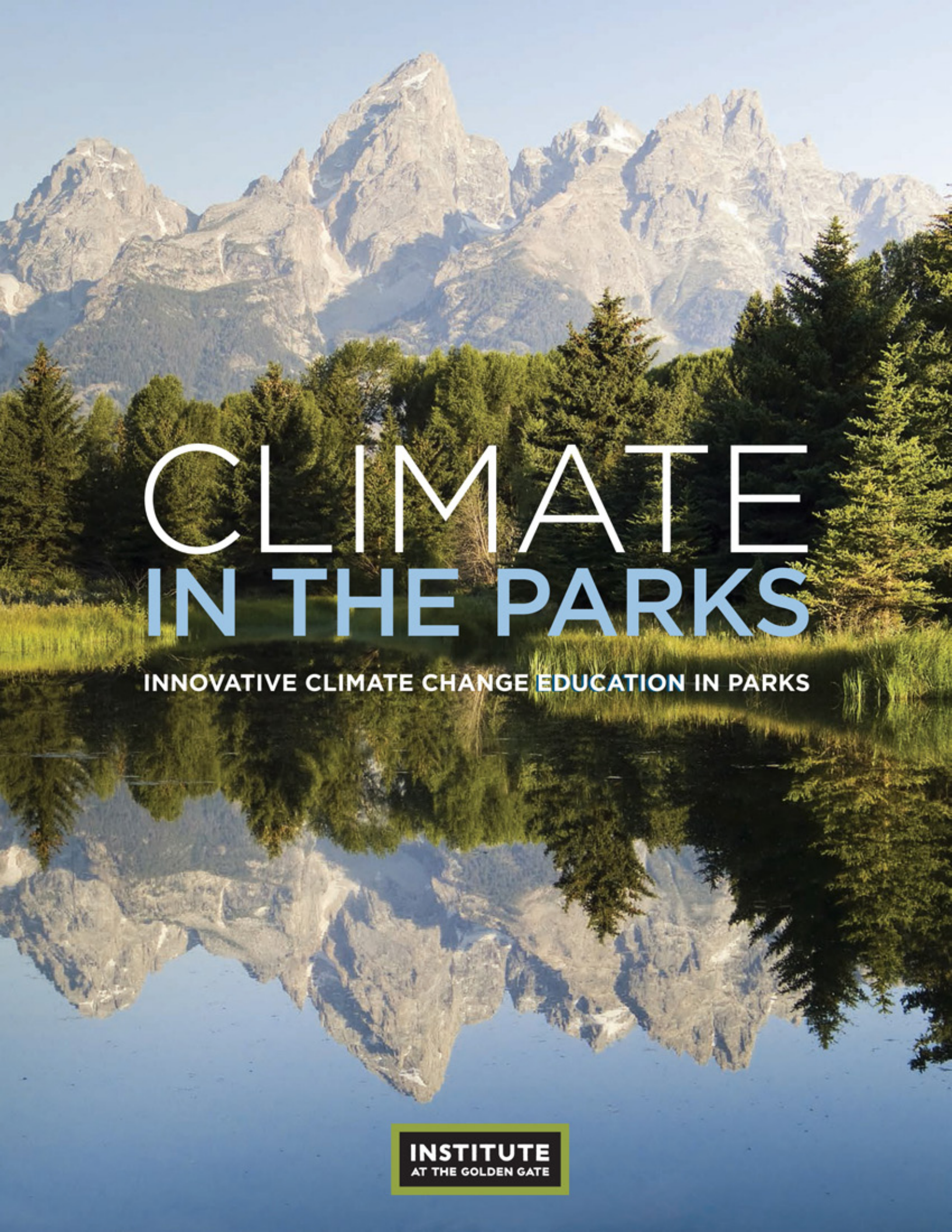
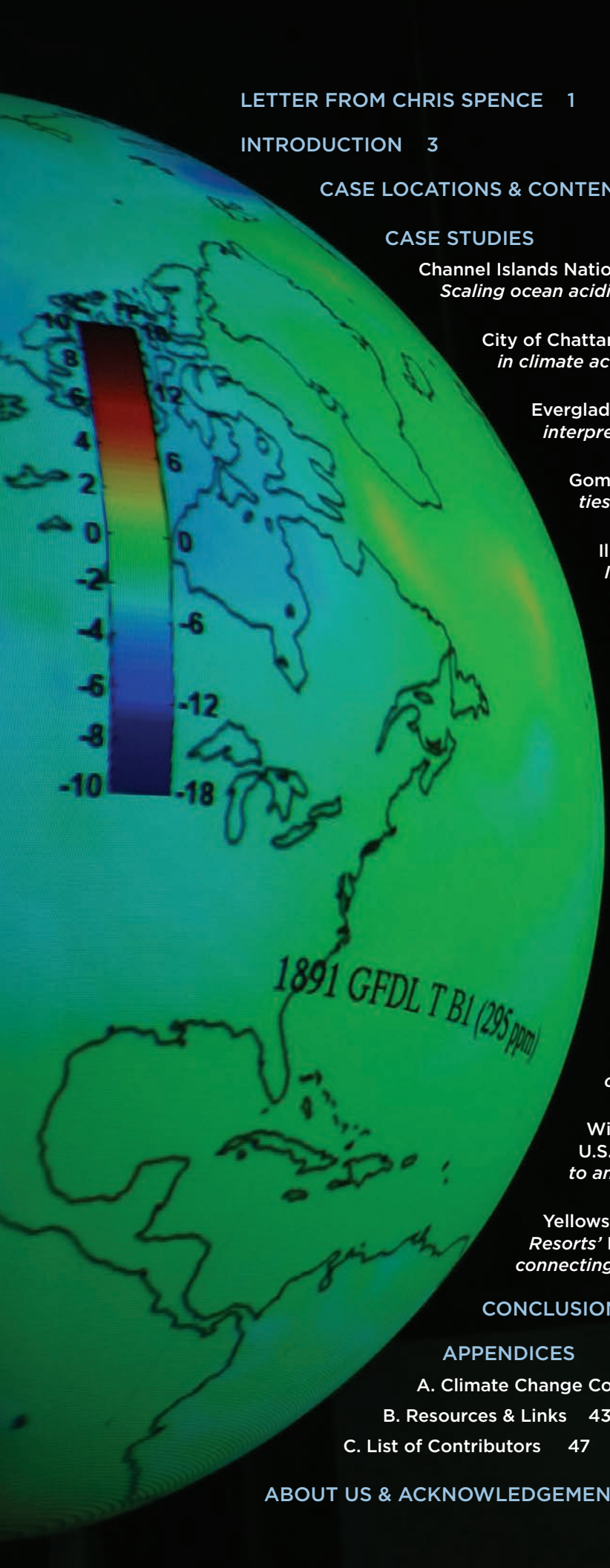


CLIMATE IN THE PARKS

INNOVATIVE CLIMATE CHANGE EDUCATION IN PARKS

INSTITUTE
AT THE GOLDEN GATE



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ABOUT US & ACKNOWLEDGEMENTS - INSIDE BACK COVER

What does the number 283 million mean to you?

If you guessed "America's population" you'd be close, but wrong.

In fact, 283 million is the number of visitors to America's national parks each and every year. That's a lot of people, but it only scratches the surface of total park visitation. In the U.S. alone, the numbers are far higher if you include state, city, and other parks, as well as protected areas. Globally, the numbers are greater still. With an estimated 160,000 parks and protected areas covering as much as 15 percent of the world's land mass, estimates put visitor numbers in the billions.

Many parks are on the front line of climate change. Park managers around the world are coming to grips with how to mitigate and adapt to the impacts. Some park leaders have also identified another role for parks. These visionaries recognize parks as an ideal venue for engaging the public on climate change. They appreciate the enormous relevance of parks to one of the most pressing problems of our time.

For the public, climate change may often feel confusing or distant, something that happens

to polar bears or glaciers in far-flung parts of the globe. Our parks can amplify the message that climate change is happening all around us, and can empower the public to realize that our collective actions can make a difference.
This report supports parks as an important educational venue. When parks take the lead to communicate about climate change they provide a tremendous public service. In *Climate in the Parks*, we have selected more than a dozen examples of innovative climate education and training practices from parks and protected areas worldwide. Each of these parks is engaging in climate change issues in a way that is appropriate and relevant for its specific circumstances and audience.

The parks profiled in *Climate in the Parks* are by no means the only ones working on this topic. In researching this report, we came across dozens of other parks and protected areas that are developing new and effective ways to engage with the public on climate change. We applaud all of these pioneers.

At the same time, our research suggests much remains to be done. Examples of good or best practices probably remain the exception rather than the rule. By identifying trailblazing programs and trainings, we hope to elevate and spread the good work already taking place. Our mission is to support all parks to seize the opportunity to play a key role in engaging the public on this important matter.

Sincerely,

Chris Spence
Director, Institute at the Golden Gate

INTRODUCTION

CHALLENGE & OPPORTUNITY

The onset of climate change has become one of the greatest challenges facing parks and protected areas in the 21st century. Climate change has created new problems and exacerbated existing issues by redefining historic weather and environmental conditions. Embedded in this challenge there is also opportunity, as parks offer visual, historic, and tangible examples of the impacts of climatic change on both small local scales and large landscape and ecosystem levels.

Many park agencies worldwide have begun extraordinary efforts to mitigate, adapt to, and educate about climate change impacts on their parks. To be successful, these efforts require the awareness, support, and stewardship of park users, staff, neighboring communities, and governments. Billions of people around the globe enjoy parks and protected areas of all sizes and jurisdictions each year. Engaging these broad audiences is a significant opportunity for parks. Through innovative programming, interpretation and signage, partnerships, and transparent mitigation and adaptation strategies, parks can maximize the relevancy, funding, and visitor outreach opportunities that climate change communication provides.

In an increasingly urbanizing world, parks play a unique community role. They provide connection to the natural world and a place to slow down, play, and connect with friends, family, and neighbors. Parks also provide an educational platform that can support and enhance traditional educational environments by experientially communicating the science and cultural components of climate change.

In her preliminary survey findings for a study titled *Building Place-Based Climate Change Education through the Lens of National Parks and Wildlife Refuges*, researcher Dr. Jessica Thompson discovered that 67 percent of U.S. National Park and National Wildlife Refuge users believe that parks should be

"Climate change challenges the very foundation of the national park system and our ability to leave America's natural and cultural heritage unimpaired for future generations."

U.S. National Park Service Director Jon Jarvis, in testimony before Congress, 2009

communicating with visitors about climate change. They may be skeptical about climate change generally, but they want more accessible information about climate effects through a park's website, exhibits, local personal stories, and other relevant channels.[1]

Climate in the Parks shows the ways in which parks are striving to meet this demand. By highlighting a representative selection of examples, *Climate in the Parks* seeks to advance a broad movement to communicate climate change topics through parks and protected areas—to demonstrate how park interpreters, park partners, community groups, and civic leaders are communicating the links among climate dynamics, changes to natural and cultural features in parks, human well-being, and overall community health. By sharing these examples, the Institute at the Golden Gate hopes to generate opportunities for parks to improve their climate education initiatives or begin new ones.

KEY FINDINGS & TAKEAWAYS

- **To address the human-influenced impacts of a changing climate, parks are promoting new approaches to stewardship and offering information and tools to enable visitors to make smart decisions.**
- **Impactful climate change communications are accurate, understandable, and relevant to the audience's shared values, daily choices, and decisions.**
- **Parks can help make climate change visible and relevant to the everyday lives of visitors, employees, and gateway communities. The impacts of a changing climate can reach people emotionally, mentally, and spiritually, as well as inspire the will to learn more and take action as a community.**
- **Through creative engagement, parks have the power to shape public sentiment by showcasing their own climate response and practice. Embodying and communicating these solutions can meaningfully convey take-home lessons for visitors to replicate in their homes, workplaces, and communities.**
- **Parks serve as places that empower people to be better stewards and caretakers of the planet, and connect them to a sense of place and community.**
- **As educational laboratories for climate change, parks can demonstrate through local scientific discoveries, technology, and art how climate has shaped a landscape in the past. Intrinsic features in parks can reveal the sources and impacts of climate change. They can also show how the rate at which the planet is changing is amplified by human activity.**

1 www.scx.sagepub.com/content/31/2/266.short

METHODOLOGY

In researching *Climate in the Parks,* we reviewed online resources, targeting key contacts and parks, surveying existing climate change education programs, and identifying areas most impacted by climate change. Dozens of park leaders and educators were interviewed. A review of parks and protected areas globally was completed and thematic areas of comparison and collective lessons learned were identified.

The case studies contained in this report are representative selections of examples that illustrate a particular climate education theme from the perspective of a specific park. Case studies cover a wide range of park types, including city, national, private, marine, and international parks. The case studies are the focus of the report and provide a glimpse into climate education taking place in various ecosystems and park systems around the world.

The report seeks to avoid the political debate and communication challenges that can accompany climate change discussion. We hold the position that human-influenced climate change is occurring and that parks have an opportunity to help the public understand this fact in a manner that produces dialogue, understanding, and action. The Institute's position is that any aspect of climate change science a park agency chooses to address can be effectively communicated through park settings.

