MEGAFIRES

THE GROWING RISK TO AMERICA'S FORESTS, COMMUNITIES, AND WILDLIFE

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Megafires is available online at: www.nwf.org/megafires-report

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Elk taking refuge in river, Sula fire, Montana, 2000. Photo: John McColgan, USFS

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PRESIDENT'S LETTER

As I write this, explosive wildfires are raging across nearly 200,000 acres in northern California, devastating communities and pushing the total area burned in 2017 to more than 8.5 million acres nationally. Although wildfires are a natural and essential feature of many forest ecosystems, there has been a dramatic increase in recent decades of unusually large and severe "megafires." There are multiple reasons for this increase in extreme wildfires. Changing climatic conditions—including earlier onset of spring, earlier snow melt, hotter summer temperatures, and prolonged drought—are reducing moisture levels in soil and forest vegetation. The spread of pest species like bark beetle, often facilitated by a changing climate, is weakening the resilience of many natural ecosystems. And seriously overgrown forests, resulting from years of fire suppression and coupled with insufficient resources and bureaucratic obstacles for proactive forest management and restoration, have created conditions that are ripe for explosive megafires.

Fighting wildfires is now devouring more than half of the U.S. Forest Service budget, depriving the agency of critical resources for restoration and improved forest management that would reduce ongoing fire risks. In recent years the agency has been spending more than $1 billion annually to fight wildfires,[1] and in 2015, one of the worst years for wildfires on record, the U.S. government as a whole spent more than $2.6 billion[2]—a record that we are poised to match this year. Despite increasing fire activity and escalating costs, Forest Service wildfire budgets are based on historical averages rather than future projections. As a result, as fire season progresses and budgeted wildfire funds are exhausted, money is shifted ("borrowed") from other activities, including recreation, wildlife management, and forest restoration. But in contrast to hurricanes, tornadoes, and major floods, disaster funds are not available to cover the exceptional costs involved in fighting these catastrophic megafires.

The social, economic, and ecological costs of these megafires has been devastating. Communities have lost thousands of buildings, suffered tens of billions of dollars in damages, and, tragically, people have died. Waterways and other habitats have been degraded, imperiling fish and wildlife. Tens of millions of tons of climate-altering carbon dioxide have been released. Unfortunately, current wildfire policy is woefully insufficient to address this urgent crisis.

Our nation needs bipartisan Congressional leadership to fix the forest fire funding crisis and ensure adequate funding for restoring forests and appropriately fighting wildfires. We must accelerate the pace of forest restoration by promoting outcome-driven, collaborative processes, by expanding the use of prescribed fire, and by improving environmental review of beneficial restoration projects. We must boost the resilience of our forests and communities, discourage development in fire-prone areas, and prioritize fire risk reduction in the wildland-urban interface. And, Congress must confront the underlying causes of climate change that are exacerbating the wildfire crisis by ensuring sufficient funding for climate research and reducing climate-altering pollution.

The time for bipartisan action is now.

Collin O'Mara

President and CEO
National Wildlife Federation

MEGAFIRES: A GROWING THREAT

Druid fire, Yellowstone National Park, 2013. Photo: Mike Lewelling, NPS

Wildfire, like actors in a Greek drama, has two opposing faces: one of destruction and another of rejuvenation. Scenes of smoldering forests and burnt-out homes vividly illustrate the destructive force of uncontrolled wildfires. Paradoxically, many U.S. forests are not only adapted to burn periodically, but actually depend on fire for their rejuvenation, maintenance, and health. Consequently, forest and wildfire management is and always has been an extraordinarily complex and high stakes issue, which rapid climate change is making even more challenging. In particular, the increase in large, intensely hot "megafires" not only poses increased risks to local communities and economies, but has the ability to permanently transform the ecosystems and habitats through which they burn, with profound implications for wildlife.

