Recreation Ecology Research Findings: Implications for Wilderness and Park Managers

Jeffrey L. Marion
Unit Leader and Scientist
Cooperative Park Studies Unit
USGS Patuxent Wildlife Research Center

304 Cheatham Hall (0324)
Virginia Tech, Dept. of Forestry
Blacksburg, VA 24061-0324
Ph: 540/231-6603, E-mail: cpsu@vt.edu

Introduction

This paper addresses one of many threats to protected natural environments: recreation use. Large and sometimes ecologically sensitive areas have been developed with facilities to accommodate visitor use and recreationists unintentionally trample vegetation, erode soil, and disturb wildlife. Such human-related biophysical changes present a dilemma for managers charged with the dual objectives of providing recreational opportunities and preserving natural environments. Wilderness and park managers now recognize that some degree of resource impairment is an inevitable consequence of recreation use in any form.

By virtue of their massive numbers, protected area recreationists pose a real and significant threat to the very resource they so cherish. This is particularly true at backcountry attraction sites, campsites, and along trails, where visitation and its effects are concentrated. Specific consequences of visitation to these areas include the trampling and subsequent loss of ground vegetation, shrubs, tree seedlings, and felling of saplings; erosion of surface litter and humus; exposure, erosion, and compaction of mineral soil; and exposure of tree roots and damage to tree trunks.

In the United States, the National Park Service and Forest Service have recognized the need for visitor management and resource protection programs to balance visitation with its associated resource impacts. The recurring question, "are we loving our parks to death?" increasingly challenges managers to develop and implement management policies, strategies, and actions that permit the recreational use of park and wilderness areas without compromising their ecological and aesthetic integrity.

The discussion that follows presents some of the principal findings and management implications of a relatively new discipline of scientific research: recreation ecology. Scientists in this discipline generally seek to identify the type and extent of resource impacts and to evaluate relationships between use-related, environmental, and managerial factors. The capabilities and managerial values of recreation impact monitoring are also described. This paper is informal, references to scientific literature are included only in a final "Recommended Readings" section.

Recreation Ecology Research Findings

Impacts from recreational trampling in natural environments typically follow a natural progression. Initial and very light trampling may only damage particularly fragile vegetation. However, at low levels of trampling the majority of vegetation cover is lost and surface organic litter (e.g., leaves and twigs) are pulverized. At moderate trampling intensities all but the most resistant plant species are lost and mineral soils are exposed as organic soil layers are eroded. High trampling intensities expose mineral soils to compaction and erosion, which in turn expose the roots of trees.

Studies of visitor impacts to campsites and trails have documented that most resource impacts are related to visitor use levels in a curvilinear fashion. For example, a study of wilderness campsites in Minnesota found that only 12 nights of campsite use per year caused substantial biophysical changes, while further increases in use caused little additional change for most forms of impact (Figure 1). A few impact parameters, such as loss of tree seedlings, are highly affected by very low levels of site use. In contrast, the exposure of mineral soil occurs later in the progression of impacts, and is related to use intensity in a more linear fashion. The majority of impact parameters, such as vegetation loss, are intermediate in their response.

One important implication of the curvilinear use/impact relationship is that nearly all use must be eliminated to achieve significant reductions in most forms of recreational impact. Level of use is an inherent determinant of recreational impacts but research has demonstrated the importance of many other factors. Three categories of influential factors and their potential for manipulation by managers are described: use-related, environmental, and managerial factors. This review is not comprehensive, the aim is to illustrate the diversity of options available to managers for reducing visitor impacts. Managers are also cautioned to consider the costs of implementation and costs to the quality of visitor experiences associated with alternative actions.

