Federal Forest Fire Policy in the United States

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Introduction

EVEN WITH LARGE EXPENDITURES AND SUBSTANTIAL INFRASTRUCTURE dedicated to fire suppression in the United States, the annual area burned by wildfire has increased in the last decade (USDA/USDI 2000; WGA 2000; NWCG 2001) (Figure 1). Given the current and future challenges posed by wildland fire, a review and reexamination of existing policy is warranted. This paper reviews the reasons why the area burned by wildfire is increasing, and discusses strategies for responding to an increasingly dangerous and difficult problem, with implications for communities, federal land management agencies, firefighters, and society itself.

The objective of this paper is to present specific ideas to reform and to improve U.S. forest fire policy and management. To be achieved, substantive reform requires better development, dissemination, and utilization of scientifically based information to assist in the efficient formulation and implementation of policy (Franklin and Agee 2003). The ensuing discussion will develop a conceptual agenda for this policy. Finally, the paper will consider how to enable these changes, recognizing that the mixed public and governmental context, as well as the setting of the land-management agencies themselves with their own histories and traditions, may naturally resist policy changes.

Historical context

Federal forest fire management in the United States began in 1886 when the U.S. Army began to patrol the newly created national parks (Agee 1974). Early responsibilities included patrols for fire suppression, unauthorized livestock grazing, and timber harvesting. In 1891, the Congress authorized President Harrison to establish forest reserves, later to be known as national forests (Pinchot 1907; Pyne 1982; Ruth 2000). Gifford Pinchot became the first chief of the agency that would manage

Figure 1. Even with large expenditures and infrastructure dedicated to fire suppression, the annual area burned by wildfire has increased over the last decade. The goals of fire management should be reduction of uncharacteristically severe wildfires. USFS photo.

the reserves, and under his direction, a national forest fire policy was initiated. The suppression of forest fires dominated early forest policy.

Henry Graves, the second chief of the U.S. Forest Service (USFS) initially demonstrated some openness to the cautious use of fire (Carle 2002). This idea was supported by USFS managers in California and plans were created to produce a permit system to allow private landowners to use controlled fire. However, the idea of using fire in forest management was strongly debated within the USFS. Chief Graves assigned forest examiner Stuart Show to study the issue (Carle 2002), and he reported that the agency should adopt a strong fire suppression policy (Figure 2).

Chief Graves eventually supported a strong fire suppression program, declaring "the first measure necessary for the successful practice of forestry is protection from fire" (Graves 1910; Pyne 1982). The earliest federal fire control policy was written shortly after Graves was appointed (DuBois 1914). William Greeley, the third USFS chief, took over the agency in 1920 and continued the strong endorsement of fire suppression, stating "the conviction burned into me is that fire prevention is the number 1 job of American foresters" (Greeley 1951). During Greeley's nine-year tenure fire suppression was paramount in federal and private forest management.

A scientific study was initiated in California on the merits of fire suppression versus light underburning, and its conclusions continued to support a strong fire suppression policy (Show and Kotok 1924). The concept of light underburning was modeled after earlier Native American uses of fire in northern California (Clar 1959). Passage of the federal Clarke-McNary Act in 1924 tied federal appropriations to the state first adopting fire

Figure 2. Suppression dominated fire policy from the early 1900s until the late 1960s and early 1970s when both the National Park Service and U.S. Forest Service revised their policy. Fire scientists and managers realized that total suppression was producing forests with high fire hazard, and such forests were being burned by high-severity wildfire. Photo by Kari Greer/NIFC.

suppression, and this law effectively created a national fire suppression policy.

The policy of fire suppression was debated in the southeast United States (Schiff 1962; Pyne 1982; Biswell 1989; Carle 2002) because the use of fire was culturally accepted in this area (Shea 1940; Komarek 1962; Schiff 1962). Further, several large wildfires in this region reinforced the need to consider policies that utilized prescribed burning to reduce fuel hazards. Eventually, a change in fire policy allowed the first use of prescribed fire on federal lands, with burning taking place in Florida's Osceola National Forest in 1943 (Bickford and Newcomb 1946).

Research initiated in the Southeast (Chapman 1926) and the western U.S. (Weaver 1943; Cooper 1960; Biswell 1961) began to identify landscape conditions that could be attributed to fire suppression. For the first time, significant changes in the structure, composition, and fuel loads were documented in forests that primarily experienced frequent, low-to-moderate-intensity fire regimes. The implications of these investigations were profound but not utilized by contemporary policy. The very policy of fire suppression that had been adopted decades earlier was actually producing forests with high fire hazards, and these forests were being burned by high-severity wildfire.

Figure 3. The first use of prescribed fires on federal lands in the west occurred at Sequoia-Kings Canyon National Parks in 1968 and Yosemite in 1970. Here, an NPS forestry foreman uses a drip torch to ignite forest litter under a canopy of giant sequoias and white fir to consume litter and kill understory white fir. NPS photo by Bruce M. Kilgore.

