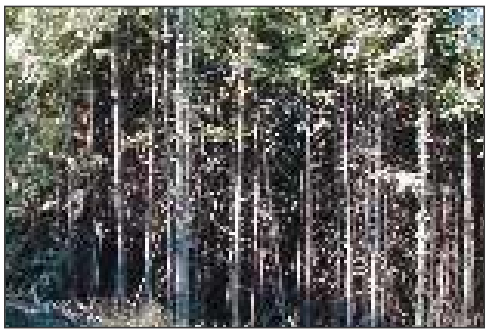
Eco-Link
Linking Social, Economic, and Ecological Issues

Fire Ecology

Volume 12, Number 1

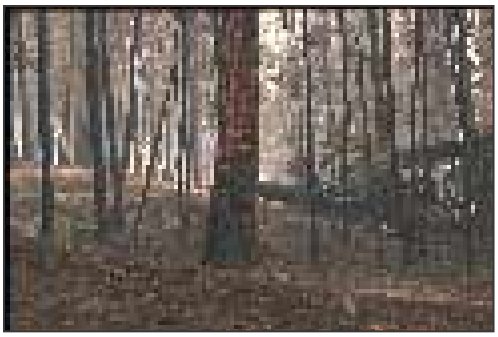
When it comes to thinking about fire in the forest, generations of Americans have grown up heeding the wisdom of Smokey Bear. For the increasingly urban population of North America that means excluding fire from the forest ecosystem at all costs. This mindset, reflected in US wildfire policy has resulted in over-crowded, unhealthy forests that, ironically, are at high risk for catastrophic fires.

Of all of the natural forces that have shaped forest ecosystems over the millennia, fire has had the most impact. Fire has helped to control competitive species and prevented overstocking. And unlike other forces like wind and weather, fire can be harnessed as a management tool. Native peoples saw fire as an ally and were proactive in its use. They used it to clear land for settlements, travel, and agriculture. Fire, both natural and man-made, has been such an omnipresent force in the forest that many modern forest ecosystems are fire dependent and need fire to maintain a healthy condition.



An overcrowded, unhealthy forest.

Fuel treatment including prescribed fire can thin tree stands and eliminate overgrown vegetation on the forest floor.



As a result of proper fire-treatment, forest are more open and healthy.

Fire can be friend or foe depending on whether it is under control or out of control. As a natural phenomenon, it is linked to the dynamics of many plant communities and animal populations. Many species of trees can withstand and thrive from the periodic low intensity burns that have historically affected them. In addition, fire helps open cones to release seeds on some species and helps recycle nutrients into the soil. The application of regular fires is a critical process for forest health. But the forests does suffer from larger intensity fires and as the boundary between wildlands and civilization draws ever closer, wildland fires poses a threat to lives, property, and resources as well as the forest itself.

Balancing concerns about the (perceived and real) threat of fire with its usefulness as a forest management tool is the dilemma facing policy makers and forest managers in this new century. The history of forest policy reflects a changing attitude and awareness of what fire is and what role it plays in the land. Understanding the benefits and the dangers of fire, the possible uses and avoidable misuses, is an important step towards maintaining a sustainable future.

Photos by (left to right): Roy Lawson/Temperate Forest Foundation Archive, Bryan Day, Karen Wattenmaker/Courtesy of NIFC/BLM

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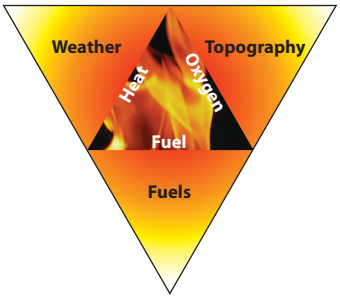
About Fire and Fuels

The word fire is from the Greek pyra meaning glowing embers. Fire is the heat and light that comes from burning substances. It is the visual indicator of the chemical process called combustion where some sort of fuel–such as the cellulose in wood–is combined with heat and oxygen to release energy. Sustained combustion from an ignition source requires a constant source of these three elements, often referred to as the fire triangle: fuel, heat and oxygen. Fire will be extinguished if any of the three of these components is depleted or missing.

