

Governance of Public Lands, Public Agencies, and Natural Resources

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Introduction

Climate change is already presenting serious challenges to the agencies that manage federal public lands, including the National Park Service (NPS), the Fish and Wildlife Service (FWS), the Bureau of Land Management (BLM), the Bureau of Reclamation (BoR), and the National Forest Service. The impacts of climate change have begun to shift the range of trees and other plants, alter the behavior (and sometimes threaten the survival) of animal species, and transform the manner in which entire ecosystems in national parks, forests, wildlife refuges, and other public lands have long functioned. These changes require new management strategies that may be difficult to design and implement because of internal agency resistance to altering traditional ways of doing business. To differing degrees, the land management agencies have begun to strike out in new directions to face the challenges posed by climate change. The laws from which they derive their management authority may pose obstacles to these efforts, however. To some extent, these laws are ill-suited to addressing modern problems, which may differ from the ones Congress envisioned when it adopted the laws and which also may undermine key assumptions on which those laws are based.

This chapter analyzes the ongoing efforts of the principal federal land management agencies to adapt to the impacts of climate change so that public natural resources continue to be available for preservation, recreational, cultural, and economic uses by present and future generations. The chapter first summarizes the kinds of impacts that climate change is having and can be expected to have on public lands and resources. It discusses potential barriers to effective adaptation and the need for planning to overcome those obstacles. The bulk of the chapter is devoted to analysis of the statutory authority of the land management agencies to protect the resources under their jurisdiction through adaptation to climate change, as well as a description of the programs these agencies have begun to implement to do so. The chapter addresses the role of agencies such as the federal Environmental Protection Agency (EPA), the Council on Environmental Quality (CEQ), and the National Oceanic and Atmospheric Administration (NOAA) in overseeing, assisting, and coordinating adaptation efforts by the land management agencies. It also describes specific adaptation efforts planned or being implemented by five land management agencies—the NPS, the FWS, the BLM,

the BoR, and the National Forest Service—either alone or in conjunction with other agencies and affected stakeholders. The chapter concludes by assessing the adequacy of adaptation initiatives to date and recommends future directions in adaptation planning and implementation.

The Effects of Climate Change on Public Lands and Resources

Climate change has already begun to alter the physical characteristics of federal land systems, and more significant changes are likely in the offing. Chapter 1 of this book describes the wide array of effects that climate change may have on the environment and on those, human and otherwise, who inhabit it. This chapter highlights by way of example the specific threats that climate change poses to lands and resources owned and managed by the federal government.¹ These examples are troubling because of both the critical ecological roles played by federal land ecosystems and the importance of lands such as the national parks to our concept of who we are as a nation. According to one professor of ecology, “What national parks give us is, in effect, a controlled landscape where we can see the natural and climatic processes at work. . . . The day that Glacier National Park announces there are no glaciers left, it will make worldwide headlines.”²

Changes in the Hydrological Cycle

Because of the importance of water to virtually everything that transpires on federal lands, changes in the hydrological cycle will affect federal land ecosystems in myriad ways. Rising temperatures may result in more precipitation in some areas of federal lands and less in others. Droughts are expected to increase as places such as the Colorado Plateau become hotter and drier. The Colorado River Basin has already experienced significant temperature increases since the 1970s, and the Colorado River has suffered through severe drought.³ Some scientists have predicted reductions of Colorado River flows from between 4 to 18 percent by 2050.⁴

Hydrology studies suggest that warming and the loss of snowpack that will accompany it likely will persist over much of the western United States during the 21st century, especially in areas such as lower-altitude mountain ranges in which the baseline climate is close to freezing thresholds.⁵ Indeed, researchers have attributed the reduced snowfalls and earlier snowmelt already experienced across the West in part to climate change.⁶ Early snowmelts due to rising air temperatures are likely to concentrate runoff in the spring, causing flooding and mud slides, and reduce water flows in the summer and fall.⁷ Important sources of water for large western cities, such as Lake Mead near Las Vegas and Lake Powell on the border of Utah and Arizona, have already had water levels drop significantly as a result of reduced snowmelt as less precipitation falls as snow and more falls as rain on federal lands that feed water sources for these cities.⁸ These changes are likely to disrupt animal and plant life and cause “wholesale changes in species composition.”⁹

Rising temperatures have caused melting of permafrost in Alaska, resulting in mudslides in the national parks in Alaska that block roads used by park visitors.¹⁰ Melting glaciers have spawned spring floods that make roads impassable. Flash floods and debris may endanger park employees and visitors.¹¹ Glaciers are shrinking in national parks such as Glacier, North Cascades, Mount Rainier, and Yosemite, and may be gone entirely in parks such as Glacier within a relatively short time. These

changes adversely affect the scenic value of the parks, and also diminish late-season river and streamflows, jeopardizing aquatic and riparian species.¹² The loss of glacial ice in Glacier Bay National Park has caused a rise in land levels as the weight of the ice has diminished, creating a risk of earthquakes as tectonic plates shift.¹³

Rising Sea Levels

Many federal land units are located along the coasts. The National Park System alone includes about 75 units bordering more than 7,000 miles of coastline.¹⁴ Sea levels in these areas may rise significantly¹⁵ for two reasons. First, water increases in volume as it warms. Second, the melting of ice sheets and glaciers in the polar areas will contribute to rising sea levels. These sea-level increases can inundate federal lands in low-lying coastal areas, leading to the possibility that entire federal land units may be lost for the first time ever. These include the Everglades, Biscayne, and Dry Tortugas national parks of Florida and New York's Ellis Island National Monument.¹⁶ Even if coastal national parks or other federal land units are not completely submerged, rising sea levels may adversely affect them by causing intrusion of saltwater into freshwater wetlands, coastal estuaries, and groundwater aquifers.¹⁷ Assateague Island off the coast of Maryland and North Carolina's Cape Hatteras National Seashore already appear to be at the threshold of significant ecosystem change or degradation.¹⁸ Stronger storms in coastal states, which some scientists have linked to climate change,¹⁹ may cause additional seawater intrusion, erosion, and flooding.²⁰

Effects on Plant Life and Ecosystems

Climate change may radically alter the distribution of plant life on federal lands. Higher temperatures will make the current habitats of some plant species unsuitable. Some vegetation may be able to move in response to altered habitats. Changed conditions apparently linked to climate change have already caused migration of plant species to higher elevations.²¹ In the forests of the Sierra Nevada, oak and chaparral have begun to displace ponderosa pines, which have moved upslope.²² But some plant species will be unable to survive as their current habitats warm. The evidence suggests, for example, that the climate of the past few decades has shifted beyond the physiological optimum for spruce growth throughout the Alaskan boreal ecosystem.²³ The ability of Joshua trees to survive in the Mojave Desert is also uncertain.²⁴ Some researchers have concluded that regional warming may be the dominant contributor to the increases in tree mortality rates in the western United States experienced between the 1970s and 2006. Temperature increases can increase tree mortality rates by reducing water supplies and increasing drought stress. According to one team of scientific researchers, "[a] contribution from warming is consistent with both the apparent role of warming in episodes of recent forest dieback in western North America and the positive correlation between short-term fluctuations in background mortality rates and climatic water deficits observed in California and Colorado."²⁵

Higher temperatures are likely to create conditions (such as a reduction in precipitation) that increase the likelihood of large wildfires²⁶ or assist in the spread of silvicultural pests that further weaken or kill trees and other plant life.²⁷ The synergistic effects of these changes may be particularly destructive. Pests such as mountain pine beetles in the forests of the Rocky Mountains have increased the risk of forest fires among stands of dead or dying trees, including whitebark pine trees. The beetles,

able to survive and reproduce more quickly because of warmer temperatures and shorter winters, have killed millions of pine trees in the Yellowstone and Grand Teton national parks alone, and have affected forests on about 25 million acres in the interior West.²⁸ Various evergreen species, including aspen and lodgepole pine stands, also have been devastated by shorter winters, hotter and drier summers, insect infestations, and the spread of tree-killing fungi.²⁹ Bandelier National Park in New Mexico has lost 90 percent of its piñon pine forests as a result of heat, drought, and beetles.³⁰ According to Forest Service scientists, 11 million of the 16 million acres in the western United States that provide suitable habitat for aspen trees are likely to become uninhabitable for the trees by 2060 as a result of climate change as rising temperatures and drought make the trees more susceptible to insects and disease.³¹ Plant communities in areas affected by sea-level rise or saltwater intrusion also could perish.³²

These kinds of changes (and human efforts to respond to them) ripple throughout ecosystems, significantly altering them even if particular ecosystem types are not completely destroyed. The effects of climate change on ecosystems will be location specific. Rising temperatures may increase the productivity of some forests,³³ such as those at high elevations in the Pacific Northwest, while reducing the productivity of those at lower elevations.³⁴ In Glacier National Park, forests could be replaced by grasslands. Alpine tundra, meadows (which depend on heavy snow cover), wildflowers (whose growth is suppressed by high temperatures), and entire cedar-hemlock ecosystems could be devastated.³⁵ Alpine tundra is at particular risk because species unable to survive in their current ranges may have no higher, cooler places to which to move.³⁶

Researchers have concluded that climate change will accelerate wind erosion and dust emissions on the Colorado Plateau. Monitoring of climate and vegetation in national parks such as Arches and Canyonlands, both in Utah, already demonstrates declines in dominant perennial vegetation cover in grasslands, leading to exponential increases in wind erosion.³⁷ These changes could impair water quality by facilitating sedimentation. Responses to pest proliferation may include increased reliance on chemical pesticides, which also can adversely affect water quality and wildlife.³⁸ Further, climate change may preclude the use of traditional ecosystem-management techniques, or increase the risks associated with these techniques. Warmer and drier conditions, for example, may increase the risk of relying on prescribed burns, whose safety depends on the existence of windless, moist conditions, as a forest-management technique.³⁹

Changes in vegetation may provide less food and protective cover for animal species.⁴⁰ The damage that mountain beetles have done to coniferous trees has put stress on grizzly bears that rely on whitebark pine seeds as an important food source. The behavior of animals often changes under stress. For example, grizzly bears deprived of their usual food sources may seek out human food, bringing them into dangerous contact with people.⁴¹

Effects on Wildlife

Climate change will affect many if not most animal species. The distribution of animal species, like that of plant species, will change as warmer temperatures generally force species to move north and to higher altitudes to find hospitable habitat. Mammal species suited to warmer temperatures may displace animals such as wolverines, lynx, and other species that depend on spring snow cover, as well as grizzly bears, bighorn

sheep, mountain goats, and pikas.⁴² The movement or loss of species such as pikas not only serves as a warning (a canary in a coal mine) of the presence and impact of climate change, but it also may have cascading effects on the ecosystems they inhabit.⁴³ Warming water temperatures will make survival harder for fish such as bull trout and salmon and amphibians such as alligators, which are accustomed to cooler water.⁴⁴ Warmer water will increase the susceptibility of fish in the rivers and streams of the Pacific Northwest and elsewhere to pathogens, such as the viruses that have affected Pacific salmon, especially if those fish are already under stress for other reasons, such as polluted water or the difficulty of navigating dams.⁴⁵ Higher temperatures also may facilitate the spread of parasites that attack wildlife and the spread of invasive species of both plants and animals that adapt better than, and therefore crowd out or prey on, indigenous species.⁴⁶ In Arizona's Saguaro National Park, for example, African buffelgrass is threatening to crowd out saguaro cactus and transform desert ecosystems into savannas of grass and mesquite.⁴⁷ Seasonal changes are already adversely affecting wildlife on federal lands. In recent years, a shortening of the "green-up" period, during which nutritious vegetation is readily available for elk and deer, and a lengthening of the summer, when food sources are scarcer, have contributed to declines in reproduction among ungulates in Yellowstone National Park.⁴⁸

Some species may be able to adapt to these kinds of environmental changes, but others, as a result of physical barriers to migration or the absence of suitable alternative habitat, may not.⁴⁹ The FWS listed the wolverine as a candidate species in 2010, finding that the North American wolverine occurring in the contiguous United States is a distinct population segment and that its addition to the lists of endangered or threatened wildlife was warranted.⁵⁰ Because the animals are dependent on late spring snowpack, climate change could accelerate their decline in Washington, Idaho, Montana, and Wyoming, the only places wolverines have well-established habitats in the contiguous United States today.⁵¹ According to researchers, wolverines may not be able to relocate to Canada because dispersal corridors between the northern Rockies in the United States and Canada may be limited.⁵² Species movements also may lead to hybridization (such as interbreeding between grizzly and polar bears), which can reduce genomic and species diversity, drive the rarer of the interbreeding species toward extinction, and make hybrids less fit than their ancestors by eliminating desirable physical attributes or behaviors (a phenomenon called outbreeding depression).⁵³ Acidification of oceans that absorb increasing levels of carbon dioxide (CO₂) from the atmosphere poses threats to corals and other marine life.⁵⁴ Other species at risk on federal lands include Canada lynx due to loss of snowpack, Florida panthers due to changing conditions in places such as the Everglades, mountain sheep due to the loss of open alpine habitat, desert bighorn sheep due to water shortages, and migratory birds due to inundation of wetlands caused by sea-level rise or storm surges.⁵⁵

Recreational and Cultural Effects

Other kinds of changes to federal land use will flow from the physical effects described above. Altered ecosystems may lessen the value of federal lands for recreational opportunities, decreasing tourism revenue for affected areas.⁵⁶ Fishing may become less productive and enjoyable in waters where fish have declined due to rising water temperatures. Recreational activities such as snowmobiling, travel by snowcoaches, cross-country skiing, and downhill skiing, which is permitted in some national forests,

will be available on federal lands for shorter periods of the year.⁵⁷ Federal lands in the Southwest may become so hot that visitorship will decline, while cooler, mountain locales may experience overcrowding.⁵⁸ Higher temperatures are likely to exacerbate ozone pollution on federal lands already experiencing air pollution problems, such as the Great Smoky Mountains National Park in Tennessee and North Carolina, making the parks less-healthy destinations.⁵⁹ Lower river and stream flows would adversely affect boating, rafting, and kayaking opportunities.⁶⁰

Cultural resources on federal lands located along the coasts, including the Statue of Liberty, the Jamestown National Historic Site in Virginia, and Olympic National Park in Washington (where petroglyphs are carved into rocks on the shore) could be destroyed by sea-level intrusion or storm surges. Flooding and erosion could damage archaeological artifacts at other locations.⁶¹ Thawing of permafrost has contributed to coastal erosion that has disrupted the lifestyle of Inupiat villagers and threatened archaeological resources in Alaska's Bering Land Bridge National Preserve and Cape Krusenstern National Monument.⁶²

The Need for Federal Adaptation Planning

As political leaders around the globe struggled, often without much success, to decide whether and how to mitigate climate change to minimize or avoid its adverse effects, scientists and policymakers alike began to emphasize the need for society to take adaptive measures for the adverse effects of climate change that would be unavoidable even if effective mitigation strategies were taken. The Intergovernmental Panel on Climate Change (IPCC) found in its Fourth Assessment Report in 2007 that “[e]ven the most stringent mitigation efforts cannot avoid further impacts of climate change in the next few decades, which makes adaptation essential, particularly in addressing near-term impacts.”⁶³ The National Research Council forcefully made the same point in 2011, stating that “[c]limate change is already happening and additional changes can be expected for all plausible scenarios of future greenhouse gas (GHG) emissions. Prudent risk management demands advanced planning to deal with possible adverse outcomes—known and unknown—by increasing the nation’s resilience to both gradual changes and the possibility of abrupt disaster events.”⁶⁴

