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To cite this article: Carena J. van Riper, Robert E. Manning, Christopher A. Monz & Kelly A. Goonan (2011) Tradeoffs Among Resource, Social, and Managerial Conditions on Mountain Summits of the Northern Forest, *Leisure Sciences*, 33:3, 228-249, DOI: [10.1080/01490400.2011.564924](https://doi.org/10.1080/01490400.2011.564924)

To link to this article: <https://doi.org/10.1080/01490400.2011.564924>



Published online: 29 Apr 2011.



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Tradeoffs Among Resource, Social, and Managerial Conditions on Mountain Summits of the Northern Forest

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This research examined the relative importance of indicators and standards of quality at three mountain summits in the Northern Forest. The three summits ranged from low to high levels of use, development, and management. Computer-generated photographs were used to present a range of resource, social, and managerial conditions in a stated choice survey. Results suggest that visitors prefer minimal resource impact, few other people, and low intensity management. However, when faced with tradeoffs, respondents accept more intensive management to help ensure resource protection. Findings also suggest that a range of recreation opportunities should be provided at mountain summits in the Northern Forest.

Keywords outdoor recreation, stated choice, indicators and standards of quality, mountain summits

Received 19 June 2010; accepted 3 January 2011.

This article was produced in partial fulfillment of the first author's Master's thesis at the University of Vermont. Appreciation is extended to the first author's thesis committee, including Drs. Robert Manning, Ruth Mickey, and Curt Ventriss. Dr. Steven Lawson, Resource Systems Group, and Dr. Len Hunt, Centre for Northern Forest Ecosystem Research, were also very helpful in the statistical modeling and experimental design associated with this research. Funding was provided by the Northeastern States Research Cooperative.

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What conditions do visitors prefer at recreation sites? This is a fundamental question in outdoor recreation management that has received increasingly sophisticated research attention over the past several decades (Manning, 2011). Early studies were primarily attitudinal, asking visitors to report the extent to which they supported or opposed a variety of recreation-related facilities and services (Bumgardner, Waring, Legg, & Goetz, 1988; Cordell & Sykes, 1969). Other studies used an observational approach correlating use with recreation site characteristics (Lime, 1971; Shafer & Thompson, 1968). More recent studies have begun to address tradeoffs among desirable elements of recreation sites using indifference curve analysis and stated choice modeling (Lawson & Manning, 2001, 2002; Manning, 2011; Newman, Manning, Dennis, & McKonly, 2005). Visitors may prefer selected conditions at recreation sites (e.g., low levels of resource impacts, high levels of solitude, low intensity management), but these conditions may conflict, especially under high levels of demand, and require tradeoffs among conditions. This study advances this line of research by drawing on three conceptual and management frameworks developed in the outdoor recreation literature and two research approaches. The study is applied to three mountain summits in the Northern Forest region of the United States.

Recreation Management Frameworks

Threefold Framework of Outdoor Recreation

Three frameworks were used to build the conceptual foundation of this study. First, outdoor recreation opportunities are generally recognized as having three dimensions—resource, social, and managerial (Manning, 2011). Early research in outdoor recreation focused primarily on resource-related impacts of outdoor recreation and identified a number of ecological impacts, including trampling of vegetation, compaction and erosion of soil, and disturbance of wildlife (Bates, 1935; Meinecke, 1928). However, it was soon recognized that outdoor recreation also had an important social dimension. For example, in his influential monograph on recreation carrying capacity, Wagar (1964) wrote:

“The study reported here was initiated with the view that the carrying capacity of recreation lands could be determined primarily in terms of ecology and the deterioration of areas. However, it soon became obvious that the resource-oriented view must be augmented by consideration of human values.” (preface)

Wagar (1964) illustrated this idea by suggesting that recreation visitors have a variety of experiential motivations. He went on to suggest in a later paper that outdoor recreation has an important managerial dimension as well (Wagar, 1968). For example, the resource and social dimensions of outdoor recreation can be managed through a variety and intensity of management actions, and these management practices can influence the type and quality of recreation resources and experiences. Thus, studies of recreation conditions preferred by visitors should address relevant resource, social, and managerial components.

Carrying Capacity and Indicators and Standards of Quality

The second management framework employed in this study is carrying capacity and the associated concept of indicators and standards of quality. In its most generic sense, carrying capacity addresses how much visitor use can be accommodated at recreation areas without unacceptable impacts to park resources or the quality of the visitor experience (Manning, 2007). Contemporary approaches to addressing carrying capacity rely on formulating indicators and standards of quality to guide analysis and management. Examples

of these approaches include Limits of Acceptable Change (LAC) (Stankey, Cole, Lucas, Peterson, & Frissell, 1985), Visitor Experience Resource Protection (VERP) (Manning, 2001; National Park Service, 1997), and Visitor Impact Management (VIM) (Graefe, Kuss, & Vaske, 1990).

Recreation Opportunity Spectrum

The third management framework used in this study is the Recreation Opportunity Spectrum (ROS) (Brown, Driver, & McConnell, 1978; Driver, Brown, Stankey, & Gregoire, 1987). Factors that define recreation experiences are combined in alternative arrangements to describe diverse recreation opportunities. As described above, the factors that define recreation opportunities are often categorized into resource, social, and managerial components. In its broadest sense, ROS is a conceptual or organizing framework for measuring and encouraging a diversity of outdoor recreation opportunities. It explicitly recognizes that experiences derived from recreation activities are related to the settings in which they occur, and that settings are in turn a function of resource, social, and managerial factors. By describing ranges of these factors, ROS illustrates the potential diversity of recreation opportunities. Thus, ROS can be useful in guiding the way in which conditions might vary among recreation sites.

