

The Visitor Experience and Resource Protection (VERP) Process:

The Application of Carrying Capacity to Arches National Park

Introduction

As the name suggests, national parks are resources of national and, increasingly, international significance. The United States national park system, for example, contains natural, historical, and cultural resources of great importance to the nation and, in many cases, the international community. Given the significance of this resource base, public demand to see and experience these areas should not be surprising.

Data on national park visitation in the U.S. dramatically support this premise. Annual visitation to the national parks is now counted in the hundreds of millions. In the decade of the 1970s, visitation increased by 30 percent. In the 1980s, visitation rose another 35 percent. If this trend continues, the national parks can expect to receive over 300 million visits by the year 2000.

The increasing popularity of the national parks presents both an opportunity and a challenge. The opportunity is to fulfill the mission of the national parks "to provide for the enjoyment of the people." The accompanying challenge, of course, is to conserve park resources for the enjoyment of future generations. This can prove difficult under conditions of high visitation.

Implicit in this dual mission of national parks is the issue of the *quality of the visitor experience*. The quality of visitor experiences must be maintained at a high level for the national parks to contribute their full potential to the enjoyment of society. Moreover, high-quality visitor experiences are more likely to develop public appreciation of, and support for, conservation of national park resources.

It is ironic that one of the greatest threats to the quality of national park visits is commonly seen as their increasing popularity. To many observers, the national parks, at least in some places and at some times, are crowded, and this detracts from the quality of the visitor experience. Moreover, natural and cultural resources can be degraded by excessive visitor use. In more formal terms, the

use of some national parks, or portions thereof, have exceeded their *carrying capacity* (Mitchell 1994; Wilkinson 1995).

This paper explores the theory and application of carrying capacity to the national parks. Primary emphasis is placed on *social* carrying capacity. The first section briefly traces the theoretical development of the carrying capacity concept. The second section describes a process now being developed within the U.S. National Park Service to help determine and manage carrying capacity in the national park system. The final section outlines the application of this carrying capacity process to Arches National Park as a model for the national park system.

The Concept of Carrying Capacity

The question of how much public use is appropriate in a national park is often framed in terms of carrying capacity. Indeed, much has been written about the carrying capacity of the national parks and related areas. The underlying concept of carrying capacity has a rich history in the natural resource professions. In particular, it has proven a useful concept in wildlife and range management where it refers to the number of animals of any one species that can be maintained in a given habitat (Dasmann 1964). Carrying capacity has obvious parallels and intuitive appeal in the field of park management. In fact, it was first suggested in the mid-1930s as a park management concept in the context of the national

parks (Sumner 1936). However, the first rigorous applications of carrying capacity to park management did not occur until the 1960s.

These initial scientific applications suggested that the concept was more complex in this new management context. At first, as might be expected, the focus was placed on the relationship between visitor use and environmental conditions. The working hypothesis was that increasing numbers of visitors causes greater environmental impact as measured by soil compaction, destruction of vegetation, and related variables. It soon became apparent, however, that there was another critical dimension of carrying capacity dealing with social aspects of the visitor experience. Wagar (1964), for example, in his early and important monograph on the application of carrying capacity to recreation, reported that his study "was initiated with the view that 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 point of view must be augmented by consideration of human values."

Wagar's point was that as more people visit a park, not only can the environmental resources of the area be affected, but the quality of the visitor experience as well. Again, the working hypothesis was that increasing numbers of visitors cause greater social impacts as measured by crowding and related variables.

Thus, as applied to national parks, carrying capacity has two components: environmental *and* social.

The early work on social carrying capacity has since blossomed into an extended literature on social aspects of outdoor recreation and their application to carrying capacity (Stankey and Lime 1973; Manning 1985; Kuss et al. 1990; Shelby and Heberlein 1986; Lime and Stankey 1971; Manning 1986; Graefe et al. 1984). But despite this impressive literature base, efforts to determine and apply social carrying capacity to areas such as the national parks have often failed. The principle difficulty lay in determining how much impact, such as crowding, was too much. Theoretical development, backed up by empirical research, generally confirms that increasing contacts or encounters between visitors leads to increased perceptions of crowding. But how much crowding should be allowed in a national park? This basic question is often referred to as the "limits of acceptable change" (Lime 1970; Frissell and Stankey 1972). Given substantial demand for public use of a national park, some decline or change in the quality of the visitor experience (e.g., some crowding) appears inevitable. But how much decline or change is acceptable or appropriate before management intervention is needed?

