The Challenge of Restoring Natural Fire to Wilderness

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Abstract—Despite clear legislative and policy direction to preserve natural conditions in wilderness, the maintenance of fire as a natural process has proven to be a significant challenge to federal land managers. As of 1998, only 88 of the 596 designated wilderness areas in the United States, excluding Alaska, had approved fire plans that allow some natural ignitions to burn; and even those areas with active natural fire programs continue to suppress many natural ignitions. As a result, none of the four federal wilderness management agencies have been able to restore fire to a level that even approaches pre-settlement fire regimes. Although prescribed fire has been utilized in some areas as a means to compensate for the lack of natural fire, it has been questioned as an appropriate wilderness management tool and is prohibited for most uses in Forest Service wilderness. The questions must be asked whether it is practical to expect restoration of natural fire regimes in wilderness and if they cannot be restored, what are the options and implications for wilderness resources and values?

The restoration of natural fire to wilderness poses significant challenges for federal wilderness management agencies. Following nearly a century of attempting to exclude fire from wilderness, land managers are now struggling with how best to restore fire as a natural ecological process (Christensen 1995; Czech 1996; Kilgore 1987). Despite abundant evidence of the importance of fire as a natural process, and legislative and policy direction to preserve natural conditions (including the process of fire) in wilderness, fire suppression remains the dominant wilderness fire management strategy (Parsons and Landres 1998). Administrative, political and practical constraints (Botti and Nichols 1995) result in suppression of most natural ignitions. If wilderness is to truly be preserved in its "natural condition," ways must be found to overcome these constraints and to allow natural ignitions to burn significantly larger areas. The most practical alternatives to increased application of natural fire in wilderness include substitution of management-ignited prescribed fire as a surrogate for natural fire, or acceptance of the inevitable divergence of fire-adapted ecosystems from their historic character because of fire suppression. Prescribed fire is considered by some to be inappropriate manipulation of wilderness, yet, continued suppression can be expected, in many cases, to increase levels and homogeneity of hazardous fuels, change successional patterns and increase the threat of wildfire to surrounding areas (Arno and Brown 1991; Christensen 1995).

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This paper briefly reviews understanding of the natural role of fire in wilderness ecosystems and the evolution of wilderness fire management policy and programs. I review the status of efforts to restore fire to wilderness by the four federal wilderness management agencies, including accomplishments to date, and then revisit the significant issues and options that face wilderness fire management as it moves into the 21st Century. Specific attention is given to assessing impediments to the expanded application of fire in wilderness and to the consequences of future wilderness fire management choices.

Wilderness Fire and the Evolution of Wilderness Fire Management

When the first wilderness preserves were designated over a century ago, management emphasized protection of what was thought to be pristine, or natural, ecosystems. Disturbances such as fire and insects were viewed as undesirable, preventing forests from attaining or maintaining their natural climax state. Fire, in particular, was considered a destroyer of wilderness resources and values, including animals, vegetation and scenery (Christensen 1995). The elimination of fire became a primary goal of wilderness and park management. This approach was consistent with the understanding of ecosystems as static entities which characterized ecological thinking of the times (Botkin 1990).

Yet, even during the height of fire suppression, informed individuals warned of the dire consequences of continuing such practices (Chapman 1912; Weaver 1943). It is particularly interesting to note the early recognition of the importance of fire in natural ecosystems by members of the Leopold family, probably the pre-eminent conservation family in American history. Aldo Leopold, in laying out plans in the early 1920s for the Gila Wilderness in New Mexico, recognized the long history and ecological role of fire in the area (Meine 1988). In 1957, at the Fifth Biennial Wilderness Conference, Starker Leopold commented that fire exclusion was the "one striking exception to the trend toward naturalness in park preservation" and that he was "convinced that ground fires some day will be reinstated in the regimen of natural factors permitted to maintain the parks in something resembling a virgin state." This discussion was not well received by National Park Service staff in attendance (Rydell 1998). Two years later, in a discussion at the Sixth Biennial Wilderness Conference, Luna Leopold asked penetrating questions about the need for controlled burning "to maintain the environment" in management of the proposed wilderness lands (Brower 1960). And then, in 1963, Starker Leopold and others (1963) recommended to the Secretary of Interior that the restoration of fire must be an important part of national park management.

Despite such early awareness of the importance of fire as a natural process, when the United States Congress passed the 1964 Wilderness Act, replete with abundant references to the preservation of "natural" conditions and the importance of maintaining "the forces of nature," the only reference to fire was in relation to measures necessary for the "control of fire."

