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IMPACTS OF CLIMATE CHANGE TO NATIONAL PARKS

HEARING

BEFORE THE

SUBCOMMITTEE ON NATIONAL PARKS

OF THE

COMMITTEE ON
ENERGY AND NATURAL RESOURCES
UNITED STATES SENATE

ONE HUNDRED ELEVENTH CONGRESS

FIRST SESSION

TO

RECEIVE TESTIMONY ON THE CURRENT AND EXPECTED IMPACTS OF CLIMATE CHANGE ON UNITS OF THE NATIONAL PARK SYSTEM

OCTOBER 28, 2009

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IMPACTS OF CLIMATE CHANGE TO NATIONAL PARKS

WEDNESDAY, OCTOBER 28, 2009

U.S. SENATE,
SUBCOMMITTEE ON NATIONAL PARKS,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The subcommittee met, pursuant to notice, at 2:10 p.m. in room SD–366, Dirksen Senate Office Building, Hon. Mark Udall presiding.

OPENING STATEMENT OF HON. MARK UDALL, U.S. SENATOR FROM COLORADO

Senator UDALL. The Subcommittee on National Parks will come to order.

Good afternoon. Welcome to all of you. This is a hearing I have been looking forward to holding for a number of months.

I want to start with an opening statement. I will turn to the ranking member for his opening statement, and then we will turn to the Director of the National Park Service for his comments.

The purpose of today's hearing is to consider the impacts of climate change on the National Park System. Understanding the challenges of climate change and how they are affecting the National Park Service is an issue that is important to me and certainly is one of the major management challenges facing the National Park Service.

Last August, the subcommittee held a hearing in Estes Park, Colorado to better understand the impacts of climate change on national parks in Colorado. I was pleased that Senator McCain was able to join me at that hearing, and we had a very good discussion on the climate-related challenges facing Rocky Mountain National Park and other parks in Colorado. I hope to use today's hearing to continue to build upon that discussion by broadening the scope to look at climate-related impacts to all units of the National Park System throughout the country.

The recent Ken Burns' PBS documentary on national parks reminded millions of Americans of the incredible and varied resources that are conserved and protected in the National Park System. As the documentary showed, it took incredible vision to set aside these lands during a period of development, expansion, and growth in our country. Despite the challenges that were overcome to protect these areas, they now face new threats to their long-term viability, and I am not sure of any long-term management issue more significant than climate change.

The climate issue is unique in that it is sweeping and unprecedented in scope. While many of our parks are relatively pristine, they are not immune to the rising temperatures that threaten fish and wildlife habitat, the increase in invasive species that displace native plant life, and the loss of irreplaceable artifacts and archeology that may be submerged with rising sea levels. While climate impacts can vary across individual regions and landscapes, it is likely that many parks will see drier summers, fewer snowfalls, and more intense wildfires. Temperatures are expected to rise most dramatically in higher latitudes, affecting high alpine ecosystems and habitat.

To a large degree, our Nation's parks are the canary in the coal mine when it comes to the on-the-ground changes due to the impacts of a warming climate. These impacts are real, significant, and can have lasting effects on these resources and our ability to protect them.

Senator McCain and I took a brief tour of Rocky Mountain National Park before the August hearing to look at places where climate change impacts are occurring. Unfortunately, the sorts of things we saw—such as trees killed by a bark beetle epidemic that has been exacerbated by a warming climate—are being felt throughout the National Park System.

As an avid park supporter, I want to ensure that our national treasures are understood and protected for generations of Americans to come. I am looking forward to learning about the impacts and the challenges we face in managing the park system in light of the challenges posed by climate change.

As I mentioned earlier, in a few minutes we will hear from the new Director—congratulations again, Director Jarvis—of the National Park Service who has a long history of working on this issue, and we also have a distinguished panel of witnesses, each of whom brings a unique perspective to this issue.

At this time, I would like to recognize my friend and the ranking member of the subcommittee, the Senator from North Carolina, Mr. Burr.

STATEMENT OF HON. RICHARD BURR, U.S. SENATOR FROM NORTH CAROLINA

Senator BURR. Mr. Chairman, I thank you.

Mr. Jarvis, I welcome you, as I will our other panelists.

I want to thank you for holding this subcommittee hearing. It has been about 3 months since we have had the opportunity to have a hearing and address the issue of the changing climate as it relates to our national parks.

Our parks provide Americans with an excellent source of solitude, wilderness, and a glimpse in our Nation's history. I agree with you, the PBS special that was run—I have contacted PBS and asked that 99 copies be delivered to other members' offices so that those that did not have an opportunity to see it will have that opportunity.

We must be good stewards of these national treasures so that they are preserved for the enjoyment of future generations.

I also hope that my colleagues, both sides of the Congress, will allow science and science alone to drive our policies in the future

and, more importantly, our investments as it relates to the efforts on climate change.

I look forward to the witnesses today, what they provide as a snapshot at this point in time. I believe that policy of this significance is snapshots over a continual period of time as we see changes that we might not have anticipated or changes that alter what in fact we anticipated.

I also look forward to hearing from the director today specifically on how climate affects our parks, and we might sneak in some other questions since he has come into this position.

I also want to thank the chairman for the time he has provided.

Senator UDALL. Thank you, Senator Burr.

Without further ado, let us move to Director Jarvis. Again, welcome. It is a treat to have you here and we look forward to your testimony. then we will direct some questions your way when you are finished.

STATEMENT OF JONATHAN B. JARVIS, DIRECTOR, NATIONAL PARK SERVICE, DEPARTMENT OF THE INTERIOR

Mr. JARVIS. Thank you, Chairman. Thank you, members of the committee. I greatly appreciate this opportunity to come to this body and speak on this major issue of climate change.

For nearly a century, the National Park Service has been charged with managing the parks, as mandated by the Organic Act of 1916. In that history, as well articulated by Mr. Burns, we have faced a lot of challenges, but the challenge of climate change is probably one of our greatest. It is a challenge to maintaining America's natural and cultural heritage unimpaired for future generations.

Secretary Salazar has prioritized the issue of climate change within the Department of the Interior and recently issued a secretarial order on September 14, 2009, establishing a climate change strategy to integrate the work of the various Department of the Interior bureaus to mitigate and adapt to the effects that we are already seeing and those that we anticipate from climate change.

The National Park Service's climate change strategy will complement the secretarial order by developing a focus on sort of three areas. Collaboration at the landscape scale, amongst all of the bureaus, particularly to derive appropriate scientific information and to develop adaptation strategies. There will be a mitigation strategy as well that is developed through and incorporated into all of our planning processes and a communications strategy that relates to both communication internally and with the public about the climate change effects that we are seeing.

The management implications for protecting species, biological communities, our visitor facilities, and cultural resources within park boundaries in a rapidly changing climate are very complex and frankly without precedent. We are already documenting accelerated melting of mountain glaciers in places like Glacier National Park and the North Cascades and reduced snowpacks and changing in the timing of stream flows that affect terrestrial and aquatic communities in our mountain parks. These have direct effects on species such as wolverine and lynx which depend on winter snow and icepacks.

The coastal parks are already seeing changes to their shorelines and their boundaries and expect even greater as sea levels rise. Marine ecosystems already show signs of coral bleaching and disease caused by increased sea surface temperatures that have resulted in the loss of more than 50 percent of the reef-building corals in the Virgin Island parks since 2005.

Fire ignitions are occurring both earlier and later in the seasons and now fires in some places have increased in both frequency and intensity, changing native and animal plant communities and contributing to the spread of exotic species.

Cultural resources are often, I think, forgotten in this process are also going to be affected by sea level rise and climate change. For instance, archeological sites and historic structures are being already damaged by these effects at Fort Jefferson, Dry Tortugas, and at Jamestown in Colonial National Historic Park.

As I mentioned, we are developing a strategic framework that I will detail briefly but am open to any questions in terms of mitigation, adaptation, and communication.

First in the area of mitigation, the NPS is leading by example by reducing our own park carbon footprint and promoting sustainable operational practices. We have set a goal in the National Park Service to exceed the Federal requirements for reducing total energy use in NPS operations, and we have established very specific goals to reach by 2016, which is the 100th anniversary of the National Park System. We want to establish a leadership role in sustainability and meeting and exceeding the Department of the Interior greenhouse gas emission goals. We already have programs like the Climate Friendly Parks Program and the Energy SmartPARKS Program as key ways that NPS can use to reduce greenhouse gases through emission inventories, climate action planning, energy conservation, and renewable energy.

There are already activities in these fields. In the Pacific West, where I was the regional director for the last 7 years, we have heavily implemented the Climate Friendly Parks Program and we are now generating over 4 percent of our own energy from renewables.

Today the U.S. Department of Energy is honoring two NPS facilities in their annual Federal Energy and Water Management Awards, one of which is the visitors center at Lassen Volcanic National Park which is receiving an award for achieving the leadership in energy and environmental design, or LEED, certification at platinum. That is the highest level that can be achieved. This is the first year-around visitor center in the National Park System to achieve a LEED platinum. It is also the first Federal building in the State of California to achieve LEED platinum. The Blue Ridge Parkway Destination Center, which opened in 2007, achieved a LEED certification of gold for its green roofing and low-flow plumbing.

So all of these kinds of efforts are great because they reduce our footprint, but they are also opportunities to demonstrate sustainability to the public.

We have 84 photovoltaic solar panels now operational on and around the Grand Canyon visitor center, which reduces 30 percent of their energy demand for that facility.

The second piece is adaptation, and in this case the broad impacts of climate change require us to begin to think and act at the landscape scale. The NPS will fully participate in the Department of the Interior-proposed landscape conservation cooperatives and the regional climate change response centers that will include partners like universities, tribes, States, other Federal agencies, private landholders, and all the other partners out there that have a stake in the changes that we are going to see at the landscape scale.

These are integral to providing the key scientific and technical support to managers and to partners for developing and implementing conservation strategies at the landscape scale. We hope to use new technologies and new strategies to help our parks be more resilient to the changes we expect to see.

The third leg of the stool is communication. With 275 million visitors to our national parks annually, we can serve as models of sustainability, adaptation, and as platforms to effectively communicate information about the effects of climate change. Information that parks provide can be a catalyst for visitors to do their own part to assist in energy conservation and the effects of climate.

The National Park Service, in conjunction with other Federal agencies, has developed a Climate Change, Wildlife and Wildlands Toolkit that interpreters in parks, zoos, aquariums, science centers, and outdoor classrooms across the country can use to help us talk about climate change.

We are also in parks making climate change information available through brochures, wayside exhibits, interpretive programs, and handouts. Information is also available on our Web site.

This administration has embarked on an ambitious and much-needed strategy to reduce the generation of greenhouse gases and our dependence on foreign oil. The National Park Service supports this effort and is committed to working with Department of the Interior and other agencies to ensure that this is done in a way that protects our national parks and our natural and cultural heritage.

Renewable energy development is not without its environmental impacts. We must make sure that these are the right projects, they are being permitted in the right locations, and they are done in the right way. The National Park Service is committed to engaging actively with all the agencies that are involved in this for proposed renewable energy projects near or adjacent to national parks.

In conclusion, our efforts to date are significant but there is much work to be done. Our actions will require involving interagency and intra-agency cooperation and leadership to build on the collective knowledge and to create solutions for protecting resources and resource values and providing for appropriate visitor enjoyment. Parks are reference markers upon which we can measure the effects of climate change. So one of our most precious values is our ability to teach us about ourselves and how we relate to the natural world. This important role may prove invaluable in the near future as we strive to understand and adapt to a changing climate.

Thank you for this opportunity to present this testimony, and I am ready for any questions you might have.

[The prepared statement of Mr. Jarvis follows:]

PREPARED STATEMENT OF JONATHAN B. JARVIS, DIRECTOR, NATIONAL PARK SERVICE, DEPARTMENT OF THE INTERIOR

Mr. Chairman and members of the subcommittee, thank you for the opportunity to present testimony on the impacts of climate change to National Parks. For nearly a century, the National Park Service (NPS) has been charged with managing the parks within the breadth and complexity of our mission as mandated by the Organic Act of 1916. While the NPS has faced daunting challenges to effective natural and cultural resource management since its inception, park managers are currently facing an increasing array of dynamic issues and unprecedented challenges, more than any encountered in the history of the National Park System. Climate change is our newest, greatest challenge to maintaining America's natural and cultural heritage unimpaired for future generations.

Secretary Salazar has prioritized the issue of climate change within the Department of the Interior (DOI). Secretarial Order No. 3289 of September 14, 2009, established a climate change strategy to integrate the work of each DOI bureau to mitigate and adapt to the effects of climate change in the pursuit of their respective missions. Recently, DOI met with Congressional staff to describe this new approach to climate change adaptation and mitigation activities.

The NPS Climate Change Strategy will complement the Secretarial Order. We are holding scenario planning workshops, assessing the vulnerability of facilities and cultural and natural resources, acquiring data and implementing a climate friendly parks program. Our climate change response steering committee is developing a strategic plan that will be presented to me and my NPS National Leadership Council. This plan will include action items for responding to the Secretarial Order and will focus on collaboration at the regional and landscape level to develop scientific information and adaptation strategies; mitigate greenhouse gases; incorporate climate change into park planning processes; and communicate internally and with the public about climate change issues.

The National Park Service Cooperative Ecosystem Studies Units, Research Learning Centers, and Inventory and Monitoring networks have been designed to link science to management issues and they will be tapped to ensure that NPS needs and interests are addressed through the Regional Climate Change Response Centers and Landscape Conservation Cooperatives. Finally, with respect to the mitigation elements of the Secretarial Order, the NPS has taken a leadership role through the Climate Friendly Parks Program.

Since implementation of the Natural Resource Challenge nearly a decade ago, the NPS has been increasing its science capacity and the professional expertise of natural resource managers. However, there is still much to be done. Earlier this month, I announced the appointment of our first ever science advisor to the director. This new and important position will help build on existing NPS science programs and advance the role of science within our bureau as we meet the challenges and opportunities of the 21st century.

DOI and NPS are rising to this challenge, and today my testimony will focus on our observations of the effects and potential future changes related to climate change in national park units. I will also discuss the NPS actions and programs underway that will prepare us for the current and anticipated impacts from climate change.

THE EFFECTS OF CLIMATE CHANGE IN NATIONAL PARK UNITS

In October 2009, the Rocky Mountain Climate Organization and the Natural Resource Defense Council published a report entitled *National Parks in Peril. The Threats of Climate Disruption*. The report cited human disruption of climate as the "greatest threat ever to our national parks" and identified eleven types of risks our parks are facing. These risks include loss of ice and snow; loss of water; higher seas and stronger coastal storms; more downpours and flooding; loss of plant communities; loss of wildlife; loss of historical and cultural resources; intolerable heat; loss of fishing; and more air pollution. This report shows broad public concern over the impacts of climate change to parks.

We have documented accelerated melting of mountain glaciers in national parks such as Glacier and North Cascades, disappearance of perennial snowfields in Alaska parks, reduced snowpacks and changes in the timing and amount of stream flow that affect terrestrial and aquatic communities in mountain parks. These impacts not only affect recreational opportunities including cross-country skiing and fishing, but the very species that depend upon winter snow and icepacks such as the ice worm, wolverine, and lynx.

Alaskan parks are seeing some of the earliest impacts of possible climate change—melting sea ice threatens marine mammals as well as coastal communities,

thawing permafrost destabilizes buildings, roads, and other facilities. Parks such as Yosemite and Great Basin are seeing high-elevation species, such as the alpine chipmunk, moving upslope, thereby reducing the effective area for their survival as well as those species that prey upon them. (Moritz et. al. 2008)

Coastal parks are a central concern. 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 4.1 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.

Park coastal ecosystems are significant habitats for the production and health of recreationally and commercially valuable fish and shellfish; they provide important ecosystem services, and offer beautiful landscapes for marine recreation and wildlife watching. The U.S. government's recently-released landmark report, Climate Change Impacts in the United States (2009), identifies a variety of changes these ecosystems are forecast to undergo. Such changes in a park context may include shoreline and park boundary changes as sea level rises. Already observed changes in marine ecosystems include coral bleaching and disease caused by increased sea surface temperatures that have led to the loss of more than 50 percent of reef-building corals in the Virgin Islands park units since 2005 (IPCC 2007, Hoegh-Guldberg 1999, Buddemeier 2004).