This issue is illustrated graphically in Figure 1. In this figure, two hypothetical relationships between visitor use and crowding are shown. It is clear from both that visitor use and

crowding are related: increasing numbers of visits cause increasing percentages of visitors to report feeling crowded. However, it is not clear at what point carrying capacity has been reached. The relationships in Figure 1 illustrate that some crowding is inevitable, given even relatively low levels of visitor use. Thus, some level of crowding must be tolerated if national parks are to remain open for public use. For the relationship defined by line A, X_1 and X_2 represent levels of visitor use that result in differing levels of crowding as defined by points Y_1 and Y_2 , respectively. But which of these points— Y_1 or Y_2 , or some other point along this axis—represents the maximum amount of crowding that is acceptable? Ultimately, this is a value judgement. Again, the principal difficulty in carrying capacity determination lies in deciding how much crowding (or of some other impact) is acceptable. Empirical relationships such as those in Figure 1 can be helpful in making informed decisions about carrying capacity, but they must be supplemented with management judgments.

To emphasize and further clarify this issue, some writers have suggested distinguishing between descriptive and evaluative (or prescriptive) components of social carrying capacity determination (Shelby and Heberlein 1986). The descriptive component of social carrying capacity focuses on factual, objective data such as the types of relationships in Figure 1. For example, what is the

relationship between the number of visitors entering an area and the number of encounters that occur between groups of visitors? Or what is the relationship between the intensity of visitor use and visitor perceptions of crowding? The evaluative or prescriptive component of social carrying capacity determination concerns the seemingly more subjective issue of how much impact or change in the visitor experience is acceptable. For example, how many contacts between visitor groups are appropriate? What level of perceived crowding should be allowed before management intervention is needed?

Recent experience with carrying capacity suggests that answers to the above questions can be found through formulation of management

objectives and development of indicators and standards of quality (National Park Service 1992; Shelby et al. 1992; Stankey et al. 1985; Graefe et al. 1990; Stankey and Manning 1986). This approach to carrying capacity focuses principal emphasis on defining the type of visitor experience to be provided and maintained, and then monitoring conditions over time to assess whether or not acceptable conditions have been exceeded.

Management objectives are broad, narrative statements which define the type of visitor experience to be provided. They are based on review of the purpose and significance of the area under consideration. Formulation of management objectives may involve review of legal, policy

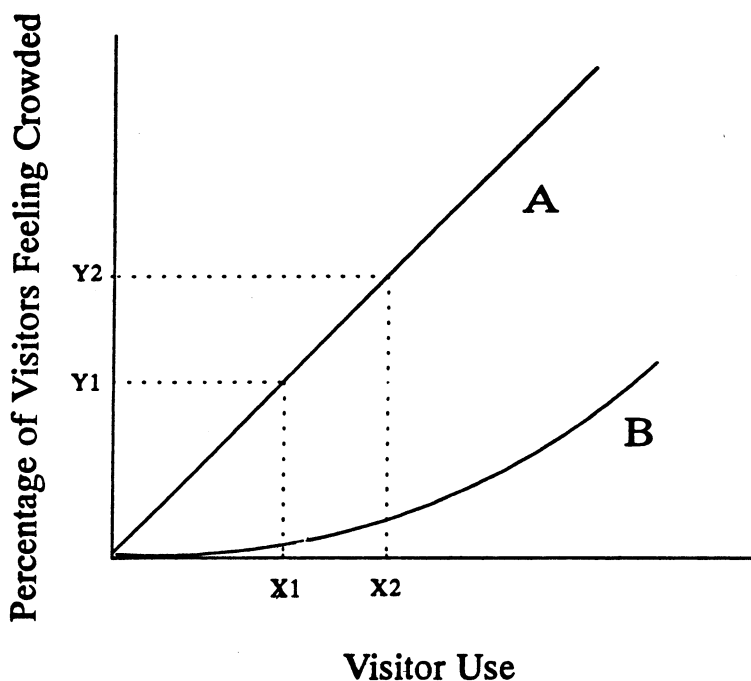


Figure 1. Hypothetical relationships between visitor use and crowding

and planning documents, consideration by an interdisciplinary planning and management team, and public involvement.