In 1962, partially in response to the results of the increasing number of scientific studies in fire ecology, the U.S. secretary of the interior requested a study on the status of federal wildlife management. The Leopold Report identified fire suppression as a policy that was adversely affecting wildlife habitats (Leopold et al. 1963). Contemporaneously, the first use of prescribed fires on federal lands in the West occurred in California in 1968 at Sequoia-Kings Canyon National Parks (USDI 1968), followed two years later by Yosemite National Park (Kilgore 1974; Parsons et al. 1986; van Wagtendonk 1991) (Figure 3). The National Park Service (NPS) continued to suppress unwanted wildfires, but fire was also used to meet resource objectives.

In 1968, the first prescribed natural fire program in Sequoia-Kings Canyon National Parks was created (USDI 1968; Kilgore 1974;

Parsons et al. 1986). This occurred because of earlier research on the effects of prescribed fire in mixed conifer forests (Biswell 1961; Hartesveldt and Harvey 1967; Kilgore and Briggs 1972) and because of the recent change in NPS fire policy. Creation of the National Wilderness System in 1964 also advanced the philosophy of wildland fire use in remote forested areas (Pyne 1982). Some USFS wilderness areas such as the Selway-Bitterroot (Idaho and Montana) and Gila (New Mexico) began a program of prescribed natural fire in the late 1960s, but similar management philosophies were rare on other national forest lands.

Shortly after the NPS revised its fire policy, the USFS did so as well. Henry DeBruin, director of fire and aviation management for the USFS, stated "we are determined to save the best of the past as we change a basic concept from fire is bad to fire is good and bad" (DeBruin 1974). While this statement represented a major shift in the philosophy of the USFS, fire suppression was still to dominate agency policy for the coming decades (Franklin and Agee 2003). The use of fire in the management of forests would remain very rare in the USFS.

Between 1960 and 2003, wildfires on Bureau of Land Management, Bureau of Indian Affairs, NPS, U.S. Fish and Wildlife Service, USFS, and all state lands averaged 1,642,000 ha annually (data from NIFC 2004). Between 1994 and 2003, the average area burned increased to 1,925,000 ha/yr; between 1999 and 2003, the average was 2,271,000 ha/yr. The amount of land burned by wildfire in the last five years is 38% larger than the average in the period 1960–2003. Federal fire suppression costs in 2000 and 2002 were $1.3 and $1.6 billion, respectively (NIFC 2004). Similar expenditures occurred in 2003, but an estimate of the final cost is not yet available.

The emerging trajectory is troubling: despite large expenditures and infrastructure (aircraft, firefighters, command centers, logistical support, etc.) dedicated to fire suppression, the annual area burned by wildfire has increased over the last decade (USDA/USDI 2000; WGA 2000; NWCG 2001).

Recent fire policies and initiatives

Federal fire policy has been significantly modified since 1995 to recognize and embrace the role of fire as an essential ecological process (USDA 1995; USDI/USDA 1995; NWCG 2001). The 2001 federal wildland fire management policy (NWCG 2001) stated that "fire, as a critical natural process, will be integrated into land and to resource management plans and activities on a landscape scale, and across agency boundaries."

One of the main objectives of the 1995 fire policy revision was to reduce fire hazards annually on 1,200,000 ha of forests using mechanical and prescribed fire treatments (USDA 1995). Progress toward this goal has been slower than anticipated (GAO 2003), due to constraints on smoke production; difficulties in plan preparation; regulatory review; potential impacts on sensitive, threatened, and endangered species; and budgetary procedures that have delayed fuels management projects. Progress has also been impaired because of the significant risks inherent in the activity, such as the individual and professional risks facing managers for the consequences of prescribed fires that escape despite proper planning and execution (Benner and Wade 1992). Another significant problem with the current system is there are few incentives or rewards for individuals that successfully produce proactive programs that use prescribed fire and mechanical methods to reduce potential fire behavior and effects.

The National Fire Plan (NFP), established in *A Report to the President in Response to the Wildfires of 2000* (USDA/USDI 2000), is now being implemented using the *Collaborative Approach for Reducing Wildfire Risks to Communities and the Environment: Ten-Year Comprehensive Strategy* (TYCS; WGA 2001). Both the NFP and the TYCS recognize that if hazardous fuels are not reduced, "the number of severe wildland fires and the costs associated with suppressing them will continue to increase." (Figure 4). Implementation of the NFP is designed to be a long-term, multibillion-dollar effort (GAO 2003). The TYCS was developed without direct federal input and recognizes that key decisions in setting priorities for restoration and fuels management should be made collaboratively at local levels. As such, the TYCS requires an on-going process whereby the local, tribal, state, and federal land management, scientific, and regulatory agencies exchange the required technical information to facilitate the decision making process. In fiscal year 2001, the first year the NFP was in effect, Congress increased funding for reduction of hazardous fuels to $401 million ($108 million was allocated in 2000) (GAO 2003). Congress continued this increased funding in 2002 and 2003.

The Healthy Forests Initiative (HFI), introduced by President Bush in August 2002, sought to address perceived difficulties in implementing fuels management projects by streamlining and shortening administrative and public review and by limiting appeals processes. The specific objectives of the HFI were to (1) facilitate timely reviews of forest health restoration and rehabilitation projects, (2) amend rules for project appeals to hasten the process of reviewing forest health projects, and (3) require prompt judicial responses to legal challenges by setting time limits for review. The new procedures were designed to allow the departments of interior and agriculture to give priority to forest thinning projects so that they could proceed within one year.

