

Use of Visual Research Methods to Measure Standards of Quality for Parks and Outdoor Recreation

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Visual research methods have been adapted and incorporated into measuring standards of quality for parks and outdoor recreation. This paper reviews and assesses this research. Visual research methods offer several potential advantages over conventional narrative/numerical questions to measure standards of quality. For example, visual methods can help "standardize" such research, focus more directly and exclusively on the treatment variables under study, offer a more elegant means of communicating variables that are difficult or awkward to describe in narrative/numerical terms, and can be used to represent conditions that are difficult to find in the field or that do not currently exist. Research suggests that visual research methods may be most appropriate in frontcountry or other high use density contexts, may result in more valid or realistic estimates of visitor standards of quality in such applications, meet generally accepted standards of validity, and may be methodologically robust. Technological and societal trends suggest that visual research methods may continue to evolve into more dynamic formats and offer opportunities for expanded applications in the future.

KEYWORDS: *Visual research; research methods; standards of quality; parks and outdoor recreation.*

Introduction

Visual research methods have played an important role in environmental science and natural resource management for many years (Daniel & Boster, 1976; Ribe, 1989; Shuttleworth, 1980) and have been adapted for use in several dimensions of recreation-related research. For example, visual approaches have been used in studies assessing the aesthetic implications of forest harvesting and insect damage (Hollenhorst, Brock, Freimund, &

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Several colleagues participated in important aspects of the studies described in this paper. Appreciation is expressed to Dr. David Lime, University of Minnesota, for his help with the study at Arches National Park; Charlie Jacobi, National Park Service, for his help with the studies at Acadia National Park; and Dr. David Cole, Aldo Leopold Wilderness Research Institute, Dr. William Stewart, University of Illinois, Dr. Jonathan Taylor, U.S. Geological Survey, and Dr. Martha Lee, Northern Arizona University, for their help with the study at Grand Canyon National Park.

Twery, 1993; McCool, Benson, & Ashor, 1986), the value of campground attributes (Daniel, Brown, King, Richards, & Stewart, 1989), litter impacts (Budruk & Manning, 2004; Heywood & Murdock, 2002), and recreation participation (Brown, Richards, Daniel, & King, 1989). The use of visual images, including slides and photographs, has been widely validated in the scientific literature (Bateson & Hui, 1992; Daniel & Boster, 1976; Daniel & Ittelson, 1981; Daniel & Meitner, 2001; Hershberger & Cass, 1974; Hull & Stewart, 1992; Kellomaki & Savolainen, 1984; Stamps, 1990).

The technology to develop visual representations of landscape settings has increased dramatically in the past twenty years. Computer aided design (CAD), geographic information systems (GIS), and virtual reality (VR) can effectively be run from laptop computers rather than the mainframes that were needed 10-20 years ago. Advances in digital cameras and photo editing software such as Adobe PhotoShop provide both the resolution and editorial control that, in experienced hands, can result in edited images that are virtually indistinguishable from original photographs or slides. These widely accessible tools allow extremely realistic and accurate depictions of potential settings and future conditions, in a format that is familiar and easily understood.

Visual research methods have recently been adapted and incorporated into measuring standards of quality in parks and outdoor recreation. Standards of quality have become an increasingly important element of park and outdoor recreation research and management in recent years, and visual research methods have been found useful in measuring and helping formulate such standards. This paper reviews and assesses the adoption and use of visual research methods in measuring standards of quality for parks and outdoor recreation.

Standards of Quality in Parks and Outdoor Recreation

Standards of quality have emerged in recent decades as an important element of planning and managing parks and outdoor recreation. Standards of quality define minimum acceptable conditions of the resource and social components of parks and outdoor recreation areas (Manning, 1999). For example, standards of quality might be set for recreation-related impacts to backcountry campsites or for the number of groups encountered per day along backcountry trails. Such standards of quality can be useful in empirically defining desired future conditions and evaluating the need for and effectiveness of management actions to control the impacts of recreation use. The concept of standards of quality has been explicitly adopted into contemporary park and outdoor recreation planning and management frameworks, including Limits of Acceptable Change (LAC) (Stankey, Cole, Lucas, Peterson, Frissell, & Washburne, 1985) and Visitor Experience and Resource Protection (VERP) (National Park Service, 1997; Manning, 2001).

However, formulating standards of quality can be challenging. Standards may be based on a variety of sources, including legal and administrative mandates, agency policy, historic precedent, expert judgement, interest group politics, and public opinion, especially that derived from outdoor recreation visitors. This latter source has special appeal because it involves those most directly interested in and affected by management actions.

Research on visitor-based standards of quality increasingly has focused on personal and social norms. Developed in the discipline of sociology, norms have attracted considerable attention as a theoretical construct and empirical framework in park and outdoor recreation research and management (see, for example, two special, double issues of *Leisure Sciences*, Volume 18, Numbers 1 and 2, and Volume 24, Numbers 3 and 4). In particular, normative theory has special application in helping to formulate standards of quality for the recreation experience. As applied in parks and outdoor recreation, norms are generally defined as standards that individuals and groups use for evaluating behavior and social and environmental conditions (Donnelly, Vaske, & Shelby, 1992; Shelby & Vaske, 1991; Vaske, Graefe, Shelby, & Heberlein, 1986). If visitors have normative standards concerning relevant aspects of park and outdoor recreation experiences, then such norms can be measured and used as a basis for helping to formulate standards of quality.

Application of normative theory and methods to help formulate visitor-based standards of quality in parks and outdoor recreation is most fully described in Shelby and Heberlein (1986), Vaske et al. (1986), Shelby, Vaske, and Donnelly (1996), and Manning (1999). These applications have relied on the work of Jackson (1965), who developed a methodology—return-potential curves—to measure norms. In the context of parks and outdoor recreation, visitors (or other survey respondents) are conventionally presented with a narrative/numerical description of a range of recreation-related impacts and asked to judge the acceptability of such conditions. For example, respondents might be asked to rate the acceptability of encountering a range of other groups per day (e.g., 0, 2, 4, 6, 8, 10) along wilderness trails. Using these methods, the personal norms of individuals can be aggregated to test for the existence of social norms or the degree to which norms are shared across groups. Normative research in outdoor recreation has focused largely on the issue of crowding (Basman, Barro, Manfredo, Vaske, & Watson, 1996; Heberlein, Alfano, & Ervin, 1986; Inglis, Johnson, & Black, 1999; Lawson & Manning, 2002; Manning, Johnson, & Vande Kamp, 1996; Manning, Lime, & Hof, 1996b; Manning, Lime, Freimund, & Pitt, 1996a; Manning, Valliere, Wang, & Jacobi, 1999; Manning, Wang, Valliere, Lawson & Newman, 2002; Patterson & Hammitt, 1990; Saarinen, 1998; Shelby, 1981; Vaske et al., 1986; Whittaker & Shelby, 1988; Williams, Roggenbuck & Bange, 1991), but has also been expanded to include other relevant issues, including ecological impacts to trails and campsites (Manning et al., 2004; Shelby, Vaske, & Harris, 1988).