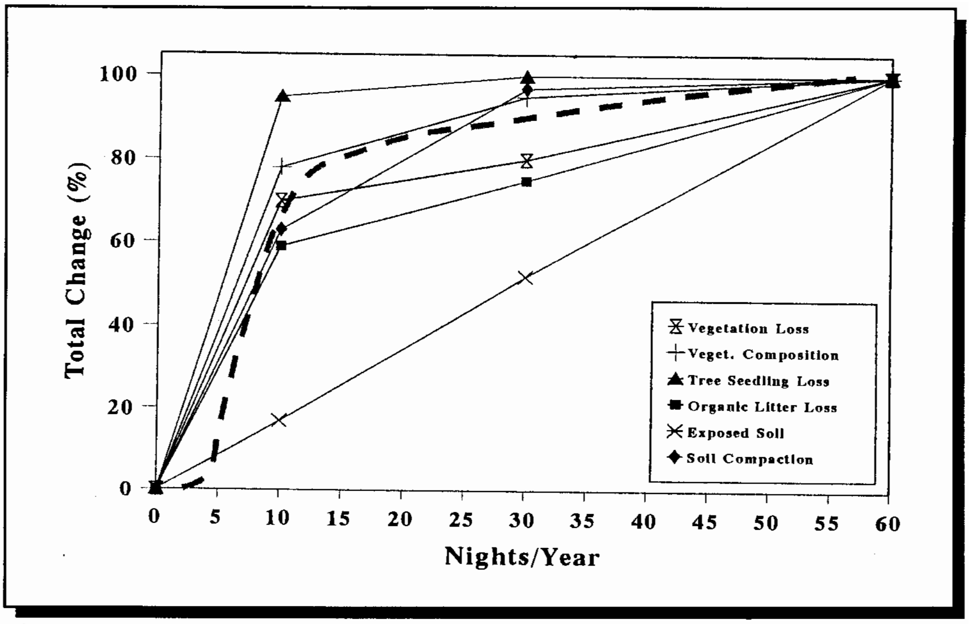

Figure 1. Use/impact relationship for selected impact parameters from a study of campsites in the Boundary Waters Canoe Area Wilderness.

Use-Related Factors

Managers are often able to control or influence a number of use-related factors shown by research to be important determinants of recreational impacts. As noted, the curvilinear use/impact relationship implies that managers would have to reduce or disperse use to extremely low levels to achieve significant reductions in most types of impacts. Research has also shown that some types of use (e.g., horse or off-road vehicle use) are more impacting, on a per capita basis, than others (e.g., hiking). Managers can prohibit such uses or restrict them to resistant environments or sites specifically designed and maintained to accommodate their higher impacts.

Many impacts are the result of uninformed or careless behavior. Managers can educate and regulate visitors to reduce high-impact behavior (e.g., building fires, chopping on trees, cutting switchbacks) and encourage low-impact behavior. Finally, large groups have a greater potential to damage resources than the same number of individuals in smaller groups. Limits on group sizes are often encouraged or required to minimize resource impacts.

Environmental Factors

Through their control over the selection of recreation sites and layout of trails, managers have the ability to minimize resource impacts by encouraging recreational use in impact resistant locations. For example, research has demonstrated considerable variability in the trampling resistance of different vegetative growth forms. In the Boundary Waters Canoe Area, vegetation groundcover averaged 52% on campsites with less than 25% tree cover, but only 4% on campsites with 75-100% tree cover. Campsites with greater sunlight penetration supported shade-intolerant grasses and sedges which, due to their flexible growth forms and other unique characteristics, are significantly more resistant to trampling than most broad-leafed herbaceous plants. The resistance of vegetation to trampling also varies by season of year. Vegetation is more susceptible to damage during the growing season and whenever soils are wet.

Similarly, soils vary in their susceptibility to compaction, as influenced by texture, organic content, and moisture. Soils with a wide range of particle sizes (e.g., loams), low organic content, and moderate to high moisture level are the most prone to compaction. Soils most prone to erosion are those with a narrow range of particle sizes, particularly those high in silt and fine sands. Both soil compaction and erosion are accelerated by the absence of vegetation and litter cover and slope is a critical factor influencing soil erosion.

Knowledge of the relative resiliency (ability to recover) of different vegetation and soil types can be used to select areas which will quickly recover following recreational trampling. Vegetation resiliency is primarily related to the length of growing season and soil productivity. Sites with high resiliency are also desirable because they support dense vegetation which helps confine use to campsites and trails. Soil resiliency is related to soil texture, soil moisture, freeze and thaw cycles, and biological activity in the soil. Recreation ecology research has shown that recovery rates on campsites and trails are considerably lower than initial impact rates, indicating that rest-rotation schemes will generally be ineffective (Figure 2).

