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How Many Visitors is Too Many at Arches?

Visitor use of Arches National Park has grown dramatically in the past few decades and now exceeds 1 million visits annually. But this use has had several important impacts in the park, including trampling of fragile soils and vegetation (**Impacts to soil; Impacts to vegetation**) and crowding on trails and at attraction sites (**Crowding; Impacts to trails; Impacts to attraction sites**). The National Park Service developed and applied its Visitor Experience and Resource Protection framework to measure and manage carrying capacity at Arches. The resulting management regime employed two management strategies (**Limit use; Reduce the impact of use**) and included division of the park into a series of spatial zones (**Zoning**), visitor education about when and where to visit, and appropriate visitor behavior (**Information/ Education**), sizing of parking lots to limit crowding and fencing to discourage walking off maintained trails (**Facility development/Site design/Maintenance**), regulation and enforcement of overflow parking (**Rules/Regulations; Law enforcement**), and mandatory permits for use of some park attractions (**Rationing/Allocation**), including those accessed through popular ranger-led tours (**Impacts to interpretive facilities/programs**).

Introduction

Carrying capacity was one of the conceptual frameworks introduced in Chapter 1. In its most generic form, carrying capacity is the amount and type of recreational use that can be accommodated in a park without unacceptable impacts to park resources or the quality of the visitor experience (Shelby and Heberlein, 1986; Stankey and Manning, 1986; Manning, 2001, 2007, 2011; Whittaker *et al.*, 2011). Carrying capacity is a long-standing and increasingly urgent issue in national parks and related areas. The National Park Service is required by the National Parks and Recreation Act of 1978 to develop plans for each park that include "identification and implementation commitments for visitor carrying capacities" (P.L 95-625). The centrality of carrying capacity is derived from its linkage to the twofold mission of parks: to protect park resources and the quality of the visitor experience, while providing for public use. The increasing urgency of this issue in national parks is driven by long-term increases in recreational use; the number of visits to the US National Park System is now approaching 300 million annually.

Arches National Park is a poster child for the issue of carrying capacity. It is a relatively small national park, but has

experienced sustained growth in attendance over the past several decades, eclipsing the 1 million mark in 2010. This popularity has come with a number of challenges, including trampling and degradation of fragile soils and vegetation, and crowding on trails and at attraction sites. Arches was the first national park to address carrying capacity using the management-by-objectives framework outlined in Chapter 1.

Arches National Park

Arches National Park was established in 1929 in southeast Utah. It comprises 77,000 acres of high elevation desert that is part of the vast Colorado Plateau. Elevations range from just over 4000 feet to about 5600 feet and the area receives under ten inches of precipitation per year. The park's distinctive sandstone landscape has been eroded by water, wind, and temperature into a series of canyons, expansive formations of "slickrock", towering monoliths and "hoodoos", sandstone "fins", and distinctive stone arches (Fig. 8.1). Over 2000 arches have been documented (arches must have an opening of at least 3 feet) representing the highest density of these geologic features in the world. Delicate Arch has become the scenic symbol of the park and the American southwest more generally, and the three-mile round-trip trail to Delicate Arch is one of the most famous trails in the US National Park System. Other distinctive features and visitor attractions include Balanced Rock, The Windows, the Fiery Furnace, and Devil's Garden.

Most of the park's soil is sandy and develops a distinctive biological crust called "cryptobiotic soil". This soil crust comprises bacteria, moss, lichens, fungi, and algae and it is vital to the desert ecosystem as it stabilizes the soil, stores water, and fixes nitrogen. It is easily disturbed by visitors walking off maintained trails and can take up to 250 years to recover from such damage.

The park and surrounding area also has an interesting human history. It was used by Native Americans for about 10,000 years before European settlement and this is manifested in rock art and other physical evidence. The historic cabin at Wolfe Ranch is an example of early American attempts to settle the area. Edward Abbey, a famous American nature writer, worked as a seasonal ranger in the park in the late 1950s and his definitive book, *Desert Solitaire*, is based on this experience.