Incorporating Visual Research Methods into Measuring Standards of Quality for Parks and Outdoor Recreation

Visual research methods offer a potentially important research approach that can be applied to measuring standards of quality in parks and outdoor recreation, and they offer several potential advantages to the narrative/numerical descriptions of park and outdoor recreation conditions noted above. Visual research methods can help "standardize" research on standards of quality by presenting a series of nearly constant images for all respondents. For example, in visual studies of crowding, all respondents see not only the same number of visitors encountered, but also potentially important characteristics of those encountered, including recreation activity engaged in, mode of travel, and group size. In more conventional narrative/numerical approaches, respondents may have to make assumptions about such characteristics, and these assumptions are likely to vary among respondents. Similarly, visual research methods can focus directly and exclusively on the variables under study. For example, in visual studies of crowding, the number and type of visitors encountered is the only "treatment" allowed to vary, with all other variables held constant. Visual research methods can be especially useful in studying standards of quality for indicator variables that are difficult or awkward to describe in narrative/numerical terms. For example, visual images of 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 have incorporated images of use densities that do not now exist, but that will occur in the future as a function of historical use trends.

Visual images in the form of artistic renderings, photographs, computer-edited photographs, and videotapes have been used to explore and assess visitor perceptions and evaluations of a range of park and outdoor recreation conditions, and this research approach has been increasingly applied in recent years to the issue of measuring and formulating standards of quality. For example, early studies used artistic renderings to represent a range of both resource and social impacts related to outdoor recreation. Martin, McCool, and Lucas (1989) used a series of 14 color drawings to illustrate a range of impact levels to 1) bare ground, 2) tree damage, and 3) fire rings at wilderness campsites in a study designed to explore potential differences in environmental perceptions between wilderness visitors and managers. Heywood (1993) used a series of 11 pen and ink sketches of different types of visitor use to explore visitor norms and conventions in picnic areas in the wildland/urban interface. Shelby and Shindler (1992) used photographs of wilderness campsites to measure normative standards for bare ground impacts and fire rings.

More recent research has used computer-edited photographs to measure visitor-based standards of quality for selected components of parks and

outdoor recreation areas and experiences. Sometimes called Image Capture Technology (ICT), the representation and editing of photographic images using microcomputers has been used in a variety of settings to assess the visual quality of environmental conditions and to represent a spectrum of visitor use and impact conditions (Chenoweth, 1990; Lime, 1990; Nassauer, 1990; Pitt, 1990; Vining & Orland, 1989). Scenic quality measurements made from photographic slides and the same image projected on a computer monitor have been found to be highly correlated (Vining & Orland, 1989). No significant differences, for example, were found in aesthetic responses between color slides, computer monitor images, and images projected from video tape (Pitt, Nassauer, Lime, & Snyder, 1993). Recent work by Daniel and Meitner (2001) points out that representative validity is strongest when computerized visualizations are close in quality and definition to that of photographic slides. The quality of ICT rendering is now often indistinguishable from original slides or photos. These studies support extending ICT techniques to measurement of standards of quality in parks and outdoor recreation, and this research approach has been increasingly applied in a variety of park and outdoor recreation contexts.

For example, initial research at Arches National Park found that the number of visitors at attraction sites such as Delicate Arch was important in determining the quality of the recreation experience (Manning, Lime, Hof, & Freimund, 1995; Manning, Lime, McMonagle, & Nordin, 1993). A second phase of research was designed to measure visitor-based standards of quality for the maximum acceptable number of visitors at such sites (Hof, Hammett, Rees, Belnap, Poe, Lime, & Manning, 1994; Manning et al., 1996a, 1996b). A series of 16 computer-edited photographs was prepared showing a range of visitors at Delicate Arch. (Representative photographs are shown in Figure 1.) (This research was applied to other park sites as well.) The number of visitors ranged from 0 to 108, with the upper end of the range designed to show approximately 30% more visitors than the current maximum. The purpose was to illustrate a full range of density conditions, including the near-term future. A representative sample of visitors who had just completed their hike to Delicate Arch was asked to examine the photographs in random order and rate the acceptability of each on a scale of -4 ("very unacceptable") to +4 ("very acceptable") with a neutral point of 0. Respondents were also asked to select the photograph that was most representative of the scene when they visited Delicate Arch and to report their degree of perceived crowding. Individual acceptability ratings were aggregated into an impact evaluation curve (sometimes called a social norm curve) (a line tracing mean acceptability ratings for each of the study photographs) and provided an empirical foundation for helping to formulate a density-related standard of quality for this site (Figure 2).

Visual research methods have been expanded to address other social and resource components of park and outdoor recreation areas and experiences. For example, outdoor recreation research suggests that perceived crowding may be influenced by visitor behavior, including recreation activi-



Figure 1. Representative Photographs of Delicate Arch Showing a Range of Visitor Use

ties, as well as density of use. Visual research methods have been used to assess the influence of visitor behavior on crowding-related standards of quality. A study of crowding on the carriage roads of Acadia National Park, a multiple use trail system, used a series of 19 photographs illustrating a range of use levels as well as alternative mixes of hikers and bicyclists, the two principal user groups (Manning et al., 1999; Manning, Valliere, Minter, Wang, & Jacobi, 2000). (Representative photographs are shown in Figure 3.) Study findings estimated crowding-related standards of quality for the carriage roads and the influence of type of user group on such standards. Alternative crowding-related standards of quality were found depending on the mix of recreation activities.

As noted above, visual research methods have also been applied to selected resource-related impacts of outdoor recreation (Manning et al., 2004; Martin et al., 1989; Shelby & Shindler, 1992;). For example, an initial visitor survey at the Isle au Haut and Schoodic Peninsula sections of Acadia National Park identified several potential indicators of quality of the recreation experience, including trail erosion and social trails (informal or visitor-caused trails) (Manning et al., 2004). To measure standards of quality, two series of five computer-edited photographs were developed for these indi-

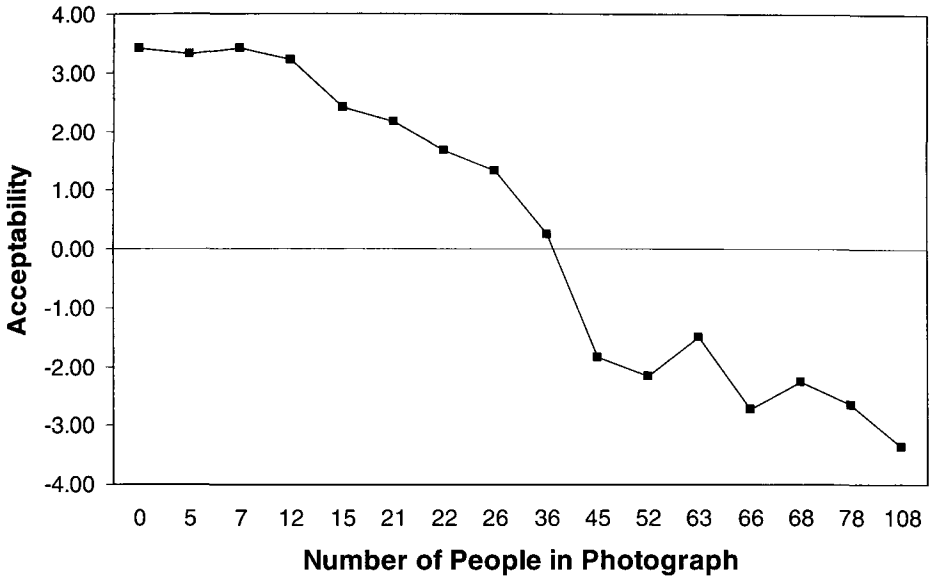


Figure 2. Social Norm Curve for Delicate Arch (The irregularities in this norm curve are due to a varying foreground and background effect that was designed into the digital images. The presence of people in the foreground of the image had a somewhat stronger influence on acceptability ratings than the background)

cator variables illustrating a range of impact levels. These photographs were incorporated into a second visitor survey, and respondents were asked to rate the acceptability of each photograph. Impact evaluation curves derived from these data provide an empirical basis for helping to formulate standards of quality for resource conditions (at least their aesthetic dimensions) at this park.

