6 Impact Patterns

Chapters 2 through 5 described impacts of wildland recreation on soil, vegetation, wildlife, and water resources. These impacts often exhibit predictable patterns both in space and over time. Recreationists consistently tend to use the same places. Visitors to developed campgrounds concentrate on shaded sites near comfort stations and water sources, whereas backcountry campers congregate around spectacular lakes with good fishing and near streams. Such places tend to be more highly impacted than less popular places. Consistent use distributions result in characteristic patterns of impact on individual sites such as trails and campsites. Impacts on both trails and campsites generally decrease as one moves from the center to the edge of the site. However, total area of campsites and width of trails commonly increase over years of use. Much of this chapter will explore the nature of spatial patterns of impact on trails and campsites.

Recreation sites and impacts are not static; they change over time. Temporal impact patterns are the second subject of this chapter. Impact to soil and ground cover vegetation generally occurs rapidly, with the rate of deterioration tending to taper off over time. However, rates of change differ with type of impact and between environments. For example, in forested areas, soil compaction and vegetation loss occur rapidly and loss of organic horizons occurs more slowly. In deserts, loss of organic horizons may occur more rapidly than soil compaction. Some impacts also continue to increase over time, such as campsite area expansion, number of campsites, and trail erosion. Recovery rates vary greatly from place to place, although they are always slower than rates of deterioration.

SPATIAL PATTERNS OF IMPACT

One of the most distinctive characteristics of recreation use is its highly concentrated nature. Most use is restricted to a small number of travel routes and destination areas. Manning (1979) calls this the "node and linkage" pattern of recreation use and impact. Nodes of impact occur at destination areas; linkages develop along the routes between nodes. The table and firepit location at a campsite, the edge of the cliff at a scenic overlook, and the riverbank at a boat put-in are examples of nodes where use is concentrated. Examples of linkages include hiking and equestrian trails, canoe portages, and the access trails between individual sites, the comfort station, and water sources in a developed campground. Concentration of use means that pronounced impacts, although locally severe, occur in only a small proportion of any recreation area. Wagar (1975) estimated that one European park, by restricting use to developed trails, has confined the direct impacts of use to only 0.1 percent of the park's 42,000 acres. In the Eagle Cap Wilderness, where users are free to travel where they will, Cole (1981) estimated that no more than about 0.5 percent of two popular drainage basins had been substantially disturbed by use of campsites or trails. Even around two very popular subalpine lakes, in the same wilderness, the proportion of the area that had been substantially disturbed was less than 2 percent (Cole 1982). In properly designed, developed campgrounds where camping pads are highly disturbed, much of the total campground may remain relatively undisturbed.

Many factors contribute to this concentration of use. Certain locations attract people over and over again. Waterfalls, lakes, and scenic viewpoints are all good examples. People also tend to be attracted to edges. Rivers, lakes, and cliff edges attract people as does the boundary between meadow and forest. Use also concentrates for reasons of safety and ease of use. Many people are more comfortable and feel safer camping or walking in places that obviously have been used before. It is also easier to walk on existing trails and to camp on sites that have already been cleared of brush and rocks. All of these factors, and others, often cause wildland users to develop an emotional bond with certain recreation sites. These users become attached to these favorite places, returning to them for repeat visits (Williams, Patterson, Ruggenbuck, and Watson 1992).

The tendency for use to be concentrated within certain parts of a recreation area can be either good or bad. Situations where this is advantageous or not will be discussed in Chapter 13, along with techniques managers can use to encourage either use concentration or its counterpart—use dispersal.

Use is also concentrated within individual sites. Typically, campers in developed sites spend more than three-quarters of their in-camp time close to the table, tent pad, and fire grill. In undeveloped sites, backpackers spend most of their in-camp time around the tent and fire areas. In fact, the installation of fire grates in backcountry is recommended as a means to concentrate users and reduce total area of disturbance (Marion 1995). These areas are the most severely impacted. The "core" campsite area is surrounded by a less intensively used area where wood may be gathered and people may walk to and from water or toilet facilities. Beyond this area is a zone that is rarely penetrated by the recreationist. On developed campsites McEwen and Tocher (1976) have called these three distinct areas the impact, intersite, and buffer zones, respectively (Fig. 1). They argue that these zones are a consistent and important feature of campsites. These zones should be recognized, their distinctive types and levels of impact should be understood, and management should be tailored to maintenance and enhancement of these zones. Because the concept of impact zones has such important implications for managing ecological impacts on campgrounds and other high-density recreation sites, McEwen and Tocher's summary of impacts and management implications for each zone is described in the following subsections.

