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Law, Regulation, and Economic Growth

Forest Policy Up in Smoke: Fire Suppression in the United States

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RESEARCH SYMPOSIUM ON
BAD PUBLIC GOODS

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Abstract

U.S. fire policy favors suppression of all fires on federal lands, despite negative impacts on forest ecosystems. Due to Forest Service fire suppression, forests which previously burned periodically have strayed from their historical range of variation. The result is a proliferation of increasingly stressed trees and dangerous accumulations of fuels. Policies do not support responsible fire management, but instead provide incentives to continue suppression of most fires. This paper examines the background and consequences of fire suppression, with recommendations for improvement. Future fire policy should incorporate incentives encouraging responsible management, including fuels reduction in the wildland urban interface and wildland fire use in remote areas.

Introduction

For most of the 20th century, U.S. federal fire policy focused on suppressing all fires on national forests. The goal was to protect timber resources and rural communities, but this policy ignored the ecological importance of fire. North American forests have evolved with fire for thousands of years. Fire returns nutrients to soils, encourages growth of older fire-resistant trees, and promotes establishment of seedlings.

Decades of fire exclusion have produced uncharacteristically dense forests in many areas. Some forests, which previously burned lightly every 15 to 30 years, are now choked with vegetation. If ignited, these forests erupt into conflagrations of much higher intensity than historic levels. Grasses, shrubs, and saplings in the understory now form a fuel ladder, through which flames can climb to the forest canopy, killing entire forest stands.

The fire problem is exacerbated by decreasing federal timber harvests since the late 1980s.¹ In the absence of fire, and with reduced timber harvests and thinning, numerous small-

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diameter trees have proliferated. Stressed trees compete for scarce water, sunlight, and growing space. In this weakened state, trees are not only at greater risk of catastrophic wildfire, but are also more susceptible to disease and insect infestation (Fretwell 1999).

Meanwhile, more people are living and building homes near forested areas, in the “wildland-urban interface” (Theobald and Romme 2007). The combination of high fuel loads and increasing human populations elevates risks of fatality and property damage due to forest fire.

According to Forest Service estimates, almost 70 percent of federal forests (151 million acres) are in need of some fuels restoration treatment, and more than 60 million acres, an area the size of Oregon, are at high risk of catastrophic wildfire (FMI 2001). Instead of protecting resources and communities, fire policy has placed them at risk (Busenberg 2004).

As part of a management program on federally-owned lands, a policy for uniform wildfire suppression is an example of a counterproductive public good provided due to perverse political incentives. This paper will discuss the evolution and consequences of fire suppression policies in the United States and provide recommendations for improving fire management in the future.

Background-The Forests and the Trees

Although North American forests are not homogenous, most forests have been affected by fire. Throughout history, lightning has sparked fire across the landscape. In addition, people have used fire as tool since they first migrated to North America over the Bering land bridge

¹ In the 1980's, national forests sold an average of 10.7 billion board feet of timber per year, but now they sell only about 2 billion board feet per year (Fedkiw 1998, 211; USDA Forest Service 2007a). Public dissatisfaction with federal timber management and restrictions due to the Endangered Species Act precipitated the decline.

(Pyne 1982).² Evidence of fire is abundant in fossil records, fire scars, and from many adaptations that plants have evolved to survive or to take advantage of fires.

Some conifers such as lodgepole and jack pines produce serotinous cones, which only release seeds when exposed to intense heat. In the Southeast, longleaf pine exists in a grass-like phase, its terminal bud protected near the ground, until it has been burned over. Without surrounding vegetation to compete with, it then sprouts vigorously to achieve a height at which it is less susceptible to damage from low flames. Some Northwestern species, such as larch, ponderosa pine, and Douglas-fir grow thick bark which allows older trees to withstand periodic light burning.³

Forests of different species, with various adaptations to fire, are habituated to different burning cycles. Northwestern ponderosa stands and Southeastern longleaf pine stands are adapted to frequent, low-intensity fires that clear out grasses and shrubs in the understory. In contrast, lodgepole forests of the Rocky Mountains are suited to infrequent, stand-replacing fires, which generally decimate the existing forest, but promote growth from seeds released from serotinous cones.

Based on these fire regimes, it is possible to create general guidelines about the appropriate use of fire in particular regions. But because a variety of forest types may exist, it is not reasonable to create blanket rules for any area, let alone for the entire nation.

