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RESEARCH UPDATE: WHAT RESEARCH HAS LEARNED ABOUT WILDERNESS MANAGEMENT

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INTRODUCTION

The workshop schedule permits only a brief overview of what research has learned and allows discussion of just one important example. We will begin with the general overview, which also provides background for the more detailed discussion of our selected example, campsite management. The summary of our research efforts indicates the scope of the program, but does not include all of our specific studies.

Several hundred Forest Service research units across the Nation investigate a broad range of forest and range management problems. Six of these units, from New Hampshire to Washington State, focus on management of forest recreation. Each research unit has its own special mission. Our unit in Missoula, Mont., has the mission of building the knowledge base for improved wilderness management.

The wilderness management research unit was established in 1967 and has had two scientists on its staff most of this time, aided by cooperators in universities and other research organizations. It is a program of applied research--focused on management, not classification, of wilderness and similar lands providing opportunities for primitive recreation.

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[1]Authors are listed in the order in which they spoke at the workshop.

Forest Service research units operate under 5-year research work unit descriptions that direct research efforts. The wilderness management research unit has had three work unit descriptions since its inception, and it will have a new one by October 1984. Thus, the specific problems studied have changed. The research program typically has included studies of ecological problems, visitor behavior, and the development of new management tools and systems.

ECOLOGICAL RESEARCH

Ecological research is aimed at the wilderness objective of maintaining natural ecosystems wherein the imprint of man is substantially unnoticeable. To date, ecological research has focused on learning how to manage recreational impacts on campsites and trails: we have mainly studied the impacts of camping on vegetation (which will be discussed later), with some study of camping's impact on soils, of trail erosion, of wildlife disturbance by recreationists (Ream 1980), and of human waste disposal (Temple and others 1982). We have also developed impact monitoring techniques for campsites and trails (Cole 1983a, 1983b).

VISITOR RESEARCH

Visitor studies are aimed at improving management of recreational visitors in order to minimize their impacts on the environment and on other visitors, while providing opportunities for high-quality wilderness experiences. This has been a continuing emphasis in the research program. In general, visitor studies have included basic studies of users' motivations, activities, knowledge, satisfaction, and preferences; use distribution patterns; trends in use and user characteristics; and responses to management actions (Lucas 1980). Social carrying capacity, which includes solitude, crowding, conflict and the factors that influence it, has been studied in depth (Stankey 1973, 1982). Nonregulatory visitor management has been stressed (Lucas 1983); for example, use of information to redistribute recreational use, including cooperative research by Professor Edwin Krumpe, director of the University of Idaho Wilderness Research Center (Krumpe and Brown 1982; Lucas 1981). Registration behavior has been and is being studied in relation to type of visitor and type of registration system to aid in basic measurement of recreational use, which is fundamental to advanced management of visitor use (Lucas 1983).

MANAGEMENT SYSTEMS DEVELOPMENT

Some of our research has been integrated into management systems or frameworks to try to maximize its usefulness. Three examples can be mentioned. First, the Limits of Acceptable Change (LAC) system is a clear, practical approach to managing recreational use within carrying capacity. The LAC system is in the final stages of development, but it already is being used by some wilderness managers.

Second, use measurement technology has been developed, partly in cooperation with the Forest Service's Missoula Equipment Development Center. Use-measurement technology has been greatly improved, but development of a fully satisfactory, cost-effective system will require further efforts.

Finally, a simulation model has been developed to predict recreational use distributions and resulting solitude or congestion under various amounts and patterns of visitor use. The simulator has been used in several national forest wildernesses and several national parks. In at least two cases, it has been used to plan rationing systems that reduced use as little as possible while still achieving management objectives (Shechter and Lucas 1978).

Research since 1967 has resulted in over 100 publications. A list is available from the research unit's office in Missoula.

CAMPSITE MANAGEMENT EXAMPLE

A large part of the research unit's program is focused on campsite management. The program includes two kinds of studies: visitor behavior and ecological impacts. We will describe the campsite management problem, its importance, the factors affecting campsite conditions, and general management strategies, first in terms of ecological research and then in terms of visitor research. Finally, we will discuss two common management actions--(1) use dispersal vs. concentration, and (2) visitor education and information.