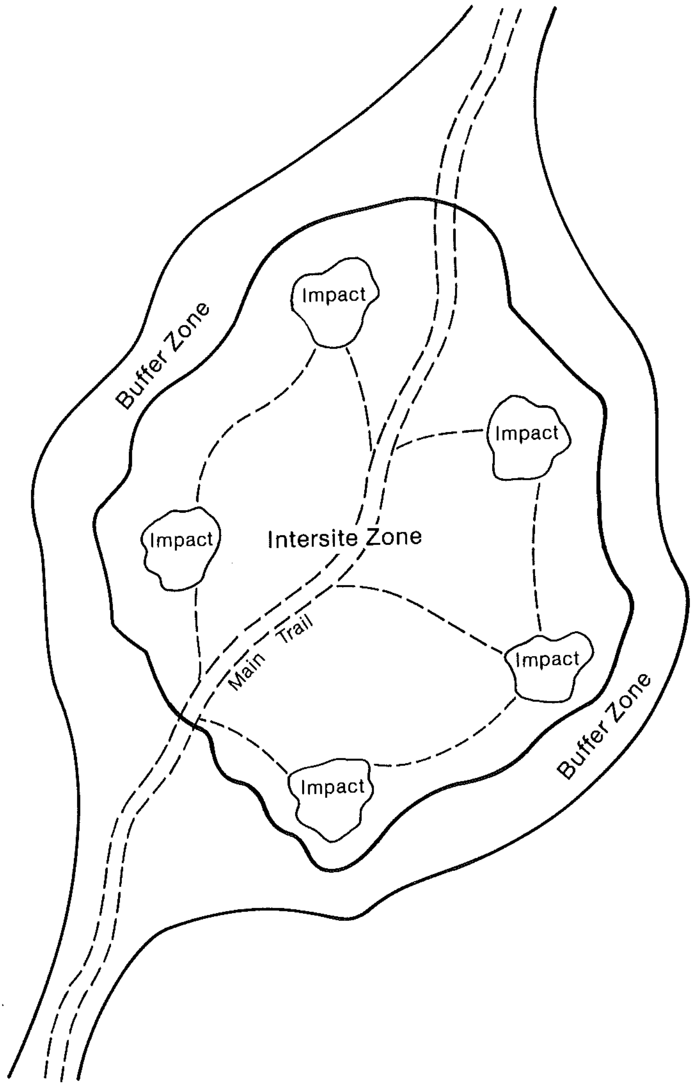


FIGURE 1. Impact, intersite, and buffer zones for a cluster of campsites in a backcountry recreation area. (*Source:* D. N. Cole.)

Impact Zone

Deterioration of soil and ground cover vegetation is severe, so impact zones quickly degenerate into hard, barren pads. Trampling pulverizes and scuffs away litter cover, eliminates herbaceous and small woody stems, and compacts soil. Soil compaction and loss of litter cover cause water infiltration rates to be severely reduced. This increases the severity of erosion. These changes occur within the first couple years of use, even with only moderate levels of visitor use. Moreover, recovery of impact zones will require long periods of time. They are likely to never recover as long as use continues. High impact zones must be accepted, although problems can be minimized through site design to keep impact zones small and hardening of surfaces with gravel, sand, or wood chips (see Chapter 13). Encouraging continued, concentrated use of these impact zones is important. Therefore, it is critical to keep these areas attractive and clean. If they become trashy, dirty, dusty, or muddy, they are likely to be abandoned, and new areas will be impacted. Key objectives for management of impact zones are to keep them as small and as attractive as possible.

Intersite Zone

Vegetation and litter are lost and soil is compacted, but these impacts are pronounced only on informal trail systems. Elsewhere, the health and vigor of soil and vegetation are not seriously reduced. Species composition of vegetation and wildlife is likely to be altered, but this will not be evident to most visitors. Of particular importance, the capacity of vegetation to regenerate is not severely compromised. Intersite zones will be the nurseries for future generations of trees, and they provide screening between individual sites. Without them, one campsite tends to blend into the next. The greatest concern with intersite zones is that they will be eliminated through expansion of impact zones. This can be avoided by creating intersite zones during the initial site design phase and by maintaining impact zones so that they do not expand. Some planting of trees, shrubs, and placing of logs and rocks may be necessary both to minimize use of intersite zones and to provide protected regeneration sites, particularly for tree seedlings. Establishment and hardening of an "official" system of informal trails between impact zones, other sites, and conveniences such as water supplies and toilets are often necessary to avoid excessive trail proliferation.

