National Park Service
U.S. Department of the Interior

Climate Change Response Program

Climate Change Response Program Newsletter

Q4 | 2015

SCIENCE • ADAPTATION • MITIGATION • COMMUNICATION

SPECIAL EDITION: Young Leaders in Climate Change Internship

Today's young adults are the first generation to grow up with an awareness of climate change. They cannot take for granted the hope of traveling with their kids or grandkids to hike on glaciers in Alaska, to explore the sea of grass in the Everglades, or to see the first permanent English settlement at Jamestown. Inviting them into our national parks as they complete their education and begin their careers can engage them in working on one of the biggest challenges the National Park Service (NPS) – and society as a whole -- has ever faced. The skills, knowledge, and dedication of today's students will be required to manage parks in a changing climate.

This edition of the Climate Change Response Program Newsletter highlights 10 young adults selected for the inaugural year of the George Melendez Wright Initiative for Young Leaders in Climate Change (YLCC). The YLCC program funds innovative, professional-level internship projects in national parks and NPS program offices. Internship positions are filled by high-caliber undergraduate and graduate students. This year, students worked on everything from archaeology to phenology; web design to GIS. They worked autonomously, gained genuine leadership experience and skills, made recommendations to park superintendents, and engaged internal and external stakeholders at high levels.

The YLCC program operates under the Department of Interior's Direct Hire Authority. The participants are eligible to be hired non-competitively into NPS jobs for which they qualify. Because of this, the program provides the NPS with a powerful tool for building a workforce capable of meeting climate change needs across the breadth of our stewardship responsibilities.

The YLCC program exists at an important intersection. It helps the NPS understand and respond to climate change. It contributes to the great need of public conservation agencies to connect with youth, as articulated in Interior Secretary Jewell's Youth in the Great Outdoors Initiative. And it illustrates how science and stewardship activities advance the NPS Centennial goal of creating the next generation of park visitors and supporters.

We are pleased to present in the following pages the stories of some of this year's YLCC participants. Enjoy them and keep an ear out – you may hear more from these students in the years to come as they move into NPS jobs that focus on managing parks in a rapidly changing world.

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In This Issue

GEORGE MELENDEZ WRIGHT
YOUNG LEADERS
IN CLIMATE CHANGE

Monitoring Ocean Acidification on the Pacific Northwest Coast

Jonathan Jones
University of California, Santa Barbara

Funded by the YLCC program, I conducted ocean acidification research at Olympic National Park. Olympic National Park and nearby San Juan National Historical Park are marine parks of particular interest in the North Coast and Cascades Inventory and Monitoring Network (NCCN). Both parks contain a high diversity of intertidal invertebrates and seaweeds, many of which are vulnerable to ocean acidification.

Ocean acidification is an anthropogenic threat to marine resources in the national park system, particularly on the west coast of North America where the oceanographic process of upwelling brings naturally low pH water to the surface from depth. Over the past decade, ocean pH off Washington's Olympic coast has declined much faster than predicted by conservative climate change models. Declining pH within Puget Sound has also been precipitous, leading to spawning failures at numerous oyster aquaculture operations. Low pH seawater can affect the formation and maintenance of shells in a vast number of intertidal organisms, all of which rely on certain pH gradients to maintain basic life functions.

During my internship, I helped collect rocky intertidal field data from four open coastal sites at Olympic and two sites at San Juan as part of the NCCN Intertidal Inventory and Monitoring Program. These data are co-located with pH sensors that provide chemical context for biological species shifts through time. I helped streamline the field protocol for pre-existing ocean acidification sensors at Olympic and led the development of a new protocol to incorporate SeaFET™ (field effect transistor) pH sensors at monitoring sites at Olympic and San Juan. During this internship, I also constructed a vulnerability assessment to highlight the organisms that will likely be most impacted by ocean acidification. This information provides a framework for mitigation, adaptation, and risk awareness for resource managers into the future.

Jones assisted in intertidal biological monitoring efforts at Olympic National Park and San Juan National Historical Park.

SeaFET™ pH sensors were incorporated into ongoing monitoring efforts at both NPS units.