The management of wilderness campsites and camping is a key element in any effective wilderness management program. The campsite is the focus of much recreation use and the impacts of such use. It is also the site where various environmental impacts (including vegetative loss, tree damage, soil erosion) intertwine with recreational experiences in a way that emphasizes the complex, interrelated nature of wilderness management. Finally, the camp setting is a place for a special kind of experience for visitors that is both very important as well as highly sensitive.

MANAGING WILDERNESS CAMPING FROM AN ECOLOGICAL PERSPECTIVE

One of the major goals of wilderness management is preservation of natural conditions. Unfortunately, camping inevitably alters natural conditions and, therefore, conflicts with this goal. The question is, how severely are natural conditions altered as a result of camping?

A study of campsites in subalpine forests in the Eagle Cap Wilderness, Oregon, sought answers to this question. Median values from a sample of 22 sites, ranging widely in use intensity, provide an estimate of typical conditions. On the typical site, 90 percent of the ground cover vegetation and one-half of the soil organic horizon has been lost. Most overstory trees have been damaged and tree reproduction has virtually been eliminated. Soil compaction has occurred, and in places this has aggravated erosion problems. Essentially every vegetative and soil characteristic we measured has been substantially altered. Moreover, this substantial level of alteration was found on lightly used sites as well as heavily used sites (Cole 1982a).

To find out whether such substantial alteration occurs in different environmental situations, we conducted a similar study in the Bob Marshall Wilderness, Montana. The campsites studied were in lower elevation forests and meadows--sites with longer growing seasons that might be more resistant to recreational impacts. Most of the same types of disturbance found in the Eagle Cap also occur on Bob Marshall sites. Some impacts, such as vegetation loss, were less pronounced. The median vegetation loss on Bob Marshall sites was only 66 percent. Other types of disturbance were more severe, however. On Bob Marshall sites, the total area disturbed by camping is unusually large, and both tree damage and the invasion of exotic species are unusually pronounced (Cole 1983c).

These results suggest that natural conditions are substantially altered wherever camping occurs on a regular basis. As the contrast between Eagle Cap and Bob Marshall sites illustrates, however, the exact nature of this disturbance varies between areas with differences in types of use and environment. Unfortunately, campsite conditions have been studied only in a few wilderness areas. Information on campsite condition is entirely lacking from major parts of the country--the Southern Rocky Mountains, the southwest deserts, and Alaska, for example. A better understanding of the nature of camping disturbance would contribute greatly to more effective and efficient management of these neglected areas. Thus, comparative studies of campsite conditions in different parts of the country are one major research need.

In addition to impacts on individual campsites, a second type of problem is the proliferation of sites. The Wilderness Act states that management is to keep man's imprint "substantially unnoticeable." Around two lakes in the Eagle Cap Wilderness, as an example, over 220 campsites were located (Cole 1982b). In places there were sites behind every tree clump and every rock outcrop where there was a patch of level ground. This situation, which is common in many wilderness areas, makes it very difficult to escape the evidence of human use.

MANAGING WILDERNESS CAMPING FROM A RECREATIONAL PERSPECTIVE

Trade-off is the keyword in the management of wilderness camping. Steps taken to control environmental impacts can have adverse impacts on the experience of visitors; conversely, management that caters to and facilitates recreational use can lead to undesirable or unacceptable impacts. No easy solutions exist, but the program of research described here can provide managers with a clearer understanding of the options available and the consequences associated with different actions.

With regard to recreational aspects of wilderness camping, let us review some of the general findings from research.

