Chapter 14
Negative Impacts of Recreation Use

Assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings. (One purpose of the National Environmental Policy Act of 1969)

Learning Objectives

1. Describe the types of negative impacts caused by outdoor recreation use.
2. Understand the interrelationships that can exist among different types of recreation impacts.
3. Explain the differences between formula-based and standards-based approaches for managing recreation impacts.
4. Describe the commonly used visitor impact management systems and the general processes for implementing them.

From the start of this text, we emphasized outdoor recreation and outdoor recreation resource management are inherently multidisciplinary. At the most basic level they involve interactions between people and natural and/or cultural/heritage recreation resources. Nowhere is this more apparent for managers than in understanding and managing the negative impacts of outdoor recreation use. While many publications use the phrase *recreation impacts* to refer to only negative or unwanted consequences of the management and use of recreation resources, we prefer to use the more accurate term *negative recreation impacts* since recreation also has a tremendous variety of *positive* impacts as explained in Chapters 1, 2, and 13. As such, negative recreation impacts are defined as any damage, intentional or otherwise, that results from outdoor recreation use. Sometimes referred to as user impacts, visitor impacts, recreation resource impacts, or ecological impacts, negative recreation impacts can affect any natural and cultural/heritage resource as well as the experiences of other recreation users. The purpose of this chapter is to introduce readers to the types of impacts commonly caused by recreation use and the various approaches that managers have at their disposal for preventing or minimizing those impacts.

Negative Recreation Impacts

Negative recreation impacts as discussed here are unwanted impacts to resources or experiences caused by recreation. There are numerous examples of resource and experience impacts caused by factors other than recreation, such as air and water pollution that drift or flow into a park from external sources. Other negative impacts can be caused by management actions or the lack of appropriate management actions. Examples include policies that detract from users' experiences, such as overly authoritative rules (conflicting with the perceived freedom essential for recreation); excessive or unwarranted entrance or use fees; inadequately trained managers and staff; inadequate information, facilities, or services; and unwanted impacts associated with the construction and maintenance or roads and other facilities. Professional recreation and natural resource managers are and should be concerned about all potential threats to recreation resources and visitor health and experiences. The focus of this chapter, however, is on the negative impacts caused by recreational use.

Negative recreation impacts are best thought of broadly as any undesirable changes to the resource base or experiences of other users caused by recreation use. Like the study and management of outdoor recreation generally, the study and management of negative recreation impacts can be approached from the standpoint of the natural resources or the people interacting with those resources. Ultimately, of course, both of these aspects can be best addressed in an integrated way. The discipline that focuses on recreation impacts to natural resources, in particular, is known as *recreation ecology* (Hammitt & Cole, 1998; Liddle, 1997). Recreation ecologists direct their attention to the degradation of soil, vegetation, wildlife, and water resources of an area caused by recreation use. Because all the elements of an ecosystem (including the humans that use them) are interrelated, the effective study and management of recreation impacts brings together many disciplines from the physical, biological, and social sciences.

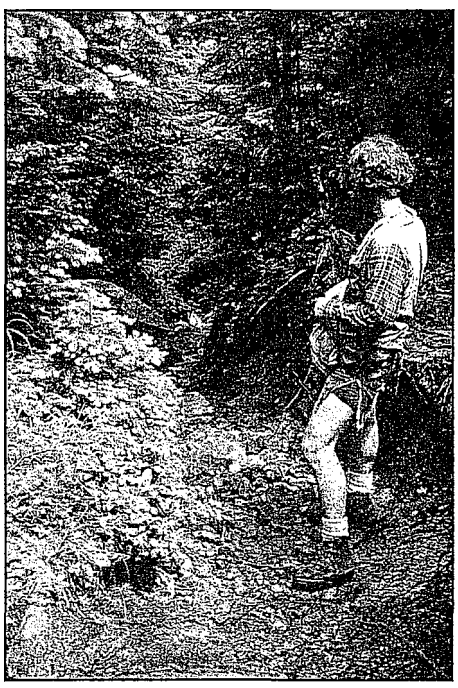
These include soil science, hydrology, geography, biology, ecology, wildlife management, forestry, psychology, sociology, and social psychology. The term *carrying capacity* is also closely related to and has long been associated with the topic of managing recreation impacts. We will return to this concept and term latter in this chapter.

Categories of Recreation Impacts

The most common and important negative outdoor recreation impacts are impacts on soil, water quality, air quality, vegetation, wildlife, and the experiences of other visitors (i.e., social impacts). These types are sometimes organized into different categories, with the most basic distinction being that between ecological (sometimes referred to as environmental) impacts and social impacts. Sometimes distinctions are also made between physical (e.g., soil, water), biological (e.g., vegetation, wildlife), and social impacts. Regardless of the groupings, the key types are the same. Each is briefly introduced next.

Impacts to Soil

Soil is comprised of minerals, living and dead organic material, water, dissolved substances, and the air spaces between the solid particles (Hammitt & Cole, 1998). Each of these components can be adversely impacted by recreation use. Impacts to soil are most commonly due to trampling from people, horses and other stock, or the effects of tires from vehicles such as bicycles, ATVs, motorcycles, or four-wheel drive vehicles. Trampling typically results in removal of leaf litter, loss of organic material, compaction, increased water runoff, and increased erosion (Manning, 1979). The eroded soils themselves may then cause additional damage when they are deposited elsewhere as sediment. These harmful processes can affect soils anywhere including trails, campsites, lakeshores, and riverbanks.



Soil erosion on trails is a destructive, and often obvious, negative impact of recreation use. (Photo by Reuben Rajala)

Impacts to Water Quality

Water is extremely important for outdoor recreation. It plays an immediate and direct role in recreation experiences like boating, fishing, skiing, and viewing scenery, and an indirect role in recreation by supporting flora and fauna and their habitats as well as for drinking and sanitation for recreation visitors themselves. Needless to say, outdoor recreation use can also adversely affect the water resources it so often depends on. Recreation impacts to water quality can be caused by such actions as

- improper disposal of human waste
- accidental "planting" of exotic aquatic species that change dissolved oxygen and nutrient levels in bodies of water
- chemical pollution from gasoline, oil, and coolants from boats and other motorized vehicles
- bathing in or near water sources and using nonbiodegradable soaps
- washing dishes in or near water sources

Water-based recreation activities can also cause other resource impacts. These include shoreline erosion from boat wakes, turbulence, and cutting action from propellers (Liddle, 1997), as well as litter related to swimming, fishing, and boating. Shoreline erosion and vegetation trampling are also common along lakes and streams frequented by anglers and other shoreline users.

