

Editorial

Understanding and Managing Impacts of Recreation Use in Mountain Environments

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Increasing demands by recreationists and tourists for access to many of the world's most valued natural environments pose threats to the long-term sustainability of naturally functioning ecosystems. Biodiversity, native flora and fauna, healthy watersheds, and inspiring vistas can be harmed by the direct and indirect effects of recreation use. Although the impact of increased numbers of tourists, whether from commercial ecotourism ventures or private individuals or groups, has raised concern even in such remote areas as the Arctic and Antarctic, the most common and widespread problems are often found in mountain environments. Whereas activities such as skiing, fishing, hunting, mountain biking, and the grazing of recreational pack stock are well known to have severe and long-lasting effects on wilderness ecosystems, it is now clear that even such presumably low-impact activities as hiking, backpacking, and mountaineering can cause impacts serious enough to require a management response. A growing body of literature documents concern over and efforts to manage the environmental effects of even these presumably less invasive activities.

High-mountain environments are particularly sensitive to the disturbances caused by recreation use. Steep topography, thin soils, sparse vegetation, short growing seasons, and climatic extremes (e.g., heavy precipitation, cold temperatures, high winds) all contribute to the sensitivity of high-mountain environments. Under such conditions, it takes relatively little use to create long-lasting impacts. For many of these same reasons, natural recovery can be excruciatingly slow. Visitor use of mountain environments has increased dramatically in recent years. This rise has led to an increase in the number of trails and campsites, including some artificially hardened sites that are virtually devoid of vegetation. Construction and maintenance of visitor facilities, such as trails, campsites, huts, and outhouses, require continued management attention, including access by maintenance crews that must reach the sites by foot, pack stock, or occasionally helicopter or other motorized transportation. In addition to management improvements, visitors move rocks and logs to build fireplaces or wind barriers to protect sleeping sites. Campfires result in blackened rocks, and the collection of branches and other wood normally found on the ground deprives the immediate area of the natural recycling of nutrients. Where downed wood is scarce, branches may be stripped even from live trees. Other impacts include soil compaction and erosion, loss of vegetation cover, mutilation of trees, water pollution, and inadequate disposal of human waste. Although most of these effects are localized around centers of human activity, others are more widespread, including the disturbance of native wildlife and the introduction of non-native species, such as trout and some game birds, to provide recreational opportunities for fishing and hunting. In addition to environmental impacts, increasing levels of recreational use can have negative effects on the experiences of the visitors themselves, including the perception

that an area is overcrowded or that its naturalness may be compromised.

Many of the most popular sites for recreation use in mountain environments have been designated as parks or wilderness or given other similar protected-area status. Although such designation is generally designed to preserve relatively unaffected ecosystems, it is now clear that the designation itself serves as an added attraction to many tourists. Visiting and hiking in parks and wilderness areas have become increasingly popular leisure activities. As recreation-use levels have increased, government agencies charged with managing these areas have often struggled to find effective means of managing the resulting impacts. Management efforts have most often included attempts to educate users about minimizing their impact (e.g., the Leave No Trace Program) and restrictions on types and levels of use (some areas may be closed to large groups or those accompanied by stock), party size, and length of stay.

In the United States, efforts to limit recreation use have proven to be particularly contentious, as proposals by management agencies to restrict the types and levels of use have frequently been challenged by those who disagree with agency priorities. For example, management proposals to restrict recreational use in urban-proximate wilderness areas in Oregon and Washington have fueled conflicts between hiking groups that support accommodating increased use and conservation groups that favor both protection of intact, undisturbed ecological systems and opportunities to experience uncrowded settings. Such groups have successfully appealed Forest Service management plans, resulting in administrative reversals of direction. Similarly, in the Sierra Nevada of California, a federal judge recently ruled partially in favor of several conservation groups regarding a multifester wilderness management plan because it did not adequately protect the ecological health of meadows, lakes, and campsites from impacts caused by commercial stock users. The judge was particularly concerned about the lack of data on recreation impact and the absence of a scientific basis for management of commercial use.

