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Keeping It Wild:

An Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservation System

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Abstract

The Interagency Wilderness Character Monitoring Team—representing the Department of the Interior (DOI) Bureau of Land Management, DOI Fish and Wildlife Service, DOI National Park Service, DOI U.S. Geological Survey, and the U.S. Forest Service—offers in this document an interagency strategy to monitor trends in wilderness character across the National Wilderness Preservation System. The overall strategy is for each wilderness to: 1) choose a set of measures from those provided in this document that are relevant, cost-effective, and tied to preserving wilderness character, 2) periodically collect data to assess trend in these measures, and 3) use these trends to assess and report on the trend in wilderness character. Each agency would then compile these trends from each wilderness to assess broad scale agency performance in preserving wilderness character. Similarly, data from each agency would be compiled to assess performance in preserving wilderness character across the National Wilderness Preservation System. This interagency monitoring strategy provides a solid foundation to tie wilderness stewardship to the legislative direction of the Wilderness Act and agency policies to preserve wilderness character.

Keywords: Wilderness Act, wilderness, wilderness character, wilderness stewardship, monitoring

Authors' Note

This publication is a report developed by a technical working group and solely represents the views of its authors. It does not represent and should not be construed to represent any agency determination or policy. In addition, this published document differs from the final report that was submitted to the Interagency Wilderness Stewardship Committee, primarily the last two sections of this publication.

Cover photos: **large center photo,** lone person in Tracy Arm-Ford's Terror Wilderness in southeastern Alaska *from Kevin Hood*; **upper left photo,** the Great Sand Dunes National Park and the Sangre de Cristo Wilderness in Colorado *from the National Park Service*; **center photo,** fern from the El Toro Wilderness in Puerto Rico *from Jerry Bauer;* **upper right photo,** southeastern Utah *from Peter Landres;* **lower right photo,** the Eagle Cap Wilderness in Oregon *from Peter Landres*.

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Executive Summary

The Interagency Wilderness Character Monitoring Team—representing the Department of the Interior (DOI) Bureau of Land Management, DOI Fish and Wildlife Service, DOI National Park Service, DOI U.S. Geological Survey, and the U.S. Forest Service—in this document offers an interagency strategy to monitor trends in wilderness character across the National Wilderness Preservation System. This interagency monitoring strategy provides:

- information for improving on-the-ground wilderness stewardship, policy review, and implementation based on credible data that are consistently collected and endure over time as personnel change;
- accountability for the legal and policy mandates "to preserve wilderness character" that apply to all four wilderness management agencies;
- a set of key wilderness stewardship goals that are common across all the agencies with responsibility for wilderness and those that are tied to the legislative direction of the 1964 Wilderness Act; and
- a tool for communicating wilderness stewardship needs and priorities within the agencies and with the public.

The intent behind this interagency strategy is for each wilderness to: 1) choose a set of measures that are relevant, cost-effective, and tied to preserving wilderness character, 2) periodically collect data to assess trend in these measures, and 3) use these trends to assess and report on the trend in wilderness character. Each agency would then compile these trends to assess broad scale agency performance in preserving wilderness character. Similarly, data from each agency would be compiled to assess performance in preserving wilderness character across the National Wilderness Preservation System.

This interagency strategy uses the statutory language of the 1964 Wilderness Act to identify four qualities of wilderness: "untrammeled," "natural," "undeveloped," and "solitude or a primitive and unconfined type of recreation." These four qualities form the foundation of this monitoring, and each is further divided into monitoring questions, indicators, and measures to allow measurement of trends.

Each agency would choose at least one measure from among the set recommended here to assess the trend in each indicator. The recommended measures were chosen to provide a range of options that maximize relevance and practicality while minimizing cost and workload. Wilderness staff may also develop their own measure for an indicator through an agency-approved process described in this document.

Data are collected to assess whether the trend in each measure is improving, stable, or degrading. If more than one measure under an indicator is monitored, standard rules are used to synthesize the results across measures to derive a trend in the indicator. These same rules are used to synthesize trends at each subsequent level to ultimately derive the trend in wilderness character.

At 5-year intervals, each wilderness would report whether the trend in wilderness character, qualities, monitoring questions, and indicators is improving, stable, or degrading. These trends can only be evaluated relative to the specific enabling legislation, unique biophysical and social environments, and administrative requirements for each wilderness. This interagency strategy, therefore, does not create or propose national numerical standards for the indicators used to assess whether wilderness character is preserved or degrading.

While there are several concerns about such broad-based monitoring, it provides a more solid foundation to tie wilderness stewardship to the legislative direction of the Wilderness Act than has existed before. This monitoring can be improved over time, and a formal process for reviewing and making these improvements is described.

An overview of the qualities, monitoring questions, and indicators for monitoring trends in wilderness character is shown in table 1 on the next page (*italics* highlight differences among the monitoring questions within a quality). The measures and their data sources for each indicator are fully described in *Appendix A*. Detailed explanations for all the elements of this table are described in this document.

Table 1. An overview of the qualities, monitoring questions, and indicators for monitoring trends in wilderness character (*italics* highlight differences among the monitoring questions within a quality).

	Quality	Monitoring question	Indicator
Wilderness character	**Untrammeled—** Wilderness is essentially unhindered and free from modern human control or manipulation	What are the trends in actions that control or *manipulate* the "earth and its community of life" inside wilderness?	Actions authorized by the Federal land manager that manipulate the biophysical environment
			Actions not authorized by the Federal land manager that manipulate the biophysical environment
	Natural— Wilderness ecological systems are substantially free from the effects of modern civilization	What are the trends in terrestrial, aquatic, and atmospheric natural *resources* inside wilderness?	Plant and animal species and communities
			Physical resources
		What are the trends in terrestrial, aquatic, and atmospheric natural *processes* inside wilderness?	Biophysical processes
	Undeveloped— Wilderness retains its primeval character and influence, and is essentially without permanent improvement or modern human occupation	What are the trends in non-recreational *development* inside wilderness?	Non-recreational structures, installations, and developments
			Inholdings
		What are the trends in *mechanization* inside wilderness?	Use of motor vehicles, motorized equipment, or mechanical transport
		What are the trends in *cultural resources* inside wilderness?	Loss of statutorily protected cultural resources
	Solitude or Primitive and Unconfined Recreation— Wilderness provides outstanding opportunities for solitude or primitive and unconfined recreation	What are the trends in outstanding opportunities for *solitude* inside wilderness?	Remoteness from sights and sounds of people inside the wilderness
			Remoteness from occupied and modified areas outside the wilderness
		What are the trends in outstanding opportunities for *primitive and unconfined recreation* inside wilderness?	Facilities that decrease self-reliant recreation
			Management restrictions on visitor behavior

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Introduction

This document presents an interagency strategy—and the rationale behind this strategy—to monitor trends in wilderness character across the National Wilderness Preservation System (NWPS). The Interagency Wilderness Character Monitoring Team representing the Department of the Interior (DOI) Bureau of Land Management, DOI Fish and Wildlife Service, DOI National Park Service, DOI U.S. Geological Survey, and the U.S. Department of Agriculture Forest Service developed this strategy. This document also offers suggestions for how each of the four wilderness management agencies could develop plans to implement this monitoring. Last, implications are offered for a Government Performance and Results Act (GPRA) wilderness performance measure that is based on this interagency strategy.

The primary stewardship mandate of the 1964 Wilderness Act (Public Law 88-577) is to preserve wilderness character, yet after 44 years, the four wilderness management agencies lack a consistent definition of wilderness character and the means for measuring its loss or preservation or assessing how stewardship affects it. This interagency strategy provides a nationally consistent approach to describing and assessing trends in wilderness character across the full extent of the NWPS.

The two primary agency audiences for this interagency strategy are local staff who implement agency policies and manage wilderness day-to-day and regional and national staff who develop agency wilderness policy and assess its effectiveness. If implemented, the results of this monitoring would provide both audiences the data and information they need to improve wilderness policy and wilderness stewardship.

This document has been extensively reviewed by wilderness managers from the four wilderness management agencies (the development and review process is described in *Appendix B*), and fulfills the tasks assigned by the Interagency Wilderness Steering Committee (IWSC) to develop this interagency monitoring strategy. (The IWSC is a long-standing team composed of the national wilderness program leads from the four wilderness management agencies, and science representatives from the DOI National Park Service, U.S. Forest Service, and DOI U.S. Geological Survey.)

Purpose and Scope of This Interagency Monitoring Strategy

The purpose of this monitoring strategy is to improve wilderness stewardship by providing managers (from field office to Washington Office) in the four wilderness management agencies with a tool to assess how wilderness character is changing over time. This monitoring strategy provides information to help answer two key questions about the outcomes of wilderness stewardship:

- How is wilderness character changing over time?
- How do stewardship actions affect trends in wilderness character?

Information from this monitoring is needed by on-the-ground managers and decision-makers to assess whether stewardship actions for an individual wilderness are fulfilling the mandate to "preserve wilderness character." Information from this monitoring is also needed to inform program managers and decision makers about the effectiveness of agency policies to preserve wilderness character. This interagency monitoring strategy will provide this information based on credible data that are consistently collected and will endure over time as personnel change.

The interagency monitoring strategy presented in this document is based, in large measure, on the work of a U.S. Forest Service team (that included representatives from the DOI wilderness agencies) that produced two key documents: "*Monitoring selected conditions related to wilderness character: A national framework*" (Landres and others 2005) and "*Technical guide for monitoring conditions related to wilderness character*" (Landres and others, in press). The Interagency Wilderness Character Monitoring Team modified the ideas in these two Forest Service documents in both large and small ways to build a monitoring strategy that would fit the needs of all four wilderness management agencies.

Wilderness character is an exceedingly complex and multidimensional concept, encompassing tangible and intangible, local and national aspects of wilderness. To create a practical monitoring tool, this interagency strategy:

- Applies to areas that are designated by Congress as wilderness;
- offers a description of wilderness character for the purposes of this monitoring—this description is not intended to be all encompassing;
- Focuses on four qualities of wilderness derived from the Definition of Wilderness, Section 2(c), in the 1964 Wilderness Act, which are directly tied to wilderness character, and not on other qualities of wilderness;
- Monitors tangible wilderness conditions that indicate how these four qualities of wilderness are changing over time within a wilderness, and does not monitor the intangible aspects of wilderness, the quality of visitor experiences, or site-specific resources of concern; and
- Assesses whether wilderness character and its four qualities are improving, stable, or degrading over time at the scale of an entire wilderness. This monitoring does not compare wilderness character from one wilderness to another or develop a numerical index of wilderness character that could be used for such purposes.

Table 2. Units and acres of designated wilderness within each of the four wilderness management agencies. There are 702 wildernesses within the NWPS.

Agency	Number of wilderness units within each agency[1, 2]	Number of wilderness acres within each agency[1]	Percent of total agency acreage that is designated wilderness[3]	Percent of NWPS acres within each agency[1]
DOI Bureau of Land Management	189	7,796,837	2	7
DOI Fish and Wildlife Service	71	20,730,602	22	19
DOI National Park Service	56	43,536,647	56	41
USDA Forest Service	418	35,372,522	19	33

[1]Source: http://wilderness.net, accessed February 5, 2008.
[2]Total number of wilderness units in this table is greater than 702 because 32 units are shared among the four wilderness management agencies.
[3]Source: Congressional Research Service 2004 report to Congress "Federal Land Management Agencies: Background on Lands and Resource Management" available from http://digital.library.unt.edu/govdocs/crs/permalink/meta-crs-6017:1.

The geographic scope of this monitoring is the entire NWPS because it applies to all designated wilderness. This is a significant amount of land nationwide and a significant amount of the land portfolio of the four agencies with responsibility for wilderness stewardship (table 2). Together, these four agencies administer nearly 107.5 million acres of Federal land that is designated as wilderness, about 17 percent of all the land managed by these four agencies.

Overview of Wilderness Character

Despite the mandate of the 1964 Wilderness Act to preserve wilderness character, the four wilderness management agencies lack a consistent definition of wilderness character and the tools to evaluate how it is changing over time. Although several programs currently monitor some of the specific resources within wilderness, the most critical need is to synthesize this and other monitoring data into a coherent understanding of what makes wilderness unique among all other Federal lands—its wilderness character.

Why Focus on Wilderness Character?

Focusing on wilderness character would help managers comply with law, fulfill agency policy, and improve wilderness stewardship.

Comply With Law

The Statement of Policy, Section 2(a), in the 1964 Wilderness Act states that wilderness areas "shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, *and so as to provide for the protection of these areas, the preservation of their wilderness character*" (emphasis added). Rohlf and Honnold (1988) and McCloskey (1999) assert that the statement "… each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area" (Section 4(b), Use of Wilderness Areas) gives the primary management direction for wilderness. Section 4(b) also states that even when the agency administers the area for other purposes, the agency must also "preserve its wilderness character." The Congressional Record (U.S. Congress 1983) supports this assertion, stating "The overriding principle guiding management of all wilderness areas, regardless of which agency administers them, is the Wilderness Act (section 4[b]) mandate to preserve their wilderness character."

The 1993 Government Performance and Results Act requires Federal agencies to demonstrate accountability "by providing … information about program results and service quality." Wilderness character monitoring provides such information about agency decisions and actions to "preserve wilderness character."

Fulfill Agency Policy

Wilderness policies from all four agencies directly address the need for preserving wilderness character (table 3). The intent of these policies is to prevent the degradation of wilderness character from its condition or state at the time the area was designated as wilderness.

Improve Wilderness Stewardship

Before the Wilderness Act was enacted, Howard Zahniser, principal author of the Act, stated that "in all concern with wilderness, the first safety must be for the wilderness character itself" (Zahniser 1961). Today, many wilderness field and program managers perceive steady erosion in wilderness character caused by widespread threats (Cole 2002; Cole

Table 3. Policy statements from each agency about wilderness character, with emphasis added.

Agency	Policy reference	Policy statement
DOI Bureau of Land Management	43 CFR Part 6300 (Federal Register, Vol. 65, No. 241, page 78358, December 14, 2000)	I. Background. "Unless Congress specifies otherwise, BLM must ensure the preservation of *wilderness character* in managing all activities conducted within wilderness areas."
	Manual 8560 – Management of Designated Wilderness Areas, Release 8-22, April 27, 1983	02. Objectives. "The Bureau administers wilderness for such other purposes for which it may have been established as also to preserve its *wilderness character*…"
		06. Policy. A. "Wilderness areas are managed so as to preserve their *wilderness character*…"
DOI Fish and Wildlife Service	Habitat Management 6 RM 8. Wilderness Area Management, 8.8 Administrative Guidelines, 1986	A. "Motorized equipment may be used in special circumstances if it is the minimum tool necessary to accomplish a task safely and without long term impairment of the area's *wilderness character*."
		C. "In Alaska, previously existing public use cabins may continue to be used and may be maintained or replaced subject to restrictions necessary to preserve the *wilderness character* of the area."
		L. "In Alaska, ANILCA authorizes the use of temporary campsites, tent platforms, shelters and other temporary facilities related to the authorized taking of fish and wildlife if they are not detrimental to the refuge purposes or *wilderness character* of the affected area."
DOI National Park Service	2006 Management Policies, Chapter 6: Wilderness Preservation and Management	6.1 General Statement. "The purpose of wilderness in the national parks includes the preservation of *wilderness character* and wilderness resources in an unimpaired condition…"
		6.3 Wilderness Resource Management, 6.3.1 General Policy. "In addition to managing these areas for the preservation of the physical wilderness resources, planning for these areas must ensure that the *wilderness character* is likewise preserved."
USDA Forest Service	Chapter 2320—Wilderness Management, June 21, 1990	2320.2—Objectives, 4. "Protect and perpetuate *wilderness character*…"
		2323.14—Visitor Management. "Plan and manage public use of wilderness in such a manner that preserves the *wilderness character* of the area."

and Landres 1996; Hendee and Dawson 2001; Landres and others 1998). There have been repeated calls for monitoring to provide information needed for improving wilderness stewardship (for example, Government Accounting Office 1989). In 1999, the four agencies requested the Pinchot Institute for Conservation to create a blue-ribbon panel to offer recommendations for improving wilderness stewardship. This panel offered four key recommendations, including one that recommended the agencies "devise monitoring and evaluation systems to ensure that we know how well wildernesses are being stewarded, especially in the context of a system of wilderness" (Pinchot Institute for Conservation 2001).

Focusing on wilderness character links on-the-ground wilderness conditions to the mandates of the Wilderness Act and agency policy to "preserve wilderness character," helping to:

- Understand how stewardship decisions influence trends in wilderness character;
- Improve agency defensibility in legal questions regarding "preservation of wilderness character";
- Establish priorities for stewardship actions that show the most promise to improve the trend in wilderness character; and
- Provide a powerful communication tool to easily convey whether or not the agency is preserving wilderness character.

What Is Wilderness Character?

The 1964 Wilderness Act doesn't define wilderness character and the congressional committees that debated the Wilderness Act did not discuss the meaning of wilderness character (Scott 2002). The Forest Service's national framework for monitoring wilderness character (Landres and others 2005) identified three mutually reinforcing societal ideals integral to the historical purpose of wilderness and to understanding wilderness character:

- Natural environments relatively free from modern human manipulation and impacts;
- Personal experiences in natural environments that are relatively free from the encumbrances and signs of modern society; and
- Symbolic meanings of humility, restraint, and interdependence in how individuals and society view their relationship to nature.

Wilderness character may be described as the combination of biophysical, experiential, and symbolic ideals that distinguishes wilderness from other lands. These ideals combine to form a complex and subtle set of relationships among the land, its management, its users, and the meanings people associate with wilderness. In total, these relationships and meanings are described as "wilderness character."

Zahniser (1956) wrote that "to know the wilderness is to know a profound humility, to recognize one's littleness, to sense dependence and interdependence, indebtedness, and responsibility." This and other writings of Zahniser strongly reinforce the idea that, fundamentally, wilderness character is the capacity of an area to elicit humility, awaken a sense of relationship and interconnectedness with the community of life, and evoke a feeling of restraint and obligation toward nature.

Wilderness Character Is Unique for Each Wilderness

Congress determines the state of wilderness character at the time an area is designated as wilderness, so every wilderness is unique in its combination of legislative and administrative direction and social and biophysical settings. For example, the character of a wilderness close to an urban area is likely to have more visitors, air pollutants, and sights and sounds of modern civilization than the character of a wilderness that is far from

an urban area. Regardless, the agency's management responsibility is to preserve the wilderness character of each area from further degradation. The legislative history of a wilderness may inform managers about why Congress designated that area and the special values or special features, purposes, and places within it (Meyer 2000).

This uniqueness means that change in wilderness character can only be understood in the context of a particular area and that it cannot be compared from one wilderness to another. Also, there can be no national numerical standard regarding wilderness character other than agency policy to preserve wilderness character relative to the time the area was designated as wilderness.

Four Qualities of Wilderness Character

Congressional intent for the meaning of wilderness character is expressed in the Definition of Wilderness, Section 2(c) of the 1964 Wilderness Act (McCloskey 1999; Rohlf and Honnold 1988; Scott 2002). The Forest Service national framework (Landres and others 2005) applied this legal definition to identify four tangible qualities of wilderness that make the idealized description of wilderness character relevant and practical to wilderness stewardship:

- *Untrammeled*—The Wilderness Act states that wilderness is "an area where the earth and its community of life are untrammeled by man," and "generally appears to have been affected primarily by the forces of nature." In short, wilderness is essentially unhindered and free from modern human control or manipulation. This quality is degraded by modern human activities or actions that control or manipulate the components or processes of ecological systems inside the wilderness.
- *Natural*—The Wilderness Act states that wilderness is "protected and managed so as to preserve its natural conditions." In short, wilderness ecological systems are substantially free from the effects of modern civilization. This quality is degraded by intended or unintended effects of modern people on the ecological systems inside the wilderness since the area was designated.
- *Undeveloped*—The Wilderness Act states that wilderness is "an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation," "where man himself is a visitor who does not remain" and "with the imprint of man's work substantially unnoticeable." This quality is degraded by the presence of structures, installations, habitations, and by the use of motor vehicles, motorized equipment, or mechanical transport that increases people's ability to occupy or modify the environment.
- *Solitude or a primitive and unconfined type of recreation*—The Wilderness Act states that wilderness has "outstanding opportunities for solitude or a primitive and unconfined type of recreation." This quality is about the *opportunity* for people to experience wilderness; it is not directly about visitor experiences per se. This quality is degraded by settings that reduce these opportunities, such as visitor

encounters, signs of modern civilization, recreation facilities, and management restrictions on visitor behavior.

Federal agencies must implement laws in their entirety, not just selected sentences, and this influenced our interpretation of these four qualities. For example, we use the word "essentially" in our interpretation of the untrammeled quality to state, in the strongest terms we could, the importance of wilderness not being manipulated while acknowledging several qualifying words that occur in the legal definition of wilderness.