Impacts to Air Quality

Recreation use can cause negative impacts to air quality. Such impacts are most often in the form of pollution from motorized vehicles, although campfire smoke can also be an air quality problem in some areas during particular climactic conditions. The source of vehicle exhaust may be recreation vehicles themselves such as boats, personal watercraft (PWC), or ATVs; automobiles and RVs used to access the recreation area; or even traffic simply passing through a natural area on a road selected, in part, for its scenery or wildlife viewing. Of particular concern have been snowmobiles and personal watercraft (PWCs), which until recently were all powered by two-cycle engines that burn a mixture of gasoline and oil. The ongoing controversy related to snowmobile use in Yellowstone National Park is a case in point. In other areas, vehicle

emissions from park visitors combines with other atmospheric pollutions drifting in from other sources to make air quality a serious concern. Great Smoky Mountains National Park, for example, holds the dubious distinction of having some of the worst air quality in the National Park System, affecting visibility from park vistas, vegetation, and visitor health. Although most of the park's pollution is caused by the burning of coal, oil, and gas in upwind areas far outside park boundaries, emissions from park visitors' vehicles are one source (National Park Service, 2001). Reduced visibility in Grand Canyon National Park, mainly caused by electric power generating facilities in the four corners area, is another example.

Impacts to Vegetation

Recreation impacts to flora are often highly visible and dramatic. Vegetative impacts affect such things as which species are present in what proportions (i.e., species composition), the amount of ground cover, seed germination, and the condition of trees and plants. Vegetative impacts can be caused by a wide variety of behavior related to outdoor recreation, including

- trampling seedlings and groundcover
- gathering firewood
- tying horses to live trees
- carving initials in trees
- "planting" exotic plant species through horse and other stock manure
- placing gasoline lanterns on live trees
- gathering flowers and other parts of plants
- grazing horses and other pack stock
- improper disposal of human waste and garbage

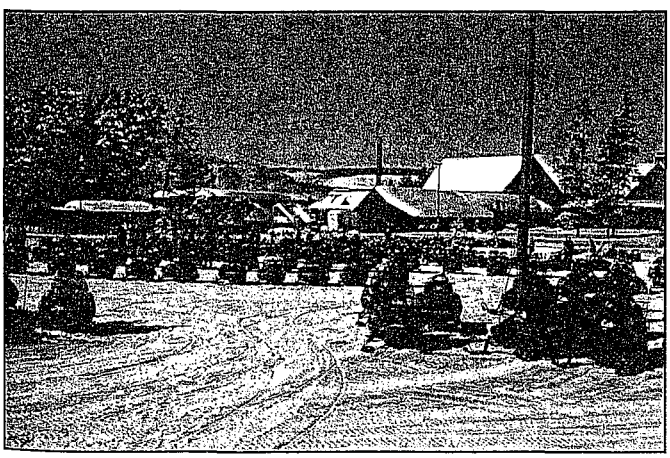
Impacts to Wildlife

Viewing or hunting wildlife and viewing or catching fish are the primary goals of many outdoor recreationists and a welcome addition to the experiences of many others who visitor outdoor recreation areas. But negative recreation impacts on wildlife and their behavior are common. Knight and Cole (1995) identified six factors of recreation that can disturb wildlife:

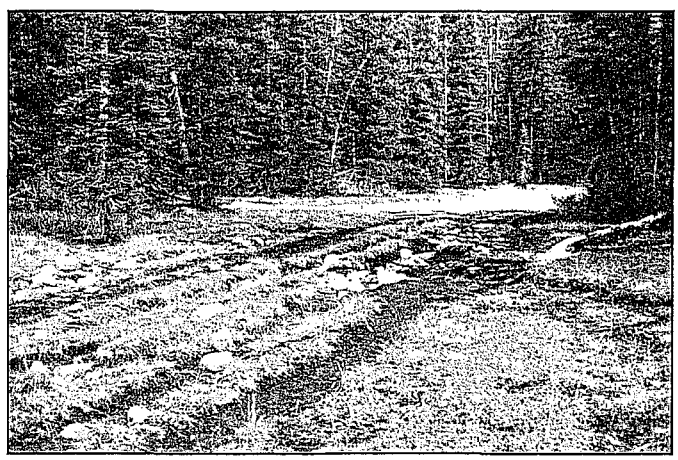
1. the recreation behavior itself
2. how predictable the impact
3. how frequent the impact
4. the magnitude of the impact
5. when the impact occurs
6. where the impact takes place

Hammitt and Cole (1998) noted some wildlife-related recreation impacts are "selective" in that they affect only a particular species. A group of birders closely following a particular rare species is a selective impact. Other impacts are "nonselective" in that they affect the local species generally as when a group of mountain bikers or hikers use a particular trail and affect the behavior of all the nearby wildlife. Examples of impacts on wildlife caused by outdoor recreation include

- poaching of wildlife
- pursuing animals to photograph them
- damaging or destroying an animal's food supply
- camping near water sources in arid environments
- disrupting breeding by being in an animal's territory during mating season
- affecting an animal's nutrition and tolerance of people by feeding them
- bringing dogs or other pets into an animal's habitat



Motorized recreation vehicles, especially those using two-cycle engines, can dramatically degrade air quality.



Outdoor recreation use can cause serious vegetation damage, as in this fragile Wyoming meadow. (Photo by Reuben Rajala)

- chasing wildlife with off-highway vehicles (OHVs), snowmobiles or other means

Social Impacts

Soils, water, air, vegetation, and wildlife are not the only elements of an ecosystem that can be adversely affected be recreation use. The people visiting an outdoor recreation area can be impacted by other recreation users as well, most frequently in regard to the recreation experiences they hope to have there. Recreation impacts to visitors' experiences caused by the presence, behavior, or even evidence of other users are called *social impacts*. The most common examples of the social impacts of outdoor recreation are crowding and conflict.

To understand the social impacts of recreation use, it is important to remember why people engage in outdoor recreation. Recall that outdoor recreation is "goal-directed behavior," meaning simply that people engage in recreation to consciously or unconsciously satisfy certain needs or to meet certain goals. In other words, our motivations, needs, and desires for certain outcomes, rewards, or experiences drive our behavior. As elaborated in Chapter 1, all outdoor recreation visitors have motives for their outdoor recreation behavior and most have multiple motives, even for a single recreation engagement. This perspective is the basis of the "behavioral approach" to understanding outdoor recreation and providing high-quality opportunities for it. In addition to the motives for outdoor recreation engagements, the behavioral approach also focuses on the experiences that result. The quality of these recreation experiences is usually measured in terms of satisfaction (i.e., the extent to which visitors are able to achieve the experiences they desired).