Gradually, we have come to understand that fire, whether ignited by lightning or humans, has long played a critical role in the evolution and functioning of many natural ecosystems (Agee 1993; Kilgore 1987; Pyne 1982). The challenge has come in developing management strategies to restore and maintain fire as a natural part of these ecosystems. The incorporation of relatively recent understanding of the important role of pre-Europeans in using fire throughout the Americas has proven particularly challenging in efforts to define naturalness and develop management goals (Denevan 1992; McCann 1999). But, most importantly, we now realize that when we attempt to eliminate fire from fire-adapted ecosystems, we cause changes in succession and nutrient cycling, as well as buildups in flammable fuels which, in turn, threaten surrounding lands. By creating conditions that are outside the range of historic variability, we threaten our very goal of preserving natural systems.

Based on a growing recognition of the importance of fire in natural ecosystems, the National Park Service (NPS) and Forest Service (FS) began to rethink their wilderness fire policy in the 1960s. In 1968, the NPS revised its management policies to formally recognize fire as a natural process. Later that year, two lightning fires were allowed to burn in the high elevations of Kings Canyon National Park in California (Parsons and van Wagtendonk 1996). Soon, a number of national parks had operational prescribed natural fire programs, under which lightning ignitions were permitted to burn under predetermined conditions (Parsons and Botti 1996; van Wagtendonk 1991). In 1971, the Forest Service (FS) revised its policy of total suppression to permit natural fires in wilderness. The first lightning fires permitted to burn in FS wilderness were in the Selway-Bitterroot Wilderness of Montana in 1972 (Williams 1995). By 1988, 26 national parks and approximately 50 FS wilderness areas had operational prescribed natural fire programs (Parsons and Landres 1998; Williams 1995). In 1988, extensive fires, both lightning- and human-ignited, burned more than 3.7 million acres throughout the western United States. These fires, largely focused around Yellowstone National Park and the northern Rocky Mountains, had a significant and immediate effect on the wilderness fire programs of the federal agencies. There was an immediate suspension of all wilderness fire programs while a national review re-examined federal fire policy. Although it endorsed the major policy objectives, the review recommended significant changes in implementation strategies. Increased operational constraints resulting from the review limited the reestablishment of natural fire programs by limiting conditions under which lightning fires could be permitted to burn (Botti and Nichols 1995). Ten years later, the area of federal wilderness burned by natural ignitions had yet to reach pre-1988 levels (Parsons 1999).

Following a difficult fire season in 1994, another review of federal wildland fire policy and programs (USDI/USDA 1995) resulted in major revisions to wildland fire terminology, as well as a renewed effort to standardize implementation procedures between the agencies. The most significant change influencing wilderness fire was the new emphasis on managing fire for resource benefits based on analysis of appropriate management responses (see Zimmerman and Bunnell in this proceedings for further discussion). As a result, what had been known as prescribed natural fires, became "wildland fires managed for resource benefits."

Despite the increased emphasis on managing wilderness fire for resource benefits (including restoration of natural processes), none of the federal wilderness agencies have a fully successful wilderness fire management program. Even the more progressive FS and NPS programs have not permitted natural fire in many wilderness units, and even where they have, many fires continue to be suppressed (Parsons 1999). Outside of Alaska, where all of the agencies permit some lightning fires to burn in a limited suppression or confine/contain strategy, neither the Bureau of Land Management (BLM) nor the Fish and Wildlife Service (FWS) have yet to implement an operational natural fire program in wilderness. These situations have raised concerns about whether current wilderness fire programs are accomplishing enough to be worth the effort (Parsons and Landres 1998).

Current Status and Accomplishments

Despite recognition of the importance of fire as a natural process in the wilderness policy statements of all four federal wilderness management agencies, and the existence of approved fire management plans that permit lightning ignitions to burn in at least some units managed by all but the FWS, 508 of the 596 designated wilderness areas outside of Alaska were still in total suppression mode as of the 1998 fire season. In fact, as of 1998, only the NPS and the FS had permitted any lightning fires to burn in wilderness. Table 1 summarizes the status and accomplishments of the wilderness natural fire programs (excluding Alaska) of the four wilderness management agencies for 1995-1998. The average of 65,037 acres burned by natural fire in national forest wilderness from 1995-1997 (recent terminology changes and the lack of a centralized database for FS wilderness fire records made it impossible to report 1998 data in this paper) represented approximately 0.2% of all FS wilderness (outside of Alaska). The average of 11,439 acres burned by natural fires in national parks from 1995-1998 was equivalent to about 0.1% of all NPS wilderness; however, only 17 of the NPS areas and 4,858 of the acres reported were for parks designated as wilderness, making the percentage of NPS wilderness actually burned per year even lower.