Technological innovations in visual research methods continue to expand, including digital photography, desktop digital editing software, and development of videotapes, compact disks (CD's), and digital video disks (DVD's). Moreover, adoption of home computers and Internet access is also growing. These trends suggest an increasing variety of visual-based media that might be adopted in visual research methods designed to measure standards of quality in parks and outdoor recreation. For example, a recent study incorporated computer-edited images of a range of social and resource conditions at Gwaii Haanas National Park Reserve, British Columbia onto a videotape that was sent to a representative sample of park visitors (Freimund, Vaske, Donnelly, & Miller, 2002). The videotape included survey instructions. More than 75% of respondents reported that the images on the videotape served as useful reminders of their visit and helped them articulate their standards for recreation-related impacts.

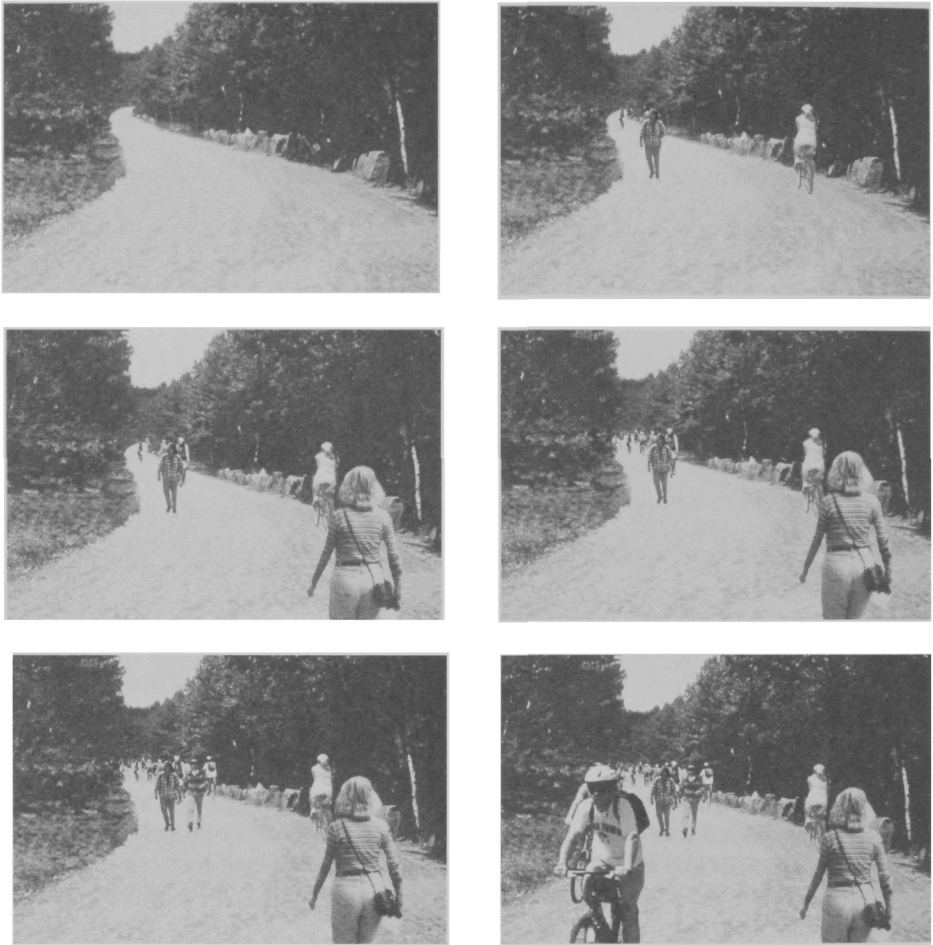


Figure 3. Representative Photographs of the Carriage Roads at Acadia National Park Showing a Range of Two Types of Visitor Use

Theoretical and Methodological Issues

Use of visual research methods in measuring standards of quality in parks and outdoor recreation has raised a number of theoretical and methodological issues. These issues include the contexts in which visual research methods may be most appropriate, comparison of standards of quality derived from visual research methods and more conventional narrative/numerical methods, validity of visual research methods, and methodological issues in applying visual research methods.

Application to Frontcountry and Other High Density Contexts

Much of the research on crowding-related standards of quality in outdoor recreation has focused on wilderness or backcountry areas. By definition, use levels in these areas are relatively low. In this context, a narrative/numerical approach to measurement of standards of quality is probably appropriate. Standards-related questions usually take one of two such forms: respondents are asked to rate the acceptability of various numbers of other visitors or groups of visitors, or respondents are simply asked to report the maximum acceptable number of encounters.

However, in frontcountry and other relatively high use contexts, this measurement approach may be less appropriate. In such high use areas it may be unrealistic to expect respondents to accurately judge or report the maximum acceptable number of visitors or groups of visitors. The research literature is suggestive of this issue. First, several studies have found that respondents are less likely to be able to report a discrete maximum acceptable number of encounters in relatively high use areas as compared to relatively low use areas (Roggenbuck, Williams, Bange & Dean, 1991; Shelby & Vaske, 1991; Vaske et al. 1986). Second, there tends to be less consensus about such crowding-related standards in relatively high use areas, and this may be due at least in part to measurement error (Manning, 1999). Third, there is evidence that self-reports of encounters by visitors in relatively high use areas are not accurate. A study of river use by Shelby and Colvin (1982) found that floaters who experienced fewer than six encounters per day with other river users generally were able to report them accurately (by comparison with actual encounters as counted by a trained observer). But at higher levels of encounters, most visitors reported only about half as many encounters as actually occurred.

Thus, in frontcountry or other high use density contexts, visual research methods may be more appropriate than conventional narrative/numerical methods because they do not require visitors to accurately keep track of and report discrete numbers of other visitors or groups of visitors encountered (or that are acceptable). For this and other reasons (as outlined in the following section), visual research methods may offer more valid estimates of crowding-related standards of quality, especially in high density settings.

However, it should be noted that in some high use areas, the absolute number of other visitors encountered (along walkways or at attraction sites) may not be an especially salient indicator variable. Crowding can be manifested in potentially many ways, including waiting times to access visitor attractions (Budruk & Manning, 2003). In such cases, narrative/numerical question formats to elicit visitor-based standards of quality may be appropriate and effective.

Comparison of Visual and Narrative/Numerical Research Methods

A related issue concerns comparison of crowding-related standards derived from visual and narrative/numerical research methods. A test of this

relationship was conducted as part of the research at Arches National Park described earlier (Manning et al., 1996a). An impact evaluation curve derived from respondent ratings of the acceptability of the 16 photographs illustrating a range of visitors at Delicate Arch estimated a crowding-related standard of quality of approximately 28 visitors at one time (the point at which aggregate acceptability ratings fell out of the acceptable range and into the unacceptable range) (Figure 2). Using a narrative/numerical approach, respondents were also asked to report a discrete maximum number of visitors at one time acceptable at the arch. The average number of visitors reported was just under 17, suggesting a substantially lower crowding-related standard of quality than derived from the visual research method.

