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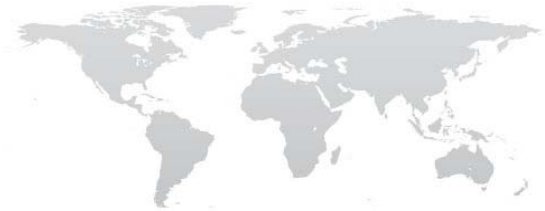

Adaptation to Climate Change in Public Lands Management

Joel B. Smith and William R. Travis[1]

As defined by the Intergovernmental Panel on Climate Change, adaptation includes a set of actions to moderate harm or exploit beneficial opportunities in response to climate change. To date, little research has addressed public policy options to frame the nation's approach to adapt to a changing climate. In light of scientific evidence of extreme and unpredictable climate change, prudent policy requires consideration of what to do if markets and people fail to anticipate these changes, or are constrained in their ability to react. This issue brief is one in a series that results from the second phase of a domestic adaptation research project conducted by Resources for the Future. The briefs are primarily intended for use by decisionmakers in confronting the complex and difficult task of effectively adapting the United States to climate change impacts, but may also offer insight and value to scholars and the general public. *This research was supported by a grant from the Smith-Richardson Foundation.*

Policy Recommendations

Climate change will result in altered ecological features, such as forests becoming grasslands, as well as changing species populations and distributions across federal lands. As a consequence, federal land ownership may not align with optimal uses, and effective adaptation may be hindered by the piecemeal division of responsibility among different agencies, notably the U.S. Forest Service (USFS), the National Park Service (NPS), the Bureau of Land Management (BLM), and the U.S. Fish and Wildlife Service (FWS). We offer recommendations for short- and long-term changes in federal land management policy to adapt to climate change.

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SHORT-TERM POLICIES

Exhibit leadership on climate change. Strong, consistent, and explicit support for climate change adaptation needs to be infused from the top. In October 2009, Interior Secretary Ken Salazar issued an order instituting a strong program on adaptation in the Interior Department, which will cover NPS, FWS, and BLM (U.S. DOI 2009). USFS would benefit from similar requirements. White House leadership may also be needed to ensure a strong and consistent response across the federal government.

Conduct vulnerability assessments and use strategic planning to incorporate climate change into their activities. Many land management agencies carry out strategic planning at the agency and parcel level, and such plans consider the consequences of climate change for meeting objectives in the future. Each agency may also need to develop new strategic goals for incorporating climate change into planning, setting priorities, and identifying resource and research needs. Cross-agency strategic planning is needed to identify and resolve cross-agency issues, such as management of adjacent federal lands, water resources, and long-range species migration.

Develop effective monitoring systems. Monitoring systems are needed to assist agencies in making decisions under uncertainty (NRC 2009). Agencies should develop richer information sources for public lands managers, for example, an elaborated version of USFS's Climate Change Resource Center at http://www.fs.fed.us/ccrc/.

Institute regional cooperation among agencies, states, and public-private partnerships to help accommodate climate and ecological change at appropriate geographical scales (for example, wildlife migration corridors). Secretary Salazar's order creates "Landscape Conservation Cooperatives" to coordinate adaptation to regional landscape matters. These cooperatives will involve U.S. Department of the Interior (DOI) agencies as well as other federal agencies, states, localities, tribes, and the private sector (US DOI 2009).

More fully implement adaptive management and ecosystems management, examine anachronistic management paradigms, and integrate climate change into more proactive decision and management regimes. This is one of the most challenging and complicated aspects of climate change adaptation. The U.S. Climate Change Science Project's Synthesis and Assessment Product (SAP) 4.4 lays out a number of adaptation options for managing ecosystems, including (Kareiva et al. 2008):

- protect key ecosystem features,
- reduce human stresses,
- protect a wide variety of forms of species (representation),

- replicate ecosystems,
- protect possible species refuges,
- relocate (transplant) species if necessary.

