

Landscape Conservation

National parks and protected area management in a changing climate: Challenges and opportunities

By Leigh Welling



USGS/DANIEL B. FAGRE

GLOBAL CLIMATE CHANGE PRESENTS far-reaching and complex challenges for protecting wildlife, ecosystems, and other treasured landscapes. How we choose to respond to this challenge could set the tone for management and policy approaches for a long time to come. The broad scale at which climate change drivers act (e.g., warming temperatures and sea-level rise) will confound park-level efforts to mitigate and adapt to impacts unless they are coordinated with the actions of other protected area managers. Regardless of how well thought out and innovative response strategies are, they need to be envisioned and implemented with an unprecedented level of collaboration and cooperation across jurisdictional boundaries if they are to be effective in the long term. We have an

opportunity now to outline a vision and lay a foundation for managing national parks within a broader protected area context.

The Intergovernmental Panel on Climate Change (IPCC) has established beyond all reasonable doubt that Earth's climate is rapidly changing. The most recent report of the IPCC (2007¹) states, "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level."

¹ IPCC. 2007. Climate change 2007: Synthesis report. Contribution of Working Groups I, II, and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [core writing team R. K. Pachauri and A. Reisinger, editors]. Cambridge University Press, Cambridge, UK and New York, New York, USA.

Research ecologist Greg Pederson and field assistant Kali Abel near Boulder Pass in Glacier National Park, Montana, where the U.S. Geological Survey is studying climate change. Tree-ring core samples collected in the park on trips like this reveal that snowpack accumulation over the last five decades is the least of any fifty-year period in about 1,000 years.

National parks and other protected areas are already experiencing impacts from climate change. Warming temperatures are causing accelerated melting of mountain glaciers, reduced snowpack, and changes in timing and amount of streamflow. Melting sea ice along coastlines threatens marine mammals as well as the human communities that depend on them, while thawing permafrost is toppling buildings, roads, and facilities and disrupting the structural basis of large areas of land. We

have documented high-elevation species, such as the pika, moving upslope in mountain parks such as Yosemite in California and Great Basin in Nevada.

While some impacts from climate change are already measurable, the long-range effects of climatic disruption on protected natural and cultural resources, infrastructure, and visitor experience are just beginning to be understood. Of potentially greater concern are the complex ways in which climate change will interact with other stressors to produce cascading impacts that cannot yet be recognized or anticipated. This is especially problematic because impacts will vary greatly among different geographic regions. How will rising sea level and changes in weather and water cycles affect our ability to protect wildlife habitat, cultural and historical features, and buildings and infrastructure? And how will species populations, communities, and ecosystems adapt to these new conditions? Not all species will respond in the same way and at the same rate, and the science of simulating the complexities of these interactions is highly uncertain.

Improving our science programs is important to be sure, but we cannot use lack of information as an excuse not to act. The climate change discussion has shifted from awareness and evidence to accountability and action. It has progressed from science to management. As stewards of our natural and cultural heritage we have an obligation to act. As we try to understand the magnitude, scale, and unpredictability of these changes, the question is, What is the most appropriate response for managers of parks and other protected areas?

Role of national parks and protected areas in climate change response

As we determine our goals for response to climate change—and how they fit in with those of our other land management and science partners—it is useful to consider

The climate change discussion has shifted from awareness and evidence to accountability and action. It has progressed from science to management. As stewards of our natural and cultural heritage we have an obligation to act.

which qualities inherent in our system of national parks might play a special role in light of climate change. While there are many attributes of parks and other protected areas that are important in this regard, four general categories have special relevance:

1. Conserving biodiversity, ecosystem services, and cultural values
2. Supporting ecosystem adaptation
3. Enhancing scientific knowledge
4. Communicating relevance

Conserving biodiversity and other values

National parks and protected areas have been the centerpiece of conservation strategies for decades as hot spots for biodiversity; for protecting such essential ecological, social, and economic services as clean water, carbon storage, genetic reservoirs, disaster mitigation, soil stabilization, recreation, and solace; and for preserving our cultural heritage. However, protected areas that were set up to safeguard particular resources, conditions, or qualities generally were established assuming a constant climate. Under climate change we know that species ranges will shift and many systems will be altered by increased disturbance. Cultural resources face a particular challenge in this regard because they are fixed in place, and most cannot be moved except at great cost and by incurring damage and loss of integrity.

The consequences could be that some protected areas will end up with very different habitat and species assemblages than they were initially designed to protect, and with very different conditions under which resources that cannot adapt still must be protected. So, while the need for resource and ecosystem protection will intensify in a changing climate, accomplishing conservation goals will be increasingly challenging. Future conservation efforts will require reevaluating management goals and expectations under different climate change scenarios to establish realistic targets and ensure the intended conservation results can be delivered.