These four qualities together comprise an approximation of wilderness character for wilderness planning, stewardship, and monitoring. For the purpose of this interagency monitoring strategy, all four qualities are equally important and none is held in higher or lower regard than the others. A detailed discussion of the historical and scientific support and specific concerns for each of the four qualities is provided in the Forest Service national framework (Landres and others 2005) and Technical Guide (Landres and others, in press) and is summarized in the *Framework for Wilderness Character Monitoring* section.

These Four Qualities Apply to All Wildernesses

These four qualities apply to all designated wilderness areas—regardless of size, location, administering agency, or other unique place-specific attributes—because they are based on the legal definition of wilderness and every wilderness law includes specific language that ties it to this definition (Hendee and Dawson 2002; Landres 2003). While individual wilderness laws may include specific exceptions or special provisions that apply to the uses and values of particular areas, no Federal legislation changes the 1964 Act's Section 2(c) Definition of Wilderness, and no legislation changes the management responsibility of Section 4(b) for "preserving the wilderness character of the area."

Wilderness Character Is More Than These Four Qualities

In addition to the four tangible qualities related to wilderness character used in this interagency strategy, there are also important intangible aspects of wilderness character that would be difficult or even impossible to quantify or monitor. These intangible aspects are diverse and include the scenic beauty and immensity of an area and the opportunity for self-discovery, self-reliance, and challenge that comes from wilderness settings. These intangible aspects are important contributors to the inspirational and psychological benefits that many people experience in wilderness (Putney and Harmon 2003; Roggenbuck and Driver 2000; Schroeder 2007). These intangible aspects of wilderness character could be added to this interagency strategy as research develops practical monitoring indicators.

Decisions and Actions May Preserve or Degrade These Four Qualities

Wilderness character may be either preserved or degraded by the actions or inactions of managers. For example, the choices to not use a chain saw, build a footbridge across a stream, or suppress a naturally ignited fire may preserve certain qualities of wilderness character. In contrast, other management actions, such as requiring visitors to use designated

campsites or authorizing administrative use of motorized equipment and mechanical transportation, may diminish certain qualities of wilderness character.

The challenge of wilderness stewardship, however, is that decisions and actions taken to protect one aspect of wilderness character may diminish another aspect. For example, a bridge built to protect a stream bank from erosion caused by people or horses crossing the stream may also diminish the opportunity for people to experience the challenge of crossing a stream. Similarly, the required use of designated campsites to prevent the proliferation of sites and associated impacts on soil and vegetation may also diminish the opportunity for unconfined recreation and the sense of freedom from the constraints of regulation. In addition, the accumulated result of seemingly small decisions and actions may cause a significant gain or loss of wilderness character over time. Because of this complexity, preserving wilderness character requires that managers approach wilderness stewardship with humility, respect, and restraint.

Approach to Interagency Wilderness Character Monitoring

The overall approach of this interagency monitoring strategy is for each wilderness to: 1) choose a set of measures that are relevant, cost-effective, and tied to preserving wilderness character, 2) periodically collect data to assess trend in these measures, and 3) use these trends to assess and report on the trend in wilderness character. Each agency would then compile these trends from each wilderness to assess broad scale agency performance in preserving wilderness character. Similarly, data from each agency would be compiled to assess performance in preserving wilderness character across the National Wilderness Preservation System.

"Structured Cafeteria Approach" for Monitoring Trends in Wilderness Character

Trends in wilderness character would be monitored in the four wilderness management agencies using a "structured cafeteria approach." In general, a cafeteria approach allows the user to select one option from among several that are offered. The structured cafeteria approach in this strategy requires the four agencies to use the same organizational framework and methods for assessing trend in wilderness character, and each would then select at least one measure to assess the trend in every indicator. This approach allows each agency to select measures that best fit its needs and capabilities, as long as the measure is appropriate and relevant to assessing trend in the indicator.

This approach balances national and local needs for monitoring by allowing each agency to select measures that are locally relevant, and then compiling just the trend (improving, stable, or degrading) for regional or national reporting. Local relevance is crucial for successful implementation—this monitoring must not satisfy national needs at the expense of local utility. Such agency flexibility is essential for this interagency strategy because the data that are currently available to all four agencies (for example, size of the wilderness) would not allow any wilderness to meaningfully assess trend in wilderness character.

Even though the structured cafeteria approach allows needed interagency and local flexibility, this approach can also be abused. Significant concerns with this approach are that: 1) meaningless measures may be selected, 2) particular measures may be selected to show a desired outcome, and 3) the set of measures that are selected may not add up to a coherent or viable assessment of trend in wilderness character. To prevent these problems, we recommend that each agency charter a team with the responsibility for reviewing all measures that are selected for this monitoring, and rejecting those found to be inappropriate or inadequate (see the *Process for Improving This Approach Over Time* section for additional tasks for these teams). In addition, all agencies would be required to report on trends in all four qualities, monitoring questions, and indicators, thereby providing a consistent and coherent assessment across the NWPS (see the *Framework for Wilderness Character Monitoring* section).

Key Elements of This Approach

The general elements of this approach are described below. Specific aspects of this approach related to the selection of indicators and measures are not discussed here but in the *Framework for Wilderness Character Monitoring* section.

Trends in Wilderness Character Would Be Monitored in Every Wilderness

Trends in wilderness character would be assessed for every wilderness within the NWPS because the Wilderness Act mandates preserving wilderness character in every wilderness. Assessing trends in every wilderness informs local management and provides a more accurate assessment of national trends than would be possible by collecting data from a sample of wildernesses. Each agency would be responsible for developing its own protocols for collecting the data, but communication among the agencies is necessary to ensure that trends could be compiled across the NWPS.

Baseline for Evaluating Change Is the Time of Wilderness Designation or the First Time This Monitoring Is Conducted

Baseline conditions provide the reference point against which change over time is measured and evaluated. Ideally, this baseline is documented at the time a wilderness is designated. For wildernesses that have already been designated, appropriate historical data, if available, should be used to describe the baseline condition retrospectively. However, few existing wildernesses actually have this information. Therefore, baseline condition would most likely be documented from the first time this monitoring is implemented, even though such a description would not give an accurate picture of how the wilderness has changed since the time of designation.

Baseline conditions are simply the beginning point for tracking trends and do not imply that these conditions are "good," "bad," or "desired." For example, at the time of designation a wilderness may have existing roads, and these roads would be part of the baseline condition of this wilderness. Monitoring would show how the undeveloped quality of wilderness stays the same if the roads are not removed or improves if these roads are removed. Baseline conditions are the starting point for tracking change over time. Local interpretation is crucial for evaluating the relevance of this change in its historical and legislative context.

This Monitoring Would Report Trends from Each Wilderness for Compilation Nationwide

Each wilderness would report trend in wilderness character, as well as trend in each of the four qualities, monitoring questions, and indicators (described in the *Framework for Wilderness Character Monitoring* section) for compilation and upward reporting. Data would be collected only for the measure and input into agency database systems—all subsequent assessments of trend are based on simple consolidation rules described in the *Assessing Trend in Wilderness Character* section.

National Trends in Wilderness Character Would be Reported Every 5 Years

A national interagency report on trends in wilderness character across the NWPS would be produced every 5 years, with interim reports possible to sustain agency and public interest. To facilitate on-the-ground stewardship decisions and actions, each measure would be monitored as frequently as appropriate to identify trends. For example, agency use of motorized equipment would appropriately be monitored annually, whereas active grazing allotments might appropriately be monitored every 5 years.

No New National Standard for Wilderness Character Would Be Developed

The Wilderness Act requires that wilderness character be preserved relative to the time the area was designated as wilderness. Consequently, the standard for each wilderness under this monitoring framework is that wilderness character in each wilderness be "stable" or "improving." However, because of the uniqueness of wilderness character in each wilderness, no national standards for the measured values of wilderness character would be developed as part of this monitoring strategy—such standards could only be developed through local planning processes.

Measures That Are Relevant to Wilderness Character Would Be Monitored Regardless of Managerial Jurisdiction

In some cases, measures are recommended that are not directly under the management jurisdiction of the agency because they are nonetheless an important part of wilderness character. For example, night sky visibility, air quality, and global climate change are all affected by many things that are beyond direct management control (as well as some that are under management control), but they nonetheless have a big impact on the social and ecological aspects of wilderness character. Such measures also demonstrate the use of wilderness as a benchmark for assessing future changes. If this monitoring were implemented, the accompanying narrative would allow discussion of how such measures are outside managerial control or jurisdiction, and that they would not be included with the GPRA performance measures.

Wildernesses Character From Different Wildernesses Would Not Be Compared

Wilderness character in a particular wilderness cannot and will not be compared to that of another wilderness under this monitoring strategy. Each wilderness is unique in its legislative and administrative direction, and in its social and biophysical setting, so comparing wilderness character among different wilderness is inappropriate. For example, a wilderness with legislative provisions that allow motor vehicles for subsistence use or to manage wildlife would be expected to have more motor vehicle uses tracked under the undeveloped quality compared to a wilderness that has no such legislative provision. The different amount of motor vehicle use among different wildernesses is not relevant. What is important is whether motorized use is decreasing, stable, or increasing over time in a particular wilderness.

While wilderness character would not be compared among wildernesses, trends in wilderness character (improving, stable, or degrading) would be compared and compiled across different wildernesses because these trends are derived in a nationally consistent manner—from this interagency strategy—and are independent of special provisions or other unique aspects of a wilderness. For example, the percentage of wildernesses with degrading trends could be compared across different regions to assess regional differences in policy implementation.

This Interagency Strategy Supports But Is Not a Substitute for Minimum Requirements or National Environmental Policy Act Analyses

The definition of wilderness character and the four qualities discussed in this interagency strategy may help management staff organize assessments on the effects of proposed projects. Such organization may be a useful foundation for Minimum Requirements or National Environmental Policy Act analyses but is not a substitute for either of these. This monitoring may be of further use to track how decisions resulting from these assessments affect wilderness character through time.

Concerns About This Interagency Approach

There are several potential concerns about using this interagency strategy to monitor trends in wilderness character. These concerns include:

- *Insufficient resources*—There is limited funding and staff to implement such monitoring, especially because it is a new initiative. To address this concern, several data sources with varying levels of accuracy and cost are described for each measure. Each agency (and potentially each wilderness) may choose the data source that is appropriate for their needs and circumstances. In addition, each agency (and potentially each wilderness) may choose a measure based on current or expected data availability.
- *Differing data needs among agencies*—While each of the four wilderness management agencies have some common data needs, they also have differing data needs as well as different wilderness policies and traditions. To address this concern, each agency (and potentially each wilderness) may choose a measure for each indicator that is directly relevant to that agency.
- *Differing monitoring systems among agencies*—Each of the four wilderness management agencies currently have widely differing systems for monitoring, data management, data use, and reporting. To address this concern, each wilderness would report only the trend (improving, stable, or degrading) in wilderness character, the four qualities, and each monitor question and indicator. The trend and status of the measure is of use only to the local wilderness and is not reported or compiled to assess broad scale trends. If the decision is made to implement this monitoring strategy across the agencies, then new data storage, management, and reporting systems would need to be developed to allow compiling these trends.
- *Sinking to the lowest common denominator*—In any such effort, the tendency is to monitor only those wilderness attributes or conditions

that are common to all four wilderness management agencies. However, the only data that are likely common is the number of acres in a wilderness, and this is clearly insufficient for monitoring trends in wilderness character. To address this concern, the structured cafeteria approach recommended in this interagency strategy requires that each wilderness choose at least one measure for each of the indicators, ensuring reporting of trends in the indicators, monitoring questions, qualities, and overall trend in wilderness character.

- *Comparing wildernesses*—As already discussed, wilderness character is unique to each wilderness and shouldn't be compared across different wildernesses. But if this monitoring were implemented, it would be easier for some people to make these comparisons even though it is inappropriate to do so. To address this concern, this document clearly states that this is inappropriate and discusses why wilderness character cannot be compared from one wilderness to another.
- *Oversimplifying*—There are three related concerns about oversimplifying wilderness character. First, developing a single assessment of trends in wilderness character for an entire wilderness requires that very different and complex elements be combined, and some of these elements may be inversely related. Second, different elements change at different rates or they may represent differing wilderness aspects. Combining these elements may obscure changes or trends that are important for the local manager to understand. Third, focusing on just these four qualities of wilderness may allow managers and others to ignore important experiential, symbolic, and intangible aspects of wilderness character (Moore 2007; Putney and Harmon 2003; Schroeder 2007). These other aspects of wilderness are just as important as the tangible ones even though they are much harder to quantify and measure. To address this concern, this document clearly states the need for users of this monitoring information to be aware of these oversimplifying limitations. In addition, a narrative from the wilderness manager would accompany the trend report, providing richer information to understand and interpret the trends.
- *Reductionism*—Splitting the legislative definition of wilderness into four relatively distinct and tangible qualities imposes reductionistic thinking on the fundamentally holistic concept of wilderness character. One problem with this reductionism is that a particular action may be associated with either a positive or negative outcome depending on the particular quality from which the action is viewed. For example, to protect the "natural" quality, a bridge may be built to reduce resource damage (such as increased sediment in the stream associated with people and horses crossing a stream). However, this bridge then reduces the "solitude or a primitive and unconfined" quality because the personal discovery and challenge of crossing the stream is diminished. To address this concern, this interagency strategy clearly states the need for users of this monitoring information to be aware of the problems of reductionism, and the accompanying narrative would allow discussion and interpretation to address this concern.

It is important to recognize that even though the goal is to monitor trends in wilderness character, this interagency strategy can only assess selected

indicators of wilderness character. Further, because many of these indicators are only coarse estimators of the wilderness attribute of interest, change in the indicators should be viewed as a "red flag" that prompts closer scrutiny about what is going on. Despite these concerns, this interagency strategy provides a more solid foundation to tie wilderness stewardship to the legislative direction of the Wilderness Act than has ever existed before.

Process for Improving This Approach Over Time

Monitoring trends in wilderness character has never been attempted before so it is important to recognize that improving the approach recommended here would be necessary. To ensure credibility and continual improvement over time, this process must be open to input from the agencies, wilderness managers, scientists, and public to reflect lessons learned during implementation as well as new thinking about wilderness character. Similarly, the outcomes of this process need to be openly communicated. Both the interagency aspects of this approach, as well as its usefulness to wilderness stewardship, would be evaluated.

A two-step improvement process is recommended. The first step would be a periodic review conducted by a team chartered within each agency. Each team would review the agency's accomplishments in implementing this monitoring, solicit input from users, assess relevance of the measures used, and review the availability of new data sources and applicable research. This periodic review would allow each wilderness and agency to update and improve the measures used in assessing trend in wilderness character. The second step would be a major review conducted at a meeting of all the agency teams and would occur after the 5-year interagency reporting on trends in wilderness character. This 5-year review would:

- solicit, compile, and organize input from users;
- assess the relevance and effectiveness of all the specific components of this monitoring (see the *Framework for Wilderness Character Monitoring* section for a description of these components);
- assess the effectiveness of data storage, analysis, and synthesis techniques; and
- assess the effectiveness of reporting and use of this monitoring information by line officers and staff.

Framework for Wilderness Character Monitoring

Overview

This interagency monitoring Framework is based on hierarchically dividing wilderness character into successively finer elements. These elements, starting from wilderness character, are:

- *Qualities*—primary elements of wilderness character that link directly to the statutory language of the 1964 Wilderness Act. In this Framework, all four qualities are necessary to assess trends in wilderness character and each wilderness would be required to report the trend for each quality.
- *Monitoring questions*—major elements under each quality that are significantly different from one another. Monitoring questions frame this monitoring to answer particular management questions. In this context, monitoring questions are similar to monitoring goals. Each wilderness and agency would be responsible for reporting on the trend for all eight monitoring questions.
- *Indicators*—distinct and important elements within each monitoring question. In nearly all cases, there is more than one indicator under a monitoring question. Each wilderness and agency would be responsible for reporting on the trend for all 13 indicators.
- *Measures*—a specific aspect of wilderness on which data are collected to assess trend of an indicator. In nearly all cases, there is more than one measure to provide each agency (and potentially each wilderness within an agency) a range of options for assessing trend in the indicator. Some of these measures are more accurate and precise but costly, while others are less accurate and precise but easier and less expensive to monitor. For example, under the indicator "Remoteness from sights and sounds of people inside wilderness" (see page 28 table 7), the measure "amount of visitor use" requires substantial effort and cost but is fairly precise. On the other hand, the measure "area of wilderness affected by access or travel routes" is fairly easy to compute in a Geographic Information System, but is not very precise because it doesn't assess the number of people inside the wilderness. This range of measures allows different agencies and wildernesses to choose the measure(s) that are relevant and practical. We recommend monitoring all the measures for which data are available to give the most accurate assessment possible and, if two or more measures are monitored, that they be equally weighted to prevent giving a biased trend in the indicator.

  For a few measures, the use of an "index" is recommended. In these cases, several attributes are considered simultaneously to assess trend and the different attributes may be weighted differently. For example, the index of physical development would combine the type and number of structures. Developing an index typically requires subjective judgments about the types of attributes to include, their relative weighting (for example, a dam has more impact than an outhouse), and how they would be mathematically combined. In the detailed descriptions of the measures given in *Appendix A*, only the types of attributes are suggested—if this interagency strategy is implemented,

each agency would need to develop these indexes based on their data capabilities and needs.

Each measure is used only once, under the quality that was deemed most relevant given the broad interagency perspective of this monitoring strategy. This approach avoids problems of double-counting some measures and the bias this would introduce. However, some measures are clearly relevant to more than one quality. Agency provided system trails, shelters, and toilets, for example, are relevant to both the undeveloped quality and the solitude or primitive and unconfined recreation quality. In such cases, different agencies (and different wildernesses if allowed by their home agency) may assign the measure to a different quality than what is presented in this framework. These differences are not nearly as important as consistency over time within an agency or wilderness because this monitoring strategy is based on assessing how wilderness character is changing only within a single wilderness.

If none of the recommended measures under a particular indicator are relevant to an agency or wilderness, other measures may be used or developed as long as the rationale is made clear for how the new measure is relevant to the indicator and how it is measurable, credible, and repeatable. For example, a wilderness may develop a measure that is relevant for assessing place-based aspects or other special features. We recommend that a wilderness character monitoring team within each agency be tasked to approve the use of such measures and communicate this use with the other wilderness management agencies.

Several data sources are given for every measure, again, to reflect different capabilities and needs of the different agencies. Each of these different data sources poses a different concern about the quantity and quality of the data and the ability to collect the data in a consistent way over time. To help offset these concerns, a narrative about the methods used and data adequacy (composed of data quantity and data quality) would accompany the data to allow future assessment of trends and use of the information (see the *Narrative About the Trend in Wilderness Character* section). An approach to assessing and recording data adequacy is developed in the Technical Guide (Landres and others, in press). Depending on the indicator and measure, these data sources are:

- *Agency data systems*—The agency routinely collects these data and stores them in a database or other computer application that is accessible to all field offices within the agency.
- *Local data entry by resource specialists*—Local agency resource specialists could use a variety of sources for data, including local office records, data from other resource specialists, professional judgment, or other sources as appropriate.
- *Record cards from staff and volunteers*—Staff or volunteers would be trained to record specific types of data. This data source may not be as rigorous as the others, and would strongly depend on the amount of effort and expertise used to collect the data.
- *National data sets*—Data can be downloaded without charge from a central access point by personnel in the four wilderness management agencies. Within this interagency monitoring strategy, 10 measures

(out of a possible 37) rely on such national data sets. For example, air quality data can be downloaded from EPA and other select websites, departure from natural fire regime downloaded from the LANDFIRE website, and night sky visibility downloaded from the Dark Sky Society website. If this interagency strategy is implemented, we recommend that a central data manager pull these national data and make them available to the four wilderness management agencies. Such centralized staff would significantly increase cost efficiency and decrease the workload on local staff.

This hierarchical set of qualities, monitoring questions, indicators, and measures allows national assessment of trends while still allowing flexibility for individual agencies and wildernesses to monitor the specific elements of wilderness character most meaningful to them. The set of recommended indicators and measures was chosen because they are relevant and would maximize cost-efficiency and minimize workforce impacts.

Within a single wilderness, change over the monitoring period in each measure is assessed as "improving," "stable," or "degrading." Each wilderness then consolidates these trends using consistent rules (explained in the *Assessing Trends in Wilderness Character* section) to assess trend in the indicator. Indicator trends are similarly compiled to assess trend in the monitoring question and quality, and ultimately to assess the trend in wilderness character.

It is crucial to understand that in this approach data are collected for the measure only, and all subsequent assessments of trend are based on simple consolidation rules. By using this assessment system consistently, trends across individual wildernesses can be compiled to assess the percent of wildernesses in which wilderness character is preserved or degrading across an agency or region or the National Wilderness Preservation System.

Untrammeled Quality

Section 2(c) of the Wilderness Act states that wilderness is "hereby recognized as an area where the earth and its community of life are untrammeled by man." The word "untrammeled" is rarely used in ordinary conversation, but Howard Zahniser, the primary author of the Wilderness Act, used untrammeled as a key word in the definition of wilderness.