² There is some debate as to the historical extent and the influence of human-caused fires in North America. Pyne (1982) claims that Native Americans used fire widely, with great impact on the landscape. Wuerthner (2006, xvii) argues that human-caused fires were limited to localized areas, such as favored areas for camping or horse pastures. Both agree, however, that Native Americans used fire as a tool.

³ See Agee (1993, 126-134) for a detailed explanation of plant adaptations to fire.

To Burn or Not to Burn

The Forest Service was created in 1905 to manage the nation's forest reserves. Soon thereafter the agency adopted a nation-wide policy of fire suppression—in order to provide protection from wildfire to rural communities and timber resources. But there were many additional reasons for the policy, both political and economic.

To begin with, in the early years, fire suppression was a means for the Forest Service to prove its qualifications. At the time, many foresters recognized the value of “light burning” to clear out understory vegetation, but the Forest Service wanted to set itself apart from this common practice of rural farmers and Native Americans. According to fire historian Stephen Pyne, “The Forest Service had insisted that it should manage the forest reserves precisely because it offered something different from frontier practices” (Pyne 1982, 106). Fire suppression helped to establish the agency as a professional organization.

Also, the Forest Service needed an uncomplicated message with respect to fire in the woods. It would not serve the agency to attempt to educate the public on the differences between appropriate and inappropriate uses of fire; “propaganda does not thrive on close distinctions” (Pyne 1982, 171). Thus, the Forest Service adopted an unequivocal anti-fire position, even though foresters within the agency were aware of the benefits of fire to some forest ecosystems. Later, Smokey Bear's anti-fire mantra—“only you can prevent forest fire”—would become one of the most effective advertising campaigns in history (Kerr 2006).

Still, professional foresters within the Forest Service debated whether light burning should be applied in national forests. In particular, foresters in the Southeast and in California had long used fire to keep understory vegetation in check and to reduce the risk of large conflagrations (Pyne 1982, 100-122). But after several wildfires ravaged settlements in the late

1800s and early 1900s, public demand for protection began to pressure federal policy towards full fire suppression.

The fires of 1910 had the most dramatic effect on forest management policy because they burned mostly on federally-owned forest lands, managed by the fledgling Forest Service. By the time autumn rains extinguished the flames, 5 million acres (an area the size of Massachusetts) had burned, with 3 million acres in Montana and Idaho alone, where 8 billion board feet of timber were incinerated. Eighty-five fatalities resulted (Pyne 1982, 249; Barker 2005, 111). The Forest Service was catapulted to the forefront of fire suppression activity in the nation. Public support for light burning practices dwindled, and professional foresters within the agency became convinced that fire protection was the primary goal of the Forest Service (Pyne 1982, 252).

Finally, and perhaps most importantly, Congress created financial incentives that favored fire suppression over any other policy. The Forest Fires Emergency Act, passed in 1908, stipulated that in fire emergencies the Forest Service could put any available funds towards suppression, and Congress would later reimburse those expenses. In other words, funding for emergency suppression had no specified limits. Though funding was not unlimited, the Forest Service could not know what the limits were without testing them. The 1910 fires were the first test of the Forest Fires Emergency Act. The Forest Service spent \$1.1 million⁴ extinguishing the fires of 1910—about 20 percent of its budget—and Congress dutifully reimbursed the funds after the smoke cleared (Pyne 1982, 263; O’Toole 2002, 26). The message was unmistakable: emergency fire suppression activities were to be free of normal budgetary constraints.

Such a policy provided little motivation either for the Forest Service to determine the optimal level of fire suppression or to pursue the selected level efficiently. As one observer noted

⁴ About \$24 million in 2006 U.S. dollars.

after large fires in 1934, “As long as the money is plentiful, it is not necessary to worry about values; if money becomes scarce, highest protection to greatest values naturally follows” (quoted in Pyne 1982, 277-278).

The Forest Service retained its policy favoring fire suppression despite knowledge of the benefits of burning. For example, a 1908 Yale University study documented the fire dependence of southern longleaf pine. But the financial incentives of the Forest Fires Emergency Act, passed the same year, swayed Forest Service policy against light burning. The Forest Service suppressed the Yale study and other pro-burning discoveries for many decades (Schiff 1962; O’Toole 2006, 218).

