Solitude Versus Access: A Study of Tradeoffs in Outdoor Recreation Using Indifference Curve Analysis

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Tradeoffs are an inherent part of many of the decisions faced by outdoor recreation visitors and managers. One of the more challenging and pervasive issues in outdoor recreation concerns the appropriate level of use, or social carrying capacity, of popular attraction sites. Decisions about appropriate levels of visitor use involve inherent tradeoffs. Specifically, a choice must often be made between limiting visitor use to ensure a high quality visitor experience and allowing high levels of visitor use to ensure that large numbers of visitors retain access to park and outdoor recreation resources. This study uses indifference curve analysis to evaluate the tradeoffs that visitors prefer to make between solitude and access at Delicate Arch, Arches National Park. Study findings facilitate more informed judgments by Arches National Park managers regarding appropriate recreation opportunities at Delicate Arch. Specifically, this research quantifies the tradeoff preferences of visitors to Delicate Arch and provides a theoretically and empirically informed basis for establishing a social carrying capacity for this site.

Keywords solitude, carrying capacity, crowding, indifference curves, paired comparison, Arches National Park

Tradeoffs are an inherent part of many of the decisions faced by outdoor recreation visitors and managers. One of the more challenging and pervasive issues in outdoor recreation concerns the appropriate level of use, or social carrying capacity, of popular attraction sites. Decisions about appropriate levels of visitor use involve inherent tradeoffs. Specifically, a choice must often be made between limiting visitor use to ensure a high quality visitor experience and allowing high levels of visitor use to ensure that large numbers of visitors retain access to park and outdoor recreation resources (Manning, Valliere, & Jacobi, 1997).

This article describes techniques used to theoretically and empirically evaluate the tradeoffs associated with social carrying capacity at Delicate Arch, Arches National Park, Utah, using indifference curve analysis. Specifically, this study examines the tradeoffs visitors prefer to make between solitude and access. Solitude is measured in terms of the number of people seen at one time at Delicate Arch, and access is measured in terms of the percentage chance of receiving a hypothetical permit to hike to Delicate Arch. The article begins with a review of relevant research, outlining the concept of social carrying capacity, the theoretical basis of indifference curve analysis, and the methodology of paired

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comparisons. This is followed by an extension and application of these theoretical and empirical techniques to Delicate Arch.

Social Carrying Capacity

The concept of a social carrying capacity addresses the issue of how much visitor use can be accommodated in a park or other outdoor recreation area without diminishing the quality of the recreation experience to an unacceptable degree (Manning, 1999; Shelby & Heberlein, 1986; Wagar, 1964). A number of frameworks have been developed to provide managers with a basis for making decisions about the social carrying capacity of parks and outdoor recreation settings. These frameworks include Visitor Experience and Resource Protection (VERP) (National Park Service, 1997), Limits of Acceptable Change (LAC) (Stankey et al., 1985), Visitor Impact Management (VIM) (Graefe, Kuss, & Vaske, 1990), Carrying Capacity Assessment Process (C-CAP) (Shelby & Heberlein, 1986), and Quality Upgrading and Learning (QUAL) (Chilman, Foster, & Everson, 1990). Common to all of these approaches is the formulation of indicators and standards of quality. Indicators of quality are measurable, manageable variables that serve as quantifiable proxies for management objectives. Standards of quality define the minimum acceptable condition of indicator variables (Manning, 1999).

Recreation research has relied increasingly upon normative theory and methods to help formulate indicators and standards of quality related to the social carrying capacity of recreation areas (Manning, 1999). The normative approach developed in recreation research is based on the theory that individuals have personal standards they use to evaluate recreation conditions. If these standards are shared across individuals, they provide a basis for defining standards of quality for recreation experiences (Shelby & Heberlein, 1986). Social carrying capacity can then be defined as the level of recreation use beyond which standards of quality are violated.

