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Spatial Strategies For Managing Visitor Impacts In National Parks

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ABSTRACT: Resource and social impacts caused by recreationists and tourists have become a management concern in national parks and equivalent protected areas. The need to contain visitor impacts within acceptable limits has prompted park and protected area managers to implement a wide variety of strategies and actions, many of which are spatial in nature. This paper classifies and illustrates the basic spatial strategies for managing visitor impacts in parks and protected areas.

A typology of four spatial strategies was proposed based on the recreation and park management literature. *Spatial segregation* is a common strategy for shielding sensitive resources from visitor impacts or for separating potentially conflicting types of use. Two forms of spatial segregation are zoning and closure. *A spatial containment strategy* is intended to minimize the aggregate extent of visitor impacts by confining use to limited designated or established locations. In contrast, *a spatial dispersal strategy* seeks to spread visitor use, reducing the frequency of use to levels that avoid or minimize permanent resource impacts or visitor crowding and conflict. Finally, *a spatial configuration strategy* minimizes impacting visitor behavior through the judicious spatial arrangement of facilities. These four spatial strategies can be implemented separately or in combination at varying spatial scales within a single park.

A survey of national park managers provides an empirical example of the diversity of implemented spatial strategies in managing visitor impacts. Spatial segregation is frequently applied in the form of camping restrictions or closures to protect sensitive natural or cultural resources and to separate incompatible visitor activities. Spatial containment is the most widely applied strategy for minimizing the areal extent of resource impacts. Spatial dispersal is commonly applied to reduce visitor crowding or conflicts in popular destination areas but is less frequently applied or effective in minimizing resource impacts. Spatial configuration was only minimally evaluated, as it was not included in the survey.

The proposed typology of spatial strategies offers a useful means of organizing and understanding the wide variety of management strategies and actions applied to managing visitor impacts in parks and protected areas. Examples from U.S. national parks demonstrate the diversity of these basic strategies and their flexibility in implementation at various spatial scales. Documentation of these examples helps illustrate their application and inform managers of the multitude of options. Further analysis from the spatial perspective is needed to extend the applicability of this typology to other recreational activities and management issues.

KEYWORDS: Visitor impacts, management strategies, spatial concepts, backcountry use, national parks

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Introduction

Resource and social impacts caused by recreationists and tourists are a growing management issue in national parks, wildernesses, and other protected areas (referred to as parks hereafter), many of which must accommodate the dual functions of resource protection and recreation provision (Manning, 1998). It is generally agreed that visitor-related resource impacts, such as ground vegetation and soil loss on recreation sites, soil erosion along trails, wildlife harassment, and tree damage often affect only a small portion of land area (Hammitt & Cole, 1998). Yet their intensification and proliferation can pose a significant threat to landscapes and ecosystems (Cole & Landres, 1996). Park managers are concerned about the ecological significance of resource impacts and how these impacts affect the quality of recreation experiences (Conrad, 1997; Marion, Roggenbuck, & Manning, 1993). Social impacts, such as perceived crowding or conflict, are also management issues that can lead to diminished recreational opportunities and quality.

In order to contain visitor impacts within acceptable limits or carrying capacities, park managers have implemented a wide variety of impact management strategies and actions, including visitor use planning and zoning, facility layout and design, site hardening and maintenance, use restrictions and regulations, and visitor communication and education (Hammitt & Cole, 1998; Manning, 1979). Although most of these strategies and actions have salient spatial elements, limited discussion exists in the recreation and park literature to organize and classify the spatial concepts and their application to visitor impact management, with a notable exception of McEwen and Tocher (1976).

The primary purpose of this paper is to identify and classify underlying spatial concepts involved in managing visitor-related resource and social impacts in parks. We have two specific objectives: (a) to propose a typology of basic spatial strategies, and (b) to provide an empirical example of backcountry management in U.S. national parks to illustrate how different spatial strategies have been implemented in managing camping impacts. An understanding of the proposed typology can help park managers and researchers understand the diversity and flexibility of strategies and actions to manage visitor impacts.

Related Literature

Managing visitor impacts is a challenge for park managers. Scientists and managers have responded to this challenge through the development and application of myriad strategies and actions. Strategies may be defined as broad, conceptual approaches to management for achieving a desirable objective (Manning, 1979), while actions or tactics are specific management and administrative tools to implement various management strategies. This paper focuses on the spatial ramifications of management strategies, although specific management actions are discussed as examples for each strategy.