Figure 4. Current fire plans recognize that if hazardous fuels are not reduced, "the number of severe wildland fires and the costs associated with suppressing them will continue to increase." Photo by Kari Greer/NIFC.

Many of the ideas presented in the HFI were enacted as the Healthy Forests Restoration Act (HFRA 2003), including expediting environmental analysis, expediting administrative review before decisions are issued, encouraging courts to expedite judicial review of legal challenges, and directing courts that consider a request for an injunction on an HFRA-authorized project to balance the short- and long-term environmental effects of undertaking the project against the effects of taking no action. New ideas contained in the HFRA that were not in the HFI include requirements governing the maintenance and restoration of old-growth forest stands, requiring that HFRA projects maximize retention of larger trees in areas other than old-growth stands, requiring at least 50 % of the dollars allocated to HFRA projects to be used to protect communities at risk of wildland fire, and to encourage project performance to be monitored and evaluated.

The multiple legislative and administrative efforts all provide support for "fuels reduction" in response to a "wildfire problem" that is both perceived and real. Irrespective of these initiatives, there is no comprehensive policy to deal with fire and fuels, and there are few indications that such a policy is in development (Franklin and Agee 2003). While the effects of forest fires are commonly discussed and debated by the public, politicians, scientists, and land managers, a number of scientific questions about fires and their effects remain. Accordingly, scientific information pertinent to specific regional issues and situations is somewhat limited. Further, there are few policy analyses available to provide credible information on the range of possible strategies, or to provide estimates and comparative evaluations of safety, effectiveness, and environmental impacts (Figure 5).

The lack of information and analysis cripples efforts to respond appropriately to accumulated fuels and high fire hazards. Equally, a lack of systematic consideration of the relative effectiveness of the current disparate national, regional, and local strategies toward wildfire has obscured the information that we now possess. The effect has been to impede progress on two fronts: by impeding thoughtful re-emphasis of policies that are or are likely to be effective, and by preventing more comprehensive reforms that will enable federal agencies to better respond to the threats posed by wildfire. In the next section we give specific recommen-

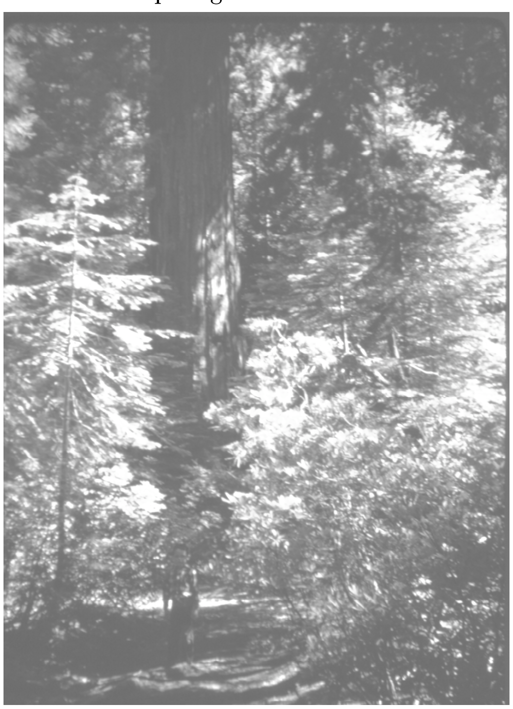

Figure 5. Various initiatives provide support for simple "fuels reduction" in response to a "wildfire problem." Yet there is no comprehensive policy to deal with fire and fuels and few indications that such a policy is in development. The complexity of problems involved are exemplified by mixed-severity fire regimes that range from low- to high-severity fire effects. These can be found in dry Douglas-fir, grand fir, juniper, and even certain giant sequoia–mixed conifer forests (see left). NPS photo by Bruce M. Kilgore.

dations on how federal forest fire policy can be improved.

Policy analysis and recommendations

Fuel types and treatment effectiveness. The primary objective of fuels management projects should be a reduction of potential fire behavior and effects, not simply the reduction of forest fuels. Recent federal fire policies and initiatives all seek to reduce fire hazard by reducing fuels. This strategy possesses an intuitive appeal, but application of the strategy may not significantly alter fire hazards. Fire behavior is not simply a function of fuels, but also of weather and topography. Fuels are the main fire behavior component that can be directly affected by management, but the type of management action and its effectiveness with respect to a particular type of fuel are critical in predicting whether the action will reduce potential fire behavior and effects. Local climate conditions can also be influenced by treatments, resulting in trade-offs between reducing canopy cover that increases air temperatures and wind speeds (van Wagtendonk 1996).

A brief introduction to the variety of wildland fuels and their characteristics is necessary to understand exactly why this knowledge and specificity is an important ingredient in achieving the overall objective. Wildland fuels are composed of four groups: ground, surface, ladder, and crown. Each of these has a different potential to influence fire behavior. Ground fuels include the duff and litter on the soil surface and generally do not contribute to wildfire spread or intensity. Surface fuels include all dead and down woody materials, grasses, other herbaceous plant materials, and short shrubs, which are often the most hazardous fuels in many forests. This is particularly likely in forests where vegetative species composition, density, and structure have been influenced by decades of fire suppression (Stephens 1998; Agee 2003). Ladder fuels are trees or tall shrubs that provide vertical continuity from surface fuels to the crowns of tall trees. Crown fuels are those in the overstory.

