



SCIENCE • ADAPTATION • MITIGATION • COMMUNICATION

Adapting to Climate Change

To enable proactive response to threats and potential opportunities presented by climate change, the National Park Service and other land managing agencies are beginning to incorporate climate change adaptation into long range strategies as well as routine planning and operations. A form of risk-management, adaptation actions aim to moderate the effects of climate change on environmental conservation, agriculture, forestry, facilities, and protection of human health and societies. This issue of *Climate Change Response Program News* highlights the basic concepts of adaptation as well as some approaches and resources available within the NPS.

Climate change is occurring, and continued global warming is inevitable for decades to come. Scientists project that if human activities continue to emit carbon dioxide (CO₂) and other greenhouse gases at current levels, average global temperatures will increase 3-7°F over the next 100 years. Even if we drastically reduce emissions, warming will continue due to response lag times inherent in the Earth's climate system. This rate of warming exceeds that experienced during at least the past 10,000 years. Among the first effects already observed are changes in natural ecosystems, which are highly adapted to their particular, local climatic conditions. In response, many organizations and agencies including the NPS are working to reduce emissions and examining ways to manage CO₂. Simultaneously, knowing that a changing climate is a constant in our future, we are working to incorporate adaptation actions into all aspects of NPS operations.

What is Climate Change Adaptation?

Current policies and practices that exist in all sectors around the globe (agriculture, transportation, energy supply, human health, water resources, and society) evolved during a remarkably stable period of the Earth's climate. Continued application of those policies "as is" assumes climatic conditions will be similar in the future. Yet future climates will substantially differ from those of the past. Accordingly, organisms and ecosystems will change, and whether proactively or reactively, managers will change existing policies, practices, and infrastructure that rely on a stable climate. Climate change adaptation may include social, economic, or ecological responses, some triggered naturally and others that are planned and implemented to intentionally accommodate uncertain future conditions.

"...a 'normal' or stable climate can no longer be assumed. The challenge is not successfully managing a transition from one equilibrium climate to another, but rather, adapting to a far more uncertain climatic future."

—Pew Center Report on Adaptation 2006

Definition

Adaptation: Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

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Above: Parks will need to adapt policies, practices and infrastructure to respond to impacts from climate change, like this flooded river walk at Golden Gate NRA. Photo courtesy of Will Elder.

The habitat range of the Shenandoah salamander is highly restricted and will become more so due to climate change. Park managers are considering adaptation options, like captive breeding or species translocation.

What is Climate Change Adaptation *Cont'd*

The NPS Adaptation Framework: The NPS *Climate Change Response Strategy* identifies adaptation as a major component to effectively cope with climate change today and into the future. Adaptation in the NPS encompasses four broad arenas: 1) adaptation planning, 2) promoting ecosystem resilience, 3) preserving cultural heritage, and 4) protecting facilities and infrastructure. The breadth of this topic emphasizes the need for approaches that coordinate across administrative and disciplinary boundaries. Adaptation actions include a wide range of activities, which can be promoted or implemented in small or large steps. Many of these steps are familiar to NPS staff – identifying key resources and values, collecting and synthesizing information, evaluating management options, developing plans, implementing activities on the ground, and monitoring results. In other cases, adapting to climate change will require managers to consider conservation goals and priorities in a new way, often by considering protection of park resources and values within a larger spatial and temporal context.

Vulnerability, Resistance and Resilience: Vulnerability of a resource to climate change depends on its *sensitivity*, *exposure* to environmental stressors, and *adaptive capacity*. Assessing vulnerability involves measuring intrinsic characteristics (e.g. physiological tolerance), external forces (e.g. temperature), and inherent and/or imposed qualities (e.g. behavior, or landscape barriers) that affect organism or ecosystem response to stress or opportunity. Climate change vulnerability also pertains to facilities and cultural resources; these may have little or no adaptive capacity, but they do exhibit sensitivity and exposure by virtue of location, material types and other factors that affect their vulnerability to climate change.