Buffer Zone

Few impacts occur in the buffer zone other than those resulting from some firewood removal, a few hiking trails, and roadways. In most primitive campgrounds the buffer zone is simply a transition zone between the developed site and the surrounding natural community. As with intersite zones, buffer zones should be delineated and protected. Avoiding encroachment from expanding intersite zones is the major concern; no active management of vegetation or soil is needed because the zone is natural.

Although these three zones have been described for campgrounds where they are most useful, the concept can also be applied to other high-use sites. Trails exhibit parallel zones, from the highly impacted trail tread through a less altered trailside zone to the undisturbed adjacent area. On most trails the tread is barren and compacted. Because it is often trenched below the local ground surface, the trail tread channels water and is subject to accelerated erosion. Where erosion is severe, roots and rocks are exposed and the trail can become difficult to use. Hikers and stock may leave the tread to walk on easier ground, enlarging the area of impact. As with the impact zone on campsites, the trail tread is an inevitable—usually purposely constructed—zone of extreme impact. Management must strive to keep the tread functional so users stay in the tread and avoid widening the impacted zone. The goals are usually to avoid erosion by diverting running water off the tread and to provide a comfortable walking surface. This may require some type of paving or bridging, particularly in wet or boggy areas. Regular monitoring and maintenance is often more essential for trails than for campsites.

The adjacent trailside zone is similar to the intersite zone. It is not natural, but the impacts that have occurred are not evident to most users. Vegetation often grows along the trailside, although its composition is usually very different from that of undisturbed environments (Cole 1981, 1991). Plants are usually low-growing, and many of the species growing here are exotic weeds inadvertently brought into the area. Soil compaction and erosion may occur, but it is less pronounced than on the tread. Perhaps the major source of impact is the initial construction of the trail. During construction, vegetation clearing opens up the trailside environment, increasing light intensities and changing moisture relationships. Moisture levels frequently increase along trails for several reasons. Fewer trees intercept less precipitation; fewer plants lose less water through evapotranspiration; and the compacted trail sheds water along its sides.

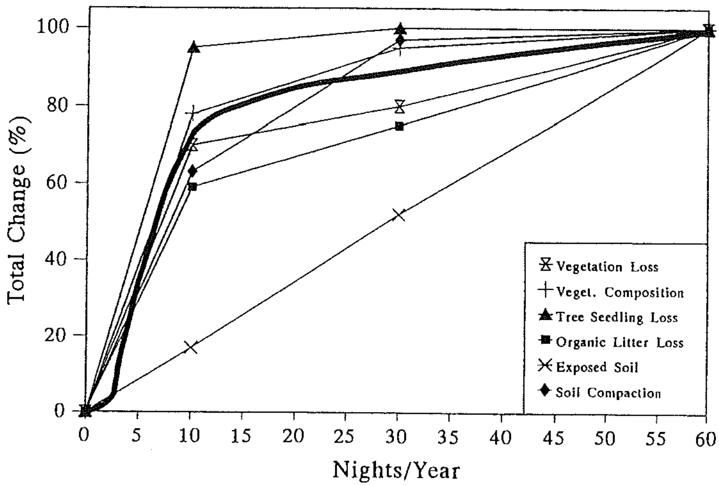
Trail construction also creates new habitats alongside trails. Rock faces are frequently either created or eliminated where trails are blasted out of rock outcrops. Flat, soil-covered surfaces are often created where trails cross steep boulder slopes on which soil and vegetation were minimal. Trails also interrupt drainages, leading to the development of boggy areas or to the drainage of areas that formerly were wet. Management of trailside zones should attempt to minimize disturbance by avoiding excessive alteration during trail construction. Thereafter, as with management of intersite zones on campsites, the most important thing is to avoid lateral expansion of the impacted tread into the trailside zones. One of the best ways to do this is to keep trailside zones rough and natural. This will tend to keep hikers and stock on the tread. The greater the contrast between the trail tread and the trailside zone, in terms of ease of walking, the easier it will be to avoid expansion of the highly disturbed tread.