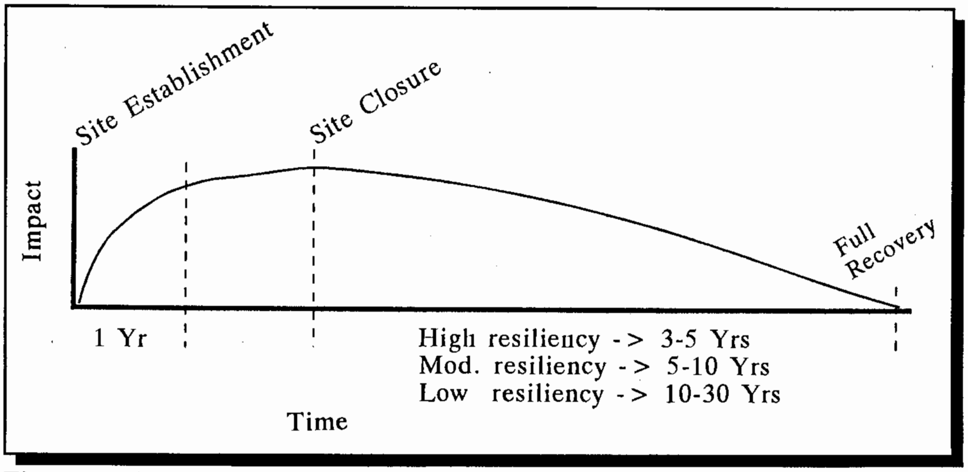

Figure 2. A comparison of campsite impact and recovery rates.

<u>Managerial Factors</u>

Visitor and site management techniques comprise the final group of factors available to managers for minimizing recreation impacts. The curvilinear use/impact relationship limits the effectiveness of use limitation as a management action. Managers of some protected areas have sought to minimize impacts by encouraging visitor dispersal. However, due to the use/impact relationship and a number of behavioral factors, this impact-minimization strategy has been successful only in areas which receive low use. Most visitors prefer hiking on established trails and camping on existing campsites. Many visitors enjoy camping close to trails and other groups for social reasons, others fear getting lost when away from trails. Areas with mountainous terrain and/or dense vegetation may limit the ability of visitors to hike off-trail or the number of suitable camping locations necessary to support a dispersed camping policy. Pre-existing trails and campsites are also more convenient, comfortable, and require less work to use. Finally, water and other scenic attractions in the backcountry will always attract larger numbers of visitors than less interesting areas. In general, management efforts to alter these natural tendencies will be unsuccessful without substantial and prohibitively expensive educational and law enforcement programs.

The opposite of dispersal, visitor containment or concentration, offers a more promising strategy for minimizing recreation impacts. Trails, which concentrate use on their treads, represent one form of containment. Furthermore, formal trails can be routed to take advantage of resistant and resilient environments while avoiding sensitive locations. Similarly, designated campsites also contain visitors and can be specifically located to minimize resource impacts.

Figure 3 illustrates the curvilinear use/impact curve and these two impact minimization strategies for campsites. To the right of the curves' inflection point, use levels on individual campsites can be increased two- and three-fold with comparatively small increases in impact. Impact is minimized not only by containing use on and within campsites but also by limiting the number of campsites to the smallest number necessary to accommodate a given amount of use. Use can also be contained by encouraging or requiring visitors to use existing (but not designated) campsites. These strategies can also be effectively combined, for example, requiring visitors to use designated sites in high use areas, existing user-selected sites in moderate use areas, and dispersed camping in lightly used areas. Such a policy would require a permit system to convey this complexity but protects resources as well as visitor freedom to travel and camp where they choose.

