrass.org/>, and <http://www.fs.fed.us/r3/coronado/> under "FireScape on the Catalina and Rincon Mountains".

The key points I want to emphasize from these examples of landscape-scale, multi-agency management problems are the following:

1. Planning, collaboration, and implementation of restoration and climate-change adaptation programs at landscape-scales are essential. Both the Tucson Basin buffelgrass and Sky Islands FireScape examples cross numerous administrative boundaries and to be effective these projects must involve collaboration and coordination among federal, state, and county agencies, and with private land owners. Fundamentally, what is needed is support for the science, planning, and implementation of treatments and restoration work on the ground. In this regard, I wish to commend Congressman Grijalva for his vision and leadership in helping develop and pass the recent Forest Landscape Restoration Act. This is precisely the kind of federal support and leadership needed for landscape-scale restoration projects.
2. In addition to funding mechanisms for planning and implementation, we need to develop science support capacity. The Southern Arizona Buffelgrass Coordination Center (SABCC) and Sky Islands FireScape initiatives both point to the need for state-of-the-art decision support and expertise in geospatial tools for mapping and prioritizing treatments, and for modeling spread of invasive species and fire behavior at multiple scales. If we are going to engage in landscape-scale treatments and adaptation, we should do it with our best scientific understanding, and monitor the results in a scientific framework. University collaboration is highly valuable in this regard because it brings scientific expertise, creativity, and credibility, as well as educational and training value for young scientists and managers.
3. Both the SABCC and FireScape programs have great potential to be national models of adaptation and mitigation of climate change-related impacts on federal, state, and private lands.

The Value of National Parks and Other Federal Lands for Tracking and Understanding Climate Change

There are many uncertainties about future climate change impacts on ecosystems and watersheds. Much of what we have learned about the effects of past and recent climate variations and change on ecosystems has come from studies conducted within the National Parks and National Forests. In the future, we need to continue and expand monitoring of climate and ecosystems within Parks, because these places offer some of the best landscapes to study climate-driven changes with the least amount of human land-use effects. Furthermore, the rationale for the Parks was, and is, that these are the places we care the most about in terms of protecting and preserving these wonders for the enjoyment by people, now and in the future.

There are two examples of climate change impacts in National Parks and Forests that I want to bring to your attention to illustrate the value of federal lands, and long-term monitoring data that comes from them. The first is a study of forest fire activity on federal lands in the western U.S. that I coauthored in the journal *Science* in 2006 with Dr. Tony Westerling of University of California, Merced and colleagues at the Scripps Institute, University of California, San Diego (Westerling et al. 2006). We used wildfire occurrence records primarily from National Forests and Parks in the eleven western states. We restricted our analyses to the period after 1970 and to fires larger than 200 hectares (about 1,000 acres) because this was the most complete and reliable type and period of documentary record.

We found a nearly 7-fold increase in area burned during the recent 17 year period from 1987 to 2003 compared to the earlier 17 year period from 1970 to 1986. This change was significantly correlated with rising spring and summer temperatures across this region, and the years with greatest numbers of large fires were consistently associated with years when spring arrived earlier, as measured by peak runoff dates in rivers. From locations of the large fires in different elevations and forest types, and patterns of spatial/temporal moisture deficits, it was apparent that warming climate was the key driver overall, and especially in some regions (e.g., the Northern Rockies). Both forest changes (fuel accumulations) and warming combined were likely important in other regions (e.g., the Southwest).

The second example is a recent paper published by a group of scientists working in western forests, led by U.S. Geological Survey scientists located at Sequoia and Kings Canyon National Parks. Drs. Philip van Mantgem and Nathan Stephenson and their colleagues gathered long-term forest monitoring data from 76 forest plots across the western U.S. (van Mantgem et al. 2009). Using data from more than 58,000 monitored trees they found that 86% of the plots showed increasing tree mortality rates over the period from about 1955 to 2007. The mortality rates doubled over periods ranging from 17 to 29 years in different plots and sub-regions during the studied time period. Mortality rates increased regardless of sub-region, elevation, tree size (age), species, or type of natural fire regime characteristic to the forests. The authors concluded that climate change (warming and drought) in the western U.S., and consequent physiological and ecological stresses on trees, was most likely the dominant factor leading to increased tree mortality rates.

Both of these studies illustrate the power of long-term monitoring data sets from National Parks and Forests for detecting and tracking climate change impacts. Neither of the studies could have been conducted without the existence of these federal units, and sustained dedication of scientists and managers who have carried out the monitoring and record keeping over many years. In addition to the national policy implications and the public educational values of such broad-scale studies, the results from local monitoring data sets have importance for management of individual National Parks and Forests.

Another important value of our Parks and Forests is that they are great places to teach our citizens about climate change and to directly engage them in the necessary monitoring and science. For example, federal agencies and the academic community are collaborating in an exciting national monitoring initiative, the USA-National Phenology Network (www.usanpn.org). Phenology is the study of the timing of events in the annual life cycle of plants and animals, including things like budburst, first bloom and leafout in plants and emergence, migration and hibernation in animals. A number of recent studies have shown that these biological events can serve as sensitive indicators of climate change effects on ecosystems. In essence, the NPN can serve as an early warning and monitoring system of climate change.

One way for us to adapt to climate change is to integrate phenological observations and models with climatic forecasts. There are not enough scientists and technicians to do this routine monitoring everywhere on the continent, so large-scale programs like USA-NPN will also have to rely on "citizen scientists". What better place to start these efforts than in our National Parks?

The key points I wish to emphasize from these examples are the following:

1. The National Parks and other federal lands are particularly valuable for monitoring, detecting, and tracking climate change.
2. Recent studies have begun to detect and describe probable, widespread climate change impacts in western National Parks and Forests, specifically increasing numbers of large forest fires and increasing tree mortality rates. These are broad-scale patterns, and the trends and primary causes of changes are different in some locations and sub-regions.
3. The National Parks and Forests can play a key role in public education about climate change and in carrying out broad-scale monitoring. Engaging people directly in observing climate change responses (e.g., the USA-NPN) is one ap-

proach. Programs such as the NPS's Research Learning Centers will also be essential in these endeavors.

The Value of Place-Based Science, and the Need for Expansion of Translational Science Capacity

During the past several decades of conducting applied research in National Parks and National Forests, one of the most effective models I have seen of translational science is a "place-based" approach, where scientists and their support teams are located at National Parks. There is a long tradition of federal agency scientists being located at research branch offices or laboratories on or near university campuses (e.g., USGS and USFS laboratories). These university-located laboratories have clearly been a huge benefit to applied science. However, the particular niche of a place-based scientist located at a National Park (or a Forest Service Supervisor's Office or Ranger District) is relatively rare. In the western U.S., there may be as few as a dozen or so such USGS lead scientists located in "Field Stations" within or very near National Parks, and fewer in the eastern U.S.

The productivity and positive impacts of these relatively few place-based scientists are remarkable. The van Mantgem et al. Science paper on tree mortality is a case in point. The lead authors, van Mantgem and Stephenson, are place-based, USGS scientists at Sequoia National Park. Another great example of scientific leadership and impact of place-based science is the Western Mountain Initiative (see <http://www.cfr.washington.edu/research.fme/wmi/>). This is a collaboration of USGS and U.S. Forest Service scientists working on climate change impact topics in the western U.S. Three of the principal investigators on this team are place-based scientists at National Parks and three are in federal laboratories located at or near universities.

The values of place-based science are well illustrated by the example of my colleague, Dr. Craig Allen, at Bandelier National Monument in northern New Mexico (see <http://www.fort.usgs.gov/resources/spotlight/place/>).

To summarize, the key values of place-based science include:

1. Place-based scientists can interact with on-site with managers on a daily basis, resulting in more effective communication, application, and follow-through of relevant science.
2. Place-based scientists can more effectively lead on proposing, conducting, arranging, overseeing, facilitating, and communicating the needed local research and monitoring.
3. Place based-scientists can act as a bridge between research and management, working to identify the information needs of management problems, secure external research funding, foster collaborations with outside institutions to conduct needed research, and communicate research findings quickly and effectively to local managers and the public.
4. Place-based scientists develop substantial expertise in the ecology of their particular landscape. Eventually this allows them to become information brokers of the deep-rooted institutional knowledge that comes from being in a place long enough to learn its lessons and grow familiar with its natural and cultural rhythms and history.
5. Place-based science, involving scientists and their teams located within National Parks, is a very effective model and it should be replicated. Currently, most of these scientists at Parks are USGS employees, but some of them started out as NPS researchers and they were eventually transferred to the USGS. The relationship of these scientists as translational-science support for local Parks and regional networks of Parks should be more formally defined and institutionalized in agreement between USGS and NPS, with the goal of sustaining the high quality and increasingly important work they conduct.

In addition to place-based science as described above there is need for support of other models of translational science. For example, I am aware that the National Park Service is currently developing a concept for "Bio-Regional Mitigation and Adaptation Planning Units" to coordinate scenario and adaptation planning efforts for Parks (Leigh Welling, NPS Climate Change Coordinator, personal communication). The Units would be strategically placed to utilize existing field resources, such as the "Inventory and Monitoring Networks" and the "Research Learning Centers". They would also coordinate with other entities, such as the NOAA RISAs, the USGS Field Stations and state and local governments. The bio-regional, landscape approach is critical for providing managers with relevant, up-to-date scientific information and for ensuring climate change efforts are dynamic, flexible and consistent across DOI and within other agencies.

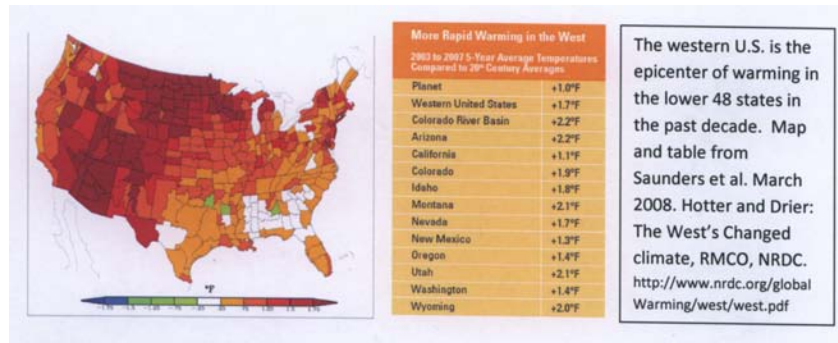
To be effective, the Units would need to have scientific, resource management, and adaptation planning staff. Resource and planning staff would use shared infor-

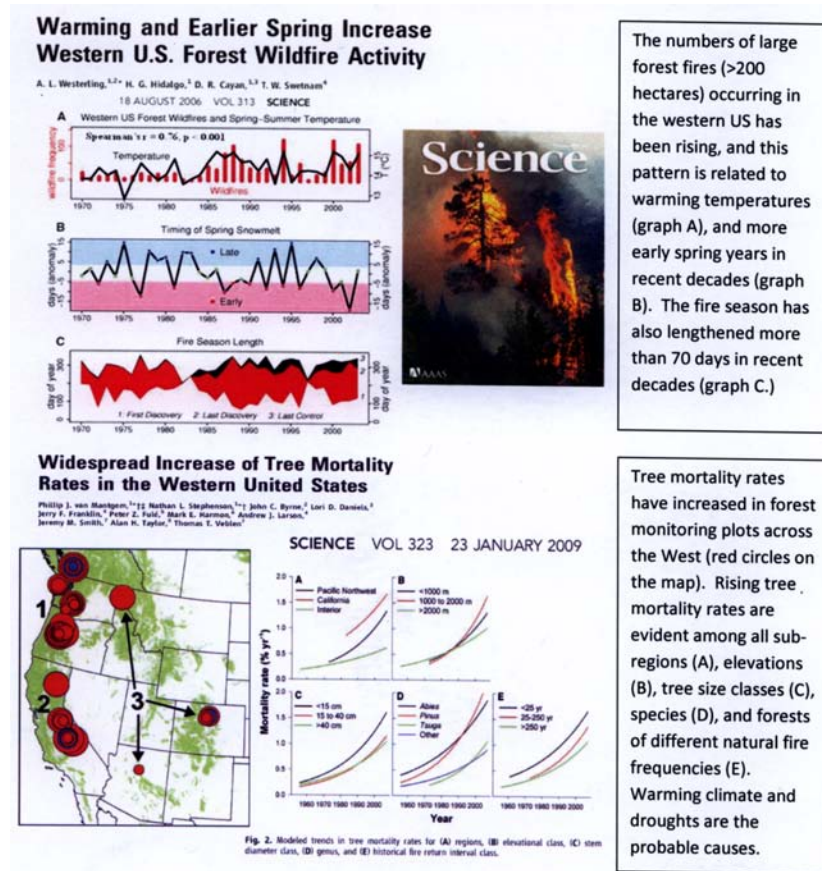
mation to build defensible and comprehensive scenarios that are integrated into a Resource Adaptation Plan for each park. Tangible results would be a list of response actions to climate change designed to reduce susceptibility of vulnerable species, ecosystems, or historic assets to harm or loss. Such actions could include documenting and inventorying historic sites that will be submerged, protecting additional species, adapting park infrastructure, identifying and protecting refugia and corridors, or transplantation and relocation of resources in extreme cases.

The final science and management initiative I wish to bring to your attention is a very dynamic consortium of federal and university scientists called CIRMOUNT (Consortium of Integrated Climate Research in Western Mountains) who came together in the early 2000s to coordinate and converse on the issues of climate change impacts in western North American mountains. Monitoring, conducting integrated research, communicating science among disciplines, and promoting policy-relevant databases are among the goals of CIRMOUNT. Climate change impacts on National Parks and other federal lands are a common focus of this consortium. This group has organized multiple symposia in the past decade on climate impacts on ecosystems, water resources and people. The meetings and initiatives include managers and policy makers as well as scientists. I encourage anyone interested in climate change impacts in the west to visit their website (<http://www.fs.fed.us/psw/cirmount/>), get on the mailing list for the newsletter (Mountain Views), and attend one of the biennial meetings. It is my hope that CIRMOUNT will be sustained in coming years by establishment of a central office in support of this dynamic organization and their important work.

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- van Mantgem, P. J., N. L. Stephenson, J. C. Byrne, L. D. Daniels, J.F. Franklin, P.Z. Fulé, M. E. Harmon, A. J. Larson, J. M. Smith, A. H. Taylor, T. T. Veblen. 2009. Widespread increase of tree mortality rates in the Western United States. *Science* 323:521-523.
- Westerling, A. L., H. G. Hidalgo, D. R. Cayan, and T. W. Swetnam. 2006. Warming and earlier spring increase western U.S. wildfire activity. *Science* 313:940-943.





Mr. GRIJALVA. Mr. John Coleman, Senior Meteorologist, KUSI, San Diego, California.

Mr. Coleman, welcome and I look forward to your comments.

**STATEMENT OF JOHN COLEMAN, SENIOR METEOROLOGIST,
KUSI, SAN DIEGO, CALIFORNIA**

Mr. COLEMAN. Thank you very much to the Committee for the invitation to appear today. And to any who listen to my remarks or who happen to read them later, I thank you for your consideration of my testimony.

I come before the Subcommittee with no allusions or expectations. And I'm aware, for the majority of the Committee, for the other witnesses here, and for most involved government officials, that my conclusions will run counter to your interests and agenda and I fear will be ignored. But, nonetheless, I have made the effort to be here today because I feel I have to contribute something that at least should be in the record.

And here's what I think I know as a scientific fact. There is no manmade significant global warming or climate change at this time. There hasn't been any in the past. And there is little reason to fear any in the future.

Now, I don't say that the activities of man do not alter the weather and climate, because it is clear that they do. What I said is that there is no significant manmade climate change, and that none should reasonably be expected to occur in the future.

I have visited most of the national parks in the United States over the many years of the past, mostly with my children. I love our parks. I have enormous appreciation for the efforts of our government to protect our environment and to provide places and ways for the citizens to enjoy the amazing beauty and the powerful natural forces that are at work around us and for us to interact with the thousands of species that live in the parks and those regulated natural areas. Clearly it is a huge task to balance between access and protection, and I honor that.

But here is the crux of what I contribute to the issue before us. The science behind the current global warming manmade climate change commotion has failed to verify. The hypothesis that our carbon footprints produced by our use of fossil fuels is producing a significant greenhouse effect that will lead to climate calamity has failed to verify. So, I repeat, there's no significant manmade global climate change.