The normative approach to defining social carrying capacity has been applied in numerous recreation studies. Several of these studies have focused on formulating crowding-related indicators and standards of quality. For example, Lewis, Lime, and Anderson (1996) developed standards of quality for the number of contacts with other visitors in the Boundary Waters Canoe Area Wilderness. A study of four wilderness areas was conducted by Roggenbuck, Williams, and Watson (1993) to examine the importance which visitors place on a series of indicators of quality related to the wilderness experience. Further, standards of quality were developed by asking visitors to indicate how much change from pristine conditions would be acceptable for several of the indicator variables. Manning, Valliere, Wang, and Jacobi (1999) applied the normative approach to defining social carrying capacity for the carriage roads in Acadia National Park. Visitors’ evaluations of a series of photographs depicting alternative levels of use along the carriage roads were used to help define standards of quality for the number of hikers and bicyclists seen along the carriage roads.

These and related studies have helped provide an empirical basis for formulating indicators and standards of quality. However, few such studies have explicitly addressed the inherent issue of tradeoffs between the quality of the recreation experience and access to park and recreation areas. Initial research suggests that more explicit consideration of such tradeoffs may have a substantial effect on standards of quality. For example, in the study of the carriage roads in Acadia National Park described above, respondents were first asked to report the maximum number of visitors “acceptable” (Manning et al., 1999). Later in the questionnaire, however, respondents were asked to report the maximum number of visitors that should be allowed to use the carriage roads before the managers should “restrict visitor use.” The latter question introduced the tradeoff of potential restrictions on visitor use.
levels and resulted in a social norm substantially higher than the former question. These findings suggest that more explicit consideration of tradeoffs between solitude and access may significantly influence normative judgments and associated standards of quality.

The study reported in this article is designed to address the issue of tradeoffs between solitude and access more directly and explicitly through application of indifference curve analysis. Indifference curve theory and techniques are used to help estimate social carrying capacity of Delicate Arch.

Indifference Curve Theory and Application

Indifference curve theory, developed in economics, provides a model representing the tradeoff decisions an individual makes in allocating a fixed level of income between two consumer goods (Nicholson, 1995). There are two primary components to the indifference curve model, the individual’s indifference curves and his or her budget constraint.

A single indifference curve represents all possible combinations of two goods (e.g., A and B) that provide the individual with the same level of utility (Findyck & Rubinfeld, 1995). The curves labeled IC₁, IC₂, and IC₃ in Figure 1 are examples of indifference curves. In theory, there are an infinite number of nonintersecting indifference curves representing the tastes and preferences of the individual with respect to goods A and B. Indifference curves further from the origin represent a higher level of utility than those closer to the origin.

Central to the theory of indifference curves is the concept of diminishing marginal utility (Nicholson, 1995). Diminishing marginal utility suggests that, as an individual accumulates larger amounts of a good, additional units of the good contribute less to the individual’s overall level of utility than do previous units of the good. It follows that, as an individual accumulates more of a good (e.g., good A), he or she will be willing to trade larger amounts of the good for an additional unit of an alternative good (e.g., good B). The diminishing marginal utility of goods implies that indifference curves are convex to the origin.

The budget constraint represents the possible combinations of goods A and B the individual can purchase, assuming the individual spends all of his or her income on the

![Image of indifference curves and budget constraint](FIGURE 1 Theoretical indifference curves and budget constraint.)
two goods (Pindyck & Rubinfeld, 1995). For example, the budget constraint labeled BC in Figure 1 represents all possible combinations of the two consumer goods A and B, for a fixed income level.

According to indifference curve theory, the optimal combination of goods A and B for a given income is located where the budget constraint is tangent to one of the individual’s indifference curves (Nicholson, 1995). This represents the highest level of utility the individual can achieve from the consumption of goods A and B, given a fixed level of income. In Figure 1, the optimal condition is represented by point X.

