



Forest Service
U.S. DEPARTMENT OF AGRICULTURE

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USDA FOREST SERVICE
**CLIMATE
ADAPTATION
PLAN**

AUTHENTICATED
U.S. GOVERNMENT
INFORMATION



**“CARING FOR THE LAND
AND SERVING PEOPLE.”**

FOREST SERVICE MOTTO

LEADERSHIP MESSAGE

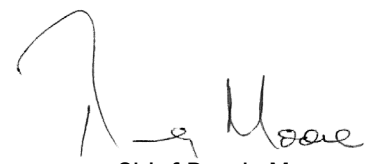
Conservation and service, core values of the USDA Forest Service, are embodied in our motto— “Caring for the land and serving people.” We, as the Forest Service, are committed to sustaining the Nation’s forests and grasslands in ways that encourage lasting ecological, economic, and social vitality. Our core values of conservation and service; joined by safety, diversity, and interdependence; drive us to adapt to the challenges posed by a rapidly changing climate on behalf of the American people.

Adaptation isn’t easy. By its very nature, it involves difficult truths and hard choices. It also spurs opportunities as it intersects with related efforts, such as the 10-year Wildfire Crisis Strategy, Shared Stewardship strategy, and the Equity Action Plan. All of these efforts inspire us to think carefully about how and where we do our work, engage in partnerships, and provide services. Success requires the engagement, creativity, and professionalism of the Forest Service workforce—not just a few of us, but all of us. The “USDA Forest Service Climate Adaptation Plan” presents a holistic approach to climate adaptation that works across the Forest Service and at all levels so we can all help shape how the plan will apply on national forests and grasslands and in our workplaces and communities.

The Forest Service has been actively engaged in climate adaptation for many years. This adaptation plan grows from lessons we’ve learned, even as it challenges us to fill gaps in knowledge and take meaningful climate actions. The plan clarifies and elevates discussion about climate change and accelerates the pace of our collective preparations and response. It recognizes that we are not in this alone, nor are our actions isolated. This plan calls for a whole-of-government response through building partnerships, advancing environmental justice, and creating economic opportunities for communities that have been historically marginalized even as they are disproportionately affected by climate change.

I ask that each employee of the Forest Service support this plan by reflecting on how you can apply your ingenuity and experience to our work as you consider the climate threats described and strategic actions recommended. These are demanding times, but there is no obstacle we can’t face if we face it together.




Chief Randy Moore



Smoke from the Taylor Fire sets into an inversion and envelops the Rogue River-Siskiyou National Forest, OR. USDA Forest Service photo by Cecilio Ricardo.

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CLIMATE CHANGE IMPACTS AND VULNERABILITIES

The Forest Service identified key risks to the agency's mission in six categories:

1. Shifting fire regimes and resulting effects on ecological integrity, multiple uses, human safety and well-being, and wildland fire management operations.
2. Extreme events and disturbances, including the effects of flooding, drought, insect outbreaks, invasive species, and severe storms.
3. Chronic stressors to watersheds and ecosystems, such as altered productivity and composition, changes in habitat for plants and animals, and implications for the agency's ability to manage these systems over time.
4. Disruption in the delivery of ecosystem products and services, including clean water, carbon uptake and storage, forest and rangeland products, and recreation opportunities.
5. Disproportionate impacts on disadvantaged communities and Tribal Nations, including human health impacts, loss of cultural resources, and threats to economic prosperity and equity.
6. Threats to the agency mission, infrastructure, and operations from disruption to operations, strains on workforce capacity, more complex public engagement, and fewer resources.

ADAPTATION ACTIONS

To reduce these risks, the Forest Service will take six overarching adaptation actions that correspond to the six categories above:

1. Adapt to changing fire regimes.
2. Prepare ecosystems and watersheds for extreme events and intensifying disturbances.
3. Sustain and improve ecosystem and watershed function in the face of chronic stressors.
4. Support the delivery of ecosystem products and services in a changing climate.
5. Deliver environmental justice through adaptation actions.
6. Increase agency capacity to respond to climate change.

CLIMATE ADAPTATION PLAN

Executive Summary

Climate change threatens the ability of the USDA Forest Service to fulfill its mission by undermining the health, diversity, and productivity of the Nation's forests and grasslands. A robust climate change response aligns with the agency's core values of conservation, interdependence, safety, diversity, and service. The "USDA Forest Service Climate Adaptation Plan" outlines key climate risks to the agency's operations and critical adaptation actions to reduce these risks and help ensure that the Forest Service continues to meet the needs of present and future generations.

Figure 1 shows the focus areas associated with these adaptation actions. The focus areas reflect more specific activities that the agency can undertake across its programs to implement the overarching actions and reduce the greatest risks to the agency's mission and operations. Tribal engagement, environmental justice, workforce climate literacy, and the USDA Climate Hubs will serve as foundations for adaptation and guide how we implement the corresponding actions to achieve the desired outcomes. The Forest Service will annually evaluate progress on adaptation actions and focus areas using the Climate Action Tracker. Actions will align with other USDA and agency programs and initiatives on climate change, environmental justice, and wildfire risk.

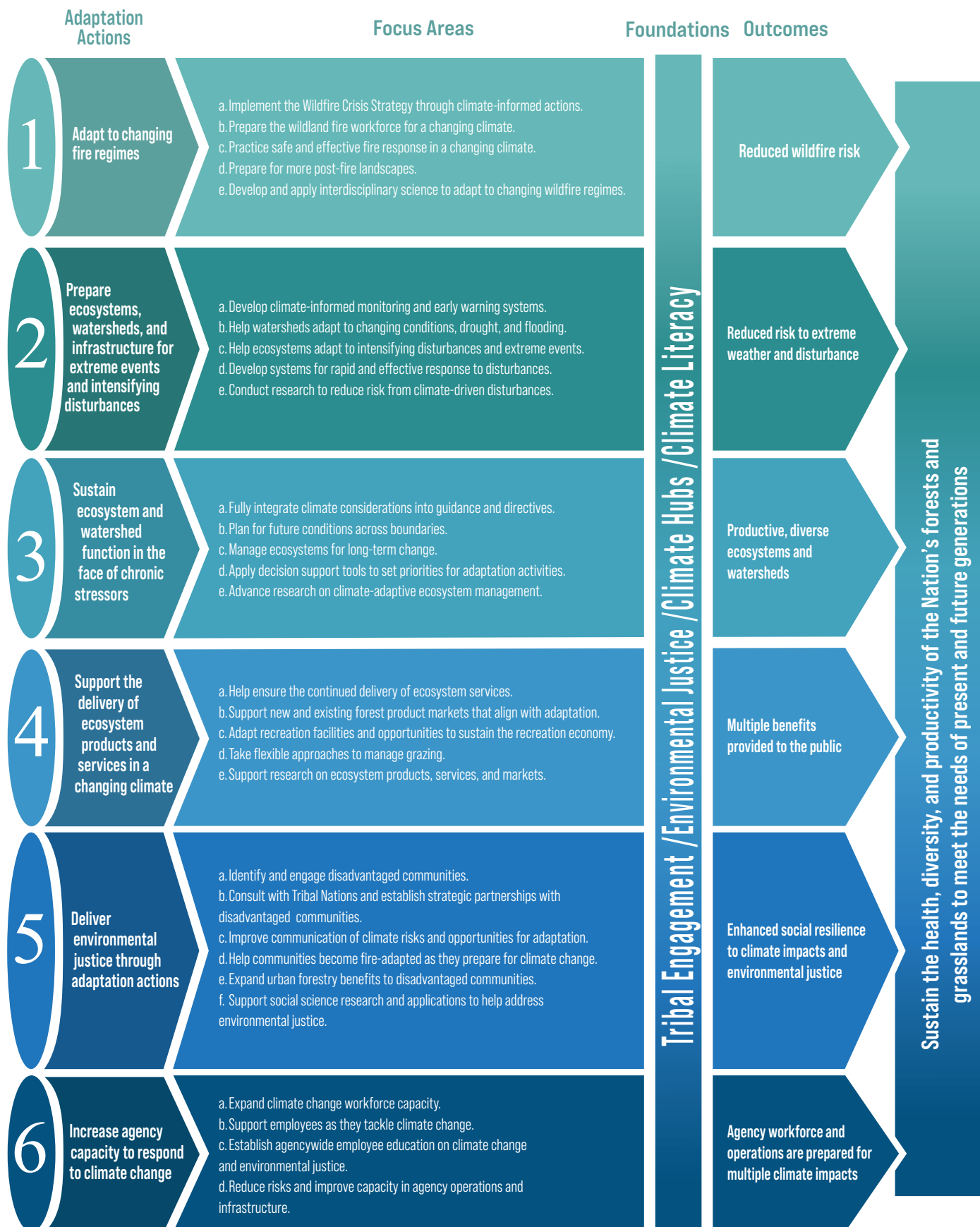


Figure 1. Overview of Agency Adaptation Actions.

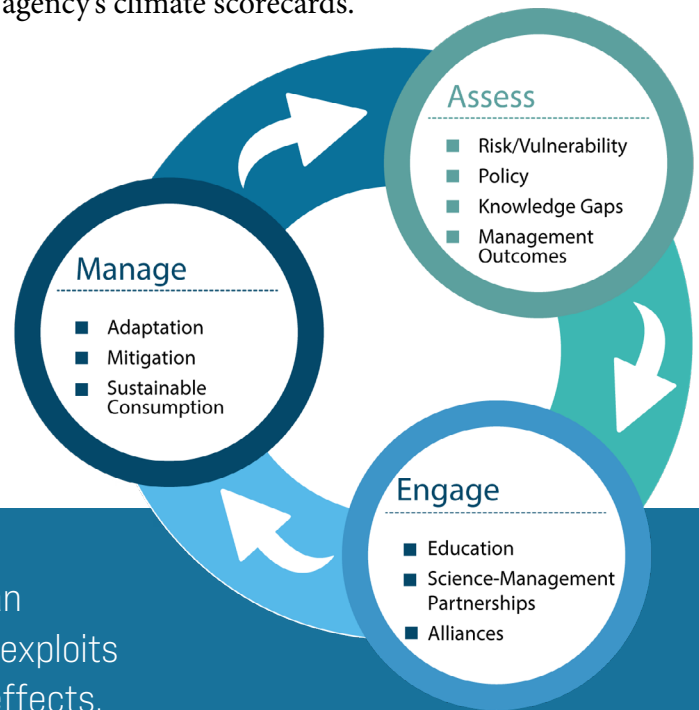
INTRODUCTION

The “USDA Forest Service Climate Adaptation Plan” presents a vision for integrating climate change adaptation into the Forest Service’s operations and mission. The plan is part of the Forest Service’s response to [Executive Order 14008: Tackling the Climate Crisis at Home and Abroad](#), which calls on Federal Departments and agencies to develop climate adaptation plans that secure environmental justice and spur economic opportunity. In October 2021, the U.S. Department of Agriculture (USDA) released its [Action Plan for Climate Adaptation and Resilience](#) to describe how the USDA is preparing for and responding to current and future impacts of climate change. As part of developing its plan, USDA issued a new departmental regulation (DR 1070-001), directing each of its agencies to update its adaptation plans. The “USDA Forest Service Climate Adaptation Plan” describes the top risks to the agency’s mission, responsibilities, and operations and outlines key actions to manage these risks.

The adaptation plan builds on the modes of action outlined in the Forest Service’s “National Roadmap for Responding to Climate Change”:

- Assessing current risks, vulnerabilities, policies, and gaps in knowledge.
- Engaging employees and stakeholders to seek solutions.
- Managing for resilience, in ecosystems and well as in human communities, through adaptation, mitigation, and sustainable consumption strategies.

These three modes of action continue to drive the agency’s work on climate change. The adaptation plan incorporates the knowledge gained and progress made in the decade since the launch of the climate change roadmap but places a new emphasis on environmental justice. To evaluate progress under the adaptation plan, the Forest Service will use a new Climate Action Tracker, which builds on previous iterations of the agency’s climate scorecards.



ADAPTATION - The adjustment in natural or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects.

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Engaging employees and stakeholders to seek solutions.

Managing for resilience, in ecosystems and well as in human communities, through adaptation, mitigation, and sustainable consumption strategies.



The Pioneer Fire, Boise National Forest, Idaho,
2016. USDA Forest Service photo by Kari Greer.

FOREST SERVICE MISSION

The mission of the Forest Service is to sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations. The Forest Service balances the short- and long-term needs of people and nature by:

- Working in collaboration with communities and agency partners.
- Delivering world-class science, technology, and land management.
- Providing access to resources and experiences that promote economic, ecological, and social vitality.
- Connecting people to the land and one another.

The Forest Service delivers on its mission via four deputy areas: National Forest System, State and Private Forestry, Research and Development, and Business Operations. The adaptation plan identifies the risks posed by climate change to the agency's mission, reduces the impact of climate change on the agency's ability to effectively conduct its activities across all four deputy areas, and indicates ways in which the agency can adapt its actions to fulfill its mission most effectively. By taking the actions outlined in the plan, the Forest Service will also support the long-term stability of carbon in ecosystems and harvested wood products as well as reduce greenhouse gas emissions from agency operations and mitigate climate change.



The Four Forest Restoration Initiative in the Kaibab, Coconino, Apache-Sitgreaves, and Tonto National Forests, Arizona. Photo from the Mogollon Rim Ranger District of the Coconino National Forest. USDA Forest Service photo by Brady Smith.

ENVIRONMENTAL JUSTICE

The “USDA Forest Service Climate Adaptation Plan” is part of a whole-of-government approach to deliver environmental justice and spur economic opportunity for overburdened and marginalized communities. By meaningfully involving these communities in cocreating climate adaptation actions and treating them fairly, the Forest Service will help ensure that they do not suffer disproportionate adverse impacts from agency decisions and that they benefit equitably from climate adaptation activities. Executive Order 14008 emphasizes environmental justice for historically marginalized communities, including low-income, minority, Indigenous, and other disadvantaged communities. The executive order launched the Justice40 Initiative, which aims to deliver 40 percent of the overall benefits from Federal investments in climate and clean energy to disadvantaged communities. The executive order refers to “disadvantaged communities” but interim implementation guidance for departments and agencies notes that community members prefer different terms, such as “overburdened and underserved communities.”¹ The Forest Service can use the USDA Climate Hubs and new and emerging

partnerships to build capacity in communities disproportionately affected by climate change. Low-income, minority, and Indigenous communities have experienced decades of disinvestment and institutional inequities that contribute to their vulnerability to climate change. The vulnerabilities include housing insecurity; preexisting health conditions; higher rates of poverty and unemployment; the higher likelihood of living near environmental hazards and contaminated lands; and a lack of access to healthcare, clean air and water, healthy foods, green space, and transportation.

“Our mission is to sustain the health, diversity, and productivity of the Nation’s forests and grasslands to meet the needs of present and future generations—the needs of everyone, from every background and walk of life. Communities of color as well as Tribal, low-income, and minority communities already live with more environmental burdens, and they are disproportionately affected by climate change. Fulfilling our mission means instilling the principles of equity and environmental justice into all of our policies, programs, and practices, including every step we take to reduce climate-related risk.”

Chief Randy Moore

¹ See footnote 4, “<https://www.whitehouse.gov/wp-content/uploads/2021/07/M-21-28.pdf>.”

ENVIRONMENTAL JUSTICE (EJ) - The fair treatment and meaningful involvement of all people regardless of race, color, culture, national origin, income, and educational levels with respect to the development, implementation, and enforcement of protective environmental laws, regulations, and policies.

FAIR TREATMENT - The principle that no group of people, including a racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences from industrial, municipal, and commercial operations or the execution of Federal, State, local, and Tribal programs and policies. In implementing its programs, the U.S. Environmental Protection Agency (EPA) has expanded the concept of fair treatment to include not only consideration of how burdens are distributed across all populations but the distribution of benefits as well.

MEANINGFUL INVOLVEMENT - Potentially affected community residents have an opportunity to participate in decisions about a proposed activity that will affect their environment and/or health. The public’s contribution can influence the regulatory agency’s decision and the concerns of all participants involved will be considered in the decision-making process. The decision-makers seek out and facilitate the involvement of those potentially affected.

TRIBAL ENGAGEMENT

In addition to the Forest Service's formal government-to-government relationships with Tribal Nations, the agency's ability to adapt to climate change depends on building trust and developing strong collaborations with Tribal Nations and other Indigenous peoples. The adaptation plan aligns with actions outlined in the upcoming publication "2022-2024 Forest Service National Tribal Relations Action Plan," a national strategic document that gives agency employees direction and assistance to help them fulfill the Forest Service's Federal Trust responsibility, honor treaty obligations, and support Tribal self-determination. The "USDA Forest Service Climate Adaptation Plan" also supports the [2021 Memorandum on Indigenous Traditional Ecological Knowledge and Federal Decision Making](#) by paving the way for collaboratively

developing climate adaptation actions that advance equity with and for the benefit of Indigenous peoples, including American Indians, Alaska Natives, Native Hawaiians, and Indigenous peoples of the U.S. territories. Traditional Ecological Knowledge, a form of Indigenous Knowledge, makes important contributions to scientific, technical, social, and economic progress in the United States. The Forest Service is committed to using this knowledge to shape its climate adaptation policies. Tribal Nations and the Forest Service can work together using their collective knowledge, experience, and resources to costeward Federal lands and contribute to the long-term sustainability of ecological and cultural resources of both Federal and Tribal lands in the face of climate change.



Yavapai-Apache Youth Dancers at Archaeology Discovery Days at V Bar V Heritage Site, Coconino National Forest, Arizona, March 2017. USDA Forest Service photo by Deborah Lee Soltesz.

RELATED INITIATIVES

The adaptation plan builds on and aligns with other department and agency policies, strategy documents, and initiatives at the interface of climate change, sustainability, and environmental justice (appendix 1). In particular, the plan aligns with key actions outlined in the [USDA Action Plan for Climate Adaptation and Resilience](#) and the [Climate-Smart Agriculture and Forestry Strategy: 90-Day Report](#). The “USDA Forest Service Climate Adaptation Plan” is supplemental to the Department’s goals to build resilience to climate change. By investing in ecosystem health, expanding education and outreach, and continuing research and development, the agency will build on the goals

established in USDA’s action plan. The Forest Service adaptation plan will use the USDA Climate Hubs to support adaptation science, technology, and tools, as called for in the USDA action plan. The Forest Service plan also echoes the need for a forest and wildfire resilience strategy highlighted in the USDA climate-smart strategy. In addition, the Forest Service plan aligns with key actions described in two recent strategic documents: the “Forest Service Equity Action Plan” and “Confronting the Wildfire Crisis: A New Strategy for Protecting Communities and Improving Resilience in America’s Forests.”



Pike Mountain Overlook, Minidoka Ranger District, Sawtooth National Forest. October 2015. USDA Forest Service photo by Nancy Brunswick.

OLD-GROWTH AND MATURE FORESTS

Old-growth and mature forests, and other forests with similar characteristics, are an ecologically and culturally important part of the National Forest System. They reside within a continuum of forest age classes and vegetation types that provides for a wide diversity of ecosystem values. Many forests with old-growth characteristics have a combination of higher carbon density and biodiversity that contributes to both carbon storage and climate resilience. They are often viewed as ideal candidates for increased conservation efforts, and are frequently found within areas designated as wilderness or roadless or other management areas where timber harvest is precluded. Even so, as climate continues to deviate from historical norms, many of these forests are expected to be at increasing risk from acute and chronic disturbances such as drought, wildfires, and insect and disease outbreaks. As a result, climate-amplified disturbances like these have become the primary threat to old-growth stands on national forests. In response, Executive Order 14072 *Strengthening the Nation’s Forests, Communities, and Local Economies* emphasizes the climate-informed stewardship of mature and old-growth forests on Federal lands, as part of a science-based approach to maintain valued characteristics and reduce wildfire risk. There is no single “right answer” in addressing the complex problem, but the spirit and practice of shared stewardship can help us generate the frank discussions necessary to consider values and risks as we find the best paths forward.