The current crisis in wildfire and forest management has its roots in three interacting dynamics: the legacy of past forest management and fire suppression; dramatic increases in housing development in the fire-prone wildland-urban interface; and rapidly changing climatic conditions. Reducing risks from megafires will require that we address each of these underlying problems, including: scaling up efforts to tackle the massive backlog in forest restoration; encouraging more responsible and fire-wise development in wildland areas; and confronting climate change both by reducing greenhouse gases and by incorporating climate considerations in forest management and restoration. What is most urgently needed, however, is to fix the broken federal budget process for fighting wildfires.

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MORE, BIGGER, AND HOTTER FIRES

Eagle Creek fire along Columbia River Gorge, 2017. Photo: Christian Roberts-Olsen, Shutterstock

For several years California and other parts of the West have been in a severe and sustained drought, and the La Niña weather of last winter was anticipated to reduce the risk of severe wildfire in the region by bringing more rain and snow. Intense summer heatwaves, however, countered many of the expected benefits, and the explosive growth of annual grasses stimulated by winter rains may have even added to the fire risk. These conditions set the stage for the deadly wildfires now scorching nearly 200,000 acres across California and devastating many local communities. Indeed, 2017 is on track to be one of the most active years for U.S. wildfires on record, with a total of 8.5 million acres burned, and more than 21,000 firefighters assigned to wildfires in 10 western states.[3]

Over 1.2 million acres have burned in Montana alone.[4] The Lolo Peak fire has burned over 50,000 acres, covering much of the surrounding areas in Montana and Idaho with smoke. The Lodgepole Complex and Rice Ridge fires have also scorched hundreds of thousands of acres in Montana. In California, a state of emergency was declared for Los Angeles County as the La Tuna fire blanketed an area near Burbank, requiring over 1,000 firefighters to protect the heavily populated area.[5] In Oregon, the Eagle Creek wildfire has burned nearly 50,000 acres across the iconic Columbia River Gorge.[6] In Washington State, the Diamond Creek fire has charred over 125,000 acres.[7]

These fires not only affected large areas of wildlife habitat, but have had direct implications for wildlife managers and their efforts to restore key wildlife populations. In Washington State, for instance, biologists raced to rescue a population of endangered pygmy rabbits as the Sutherland Canyon fire threatened to overtake their captive breeding enclosure.[8] Thick smoke and the threat of new fires in Montana forced federal wildlife managers to postpone the annual roundup at the National Bison Range.[9] Western wildfires in 2017 have also had serious impacts on people and communities, blanketing cities in ash, and in many areas making the air dangerous to breathe.

With massive fires continuing to cover the West, experts are observing some disturbing trends. There is strong evidence that regional warming and drying in the western United States is linked to increased fire frequency and size, as well as to longer fire seasons.[10] The U.S. Forest Service, for example, has concluded that fire seasons are now on average 78 days longer than in 1970.[11] The area of forest burned annually in the Pacific Northwest has increased by nearly 5,000 percent since the early 1970s, while the area burned in the Southwest has increased by nearly 1,200 percent.[12, 13]

It is not only the frequency and size of fires that are changing, but also their intensity and severity. Indeed, more, bigger, and hotter wildfires are becoming the new normal. Extreme fire behavior—characterized by rapid fire spread, intense burning, prolific crowning, strong convection columns, and unpredictable shifts—not only can have serious ecological effects, but increasingly puts wildland firefighters at risk. Decades of fire suppression has in many places prevented smaller, less-intense surface fires that help to naturally thin forests. As a result, many forests have grown so dense that once ignited, flames quickly climb understory "ladder fuels" and set the tree canopies ablaze. Crown fires can burn so hot they have the ability to create their own weather, spreading the fire ever further and hindering control efforts. Complicating matters more, there has been an increase in the number of human-caused wildfire ignitions, due in part to the dramatic expansion of housing into the wildland-urban interface. Nearly 45 million housing units are now in naturally fire-prone wildland areas,[14] and one study estimates that human-caused ignition is responsible for 84 percent of all U.S. wildfires.[15]