NPS data indicate 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 both frequency and intensity, changing native plant and animal communities and contributing to the spread of invasive exotic species (Westerling et al. 2006). Wildland fire frequency and intensity also are impacting cultural resources, as hotter fires and our efforts to fight them directly damage both surficial and buried archeological sites.

Because the amount of precipitation stored as snowpack is expected to decrease and annual snowmelt is expected to commence earlier in the spring in mountain states such as Colorado, the overall expected effect will be decreasing volume of water available annually for storage in Colorado River basin reservoirs (IPCC 2007). It is also thought that there will be increased year-to-year variability in basin hydrologic conditions and decreased certainty as to the amount of annual water production (Guido 2008 and Knowles et al 2006). Given these expected changes and the present allocation of Colorado River Basin water resources and the ever-increasing demand for water in the southwest, the expected changes will present challenges to both water and park resource managers.

While some impacts from climate change are already measurable, the long-range effects of climate disruption on park natural and cultural resources, developed infrastructure, and visitor experience are just beginning to be understood. The management implications for protecting species, biological communities, and physical resources within finite land management boundaries in a rapidly changing climate are complex and without precedent.

Cultural resources are also expected to be significantly affected by climate change. For example, rising water levels are already damaging archeological sites, historic structures, and cultural landscapes such as Fort Jefferson in Dry Tortugas National Park (Florida), Jamestown in Colonial National Historical Park (Virginia), and Ellis Island National Monument and the Statue of Liberty National Monument in Upper New York Bay. 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 ancient shell middens at George Washington's Birthplace National Monument and on the coast of Everglades National Park. 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 accelerated erosion from rising seas and more intense storm surges.

The focus of the climate change discussion has largely shifted from the evidence that climate change is occurring 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 climate change challenges to parks, NPS is working with DOI to undertake a collective and coordinated strategy that builds upon and expands existing partnerships such as those between NPS, other bureaus, and non-governmental stakeholders. Building the capacity to respond to climate change will involve identifying, linking, prioritizing, and implementing a range of short and long-term activities. NPS's ability to work cooperatively with other federal agencies, states, local agencies and the public to address the cumulative impacts of climate change on park natural resources was greatly improved with the passage of section 301 of the *Consolidated Natural Resources Act of 2008*, which authorizes NPS to spend appropriated funds cooperatively on work conducted outside park boundaries for the purpose of protecting park natural resources.

The NPS now is developing a strategic framework for action that will detail short and long-term actions in three major areas: mitigation, adaptation, and communication. The framework will address park, regional and national-level needs and concerns by incorporating actions to address the core elements associated with proactive climate change impact management—Legal and Policy; Planning; Science; Resource Stewardship; Greenhouse Gas Emission and Sustainable Operations; and Communication.

Some of our key actions to date include:

- Initiating the Climate Friendly Parks Program in 2003 in conjunction with the Environmental Protection Agency. The program promotes sustainable operations in parks and creates park climate action plans to reduce greenhouse gas emissions. It now involves almost 60 parks.
- Utilizing Environmental Management System Plans to track and reduce park environmental impacts and set targets for sustainable park operations.
- Hosting or participating in a series of regional and interagency workshops to explore climate change impacts and coping strategies over the past three years.
- Adopting an Ocean Park Stewardship Action Plan in 2006 to guide actions to address ocean-related climate change impacts.
- Forming a service-wide Climate Change Response Steering Committee to foster communications, provide recommendations, and serve as an advisory body to NPS leadership.

Successful park approaches to mitigating climate change impacts require the very best science, including physical, biological, social, and cultural disciplines. Since 1999, NPS has used strategically placed Research Learning Centers throughout the country, in addition to the Cooperative Ecosystem Studies Units (CESU) Network to collaborate with leading research institutions, including universities, NGOs and State and federal partners, to provide the necessary science for informing sustainable adaptive management of park resources. The 17 CESUs in the network cover all regions of the country, with a total of 250 partners including 13 federal agencies. The program has been highly successful in producing cutting edge collaborative research and providing technical assistance and capacity building for the NPS, State and local agencies, and other federal and non-governmental partners.

LOOKING TO THE FUTURE—MITIGATION, ADAPTATION, COMMUNICATION

While efforts to date are significant, much work lies ahead to address climate change impacts on park resources and visitor enjoyment and to respond strategically to those impacts in ways that are compatible with park purposes and values. Our actions will necessarily involve strong intra-and interagency cooperation and leadership to build on collective knowledge and to create new solutions for protecting resources and resource values and providing for appropriate enjoyment.

MITIGATION—LEADING BY EXAMPLE

In the area of mitigation, the NPS is leading by example by reducing park carbon footprints and promoting sustainable operational practices. The NPS has set a goal to significantly exceed the federal requirements for reducing total energy use in NPS operations and having a portion of park energy come from renewables by 2016, the 100th year anniversary of the establishment of the National Park Service. We also look forward to taking a leadership role in meeting or exceeding the DOI greenhouse gas emission reduction goals developed in response to Executive Order 13514 on Federal Leadership in Environmental, Energy, and Economic Performance issued October 5, 2009.

The Climate Friendly Parks Program and the Energy SmartPARKS Program are two of the key ways that NPS is mitigating greenhouse gases through these areas of emphasis:

- Emissions Inventories: Parks quantify and track their emissions and identify specific areas where reductions can be most readily achieved.
- Climate Action Planning: Parks use the Climate Leadership in Parks (CLIP) tool to identify carbon reduction goals and actions to follow through on these goals. Almost sixty parks are now in the process of completing these plans.
- Energy Conservation: Significant portions of greenhouse gas emissions in parks come from transportation, energy consumption in buildings, 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 energy from renewable sources, such as photovoltaic systems and geothermal heat exchangers. 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.

NPS regions are also moving forward with their own climate change initiatives. For example, the Pacific West Region (PWR) 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 greenhouse gas targets. The 58 parks in the region have set a target of becoming carbon neutral for park operations by 2016 and now generate over 4% of their energy from renewable sources.

SAFEGUARDING AND PROTECTING PARK RESOURCES, STRUCTURES, AND USES—ADAPTATION PLANNING AND IMPLEMENTATION

While mitigating the causes of climate change is essential, parks must plan now for adapting to the resource and visitor use impacts of climate change. Worldwide, national parks and protected areas represent the core areas, refugia, and often, habitat and source populations for species which disperse nationally and internationally.

Within North America, declines in native species populations and their ability to persist have been observed, and climate change and habitat loss and fragmentation are among the factors contributing to these declines. Over 800 animal species that occur in national parks migrate beyond boundaries through air, water, and over land. Because animal species do not detect jurisdictional boundaries, the success of recovery programs for imperiled or at-risk species often depends on cooperation and collaboration among our nation's governmental agencies, non-governmental organizations, private landowners, and the international community.

Given the broad impacts of climate change, management responses to such impacts must be coordinated on a landscape-level basis. Enhancing scientific expertise within the Service will enable NPS to expand formal relationships with partners outside park units who share our concerns, and will foster development of cooperative projects to further conservation of shared species and their habitats.

The NPS will fully participate with each of the DOI-proposed Landscape Conservation Cooperatives (LCC) and Regional Climate Change Response Centers (RCC) including universities, tribes, states, federal agencies and other partners and stakeholders. The LCCs and the Regional Climate Change Response Centers are integral to climate adaptation efforts, providing scientific and technical support to managers and partnerships responsible for developing and implementing conservation strategies at landscape scales in a changing climate. With these partners and others, we will use new technologies and strategies in a more unified approach to make parks key participants in continental conservation.

For adaptation planning and implementation, our highest priority is to support the ability of species, communities, and ecosystems to respond to changing conditions. For example, changes in weather patterns, water availability, and wildland fire will stimulate changes in the distribution and abundance of plants, animals, and ecological communities through both adaptation and migration. NPS actions to build resilience and reduce other ecosystem stressors, especially the effects of exotic species, will help to reduce the extent or intensity of some of the most deleterious impacts on park resources from climate change. NPS actions to restore currently de-

graded natural ecosystems can make them more resilient to future effects of climate change. These types of resource management activities are already occurring in national parks, but will become increasingly important as park management priorities. We need to intensify our exotic species control work and subsequent ecosystem restoration by developing comprehensive resiliency strategies for four initial focus areas: high altitude, high latitude, southwest arid lands, and ocean ecosystems. Examples of our current activities include the restoration of major ecosystems such as the Everglades; the establishment of marine reserves in units of the National Park System; removal of invasive exotic animals such as Burmese pythons, feral pigs, and goats; and reduction of the abundance and impact of exotic plant species.

A critical component for adaptation planning and implementation involves continuing to build our long-term science information and ecosystem monitoring (Vital Signs) capacities. The National Park System represents a wide range of ecosystems scattered across the nation, and therefore, embraces a broad spectrum of diverse natural environments. Because of this diversity, parks present tremendous opportunities to observe the effects of climate change on known resource conditions that park scientists and managers have documented over decades.

The NPS Inventory and Monitoring program includes 32 networks serving more than 270 parks, and data from this program are presently being summarized and synthesized to better establish the current condition of park resources and to provide a baseline against which to better assess and understand future natural resource conditions. Inventory and Monitoring networks are strategically positioned to help parks acquire the information they need to make informed decisions, to employ adaptive management, and to test alternative strategies for adapting park resources and visitor uses to the effects of climate change.

In addition to natural resource monitoring and condition assessments, we conduct condition assessments of cultural resources and ethnographic studies that include information on past and current subsistence uses of park natural resources. Information from these programs also informs state and other members of landscape-scale partnerships and provides valuable site-specific information for use by scientists looking at regional and national scale trends.

Although resource management planning for future decision-making must be based on expectations of future conditions, in an era of climate change, the future will be characterized by highly consequential and unprecedented changes that cannot be forecast with as much accuracy and precision as we would like. Consequently, during the next ten years the NPS will utilize a scenario planning approach that uses the best available science to explore a range of plausible "multiple working futures" and consider appropriate actions within each of those possible futures, including changes in park zoning, the landscaping of developed park areas with native rather than exotic species, and the design or location of buildings and roads and infrastructure. 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 and contribute to landscape-scale partnerships.

PARKS SERVE AS MODELS OF SUSTAINABILITY AND PLACES TO COMMUNICATE CLIMATE CHANGE INFORMATION

There is a great need at this time to communicate the complexities of climate change and the actions that can be taken. With 275 million visits annually, the parks can serve as models of sustainability and adaptation and as platforms to effectively communicate information about the effects of climate change. Information that parks provide can be a catalyst for visitors to do their part for climate friendly parks and beyond.

NPS is instituting a number of efforts to communicate the effects of climate change and its impacts to national parks. These include a monthly web-based seminar series featuring climate change experts on science, communication, and management topics. They also include interpretive training using a decision-tree for developing knowledge around individual aspects of climate change that will help park rangers to frame interpretive programs and answer visitor questions. The NPS, in conjunction with other federal agencies, has developed a "Climate Change, Wildlife and Wildlands Toolkit" that interpreters in parks, zoos, aquariums, science centers and outdoor and classroom educators across the country may use to talk about climate change. In addition, NPS in partnership with the U.S. Fish and Wildlife Service together are creating summaries of climate change knowledge for specific bioregions—a series of 11 bioregional documents envisioned to date—to summarize the current state of knowledge about climate change and impacts to protected areas in those bioregions, with a focus on national parks and refuges.

Looking forward, the NPS has a goal of every park having climate change information available through brochures, wayside exhibits, interpretive programs and handouts, and park websites. The Climate Friendly Parks Program has encouraged achieving this goal, and many parks, including Point Reyes National Seashore, Glacier National Park, Apostle Islands National Lakeshore, Everglades National Park, Dry Tortugas National Park, and Kenai Fjords National Park, make climate change information 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 own carbon footprints. In addition, NPS also is exploring ways to utilize its national preservation programs, such as Preservation Assistance and the National Center for Preservation Technology, to develop and disseminate information on sustainability, historic preservation, and guidance for adaptive reuse of historic buildings.

MEETING OUR NATION'S RENEWABLE ENERGY GOALS WHILE PROTECTING TREASURED LANDSCAPES

The Administration has embarked on an ambitious and much needed strategy to reduce the generation of greenhouse gases and our national dependence on foreign oil in a way that safeguards our environment. As part of that strategy, the Secretary has set specific goals for generating renewable energy from the public lands and the outer continental shelf, including solar, wind, geothermal, biomass, and hydroelectric projects. The Secretary has committed to fast tracking the compliance and the development of corridors to carry this energy to the areas of greatest demand. He also has made clear that he is committed to doing so in a manner that protects the environment, including our treasured landscapes.

The NPS supports this effort, and is committed to working with DOI and others to ensure that the siting and permitting of renewable energy development, including energy transmission and needed ancillary facilities, is done in a way that protects our natural and cultural heritage. We definitely need to be "smart from the start." Renewable energy development is not without its environmental impacts. We must be sure that the right projects are being permitted in the right locations and in the right way.

The NPS is pro-actively engaging other agencies and project proponents to resolve concerns associated with proposed renewable energy projects adjacent to park boundaries. I will be meeting with my counterparts in DOI to further this coordination and collaboration.

CONCLUSION

Our national park units provide environmental baselines to track and assess change, and they stand as some of the last vestiges where species populations, essential habitats, and ecological components function naturally. National parks also serve as core essential habitats as well as critical habitats for source populations of species. To succeed in the face of climate change, the NPS must lead by example in minimizing carbon footprints and promoting sustainable operational practices to ensure that intact ecosystem services are sustained within and outside of park boundaries.

One of the most precious values of the national parks is their ability to teach us about ourselves and how we relate to the natural world. This important role may prove invaluable in the near future as we strive to understand and adapt to a changing climate. We must engage in an unprecedented level of collaboration and cooperation with other agencies and partners to ensure that scientific information is collected, analyzed, and applied to better protect resources and explain 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 am pleased to answer any questions members of the committee may have.

Senator UDALL. Thank you, Director Jarvis.

Let me recognize myself first to begin a round of questions.

As Senator Burr mentioned, we ought to really focus on science. I understand that there is a general consensus among scientists that park resources are being affected as the result of climate change in a wide variety of environments, whether they be coastal or alpine or desert, what have you.

Do you feel that the Park Service has a good handle on where these effects are happening and the severity of them? If not, what else would you like to see done?

Mr. JARVIS. First, I agree absolutely that the key to developing adaptation strategies and resilience and even communicating to the public—we need a very robust science program. As you may have heard, I have added to my National Park Service staff a science advisor, Dr. Gary Machlis, who is here with us today, to serve in that role, to help us synthesize and direct both the science we have and to help us procure and obtain the science that we need in order to better understand this.

The Department of the Interior is, in cooperation with the other bureaus and particularly led by the U.S. Geological Survey, going to launch a series of regional climate change response centers which are intended to be, for the most part, university-based, geographically focused on developing specific science, specific research that will help us design our future adaptation programs. It is intended to be applied science that will really assist our managers. I think the role of Dr. Machlis and our organization is to ensure that our managers are actually getting the science they need to address these things. I think in some areas we have fairly good science, and there are a lot of areas we really do not yet understand what these effects may mean.

Senator UDALL. In your testimony, you discussed the role of renewable energy on public lands. Director Jarvis, could you expand on how the NPS is working more broadly with the Department itself on developing renewable energy?

Mr. JARVIS. In two areas. One, in sort of our own house, we are looking to where renewables may be appropriate that are for our operations. We are really not looking on national park lands, nor should we frankly, to be producing renewable powers for export.

However, on the public lands that in many cases are immediately adjacent or within the environs of national parks, such as BLM lands, there are large proposals for major development of solar arrays, hydro-solar, hydro-kinetics, wind energy, all of those kinds of things. Then that energy must be moved via corridors across the landscape from perhaps places that energy can be developed to energy where it is really needed.