Reducing surface fuels will limit the intensity of fires and allow more of the forest to survive when it does burn. Thinning treatments can be directed to effectively reduce ladder and crown fuels. However, where logging residues (activity fuels) are left on site, potential fire behavior and effects may be either similar to or more extreme than an untreated forest (Stephens 1998). Finally, in forests that experienced frequent, low-intensity to moderate-intensity fire regimes prior to a long period of fire suppression, fuels treatments should focus on surface, ladder, and then crown fuels (Stephens 1998; Agee 2003). The difference between fuel types, the subtlety of their interactions, and differences in their behavior in different types of fire regimes are all important in developing fuels management strategies to appropriately reduce potential fire behavior and effects.

The USFS has used the "condition class system" to identify and prioritize areas in need of fuels treatments (Schmidt et al. 2002). This national system attempts to identify the number of fire return intervals that have been missed due to fire suppression. The assumption is forests that have missed more intervals will have higher hazards, but there are exceptions. Many ponderosa pine (*Pinus ponderosa* Laws.) and Jeffrey pine (*Pinus jeffreyi* Grev. and Balf) forests have missed 10–15 fire intervals but the effects of 100 years of fire suppression on the amounts and arrangement of fuels and potential for uncharacteristically severe fire may be greater in a mixed conifer forest, which have missed only three to four fire intervals (Franklin and Agee 2003; Stephens 2004). This occurs because mixed conifer forests are generally more productive, resulting in more rapid fuel accumulations. An index based on departures from historic fire return intervals is therefore not the best basis for setting fuel treatment priorities (Franklin and Agee 2003). The condition class system is also a coarse classification system that was never intended for use at the local level, which requires evaluation at much finer spatial scales. Federal scientists have recognized this problem and in 2003 began the "landfire project" whose objective is to produce fine-resolution condition class data for the entire country in approximately three years.

Current fire policies attempt to generate high levels of "acres treated" with minimal evaluation of treatment effectiveness. Most fuel treatments on USFS lands do not even measure fuels before and after treatment, something that would be a fundamental aspect of any evaluation program. Current federal fire policies include NFPORS (the National Fire Plan Operations Reporting System) that allows the federal agencies to record expenditures and treatment locations, but it cannot be used to determine if treatments accomplished their objectives (GAO 2002). A strong commitment to adaptive management and all-party monitoring is needed (Figure 6) to overcome this problem (see below).

Fire and landscapes. Fire itself can help to reduce the total amount of area burned by wildfire. Many fires ignited by lightning in remote areas can produce positive effects, provided that they are carefully managed and monitored. These fires could also serve to reduce fire hazards and assist in the reintroduction of fire as an ecosystem process, particularly in western forests that have experienced large wildfires in the last decade (NWCG 2001). Improved utilization of the existing wildland fire use policy provides for careful and gradual reintroduction of fire into landscapes (NWCG 2001). There is risk in such a program, of course. But unless fuels management techniques are employed in appropriate forest types (those that once experienced frequent, low-to-moderate-intensity fire regimes) at necessary spatial scales and arrangements (Finney 2001), many of these forests will continue to be subject to uncharacteristically severe fires. The USFS wildland fire use policy is underutilized: less than 5% of national forests have approved fire plans (Ingalsbee 2001). Creation of fire plans should be a priority for all forests with hazardous fuel conditions. The wildland fire use policy already provides a mechanism of addressing an important component of accumulated wildland fuels. Broader implementation would offer an unprecedented opportunity to gather valuable ecological and organizational information about the results of the experience across an array of regions and landscapes.

To be effective, landscape fuel reduction strategies should be better linked to past fire causes. Lightning strikes are stochastic, making it difficult for fire managers to forecast areas of higher ignition potential. Strategically placed area treatments (SPLATs) may be an effective strategy to reduce landscape fire behavior in large, heterogeneous areas (Finney 2001). SPLATs are a system of overlapping area fuel treatments designed to minimize the area burned by high-intensity head fires in diverse terrain. The performance of SPLATs has not been field tested, but computer simulations have produced promising results.

Human-caused fires commonly occur near transportation corridors (highways, roads, trails), campgrounds, and urban areas, making it possible for fire managers to forecast areas of higher ignition potential. Defensible

Figure 6. Current policies try to generate many "acres treated" with minimal evaluation of treatment effectiveness. A strong commitment to adaptive management and all-party monitoring is needed to determine if treatments accomplish their objective. NPS photo.

fuel profile zones (DFPZs) placed near areas of high human-caused ignitions can be used to decrease the probability of large, high-severity fires by improving suppression efficiency (Kalabokidis and Omi 1998; Agee et al. 2000). DFPZs are linear landscape elements approximately 0.5–1.0 km wide, typically constructed along roads to break up fuel continuity and provide a defensible zone for fire-suppression forces. Installation and maintenance of these structures (SPLATs and DFPZs) at appropriate spatial scales should reduce forest fire area and severity. DFPZs will be effective in reducing losses in the urban–wildland intermix only if they are used in combination with combustion-resistant homes that have defensible space from wildland and domestic vegetation. Continued growth of human populations in the urban–wildland interface is one of the most challenging issues facing fire managers because it places additional assets at risk and reduces management options.