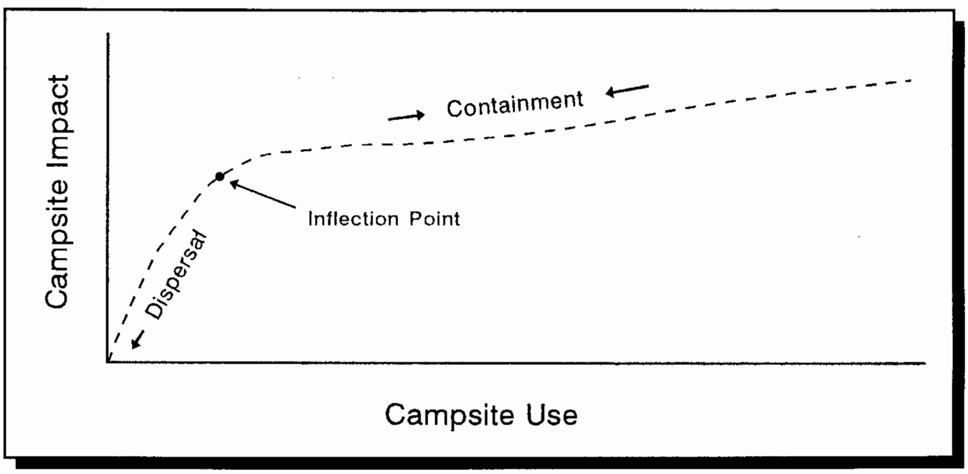

Figure 3. Use/impact curve illustrating the intended locations of typical or average campsites under the dispersal and containment strategies.

Area closures represent the most restrictive policy for preventing visitor impacts. The closure of specific areas to trails and/or camping is justified when sensitive or rare species and habitats must be protected. They may also be appropriate when their effect is to shift use from impact-susceptible locations to impact-resistant locations. However, managers have often used areas closures to remedy situations where impacts have simply reached unacceptable levels. Unless additional measures are implemented to prevent a reoccurrence of the impacts, an area closure has the short-term effect of resolving the problems only to have them reoccur in new locations at a later date.

Finally, site selection, construction, maintenance, and rehabilitation programs offer great potential for minimizing resource impacts. For example, trail construction and maintenance practices have long been used by managers to promote good trail drainage and to harden trail treads to sustain trampling pressures. Trail location and maintenance may well be more critical than type and amount of use in influencing soil erosion, perhaps the most significant form of trail impact. These types of site management programs are less commonly applied to recreation sites or campsites but offer the same potential to minimize impacts. Such practices can be applied to select and prepare sites to resist deterioration under use, to minimize many types of site impacts (e.g., site expansion), and to speed recovery on recreation sites damaged by use.

Recreation Impact Monitoring

Traditionally, managers have relied upon a wait-and-see outlook and subjective impressions of deterioration in resource conditions to guide their management of visitor impacts. Increasing recreation use, public scrutiny, and participatory public land management have driven an increasing need for more objective information. Scientists and managers have developed numerous visitor impact monitoring programs which can both support and defend management decision making. Information collected can describe the nature and severity of resource impacts and the relationships of controlling use-related, environmental, and managerial factors. Research has revealed that these relationships are complex and not always intuitively obvious. A reliable information base is therefore essential to managers seeking to develop effective visitor and resource management programs.

Visitor impact monitoring programs provide an objective record of resource conditions, even though individual managers may come and go. The type, magnitude, and, in some instances, the causes of resource deterioration and improvement can be detected and evaluated. Deteriorating conditions can be detected before severe or irreversible impacts occur, allowing time for implementing corrective actions. Relationships between specific impacts and other controlling factors may suggest effective management actions. Monitoring data also permits an evaluation of the success or failure of implemented resource protection measures.

Finally, a visitor impact monitoring program provides an essential element for recreation resource planning and management frameworks such as the Limits of Acceptable Change (LAC) or Visitor Impact Management (VIM) systems (Figure 4). These frameworks evolved from and are currently replacing management approaches based on the more traditional carrying capacity model.

Under the LAC and VIM frameworks, numerical standards can be set for individual impact parameters to specify the limits of acceptable change. These limits define the critical boundary line between acceptable and unacceptable conditions, establishing a measurable reference point to which future conditions can be compared. A visitor impact monitoring program can provide information necessary for formulating realistic standards and for periodically evaluating resource conditions in relation to these standards.