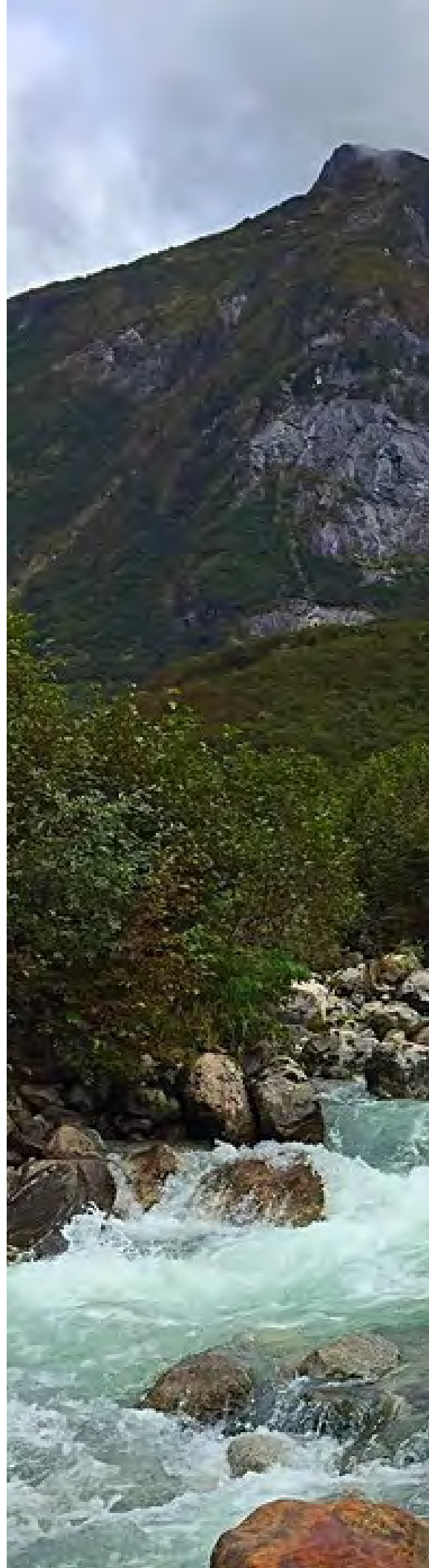
CLIMATE CHANGE IMPACTS AND ADAPTATION ACTIONS

Climate change threatens the Forest Service's ability to fulfill its mission. The wide-ranging impacts of climate change reflect the complexity of the landscapes that the Forest Service manages and the diversity of the communities that the agency serves. The Forest Service's ongoing ability to care for the land and serve people depends on its ability to adapt to climate change. Adaptation requires coordination across the Forest Service's four Deputy Areas in working toward science-based land management solutions. Adaptation actions will build on the agency's existing programs while also requiring new approaches that focus on climate change adaptation.

The Forest Service has identified six key climate-related vulnerabilities that affect its mission, grounded by the most recent [National Climate Assessment](#):

1. **Shifting wildfire regimes**
2. **Extreme events and disturbances**
3. **Chronic stressors to watersheds and ecosystems**
4. **Disruption in provisioning of forest products and services**
5. **Environmental injustice and social vulnerability**
6. **Threats to agency workforce and operations**

The first three themes represent physical and ecological threats to the agency's natural resources; the latter three reflect the social, economic, and organizational implications of those threats. Results from an agencywide survey of 648 employees, 4 workshops involving about 250 Forest Service employees, and 3 Tribal and partner engagement sessions expounded on the agency risks related to climate vulnerabilities and the potential adaptation actions (appendix 2). The six key vulnerabilities and the corresponding adaptation actions provide a framework for organizing the agency's work across Deputy Areas. Progress on these actions will be tracked annually using the agencywide Climate Action Tracker (appendix 3).



Creek into Shakes Lake Stikine Wilderness.
USDA Forest Service photo by Karen Dillman.



SHIFTING WILDFIRE REGIMES

As fire regimes shift in a warmer and potentially drier climate, the agency will face challenges in reducing risks and realizing benefits from fire. Fire season length and area burned have increased in recent decades, and these trends will likely continue as the climate further warms. With increases in area burned, there will be more high severity fires, which presents particular challenges for ecosystems and communities. In dry forest types that historically experienced frequent fires, over a century of fire exclusion and other land management practices have contributed to increased stand densities and higher fuel levels, making them vulnerable to larger and uncharacteristically severe fires. Fire is an important ecological process and a useful management tool. However, warmer and drier conditions may hinder the Forest Service's ability to manage fire for social and ecological benefits in some areas. Recent fire years offer examples of the types of historically rare fire events expected to occur more frequently under climate change, including fires burning through communities, frequent fires in forest types that historically burned infrequently, fires occurring outside of the historical fire season, and extreme fire behavior at night.

Effects of Changing Fire Regimes on Ecological Integrity

The ecological integrity of many ecosystems depends on specific fire regimes, and climate-induced changes in fire regimes will affect ecological integrity. Increases in fire may benefit some ecosystems; however, high-severity wildfires over large areas can harm old-growth forests, decrease structural and biological diversity, degrade wildlife habitat, remove soil organic matter, and leave large patches that lack surviving trees as seed sources. Fires in rangeland vegetation can facilitate the spread of nonnative grasses at the expense of native species. These effects can increase the Forest Service's reforestation workload and demands on its nursery system. Climate-intensified wildfire also affects ecological integrity by interacting with other extreme events, disturbances, and chronic stressors such as drought.

Consequences of Shifting Fire Regimes for Multiple Use

The effects of climate change on wildfire have consequences for the delivery of goods and services from the Nation's forests and grasslands. For

example, uncharacteristically large and severe fires affect watershed function, increasing erosion and vulnerability to landslides. Downstream water users may experience decreases in water quality and increased costs of removing sediment and debris from reservoirs, and these impacts can persist years after a fire. These types of fires can have adverse effects on habitat for some wildlife species, especially those that rely on old-growth forests and other late-successional habitats. Burned landscapes present hazards to recreationists, and the increasing area burned is adding to the workload for agency staff in providing safe and desirable recreational opportunities.

Impacts of Changing Fire Regimes on Communities

Changing fire regimes affect people and their well-being. More people are moving into areas at high risk from wildfire, which elevates the threat to lives and property. Smoke from wildfires adversely impacts public health in urban and rural communities located near and far from wildfires, especially for people with preexisting health conditions and limited access to high-quality healthcare. Wildfires and postfire flooding can damage homes; pollute drinking water; and imperil roads, electrical transmission systems, and other critical infrastructure. Fire damage to local infrastructure imposes a higher burden on low-income, minority, and Indigenous peoples who are less likely to be mobile than the general population. For Indigenous peoples and others with spiritual connections to the landscape, catastrophic wildfires can damage sacred sites, cultural resources, and the fabric of communities. Cultural survival is further threatened because the identity and spirituality of Tribal Nations and Indigenous peoples are inextricably tied to ancestral homelands.



Caldor Fire aftermath on Lake Tahoe Basin, California. USDA Forest Service photo by Cecilio Ricardo.

Impacts of Changing Fire Regimes on Mission and Operations

Fires and threats associated with extreme fire danger may hinder the agency's ability to deliver on its mission. As droughts become more frequent and severe in some areas, managers may need to place temporary limits on public access to national forests and grasslands to reduce risks from human-caused ignitions and avoid evacuating visitors when fires occur. Extreme fire danger and longer, more intense fire seasons can also keep the Forest Service from conducting mechanical treatments and from using both planned and unplanned ignitions to reduce wildfire risk and restore ecological integrity.

Longer fire years and more unpredictable wildfires are taxing for all Forest Service employees and especially

for wildland firefighters. Climate change can exacerbate existing stress from economic and housing insecurity faced by firefighters and create additional stress of a longer and more active fire season. Changes in fire behavior also present risks to wildland firefighter safety. In areas affected by insect outbreaks, hazards may include more downed fuels and standing snags. Higher summer temperatures elevate the health and safety risks faced by firefighters. The Forest Service's reliance on a primarily seasonal firefighting workforce complicates preparations for longer fire years. As fires rise in number and duration, employees from across the Forest Service are increasingly called upon to support wildland fire suppression and Burned Area Emergency Response (BAER), taking employees away from fulfilling their primary duties and completing other mission-critical work.



Firefighters march into action to provide hose laying support in the Rogue River-Siskiyou National Forest, Oregon. USDA Forest Service photo by Cecilio Ricardo.

ACTION 1

ADAPT TO CHANGING FIRE REGIMES

Climate change intensifies the need for the Forest Service and the communities it serves to determine how to safely coexist with wildfire. Realizing the benefits of fire for ecosystems and communities while reducing the risks will mean helping landscapes, communities, and the wildland fire workforce adapt to novel fire regimes, longer fire years, and more area

burned. Adaptation will build on existing plans and programs for reducing wildfire risk, including the measures described in the Forest Service's Wildfire Crisis Strategy and funded through the Bipartisan Infrastructure Law. Adaptation will also benefit from innovation in light of rapidly changing landscapes and emerging science.

1a: Implement the Wildfire Crisis Strategy through climate-informed actions

In early 2022, the Forest Service released the Wildfire Crisis Strategy, with the 10-year goal of treating an additional 20 million acres on the National Forest System and an additional 30 million acres on other lands for fuels and forest health. The strategy responds to the effects of climate change in degrading forest health and elevating wildfire risk, especially in the Western United States, by funding activities aligned with climate adaptation goals related to wildfires. The agency will integrate climate change considerations into landscape prioritization, treatment design, and implementation of wildfire risk reduction activities funded by the Bipartisan Infrastructure Law. Treatments can help prepare landscapes for the impacts of other climate-intensified disturbances, including insect outbreaks.



The 2022 Interagency Wildland Fire Briefing. USDA Forest Service photo.

1a SUPPORTING ACTIVITIES

- Explicitly consider how climate change affects fire regimes and other disturbances when identifying treatment locations and types at scale.
- Increase the use of planned and unplanned ignitions across shared landscapes while accommodating seasonal shifts in burning opportunities and other implementation challenges brought on by climate change.
- Carry out thinning treatments that reduce near-term wildfire risks and allow landscapes to accommodate beneficial fire, thereby facilitating long-term adaptation to climate-related changes in wildfire and other disturbances and stressors.
- Collaborate with Tribal Nations and Indigenous peoples to practice cultural burning to reduce risks to communities and cultural resources, integrating Indigenous Traditional Ecological Knowledge into Forest Service land management practices, as appropriate.

1b: Prepare the wildland fire workforce for a changing climate

Changing fire regimes directly affect the daily work of wildland firefighters, and a central element of adapting the Forest Service to climate change involves preparing the wildland fire workforce for climate-driven fire years. The Bipartisan Infrastructure Law provides support by raising firefighter pay in certain regions, shifting positions from seasonal to permanent, and spurring the development of a wildland firefighting job series. However, sustained efforts are necessary to recruit, train, and retain skilled wildland firefighters and offer them nonfire opportunities in the agency should they choose to take them. Continuity of professional experience will enable continued improvement in approaches for managing fire under changing conditions. The Forest Service will grow its year-round workforce capacity to conduct prescribed fire and other activities at the appropriate scale to effect meaningful change.

Two firefighters with the Blue Ridge Hot Shots, climb a steep mountain with arduous lava rocks to battle the Dixie Fire in Lassen National Forest. USDA Forest Service photo by Cecilio Ricardo.

1b SUPPORTING ACTIVITIES

- Help ensure that pay structures, benefits, and promotion opportunities support wildland firefighters and their families enough to retain them in the agency, in part for their experience and institutional knowledge.
- Expand the Forest Service's capacity for year-round fire response and fuels treatments through actions such as creating more year-round wildland firefighting positions, providing firefighters sufficient time off between assignments to rest and recuperate, or developing a separate workforce dedicated to prescribed fire and fuels treatments.
- Expand the capacity of incident management teams to prepare for more complex fire events happening concurrently around the country and the need to use planned and unplanned ignitions to reduce wildfire risk.
- Through training and support, expand the capacity of the agency's non-firefighter workforce to conduct critical elements of suppression and post-fire recovery such as resource advisors and BAER personnel.



1c: Practice safe and effective fire response in a changing climate

Climate change is escalating the occurrence of extreme fire conditions, threatening firefighter and public safety and presenting challenges to effective fire management. Climate change is also contributing to the increasing size and severity of wildfires each year. Adapting to change requires processes and structures that enable safe and effective fire responses across a wide range of conditions and allow managers to use wildfires to achieve management objectives when possible.

1c SUPPORTING ACTIVITIES

- Prepare for synchronized large fire events across multiple regions in the Western United States as temperatures rise and some of these become drier.
- Integrate climate change into prefire planning, decision support tools, and risk management approaches (such as potential operational delineations and the Wildland Fire Decision Support System) to help ensure that wildland fire response is safe and effective and helps ecosystems adapt to climate change.
- Improve understanding of fire behavior and fire effects in forests and other ecosystems that historically have not burned frequently but may experience increased fire due to climate change.

The 2022 Interagency Wildland Fire Briefing. USDA Forest Service photo.



1d: Prepare for more post-fire landscapes

As fire behavior changes, the Forest Service needs new approaches to managing postfire landscapes. In some instances, fires may help reduce fuel loads, creating landscape mosaics with different forest structures that encourage regeneration. The Forest Service will capitalize on such outcomes to move landscapes towards conditions that are adapted to climate change while reducing wildfire risk and delivering ecosystem goods and services. In other situations, uncharacteristically large and severe fires may have adverse impacts on ecological integrity, soils, watersheds, and the ability of postfire landscapes to recover enough to continue providing ecosystem services. Such landscapes may need restoration, reforestation, and postfire fuels management. Adaptation in these contexts will involve reducing risks from postfire hazards and facilitating the recovery of postfire landscapes.



1d SUPPORTING ACTIVITIES

- Increase the capacity of the BAER program and its workforce; including soil scientists, hydrologists, and other specialists; to immediately treat severely burned large landscapes and reduce risks to safety, access, water quality, and critical natural resources.
- Implement the Burned Area Recovery program to address nonemergency postfire restoration needs and adapt recovering ecosystems to changing climate conditions.
- Quickly and effectively remove hazardous trees to improve access to burned landscapes shortly after wildfires.
- Implement fuels treatments, including planned ignitions, to reduce risks of reburns and take advantage of the beneficial effects of wildfires for ecological integrity.
- Carry out longer term postfire restoration, regeneration, and planting, including strategies based on the best available science to facilitate transitions to ecosystems that are adapted to future climates where appropriate.
- Use partnerships to increase nursery capacity, native seed collection, and other activities that support reforestation and restoration.

Tree planters planting Whitebark pine seedlings in Skyland area, Flathead National Forest, MT. USDA Forest Service photo by Erika Williams.

1e: Develop and apply interdisciplinary science to adapt to changing wildfire regimes

The Forest Service has a strong track record of actionable science on fire behavior, fire ecology, and risk management. Continued research will give managers the information they need to understand drivers of wildfire change, prepare for changing wildfire conditions, and manage for landscapes resilient to damaging fire. Social science research on fire will help the agency understand how managers approach wildfire in a warming world, how the public and communities perceive the topic, and how to bring together these different perspectives.

Fire behavior packages positioned by Bret Butler of the Rocky Mountain Research Station capture data from flaming front as it curled over the ridge top. USDA Forest Service photo by Roger Ottmar.

1e SUPPORTING ACTIVITIES

- Collaborate with managers and Tribal Nations on research that advances understanding of wildfire risk to ecosystems and communities, supports effective fuel treatments, and enables adaptation to changing wildfire fire regimes, including participatory research with Tribal Nations and Indigenous peoples that incorporates Indigenous Traditional Ecological Knowledge.
- Deliver science that facilitates safe and effective wildfire response, including tools that project wildfire probability and behavior, smoke issues, and carbon emissions under a changing climate.
- Advance social science research to better understand perceptions of wildfire risk, fuels treatment options, and barriers to and opportunities for expanded use of planned and unplanned ignitions as management tools.
- Provide research to support managers in preparing for novel climate conditions, facilitating landscape transitions, and articulating emerging management objectives.



EXTREME EVENTS AND DISTURBANCES

Climate change will contribute to more frequent and intense extreme events and disturbances in addition to wildfire, including floods, drought, hurricanes, insect and disease outbreaks, and the spread of invasive species. These disturbances already affect the Nation's forests and grasslands but will likely increase in intensity and frequency because of climate change. Flooding may increase in many of the Nation's watersheds due to changes in precipitation patterns and hydrologic processes. Increased warming of the global system will likely result in more intense hurricanes and other storms, and increase the likelihood of extreme droughts in many parts of the United States. Biological disturbance agents, including insects, pathogens, and invasive plant and animal species, will contribute to the loss of ecological integrity through increased mortality and competition with native species. These extreme events and disturbances, including wildfire, can interact and be compounded by one another.

Flooding, Heavy Rains, and Geologic Hazards

Precipitation patterns are already changing and will likely change further because of climate change. In some parts of the country, rainfall is becoming more concentrated in fewer but more intense storms. Increases in ocean temperatures may result in more intense rain from hurricanes in the Southeast and atmospheric rivers and other storms along the West Coast. Coupled with earlier snowmelt from warmer weather, heavy rains are contributing to increased flooding in some areas. The effects can lead to landslides, debris flows, and other geologic hazards, especially in burned areas or areas with highly erodible soil. Flooding damages Forest Service roads and infrastructure, particularly near stream crossings and along streams. Many recreation sites are located along streams and rivers, where flash floods can endanger recreationists and damage recreation infrastructure. Hillslope erosion can remove soil, affecting long-term forest productivity.

Floods involving rivers and streams that originate in national forests have caused significant damage and loss of life in downstream communities. For example, the 2013 Colorado Front Range floods occurred in several river basins that transect national forest lands, resulting in the loss of lives, evacuations, and destruction of nearly 20,000 structures. In recent years, mudslides in burned areas following heavy precipitation have caused shutdowns of interstate highways in Colorado and Oregon and extreme rain has caused significant damage to Forest Service infrastructure in the Midwest and Northeast. These effects on transportation systems have impacted nearby communities and disrupted national and local economies. Such events may occur more frequently or be more severe because of climate change.

Intensified Drought and Heat Waves

Many ecosystems are having more frequent and severe droughts due to warmer temperatures, altered precipitation patterns, and reduced snowpack. Even in places with more annual precipitation, soil moisture may decline as evapotranspiration rises with higher temperatures. Drought elevates the vulnerability of ecosystems to disturbances, including wildfires and outbreaks of insects and some pathogens. Drought can result in forest mortality, decreased forest and rangeland productivity, and regeneration failures. Riparian areas and wetlands may have lower water levels, altering habitats for aquatic and terrestrial species. In some areas, increased demand for water from downstream communities and agricultural producers may lower water levels in streams as well as reservoirs and other water bodies on national forests, depriving visitors of water-based recreational opportunities. The ecological effects of drought may also affect valued cultural resources. For example, recent droughts in the Southwest have contributed to the large-scale mortality of piñon pine, a tree valued by communities for pine nuts and fuelwood. Intense heatwaves, like on the West Coast in 2021, may damage forests and cause fatalities and adverse health impacts on human communities. Without adaptation, the likelihood of annual water shortages is likely to rise in many parts of the United States, with disproportionate adverse impacts on water sources for disadvantaged communities and resources relied on by Tribal Nations and other Indigenous peoples.

Insect and Pathogen Outbreaks

Dry conditions amplified by climate change increase the likelihood of insect outbreaks. Warmer temperatures can directly influence population growth for many native and introduced insect species while reducing the chances of winter mortality that controls insect populations. Warmer, drier conditions increase stress on host trees, reducing their capacity to defend themselves against insect pests. Widespread tree mortality from drought and bark beetle outbreaks, such as that in the Sierra Nevada of California in the mid-2010s, can contribute to increased wildfire severity in some instances. Recent outbreaks of spruce beetle and mountain pine beetle have occurred throughout the Western United States during a multidecadal dry period that started in the early 2000s. Tree mortality from these outbreaks can reduce scenic qualities valued by recreationists. The outbreaks can create hazards for wildland firefighters, Forest Service employees, and visitors to national forests. In other parts of the country, wetter conditions may increase the presence of some fungal pathogens of insects, which can reduce populations of some defoliators and potentially benefit some tree species. Forest structural

changes from insect outbreaks also alter wildlife habitats and water availability for downstream users. As temperatures warm and bark beetles increase reproductive capacity at higher elevations or shift into new habitats, the agency may face increasing difficulty in restoring whitebark pine, a culturally and ecologically important species under consideration for listing under the Endangered Species Act.

Climate change may also exacerbate the impacts of native and introduced tree pathogens. Warmer, drier conditions in some parts of the country may support the success of some pathogens and limit the success of others, depending on their temperature requirements and water relations. Warmer, drier climates may also increase host susceptibility to tree pathogens, causing tree decline and mortality. Tree pathogens can also interact with other climate-related disturbance processes to reduce productivity and overall forest health. For example, water molds such as the fungus that causes sudden oak death may be less successful in drier conditions but thrive in areas with increased moisture, whereas white pine blister rust has moved upslope under warming conditions causing tree mortality in high-elevation forests.



Impact from ongoing spruce beetle infestation that has caused more than 50 percent mortality on Engelmann spruce as of 2021 at the headwaters of the Pecos River within the Pecos wilderness, Santa Fe National Forest. USDA Forest Service photo by Daniel Ryerson.

Invasive Species and Climate Change

More disturbances, coupled with warmer temperatures and changes in precipitation, facilitate the spread and establishment of invasive plant and animal species. Many invasive plant species can outcompete native vegetation, especially under changing climate conditions. In the Eastern United States, plants such as kudzu and other vine species are spreading under warmer and wetter conditions. In the West, annual grasses like cheatgrass benefit from increased wildfire, quickly spreading into burned areas where their high flammability increases the likelihood of recurring fires. The spread of invasive grasses in desert ecosystems increases fuel continuity, allowing fires to spread into areas where they historically would not have and where iconic species like saguaro are not tolerant of fire. Invasive plants can also affect wildlife habitats. For example, the spread of cheatgrass is increasingly affecting sensitive sagebrush habitats in the Great Basin, hindering efforts by the agency and its partners to conserve and restore sage-grouse populations.

In addition to invasive plants, the agency faces ongoing challenges from invasive aquatic and terrestrial animal species in connection with climate change. For example, native cutthroat trout throughout the Western United States will contend with the compounding effects of warming streams and invasive fish species that can outcompete native trout. Nonnative insect species, such as emerald ash borer and hemlock wooly adelgid, may also be able to spread northward and to higher elevations with warming winter temperatures, leading to tree mortality and reduction in ecological integrity.

