

WILDLAND FIRE USE: THE DILEMMA OF MANAGING AND RESTORING NATURAL FIRE AND FUELS IN UNITED STATES WILDERNESS

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ABSTRACT

The management of natural fire and fuels in wilderness areas of the United States presents a significant dilemma to federal land managers. Wilderness fire management requires balancing mandates to both preserve natural conditions and minimize the impacts of human activities. It also requires consideration of ecological and social values both within and outside of wilderness. In many wilderness and similarly protected areas, decades of fire exclusion have resulted in conditions of unnatural vegetation and fuel accumulation. Resulting fires are increasingly of sizes and intensities unprecedented in fire history records. Although current federal interagency fire policy facilitates the use of natural ignitions (wildland fire use for resource benefits) to restore more natural fire regimes, concerns about damage to natural resources, smoke impacts on surrounding communities, and threats to life and property on adjacent lands result in the suppression of most natural ignitions occurring within wilderness. In addition, natural ignitions outside of wilderness that would otherwise burn into wilderness are commonly suppressed before they reach the wilderness boundary.

If natural ignitions are not used to restore fire frequencies and intensities characteristic of pre-settlement conditions in wilderness, fire managers must decide whether to actively manage fire and fuels to restore more natural fire and fuel conditions. Although prescribed fire may be an effective means of restoring fire as a natural process, it is done at the cost of sacrificing the important value of wilderness, the freedom from human control or manipulation—one of the core values of wilderness. We review this dilemma about the management and restoration of fire and fuels in wilderness, and the challenges in determining appropriate and acceptable actions in wilderness.

keywords: benefits, fire, natural fire, prescribed fire, restoration, United States, values, wilderness.

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INTRODUCTION

Although the importance of fire as a natural ecological process in wilderness and other similarly managed areas in the United States is recognized by both legislation and policy, federal land management agencies have found it difficult to implement successful wilderness fire management programs (Parsons and Landres 1998, Parsons 2000a). Legal and practical constraints as well as philosophical differences over the appropriateness of manipulative restoration in wilderness (Cole 2000) have combined to raise significant questions about the feasibility of ever fully restoring fire as a natural ecological process in most wilderness areas.

The fire season of 2000 renewed debate over how fire and fuels should be managed in wildland ecosystems. President William Clinton's Fire Plan, issued in September of 2000 (Babbitt and Glickman 2000), emphasizes efforts needed to ensure sufficient firefighting resources, fuels treatment necessary to protect the wildland-urban interface, and the restoration of damaged landscapes. Proposed actions include mechanical

thinning, prescribed fire, revegetation, and soil stabilization. Although such active management may be appropriate and necessary for many wildland situations, there are some lands where legislation and policy call for a different approach. These lands—including designated wilderness, parks, and other similarly managed areas—are, by law, to be protected and preserved in their natural condition. This includes the preservation and, where necessary, restoration of fire as a natural ecological process, that is, fire that burns within the general frequencies and intensities and with similar ecological effects that characterized pre-European settlement fires. With current emphasis being placed on the management of high risk and wildland-urban interface situations it is unclear whether the resources and commitment exist to simultaneously expand efforts to restore fire to wilderness and, other more remote wildlands.

Current federal fire policy clearly recognizes the importance of fire as "an essential ecological process" that should be reintroduced into the ecosystem (U.S. Department of the Interior and U.S. Department of Ag-

riculture 1995). Zimmerman and Bunnell (2000) emphasize the application of that policy to all federal lands, including wilderness. They also suggest the new policies actually provide for increased opportunities for the return of natural fire (i.e., fire ignited by lightning) to wilderness. Nevertheless, recent discussions regarding wildland fire management have largely excluded mention of wilderness (we include large national parks and other areas managed for similar purposes in our use of the term *wilderness*). If fire is to ever be effectively managed and restored in wilderness, it is essential that fire managers be aware that these lands are under a unique set of legislative constraints that require special consideration in planning and action.

In this paper we review the goals, accomplishments, and constraints of managing and restoring natural fire in wilderness. We emphasize discussion of values and how those values influence the development and application of wilderness fire management practice. We also discuss several unique challenges associated with balancing mandates to preserve natural conditions while minimizing the impacts of human activities, including the appropriateness of manipulative restoration (including prescribed fire use) to restore more natural conditions. We address the management implications of these challenges and suggest the need to address them in fire management plans.

