Campsite Survey Implications for Managing Designated Campsites at Great Smoky Mountains National Park

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Abstract: Backcountry campsites and shelters in Great Smoky Mountains National Park were surveyed in 1993 as part of a new impact monitoring program. A total of 395 campsites and shelters were located and assessed, including 309 legal campsites located at 84 designated campgrounds, 68 illegal campsites, and 18 shelters. Primary campsite management problems identified by the survey include: (1) campsite proliferation, (2) campsite expansion and excessive size, (3) excessive vegetation loss and soil exposure, (4) lack of visitor solitude at campsites, (5) excessive tree damage, and (6) illegal camping. A number of potential management options are recommended to address the identified campsite management problems. Many problems are linked to the ability of visitors to determine the location and number of individual campsites within each designated campground. Our principal recommendation is that managers apply site-selection criteria to existing and potential new campsite locations to identify and designate campsites that will resist and constrain the areal extent of impacts and enhance visitor solitude. Educational solutions are also offered.
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Park and wilderness managers must maintain a balance between resource protection and recreation provision mandates. Though a central purpose for the creation and management of protected areas, visitation has the potential to degrade both natural resources (Hammitt and Cole 1987, Kuss and others 1990) and the experiences of visitors (Lucas 1979, Shelby and Shindler 1990). This is particularly true along trails and at overnight campsites and day-use recreation sites, where visitation and its effects are concentrated.

Historically, protected area managers have often relied upon their subjective impressions of campsite and trail conditions as a basis for management decision making. However, increasing participation in wildland recreation continues to challenge managers responsible for minimizing the environmental and social impacts associated with such visitation. More objective and scientifically defensible visitor impact assessment and monitoring programs are needed to help develop and support effective management actions (Marion 1995). Additionally, research from the discipline of recreation ecology is yielding new knowledge that can assist managers in reducing resource impacts associated with wildland recreation (Cole 1987, Cole and others 1987, Leung and Marion 1996).

This paper describes selected results from the development and application of a backcountry campsite monitoring program for Great Smoky Mountains National Park. The goal of this work was to obtain reliable yet cost-effective measurements of managerially relevant campsite condition indicators for all backcountry campsites and shelters. Our focus in this paper is on presenting and discussing implications and recommendations derived from the first monitoring cycle.

STUDY AREA

Great Smoky Mountains National Park (GSMNP) was established in 1934 and has grown in size to include 514,885 acres along the boundary of Tennessee and North Carolina. This National Park Service (NPS) unit includes

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69 miles of the Appalachian Trail and is distinguished by its 1978 designation as an International Biosphere Reserve. Approximately 425,000 acres, 83% of the park's acreage, are recommended for wilderness designation. Under NPS management policies, such lands must be managed as wilderness.

The southern Appalachian Mountains, including exceptionally diverse flora and fauna, comprise the park's primary public attraction. Elevations range from 840 feet to 6,643 feet. Twenty peaks rise above 6,000 feet in elevation and the topography is steep; only 10 percent of the park's lands have slopes of less than 10 degrees. Major plant communities include cove hardwoods, hemlock, mixed oak, northern hardwood, pine and oak, beech, and spruce-fir, with some of the most extensive virgin forests in the eastern United States.

GSMNP reported 9.28 million recreation visits in 1993 making it one of the most heavily visited parks in the National Park system (NPS 1993). While many of these visitors remain close to their cars, a considerable number also engage in day hiking and overnight camping activities. Backcountry overnight stays reported by the park for 1993 were just over 96,459, sixth highest within the National Park system (NPS 1993).

Prior to 1972, backcountry camping was largely unregulated, specifying only distance restrictions from park roads, Clingman's Dome Tower, and water resources. Beginning in 1972, camping was rationed along the Appalachian Trail and several other trails to reduce crowding and impacts at popular camping areas. A backcountry use pamphlet listed 43 suggested camping areas and 18 backcountry shelters. In 1973, a designated site camping policy was implemented, including 79 backcountry camping areas. Use of shelters was restricted to their bunk capacity. A cross-country hiking policy was established in 1974, permitting camping at non-designated sites. Horseback camping was restricted to 23 of the backcountry camping areas, with occupancy restricted to available hitchrack space. Backcountry visitation peaked in 1976 (115,300 overnight stays), prompting a campsite impact survey by Bratton and others (1978). Their study documented resource conditions at 20 shelters, 93 camping areas, and 289 illegal campsites.