Rather than leaving a tapestry of burned and unburned areas, which facilitates forest regeneration and provides a diversity of habitats for wildlife, ultra-hot megafires can destroy complete forest stands and burn across entire landscapes. If hot enough, extreme fires can even sterilize the soil by killing subsurface seed banks that normally aid in post-fire recovery. Indeed, forests in some places may never recover from these fires and instead be permanently transformed into shrubland or grasslands.[16] For example, in 2011 the Las Conchas fire in New Mexico burned more than 156,000 acres of forest and scrubland, one of the largest fires in the state's history. The fire burned so intensely that only bare dirt and tree stumps were left in many places, and some burned areas will probably never revert to forest.[17, 18]

An increase in the frequency of wildfire events can also lead to the long-term conversion of forests and other wildlife habitats by enabling the expansion of non-native invasive species.[19] Many invasive plants are able to rapidly colonize disturbed areas, often outcompeting native species. For example, in northern Nevada and elsewhere in the Great Basin, burned sagebrush ecosystems, on which sage grouse and migrating mule deer depend, often convert to grasslands dominated by invasive cheatgrass, which has little wildlife value. Unfortunately, cheatgrass also provides the type of fine fuel that promotes even more frequent wildfires in these areas, leading to permanent conversion from native sagebrush steppe habitat to invasive grassland.[20] This conversion is not only a major contributor to the decline of sage grouse, but also effects the many other wildlife that depend on this habitat type, including short-horned lizard, sharp-tailed grouse, pygmy rabbit, and Brewer's sparrow.

Some wildlife may be able to adapt or even thrive in fire-altered or transformed habitats, or migrate to areas better supporting their needs. Others, though, will be negatively impacted either as an immediate effect of a large fire, or in the aftermath when food resources, water, or shelter are hard to come by, or their habitats are permanently lost.[21]

Pygmy rabbit. Photo: USFWS

Wildfires in central Idaho, 2013. Photo: NASA

HOW CLIMATE CHANGE INCREASES THE RISK OF MEGAFIRES

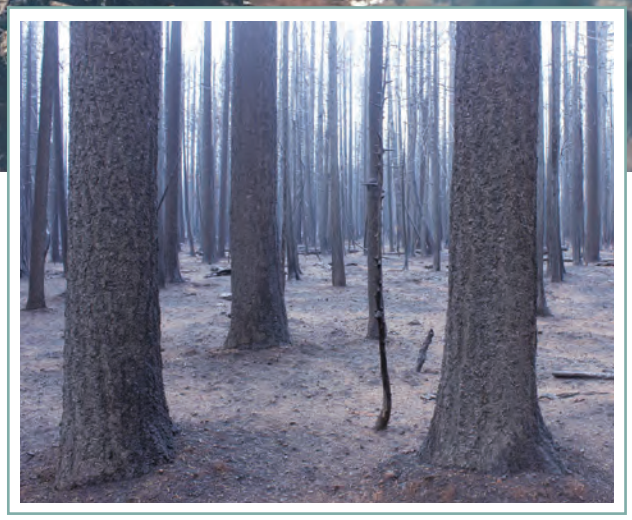
Climate change increases the risk of more frequent and severe fire in several ways. Earlier spring snowmelt, higher temperatures in spring, summer, and fall, and increases in evapotranspiration, all contribute to drying of vegetation, and extend the geographic area and time periods in which forests become combustible.[22] These changing climatic conditions have resulted in wildfire seasons becoming longer, particularly in the western United States. In parts of California, fire season is now 50 days longer than in 1979,[23] while Alaska moved its official fire season, defined as the date permits are required for burning residential yard and other refuse, from May to April.[24] With fires burning both earlier and later, some places may even start experiencing what has been called "year-round fire season."

Higher temperatures and extreme drought can trigger tree stress and mortality, which can increase fire risk. In California, for instance, more than 100 million trees died during the recent prolonged drought. And as discussed below, drought-induced stress can exacerbate outbreaks of forest pests, such as bark beetles, which can also increase the susceptibility of forests to wildfire.[25] Drought conditions can also contribute to super-hot fires that produce more lasting damage, where high temperatures penetrate deeper into soils and prevent seeds from germinating once the fire is over.