Fire Triangle

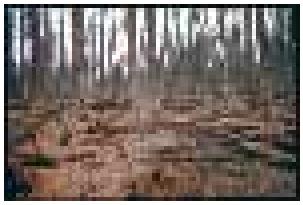


How large a fire can become is determined largely by the fire behavior triangle: weather, topography, and fuels. Fire is more prevalent in summer months where hot, dry conditions are more conducive to starting and sustaining blazes. In the same way fire to travels uphill more easily due to convection. But most important in understanding fire behavior is understanding fuels.

How a wildfire burns depends largely on the available fuels. In the wild, fire is typically spread by fine fuels (pine needles, leaves, grass, etc.) both on the surface and in the tree crowns. These are known as one hour time lag fuels, because they dry out (lose two-thirds of their moisture content) in about an hour. Small fuels, known as 10 hour time lag fuels, are woody twigs and branches, up to one inch in diameter; these fuels also help spread wildfires because they ignite and burn quickly. Larger fuels–particularly the 1000-hour time lag fuels (more than three inches in diameter)–may contribute to the intensity and thus to the damage fires cause, but contribute little to the rate of spread, because they are slow to ignite

Surface fire burning off forest undergrowth

Crown fire consuming large trees



Types of Wildfires

Not all fires in the wild are catastrophic. Low intensity fires can be helpful in maintaining some fire-adapted ecosystems. Indeed, fire is sometimes necessary, in some serotinous species, to release seeds for reproduction. Many species of mature trees are able to withstand all but the most intense blazes. But years of fire suppression and logging practices in public forests have resulted in high fuel loading which allows fires to burn hotter and climb into the tree canopies or crowns. These conflagrations can clear out stands of trees.

The three primary classes of wild-land fires are surface, crown, and ground. These classifications depend on the types of fuels involved and the fire's intensity.

Surface fires typically burn rapidly at a low intensity and consume light fuels while presenting little danger to mature trees and root systems.

Crown fires generally result from ground fires and occur in the upper sections of trees, which can cause embers and branches to fall and spread the fire.

Ground fires are the most infrequent type of fire and are very intense blazes that destroy all vegetation and organic manner, leaving only bare earth. These largest fires actually create their own winds and weather, increasing the flow of oxygen and "feeding" the fire.

Older trees, which can survive ground-level fires, don't live through flames that climb up small trees like ladders to engulf the treetops. As fire is carried into the crowns of the trees it more easily can travel to adjacent trees–other fuel sources–further compounding the problem.

Ignition Sources

In the wild, there are two main catalysts for fire–lightning strikes or humans. According to the US Fire Administration, humans cause 88% of wildland fires while lightning is responsible for 12%. (1988-97 average–Based on data from the National Interagency Fire Center) Conversely, lightning-caused fires are responsible for 52% of the acreage burned as opposed to the 48% that human-caused fires burn.

Fire Control

Fire control involves removing one of the elements required to sustain fire–such as removing the continuous fuel supply for the fire by creating a fire line dug down to mineral soil or suppressing the heat or oxygen with water or chemicals. Fire is a force that can easily grow beyond our ability to control. At very high fuel loadings, fire behavior overwhelms even the best fire suppression efforts. Under extreme conditions, control of fire becomes dependent on relief in weather or a break in fuels.

Fire and Forest Health

Fire is recognized, by the US Government, as a critical process affecting forest health. Forest health is defined by the US Forest Service as; a condition wherein a forest has the capacity across the landscape for renewal, for recovery from a wide range of disturbances, and for retention of its ecological resiliency while meeting current and future needs of people for desired levels of values, uses, products, and services. Many forests have become fire dependent, requiring regular fire regimes to maintain their health. The maintenance of regular burning regimes helps prevent surface fuel buildup and an over-accumulation of small trees and brush that makes forests more susceptible to severe wildland fires, insect infestations, and disease outbreaks. Healthy forests are vitally important as animal habitat, as watersheds, and for resource production. Fire affects forest health issues such as fuel loading, wildlife impact, and watershed impact.

Burn cleared forest

Benefits of Light Burning

In addition to maintaining open forests, fire serves fuel reduction, site preparation for seeding or planting, enhancement of wildlife habitat, control of undesired vegetation, range forage improvement, forest pathogen control, improved access, improved appearance, biotic community restoration and maintenance, enhancement of rare or endangered species.