The IPCC also emphasized that the longer effective mitigation measures are delayed, the more difficult the adaptation challenges will become. It stated that “[a]lthough many early impacts of climate change can be effectively addressed through adaptation, the options for successful adaptation diminish and the associated costs increase with increasing climate change.”⁶⁵ As a starting point, the IPCC recommended building adaptation measures into land use planning and infrastructure design to reduce vulnerability in existing disaster risk-reduction strategies.⁶⁶

The Adaptation Policy Vacuum

Following the IPCC’s lead, various groups called for adaptation research and planning within the United States. In response to suggestions by Obama administration Science and Technology Advisor John Holdren, prominent users and providers of adaptation information prepared a report that noted the absence of any overall national climate adaptation strategy, a lack of coordination among federal agencies and policymakers at other levels of government and the private sector, and the existence of policies and subsidies that discouraged effective adaptive actions.⁶⁷ The federal government’s failure to

set priorities for adaptation and allocate clear roles to different federal agencies created significant obstacles to effective planning and implementation of adaptation measures.⁶⁸

Other observers reached similar conclusions. The Pew Center on Global Climate Change, composed of business leaders, policymakers, scientists, and other climate change experts, concluded that existing laws, programs, policies, and management approaches that were adopted on the assumption that the climate is not changing have created barriers to effective adaptation and have increased vulnerability to climate change.⁶⁹ The Pew Center called for vigorous federal leadership in creating a framework for effective responses to climate change. It cited as one of the primary justifications for a strong federal role the fact that the federal government owns or manages about 30 percent of the nation's land and manages much of its infrastructure, including roads, bridges, and flood-control and navigation facilities. Many of these resources and facilities are at risk from climate change.⁷⁰ The Pew Center called for a clear commitment by national leaders to creating an adaptation program, executive branch action to execute and fund its activities, and federal coordination of efforts by all levels of government.⁷¹ Academics joined the chorus in highlighting the need for federal agencies, including the land management agencies, to incorporate assessment of adaptation risks and formulation of strategies into their planning and project implementation efforts.⁷²

The Initiation of a Coordinated Federal Adaptation Framework

The White House responded to calls for federal leadership on climate change adaptation in 2009 when it created a new Interagency Climate Change Adaptation Task Force to be co-chaired by the CEQ, the Office of Science and Technology Policy, and NOAA. Among the goals of the Task Force, which began meeting in spring 2009, were recommending a national adaptation strategy using best practices derived from the best available science, integrating climate change resilience and adaptive capacity into federal government operations, and broadening the understanding of vulnerability to climate impacts.⁷³ Composed of more than 20 federal agencies and executive branch offices, the Task Force created workgroups to respond to the impacts of climate change on specific sectors and agency responsibilities, including science inputs to adaptation and water resource management. President Obama later issued an executive order requiring federal agencies to “participate actively” in the Task Force’s development of a national strategy for adaptation, and to develop policies and practices compatible with that strategy. The president directed the chair of the CEQ, following consultation with federal agencies and the Task Force, to submit to him a progress report on agency actions in support of the national adaptation strategy and recommendations for further adaptive measures.⁷⁴

The Task Force issued its report to the president in October 2010. Emphasizing the urgency of understanding and preparing for climate change, the Task Force report noted the federal government’s important stake in adaptation, stemming from, among other things, the effects of climate change on federal services, operations, programs, and assets.⁷⁵ It recognized the need for federal leadership to address climate impacts on federal infrastructure interests and on natural, cultural, and historic properties that it has statutory duties to protect.⁷⁶ Although all of the Task Force’s guiding principles for adaptation are relevant to federal land management, one has particular resonance in this context: crafting adaptation approaches that seek “to increase

ecosystem resilience and protect critical ecosystem services on which humans depend to reduce vulnerability of human and natural systems to climate change.”⁷⁷ The report also identified as a policy goal improved water resource management by increasing water-use efficiency to reduce climate change impacts and development of a national action plan to strengthen adaptation for freshwater resources.⁷⁸ It recognized the need for a national approach to problems that cut across sectors and agencies, including strengthening coastal and ocean resilience and protecting fish, wildlife, plant resources, and their habitats.⁷⁹ The Task Force identified as examples of important adaptation initiatives by federal agencies the Interior Department’s eight regional Climate Centers and its 21 Landscape Conservation Cooperatives to inform science-based adaptation and mitigation strategies and adaptive management techniques in partnership with resource managers.⁸⁰ The Task Force also called for the implementation of adaptation planning within federal agencies to consider and address climate change impacts on missions, operations, and programs.⁸¹

Several months later, the CEQ, based on recommendations from one of the Task Force’s working groups, issued instructions for implementing adaptation planning in conformity with President Obama’s executive order.⁸² The instructions require each agency to issue an adaptation policy statement that describes its vision for successful adaptation planning, identifies initial adaptation goals, considers how to coordinate programs and operations on adaptation within the agency and with other agencies on matters of common interest, and identifies programs and resources to support the adaptation planning process. Agencies also had to inform the CEQ on how climate change will affect agency missions, programs, and operations; assess their vulnerability to climate change and identify priority adaptation actions to be implemented in fiscal year 2010; and submit to the CEQ adaptation plans for implementation for fiscal year 2013.⁸³

Congress, too, took steps to increase the development of adaptation policy for natural resource management. In the Fiscal Year 2010 Appropriations Act, Congress ordered the development of a National Fish, Wildlife, and Plants Climate Adaptation Strategy (NFWPCAS), spearheaded by the FWS.⁸⁴ The goal was the development of a government-wide strategy to provide a unified, science-based approach to reducing the impact of climate change on species, habitats, and ecological processes.⁸⁵

Finally, individual land management agencies began to coordinate adaptation planning. The Department of the Interior, in particular, has sought to mandate and coordinate management actions directed toward climate change by its bureaus and agencies. In 2009, the secretary of the interior issued Order No. 3289, which established a department-wide approach for increasing science-based understanding of climate change and coordinating an effective response to the resources it manages.⁸⁶ The order established a Climate Change Response Center within the Office of the Secretary to coordinate departmental climate change policies and programs and to coordinate climate change programs with other federal agencies such as EPA, the CEQ, and the Department of Agriculture.⁸⁷ The order requires each bureau and office within the department to analyze and consider potential climate change impacts in planning, priority setting for scientific research, and determining potential uses of resources within its jurisdiction.⁸⁸ It directs that management actions in response to climate change be coordinated on a landscape level, recognizing that wildlife migration, insect infestations, and wildlife threats linked to climate change will extend beyond the borders of particular national parks, national wildlife refuges, and other federal land tracts. The

order encourages the development of Landscape Conservation Cooperatives to work with the Regional Climate Change Response Centers.⁸⁹

The heightened emphasis on adaptation of the federal government as a land and resource manager, and of the Interior Department in particular, is reflected in that department's Strategic Plan for Fiscal Years 2011–2016. The plan establishes as a priority developing the goal of “the means by which better coordinated science-based decisions can be made for managing our natural resources using climate science and multi-bureau conservation cooperatives across the country. These centers will develop and deploy adaptation strategies to regional climate change impacts to land, water, fish and wildlife, cultural heritage, and tribal resources.”⁹⁰ The plan identified as a key strategy for providing a scientific foundation for decision making the departmental support of research and monitoring initiatives on the effects of GHGs on ecosystems, and the identification of lands, resources, and communities most vulnerable to climate change.⁹¹

These initiatives laid the groundwork for adaptation planning and policy development by the individual federal land management agencies. By late 2010, the Pew Center, which not too long before had criticized the lack of a coherent federal adaptation program, was applauding the efforts of federal agencies to “‘mainstream’ consideration of climate change adaptation across their programs and policies.”⁹² The next section addresses the efforts made to date by five principal land management agencies to prepare for and respond to climate change.

Adaptation Initiatives and Federal Lands

Although the Climate Change Adaptation Task Force has taken the lead in coordinating federal climate change adaptation research and policy, the specifics of adaptation strategies to deal with particular resource management problems stemming from climate change are left to land management agencies within the Interior and Agriculture departments. This section identifies the statutory authority for the individual land management agencies to factor climate change adaptation into their decision-making processes and describes the programs and approaches created by these agencies to address adaptation. The discussion begins with two laws that authorize or require all federal agencies to engage in efforts to adapt to climate change. It then addresses how individual agency organic statutes affect efforts to adapt to climate change and how the land management agencies have used their authority under those laws to protect the lands and resources under their charge from the effects of climate change.

Cross-Cutting Statutory Authority

Although the authority of the land management agencies to take steps to adapt to climate change depends largely on the provisions of their organic statutes, two laws—the National Environmental Policy Act (NEPA) and the Endangered Species Act (ESA)—apply to all agencies and may require that they consider the impacts of climate change on agency programs and projects, including the ways in which agencies can design and implement those projects to make federal lands and resources more resilient to the anticipated stresses associated with climate change.

The National Environmental Policy Act

NEPA requires federal agencies to consider the potential environmental consequences of proposed actions and to disclose the resulting analysis to the public. The statute's

core is section 102(2)(C), which requires agencies to accompany any proposal for major federal action significantly affecting the quality of the human environment with an environmental impact statement that addresses, among other things, the anticipated environmental impact of the proposed action and alternatives to it.⁹³

Few cases have addressed alleged failures by the land management agencies to consider either how proposed actions would affect efforts to adapt to climate change or how the need to adapt would affect agency proposals. In one case, the Ninth Circuit held that the FWS did not violate NEPA by issuing a finding of no significant impact in connection with its issuance of regulations under the ESA authorizing non-lethal takes of polar bears from oil and gas activities in the Beaufort Sea. The court found that the FWS's environmental assessment acknowledged the long-term effects of climate change on polar bears, including increased use of coastal environments, increased bear/human encounters, changes in polar bear body condition, decline in cub survival, and increased potential for stress and mortality. Although the evidence indicated that global warming poses a generalized threat to polar bear populations, it did not demonstrate that nonlethal takes arising from oil and gas activities during a particular period of time were likely to have significant impacts.⁹⁴ In another case, a district court found that the Forest Service, the BLM, and the FWS adequately considered the effects of climate change on species stability and distribution in a supplemental environmental impact statement on implementation of the Northwest Forest Plan for managing federally owned forests in the Pacific Northwest.⁹⁵

The agencies in these cases successfully defended against allegations of NEPA noncompliance, but, as discussed at length in chapter 15, "Impact Review, Disclosure, and Planning," the application of NEPA in the context of climate change adaptation is likely to be a recurring issue. NEPA's mandate to consider alternatives would appear to require consideration of alternatives consistent with the purpose and need for a particular project that would lessen adverse environmental consequences by facilitating the ability of affected lands and resources to adapt to anticipated climate change effects.

In addition, agencies often rely on mitigation measures to avoid the need to prepare impact statements. Although the U.S. Supreme Court has made it clear that NEPA does not require that agencies actually implement any such measures,⁹⁶ an agency that describes adaptation measures that will mitigate the impacts of climate change on resources associated with a proposal must do so with sufficient care to ensure that it has taken a hard look at the impact of the project on the adaptive capacity of those resources.⁹⁷ In 2011, the CEQ issued guidance on the use of mitigation and monitoring to comply with NEPA requirements.⁹⁸ The guidance, which applies to the preparation of both environmental assessments and impact statements, provides that agencies may use commitments to perform (or ensure the performance of) mitigation measures to support a finding of no significant impact. Agencies should not commit to mitigation measures, however, if there are insufficient legal authorities or if sufficient resources to implement the measures are unlikely to be available.⁹⁹

The Endangered Species Act

The impacts of climate change on plant and animal species found on federal lands will implicate the provisions of the ESA. Climate change will adversely affect some species in ways that justify listing them as endangered or threatened species.¹⁰⁰ Listing a species is a form of adaptation in that it invokes a series of constraints on both agency

and private behavior with potential effects on the species to promote its conservation and recovery. The ESA will alter the manner in which the land management agencies must structure their policies and programs to avoid jeopardizing listed species or their critical habitats,¹⁰¹ and the effects of climate change may increase the risks that agency actions, or private actions on federal lands authorized by the agencies, will amount to a prohibited taking.¹⁰² Again, to the extent that these constraints enhance the species' resilience to threats such as those posed by climate change, the ESA will require agencies to engage in adaptation. The land management agencies are likely to build adaptation measures explicitly into the recovery plans they adopt for the conservation and survival of listed species.¹⁰³ Chapter 10 fully explores climate change adaptation and its relationship to endangered species and the ecosystems they inhabit. This section briefly discusses several illustrative cases in which that relationship has had particular resonance for the federal land management agencies.

The impact of climate change has factored into several cases involving challenges to listing and critical habitat designation decisions under the ESA. In one case, an environmental group challenged the designation by the FWS of critical habitat for the Canada lynx, arguing that the FWS failed to consider the need for unoccupied habitat to account for future habitat loss due to climate change. The court upheld as reasonable the FWS's conclusion that the best available science did not allow for climate predictions at the appropriate scale to enable it to designate unoccupied habitat. The court characterized the plaintiffs' claim as "little more than an attempt to force the Service to designate backup habitat in the hope it will someday become useful to the lynx."¹⁰⁴ Had the plaintiff succeeded, the constraints on development arising from critical habitat designation might have facilitated the lynx's capacity to adapt to climate change. Another district court upheld the FWS's decision to list polar bears as a threatened, but not an endangered, species.¹⁰⁵ The court concluded that the agency adequately explained its listing decision, and in particular its decision to assess the bear's prospects from the perspective of a 45-year foreseeable future, on the basis of factors that included the life history and population dynamics of polar bears, documented changes to date in sea ice resulting from climate change, and the direction of projected future rates of change in sea ice.¹⁰⁶ The court also upheld the FWS's refusal to designate any distinct population segments for the bear, deferring to the agency's determination that, despite behavioral differences among population segments, "polar bears are universally similar in one crucial respect—namely, their dependence on sea ice habitat and negative response to loss of that habitat."¹⁰⁷ The Ninth Circuit enjoined the FWS's decision to delist grizzly bears as threatened in part because it did not adequately consider evidence showing that climate change was adversely affecting whitebark pine nuts, an important source of food for grizzlies in the Greater Yellowstone Area.¹⁰⁸ The delisting had the effect of impairing the bear's ability to adapt to changes in its habitat linked to climate change.

Litigants also have based challenges to agency compliance with the ESA's no-jeopardy provision on failure to adequately account for the impact of climate change on listed species or their habitats, with mixed results. In one case, a court held that the Forest Service was not required to reinitiate consultation with the FWS on its decision to authorize sheep grazing in a national forest because there was no new information that revealed that grazing might affect listed species or their critical habitat in a manner or to an extent not previously considered.¹⁰⁹ In an earlier case, another court deemed flawed a biological opinion prepared by the FWS finding that the operation

of federal and state water diversion projects in the California Bay Delta area would not jeopardize delta smelt or adversely modify their critical habitat. The court held that the opinion did not adequately account for evidence showing that climate change would harm smelt adversely affected by the projects' water diversions. The court characterized the "absence of any discussion in the BiOp of how to deal with any climate change" as a failure to analyze an important aspect of the problem.¹¹⁰ In essence, the agency neglected to consider how the diversions made it harder for the smelt to adapt to climate change.

