



A Strategic Response to Climate Change: The U.S. Forest Service Approach<sup>1</sup>

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The focus of the U.S. Forest Service is first and foremost on the nation's forests and grasslands—on protecting and conserving them for all the benefits people get from them, both now and in the future. Forest and grassland ecosystems are shaped by climate. When the climate changes, many things change with it: temperature, precipitation, snowpack size, runoff amounts, soil moisture levels—the list goes on. Add eutrophication and declining water quality to the mix, plus invasive species, acid deposition, land use change, and a host of other factors, and today's land managers are confronted with a whole new problem environment (fig. 1). As ecosystems change, people can no longer rely on the benefits they provide, such as clean air and water, habitat for wildlife, opportunities for outdoor recreation, and more. Climate change has therefore become a focal point for the Forest Service: It threatens the agency's ability to fulfill its mission.

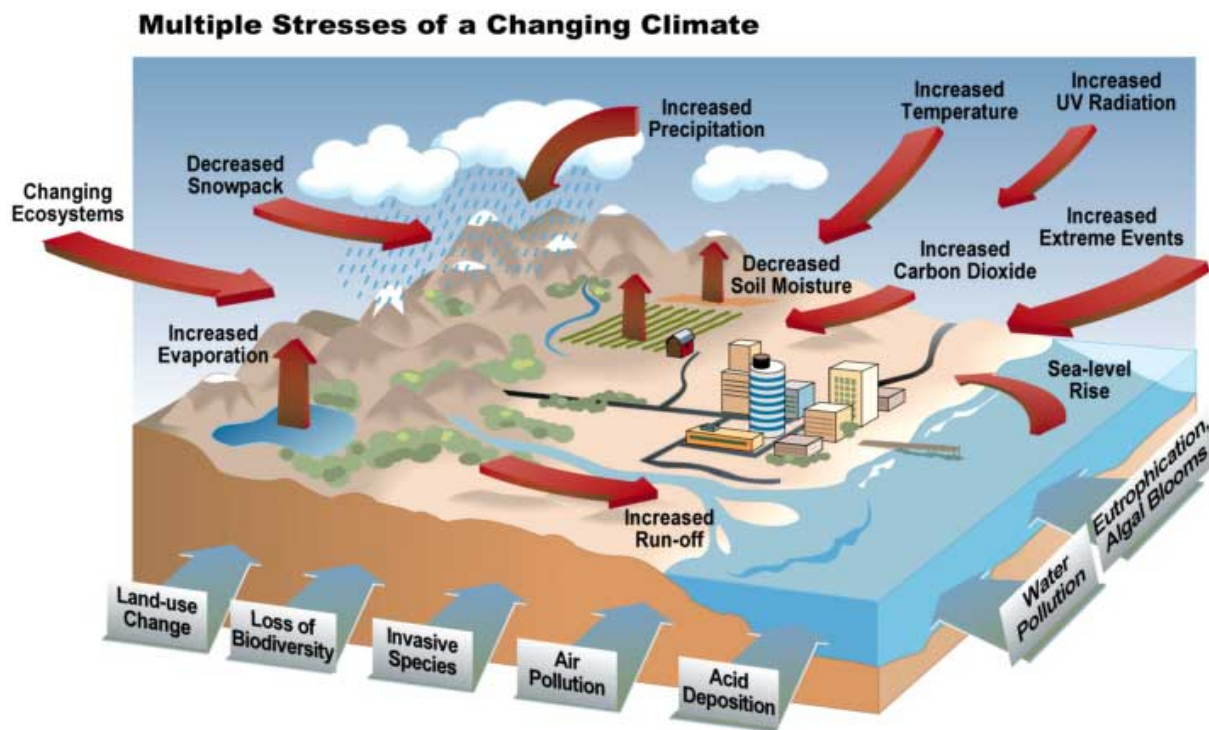


Figure 1—Climate change impacts, coupled with other stresses, are confronting land managers today with a whole new problem environment.

<sup>1</sup> The article summarizes the Forest Service Strategic Framework for Responding to Climate Change (U.S. Forest Service 2008).

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How can the Forest Service respond? What can an organization like the Forest Service do to help the nation, and indeed the world, to meet the challenge of climate change?

### **Basis for Responding**

In a sense, the Forest Service has long been responding to climate change. Climates fluctuate naturally—oscillating, for example, between periods of wet and dry or hot and cold. In writing land management prescriptions for forests and grasslands, Forest Service professionals have always studied local and regional climate patterns, taking precipitation, soil moisture, and other climatic conditions and trends into account.