In 1993, the year our survey was conducted, camping was permitted at 84 designated backcountry camping areas (hereafter referred to as campgrounds) and 18 shelters. Overnight visitors must obtain a self-registered camping permit. Reservations for specific campgrounds must also be obtained if their anticipated itinerary includes one of the 15 rationed campgrounds or 18 shelters. Maximum party size is eight and visitors may stay only one consecutive night at shelters and up to three consecutive nights at campgrounds. Campfires are permitted only at designated campgrounds and shelters.

Horseback riders are restricted to park trails specifically designated for horse use and to 51 of the 84 designated campgrounds or to 13 of the 18 shelters (64 areas total). Hitchracks are provided at many of the campgrounds and shelters where camping with horses is permitted.

RESEARCH METHODS

This project's research objectives called for developing a standardized assessment system to monitor resource conditions on backcountry campsites. Three types of comparisons are possible. Resource impacts caused by camping are inferred by comparing onsite and offsite (control) conditions. Trends in campsite conditions are documented by comparing campsite impacts assessed during two or more monitoring cycles. Additionally, various groupings of campsites (e.g. rationed vs. unrationed) can be compared to evaluate the influence of additional environmental, use-related, or managerial factors. Procedures applied during this study employed all three forms of comparison to infer the extent of change caused by camping.

Monitoring Procedures

Monitoring procedures employed during this study emphasize a multi-indicator measurement-based approach but add descriptive condition class assessments and photographs (see Marion and Leung 1997). For campsites with exposed soil, all three approaches were applied, requiring a field crew of two persons approximately 15 minutes to complete. For less disturbed campsites, an abbreviated set of procedures was applied. A comprehensive campsite monitoring manual was developed, including detailed descriptions of all campsite assessment methods and materials employed during the survey (Marion and Leung 1997).

The survey's objective was to conduct a

census of all discernible backcountry campsites. A census was viewed as necessary to accurately characterize the distribution of campsites and aggregate change for each campsite condition indicator (e.g. the total area of disturbance affected by camping). Such comprehensive data would also be needed to support implementation of standards-based management frameworks. Such data are essential for developing realistic standards for various opportunity classes and for identifying the number and location of campsites that exceed those standards.

Field work, including one week of staff training, was conducted from June 1 to August 15, 1993. During this same time, period field staff also surveyed the condition of 72 park trails (328 miles) as part of a separate study (Marion 1994).

Campsites were defined as areas of obvious vegetative or organic litter disturbance that in the judgment of field staff were caused by camping activities. Furthermore, disturbance had to be of such extent to produce a discernible boundary between disturbed and undisturbed areas. All indicator conditions were assessed only within the established boundary of a campsite, although procedures allowed for additional assessments within obvious "satellite" use areas. Fixing the area of interest within campsite boundaries is necessary to increase the precision of assessments.

Campsites were located using a variety of information and approaches. Designated campsites were located through thorough searches of the areas around each backcountry campground. Illegal campsites were located by consulting park staff most familiar with the backcountry and by following every recognizable side path during thorough ground-based searches.

Campsite indicators were selected following a review of recreation ecology literature, discussions with park staff, and consideration or published criteria guiding the selection of monitoring indicators (Cole 1989, Marion 1991, Merigliano 1990). For soil, the percentage of exposed soil was assessed according to a six-category cover-class scale. The number of trees with moderate to severe root exposure was counted within delineated campsite boundaries as an indication of soil compaction and erosion. For vegetation, the percentage of ground covered by vegetation on-site and off-site was estimated using the six-category cover class scale. The number and degree of damaged trees and number of tree stumps was also assessed. Aesthetic and behavioral indicators included the number of trails extending from a campsite, distance to formal park trail, number of fire rings or scars, and the presence of litter or improperly disposed human waste.

