

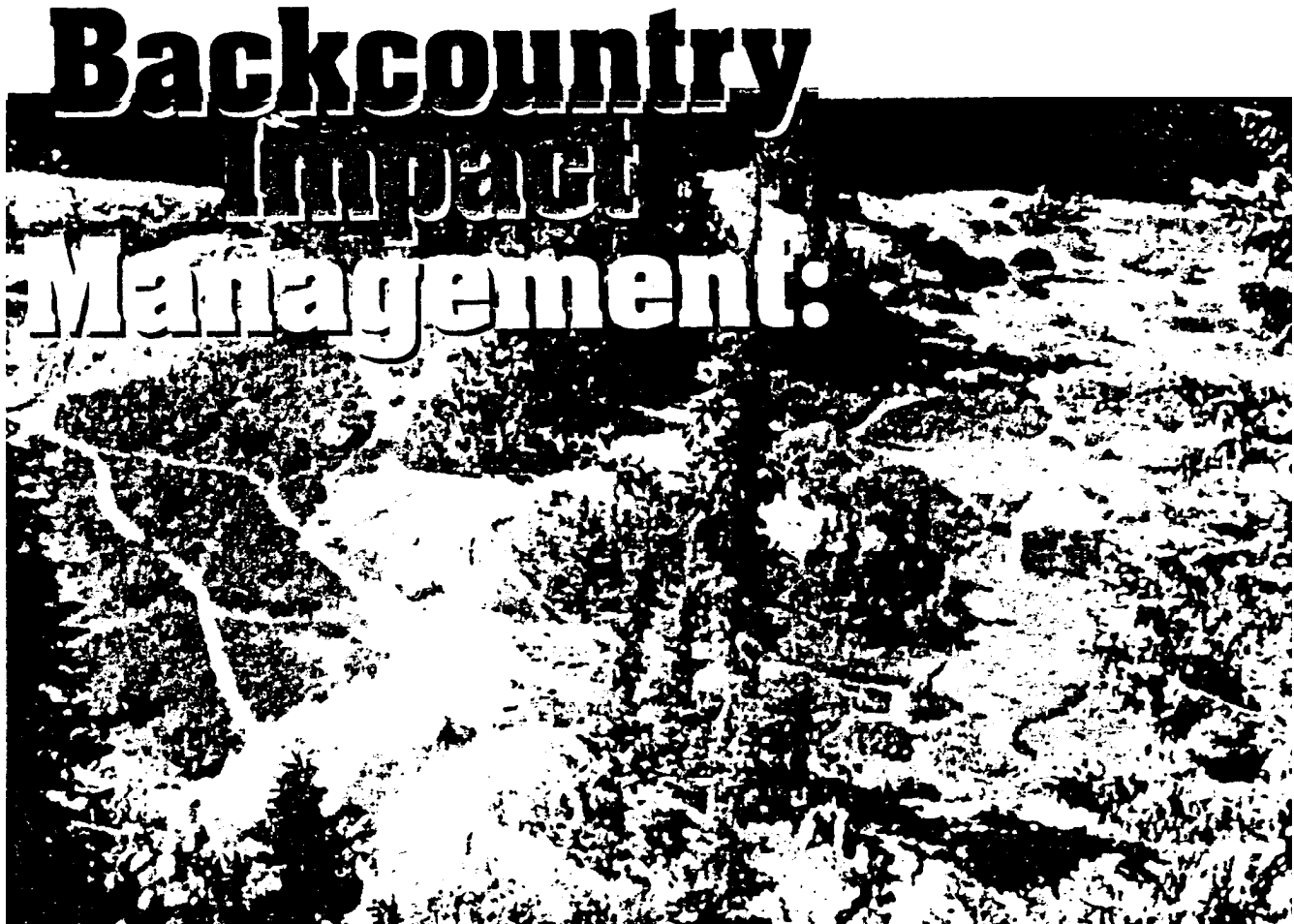


Figure 1: A web of informal user-created trails, Rampart Lakes. Alpine Lakes Wilderness, Washington.

Lessons from Research

by David N. Cole

Recreational use of backcountry inevitably impacts environments intended for preservation. Where use is light or where management programs provide adequate protection, impacts need not be unacceptably severe. However, where use is heavy and protective actions are inadequate, impacts may be severe and widespread. Trails may become deeply eroded trenches or mudholes and criss-cross the landscape like a spider web (Figure 1). Campsites, viewpoints and other destination areas may be stripped of all groundcover vegetation and standing trees may be scarred and killed. Mineral soil

may be exposed, compacted and even eroded away, once the vegetation layer and organic horizons are eliminated.