By the 1980s, however, there was rising concern among scientists that climates were changing on a global scale in ways that went beyond natural fluctuations. Such concerns translated into a congressional mandate to the Forest Service to include climate change research in its 5-year scientific reports under the Forest and Rangeland Renewable Resources Planning Act of 1974. Ever since, Forest Service scientists have been in the forefront of climate change research, generating important studies and making key contributions to the U.S. Climate Change Science Program and the Intergovernmental Panel on Climate Change (IPCC)—see, for example, Joyce and Birdsey (2000), IPCC (2007), Joyce et al. (2008), Millar et al. (2007), and Ryan et al. (2008).

In January 2005, the Forest Service invited hundreds of forest stakeholders and other partners to a Centennial Congress in Washington, DC. Participants identified climate change as one of the major long-term challenges to conservation in the 21<sup>st</sup> century. Within a year, Forest Service Chief Dale Bosworth had elevated climate change to a national concern for the entire agency. In local, regional, and national forums, Forest Service leaders began wide-ranging discussions on how best to address the issue, and a national team was formed to devise an agencywide climate change strategy. In October 2008, the team completed the Forest Service Strategic Framework for Responding to Climate Change (U.S. Forest Service 2008), the approach outlined in this paper.

### **Foundations of the Approach**

The mission of the Forest Service is caring for the land and serving people by delivering the ecosystem services that Americans want and need. Ecosystem services are the benefits people obtain from ecosystems—basic services such as food, water, wood, and medicine; environmental services such as pollination, erosion control, wildlife habitat, and carbon sequestration; cultural services such as recreation, ecotourism, and educational and spiritual values; and supporting services such as nutrient cycling, soil formation, and primary productivity (Millennium Ecosystem Assessment 2005). The nation's forests and grasslands contain vital components of biodiversity, an essential part of America's national heritage. They provide most of the water Americans use for drinking, agriculture, and industry. They furnish fiber for paper, lumber, and other wood products. They provide clean air, livestock feed, and recreation opportunities; and they support habitat for myriad plant and wildlife species. Healthy and productive forests and grasslands can also supply renewable energy and other offsets for fossil fuel emissions.



Climate change threatens all of these services. Since the 1980s, Americans have seen such effects as changing water regimes, spreading bark beetle infestations, and increasing wildfire severity and area burned. Even if global greenhouse gas buildups were reversed today, global temperatures would continue to rise for the next hundred years (IPCC 2007), bringing regional warming, changes in precipitation, weather extremes, severe drought, earlier snowmelt, rising sea levels, changes in water supplies, and other effects. As it is, global greenhouse emissions are still rising, exacerbating all of these long-term effects. The capacity of many plant and animal species to migrate or adapt will likely be exceeded. Ecosystem processes, water availability, species assemblages, and the structure of plant and animal communities and their interactions will change. In many areas, it will no longer be possible to maintain vegetation within the historical range of variability. Land management approaches based on current or historical conditions will need to be adjusted.

One way of adjusting them to address climate change is through facilitated adaptation<sup>3</sup>—taking action to reduce the vulnerability of natural and human systems to the impacts of climate change. There are two kinds of facilitated adaptation—anticipatory and opportunistic. Anticipatory actions, designed to prevent disruptions, might include constructing new water storage facilities, thinning forests to increase tolerance to drought and resistance to wildfire and insects, and helping species survive through genetic conservation or migration to suitable habitat. Opportunistic actions, designed to take advantage of disturbances such as wildfires, might include planting new species or genotypes better adapted to future conditions, and altering a forest structure to enhance ecosystem resiliency under future conditions.

Another way of addressing climate change is through mitigation—taking action to reduce carbon emissions and enhance carbon sinks in human and natural systems. Net carbon uptake by forest ecosystems in the United States currently offsets about 10 percent of all U.S. greenhouse gas emissions (Birdsey et al. 2006). Globally, deforestation is responsible for about 20 percent of human-caused carbon emissions (Food and Agriculture Organization 2005). Mitigation strategies in the United States might include energy conservation, alternative energy use, and various forest-related activities, such as afforestation, reforestation, avoided deforestation, wood substitution for more energy-intensive materials, and use of energy from wood to substitute for fossil fuels (Bosworth et al. 2008, Kimbell et al. 2009).

### **Vision and Guiding Principles**

The Forest Service's approach begins with a strategic vision: a future when forests and grasslands successfully adapt to climate change, sustaining the ecosystem services that Americans want and need; when America's forests and grasslands, through the carbon they take up and store, contribute to mitigating climate change; when many of the risks and uncertainties associated with climate change are reduced through scientific research; when partners work together to address climate change, building on each other's strengths through national and

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<sup>3</sup> As opposed to natural adaptation (reactive responses by natural systems to the effects of a changing climate, such as species migration or behavior modification).



global alliances; and when Americans, based on a thorough understanding of climate change and the need to address it, are prepared to participate in making related decisions and taking action.