Perennial Arctic Alpine Snow and Ice Patch Monitoring: Alaska

Molly Tedesche
University of Alaska, Fairbanks

The perennial snow and ice patch modeling project in the central Brooks Range of Gates of the Arctic National Park and Preserve (GAAR) in Alaska was initiated in response to climate change. These historically permanent fields are now melting and retreating due to an increase in average yearly air temperatures.

Melting perennial snow and ice fields in locations such as the Southern Yukon, Northwest Territories of Canada, and Wrangell Mountains in Alaska, recently revealed globally significant artifacts and ancient animal dung. These receding snow fields are revealing well-preserved archaeological and paleoecological specimens left behind by ancient Inuit hunters and the caribou herds that they may have tracked across the snow patches thousands of years ago. Caribou flock to these areas during summer months, to stay cool and to avoid swarms of mosquitos.

Scientists at GAAR aren't sure yet if there are ancient artifacts or animal remains lying within the perennial snow and ice in the Brooks Range. Modeling and predicting which snow patches have archaeological potential and which might melt fastest is an important first step for retrieving and preserving any possible specimens. Using remotely-sensed and field-collected data on these snow patches can also help scientists estimate how much they may have changed over decades, centuries, and possibly even millennia. This rate of change in snow and ice field extent and mass could also yield important clues as to how climate change is affecting important national park resources.

During my 2015 YLCC internship, I worked closely with NPS Archaeologists Dr. Jeff Rasic and Adam Freeburg. Over the summer, I used remotely sensed snow cover data and radio collared caribou data to model caribou herd interactions with snow and ice patches in the Central Brooks Range. I also spent time in the field, collecting snow and hydrology data on some of these perennially frozen patches and working with NPS archaeologist Chris Ciancibelli. The field work for this project entailed accessing remote, mid-to-high elevation perennial snow fields via helicopter, and surveying them by foot and by air.

The snow and ice patch modeling project has generated much interest within Alaska and beyond. The work was featured on the local Fairbanks public radio, as well as news articles in the Washington Times, the Alaska Dispatch News (ADN): **http://www.adn.com/article/20151016/melting-brooks-range-snow-patches-may-reveal-ancient-artifacts**, and for the International Arctic Research Center at UAF: **http://www.iarc.uaf.edu/research/highlights/2015/tedesche-snow-research**.

Tedesche digs a snow field test pit to look at layering of different phases/ages of snow and ice as they change over years of compaction, as well as measures temperatures to characterize the thermal gradient.

Snow patch melt water samples were collected and sent to a lab to analyze water chemistry.

