

Defining and Managing the Quality of Wilderness Recreation Experiences

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Abstract—There is a substantial body of scientific literature on defining and managing the quality of wilderness experiences. Two conceptual frameworks derived from this literature—carrying capacity and the Recreation Opportunity Spectrum (ROS)—suggest that wilderness recreation experiences can be defined through indicators and standards of quality, and that wilderness recreation should be managed to ensure that standards of quality are sustained over time. This paper briefly describes the conceptual frameworks of carrying capacity and ROS; reviews the growing literature on wilderness-related indicators and standards of quality, and wilderness recreation management; and suggests a number of issues that warrant further research and management attention.

The Wilderness Act, along with the organic legislation creating the four federal wilderness management agencies, prescribes multiple objectives of wilderness. One of the principal objectives of this legislation is to provide outdoor recreation opportunities. Passage of the Wilderness Act in 1964 marked the beginning of a period of intensive research on outdoor recreation in wilderness and related areas, and this research has given rise to a substantial body of scientific literature on defining and managing the quality of wilderness experiences.

While the literature on wilderness recreation is diverse, several conceptual frameworks have evolved that help integrate and synthesize information from recreation research. Two traditional frameworks are carrying capacity and the Recreation Opportunity Spectrum (ROS). Both of these frameworks suggest that wilderness and related outdoor recreation experiences can be defined through indicators and standards of quality, and that wilderness recreation should be managed to ensure that standards of quality are sustained over time.

This paper uses the above conceptual frameworks and approaches to review and synthesize the literature on defining and managing wilderness and related outdoor recreation experiences. The conceptual frameworks of carrying capacity and ROS are briefly reviewed in the first section to trace

the evolution and contemporary emphasis on indicators and standards of quality and related wilderness recreation management practices. The next two sections review the growing literature on wilderness-related indicators and standards of quality and wilderness recreation management. A final section suggests a number of issues that warrant further research and management attention.

This paper takes an expansive approach to reviewing the literature on management of wilderness and related areas for recreation experiences. Studies included in this review focus on both designated wilderness areas and areas that might be described as wilderness with a lower case “w.” The intent is to identify principles, concepts and patterns that can be synthesized from the growing scientific literature on defining and managing wilderness-related recreation experiences.

Wilderness Recreation Management Frameworks

Carrying Capacity

Rapidly expanding recreation in the 1950s and 1960s gave rise to concerns over acceptable use levels of wilderness and related outdoor recreation areas. While interest in the impacts of recreation on the natural resource base predominated, there was also emerging interest in the effects of increased use on the quality of the recreation experience. Early studies prompted theorists to search for a way such issues might be fit into an organizational framework to help formulate outdoor recreation policy. A resulting paradigm was the concept of carrying capacity.

The first rigorous application of carrying capacity to outdoor recreation came in the early 1960s with a conceptual monograph (Wagar 1964) and a preliminary empirical treatment (Lucas 1964). Perhaps the major contribution of Wagar’s conceptual analysis was the expansion of carrying capacity from its dominant emphasis on environmental effects to a dual focus that included social or experiential considerations:

The study reported here was initiated with the view that the carrying capacity of recreation lands could be determined primarily in terms of ecology and the deterioration of areas. However, it soon became obvious that the resource-oriented point of view must be augmented by consideration of human values (Wagar 1964, preface).

Wagar’s point was that as more people visit a wilderness or related recreation area, not only the environmental resources of the area are affected, but also the quality of the recreation experience. Thus, carrying capacity was expanded

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to include consideration of the social environment as well as the biophysical environment. The effects of increasing use on recreation quality were illustrated by means of hypothetical relationships between increasing use level and visitor satisfaction. This analysis suggested that the effects of crowding on satisfaction would vary, depending on visitor needs or motivations.

A preliminary attempt to estimate the recreation carrying capacity of the Boundary Waters Canoe Area, in Minnesota, followed shortly, and it found that perceptions of crowding varied by different user groups (Lucas 1964). Paddling canoeists were found to be more sensitive to crowding than motor canoeists, who were in turn more sensitive to crowding than other motorboaters. A range of carrying capacities was estimated depending on these different relationships.