My experience thus far within the Department of the Interior where most of this work is being done has been a very robust and very cooperative relationship where all of us are at the table to ensure that as these developments are completed—and many of them are on fast tracks to get them done—that the National Park Service's concerns for connectivity, for wildlife corridors, for viewsheds, for water, for cultural resources effects are all being strongly considered as we develop this on a landscape scale. So we are very actively engaged in all of this at this time.

Senator UDALL. My time is expiring, but let me at least ask you one question that may take additional testimony for the record.

You have to manage within finite boundaries in an increasingly complex and rapidly changing environment and really without precedent, as you point out. Do you think you have the authority to manage for the ongoing and expected effects of climate change or those effects related to climate change?

Mr. JARVIS. At this time, I cannot specify any additional authorities that I think the National Park Service needs.

If there is any silver lining to climate change, it forces us as a country, as particularly Federal agencies that have this responsibility, to think and act at the landscape scale.

As you well know, the Federal estate of this country or the entire estate was divided up into specific boundaries, whether it was military reservations or Indian reservations or national parks or forests or BLM lands and then the private side as well. For many years, we have managed those with some expectation of predictability about their long-term sustainability and climate change challenges that, challenges us in a very large way, that perhaps for migratory species like migratory waterfowl, that these wetlands will no longer be there.

So the question becomes, where are they going to be, where should they be?

At this point, we are in that dialog. We are in that discussion, and I do not think we are ready yet to say we need new authorities. What we need is the commitment on the part of the Congress and the President and the Department of the Interior and the Department of Agriculture, as the other major land managers here, to really work cooperatively to look at strategies for long-term sustainability of these ecosystems.

Senator UDALL. Thank you for those answers.

Senator Burr.

Senator BURR. Mr. Jarvis, welcome. Let me go straight to sort of the Pacific West where you instituted a goal in 58 parks to have a carbon-neutral park operation by 2016. Let me ask, if I could, what was the cost of that program projected over that period of time?

Mr. JARVIS. We found that it depends on which—we set that goal and then we began to dive down into it to really understand it. A lot of it depends——

Senator BURR. But you had started instituting things, I think I heard you say in your testimony.

Mr. JARVIS. Yes, we had.

Senator BURR. What was the achievement of a carbon-neutral parks operation in 58 parks going to cost?

Mr. JARVIS. I do not have the bottom line figure on that. I do not know what that total would cost.

Senator BURR. So the Park Service, before starting this program, did not ask for what the price tag was going to be.

Mr. JARVIS. No, sir, we did not.

Senator BURR. Let me ask for a clarification. You talked about the reduction of electricity at the Grand Canyon by 30 percent, if I understood you, for Grand Canyon facilities.

Mr. JARVIS. That one facility.

Senator BURR. That one facility.

Mr. JARVIS. Yes, sir.

Senator BURR. Since the Grand Canyon derives their power from the Hoover Dam, therefore, reducing that electricity did not reduce carbon at all. Is that a wise investment if the goal is to reduce the carbon footprint?

Mr. JARVIS. As I understand the electrical system in this country, it is very much of an integrated system, and there is sort of a total demand and then some of that demand comes from green power and some of it comes from coal-fired powerplants or a variety of other sources. I think the goal here is, where we can, to look for those opportunities to add renewables where it is appropriate. I think what it does is it offsets the overall demand in that case.

Senator BURR. You are right in a general sense, but from the standpoint of our inability to store electricity when you have got something as massive as the Hoover Dam project, it means that that is either consumed or you cut back on your generating capacity. Yet, you still have the water flow. I only point out the point because you made it perfectly clear. The goal is to reduce carbon, to become carbon-neutral. I just found it odd that that would have been a project that we would have invested in since it had no impact on what the goal was.

Do you intend to expand this program park-wide?

Mr. JARVIS. We have not done the analysis nationwide to figure out how we would get our organization to sort of a carbon-neutral standpoint.

Senator BURR. So we would not know what that would cost for the entire park system.

Mr. JARVIS. No.

Senator BURR. I have heard that there is a goal of 2016, and I have heard that the 2016 was removed. Can you clarify that for me?

Mr. JARVIS. We are reconsidering whether or not we can bring the Pacific West—let me get down into the details on that. Under current regulations for power in, for instance, southern California, essentially if you are an agency like the National Park Service, we can produce power at the local site but, as they say, behind the meter. So I would have to, under current regulatory law, build enough solar arrays in Yosemite National Park in order to offset its use. That would be unacceptable for a variety of reasons. It is fairly obvious that you would not want to build that kind of solar array in Yosemite National Park. What I would like to be able to do is to build a solar array on other lands, perhaps abandoned mine lands some place like within the Mojave, that could offset Yosemite. But we do not have the regulatory authorities to do that at this time and that is one of the things we have been negotiating with the regulators and the power producers who are actually very supportive of this in concept, but in terms of current authorities, we are not there.

Senator BURR. Are you not also talking about regulating land adjacent to parks, buffer zones that are not under Park Service jurisdiction?

Mr. JARVIS. No, sir, we are not proposing any type regulation or buffer zones outside——

Senator BURR. Would you agree that to do that, you would have to have legislation passed in Congress in some fashion that would——

Mr. JARVIS. In order to regulate?

Senator BURR. Sure.

Mr. JARVIS. Absolutely. We are not proposing or even asking for that.

Senator BURR. Let me ask for just a clarification on your point about the increased fire hazards in parks and climate playing a role in that. Would it be wise for us to consider a timber harvest program more aggressive so that we can get some of that dry timber out to reduce the fire impact?

Mr. JARVIS. In the National Park Service, we do not allow that kind of timber harvest because it is in conflict with our organic legislation, and I really cannot speak to the other public lands in that regard.

I think what we need to do in my opinion is reevaluate our fire policies in terms of both how we use wildland fire, prescribed fire, as well as fuel reduction.

Senator BURR. I spoke incorrectly. I meant the fuel reduction program.

I thank the chairman.

Senator UDALL. Thank you, Senator Burr.

Senator Shaheen.

Senator SHAHEEN. Thank you, Mr. Chairman.

Congratulations, Mr. Jarvis, on your recent approval.

Mr. JARVIS. Thank you.

Senator SHAHEEN. I share the concern that you and the chairman have expressed about the impact that climate change is having on our national parks and applaud efforts to mitigate in whatever way you can those impacts and believe that what we need is legislation at the Federal level that is going to address this issue throughout the country, not just in the national parks.

While we do not have any national parks in New Hampshire, we are the home to Ken Burns who is the documentary filmmaker of the national park series, and he said that that has been one of the series that he has enjoyed most. So it is truly an impressive film.

I am actually here not, however, to discuss with you the impacts of climate change on our national parks, but to raise another concern that we have in the Northeast about what is happening with reorganization of the park office in the Northeast Region. As you may recall, I raised this concern with you at your nomination hearing. The reorganization is leading to the reduction of staff from 107 to 45 in the Boston regional office, a loss of 62 positions that are going to be replaced in Philadelphia actually, as I understand, with even more positions. The real impact for us is what is happening with parks programs in the Northeast and particularly in New Hampshire, the Rivers, Trails, and Conservation Assistance Program is one that we have relied on. It has made a huge difference for us as we have tried to protect special places in New Hampshire. I am very concerned about what the impact of this reorganization is going to be on that program and other Park Service programs in New Hampshire and throughout New England.

I understand that the plan has been in the works for some time. But when you were here at your confirmation hearing, I asked you about the status of the reorganization, and you committed that you would take a close look at what is being proposed once you were confirmed. You said—and I quote—"my commitment to you is to

take a very close look at what is being proposed in the Northeast Region and work with your office to find a solution."

Unfortunately, since we spoke, I received a letter that indicates to me at least that the decision has already been made, that the reorganization is going forward. I found that very disappointing and just wondered if you could clarify the status of the reorganization and whether, in fact, you are going to have an opportunity to take a close look at what is being proposed and consider whether to go forward with that.

Mr. JARVIS. Thank you, Senator. I actually have looked into this with some detail, and there are three parts to it. As you indicated, a lot of these actions, particularly the personnel actions, at the time of my confirmation hearing were already in play and related to offers of early retirement for, I believe, 22 employees, of which a number took those opportunities as Federal employees, which they can.

But I did insist on a reevaluation with the Regional Director of the Northeast, Dennis Reidenbach, to give me an alternative reorganization, which retained most of the existing staff in that office, which he has presented to me. We had a conversation on it this past week, which I think will retain pretty much all of the existing staff in that office.

The third piece, though, is that the Rivers and Trails Conservation Assistance Program, which is the community assistance arm of the National Park Service (it has nothing really to do with the units) it has been in decline for 8 years in terms of the budget. So those positions have just—I mean, you speak specifically of your home State, but across the country, these positions have been in decline. So it is an area that I want to regrow in the organization. I have hired a deputy director for community assistance, feeling that these are very important individuals and assets for the program. But that is an appropriations issue, but it is my intent—although fiscal year 2011 is really the first budget that I am having an opportunity to have any influence over—to talk about rebuilding the RTCA program, which can be collocated pretty much anywhere and certainly in your State.

So I am on top of this and would be glad to come by and give you the details on our proposed alternative.

Senator SHAHEEN. I would appreciate that, and we will contact your office about setting up a time. Thank you.

Senator UDALL. Thank you, Senator Shaheen.

I think we will do a second round, and let me recognize myself.

Director Jarvis, you talked about several park units that face a potential threat from rising sea levels. Could you talk about specific management tools that you are beginning to utilize to protect cultural resources in national parks from the effects of climate change? Of course, it would not just apply to coastal areas but those are very, very obvious.

Mr. JARVIS. Yes, chairman. The coastal areas are one of our highest concerns in terms of cultural resources. We have literally thousands of miles of coastal resources in national park units. For instance, in the Hawaii Islands on the big island of Hawaii, there are cultural resources that are very important to native Hawaiians like at Kaloko-Honokohau or Puukohola Heiau, and these potentially

will be impacted by sea level rise. So No. 1 is prioritizing their inventory to determine what is truly at risk, and if possible, in some cases, documenting them or, in some cases, collecting them if we really feel that they are going to be damaged by sea level rise or storm surge. I think in some cases it is going to require us to do a triage to say what is our highest value and what can be protected.

The second question, just what is uphill, we are working with the U.S. Geological Survey to do detailed mapping of our coastlines within the national parks, down to fairly tight detail, and then taking the predictive models of sea level rise to sort of look at what zone will have the predominant both effect of a sea level rise, as well as storm surge, and then refocusing our priorities in terms of inventory of cultural resources within those zones.

Senator UDALL. One of the most interesting adventures I had through the years was hiking the Olympic seashore during the winter during a high tide cycle and a storm cycle. Those are small beaches.

Mr. JARVIS. Did you make it up the slope before the waves hit——

Senator UDALL. There were some fairly desperate beach crossings trying to time it and not be caught up in the backwash of the huge logs and all the rest that the surf picks up. But I think just about that area and how it would be affected.

A little closer to home, talking about fish and wildlife, I was recently notified in the Black Canyon of the Gunnison National Park that the native Colorado cutthroat which has refuge there has lost 90 percent of its historic range according to experts. What will you do to ensure that fish and wildlife habitat remains intact across park units? What can you do, I should add.

Mr. JARVIS. I think particularly fish species that have depended upon snowpack, which as it melts through the summers, really retains the cool temperatures particularly that trout need, are going to be one of our greatest challenges.

Our two best partners in preserving wildlife and fish are the States and the U.S. Fish and Wildlife Service. I think these landscape conservation cooperatives that are being designed and being launched—there is funding in fiscal 1910 and fiscal 1911 to stand these up. We are already starting to make a determination of where the most sensitive environments are that we really need to stand these up and to put wildlife, in particular fish and wildlife which certainly do not pay any attention to administrative boundaries, are going to be the absolute key to figure out how we preserve these over the long term where these animals are going to have to move to in order to survive.

Senator UDALL. The National Park Service management policies say very little that directly refers to climate change. Should that document reflect more broadly the state of our knowledge and concern about climate change?

Mr. JARVIS. At some point, yes, but the management policies currently provide us, I think, the appropriate level of guidance in order to begin this process of understanding climate change and the effects. But I think within 3 or 4 years, when we really get these landscape conservation cooperatives up, we begin to really

focus the science and better understand these effects, then I think there are going to have to be at least some amendments ultimately to our management policies. But not at the moment.

Senator UDALL. Not at the moment. You would wait until we had more developed knowledge and——

Mr. JARVIS. Yes.

Senator UDALL [continuing]. Had a better sense of the field of play. Then that knowledge could inform revision of those policies.

Mr. JARVIS. Yes, sir.

Senator UDALL. Senator Burr.

Senator BURR. Mr. Chairman, I will be really quick.

Mr. Jarvis, I am really searching for your help in leading me in the direction to convince people on the Outer Banks of North Carolina, some old enough to remember when most of the banks were covered in ocean, that there is a fear for the developed end of those, as well as the Hatteras National Seashore area, that climate change makes them susceptible now to those barrier islands being gone, given that they remember when they were not there. How do I explain that to them?

Mr. JARVIS. I think it is a challenge, Senator. I think that climate change is a tough concept for a lot of folks to get their grips on. Our frame of reference as humans tends to be fairly short. Some of us have been around a long time, so it seems long. But I think that this is an effect that has been building for some time. I think this is one of the roles of the National Park Service.

For instance, at Mount Rainier National Park where I was the superintendent, we have folks that have been coming there for generations. They ask, well, what about the ice caves? I used to go in the ice caves. The ice caves are long gone. It gives them sort of a frame of reference.

We have fairly good data that can link the loss of the ice caves and the retreat of the glaciers to climate change.

Senator BURR. But can you do a similar thing as it relates—I will ask Dr. Noss the same thing because he goes into great depth about water levels. How do you make the connection when those barrier islands were covered prior to us producing the level of carbon that we are doing today? I am not sure that you can all do it on currents, which do have an impact on where an inlet is cut but not necessarily whether an entire barrier island is under water. At what point do you require science to say here is the link?

Mr. JARVIS. I think that personally I am not qualified to speak to that particular issue in terms of how you link climate change to the barrier islands, and I would defer to Dr. Noss to answer that question.

But I think it is a challenge for us to make it relevant, to make these issues understandable enough for individuals to take action and be concerned. I think that is a challenge.

Senator BURR. Let me just say, Mr. Jarvis, that is exactly the point I wanted to make, that if you want the American people to buy into an effort—because this is their parks. This is their investment. Ken Burns said it is about the future and future generations, and I believe in that. But without the willingness of the American people to make the investment, we will come up woefully short of what you might want to do or what science might suggest that we

want to do. I think every step that we make has to be one that we get the buy-in from the person who actually signs the check, and that is the American taxpayer, that this is beneficial.

I think when we have areas that we cannot make the direct connection—to me, I will not try to go sell that the water rise is a function of climate change to people on the coast that probably are over 80–some years old because they can remember when the islands were covered, and you lose the credibility right then. So my point to you is we have got to think through what we do about the way that we communicate it, but it has to be sellable.

Mr. JARVIS. I could not agree more. I think it is a responsibility, and I think it is one of the unique responsibilities of the National Park Service to help communicate it. But we cannot be hysterical about it and we cannot take it beyond what the science really supports either.

Senator UDALL. Thank you, Senator Burr.

I want to thank you, Director Jarvis. If you had any final comments for the record, I am happy to either hear them now or you can certainly direct them to us over the next couple weeks.

I did want to also mention when you mentioned your stint at Mount Rainier, we have been blessed on the committee with the services of one of the NPS' finest, Mike Gauthier, who is also known as "Gator." He is sitting behind me here, and we want you to know that we appreciate his service and his knowledge of the National Park Service and the great work the flat hats do.

But thank you again for being here today.

Mr. JARVIS. Thank you, chairman. Thank you, Senator.

Senator UDALL. We will ask the second panel to take your seats and we will turn right to your testimony.