Climate education may prove to be the single most important role parks can play in an era of climate change. Through direct education, training, and partnerships, the parks highlighted in this report, and many others worldwide, are encouraging the public to become stewards of a changing world.

"Being able to show tangible impacts is a great [way] to get people engaged. But, getting people involved in citizen science and mitigation through service learning is the [best way]."

Julia Washburn, Associate Director of Interpretation and Education, U.S. National Park Service

CASE LOCATIONS

1. **Channel Islands National Marine Sanctuary**, California, U.S.
Scaling ocean acidification interpretation for volunteers and teachers

2. **City of Chattanooga City Parks**, Tennessee, U.S.
Engaging citizen foresters in climate action

3. **Everglades National Park**, Florida, U.S.
Climate change interpretation trainings

4. **Gombe National Park**, Tanzania
Engaging gateway communities for conservation and climate change adaptation

5. **Ilulissat Icefjords World Heritage Site**, Greenland
Interpreting climate change in remote areas

6. **Johannesburg City Parks**, South Africa
Connecting climate change and communities

7. **Lewis and Clark National Monument**, Oregon, U.S. and **North Cascades National Park**, Washington, U.S
A model for youth climate leadership training

8. **New England Aquarium**, Massachusetts, U.S.
Scaling ocean-climate interpretation

9. **Pico de Orizaba National Park**, Mexico
Tickell Climate Theatre Network using Science on a Sphere interpretation tools

10. **City of Rotterdam**, Netherlands
Connecting public health and climate change through parks and green spaces

11. **Russell Cave National Monument**, Alabama, U.S.
Using prehistoric information to link past and present climate change

12. **Wildcat Glades Conservation & Audubon Center**, Missouri, U.S.
Communicating climate change to an entire community

13. **Yellowstone National Park**, Wyoming, U.S.
Xanterra Parks & Resorts' "For Future Generations: Yellowstone Gifts" *retail store—connecting consumer choices to climate change information*

CASE CONTENT

	Urban	Remote	Marine	Training	Public	Youth	Partnerships
Channel Islands N.M.S. (pg. 8)		X	X	X	X		X
City of Chattanooga (pg. 11)	X				X		X
Everglades N.P. (pg. 13)				X			X
Gombe N.P. (pg. 15)		X		X			X
Ilulissat World Heritage Site (pg. 17)		X			X		
Johannesburg City Parks (pg. 19)	X				X	X	X
Lewis and Clark N.H.P. and North Cascades N.P. (pg. 21)				X	X	X	X
New England Aquarium (pg. 24)			X	X			X
Pico de Orizaba N.P. (pg. 27)		X			X		X
City of Rotterdam (pg. 29)	X				X		
Russell Cave N.M. (pg. 31)		X			X		
Wildcat Glades Conservation & Audubon Center (pg. 33)					X		
Yellowstone N.P. (pg. 35)					X		X

NPS CLIMATE CHANGE RESPONSE PROGRAM

The National Park Service's (NPS) Climate Change Response Program (CCRP) supports national parks' efforts to address the challenges posed by climate change. Established by NPS Director Jon Jarvis in 2007, CCRP provides guidance, scientific information, and recommendations that support stewardship actions to preserve the nation's natural and cultural heritage in the face of changing climate realities.

CCRP's climate change strategy emphasizes four areas—science, adaptation, mitigation, and communication. Nearly a dozen committees contribute to a CCRP network, including Research Learning Centers, Climate Science Centers, and Landscape Conservation Cooperatives. The information generated by this network is used to support NPS resource managers to establish adaptation plans for each park, and assist NPS educators in engaging the public through interpretation and education initiatives.

CCRP offers a wide variety of tools and resources that bolster visitor programs and internal trainings for all national parks, including newsletters, webinars, video footage, a Climate Change SharePoint, and an NPS-wide *Climate Action Plan*.

www.nature.nps.gov/climatechange

CASE STUDIES

CHANNEL ISLANDS NATIONAL MARINE SANCTUARY, CALIFORNIA, U.S.

Ocean acidification interpretation for volunteers and teachers

PARK/SITE NAME: Channel Islands National Marine Sanctuary
HIGHLIGHTED PROGRAM: Ocean acidification training workshops for volunteers
PARK AGENCY: National Oceanic and Atmospheric Administration
LOCATION: California, U.S.
KEY POINT: Ocean acidification and climate change interpretation training for volunteers

SUMMARY

The Channel Islands National Marine Sanctuary is a leader in creating educational content on ocean acidification. By spearheading training workshops for science teachers and interpreters from parks and aquariums, Channel Islands National Marine Sanctuary is helping other parks and organizations to benefit from and adopt ocean acidification lessons and activities.

CASE STUDY

In response to local and global concerns about ocean acidification, Channel Islands National Marine Sanctuary (CINMS) began to research the impacts of ocean acidification on the CINMS waters in 2008. This led to a report by the Sanctuary Advisory Council's Conservation Working Group titled *Ocean Acidification in the Channel Islands National Marine Sanctuary: Cause, Effect and Response.*[2]

As a result of this study, the volunteer training workshops on ocean acidification were highlighted as an outreach priority. "We identified the need to arm volunteers with scientific background and current research on ocean acidification," explains Laura Francis, Education Coordinator at CINMS.

The volunteers with these programs interact with the public on whale watching boats, at outreach events, and in aquarium settings.

2 www.channelislands.noaa.gov/sac/pdf/cwg-oar.pdf

The ocean acidification workshops for volunteers feature:

- Training in ocean acidification science
- Case studies on successful aquarium education and outreach efforts
- Hands-on interactive activities demonstrating physical properties of ocean acidification
- Opportunities to interact with people and organizations that are making a difference in their communities by reducing energy use and developing environmentally sustainable practices

All partners contributed to development of the workshop agenda and program implementation. The workshops are funded with donations and in-kind contributions from partners and suporters.

Employees of Citrix Online also donated their time to develop a comprehensive website that helped to scale the program. "I think the fact that we were able to work with volunteers from Citrix to develop a fairly comprehensive website (www.acidocean.org) that archives the science talks, resources, and educational activities—as well as provides people with a place to make an ocean pledge—is a huge success [and savings]," Francis explains. "I have received emails from educators around the country who have found the website to be a valuable tool. It is also a great framework for other sanctuaries and organizations to use if they would like to host a similar workshop."

The initial volunteer workshops educated 128 volunteers. An additional 75 high school students, teachers, and family members attended an open house and ocean acidification lab tour coordinated by CINMS and University of California–Santa Barbara Marine Science Institute. CINMS also has applied ocean acidification workshop content to other National Oceanic and Atmospheric Administration programs, such as Oceans for Life, a youth field study program.

Initial feedback has been very positive.

CONTINUING TO INNOVATE

To develop content for their ocean acidification workshops, Channel Islands National Marine Sanctuary, West Coast National Marine Sanctuaries, and Monterey Bay Aquarium Research Institute collaborated to host an *Effective Practices for Ocean Acidification Communication and Education Workshop* adjacent to the Third International Symposium on the Ocean in a High CO_2 World in Monterey. The symposium convened 540 scientists to share the latest research on ocean acidification.

The workshop was attended by 90 participants,* and brought together expert ocean-climate scientists; NOAA professionals from marine sanctuaries and estuarine research reserves; and educators from national and state parks, aquariums, informal science centers, and non-governmental organizations. Workshop participants identified the most effective messages, tools, and case studies to communicate the impacts of ocean acidification and foster positive public action. The workshop focused on California Current ecosystems, food webs, fisheries, and tourism impacts, and included various types of outreach activities—such as aquarium programs, classroom lessons and activities, exhibits, and community engagement—with their respective target audiences.

"The workshop will serve as a model for other regions," Francis says. "The results will inform the development of a NOAA-wide ocean acidification education action plan. Working groups will continue to refine messages and case studies, and 85% of participants indicated that they plan to incorporate what they learned into the ocean acidification communications strategies at their organization."

* This symposium was a direct outcome of the West Coast Ocean Acidification Action Plan Task Force, a partnership between West Coast National Marine Sanctuaries and Monterey Bay Aquarium Research Institute.

NPS CLIMATE FRIENDLY PARKS PROGRAM

The U.S. National Park Service's (NPS) Climate Friendly Parks Program (CFPP) was created in 2002 as a collaborative effort between the NPS and the U.S. Environmental Protection Agency. CFPP provides parks and their neighboring communities with the tools and technical support to measure and reduce their greenhouse gas emissions by integrating climate-friendly practices and green technologies into their operations.

The program has a three-tiered certification approach: 1) measure park-based greenhouse gas emissions, 2) develop sustainable strategies to mitigate park emissions and adapt to climate change impacts, and 3) educate the public about these efforts in order to serve as models of climate-friendly behavior. CFPP is a component of NPS's Green Parks Plan, an operations and mitigation component of the larger NPS Climate Change Response Program. More than 70 parks nationwide participate in CCRP.

www.nps.gov/climatefriendlyparks

From workshop evaluations, CINMS found that participants liked the mix of science presentations, interpretive techniques, and hands-on activities. Survey results indicate that pre-workshop understanding of ocean acidification jumped from 10 percent to 68 percent post-workshop. One volunteer participant noted, "Before [the workshop], I assumed CO_2 affected the oceans, but now I know how it directly affects the ocean and how fast!" Another volunteer said the best part of the workshop was that "it gave me a lot of information that I was able to internalize, so that I can now communicate to others."

The team also learned that they need to conduct follow-up workshops to fully realize the potential of the training initiated by the ocean acidification workshops. "Some volunteers are not fully comfortable interpreting the topic after one half-day workshop," Francis explains. "We hope to do a follow-up workshop in the near future to provide additional training on using the materials and focusing on key ocean acidification communication messages."

CITY OF CHATTANOOGA, TENNESSEE, U.S.

Engaging citizen foresters in climate action

PARK/SITE NAME: Chattanooga city parks and green spaces
HIGHLIGHTED PROGRAM: Citizen Forester, using U.S. Forest Service i-Tree tools
PARK AGENCY: City of Chattanooga
LOCATION: Chattanooga, Tennessee, U.S.
KEY POINT: Using forestry to educate on climate change and improve environmental services

SUMMARY

In Chattanooga, Tennessee, the community value of trees is central to the city's climate change initiatives. Trees are viewed by the city as common ground for building community spirit, pride, and economic value. With the help of tools developed by the U.S. Forest Service, the city is able to better educate its citizens about the many benefits of trees and make a link to the role trees play in climate change mitigation.

CASE STUDY

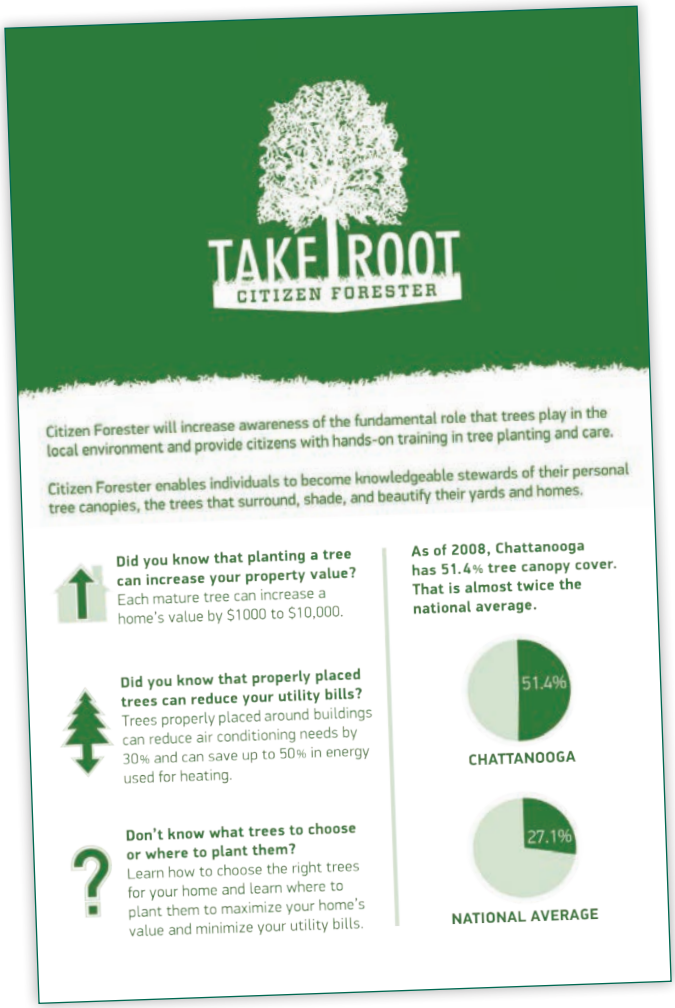
Chattanooga is the fourth largest city in Tennessee, located in the southeastern corner of the state, near the Appalachian Trail and the Great Smoky Mountains. Considered one of the most polluted cities in America in 1969, Chattanooga is now considered by National Geographic Magazine as one of the 50 best places to live in the country.