Limits of Acceptable Change—Carrying capacity has attracted intensive focus as a research and management concept in wilderness recreation. Several bibliographies, books and review papers have been published on carrying capacity and related issues, and these publications contain hundreds of citations (for example, Graefe and others 1984; Kuss and others 1990; Shelby and Heberlein 1986; Stankey and Lime 1973; Stankey and Manning 1986). Despite this impressive literature base, efforts to apply carrying capacity to wilderness and related outdoor recreation areas has often resulted in frustration. The principal difficulty lies in determining how much impact or change should be allowed within each of the components that make up the carrying capacity concept: biophysical resources and the quality of the recreation experience.

The growing research base on wilderness recreation indicates that increasing visitor use often causes impact or change. This is especially clear with biophysical resources. An early study in the Boundary Waters Canoe Area, for example, found that an average of 80% of ground cover vegetation was destroyed at campsites in a single season, even under relatively light levels of use (Frissell and Duncan 1965). The biophysical and ecological impacts of outdoor recreation have been summarized and synthesized in a number of studies (for example, Cole 1987, Kuss and others 1990, Hammitt and Cole 1998), including a companion paper by Leung and Marion in this volume. Research also suggests that increasing visitor use can change the quality of the recreation experience through crowding, conflict and other impacts. This issue is often referred to as the “limits of acceptable change” (Frissell and Stankey 1972). Some change in the biophysical and social environments of wilderness recreation is inevitable, but sooner or later, the amount, nature or type of change may become unacceptable. But what determines the limits of acceptable change?

This issue is illustrated graphically in figure 1, which shows a hypothetical relationship between visitor use and impacts to the biophysical and social environments. This relationship suggests that increasing wilderness use can and often does increase impacts, in the form of damage to fragile soils and vegetation, and crowding and conflicting uses. However, it is not clear from this relationship at what point carrying capacity has been reached. For this relationship, X1 and X2 represent alternative levels of visitor use that result in corresponding levels of impact, as defined by points Y1 and Y2, respectively. But which of these points—Y1 or Y2,

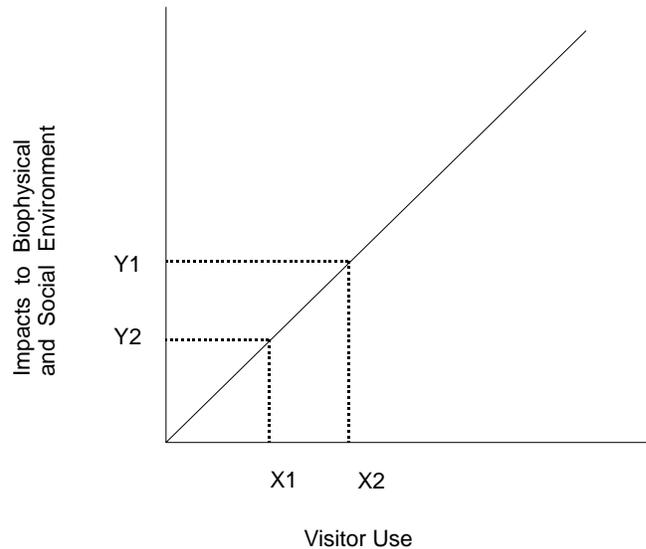


Figure 1—Hypothetical relationship between visitor use and impact to the biophysical and social environments (from Manning and Lime 1996).

or some other point along the vertical axis—represents the maximum amount of impact that is acceptable?

To emphasize and further clarify this issue, some studies have suggested distinguishing between descriptive and prescriptive components of carrying capacity (Shelby and Heberlein 1984, 1986). The descriptive component of carrying capacity focuses on factual, objective data such as the relationship in figure 1. For example, what is the relationship between the amount of visitor use and perceived crowding? The prescriptive component of carrying capacity determination involves the seemingly more subjective issue of how much impact or change in the recreation environment is acceptable. For example, what level of perceived crowding should be allowed?

Indicators and Standards of Quality—Recent experience with carrying capacity suggests that answers to the above questions can be found through formulation of management objectives and associated indicators and standards of quality (Boteler 1984; P. Brown 1977; Bury 1976; Frissell and Stankey 1972; Graefe and others 1990; Lime and Stankey 1971; Lime 1977a, 1979, 1995; Lucas and Stankey 1974; Manning and others 1995a, 1995c; Manning and Lime 1996; Manning and others 1996b,e; Manning 1997; National Park Service 1997; Shelby and others 1992b; Shindler 1992; Stankey 1980b; Stankey and others 1985; Stankey and Manning 1986). This approach to carrying capacity focuses on defining the type of visitor experience to be provided. Management objectives are broad narrative statements defining the type of visitor experience to be provided. Indicators of quality are more specific, measurable variables reflecting the essence or meaning of management objectives. They are quantifiable proxies or measures of management objectives. Indicators of quality may include elements of the biophysical, social and management environments that are important in determining the quality of the visitor experience. Standards of quality define the minimum acceptable condition of indicator variables.