Evaluating Effects of Climate Change on Cultural Resources at Coastal Parks

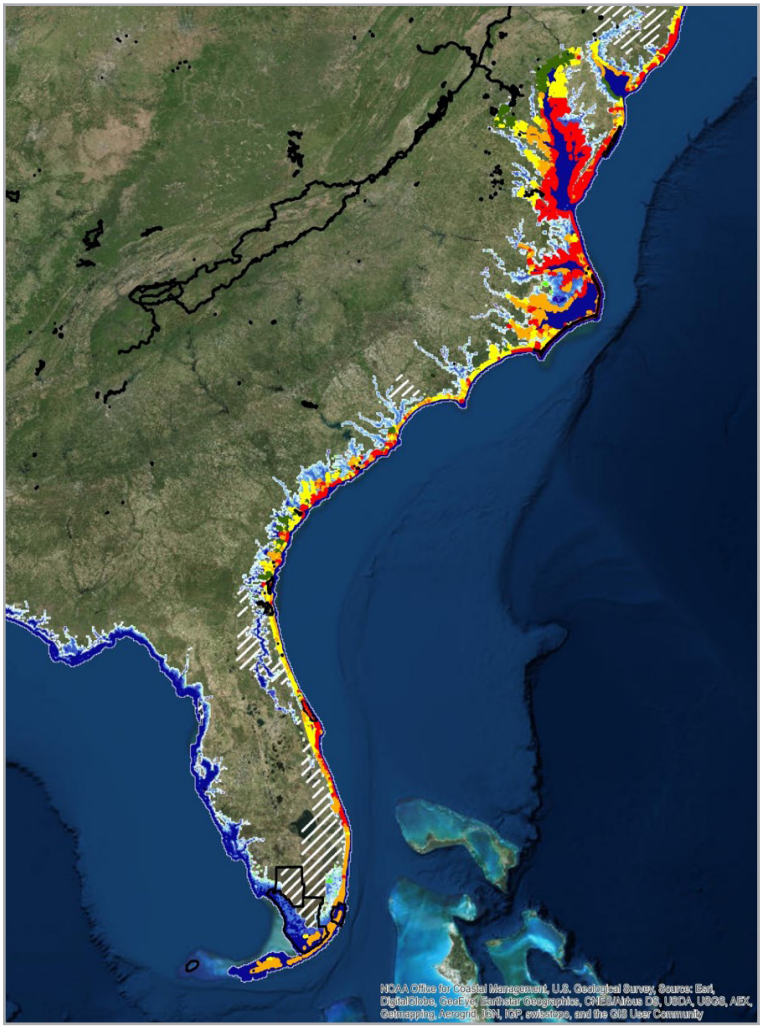
Lindsey Cochran
University of Tennessee

Global climate change threatens many cultural resources protected within the national park system. During my 2015 YLCC internship, I worked in Washington, D.C. to evaluate the effect of near-historical climate change to cultural resources within five units of the NPS. My project explored the applicability and accuracy of a previously existing Archeological Sites Management Information System (ASMIS) database to evaluate the effects of climate change on known archeological sites observed through a Geographic Information System.

The national parks units studied were Cape Canaveral National Seashore, Cumberland Island National Seashore, Timucuan Ecological & Historic Preserve, Cape Lookout National Seashore, and Colonial National Historical Park. Each unit contains archeological sites that span from the Archaic period to the present day, many of which are threatened because of climatic changes. ASMIS data were collected for each site to determine the relative proportions of the total cultural resources versus the number of cultural resources impacted by climate change.

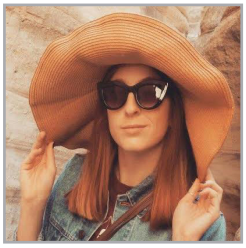
A total of four variables were extracted from ASMIS to represent impacts from near-historical to present day climate change. These variables are: (1) condition of the archeological site; (2) disturbance levels of the archeological site; (3) type of disturbance to the cultural resource; (4) and effect to the sites from the type of disturbance. Additional map and spatial projection layer sources include datasets from the US Geological Survey, Federal Emergency Management Agency, and the National Oceanic and Atmospheric Administration, all of which were corroborated with historical maps to assess the impact of storms dating as early as the 1880s. Triangulating these data sources facilitated accurate estimates of the cause and extent of damage to archeological sites.

Results suggest that incorporating this kind of mapping research at other parks and integrating ASMIS data into park planning is a time and cost-efficient strategy to identify—and respond to—the impacts of climate change. Additionally, decreasing the time interval between surveys, requiring location information within ASMIS, and improving geodata on archeology sites would greatly increase the uses of ASMIS for the purposes of observing the impact of climate change on cultural resources. Ensuring the accuracy within existing documentation of all known cultural resources is an essential first step to adapt to the deleterious effects of a changing global environment.



Projected effects of a six-foot global mean sea level rise across the Eastern Seaboard with a coastal vulnerability index (depicted on a range from red to green, with red being the most vulnerable and green being the least vulnerable)

Advancing Resilient Design for Historic Buildings: Gateway NRA



Halley Ramos
University of New Mexico

On October 29, 2012 Hurricane Sandy hit Gateway National Recreation Area causing severe damage to all three units of the park. Sandy impacted many structures within Fort Hancock and the Sandy Hook Proving Ground National Historic Landmark District. A majority of the historic structures were damaged by floodwaters. Some areas have remained closed due to sustained damage, and will reopen once they are safe for visitors and employees.

One of the major climate change challenges faced by Gateway is that historic buildings once safe from river floods and ocean levels may now be in jeopardy. During my 2015 YLCC internship, my work focused primarily on preserving cultural resources in the park by increasing resilience to future impacts of climate change.

Gateway is still in recovery, and is using funds appropriated by the Sandy Recovery Improvement Act to rebuild. The park is proposing to plan, design, and rehabilitate Building 7 along Officer's Row using new and green technologies and improved storm preparedness designs. The goal of my internship project was to develop and recommend strategies for how to incorporate sustainable climate change adaptation and storm preparedness materials, details, and options into the rehabilitation of Building 7. Over the summer, this was achieved through the development of details for specific elements of sustainable design and design guidelines for historic buildings and climate change adaptation options. The final product of the internship was a portfolio of green technologies that will help Gateway staff take a proactive approach to incorporating climate change considerations during the initial planning and design phases of the project.