Impact patterns are less evident where use is more diffuse than it is on campsites and trails. This applies to cross-country travel by motorized or nonmotorized means and certain scenic areas, picnic areas, or places where stock are allowed to roam and graze. Even in such situations, however, there is usually a gradient from high impact zones to the natural community. Where concentrated use around nodes, edges, and facilities leads to pronounced impact, management will need to control use distribution in such a way that impact zones do not expand and proliferate over time. Recognition of these zones and spatial patterns is an important first step in devising management strategies for controlling impact. We will discuss this further in Chapter 13 on site management.

Spatial patterns are most pronounced and important in describing and managing impacts on vegetation and soil, components of the ecosystem that are stationary. Patterns are less distinctive when we consider animals and water, components that move around. Smaller animals are affected primarily by habitat alteration; as with vegetation and soil, such impact is highly concentrated. Larger animals, however, may be affected over very large areas. A grizzly bear or bald eagle population may be affected over its entire range, even though recreational use is highly localized and concentrated. This is especially true where recreational use is concentrated on an animal's preferred habitat or on critical feeding or breeding grounds. For many animals that live on or in the water, for example, it may be irrelevant that recreational use and impact are minimal a few yards from the water; if all of their habitat is subject to disturbance by recreational use, then they are likely to be highly disturbed. Bird populations, disturbed at their nesting sites, may show evidence of this disturbance in their wintering grounds, even if no recreational use occurs there. Impacts on water can also be felt far from the point where pollution occurs. Dilution of pollutants by water tends to reduce the severity of impact, but it increases the area affected. Because wildlife- and water-related impacts can spread far beyond the places where disturbance originates, management of these impacts provides challenges that vegetation and soil impacts do not.

TEMPORAL PATTERNS OF IMPACT

The rate at which impact occurs varies with type of impact. As mentioned before, herbaceous vegetation loss generally occurs more rapidly than loss of soil organic horizons. Rates are also dependent on use levels. Impact occurs most rapidly where use levels are heavy. Generally, however, impacts on vegetation and soil occur rapidly wherever use levels are even moderate (Fig. 2). A number of studies also show that the relationship between site impacts and the age of a site is asymptotic rather than linear (Fig. 3). That is, impacts increase rapidly during the first few years after a site is used



Total Change represents the difference between indicator measures taken on undisturbed control plots and on campsites with 60 or more nights of visitation annually. Thus, approximately 70% of the vegetation loss that occurs on campsites receiving 60+ nights/year has already occurred after only 10 nights/year.

FIGURE 2. Change in campsite impact parameters under low to moderate levels of annual visitation, Boundary Waters Canoe Area Wilderness. (*Source:* Leung and Marion 1995.)

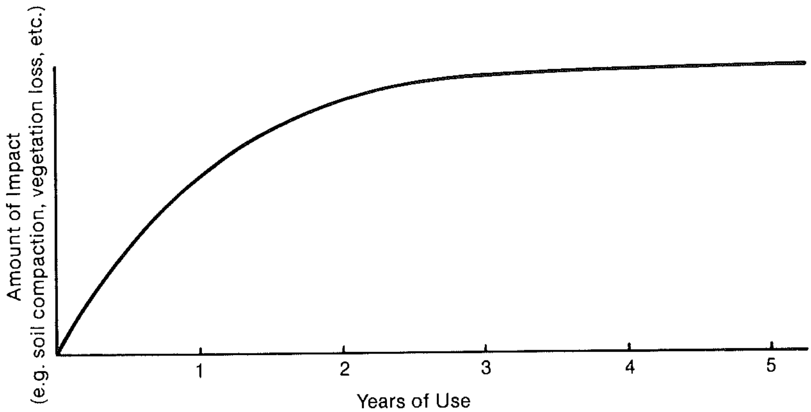


FIGURE 3. Most impact on recreation sites occurs within the first few years after the site is opened. (*Source:* D. N. Cole.)

and then increase more slowly, if at all, thereafter (Cole and Marion 1986). In describing developed campsites, Hart (1982) distinguishes between a short break-in period, when the campsite is developed and initially used by campers—the period when most of the impact occurs—and a dynamic equilibrium period when changes are minimal. During the equilibrium period additional impacts caused by use tend to be offset by maintenance activities and natural rejuvenation processes. On forested campsites the final change is death of the overstory. This death may or may not be hastened by recreational use. When it occurs, the forested site will usually be replaced by an open campsite because there is usually no tree regeneration to replace the overstory.