Hurricanes and Sea Level Rise

Forests in tropical and coastal areas may face unique climate threats. Warmer sea surface temperatures contribute to higher winds and more rainfall intensity from tropical storms, even in areas far from coastal lands. Storms with high winds and torrential rains topple and damage trees; compromising ecosystem services and destroying communications, energy, and transportation systems relied upon by Forest Service employees and surrounding communities. Sea level rise may also make coastal areas more susceptible to storm surges, and standing water and salinity can reduce tree growth and kill trees.

In recent years, hurricanes have had significant impacts on national forests in the Southern Region. In 2017, for example, Hurricanes Irma and María occurred 2 weeks apart, damaging millions of trees over wide swaths of forest and resulting in the 4-year closure of the El Portal Visitors Center on Puerto Rico's El Yunque National Forest, the National Forest System's only tropical rain forest. Other national forests in the Southeast, including the Francis Marion National Forest in coastal South Carolina and the national forests in Mississippi, have also experienced devastating impacts from hurricanes in recent years. These events also demonstrate how hurricanes can increase the risks of landslides, flooding, and debris flows.

ACTION 2

PREPARE ECOSYSTEMS, WATERSHEDS, AND INFRASTRUCTURE FOR EXTREME EVENTS AND INTENSIFYING DISTURBANCES

Adapting to rapid shifts in disturbance regimes will involve building on the agency's ongoing work to restore and maintain functioning ecosystems and watersheds, while simultaneously coping with new and intensified stressors. The Forest Service will modify the design, intensity, location, and timing of ongoing management activities and pursue new approaches as conditions rapidly change. Flexible management will

become especially important, and managers will need to consider new ways of responding to disturbances, recognizing when restoring historical conditions is no longer possible. Managers and partners will need effective monitoring, research, and communication systems to manage risk and to rapidly and effectively respond to disturbances.

2a: Develop climate-informed monitoring and early warning systems

Integrating information on climate conditions with monitoring data will help managers allocate resources to areas most at risk and understand climate-driven changes in real-time. Monitoring and early warning systems will help managers anticipate rapid changes and respond to disturbances. Such systems will be tailored to detect the shifts and increased variability of disturbances associated with climate change. Robust forewarning and real-time information will help Forest Service managers to act quickly and reduce risks to landscapes and people.



The Healthy Homes Partnership is helping flood victims in Louisiana recover and rebuild. USDA Forest Service photo.

2a SUPPORTING ACTIVITIES

- Integrate satellite-based remote sensing into aerial and field surveys to broaden Forest Health Monitoring survey coverage for early detection and rapid response to climate-driven insect and disease disturbances.
- Use information on climate and disturbances for early detection and rapid response to invasive species in the areas most at risk.
- Work with partners to use flood forecasting and early warning systems to protect visitors on public lands and people in local communities, especially near burned areas.
- Integrate information on drought, rainfall, and temperature changes into the holistic monitoring, assessment, and reporting of wildfires, insect outbreaks, forest blowdowns, and other disturbances.
- Collaborate internally and externally in disaster planning, preparation, response, and recovery.
- Honor and incorporate Indigenous Traditional Ecological Knowledge to inform climate-related monitoring.

2b: Help watersheds adapt to changing conditions, drought, and flooding

Land managers will prepare streams, rivers, lakes, and reservoirs for climate change so that downstream communities continue to get clean and abundant water from the Nation's forests and grasslands, even after extreme events. Functioning watersheds can absorb large pulses of water from heavy rain and rapid snowmelt while also weathering the effects of intense droughts. The Forest Service has decades of experience in watershed restoration, including reconnecting streams to floodplains, adding wood structures to rivers, rightsizing culverts, and decommissioning unneeded roads. The agency will adjust these activities to incorporate the effects of climate change into project prioritization, planning, and implementation to increase the odds of success in a changing climate.

2c: Help ecosystems adapt to intensifying disturbances and extreme events

Land managers will help ecosystems resist the effects of disturbances and build resilience to enable recovery. In some forests, this may include treatments to reduce tree densities, maintain species diversity, or create heterogeneous landscapes that can withstand droughts and insect outbreaks while continuing to maintain forest cover at the landscape scale. In rangelands, managing for diverse native plant communities may help prepare ecosystems for drought and intensifying disturbances, including the spread of invasive species. As the Forest Service scales up vegetation management to reduce wildfire risk, treatments will need to reduce risks not only from wildfire but also from other disturbances.

2b SUPPORTING ACTIVITIES

- Implement projects that improve watershed function and prepare streams, rivers, and other water bodies for extreme events, flooding, and changes in hydrology.
- Design and maintain infrastructure, including roads, buildings, and stream crossings, to accommodate increases in flooding and geologic hazards such as landslides through the Legacy Roads and Trails Program and funding provided by the Great American Outdoors Act.
- Assess landscapes for geologic hazards (such as landslides) induced by heavy rains and reduce risks to priority areas.

2c SUPPORTING ACTIVITIES

- Design wildfire risk reduction and forest restoration treatments to account for multiple climate-driven disturbances.
- Increase the resistance of rangeland vegetation to invasive grasses through active management and research, considering vulnerability to climate change, increased fire, and other disturbances in prioritizing treatments.
- Manage for forest ecosystem structure and species composition adapted to disturbances such as sea-level rise, flooding, and high wind events such as hurricanes, tornadoes, and derechos. Manage for urban forests that are adapted to drought, heatwaves, insects, pathogens, and other disturbances.

2d: Develop systems for rapid and effective response to disturbances

The Forest Service will need systems for a rapid and effective response to disturbances. Quick and effective treatments will help stop the spread of insects, diseases, and invasive species before they become serious problems. Climate change may limit treatment effectiveness, especially for novel invasive species or for native insects introduced through climate-induced range shifts. Interdisciplinary approaches in collaboration with other Federal agencies, Tribal Nations, States, and other partners stand the best chance of success, especially when decisive, quick, and large-scale actions are needed.

2e: Conduct research to reduce risks from climate-driven disturbances

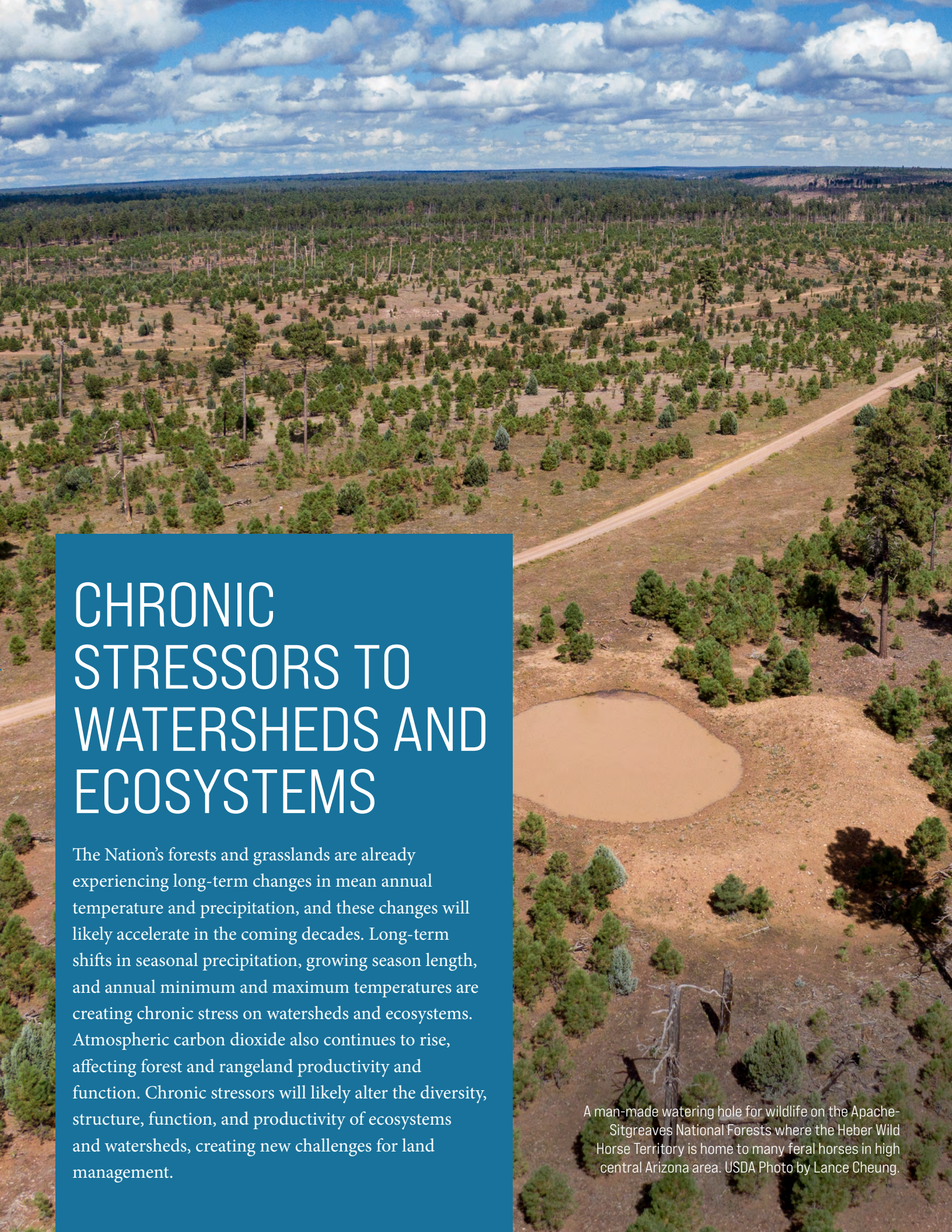
Through research, the Forest Service provides critical information on the extent and severity of disturbance effects and their implications for ecosystems and communities. Researchers will help the Forest Service understand the effects of climate-related disturbances, identify risks, and test mechanisms to prepare for and recover from these events. Studies of past disturbances, current research initiatives, and emerging techniques will help agency employees and partners learn how to support climate adaptation.

2d SUPPORTING ACTIVITIES

- Conduct National Environmental Policy Act analyses in a strategic manner and at the right scale, facilitating the expedited implementation of adaptation actions before and after disturbance events where appropriate.
- Aid urban and rural communities and nonindustrial private landowners in responding to insect outbreaks, pathogens, and severe weather events through the Urban and Community Forestry and Forest Stewardship programs.
- Manage permits for flexibility in timing and intensity of use to allow for agile responses to drought.

2e SUPPORTING ACTIVITIES

- Characterize disturbance processes and effects of new climatic conditions and identify disturbance-prone landscapes to support adaptive management.
- Develop science to support best management practices, frameworks, and tools to support the adaptation of species, ecosystems, communities, and landscapes to climate-related disturbances.
- Use inventory, monitoring, and long-term research at experimental forests and ranges to evaluate the effectiveness of management actions to help ecosystems adapt to the effects of climate-driven disturbances.
- Use social science and collaborative methods to assess risk, perceptions, barriers, equity, and the role of governance networks in climate adaptation and disaster planning and preparedness.

An aerial photograph of a vast, dry forest landscape. The ground is covered with numerous small, green, conical evergreen trees, likely piñons, spaced out across a brown, arid terrain. A wide, light-brown dirt road winds diagonally from the middle ground towards the upper right. In the lower right foreground, there is a small, irregularly shaped pond with murky, brown water, surrounded by more trees and dry vegetation. The background shows a dense line of taller trees under a bright blue sky filled with large, white, fluffy clouds.

CHRONIC STRESSORS TO WATERSHEDS AND ECOSYSTEMS

The Nation's forests and grasslands are already experiencing long-term changes in mean annual temperature and precipitation, and these changes will likely accelerate in the coming decades. Long-term shifts in seasonal precipitation, growing season length, and annual minimum and maximum temperatures are creating chronic stress on watersheds and ecosystems. Atmospheric carbon dioxide also continues to rise, affecting forest and rangeland productivity and function. Chronic stressors will likely alter the diversity, structure, function, and productivity of ecosystems and watersheds, creating new challenges for land management.

A man-made watering hole for wildlife on the Apache-Sitgreaves National Forests where the Heber Wild Horse Territory is home to many feral horses in high central Arizona area. USDA Photo by Lance Cheung.

Changes in Forest and Grassland Productivity and Composition

Long-term shifts in annual precipitation and temperature contribute to changes in the productivity of—and the distribution of plant and animal communities on—our Nation’s forests and grasslands. In places where cold temperatures currently limit vegetation growth, increased warming may lead to rising productivity and the expansion of forests into higher elevations or latitudes. Places where moisture availability is a limiting factor may experience decreased forest productivity or lack of regeneration, sometimes leading to conversion from forests to grasslands or shrublands. Long-term changes in carbon dioxide and moisture availability will likely affect rangeland productivity and the quantity and quality of forage for livestock and wildlife grazing. As the agency revises land management plans under the 2012 regulations for the National Forest Management Act, planning teams will need to consider how these

long-term ecosystem shifts may push systems outside of the natural range of variability and, in turn, how these effects will impact ecological integrity.

Stress on Soils, Watersheds, and Aquatic Systems

Long-term changes in temperature and precipitation will also contribute to shifts in hydrologic cycles, affecting soils, watersheds, and aquatic ecosystems. In many parts of the United States, changes in the timing and nature of precipitation will lead to more variable streamflow, with higher peak flows and lower minimum flows. As temperatures warm, some watersheds will likely undergo shifts from snow-dominated to rain-dominated hydrology. Warmer water temperatures are affecting coldwater-dependent aquatic species that are important for ecosystems, Indigenous peoples, and recreationists. Altered precipitation regimes, earlier snowmelt, and reduced snowpack can affect water supplies for downstream communities. Long-term reductions in precipitation



A young horse and Angus bull take in the morning light on the Gravelly Mountain Range in the Beaverhead-Deerlodge National Forest. USDA Forest Service Photo by Preston Keres.

in some regions may also affect groundwater recharge, leading to long-term losses in water availability for municipal services and agriculture. Interactions between climate and wildfires also pose increased threats to watershed hydrology, soils, aquatic ecosystems, and riparian communities. Such dynamics can degrade soil and watershed condition and create obstacles to restoring high-priority watersheds.

Effects on Wildlife and Plant Biodiversity

Changes in ecosystem productivity, distribution, and water availability will affect plant and wildlife biodiversity, habitats, and abundance. Climate change impacts on aquatic and terrestrial ecosystems will alter ecological processes and amplify other anthropogenic threats to species and habitats, such as land-use conversion to developed uses. Managing for species with limited habitat requirements may become more challenging, especially for species in high-elevation or extreme northern habitats and species with narrow

habitat requirements and low tolerance or resistance to environmental change. Ecosystem changes may affect the distribution and viability of threatened, endangered, and other at-risk species. These impacts will test the agency's ability to conserve habitat and contribute to the recovery of species listed under the Endangered Species Act. More effort and investment may be required to stay in compliance with the Endangered Species Act, and more coordination may be needed with other agencies that have regulatory oversight of listed species.

Climate change threatens biodiversity as habitats shift, and species with wide habitat ranges, including nonnative invasive species, outcompete species with narrower requirements. Climate change may also alter wildlife migration patterns, create asynchronies between plants and pollinators, contribute to plant and wildlife disease, and lead to novel combinations of species that did not previously coexist. People who depend on these species for economic, cultural, or recreational purposes may lose species that they value in some places.



A Greater Sage-Grouse male in the Curlew National Grassland performs his mating display by spreading his plumage, strutting, and inflating his air sacks on his breast. USDA Forest Service photo by Kathleen Gorby.

ACTION 3

SUSTAIN AND IMPROVE ECOSYSTEM AND WATERSHED FUNCTION IN THE FACE OF CHRONIC STRESSORS

As chronic stresses mount in a changing climate, the Forest Service will help ecosystems and watersheds maintain their core functions and integrity. Unless the agency takes action, ecosystems and watersheds might adapt on their own, but core functions and

integrity might not persist. Integrating climate science and decision support tools into program and project planning, guidance, and implementation will help the Forest Service place the right adaptation actions in the right places.

3a: Fully integrate climate considerations into guidance and directives

Managers and decision-makers rely on guidance and directives to shape their actions. The Forest Service directive system serves as the primary basis for managing programs and the primary source of administrative direction for Forest Service employees. Directives will be revised, as appropriate, to provide direction for incorporating climate change into management decisions and allowing for management flexibility under rapidly changing conditions. In addition, the Forest Service has selection criteria for competitive funding for internal projects and assistance to State and private entities. Including climate change considerations in the selection criteria will enable projects to account for climate-related threats. The Forest Service needs to review and update its guidance to allow for and encourage adaptation actions.

3a SUPPORTING ACTIVITIES

- Update guidance and directives in the Forest Service directive system to facilitate climate change adaptation, where appropriate.
- Provide guidance and assistance to national forests and grasslands on the appropriate use of assisted migration as a management tool in partnership with other Federal agencies, Tribal Nations, States, and other partners.
- Integrate climate change adaptation into guidance and criteria for proposals for competitive funding, including through Cooperative Forestry programs, the Collaborative Forest Landscape Restoration Program, the Joint Chiefs Landscape Restoration Program in collaboration with the USDA, Natural Resources Conservation Service, and other programs authorized under recent legislation such as the Bipartisan Infrastructure Law and the Great American Outdoors Act.

3b: Plan for future conditions across boundaries

The pace and scale of climate change require the Forest Service to think at broader spatial scales and time horizons. Spanning jurisdictional and ecological boundaries, climate change will require planning to account for landscape-scale change. Planning for desired future conditions that accounts only for past climatic conditions leaves forests and grasslands at risk of no longer being able to sustain ecological integrity and provide multiple benefits to the public. Cross-boundary plans grounded in science on long-term landscape-scale trends and climate projections will help the Forest Service prepare for ongoing and anticipated changes.



Close-up view of hands surrounding a pine tree seedling freshly planted. USDA Forest Service photo.

3b SUPPORTING ACTIVITIES

- Fully integrate climate vulnerability assessments and adaptation strategies into land management planning and other planning across landscapes.
- Work with Federal agencies, Tribal Nations, States, and other partners to conserve, connect, and restore 30 percent of America's lands and waters by 2030, in alignment with the goals outlined in "Conserving and Restoring America the Beautiful."
- Use mechanisms such as the Tribal Forest Protection Act, Good Neighbor Authority, and Shared Stewardship agreements to work with Tribal Nations, States, and other partners to reduce climate-related risks to ecosystems.
- Honor Tribal sovereignty and respect for Tribal trust and treaty rights through consultations with Tribal nations on all actions affecting cultural, natural, and sacred sites on public lands.
- Provide science and technical assistance for climate adaptation planning in other countries through Forest Service International Programs.
- Use regional and national assessments, such as the Resource Planning Act assessment, to understand the effects of climate change, land use change, and other factors on the status and trends of renewable resources in long-term planning.

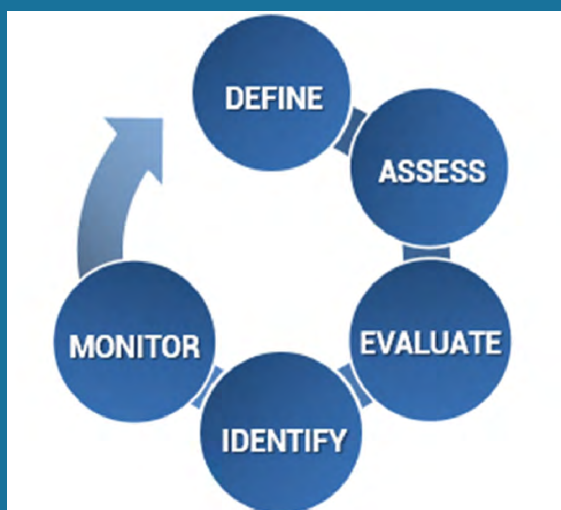
3c: Manage ecosystems for long-term change

On-the-ground management will require a wide range of actions to protect at-risk plant and animal species and ecosystems, improve ecosystem resilience, and in some cases facilitate transitions to more climate-adapted conditions. The Forest Service will employ tested, science-based adaptation actions to maintain ecosystem function in balance with other social, economic, and cultural values; not all actions will be appropriate everywhere. Actions will ultimately depend on local goals and objectives and will be guided by local expertise, Indigenous Traditional Ecological Knowledge, and scientific research.

3c SUPPORTING ACTIVITIES

- Support climate-informed reforestation and restoration, using climate decision support tools to assist in native seed sourcing and planting climate-adapted nursery stock where appropriate.
- Incorporate prescribed and cultural burning as well as the use of unplanned ignitions into land management practices, where appropriate.
- Increase conservation and recovery efforts for at-risk plant and animal species in partnership with other Federal and State agencies and in consultation with Tribal governments.
- Identify and protect climate refugia, such as coldwater streams and cool microclimates, as well as movement corridors for species migration.
- Help wildlife populations adapt to climate change by increasing redundancy and heterogeneity of habitat, decreasing other stressors, and improving connectivity.

ADAPTATION WORKBOOK



The [Adaptation Workbook](#) is a structured process to consider the potential effects of climate change and design land management and conservation actions that can help prepare for changing conditions. The process is completely flexible to accommodate a wide variety of geographic locations, ownership types, ecosystems and land uses, management goals, and project sizes.