Gentlemen, welcome. Let me turn immediately to Dr. Williams who is the President of the Wildlife Management Institute from Gardners, Pennsylvania. We would like to hear your testimony, and then we will come across to the other two witnesses, and then we will come back around for a series of questions. If you can keep your remarks in that 5– or 6–minute timeframe, that would be appreciated so we can then have some time for an exchange of ideas and questions. Dr. Williams, the floor is yours.

STATEMENT OF STEVEN WILLIAMS, PH.D., PRESIDENT, WILDLIFE MANAGEMENT INSTITUTE, GARDNERS, PA

Mr. WILLIAMS. Thank you, Mr. Chairman, members of the subcommittee for this opportunity to address the impacts of climate change on our National Park System.

I am Steve Williams, the President of the Wildlife Management Institute. We are a nonprofit organization founded in 1911. It is a scientific and educational organization dedicated to conservation of North America's wildlife and natural resources.

Prior to serving in this capacity, I had the honor to serve as the Director of the U.S. Fish and Wildlife Service and in addition have 17 years of experience working for three State fish and wildlife agencies.

I sit here today before the subcommittee not as an expert in the origin or solution to climate change, but as a wildlife professional who has had the good fortune of experiencing most of the major

biomes on this continent and the ability to interact with professional managers of those properties.

Climate change, I believe, whether a function of natural processes, human processes, or probably more likely a combination of both, is occurring across the continent. I make this statement based on my understanding of the scientific literature, discussions with Federal, State, and academicians, and some of my personal experiences.

Very briefly, in terms of short-term observations, not scientific, but anecdotal, I just bring up, I guess, two situations.

Thirty years ago, my wife and I on our honeymoon went to Glacier National Park. We had the good fortune about 4 years ago to return to that park, and both remarked on the loss of glaciers that we thought we observed. Looking at the pictorial history of Glacier, our observations were confirmed.

In a similar vein, over the last 35 years, I have spent a fair amount of time in Grand Teton National Park, worked there for 7 years guiding float trips on the Snake River and experienced the same loss in glaciers.

Warmer and drier climates are expected to alter weather patterns, and I will not go through all those details. I think Director Jarvis did a good job of hitting on those. But those changes will have impacts on the timing and process of plant and animal life cycles, and they will also have an impact on a species' ability to reproduce and survive. If you combine those climate change impacts with human impacts on the environment related to energy development, population growth, just development of places to live, transportation, and so on, that impact is really quite substantial. If we view it over thousands of generations that have resulted in what we observe in the wild today, I do not think there is any question that the last 100 years has really caused a different set of circumstances in how those species have evolved.

The National Park Service has an excellent—along with some of our other public lands—but provide an excellent venue as a natural laboratory, if you will, to measure some of the impacts of climate change. Are species moving up attitudinally? What are the impacts on forage production on those national park lands, fish health studies, and so on?

So that is sort of the ecological side of it.

If I could, just for the last part of my comments, focus more on the management challenges for the National Park Service just in general.

Director Jarvis mentioned in the Organic Act the reference to leaving these lands unimpaired for the enjoyment of future generations. That is the language in the act.

I think a challenge for the service will be to try to meet that goal—as the entire landscape changes in response to climate change, to meet that goal of areas within portions of that whole natural landscape.

Second, that is the way the Park Service has been managing, rightfully so, for the life span of the agency. I suspect that there may be some challenges in trying to meet that mission and some of the realities of climate-induced change.

I am very happy to hear and understand that the National Park Service is also putting together a strategic plan, similar to the draft the U.S. Fish and Wildlife Service has put together. I hope that strategic plan is flexible and adaptive. I hope that that plan recognizes the uncertainty associated with climate change, adaptive management processes, and the potential scenarios that may face parks.

I will conclude by saying that adaptation funding, which fortunately is included in the climate change legislation that Congress is considering now, will be absolutely essential for our national parks, national forest, national wildlife refuges, and even some of the State conservation lands to monitor climate change impacts, survey plant and animal species and their distribution, restore and manage habitats, deal with impacts to wetlands, and so on and so forth.

We have invested a lot in our national parks and public lands through the years, and the past political leaders and members of the administration and Congress have created a very powerful conservation legacy that we all enjoy. I hope that as we move forward, the way we treat our national parks and other public lands will speak volumes, I believe, with regard to our commitment to the past, certainly our commitment to the future and our own conservation legacy.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Williams follows:]

PREPARED STATEMENT OF STEVEN WILLIAMS, PH.D., PRESIDENT, WILDLIFE MANAGEMENT INSTITUTE, GARDNERS, PA

Mr. Chairman and members of the subcommittee, thank you for the opportunity to address the issue of current and expected impacts of climate change on the National Park System.

I am Steve Williams, President of the Wildlife Management Institute. Founded in 1911, WMI is a private, nonprofit, scientific and educational organization, dedicated to the conservation, enhancement and professional management of North America's wildlife and natural resources. Prior to serving in this capacity, I had the honor of serving as the Director of the U.S. Fish and Wildlife Service. In addition, I have 17 years of experience working for three state fish and wildlife agencies. I serve on the Board of Directors of the American Wildlife Conservation Partners, the Theodore Roosevelt Conservation Partnership, the National Fish and Wildlife Foundation, and the Conservation Committee of the Boone and Crockett Club.

I come before you today not as an expert in the origin or solution to climate change, rather as a wildlife professional who has had the opportunity to experience most of the major biomes of this continent and to interact with the professional resource managers responsible for their management. Climate change, whether a function of natural processes, human processes, or a combination of both, is occurring across the continent. I make this statement based on my understanding of the scientific literature, my discussions with federal, state, and academic scientists, and my personal experiences.

First from a personal and admittedly anecdotal perspective, I can identify two National Parks where I believe, in my short life span, I have seen the effects of climate change. The first is Glacier National Park. Thirty years ago while on our honeymoon, my wife and I visited the Canadian Rockies and Glacier National Park. We were astounded by the beauty of these alpine areas. About four years ago we returned to Glacier only to see fewer surface areas and volumes of glaciers. We both remarked about how the park had changed and how the pictorial vistas had been diminished. Later I viewed a pictorial history of the major glaciers in Glacier National Park and our observations where confirmed. Some predict that in less than 30 years the glaciers will cease to exist at this "Crown of the Continent." If so, the crown will have lost much of its luster.

My second example involves my 35 year span of time with Grand Teton National Park. During the summers between 1974 and 1981, I worked on a dude ranch in

the middle of Jackson Hole. Four of those summers I guided float trips on the Snake River which entailed conducting 3-4 trips a day, six days a week, through the heart of Jackson Hole. The spectacular Grand Teton mountain range was the backdrop and focal point of these trips. Although I did not conduct any scientific analysis of snowpack and glacial volumes, I knew those mountains both from afar and near. Over the course of the last 35 years, I have a spent a few days most every summer visiting Grand Teton National Park. My most recent trip there was in August of this year. Through the years, I noticed a considerable decline in the glaciers that I had become familiar with some 30-35 years ago. It is undeniable that Teton Glacier on the Grand Teton and Falling Ice and Skillet Glaciers on Mt. Moran have retreated in that relatively short time span. The grandeur of the Grand Teton range has become somewhat diminished.

While Director of the Fish and Wildlife Service, I observed numerous glaciers that have retreated throughout Alaska whether they were in the Brooks Range, the Chugach National Forest, or on the Bristol Bay Peninsula. While serving in this position and based on my discussions with resource professionals across the country, I recognized that the successful management of our nation's natural resources, for the use and enjoyment of current and future citizens, would hinge on how state and federal natural resource managers adapt to global climate change, change that may impact every biome and habitat that we now recognize.

The projected impacts of climate change have been well identified. Warmer and drier climates are expected to result in weather patterns that produce: changes in the amounts and patterns of precipitation; increased stream and river temperatures; frequency and intensity of severe weather events; longer and more intense droughts; levels of snowpack and the timing of their melt; more severe wildfires; expansion of the range and distribution of insects, parasites, diseases and invasive species; and changes in the timing of runoff and intensity of flooding. All of these changes would have impacts on the timing and process of plant and animal life cycles. Each of these factors alone and in combination, will undoubtedly affect plant growth, structure, and distribution. In turn, they may also directly impact a species' ability to reproduce and survive.

Scientists expect stream temperatures to increase and flow patterns to be dramatically altered. National Parks provide exceptional fishing opportunities in the Appalachian and Rocky Mountains. Unfortunately these streams may become uninhabitable for native trout which are sought after by millions of anglers. Altered stream flow patterns due to the timing and speed of snow pack melt will also threaten downstream watersheds and water supplies for human populations. Elk populations are expected to move to more northern or higher elevations in search of more palatable forage, escape from insects, and cooler temperatures. Overabundant elk populations like those in Rocky Mountain National Park will stress their food supply and neighboring properties as they change their distribution and migration patterns. Desert fishes and reptiles may die out as ground water becomes depleted and water sources dry up. Coastal parks will experience a rise in ocean levels, increased beach erosion, and salt water intrusion into coastal marshes and water supplies. Alaskan National Parks have already observed glacial retreat and erosion of coastal lands. Melting of the permafrost across the Alaskan tundra has resulted in impacts to Alaskan native villages, release of previously stored carbon reserves, and changes in plant habitat. As the term implies, global climate change will have far reaching impacts on our environment and those who inhabit it.

Combine these climate changes impacts to our environment with those caused directly by humans and the future looks even more challenging. Increases in human population and our growing demand for energy, development, transportation and natural resources will further strain natural landscapes as they respond to climate change. These trends threaten to unravel relatively delicate, natural landscapes in an unprecedented manner. Although scientists report that climate cycles have occurred over the 100,000 years or more of human habitation on earth, during the last hundred or so years we have experienced a rapid rate of global warming. This time period also coincides with the most rapid increase in human population growth and industrial development the world has ever experienced. For most of history, human culture has evolved in concert with plant and animal species. The natural world we observe today has responded to and evolved with environmental change over thousands of generations. The rapid human growth and its impacts which we have recently experienced had a dominant influence on the environment in a period of about 100 years, not thousands of generations. The current and future ecological disturbances associated with climate change, habitat loss and fragmentation, energy and water development, transportation, and invasive species present a near term, natural selection process and evolutionary challenge which, arguably, has never occurred in a 100 to 200 year time period.

How do we study and understand the ecological and cultural ramifications of this change? The almost 84 million acres of National Park Service (NPS) units, many in relatively large land masses, offer venues to inventory ecological resources, monitor resource response to climate change, detect that response, conduct research on intact and disturbed ecosystems, and prescribe and conduct management adaptations to climate change. NPS and its sister organizations' lands, the National Wildlife Refuges and National Forests provide some of the best laboratories to study ecological systems.

NPS units occur in every major biome on the continent. From the Gates of the Arctic and Denali to the Florida Everglades, the Grand Canyon to the Great Smoky Mountains, Rocky Mountain National Park to the Caribbean coral reefs, and California's Death Valley to the Tallgrass Prairie Preserve of Kansas; NPS units have preserved ecosystems in relatively unimpaired states. The Greater Yellowstone ecosystem, one of the largest, nearly intact ecosystem in the contiguous United States, incorporates National Parks, Forests, and Refuges but at the core is the NPS' first National Park, Yellowstone.

These examples or fragments of natural ecosystems should become laboratories within which scientists can examine and document climate change impacts. Mountainous park units would allow studies to measure altitudinal distributions of plant and animal species that could shed light on the response of organisms to increased temperatures. Consider the fact that the Missouri, Colorado, Snake, and Columbia Rivers have their origins in NPS units. Water quantity and quality monitoring in the headwaters of some of the nation's most important rivers will provide critical information for downstream communities and industries. Forage production studies within NPS units would provide essential information for forest and range managers who wish to learn how climate change affects these ecosystems. Fish health studies on affected NPS stream and river systems would provide valuable information for fisheries biologists who rely on these stocks to supply and replenish fish populations. Migration and movement corridors for dispersing wildlife need to be studied and documented for the future. The studies which would provide valuable answers for ecologists and fish and wildlife managers are almost unlimited.

From the National Park management perspective, climate change provides a daunting challenge. The organic act's purpose, which established the NPS in 1916, was "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." This ambitious goal, although admirable in 1916, poses a conundrum for current and future park managers. In the face of climate change that threatens to change the entire natural landscape, how does one manage for no change within portions of that natural landscape? Is the current management philosophy and culture of the NPS equipped to reconcile its congressionally mandated and static mission with the realities of climate-induced change? How does the NPS work in collaboration with its federal, state, and private partners and neighbors in achieving this static mission, in light of their partners' dynamic future missions and goals?

The Department of Interior (DOI), with Secretary Salazar's leadership, has taken recent steps to address this management challenge across all bureaus in the department. The September 2009 secretarial order established a framework for agency collaboration and coordination in response to climate change. Climate Change Response Centers and Landscape Conservation Cooperatives have been created to better coordinate data sharing and management within Interior bureaus and to provide collaboration with DOI partners. The U.S. Fish and Wildlife Service has published a draft Strategic Plan for Climate Change which is currently open for public comment. This plan focuses on: adaptation, mitigation, and engagement. I understand and applaud the fact that the NPS is working on a similar document that will contain these common elements.

I believe that NPS leaders, regional, managerial, and field staff will face a cultural and organizational challenge as they confront the response to climate change. It will be vital that the NPS organization from top to bottom be coordinated as they plan and implement their activities. The size and apparent autonomy of many of the NPS units coupled with their close ties to local communities, could present management challenges in carrying out a common, landscape-scale strategic plan for climate change response. This strategic plan should be flexible and adaptive to changing inputs and impacts. Planning documents should incorporate uncertainty, adaptive management processes, and plans for an array of potential scenarios that may face the individual park unit depending on the form and manner that climate change shapes their park. This dynamic approach may be uncomfortable for an organization with a mandate and culture of maintaining the status quo—"in such

manner and by such means as will leave them unimpaired for the enjoyment of future generations."

Given the predicted impacts of climate change on the nation's landscapes, which include our National Parks, resource managers should be focused on mitigation and adaptation to enhance the resilience and recovery of these habitats. Response to environmental stressors such as fire, drought, insects, and floods will challenge on the ground management in ways never before experienced. I believe management plans should focus on maintaining landscape character and return to natural conditions rather than pre-determined, prescriptive management actions to achieve singular goals. Management should focus on adapting techniques and activities based on what has been learned about past performance of those activities. This adaptive management approach provides a dynamic process informed by success and failure, and responsive to the uncertainties associated with climate change impacts.

Additional funding to assist in adaptation will be necessary to maintain the reputation of National Parks as the nation's premier examples of our nation's conservation treasures. Recent DOI budget priorities, including funding for the Landscape Conservation Cooperatives, will be helpful to federal agencies and their partners. Additional funding to coordinate data collection, analysis, and exchange between federal agencies such as the U.S. Geological Survey and the National Oceanic and Atmospheric Administration will be necessary to provide finer-scaled, climate predictive models than those currently available. Land management agencies will rely on these experts to help define the range of ecological conditions to be expected on individual management units.

Adaptation funding will be necessary to update, repair, and maintain park infrastructure and visitor facilities. In addition, adaptation funding will be required in our National Parks, National Forests, National Wildlife Refuges, and state conservation lands to monitor impacts, survey plant and animal species and their distribution, conduct research on climate change effects, distribute water, battle invasive species, repair water control structures, restore and manage habitat, create and protect wetland habitat, and manage current and new threatened and endangered species. Without adequate adaptation funding, natural resource managers will not be able to respond to the obscure and obvious changes occurring across the landscapes for which they are responsible and held in trust for the public.

Current funding for status quo management is inadequate to address major maintenance and capital improvement projects. Federal agency backlogs for these projects total hundreds of millions of dollars. It would be a travesty to further exacerbate these financial problems by ignoring climate change impacts and their expense on public lands. Fortunately, current climate change legislation includes significant financial investments in our nation's environmental treasures. National conservation, protection, and preservation organizations strongly agree that Congress must address our natural resources and the need for adaptation funding in any climate legislation that passes Congress. This adaptation funding would enhance federal agency activities to prepare for and adapt to a changing climate. In addition, it would provide significant funding to state fish and wildlife agencies to address climate change impacts identified in Statewide Action Plans. A comprehensive and coordinated federal, state, and private response to climate change impacts is essential. Fish, wildlife, and their habitats are not constrained by government, political, or organizational boundaries. The National Park Service understands that this approach to conservation is essential.