It is proposed that this Building 7 will be used as a model of resilient design for other ongoing and potential projects at Gateway NRA. The structure will also demonstrate techniques for reducing the structure's personal and institutional carbon footprint, all while meeting the Secretary of Interior's Standards for Rehabilitation.

Historic Building 7 along Offer's Row at Gateway National Recreation Area, prior to resilience rehab, which is scheduled to begin in the near future.

Climate Influences Thermal Spring Quantity and Quality

Amanda Webb
University of Arizona

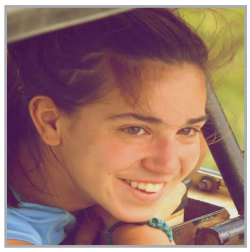
When I arrived at Hot Springs National Park for my YLCC internship, I could see that the park's thermal springs are unique natural and cultural resources. For many years, the springs have attracted people to soak in the naturally heated water for therapeutic and recreational purposes. The park's bathhouses and hiking trails, along with the historic business district of neighboring Hot Springs, Arkansas, provide an aesthetic destination for tourists, members of the community, and visitors seeking therapeutic benefits from the water.

Hot Springs National Park protects the geothermal waters and associated land for public health, wellness, and enjoyment. Currently, the discharge from the springs is of sufficient quality and quantity to supply water to public fountains and concessioners. However, spring source waters are supplied by rain that falls on nearby mountains and percolates deep into the ground. Changes in climate could initiate altered spring flows or water quality at Hot Springs, with potential impacts on the future availability or suitability of spring discharge for drinking and bathing. Adverse effects of climate on the springs could impact water users, water conveyance systems, and the local tourism economy.

My internship involved four primary objectives: review literature and synthesize information on regional climate change for park management; explore relationships between precipitation and spring flow by analyzing local weather and spring discharge data; assist the US Geological Survey with the development of a model to predict how land use and climate change might affect the park's hot springs; and communicate trends in regional climate change and possible future climate effects on the springs to management and park visitors. The products and results of my internship are an important step in improving understanding of the link between climate and spring conditions, and will help management identify possible impacts under different climate change scenarios.

The mountains of Hot Springs National Park surround historic downtown Hot Springs, AR.

Developing a climate change toolkit for the Pacific West Region



Natasha Way
McGill University

During my 2015 YLCC internship, I worked at Point Reyes National Seashore where I helped create an online Climate Change Toolkit for the Pacific West Region of the NPS. This web-based tool provides information to support NPS parks and employees as they respond to climate change.

The toolkit serves as an organized central hub where users can find links to useful resources on climate science, adaptation strategies, mitigation programs, and climate change communication. Resources on the toolkit are organized by both operational program area (Interpretation/Education, Facilities Management, Cultural Resources, and Natural Resources) and by park. A park interpreter creating an educational program focused on climate change, for example, could find inspiration within the toolkit, which provides links to lesson plans, curriculum-based programs and educational materials from both NPS and non-NPS sources.

During my internship, a team of dedicated employees from around the region assisted me in finding useful resources and developing the site. They provided important input for site design and organization to ensure the structure was both clear and useful. In doing so, we tailored the site to address issues and include content of specific importance to NPS employees in the region.

At the end of my internship, I conducted a beta test of the site with a limited audience. I used the feedback I received to create a road map for those still involved in developing the site and making improvements. The toolkit team continues to work on the site, which should go live in the very near future. It is hoped the site will evolve to include both periodic updates that reflect current science and an interactive area for users to ask questions and post ideas.

Way learns about the effects of climate change on intertidal zones at Point Reyes National Seashore.

Climate Change Impacts on the Iconic Saguaro Cactus and its Nurse Plants

Daniel E. Winkler
University of California, Irvine

Saguaro National Park is experiencing multiple impacts from climate change and is likely to see changes to its native plant community. The impact on the iconic Saguaro cactus is unknown, but survival of young plants has declined dramatically in the past 20 years as the park has experienced higher temperatures and drought (Figure 1).