Since passage of the Act, the word untrammeled and its meaning for wilderness stewardship have been discussed at length (for example, Aplet 1999, Scott 2002). Untrammeled means "allowed to run free" (American Heritage Dictionary 1992). Synonyms for untrammeled include unrestrained, unmanipulated, unrestricted, unhindered, unimpeded, unencumbered, self-willed, and wild.

Zahniser (1963) noted that the inspiration for wilderness preservation "is to use 'skill, judgment, and ecologic sensitivity' for the protection of some areas within which natural forces may operate without man's management and manipulation." Wilderness is very different from other Federal lands in that legislation dictates not only the goals of stewardship, but how management is to be approached—with humility and with

an eye toward not interfering with nature and not manipulating the land and its community of life. Furthering this notion, Lucas (1973) commented, "If ecological processes operate essentially uncontrolled within the Wilderness frame of reference, the results, whatever they might be, are desirable by definition. The object is not to stop change, nor to recreate conditions as of some arbitrary historical date, nor to strive for favorable change in big game populations or in scenic vistas. The object is to let nature 'roll the dice' and accept the results with interest and scientific curiosity." More recently, Nash (2004) noted that "Restraint is at the core of the new valuation of wilderness as a moral resource. When we protect wilderness we deliberately withhold our power to change the landscape."

Actions that intentionally manipulate or control ecological systems inside wilderness degrade the untrammeled quality of wilderness character, even though they may be taken to restore natural conditions or for other purposes. For example, wilderness is manipulated and the untrammeled quality of wilderness character is diminished when naturally ignited fires are suppressed inside wilderness, dams are built that impede natural water flow, or selected animals or plants are removed. Wilderness is also manipulated when restoration actions remove trees and fuels that have accumulated because of fire suppression, herbicides are used to control certain plants, or wildlife populations are manipulated by actions that provide food or water. This concept of trammeling applies to all manipulation since the time of wilderness designation but does not apply to manipulations that occurred prior to wilderness designation, such as the use of fire by native people to promote game habitat, because the mandates of the Wilderness Act don't apply prior to designation.

Unlike management on any other Federal land, wilderness legislation directs the managing agency to scrutinize its actions and minimize control or interference with plants, animals, soils, water bodies, and natural processes. Prominence of "untrammeled" in the Wilderness Act distinguishes the untrammeled quality from the natural quality, although the two are clearly linked. In essence, the untrammeled quality monitors *actions* that intentionally manipulate or control ecological systems, whereas the natural quality monitors the intentional and unintentional *effects* from actions taken inside wilderness as well as from external forces on these systems. Separating actions from effects offers clearer understanding of trends in actions compared to trends in effects, permitting more effective analysis and use of the information to improve wilderness stewardship.

Monitoring Framework for This Quality

The untrammeled quality is degraded by modern human actions that intentionally control or manipulate the components or processes of ecological systems inside the wilderness (table 4). The Forest Service Technical Guide (Landres and others, in press) defines "actions" and offers detailed protocols for using actions as a measure. A detailed discussion of the monitoring questions, indicators, measures, and data sources for the untrammeled quality is in *Appendix A*.

Table 4. Recommended monitoring framework for the untrammeled quality.

Quality	Monitoring question	Indicator	Measure	Data sources
Untrammeled – Wilderness is essentially unhindered and free from modern human control or manipulation	What are the trends in actions that control or manipulate the "earth and its community of life" inside wilderness?	Actions authorized by the Federal land manager that manipulate the biophysical environment	Number of actions to manage plants, animals, pathogens, soil, water, or fire	▪ Agency data systems (if available) ▪ Local data entry by resource specialists ▪ Minimum Requirements analyses
			Percent of natural fire starts that received a suppression response	▪ Agency data systems ▪ National fire data systems ▪ Local data entry by resource specialists
			Number of lakes and other water bodies stocked with fish	▪ Agency data systems (if available) ▪ State agencies ▪ Local data entry by resource specialists
		Actions not authorized by the Federal land manager that manipulate the biophysical environment	Number of unauthorized actions by agencies, citizen groups, or individuals that manipulate plants, animals, pathogens, soil, water, or fire	▪ Law enforcement data systems (if available) ▪ Other federal and state agency data systems ▪ Record cards from other staff and volunteers ▪ Local data entry by resource specialists

Natural Quality

One of the major themes running throughout the 1964 Wilderness Act is that wilderness should be free from the effects of "an increasing population, accompanied by expanding settlement and growing mechanization" and that the "earth and its community of life…is protected and managed so as to preserve its natural conditions" (Section 2(a) and 2(c), respectively). Historically, wilderness is strongly associated with protecting and preserving ecological systems from the impacts of modern people (Sutter 2004).

In today's terms, this means that the indigenous species composition, structures, and functions of the ecological systems in wilderness are protected and allowed to be on their own, without the planned intervention or the unintended effects of modern civilization. Only through such protection may wilderness truly serve as "a laboratory for the study of land-health" (Leopold 1949) and as an ecological baseline for understanding the effects of modern civilization on natural systems (Arcese 1997).

Ecological systems inside wilderness are directly affected by things that happen inside as well as outside the wilderness, and by actions taken by agencies or citizens inside wilderness. For example, non-indigenous fish are intentionally introduced for recreational fishing, yet have far-reaching unanticipated negative effects on native biological diversity and nutrient

cycling in wilderness lakes (Knapp and others 2001). Livestock grazing may be allowed in wilderness, yet may contribute to soil disturbance and the spread of non-indigenous plants (Belsky and Blumenthal1997). Biological control agents may be used to eradicate invasive non-indigenous plants, yet may have unintended effects on indigenous plants (Louda and Stiling 2004). Dams outside wilderness alter hydrological flow regimes, adversely affecting the riparian plant communities within wilderness (Cowell and Dyer 2002). Air pollutants from sources outside wilderness disperse long distances, affecting wilderness vegetation, soils, and aquatic systems (Schreiber and Newman 1987). Every wilderness shows the impacts from becoming increasingly isolated within a "sea" of modern development (Landres and others 1998).

All ecological systems change over time and vary from one place to another, and this monitoring is not intended to maintain static or unchanging natural conditions in wilderness. Monitoring only anthropogenic effects on natural conditions implies that there is sufficient understanding about these conditions and how they naturally vary over time and across a landscape to separate human-caused from natural change. In practice, this understanding is lacking. Therefore, trends in the indicators should be considered only "red flags" that suggest the need for research and more intensive monitoring to verify the change and understand its cause.

Monitoring Framework for This Quality

This quality is degraded by the effects of modern people on the ecological systems inside the wilderness since the time the area was designated as wilderness (table 5). Ideally, the ecological effects of all actions taken inside and the effects from activities occurring outside the wilderness would be monitored. Practical and conceptual constraints, however, mean that only a limited set of these effects could be monitored. For example, this monitoring is not intended for understanding the demography of listed species populations or the rates of carbon and nutrient cycling. Likewise, understanding cause-and-effect relationships is beyond the purpose, and practical and technical scope, of this monitoring framework. Several of the measures may be monitored using national data sets that are readily and freely available. A detailed discussion of the monitoring questions, indicators, measures, and data sources for the natural quality is in *Appendix A*.

Undeveloped Quality

Wilderness is defined in Section 2(c) of the 1964 Wilderness Act as "an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation," with "the imprint of man's work substantially unnoticeable." The basic idea that wilderness is undeveloped runs through every definition of wilderness. For example, Aldo Leopold (1921) envisioned wilderness as "a continuous stretch of country preserved in its natural state, open to lawful hunting and fishing, devoid of roads, artificial trails, cottages, or other works of man." Hubert Humphrey (1957), an original sponsor of the Wilderness Act, clarified his definition of wilderness as "the native

Table 5. Recommended monitoring framework for the natural quality.

Quality	Monitoring question	Indicator	Measure	Data sources
Natural – Wilderness ecological systems are substantially free from the effects of modern civilization	What are the trends in terrestrial, aquatic, and atmospheric natural resources inside wilderness?	Plant and animal species and communities	Abundance, distribution, or number of indigenous species that are listed as threatened and endangered, sensitive, or of concern	▪ Agency data systems (if available) ▪ Local data entry by resource specialists ▪ State agencies and other partners ▪ Record cards from staff and volunteers
			Number of extirpated indigenous species	▪ Agency data systems (if available) ▪ Local data entry by resource specialists ▪ State agencies and other partners
			Number of non-indigenous species	▪ Agency data systems (if available) ▪ Local data entry by resource specialists ▪ State agencies and other partners ▪ National FIA data
			Abundance, distribution, or number of invasive non-indigenous species	▪ Agency data systems (if available) ▪ Local data entry by resource specialists ▪ State agencies and other partners ▪ National FIA data ▪ Record cards from staff and volunteers
			Number of acres of authorized active grazing allotments and number of animal unit months (AUMs) of actual use inside wilderness	▪ Agency data systems (if available) ▪ Local data entry by resource specialists
			Change in demography or composition of communities	▪ National FIA data ▪ Remote sensing (satellite imagery, aerial photography) ▪ Photopoints (for particular places of concern) ▪ Local data entry by resource specialists
		Physical resources	Visibility based on average deciview and sum of anthropogenic fine nitrate and sulfate	▪ National IMPROVE data
			Ozone air pollution based on concentration of N100 episodic and W126 chronic ozone exposure affecting sensitive plants	▪ National EPA AIRS data ▪ National CASTNET data

Table 5. *Continued*.

Quality	Monitoring question	Indicator	Measure	Data sources
			Acid deposition based on concentration of sulfur and nitrogen in wet deposition	▪ National NADP/NTN data
			Extent and magnitude of change in water quality	▪ Agency data systems (if available) ▪ Water quality monitoring stations
			Extent and magnitude of human-caused stream bank erosion	▪ Photopoints ▪ Record cards from staff and volunteers
			Extent and magnitude of disturbance or loss of soil or soil crusts	▪ Remote sensing (aerial photography, satellite imagery) ▪ Photopoints ▪ Record cards from staff and volunteers
	What are the trends in terrestrial, aquatic, and atmospheric natural processes inside wilderness?	Biophysical processes	Departure from natural fire regimes averaged over the wilderness	▪ National LANDFIRE modeling program
			Extent and magnitude of global climate change	▪ National RAWS data stations ▪ National MODIS satellite imagery ▪ National SNOTEL data stations ▪ Photopoints ▪ Historical/recent photo pairs ▪ Remote sensing (aerial photography, satellite imagery)
			Area and magnitude for pathways for movement of non-indigenous species into the wilderness	▪ Agency data systems (if available) ▪ Local data entry by resource specialists ▪ State agencies and other partners
			Area and magnitude of loss of connectivity with the surrounding landscape	▪ Agency data systems (if available) ▪ Local data entry by resource specialists ▪ State agencies and other partners ▪ Remote sensing (aerial photography, satellite imagery)

condition of the area, undeveloped … untouched by the hand of man or his mechanical products."

The Wilderness Act identifies "expanding settlement and growing mechanization" as forces causing wild country to become occupied and modified, and clarifies in Section 4(c) that "there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation." An early Forest Service review of wilderness policy (USDA Forest Service 1972) noted that buildings or structures are usually installed for only one purpose—to facilitate human activity. The building or structure not only occupies the land, but also makes it easier for people to impose their will on the environment, thereby modifying it. This policy review also found that motorized equipment and mechanical transport similarly make it easier for people to occupy and modify the land. Zahniser (1956) articulated this idea when he argued the need for "areas of the earth within which we stand without our mechanisms that make us immediate masters over our environment." While the use of motor vehicles, motorized equipment, or mechanical transport diminishes the opportunity for visitors to experience natural quiet and primitive recreation, these uses are included under this undeveloped quality due to the close association in the legislative history between motorized use, mechanical transport, and people's ability to develop, occupy, and modify wilderness.

Few wildernesses have escaped at least some modern human occupation and modification. Many developments were "grandfathered" into the wilderness by special provisions in the enabling legislation, including buildings, roads, dams, powerline and water pipe corridors, and mines. While the continuing presence of these developments may be legal uses of wilderness, the resulting facilities, structures, and authorizations for motorized use and mechanical transport can have far-reaching effects on wilderness character (Hendee and Dawson 2002). The different special provisions unique to each wilderness underscore the importance of not comparing one wilderness to another.

Many developments degrade both the undeveloped quality and the solitude or primitive and unconfined recreation quality. It is not the purpose of this interagency strategy to determine whether a particular development has a greater impact on one quality or another. Such decisions are more appropriately made within a single agency or wilderness. Instead, this interagency strategy monitors non-recreational developments (such as administrative sites, dams, stock fencing, or fixed instrumentation sites) under the undeveloped quality, and recreation-focused developments (such as trails, campsites, shelters, or toilets) under the solitude or primitive and unconfined recreation quality because of the strong connection of the latter quality to recreational experiences. This distinction is also made to avoid double-counting recreational developments under both qualities.

Cultural resources (also known as heritage resources) within a wilderness may be an important part of wilderness character. These resources are the remains of patterned human activities that occurred in the past and include prehistoric sites, historical sites and structures, cultural landscapes, traditional use areas, and traditional cultural properties. These resources

are included under the undeveloped quality rather than one of the other qualities because they primarily represent human relationships with the land prior to modern wilderness designation.

Including cultural resources in this interagency strategy is controversial, with substantive reasons for both including and not including them. We included them because they help us understand our past and present relationships to the land (directly supporting the basis for the undeveloped quality as explained above), are important for conveying stories about the land that help us gain this understanding, and are tangible evidence of one of the values of wilderness described in Section 2(c)(4) of the Wilderness Act that is not accounted for elsewhere in this strategy. In addition, we wanted to be inclusive at this beginning stage of monitoring wilderness character. The principle reason for not including cultural resources is that a District Court judge recently ruled that they are not protected under the Wilderness Act, but instead are protected and managed under the National Historic Preservation Act. (Cultural resources are also protected under the Archaeological Resources Protection Act and the Native American Graves Protection and Repatriation Act.) Despite this ruling, several members of the IWCMT view cultural resources as integral to a wilderness area's character.

Agency staffs have debated for years about what is considered a significant cultural resource in wilderness and about how these resources should be managed. For the purposes of this interagency monitoring strategy, it is vital for local wilderness staff and cultural resources staff, using both the Wilderness Act and cultural resource protection laws, to work together and develop a common understanding for what to monitor for the purpose of observing trends in wilderness character.

Monitoring Framework for This Quality

The presence of structures, installations, habitations, and other evidence of modern human presence or occupation (table 6) degrades this quality. A detailed discussion of the monitoring questions, indicators, measures, and data sources for the undeveloped quality is in *Appendix A*.

Solitude or Primitive and Unconfined Quality

The Wilderness Act states in Section 2(c) that wilderness has "outstanding opportunities for solitude or a primitive and unconfined type of recreation." What the framers of the Wilderness Act meant by this wording isn't recorded in the legislative history of the Act, and there has been much discussion and debate about the meaning of these words among wilderness managers and scholars (Hendee and Dawson 2002). However, early wilderness writings of Aldo Leopold, Robert Marshall, Howard Zahniser, and others paint a rich picture about the type of experience envisioned in wilderness environments (see Landres and others 2005 for examples). These writings strongly enforce the vital role of solitude in places that are primitive and unconfined as central to the idea of wilderness.

The meaning of solitude has been at the center of considerable debate among researchers and the public (for example, see Washington Trails Association 1997), with meanings ranging from a lack of seeing other

Table 6. Recommended monitoring framework for the undeveloped quality.

Quality	Monitoring question	Indicator	Measure	Data sources
Undeveloped – Wilderness retains its primeval character and influence, and is essentially without permanent improvement or modern human occupation	What are the trends in non-recreational development inside wilderness?	Non-recreational structures, installations, and developments	Index of authorized physical development	▪ Agency data systems (if available) ▪ Local data entry by resource specialists
			Index of unauthorized (user-created) physical development	▪ Record cards from staff and volunteers for unauthorized structures and developments ▪ Record cards and photopoints for user-created trails
		Inholdings	Area and existing or potential impact of inholdings	▪ Agency data systems (if available) ▪ Local data entry by resource specialists
	What are the trends in mechanization inside wilderness?	Use of motor vehicles, motorized equipment, or mechanical transport	Type and amount of administrative and non-emergency use of motor vehicles, motorized equipment, or mechanical transport	▪ Agency data systems (if available) ▪ Local data entry by resource specialists
			Type and amount of emergency use of motor vehicles, motorized equipment, or mechanical transport	▪ Agency data systems (if available) ▪ Local data entry by resource specialists
			Type and amount of motor vehicle, motorized equipment, or mechanical transport use not authorized by the Federal land manager	▪ Agency data systems (if available) ▪ Local data entry by resource specialists ▪ Record cards from staff and volunteers
	What are the trends in cultural resources inside wilderness?	Loss of statutorily protected cultural resources	Number and severity of disturbances to cultural resources	▪ Agency data systems (if available) ▪ Local data entry by resource specialists ▪ Photopoints ▪ Record cards from staff and volunteers

people, to privacy, to freedom from societal constraints and obligations, to freedom from management regulations (Hall 2001; Hollenhorst and Jones 2001). Given the content of early wilderness writings, it is likely that solitude was viewed holistically, encompassing attributes such as separation from people and civilization, inspiration (an awakening of the senses, connection with the beauty of nature and the larger community of life), and a sense of timelessness (allowing one to let go of day-to-day obligations, go at one's own pace, and spend time reflecting).

Primitive and unconfined recreation has also been the subject of much debate. Primitive recreation has largely been interpreted as travel by

non-motorized and non-mechanical means (for example by horse, foot, or canoe) that reinforce the connection to our ancestors and our American heritage. However, primitive recreation also encompasses reliance on personal skills to travel and camp in an area, rather than reliance on facilities or outside help (Roggenbuck 2004). Unconfined encompasses attributes such as self-discovery, exploration, and freedom from societal or managerial controls (Hendee and Dawson 2002; Lucas 1983; Nash 1996). Primitive and unconfined environments together provide ideal opportunities for the physical and mental challenges associated with adventure, real consequences for mistakes, and personal growth that result from facing and overcoming obstacles (Borrie 2000; Dustin and McAvoy 2000).

In certain situations, managers may need to make a difficult decision about the need for resource protection while also providing outstanding opportunities for solitude or primitive and unconfined recreation. For example, administrative sites or a minimal system of trails may be considered essential to manage the effects of recreation while still allowing people to use and enjoy wilderness. However, since structures and system trails may strongly influence opportunities for solitude or primitive and unconfined recreation, the agencies need to show restraint in fulfilling their administrative responsibilities so that this quality of wilderness does not slowly erode over time.

The complexity of human experiences argues that many different factors contribute in known and unknown ways to the experience of solitude or primitive and unconfined recreation (Borrie and Birzell 2001; Hendee and Dawson 2002; Manning and Lime 2000). For example, experiences may be influenced by factors largely beyond the control and influence of managers, including attributes of the physical landscape, presence of certain insects and animals (for example, mosquitos and grizzly bears), local weather, intra- and inter-group dynamics, and skills and knowledge an individual brings to the experience. In contrast, managers may exert some control over use levels, types and patterns of use, level of development (both inside and adjacent to wilderness), amount and type of information available about the wilderness, and types of regulations imposed, all of which influence the opportunity to experience solitude or a primitive and unconfined type of recreation (Cole and others 1987; Hollenhorst and Jones 2001; Lucas 1973; McDonald and others 1989l; Patterson and others 1998; Watson 1995).

Given the complexity of human interactions with their environment and other people, the intent of monitoring this quality is not to understand people's experiences, perceptions, or motivations in wilderness. Instead, this monitoring strategy focuses on the mandate in the Wilderness Act to provide outstanding *opportunities* and to monitor how these *opportunities* are changing over time (Cole 2004; Dawson 2004). This monitoring will not answer questions related to whether people perceive these changes as good or bad, nor will it answer questions about whether the changes are causing people to alter their expectations or their behavior. While important, these questions are beyond the current scope of this Framework.

Monitoring Framework for This Quality

Monitoring this quality focuses exclusively on assessing how the opportunity for people to experience wilderness is changing, not on how visitor experiences are changing. This quality is degraded by settings that reduce these opportunities, such as encounters with other wilderness visitors, signs of modern civilization adjacent to the wilderness that affect these opportunities inside wilderness, facilities provided by the agency or created by users that reduce people's self-reliance, and management restrictions on visitor behavior (table 7). A detailed discussion of the monitoring questions, indicators, measures, and data sources for the solitude or primitive and unconfined recreation quality is in *Appendix A*.

Table 7. Recommended monitoring framework for the solitude or primitive and unconfined quality.