For more than one hundred years our nation has recognized the special importance of our nation's natural resources. At the federal level we have established National Parks, National Monuments, National Forests, National Wildlife Refuges, and other protected public lands. Numerous laws and regulations have been passed, federal and state agencies have been created, and billions of dollars have been invested in the management of these national treasures. The American public and visitors from across the world have revealed in their awe inspiring beauty, more than 275 million visitor-days annually in National Parks alone. The nation has benefited from the ecological services, such as clean water and air, which they provide. We have visited these national treasures to enhance our quality of life and educate our children and grandchildren about their natural wonders.

As we face climate change impacts over the coming decades, our nation's citizens deserve our continued investment in a uniquely American experiment in conservation, setting aside some of our most spectacular lands for protection and public use. This experiment has become so successful that it is the envy of the world. Our nation's past political leaders have created a powerful conservation legacy for all of us to use and enjoy. How we treat our National Parks and our other public lands will speak volumes about our regard for their work, the value we place on current and future generations, and our own conservation legacy.

Senator UDALL. Thank you, Dr. Williams.

Next, we will turn to the Honorable Iliff McMahan, Jr., who is County Mayor from Newport, Tennessee. Mayor, welcome. I know Senator Burr and I appreciate those elected officials who make local government work, and we are really pleased you had an opportunity to come up here and join us. We look forward to your testimony.

STATEMENT OF ILIFF MCMAHAN, JR., MAYOR, COCKE COUNTY, NEWPORT, TN

Mr. MCMAHAN. Chairman Udall and Senator Burr, thank you very much for inviting me to testify on the current and expected impacts of climate change on the National Park System.

As you said, I am Iliff McMahan, Jr., and since elected in 2002, I have served as the County Mayor of Cocke County, Tennessee. Fourteen years ago, before becoming mayor, I served as the first tourism director for Cocke County where we focused on marketing our county has an ecotourism destination of choice.

My appearance here today is to highlight the relationship between our national parks and Cocke County and how rural communities and economies are dependent upon the ecological stability of national parks. National parks face many challenges, but none as far-reaching as climate change. If not addressed, climate change threatens the economic well-being of Cocke County and similar national park gateway communities around the Nation.

Cocke County is a rural community in east Tennessee with a population of 35,000 citizens and contains a portion of two units of the National Park System, a national forest, a State forest, and three major watersheds. Approximately 35 percent of the land in our county is publicly owned and produces very little tax income.

However, we receive significant economic benefits from our public lands by serving as the northern gateway to the Nation's most visited national park, the Great Smoky Mountains. This places upon us an awesome responsibility to work with our partners to protect these very special places. Cocke County has had to look beyond traditional economic development opportunities and toward marketing our natural resources to diversify our economy. This has helped to insulate our county from the very worst impacts of the economic downturn.

In the Smokies, bad air quality, mercury pollution, decreased visibility, acid deposition, and invasive species are decimating our forests and our wildlife. But there is one issue we are failing to address at this time: climate change and our national parks. Congress needs to provide better policies and more funding to address the climate change and all of the challenges that face our national parks. Many tourists come to the Smokies to fish our cool streams but just an increase of 2 degrees or an extended drought like we experienced in 2007–2008 could weaken native fish populations forever. This would be a major loss to the regional biodiversity, and this would also be a major loss to our local economies.

Cocke County depends upon our visitors to eat at our restaurants, buy fuel and groceries in our stores, stay in our lodging, and contribute to the tax base that keeps us prosperous. In Arkan-

sas, Missouri, and Tennessee alone fishing created $2 billion in related expenditures in 2006.

Like many rural counties around the country, my county depends upon the health and vitality of our State and Federal lands for our continued and future prosperity. National park lands where air and water and wildlife are protected means tourists will continue to come to Cocke County to see, to hear, and to experience our spectacular park lands. If these resources are diminished by allowing climate change to continue unaddressed, our county's existing and financial future health will be impacted.

Now, I am no expert on climate policy, but what I do know is that our parks are changing and we have a unique opportunity now to protect these special places and at the same time boost our local economies. As County Mayor, it is my responsibility to work with you in partnership to make sure that we are proactive park stewards. Fully funding a coordinated effort between our partners to conduct scientific research, natural resource adaptation, and management projects just makes good business sense for the future of our national parks and for our gateway communities.

Now, in conclusion, sir, I feel that every day is another opportunity for Cocke County to strive to realize our full potential as a viable and sustainable rural community. We value our mountain traditions and our natural resources and we work daily to showcase them to the world. Therefore, it is incumbent upon us to work together in partnership to protect our valuable national parks from our changing climate and assure that future generations will be able to enjoy the Smokies as we do today.

I want to thank you for inviting me to testify, to share our story, and to join this conversation on the future health and well-being of our national parks. I want to say God bless you in your efforts. Thank you very much, Mr. Chairman, Senator Burr. Appreciate it.

[The prepared statement of Mr. McMahan follows:]

PREPARED STATEMENT OF ILIFF MCMAHAN, JR., MAYOR, COCKE COUNTY, NEWPORT, TN

Chairman Udall and members of the Subcommittee, thank you for inviting me to testify on the current and expected impacts of climate change on units of the National Park System. I am Iliff McMahan, Jr. and since 2002 I have served as the County Mayor of Cocke County, Tennessee. Before becoming mayor I served as the first Tourism Director for Cocke County, as the first Tourism Director for the Morristown Area Chamber of Commerce, later as General Manager of the Chamber, and as Manager of Marketing and Public Relations for Newport, Tennessee Utilities. In 2004, I was elected to a position on the national board of directors for the County Executives of America representing rural counties across the nation, and was appointed by Tennessee Governor Phil Bredesen to a statewide position on the Tennessee Workforce Development Board, an advisory council to the Governor. In addition, I serve on the boards for several organizations: the East Tennessee Development District, East Tennessee Human Resources Agency, currently serve as Chairman for the East Tennessee Regional Agribusiness Marketing Authority, a member of the National Parks Conservation Association Southeast Regional Council, Smoky Mountains Workforce Development Board, East TN Quality Growth Council, Great Smoky Mountains Regional Greenways Council, and Boys & Girls Club of Newport/Cocke County. My appearance here today, however is not on behalf of any organization, but rather to highlight the interconnectedness between the ecological stability of the Great Smoky Mountains National Park and Appalachian National Scenic Trail and the economy of Cocke County, Tennessee. I would also like to highlight how across the United States rural economies are dependent on the ecological stability of national parks. National parks face many threats, but none as far-reaching as climate change. If not addressed climate change threatens the economic well-

being of Cocke County and similar national park gateway communities around the United States.

My testimony addresses the following topics: (1) the Cocke County economy and our dependence on our national park units, (2) the projected impact of climate change on the Great Smoky Mountains National Park and the Appalachian National Scenic Trail and by extension to our gateway community economy, (3) the need for a coordinated local, state, and federal collaborative plan to address climate change in national parks to protect both our natural and cultural heritage and the economies of surrounding communities, and (4) the opportunity for economic growth that setting aside funds for scientific research and natural resource adaptation provides for national park gateway communities.

THE COCKE COUNTY, TENNESSEE ECONOMY AND OUR NATIONAL PARKS

Cocke County is a small rural county in East Tennessee with a population of thirty-five thousand citizens and a land-base of four-hundred and thirty-four square miles. Of the ninety-five counties in Tennessee Cocke County is the only county which contains a portion of two units of the National Park Service (The Appalachian National Scenic Trail and the Great Smoky Mountains National Park), a national forest (the Cherokee National Forest), and a state forest (Martha Sundquist State Forest). We are also home to the Nolichucky, Upper French Broad, and Pigeon River Watersheds; three of the largest watersheds in the State of Tennessee. Approximately, thirty-five percent of the land in our county is publicly owned and does not produce tax income. However, in addition to payments in lieu of taxes, we receive significant economic and community benefit from our public lands. In particular, Cocke County serves as the northern gateway to our nation's most visited national park, the Great Smoky Mountains National Park. Our county's proximity to so many notable state and federal lands places upon us an awesome responsibility to work with state and federal government to protect these special places.

As a small rural county with a large percentage of lands in public holding, Cocke County has had to look beyond traditional economic development opportunities to our natural resources to diversify our economy. Most relevant to today's hearing topic, since 1995 Cocke County has seen a significant increase in the size and capacity of our county's ecological-tourism based industry. Horseback riding, camping, hiking, backpacking, whitewater rafting, hunting, fishing, and a myriad of additional outdoor activities have increased and continue to grow in Cocke County. Despite the national economic downturn of the past year we have seen a significant increase in tax income from these and associated activities. Our work to expand and grow Cocke County's thriving eco-tourism industry has insulated our county from the worst impacts of the economic downturn.

Around the United States between 1970 and 2003 rural counties like Cocke County that neighbor national parks outperformed non-park rural counties by forty-three percent in job growth, thirty-seven percent in personal income growth, and an impressive eighty-six percent in population growth. National parks generate four dollars in value for every tax dollar invested, support over thirteen billion dollars in private sector activity, and over four billion dollars in wages in gateway communities like mine. Outdoor recreation nationally supports nearly six and a half million jobs and creates eighty-eight billion dollars in state and federal tax revenue nationally. My county depends on the health and vitality of our State and Federal lands for our continued and future prosperity. National park lands where air, water, and wildlife are protected means tourists will continue to come to Cocke County to see, hear, and hike in our spectacular park lands. If these resources are diminished in favor of development or by allowing climate change to continue unaddressed our county's existing and future financial health could be impacted.

THE IMPACT OF CLIMATE CHANGE ON COCKE COUNTY AND OUR NATIONAL PARK UNITS

This year Tennesseans and the nation celebrated the seventy-fifth anniversary of the creation of the Great Smoky Mountains National Park and in 2016 we will all celebrate the centennial of the creation of the national park service. There are many threats that face parks around the country. In the Smokies and Cocke County bad air quality frequently results in violations of the Environmental Protection Agency's air quality standards in the summer months. Significant concentrations of airborne mercury are deposited in the region, poisoning species from native trout to the iconic black bear. Decreased visibility results from haze pollution and degrades the scenic vistas that are an important attraction for visitors. Acid deposition weakens fragile ecosystems and poisons our streams. Invasive species are decimating forest and the wildlife that depend on their health. The human footprint around the Smokies, Cocke County included, is large and increasingly threatening traditional wildlife

corridors. These are all long-standing issues I have in my time worked with county, state, and national counterparts to address, but there is one issue we are failing in the policy realm to address at this time: climate change in our national parks. Congress needs to provide more funding and better policies to address climate change and all of the issues that face our national park units cumulatively rather than address one impact at a time.

The Smokies provide an island of wilderness in one of the most populated parts of the country. Temperatures in Appalachia have been on the rise since the 1970's and already these changes have taken a toll. Climate models have predicted increased drought, increased flooding, and temperature increases in the southern Appalachian region. Iconic species, such as the Frasier fir, already under pressure from air pollution and invasive species, could disappear without proactive effort on our part. Without a change of course conditions in the park could become unsuitable for flora and fauna found nowhere else in the world.

Many tourists come to the Smokies to fish our cool streams, but an increase of just two degrees Celsius or an extended drought could alter or weaken native fish populations forever. This would be a major loss to regional bio-diversity, but this would also be a major loss to local economies. Cocke County depends on fisherman to eat at our restaurants, buy fuel and groceries in our stores, stay in our lodging, and to contribute to the tax base that keeps Cocke County running. In Arkansas, Missouri, and Tennessee alone fishing created two-billion dollars in related expenditures in 2006. Counties like mine around the United States have a lot to lose if we fail to address the most significant impacts of climate change. A United States Travel Association poll taken in 2009 showed that sixty-four percent of travelers are concerned about climate change. Travelers are the bread and butter of my gateway county economy, and if visitors are concerned, leaders in every national park gateway community should be too.

THE NEED FOR A COLLABORATIVE ADAPTATION PLAN

Every year over ten million visitors come to the Great Smoky Mountains National Park, to hike the Appalachian National Scenic Trail, and to visit our other state and federal lands. In fact, this year despite the economic downturn the Great Smoky Mountains and other units of the national park system have seen a five percent increase in visitation. Global climate change threatens our unique resource. The Great Smoky Mountains is the most diverse biosphere in the northern hemisphere, and given our dependence on the park for our economic well-being and our personal connection and history around this unique place, it is our job to make sure that we protect and create the opportunity for all our national parks to adapt to the most sever impacts of climate change. We must work nationally to develop an effective strategy to lower overall global concentrations of greenhouse gases to protect our parks, but there is much to be done on the ground to deal with the impacts that are at this point beyond our control. Coordinating and planning to mitigate impacts to natural and cultural resources as well as develop tools to adapt to the changing environment will help to assure that the Smokies remain intact so future generations of Cocke County residents and visitors will have an opportunity to connect to our beautiful and unique parks.

It is widely accepted that our national parks can play an important role in understanding climate change and responding to it. First, the national parks provide a classroom for understanding and studying how climate change is impacting our entire environment. Second, the national parks offer a refuge for species that are—or might be—displaced by a changing climate. Third, as part of the mix of state and federal lands, the national parks will play an important role sustaining ecosystems and ecological processes that see no park boundary. The national parks, simply put, give us the ability to better understand, mitigate, and adapt to a changing climate.

The natural resource adaptation provisions passed in the House of Representatives, "Clean Energy and American Security Act" set up a structure for resource adaptation that should be strongly considered by members of the Senate. It is my understanding that the Kerry-Boxer, "Clean Energy, Jobs, and American Power Act" and a climate change adaptation bill sponsored by Senator Jeff Bingaman also mirror the language regarding the establishment of a coordinated local, state, and federal effort to fund the required scientific research and on the ground projects that need to happen to protect our national parks from the worst impacts of climate change. I would like to applaud and thank all of you for your efforts. However, I would also like to urge you to consider fully funding these efforts to make sure that across the board natural resource adaptation projects adequately protect the parks in our backyard.

ECONOMIC GROWTH FROM NATURAL RESOURCE ADAPTATION

I'm no expert on climate policy, but what I do know is that our parks are changing and we have a unique opportunity to protect these special places and simultaneously boost local economies. In Cocke County we are lucky in these tough economic times to have outstanding pubic lands as a reliable source of economic prosperity. However, the national park lands that sustain our strong eco-tourism based economic growth prevent growth in traditional economic sectors such as manufacturing. For all of the added benefits our park units provide to our community we still have to deal with the challenge of being a rural community working to grow sustainably. Fully funding natural resource adaptation programs around national park units and other federal and state lands will create much needed jobs around the United States and Cocke County is no exception.

By safeguarding wildlife populations, rivers, forests, and deserts in national parks around the United States a strong well-funded natural resource adaptation program will protect national park units that maintain seven-hundred and thirty billion dollars in economic activity and sustain nearly six and a half million jobs nationwide. It will also create new jobs in gateway communities around the country. A fully funded program would create jobs around the United States for scientists, engineers, construction crews, equipment operators, firefighters, educators, students, youth workers, and the host of support service providers in manufacturing and local business. The important work that needs to be done to restore wetlands, forests, and maintaining habitat for wildlife migration and corridors will create opportunity around the country and hopefully at my home in Cocke County. By protecting our natural resources in national parks and other state and federal lands we can sustain a critical economic engine for our communities that might otherwise sputter out in the face of growing impacts from climate change.

It is my job as County Mayor, and my personal responsibility as a member of a family that gave up our land for the creation of the Great Smoky Mountains National Park, to work with you in partnership to make sure that we are proactive park stewards. I am not an expert on climate policy, but as the owner of a working cattle farm, it is clear to me that if you do not maintain and manage your herd properly you are going to have a heck of a time keeping the farm open and an even more difficult time turning a profit. Like a working farm, we need to maintain our national parks with progressive stewardship and adjust to changes in the weather or else we might lose the farm. Fully funding a coordinated effort between local, state, and federal agencies to conduct the appropriate scientific research, natural resource adaptation and management projects makes good business sense for the future of our national parks.