Several recreation-related studies have applied indifference curve theory to evaluate individuals’ tradeoff decisions. In each of these studies, the method of paired comparisons was used to estimate indifference curves. Sinden (1974) estimated indifference curves for individuals’ tradeoffs among day use visits to a state park in Oregon and day use in the respondents’ best alternative activity to recreation at the state park. Findlater and Sinden (1982) studied the tradeoffs people in Brisbane, Australia make in allocating their time between day trips to Lamington National Park and day trips to the Gold Coast beaches of southern Australia. Bennett and Smith (1985) conducted a study of individuals’ tradeoff preferences for days vacationing in Bunya Mountains National Park, Australia and time spent watching movies.

The method of paired comparisons used to estimate indifference curves in each of the studies outlined above has been employed in a number of other recreation research applications. For example, a paired comparison experiment was conducted by Louviere and Woodworth (1985) to study individuals’ recreation choices among parks in Iowa. The authors found that distance to the park from home had the largest effect on individuals’ choices of parks to visit. Louviere and Timmermans (1990) used the paired comparison method to study the effect of park and forest preserve attributes on individuals’ recreation choices in the Eindhoven region of The Netherlands. Results of the analysis were used to evaluate how individuals’ choices of parks to visit were influenced by each of 19 park and forest preserve attributes. More recently, Mackenzie (1993) conducted a study of duck hunters’ preferences for alternative hypothetical duck hunting trips. Study findings provide insight into the relative importance of the attributes of a duck hunting trip to duck hunters.

This article extends the theoretical and empirical approaches of indifference curve analysis and paired comparisons to evaluate social carrying capacity at a national park attraction site. Both indifference curves and a budget constraint are derived using the paired comparison approach to estimate preferred tradeoffs between solitude and access at Delicate Arch. This analysis provides a theoretical and empirical basis for managing social carrying capacity of the site.

Study Methods

Indifference curve analysis was applied to the evaluation of social carrying capacity at Delicate Arch by substituting solitude at Delicate Arch and access to Delicate Arch for consumer goods (i.e., goods A and B in Figure 1). Specifically, the maximum number of people seen at one time at Delicate Arch was substituted for good B along the y-axis, and the percentage chance of receiving a hypothetical permit to hike to Delicate Arch was substituted for good A along the x-axis. This analysis required estimation of indifference curves, development of a budget constraint, and determination of the point of tangency between the budget constraint and the indifference curve representing the optimal level of utility. Study data were derived from a survey of visitors to Delicate Arch. All of these components are described in the following paragraphs.
Indifference Curves

Indifference curves were estimated following a procedure adapted from MacCrimmon and Toda (1969). In this procedure, respondents are presented with a series of pairs of solitude and access conditions. The first component of each pair of conditions is a fixed reference condition, against which respondents evaluate an alternative condition. Respondents are asked to indicate their preference within each pair of conditions they evaluate. For example, respondents were asked to express their preference between a first set of conditions—having a 100 percent chance of receiving a permit to hike to Delicate Arch and seeing no more than 108 people at one time at Delicate Arch—and a second set of conditions—having a 50 percent chance of receiving a permit to hike to Delicate Arch and seeing no more than 36 people at one time at the Arch.

Figure 2 illustrates the method used to map respondents’ preferences for solitude and access at Delicate Arch. Solitude is represented along the y-axis as the maximum number of people seen at one time at Delicate Arch. Access is represented by two corresponding sets of numbers along the x-axis. The first set of numbers along the x-axis is the percentage chance of receiving a permit to hike to Delicate Arch. The second set of numbers along the x-axis is the total number of vehicles allowed to enter Arches National Park per day. The percentage chance visitors have of receiving a permit to hike to Delicate Arch is used as a proxy for total daily use of Arches National Park in the study. For example, current average total daily use of Arches National Park is 1,345 vehicles per day. In this study, current average total use of Arches National Park is expressed as visitors having a 100 percent chance of receiving a permit to hike to Delicate Arch, since currently, anyone who wants to hike to Delicate Arch is allowed to. Restricting access to one half of current average total daily use of Arches National Park (i.e., allowing 673 vehicles per day) is expressed in terms of visitors having a 50 percent chance of receiving a permit to hike to Delicate Arch. In order to consider scenarios in which total daily use of Arches National Park is allowed to exceed current use levels, the percentage chance of receiving a permit was extended beyond a 100 percent chance of receiving a permit. However, respondents were not asked

![Diagram of indifference curves](image-url)
to evaluate any conditions in which the percentage chance of receiving a permit to hike to Delicate Arch was greater than 100 percent.