Fire Regimes and Fuel Loading

Forest fire regimes have been altered by exclusion efforts, combined with other land-use practices, so that today's fires tend to be larger and more severe than those of past centuries. As described earlier, many established trees are capable of surviving smaller, surface fires. "Open ponderosa pine, larch, and Douglas-fir forests at lower elevations in the West burn naturally every 5 to 30 years," according to Robert W. Mutch writing for the *Journal of Forestry*, "maintaining rather open, fuel-free stands with few fir trees. But in more recent times managers have harvested the larch and pine overstory extensively while excluding fire. In the absence of fire, stand composition has shifted toward an unnaturally dense understory of Douglas-fir, grand fir, white fir, or incense cedar. Spruce budworm, Douglas-fir bark beetles, other destructive pests, and forest diseases have enjoyed a steady diet of stressed fir trees, leading to mortality, fuel build ups, and high-intensity wildfires."

Post-burn regrowth

Wildlife Impacts

Fire effects on wildlife are complex because they are often indirect, affecting habit more than individuals. Fire is beneficial to some species and detrimental to others. Fire benefits animals by clearing out the forest floor–old, woody growth gets burned off to be replaced by new succulent shoots sought by elk. Grizzly bears receive their favorite foods, huckleberries. Twenty or so years after a fire burns through a forest, huckleberries, serviceberries, elderberries and other fruit-bearing shrubs dominate the site. New growth of lush shrubs and wildflowers attracts all kinds of insects which in turn is a boon for insect-eating birds. The birds also nest within burned areas. Many species favored as game animals benefit from habitat changes which reduce forest cover or increase the edge around openings. The major wildlife effect of fire is on animal habitat: food, cover, and water.

Elk in fire-adapted environment.

Watershed and Soil Impact

Fire affects the physical, chemical, and biological characteristics of forest soils and can impact the watershed capabilities of the forest. The forest litter normally acts as a sponge, absorbing water from rain and releasing it gradually as part of the water cycle. At low intensities, fire is ecologically beneficial because nutrients are cycled. In addition, the soil's organic layer is not consumed and the remaining organic material stabilizes the soil surface and helps prevent erosion. High-intensity fires consume the soil's organic layer and burn off or volatilize nutrients. With this layer gone, water runs unimpeded over the surface, and the soil becomes more susceptible to erosion. In extremely severe fires, the soil can become hydrophobic, losing its capacity to absorb water as a result of the fine, powder-like ash that makes water bead on the surface. These conditions result in highly erodible soils which can be seriously detrimental to watersheds.

Light burns recycle nutrients into the forest floor.

Effects of Fire Suppression

One of the major consequences of fire suppression is increased stand density as fire-intolerant species replaced fire-tolerant species. Forest stands that typically grew 50 larger fire-tolerant trees per acre became encroached with more than 600 mostly small, fire-intolerant trees per acre. Without the historical, recurring underburns, seedlings filled in beneath the older trees–transforming open park-like forests into dense forests. These conditions nurture insect infestations–like the bark beetle–and disease.

Photos by Karen Wattenmaker/Courtesy of NIFC/BLM

History of North American Fire

Fire, both natural and man-made, has always played a role in shaping the forests and grasslands of North America. Since time immemorial, lightning-caused fires have burned across this continent. With the arrival of Paleo-Indians from Asia across the Bering Land bridge, fire had a new source. Besides using fire to warm themselves and cook their food Paleo-Indians used it extensively in their everyday lives; building canoes, collecting, hunting, wiping out pests, signalling, and warfare. Fire was seen as a powerful tool to shape their environment. As historian Thomas Bonnicksen reports,

> *"Indians burned holes in forests because sunny meadows provided more food for game than a dense forest, and they concentrated the animals so that they were easier to hunt. Clearings also improved the growth of berries and other edible plants, and they provided Indians with some safety from the wildfires that often threatened their camps. Thus, scattering meadows within a sea of trees became an important method of Indian burning in Canada, the Pacific Northwest, and the East."* [Bonnicksen, Thomas, *America's Ancient Forests, From the Ice Age to the Age of Discovery,* p 199]