The Workbook consists of 5 basic steps:

1. Define goals and objectives
2. Assess climate impacts and vulnerabilities
3. Evaluate objectives considering climate impacts
4. Identify adaptation approaches and tactics for implementation
5. Monitor effectiveness of implemented actions

3d: Apply decision support tools to set priorities for adaptation activities

The Forest Service manages 193 million acres of Federal land. Managing such a large land base requires managers to focus on actions where most needed; in some cases, the best course of action may be no action at all. The Forest Service has already developed numerous decision support tools that help managers identify if, when, where, and how to apply adaptation strategies. These tools, along with new resources, will enable managers to prioritize their actions and manage the land most effectively.

3e: Advance research on climate-adaptive ecosystem management

The Forest Service conducts long-term inventory, monitoring, and analysis using remote sensing technologies, field studies, and a network of experimental forests and ranges on Federal land. The Forest Service also partners with Federal, Tribal, State, and university partners on numerous long-term research studies in urban and rural areas. The agency also integrates biophysical expertise with climate projections to help land managers understand chronic climate change impacts under a range of scenarios.

3d SUPPORTING ACTIVITIES

- Develop geospatial tools for identifying high-priority areas for helping ecosystems adapt to climate change.
- Encourage interagency analysis, climate data sharing, and the application of combined expertise, where appropriate, for selecting high-priority landscapes for treatment and assessing risks from disturbances to further costeward landscapes across agencies.
- Encourage the use of adaptation planning tools to select appropriate adaptation actions, such as the Adaptation Workbook, Adaptation Library, and the Tribal Adaptation Menu.

3e SUPPORTING ACTIVITIES

- Conduct research and develop integrated assessments to improve understanding of the risk associated with chronic effects of climate change, recognizing the value of biodiversity, climate refugia, old growth forests, and species migration corridors.
- Develop an understanding of climate-habitat relationships at the species and population level to support assisted migration and scenario modeling.
- Support scenario planning to provide information on chronic effects of climate change under different management scenarios.
- Develop and test science-based management practices, frameworks, tools, and genetic information to support adaptation to chronic effects of climate change.

A full-page photograph of a man in bright orange shorts jumping into a river. He is in mid-air with his arms raised. In the background, two other people are swimming in the water. The river is surrounded by a dense forest on a hillside.

DISRUPTIONS IN THE DELIVERY OF ECOSYSTEM PRODUCTS AND SERVICES

Climate change will affect the ability of the Nation's forests and grasslands to furnish important services to the public, including clean water and air, carbon storage and uptake, timber and nontimber forest products, productive grazing land, and recreation opportunities. These benefits may be lost or altered due to changes in wildfire, extreme events, and chronic stresses on watersheds and ecosystems. These impacts of climate change will interact with changes in demands for products and services resulting from shifts in population and economic growth.

Luis Reyes jumps into the Ocoee River with other kids at Mac Point in the Cherokee National Forest, TN.
USDA Forest Service photo by Cecilio Ricardo.

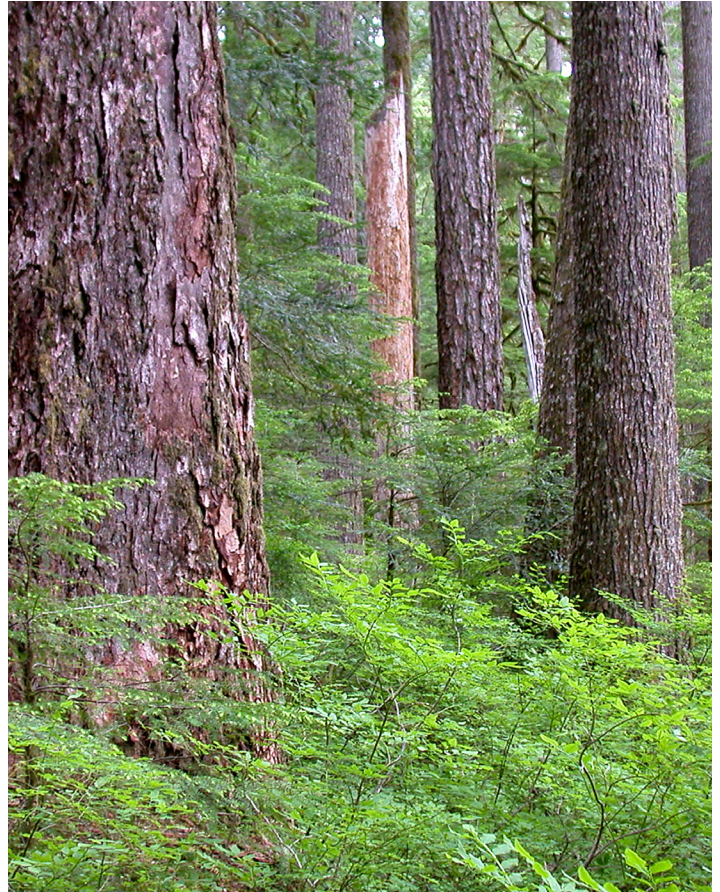
Threats to Water Supply

The national forests and grasslands supply drinking water to over [60 million Americans](#). Catastrophic losses from wildfire, coupled with the effects of other disturbances and long-term changes in water supply, will affect the ability of the National Forest System to continue to provide the quality and quantity of water that cities, rural communities, and Indigenous peoples have depended upon for generations. This puts urban and rural communities at risk of water shortages and could create tension over scarce water supplies. Disadvantaged communities may suffer disproportionate negative impacts when safe drinking water is scarce.

Changes in Carbon Uptake and Storage

Forests in the United States currently take up more carbon than they release to the atmosphere on an annual basis, making them a carbon sink. In addition, harvested wood products store carbon, displacing fossil-fuel-intensive products like steel and concrete. In urban areas, trees planted near homes can help reduce

carbon emissions from heating and cooling energy use in addition to storing carbon directly. Forest mortality and reduced productivity due to climate-related disturbances and stressors may reduce the ability of the Nation's forests and grasslands to store carbon and continue to serve as carbon sinks.



Old-growth forest. USDA Forest Service photo.

CARBON STEWARDSHIP

America's forests provide multiple benefits, such as clean air and water, biodiversity, recreation, wildlife habitat, and timber and nontimber forest products. In this era of climate change, carbon uptake and storage are also critical benefits from healthy forests. Nearly 13 percent of U.S. carbon emissions are taken up and stored in America's forests, including old-growth and other wildland, urban, and working forests.

Unfortunately, many forests are increasingly vulnerable to climate-amplified impacts and stressors. If a forest is vulnerable, so is its carbon. Thoughtful carbon stewardship does not seek to maximize carbon at the expense of forest health but rather to optimize carbon within the context of ecosystem integrity and climate adaptation. Some forests, such as those at risk for high severity wildfire, might require hazardous fuels treatments and other forest health interventions that reduce carbon storage in the short term even as they stabilize carbon in the long term. These ideas are at the core of the USDA climate-smart strategy, which supports the Forest Service goals of protecting communities and watersheds and creating long-term, nature-based climate solutions.

Threats to Timber and Nontimber Forest Products

Wood is a renewable, sustainable resource the Nation needs to reduce greenhouse gas accumulations in the atmosphere and avoid catastrophic climate change.

Wood-based products can substitute for other materials with a larger carbon footprint. In addition, the timber industry, supplied from both Federal and non-Federal lands, supports millions of jobs across the United States and is an integral part of the economy. Climate change presents an additional challenge to an industry that has already been affected by outside forces, such as changes in usage trends and demand for building materials. High volumes of salvage timber from fire, storms, and other disturbances can saturate local harvesting capacity and markets for salvage logs. In addition, long-term changes in timber supply due to shifts in forest composition and productivity may

result in challenges.

Climate change may also affect the availability of nontimber forest products, such as fuelwood, medicinal plants, nuts and fruits, maple syrup, Christmas trees, and arts and crafts materials that are important for regional and local economies. These products include subsistence foods that have cultural, nutritional, and economic benefits for Indigenous peoples and rural communities. Maple syrup production, for example, depends on a narrow range of temperatures just below freezing at night and just above freezing during the day. Climatic shifts may alter sap production as well as threaten the overall health and productivity of sugar maples, which are central to the land and part of the cultural identity and economy for many Indigenous peoples and rural communities in the Midwest and Northeast.



Forest Service Fire Management Officer and a Forest Service Public Affairs Officer look at cold wood at a timber sale on the North Mills Area, Pisgah Ranger District, Pisgah National Forest, NC. USDA Forest Service photo by Cecilio Ricardo.

Stress to Rangelands and Forage Production

Increased drought and disturbances can harm forage production. More frequent and severe wildfires are likely to damage fences, water systems, and other range improvements. Invasive plants reduce rangeland health, forage quality, and the potential for carbon sequestration in soil. Increasing stress from drought on rangeland vegetation and riparian areas can make them more susceptible to damage from grazing. Drought conditions often lead to restricted grazing to protect rangeland health. Many national forests have high-elevation pastures that permittees use in summer, and range managers may see more pressure for expanded grazing in spring and fall as temperatures warm and snowpack decreases.

Effects on Recreation Opportunities and Infrastructure

Outdoor recreation, important to the American economy and culture, will be affected by a changing climate. Rising water temperature, changes in streamflow, and altered growing seasons may alter or reduce opportunities for hunting and fishing. Decreased snow cover may reduce opportunities for winter activities, such as alpine skiing or snowmobiling, creating unpredictability for local communities that depend on winter recreation. The summer recreation season may lengthen in some areas as the shoulder seasons become more hospitable, and summer high temperatures and changes in air quality may increase health risks for visitors in some places. Visitors will also face more safety risks from heavy rain, flash flooding, and wildfire. Extreme events may also damage campgrounds, trailheads, roads, and other key infrastructure. Higher recreational demand during some seasons and increased risk to visitors may also place burdens on staffing.

Forest Service personnel use snowmobiles to pull the heavy trail grooming device over fresh snow to compact and flatten the snow trail for cross-country skiers to use on the George Washington Pines ski trail in the Superior National Forest region in Minnesota. USDA Forest Service photo by Lance Cheung.



ACTION 4

SUPPORT THE DELIVERY OF ECOSYSTEM PRODUCTS AND SERVICES IN A CHANGING CLIMATE

People will continue to need multiple benefits from the national forests and grasslands even as climate change affects both the supply of—and demand for—traditional and nontraditional uses and services. The Multiple-Use Sustained-Yield Act requires the Forest Service to provide a variety of services from the National Forest System without degrading the

productivity of the land. The agency will adapt to changing demand, support the development of innovative products and markets, and manage recreation and tourism opportunities under changing conditions to serve people while maintaining healthy, productive ecosystems.

4a: Help ensure the continued delivery of ecosystem services

A major goal for the Forest Service in helping ecosystems adapt to a changing climate will be the ongoing delivery of ecosystem services from the National Forest System, including clean drinking water and carbon uptake and storage. Protecting water quantity and quality for downstream users will require working with water providers and utilities to adapt natural and built infrastructure to climate change. The Forest Service will also likely face increased demands to manage ecosystems for carbon storage and sequestration. In response, the agency will find ways to balance carbon stewardship and the delivery of other goods and services with climate change adaptation.



Tourists take photos in Wade Lake in the Beaverhead-Deerlodge National Forests. USDA Photo by Preston Keres.

4a SUPPORTING ACTIVITIES

- Target watersheds vulnerable to climate change for watershed restoration projects that improve the natural storage of water for municipal and agricultural uses.
- Work with water providers and downstream communities to help them understand the risks from wildfire and declining snowpack, take steps to reduce risks to water systems, and effectively respond following disturbances.
- Develop projects that provide both adaptation and greenhouse gas mitigation benefits, such as agroforestry; reforestation and other natural climate solutions; methane capture; biomass removal and sequestration via biochar; and avoiding wildfire emissions.
- Develop public-private partnerships to support the delivery of critical ecosystem services in the face of climate change.

4b: Support new and existing forest product markets that align with adaptation

A changing climate and the management response will create shifts in market supply and demand. Loss of productivity and increased disturbances may reduce the viability of some traditional markets, and new markets may emerge for forest products. Adaptation activities, including hazardous fuels reduction and forest health treatments, may yield byproducts that are not viable on existing wood markets. Encouraging the development of additional markets for such byproducts would help offset costs associated with these activities and help support local economies as they deal with ongoing disruptions in traditional timber markets. Increasing the use of wood to meet industrial and consumer needs will also help reduce greenhouse gas emissions from nonrenewable and unsustainable products. The Forest Service will help smooth the way for economic shifts by developing partnerships, tools, and technologies to support new and emerging products and markets and furnishing sustainable supplies of new resources to support vibrant and diverse economies.

4b SUPPORTING ACTIVITIES

- Work with industry and Tribal enterprises to support economically viable markets for wood products from salvage harvests and fuels reduction activities, including small-diameter timber and nontimber forest products through programs such as the Financial Assistance to Mills Program in the Bipartisan Infrastructure Law.
- Develop new products from unused woody material and other biomass and new markets for high-value products such as cross-laminated timber, biochar, and nanocellulose.
- Manage ecosystems to support the long-term sustainability of culturally and economically important nontimber forest products.
- Identify and reduce vulnerabilities in forest product supply chains.

ADAPTA

The Caribbean Climate Hub for Tropical Agriculture and Forestry has the task of identifying and documenting sustainable management practices that farmers, ranchers, producers, and managers of agricultural and forestry lands can adopt to increase their resilience to climate change. ADAPTA (<https://www.climatehubs.usda.gov/hubs/caribbean/project/adapta-climate-adaptation-project>) provides climate services and provides educational resources for professionals in the agricultural sector in Puerto Rico and the U.S. Virgin Islands through videos, factsheets, and training workshops.



In the aftermath of the hurricanes, El Yunque closed for repairs and restoration work. USDA Forest Service photo.

4c: Adapt recreation facilities and opportunities to sustain the recreation economy

The Forest Service will anticipate recreation opportunities under changing landscape conditions and help recreationists adjust their expectations while keeping visitors safe from wildfire, extreme heat, flooding, and storms. As it adjusts to the impacts of climate change, the Forest Service will also help ensure that recreational opportunities are distributed equitably and that they continue to support local economies.

4c SUPPORTING ACTIVITIES

- Support planning and actions to reduce the risks from climate change to trails, buildings, campsites, and other recreation infrastructure such as through the BIL Ecosystem Restoration recreation funding.
- Develop new ways of communicating risks and opportunities to the recreating public.
- Develop adaptation actions that increase recreation accessibility and availability to disadvantaged communities.
- Work with partners and communities to find innovative ways of sustaining local recreation economies as they deal with climate-change-related shifts in recreation demand and opportunities.

4d: Take flexible approaches to manage grazing

The impacts of climate change on forage productivity and quality include the rising severity of drought and wildfire, as well as the spread of invasive species. The Forest Service will adjust its grazing management and its systems for administering grazing permits accordingly. Adjustments will also account for the increased vulnerability of ecosystems and watersheds to adverse impacts from grazing.

4d SUPPORTING ACTIVITIES

- Increase flexibility in grazing management to allow for changes in the timing and intensity of livestock grazing.
- Work with permittees to make range improvements (in fencing, water systems, and so forth) that enhance ecosystem adaptation to climate change.
- Restore and maintain native rangeland vegetation, where appropriate, especially species adapted to climate change.
- Provide decision support on agroforestry practices that support grazing.

4e: Support research on ecosystem products, services, and markets

Delivering products and services in a changing climate requires an understanding of how climate change will affect demand for them. It also requires research on developing new markets, including markets for small-diameter wood and other byproducts from adaptation activities. The Forest Service's and its partners' expertise in forest product development, natural resource management, and forest economics can help meet these needs.



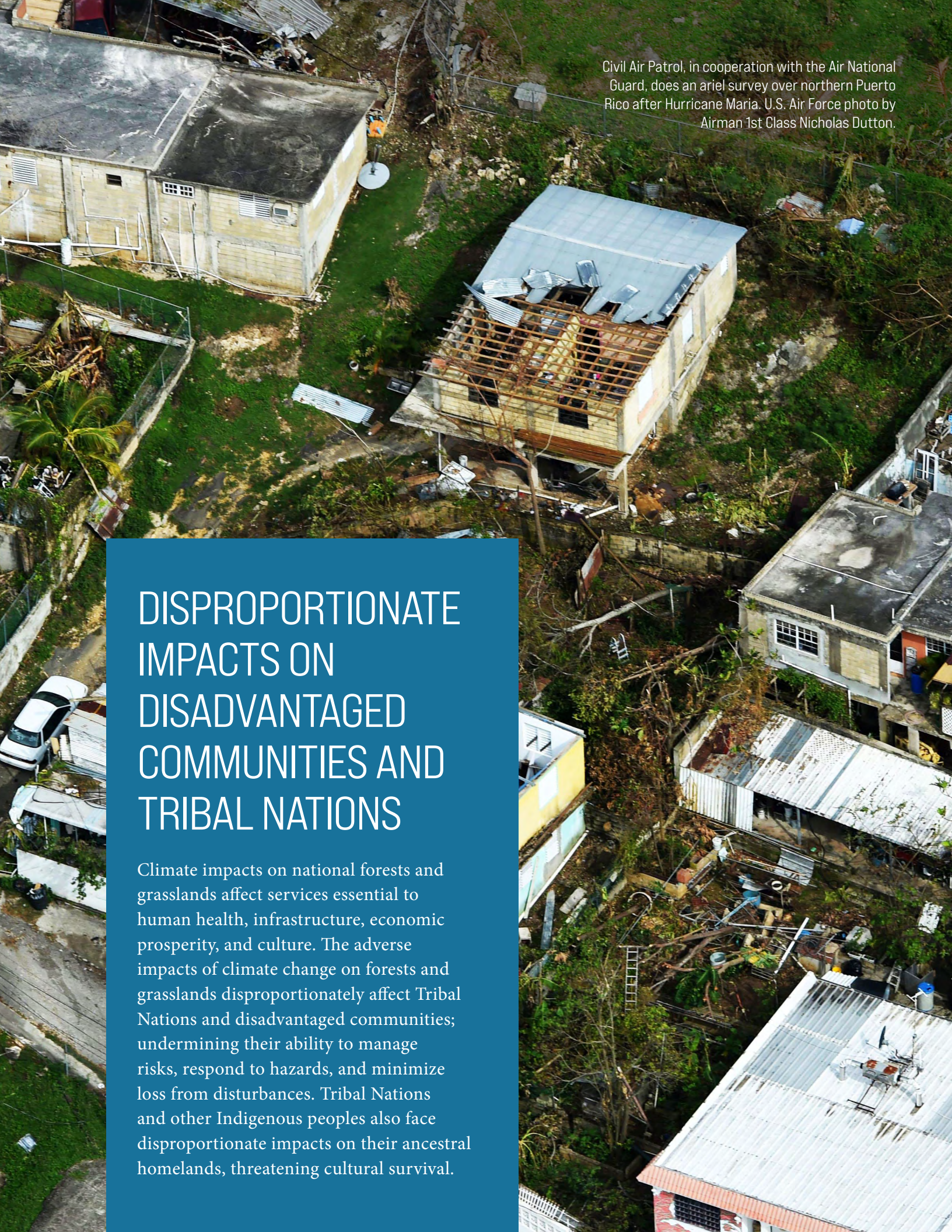
Adaptive Silviculture for Climate Change Transition Site at the Cutfoot Experimental Forest. USDA Forest Service photo by Leslie A. Brandt.

4e SUPPORTING ACTIVITIES

- Conduct research to anticipate changes in recreational demand, including from disadvantaged communities and to identify emerging opportunities for increased use and new recreational activities.
- Develop tools and information to help land managers understand climate change effects on ecosystem services and markets, including carbon sequestration and their management implications and vulnerability.
- Provide decision support tools and models for anticipating and responding to climate-related changes in social, economic, and political factors that influence the supply of and demand for ecosystem services.
- Assess the availability of resources and manufacturing potential for traditional and new forest products, conduct economic feasibility studies, and determine the supply chain infrastructure needed to promote the use of forest products.

ADAPTIVE SILVICULTURE FOR CLIMATE CHANGE

The [Adaptive Silviculture for Climate Change \(ASCC\)](#) network is addressing a critical need from forest managers to understand and implement climate-adaptive forest management strategies across different forest types in the United States and Canada. The network has engaged Forest Service climate change thought leaders from across the United States; built a robust experimental and science delivery framework to develop, evaluate, and demonstrate adaptation strategies; and engages a wide variety of partners and teams of scientists from across the United States and Canada.

An aerial photograph showing the aftermath of Hurricane Maria in northern Puerto Rico. The image captures several buildings that have suffered significant structural damage. One prominent building in the center has a roof that is partially collapsed, revealing the wooden framework. To its left, another building has a dark, possibly damaged roof. The surrounding area is a mix of green vegetation and debris, with some trees appearing uprooted or broken. In the bottom left corner, a white car is parked on a paved area. The overall scene conveys the extent of the destruction caused by the hurricane.

Civil Air Patrol, in cooperation with the Air National Guard, does an ariel survey over northern Puerto Rico after Hurricane Maria. U.S. Air Force photo by Airman 1st Class Nicholas Dutton.

DISPROPORTIONATE IMPACTS ON DISADVANTAGED COMMUNITIES AND TRIBAL NATIONS

Climate impacts on national forests and grasslands affect services essential to human health, infrastructure, economic prosperity, and culture. The adverse impacts of climate change on forests and grasslands disproportionately affect Tribal Nations and disadvantaged communities; undermining their ability to manage risks, respond to hazards, and minimize loss from disturbances. Tribal Nations and other Indigenous peoples also face disproportionate impacts on their ancestral homelands, threatening cultural survival.