The crowding literature may help to explain why the crowding standards derived from visual research methods are substantially higher than those derived from more conventional narrative/numerical methods, and why the former may be a more valid or realistic estimate. Studies of crowding in outdoor recreation indicate that perceived crowding may be a function of several categories of variables, including the characteristics of respondents, the characteristics of visitors encountered, and situational or environmental variables (Manning, 1985, 1999). The second category of variables—the characteristics of visitors encountered—may be of particular interest when comparing visual and narrative/numerical research methods. There is considerable evidence in the literature that the characteristics of visitors encountered can affect crowding-related standards of quality. Factors found important include the type and size of group, visitor behavior, and the degree to which groups are perceived to be alike. For example, several studies have found differential crowding effects based on non-motorized versus motorized boats (Lucas, 1964), hikers and horseback riders (Stankey, 1973, 1980), and small versus large groups (Lime, 1972; Stankey, 1973). In all of these cases, encounters with one type of visitor (the latter type in the above cases) has greater impact on perceived crowding than encounters with the other type of visitor.

Similarly, inappropriate behavior (e.g., noncompliance with rules and regulations, boisterous behavior) can contribute in important ways to perceived crowding. In fact, several studies indicate that such behavior can have a greater impact on perceived crowding than sheer number of encounters (Driver & Bassett, 1975; Titre & Mills, 1982; West, 1982).

Finally, perceived likeness between groups can affect judgements about crowding. This concept might best be understood through appreciation of the role of social groups in outdoor recreation. Numerous researchers (Buchanan, Christensen, & Burdige, 1981; Burch, 1964, 1969; Cheek, 1971; Dottavio, O'Leary, & Koth, 1980; Field & O'Leary, 1973; Meyersohn, 1969) have emphasized the importance of the social group in outdoor recreation: the vast majority of people participate in outdoor recreation in family and friendship groups. This suggests the notion of solitude so often associated with certain types of outdoor recreation may not mean simple isolation from

others. It also suggests an inward focus on interpersonal relationships within the social group.

Several studies have developed empirical insights that begin to link the concepts of social groups, solitude, perceived likeness between groups, and crowding-related standards of quality. Twight, Smith and Wassinger (1981) and Hammitt (1982), for example, have demonstrated that solitude is a multidimensional concept and that, in the context of outdoor recreation, solitude may have more to do with interaction among group members free from disruptions than with physical isolation. This suggests that as long as encounters with other groups are not considered to be disturbing, they do not engender feelings of crowding. And this, in turn, suggests the notion of perceived likeness. In particular, Lee (1972, 1975, 1977) suggests that much of the social interaction between groups in outdoor recreation settings is conducted with little conscious deliberation, or, in more technical terms, in nonsymbolic modes of communication. Blumer (1936) defines such communication as "spontaneous and direct responses to the gestures of the other individual, without the intermediation of any interpretation." People are therefore largely unaware of such social interaction, and it has little effect on perceptions of crowding. Lee concludes that the quality of a recreation experience "appears to be closely linked with the opportunity to take for granted the behavior of other visitors," and that "an essential ingredient for such an experience [is] the assumption that other visitors are very much like oneself, and will, therefore, behave in a similar manner." Thus, to the extent that groups are perceived as alike and require little conscious attention, encounters may have less impact on perceived crowding than might otherwise be expected.

The studies and ideas described above may suggest why crowding-related standards of quality developed from the traditional narrative/numerical approach might be most appropriately interpreted as the lower bounds of acceptability. The crowding literature illustrates that all contacts do not contribute equally to perceived crowding. However, studies that query respondents directly about appropriate encounter levels (i.e., narrative/numerical studies) contain an implied assumption that all encounters are similar. Moreover, such studies by their very nature focus on encounters that require full and explicit attention by the respondent. In other words, they present the worst case. Encounters between groups that are similar and thus may require and receive little conscious attention, and may have relatively little effect on perceived crowding, are left unconsidered. Crowding-related standards of quality based on narrative/numerical research methods might be increased to the extent that groups are compatible in mode of travel, size, behavior, and other factors that contribute to perceptions of likeness.

Based on this reasoning, visual research methods may represent a more realistic approach to measuring crowding-related standards of quality. Respondents are able to examine a visual portrayal of use conditions, including at least some relevant characteristics of those encountered (e.g., recreation

activity, mode of travel, size of group). It is likely that some of the visitors portrayed in these scenes may not consciously register in the minds of respondents. The differences in crowding-related standards of quality found in studies comparing visual and narrative/numerical research methods tend to support this idea empirically.

Findings from the study of crowding-related standards of quality on the carriage roads of Acadia National Park, described earlier, provide additional empirical support for the conceptual ideas discussed above (Manning et al., 2000). In this study, a series of computer-edited images presented both a range of use levels along the carriage roads and alternative mixes of the primary user groups—hikers and bikers. The mixes of hikers and bikers ranged from equal distributions to exclusively either hikers or bikers. Study findings suggest that crowding-related standards of quality are influenced by both the number and type of users. For example, when impact evaluation curves (derived from the mean acceptability ratings for each photograph) were constructed for the subpopulation of respondents who were hiking, the curve fell out of the acceptable range and into the unacceptable range (i.e., crossed the neutral or “0” point on the acceptability scale) at 16 visitors for the series of photographs that showed a range of exclusively hikers. However, the impact evaluation curve for the same subpopulation of respondents who were hiking crossed the neutral point of the acceptability scale at 10 visitors for the series of photographs that showed the same range of exclusively bikers. These findings support the notion that crowding-related standards of quality can be influenced in a substantive way by presenting information on type of recreation activity. This type of information can be presented effectively and subtly through visual methods, but may be too complex and explicit to be effectively presented in a conventional narrative/numeric manner.

Validity of Visual Research Methods

As visual research methods are increasingly applied to measure standards of quality in parks and outdoor recreation, it is important that the validity of this approach be assessed. However, the issue of validity is complex and can be assessed in multiple ways (Carmines & Zeller, 1979; Nunnally, 1978). In its most generic sense, the concept of validity refers to the degree to which an instrument does what it is intended to do, or measures what it purports to measure. To what degree do visual research methods for measuring standards of quality provide valid estimates of the minimum acceptable conditions of parks and related areas? Several approaches to measuring validity may be appropriate to answering this question.

“Face” validity is a conventional approach to assessing validity, and refers to the extent to which an instrument “looks like” it measures what it is intended to measure. Studies incorporating visual research methods in measuring standards of quality for parks and outdoor recreation might contribute to assessing face validity in two ways. First, several studies have adapted and applied a “verbal protocol analysis” (Schkade & Payne, 1994) designed

to assist respondents in assessing the degree to which they understood study questions and the extent to which they are confident in their answers (Manning, Valliere, Wang, & Lawson, 2001). A series of statements was presented to respondents at the conclusion of visitor surveys employing visual research methods to measure standards of quality, and respondents were asked to indicate the extent to which they agreed or disagreed with these statements. Statements included "I understood the questions that were asked," "The photographs realistically represent different levels of use at this area," "I was confused by the questions that asked me to choose between the photographs," "It was very difficult to rate the acceptability of the photographs," "The answers I gave to these questions accurately represent my feelings about acceptable use levels on the trails I hiked," and "The National Park Service should manage visitor use levels based on the kind of information collected in studies like these." The verbal protocol assessment was administered in conjunction with visually-based visitor surveys administered at several sites at Grand Canyon, Arches, and Yosemite National Parks.