WILDERNESS AND WILDERNESS FIRE

The 1964 Wilderness Act (Public Law 88-577) called for the "preservation and protection" of designated lands "in their natural condition." Wilderness is defined as "undeveloped federal land retaining its primeval character and influence," and "an area where the earth and its community of life are untrammelled by man." Today, over 105 million acres managed by the Bureau of Land Management (BLM), Fish and Wildlife Service (FWS), Forest Service (FS), and National Park Service (NPS) have been designated as wilderness by the United States Congress (Landres and Meyer 2000). In addition, each of these agencies manage extensive additional lands that have been evaluated, proposed, or recommended for designation as wilderness. These lands are, by policy, managed as if they were wilderness.

Fire is one of the most important and widespread naturally occurring ecosystem processes. The spatial and temporal distributions of both naturally and human-ignited fires have influenced the composition, structure, and distribution of vegetation for millennia (Christensen 1995). Over the past century the purposeful exclusion of fire *from* many wildland ecosystems has caused unanticipated and unprecedented changes in these systems (Swetnam et al. 1999). Changes in fire regime have resulted in the unnatural accumulation of fuels, altered composition and spatial patterns of vegetation, altered successional trajectories of vegetation, and increased risk to ecological and social values within and outside of wilderness (Kilgore

1987, Arno and Brown 1991). Ecological values-at-risk *from* the exclusion of fire include old-growth forests, native species, and biodiversity—the elements of "naturalness" that are so important to wilderness. Social values-at-risk include life, property, and human health, as well as the essence of "wildness" that is also so important to wilderness (Cole 2001).

The policies of all four federal agencies responsible for managing wilderness areas in the U.S. recognize the importance of fire as a natural ecological process and the desirability of restoring the historic role of fire to wilderness ecosystems (Parsons and Landres 1998). In 1995 the secretaries of the departments of the Interior and Agriculture issued *Federal Wildland Fire Management: Policy and Program Review*, providing policy direction for all federal wildland fire activities (U.S. Department of the Interior and U.S. Department of Agriculture 1995). A guiding principle of this Federal Wildland Fire Management Program is that "The role of wildland fire as an essential ecological process will be incorporated into the planning process." The new direction provides for allowing fires *from* natural ignition sources to be managed for resource benefits wherever an approved fire management plan is in place (Zimmerman and Bunnell 2000).

Despite recognition of the importance of and need to restore natural fire to wilderness, the federal agencies have been largely unsuccessful in accomplishing this task (Parsons and Landres 1998). As of the 1998 fire season, only 88 of the 596 designated wilderness areas outside of Alaska had approved fire plans that allowed natural ignitions to burn (Parsons 2000a). An additional 10 non-wilderness national parks had such plans. However, even those areas with the most progressive wilderness fire-use programs continue to suppress most natural ignitions.

Recent assessments of some of the most successful wilderness fire programs in the country have documented major discrepancies between mean fire return intervals achieved under recent management (a mixture of natural fire, prescribed fire, and fire suppression) and pre-settlement fire regimes (Brown et al.

1994, van Wagendonk 1995, Caprio and Graber 2000). In the most comprehensive analysis to date of the effectiveness of a modern fire management program in restoring pre settlement fire regimes, Caprio and Graber (2000:238) state that Sequoia and Kings Canyon national parks "are continuing to fall behind in area that needs to be burned, if pre-European settlement conditions are the objective." They further conclude (Caprio and Graber 2000:239-240) "we are not maintaining fire as a natural process to the extent that policy prescribes," and that at specific locations where constraints cannot be overcome "alternative means of achieving management goals may be required." On a broader scale, NPS efforts to restore natural fire have been largely unsuccessful in the aftermath of the restrictions put in place following the 1988 fires in Yellowstone National Park (Parsons and Botti 1996, Parsons 2000a).

Efforts to restore fire to wilderness on the scale necessary to replicate pre-settlement conditions are

hindered by a wide variety of political and practical constraints, including limited funding, availability of qualified personnel, political boundaries, interagency cooperation, rare or invasive species, cultural resources, and air quality concerns (Botti and Nichols 1995, Bryan 1997). In the following sections we address a central dilemma as well as other issues that pose significant challenges to the management and restoration of fire and fuels in wilderness.