Whether intended or not, the presence of fire, both natural and man-made had a significant impact on the wilderness; it helped to shape the ancient forests into a diverse mosaic. Bonnicksen further observes;

> *"Lightning and human-ignited fires disrupted the movement of trees and other plants as the climate warmed at the close of the Ice Age. Pioneer species led the way and settler species gradually moved in and replaced them. They sorted themselves over the landscape on soils where certain species had an advantage over others. Some trees stayed on the better soils, such as beech, some stayed near streams where moisture was plentiful, such as cottonwood, and other stayed on poor, sandy soils, such as jack pine. Regardless of the soil, fires, as well as hurricanes, tornadoes, floods, and other disturbances, periodically carve openings within forests, or even sweep them aside. These openings allow pioneer species to invade, and future fires and other disturbances retard or prevent the infiltration of pioneer forests by settler species. Thus pioneer forests can remain in the same place indefinitely as long as the disturbances continue. By increasing the number of fires, Paleoindians and modern Indians created even more openings in which pioneer species could grow. As a result, the forests that fire maintains, such as pine, oak, and aspen, covered larger areas of North America than would have been possible in an uninhabited wilderness."* [Bonnicksen, p 147]

Wildland Fire Policy

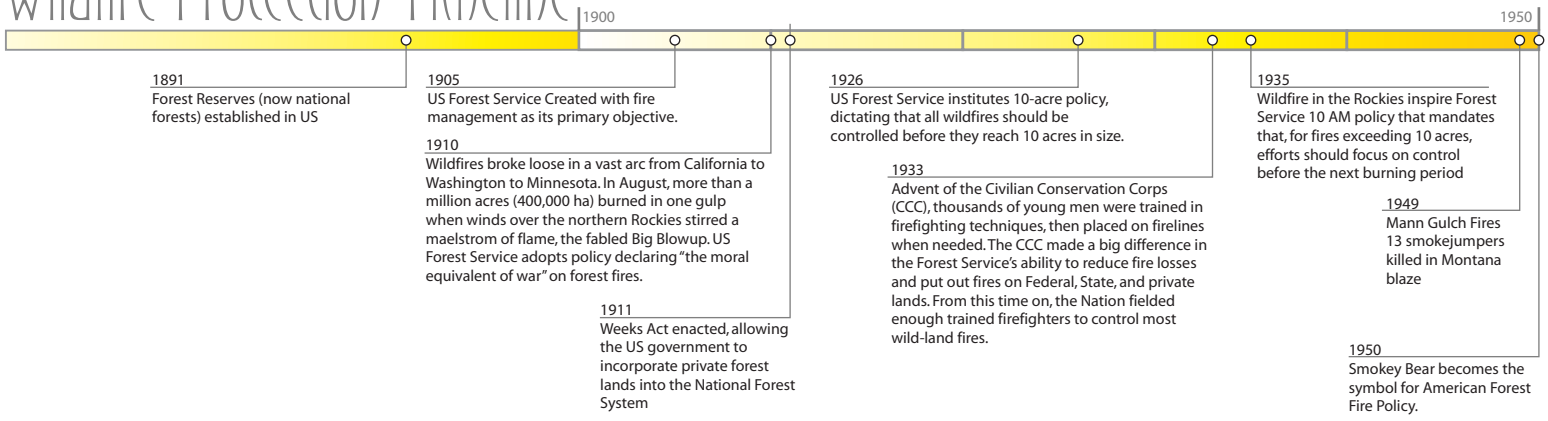
US Fire Policy has evolved over the last century from one of total fire suppression to its present form incorporating fire as a critical process. In 1910, after catastrophic blazes burned more than five million acres and killed 79 firefighters in the Southern Rockies, the US Forest Service adopted a clear, single fire management philosophy that was to guide its policy for the next 50 years. This philosophy declared "the moral equivalent of war" on forest fires. The even more rigid 10 a.m. policy was adopted in 1933 after a burn in the Tillamook forest of Oregon destroyed three million acres of essentially virgin timberland. All fires were to be controlled as quickly as possible, preferably during the first duty shift after detection. If that wasn't possible, fires were to be controlled by 10 a.m. of the following day.