Every day that I see the sun rise over Mount Cammerer in the Smokies is another day to help Cocke County realize our full potential as a viable and sustainable rural community. Cocke County is a community where we value our mountain traditions and natural resources and we work daily to showcase them to the world. Global climate change is a major threat to our precious heritage, but through thoughtful, progressive policy initiatives and a little American ingenuity we can protect our valuable national park resources and assure that our future generations will be able to enjoy the Smokies and hike the Appalachian Trail as we can today.

Senator UDALL. Thank you very much, Mayor.

We turn to Dr. Reed Noss. He is the Davis-Shine Professor of Conservation Biology at the University of Central Florida in Orlando, Florida. Doctor, welcome. The floor is yours.

STATEMENT OF REED F. NOSS, PH.D., DAVIS-SHINE PROFESSOR OF CONSERVATION BIOLOGY, UNIVERSITY OF CENTRAL FLORIDA, ORLANDO, FL

Mr. NOSS. Thanks very much, and good afternoon, Senator Udall, Senator Burr, and others present.

As Senator Udall mentioned, I am at the University of Central Florida. I am also President of the Florida Institute for Conservation Science, which is a nonprofit science think tank, and an elected fellow with the American Association for the Advancement of Science. Relevant to this hearing, I recently served as Vice Chair

of a Federal advisory committee for the U.S. Climate Change Science Program.

I want to get right to the heart of the major topic of discussion here, which is the relationship between climate change and the integrity of our national parks. There are two basic points I want to make.

One is that climate change will not be good for national parks. That is a no-brainer, but there is no getting around it. There are going to be problems.

But the second point is also very important. There are things we can do now, and hopefully proactively, to reduce the impacts of climate change on national parks, and these things fall into the category of adaptation, which Director Jarvis and others have already referred to. They force us, as Director Jarvis pointed out, to start thinking at a landscape level, which will also help address a lot of other problems facing the national parks.

So we might ask what kinds of parks are most at risk.

I do not want to spend much time on this. Those in the far north, those in the continental interior are projected to experience the greatest increases in temperature and associated moisture stress. I believe the committee is well familiar with that. Also, of course, the high elevation alpine zones in our mountain parks, in the Rockies, the Cascades, the Sierra Nevada, but also the Appalachians. These areas will be at risk because, as temperature warms, vegetation moves up the slope. Those at the top more or less get pinched right off the top of the mountain.

Now, one bit of good news, I think, a ray of hope, is that mountainous parks in some respects, especially for terrestrial species may have more resilience to climate change than other kinds of parks, and the reason is that except for these very high elevation areas, at least here there is an elevational gradient relatively intact along which species can move in response to climate change. So, for example, by moving up slope 1,000 feet, you get to a climate that is about 3 degrees cooler on average. You would have to go 100 miles northward to get to that same temperature difference. So there is some advantage there.

Also you have micro-climates such as north-facing slopes, sheltered coves, areas around seeps and springs where species can basically seek refuge during these periods of hotter climate. These have probably been very important in the past.

In low-lying flat terrain, actually the options for adaptation are much more limited, and it is becoming clear to me that the national park units and other natural areas in low-lying coastal areas may be at the greatest risk both for their cultural and their biological resources, especially over the next few decades and beyond. It is important to bear in mind that in the eastern U.S. most of the acreage in the National Park System is very low-lying coastal area. Look at Everglades National Park and the contiguous Big Cypress National Preserve. We have got 2.2 million acres there, more than 2.2 million acres, which is larger than Yellowstone, much of it very low elevation. Nine of the 10 national seashores are in the east, also very low elevation and therefore subject to storm surge, to general sea level rise, and other problems related to those factors.

So what will happen to those low-lying areas? It differs tremendously from area to area, and I think this is what Senator Burr was getting at in his question earlier. We can come back to that. But basically I included in the packet in my written testimony a projection for Florida and the boundaries of the national parks did not come out as well as I had hoped. But you can see the projection. This is for 1-meter, 3-meter, and 6-meter increments in sea level. Basically most of Everglades National Park would be inundated with just a 1-meter rise in sea level, and this is now considered a conservative estimate of sea level rise by the year 2100. It could be faster. It could be quicker. It is very improbable that it will be slower or less.

So what do we do about this? The best we can do, I think, is assist the movement of these coastal species and habitats inland. Now, I cannot say, I cannot claim that I can tell you how to do this. No scientist right now can tell you exactly how to do this. We need more research. We need some experimentation with various options which will include, I think, some intensive engineering options.

Basically there are two major ways that we can deal with it. One is to armor the shoreline with sea walls and levees and other structures, bring in tons of sand to replenish beaches that are eroding away. The second option is basically to implement some form of managed retreat where we systematically start to relocate human communities, some structures at least, species and habitats, if we can figure out how, inland as sea level rises.

Neither of these options are going to be cheap. They are both going to be expensive. The first option, coastal armoring, is at best a short-term fix, and it will very soon become economically unsustainable except for some very special cases. It will be probably an ecological disaster in some areas because it will prevent species from moving inland. For our coastal national parks, really the only option again is to assist movement of species inland.

Along with this, I think, for the short term we should protect as much coastal habitat as we can—and I am talking really as a society here, not just the National Park Service—look very carefully at development in flood-prone areas, for example, in these low-lying coastal areas, and try to establish broad movement corridors from the coastal national park units inland to link up with other conservation areas that are on higher ground.

I urge this committee to think hard about these issues and initiate a process to determine precisely what needs to be done to minimize the impacts of sea level rise and other climatic phenomena on national parks and our natural heritage. I think it is especially important right now that funding and direction for adaptation to climate change, including sea level rise, be included in any climate change legislation. I am very encouraged to see movement in that direction.

Thank you very much for the opportunity to testify before this esteemed subcommittee.

[The prepared statement of Mr. Noss follows:]

PREPARED STATEMENT OF REED F. NOSS, PH.D., DAVIS-SHINE PROFESSOR OF CONSERVATION BIOLOGY, UNIVERSITY OF CENTRAL FLORIDA, ORLANDO, FL

I am Reed Noss, the Davis-Shine Professor of Conservation Biology at the University of Central Florida and President of the Florida Institute for Conservation

Science. I have an M.S. degree in Ecology from the University of Tennessee and a Ph.D. in Wildlife Ecology from the University of Florida. I am the author of more than 260 scientific and semi-technical articles and several books. I have served as Editor-in-Chief of the journal *Conservation Biology* and as President of the Society for Conservation Biology. I am an elected Fellow of the American Association for the Advancement of Science. I was recently the Vice-Chair of a Federal Advisory Committee for the U.S. Climate Change Science Program. I am currently organizing a scientific workshop and book on adaptation to sea-level rise in Florida. At many times in the past I have served as an *ad hoc* advisor to the National Park Service and other federal agencies.

Our national parks have long been valued as public playgrounds, places for spiritual enrichment, and as bastions of democracy. Especially over the last few decades, the national park system has also been viewed as a reservoir of wildlife and biological diversity. We all know that this value is sometimes compromised, both by over-development and other problems within the parks and by things going on beyond park boundaries.

The best known examples of problems originating outside park boundaries, but affecting parks are clear-cutting, intensive agriculture, road-building, energy development, and urbanization, sometimes occurring right up to the boundaries of national parks. These activities turn some parks into ecological islands surrounded by highly altered land. Migrations of large mammals such as elk, bison, and pronghorn antelope in and out of some western national parks have been disrupted, to the extent that some populations face extinction.

Less visible but just as dangerous to the ecological integrity of national parks are air and water pollution, acid precipitation, and water withdrawals for agriculture and urban uses. Recently, undeniable scientific evidence has become available showing that climate change and attendant impacts such as sea-level rise may be the greatest environmental threat our nation and the world have ever faced. National parks are not exempt from this threat—in fact, due their locations (very high elevations or very low coastal elevations) they are probably more vulnerable than most other lands.

The two main things we know about climate change in relation to national parks are that:

1) Climate change will not be good for national parks—but
2) There are things we can do proactively to reduce the impacts of climate change on national parks—these things fall into the category of "adaptation."

Adaptation to climate change is very urgent because we are already seeing negative impacts of climate change on wildlife and ecosystems, and those impacts will continue to worsen for at least decades and probably centuries, even if we drastically reduce our combustion of fossil fuels and other inputs of greenhouse gases into the atmosphere.

To reduce the impacts of climate change on national parks in a cost-effective way, we need to prioritize, which requires asking several key questions:

1) What kinds of species are at greatest risk from climate change?
2) What national parks are most at risk from climate change, in terms of losing species and ecosystem functions?
3) Conversely, what kinds of parks are likely to be most resilient to climate change?
4) What kinds of actions should we take to minimize losses of biological diversity and ecological integrity within national parks?

All of these questions, but especially the last, require sound scientific research to answer with confidence and in detail. Nevertheless, we have sufficient knowledge now to make some generalizations and head in the right direction.

First, what kinds of species are likely to be at greatest risk? We can assume they will be:

- Species with narrow geographic distributions (i.e., endemics), in which case loss of only a small area of habitat could result in extinction.
- Species closely associated with habitats likely to be eliminated or greatly reduced by climate change. These include arctic, alpine, low-lying coastal, and nearshore marine habitats.
- Species that are not very mobile and cannot disperse quickly.
- Species that show limited responsiveness to natural selection (from low genetic diversity, long generation times, etc.).
- Species that are highly susceptible to emerging diseases and invasive non-native predators and competitors.

What kinds of national parks are likely to experience intense impacts from climate change? We can predict that these include parks in the far north, for example Alaska, and in the continental interior, because these are the regions expected to show the greatest increases in temperature and associated water stress. Alpine areas within parks—for example in the Rocky Mountains, Sierra Nevada, and Cascades—are also at high risk. Alpine areas and their species stand to be pinched right of the top of mountains as vegetation zones move upwards in elevation with warming temperatures.

But are mountain parks more at risk generally? Probably not. There are many reasons to suspect that parks with extensive elevation gradients and high topographic diversity will be more resilient to climate change than parks with limited topography. With adequate elevation range available, a terrestrial species can migrate upslope and reach a cooler climate with much less distance to travel than moving northward. In general, an average temperature 3° F cooler can be reached by moving upslope 1000 feet but would require moving northward 100 miles.

In mountainous parks, species can also seek cooler microclimates such as sheltered coves, northfacing slopes, and areas around seeps and springs. Indeed, these cooler microhabitats probably serve an important role as refuges for species during times of hotter climate, from which they can move out and repopulate the surrounding landscape as the regional climate cools again.

Therefore, perhaps the most compelling recommendations that scientists can make with respect to biological adaptation to climate change are to:

- Maintain intact, connected habitats along environmental gradients, for example from the lowlands to the mountaintops.
- Locate and protect local areas of cooler and wetter microclimate.

Opportunities for adaptation are more restricted in flat terrain. National parks and other natural areas in low-lying coastal regions are the most vulnerable of all and will require the most immediate and probably the most costly intervention in order to prevent widespread losses of species. The culprit, of course, is sea-level rise.

Eminent geologists Orrin Pilkey and Rob Young recently wrote in their book *The Rising Sea* (2009): "Of all the ongoing and expected changes from global warming. . .the increase in the volume of the oceans and accompanying rise in the level of the sea will be the most immediate, the most certain, the most widespread, and the most economically visible in its effects."

Most of the acreage of the national park system in the eastern United States is coastal. Everglades National Park and the contiguous Big Cypress National Preserve total more than 2.2 million acres, slightly larger than Yellowstone National Park. The nearby Biscayne National Park encompasses another 172,000 acres. All but one of our 10 national seashores are on the Atlantic or Gulf Coasts, and these eastern national seashores total nearly 525,000 acres.

What will happen to these eastern national park units with rising sea level? Projections for Florida, as an example, do not look good (Fig. 1).* Most projections now show the sea rising at least 1 meter by the year 2100—this is the level currently estimated by the U.S. Climate Change Science Program. However, many recent projections are higher (for example, the State of California is now assuming 1.4 meters by 2100 in its planning) and some studies suggest that the rise to 1 meter or more above current levels could happen significantly sooner than 2100, depending on what happens to the polar ice caps.

Faced with projections such as these, a natural response would be despair. In Florida, we are currently in denial. I am not sure which is worse. A more intelligent approach is to examine the options for adaptation to the inevitable changes that will occur.

These options fall into two classes: (1) armor the shoreline with seawalls, levees and other structures, and bring in large amounts of new sand to build artificial beaches; or (2) managed retreat, where we relocate people, valuable structures, species, and habitat further inland, above the expected level of sea-level rise. Because many structures can not be relocated economically, they will have to be abandoned.

Pursuing either of these options will be difficult and expensive. The first option—coastal armoring and building artificial beaches—would be only a short-term fix, at best, and will soon prove economically unsustainable. It would be a disaster ecologically as well, by preventing the natural inland movement of habitats and species, which has occurred during previous periods of sea-level rise many times over the past millions of years.

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* Graphic has been retained in subcommittee files.

For coastal national park units, assisting the movement of species inland to colonize new habitats is the only strategy with any hope of success. Yet we are still faced with many questions and much uncertainty about answers. In the Everglades, for example, can we really expect unique communities such as marl prairies (home of the federally Endangered Cape Sable Seaside Sparrow) to "migrate" inland? We simply do not know.

What about our national seashores? Most of these national park units are on barrier islands. Barrier islands naturally move around over time with changes in sea levels and currents. But before long there will be nowhere to move. The shorelines landward of the barrier islands, like much of the islands themselves, are often heavily developed.

All we can do in these cases is protect as much coastal habitat as possible now and establish broad movement corridors from coastal parks and other natural areas to inland conservation areas. We probably will have to physically translocate some species to higher ground and take others into captivity indefinitely. We may have to create new beaches, well inland of their current location, to provide essential nesting and feeding habitat for sea turtles, shorebirds, and many other creatures.

Sea-level rise and other challenges to national parks and our natural heritage posed by climate change do not have to be a catastrophe. As Orrin Pilkey and Rob Young put it, sea-level rise and its associated impacts "could all be seen as an opportunity for society to redesign with nature, to anticipate the changes that will occur in the future and to respond in such a fashion as to maintain a coast that future generations will find both useful and enjoyable. It provides a challenge to scientists, planners, environmentalists, politicians, and other citizens alike to stretch the limits of their imagination to respond with flexibility and with careful foresight to development challenges that our society has not faced before."

I urge this subcommittee to think hard about these questions and initiate a process to determine precisely what needs to be done to minimize the impacts of sea-level rise and other climatic phenomena on national parks and America's natural heritage in general. The sooner we take action, the more of our natural heritage can be preserved for future generations. We still have a chance to make a difference.

Thank you for the opportunity to testify before this subcommittee.

Senator UDALL. Dr. Noss, thank you for that testimony. Thank you to the panel. All three of you added value and some important insights.

Mayor McMahan, if I could turn to you. I have to make note that your enthusiasm is contagious. I am married to a North Carolinian. Of course, I am sitting next to a North Carolinian. I have to believe that your cousins in North Carolina match your enthusiasm for the Great Smokies and for the resources——

Mr. MCMAHAN. Yes, sir. Thank you.

Senator UDALL [continuing]. That you are so fortunate to have in your back yard.

I assume your Congressman is Congressman Wamp?

Mr. MCMAHAN. No, sir. No. My Congressman is Congressman Phil Roe.

Senator UDALL. Yes, all right.

Mr. MCMAHAN. A brand new Congressman, first term.

Senator UDALL. So Congressman Wamp, as Senator Burr I know, has great enthusiasm about all things Tennessean. Again, you remind me of his passion for your wonderful State.

Mr. MCMAHAN. Thank you.

Senator UDALL. You made it very clear that the economic downturn has had very little effect on your visitation numbers, which is great news. I think it further points out that national parks bring in significant dollars, and gateway communities can thrive even in harsh economic times.