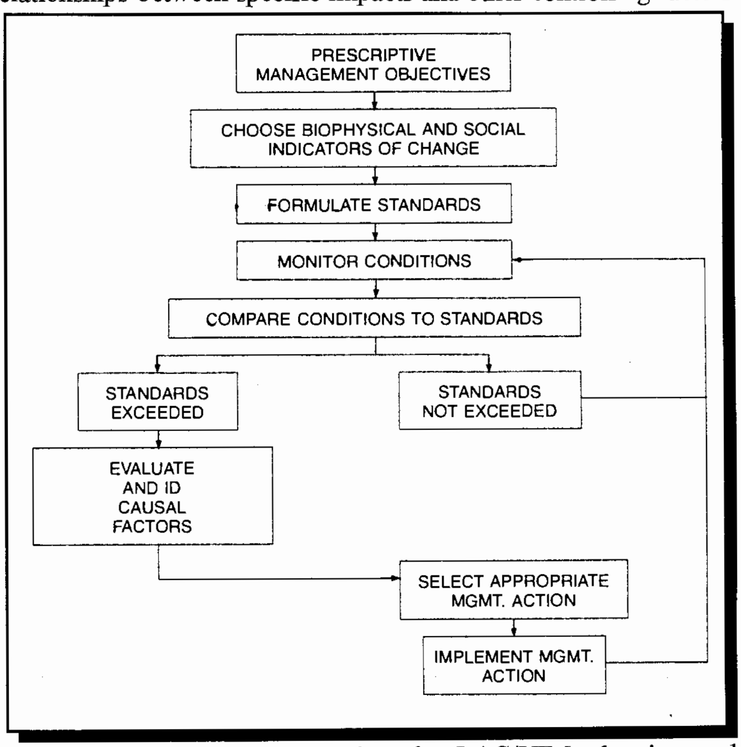

Figure 4. Schematic illustrating the LAC/VIM planning and management frameworks.

Conclusion

Wilderness and park managers operate under a dual legal mandate: provide high quality recreation experiences and protect natural resources and processes. Recreational use in protected natural environments require managers to balance these conflicting objectives. Managers must strive to minimize rather than eliminate impacts, with consideration given to the consequences of their decisions on the quality of visitors' experiences. Use-related, environmental, and managerial factors are important determinants of the effectiveness of management strategies. Managers must consider the individual site and aggregate or area-wide effects of their policies under both short- and long-term perspectives. Finally, visitor impact monitoring programs offer significant benefits to managers and provide an essential element in the new LAC and VIM planning and management decision making frameworks.

Recommended Readings

The objective of this informal paper was to introduce the discipline of recreation ecology and its application to the management of visitor impacts in protected areas. The review provided was necessarily brief and greatly simplified; readers are urged to further explore the recreation ecology literature on their own. This section is included to direct readers to the most comprehensive publications available on selected topics.

Recreation Ecology Literature Reviews

Cole, David N. 1987. Research on soil and vegetation in wilderness: A state-of-knowledge review. In: Proceedings of the National Wilderness Research Conference: Issues, State-of-Knowledge, Future Directions. R. C. Lucas (Compiler) July 23-26, 1985, Fort Collins, CO. U.S. Department of Agriculture, Forest Service, Intermountain Research Station. Ogden, UT. General Technical Report, INT-220, pp. 135-177.

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Cole, David N. 1989. Wilderness campsite monitoring methods: A sourcebook. U.S. Department of Agriculture, Forest Service, Intermountain Forest Experiment Station. General Technical Rpt. INT-259. Ogden, Utah. 57 pp.

Marion, Jeffrey L. 1991. Developing a natural resource inventory and monitoring program for visitor impacts on recreation sites: A procedural manual. U.S. Department of Interior, National Park Service, Natural Resources Report NPS/NRVT/NRR-91/06, 59 pp.

Cole, David N. 1989. Wilderness campsite monitoring methods: A sourcebook. U.S. Department of Agriculture, Forest Service, Intermountain Forest Experiment Station. General Technical Rpt. INT-259. Ogden, Utah. 57 pp.

Marion, Jeffrey L. 1991. Developing a natural resource inventory and monitoring program for visitor impacts on recreation sites: A procedural manual. U.S. Department of Interior, National Park Service, Natural Resources Report NPS/NRVT/NRR-91/06, 59 pp.

Limits of Acceptable Change, Visitor Impact Management

Graefe, Alan R., Fred R. Kuss, and Jerry J. Vaske. 1990. Visitor impact management: The planning framework. National Parks and Conservation Association. Volume 2. Washington, D.C. 105 pp.

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Low-Impact Camping and Hiking Practices

Cole, David N. and Jim Benedict. 1983. How to pick a campsite you can leave without a trace. Backpacker 11(5):40, 44, 87.

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