

Scientists Identify, Evaluate Indicators To Monitor Wilderness Conditions

By Linda Merigiano and Ed Krumpe

Wilderness managers face a difficult challenge: how to protect an area's natural ecological conditions and, at the same time, provide opportunities for visitors to enjoy a wilderness experience (Wilderness Act PL 88-577). Human use inevitably causes some change in wilderness conditions; therefore, managers now seek ways to detect unacceptable changes in environmental and experiential conditions. The 1985 Fall issue of *Park Science* highlights two new approaches being developed to help managers meet this challenge: the Forest Service "Limits of Acceptable Change" system and the National Park Service "Visitor Impact Management" system. Common to both these approaches are monitoring indicators, which are defined as specific elements of the wilderness setting that change in response to human impacts (adapted from Stankey et. al. 1984).

Current interest in monitoring indicators also comes from legal mandates such as amendments to NEPA (PL 91-190), which call for "the development and use of indices and monitoring systems." However, managers cannot afford to monitor every aspect of the park or wilderness environment; thus, they will need to select a limited number of indicators. To date there has been little information available to help managers select the indicators that have a proven ability to detect changes in soil, water, air, vegetation, wildlife and recreation experiential conditions. As Wall and Wright (1977) concluded:

The most appropriate measures of environmental impact have yet to be determined. Assimilation of the knowledge from various fields will be difficult unless researchers from different disciplines work together (p. 50).

Last year the University of Idaho Wilderness Research Center began a study to identify and evaluate indicators that could be used to monitor human-caused change in wilderness conditions. Hundreds of indicators *could* be monitored: thus, this exploratory study sought to determine which indicators of-

fered potential to warrant further field testing.

Through a series of three questionnaires, a panel of 100 biological, physical and social scientists, who had conducted research in wilderness and National Parks, were asked to identify and evaluate indicators. Nine criteria were developed from a prior literature review to provide a common basis for the scientists to identify and evaluate potential indicators. These criteria are listed in Table 1.

The panel identified more than 200 indicators that could be used to monitor wilderness conditions. These preliminary indicators then were organized under three basic wilderness components: BIOLOG-

Table 1

Criteria Used to Identify and Evaluate Indicators

Long-term significance	- The indicator detects a change in conditions which cannot be reversed in five seasons with reasonable management effort.
Short-term significance	- The indicator detects a change in conditions which occurs within one season.
Responsive	- The indicator detects a change in conditions which is potentially responsive to management control.
Detects amount	- The indicator detects the amount of change in conditions.
Sensitive to wilderness	- The indicator detects a reduction in the area's ability to provide a wilderness experience (defined as a primitive and unconfined type of recreation having outstanding opportunities for solitude).
Feasible	- The indicator can be measured by field personnel using simple equipment and sampling techniques.
Reliable	- With training, different observers will collect the same information.
Correlates with human use	- The indicator detects a change in conditions which can be correlated with a specific type of human use.
Economical	- The indicator produces information of acceptable accuracy which is worth the expense of measurement.

ICAL (vegetation and wildlife/fish), PHYSICAL (soil, water, and air) and HUMAN (visitor population description and experience). Each panel member then selected the 20 preliminary indicators they felt best met the criteria.

In the final questionnaire, each of the 32 most frequently selected indicators was evaluated by the panel to determine whether or not the indicator met each of the nine criteria. The top three ranking indicators for various components of the wilderness environment are presented in the preliminary results displayed in Table 2. Further literature review of

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Table 2
Indicators Evaluated Highest by Scientists to Monitor Wilderness Conditions

BIOLOGICAL	PHYSICAL	HUMAN
Vegetation	Soil	Visitor Population Description
• Number and distribution of campsites per area • Percent of ground cover loss on campsites • Range condition and trend in grazed meadows	• Firing density (number/area) • Percent or area of exposed mineral soil on campsites • Number of multiple trails in meadows or wet areas	• Number of groups per area, trail or river per day • Distribution of visitor use over week or season • Number of pack animals per trail per day
Wildlife/Fish	Water	Experience
• Abundance of selected wildlife/fish spp. sensitive to human presence • Population trend of selected wildlife/fish spp. sensitive to human presence • Distribution of selected wildlife /fish spp. sensitive to human presence	• Fecal coliform count • Fecal coliform/fecal streptococci ratio • Mean concentration of selected nutrients in water (e.g. nitrates, sulfates, phosphates)	• Number of other groups encountered while at campsite • Quantity and distribution of litter (human garbage) • Number of other groups encountered on trails or rivers per day
	Air	
	• Air visibility • Ambient concentration of selected chemicals in air (e.g. SO₂, NO₂, O₃)	

Based on the cumulative score for each indicator on the nine criteria

indicators will supplement information collected from the panel of scientists. At the completion of this study we will report the ranking of all 200 indicators. In addition, we will report how each of the top 32 indicators was scored on the nine criteria (see Table 2).

Results of this study have revealed that the identification and evaluation of indicators to monitor wilderness conditions is an extremely complex topic. Given the current state of knowledge, managers will need to monitor many indicators to cover all wilderness components. Only when the relationship between indicators and their ability to detect change in wilderness conditions is better understood, can the number of indicators monitored be significantly reduced.

However, this study has developed criteria to evaluate indicators and has identified the indicators that seem to offer the most potential to monitor wilderness conditions. The stage is now set for further research to develop appropriate measurement techniques and set up long-term monitoring programs to field test potential indicators in various ecosystems.

Literature Cited

- Stankey, G.H., S.F. McCool and G.L. Stokes. 1984. *Limits of Acceptable Change: a new framework for managing the Bob Marshall Wilderness complex. Western Wildlands 10(3):33-37.*
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