Mayor Ron Littlefield signed the U.S. Conference of Mayors' Climate Protection Agreement in 2006 that led in 2008 to one of the nation's first citizen visioning processes designed to set specific socially beneficial long-range goals and create a Climate Action Plan. All residents were invited to participate. More than 1,000 suggestions were considered in developing 47 action items in the Climate Action Plan—one of which is the Citizen Forester educational initiative, launched in 2011.

During the citizen visioning sessions, trees were determined to be the most significant way to offset the city's heat island effect, and improve energy efficiency and carbon sequestration. Trees were also recognized for their ability to mitigate the effects of more frequent climate-induced violent weather events, including severe drought and storm water detention.

Coincidentally, that same year, Volkswagen sited its sole U.S. production plant in Chattanooga. This led Wolfsburg, Germany—the home of Volkswagen's headquarters—to become Chattanooga's newest sister city. This German-American relationship was very influential on the people of Chattanooga. Volkswagen and Wolfsburg illustrated to Chattanooga residents a different way of valuing tree canopy. In Germany, replanting trees and climate change mitigation are taken very seriously. Before Volkswagen finalized their decision to site their plant in Chattanooga, they expressed dismay that the city had clear-cut the facility site without replacing any of the lost trees.

Chattanooga took the initiative to analyze the structure, health, benefits, and values of its street tree population using the i-Tree Streets



(formerly STRATUM) model.[3] The street tree data was paired with American Forests' Urban Ecosystems Analysis (UEA)[4] to measure the ecosystem service value of private and public green-ways, and then strategically guide the city on where to plant trees. The results and images from these analyses are used to educate tree planting volunteers and citizen foresters, who are an extension of the city's larger Take Root greening program.

The Citizen Forester educational initiative also sponsors subsidized educational programs for homeowners and gardeners on the value, benefits, and care of trees. While learning about climate change and how much energy trees can save, residents receive tree seedlings and can graduate to the next level which includes instruction on the management of trees damaged by construction and disease.

Gene Hyde, City Forester for Chattanooga's Department of Public Works, explains the goal and impact of these programs. "My primary hope of our Citizen Forester educational initiative is to engage and educate the populace in the many valuable benefits and ecosystem services of trees," Hyde says. "In Chattanooga, trees provide $1.2 billion of storm water detention services, sequester 15,943 tons of carbon annually, and absorb 4.5 million pounds of air pollution. The value of the ecosystem services provided by our trees for the absorption of air pollution is estimated to be $12 million."

Chattanooga continues to innovate. They are at the early stages of bringing the concept of a "wedding forest" to the city, which is modeled after an old German tradition revived in Hamm, Germany—another sister city to Chattanooga. A wedding forest adds another community dimension to their Climate Action Plan, allowing the public to plant trees in the city's parks and greenways for any life milestone worthy of commemoration.

TEN YEAR RETREAT PROJECT

Ten Year Retreat is a website that links artists and scientists from around the world working on climate change. Ten Year Retreat Project Director Joy von Wolffersdorff explains the collaboration, "Climatologists select locations that they believe will show a visible change over 10 years. Artists will then document locations of their choice over 10 years. Artists may work in any medium, including all traditional two-dimensional and three-dimensional media, as well as digital, sound, video, music, and writing. All artwork will be viewed on the website as it progresses over the 10 years. Each artist and scientist participating will have individual profile pages on the website which will include links to their own work and research."

www.tenyearretreat.com

3 The STRATUM report was based on a 3 percent sample of street trees.

4 www.americanforests.org/

EVERGLADES NATIONAL PARK, FLORIDA, U.S.

Climate change interpretation staff trainings

PARK/SITE NAME: Everglades National Park
HIGHLIGHTED PROGRAM: Climate change interpretive trainings
PARK AGENCY: National Park Service
LOCATION: Florida, U.S.
KEY POINT: Development of an internal climate change training module

SUMMARY

Everglades National Park is leading an effort in south Florida to scale climate change education locally. The park has created a popular internal training module on climate change based on the National Park Service climate change interpretation curriculum. Everglades' staff uses the module to educate park interpreters on the climate change impacts affecting parks in south Florida and how to utilize interpretive techniques to effectively engage their audiences on this topic.

EARTH TO SKY

Earth to Sky is a resource for interpreters, educators, and scientists to learn and share science and communication techniques for developing products and programs for use in refuges, parks, and other sites of place-based education.

www.earthtosky.org

CASE STUDY

According to Larry Perez, Science Communications Outreach at Pine Island District of Everglades National Park, "there has been a visible vegetation shift in mangroves, moving 1.5 kilometers in the past decade. We have also seen a great deal of coastal erosion and changes from freshwater to saline ecosystems." Likewise, due to the impacts of record-breaking hurricanes, the park had to relocate their facilities. "When Hurricanes Katrina and Wilma destroyed the Flamingo Lodge, visitors were very impacted [by the lack of] overnight accommodation there," Perez says.

With climate change making such a significant impact at Everglades, training park interpreters in the subject is essential. "We normally train interpreters on skills and techniques. With climate change we are learning we need to train interpreters on content," says Julia Washburn, National Park Service Associate Director of Interpretation and Education.

In response, the park has created a popular internal training module on climate change based on the National Park Service climate change interpretation curriculum. The module, intended for park interpreters, illustrates the impacts of climate change and shares techniques on how to convey that information to the public.

In 2011, Everglades staff participated in the initial weeklong pilot course of nationwide, multi-agency Interpreting Climate Change curriculum for use by front-line staff. At Everglades, Larry Perez and Park Ranger Greg Litten took the initiative to further refine the content. "Our front-line interpretive staff doesn't have time for a week-long preliminary course in climate change. Therefore we condensed this curriculum into a two-day workshop which suits our time constraints," Perez explains. "The courses help provide confidence to interpreters, and [the courses] can be complemented with video training modules for distance-learning. We actively encourage front-line staff to include these topics in their programs."

Because of their leadership and engagement on the subject, Everglades staff is asked to

NPS SEA LEVEL CHANGE EXHIBITS

In cooperation with the national Climate Change Response Program and other coastal parks, Everglades National Park is participating in a nationwide network of sea level rise exhibits to interpret the impacts of climate change beyond any individual park boundary. Temperate and tropical coastal parks, including Everglades, Dry Tortugas, Biscayne, Big Cypress, Golden Gate, and Point Reyes are collaborating with sub-arctic coastal national parks, like Kenai Fjords, to help draw connections between the overarching theme of melting glaciers and ice caps, and global sea level rise. This project uses a prototype exhibit developed at the Golden Gate National Recreation Area as the inspiration for the larger effort.

"Sea level poles are put in place for visitors to ponder how landscapes in front of them are changing in tandem with other places," says Larry Perez, Science Communications Outreach at Pine Island District of Everglades National Park. "Visitors standing outside Kenai Fjords' visitor center can look out at a dramatically receding glacier while simultaneously reflecting on how glacier melt water is affecting a rising sea in Florida. We plan to make the information accessible by building on social media and link [the exhibits] through mobile technology."

deliver climate change communication workshops to interpretive personnel across the National Park Service. They also deliver similar workshops to partner organizations, most notably several National Oceanic and Atmospheric Administration National Estuarine Research Reserves in Florida and Texas. Perez adds, "Everglades staff has also worked alongside the NPS Climate Change Response Program, Colorado State University, the National Parks Conservation Association, and the U.S. Fish and Wildlife Service through a National Science Foundation grant to aid a nationwide effort to advance the dialogue about climate change in parks and refuges. South Florida is one of five pilot locations using a variety of novel interpretive techniques, many of which aspire to reach across jurisdictional boundaries to interpret climate change on federal, state, local, and private lands."

GOMBE NATIONAL PARK, TANZANIA

Engaging gateway communities for conservation and climate change adaptation

PARK/SITE NAME: Gombe National Park
HIGHLIGHTED PROGRAM: Forest preservation and incentivizing conservation
PARK AGENCY: Tanzania National Parks
LOCATION: Tanzania, East Africa
KEY POINT: Engaging community involvement to promote long-term forest conservation and climate change adaptation

SUMMARY

The Jane Goodall Institute, with the assistance of the United Nations and cutting edge technology firms, has partnered with Gombe National Park and surrounding communities to address the local effects of climate change and how the area can adapt to these effects. The successful outreach initiated to protect the park now serves as a community-based model for climate change mitigation and adaptation efforts in all Tanzanian parks.

CASE STUDY

Gombe National Park, a thin strip of ancient forest on the shore of Lake Tanganyika, is struggling with deforestation, soil erosion, and loss of soil fertility around the park due to agriculture and firewood collection. By the early 1990s, there was almost a total absence of trees outside the park, affecting human and animal populations that depend on the forest, including the chimpanzees studied by Dr. Jane Goodall.

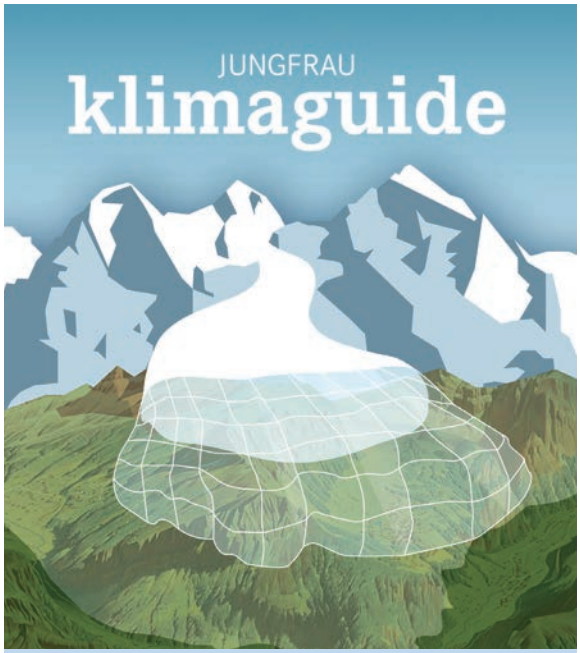
In 1994, Dr. Goodall established what has become one of the most comprehensive conservation programs in Africa, TACARE (pronounced "take care"), which integrates traditional conservation approaches with a broad range of community development projects. Despite TACARE's successful results in creating community incentives to better protect the park, climate change has presented new challenges. Temperature increases and changing levels of rainfall have led to water shortages that have already severely affected animal migration and plant growth.

TACARE approached the challenges presented by climate change by first helping local communities protect and restore the forest surrounding the park—most of which is communal and government land. TACARE did this by establishing forest mitigation programs that sequester carbon dioxide and provide funding for sustainable livelihoods. TACARE also determined these methods would help the people and the park adapt to a drier climate.

With support from the United Nation's Reducing Emissions from Deforestation and Degradation program, Jane Goodall Institute (JGI) employs cutting-edge technologies around the park to enable park staff and communities to take a leadership role in gathering forest data. In partnership with Esri, DigitalGlobe, and Google Earth Outreach, JGI is using high-resolution satellite images and Geographic Information System technology to map the forest, chimpanzee habitat, and human land use. Specially trained community forest monitors collect the data needed to help prove that their efforts are protecting the forest.

Because of its close working relationship with communities on the ground, JGI is uniquely positioned to share the information it gathers and engage local communities as partners in their conservation mission.

The forest mitigation programs around Gombe are gaining international recognition for directly linking climate change impacts to a wider climate adaptation framework centered on the tenets of ecosystem-based management and community involvement. JGI and Gombe National Park's community-based approach to conservation has established a valuable model for other areas initiating long-term conservation programs. Conservation groups are working to share approaches and promote best practices for adaptation to climate change over the entire continent of Africa.



JUNGFRAU CLIMATE GUIDE APP JUNGFRAU WORLD HERITAGE REGION, SWITZERLAND

Jungfrau Climate Guide is a multimedia climate guide for Apple's iPhone platform, exclusive to the Jungfrau World Heritage Region of Switzerland. Jungfrau Climate Guide was produced by Texetera, with the financial support from BKW FMB Energy Ltd. and the communities in the region. The Guide creatively highlights climate science research of the Oeschger Center, University of Bern for visitors in the Jungfrau World Heritage Site.

Jungfrau Climate Guide focuses on Jungfrau glaciers using seven interpretive trails. "The Climate Guide allows visitors to witness climate impacts while hiking," says Jungfrau Climate Guide producer Erik Thurnherr. "We include bonus materials such as comparisons of historic paintings and photos to present photography, original drafts from scientific publications, television programs, and interviews. The guide also ties in climate action tips and addresses strong local renewable energy initiatives in Jungfrau towns such as Grindawald."

www.jungfrau-klimaguide.ch

ILULISSAT ICEFJORD WORLD HERITAGE SITE, GREENLAND

Interpreting climate change in remote areas

PARK/SITE NAME: Ilulissat Icefjord
HIGHLIGHTED PROGRAM: Ilulissat World Heritage Station
PARK AGENCY: United Nations Educational, Scientific and Cultural Organization (UNESCO), World Heritage Commission
LOCATION: Greenland
KEY POINT: Development of a research and educational facility to highlight changing Arctic landscapes and ice core information

SUMMARY

Ilulissat Icefjord, a natural World Heritage Site in Greenland, is one of the largest, most active glaciers in the world. Through the creation of a research and visitor station near the town of Ilulissat, the local World Heritage Office plans to demonstrate arctic climate science and arctic conservation to the public. When complete, visitors and online viewers will be able to apply lessons learned from the Ilulissat Icefjord to actions they can take to protect this sensitive arctic environment.