Quality	Monitoring question	Indicator	Measure	Data sources
Solitude or Primitive and Unconfined Recreation – Wilderness provides outstanding opportunities for solitude or primitive and unconfined recreation	What are the trends in outstanding opportunities for solitude inside wilderness?	Remoteness from sights and sounds of people inside the wilderness	Amount of visitor use	▪ Agency data systems (if available) ▪ Local data entry by resource specialists
			Number of trail contacts	▪ Record cards from staff and volunteers
			Number and condition of campsites	▪ Agency data systems (if available) ▪ Record cards from staff and volunteers
			Area of wilderness affected by access or travel routes that are inside the wilderness	▪ Agency GIS data systems, aerial photography
		Remoteness from occupied and modified areas outside the wilderness	Area of wilderness affected by access or travel routes that are adjacent to the wilderness	▪ Agency GIS data systems, aerial photography
			Night sky visibility averaged over the wilderness	▪ National night sky visibility maps
			Extent and magnitude of intrusions on the natural soundscape	▪ Agency data systems (if available) ▪ Local data entry by resource specialists
	What are the trends in outstanding opportunities for primitive and unconfined recreation inside wilderness?	Facilities that decrease self-reliant recreation	Type and number of agency-provided recreation facilities	▪ Agency data systems (if available) ▪ Local data entry by resource specialists
			Type and number of user-created recreation facilities	▪ Agency data systems (if available) ▪ Local data entry by resource specialists ▪ Record cards from staff and volunteers
		Management restrictions on visitor behavior	Type and extent of management restrictions	▪ Agency data systems (if available) ▪ Local data entry by resource specialists

Assessing and Reporting Trend in Wilderness Character

Assessing trends in individual measures and indicators is essential for local managers, but it is just as critical to understand and report on the big picture—how wilderness character is changing over time across the NWPS. This big picture is a powerful and effective tool for communicating about wilderness within the agency and with external audiences.

Method for Assessing Trend in Wilderness Character

Two steps that are used to assess trend in wilderness character are briefly summarized here, and are explained in detail in the Technical Guide (Landres and others, in press).

First, an important change in each measure is defined by each agency or wilderness. For example, this could be a 5 percent change in the number of actions to manage wildlife, a 10 percent change in the number of recreation facilities, or any change in the number of extirpated indigenous species over the 5-year monitoring period. Based on this criterion, the trend in the measure is categorized as either improving (for example, a greater than 5 percent reduction in manipulating wildlife), stable (less than a 5 percent change in manipulating wildlife), or degrading (a greater than 5 percent increase in manipulating wildlife).

Using this criterion for assessing important change in a measure, different types of change can be assessed depending on the information needed. For example, short term change would be assessed between successive monitoring cycles (for example, between the 4th and 5th monitoring cycles), whereas long term change would be assessed between the most recent and oldest monitoring cycles (for example, between the 1st and 5th monitoring cycles). Once there are data from at least 5 monitoring cycles, other statistical tools, such as regression analysis, can be used to assess an overall trend across all the monitoring cycles.

Second, a consistent set of rules is used to synthesize trends from the measure up to the overall trend in wilderness character. These rules are:

1. Assign a numerical score for the trend in each measure (shown diagrammatically with arrows), as follows:
   - Improving (⇧): +1
   - Stable (⇔): 0
   - Degrading (⇩): –1
2. Assign a trend for the indicator, as follows:
   - If the indicator has just one measure, the trend for the indicator is the same as the measure.
   - If the indicator has more than one measure, trends from each measure are summed to yield a single numerical score for the indicator. If this sum is positive, the indicator has improved and is assigned an overall numerical score of +1. If this sum is negative, the indicator has degraded and is assigned an overall numerical score of -1. If the sum is zero because the numerical scores from the improving measures exactly offset the numerical scores from the degrading measures, the indicator is called “offsetting

stable (⇳)" to differentiate it from stability at the measure level. Offsetting stable is assigned a numerical score of 0 to be used in the following steps.

3. Assign a trend for the monitoring question, following the same process described above for assigning a trend to the indicator.
4. Assign a trend for the quality of wilderness character, following the same process described above for assigning a trend to the indicator.
5. Assign a trend for wilderness character, following the same process described above for assigning a trend to the indicator. This trend in wilderness character is categorized as preserved (improving or offsetting stable) or degrading to follow the statutory language of the Wilderness Act.

Together, these steps allow a wilderness to compile trend information from the level of the measure up to the overall trend in wilderness character (table 8).

These decision rules allow local staff to assess the direction of change in wilderness character, but they do not assess the magnitude or intensity of this change. Local staff can put this overall trend in wilderness character in its appropriate context by reviewing the raw data for the individual measures that contributed to this overall trend. Regional and national staff can compile these individual wilderness trends to assess the percentage of wildernesses in which wilderness character is preserved or degrading.

Narrative About the Trend in Wilderness Character

A narrative would be useful to provide information about local conditions, circumstances, and context that affect the interpretation and use of the results of this trend assessment. This narrative gives local managers the opportunity to add qualitative information and insights from their professional judgment to complement and help interpret the data obtained from the measures. This narrative would be a valuable part of the legacy information passed to future wilderness managers and would help ensure consistency in reporting over time. The following questions could serve to structure this narrative (see the Technical Guide [Landres and others, in press] for more examples):

- Is there confidence in the data generated by this monitoring protocol?
- Is this trend in wilderness character an accurate reflection of recent conditions in the wilderness?
- How should this trend in wilderness character be interpreted if one of the four qualities is improving while another is degrading?
- Have decisions been made (for example, to not take certain actions) that would not be reflected in this monitoring and affect the interpretation of this trend in wilderness character?

Reporting on Trends in Wilderness Character

This monitoring would provide data and assessment information for both local and national audiences. Examples of both types of reports are in the Forest Service Technical Guide (Landres and others, in press).

Table 8. Hypothetical example showing how the decision rules are used to assess the trend in wilderness character between monitoring periods within a wilderness.

Measure	Trend in measure	Trend in indicator	Trend in question	Trend in quality	Trend in wilderness character
Untrammeled quality:					
Management actions	⇩	⇳	⇧	⇧	
Fires suppressed	⇧				
Lakes stocked with fish	⇧	⇧			
Unauthorized actions	⇧				
Natural quality:					
Listed species	⇔	⇩	⇳	⇩	
Extirpated species	⇔				
Invasive non-indigenous species	⇩				
Grazing allotments	⇔				
Visibility	⇔	⇧			
Ozone	⇧				
Acid deposition	⇔				
Fire regime departure	⇩	⇩	⇩		
Global climate change	⇩				
Undeveloped quality:					⇩
Authorized development	⇧	⇳	⇩	⇩	
Unauthorized development	⇩				
Inholdings	⇩	⇩			
Authorized mechanized uses	⇩	⇩	⇩		
Emergency mechanized uses	⇩				
Loss of cultural resources	⇩	⇩	⇩		
Solitude or primitive and unconfined quality:					
Visitor use	⇔	⇩	⇩	⇳	
Campsites	⇩				
Night sky visibility	⇩	⇩			
Soundscape	⇩				
Recreation facilities	⇧	⇧	⇧		
Visitor restrictions	⇧	⇧			

- *Local reports*—designed for local managers to improve wilderness stewardship. There could be two different types of reports: a summarized version suitable for communicating with line officers and interested citizens and a detailed version for the on-the-ground manager comparing current conditions against locally established standards. Local reports would be produced annually. Every 5 years, local results would be transmitted to a central office for producing the national report.
- *National reports*—designed for regional and national program managers to assist with accountability for wilderness stewardship and policy review. There could be two different types of reports: a summarized version suitable for communicating with agency

leadership, congressional staff, and similar public audiences and a more detailed regional or state version to assist with understanding policy implementation at this scale. National reports would be produced every 5 years and would cover trends within an agency and across the National Wilderness Preservation System. To facilitate compilation of data, assessment of regional and national trends, and reporting, each agency would ideally use a common data application similar to the National Biological Information Infrastructure that is administered by the U.S. Geological Survey.

Implementing This Interagency Strategy

Implementing this strategy would require substantial commitment. Successful implementation would require support from the top down and bottom up—that is, from both program leads to field staff. The IWSC is in a unique position to support successful implementation because of their role providing staff support to the program leads on the Interagency Wilderness Policy Council, as well as leadership to wilderness staff in their respective agencies. The IWSC is also one of the primary groups fostering interagency coordination and communication, which is necessary for successful implementation of this strategy.

Accordingly, we suggest that the IWSC formally:

1. Recognize the central mandate of preserving wilderness character;
2. Endorse the necessity of assessing trends in wilderness character to better inform wilderness stewardship decisions;
3. Endorse this interagency strategy as the tool to assess trends in wilderness character and endorse the description of wilderness character used in this strategy;
4. Endorse posting this draft interagency strategy on the Interagency Wilderness Character Monitoring Team's document website;
5. Recommend that the Interagency Wilderness Policy Council give the "green-light" to share the interagency strategy within each of the wilderness management agencies and to agency partners and the public;
6. Recommend that the Interagency Wilderness Policy Council approve and support implementation of this interagency strategy within the four wilderness management agencies in partnership with the U.S. Geological Survey and Forest Service Research and Development through the Aldo Leopold Wilderness Research Institute;
7. Recommend that the Interagency Wilderness Policy Council charter an interagency team to provide coordination and communication among the agencies to implement this interagency strategy to assess and report on trends in wilderness character across the National Wilderness Preservation System; and
8. Recommend that the interagency Arthur Carhart National Wilderness Training Center be assigned the lead and resources to develop training materials to facilitate consistent implementation of this interagency strategy.

The IWSC could take several other actions, both interagency as well as agency-specific, that would contribute to successful implementation of this strategy. Agency-specific actions taken by the IWSC members could include:

- encouraging broad-based support for this monitoring among the different agency programs and staff groups, including administrative, financial, information and data systems, science, on-the-ground, line officers, and others as appropriate;
- facilitating a review of data that are currently available within the agency or from outside sources that could be used to monitor trends in wilderness character;

- facilitating development of protocols for collecting data for each measure that are credible, reliable, and practical;
- facilitating development of protocols for storing and managing these data within current agency data systems; and
- conducting periodic review of this monitoring and its effectiveness within the agency.

Interagency actions taken by the IWSC could include:

- facilitating staffing for a program manager and data manager to oversee implementation of this interagency strategy;
- facilitating development of interagency protocols for compiling and managing data from each agency on trends in wilderness character for reporting on trends across the NWPS;
- developing procedures for active and on-going communication and coordination among the agencies about monitoring trends in wilderness character;
- endorsing a website that provides interagency, NWPS-wide communication products such as fact sheets geared to specific audiences, computer presentations, answers to frequently asked questions, and monitoring reports; and
- hosting a 5-year review of the effectiveness of this interagency strategy to monitor trends in wilderness character.

In addition to these actions described above, general implementation strategies for each agency are described in *Appendix C*.

Implications for a GPRA Wilderness Measure

The Government Performance and Results Act of 1993 (GPRA) mandates that the federal agencies demonstrate accountability "by providing…information about program results and service quality." The U.S. Forest Service currently uses "number of wilderness areas managed to minimum stewardship level" as this performance measure for wilderness. The three DOI wilderness agencies currently use a common GPRA wilderness performance measure, "Percent of acres of designated wilderness achieving wilderness character objectives as specified by statute."

The Interagency Wilderness Character Monitoring Team suggests that the four wilderness management agencies consider using a GPRA wilderness performance measure that is consistent with the interagency strategy described in this document. This GPRA wilderness performance measure could be:

> "Percent of designated wilderness areas meeting objectives for "preserving wilderness character" as defined by interagency protocol and statute."

The Team suggests that the objectives cited in the proposed GPRA wilderness performance measure be defined as follows:

> "Years 1 through 5: Each agency will report the percent of designated wilderness areas that have implemented wilderness character monitoring according to the interagency standards detailed in *Keeping it Wild: An Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservation System*. It is expected the GPRA measure for each agency by the end of Year 5 will be to report 100 percent."
>
> "Years 6+: Each agency will report the percent of designated wilderness areas where wilderness character is "stable" or "improving" according to the methods detailed in *Keeping it Wild: An Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservation System*."

This proposed change to the currently used GPRA wilderness performance measures would need to be implemented in the four Federal agencies differently. In the U.S. Forest Service, the current performance measure is an effective measure for evaluating trends in management activities, including the performance of individual management units, which helps to improve stewardship by focusing on key program elements. However, this performance measure does not address the outcomes of management decisions and actions on wilderness character. Therefore, we suggest that the Forest Service consider integrating an evaluation of trends in wilderness character into the current GPRA performance measure. For the three DOI agencies, we suggest that they consider revising their current GPRA performance measure to be consistent with this interagency strategy as described above.

Not all measures of wilderness character are directly under the control of the land managing agency. Therefore, the measures used to report for this GPRA wilderness performance measure would be the subset of the wilderness character measures that are predominantly within the management capability and authority of the Federal agency. For instance, though it is acknowledged that changes in air quality can have a profound impact on wilderness character, those changes are rarely within the purview of the local land manager and it would be inappropriate to base a GPRA performance goal on changes in air quality.

It is expected that there may be significant differences between the Federal agencies in how the GPRA performance goal is implemented, particularly during the first 5 years. For example, one agency may expect 20 percent of its wilderness areas to have completely implemented the monitoring each year, while another agency may expect all of its wilderness areas to have implemented 20 percent of the monitoring protocol each year. Additionally, as this interagency strategy allows different agencies to select different measures for each indicator, each agency can be expected to select a different subset of measures to incorporate into their GPRA wilderness performance measure.

References

American Heritage Dictionary. 1992. Houghton Mifflin Company, Boston, MA.

Aplet, G.H. 1999. On the nature of wildness: exploring what wilderness really protects. Denver University Law Review 76:347-367.

Arcese, P. 1997. The role of protected areas as ecological baselines. Journal of Wildlife Management 61:587-602.

Belsky, A.J.; Blumenthal, D.M. 1997. Effects of livestock grazing on stand dynamics and soils in upland forests of the Interior West. Conservation Biology 11:315-327.

Borrie, W.T. 2000. Impacts of technology on the meaning of wilderness. *In* Personal, Societal, and Ecological Values of Wilderness: Sixth World Wilderness Congress Proceedings on Recreation, Management, and Allocation, Volume II; 1998 Oct 24-29, Bangalore, India (A.E. Watson, G.H. Aplet, and J.C. Hendee, compilers). Proceedings RMRS-P-14 Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 87-88.

Borrie, W.T.; Roggenbuck, J.W. 1998. Providing an authentic wilderness experience? Thinking beyond the Wilderness Act of 1964. *In* Wilderness and natural areas in eastern North America: Research, Management, and Planning (D.L. Kulhavy and M.H. Legg, editors). Stephen F. Austin State University, Nacogdoches, TX: 34-44.

Borrie, W.T.; Birzell, R.M. 2001. Approaches to measuring quality of the wilderness experience. *In* Visitor Use Density and Wilderness Experience: Proceedings (W.A. Friedmund and D.N. Cole, compilers). RMRS-P-20. Fort Collins, CO: U.S. Department of Agriculture, Forest Service Rocky Mountain Research Station: 29-38.

Boutcher, S.; Landres, P. 2006. Final Pilot Test Report: A national protocol to evaluate trends in wilderness character. Report on file at the Aldo Leopold Wilderness Research Institute, Missoula, MT.

Cinzano, P.; Falchi, F.; Elvidge, C.D. 2001. The first world atlas of the artificial night sky brightness. Monthly Notices of the Royal Astronomical Society 328:689-707.

Clinton, W.J. 1999. Executive Order 13112 of February 3, 1999—Invasive Species. Federal Register, Volume 64, Number 25, February 8, 1999.

Cole, D.N. 2002. Ecological impacts of wilderness recreation and their management. *In* Wilderness Management: Stewardship and Protection of Resources and Values (J.C. Hendee and C.P. Dawson, editors). Third Edition. Golden, CO: Fulcrum Publishing: 413-459.

Cole, D.N. 2004. Wilderness experiences: what should we be managing for? International Journal of Wilderness 10(3):25-27.

Cole, D.N.; Petersen, M.E.; Lucas, R.C. 1987. Managing wilderness recreation use: common problems and potential solutions. Gen. Tech. Rep. INT-230. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station.

Cole, D.N.; Landres, P.B. 1996. Threats to wilderness ecosystems: impacts and research needs. Ecological Applications 6:168-184.

Cowell, C.M.; Dyer, J.M. 2002. Vegetation development in a modified riparian environment: human imprints on an Allegheny River wilderness. Annals of the Association of American Geographers 92:189-202.

Dawson, C. 2004. Monitoring outstanding opportunities for solitude. International Journal of Wilderness 10(3):12-14, 20.

Dustin, D.L.; McAvoy, L.H. 2000. Of what avail are forty freedoms: the significance of wilderness in the 21st century. International Journal of Wilderness 6(2):25-26.

Government Accounting Office. 1989. Wilderness preservation: problems in some national forests should be addressed. GAO/RCED-89-202. Washington, DC: U.S. Government Printing Office.

Hall, T.E. 2001. Hikers' perspectives on solitude and wilderness. International Journal of Wilderness 7(2):20-24.

Hammitt, W.E.; Rutlin, W.M. 1995. Use encounter standards and curves for achieved privacy in wilderness. Leisure Sciences 17:245-262.

Hendee, J.C.; Dawson, C.P. 2001. Stewardship to address the threats to wilderness resources and values. International Journal of Wilderness 7(3):4-9.

Hendee, J.C.; Dawson, C.P. 2002. Wilderness management: stewardship and protection of resources and values, third edition. Golden, CO: Fulcrum Publishing.

Hollenhorst, S.J.; Jones, C.D. 2001. Wilderness solitude: beyond the social-spatial perspectives. *In* Visitor Use Density and Wilderness Experience: Proceedings (W.A. Friedmund and D.N. Cole, compilers). RMRS-P-20. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Humphrey, H.H. 1957. Testimony June 19-20 for the U.S. Congress, Senate Committee on Interior and Insular Affairs, published hearings on S. 1176.

Johnson, B.J.; Hall, T.E.; Cole D.N. 2005. Naturalness, primitiveness, remoteness and wilderness: wilderness visitors' understanding of Wilderness Act concepts. Unpublished report, University of Idaho, Moscow, ID.

Knapp, R.A.; Corn, P.S.; Schindler, D.E. 2001. The introduction of nonnative fish into wilderness lakes: good intentions, conflicting mandates, and unintended consequences. Ecosystems 4:275-278.

Landres, P. 2003. Database of wilderness laws and their management language. Excel database on file at the Aldo Leopold Wilderness Research Institute, Missoula, MT.

Landres P.; Marsh, S.; Merigliano, L.; Ritter, D.; Norman, A. 1998. Boundary effects on national forest wildernesses and other natural areas. *In* Stewardship Across Boundaries (R.L. Knight and P.B. Landres, editors). Washington, DC: Island Press: 117-139.

Landres, P.; Boutcher, S.; Merigliano, L.; Barns, C.; Davis, D.; Hall, T.; Henry, S.; Hunter, B.; Janiga, P.; Laker, M.; McPherson, A.; Powell, D.S.; Rowan, M.; Sater, S. 2005. Monitoring selected conditions related to wilderness character: a national framework. Gen. Tech. Rep. RMRS-GTR-151. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Landres, P.;Boutcher, S.; Hall, T.; Dean, L.; Mebane, A.; Blett, T.; Merigliano, L. *In press.* Technical guide for monitoring selected conditions related to wilderness character. Gen. Tech. Rep. Washington, DC: U.S. Department of Agriculture, Forest Service. 236 p.

Leopold, A. 1921. The wilderness and its place in forest recreational policy. Journal of Forestry 19(7):718-721.

Leopold, A. 1949. A sand county almanac and sketches here and there. London, England: Oxford University Press.

Lodge, D.M.;Williams, S.; MacIsaac, H.J.; Hayes, K.R.; Leung, B.; Reichard, S.; Mack, R.N.; Moyle, P.B.; Smith, M.; Andow, D.A.; Carlton, J.T.; McMichael, A. 2006. Biological invasions: recommendations for U.S. policy and management. Ecological Applications 16:2035-2054.

Louda, S.M.; Stiling, P. 2004. The double-edged sword of biological control in conservation and restoration. Conservation Biology 18:50-53.

Lucas, R.C. 1973. Wilderness: a management framework. Journal of Soil and Water Conservation 28:150-154.

Lucas, R.C. 1983. The role of regulations in recreation management. Western Wildlands 9(2):6-10.

Manning, R.E.; Lime, D.W. 2000. Defining and managing the quality of wilderness recreation experiences. *In* Wilderness Science in a Time of Change Conference, Volume 4: Wilderness visitors, experiences, and visitor management (S.F. McCool, D.N. Cole, W.T. Borrrie, and J.O'Loughlin, compilers). Proceedings. RMRS-P-15-VOL-4. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 13-52.

Manning, R.; Valliere, W.; Hallo, J.; Newman, P.; Pilcher, E.; Savidge, M.; Dugan, D. 2007. From landscapes to soundscapes: understanding and managing natural quiet in the National Parks. *In* proceedings of the 2006 Northeastern Recreation Research Symposium (R. Burns, K. Robinson, compilers). Gen. Tech. Rep. GTR-NRS-P-14. Newton Square, PA: U.S. Department of Agricluture, Forest Service, Northern Research Station: 601-606.