Agency-Specific Authority and Programs

Congress has authorized agencies with environmental expertise, such as EPA, the CEQ, and NOAA, to develop and disseminate scientific information to assist other agencies in their efforts to prepare for and respond to climate change. The following discussion summarizes both the role of EPA, the CEQ, and NOAA in bolstering the federal government's capacity to protect its lands and resources from climate change and the specific policies and programs crafted by the land management agencies to facilitate such adaptation. The discussion focuses mostly on general planning efforts rather than project-level decisions for two reasons, although some project-level initiatives are covered. First, ecosystem and landscape level planning will govern adaptation efforts across a wide range of agency projects. Second, sufficiently few of the agencies' planning measures for climate change adaptation have been implemented (or at least reported on) to date at the project level to allow for useful generalizations.¹¹¹ The section below titled "The Future of Adaptation and Natural Resource Management" addresses some of the obstacles to project-level implementation of broad climate change adaptation planning initiatives.

The Environmental Protection Agency

EPA has regulatory authority over sources that emit GHGs, such as motor vehicles.¹¹² Its role in planning for and facilitating adaptation is more indirect. The Global Climate Protection Act of 1987 directed EPA to develop a coordinated national policy on global climate change, taking into account research provided by the National Academy of Sciences, NOAA, the National Aeronautic and Space Administration, the Department of Energy, and other organizations engaged in scientific research on climate change.¹¹³ EPA participates in the U.S. Climate Change Science Program (CCSP), which coordinates and integrates scientific research on climate change across the federal government.¹¹⁴ In the endangerment finding that triggered EPA's authority to regulate GHGs under the Clean Air Act, EPA stated that planned adaptation is "an important near-term risk-minimizing strategy."¹¹⁵ EPA also has developed program strategies, in cooperation with the Agriculture and Interior departments, to protect water quality, wetlands, and estuaries that may be useful in making federal lands more resilient to climate change.¹¹⁶

In June 2011, EPA Administrator Lisa Jackson issued a policy statement on adaptation in which she committed the agency to identifying and responding to the challenges that a changing climate poses to human health and the environment.¹¹⁷ The statement indicates that, given the unprecedented changes in climate verified by scientists, EPA must adapt in order to continue fulfilling its mission of protecting human health and the environment. In particular, adaptation will require that EPA

“anticipate and plan for future changes in climate and incorporate considerations of climate change into many of its programs, policies, rules and operations to ensure they are effective under future climatic conditions.”¹¹⁸ Among other things, the policy statement committed EPA to publishing a climate change adaptation plan by June 2012, fully implementing President Obama’s executive order on adaptation planning and the CEQ’s implementing instructions; identifying priority actions needed to carry out the actions called for in the policy statement and EPA adaptation plan and reflect these priorities in the agency’s annual budget submissions; developing strategic and performance measures for evaluating progress toward mainstreaming climate adaptation into EPA’s programs and operations; incorporating consideration of environmental justice issues into the design and evaluation of adaptation strategies; and coordinating with other agencies and interagency efforts, including the Interagency Climate Change Adaptation Task Force, on adaptation issues that cut across agency jurisdictions.¹¹⁹

The Council on Environmental Quality

The role of the CEQ in overseeing assessment of climate change risks under NEPA is discussed in chapter 15, “Impact Review, Disclosure, and Planning.” This section focuses on the CEQ’s actions concerning adaptation that are most directly relevant to management of federal lands and resources. As indicated above, the CEQ in 2011 issued instructions to agencies on how to incorporate climate change adaptation considerations into their planning processes.

In addition, the CEQ issued draft guidance in 2010 on the manner in which agencies should consider the impacts of climate change in fulfilling their NEPA responsibilities.¹²⁰ The draft guidance indicated that climate change may affect federal agencies’ NEPA analyses in two ways. First, proposed agency actions may affect climate change in different ways if, for example, they generate different levels of GHG emissions. Second, climate change may affect the viability or success of agency actions and their alternatives differently.¹²¹ The CEQ indicated, however, without explaining why, that it did not propose to make the guidance applicable to federal land and resource management actions. Instead, it sought public comment on the appropriate means of assessing the GHG emissions and sequestration that are affected by federal land and resource management decisions. In particular, the CEQ sought comments on, among other things, (1) how NEPA documents regarding energy and resource management programs should assess climate change impacts; (2) what should be included in specific NEPA guidance for projects applicable to the federal land management agencies and for planning by these agencies; (3) how uncertainties associated with climate change projections and species and ecosystem responses should be addressed in protocols for assessing land management practices; (4) how NEPA analyses should be tailored to address the beneficial effects on GHG emissions of federal land and resource management actions; and (5) whether the CEQ should provide guidance on determining whether GHG emissions from proposed actions on federal lands are “significant” for NEPA purposes.¹²² The agency provided no insight into why it considered the application of NEPA to the federal land management agencies to present unique problems or how it might ultimately craft separate guidance that might affect efforts by those agencies to adapt to climate change.

As this book was being printed, CEQ has not issued its final guidance. The agency has not disclosed the reasons for the delay.

The National Oceanic and Atmospheric Administration

NOAA plays a significant role in developing and disseminating information about anthropogenic climate change and how society should respond to it. Its role is derived from Congress's creation of a National Climate Program to "assist the Nation and the world to understand *and respond to* natural and man-induced climate processes and their implications."¹²³ More than 120 NOAA scientists contributed to the IPCC's 2007 climate change assessments and shared in the Nobel Prize awarded for that effort. NOAA scientists have worked on models of the effects of climate change on biological, geological, and chemical cycles as well as on ecosystems. NOAA is the lead agency in the U.S. Climate Change Science Program in which EPA also participates, focusing on uncertainties of the global carbon cycle, the operation of carbon reservoirs like the oceans, and the manner in which carbon cycling might change.¹²⁴ These efforts will produce information that should be useful to land management agencies designing policies to adapt to climate change. NOAA proposed in its fiscal year 2012 budget to reorganize its climate-related functions by establishing a Climate Service line office to allow the agency to provide a reliable and authoritative source for climate data and decision-support services and to more effectively coordinate with other agencies in preparing for and responding to climate change.¹²⁵ An appropriations bill adopted in April 2011 prohibited through the end of fiscal year 2011 the use of any appropriated funds to implement, establish, or create a NOAA Climate Service.¹²⁶ The activities that the proposed Climate Service would have handled will be funded in fiscal year 2013 through NOAA's Office of Oceanic and Atmospheric Research.

In 2010, NOAA issued a strategic plan aimed at facilitating informed anticipation of and response to climate and its impacts, including preparation for and response to weather-related events, and the preservation of resilient ecosystems that can absorb impacts without significant changes in condition or function. The information provided by NOAA is designed to help people make informed decisions that reduce vulnerability to environmental hazards and stresses, while increasing society's ability to cope with them. NOAA shares its information with a host of federal agencies, including the Agriculture and Interior departments. Its collaborative efforts with these agencies focus on the impacts of climate change on the nation's ocean and coastal ecosystems. NOAA intends to provide the land management agencies, among others, with up-to-date descriptions of the state of the climate; regional information derived from global climate models; predictions of likely climate impacts; and the delivery of short- and long-term forecasts and early warnings. This assistance is designed to help agency policymakers such as water resource managers prepare for and adapt and respond to conditions that include drought and flooding, so that they can more effectively manage the resources over which they have jurisdiction. In addition, the strategic plan describes NOAA's efforts to collect ecosystem data and explore innovative technologies such as genomics, ecosystem models, and alternative sampling techniques. This research should improve assessments of the status of living marine resources and ecosystems, and enhance coordination and cooperation among scientists, policymakers within the land management agencies and elsewhere, and stakeholders to ensure that this information is effectively incorporated into management practices. NOAA will apply habitat science to develop policy measures to enhance capacity to support conservation actions by federal agencies to protect marine, coastal, and riverine habitats

that support endangered and threatened species, marine mammals, and other species of concern through conservation actions.¹²⁷

The National Park Service

The NPS is governed by a preservation mandate.¹²⁸ It is responsible for managing the national parks and monuments, whose purpose is to “conserve the scenery and natural and historic objects and the wild life therein and to provide for [their] enjoyment . . . in such manner . . . as will leave them unimpaired for the enjoyment of future generations.”¹²⁹ The National Park Service Organic Act authorizes the secretary of the interior to issue regulations for the proper use and management of the national parks and monuments,¹³⁰ and the agency will need to use that authority to prepare the parks and monuments for climate-related changes. Absent adaptive actions, climate change will threaten the agency’s ability to conserve the resources it is charged with protecting and impair the ability of present and future generations to enjoy them.

According to the NPS, “[t]hrough natural evolution and change are an integral part of our national parks, climate change will fundamentally transform the natural and cultural landscapes of national parks in the not-too-distant future.”¹³¹ The agency has identified eight “drivers” of climate change: temperature change, sea-level rise, evaporation and precipitation, snowfall and snowcover, sea ice and glaciers, streamflow, growing seasons, and extreme events and storms that are likely to trigger significant changes in park ecosystems.¹³² It has established a Climate Change Response Steering Committee to provide guidance within the agency on how to address the challenges presented by these changes. The NPS has committed to incorporating climate change considerations into planning documents (including NEPA evaluations), general management plans for individual parks, and resource stewardship strategies.¹³³

In 2010, the NPS issued its first Climate Change Response Strategy, to be administered by a coordinating group composed of the associate directors for Natural Resource Stewardship and Science, Cultural Resources, Interpretation and Education, and Park Planning, Facilities and Lands.¹³⁴ The strategy addresses both mitigation and adaptation. Recognizing the need to use a flexible approach for incorporating new science into management decisions, the agency has identified important steps to effective national and cultural resource management in the face of the uncertainties created by climate change. These include dedication of funds to climate change programs and personnel, adding flexibility to existing funding sources, building networks with partners and information providers, and increasing reliance on new decision-making practices such as scenario planning and adaptive management.¹³⁵ Among the agency’s climate change science goals are developing an integrated data system that allows efficient discovery and sharing of climate change information with other agencies and the public, and ecological models that resource managers can use to plan for and adapt to climate change.¹³⁶

The strategy identifies specific adaptation goals and actions. The NPS will incorporate climate change considerations and responses in all levels of planning. It will select and implement adaptation actions to increase the resilience of natural systems, using vulnerability assessments and scenario planning to inform the development of adaptation plans at appropriate scales. The NPS plans to prioritize resources threatened by climate change, taking into account legal mandates, stakeholder values, and

other nonscientific attributes. It has promised to collaborate in the development of cross-jurisdictional conservation plans to protect and restore connectivity and other landscape-scale components of resilience. The strategy indicates that the agency will establish management guidelines for taking adaptive measures based on the U.S. Climate Change Science Program Synthesis and Assessment Product. The NPS will use the best available science to develop a process for prioritizing cultural resource adaptation projects to protect archaeological sites, historic structures, and other cultural resources, and will seek to strengthen partnerships with traditionally associated peoples. Finally, the agency will direct adaptation efforts at protecting facilities and infrastructure. The options for doing so include design of movable or resilient structures, nontraditional operating schedules, nonstructural alternatives to accommodate visitor and employee use, and colocation of facilities with gateway communities and other agencies in more resilient locations.¹³⁷

As the NPS strategy recognizes, most resource protection laws applicable to the agency were not designed with climate change in mind. The agency is committed to establishing service-wide consistency in interpreting NPS missions and mandates within the context of climate change to ensure that response actions comply with the law. This task will not be easy. It will require confronting questions such as how the NPS should reconcile its mandate to protect and maintain “natural” systems with the human-caused effects of climate change. In other words, if the NPS intervenes to abate climate-related effects that threaten park resources, will it improperly disrupt the very natural systems it was created to protect? The agency also needs to consider how to respond to the loss of resources specifically listed in the enabling legislation for a particular unit. Should the NPS change the goals of managing California’s Joshua Tree National Park, for example, if it no longer contains Joshua trees? The strategy also inquires as to how the NPS should comply with the Organic Act’s “no impairment” mandate when climate change threatens the geographic range or even the existence of resources. How should the agency respond, for example, if Florida’s Everglades winds up entirely under water? Finally, the agency will need to consider whether and when active manipulation such as assisted migration is an appropriate means of saving a species.¹³⁸ These questions vividly convey the precedent-shattering nature of the legal, policy, and management challenges facing not only the NPS but all federal land management agencies in the era of climate change.

The Fish and Wildlife Service

The FWS plays more than one role in protecting the nation’s natural resources. It is responsible, along with the National Marine Fisheries Service, for listing species as endangered or threatened and designating critical habitat for them under the ESA.¹³⁹ It is also responsible for consulting under the ESA with other agencies proposing to take actions that have the potential to jeopardize listed species or adversely affect their critical habitat so that it may, among other things, recommend less-damaging alternatives.¹⁴⁰ And the FWS develops recovery plans for listed species.¹⁴¹ The application of the ESA to species affected by climate change is discussed above under the heading “Cross-Cutting Statutory Authority” and also in chapter 10.

In addition, the FWS manages the nation’s wildlife refuges. The National Wildlife Refuge System Administration Act, as amended in 1997,¹⁴² charges the FWS with the task of administering a national network of lands and waters for the conservation, management, and restoration of fish, wildlife, and plant resources and their habitats for the benefit of present and future generations.¹⁴³ The statute requires that the

FWS maintain “the biological integrity, diversity, and environmental health” of the National Wildlife Refuge System (NWRS or the System), assist in the maintenance of adequate water quality and quantity to fulfill the missions of the System, ensure that opportunities are provided for compatible wildlife-dependent recreational uses of the System, collaborate with other federal agencies and state fish and wildlife agencies in refuge management, and monitor the status and trends of fish, wildlife, and plants in each refuge.¹⁴⁴ The Act directs the FWS to adopt a comprehensive conservation plan for each refuge and manage the refuge consistent with the plan.¹⁴⁵ The NWRS is sometimes described as a dominant-use system in that refuges must be managed primarily to protect fish and wildlife, but recreational uses are encouraged to the extent they are compatible with that primary objective.¹⁴⁶

The FWS began relatively early to build a foundation for addressing the impacts of climate change on fish and wildlife. Its initial actions included monitoring sea-level rise and exploring ways to protect coastal refuges; making sure that fish and wildlife resources are considered in water allocation decisions, especially in the arid Southwest; and developing partnerships with others responsible for or interested in protecting fish and wildlife resources from the effects of climate change.¹⁴⁷

The FWS took a more systematic approach in 2010, when it issued its strategic climate change adaptation plan.¹⁴⁸ The FWS has committed itself to building shared scientific and technical capabilities with others in the conservation community that have wildlife management responsibilities, including state agencies and tribal entities.¹⁴⁹ The agency’s strategy therefore rests on six principles: (1) continual evaluation of priorities and approaches, (2) coordination and collaboration with other relevant actors, (3) reliance on the best science, (4) emphasis on conservation of habitats within sustainable landscapes, (5) development of state-of-the-art technical capacity to meet climate change challenges, and (6) leadership in national and international adaptation efforts.¹⁵⁰ The FWS’s premise is that decisive, bold action is necessary in light of climate change’s potential to exacerbate existing pressures on fish and wildlife sustainability, including the spread of invasive species, increased competition for scarce water supplies, wildfires, damage to wildlife from environmental contaminants, and habitat loss. The strategic plan characterizes climate change as “the transformational conservation challenge of our time,” a challenge of “unprecedented scope and magnitude,” and explicitly recognizes that the agency will need “to recalibrate our conservation goals by integrating climate change.”¹⁵¹ The real challenge for the FWS and the other land management agencies is to apply the broad approaches reflected in documents like strategic plans in day-to-day management decisions. Recognizing that need, the FWS plans to “step down” the plan’s components to management of the national wildlife refuges.¹⁵²