CASE STUDY

Ilulissat Icefjord is 695,000 square miles—about 10 times the size of Washington state in the U.S.—and is situated just north of the Arctic Circle in West Greenland. The Icefjord is the most visited tourist attraction in Greenland. Each year, approximately 36,000 visitors experience the huge ice sheets and awe-inspiring natural phenomena and dramatic sounds of the fast-moving glacial ice stream.

Listed as a natural World Heritage Site in 2004, Ilulissat Icefjord is one of the few glaciers through which the Greenland ice cap reaches the sea. Studied for more than 250 years, the Ilulissat Icefjord plays a central role in the study of glaciology and climate variability. The Greenland ice sheet has provided scientists with the longest, most well-preserved ice cores in the Northern Hemisphere (three kilometers long) revealing past temperature and precipitation trends going back almost 250,000 years.

At the World Heritage Site in Greenland, plans are now underway to construct the Ilulissat Icefjord Station near the town of Ilulissat (which means "iceberg" in Greenlandic). Due to open in 2015, the sustainably-designed station will function as a hub for researchers. It will also allow visitors and off-site students to participate in and learn about the science taking place at the icefjord. According to the UNESCO office's objects clause, "Ilulissat World Heritage Station will be the focal point for coordination, information, and live demonstrations of knowledge about Ilulissat Ice Fjord and its surrounding nature and culture, including the ice sheet."

There has been extensive user and citizen involvement in the development of the station, with ideas coming from local students and neighboring residents. Scientists, whose research will stream live globally from the station, have also contributed to the plans. "The Icefjord Station will be a much welcomed science station; of great value to scientists and to the public as well," says David Holland, Icefjord researcher from New York University. "[It] will be a room where scientists can set up and test equipment before deploying it. Visitors can tour the area, ask questions, and actually see the science effort that is taking place in the area."

Many lessons about arctic climate science and conservation will come to life in the new station. UNESCO's World Heritage Commission also plans to use Ilulissat Icefjord Station as an example to promote climate education globally.

LOSING A LEGACY EXHIBIT - GLACIER NATIONAL PARK

The traveling exhibit, *Losing a Legacy: A Photographic Story of Disappearing Glaciers*, features the United States Geological Survey's (USGS) Repeat Photography Project and illustrates how the Climate Change in Mountain Ecosystems program has been blending the science of climate change research with landscape photography from Glacier National Park. Photo pairs, consisting of a historic photo matched with a contemporary image from the same location, document dramatic change among the 19 glaciers highlighted in the exhibit.

USGS Physical Scientist Lisa McKeon created the exhibit to show new audiences the results from the study of glacier retreat in the park. Designed to be appreciated as both art and science, the exhibit does not explicitly mention climate change. Ms. McKeon notes that "the exhibit presents the images and allows the viewer to make comparisons and draw conclusions themselves. Overwhelmingly, people of any age or culture make the connection to climate change on their own since it is easy to interpret the melting of ice."

The exhibit has been a popular feature, especially for school groups, at several museums and art galleries across Montana. It is on permanent display at the Many Glacier Hotel in Glacier National Park where visitors from around the world take time to comment on the exhibit's visual impact. Repeat photography is also featured in roadside exhibits, presentations, lectures, web pages, news media, and other artwork.

www.nrmsc.usgs.gov/science/feature/RepeatPhotoExhibit

JOHANNESBURG CITY PARKS, SOUTH AFRICA

Connecting climate change and communities

PARK/SITE NAME: Johannesburg city parks and green spaces
HIGHLIGHTED PROGRAM: Johannesburg City Parks Environmental Education Unit
PARK AGENCY: City of Johannesburg
LOCATION: Johannesburg, South Africa
KEY POINT: Teaching climate change though city schools and parks

SUMMARY

At city parks in Johannesburg, community leaders and educators are taking a proactive role in building public understanding of climate change effects and engaging civic participation in the search for solutions.

CASE STUDY

The Environmental Education Unit of Johannesburg City Parks' (JCP) is responsible for the facilitation of climate change education in the city. The Environmental Education Unit integrates climate change into three broad program areas: school programs, environmental awareness-raising initiatives, and capacity-building programs.

For schools, JCP develops a climate change curriculum for grades 7–11 that is taught at four JCP environmental education centers. Annually, 9,000 students from 150 schools attend these programs. The curriculum is linked to activities such as planting drought-tolerant indigenous gardens and growing food gardens on school grounds. These gardens are also used for science-based activities and lessons.

"Through garden-based education workshops, the children learn about principles such as the value of indigenous trees or plants as opposed to alien plants, and their role in biodiversity preservation and climate change control," says Sinah Magalo, Manager of Johannesburg City Parks' Environmental Education Unit.

JCP also hosts climate change workshops, exhibitions, and tree-planting events for the public. At the workshops, members of the community are encouraged to participate in climate change dialogue and strengthen community leadership. Activities and discussions are tailored for each type of group.

"During workshops we do an activity that analyses the current practice of each community member with regard to waste, energy, and green issues," Magalo explains. "Thereafter, each community member looks at his or her behavior and plans what he or she will be doing to change his or her behavior. Through these workshops community members have started recycling and have developed food gardens in their homes and schools. We have seen that communities are respecting the trees that we plant in our streets and not vandalizing them."

Exhibitions on climate change issues are conducted in parks, shopping centers, and malls. The exhibits raise awareness on the causes and effects of climate change—and actions communities can undertake to lessen the impacts.

"Exhibitions and workshops raise awareness of what climate change is, how it affects communities, and what communities can do to decrease their carbon footprint," Magalo says. "During the exhibition, community members engage in a question and answer activity that focuses on simple practices community members can do in their homes to decrease their carbon emissions, such as recycling, indigenous tree planting, and using energy-saving light bulbs."

Tree-planting events are organized for both schools and communities, with various public and private organizations sponsoring the tools needed for these projects. "These organizations also ensure that the gardens are developed and sustained by training those who benefit from the garden, as well as by providing onsite monitoring of the gardens on a continuous basis. The planting process is preceded by education and awareness on the need for greening and development of parks," Magalo says.

JCP distributes free fruit trees to communities as part of their developing climate initiative. This is done to encourage self-sufficiency in food production and as a way to offset carbon emissions. "The trees also reduce impacts of flooding and soil erosion," Magalo elaborates. "Three thousand fruit trees have been distributed to communities so far. Prior to the distribution of the trees, door-to-door education is conducted to instruct community members on fruit tree care and maintenance. After distribution of the trees, a monitoring program is conducted to visit households that received trees to ensure that trees are planted and taken care of."

LEWIS AND CLARK NATIONAL HISTORICAL PARK, OREGON, U.S.
NORTH CASCADES NATIONAL PARK, WASHINGTON, U.S.

A model for youth climate leadership training

PARK/SITE NAME: Lewis and Clark National Historical Park and North Cascades National Park
HIGHLIGHTED PROGRAM: Cascades Climate Challenge
PARK AGENCY: National Park Service
LOCATION: Oregon and Washington, U.S.
KEY POINT: Partnership with North Cascades Institute to create a youth climate leaders program

SUMMARY

Lewis and Clark National Historical Park has created a model program for producing young climate leaders through a key partnership with the North Cascades Institute. Lewis and Clark broadened its youth outreach network and integrated climate change as a theme in its youth programs in response to the National Park Service's Climate Change Response Strategy and the 2011 NPS Director's Call to Action.

CASE STUDY

Nestled in the Pacific Northwest between the urbanized banks of the Columbia River and the Pacific Ocean, Lewis and Clark National Historical Park caters to school groups of all grade levels as well as young people seeking skills in leadership, sciences, and the arts. The park's most significant contribution to climate education is through its partnership with North Cascades Institute (NCI).

NCI's mission is to conserve and restore Northwest environments through youth education. Central to its programs are diverse and fun park experiences that foster deeper connections to nature and create the next generation of environmental stewards. To accomplish this, NCI relies on park partners like Lewis and Clark to recruit diverse students and teachers from their communities. Program participants are encouraged to remain connected to their local parks, and in some cases seek employment, thereby diversifying the workforce at these parks. NCI also offers toolkits and consultation to help other organizations design similar youth education programs.

"Working with the wonderful staff at Lewis and Clark has created one of our most successful partnerships, from student recruitment to service project follow-up to employing alumni in the park," says Aneka Singlaub, Climate Challenge Program Coordinator for NCI. "Park educators recruit from neighboring schools and give inspiring presentations about our programs on campuses, and encourage students that wouldn't otherwise have this opportunity. North Cascades National Park, another program partner, helps with service projects, recruiting, and provides logistical, transportation, stewardship, and educational support."

NCI's most notable program, the Cascades Climate Challenge (CCC), takes place in North

Cascades National Park each summer and is devoted entirely to climate change education. CCC is a successful youth leadership program focused on climate change science, outdoor skills, personal leadership, and presentation skills.

The first pilot of the CCC ran in 2009, initiated by a National Park Foundation grant. After a rigorous application and selection process, this tuition-free program brings together two groups of 20 high school leaders from the Pacific Northwest to spend three weeks in an immersive summer field session in the North Cascades.

Each student comes away with the ability to articulate the basic principles behind climate change. "We give them science and let them form their own opinion through debate and discussion," Singlaub explains. "We focus on the composition of the atmosphere, carbon cycling, temperature records, observable changes in glacial mass and atmospheric carbon, projections for the future, resulting habitat disturbances, and impacts on human communities." Students simultaneously develop a strong connection to place. For instance, students from Seattle understand the connection between receding glaciers in the North Cascades and hydropower in the city of Seattle.

Students meet with researchers in the field and learn about phenology and research studies that measure water temperature or observe climate-sensitive animal species like picas. They also participate in an outdoor leadership progression of self-assessment, experiential challenge, social support, and reflection.

One of the most successful components of CCC, according to Singlaub, is that it is designed to be challenging and promote hope for the future. "We focus on 'what can you do,' such as, analyzing carbon footprints; what are the behavior changes that make the most difference? And how can we be change agents?" Singlaub says. "The most empowering piece is for students to give a presentation at the end of the program about what they have experienced in the park, what they have learned, and what they are going to do next. Sometimes they present to over a 100 people at the campfire ranger program at the local campground. Students are very empowered by all the support from the enthusiastic audience."

Upon returning home, students design and implement a service-learning project in their home community to teach others about civic responsibility and ways they can address climate change—energy efficiency, recycling, composting, alternative transportation, and renewable energy. Many service projects involve student participants sharing their park experiences and teaching lessons in climate change to local elementary or middle school students and then leading them in an outdoors service project. "Each of our 40 students per year reaches at least another 20 to 25 students in their home communities. This ensures a strong climate message coming from passionate individuals to diverse communities throughout the Pacific Northwest," Singlaub says.

"NCI provides alumni with tools to continue to give presentations and lessons," Singlaub continues. "Students use clips from an electronic field trip about climate change in the North Cascades. They also attend youth climate change seminars, present at conferences, and participate in regional workshops on climate change education in the Pacific Northwest."

NCI estimates that the 40 CCC students in 2011 taught 1,600 elementary and middle school students about climate change—far more than the targeted goal of 800 students. An additional 800 students are expected to be educated through CCC graduates' activities scheduled for the start of the 2012-13 school year, which will bring the grand total to 2,400.

Visit Parks Climate Challenge for more information on developing youth programs in parks, including testimonials, resources, and tools to successfully deliver national park-centric climate change lessons.

www.parksclimatechallenge.org

FLORISSANT FOSSIL BEDS NATIONAL MONUMENT

Florissant Fossil Beds National Monument in Colorado protects one of the richest, most diverse fossil deposits in the world. Over the past few years, Florissant's Division of Interpretation has explored how to best incorporate the story of modern climate change into their current interpretation of dramatically varying paleoclimates. A new fossil exhibit will allow the park to more deeply communicate the story of ancient and present changes in climate.

The new permanent exhibit focuses on climate change in the late Eocene epoch, which ended 34 million years ago. The exhibit begins with a short orientation film that gives an overview of the Monument. Visitors then pass through a series of dioramas that explore the ancient climate and ecosystem and finally how the area was preserved in stone. A large portion of the exhibit area introduces visitors to the real scientists who have conducted studies here, their methods, and their results. Many of these studies involve paleoclimatology and modern climate change.

The final stage of the exhibit is a fossil wall filled with Florissant's fossil examples and enlarged fossil images. The fossil wall is devoted entirely to the effects of climate change.

"We decided to have the theme of the final fossil exhibit display three group of fossils that thrived here at the end of the Eocene. The message is that when climate changes, living communities either adapt, go extinct, or move," Ranger Jeff Wolin says. "We address how the present rate of climate change is happening on a fast time scale. Species today, like in the Eocene, will also adapt, go extinct, or move."