Nearly all respondents at all three parks agreed that they understood the questions that were asked. Similarly, the vast majority of respondents agreed that the photographs used in the studies realistically represented different levels of use at the study sites. A majority or plurality of respondents reported that they were not confused by the questions that asked them to choose the photograph that represented the highest acceptable level of use, and that it was not difficult to rate the acceptability of the photographs. The vast majority of respondents agreed that their answers to the crowding-related questions accurately represented their feelings about acceptable use levels at the study sites. Finally, a strong majority of respondents agreed that the National Park Service should manage visitor use levels based on the type of information collected in these kinds of studies. Similar findings were reported by Freimund et al. (2002) where 80 percent of the respondents agreed that the information gained on the video tapes "was a worthwhile addition to the paper questionnaire."

A second way of assessing face validity concerns the logic and consistency of study findings derived from visual research approaches. Three approaches might be used to explore this issue. First, the impact evaluation curve shown in Figure 4 is a representative example of those derived from visual research methods. Data used to derive the figure are from a study employing six photographs illustrating a range of use densities in a strategic location in the prison cell house of Alcatraz Island, a unit of Golden Gate National Recreation Area (Manning et al., 2002). The points defining the impact evaluation curve are mean acceptability ratings for the six photographs. As would be expected, average acceptability ratings decline with increasing use levels, and there is a strong statistical relationship between these variables, with the number of visitors in the photographs explaining 58% of the variance in acceptability scores.

A second approach to examining the logic and consistency of study findings from visual research concerns the use of alternative "evaluative dimensions." The studies described above at Grand Canyon, Arches, and Yo-

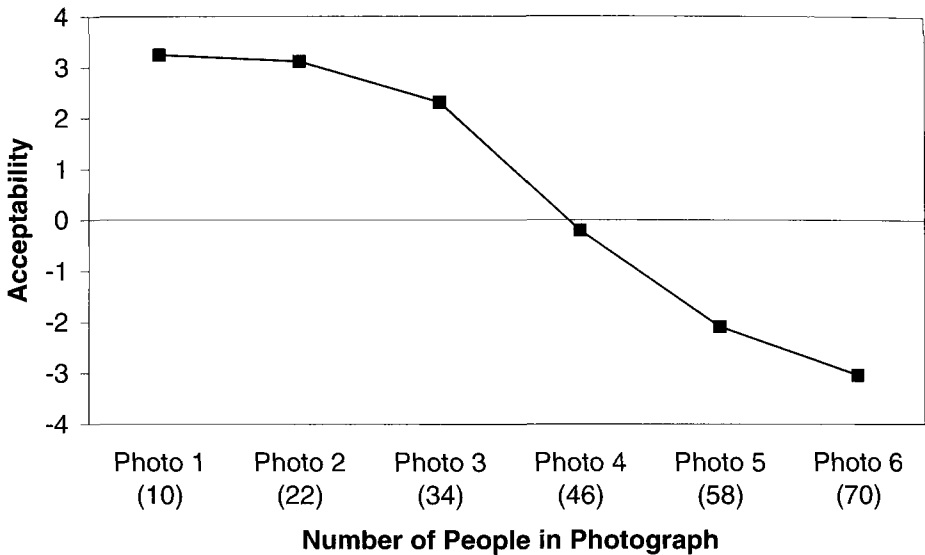


Figure 4. Impact Evaluation Curve for the Prison Cell House at Alcatraz Island

semitic National Parks incorporated four evaluative dimensions in measuring visitor-based standards of quality: “preference” (the condition respondents preferred), “acceptability” (the maximum level of impact respondents judged acceptable), “management action” (the maximum level of impact respondents felt the National Park Service should allow before limiting visitor use), and “displacement” (the level of impact that would keep respondents from visiting the park again) (Manning et al., 1999, 2001). Logic suggests that crowding-related standards of quality estimated from these alternative evaluative dimensions would be ordered, with the lowest standards associated with the preference dimension, the highest standards associated with the displacement dimension, and the acceptability and management action related standards near the midpoint of the range. This pattern of findings was consistent across all sample sites at all three study parks.

Another approach to assessing validity concerns the concept of “predictive” or “criterion” validity. This approach examines the correlation between findings derived from a study instrument and some important form of behavior that is external to the instrument, the latter referred to as the criterion. The concept of congruence offers a test of criterion validity. Congruence refers to the extent to which visitors behave in relation to their stated standards (Manning, 1999; Shelby & Heberlein, 1986). Data from the study of visitors to Delicate Arch reported earlier in this paper offer a test of congruence (Manning et al., 1996a). Three variables were used to test congruence: 1) the visitor-based standard of quality for the maximum acceptable number of visitors at Delicate Arch, 2) the number of visitors in the photo-

graph that respondents reported as best representing the density condition when they visited Delicate Arch, and 3) a measure of perceived crowding at Delicate Arch. It was hypothesized that if respondents experienced more visitors at Delicate Arch than the visitor-based standard of quality, they would rate the experience as at least "slightly crowded." Likewise, if they experienced fewer visitors than the standard of quality, they would rate the experience as "not at all crowded." Study findings showed that 74% of respondents fell into one of these two categories of congruence.

A fourth conventional approach to assessing validity applies the concept of "construct" validity. This approach to validity examines the degree to which multiple variables which comprise a theoretical construct are represented in instruments designed to measure that construct. Measures of crowding-related standards of quality are ultimately aimed at the theoretical construct of crowding. As noted earlier in this paper, normative interpretation of crowding in outdoor recreation has generally recognized three broad types of variables as mediating perceived crowding: 1) characteristics of respondents (e.g., recreation activity in which the respondent is engaged), 2) characteristics of those encountered (e.g., recreation activity in which those encountered are engaged), and 3) situational variables (e.g., location in which encounters occur) (Manning 1985, 1999). Visual research methods applied to measuring standards of quality have begun to incorporate all three types of these variables. For example, the study of carriage road use at Acadia National Park described earlier in this paper used a visual research approach to measure crowding-related standards of quality for two types of respondents/trail users (hikers and bicyclists), for encountering two types of trail users (hikers and bicyclists), and for two types of trails (high and low use trails) (Manning et al., 2000). In the study of Gwaii Hannas visitors described earlier, respondents discriminated clearly among the standards they held for encounters with kayakers or facilities as the context of the encounter changed. For example, evaluations of an encounter with nine other kayaks at one time at an "attraction site" were acceptable where it was unacceptable in a "wild place" (Freimund et al., 2002). Inclusion of multiple variables or dimensions of the theoretical construct of crowding into visually-based measures of crowding-related standards of quality can be seen to enhance the power and resolution of such measures as well as contributing to their construct validity.