Over the past 50 years, knowledge about recreation impacts has advanced to the point where it provides a scientific basis for management of the backcountry. The earliest backcountry recreation impact studies date from the 1940s and focused on packstock grazing in Sequoia and Kings Canyon National Parks, California. During the 1960s, backcountry campsite impacts were studied in Grand Teton National Park, Wyoming, Mt. Rainier National Park and

Glacier Peak Wilderness in Washington, and the Boundary Waters Canoe Area in Minnesota. Then, starting in the 1970s, in response to dramatic increases in backcountry use, studies of backcountry recreation impact increased dramatically. This article explores conclusions derived from these studies and what those conclusions imply about the appropriateness of various potential management strategies.

A wide variety of research methodologies have been used to study the impacts of backcountry recreation. Most studies have been descriptive surveys of resource conditions on recreation sites, at one point in time. Often these conditions are compared to those on undisturbed sites, providing estimates of the amount of impact caused by recreational use. With other research designs-natural or simulated experiments-conditions are measured before and after recreational use or a change in

management program. Most useful, regardless of whether they utilize the survey or the experimental approach, are longitudinal studies that follow conditions over time and assess the influence of individual factors (such as amount of use or environmental conditions). Such

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studies provide a temporal perspective on how impacts develop and change and suggest the likely effectiveness of alternative management strategies.

Temporal Patterns

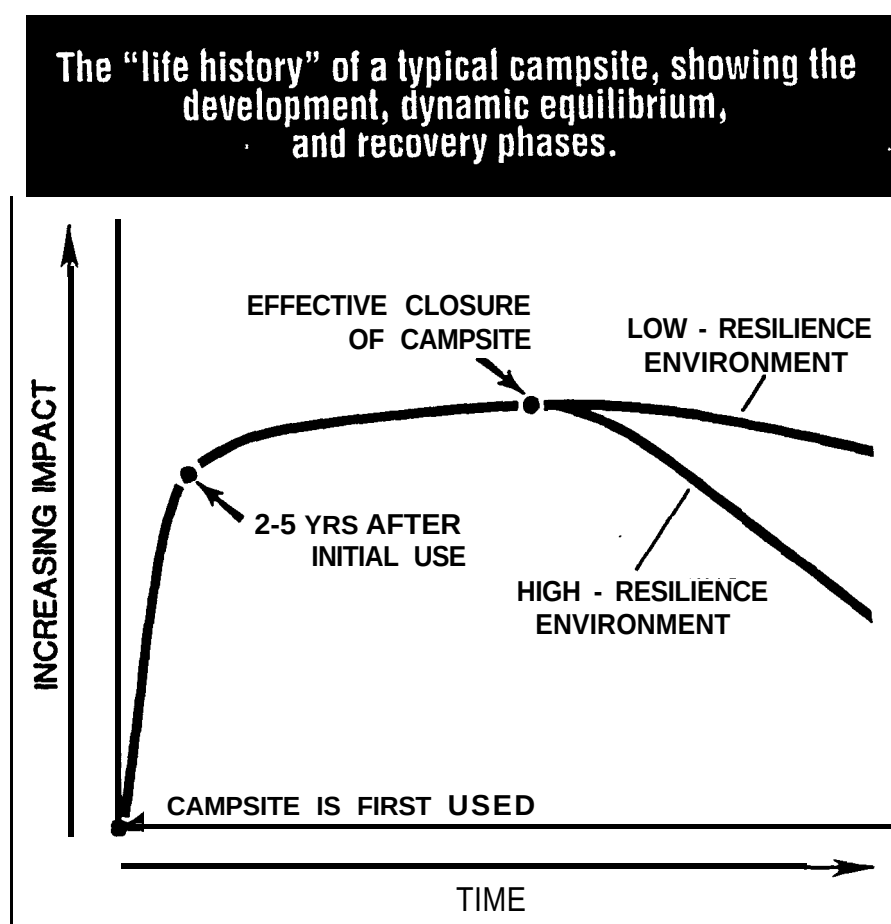
Most studies of change over time have focused on campsite impacts. Campsite change can be assessed at both the scale of the individual campsite and at a larger landscape scale. Individual campsites go through a typical “life history” (Figure 2). Impact usually occurs rapidly after a previously undisturbed site is first used as a campsite. During this “development” phase, near-maximum levels of impact occur within the first few years that a campsite is used. The rate of deterioration varies between kinds of impact and with amount of use and environmental durability. Loss of vegetation cover occurs particularly rapidly, while exposure and compaction of mineral soil occurs somewhat more slowly. Deterioration occurs more rapidly as amount of use increases and as site durability decreases.