Impacts on Indigenous peoples

Climate change threatens the cultures of Indigenous peoples and their ways of life. Warming temperatures and changing weather patterns will limit the availability of clean drinking water, fish, game, and wild and cultivated crops that play important roles in traditional culture, healthcare, and local economies. Tribal Nations depend on landscapes and ecosystems with cultural keystone species for subsistence, food sovereignty, and cultural identity, all of which are at risk from climate change. For example, rising stream temperatures are causing declines in salmon populations along the West Coast; salmon, a culturally significant food for the region's Indigenous peoples, is also important to the regional economy. In addition to serving as a traditional source of nourishment for Indigenous peoples, salmon are integral to the art of the Pacific Northwest. In parts of California, changing climate conditions are causing oak trees to produce fewer acorns, a traditional food source. Paper birch, a culturally important resource for Indigenous peoples in the Midwest and Northeast, is declining in part from warming temperatures. Working closely with Indigenous peoples and through government-to-government consultation with Tribal Nations will enable the Forest Service to better understand climate-related impacts and collaborate on approaches to climate change adaptation that incorporate Indigenous Traditional Ecological Knowledge.

Human Health Impacts

Wildfires and extreme events can directly affect human health, especially for people living in disadvantaged communities. Large severe wildfires can reduce air quality for weeks or months at a time in regions across the United States. People whose livelihoods necessitate sustained exposure to hazardous air quality produced by wildfire smoke may endure much greater health risks than the general population. Climate change impacts on watersheds on the national forests and grasslands can affect access to clean drinking water if

water is not appropriately treated. For disadvantaged communities, paying higher fees for water delivery and buying bottled drinking water are additional burdens.

Forests generally benefit human health. For example, trees in urban areas can help lower local temperatures, reducing heat-related risks to people, especially those without air conditioning or in poor health. However, the urban tree canopy is often lowest in areas of high poverty, and urban trees may be vulnerable to the impacts of climate change. People can enjoy health benefits, both physical and mental, from visiting their national forests, which offer respite to urban populations during hot summers. However, disadvantaged communities may face barriers to access exacerbated by climate-driven disturbances.



The Forest Service is planning and carrying out an urban silviculture project at Stillmeadow Community PeacePark with community residents. USDA Forest Service photo.

Threats to Natural and Built Infrastructure

Climate-driven disturbances can affect both natural and built infrastructure, with far-reaching effects on communities. Forests and other ecosystems constitute natural infrastructure that supplies abundant water in streams, absorbs stormwater, and filters pollutants from drinking water for downstream communities. In urban areas, trees and other vegetation play an important role in managing stormwater, which will become even more important as the frequency and intensity of heavy rain events increase. More effort may be required to maintain both natural and built infrastructure in the future. In some cases, costly technological alternatives may be needed to replace ecosystem services, such as water delivery, that are essential to human health and prosperity.

Fires and post-fire flooding and debris flows can damage roads, reservoirs, electrical transmission systems, and other built infrastructure essential to thriving economies. Disruptions to electrical grids caused by uncharacteristically severe wildfires and downed trees can affect water treatment, transportation services, public health, and day-to-day life in communities near national forests. Disadvantaged communities face higher risks due to chronic underinvestment in infrastructure, making them more vulnerable to power outages, poor water quality and quantity, and even loss of their homes. Residents of disadvantaged communities may lack the financial resources to compensate for the loss of ecosystem services and disruptions to services provided through built infrastructure, as well as the means to evacuate in the event of a disaster.

Damage to Cultural Resources and Threats to Cultural Survival

Climate change poses a variety of challenges to the social and cultural fabric of communities. People have cultural and spiritual connections to landscapes that can be fundamentally changed by uncharacteristically severe wildfire or another disaster related to climate change. Many plant and wildlife species of cultural importance to Indigenous peoples may lose suitable habitats. Historic properties and archaeological sites are also at risk from climate change impacts. Burial sites along flood plains, for example, are vulnerable to floods that are becoming more prolonged and severe. The Tribal Forest Protection Act, designed specifically to protect tribal lands and communities from threats on the National Forest System or originating from it, is a key tool to address such impacts.

Many communities, especially in rural areas, have cultural identities tied to uses and resources associated with national forests and grasslands. As climate change affects these uses, it can weaken traditional ties to the land. For example, ranching communities may find it difficult to maintain their way of life if climate change impacts on the national forests and grasslands reduce rangeland productivity and affect grazing opportunities. Likewise, rural communities with a long history of winter sports, such as skiing or snowmobiling, may face challenges as winters become shorter, with reduced snowpacks.



Yellow birch leaves and white trunks. USDA Forest Service photo.

ACTION 5

DELIVER ENVIRONMENTAL JUSTICE THROUGH ADAPTATION ACTIONS

The Forest Service will support climate adaptation actions that help disadvantaged communities prepare for climate effects. While pursuing climate adaptation actions, and through our work in support of the Justice40 Initiative, the Forest Service will advance environmental justice and strive for equitable environmental outcomes in urban and rural

communities. The Forest Service will strengthen relationships with Tribal Nations through government-to-government consultation to cocreate management activities and programs that reduce the adverse impacts of climate change on all beings. The Forest Service will also build relationships with new and existing partners to deliver environmental justice.

5a: Identify and engage disadvantaged communities

During the past half-century, the Forest Service has received public input and engagement in its decision-making from populations that tend to be mostly white and of higher income. People of color, Indigenous peoples, and lower income populations have often been unrepresented and underserved. Through sustained engagement, the agency will better understand how disadvantaged communities rely on National Forest System lands and Forest Service programs.



Green Corps members with trash bags of invasive spotted knapweed they collected near Round Island Lighthouse on Lake Huron. Photo courtesy of The Greening of Detroit.

5a SUPPORTING ACTIVITIES

- Analyze population characteristics to prioritize climate adaptation projects that engage and benefit disadvantaged communities.
- Use analyses of population characteristics to reach disadvantaged communities in public engagement and outreach processes for climate adaptation projects, such as reducing hazardous fuels on National Forest System lands and awarding Cooperative Forestry grants to increase tree canopy in urban areas in alignment with Justice40 Initiative goals.
- Offer disadvantaged communities more opportunities to join in public engagement processes by distributing public meeting notices to them in accessible languages and holding meetings at times and in places that are convenient for them.
- Develop capacity for facilitating engagement with underserved communities.

5b: Consult with Tribal Nations and establish strategic partnerships with disadvantaged communities

Fostering meaningful relationships with Tribal Nations through government-to-government consultation and building trusting partnerships with disadvantaged communities is the basis for successful climate adaptation. By honoring treaty rights and establishing strategic partnerships with organizations dedicated to diversity, equity, inclusion, and access, the Forest Service will improve the delivery of information and technology to Tribal Nations and disadvantaged communities.



Each year the San Juan National Forest consults with interested Tribes about planned projects for the year. USDA Forest Service photo.

5c: Improve communication of climate risks and opportunities for adaptation

As climate change and climate-related hazards become more prevalent, the Forest Service will communicate the related risks to visitors, local communities, and disadvantaged communities. The Forest Service will also increase access to the national forests and grasslands for disadvantaged communities in alignment with the Equity Action Plan.

5b SUPPORTING ACTIVITIES

- Consult with Tribal Nations and partner with Tribal organizations and disadvantaged communities to prepare for climate-related disruptions to electrical power, water systems, transportation, and communication networks as well as to improve access to emergency services and healthcare.
- Through technology transfer partnerships, provide environmental justice tools to disadvantaged communities, enabling them to join in creating approaches to managing climate-related risks.
- Codevelop adaptation strategies in consultation with Tribal Nations and National Tribal Organizations and in partnership with organizations representing disadvantaged communities.

5c SUPPORTING ACTIVITIES

- Create an environmental justice communication strategy for climate adaptation with tools to help agency employees build more effective working relationships with new and existing partners, especially those representing disadvantaged communities.
- Strengthen government-to-government consultation with Tribes by providing Forest Service staff with more opportunities to build cultural competency and more opportunities to learn about climate change issues faced by Tribal communities.
- Develop practices for agency employees to overcome language barriers for communicating about climate change adaptation, in alignment with limited English proficiency programs in the Equity Action Plan.
- Work with new and existing partners representing disadvantaged communities to expand recreation opportunities and access to national forests and grasslands.

5d: Help communities become fire-adapted as they prepare for climate change

The Forest Service plays an important role in mitigating risks to urban and rural communities from natural hazards exacerbated by climate change. By reducing risks, Forest Service climate adaptation actions are critical to disadvantaged communities because they are more at risk from wildfire and other disasters than high-income communities. As described in our Equity Action Plan and Justice40 Implementation Plans, the Forest Service will help communities, especially disadvantaged communities, prepare for increased smoke from more frequent and severe wildfires. The agency will also take actions aligned with the Forest Service's Justice40 Initiative and Equity Action Plan.

The Firewise Communities Mobile Education Unit offers countless consumer-friendly safety tips on a wide range of timely and important topics—everything you need to know to keep you, your family, and your neighbors safe from fire and related hazards. USDA Forest Service photo.

5d SUPPORTING ACTIVITIES

- Provide technical expertise, research, and funding to support fuels treatments and wildfire preparedness planning and to help residents create defensible space around homes and communities.
- Partner with local organizations and utilities to increase the resilience of natural and built infrastructure for water, electricity, and transportation for disadvantaged communities.
- Improve access to tools such as the Smoke-Ready Toolbox to help people learn about fire-related health risks like smoke exposure and how to manage them.
- Support community wildfire preparedness by providing scientific and financial resources to local communities, including community wildfire protection planning, grant programs, and access to organizations such as the Fire-Adapted Communities Learning Network.



5e. Expand urban forestry benefits to disadvantaged communities

The Forest Service's Urban and Community Forestry program supports nature-based solutions by propagating a resilient and equitable urban tree canopy. Expanding community engagement in the Urban and Community Forestry Program is a priority under the Agency's Justice40 Initiative. By expanding tree planting programs in disadvantaged urban areas, the Forest Service will help reduce urban heat island effects on human health and well-being in the face of climate change.



Forest Service climate specialist leads discussion on climate impacts with managers. USDA Forest Service photo by Leslie A. Brandt.

5f. Support social science research and to help address environmental justice

The Forest Service's social science research explores the cultural and economic dimensions of climate change effects to help land managers make climate-informed decisions. Climate adaptation strategies will build on the unique strengths of social science research to reduce inequities in resource management.

5e SUPPORTING ACTIVITIES

- Support tree planting programs for people in low-income and historically marginalized urban neighborhoods who suffer disproportionately from pollution and warmer temperatures related to climate change.
- Work with community organizations to provide training in tree care and urban forestry to support the long-term survival of planted trees and provide job training opportunities.
- Encourage funding proposals from applicants from disadvantaged urban communities through Forest Service's Urban and Community Forestry Program in alignment with Justice40 Initiative goals.

5f SUPPORTING ACTIVITIES

- Assess risks climate-related related to climate change to human communities and cultural resources.
- Increase support for social science on barriers to adaptive actions with examples of success in overcoming them, such as the Tribal Adaptation Menu.
- Support urban forestry research and monitoring to understand climate effects on urban forests and identify opportunities to increase the climate resilience of urban communities.
- Provide research that supports sustainability and restoration of culturally important species, ecosystems, and landscapes, with special concern for Tribal treaty resources, and that improves understanding and appropriate use of Indigenous Traditional Ecological Knowledge.

Santa Fe National Forest Forester measures the circumference of a tree. USDA Forest Service photo by Andy McMillan.

THREATS TO THE FOREST SERVICE'S MISSION, INFRASTRUCTURE, AND OPERATIONS

The impacts of climate change affect the ability of the Forest Service to fulfill its mission, sometimes generating direct threats to its workforce and operations. Climate change may create new challenges for public engagement as well as place additional stress on an understaffed workforce. Extreme events may damage or destroy critical infrastructure, disrupting operations and elevating health and safety risks to the workforce. Preparing for and responding to these changes will require clear performance and accountability measures that prioritize climate action.



Challenges to Public Engagement

Climate change has implications for the agency's relationships and communication with States, partners, and the public as well as for government-to-government consultation with Tribal Nations and the honoring of treaty and other reserved rights. Rising stress on natural resources from climate change may create tensions when making decisions where values conflict. For example, the Forest Service may need to relocate recreation sites beloved by visitors to areas less at risk. Agency leaders will have to balance the need for rapid decision-making to reduce environmental risk with the need for comprehensive public engagement that ensures that all concerns and needs are heard. Competing risks may need to be balanced. For example, minimizing risks to people and ecosystems may lead to short-term reductions in carbon storage, which constitutes a tradeoff against the need to increase long-term carbon storage to reduce climate change. The complexity of climate change will require the agency to develop adept communication approaches that connect adaptation to the agency's mission while recognizing the uncertainty and challenges inherent in climate change.

Disruptions to Operations and Vulnerable Infrastructure

Climate change will have direct and indirect effects on the Forest Service's day-to-day operations. Wildfire, floods, and severe storms will continue to damage the agency's transportation infrastructure as well as water, electrical, and communications systems. Infrastructure damage can affect the ability of employees to do their work and disrupt access for visitors and local communities to public lands. Longer and more intense fire years shift financial and personnel resources into fire suppression at the expense of longer term work needed to reduce wildfire risks and adapt to climate change. Climate change may alter visitation patterns, including increasing use during shoulder seasons, stretching the Forest Service's ability to provide recreational opportunities at times when staff and concessionaires are not available and when roads

may be closed. Longer recreation seasons may also place additional stress on infrastructure, reducing its effective lifespan.

Workforce and Employee Climate Resilience

The declining size of the Forest Service workforce has reduced the capacity of the agency to adapt to climate change. Forty percent of positions in the agency are currently unfilled, leaving the remaining workforce overstretched and unable to fully address or prepare for all the challenges created by climate change. As the fire year becomes longer and more severe, and is projected to increase more in the future, more workforce time is spent away from home on fire assignments. Longer fire seasons driven in part by climate change thus can lead to more work-related stress for both employees on assignments who must spend more time away from home and those who remain at the home office saddled with additional workloads. Employees have less time to attend needed training on climate change vulnerability assessments and adaptation and to incorporate climate change concepts into planning and actions. Climate change also has a direct effect on employee safety. Hotter conditions and low air quality from smoke can increase the risk of heat-related and respiratory illnesses, and fire and other natural disasters can put workers at risk of injury or even death.

Climate change may affect the ability of the Forest Service to recruit and retain employees. Fewer workers may be interested in field-based positions with rising risks to their health and safety. Climate-induced regional population shifts may also affect recruitment and retention, especially in areas where government housing is not available. Some employees may be forced to relocate due to rising sea levels, wildfire, extreme storms, and other climate-related factors. In 2020 and 2021, many employees lost their homes to wildfires, and hundreds of employees were displaced from their communities for multiple weeks. Similar



Boston Urban Connections Coordinator shares information about the Forest Service during Boston's GreenFest. USDA Forest Service photo.

displacements are likely to increase. Some employees may no longer consider local communities desirable places to live because of fire-related risks or extreme heat. Other communities may become so popular as an escape from poor climate conditions that housing costs become unaffordable for agency employees. These and other factors may lead to lower morale and workforce retention.

unprepared for difficult conversations with the public about climate vulnerabilities and the need to reduce the corresponding risks.

Climate Change Performance and Accountability Measures

The Forest Service's performance and accountability metrics focus on near-term targets assuming historical climate regimes. This reduces the agency's ability to mainstream climate adaptation into day-to-day operations, leaving it vulnerable as the climate continues to change. The Forest Service may not be prepared for the challenges associated with impacts on ecosystems, changes in workforce needs, and shifts in public safety and perceptions. Employees perceive that climate change adaptation, except in connection with wildfire risk reduction, is not an agency priority. Few employees have jobs that require them to focus on climate change, so few take the time to incorporate climate change into their work or factor it into their decisions. Failure to fully tap the creativity and experience of the workforce in responding to climate change leaves the agency



A fire engine crew conducts digging fireline training. USDA Forest Service photo by Brandon Everett.

ACTION 6

INCREASE AGENCY CAPACITY TO RESPOND TO CLIMATE CHANGE

The Forest Service will increase its capacity for climate preparation and response across all four deputy areas and the USDA Climate Hubs. Partnerships between researchers and managers offer opportunities to identify adaptation actions that are both grounded in science and feasible in practice. Shared Stewardship agreements will help the Forest Service work across boundaries and build on the capacity of Tribal Nations,

State agencies, and external partners. Expanding capacity will require continued innovations in hiring and other human resources activities to help ensure that the agency has the workforce it needs to take on the challenge of climate change. The agency will build a representative workforce in alignment with the goals of the Equity Action Plan, integrating environmental justice into Forest Service operations.

6a: Expand climate change workforce capacity

The Forest Service will develop a climate-focused workforce of sufficient size and with the specialized training and experience needed to directly support adaptation work in the short term, while also working across Deputy Areas to increase Agency capacity and climate literacy to help mainstream adaptation work throughout Forest Service operations and activities. This may include expanding the scope of work in existing positions to include specific duties and performance measures related to climate change. It may also include expanding the workforce to include more employees specifically focused on climate change, sustainability, and environmental justice. As it recruits new employees to tackle the climate crisis, the agency will build on ongoing innovation in hiring, training, and developing other human resources activities.

6a SUPPORTING ACTIVITIES

- Prepare the Civilian Climate Corps to conduct activities described in this adaptation plan.
- Recruit, train, and build a pipeline for talented employees to fill key needs in climate, sustainability, and environmental justice while increasing diversity and inclusion in the workforce.
- Recruit highly trained professionals in research, decision support, and management with expertise in climate change, sustainability, and environmental justice.
- Build a diverse workforce using a variety of tools to reach out to diverse candidate pools, such as university networks, Tribal Nations, social media, and professional societies.

6b: Support employees as they tackle climate change

The Forest Service workforce is highly trained and dedicated, with a wealth of skills and institutional knowledge needed to tackle climate change. The Forest Service will support employees both personally and professionally as they take on climate change challenges and as climate change affects them.

6b SUPPORTING ACTIVITIES

- Provide flexibility in the timing and location of work to reduce climate-related risks and account for climate-induced displacement and disruptions.
- Support employee health, wellness, and safety programs to increase personal resilience to climate change and its impacts on mental and physical health.
- Support employees facing challenges from housing displacement due to climate-intensified disturbances, increased housing costs, and population shifts.
- Incentivize and reward work on climate change research and adaptation, environmental justice, and sustainability.

6c: Establish agencywide employee education programs on climate change and environmental justice

Climate literacy is the foundation of success in responding to climate change. Forest Service employees will acquire a common understanding of climate change concepts, terms, and tools so they can apply them consistently across the agency in making management decisions. Through the Justice40 Initiative, we will increase our climate-related trainings offered through career development programs. Work on climate change will be grounded in environmental justice, so employees will also acquire a common understanding of the corresponding concepts and best practices.

6c SUPPORTING ACTIVITIES

- Include basic climate change training in new employee orientation.
- Give all employees regular educational opportunities on climate, sustainability, and environmental justice in natural resource management.
- Create targeted training for specialists and agency leaders on how to effectively integrate climate change considerations into their programs and decisions.

6d: Reduce risks and improve capacity in agency operations and infrastructure

To operate effectively in the face of climate-related disasters, the Forest Service will reduce risks to its physical and information technology infrastructures. The agency will also invest in the data and information needed to identify risks and track progress on taking the adaptation actions needed for continuity of operations in delivering benefits to the public. Improvements to facilities and infrastructure will also help the agency reduce greenhouse gas emissions associated with its operations. These mitigation measures will model best practices for the public and help the agency attract and retain a talented workforce.

6d SUPPORTING ACTIVITIES

- Fully integrate corporate databases to track climate-related actions and impacts.
- Assess risks to agency infrastructure using vulnerability assessments and geospatial tools and reduce the risks through repair, replacement, or relocation.
- Adjust agency operations to increase safety and resource protection during extreme events, wildfires, and other disturbances.
- Reduce climate impacts from agency operations, including from facilities and fleet, while minimizing associated costs and advancing sustainable operations.

SUSTAINABLE OPERATIONS

Improving the environmental sustainability of Forest Service operations is key to mitigating the agency's environmental footprint and aligning with its mission, as well as supporting climate adaptation. The Forest Service continues to encourage and track early adopter work in six identified environmental footprint areas: energy conservation, water conservation, fleet and transportation, sustainable procurement, waste prevention and recycling, and sustainable leadership. Reducing impacts in these areas aligns with the agency's values of conservation and interdependence. It also results in lower greenhouse gas emissions (GHG) and lower lifecycle costs of facilities, fleet, and other equipment. Moreover, it is a form of adaptation to changes in regulatory and business drivers stemming from climate change and can improve operational resilience. An example is the Off-Grid Energy Savings Performance Contract Project completed in 2019 at five remote, mission-critical sites in the Pacific Southwest Region. This project reduced GHG emissions via photovoltaic solar panels and batteries (in some cases mounted on trailers) and improved resilience by reducing reliance on existing generators, which were breakdown-prone and expensive to fuel.