Classifications of visitor impact management strategies and actions have been compiled as handbooks to guide managers in the selection of preferred management options. Developed primarily for wilderness managers, Cole, Lucas and Peterson (1987) described 8 basic management strategies and 37 management actions that address recreational use problems: (a) reduce use of the entire wilderness, (b) reduce use of problem areas, (c) modify the location of use within problem areas, (d) modify the timing of use, (e) modify type of use and visitor behavior, (f) modify visitor expectations, (g) increase the resistance of the resource, and (h) maintain or rehabilitate the resource. More recently, Anderson, Lime, and Wang (1998) developed a handbook for U.S. National Park Service managers. This handbook organizes 26 management actions into five major groups: site management, rationing and allocation, regulations, deterrence and enforcement, and visitor education.

Classification systems have also been advanced to assist managers in understanding relationships among strategies and actions. One of the simplest classifications is the dichotomy of direct versus indirect management (Gilbert, Peterson, & Lime, 1972; McAvoy & Dustin, 1982). Direct management refers to approaches that regulate or restrict visitor behavior and result in a real or perceived reduction in visitor freedom. In contrast, indirect management approaches influence visitor choice or behavior through unobtrusive measures. For example, damage to trees might be addressed by prohibiting fires or axes (direct actions) or by educational efforts that encourage the substitution of stoves or teach *Leave No Trace* firewood gathering practices (indirect actions).

Another simple classification system is the containment-dispersal dichotomy (Cole, 1981; Mieczkowski, 1995). The containment strategy seeks to limit the spatial extent of visitor impacts through actions that contain or limit where visitor activities occur. The dispersal strategy seeks to reduce the frequency of use at each recreation site so that permanent resource impacts are avoided. For example, the area of disturbance associated with camping may be minimized by requiring visitors to use only designated campsites (containment) or by instructing them to find sites that show no indication of prior use (dispersal).

Manning (1979) developed a classification of management strategies based on the supply and durability of recreation resources. The four-tier

system includes increasing supply, reducing impact of use, increasing resource durability, and limiting use. This classification was presented as a hierarchy of strategies, sub-strategies, and actions to illustrate the relationships among the elements included (Manning, 1979).

Many of the strategies and actions and the classification systems possess a spatial dimension, which has seldom been examined. Nevertheless, understanding the spatial dimension of visitor impact management is helpful in at least two ways. First, many management decisions are spatial in nature, involving permitting, restricting, or modifying visitor activities in space. An appreciation of spatial concepts may help managers organize options and understand the relationships among them. Second, managers must often make decisions at multiple spatial scales simultaneously. For example, managers may need to implement different policies in different zones or sites. Improved insights regarding alternative spatial scales of implementation would inform managers of the flexibility of implementing different strategies for different places.

Geographers have previously investigated some of the spatial patterns and processes associated with recreation and tourism (Cole, 1989; Leung, 1998; Smith, 1983). At least four themes have been described in the geography literature: (1) the spatial variabilities of recreation and tourism demand; (2) spatial patterns and processes of recreational or tourism travel and activities; (3) spatial consequences of proposed land use decisions (e.g., construction of a new reservoir); and (4) the spatial planning and management solutions to resource and social problems resulting from recreational use (Meighen & Vogler, 1997). However, there has been limited discussion and application of spatial concepts in recreation resource and visitor management.

In the recreation and park literature, spatial elements are integral to several planning and management frameworks, such as the U.S. Forest Service's Recreation Opportunity Spectrum (ROS) (Clark & Stankey, 1979) and Limits of Acceptable Change (LAC) (Stankey, Cole, Lucas, Petersen, and Frissell 1985), and the U.S. National Park Service's Visitor Experience and Resource Protection (VERP) system (USDI, 1997). The ROS planning system, for example, seeks to provide a range of recreation opportunities by means of zoning. Visitor use zones are defined as a spectrum of six opportunity setting classes. In the LAC management framework, opportunity zones are often established first, and provide a foundation for the selection of indicators and standards. The VERP management framework adapts the LAC to national park settings and ties management decision making to management zones.

A Proposed Typology of Spatial Strategies

Based on the above literature, a typology of spatial strategies for managing visitor-related resource and social impacts is proposed (see Table 1).