Managers develop adaptation strategies to reduce vulnerability, or facilitate transition to a new desired state. Most adaptation strategies today reflect long-time conservation approaches which aim to promote *resistance* (ability to resist change or disturbance) and *resilience* (ability to take in impacts and recover from disturbance). These strategies, such as removing invasive species, reducing pollution, and minimizing fragmentation strive to diminish other stressors as well.

What is unique about climate change adaptation? Aren't we always adapting in our management? Many parks will change in profound ways due to climate change, in some cases affecting fundamental resources for which a park was established. Thus, climate change adaptation will not only require vulnerability information, it will require managers to reconsider conservation goals and priorities, and prepare for transition to new conditions. To be effective, the scale of

many adaptation strategies will compel parks to increasingly work within landscape-scale partnerships on adaptation goals shared across multiple jurisdictions. Climate change also means that the past is no longer a guide for the future; thus, management will occur in a context of far more uncertainty, requiring new tools (such as scenario thinking) that support decision-making despite uncertain and uncontrollable conditions. Monitoring the results of management actions will be essential to learning and to improving management decisions.

Current Activities: Numerous projects and activities focused on climate change adaptation are underway in the NPS. For natural resource adaptation, current approaches emphasize decreasing vulnerability through reducing stressors and promoting healthy ecosystem function (e.g. habitat restoration and removing invasive species), identifying climate refugia, removing barriers and promoting habitat connectivity. To promote long range thinking, the NPS is working with science partners to examine new considerations for conservation goals. NPS employees actively participate in multi-jurisdictional initiatives, and the NPS Climate Change Response Program supports full-time staff in four DOI Landscape Conservation Cooperatives (LCC's) toward this purpose. Additionally, the NPS continues to develop scenario thinking as a tool to facilitate planning for rapidly changing physical, ecological, social and political contexts. Developing guidance to incorporate climate change adaptation into NPS planning is a major focus in 2012; the next newsletter will explore these activities in more detail.

Climate change adaptation encompasses an extremely broad range of activities and topics. Every park can integrate some aspect of adaptation into routine operations – whether through interpretation, considering climate change in planning, or undertaking adaptation actions on the ground. Contact: Cat_Hawkins_Hoffman@nps.gov

Definitions

Resistance: The ability of an organism, population, community, or ecosystem to withstand a change or disturbance without significant loss of structure or function.

Resilience: The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change.

ADAPTATION OVERVIEW

What is in that Alphabet Soup Anyway?

GLOBAL

IPCC

The Intergovernmental Panel on Climate Change (IPCC) is a United Nations science panel established in 1988. It periodically convenes the world's leading scientists to assess recent published scientific information and produce peer-reviewed reports on all aspects of global climate change, including greenhouse gases, physical science, impacts, adaptation, vulnerability, and mitigation. The IPCC completed reports in 1990, 1995, 2001 and 2007. The IPCC Fifth Assessment Report is scheduled for completion in 2013. IPCC reports provide the most comprehensive scientific treatments of climate change available and constitute the standard references for scientists and policymakers.

The NPS uses IPCC reports to guide its work on climate change and contributes to the scientific assessment process. For example, the 2007 IPCC reports provide the scientific basis for the NPS *Climate Change Response Strategy* and NPS scientists use IPCC climate projections to analyze the vulnerability of ecosystems such as forests, wildlife, and other resources. NPS also uses IPCC guidelines to calculate how to reduce greenhouse gas emissions from park operations and will contribute a lead author for new guidelines on quantifying emissions and storage in wetland ecosystems. More info: <http://www.ipcc.ch>

NATIONAL

USGCRP

Previously known as the U.S. Climate Change Science Program (2002-2008), the U.S. Global Change Research Program (USGCRP) coordinates federal research on climate change and its implications for society. Congress created the USGCRP through the U.S. Global Change Research Act (USGCRA) in 1990. Thirteen U.S. departments and agencies participate, including the Department of the Interior. The USGCRP supports many aspects of the Nation's climate change research and modeling, including atmospheric, oceanic, land, and space-based observing systems. Currently, the USGCRP is developing a new 10-year strategic plan, available at: <http://strategicplancomments.globalchange.gov/> More info: <http://www.globalchange.gov/>