The impacts resulting from development and initial use of campsites have been studied in wilderness by Merriam, Smith, Miller, Huang, Tappeiner, Goeckermann, Bloemendal, and Costello (1973) and in a developed campground by LaPage (1967). After two years of use, soil penetration resistance (compaction) on campsites in the Boundary Waters Canoe Area Wilderness reached near-maximum levels that were not substantially surpassed in the following years. Follow-up studies by Merriam and students at 7 and 14 years after original site development showed that bare soil area and site expansion were the major impacts to increase over time (Marion 1984; Merriam and Peterson 1983). On car campgrounds in Pennsylvania, vegetation loss was most severe after the first year of use; vegetation cover actually increased in the following years, as trampling-tolerant non-native species replaced the original native occupants of the site.

Other impacts on campsites do not occur so rapidly with initial use and may continue to deteriorate with time. The most important of these types of impact are site expansion, damage to trees, and loss of organic matter (Cole and Marion 1986; Cole and Hall 1992). Site expansion occurs whenever a party either needs more space or prefers to use an unused portion of the site. Thus it is most likely to occur where sites are used by large parties or where impact zones are unattractive or undesirable (e.g., muddy or not flat). Over 5 years, 10 newly developed campsites in the Boundary Waters Canoe Area increased more than 50 percent in size, and the size of another 4 more than doubled. Figure 4 shows an example of how one of these Boundary Waters campsites doubled in size in just two years. Note the expansion to contiguous areas the first year, followed by development of a satellite site the second year. Some of the most serious problems with site expansion occur on campsites used by outfitters. Outfitted parties often consist of numerous unaffiliated groups of people, each seeking some privacy from the other groups. In their seeking out private places to set up tents, a large area is affected.

Satellite campsites often develop into new campsites, or they may expand and become incorporated into the original campsite, increasing the total disturbed area. Studies of longer-term changes in campsite impacts also indicate that a major increase occurs in the number of newly created campsites. Cole (1993) examined proliferation and campsite conditions in three wilderness areas over 12- to 16-year periods. A dramatic increase in the number of campsites in all three areas was the primary impact occurring during the trend study. This is not to imply that some campsites do not improve, as newly created sites may defer use pressures on original campsites (Fig. 5). However, the "site-pioneering" behavior of campers over longer periods of time and the proliferation of campsites are of major concern to wildland recreation managers. In fact, the systemwide or ecological unit proliferation of campsites and

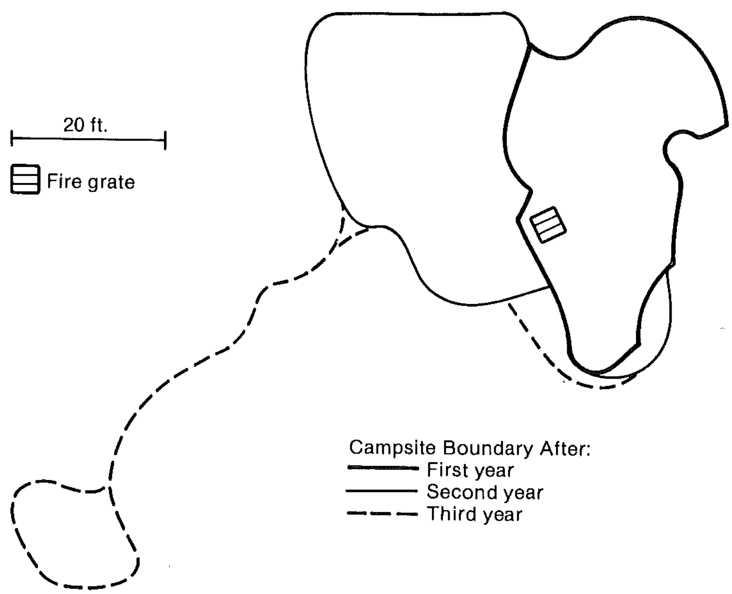


FIGURE 4. Campsites tend to expand in size over time. Development of satellite sites is a common pattern of site expansion. (*Source:* Adapted from Merriam, Smith, Miller, Huang, Tappeiner, Goeckermann, Bloemendal, and Costello. "Newly Developed Campsites in the BWCA: Study of Five Years Use," in University of Minnesota Agricultural Experimental Station Bulletin, 1973. Used with permission of the publisher.)