TABLE 1
A Typology of Spatial Strategies for Managing Visitor Impacts in National Parks and Other Protected Areas

	Management Strategy			
	Spatial Segregation	Spatial Containment	Spatial Dispersal	Spatial Configuration
Primary Goal(s)	• Match types and levels of visitation with resource capabilities	• Concentrate visitation pressure on a limited number of established or resistant locations	• Spread visitation pressure across a large area to maintain low frequency of use per unit area	• Reduce unnecessary visitor impacts through spatial arrangement of recreation facilities and resources
	• Shield sensitive areas and resources from visitation pressure		• Increase distance between parties with same number of sites	
Common Forms of Implementation	• Use zoning	• Designated areas	• Linear dispersal	• Campground layout
	• Exclude by buffer area requirements or closures	• Designated sites	• Total dispersal	• Trail networks
Common Spatial Scales of Implementation	• Site, regional, park-wide	• Site, regional	• Site, regional, park-wide	• Site
Common Tools of Implementation	• Park planning and management frameworks	• Regulations	• Regulations	• Site planning and design
	• Regulations	• Provisions of facilities	• Leave No Trace (LNT) education	• Provision of facilities
	• Physical barriers	• Site maintenance		

We describe four basic strategies: (1) spatial segregation, (2) spatial containment, (3) spatial dispersal, and (4) spatial configuration.

These basic strategies can be implemented separately or in combination at different spatial and temporal scales, and can be achieved through the use of different management actions and tools (Hammitt & Cole, 1998; Mieczkowski, 1995). However, it should be noted that the typology is not inclusive of all possible strategies available to managers, since not all strategies have a spatial dimension. The following are descriptions and illustrations of these four spatial strategies.

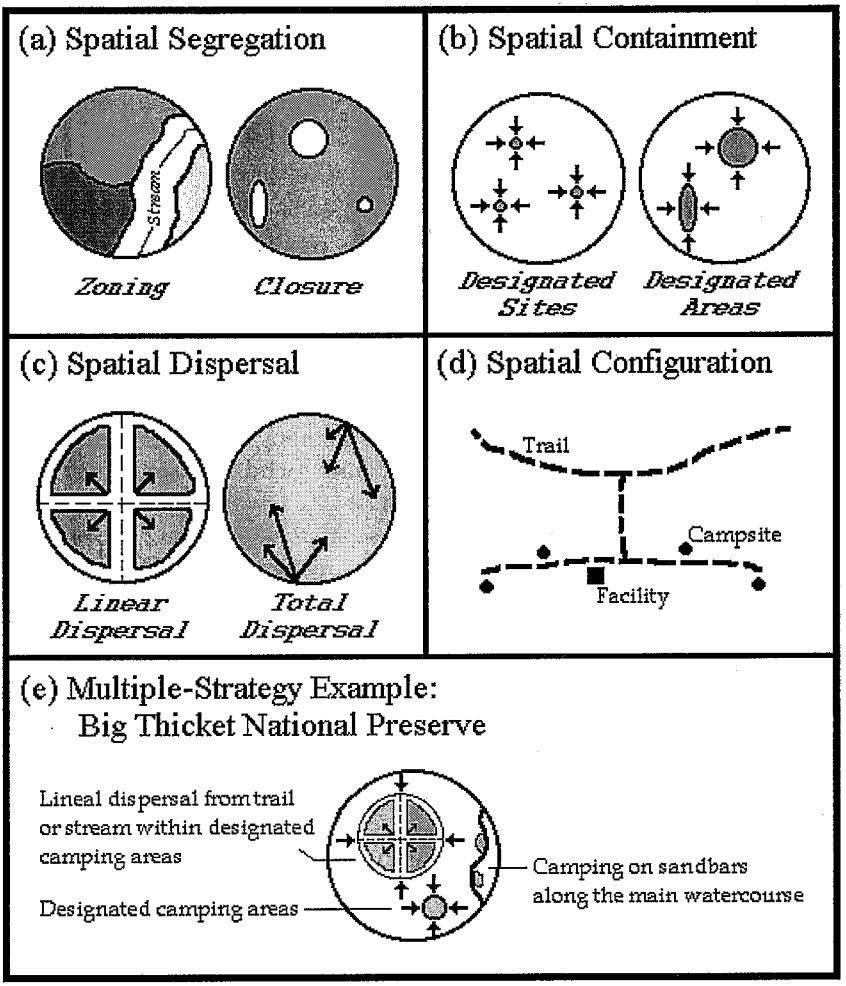
Spatial Segregation

The primary goal of spatial segregation is to separate potentially conflicting types or levels of visitation, or to match types or levels of visitation with resource capabilities (see Table 1). For example, motorized activities are often separated spatially from human-powered activities. Spatial segregation can be achieved using nonregulatory means by simply identifying and communicating the areas or trails where potentially conflicting uses occur.