The “development” phase is followed by a more stable “dynamic equilibrium” phase. On sites where the amount and type of use remains relatively constant, season-

al and year-to-year fluctuations, dictated largely by climatic variation, may exceed unidirectional change for many kinds of impact. For example, on long-established campsites in the Eagle Cap Wilderness in Oregon, mean vegetation cover was 15 percent in 1979, 12 percent in 1984 and 19 percent in 1990. Vegetation cover on these campsites might be expected to fluctuate between 10 and 20 percent indefinitely, as long as use characteristics are relatively stable.

impact tend to deteriorate more steadily because recovery processes are so slow. For example, mineral soil exposure on Eagle Cap camp sites increased from 33 percent in 1979 to 41 percent in 1984 and 44 percent in 1990. In these western subalpine forests, the accumulation of new litter cannot keep pace with the rate of litter loss. But, in eastern deciduous forests, the amount of mineral soil exposure might be more stable because litter production is so high. Tree damage also

FIGURE 2



Devegetated area and soil compaction are other impacts that are often relatively stable on established campsites. Other kinds of

tends to be cumulative, worsening over time.

Once a campsite is effectively closed to further camping, a

“recovery” phase begins. The rate of recovery is highly variable but always slower than the rate of deterioration. Recovery rate varies between kinds of impact and environments, as well as with amount of previous impact. After 15 years without use, litter accumulation and soil penetration resistance on campsites in Kings Canyon National Park had reached predisturbance levels, but tree mutilations and vegetation loss were still evident. Experimentally trampled trails, in grasslands in Montana, recovered 100 percent in 5 years, while trails in neighboring forests only recovered 26 percent.

Given the same environmental setting, more highly impacted sites will require longer periods to recover. When different environmental settings are compared, however, it is difficult to predict how long recovery will take merely on the basis of how impacted a site is. Some of the environments that are most disturbed by recreation are capable of relatively rapid recovery once disturbance stops. There is some evidence that differences in recovery rates, between different environments, may exceed differences in deterioration rates. In addition, management could be more effective in speeding up recovery than in slowing down deterioration.

At a larger spatial scale, there is a tendency for impacts to proliferate and spread across the landscape, where the distribution of recreational traffic is not tightly controlled. For example, in two drainages in the Eagle Cap Wilderness, the number of campsites increased from 336 in 1975 to 748 in 1990. Such proliferation occurs because sites deteriorate rapidly and recover slowly. As use shifts across the landscape, new disturbances appear more rapidly than old ones disappear.

Proliferation can be exacerbated by management strategies that promote dispersal of use. The common result, ever-expanding zones of impact, is among the most serious recreation impact problems facing backcountry managers.

Impact is inevitable with use. Although managers can control the extent and location of impacts, they cannot avoid impacts entirely.

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Knowing that once impact occurs recovery will take a long time, managers should be anticipatory rather than reactive. For example, the seemingly logical strategy of rotating use-temporarily closing sites to allow recovery or frequently relocating trails-is likely to be counterproductive because it usually results in a pronounced increase in total impact. Many closed and recovering places do not recover quickly and are joined by the newly open and available sites in being impacted.

Finally study results emphasize the importance of minimizing impacts in parts of the backcountry that are currently relatively undisturbed. Management plans often give little consideration to such areas even though these places are most vulnerable to further disturbance and are the places where anticipatory management is likely to be most effective.