Although there are multiple reasons for the overall increase in wildfire activity, researchers have concluded that over the past few decades climate change has

caused more than half the increase in fuel aridity, and is responsible for a doubling in the cumulative forest area burned.[26] Looking to the future, researchers project that climate change will increase the potential for very large fires, both through increasingly frequent conditions conducive to these fires (i.e., changes in temperature, precipitation, and relative humidity) and through lengthening of the seasonal window when fuels and weather support these fires.[27, 28]

Not only does climate change increase the risk of extreme fires, but megafires in turn contribute to the underlying cause of climate change through the release of large quantities of carbon into the atmosphere. In Washington State, for instance, wildfires were the second largest source of carbon dioxide emissions in 2015, behind only the transportation sector.[29] Although wildfires always release carbon, the amount released through most low intensity fires typically is offset in subsequent years by vegetation regrowth and recovery in the burnt area. In contrast, the massive amounts of carbon released by megafires, coupled with declines in the capacity of the landscape to recover, may in some instances lead to a shift from carbon "sink" to carbon "source." [30]



King fire, California, 2014. Photo: USFS

Researchers have concluded that over the past few decades climate change has caused more than half the increase in fuel aridity, and is responsible for a doubling in the cumulative forest area burned.

FROM FIRES TO FLOODS

Because severe fires can burn away much of the vegetation that holds soil in place and retains run-off, when the rainy season returns there is often an increased risk of flooding below the burned area. For example, the 2010 Schultz fire burned just over 15,000 forested acres above Flagstaff, Arizona and caused the evacuation of hundreds of homes. Monsoon rains following the fire caused heavy flooding that resulted in extensive property damage in Flagstaff and took the life of a young girl. Overall, estimates of the total impact of the Schultz fire place the cost between $133 million and $147 million. These costs are a heavy burden on rural communities, and to reduce the risk of future fire and flood disasters, the Flagstaff community passed a $10 million bond to finance wildfire control treatments throughout local watersheds, including on federal lands.[31]

Runoff from burned areas can also result in soil and ash polluting streams and rivers. The ash can increase the pH level in water, and sediment can clog the gills of fish as well as destroy and degrade fish habitat. Studies in Arizona show that the state fish, the Apache trout, can suffer severe population declines following major wildfires.[32]

Monsoon rains following the fire caused heavy flooding that resulted in extensive property damage in Flagstaff and took the life of a young girl.

Schultz fire above Flagstaff, Arizona. Photo: Brady Smith, USFS

Aftermath of Schultz fire. Photo: Bill Morrow

Apache trout. Photo: USFWS

Mountain pine beetle infestation, Colorado. Photo: Hustvedt

BEETLE INFESTATIONS CAN AMPLIFY FIRE RISK

Fire is not the only major, climate-amplified disturbance affecting U.S. forests. Bark beetles are naturally occurring forest insects that have reached unprecedented epidemic levels over the past two decades. Mountain pine beetle infestations in particular have caused significant tree mortality across millions of acres in the Rocky Mountains. These beetle outbreaks have been correlated with climatic changes, and especially warmer winter temperatures that allow more beetles to successfully overwinter.[33]

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Various species of bark beetles are also causing significant forest damage elsewhere in the U.S., including Alaska and the Southeast, and appear to be expanding their range due to warming conditions. Southern bark beetles, for instance, historically have been restricted to pitch pine forests of the South, constrained by cold winters further north. That has now changed, and since 2002 the beetles have damaged more than 30,000 acres of forest in New Jersey, and recently have been detected in forests as far north as Massachusetts.[34]

In addition to the effect of rising winter and summer temperatures on beetle reproduction, drought conditions create water stress in forest trees and can make them more susceptible to bark beetle infestations.