Create effective and coordinated research programs. Rather than a climate change research and policy assessment capacity agency by agency, a closely networked, multi-agency system of climate expertise should be created.

Use the public lands planning and management process as an instrument for testing adaptation strategies and tactics, and informing the public about climate change impacts and adaptations. Not only are there significant uncertainties about how ecosystems will be affected by climate change, but there are also many uncertainties on how to aid or facilitate ecosystem adaptation. This combination makes it imperative that land managers be willing and able to experiment with different types of adaptations such as those identified above. The system should encourage prudent risk taking and enable managers to learn from successes and failures, adopting an "adaptive management" approach.

LONG-TERM POLICIES

Examine ways to provide management flexibility while maintaining public input and checks on agency discretion. Climate change may require a rebalancing of local and national interests, and new ways of granting site-specific flexibility within national standards and guidelines.

Review and revise legislation to allow for integrated and more unified management of federal lands. One way to overcome a balkanization of federal land management through differing legislative mandates is to craft a single statute for governing management of public natural lands.

The statute would allow for multiple objectives and create a standard process for determining and selecting single- or multiple-purpose uses suitable for environmental and societal conditions.

Explore changes in how the federal government is organized that can promote a more integrated management of federal lands and response to climate change. Among the options are:

- *Integrate land management* within DOI. Prepare integrated land management plans incorporating climate change for BLM, NPS, and FWS. Secretary Salazar's order creates a mechanism for addressing adaptation on a regional scale (U.S. DOI 2009). Note that DOI does not include all agencies that will be managing federal lands under climate change such as USFS.

- *Create a Department of Natural Resources*. This would include all agencies currently in DOI, as well as USFS, the U.S. Environmental Protection Agency, the Army Corps, and the National Oceanic and Atmospheric Administration. This would facilitate coordination of natural resource management activities and could even allow for consolidation of management functions. On the other hand, it would create a very large and potentially unwieldy department, analogous to the Department of Homeland Security.
- *Consolidate research and monitoring for environmental change across agencies*, and maintain and grow the research infrastructure while ensuring useful outputs by developing climate-aware decision-support tools to increase robust decisionmaking on public lands. The National Climate Service (NCS) could serve as a means to carry out this proposal. NCS would need to effectively combine research functions carried out by many agencies.

Public Lands Management in a Changing Climate

Roughly one-third of the land in the United States is owned and managed by the federal government, ranging from well-known national parks like the Everglades and Great Smokey Mountains to small, but critical wildlife refuges.[2] How climate change will affect federal public lands is a particular target of concern because of the ecosystem services they provide, ranging from maintenance of naturalness and ecological diversity (especially in the case of National Parks and Wildlife Refuges) to provision of traditional resources like timber from USFS lands and forage for livestock grazing on BLM holdings.

This policy assessment examines options and barriers to adapting to climate change in federal lands management. Our focus is on the four largest public lands systems, managed by the NPS, USFS, BLM, and FWS. Each agency has its own history, legislative and executive mandates, traditions, and cultures. But all the federal land agencies share a similar land management-planning environment: they operate in the public sphere and answer to principles of democratic governance. Thus, they cannot adapt simply through administrative fiat but must operate with the consent of Congress and stakeholders.

THE CHALLENGE OF LAND MANAGEMENT UNDER CLIMATE CHANGE

To some extent, public lands and the resources on them are already affected by climate change. In many cases it is not an exaggeration to expect that climate change will dramatically alter the very character of habitats and ecosystems. Over the next century and beyond, species will shift by longitude (generally northward) and by altitude (for example, to higher elevations). The existence

[2]. The federal government owns one-third to one-half or more of the land in many western states , far more than the percentage of land it owns in eastern states.

of some ecosystems, such as the Everglades (NPS n.d.) and coral reefs, will be threatened. In many cases, impacts of climate change are already being observed. For example, the habitat of the Edith's checkerspot butterfly (*Euphydryas editha quino*) has already moved northward in California (Parmesan 1996). In some cases, the changes could be gradual. Species better suited to a changing climate may gradually migrate into areas dominated by species that will be ill-suited to the new climate. In many other cases, the transition may not be so gradual. Many areas will face increased fire risk, particularly in the West (Westerling et al. 2006). Warmer temperatures may make it easier for disease to spread or pests to survive, thus threatening the health of many forests (for example, Kurz et al. 2008).