Research Approaches

Stated Choice Modeling

As described above, stated choice modeling is one approach to measuring the tradeoffs inherently made in competing recreation conditions (Kemperman & Timmermans, 2006; Lawson & Manning, 2002; Louviere & Timmermans, 1990; Stynes & Peterson, 1984). This methodology is a form of environmental valuation that asks respondents to choose between two alternative sets of recreation conditions (or “configurations of attributes” in stated choice parlance, or combinations of “indicators and standards of quality” in conventional outdoor recreation terminology). The choices respondents make among alternative sets of conditions indicate the relative importance of each attribute measured in the experimental design and a willingness to make tradeoffs, thus offering a realistic portrayal of human behavior. The results from a stated choice model allow for predictions of how a respondent would react to future changes within the attributes of an experimental design (Louviere, Hensher, & Swait, 2000). Based on utility maximization, the theory underpinning stated choice and preference research, an individual will make choices that maximize benefits and as such, a preference for one alternative over another should indicate the associated levels of utility (McFadden, 1974).

Stated choice modeling was initially employed in marketing and transportation research (Ben-Akiva & Lerman, 1985) and later extended to the environmental field to elicit preferences for agricultural and biological research (Louviere & Hensher, 1983), environmental programs (Opaluch, Swallow, Weaver, Wessells, & Wichelns, 1993), and recreational experiences (Louviere & Timmermans, 1990; Stynes & Peterson, 1984). In the last decade, stated choice experiments have become more numerous and have been used to assess the preferences of recreation user groups such as hunters (Hunter, Haider, & Botton, 2005), scuba divers (Sorice, Oh, & Ditton, 2007), and mountain climbers (Scarpa & Thiene, 2005; Hanley, Wright, & Koop, 2002). The settings in which these techniques have been applied vary from wilderness areas (Lawson & Manning, 2002, 2003; Newman

et al., 2005) to frontcountry parks and urban forests (Arnberger & Haider, 2007; Bullock & Lawson, 2008; Cahill, Marion, & Lawson, 2008; Reichhart & Arnberger, 2010).

There have been mixed results from stated choice studies. For example, a study at Acadia National Park found that visitors were willing to accept an increased number of encounters with other visitors and higher levels of biophysical degradation in the park to have greater freedom and access (Cahill et al., 2008). Another stated choice study at Acadia National Park similarly found that visitors were opposed to restrictions on levels of use; however, respondents did support management actions to minimize degradation caused by visitors walking off designated trails (Bullock & Lawson, 2008). These findings suggest that access and a strong management presence can be important elements of recreation use in frontcountry recreation opportunities.

Outdoor recreation in backcountry settings typically involves large and remote spaces that provide distinct opportunities for visitors. Preferences for low visitation rates, little environmental degradation, freedom, and spontaneity in this context may cause visitors to accept relatively high intensity of management to achieve these conditions. For example, a study of the wilderness portion of Denali National Park found that visitors were willing to accept restrictions on levels of use and campsite location to help achieve desirable social and environmental conditions (i.e., low levels of campsite impacts and high levels of trail and campsite solitude) (Lawson & Manning, 2002). Conversely, a study of visitors to the wilderness portion of Isle Royale National Park found that visitors were willing to accept less campsite solitude to prevent restrictive limits on visitor use levels and patterns (Lawson & Manning, 2003).

Visual Research Methods

Visual research approaches involve simulations of a range of recreation-related impacts and conditions and have been used in normative studies of indicators and standards of quality and stated choice modeling (Bullock & Lawson, 2008; Cahill et al., 2008; Lawson & Manning, 2002; Newman et al., 2005). Visual research approaches offer several advantages over numerical and narrative descriptions of recreation impacts and conditions, including the ability to provide pertinent information to respondents that would otherwise be difficult or awkward to communicate (Manning & Freimund, 2004). For example, in visual studies of crowding, all respondents see not only the number of visitors encountered but also important characteristics of those encountered, including recreation activity engaged in, mode of travel, and group size. This is potentially important because perceived crowding has been found to be mediated by such variables (Manning, 1986, 2011; Manning, Valliere, Minter, Wang, & Jacobi, 2000). In more conventional approaches, respondents may have to make assumptions about such characteristics, and these assumptions are likely to vary. Visual research methods also focus directly and exclusively on the variables under study. That is, only the treatment variable changes while all other variables included in the image remain constant. Visual simulations of some indicators, such as trail and campsite impacts, may represent a more powerful and elegant means of communication with respondents than detailed and technical narrative descriptions. Finally, visual images can be edited to present conditions that are difficult to find in the field or that do not currently exist. For example, visual studies of crowding and resource impacts can incorporate conditions that do not now exist but might occur in the future as a function of continuing use trends.

A study at Arches National Park represents how visual research methods have been used to study standards of quality for recreation conditions (Manning, Lime, Hof, & Freimund, 1995). In this study, the number of people at one time (PAOT) at Delicate Arch was found to be important to visitors in determining the quality of the experience of hiking to this

iconic feature. To explore standards of quality for PAOT, a series of 16 images was created using photo editing software to represent a range of PAOT levels at Delicate Arch. These photographs were incorporated into a visitor survey in which respondents were asked to rate the acceptability of each photograph. The study found that visitor acceptability ratings fall out of the acceptable range at about 30 PAOT and that this may be an appropriate standard of quality. Visual research methods have been expanded to address resource, social, and managerial components of outdoor recreation opportunities.

Increased application of visual research methods has revealed a range of issues that may influence its utility. Several important considerations include the validity and reliability of visual measures (Palmer & Hoffman, 2001; Bateson & Hui, 1992), the degree of realism depicted in simulated environments (Lange, 2001), and the challenges of applying visual methods to a range of environmental planning, management, and design issues (Lange, 1994). An additional concern is the ability of static images such as computer-generated photographs to fully capture experiential sensations such as the speed, distance, and direction of movement in a recreation setting (Reichhart & Arnberger, 2010). For example, recent research has compared digital photographic methods with 3D computer animations to assess social carrying capacities on urban trails (Reichhart, Arnberger, & Muhar, 2007) and motorized traffic conditions in natural settings (Valliere, Park, Hallo, Stanfield-McCown, & Manning, 2006). Much of this emerging body of literature on visual research and related methods has found this approach to be relatively robust and useful (Freimund, Vaske, Donnelly, & Miller, 2002; Krymkowski, Manning, & Valliere, 2009; Needham, Rollins, & Wood, 2004; Manning, 2011; Manning & Freimund, 2004; Manning, Freimund, Lime, & Pitt, 1996; Manning et al., 2000).