NCA

Under the U.S. Global Change Research Act of 1990, Congress charged the USGCRP with producing a National Climate Assessment (NCA) every four years. NCA reports are an important source of synthesized, peer-reviewed climate science and adaptation information for the U.S., providing higher resolution and more detail than the IPCC. The first NCA (2000)

included a series of regional and sectoral (e.g. agriculture, water, forests, etc.) reports as well as a national synthesis. The second NCA (2009) included 21 Synthesis and Assessment Products (SAPs), a comprehensive set of reports that reviewed most major climate change topics. The NPS is currently involved in many activities to support development of the upcoming 2013 NCA, including participation in high-level advisory committees, technical panels, working groups, and writing teams. The 2013 NCA will provide detailed technical reports that focus on geographical regions, sectors, and cross-sectoral issues (e.g. energy-water interactions).

More info: <http://www.globalchange.gov/component/content/article/67-themes/154-spotlight1>

DEPT OF THE INTERIOR

CSCs

In September 2009 the Secretary of the Interior issued an order to establish a department-wide initiative to address the impacts of climate change on America's land, water, and other natural and cultural resources. Secretarial Order 3289 established 8 regional Climate Science Centers (CSCs) as a key component of that initiative, to provide scientific information and decision tools for effective decision making at regional to local scales. While the CSCs involve all the Department of the Interior (DOI) bureaus, they are functionally operated and largely staffed through the USGS as an expansion of their National Climate Change and Wildlife Science Center. CSCs are located at host universities selected through a competitive process that will be reannounced every five years. NPS staff participated in the selection process and committed to full time positions at three CSCs, with a focus on social and cultural sciences. More info: <http://www.doi.gov/csc/index.cfm>

LCCs

Also established under SO 3289, Landscape Conservation Cooperatives (LCCs) are public-private partnerships that work at the interface of science and management to respond to large scale stressors, including climate change, that require landscape-level, coordinated responses. Much of the funding and organizational capacity for the LCCs comes through the U.S. Fish and Wildlife Service. LCC partners develop their own governance and operating procedures. There are 22 LCCs, four of which have a full-time NPS staff member, and others have a designated NPS liaison.

More info: <http://www.doi.gov/lcc/index.cfm>

The Cockspar Lighthouse at Fort Pulaski NM demonstrates the need for adaptation strategies to respond to the rising sea. Notice the high water line at the base of the lighthouse. Current projections indicate sea level in this area may rise as much as 2.3 feet over the next 50 years.



Adaptation Resources

The Climate Adaptation Knowledge Exchange (CAKE) is

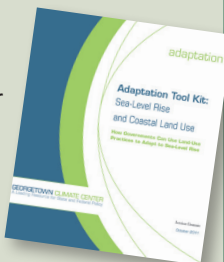


an online forum that organizes adaptation research and information, case studies, and tools. It also allows users to submit new resources as well as interact with each other once you create a free profile.

<http://www.cakex.org/>

As directed by Congress, the development of a National Fish, Wildlife, and Plants Climate Adaptation Strategy (NFWP) is underway under guidance of the Council on Environmental Quality (CEQ) Interagency Climate Change Adaptation Task Force. The objective of the Strategy is to identify and define principles and approaches to maintain key terrestrial, freshwater and marine ecosystems and functions to sustain the nation's valuable fish, wildlife and plant resources and associated ecosystem services in the face of accelerating climate change. The Strategy will be available for public review and comment in Jan-Feb, 2012. <http://www.wildlifeadaptationstrategy.gov>

The Georgetown Climate Center recently released an "adaptation toolkit" including a website and case studies to support state and federal policymakers, resource managers and others who are working to help communities adapt to climate change. <http://www.georgetownclimate.org/adaptation/clearinghouse>



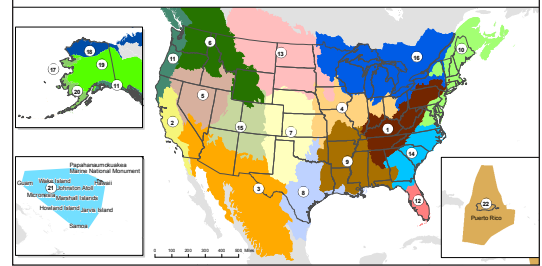
NPS Staff in LCCs

NPS has committed to five full time landscape adaptation coordinators to support LCCs, four of which are in place and introduced below.