US policy wasn't to back down from full fire suppression until two events–the issuance of the *Leopold Report* in 1963 and the subsequent enactment of the "Wilderness Act of 1964"–challenged the principles which had guided US wildland fire policy since its beginnings. This led to a new view of the role of natural fire in wilderness and inaugurated a slow transformation of fire policy.

In 1971, the Forest Service reexamined its 10 a.m. policy, and adopted a major modification by allowing natural "prescribed fires" to burn under specified conditions. In 1978, the Forest Service again made a significant revision in its fire management policy. The objective of wildfire suppression was changed to one of managing fire suppression costs and damages, consistent with land and resource management objectives. Prescribed fire to protect, maintain and enhance National Forest resources was reaffirmed as an approved management practice.

But decades of fire suppression proved to have serious repercussions on forest health. Because of altered vegetation patterns due to aggressive fire suppression, development, and land-use practices, large wildfires now threaten millions of both public and private acres. Potentially serious ecological deterioration is possible where fuel loads have become extremely high. In these areas, public and private values are at risk. To reduce the threat of these catastrophic fires, federal wildland fire policy was revised in 1995 and engages a proactive approach to managing fire

Wildfire Protection Timeline



Wildland Fire Policy Continued

The Federal Wildland Fire Management Policy and Program Review was chartered in 1994 by the Secretaries of the Interior and Agriculture to ensure that federal policies are uniform and programs are cooperative and cohesive. The review was conducted by the agencies responsible for wildland fire protection–the Forest Service, the Bureau of Land Management, the National Park Service, the US Fish & Wildlife Service, and the Bureau of Indian Affairs–as well as the National Biological Service, Environmental Protection Agency, National Weather Service, and FEMA. The resulting report presents fundamental principles of fire management and recommends a set of federal wildland fire policies. Though the different missions of the agencies sometimes result in differences in operations, a cohesive set of federal fire policies improves the effectiveness and efficiency of fire management.

To read more in detail about US Wildland fire policy go online to: http://www.fs.fed.us/fire/policy.shtml

Key Points in US Wildland Fire Policy

Protection of human life is the first priority in wildland fire management. Property and resource values are the second priority, with management decisions based on values to be protected.

Wildland fire, as a critical natural process, must be reintroduced into the ecosystem. Fire will be allowed to function as nearly as possible in its natural role to achieve the long-term goals of ecosystem health.

Where wildland fire cannot be safely reintroduced because of hazardous fuel build-ups, some form of pretreatment must be considered, particularly in wildland/urban interface areas.

Wildland fire management decisions and resource management decisions go hand in hand and are based on approved Fire Management and land and resource management plans. Fire managers also have the ability to choose from the full spectrum of fire management options, from prompt suppression to allowing fire to function in its natural ecological role.

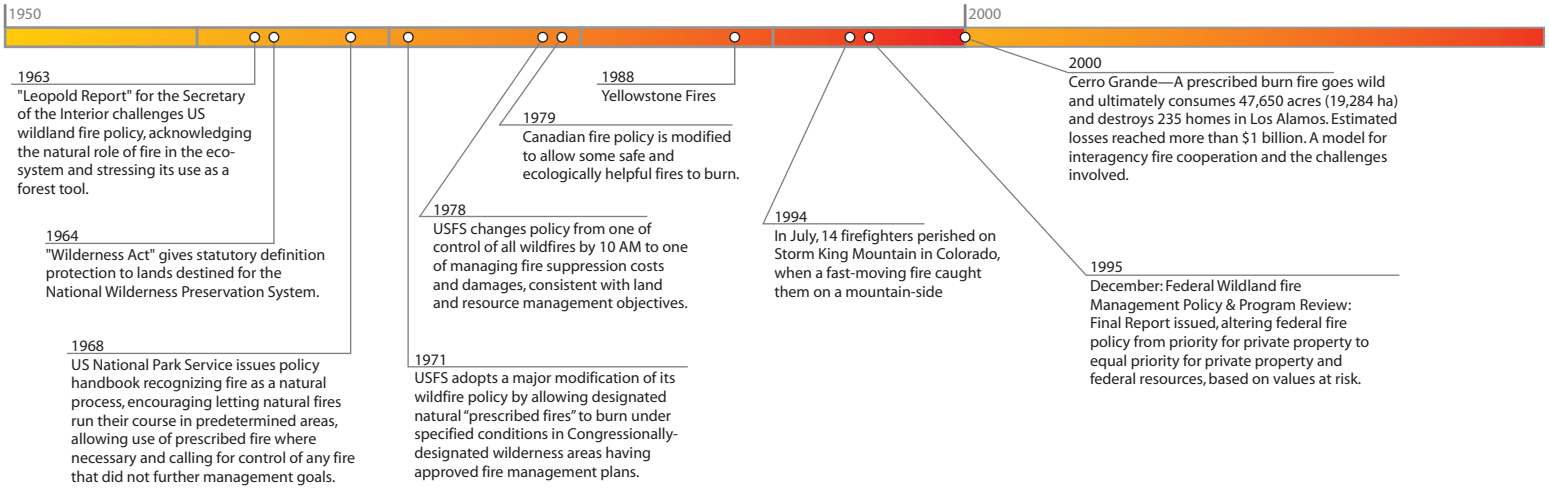
The role of federal agencies in the wildland/urban interface includes wildland firefighting, hazard fuels reduction, cooperative prevention and education, and technical assistance. Primary responsibility rests at the state and local levels.