In realizing its vision for addressing climate change, the Forest Service is guided by seven basic principles:

1. Adaptation to the effects of climate change is essential for sustaining the ability of forests and grasslands to provide ecosystem services and mitigate greenhouse gas emissions.
2. Management for adaptation is not possible or needed everywhere; priorities need to be set.
3. Improved risk analysis and decision support tools are critical for facilitating new policies and management approaches in the face of uncertainty.
4. Continual monitoring and incorporation of new science into planning, policies, and decisionmaking processes are necessary for successful adaptation and mitigation.
5. Alliances and collaboration are essential for achieving science-based, integrated approaches to adaptation and mitigation.
6. Institutional and public support and encouragement for implementing innovative approaches are needed.
7. Strategies, policies, and actions for addressing climate change need to be integrated across all parts of the Forest Service at every level.

### **Strategic Goals**

To realize its strategic vision for addressing climate change, the Forest Service will pursue seven fundamental goals (summarized in the sidebar). The first four are oriented primarily toward the land, the last three primarily toward people. However, all seven goals are ultimately designed to serve people: Achieving each will help ensure that Americans continue to get the ecosystem services they want and need from their forests and grasslands.

### ***Science***

Natural resource professionals know a lot about forests and grasslands, but many knowledge gaps remain, especially in an era of climate change. Much remains to be learned about the effects of climate change and its cumulative impacts on natural and human systems in the new problem environment (fig. 1). In August 2008, the Forest Service laid out a 10-year research strategy for studying climate change (U.S. Forest Service 2009a). Already, researchers are beginning to model climate change impacts on species, vegetation structure, stand dynamics, water supplies, and disturbance patterns at regional and local scales. Researchers will conduct an ongoing dialogue with land managers and other science users, modifying their priorities in response to user needs. They will help translate science into land management applications, including user-friendly databases, predictive models, decision support tools, and monitoring systems, helping to reduce the uncertainties associated with climate change. Researchers will also develop more cost-effective methods for greenhouse gas accounting, carbon sequestration and storage in



### Forest Service Goals for Addressing Climate Change

1. **Science:** Advance scientific understanding of the environmental, economic, and social implications of climate change and related adaptation and mitigation activities.
2. **Adaptation:** Enhance the capacity of forests and grasslands to adapt to the environmental stresses of climate change and continue delivering ecosystem services.
3. **Mitigation:** Manage forests and grasslands to reduce the buildup of greenhouse gases while continuing to deliver a full range of ecosystem services.
4. **Policy:** Integrate climate change into agency policies, program guidance, and communications, and coordinate across all departments at all levels.
5. **Sustainable operations:** Reduce the environmental footprint of agency operations and become a leading example of a green organization.
6. **Education:** Advance public understanding of sustainable resource consumption and land management in an era of climate change, including the need for adaptation and mitigation.
7. **Alliances:** Build strong national and international alliances for sustainable forest management in an era of climate change, including adaptation and mitigation.

vegetation and soils, and biomass utilization, including the substitution of energy from wood for fossil fuels.

#### *Adaptation*

On national forest land, the Forest Service will focus on helping ecosystems adapt to the effects of climate change. Current restoration activities, including thinning and fire use, will serve to promote ecosystem health and resilience in the face of future climate-related stresses. However, institutional barriers as well as a lack of markets for small-diameter timber and other restoration byproducts will constrain adaptation-related projects. The Forest Service's Woody Biomass Utilization Strategy addresses both institutional barriers and the need for new markets (Patton-Mallory 2008). The Forest Service will also work with communities, private landowners, other agencies, and international partners, helping them adopt adaptation techniques.

Climate change is fraught with risk and uncertainty, and land managers will need to take both into account in adaptation-related projects. Some methods might be expanded, such as planting more diverse species or genetic mixes during reforestation. New management strategies might be used, such as assisted migration or moderating extreme streamflows. Climate change is likely to dramatically alter snowpack size and the amount and seasonality of precipitation, so land managers will need to address climate-related water issues, especially in the West. The Forest Service's emerging water strategy will help. For both water and vegetation management, specific



adaptation techniques will need to be developed and evaluated. Monitoring and adaptive management will be key.