The FWS strategic plan indicates that the agency has begun building the infrastructure needed to infuse adaptation and other climate change considerations into more discrete resource management contexts. The plan describes what the agency calls three “progressive strategies”—adaptation, mitigation, and engagement. To carry them out, the agency has created a National Climate Team and eight Regional Climate Teams, to be supervised by a National Science Applications Executive Team. The national team includes representatives from service regions and programs, while the regional teams will include both regional office and field employees. These teams will help develop national climate change policies and guidance; help direct the FWS’s climate change activities, including budget and performance; develop and implement policy; assist in landscape conservation design and evaluation; develop internal and

external partnerships; interact with Congress; and provide directions for scientific research. The agency envisions an “iterative” rather than a hierarchical approach.¹⁵³

More specifically, the strategic plan indicates that the FWS will help the U.S. Geological Survey create Regional Climate Science Partnerships to acquire and analyze the information needed to better understand and address the impacts of climate change on fish, wildlife, and their habitats at all spatial scales. These collaborative efforts will strive to make climate model outputs usable at multiple planning scales, integrate model outputs with ecological and land use models to project changes in fish and wildlife distribution, and support climate monitoring programs needed for successful adaptation planning.¹⁵⁴ The plan also will establish 21 Landscape Conservation Cooperatives to enable members of the conservation community to deliver conservation in ways that integrate efforts at all levels of government, such as by ensuring habitat connectivity between large habitat blocks and conservation of key landscapes and populations, particularly through protected areas such as the national wildlife refuges. These efforts will build on existing initiatives such as migratory bird joint ventures and will develop measurable biological objectives to guide landscape-scale conservation design.¹⁵⁵

According to the plan, the FWS will apply Strategic Habitat Conservation as its framework for landscape conservation. This approach aims to conserve terrestrial, freshwater, and marine habitats within sustainable landscapes to conserve target populations of species or suites of species and the ecological functions that sustain them. It will rely heavily on adaptive management, divided into five steps: setting goals, developing plans to meet the goals, implementing plans, measuring success, and increasing knowledge and understanding through repetitive looping of all five elements.¹⁵⁶

The plan envisions new organizational and managerial processes to help the FWS evaluate its actions to address climate change and informational outreach efforts to engage business, nongovernmental organizations, and the public in innovative actions to minimize the impacts of climate change on fish and wildlife. The agency’s goal is development of a National Fish and Wildlife Climate Change Adaptation Strategy by the end of 2012 that will act as a blueprint to guide wildlife adaptation partnerships in the next 50 to 100 years. That strategy will likely identify and define integrated approaches to maintaining key ecosystems and functions (such as pollination, seed dispersal, nutrient cycling, and predator–prey relationships) needed to sustain fish and wildlife resources in the face of climate change and rely on landscape-scale approaches. The agency will consider adaptation strategies being developed for other sectors (including agriculture, human health, and transportation) to complement those strategies and minimize conflicts.¹⁵⁷ The FWS also plans to create a National Biological Inventory and Monitoring Partnership with agencies such as the NPS, the Forest Service, and the U.S. Geological Survey to generate empirical data needed to track the effects of climate change and to model predicted population and habitat change through tools such as remote sensing.¹⁵⁸ Finally, the agency will organize a National Climate Change Forum to exchange ideas and build networks among members of the conservation community.¹⁵⁹

The strategic plan identifies four basic adaptation approaches: resistance, resilience, response, and realignment. Resistance involves managing fish and wildlife to forestall undesired climate change effects. The FWS anticipates it will be most effective when the magnitude of climate change is small. Resistance also may be appropriate

on a short-term basis while other strategies are being developed. Resilience involves improving the capacity of ecosystems to return to desired conditions after disturbance. The agency recognizes that this approach is likely to become more difficult as changes in climate accumulate over time. A responsive approach is based on efforts to manage toward future landscape conditions by predicting and working with the effects of climate change. The goal is to facilitate the transition of ecosystems from current, natural states to new conditions resulting from climate change. These include mimicking or assisting natural adaptive processes such as species dispersal or migration to avoid rapid threshold or catastrophic conversions that might occur otherwise. Realignment may be appropriate for ecosystems that have already been significantly disturbed. The objective is to realign a system to expected future conditions instead of trying to restore historic conditions. For the national wildlife refuges, this approach may involve “targeted restoration” that focuses on “strategically replacing highly altered landscapes with native plant communities to create the best possible current and future habitat for trust species.”¹⁶⁰ Each of these approaches can be implemented in either a reactive or an anticipatory manner. The choice of adaptation approach will depend on the state of scientific knowledge, available management technologies and techniques, and policy constraints and opportunities. The plan indicates that the FWS will focus on resistance and resilience in the near term, but as it builds technical and institutional capacity, it will likely shift toward responsive and realignment approaches, especially of the anticipatory kind.¹⁶¹

The FWS also issued a draft five-year action plan to implement the goals of the strategic plan and “give it ‘legs.’” The FWS designed the actions in the draft plan to enable it “to respond to the most pressing, near-term climate change threats and opportunities, while at the same time to lay the foundation for the Service’s long-term response.”¹⁶² Thus, the FWS, perhaps more than any of the other land management agencies, has developed both short-term and long-term strategies for adaptation, and has begun changing the processes and substantive criteria for fish and wildlife management decisions to ensure that the strategies are implemented on the ground.

The Bureau of Land Management

The BLM is one of two land management agencies that operate under a multiple-use mandate.¹⁶³ The Federal Land Policy and Management Act (FLPMA), which is the BLM’s authorizing statute, directs the agency to develop land use plans (called resource management plans) for the public lands under its jurisdiction. These plans must observe the principles of multiple use and sustained yield established in an earlier law, the Multiple-Use, Sustained-Yield Act of 1960 (MUSYA); use a science-based interdisciplinary approach to land management; give priority to protecting areas of critical environmental concern; and consider present and potential uses of the public lands.¹⁶⁴ The BLM must then manage the public lands under principles of multiple use and sustained yield in accordance with the land use plans.¹⁶⁵ The MUSYA defines multiple use as use of federal lands in the combination that best meets the needs of the American people (but not necessarily the combination that maximizes dollar return or unit output), taking into account changing needs and conditions, and recognizing that “some land will be used for less than all of the resources.”¹⁶⁶ Sustained yield is the achievement and maintenance in perpetuity of high-level output of renewable resources without impairing the productivity of the land.¹⁶⁷ The public lands administered by the BLM generally lack the spectacular scenery found in many national parks

and forests, but the agency nevertheless must accommodate potentially conflicting uses, including cattle and sheep grazing and recreation.

The BLM's effort to understand, anticipate, and respond to the effects of climate change on public lands includes two connected initiatives, the preparation of Rapid Ecoregional Assessments (REAs) and a proposed landscape approach for managing public lands. The latter endeavor, which was still under development as of mid-2012, responds to Secretarial Order 3289, described above, issued by Interior Secretary Salazar. The agency intends to rely on these initiatives to inform, focus, and coordinate management efforts by cohesively integrating conservation, restoration, and development programs.¹⁶⁸

The BLM defines landscapes as "large, connected geographical regions that have similar environmental characteristics, for example, the Sonoran Desert and the Colorado Plateau. These landscapes span administrative boundaries and can encompass all or portions of several BLM field offices."¹⁶⁹ The agency's landscape approach examines these larger areas to determine patterns of environmental change, natural and human influences, and opportunities for resource conservation, restoration, and development that may not be evident when managing smaller areas. Although BLM field offices maintain their central role in managing public lands, such as by preparing land use plans and authorizing specific land uses, the landscape approach helps focus and integrate these local management efforts. Landscape-based management depends on accurate scientific information on climate change and other matters. The Interior Department is establishing eight regional Climate Science Centers to provide scientific information and tools to help land managers anticipate, monitor, and adapt to climate change impacts.¹⁷⁰ This information will feed into an adaptive management approach to decision making.

REAs synthesize the information about resource conditions and trends within an ecoregion (a large landscape defined by its ecological characteristics), identifying and mapping areas of high ecological value such as important wildlife habitats and corridors, and gauge the potential risks from climate change and other "overarching change agents."¹⁷¹ REAs also establish landscape-scale baseline ecological data to gauge the effect and effectiveness of future management actions. The BLM piloted REAs in three ecoregions (the Northern Great Basin, Wyoming Basin, and Chihuahuan Desert), and in 2010 it initiated REAs for seven additional ecoregions varying in size from 11.5 to 88.3 million acres.¹⁷² Land managers will use the results of the REAs to identify management strategies for lands within an ecoregion. The REAs will also help coordinate and implement these priorities at the BLM's state and field-office levels.¹⁷³ More specifically, REAs document key resource values (or conservation elements), assess the collective effects of projected trends, identify science gaps and data needs, and provide a baseline to evaluate and guide future management actions. Although REAs do not themselves allocate resource uses or make management decisions, "[t]hey provide science-based information and tools for land managers and stakeholders to consider in subsequent resource planning and decision-making processes."¹⁷⁴

The Bureau of Reclamation

The BoR administers federal reclamation projects and distributes project water.¹⁷⁵ The Omnibus Public Land Management Act of 2009 requires the secretary of the interior, through the BoR, to establish a climate change adaptation program that coordinates with EPA, the U.S. Geological Survey, NOAA, and state water resource

agencies to assess the risks resulting from and effects of global climate change on the quantity of water resources available at federal reclamation projects.¹⁷⁶ The Act also requires the BoR to develop strategies at watershed and aquifer system scales to address potential water shortages, conflicts, and adverse impacts to water users and the environment.¹⁷⁷ The BoR must assess risks to the water supply of each major reclamation river basin, including changes in snowpack, the timing and quantity of runoff, groundwater recharge and discharge, and shifts in demand for water as a result of increasing temperatures and rates of reservoir evaporation. It must assess for each major reclamation river basin the extent to which changes in the water supply will affect its ability to deliver water to its contractors, the operation of hydroelectric power-generation facilities, recreation at reclamation facilities, fish and wildlife habitat, endangered or threatened species, water-quality issues (including changes in salinity levels), flow and water-dependent ecological resiliency, and flood-control management. The statute requires the BoR to develop strategies to mitigate the adverse impacts of climate change on water supply, including strategies to modify reservoir storage or operating guidelines; develop new water management, operating, or habitat restoration plans; enhance water conservation; and improve hydrologic models and other decision support systems. The BoR must report to Congress on the results of its studies and efforts.¹⁷⁸

The BoR participates in both the Interagency Adaptation Task Force and the Water Resources and Climate Change Adaptation Workgroup that supports the Task Force. That workgroup issued in October 2011 a National Action Plan for adaptation of freshwater resources management to climate change, which establishes six basic, common-sense recommendations: (1) establishing a planning process to adapt water resources management to climate change, (2) improving water resources and climate change information for decision making, (3) strengthening assessment of the vulnerability of water resources to climate change, (4) expanding water use efficiency, (5) supporting integrated water resources management, and (6) supporting training and outreach to build response capability.¹⁷⁹

The BoR has focused on collaborating on the development and distribution of information on the impacts of climate change on water management. It has worked with the Army Corps of Engineers, NOAA, and the U.S. Geological Survey to coordinate efforts by water managers and climate scientists to identify common information gaps that affect the nation's capacity to assess, forecast, and adapt to climate change impacts on western water supplies. The workgroup has sponsored workshops to promote collaboration among climate change studies involving the Colorado River Basin and has worked with the Department of Energy and others to produce local- and regional-level climate change impact projections to inform decision making by water management agencies.¹⁸⁰ The BoR and the Army Corps of Engineers have jointly published a report designed to facilitate information gathering that promotes sustainable water resources planning and management.¹⁸¹ As part of a WaterSMART Task Force created by the interior secretary "to obtain the best available science on the impacts of climate change on water supplies and to ensure integration of sustainable water strategies" within the Interior Department agencies,¹⁸² the BoR has worked with water and power delivery authorities to develop mitigation and adaptation strategies to meet present and future water supply and demand imbalances. In addition, the BoR has joined agencies such as the FWS and tribes in the Southwest to conduct outreach events and inform stakeholders about the activities of Landscape

Conservation Cooperatives to coordinate science-based responses to climate change impacts on water.¹⁸³

In addition to these information-gathering and planning efforts, the BoR has begun to take actions that seek to increase adaptive capacity or strengthen conditions favorable to adaptation. These include operation of a pilot run of a desalting plant to achieve sustainability through water conservation; development of alternative water supplies to help areas in which reduced snowpack has reduced streamflow so that minimum streamflow conditions can be maintained to help manage steelhead recovery efforts; design of a new turbine runner at Hoover Dam to compensate for reduced generating capacity resulting from decreased water levels at Lake Mead; the financing of water and energy efficiency improvements that save water; and development of alternatives to reduce heating in Lewiston Reservoir to increase the reliability of the cold water reservoir behind California's Trinity Dam.¹⁸⁴

The National Forest Service

The National Forest Service derives most of its authority to manage the national forests and grasslands from the Organic Act of 1897,¹⁸⁵ the MUSYA,¹⁸⁶ and the National Forest Management Act of 1976 (NFMA).¹⁸⁷ The 1897 Act defines the traditional basic purposes of national forest management, including securing favorable conditions of water flows and furnishing a continuous supply of timber.¹⁸⁸ The Forest Service, along with the BLM, is a multiple-use agency charged with the duty to manage the lands and resources under its jurisdiction for a variety of not entirely compatible uses. The MUSYA requires that the national forests be administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes,¹⁸⁹ and for multiple use and sustained yield.¹⁹⁰ The NFMA established a policy that the national forests be managed under multiple-use, sustained-yield principles in accordance with land use plans developed by the Forest Service.¹⁹¹ Partly in response to the Forest Service's excessive award of timber harvests in the decades after World War II, the NFMA establishes both procedural and substantive requirements for land and resource management plans, including providing for diversity of plant and animal communities needed to meet multiple-use objectives and constraining both available harvesting techniques and the areas in which timber harvesting may occur.¹⁹² Individual projects such as timber harvests must comply with applicable land use plan provisions.¹⁹³ Traditionally, the Forest Service has been afforded broad discretion in making management choices for the national forests,¹⁹⁴ although NEPA, the ESA, and the NFMA have curtailed that discretion, often dramatically.¹⁹⁵

The Forest Service declared in a five-year strategic plan adopted in 2007 that “[c]limate change will impact forest, range, and human well-being by potentially altering the ability of ecosystems to provide life-supporting goods and services. The implication for natural resource management is to be flexible and adapt management strategies to help mitigate the effects of climate change.”¹⁹⁶ The agency acknowledged the need to develop new knowledge to enable it to manage in the face of those changes so as to ensure the continued flow of goods, services, and values from forests and rangelands. The next five-year plan focused more extensively on climate change, declaring that one of its four key strategic goals is to ensure that the national forests and private forest lands are conserved, restored, and made more resilient to climate change.¹⁹⁷