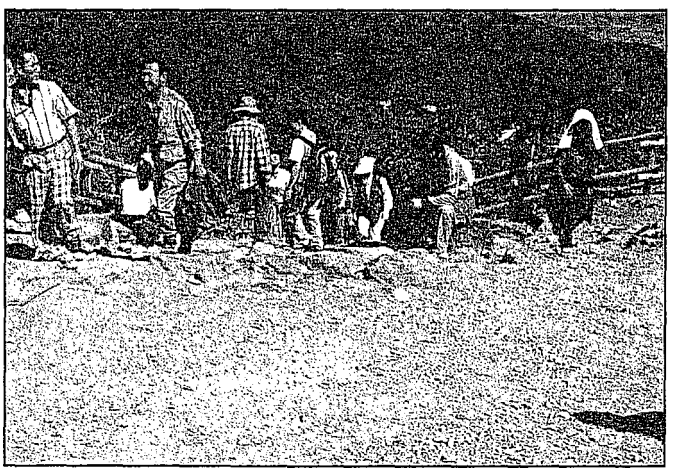
Many factors can reduce the satisfaction someone experiences with their outdoor recreation, including bad weather, illness, not catching a fish or seeing an elk, inadequate facilities, and so on. A social impact occurs when the source of a visitor's dissatisfaction is the presence, behavior, or even evidence of other users. Although outdoor recreation research generally shows most outdoor recreation users are satisfied, social impacts can and do become serious problems. The most common of these social impacts are *perceived crowding* and *recreational conflict*.

Perceived Crowding

When people think about "crowded" places, they are more likely to recall a crowded sidewalk, party, or concert than a crowded outdoor recreation setting. But crowding frequently is a problem for outdoor recreationists and, therefore, is an ongoing concern for outdoor recreation managers. Recreation crowding has been the subject of dozens of scientific studies focused on recreation activities as varied as hunting, fishing, climbing, backpacking, tubing, rafting, canoeing, hiking, sailboating, and wildlife photography.

Recreation crowding has to do with more than simply the objective number of people present in an area or even the density of people present there. Because users' satisfaction with their recreation experiences involves their personal evaluations, recreational crowding includes a subjective element and is therefore frequently referred to as *perceived crowding*. Crowding in a recreation setting is best defined as a negative appraisal of the density of other people in an area (Kuss, Graefe & Vaske, 1990). In other words, when recreationists' experiences are negatively affected by the number or density of people present, they are experiencing crowding. It may be helpful to think of perceived crowding as the user's value judgment that there are simply "too many" people present in a particular situation at a particular time. Of course, what constitutes "too many" can vary greatly from person to person and situation to situation.

The situational and subjective nature of recreation crowding is illustrated by the results of a study at Buck Island Reef National Monument in the U.S. Virgin Islands (Graefe & Moore, 1991). One of the main attractions at this National Park Service unit is an underwater snorkeling trail, which most visitors access on "head boats" operated by commercial tour companies. Even though visitor numbers and densities were high on the underwater trail itself, users reported low levels of crowding there. This was because many users were inexperienced snorkelers and liked the assurance and increased safety of having others nearby. Visitors reported being much more crowded when they spent their lunch times on the nearby beach, however, even though the actual densities of other people there were far lower than on the underwater trail. The same people were apparently more sensitive to others on



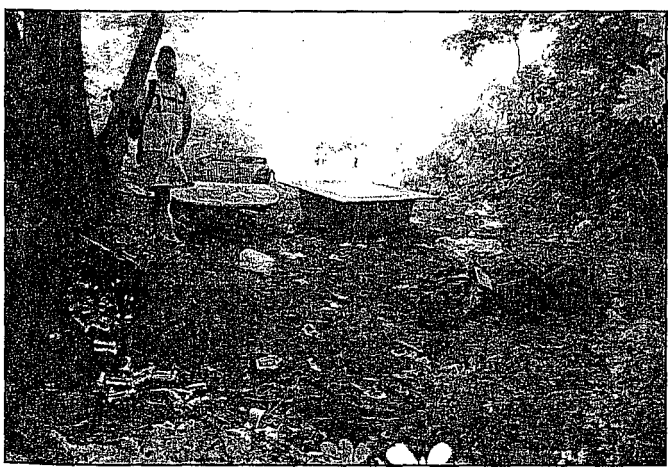
Levels of crowding in outdoor recreation settings is dependent on many things, not simply the number or density of other people present.

the beach because they were expecting more solitude there and many wanted more privacy with their significant others than was actually available.

In fact, sensitivity to crowding and other social impacts of outdoor recreation varies from person to person, place to place, and situation to situation. More specific factors that affect levels of social impacts in general will be summarized shortly. (For excellent reviews and syntheses of research related to recreation crowding see Kuss, Graefe & Vaske, 1990 and Manning, 1999.)

Conflicts Among Users

Another common social impact of outdoor recreation is *recreation conflict.* As with crowding, conflict is not an objective state, but depends on individual interpretations of past, present, and future contacts with others (Jacob & Schreyer, 1980). Recreational conflict is also more than simple competition for limited recreation resources. Recreational conflict is best defined as "goal interference attributed to another's behavior" (Jacob & Schreyer, 1980, p. 369). In other words, conflict is a special type of dissatisfaction that occurs when one person cannot achieve the recreation experiences they desire because of the interference of other users. Examples could include the sounds of motorboats interfering with the experiences of backcountry canoers, inconsiderate mountain bikers frightening trail hikers, large horseback groups making it difficult for mountain bikers to pass on a trail, or large groups of commercial rafters blocking rapids and otherwise spoiling the experiences whitewater kayakers. Recreational conflict has been found between cross-country skiers and snowmobilers, and hikers and motorcyclists, canoe paddlers and motorboaters, nonmotorized raft users and motorized raft users, mountain bikers and hikers, downhill skiers and snowboarders, hikers and horseback riders. However, it is important to realize such findings do not imply that these pairs of activities are inherently incompatible. Conflict is an individual reaction and goal interference can occur among individuals involved in different activities, the same activity, or for reasons that may not be related to the "offending" user's activity at all, such as rude or unsafe actions.



Litter can be an obvious negative impact of recreation use, as this site in the Boston Harbor Islands illustrates. (Photo by Yu-Fai Leung)

Recreational conflict is sometimes broken down into two distinct types. *Interpersonal conflict* involves some sort of contact or encounter among the parties (at least visually), while *social-values conflict* need not involve contact at all. An example of social values conflict in a recreation setting would be nonhunters experiencing conflict simply by knowing that they must share the area with hunters or visa versa (Vaske, Donnelly, Wittmann & Laidlaw, 1995). Conflicts in outdoor recreation are sometimes "asymmetrical" or "one-way" as well. This occurs when one group dislikes contacts with another but the reverse is not true. For example, cross-country skiers tend to dislike encountering snowmobilers, but snowmobilers are not as unhappy about encountering cross-country skiers (Jackson & Wong, 1982; Knopp & Tyger, 1973).