As large swaths of forest succumb to beetle infestations, beetle-killed trees can increase the risk of wildfires, particularly early in an outbreak when dead or dying needles are still on the trees.[35] Colorado, for example, has recently experienced the largest bark beetle outbreak in its recorded history, which left hundreds of thousands of trees dead and vulnerable to wildfire.[36] In 2016, the Beaver Creek fire burned over 38,000 acres and cost an estimated $30 million to contain.[37] The fire was made more difficult to manage as it burned through beetle infested timber and dead trees.

The combination of beetle kill and fire can have serious effects on native wildlife. As an example, the 2016 Hayden Pass fire in Colorado's Sangre de Cristo range burned through an area badly affected by bark beetles. This area contains streams that are the only known refuge for a unique and isolated population of cutthroat trout, which was only discovered by biologists in 1996. Fall monsoon rains after the fire washed significant amounts of debris, ash, and sediment into the trout's habitat. Surveys following the fire and rains did not locate any remaining trout in Hayden Creek, and this unique trout might have been extirpated but for emergency rescue efforts following the fire that brought 158 of the fish into captivity for breeding and reintroduction.[38]

Smoke drifting over Las Vegas from Mount Charleston fire, 2013. Photo: Tomás Del Coro

MORE HAZE FOLLOWS MEGAFIRES

Western high country and wilderness are increasingly seeing the impacts of haze pollution from megafires, obscuring the views westerners and visitors alike cherish. New research indicates that more frequent drought and wildfire are leading to increased haze in western states as the fires produce a combination of small dust, soot, ash, smoke particles, and other air pollutants.[39] Small particles are public health concerns as they can lodge deep within the lungs and cause respiratory and cardiac distress and illness, and even premature death.[40]

It is not only remote and wild places out West being impacted. Urban areas are also being affected by these fires. In 2014, the Carpenter 1 fire burned the landmark peak of Mount Charleston 35 miles northwest of Las Vegas. Smoke from the fire triggered a health advisory from the Clark County Department of Air Quality that lasted days and impacted the entire Las Vegas area.[41]

A GROWING THREAT IN THE SOUTHEAST

Fire damage, Gatlinburg, Tennessee, 2016. Photo: Michael Tapp

Extreme fires are not restricted to the arid West: the Southeast is also experiencing an increasing number of large and intense blazes. Many southeastern forests, especially softwood pines, are fire-adapted and depend on relatively frequent, low intensity burns for their maintenance.

A changing climate and associated periodic drought conditions, however, are contributing to much larger, more intense wildfires that can affect not just drier pinelands, but burn typically moist hardwood forests as well. Although the southeast is in general characterized by warm, humid climates, severe drought conditions, such as occurred in 2007 and 2016, are creating conditions ripe for major fires. Last year, some of the biggest fires in the Southeast were in Georgia and North Carolina,[42] but the fire that caught the most national attention occurred in Tennessee. This explosive fire started in Great Smoky Mountains National Park as a result of human activities, and quickly spread to the gateway towns of Gatlinburg and Pigeon Forge, Tennessee. The Gatlinburg fire burned 1,700 structures, caused 14,000 to evacuate, and resulted in the death of 14 people, the deadliest the state has ever experienced.[43]

Forecasting the long-term impacts of climate change in the Southeast is challenging because of variability in precipitation patterns across the region. It is clear, however, that summer and winter temperatures in the region are rising. This will increase evapotranspiration and make drought conditions more likely during periods of low precipitation, with consequent increase in wildfire risk.[44]

Prescribed burns are an important and widely used management tool in the region, and are essential for maintaining and restoring the biologically rich longleaf pine forests, as well as for rebuilding populations of popular game species like bobwhite quail. To be effective and safe, these controlled burns must be carried out under particular weather conditions. Projected climate shifts are likely to shrink the availability of those conditions and significantly constrain the capacity for wildlife and natural resource managers to employ this essential tool for forest restoration and management.