The concept of validity is complex, and might most appropriately be described as an objective to which research should aspire rather than an end to be reached. In the words of Nunnally (1978, p. 87), "validity is usually a matter of degree rather than an all or none property, and validation is an unending process." Validity can be assessed through theoretical, empirical, and common sense approaches. Findings from visual research approaches described above tend to support the validity of visual research methods applied to measurement of standards of quality in parks and outdoor recreation.

Methodological Issues

As application of visual research methods to measuring standards of quality proceeds, methodological issues have arisen. For example, in other environmental applications of visual research methods, the landscape perspective of photographs may influence assessments of environmental conditions reported by respondents (Brown et al., 1989; Daniel & Boster, 1976; Hollenhorst et al., 1993). This issue was explored in the context of measuring crowding-related standards of quality in parks (Manning et al., 2002). As part of the visitor survey at Grand Canyon National Park described earlier in this paper, two sets of photographs were prepared to illustrate a range of visitor use levels on the Bright Angel Trail, the principal trail that connects the South Rim of the Canyon with the Colorado River. (Representative photographs are shown in Figure 5.) Both sets of photographs showed the same range of visitor use levels along the same 50-meter section of trail. However, one set of photographs was taken looking "up" the trail (showing a characteristically "closed in" view) while the other set of photographs was taken looking "down" the trail (showing a characteristically "open" view). Half the sample of 310 hikers viewed the former set of photographs and half viewed the latter. Study data indicate virtually no differences in the crowding-related standards reported by respondents.

"Starting point bias" represents another potential methodological issue associated with visual research methods (as well as more conventional narrative/numerical methods). Research on willingness-to-pay for environmental amenities suggests that the initial monetary values presented to respondents may influence the ultimate value derived from the research (Desvousges, Smith, & McGivney, 1983; Rowe, D'Arge, & Brookshire, 1980; Thayer, 1981). To explore this issue in the context of using visual research methods in measuring park and outdoor recreation standards, respondents to one site in the Grand Canyon National Park study described above were split into two subsamples. The first group of respondents was shown the six study photographs of a range of visitor use levels in increasing order of use density, while the other group of respondents saw the photographs in decreasing order. Study data indicate no substantive differences in the crowding-related standards reported by the two groups of respondents.

Finally, placement of individuals in study photographs may influence crowding-related standards of quality. For example, in the study of Delicate Arch described earlier (and reported in Figure 2), individuals in the foreground of study photographs were found to influence acceptability ratings to a larger degree than individuals in the background. Subsequent visually-based research has been careful to distribute individuals equally in the foreground and background of study photographs.

While there are likely to be many methodological issues inherent in visual research methods as they are applied to measuring standards of quality in parks and other outdoor recreation areas, initial research suggests that these methods may be relatively robust. That is, careful applications do not appear to be heavily influenced by methodological variations.

Looking Down the Trail**Looking Up the Trail**

Figure 5. Representative Photographs of the Bright Angel Trail Presented from Alternative Landscape Perspectives

Conclusions

Visual research methods have played an important role in environmental research and management for several decades. More recently, these methods have been adapted for use in measuring standards of quality in parks and outdoor recreation. Study findings suggest that visual research methods may have some advantages over more conventional narrative/numerical research approaches, and that visual research methods may be particularly appropriate in selected park and outdoor recreation contexts such as front-county and other high use areas and for resource-related impacts that are difficult to describe in narrative/numerical formats. Moreover, in certain contexts (e.g., high use density areas) visual research methods may result in more realistic estimates of visitor-based standards of quality. Findings from studies employing visual research methods generally meet conventional tests of research validity. Finally, tests of selected methodological issues inherent in visual research approaches suggest that these methods may be relatively robust in that resulting data do not appear to be greatly influenced by methodological alternatives. Visual research methods are being increasingly adopted into studies of park and outdoor recreation standards, and have received strong endorsement in the literature. For example, a recent analysis by Hall and Roggenbuck (2002, p. 334) concluded that "the short phrases used in normative questions (such as "number of encounters per day") cannot capture the true complexity and nature of a recreation experience and respondents must inevitably fill in background assumptions and conditions. . . . Thus, we feel that. . . visual approaches are superior to the traditional. . . form of numerically based question[s]."

Although visual research methods are promising as an approach to measuring standards of quality in parks and outdoor recreation, there are several issues that warrant attention and that may limit their usefulness. A photograph can portray a more realistic description of a recreation setting than can a number or short narrative statement, but there are limitations to what a photograph can present. It is unrealistic to expect that photographs can display all relevant characteristics of visitor use and users. Moreover, still photographs are static, only account for visual stimuli, and by definition may not be well suited to representing the inherent dynamics of a recreation experience. Video photography and other dynamic media may represent at least a partial solution to this issue. For example, Bateson and Hui (1992) used videotape to portray interactions between customers and service personnel, and Eroglu and Harrell (1986) and Rohrman and Bishop (2002) found that non-visual variables, such as sound and smell, can affect perceived crowding. Given the pace of technological advancement, the possibilities for edited digital video, virtual reality and other ways of representing reality may emerge as viable research tools much sooner than might be expected. When they do, this review suggests that these visual media will further facilitate effective communication between researchers and respondents and our un-

derstanding of the acceptability of social and ecological conditions in parks and outdoor recreation.

Literature Cited

- Basman, C. M., Barro, S. C., Manfredo, M. J., Vaske, J. J., & Watson, A. (1996). Norm accessibility: An exploratory study of backcountry and frontcountry recreational norms. *Leisure Sciences*, 18(2), 177-191.
- Bateson, J. & Hui, M. (1992). The ecological validity of photographic slides and videotapes in simulating the service setting. *Journal of Consumer Research*, 19: 271-281.
- Blumer, H. (1936). Social attitudes and nonsymbolic interaction. *Journal of Educational Sociology*, 9, 515-523.
- Brown, T., Richards, M., Daniel, T., & King, D. (1989). Recreation participation and the validity of photo-based preference judgements. *Journal of Leisure Research*, 21, 40-60.
- Buchanan, T., Christensen, J. E., & Burdge, R. J. (1981). Social groups and the meanings of outdoor recreation activities. *Journal of Leisure Research*, 13(3), 254-266.
- Budruk, M. & Manning, R. (2004). Indicators and standards of quality at an urban-proximate park: Litter and graffiti at Boston Harbor Islands National Recreation Area. *Proceedings of the 2003 Northeastern Recreation Research Symposium*, USDA Forest Service 6TR NE 317, pp. 24-31.
- Budruk, M. & Manning, R. (2003). Crowding related norms in outdoor recreation: U.S. versus international visitors. *Proceedings of the 2002 Northeastern Recreation Research Symposium*, pp. 216-221.
- Burch, W. R., Jr. (1964). Two concepts for guiding recreation decisions. *Journal of Forestry*, 62, 707-712.
- Burch, W. R., Jr. (1969). The social circles of leisure: Competing explanations. *Journal of Leisure Research*, 1(2), 125-147.
- Carmines, E. & Zeller, R. (1979). *Reliability and Validity Assessment*. Thousand Oaks, California: SAGE Publications, Inc.
- Cheek, N. H., Jr. (1971). Toward a sociology of not-work. *Pacific Sociological Review*, 14, 245-258.
- Chenoweth, R. (1990). Image capture technology and aesthetic regulation of landscapes adjacent to public lands. In *Managing America's enduring wilderness resource*. St. Paul, MN: University of Minnesota, pp. 563-568.
- Daniel, T., & Boster, R. (1976). *Measuring landscape esthetics: The scenic beauty estimation method*. (Research Paper RM-167). Fort Collins, Colorado: USDA Forest Service, Rocky Mountain Forest and Range Experiment Station.
- Daniel, T., & Ittleson, W. (1981). Conditions for environmental perception research: Comment on "the psychological representation of molar physical environments" by Ward and Russel. *Journal of Experimental Psychology*, 110, 153-157.
- Daniel, T. & Meitner, M. 2001. Representational validity of landscape visualizations: The effects of graphical realism on perceived scenic beauty of forest vistas. *Journal of Environmental Psychology*, 21, 61-72.
- Daniel, T., Brown, T., King, D., Richards, M., & Stewart, W. (1989). Perceived scenic beauty and contingent valuation of forest campgrounds. *Forest Science*, 35, 76-90.
- Desvousges, W. H., Smith, V. K., & McGivney, M. P. (1983). A comparison of alternative approaches for estimating recreation and related benefits of water quality improvements. U.S. Environmental Protection Agency, EPA 230-05-83-001.