Such changes would have serious implications for management of federal lands. Lands managed for particular uses may no longer be suitable for those uses, as vegetation and ecosystems change. Agencies will need to keep options open to be able to change management practices to suit different types of ecosystems.

Agency-Specific Decisionmaking

Each of the four main public land systems in the United States sprung from unique sets of historical and ecological circumstances, and each can be expected to respond differently to climate change.

NATIONAL FORESTS

National Forests cover some 190 million acres, including forests and grasslands. National Forest land planning and management are guided primarily by the 1976 National Forest Management Act (NFMA), which established three main management guidelines (Loomis 1993):

- Forest lands are managed to yield multiple benefits, including timber, watershed, wildlife, grazing, recreation, and wilderness, in a "sustained yield" manner. Managers are given wide discretion in assigning those uses to different areas, and in defining sustained yield.
- Plans are made within a 50-year horizon (during which significant climate change can be expected).
- Plans are predicated on forest status and trends determined through scientific and technical analysis. The forest planning process creates detailed land use plans on a nominally 15-year cycle for each management unit. These plans lay out targets for multiple uses and ecosystem services, often in detailed, quantitative fashion, and incorporate special goals, like wilderness management and species protection. The overarching principle of USFS management is multiple uses; even the most

restricted land classes, like wilderness, where no logging is allowed, must also provide watershed, habitat, forage, and recreation (USFS 2008).

NATIONAL PARKS

National Parks planning is much less specified by omnibus legislation and has emerged more through legislation creating individual parks and detailed rules and regulations adopted by NPS. These rules are often quite specific to each park unit, which has large discretion in developing plans and specific resource management strategies.

Attention to ecological issues and potential climate change falls on the so-called "natural parks," like the Everglades and Yellowstone, rather than historic sites and battlefields, but NPS will also make critical planning decisions sensitive to climate change in, for example, National Recreation Areas, Wild and Scenic Rivers, and National Seashores. Overall, of some 330 total park units in the United States, 270 are identified as containing significant natural resources and values potentially sensitive to climate impacts (Baron et al. 2008).

The overarching principle of National Parks management is preservation, but three long-standing management strains have beleaguered parks management for NPS's entire history:

- the tension between preservation and use (including recreational development, like lodges and campgrounds);
- the definition of "natural" and the tension between active management and intervention to achieve preservation (e.g., culling bison herds), and passive approaches that "let nature run its course;" and
- external and cross-boundary threats, especially water flows, air and water quality, and migratory wildlife.

The latter two strike at the heart of management challenges in a changing climate: What is natural if the baseline is changing, and how much intervention is permissible either to maintain a fixed natural baseline or allow for natural adaptation to a shifting baseline? Preservation might be interpreted by agencies and stakeholders simply as managing for the status quo or more aggressively acting to recreate past conditions (for example, removing exotic species, restoring missing species). This poses a dilemma of whether park managers should attempt to preserve historic ecosystems or enable new ones to become established. If the latter, then given the uncertainties about regional and local climate change, it is not clear which new ecosystems will take hold as the climate changes.

BUREAU OF LAND MANAGEMENT LANDS

BLM administers some 256 million acres, mostly in the western United States. BLM management challenges have been mostly divided between livestock grazing and minerals and energy management, under the principle of multiple-use planning defined by the 1976 Federal Land Policy and Management Act (FLPMA).

