EXAMINING THE INFLUENCE OF GEOSPATIAL VARIABLES ON PRIMITIVE ROADSIDE CAMPSITE CONDITIONS

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Abstract

This study examines the geospatial characteristics of primitive roadside campsites in the Adirondack Park, the management implications of those characteristics, and their potential influences on the environmental conditions of such campsites. Due to an absence of prescribed management guidelines, roadside campsites are a debated issue among Adirondack Park Stakeholders. Some have argued that they should be managed in accordance with the guidelines set forth for *primitive tent sites* in the Adirondack Park. The geospatial analyses conducted in this study inform this debate by assessing whether each roadside campsite complies with the management guidelines for primitive tent sites; results indicate that the majority of roadside sites do not comply. Further, results of a multiple linear regression model suggest that campsite conditions (in relation to soil and vegetation health) may be influenced by several geospatial variables, including a site's distance from roads, distance from water resources, size, and slope. Implications for theory and management are discussed.

1.0 Introduction and background

Natural resource and recreation managers often struggle with balancing the somewhat contradictory objectives of preserving the natural environment while at the same time providing high quality recreation experiences for the public. Such is the case in the Adirondack Park, a six million acre parcel of interspersed public and private land located in upstate New York. Overnight camping is one of many historic and popular recreational activities pursued by park residents and visitors. However, like all forms of outdoor recreation, the activity of camping on public lands must be managed to control resulting impacts on the natural environment.

New York State's Adirondack Park (AP) provides the public with a wide variety of opportunities for overnight camping. Campsites in the AP Forest Preserve (FP) can generally be categorized into one of three types. *Primitive tent sites* have an undeveloped character, no controlled access,

and are located within the interior of a forest at a significant distance from a road or trailhead. Primitive tent sites are located throughout the forest preserve, most commonly on lands designated as Wild Forest or Wilderness. *Developed campgrounds* are concentrated collections of campsites with controlled access and associated fees per night, which typically provide several amenities, and are located on lands classified as Intensive Use. Finally, *roadside campsites* can be described as a hybrid between primitive tent sites and campground sites. They are located on or near FP roads, do not have restricted access or fees, and often provide a very limited set of amenities such as fireplaces, picnic tables, and pit privies. They generally provide opportunities for primitive, vehicle-based camping experiences, and are most commonly found on lands classified as Wild Forest. The Adirondack Park State Land Master Plan (APSLMP) defines and provides management guidelines for only the first two camping settings. Resulting debate regarding the most appropriate way to define and manage roadside settings motivates this study. Some stakeholders have argued that roadside campsites should be considered under the definition and management guidelines of primitive tent sites. The negative impacts on the environment that results from roadside camping are, presumably, a concern for this stakeholder group. Others, however, have argued that roadside campsites represent a distinct type of camping opportunity in the AP, and should be provided with a separate definition and management guidelines in the APSLMP. There are two primary purposes of this study. First, a series of geospatial analyses were conducted to determine the extent to which roadside campsites conform to management guidelines for primitive tent sites in the AP. Second, a regression analyses was conducted in order to examine the influences of geospatial variables on roadside campsite conditions.

2.0 Literature review

The following sections provide brief reviews of the literature pertaining to the two purposes of this study. First, a review of relevant policy and legislation regarding the activity of camping in the AP is discussed. Following this discussion, a review of literature from the field of recreation ecology provides a brief overview of the state of knowledge regarding recreational impacts on natural resources, with a particular emphasis on campsite impacts.

2.1 Camping in the Adirondack Park

Public camping opportunities in the AP can generally be categorized into one of three types: Campgrounds, Primitive Tent Sites and Lean-tos, and Primitive Roadside Sites. The APSLMP defines a primitive tent site as “a designated tent site of an undeveloped character providing space for not more than three tents, which may have an associated pit privy and fire ring, designed to accommodate a maximum of eight people on a temporary or transient basis, and located so as to accommodate the need for shelter in a manner least intrusive on the surrounding environment” (New York State Department of Environmental Conservation, 2014, p. 17). The APSLMP stipulates that these sites should be located at least 100 ft. away from the mean high water mark of any water body and that they should be located at least ¼ mile away from each

other. Additionally, section 190.3 of the New York State Environmental Conservation Law 6 (NYCRR) stipulates that camping may only occur at sites located at least 150 ft. away from any road, trail, spring, stream, pond, or any other body of water, unless that camping site is designated by the New York State Department of Environmental Conservation.