The acreage burned by natural fire on FS wilderness in recent years exceeds that burned in most years prior to 1988 (Parsons 1999), but most of that acreage can be accounted for by a few exceptionally large fires (in Arizona and New Mexico in 1995 and 1997 and Oregon and Montana in 1996), some of which had to be suppressed when they escaped their prescribed boundaries and threatened nearby communities. Thus, it is not clear if recent accomplishments are truly indicative of a long-term trend of increasing acreage burned by natural fires. Most FS wildernesses, including many with

Table 1–Natural fire programs for the four federal wilderness management agencies, excluding Alaska, 1995-1998.

Agency	Total wilderness acres (x10^6)	No. wilderness areas	No. approved natural fire plans	Ave. acres burned/yr
BLM	5.2	131	6	0
FWS	2.0	50	0	0
FS[a]	29.0	380	65	65,037
NPS	10.3	36	27[b]	11,439[c]

[a]FS data for 1995-1997.
[b]Includes 10 nonwilderness parks.
[c]Only 4,858 acres of this is designated wilderness.

natural fire programs, have permitted few, if any, lightning fires to burn in recent years. Even in the Bob Marshall Wilderness in northwest Montana, with one of the most progressive natural fire programs, the average number of natural ignitions permitted to burn has dropped by over 50 percent, the average size of natural fires has dropped by 75 percent, and only 19 percent of all eligible lightning fire starts have been permitted to burn since 1988 (Eckert, personal communication). Some lightning fires have been permitted to burn on FS lands under a confine/contain strategy; however, the fact that such fires are classified as suppressed wildfires makes it impossible to incorporate them into an analysis of natural fire accomplishments (Parsons 1999).

Beginning in 1998 with implementation of a new Federal Wildland Fire Policy (Zimmerman and Bunnell, this proceedings), several significant changes influenced the Forest Service's wildland fire management program. These include the ability to allow natural ignitions to be managed for resource benefits, as well as a change in FS policy to allow use of suppression funds to manage wildland fire for resource benefits (only the Department of Interior had previously allowed such use). As a result, in 1998, significant more lightning fires on FS land in the northern Rocky Mountains were permitted to burn (managed for resource benefits) following analysis of the appropriate management response, as called for in the new Federal Wildland Fire Policy. This has caused Zimmerman and Bunnell to express considerable optimism regarding the future of the FS wilderness fire program under the new policy.

As of 1998, 27 national parks had approved fire management plans that permitted natural fires to burn. This included 17 of the 36 parks outside of Alaska with designated wilderness, as well as 10 nonwilderness parks (although parks like Glacier, Grand Canyon, and Voyageurs have never been congressionally designated as wilderness, they are managed as if they were). Acreage burned by natural fire in national parks in recent years has yet to approach pre-1988 levels (figure 1). Perhaps more significantly, a comparison of the NPS natural fire program for five-year periods before (1983-1987) and after (1994-1998) the 1988 Yellowstone fires shows a marked decrease in the mean number of natural fires per year, the number of parks with natural fires allowed to burn per year, the mean annual acres burned per year and the mean fire size (table 2). Specifically, the mean number of acres burned per year by natural fire has dropped from over 32,000 prior to 1988 to less than 11,000 in the most recent five-year period. Mean fire size has decreased from 209 acres to 137 acres. Since even the pre-1988 accomplishments were considered well below that required to approximate presettlement fire frequencies, these decreases are of considerable concern to the National Park Service. The lack of progress in expanding the NPS natural fire program has been largely attributed to the increased planning and management constraints following the 1988 Yellowstone fires and subsequent policy review (Botti and Nichols 1995; Parsons and Landres 1998).

Although the BLM approved its first Wilderness Management Plan that permitted natural fires to burn in 1990 (the Mount Trumbull and Mount Logan Wildernesses in northwestern Arizona), they have yet to permit a natural fire to burn. The FWS has yet to approve a program that permits the use of natural fire outside of Alaska (see Parsons and Landres 1998 for further discussion).