Fire as an ecosystem process. To be effective across diverse forest types and conditions in the United States, fire policy should better recognize and respond to the diversity of fire regimes in the nation's forests. Some management activities can reduce the severity of wildfires in some forests (Martin et al. 1989; Weatherspoon and Skinner 1996; van Wagtendonk 1996; Stephens 1998; Moore et al. 1999; Fulé et al. 2001; Pollet and Omi 2002), but some forest types such as Rocky Mountain lodgepole pine (*Pinus contorta* var. *latifolia* Dougl.) are adapted to and require periodic high-severity, stand-replacement fires (Romme and Knight 1981; Veblen et al. 1994; Turner and Romme 1994; Christensen et al. 1998).

Assessment of how fire is affecting forests would be enhanced if information were provided by land management agencies about the specific type of fire and whether the particular ecosystem is adapted to it. Agencies should report the actual amount of area burned by low-, mixed-, and high-severity fire and which proportion of these categories is outside the desired conditions or trends for each forest type. Natural variations, or reference conditions derived from historical ecology, can be used to assist in the definition of desired severity categories (Swetnam et al. 1999; Stephens et. al 2003; Stephens and Gill 2005). Currently, the only wildfire data recorded on USFS lands are total area burned, dominant vegetation types within the perimeter, and fire location. Ground-based severity measurements are recorded for some fires, but these measurements cover only a small portion of the burned area. Remote sensing can assist in the evaluation of fire severity at large spatial scales. This type of analysis should be routinely done on all forest fires.

Despite the complexity inherent in local fire regimes, regional fire activity often oscillates in phase with year-to-year climate variability (Clark 1988; Swetnam 1993). For example, the area burned annually across the southern United States tends to decrease in El Niño years and increase during La Niña years (Swetnam and Betancourt 1990). In northern California, the impact of climatic change on wildland fire and suppression effectiveness is predicted to change in the inland regions of the state (Fried et al. 2004). Despite enhancement of fire suppression efforts, the number of escaped fires (those exceeding initial containment limits) is forecast to increase by 51% in the south San Francisco Bay area and by 125% in the Sierra Nevada (Fried et al. 2004). In addition to the increased suppression costs and economic damages, changes in fire severity of this magnitude would have widespread impacts on vegetation distribution, forest condition, and carbon storage, and greatly increase the risk to property, natural resources, and human life. Changing climates may necessitate creation of fire policies that are easily adaptable because of large uncertainties.

Administrative and management constraints. Many species-specific conservation strategies developed in recent years, especially those developed to comply with the Endangered Species Act of 1973 (U.S.C. 16, sections 1531–1544), or species viability requirements of public land management statues such as the National Forest Management Act of 1976 (Public Law 94-588; Statutes at Large 90:2949) or the Federal Land Management and Policy Act of 1976 (U.S.C. 43, sections 1700–1784), can be classified as fine-filter approaches. These are conservation strategies designed for individual species without strong consideration given to maintaining natural ecosystem processes (Agee 2003). Coarse-scale strategies, on the other hand, seek to preserve biological diversity of forests, primarily by maintaining a variety of ecosystems and structures across the landscape. In many forests, fire served as a natural coarse filter before suppression.

Many fine-scale strategies, such as those often employed to respond to concerns regarding the viability of threatened and endangered species, produce extensive management constraints such as the systematic exclusion of fire from fire-dependent habitat, or the restriction that prescribed fire cannot be used until a specified amount of precipitation occurs. Such constraints essentially remove prescribed fire as a management option. The fine-scale filter may achieve short-term objectives for individual species, but generally leaves the majority of the habitat at risk to large, catastrophic wildfire (Agee 2003). This strategy is likely to fail in the long term because without effective fuel reduction treatments, most wildland areas will eventually burn under severe wildfire conditions. Fine- and coarse-filter approaches, however, may be employed simultaneously. To be more effective, successful conservation strategies should emphasize the coarse-filter approach, utilizing the fine filter in carefully selected areas only when absolutely necessary (Agee 2003).

Questions have been raised about the ability of federal agencies to efficiently execute fuels management projects (HFRA 2003). A recent analysis determined that there is little evidence that fuels management projects are being significantly delayed once they are released to the public for comment (in 2001 and 2002, final decisions on 95% of the 762 fuels management projects were made in 90 days or fewer; GAO 2003). Reforms may be needed to reduce the time required to produce the necessary environmental impact statements (EISs) and environmental assessments (EAs). EISs and EAs could be improved if they focused on defining the desired range of conditions or trends instead of focusing on spatial and temporal management constraints (fine-filter approach); the latter is much more common today. We should focus on the outcomes of fuels management projects, not on the methods used to reduce hazards. Present high transaction costs are probably reducing the opportunity for successful fuel reduction projects in federal forests.

Many wildland areas in the United States have experienced an increase in area burned over the last decade (USDA/USDI 2000; WGA 2001; NWCG 2001), and active management (Agee 2003) is necessary to reduce this trend. Prescribed fire can be used to reduce fuel hazards in many of these forests. Unfortunately, multiple constraints (air quality, wildlife, weather, and personnel availability) routinely limit periods for burning operations. As a result, many fire managers may have a single week or less when burning is actually permitted. With such limitations, it is simply not possible to use fire to reduce high hazards on millions of hectares of forests. Smoke from forest fires (of appropriate severity and size) is a natural ecosystem component, and regulations should be adapted to allow more burning opportunities while also considering public health. In contrast, wildfires produce extreme amounts of smoke that can inundate large areas for weeks or months, producing a variety of effects and unwanted impacts.