With both recreation crowding and conflict, the same objective conditions might or might not produce social impacts. In general the dynamic is that people visit recreation areas with particular goals and expectations about the kinds of conditions and experiences they desire. When faced with threats to their ability to realize those experiences, they either experience the crowding/conflict or they may employ coping strategies to avoid the social impact. Crowding or conflict can then also result when the person's coping strategies are not successful. The most common coping strategies are substitution, redefinition of the experience, and rationalization (Manning, 1999).

Substitution occurs when a person chooses a different activity, place, or time for their recreation when they find the original conditions unacceptable. For example, a fly fisher who finds her favorite stream too crowded on a Saturday morning might decide to try another stream that morning, return to the same stream at a less crowded time, or put the rod away and go hiking instead. These are examples of place, time, and activity substitution, respectively. When recreation users choose, or are forced, to substitute alternatives for their preferred place, time, or activity, they are said to have been *displaced.*

Redefining the experience involves the person changing their recreation goal or their preference for a particular recreation opportunity. For example, if a camper hoping for solitude finds his preferred campsite occupied, he might consciously or unconsciously decide to enjoy the company of the other campers. He has, in essence, changed his recreation goal from solitude to social interaction, and therefore has not experienced crowding or conflict. This redefinition of the experience is sometimes

referred to as *product shift* (Shelby, Bregenzer & Johnson, 1986; Shelby & Heberlein, 1986).

Rationalization occurs if a person feels they have so much invested in the outing (personally and/or financially) that they convince themselves (and perhaps others) they were satisfied anyway, even if the conditions fell far short of their hopes.

General Characteristics of Negative Recreation Impacts

The previous discussion should give some indication of the breath of impacts that outdoor recreation can have on soils, vegetation, wildlife, water, air, and recreation experiences. In fact, almost all recreation use causes some sort of impact. Some impacts are very subtle and imperceptible in the short term, while others are severe and quite obvious. The relationships among impacts and their dynamics can be quite complex, of course, and the better a manager's understanding of this complexity, the more likely it is the impacts can be managed effectively. After a thorough review of the scientific research related to recreation impacts, Graefe, Kuss, and Vaske (1990, pp. 1–2) came to the following five major conclusions and recommended that they be incorporated into any system for managing impacts. We have reworded the titles of their conclusions slightly and provide examples of each for clarification.

Impacts Are Interrelated

Environments and individuals do not respond to recreation use in a single, predictable way. Different impacts are frequently related with one another and often respond to recreation use in complicated ways. Recreation impacts can also be either direct or indirect (Graefe, Kuss & Vaske, 1990; Hammitt & Cole, 1998). For example, trampling by hikers on a steep trail will likely cause the direct impacts of soil compaction and erosion. That erosion, in turn, may cause increased runoff and sedimentation downhill that results in the indirect impact of sedimentation that can damage vegetation and decrease water quality. Or, consider the case of severe physical and biological impacts that then cause indirect impacts on users' recreation experiences when they are noticed. Evidence of other people, such as "beaten out" campsites, litter, badly eroded trails, initials carved in trees, and motorcycle tracks, can lead to feelings of crowding, conflict, or dissatisfaction in general, even without actually seeing the other users themselves.

Impact Levels Are Related to Use to Some Extent

Although most impacts are related in some way to the amount of recreation use an area receives, the relationships are usually not direct or linear. For example, steady increases in the number of people using an area will not usually cause equivalent increases in resource damage or social impacts. Most damage to soils and vegetation at campsites, for instance, occurs after relatively few groups use the site. After the initial impacts have occurred, addition groups cause less damage per group. Other factors such as tolerance to impacts and visitor preferences and expectations make use-impact relationships more complicated.

Tolerance to Impacts Varies

The way impacts relate to levels of use vary widely. These variations may be from species to species, ecosystem to ecosystem, or even from one person to another. For example, some plants and soils are hardy, some are fragile. Some users may feel crowded by meeting one other group in the backcountry, while others may not mind encountering dozens.

Influences Are Activity-Specific

Some types of recreation activities cause more or faster impacts than do others. Horses, bikes, walkers, and snowmobiles all affect resources differently. And often the *style* of use is even more important than the type of activity. For example, one irresponsible mountain biker can cause more physical damage and recreation conflict than many responsible ones combined.

Influences Are Site-Specific

The effects of recreation use depend on where and when the use takes place. Different areas of a recreation site are not equally susceptible to impact. As in the Buck Island Reef example noted earlier, the location of contact affects social impacts. Similarly, the level of physical and biological impacts can be related to such factors as slope, orientation to the sun, microclimate, vegetation type and density, and soil type. The time of year and time of day can be important, too. Trails are typically most fragile in the spring, for example, because of wetter soils.

What Factors Influence Levels of Recreation Impacts?

Research indicates many factors affect the severity of recreation impacts. Some of the most important ones are noted next with brief examples. Each applies in varying degrees to soil impacts, vegetation impacts, wildlife impacts, water

quality impacts, air quality impacts, and social impacts. As noted previously, it is important to remember that impacts tend to be interrelated with one another and not necessarily related to increasing use in direct or linear ways. The same caveats apply to the factors noted here. They are often interrelated and generally do not affect the levels of impacts in linear or direct ways.

The following list of factors that influence levels of recreation impacts is based, in part, on summaries of the literature provided in Hammitt and Cole (1998), Kuss, Graefe, and Vaske (1990), Moore (1994), and Hendee and Dawson (2002). Some of the relationships described in these factors are supported by strong scientific evidence and others are only suggested by a few studies. Research on these relationships and factors is continuing.

Environmental durability. The ability of the resource elements to resist damage. Some species and ecosystems are more sensitive to recreation use than are others.

Environmental resilience. The ability of the resource elements to recover from damage. Some species and ecosystems are more resilient to damage caused by recreation use than are others.

Type of activity. Larger, heavier uses (e.g., motorized vehicles, horses) tend to cause more impacts than others. Nonmechanized users (e.g., hikers, cross-country skiers) tend to be more sensitive to contacts with others than are mechanized users.

Size of group. Larger groups tend to cause more damage to resources, in part, because they spread out more than smaller groups do. Members of smaller groups also tend to be more sensitive to the presence and behavior of others. Contacts with large groups generally cause greater social impacts than contacts with small groups.

Location of contact. Users generally have their lowest tolerance for contacts with others in remote wilderness areas. Tolerance for others tends to be highest at trailheads, lower on the trail, and lowest at campsites. Tolerance is probably lowest at campsites because people tend to want more privacy there.

Time of use. Some sites and species are more sensitive to impacts at certain time than others. Soils and vegetation can be more sensitive in wet springs than dry summers or frozen winters. Wildlife is more sensitive to disruption during breeding season and winter when their food is less available and their energy reserves are limited.