Northern bobwhite quail. Photo: Dick Daniels

RE-ESTABLISHING NATURAL FIRE REGIMES

While fire is a natural process in most U.S. forests, there is wide variation in the natural fire regimes that characterize different forest types. Fire regime refers to a combination of factors, such as the frequency, intensity, size, pattern, season, and severity of burns.[45] As an example, many low-elevation ponderosa pine forests historically had a fairly frequent fire return interval (every 10-30 years), with low-severity surface fires that resulted in relatively open forest conditions.[46] In contrast, northern Rockies lodgepole pine forests historically had long fire return cycles (often greater than 100 years), with high-severity, stand-replacing crown fires (as occurred, for example, in the 1988 Yellowstone fires). Understanding natural fire regimes is key to evaluating forest restoration needs, since they provide a benchmark for determining the degree to which current forest conditions deviate from their

Low-intensity prescribed burn in ponderosa pine forest on the Coconino National Forest, Arizona. Photo: Brady Smith, USFS

"historical range of variability." Altered fire regimes, often due to long-term fire suppression, are a principle cause of elevated fire risk in many places, and re-establishing an area's natural fire regime can therefore be an important goal for forest management and restoration.

Beginning in the early 1900s, Federal and State agencies began carrying out aggressive fire suppression policies in efforts to reduce the loss of economically valuable timber and to protect communities. The role of fire in maintaining healthy ecosystems was not well understood at the time, and just as with the unbounded predator control taking place during that same period, these management policies produced unintended and far-reaching ecological consequences. Lack of fire in many fire-dependent forests led to the build-up of flammable materials and significantly affected forest successional patterns and processes. Changes were particularly dramatic in areas where fires historically were relatively frequent and of low intensity. Increasingly overgrown conditions and high fuel loads elevated fire risk in many areas, leaving them ripe for the ignition and spread of high intensity and severe burns.

Over the past forty years there has been an enormous amount of research on the fundamental role of fire in forest systems, resulting in an increased awareness and appreciation of fire as an essential natural process. This has been accompanied by major advances in efforts to re-establish natural fire regimes by putting fire back into these systems, as well as development of other ecological restoration techniques designed to enhance forest health and resilience.

Over the past forty years there has been an enormous amount of research on the fundamental role of fire in forest systems, resulting in an increased awareness and appreciation of fire as an essential natural process.

ADDRESSING THE MASSIVE FOREST RESTORATION BACKLOG

The scale of forest restoration needs is enormous. The U.S. Forest Service estimates that between 65 and 82 million acres are in need of restoration just on lands within their 193 million acre national forest and grassland system.[47] There is, however, no "one size fits all" approach for forest restoration given the wide range of forest types, natural fire regimes, and current watershed conditions. Rather, restoration and hazardous fuels reduction efforts must be firmly grounded in an understanding of the dynamics of particular forest types, take into account the local and regional ecological context, as well as the needs and concerns of local communities, industry, and other stakeholders.

Reintroducing fire into systems through the use of prescribed or controlled burns is one of the most important restoration approaches, and there is a need to dramatically expand the appropriate application of this management tool. There are places, however, where fuel loads are simply too high or conditions too dangerous for prescribed burns to be safely used. In these instances hazardous fuel loads can be reduced through a variety of mechanical thinning techniques. Ecologically appropriate thinning usually emphasizes removal of small diameter trees and dense understory vegetation. Salvage logging, which focuses on post-fire harvesting of larger-diameter standing trees, is far more controversial. Although providing economic benefit, it should only be considered on a

Collaborative forest restoration partnership in the Greater La Pine Basin, Oregon. Photo: USFS

site-specific basis since the practice can have significant ecological impacts, and its effects on reducing (or even increasing) fire risk is actively debated.[48, 49] Other forest restoration approaches include controlling invasive species, restoring streams, replacing undersized culverts, enhancing wildlife habitat, and decommissioning old forest roads.

In carrying out restoration and hazardous fuels reductions, it is also important to ensure that broader ecological and wildlife needs are taken into consideration. For example, many wildlife species depend on snags (standing dead trees) and downed woody debris for different stages in their life cycles. Some species, such as the declining black-backed woodpecker, are almost entirely dependent on post-fire snags.[50]

In an era of rapid climate change, forest restoration efforts increasingly will need to take future climatic conditions into account, rather than base management decisions on historical climatic conditions. An emphasis on climate adaptation and resilience in forest management will be especially important given the long life span of most tree species.[51, 52] Post-fire recovery efforts, in particular, will need to carefully consider the species composition and genetic variability in plant materials used in restoration efforts in order to anticipate and prepare for changing temperature and precipitation patterns and resulting shifts in habitat suitability.