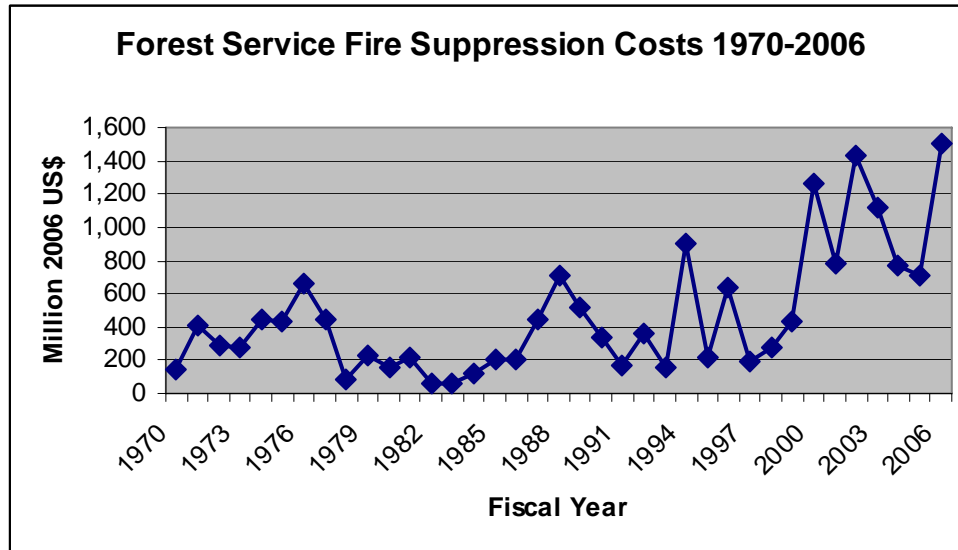
Two Steps Forward, Two Steps Back

It wasn’t until 1970 that the Forest Service publicly acknowledged the ecological importance of fire, allowing some fires to burn under accepted weather conditions. In 1978, the Forest Service officially abandoned its policy that required all fires to be extinguished as quickly as possible. The Forest Fires Emergency Act was repealed the same year (Pyne 1982; 259, 290-291).

Forest economist Randal O’Toole notes that initially, the policy changes of the 1970s “led to subtle yet significant changes on the ground” (O’Toole 2006, 219). Instead of immediately suppressing all fires, the Forest Service began taking greater advantage of topography and natural barriers to contain fires—keeping suppression costs down, and allowing more acres to burn. Average annual suppression costs⁵ dropped from \$381 million in the mid-1970s to \$156 million from 1979 to 1986 (Schuster 1999). (See Figure 1.)

⁵ Here and below, financial data are adjusted for inflation to 2006 US dollars.

Figure 1



(Sources: Schuster 1999 and NIFC nd)

The repeal of the Forest Fires Emergency Act put a stop to unconstrained reimbursements of emergency fire suppression spending. Like other forest management activities, firefighting was funded as a line-item, which generally covered annual suppression expenditures for the first decade. In years of more expensive fires, the Forest Service drew on its reforestation fund, and then paid itself back during less costly years (O’Toole 2006, 219).

But the late 1980s produced several extreme fire years. Annual Forest Service suppression costs from 1987 to 1990 averaged \$502 million (Schuster 1999). The 1.5 million acre Yellowstone fires of 1988 attracted nation-wide interest and concerns about fire management policy. Congress, the media, and the public questioned the federal policy that allowed some fires to burn unfettered, “destroying” America’s first national park.

Many were not aware that the lodgepole forests which constitute 80 percent of Yellowstone National Park are habituated to intense, stand-replacing fires. In fact, the waxy resin that seals lodgepole pine cones shut generally requires the high temperatures of fire in order to melt and release seeds. The 1988 fires were no anomaly, but a regular event occurring every century for millennia (Barker 2005; 191, 206). Nevertheless, the outcry forced a reevaluation of

fire policy (Aucoin 2006). Managers were mandated to create fire plans for all federal forest lands, and all fires were to be suppressed until fire plans were in place.

Congress poured more money into suppression funding, tripling the Forest Service's annual appropriation in 1989. Even this increase did not put a dent into the agency's suppression deficit, and the Forest Service began to express concern at the depletion of its reforestation fund. In 1990, Congress repaid the fund, once again establishing a precedent of reimbursal of emergency firefighting spending (O'Toole 2006, 219).