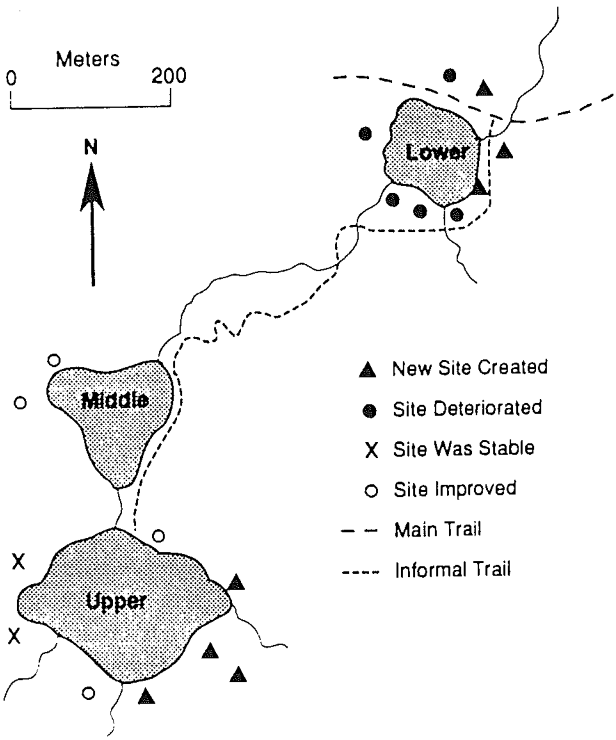


FIGURE 5. Proliferation and change in campsite condition over a 16-year period (1972–1988), Jerome Rock Lakes, Lee Metcalf Wilderness, MT. (*Source:* Cole 1993.)

their associated impacts appear more important than individual site deterioration over time. More will be said about this topic in Chapter 7, in which longer-term trends are the focus.

Damage to trees is cumulative and, therefore, increases over time. Exposure of tree roots, physical damage to tree trunks, and sapling removal are long-term processes that may affect the vigor and growth rate of trees. Once a tree is felled or severely scarred, it will remain that way until it rots. Because old damage is slow to disappear, any new damage represents an increase in impact over time. Even though tree damage is one of those impacts that does increase over time, most tree damage occurs in the impact zone shortly after a site is opened.

Loss of organic matter over time is somewhat different. Loss of organic matter caused by scuffing and erosion of litter can be offset by the yearly leaf fall of hardwoods or the more continuous needle fall of conifers. However, loss of litter exceeds yearly litter fall on all but the most lightly used campsites. Consequently, a net loss occurs, and litter depth and cover decline over time (Cole and Marion 1986). On forested sites, the decline is not as rapid as vegetation loss, so near-maximum levels of litter loss occur at a more advanced age than vegetation loss. On Boundary Waters Canoe Area campsites mineral

FIGURE 6. Trail widening in the form of multiple braided trails is a common impact pattern. (*Photo:* R. C. Lucas.)

soil was not exposed until sometime between the second and fifth years of use, and it was still increasing 14 years after the campsites were first developed.

On trails the rate at which impact occurs may be even more rapid. Initial impacts associated with trail development include intentional felling of trees, removal of brush and ground vegetation, surface flattening, soil compaction, and drainage alteration. Once these changes have been initiated, those associated with trail use are usually of less importance. Two impacts that can become more pronounced with time are trail widening and erosion (Cole 1991; Marion 1984). Trail widening is analogous to campsite expansion. It occurs where the trail tread is difficult to walk on, particularly where it is muddy or rocky. Widening can be continuous, or it can occur as a series of braided trails (Fig. 6).

Although trampling can cause erosion of some trails, its principal effect is to make the trail surface more susceptible to erosion, by churning up the soil, reducing infiltration rates, removing vegetation, and channeling water. The primary agent of erosion is running water from intercepted streams, snowmelt, springs, and even intense precipitation. Once water is channeled down a trail, erosion will occur and will probably increase in severity over time. Such erosion is likely to continue, with or without use, until water bars or some other drainage control device is installed to divert water off the trail.

Temporal patterns of impact on wildlife and water are less well understood. For wildlife they vary greatly between species and even within species. Some animals such as white-tailed deer can become habituated to disturbance. This creates a pattern of change over time that is analogous to vegetation loss on campsites. Initial impact is serious, but disturbance decreases over time as the animal develops a tolerance for disturbance. Many animals can develop a tolerance for predictable disturbances, but are adversely affected by unpredictable types of disturbance.

Other animals can tolerate infrequent disturbance but become bothered by frequent disturbance. This pattern is the opposite of changes in vegetation and soil. In this case there is an initial resistance to impact, but once disturbance becomes frequent, a severe reaction takes place. Disturbance of certain types of nesting birds provides a good example. Parents may put up with the first few groups of visitors that come close to their nests. At some point, however, their tolerance of these intrusions will be exceeded, and they will abandon their nest.