In contrast to primitive tent sites, a campground is defined by APSLMP as "a concentrated, developed camping area with controlled access, not meeting the standards for individual, primitive tent sites or lean-tos, which is designed to accommodate a significant number of overnight visitors and may incorporate associated day-use facilities" (New York State Department of Environmental Conservation, 2014, p. 15). Though campgrounds vary in the types of opportunities they offer, they often provide several amenities such as playgrounds, running water, boat launching sites, hookups for electricity, firewood sales, etc. There are 44 campgrounds dispersed throughout the APSLMP that typically require the user to pay a fee per night of stay, which is usually around $20 (New York State Department of Environmental Conservation, 2014).

2.2 Recreational Impacts on the natural environment

Recreation managers and policy makers are often tasked with a dual mission of preserving the natural environment while at the same time providing high quality recreation opportunities to the public. This dual mission is somewhat contradictory, as the provision of recreation opportunities alters the natural environment in a variety of ways (e.g., recreation improvements/developments, trampling of soils and vegetation, impacts to air, water, wildlife, dark skies, etc.). The traditional convention regarding the relationship between use and impact assumed that as the amount of recreational use of an area increases so does the level of impact on natural resources. It should be noted that this relationship often follows a curvilinear pattern, where impacts tend to be relatively high at low levels of use and, though they continue to increase, tend to level off as use approaches or exceeds the carrying capacity of an area (Frissell & Duncan, 1965; Manning, 1978; Hammitt & Cole, 1998). However, recent researchers have noted that this relationship is oversimplified, as impacts on natural resources may be influenced by several other factors related to recreational use, environmental conditions, and management/site design considerations.

Research has shown that impacts may be influenced by a variety of use-related factors, such as amount, distribution, seasonality, user type, party size, user behavior and education, mode of travel, etc. (Hammit & Cole, 1998). Further, research has shown that a variety of environmental factors may influence impacts on the natural environment. These may include the types of natural resources (some soil and vegetation types are more resilient than others and can withstand higher levels of use) and geospatial characteristics such as topography, slope steepness and position, elevation and aspect (Hammit & Cole, 1998). Site design considerations represent a third class of factors that has been shown to influence the amount and types of impacts on the

natural environment. Manning (1979) described a node and linkage pattern of recreational impacts, where recreation use and impacts tend to be concentrated along activity facilities/nodes (trailheads, water access sites, etc.) and travel routes (e.g., trails, roads). Such a pattern suggests that an area's proximity to such facilities/nodes may influence its environmental condition. Finally, a number of management actions can be taken to "harden" natural resources, thus making them less vulnerable to recreational impacts. Careful planning and design of recreational areas may discourage behavior that would result in unacceptable levels of impact. For example, managers of the Annapolis Rocks Campground along the Appalachian Trail were able to reduce environmental impacts by closing a series of large, flat, user-created campsites and constructing a series of smaller, designated, side-hill campsites connected by a trail (Daniels & Marion, 2006). These sites were located on sloped terrain to discourage site expansion. In addition, managers prohibited the use of campfires and alcohol. Though the long-term effects of these actions are yet unknown, preliminary research suggests a substantial reduction in the amount of recreational impact at the campground area.

3.0 Methods

This study incorporates data from two sources. First, an inventory of all roadside campsites existing on FP lands within the AP was conducted during the spring and summer of 2009 (Graefe, Dawson, & Gerstenberger, 2010). Researchers utilized a roving exploratory technique to locate and assess all roadside campsites existing on the 2.4 million acres of FP lands. Second, geospatial data were utilized from the Shared Adirondack Park Geographic Information Database (CD-ROM ver. 1.0, 2001). Variables examined during the roadside campsite inventory include:

- *Campsite designation* – a measure of whether or not a roadside campsite was officially designated, as indicated by the presence or absence of a NYSDEC "Camp Here" disk.
- *Distance from hosting FP road* – The estimated distance from the center of a roadside campsite to its hosting road. This variable was measured using a rangefinder, or by pacing when a clear line of sight was unavailable.
- *Campsite circumference* – This variable provides a rough estimate of the size of each roadside campsite. Due to time constraints, each campsite was assumed to be circular in shape, and the circumference was measured by pacing the perimeter.
- *Condition class* – The environmental condition of each campsite was assessed in relation to levels of soil compaction and vegetation health. Each campsite was categorized into one of five condition classes, following the recommendation of Frissell (1978). Figures 1-5 provide visual examples of roadside campsites in the AP Forest Preserve representing each class.