McCloskey, M. 1999. Changing views of what the wilderness system is all about. Denver University Law Review 76:369-381.

McCool, S.F. 2004. Wilderness character and the notion of an "unconfined" experience. International Journal of Wilderness 10(3):15-17.

McDonald, B.; Guldin, R.; Wetherhill, R. 1989. The spirit of wilderness: the use and opportunity of wilderness experience for personal growth. *In* Wilderness benchmark 1988: proceedings of the national wilderness colloquium (H.R. Freilich, compiler). Gen. Tech. Rep. SE-51. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station: 193-207.

Meyer, S.S. 2000. Legislative interpretation as a guiding tool for wilderness management. *In* Wilderness Science in a Time of Change Conference, Volume 5: Wilderness ecosystems, threats, and management (S.F. McCool, D.N. Cole, W.T. Borrrie, and J.O'Loughlin, compilers). Proceedings RMRS-P-15-VOL-5. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 343-347.

Moore, K.D. 2007. In the shadow of the cedars: the spiritual values of old-growth forests. Conservation Biology 21:1120-1123.

Nash, R. 1996. A wilderness ethic for the age of cyberspace. International Journal of Wilderness 2(3):4-5.

Nash, R. 2004. Celebrating Wilderness in 2004. George Wright Forum 21(3):6-8.

Patterson, M.E.; Watson, A.E.; Wiliams, D.R.; Roggenbuck, J.R. 1998. An hermeneutic approach to studying the nature of wilderness experiences. Journal of Leisure Research 30:423-452.

Pinchot Institute for Conservation. 2001. Ensuring the Stewardship of the National Wilderness Preservation System. A report to the USDA Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey. Washington, DC: Pinchot Institute for Conservation.

Putney, A.D.; Harmon, D. 2003. Intangible values and protected areas: towards a more holistic approach to management. *In* The Full Value of Parks: From Economics to the Intangible (D. Harmon, and A.D. Putney, editors). Lanham, MD: Rowman & Littlefield Publishers: 311-326.

Roggenbuck, J.W. 2004. Managing for primitive recreation in wilderness. International Journal of Wilderness 10(3):21-24.

Roggenbuck, J.W.; Driver, B.L. 2000. Benefits of nonfacilitated uses of wilderness. *In* Wilderness science in a time of change conference, Volume 3: Wilderness as a place for scientific inquiry (S.F. McCool, D.N. Cole, W.T. Borrrie, and J.O'Loughlin, compilers) proceedings. RMRS-P-15-VOL-3.

Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 33-49.

Rohlf, D.; Honnold, D.L. 1988. Managing the balance of nature: the legal framework of wilderness management. Ecology Law Quarterly 15:249-279.

Schmidt, K.M.; Menakis, J.P.; Hardy, C.C.; Hann, W.J.; Bunnell, D.L. 2002. Development of coarse-scale spatial data for wildland fire and fuel management. Gen. Tech. Rep. RMRS-GTR-87. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Schreiber, R.K.; Newman, J.R. 1987. Air quality in wilderness: a state-of-knowledge review. *In* National Wilderness Research Conference: Issues, state-of-knowledge, future directions (R.C. Lucas, compiler). Proceedings. Gen. Tech. Rep. INT-220. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station: 104-134.

Schroeder, H.W. 2007. Symbolism, experience, and the value of wilderness. International Journal of Wilderness 13(1):13-18.

Scott, D.W. 2002. "Untrammeled," "wilderness character," and the challenges of wilderness preservation. Wild Earth 11(3/4):72-79.

Sutter, P. 2004. Driven wild: how the fight against automobiles launched the modern wilderness movement. Seattle, WA: University of Washington Press.

USDA Forest Service. 1972. Wilderness Policy Review, May 17, 1972, authored by W.A. Worf, C.G. Gorgensen, and R.C. Lucas. Unpublished document on file at the Aldo Leopold Wilderness Research Institute, Missoula, MT.

United States Congress. 1983. U.S. House Report 98-40 from the Committee on Interior and Insular Affairs, March 18, p. 43.

Washington Trails Association. 1997. Comments on wilderness solitude. Special reprint from Signpost for Northwest Trails. Seattle, WA.

Watson, A.E. 1995. Opportunities for solitude in the Boundary Waters Canoe Area Wilderness. Northern Journal of Applied Forestry 12(1):12-18.

Zahniser, H. 1956. The need for wilderness areas. The Living Wilderness 59(Winter to Spring): 37-43.

Zahniser, H. 1961. Editorial: Managed to be left unmanaged. The Living Wilderness 76(Spring to Summer): 2.

Zahniser, H. 1963. Editorial: Guardians not gardeners. The Living Wilderness 83(Spring to Summer): 2.

Appendix A—Details About Monitoring the Four Qualities

This appendix provides details about all the monitoring questions, indicators, measures, and data sources for the four qualities that comprise wilderness character.

Untrammeled Quality

This section provides details about all the monitoring questions, indicators, measures, and data sources for the untrammeled quality, beginning with an overview (for reference) in table 9.

Table 9. An overview of the monitoring question, indicators, measures, and data sources for the untrammeled quality.

Untrammeled quality Wilderness is essentially unhindered and free from modern human control or manipulation			
Monitoring question	**Indicator**	**Measure**	**Data sources**
What are the trends in actions that control or manipulate the "earth and its community of life" inside wilderness?	Actions authorized by the Federal land manager that manipulate the biophysical environment	Number of actions to manage plants, animals, pathogens, soil, water, or fire	▪ Agency data systems (if available) ▪ Local data entry by resource specialists ▪ Minimum Requirements analyses
		Percent of natural fire starts that received a suppression response	▪ Agency data systems ▪ National fire data systems ▪ Local data entry by resource specialists
		Number of lakes and other water bodies stocked with fish	▪ Agency data systems (if available) ▪ State agencies ▪ Local data entry by resource specialists
	Actions not authorized by the Federal land manager that manipulate the biophysical environment	Number of unauthorized actions by agencies, citizen groups, or individuals that manipulate plants, animals, pathogens, soil, water, or fire	▪ Law enforcement data systems (if available) ▪ Other federal and state agency data systems ▪ Record cards from other staff and volunteers ▪ Local data entry by resource specialists

Monitoring Question: What are the trends in actions that control or manipulate the "earth and its community of life" inside wilderness? This monitoring question addresses actions that manipulate or control ecological systems inside wilderness. This question focuses on actions rather than authorizations so the number of manipulations that actually occurred can be monitored. There are two indicators under this monitoring question:

- *Indicator: Actions authorized by the Federal land manager that manipulate the biophysical environment.* This indicator would track trends in all the actions that an agency authorizes to manipulate any aspect of the ecological system inside wilderness, including discretionary and non-discretionary actions (non-discretionary actions are those that are compelled to uphold other laws; the reason for an action would be recorded under the measure). There are three possible measures under this indicator and all would be monitored annually:
  - ◊ *Measure: Number of actions to manage plants, animals, pathogens, soil, water, or fire.* All significant authorized actions

that directly manipulate or control plants, animals, pathogens, soil, water, or fire are monitored. The intent of this measure is to track large-scale or significant actions—small scale actions such as removing a hazard tree would not be included. Examples of actions that would be counted include spraying herbicides to remove an invasive plant, introducing a plant or animal, radio-collaring animals, electro-shocking fish, or using management-ignited prescribed fire. Definitions and set of rules for counting actions are described in the Technical Guide (Landres and others, in press). An increasing number of manipulative actions authorized by the Federal land manager degrade the untrammeled quality.

  - ◊ *Measure: Percent of natural fire starts that received a suppression response.* The act of suppressing a naturally-ignited fire, regardless of how many acres the fire has burned or may burn, manipulates wilderness. This measure tracks fires that receive any form of suppression response. Only fires that were naturally ignited are included in this measure—fires that were started by human activity are not included. The untrammeled quality is degraded by an increasing number of natural fire starts that are suppressed.
  - ◊ *Measure: Number of lakes and other water bodies stocked with fish.* Stocking lakes, streams, or other water bodies inside wilderness is a significant manipulation. The number of lakes or other water bodies that are stocked is a separate measure to bring explicit focus to authorized Federal and State agency stocking programs, even though this measure would not likely apply to desert wildernesses or others without recreational fishing opportunity. An increasing number of lakes and other water bodies that are stocked with fish degrade the untrammeled quality.

- *Indicator: Actions not authorized by the Federal land manager that manipulate the biophysical environment.* This indicator would track trends in actions that are not authorized by the Federal land manager that manipulate any aspect of the ecological system inside wilderness. Unauthorized actions are fundamentally different from authorized actions and the types of data available to monitor them are different as well. Typically, unauthorized actions include such things as citizen groups creating a recreational fishery by stocking fish in a wilderness lake. In addition, other Federal or state agencies that have not been given authorization by the administering agency's Federal land manager may take actions. This indicator tracks unauthorized actions rather than violations because some actions may not be citable yet still be unauthorized actions that trammel the wilderness. There is one possible measure under this indicator and it would be monitored annually:
  - ◊ *Measure: Number of unauthorized actions by agencies, citizen groups, or individuals that manipulate plants, animals, pathogens, soil, water, or fire.* Agency law enforcement data systems may provide some data, but record cards and data entry from resource specialists would likely be necessary. The level of effort used to collect these data would strongly influence the

result—level of effort, therefore, needs to be taken into account in interpreting this result. An increasing number of manipulative actions taken by other agencies, citizen groups, or individuals degrade the untrammeled quality.

Natural Quality

This section provides details about all the monitoring questions, indicators, measures, and data sources for the natural quality, beginning with an overview (for reference) in table 10.

Table 10. An overview of the monitoring question, indicators, measures, and data sources for the natural quality.

Natural quality Wilderness ecological systems are substantially free from the effects of modern civilization			
Monitoring question	**Indicator**	**Measure**	**Data sources**
What are the trends in terrestrial, aquatic, and atmospheric natural resources inside wilderness?	Plant and animal species and communities	Abundance, distribution, or number of indigenous species that are listed as threatened and endangered, sensitive, or of concern	▪ Agency data systems (if available) ▪ Local data entry by resource specialists ▪ State agencies and other partners (e.g., NatureServe data) ▪ Record cards from staff and volunteers
		Number of extirpated indigenous species	▪ Agency data systems (if available) ▪ Local data entry by resource specialists ▪ State agencies and other partners (for example, NatureServe data)
		Number of non-indigenous species	▪ Agency data systems (if available) ▪ Local data entry by resource specialists ▪ State agencies and other partners (for example, NatureServe data) ▪ National FIA data
		Abundance, distribution, or number of invasive non-indigenous species	▪ Agency data systems (if available) ▪ Local data entry by resource specialists ▪ State agencies and other partners (for example, NatureServe data) ▪ National FIA data ▪ Record cards from staff and volunteers
		Number of acres of authorized active grazing allotments and number of animal unit months (AUMs) of actual use inside wilderness	▪ Agency data systems (if available) ▪ Local data entry by resource specialists
		Change in demography or composition of communities	▪ National FIA data ▪ Remote sensing (satellite imagery, aerial photography) ▪ Photopoints (for particular places of concern) ▪ Local data entry by resource specialists
	Physical resources	Visibility based on average deciview and sum of anthropogenic fine nitrate and sulfate	▪ National IMPROVE data
		Ozone air pollution based on concentration of N100 episodic and W126 chronic ozone exposure affecting sensitive plants	▪ National EPA AIRS data ▪ National CASTNET data
		Acid deposition based on concentration of sulfur and nitrogen in wet deposition	▪ National NADP/NTN data

Table 10. *Continued*.

Natural quality Wilderness ecological systems are substantially free from the effects of modern civilization			
Monitoring question	**Indicator**	**Measure**	**Data sources**
		Extent and magnitude of change in water quality	▪ Agency data systems (if available) ▪ Water quality monitoring stations
		Extent and magnitude of human-caused stream bank erosion	▪ Photopoints ▪ Record cards from staff and volunteers
		Extent and magnitude of disturbance or loss of soil or soil crusts	▪ Remote sensing (aerial photography, satellite imagery) ▪ Photopoints ▪ Record cards from staff and volunteers
What are the trends in terrestrial, aquatic, and atmospheric natural processes inside wilderness?	Biophysical processes	Departure from natural fire regimes averaged over the wilderness	▪ National LANDFIRE modeling program
		Extent and magnitude of global climate change	▪ National RAWS data stations ▪ National MODIS satellite imagery ▪ National SNOTEL data stations ▪ Photopoints ▪ Historical/recent photo pairs ▪ Remote sensing (aerial photography, satellite imagery)
		Area and magnitude for pathways for movement of non-indigenous species into the wilderness	▪ Agency data systems (if available) ▪ Local data entry by resource specialists ▪ State agencies and other partners
		Area and magnitude of loss of connectivity with the surrounding landscape	▪ Agency data systems (if available) ▪ Local data entry by resource specialists ▪ State agencies and other partners ▪ Remote sensing (aerial photography, satellite imagery)

Monitoring Question: What are the trends in terrestrial, aquatic, and atmospheric natural resources inside wilderness? This monitoring question addresses how selected biological and physical resources in terrestrial, aquatic, and atmospheric environments change over time. The two indicators under this monitoring question reflect a basic division between biological and physical resources.

- *Indicator: Plant and animal species and communities.* This indicator tracks trends in selected plant and animal species and plant and animal communities, in both terrestrial and aquatic environments. No wilderness has a complete species list and this indicator is not intended to provide such a list. Instead, this indicator would track species and communities that are of concern, as well as species that are a threat to the indigenous species. There are six possible measures under this indicator, and all would be monitored every 5 years, except the grazing measure would be monitored annually:
  - ◊ *Measure: Abundance, distribution, or number of indigenous species that are listed as threatened and endangered, sensitive, or*

of concern. Wilderness may serve as a place where populations of plant and animal species on State or Federal threatened and endangered species lists can find some measure of protection. In addition, State and Federal agencies may list other species that are known to be sensitive to particular threats or species that are of concern but not yet listed as threatened or endangered. Local staff would need to input any change in listing status of a species to avoid showing a spurious trend in this measure. This measure is worded to show the different types of data relevant to species populations that a wilderness may choose from to assess trend:

- abundance and verified distribution yield the best information about the status and trend of listed populations, but may be much more expensive and difficult to gather;
- distribution and relative abundance based on record cards is less expensive but not as accurate or precise a way to assess trend; and
- number of species is acceptable and the least expensive as a measure, but it does not yield any information on the status of the population as do the other measures.

If the abundance, area occupied, or number of listed species change between monitoring periods, the local manager and resource specialist together will need to interpret if this change degrades the natural quality of wilderness character. This interpretation needs to be done carefully because factors inside and outside the wilderness may affect listed species populations in either positive or negative ways.

◊ *Measure: Number of extirpated indigenous species.* The loss or extirpation of indigenous species from a wilderness profoundly affects public understanding and experience of that area. The wolf and grizzly bear, for example, have long been symbols for wilderness, and those areas that now lack these species are, in the view of most people, less wild and less of a wilderness. The loss of individual species, such as beaver, may also profoundly affect wilderness ecosystems. This measure assesses trend based on the known history of an area from the time of European contact to the present day. Going back to the time of European contact is necessary for this measure because (1) public perception of the natural quality of wilderness character is strongly associated with species that were likely extirpated before wilderness designation, such as wolves and grizzly bears, and (2) if species that were extirpated before wilderness designation (wolves for example) were restored to a wilderness, most people would associate this with an improvement in the natural quality of wilderness character. The Technical Guide (Landres and others, in press) provides an approach for gathering the data for this measure. The natural quality is degraded if the number of extirpated indigenous species increases.

◊ *Measure: Number of non-indigenous species.* Non-indigenous species may significantly alter the composition, structure, and function of natural communities, thereby degrading or eliminating indigenous species and altering animal habitat.

Indigenous species are those that occur naturally in a particular area (American Heritage Dictionary 1992), and non-indigenous or naturalized species are those that occur in an area by modern human influence (Clinton 1999; Lodge and others 2006). The distinction between indigenous and non-indigenous can be confused if geographic scale isn't accurately described. For example, moose are indigenous to the state of Colorado but are not indigenous to many higher elevation wildernesses. Similarly, a species may be indigenous to one part of a wilderness but not other parts. Some species of fish, for example, may be indigenous to streams but not high elevation lakes that were filled with ice during cooler glacial periods. Other species that are counted as non-indigenous in the context of this monitoring include domestic livestock such as cattle, horses, and sheep that are present in wilderness by permit, or species that have become established, such as mustangs and burros. This measure is the simple total number of non-indigenous plant and animal species that occur inside the wilderness, excluding invasive non-indigenous species that are monitored separately. Data from the national Forest Inventory and Analysis program may be useful in assessing trends in this measure. The natural quality is degraded if the number of non-indigenous species increases.

◊ *Measure: Abundance, distribution, or number of invasive non-indigenous species.* Invasive species are commonly defined as "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health" (Clinton 1999). Local staff would determine which species are considered invasive, and these species would not be included in the previous measure (non-indigenous species). For plants, data from the national Forest Inventory and Analysis program may be useful in assessing trends in this measure. This measure would also include introduced species such as fish, birds, mammals, and invertebrates. For introduced fish, data on the number of lakes or stream miles stocked could be used to assess trend. This measure is worded to show the different types of data relevant to invasive species populations that a wilderness may choose from to assess trend:

- abundance and verified distribution yield the best information about the status and trend of invasive non-indigenous species, but may be much more expensive and difficult to gather;
- distribution and relative abundance based on record cards is less expensive but not as accurate or precise a way to assess trend; and
- number of species acceptable and the least expensive but does not give any information on the status or spread of invasive non-indigenous species as to the other measures.

The natural quality is degraded if the abundance, area occupied, or number of invasive non-indigenous species increases.

◊ *Measure: Number of acres of authorized active grazing allotments and number of animal unit months (AUMs) of*

actual use inside wilderness. Grazing by large non-indigenous herbivores such as domestic cattle, horses, and sheep may significantly degrade diminish the natural quality. Only allotments that are currently authorized for grazing use at any time of the year inside the wilderness would be recorded, along with the actual number of AUMs. The Technical Guide (Landres and others, in press) provides an approach for gathering the data for this measure. The natural quality is degraded if the number of acres or AUMs increases.

◊ *Measure: Change in demography or composition of communities.* Communities of animals and especially plants, for example a lodgepole pine forest or the distinct set of plants living on serpentine soil, are typically the most visible ecological component of an area. Data from the national Forest Inventory and Analysis program may be useful in assessing trends in this measure. This measure is worded to show the different types of data that are relevant to communities that a wilderness may choose from to assess trend:

- demography of the dominant species (birth and death rates, age-class distribution, density) yield the best information about the status and trend of the community, but may be much more expensive and difficult to gather;
- species composition, or the list of species that comprise the community, is less expensive but not as accurate or precise a way to assess trend, although it provides other information that may be of value to understand the forces affecting the environment inside wilderness; and
- ecosystem composition, or the list of community types within the landscape and how they are distributed, provides information that may be of value to understand the forces affecting the environment inside wilderness.

If demography or composition changed, this would typically be interpreted as degradation in the natural quality. However, careful interpretation by the local resource specialist is necessary to try to separate change that is human-caused (a degradation) from natural (not a degradation).