To access more information including a link to each LCC's website, click on the *number* for the desired LCC on the map on DOI's website.

<http://www.doi.gov/lcc/index.cfm>

Landscape Conservation Cooperatives



Tom Olliff

As co-lead of the Great Northern (GNLCC), Tom is responsible for taking a much broader view of geographic areas than most land managers are able to do. Helping to facilitate dialogue across an area extending over 260 million acres, he works to increase collaboration across an international landscape—including federal, state, tribal, non-governmental organizations, and Canadian organizations. The focus of GNLCC is to support managers of land, water, fish, wildlife, and cultural heritage resources in response to climate change and other landscape-level stressors. Tom previously lived and worked in Yellowstone NP for 32 years, serving in many different positions, last of which as the Chief of Resources.



Amanda Babson

Amanda is the Coastal Landscape Adaptation Coordinator for the North Atlantic (NALCC), leading science and resource management efforts related to climate change adaptation for coastal parks in the Northeast Region and throughout the nation. She previously worked for the EPA in the Global Change Research Program where she conducted climate change vulnerability assessments as part of the USEPA Climate Ready Estuaries Program. Amanda works at the University of Rhode Island with other NPS personnel associated with the North Atlantic Coast Cooperative Ecosystem Studies Unit, Northeast Coastal and Barrier Monitoring Network, and the Northeast Region GIS Field Technical Support Center.



Janet Cakir

Janet is the Climate Change, Socioeconomics, and Adaptation Coordinator for the South Atlantic (SALCC). She comes to the NPS with a strong geospatial background combined with experience in environmental economics and the utilization and interpretation of air quality modeling data. She has held multiple federal positions all emphasizing environmental health. Janet worked for the EPA's Office of Air and Radiation, Air Benefit Cost Analysis Group; as a team lead at the USDOA's Natural Resources Conservation Service; and as a program analyst at the National Institute of Environmental Health Sciences.



Stanton Enomoto

In March 2011 Stanton became the Climate Change Cultural Resources Adaptation Coordinator serving the Pacific Islands LCC (PICCC). As part of the Pacific West Region's Cultural Resources Program, he works across disciplines and program areas within the NPS to develop and coordinate adaptation strategies and guidance for climate-sensitive cultural resources. Prior to joining the NPS, Stanton was the chief operating officer for the State of Hawaii's Office of Hawaiian Affairs.



NPS Climate Change Adaptation Staff

NPS staff working to address adaptation needs at a national level are:

Intra- and Inter-agency Adaptation:

Cat_Hawkins_Hoffman@nps.gov

National Climate Change Adaptation Coordinator

Douglas_Parsons@nps.gov

Climate Change Liaison

Coastal Adaptation:

Rebecca_Beavers@nps.gov

Cultural Resource Adaptation:

Marcy_Rockman@nps.gov

Adaptation Projects in the CESUs/RLCs:

Tim_Watkins@nps.gov

Adaptation Planning:

Don_Weeks@nps.gov

Matt_Rose@nps.gov

LCC Project Highlights

Great Northern (GNLCC)

The GNLCC has embarked on a new commitment to international, transboundary cooperation, helping to implement a Memorandum of Understanding (MOU) on environmental cooperation. The MOU commits British Columbia and Montana, working with the U.S. government as needed, to preclude exploration and development of coal, minerals, oil, and gas in the North Fork Flathead River Basin. Undammed and ecologically pristine, the North Fork of the Flathead River runs some 153 miles from British Columbia south into Montana where it marks the western boundary of Glacier NP. The valley supports logging, recreation, hunting, and other uses by a mix of federal, state, provincial, tribal, and private interests. Coal-bed methane extraction, oil and gas development, and proposed coal mining through mountaintop removal all have the potential to impact the river, threatening terrestrial and aquatic resources. The GNLCC is working with local partnerships such as the Crown Managers Partnership to convene a team of fisheries biologists from the NPS, USGS, USFS, University of Montana, and the State of Montana to design and conduct a cross-boundary study of fish population density, distribution, and reproduction. This GNLCC-funded study is a first step towards meeting provisions of the MOU.