Many species of wildlife have co-evolved with fire (Smith 2000), and any local or regional reintroduction of fire must be carefully monitored to ensure species viability. Additionally, adaptive management programs must be used to learn from management actions (Shindler and Cheek 1999) because there is insufficient information on the ecological effects of fuels treatments. Mechanical treatments may be appropriate for use in combination with prescribed fire (Stephens 1998), a practice that has the potential to reduce fire hazards and emissions in certain cases. Using mechanical methods in fire- hazard-reduction treatments can produce timber resources, but when this occurs, the primary objective must continue to be the reduction in potential fire behavior and effects.

Seventy percent of the funding from the NFP has been directed to fire suppression, resulting in the hiring of approximately 5,500 firefighters and the purchasing of hundreds of vehicles and aircraft. Similar investments in professional fire ecology or fuels management positions have not occurred. Large-scale fuels management programs have been planned in all western states, but implementation of these programs has been challenging. In the Pacific Northwest there are approximately 3.6 million ha of forests in need of fuel treatment. The treatment goal for this area in 2004 is 52,000 ha. At this rate it would take 69 years to treat all of the area once, a period that approximates the effective duration of fire suppression. USFS lands in California include approximately 6.2 million ha of forests that are in need of fuel treatments. The current management plan forecasts treatment of 23% of this area in 20 years. If the goal were to treat the entire area it would require 87 years. The use of SPLATs (strategically placed area treatments) should reduce the total area that needs to be treated before landscape fire behavior and effects are reduced, but the challenges to treat very large areas are formidable. The costs of treatments can be high, especially when many small trees need to be removed and there is no market for such materials. Many plans underestimate the actual costs of implementing effective fuels treatments, especially in forests dominated by small trees.

Social interactions and institutions. Sustainable fire policies must respond to complex social, political, and economic forces. Currently, there are diverse opinions among executive-branch officials, Congress, federal agencies, state and local governments, tribes, environmental groups, and commodity groups as to what should actually be done to reduce fire hazards in federal forests. Diversity and disagreement can be healthy in any debate, and may eventually strengthen any policy. Even with better collaborative efforts that occur earlier in the planning process, and the streamlined administrative review of fuels management projects provided by the HFRA (2003), satisfying legal requirements may still derail the best intentions of federal land managers, the public, and other interests. The requirements of federal law and due process may in some instances permit a single interest to override others, and derail a collaborative effort to institute a regional or local fuels management plan.

Mechanisms for collaborative stewardship should be refined and created to encourage participants to interact on how to proceed in the face of disagreements as to what policies are appropriate and effective (Figure 7). Actions that may assist this interaction include (1) initiating small projects that provide an opportunity for a local dialogue on the outcomes of fuel treatments; (2) locating projects in areas where there is substantial agreement on restoration objectives; (3) reflecting and celebrating accomplishments in order to build relationships, trust, and support; (4) creating an extensive, well-designed adaptive management program to learn from management actions; (5) initiating all-party monitoring to assure credible post-treatment data and analysis (monitoring should be coordinated by a non-federal group to ensure independence); (6) striving to distribute the costs and benefits of restoration equitably; and (7) ensuring that scientific data and other information gained as a result of the adaptive management process are actually used.

This would provide information to land managers and scientists that will help to improve future management actions, and would also provide information to federal, state, and local governments and the public regarding the effectiveness of elements of legislation and policy in achieving the overall objective of reducing losses from wildfire. In establishing and implementing collaborative projects, and utilizing experimentation and adaptive management, successes on the ground will serve as opportunities to gain knowledge and experi-

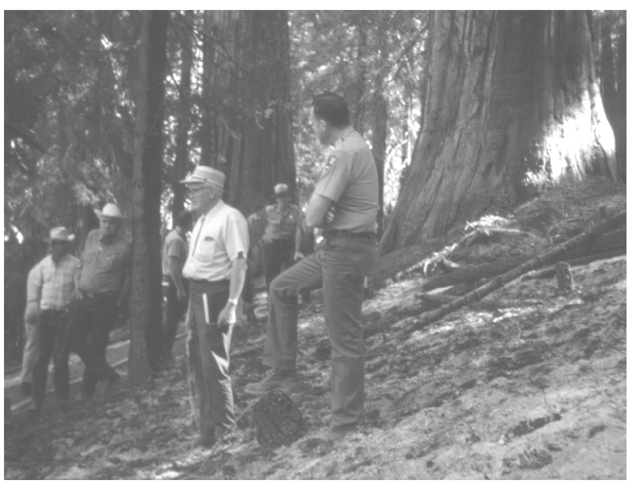

Figure 7. Sustainable fire policies must respond to complex social, political, and economic forces. These include local, state, and federal agencies, as well as environmental and commodity groups. Mechanisms for collaborative stewardship should be created to help participants work toward the common goal of reducing uncharacteristically severe wildfires. NPS photo by Bruce M. Kilgore.

ence, reflect and revise policies and prescriptions, and serve as precedents for eventual broader application at landscape scales.