This is the system today. The Forest Service receives an annual appropriation for fire suppression, and if costs exceed the appropriated amount, the agency borrows from its other programs. After the fire season, the president can allow the Forest Service to draw on an emergency fund in order to repay itself (O'Toole 2006, 219). Despite substantial increases in appropriations for suppression since 2000, the Forest Service continues to depend on additional reimbursements of emergency firefighting spending (Alkire 2004). For example, from 2003 to 2006, the Forest Service received an annual average of \$613 million in Congressional suppression appropriations, and \$557 million more in emergency funding (USDA Forest Service 2004, 2005, 2006a, 2007b).

Despite the about-face in forest policy in the 1970s, little has changed with respect to the overall response to fire on federal lands. The Forest Service cannot ascertain the limits on funding for emergency fire suppression without pushing the boundaries. To agency personnel, emergency suppression funding seems limitless. This provides a strong incentive to suppress fires, and to do it inefficiently, regardless of the general knowledge of the benefit of fire to various forest ecosystems. Since 2000, Forest Service fire suppression costs have averaged over \$1 billion annually, and less than one percent of fires were allowed to burn (NIFC nd).

The Firefighting Paradox

The Forest Service has admitted the mistake in attempting to suppress all fires on national forests. Today, fire is recognized as an essential part of many forest ecosystems. According to former Forest Service Chief Dale Bosworth, the national forests' greatest threats include hazardous accumulations of fuels due to the exclusion of fire, and the dangerous fires that could result from ignition of these fuels (USDA Forest Service 2006b).

One of the Forest Service's main objectives is to mitigate the threat of catastrophic wildfire due to hazardous fuels accumulations. Although the increased fuel load was the result of Forest Service mismanagement—ignoring scientific research and choosing to suppress fires—Congress's reaction has been to increase the agency's budget. Between 1999 and 2006, budgets for wildland fire management have more than doubled, including significant increases for both fuels reduction and fire suppression (USDA Forest Service 2001, 2007b).

It would seem logical that a component of hazardous fuels reduction would also entail a reduction in wildfire suppression, but this is not the case. "Though most fire ecologists agree that the Forest Service should let more wildfires burn, the agency argues that excess fuels make it too risky to do so" (O'Toole 2002-2003, 17). A problem that the Forest Service created—excess fuels—prevents appropriate burning, and so the problem grows. "It is one of the great paradoxes of fire suppression that the more effective we are at fire suppression, the more fuels accumulate and the more intense the next fire will be" (quoted in USDA Forest Service and US DOI 2001, 9).

Increasing numbers of homes in forested areas contribute to risks associated with wildfire. Some researchers claim that the expansion of the wildland-urban interface can also be partly attributed to past fire suppression practices. "Past effective wildfire suppression has

encouraged home construction in forested areas, adding to damage if suppression is later unsuccessful” (Donovan and Brown 2007, 77). Between 1970 and 2000, developed portions of the wildland-urban interface grew in area by 52 percent (Theobald and Romme 2007).

Political and public pressure to protect these homes from fires often shapes management decisions. In some cases, fires cannot be controlled without a change in the weather, but firefighters feel compelled to at least try to save homes. “Many in the firefighting community know their puny efforts are meaningless, but it is perceived as important to make the attempt, no matter how futile” (Wuerthner 2006, 203). “These large ‘project fires’ are sometimes dubbed ‘political shows’ by experienced firefighters who know when their labors will have no effect on fire behavior” (Ingalsbee 2000, 5). Public expectations and threats of negative media exposure in the wildland-urban interface direct management decisions which can be costly and inappropriate.

Homes and structures adjacent to forest lands also increase suppression costs (USDA Office of Inspector General 2006). Firefighters have admitted to spending more money attempting to preserve structures—like mining shacks and hunter’s cabins—than the structures themselves were worth (Ingalsbee 2000, 4; Truesdale 1995). The protection of private homes in wildland-urban interface areas is comparable to federal flood insurance—a subsidy to people who build homes in risky locations (Donovan and Brown 2007).

Aside from the money that fire suppression brings into the Forest Service, firefighting is big business in many areas. “A new ‘fire-dependent’ class of government agencies and private corporations has accumulated enormous power and profits from firefighting” (Ingalsbee 2006, 223). Firefighting receives about a quarter of the Forest Service’s resource management funding every year (Nelson 2000, 4). Local businesses and federal contractors have come to depend on an influx of firefighting dollars.