### *Mitigation*

Facilitated adaptation will be complemented by mitigation. The Forest Service will strive to optimize forest and grassland productivity and health, balancing carbon sequestration against other ecosystem services. Carbon accrues in trees, soil, and wood products; this alone gives forestry a role to play in mitigation. Moreover, because wood resources are renewable, wood-based bioenergy can offset emissions from fossil fuels. Forests destroyed through land use conversion or damaged by insects, disease, and wildfire add carbon to the atmosphere. Accordingly, mitigation activities might include increasing carbon sequestration, avoiding deforestation, using more renewable fuels, and reducing emissions from disturbances such as wildfires. The key to sequestering carbon will be to move harvested biomass into solid wood products and fossil fuel substitutes or to incorporate carbon into soil.

Most opportunities for increased carbon sequestration on forests and grasslands are on private lands. The Forest Service can contribute research and decision support for mitigation-oriented management activities, working with partners at home and abroad. For example, the agency will work closely with the new Office of Ecosystem Services and Markets in USDA to help private forest landowners take advantage of emerging markets for ecosystem services, including carbon markets. The Forest Service's Open Space Conservation Strategy describes ways of preventing conversion of forests to developed land (U.S. Forest Service 2007). On national forest land, carbon sequestration potential is limited by the many small trees that make forests susceptible to wildfire, insects, and disease. Land managers can reduce the risk by removing small-diameter materials and letting remaining trees grow larger, based on strategies outlined in the Forest Service's restoration policy framework (U.S. Forest Service 2006).

### *Policy*

For a climate change strategy to succeed, the Forest Service will need a cohesive, well-coordinated approach. Several national strategies are in place or under development that could complement and reinforce such an approach, including strategies on water, open space, invasive species, biomass utilization, ecological restoration, integrated vegetation management, and research and development. The agency has begun taking climate change into account in formulating policies, program guidance, and communications, particularly with respect to forest planning, environmental analysis, and budget guidance. Coordination across Forest Service Deputy areas (especially National Forest System, Research and Development, and State and Private Forestry) will be key. Some regional offices and research stations have already begun to identify actions to improve integration.

### *Sustainable Operations*

With about 30,000 employees and thousands of buildings and vehicles across the country, the Forest Service has an obligation—and an opportunity—to mitigate climate change by reducing



its own environmental footprint, thereby setting an example. The agency is exploring ways of reducing its environmental footprint in five key areas: energy use, water consumption, green purchasing, fleet and transportation, and waste prevention and recycling (U.S. Forest Service 2009b). Through its sustainability leadership initiative, the Forest Service is also striving to exceed related requirements set in the past by legislation and executive order. Opportunities for reducing the agency's environmental footprint include, for example, implementing recycling programs, increasing options for telecommuting, locating facilities near mass transit stations, and obviating the need for travel through the use of videoconference technology.

### *Education*

Americans can best participate in decisions about public land management and take related actions if they are environmentally literate, with a good understanding of climate change, its impacts on ecosystems, and the need for both adaptation and mitigation. The Forest Service has a long tradition of building environmental awareness; in 2007, the agency made it a national priority to reconnect Americans with nature, particularly children (Kimbell et al. 2009b). In partnership with other organizations, the Forest Service will provide high-quality, science-based education and outreach on the role of forests and grasslands in delivering ecosystem services in an era of climate change.

### *Alliances*

The scale of climate change ranges from local to global; its enormity and complexity are almost unfathomable. No organization working alone can handle the challenge it poses. Around the world, organizations of all kinds, both governmental and nongovernmental, have been developing strategies for addressing climate change. The Forest Service can learn from and build on their insights and experiences. The agency has a long record of working with partners to achieve shared objectives, collaborating in areas ranging from cooperative research, to forest health, to fire suppression. The Forest Service will strive to build broad alliances, both nationally and internationally, to meet the challenge of climate change.

### *Next Steps*

Now that the Forest Service has a strategy for responding to climate change, what comes next? In some ways, the Forest Service is already addressing climate change. Restoration activities in long-needle pine forests, for example, tend to help ecosystems adapt to climate change by enhancing their resilience to drought and disturbances. However, the next step for the agency is to specifically work toward all seven goals outlined in the strategy. In an appendix to the Strategic Framework, the authors listed concrete steps that the agency can take in each of the seven areas to help meet all seven goals, such as helping to develop protocols for carbon accounting (thereby promoting mitigation) (U.S. Forest Service 2008). In January 2009, the Forest Service adopted a plan for implementing the Strategic Framework (U.S. Forest Service 2009c). Based on the Framework and the associated Implementation Plan, the agency is working with partners to protect and sustain America's forests and grasslands for generations to come, even in an era of climate change.



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