Study Methods

This study used stated choice modeling in a survey addressing resource, social, and managerial conditions associated with outdoor recreation. This approach was adopted to better understand the relative importance of indicators and standards of quality that defined outdoor recreation experiences on three mountain summits. Visual simulations were used to present six indicators and a range of associated standards of quality that were incorporated into the stated choice experiment. The modeling used a dichotomous choice approach in which respondents were presented with sets of two photographs that included alternative combinations of standards of quality for each of the six indicator variables and were asked to indicate which of the two photographs they preferred. The study was applied to mountain summits in the Northern Forest because of the popularity of these areas for recreation and their inherently fragile character.

Site Selection

Three mountain summits were selected for this research, ranging from high to low levels of visitor use, development, and management: Cadillac Mountain, Maine (Cadillac); Camel's Hump, Vermont (Camel's Hump); and Cascade Mountain, New York (Cascade) (see Figure 1). An advisory group of representatives from public and private outdoor recreation-related institutions from the Northern Forest states was formed in fall 2007 to aid in the selection of study sites to represent a spectrum of recreation opportunities. Group members were asked to evaluate a number of summits specific to their state based on criteria derived from the Recreation Opportunity Spectrum (Clark & Stankey, 1979), including access, use level, recreational uses present, management presence, and level of development. The 46 high peaks (over 4,000 feet) in the Adirondacks, the 100 highest peaks



FIGURE 1 Study context in the Northern Forest region of the United States.

in New England, and all peaks above 1,000 feet in Acadia National Park were evaluated for possible inclusion in this study. Only treeless summits were considered due to their finite nature and popularity among recreationists. Cost and the feasibility of sampling were also considerations due to concerns surrounding access during the field season and adequate visitation at areas of low use.

Study Context

This study was conducted in the Northern Forest, a region of relatively contiguous woodland comprising 26 million acres in New York, Vermont, New Hampshire, and Maine (Malmshemer, Bentley, & Floyd, 2002). There are a variety of ecosystems in the region that include northern hardwood and boreal forests dispersed throughout federal, state, and private lands (Harper, Faulk, & Rankin, 1990). Within the Northern Forest, mountain summits are highly popular destinations that play an important role in outdoor recreation and tourism, aesthetic value, and economic support of local communities (Johnson & Dawson, 2004; Porter, Erickson, & Whaley, 2010). These alpine areas contain biophysical characteristics that are particularly susceptible to degradation (Monz, 2000). Protection of the ecological integrity of mountain summits and their potential for outdoor recreation has become a priority for management and conservation organizations (Godde, Price, & Zimmermann, 2000; Jenik, 1997).

Among the three sites that were identified for this research, Cadillac was selected as the most heavily used, developed, and managed summit according to the adapted ROS classification. Cadillac is one of the most popular destinations in Acadia National Park. Acadia has hosted an average of nearly 2.5 million visitors per year since 1990, and Cadillac accommodates nearly 6,000 visitors per day during the summer season (Jacobi, 2003; Manning, 2009). At 1,532 feet, this iconic peak offers remarkable views of the North Atlantic coast, a diversity of habitats including trails that meander through forests of spruce and pitch pine, and a scenic road that winds its way up to an exposed granite summit. Cadillac offers a wealth of recreation opportunities and is highly accessible to

the public. Accordingly, park managers have implemented several efforts to sustain heavy use, including a paved loop trail, a visitor contact station that offers refreshments and information for tourists, and a road leading to the summit (Manning, 2009).

The second study site, Camel's Hump, was selected because of its relatively moderate levels of use, development, and management. Reaching above 4,000 feet, Camel's Hump is the highest undeveloped summit along the main ridge of the Green Mountains in Vermont. The summit is home to 10 acres of globally endangered arctic tundra vegetation and is a highly popular hiking destination in the northeast (Johnson, 1998). The Green Mountain Club, one of the organizations that manage Camel's Hump, employs a summit steward program to protect the peak's vegetation during the high-use season. On nice summer days, visitation rates can reach up to 500 people per day. The popular day hike to the summit offers a panoramic view and access from three trails, one of which coincides with Vermont's Long Trail.

The third study site selected for this research was Cascade. This peak represents the lower end of the spectrum in terms of use, development, and management, and is located in the Adirondack Forest Preserve in New York. The New York Department of Environmental Conservation owns the land, and the Adirondack Mountain Club and the Nature Conservancy work in cooperation to help manage the area. The summit trail ascends 2,000 feet in 2.4 miles reaching an elevation just above 4,000 feet. The primary trail to the summit of Cascade is considered one of the more popular day hikes among the 46 high peaks in New York and has an easily accessible trailhead located adjacent to a major highway. Between 12,000 and 14,000 people visit Cascade each year (J. Goren, personal communication, March 2009). There are no informational signs on the summit to keep people on-trail and no steward program to caution and educate the public about sensitive vegetation. However, there are water bars and stone staircases placed along the trail to minimize impact caused by foot traffic.

Selection of Indicators of Quality

The indicators of quality selected for this research fall within the resource, social, and managerial dimensions of outdoor recreation as described above (Manning, 2011). Guided by a review of the outdoor recreation literature and related empirical work examining visitor use and resource conditions on these summits (Goonan, 2009; Manning, 2009; van Riper, 2009), six indicators were selected: 1) resource conditions on-trail, 2) resource conditions off-trail, 3) number of people on-trail, 4) number of people off-trail, 5) management to mitigate on-trail ecological impacts, and 6) management to keep visitors on designated trails. The indicator variables were selected because they were generally applicable to all three study sites, often important to recreationists, and representative of management concerns.