THE DILEMMA OF NATURAL FIRE IN WILDERNESS

The management and restoration of natural fire and fuels in wilderness pose a dilemma—a situation requiring a choice between equally undesirable alternatives. The dilemma stems from the need, in some situations, to choose between two different core values of wilderness—wildness and naturalness—where this choice of one value will likely lead to the reduction or loss of the other value. This choice between wildness and naturalness (Landres et al. 2000b, Cole 2001) parallels the well-documented debate about whether forest and fire restoration in national parks should be guided by process- or structural-driven philosophies (Bonnicksen and Stone 1982, Parsons et al. 1986, Vale 1987). The outcomes will differ depending on the choices made.

Whether conscious or not, values and philosophical views ultimately drive the choices made in managing or restoring natural fire and fuels in wilderness. The 1964 Wilderness Act protects both ecological and social values in wilderness. Ecological values include the natural conditions native to an area—the mixture of young and old forests, animals, plants, soil microbes and fungi—as well as ecological processes such as predator-prey interactions; disturbances such as fire, disease, wind storms, and landslides; and evolutionary processes. In short, "naturalness" is a core value of wilderness representing conditions that are relatively unaffected by modern people (Landres et al. 1998). Social values include the aesthetic, recreational, spiritual, and therapeutic benefits of solitude in undeveloped natural areas. One of the most important and enduring social values of wilderness is its being "untrammelled" and unmanipulated by people and their desires—its "wildness" (Aplet 1999).

Although wilderness is managed for the twin values of naturalness and wildness, in some cases managing for one may compromise the other (Cole 1996, 2000; Landres et al. 2000b). When the Wilderness Act was written, these core values were undoubtedly meant to reinforce one another. Recent recognition of the large-scale impacts of acid deposition, exotic species, and fire suppression has led to a call for restoring native ecological conditions in wilderness (Graber 1983). In some cases restoration plans include intensive actions, such as the mechanical reduction of fuels accumulated over the decades of fire suppression (Bonnicksen and Stone 1985). This manipulation, even for the purpose of restoring native ecological conditions,

is viewed by some as a control of wilderness that abrogates the untrammelled and wild legislative intent of the Wilderness Act (Nickas 1998). The decision of whether wilderness ecosystems should be manipulated toward naturalness or left wild may be one of the major wilderness management dilemmas of the 21st century (Cole 2001).

How we weigh the values of naturalness and wildness strongly impacts how we manage fire and fuels in wilderness. For example, if we choose to emphasize the maintenance or restoration of naturalness we will likely favor active management of fire and fuels through prescribed burning and mechanical fuel reduction to maintain species compositions, spatial and temporal patterns of fuels and forest structure, and ecological processes native to an area. Although the sheer magnitude of the effort required to overcome the effects of fire suppression makes it difficult to attain the goal of natural conditions in many areas, naturalness, to the extent it can be satisfactorily quantified, can provide a useful target for management.

If we choose to favor wildness as the primary wilderness value we will strive to allow all natural ignitions to burn without human intervention, control, or manipulation; prescribed fire and other manipulative tools to create desirable conditions would not be used. The goal of wildness is rarely attained in today's world because risks to non-wilderness values, such as the threat of fire crossing onto non-wilderness lands, result in the suppression of many, if not most, natural fires. Although wildness remains an important social value and management goal in wilderness, managing for wildness may compromise naturalness by allowing unnaturally large and intense fires to burn following decades of fuel accumulation from active fire suppression. The goal of wilderness management should be to optimize both naturalness and wildness. This two-fold goal may be most easily accomplished in those areas where fire suppression has had minimal impact. For example, at higher elevations, natural ignitions may often be allowed to burn because the current fire return interval and fuel conditions are within the historic range of variability. Examples of where such programs have experienced some success include the Selway-Bitterroot Wilderness in Montana, and Yosemite and Sequoia-Kings Canyon wildernesses in California (Brown et al. 1994, Parsons and van Wagtendonk 1996).

In other places, where fire return intervals and fuels are clearly well beyond the historic range of variability, we must often confront the dilemma of whether to manage primarily for naturalness or wildness. In these situations there are several challenges to crafting an effective fire management plan that explicitly acknowledges and optimizes both the naturalness and wildness values of wilderness.