Ultimately, the most important question related to the restoration of natural fire in wilderness is how close do our management programs and accomplishments come to reestablishing "natural" fire regimes? To date, such comparisons are extremely limited. One reason for this is the lack of a consistent reporting process for wilderness fire accomplishments. For example, only the Forest Service distinguishes wilderness from nonwilderness fires. Such comparisons also require an understanding of fire history that is not available for many areas; where it is available, arbitrary decisions must be made about what time period is to be used as the baseline for comparison. The choice of any given time interval to represent the natural or target fire regime is unlikely to reflect the full range of historic variability (Swetnam

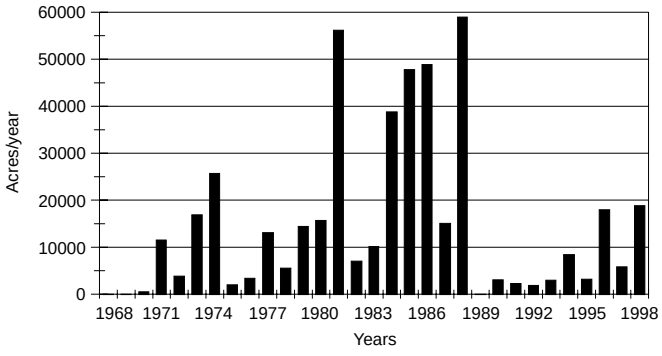

Figure 1—Natural fire acres burned per year for 1967-1998 on National Park Service lands. This data includes nonwilderness as well as wilderness parks.

Table 2—Comparison of National Park Service natural fire programs for 5-year periods before and after 1988.

	1983-1987	1994-1998
No. natural fire plans	26	27
Mean no. parks with fires	22	13
Mean no. fires per year	154	79
Mean annual acres burned	32,135	10,833
Mean fire size (acres)	209	137

1993). Despite these limitations, Brown and others (1994) have determined that the average annual area burned prior to the advent of fire suppression in the Selway-Bitterroot Wilderness in Idaho and Montana was 1.5 to 1.9 times greater than has burned during recent years. Analyses for several forest types in the Sierra Nevada of California also document that area burned under current management strategies is well below that required to approach presuppression fire frequencies (Parsons 1995; vanWagtendonk 1995). Recent work by Caprio and Graber (this proceedings) in Sequoia and Kings Canyon National Parks provides the most comprehensive comparison to date between accomplishments of current fire management programs (including natural fires, prescribed fires, and wildfires) and presettlement fire regimes for a number of vegetation types. They also found that accomplishments fall well below that required to restore presuppression fire frequencies. Although such data are limited, it is clear that recent accomplishments fall well below targets in all areas for which data have been evaluated.

In addition to the policy and administrative constraints that have limited the use of natural fire, even in the larger units, a number of other reasons explain why natural fire can never be expected to be allowed to burn in some wildernesses. These include the small size of many wilderness areas, resulting in many natural ignitions outside of wilderness being suppressed before they can burn into the area, the risk of fire escaping onto adjacent lands managed for other purposes, the threat of unnaturally intense fires causing unacceptable resource damage and the threat of smoke causing unacceptable impacts to surrounding areas. Together, such concerns raise serious questions about the potential for natural fire to ever be able to effectively restore natural fire regimes in many wilderness areas.

A Role for Prescribed Fire?

If natural ignitions are not going to be sufficient to restore desirable fire regimes in most wilderness areas, it will be necessary to look at potential consequences, as well as other options. Management-ignited prescribed fire, either as a supplement to or substitute for natural fire, has been used as a wilderness fire management tool by the Department of Interior agencies (BLM, FWS, NPS) for some time. In fact, the FWS relies almost entirely on prescribed fire to accomplish wilderness management objectives. Specific objectives of BLM and FWS prescribed fire programs include reduction of hazardous fuels, range improvement, wildlife habitat enhancement and restoration of natural fire regimes (Parsons 1999). National Park Service policy approves the use of prescribed fire for the "protection and preservation of wilderness character and resources." The use of management ignitions is widespread within the agency, including within designated wilderness (Botti and Nichols 1995). In tracing the history of prescribed fire in national parks, Botti and Nichols (1995) showed that the use of prescribed fire, in contrast to the natural fire program, continued to expand after the 1988 Yellowstone fires. In figure 2, I present the natural fire and prescribed fire data (mean acres burned per year) for the same 25 natural fire parks analyzed by Botti and Nichols (1995) for the most recent four-year period (1995-1998). Although the use of natural fire has yet to recover to pre-1988 levels (figure 1), the use of prescribed fire has continued to grow, well surpassing the acreage burned pre-1988, as well as that burned by natural fire. In addition, many parks that do not have natural fire programs now rely entirely on prescribed fire to accomplish wilderness fire objectives.