The agency issued a Strategic Framework for Responding to Climate Change in 2008.¹⁹⁸ It stated that the Forest Service would engage in “facilitated adaptation”

to adjust to and reduce the negative impacts of climate change on ecological, economic, and social systems. This strategy would include anticipatory actions aimed at preventing serious disruptions due to climate change, such as thinning of forests to increase tolerance to drought and resistance to wildfire or insects, genetic conservation of species, assisted migration of species to suitable habitat, development of wildlife corridors to facilitate migration, and construction of new water storage facilities.¹⁹⁹ It also would include “opportunistic actions” that take advantage of man-made or natural disturbance events to facilitate adaptation, such as planting species different from those present before disturbance or conversion of vegetation structure to make it more resilient to a changing climate.²⁰⁰ Some traditional management techniques would remain useful. Actions such as thinning of stands, fuels reduction, and prescribed fire may not only reduce wildfire risks and vulnerability to pest infestations, but may also help restore ecological health and resilience to stresses linked to climate change.²⁰¹

The 2008 strategy declared that the Forest Service would integrate climate change considerations into Forest Service policies, program guidance, and communications, and that the agency had taken “important first steps in grappling with the issues of addressing climate change in forest plans, NEPA analysis, and budget guidance.”²⁰² The agency listed strategies that “could” reinforce a comprehensive and cohesive approach to climate change, including integrated vegetation management, biomass, open space, ecological restoration, water, and research and development.²⁰³ The Strategic Framework stated that implementation of concrete actions would help fulfill the agency’s vision, and it recommended steps that included setting priorities for adaptation actions; working with partners; and assessing how specific management actions such as fire suppression, fuels treatment, post-fire rehabilitation, timber harvest, invasive species management,²⁰⁴ ecological restoration, and watershed management may contribute to adaptation objectives.²⁰⁵

As field managers began implementing the framework, however, the need for a more complete approach to developing long-term responses to climate change became clear.²⁰⁶ Accordingly, in 2010, the agency issued a “roadmap” for responding to climate change that builds on the 2008 Strategic Framework.²⁰⁷ The report noted that most of the urgent forest and grassland management challenges of the past 20 years, including wildfires, changes in water regimes, and insect infestations, have been driven by climate change. The Forest Service’s management strategies have had to evolve to meet those challenges, and its scientists have contributed to national and international assessment of the effects of climate change and the development of management strategies for forests and grasslands. The road map listed ongoing efforts by the agency to study climate change, assess risks and vulnerabilities, identify knowledge gaps, and craft new policies to foster effective responses to climate change. These include work by the agency’s Climate Change Resource Center to provide new information, such as evaluations of potential climate change impacts on ecosystems, to help managers respond to climate-related threats;²⁰⁸ conducting workshops for scientists and managers at local, regional, and national levels to help develop adaptation strategies; and conducting ongoing national monitoring networks.²⁰⁹

The road map also states that the Forest Service is in the process of aligning agency policy with its strategic response to climate change through review of manuals and other policy documents and evaluation of policy to ensure that it is sufficiently flexible to deal with climate change, and through development of proposals to address

policy gaps.²¹⁰ The Forest Service is in the process of incorporating assessments of climate-related vulnerabilities and uncertainties into land management and project-level environmental analyses and protecting rare and sensitive species by restoring and reconnecting habitats. The road map indicates that the agency will soon develop a risk-based management system to identify adaptation priorities across landscapes and watersheds and refine management practices for addressing projected climate change impacts and ecosystem dynamics, relying on risk management and adaptive management. In addition, it will collaborate with partners, including private landowners, to develop land management plans that establish priority locations for maintaining and restoring habitat connectivity that provide migration corridors for displaced species. Likewise, it will remove physical impediments to the movement of species and manage ecosystems to decrease fragmentation.²¹¹ In the longer term, the agency will increase research support for assessments of climate change impacts and implement a genetic resources conservation strategy to facilitate transition to more resilient ecosystems.²¹² It also will work to restore disturbed areas by planting stock adaptable to changing conditions, implement genetic conservation strategies for at-risk populations, and use monitoring to evaluate the effects of management actions designed to facilitate adaptation.²¹³

The Forest Service's road map seems considerably less specific than the FWS's climate change adaptation plans and programs, and the Forest Service appears to be behind some other agencies in implementing its broader strategies and ensuring that climate change adaptation is an important consideration at the individual project level. Perhaps the Forest Service's efforts to build adaptation into its everyday efforts to manage the national forests and grasslands will receive a boost when it issues the final version of the latest iteration of its planning rule. The proposed version of the rule provides insights into the likely direction of the final rule, and it places notably greater emphasis on climate change and the agency's commitment to effective adaptation to climate change than have previous versions of the planning rule.

The Forest Service pronounced at the outset of the preamble to its proposed rule that "[t]he new planning rule must be responsive to the challenges of climate change."²¹⁴ One of the reasons provided by the agency for overhauling the 1982 planning rule that the proposal would replace is a new understanding of the challenges and stressors that may affect forest resources, including climate change.²¹⁵ Plans would have to address changing environmental conditions such as climate change with strategies to maintain or restore ecosystem and watershed health and resilience; protect key ecosystem elements, including water resources; and provide for plant and animal diversity.²¹⁶

The Forest Service recognizes that climate change will affect sustainability in ways that are outside its control, explaining that in the past this lack of control has precluded consistent compliance with the existing requirement that plans maintain viable populations of native vertebrate species.²¹⁷ Nevertheless, the proposed rule would require identification, assessment, and consideration of climate change as a potential ecosystem driver (such as for aquatic habitats) when developing plan components to achieve sustainability. Plans would have to provide for integrated resource management, taking into account reasonably foreseeable risks to sustainability and the potential impacts of climate change and other stressors on a unit's resources.²¹⁸ They would have to include measures to maintain or restore the structure, function, composition, and connectivity of healthy and resilient ecosystems, taking into account

potential system drivers such as climate change.²¹⁹ Unit-level monitoring would focus on measurable changes related to climate change to help managers understand potential impacts to resources and allow them to coordinate with other agency actions on climate change, using “a broader-scale approach.”²²⁰ Indeed, the preamble states that efforts to address climate change and related stressors require a landscape perspective.²²¹ The proposed planning rules thus seek to incorporate climate change adaptation considerations into unit-level planning, while at the same time recognizing the likelihood that effective adaptation will require planning at a larger scale, including efforts to coordinate with other federal land managers and private landowners.

The Future of Adaptation and Natural Resource Management

Notwithstanding the array of strategies, plans, and initiatives described in this chapter, at least as late as 2010, few completed adaptation plans or implemented projects existed at the individual unit level within any of the federal land management systems.²²² One survey of recovery plans prepared by the FWS under the ESA found that only about 10 percent addressed climate change at all, and of those that did, the great majority provided either a simple statement of threats or limited threat analysis.²²³ It is therefore not clear how successful the agencies will be in incorporating into management decisions what in many instances is an entirely new set of considerations.

Institutional Challenges to Effective Adaptation

A recent survey of employees at the land management agencies provides insights into the institutional challenges facing the agencies as they seek to bolster the capacity of federal lands and resources to withstand and adapt to climate change, over and above the physical challenges addressed above (such as uncertainty about the timing, location, and scale of problems associated with climate change, as well as the sheer novelty of some of those problems for agency decision makers). The survey inquired about the reasons for the dearth of actions geared directly at making federal lands and resources more resilient to climate change. Respondents cited as one group of reasons the absence of a climate change adaptation mandate at the national level; the vagueness of national, regional, or unit-specific policy mandates; and a perception that they were under no obligation to begin planning or implementing adaptation measures. The strategies and plans discussed above seem to address the first and third concerns, but it is not clear whether the steps taken to incorporate adaptation analysis and action into agency policymaking and implementation processes are sufficiently specific at this point to address the second concern. Presumably, guidance and directives will become more specific as the land management agencies continue to put their new plans and programs into operation.

Another category of obstacles to effective adaptation plans and projects at the unit level identified in the survey included inadequate information and resources and perceived public opposition.²²⁴ All of the land management agencies have committed themselves to the acquisition and sharing of information concerning climate change problems and responses. Resource shortages are a harder nut to crack given congressional budget-cutting and deficit-reduction initiatives. Agencies might choose to shift resources internally toward climate change efforts, but doing so may create shortages and constraints in other areas. They will be hard pressed to develop effective climate change adaptation programs without adequate funding, and that may be a hard sell

given intransigence to accepting even the overwhelming scientific consensus that climate change is already occurring, no less any sense of urgency in addressing it, within some congressional quarters. Likewise, if the public does not place a high priority on adaptation, adaptation programs may be a hard sell for policymakers. The public education and outreach programs to which the land management agencies have committed themselves may contribute to public buy-in, however, especially in locations that have experienced changes readily linked to climate change.

The survey respondents identified inertia, resistance to change, and a culture of handling resource problems in traditional ways within the agencies as a third set of obstacles to an emphasis on taking adaptive actions.²²⁵ One study remarked, for example, that “[t]he concept of [national wildlife] refuges as isolated conservation fortresses managed to resist change will not fulfill the promise of the [Refuge System’s Organic Act], nor will it meet the needs of American wildlife.”²²⁶ Some of the plans and programs described above address those problems head on, committing the land management agencies to learning about and carrying out new approaches to resource management that have been crafted with the unique challenges posed by climate change in mind.²²⁷ How quickly these approaches make inroads into traditional resource management approaches at the unit level remains to be seen.

The survey respondents also addressed the possibility that some of the federal laws governing resource management will impair agencies’ climate change adaptation efforts because they were adopted before climate change was a recognized phenomenon and may not be well-suited to addressing it. The bulk of the respondents viewed NEPA as an “enabler” whose procedural thrust is likely to facilitate incorporation of adaptation considerations into agency planning. They were less optimistic about the ability of the ESA to contribute to adaptation efforts, tending to view its focus on individual species as an obstacle to the ecosystem-wide focus that effective adaptation will typically require.²²⁸ Echoing some of the questions raised by the NPS in its 2010 strategy, respondents expressed concern that the emphasis on preservation of “natural” conditions reflected in the NPS Organic Act and the Wilderness Act might hinder adaptation efforts.²²⁹ That focus may make intervention and manipulation to achieve adaptation goals problematic. Some agency survey respondents tended to regard the organic legislation for the national forests as more amenable to increased emphasis on adaptation in light of its mandates for long-range planning,²³⁰ while others characterized the difficulty of revising forest plans to reflect new scientific information as a barrier to Forest Service efforts to accommodate adaptation.²³¹ The fate of the Forest Service’s proposed planning rule,²³² and the procedures it provides for updating and revision of plans, will determine in part which view is more prescient. In any event, the survey responses raise the possibility that existing legislation will make it easier for some land management agencies but harder for others to build climate change adaptation considerations into the day-to-day decision-making processes.

Geographic and Jurisdictional Challenges to Effective Adaptation

A logical strategy for agencies to begin trying to make the resources they manage more resilient to climate change is to reduce stressors that make ecosystems or particular natural resources vulnerable to the adverse effects of climate change.²³³ This is a sensible strategy because it avoids or minimizes many of the problems described above. Agencies that seek to remove existing stressors will be dealing with problems with which they are familiar, reducing the risk of intransigence to new approaches.

Actions to address these problems often can be justified on their own terms (such as protecting water quality for aquatic fish and wildlife), thereby avoiding the need to confront climate change skeptics. Finally, the agencies' authorizing statutes are likely to most clearly and directly apply to traditional problems that create existing ecosystem stresses, minimizing legal uncertainty about the scope of the agencies' power to address them. Some of the land management agencies have already sought to increase resilience by attacking co-stressors. The National Park Service, for example, has removed two dams in a large estuary in Point Reyes National Seashore in California to enhance survival rates for endangered trout and salmon and has removed canals and levees in Everglades National Park to restore natural freshwater flows and block saltwater intrusion.²³⁴

Reduction of co-stressors will not suffice as a mechanism for addressing many climate change problems, however. More innovative strategies such as relocation and assisted migration may be needed to address problems like the inability of plant and animal species to survive in their traditional habitats.²³⁵ Climate change may alter the functioning of the national wildlife refuges, for example, so that northerly units assume the functions previously observed in more southerly units.²³⁶ Some of the land management agencies have begun addressing these kinds of challenges. NPS biologists at Hawaii Volcanoes and Haleakala National Parks, for example, are in the process of collecting and dispersing seeds and cuttings of 50 rare species of flowering plants to new locations, “[h]op[ing] to beat the odds of extinction in a shifting rainforest.”²³⁷ Similarly, the BLM, under a project called Seeds of Success, has begun collecting seeds that may be replanted if climate change makes it impossible for plant species to survive in their current locations.²³⁸

The adequacy of existing legislation to address these more novel strategies is likely to be a more contentious question than whether that legislation authorizes actions to address co-stressors. One important question is whether existing legislation permits agencies to implement relocation or assisted migration projects. The ESA explicitly authorizes the FWS to introduce experimental populations of endangered or threatened species in new locations,²³⁹ and the broad discretionary authority delegated to the other land management agencies may enable them to take similar actions for species not yet listed under the ESA. The NFMA's requirement that the Forest Service “provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives” appears to be one such provision.²⁴⁰ The NPS Organic Act's broadly worded discretionary directive to “promote and regulate” the use of the national parks and monuments “by such means and measures as conform to the[ir] fundamental purpose,” including conserving wildlife, may be another.²⁴¹

Relocation and assisted migration efforts will face both practical and legal difficulties, however. Indeed, the problems that will face agencies considering relocation or assisted migration illustrate the kinds of challenges the land management agencies are likely to confront as they move beyond reduction of co-stressors in seeking to minimize the adverse effects of climate change through a variety of techniques. It is likely that lands suitable for alternative habitat for plants and animals adversely affected by climate change will not exist within the same land management system in which the affected species are currently found, or even within any of the existing land management systems. More broadly, the location and scope of climate change problems will rarely align with the jurisdictional boundaries staked out in the statutes vesting the

agencies with their authority to address climate change. The scientific community has warned against allowing political boundaries to trump biological ones:

[W]e need to manage resources on biologically appropriate, not politically expedient, scales of space and time. . . . Current approaches . . . that are based on jurisdictional boundaries not designed to consider cross-scale feedback, are inadequate for managing . . . biomes. Because of the inherent interactions among biological hierarchies and spatiotemporal scales, . . . comprehensive consistent socioeconomic policies are necessary at landscape scales.²⁴²

If appropriate substitute habitat for a species in trouble exists within other land management systems, the agencies managing the traditional and desired new habitats will have to coordinate their actions. As the agencies have recognized, the need for coordination, not only among the federal land management agencies, but also between those agencies and state governments or private landowners, is an inescapable component of successful adaptation strategies. The plans and approaches described in this chapter all include commitments to coordinated efforts to adapt to climate change. The agencies will nevertheless have to guard against resistance to actually working in concert that may arise from factors such as the fear of ceding jurisdictional turf to another agency or distrust of the capacities or commitments of those agencies.

Bodies such as the CEQ or the Interagency Climate Change Adaptation Task Force may be able to minimize such difficulties. The Task Force established as an overarching policy goal the coordination of the capabilities of the federal government to support adaptation.²⁴³ The Task Force concluded that effective effort to reduce the impacts of climate change on the nation's fish, wildlife, and plant resources and their habitats "requires collaboration among the Federal Government, states, Tribes, non-governmental organizations, private industry, and private landowners."²⁴⁴

If none of the federal lands systems contains suitable alternative habitat, the land management agencies may need to consider acquiring property that does contain suitable habitat through land exchanges or purchases. Acquisitions to enlarge the borders of national parks, forests, or wildlife refuges can protect species while they seek out new ranges.²⁴⁵ Existing laws authorize agencies to engage in exchanges or to acquire title to additional lands.²⁴⁶ That authority is constrained, however, so that new legislation authorizing particular acquisitions may be necessary. In some instances, acquisition of conservation easements or other less-than-fee interests may suffice.