A common form of spatial segregation is zoning, which, as mentioned, is an underlying concept in such park planning and management frameworks as ROS, LAC, and VERP. These frameworks employ zoning implemented at various spatial scales to separate and manage desired use types and intensities. Spatial zoning permits managers to direct visitors to areas where physical and social conditions can be managed to sustain different types of high-quality visitor experiences. For example, motorized and mechanical activities (e.g., mountain biking) may be permitted in a frontcountry zone but prohibited from a primitive or wilderness zone. Alternately, entry point quotas can be established and manipulated to control visitation levels within travel zones so that a range of social settings is maintained (e.g., high density use areas for social experiences versus low density use areas for solitude oriented experiences).

A second form of spatial segregation seeks to match desired use types and intensities with commensurate environmental capabilities, e.g., using spatial exclusion actions such as *buffer area regulations or closures* (see Table 1). Buffer area regulations are commonly used to discourage or prohibit visitors from engaging in specific activities within specified buffer strips. For example, visitors may be asked or required to camp a minimum distance away from water resources to protect sensitive riparian ecosystems. Closures are conceptually similar to buffer areas, by which visitation is prohibited from well-defined environmentally or culturally sensitive sites or zones. Closures may be site- and time-specific, such as when park managers prohibit camping or visitation in areas proximate to a bald eagle's nest or a grizzly bear's recent kill. The effectiveness of closure is variable, and may be enhanced by the use of signs or physical barriers such as fencing. Graphic illustrations of the spatial segregation concept are provided in Figure 1(a).

Figure 1
Graphic Illustration of Spatial Strategies for Managing Visitor Impacts in National Parks



Spatial Containment

The goal of spatial containment is to limit aggregate extent of resource impact by concentrating visitor use within a limited number of areas or sites or within a single site. The areas are typically chosen on the basis of their inherent resistance to visitor impacts, or they are hardened and/or maintained to support high use intensities. The rationale for spatial containment is built on recreation ecology (visitor impact) research, in which a consistent curvilinear relationship has been identified between the amount of use and impact intensity for most common forms of trampling-related resource

impact (Cole, 1981, 1992). The majority of resource impact is created by low to moderate levels of recreational trampling while further increases in recreational traffic results in limited additional impact intensity. An important implication of this relationship is that concentrating heavy use on a limited number of impacted sites or trails will result in less aggregate impact than spreading use among a larger number of low to moderate use locations.

Containment can be a consequence of implementing spatial segregation, which uses regulatory means to coerce visitors to desired zones or locations. More often, spatial containment is implemented by *designating areas or sites* (see Figure 1(b)). For example, problems with the proliferation of trails or campsites may be avoided by clearly designating specific trails for use. Spatial containment may also be achieved by nonregulatory means, such as information and education, site selection and design, and provision of facilities that encourage concentration of use (Farrell & Marion, 1998). *Leave No Trace* visitor education practices emphasize a containment strategy by directing visitors to use only pre-existing sites when camping in moderate to high use areas.

Spatial containment actions applied to a single site can also limit problems with site expansion. Careful site selection can identify sites with topography or natural features that restrict traffic to a limited area. Site design and construction work can incorporate natural or artificial barriers that restrict traffic patterns and limit use areas.

Spatial Dispersal

The goal of spatial dispersal is to spread visitor use over a large number of areas or sites to minimize resource or social impacts (see Table 1). Resource impacts are minimized by reducing the frequency of use on any single site to levels that preclude the development of lasting changes. Social impacts are minimized by increasing the distance between visitor groups or sites to reduce perceived conflict or crowding (Dailey & Redman, 1975).