IMPLEMENTATION

The Forest Service is already a leader in climate change research, decision support, and adaptation actions on the ground. Data collected through the agency's Climate Change Performance Scorecard and Sustainability Scorecard over the past decade shows that all national forests and grasslands already have locally specific vulnerability information and that many are integrating climate change into their planning and management. Ongoing integration of climate change considerations into agency programs will help in carrying out the Forest Service Climate Adaptation Plan.

These entities focus specifically on climate change impacts and adaptation, but all Forest Service programs across the four deputy areas will play a role in carrying out the adaptation plan. Line officers across the agency will play a pivotal role in implementing this plan by using their decision-making authority and providing support of the plan's goals. The Forest Service will work with the USDA, Natural Resources Conservation Service to coordinate adaptation actions across boundaries. In addition, the Forest Service will coordinate with other USDA agencies, other Federal agencies, Tribal Nations, States, international partners, and other partners in refining projects and carrying out actions. Coordination with partners from organizations focused on environmental justice and equity will help ensure that the actions are distributed equitably and do not lead to unintended consequences.

FOREST SERVICE CLIMATE ADAPTATION PROGRAMS AND INITIATIVES

Forest Service programs and initiatives that focus on climate change adaptation include:

- The Office of Sustainability and Climate, which provides guidance, tools, information, and technical assistance on climate change across the agency.
- The Northern Institute of Applied Climate Science and Adaptation Partners, which provide vulnerability assessments and support adaptation planning for national forests and grasslands, other Federal agencies, Tribal Nations, States, and private and municipal entities.
- The Eastern Forest Environmental Threat Assessment Center and the Western Wildland Environmental Threat Assessment Center, which develop science and assessments on environmental threats, including climate change, for agency managers and their partners.
- Forest Service Research and Development, which conducts basic and applied research on climate change impacts and adaptation and delivers tools and information to managers across five research stations, two threat centers, and the Forest Products Laboratory.
- A network of regional and national forest and grassland climate change coordinators and research station science advisors who deliver climate change information to all programs throughout the Forest Service.
- Communities of practice focused on climate adaptation, climate data and tools, and environmental justice, which share lessons learned and the latest tools across deputy areas.
- USDA Climate Hubs through which climate science, information, and technology are shared among diverse audiences.

Evaluating Progress

The Forest Service will track progress on adaptation actions, in addition to actions related to sustainable operations and carbon stewardship, using the Climate Action Tracker (CAT, Figure 2). The Forest Service's Office of Sustainability and Climate will prepare annual reports on these activities for Forest Service and Departmental leadership. The agency developed the CAT with broad input from across the Forest Service and using an agile learning approach to help ensure it evolves with changing needs, information availability, and sophistication. Ultimately, the Forest Service will populate the CAT via standardized work streams and databases used in day-to-day operations. Initially, the agency will use staff surveys and database queries to inform the CAT while identifying gaps and opportunities for database development and integration. Release of the first version of the CAT is expected shortly after the release of the "USDA Forest Service Climate Adaptation Plan." The Forest Service organized the CAT to support agency goals across the agency's deputy areas with four top-level dimensions: serving people, natural resource management, infrastructure and operations, and organizational capacity (appendix 3). Adaptation is a component of all four dimensions. Each dimension is served by multiple strategic objectives that are measured through a targeted staff survey and database reporting. The metrics for a given objective will vary by deputy area, since different parts of the Forest Service engage in different activities. This structure also allows for easier identification and coordination of Forest Service programs and initiatives across deputy areas that contribute to the same objectives and metrics.

In addition to the CAT, the agency can track adaptation outcomes in landscape, social, and economic conditions using programs that support long-term monitoring, including the Forest Inventory and Analysis program, Forest Health Monitoring, and long-term studies on the experimental forests and rangelands. The Forest Service has also developed

new techniques for remote sensing and near-term tracking of impacts from climate-driven disturbances. Integrating these tools into management decision-making will help ensure continued progress.

Barriers To Implementation

The agencywide survey conducted for this plan indicates lack of staff, insufficient financial resources, lack of leadership support, and conflicts with other priorities were the top four barriers to adaptation actions by the Forest Service. Climate change may heighten all four barriers as more resources are needed to respond to climate-related wildfires and extreme events, leaving fewer resources for long-term planning and management in response to climate change. Survey respondents perceived a lack of guidance and policy direction as barriers: employees do not always believe that they have the authority or direction to take the needed steps to assess climate-related risks and develop adaptation actions. The adaptation plan outlines actions to address such barriers, including increased staffing and updated guidance. However, success will partly depend on appropriation levels and enabling legislation, which are outside of the agency's control.



Figure 2. Dimensions and strategic objectives in the Climate Action Tracker.

FOUNDATIONS FOR ADAPTATION

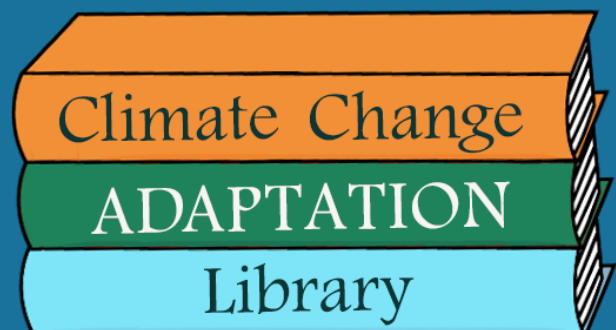
Tribal engagement, environmental justice, workforce climate literacy, and the USDA Climate Hubs are foundations for successful and widespread adaptation. Solidifying and building upon these foundations will yield the greatest benefits from multiple knowledge systems, community perspectives and needs, workforce creativity and professionalism, and dedicated focus. The Forest Service can meet our obligations as a Federal agency to honor the intent of Joint Secretarial Order 3403, while benefiting from millennia of Indigenous Traditional Ecological Knowledge to adapt landscapes to climate change. The agency can work to secure environmental justice by ensuring that adaptation actions are distributed equitably and in a way that accounts for the disproportionate impacts of climate change on disadvantaged communities. By extending workforce climate literacy agencywide, the Forest Service will prepare employees to manage risks, develop appropriate adaptation actions, and communicate both risks and actions effectively in engaging with the public. The USDA Climate Hubs are well-positioned to deliver science, synthesis products, and other support for adaptation actions at landscape scales.

Cedar Fire in Sugarloaf Mountain Park near the Forest Service Sequoia National Forest, Posey, CA. USDA photo by Lance Cheung.



ADAPTATION LIBRARY

The [Climate Change Adaptation Library for the Western United States](#) compiles information derived from climate change vulnerability assessments conducted by adaptation partners and collaborators as members of science-management partnerships. The library allows users to identify adaptation actions based on region, resource area, climate change effects, and specific topic areas (e.g., aquatic, conifers, trails, transportation).



Tribal Engagement

Government-to-government consultation, honoring treaty and reserved rights and developing strong collaborations with Tribes and other Indigenous peoples, is a foundation for the agency's ability to adapt to climate change. The Forest Service will learn from successful examples of Tribal climate adaptation across the country, recognizing that each Tribal Nation faces its unique challenges and provides its unique perspectives. Resources are already available that can be used to facilitate the integration of Tribal perspectives and knowledge in adaptation. For example, the Institute for Tribal Environmental Professionals Tribes and Climate Change Program provides training, webinars, and workshops for Tribal natural resource professionals and their partners on climate impacts and adaptation. Many Tribal Nations and organizations are developing natural resource vulnerability assessments and adaptation plans that provide excellent examples of blending western science and Indigenous Traditional Ecological Knowledge, such as the Karuk Climate Adaptation Plan and the Climate Change Vulnerability Assessment and Adaptation Plan for the 1854 Ceded Territory. Another example is the award-winning climate adaptation model developed by the Northern Institute of Applied Climate Science and Tribal partners, [Dibaginijgaadeg Anishinaabe Ezhitwaad – A Tribal Climate Adaptation Menu](#), a tool created to strengthen the connection between Indigenous values and climate adaptation planning. By learning from these examples and strengthening relationships with Tribal Nations and Indigenous peoples, the Forest Service will be better able to understand and prepare for the effects of climate change.

Environmental Justice

The principles of environmental justice—fair treatment and meaningful involvement—will guide the Forest Service in engaging disadvantaged communities in cocreating inclusive adaptation actions in response to the disproportionate impacts of climate change. Adaptation actions to redress environmental injustices will remove barriers to meaningful involvement by Indigenous peoples, communities of color, and other disadvantaged communities in project planning and development and the coproduction of knowledge. Adaptation actions will include delivering information and capacity to disadvantaged communities and helping them prepare for increasing climate-related disasters. Incorporating environmental justice and equity into Forest Service programs is critical: the number of people directly impacted by climate change and climate-related disasters increases annually. Tribal Nations and low-income, minority, and disadvantaged communities suffer disproportionate and cumulative negative impacts. Engaging populations from diverse backgrounds will expose land managers to new ideas and perspectives and help ensure that adaptation actions do not lead to unintended consequences for people or the environment.



This Tribal Climate Adaptation Menu, developed by collaborators representing Tribal, academic, intertribal, and government entities in the Great Lakes, provides a framework to integrate indigenous and traditional knowledge, culture, language, and history into the climate adaptation planning process. Artwork by Ziigwanikwe Katy Bresette.

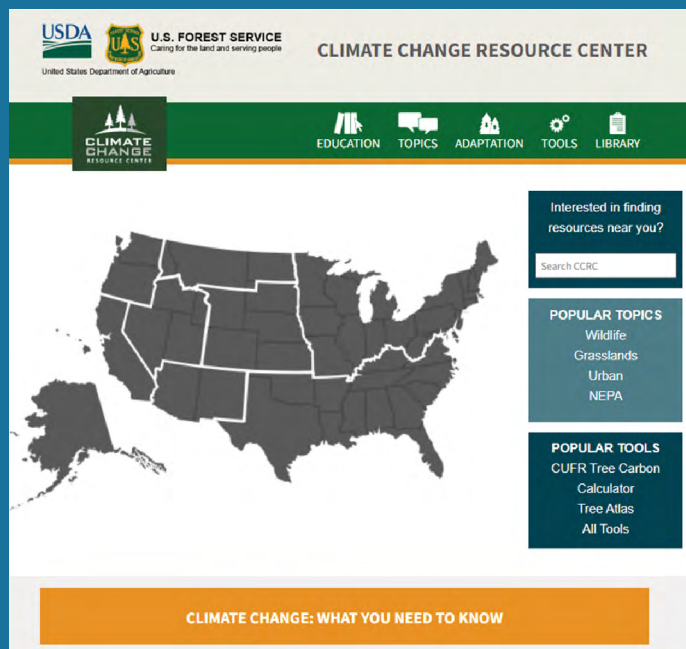
Workforce Climate Literacy

The Forest Service needs a workforce that has the knowledge and skills to conceive and fully implement effective adaptation actions. All employees need a basic understanding of the implications of climate change for the agency's mission and operations and a foundational understanding of how adaptation can help reduce its impacts. Natural resource specialists and other technical staff require specialized knowledge about the impacts of climate change on the resources they manage, along with knowledge of specific adaptation tools and strategies. Employees in public engagement, planning, or leadership roles need training in how to effectively communicate with the public about climate change impacts and agency adaptation actions.

The Forest Service can build on ongoing activities and resources to develop workforce climate literacy. The agency hosts a monthly First Friday All Climate Change Talks webinar series that is open to all employees. The Office of Sustainability and Climate hosts regular webinars for all employees on climate change impacts, adaptation, and environmental justice. The Forest Service's Climate Change Resource Center provides introductory modules on climate change science, impacts, and adaptation that are open to employees and the public. In addition, programs throughout the agency host training for specialists on integrating climate change into their programs and projects. More coordination is needed to meet climate literacy needs, especially ones regarding environmental justice.

CLIMATE CHANGE RESOURCE CENTER

The [Forest Service Climate Change Resource Center](#) is a web-based, national platform that connects land managers and decision-makers with usable, high-quality science to address climate change in natural resources planning and management. The Climate Change Resource Center (CCRC) provides expert-reviewed information about climate change impacts on forests and other ecosystems and approaches to adaptation and mitigation in forests and grasslands. The CCRC includes educational resources, climate change and carbon tools, video presentations, literature, and briefings on management-relevant topics, ranging from basic climate change information to details on specific management responses. The CCRC also curates a compendium of more than 500 climate adaptation approaches, developed by Adaptation Partners and the Northern Institute of Applied Climate Science.



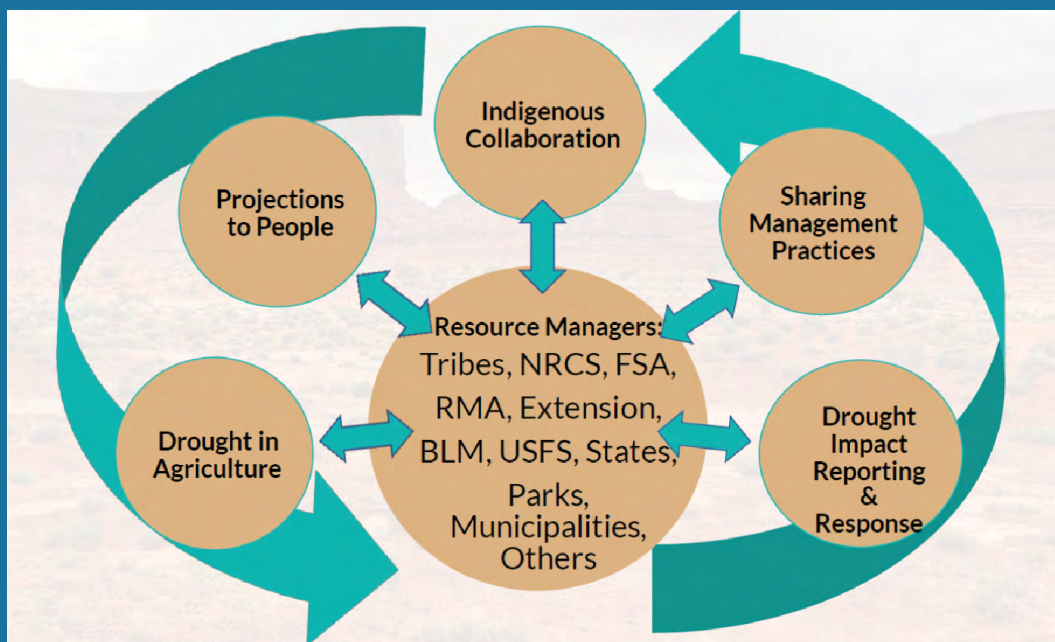
USDA Climate Hubs

USDA agencies, including the Forest Service, are providing increased support for the USDA Climate Hubs, which are unique in their work across agency boundaries at the intersection of agricultural systems, forests and rangelands, and climate change. In addition to delivering science, the USDA Climate Hubs play a key role in convening partners and assessing needs for climate science to support adaptation in forests, rangelands, and agricultural systems. The USDA Climate Hubs can collaborate across USDA to convene partners, determine needs, and coproduce science in support of adaptation. The broader USDA Climate

Hubs collaborative network includes land-grant universities and cooperative extension, State natural resource agencies, nongovernmental partners, and international organizations. The USDA Climate Hubs can work with these partners to assist national forest and grassland managers and State and Private Forestry staff in applying climate science and adaptation actions to local landscapes. The USDA Climate Hubs will support the adaptation plan by coordinating with the Office of Sustainability and Climate, the network of climate change coordinators, and other Forest Service programs to identify and implement high-priority actions at national, regional, and local scales.

SOUTHWEST DROUGHT LEARNING NETWORK

The Drought Learning Network (DLN) is a peer-to-peer knowledge exchange between climate service providers and resource managers. The main goal of the DLN is to gather and share lessons learned from drought events to improve responses to future droughts. The DLN was conceptualized as a framework for stakeholders to share experiences in preparing for, responding to, and recovering from drought to inform current and future response and mitigation actions.



INTENDED OUTCOMES

Through the six adaptation actions, the Forest Service will support long-term outcomes to further its mission. These intended outcomes include:

- Reduced wildfire risk.
- Reduced risk of extreme weather and disturbance.
- Productive, diverse ecosystems and watersheds.
- Multiple benefits provided to the public.
- Enhanced social resilience to climate impacts and environmental justice.
- Agency workforce and operations are prepared for multiple climate impacts.

The Forest Service will track actions and outputs supporting these outcomes annually through the Climate Action Tracker. These actions will be facilitated by the four foundations of Tribal engagement, environmental justice, workforce climate literacy, and the USDA Climate Hubs. By working toward these outcomes, the Forest Service will help sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations.

HURRICANE PREPARATION AND RECOVERY GUIDES FOR LAND MANAGERS

These guides, developed by the Southeast Climate Hub, include considerations for building a resilient operation, long-term operation maintenance, short-term preparedness actions, and post-hurricane recovery. All of the guides include a wealth of online resources for state- or commodity-specific information from Federal, State, university, and other organizations.



GLOSSARY

Adaptation: Adjustment in natural or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects ([U.S. Global Change Research Program](#)). Climate change adaptation includes initiatives and measures to reduce the vulnerability of natural and human systems to actual or expected climate change effects. Adaptation strategies include (1) building resistance to climate-related stressors; (2) increasing ecosystem resilience by minimizing the severity of climate change impacts, reducing vulnerabilities, and/or increasing the adaptive capacity of ecosystem elements; and (3) facilitating ecological transitions in response to changing environmental conditions ([FSH 1909.12 zero code](#)).

Assisted migration: The intentional movement of plants or animals into areas assumed to be their future habitats ([U.S. Global Change Research Program](#)). This can include the human-assisted movement of seed sources or populations (genotypes) to new locations within the historical established range of a species (assisted population migration); moving seed sources or populations from their current range to suitable areas just beyond the historical species range; facilitating or mimicking natural dispersal (assisted range expansion); and moving seed sources or populations to a location far outside the historical species range, beyond locations accessible by natural dispersal (assisted species migration) (see [Climate Change Resource Center](#)).

Disturbance: Any relatively discrete event in time that disrupts ecosystem, watershed, community, or species population structure and/or function and changes resources, substrate availability, or the physical environment ([36 CFR 219.19](#)).

Ecological integrity: The quality or condition of an ecosystem when its dominant ecological characteristics (for example, composition, structure, function, connectivity, and species composition and diversity) occur within the natural range of variation and can withstand and recover from most perturbations imposed by natural environmental dynamics or human influence ([36 CFR 219.19](#)).

Ecosystem services: The benefits produced by ecosystems on which people depend, for example, fisheries, drinking water, fertile soils for growing crops, climate regulation, and aesthetic and cultural values ([U.S. Global Change Research Program](#)).

Environmental justice: The fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Environmental justice means that everyone enjoys the same degree of protection from environmental and health hazards and has equal access to the decision-making process for ensuring that people have a healthy environment in which to live, learn, and work ([EO 12898](#), [U.S. EPA](#)).

Equity: The consistent and systematic fair, just, and impartial treatment of all individuals, including individuals who belong to underserved communities that have been denied such treatment, such as Black, Latino, Indigenous and American Indian persons, Asian Americans, and Pacific Islanders, and other persons of color; members of religious minorities; lesbian, gay, bisexual, transgender, and queer (LGBTQ+) persons; persons with disabilities; persons who live in rural areas; and persons otherwise adversely affected by persistent poverty or inequality ([EO 13985](#)).

Evapotranspiration: Evaporation of water from soil and plant leaves ([U.S. Global Change Research Program](#)).

Extreme event: A weather event that is rare at a particular place and time of year, including, heatwaves, cold waves, heavy rains, periods of drought and flooding, and severe storms ([U.S. Global Change Research Program](#)).

Indigenous Traditional Ecological Knowledge: A body of observations, oral and written knowledge, practices, and beliefs that promotes environmental sustainability and the responsible stewardship of natural resources through relationships between humans and environmental systems. It is applied to phenomena across biological, physical, cultural, and spiritual systems ([November 15, 2021, Memorandum on Indigenous Traditional Ecological Knowledge and Federal Decision Making](#)).

Refugia: Areas that remain relatively buffered from contemporary climate change over time and enable the persistence of valued physical, ecological, and sociocultural resources ([Climate Change Resource Center](#)).

Resilience: The capability to anticipate, prepare for, respond to, and recover from significant multihazard threats with minimum damage to social well-being, the economy, and the environment. In the context of ecosystems, the Forest Service defines resilience as the ability of an ecosystem and its component parts to absorb or recover from the effects of disturbances through preservation, restoration, or improvement of its essential structures and functions and redundancy of ecological patterns across the landscape ([U.S. Global Change Research Program](#)).

Stressors: Factors that may directly or indirectly degrade or impair ecosystem composition, structure, or ecological processes in a manner that may impair the ecological integrity of an ecosystem. Such factors include invasive species, loss of connectivity, and the disruption of a natural disturbance regime ([36 CFR 219.19](#)).

Vulnerability: The degree to which physical, biological, and socioeconomic systems are susceptible to and unable to cope with the adverse impacts of climate change ([U.S. Global Change Research Program](#)).