I have studied the research papers of the United Nations Intergovernmental Panel on Climate Change, and examined the science presented by Al Gore and his books, his movies, and his PowerPoint, and I have respect for Mr. Gore. He served honorably as Vice President and as a U.S. Senator. And I have traced the history of the development of the concept of carbon dioxide in the exhaust from our cars and our power plants and our industrial plants entering our atmosphere and interacting with the primary greenhouse gas, water vapor to magnify warming. It all collapses into a failed theory when examined with scientific care.

And I want you to know I'm not alone in reaching this conclusion. In the past year 34,000 scientists, 10,000 of them with Ph.D.s, have signed a statement debunking global warming. There is no solid scientific evidence that by burning fossil fuels our civilization increases the amount of carbon dioxide, CO₂—excuse me. There is solid evidence that by burning fossil fuels we increase the amount of CO₂ carbon dioxide in the atmosphere. However, even after 150 years of burning fossil fuels, CO₂ remains a tiny trace gas. To be precise, only 380 molecules out of every one million are CO₂.

Scientists with an anti-fossil fuel agenda developed a theory, what they call radiative forcing, to explain how this trace gas could create runaway greenhouse warming. And they put that theory into general circulation computer models, and their models then projected a continuous rapid rise in temperatures globally year after year. And in the 1980s and the 1990s their models seemed to be on track as the temperatures climbed. And in 1998 that warming stopped. By 2002 a rapid cooling had begun. And that cooling continues today.

The computer proof has gone poof. It has failed. It has been clear to me and many others around me that warming in the '80s and

'90s was at the peak of a solar cycle. And now that the sun has gone quiet, very quiet, that cooling now grips our planet. Yet the models continue to predict warming. And it's not happening. There is no significant warming from CO₂. And in fact our temperatures have now retreated to the point where they began a hundred years ago.

I am painfully aware that the global warming has become a political issue, and I deeply regret that. Because the latest Gallup Poll documents the wide divide on this issue. Sixty-six percent of the Republicans are of the opinion that the claims of global warming are exaggerated. Only 22 percent of Democrats are of that position.

Now I want to make it very clear that my conclusion is in no way politically based. And I regret that political tie-in because it makes it very difficult. I recall I was a science reporter for ABC back in the 1970s when there was a similar theory of excitement about a coming Ice Age. And thankfully our government and our political parties didn't get involved then. So, when the science got things straightened out and no Ice Age developed, the frenzy quickly faded away. But unfortunately this time with people with the anti-fossil fuel agenda had jumped onto the global warming bandwagon and they just don't seem to want to let go. They have claimed that they have changed their rhetoric to climate change from global warming, but they're still wrapped up in the cap and trade to tax our fossil fuels.

This tax will do great harm to our economy. And I think it will do nothing of consequence to protect the environment. So, my advice to the National Park Service and to this Subcommittee is do nothing to mitigate manmade global warming or climate change because there is none. Reject your extremists' agendas, concentrate on your wonderful work, which I honor, of protecting our natural resources and making the natural experiences available to us citizens of today and the generations to follow.

And to any who have an interest in pursuing the sources behind my scientific conclusions, I have provided a list of internet links with my written testimony.

And again I thank you, knowing I run quite counter to the drift of this hearing, for allowing me to present my testimony and place it on the record.

Mr. GRIJALVA. Thank you. Sir.

[The prepared statement of Mr. Coleman follows:]

Statement of John Coleman

Thank you to the Committee for the invitation to appear here today. And to any who listen to my remarks or read them later, thank you for your consideration of my testimony.

I come before this Subcommittee with no allusions or expectations. I am aware that for the majority of the Committee and most involved government officials my conclusions will run counter to your interests and agenda and will be ignored. Nonetheless, I have made the effort to be here today because I feel what I have to contribute should at least be in the record.

Here is what I know as scientific fact: There is no significant man-made global warming or climate change at this time, there has not been any in the past and there is little reason to fear any in the future.

I did not say that the activities of man do not alter the weather and climate, because it is clear they do. What I said there is no significant man-made climate change and none should be reasonably expected to occur in the future.

I have visited most of the National Parks in the United States and love them. I have enormous appreciation for the efforts to protect our environment and provide places and ways for the citizens to enjoy the amazing beauty and powerful natural forces at work around us and interact with the thousands of species that live in those parks and related natural areas. Clearly, it is a huge task to balance between access and protection. I honor that.

But here is crux of what I can contribute to the issue before us. The science behind this current global warming, man-made climate change commotion, has failed to verify. The hypothesis that our carbon footprints produced by our use of fossil fuels is producing a significant greenhouse effect that will lead to climate calamity has failed to verify. So I repeat, there is no significant man-made global climate change.

I have studied the research papers of the United Nations Intergovernmental Panel on Climate Change and examined the science presented by Al Gore in his books, his movie and his power point. I have traced the history of the development of the concept of carbon dioxide in the exhaust from our cars, power plants and industrial plants entering the atmosphere and interacting with the primary greenhouse gas, water vapor, to magnify warming. It all collapses into a failed theory when examined with scientific care. I am not alone in reaching this conclusion. In the past year, 34 thousand scientists, 10 thousand with PhDs, have signed a statement debunking global warming.

There is solid scientific evidence that by burning fossil fuels our civilization increases the amount of carbon dioxide, CO₂, in the atmosphere. However, even after 150 years of burning fossil fuels, CO₂ remains a tiny trace gas. To be precise only 380 molecules out of every one million are CO₂. Scientists with an anti-fossil fuel agenda developed a theory of radiative forcing to explain how this trace gas could create runaway greenhouse warming. They put that theory into general circulation computer models. Their models then projected a continuous rapid rise in global temperatures year after year. In the 1980s and 1990's the models seemed on track as temperatures climbed. But in 1998 the warming stopped. By 2002 a rapid cooling had begun. That cooling continues today. The computer proof has failed. It has become clear the warming in the 80s and 90s was at the peak of a solar cycle and now that the sun has gone very quiet, cooling has gripped the planet. Yet the models continue to predict warming that is not happening. There is no significant warming from CO₂.

I am painfully aware that global warming has become a political issue. I deeply regret that. The latest Gallup Poll documents the wide divide on the issue: 66 percent of Republicans are of the opinion that the claims of global warming are exaggerated; only 22 percent of Democrats are of that position. I want to make very clear my conclusion is in no way politically based.

I was a science reporter for ABC News in the 1970's when there was a similar flurry of excitement about a coming Ice Age. Thankfully our government and political parties didn't get involved so when the science got things straightened out, the frenzy faded away. Unfortunately, this time people with the anti fossil fuel agenda had jumped on the global warming bandwagon and just won't let go. They have calmed the rhetoric to climate change, but they are still all wrapped up in cap and trade to tax our use of fossil fuels. This will do great harm to our economy but do nothing of consequence to protect the environment.

My advice to the National Park Service and the Subcommittee is: Do nothing to mitigate man-made global warming or climate change, because there is none. Reject the extremist agendas and concentrate on your wonderful work protecting our natural resources and making natural experiences available to us citizens of today and generations to follow.

To any who have an interest in pursuing the sources behind my scientific conclusions I provide a list of internet links with my written testimony.

Again, thank you for allowing me to present my testimony and place it into the record.

Links referenced in John Coleman's remarks

The United Nations Intergovernmental Panel on Climate Change: <http://www.ipcc.ch/>

The Al Gore movie, "An Inconvenient Truth": <http://www.climatecrisis.net/>

An online article about the word "deniers" used to describe Global Warming skeptics: <http://www.spiked-online.com/index.php?site/article/1782/>

United Nations IPCC Chapter 9, the key chapter on CO₂ Forcing: <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-chapter9.pdf>

Natural Resources Defense Council Global Warming report: <http://www.nrdc.org/globalWarming/fcons.asp>

Michael Mann and the Hockey Stick Chart: [http://en.wikipedia.org/wiki/Michael Mann \(scientist\)](http://en.wikipedia.org/wiki/Michael_Mann_(scientist))

Stephen McIntyre and Ross McKittrick's Paper refuting the Hockey Stick Chart: <http://www.climateaudit.org/pdf/mcintyre.grl.2005.pdf>

Stephen McIntyre's website: <http://www.climateaudit.org>

Ross McKittrick's website: <http://www.uoguelph.ca/rmckitri/ross.html>

NASA web pages on average annual temperatures: http://www.nasa.gov/vision/earth/lookingatearth/earth_warm.html

Dr. Mayhay Khandekar and Joseph D'Aleo's post on the problems with the NASA average temperature calculations: <http://icecap.us/images/uploads/PITFALLS.pdf>

Dr. Roger Pielke Sr.'s post on problems with calculation average global temperatures: <http://climatesci.org/2008/02/08/an-error-in-the-construction-of-a-single-global-average-surface-temperature/>

Ross McKittrick and Pat Michaels paper detailing how observation points change over time influences global average temperatures: <http://icecap.us/images/uploads/MM.JGRDec07.pdf>

Anthony Watts discovers serious site problems with many official weather observation stations in the United States and conducts a national effort to survey every location: <http://surfacestations.org/>

Dr. Ben Herman investigates questionable exaggerations in maximum temperatures at locations where certain types of new temperature sensors have been installed: <http://climatesci.org/2008/01/21/guest-weblog-by-professor-ben-herman-of-the-university-of-arizona-maximum-temperature-trends/>

The controversy about the influence of urban heat islands on global temperatures is covered in the Wikipedia article at: http://en.wikipedia.org/wiki/Urban_heat_island

Long term climate changes on Earth, resulting from natural causes, primarily variations in the radiation received from the Sun are detailed by D. Bruce Merrifield: http://www.americanthinker.com/2007/07/global_warming_and_solar_radiation.html

I write about the solar influence on climate variations on Earth in my brief The Force behind Climate Change: <http://images.bimedia.net/documents/Comments+on+Global+Warming.pdf>

Roger Revelle, the Grandfather of Global Warming and the man who inspired Al Gore, cautioned against alarmism from the carbon dioxide build-up: <http://www.kusi.com/weather/colemanscorner/40867912.html>

Carbon Dioxide characterized as a pollutant, the force behind global warming: <http://worldcoolers.org/co2map/>

Typical newspaper article decrying carbon dioxide build-up in the atmosphere: http://seattletimes.nwsources.com/html/nationworld/2003716817_carbon22.html

Union of Concerned Scientists page on carbon dioxide: http://www.ucsusa.org/clean_vehicles/vehicles_health/cars-and-trucks-and-global-warming.html

The key Paper by Arthur B. Robinson, Noah E. Robinson and Willie Soon that explains that Carbon Dioxide Forcing is not valid: http://scienceandpublicpolicy.org/images/stories/papers/other/Robinson_Soon.pdf

Another excellent Paper by Allan M.R. MacRae showing that Carbon Dioxide is not the primary force in climate change: <http://icecap.us/images/uploads/CO2vsTMacRae.pdf>

Dr. David Evans Paper showing that Carbon Dioxide does not cause Global Warming: <http://icecap.us/images/uploads/Evans-CO2DoesNotCauseGW.pdf>

Alan Cheetham details the history of the IPCC (Intergovernmental Panel on Climate Change): http://www.appinsys.com/GlobalWarming/GW_History.htm

Dr. John McLean details the lack of significant peer review of the IPCC documents: http://scienceandpublicpolicy.org/images/stories/papers/originals/mclean/mclean_IPCC_review_final_9-5-07.pdf

Dr. Vincent Gray writes about his experience as a member of the IPCC: http://nzclimatescience.net/index.php?option=com_content&task=view&id=155&Itemid=1

The report on the over 700 scientists who have spoken out in opposition to global warming: http://www.epw.senate.gov/public/index.cfm?FuseAction=Minority.Blogs&ContentRecord_id=10fe77b0-802a-23ad-4df1-fc38ed4f85e3

The website of the global warming debunkers petition with over 31 thousand signatures: <http://www.petitionproject.org/>

My webpage which contains numerous other documents and links: <http://www.kusi.com/weather/colemanscorner>

Mr. GRIJALVA. Let me begin by asking Mr. Harja a couple of questions.

And first of all, let me commend your organization and the Governor's Association for the fine work that they've done in the corridor initiative. And I think that initiative has kind of focused a discussion on some regional aspects of this that I think are part of this whole hearing and this whole discussion about how the public lands interface with the issue of climate change.

You talked about shared responsibility as part of where we need to be. Can you give us a better idea of what resources and tools the states are going to need in order to be able to effectively deal with the initiative. And then, as a secondary question, what should the role of the Federal government be in the implementation of that initiative as well. Two-part question.

Mr. HARJA. Thank you for the question, Mr. Chairman.

Tools, a lot of it is fairly basic; things like computer programs, GIS work. GIS is going to be very important to mapping and then taking the layers you've mapped and then comparing it to proposals for development. A number of states aren't to that capacity yet.

It's also personnel to investigate. If Mr. Coleman is correct and there is no issue, I guess there's no issue. But nonetheless, the states say that things are moving. And we've got to consider that. So, we've got to have the capacity to do a little more research.

As I said, the data is there in some places. In some places it's not. And so the capacity to get out and determine what the situation is is crucial.

Monitoring. As a matter of fact, just as a quick aside, it isn't just wildlife. Air quality is very important; and as fires occur and the air quality is affected, monitoring stations are vital. And one of them in Canyonlands National Park is threatened, one of the air quality stations, measuring stations. So, it's a big interrelated issue. And the states in partnership with our Federal and NGO friends have to be able to gather the data and interpret it and use it, no matter where it scientifically leads.

In terms of our Federal partnerships, it's key that the Federal government has got to be able to take the data and the recommendations from the states and make significant use of them. We worked hard in Utah, for example, on some resource management plans. They used our data. That's what we need. We need the agencies to understand the states have information. A lot of it is coming from our partners in the NGO community. A lot of it is generated ourselves. But they've got to consider it. And they've got to work with us on it. Rather than just assuming—I'm not speaking of the Parks Service necessarily. Bureau of Land Management, Forest Service, and the Bureau of Reclamation have to work on balance.

Hope that answers your questions.

Mr. GRIJALVA. Thank you. I know you have another appointment that you're probably going to have to leave pretty soon.

Mr. HARJA. I'm OK for the moment.

Mr. GRIJALVA. OK. Well, just in case you do, let me turn to Mrs. Napolitano and see if she has any questions for you. And while we're talking with the other panelists, if you need to leave—

Mrs. NAPOLITANO. Thank you, Mr. Chairman. Yes, I do have some.

The Western Governor's Association, does it cover the same area that the Bureau of Reclamation does in the 17 western states?

Mr. HARJA. I don't know the Bureau of Reclamation boundaries. The Western Governor's Association is all the states west of the Dakotas, Kansas. Does not include Oklahoma or Texas—excuse me, it does include Texas but not Oklahoma.

Mrs. NAPOLITANO. OK. In page 2 you refer to much information is missing, and this is the Western Governors' Wildlife Council. Do you work with any of the agencies that have been today mentioned or given in testimony?

Mr. HARJA. Did I mention their names?

Mrs. NAPOLITANO. No. Is the council working with all these different agencies?

Mr. HARJA. Yes. The council is a coordinating body. Members of the council are heads of the wildlife agencies in the western states, not all of them. And people like myself work with Governors. So, we understand that the data is missing because of State of Arizona informs us that they need better data. Does that answer your question?

Mrs. NAPOLITANO. Partly because you say that sometimes other states offers differently.

Mr. HARJA. Yes.

Mrs. NAPOLITANO. So, some of these national organizations may have some of the information that the states may have available to them.

Mr. HARJA. Correct.

Mrs. NAPOLITANO. That's why I'm asking do you work with them.

Mr. HARJA. Oh, excuse me. OK. I understand your question. Bird data, for example, is often gathered by NGO's. And we use that in Utah, for example. The point is, as we shift forward and try to protect these corridors, connectivity issues—even climate change is part of that—we've got to find the best data. We don't have it all right now. We have some good data. We have some so-so data. It's got to improve. We've got to gather it and then be able to use it. It comes from a lot of sources.

Mrs. NAPOLITANO. OK.

And then I think I'll just close with this one. But my vital interest, of course, is watershed. And I'm not sure whether the wildlife council actually includes into their area of research and whatever the issue of water, protection of the watershed, reforestation to be able to reestablish the watershed after fires and, of course, education of the visitors. And as was stated, there's a need for additional funding to be able to do all of the above. And how are we allowing cattle grazing, cabins to be able to provide leasing funding, you know, visitor charges, all of that that might be able to help expand the income to be able to do a little more or beyond what's being done now?

Mr. HARJA. That's a multiple question.

Mrs. NAPOLITANO. Yes, it is.

Mr. HARJA. See if I can remember.

Mrs. NAPOLITANO. Because you're on limited time.