Although the NFP (USDA/USDI 2000), TYCS (WGA 2001), and HFRA (2003) apply to all federal agencies (USFS, National Park Service, Bureau of Land Management, U.S. Fish and Wildlife Service, Department of Defense), each agency will implement these policies within its own institutional contexts. This will result in different aspects of the policies being emphasized in different areas. Allowing some diversity in implementation is an opportunity to learn which strategy is the most effective. Certainly the federal agencies should work collaboratively to reduce potential fire behavior and effects, particularly at shared property boundaries.

Fire suppression costs and strategies. Large fire-suppression activities in 2002 and 2003 required extraordinary emergency expenditures. Funds available for fire suppression in these years were insufficient due to the fact that the federal budget for these activities was inadequate. Additional emergency funding was secured by the rescission of funds that had been appropriated from unrelated management and research programs (GAO 2004). The federal Office of Management and Budget influenced the reallocation of these resources, forcing the USFS to use funds from non-suppression activities to pay for suppression. Ironically, the rescission removed resources from fuels management programs that were authorized by the NFP and TYCS. In 2003, according to Dale Bosworth, chief of the U.S. Forest Service, approximately 60,000 ha of USFS land were left untreated when funds were transferred to fight wildfires (Berman 2004). Another impact of the rescissions is negative impacts on collaborations with private, state, and federal partners (GAO 2004).

To prevent this pattern from recurring, Congress should provide a larger federal fire suppression budget. The present annual budget is approximately $400 million. Despite this sum, recent experience suggests that it may be insufficient, as suppression costs of more than $1 billion have occurred in three of the last four years prior to 2004. Accordingly, the president and the Congress should consider and develop more realistic budgets and multiyear funding, such as a trust fund or reserve account. Current-year fire suppression budgets could also be calculated by using a moving average of suppression costs for the previous five years. This strategy responds to trends in total area burned and associated costs, and is designed to produce a more realistic estimate of fire suppression costs. If present-year suppression costs are lower than an average of the previous five years, any unused resources could be saved to meet obligations incurred in future high-cost years. This would remove the need for future rescissions, that will help to ensure that critically needed fuel management projects move forward.

Fire suppression strategies, for reasons of effectiveness and efficiency, should recognize that each wildfire is different, and tailor strategies and tactics to the unique demands of each fire. Wildfires can be separated into general categories along a spectrum of size and complexity (Jerry Williams, personal communication). They range from the small initial attack fire to the enormous and complex megafire. During the last decade, approximately 97–99% of all wildland fires have been successfully suppressed during initial attack. The majority of these fires are less than 0.1 ha in size, and collectively, they burn a very small area.

The U.S. fire suppression system is designed to be very effective in initial attack operations because of spatially distributed suppression resources, excellent early firedetection ability, and appropriate tactics and training for these events. Fires that escape initial attack can be classified as "transition" or "extended-attack" fires. Current policy responds to such fires essentially the same as it does to an initial attack event. This strategy can produce dangerous situations because these fires can change behavior quickly due to the fact that they are actively growing and that they often burn under varying weather conditions. Among other things, the majority of firefighter fatalities in the last decade have occurred on these types of fires, which include the Storm King Mountain Fire (Colorado) in 1994 and the Thirtymile Fire (Washington) in 2002. Tactics could be revised to recognize that initial attack tactics are not safe and effective during changing fire conditions.

The largest fires, classified as "megafires" by public agencies, produce extreme fire behavior mainly because of severe fire weather and substantial accumulations of fuels. It is common for fire suppression agencies to a commit large amount of resources to fight these fires even though the probability of success is very low. In many cases fire managers continue to aggressively fight megafires because of public perception and liability concerns (e.g., you have to at least look like you are doing something or people and politicians will protest). Fire policy should be changed to reflect a more refined index of threats, potential harm, and possible effectiveness (Figure 8). This in turn would allow managers to take a defensive posture until conditions change. Suppression operations can be applied to the flanks of such fires but expending tens of millions of dollars during their peak burning periods cannot be justified. Congress will have to debate and approve this change in policy, because the federal land management agencies cannot implement this change without strong congressional support.

Summary of recommendations

Taken together, these recommendations would substantially change the course and conduct of national forest fire policy. The proposed changes are as follows:

- Restate the objectives of fuels management programs to be the reduction of potential fire behavior and effects.

Figure 8. Fire managers may continue to fight megafires because of public perception and liability concerns. National fire policy should be changed to reflect a more refined index of threats and potential harm—thus allowing managers to take a defensive posture until conditions change. © Karen Wattenmaker/kwphoto.com.

- Adopt policies and programs that are straightforward and pragmatic and also reflect awareness of and sensitivity to their environmental and social impacts.
- Improve the budgeting process for both fuels management and fire suppression to ensure funding sufficient to achieve overall and annual program objectives.
- Initiate a vigorous adaptive management program that utilizes a rigorous program of monitoring, experimentation, and research to improve fire and fuels management policies, strategies, and projects. Create a national accounting system to collect accurate information on the location, costs, and effectiveness of fuels treatments.
- Periodically evaluate particular strategies and progress toward the overall objective of reducing potential fire behavior and effects. Have independent scientific panels conduct the reviews, with the results and any recommendations transmitted to the government for consideration by the executive and legislative branches.
- Utilize and publicize the results of adaptive management to educate land managers, other agencies, elected officials, scientists, and the public.