Structural fire protection in the wildland/urban interface is the responsibility of tribal, state, and local governments.

The Western Governors' Association will serve as a catalyst to involve state and local agencies and private stakeholders in achieving a cooperative approach to fire prevention and protection in the wildland/urban interface.

Federal agencies must place more emphasis on educating internal and external audiences about how and why we use and manage wildland fire.

Finally, agencies and the public must change their expectation that all wildfires can be controlled or suppressed. No organization, technology, or equipment can provide absolute protection when unusual fuel build-ups, extreme weather conditions, multiple ignitions, and extreme fire behavior periodically come together to form catastrophic events.



Policy Making Issues

The US policy of suppressing all wildland fire over the past century has put forests more at risk for large catastrophic fires. The United States Department of Agriculture (USDA) Forest Service has identified approximately 39 million acres (approximately 27%) of National Forest System lands–primarily in the interior West and the Atlantic coastal States–that are at high risk from catastrophic fires. Many of these forests are overcrowded, resulting in high mortality rates from insect and disease outbreaks. High mortality rates result in excessive fuel buildups. The US Forest Service cites forest wildfire threat as one of the top forest health issues in its 1999 Forest Health Update. To alleviate the problems of large fire risk, policy makers agree that fuel treatment is a necessity. But prescribed burning raises numerous environmental concerns. Among these issues are the Wildland/Urban interface, Air Quality, and Climate Change.

Treating downed fuel

Starting a prescribed burn

The Wildland/Urban Interface

Prescribed Burns and Fuel Treatment

Prescribed fire is the use of wildland fire to accomplish land and resource management objectives. To minimize fuel buildups, the USDA Forest Service annually treats about 1.5 million acres through mechanical treatment and prescribed burning. By the year 2005, the goal is to treat at least three million acres per year to address the most critical high-fire-risk areas. Prescribed fires may be ignited either by resource managers under controlled conditions or by natural events such as lightning. The biggest risk of this method is that the prescribed burn might get out of control as occurred during the Cerro Grande fire of 2000. In addition to these treatments, the threat of destructive crown fires in unnaturally dense forest stands is being reduced through thinning of small-diameter trees. Wildlife biologists participate in treatment design and implementation to ensure that wildlife habitat needs are being met while reducing the potential for catastrophic wildland fires.

Wildland/Urban Interface

Increases in people encroaching into or moving adjacent to the wildlands has increased the risk to people that wildfires cause. This line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels is defined as the wildland/urban interface. Fires in these areas are harder to control and are more costly than fires in wildlands due to costlier firefighting methods.

To address this problem, the USDA Forest Service has identified areas at high risk and worked to increase the number of acres treated to reduce excessive fuel levels thus reducing the risk. State and local partners play a key role in coordinated solutions in fire-prone wildland/urban interface areas.

Photo by Bryan Day

Smoke from wildland fire is a major concern.