In Figure 2, the point \( P_0 \) is the reference point corresponding to a 100 percent chance of receiving a permit to hike to Delicate Arch and seeing no more than 108 people at one time at the Arch. It is assumed that all points in the graph directly above and to the right of this point would be preferred by a respondent when compared to this reference point. For example, point \( P_1 \) would logically be preferred to \( P_0 \) because respondents would see no more than 36 people at one time at Delicate Arch while having the same chance of receiving a permit to hike to Delicate Arch. Therefore, such comparisons need not be made. This area of the graph is indicated as \( A_1 \).

Similar logical assumptions can be made about points to the left of \( P_0 \). For example, suppose a respondent indicates that he or she prefers the conditions described by point \( P_2 \) to the conditions described by the reference point \( P_0 \). Following the logic described above, it can be assumed that the respondent prefers all points directly above \( P_2 \) to \( P_0 \). Further, it can be assumed that the respondent prefers all points to the right of \( P_2 \) as well, because points to the right of \( P_2 \) represent an increase in the respondent's chance of receiving a permit to hike to Delicate Arch while holding constant the maximum number of people the respondent would see at one time at Delicate Arch. Therefore, further comparisons do not need to be made between the conditions described by the reference point \( P_0 \) and the conditions described by points in the area of the graph above and to the right of the point \( P_2 \). This area of the graph is indicated as \( A_2 \).

Following similar logic, if a respondent prefers the conditions described by point \( P_0 \) to \( P_3 \), then the respondent would also prefer \( P_0 \) to all points below and to the left of \( P_3 \). Again, such comparisons need not be made. This area of the graph is indicated as \( A_3 \).

This procedure defines the space within which an indifference curve must lie. A logical series of paired comparisons of solitude and access conditions at Delicate Arch was presented to each respondent. The pairs of conditions were developed by locating the combination of solitude and access nearest the center point of the possible space within which the indifference curve could lie subsequent to each response. This battery of questions produced three data points from which to define an indifference curve for each respondent.

Regression analysis was used to estimate an indifference curve for each respondent based on the data points derived. For each respondent, a hyperbolic, semilog, and quadratic curve were fit to his or her data points. The functional form for each individual indifference curve was selected based on the goodness of fit (R-square) of the regression equation, and the explanatory significance of the access variable (chance of receiving a permit) on the number of people at Delicate Arch.

**Budget Constraint**

A simulation model of visitor use at Arches National Park was used to estimate points along the budget constraint representing the possible combinations of solitude and access at Delicate Arch. Computer simulation models have been successfully applied to a variety of park and outdoor recreation areas (e.g., Potter & Manning, 1984; Schechter & Lucas, 1978; Wang & Manning, 1999). The simulation model was constructed as part of a larger research project at Arches National Park using data from the summers of 1997 and 1998 (Wang & Manning, in press). Field data were gathered describing visitor arrival rates, travel routes, group sizes, pause places and times, and travel speeds. These baseline data were then used to construct a discrete-event dynamic simulation model using the software ExtendTM. The model simulates visitor travel in vehicles and on foot through a simulated day. Data can be gathered about visitor numbers at any point in the park model, such as Delicate Arch.
The simulation model was run at three levels of daily visitor use. The first level of use represented the Park’s average daily use in the summer, which is expressed in the study as a 100 percent chance of receiving a permit to hike to Delicate Arch. The second level of use was 50 percent of the Park’s average daily use, which is expressed in the study as a 50 percent chance of receiving a permit to hike to Delicate Arch. The third level of use was 25 percent of the Park’s average daily use, which is expressed in the study as a 25 percent chance of receiving a permit to hike to Delicate Arch (see note 2).