Saguaro cacti are known for being part of a nurse-protégé relationship with desert trees and shrubs that provide them with protection from extreme heat during summer and cold during winter. Because this relationship is not fully understood, research on nurse-protégé relationships and how they will be impacted by human-induced climate change should be assigned a high priority. Altered precipitation, increased temperatures, and altered availability of water and nutrients due to changes in associated vegetation may have direct effects on saguaro recruitment, establishment, and regeneration. It is also probable that climate change will have indirect effects on saguaro cacti by altering seasonal dynamics of water use by nurse species or other associated species saguaro depend on.

As a 2015 YLCC intern, I worked with biologists at Saguaro National Park to examine the influence of climate change on Saguaro cacti and other desert plant species. My research leveraged the park's focus on the Saguaro and climate change as part of citizen science activities during the 100th anniversary of the NPS. I identified key research sites and installed soil moisture sensors to track water dynamics under and near nurse trees and Saguaros (Figure 2). The long-term data these sensors will produce are critical for better understanding the impacts of climate change.

During my internship, I also designed an experimental blueprint for future research to successfully disentangle the interactions of Saguaro cacti, their nurses, and climate change at Saguaro National Park. This research will be tied with Saguaro's active interpretive and social media initiatives, and help resource managers plan for the future of the park's namesake, as climatic conditions in the desert Southwest continue to change.

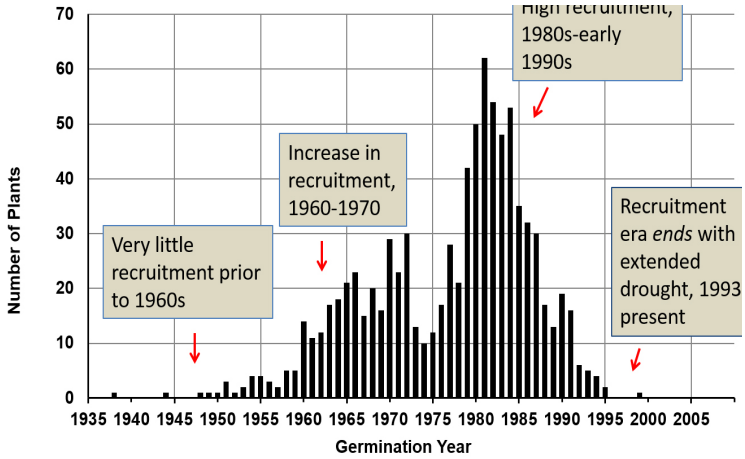


Figure 1. Declines in Saguaro cacti regeneration rates using estimates of germination year (J. Conver, unpubl. data). The number of new individuals surviving each year has declined dramatically in the past 30 years. Mechanisms for the decline are unknown but are presumed to be related to climate-induced drought that has persisted in the desert southwest for the past couple decades.

Figure 2. Experimental site where heat dissipation sensors were deployed in July 2015. Focal nurse paloverde is off center with shrubs and a small saguaro located underneath its canopy. Data logger, framing, and solar panel are to the right of the focal individuals. Disturbed soil in the foreground indicate where sensors were deployed away from the nurse for comparison.

Coastal Vulnerability to Climate Change in the Boston Harbor Islands

Michael Endicott
Rutgers University/Clark University

Through the YLCC program—and in collaboration with researchers from Boston University and Northeastern University—I worked this summer at Boston Harbor Islands National Recreation Area assessing the impact of rising sea levels. My project sought to engage the best available science on climate change and communicate the implications of my work to park stakeholders.

Central to my project was the use of geographic information systems (GIS), digital mapping technology that served as the foundation for developing an understanding of climate change's impacts on the islands throughout Boston Harbor. The core of my work was gathering detailed elevation data of coastal features through extensive fieldwork using survey-grade equipment. This data can be used to populate dynamic models that attempt to capture both the movement of water and sediments in response to sea level rise, and the resulting changes expected to the shape and elevation of coastal features. I also documented the precise locations of important park resources and facilities so that they can be incorporated into future modeling in order to understand their vulnerability to sea level rise.

A unique characteristic of the Boston Harbor Islands National Recreation Area is that it is managed by a diverse group of partners including the NPS, the U.S. Coast Guard, the Massachusetts Department of Conservation and Recreation, the city of Boston, and nonprofit agencies. At a partnership meeting in September, I presented to these groups regarding the implications of climate change and my summer work. I encouraged attendees to bear in mind the park facilities and resources of most concern with regards to rising sea levels as efforts to understand the impact of climate change are advanced in the future.