Length of stay. Groups that stay in the backcountry longer generally have more impact than ones that stay only a short time. Day hikers usually cause less impact than overnight campers and longer stay campers may cause more impacts, still, by "improving" their campsites to make them more comfortable.

User motivation. *Why* a user engages in their outdoor recreation can affect their sensitivity to contacts with others. For example, nature and solitude seekers tend to be less tolerant of contacts with others than are excitement, thrill, and social contact seekers.

User behavior. *What* other users do is often more important than *how many* there are. For example, one user cutting live trees for firewood will cause more vegetative damage than dozens who use camp stoves instead of campfires. Similarly, one inconsiderate camper playing a loud radio can cause more crowding and conflict than would many others who behave considerately. Properly educated users who behave responsibly can minimize nearly all of their impacts dramatically.

Type of user encountered. Users tend to be most tolerant of people who seem to be like themselves rather than different. The type of activity someone is engaged in is often the most visible cue others use to judge how alike they may be, although stereotypes based on visible cues can be quite inaccurate.

When the user first visited. Many users evaluate present conditions against their earliest visits to that site, making long-time visitors more sensitive in general than newcomers. This tendency is sometimes referred to as a *floating baseline* and may be related to the so-called *last settler syndrome* where some users want conditions and allowed uses to stay the same as when they themselves first used the site.

User preferences and expectations. Discrepancies between actual, expected, and preferred conditions or encounters can relate to feelings of crowding, conflict, or dissatisfaction in general.

User norms. Norms are essentially the unwritten "rules" that users hold related to how an area should be used and what conditions "should" be like there. Breaking these unwritten rules can lead to social impacts. For example, tubers may feel it is perfectly appropriate to drink and be boisterous on a particular river segment, while anglers might feel the same river segment should be used quietly and with more reverence. Differences in norms are likely an important factor in the social values conflicts mentioned earlier.

Number and density of others present. The number and density of others often have some relationship with recreation impacts, but the connections are usually weak and often indirect. Concentrations of users can cause more damage to a particular site than dispersed ones, although the same number of users dispersed in a fragile environment may cause more total impact than if they are concentrated in the most durable site available. Note that the number of others present in an area and the number of others actually seen can be quite different. The number of others seen can be affected by factors as simple as whether the others use brightly colored versus earth-toned clothes, tents, and equipment.

Level of user experience. Users who are more experienced or expert tend to be more sensitive than novices. This is probably due to the fact that more experienced users often have more refined needs and expectations than beginners. More refined needs and expectations are more easily disrupted by undesirable site conditions or social conditions.

Definition of place. Attitudes toward and perceptions of the environment can affect how sensitive users are to impacts. Those who are more attached to a particular place tend to be more sensitive to impacts there than are more casual visitors.

Level of tolerance. Individuals differ in how tolerant they are of others generally, and they bring these attitudes with them when they come to outdoor recreation settings.

Systems for Managing Negative Recreation Impacts

For many years this area of outdoor recreation management was almost universally referred to as *recreation carrying capacity*. It is really an adaptation of the carrying capacity concept borrowed from range and wildlife management that estimated the number of animals that a certain range could support long term within the limits of its soils, water, and vegetation (e.g., head of sheep per acre per month). The recreation carrying capacity concept is now over 40 years old and was originally defined as the "level of recreational use an area can withstand while providing a sustained quality of recreation" (Wagar, 1964, p. 3). Carrying capacity is now typically examined in two parts: *physical carrying capacity* and *social carrying capacity*. The important implication of all carrying capacity and recreation impact management systems is that a quality environment is necessary to provide quality recreation opportunities.

There are two basic approaches to assessing and managing recreation impacts: formula-based and standards-based.

Formula-Based Approaches

These are generally the early approaches based more strictly on the original range and wildlife management carrying capacity concept. They attempt to identify a maximum number of people an area can accommodate and still provide for healthy resources and reasonably high-quality recreation. However, a strict carrying capacity concept doesn't work well for outdoor recreation management because outcomes like recreation experiences are much harder to measure and much more complex than head of livestock per acre per month, and the inputs are much more varied and interrelated than the forage and water needed to raise healthy animals.

The system used to determine a carrying capacity for backcountry recreation in Yosemite National Park in the early 1980s is an example of a formula-based approach. The following formula was used to determine the maximum "people at one time" (PAOT) that the area was expected to sustain (Wagtendonk, 1983):

Carrying Capacity = A – (BA)

Where:

A= .01 x (total acreage of the zone) + 2 x (total trail mileage in the zone)

B = (relative uniqueness of the system + relative vulnerability of the system + relative resiliency of the system + ease of reparability of the system by man)/36

Each of the variables used in factor B were estimated and measured on a 0 to 9 point scale. These calculations were made for each backcountry zone and resulted in a carrying capacity for that zone in PAOT. This type of approach is almost never used today. Currently all major systems for managing recreation impacts are standards rather than formula-based.

Standards-Based Approaches

For years the most common management response to unacceptable recreation impacts was to restrict the amount of recreation use allowed in an area or to close it entirely. We now know the causes of recreation impacts are much more complex and interrelated than simply how many people use a particular area. Older formula-based approaches focused primarily on recreation use levels. However, the more sophisticated and appropriate approach is to focus on the level of impact, not just the number of people using the area. Standards-based approaches were designed to do just that.

Standards-based approaches to identifying and managing recreation impacts are systematic approaches to evaluate, manage, and monitor the recreation impacts themselves (rather than the number of people) and to keep the impacts within some appropriate, agreed on levels (i.e., standards). Standards-based approaches have all but replaced the older formula-based approaches. The most common examples of standards-based approaches in use today include the following:

Limits of Acceptable Change (LAC)

LAC was developed by USDA Forest Service scientists and is currently the most well-known and widely used of the standards-based approaches (Stankey et al., 1985). LAC has been used by the U.S. Forest Service and Bureau

of Land Management for many years. Although LAC was originally designed to help manage wilderness resources, it is applicable to and has been used in many outdoor recreation settings and is currently being used in several countries outside the United States as well.

Visitor Experience and Resource Protection (VERP)

VERP is the most recent of the standard-based approaches. This relatively new approach was developed by university and National Park Service (NPS) scientists working in collaboration (Manning, Lime & Hof, 1996). Parts of the VERP process were designed to be integrated with requirements of the NPS general park planning process.

Visitor Impact Management System (VIM)

VIM was developed by University of Maryland scientists working with the nonprofit National Parks and Conservation Association in hopes that it would be adopted by the National Park Service (Graefe, Kuss & Vaske, 1990). This is one of the simplest of the four standards-based approaches, but it has not been widely adopted by any of the major land managing agencies.