Data Analysis

Data were entered into dBASE IV and exported into SPSSPC+ for statistical analyses. Data were error-checked and new variables were calculated. For example, vegetation loss (ft^2) was calculated by subtracting the midpoint of the off-site vegetation cover class estimate from the midpoint of the on-site estimate and multiplying by the campsite area to obtain an estimate of the area over which vegetation cover has been removed on campsites (Marion and Leung 1997. A full range of descriptive and relational statistical analyses were performed. Both mean and median values are reported. The mean is not always the best measure of central tendency, due to the effect of outlier data and distributions which are highly skewed. In these instances the median provides a better estimate of central tendency and is emphasized in the following discussions.

RESULTS

Survey staff located and assessed 395 individual campsites and shelters. Sixty-eight campsites were judged to be illegal. Half of these campsites are located near designated campgrounds and field staff encountered some difficulties in differentiating between legal and illegal campsites. Survey staff assessed 237 legal campsites at the park's 67 unrationed backcountry campgrounds (3.5 sites/campground) and 72 campsites at the 15 rationed campgrounds (4.8 sites/campground). All 18 of the rationed shelter sites were also evaluated. The number of individual campsites per designated campground ranges from 1 to 12 with a mean of 3.8, excluding shelters, all of which were assessed as single sites. Of the 82 designated campgrounds, 9 have only 1 campsite, 18 have 2 campsites, 20 have 3 campsites, 10 have 4 campsites, 9 have 5 campsites, and 16 have 6 or more campsites.

The majority of illegal campsites (54, 79%) are within 100 feet of formal trails, nearly 60% are within 25 feet of park trails (Table 1). Similarly, more than half of the legal campsites and shelters (188, 58%) are within 100 feet of formal park trails. Only 71 legal campsites and

Table 1. Results for selected indicators for campsites and shelters by legal and rationing status.

Indicator[1]		Illegal Campsites (N=68)	Legal Unrationed Campsites (N=237)	Legal Rationed Campsites (N=72)	Legal Rationed Shelters (N=18)
Distance to Trail (ft)	≤25	40	69	20	8
	26-100	14	67	22	2
	101-200	9	45	18	5
	≥201	5	56	12	3
	Mean	56	136	102	105
	Median	20	70	76	29
No. Sites Visible (#)	0	54	46	8	15
	1	12	82	19	3
	2	2	54	15	0
	≥3	0	54	30	0
	Mean	0.2	1.6	2.5	0.2
Campsite Size (ft^2)	Mean	515	1311	2530	3218
	Median	382	876	1740	2895
	Sum	35,052	310,761	182,143	57,920
Vegetation Loss (ft^2)	Mean	273	814	1208	1522
	Median	159	521	653	1431
	Sum	8201	129,435	72,478	24,353
Exposed Soil (ft^2)	Mean	266	812	1489	1398
	Median	182	470	856	1361
	Sum	7970	129,064	89,352	22,365
Damaged Trees (#)	Mean	0.7	2.9	5.6	2.1
	Median	0	1	2	0
	Sum	45	690	401	37
Trees w/Root Exposure (#)	Mean	0.6	1.2	2.0	0.7
	Median	0	0	1	0
	Sum	18	186	120	11
Stumps (#)	Mean	0.7	1.9	3.4	0.9
	Median	0	1	2	0
	Sum	47	460	247	17

[1]N is the number of campsites for all indicators except vegetation loss, exposed soil, and trees with root exposure, which were assessed only on campsite with exposed soil (see Methods section). N values for these indicators are 30, 160, 60, and 18.

shelters (21%) are located more than 200 feet from park trails, thus four-fifths of the park's designated campgrounds and shelters are likely to be visible from the park's formal trail system.