Conclusion

The historic functioning of the lands and resources owned and managed by the federal government for preservation, recreational, historic, scientific, and economic uses will be disrupted by climate change, in some cases dramatically. The agencies face significant challenges in their efforts to make these lands and resources resilient to climate change so that they remain capable of sustaining the ecosystems and providing other services they have long performed. Some of these challenges result from scientific uncertainty about the timing, location, and scope of climate change, which makes informed planning difficult. Similarly, the unprecedented nature of some of the anticipated changes, at least within human memory, deprives land managers of historical analogs to guide future efforts to adapt to climate change. Still other challenges are institutional in nature, as agencies resist changes in traditional management techniques or confront the need to coordinate management actions with other

agencies and stakeholders that have not always been close allies or that have different interests. Finally, the land management agencies face important legal obstacles to effective climate change adaptation. In the absence of an overarching federal statute specifically authorizing and directing the federal land management agencies to take appropriate adaptive actions to minimize the adverse effects of climate change, the agencies have had to rely, and will likely continue to have to rely for the foreseeable future, on existing laws that were adopted before the threats posed by climate change had clearly emerged.

Despite these challenges, the land management agencies have embarked upon a concerted, if uneven, effort to beef up the federal government's capacity to prepare for and respond to climate change as it affects federal lands and the natural and cultural resources they contain. This effort accelerated notably beginning in 2009, under the prodding of cross-agency initiatives such as the Interagency Climate Change Adaptation Task Force. Some of the land management agencies, such as the FWS, appear to have established a more comprehensive framework for adaptation than others. As the agencies continue to plan for and implement projects that make the lands and resources they control more resilient to climate change, it is important that they share their knowledge with one another, as well as coordinate their efforts. The agencies have committed to engaging in exactly these kinds of collaborations. No amount of planning and preparation can avoid the disruptions that climate change will cause. With leadership, commitment, and adequate resources, however, the agencies can create a legal and policy infrastructure that minimizes the risk that federal lands and resources will no longer be able to provide the rich array of benefits to which the nation has become accustomed.

Notes

1. For additional discussion of the effects of climate change on federal lands and resources, see Robert L. Glicksman, *Ecosystem Resilience to Disruptions Linked to Global Climate Change: An Adaptive Approach to Federal Land Management*, 87 NEB. L. REV. 833 (2009).

2. Nicholas K. Geranios, *Glacier Turns 100, But Age Has Not Been Kind*, ASSOCIATED PRESS, May 11, 2010.

3. ROCKY MOUNTAIN CLIMATE ORG. & NATURAL RESOURCES DEFENSE COUNCIL, NATIONAL PARKS IN PERIL: THE THREATS OF CLIMATE DISRUPTION 12 (Oct. 2009) [hereinafter PARKS IN PERIL].

4. *Id.*

5. U.S. DEP'T OF THE INTERIOR, BUREAU OF RECLAMATION, MANAGING WATER IN THE WEST: SECURE WATER ACT SECTION 9503(C)—RECLAMATION CLIMATE CHANGE AND WATER 2011 (April 2011), at 179 [hereinafter BUREAU OF RECLAMATION, SECURE]. Cool-season snowpack could increase in high-altitude and high-latitude areas, however. *Id.*

6. PARKS IN PERIL, *supra* note 3, at 9.

7. Matthew Zinn, *Adapting to Climate Change: Environmental Law in a Warmer World*, 34 ECOLOGY L.Q. 61, 68–69 (2007); UNIVERSITY OF MONTANA, IMPACTS OF CLIMATE CHANGE ON FORESTS OF THE NORTHERN ROCKY MOUNTAINS 2 (January 2010), <http://bipartisanpolicy.org/sites/default/files/Rocky%20Mountain%20Forest%20Overview.pdf>.

8. Paul Solotaroff, *The Ghost Park*, MEN'S J. (Apr. 5, 2011), available at <http://www.mensjournal.com/the-ghost-park>.

9. ROCKY MOUNTAIN CLIMATE ORGANIZATION, GLACIER NATIONAL PARK IN PERIL: THE THREATS OF CLIMATE DISRUPTION iv (April 2010), http://www.rockymountainclimate.org/images/GlacierInPeril_full.pdf [hereinafter GLACIER NATIONAL PARK IN PERIL].

10. Yereth Rosen, *Climate Change Keenly Felt in Alaska's National Parks*, REUTERS, Feb. 12, 2011, available at <http://www.reuters.com/article/2011/02/12/us-alaska-climate-idUSTRE71B23320110212?feedType=RSS&feedName=domesticNews>.

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11. *Id.*
 12. PARKS IN PERIL, *supra* note 3, at 9.
 13. *Id.*
 14. *Id.* at 15.
 15. *Id.*
 16. *Id.* at 15–16.
 17. Zinn, *supra* note 7, at 76–78.
 18. PARKS IN PERIL, *supra* note 3, at 16.
 19. See generally Robert L. Glicksman, *Global Climate Change and the Risks to Coastal Areas from Hurricanes and Rising Sea Levels: The Costs of Doing Nothing*, 52 LOYOLA L. REV. 1127 (2006).
 20. Zinn, *supra* note 7, at 79–80; PARKS IN PERIL, *supra* note 3, at 17–18.
 21. Pieter S.A. Beck et al., *Changes in Forest Productivity Across Alaska Consistent with Biome Shift*, 14 ECOLOGY LETTERS 373, 377 (Feb. 21, 2011) (concluding that “the productivity patterns we document in mature unburned forests are driven more by climate (temperature and moisture) than ozone, nitrogen or CO₂ fertilization effects”). Climate change has already begun to alter the timing of plant activity. Species that bloom earlier may be subject to frosts that kill them or impair reproduction. See, e.g., Elisabeth Beaubien & Andreas Hamann, *Spring Flowering Response to Climate Change Between 1936 and 2006 in Alberta, Canada*, 61 BIOSCIENCE 514 (July 2011).
 22. PARKS IN PERIL, *supra* note 3, at 21.
 23. Beck et al., *supra* note 21, at 377.
 24. Kenneth L. Cole et al., *Past and Ongoing Shifts in Joshua Tree Distribution Support Future Modeled Range Contraction*, 21 ECOLOGICAL APPLICATIONS 1 (2011). For a more optimistic prognosis, see *Outlook Improves for Joshua Trees*, DAILY PRESS, Apr. 8, 2011, available at <http://www.vvdailynews.com/articles/joshua-26988-trees-park.html>.
 25. Phillip J. van Mantgem et al., *Widespread Increase of Tree Mortality Rates in the Western United States*, 323 SCI. 521 (Jan. 23, 2009). The authors concluded that “our results are inconsistent with a major role for endogenous causes of increasing mortality rates. Instead, the evidence is consistent with contributions from exogenous causes, with regional warming and consequent drought stress being the most likely drivers.” See also David D. Breshears et al., *Regional Vegetation Die-off in Response to Global-Change-type Drought*, 102 PROC. NAT’L ACAD. SCI. U.S.A. 15144 (2005) (documenting “rapid, regional-scale mortality of a dominant tree species in response to subcontinental drought accompanied by anomalously high temperatures”).
 26. See generally WILDLAND FIRE LEADERSHIP COUNCIL, THE FEDERAL LAND ASSISTANCE, MANAGEMENT AND ENHANCEMENT ACT OF 2009: REPORT TO CONGRESS 18–20 (March 2011).
 27. See, e.g., Breshears et al., *supra* note 25, at 15144 (concluding that “[a]lthough the proximal cause of mortality for most of the trees [in forests in the western U.S.] was apparently infestation by bark beetles, such outbreaks are tightly tied to drought-induced water stress” linked to temperature increases).
 28. See Jesse A. Logan et al., *Whitebark Pine Vulnerability to Climate-Driven Mountain Pine Beetle Disturbance in the Greater Yellowstone Ecosystem*, 20 ECOLOGICAL APPLICATIONS 895 (June 2010) (“Across the GYE, whitebark pine (*Pinus albicaulis*), an important component of the ecosystem, is facing serious decline. Mountain pine beetle (MPB, *Dendroctonus ponderosae*) outbreaks are occurring throughout the entire distribution of the GYE whitebark pine (Fig. 1), in some areas resulting in whitebark pine mortality exceeding 95% of cone bearing trees.”). Kenneth F. Raffa et al., *Cross-Scale Drivers of Natural Disturbances Prone to Anthropogenic Amplification: The Dynamics of Bark Beetle Eruptions*, 58 BIOSCIENCE 501, 503 (June 2008) (citations omitted), found that mountain pine beetles have affected large stretches of land in western Canada since 1999, causing higher than normal levels of mortality.
- In July 2011, the Fish and Wildlife Service issued a finding that the listing of whitebark pines as endangered or threatened under the Endangered Species Act was warranted but precluded by higher priority actions. The agency found that “[t]he interaction between fire suppression and environmental effects from climate change exacerbates the impacts to *P. albicaulis* [whitebark

pinus], and in the future will be particularly devastating to *P. albicaulis* populations as *P. albicaulis* seed sources are expected to become increasingly limited by continued impacts from white pine blister rust and mountain pine beetle.” Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition To List *Pinus albicaulis* as Endangered or Threatened With Critical Habitat, 76 Fed. Reg. 42,631 (July 19, 2011).

29. Nicholas C. Coops & Richard H. Waring, *A Process-Based Approach to Estimate Lodgepole Pine (Pinus contorta Dougl.) Distribution in the Pacific Northwest under Climate Change*, 105 CLIMATIC CHANGE 313 (2010) (“With projected increasing warming over the rest of the century, without a commensurate large increase in precipitation, the environment will be both too warm and too dry for lodgepole pine to compete well with other Northwest tree species. . . . By 2080, the species is expected to be almost absent from Oregon, Washington and Idaho.”). See also PARKS IN PERIL, *supra* note 3, at 21; John Collins Rudolf, *Climate Change Takes Toll on the Lodgepole Pine*, GREEN: A BLOG ABOUT ENERGY AND THE ENVIRONMENT (Feb. 28, 2011), available at <http://green.blogs.nytimes.com/2011/02/28/climate-change-takes-toll-on-the-lodgepole-pine/>; Emily K. Smith et al., *Blister Rust Incidence in Treeline Whitebark Pine, Glacier National Park, U.S.A.: Environmental and Topographic Influences*, 43 ARCTIC, ANTARCTIC & ALPINE RES. 107 (February 2011).

30. Melinda Burns, *Climate Change Could Spell Disaster for National Parks*, PAC. STANDARD (Sept. 20, 2010), available at <http://www.miller-mccune.com/environment/climate-change-could-spell-disaster-for-national-parks-23068/>.

31. Scott Condon, *Aspen Symposium: Grim Outlook for Forests Because of Bugs, Disease*, ASPEN TIMES, Feb. 19, 2011, available at <http://www.aspentimes.com/article/20110219/NEWS/110219812>. More than a million acres of aspen forests died between 2003 and 2009. *Id.*

32. PARKS IN PERIL, *supra* note 3, at 24.

33. See, e.g., CONGRESSIONAL BUDGET OFFICE, POTENTIAL IMPACTS OF CLIMATE CHANGE IN THE UNITED STATES 12 (May 2009) (“Studies generally conclude that warming and higher atmospheric concentrations of carbon dioxide will boost global forest growth and timber production over the course of the 21st century, although the effects on timber supply in specific regions will vary.”).

34. Gregory Latta et al., *Analysis of Potential Impacts of Climate Change on Forests of the United States Pacific Northwest*, 259 FOREST ECOLOGY & MGMT. 720 (February 2010).

35. GLACIER NATIONAL PARK IN PERIL, *supra* note 9, at iv.

36. PARKS IN PERIL, *supra* note 3, at 21.

37. Seth W. Munson et al., *Responses of Wind Erosion to Climate-Induced Vegetation Changes on the Colorado Plateau*, PROC. NAT’L ACAD. SCI. U.S.A. (Feb. 22, 2011), available at <http://www.pnas.org/content/early/2011/02/16/1014947108.full.pdf+html>.

38. Zinn, *supra* note 7, at 74; PARKS IN PERIL, *supra* note 3, at 20.

39. April Reese, *Drier, Hotter Conditions Place Prescribed Fire Projects Under Scrutiny*, LAND LETTER, Apr. 15, 2010.

40. Geranios, *supra* note 2.

41. See *Greater Yellowstone Coal, Inc. v. Servheen*, 665 F.3d 1015, 1026 (9th Cir. 2011) (chastising the FWS for failing to address in deciding to delist under the Endangered Species Act a distinct population segment of grizzlies “the heart of the threat that whitebark pine loss poses to the bears: increased proximity to humans when bears *do* adapt to seed shortages by seeking substitute foods”); Solotaroff, *supra* note 8.

42. GLACIER NATIONAL PARK IN PERIL, *supra* note 9, at iv.

43. See Eric A. Beever et al., *Contemporary Climate Change Alters the Pace and Drivers of Extinction*, 17 GLOBAL CHANGE BIOLOGY 2054 (2011) (concluding that “[i]ncreasing rates of site-level pika losses are consistent with surprising climate anomalies during the last decade” in the Great Basin ecoregion and that losses of pika “have important implications not only because of their indication of an increasing pace of environmental change, but also because they may precipitate secondary ecosystem consequences”). See also Rebecca J. Rowe, Rebecca C. Terry & Eric A. Rickart, *Environmental Change and Declining Resource Availability for Small-Mammal Communities in the Great Basin*, 96 ECOLOGY 1366 (2011).

