

A New Era for Conservation: Review of Climate Change Adaptation Literature

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EXECUTIVE SUMMARY

Natural resource managers and conservationists are coming to grips with the fact that rapid global warming and associated climate changes are already having a considerable impact on the world's ecological systems. More and larger shifts are expected, even in the best-case scenarios for greenhouse gas emissions reductions and future warming. These climate changes are ushering in a fundamental shift in natural resource management and conservation, to help natural systems withstand and adapt to new climate conditions.

This literature review summarizes recent science on climate change adaptation in the context of natural resource management and fish and wildlife conservation. The review was prepared as a background contribution to the *Adaptation 2009* conference being held February 2009 in Washington, DC, under the auspices of the National Council on Science and the Environment (NCSE) and National Wildlife Federation (NWF). The review starts with an overview of the concept of climate change adaptation, including overarching principles and barriers experienced to date in adaptation planning and implementation. We then provide specific examples of adaptation strategies for four broad habitat types: (1) forests; (2) grasslands and shrublands; (3) freshwater systems; and (4) coasts and estuaries.

The term “adaptation” has been used in the climate change community since the early 1990's, but no single definition has been generally adopted among conservation professionals. Most definitions offered in the literature in some way reflect that climate change adaptation involves “initiatives and measures designed to reduce the vulnerability of natural and human systems against actual or expected climate change effects.” The term adaptation, however, is not yet well-understood by the general public in the context of climate change. In part the term has engendered confusion because the same word refers to the process by which organisms naturally adapt over time to survive in a new environment, even though the rapid rate of climate change is expected to outpace the capacity of many organisms to adapt in this classical sense.

U.S. natural resource managers and conservationists are accelerating their plans and actions for climate change adaptation, in large part because the magnitude and urgency of the problem has become increasingly apparent. Nonetheless, a number of factors continue to pose a challenge to adaptation planning and implementation. Among these are the limited availability of place-based information about future climate conditions, difficulty in planning in the face of uncertainty, and lack of credible management and policy options. In addition, inadequate funding and capacity combined with various institutional barriers remain as major challenges to moving forward. Progress is being made, however, as illustrated by the recent release of draft climate change adaptation strategies by the U.S. Department of the Interior and the U.S. Fish and Wildlife Service, as well as efforts underway in a number of states to explicitly address climate change in State Wildlife Action Plans.

Climate change adaptation measures identified in the literature generally address the following five overarching principles:

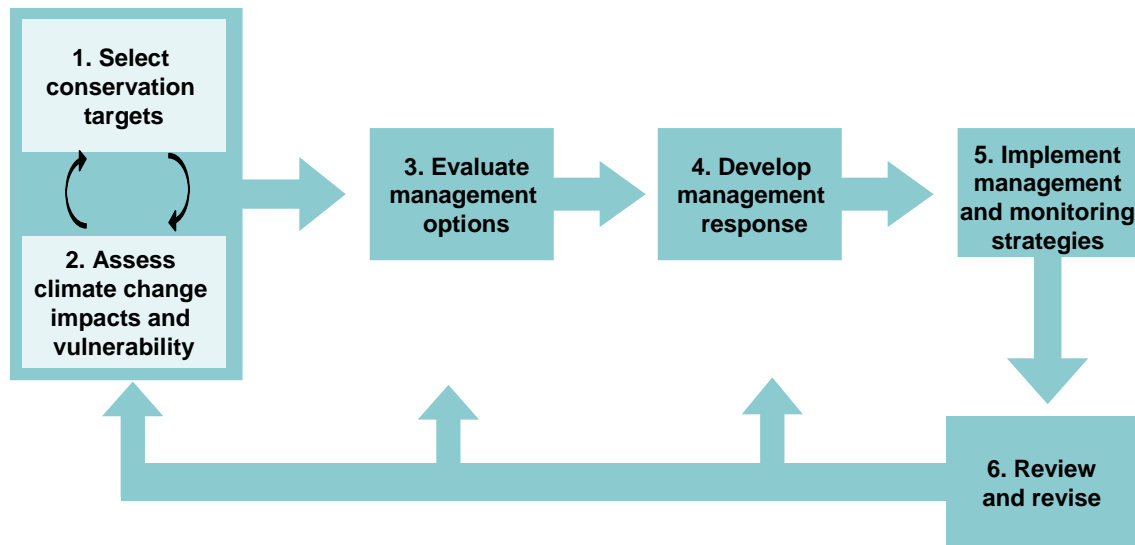
- 1. Reduce other, non-climate stressors.** Addressing other conservation challenges—such as habitat destruction and fragmentation, pollution, and invasive species—will be critical for

improving the ability of natural systems to withstand or adapt to climate change. Reducing these stressors will increase the resilience of the systems, referring to the ability of a system to recover from a disturbance and return to a functional state.