An example may help illuminate these ideas and terms. Review of the 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 other visitors encountered along trails and at campsites is important in defining solitude for wilderness visitors. Thus, trail and camp encounters are potentially good indicators of quality. Research also suggests that wilderness visitors may have normative standards about how many trail and camp encounters can be experienced before opportunities for solitude decline to an unacceptable degree. For example, a number of studies suggest that wilderness visitors prefer to see no more than three to five other groups per day along trails. Thus, a maximum of five encounters per day with other groups along trails may be a good standard of quality.

Carrying Capacity Frameworks—The literature described above has given rise to several frameworks for determining and applying carrying capacity to wilderness and related outdoor recreation areas. These frameworks include Limits of Acceptable Change (McCool and Cole 1997a; Stankey and others 1985); Visitor Impact Management (Graefe and others 1990), Visitor Experience and Resource Protection (Hof and Lime 1997; Manning and others 1996b; National Park Service 1997), Carrying Capacity Assessment Process (Shelby and Heberlein 1986), Quality Upgrading and Learning (Chilman and others 1989, 1990) and Visitor Activity Management Process (Environment Canada and Park Service 1991). All of these frameworks incorporate the ideas about carrying capacity

described above and provide a rational, structured process for making carrying capacity decisions.

The basic steps or elements of the three most widely applied carrying capacity frameworks are shown in table 1. While terminology, sequencing and other aspects may vary among these frameworks, all share a common underlying logic. Core elements of these frameworks include:

1. Definition of the types of recreation opportunities to be provided. Recreation opportunities should be defined as specifically and quantitatively as possible through indicators and standards of quality.
2. Management action designed to sustain standards of quality over time. When standards of quality are in danger of being violated, management intervention is required.

Several applications and evaluations of these carrying capacity frameworks and related processes are described in the literature (Absher 1989; Ashor and others 1986; Graefe and others 1986; Graefe and others 1990; Hof and others 1994; Kaltenborn and Emmelin 1993; Manning and others 1995a,b,c; Manning and Lime 1996; Manning and others 1996b,c; Manning 1997; McCool and Cole 1997b; McCoy and others 1995; Ritter 1997; Shelby and Heberlein 1986; Warren 1997; Vaske and others 1992).

The Recreation Opportunity Spectrum (ROS)

Diversity in Outdoor Recreation—Many studies have been conducted of visitors to wilderness and related outdoor recreation areas over the past several decades. The objectives,

Table 1—Carrying capacity frameworks.

| Limits of acceptable change | Visitor impact management | Visitor experience and resource protection |
|---|---|---|
| Step 1. Identify area concerns and issues | Step 1. Pre-assessment data base reviews | Element 1. Assemble an interdisciplinary project team |
| Step 2. Define and describe opportunity classes | Step 2. Review of management objectives | Element 2. Develop a public involvement strategy. |
| Step 3. Select indicators of resource and social conditions | Step 3. Selection of key impact indicators | Element 3. Develop statements of primary park purpose, significance, and primary interpretive themes. |
| Step 4. Inventory resource and social conditions. | Step 4. Selection of standards for key impact indicators. | Element 4. Analyze park resources and existing visitor use. |
| Step 5. Specify standards for resource and social indicators. | Step 5. Comparison of standards and existing conditions. | Element 5. Describe a potential range of visitor experiences and resource conditions. |
| Step 6. Identify alternative opportunity class allocations. | Step 6. Identify probable causes of impacts | Element 6. Allocate potential zones to specific locations |
| Step 7. Identify management actions for each alternative. | Step 7. Identify management strategies | Element 7. Select indicators and specify standards for each zone; develop a monitoring plan. |
| Step 8. Evaluation and selection of an alternative. | Step 8. Implementation | Element 8. Monitor resource and social indicators. |
| Step 9. Implement actions and monitor conditions. | | Element 9. Take management action. |

scope and methods of these studies are highly variable, but at least one general finding has been pervasive: Wilderness and related outdoor recreation are diverse. This is a recurring theme, whether in regard to recreation activities, socio-economic and cultural characteristics of visitors, attitudes about policy, preferences for services and facilities, sensitivity to crowding and conflict, experience level, and motivations for and benefits received from recreation participation. Diversity in tastes for outdoor recreation is found equally in studies of developed campgrounds and investigations of wilderness hikers.