The Challenge of Appropriate and Acceptable Restoration

The principal goal of wilderness fire management should be to allow all naturally ignited fires to burn.

However, a legacy of 20th-century fire exclusion, and the potential adverse social and ecological consequences of wildland fire results in continued exclusion in many areas (e.g., in small wildernesses [e.g., national forest wildernesses in Florida] or portions of large wildernesses adjacent to private or commercial property [e.g., Bitterroot Valley in western Montana]) (Parsons 2000a). Therefore, efforts to restore naturally occurring fire and fuels (vegetation and ground fuels that resemble the quantities, composition and structure that would have occurred without fire exclusion) must be considered to protect the naturalness value of wilderness. In such situations the appropriateness and acceptability of explicit management actions designed to restore more natural conditions need to be thoroughly discussed and evaluated.

In such situations the appropriateness of restoration depends on many factors. A full discussion of these factors is beyond the scope of this paper, but they include 1) philosophical opposition to intentionally manipulating fire and fuels; 2) depth and certainty of knowledge about the natural ecosystem, fire regime, fuels, and their interactions; 3) ability to assess the ecological and social consequences of taking restoration actions versus not taking such actions; 4) the landscape-scale context of the ecosystem; and 5) local, regional, and national public perceptions of wilderness, naturalness, wildness, and restoration in wilderness. Clearly, determining the appropriateness of restoring natural fire and fuels in wilderness will require considerable effort to evaluate and weigh all these factors.

Once a decision is made that restoration is appropriate, the acceptability of various restoration options needs to be evaluated. Next to naturally ignited wildland fire, prescribed fire is usually the preferred tool for reducing fuels in wilderness. However, wilderness policies are often unclear and inconsistent regarding the use of prescribed fire. For example, are prescribed fire or other forms of fuel treatment acceptable substitutes for natural fire under certain circumstances? The BLM, FWS, and NPS use prescribed fire to reduce fuels, restore natural fire regimes, and accomplish other resource objectives in wilderness (Parsons 2000a). The FS, on the other hand, is much more restrictive in its use of prescribed fire in wilderness, especially for purposes other than the reduction of hazardous fuels (Parsons 2000b).

Mechanical treatment of fuels is generally considered inappropriate and unacceptable in wilderness, although it is extensively used on non-wilderness lands throughout the western United States to reduce hazardous fuels or manipulate vegetation (Heinlein et al. 2000). Several national parks (e.g., Grand Canyon and Bandelier) are currently experimenting with limited mechanical treatment of fuels as part of ecological restoration programs within wilderness (Heinlein et al. 2000, Sydoriak et al. 2000). These programs are undergoing intense scrutiny by both scientists and wilderness advocates, and their outcome may have significant implications for future wilderness management.

The use of prescribed fire, and especially mechan-

ical fuel reduction, may be strongly opposed as philosophically inappropriate and unacceptable in wilderness (Landres et al. 2000a). For example, Nickas (1998:4) stated that "more troubling in many ways than fire suppression is the growing tendency toward utilizing management-ignited fire," and that "when managers light the match, fire ceases to be a natural force and instead becomes a manipulative tool." Other reasons for opposing manipulative restoration include the lack of site-specific information on the natural fire regime and fuels, a lack of understanding about the long-term consequences of restoration actions, and concerns about the precedent of using such intense manipulations in wilderness.

The Challenge of Perceived Risks and Benefits

Natural ignitions are suppressed whenever the values-at-risk override the goal of allowing natural ignitions to burn. Each suppression decision reinforces a feedback cycle where fuels continue to accumulate, the potential for loss (i.e., risk) escalates, and the pressure to suppress future fires grows (Miller et al. 2000). Many of the risk factors are outside the fire manager's control such as residential development along wilderness boundaries, extreme drought conditions, smoke dispersal, and the national fire situation. In addition, most fire management decisions are based largely on the negative consequences of fire, limiting the motives for using naturally ignited wildland fire as a management strategy and perpetuating the risk-suppression cycle. Unfortunate fire situations such as the 2000 Cerro Grande Fire in New Mexico may deeply reinforce a risk-averse attitude and further entrench this risk-suppression cycle.