For each use level, the model was run 12 times to account for variability in model parameters. The outputs from the simulation model runs were used to estimate the maximum number of people any one visitor would see at one time at Delicate Arch, for each of the three total daily use levels. A linear budget constraint was estimated from the three data points.⁴

**Indifference Curve Analysis**

Lastly, each individual’s indifference curve was mathematically adjusted by adding a constant term to the equation for the indifference curve, to find the point where the indifference curve is tangent to the budget constraint. The point of tangency between the adjusted indifference curve and the budget constraint reveals the respondent’s preferred combination of solitude and access, given the possible conditions at Delicate Arch.

**Visitor Survey**

Questionnaires were administered to visitors during the summer of 1999 as they returned from their hike to Delicate Arch. The questionnaire included photographs depicting the number of visitors at Delicate Arch associated with each pair of conditions that respondents were asked to evaluate.⁵ The questionnaire was administered on a laptop computer to randomly selected visitors. At the start of each sampling day, the interviewer selected the first visitor to return from his or her hike to Delicate Arch and asked if he or she would be willing to participate in the survey. If the visitor was willing to participate, he or she was given the self-administered questionnaire. When the respondent completed the questionnaire, the interviewer selected the next visitor to return from Delicate Arch. The process continued this way through the duration of each sampling day, resulting in a total of 124 completed questionnaires.

**Study Findings**

Study findings are presented for the estimation of each respondent’s indifference curve and the budget constraint. Additionally, the preferred combinations of solitude and access at Delicate Arch derived from the indifference curve analysis are presented.

**Indifference Curves**

Indifference curves were derived for 123 respondents based on their evaluation of the tradeoffs between solitude and access at Delicate Arch presented in the questionnaire. Data from one respondent were excluded from the analysis because the data did not conform to the expected properties of indifference curves. Specifically, the indifference curve did not demonstrate a diminishing marginal rate of substitution.

Analysis of sample data resulted in a total of 123 indifference curves, however, some individuals responded to the tradeoff questions with the same answers as other respondents. As a result, there were a total of 16 unique indifference curves estimated. Respondents
were categorized into one of three groups based on the slope and form of their indifference curves. The first group includes individuals whose preferences are “access oriented.” The indifference curves for these individuals are characterized by steep slopes, suggesting that “access oriented” respondents would tolerate large increases in the number of people seen at Delicate Arch to help ensure they would be granted access to the Arch (Figure 3). The second group includes individuals whose preferences are “solitude oriented.” The indifference curves for these individuals are characterized by flat slopes up to a threshold, suggesting that “solitude oriented” respondents would tolerate substantial reductions in their chances of receiving access to Delicate Arch to help ensure that, if they received access to the Arch, they would see relatively few people (Figure 3). The third group includes individuals whose preferences are “tradeoff oriented.” The indifference curves for these individuals are characterized by moderate slopes, suggesting that “tradeoff oriented” respondents would prefer tradeoffs between solitude and access of a more proportional nature (Figure 3).

Based on the shape and slope of the 123 indifference curves estimated, nearly half (48.8%) of all respondents revealed preferences characterized as “solitude oriented,” compared with just one-fifth of respondents (20.3%) having preferences characterized as “access oriented.” Just under one-third (30.9%) of respondents had preferences that were characterized as being “tradeoff oriented.”

**Budget Constraint**

The budget constraint defining the possible combinations of solitude and access for Delicate Arch was derived from output generated by the simulation model of visitor use at Arches National Park described above. Output from the simulation model resulted in three data points for the budget constraint. Regression analysis was used to estimate a linear budget constraint based on the three data points. Figure 4 presents the budget constraint defining the possible combinations of solitude and access at Delicate Arch.
FIGURE 4 Budget constraint for Delicate Arch.