In sum, since fighting fire enjoys widespread support from businesses, property owners, Congress, and the Forest Service itself, only a small percentage of fires are allowed to burn on national forests. This risk-avoidance strategy is typical of “bureaucratic myopia” (Shughart 2006)—no politician or bureaucrat wants fire damage or casualties to occur on his watch. But suppressing fires in the present can result in greater problems in the future. As fuels accumulate, many forests stray further from their historical range of variation, and fires threaten to be more damaging and dangerous.

A Bad Public Good

Fire suppression policy has backfired because of the political nature of public land management. Public ownership of forests results in management decisions based on politics, rather than on local, professional, or scientific knowledge. With respect to fire management, the outcome of political decision-making has been too much fire suppression—fires are extinguished regardless of the cost or ecological effect.

Publicly-owned forests offer many amenities that are non-rivalrous and non-excludable such as open space, clean air, and biodiversity. Many suggest that such goods will not be provided by the private sector, and instead should be the responsibility of the government (Jackson et al. 2003, 361-63). But government management does not guarantee optimal results (see Haddock 2007 for a discussion of “bad public goods”).

Fire suppression policy has not resulted in responsible forest stewardship. Fire-adapted forests have been altered from their historical conditions, and are at increased risk of damage. In addition, the annual borrowing of funds for firefighting regularly interrupts other Forest Service

programs, including timber production, reforestation, research, and restoration (Alkire 2004, Straub 2008).

Although the Forest Service is staffed by qualified professionals, bureaucratic incentives do not always encourage the best management of natural resources on national forests (O'Toole 2002). This is exemplified in fire policy decisions that increase the Forest Service's budget, but result in fuel-choked forests of weakened trees.

To put it mildly, there is room for improvement in federal fire policy. Most fires are suppressed, at a huge cost to taxpayers, and often to the detriment of forest resources and amenities. A more balanced approach will provide incentives for responsible forest stewardship, with a greater emphasis on allowing some fires to burn in remote areas, and fuels reduction in the wildland-urban interface.

1. Restructuring Budgets to Get the Incentives Right

With unlimited funds for emergency fire suppression, federal agencies have little motivation to allow burns. If Congress appropriately reformulated firefighting funding, managers would have better incentives to adjust suppression strategies, as they did initially in the late 1970s. This would not only reduce suppression costs, but also restore fire to the landscape and reduce fuels accumulations.

The first step would be to curtail repayments of emergency fire suppression spending. With suppression appropriations on the rise—by as much as 23 percent between 2007 and 2008 (USDA Forest Service 2007b)—it is possible that supplemental emergency funding could be eliminated. Ample suppression appropriations should also negate the necessity to borrow

firefighting funds from other Forest Service programs, encouraging more efficient management throughout the agency.

Another option could be to fund fire suppression out of each individual forest's budget. During a Forest Service investigation of expensive fires, managers "said they would have fought fires differently, and at a lower cost, if the money had come from the forest's allocated budget," instead of from federal emergency fire suppression funds (Truesdale 1995, 10). This approach would curb suppression costs, better encourage fire management tailored to local conditions, and provide an incentive to allow some fires to burn unsuppressed.

O'Toole suggests that each national forest, park, or Bureau of Land Management district should be funded out of its own receipts (O'Toole 2006, 220). Timber revenues could be supplemented with fees for recreation, grazing, mining, and other forest uses (O'Toole 1995).

Limiting emergency suppression funds might be the best way to ensure that fire will be restored to forests and that firefighting expenses do not spiral out of control. But in the face of large fires that will inevitably occur, Congress is unlikely to retain a policy that curbs emergency suppression funding. It may be more realistic to first fund fire suppression expenses from local budgets on a trial basis in some areas. Based on the relative success of this step, policy reform could begin to work towards eliminating unconstrained reimbursements of emergency firefighting expenses.

2. Wildland Fire Use

"Wildland fire use" refers to the management strategy of allowing fires to burn without suppression action under accepted weather conditions. These blazes burn either until they are extinguished by weather, or until they threaten property, valued resources, or human life, at

which time they are actively suppressed. Under the appropriate conditions, wildland fire use restores fire to forest ecosystems and is much less costly than suppression. By some estimates, per-acre costs for monitoring these burns are more than 90 percent less than fire suppression costs (Dale et al 2005).