Other challenges to the management of recreation use in parks and wilderness areas are posed by unclear policy. Legal and policy direction provided by the U.S. Congress (e.g., legislation such as the 1964 Wilderness Act and the National Park Service Organic Act) and the land management agencies (agency recreation and wilderness policies) is often confusing, with arguably conflicting emphasis being given to the seemingly contradictory goals of preserving recreational opportunities and protecting natural ecological environments. This dilemma can be compounded by pressures to assure that commercial tourist services remain economically viable. The requirement to fully engage all interested parties in the development and evaluation of management options can lead to significant delays in the plan-

ning process as participants struggle to find ways to accommodate a wide diversity of concerns and values.

One of the most significant challenges associated with the planning and implementation of visitor-use management strategies is lack of information on trends in resource conditions, relationships between use levels and impacts, and the consequences of proposed management options. Although some extremely useful scientific studies of recreation impacts are available, funds have generally been inadequate to support the necessary research and the monitoring needed to provide a full understanding of impacts, management options, and the consequences of all options.

Trampling of vegetation and soils by humans and domestic animals is one of the principal ecological impacts of recreation use. Trampling results in the abrasion of vegetation and surface soil organic layers as well as the compaction of soils. These in turn affect the physiological and morphological characteristics of the vegetation, often including reduction of the vigor and reproductive capacity of all but the most resistant species. Recovery of vegetation and soils following severe trampling is generally a long-term proposition unless active management treatments are employed. Consequently, trampling is one of the criteria most often used in making decisions on allowable use levels. Yet, if trampling impacts are to be used as criteria for restricting visitor use, it is essential that the relationships between use levels (including types and timing of use) and impacts be better understood. Improved understanding of recovery rates of denuded sites is also needed. Examples of the current understanding of such relationships are presented in several articles in this issue.

Cole and Monz report the results of experiments evaluating different levels of trampling disturbance on five high-elevation plant communities in the Wind River Mountains of Wyoming, U.S.A. They found significant differences between plant communities and growth forms in their ability to tolerate trampling disturbance. Impacts to plant structure (cover and height) were generally more significant than impacts to plant composition. Communities dominated by turf-forming graminoids and low-growing forbs were found to be most resistant to trampling, whereas those with woody, chamaephytic cover were the least resilient. The authors suggest that trampling impacts can be reduced by directing use away from the less tolerant communities.

In studies conducted in the grass heaths and alpine pasture vegetation above timberline in four regions of the Austrian Alps, Klug et al. investigated the effects of trampling on species com-

position, plant cover and frequency, biomass, and seed banks. Their studies, designed to assess the ability of these high-elevation communities to withstand different use levels, documented clear differences in plant structure and cover between the heavily and less heavily used portions of trails. Only a few highly specialized species were regularly found on trails, and these species were all more common on trails than on less disturbed sites. Although high numbers of seeds were found in the soil of even the most impacted sites, most of these are unable to germinate or establish themselves on those sites. The authors found no evidence that these seed banks will be effective in helping to naturally revegetate heavily impacted trails.

The recovery of native vegetation on heavily trampled sites is often a key component of efforts to restore impacts caused by recreation use. In a study of vegetation recovery in previously denuded plots on Niwot Ridge, Colorado, U.S.A., Ebersole adds to our limited knowledge about vegetation succession following severe disturbance in alpine communities. Key findings include documentation that moister communities generally regained cover faster than drier communities, that vegetative expansion from plot edges provided more regrowth than regeneration from seed, and that there was a lack of differentiation between early and late successional species as all species acted as both colonizers and components of mature vegetation. The slow recovery of these denuded sites emphasizes the importance of maintaining vegetation cover in alpine communities. Once a site has been denuded, active restoration will often be required if new plant cover is desired within even several decades.

In summary, effective understanding and management of recreation use and its resulting impacts is limited by a number of factors. These include a lack of consensus among those who use and value the areas regarding both their purpose and appropriate use; lack of clear policy direction to evaluate priorities and options; lack of adequate staff, training, and financial support for management planning and implementation (including the required public involvement); and lack of adequate scientific information to fully understand the nature of such impacts as well as the consequences of management choices. The basic scientific understanding provided by research such as that cited above is essential to provide the direction and guidance needed for effective management of recreation use and impacts. Funding to support additional studies of recreation impacts in natural environments will be needed if we hope to be responsive to the increasing pressures posed by recreation use in our remaining natural environments.