Computer-generated photographs were constructed with Photoshop software (Adobe, Inc., v. 10.0) to depict a range of standards of quality for the six indicator variables (see Figure 2). The base photograph was a compilation of several mountain summits that were as representative as possible to the three study sites. The six indicator variables were included in the base photograph, and a range of conditions was prepared for each of these indicator variables. The purpose of the survey was described to respondents in a short narrative statement on the first page of the questionnaire. This narrative was intended to sensitize visitors to the general nature of the study. The pairs of stated choice scenarios that followed in the questionnaire were represented *only* using visual simulations. Contrary to nearly all recreation-related stated choice research, this study did not explicitly identify

Please look at the two pictures in **Tab 1** of the binder. Which of the conditions represented in these pictures would you prefer to find on this mountain summit? (Circle one number.)

Tab1, Picture A		Tab 1, Picture B					
4	3	2	1	1	2	3	4
Strongly prefer picture A		Moderately prefer picture A		Moderately prefer picture B		Strongly prefer picture B	

FIGURE 2 Example of survey question and paired photographs used in the stated choice survey.

the indicators under study nor describe the range of standards for each indicator variable. This approach was intended to advance earlier studies because the indicators represented in the management scenarios were implicitly embedded in the study photographs, thereby minimizing bias introduced by the researchers.

Survey Administration

On-site self-administered questionnaires were distributed to reach a representative sample of adult visitors during the summer and fall of 2008. Survey dates were stratified by day of the week (weekend vs. weekday) and time of the day (am vs. pm). During the sample periods, visitors were approached by a trained survey administrator and asked to complete the questionnaire. All surveys were administered during the visitor experience either at the mountain summits or trailhead after visitors returned from the summit. Adult visitors were selected from groups by identifying the person with the most recent birthday. At the onset of the survey, the administrator gave instructions on how to complete the questionnaire, ensured the respondents had experienced the destination, and presented them with a binder that included nine pairs of photographs.

Experimental Design

The six indicators of quality included in the experimental design of this study were assigned three standards of quality to encompass a realistic range of resource, social, and managerial conditions at the three mountain summits (see Table 1). The three standards were represented in the design with effects coding. The first standard was treated as a baseline or excluded value to avoid overallocating the model, while the others were represented with statistical indicators (Boxall, Adamowicz, Swait, Williams, & Louviere, 1996; Lawson & Manning, 2002; Newman et al., 2005). In this effects coding scheme, the coefficients of the excluded levels were equal to the negative sum of the coefficients of the levels entered into the model.

A fractional factorial design was used to accommodate pairs of management scenarios and minimize the number of profiles necessary to estimate the study parameters (Green, 1974). The standards were combined using an 18 choice set “shifted” design that was orthogonally blocked into two survey versions, such that each respondent needed to review nine paired comparisons. The operative question asked visitors to select the scenario from the paired comparison they preferred. The two survey versions, each containing nine paired photographs, were evenly distributed among the three study sites. A restricted evaluation was used, in that respondents were not provided an option to choose neither scenario if both were unacceptable.

This design did not include interaction terms because of the applied approach adopted by the authors. Although estimating interactions would have helped to answer intriguing theoretical questions, the present study was conducted as a practical application of stated choice modeling and thus, only included main effects. The decision to exclude interactions was further supported by past research suggesting that a main effects model would account for the majority (i.e., 70–90%) of explained variance (Louviere et al., 2000), the authors’ expectations to not find confounding effects in the model, and the design’s ability to produce statistically robust results (Ferrini & Scarpa, 2007).

TABLE 1 Indicators and Standards of Quality Selected to Represent Recreation Conditions at Three Mountain Summits in the Northern Forest**Resource Dimension***Resource conditions on-trail*

1. Visitor use on-trail has caused slight damage
2. Visitor use on-trail has caused moderate trail widening and deepening
3. Visitor use on-trail has caused severe trail widening and deepening

Resource conditions off-trail

1. Visitor use off-trail has caused 10% damage to vegetation and soil
2. Visitor use off-trail has caused 50% damage to vegetation and soil
3. Visitor use off-trail has caused 90% damage to vegetation and soil

Social Dimension*Number of people on-trail*

1. Encounter no other visitors on-trail
2. Encounter 18 other visitors on-trail
3. Encounter 36 other visitors on-trail

Number of people off-trail

1. Encounter no other visitors off-trail
2. Encounter 18 other visitors off-trail
3. Encounter 36 other visitors off-trail

Managerial Dimension*Management on-trail*

1. The designated trail is rock and soil
2. The designated trail is rock, soil, and stepping stones
3. The designated trail is paved

Management off-trail

1. Educational signage indicating visitors should stay on-trail
2. Educational signage and a scree wall along the margins of the trail
3. Educational signage, a scree wall, and a fence along the margins of the trail

Model Analysis

An analysis of all stated choice data used for this research was conducted *a priori* to check the statistical conclusion validity among survey results. All data were aggregated into a full sample model and analyzed with a fixed-effects panel data estimator to account for collinearity among individual observations. In this procedure, the respondent's choice was treated as a dependent variable and regressed on a function of the differences among the three standards of quality associated with each indicator. The results from this analysis indicated that preferences for the six indicators of quality were consistent with intuition. However, this study hypothesized that there would be differences across sites based on preference so site-specific models were subsequently computed. Thus, the findings reported from this research are divided by study site.

There were three stages of analysis conducted to determine the tradeoffs visitors would be willing to make among potential indicators and standards of quality. First, the relative importance of six indicator variables was calculated using a Likelihood Ratio (LR) chi square test. The LR chi square values were used to rank the indicator variables; coefficients with larger chi square values had a greater influence on the overall fit of the model (Holmes & Adamowicz, 2003). Second, alternative specific conditional logistic regression was used to estimate the utility of the three standards associated with the six indicator variables.

The resulting regression coefficients were treated as proxies for utility and were assumed to measure visitors' preferences for standards of quality (Opaluch et al., 1993). Finally, the three models were compared using effects coded variables and interaction terms that corresponded to the three study sites. The interaction terms were products of the effects coded variables and a set of dummy coded variables that were created to indicate the study site. All of the survey data analyzed in this study were coded in an online database using Perseus Version 6.0. The alternative specific conditional logit models were estimated in an extension program of LIMDEP Version 9.0, titled NLOGIT Version 4.0.