In addition, several geospatial data layers were utilized to better understand how roadside campsites were situated in relation to environmental features and manmade infrastructure. The *proximity* tool within ArcGIS was used to measure the distance of each roadside campsite from

(1) major roads, (2) surface water resources (e.g., lakes, ponds, streams, and rivers), and (3) recreational trails.

Figure 1. CC1 - Ground vegetation flattened but not permanently injured

Figure 2. CC2 - Ground vegetation worn away around fireplace or center of activity

Figure 3. CC3 - Ground vegetation lost on most of the site, but humus and litter still. present in all but a few areas

Figure 4. CC4 - Bare mineral soil obvious. Tree roots exposed on the surface.

Figure 5. CC5 - Soil erosion obvious. Trees reduced in vigor and dead.

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Finally, the elevation of each roadside campsite was determined along with the slope of the surrounding terrain using the *extraction* tool. All variables, with the exception of slope, were converted to ft. for the sake of consistency and to ease interpretation of the results. In addition to descriptive analyses, a multiple linear regression analysis was conducted to examine the influence of geospatial variables on roadside campsite conditions.

Only sites categorized as condition classes one through five were included for the regression analysis (n = 504), as sites categorized as condition class six provided gravel camping surfaces to accommodate persons with disabilities. All geospatial variables described above were included as independent variables in the regression model predicting campsite conditions.

4.0 Results

A total of 531 roadside campsites were inventoried during the spring and summer of 2009. Subsequently, geographic characteristics for each campsite were obtained from the Shared Adirondack Park Geographic Information Database (CD-ROM ver. 1.0, 2001).

4.1 Descriptive results

The majority of roadside campsites in the AP were officially designated by the NYSDEC (68.6%), as indicated by the presence of an official "camp here" disk (Table 1). Most sites were located less than 150 ft. from their hosting forest preserve road (81%). A substantial proportion of sites were located less than 150 ft. from major roads (33.9%), recreational trails (44.1%), and water resources (31.3%).

About 40% of sites were categorized as condition class one or condition class two, which represent levels of impact that might be deemed acceptable by most managers. About 34% of sites were categorized as condition class three, which might be interpreted as being on the border between acceptable and unacceptable.

About 22% were categorized as condition class four or five, indicating a level of impact that most managers would find unacceptable. The slope and elevation varied across roadside campsites, with a median slope of 1.5 degrees and a median elevation of 1,738 feet.

4.2 Regression results

The geospatial variables examined in this study explained 22% of the variance in campsite conditions (adjusted $R^2 = 0.22$, $p < .001$). Statistically significant geospatial predictors of campsite condition, in decreasing order of effect size, include site circumference (.229), distance from water resources (-.218), distance from major roads (-.187), distance from hosting forest preserve road (.183), and slope (.145). Non-significant independent variables include site designation, distance from recreational trails, and elevation (Table 2).

Table 1.
Descriptive Results

Variable	**% of Total (n = 531)**
Site Designation (DEC Disk Presence):	
No	31.4%
Yes	68.6%
Distance from Hosting Forest Road (median = 67 ft.):	
0 – 150 ft.	81.0%
151 – 300 ft.	10.5%
Over 300 ft.	8.5%
Circumference of Site (median = 135 ft.):	
0 – 150 ft.	67.9%
151 – 300 ft.	31.9%
Over 300 ft.	0.2%
Condition Class:	
CC-1	18.7%
CC-2	22.9%
CC-3	33.9%
CC-4	19.5%
CC-5	2.1%
CC-6 (Gravel Site/ADA)	2.9%
Distance from Major Roads (median = 605 ft.)	
0 – 150 ft.	33.9%
151 – 300 ft.	9.2%
Over 300 ft.	56.9%
Distance from Water Resources (median = 310 ft.)	
0 – 150 ft.	31.3%
151 – 300 ft.	17.7%

Over 300 ft.	51.0%
Distance from Recreational Trails (median = 200 ft.)	
0 – 150 ft.	44.1%
151 – 300 ft.	11.7%
Over 300 ft.	44.3%
Slope of Terrain (median = 1.5 degrees)	
0-1 degree	43.3%
1.01 – 2 degrees	15.0%
2.01 – 3 degrees	15.4%
Over 3 degrees	26.4%
Elevation (median = 1738 ft.)	
500 – 1,000 ft.	3.0%
1,001 – 1,500 ft.	20.3%
1,501 – 2,000 ft.	64.0%
Over 2,000 ft.	12.6%

Table 2.