- 2. Manage for ecological function and protection of biological diversity.** Healthy, biologically diverse ecosystems will be better able to withstand some of the impacts of climate change. Ecosystem resilience can be enhanced by protecting biodiversity among different functional groups, among species within function groups, and variations within species and populations, in addition to species richness itself.
- 3. Establish habitat buffer zones and wildlife corridors.** Improving habitat “connectivity” to facilitate species migration and range shifts in response to changing climate condition is an important adaptation strategy.
- 4. Implement “proactive” management and restoration strategies.** Efforts that actively facilitate the ability of species, habitats and ecosystems to accommodate climate change—for example, beach renourishment, enhancing marsh accretion, planting climate-resistant species, and translocating species—may be necessary to protect highly valued species or ecosystems when other options are insufficient.
- 5. Increase monitoring and facilitate management under uncertainty.** Because there will always be some uncertainty about future climate change impacts and the effectiveness of proposed management strategies, careful monitoring of ecosystem health coupled with management approaches that accommodate uncertainty will be required.

Putting these overarching principles into action will require that agencies identify conservation targets, consider their vulnerability, evaluate management options, and then develop and implement management and monitoring strategies. Based on our review of the literature, we offer the following conceptual framework for developing and implementing adaptation strategies (Figure 1). It is important to note that the development and implementation of a successful climate change adaptation strategy for natural resources will need to employ an iterative adaptive management approach, incorporate significant stakeholder engagement, and promote sharing of knowledge among conservation practitioners and other experts.

Figure 1. Framework for developing and implementing adaptations strategies



Climate Change Adaptation across the Landscape: *A survey of federal and state agencies, conservation organizations and academic institutions in the United States*

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EXECUTIVE SUMMARY

Climate change is proceeding at a rate at which there will be unavoidable impacts to natural systems and fish and wildlife habitat. Even with the most rigorous emissions reductions we need to plan climate adaptation measures to help natural systems persist in the face of changing climate conditions. Such climate change adaptation is a new challenge for natural resource managers who are grappling with what it will entail in the context of conservation.

To develop a clear definition and statement of need for adaptation we conducted 68 interviews of federal and state agency staff, non-governmental organization conservationists, and academic scientists who are thinking about or working on climate change adaptation. We asked these experts to define climate change adaptation, to discuss ongoing adaptation planning efforts, to provide us with examples of adaptation techniques and practices, and to list costs associated with these techniques. We also asked participants to discuss the challenges to planning for and implementing adaptation, the metrics associated with adaptation project monitoring, partnership opportunities, and communication strategies.

Most participants defined climate change adaptation to encompass anticipating, preparing for, and responding to the expected impacts of climate change in order to promote ecological resilience in natural systems, and to allow these systems to respond to change. A significant minority of participants expressed concern about the use of the term, noting that it could be easily confused with the scientific definition, and some offered alternatives. These concerns provide further support for the need to adopt a widely accessible definition of climate change adaptation.

Many participants are involved in adaptation planning, revision of existing conservation and management plans and reprioritization of conservation and restoration efforts based on climate change. Few examples of specific adaptation techniques or strategies, costs associated with strategies or metrics to measure the effect of techniques are available at this time. Participants identified several barriers to planning for and implementing adaptation strategies: a lack of resources and funding, the need for place-based adaptation strategies and available case studies to guide planning efforts, and further development of adaptation tools, models and guidance.

Despite these challenges, the survey responses suggest that progress is being made to plan and implement adaptation strategies, develop tools and models for adaptation planning, and to help build capacity in state and federal agencies that do not currently have the resources to take on the challenge alone. In particular, promising partnerships are developing within and among the federal and state agencies, conservation organizations and the academic sector. However, without increased funding to support adaptation efforts these partnerships will not be enough to prevent natural system collapse and biodiversity loss. The survey participants made it clear that the agencies responsible for managing the lands and waters of the United States and the agencies, organizations and institutions that support their work are in desperate need of new funding to fully understand, plan for, and address the challenges ahead.