Indicators of quality are more specific measurable variables which reflect the essence or meaning of management objects; they are quantifiable proxies or measures of management objectives. Indicators of quality may include elements of both the physical and social environment that are important in determining the quality of the visitor experience. *Standards of quality* define the quantitative and measurable condition of each indicator variable.

An example of management objectives, indicators, and standards may be helpful. Review of the U.S. Wilderness Act of 1964 suggests that areas contained in the National Wilderness Preservation System are to be managed to provide opportunities for visitor solitude. Thus, providing opportunities for solitude is an appropriate management objective for most wilderness areas. Moreover, research on wilderness use suggests that the number of visitors encountered along trails and at campsites is important to wilderness visitors in defining solitude. Thus, trail and camp encounters become key indicators of quality and help to make the general management objective of solitude more operational. Further research suggests that wilderness visitors often have normative standards about how many trail and camp encounters can be tolerated before the quality of the visitor experience de-

clines to an unacceptable degree (Vaske et al. 1986; Whittaker and Shelby 1988; Heberlein et al. 1986; Roggenbuck et al. 1991; Shelby and Vaske 1991). This consensus (sometimes called "social norms") among visitors helps to define a standard of quality.

By defining indicators and standards of quality, carrying capacity can be determined and managed through a monitoring program. Indicator variables can be monitored over time; once standards have been reached, carrying capacity has been reached as well. This approach to carrying capacity is central to contemporary park planning frameworks, including Limits of Acceptable Change (LAC) (Stankey et al. 1985), Visitor Impact Management (VIM) (Graefe et al. 1990), Carrying Capacity Assessment Process (C-CAP) (Shelby and Heberlein 1986), Quality Upgrading and Learning (QUAL) (Chilman et al. 1990), Recreation Management Planning Process (Manning 1986), and the Visitor Experience and Resource Protection (VERP) process currently under development by the National Park Service (National Park Service 1993; Hof et al. 1994).

Carrying Capacity in U.S. National Parks: The VERP Process

The U.S. National Park Service has long recognized the need to apply the concept of carrying capacity to parks that have been experiencing problems from increasing public use. In fact, the 1978 U.S. General Au-

thorities Act requires each park's general management plan to include "identification of and implementation commitments for carrying capacities for all areas of the unit" (U.S. Congress 1978). Although Park Service management policies and planning guidelines acknowledge this responsibility, there has been little direction or agreement on an approach or methodology for how to identify a park's carrying capacity. Park planners and managers have been reluctant to state that parks, or areas within parks, are receiving inappropriate or excessive use because they have lacked the rationale and empirical data to make such determinations.

For the past three years, an interdisciplinary team of Park Service planners, managers, and researchers has been developing a framework to identify and manage carrying capacity in the national park system. As described in the previous section, this framework is based on identification of appropriate resource and social conditions—indicators and standards of quality—to be achieved and maintained in the national parks. The process is called Visitor Experience and Resource Protection (VERP).

VERP consists of nine basic steps as shown in Figure 2. The first six steps are requirements of general park planning and ideally should be a part of each park's general management plan (GMP). The final three steps require periodic review and adjustment and are most appropriately handled through park operation and management activities. Briefly,

the steps are as follows:

- In Step 1 a project team is assembled. This should be an interdisciplinary team comprising park planners, managers, and researchers.
- Step 2 consists of developing clear statements of park purposes, significance, and primary interpretive themes. This step clarifies the most basic assumptions about the park's use and management, and sets the foundation for the rest of the process.
- In Step 3 the park's important resources and potential visitor experiences are mapped and analyzed. The product of this step is a set of overlay maps showing the spatial distributions of important resources, landscape units, and the range of visitor experience opportunities.
- In Step 4 the team identifies potential management zones that cover the range of desired resource and social conditions consistent with the park's purpose. This is where the process begins to be prescriptive. Different actions will be taken by the Park Service in different zones with regard to the types and levels of uses and facilities. The zones are defined by carefully analyzing resource constraints and sensitivities, resource attributes for visitor use, and management goals for the park. The existing park infrastructure (roads, parking lots, etc.) is not a deciding factor in determining the zones.