Results

A total of 772 visitor groups were contacted at the three study sites. A response rate of 86% was achieved, resulting in 654 completed and usable questionnaires. There were 259 surveys completed at Cadillac (79% response rate), 197 at Camel's Hump (94% response rate), and 198 at Cascade (88% response rate). In total, 5,812 paired comparisons were entered into the model.

Nonresponse bias was assessed by comparing the socio-demographic information collected in on-site contact logs for respondents and nonrespondents. There were no significant differences among respondents based on personal group size ($F = 1.52$, $df = 759$, $p = 0.22$). However, there was bias based on gender, in that more males refused to complete the questionnaire ($\chi^2 = 9.42$, $df = 1$, $p \leq 0.01$). No adjustments were made to the data based on this demographic-related bias, and this should be taken into consideration in the interpretation of these results.

Descriptive Statistics

Most respondents (57.6%) were male, with an average age of 43 years. Visitors to Cadillac were significantly older than visitors to the other two study sites ($F = 13.86$, $df = 2$, $p \leq 0.01$). More specifically, nearly half (46.8%) of the visitors to Cadillac were older than 50, whereas 15.1% and 21.7% fell into this category at Camel's Hump and Cascade, respectively. At all three sites, respondents were highly educated: nearly three-fourths (77.7%) attained a Bachelor's degree or higher. When asked which racial groups respondents identified with, the vast majority (89.0%) identified as White, 2.4% as American Indian or Alaska Native, 0.8% as Black or African American, 2.1% as Asian, and 0.5% as Native Hawaiian or other Pacific Islander. With regard to ethnicity, only 2.0% were of Hispanic descent.

The analyses of trip characteristics among survey respondents suggested the majority of visitors (85.1%) at all three sites lived in the United States, and one in 10 were from Canada. Just over half (64.8%) of the visitors at Cascade were residents of New York, and a similar majority (66.5%) at Camel's Hump were from Vermont. Cadillac visitors, on the other hand, reported traveling from a variety of states including Maine (12.2%), Massachusetts (12.2%), and Pennsylvania (9.3%). The average group size at all three summits was between three and four people, and Cadillac and Cascade accommodated larger groups than Camel's Hump ($F = 3.40$, $df = 2$, $p \leq 0.05$). There was an even distribution among group types at Camel's Hump and Cascade; however, the majority (77.8%) of Cadillac visitors traveled with families ($\chi^2 = 85.36$, $df = 8$, $p \leq 0.01$). Cadillac and Cascade visitors spent two hours on the summit, which was greater than the time reported by visitors at Camel's Hump ($F = 6.20$, $df = 2$, $p \leq 0.01$). On average, half of all respondents made prior trips to the three study sites, and in the past year more visitors had previously been to Camel's Hump

than Cadillac or Cascade ($F = 8.51$, $df = 2$, $p \leq 0.01$). Cadillac visitors had the greatest number of years visiting, reporting an average of 20 or more previous visits.

Relative Importance of Indicators of Quality

The first stage of analysis examined the relative importance of six indicators of quality at the three study sites. Each of the indicators was constrained to zero one at a time to measure its relative influence on the fit of the model. The findings suggested that certain indicators were driving respondents' decisions, the most important of which was the number of people off-trail. The ordinal ranking of the LR chi square values illustrated the differences among respondents' preferences.

At Cadillac, the number of people off-trail was by far the most important indicator of quality. This indicator had a notably higher LR chi square value relative to the other variables, suggesting that respondents were sensitive to people walking off designated trails. The second and third most important indicator variables in the model included resource conditions off-trail and number of people on-trail. The LR chi square values indicated that the remaining indicators measuring management off-trail, management on-trail, and resource conditions on-trail ranked fourth, fifth, and sixth, respectively.

Similar to Cadillac visitors' preferences, Camel's Hump respondents were most heavily influenced by the number of people off-trail; this variable clearly had the greatest influence on the fit of the model. The indicator variable that ranked second, number of people off-trail, also fell within the social dimension of recreation opportunities. Management tactics such as a scree wall and fencing used to keep people on designated trails were included in the third most important indicator and tactics such as stepping stones and pavement comprised the fourth most important indicator of quality. The two least important indicators were resource conditions on-trail and resource conditions off-trail.

At Cascade, survey respondents similarly ranked the indicators of quality estimated in this phase of the analysis. Again, there were dramatic differences between respondents' reactions to the number of people off-trail and the second most important indicator that measured resource conditions off-trail. The research results further revealed the remaining indicators ranked in descending order of importance (see Table 2).

Preferences for Standards of Quality

The second stage of analysis used alternative specific conditional logistic regression to examine visitors' preferences for three potential standards of quality associated with each of the six indicator variables. Results suggested that respondents preferred little environmental degradation on and off-trail, few other people on and off-trail, and a low intensity of management on and off-trail (see Figure 3). Several exceptions to this trend did emerge, and these inconsistencies are detailed in the discussion section. For the majority of indicator variables, there was a general trend in responses indicating that visitors found the greatest utility in low levels of impact; as impact increased, utility decreased. For example, the first standard of quality for the indicator measuring the number of people off-trail was most preferable. As the number of people increased, the recreation conditions were rated as less desirable.

