

# Monitoring to Protect the Character of Individual Wildernesses

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**Abstract**—A primary goal of wilderness stewardship is to protect individual wilderness areas from most anthropogenic change. Numerous agents of change threaten to degrade wilderness character. These agents of change are both internal (for example, grazing) and external (for example, polluting industries) to wilderness. They can be activities (for example, recreation use) or the indirect effects of activities (for example, invasion of exotic species), and can also be management actions (for example, fire suppression). Wilderness managers need information about both these agents of change (or threats) and the attributes of wilderness character that they threaten. They need monitoring data about (1) the magnitude of threats and (2) changes in wilderness attributes caused by these threats (impacts), in order to be in a better position to protect the wilderness character of the areas that they steward. This paper uses a matrix approach to provide a comprehensive overview of wilderness protection monitoring. It describes the current state-of-the-art. It identifies substantial knowledge and technological gaps, as well as research needs.

## Introduction

Public lands that have been officially designated as wilderness have many different values (McCloskey 1990, Noss 1991). Some of these values are readily apparent and easy to describe; others are not. The most commonly recognized wilderness values are ecological and experiential values. Wildernesses have ecological value because, at least ideally, they preserve lands in a natural condition and allow for the free play of natural processes. They provide refuge for plants and animals, are source areas for clean water and are available as reference areas for science. The experiential values of wilderness stem from their availability for appropriate recreational use. Although different people seek and find diverse experiences in wilderness, wilderness offers some of the most outstanding opportunities for experiencing solitude and a sense of freedom and spontaneity within large natural environments. For many, wilderness provides therapeutic, educational, and spiritual values (Hendee and Dawson 2002).

A third set of wilderness values might be termed the symbolic values of wilderness. These values are more difficult to articulate and are less readily apparent than the ecological and experiential values of wilderness, but they are perhaps the values most unique to wilderness. These are the values most frequently articulated in the language of those most influential in passing the Wilderness Act

(Zahniser 1956-57). Perhaps the most important symbolic value of wilderness is wilderness as a symbol of restraint and humility. This value is well-captured in the definition of wilderness, contained in the Wilderness Act, as “an area where the earth and its community of life are untrammeled by man.” “Untrammeled” is simultaneously the most important and the most misunderstood word in the Wilderness Act. “Synonymous with unconfined, unfettered and unrestrained,” untrammeled suggests “freedom from human control rather than lack of human influence” (Cole 2000, p. 78). Much of the symbolic value of wilderness derives from its being land that humans do not mold to their purposes. Wilderness is a place that humans should not intentionally manipulate for any reason—even to enhance the ecological or experiential values of wilderness.

Although wilderness lands have additional values (such as economic benefits), it is largely the ecological, experiential and symbolic values that constitute the wilderness character of these lands and the primary legislative mandate for wilderness managers is to protect the wilderness character of the lands they steward. Where these values are threatened, wilderness managers must act to protect them. An important element of any protection program is the identification of threats and the monitoring of impacts to wilderness values. Therefore, in order to protect the wilderness character of the individual wilderness areas that they steward, managers need monitoring

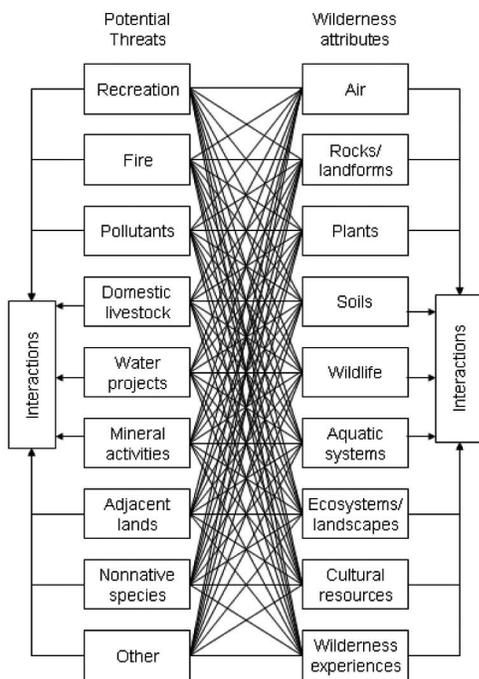
programs related to ecological, experiential and symbolic values. This paper provides an overview of the breadth of monitoring needed to adequately protect the wilderness character of individual wildernesses. It also reviews the types of wilderness monitoring that are best developed and suggests priorities for further work.

## Protecting the Ecological and Experiential Values of Wilderness

There are numerous threats to the ecological and experiential values of wilderness. These threats are both internal and external to wilderness. They include human activities, the indirect effects of activities and also management actions. Managers must be concerned about the impacts that potential threats have on attributes of wilderness character.