- Donnelly, M., Vaske, J., & Shelby, B. (1992). Measuring backcountry standards in visitor surveys. In *Defining wilderness quality: The role of standards in wilderness management—A workshop proceedings*. USDA Forest Service General Technical Report PNW-GTR-305, pp. 38-52.
- Dottavio, F. D., O'Leary, J., & Koth, B. (1980). The social group variable in recreation participation studies. *Journal of Leisure Research*, 12(4), 357-367.
- Driver, B. L., & Bassett, J. (1975). Defining conflicts among river users: A case study of Michigan's Au Sable River. *Naturalist*, 26(1), 19-23.
- Eroglu, S. & Harrell, D. (1986). Retail crowding: Theoretical and strategic implications. *Journal of Retailing*, 62, 347-363.
- Field, D. R., & O'Leary, J. (1973). Social groups as a basis for assessing participation in selected water activities. *Journal of Leisure Research*, 5(1), 16-25.
- Freimund, W., Vaski, J., Donnelly, M., & Miller, T. (2002). Using video surveys to access dispersed backcountry visitors' norms. *Leisure Sciences*, 24, 349-362.
- Hall, T. & Roggenbuck, J. (2002). Response format effects in questions about norms: Implications for the reliability and validity of the normative approach. *Leisure Sciences*, 24, 325-338.
- Hammitt, W. E. (1982). Cognitive dimensions of wilderness solitude. *Environment and Behavior*, 14(4), 478-493.
- Heberlein, T. A., Alfano, G. E., & Ervin, L. H. (1986). Using a social carrying capacity model to estimate the effects of marina development at the Apostle Islands National Seashore. *Leisure Sciences*, 8(1), 257-274.
- Hershberger, R. & Cass, R. (1974). Predicting user responses to building. *Man-Environment Interactions: Evaluations and Applications*. Stroudsbury, PA: Dowden, Hutchinson & Ross, 117-134.
- Heywood, J. (1993). Behavioral conventions in higher density, day use wildland/urban recreation settings: A preliminary case study. *Journal of Leisure Research*, 25, 39-52.
- Heywood, J., & Murdock, W. (2002). Social norms in outdoor recreation: Searching for the behavior-condition link. *Leisure Sciences*, 24, 283-296.
- Hof, M., Hammett, J., Rees, M., Belnap, J., Poc, N., Lime, D., & Manning, R. (1994). Getting a handle on carrying capacity: A pilot project at Arches National Park. *Park Science*, 14(1), 11-13.
- Hollenhorst, S., Brock, S., Freimund, W. & Twery, M. (1993). Predicting the effects of gypsy moth on near-view aesthetic preferences and recreation behavior intentions. *Forest Science*, 39, 28-40.
- Hull, B. & Stewart, W. (1992). Validity of photo-based scenic beauty judgements. *Journal of Environmental Psychology*, 12, 101-114.
- Inglis, G. J., Johnson, V. I., & Black, F. (1999). Crowding norms in marine settings: A case study of snorkeling on the Great Barrier Reef. *Environmental Management*, 24(3), 369-381.
- Jackson, J. (1965). Standard characteristics of norms. In *Current Studies in Social Psychology*. New York: Holt, Rinehart, and Winston, pp. 301-301.
- Kellomaki, S., & Savolainen, R. (1984). The scenic value of forest landscape as assessed in the field and the laboratory. *Landscape Planning*, 11, 97-108.
- Lawson, S. & Manning, R. (2002). Tradeoffs among social, resource, and managerial attributes of the denali wilderness experience: A contextual approach to normative research. *Leisure Sciences*, 24, 297-312.
- Lee, R. G. (1972). The social definition of outdoor recreation places. In W. R. Burch, N. H. Cheek, & L Taylor, (Eds.) *Social behavior, natural resources, and the environment*. New York: Harper & Row, pp. 68-84.
- Lee, R. G. (1975). *The management of human components in the Yosemite National Park ecosystem: Final research report*. Berkeley: University of California.

- Lee, R. G. (1977). Alone with others: The paradox of privacy in wilderness. *Leisure Sciences*, 1(1), 3-9.
- Lime, D. W. (1972). *Large groups in the Boundary Waters canoe area: Their numbers, characteristics, and impact*. USDA Forest Service Research Note NC-142.
- Lime, D. (1990). Image capture technology: An exciting new tool for wilderness managers. In *Managing America's Enduring Wilderness Resource*. St. Paul, MN: University of Minnesota, pp. 549-552.
- Lucas, R. C. (1964). Wilderness perception and use: The example of the Boundary Waters Canoe Area. *Natural Resources Journal*, 3(3), 394-411.
- Manning, R. E. (1985). Crowding norms in backcountry settings: A review and synthesis. *Journal of Leisure Research*, 17(2), 75-89.
- Manning, R. (1999). *Studies in Outdoor Recreation*. Corvallis, OR: Oregon State University Press.
- Manning, R. (2001). Visitor experience and resource protection: A framework for managing the carrying capacity of national parks. *Journal of Park and Recreation Administration*, 19, 93-108.
- Manning, R., Johnson, D., & Vande Kamp, M. (1996). Norm congruence among tour boat passengers to Glacier Bay National Park. *Leisure Sciences*, 18(2), 125-141.
- Manning, R., Lawson, S., Newman, P., Budruk, M., Valliere, W., Laven, D., et al., (2004). Visitor perceptions of recreation-related resource impacts. *Environmental Impacts of Ecotourism*. London: CAB International, pp. 259-272.
- Manning, R., Lawson, S., Newman, P., Laven, D., & Valliere, W. (2002). Methodological issues in measuring crowding-related norms in outdoor recreation. *Leisure Sciences*, 24, 339-348.
- Manning, R., Lime, D., Freimund, W., & Pitt, D. (1996a). Crowding norms at frontcountry sites: A visual approach to setting standards of quality. *Leisure Sciences*, 18, 39-59.
- Manning, R., Lime, D., & Hof, M. (1996b). Social carrying capacity of natural areas: Theory and application in the national parks. *Natural Areas Journal*, 16(2), 118-127.
- Manning, R., Lime, D., Hof, M., & Freimund, W. (1995). The visitor experience and resource protection (VERP) process: The application of carrying capacity to Arches National Park. *The George Wright Forum*, 12(3), 41-55.
- Manning, R. E., Lime, D. W., McMonagel, R. F., & Nordin, P. (1993). *Indicators and standards of quality for the visitor experience at Arches National Park: Phase 1 research*. University of Minnesota Cooperative Park Studies Unit, 54 pp.
- Manning, R., Newman, P., Valliere, W., Wang, B., & Lawson, S. (2001). Respondent self-assessment of research on crowding norms in outdoor recreation. *Journal of Leisure Research*, 33(3), 251-271.
- Manning, R., Valliere, W., Minter, B., Wang, B., & Jacobi, C. (2000). Crowding in parks and outdoor recreation: A theoretical, empirical, and managerial analysis. *Journal of Park and Recreation Administration*, 18(4), 57-72.
- Manning, R., Valliere, W., Wang, B., & Jacobi, C. (1999). Crowding norms: Alternative measurement approaches. *Leisure Sciences*, 21(2), 97-115.
- Manning, R., Wang, B., Valliere, W., Lawson, S., & Newman, P. (2002). Research to estimate and manage carrying capacity of a tourist attraction: A study of Alcatraz Island. *Journal of Sustainable Tourism*, 10, 388-464.
- Martin, S., McCool, S., & Lucas, R. (1989). Wilderness campsite impacts: Do managers and visitors see them the same? *Environmental Management*, 13: 623-629.
- McCool, S., Benson, R. & Ashor, J. (1986). How the public perceives the visual effects of timber harvesting: An evaluation of interest group preferences. *Environmental Management*, 10, 385-391.
- Meyersohn, R. (1969). The sociology of leisure in the United States: Introduction and bibliography, 1945-1965. *Journal of Leisure Research*, 1(1), 53-68.