Factors That Influence Amount of Impact

We now better understand which factors determine whether impacts

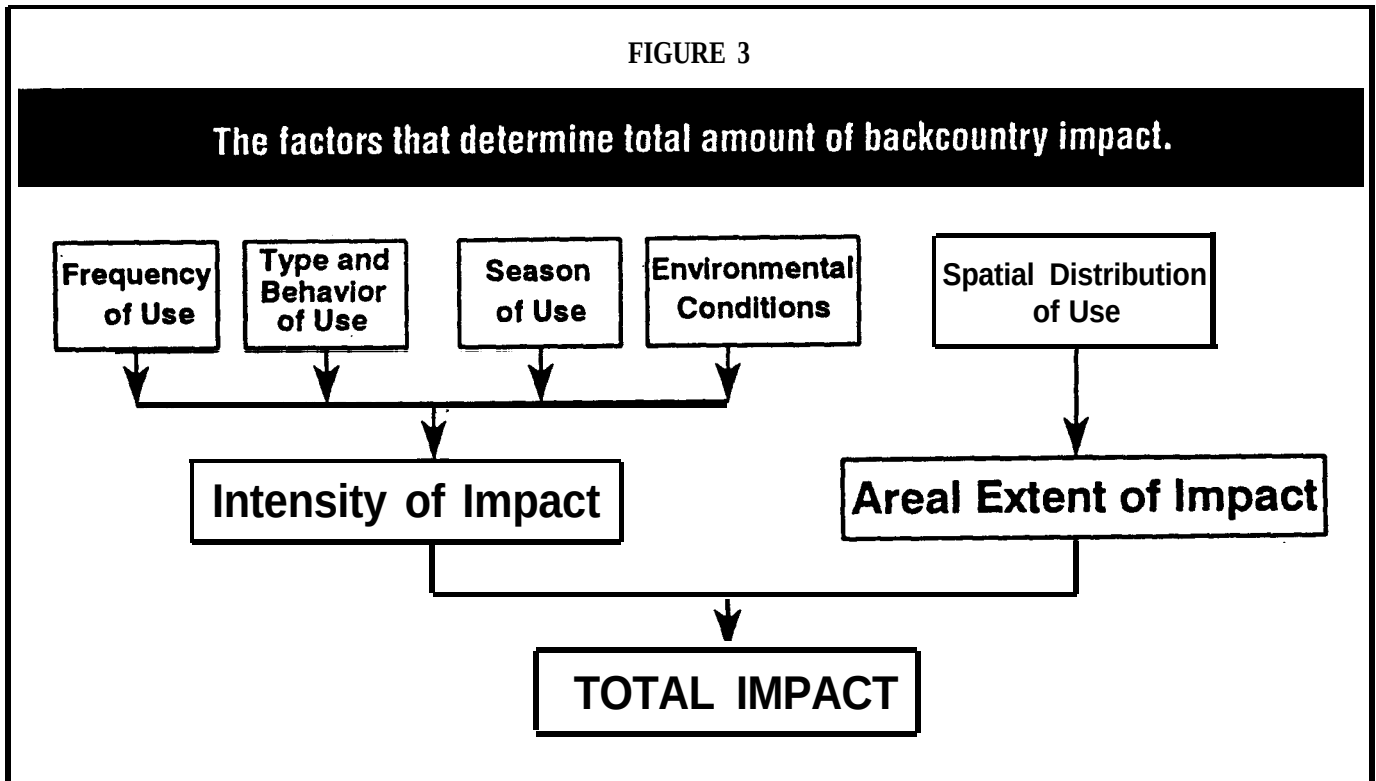
will be severe or not. Again most research has been conducted on campsites; however, trails and meadows grazed by stock have also been studied. Total impact is a product of the intensity of impact at any one place and the areal extent of impacted places (Figure 3). The principal factors that seem to determine intensity of impact are (1) frequency of use, (2) type and behavior of use, (3) season of use and (4) environmental conditions. The areal extent of impact is primarily a result of the spatial distribution of recreation use.

Frequency of Use

The relationship between frequency of recreation use and intensity of impact is asymptotic. At first, increases in use frequency cause pronounced increases in impact; however, the rate of increase in impact decreases as frequency of use increases. Where use is relatively light, then sites that receive even slightly different amounts of use may have very different impact levels. Conversely where use is heavy, sites that receive substantially different amounts of use may have similar impact levels.

This suggests that little can be gained by trying to reduce use frequencies in popular places that receive heavy use. In fact, reductions at one place can be counterproductive because those visitors are likely to go elsewhere. This will increase the areal extent of impact and therefore, total impact. Conversely much can be gained by reducing use frequencies in places that receive light use. While reductions in use frequency at individual places again will increase the areal extent of use and impact, if use levels are low enough everywhere, these more widespread impacts can be negligible. This is a risky but potentially worthwhile strategy. The key to success is reducing use

FIGURE 3



frequencies on individual sites to negligible levels. This is only possible where use levels are low and visitors are willing to disperse widely, both in space and time.

Type and Behavior of Use

Although seldom studied, it is intuitively obvious that certain users cause more impact than others. Groups that cook over fires will cause more impact to wood supplies and campfire sites than those who cook on stoves. Groups who travel with packstock and turn them out to graze in meadows will have more impact on meadow vegetation than backpack groups. Individuals who shortcut switchbacks will cause more trail erosion than groups who keep to the trail. For many types of impact—tree felling, soil sterilization from campfires and defoliation by grazing, for example—impacts are only caused by certain users. In the absence of such users, these

impacts do not occur at all. In many cases, then, the type and behavior of use have a more pronounced influence on backcountry impacts than the other factors.

Clearly much can be gained by influencing the type and behavior

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of backcountry use. Certain particularly destructive types of use can be prohibited or confined to certain zones, trails or sites. Visitors can also be taught low-impact practices that enable them to reduce their impact to minimal levels.