Visitor Activity Management Process (VAMP)

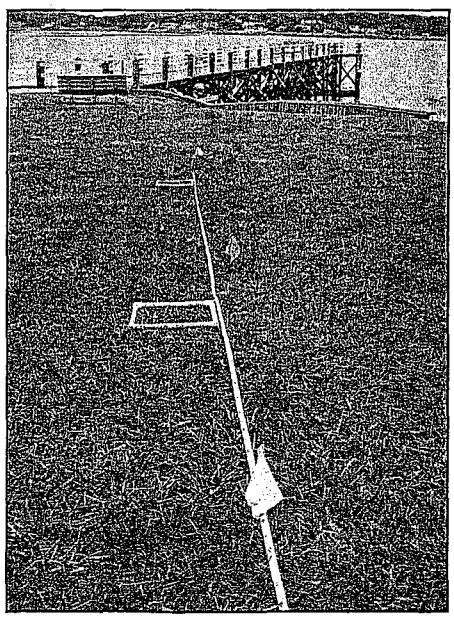
As noted in Chapter 12, VAMP is a Canadian model (Graham, Nilsen & Payne, 1988; Parks Canada, 1991) that shares similar objectives with the LAC, VERP, and VIM systems and uses a similar process. However, VAMP frequently serves a much wider role in guiding the planning and management processes of entire parks and other areas administered by Parks Canada. VAMP is no longer being used by Parks Canada as a distinct management planning system under the name of VAMP, but has now been integrated into a number of other guides and processes used by that agency.

Figures 14.1, 14.2, and 14.3 (pp. 218–219) give illustrations of the basic steps in the three standards-based recreation impact management systems just mentioned.

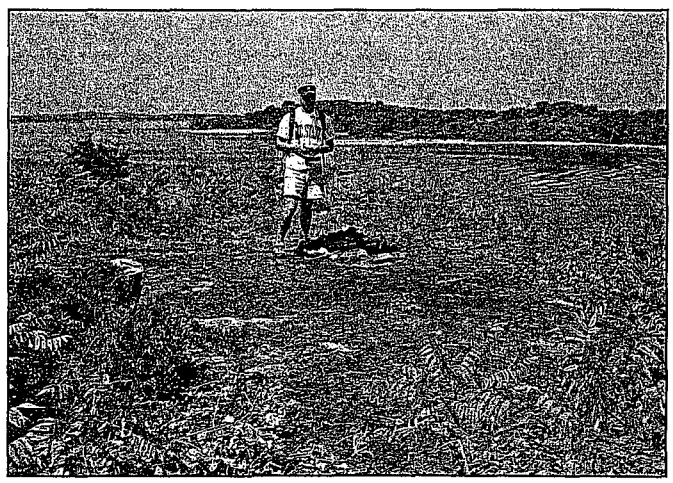
There are more similarities than differences among the three impact management systems illustrated. Each has similar orientations and steps and promotes active collaboration of the planners and managers with the stakeholders who either affect or will be affected by any managerial actions taken. The degree of such collaboration has varied from one application of these three systems to another, but in general it has been a part of the process. A difference among the systems is the extent to which they are used to help guide the overall management of an area as opposed to being applied more at the smaller recreation site or project level. The VAMP system is more integrated into management planning of much larger sites and reserves than are the other three systems. Regardless of the degree of such integration, of course, each of these impact management systems must be applied within the bounds of the policy directives guiding the agency.

As noted here and in Chapter 12, the LAC, VERP, and VIM impact management systems are similar in their steps and orientations. The eight steps of the VIM system are presented next in slightly more detail as an example of the logic and application of standards-based approaches in general (Graefe, Kuss & Vaske, 1990, pp. 9–27). The steps in the VIM process are as follows:

Preassessment database review. The goal of this first step is to identify and summarize information pertinent to the site and its purpose by means of a thorough review of all relevant sources of information about the area. These may include enabling legislation and other policy



Impact assessment and management systems like limits of acceptable change (LAC) can employ many specialized techniques, such as vegetation transects. (Photo by Yu-Fai Leung)



Systematically measuring and recording the levels of selected impact indicators is an essential part of all standards-based approaches. (Photo by Yu-Fai Leung)

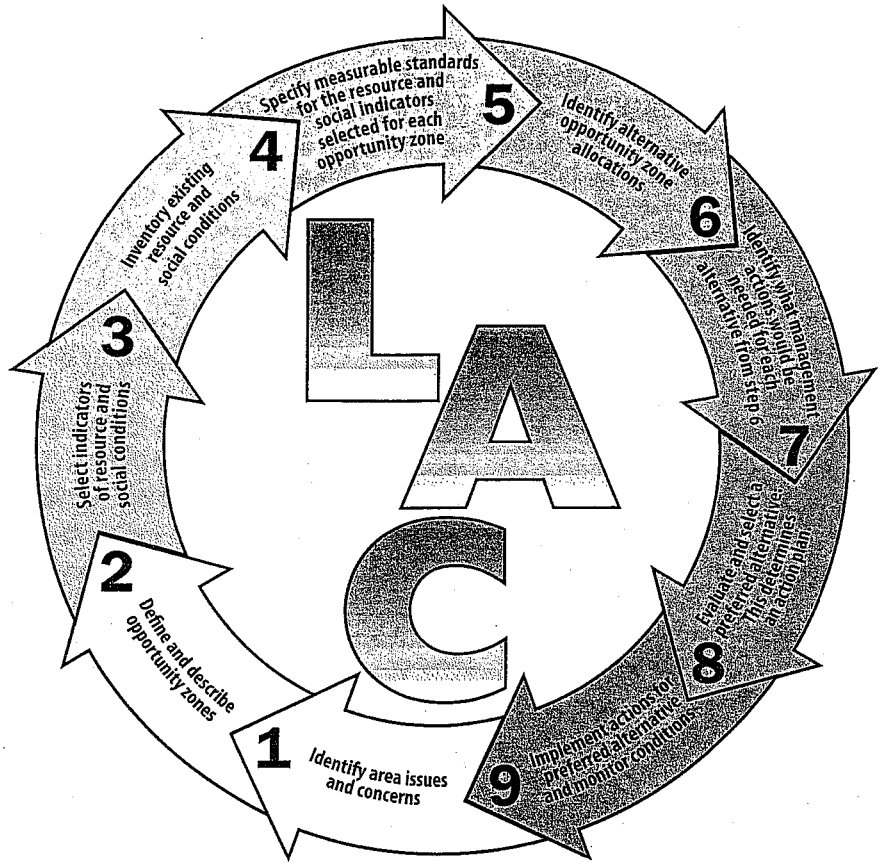


Figure 14.1 Steps of the limits of acceptable change (LAC) process. Source: Stankey et al. (1985, Fig. 1, p. 3)