- In Step 5 the team applies the potential management zones on the ground to identify a proposed plan and alternatives. A zoning scheme is identified by overlaying the potential management zones on the areas where the team believes that different visitor experiences should occur in the park. The park's purpose, significant resources, and existing infrastructure are also factored into this analysis. Different configurations of the potential management zones can lead to different alternatives.
- Step 6 involves selecting indicators of quality and specifying associated standards for each zone. The purpose of this step is to identify measurable physical, social, or ecological variables that will indicate whether or not a desired resource or social condition is being met. This is a pivotal step that defines the zones, transforming subjective descriptions into objective measurements of conditions in those zones.
- In Step 7 the park staff compares desired conditions with existing conditions. Each zone needs to be monitored to determine if there are discrepancies with the desired resource and social conditions.
- Step 8 consists of identifying probable causes of discrepancies in each zone. It is important in this step to accurately identify the root causes of the discrepancies.
- In Step 9 the park staff identifies management strategies to address discrepancies. Visitor use management prescriptions should start with the least restrictive measures that will accomplish the objective and move toward more restrictive measures if needed.

Although Step 9 is the final formal step shown in Figure 2, the process does not end there. Long-term monitoring is an essential element of the VERP process. Monitoring provides continual, systematic feedback to park managers to ensure that desired resource and visitor experience conditions continue to be achieved over the long term. In this way, carrying capacity has been identified and managed.

Carrying Capacity of Arches National Park

The VERP process described above is currently being applied at Arches National Park, Utah. The purpose of the test is to refine the VERP process and provide a model for the rest of the national park system. Research aimed at defining indicators and standards of quality for the visitor experience is described in this section. As noted earlier, indicators and standards of quality are pivotal points of carrying capacity determination. Complimentary research has addressed indicators and standards for natural resource conditions such as soil disturbance and compaction and destruction of vegetation.

Arches National Park covers 73,000 acres of high-elevation desert with outstanding slick rock forma-