Research points out that not only are there differences in taste among people, but that people's tastes change over time as well (Burch 1966). A study in the Pacific Northwest, for example, found that the type of camping chosen (wilderness camping, automobile camping or some combination of the two) was strongly related to changes in stage of the family life cycle. A nationwide panel study of campers found similar relationships between camping activity and family life cycle (LaPage 1973, LaPage and Ragain 1974). Based on these relationships, it has been suggested that outdoor recreation "is like an omnibus—the seats are often full but often occupied by different persons as they adjust to the flow of time" (Burch 1966).

ROS—ROS is a conceptual framework for encouraging diversity in wilderness and related outdoor recreation opportunities. Relationships among site factors that combine to define recreation opportunities are arranged in configurations that suggest categories of opportunities. ROS has been adopted by two wilderness management agencies, the U.S. Forest Service and the Bureau of Land Management (Buist and Hoots 1982; Driver and others 1987). ROS was developed simultaneously by two groups of researchers: Clark and Stankey (1979) and Brown, Driver, and associates (P. Brown and others 1978; P. Brown and others 1979; Driver and Brown 1978).

ROS recognizes four levels of demands for recreation—(1) activities, (2) settings, (3) motivations, and (4) ultimate benefits, and the focus is on level 2 demands-settings. Brown, Driver and associates take a more empirically oriented approach to ROS, seeking to link settings to the motivations or psychological outcomes they fulfill. Clark and Stankey (1979) take a more applied approach. They note that as knowledge of linkages between recreation settings and psychological outcomes improves, so does the efficacy of meeting visitor demands. In the meantime, managers should emphasize the provision of diversity in recreation settings, based on the assumption that a corresponding diversity of experiences will be produced.

ROS also recognizes that wilderness and related recreation settings are defined by three broad categories of factors: environmental, social and managerial. By describing ranges of these factors, selected types of recreation opportunities can be defined. Clark and Stankey (1979) are most specific in defining these factors and the resulting recreation opportunity types. They suggest that six basic factors—access, nonrecreational resource uses, on-site management, social interaction, acceptability of visitor impacts and acceptable regimentation—be used to define the opportunity spectrum.

P. Brown and others (1978) take a more narrative or descriptive approach to defining recreation opportunity types. Six opportunity classes are identified; for each recreation opportunity class, the associated experience provided and the physical, social and managerial settings are described. Five specific factors are used to define and distinguish among recreation opportunity classes: managerial regimentation, interaction among user groups, evidence of human modification of the environment, size or extent of area of opportunity and remoteness.

Defining and Managing Wilderness Recreation

Carrying capacity and ROS provide useful frameworks for integrating and synthesizing much of the social science literature on wilderness and related outdoor recreation. Taken together, they suggest a basic approach to defining and managing wilderness experiences. First, wilderness experiences can be defined through indicators and standards of quality. Indicators and standards of quality can be formulated for the resource, social and managerial components of wilderness recreation opportunities. Second, management action is needed to sustain standards of quality over time. If standards of quality are not maintained, wilderness experiences will change in unknown and perhaps undesirable ways. The next two sections of this paper review the wilderness and related recreation literature that addresses indicators and standards of quality of wilderness experiences and management of wilderness recreation.

Defining Wilderness Recreation: Indicators and Standards of Quality

The previous section described the way in which indicators and standards of quality have emerged as a central focus of contemporary wilderness recreation management frameworks. But how are indicators and standards of quality formulated? Moreover, what indicators and standards of quality have been suggested in the research literature?

Research on crowding in outdoor recreation suggests of an important approach to formulating indicators and standards of quality. Crowding can be understood as a normative process. That is, wilderness visitors often have preferences, expectations or other standards to judge a situation as crowded or not. In fact, research demonstrates that such standards are often more important in crowding judgments than the number of other groups encountered (Manning 1985; Shelby and Heberlein 1986). If such standards can be defined and measured, they may be useful in formulating indicators and standards of quality for wilderness recreation.