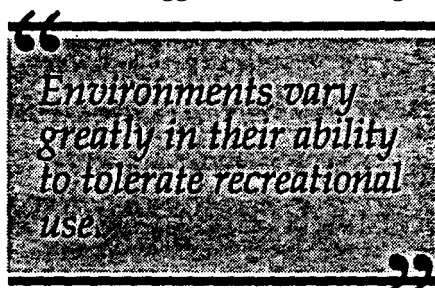
Season of Use

This factor most likely influences impact levels on trails and in grazed areas. In fact, a well-established range management practice, in regions with pronounced wet and dry seasons, is to keep livestock out of grazing areas during seasons (usually spring and early summer) when soils are water-saturated and plants are rapidly growing. This practice reduces soil compaction and erosion and increases plant vigor in grazed areas. A similar practice has been applied to recreational stock management in a few backcountry areas, but the potential for benefit from more widespread application of this practice is high. Keeping all traffic off trails during seasons when soils are water-saturated would have similar benefits.

Environmental Conditions

Environments vary greatly in their ability to tolerate recreational

use. For example, as few as 20 hikers can destroy 50 percent of the vegetation cover in some vegetation types; in other vegetation types, 50 percent cover is lost only after 600 hikers have crossed the area. This suggests that some vege-



tation types can absorb more than 30 times as much use as others, with no more damage.

Environmental influences on site susceptibility are complex and our understanding is still rudimentary. Any environmental setting may be susceptible to one type of impact and resistant to another. There also may be little relationship between a site's resistance-its ability to tolerate use without changing, and its resilience, its ability to recover from changes that do occur.

At the risk of overgeneralizing, a few conclusions about site susceptibility seem warranted. Characteristics of durable campsites and other modes of concentrated use include (1) either lack of ground cover vegetation or presence of tolerant vegetation (grass-like plank are most tolerant--short woody plank are least tolerant), (2) an open rather than closed tree canopy, (3) thick organic soil horizons, and (4) a relatively flat but well-drained site.

Trail durability is dictated more by soil and topographic characteristics. Trail problems are usually the exception rather than the rule. Problems commonly occur where (1) slopes are too steep, (2) trails run straight up the slope and intercept water draining off slopes, (3)

there is inadequate drainage off trails, (4) soils are fine-textured, stone-free and homogeneous or highly organic, and (5) soils are poorly drained or have high water tables.

Because durability varies between environmental settings, impacts can be minimized if use occurs primarily on durable sites. Managers can build facilities on sites that are particularly durable or prohibit use of sites that are particularly fragile. Alternatively they can teach visitors about the relative durability of different environments, encourage use of durable places and discourage use of fragile places. Managers can also artificially increase site durability, for example, by hardening campsites, placing water bars across trails or planting durable vegetation.

Spatial Distribution of Use

Spreading a particular number of visitors over a large geographic area will increase the number of disturbed places but decrease the frequency that any one place is disturbed. Increasing the spatial distribution of use, then, will increase the areal extent of impact and decrease the intensity of impact on individual sites. Decreasing the spatial distribution will have the opposite effect. Because total impact is the product of intensity of impact and areal extent of impact, the appropriateness of dispersing versus concentrating use will depend on the relative response of intensity and areal extent to a change in use distribution.

The relationship between areal extent of use and area of impact should be approximately linear. For example, if the used area doubles, the area that is impacted should also roughly double. In contrast, the relationship between frequency of use and intensity of impact is curvilinear. Where use frequency is low, spreading people

out more may be an effective management strategy because it would reduce impact intensity more than it increases the areal extent of impact. Where use frequency is high, spreading people out more will have little effect on impact intensity, but it will increase areal extent and therefore total impact. The alternative strategy, confining use to as small an area as possible, is the strategy likely to be most effective in high use areas.

Conclusions

Based on research on how impacts change over time and on the factors that influence total impact, management strategies with the most promise include (1) controlling type of use, (2) encouraging low impact behaviors, (3) avoiding use during seasons when soil and vegetation are particularly vulnerable to disturbance, (4) encouraging use of durable sites, (5) confining use in popular places, and (6) perhaps, dispersing use widely in lightly used places. This latter strategy is risky and if attempted, conditions should be monitored closely.

Attempts to reduce amount of use, by themselves, are unlikely to substantially control the impacts of backcountry recreationists. However, use reductions in combination with controls on where recreationists go can be effective. The costs of denied access, while perhaps justified, must still be considered. Those visitors will either go elsewhere, and increase impacts there or they will stay home and miss out on the benefits of backcountry recreation.

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