There were three other noteworthy findings concerning this analysis. First, the indicator measuring the number of people off-trail strongly influenced respondents' preferences, and the differences among the three standards for this indicator were very pronounced. Second, the resource conditions on-trail indicator for Cadillac visitors did not follow the intuitive trend present in the majority of responses. At Cadillac, high levels of impact to the trail

TABLE 2 Stated Choice Model Coefficients for Six Indicators of Quality and Relative Importance of Associated Standards of Quality (n = 5,812)

Indicators of Quality	Cadillac Mountain		Camel's Hump		Cascade Mountain	
	Coefficient (S.E)	LR χ^2	Coefficient (S.E)	LR χ^2	Coefficient (S.E)	LR χ^2
Resource conditions on-trail						
Low	.08 (-)	6th	.18 (-)	5th	.16 (-)	5th
Medium	-.03 (.04)	2.13	.01 (.05)	14.46	-.02 (.05)	6.57
High	.11** (.04)		-.19** (.05)		-.14** (.05)	
Resource conditions off-trail						
Low	.28 (-)	2nd	.11 (-)	6th	.30 (-)	2nd
Medium	.03 (.04)	75.46	.04 (.05)	4.22	.15** (.05)	85.54
High	-.31** (.04)		-.14** (.05)		-.45** (.05)	
Number of people on-trail						
Low	.09 (-)	3rd	.28 (-)	2nd	.32 (-)	3rd
Medium	.25** (.04)	75.18	.06 (.05)	60.16	-.01 (.05)	57.91
High	-.34** (.04)		-.34** (.05)		-.31** (.05)	
Number of people off-trail						
Low	.62 (-)	1st	.78 (-)	1st	.78 (-)	1st
Medium	-.11** (.04)	312.94	-.17** (.05)	348.28	-.13** (.05)	331.44
High	-.51** (.04)		-.61** (.05)		-.65** (.05)	
Management conditions on-trail						
Low	.14 (-)	5th	.19 (-)	4th	.17 (-)	4th
Medium	-.04 (.04)	6.79	-.04 (.05)	12.22	-.04 (.05)	6.74
High	-.10** (.04)		-.15** (.05)		-.13** (.05)	
Management conditions off-trail						
Low	.20 (-)	4th	.15 (-)	3rd	.13 (-)	6th
Medium	-.07 (.04)	18.75	.11* (.05)	24.27	-.01 (.05)	2.89
High	-.13** (.04)		-.26** (.05)		-.13** (.05)	

*p ≤ .05. ** p ≤ .01.

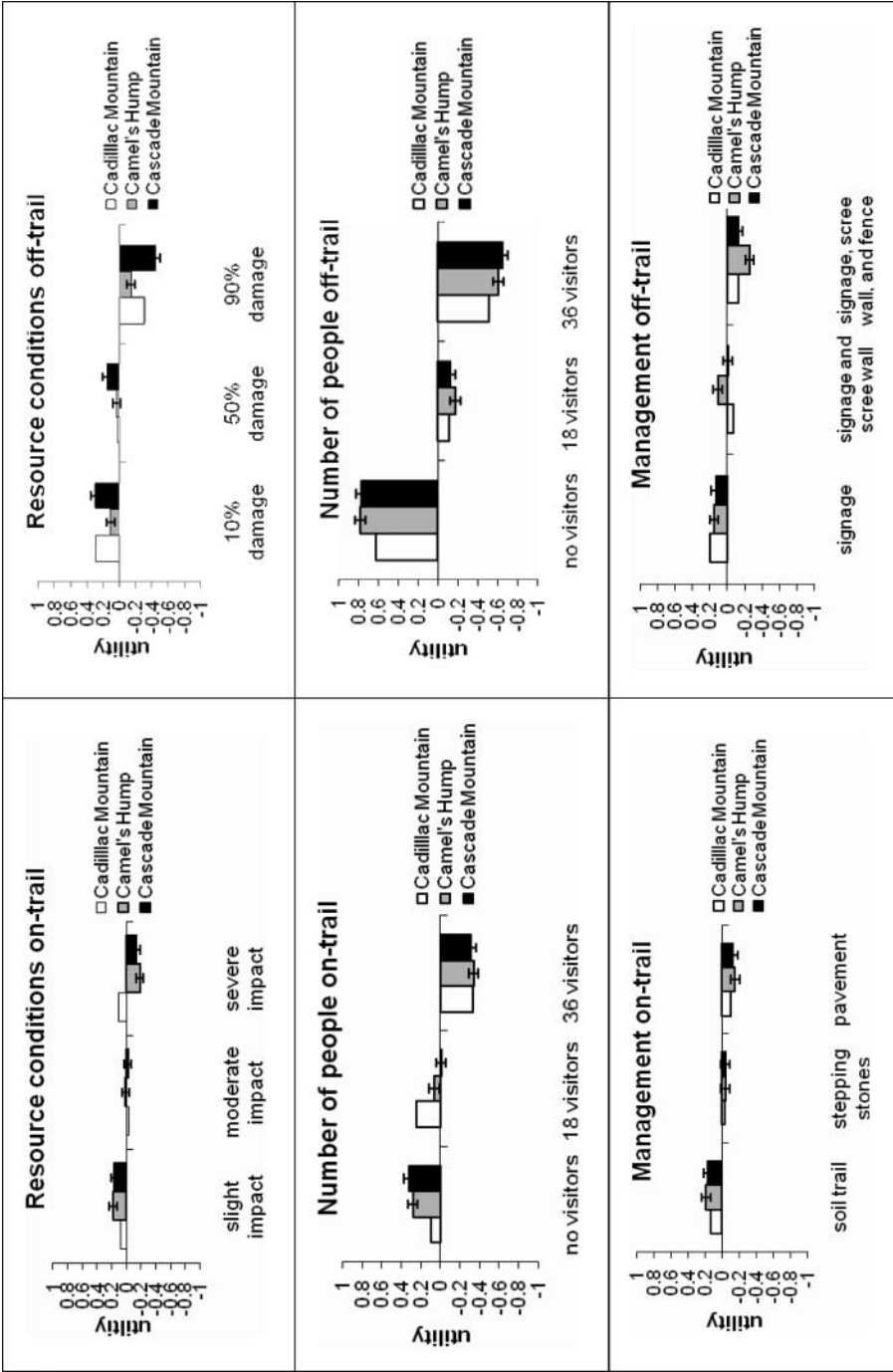


FIGURE 3 Graphical representation of the levels of utility reported for standards of quality and for six indicator variables measured at the three study sites.