- *Indicator: Physical resources.* This indicator tracks trends in selected physical resources. There are six measures under this indicator reflecting air, water, and soil resources. (Soil is both a biological and physical resource but is placed here for convenience.) Trends in air quality are monitored because of the effects of air pollutants on plants, animals, soil, and water inside wilderness. The 1977 Clean Air Act and subsequent amendments mandate affirmative protection responsibilities on Federal land managers within Class I wildernesses designated by this Act and Class II wildernesses designated after 1977. Several types of air pollutants are monitored through a variety of large networks, sometimes in the immediate vicinity of wildernesses and sometimes in representative sites. Air quality modeling provides broad estimates of pollution levels where on-site monitoring is not possible or feasible. All air quality data are available nationwide and can be readily downloaded. There are six

possible measures under this indicator and all would be monitored annually:

- *Measure: Visibility based on average deciview and sum of anthropogenic fine nitrate and sulfate.* Deciview is a cumulative haziness index used to express light extinction. Basically, deciview is the visibility a wilderness visitor would experience. Fine nitrate and sulfate directly indicate degradation of visibility conditions. These data are available nationally from the IMPROVE (Interagency Monitoring of Protected Visual Environments) database. The Technical Guide (Landres and others, in press) provides detailed protocols for downloading, processing, and interpreting these data. The natural quality is degraded if visibility declines.
- *Measure: Ozone air pollution based on concentration of N100 episodic and W126 chronic ozone exposure affecting sensitive plants.* Ozone and its precursor emissions—nitrogen oxides and volatile organic compounds—can travel long distances, resulting in elevated ozone levels in wildernesses. Episodic ozone is the number of hours when the measured ozone concentration is greater than or equal to 100 parts per billion. Chronic ozone is the seasonal ozone exposure of vegetation over the entire growing season. These data are available nationally from either the Environmental Protection Agency's AIRS (Aerometric Information Retrieval System) or CASTNET (Clean Air Status and Trends Network) databases, or spatial interpolation. The Technical Guide (Landres and others, in press) provides detailed protocols for downloading, processing, and interpreting these data. The natural quality is degraded if ozone increases.
- *Measure: Acid deposition based on concentration of sulfur and nitrogen in wet deposition.* The concentration of sulfur and nitrogen in rain and snow is a major contributor to acid deposition, adversely affecting algae, aquatic invertebrates, amphibians, fish, soil microorganisms, plants, and trees. These data are available from NADP/NTN (National Atmospheric Deposition Program/National Trends Network) and by spatial interpolation for those wildernesses not covered by this network. The Technical Guide (Landres and others, in press) provides detailed protocols for downloading, processing, and interpreting these data. The natural quality is degraded if acid deposition increases.
- *Measure: Extent and magnitude of change in water quality.* This measure would assess trends in the physical and chemical aspects of water (changes to biological aspects would be monitored under the plant and animal indicator). Despite the general importance of water and a myriad of national water monitoring programs, water monitoring in wilderness is generally conducted only for site-specific concerns. For example, impacts from grazing (sediment, manure), mining (sediment, heavy metals, and other toxics), air pollutants, and recreation (sediment, fecal coliform bacteria) vary tremendously from wilderness to wilderness and from one site to another within a wilderness. The nearest water monitoring

station downstream from the wilderness may provide cumulative data on the water flowing through the wilderness. Because of the tremendous variability in threats to water quality and the location (and capability) of monitoring stations, local managers are encouraged to identify specific measures that are relevant to monitor, based on discussions with agency and other local water specialists. If water quality changes, this would typically be interpreted as degradation in the natural quality. However, this interpretation needs to be done carefully by the local resource specialist to try to separate change that is human-caused (a degradation) from natural (not a degradation).

- ◊ *Measure: Extent and magnitude of human-caused stream bank erosion.* Stream bank erosion is a visible sign of soil loss that may also cause increased sediment in the adjacent stream. Stream bank erosion could be caused by people (visitors or administrative staff) or horses where a trail crosses a stream, grazing livestock, trespass all-terrain-vehicles, or other local circumstances. Data on stream bank erosion would most likely come from photopoints and record cards. The natural quality is degraded if human-caused stream bank erosion increases.
- ◊ *Measure: Extent and magnitude of disturbance or loss of soil or soil crusts.* Many different activities could disturb soil and soil crusts, for example, trampling by livestock or people, administrative actions, or authorized and unauthorized use of motor vehicles, motorized equipment, or mechanical transport. Loss or disturbance of soil and rock would vary tremendously from one wilderness to another depending on factors such as bedrock, soil type, wind, topography, and vegetation cover. Once disturbed, wind or water may more easily remove the soil. Similar to stream bank erosion, data for this measure would most likely come from photopoints and record cards, or from remote sensing for large areas. If the extent or magnitude of soil loss increases, this would typically be interpreted as degradation in the natural quality. However, careful interpretation by the local resource specialist is necessary to try to separate change that is human-caused (a degradation) from natural (not a degradation).

Monitoring Question: What are the trends in terrestrial, aquatic, and atmospheric natural processes inside wilderness? This monitoring question focuses on the natural processes that occur in the terrestrial, aquatic, and atmospheric systems inside wilderness. Ecological processes are the interactions that occur between physical and biological components of ecosystems. Disturbances caused by fire, flooding, wind, and pathogens or insects are natural processes that may be altered or disrupted by anthropogenic actions. These processes, including disturbances, are a vital part of most wilderness ecosystems. There is one indicator under this monitoring question:

- *Indicator: Biophysical processes.* This indicator would track the alteration or disruption of natural biophysical processes inside wilderness. Every wilderness is also embedded in its surrounding landscape, and since processes flow across the administrative boundary of a wilderness, conditions outside the wilderness affect

what is occurring inside. There are four possible measures under this indicator and all would be monitored every 5 years:

◊ *Measure: Departure from natural fire regimes averaged over the wilderness.* Fire plays a vital ecological role in many wildernesses, and excluding or suppressing natural fire alters this process with serious adverse consequences to the ecosystem. Data showing the departure from natural fire regimes (Fire Regime Condition Classes; Schmidt and others 2002) are available nationally from the federal LANDFIRE program. The natural quality is degraded if departure from natural fire regimes increases.

◊ *Measure: Extent and magnitude of global climate change.* Data are available nationally that may be used to assess trends in selected aspects of the environment that are strongly correlated with global climate change. If available, these data could be pulled by a central data manager and made available with no direct cost to the wilderness. Examples include:

- change in timing of plant greening, with data from MODIS (Moderate Resolution Imaging Spectroradiometer) satellite imagery available from National Aeronautics and Space Administration;
- glacial retreat, with data from photopoints, photo-pairs comparing recent with historical photographs, aerial photography, and other satellite imagery;
- change in temperature and precipitation patterns, with data from existing RAWS (Remote Automated Weather Stations) weather stations that could be averaged over the different monitoring sites in or adjacent to the wilderness;
- change in snow depth, with data from existing SNOTEL (SNOpack TELemetry) stations or manual snow courses, which could be averaged over the different monitoring sites in or adjacent to the wilderness;
- coastal erosion or accretion, with data from photopoints, photo-pairs comparing recent with historical photographs, and from aerial photography and other satellite imagery averaged over the coastal portion of the wilderness;
- change in extent and magnitude of insect and pathogen outbreaks, with data coming from a variety of State and Federal agencies; and
- change in the geographic distribution of selected communities (for example, change in elevation of alpine tundra or treeline), with data from photopoints, photo-pairs comparing recent with historical photographs, aerial photography, and other satellite imagery.

In all these examples, a change would typically be interpreted as degradation in the natural quality. However, this interpretation needs to be done carefully by the local resource specialist to try to separate change that is human-caused (a degradation) from natural (not a degradation).

- ◊ *Measure: Area and magnitude for pathways for movement of non-indigenous species into the wilderness.* Conditions outside the wilderness may foster movement of non-indigenous species into the wilderness. These conditions include the proximity of roads and other developments, land disturbed from logging or other commercial practices, or the known occurrence of non-indigenous species such as zebra mussels or non-indigenous fish species in streams that run from the wilderness. Data for this measure would largely depend on the local resource specialist using professional judgment to estimate the potential impact from existing conditions. The natural quality is degraded if area or magnitude of these pathways increases.
- ◊ *Measure: Area and magnitude of loss of connectivity with the surrounding landscape.* Conditions outside the wilderness may also sever or reduce beneficial ecological flows that naturally would have moved across a landscape and into the wilderness. For example, development outside a wilderness may impede seasonal movement of wildlife into a wilderness, or this same development may increase the need for fire suppression actions that stop naturally ignited fires from moving into the wilderness. For some wildernesses, fragmentation of forest vegetation (available from the USGS National Land Cover Pattern Database) is a source of national data. Otherwise, the data for this measure would largely depend on the local resource specialist using professional judgment to estimate the potential impact from existing conditions. The natural quality is degraded if area or magnitude of this loss of connectivity increases.

Undeveloped Quality

This section provides details about all the monitoring questions, indicators, measures, and data sources for the undeveloped quality, beginning with an overview (for reference) in table 11.

Monitoring Question: What are the trends in non-recreational development inside wilderness? The first monitoring question addresses the presence of developments because they are clear evidence of human occupation or modification. Only developments that are *not* primarily for a recreation purpose or use are monitored under this monitoring question, whereas trends in developments that have a recreation purpose or use are monitored under the solitude or primitive and unconfined recreation quality (the *Undeveloped Quality* section on page 21 discusses the reasons for this distinction). There are two indicators under this monitoring question:

- *Indicator: Non-recreational structures, installations, and developments.* This indicator would track trends in the number and development level of structures, installations, or other developments inside wilderness that are primarily non-recreational. There are two possible measures under this indicator and both would be monitored every 5 years:
  - ◊ *Measure: Index of authorized physical development.* This index could be composed of the number of structures, installations, and developments combined with a relative weighting of the

Table 11. An overview of the monitoring question, indicators, measures, and data sources for the undeveloped quality.

Udeveloped quality Wilderness retains its primeval character and influence, and is essentially without permanent improvement or modern human occupation			
Monitoring question	**Indicator**	**Measure**	**Data sources**
What are the trends in non-recreational development inside wilderness?	Non-recreational structures, installations, and developments	Index of authorized physical development	▪ Agency data systems (if available) ▪ Local data entry by resource specialists
		Index of unauthorized (user-created) physical development	▪ Record cards from staff and volunteers for unauthorized structures and developments ▪ Record cards and photopoints
	Inholdings	Area and existing or potential impact of inholdings	▪ Agency data systems (if available) ▪ Local data entry by resource specialists
What are the trends in mechanization inside wilderness?	Use of motor vehicles, motorized equipment, or mechanical transport	Type and amount of administrative and non-emergency use of motor vehicles, motorized equipment, or mechanical transport	▪ Agency data systems (if available) ▪ Local data entry by resource specialists
		Type and amount of emergency use of motor vehicles, motorized equipment, or mechanical transport	▪ Agency data systems (if available) ▪ Local data entry by resource specialists
		Type and amount of motor vehicle, motorized equipment, or mechanical transport use not authorized by the Federal land manager	▪ Agency data systems (if available) ▪ Local data entry by resource specialists ▪ Record cards from staff and volunteers
What are the trends in cultural resources inside wilderness?	Loss of statutorily protected cultural resources	Number and severity of disturbances to cultural resources	▪ Agency data systems (if available) ▪ Local data entry by resource specialists ▪ Photopoints ▪ Record cards from staff and volunteers

level of impact on the undeveloped quality of each of these. For example, an earthen dam would have less relative weight than a concrete dam, or an administrative structure built from logs would have less weight than one built of steel. This index would include buildings, administrative trails or roads used for any administrative purpose, roads used to access inholdings, dams, mines, utilities, water catchments and developments, fixed instrumentation sites, tracking devices, or other developments authorized by the Federal land manager. Structures and installations that were built before wilderness designation, as well as temporary developments and those used for monitoring trends in wilderness character, would be included. The Technical Guide (Landres and others, in press) provides an approach for computing this index. The undeveloped quality is degraded if this index of authorized development increased.

◊ *Measure: Index of unauthorized (user-created) physical development.* This index is similar to the previous one but would be for user-created structures, installations, and developments

that have not been authorized by the Federal land manager. Examples include fences, trails or roads used to access inholdings or other developments, water catchments and developments, fixed instrumentation sites, or radio-repeaters. The protocols described for computing the previous index could be applied to this one as well. The undeveloped quality is degraded if this index of unauthorized development increased.

- *Indicator: Inholdings.* This indicator would track trends in inholdings that occur within a wilderness. Since inholdings interior to designated wilderness are not given the same protections as the wilderness lands around them, these lands can be developed for various purposes at the discretion of the landowner, and thereby have a large impact on the surrounding wilderness. There is one possible measure under this indicator and it would be monitored every 5 years:
  - ◊ *Measure: Area and existing or potential impact of inholdings.* This measure would be composed of the number of acres of the inholding combined with a relative weighting of the existing or proposed development and resulting impact on surrounding wilderness values. The undeveloped quality is degraded if the area and impact of inholdings increased.

Monitoring Question: What are the trends in mechanization inside wilderness? The second monitoring question addresses trends in mechanization inside wilderness. The Wilderness Act discusses three forms of mechanization that degrade wilderness character: motor vehicles (aircraft and motorboats are included here), motorized equipment, and mechanical transport. Agency policies restrict the use of motor vehicles, motorized equipment, and mechanical transport, requiring authorizations for such use when deemed necessary. By monitoring these authorized uses, trends in Section 4(c) activities deemed by the agency to be the "minimum necessary" would be tracked. In addition, a wilderness may add a measure to monitor trends in public uses of mechanization that are allowed by special provision of law but not specifically authorized by the Federal land manager (for example, in Alaska). There is one indicator under this monitoring question:

- *Indicator: Use of motor vehicles, motorized equipment, or mechanical transport.* This indicator tracks the actual use of motor vehicles, motorized equipment, or mechanical transport for all reasons and purposes. Motor vehicles include any land, water, or air vehicles that are gas or electric powered, including motor boats, aircraft, or snowmobiles. Motorized equipment includes any machines or tools that use a motor or engine, such as chain saws or generators. Generally, small hand-carried devices powered by batteries, such as shavers, wristwatches, flashlights, or cameras are not considered motorized equipment. Mechanical transport includes the use of any contrivance for moving people or material in or over land, water, or air, having moving parts or providing a mechanical advantage to the user and powered by a living or nonliving power source. Examples include sailboats, hang gliders, parachutes, bicycles, game carriers, carts, and wagons. Wheelchairs are not included when used as necessary medical appliances. Skis,

snowshoes, rafts, canoes, sleds, travois, or similar primitive devices may have moving parts but do not provide mechanical advantage, and therefore are not considered mechanical transport. There are three possible measures under this indicator based on the purpose of use and all would be monitored annually:

- ◊ *Measure: Type and amount of administrative and non-emergency use of motor vehicles, motorized equipment, or mechanical transport.* This measure includes all such uses that are authorized by the Federal land manager. Data for this measure would most likely come from agency data systems or the local resource specialist. The Technical Guide (Landres and others, in press) provides an approach for computing this measure. The undeveloped quality is degraded if the type and amount of administrative and non-emergency mechanized use increased.
- ◊ *Measure: Type and amount of emergency use of motor vehicles, motorized equipment, or mechanical transport.* This measure includes all such uses for emergency purposes, such as fire or search-and-rescue. Data for this measure would most likely come from agency data systems or the local resource specialist. The Technical Guide (Landres and others, in press) provides an approach for computing this measure. The undeveloped quality is degraded if the type and amount of emergency mechanized use increased.
- ◊ *Measure: Type and amount of motor vehicle, motorized equipment, or mechanical transport use not authorized by the Federal land manager.* This measure includes all such uses that were not authorized by the administering agency's Federal land manager, typically actions by individuals or citizen groups. If actions taken by other Federal or state agencies occur without authorization of the Federal land manager, they are also included in this measure. The data for this measure could come from agency law enforcement data systems, local resource specialists, and record cards. The undeveloped quality is degraded if the type and amount of unauthorized mechanized use increased.

Monitoring Question: What are the trends in cultural resources inside wilderness? The third monitoring question addresses trends in the preservation and degradation of cultural resources. There is one indicator under this monitoring question:

- *Indicator: Loss of statutorily protected cultural resources.* This indicator would track evidence of disturbance or loss of cultural resources that are protected by law and agency policy. This disturbance or loss could be authorized (for example, purposeful removal to accomplish specific planning direction), unauthorized (for example, pot hunting), or natural (for example, from soil erosion). There is one possible measure under this indicator and it would be monitored every 5 years:
  - ◊ *Measure: Number and severity of disturbances to cultural resources.* This measure would track the type of cultural or heritage site that is affected, number of sites affected, and severity of disturbance. The data for this measure could come from agency law enforcement data systems, photopoints, and

record cards. The undeveloped quality is degraded if the number or severity of disturbances increased.

Solitude or Primitive and Unconfined Recreation Quality

This section provides details about all the monitoring questions, indicators, measures, and data sources for the solitude or primitive and unconfined recreation quality, beginning with an overview (for reference) in table 12.

Monitoring Question: What are trends in outstanding opportunities for solitude inside wilderness? The first monitoring question addresses how trends in outstanding opportunities for solitude are changing over time. The trend in solitude is separated from primitive and unconfined recreation at the level of the monitoring question to provide explicit stewardship focus on solitude. Opportunities for solitude are affected by many events and conditions inside wilderness as well as beyond the wilderness boundary. The two indicators under this monitoring question

Table 12. An overview of the monitoring question, indicators, measures, and data sources for the solitude or primitive and unconfined recreation quality.

Solitude or primitive and unconfined recreation quality Wilderness provides outstanding opportunities for solitude or primitive and unconfined recreation			
Monitoring question	**Indicator**	**Measure**	**Data sources**
What are the trends in outstanding opportunities for solitude inside wilderness?	Remoteness from sights and sounds of people inside the wilderness	Amount of visitor use	▪ Agency data systems (if available) ▪ Local data entry by resource specialists
		Number of trail contacts	▪ Record cards from staff and volunteers
		Number and condition of campsites	▪ Agency data systems (if available) ▪ Record cards from staff and volunteers
		Area of wilderness affected by access or travel routes that are inside the wilderness	▪ Agency GIS data systems, aerial photography
	Remoteness from occupied and modified areas outside the wilderness	Area of wilderness affected by access or travel routes that are adjacent to the wilderness	▪ Agency GIS data systems, aerial photography
		Night sky visibility averaged over the wilderness	▪ National night sky visibility maps
		Extent and magnitude of intrusions on the natural soundscape	▪ Agency data systems (if available) ▪ Local data entry by resource specialists
What are the trends in outstanding opportunities for primitive and unconfined recreation inside wilderness?	Facilities that decrease self-reliant recreation	Type and number of agency-provided recreation facilities	▪ Agency data systems (if available) ▪ Local data entry by resource specialists
		Type and number of user-created recreation facilities	▪ Agency data systems (if available) ▪ Local data entry by resource specialists ▪ Record cards from staff and volunteers
	Management restrictions on visitor behavior	Type and extent of management restrictions	▪ Agency data systems (if available) ▪ Local data entry by resource specialists

focus on selected conditions inside and outside of wilderness that reduce feelings of remoteness, because remoteness has been shown to be important to achieving a sense of solitude (Dawson 2004):

- *Indicator: Remoteness from sights and sounds of people inside the wilderness.* This indicator tracks the amount of actual and potential recreation use that diminishes opportunities for solitude. A greater amount of use may cause more encounters among groups, in turn decreasing opportunities for solitude (Hall 2001; Hammitt and Rutlin 1995). A greater amount of use also may affect feelings of peace, quiet, and mental calm that are strongly associated with solitude. Local staff will need to determine the amount of increased use that degrades this indicator. Wildernesses that have little or no recreation use could still report on this indicator. There are four possible measures under this indicator—the first three address different aspects of recreation use and would be monitored annually, whereas the fourth addresses the potential for a visitor to "get away" via access and travel routes and would be monitored every 5 years because these routes do not change frequently:
    - ◊ *Measure: Amount of visitor use*. There are several different data sources that could be used to measure trend in the amount of visitor use, such as the number of wilderness permits or registrations, trail counters, number of cars parked at a trailhead, violations of group size limits, or infrared or photographic remotely sensed data. Clearly these are coarse estimators because the size and capacity of the area strongly influence the effect of these visitors on solitude, as does the timing of when these visitations occur. To correctly interpret change over time, local staff will need to develop ways to standardize data collection and account for the amount of effort used to collect the data. This quality would be degraded if the amount of visitor use increases beyond this locally determined standard.
    - ◊ *Measure: Number of trail contacts*. This measure focuses on contacts the recreation user has with other wilderness visitors as well as administrative staff along a trail where most encounters occur. This measure could be composed of the number of contacts per unit time, kind of contact (visitor or administrative staff), and location of contact (for example, <1 mile from the trailhead, 1 to 5 miles from the trailhead, 5 to 10 miles, >10 miles, or management zone). To correctly interpret change over time, local staff will need to develop ways to standardize data collection and account for the amount of effort used to collect the data. This quality would be degraded if the number of trail contacts increases.
    - ◊ *Measure: Number of campsites.* This measure would be the number of campsites per unit area and the condition of those campsites. The Technical Guide (Landres and others, in press) provides an approach for computing this measure. To correctly interpret change over time, local staff will need to develop ways to standardize data collection and account for the amount of effort used to collect the data. This quality would be degraded if the number of campsites increases.

- ◊ *Measure: Area of wilderness affected by access or travel routes that are inside the wilderness.* This measure tracks the amount of area inside a wilderness that is influenced by the presence of access or travel routes. Since most wilderness visitors stay on or close to trails, this is a measure of the area frequented by visitors and is a coarse estimator of the area with reduced opportunities for those seeking solitude. System trails and aircraft landing sites within a wilderness would be included, as well as administrative trails or routes that may have occasional motorized vehicles. All of these routes would be buffered by a set distance and this area subtracted from the total wilderness area. Local staffs need to set these distances because factors such as vegetation density and surrounding topography strongly influence the actual distance that a route would affect the opportunity for solitude. The Technical Guide (Landres and others, in press) provides an approach for computing this measure. This quality would be degraded if the area affected by travel routes increases.