A spatial dispersal strategy may be implemented by setting travel zone quotas, but in practice this strategy has often been implemented through education and information in which the rationale for dispersal is conveyed (Krumpe & Brown, 1982). Certain spatial exclusion actions, such as buffer area regulations described in the segregation strategy, may also be applied to this strategy. A common form of spatial dispersal may be called *linear dispersal*, in which visitors are asked to camp out-of-sight or some minimum distance from trail or river corridors (see Figure 1(c). Alternately, visitors may be instructed to camp only on pristine sites that are out-of-sight of any other camped group, an example of *total dispersal.* The goal of spatial dispersal is, however, difficult to achieve, as visitors tend to congregate along travel corridors (Echelberger, Leonard, & Adler, 1983), even though the minimum distance requirements are met. Some barriers to the success of this strategy include landform complexity, low ecosystem resistance and resilience, and low compliance rates of visitors to dispersal regulations (Canon, Adler, & Leonard, 1979).

Spatial Configuration

The goal of a spatial configuration strategy is to minimize visitor resource or social impacts through the judicious spatial arrangement of recreation facilities and resources such that impacting behavior is discouraged (see Table 1). This strategy is often the least obtrusive strategy among the four, since it is aimed at influencing instead of regulating or restricting visitor behavior. For example, trail manuals commonly recommend against trail alignments that are perpendicular to the contour to minimize trail slopes and tread erosion (Demrow & Salibury, 1998). Careful trail designs can also limit the number of stream crossings or design them so that sediment input is minimized.

Spatial configuration is most commonly applied in the layout of recreational facilities (see Table 1). As illustrated in Figure 1(d), a linear arrangement of tent sites and sanitary facilities at a campground discourages the creation of social trails. Placing campsites away from each other and the main trail also separates visitor groups to enhance perceived solitude and reduce use conflicts.

Spatial Strategies in U.S. National Parks: An Empirical Example

The diversity of applications of these basic spatial strategies is illustrated by results from a survey of U.S. national park managers (Marion et al., 1993). These results provide support for the conceptualization of the spatial strategies typology.

Methods

A nationwide survey of managers at national park units in the U.S. with substantial backcountry resources and visitation was conducted in 1991–92. All parks listed as having backcountry camping opportunities available (USDI, 1988) and/or reporting backcountry visitation (USDI, 1990) were sent a mail-back questionnaire ($N = 106$). A cover letter asked park superintendents to direct the survey to park staff responsible for backcountry recreation management. One follow-up letter and phone calls led to the return of 93 completed surveys for a 92% response rate (five park managers excluded their parks from the survey due to their lack of perceived backcountry).

The questionnaire was composed of six sections: (a) description of backcountry areas and use, (b) recreation management problem identification, (c) recreation management actions, (d) effectiveness of recreation management actions, (e) recreation carrying capacity, and (f) resource and visitor experience monitoring. A listing of over 100 specific management actions, organized into 10 topical categories, were included in section (c). Respondents were asked to review the list and check all actions currently in effect for all or some portion of their park's backcountry (with an option to list additional actions absent from the list).

Survey responses in section (c) were examined to illustrate and document the extent of application of the four spatial strategies. However, the

spatial configuration strategy was conceived after the survey had been conducted. Few survey items pertained to this strategy so it could only be minimally evaluated.

Results

Spatial Segregation

A common application of the segregation strategy is to separate potentially conflicting types of visitor use. Managers at 11 parks segregate different types of visitor use by geographic area, and trails are designated for different types of visitor use at 25 parks (see Table 2). At Yellowstone National Park (Wyoming), snowmobilers are restricted to roadways, but cross-country skiers may go off-road. At numerous parks, including Rocky Mountain National Park, horse riders are restricted to a subset of trails and campsites designated for equestrian use. Managers have further segregated designated campsites by type of use, with separate sites for general visitors, groups, stock users, commercial outfitters, and even llama users. Similarly, managers can segregate different densities of visitor use through zoning to maintain a range of opportunities for visitor experiences ranging from social to solitude. For example, managers at 6 parks ration permits by travel or management zones.