Fire and Air Quality

Smoke is a factor that may affect land managers' ability to use larger and more frequent wildland fire for maintenance and restoration of fire-dependent ecosystems. Wildland fire directly affects the amount of airborne particulates in the atmosphere. Wildland fire emissions are regulated by federal air quality programs under the Clean Air Act (CAA). The Environmental Protection Agency (EPA) is required to set air quality standards for pollutants that affect public health. Present regulatory policies measure prescribed fire emissions, but not wildland fire emissions. In treating acres at risk–and minimizing the impact to the public–the USDA Forest Service works closely with the EPA, state organizations, and others to manage smoke duration and volume. A growing body of scientific evidence suggests that mechanical treatments followed by prescribed fire can reduce the overall adverse impacts to air quality by reducing the amount of fuel that would otherwise be available during the wildland fire season. With guidance from the national level to provide consistent interpretation, further cooperation at the local level will help to achieve a balance of air quality and other ecosystem goals.

Fire and Climate Change

Forest fires affect the global carbon cycle, and thus the climate, in three main ways (Kasischke 2000). First, fire releases large quantities of carbon into the atmosphere through the combustion of plant material and surface soil organic matter. Second, fire-killed vegetation decomposes over time emitting carbon. Third, the vegetation on newly burned sites may not absorb as much carbon from the atmosphere as the decaying vegetation emits, or as much as the pre-fire vegetation absorbed, for several years or decades after a fire. Fires are thus an important part of the global carbon cycle, with increased fire frequency generally causing a net reduction in biospheric carbon storage.

Photos by (top to bottom): Tom Iraci, Bryan Day, Karen Wattenmaker, and Bryan Day/Courtesy of NIFC/BLM

US Agencies in charge of Fire Policy

Because of the destructive risk of fire in the ecosystem, its presence is highly monitored by various agencies who must balance land management objectives with protection from fire danger. The federal government is responsible for fire protection on federal lands. Lands administrated by the USDA's US Forest Service and the Department of the Interior's Bureau of Indian Affairs, Bureau of Land Management, Fish & Wildlife Service, and National Park Service are protected by their respective agencies. States are responsible for fire protection on non-federal land and National Association of State Foresters brings together these state agencies. Local governments are responsible for putting out structural fires.

The FY 2001 Interior and Related Agencies Appropriations Act (PL 106-291) provided a total of $2,893,656,000 to the USDA Forest Service and the Department of the Interior for National Fire Plan and base fire program funding. Approximately $1.9 billion was allocated to the Forest Service and the Department of the Interior received approximately $979 million.

For more information go online to: http://www.fireplan.gov/overview.cfm

Career as a Wildland Firefighter

During firefighting efforts, the wildland firefighter gets a variety of assignments working under arduous and stressful conditions; in heavy smoke and intense heat, climbing steep and rugged terrain, and working with very little sleep or rest. Firefighters in these positions often do project work–such as thinning, fuels management, or other work–when not on an actual fire assignment. Crews often travel to other states and regions to support fire management throughout the United States, and they occasionally receive international assignments. A firefighter can be a member of an engine crew, a hotshot crew, a smokejumper crew, a helicopter crew, or an organized handcrew.

Engine Crew: The engine crew specializes in initial attack on wildland fires. They are occasionally called to respond to a vehicle accident or medical emergency. Engine crews work with specialized firefighting equipment and perform many strenuous activities, including construction of fireline with hand tools, hose lays, burnout operations, and mopping up hotspots near the fire's edge.

Handcrew: A handcrew is a 20-person organized team; they build fireline, burn out fire areas, and mop up after the fire using chainsaws and hand tools such as pulaskis and shovels. Hotshots draw specialized assignments that reflect their higher levels of experience and training, and they're often dispatched nationwide from the National Interagency Fire Center (NIFC) in Boise, Idaho. These crews are interagency national shared resources.

Hotshot Crew: Interagency Hotshot Crews are professional wildland fire suppression teams specifically trained, organized and equipped for rapid response to wildfire situations anywhere in North America. Hotshots are diverse teams of career and temporary agency employees who work in the most difficult fire environments imaginable.