Mr. HARJA. OK. Watersheds are key. I want to emphasize that. Watersheds are key. And forests are often the headwaters of those watersheds. In Utah we're losing the aspen community. And efforts to retain that and enhance the aspen community are very, very important. The loss of the spruce and other conifers from beetles is huge.

But we focus in Utah, for example, on watersheds. We have a whole funding source put together to try to protect watershed sage-grouse areas, for example, are key. Other states have similar efforts.

In terms of the council, of course, it's one point for the states to understand what's going on around the West. Everybody is working in different directions. Our colleagues from Washington State have a whole different issue in watersheds and timber cuts up there than Arizona does.

But endangered species that live in rivers, for example, are very, very important. You recall we're attempting to move a tailings pile near Moab, Utah, that might affect the Colorado in your—

Mrs. NAPOLITANO. I have some information on that.

Mr. HARJA. I appreciate your efforts to help up there, from my perspective.

So, that's kind of where we're started. And watershed is the basis of the examining of the issues. And we go from there.

Mrs. NAPOLITANO. Well, part of that question goes to the rivers. And, of course, you may not have the same problem as the invasive species in some of the dams and some of the rivers of quagga and zebra mussel infestation, in which the evolution of this infestation is the warming of the waters, is my understanding. So, we look at invasive species research and development to be able to counter—or be able to begin to look at—how you address some of those invasive species and where you go from there.

Mr. HARJA. You're absolutely right. We're watching a huge increase in cheatgrass, having huge effects on fires. Various weeds are moving by vehicles or such into high forests. It is dramatically changing the aspect. And trying to get a hold of that is also extremely important. I don't have all the answers for you today, but that's one of the areas that the council wants to work on in cooperation with our Federal agencies.

Mrs. NAPOLITANO. Well, with the infestation of zebra mussels they're taking to having the boats washed off before putting them into the water. Maybe we ought to wash tires.

Mr. HARJA. I agree.

Mrs. NAPOLITANO. I'm being facetious but, you know, desperate times call for desperate measures.

Mr. HARJA. Not only wash the vehicles, but they'd have to let them dry.

Mrs. NAPOLITANO. Thank you.

Mr. GRIJALVA. Thank you.

Mr. Harja, one more question.

Mr. HARJA. Sure.

Mr. GRIJALVA. Within the 19 western states and the corridor initiative, in a broader initiative, how does that fit in? You know, the Dakotas, as wildlife and the range changes and—

Mr. HARJA. Yes. And that's why the council isn't focused necessarily on specific issues as much as trying to make sure that the approaches around the West are the same. The Dakotas are range land. Washington State has got huge stands of trees. We can't focus at our level on those specific issues. What we try to focus on is making sure that the states are approaching it in a similar manner and make sure that the Federal agencies are aware of that.

So, you know, we're focused on gathering data, for example, to make sure that these standards for critical habitat are the same. And you've got the Fish and Wildlife Service with ESA critical habitat.

We're trying to make sure that corridors are identified before it's too late, say, and then work with our Federal agencies to protect them. It's a little higher level than, say, working on trees and aspen regeneration. That's kind of from my perspective. The council is focused on the higher one.

Mr. GRIJALVA. Thank you.

Ms. Shaw, you talked about the likely need to alter existing management practices, governances, to achieve the adaptation objective. Could you expand a little bit about some examples of what you think those changes should be?

Ms. SHAW. Yes. I think like the National Park Service, The Nature Conservancy has areas of special resources across the country and across the world that we're protecting because they harbor species that are important or unique or they support certain ecosystem processes that support human communities, water and watershed.

It's clear that we've identified specific places in a static climate that are important today. But under a changing climate, resources, plants, and animals will move. And the availability of water and the other important ecosystem services from those places will also change. So, I think it's really incumbent upon us to understand what those changes will be and at what regional scale they will operate, how they will change, and then work with partner agencies and partner NGO's to ensure that we can protect them in the future.

I think that's going to mean not just government entities but also private landowners to provide incentives to manage land to protect the species that we care most about and that serve as part of the public trust.

Mr. GRIJALVA. And it was mentioned I think earlier as one of the comments by Mr. Jarvis—and now that I think about it let me pose the question, Ms. Shaw. As we're trying to come to grips with climate change in general, globally and both here and in the United States, and also now as specifically with regards to the public lands, with regards to the public lands there's two kind of forces going on in terms of the policy development. There is the extraction part of it, what we can get out in terms of energy, what's in the ground. And now with renewables, what's above the ground. And so the need to do that—or the urgency to do that, to deal with the consequence of climate change to some extent. And then the very valid point that's been made over and over today and in the previous hearing, a new way of looking at land use and planning in terms of scenario planning, adaptation, restoration, corridor linkages. How do you see that balance being struck?

Ms. SHAW. I think, depending on the resource that you're talking about, whether that you're trying to protect or that you're extracting, the balance will be struck in very different ways. And as you know, right now in the Mojave Desert in California—to meet the goal of 33 percent of all electricity from renewable energies—we're looking at the development of vast solar rays in the desert. These are important lands both for meeting those renewable energy goals but also for protecting species.

I think it's not about one or other, but it's about having heightened coordination among the entities and the stakeholders that matter, and making sure that we put in place a process that can make sure that we are thinking about the needs of meeting energy demands today and into the future and protecting the natural resources, the species and plants and animals that many of our public lands were designed to protect into the future.

And I think that it does mean very considerable process. Here in California there is underway by the state a Desert NCCP process to try and get all the stakeholders to the table so we can really look carefully at how we meet those renewable energy goals but also design across the landscape in a way that allows for adaptation of plants and species.

Mr. GRIJALVA. Defining that balance is going to be, I think, a huge policy question.

Ms. SHAW. I think that's why we're all here. I think that we're definitely in new territory. This is absolutely business unusual. We are going to be using some of the same tools and some of the same planning processes that we have before, but with very different inputs and information and thinking very differently on very longer time horizons about what we want to see as outcomes so that we don't preclude the persistence of any single plant or animal, and so that we can meet those energy goals that are so important for curbing greenhouse gas emissions.

Mr. GRIJALVA. Thank you.

I think that question is going to be one that we're all going to be deeply involved in, in how you define that balance. Because it needs to be defined.

Ms. SHAW. That's right.

Mr. GRIJALVA. Because I think it's gone back and forth. It's always been an either-or proposition. And we're kind of in this state now where there has to be a definition of what that balance means. Yes, it's going to be an interesting process.

Professor, it doesn't matter that the climate disturbances that we're dealing with are caused by human activity. It just doesn't matter. That's not part of the equation. But we do have some challenges before us. We have the invading buffelgrass and invasive species that you spoken about in other areas. We have dying forests. You have crumbling coast, reduced snow packs no matter what the cause. And don't we have to deal with these challenges even if this other cause question is up there in the air? I don't think it's in the air but it was introduced in the air today.

Mr. SWETNAM. Oh, I think it's a very good point. Temperatures are warming up. The recent decade is the warmest decade in the last century globally. And the Western United States shows a very similar trend. As to whether or not the warming in the Western

United States is definitely attributable to climate change is still an open question, but there is an increasing body of evidence pointing to global warming as the cause of the droughts and the warming temperatures we're seeing in the Western United States.

Beyond that, though, we are seeing extraordinary warming trends and we're seeing responses to it. Wildfires are increasing. There's a very clear connection between droughts, warm temperatures, and increasing size and severity of the wildfires. And likewise, bark beetle outbreaks and dying trees are increasing across the west. And the evidence is compelling, very compelling, that this is related to the warming temperatures.

Now, this is all happening in the context of landscapes that we live in. And we've got increasing populations and increasing demands on the water resources, in particular, in these place. So, we have to deal with it.

And it's very likely that the warming is going to continue and it's going to get worse. So, this question about whether it's human caused or not, we can debate about that endlessly, I believe. And I think the evidence is overwhelming that it is largely driven by humans, and we need to get on with dealing with it.

And I think that's why we're here. This hearing is actually to talk about the impacts of the current climate changes that we're seeing, the warming and the likely warming in the future.

Mr. GRIJALVA. Could you just for a second respond to that balance question that I asked, a little bit ago, about how you strike that balance, your idea.

Mr. SWETNAM. Balance between dealing with energy—

Mr. GRIJALVA. The need to take energy and the need to balance, restore, and protect.

Mr. SWETNAM. Yes, I think that is indeed going to be a very critical issue is how we move forward with adapting our environments to live in them better and to develop energy resources to deal with the carbon issue. This is another balance issue regarding forests restoration, for example. Here's a key balance issue. As we need to move forward to forests that are more open and have less fuels in them, we need to do more prescribed burning. And prescribed burning actually emits carbon to the atmosphere. We need to better understand the balance of carbon in our ecosystems in the restored state or in the current state versus what we might get with wildfires that run through these forests and totally destroy them and convert them to grasslands or shrub fields. So, what kind of carbon do we get in our forest ecosystem that's going to enter into a grassland or a shrub field, which is maintaining it as a forest?

So, there are going to be balance questions like this all along. The energy issues are how we develop solar energy in the deserts, for example. There's going to be balance issues on how we move in restoration to maintain the right balance of carbon, carbon sequestration in our forests.

Mr. GRIJALVA. Thank you.

If I may, Mr. Coleman, let me ask you the same question that I asked the professor. Does it—does it matter the climate disturbance we're seeing weren't caused by human activity? And the same challenges I talked about, invasive species, dying forests, crumbling coasts, disappearing aquifers, reduced snow packs, these are still

challenges that we have to deal with. Do you agree with that or—

Mr. COLEMAN. I watched all of this very carefully, and of course we need to deal with it. And 160 years of pretty good weather records, pretty good, we can identify 11 periods of drought in the Western U.S. They have occurred irregardless of mankind's activities. The worst drought, five-year drought, was 1929, 1934. The most severe in California where we are today, and my home, occurred in 1976 and '77. We have had a drought in recent years. I'm happy to report that it is now—nature is now beginning to solve that drought. The drought has greatly eased. We had 102 percent of normal snow pack and the watershed of the Colorado River—

Mr. GRIJALVA. So, do we let it run its course, this drought?

Mr. COLEMAN. Well, I think we don't have a choice. Because we're not in control. Nature is in control.

Mr. GRIJALVA. There's nothing we can do to mitigate—

Mr. COLEMAN. Our problem, of course, is getting enough water to drink. And with 20 million people now living in Southern California, depending on the snow pack of the Sierra and the Colorado River, we are way overtaxing our resources. And this is a very serious matter. And forest fires are a very serious matter for us. I was evacuated from my home because of one, which came two blocks from me. So I'm very, very well aware and very conscious of this.

I think there are a lot of things we're in charge of, but one of them isn't climate. Unfortunately, from our point of view, I guess, we can't stop droughts. We can't stop El Niños. We are currently in what's known as a PDO, a Pacific Decadal Oscillation. The sun has gone very quiet. We've hardly had a sun spot. The sun's the quietest it's been in a hundred years. The Pacific Ocean has gone into a very cool mode. The Pacific Ocean, the biggest ocean on planet Earth, controls our climate of the United States. And our climate is definitely cooling.

Mr. GRIJALVA. Well let—

Mr. COLEMAN. And we have to deal with that.

Mr. GRIJALVA. Thank you for going beyond the question that I asked.

Mr. COLEMAN. Oh, I'm sorry, sir. But thank you for asking.

Mr. GRIJALVA. Let me turn to Mrs. Napolitano for any questions she may have.

Mrs. NAPOLITANO. Well, Mr. Chair, I know that we have another panel. But there are some issues—not issues, but questions that I had.

For Mr. Swetnam, on page 7 you talk about developing—let's see—education. And any time I want to make any message viable, I go to school kids. Because they take the message home and they're the future, they're the ones who need to understand how that would be impacted. So when you talk about the research learning centers, engaging people, they can play a key role. Are you going to be able to gear it toward children also? And maybe even put them on cable as informational, educational, et cetera. We miss a lot. We educate adults. What happened in educating our children, because they are the future.

Mr. SWETNAM. Yes, of course. As a university professor, I very much appreciate the educational needs and emphasis. And I think

that the Park Services Research and Learning Centers are great opportunities to engage the public and help them understand ecological variability and climate variability and climate change. I was very encouraged to hear Jon Jarvis' comments with this regard and the focus of the Park Service in coming here on the research learning centers. And not only those places, but the parks in general. Virtually every park. Most parks should have some interpretative materials and displays and educational opportunities.

Mrs. NAPOLITANO. Well, I'm sorry, my time is going to be very limited. But I guess maybe a suggestion would be, because I deal a lot with water agencies, and they've taken to doing Earth Day celebrations where they teach, they bring in families. And they begin to have hands-on displays where children can actually feel, hear, see the things that you have on posters and on handouts. Water districts at the local levels adjacent to parks areas, maybe they should be engaged in being able to have continuum, if you will, of information for the youngsters and their families. And this is just one of the things that I've learned, if I want to engage parents I engage the children first.

Mr. SWETNAM. Yes, the hands-on activities especially are most effective.

Mrs. NAPOLITANO. Thank you.

There's several other questions, but I think I'll defer with the Chair and I'll put them in writing.

Mr. GRIJALVA. Thank you.

And let me thank the panelists. I don't have any follow-ups.

There's some specific written questions that we will forward to you. And if you could get them back to the committee so we could make them part of the record. Thank you very much. It's very much appreciated.

Mr. GRIJALVA. If I could invite the next panel, please.

Thank you very much, and welcome. Let me begin with Mr. Robert Keiter, Director of Wallace Stegner Center for Land, Resources, and Environment, University of Utah. Welcome, and thank you for coming. I am looking forward to your comments.

STATEMENT OF ROBERT B. KEITER, DIRECTOR, WALLACE STEGNER CENTER FOR LAND, RESOURCES, AND THE ENVIRONMENT, UNIVERSITY OF UTAH, SALT LAKE CITY, UTAH

Mr. KEITER. Thank you very much, Chairman Grijalva and Congresswoman Napolitano, for the opportunity to testify today before the Subcommittee on the role of National Parks in combating climate change.

As the Chairman noted, I'm Bob Keiter. I serve as the Wallace Stegner Distinguished Professor of Law and Director of the Wallace Stegner at the University of Utah, the S.J. Quinney College of Law.

I'm appearing here today in my individual professional capacity, and my testimony is based on 25 years of research and teaching on public land law and policy.

Our diverse National Parks System features an incredible array of ecosystems, many of which are already being impacted by climate change, as are the surrounding landscapes. As others have chronicled, these impacts include the rapid loss of the iconic glaciers at Glacier National Park, the gradual disappearance of the

namesake Joshua trees in our neighboring national park today. The list goes on. Although these problems are serious, our national parks can and should play several important roles in understanding climate change and responding to it; namely as baseline study areas, biodiversity refuges, the critical cores of larger ecosystems, and as carbon storage sites.

To play these roles effectively, however, the national parks must be fully and adequately protected. Without sufficient legal protection the national parks and their myriad wildlife, water, and other resources are at increased risk. Climate change will also impact the surrounding communities that rely on national parks as anchors for their economic welfare.

Given these risks, we must not only protect existing parks and their resources but also expand the National Park System to ensure that we can adapt to climate change and mitigate its effect. In short, we must regard and manage our national parks as parts of the larger landscapes that sustains the biodiversity and ecosystem services that are vital to our society. And I think several of the witnesses earlier today have made basically that same point.

My testimony will focus then on two key climate change adaptation mitigation concerns. One, how can we better protect the national parks, and two, how might we expand the National Park System.

And in focusing on these questions, I don't mean to diminish the importance of the recent legislative proposals that I know the committee is well familiar with, including the recent Waxman-Markey discussion draft. I view instead my ideas as complimentary to and intended to strengthen several of the proposals that are part of this discussion legislation.

Numerous studies over the past several decades have documented that the parks face serious environmental challenges that can be traced to developments or activities occurring on adjacent Federal, state, tribal, and private lands. And these impacts today are being exacerbated by climate change. They include threats from oil and gas development on nearby Federal and state lands. Too many roads and too much unregulated off-road vehicle activity in sensitive locations, and ill-planned subdivisions intruding on critical wildlife habitat, migration corridors, and other sensitive areas which can either individually or cumulatively destabilize vital park ecosystems, rendering them both less resilient and adaptable.

The important lesson and the one that climate changes reinforce is clear, we must begin to plan and manage at a landscape or ecosystem scale if we are to conserve and restore our ecologically critical Federal lands and resources.

The parks at this scale serve as the critical cores of the larger ecosystems and the interconnected watersheds, airsheds, and wildlife habitats.