Solitude is a quality sought by many wilderness visitors, but it appears to be especially important in definitions of desirable campsites. Typically, visitors report preference for a site out of sight and sound of other parties; in a recent study of visitors to the Bob Marshall, Great Bear, and Scapegoat Wildernesses in western Montana, 72 percent wanted no other camps within sight or sound, and 85 percent desired no more than one other camp. In another paper in these proceedings, Pritchart relates encountering a situation where 120 people were camped in an area with 8 sites; such conditions almost certainly result in severe impacts on visitor experiences. Nearly 15 years ago, it was argued that the ability of an area to provide opportunities for campsite solitude might represent a critical "bottleneck" in an area's capacity--a conclusion that still appears applicable (Stankey 1973).

The campsite also appears to serve an important role in serving as a place where close intragroup relationships can be enjoyed and strengthened. In this sense, others camped nearby might represent "strangers" who potentially might interfere with this relationship.

Several studies have produced evidence that visitors prefer campsites away from others (out of sight and sound), that reported satisfaction declines as the presence of others goes up, and that having to camp near others reduces enjoyment (Lucas 1964; Stankey 1973, 1980; Roggenbuck and others 1982). These findings are also impressive in that they have been obtained in different areas, with wide variations in use intensity, and in areas studied over a wide span of time.

While the research clearly indicates that the level of use at the site is a critical factor for many users, we cannot make a similar statement about the role of environmental impact. Certainly environmental impacts at campsites (such as loss of vegetation and damage to trees) are a problem and one with which managers are particularly concerned. Nevertheless, the extent to which these impacts influence visitors' choice and use of sites or their enjoyment of the experience is unclear (Lucas 1979). While our capacity to estimate the amount or magnitude of the environmental impact problem is good, the ability to assess its importance is poor. Most places, at least some impact is all right (in fact, by definition, a campsite is an impacted location or it could not be recognized); however, at some point these impacts become excessive. Managers' ideas as to what is excessive are almost certainly different than those of users and, again, the function of research is to help identify these different views to help managers in making decisions about when and how to respond to campsite impacts.

Management concern over campsite impacts often translates into various rules and regulations on visitor use. This would include measures such as assigned campsites, length of stay limits, and setbacks from lake or stream shores. However, such measures can severely conflict with the experiences that visitors seek. Directly controlling where or how long one can camp can easily jeopardize visitor feelings of freedom and spontaneity. Again, steps taken to control one type of impact can themselves lead to other impacts that are equally or perhaps even more unacceptable than those which they were intended to correct.

For example, one potential technique for distributing users more evenly over an area's total number of campsites would be to implement a program of assigned campsites. But this technique was the least-favored use control measure in one study, ranking even lower than charging a fee (Stankey 1973). Thus, it is clear that the campsite is a particularly sensitive component of the wilderness recreation experience and that well-intentioned actions to control one type of problem might replace it with an even more serious one.

Another common response to campsite impact management is the provision of facilities, constructed to either prevent, minimize, or at least contain impact. Additionally, facilities might be provided on the grounds that visitors need or want them. Research indicates, however, that generally, wilderness visitors are not supportive of facilities such as tent pads or toilets (Lucas 1980, and research in progress). Specialized facilities that cater to certain groups, such as corrals or hitching rails for horse users, are endorsed by these groups, as one might expect, but their level of support is not overwhelming. Visitor support for facilities in Alaskan wilderness has not been adequately studied; facilities such as cabins and shelters are often cited as necessary to cope with weather and bears. In a current study of persons visiting Alaska's Admiralty Island Wilderness, only about 10 percent supported a ban on cabins.

Another important recreational aspect of the campsite is the campfire. Most overnight visitors have a fire. Campfires result in a variety of environmental impacts--downed wood removal, soil sterilization, site modification, and in some cases, destruction of live vegetation (Cole and Dalle-Molle 1982). Concerns about these impacts have led to efforts to regulate the use of campfires. Washburne and Cole (1983) report that for the National Wilderness Preservation System as a whole, campfires were prohibited in 15 percent of the areas, allowed only in designated locations in 8 percent of the areas, and discouraged in an additional 18 percent of the areas. Where fire rings had been built by visitors, the general management policy is to remove or control the number of fire rings in all but 20 percent of the areas.