Grazing and rangeland planning are sensitive to climate, and BLM must balance longstanding privileges that give grazing permitees rights to a certain amount of forage with legislative mandates to set grazing amounts based on the scientifically determined capacity of the range. This has often meant reduced stocking, or at least proposals to reduce stocking rates, from historic highs. FLPMA enjoined BLM to provide range monitoring data to support any proposed grazing changes, but rangeland monitoring data are inconsistent, and even the basic concepts of range "condition" and "trend" are poorly defined (NRC 1994). This will make it difficult to establish any climate signal to support significant changes in a grazing program.

NATIONAL WILDLIFE REFUGE SYSTEM

FWS manages some 96 million acres scattered in 584 relatively small wildlife refuges, often created to meet very specific goals (such as providing waterfowl habitat). Since 1903, executive order and legislation have created hundreds of refuges, and it was not until 1966 that the National Wildlife Refuge System Administration Act bound them into a "system" of refuges. A mandate for ecological management was included in the 1997 National Wildlife Refuge System Improvement Act (NWRSIA), which required FWS to maintain the "biological integrity, diversity, and environmental health" of the refuge system. NWRSIA also requires comprehensive management plans for each refuge on a 15-year planning cycle. Most refuges are managed to protect specific species (such as elk) or types of species (such as waterfowl). Growing attention to ecosystems and adaptive management have broadened the agency's approach, and several wildlife refuge plans being written now incorporate concerns about climate change, though with few details of potential adaptation actions (CCSP 2008).

The Public Lands Planning Process in a Changing Climate

Some federal land agencies are developing policy guidance on how to deal with a changing climate. In many ways they are in the position of most decisionmakers facing an uncertain climate future: assessing potential effects and response options, but hampered in terms of specific actions by the large uncertainty surrounding regional and local climate change and impacts.

How adaptable in general is public lands planning to climate change? Most planning and management practices on federal public lands are prescribed in process and procedure more than in content or specific action. The body of law and regulations overlaid on public lands defines how

to make decisions, rather than the outcomes of those decisions, and the "how" is thick in process, especially for stakeholder input and environmental impact. When important management plans have been challenged legally (for example, the spotted owl recovery plan for Northwest forests), the courts have tended to support agency decisions as long as they were made according to procedural templates laid out in legislation and to rules and regulations promulgated by each agency.

In many ways this tradition of public lands planning and jurisprudence bodes well for adaptability to climate change. Except where legislation or court decisions have defined very specific goals, agency plans and decisions can be revisited and revised as conditions warrant. So the process is in theory quite flexible in the face of new challenges, like climate change. However, legislation, regulations, and various standards and guidelines associated with public lands management are virtually silent on how to address climate variability and climate change. Thus, agencies would be acting on their own initiative to adapt to climate change.

A hint of agency response to climate change comes from their effort to adopt "ecosystems management" and "adaptive management" (see especially Cortner and Moote 1999), which has been halting and inconsistent despite support from Congress and the courts. The barriers—training, static management paradigms, and the need to satisfy multiple interests—would seem especially likely to reemerge in the early stages of response to significant climate change. In particular, the tension between flexibility and consistency of decisionmaking will likely beleaguer responses to novel conditions in a changing climate. In principle the agencies have the power to adapt to climate change, but in practice the long struggle to accommodate multiple goals and competing interests with each land use decision has robbed the federal lands planning process of some flexibility needed to adapt to a changing climate.

SPECIFIC OVERARCHING MANDATES

Adaptation is most constrained where legislation is specific, even to the point of defining preferred land management actions and demanding certain outputs. On federal lands, these sorts of constraints include a few key, overarching legislative mandates, particularly for species protection (the 1973 Endangered Species Act, known as ESA) and wilderness management (the 1964 Wilderness Act). Species recovery plans, target populations, and habitat conservation plans required by ESA tend toward rigidity, due simply to the often excruciating administrative process by which they are developed. Recovery plans can include significant limits on land development in some of the fastest-growing parts of the nation and are simply not readily modified in response to expected or actual climate change. A few other very focused legislative and executive mandates also limit public lands management options. For example, the 1971 Wild and Free Roaming Horse and Burro Act severely limited BLM's tools for controlling populations of horses and burros on western rangelands, the carrying capacity of which is closely linked to climate conditions.