The existing law, as I've explained in my written testimony, is not adequate to meet the challenge of landscape level planning and management. It doesn't ensure meaningful interagency coordination and consultation which several witnesses both today and at your earlier hearing have referred to as critical to address climate change. It also does not necessarily establish clear-cut management priorities consistent with the climate change challenge. So, we need

to strengthen and put some real teeth into the coordination provisions that are in existing law, or there's little evidence or hope that we will see better or more consistent coordination either at the planning stage or the project decision-making stage that the Federal agencies go through.

My first recommendation then, Congress should adopt a more detailed interagency coordination mandate that would apply to all Federal land management agencies, not only making interagency coordination efforts transparent as a mandatory part of agency decision records, but also making it enforceable in court. This would require the agencies during their planning processes and whenever contemplating an action with significant climate change implications to consult with the National Park Service by preparing an interagency coordination statement documenting the collaboration effort, potential impacts and mitigation strategies, and responses to any expressed park concerns regarding climate change.

Congress could go further. It could put additional teeth into this idea of improved interagency coordination by adopting a new consistency requirement that would require consistency between the Park Service's climate change plans, and the management goals of other Federal agencies on adjacent lands, perhaps using a model derived from the Coastal Zone and Management Act Consistency Provisions. If even more teeth are necessary, the No Feasible Alternative concept that is part of the Transportation Act could also be utilized to address and promote consistency and coordination.

Further step, the adoption of a model drawing upon the Surface Mine Control And Reclamation Act that would incorporate an unsuitability provision into the Federal Land Management legislation, empowering the Secretary of the Interior, upon petition, to designate lands adjacent to national parks or other protected areas as unsuitable for mining, logging, road-building, and other intensive activities that could exacerbate climate change challenges.

Some other thoughts regarding improving Federal land management efforts, the adoption of new substantive standards; perhaps an explicit biodiversity conservation mandate for all of the Federal land management agencies, or an ecosystem conservation mandate as an alternative.

Strengthening the National Park Services authority to respond to activities occurring outside its boundaries would also be helpful to that agency to promote coordination on adjacent lands.

We need to also, in addressing this problem at the landscape scale, to involve the states, the tribes, and private landowners that are located near or adjacent to the parks. Congress should make full use of its conditional spending power to do this, to seek to induce and encourage meaningful landscape-scale planning with mitigation and adaptation strategies, perhaps by conditioning Federal funds to these entities, contingent upon their coordinating their land use and transportation plans and economic development efforts with larger regional climate change planning efforts that are being undertaken by the Federal agencies.

If I can make a couple of other points, moving off of current management of the national parks and surrounding Federal lands, and address the question of expansion of the National Park System. That too, it seems to me, would be helpful in order to protect and

restore vital landscapes, including critical wildlife migration corridors, important watersheds, and other sensitive locations. The conventional approaches are certainly available, and the committee is well aware of them; the designation of new parks, monuments, or boundary adjustments. Let me suggest a new approach for expanding the park system. And that is to target currently damaged landscapes for inclusion into the system following a period of restoration.

Most scientists, including several who testified both today and at your earlier hearing, have endorsed ecosystem restoration as an important strategy for mitigating climate change impacts as a historical matter. As our regional director Jon Jarvis noted earlier, the Park Service National Park System has experience with incorporating restored—incorporating and restoring damaged lands into the system, the Great Smokey Mountains, Shenandoah, Redwoods, serving as examples.

Adding these—adding damage but restorable lands to the park system will require us to begin thinking about national parks from a longer-term perspective. But climate change is forcing us to adopt that strategy—or that perspective, excuse me. One strategy for accomplishing this park expansion restoration idea would be to think of it as a two-step approach, first setting aside the targeted lands for protection and restoration, perhaps as new national restoration areas, and then later seeking national park or another appropriate protective status once the landscape has been repaired.

An alternative expansion approach would be to adopt a new landscape overlay designation, perhaps something like natural heritage areas or landscapes that would knit together an array of contiguous Federal lands that cover particular sensitive or vital landscapes such as the Greater Yellowstone area or the Greater Grand Canyon region or the Crown of the Continent ecosystem.

For these special climate change mitigation landscapes Congress would need to establish new more protective management standards to protect the area's wildlife watersheds and other resources from warming pressures.

A related concern already addressed today but let me add my endorsement of it is the potential need for new Federal wildlife corridor legislation or at least some congressional direction and support for the wildlife corridor concept that has now been endorsed strongly by the Western Governor's Association.

Any Federal legislation could be modeled after the National Trail System Act of 1968, which involves Federal and state officials in making designation decisions and is likewise sensitive to private landowner concerns.

To conclude let me note that these proposals raise sensitive political bureaucratic interagency concerns. And although some progress toward more coordinated landscape scale management has been made, the need for institutionalized coordination and consultation arrangements cannot be overlooked if we are going to effectively address the climate change challenge. Funding for these proposed initiatives might come from new revenues generated by a cap and trade system or a Federal carbon tax. Put simply, nothing less than significant strengthening of our existing laws and strategic expansion of our National Park System will provide the

means necessary to mitigate the impact of a warming climate on our precious natural resources and sustain the resilient capacities of our vital ecosystems.

Thank you.

Mr. GRIJALVA. Thank you.

[The prepared statement of Mr. Keiter follows:]

Statement of Robert B. Keiter, J.D., Wallace Stegner Distinguished Professor of Law, Director, Wallace Stegner Center for Land, Resources and the Environment, University of Utah S.J. Quinney College of Law, Salt Lake City, Utah

Chairman Grijalva and members of the Subcommittee, thank you for inviting me to testify on the role of national parks in combating climate change. I am Bob Keiter and I am the Wallace Stegner Professor of Law, a Distinguished University Professor, and Director of the Wallace Stegner Center for Land, Resources and the Environment at the University of Utah's S.J. Quinney College of Law. In addition, I serve on the boards for several organizations: the Sonoran Institute, the Rocky Mountain Mineral Law Foundation, the University of Utah's Institute for Clean and Secure Energy, the University of Wyoming's Ruckelshaus Institute of Environment and Natural Resources, and the University of Montana's Public Land and Resources Law Review. My appearance here today, however, is not on behalf of any organization, but rather to present my ideas on the role that the national parks can play in addressing our nation's climate change challenge and how Congress might best ensure the parks can play that role. My testimony is based upon 25 years of research and teaching on public land law and policy, which includes four books and numerous book chapters and journal articles on these topics, several of which address national parks, climate change-related concerns, and regional or ecosystem-based management.

Climate Change and the National Parks

The American national park system consists of over 390 units covering nearly 80 million acres, with units in 49 of the 50 states and several territories. Our large and diverse national park system features an incredible array of distinct ecosystems, many of which are already being impacted by climate change. As others have chronicled, these impacts include: the rapid loss of iconic glaciers at Glacier National Park; the gradual disappearance of the namesake Joshua trees from Joshua Tree National Park; the unprecedented spread of insect-caused diseases that are devastating forests in the Great Smoky Mountains, Yellowstone, and elsewhere; and the loss of coral reefs in Biscayne and Virgin Islands national parks. Very few doubt that these warming impacts will affect other national parks and irreparably alter the park flora and fauna as well as vital ecosystem processes with repercussions that will extend well beyond the boundary lines.

Our national parks can potentially play several important roles in understanding climate change and responding to it. First, as legally protected and relatively intact natural areas, the national parks can provide a baseline for understanding and studying how climate change is impacting the natural world, particularly the various species and ecosystems that can be found in the parks. Second, given their protected status, the national parks can offer a refuge for species that are—or might be—displaced from their native habitat by a changing climate. Third, as part of larger federal public lands complexes, the national parks may play a key role in promoting resilience across the landscape and sustaining vital ecosystems and ecological processes that transcend conventional boundary lines. Fourth, as relatively undisturbed sanctuaries with extensive forest and grass cover, many national parks can serve as a carbon storage repository and thus help reduce the amount of CO₂ escaping into the atmosphere. The national parks, simply put, give us the ability to better understand, mitigate, and adapt to a changing climate.

However, to play these roles effectively in our warming world, the national parks must be fully and adequately protected. Without adequate legal protection, the national parks are at risk: park species can be lost or displaced; wildlife habitat can be destroyed or altered; critical cross-boundary migration corridors that can be blocked or fragmented; water quality can be degraded, while vital water supplies can be diminished; air quality can suffer deterioration; park forests and grasslands can be put at increased risk from invasive species, diseases, and wildfires; historic buildings and other cultural sites can be lost or damaged; and the list goes on. Any or all of these impacts can also adversely affect park visitor experiences and visitation levels, which will inevitably affect surrounding communities that so often rely

on national parks as anchors for their economic welfare. The unambiguous realities of these risks present powerful reasons not only to protect existing parks and resources, but also to expand national parks in order to ensure we can adapt to climate change and mitigate its effects. In short, we must regard and manage our national parks as parts of the larger landscape that sustains the biodiversity and ecosystem services that are vital to our society.

I will therefore focus my testimony on two key concerns that should be addressed if we are to effectively mitigate and adapt to the climate change threat: 1) how to better protect the national parks; and 2) how to expand the national park system. In doing so, I do not mean to overlook or diminish the importance of recent proposals designed to address climate change, such as those found in the Dingell-Boucher discussion draft, which was circulated in the 110th Congress. The natural resource provisions in that draft legislation—including new natural resource adaptation plans, a natural resource adaptation climate change fund, and other innovative provisions—would provide comprehensive guidance and assistance to the federal and state agencies charged with sustaining our public lands and resources, and they merit serious consideration on those grounds. My recommendations, though, are more specific to the national parks and supplement several provisions found in these earlier proposals. In that spirit, what follows are proposed changes or additions to existing law designed to enhance the role of national parks as key climate change laboratories and sanctuaries, and thus ensure that these benefits extend across the landscape.

Protecting the National Parks

During the past three decades, numerous studies have documented that the national parks face serious environmental challenges that can be traced to developments or activities occurring on adjacent federal, state, and private lands. See, e.g., U.S. Gen. Accounting Office, *Activities Outside Park Borders Have Caused Damage to Resources and Will Likely Cause More* (1994); National Park System Advisory Board, *Rethinking the National Parks for the 21st Century* 5-6 (2001). These threatening activities include oil and gas development on nearby federal and state lands, too many roads and too much unregulated off road vehicle activity in sensitive locations, and ill-planned subdivisions intruding on critical wildlife habitat, migration corridors, and other sensitive areas. In the face of a warming climate, which is already stressing national park resources, these external developments or activities—either individually or cumulatively—can destabilize vital park ecosystems, rendering them less resilient and undermining their utility as baseline study areas, biodiversity refuges, or carbon storage sites. The important lesson—and one that climate change has reinforced—is clear: We must begin to plan and manage at a landscape or ecosystem scale if we are to conserve and restore our ecologically critical federal lands and resources. At this scale, the national parks serve as the critical core of larger ecosystems that contain interconnected watersheds, air sheds, and wildlife habitats.

The initial question is whether the existing law is adequate to meet the challenge of landscape level planning and management sensitive to the national parks. At a superficial level, several legal provisions seem to offer important protection to the national parks; but upon closer inspection, these laws do not fully protect park lands and resources, and they are decidedly not designed to address the additional challenges associated with climate change. The amended National Parks Organic Act instructs the National Park Service to conserve its scenic and wildlife resources in an “unimpaired [condition] for the enjoyment of future generations” and to protect “the high public value and integrity of the National Park System.” 16 U.S.C. §§ 1, 1a-1. The National Environmental Policy Act (NEPA) requires all federal agencies to prepare an environmental analysis before taking any action that will significantly affect the human environment, but these requirements are merely procedural and do not require the agency to make environmentally protective decisions. 42 U.S.C. § 4332(2)(C). The Endangered Species Act does protect federally listed species and their critical habitat, but it only applies when listed species are present, and it has not always been rigorously enforced. 16 U.S.C. § 1531 et seq. While these laws compel the Park Service to protectively manage its own lands, they do not compel the same level of protective management on adjacent federal lands, at least not unless listed endangered species are present.

A very real problem, then, is how management priorities are set and implemented on adjacent federal lands, most often neighboring national forest or BLM lands. The Forest Service and the BLM manage their lands under a multiple-use standard, which frequently means mining, logging, grazing, and industrial level recreation. 16 U.S.C. § 528; 43 U.S.C. § 1732. On these lands, the National Forest Management Act (NFMA) and the Federal Land Policy and Management Act (FLPMA) contain provi-

sions requiring the Forest Service and the BLM to coordinate their resource planning and project-level decisions with other federal agencies, which would include adjoining national parks. 16 U.S.C. § 1604(a); 43 U.S.C. § 1712(c)(9). But these coordination provisions have not proven enforceable, and they are frequently overlooked to achieve other multiple-use priorities. Recent reports indicate that the BLM completely disregarded an earlier interagency consultation agreement with the Park Service in order to expedite the sale of extensive oil and gas leases near Arches, Canyonlands, and Dinosaur national park units in Utah. Similar problems are evident at Grand Canyon National Park, where the Forest Service is moving ahead to permit uranium mining on national forest lands adjacent to the park, despite the Park Service's persistent objection. Moreover, the federal laws cited above have little or no application on adjacent state or private lands, which can be equally important to maintaining ecological integrity and resilience on the broader landscape.

In the case of adjacent federal lands, it is frequently suggested that better coordination or more consultation between the national parks and other federal land managers should sufficiently protect the parks from possible harm. Indeed, several witnesses at the Subcommittee's March 3, 2009, hearing on climate change and the federal lands offered interagency coordination as a potential solution for the climate change problem. In my view, unless federal law is strengthened to put some real teeth into existing coordination provisions, there is little evidence or hope that we will see better or more consistent coordination among the federal land management agencies. In fact, voluntary, non-binding interagency coordination gains made during one administration are likely to fade during the next one, as we witnessed with the Bush administration's utter disregard of the Clinton administration's ecosystem management initiatives.

Moreover, coordination is inherently complex. To be effective, it must occur at two separate levels: the planning level where broad scale resource management plans are developed, and the project level where individual project proposals are assessed and ultimately approved. In the case of climate change, a coordinated landscape level planning process is crucial; it is at this level that the agencies have the opportunity to set resource management priorities and mitigation strategies to address sensitive resource issues. But the Supreme Court has ruled that resource management plans are not generally subject to judicial review and that these plans ordinarily do not impose legally binding obligations. See *Ohio Forestry Association v. Sierra Club*, 523 U.S. 726 (1998); *Norton v. Southern Utah Wilderness Alliance*, 542 U.S. 55 (2004). (These court decisions, I should note, suggest that the Dingell-Boucher federal natural resource adaptation plans may not be enforceable or judicially reviewable, unless Congress specifies otherwise.) An effective coordination strategy for climate change purposes must therefore ensure meaningful and accountable coordination at both the planning and project levels.

So, as an antidote to climate change, how might Congress go about imposing meaningful and enforceable interagency coordination or consultation obligations on the public land agencies? Several related options are available. (Though the following options are framed in general terms, the goal in each instance is to promote landscape scale management to meet the climate change challenge.)

Congress should adopt a new and more detailed interagency coordination mandate that would apply to all federal land management agencies, not only making interagency coordination efforts a mandatory part of agency decision records, but also making it enforceable in court. This would require federal land management agencies, during their planning processes and whenever contemplating an action with significant climate change implications for nearby national parks, to consult with the National Park Service by preparing an interagency coordination statement documenting the collaboration effort, potential impacts and mitigation strategies, and responses to any expressed national park concerns. The idea is to require transparency through specific written documentation of the consultation as part of the planning or project decision process to ensure that climate change concerns are addressed and mitigation commitments are adopted. With judicial enforcement lurking in the background, the agencies would be accountable for their coordination efforts, which should ensure more meaningful and better interagency collaboration.

This interagency coordination statement could be readily incorporated into normal planning and NEPA processes, or it could be a separate stand-alone document. It might be implemented by Congress by including this requirement as part of each agency's climate change adaptation plan, or by amending NEPA to set forth this new requirement, or by instructing the Council of Environmental Quality (CEQ) to add a new interagency coordination statement requirement to its NEPA rules. Or Congress could amend the organic legislation governing the Forest Service, the BLM, and other agencies to incorporate these new interagency coordination statement requirements into the existing coordination provisions found in the National

Forest Management Act, the Federal Land Policy and Management Act, and other legislation. Although such an interagency coordination statement would impose only a new procedural—rather than a substantive—requirement on the agencies, judicial enforcement of the NEPA EIS procedural requirements has had the salutary effect of ensuring that action agencies give full consideration to the environmental implications of their decisions. If the courts were instructed to similarly enforce an explicit interagency coordination process, then it should yield similar results.