TABLE 3 Three Comparisons Among Visitors' Preferences for Recreation Conditions at the Three Study Sites

Indicators of Quality	Cadillac Versus Camel's Hump LR χ^2	Cadillac versus Cascade LR χ^2	Camel's Hump Versus Cascade LR χ^2
Resource conditions on-trail	27.691*	19.956*	0.536
Resource conditions off-trail	10.946*	5.233	20.385*
Number of people on-trail	10.999*	18.029*	0.868
Number of people off-trail	6.820*	7.129*	0.532
Management on-trail	0.874	0.289	0.121
Management off-trail	9.434*	1.407	4.368

* $p \leq .05$.

system were preferred over moderate and low levels of impact. Finally, the indicator measuring the number of people on-trail at Cadillac was another exception to the general trend in responses, in that Cadillac visitors preferred some people to no other people in the study photographs.

Comparison Among the Three Study Sites

The third stage of analysis in this study compared findings among the stated choice models corresponding to the three study sites. These results suggested that there were several substantive differences among respondents' preferences for recreation conditions at the three mountain summits (see Table 3). The interaction terms and the parameters of the base effects codes that corresponded to the respective study sites were used to test whether there were differences among responses. This procedure allowed for three major comparisons: Cadillac versus Camel's Hump visitors, Cadillac versus Cascade visitors, and Camel's Hump versus Cascade visitors. The individual indicators of quality within the three comparisons revealed that half of the indicators differed to a statistically significant degree. Specifically, five of the six indicator variables between Cadillac and Camel's Hump visitors differed, three of the six indicators between Cadillac and Cascade visitors differed, and one of the six indicators between Camel's Hump and Cascade visitors differed. No indicators were significantly different across all three comparisons. Of the indicators that did not differ, preferences for on-trail management techniques were similar in all three comparisons, suggesting that respondents shared opinions about stepping stones and pavement irrespective of varying levels of use, management, and development.

Discussion

This study assessed the relative importance placed on six indicators of quality that fell within the resource, social, and managerial dimensions of outdoor recreation; determined the tradeoffs visitors would be willing to make among potential standards of quality; and compared these findings across three study sites that offered a range of recreational opportunities in the Northern Forest of the United States. The results from this study have several implications that can be organized into the three stages of analysis, including the relative importance of indicators of quality, preferences for potential standards of quality, and the comparisons between pairs of study sites.

Relative Importance of Indicators of Quality

The results from the first stage of analysis, estimation of LR chi square tests, demonstrated that certain indicators elicited a strong response from visitors and were relatively more important. The benefits associated with the three stated choice models provided insight into respondents' preferences for potential standards of quality, thereby generating comparisons among the six indicators of quality (Holmes & Adamowicz, 2003). The most important indicator at all three study sites was the number of people off-trail. The chi square statistics for this indicator were dramatically higher than the next most important indicator at all three study sites, suggesting that respondents had strong preferences for the number of people off-trail. There are several possible explanations for this finding. First, this may reinforce the notion that visitors were concerned with degradation to vegetation and soil off designated trails and may respond favorably to management actions that prevent impact to sensitive vegetation on the three summits (Bullock & Lawson, 2008). Second, respondents may feel strongly about the number of people off-trail out of principle. In other words, study photographs that showed people outside of barriers designed to discourage off-trail use (e.g., fencing) may have triggered an adverse reaction because those individuals were not abiding by rules and regulations. An alternative explanation for visitors' strong opposition to off-trail use may relate to perceived levels of crowding in that scenarios including a high density of people on and off-trail were deemed less desirable.

The second most important indicator variable for Cascade and Cadillac visitors measured resource conditions off-trail, suggesting that visitors were concerned with degradation to the fragile ecosystems typically found on mountain summits and may support more aggressive management techniques to protect soil and vegetation. Alternatively, this finding may reflect a visual aesthetic response to the presence of green vegetation in the study photographs as opposed to concern over conditions of the ecosystem. Off-trail impacts were of particular importance at Cascade due to high levels of on-site environmental impact and less management presence compared to the other two study sites (Goonan, 2009). It may be wise for managers of Cascade to consider increasing educational and/or interpretative signage at the summit or otherwise employing techniques to change visitor behavior. To ensure that visitors are aware of the impacts they cause by walking off-trail, there are a number of alternatives available for recreation managers (see Marion & Reid, 2007). Similar to Cascade and Cadillac, Camel's Hump visitors were most concerned with the number of people off-trail; however, they were least concerned with resource conditions on and off-trail. A number of management techniques were employed at the summit of Camel's Hump to protect the summit's alpine vegetation, including a summit steward program that raised awareness of environmental conditions and educational signage communicated the importance of not trampling sensitive vegetation. It may be that while visitors at Camel's Hump were concerned with off-trail use, they believed environmental degradation at the summit was adequately addressed.

Preferences for Standards of Quality

The results from the second stage of analysis that used alternative specific conditional logistic regression suggested that visitors had varying degrees of preferences for the three standards associated with the six indicator variables. This information can be useful for managers to evaluate the importance visitors place on particular aspects of outdoor recreation experiences and infer value judgments reflected in a respondent's choice of one alternative over another (Louviere & Timmermans, 1990). Low levels of impact were assumed to have the greatest utility for respondents in that as impact increased, the utility visitors associated

with indicator variables decreased, suggesting that respondents preferred minimal ecological degradation, few other people, and low intensity of management (Cahill, Marion, & Lawson, 2007).

There are two findings associated with this analysis that are counterintuitive and warrant discussion. These findings could be an artifact of the photographs employed to measure the tradeoffs made among standards of quality or could relate to respondents' value judgments. The first unintuitive finding suggested that visitors to Cadillac preferred high environmental impact to the trail system over moderate and low levels of impact. It may be that the study photographs that portrayed impact by widening the trail and decreasing soil cover did not resonate well with respondents at Cadillac because the actual trail system was paved. In other words, the measurement of high levels of trail impact (i.e., bare granite) could have more closely aligned with on-site conditions. Alternatively, visitors to Cadillac were not perceptive of the conditions represented in the study photographs because of limited knowledge of the natural progression of ecological impacts (Hammit & Cole, 1998).