Challenges and Barriers to Adaptation

Public lands planning and management is a complex and idiosyncratic process that evolved over decades through different policy mandates, demands from society, scientific understanding of nature, and relationships with stakeholders and interests groups.

STATIC MANAGEMENT PARADIGMS

Non-stationarity of climate bucks the traditional assumption that past conditions offer guidance for future management. This challenges NPS preservation polices and USFS efforts to implement ecosystems management by framing desired future conditions within the past "range of natural variation." Both agencies lack an analog for the future. In a recent case study of potential climate adaptations on the Tahoe National Forest, Joyce et al. (2008) identify this and other "static" practices as problematic, including:

- a general paradigm of "retaining" and "restoring" previous conditions;
- burned area restoration principles that require treatments based on the pre-fire conditions, even if those might be ill-adapted to current and likely future climate;
- rigid and static sensitive species management; and
- stakeholders (of all types, from grazing interests to environmental groups) that prefer the status quo.

PUBLIC AND STAKEHOLDER ACCEPTANCE

A major constraint on adaptation emanates from the legal agreements accommodating user interests and interest groups' burgeoning attention to acre-by-acre management decisions. The demanding process by which any non-trivial public lands decision is made, crafted to please all interest groups and thus avoid appeals and lawsuits, slows innovation and adaptation. Since each major decision or plan (for example, a 15-year forest plan) must run a demanding gauntlet of public input and review, and each plan specifies land uses that are important to an array of stakeholders, change will not come easy. Many stakeholders have livelihoods and fiscal well-being directly tied to the flow of public lands resources, including ranchers, timber companies, local governments (who received a share of annual federal lands receipts), ski resorts, and water rights holders.

In some of these relationships, the stakeholder has a rather strong sway over the agencies. With urging from Congress, the agencies have been hesitant to make choices that negatively affect particular interests. For example, for most of their history, BLM grazing programs were essentially directed by boards of permit holders (Wilkinson 1992). Joyce et al. (2008) identify a National

Forests trend whereby individuals and groups simply oppose any "active" management—for example, any action that might disturb existing conditions.

FUNDING, STAFFING, AND TRAINING

Funding and staffing are likely to constrain the ability of federal land managers to adapt to climate change, at least for the near future (Kareiva et al. 2008). The large federal deficit likely means that abundant resources will not be available for adaptation in the near future. Perhaps a cap-and-trade policy to control greenhouse gas emissions will yield new sources of financing for adaptation.

SCIENCE, RESEARCH, AND MONITORING

USFS, with its experimental forest research sites, Long Term Ecological Research (LTER) sites, and tradition of collecting data especially on forest growth—all supported by a robust research-station network—would seem especially well positioned to detect and analyze the impacts of climate change. NPS has struggled to maintain a consistent science and monitoring program, dealing with inadequate funding, fragmented programs, and inconsistency as research has swung from one controversial issue to another on a park-by-park basis. Yet, some of the most important habitat monitoring and assessment efforts needed to help natural area managers adapt to climate change is conducted in National Parks by NPS scientists (Baron et al. 2008).

BLM has less in-house scientific capacity and has been criticized for the lack of science underpinning its grazing programs (Donahue 2007). The last hard look at rangeland monitoring and assessment approaches (NRC 1994) concludes that the agencies could neither accurately determine the health of the nation's rangelands nor unambiguously assess trends in range ecosystems. The National Research Council's extensive set of recommendations for developing a comprehensive rangeland assessment has only partially been implemented. Interestingly, range science was conspicuously absent from SAP 4.4 on adaptation for climate sensitive ecosystems (CCSP 2008).