Congress might put additional teeth into a new interagency coordination or cooperation mandate by requiring “consistency” between NPS climate change plans or management goals and those of adjacent federal agencies. The model for this type of provision is the Coastal Zone Management Act, which requires that federal agency actions affecting coastal zone lands or waters must be consistent with the state coastal zone plan. 16 U.S.C. § 1456(c). Under this standard, for example, the courts have found that industrial pipeline projects and off-shore energy lease decisions require a “consistency” review and the consideration of alternatives to the proposal. *Millennium Pipeline Co., L.P. v. Gutierrez*, 424 F.Supp.2d 168 (D.D.C. 2006); *California v. Norton*, 311 F.3d 1162 (9th Cir. 2002). The trigger for a “consistency” review might be the potential “impairment” of national park lands or resources, which would draw upon the protective standard already in the National Parks Organic Act. Moreover, state natural resource and wildlife agencies might be subjected to the same consistency standards as a condition to receiving federal grant funds to support their planning efforts and management programs.

If even more teeth are needed, Congress might prohibit intensive development activities on public lands adjacent to national parks unless there is no feasible alternative to the proposal and climate change concerns can be adequately mitigated. This proposal draws upon a similar provision found in Section 4(f) of the Transportation Act, which prohibits new transportation projects that require the use of public parks or other sensitive lands unless there is “no prudent or feasible alternative to using that land” and “all possible planning to minimize harm to the park” has been undertaken. 49 U.S.C. § 303(c). Under this provision, the Tenth Circuit Court of Appeals blocked construction of a new airport adjacent to Glen Canyon National Recreation Area in southern Utah, concluding that the responsible agencies had not adequately considered how airport noise would impact the park visitor experience. *National Parks and Conservation Ass’n v. Federal Aviation Administration*, 998 F.2d 1523 (10th Cir. 1993). A similar type of statutory provision that more broadly protected national parks from adjacent or nearby development projects with significant climate change impacts would help maintain the integrity of park ecosystems, wildlife, and other vital resources, which are key to mitigating climate change impacts.

Alternatively, Congress could promote consistency in the management of federal lands by prohibiting unsuitable or inappropriate development on sensitive lands adjacent to national parks. To do so, Congress could adopt new “unsuitability” legislation empowering the Secretary of the Interior, upon petition, to designate lands adjacent to national parks (or other protected areas) as “unsuitable” for mining, logging, road building, or other intensive activities that could exacerbate climate change problems. This approach could be modeled on the “unsuitability” provision in the Surface Mining Control and Reclamation Act. 30 U.S.C. § 1272; *Utah International v. Dept. of the Interior*, 553 F.Supp. 872 (D. Utah 1982). As such, it would be quite similar to the Secretary’s FLPMA-based withdrawal power; it could be made revocable, either by the Secretary or by Congress, and its exercise could be governed by precise standards to protect against possible abuse.

Whichever route is chosen, the ultimate goal is to promote meaningful and coordinated landscape scale management that is responsive to the climate change problem. This can only be done by ensuring that agency coordination efforts are documented and truly transparent, and that the agencies are fully accountable. To do so, clear standards and procedures must be set forth to govern interagency coordination and consultation, and these new coordination requirements must be enforceable in the courts through citizen suits.

Beyond improving interagency coordination, Congress should consider adopting new substantive standards designed to improve federal resource management at the landscape scale as a means to address climate change concerns. Because the loss of biodiversity is a key concern among climate scientists, Congress should legislatively clarify that biodiversity conservation at the landscape scale is a priority responsibility in agency planning and management decisions. Although some federal public land agencies already have statutory biodiversity conservation mandates (namely for the national forests and the national wildlife refuges), these mandates are not entirely clear (particularly in the case of the national forests), and they can present enforcement problems. The problem is most plainly illustrated by the Bush

administration's revisions to the national forest planning rules, which essentially deleted enforceable biodiversity conservation requirements, giving the Forest Service near carte blanche discretion in this important area. A new explicit biodiversity conservation mandate, perhaps linked with maintaining and restoring sustainable ecosystems, would give this key aspect of climate change strategy the prominence that it merits on the federal climate agenda. This might be done by noting a connection with the Endangered Species Act, namely that an effective biodiversity conservation program should reduce the number of species that will require listing under the ESA and thus ultimately help preserve the land management agencies' decision making autonomy. It also might be done by establishing new federal ecosystem management requirements applicable across the public lands.

In addition, given the important role of the national parks in addressing climate change, Congress should consider strengthening the National Park Service's authority under the Organic Act, particularly its ability to respond effectively to cross-boundary problems. As has been frequently documented, the Park Service has historically been reluctant to assert itself outside its boundary line, regularly questioning whether it has any responsibility or authority over external matters. Most commentators agree that the Park Service does have a responsibility to protect park lands and resources from threatening activities occurring outside the parks, a view captured in the National Parks Organic Act and the so-called Redwood amendments to that act. 16 U.S.C. §§ 1, 1a-1. The DOI Solicitor has read these statutory provisions to vest agency officials with this protective responsibility, concluding that the relevant law "infuses the Secretary's decisions with a concern for park values and purposes, and signals caution where [these]—could be threatened." Options Regarding Applications for Hardrock Mineral Prospecting Permits on Acquired Lands Near a Unit of the National Park System, M #36993, at 23 (April 16, 1998). The Park Service's Management Policies likewise acknowledge that "activities proposed for adjacent lands may significantly affect park programs, resources, and values," and that park officials "will use all available tools to protect park resources and values from unacceptable impacts." National Park Service, Management Policies 1.6 (2006). Nonetheless, given the potential devastating implications of climate change and the important role that the national parks must play in addressing it, Congress should give the agency some explicit authority outside its boundaries, perhaps through a mandatory consultation process whenever adjacent activities or developments might impair park resources.

To effectively address climate change at the landscape scale, state and private lands located near or adjacent to national parks cannot be overlooked. Federal law, however, has little impact on these lands, and most state and private landowners will resist new federal regulatory mandates. The alternative, therefore, is to use Congress's conditional spending power to induce changes in state and private landowner behavior that will redound to the benefit of the national parks and encourage landscape scale planning with meaningful mitigation and adaptation strategies. This can be done by making federal funds available to the states and local communities contingent on them coordinating their land use and transportation plans or economic development efforts with the regional climate change planning efforts undertaken by the adjacent federal land management agencies. The important point is to promote consistency between state and local planning efforts and those occurring at the federal level, while developing coordinated landscape scale mitigation and adaptation strategies keyed to regional climate change concerns. A similar incentive-based approach should be employed to bring tribal governments into these coordinated planning and mitigation efforts.

Expanding the National Park System

To address the risks and uncertainties inherent in climate change, Congress should also consider expanding the national park system to ensure that sufficient space is available to make the adaptations and mitigations that will be required. By expanding the national park system, Congress can protect and restore vital landscapes that encompass critical wildlife migration corridors, sensitive watersheds, or other locations that are deemed essential to meeting the climate change challenge. Not only would strategic park boundary expansions or the addition of new units enhance the conservation and scientific value of the existing park system, but it would also enhance carbon storage opportunities.

Congress is, of course, quite familiar with the conventional legislative approaches that have been used to expand the national park system. These include the creation of new national parks, national monuments, national recreation areas, national heritage areas, and the like, as well as boundary adjustments to existing national park units. Over the years, Congress has shown a willingness to reconfigure park boundaries and to add new units on nearby federal lands with a view toward creating

more ecologically manageable park units, as illustrated by the California Desert legislation. Congress can—and should—give serious consideration to using these conventional strategies to enable the national park system to effectively meet the climate change challenge. Indeed, with reconfigured boundary lines and a more ecologically sensitive management structure in place, the Park Service and other federal land management agencies should be better able to employ the adaptive management strategies necessary to address the attendant risks and uncertainties that climate change portends.

A new approach to expanding the national park system that Congress should consider is targeting currently damaged landscapes for inclusion into the system following a period of restoration. Most scientists, including several who testified at the Subcommittee's March 3, 2009, hearing on federal lands, have endorsed ecosystem restoration as an important strategy for mitigating climate change impacts. As a historical matter, several of the eastern national parks, including Great Smoky Mountains and Shenandoah, were created from previously logged, mined, and farmed landscapes, and today they represent important components of the national park system. The same is true of the eastern and midwestern national forests, many of which had been devastated by over logging before they were reacquired by the federal government during the early 20th century under the Weeks Act; today these forest lands are fully restored and provide an array of resources and benefits to a large segment of our populace, and their role will only become increasingly important as temperatures continue rising.

Adding damaged but restorable lands to the national park system will require us to begin thinking about national parks from a longer term perspective, but climate change is forcing us to adopt that perspective. As an agency that takes prides in its environmental management skills and one that has historical experience restoring damaged landscapes, the National Park Service should relish the challenge of bringing a damaged ecosystem back to life, not to mention the management efficiencies that would be realized when adjacent lands are added to an existing national park unit. One strategy for accomplishing this park expansion restoration idea would be to think of it as a two step approach; first setting aside the targeted lands for protection and restoration, perhaps as new national restoration areas, and then later seeking national park or another appropriate protective status once the landscape has been repaired. Whatever approach is taken, our grandchildren will thank us, just as we thank our forebears for their farsightedness in first establishing and then restoring our large eastern national parks and forests.

An alternative expansion approach that Congress should consider is the creation of a new landscape scale overlay designation designed to protect targeted landscapes for climate change mitigation purposes, perhaps as Natural Heritage Areas or Landscapes. The idea is to identify and knit together an array of contiguous federal lands that cover a particular sensitive or vital landscape, such as the Greater Yellowstone area, the Crown of the Continent ecosystem, or the Greater Grand Canyon region. For these special climate change mitigation landscapes, Congress would need to establish new, more protective management standards to protect the area's wildlife, watersheds, and other resources from warming pressures. The important point is to ensure that migratory corridors are protected, that jointly managed watersheds are safeguarded, and that the needs of other climate-sensitive resources are adequately addressed. In most instances, this should not entail significant changes in current management standards or priorities, and it may not require shifting management responsibility from one agency to another. As noted earlier, nearby state and private lands might be incorporated for management purposes into these special designations through a carefully designed federal funding program linked to integrated planning and development requirements.

A related concern that merits congressional attention is the need for new federal wildlife corridor legislation, or at least some congressional direction and support for the wildlife corridor concept. The scientific community agrees that a warming climate is altering national park and other protected area ecosystems, thus forcing park wildlife species to seek more suitable habitat outside park boundaries. But as already noted, many of the lands surrounding national parks (and other wildlife reserves) face significant development pressures that could make safe passage treacherous at best and lethal at worst. It is important, therefore, to safeguard essential corridors to enable climate-impacted wildlife to survive by changing their home ranges as global warming alters their surrounding habitats. A new system of designated wildlife corridors would facilitate that movement and serve as an important climate change adaptation strategy.

The concept of protected wildlife corridors has already been endorsed by the Western Governors' Association, largely in response to the growing impacts that energy activities and other developments are having on the public lands. Western Gov-

ernors' Association, Protecting Wildlife Corridors and Crucial Wildlife Habitat in the West, Policy Resolution 07-01 (Feb. 27, 2007). Thus far, the WGA has created a Western Wildlife Habitat Council to identify potential wildlife corridors and designed a process for protecting these corridors. Western Governors' Association, Western Wildlife Habitat Council Established (June 29, 2008). New federal wildlife corridor legislation could be modeled on the 1968 National Trails System Act, which designated and funded several such trails and created a process for future trail designations. 16 U.S.C. §§ 1241-49. To create this system, Congress should direct federal land managers and state wildlife officials to collaboratively determine where corridors might be best located for maximum impact. On federal public lands, a new corridor designation could be simply overlaid, with some new management restraints and planning obligations to ensure adequate protection. On private lands, federal funds should be made available to provide landowners with an incentive to participate in the corridor program. Just as in the case of national trails, it should be possible to design a national wildlife corridor program that will help address climate change without significantly disrupting land ownership patterns.

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Clearly, the national parks are already being affected by climate change impacts, and the parks have a significant role to play in addressing the climate change challenge that we face. Because the national parks provide sanctuary for important wildlife species and other biodiversity resources, protective management of the parks and surrounding lands should be a critical part of any national climate change strategy. New legal standards designed to promote landscape scale planning and to better coordinate park management with adjacent federal, state, tribal, and private lands are essential to promote managerial consistency and the protection and restoration of regional ecosystems. The strategic and ecologically-based expansion of the national park system can also help effectively address looming climate change impacts. Funding for these initiatives might come from the new revenues generated by a national cap and trade carbon management program or by a new federal carbon tax. In sum, I urge the Subcommittee to give serious consideration to the various proposals outlined above as potential means to mitigate the impact of a warming climate on our national parks and to sustain the resilient capacities of our vital ecosystems.

Mr. GRIJALVA. Melyssa Watson, Director, Wilderness Support Center, welcome. I am looking forward to your comments.

**STATEMENT OF MELYSSA WATSON, DIRECTOR,
WILDERNESS SUPPORT CENTER, DURANGO, CALIFORNIA**

Ms. WATSON. Thank you, Mr. Chairman and Congresswoman Napolitano. It's a real honor to be here today again, my name is Melyssa Watson. I am the Senior Director for Wilderness of the Wilderness Society.

Before I begin, I want to thank the Chairman, the Congresswoman, and other members of the Subcommittee, for your leadership on the Omnibus Public Lands Act that the President signed into law just last week. Without your perseverance and commitment to this legislation we wouldn't have seen it become law. So, thank you.

Mrs. NAPOLITANO. Well, thank.

Mr. GRIJALVA. He was point on that.

Ms. WATSON. Absolutely.

Let me also thank you and your staff for working so hard to include a natural resources adaptation title in the upcoming climate legislation. We look forward to working with you on this in the coming months.

Today I'm going to speak to the unique role that wilderness areas, both within and outside our national parks, have to play in

our country's efforts to provide climate change and also provide some policy recommendations.

While not even the most ardent wilderness advocate would suggest that wilderness is the solution to helping communities and ecosystems adapt to a changing climate, it is one important tool that we should use as part of a balanced portfolio of climate change adaptation and mitigation strategies.

First, wilderness preserves the potential to produce ecosystem services such as keeping our water clean, keeping nutrients in our soils, and filtering the air that we breathe.

Further, many wilderness areas and other public lands are natural carbon sinks. Carbon sequestration has not yet been widely recognized as a valuable ecosystem service, and this needs to change.

Second, wilderness is a critical scientific yardstick or control for comparing the varying types of active management outside of wilderness. As land managers experiment to maximum our land's adaptive capacity, wilderness may be the most effective conservation strategy in the future, just as it has been in the past.

Finally, wilderness areas provide refuge from disturbances resulting from climate change. Clearly large unfragmented core landscapes protected as wilderness provide wildlife with room to roam and refuge from areas suffering from climate impact such as drought, floods and fire. They're really the essential building blocks that we need as we work to protect and connect landscapes and preserve ecological function over time.

When it comes to protecting and connecting landscapes, the Park Service has a long and proud history of land stewardship, wilderness management, and biodiversity protection. The agency has a tremendous opportunity and perhaps even an obligation to play a significant leadership role within the Federal government on climate adaptation and mitigation. I was really encouraged to hear the comments of Mr. Jarvis earlier in this hearing.

As the Chairman is well aware, Congress too, obviously, has a vital role in addressing climate change. First, the most urgent action Congress should undertake is to pass legislation that ends the practice of dumping harmful global-warming pollution into the atmosphere for free. We need legislation that will place a declining cap on the emissions of greenhouse gases, through auctioning permits and using revenues for public benefit.

Second, Congress should ensure that the Park Service and other land management agencies have the necessary resources to respond to climate change by providing dedicated annual funding to support new investments and safeguarding the natural system that sustains our human communities, as well as robust populations of fish and wildlife.

Third, Congress should require Federal agencies to be climate smart by incorporating consideration of climate change into all of their planning and decision making.

Fourth, to prevent the further loss of the carbon stored on our public and private lands, Congress should consider the establishment of the U.S. Climate Reserve as a national priority, and further establish the goal of no net loss of our nation's carbon sink in the coming decade.

Finally, energy policy decisions and the fate of our public lands are inextricably intertwined. Congress can ensure that renewable energy is developed without impeding ecological adaptation, destructing carbon storage, or harming important wildlife habitat. And we look forward to working with Congress and the administration to strike that balance.