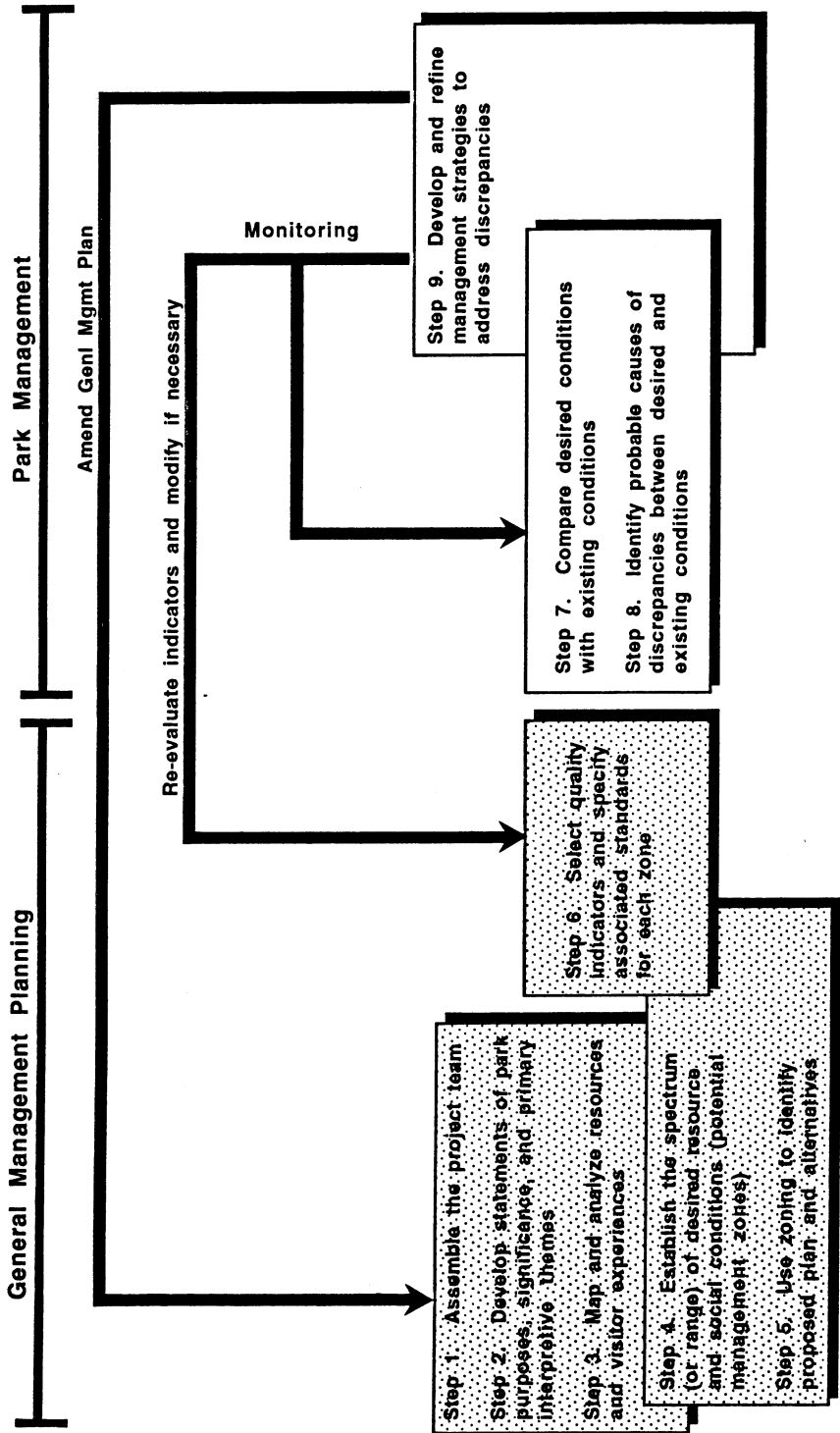


Figure 2. Visitor Experience and Resource Protection (VERP) process.

tions, including nearly 2,000 stone arches. Most of the park's scenic attractions are readily accessible through a well-developed road and trail system. Visitation to Arches has been increasing rapidly. The number of visits increased 91 percent in the decade of the 1980s, and the park now receives over three quarters of a million visits annually with use continuing to increase at a substantial rate.

Following the VERP model, an interdisciplinary project team was created, composed of planners from the Park Service's Denver Service Center, Arches National Park staff, and USNPS scientists (Step 1). Workshops were conducted to develop statements of park purposes, significance, and primary interpretive themes (Step 2). Authorizing legislation and the current General Management Plan provided important reference sources. Park resources and existing visitor experiences were then mapped (Step 3) and a spectrum of desired resource and social conditions was constructed using a simple matrix format (Step 4). Based on this analysis, a system of nine zones ranging from developed to primitive was created and overlaid on the park (Step 5).

Step 6 requires selecting indicators of quality and specifying associated standards for each zone. This required a social science research program that was conducted in two phases. Phase I was aimed at identifying potential indicators of quality (Manning et al. 1993). Personal in-

terviews were conducted with 112 visitors throughout the park. In addition, ten focus group sessions were held with park visitors, park staff, and local community residents. Respondents and participants were selected through a purposive rather than random sampling procedure. Thus, data are primarily qualitative in nature. This exploratory effort was conducted to develop insights into potential indicators of the quality of the visitor experience. Interviews and focus group sessions were guided by a standardized questionnaire.

The questionnaire contained two major sections that focused on identifying potential indicators of the quality of the visitor experience. The first section contained a battery of open-ended questions which probed for park conditions and issues which visitors and others considered important to determining the quality of the park experience. The second section contained a battery of closed-ended questions which also probed for indicators of quality. Fifty-three wide-ranging park conditions or issues were presented to respondents who were asked to indicate the extent to which each item was considered to be a problem in the park. The items presented were developed on the basis of literature review, discussion with park planners and staff, and personal observations in the park.

Findings from the Phase I research suggested several indicators of quality for the park, including the number of people at frontcountry attraction sites and along trails, the

number of parties encountered along backcountry trails and at campsites, the number of vehicles encountered along roads, the number of social trails and associated soil and vegetation impacts, the level of trail development, and visitor knowledge of regulations regarding off-trail hiking.

Phase II of the research program was designed to identify specific indicators of quality and set associated standards (Lime et al. 1994). The primary objectives of this phase of research were to determine the relative importance of indicator variables across the nine park zones and to set standards for the most important indicator variables. A survey of park visitors was conducted, covering all nine park zones. The survey was administered to a representative sample of over 1,500 park visitors by means of both personal interviews and mail-back questionnaires.

The survey instruments contained two major sections related to carrying capacity and the VERP process. The first section focused on determining the relative importance of indicator variables identified in Phase I research. Fourteen indicator variables were distilled from the previous phase of research, and respondents were asked to rate the importance of each variable in determining the quality of their experience at the park zone in which they were interviewed. This section of the questionnaire was needed for two reasons. First, Phase I research was qualitative in nature; its purpose was simply to explore for potential indicators of quality. Phase

II research was needed to become more quantitative by asking respondents to rate the relative importance of these potential indicators of quality. This required a larger and more representative sample. Second, it was hypothesized that indicator variables would vary by park zone. Sampling was conducted in all nine park zones, and questions were keyed directly to those specific areas. This zoning approach is appropriate to carrying capacity and the VERP process as relatively large areas such as national parks can and probably should provide a variety of visitor experiences.