*Indifference Curve Analysis*

Each respondent's preferred combination of solitude and access at Delicate Arch was calculated by adjusting his or her indifference curve to find the point where the curve is tangent to the estimated budget constraint. Figure 5 presents the percent of respondents with each of
the preferred combinations of solitude and access at Delicate Arch. The budget constraint for Delicate Arch is represented by the line labeled BC. Each point noted along the budget constraint represents a preferred combination of solitude and access at Delicate Arch for at least one respondent. The number beside each point indicates the percent of respondents with the corresponding preferred combination of solitude and access.6

The preferred combinations of solitude and access for those individuals characterized as "access oriented" ranged from allowing a total of 2,018 vehicles into Arches National Park per day and seeing no more than 81 people at one time at Delicate Arch, to allowing a total of 3,605 vehicles into the Park per day and seeing no more than 132 people at one time at the Arch. The preferred combinations of solitude and access at Delicate Arch for respondents characterized as "solitude oriented" ranged from allowing a total of 484 vehicles into Arches National Park per day and seeing no more than 33 people at one time at Delicate Arch, to allowing a total of 673 vehicles into the Park per day and seeing no more than 59 people at one time at the Arch. For those respondents characterized as "tradeoff oriented," preferred combinations ranged from allowing a total of 847 vehicles into Arches National Park per day and seeing no more than 44 people at one time at Delicate Arch, to allowing a total of 1,910 vehicles into the Park per day and seeing no more than 78 people at one time at the Arch.

Conclusions

The results of this study suggest that the theoretical framework of indifference curve analysis and the methodological approach of paired comparisons can be used to evaluate tradeoffs in outdoor recreation. Applied to the issue of solitude versus access, study findings quantify the tradeoff preferences of visitors to Delicate Arch and provide a theoretically and empirically informed basis for managing a social carrying capacity for this site.7

Study findings can inform outdoor recreation management in several ways. First, the indifference curves derived in this study estimate the tradeoffs visitors prefer between the two competing goods of solitude and access. The form and slope of these indifference curves indicate the relative value that visitors place on these traditionally important attributes of outdoor recreation, and they can guide management decisions regarding the design and management of appropriate outdoor recreation experiences. For example, the plurality of respondents in this study (48.8%) reported data that describe indifference curves with relatively flat slopes indicating that this segment of visitors values solitude more than access. A number of management practices can be used to limit visitor use (e.g., parking lot size, permits) in order to maintain minimum acceptable levels of solitude, and such management practices may be warranted for this segment of the visitor population.

Second, the point of tangency between an indifference curve and the budget constraint estimates the optimum combination of solitude and access, and may be considered a measure of social carrying capacity. As might be expected, this measure of social carrying capacity varies among those in the sample included in this study. Such findings might be addressed in several ways. For example, the optimum social carrying capacity of Delicate Arch for nearly two-thirds of the sample (64.2%) is below current use levels. Clearly, most visitors would prefer to give up some of their current access to Delicate Arch to ensure that they experience an acceptable level of solitude. In more quantitative terms (taken from Figure 5), most visitors would accept only a 40% to 80% chance of receiving a permit to hike to Delicate Arch in order to ensure that they do not see more than 35 to 55 people at one time at the Arch. Study findings also indicate that the optimum social carrying capacity of Delicate Arch for a substantial minority of respondents is well beyond current use levels. These visitors would accept seeing approximately 70 up to nearly 130 people at
one time at the Arch to help ensure that they would be able to obtain a permit to hike to Delicate Arch. This suggests that a spectrum of visitor opportunities—and concomitant carrying capacities—might be provided within Arches National Park, or temporally at Delicate Arch itself. Study data have the power of empirically informing such management judgements.

On a more general level, study data help inform managers about the traditionally difficult "evaluative" or "prescriptive" component of carrying capacity. The carrying capacity literature often distinguishes between descriptive and prescriptive components of carrying capacity (Shelby & Heberlein, 1986). The descriptive component addresses the relationships between increasing visitor use and impacts to the quality of the visitor experience. The prescriptive component addresses the maximum acceptable level of impact in order to maintain a minimum acceptable quality of visitor experience. As noted at the beginning of this article, previous research on social carrying capacity has not fully addressed the prescriptive component of carrying capacity, because it has not explicitly considered tradeoffs between competing goods that are inherent in social carrying capacity analysis (Manning, Valliere, Wang, & Jacobi, 1999). The research described in this study addresses such tradeoffs more explicitly.