A few science elements focused on climate change are emerging in the federal lands system. Congress created the National Climate Change and Wildlife Science Center within the Biological Resources Discipline in 2008, and demonstration research projects are bringing climate change questions to bear on specific wildlife management problems, including elk in the Rocky Mountains. The strategic plan for this center portends greater science guidance to adaptation questions on public lands. Other ecosystem-focused federal research efforts, like the National Science Foundation-sponsored LTER program and the emerging National Ecological Observatory Network (NEON), provide some basis for a national monitoring system that could yield scientific guidance for land management in a changing climate. But the "system" is mostly conceptual.

Interior Secretary Salazar's order created Regional Climate Change Response Centers to provide science to support regional decisionmaking (U.S. DOI 2009).[3]

Issues and Findings

Based on our analysis of the current state of federal lands management and the capacity of the federal agencies to adapt to climate change, our findings are as follow.

Fragmentation of land ownership is a barrier to ecological adaptation. The western landscape especially is divided up among federal government lands, state-owned lands, municipal or county lands, tribal lands, and private property. In addition, federal lands are divided mostly among USFS, NPS, BLM, and FWS. Continued designation of uses by historic federal agency management may become anachronistic in some cases. The situation is further complicated when non-federal lands are taken into account. For example, one adaptation response is migration corridors (Kareiva et al. 2008). These may require coordination not just on federal lands, but also with non-federal lands. Secretary of Interior Salazar's recently proposed Regional Response Councils (U.S. DOI 2009) may be one mechanism to promote regional coordination and overcome such barriers, but such coordination will likely be a challenge.

Some current problems may become more acute within the near future. One important example is the urban-wildland interface. The combination of growing populations in fire-prone areas, along with increasing risks from fires resulting from climate change, is likely to lead to more fires and more threats to lives and property. This will pose increasing challenges for federal land managers in the West.

In general, the statutes do not hamper consideration of climate change, but some barriers need to be addressed. FLPMA and NFMA allow for consideration of changing conditions, and the National Environmental Policy Act (NEPA) can be used to consider climate change impacts. Use of NEPA by the executive branch does not require new legislation (Pyke and Batten 2008). Some legislative mandates and traditions, however, may hinder adaptation on federal lands. Examples include specific goals of individual National Parks and species-focused Wildlife Refuges, as well as grazing preferences on BLM lands. These limitations should be removed to allow NPS, FWS, and BLM to manage lands for changing climate and environmental conditions.

The agencies vary in embracing the need to adapt to climate change. All three agencies have been studying climate change and preparing plans. USFS appears to be most advanced on climate change, having studied it for more than 10 years. FWS has begun planning for climate change and is researching impacts. NPS is starting to address adaptation and has been developing adaptation

[3]. Some concepts for a National Climate Service could build on this research and monitoring infrastructure, bring in the national climate network, and create a robust system for applying climate science to land management, but its future remains uncertain.

plans for some parks. While evidence of some forward thinking does not mean that the entire organization is on board, in general, all three agencies appear to be working to address adaptation. In contrast, BLM has begun to take only very preliminary steps to adapt to climate change.

Current funding and staffing levels in general appear inadequate for federal agencies to effectively manage climate change. CCSP (2008) reviews federal policies on ecosystem management and concluded that land management agencies need enhanced funding and staffing to incorporate adaptation into their activities, although specific amounts were not given. Among the necessary staff are those who can understand climate change and explain the science, functions the National Climate Service possibly could perform.

Public perception and stakeholder support for changes in land management practices in anticipation of or response to climate change may be a barrier to federal adaptation. Stakeholders deriving direct or indirect benefits from historic uses of federal lands may well be resistant to changes in those uses. Logging and ranching communities are likely to resist changes in dedicated uses of USFS and BLM lands. A second possible barrier is that the public may blame federal authorities for not anticipating or doing enough to avoid or offset disturbances such as fires and pests. Public education campaigns may be one way to reduce this problem, although they are unlikely to eliminate it. Ironically, increased flexibility for federal managers to change uses may make it more difficult for them to resist local pressures for certain land uses, especially if those pressures are reinforced by Congress.

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