My internship offered invaluable perspective on using GIS in the context of conservation, providing on-the-ground experience connecting a real-world place of interest to on-screen data. The work I undertook this summer will inform my future education as I begin studies in pursuit of a master of science degree in GIS at Clark University this fall.

Endicott strolls the beach using survey-grade GPS gear to record precise elevation measurements of coastal features.

Modeling climate change impacts to archaeological resources in Yellowstone

Laura Cannon
University of Wyoming

Yellowstone National Park is a vast area of land, totaling 2.2 million acres. Only 3% of the park has ever been surveyed for the presence of archaeological sites, yet there is evidence that prehistoric humans have used the landscape for 11,000 years. Federal laws protect archaeological sites, while the NPS is charged with protecting and managing all resources for the enjoyment of future generations. Fulfilling these mandates requires some understanding of how—and at what rate—archaeological sites in Yellowstone would be impacted by climate change, which became the focal question of my 2015 YLCC internship.

My research revealed three main climate change impacts to archaeological sites within the park: the melting of high-altitude ice patches in which prehistoric hunting artifacts are preserved; early spring snow-melt leading to intense stream flow resulting in bank erosion and flooding; and less precipitation making for longer, more intense wildland fire seasons. As part of my project, a computer model was built that predicts the locations of archaeological sites with 90% accuracy, while wildland fire risk was modeled using weather projections. The project outputs help park managers identify areas of high risk, and help quantify how much risk may increases through the end of this century.

Though unexplored, Lamar Valley is likely an archeologically-rich area of Yellowstone National Park.

Climate change communications and outreach in the Southeast

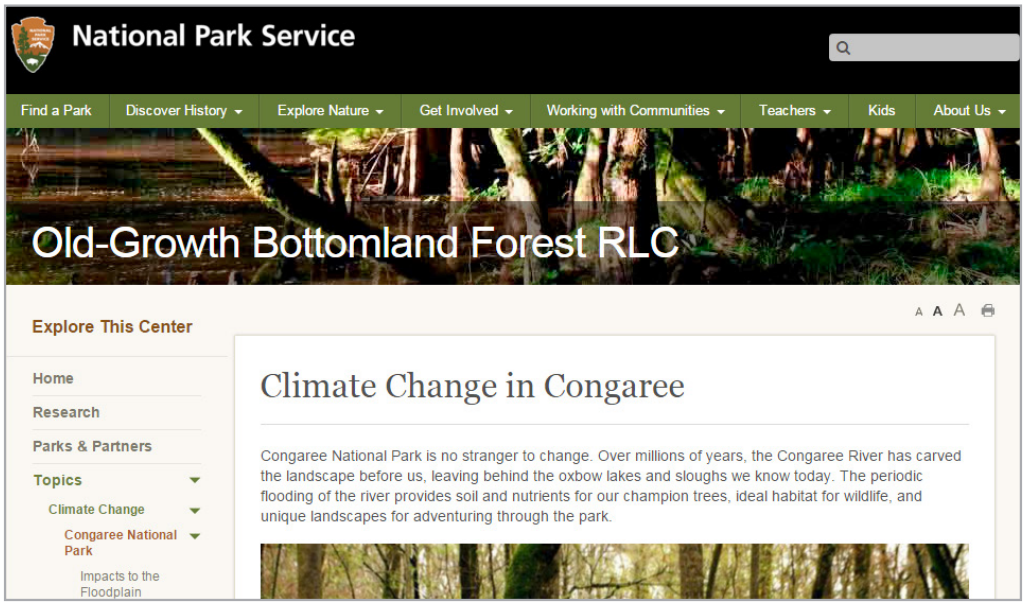
Monica Gregory
Indiana University

During my 2015 YLCC internship, I worked on a climate change communications and public education project that published five web pages for three NPS sites, totaling fifteen pages on climate change topics. The project was intended to reach a general audience with a focus on engaging Millennials.