Contact: Tom_Olliff@nps.gov

Or visit: <http://greatnorthernlcc.org>

South Atlantic (SALCC)

The SALCC recently initiated development of a high-level strategic/business plan, originating by conducting a short survey of employees and steering committee members regarding their interests and expectations for the SALCC. Target for completion of the plan is the end of January 2012. Other projects underway in the SALCC include obtaining “seamless” LiDAR coverage for

the entire SALCC over time, and developing an “Optimal Conservation Strategy Prototype.” The Prototype will help SALCC partners identify vulnerabilities of natural and cultural resources and where they might act to sustain those resources.

Contact: Janet_Cakir@nps.gov

Or visit: <http://www.southatlanticlcc.org>

Pacific Islands Climate Change Cooperative

The concept of integrating cultural and social issues with natural resource conservation is a core principle of the PICCC, embodied in its enabling charter. PICCC members recognize the intimate and living connection between island communities and natural elements of the islands that enrich and sustain them. Throughout the Pacific Islands the composition and function of various ecosystems, the numerous cultural sites, features, and landscapes, the generational transmission of cultural knowledge, and the continuity and evolution of traditional practices that depend upon the natural world reflect this inextricable “biocultural” relationship.

Two on-going projects of PICCC: 1) Designing a framework to address climate impacts on cultural resources at Hawaii Volcanoes NP and at Kaloko-Honokohau NHP. Central to development of the framework will be a survey and consultation with key community advisors and experts as well as park staff. 2) Developing protocols to assess vulnerability of historic resources at War in the Pacific NHP in Guam and American Memorial Park in Saipan. This project involves an assessment of the parks’ ecology, geography and historic resources in relation to various climate drivers to determine the relative vulnerability of the resources to climate change impacts.

Contact: Stanton_Enomoto@nps.gov

Or visit: <http://piccc.net>

Adapting to Climate Change in the Coastal Zone

Over 100 NPS park units located in coastal or lake areas are at risk from effects of sea level rise, lower lake levels, salt water intrusion, and/or inundation during storms. The NPS is developing vulnerability screening and adaptation strategies for coastal parks as they are among those most obviously threatened by climate change. In collaboration with the NPS Sustainable Operations and Climate Change (SOCC) staff and contractors, work is underway to design a “high-level screening” approach to determine which park facilities are at greatest risk to sea level rise. Additionally, a project led by Dr. Rob Young and collaborator Katie Peek of Western Carolina University will describe adaptation options and considerations for the wide range of NPS facilities and cultural

resources in coastal areas. Their work will provide a handbook to assist with long-range planning for vulnerable facilities/resources, and will integrate with continued work by the SOCC contractor to develop a park-level risk screening tool. Contributing to wider efforts, NRSS staff are also supporting the National Ocean Policy Workgroup for Coastal Adaptation to Climate Change and Ocean Acidification in developing a strategic action plan under guidance from the White House Council on Environmental Quality (<http://www.whitehouse.gov/administration/eop/oceans/sap>), as well as the US Army Corps of Engineers team in developing the Engineering Technical Letter for Sea Level Rise (<http://corpsclimate.us/etl.cfm>). Contact: Rebecca_Beavers@nps.gov



Robert Young

Rob is a professor of coastal geology at Western Carolina University and Director of the Program for the Study of Developed



Shorelines. In September 2011, Rob began work with the Climate Change Response Program to provide practical and actionable options for adaptation to long-term sea level rise and storm impacts in coastal parks. While with the NPS, he will develop a guide to adaptation strategies for facilities and cultural resources in the coastal zone that will support long-range planning for vulnerable infrastructure, and provide recommendations for immediate response to events like roads or structures destroyed in a storm, for example.