Segregation is also a commonly applied resource protection strategy that seeks to match visitation characteristics with resource capabilities. Areas containing sensitive natural or cultural resources may be closed to use. For example, managers at 43 parks reported that they prohibit use of environmentally or archeologically sensitive areas (see Table 2). A few parks, such as Mesa Verde National Park (Colorado), prohibit camping park-wide to protect sensitive archaeological resources. More frequently, closures apply only to specific areas and activities, primarily camping. Managers at 50 parks discourage or prohibit camping in fragile ecosystems or vegetation types. For example, camping is prohibited within the sand dunes at Padre Island National Seashore (Texas). Sometimes these actions are applied to protect human safety or resources that are sensitive to use only during specific times. For example, camping is suspended in several areas during the winter season at Isle Royale National Park (Michigan), in part to protect sensitive wildlife.

Closures may also be implemented to define protective buffer zones, such as when managers discourage or prohibit camping within a certain distance of water to protect sensitive riparian vegetation (45 parks; see Table 2). Alternately, managers at 37 parks reported that they purposefully locate campsites and facilities on durable sites, and managers at 38 parks relocate trails from fragile to durable soils or vegetation types.

Spatial Containment

Spatial containment seeks to concentrate visitor use and impact, minimizing the number of locations and the aggregate areal extent of impact. The development of formal trail systems within parks represents the

most common form of spatial containment. Trails can be carefully sited, constructed, and maintained to sustain substantial visitor traffic, thereby protecting off-trail areas. For example, managers commonly discourage off-trail travel (44 parks) and use of unofficial (visitor-created) trails (42 parks; see Table 3). Similarly, managers may encourage or require camping within designated zones (34 parks) or on designated campsites (30 parks). At a finer scale, managers can concentrate visitor activities within site boundaries through the provision of facilities that attract and contain use. Survey results indicate that fire grates are the most common facility (28 parks), followed by tables (19 parks), and tent platforms (12 parks).

TABLE 2
Spatial Segregation Strategies and Management Actions Implemented by U.S. National Park Managers for Controlling Camping-Related Visitor Impacts

Management Action	Number (Percentage) of National Parks Taking the Action
Discourage or prohibit camping in fragile ecosystems or vegetation types	50 (54%)
Discourage or prohibit camping within a certain distance of water	45 (48%)
Close environmentally sensitive areas to all use	43 (46%)
Discourage or prohibit camping within certain designated geographic areas	39 (42%)
Relocate trails from fragile to durable soils or vegetation types	38 (41%)
Locate campsites and facilities on durable sites	37 (40%)
Prohibit camping in areas critical to wildlife	36 (39%)
Relocate campsites from fragile areas	32 (34%)
Designate trails for different types of visitor use	25 (27%)
Discourage or prohibit horse use in certain ecosystem/vegetation types	17 (18%)
Discourage or prohibit camping in areas where waste disposal is a problem	11 (12%)
Segregate different types of visitor use by geographical area	11 (12%)
Prohibit use in areas critical to wildlife	10 (11%)
Restrict or ration permits by travel or management zones	6 (7%)

TABLE 3
Spatial Containment Strategies and Management Actions Implemented by U.S. National Park Managers for Controlling Camping-Related Visitor Impacts

Management Action	Number (Percentage) of National Parks Taking the Action
Discourage or prohibit off-trail horse use	45 (48%)
Discourage off-trail travel	44 (47%)
Discourage use of unofficial trails	42 (45%)
Encourage or require camping on designated campsites	40 (43%)
Encourage or require camping in designated zones	34 (37%)
Provide fire grates	28 (30%)
Delineate trail edges to keep visitors on a defined tread	23 (25%)
Provide tables	19 (20%)
Provide tent platforms	12 (13%)

Spatial Dispersal

Spatial dispersal seeks to spread visitor use sufficiently to avoid development of highly impacted sites or social problems such as visitor crowding and conflicts. A light-handed approach to dispersing visitors is to encourage the use of less popular access points and backcountry areas (35 parks, see Table 4). Alternately, managers may inform visitors about crowded conditions (52 parks) or conflicting uses (37 parks) they may encounter in certain areas. The intent of such actions is to disperse visitors away from popular high-density use areas to reduce social and resource impact problems.

Managers have experimented with a number of different actions aimed at dispersing camping activities. Examples include discouraging or prohibiting camping within a certain distance or sight of trails (39 parks), other campsites (35 parks), and popular features (24 parks, see Table 4). Geared toward a pure form of dispersal, managers may encourage or require visitors to camp only on sites with no evidence of use (12 parks) or travel off-trail (10 parks). These actions prevent the development of permanent campsites and trails by reducing the frequency of use to levels that avoid lasting vegetation damage. Denali National Park and Preserve (Alaska) manages one of the more successful visitor dispersal programs. Overnight backcountry use is restricted to achieve low use densities, generally in the range of six visitors per 15,000–60,000 acres per night. Minimum impact hiking and camping practices are also emphasized and communicated through park literature and a novel interactive computer simulator program.