The second major section of the survey questionnaires was directed at determining standards of quality for selected indicator variables. Five indicator variables received special attention: 1) the number of people at one time at major frontcountry attraction sites, 2) the number of people at one time along frontcountry trails, 3) the amount of environmental impact caused to soil and vegetation by off-trail hiking, 4) the number of parties encountered along backcountry trails and at campsites, and 5) the number of vehicles encountered along unpaved roads. The first three of these variables were addressed by a series of photographs which illustrated a range of impact conditions. Photographs were developed using a computer-based image capture technology (Pitt 1990; Lime 1990; Nassauer 1990; Chenoweth 1990). Base photographs of park sites were taken, and these images were then modified to present a range of

impact conditions (e.g., number of visitors present, amount of environmental impact). A set of sixteen photographs was developed for each major attraction site and trail, presenting a wide-ranging number of visitors present. An analogous set of photographs was developed for a range of environmental impacts caused by off-trail hiking. Respondents rated the acceptability of each photograph on a scale of -4 (very unacceptable) to +4 (very acceptable). Representative photographs for the number of visitors at Delicate Arch and environmental impact along the trail to Delicate Arch are shown on the Cover and in Figure 3, respectively. Questions regarding encounters in the backcountry and along unpaved roads were asked in a more conventional narrative format.

Earlier in this paper, it was noted that social norms often exist concerning important elements of the visitor experience. That is, there is often some consensus among visitors about how much impact can be tolerated before the quality of the experience declines to an unacceptable degree. Methodological techniques have been developed and refined to measure such social norms of park visitors (Heberlein et al. 1986; Manning 1985; Shelby et al. 1992; Shelby and Heberlein 1986; Vaske et al. 1986; Whittaker and Shelby 1988). The research program at Arches National Park was built on these techniques. Findings from Phase II research provided the basis for selection of indicators and standards of quality

for each of the nine park zones. Where appropriate, at least one social indicator was chosen for each zone and standards were set for each indicator variable. For example, the "pedestrian" zone contains several of the most prominent attraction sites in the park, including Delicate Arch. Visitors reported that the number of people at such attraction sites at any one time was important in determining the quality of their experiences. Thus, the number of people at one time (PAOT) at Delicate Arch was selected as an indicator of quality for that zone. Moreover, findings from the series of 16 photographs of Delicate Arch (as shown in Figure 4) suggested that visitors generally find up to 30 PAOT to be acceptable. (It can be seen from the figure that the line tracing visitor evaluations of the sixteen photographs crosses from the acceptable range to the unacceptable range at 30 PAOT). Based on these findings, 30 PAOT was selected by the project team as the standard of quality. Indicators and standards of quality were set for all zones in this manner. A companion set of resource-based indicators and standards of quality was set based on a program of ecological research (National Park Service 1995).

A monitoring program focused on indicators of quality has been designed and is now being implemented in the park. This will allow park staff to address steps 7, 8, and 9 of the VERP process. This monitoring program will determine the extent to which standards of quality are

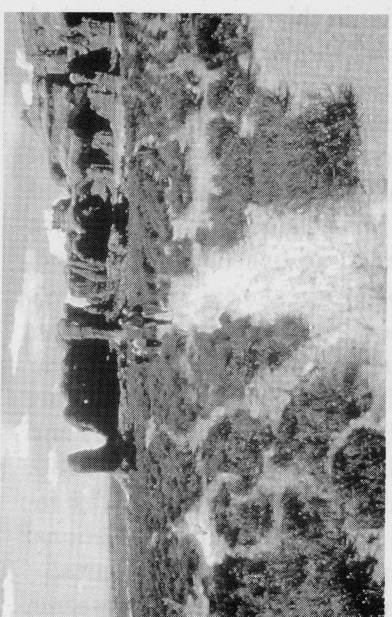
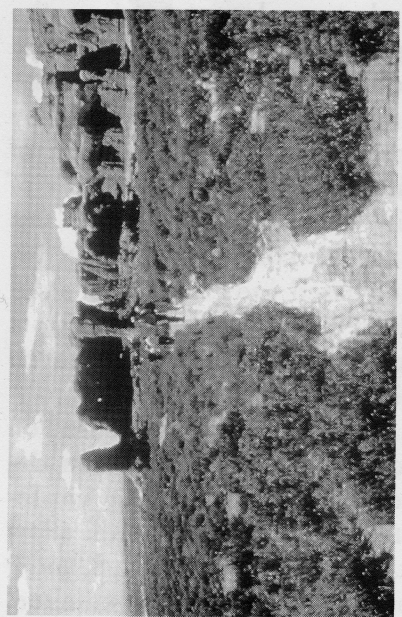