### The Threats Matrix

Figure 1 shows a conceptual model of the most significant threats to and attributes of wilderness that can be applied to wilderness protection (Cole 1994). As the numerous lines radiating from each individual threat suggest, any single threat will impact many different wilderness attributes and values. Therefore, the impacts of any single threat will differ depending on the attributes



**Figure 1.** Linkages between important potential threats and the wilderness attributes they impact.

the threat impacts. For example, the effects of fire suppression on vegetation are very different from the effects of fire suppression on wilderness experiences. Similarly, the effects of different threats on a single attribute are highly variable. The implication of this is that managers need to understand the linkages between each significant potential threat and each individual wilderness attribute. If this was not challenging enough, these potential threats and impacts interact synergistically. Therefore, managers need to also understand the cumulative impacts of multiple threats. Separating individual attributes is even more artificial than separating threats because impacts occur at all temporal and spatial scales.

Despite the artificiality of separating individual threats and wilderness attributes, the matrix that results by combining threats and attributes is a convenient way to depict the breadth of topics that might be included in a wilderness monitoring program (fig. 2). In this matrix, threats form columns and attributes form rows. Each cell consists of the various impacts that each threat causes to each attribute. Figure 2 includes most of the common wilderness threats. While this matrix was developed for a generic wilderness, individual wilderness units might adapt it to their specific needs by either adding additional threats or attributes or by deleting ones that are not relevant to their situation.

### Monitoring Threats and Impacts

These threats and impacts vary in terms of their significance, our knowledge about them and the availability of monitoring protocols and programs. Most monitoring programs aim to assess either the threat or changes in wilderness attributes; a few assess impacts directly. Cole and Landres (1996) review knowledge about the most common threats and impacts to wilderness ecosystems. Hende and Dawson (2002) provide a good overview of concerns related to wilderness experiences.

Most attention within wilderness has been devoted to understanding, monitoring and mitigating the threat posed by recreation use and the impacts that it causes. Nevertheless, surprisingly few wilderness areas have reliable estimates of the amount of recreational visitation they receive. The most reliable data are for overnight visitors to wildernesses managed by the National Park Service, because permits are usually required for overnight stays in those areas.

Monitoring data on campsite conditions (impacts of camping on soil and vegetation) are also relatively common. As of 2000, about one-half of the 628 wildernesses in the United States had some type of baseline data on campsite conditions (Cole and Wright 2003). However, only about one-third had data on campsites for the entire wilderness.

		POTENTIAL THREATS (Agent of change and associated management)								
		Recreation	Fire	Pollutants	Domestic Livestock	Adjacent Lands	Water Projects	Mineral Activities	Non-native Species	Other
ATTRIBUTES OF WILDERNESS CHARACTER	Air									
	Rocks, Landforms									
	Plants, Soil									
	Wildlife									
	Aquatic Systems									
	Ecosystems, Landscapes									
	Cultural Resources									
	Wilderness experiences									

\*Includes scientific uses, overflights, other laws and mandates, inholdings, subsistence uses, previous uses, wildlife extirpations, and future threats

**Figure 2.** The threats matrix in which cells represent the impacts that each potential threat has on each attribute of wilderness character.

There are several explanations for the prevalence of campsite monitoring programs in wilderness. First, campsite impacts are among the more obvious adverse effects of recreation use and represent problems that wilderness managers spend considerable time and resources trying to “fix.” Second, campsite impacts provide one of the few situations where it is possible to directly assess and monitor the impact of concern. The impacts of camping on vegetation and soil are intensive, stationary and highly localized. This makes it possible—by comparing campsite conditions to adjacent undisturbed controls—to quite precisely measure the effects of camping. For most other impacts, including the effects of recreation on animals or on visitor experiences, this cannot be done. For these threat-attribute combinations, inferences about impacts must be drawn from data on the threat and the attribute. For example, we can count visitors and we can monitor wildlife populations, but we generally cannot measure wildlife impacts directly. We can attempt to attribute changes in wildlife populations to visitation but this is often highly speculative.

Beyond recreation, assessment of atmospheric pollutants in individual wildernesses is perhaps the best developed monitoring program. This program emphasis is clearly the result of legislative mandates imposed by the Clean Air Act of 1970. Federal land managers are

responsible for protecting air quality-related values in parks and wilderness from air pollution damage or impairment. Monitoring efforts are focused primarily on the wilderness attribute (air), rather than the threat (source of pollution) or impact. Some of the most common attributes being measured include visibility (which is reduced by fine particles), ozone, and deposition of sulphur and nitrogen compounds (Tonnessen 2000). However, because there is substantial consensus about what air quality should be like under “natural” conditions and because substantial research has been conducted on the adverse effects of pollutants on flora, fauna and aquatic systems, these data can be used to estimate the impacts of atmospheric pollutants.

Increased awareness of problems resulting from the introduction of nonnative species has led to improved monitoring efforts recently. Most often these efforts are confined to plants deemed to be “noxious.” Programs to monitor the effects of livestock grazing also exist. Monitoring range conditions is probably more common where the grazers are cattle or sheep than where the grazers are recreational pack stock.