CULTURAL RESOURCE ADAPTATION

How Can Cultural Resources Adapt?

Cultural resources – including archaeological sites, prehistoric and historic buildings and structures, cultural landscapes, ethnographic knowledge and practices, and museum collections – are inanimate and either fixed in place or hold much of their significance and cultural value from their relationships to a specific place. In many cases, unlike natural resources, cultural resources cannot themselves adapt to changing environments. What can adapt are the ways in which humans act and organize themselves with respect to cultural resources.

The NPS approach to cultural resources in relation to climate change adaptation emphasizes a diversity of stewardship, research, and interpretive and communication projects and programs appropriate for changing and unpredictable environments. Nationally, several programs are underway to better integrate assessment and management of cultural resources with natural resources. These include cultural resource representation and assistance to the Landscape Conservation Cooperative network, and development of management options for coastal cultural resources threatened by sea level rise (part of the CCRP and Facilities coastal adaptation projects).

Initial cultural resource adaptation projects will focus on resources most threatened in the near-term, balanced with longer-term inventory, monitoring, and documentation work, and interpretation and translation of cultural resources for many audiences. Projects in progress or development include (but are not limited to) climate change impact modeling and ground-truth inventory of

coastal sites in Alaska and interior sites at Gates of the Arctic, ice patch archaeology in Glacier, environmental history and future management plans in the Midwest Region, and vulnerability assessment development in the Southeast Region.

Section 5 of Secretarial Order 3289 expresses a commitment to coordinate consistently and well with American Indians and Alaska Natives on climate change initiatives. Currently, NPS cultural resource staff Stanton Enomoto and Marcy Rockman are helping to plan a NOAA-Smithsonian workshop on indigenous knowledge and climate change scheduled for July 16-19, 2012 at the National Museum of the American Indian in Washington, DC.

Contact: Marcy_Rockman@nps.gov

Marcy Rockman

Marcy is the NPS Climate Change Adaptation Coordinator for Cultural Resources. In this role she addresses impacts of climate change on cultural resources and translation of archaeological information into forms useful for federal and partnership planning regarding adaptation and resilience. Marcy is a former AAAS Fellow and a fellow with the Cotsen Institute of Archaeology at UCLA. An archaeologist by training, Marcy has focused her long-term research on the landscape learning process, which is how human populations gather, share, remember, and transmit environmental information.



Monthly Climate Change Webinar Series

(2nd Thursday of every month; 2:00 p.m. - 3:30 p.m. EST)

January's presentation will feature Dr. Peter Marra, a Research Scientist working for the Smithsonian Conservation Biology Institute. His presentation will provide an overview of work he has done with the Migratory Bird Project specifically related to the relationships between the timing and rate of spring migration of long-distance migratory birds, and variables such as temperature, the North Atlantic Oscillation (NAO) and plant phenology.

Next Webinar: Jan 12th, 2012

Follow this link to register for this webinar:

<https://www1.gotomeeting.com/register/247788448>

Servicewide Comprehensive Call

The Servicewide Comprehensive Call for projects starting FY2013-2015 has been announced. Funding for climate change adaptation projects is now available in the new consolidated Natural Resource funding source. You can find the Director's Memo and schedule deadlines here:

<http://classicinside.nps.gov/budget3/call.htm>

To view the guidance, click on the PMIS SCC Program Guidance link and select the FY2014 "Natural Resource SCC Guidance."

More Information

This newsletter is a bimonthly forum sharing news related to NPS efforts to manage our parks in a changing climate.

Dr. Leigh Welling, Chief Climate Change Response Program

Leigh_Welling@nps.gov

Comments & Submissions:
Angie_Richman@nps.gov

The Climate Change Response Program can be found on the web at: <http://www.nps.gov/climatechange>