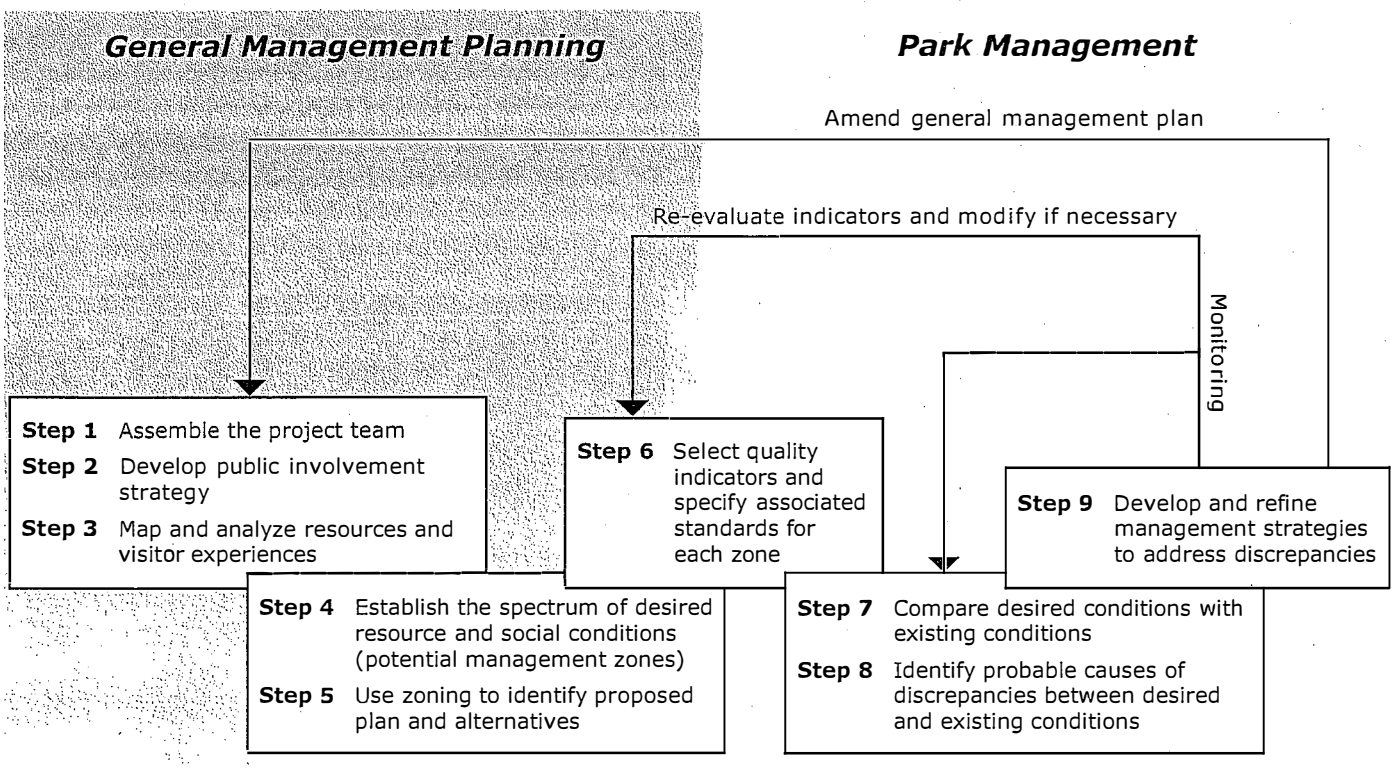


Figure 14.2 Steps of the visitor experience and resource protection (VERP) process. Source: Hof et al., 1994, p. 11

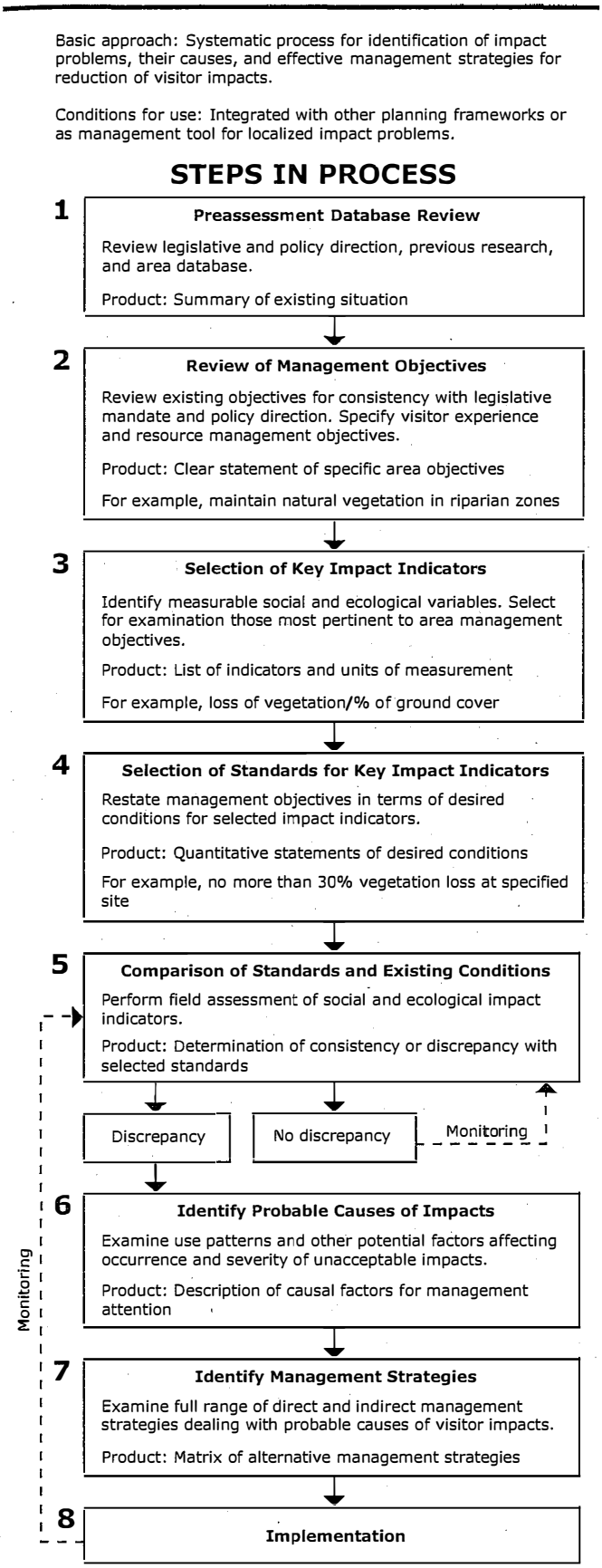


Figure 14.3 Steps of the visitor impact management system (VIM) process. Adapted from Graefe, Kuss & Vaske (1990, Fig. 1, p. 10)

directives, agency mission statement, previous research, proceedings of meetings establishing the area, specific databases related to existing area conditions, and so forth. This step must also delineate the boundaries of the physical area to be evaluated.