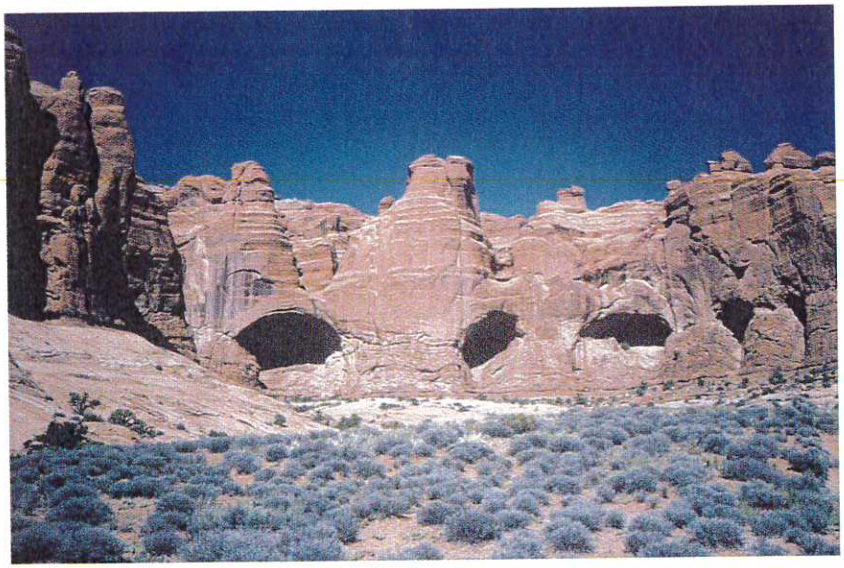

Fig. 8.1. Arches National Park features impressive slickrock formations, including a collection of natural stone arches. (Photo by Robert Manning.)

Measuring and Managing Carrying Capacity

The National Park Service developed its management-by-objectives framework—Visitor Experience and Resource Protection (VERP)—for measuring and managing carrying capacity in the 1990s (National Park Service, 1995; Manning, 2001). This framework was first applied at Arches and the resulting plan was the first in the National Park System to address carrying capacity in a comprehensive, park-wide manner (National Park Service, 1995). As described in Chapter 1, this management framework consists of three primary steps:

1. formulation of management objectives and associated indicators and standards of quality;
2. monitoring indicators of quality; and
3. managing the park to ensure that standards of quality are maintained.

Since this plan was applied to the whole park, an initial step was to divide the park into a series of zones that ranged from "developed" (small areas that include roads, parking lots, a visitor center, and a campground) to "primitive" (large areas of the park that have no facilities and are relatively undisturbed).

To support formulation of indicators and standards of quality for each zone, a program of natural and social science was conducted. Natural science focused on the effects of trampling of the park's fragile soils and vegetation. The cryptobiotic soil crust noted above is found extensively throughout the park. Ecological research documented the extent and location of this soil crust, the relationship between recreational use and damage to soil crust, and developed a soil crust monitoring protocol (Belnap, 1998).

Social science focused on understanding the quality of the visitor experience (Manning *et al.*, 1996b,c). An initial phase of study included focus groups with visitors and other stakeholders (e.g., residents of communities outside the park, park staff). Several indicators of quality were identified, including crowding on trails and at attraction sites and the aesthetic implications of impacts to the microbiotic soil crust caused by visitors walking off maintained trails. A second phase of the social science research administered a survey to park visitors. As part of the survey, visual simulations were prepared of a range of visitor use levels on trails and at attraction sites and a range of impacts to soil and vegetation. For example, a series of computer-edited photographs was prepared illustrating a wide range of visitor use levels at Delicate Arch (see Fig. 8.2). Visitors who had just completed a hike to Delicate Arch were asked to rate the acceptability of these photographs based on the number of visitors shown. Average acceptability ratings were computed and graphed, and the graph for Delicate Arch is shown in Fig. 8.3. For Delicate Arch, average acceptability ratings fall out of the acceptable range and into the unacceptable range at about 30 people-at-one-time (PAOT), and this was established as a standard of quality for Delicate Arch. Crowding-related standards of quality were established for all park zones based on this research and related information.

The park is now being managed to help ensure that standards of quality are being maintained. This includes several management practices. For example, the parking lots serving the park's three main visitor attraction sites—Delicate Arch, the Windows, and Devil's Garden—were sized to help ensure that crowding-related standards of quality are not violated. This sizing was based on simultaneous counts of the number of cars in parking lots and the number of visitors at attraction sites such as Delicate Arch. Statistical models were then developed to estimate the maximum number of cars that could be accommodated in parking lots without violating crowding-related standards of quality. Parking lots were stripped to designate authorized parking spots, natural rock barriers were placed around parking lots to discourage overflow parking, a regulation against overflow parking was adopted and communicated in signs, and the regulation against overflow parking was enforced when needed.

Permit systems are used to control the amount of use in some areas. For example, a day-use permit is required for the Fiery