Many visitors recognize the impacts that wood fires can produce. Increasingly, visitors utilize petroleum-fueled stoves that eliminate these impacts and which are also more convenient for cooking. In the Bob Marshall Wilderness, for example, about twice as many visitors used a fuel stove in combination with a wood fire in 1982 as did in 1970 (Lucas 1980, and research in progress).

Wood fires still provide an important symbolic focus to the camp experience--an evening around the fire is a valued aspect of wilderness camping for many people. Excessively tight controls on such fires can significantly reduce the quality of the experience. The challenge to managers is to explain the need for care in the use of wood fires, provide guidelines on how and where to build fires, instruct visitors in the proper techniques for cleanup, and provide a clear rationale for when they must be restricted.

WHAT IS BEING DONE ABOUT CAMPSITE PROBLEMS?

A few years ago, we surveyed the managers of all existing wilderness areas and many areas that were likely to be added to the wilderness system (Washburne and Cole 1983). Among other questions, we asked what actions they were taking to minimize campsite problems. Campsite management techniques can be grouped into three basic strategies. The first strategy seeks to minimize problems by managing amount and frequency of use. The second strategy involves managing type of use and user behavior. The third strategy consists of managing the location of camping.

Table 1 shows the percentage of areas using some of these management alternatives. Clearly a wide variety of management techniques are available. The most effective management programs will probably use several of these techniques simultaneously and will give consideration to all possible techniques.

Surprisingly, very few of these techniques are commonly used. Only use dispersal, minimum impact education, and party size limits have been used in more than one-third of the areas. This may reflect different problems and situations that require different types of solutions. It probably also reflects a lack of communication about techniques being used and their effectiveness.

Let's focus now on the two most common of these actions--use dispersal and minimum impact education.

USE DISPERSAL

In most wildernesses, visitor use is highly concentrated geographically. Typically, something like 50 percent of all use occurs on only 10 percent of the trail miles (Hendee and others 1978). Most of the wilderness is unvisited and largely undisturbed. Nevertheless, campsite problems do occur where people concentrate. This has spurred considerable interest in use dispersal--spreading use more evenly throughout the wilderness.

The following items include some of the pros and cons of use dispersal:

1. If use is more evenly dispersed, some of the most frequently used sites will be used less frequently; this should lead to a reduction in impact on these sites.

2. However, some infrequently used sites will now be used more frequently; this should lead to an increase in impact on these sites.

3. As people spread out and move into previously little-used areas, new sites will be used. This will increase the number of campsites and the proportion of the wilderness where camping disturbance is evident.

4. Although no data are available, it is reasonable to assume that disturbance of sensitive wildlife species will intensify as visitation of the most undisturbed parts of the wilderness increases.

5. On the social side, the number of encounters with other parties should be reduced, particularly in popular places.

6. However, dispersal will lead to increased encounter levels in infrequently used parts of the wilderness and less of the area will offer opportunities for high levels of solitude.

To simplify, use dispersal involves two basic trade-offs that must be considered. On the social side, is the decrease in number of encounters worth the constriction in range of opportunities caused by the loss of areas that had offered high levels of solitude? On the ecological side, is a decrease in the severity of impact on the most frequently used sites worth the increased number of sites and the wider distribution of sites that accompanies dispersal?

These are difficult questions, but ones that research could shed some light on. On the social side, we know that visitors generally prefer low levels of encounters (see Stankey 1973, for example). We also know that there is a wide range of experiences sought by different wilderness users (see Brown and Haas 1980, for example) and a major segment of wilderness users would be adversely affected if opportunities for high levels of solitude were lost. Although it is difficult to evaluate this trade-off, it is clear that the appropriateness of dispersal varies both between and within wilderness areas.

We are in a slightly better position to evaluate the ecological trade-off because we do have some data on the relationship between amount of use and amount of impact. Because dispersal inevitably leads to an increase in the number of disturbed sites, it can only be justified on ecological grounds if reducing use leads to a significant improvement in the condition of heavily used sites.