The number of other campsites in the area that are visible from each campsite, a measure of campsite intervisiblitiy, was assessed to evaluate the potential for solitude while camping. The potential for solitude at illegal campsites is substantially higher than for legal campsites: no other sites are visible from 54 (79%) of illegal campsites, compared to 69 (21%) of all legal campsites (Table 1). Within designated campgrounds, individual campsites often occur in dense clusters. For example, three or more other campsites are visible from 54 (23%) of the legal unrationed campsites and from 30 (42%) of the legal rationed campsites (Table 1). Twelve of the rationed campsites have five or more other sites visible. The close proximity of campsites and trails diminishes solitude for both hikers and campers. Current campsite locations do not reflect Wilderness Act mandates that specify solitude as a principal element of wilderness recreation.

Campsite Conditions

Campsite condition comparisons across legal

and rationing status are presented in Table 1 for selected impact indicators. Results indicate substantial differences in campsite conditions exist between these various campsite stratifications.

Illegal campsites are generally quite small in size (median size = 382 ft^2) with limited vegetation loss or exposed soil (Table 1). The sum of campsite area for all illegal sites, referred to as aggregate impact, totals 35,052 ft^2 or 0.8 acres (Table 1). The extent of tree damage and root exposure on these sites is low. Legal unrationed campsites are larger in size (median size = 876 ft^2) and account for the largest aggregate impact of any category (310,761 ft^2) (Table 1). For remaining indicators all measures of change are more than double the values for illegal campsites. Legal rationed campsites (median = 1740 ft^2) are approximately twice the size of the unrationed sites (Table 1). The area of vegetation loss and exposed soil are also substantially larger and the number of damaged trees and stumps (median = 2/site for both indicators) are the highest for any category.

Shelters have the largest areal measures of change, with a median size of 2985 ft^2, vegetation loss of 1431 ft^2, and exposed soil of 1361 ft^2 (Table 1). Median values for the remaining indicators indicate limited impacts, more similar to conditions on illegal campsites than those on designated campground sites.

Two campsite condition indicators, campsite area and damaged trees, exhibit extensive change and warrant additional attention. As a group, legal campsites and shelters range in size from 36 to 23,948 ft^2 with a median size of 1,039. Approximately one-quarter of the campsites are less than 501 ft^2 in size (80, 24%), and about one-half are less than 1001 ft^2 in size. However, 62 campsites (19%) are between 2000 and 4000 ft^2 and 30 campsites (9%) are larger than 4000 ft^2, an area of approximately 63x63 feet.

For legal campsites and shelters that have trees within their boundaries (N=245), approximately 63% of the trees on the typical site are damaged (as indicated by median values). More importantly, all campsite trees are damaged on 69 (28%) of the campsites. The number of damaged trees ranges from 0 to 53 with a median of 2 (mean = 3.5). Twenty percent of the campsites have 6 or more damaged trees, 10% have 9 or more, and 8 campsites have 20 or more damaged trees. For all legal campsites, a total of 1,128 of the 1,943 trees assessed (58%) were evaluated as damaged. In off-site areas of legal campsites, surveyors found an additional 1,249 damaged trees.

Aggregate measures of impact have more ecological significance than median or mean values for various stratifications of campsites. Managers must balance their goal of providing for appropriate recreational visitation with that of resource protection. Thus, an important objective is to limit the total area of disturbance or exposed soil, or the total number of damaged trees. The legal unrationed campsites account for the greatest area of disturbance, including over half (53%) of the total area of disturbance associated with all campsites and shelters (585,876 ft^2, 13.5 acres). The large number of sites in this category (N=237) is the primary factor explaining this finding (Table 1). Legal rationed campsites, primarily due to their larger sizes, also contribute substantially to the total area of disturbance (182,143 ft^2, 31%). Findings and contributing factors for the remaining variables mirror those of campsite size (Table 1).

DISCUSSION

This survey identified a number of problems associated with backcountry campsites in Great Smoky Mountains National Park, including: (1) campsite proliferation, (2) campsite expansion and excessive size, (3) excessive vegetation loss and soil exposure, (4) lack of visitor solitude at campsites, (5) excessive tree damage, and (6) illegal camping. Recreation ecology research findings support the park's current policy of restricting most campers to designated campsites. These studies document a curvilinear relationship between overnight visitation and most forms of campsite impact (Cole 1987, Marion and Merriam 1985, Marion and Cole 1996). Conditions change rapidly with initial campsite use but the rate of change diminishes with increasing use. An important implication of this relationship is that aggregate impact is most effectively minimized by concentrating visitation on a limited number of campsites—the principal objective of a designated site camping policy.