In contrast to wilderness managed by the Department of Interior agencies, Forest Service wilderness is subject to extremely limited prescribed fire. With the exception of the national forests of Florida, where the Chief of the Forest Service granted a 1995 blanket approval for use of prescribed fire for resource objectives, FS policy does not permit the use of prescribed fire in wilderness for purposes other than the reduction of unnatural buildups of fuel (Parsons 1999). Despite numerous calls for increased use of prescribed fire in FS wilderness (Brown 1992; Mutch 1995), and optimism that the new Federal Wildland Fire Policy will facilitate increased use of prescribed fire (Zimmerman and Bunnell, this proceedings), there continues to be considerable opposition both within and outside the agency to such a change. Perhaps of greatest concern is that the use of prescribed fire could become an accepted alternative to natural ignitions and, as such would soon become the dominant wilderness fire management strategy. Since prescribed

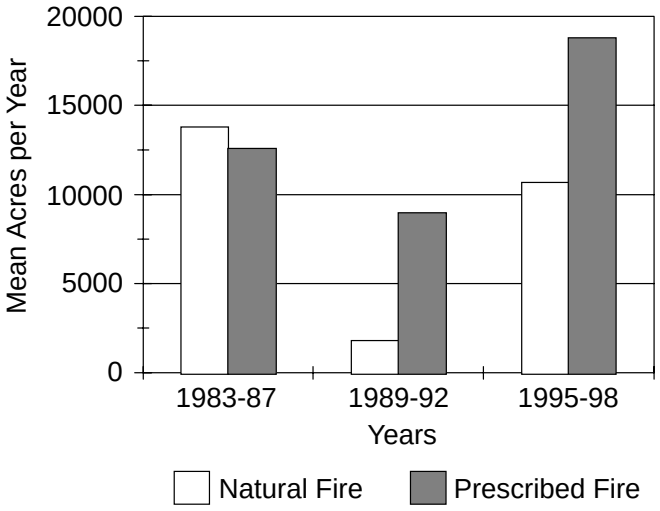

Figure 2—Mean acres burned per year, for three 4-year periods, by natural and prescribed fires in the 25 natural fire national parks analyzed by Botti and Nichols (1995). The time periods represent the period immediately before the 1998 Yellowstone fires (1983-1987), the period immediately following 1988 (1989-1992) and the most recent four years for which data are available (1995-1998).

fire is viewed by many as inappropriate intervention that detracts from the wild or untrammeled nature of wilderness, some feel that its use conflicts with the primary purposes of wilderness. Nickas (1998) exemplifies this attitude in stating "more troubling in many ways than fire suppression is the growing tendency toward utilizing management-ignited ("prescribed") fire" and "when managers light the match, fire ceases to be a natural force and instead becomes a manipulative tool." It seems clear that the use of prescribed fire in wilderness presents a fundamental dilemma that must be addressed before the future of wilderness fire management can be fully resolved.

If neither natural or prescribed fire proves sufficient to restore more natural fire regimes to wilderness, we must be prepared to consider the alternatives. There is little question that continued emphasis on fire suppression will ultimately lead to increasing numbers of unnaturally severe wildfires that threaten both wilderness and adjacent nonwilderness resources. Yet the only other option appears to be the use of mechanical manipulation to reduce unnatural vegetation, a practice sure to raise the ire of wilderness advocates as inappropriate and unnecessary. Fire, whether natural or prescribed, appears to be a preferred alternative to either continued suppression or mechanical manipulation.

Issues and Options

It is clear that fire is an important natural process in many wilderness areas and that if fire is not permitted to burn, those areas cannot be considered as truly natural. Yet, despite clear policy direction recognizing the importance of natural fire, suppression continues to be the dominant fire management strategy in most wilderness areas. Moreover, it is becoming clear that wilderness managers will probably never be able to allow enough natural fire to burn to restore even a semblance of natural fire regimes in most wilderness areas. This raises the dilemma of what to do if we are unable to significantly increase the use of natural fire. The principal options appear to be to either live with the consequences of continued suppression (shifts in vegetation and increasing hazardous fuel accumulations) or to consider prescribed fire or some other surrogate for natural fire (most likely, mechanical manipulation of vegetation). These options will result either in increasingly unnatural, although admittedly wild conditions or the use of manipulative management to restore and maintain some vision of what natural conditions should be.