This section of the paper describes the application of normative theory and methods to the formulation of indicators and standards of quality. Characteristics of good indicators and standards of quality are outlined, examples of indicators and standards of quality are compiled and presented, and a series of conclusions from this research are

developed and discussed. Finally, a series of theoretical and methodological issues are identified regarding application of the normative approach to indicators and standards of quality in wilderness and related outdoor recreation.

Norm Theory and Methods

Developed in the disciplines of sociology and social-psychology, normative theory and related empirical methods have attracted substantial attention as organizing concepts in wilderness and related outdoor recreation research and management (Heberlein 1977; Shelby and others 1996; Shelby and Heberlein 1986; Vaske and others 1986, 1992, 1993). Much of this literature has been organized around the work of Jackson (1965), who developed a methodology for measuring norms. Adapting these methods to outdoor recreation, visitors can be asked to evaluate alternative levels of potential impacts caused by increasing recreation use levels or changing types of recreation use. For example, visitors might be asked to rate the acceptability of encountering increasing numbers of recreation groups while hiking along trails. Resulting data would measure the personal crowding norm of each respondent. These data can then be aggregated to test for social crowding norms, or the degree to which norms are shared across groups such as first-time versus experienced hikers.

Social norms can be illustrated graphically, as shown in figure 2. Using hypothetical data associated with the example described above, this graph plots average acceptability ratings for encountering increasing numbers of visitor groups along trails. The line plotted in this illustration is sometimes called an “encounter” or “contact preference curve” (when applied to crowding-related variables), or it might be called an “impact acceptability curve” more generally, or simply a “norm curve.”

Norm curves like the one in figure 2 have several potentially important features or characteristics. First, all points along the curve above the neutral line—the point on the vertical axis where evaluation ratings fall from the acceptable into the unacceptable range—define the “range of acceptable conditions.” All of the conditions represented in this range are judged to meet some level of acceptability by

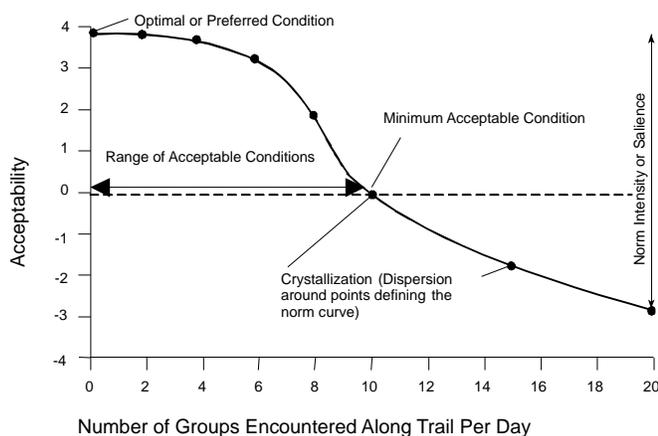


Figure 2—Norm curve.

about half of all respondents. The “optimum condition” is defined by the highest point on the norm curve. This is the condition that received the highest rating of acceptability from the sample as a whole. The “minimum acceptable condition” is defined as the point at which the norm curve crosses the neutral line. This is the condition that approximately half of the sample finds acceptable and half finds unacceptable. “Norm intensity” or norm “salience”—the strength of respondents’ feelings about the importance of a potential indicator of quality—is suggested by the distance of the norm curve above and below the neutral line. The greater this distance, the more strongly respondents feel about the indicator of quality or the condition being measured. High measures of norm intensity or salience suggest that a variable may be a good indicator of quality because respondents feel it is important in defining the quality of the recreation experience. “Crystallization” of the norm concerns the amount of agreement or consensus about the norm. It is usually measured by standard deviations or other measures of variance of the points that describe the norm curve. The less variance or dispersion of data around those points, the more consensus there is about social norms. Norm curves are sometimes constructed with the vertical axis of the graph representing the percentage of respondents who report each level of impact as the maximum acceptable.

Norms can also be measured using a shorter, open-ended question format by asking respondents to report the maximum level of impact that is acceptable to them. In the example illustrated in figure 2, respondents could simply be asked to report the maximum number of groups they would find acceptable while hiking along trails during a day’s time. This format is designed to be less burdensome to respondents, but it also yields less information. Alternative question formats for measuring norms are addressed more fully later in this section.