The second counterintuitive finding in the third stage of analysis was found in Cadillac respondents' preferences for the number of people on-trail. Visitors to Cadillac preferred some people over no people on-trail. This finding could be linked to visitors' opposition to restrictions on use levels, in that the photographs with low numbers of visitors could be perceived as a result of limits on use imposed by management (Cahill et al., 2007; Lawson & Manning, 2002, 2003). A second possibility is that visitors at Cadillac Mountain would feel more comfortable participating in a recreation activity in which other people were involved. The analysis of socio-demographic characteristics illustrated that visitors to Cadillac were significantly older than visitors to the other two study sites, which may help to explain this finding. For example, older visitors might have been more concerned with safety and/or felt uncomfortable in a place where no one would be around to help in the case of an injury.

Comparison among the Three Study Sites

The third stage of analysis compared the stated choice models for the three study sites and revealed different preferences for opportunities at these areas. In general, visitors reported similar trends in the utilities of the standards of quality, thereby preferring few resource, social, and managerial impacts, and rated half of the indicator variables differently, suggesting that the visitors at the three summits preferred somewhat different outdoor recreation experiences. The adapted ROS framework defined opportunities offered at the three summits and revealed findings that supported the notion that distinct recreational environments should be maintained. The management conditions associated with the range of settings defined by the ROS helped to explain several of the differences observed in the study findings. For example, management of Cadillac was distinct from the other two summits in that Cadillac was accessible by car, whereas the Camel's Hump and Cascade experiences entailed three-mile hikes to the summits. These conditions likely created different expectations concerning the visitor experience and allowed different segments of the population to visit the study sites. In other words, visitors who were not physically able to hike Camel's Hump and Cascade were able to drive to the summit of Cadillac.

When the comparisons were dichotomized, visitors to Cadillac and Cascade were more similar than visitors to Cadillac and Camel's Hump. Visitor preferences for the majority of indicators in the Camel's Hump and Cascade models did not differ, suggesting that similar outdoor recreation opportunities were desired by visitors at the two summits. The descriptive findings from this study reinforce the notion that visitors at Camel's Hump and Cascade were comparable, particularly with respect to group types and measures of

experience use history, suggesting that the similarities among trip characteristics influenced visitors' evaluations of recreation conditions (White, Virden, & van Riper, 2008). The socio-demographic characteristics such as age further distinguished Cadillac visitors from Camel's Hump and Cascade visitors. These differences may have influenced Cadillac visitors' evaluations, especially regarding matters of access and personal safety.

The indicator measuring intensity of on-trail management was equally preferred by survey respondents across the three study sites. It may be that on-trail management was equally valued to provide accessibility for people with physical limitations (Cahill et al., 2008). Conversely, respondents may perceive more developed conditions as similarly unfavorable. These findings suggest that visitors will respond in the same way to pavement and stepping stones in both front and backcountry settings.

Limitations

There are several potential limitations associated with this study that should be taken into consideration. First, the survey instrument was not pretested to account for respondent burden. Although a fractional factorial design was employed to minimize the number of stated choice scenarios presented to respondents, the survey instrument was not pilot tested. This can be problematic because proper pilot testing reveals the degree of cognitive complexity in stated choice experiments (Louviere et al., 2000). However, observational and anecdotal evidence collected by the survey administrators suggest that respondents experienced low levels of burden and remained aware of the indicators and standards of quality being measured, perhaps because of the visual format of the survey instrument. In other words, the ease of examining computer-generated photographs seemed to present fewer burdens on respondents than would be experienced with a written questionnaire.

Second, the results from this study were possibly affected by respondents' knowledge of resource conditions off-trail in that visitors may not have associated cleared vegetation with human use. For example, a visitor may not attribute a bare granite summit to excessive human use and/or degradation of environmental conditions. Instead, he or she may assume that a lack of vegetation is a product of natural processes. This limitation could be avoided by describing the recreation conditions presented in the study photographs; however, written narratives were intentionally excluded to not draw direct attention to the indicators represented in the management scenarios, and avoid related biases introduced by the researchers.

Finally, the placement of study sites along the ROS may be considered a limitation, because the lower end of the spectrum was not fully captured in the research results. Assuming that the three mountain summits selected for this study offered a range of different opportunities for recreation, visitors' preferences would have been equally distinguishable among study sites. However, Camel's Hump and Cascade visitors were more similar than Cadillac visitors in terms of their preferences for recreation conditions. Although an advisory group was consulted to inform the selection of study sites, the final placement of summits along the adapted ROS did not fully align with the anticipated design.

Conclusion

This study builds on three conceptual frameworks in the outdoor recreation literature—the threefold framework of recreation opportunities, indicators and standards of quality, and the Recreation Opportunity Spectrum—to develop a conceptual foundation for exploring visitor preferences for conditions at a range of recreation sites. Two research approaches—stated choice modeling and visual simulations—are used to gather data on visitor preferences,

with special focus on the tradeoffs visitors prefer to make among competing recreation conditions. Study findings present insights into the relative importance of indicators of quality, how visitors prefer to make tradeoffs among alternative mixes of standards of quality, and how these findings vary over a spectrum of mountain summits as defined by level of use, development, and management. Such findings can help guide management of recreation sites while also emphasizing the importance of providing a range of recreation opportunities.

The study advances research on visitor preferences for recreation conditions by organizing thinking on the basis of several outdoor recreation frameworks, thereby helping to “standardize” this type of research and enhance the extent to which it can be generalized. The study innovatively combines the two research methods of stated choice analysis and visual simulations, which allows a multivariate approach to exploring tradeoffs among competing indicators and standards of quality. Moreover, exclusive use of visual simulations to represent the range of indicators and standards strengthens the validity of study findings by challenging respondents to draw exclusively on their own perceptions of recreation conditions as represented in the study photographs without introduction of any intermediation and potential bias by researchers.

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