In conclusion, I'd urge the Subcommittee to be visionary in tackling climate change. The same kind of vision and foresight that created our national parks and system of public lands is needed today, but perhaps on an even larger scale that meets the challenges posed by climate change.

Thank you again for the opportunity. And I look forward to your questions.

Mr. GRIJALVA. Thank you very much.

[The prepared statement of Ms. Watson follows:]

**Statement of Melyssa L. Watson, Senior Director for Wilderness,
The Wilderness Society**

America's public lands—some 600 million acres of land and 150,000 square miles of protected waters—are the birthright of every citizen, and the legacy we hold in trust for generations to come. Global warming poses an unprecedented threat to the nation's iconic landscapes—our national parks, forests, wilderness areas, desert lands managed by the Bureau of Land Management, and wildlife refuges. At the same time, our country's parks and other public lands offer one of our best hopes for sustaining the plants, animals, birds, clean water and air, and recreational opportunities that are important to our heritage. They store carbon and provide large core protected areas that will be essential in adapting to a changing climate. These lands also provide critical services for our communities, including filtering the air we breathe and the water we drink, and play important roles in our nation's economy. Protecting these natural places is more important now than ever before.

Public Lands in a Changing Climate

America's National Parks and other public lands include some of the nation's most intact and diverse ecosystems and have an important role to play in helping us address the effects of climate change on wildlife and our communities. In addition to their vital role in carbon storage and sequestration, protected wildlands can help species cope with the many threats exacerbated by climate change. For example, wildlands provide important habitat and migration paths and large, intact landscapes create a greater buffer for wildlife from the impact of disturbances, such as floods, hurricanes, and fires made more intense by climate change.

Our economic health depends on the health of our public lands. One in every 20 American jobs is related to outdoor recreation that depends on land and ecosystem conservation. This includes fishing, hunting, hiking and canoeing jobs which are at particular risk from the on the ground impacts of climate change. Eighty-five percent of all hunters in the West use public lands for hunting and fishing. The estimated value of water flowing from national forest land is \$7.2 billion per year from both instream and offstream uses.

Community health depends on the health of our natural ecosystems. One important function of natural ecosystems is to protect our public health. Ecosystem services are those things that we would have to produce ourselves if they were not provided by nature. Some are so basic, such as keeping our water clean, keeping nutrients in our soils, and filtering the air we breathe, that we are barely aware of what it would take to provide man-made substitutes for these necessary functions. For example, our forests provide 53% of the nation's drinking water to more than 180 million people and 66 million rely directly on National Forest lands as their water source. Other services, such as carbon storage, are necessary complements to the fight to reduce greenhouse gas emissions. It is clear that we cannot live without these services, and that our welfare is tied to their protection.

With protection, our public lands provide a critical component of ecosystem resiliency and strength. They safeguard our natural systems and the goods and services on which our human communities depend.

The Unique Role of Wilderness

Our designated wilderness lands are one of our nation's greatest treasures. We have praised the foresight and perseverance of generations of leaders in their work to establish, protect and grow our system of wilderness lands and we will continue to celebrate the recreational, scenic, educational and conservation benefits of protected wilderness. The prescience of those early wilderness leaders is likely to be especially important in an era of climate disruption.

While not even the most ardent wilderness advocate would suggest that wilderness is the solution to helping ecosystems and communities adapt to a changing climate—there must be many approaches if we are to successfully address the issue—protected wild ecosystems most certainly have a unique and very critical role in helping land managers figure out a path forward.

Wilderness preserves the potential to produce ecosystem services. As a strategy for protection of biodiversity and productive potential, the advantages of wilderness are well known: wilderness produces the best water quality, it provides a refuge for species from numerous anthropogenic stressors outside wilderness, and it provides unique recreational and aesthetic experiences. Wilderness represents the best strategy we have identified so far for achieving all these benefits and will remain an important strategy in the face of climate change.

Wilderness is a strategy for spreading the risk of failing to find the right adaptation options on non-wilderness lands. Climate change has changed the rules that have guided conservation for the past century. If our goal is to conserve and manage lands so that they are resilient in the face of climate change, then forms of management that were relied on to produce goods and services may not work in the future. Land management will have to be explicitly experimental to find new ways to sustain ecosystem services for the future. Wilderness is a unique form of land management among a suite of approaches that will have to be employed to maximize adaptive capacity. It is impossible to determine at present, but wilderness may turn out to be the most effective conservation strategy in the future, just as it has been in the past.

Wilderness is a critical scientific yardstick. New methods of forestry and range, wildlife, and watershed management will need to be utilized in order to adapt to future climate. The success of these new approaches is anything but certain, and their performance will need to be monitored and measured against a standard of comparison. Wilderness can provide a scientific yardstick, or “control,” for comparing the effects of active management outside wilderness.

Wilderness provides refuge from disturbances resulting from climate change. Wild ecosystems are constantly changing in response to such forces as fire and water; stasis is the exception. However, climate change is altering the environment to reflect conditions previously considered extreme or which are entirely out of the range that species have contended with in the past. Increases in fire frequency and changes in the timing and intensity of storms, for example, will alter the recovery time of ecosystems and their ability to provide habitat for wildlife. To survive these changes, species will need to be able to move around the landscape to find the places that still provide habitat. Large, unfragmented wilderness provides species with “room to roam” and refuge from areas that have burned, are experiencing drought or floods or from the effects of other climate-related disturbances.

A Path Forward

Climate change is forcing policymakers to take a new look at wilderness areas as prime examples of large intact ecosystems that can serve as reservoirs for biodiversity and clean water that will be essential to the provision of ecosystem services in the future. Also, because we were wise enough to protect areas of our country from extractive uses, deforestation and development, we have in place natural carbon sinks that can help us fight back against global warming. Yet carbon sequestration has not yet been recognized as a valuable ecosystem service provided by our wilderness areas, parks and other public wildlands.

Similarly, natural resources adaptation efforts have rarely moved from the vulnerability assessment phase to the implementation phase—that is we have studied the problem but have done little as a country to actually implement plans to address it. The vulnerability of our public lands to a few degrees rise in temperature is deep, profound and, unfortunately, inescapable. Even if all emissions of greenhouse gases were to stop tomorrow, the emissions of the last 100 years are causing global warming that we must anticipate and adapt to. We have little time. We must move ahead, from gathering and synthesizing data to implementing adaptation strategies.

We need to be both proactive and reactive. That is, we must have the ability to react and deal with climate change after an event or impacts have occurred, and

we need to take action to prevent and reduce exposure to future impacts. The details of future scenarios, in terms of timing, scale, and severity, cannot be known with certainty and this uncertainty has been used as a smokescreen to delay action. However, even without precise knowledge of future events “which we will probably never gain—proactive policy planning improves preparedness by integrating adaptation considerations into the decision-making process.

Even with all of the uncertainty, land managers already have many of the needed tools. A balanced portfolio of adaptation and mitigation strategies provides an insurance policy for our natural heritage that diminishes the risks associated with climate change. We may need to utilize them in new and creative ways, but today’s conservation work is still relevant:

One, expand core protected areas, reconnect the land and reduce avoidable stressors. Scale matters in wildland and ecosystem conservation. Large, connected, intact ecosystems offer the best hope of surviving global warming, sustaining the capacity to sequester carbon, preserve species habitat and protect human communities. This was true before the threat of climate change was first recognized, and it is even truer today now that the threat is accepted as a reality. We need to protect large areas of habitat set within sympathetically managed, jurisdictionally and ecologically diverse landscapes that can also yield food, fuel, and materials. Through the use of protective designations and conservation management on our public lands as well as conservation easements, acquisition from willing sellers, and complementary management of private lands we can:

- Reduce fragmentation and increase the size of core protected lands;
- Ensure representation and redundancy of different ecosystem and habitat types to minimize the potential for loss of component parts; and
- Protect lands along a variety of elevational and latitudinal ranges to ensure connectivity across environmental gradients and allow wildlife to migrate to suitable habitat as climate changes.

Scientists frequently point out that given the uncertainty of how global warming will affect the climate and resiliency of any particular natural environment, the first best strategy is to reduce the non-climate pressures that threaten critical ecosystems and the communities that depend on them. Toxics, development, agricultural intensification, overgrazing, loss of wetlands to infill, etc. are all added stresses to a system already stressed to the brink. Protection of large, connected, intact landscapes can reduce the effects of these pressures on climate-stressed ecosystems.

Two, develop strong adaptation plans. Land managers must consider, analyze, and develop plans to address the impacts of climate change when undertaking planning exercises, setting priorities, and making management decisions.

Adaptation strategies must develop at the local and regional levels. Climate change and associated impacts vary greatly from location to location. Yet systems such as water resources and habitat cross traditional jurisdictional lines. Those engaged in planning need to share information, plan together, and collaboratively modify existing policies and procedures to ensure effective solutions. The exchange of information, resources, best practices, and lessons learned across jurisdictions and among different stakeholders is a key element of successful adaption planning.

We also must avoid the situation where the adaptation actions of one sector compromise sustainable adaption in another, or threaten our ability to protect vulnerable species and ecosystems. This is yet another reason to focus on collaboration and cooperation between and amongst interest groups and experts.

Strong, science-based adaptation plans should include:

- an experimental framework in which management is conducted using experimental treatments, “controls”, monitoring, and constant learning in a cycle of adaptive management;
- protection for existing and potential ecological movement corridors (including those that will enable wildlife, as it moves, to pass through urban and developed areas) between major ecosystems;
- protection for mature and complex elements of the ecosystem, such as mature forest stands, as these are both difficult to replace once lost and likely to be resilient to climate change (having demonstrated the ability to adapt to past changes in climate);
- mechanisms to engage the public in ongoing collaborative management; and
- for many ecosystems, an evaluation of the need to secure additional water rights for drought-prone ecosystems.

Three, manage for change. Adaption to climate change must address uncertainty. We must adopt management approaches that both assess and react to risks, but are also designed to learn from experience. Monitoring provides an essential feedback loop to assess effectiveness and develop action accordingly. Public land

managers have a host of tools available to help them appropriately manage their resources in the face of climate change. Some of the tools and actions that managers must consider include:

- Restoration of natural fire regimes through the use of prescribed fire, wildland fire use, and mechanical treatment where necessary to reduce damage from unnatural fire behavior more likely in a warmer climate;
- Removal or management of non-native, invasive species that weaken ecosystems and increase susceptibility to climate change;
- Conservation of rare species and restoration of extirpated species—though not necessarily in their historical locales) as these may be important to future ecosystem function through partnerships between agencies, research institutions and private partners;
- Management of post-disturbance environments for future resilience (e.g., if replanting after a fire is necessary, consider species that may be better adapted to future climates); and
- Monitoring of ecological and human systems in order to anticipate impacts and adjust management techniques.

Finally, we recognize the unique role the National Park Service (NPS) can play in climate change adaptation and mitigation. With the Park Service's long and proud history of leadership on treasured landscape stewardship and conservation, wilderness designation and biodiversity protection, NPS has a tremendous opportunity—perhaps even an obligation—to play a significant leadership role within the Department of the Interior (DOI) and with other federal land management agencies on issues relating to climate adaptation and mitigation. In addition to opportunities to initiate and coordinate on important science and vulnerability assessments, no less meaningful would be leadership on reducing DOI's own carbon footprint. We encourage NPS to set a high bar and ambitious goals that can serve as models for NPS as well as other federal agencies. What a tremendous accomplishment it would be for NPS to be carbon neutral by the NPS Centennial in 2018!

The Congressional Role

First, the most time-sensitive role that Congress can play is to pass legislation that ends the practice of dumping harmful global warming pollution into the atmosphere for free. The President has submitted a budget that assumes the end of uncapped free dumping by polluters. Congress needs to pass the legislation that will put that assumption into practice, by placing a declining cap on the emissions of greenhouse gases, making the polluters pay through auctioning permits and capturing the auction revenues for public benefits.

Second, we need to ensure that agencies have the necessary resources to respond to the new climate imperatives. Congress should provide dedicated and assured annual funding to our land management agencies that will

- support new investments in safeguarding the natural systems that sustain human communities and robust fish and wildlife populations
- provide funding for a broad range of eligible activities including conservation, restoration, enhancements, planning, research and monitoring and education.
- encourage investment in habitat acquisition and protection. The Land and Water Conservation Fund, for example, was woefully underfunded during the Bush Administration. The new Administration has placed a high priority on this important program, increasing its budget by 50 percent next year and fully funding it by 2014.

Funding for land management climate priorities should come from the auction of carbon allowances under a new climate bill. This investment in natural resources must be dedicated (not appropriated annually) so that resource managers can plan ahead in their adaptation projects knowing funding is secure and to ensure funding goes exclusively to global warming-related projects. This is the approach that has been so successful in funding the Pittman-Robertson Wildlife Restoration Act since 1950. It works for wildlife land acquisition—now we need to take the same approach to climate-related land acquisition, management and protection intended to protect all human communities as well.

Third, the agencies must have a clear and strong mandate to be “climate smart” by incorporating consideration of climate change into all of their planning, decision-making and research priority setting process. All federal agencies engaged in land management and biodiversity activities should protect, maintain, restore and value biodiversity and wildlife habitat, while incorporating climate change mitigation and adaptation activities into management and planning. This may require new policies or legislation.

Fourth, Congress should declare the establishment of a U.S. Climate Reserve a national priority, with the intention of ensuring through a variety of regulatory

sticks and financial carrots that we achieve a “no net loss” standard with respect to preserving the nation’s carbon sink. California, for example, has proposed that it set a 2020 target for emissions reductions that assumes no net loss of current sequestration services from its forests and has called on the federal government to adopt a similar goal for federal lands. The Wilderness Society urges Congress to establish an explicit federal target of “No Net Loss” in the existing sequestration value of our public forests.

This U.S. Climate Reserve needs to be nurtured and enhanced, both as a carbon sink and as a storehouse of other ecosystem services on which we rely. Congress should also provide incentives for private landowners to manage their lands in a manner which contributes to the protection of our country’s carbon storage capacity. Sixty percent of our nation’s forests are privately-owned so their management must be part of the effort to mitigate the threat of climate change. From Wilderness designation to wetland banking, we need a truly national strategy to stop the galloping destruction of our existing carbon stocks that begins with the recognition that our forests, as well as other carbon storing ecosystems such as grasslands and pinyon-juniper, are weapons in the fight against global warming and should be protected like an army protects the armory.

Finally, energy policy decisions and the fate of our public lands are inextricably intertwined. We must sustain the integrity of our wildlands and wildlife habitats as we make the transition to a new sustainable energy economy. Abundant wind, solar, and geothermal resources are found on public lands, especially here in the Southwest where solar resources are concentrated. Interest in developing these resources is rapidly increasing. As with any development that occurs in predominantly natural systems, large-scale renewable energy projects can entail a range of adverse impacts and must be carefully planned and sited to ensure renewable energy generation does not unintentionally impede ecological adaptation, disrupt carbon storage, or fragment large core areas of protected public lands.

We need not choose between development of renewable energy and protection of the country’s wildlife and treasured landscapes. We have the opportunity to develop renewable energy the right way, to prioritize development on already disturbed lands, brownfields and sites close to the communities they serve to reduce transmission needs, costs and losses. Siting on public lands should require an open and transparent process about where it is best to build clean energy generation facilities and about how to ensure renewable energy installations are kind to both the land and the atmosphere. In this way, they can avoid the conflicts we’ve seen over other forms of energy development on public lands. We applaud Secretary Salazar for issuing a Secretarial Order prioritizing renewable energy development over other forms of energy on the public lands, and for establishing a task force that concerning renewable energy development and its impacts on global warming. It is imperative that we act now to develop these resources in the right way from the start lest our communities and ecosystems suffer from the devastating impacts of global warming.

Conclusions

In 2007, in response to a request from this body, the Government Accountability Office issued a report recommending that the Secretaries of the Interior, Agriculture and Commerce develop guidance advising managers on how to address climate change effects on the resources they manage. In commenting on the draft GAO report, the agencies generally agreed with this recommendation, but they have been slow to take action.

The nation’s national parks, wilderness areas and other public lands cannot afford any further delay. Climate change must be a major, if not the primary, factor in making sound land management planning decisions and in shaping the agenda for land conservation actions for the foreseeable future.

Thank you for opportunity to testify today.

Mr. GRIJALVA. Mr. Michael Cipra, California Desert Program Manager, National Parks Conservation Association, welcome.

Mr. CIPRA. Thank you.

Mr. GRIJALVA. Thank you.