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44. Solotaroff, *supra* note 8.
45. *Salmon: Warming Stress Leads to Fish Die-Off from Viral Disease*, CLIMATEWIRE, Apr. 22, 2011.
46. Zinn, *supra* note 7, at 74.
47. PARKS IN PERIL, *supra* note 3, at 22; Burns, *supra* note 30 (describing how invasive grass at Saguaro National Park is crowding out native saguaro cactus).
48. UNIVERSITY OF WYOMING, ABSAROKA ELK ECOLOGY PROJECT: 2010 PROGRESS UPDATE, <http://gf.state.wy.us/downloads/pdf/RegionalNews/dh-elm%20ecology%202010.pdf>; Shauna Stephenson, *Yellowstone Elk Study Points to Lasting Effects of a Hotter, Longer Summer*, NEW WEST, Mar. 9, 2011, available at http://www.newwest.net/topic/article/yellowstone_elk_study_points_to_lasting_effects_of_a_hotter_longer_summer/C41/L41/#comments (reporting findings of the Asaroka researchers that “between 1989 and 2010, the green-up period has been compressed by 40 percent, or by about 27 days,” and that “July temperatures, which used to average about 66 degrees, have increased 8 degrees since 1989, which coincides with times of drought and reduced snowpack,” resulting in lower-quality food for ungulates).
49. Zinn, *supra* note 7, at 73.
50. U.S. Fish & Wildlife Serv., *Endangered and Threatened Wildlife and Plants: 12-Month Finding on a Petition to List the North American Wolverine as Endangered or Threatened*, 75 Fed. Reg. 78,030 (Dec. 14, 2010). The FWS also concluded, however, that listing of the wolverine as either endangered or threatened was precluded by higher-priority actions.
51. See Synte Peacock, *Projected 21st Century Climate Change for Wolverine Habitats Within the Contiguous United States*, ENVTL. RES. LETTER 6 014007 (2011) (concluding that it is “likely that the present-day wolverine habitat could undergo dramatic modification in the decades to come” and that climate change threatens the wolverine through reduction or elimination of snow cover and increases in temperatures to levels the animal cannot tolerate).
52. *Id.* at 8. The author concluded that “[u]nless the wolverine is able to very rapidly adapt to summer-time temperatures far above anything it currently experiences, and to a spring with little or zero snow cover, it is unlikely that it will continue to survive in the contiguous US under a high or medium–low emissions scenario.” *Id.* at 10.
53. Brendan Kelly et al., *The Arctic Melting Pot*, 468 NATURE 891 (Dec. 16, 2010).
54. PARKS IN PERIL, *supra* note 3, at 30–31; Rosen, *supra* note 10.
55. PARKS IN PERIL, *supra* note 3, at 25–27, 29–30.
56. See, e.g., GLACIER NATIONAL PARK IN PERIL, *supra* note 9, at iii (predicting decline in visitors to Glacier National Park as a result of climate-induced changes); *id.* at 2 (“a climate disrupted by human activities—by our emissions of heat-trapping pollutants, principally carbon dioxide from burning fossil fuels—threatens both Glacier’s special natural resources and the tourism based on them.”).
57. PARKS IN PERIL, *supra* note 3, at 10.
58. *Id.* at 35–36.
59. *Id.* at 37–38.
60. *Id.* at 13.
61. *Id.* at 34.
62. Rosen, *supra* note 10.
63. INTERNATIONAL GOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: IMPACTS, ADAPTATION AND VULNERABILITY [hereinafter IPCC, IMPACTS], available at http://www.ipcc.ch/publications_and_data/ar4/wg2/en/spmssp-d.html.
64. NAT’L RESEARCH COUNCIL, AMERICA’S CLIMATE CHOICES 3 (2011).
65. IPCC, IMPACTS, *supra* note 63.
66. *Id.*
67. See REPORT BY THE NATIONAL CLIMATE ADAPTATION SUMMIT COMMITTEE (Sept. 29, 2010), http://www.joss.ucar.edu/events/2010/ncas/ncas_report.pdf.
68. *Id.*
69. PEW CENTER ON GLOBAL CLIMATE CHANGE, ADAPTING TO CLIMATE CHANGE: A CALL FOR FEDERAL LEADERSHIP 8 (March 2010).
70. *Id.* at 6, 8.

71. *Id.* at 11, 13. For general discussion of the appropriate federal role in climate change adaptation efforts, see Robert L. Glicksman, *Climate Change Adaptation: A Collective Action Perspective on Federalism Considerations*, 40 ENVTL. L. 1159 (2010).

72. See, e.g., Daniel A. Farber, *Adaptation Planning and Climate Impact Assessments: Learning from NEPA's Flaws*, 39 ENVTL. L. REP. 10605, 10609 (2009).

73. PROGRESS REPORT OF THE INTERAGENCY CLIMATE CHANGE ADAPTATION TASK FORCE 2 (Mar. 16, 2010), <http://www.whitehouse.gov/sites/default/files/microsites/ceq/20100315-interagency-adaptation-progress-report.pdf>. A group of federal agencies have collaborated with nongovernmental organizations to develop guidance for natural resource managers and other decision makers on climate change vulnerability assessments. See INTERAGENCY CLIMATE CHANGE ADAPTATION TASK FORCE, FEDERAL ACTIONS FOR A CLIMATE RESILIENT NATION: A PROGRESS REPORT OF THE INTERAGENCY CLIMATE CHANGE ADAPTATION TASK FORCE 21 (Oct. 28, 2011) [hereinafter CLIMATE RESILIENT NATION] (citing P. Glick, B.A. Stein & N.A. Adelson, *Scanning the Conservation Horizon: A Guide to Climate Change Vulnerability Assessment* (2011)).

74. Federal Leadership in Environmental, Energy, and Economic Performance, Exec. Order No. 13514, § 16, 74 Fed. Reg. 52,117, 52,124 (Oct. 5, 2009).

75. THE WHITE HOUSE COUNCIL ON ENVIRONMENTAL QUALITY, PROGRESS REPORT OF THE INTERAGENCY CLIMATE CHANGE TASK FORCE: RECOMMENDED ACTIONS IN SUPPORT OF A NATIONAL CLIMATE CHANGE ADAPTATION STRATEGY 8 (Oct. 5, 2010) [hereinafter TASK FORCE REPORT].

76. *Id.* at 8.

77. *Id.* at 10.

78. *Id.* at 11. A year later, the Task Force's Water Resources and Climate Change Adaptation Workgroup made a series of priority recommendations for collaborative public and private management of freshwater resources in response to climate change to protect water quality and aquatic ecosystems. INTERAGENCY CLIMATE CHANGE ADAPTATION TASK FORCE, NATIONAL ACTION PLAN: PRIORITIES FOR MANAGING FRESHWATER RESOURCES IN A CHANGING CLIMATE (Oct. 2011) [hereinafter MANAGING FRESHWATER RESOURCES].

79. TASK FORCE REPORT, *supra* note 75, at 42.

80. *Id.* at 23.

81. *Id.* at 52.

82. COUNCIL ON ENVTL. QUALITY, FEDERAL AGENCY CLIMATE CHANGE ADAPTATION PLANNING: IMPLEMENTING INSTRUCTIONS (Mar. 4, 2011).

83. *Id.*

84. See H.R. REP. NO. 111-316 (2009), at 76.

85. TASK FORCE REPORT, *supra* note 75, at 44.

86. Secretarial Order No. 3289, Addressing the Impacts of Climate Change on America's Water, Land, and Other Natural and Cultural Resources, § 1 (Sept. 14, 2009), <http://www.fws.gov/home/climatechange/pdf/SecOrder3289.pdf>.

87. *Id.* § 3.

88. *Id.* § 3(a).

89. *Id.* § 3(c).

90. UNITED STATES DEP'T OF THE INTERIOR, STRATEGIC PLAN FOR FISCAL YEARS 2011–2016, at 11.

91. *Id.* at 31.

92. PEW CENTER ON GLOBAL CLIMATE CHANGE, *supra* note 69, at 1.

93. 42 U.S.C. § 4332(2)(C).

94. *Ctr. for Biological Diversity v. Kempthorne*, 588 F.3d 701, 711–12 (9th Cir. 2009).

95. *Conservation Nw. v. Rey*, 674 F. Supp. 2d 1232, 1253 (W.D. Wash. 2009).

96. *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 352–53 (1989).

97. *Cf. Neighbors of Cuddy Mountain v. U.S. Forest Serv.*, 137 F.3d 1069, 1080–83 (9th Cir. 1998) (finding NEPA violation based on perfunctory description of mitigation measures).

98. CEQ, Memorandum for Heads of Federal Agencies, Appropriate Use of Mitigation and Monitoring and Clarifying the Appropriate Use of Mitigated Findings of No Significant

Impact (2011), http://ceq.hss.doe.gov/current_developments/docs/Mitigation_and_Monitoring_Guidance_14Jan2011.pdf.

99. *Id.* The guidance also provides that agencies should take steps to ensure that mitigation commitments are actually implemented by clearly identifying commitments to mitigation measures in their decision documents. They should specify measurable performance standards or clear results, thus establishing clear expectations. In addition, agencies should establish a time frame for the agency action and mitigation measures so that the start date and duration of the mitigation commitment are clear.

100. 16 U.S.C. § 1533.

101. 16 U.S.C. § 1536(a)(2).

102. 16 U.S.C. § 1538(a)(1)(B).

103. 16 U.S.C. § 1533(f)(1).

104. *Alliance for Wild Rockies v. Lyder*, 728 F. Supp. 2d 1126, 1143 (D. Mont. 2010). *See also* *Ctr. for Biological Diversity v. Lubchenco*, 758 F. Supp. 2d 945 (N.D. Cal. 2010) (upholding decision of the National Marine Fisheries Service not to list the ribbon seal as threatened on the ground that the effects of climate change on the seal and its habitat beyond 2050 were too speculative to warrant listing).

105. *In re* Polar Bear Endangered Species Act Listing and § 4(d) Rule Litig., 794 F. Supp. 2d 65 (D.D.C. 2011).

106. *Id.* at 95–96.

107. *Id.* at 100. The same court later upheld FWS regulations issued under § 4(d) of the ESA that applied the § 9 take prohibition to polar bears. *In re* Polar Bear Endangered Species Act Listing and § 4(d) Rule Litigation, 818 F. Supp. 2d 214 (D.D.C. 2011).

108. *Greater Yellowstone Coal., Inc. v. Servheen*, 665 F.3d 1015 (9th Cir. 2011).

109. *W. Watershed Project v. U.S. Forest Serv.*, 780 F. Supp. 2d 1115, 1124 (D. Idaho 2011).

110. *Natural Res. Def. Council v. Kempthorne*, 506 F. Supp. 2d 322, 370 (E.D. Cal. 2007). *See also* *South Yuba River Citizens League v. Nat'l Marine Fisheries Serv.*, 723 F. Supp. 2d 1247 (E.D. Cal. 2010) (invalidating biological opinion because it concluded that a dam operation and water diversion project would exacerbate stressors, including climate change, on listed fish without explaining why those combined stressors would not jeopardize the species).

111. According to the Adaptation Task Force, although “[f]ederal agencies are at different stages of adaptation planning,” most seem to be engaged in the initial stages, which will lay “the foundation for agencies to more fully integrate actions into their operations and management to reduce climate risks to Federal programs, services, and the Nation.” CLIMATE RESILIENT NATION, *supra* note 73, at 7. *See also* Jamie Iguchi, Note, *Improving the Improvement Act: Climate Change Management in the National Wildlife Refuge System*, 34 Spring ENVIRONS 247, 258 (2011) (stating that “[i]t is too early to determine the effectiveness” of the Interior Secretary’s Order No. 3289, discussed at *supra* notes 86–89 and accompanying text).

112. *See, e.g.*, 42 U.S.C. § 7521(a)(1); *Massachusetts v. EPA*, 549 U.S. 497 (2007).

113. Pub. L. No. 100-204, § 1103(b), 101 Stat 1331 (codified at 15 U.S.C. § 2901 note).

114. U.S. ENVTL. PROT. AGENCY, GLOBAL CHANGE RESEARCH, SCIENCE OVERVIEW, *available at* <http://www.epa.gov/ord/npd/globalresearch-intro.htm>.

115. U.S. ENVTL. PROT. AGENCY, ENDANGERMENT FINDING AND CAUSE OR CONTRIBUTE FINDINGS FOR GREENHOUSE GASES UNDER SECTION 202(A) OF THE CLEAN AIR ACT; Final Rule, 74 Fed. Reg. 66,496, 66,512 (Dec. 15, 2009). *Coal. for Responsible Regulation v. EPA*, 2012 WL 2381955 (D.C. Cir. June 26, 2012), upheld the Endangerment Finding against a series of attacks by industry and some states.

116. *See, e.g.*, U.S. ENVTL. PROT. AGENCY, NATIONAL WATER PROGRAM STRATEGY: RESPONSE TO CLIMATE CHANGE, KEY ACTION UPDATE FOR 2010–2011 (August 2010), <http://water.epa.gov/scitech/climatechange/upload/NWP-Key-Action-Update-2010-2011.pdf>; U.S. ENVTL. PROT. AGENCY, ADAPTATION PLANNING FOR THE NATIONAL ESTUARY PROGRAM (May 2009), <http://www.epa.gov/cre/downloads/CREAdaptationPlanning-Final.pdf>.

117. U.S. ENVTL. PROT. AGENCY, POLICY STATEMENT ON CLIMATE-CHANGE ADAPTATION (June 2, 2011), <http://www.epa.gov/climatechange/effects/downloads/adaptation-statement.pdf>.

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118. *Id.* at 1.
119. *Id.* at 2.
120. CEQ, National Environmental Policy Act (NEPA) Draft Guidance, Consideration of the Effects of Climate Change and Greenhouse Gas Emissions, 75 Fed. Reg. 8046 (2010) (notice of availability).
121. Council on Environmental Quality, Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions 1 (Feb. 18, 2010), <http://www.whitehouse.gov/sites/default/files/microsites/ceq/20100218-nepa-consideration-effects-ghg-draft-guidance.pdf>.
122. *Id.* at 11–12.
123. 15 U.S.C. § 2902 (emphasis added). *See also id.* § 2904 (vesting the Secretary of Commerce with responsibility to administer the program).
124. NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, CLIMATE CHANGE, *available at* <http://www.oar.noaa.gov/research/2007/climatechange.shtml>.
125. National Oceanic and Atmospheric Administration, FY 2012 Budget Reorganization Summary, [http://www.corporateservices.noaa.gov/nbo/fy12_bluebook/chapter2_2012_Budget Reorganization.pdf](http://www.corporateservices.noaa.gov/nbo/fy12_bluebook/chapter2_2012_Budget_Reorganization.pdf). *See also* Notice of Availability of a Draft NOAA Climate Service Strategic Vision and Framework for Public Review, and Notice of Informational Webinar Meetings, 75 Fed. Reg. 55739 (Sept. 22, 2010).
126. Department of Defense and Full-Year Continuing Appropriations Act 2011, Pub. L. No. 112-10, § 1348, 125 Stat 38, 124 (codified at 49 USCA § 40101 note). *See also* Brian Vastag, *Congress Kills Request for National Climate Service*, WASH. POST, Nov. 20, 2011 (describing political forces leading to a congressional budget deal prohibiting NOAA from creating a National Climate Service).
127. NOAA'S NEXT-GENERATION STRATEGIC PLAN (December 2010), *available at* <http://www.ppi.noaa.gov/ngsp/>.
128. *See generally* 3 GEORGE CAMERON COGGINS & ROBERT L. GLICKSMAN, PUBLIC NATURAL RESOURCES LAW §§ 23:1–23:6 (2d ed. 2007).
129. 16 U.S.C. § 1.
130. *Id.* § 3.
131. NATIONAL PARK SERVICE, CLIMATE CHANGE IS REAL, *available at* <http://www.nature.nps.gov/climatechange/overview.cfm>.
132. NATIONAL PARK SERVICE, CLIMATE CHANGE HAS CONSEQUENCES FOR PARKS, PEOPLE, AND THE PLANET, *available at* <http://www.nature.nps.gov/climatechange/effects.cfm>.
133. NATIONAL PARK SERVICE, NPS RESPONSES TO CLIMATE CHANGE, *available at* <http://www.nature.nps.gov/climatechange/response.cfm>.
134. NATIONAL PARK SERVICE, CLIMATE CHANGE RESPONSE STRATEGY 1 (September 2010).
135. *Id.* at 9.
136. *Id.* at 12–13.
137. *Id.* at 14–18.
138. *Id.* at 23.
139. 16 U.S.C. § 1533.
140. *Id.* § 1536(b).
141. *Id.* § 1533(f).
142. 42 U.S.C. §§ 668dd to 668ee.
143. *Id.* § 668dd(a)(2).
144. *Id.* § 668dd(a)(4).
145. *Id.* § 668dd(e)(1).
146. *See generally* 3 COGGINS & GLICKSMAN, *supra* note 128, at § 24:1.
147. U.S. FISH & WILDLIFE SERV., RISING TO THE URGENT CHALLENGE: STRATEGIC PLAN FOR RESPONDING TO ACCELERATING CLIMATE CHANGE 6 (2010) [hereinafter FWS, RISING TO THE CHALLENGE].
148. FWS, RISING TO THE CHALLENGE, *supra* note 147.
149. For discussion of adaptation strategies that may be available to state fish and wildlife agencies, see ASSOCIATION OF FISH AND WILDLIFE AGENCIES, VOLUNTARY GUIDANCE FOR

STATES TO INCORPORATE CLIMATE CHANGE INTO STATE WILDLIFE ACTION PLANS & OTHER MANAGEMENT PLANS (December 2009).