- *Indicator: Remoteness from occupied and modified areas outside the wilderness.* This indicator tracks selected conditions occurring on lands adjacent to the wilderness that affect visitors' opportunities for solitude. Even though managers may not be able to take action to mitigate or prevent some of these conditions, they nonetheless may diminish wilderness character. There are three possible measures under this indicator and all would be monitored every 5 years:
  - ◊ *Measure: Area of wilderness affected by access or travel routes that are adjacent to the wilderness.* This measure tracks the amount of area inside a wilderness that is influenced by the presence of access or travel routes that are adjacent to the wilderness. For example, open maintained roads, motorized trails, railways, and shorelines that are used as travel-ways surrounding a wilderness would be buffered by a set distance and this area subtracted from the total wilderness area. Local staff needs to set this distance because factors such as vegetation density and surrounding topography strongly influence the actual distance that a route would affect the opportunity for solitude. The Technical Guide (Landres and others, in press) provides an approach for computing this measure. This quality would be degraded if the area affected by travel routes increases.
  - ◊ *Measure: Night sky visibility averaged over the wilderness.* This measure tracks the visibility of the night sky derived from recent research results that are readily available nationwide (Cinzano and others 2001). Wilderness boundaries would be overlaid on these results in a Geographic Information System to derive a single averaged measure for the wilderness. Night sky visibility contributes to the important social values in wilderness of humility and being part of something larger, and strongly contributes to the wilderness character of an area. Wilderness managers cannot reduce all light pollution affecting a wilderness, but managers can take actions at administrative sites and work with local communities. This quality would be degraded if night sky visibility decreases.

◊ *Measure: Extent and magnitude of intrusions on the natural soundscape.* This measure tracks anthropogenic sounds that degrade the natural soundscape, such as the intensity and frequency of sounds from airplane overflights, motorized equipment, or motorized vehicles. The DOI National Park Service has developed soundscape monitoring that can effectively separate anthropogenic from natural sounds. These sounds could be recorded from set locations within the wilderness that are chosen to represent specific soundscape zones. This monitoring presents an opportunity for collaboration among the wilderness management agencies to share data and analysis techniques. Just like night sky visibility, the natural soundscape strongly contributes to the wilderness character of an area (Manning and others 2007), and managers could take actions that affect this measure, for example, by not using motorized equipment specifically because of its impact on the natural soundscape. This quality would be degraded if intrusions on the natural soundscape increased.

Monitoring Question: What are the trends in outstanding opportunities for primitive and unconfined recreation inside wilderness? The second monitoring question addresses how trends in outstanding opportunities for primitive and unconfined recreation are changing over time. Opportunities for primitive and unconfined recreation are most outstanding where visitors must rely on their own skills to navigate, travel, and live, and where they have a high degree of freedom over their own actions and decisions (Borrie and Roggenbuck 1998; Johnson and others 2005; Roggenbuck 2004). Structures, installations, and developments that have a recreation purpose or use are monitored under this question. (Structures, installations, and developments that do not have a primary recreation purpose or use are monitored as part of the undeveloped quality.) The two indicators under this monitoring question focus on traveling and camping in wilderness, and the freedom of choice while there:

- *Indicator: Facilities that decrease self-reliant recreation.* This indicator tracks trends in durable or permanent facilities that are used primarily for recreational purposes, regardless of whether these are for resource protection or visitor convenience. These facilities degrade the perceived opportunity for primitive and unconfined recreation. For example, if the agency installs a toilet, then most people would use it because it's there, and most visitors would assume that the agency wants them to use it to protect other resources. Similarly, user-created trails or shelters degrade this quality of wilderness character. These recreation-focused facilities are not tracked under the undeveloped quality. There are two possible measures under this indicator to differentiate recreation facilities that are authorized by the Federal land manager from those that are not so authorized. Both measures would be monitored every 5 years:
  - ◊ *Measure: Type and number of agency-provided recreation facilities.* This measure is composed of the type and number of recreation facilities provided or permitted by the agency, including miles of system trails, trail signs and other markers, shelters, developed water sources, toilets, picnic tables, bear boxes and poles, designated or constructed campsites, corrals,

or bridges and other structures built to help visitors cross rivers. These different types of facilities could be weighted by their impact on this quality. For example, a bridge made of natural materials would have less of an impact than one made of steel or plastic, and a primitive trail would have less impact than a highly developed one. The Technical Guide (Landres and others, in press) provides an approach for counting and weighting these facilities. This quality would be degraded if the number of agency-created recreation facilities increased.

- ◊ *Measure: Type and number of user-created recreation facilities.* This measure is composed of the type and number of facilities built or installed by users for recreation purposes, including shelters, trails and trail markings, fixed climbing anchors, bridges, corrals, or bear boxes or poles. These different types of facilities could be weighted by their impact on this quality. For example, a structure built of natural materials would have less of an impact than one made of artificial material. The Technical Guide (Landres and others, in press) provides an approach for counting these facilities. This quality would be degraded if the number of user-created recreation facilities increased.

- *Indicator: Management restrictions on visitor behavior*. This indicator tracks trends in restrictions that the agency places on visitor behavior inside wilderness. Visitors' opportunities to experience freedom from management are significantly affected by the number and type of regulations in place (McCool 2004). There is one possible measure under this indicator and it would be monitored every 5 years:
  - ◊ *Measure: Type and extent of management restrictions.* This measure would be composed of the number of restrictions and the extent of the area within the wilderness affected by the restriction. Examples of such restrictions include prohibited or limited use of campfires, the required use of designated campsites or campsite setbacks, restrictions on stock use, and requiring permits for wilderness visits. The Technical Guide (Landres and others, in press) provides an extensive list of management restrictions and an approach for computing this measure. This quality would be degraded if the type and extent of management restrictions increased.

Appendix B—Process Used to Develop This Interagency Strategy

The initiative for this interagency strategy began with a task on the 2004 Action Plan of the Interagency Wilderness Policy Council to "Create an interagency team to develop interagency wilderness character monitoring protocols." To implement this task, the IWSC developed an Operating Agreement in late 2006 that laid out staffing for the Interagency Wilderness Character Monitoring Team, as well as Team responsibilities, products, funding, and a timeline.

The first face-to-face meeting of the Team occurred in late January 2007. At this meeting the foundational ideas necessary for an interagency strategy were discussed and agreed upon. Monthly conference calls were held up until July 2007 to refine the ideas discussed at the January meeting and forge the first draft set of qualities, monitoring questions, indicators, and measures. In mid-July 2007, agency representatives on the Team sent this draft out for review within their agency. A total of 209 comments were received from 26 reviewers. Bi-weekly conference calls were held throughout August and September 2007 to discuss these comments and revise the set of monitoring questions, indicators, and measures.

A second face-to-face meeting was held in mid-October 2007 to resolve major issues about this interagency strategy, develop a final set of indicators and measures, and review the first complete draft of this document. The second draft of this document was completed by mid-November 2007, and again sent out for review within each agency and by the IWSC. A total of 79 comments were received from 27 reviewers. All comments were discussed on conference calls and through email. A third draft document was developed based on these comments. The Team reviewed this penultimate draft, made final revisions, and submitted the draft to the IWSC.

Appendix C—Agency-Specific Implementation Strategies

This appendix offers suggestions for how each agency could implement this interagency monitoring. Although this interagency strategy provides needed standardization for how trends in preserving wilderness character would be assessed, each agency has its own policies, procedures, and cultures, leading to differences in how this interagency strategy would be implemented. These suggestions for each agency were written by their representatives on this Team following a consistent format, and employees of an agency only need to read the subsection for their agency.

The agency-specific strategies offered below are not intended to be detailed implementation plans, but rather an approach for how these plans could be developed and their structure and general direction. In general, the agency-specific implementation strategies offered below would be useful for:

- introducing others within the agency or bureau to the concept of monitoring trends in wilderness character;
- giving people within the agency or bureau a general feel for the outcomes and benefits of this monitoring, and the costs in terms of dollars and time;
- starting the internal thinking of what would be included in this monitoring, who would be involved, and how this monitoring would be implemented;
- understanding the potential internal and external administrative, political, cultural hurdles to implementing this monitoring; and
- understanding the internal and external communication that would be needed to successfully implement this monitoring.

DOI Bureau of Land Management (BLM)

A general approach for implementing this interagency strategy in the BLM is offered below, as well as some implications of committing to this monitoring. A specific implementation proposal will be developed separately.

Background

This strategy provides BLM guidance in implementing a nationally consistent approach to assessing trends in wilderness character across the entire agency. As with any data gathering effort, the goal would be to increase the quality and reliability of information available to decision makers. This would lead to better understanding of agency performance in meeting the central mandate of the 1964 Wilderness Act: preservation of wilderness character. It would also lead to a better understanding and recognition of how agency decisions affect the wilderness resource.

Benefits and Impacts

The benefits to the BLM of implementing this monitoring strategy include better understanding of how well we are preserving wilderness character, recognition of how decisions affect wilderness character, and greater accountability in meeting congressional mandates. Specific

products would include a national database of trends in wilderness character by individual wilderness and an initial baseline and annual monitoring report for each wilderness. These data could be aggregated to the Field Office, District, and State level, as appropriate. Using standard methods to generate these products would bring consistency to a program that currently varies widely. These products could be used to justify appropriated budgets, gain stakeholder support for management goals, develop management plans for wilderness areas, improve NEPA analysis of wilderness impacts, and ultimately maintain or improve wilderness character.

Staff and budget impacts of implementing this strategy would be mostly limited to refocusing work of existing staff. BLM has a budgeted wilderness program, and budget directives over the last few years have directed staff to spend a significant portion of their time monitoring wilderness character. BLM has also made a large investment in GIS and related technologies that should allow database construction, data analysis, and report generation to be conducted using existing tools. Any additional workload is expected to be significant only during the period of establishing baseline data. There would be workload impacts to state GIS and wilderness program leads to initially design databases. Staff support from other resource specialists would be needed, but it is anticipated that this monitoring would fit with existing workloads of other staff. Many of the measures used in this effort are already tracked by other BLM programs such as weeds, range, or fire. The interagency strategy recommends that a single person be appointed as an interagency lead data administrator for implementation. If a new position were created to fill this need, BLM would be expected to contribute a portion of the salary, though it is possible this position would be filled and funded by the U.S. Geological Survey. Another option would be to assign an existing staff member from the National Lands Conservation System (NLCS) division as a wilderness character monitoring lead for BLM. This would require some reprogramming of Washington Office (WO) workload, but would not require additional funding. Under either option, some additional WO workload is to be expected.

Pilot Testing

New Mexico was suggested for a pilot test for reasons outlined below. James Sippel, the current New Mexico Wilderness Program Lead, has enthusiastically agreed, but as yet there has been no involvement with the New Mexico State Director to finalize this decision, which should be made only after the Interagency Wilderness Policy Council decides on whether or not to pursue this monitoring on an interagency basis. If the IWPC were to decline, BLM would then need to decide if this protocol would be followed without interagency participation.

New Mexico would serve as an excellent pilot test for the following reasons:

- the State Program Lead is already familiar with the concept of wilderness character monitoring, having participated in the pilot study by the Forest Service at his previous job;
- there are enough wilderness areas in the state to offer some diversity of data, but not so many as to be overwhelming at the outset and the

distribution between Field Offices is asymmetrical, allowing a more realistic gauge of potential workload disparities;

- the state has a mix of relatively new and old wilderness areas, with a variety of baseline data already available; and
- with State Director buyoff (if following a rapid decision by the Interagency Wilderness Policy Council on the fate of the interagency program), it is believed the pilot test could be conducted in FY08 with target complete implementation in FY09.

Indicators and Measures

The Interagency Wilderness Character Monitoring Team recommends that all indicators be addressed. Specific measures that are expected to be of most benefit to the BLM will be selected.

Implementation Plan

Several steps must be taken prior to development of a complete implementation plan:

1. The Interagency Wilderness Steering Committee must decide to pass this interagency strategy for monitoring trends in wilderness character to the Interagency Wilderness Policy Council.
2. The Interagency Wilderness Policy Council must decide to accept this interagency strategy.
3. Without affirmative action on either of the steps above, the BLM must decide to accept this interagency strategy (or a modified version thereof) unilaterally.
4. The U.S. Geological Survey must decide to what degree they would support the interagency (or BLM-specific) effort.

To flesh out the implementation plan, it is suggested that the BLM establish a team composed of one WO member, three State Lead members, and three District or Field Office members. It would be the duty of this team to analyze funding and staff needs to fully implement this program and detail funding, responsibilities, and scheduling of monitoring implementation targets. It is expected most of the work of this team would be completed within a year. Out-year work would include analyzing the need to adjust the original decisions as well as approve changes in the measures chosen or reporting standards.

Data

Three types of data are generated by this monitoring effort. The first type of data used in implementing this strategy would be data collected for assessing individual measures. For nationally available datasets such as the IMPROVE and CASTNET air quality databases, it is recommended that data be stored on either a Washington Office GIS server or (preferably) stored by the U.S. Geological Survey at one of their national centers. For locally derived data such as invasive weed inventories, data would be stored on each state's GIS server, with any paper-based data kept at the local office. The goal is to avoid duplication of efforts with regard to acquiring, storing, and maintaining the datasets by performing these tasks at the highest organizational level possible.

The second type of data is the narratives. It is important that a narrative document be prepared each year when the monitoring data are gathered and assessed. This document should address each individual measure used and values derived for them, the source and quality of the data used, and justification for deviation from the protocols for each measure. Original documents should be filed at each State Office with the state wilderness lead, with copies kept at the local office. Electronic files of each document should also be stored on each state's central GIS server for linking with GIS layers and Access databases.

Past budget directives have specified that a yearly monitoring report be prepared for each wilderness, so requiring these two types of data is not an entirely new requirement.

The third type of data would be the outcome of the analysis, or the trend. Each indicator, monitoring question, and wilderness character quality, as well as the wilderness as a whole, would be assigned a trend, either up, down, or stable. It is recommended that these trends be stored in a Microsoft Access database on each state's central GIS server and that unique identifiers currently used for the wilderness polygon GIS layer be used for database linking. This format is available to all BLM personnel and should be readily capable of being integrated into other BLM IT systems. Close coordination in designing this database would have to occur between state GIS and wilderness leads. The databases may look different from state to state, but if the interagency strategy were followed, the same information would be consistently entered.

Analysis and Reporting

The central workload for analyzing and reporting data would fall on the national data lead (BLM or interagency) for data derived from national datasets, State Office wilderness program leads for state-wide compilation, and Field Office wilderness staff for locally derived data. Analysis would follow agency-specific technical guidance and again, the narrative would justify any deviation from these guidelines. Field or District Office staff would take the lead in preparing accompanying narratives and forwarding them to State leads. It is estimated that for most wilderness areas, this split between national, state, and local workloads would be roughly equal, depending on the measures used. District and State leads would be responsible for answering questions and providing general direction and required to report annually on progress toward monitoring all wildernesses using this strategy. State program leads would report outcomes to the national lead, who would forward them to a central data repository for the entire NWPS, likely stored and maintained by USGS.

Hurdles

- *History*—The primary hurdle to overcome in implementing this monitoring program is overcoming the "bad taste" left with managers by the original GPRA requirement for measuring wilderness character in acres that could be readily compared across the BLM. A key part of any communication plan would be to address—and assuage—These concerns (see *Communication* below).
- *Workloads*—staff at all levels of BLM already have significant workloads. While implementing this strategy should be considered

as part of the existing workload of monitoring wilderness character, staff would see the extra time and effort needed to perform monitoring in a consistent and meaningful way as new work. Implementing this strategy correctly, particularly during the gathering of baseline data, may mean less time for other important work like planning, outreach, and visitor contact. Key to solving this dilemma would be gaining support for this effort from all levels of management. Basing GPRA performance on the appropriate use of this effort is a good start (see also *Communication* below). Eventually, Manual 8560 should be revised to reflect this work; in the interim, an Instruction Memorandum may be appropriate.

- *Budget*—Currently, no additional funding has been directed to this effort. Keeping budget impacts minimal was a basic criterion in developing this strategy. The congressional mandate for wilderness preservation is important regardless of budgets. Showing greater accountability can give justification for funding increases, especially given the recent congressional attention to the NLCS.
- *Varying levels of IT expertise*—This is largely a function of the age gap among BLM staff. Younger employees tend to have more knowledge of databases and GIS. Some states may support implementation but lack personnel with the skills to implement national or statewide databases. This could lead to very different methods of implementation, for example some states may prefer to gather mainly paper information and forego use of a database. As a solution, it is recommended that implementation of this monitoring strategy employ the most current database technology. Begin communication immediately with state GIS and IT specialists to notify them of these efforts and request their involvement. It is also essential that the national data lead, whether it is an interagency or BLM position, be knowledgeable and experienced with IT and GIS as well as wilderness stewardship requirements.

Communication

To successfully implement this monitoring within the BLM, communication (and buy-off) must be both "top-down" and "bottom-up."

To gain acceptance from the State Directors, it may well be necessary to directly address their concerns and misgivings face-to-face at an Executive Leadership Team or other high-level meeting. The National Landscape Conservation System and Community Programs Director and the NLCS Division Chief should decide the best person or persons to make that presentation, taking into account both the familiarity of the presenter with the strategy and the needs of the audience.

Field personnel would also need help in embracing—and implementing—this monitoring strategy. Formal training would help staff understand the reason behind this monitoring and facilitate its implementation.

Communication must stress what wilderness character monitoring is and what it isn't:

- It is a method to assess change at one wilderness over time, and it is *not* a way to compare wildernesses.

- It looks only at previously designated units and how, over time, the impacts to these units change. It is *not* a way to determine if a proposed area is suitable for wilderness designation.
- It looks at how the pre-exiting levels of measures change over time. It does *not* set standards for how many miles of fence, use-days of motorized equipment, or acres of invasive weeds are acceptable, nor does it develop standards for any of the other measures of wilderness character.
- Preserving wilderness character is required by the Wilderness Act, but it is *not* a new requirement.
- Monitoring these specific measures, rolled up and reported as required by this strategy, is new, but monitoring wilderness character is *not* a new requirement.

For over 20 years with the responsiblity for units in the National Wilderness Preservation System, the BLM has "gotten by" without a great deal of accountability for the wilderness program. In this they are no different from the other three wilderness stewardship agencies. To remedy this, supervisors at all levels are encouraged to tie annual performance evaluations for all relevant staff (not just wilderness program leads) to implementation of this monitoring.

DOI Fish and Wildlife Service (USFWS)

A general approach for implementing this interagency strategy by the USFWS is described below. In addition, issues that remain to be resolved are outlined, as are resource needs required to implement this protocol. If the interagency strategy is accepted, then the ideas presented below in draft form would provide a suggested course of action to facilitate its implementation within the USFWS.

Background

This interagency strategy is important to the USFWS as it would provide information for improving on-the-ground wilderness stewardship and wilderness policy review and implementation at the station, regional, and national level. Implementing this strategy would result in a standardized method for tracking trends and would allow us to measure our stewardship of wilderness in a more consistent and objective manner. In addition, it would provide accountability for the legal and policy mandate "to preserve wilderness character" (including opportunities for the public to use and enjoy wilderness in appropriate and compatible ways), identify key wilderness stewardship goals and priorities, and tie key goals to the legislative direction of the 1964 Wilderness Act. Furthermore, this strategy would provide a solid basis for communicating wilderness stewardship needs and priorities within the USFWS and with the public.

Benefits and Impacts

Monitoring wilderness character would provide information on the status and condition of USFWS managed wilderness areas to benefit the USFWS at the local, regional, and national levels.

At the local level, project leaders would be able to assess on an annual basis whether local management decisions are cumulatively improving or degrading wilderness character. With this increased understanding, managers would be able to adapt their management actions in ways that would better preserve wilderness character. Ultimately this would result in a more consistent and objective approach to the management of wilderness resources at the local level.

At the regional level, Refuge Supervisors would be able to assess the condition of wilderness areas within the region, allowing them to provide guidance and leadership on wilderness stewardship issues. This would ultimately result in minimizing impacts by implementing successful management strategies at the regional level and avoiding actions that are found to impair wilderness resources.

At the national level, the condition of USFWS managed wilderness areas can be assessed and reported on in a consistent and objective manner. The successful and productive management of USFWS wilderness areas can be reported to the other wilderness management agencies so they can learn from each other's wilderness stewardship decisions and coordinate their stewardship to the greatest extent possible. We can also communicate our successes (and failures) to the public to enlist their support in improving our wilderness stewardship across the System.

Monitoring wilderness character would require some additional resources at both the local and national levels. Individuals at the local level would need to spend additional time collecting and tabulating selected measures identified to assess wilderness character, especially during the period of establishing the Strategy. Additional funding is not anticipated at the local or regional level, although there would be a need to refocus a small amount of staff time to implement the monitoring. Very little (if any) additional resource needs are anticipated at the regional level. Much of the effort needed at the regional level can likely be accomplished through the regularly scheduled teleconferences by the regional wilderness coordinators. Additional time and resources would also be needed to collate, analyze, and report trends at the national level. Additional funding may be necessary at the national level to accomplish these actions. Furthermore, we recommend a continued role by staff within the U.S. Geological Survey. We envision the role of U.S. Geological Survey personnel to provide data common to all wilderness areas on an annual basis and to collect, analyze, and report on the trends in wilderness character every 5 years. Some funding may need to be provided by each of the four agencies managing wilderness to accomplish this task.