Wildland fire use is most suitable in remote areas that have not strayed from their historical fire regime. According to Forest Service estimates, 31 percent of federal forests are within the historical range of variation (FMI 2001). These are fire-adapted forests that burned during the last century despite suppression policies and forests that are habituated to infrequent fire—occurring every hundred years or more—that have not been significantly affected by several decades of fire exclusion. In other areas, like the wildland-urban interface and forests adapted to frequent fires that have not burned recently, wildland fire use may be too risky without some initial fuels reduction treatments.

Despite the value of wildland fire use, there are several barriers restricting its application. In addition to the financial incentives favoring fire suppression, federal policies create obstacles to wildland fire use. To begin with, despite repeated mandates for planning, the Forest Service has only completed a fraction of its fire management plans, without which all fires are automatically suppressed (Dale 2006; O’Toole 2002, 35).

Once fire management plans are in place, in order to forgo suppression, managers must prepare short-term and long-term risk assessments, a complexity analysis, a needs assessment, and fire behavior predictions—none of which is required for fire suppression (O’Toole 2006). A decision for wildland fire use also requires a qualified Fire Behavior Analyst on site. With recent cutbacks in Forest Service personnel, analysts are often not available (Dale 2006).

Erring on the side of short-run safety, fire management plans that do exist usually only allow fires to burn in remote areas, often designated wilderness areas. Also, only lightning-ignited fires are eligible, all human-ignited fires are suppressed. O’Toole calculates that at most, only about 2.2 percent of fires are eligible any given year, since just less than 18 percent of national forests are in wilderness areas and about 12 percent of fires are sparked by lightning (O’Toole 2006, 220).

These barriers, combined with abundant funding for emergency firefighting, favor suppression of most fires. In order to restore fire to forest ecosystems, managers should be encouraged to weigh both the long- and short-term costs and benefits of all alternatives—suppression, wildland fire use, and fuels reduction. If managers do not face disincentives when deciding to allow fires to burn, they are more likely to make appropriate decisions about wildland fire use.

3. Fuels Reduction

Fuels reduction, either by prescribed burning or mechanical removal of fuels, can address the fire problem before the sparks fly.⁶ There are limitations to fuels reduction treatments, however, so they should be focused where they will have the greatest effect—in low severity fire regimes and the wildland-urban interface.

One reason that fuels reduction treatments should be limited is that they may not address the important effects of climate and weather on fire behavior. Some studies suggest that it is drought and warmer temperatures—not fuels accumulations—that are the major explanatory

⁶ Prescribed burning can only occur when weather conditions are amenable to a controllable fire, generally in the spring or fall, with low temperatures and low winds. Mechanical removal encompasses a range of treatments from hand-piling to timber harvesting—all of which entail some sort of physical elimination of fuels. Mechanical treatments are often paired with burning; for example, slash burning following thinning. This pairing increases the effectiveness of treatments for fuels reduction purposes.

factors for large fires (O'Toole 2002-2003, Pierce et al. 2004). It is an unrealistic goal to return all forests to historical states, in light of the fact that agencies have no control over drought or temperature.

In addition, like fire suppression, fuels reduction is not appropriate on all forests. Forests habituated to infrequent but intense fires rely on an accumulation of fuels to carry flames. Fuels reduction would force these forests away from their historical states.

Currently, the Forest Service and Bureau of Land Management treat about 2.5 million acres for fuels reduction annually. Some estimate that at this rate, it will take more than 70 years to address all acres in need of treatment (Power 2006, 211). Before the task could be completed, the first areas treated would again be at risk. Estimated costs vary, but even conservative approximations run into the hundreds of billions of dollars (Power 2006, 213). It seems that federal agencies may be embarking on an endless, excessively costly mission in their fuels reduction programs. While this assures continuing employment for the bureaucracy, it is not an efficient solution to the fuels problem in all areas.

Instead, fuels reduction treatments should be limited to some areas—such as ponderosa and longleaf pine forests—that are adapted to frequent, low-intensity fires. These forests are likely the easiest to treat for fuels reduction, and therefore least costly. Once they are brought within their historical range of variation, periodic, low-intensity prescribed fires—or wildland fire use—could maintain this state at a relatively low cost.