Review of management objectives. Where management objectives exist for an area, they should be reviewed for consistency with all relevant legislative mandates and agency policy. If clear and specific visitor experience and natural resource management objectives do not exist, they should be established as part of this step. Specific objectives provide much better guidance for identifying and managing recreation impacts than do broad or vague ones, of course. This step is often the most important one in the process because clear objectives often do not exist. Examples of objectives from a VIM application for a popular trail in Glacier National Park (Graefe, Kuss & Vaske, 1990, p. 30) include the following:

1. to offer an opportunity for visitors to observe and experience an alpine ecosystem at close range through intimate contact provided by a trail structured to facilitate access to this area and to protect the fragile environment
2. to manage soil and vegetation resources by application of the carrying capacity concept to control ecosystem impacts at an acceptable level
3. to provide opportunities for visitors to fully experience the park's unique semi-wilderness areas without adverse impact on the resources

Selection of key impact indicators. In this step the measurable social and ecological variables most pertinent to area management objectives are identified. The best of these variables are then selected to serve as the key impact indicators. As much as possible, the impact indicators should be

- directly observable
- easy to measure
- directly related to area objectives
- sensitive to changing use
- amenable to management

It is almost always best to use multiple indicators and to include ones which target physical, biological, and social impacts. Examples of good indicators would be depth of trail erosion or the number of fire rings at a campsite.

Selection of standards for key impact indicators. This step involves the quantitative restatement of management objectives to reflect the desired conditions for selected impact indicators. Setting appropriate *measurable* maximum or minimum acceptable levels for each indicator is

essential. Standards may be sophisticated measures, such as multi-item indices of water chemistry in parts per million, or more subjective visual ratings, such as low, moderate, or extensive levels of campsite deterioration based on specific criteria. Examples of standards, in terms of the examples given in the previous step, might be "no more than four inches of trail erosion depth" or "no more than a single fire ring at each campsite."

Comparison of standards and existing conditions. This step entails actually measuring the conditions of each indicator in the field and comparing them with the standards set for each. If the level of an indicator is found to be unacceptable, the process moves on to the next step. If not, its levels should be monitored as specified in the final step.

Identify probable causes of impacts. This step attempts to determine the most important causes affecting the occurrence and severity of any impacts found to be unacceptable in the previous step. To be useful to management, the causes identified need to be more specific than "too much use." Remember to consider all the possible factors that could affect impact levels identified earlier in this chapter, including

- spatial use patterns
- user behavior
- level of use
- time of use (e.g., day, week, season)
- type of use
- concentration of use
- length of stay
- size of group

Recognize there may be a need to gather more data to understand the causes of the impacts well enough to be able to address them effectively.

Identify management strategies. This step identifies the specific management strategies most likely to address the causes of the unacceptable recreation impacts. It is important to consider the full range of direct (e.g., regulations and restrictions) and indirect (e.g., less obtrusive) management options in this step. When identifying strategies, be certain to focus on the likely causes of the impacts and not on the impact conditions, which are actually the symptoms. Chapter 16 presents details on the many options for influencing visitor behavior.

Implementation. This step is when the previously identified management strategies are implemented to address the unacceptable recreation impacts identified earlier. Implementation should specify who, what, when, where, and how to actually carry out each strategy. Implicit in this step is the fact that the levels of each indicator must be monitored on an ongoing basis in the field to assess the effectiveness of the management strategies implemented and to track any trends in impacts. Monitoring also assures the strategies implemented are not also causing additional unanticipated problems.

Before leaving this discussion of managing recreation impacts it is important to point out two things. The first relates to the term *carrying capacity* itself and the second has to do with the perspective we should have when addressing recreation impacts in general. As noted earlier, the concept of carrying capacity and the term itself were borrowed from range and wildlife management and applied to the field of recreation resource management. Some people believe that term no longer fits with the current emphasis on standards-based approaches to managing recreation impacts and should be phased out. Their main objection is they feel the word *capacity* implies a maximum number, especially to members of the general public. Since the maximum numbers of people that resulted from the early formula-based approaches have given way to impact-oriented standards in the current standards-based approaches, they feel the term carrying capacity is inappropriate.

Others have adapted and updated the definition of carrying capacity and feel it is still the most appropriate term. For example, the authors of VERP define carrying capacity as "the type and level of visitor use that can be accommodated while sustaining the desired resource and social conditions that complement the purposes of the park units and their management objectives" (Hof et al., 1994, p. 11). Such a definition clearly emphasizes that resource and social standards are essential. Similarly, Hendee and Dawson (2002, p. 234) believe there has been an "evolving recognition of carrying capacity as a conceptual approach, derived from social and ecological judgments about appropriate wilderness conditions." It is important for outdoor recreation managers to be aware that the term carrying capacity is still commonly used, but that it can be misleading to the uninformed, particularly members of the general public who may wrongly expect that the process will always result in a maximum level of allowable use.

The second point to remember in terms of understanding and managing recreation impacts is that, in one respect, recreation impacts are problems of success. Outdoor recreation is popular—so popular that more people are participating and doing so in more diverse ways. These increasing use pressures can, in turn, cause increasing impacts on the environment and the experiences of others. This point is not intended to lessen the importance of doing everything we can to minimize recreation-related

impacts to resources and experiences, including helping visitors to better understand their responsibilities. It is simply a reminder that the challenge of recreation impacts results, to some degree, from the sheer popularity of outdoor recreation itself.

Summary

This chapter introduced the concept of negative impacts of recreation use and presented information on systems currently used to identify and to manage such impacts. These impacts are best thought of broadly to be any undesirable changes to the resource base or experiences of other users caused by recreation use. The negative impacts of recreation use can be divided into six categories: soil impacts, water quality impacts, air quality impacts, vegetation impacts, wildlife impacts, and social impacts. Perceived crowding and recreation conflict are the most common social impacts of recreation use. In terms of recreation impacts overall, we presented and discussed five main conclusions based on Kuss, Graefe, and Vaske (1990): impacts are interrelated, impact levels are related to use to some extent, tolerance to impacts varies, influences are activity-specific, and influences are site-specific. We then reviewed over a dozen factors that appear to influence the levels of recreation impacts. Finally, the most important systems for managing negative recreation impacts that are commonly used today were introduced and discussed, including limits of acceptable change (LAC), visitor experience and resource protection (VERP), visitor impact management system (VIM), and visitor activity management process (VAMP). All of these systems are "standards-based" rather than "formula-based." In the next chapter we broaden our view from recreation impacts to address the important topic of how to actually gather data for managing outdoor recreation.

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