While the findings from this study appear promising, more research is clearly warranted. Further research might focus on the effect on social carrying capacity of shifting the budget constraint associated with an attraction site. Shifting the budget constraint might be accomplished through visitor management or site design. For example, the budget constraint representing possible combinations of the number of people at one time at Delicate Arch and the total use level of Arches National Park (or percentage chance of receiving a permit) could be shifted by scheduling the departure times of visitors hiking to Delicate Arch (Manning & Potter, 1984). By scheduling hiking trips to Delicate Arch more evenly over the hours of the day, park managers could lower the maximum number of people at one time at Delicate Arch while holding total use level constant (or increasing total use level while holding the maximum number of people at one time at the Arch constant). Such a shift in the budget constraint would influence optimum carrying capacity, and the indifference curve analysis would quantify this relationship.

Further research might also address tradeoffs between other attributes of outdoor recreation experiences. For instance, in the example described above, indifference curve analysis could study the relationship between solitude and the freedom traditionally associated with outdoor recreation. Scheduling the departure times of visitors hiking to Delicate Arch potentially impinges on the freedom associated with this activity. To what degree do visitors prefer to relinquish this freedom in order to enhance opportunities for solitude? The research approach described in this article might be adapted to help answer such questions.

Finally, the research approach described here may be useful in analyzing visitor preferences for alternative access allocation techniques, and for estimating how such allocation practices might influence social carrying capacity. There is evidence in the contingent valuation literature that individuals' willingness to pay for various environmental goods and services may be influenced by the "payment vehicle" presented to study participants (Manning, Lawson, & Fryniier, 1999). For instance, contingent valuation study participants may be more receptive to paying for an environmental program through contributions to a voluntary fund than through increased taxes. In an analogous manner, individuals' tradeoff preferences between solitude and access may be influenced by the way in which access to attraction sites is allocated (e.g., permit system, reservations, first-come first-served). Indifference curve analysis can further inform decisions about social carrying capacity of recreation areas by investigating the relationship between visitors' tradeoff preferences and alternative access allocation techniques.
Notes

1. The number of people seen at an attraction site may not be a comprehensive measure of solitude, however, it is used as a proxy for solitude in this study. Previous research at Arches National Park found that the number of people seen at major attraction sites was important in defining the quality of visitor experiences (Manning, Lime, Freiman, & Pitt, 1996). Similarly, visitor access to Delicate Arch could be managed in ways other than by a permit system. However, permits are often used to manage recreation use, and were used as a proxy for access in this study.

2. During the summer of 1997, a mechanical counter was placed at the main entrance of Arches National Park to count the total number of vehicles entering the Park per day. The current total daily use in this study is the average of seven days of vehicle counts recorded during the summer of 1997.

3. Previous research at Arches National Park found that most visitors preferred to see relatively few people at Delicate Arch (Manning, Lime, Freiman, & Pitt, 1996).

4. Given the scope of this article, a linear budget constraint was assumed for the purposes of simplification. Subsequent research should investigate the validity of this assumption.

5. The use of photographs in the study is described more fully in Manning, Lime, Freiman, and Pitt (1996).

6. The budget constraint was constructed using the maximum number of people seen at one time at Delicate Arch corresponding to each total use level used to run the simulation model. An alternative would have been to select the average or minimum number of people seen at one time corresponding to each total use level used to run the simulation model. Selecting the average or minimum number of people seen at one time would shift the budget constraint further out from the origin. Such a shift would reduce the number of respondents with optimal combinations of solitude and access below current use levels. The issue of shifting the budget constraint should be addressed in future research.

7. Standards of quality based on visitors' tradeoff preferences examined in this study provide the basis for a potential social carrying capacity related to the number of people seen at Delicate Arch at one time and the chance of receiving access to visit the Arch. There are many potential carrying capacities for Delicate Arch related to other social, resource, and managerial attributes of the visitor experience at the Arch.

References