In our study of Eagle Cap campsites, we were able to compare the amount of impact on sites that had received very different amounts of use. We compared sites with estimated use levels of less than 5 nights per year, 10 to 20 nights per year, and 25 to 50 nights per year (Cole 1982a). Selected results are presented in figure 1.

For most types of impact, the relationship between amount of use and level of impact were similar to that for vegetation loss. Only a night or two of camping per year is sufficient to cause serious alteration. For certain variables, however, such as area of the campsite, disturbance is much lower on lightly used sites. Even for these variables, near-maximum levels of impact occur at use levels of 10 to 20 nights per year. The overall impact index (fig. 1) aggregates measures of camp area, vegetation loss, increase in bare ground, change in species composition, tree seedling loss, tree damage, loss of soil organic horizons, and decrease in infiltration rates. This index suggests that the disturbance of sites used only a few nights per year is about two-thirds as severe as the disturbance of the most frequently used sites; the disturbance of sites used 10 to 20 nights per year is about 90 percent of that on the most frequently used sites.

This clearly shows that use dispersal, by reducing use on the most frequently used sites, would have only minimal positive effects. On the other hand, the increased use of infrequently used sites that would accompany dispersal would have significant negative effects, and new campsites that develop are likely to deteriorate rapidly.

This suggests that in wildernesses similar to the Eagle Cap, use dispersal cannot be justified on ecological grounds; however, social reasons may justify the action. Or perhaps dispersal at a smaller scale could be justified. For example, use dispersal within a popular destination area, such as around a lake, might have more benefits than costs. Dispersal may also be justified in remote, lightly used areas where campsite use levels can be kept very low. Finally, the Eagle Cap results may not apply to other environmental situations, such as the East, where recuperative abilities are greater. Studies similar to the Eagle Cap study should be undertaken in a range of environmental situations to evaluate this possibility.

In conclusion, we are making significant progress toward a better understanding of how to use dispersal and its counterpart, concentration, as tools in minimizing campsite problems. The situation is extremely complex. Both social and ecological trade-offs need to be evaluated and integrated. Dispersal at the wilderness-wide level has very different implications than dispersal within a destination area, such as around a lake. Appropriateness also varies greatly with environmental conditions, type of use, and user preferences. All of these are factors that, through research, we hope to understand more adequately in the future.

Education as a Management Strategy

Because of the sensitive nature of the wilderness experience, particularly as it is enjoyed at the campsite, there is much interest in ways in which education could be used as a management strategy. In a nationwide survey of wilderness managers (Washburne and Cole 1983), 60 percent of the respondents indicated that they relied upon educational techniques to deal with various management problems.

There are a number of advantages to an educational approach. It takes managers out of the "policeman" role that can easily develop under a regulatory approach. Moreover, given the typically high education level of most wilderness visitors, such an approach probably has a greater likelihood of success, in that visitors can utilize information, deal with concepts and interrelationships, and follow the rationale underlying a particular management approach.

However, the educational approach does have limitations. It is probably most effective in dealing with certain kinds of problems. For example, table 2 presents a classification of a range of visitor actions or behaviors. As this table shows, some actions will be little affected by educational programs. Illegal actions, particularly those undertaken purposively, will probably be best dealt with through law enforcement. Unavoidable impacts will occur as long as people are permitted to use an area; soil will be compressed, vegetation trampled, etc., and no amount of education can eliminate these effects.

The basic assumptions underlying an educational approach to management are (1) that many problems result from careless or uninformed behavior; (2) that visitors, once educated, will be willing and able to undertake the appropriate behavior; and (3) that by educating people as to what is proper and appropriate behavior, many problems will either be curtailed or reduced, thereby eliminating the need for other more costly or regulatory approaches.