Figure 3. Representative photographs showing alternative levels of environmental impact on the trail to Delicate Arch.

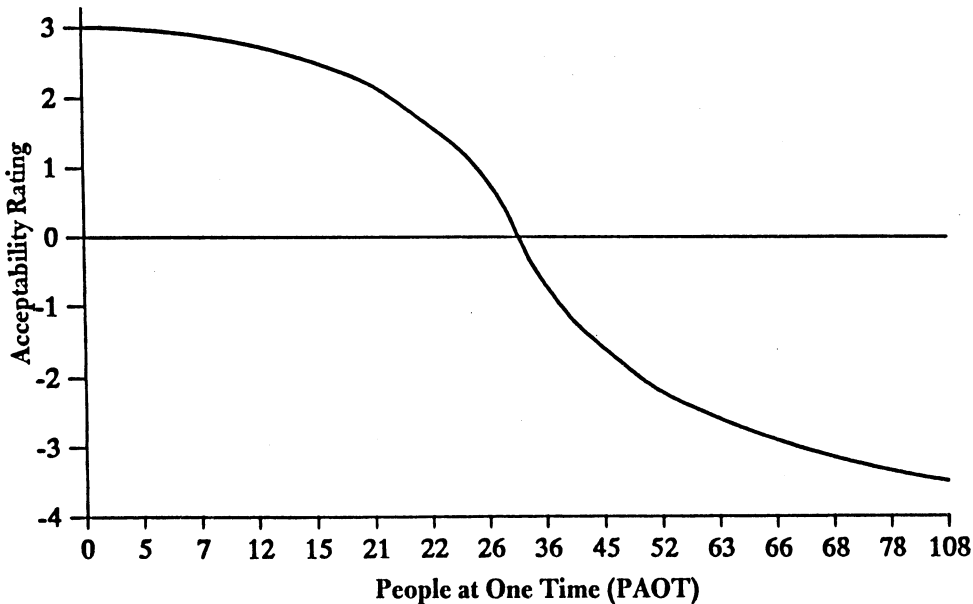


Figure 4. Visitor evaluation of 16 photographs of Delicate Arch showing alternative levels of visitor use.

30 PAOT at Delicate Arch) are not violated. Parking lot size can be adjusted up or down depending upon monitoring results. The VERP process requires management action whenever standards of quality have been violated. Park managers must be prepared and committed to initiating such management actions.

Conclusion

Nearly thirty years of research and development on the concept of carrying capacity has led to development of several planning and management frameworks. All of these carrying capacity frameworks rely on a similar series of steps. VERP is specifically designed to identify and manage carrying capacity in the national park system. Carrying capacity is determined by developing desired re-

source and social conditions through a series of indicators and standards of quality. Indicators are monitored over time, and when associated standards of quality have been reached, carrying capacity has been reached as well. If standards are violated, the VERP process requires that management action be taken.

VERP is now being applied at Arches National Park. The park has been divided into a series of zones, and, through a program of research, social and resource indicators and being met, and will help develop insights into the causes of any violations of standards. Park managers are planning to use parking lot size at attraction sites and trailheads as a primary management tool. The monitoring program will help determine the appropriate size of parking lots to

ensure that standards of quality (e.g., standards of quality have been specified for each zone. A monitoring program is now being instituted in the park to insure that standards of quality are not violated and to determine when and where management action is needed to keep park use within carrying capacity. Additional applications of VERP are now being undertaken at several Park Service areas, including Acadia National Park, Glacier National Park,

Mount Rainier National Park, and Saint Croix National Scenic Riverway.

VERP provides a theoretically sound and rational process for determining and managing carrying capacity in the national park system. An associated research program can provide a strong empirical basis for applying the VERP process. Arches National Park provides a model for applying the VERP process throughout the national park system.

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