150. FWS, RISING TO THE CHALLENGE, *supra* note 147, at 2.

151. *Id.* at 8, 10.

152. U.S. FISH & WILDLIFE SERV., CONSERVING THE FUTURE: WILDLIFE REFUGES AND THE NEXT GENERATION 15, Draft, http://americaswildlife.org/wp-content/uploads/2011/02/Draft_Vision.Refuge.System.pdf [hereinafter FWS, CONSERVING THE FUTURE]. See generally Brad Griffith et al., *Climate Change Adaptation for the U.S. National Wildlife Refuge System*, 44 ENVTL. MGMT. 1043 (December 2009); Iguchi, *supra* note 111.

153. FWS, RISING TO THE CHALLENGE, *supra* note 147, at 11.

154. *Id.* at 20.

155. *Id.* at 20–21. A map of the 21 LCC locations is at *id.* at 21. See also MANAGING FRESHWATER RESOURCES, *supra* note 78, at 9 (discussing Landscape Conservation Cooperatives and other cooperative efforts by federal agencies to cooperate in freshwater resources management in the face of climate change).

156. FWS, RISING TO THE CHALLENGE, *supra* note 147, at 14–15.

157. *Id.* at 19–20.

158. *Id.* at 26. See also U.S. FISH & WILDLIFE SERV., NATIONAL WILDLIFE REFUGE SYSTEM, STRATEGIC PLAN FOR THE NATIONAL WILDLIFE REFUGE SYSTEM BIOLOGICAL MONITORING TEAM PILOT PROJECT FISCAL YEARS 2006–2010 (2005).

159. FWS, RISING TO THE CHALLENGE, *supra* note 147, at 13–14.

160. FWS, CONSERVING THE FUTURE, *supra* note 152, at 14.

161. FWS, RISING TO THE CHALLENGE, *supra* note 147, at 15–16, 18.

162. U.S. FISH & WILDLIFE SERV., APPENDIX: 5-YEAR ACTION PLAN FOR IMPLEMENTING THE CLIMATE CHANGE STRATEGIC PLAN 1, <http://www.fws.gov/home/climatechange/pdf/CCDraftActionPlan92209.pdf> (September 2009).

163. See generally 3 COGGINS & GLICKSMAN, *supra* note 128, at §§ 30:1 to 30:8.

164. 43 U.S.C. § 1712(a), (c)(1).

165. *Id.* § 1732(a).

166. 16 U.S.C. § 531(a).

167. *Id.* § 531(b).

168. BUREAU OF LAND MANAGEMENT, CLIMATE CHANGE: BLM'S RESPONSE, available at <http://www.blm.gov/wo/st/en/prog/more/climatechange/html>.

169. BUREAU OF LAND MANAGEMENT, THE BLM'S PROPOSED LANDSCAPE APPROACH FOR MANAGING PUBLIC LANDS 3, http://www.blm.gov/pgdata/etc/medialib/blm/wo/Communications_Directorate/public_affairs/landscape_approach.Par.32078.File.dat/landscape_approach.pdf [hereinafter BLM, LANDSCAPE APPROACH].

170. *Id.*

171. BUREAU OF LAND MANAGEMENT, AN INTRODUCTION TO RAPID ECOREGIONAL ASSESSMENTS 1, http://www.blm.gov/pgdata/etc/medialib/blm/wo/Communications_Directorate/public_affairs/landscape_approach.Par.84084.File.dat/REAintroduction.pdf [hereinafter BLM, REAs].

172. BLM, LANDSCAPE APPROACH, *supra* note 169, at 2. For an example of a completed REA, see BUREAU OF LAND MANAGEMENT, RAPID ECOREGIONAL ASSESSMENT OF THE NORTHERN BASIN AND RANGE AND SNAKE RIVER PLAIN (2009). For an assessment of the REAs to date, see MARSHA BRACKE & MAGGIE MCCAFFREY, LESSONS LEARNED REPORT: ECOREGIONAL ASSESSMENT PROCESSES (November 2010).

173. BLM, LANDSCAPE APPROACH, *supra* note 169, at 2.

174. BLM, REAs, *supra* note 171, at 2.

175. See 1 COGGINS & GLICKSMAN, *supra* note 128, at § 6:18.

176. Omnibus Public Land Management Act of 2009, Pub. L. No. 111-11, § 9305, 123 Stat. 991, 1332 (codified at 42 U.S.C. § 10363).

177. *Id.* § 9503(a)(2).

178. *Id.* § 9503(b).

179. MANAGING FRESHWATER RESOURCES, *supra* note 78.

180. BUREAU OF RECLAMATION, SECURE, *supra* note 5, at 185–86.

181. U.S. ARMY CORPS OF ENGINEERS & BUREAU OF RECLAMATION, ADDRESSING CLIMATE CHANGE IN LONG-TERM WATER RESOURCES PLANNING AND MANAGEMENT: USER NEEDS FOR IMPROVING TOOLS AND INFORMATION (January 2011).

182. Secretarial Order, Department of the Interior WaterSMART Program—Sustain and Manage America’s Resources for Tomorrow § 4(a)(2) (Feb. 22, 2010), *available at* <http://www.doi.gov/watersmart/html/about.html>. For more on the WaterSMART program, see CLIMATE RESILIENT NATION, *supra* note 73, at 18–19.

183. BUREAU OF RECLAMATION, SECURE, *supra* note 5, at 186–87.

184. *Id.* at 189–92.

185. 16 U.S.C. §§ 473 to 482 (partially repealed 1976).

186. 16 U.S.C. §§ 528 to 531.

187. 16 U.S.C. §§ 1600 to 1616.

188. 16 U.S.C. § 475.

189. 16 U.S.C. § 528.

190. *Id.* § 529.

191. 16 U.S.C. § 1601(d)(1).

192. *Id.* § 1604(g).

193. *Id.* § 1604(i).

194. *See, e.g.*, Perkins v. Bergland, 608 F.2d 803 (9th Cir. 1979).

195. *See, e.g.*, Pacific Rivers Council v. Thomas, 30 F.3d 1050 (9th Cir. 1994); Seattle Audubon Soc’y v. Espy, 998 F.2d 699 (9th Cir. 1993).

196. USDA FOREST SERVICE STRATEGIC PLAN FY 2007–2012, at 4 (July 2007).

197. USDA FOREST SERVICE STRATEGIC PLAN FY 2010–2015, at 14 (July 2010).

198. USDA FOREST SERVICE, FOREST SERVICE STRATEGIC FRAMEWORK FOR RESPONDING TO CLIMATE CHANGE (October 2008), <http://www.fs.fed.us/climatechange/documents/strategic-framework-climate-change-1-0.pdf> [hereinafter FOREST SERVICE, STRATEGIC FRAMEWORK].

199. *Id.* at 4.

200. *Id.*

201. *Id.* at 9.

202. *Id.* at 11.

203. *Id.*

204. The Forest Service’s concern over the role of climate change in posing threats to sustainability by facilitating the spread of invasive species is one reason for the agency’s decision to establish an internal directive for invasive species management. *See* National Forest System Invasive Species Management Policy, 76 Fed. Reg. 75,860, 75,861 (Dec. 5, 2011).

205. FOREST SERVICE, STRATEGIC FRAMEWORK, *supra* note 198, at 13.

206. USDA FOREST SERVICE, NATIONAL ROADMAP FOR RESPONDING TO CLIMATE CHANGE 2–3 (July 2010) [hereinafter FOREST SERVICE, ROADMAP].

207. FOREST SERVICE, ROADMAP, *supra* note 206. On June 3, 2011, the office of the secretary of agriculture issued a policy statement on climate change adaptation, <http://www.ocio.usda.gov/directives/doc/DR1070-001.pdf>. The policy “establishes a USDA-wide directive to integrate climate change adaptation planning and actions into USDA programs, policies, and operations.” *Id.* at 1. The policy statement committed the department to the development of an adaptation plan within a year and an assessment of agency vulnerabilities to climate change. It ordered all Agriculture Department offices and agencies to analyze how climate change may affect the ability of the agency or office to achieve its mission and its policy, program, and operational objectives by reviewing existing programs, operations, policies, and authorities, and to consider potential climate change impacts when undertaking long-term planning exercises. *Id.* at 2. Congressional appropriations riders interfered with implementing that policy statement. *See, e.g.*, <http://thomas.loc.gov/cgi-bin/bdquery/D?d112:49:./temp/~bdGxK8:./home/LegislativeData.phpl>.

208. The center’s website is at <http://www.fs.fed.us/ccrc/>.

209. FOREST SERVICE, ROADMAP, *supra* note 206, at 10–11.

210. *Id.* at 11–12.

211. *Id.* at 27–28.

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212. *Id.* at 13.
213. *Id.* at 28.
214. USDA Forest Service, National Forest System Land Management Planning; Proposed Rule, 76 Fed. Reg. 8480, 8480 (Feb. 14, 2011).
215. *Id.* at 8482.
216. *Id.* at 8481.
217. *Id.* at 8490, 8494.
218. *Id.* at 8495. *See also id.* at 8516 (proposed 36 C.F.R. § 219.5(a)) (describing goal of creating “a responsive and agile planning process that informs integrated resource management and allows the Forest Service to adapt to changing conditions, including climate change”); *id.* at 8519 (proposed 36 C.F.R. § 219.10(a)(9)).
219. *Id.* at 8518 (proposed 36 C.F.R. § 219.8(a)(1)(ii)).
220. *Id.* at 8498; *id.* at 8520 (proposed 36 C.F.R. § 219.12(a)(5)(v)) (authorizing managers to set the scope and scale of unit monitoring based on measurable changes in the unit related to climate change).
221. *Id.* at 8508. Shortly before this book went to press, the Forest Service issued its final planning rule. 77 Fed. Reg. 21,162, 21,164 (Apr. 9, 2012). The new rule lists several purposes and needs that a plan must address, including making national forest lands more resilient to climate change and ensuring that all plans will be responsive and can adapt to issues such as the challenges of climate change. The rule is designed to “create a responsive planning process that informs integrated resource management and allows the Forest Service to adapt to changing conditions, including climate change, and improve management based on new information and monitoring.” 36 C.F.R. § 219.5(a). Among other things, each forest plan must include a monitoring program that assesses measurable changes on the plan area related to climate change and other stressors that may be affecting that area. 36 C.F.R. § 219.12(a)(5)(vi). This requirement is to ensure that information related to climate change will be addressed “in a consistent and strategic fashion.” 77 Fed. Reg. at 21,176. In addition, planning officials must consider climate change when providing for ecosystem services and multiple uses. 36 C.F.R. § 219.10(a)(8). These provisions of the planning rule appear to reflect the Forest Service’s commitment to build climate change adaptation considerations systematically into its management of the national forests.
222. *See* Lesley Jantarasami et al., *Institutional Barriers to Climate Change Adaptation in U.S. National Parks and Forests*, 15 *ECOLOGY & SOC’Y* 33 (2010).
223. Anthony Povilitis & Kieran Suckling, *Addressing Climate Change Threats to Endangered Species in U.S. Recovery Plans*, 24 *CONSERVATION BIOLOGY* 372, 374 (2010).
224. Jantarasami et al., *supra* note 222.
225. *Id.*
226. Griffith et al., *supra* note 152, at 1050. *See also id.* at 1049 (“The historical concept of refuges as fixed islands of safe haven for species is no longer viable. The historical concept of dynamic equilibrium must be replaced with the concept of dynamic trends that are driven by spatially and temporally variable climate forcing.”).
227. *See, e.g.*, National Forest System Land Management Planning, Proposed Rule, 76 Fed. Reg. 8480, 8492 (Feb. 14, 2011) (noting that “[c]limate change and related stressors could . . . make it impossible to maintain current ecosystem conditions”); *id.* at 8509 (referring to the need to eliminate “required prescriptive benchmark analysis” in the face of climate change).
228. Jantarasami et al., *supra* note 222. *See also* Griffith et al., *supra* note 152, at 1047 (arguing that the ESA’s no-jeopardy provision constrains the FWS’s broad discretion under the National Wildlife Refuge System Improvement Act to manage wildlife refuges in ways that achieve the system’s conservation mission).
229. Jantarasami et al., *supra* note 222. *See also* FWS, *CONSERVING THE FUTURE*, *supra* note 152, at 21 (“To adhere to the principles of wilderness stewardship, adapting to climate change will require resisting manipulation and embracing the Wilderness Act provision regarding scientific purpose.”).
230. 16 U.S.C. § 1604.
231. Jantarasami et al., *supra* note 222.

232. National Forest System Land Management Planning, Proposed Rule, 76 Fed. Reg. 8480 (Feb. 14, 2011). The Forest Service finalized the new planning rule in 2012. *See* 77 Fed. Reg. 21,162, 21,164 (Apr. 9, 2012).

233. *See, e.g.,* Raffa et al., *supra* note 28, at 514 (“Management strategies should be aimed at reducing the likelihood that the set of conditions required to pass the eruptive threshold will co-occur.”).

234. Burns, *supra* note 30.

235. Viti et al., *Assisted Migration of Plants: Changes in Latitudes, Changes in Attitudes*, 143 BIOLOGICAL CONSERVATION 18 (January 2010) (references omitted), note that “climate change is rapidly shifting climate envelopes for plants and to higher elevations, to such an extent that human-mediated movement of species may become necessary for more conservative species that are less mobile or adaptable.” The authors argue that “assisted migration may become commonplace for many species,” and they support “efforts to create decision-making frameworks that weigh the risk of doing nothing with the risks of translocating species.” They add that “well-conceived translocations of species may reduce the risk of extinction, as well as increase the number of potential taxa creating new assemblages in a fluid landscape responding to broad scale changes.” *Id.*

236. Griffith et al., *supra* note 152, at 1049.

237. Burns, *supra* note 30.

238. Anne Raver, *A Hunt for Seeds to Save Species, Perhaps by Helping Them Move*, N.Y. TIMES, Nov. 10, 2009; Seeds of Success: National Native Seed Collection Program, Memorandum of Understanding, *available at* <http://www.nps.gov/plants/sos/mou.html>.

239. 16 U.S.C. § 1539(j).

240. 16 U.S.C. § 1604(g)(3)(B).

241. 16 U.S.C. § 1.

242. Raffa et al., *supra* note 28, at 515.

243. TASK FORCE REPORT, *supra* note 75, at 25.

244. *Id.* at 43.

245. Bruce Stutz, *Adaptation Emerges as Key Part of Any Climate Change Plan*, YALE ENV'T 360 (May 26, 2009), *available at* <http://e360.yale.edu/content/feature.msp?id=2156>. *See also* Griffith et al., *supra* note 152, at 1049 (“The NWRSIA requires system expansion and adaptation to climate change requires the NWRS to consider lands and waters outside refuge boundaries as means to expand the conservation footprint. In some instances acquisition of property for system expansion will best serve the conservation mission of the NWRS.”).

246. *See* 2 COGGINS & GLICKSMAN, *supra* note 128, §§ 13:24 to 13:50.