70 crews nationwide are employed by the US Forest Service (53 crews), Bureau of Land Management (8 crews), National Park Service (2 crews), various Native American Tribes (5 crews) and State Forestry Agency Crews (2).

Smokejumpers: These are specialized firefighters who parachute in to remote areas for initial attack on wildland fires. Smokejumpers must be self-reliant and work both independently and as an organized team. Smokejumpers have at least one year of prior firefighting experience.

Helicopter Crew: Helicopter (helitack) crew members provide a quick and aggressive response to wildland fires in remote areas. Some crews specialize in rappel operations, and helitack firefighters often work in remote areas transporting cargo, personnel, and other supplies to and from fire areas.

Summary

Fire is an inevitable force in our environment. We've become well aware of the destructive force that fire has through decades of anti-fire campaigns. But, as policy-makers and the public are beginning to realize, fire also has a necessary role in maintaining the forests that we've come to cherish and protect. If we are to maintain the integrity of our forest resources then we will have to better understand the role that fire plays and learn to utilize it to our benefit instead of fighting it to our detriment. This is the role that fire ecology plays, learning to appropriately manage this force of nature.

Gerald Williams, historical analyst for the USDA Forest Service reminds us that, "Eliminating fire from fire-adapted forests does not restore them to pristine parkands or primeval wilderness. Instead, removing fire usually creates an environment or eco-system that has never before existed." If we wish to maintain our forest trust for future generations we must heed the lessons of fire ecology. Trees are a true renewable resource and our forests are an inheritance that we must protect for a sustainable future.

Glossary of Terms

Crown fire–A fire burning into the crowns of the vegetation, generally associated with an intense understory fire.

Ecosystem–The complex of a community of organisms and its environment functioning as an ecological unit in nature.

Ecosystem Management–The careful and skillful use of ecological, economic, social, and managerial principles in managing ecosystem integrity and desired conditions, uses, products, and services over the long term.

Fire-Adapted Ecosystem–An ecosystem with the ability to survive and regenerate in a fire-prone environment.

Fire Dependence–Plants or plant communities that rely on fire as one mechanism to create the optimal situation for their survival.

Fire Regime–The circumstances of fires characterized by fire frequency, seasonality, intensity, duration and scale (patch size), as well as regularity or variability.

Fire Frequency (Fire Return Interval)– How often fire burns a given area; often expressed in terms of fire return intervals (e.g., fire returns to a site every 5-15 years).

Fuel–All the dead and living material that will burn. This includes grasses, dead branches and pine needles on the ground, as well as standing live and dead trees. Also included are minerals near the surface, such as coal that will burn during a fire, and human–built structures.

Prescribed fire–A fire ignited under known conditions of fuel, weather, and topography to achieve specific objectives.

Restoration–The return of an ecosystem or habitat toward its original structure, natural complement of species, and natural functions or ecological processes

Serotinous–A pine cone or other seed case that requires heat from a fire to open and release the seed.

Surface fire–A fire burning along the surface without significant movement into the understory or overstory, with flame length usually below one meter.

Sustainability–Meeting the needs of the current generation without compromising the ability of future generations to meet their needs. Ecological sustainability entails maintaining the composition, structure and processes of a system, as well as species diversity and ecological productivity. The core element of sustainability is that it is future-oriented.

Understory fire–A fire burning in the understory, more intense than a surface fire and with flame lengths of 1-3 meters.

Wildfire–A fire, naturally caused or caused by humans, that is not meeting land management objectives.

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More Info

The National Interagency Fire Center Website is an up to date resource for wildland fire information: http://www.nifc.gov/

The Canadian Interagency Forest Fire Centre Website is an up to date resource for Canadian wildland fire information: http://www.ciffc.ca/

US Forest Service Fire and Aviation Management Website http://www.fs.fed.us/fire/fire_new/

US Bureau of Land Management Office of Fire and Aviation Website: http://www.fire.blm.gov/index.htm

FireWise web site for valuable information for homeowners on how to create survivable space around property in the wildland/urban interface. http://www.firewise.org/

To find information online about fire's effect on wildlife and plants: http://www.fs.fed.us/database/feis/

US Forest Service 1999 report on forest health online: http://www.fs.fed.us/foresthealth/fh_update/update99/index.html

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