At GSMNP managers have additionally sought to control camping impacts by rationing visitation at the most popular and highly impacted campgrounds. Data from this survey suggest that this action is highly effective at

shelters where use is restricted to their bunk capacities. The large tent camping areas situated around shelters that the earlier survey by Bratton and others (1978) document have largely recovered. Park permit data indicate that the shelters accommodated 37% of the overnight backcountry visitation in 1993 (excluding drive-in horse camps), yet our survey found that shelters account for only 10% of the total area of disturbance. The effectiveness of rationing at shelters is explained by the elimination of tent camping areas and the extreme spatial concentration of activities caused by the shelters.

Rationing at campgrounds is a far less effective management action. The curvilinear use/impact relationship implies that dramatic reductions in visitation would be needed in order to achieve any substantive reductions in campsite impacts. In contrast to shelters, rationing at campgrounds does not completely eliminate any tenting areas because visitors, though their numbers are reduced, retain the ability to camp in any location they choose. Even low to moderate levels of visitation are sufficient to prevent substantial recovery on previously heavily impacted campsites (Cole and Ranz 1983). In 1993, rationed campgrounds accommodated 17% of the overnight backcountry visitation, yet our survey found that rationed campgrounds account for 31% of the total area of disturbance. Finally, rationing does little to address solitude issues as it does not increase the spatial distribution of campsites relative to trails and each other.

It is pertinent to conduct a brief problem analysis before considering alternative management options for reducing campsite impacts. Many of the campsite management problems and their principal contributing factors are interrelated. For example, the locations of individual campsites are selected by visitors; even campground designations were historically assigned to pre-existing visitor-selected campsites. Problems with campsite proliferation and expansion, groundcover degradation, and lack of solitude are all directly related to this contributing factor. Survey results indicate that visitors can and often do choose campsite locations that are fragile, rather than resistant; close to, rather than apart from, other campsites, park trails, and streams, and in areas with great expansion potential rather than in areas where topography limits campsite expansion and proliferation. Additionally, park literature in 1993 did not convey any information addressing these issues; thus, visitors may have been unaware of the impacts of their activities, park management's concern, or appropriate minimum impact camping practices.

Potential Management Options

Managers must develop a thorough understanding of the nature, extent, and contributing causes of campsite degradation problems before defining the range of potential management solutions. Marion and Leung (1997) provide a more comprehensive review of these topics, which are greatly abbreviated in this paper. The most effective management strategies and actions are those that address the underlying causes of degradation problems. For example, a program to assist natural recovery on illegal campsites will be ineffective if the causes of illegal site use are not resolved. In addition to the likely effectiveness of alternative management options, participants in the decision process must also consider the costs of implementation to both managers and visitors, and secondary or side effects (Cole and others 1987). Both initial and recurring costs in funding and personnel needed to implement the action must be considered. Given that wilderness visitation is to be "primitive and unconfined", managers must consider the effects of their actions on visitor freedom, obtrusiveness, when and where the visitor is affected, the number of visitors affected, and the importance of activities that are affected (Cole and others 1987, Hendee and others 1990).

We offer some potential or preliminary management options for the consideration of park staff and others involved in managing backcountry recreation at GSMNP. Research findings from recreation ecology and the results from our survey support the general strategy of visitor containment to minimize camping impacts, as implemented by the designated site camping policy at GSMNP. The cross-country camping zones, which could be expanded to include more of the most remote and rarely visited park areas, could be effectively managed under a camping dispersal strategy. Visitors would be encouraged to select resistant pristine locations for camping and to rigorously apply the *Leave No Trace* camping practices that are most appropriate to this form of camping (NOLS 1994).