How can the risk-suppression cycle be weakened or reversed? A partial solution is to give equal consideration to the potential benefits of wildland fire. Many benefits may be realized through the use of wildland fire, such as fuel reduction, maintenance of species composition and structure, enhanced nutrient availability, and improved wildlife habitat. However, these benefits are often not well articulated or understood. Managers need a way to consider information on both the benefits and risks of wildland fire if they are to adequately assess the tradeoffs between continued suppression and wildland fire use. A balanced assessment of the potential benefits and losses may provide managers the necessary motivation and defensible justification to allow natural ignitions in wilderness to burn. For example, a model currently under development attempts to help managers evaluate information on both risks and benefits in a way that minimizes risks while maximizing benefits (Miller et al. 2000). Such an approach could help balance the risk-suppression cycle with a more sustainable cycle between wildland fire use and its benefits.

The Challenge of Information and Planning

The complexity and consequences of natural fire and fuels require a frank appraisal of what is known and not known about managing and restoring this key

ecological process. Incorporating the best available science into policy and management decisions is always a priority. Unfortunately, our knowledge is not always sufficient to fully understand the consequences of management decisions. At other times it is not always clear how to best use the knowledge we have. Agee's (2000) state-of-knowledge review of wilderness fire science recognizes recent advances in understanding, but urges developing better models to predict the effects of different fire management options.

The importance of new models is shown by a recent study of the effects of natural fire, prescribed fire, and harvest treatments on forest composition and structure following a century of fire suppression in mixed-conifer forests of the Sierra Nevada (Miller and Urban 2000). Model simulations suggest that whereas the more severe treatments (harvest and high-intensity prescribed fire) were most effective in restoring pre-suppression forest characteristics, all simulated treatments eventually converged in their effects within several hundred years. This implies that any of the management strategies simulated by the model may result in the restoration of pre-suppression forest characteristics, and that social values may ultimately be the most important consideration when deciding which management strategy to employ.

Although we have increased our knowledge in recent years about the natural heterogeneity and dynamic nature of native ecosystems, we are still struggling with how to incorporate this understanding into land management decisions (Christensen 1988, 1995). We have also begun to recognize the importance of understanding historical conditions, and what is commonly referred to as historical or natural variability (Landres et al. 1999, Swetnam et al. 1999). There is less agreement on how historical information should be used. For example, although historical data may at first appear to provide a useful guide to defining target "natural" conditions, those data may actually represent conditions that existed under a different climate (Millar and Woolfenden 1999). In such cases, management implications must be adjusted accordingly.

Land management decisions are often based solely on understanding of the effects on the bio-physical environment, but in today's world managers also need to understand how the public perceives and responds to an issue (Shindler and Cramer 1999). This social understanding is especially important given the strong views different people are likely to have about the appropriateness and acceptability of managing and restoring wilderness fire and fuels (Stankey and McCool 1995). Public perceptions and values also vary from one area to another, and across local, regional, and national scales. For example, there may be considerable tension between local rural attitudes and national urban views on wilderness fire. In addition, public attitudes change over time, strongly influencing wilderness management policy and actions (Watson and Landres 1999). Determining the appropriateness and acceptability of managing and restoring wilderness fire and fuels requires a deep understanding of diverse social values. Kennedy et al. (1998) suggest that the most

important role for public land managers is often as social value brokers and conflict management facilitators.

Managers have critical information needs for tactical operations as well as strategic planning activities. Tactical decisions, such as the decision whether or not to suppress a wildland fire, must be made within very tight time constraints and with the information available at the time of a fire. Although wildland fire managers attempt to consider both the positive and negative impacts of fire, this assessment is difficult because fires may burn through entire landscapes with widely varying impacts. Managers do not often have access to this landscape-scale information within this short time frame. Long-term strategic planning also involves the assessment of tradeoffs between the positive and negative impacts of fire and therefore requires information about the social and ecological consequences of different management actions across a landscape. Unfortunately, this information is seldom available.

MANAGEMENT IMPLICATIONS

Although fire exclusion clearly remains the dominant strategy in wilderness fire management, in many areas there is increasing recognition of the importance of natural fire, and increasing desire to allow fire to play its natural role in wildland ecosystems. However, the management and restoration of natural fire in wilderness pose a significant dilemma as agency wilderness and fire staff struggle to protect and preserve both naturalness and wildness. There are many challenges to developing appropriate and acceptable plans for managing or restoring natural fire in wilderness, and we offer several suggestions for such plans.