"The exhibit aims to show visitors how Florissant is a place to contemplate both ancient and modern climate change. modern climate change," Wolin explains. "The exhibit points out that the visitor currently stands in a sustainable, green building that was built specifically to reduce the park's carbon footprint. To inspire reduction in the global carbon footprint, the exhibit will offer some simple acts that visitors can do in their lives to help mitigate their impact on climate change."

Lewis and Clark also recruits teachers to participate in NCI's teacher training program. This program allows educators to learn science tools, and integrate their lesson plans with outdoor experiences using Lewis and Clark as a destination for student field trips. "[After completing a course], a teacher from Knappa, Washington is developing five protocols for kids to measure climate change in the park," says Ranger Will George. "Protocols include plant phenology, birds, water monitoring, and even sound. We also can use explorers explorers Meriwether Lewis and William Clark's detailed journals to compare today's weather to a particular day in the past and infer how climate has changed."

Lewis and Clark National Historical Park continues to recruit for the CCC program. The park's programs benefit from the CCC graduates who return to Lewis and Clark and neighboring schools to inspire and engage other young people.

NEW ENGLAND AQUARIUM, MASSACHUSETTS, U.S.

Scaling ocean-climate interpretation

PARK/SITE NAME: New England Aquarium
HIGHLIGHTED PROGRAM: Phoenix Islands Protected Area (Kiribati) and National Network for Ocean and Climate Change Interpretation
PARK AGENCY: Not applicable
LOCATION: Massachusetts, U.S.
KEY POINT: Connecting with other informal science education providers and developing partnerships to train interpreters and develop strong educational content

SUMMARY

The New England Aquarium supports important research on climate change and is leading a nationwide consortium of institutions working to better engage interpreters and public audiences on the link between ocean health and climate change. New England Aquarium supported the establishment of Phoenix Islands Protected Area in Kiribati, and developed the National Network for Ocean and Climate Change Interpretation. Both of these projects play a central role in New England Aquarium's deployment of climate education through protected area platforms.

CASE STUDY

In recent years, aquariums, zoos, and museums—many of which are located in or partner with parks—have begun building greater capacity for science education to strengthen public understanding of climate change and its impacts.

PHOENIX ISLANDS PROTECTED AREA

To establish Phoenix Islands Protected Area, the island nation of Kiribati replaced its fishing license system with a long-term conservation trust. Kiribati President Anote Tong is very concerned about the serious implications of climate change on his Pacific nation. He describes the Phoenix Islands endowment as Kiribati's "gift to humanity and an investment for future generations of this planet."

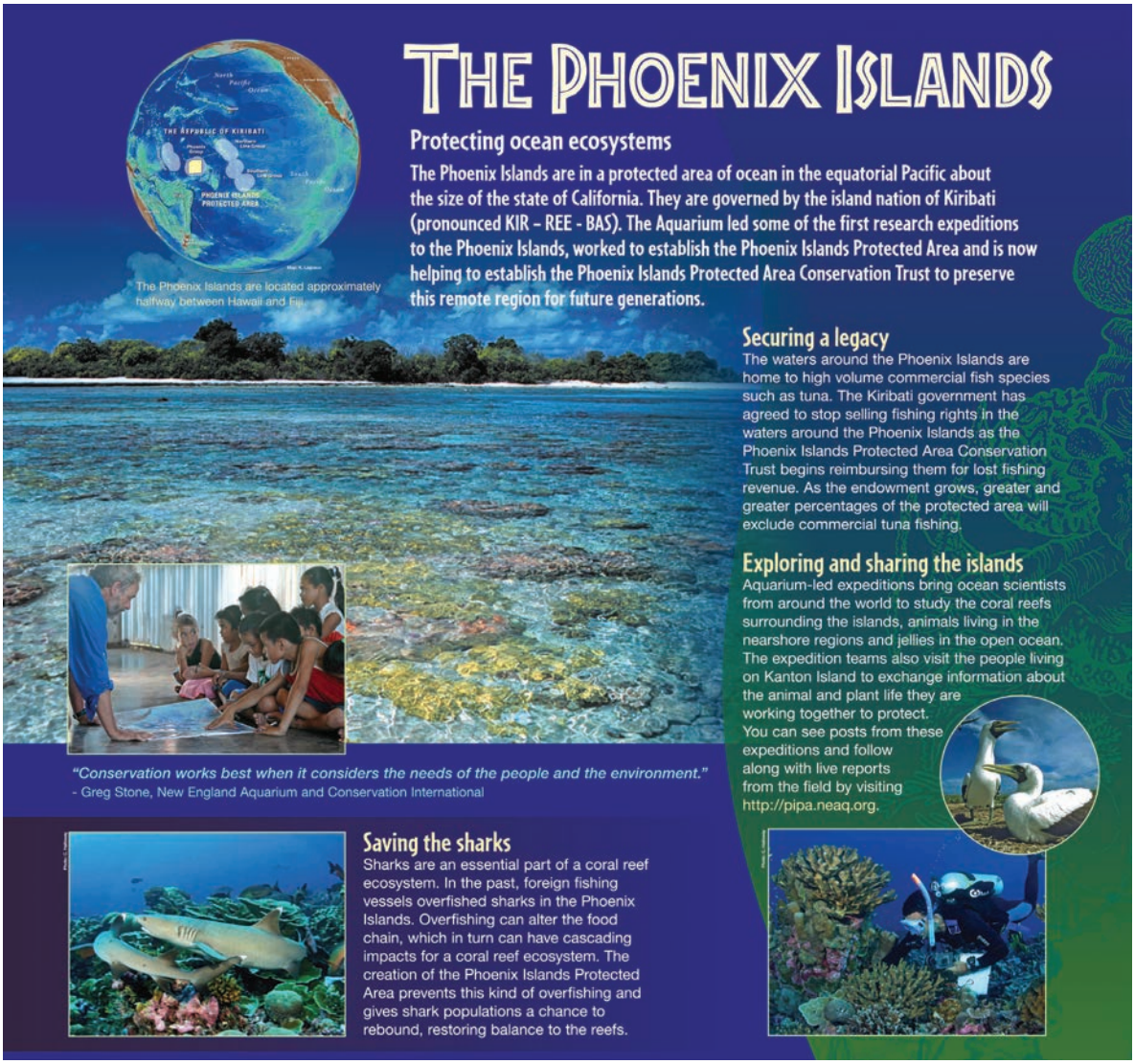
whc.unesco.org/en/list/1325

Since climate change is a significant area of research for New England Aquarium (NEAq) scientists, NEAq sought to use Phoenix Islands Protected Area (PIPA) and other research sites to demonstrate the relationship between climate change and ocean health for aquarium visitors.

PIPA, located between Hawaii and Fiji in the South Pacific Ocean, is the world's second largest marine protected area. It includes one of the last protected reef systems, and is considered by scientists a key location for studying the impacts of global climate change in an area with little local disturbance.

"We have found the rate of recovery in protected ecosystems is faster than other systems. The Phoenix Island reef system is more resilient now that it is protected," explains Dr. William Spitzer, Vice President of Programs, Exhibits, and Planning at NEAq. "In the Aquarium, we use PIPA as an example of how marine protected areas can help make vulnerable ecosystems more resilient to climate change impacts, since they are protected from overfishing, habitat destruction, pollution, and other factors. PIPA examples are used in our exhibits, interpretation by staff and volunteers, PIPA expedition blogs, and media outreach."

NEAq focuses on positive achievements and civic participation. "A sense of hopefulness and empowerment is important," asserts Spitzer. "It's easy to get overwhelmed and depressed by the large implications of this topic. It's an issue of values, so we need to find common ground in viewpoints to promote responsible stewardship.



We provide enough information so [the public] can distinguish between climate and weather using a sequence-cause-effect model. Our exhibits, interpreters, and online resources describe what visitors can do to help. We try to get beyond the problem and empower them with individual and collective solutions."

NEAq sought to expand its climate change communications beyond the Aquarium. NEAq is now leading a multi-million dollar national effort, supported by the National Science Foundation, to build the capacity of interpreters at aquariums, coastal national parks, marine sanctuaries, and other education centers to effectively communicate climate impacts on coastal zones and marine life.

NEAq's climate education initiatives include three objectives:

- Build a national coalition of aquariums and related informal education institutions collaborating on climate change education
- Develop an interpretive framework for climate change and the ocean that is scientifically sound, research-based, field tested, and evaluated
- Build the capacity of aquariums to interpret climate change via training for interpreters, interactive exhibits and activities, and communities of practice for ongoing support

"Interpreters are our primary audiences," Spitzer explains. "They are very influential people. They are trusted sources with a great ability to translate science in ways people can tolerate. They train many people, like volunteers, and often have large social networks. At institutions like aquariums, interpreters can influence [educational outcomes] much more."

NEAq's climate change initiative includes several projects that have built on one another—supporting NEAq's interpreter trainings and the national coalition of informal science education institutions. The latest project is the creation of the National Network for Ocean and Climate Change Interpretation (NNOCCI), which is a collaborative network led by NEAq with funding from the National Science Foundation.

NNOCCI collaborators include the Association of Zoos and Aquariums, National Aquarium (youth development), Monterey Bay Aquarium (web services), Woods Hole Oceanographic Institution (climate scientists), The FrameWorks Institute (cultural and cognitive models, linguistics and communications research), New Knowledge Organization (evaluation and learning research), Pennsylvania State University (project evaluation), and Ohio's Center of Science and Industry (process evaluation).

Through the process of building this network, NEAq benefits from and applies NNOCCI's results and experience to its own climate interpretation programs and practices. For instance, to study their audience and build their point-of-view, NEAq has employed cultural market research and Strategic Frame Analysis from the FrameWorks Institute. To evaluate the effectiveness of their climate education programs they employ a series of formative, empowerment, summative, and social impact evaluations standardized by the New Knowledge Organization and Pennsylvania State University.

The NNOCCI project builds on prior collaborative projects funded by the Institute of Museum and Library Services and the National Oceanic and Atmospheric Administration. Since 2008, these projects have directly facilitated capacity-building with leadership staff from more than 25 institutions and influenced training for more than 1,000 interpreters.

"The Aquarium's collaborative trainings are a combination of in-person and online group facilitation," Spitzer says. "NNOCCI is adopting and adapting a training model they call a 'Study Circle.' Pairs of colleagues from 10 informal science education institutions come together with early career scientists and work together for over 100 hours during a period of six months," Spitzer states. "This includes three face-to-face meetings in an intense seminar environment, online correspondence, reading, practice, etc."

"We can see progress. Alumni of these study circles want to continue to work together and talk about what they have done," Spitzer says. John Anderson, NEAq Director of Education, adds: "Evaluation from pilot study circles indicates participants did feel more hopeful and more willing to raise topics of climate change in their interpretive work and in conversations among their close associates."

"We continue to work with more institutions, and are getting more sophisticated at improving communications. The demo phase is now complete. The next phase is to scale it up," Spitzer says.[5]

5 www.support.neaq.org/site/PageNavigator/prof_devel_study_circle.html

PICO DE ORIZABA NATIONAL PARK, MEXICO

Tickell Climate Theatre Network using Science on a Sphere interpretation tools

PARK/SITE NAME: Pico de Orizaba National Park
HIGHLIGHTED PROGRAM: Tickell Climate Theatre Network and NOAA's *Science on a Sphere®* Program
PARK AGENCY: National Commission of Protected Natural Areas (*Comisión Nacional de Áreas Naturales Protegidas*)
LOCATION: Veracruz and Puebla States, Mexico
KEY POINT: Expanding a climate interpretation network using Science on a Sphere technology

SUMMARY

In educational parks across Mexico a network of climate theatres has been created to generate broad public interest in climate protection. Located within Pico de Orizaba National Park, the Tickell Climate Theatre Network employs Science on a Sphere projection technology from the U.S. National Oceanic and Atmospheric Administration. Thanks to the success of the program, the network is expanding beyond the borders of Mexico into neighboring countries, to Europe, Asia, and the Middle East.

CASE STUDY

In the wake of increased occurrences of searing droughts in Northern Mexico, floods in Southern Mexico, and worsening air quality in Mexico City, a handful of Mexican environmentalists and scientists seized an opportunity to leverage national and cultural pride to create a groundswell of support for strong climate action.

The Tickell Climate Theatre Network (TCTN) was inspired by the creation of the world's highest climate observatory, the Sir Crispin Tickell High Altitude Climate Observatory at an altitude of 15,000 feet atop Sierra Negra in Mexico. The combination of the world's highest greenhouse gas monitoring station, a tradition of inspiring architecture that evokes ancient cultural ancestry, and cutting-edge visualization and projection technologies has catalyzed rapid development of TCTN.

SCIENCE ON A SPHERE®

Science On a Sphere **is a room-sized, global display system that uses computers and video projectors to display planetary data onto a six-foot diameter sphere, analogous to a giant animated globe. The U.S. National Oceanic and Atmospheric Administration developed *Science On a Sphere* as an educational tool to help illustrate earth system science to people of all ages. Animated images of atmospheric storms, climate change, and ocean temperature can be shown on the sphere, which is used to explain environmental processes in a way that is simultaneously intuitive and captivating.**

www.sos.noaa.gov

Visit the Climate Institute's Smart Solutions blog, as well as other tools and resources at www.climate.org.