APPENDIX 1: RELATED AGENCY INITIATIVES

Administration Priorities and Executive Orders

EO 14008: Tackling the Climate Crisis at Home and Abroad

Executive Order 14008 established a governmentwide approach to tackling climate change and directed departments and agencies to develop climate adaptation plans. Delivering environmental justice is a central theme that runs through Executive Order 14008. It also resulted in two other strategic documents that will shape the Forest Service's actions on climate change. [The Climate-Smart Agriculture and Forestry Strategy: 90-Day Progress Report](#) summarizes recommendations, based on outreach with external organizations, to USDA and its agencies as they develop strategies for adapting to climate change. The "USDA Forest Service Climate Adaptation Plan" builds on these recommendations by identifying specific impacts and adaptation actions that align with concepts in the report. Also in response to EO 14008, an interagency team released the [Conserving and Restoring America the Beautiful report](#), which outlines principles and priorities for a campaign to conserve and restore at least 30 percent of the Nation's lands and waters by 2030. These principles emphasize collaboration, local leadership, and Tribal sovereignty. Activities outlined in this "USDA Forest Service Climate Adaptation Plan" will help the agency restore and adapt the lands it manages to climate change in line with the goals of the "American the Beautiful" campaign.

EO 14057: Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability

Executive Order 14057 and the accompanying [Federal Sustainability Plan](#) set out a range of sustainability goals for Federal agencies. Although Executive Order 14057 focuses primarily on sustainable operations and reducing greenhouse gas emissions, several components also relate to adaptation and resilience. Initiatives associated with Executive Order 14057 relevant to the "USDA Forest Service Climate Adaptation Plan" include developing climate-resilient infrastructure and operations, developing a climate and sustainability-focused workforce, and advancing environmental justice and equity.

EO 14072: Strengthening the Nation's Forests, Communities, and Local Economies

[Executive Order 14072](#) expands governmentwide efforts to tackle the climate crisis by (1) safeguarding mature and old-growth forests on federal lands, as part of a science-based approach to reduce wildfire risk; (2) Strengthening reforestation partnerships across the country to support local economies and ensure we retain forest ecosystems and sustainable supplies of forest products for years to come; (3) Combating global deforestation to deliver on key COP26 commitments; and (4) Enlisting nature to address the climate crisis with comprehensive efforts to deploy nature-based solutions that reduce emissions and build resilience.

USDA Climate Hubs 5-Year Strategic Plan

The mission of the USDA Climate Hubs is to develop and deliver science-based, region-specific information and technologies for agricultural, forest, and natural resource managers and communities that enable climate-informed decision-making and to assist in implementing those decisions. The Climate Hubs Strategic Plan 2020-2025 outlines three goals to support mission delivery:

- Enhance working lands resilience and productivity.
- Build climate awareness.
- Continually improve program effectiveness.

The USDA Climate Hubs will advance these goals by working collaboratively with agencies and partners to provide science and data synthesis; tool and technology development; and outreach, convening, and training to better serve communities and underrepresented groups and grow partnerships. The program continually evaluates and refines program metrics and procedures to improve effectiveness and communicate success.

Forest Service Climate Change Initiatives

This plan aligns with a series of past and ongoing efforts in the Forest Service to respond to climate change through research and land management activities.

Forest Service Strategic Framework for Responding to Climate Change

[The Strategic Framework for Responding to Climate Change](#) was released in 2008 and outlines seven goals to address climate change:

- **SCIENCE**—Advance our understanding of the environmental, economic, and social implications of climate change and related adaptation and mitigation activities on forests and grasslands.
- **ADAPTATION**—Enhance the capacity of forests and grasslands to adapt to the environmental stresses of climate change and maintain ecosystem services.
- **MITIGATION**—Promote the management of forests and grasslands to reduce the buildup of greenhouse gases, while sustaining the multiple benefits and services of these ecosystems.
- **POLICY**—Integrate climate change, as appropriate, into Forest Service policies, program guidance, and communications and put in place effective mechanisms to coordinate across and within deputy areas.

- **SUSTAINABLE OPERATIONS**—Reduce the environmental footprint of Forest Service operations and be a leading example of a green organization.
- **EDUCATION**—Advance awareness and understanding regarding principles and methods for sustaining forests and grasslands, and sustainable resource consumption, in a changing climate.
- **ALLIANCES**—Establish, enhance, and retain strong alliances and partnerships with Federal agencies, State and local governments, Tribes, private landowners, nongovernmental organizations, and international partners to provide sustainable forests and grasslands for present and future generations.

These goals continue to guide the Forest Service's climate response and align with many of the adaptation actions described in this plan.

Forest Service National Roadmap for Responding to Climate Change.

The [Roadmap](#), released in 2010, builds on the strategic framework and lays out three types of actions for the Forest Service to employ in a continuous cycle of adaptive management based on monitoring and evaluation. The roadmap remains relevant today: the strategic framework involving assessment, engagement, and management underlies the process used to develop this plan.

Climate scorecards

The Forest Service has been tracking progress on climate change actions since 2011 using an annual scorecard. From 2011 to 2016, the Forest Service used the Climate Change Performance Scorecard to measure initial progress in building agency capacity to address climate change. In 2019 and 2020, the Forest Service transitioned to its Sustainability Scorecard, which was built on the previous iteration but provided more structure for units to measure their progress. The agency is currently developing the third iteration of a scorecard, the Climate Action Tracker (CAT),

which will align with USDA and Forest Service climate change and strategic plans. The CAT, which will include new measures for environmental justice, will launch in fall 2022 and continue annually thereafter, with reporting at the national, regional, and forest levels. It will be a tool for evaluating progress on actions outlined in this adaptation plan.

Forest Service Strategic Plan, 2015-2020

The Forest Service's strategic plan, in the section "Sustain Our Nation's Forests and Grasslands," includes the strategic objectives of fostering resilient, adaptive ecosystems to mitigate climate change and mitigating wildfire risk. Adaptation actions discussed in this plan support these strategic objectives.

Forest Service Global Change Research Strategy, 2009-2019

[The Forest Service Global Change Research Strategy](#) outlines research across a range of management, science, and science delivery actions aimed at developing adaptation and mitigation approaches to sustain healthy ecosystems, including:

- Research to enhance ecosystem sustainability.
- Research to increase carbon sequestration.
- Research to provide decision support.

Shared research needs: infrastructure, scientific collaboration, and science delivery.

Forest Service research and science delivery is an essential component of the adaptation plan, providing the foundation for understanding climate change impacts and the consequences of potential adaptation actions and developing tools and management systems to facilitate ecosystem, landscape, and community adaptation.

International Initiatives

Forest Service international engagement supports administration priorities, including the President's Emergency Plan for Adaptation and Resilience (PREPARE) and the Plan to Conserve Global Forests, both announced at UNFCCC COP26 in Glasgow in December 2021. PREPARE supports developing countries and communities in vulnerable situations around the world in adapting to and managing the impacts of climate change. The Plan to Conserve Global Forests promotes the conservation and restoration of critical ecosystems that serve as global carbon sinks.

Related Forest Service Policies and Initiatives

In addition to building on Forest Service initiatives that focus on climate change, the "USDA Forest Service Climate Adaptation Plan" aligns with policies and initiatives that address related topics, including wildfire, ecological restoration and reforestation, and planning.

Confronting the Wildfire Crisis: A Strategy for Protecting Communities and Improving Resilience in America's Forests

Under the [10-Year Wildfire Crisis Strategy](#), the Forest Service will work with partners to treat up to an additional 20 million acres on National Forest System lands; treat up to an additional 30 million acres on other Federal, Tribal, State, and private lands; and develop a plan for long-term maintenance beyond the 10 years. The "USDA Forest Service Climate Adaptation Plan" includes sections on the impacts of climate change on wildfire and adaptation actions related to wildfire, which expand on the Wildfire Crisis Strategy.

Equity Action Plan

The Equity Action Plan includes actions with the potential for creating systemic change that benefits employees, Tribal Nations, partners, and the public. The Equity Action Plan commits the Forest Service to assess barriers and identifying equity outcomes for underserved communities. Actions in the adaptation plan align with actions in the Equity Action Plan.

USDA Forest Service National Tribal Relations Action Plan

The National Tribal Relations Action Plan for fiscal years 2022 to 2024 outlines steps for the agency to take to meet its Federal trust responsibility, honor treaty obligations, and support Tribal self-determination. Guided by this plan, the Forest Service will meet its obligations through consultation, collaboration, and coordination with Tribal Nations and Alaska Native corporations.

Ecological Restoration and Resilience Directive (FSM 2020)

The primary objective of this foundational policy for sustainable management of National Forest System lands is to restore and maintain resilient ecosystems with the capacity to withstand stressors and recover from disturbances, especially those under changing and uncertain environmental conditions, including climate change and extreme events.

Shared Stewardship Strategy

The [Shared Stewardship](#) strategy fosters cooperation, comanagement, and collaborative priority setting for forests, including fuels and forest health treatments, involving the Forest Service and other Federal, Tribal, State, and local government agencies, along with private organizations and landowners. This strategy promotes efficiencies in project planning at a landscape scale to help ensure that treatments target the areas at highest risk.

2012 Planning Rule

The [Planning Rule](#) gives guidelines for land and resource management plan development and revision by the national forests and grasslands under the National Forest Management Act. The rule requires consideration of climate change in land management planning and includes requirements related to sustainability and ecological integrity to facilitate the restoration and maintenance of resilient ecosystems on the national forests and grasslands. Revised land management plans developed under this rule offer opportunities to reduce vulnerabilities and take adaptation actions.

Watershed Condition Framework and Terrestrial Condition Assessment

The [Watershed Condition Framework](#) (WCF) establishes a process for evaluating and improving the health of watersheds on national forests and grasslands. Watershed restoration under the WCF offers a key opportunity for reducing climate change vulnerabilities and taking adaptation actions. The [Terrestrial Condition Assessment](#) (TCA), a complement to the WCF, assesses the ecological integrity of terrestrial systems. The TCA identified potential restoration opportunities on 9 million acres of National Forest System lands that burned at uncharacteristically high severities, 80 million acres with high to very high wildfire hazard potential, 23 million acres with tree mortality due to insect and disease outbreaks, and an additional 25 million acres at risk for tree mortality due to insect and disease infestations.

National Strategy for a Sustainable Trail System

Released in 2017, the [National Strategy for a Sustainable Trail System](#) outlines challenges and goals for managing the National Forest System's nearly 160,000 miles of motorized and nonmotorized trails. Climate-informed trail stewardship would support many goals outlined in the strategy.

APPENDIX 2: PLAN DEVELOPMENT PROCESS

Cross-Deputy Team

Representatives from National Forest System, State and Private Forestry, Research and Development, and the USDA Climate Hubs formed a cross-mission-area team to guide the development of the adaptation plan, with input from across the agency.

The core team included representation from the following offices: Office of Sustainability and Climate (NFS), Western Wildlands Environmental Threat Assessment Center (R&D), Sustainable Forest Management Research (R&D), Forest Health Protection (S&PF), Pacific Northwest Regional Office (NFS), Northern Forests Climate Hub (R&D), Northwest Climate Hub (R&D), and Office of the Deputy Chief (NFS).

Plan Input and Creation

The core team engaged with all deputy areas from the Washington Office and with and to solicit feedback and provide information about plan design and creation. The core team collected targeted input into the plan at multiple levels:

- Forest Service employees were invited to provide input via a web-based survey on climate change risks, climate adaptation, and environmental justice from November 4 to November 30, 2021. The agency received 648 responses that helped frame the key risks and adaptation actions that went into the adaptation plan.

- Four cross-deputy area workshops were held in January 2021: Fire (January 11); Eastern Friendly Time Zone (January 18); Western Friendly Time Zone (January 20); and Environmental Justice (January 25). A total of about 250 employees with expertise in climate change, environmental justice, and related topics participated, providing knowledge of climate change risks and critical adaptation actions.
- Three externally focused roundtables were held with the following groups: Tribal Nations and Tribal organizations (December 17); forest industry and nongovernmental organizations (January 26); and State forestry representatives (January 27). Approximately 100 representatives attended these sessions, identifying key climate-related risks and adaptation actions of interest to organizations that work closely with the agency.
- The core team engaged with agency subject matter experts for review and specific input, including from environmental justice staff and USDA Climate Hubs to ensure that USDA guidance was adequately addressed.
- The writing team evaluated complementary Federal, departmental, and agency climate impact assessments and plans for alignment with this plan.
- The core team designed the adaptation plan in parallel with the Climate Action Tracker for monitoring progress and effectiveness.
- The core team led the writing of the plan, building content from the above feedback and coordinating additional subject matter expert input and review.

Climate Adaptation Plan Survey

In November 2021, the Forest Service Climate Adaptation Plan Core Team developed a web-based survey to inform the adaptation plan, following guidance developed by the USDA Office of the Chief Economist. The survey was distributed broadly to Forest Service employees and the USDA Climate Hubs. This survey included questions on climate change risks, adaptation actions, environmental justice, and

related topics. A total of 648 Forest Service employees responded to this survey across all deputy areas. Respondents were well-distributed geographically, with respondents in 40 States plus Washington, DC, and Puerto Rico, and substantial numbers of respondents from each region. The text results were summarized and used to inform the adaptation plan, as well as the virtual workshops and roundtables.

Informational Resources

The survey asked employees, “What informational resources do you use to address climate change issues?” Of the 12 options provided, the most frequent source was peer-reviewed publications, followed by Forest Service Research and Development and Forest Inventory and Analysis data and models, climate change vulnerability assessments, and the Office of Sustainability and Climate. They also had an opportunity to list other information sources; common responses included Forest Service regional offices, other agencies, and organizations, as well as universities, nonprofit organizations, and other partners focused on climate change adaptation, such as the USDA.

Climate Change Impacts

The survey asked respondents to rate a series of current or projected climate impacts affecting their program or office’s ability to carry out the agency’s mission. The list of impacts was based on climate science from the National Climate Assessment and represented common threats anticipated across the United States (Figure 3).

Adaptation Actions

The survey asked respondents, “What are some actions that your local program/office has taken to identify and reduce climate-related risks in the past five years?” and “What additional actions could your program/office or the Forest Service be taking to reduce climate-related risks to our agency?” There were 487 and 480 responses to each question, respectively. Common responses included adaptation actions related to changes in prescribed burning and fuels

management; assisted migration; habitat protection; riparian restoration; improved planning, funding, and monitoring; data and tools; greater collaboration; improved infrastructure; more sustainable operations; improved training, education, and leadership; and measures to improve employee safety and well-being, among other measures.

Challenges

The survey asked respondents what their top three challenges were in implementing adaptation actions. The most common categories selected were lack of staff, lack of financial resources, and conflicts with other priorities (Figure 4). Seventy-six respondents also provided additional challenges in the “Other” category. Their responses included issues related to burnout, culture, leadership, messaging, permitting and regulatory requirements, data, and technical needs.

USDA Climate Hubs

The survey asked, “What additional assistance could the USDA Climate Hubs provide (through technical assistance, science delivery, etc.) to help you in assessing vulnerability and developing potential adaptation actions?” There were 144 responses to this question. Some employees were not aware of the USDA Climate Hubs or their role in providing climate information. Many offered suggestions related to education and outreach, staffing, funding, guidance, data, tools, and case studies.

Environmental Justice

The survey asked a series of questions on environmental justice issues. It provided a brief description of environmental justice, then asked, “Does your program/office currently serve Indigenous, low-income, and minority populations (EJ populations)? If yes, please describe.” Approximately 69 percent of respondents said yes, 11 percent said no, and 20 percent said they didn’t know; 397 provided additional information, including examples of projects conducted in their forests or offices.

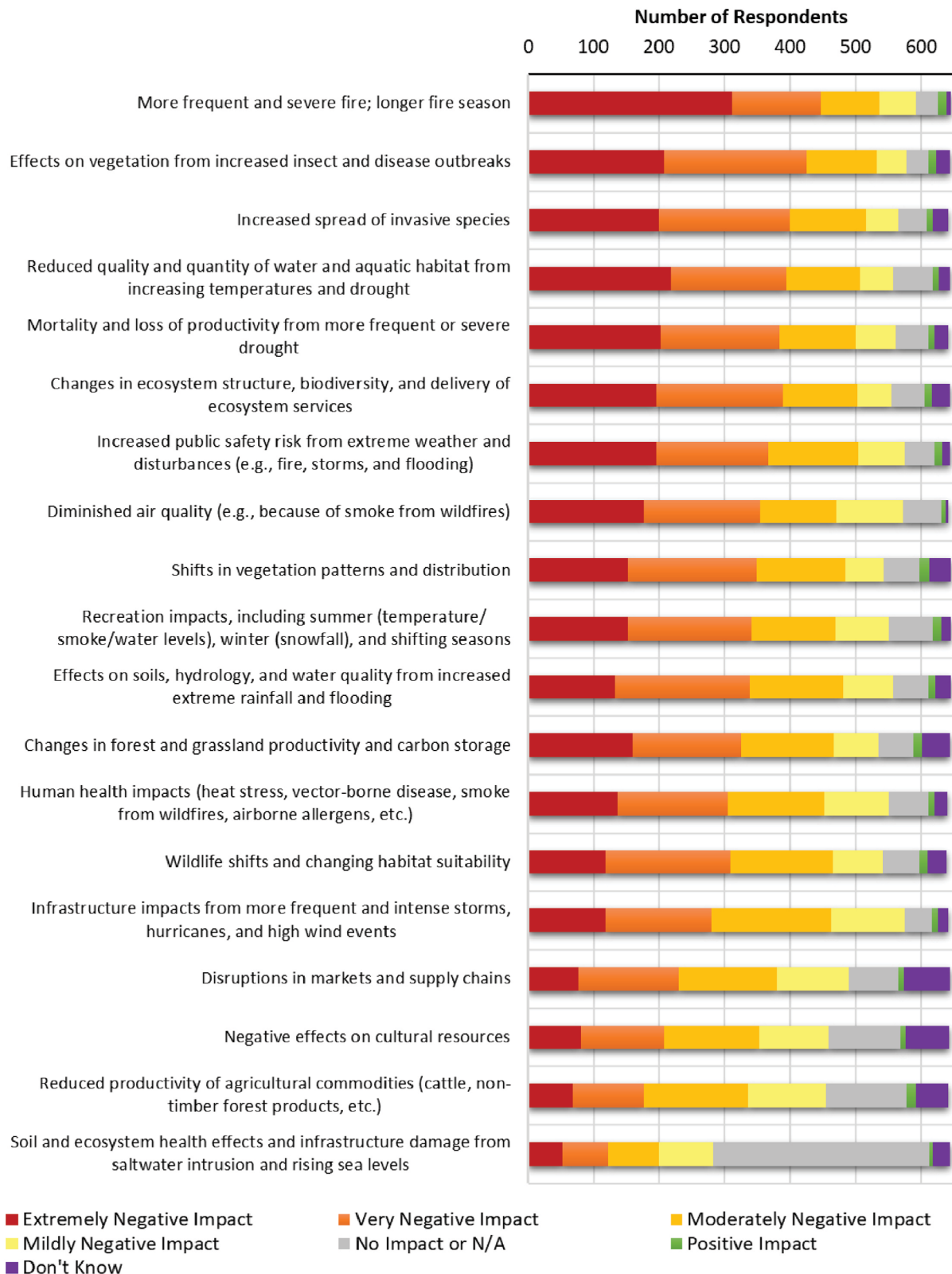


Figure 3. Responses to the question “Below is a list of climate change impacts from the National Climate Assessment that are either already occurring or projected to occur in the United States and that have the potential to affect our mission. Rate which impacts listed below you think will have the largest effect on your program/office’s ability to carry out the agency’s mission.” In addition to the predefined impact categories, respondents could also provide feedback on other climate impacts affecting their work or likely to affect it in the future. Respondents described issues related to habitat and ecosystems; rare and endangered species; invasive species, pathogens, and pests; drought and water quality and quantity; changes to soils; fire effects; infrastructure damage from flooding; communities, recreation, subsistence, cultural use, and livestock; environmental justice issues; and effects on employee recruitment, retention, safety, and well-being, among other themes.

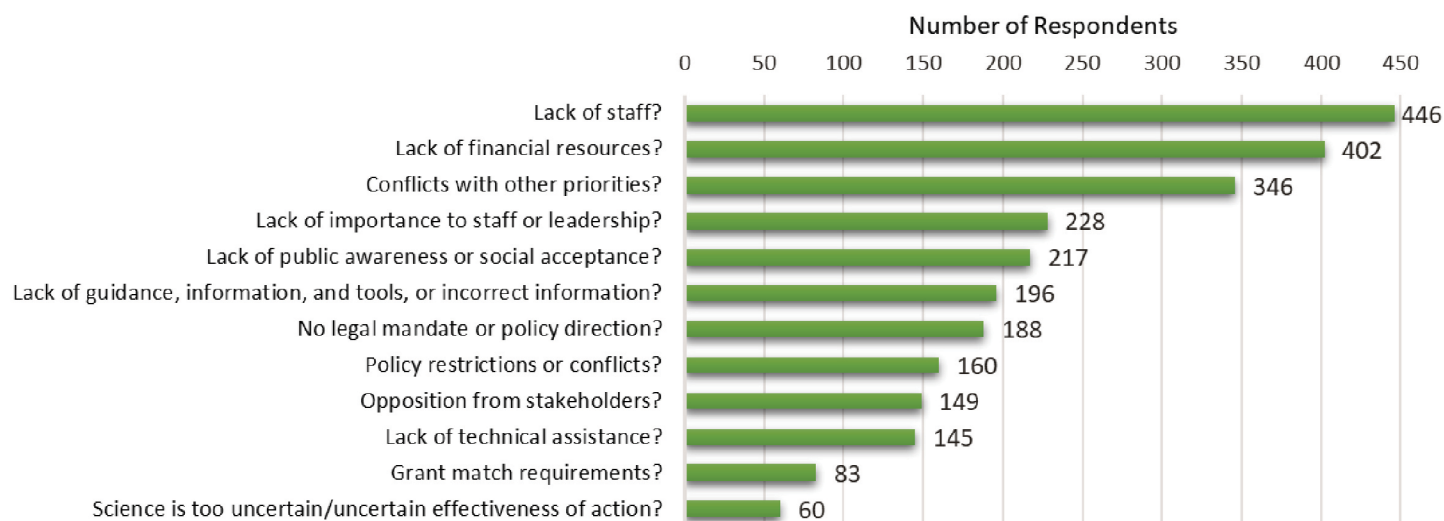


Figure 4. What challenges do you foresee in implementing these actions? (Select the top three).