Given the enormous scale of restoration needs, it is also important to carefully target areas most in need of restoration and hazardous fuels reduction.[53] In general, fuel reduction treatments will be most appropriate close to and around wildland communities, rather than in remote backcountry and wilderness areas. Not only is the wildland-urban interface where people and property are at highest risk from wildfire, but given the preponderance of human-caused ignitions, areas of high human activity are also some of the places most likely for fires to start.[54]

In recent years there has been considerable progress in addressing the massive forest restoration need, and the Forest Service currently is treating about five million acres a year, aided by a number of promising partnership programs.[55] The Collaborative Forest Landscape Restoration Program, for example, has worked with partners to reduce wildfire risk on 1.45 million acres and improve wildlife habitat on 1.3 million acres.[56] This innovative program was created to encourage partnerships between the federal government and diverse local interests, including sawmill owners, conservationists, businesses, and sportsmen. By creating opportunities for dialogue and collaboration among groups that often have been adversaries, the program is designed to promote more science-based planning and restoration, and fewer court challenges. These creative collaborations have helped increase Forest Service timber volume by 20 percent since 2008. Other policies, such as Good Neighbor Authority and Stewardship Contracting, have also been put in place to create additional incentives for forest management and restoration, and provide significant benefits to communities and wildlife. While more work is needed, we can look to these collaborative models for ways to address the many issues facing our forests.

Restoring and enhancing the health of our forests has multiple societal benefits beyond traditional uses, such as providing timber and livestock forage. These include fueling our growing outdoor economy, providing abundant and clean water, enhancing wildlife populations, and sequestering and storing carbon. Healthy forests are essential for the outdoor recreation industry, which currently contributes $887 billion to our national economy annually, is responsible for 7.6 million direct jobs, and generates $124.5 billion in federal, state, and local tax revenue.[57] Forests are hugely important for producing the water that people depend on, and some 180 million people in over 68,000 communities rely on national forest lands to capture and filter their drinking water.[58] Forests also provide habitat for a vast array of wildlife, yet nearly one-in-five forest-dependent animal species is imperiled or vulnerable.[59] Forests are also a major factor in sequestering and storing carbon that would otherwise enter the atmosphere and contribute to climate change. Indeed, U.S. forests account for more than 90 percent of the country's carbon sink.[60]

FIXING THE FEDERAL FIRE BUDGET

Happy Dog fire, Oregon, 2017. Kari Greer, USFS

Despite the enormous benefits that healthy forests provide, federal efforts to enhance their health and resilience are being impeded by antiquated approaches to funding the accelerating costs of fighting wildfires. Addressing the massive restoration backlog starts with fixing the broken federal fire budgeting process.

Traditionally, federal budgets for fighting wildfire have been based on rolling ten year historical averages. While this budgeting approach may have worked in prior eras, given the dramatic increase in the number and size of wildfires, and the rapidly escalating costs of fighting these fires, this retrospective approach is clearly inadequate for today's needs. Today, fighting wildfire consumes more than 50 percent of the Forest Service's budget, and this number could grow to 67 percent over the next decade, in large part due to a changing climate and ensuing drought conditions.[61] Annually, the United States spends more than $1 billion to fight wildfires,[62] and in 2015, one of the worst years for wildfires on record, the U. S. government spent more than $2.6 billion.[63] Large catastrophic megafires eat up a disproportionate amount of federal resources, with just one to two percent of fires consuming 30 percent or more of agency firefighting budgets each year.[64] These costs are only expected to rise as the climate continues to change, and as more homes are built in fire-prone wildland areas.