Regression Model Predicting Campsite Condition Classes 1-5

Independent Variables	Unstandardized Coefficients		Standardized Coefficients	t	P
	B	Std. Error	Beta		
Constant	1.387	.383		3.618	<.001
Designation (Disk)	.126	.100	.055	1.256	.210
Distance from Forest Roads	.002	.000	.183	4.240	<.001
Circumference	.005	.001	.229	5.320	<.001
Distance from Major Roads	-1.679E-005	.000	-.187	-3.427	.001
Distance from Recreational Trails	6.512E-006	.000	.028	.624	.533
Elevation	.001	.000	.071	1.261	.208
Slope	.050	.015	.145	3.288	.001
Distance from Water Resources	-.001	.000	-.218	-5.185	<.001

Note: Model adjusted R^2 = .22

5.0 Discussion

The results of this research have both practical and theoretical applications. First, a campsite's proximity to other natural resources and manmade infrastructure is relevant for answering the question of whether a site is in compliance with management/design guidelines for primitive tent sites in the AP (this is particularly relevant because some stakeholders have suggested that roadside campsites should be considered within the same category as primitive tent sites). For example, an **undesignated** site located less than 150 ft. from a road, trail, or water body would be in violation of the separation guidelines set forth in the Environmental Conservation Law and would, therefore, be considered illegal or non-conforming as a primitive tent site.

The data summarized in Table 1 suggest that a majority of roadside campsites are not in compliance with these guidelines. Therefore, if a decision would be made to include roadside campsites under the primitive tent site category, then undesignated sites that violate these spatial requirements would require management action (e.g., official designation, closure, or relocation). GIS technologies provide an efficient and effective method for making spatial comparisons and identifying specific campsites that might be in need of management action.

The spatial variables derived from the Shared Adirondack Park Geographic Information CD-ROM can be useful as independent variables in other important analyses. For example, a campsite's condition (in relation to soil and vegetation health) can be predicted, to an extent, by its spatial characteristics. A multiple linear regression analysis revealed that 22% of the variance in roadside campsite condition was explained by the spatial variables examined in this study (Table 2). Independent variables influencing campsite condition included site size, distance from hosting forest preserve roads, distance from major roads (i.e., highways), distance from water resources, and slope ($p \leq .001$ for each). In general, sites located at greater distances from major roads and water resources were less impacted than sites that were located in close proximity to such facilities, supporting the node and linkage spatial pattern of recreational impacts. This finding is not surprising, as sites located closer to major roads and water resources are highly attractive due to their convenience and their provisioning of opportunities to participate in water-based recreation.

An unexpected result of this analysis was the positive relationship found between campsite condition and distance from hosting forest preserve road. Logic and theory would suggest that sites located at farther distances from forest preserve roads would be less impacted than sites in close proximity. However, the opposite was found in this study. A possible explanation for this finding is that sites located farther from forest preserve roads might be more popular (i.e., used more often) than sites located closer to forest preserve roads, as such sites provide better opportunities to experience solitude (i.e., they might allow visitors to escape the sights and sounds of other campers or cars passing by). If this speculation were true, then the higher impact at sites located farther away from FP roads might simply be a function of the amount of use that occurs within these sites.

As expected, slope and campsite circumference (size) were positively related to campsite impacts (i.e., larger and steeper sites were associated with higher levels of impact). Previous research has shown that erosion potential tends to increase with slope (Hammitt & Cole, 1998). At first glance, this finding might encourage managers to locate campsites in flatter terrain to reduce the potential for erosion. However, other research has shown that intentionally placing campsites on sloped terrain may reduce other user-created impacts such as site expansion and the development of satellite sites and social trails (Daniels & Marion, 2006). These conflicting implications suggest that managers and planners should take a holistic and site-specific approach

when designing primitive camping facilities, incorporating social, environmental, and managerial factors in their decisions.

Predictive models are useful to managers wishing to improve the design and placement of dispersed, primitive campsites within natural resource areas. Improved or ideal placement of such camping resources might enhance managers in their goal of balancing social and resource objectives, and would likely result in decreased costs associated with campsite maintenance, revegetation, or relocations. A notable limitation of this analysis is the absence of variables describing the amount and type of recreational use that occurs at roadside campsites. The inclusion of such variables would likely improve the predictive ability of the model, but unfortunately these data were not available or known. Future studies examining recreation impacts might improve their predictive capacities by incorporating spatial, environmental, and social variables (e.g., use levels), and by examining the interactive effects of such variables on recreation resources.

6.0 References

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