**STATEMENT OF MICHAEL CIPRA, CALIFORNIA DESERT
PROGRAM MANAGER, NATIONAL PARKS CONSERVATION
ASSOCIATION, JOSHUA TREE, CALIFORNIA**

Mr. CIPRA. Chairman Grijalva and Congresswoman Napolitano, I wanted to thank you for your leadership. I wanted to thank you for inviting me to testify. And I wanted to say, welcome to the California desert.

Founded in 1919, the National Parks Conservation Association works to protect, preserve, and enhance America's National Park System for present and future generations.

I'm here today on behalf of our more than 330,000 members who care deeply about the wildlife ecosystem, the cultural resources that our parks preserve, and want to see these unique American treasures passed on to our children and grandchildren undiminished.

The single greatest threat to the health of our national parks is global climate change. It threatens not only the plants and animals, but also the health and economic viability of many communities that rely on the park's reserves and monuments. Outdoor pursuits that depend on healthy ecosystems contribute 730 million dollars annually to the U.S. Economy. Keeping wildlife populations, rivers, forests, deserts and our national parks healthy will allow us to support nearly 6.5 million existing jobs and continue to generate \$88 billion annually in state and national tax revenue.

Today we sit outside Joshua Tree National Park. Over 1.3 million people visit this park every year because of its unique natural opportunities, to see animals like bighorn sheep and desert tortoise in the wild, or to stand at sunset in a forest of Joshua trees, the park's namesake species.

However, based on the research of Dr. Ken Cole, of the USGS, the effects of climate change over the next hundred years could remove Joshua trees as a species from the national park that bears their name.

What does it mean to have a Joshua Tree National Park without Joshua trees? On a scientific level it means fewer animals and an ecosystem out of balance. On an economic level it means fewer recreation visits and less money generated for our communities. And on a spiritual level it means that our grandchildren will see a diminished world.

Joshua Tree is not the only national park that's being affected by climate change. In fewer than 20 years glaciers will disappear from Glacier National Park. Coral reefs are dying at Biscayne and Virgin Island National parks due to increased heat and disease. Insect pests are thriving. They're devastating forests from Great Smoky Mountains to Yellowstone. As temperatures rise species throughout our national parks are being driven upward in elevation and are literally running out of space where they can live.

Reducing greenhouse gas emissions is absolutely necessary to guarantee the health of our parks, our wildlife, our communities, and our children's future. But reducing emissions is not enough. The effects of climate change are already impacting wildlife and natural systems throughout the national parks. Even with immediate action to reduce greenhouse gases, these negative impacts on

wildlife and natural systems will continue for many decades to come.

By establishing a coordinated national plan to protect natural resources and dedicating a portion of the revenues from the auction of pollution permits under a Federal cap and trade system for wildlife and ecosystem adaptation programs, we can preserve the life-supporting services provided by our national parks and other natural lands.

Federal, state, and tribal agencies must work together in a coordinated way to address the crucial issues related to the survival of plant and animal species. Their work must be informed by the best and latest science. Effective programs must focus on building ecosystem resilience by protecting important habitat in migration corridors and reducing other stressors such as air pollution and nonnative species.

NPCA is very encouraged by the legislation introduced in the House Energy and Commerce Committee on March 31 by representatives Waxman and Markey. Their comprehensive energy and climate bill would substantially reduce greenhouse gas emissions through an integrated set of policies that are sensible and achievable, including clean renewable energy, energy efficiency, clean fuels and vehicles, and a declining cap on emissions of major emitters. We are especially pleased that congressmen Waxman and Markey included in their bill a robust adaptation title that would safeguard natural resources and wildlife from climate change impacts. We recognize that the House Natural Resources Committee is continuing its leadership and its work on natural resource adaptation issues, and we offer our assistance and support for your work.

As Americans we have faced tremendous economic and environmental challenges before, and we have met these challenges with courage, with urgency, and with a coordinated response. After all, we are the Nation that invented the national park idea and brought it to the rest of the world. This truly democratic idea that the best of our natural and cultural heritage is not something to be enjoyed by just a few privileged individuals, but should be owned by all of us, to guarantee our collective health in the future, for our recreation and education and spiritual growth and economic health, and for our children's benefit as well.

Thank you for the opportunity to provide testimony. I'll look forward to any questions you have.

Mr. GRIJALVA. Thank you.

[The prepared statement of Mr. Cipra follows:]

**Statement of Michael Cipra, California Desert Program Manager,
National Parks Conservation Association**

Mr. Chairman, and other distinguished Members of the Subcommittee, thank you for inviting me to testify about the challenges that our national parks face as a result of climate change, and the opportunity that we have to meet these challenges.

Founded in 1919, the National Parks Conservation Association works to protect, preserve, and enhance America's National Park System for present and future generations. Today, we have 24 regional and field offices across the country, including the California Desert Field Office in Joshua Tree, California, which I manage. I'm here today on behalf of our more than 330,000 members, who care deeply about the wildlife and ecosystems our parks preserve, and want to see these unique American treasures passed on to our children and grandchildren undiminished.

The single greatest threat to the health of our national parks is global climate change. It threatens not only the plants and animals, but also the health and economic viability of many communities that rely on the parks, preserves, and monuments. According to a 2006 study by the Outdoor Industry Association, fishing, hunting, wildlife watching, hiking and other outdoor pursuits that depend on healthy ecosystems contribute \$730 billion annually to the U.S. economy. Keeping wildlife populations, rivers, forests, deserts, and our national parks healthy will allow us to support nearly 6.5 million existing jobs and continue to generate \$88 billion in state and national tax revenue.

Today we sit outside Joshua Tree National Park, which is visited by over 1.3 million people every year. So many people visit this desert park because of its unique natural opportunities—to see animals like bighorn sheep and desert tortoise in the wild, to gaze in wonder at a field of blooming wildflowers or stand at sunset in a forest of Joshua trees, the park's namesake species. Joshua Tree was ushered into the park system largely through the efforts of an inspired American citizen, Minerva Hamilton Hoyt. Minerva Hoyt was a desert enthusiast in the 1920s and 1930s, who witnessed the widespread destruction of native desert plant life by thoughtless people who dug up, burned, and otherwise destroyed many of the cacti and Joshua trees that Ms. Hoyt found beautiful. So she did something quintessentially American—she worked to protect the natural world, not just for herself but for all Americans, including those not yet born. Largely through Minerva Hoyt's tireless efforts to educate others about the beauty and value of the desert, Joshua Tree was shepherded into the National Park System as a national monument. In 1994, with the passage of the California Desert Protection Act, Joshua Tree achieved national park status.

We stand today at another important crossroads for this park, a moment when we can witness damage and destruction wrought by human activity, and a moment when we have the opportunity to protect what has great value for the American people.

A month ago, the National Parks Conservation Association, in partnership with the National Park Service and a number of other organizations, hosted the second annual Climate Change and the California Desert Conference in Joshua Tree, California. One of our distinguished speakers was Kirsten Erin Ironside from Northern Arizona University. Professor Ironside presented the results of her research conducted with Dr. Ken Cole of the U.S. Geological Survey. This research applies climate models to the home range of *Yucca brevifolia*, a species commonly known as the Joshua tree. The results that Professor Ironside presented at our conference were stark. In all six of the climate models she explored, in 100 years, there was no new recruitment of Joshua trees in Joshua Tree National Park, and significant death of existing trees. Consider that for a second. As a result of climate change, there may no longer be Joshua trees in Joshua Tree National Park. This plant is not just an iconic image on a postcard—it is critical to the health of this desert ecosystem. Ecologists refer to the Joshua tree as a “foundation species”—a plant that serves as living habitat for a whole range of animals, providing food and shelter critical to the survival of everything from Great Horned Owls, which nest in the tree tops, to night lizards, North America's smallest lizards, which give live birth to their young beneath decaying bark of the Joshua tree. The Joshua tree is absolutely critical to the health and integrity of Joshua Tree National Park's ecosystem. And based on the research of Dr. Cole and Professor Ironside, the effects of climate change over the next 100 years may mean that Joshua trees as a species will not survive in the national park that bears their name.

What does it mean to have a Joshua Tree National Park without Joshua trees? On a scientific level, it means fewer animals and an ecosystem out of balance. On an economic level, it means fewer recreation visits and less money generated for our communities. And on a spiritual level, it means that our grandchildren will see a diminished world.

Minerva Hamilton Hoyt watched the native plants disappear from this desert, and she didn't despair or give up or lose hope. She decided to do something to halt the destruction she saw. This is the story of America. We have a rich history of rising to meet conservation challenges. After all, we are the nation that invented the national park idea and brought it to the rest of the world—this truly democratic idea that the best of our natural and cultural heritage is not something to be enjoyed by just a few privileged individuals, but should be owned by all of us, to guarantee our collective health and future, for our recreation and education and spiritual growth and economic benefit, and for our children's benefit as well.

Joshua Tree is not the only national park that is being affected by climate change. In fewer than 20 years, glaciers will disappear from Glacier National Park. Coral reefs are dying in Biscayne and Virgin Island National Parks due to increased heat

and disease. Insect pests are thriving, and are devastating forests from Great Smoky Mountains to Yellowstone. Water levels at Lake Mead are in decline as a result of extended drought. As temperatures rise, species throughout our national parks are being driven upward in elevation and are literally running out of space where they can live. Global warming poses an unprecedented threat to the natural world and the survival of wildlife that Americans cherish. Ecosystems that support healthy wildlife also support healthy human communities and are the foundation of a robust economy.

Reducing greenhouse gas emissions is absolutely necessary to guarantee the health of our parks, our wildlife, our communities, and our children's future. But reducing emissions is not enough. The effects of climate change are already impacting wildlife and natural systems throughout the national parks and across multiple land management agencies. Even with immediate action to reduce greenhouse gases, those negative impacts on wildlife and natural systems will continue for many decades to come.

There is an historic opportunity for us as Americans to address these challenges. Federal, state and tribal agencies must work together in a coordinated way to address the crucial issues related to the survival of plant and animal species, as well as intact ecosystems. Their work must be informed by the best and latest science. Effective wildlife adaptation activities must focus on building ecosystem resiliency by protecting important habitat and migration corridors and reducing other stressors, such as air pollution and non-native species.

Joshua Tree National Park presents a prime example of how other environmental stressors such as air pollution and non-native species can combine with climate change to create significant challenges. High levels of nitrogen are currently being deposited on the soil in Joshua Tree National Park by air pollution moving east from the Los Angeles Basin. Dr. Edith Allen of the University of California at Riverside found that these nitrogen levels are 15 to 30 times higher than the levels in an undisturbed ecosystem. The park's native desert plants have evolved to thrive without this extra nitrogen. But many invasive plants, grasses in particular, do really well with the added fertilizer from air pollution. Exotic grasses, such as red brome and cheatgrass, now represent up to 60 percent of the park's biomass from annual plants. The increased fuel loads provided by these exotic grasses can then carry lightning-ignited fires from plant to plant, resulting in increasingly large and destructive wildfires throughout the Mojave Desert region. In 1999, the Juniper Complex fire, burned 13,894 acres of slow-growing California junipers, pinyon pines, and Joshua trees. This was the largest fire in Joshua Tree National Park's history.

Desert plants are highly susceptible to fire, particularly during times of drought. Desert tortoises and other ground-dwelling animals have low survivability during an intense fire event. And for people who live in an urban-park interface, homes and even families are put at risk. Now overlay climate change on these challenges posed by air pollution and invasive species. Invasive, fire-carrying grasses like red brome have accelerated growth with increased levels of atmospheric carbon dioxide, while plants like Joshua trees may never recover their habitat due to the increased temperatures and evaporation caused by climate change. To address the challenges of maintaining an intact ecosystem at Joshua Tree National Park, managers need the resources to simultaneously address exotic species control, manage fires, monitor air pollution, and work cooperatively with land management agencies such as the BLM to create ecological linkage corridors free from invasive species.

And that's just one park. Efforts to estimate the financial investment it will take to help wildlife and ecosystems vulnerable to climate change's impacts are too preliminary to precisely quantify. Like the mitigation of greenhouse gas emissions, the size and seriousness of the threat requires an urgent response. Making a substantial new financial commitment to conservation science and ecosystem management is a significant challenge we must meet. Given both the magnitude of the funding necessary and the need for a reliable funding stream, this challenge cannot be met through the annual congressional appropriations process. Funding will need to be sustained over multiple decades to protect our parks and other natural wealth.

Fortunately, legislation to address global warming provides an historic opportunity and an appropriate avenue to safeguard our national parks, their fish, plants, and wildlife, from the destructive effects of climate change. Virtually all of the legislative proposals advanced in the 110th Congress to reduce global warming emissions appropriately recognized the need to address the unavoidable and severe harm that climate change will have on wildlife and the ecosystems that sustain us all. These proposals did so by establishing a coordinated national plan to protect natural resources, and dedicating a portion of the revenues from the auction of pollution permits under a federal cap-and-trade system. The Senate's Climate Security Act, for example, proposed allocating roughly 7 percent of federal revenues from the sale of

allowances, or roughly \$7 billion per year to addressing the impacts of global warming on wildlife. This funding would be made available automatically and not be subject to the uncertainties of the annual federal appropriations process. Such funding would be but a small fraction of the value of the life-supporting services provided annually by our national parks and other natural lands, and is commensurate with the challenge before us.

NPCA is very encouraged by the legislation introduced in the House Energy and Commerce Committee on March 31 by Representatives Waxman and Markey. Their comprehensive energy and climate bill would substantially reduce greenhouse gas emissions through an integrated set of policies that are sensible and achievable, including clean renewable energy, energy efficiency, clean fuels and vehicles, and a declining cap on emissions of major emitters. We are especially pleased that Congressmen Waxman and Markey included in their bill a robust adaptation title that would safeguard natural resources and wildlife from climate change impacts. NPCA recognizes that the House Natural Resources Committee is continuing its work on natural resource adaptation issues, and we offer our assistance and support for your work.

Given the direct and severe impact of global warming on wildlife and ecosystems, it is appropriate that at least a percentage of the significant federal revenue from the auction of pollution permits, which estimates place as high as hundreds of billions of dollars, be used to address the damage and protect life-supporting ecological services. The significant and certain funding stream provided in a cap-and-trade bill can provide the most effective mechanism to ensure that the nation's federal, state and tribal natural-resource agencies will have the financial resources necessary to effectively address climate change's unavoidable impacts.

If we are realistic in our analysis of climate change, we must anticipate a future that presents huge challenges for our national parks, our natural systems, our communities, our health, and our economic future. As Americans, we have faced tremendous economic and environmental challenges before, from the dust bowl of the 1930s to the loss of species from DDT. And we have met these challenges with courage, with urgency, and with a coordinated response. That time to meet our challenges has arrived again. Climate change presents the single greatest threat to our environment, and our health and economic future depends on how we meet this challenge. Introducing cap-and-trade legislation with a dedicated funding source for wildlife and ecosystem adaptation activities is crucial to a healthy future for our economy, our national parks, and our children's health. Thank you for the opportunity to provide testimony, and I look forward to any questions you may have.

Mr. GRIJALVA. Professor, first of all let me thank you for your very thoughtful and helpful points and ideas, the same points and ideas we've been asking other witnesses about. Your point of view is very much appreciated.

In the legislation—I don't know if you've reviewed it yet—but in the legislation that's being promoted right now in the draft, Waxman and Markey, the adaptation language in there, have you had a chance to look at that?

Mr. KEITER. I have read through it, relatively quickly, but I have had a chance—

Mr. GRIJALVA. Any reactions to that?

Mr. KEITER. I think that it takes us a good ways down the road. What I'm particularly concerned about, as I indicated in my testimony, is promoting interagency coordination, collaboration, and consistency in this area.

There is a provision in there, as I recall, that it calls for cooperation between the agencies. And I think that gets us partway there. What I'm concerned about is that it's not very specific in terms of what is required. And my experience over the years, trying to understand how the various particularly public land agencies interact with each other, is that in particular locations with particular park or forest managers, or district rangers, if the personalities mesh, things work well. But those positions change. And I see the need

to try to institutionalize better coordination. The best idea I've been able to come up with is the one I alluded to in my testimony, that is perhaps requiring a written interagency coordination statement that would reflect—perhaps as part of the environmental impact analysis process—the coordination efforts, require specific responses by an action agency to the concerns of other agencies, and require specific mitigation and adaptation responses as part of the climate change concern that all of the agencies share.

I also think that it would be helpful, frankly, if this sort of a coordination statement or requirement was potentially enforceable in court. My experience is that when that looms in the background, that the agencies take those sorts of obligations seriously. NEPA has had a salutary effect because environmental impact statements can be challenged in court. And I think something like this might work in a similar sort of manner.