A principle advantage of the campsite designation strategy is the ability to direct camping to areas that resist and spatially

(a)

(b)

Fig. 1. Flat topography offers no constraint to the expansion of this 2,560 ft^2 campsite (a) in the Upper Ripskin backcountry campground. In contrast, the sloping topography within which the Medicine Branch Bluff campground is located, limits site proliferation and the expansion of this 767 ft^2 campsite (b).

constrain camping impacts. This can be accomplished by applying site selection criteria that rate such attributes as vegetation resistance to trampling, erosion potential due to slopes or soil texture, topography or other features that restrict campsite expansion and proliferation (Fig. 1), and proximity to sensitive areas such as stream banks or cultural sites. Social attributes can also be incorporated to protect and ensure the opportunity for solitude by establishing visibility or distance criteria for locating campsites. Preliminary bio-physical and social criteria are offered by Marion and Leung (1997) some of which were applied to campsites as part of the 1993 survey.

Application of the criteria to existing and potential new campsite locations can yield information useful to the selection of campsites that can be individually designated (as opposed to campground designations). Campsites could be designated by firmly anchoring camping posts, firegrates, or camping symbol signs. Such physical features will naturally concentrate future visitation to their immediate vicinity; alternately, visitors could be required to camp within a specified distance of the selected feature. Both theoretical (Cole 1992) and empirical (Marion 1995) research supports the merits of such features in achieving substantial reductions in the total area of disturbance through the spatial concentration of camping activities. As previously noted, managers must weigh the advantages of these proposed actions with their management and visitor costs.

If individual campsites are designated, each campground would have an inherent capacity equivalent to the number of campsites. Visitors would have to be made aware of this to allow time to locate an available campsite in popular areas. Park staff should seek to match the number and distribution of campsites to current visitor travel preferences. Most problems related to insufficient campground capacity can be resolved by adding campsites or additional campgrounds. Those that cannot are, in our opinion, best addressed through a system of entry point quotas rather than campsite rationing. Under entry point quotas, visitors retain greater freedom to travel and alter their schedules while in the backcountry. Refer to Marion and Leung (1997) for further discussion on this topic.

Educational and campsite maintenance programs can also play important roles in reducing campsite degradation. A comprehensive pamphlet titled "Leaving No Trace in Great Smoky Mountains National Park" was developed in 1995 and is now widely distributed to backcountry visitors (NOLS 1995, Marion and Brame 1996). Tree damage can best be addressed by encouraging visitors to use stoves and avoid building fires. Small Leave No Trace campfires should be built with dead and down wood that can be broken by hand. Axes and saws are unnecessary and should be prohibited. Efforts are also being made to enhance the personal communication of this information and its integration in other park literature. Finally, backcountry maintenance efforts could be expanded to deter site expansion on designated campsites (Marion and Sober 1987) and to speed the recovery of closed and illegal campsites (Cole and Schreiner 1981).

Illegal camping is substantially reduced from the late 1970's when Bratton's survey revealed 289 illegal campsites (Bratton and others 1978). Survey staff conducted careful and exhaustive searches for illegal campsites at substantial distances from formal trails so we believe this finding accurately reflects the status of illegal camping. Further reduction of illegal camping will require an improved understanding of underlying causes. Are illegal campers unaware of the park's camping regulations? Does illegal camping occur only when there is crowding, conflict, or insufficient space at non-rationed campgrounds? Are illegal campers aware of the regulations but feel that their chances of being caught or fined are small? Additional information is needed for these questions before effective management options can be discussed.

CONCLUSIONS

Visitor impact monitoring programs offer protected area managers an objective tool for documenting trends in resource conditions as affected by recreational activities. Monitoring data describe the nature and extent of resource changes and can be analyzed to reveal the influence of use-related, environmental, and managerial factors. As demonstrated in this paper, monitoring data permit the quantitative documentation of site-specific conditions, providing a permanent and impartial record of changing resource conditions. Our analysis and interpretation revealed a number of campsite management problems, to which we applied recreation ecology and wildland recreation management knowledge to offer some potential management options. These findings provide

GSMNP managers with an improved understanding of backcountry campsite conditions and how additional actions might substantially improve both resource and social conditions. We recommend further evaluation of these and other alternatives by park managers to consider management and visitor costs, and to incorporate the advice of experienced backcountry staff and representatives of the public and organized interests.

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