Indicators of Quality

Indicators of quality are receiving increasing attention in the outdoor recreation literature. Normative theory and methods as described above have been applied less directly to indicators of quality than standards of quality. However, the extent to which visitors agree about the importance of potential indicators of quality is important and reflects a substantive normative component. Moreover, norm intensity or salience, as described above, is a measure of the importance of potential indicators of quality and can be derived from normative methods. The literature has addressed two important issues regarding indicators of quality: 1. criteria defining good indicators of quality and 2. studies designed to identify potential indicators of quality.

Characteristics for Good Indicators of Quality—Several studies have explored criteria that might be used to define effective indicators of quality in wilderness and related areas (Merigliano 1990; National Park Service 1997; Schomaker 1984; Stankey and others 1985; Whittaker and Shelby 1992). These criteria can be used to further understand the role of indicators and standards of quality in outdoor recreation and to help evaluate and select among potential indicator variables. Criteria for good indicators of quality include the following:

1. Specific. Indicators should define specific rather than general conditions. For example, “solitude” would not be a good indicator of quality because it is too general. “The number of other groups encountered per day along trails” would be a better indicator variable.
2. Objective. Indicators should be objective rather than subjective. That is, indicator variables should be measured in absolute, unequivocal terms. Variables that are subjective, expressed in relative terms or subject to interpretation make poor indicators. For example, “the number of people at one time at Wild Arch” is an objective indicator because it is an absolute number that can be readily counted and reported. However, “the percentage of visitors who feel crowded at Wild Arch” is a subjective indicator because it is subject to interpretation by visitors—it depends on the types of visitors making the judgment, the behavior of other visitors and other variables.
3. Reliable and repeatable. An indicator is reliable and repeatable when measurement yields similar results under similar conditions. This criterion is important because monitoring of indicator variables is often conducted by more than one person.
4. Related to visitor use. Indicators should be related to at least one of the following attributes of visitor use: level of use, type of use, location of use or behavior of visitors. A major role of indicators of quality is to help determine when management action is needed to control the impacts of visitor use. Thus, there should be a strong correlation between visitor use and indicators of quality.
5. Sensitive. Indicators should be sensitive to visitor use over a relatively short period of time. As the level of use changes, an indicator should respond in roughly the same proportional degree. If an indicator changes only after impacts are substantial, it will not serve as an early warning mechanism, allowing managers to react in a timely manner.
6. Manageable. Indicators should be responsive to and help determine the effectiveness of, management actions. The underlying rationale of indicators is they should be maintained within prescribed standards of quality. This implies that they must be manageable.
7. Efficient and effective to measure. Indicators should be relatively easy and cost-effective to measure. Indicators of quality should be monitored on a regular basis. Therefore, the more expertise, time, equipment and

staff needed to take such measurements, the less desirable a potential indicator of quality may be.

8. Significant. Perhaps the most important characteristic of indicators is that they help define the quality of the visitor experience. This is inherent in the very term “indicator.” It does little good to monitor the condition of a variable that is unimportant in defining the quality of the visitor experience.

It may be useful to incorporate these criteria within a matrix for evaluating potential indicators of quality, as shown in figure 3. Potential indicator variables can be arrayed along the horizontal axis of the matrix and rated as to how well they meet the criteria described above.

Potential Indicators of Quality—Research has also focused on identifying potential indicators of quality for a variety of recreation settings and activities, including wilderness areas. This research has been aimed at determining variables important to visitors in defining the quality of the recreation experience. In a broad sense, much of the research literature on outdoor recreation has some application to this issue. For example, preferences of visitors for site attributes, crowding and encounters with other visitors, motivations for recreation and conflict with other types of users all suggest potential indicators of quality. However, beyond these broad categories of research, several studies have addressed indicators of quality more directly. Potential indicators of quality identified in these studies are compiled in table 2.

These studies have addressed a variety of recreation areas and activities and utilized several study methods, including open- and closed-ended questions and surveys of visitors, interest groups, managers and scientists. However, at least five general conclusions might be derived from these study findings. First, it is apparent that potential indicators of quality can be wide ranging. It may be useful to employ a three-fold framework of outdoor recreation—environmental, social and managerial factors—when thinking about potential indicators of quality. All of the indicator variables in table 2 can be classified into environmental, social or managerial components.