Mr. GRIJALVA. I think that Mr. Cipra said, I think, the legislation takes us a long way. And the point of this Subcommittee, and hopefully the Full Committee, will be to hone in where our jurisdiction is, and hone in effectively that we should not deal with the public lands as an after-the-fact thought. Once legislation is moving, to have a marker down in terms of a piece of legislation that we are able to influence the outcome of the full legislation. And some of the thoughts that you brought here today were very good.

I think in your studies of the Glacier National Park and its neighbors you talked about you observed some of the other factors besides climate change, development proposals that might harm the park, and sometimes the reluctance, for whatever reason, of land managers there to speak out about what that potential harm could be. And we're talking about regional solutions as we move forward. And do you recommend any explicit authority that we should indicate—and this is to NPS—in order to deal with those harmful encroachments, whatever they may be?

Mr. KEITER. Right.

Mr. GRIJALVA. And do you think that's been a failure of law or is it just a practice that's not practiced?

Mr. KEITER. Well, as the committee is well aware, there are difficult political and relationship issues both between the Park Service and sister Federal land management agencies as well as the surrounding private and tribal landowners. And in some locations that has dissuaded park managers from being as assertive as they might be.

I guess what might be most helpful would be a clear expression from Congress to the Park Service that it needs to be actively engaged in management and planning decision making for the entire landscape or ecosystem where individual national park units sit.

There is language to that effect in the 2006 management policies document that was alluded to earlier today. And that I think is helpful. But direction from Congress making explicit the authority or at a minimum the responsibility and the authority of the Park Service to participate and engage would be helpful.

Mr. GRIJALVA. I think that Secretary Salazar and the President made a very good point. And it's going to be very helpful through this process. Because I can understand some of the reluctance, given some of the other political machinations that have been going

on for eight years. I think what they said was that there's going to be a reliance on science and fact-based decision making. And I think if that becomes the gold standard, I think we're all in much better shape as we go along.

Ms. WATSON, my question is about—I think we were talking about it back in the anteroom before the hearing. We're kind of—we're going into uncharted waters here on adaptation strategies for our public lands. And as we go forward, I have heard I don't know how many times at the hearings in Washington from some of our colleagues about how environmental radicals are absolutely hamstringing the system with the lawsuits. I don't share that view, but I'm curious to know from your organizational point of view—and I'm going to ask then if you could respond right after her, Mr. Cipra, we're building a bicycle while we're riding it. That's the scenario here. And so how much leeway—how much good faith effort do we give the National Park Services to begin the adaptation strategy? And some of those efforts are going to not have the success that we would want them to have. What's the latitude that you see organizationally, if there is indeed transparency, good faith effort, public process? Put all those into what is being done, but yet that adaptation restoration strategy didn't have the outcome that it was intended to. How do you see leeway in terms of community based and NGO's out there?

Ms. WATSON. Sure. Thanks for the question. And I do think with those safeguards in place we have to allow a fair amount of leeway. I think we recognize that some land management is going to have to be explicitly experimental. Moving forward, we don't know what's going to work everywhere. I think that we do have some forms of land management that are well tested, that we should continue to use, wilderness among them. But having those in place will allow us to be experimental in other places. And certainly from my organization's perspective, that's something that we support and encourage. And I think in the context of looking at the larger landscape, we have to do that, and understand what's going to work across a range of ecosystems, both for wildlife but for the communities that depend upon the services that our public lands provide.

Mr. GRIJALVA. Sir, if you don't mind.

Mr. CIPRA. Absolutely. Sometimes the National Parks Conservation Association is described as a watchdog. I tend to see it more as a guardian angel or maybe—

Mr. GRIJALVA. Guard dog?

Mr. CIPRA. Life partner, yeah, for the National Park Service. And I think flexibility is absolutely the key. That there needs to be a flexibility and a willingness to partner. I think the more partners the better in our attempt to deal with the impacts of climate change.

And I think that National Parks Conservation Association is already partnering with the National Park Service in the climate-friendly parks program, which is also involving the environmental protection agency, as Director Jarvis alluded to earlier.

And you look at a park like Joshua Tree National Park that's taking some really fantastic steps, you have solar panels on shade

structures, that before they even put in the solar panels they were looking at ways to make the buildings more efficient.

The Park Service is leading by example, in my mind. And we would want to continue to support them.

Mr. GRIJALVA. Thank you.

Ms. Watson, one other question. Then there's one for everybody. Two for everybody.

In your testimony, you talk about managing for change. Can you expand on that briefly.

Ms. WATSON. Sure. I think that in terms of managing for changes, I said earlier we don't know what's going to work in every instance and, therefore, we need to be willing to experiment with new forms of management at the same time we use some other controls of existing management to measure against.

I think we also need to be looking at not only what has worked, but be willing to explore new concepts like the U.S. Climate Reserve that I mentioned in my written testimony, and create new tools that could be part of managing for change in the future. I think there are any number of ways. I could go on for some time, but I'll stop there.

Mr. GRIJALVA. Well, I appreciate that.

If all of you could as briefly as possible respond, Mrs. Napolitano needs to ask questions. She's giving me a dirty look. I'm not looking that way but—

Mrs. NAPOLITANO. He can feel it.

Mr. GRIJALVA. I can feel it.

Cap and trade could guarantee a revenue stream for the parks systems and the public lands. We've also talked about the need to expand, increase, supplement efforts that are going on, initiate corridor activity, initiate adaptation and restoration, planning and projects that are not part of the landscape right now. And many have seen that cap and trade as a resource that can be tapped. Your reactions.

Ms. WATSON. Well, I'll start.

I think that absolutely there are any number of priorities that can and perhaps should be funded as legislation moves forward. I think the role of public lands and natural resource adaptation is especially critical in funding for some core components of that. I think supporting new investments in the kind of management for change that we were just talking about would be critical, providing some funding for what works now, existing activities around restoration, planning, research, and education that some of the other witnesses have talked about. But also encouraging investment and habitat acquisition and protection will be critical. The land, water conservation fund and other sources of funding I think have to be part of that equation.

Mr. GRIJALVA. OK. If there's a reaction. It's not necessary.

Mr. CIPRA. National Parks Conservation Association would definitely agree that there be a balance between some of the things we talked about in terms of education. LWCF funding for acquisition of crucial wildlife. People are saying wildlife corridors; ecological linkages is a great way to put it as well. And I think for National Park Service and other Federal agencies to be able to deal with it on the ground effect of climate change.

Mr. GRIJALVA. Professor, any comment on that?

Mr. KEITER. I think I would echo what the other witnesses have said, that some funding source I think would be necessary to improve coordination, facilitate large-scale landscape management, and in particular to provide funding to induce additional collaboration and cooperation from state, tribal, and private landowners through the contingent funding mechanism that is available from Congress.

Mr. GRIJALVA. OK. Now, that's one of the things that worries me, that we might have legislation that will have all the authorizing language that we want, but nothing behind it. And so I think as we look at this legislation, we want to explore what the variety of revenue streams are available in order for whatever we are legislating. Actually there's an opportunity for the public lands area, watershed areas, et cetera, to be able to carry out some of these things.

The question I'm going to send to you is about the earlier question I asked about balance. I think that's an important question, and even as part of this discussion. We talked about using damaged land as a primary site and not for renewable activity. Talked about buffering along some very important areas, interagency cooperation where other ideas that were mentioned. But I still think this balance definition question for our land managers and our leadership in the Park Service is essential that we get around to that as quickly as possible. Because I think otherwise, we're always going to be fighting the battle over the latest initiative as opposed to having some plan that we're working over. So, I would send that to you. And if you could respond to it, it will be very helpful.

Mrs. Napolitano?

Mrs. NAPOLITANO. Thank you, Mr. Chairman. And yes, I'm chomping at the bit.

Mr. Keiter, I have a lot of questions. I may have to submit some of them in writing. But you state on page 3, the first paragraph, in regard to the threatened activities, you include oil and gas development on nearby Federal and state lands, too many roads, too much regulated off-road vehicles activity, ill-planned subdivisions. So, we see that in many areas. But how prevalent is the use of these public lands in regard—because I know they use a lot of water, number one. But do they clean it up? And is there a funding mechanism to be able to force that, going after the potential responsible parties, the PRPs, if you will. And our talk in Moab is a perfect example of how we need to know how many of these are left untended and will have to be cleaned up at taxpayer expense.

Mr. KEITER. You're talking about the aftermath of energy development—

Mrs. NAPOLITANO. Correct.

Mr. KEITER.—or other mineral development in particular.

Mrs. NAPOLITANO. Correct, on public land.

Mr. KEITER. On the public lands, yes. Well, there are some studies available—and I can't recite them off the top of my head—from the Congressional Research Service and other government entities, that document the legacy of some of the mining and energy development activities on the public lands. By and large my observation is that when we get into the energy development field, the larger

energy companies seem to be pretty good about taking care of the developments that they pursue. The ability of some of the smaller companies to do that is questionable, based upon again observation.

Mrs. NAPOLITANO. OK.

Mr. KEITER. In this instance, the law provides some backup but it doesn't—it needs people available to enforce it.

Mrs. NAPOLITANO. Thank you.

So, this goes back to the funding, to be able to follow and be sure that those entities have left the same or better as they found it when they were doing their projects.

Mr. KEITER. There generally are reclamation obligations attached. But again, they're not always followed through on.

Mrs. NAPOLITANO. Then also on page—the same one, you talked about ESA. The Endangered Species Act protects Federally listed species and their critical habitat but only applies when listed species are present, and not always rigorously enforced. Would you clarify that?

Mr. KEITER. The point I was trying to make there is that in addition to the various Federal lands and the private lands that make up the larger landscape, the Endangered Species Act functions as something of an umbrella for protection across the landscape so long as a Federally listed species is present. And it serves to constrain the management decisions, both the Federal land managers and private landowners. And this is perhaps most obvious when you think about the Northwest Forest Plan that was put in place back—what is it now, 15 or so years ago. Driven in large part by the presence of several endangered species, most prominently the Northern Spotted Owl. And it's the presence of that species that then forces everyone together to coordinate their management activities. In the absence of a wide-ranging Federally listed species it is difficult frequently to bring the diverse land management agencies and landowners together for conservation management objectives.

Mrs. NAPOLITANO. Well, sometimes there are discussions in Washington committees about ESA being responsible for a lot of things, that they do not take endangered species that have now been protected and have reached a level of—they should be dropped off the list, in other words. Is there something there that we need to start looking at?

Mr. KEITER. It seems to me that the criteria for listing a species under the Endangered Species Act—and there are five of them in the statute—are the same criteria for delisting a species. And, by and large, I think that if applied fairly and in an appropriate scientific manner, those are workable standards. And we do have some examples of species coming off of the list. We have some that have been controversial. But I think by and large the basic standards that are there work pretty well. And they've been refined sufficiently by agency interpretation and judicial interpretation so most of the folks know what the rules of the game are today.

Mrs. NAPOLITANO. Well, given a lot of what's been reported that climate change is going to reduce a lot of these species and there is a great thrust to continue protecting them, whatever the cost, would—some people say—pit people versus the ESA's list? What is

it that Congress needs to do to be able to address it and have a win-win, rather than an argument that takes it to court and only attorneys win?

Mr. KEITER. A good question. There certainly has been plenty of litigation under the Endangered Species Act. There are several I would characterize them as sort of modest reform proposals that have floated around in Congress over the last decade roughly. And several of those make some sense to me. I don't see the need for radical revision of the Endangered Species Act. Some of the administrative changes that were put in place during President Clinton's tenure that opened the door for the creation of multiple species habitat conservation plans alluded to in earlier testimony today provide a vehicle to get people together for planning under the—to live with the Endangered Species Act, it seems to have worked reasonably well in most locations. So, I don't see a need for radical change.

The one thing I do allude to in my testimony that might be helpful would be for Congress to come forth with an explicit biodiversity conservation mandate for all of the Federal land management and perhaps even water management agency as part of their organic missions with the view that if they are proactive in conserving biodiversity that will potentially guard against later listing. And so if we can get out in front of the curve and avoid the Federal listing and the sort of regulatory mechanisms that come with it, I think we would be ahead of the game. So, I would recommend that as something for the Subcommittee to think about.

Mrs. NAPOLITANO. Some might see the mandate as another regulation on top of other regulations—but you're right, you have a good point.

Ms. Watson, on page 3 of your testimony—in the second paragraph—you talk about something I find very interesting—the room-to-roam statement. In my area, we are at the other end of the spectrum. And I've heard it in other testimony that wildlife habitat is being encroached upon by development, and so they're being pushed and there's not enough room for them to roam. So, they're coming down to districts like mine because of food scarcity and water scarcity. What is it that we can do then? What's the impact? What it is that people need to understand is a valuable lesson for us to learn about both these things that are happening.

Ms. WATSON. I think it's a really critical issue. And I think we—in addition to having large core areas, in some places we're finding aren't large enough, we need to not only consider expansion of those areas where that's possible, but also looking to the issues of corridors and how to manage for migratory patterns and give wildlife the ability to move from one large core area to another. I think that's something the Western Governors' Association and other folks who have testified have talked about in some detail—and that we strongly support.

Mrs. NAPOLITANO. But if there's not enough water, there's not enough habitat, and the animals are coming down into habitated areas to find food.

Ms. WATSON. Right.

Mrs. NAPOLITANO. So, how do we address the issue of them being fed or balancing the ecosystem so they have their own source of food in those quarters?

Ms. WATSON. I think that it's a really challenging question, particular as we think about the impacts of climate change. And as that scenario becomes more likely where their core habitat is so impacted that they need to move elsewhere, I think really we need to study more of what is needed to not only provide the resources in those core habitats but also understand more where they're going to go, and certainly the impacts on communities in California and elsewhere when that happens. I don't think there is one answer, unfortunately. But we look forward to working with the committee as this becomes more and more an issue.

Mrs. NAPOLITANO. Mr. Cipra, I have heard especially in my Subcommittee that the government owns a large amount of U.S. Land; in other words, in California, maybe in Colorado, maybe in Utah some, that they need to be able to sell off so that we can have more economy. Kind of flies in the face of some of the things that we talk about, adding to park land and conserving land for future use. I have a great-grandson so I have a great stake in this.

But a lot of it is owned by the conservancies and parks and historical sites, et cetera. How do we counter some of those challenges from some of the business community who would like to see land opened, especially for logging and mining and all those things?

Mr. CIPRA. Well, I think it's important to recognize how much our public lands contribute to our economy. And I think that recognition is absolutely critical. And I don't think it's a matter of countering an argument, I think it's a matter of bringing folks in and recognizing that that's the life blood of a lot of communities.

This park, for example, generates \$45 million annually for local communities. And I think when people recognize that, they're supportive. And this park has a very good relationship, for example, with the City of Twentynine Palms, with the town of Yucca Valley, with Joshua Tree as well.

So, I think it's a matter of bringing people in and to think about the public lands and wildlife corridors and ecological linkages when we're creating those, when we're establishing those. And for those to have long-term viability you have to bring in stakeholders. You have to bring in people who do own the private land in that area, and those people have to be part of the process.

So, I would recommend full and open process and partnerships between the parks and local communities.

Mrs. NAPOLITANO. Well, it's all right when it's local communities. When outside come in and try to benefit from it and the whole issue is, go in, dig it in, and leave it. And that to me is a concern.

Thank you, Mr. Chair.

Mr. GRIJALVA. Thank you.

And thank all the witnesses today. Very informative. And as we go down the road in formation of this legislation, let me first of all thank Mr. Jarvis. I think for me he crystallized where I began with this process, which is the canary in the mine in terms of climate change, that we had an opportunity here, and I still see this as an opportunity to be very effective, set some wonderful examples, about how to begin to deal with this very vexing issue.

There are political minefields ahead of us. I know that. But nevertheless I think that effort of protecting the very precious resources of this nation is worth the walk.

With things today about resources, i.e., funding, those good well-written gestures without the backbone of resources is not going to do anything. An institutional agency mandate about cooperation and shared responsibility and coordination on this issue, and public land and water resources. We see it as a critical core to climate change legislation, and our intent is to work on it in a more detailed and specific manner as we go forward.

I want to thank you very much. The key point today was inter-agency cooperation. Another key point today, I think Mr. Jarvis as well said, the park system and our public lands could be in a leadership role on this issue, not only nationally but internationally if we grip this question with the kind of urgency that I think we should.

I want to thank everybody. The issues of adaptation, restoration, linkages, and necessary mandates are all part of the discussion in this legislation—as well as the funding. So, I appreciate it. You’ve brought us farther than we were. And we’re very appreciative of that.

And the meeting is adjourned. Thank you.

[Whereupon, the Subcommittee was adjourned.]