- Nassauer, J. (1990). Using image capture technology to generate wilderness management solutions. In *Managing America's Enduring Wilderness Resource*. St. Paul, MN: University of Minnesota, pp. 553-562.
- National Park Service. (1997). *Visitor experience and resource protection (VERP) framework: A handbook for planners and managers*. Denver: Denver Service Center.
- Nunnally, J. (1978). *Psychometric Theory*. New York: McGraw-Hill Book Company.
- Patterson, M. E., & Hammitt, W. E. (1990). Backcountry encounter norms, actual reported encounters, and their relationship to wilderness solitude. *Journal of Leisure Research*, 22(3), 259-275.
- Pitt, D. (1990). Developing an image capture system to see wilderness management solutions. In *Managing America's Enduring Wilderness Resource*. St. Paul, MN: University of Minnesota, pp. 541-548.
- Pitt, D., Nassauer, J., Lime, D. & Snyder, D. (1993). The validity of video imaging presentation media as compared with photographic slides. Unpublished manuscript, University of Minnesota.
- Ribe, R. (1989). The aesthetics of forestry: What has empirical preference research taught us? *Environmental Management*, 13(1), 55-74.
- Roggenbuck, J., Williams, D., Bange, S., and Dean, D. (1991). River float trip encounter norms: Questioning the use of the social norms concept. *Journal of Leisure Research*, 23: 133-153.
- Rohrmann, B. & Bishop, I. (2002). Subjective responses to computer simulations of urban environments. *Journal of Environmental Psychology*, 22(4): 319-330.
- Rowe, R. D., d'Arge, R. C., & Brookshire, D. S. (1980). An experiment on the economic value of visibility. *Journal of Environmental Economics and Management*, 7, 1-19.
- Saarinen, J. (1998). Cultural influences on wilderness encounter responses: A case study from Finland. *International Journal of Wilderness*, 4, 28-32.
- Schkade, D. A., & Payne, J. W. (1994). How people respond to contingent valuation questions: A verbal protocol analysis of willingness to pay for environmental regulation. *Journal of Environmental Economics and Management* 26, 88-109.
- Shelby, B. (1981). Encounter norms in backcountry settings: Studies of three rivers. *Journal of Leisure Research*, 13: 129-138.
- Shelby, B., & Colvin, R. (1982). Encounter measures in carrying capacity research: Actual, reported, and diary contacts. *Journal of Leisure Research*, 14(4), 350-360.
- Shelby, B., & Heberlein, T. (1986). *Carrying Capacity in Recreation Settings*. Corvallis, Oregon: Oregon State University Press.
- Shelby, B. & Shindler, B. (1992). Interest group standards for ecological impacts at wilderness campsites. *Leisure Sciences*, 14, 17-27.
- Shelby, B., & Vaske, J. (1991). Using normative data to develop evaluative standards for resource management: A comment on three recent papers. *Journal of Leisure Research*, 23, 173-187.
- Shelby, B., Vaske, J., & Donnelly, M. (1996). Norms, standards and natural resources. *Leisure Sciences*, 18, 103-123.
- Shelby, B., Vaske, J. J., & Harris, R. (1988). User standards for ecological impacts at wilderness Campsites. *Journal of Leisure Research*, 20(3), 245-256.
- Shuttleworth, S. (1980). The use of photographs as an environmental presentation medium in landscape studies. *Journal of Environmental Management*, 11, 61-76.
- Stamps, A. (1990). Use of photographs to simulate environments: A meta-analysis. *Perceptual and Motor Skills*, 71: 907-913.
- Stankey, G. H. (1973). *Visitor perception of wilderness recreation carrying capacity*. USDA Forest Service Research Paper INT-142.
- Stankey, G. H. (1980). *A comparison of carrying capacity perceptions among visitors to two wildernesses*. USDA Forest Service Research Paper INT-242.

- Stankey, G., Cole, D., Lucas, R., Peterson, M., Frissell, S., & Washburne, R. (1985). *The limits of acceptable change (LAC) system for wilderness planning*. USDA Forest Service General Technical Report INT-176.
- Thayer, M. A. (1981). Contingent valuation techniques for assessing environmental impacts: Further evidence. *Journal of Environmental Economics and Management*, 8, 27-44.
- Titre, J., & Mills, A. S. (1982). Effect of encounters on perceived crowding and satisfaction. In *Forest and river recreation: Research update* (pp. 146-153). University of Minnesota Agricultural Experiment Station Miscellaneous Publication 18.
- Twight, B. W., Smith, K. L., & Wassinger, G. H. (1981). Privacy and camping: Closeness to the self vs. closeness to others. *Leisure Sciences*, 4(4), 427-441.
- Vaske, J., A. Graefe, A., Shelby, B., & Heberlein, T. (1986). Backcountry encounter norms: Theory, method, and empirical evidence. *Journal of Leisure Research*, 18, 137-153.
- Vining, J., & Orland, B. (1989). The video advantage: A comparison of two environmental representation techniques. *Journal of Environmental Management*, 29, 275-283.
- West, P. C. (1982). Effects of user behavior on the perception of crowding in backcountry forest recreation. *Forest Science*, 28(1), 95-105.
- Whittaker, D., & Shelby, B. (1988). Types of norms for recreation impacts: Extending the social norm concept. *Journal of Leisure Research*, 20(4), 261-273.
- Williams, D., Roggenbuck, J. W., & Bange, S. P. (1991). The effect of norm-encounter compatibility on crowding perceptions, experience, and behavior in river recreation settings. *Journal of Leisure Research*, 23, 154-172.