Involve the Public.-Developing appropriate and acceptable wilderness fire plans requires strong public involvement because the values-at-risk, the differences in philosophical view, the intense emotional reaction that fire often invokes, and the movement towards ecosystem management all point to the critical need for civic dialogue and collaborative processes among managers, scientists, and public stakeholders.

Recognize Limited Understanding.-Fire, and its management, is extraordinarily complex, and in wilderness there is an extra burden to be especially prudent and humble. We all know we will never have perfect information, and we need to be equally cautious about recognizing the potential limitations and consequences of making decisions based on limited knowledge and extrapolating from site-specific information. There are ample opportunities to learn from fire by treating management actions as experiments and learning from those experiences.

Develop Better Information.-Better information and understanding are needed for many topics, including local, regional, and national public values related to fire and its management; social and ecological risks and benefits of natural fire; and social and ecological consequences of different management alternatives for wilderness fire, including restoration and continued

suppression. There is a critical need for this information over long time frames and large areas.

Develop Decision-Support Tools.-Formal guidelines and decision-support tools help ensure that all relevant issues are addressed. For example, a structured guideline to identify appropriate and acceptable restoration actions would likely include the following steps: 1) evaluate current conditions; 2) identify the problem(s) from the perspective of different stakeholders; 3) define appropriate management goals; and finally 4) identify which actions are acceptable. A decision-support tool that explicitly recognizes both the risks and benefits of natural fire would help fire management staff develop landscape-scale priorities for managing and restoring wilderness fire.

Define Clear and Appropriate Goals.-Appropriate goals need to be clearly defined for managing and restoring the natural role of fire in wilderness ecosystems. In some cases, such as in fire regimes with long return intervals or in the remote center of a very large wilderness, both naturalness and wildness can be maximized. In other cases, such as in small wildernesses or on the margins of a large wilderness where the risks often outweigh the benefits of natural fire, a conscious choice between naturalness or wildness may be necessary, and prescribed fire will likely be used to replace natural ignitions that are suppressed. And in still other cases, short-term restoration actions may be used to reverse the effects of decades of fire exclusion so lightning fires can again be permitted to burn (Barrett 1999). In all these cases, the key point is to define clear and appropriate goals.

Develop a Fire Management Plan.-The fire management plan (FMP) provides strategic and specific direction for the management and restoration of natural fire and fuels in wilderness. The FMP can explicitly identify the myriad social and ecological values and consequences of alternative management and restoration actions. Most importantly, the FMP is a vehicle for 1) compiling relevant information and engaging in a public dialogue about the management and restoration of wilderness fire; 2) integrating wilderness fire planning into the surrounding area; and 3) clearly articulating the goals and objectives for wilderness fire. The issues relevant to wilderness fire and its management are too contentious and too complex to be decided in the middle of a fire. By "pre-loading" potential actions into the FMP, tactical fire operations are more efficient and defensible.

The challenges of fire and fuels management in wilderness discussed in this paper are only a sampling of the challenges faced by those attempting to manage and restore the natural role of fire in wilderness. Among numerous other challenges that wilderness fire managers must deal with are 1) changing terminology (what was once known as *prescribed natural fire* is now called *wildland fire use for resource benefits*); 2) budget and staffing (these may become less significant obstacles following the funding increases being implemented as a result of the 2000 fires); 3) the use of the minimum tool concepts in management actions; 4) impacts of smoke on surrounding communities; and 5)

managing across agency, or federal and state, or private boundaries. Although these issues are particularly challenging for wilderness, most of them also apply to all wildlands and especially to the wildland-urban interface.

CONCLUSIONS

The ultimate question of wilderness fire management is what will likely happen if we do not allow natural ignitions to burn or restore the role of natural fire to wilderness. Our options appear to be limited to active management, either through prescribed fire or mechanical manipulation, continued suppression, or a combination of these actions. Active management may compromise the value of wilderness that is a vital part of wilderness, whereas continued suppression will likely result in increasingly large and hot fires, the full consequences of which we do not fully understand, but which will likely compromise the value of naturalness that is also a vital part of wilderness. We need to address this dilemma and these challenges while we still have an opportunity to make a difference in deciding what the nature of wilderness will be in the future.

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