Alternatively, and in other fire regimes, fuels reduction treatments should be focused in the wildland-urban interface, where they will be the most effective in protecting communities. In these areas, it is too risky to let wildfires burn without suppression, so the only way to return fire to ecosystems is through prescribed burning under safe conditions. Both prescribed burning and

mechanical treatments can also help to reduce fuels accumulations in the wildland-urban interface.

Additionally, homeowners can make a significant reduction in risk of home ignition through actions on their own property (Cohen 2000). Researchers recommend using less flammable building and landscaping materials, cleaning gutters, clearing brush, and maintaining a green lawn within a radius of 30-120 feet from buildings. Thinning of adjacent forest lands outside of the 120 feet radius may have little effect on home ignitions (Power 2006, 210).

Limiting fuels reduction treatments to the immediate area around homes would significantly reduce the task load. The Forest Service estimates that only about 1.9 million acres in the wildland-urban interface are at risk of fire. The majority of this area is private land (O'Toole 2002-2003, 19). At current rates and funding levels, and with landowner cooperation, the Forest Service could treat the entire 1.9 acres within a single year. Even if federal dollars went towards reducing fuel hazards on private lands, it would be a considerable savings in suppression costs later.

Insurance companies are beginning to implement programs that require homeowners to take steps to “fireproof” their homes, such as trimming branches, moving firewood piles away from structures, and cleaning gutters and lawns of pine needles and other flammable debris. For example, State Farm Insurance Company offers lower premiums to homeowners in Arizona, Nevada, New Mexico, Utah, Colorado, and Wyoming, who have taken steps to prevent home ignition (Power 2006).

Local jurisdictions are also adopting regulations that require homeowners to protect themselves from wildfires. Regulations exist at the state, county, or city level in California, Oregon, Colorado, Florida, Idaho, Montana, New Mexico, Utah, and Washington. Some local

fire departments and zoning boards have enacted fire standards for new developments in high-risk areas. Codes may prevent development on steep slopes, or require fire-resistant building materials and wider streets to facilitate access for emergency vehicles (Power 2006). A recent study suggests that without additional zoning for wildland-urban interface areas, suppression costs can be expected to increase by as much as four times (Gude et al 2008).

Fires will occur regardless of fuels reduction efforts. In some areas, forests will burn catastrophically, and this is largely beyond the control of federal agencies. Many forest ecosystems depend on intense, stand-replacing fires. Efforts to prevent these are not only futile, but counter-productive. Drought and temperature play a significant role in fire behavior, and are beyond the control of federal agencies. Fuels treatments should be concentrated in only certain areas, particularly in the wildland-urban interface and low-intensity fire regimes.

Conclusion

As a part of public land management, fire suppression by a federal agency is subject to the pitfalls of public goods provision. Fire suppression on federal forests has been over-provided, increasing long-term risks to timber resources and rural communities, and degrading forest ecosystems and other Forest Service programs. Continued federal ownership of national forests will be associated with ongoing federal management, but there is room for improvement.

In order to achieve management goals, financial incentives need to be restructured to better encourage responsible stewardship. As long as there is a blank check for emergency fire suppression, wildland fire use will be limited, and most fires will be suppressed at great cost to taxpayers. It will take a shift for Congress to put a cap on reimbursement of emergency fire spending. The public is sensitive to reports of devastation by fire, and Congress responds by

throwing money at the flames. If funding for emergency firefighting is withdrawn, the public will question the lack of support and the policy that allows forests to burn, putting lives and structures at risk. Nevertheless, limiting emergency suppression funding will be the most effective factor in instigating significant change in fire management.

Other efforts should be focused on fuels reduction and restoring fire-adapted ecosystems, as appropriate for local conditions. Fire's role is not the same across all landscapes or to all species. A successful fire policy should incorporate a greater degree of local control, and encourage managers to consider long- and short- term costs and benefits. Such a policy would rely on funding suppression from local budgets, removing barriers to wildland fire use, and emphasizing fuels reduction and homeowner responsibility in the wildland-urban interface.

As a public good, fire suppression on public lands is not guaranteed to be provided at optimal levels. It may not be possible to reach an ideal solution under current institutional arrangements. But a comparative approach to the problem (Demsetz 1969) could at least produce a fire policy that will not increase risks to forest resources and rural communities. It is unreasonable to spend billions of dollars on a counter-productive program of fire suppression. With a few changes, federal policy can be adjusted to curb wasteful spending and to encourage the return of fire to forest ecosystems.

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