Second, study findings suggest that many potential indicators of quality are rated at least somewhat important in defining the quality of the recreation experience. This is generally consistent with the “multiple satisfaction” or behavioral approach to outdoor recreation (Haas and others 1980; Hendee 1974; Driver and Toucher 1970).

| Potential Indicators of Quality | Criteria for Good Indicators of Quality | | | | | | | |
|---------------------------------|---|-----------|-----------------------|------------------------|-----------|------------|----------------------------------|-------------|
| | Specific | Objective | Reliable & Repeatable | Related to Visitor Use | Sensitive | Manageable | Efficient & Effective to Measure | Significant |
| Indicator 1 | | | | | | | | |
| Indicator 2 | | | | | | | | |
| Indicator 3 | | | | | | | | |
| Indicator 4 | | | | | | | | |
| Indicator 5 | | | | | | | | |
| Indicator . . . | | | | | | | | |

Figure 3—Evaluation matrix for selecting indicators of quality.

Table 2—Potential indicators of quality.

| Study/area/respondents | Potential indicator of quality |
|--|--|
| Mergliano 1990 Wilderness Wilderness managers and scientists | <ul style="list-style-type: none"> - Number of campsites above an acceptable impact index - Percent of visitors who report seeing wildlife - Range condition and trend - Air visibility—extinction coefficient or visual range - Litter quantity—number of pieces of litter per campsite or per trail mile; number of pounds of garbage packed out each season - Number of manager-created structures - Number of signs per trail mile - Trail condition—length of multiple trails or number of trail miles with unacceptable problems to visitors (e.g., depth exceeding 8 inches, year-round muddiness) - Length of trail in areas managed as trailless - Fecal coliform/fecal streptococci ratio (drinking water quality) - Number of occupied campsites within sight or sound of each other or visitor report of number of groups camped within sight or sound - Number of violations of no-trace regulations - Percent of groups carrying a stove (not using a campfire) - Number of occurrences of unburied human feces - Number of occurrences of motorized noise per day - Percent of season wilderness rangers are out patrolling the area - Number of regulations that limit visitor use or restrict travel - Number of regulatory signs posted beyond trailhead |
| Shindler and Shelby 1992 Wilderness campsites Members of five interest groups | <ul style="list-style-type: none"> - Amount of bare ground - Size and appearance of fire rings - Distance from trail - Screening from other sites - Out of sight/sound of other sites - Evidence of litter - View of scenery - Available firewood - Sheltered from weather - Dry and well drained - Water for aesthetic reasons - Flat place for sleeping- Close to good fishing - Logs and Rocks for seating - Close to drinking/cooking water |
| Whittaker 1992 Five Alaska rivers Floaters, motorboats | <ul style="list-style-type: none"> - Litter - Signs of use - Campsite competition - Fishing competition - Launch congestion - River encounters - Camp encounters - Powerboat use - Airboat use - Rafting/canoeing use - Airplane landings - Helicopter landings - ORV use - Hazard signs - Interpretive signs - Public use cabins - Private cabins - Concessions - Long-term camps |
| Roggenbuck and others 1993 Four wilderness areas Visitors | <ul style="list-style-type: none"> - Amount of litter I see - Number of trees around campsite that have been damaged by people - Amount of noise associated with human activities within the wilderness - Amount of man-made noise originating from outside the wilderness - Number of wild animals I see - Amount of vegetation loss and bare ground around a campsite |

(con.)

Table 2—Con.