The survey then asked, “Do you have an adequate understanding of climate justice and strategies for mitigating the threats to EJ populations associated with climate change?”. Approximately 20 percent of respondents said they had little to no understanding, 51 percent said they had some understanding, another 20 percent said they had a good understanding, and 8 percent of respondents said they had a very good understanding. These results indicate a need for more education, training, and outreach on these issues.

The survey asked respondents, “Does your program/office face barriers to assisting EJ communities in preparing for the risks associated with climate change?”. If yes, please describe.” About 50 percent of respondents said they didn’t know, with another 37 percent saying yes, and 13 percent saying no. Among the responses, 222 provided additional information on these barriers, including issues related to staff, capacity, and funding; leadership; training and outreach; lack of relationships and language barriers; lack of data and expertise; and challenges in getting grant opportunities to these communities, among others.

Finally, the survey asked, “What would help your program/office have a more positive impact on EJ communities?”, to which 380 responded with ideas for addressing each of the challenges described above. This included more funding and staff, better leadership

support and coordination, more training and outreach, better translation services and better community connections, more flexible funding, better data and mapping, case studies, guidance, and tools.

Throughout the environmental justice questions, many respondents indicated confusion about terminology (what is environmental justice, and what does this include?), potentially creating an opportunity for employee education and outreach on environmental justice, how the Forest Service is currently addressing this issue, and why it matters for the agency’s work.

Climate Adaptation Plan Roundtables

In December 2021 and January 2022, the Forest Service Office of Sustainability and Climate hosted three virtual roundtable discussions to gather input and feedback from Tribes and external partners on the Climate Adaptation Plan. The first, a roundtable for Tribes and Tribal organizations, was on December 17, 2021, with around 20 attendees. The second, a roundtable for nongovernmental organizations and industry groups, was on January 26, 2022, with around 65 attendees. The final roundtable for State foresters was on January 27, 2022, with around 25 attendees. The Office of Tribal Relations and State and Private Forestry assisted in determining invitees.

Each roundtable was 90 minutes long and began with brief opening remarks from both the Office of Sustainability and Climate acting director and deputy director, followed by a group listening session. Participants were given three questions as a prompt to guide the session. The first two questions were the same for all roundtables: (1) What climate change impacts are you most concerned about? and (2) What actions would you like to see the Forest Service take or not take to address climate change impacts? The third question was tailored to each roundtable as follows:

- How can we best work with Tribes in developing and implementing this Climate Adaptation Plan? (Tribal Roundtable)
- How would you like to see partnerships included in the Plan? (Nongovernmental Organization and Industry Roundtable)
- What needs to be done to scale up and address climate change? Are there barriers or challenges we could address? (State Foresters Roundtable)

Tribal Roundtable—December 17, 2021

Climate Change Impacts

Key themes discussed at the Tribal roundtable included impacts of climate change on ecosystem services, including biodiversity, water provisioning (quantity and quality), agriculture, and spiritual/cultural services; declining forest health; and risks to safety, infrastructure, and emergency management capacity posed by extreme events and disturbances, such as wildfire, flooding, and heavy winds. Participants also emphasized concern over disproportionate impacts on Indigenous, subsistence-practicing, and other vulnerable communities. They also stressed that climate change impacts on forestlands could also impact treaty rights.

Adaptation Actions

In general, responses emphasized landscape-scale and collaborative management actions and goals. Water was a key theme across several responses, emphasizing managing watershed health and maintaining access to water by people, other beings, and ecosystems. Participants mentioned managing watershed health (headwaters, downstream flows, storage capacity), improving water quantity and quality, increasing drought resilience, and preserving groundwater. Participants also emphasized a desire to see Tribal knowledge and perspectives incorporated into management actions, such as landscape-scale incorporation of Indigenous Traditional Ecological Knowledge and cultural burning practices. Participants also provided examples of successful Tribal landscape-scale collaborations, plans, and vulnerability assessments.

Working Together

Participants emphasized the need to recognize, incorporate, and learn from Tribal and Indigenous perspectives, world views, and knowledge. For example, Mother Earth and the interconnectedness of all beings, including natural and cultural resources, are central to many Tribal and Indigenous perspectives on climate adaptation. Additionally, participants stressed the need to prioritize formal engagement mechanisms like memorandums of understandings; to fully implement the Tribal Forest Protection Act; and encourage collaboration between States, the Federal Government, and Tribes.

Nongovernmental Organization and Industry Roundtable—January 26, 2022

Climate Change Impacts

Key themes discussed at the nongovernmental organization and industry roundtable included declining forest health (i.e., insect and disease outbreaks, invasive species); impacts on ecosystem services, including carbon uptake/storage and biodiversity; and risks posed by extreme events and disturbances, such as wildfire and drought. Participants were also concerned about Impacts on human health, including disproportionate exposure of vulnerable communities to fire and smoke and exposure of urban communities to extreme heat.

Adaptation Actions

A common theme was the need to take a holistic, multiple-benefit, and multiple-use perspective to the Climate Adaptation Plan that facilitates resilience. Examples of achieving this perspective include considering whole ecosystems, watersheds, or landscapes; addressing and managing forest health and resilience; and supporting biodiversity and wildlife (e.g., maintaining habitat connectivity, refugia, and old growth). Several participants also emphasized the need to consider both adaptation and mitigation in the adaptation plan, as the two concepts are related (e.g., declining forest health increases emissions from wildfire smoke; managing healthy forests and forest soils sequesters more carbon).

Some participants emphasized a need for a proactive approach to adaptation and management. In the context of wildfire, examples included more support for prescribed burns and thinning and the need to help communities cope with and adapt to fire (i.e., supporting “fire-adapted communities”). Another proactive approach mentioned was to support private owners in “keeping forests as forests” (e.g., by analyzing benefits from private forest lands and the wood products industry).

Participants mentioned prioritizing and investing in existing Forest Service resources and programs can better serve climate adaptation needs. Specific examples included existing genetic resources, the Experimental Forest and Range Network, Forest Products Laboratory, and the Resources Planning Act Assessment. Other recommendations included elevating outcomes-based performance measures and filling vacant positions needed to manage adaptation.

Working Together

Participants emphasized the benefits of partnerships, collaboratives, and networks for learning and adapting to climate change. These include gaining larger scale and cross-boundary perspectives, and access to new resources and knowledge. Participants also requested that the Forest Service make it clear how climate change is nested in other agency priorities and how different agencies integrate adaptation plans. In addition, participants discussed recognizing treaty rights and the need for more meaningful Tribal consultation and costewardship (facilitated by Tribal Forest Protection Act and Good Neighbor Authority).

State Foresters Roundtable—January 27, 2022

Climate Change Impacts

Key themes discussed at the State Foresters Roundtable included declining forest health and land area; impacts to ecosystem services, including carbon uptake/storage, biodiversity, and wildlife habitat; and risks posed by extreme events and disturbances, such as wildfire, drought, flooding, and extreme heat. In addition, participants cited concern over declines in the forest and fire management workforce and difficulty attracting, training, and retaining highly qualified workers. Lastly, participants mentioned changes to forest recreation, including overcrowding and an influx of new users, which can stress recreation infrastructure and increase the prevalence of risky behavior (e.g., fire risk).

Adaptation Actions

A key theme was supporting and incentivizing private landowners to keep forests as forests. Examples of how to do this include establishing longer term timber contracts (i.e., incentivizing investment in the infrastructure needed to produce wood products), helping develop markets for timber products and biomass, and supporting wood innovations. Participants also requested greater clarity around carbon credits (i.e., accounting procedures, how to achieve additionality) and increased support for reforestation, including increasing nursery capacity and available seed stock.

Participants also requested science delivery and education services. For example, additional training could help support both wildfire response and prescribed burn application. Participants would also appreciate concise, consistent, and up-to-date science-based talking points on forests and climate change so that messaging across the Forest Service and partners is clear. These talking points should include both the impacts of climate change and how well-managed forests can be a solution to the problem.

Working Together

Participants stressed that climate change requires both the Forest Service and its partners to be ready to engage and assist quickly and on-demand. Examples of how to do this include providing and funding the full suite of State and private forestry programs, having regional partnerships already established and ready to act and addressing indecision (i.e., predetermining who needs to act when a problem arises). Establishing a mechanism or program for recognizing early adopters and good land stewards was also mentioned, as these partners are critical to advancing climate adaptation on private lands.

Climate Adaptation Plan Workshops

In January 2022, the Forest Service Climate Adaptation Plan Core Team arranged a series of workshops to gather input on climate change impacts and adaptation measures. This consisted of a workshop on fire issues (January 11), two general workshops (January 18 and 20), and an environmental justice workshop (January 25). The core team sought representation from across geographies, deputy areas, and programs in the agency, including employees engaged in climate change adaptation and environmental justice as well as those in decision-making roles. Approximately 70 people participated in each workshop. For each session, the core team introduced the adaptation plan and the goals of the workshops, then divided participants into breakout groups to discuss a series of questions about climate change impacts and adaptation measures. This information helped to inform the writing of the Climate Adaptation Plan, including specific examples used throughout the plan.

Climate Change Impacts

The impacts discussion included questions on the consequences of each impact, specific examples, challenges, and opportunities related to this impact, science and information needs, and environmental justice considerations. Discussions were wide-ranging and considered a variety of issues around each impact. Below is a selection of some of the climate change impacts discussed in these workshops; this is not a comprehensive list of all the topics discussed.

- **Cultural resources:** Impacts on cultural sites and on plants and animals that are important for Indigenous and other cultural groups.

- **Drought:** Effects on tree mortality (including large trees such as sequoias), reforestation and seedling availability, conversion of forests to nonforest land, riparian and aquatic habitats and organisms, fisheries, agriculture, grazing, recreation (e.g., river and lake recreation opportunities), subsistence, water quality and quantity, water management issues, and social and economic effects on rural communities.
- **Heavy rainfall and flooding:** Urban flooding, water quality issues, changes to soils and hydrology, landslides, lost access to communities, post-fire erosion, damage to roads, bridges, culverts, facilities, and homes, and equity issues in responding to floods.
- **Invasive species:** The encroachment of pest species into new habitats, interactions with fire, increased tree mortality, increased hazard trees, aquatic invasives and effects on fisheries (e.g., nonnative trout), loss of native species, loss of native grasses, and side-effects of increased pesticide use.
- **Species distribution:** Loss of vulnerable species, vegetation type conversion (e.g., loss of forest, encroachment on alpine areas), creation of novel ecosystems, reduction in timber and carbon storage, impacts on wildflowers, and need for assisted migration programs.
- **Sea-level rise:** Impacts on Indigenous communities.
- **Snowfall:** Rain on snow events, earlier snowmelt, and loss of ski resorts.
- **Temperature change:** Urban heat islands, increased demand for recreation opportunities, and increased energy costs.
- **Wildfire:** Effects on ecosystem structure and productivity (e.g., conversion to grasslands), effects on soils and hydrology, effects on fish and wildlife, invasive species, lost biodiversity, loss of large trees, loss of timber and carbon, air quality, human health and safety (including to Forest Service employees), emergency management issues (e.g., challenges of communicating risk, especially to non-English speaking communities), shifting tourism and

recreational use patterns to avoid fire and smoke issues, effects on subsistence and cultural resources, effects on grazing, damage to infrastructure and homes, loss of access to communities, human migration, effects on water quality and quantity, economic effects, equity issues in rebuilding after wildfires, increased complexity of wildfire incidents, effects on staffing, resources, workload, and other priorities, and loss of public trust.

- **Wildlife:** Losses and changes to habitat (e.g., large tree habitat, loss of deep snow for denning, alpine species), species lost, effects of pests and diseases, effects on aquatic organisms and fisheries from stream temperature, species migration, and changes in movement patterns, effects of phenology changes, and conflicting priorities between different species and resources.

Adaptation Actions

In the adaptation breakout sessions, participants discussed ways to address the impacts they identified. These included possible adaptation actions, resources needed, potential collaborations, environmental justice collaborations, and information needs. Below is a summary of some of the topics discussed in these workshops. The core team considered and evaluated these suggestions for their feasibility, alignment with the agency mission and current policies, and relevance for addressing climate impacts.

- **Carbon:** Carbon analysis, management, and communication of carbon risks and benefits.
- **Data and Knowledge Sharing:** Integrated databases, external and internal climate communication, decision support, and sharing lessons learned.
- **Drought:** Proactive management, building flexibility and faster response times into management, adjusting the timing of forest and range operations, and partnering with other organizations to aid in response.

- **Environmental Justice:** Improving and increasing engagement with communities, including providing training and decision support services; strengthening partnerships with environmental justice organizations, improving coordination and integration of related Forest Service activities, research, and management actions; hiring locally; and making funding more accessible to underserved communities.
- **Fire:** Accelerating the pace and scale of prescribed burning, including during shoulder seasons; using wildland fire as a management tool when appropriate; long-term wildfire planning and risk analysis that incorporates climate change and pre- and post-fire considerations; working with partners to build trust.
- **Heavy Rainfall and Flooding:** Developing flood early warning systems, producing, and sharing research on flood and heavy rainfall risks, and managing ecosystems to accommodate increases in flooding (e.g., reconnect floodplains, restore riparian and instream habitat).
- **Infrastructure:** Systematically making infrastructure more resilient to climate change impacts, including updated design, and decommissioning at-risk infrastructure.
- **Monitoring:** Monitoring to understand wildfire, fuel treatment, and timber management effects on multiple resources and ecological processes (e.g., plants, insects/pests, wildlife, recreation, cultural services); prioritizing monitoring in adaptive management; standardized approaches for consistency in datasets; and early detection of invasive species and pests.
- **Organizational Adaptation:** Focusing on adaptation outcomes, facilitating engagements between decision-makers and stakeholders, and providing funding for pilot projects and other approaches that promote innovation.
- **Outreach:** Connecting and engaging with communities and partners to facilitate transboundary management; creating community liaison roles to better engage environmental justice and urban communities; working with communities to increase awareness of adaptation to wildfire smoke (“smoke-adapted communities”), and creating consistent, tailored messaging about climate-related issues (including wildfire and prescribed burning).
- **Planning and National Environmental Policy Act (NEPA):** Processes to incorporate climate change information (e.g., vulnerability assessments) into planning and NEPA; cross-boundary, landscape-scale collaborative planning; including Indigenous Traditional Ecological Knowledge in planning; incorporating adaptation into plan amendments; building relationships between research and planning; and modernizing and streamlining the NEPA process to account for climate change.
- **Recreation:** Accommodating changes in climate and visitor use patterns by shifting the timing of activities, promoting shoulder season and nonwinter activities, and anticipating high-use times; identifying areas where recreation can persist (“recreation refugia”); and evaluating visitor experiences considering climate-related concerns like wildfire, drought, and heat.
- **Research:** Applying long-term and cross-boundary modeling, tailoring research to local needs, developing, and using tools to optimize treatments based on objectives and values at risk, mapping climate effects on geological hazard risks, and mapping stewardship networks to indicate pathways for community involvement.

- **Species Distribution:** Re-evaluating ecological zones, seed zones, and species distributions to incorporate climate change; developing official guidance on assisted migration that includes both biophysical and cultural considerations; strengthening plant breeding and genetics program, including nurseries; mapping habitats to identify fragmentation, connectivity needs, potential climate refugia, and species in need of ex-situ conservation.
- **Timber Program:** Developing and implementing climate-informed reforestation, restoration, and silvicultural practices; increasing the pace and scale of reforestation and restoration; integrating fuels, timber, markets, and outreach work via coordination across Forest Service programs and partnerships; using models to identify areas that can provide multiple benefits or the greatest return on investment, and developing markets for underutilized and innovative wood products to reduce wildfire risk and benefit rural economies.
- **Training:** Training to build climate literacy across the agency, including leadership; including Indigenous Traditional Ecological Knowledge in climate change training; and promoting knowledge exchange via partnerships and inclusion in existing training programs.
- **Vegetation Management:** Selecting species and genotypes that are resilient to climate change and disturbance; using disturbance as a management tool, including leveraging benefits of low-and moderate-severity fire; placing mechanical treatments in high priority areas; supporting year-round fire management and permanent adaptation, and implementing cross-boundary fuels treatments by leveraging partnerships.
- **Workforce:** Developing performance measures associated with climate change adaptation; integrating climate change work across Deputy Areas, including designating leaders and science delivery specialists; prioritizing workforce diversity; and quickly hiring and training new staff in climate-focused positions, including proactive fire management and response.

APPENDIX 3: CLIMATE ACTION TRACKER

The Forest Service will use the Climate Action Tracker (CAT) to evaluate progress on climate response, including adaptation actions described in this plan. The CAT builds on previous agency climate scorecards and aims to track agency progress across four dimensions: Natural Resource Stewardship, Operations

and Infrastructure, Organizational Capacity, and Serving People. The agency will measure progress on strategic objectives within each dimension through outcome-based metrics tied to each deputy area and level within the agency (Table 1). The Forest Service will track metrics using existing agencywide databases where possible. It will obtain additional information through an annual survey of agency staff responsible for coordinating climate and sustainable operations work. The Climate Action Tracker is an adaptive tool that the Forest Service will modify and expand as new climate-related initiatives unfold and new tools and information become available.



Table 1. Climate Action Tracker dimensions, strategic objectives, and corresponding adaptation plan focus areas

CAT Dimension	CAT Strategic Objective	CAT Strategic Objective (full)	Adaptation Plan Focus Areas ¹
Natural Resources Stewardship	Carbon and Climate Research	Deliver and support world-class research on the effects of climate change on ecosystems and communities, adaptation strategies, and carbon cycling and stewardship.	1e, 2e, 3e, 4e, 5f
	Natural Resources Adaptation	Integrate climate change science and information into management actions to prepare for and respond to changing climate conditions.	1a, 1d, 2a-d, 3a, c-d, 4c-d, 6d
	Carbon Stewardship²	Understand and integrate carbon science and climate adaptation into long-term stewardship of carbon resources, recognizing carbon as one of many benefits forests and grasslands provide.	4a-b
Operations and Infrastructure	Climate-Ready Infrastructure	Design facilities and infrastructure to adapt to the effects of climate change while minimizing their environmental footprint.	2b, 4c, 6d
	Sustainable Operations²	Take tangible steps to integrate the six Environmental Footprint Areas (Energy, Water, Fleet & Transportation, Waste Prevention & Recycling, Sustainable Acquisition, and Sustainability Leadership) across program functions and organizational levels to reduce resource consumption, operational costs, and related greenhouse gas emissions.	6d
Organizational Capacity	Employee Training	Increase employee understanding of climate change science, effects on cultural, economic, and natural resources and human communities, and potential adaptation actions and responses; increase ability of specialists and agency leaders to incorporate and communicate relevant climate information and environmental justice into their programs of work.	6c
	Financial Investment	Make sound investments by assessing climate risks and considering vulnerable communities and ecosystems; leverage funding through partnerships to integrate climate change science and response into all our programs and activities.	3a, 5e
	Workforce	Build and foster an inclusive, diverse, adaptable, and effective workforce that will lead and implement climate change adaptation, sustainable operations, carbon stewardship, and environmental justice efforts.	1b, 6a-b
Serving People	Environmental Justice	Engage with disadvantaged communities to understand the effects of climate change and develop strategies to reduce the disproportionate impacts on these communities, helping to ensure the benefits of climate change activities are distributed equitably.	5a-f
	Outreach	Exchange information, research, tools, education, and training with external audiences on the effects of climate change on our forests, grasslands, and communities and communicate science on how to effectively adapt to and mitigate these changes.	5c
	Partnerships	Collaborate with the public and international, Federal, State, local government, non-governmental, and industry partners and organizations to understand and respond to the effects of climate change on forests, grasslands, and communities.	3b, 5b
	Tribal Engagement	Consult, coordinate, and collaborate with Tribal Nations and engage with Indigenous peoples to better understand and address Tribal and Indigenous needs and apply community-driven responses to the effects of climate change.	5b-c

¹The focus areas listed here are not a comprehensive list of all actions aligned with this strategic objective. Additional focus areas and actions related to climate change and sustainability through other departmental and agency initiatives may also relate to this objective.

²These strategic objectives are complementary to but not the primary focus of the adaptation plan.





After a wildfire, experts need to assess the potential for debris flow, the geological phenomena in which water-laden masses of soil and fragmented rock rush down mountainsides, funnel into stream channels, and form thick, muddy deposits on valley floors. USDA Forest Service photo.

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