I am curious how you see the potential effects of climate change, drought, worsening air quality, to name two, in your region on visitation of the Smokies and other national parks, if it were to con-

tinue to develop in the way we hope it does not but looks like it may well.

Mr. MCMAHAN. Yes, sir. Senator, it would be devastating. I believe that if we continue to allow climate change to go unaddressed, I feel that—we are blessed. We live in the most diverse biosphere in the western hemisphere. I mean, there are more plant and animal species in the lower Appalachians, the Great Smoky Mountain National Park, than anywhere else. They are the third oldest mountain range in the world. When you have that kind of rich history sitting in your back yard where you have got more visitors than the top three other parks combined in visitation—we have about 10 million visitors a year to the Great Smoky Mountain National Park—that is a blessing. You get to share your precious natural resources and your cultural heritage traditions to the entire world.

The down side of that is that the footprint is enormous, and when you are talking about—I know out West and these esteemed gentlemen up here have been out West a lot and been to some of those parks. You have millions and millions of acres and lots less visitation. But when you are talking 525,000 acres, just a half a million acres, and the footprint of 10 million visitors, it takes a toll, and on top of that with the kind of climate change that we have been seeing, especially with the drought a couple years ago—I have a working cattle farm. I had to buy hay for 2 years at exorbitant prices from surrounding States. It was devastating to the economy of the local farmers.

Now, in saying that, I do not think we can afford not to look at climate change because in the future, if we do not, then what we have and what we know now and we have known for the first 100 years, by 2016 at the centennial we are not going to know where to go in the next 100 years. So I feel that if we do fully fund research projects and adaptation projects, then I feel truly what is going to happen is that we are going to get in front—we are going to be proactive in getting in front of this problem and see what we can do. There will be an influx of capital investment, which in turn for us economically will turn around and create jobs and, in turn, increase our tax base. If we allow our parks to go unattended in this, then the decimation will be just absolutely—it will be brutal and then people will not come anymore.

The Great Smoky Mountains National Park just celebrated its 75th this year. My family comes from the park. We were kicked out of the park. We were kicked out.

I know that Senator Burr probably has friends that have family that were kicked out of the park on the North Carolina side. When we left, we were not happy campers, truly. Literally we were kicked out and the Federal Government has taken over.

We have gotten over it. We love what has happened with the parks. We love what the Federal Government has done with it now, but we also feel that it is incumbent upon the Federal Government to work with us in partnership to create new strategies, new policies to address what we have always wanted to do, which is to keep our cultural heritage traditions and our precious natural resources and that is all we are asking.

Senator UDALL. Thank you for sharing that understanding and your experiences with us. I marvel at your family's history.

Since I spent so much time encouraging you to talk about the Great Smokies, I hope Senator Burr will get somebody else on the panel to talk about Rocky Mountain National Park so I can make myself whole with my constituents back in Colorado because we are proud of our parks.

Dr. Williams, in the time I have got remaining—and I think we may well do a second round—I wanted to follow up on your statement about streams becoming uninhabitable for native trout because the water temperatures are very important to trout health. Are you of the mind that sportsmen and sportswomen are aware of the impacts to trout streams in parks and how those changes could affect recreational opportunities? How do you see the Park Service engaging this constituency to help educate the general public?

Mr. WILLIAMS. Thank you. The first part of your question—I think the answer is there is a growing awareness from hunters and anglers across this country. The Wildlife Management Institute, in cooperation with about eight other major national conservation organizations, Ducks Unlimited, Trout Unlimited, that type, edited and produced a book called Seasons' End which deals with the challenges of climate change. That was an attempt to help inform and educate hunters and anglers across this country who, I would say, about 4 or 5 years ago probably really were not engaged in this issue. Not only that book, but those major conservation organizations produce—almost all of them produce monthly magazines and have covered this topic. So that awareness is growing. I do not think there is any question about it.

We have been involved in some polling of hunters and anglers, national polls. It ranks up there as a concern. The other concerns are the economy, energy, and so on that supersede that. But I think those polls are very important. In the most recent one we did, if I could characterize, one of the responses was we know that climate change is an issue and we think that steps should be taken now to address it rather than wait because it will cost less to deal with it now than it will if we wait 10–15 years. So hunters and anglers are aware and that concern is growing.

The Park Service provides—again, as I guess two of the panelists here talked about—tremendous fishing opportunities across the country, in particular—well, I will talk about Rocky Mountain National Park. There is tremendous fishing there. It is a place that all us easterners dream about and eventually hopefully get a chance to go fish some of those wonderful areas.

But I have got to go back to the Great Smoky Mountains. In Seasons' End, in that book, the chapter that dealt with cold water fisheries, trout fisheries, the experts, the fisheries biologists that work those areas and those Appalachian streams have made some pretty dire predictions about what might happen to the native trout species, particularly brook trout, in those streams because of warming temperatures in streams and the change in stream flow as a function of change in snowmelt and snowpack.

Senator UDALL. Thank you.

Senator Burr.

Senator BURR. Dr. Williams, let me assure you the brook trout are still alive and well. I caught one not long ago.

Mr. WILLIAMS. Very good.

Senator BURR. Just outside the borders of the Great Smokies.

Mayor, let me welcome you.

Mr. MCMAHAN. Thank you.

Senator BURR. I feel like I have a direct tie to you. If it had not been for North Carolina giving Tennessee that land, you would not have Tennessee.

Mr. MCMAHAN. Yes, sir. I appreciate that direct tie.

Senator BURR. But we thank you for sharing the park with us, and it is my hope you will not have to buy hay this year based upon how much rain we have had.

Mr. MCMAHAN. No, sir. I have had three cuttings already. I think we are fine.

Senator BURR. A lot of things have changed.

Let me ask you.

Mr. MCMAHAN. Yes, sir.

Senator BURR. If, for some reason in an attempt to try to address human effects on climate, the Park Service came out tomorrow and said we are banning automobiles from the Great Smoky Mountains National Park, what would that do to the 10 million visitors we have?

Mr. MCMAHAN. If they just out and banned it right now? It would be decimating to visitation.

Senator BURR. There are some things that we might both look at and say this could have a marginal impact on climate change, but from a standpoint of what the parks are there for, this is not the right direction for us to go. Do you agree?

Mr. MCMAHAN. Absolutely. Yes, sir.

Senator BURR. Dr. Noss, I am going to give you an opportunity to give me the words to sell coastal residents in North Carolina who have lived when they saw most of the Outer Banks covered in water, only to now be pretty heavily developed in some areas and in other areas, a protected national park with some controversy on usage right now. But how can you lead me on how I convey to them that they are in jeopardy of those at some point being under water, the result of climate change versus their historical knowledge of cyclical changes?

Mr. NOSS. I understand your question, and I would have a hard time explaining to them too except for to just point to the bigger picture. I think this is a classic example of the limitations, not the wrongness but simply the limitations, of taking a purely local view because if you take a little broader view, these barrier islands move around. They come and go, whereas some of yours have grown, there have been other barrier islands that have disappeared completely or moved considerably over the same span of time.

Senator BURR. Not the result of climate change.

Mr. NOSS. Yes, as a result of sea level rise just recently. I will point to increasing storm surge from hurricanes. I will point you to a book from a couple folks in your——

Senator BURR. Are hurricanes the result of climate change?

Mr. NOSS. Yes. The increasing sea surface temperature is now accepted as the major factor for the increasing intensity of hurricanes, which means storm surge.

Senator BURR. If progressively this gets worse every year, progressively—I mean, this is not something that skips a year or skips a decade as far as the impact of climate change.

Mr. NOSS. Oh, no. It can skip years and decades.

Senator BURR. So this year's low experience of hurricanes is a skip. It's an aberration in the trend?

Mr. NOSS. We are in an El Nino year and during El Nino years, the intensity and the frequency of Atlantic hurricanes is reduced. Next time we get into a La Nina, which is the opposite situation, we can expect that hurricanes will again come back with force. A lot of the hurricanes in 2003–2004 were both during relative La Nina periods. So that is a somewhat cyclic situation. But the general trend is toward increasing——

Senator BURR. So let me see if I understand this. If we knew we were in that cycle, why would the guy out in Colorado and the national weather forecast not have said, you know, this is going to be a year we are not going to have many hurricanes. They actually projected this year we were going to have more than we did last year.

Mr. NOSS. Because very interestingly, the cycle is changing. We are getting to shorter periods of time between El Nino events, in particular, and increasing intensity——

Senator BURR. But, Dr. Noss, this is like me watching the news last night, because I had an honor flight of 100 veterans coming up today, and when I saw the forecast for today, I called 10 people in my office and made sure they were going to be at the World War II Memorial this morning with umbrellas based upon what they forecast last night, only to get to the World War II Memorial this morning and the sun was out.

So I guess my point is if we are relying on science to drive this massive change in our policy at the parks and potentially the public investment and we cannot, 6 months out, look at say, well, you know, this is a La Nina year or—what was the other one?

Mr. NOSS. El Nino and La Nina.

Senator BURR. Whichever one produces less, why could we not project that 6 months ago when the hurricane forecasters looked at it and said, well, this is a La Nina year, so we are not going to have many?

Mr. NOSS. As counter-intuitive as it seems, long-term trends in climate are actually more reliable and many times easier to predict than weather day to day, and the same thing with these El Nino and La Nina years. It was not predicted that the cycle would shorten and the intensity of both the El Nino and the La Nina would increase, but it is something that happened. Some people had predicted that, but it was not generally accepted until quite recently.

Senator BURR. I read your testimony and I was just struck by one thing, if I could read it.

Mr. NOSS. Sure.

Senator BURR. "Most projections now show the sea rising by at least 1 meter by the year 2100. This is the level currently estimated by the U.S. Climate Change Science Program. However,

many recent projections are higher. For example, the State of California has now assumed 1.4 meters by 2100 in its planning, and some studies suggest that a rise to 1 meter or more above current levels could happen significantly sooner than 2100." Then you made the statement verbally: It is improbable it will be slower or less.

So let me just ask you. Is there any scientific data that suggests it is going to be slower or less?

Mr. NOSS. There are certainly some scientists that claim that, and we have had an odd situation globally over the last 10 years, what appears to be odd, in that climate has been relatively stable in terms of temperature for the last 10 years. But if you look at the bigger picture, this is not unexpected. You have climate, in terms of global temperature, for example, going up, stabilizing for a while, going up again, stabilizing for a while, and in the big scheme of things, it is going to drop over thousands of years.

So the trend is definitely upwards, and there is a lag time. The sea surface temperature and sea temperatures generally have continued to increase markedly over this last 10 years even though air temperature has been stable. So last July was the highest sea surface temperature average worldwide ever recorded in the history of humans taking measurements of sea surface temperature. We do know that there is a strong connection now between the intensity of hurricanes and sea surface temperature. It is still controversial whether we are going to have more hurricanes as a result of this.

Senator BURR. How long have we kept data on sea temperatures?

Mr. NOSS. At least a couple centuries.

Senator BURR. Globally?

Mr. NOSS. I would have to look and see exactly how many points. We take measurements in many more points now, but there have been people measuring ocean temperatures for a long time.

Senator BURR. You suggest that some of what we have been through is cyclical. We are going to go through this and then the temperature is going to come back down.

Mr. NOSS. Over the big span of time, absolutely. We have been through this before.

Senator BURR. It makes it even tougher for me then to understand the connection to carbon and some of the things that we are talking about doing if in fact this has happened before and those items did not contribute to it.

Mr. NOSS. They did. There were other factors that led to fluctuations in carbon dioxide content on a global scale, factors including volcanism, volcano activity, and lots of other things. But I am talking about on the scale of tens of thousands to millions of years. So, for example, the last time we had significantly higher sea levels was during the last interglacial period, a period between glaciers of the Ice Age, which was around 40,000 to 50,000 years ago. There was a recent study done. It showed that at that time, sea levels rose very rapidly, maybe as rapid or more so than we are even seeing now.

Senator BURR. Was the United States geographically even in the location that it is today then?

Mr. NOSS. Yes, pretty much so actually. It is just that we were——

Senator BURR. The tectonic plates had separated and we had all the——

Mr. NOSS. It has not changed much since then. It has not changed much for the last few million years.

Now, the big difference between this episode of global warming and climate change in general and those of the past is that species could move in response to climate change in the past because there were not all these barriers in the way. There were not cities. There were not big agricultural fields. There were not highways.

Senator BURR. I think Dr. Williams got into that very well, that this is as much a challenge about the growth of population.

Mr. NOSS. Absolutely.

Senator BURR. Listen, I want to thank all of you. I hope that the proposals that come out of the Park Service are reasonable and rational and achievable and effective. I hope if, in fact, we think that a policy like removal of automobiles or a cap on the population is something that ought to be policy, that we will sober up before we go out and publicly say that. But I am confident that from a standpoint of our Park Service, the investment in the policy, this is something we have to do in collaboration with the American people and, yes, with the mayors and the communities that surround those parks. If it is not beneficial, if it is not there for the purpose that we protected them—and that is for the public use—then I am not sure that the American people will buy into what the remediation might be.

I thank all three of you.

Senator UDALL. Let me thank also, as we bring the hearing to a conclusion, the three witnesses. Your testimony has been enlightening and enjoyable.

I would add my thoughts, as we conclude, that I do believe we cannot afford to not respond. As Dr. Williams suggested, if we do not address it now, it will cost us a much greater price later on.

The record will remain open for 2 weeks.

Again, thank you for your testimony here today.

The hearing is now adjourned.

[Whereupon, at 3:30 p.m., the hearing was adjourned.]

APPENDIXES

APPENDIX I

Responses to Additional Questions

[Responses to the following questions were not received at the time the hearing went to press:]

QUESTIONS FOR JONATHAN B. JARVIS FROM SENATOR MURKOWSKI

BUFFER ZONES/PARK SERVICE JURISDICTION

Question 1. Recently, there have been a number of National Park Service endorsed situations which sought to increase NPS land or had the effect of creating buffer zones around existing National Park Service Units.

It is important to note that the Park Service only manages land within the boundaries of the National Park Units, and is not provided with the jurisdiction to manage lands outside of those Units. What role should the National Park Service play in creating and mandating policy for lands surrounding National Park Units? If the Park Service plays a role in overseeing surrounding lands or resources, the NPS would have extremely far reaching jurisdiction, wouldn't you agree?

OTHER LAND MANAGEMENT AGENCIES

Question 2. Each land management agency and bureau has their own statutory mission statements and manages lands differently than the National Park Service. All of these agencies' missions apply within the borders of the land for which the difference agencies have jurisdiction, but not outside of those borders.

Does the Park Service believe that its own Organic Act should allow it to pursue efforts that may be in contrast to efforts of other land management agencies?

Question 3. The Secretary of the Interior has begun a Climate Change Initiative which, among other things established "cooperatives" through which "Interior bureaus and agencies must work together, and with other federal, state, tribal and local governments, and private landowner partners, to develop landscape-level strategies for understanding and responding to climate change impacts."

What is the Park Service's role in these cooperatives, and the Climate Change Initiative in general? Are there, and will there continue to be, differences between different land management agencies on how Climate Change should be approached within their respective jurisdictions? To what extent will the Park Service influence activities outside of its jurisdiction?

APPENDIX II

Additional Material Submitted for the Record

NATIONAL PARKS CONSERVATION ASSOCIATION,
CLEAN AIR & CLIMATE PROGRAMS,
Washington, DC, October 28, 2009.

Hon. MARK UDALL,
Chairman, Subcommittee on National Parks, Senate Energy and Natural Resources Committee, Dirksen Senate Office Building, Room 304, 1st and C Streets, NE, Washington, DC.

DEAR CHAIRMAN UDALL,

Please accept the following testimony and attached reports on behalf of the National Parks Conservation Association (NPCA) in connection with the hearing by the Subcommittee on National Parks to receive testimony on the current and expected impacts of climate change on units of the National Park System.

Founded in 1919, NPCA 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, from southern Florida to Alaska, and 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.