"TCTN is the leading active campaign in Mexico for climate education for [the past] five years. The greatest part is that leadership came from below—from young scientists not caught up in politics," says John Topping, President of the U.S.-based Climate Institute, a partner in the creation of TCTN.

The first Tickell Observatory Climate Education and Outreach Center was requested by the State of Puebla's Secretary for Natural Resources and Environment. It was located in Flor de Bosque, a 1,600-acre educational park in Puebla, the city closest to Pico de Orizaba National Park. Aided by local and national support and the U.S.-based Climate Institute, Climate Institute, NOAA's *Science on a Sphere* projection technology was installed in a theatre inside a traditional Mexican architecture-inspired building in 2009. In its first year, over 90,000 visitors viewed a 40-minute multimedia presentation on climate change and its implications.

The observatory was named to honor Sir Crispin Tickell, a prominent international advisor on climate, and former United Kingdom Ambassador to Mexico (1981-83) who championed the need for a high altitude observatory in Mexico. "The observatory was partly established to stimulate public interest and national excitement. The spheres have made a huge difference in public interest and getting politicians on board," Topping says.

The original theatre was a strong success and in 2010, a climate theater was inaugurated by Mayor Marcelo Ebrard in Mexico City's Museum of Natural History in Chapultepec Park. There are now 12 Tickell Climate Theatres in total—also called "Houses of the Earth"—with two more theatres planned for Chetumal and Oaxaca. Most of the theatres are located in popular city parks and use traditional Mexican or native architecture. Others are in existing buildings, such as museums. The theatre locations are coordinated by the Climate Institute, but owned and operated by either the state or city government.

"The sphere projection is like a planetarium presentation. Interpreters tailor each projection to their imagination and the needs of a particular audience," says Topping. "They can run over 300 programs from NOAA's content database. Presentations range from the origins of the planet, to climate and energy, to black carbon. The visuals supplement the interpreter's presentation, and there is a lot of informal interaction [with the audience]."

The last few minutes of each session are devoted to motivational, inspirational takeaway messages. Outside each theatre is a culturally appropriate mural on climate change. It tells a story of carbon dioxide levels from the beginnings of life to the arrival of reptiles, the impacts of asteroids, and the movement of the Pangaea landmass, and ends with human industrialization. In order to strengthen the solutions and civic engagement component of the theatre network, the Climate Institute created the Smart Solutions blog as a as a way to share best practices as more theatres are developed.[6]

TCTN has stirred more than provincial interest. According to Topping, "[TCTN] helped to catalyze actions that resulted in the enactment of strong climate legislation [in Mexico]." TCTN is now attracting interest from other countries in Latin America, the Middle East, Philippines, Spain, United Kingdom, and the United States.

"All along we have envisioned that in each country climate theatres would be tailored to national needs and cultural preferences, and would seek to instill a sense of pride and ownership in visitors, Topping states. "Moreover, the naming of the Network for Sir Crispin Tickell provides an international link that transcends any single country."

6 www.climate.org/smart-solutions/
www.climate.org/resources/educational/games.html

CITY OF ROTTERDAM, NETHERLANDS

Connecting public health and climate change through parks and green spaces

PARK/SITE NAME: Rotterdam city parks and green spaces
HIGHLIGHTED PROGRAM: Rotterdam Climate Initiative
PARK AGENCY: City of Rotterdam
LOCATION: Rotterdam, Netherlands
KEY POINT: Incorporating parks and green spaces as climate change adaptation and education areas

SUMMARY

In the low-lying delta city of Rotterdam, Netherlands, a looming threat from flood waters and rising sea levels has resulted in re-engineering public spaces to help protect the city. As a part of this effort, many public spaces such as city parks and greenways are being used as platforms to communicate the Rotterdam Climate Initiative, local public health threats associated with a warming climate, and changes in civic infrastructure in response to climate-oriented threats.

CASE STUDY

In the recent decade, Rotterdam has experienced small-scale river overflow and severe rain events. "Facing copious amounts of rainwater, city planners redesigned public spaces and parks to include temporary 'water squares' to manage the excess of water," says Arnoud Molenaar, City of Rotterdam's Adaptation Program Manager. This climate change adaptation to public spaces has created communication needs and public health challenges for city planners.

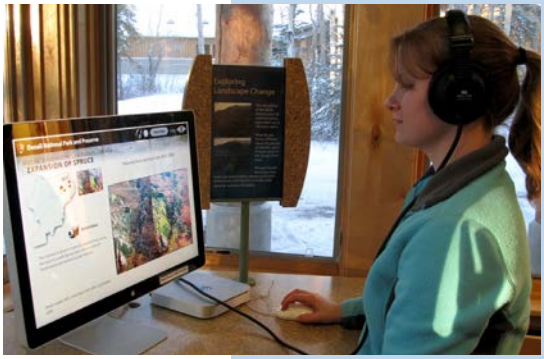
In order to gain public support for "climate-proofing" the city and reducing greenhouse gas emissions by 50%, Rotterdam established the Rotterdam Climate Initiative (RCI) in 2007. Implemented by the Departments of Public Works and Urban Development, RCI promotes a self-reliant, carbon-neutral, local economy and brings the city and its citizens together to demonstrate the public benefits of taking action on climate change.

In 2008, as part of the Climate Initiative, Rotterdam started with an integrated adaptation program: the Rotterdam Climate Proof program. This effort created a common brand and signage that refers to the RCI and helps the public understand that a particular effort is due to intentional climate adaptation, mitigation, or sustainability practices. RCI signs can be seen on the city's green roofs, green ports, and public vegetable gardens spread out over the city. This branding has helped to unify the city's climate change activities and communicate civic activities to the public in a comprehensive, engaging manner.

ROTTERDAM.CLIMATE.INITIATIVE

Since climate change contributes to public health threats, RCI also collaborates with the city's public health and recreation departments. "Our public recreation water has become an important public health concern, as much of the overflow is contaminated nitrogen-rich water," says Josine van der Bogaard, Senior Urban Planning Advisor for the Regional Health Authority in Rotterdam. "When the overflow combines with surface water, blue-green algae become problematic once water temperatures begin to increase."

A warming climate also has created more allergen and insect problems in Rotterdam. More frequent cases of insect-borne illnesses (such



EXPLORING LANDSCAPE CHANGE THROUGH REPEAT PHOTOGRAPHY IN DENALI

More than 30 repeat photo pairs spanning 30 to 100 years are the highlight of this repeat photography eResource. Each photo pair captures dramatic changes in several categories (i.e. glacial retreat, expansion of woody vegetation). Some changes visible in the photos are directly linked to a warming global climate, while others provide clues best investigated with scientific data.

The aim is not only to feature changes visible through repeat photography, but also to guide visitors in interpreting the changes themselves by placing them in a larger ecological context and helping visitors understand their potential effects. Additionally, text and features of the eResource encourage visitors to be on the lookout for similar changes occurring where they live.

The exhibit is prominently displayed at a computer kiosk with audio narration in Denali National Park and Preserve's Murie Science and Learning Center, which receives approximately 20,000 visitors each year. The exhibit is also viewable from any computer and downloadable from the Denali eFeatures web page that receives more than 6,000 page views per year.

www.go.nps.gov/DenaLandChange

as Lyme disease) are reported, there has been a greater presence of fire mosquitoes, and an allergen-causing caterpillar is shifting its range into more Rotterdam's latitude as the temperature warms.

Rotterdam's Regional Public Health Authority communicates information on climate-related public health threats in public spaces. Signage in parks and green spaces focuses on positive messages that connect directly to people's daily lives. The city also uses awareness signs to flag places where it is dangerous to swim, and directs the public to a comprehensive health website. The website details the health risks from climate change impacts, and provides information sheets on sustainability solutions being implemented by the city.

NATUURKALENDER

Rotterdam is addressing rising allergen and insect issues in part through a national citizen-phenology program. Many residents post on the Dutch Nature's Calendar Network (Natuurkalender) when local plants flower or when a certain insect is observed. Models from Natuurkalender help to forecast pollen outbreaks and help doctors predict when allergy sufferers may need medication.

www.natuurkalender.nl

RUSSELL CAVE NATIONAL MONUMENT, ALABAMA, U.S.

Using prehistoric information to link past and present climate change

PARK/SITE NAME: Russell Cave National Monument
HIGHLIGHTED PROGRAM: Educating on adapting to climate change
PARK AGENCY: National Park Service
LOCATION: Alabama, U.S.
KEY POINT: Interpreting historic and modern climate change through existing park themes

SUMMARY

Russell Cave National Monument in Alabama is an archeological site that tells a story of ancient cultures through time. Park interpreters use food as a central theme to link prehistoric and modern climate change. Subsistence foods reveal a meaningful parallel for how local peoples have adapted to shifts in climate through time, as humans transitioned from hunter-gatherer societies to more agrarian civilizations.

CASE STUDY

The history of human occupation of Russell Cave is a story of adaptation to changing climate conditions. The process of interpreting that history is one of peeling back the layers of human and climate history and tying them to present conditions and experience. "The mission is survival," says Keena Nichelle Graham, park ranger at Russell Cave National Monument. "Historic peoples of Russell Cave survived extreme changes in temperatures. When food and animals disappeared, they had to adapt to new ways that would sustain them. They improvised their weapons to go for faster moving smaller game when food became less available." In extreme conditions, they would abandon the cave.

In addition to interpreting the archeological history of climate change as it relates to diet changes at Russell Cave, the park also ties in modern climate change. They do this by demonstrating how modern populations in the area can better survive and adapt to a rapidly warming climate by growing native foods.

Interpretative staff have planted native food gardens to demonstrate how North American Indians grew a variety of native crops that are better adapted to the region's drought-prone climate. They also describe how growing "polycultures" of native foods in the area can shrink the ecological and carbon footprint of food, and in turn ensure greater local biodiversity while securing the regional food supply.

"Native foods include anything from squash, nuts, beans, persimmons, blackberries, strawberries, grapes, and mints. If grown properly, these foods are more resilient to local climate change than the monocultures of corn that presently surround the park," Graham says. "We tie in how past events, such as the potato famine during the mini ice age, are happening more often as industry comes into agriculture."

Park visitors are offered varied opportunities to engage in dialogue about paleoclimate

NPS TEACHER-RANGER-TEACHER PROGRAM

Teacher-Ranger-Teacher links national parks with teachers who spend a summer as a Ranger in the parks developing educational materials and curriculum that benefit both the parks and the classroom.

www.nps.gov/learn/trt

and modern climate change, including public presentations led by archeologists and ethnobotanists studying the area's prehistoric diets and plant life. "Climate change is a key part of our understanding of how populations in the region grew through time," says Dr. Kandace D. Hollenbach, Anthropology Professor at the University of Tennessee.

To reach younger crowds, Russell Cave National Monument has begun using the Teacher-Ranger-Teacher program to recruit teachers to work on projects like curriculum activities for native food demonstrations and content for the Junior Ranger booklet. The program aims to reach 200 children per year. Russell Cave also works with the Jackson County 4-H educational program through the University of Alabama's Cooperative Extension System. This program empowers underserved, diverse youth to become compassionate and involved members of society.

"We try to get people to understand the process by which climate change happens," Graham states. "Our visitors in general agree that climate is changing and disagree about the source. We can agree to disagree and still foster stewardship and still present the facts as we know them, as opposed to shoving opinions in their face."

Around the park visitor center, rain barrels and composters have been installed to encourage people to ask questions about them. In the words of Graham, "It's our [clever] way of provoking the climate change conversation."

CRISSY FIELD CENTER, GOLDEN GATE NATIONAL RECREATION AREA

Climate change and energy issues are major components of Project WISE (Watersheds Inspiring Student Education), a partnership of San Francisco public high school Galileo Academy of Science and Technology, the Golden Gate National Parks Conservancy, the National Park Service, and the Presidio Trust.

Initiated in 2001, this year-long environmental science program includes weekly visits to the Crissy Field Center and Presidio of San Francisco to engage young people outside the classroom and in their national parks. Through tangible and relevant student-driven lab experiments, field investigations, and digital media projects, students become more engaged in science not only by learning scientific concepts but also gaining 21st-century skills in collaboration, technology, and social and environmental responsibility. Project WISE students also learn about the causes and effects of global warming. They use that information to identify actionable items for positive change on the personal, school-wide, and policy levels.

www.parksconservancy.org/programs/crissy-field-center

WILDCAT GLADES CONSERVATION & AUDUBON CENTER, MISSOURI, U.S.