Promoting ecosystem adaptation

National parks and other protected areas can be among the most effective tools for adapting to climate change, if managed within the context of larger landscapes. Natural areas such as forests or riparian environments often exhibit greater resilience to change than human-altered systems, thereby allowing species to adapt. Several characteristics of natural protected areas can support ecosystem adaptation:

- Availability of climate refugia or habitats that persist as climate changes
- Landscape connectivity that allows plants and animals to move to more suitable locations
- Viable populations with sufficient genetic diversity to adapt

National parks and other protected areas can be among the most effective tools for adapting to climate change, if managed within the context of larger landscapes.

- Areas of natural habitat large enough to be resilient to large-scale disturbances and long-term changes
- Lack of additional threats and stressors.

A management approach that supports these elements for ecosystem adaptation cannot be accomplished without collaboration, and the National Park Service is actively engaged in creating and sustaining science-management partnerships toward this end (see sidebar, next page). Several articles in this special edition of *Park Science* describe how we are beginning to frame this issue. This will require a broad and bold vision that goes beyond the current system of lands to identify and connect key features and processes through additional protection measures that include refugia, corridors, and buffer zones. Networks of these areas within large landscapes can provide the highest level of resilience to climate change by carefully defining and managing connections or corridors between protected areas, removing or preventing barriers such as roads or monoculture forests or crops, and creating stepping-stones for particular species. No single entity or level of government can effectively adapt to climate change alone, but collectively, as a conservation community, we can.

Enhancing scientific knowledge

Conserving biodiversity and ecosystem function while allowing species to adapt to climate change will require readily available, high-quality scientific information. National parks and other protected areas offer unique opportunities for research on climate change because these ecosystems represent some of the most pristine lands, those least modified by humans. Such areas

have immense and increasing value to civilization as laboratories for basic research. In many cases they are the best baselines from which to understand the complex interactions of natural systems.

Protected areas are also important to the conservation sciences as we become more aware that they are not islands but interact substantially with their surrounding environments. The longevity of these invaluable resources will depend heavily on management recommendations and restoration efforts guided in turn by high-quality research and monitoring information. In this way management actions can be flexible and adaptive to changing conditions and trends. A second thematic issue of *Park Science*—to follow in a few months—will delve into the scientific research and observations of climate change in national parks and the kinds of management considerations they are helping to inform.

Communicating relevance

In a future in which more people will be vying for fewer resources, and where climate change is likely to cause a greater strain on people's livelihoods and the availability of resources, expanding the network of protected ecosystems will require a high level of public support. To gain that support, the relevance of protected areas must become more apparent to the human communities that live in or depend on them. As discussed in several articles in this issue, many opportunities exist to engage citizens of all ages in experiencing the wonders of these areas and witnessing the changes that are taking place. Through direct experience in these natural classrooms or a wide range of interpretive and educational media, the public can come to understand how climate

change is affecting the planet's resources and how they can adapt their behavior to promote resource stewardship.

Conclusion

Many issues compete for the attention of park managers, and climate change has often been perceived as a future, rather than an immediate, threat. The variables associated with climate change compound our ability to plan for and respond to it. These include the scientific uncertainties mentioned earlier in this article, as well as questions about how visitor experience will be impacted, what kinds of management actions the public will expect and support, and how to build the capacity to respond given current fiscal constraints. The tasks ahead are clearly daunting, but if there is a silver lining it is that climate change requires us to think with a systems perspective and this necessitates collective action and problem-solving.

Our work with climate change has been described as "building the bicycle while riding it." We are developing ideas and applying them in real time. Though the challenges are difficult, we are making progress through commitment, teamwork, and thoughtful exploration and application of creative solutions. Over the past several years we have made strides to define and structure the critical issues presented by climate change, decide how we should respond, and begin to cultivate interactive and flexible processes for reasoned action. Some of the best and most current work on climate change science, adaptation, planning, and communication is discussed in the articles that follow in this (spring) and the next (summer) issue of *Park Science*. Out of need, landscape conservation is coming together over climate change

and this opportunity will make the National Park Service a more proactive and effective caretaker of our national heritage and a strong partner for linking science with resource conservation at all scales.

About the author

Leigh Welling has been involved in climate change research and education

since the mid-1980s when she began her graduate work in paleoceanography at Oregon State University. She is manager of the Climate Change Response Program, National Park Service, Fort Collins, Colorado, and can be reached at leigh_welling@nps.gov.