A long-term commitment from the U.S. administration, Congress, governors, land-management agencies, tribes, and the public, is required to begin to reduce hazards and decrease the annual area burned by uncharacteristically severe wildfire. A reduction in megafires will probably only occur when fuels management projects have been installed in appropriate forest types at necessary spatial scales and arrangements. Managers cannot abandon areas of reduced fire hazards once they are created; they will have to be maintained into the future to remain effective.

Conclusion: policy and politics

Managing wildland fire in the United States has evolved considerably from the initial efforts of the USFS and other public agencies. The recent trajectory of wildland fire in the United States, however, reveals that the average annual area burned is increasing. Further, this increase is occurring despite a parallel rise in resources and funds utilized to manage fuels and suppress fire. Analysis of the effectiveness of various wildland fire policies indicates that despite scientific and widespread public concern, recent policy initiatives do not yet satisfactorily or comprehensively address certain significant and essential components of the issue.

Several recent programs, especially the National Fire Plan (USDA/USDI 2001), the Ten-Year Comprehensive Strategy (WGA 2001), and other initiatives, though perceived as essentially acceptable by federal managers, remain controversial. Individual site-specific projects, even at relatively small scales, are often problematic. More importantly, even if implemented as designed, the total effect of existing federal programs, including the Healthy Forest Restoration Act (HFRA 2003), remains a less-than-comprehensive approach to wildland fire. Other forces such as global climate change (Torn and Fried 1992; Karl 1998; Fried et al. 2004) may further complicate fire management. Climate change may lead to differences in plant distributions (Bachelet et al. 2001) and lightning frequency (Price and Rind 1994), which could increase ignitions and the length of fire seasons, further exacerbating wildfire effects.

Policy-making depends on technical and scientific information, but the choices made are inherently political ones. For this reason, even if a particular issue is relatively uncomplicated and the design of a solution may be easily understood, policy formulation is often complicated. Substantive objectives, such as fuel hazard reduction, must compete for legislative and administrative attention and resources with other worthwhile objectives and programs. Similarly, other forces can deflect the consideration of substantive objectives and priorities, even when they are supported by scientific and technical information. Budgetary concerns, for example, may override even the soundest programmatic proposals. The policy process generally responds to conflicting objectives by making choices about priorities and methods as it designs programs. Complicated arguments are often reduced to simple ones, in order to enact a program intended to address essential aspects of a particular issue. These aspects of legislative and policy processes may help those attempting to create new fire policy to further understand the gaps and shortcomings in the present policy environment.

The preceding review of wildland fire policies argues that despite recent legislative enhancements, the present amalgamation of polices remains inadequate and does not provide a comprehensive scientific framework to address the issues and problems of wildland fire. Refocusing federal and public agency efforts will require partial redirection of the missions of land management agencies. For this reason, the U.S. Congress, with the assistance of the National Academy of Sciences, should commission an independent and thorough review of wildland firefighting and fuels management objectives and strategies. The results will inform Congress and the public on the status and effectiveness of wildland fire polices and on continuing and emerging issues. The information is also likely to be useful to agencies who must ensure that their firefighting and fuels treatments strategies are effective and efficient, if for no other reasons than that they must protect public safety and maximize scarce resources. Finally, to the extent that the report confirms existing data that tend to suggest that current policies insufficiently pursue the objective of reducing fire severity, this information would provide additional support for legislative reforms to change the behavior of federal land management agencies.

The nature of the legislative and policy processes suggest that it will be difficult to successfully promote and enact major legislation to substantively reform and redirect existing fire policy. Despite recent intense attention focused on the issue in Congress in the aftermath of the fires of 2003, legislative support for the elements of the proposal will take time. While Congress's recent attention may be unlikely to extend to additional legislative initiatives, enactment of the HFRA clearly did not settle all of the outstanding fuel management issues and concerns. Indeed, budget and funding issues are likely to require on-going congressional attention (D. Bosworth, quoted in Berman [2004]). Further, even if the series of legislative and programmatic changes were enacted, the physical setting, natural variability, and large area of fuels accumulations and fire hazards that are already identified suggest that the successful implementation of such a program will require a substantial shift in agency behavior and priorities.

Many of the essential ingredients of a science-based national program are already being implemented at a variety of scales in disparate locations on federal and private lands, as small-to-medium scale fuels-management programs, research (e.g., the National Study of Fire and Fire Surrogate Treatments for Ecological Restoration), and management programs including on-going prescribed natural-fire areas (van Wagtendonk 1994; Rollins et al. 2001). Community-based efforts from the NFP are reducing fire hazards in the urban–wildland intermix using collaborative agreements. This offers an opportunity to observe the effectiveness of an overall approach aimed at reduction of potential fire severity. Employing these strategies with collaborative planning and adaptive management will point the way for a developing a science-based federal wildland policy. Experimentation and research (e.g., the Joint Fire Sciences Program) should be encouraged as tools to enable safer and more effective methods of addressing the problems caused by uncharacteristically severe forest fires.

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