Impacts on water also vary between the two extremes of rapid response to initial disturbance and initial resistance followed by a severe response. Fecal contamination at any place or time may be serious one day and gone the next, provided the input is not continuous. On the other hand, some pollutants accumulate over time. Initially, they may not present problems because they are diluted by water, but over time they may reach levels that present problems. For example, recreational use around alpine lakes in Kings Canyon National Park caused trace elements to accumulate to levels that eventually led to changes in biota. These changes have not been reversed by more than a decade of reduced use levels (Taylor and Erman 1979).

RECOVERY RATES OF IMPACTS

Recovery rates are more variable than deterioration rates because they are more dependent on environmental factors. For example, 1000 people walking single file across wildflower fields on a mountain top and in a valley bottom would, in both cases, kill all plants in their path in one day; however, recovery of the mountain top vegetation might take many times longer than recovery of the valley bottom vegetation because the growing season on the mountaintop is much shorter and soils are poorer.

Recovery rates for soils may be less variable than rates for vegetation. Although compaction levels are not consistent between studies, several studies report that compaction levels can return to normal after 6 to 18 years (Cole and Hall 1992; Hatchell and Ralston 1971; Parsons and DeBenedetti 1979; Stohlgren and Parsons 1986). Recovery of organic matter levels may take longer. In Kings Canyon National Park, Parsons and DeBenedetti (1979) found that the depth of organic horizons and accumulation of woody fuels on campsites closed for 15 years had not returned to normal. Recovery from erosion will take even longer. Once it occurs, recovery will require centuries.

Recovery of vegetation on trails subjected to experimental trampling illustrates the variability of recovery rates. Some trails in the southern Appalachians were almost completely revegetated just one year after trampling (Studlar 1983). In contrast, the vegetation cover of dry alpine meadows in Glacier National Park had recovered only 24 percent after six years (Hartley 1976). Rates can even be highly variable in different environments within the same general area. For example, five years after being experimentally trampled by horses, vegetation cover of a grassland was 100 percent of normal; cover in a nearby forest was only 26 percent of normal (Weaver, Dale, and Hartley 1979).

More recent trampling experiments have concentrated on spatial and temporal recovery rates among species within zones of campsites, and in tropical environments. Sun (1992) and Sun and Liddle (1991) found that the trampling resistance and recovery rates among eight species varied greatly. Plant resistance was not significantly correlated with recovery or growth rate, whereas recovery rate was positively correlated with growth rate. High resistance and high recovery appear to be two exclusive characteristics of plant species. Plants that are resistant to trampling tend to have low growth rates; plants with fast growth rates appear to use a recovery strategy (Sun 1992). In addition to species differences in recovery, research has shown that the spatial zones within a campsite or trail recover at different rates (Stohlgren and Parsons 1986; Taylor, Reader, and Larson 1993). The stratification of use zones in campsite impacts can be an important step in assessing recovery. For example, closure of campsites for three years resulted in bulk density of soils in the core (impact) zone of campsites to recover more slowly each year than the intermediate (intersite) and periphery (buffer) zones. Mean foliar cover also recovered much more slowly in the core areas than in intermediate areas. Taylor, Reader, and Larson (1993) looked at zones of trail impacts while examining the question, "To what degree is vegetation response to trampling consistent among different temporal (short- vs. long-term) and spatial (path vs. wider corridors) scales of trampling?" They found that as trampling frequently increased, community composition changed progressively at both 4 m and 1 m distances from the trail centerline. Species richness was less affected by trampling and decreased only within 1 m of the trail centerline at the highest level of trampling (25,000 passes per season for 18 years).

Trampling, and even nontrampling, studies indicate that recovery rates of impact always require more time than resistance rates, and that plentiful rainfall and longer growth seasons increase the rate of recovery (Marion and Cole 1996). For example, recovery rates tend to be faster in the southern Appalachians than in the drier mountains of the western United States. Studies in tropical rain forests also indicate a more rapid recovery rate than reported for temperate forest. Study of a trail in Costa Rica, abandoned for 32 months, showed that recovery was significant and that herbs and seedlings were more abundant along the recovering trail than in undisturbed forest (Boucher, Aviles, Chepote, Dominquez Gil, and Vilchez 1991). These authors conclude that the rapid rate of recovery suggests that trail closure for a few years may be sufficient to allow vegetation recovery in tropical rain forests. The speed of recovery also lends support to the hypothesis that highly productive forests, although sensitive to trampling impact, will also have high levels of resilience (Kuss 1986; Cole and Marion 1988).