CLIMATE CHANGE WILL HAVE SERIOUS LONG-TERM IMPACTS ON OUR NATIONAL PARKS

The effects of climate change have been visible for years in our national parks. Glaciers are disappearing faster than scientists had predicted even a few years ago. Native trees and animals are losing ground because changing temperature and weather patterns are making the availability of food, water, and shelter less certain. Fish and wildlife are being driven from their national park homes by changes that are unfolding faster than the animals' ability to adapt.

America's national parks are showing the signs of climate change. From Yosemite's forests in California to the Gulf Stream waters of the Florida coast, from the top of the Rocky Mountains to the shores of the Chesapeake Bay, these lands and the incredible diversity of life they support are all feeling the heat. Climate change is here and now, affecting the coral reefs in Florida at Biscayne National Park, lodgepole pines in Rocky Mountain National Park and animals that rely on snow in Yellowstone National Park.

NPCA is submitting for the record our 2009 report, *Climate Change & National Park Wildlife: A Survival Guide for a Warming World*, which details the climate change impacts on wildlife in dozens of national parks throughout the country. An electronic version is available at www.npca.org/survivalguide. We are also submitting for the record our 2007 report, *Unnatural Disaster: Global Warming and Our National Parks*, which details climate change impacts on national parks throughout the country. An electronic version is available at www.npca.org/globalwarming.

As detailed in NPCA's reports, national parks, including their roads and buildings as well as their natural, historical, and cultural resources, are highly vulnerable to climate change impacts already unfolding across their landscapes. Following are some of the key findings of our reports with regard to climate change impacts on the national parks:

GLOBAL WARMING IMPACTS ON OUR NATIONAL PARKS

	ALASKA	
AK	Katmai	Ocean warming may affect salmon fisheries and scientists are exploring possible links between warmer river temperatures and increased parasites in salmon.
AK	Wrangell-St. Elias	Thawing permafrost will damage infrastructure and reduce the size and location of ponds on which waterfowl depend.
	PACIFIC COAST MOUNTAINS	
WA	North Cascades	Seventy to 90 percent of the snow pack could disappear by the end of this century, threatening winter sports and water supplies.
WA	Olympic Mount Rainier NP	Warmer winters and more extreme precipitation events could increase winter flood risk; An increase in stream water temperature and shallower stream will cause the decline of suitable salmon habitat.
OR	Lewis and Clark	Earlier snowmelts and spring flooding can decimate already-stressed salmon populations.
CA	Yosemite National Park Sequoia National Park Kings Canyon National Park	The yellow-legged frog is threatened by disappearing ponds caused by increased evaporation and by the lack of water replenishment from higher altitude sources; Warming and drought have made wildfire 3 season longer and more damaging, and increased insect damage; Warmer temperatures will worsen ground-level ozone problems; Increasing wildfires will contribute more smoke and airborne particulates.
	ROCKY MOUNTAINS	
MT	Glacier	The sculpted peaks, magical hanging valleys, azure lakes are all here because of the glaciers. By 2030, the glaciers will be gone and they will take a part of the Park with them; Wolverines could decline as snowfields they depend on for dens disappear and carrion from winter-killed animals becomes less available.

GLOBAL WARMING IMPACTS ON OUR NATIONAL PARKS—Continued

WY-MT-ID	Yellowstone	Recent warmer winters have led to burgeoning Whitebark pine insect infestations killing thousands of trees and dramatically decreasing the availability of the pine nut, a critical fall food source for grizzly bears.
CO	Rocky Mountain	Rising temperatures and diminishing snow pack are allowing trees to take over high elevation alpine tundra putting animal species that have adapted to this ecosystem at great risk.
	SOUTHWEST	
UT	Canyonlands Arches Capitol Reef	Bighorn sheep are threatened by an increasing scarcity of its food caused by changes in precipitation patterns.
AZ	Saguaro	Higher temperatures are allowing invasive grasses to displace native plants, and these grasses fuel wildfires, which used to be rare in this ecosystem.
TX	Big Bend	The Rio Grande is forecasted to narrow and dry up in places, encouraging invasive plant growth and affecting wildlife. CA JOSHUA TREE More than 90% of Joshua trees in the park could be wiped out within a century.
	GREAT LAKES	
MI	Isle Royale	Wolf and Moose populations are declining at a rapid rate due to unusually warm summers, directly threatening their symbiotic relationship.
WI	Apostle Islands	With the water level in Lake Superior decreasing, recreational infrastructure must be redesigned and replaced in order to maintain the visitors' enjoyment of the park and safety.
MI	Sleeping Bear Dunes	Climate change will exacerbate existing stresses on waterfowl, shorebirds, and migratory birds, such as water pollution and non-native species.
IN	Indiana Dunes	This park ranks third of all U.S. national parks in plant diversity, but the diversity of aquatic and land-based flora will decline significantly.
	NORTHEAST	

GLOBAL WARMING IMPACTS ON OUR NATIONAL PARKS—Continued

ME MA NY	Acadia Cape Cod Fire Island	Climate change is diminishing the availability of nesting habitats for red knots and other shorebirds that annually migrate along the Atlantic Flyway.
ME	Acadia	Rising seas may permanently submerge the park's islands, while warmer summers will result in increased evapotranspiration rates, which could destroy the park's many wetland ecosystems.
MA	Cape Cod	Much of the Cape's rich mosaic of marine, estuarine, fresh water, and terrestrial ecosystems, already damaged by rapid sea level rise over the last decade, could be completely lost to future generations as submersion and erosion claims ever more of this low-lying park.
NY	Fire Island	Sea-level rise will increase shoreline erosion, saltwater intrusion into groundwater aquifers, and drown out endangered native species, while increased storms threaten historical and cultural treasures.
NY	Ellis Island	Immigration records that connect over 40 percent of Americans to our collective past would have to be removed from the park or risk destruction from rising seas.
ME-GA	Appalachian National Scenic Trail	More floods can lead to higher landslide risk, threatening portions of the high elevation trail, and communities that lie below.
	MID-ATLANTIC	
MD, VA	Chesapeake Bay	Warmer water is likely to increase outbreaks of two dangerous oyster diseases.
VA	Historic Jamestown	Jamestown celebrated its 400th anniversary in 2007, but much of the park could be under water before its 500th anniversary.
VA	Shenandoah	More droughts, floods, and warmer streams can diminish native trout populations.
VA, NC	Blue Ridge Parkway	Warmer summers can produce more ozone 5 NC pollution and more "code red" air quality days, increasing health risks for visitors.
	SOUTHEAST	

GLOBAL WARMING IMPACTS ON OUR NATIONAL PARKS—Continued

TN, NC	Great Smoky Mountains	Rare and ancient forests may be threatened by increasing ground-level ozone and insect pests unleashed by warming; the park is expected to lose most of its populations of red squirrel, northern flying squirrel, and southern red-back vole.
NC, SC, GA, FL, MS	Wright Brothers National Monument Fort Sumter Fort Pulaski Gulf Islands National Seashore	Sea level rise, increasing storm strength, and flooding threaten low-lying historic areas and historical structures that tell the story of our nation from its earliest days.
FL	Everglades	More powerful hurricanes combined with sea level rise could destroy park buildings and roads, increasingly cutting-off visitor access.
VI	Virgin Islands NP	Warming ocean temperatures and disease may be the primary contributing factors to the decline of coral reef habitats.
FL	Biscayne Bay Dry Tortugas	Rising, warming and acidifying seas threaten coral reefs and sport fishing. Toxic or unusual algal blooms may threaten wildlife and tourism.

These impacts degrade not only the parks and their wildlife, but also are beginning to have a significant impact on the National Park Service's budget. Just one result of climate change—increased seasonal flooding in the pacific west—underscores the seriousness of the challenge.

Because winter temperatures in coastal Pacific mountains hover close to freezing, the few degrees rise predicted for this region will cause more and more precipitation to fall as rain rather than snow. Predicted increases in extreme winter precipitation with expected shifts toward rain rather than snow could greatly increase the likelihood of flooding. In North Cascades National Park, the three worst floods in park history have occurred in the fall when rain fell on snow that already had accumulated in the mountains. In November 2006, Mount Rainier National Park suffered the most damaging flood in its 108-year history when nearly 18 inches of rain fell in just 36 hours. The flooding broke the main utility lines, destroyed large sections of roads, trails, and campgrounds, and filled reservoirs with mud and debris. The major year-round road through the park was closed for six months, and a major north-south road was closed for over a year. Rebuilding cost to date has exceeded $40 million.

The National Park Service desperately needs a plan to protect America's assets from climate change. Equally importantly, NPS needs the resources commensurate with the enormity of the challenge.

NATIONAL PARKS CAN BE PART OF THE SOLUTION TO CLIMATE CHANGE

What's happening in the parks is symptomatic of changes unfolding across the larger landscapes to which they are inseparably connected, the same landscapes that contain our communities. Changes that harm wildlife—depriving them of food, water, or shelter—will ultimately harm us. Given the iconic importance of parks, and that they protect core ecoregions of this country, working to safeguard parks and their wildlife from climate change should be a central strategy in safeguarding our nation from climate change.

Solutions are neither simple nor quick and easy. It will take decisive action on the part of our federal government and all of us to meet the challenge and keep our faith with future generations. To avoid the potentially catastrophic loss of ani-

mal and plant life, it is imperative that we wean ourselves from energy sources like coal and oil that are accelerating rising temperatures and causing unnatural climate change. It is equally imperative that we pursue new strategies to preserve functioning ecosystems and the full diversity of life they support.

National parks can play an important role in these strategies, preserving healthy ecosystems and their wildlife, in part by helping them to adapt to new climatic conditions. But some challenges must be addressed before the parks can fully step into this role. Right now, no national plan exists to manage wildlife throughout their habitat, which often is a patchwork of lands managed by multiple federal agencies, states, tribes, municipalities, and private landholders. Wildlife need corridors that enable them to migrate between protected lands as climate change renders their current homes inhospitable. We also need to work harder to reduce air and water pollution that compound climate change stresses on wildlife. All of these elements must be put in place as soon as possible to safeguard all living communities.

We must act now to secure America's natural legacy before it is lost to our children and grandchildren. The National Park System can play a central role in restoring and preserving the healthy ecosystems necessary for wildlife—and indeed ourselves—to thrive.

FIVE KEY ACTIONS ARE NEEDED TO SAFEGUARD NATIONAL PARKS FROM CLIMATE CHANGE

The choice is now ours to either chronicle the decline of our national parks or take actions to make our national parks part of the climate change solution. If we fail to act, many species of fish and wildlife could disappear from the parks—or even become extinct.

That we must reduce global warming pollution to protect our natural world and human communities is now understood by many. But that is not all we must do. Unnatural climate change is already underway and will continue for decades even if we put a stop to all global warming pollution today.

Additional steps must be taken now to safeguard wildlife. We must protect the places that will help wildlife survive as the climate changes, manage wildlife anticipating the changes ahead, and improve the ecological health of the national parks and their surrounding landscapes to give fish and wildlife a fighting chance to survive unnatural climate change.

NPCA advocates five steps that, taken together, will help safeguard fish and wildlife, their homes, and our communities, from climate change. Here's what needs to be done:

1. Stop contributing to climate change.—Many wildlife species are struggling to cope with climate changes already underway. Some will not be able to endure much more change, and could disappear from national parks and even go extinct if climate change is unchecked. We must limit its effects by rapidly reducing greenhouse gas emissions and switching to less-polluting sources of energy.

2. Reduce and eliminate existing harms that make wildlife more vulnerable to climate change.—The damaging effects of climate change are compounded by existing stresses on wildlife. Air and water pollution, development of adjacent wild lands, and other forces are harming national park wildlife now, and adding climate change to the mix could be disastrous. By reducing and eliminating these environmental harms we can significantly decrease the vulnerability of plants, fish, and wildlife to climate change as well as produce rapid and tangible benefits—such as clean air and water—that both people and wildlife need to thrive.

3. Give wildlife freedom to roam.—Climate change will cause some wildlife to move outside the parks' protected boundaries, while other species may move in. Because national parks, like all protected areas, are interconnected with surrounding landscapes, cooperation and coordination among all land owners—public and private—is essential to preserve functioning ecosystems and the wildlife they support. National parks can play a key role in conserving wildlife across the landscape. In some cases they provide natural corridors; in other cases new corridors will be needed to connect parks and other protected lands so that wildlife can move in response to climate change.

4. Adopt "climate smart" management practices.—As one of the nation's premiere land managing agencies the National Park Service needs working models and sufficient resources to preserve biological diversity and ecosystem functions threatened by climate change. Familiar and emerging concepts like habitat restoration, connective corridors, facilitated migration, elimination of compounding stressors, scenario modeling, mobile conservation areas, and genetic diversity, must be woven together into a coherent, workable, and replicable model. Amer-

ica's national parks are poised to assist in developing that model, but they currently lack sufficient funding and management capacity needed to formulate, implement, and market an ecosystem-wide "climate smart" adaptation model.

Climate-smart management includes four key elements:

(1) Training national park managers to build climate change into their work,

(2) Establishing guidance and policies that enable park staff to work closely and equally with other federal, state, local and private landowners,

(3) Providing sufficient funding and staffing for the challenge at hand, and

(4) Creating a political and organizational setting that facilitates appropriate, timely, and collaborative action.

While research and monitoring should be a part of any park's approach to climate-smart management, real focus needs to be placed on implementing management changes now based on what we already know.

National Parks are the ideal laboratories to develop and deploy new conservation strategies for combating the effects of climate change. They are the symbols of America, beloved by millions of our own citizens, and admired as a model throughout the world. They are home to some of the best science and innovative thinking on climate change and ecosystem management. And they enjoy strong support across the political spectrum, a dynamic that has helped parks achieve the highest level of ecosystem protection among public lands.

With its strong political support and scientific information, the National Park System can be empowered to lead the way in preserving the maximum degree of biological diversity and ecosystem function in the coming changing climates.

5. National parks lead by example.—With more than 270 million annual visitors, a core education mission, and a tradition of scientific leadership, national parks have an unparalleled ability to engage Americans in the fight against climate change. National parks can help visitors understand climate change is already occurring, the vulnerabilities of tomorrow, and how we can all reduce our contribution to global warming.

National parks can also serve as natural laboratories for testing innovative ways to safeguard wildlife from the effects of climate change, and to reduce greenhouse gases that are causing climate change.

CLIMATE LEGISLATION CURRENTLY BEFORE CONGRESS CAN HELP SAFEGUARD THE NATIONAL PARKS

As the Subcommittee on National Parks continues to examine polices to safeguard national parks from climate change, there is an immediate opportunity to secure critical protections for parks and all natural resources through climate change legislation now under consideration in both the Environment and Public Works and Energy and Natural Resources Committees. NPCA supports the *Clean Energy Jobs and American Power Act*, co-sponsored by Senators Boxer and Kerry, as well as legislation recently introduced by Senators Bingaman, Baucus, Whitehouse, and T. Udall, the *Natural Resources Climate Adaptation Act*, which establishes a comprehensive system for safeguarding America's vital natural resources from climate change.

BY SAFEGUARDING NATIONAL PARKS WE HELP SECURE OUR OWN FUTURE

National parks are America's national treasures. It is a uniquely American idea that each of us owns our national parks. They have been entrusted to us, and it is our responsibility to make sure that climate change does not rob the parks of their incredibly rich array of plants, fish, reptiles, birds, and mammals.

Wildlife is threatened now as perhaps never before. The Intergovernmental Panel on Climate Change warns that up to a quarter of assessed species could face extinction due to global warming by the end of this century. It's difficult to imagine that the changes leading to mass wildlife extinctions would not also profoundly threaten human life.

Decisive action now can help bring about a more hopeful future for wildlife and for ourselves. Taking the five steps recommended here will help safeguard national park wildlife by preserving and strengthening the ecosystems that support all wildlife. In turn our communities, which have always relied on healthy natural resources, will be better equipped to cope with the changes ahead.

Thank you for considering NPCA's views on the important issue of safeguarding our national parks from climate change impacts.

Sincerely,

MARK WENZLER,
Director.

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