This project was partner-driven, and the planning and review process was largely collaborative in nature. Based out of South Carolina, I worked extensively with my mentors, Dr. David Shelley (Congaree National Park), Dr. Janet Cakir (South Atlantic Landscape Conservation Cooperative), and Dr. Giselle Mora-Bourgeois (Gulf Coast Ecosystem Studies Unit.) With their support, I researched best practices in climate change communications and studied the psychology behind public opinion and engagement before collecting and synthesizing research specific to each park.

Through a literature review, independent research, and interviews with staff from Congaree National Park, Cape Lookout National Seashore, and Chattahoochee River National Recreation Area, I collected qualitative and quantitative data on climate change impacts specific to each park site. Congaree personnel are most concerned with climate stressors on decreased water quality, increased distribution of invasive species, and changing phenology. Cape Lookout staff are focused on adapting to sea-level rise, increased frequency and intensity of hurricanes and storm surge, and beach erosion. Chattahoochee employees focus on development pressures and climate change, shifting stream flow regimes, and regional watershed health.

All webpages created under my project can be viewed at *Congaree's Old-Growth Bottomland Forest Research and Education Center*. Project partners hope to use this work as a template to expand the effort and create similar web pages for additional parks in the Southeast region. Following my graduation in May 2016, I hope to continue work on human behavior and climate change, specifically in resource governance, collaborative partnerships, and shifting community identity in the face of a changing natural and cultural landscape.



Homepage of the Climate Change in Congaree website, hosted by the Old-Growth Bottomland Forest Research and Education Center.

Climate Change Response Program
Natural Resource Stewardship and Science

This quarterly newsletter celebrates the latest initiatives and accomplishments by National Park Service sites and programs in response to climate change.

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Social Media
NPSClimateChange

Training Announcement: Interpreting Climate Change Virtual Course

Looking for an opportunity to increase effectiveness in communicating climate change? The next session of the free online virtual course on Interpreting Climate Change will be held February 9-12, 2016. It is particularly relevant for any NPS interpreter, educator, public affairs specialist, or program manager who interacts with the public or supervises those who do. This course is also helpful for employees working at historical and cultural sites to help them discover effective and provocative ways to engage with their visitors on this issue.

Participants will learn valuable skills and techniques for engaging visitors such as facilitated dialogue, skills for dealing with controversy, and presenting multiple perspectives. They'll engage in group discussions to share best practices, build confidence, and identify meaningful site connections. Although the focus of this course will be on personal services interpretation, many of the best practices are also applicable to media development.

This course will be presented via a distance learning "virtual" classroom — each day will involve a schedule of webex plenary sessions, activities, and group discussions. Virtual class participation will require a work station with computer, reliable internet, and phone access. Time commitment for this class is 20 hours total class time plus a few hours for pre-course assignments and up to one hour of homework each day.

Registration is now open in DOILearn and closes January 11, 2016; to register, search for "interpreting climate change."

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Training Announcement: Climate Fundamentals Academy

The *Association of Climate Change Officers (ACCO)*, will offer a 3 part series of 2-day training workshops toward the goal of satisfying all course requirements for the Climate Governance Certificate. The Climate Governance Certificate is a credential issued through the ACCO's CCO Certification program.

The academies provide curriculum on topics including understanding climate science and variability, identifying climate hazards and conducting vulnerability assessments, and fundamental governance and stakeholder engagement strategies.

Under an agreement the ACCO will offer the Climate Fundamentals Academy (CFA) series for free for NPS employees only, in many locations during 2016. The first of which will be in the Boston area, as well as another in the National Capital Region.

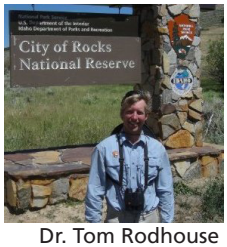
The first of the Boston area CFA will take place January 7-8, with subsequent 2-day workshops scheduled for Spring and Summer 2016. To register for this course, please follow this *link*.

The first of the National Capital Region CFA will take place February 17-18, with subsequent 2-day workshops scheduled for spring and summer 2016. To register for this course, please follow this *link*.

Monthly Webinar Series

Join CCRP for presentations by leading climate change scientists and communicators on the second Tuesday of every month from 2:00 to 3:30 PM EST.

January 14| Pikas in Peril Update, Dr. Tom Rodhouse, Upper Columbia Basin Network. *Register for the webinar here*



Dr. Tom Rodhouse