Management practices, of course, can have a significant influence on the rate at which impacts recover. The elimination of some closely spaced designated campsites and the installation of anchored fire grates reduced the total area of campsite disturbances by 50 percent over a five-year period (Marion 1995; Marion and Cole 1996). Fire grate installation provided a focal point within campsites that increased the concentration of activities, allowing peripheral areas to recover. Campsite impacts not only recovered; they decreased rapidly once disturbance was terminated. The fertile environment of the Delaware Water Gap National Recreation Area was a factor in rapid recovery (Marion and Cole 1996). This study also indicated that although the management actions increased the intensity of use on and within individual campsites, there was no resultant increase in the intensity of impact on individual campsites. This is probably due to the fact that the established sites were already stabilized in terms of use-intensity-related impacts, and that the fire grates focused use patterns. Over the five-year period, campsites, in general, decreased in areal extent (Fig. 7).

SUMMARY

1. Recreational resource impacts do not occur randomly in space, but exhibit concentrated and predictable spatial patterns. Most impacts, like use patterns, are restricted to a small number of travel routes and destination areas.

2. In campsites, three distinct areas or zones of impact occur: (1) the impact, (2) intersite, and (3) buffer zones. Each zone of impact has distinct types and levels of impact and management implications.

3. Most impacts on vegetation and soil show an asymptotic rather than linear relationship over time. Vegetation disturbance and soil compaction increase rapidly

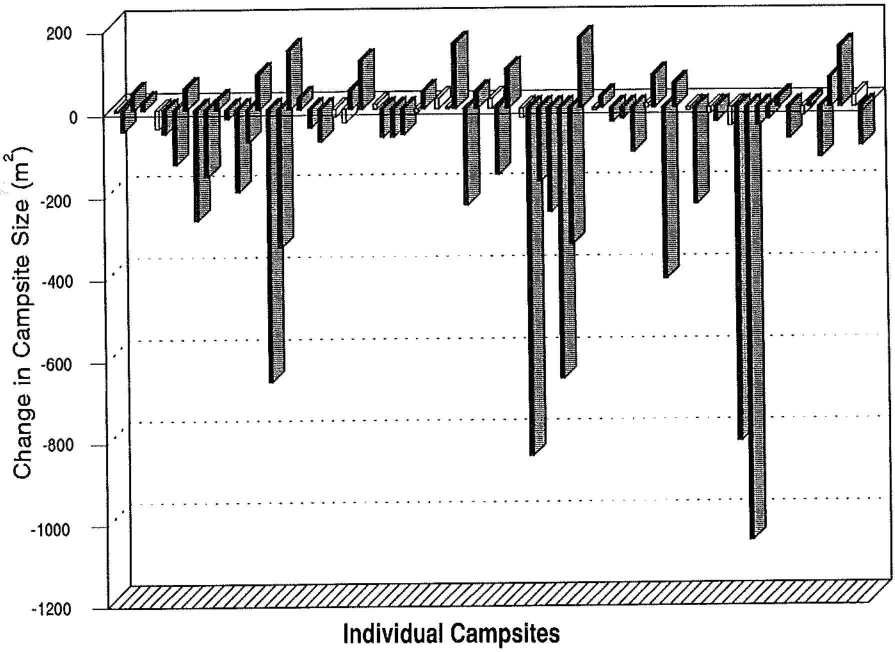


FIGURE 7. Change in campsite size from 1986 to 1991 after initiation of management actions, Delaware Water Gap Recreation Area, PA. Campsites with positive bar values increased in size, negative values decreased in size, and those bars not shaded did not change enough to meet the 20 percent estimated measurement error. (*Source:* Marion 1995.)

during the first couple of years after a site is used, but increase more slowly thereafter. However, some impacts, such as site expansion, continue to increase over time.

4. The rate at which impacts occur (resistance) and recover (resilience) vary over space and time and are influenced by many use, environmental, and management conditions. However, recovery rates are almost always slower than impact rates. Rates of recovery are quite slow on heavily used, established sites. Longer-term trend studies indicate that proliferation of new campsites is more important than increases in impacts of established sites. Thus, changes in areawide or systemwide impacts over time may be a greater management concern than established site impacts.

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