Communicating climate change to an entire community

PARK/SITE NAME: Wildcat Glades Conservation & Audubon Center
HIGHLIGHTED PROGRAM: Non-controversial, positive climate change communications
PARK AGENCY: National Audubon Society
LOCATION: Missouri, U.S.
KEY POINT: Incorporating climate change messaging into all programs and communications in non-confrontational ways

SUMMARY

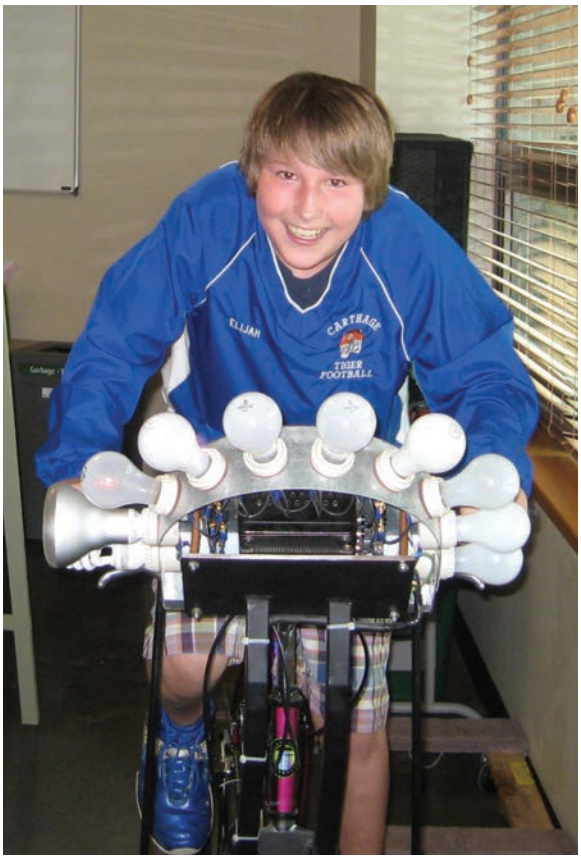
The Wildcat Glades Conservation & Audubon Center in Joplin, Missouri integrates climate change messaging into a range of programs, from invasive species management to annual citizen science activities, despite push-back on climate change as a relevant topic.

CASE STUDY

Wildcat Glades Conservation & Audubon Center is part of a partnership protecting 27 acres of threatened chert glade habitat. The partnership includes the National Audubon Society, City of Joplin, and Missouri Department of Conservation. Wildcat Glades includes four miles of trails and an interpretive center, and provides protection for the city's main water source. Visitors and school groups come to Wildcat Glades to learn about the unique flora and fauna that thrives on the rare, shallow, chert glade soils.

Climate change exacerbates the challenge of conserving native ecology, and the flora and fauna of the chert glade are very susceptible to invasive species. Chris Pistole, education director at Wildcat Glades asserts, "We have been observing many forecasted climatic impacts on the ground. We expect this phenomenon to increase."

Climate change can be a sensitive topic for some in the region. When climate change made the cover of the Wildcat Glades newsletter in 2010, some major donors threatened to pull funding. Wildcat Glades managers and interpreters responded positively to the challenge brought by their funders. They found a way to incorporate climate change messaging into existing natural history programs without provoking negative reactions. They did so by prioritizing the human bond with nature, being mindful of terminology, engaging the audience in dialogue about climate impacts, and adapting the National Audubon Society's climate change resources to suit their park's needs and observations.



"Our first and foremost priority is that our visitors develop an appreciation and love for nature," Pistole says. "Particularly with the young kids in elementary school, we find it is most important to let them play as a means to connect with their native habitat. Once they are ready for more information, we slowly go deeper. When it comes to climate change, we make it relevant to our ecosystem and we stay away from doom and gloom or too much negative. Kids don't respond well when we tell them that rainforests in other countries are being destroyed. It is much more effective to let them play in their backyards where they can build intimate connections to their native habitats. With adults we find there are political connotations attached to terms, such as 'global warming,' which come across as misleading to our audiences. Instead we will occasionally replace the controversial term with a phrase that is agreeable, like 'weather on steroids.'"

Wildcat Glades keeps a positive tone by focusing their climate-oriented messaging on local environmental factors, such as saving money and reducing greenhouse gas emissions through energy conservation. "On Earth Day in 2010 we threw an Energy Festival at Wildcat Park. Our Energy Olympics activities were a great hit with the community," says Pistole.

Wildcat Glades uses forecasting tools developed by the Union of Concerned Scientists to predict climate scenarios for their location. "We use local impacts like [invasive plant encroachment] as an entry point to engage audiences on the topic of climate change," Pistole says. "We like to provide facts from observations on the ground and engage our audience in dialogue by asking questions. A warming climate gets people to think about how native ecology functions and how it will respond."

Making the data relevant to people's everyday lives is another important tactic. "We are noticing that flora is blooming up to a month ahead of schedule in spring," relates Pistole. "We make this relevant to our audience by tying it into phenomena city residents can relate to. For instance, this past spring, the Iris Society canceled the city's 80th Mother's Day Iris Show as the irises bloomed several weeks before normal. Canceling this annual tradition due to climatic impacts made big news in Joplin."

Engaging park visitors in citizen science also supports climate change education. Wildcat Glades employs National Audubon Society programs like the Great Backyard Bird Count and the Christmas Bird Count. These citizen science programs, as well as online checklist programs like e-Bird, developed by the Cornell Lab of Ornithology, utilize meticulous scientific processes to study bird ranges. The resulting high-quality data from these programs can be used by scientists to determine how climate is impacting birds. For educators, results of these studies can be effectively used to tie in climate change messaging with a variety of audiences.

Wildcat Glades interpreters also share their lessons learned with other educators in the region. In a regional workshop for the National Association for Interpretation, Wildcat Glades interpreters were invited to present on climate change communications.

"It was well-attended and got great reviews by mostly non-formal educators—interpreters working at all kinds of parks and interpretive sites," Pistole says. "I had many tell me afterwards that they were afraid to talk about climate change because of the controversy in their area, but that they now saw ways to include it in other program topics as well and not advertise it as 'climate change', and possibly stir up controversy or drive people away. They felt more knowledgeable about climate change and therefore more comfortable discussing it."

YELLOWSTONE NATIONAL PARK, WYOMING, U.S.

Xanterra Parks & Resorts' For Future Generations: Yellowstone Gifts *retail store—connecting consumers to climate information*

PARK/SITE NAME: Yellowstone National Park
HIGHLIGHTED PROGRAM: *For Future Generations: Yellowstone Gifts* retail store
PARK AGENCY: National Park Service; concessionaire Xanterra Parks & Resorts
LOCATION: Yellowstone National Park, Wyoming, U.S.
KEY POINT: Providing sustainability and climate change information through consumer products and education at a retail outlet

SUMMARY

National Park Service concessionaire Xanterra Parks & Resorts has created a souvenir shop in Yellowstone National Park that links the visitor experience with climate change solutions and responsible consumer purchasing choices.

CASE STUDY

To assist the National Park Service in raising awareness about climate change, Xanterra Parks & Resorts launched a "For Future Generations" campaign in 2009. Central to this initiative is a line of retail stores in national parks. Xanterra's flagship store in Yellowstone National Park's Mammoth Hot Springs Hotel, called For Future Generations: Yellowstone Gifts, was the first to open in 2010. Often dubbed the "climate store," the gift shop aims to empower park visitors and employees with sustainable shopping options that relate to the park.

"Although climate education and retail may be an odd juxtaposition, we have found providing a retail space dedicated to climate literacy compliments the environmental education experience in the park." says Dylan Hoffman, Director of Sustainability at Xanterra Parks & Resorts in Yellowstone National Park. "It also encourages our guests to make a connection between our purchasing decisions and a product's environmental impact."

The climate store offers a first-of-its kind sustainable retail scorecard, describing the sustainable attributes of each product, such as

its impacts on the environment and benefits for the local community. Featured products include everything from climate literature, park-specific interpretive products, local products, products that are made of recyclable material or designed to reduce environmental impacts, custom souvenirs, and regional Native American crafts and foods. Both conventional and sustainable options are offered, and differentiated by their scorecard.

"Digital slideshows display compelling facts that visitors can relate with, such as what impact a changing climate has on the local wildlife that many visitors have come to the park to experience," Hoffman says.

Digital displays also highlight climate action tips and the company's sustainability efforts as part of its Environmental Management System, Ecologix. Tips are presented on the screen, such as, "Did you know a 2°F adjustment to

your thermostat eliminates up to 500 pounds of CO_2 and saves $$$?"

In a partnership with the National Park Foundation and the hotel, iconic Yellowstone animals are represented as plush animal toys available for purchase through the Plush Program. The stuffed animals greet visitors when they enter their rooms in the hotel, and $2 from each sale benefits the Foundation's efforts. The stuffed animals come inside a "habitat" that incorporates information on the impacts of climate change and messaging on how visitors can take action at home.

Visitors can also visit the store's climate action kiosk where they are asked to fill out *Take Action* pledges. One pledge prompts visitors with "I'll help protect the parks by..." As an example, Kimberly from Ontario, Canada answered "reducing energy and water consumption, and spreading awareness about environmental efforts." Just outside the store is a hydration filling station, where visitors can top-off their reusable water bottles which are available for purchase at the store.

Employees also are educated in the process. "Our employees get climate education both during initial training and through ongoing training over the course of their season," Hoffman says. "We do 'Green Tailgates' every two weeks which go over various aspects of our environmental efforts and weekly email dispatches called 'SustainaBits' that go out to all employees."

Although climate stores now operate in other national and state parks, the original store in Yellowstone continues to refine the concept. Hoffman's team is currently surveying guests to see how they respond to current efforts and gauge how the scorecard is working. "We ultimately want

to find out if and how the message of a product is making its way to the guests," Hoffman explains. "We also are working to make the environmental performance of the product more apparent."

Hoffman's next plan is to reconnect with park scientists so that current efforts and facts, such as the park's first ever ecosystem-wide greenhouse gas inventory, can be highlighted to visitors through the retail space.

CONCLUSION

The parks community's response to climate change is a defining opportunity. Parks provide a tremendous public service when they adapt their messaging and education to most appropriately and effectively communicate and inspire action on climate change.

Each geographic and cultural location offers a different perspective. Compiling local knowledge and tailoring it for specific audiences provides valuable public education opportunities and drives park relevance, visitation, and stewardship.

As shown throughout this report, park agencies, communities, and leaders are taking up this challenge and developing creative, effective educational programming and communications on climate change. In the process, they are strengthening the public's connection to parks, and building an ethic of conservation for the 21st century.

These vital contributions to the global challenge of climate change—and the positioning of parks, protected areas, and partner organizations as important components of our collective response—have the potential to transform conservation and stewardship dialogues for years to come.

CLIMATE CHANGE EDUCATION & PARKS

For more information on the Institute at the Golden Gate's Climate Change Education & Parks program, visit www.instituteatgoldengate.org

"We are moving into an era that requires more than environmental education and climate literacy. Climate change is an issue with huge implications. It's an issue that needs to draw on public values and civic engagement, creating a sense of hopefulness and empowerment by encouraging people to participate in the solutions."

— Dr. William Spitzer, New England Aquarium

APPENDICES

APPENDIX A

CLIMATE CHANGE COMMUNICATIONS: STRATEGIES & ACTION STEPS

The following strategies and action steps focus on tailoring place-based climate change communication and education.[7]

AUDIENCE

- **Know your audience and frame your message**
  Thoroughly analyze your audience to determine social identities, common values, and knowledge. Consider incorporating social and learning sciences in your approach.
- **Respect all views**
  Consider everyone in the audience as the expert in their point of view.
- **Understand your audience's trusted sources**
  Where do they get their information?
- **Give and take feedback from audiences**
  Surveys, interviews, and focus groups can help to obtain this information.

MESSAGE

- **Rigorously understand your message and point of view**
  What are you working to communicate?

7 Based on the CRED guide, ICLEI Climate Change Communication Guide; NOAA's Climate Office and Jane Lubchenco Interview; NEAq's strategic communications research; www.climateaccess.org/sites/default/files/Climate%20Communications%20and%20Behavior%20Change.pdf

- **Understand the common pitfalls and talking points**
  How do others successfully communicate similar messages?
- **Vary the medium and style of message**
  Audiences and individuals learn in different ways, and interpreters have varying strengths and experience as educators.
- **Make the message salient, actionable, meaningful, and relevant to your audience's common values, daily lives, choices, and decisions**
  - **Make the message meaningful**
    Provide a familiar context and calibrate data to the visitors' frame of reference.
  - **Use universal tie-ins to everyday life**
    Prioritize issues with clear direct impacts, such as jobs and health care. Use tie-ins that cater to specific groups in your audience.
  - **Localize messages without losing sight of the big picture**
    Draw connections to local plants, animals, physical elements, cultures, and communities experienced in the park or local area while demonstrating long-term thinking. Avoid over-reference to faraway places and people impacted by climate change.
- **Translate current scientific data into context and concrete experience**
  Focus on what is happening on the ground by emphasizing empirical research vs. predictive research.
- **Humanize climate change with relational dialogue**
  Consider an approach that focuses on creating conversational dialogue around local perspectives and solutions. Analyze how livelihoods of individuals have been influenced by climate change.
- **Build on your audience's connection to nature**
  Interpret climate change based on an established relationship to the natural world and develop a progression of messages to deepen the experience.
- **Do not rely solely on science**
  Do not assume that scientific facts about climate change will effectively lead to rational choices and changes in attitudes or social norms. Engaging people in climate observation and inspiring them to act can be pursued at any level of knowledge.
- **Base your message on sound science, trusted sources, and transparency**
  - **Address scientific and climate uncertainties**
    Know where your data came from and the limits of your knowledge.
  - **Touch on scientific consensus**
    Explain how science works and the process by which scientific knowledge is established.
  - **Use accessible science, presented in manageable chunks**
    Provide easily accessible resources.
- **Use simple, concise, clear messages**
  Use messages that are easy to understand without losing accuracy.
- **Avoid oversimplification**
  Simplifying a message too much can make it inaccurate or too easy to dismiss.