Since the Wilderness Act calls for both wild (untrammeled or unmanipulated) and natural conditions this presents a significant dilemma for wilderness management (Aplet 1999; Cole 1996). For example, the use of prescribed fire may make the system more natural, but it will be at the cost of being less wild, or self-willed (Nickas 1998). Of course, we must remember that the current situation, where suppression dominates, is also a highly unnatural condition perpetuated by a different type of "management." The question of wildness versus naturalness raises important philosophical and policy questions that have yet to be fully addressed (Aplet 1999). One option that has been raised by Cole (1996) is that different wilderness areas, or portions of wildernesses, could be managed for different purposes. In the case of fire, some areas might be managed to maintain natural fire regimes through whatever means are necessary, while others could be managed to maximize wildness, recognizing that the system may become increasingly unnatural.

In addition to the fundamental policy issue raised above, there are a number of other issues that must be addressed in the struggle to restore natural fire to wilderness. These include the challenge of implementing the new Federal Wildland Fire Management Policy and the associated terminology changes. The concept of calling natural ignitions allowed to burn (previously called prescribed natural fires) wildland fire use for resource benefits is already presenting challenges for communication among and between fire and wilderness managers and the public (Dietrich 1999). Other changes mandated by the new fire policy are being addressed in new interagency implementation guides. Zimmerman and Bunnell (this proceedings) have shown reason to be optimistic that many of the changes will improve agency abilities to use natural fire in wilderness.

Another issue in need of immediate attention is the lack of standardized record keeping and reporting procedures for wilderness fire. At this time, only the NPS has a centralized database where records on both natural and prescribed fire can be obtained. Only the FS designates whether a fire burns in wilderness or not, but the lack of standardized record keeping and reporting procedures makes it particularly difficult to obtain FS fire records without contacting individual units. Consistent reporting is essential to evaluating the accomplishments and effectiveness of wilderness fire programs (Parsons and Landres 1998).

In many wilderness areas, natural fires simply cannot be permitted to burn. Reasons include being too small to contain a fire, location in areas where the primary ignition points are outside the boundaries, location within matrices of high value private lands where the risk of escape is too great, or location adjacent to areas particularly sensitive to air quality concerns. Although such reasons convinced the FS to permit expanded use of prescribed fire in the national forests of Florida, there has yet to be a systematic analysis of where natural fire programs have the most and least potential to be successful and, thus, where other options need to be considered. We do understand that the natural fire success stories in both the FS and NPS have been largely in a limited number of large, remote areas, characterized largely by low and mixed severity fire regimes. The challenge will be considerably more difficult when these approaches are applied to smaller areas, areas in proximity to private and other high value lands or areas characterized by infrequent, high severity fire regimes.

A need with which few disagree is that science must inform management choices. Although the ultimate choices as to what outcomes are most desirable must be made by those responsible for managing the areas, their decisions should be informed by the best available science. In the case of wilderness fire, specific roles for science include the need to compare accomplishments with our best understanding of presettlement fire regimes, improve understanding of the effects of varying fire intensities, frequencies and seasonality, improve predictive models and the ecological knowledge to drive those models and improve understanding of public acceptability of options. Most importantly, scientists need to assess the consequences of alternative future scenarios, including the effects on wilderness ecosystems and on

societal values. The most effective management decisions can be made only when they are informed by the best possible science.

Conclusions

Although the current policies of all four wilderness management agencies clearly recognize the importance of fire as a natural part of wilderness ecosystems, implementation of wilderness fire programs varies greatly between agencies and is far from what would be required to restore natural fire regimes. It can no longer be assumed that natural fire programs will be adequate to restore fire to wilderness. The various constraints under which wilderness and fire managers must work make it highly unlikely that natural fire can ever be fully restored to most wildernesses. And since continuing on the current course is only making matters worse by perpetuating the changes caused by fire suppression, it is clearly time to address management options and the consequences of those options. The fact that the alternatives identified to date all present problems of their own—philosophical, policy, and practical problems—presents a real challenge, but one that we cannot afford to postpone. We are falling farther behind each year. It is time to address the challenges and choose between the available options. The optimism evinced by Zimmerman and Bunnel (this proceedings) regarding the potential for the new Federal Wildland Fire and Management Policy to provide a mechanism to more fully achieve wilderness fire objectives is promising but must be more fully evaluated.

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