An educational approach has promise for resolving both ecological impact problems as well as recreational conflicts at campsites. For example, work on ecological impact at campsites has provided substantial evidence that the location of a camp is crucial in terms of the potential impacts that occur. In selecting a previously unused site, visitors need information that will help them minimize their impact. As an example, conventional wisdom recommends camping in forested locations, as opposed to meadows. Esthetically, impacts are more evident in meadows; however, as research has demonstrated, forested sites often suffer more impact than meadow sites (Cole 1979). Thus, when advising visitors, managers must decide which is more important--control of ecological impacts or esthetic impacts.

To aid managers and visitors alike, Cole and Benedict (1983) have developed a framework linking existing campsite condition and impact indicators with the appropriate user response (see table 3).

Such information is an important part of visitor education. Intuitively, explaining "why" a particular behavior is desirable seems crucial to gaining public acceptance. But we need to study how much an explanation or rationale improves compliance and understanding.

Education is an important tool in the bag of managerial options. As previously noted, it is especially important in dealing with certain kinds of problems. Additionally, more needs to be done to identify the key information that we supply to visitors, how to best convey this information, how to determine whether education produces the desired behavior, and finally, how to evaluate the performance of different educational approaches as well as other management strategies.

SUMMARY

This discussion has shown the complex interconnections between ecological and visitor elements, and has shown why simple, single problem solutions are so elusive. It also has shown that research has added to our knowledge, and has described a few applications of that new knowledge. The discussion also has highlighted some of the serious gaps in understanding that will hamper managers' attempts to protect wilderness while providing for its enjoyment.

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Table 1.--Management actions that affect campsite impact, U.S. National Wilderness Preservation System, and likely additions

Management actions	Percent of areas that have taken this action: FS[1]	NPS	F&WS	BLM	All agencies
Manage Amount or Frequency of Use					
- No camping allowed	1	8	59	0	9
- Use is limited	6	38	8	9	13
- Use dispersal is encouraged	58	52	7	36	50
- Encourage camping on previously unused sites	16	2	0	0	11
- Camping allowed on designated sites only	5	44	7	0	14
- Encourage camping on previously used sites	15	16	0	9	13
- Some campsites temporarily closed	15	24	7	9	16
Manage Type of Use					
- Minimum impact education program	60	65	5	36	56
- Maximum limit on party size	58	49	10	18	48
- Fires prohibited	1	43	59	0	15
- Fires discouraged	20	16	0	36	18
- No stock allowed in camp	11	40	0	11	15
Manage Site Conditions					
- Camping allowed on designated sites only	5	44	7	0	14
- No camping allowed in certain ecosystems	4	22	3	9	8
- No camping allowed close to water bodies	37	22	7	18	30
- Some campsites permanently closed	20	41	3	0	21

SOURCE: Washburne and Cole 1983.

[1]FS = Forest Service
NPS = National Park Service
F&WS = Fish and Wildlife Service
BLM = Bureau of Land Management.

Table 2.--Five types of visitor actions, examples, and general management response[1]

Type of visitor action	Example	Management response
1. Illegal	Motorcycle violation	Law enforcement
2. Careless	Littering, Nuisance activity (e.g., shouting)	Persuasion, education about impacts; rule enforcement
3. Unskilled	Ditching tent	Primarily education about low-impact use practices; some rule enforcement
4. Uninformed	Concentrated use	Education--information
5. Unavoidable impacts	Human waste, physical impact of even careful use	Reduction of use levels to limit unavoidable impacts; relocation of use to more durable site

[1]From Hendee and others 1978.

Table 3.--Campsite condition and recommended user respon

Condition class	Visible indicators	
1. Pristine	The site appears never to have been used before.	U I i a I a i u s a l
2. Semi-pristine	Sites are barely recognizable as campsites. Vegetation has been flattened, but bare areas have not been created.	D T e h
3. Lightly impacted	Ground vegetation worn away around the fireplace or center of activity.	U U s g i p p
4. Moderately impacted	Ground vegetation worn away on most of the site, but humus, litter decomposing leaves and needles are usually present on much of the site.	U T d b b a

FIGURE CAPTIONS

Figure 1.--Relationship between estimated use frequency and selected campsite impact parameters. The overall impact index is an aggregate measure expressed as a percent of its highest possible value.