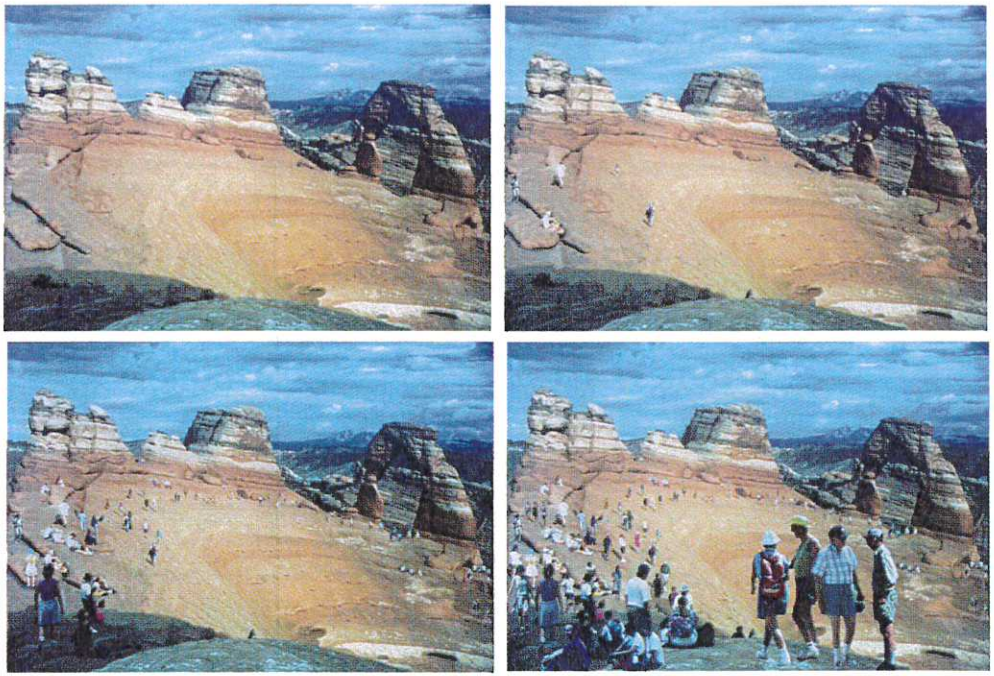

Fig. 8.2. How many visitors is too many? A set of visual simulations allows survey respondents to see the results of varying levels of visitor use. (Images by Wayne Freimund, Dave Lime, and Robert Manning.)

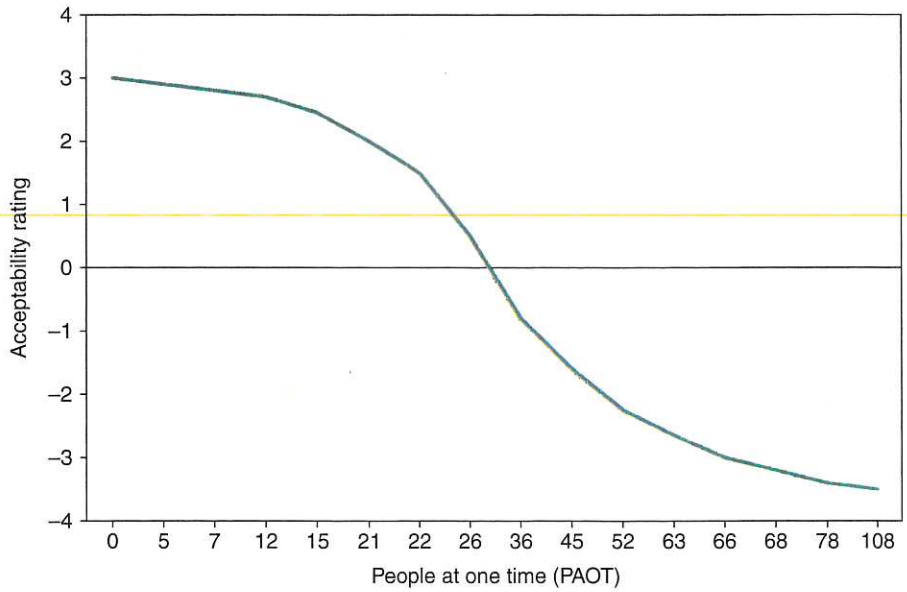

Fig. 8.3. Social norm curve for the acceptability of seeing visitors at Delicate Arch. (Adapted from Manning et al., 1996b.)

Furnace and the number permits is limited. Visitors must watch an educational film on how to minimize impacts to soil and vegetation before being issued a permit. The only other way to access the Fiery Furnace is on a ranger-led tour. These tours are very popular and reservations may be made up to 6 months in advance. Permits are also required for overnight use of the primitive zone of the park. The park employs an extensive system of information and education to guide visitor use, including suggestions about where and when to visit to avoid crowding and advising against walking off maintained trails, including why visitors should abide by this advice. Information and education are delivered on the park's website, in the park newspaper that is given to all visitors, on signs in the park, in the park visitor center, on ranger-guided activities, and in social media such as Facebook and Twitter. Where social trails begin to appear, small, ground-level posts are installed reminding visitors to stay on maintained trails. Finally, low wooden fences have been erected in strategic places at major park attractions to discourage off-trail hiking and development of social trails.

In accordance with the VERP framework, the park must monitor indicators of quality to ensure that standards of quality are being maintained. This includes measuring the amount of disturbance to soil and vegetation and the number of visitors on trails and at attraction sites. However, monitoring is costly in terms of both money and staff time, and the park has struggled to maintain this activity. The VERP plan formulated and implemented at the park suggested that the National Park Service should dedicate staff time to this activity, but there are many competing demands for staff time and monitoring remains a challenge.

Further Reading

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