Pilot Testing

We propose selecting two to three refuges in each region for an initial testing of the monitoring framework. These selected refuges would assess and report on wilderness trends using the wilderness monitoring framework identified in this report. We also propose working with the national and regional Refuge Annual Performance Planning (RAPP) coordinators to allow for data reporting and analysis through our existing software application. We believe the pilot testing could occur within Fiscal Year 2008 and target complete implementation of the program in Fiscal Year 2009.

Indicators and Measures

The Interagency Wilderness Character Monitoring Team recommends all indicators be addressed. However, only those measures found to be relevant to USFWS managed wilderness areas and possess data sources that are readily available need to be addressed within the Strategy. These data sources may improve over time, making it possible to address additional indicators in the future.

Implementation Plan

The following plan is contingent upon several factors. USFWS members on the Interagency Wilderness Steering Committee and Interagency Wilderness Policy Council must agree to the recommendations provided in this document. Furthermore, the U.S. Geological Survey must determine to what degree they would continue to participate in this interagency strategy.

If the interagency strategy is adopted, we propose developing an implementation team consisting of the regional wilderness coordinators, the national wilderness coordinator, an individual associated with USFWS's Inventory and Monitoring program, and the USFWS's representative at the Arthur Carhart National Wilderness Training Center. The Inventory and Monitoring participant should chair the team. We anticipate very little, if any, additional funding would be necessary at the station or regional level to implement this monitoring program. There would be costs associated with developing reporting procedures and acquiring data from national databases (for example, an individual at the national level associated with acquiring data from national databases and entering that data for each refuge). There would also be additional responsibilities associated with developing the database and instructions associated with entering data. This team would work with the RAPP coordinators to assess the monitoring framework to determine if there is additional staffing, funding, responsibility, and scheduling needs. We would also need to develop a national monitoring program including a development timeframe. This team would need to meet annually to discuss issues associated with data collection or to discuss changes (additions or deletions) to the monitoring program based on input from the field. Finally, the Interagency Wilderness Steering Committee would need to discuss issues associated with data collection or to discuss changes to the monitoring program. We envision the majority of this work being accomplished within the first year; however, internal agency and interagency meetings would need to occur annually.

Data

Data sets would be collected and generated for assessing individual measures. Some of these measures are designed to incorporate data from nationally available data sets. For these national data sets, we recommend that data be collected and stored by either the Service Washington Office or the U.S. Geological Survey. We believe the RAPP software could readily be modified to incorporate data collected and input at the local level. As with other data collected within the RAPP, data sources can be identified within the database for use in future years to accommodate staff changes and ensure consistency between years. There would

be a need to work with the RAPP coordinators to develop the ability to assess the trend of each measure over time. The assessment of trends in wilderness character would provide important information regarding USFWS managed wilderness areas. This step is critically important for this Strategy to be relevant at the local and regional levels. Furthermore, this would allow for the assessment of a trend for each monitoring question, wilderness character quality, indicator, and measure at the local, regional, and national levels.

Given that the software associated with inputting data to RAPP is tiered to provide information to the Department of Interior, there already is a seamless method to share data with the other two agencies managing wilderness within the department. There would need to be further discussion on how to share data with the Forest Service. The role of the U.S. Geological Survey is likely important for the integration of data between the two departments.

Analysis and Reporting

As mentioned previously, we believe the monitoring questions could be easily incorporated into the existing RAPP data collection process. This precludes the need for developing an additional data collection system and results in a more detailed analysis on how we determine refuges are managing wilderness areas. Furthermore, this would result in stations having more information on actions that benefit or impact wilderness character and a more goal oriented approach to wilderness stewardship at the station, regional, and national levels. Results of the data analysis should be reported at the station, regional, and national levels. Although the National Wilderness Preservation System-wide analysis and reporting should be conducted at the national level (ideally by the U.S. Geological Survey), it is critical that the National Wildlife Refuge System RAPP database allow local managers to readily assess the trends in wilderness character.

Hurdles

We recognize the challenge of requesting additional data collection requirements at the field level. Addressing this challenge was an integral component of the Strategy. Both USFWS representatives on this Interagency Team were from field stations and we were hesitant to support the adoption of any measures requiring even moderate increases to staff resources. However, given the level in which we currently monitor wilderness resources, any additional measure would result in an increase in staff time to collect and report data. We believe this is a hurdle to implementing this monitoring program. There would be a need for additional commitments by staff to collect additional data throughout the year. The key to overcoming this hurdle involves gaining support for this effort at the local, regional, and national levels.

We recognize there may be no additional funds available to implement this strategy. This was an important factor recognized during the development of this Strategy. All efforts were made to ensure no additional funds were needed to implement this Strategy at the local level. However, there would be a need for some additional funding at the national level to oversee the collation, analysis, and reporting of this monitoring program. If

the U.S. Geological Survey is willing, funding may be needed from each of the four agencies to ensure this participation.

Communication

If this interagency strategy is adopted, there would be a need to brief each of the Assistant Regional Directors (ARDs) for refuges, regional wilderness coordinators, and stations managing federally designated wilderness. Service members of the Interagency Wilderness Character Monitoring Team would be available to meet with the ARDs and regional wilderness coordinators to provide this briefing. This briefing should include the message that this interagency strategy:

- does not compare wilderness areas against each other;
- does not compare wilderness management between agencies;
- was designed to determine trends in wilderness character for each individual unit;
- provides information that would be useful at the local level and benefit project leaders in their management of wilderness areas; and
- provides information that would be reported for assessment at the regional and national level that would allow for regional and national leadership in wilderness management.

In addition, the Arthur Carhart National Wilderness Training Center should develop a training module to use at unit and regional wilderness workshops. This would allow consistent data collection and assessment of trends in wilderness character.

DOI National Park Service (NPS)

A general approach for implementing this interagency strategy in the NPS is offered below.

Background

This interagency strategy provides guidance to NPS managers for implementing a wilderness character monitoring program to assess whether the Wilderness Act mandate and NPS policies for preserving wilderness character are being achieved. By focusing wilderness character monitoring on the four qualities identified in this document—untrammeled, undeveloped, natural, and solitude or a primitive and unconfined type of recreation—NPS managers would better understand what management practices to adopt to ensure maintaining or improving wilderness character of the areas they manage.

Benefits and Impacts

At the local level, wilderness character monitoring would help NPS managers understand how their individual management decisions have affected or are likely to affect the four qualities of wilderness character and to clearly see the trade-offs of effects among the four qualities for any given management action. This greater understanding would influence decisions regarding scientific activities conducted in wilderness,

resource management approaches to maintaining and improving resource condition in wilderness, visitor use and resource protection actions, and focal points for interpretive programs about wilderness.

At regional and national levels, this monitoring would assure consistency, continuity, and accountability in the way wilderness character is monitored and assessed across wilderness areas in the National Park System. The compilation of monitoring trends for multiple parks would permit reporting on the trends in National Park System components of the National Wilderness Preservation System. The ability to report on these trends would provide useful information for responding to public inquiries about the condition of wilderness and developing funding proposals for adding capability to park wilderness management programs.

This monitoring protocol would be invaluable if the revised Wilderness GPRA Measure described in the *Implications for A GPRA Wilderness Measure* section is adopted.

Implementing this monitoring framework would require dedicating park staff time to gathering available data contained in park files, acquiring new data for specific measures (in some cases), and, should the park choose to initiate new types of data collection to track new measures, acquiring staff time and equipment (possibly) that currently does not exist. Regional and/or national staff would be expected to help compile wilderness specific information that would be extracted from regional or national databases.

Without specific funding for wilderness programs in each park and no additional funding, money would need to be diverted from other program areas and used to fund this monitoring program. How this monitoring may be integrated into the National Park System's overall Inventory and Monitoring Program would need to be investigated.

Pilot Testing

The NPS would recruit at least one park containing wilderness in each of its six administrative regions with wilderness to conduct a pilot test in a National Park System context. The NPS would provide an overview context for the pilot testing to ensure that all six parks would be able to provide feedback on key questions about applying the framework in parks. The results of the pilot testing would aid in making decisions on whether reference manual level guidance and a budget initiative need to be developed.

Indicators and Measures

The NPS would rely on pilot testing results to determine which specific measures would be most beneficial in a park context. A key aspect of the pilot testing would be to explore which, if any, existing vital signs elements can be used directly as data sources to address relevant wilderness character monitoring measures. A second key aspect would be to assess whether it would be appropriate for the vital signs program to add one or more new measures designed specifically to provide data to address a wilderness character measure.

Implementation Plan

The NPS would form an interdisciplinary team to develop the specific service-wide implementation plan. This team would be composed of the national wilderness program chief, regional wilderness coordinators, a vital signs program representative, three park representatives, and the Arthur Carhart National Wilderness Training Center representative. The team would use elements identified and explored during the pilot testing process for park, regional, and Washington offices as appropriate during the development of the specific implementation plan.

Data

Data collected in a park would be managed by that individual park, either as a stand alone wilderness database or as components of a vital signs database. Data obtained from nationwide databases would be extracted and served by NPS Washington Office divisions most closely associated with the subject of the data. The Washington Office would be the responsible party for assembling NPS-wide trend data, drawing the data either directly from park databases or from Regional Office databases should Regional Directors choose to establish regional databases.

Analysis and Reporting

Park data analyses would be reported to NPS regional directors. Regional directors would report regional office analyses to the NPS Washington Office that, in turn, will prepare the NPS summary report. Managers at each administrative level of the NPS would use the information to develop appropriate management documents.

Hurdles

Key hurdles include inadequate funding and staffing. There may also be reluctance by some managers to implement this monitoring program if they are currently using another method to assess wilderness character in their parks. In some cases, current levels of communication and coordination across park division boundaries may cause difficulties in determining which division may be responsible for collecting what types of data, who would track all data, and who would facilitate assembly of an overall assessment of trend in the park's wilderness character.

Communication

One key communication need is informing the NPS management chain of command about the strategy and opportunity it provides for improving the stewardship of wilderness character. An important point in this communication is that the strategy tracks trends in wilderness character within a single wilderness area and does not compare it to any other wilderness area or the management of wilderness areas between other agencies. Another key communication need is providing training to regional and park staffs about this monitoring and the opportunities it offers for increasing the effectiveness of park wilderness stewardship activities. The Arthur Carhart National Wilderness Training Center should develop a training module to use at unit wilderness workshops and other venues. A third key communication need is to include park interpretation staff in the information dissemination process so they can use the

information to provide more wilderness-oriented interpretive programs and information to park visitors.

U.S. Forest Service

A general approach for implementing this interagency strategy in the Forest Service is offered below, based largely on extensive development already conducted by the agency to implement this monitoring.

Background

Although about 19 percent of all the land managed by the Forest Service (about 35 million acres) is designated wilderness, the Forest Service currently lacks a nationally consistent way to evaluate how well it is fulfilling the central mandate of the 1964 Wilderness Act to preserve the area's wilderness character.

The history of the Forest Service includes foundational work to create the system of designated wilderness we now have the privilege of stewarding. To uphold this legacy, the Forest Service needs to retain its leadership by monitoring trends in wilderness character and using this information to guide stewardship actions at all administrative levels.

Benefits and Impacts

The benefits of this monitoring to the Forest Service include:

- better information available to decision-makers at all administrative levels to guide decisions and focus stewardship efforts in a time of limited budgets;
- improved ability to guard against legal vulnerability by being able to include information about trends in wilderness character in NEPA analysis documents and disclose how proposed actions support maintaining or improving wilderness character;
- improved accountability for results tied directly to the mandate to "preserve wilderness character;
- improved integration with other resource programs including information available to the local manager that today is not easily available (for example, air quality data for specific wilderness); and
- complementing and moving the agency beyond the Chief's 10-Year Wilderness Stewardship Challenge.

While improving wilderness stewardship must occur at the local level, the ability to compile information at regional and national levels provides a powerful communication tool that is essential to evaluate program effectiveness at all administrative levels.

The Chief's 10-Year Wilderness Stewardship Challenge (Chief's 10-YWSC) and wilderness character monitoring complement one another. Conceptually, the Chief's 10-YSC evaluates trends in elements of the management program, whereas wilderness character monitoring assesses the results or outcomes of these program elements. The Chief's 10-YWSC will end in 2014 and discussion has not yet occurred to determine what would happen with the current performance measure after that time. Reporting trends in wilderness character could serve as a next

logical step. Prior to 2014, individual wildernesses could begin compiling information in accordance with the wilderness character monitoring protocol to help fulfill the requirements of elements 2, 3, 6, and 9 of the Chief's 10-YWSC. If this were accomplished, the Forest Service could begin to have trend data for at least some aspects of wilderness character in the foreseeable future.

This monitoring strategy has been designed specifically with the objective of minimizing impact on field-level workloads. Data stewards are already identified within the Forest Service for every wilderness and these data stewards already report annually on wilderness accomplishments through the Infra-WILD database. Good communication with data stewards would be required to encourage gathering local data for measures associated with wilderness character to help fulfill elements of the Chief's 10-YWSC. The largest workload impact on field staff would be incurred in the first year when baseline information was being compiled and reported. After the initial investment, some measures are only reported every 5 years, lessening the annual impact on field staff. To further lessen impact on field staff, a central data analyst could be hired to maximize efficiency in collecting data from national databases. This could be a new position or potentially a re-prioritization of work associated with an existing position. It is also possible that efficiency could be gained by sharing the funding for such a position among all agencies conducting this monitoring, including the U.S. Geological Survey.

Pilot Testing

Pilot testing the Forest Service's wilderness character monitoring protocol in each of the Forest Service regions was completed in 2006. A total of 121 Forest Service personnel participated in these tests, including 23 wilderness managers, 95 resource specialists such as wildlife biologists, air resource managers and engineers, and three district rangers. The full pilot test results are available in the report "Final Pilot Test Report: A National Protocol to Evaluate Trends in Wilderness Character" (Boutcher and Landres 2006).

Primary findings from the pilot test were:

- all local pilot test participants felt implementation of this monitoring would improve their understanding of wilderness character.
- all but one of the local pilot test participants felt wilderness character monitoring was worthwhile.
- not all measures were relevant in every wilderness, but all measures had relevance in a majority of wildernesses.
- despite the diversity of wilderness across the country, the rationale for this monitoring made sense and was applicable across the entire system of 418 Forest Service wildernesses.
- the completeness and accuracy of data currently stored in corporate and external information systems varies greatly.
- all pilot test participants felt the protocol was do-able and the anticipated workload was reasonable (estimates derived from pilot testing were that initial baseline monitoring would take between 33 and 130 hours depending on wilderness complexity level, and annual monitoring thereafter would take about 14 hours in each wilderness).

Indicators and Measures

The Interagency Wilderness Character Monitoring Team recommends that data be collected to assess trend for all indicators. While this interagency wilderness character monitoring identifies some new measures and modifies some of the measures initially developed by the Forest Service, the changes are not anticipated to alter the finding that most measures would be relevant to Forest Service wildernesses. In addition, this monitoring strategy recommends a "cafeteria" approach that would provide flexibility to the Forest Service to identify a core subset of measures that might be most beneficial. It is recommended that the Forest Service Wilderness Information Management Steering group be tasked with identifying this subset of measures after approval of this monitoring strategy.

Implementation Plan

An implementation plan is needed to carefully prepare the different levels of management, from field office to Washington Office. Implementation analysis and briefing materials were presented to Deputy Chief Joel Holtrop in 2007. Specific staffing and funding needs were identified, as well as a timeframe for implementing this monitoring. At that time, the agency could not commit national funding and staff toward implementation. This past work would need to be updated to address the current situation of decreased funding and staffing as well as the agency's current reorganization initiative. The updated implementation plan would need to outline what has changed since 2007 and propose a new strategy for accomplishing wilderness character monitoring.

Data

The data called for in the Forest Service protocol for monitoring wilderness character came from several data sources, which can generally be categorized as:

- new data entered using office records and professional knowledge;
- existing data currently residing in a corporate database, with opportunities for validation and modification; and
- existing data from external data sources.

The Wilderness Character module of Infra-WILD would provide the tool necessary to access corporate Forest Service data. Forms have been drafted for the entry of new data and to facilitate the review and editing of existing data, including the data stored elsewhere in Infra or in the Natural Resource Information System. Utilities can be developed to access external data sources, which in most cases would be served over the Internet.

Analysis and Reporting

This monitoring would allow the Forest Service to report on the percentage of wildernesses that show a stable or improving trend for wilderness character and a degrading trend in wilderness character compared with baseline conditions for each area. Such information would be a powerful tool to demonstrate where stewardship is yielding positive results and

where improvement is needed. Two different reports would be produced to present monitoring results:

- *National Wilderness Report*—The purpose of the National Wilderness Report is to communicate monitoring results with line officers and program managers to inform policy review and improve wilderness stewardship. The National Wilderness Report would consist of two components: (1) a two-page summary of monitoring results suitable for briefings to the National Leadership Team and similar audiences and (2) an expanded report summarizing trends in wilderness character, qualities, indicators, and measures for each region.
- *Local Wilderness Report*—A standard report format would be built into the Infra-WILD application allowing the local wilderness manager to query the database and produce a report for an individual wilderness. Local managers would be able to produce two different reports: (1) a summarized report suitable for communicating monitoring results with line officers and potentially with interested citizens and (2) a "data dump" of all the information entered into the system for use by the local manager to compare current conditions against locally established standards.

The National Wilderness Report would be produced on a 5-year cycle. Every year, data would be summarized for 20 percent of National Forest System wildernesses (approximately 80 wildernesses per year). Updates would be produced annually and a comprehensive report produced every 5 years. Producing a report annually for a portion of National Forest System wildernesses allows compilation and synthesis work to be spread evenly rather than having to "staff up" once every 5 years. Additionally, annual reports provide a more even information flow to leaders in the wilderness program so that some information about trends in wilderness character is available to inform program decisions every year. At the forest level, highlights from Infra-WILD reports produced for local wildernesses could be included in the monitoring and evaluation reports, as required by planning regulations.

Regional or national displays of information about many wildernesses can present a much more compelling picture than information about a single wilderness. Only at the local level would absolute values be generated for each measure. These raw data can provide meaningful information to the local manager about how conditions compare with locally established standards and the magnitude of change observed from one monitoring period to another.

Hurdles

Corporate data systems have increased database reporting workloads to the point of overload, and implementing wilderness character monitoring would increase data steward's time commitment. The additional workload must come with funding to compensate for the added work or existing workloads must be re-prioritized.

Communication

Ironically, communicating the need for wilderness character monitoring might prove to be more difficult than the actual monitoring or data

reporting. Explaining the story of how Congress gave the Federal agencies a mandate to preserve wilderness character in the Wilderness Act of 1964, but never fully articulated or defined wilderness character, has created a void in wilderness management for 44 years. Additionally, monitoring indicators that can actually evaluate trends in wilderness character over time have never been developed—until now. Currently, the Forest Service is focusing its monitoring priorities on managing wilderness to standard to reach a minimal wilderness stewardship level. The Agency is now in its third full year of reporting the progress of its management to standard in Infra-WILD. The goal of the Chief's 10-YWSC is to have all 418 Forest Service wildernesses managed to standard by the 50th Anniversary of Wilderness in 2014. An essential part of the communication plan would be to articulate how the Chief's 10-YWSC and wilderness character monitoring complement each other and how the transition would occur from reporting on the Chief's 10-YWSC to reporting on trends in wilderness character.

If this monitoring strategy is approved by the IWSC and IWPC, it is recommended that a team be tasked with developing an updated Implementation Plan and a Communication Plan. The team should include the Washington Office wilderness information manager, one regional wilderness program manager, one field-level wilderness manager, and one wilderness researcher (Peter Landres of the Aldo Leopold Wilderness Research Institute). Additionally, one Regional Recreation/Wilderness Director should be involved in developing the communication plan. This is imperative because the Regional Forester support is essential to implement this monitoring. To gain Regional Forester support, the Regional Recreation/Wilderness Director must fully understand and support this effort. Secondly, a staff person from the Washington Office Communications and Legislative Affairs staff should also be engaged in the development of the Communication Plan. This position is an important component because talking points developed by the team would eventually be communicated to the Department of Agriculture staff and Congress. Having a Washington Office public affairs staff person engaged in the development of the Communication Plan would help ensure the document meets the needs of Washington Office and the Department.

Finally, it is recommended that the Communication Plan be transmitted to the field via the Regional Wilderness Program Managers and the Arthur Carhart National Wilderness Training Center (ACNWTC). The interagency Carhart staff is in the best position to produce training materials and workshops to help convey the purpose, need, goals, and objectives of the wilderness character monitoring. It is further recommended that each Region host a regional training course conducted by the ACNWTC interagency staff to provide wilderness managers and on-the-ground wilderness rangers the necessary skills to properly and consistently monitor and report wilderness indicators and measurements. Additionally, the interagency wilderness website [http://www.wilderness.net] should be fully used to make wilderness character monitoring program information readily accessible. All pertinent wilderness character monitoring documents can be stored and easily downloaded from a "toolbox" dedicated to this subject matter.

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