The impacts associated with fire and how fire is managed are probably the least adequately monitored but among the most significant impacts to wilderness character. For these, not only is it impossible to directly

monitor impacts, it is also impossible to monitor the threat very precisely. The threat is not fire itself; nor is it the suppression of fire. The magnitude of threat is the degree to which the fire regime differs from a “natural” fire regime, something that cannot be estimated very precisely given climate change, definitional problems related to appropriate spatial and temporal scales, and unresolved issues such as the past role and influence of native Americans. Most often, vegetation structure and composition are assessed, from which inferences about impacts of fire management are drawn.

## Protecting the Symbolic Values of Wilderness

Less attention has been given to articulating threats to the symbolic values of wilderness and how impacts to such values might be monitored. For the values of humility and restraint, as suggested by the concept of “untrammled” wilderness, the primary threats are intentional manipulations of wilderness ecosystems and other ecological attributes. Manipulations of wilderness ecosystems can be intentional or unintentional. They can be undertaken with the intent of altering conditions within wilderness or they can be the consequence of an attempt to control conditions outside of wilderness. Manipulations can be undertaken to enhance other wilderness values (most commonly naturalness) or not. The symbolic values of restraint, humility and untrammled wilderness are most compromised by intentional manipulations undertaken to alter conditions within wilderness.

I know of no attempts to monitor threats to or loss of the symbolic values of wilderness. However, in the effort to develop a national assessment of trends in wilderness character (see Landres in this proceedings), protocols are being developed that might prove useful in individual wildernesses as well. The general approach being advocated is simply to report the prevalence of actions designed to manipulate the biophysical environment. These might include anything from igniting prescribed fires to planting fish to placing radio collars on wolves. The more manipulative actions that are taken, the more symbolic values are at risk.

## Priorities for Improving Wilderness Monitoring

When it comes to monitoring to protect the values of individual wildernesses, the needs are huge and

current efforts are meager to non-existent. The paucity of resources available for wilderness stewardship generally and monitoring specifically probably reflects a belief that the job of wilderness is a simple one. Conversely, I have argued that there is no other responsibility given to land managers that is more difficult to do well than wilderness stewardship (Cole 1990). Given the likelihood that available resources will continue to be scarce, careful consideration of monitoring priorities is critical.

Opinions regarding monitoring priorities are diverse, depending to a great degree on one’s value system. For many (certainly most ecologists), the ecological values of wilderness are considered most significant, leading them to assert that priority should be given to the most pervasive ecological impacts in wilderness. Others, however, may consider experiential or symbolic values to be most significant, leading them to different conclusions about the most important attributes to monitor.

Three criteria that might be applied to priority setting include: (1) the ability of managers to mitigate impacts, (2) the pervasiveness of impacts, and (3) the uniqueness of what is threatened. Recreation impacts are probably the impacts that managers can most readily control. Although intense, many recreation impacts are highly localized and recreation use is subject to managerial control. Among the most pervasive impacts are likely to be those associated with fire and its management, atmospheric pollutants and the effects of adjacent lands and their management on wilderness. In contrast to recreation, the impacts of these threats are not nearly as intensive but are much more extensive, sometimes affecting most of the wilderness. From the perspective of protecting ecological values, the impacts of these threats are likely to be highly significant but difficult to assess with much precision. Development of more precise methods for assessing and interpreting impacts is a high priority research need. Finally, the most unique values at risk are likely to be the symbolic values of wilderness. No lands other than wilderness are likely to be declared off-limits to intentional manipulation out of a sense of restraint and humility. In fact, it is unlikely that we will even show this restraint in wilderness. Therefore, more attention needs to be given to monitoring trends in these values. Impacts to rare and endangered plant and animal populations also demand high priority, based on the criterion of uniqueness. They typically are receiving substantial attention.

## Conclusions

More personal and financial resources need to be devoted to wilderness stewardship if agencies are to

redeem their responsibility to protect wilderness character. Much of this could be achieved if wilderness received the attention that it deserves within land management agencies. In the Forest Service, for example, 18 percent of lands are designated wilderness. However, the agency spends less than 1 percent of its annual budget on wilderness stewardship. In the past, most attention within wilderness has been devoted to recreation management. Other issues need more attention—not at the expense of recreation management, which continues to be underfunded, but as a complement. More attention needs to be devoted to understanding and monitoring the effects of pervasive threats such as fire and its management and the influence of management and development of adjacent lands. More attention also needs to be given to understanding the symbolic values of wilderness and how they might be monitored and protected. Finally, every individual wilderness is unique. This means that the wilderness character of each wilderness is unique and is often better understood holistically than when reduced to cells in a matrix. Considerable ingenuity is needed to better incorporate holism and uniqueness in our attempts to monitor and steward wilderness.

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