Unfortunately, the current fire funding system is not only inadequate for fighting fires, it is also compromising the ability of agencies to proactively reduce fire risks. Because of the retrospective budgeting process for fire control and suppression funds, during active fire years (which are now the norm) as fire season progresses and available wildfire funds are exhausted, money is shifted (euphemistically termed "borrowed") from accounts funding other important agency activities. This fire borrowing severely affects the government's ability to carry out the programs for which those funds were originally intended, including recreation, wildlife management, and forest restoration. A permanent fix is needed to address this growing problem.

Part of that fix must include a recognition that the number, size, and cost of wildfires on federal lands is increasing and should be budgeted for appropriately. Additionally, instead of expecting agencies to cover the exceptional costs of fighting truly catastrophic fires from their limited annual appropriations, these expenses should be eligible to be covered by specially appropriated disaster funds, similar to how hurricanes, tornadoes, and major flood events have long been treated.

RECOMMENDATIONS

The U.S. must address the growing threat of megafires through a comprehensive wildfire funding fix, through dramatically scaling up the pace of forest restoration, through incorporating climate adaptation practices into forest restoration and management, and through achieving significant reductions in climate-altering carbon pollution. By restoring and better managing U.S. forests, it is possible to reduce fire risks to communities, increase populations of cherished wildlife species, and protect our climate by enhancing the carbon sequestration and storage potential of our forests. These steps will help ensure that America's forests will be sustainable and resilient in the face of a rapidly changing and uncertain future, and will be capable of continuing to provide important economic, ecological, and societal benefits.

ENSURE ADEQUATE AND DEPENDABLE WILDFIRE FUNDING

- Provide sufficient funding for federal agencies to respond to wildfires, recognizing the growing average annual cost of firefighting;
- Allow the Forest Service to access a disaster funding account for catastrophic and extraordinarily costly fires;
- End the transfer of funds from conservation, forest management, and other non-fire programs to cover growing fire suppression costs; and

Prescribed burn, western Oregon. Photo: BLM

- Increase federal funding to implement proactive restoration and fire risk reduction, such as prescribed burns (when appropriate), on public and private forested lands.

ACCELERATE RESTORATION PROJECTS AND IMPROVE FOREST MANAGEMENT

- Prioritize restoration projects that achieve outcomes related to improved forest resilience, increased wildlife populations, and watershed health;
- Carry out significantly more prescribed and managed burns in fire-adapted forests;
- Improve environmental review processes for large-scale landscapes and for project-level sites in the short-term that help achieve and facilitate forest restoration and healthy forest management; and
- Expand on successful nationwide policies such as Good Neighbor Authority and Stewardship Contracting, which provide models for how stakeholders can work collaboratively towards mutually beneficial forest management goals and bring additional non-federal resources to restoration projects.

PREPARE FOR CHANGING CLIMATIC CONDITIONS AND FOR MORE FREQUENT AND SEVERE WILDFIRES

- Integrate climate adaptation principles into forest management and restoration efforts to ensure they are designed for future, rather than past, climatic conditions and promote sustainability and resilience of forest resources;
- Encourage wildland communities to incentivize new housing in areas of lower fire risk, promote or mandate the use fire-resistant building materials, and adopt other fire-wise approaches for reducing wildfire risk; and
- Prioritize hazardous fuel reduction investments in the wildland-urban interface where they will have the greatest effect on reducing the impacts and costs of wildfires.

REDUCE CLIMATE-ALTERING CARBON POLLUTION

- Manage forests on federal lands in ways that promote continued capture and storage of carbon, and foster financial incentives and markets to encourage carbon sequestration on private forest lands;
- Implement common sense safeguards—like greenhouse gas limits for power plants, vehicles, and oil and gas facilities—that are needed to protect public health and wildlife from climate impacts;
- Enact measures at state and local levels of government to curb carbon pollution and expand use of clean, renewable energy; and
- Ensure that federal agencies have sufficient resources to pursue important climate change research and monitoring, and to spur the development and adoption of clean energy technologies.

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Post-fire wildflower display. Photo: Damian Gadal

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