- **Consider complementary emotional appeals**
  - **Use the power of positivity and non-patronizing optimism**
    Frame climate protection as achievable, and avoid using guilt. Focus on solutions. Celebrate accomplishments and highlight success stories.
  - **Handle controversial content creatively**
    Provide information that allows the audience to piece together their own conclusions.
  - **Use joy, humor, play, storytelling, and role models**
    Bring fun and adventure to excite your audience. Add serious context to a joyous experience. Tie messages to stories and people in the news, and public figures who are taking positive action.
- **Terminology matters**
  Refrain from overusing common terms with mixed messaging (e.g. mixing "global warming" and "climate change"). Occasionally, replace such terms with others such as "warming climate," or "rising global mean temperatures." Avoid highly partisan terms as well as rhetorical and shrill language.

ACTION

- **Inspire civic engagement, positive attitudes, and new social norms**
  Empower your audiences with the tools to find out more and take action. Provide relevant opportunities to engage audiences in park and community stewardship.
- **Highlight park actions**
  Implement and showcase green practices related to reducing emissions throughout your agency and programs.
- **Offer opportunities to sign pledges for personal accountability**
  These can incorporate actions of specific local or park relevance.
- **Make actions manageable**
  Give examples of solutions that are working and that your target audience can implement.
- **Illustrate the benefits of taking action**
  Consider actions and consequences at the individual, family, community, and global scale.
- **Build a sense of belonging and personal choice**
  Also known as "choice expansion," focus on providing simple, straightforward choices.
- **Network and create networks**
  Establish or join a network of educators. Establish park networks so visitors can visualize how other parks are connected via climate impacts in other geographies.
- **Continuously evaluate**
  Have a clear understanding of expected learning and action goals, and clear metrics that relate to those goals.
- **Add interactive and experiential components to your exhibits and programs**
  Encourage interaction with topics and provide the opportunity to use all of the senses.
- **Provide opportunities for people to learn on their own**
  Provide detailed information for take-home solutions and making smart decisions.
- **Show results and share successes**
  Help visitors understand that their actions and park actions make a difference.

BUILDING A CLIMATE CHANGE COMMUNICATIONS PLAN: 10 STRATEGIC ACTIONS

1. **Conduct market and demographic research to understand your audience**
   A strong knowledge of your target audience informs the basis of all communications and strategy.

2. **Develop an inventory of relevant assessments (local, regional, global)**
   i. **Empirical data assessment**
      Analyze what is happening on the ground currently.
   ii. **Paleo-data assessment**
      Compare the rates of climate change from relevant past periods to present time.
   iii. **Vulnerability and risk assessment**
      Analyze the sensitivity and adaptability of your geography. A traditional risk assessment analysis can be used to prioritize action steps.
   iv. **Local solutions assessment**
      Identify solutions to empirical issues and apply this assessment toward establishing broad opportunities for communications and education.

3. **Acquire resources and tools**
   Consider local opportunities, online resources, and materials from other park agencies.

4. **Acquire local knowledge and participation**
   Building on local relationships to place and history helps to humanize climate change. Consider partnerships and collaborations with gateway communities, local scientists and universities, and affiliated organizations.

5. **Train and engage staff**
   Provide specialized training, resources, and ongoing topical support to build interpretation confidence and knowledge.

6. **Encourage concessionaires, visitor centers, and educational facilities to innovate**
   Consider new ways to communicate current priorities that could incorporate climate change messaging.

7. **Share best practices with professional audiences via networks**
   The websites www.climateinterpreter.org and www.climateaccess.org offer strong climate communication networks.

8. **Develop experiential tools**
   i. **Online and technology solutions**
      Provide a variety of new media, video, and interactive technology educational opportunities.
   ii. **Interpretive trails**
      Consider incorporating climate change communications into existing trail systems.
   iii. **Historic legacy**
      Emphasize maps and the local geomorphological imprint of climate change over time. Where relevant, include that the climate of many areas was a key factor in local human history and development.

iv. **Exhibitions**
Use targeted special exhibitions to raise awareness and provide for new learning and program development.

v. **Artistic displays**
Explore using public art and other nonscientific media as a medium for communication.

9. **Develop park programs**

i. **Build on existing programs, events, infrastructure, and partnerships**
Consider adapting existing programs and events to incorporate climate change messaging.

ii. **Develop new partnerships and programs**
Communicating about climate change can lead to development and programming opportunities with new and existing partners.

iii. **Adopt climate-friendly operational practices**
Ensure your park is doing all it can with your own climate and sustainability-related operations.

iv. **Provide opportunities for public participation**
Offer citizen science, service-learning, and volunteer opportunities to help familiarize audiences with climate science, highlight local issues, and empower new actions.

10. **Evaluation**
Create an evaluation framework for climate education program goals and activities, including audience evaluation, peer review, and community engagement.

APPENDIX B

RESOURCES & LINKS

CAL-adapt
Climate change research and data from California.
www.cal-adapt.org

CIRES Education Outreach Program
Climate change educational resources for all age levels.
http://cires.colorado.edu/education/outreach/resources/climate.html

City Park Forum, American Planning Association
The City Park Forum Briefing Paper on Climate Change Management.
www.planning.org/cityparks/briefingpapers/climatechange.htm

City Parks Alliance
A membership organization serving and advocating for urban parks.
www.cityparksalliance.org

Climate Access
Supporting the transformation to low-carbon, resilient communities.
www.climateaccess.org

Climate Adaption Knowledge Exchange
A clearinghouse of climate change adaption information, projects, and case studies.
www.cakex.org

Climate Central
Researching and reporting on climate change and its impact on the American public.
www.climatecentral.org

Climate Change Response Program, National Park Service
The central information resource for NPS climate change-related effort.
www.nature.nps.gov/climatechange

Climate Desk
A journalistic collaboration exploring the human, environmental, economic, and political impacts of climate change.
www.climatedesk.org

Climate Friendly Parks Program, National Park Service
A resource to help parks, visitors, and regions become more climate friendly.
www.nps.gov/climatefriendlyparks

Climate Institute
A collaborative resource for leaders and educators on climate change and emmissions reductions.
www.climate.org

Climate Interpreter
A clearinghouse coalition of individuals and organizations interpreting climate change.
www.climateinterpreter.org

Climate Literacy and Energy Awareness Network (CLEAN)
A reviewed collection of resources for sharing and discussing climate and energy science teaching.
www.cleanet.org

Climate Watch
Climate science information from NOAA.
www.climatewatch.noaa.gov

Climate Wisconsin
Climate change information and stories from the state of Wisconsin.
www.climatewisconsin.org

Climate Wizard
A resource for visualization of climate change data.
www.climatewizard.org

ClimateWorks Foundation
Supporting public policies that prevent climate change and promote global prosperity.
www.climateworks.org

Colorado University Climate Education Portal
Climate education resources and videos for teachers, policymakers, and the public.
http://learnmoreaboutclimate.colorado.edu

Earth to Sky
Resources and information for learning and sharing science education techniques.
www.earthtosky.org

Earth: The Operators' Manual
A PBS network program exploring climate history and energy use.
http://video.pbs.org/video/1855661681

EcoAdapt
Information and resources for climate adaptation.
www.ecoadapt.org

Europarc Federation
An information sharing resource for European protected areas.
www.europarc.org

Governors' Climate and Forests Task Force
A collaborative effort among 19 international states and provinces to support forests inclusion in climate policy.
www.gcftaskforce.org

Information Is Beautiful
A creator of visual information and infographics.
www.informationisbeautiful.net

Naomi Oreskes: "Answering Climate Change Skeptics" video
Tactics for responding to climate change questions.
www.youtube.com/watch?v=XXyTpY0NCp0

NASA Innovations in Climate Education (NICE)
An information and resource clearinghouse for educators from NASA.
https://nice.larc.nasa.gov

National Center for Science Education
A resource for teaching the science behind climate change.
http://ncse.com/climate

National Marine Protected Areas Center, National Oceanic and Atmospheric Administration
Information and resources on marine protected areas and ocean science.
www.mpa.gov

Center for Urban Ecology, National Park Service
A natural and cultural resource management information source focused on the U.S. National Capitol Region.
www.nps.gov/cue

National Ocean Service, National Oceanic and Atmospheric Administration
Climate literacy publications from NOAA's National Ocean Service.
http://oceanservice.noaa.gov/education/literacy.html

Parks Climate Challenge
Providing teachers with the tools to deliver national park-centric climate change lessons.
www.parksclimatechallenge.org

Project 2061, American Association for the Advancement of Science
Developing assessment items to measure students' understanding of ideas about energy and evolution.
www.project2061.org

Surging Seas
Sea level rise analysis graphics and maps by Climate Central.
http://sealevel.climatecentral.org/surgingseas/gauge/9414290#show=cities&center=12/37.8514/122.4454&surge=1

The Cultural Cognition Project at Yale University
A group of scholars studying how cultural values shape public risk perceptions and related policy beliefs.
www.culturalcognition.net

The Daily Climate
An independent media organization working to increase public understanding of climate change.
www.dailyclimate.org

Tribes & Climate Change
A clearinghouse of information on climate change impacts on Native Americans and Alaska Natives.
www4.nau.edu/tribalclimatechange/resources/impacts.asp#ewoodlands

U.S. Dept. of State: Federal Climate Change Programs
A list of U.S. federal climate change programs, grouped by primary audience.
www.state.gov/documents/organization/140003.pdf

U.S. Global Change Research Program
Integrating federal research on global change and climate change.
www.globalchange.gov

U.S. Ice Drilling Program
Information about ice core drilling, expeditions, and management.
www.icedrill.org

UNESCO Global Climate Change
UNESCO climate change-related information and resources.
www.unesco.org/new/en/natural-sciences/special-themes/global-climate-change

U.S. Forest Service, Northern Research Station
Information from the U.S. Forest Service's Northern Research Station.
www.nrs.fs.fed.us

Will Steger Foundation
Educating, inspiring, and empowering people to engage in solutions to climate change.
www.willstegerfoundation.org

Yale Project on Climate Change Communication
Research, strategies, and tools for effectively communicating climate change, including Global Warming's Six Americas.
http://environment.yale.edu/climate

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APPENDIX C

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Thunderbird Glacier, 2009. Joy von Wolffersdorff

ABOUT US

THE INSTITUTE AT THE GOLDEN GATE

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The Institute at the Golden Gate champions sustainable development and environmental stewardship. Our mission is to drive action and change on the critical issues of our time. Leveraging our expertise and networks—especially those in parks and protected areas—the Institute acts as a catalyst and leader, incubating and implementing new ideas, policies, and practices where it can have a clear impact.

GOLDEN GATE NATIONAL PARKS CONSERVANCY

Fort Mason | San Francisco, California | (415) 561-3000 | www.parksconservancy.org

The Golden Gate National Parks Conservancy is the nonprofit membership organization created to preserve the Golden Gate National Parks, enhance the experiences of park visitors, and build a community dedicated to conserving the parks for the future. The Parks Conservancy is an authorized "cooperating association" of the National Park Service and is one of more than 70 such nonprofit organizations working with national parks around the country.

NATIONAL PARK SERVICE

www.nps.gov

The National Park Service is a federal agency within the U.S. Department of the Interior responsible for the preservation and public enjoyment of America's most significant natural, cultural, historic, and scenic treasures. The agency manages the three Golden Gate National Parks (Golden Gate National Recreation Area, Muir Woods National Monument, and Fort Point National Historic Site) and 398 other parks across the country.

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Alison Loomis is an environmental researcher and sustainability consultant providing cross-functional guidance to organizations developing innovative sustainability strategies, programs, and initiatives. A trained environmental scientist and geographer, Alison holds a B.A. from the University of Colorado at Boulder and an MPHIL from Cambridge University, UK. Her work in conservation, eco-literacy, climate science, and sustainable tourism is informed by field work with diverse programs in Alaska, California, Colorado, Hawaii, Madagascar, and Panama.

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CLIMATE CHANGE EDUCATION & PARKS PROGRAM

The Institute at the Golden Gate's Climate Change Education & Parks Program aims to help parks serve as platforms for climate change education. By exploring the ways in which parks are engaging audiences on climate change, the Institute seeks to unify knowledge from different agencies, organizations, and geographies. In doing so, the Institute hopes to foster increased information sharing, collaboration, and collective action among parks, partners, other educators, and communities.

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