TABLE 4
Spatial Dispersal Strategies and Management Actions Implemented by U.S. National Park Managers for Controlling Camping-Related Visitor Impacts

Management Action	Number (Percentage) of National Parks Taking the Action
Inform visitors about crowded conditions they may encounter in certain areas	52 (56%)
Discourage or prohibit camping within a certain distance or sight of trails	39 (42%)
Inform visitors about conflicting uses they may encounter in certain areas	37 (40%)
Discourage or prohibit camping within a certain distance or sight of other campsites	35 (38%)
Encourage use of less popular access points and backcountry areas	35 (38%)
Discourage or prohibit camping within a certain distance or sight of popular features	24 (26%)
Encourage or require camping on sites with no evidence of use	12 (13%)

Spatial Configuration

At the site scale, managers can minimize visitor impacts by carefully arranging facilities to channel and concentrate visitor activities within intended use areas. However, only one survey item pertained to use of this strategy. Managers at 40 parks indicated that firepit and facility locations are used to concentrate use on campsites.

Discussion

Spatial segregation is often a preferred management strategy for separating noncompatible recreational activities. Somewhat surprisingly, managers at only six parks apply the segregation strategy to manage a range of social settings (e.g., high to low visitor densities). As visitation continues to increase, such actions will likely become increasingly necessary, particularly in wilderness where legislation emphasizes the need to manage for visitor solitude.

Backcountry trail systems represent the most widespread and successful application of the *spatial containment strategy.* Traffic is focused onto carefully selected and managed trail treads, thereby eliminating numerous visitor-created trails that would develop in the absence of a formal system. Many park managers have also successfully applied a containment strategy to the management of backcountry camping.

Survey results indicate that the *spatial dispersal strategy* has been a common management response to excessive impacts occurring in popular destination areas such as lake basins or riparian corridors. Dispersing use away from these areas may be an effective strategy for reducing social impacts, particularly crowding. However, there is ample evidence that spatial dispersal to a level of use that precludes the development of lasting vegetation damage is exceptionally difficult to achieve (Hammitt & Cole, 1998). For example, research suggests that the dispersal strategy often merely redistributes use and resource impacts to new sites in adjacent areas (Cole, 1993; Cole, Watson, Hall, & Spildie, 1997). Such a strategy may therefore contribute to an increase in aggregate or total impact if the pre-existing sites recover extremely slowly (Cole & Ranz, 1983) or if more sites are created than were closed.

The spatial configuration strategy is less applicable to backcountry settings and is possible only when managers develop visitor facilities, such as groupings of designated campsites and associated facilities. Facilities provided on backcountry campsites include fire grates, picnic tables, tent platforms, camping shelters/huts, toilets, food storage structures, and hitching rails. The arrangement of facilities and their spatial relationship to trails, campsites, water sources, and the local topography can strongly influence the type and extent of resource impact associated with their access and use. For example, traffic patterns can be consolidated when facilities are clustered and arranged in a linear pattern so that visitor access is limited to one or two short trails. Visually defining trail and site borders with native stone or logs can also enhance the spatial containment of traffic.

The majority of national parks surveyed has adopted more than one of the basic spatial strategies, with different strategies implemented within separate management zones. Figure 1(e) illustrates a multiple-strategy example, in which spatial containment and dispersal strategies are implemented within separate zones at Big Thicket National Preserve in Texas. River camping is restricted to sandbars along the main watercourse, and land-accessed camping is either lineally dispersed away from roads and trails or restricted to designated areas.

Shenandoah National Park provides a more comprehensive example of the multi-strategy approach. Management experience and campsite monitoring (Williams & Marion, 1995) revealed that a dispersed camping strategy was ineffective in areas receiving moderate to high use. A multi-strategy camping policy was therefore incorporated into a revised backcountry and wilderness management plan (USDI, 1998) with implementation beginning in 1999. Designed to minimize resource impacts and enhance visitor solitude, the policy employs camping closures to protect sensitive natural or cultural resource areas (spatial segregation), designated site camping in the most popular areas (spatial containment), and established site camping in moderate and low use areas (spatial containment). Designated sites will be arranged as shown in Figure 1(d), including some facilities such as pit toilets and food storage devices (spatial configuration).

In areas managed for established site camping, visitors will use only pre-existing campsites, allowing managers to close and rehabilitate sites that are less resistant or are close to streams, trails, or other campsites. If no existing campsites are available, visitors will be directed to select and use a resistant pristine site (spatial dispersal).

Management Implications and Conclusions

The typology of spatial strategies proposed in this paper offers a useful means of organizing and understanding the wide variety of management strategies and actions applied to minimizing visitor impacts in parks and protected areas. Further analysis from the spatial perspective is needed to extend the applicability of this typology to other recreational activities and management issues.

The U.S. national park survey findings and examples demonstrate the diversity of spatial strategies and implementation options adopted in backcountry and wilderness settings. In many areas multiple and integrative strategies are being employed with greater success than single strategies. For example, many backcountry areas, particularly National Forests, are managed under at-large camping policies whereby visitors may camp in any area without restriction. Even in these areas spatial strategies, notably containment and dispersal, may be simultaneously applied to minimize hiking and camping impacts.

Although there are many strategies and actions for managing visitor impacts, not all strategies and actions are effective or appropriate in all situations. Many factors can influence the success of a strategy or action, and the relative importance of these factors vary from case to case. These factors may be grouped as political (e.g., public acceptability), use-related (e.g., type and amount of use, user behavior), environmental (e.g., topography, soil and vegetation type), and managerial (e.g., staffing, funding, policies, regulations). Comprehensive guidance on selecting preferred strategies and actions that consider these factors may be found in Cole et al. (1987) and Anderson et al. (1998). Management decision making frameworks such as LAC and VERP are also being applied with increasing frequency. We limit our discussion to a summary of more general recommendations specific to this spatial typology of strategies.

Legislation and planning objectives guide management decision making, including identifying social or resource problems that require management action. However, before a management strategy or action can be selected, managers must identify and understand the causes that contribute to the problem(s) and relevant influential factors. For example, at Shenandoah National Park, management experience and scientific knowledge suggested that the dispersed camping strategy was ineffective in minimizing resource impacts in moderate to high use areas. A number of causes were identified: (a) limited availability of potential camping locations due to topography and park regulations prohibiting camping near streams or within sight of trails, (b) fragile groundcover vegetation, and (c) visitor noncompliance—

few visitors dispersed beyond sight of trails, away from water, or to previously undisturbed sites. A successful dispersal strategy would require very low use levels or large numbers of potential camping locations with resistant vegetation (e.g., grasses) and visitors willing to search for pristine sites and use *Leave No Trace* camping practices.

Identification of potential strategies and actions is the next step. A careful and comprehensive review that considers a broad array of alternatives (spatial and non-spatial) ensures the best possible selection. This is followed by an examination of each potential strategy, with consideration of the various relevant factors and constraints that may influence the effectiveness of a particular strategy. For example, at Shenandoah National Park, factors such as management policies and funding limited the use of a spatial configuration strategy in backcountry and wilderness settings. Their review process yielded recommended lists of strategies and actions for each management zone, arrayed in order from indirect to direct. Indirect actions are often preferred when conditions are approaching unacceptable levels or if there is good reason to believe they will be effective. In high use areas, more direct actions, such as designated site camping (spatial containment), were viewed as necessary to minimize resource and social impacts.

A combination of strategies and actions will often provide a more effective solution to problems. For example, area closures (spatial segregation) may be needed to protect sensitive resources, designated campsites (spatial containment) may be needed to minimize resource degradation in high use areas, but pristine site camping (spatial dispersal) preserves visitor freedom and may prevent permanent resource impact in less visited areas. Similarly, effective implementation of a containment strategy requires supporting site management actions to select, construct, and maintain resistant designated campsites; education actions to communicate camping regulations, site locations, and *Leave No Trace* practices to visitors; and enforcement actions to ensure visitor compliance.

This paper demonstrates the utility of a spatial approach to visitor impact management in parks. However, little, if any, information is available to evaluate the spatial effects of management. Further studies are needed to document if and what spatial effects occur as a result of implementing specific management strategies or actions.

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