| Study/area/respondents | Potential indicator of quality |
|---|---|
| | <ul style="list-style-type: none"> - Number of horse groups that camp within sight or sound of my campsite - Number of hiker groups that camp within sight or sound of my campsite - Number of horse groups that travel past my campsite while I am there - Number of campfire rings that people have made - Number of hiker groups that walk past my campsite - Number of large groups that I see along the trails - Number of horse groups I see along the trails in a day - Percent of time other people are in sight when I'm on the trail - Visibility of lights originating from outside the wilderness - Total number of people I see hiking along the trail - Number of groups of hikers I see along the trail - Amount of time I spend traveling on old roads in the wilderness - Number of miles of gravel road I travel to get to the wilderness |
| Shafer and Hammitt 1994 Cohutta Wilderness, GA Visitors | <ul style="list-style-type: none"> - The total amount of time that your party has in an area without seeing or hearing anyone else - The amount of restriction management places on where you may travel in the area - The number of permanent structures placed by management in the wilderness - Seeing an unusual type of plant - The amount of restriction management places on where you may camp in an area - The level of difficulty required to obtain an overnight permit - The number of vehicles you see at the trailhead - The number of fire rings found in a campsite - The number of days in a row you are able to stay in the wilderness on a given trip - The number of signs designating locations in the wilderness - The number of groups you pass during the day while traveling - Having signs placed by wilderness managers which state regulations about wilderness - The amount of wilderness which does not have trails in it - The distance of campfires from trailheads - The number of rangers you see in the area - The amount of ranger contact in the backcountry to check your permit and/or explain regulations about use - The amount of litter found in campsites - The amount of litter seen along the trail - The number of trees or other vegetation damaged by previous users - The amount of noise heard in the area which comes from outside the wilderness - The amount of fully mature forest in the wilderness area - Observing a natural ecosystem at work - The amount of solitude your group experiences - The amount of noise heard in the area which comes from other wilderness visitors - The number of different species of wildlife you see - The number of areas in the wilderness that are very remote - The distance between your campsite and the campsite of others - Seeing specific types of wildlife - The amount of light visible at night which comes from outside the wilderness - The level of trail maintenance - The number of groups that pass within sight of your camp - An area in the wilderness which is left completely primitive (no trails, bridges) - Having a portion of the wilderness where camping location is unconfined - Having trail markers placed by management (blazes, cairns, posts) |
| Manning and others 1995b; 1995c; 1996b; Manning and Lime 1996 Arches National Park, UT Visitors | <ul style="list-style-type: none"> - Orientation, information, and interpretive services - Number and type of visitor facilities - Number of people encountered - Visitor behavior and activities - Resource impacts - Park management activities - Quality and condition of natural features |
| Jacobi and others 1996 Acadia National Park, ME Carriage road visitors | <ul style="list-style-type: none"> - Number of visitors encountered - Type of visitors encountered (hikers or bikers) - Behavior of visitors (speed of bikers, keeping to the right, obstructing the roads, traveling off the roads) |

Third, most of the studies on indicators of quality have found some variables more important than others. For example, litter and other signs of use impacts appear to be universally important. Management-related impacts (such as signs, presence of rangers) appear to be less important. Encounters with other visitors are important, but how these encounters are manifested may be even more important. For example, type of visitor encountered (for example, hikers encountering bikers or stock users, floaters encountering motorboaters) often is very important to the quality of the recreation experience. This is consistent with the recreation literature on crowding and conflict. Behavior of other visitors and associated noise are also important, as are “competition-related” impacts, such as having to share a campsite.

Fourth, visitors to wilderness or wilderness-related areas may be generally more sensitive to a variety of potential indicators of quality than visitors to more highly used and developed areas. However, research may have simply not yet identified and studied the indicators of quality that are most important to visitors in more highly used areas.

Fifth, for wilderness campsites, social indicators of quality may be generally more important than ecological indicators. For example, scenic views and screening from other campsites may be more important than amount of bare ground and size of fire rings. This is generally consistent with other research that suggests the importance of camping out of sight and sound of other groups and a general lack of perceptiveness on the part of many visitors about the ecological impacts of recreation.

Standards of Quality

Standards of quality have received substantial attention in the outdoor recreation literature. As with the literature on indicators of quality, two important issues have been addressed: (1) characteristics of good standards of quality, and (2) studies designed to identify standards of quality.

Characteristics of Good Standards of Quality—Several studies have explored characteristics that might define good standards of quality (Brunson and others 1992; National Park Service 1997; Schomaker 1984; Whittaker and Shelby 1992). To the extent possible, good standards of quality should incorporate the following characteristics:

1. Quantitative. Standards should be expressed in a quantitative manner. Since indicators of quality are specific and measurable variables, standards of quality can and should be expressed in an unequivocal way. For example, if an indicator is “the number of encounters with other groups per day on the river,” the standard might be “an average of no more than three encounters with other groups per day on the river.” In contrast, “low numbers of encounters with other groups per day on the river” would be a poor standard of quality because it does not specify the minimum acceptable condition in unambiguous terms.
2. Time- or space-bounded. Incorporating a time- or space-bounded element into a standard of quality expresses both how much of an impact is acceptable and how often or where such impacts can occur. It is often desirable for standards to have a time period associated with them.

This is especially relevant for crowding-related issues. For instance, in the above example, the standard of quality for encounters with other groups on the river was expressed in terms of “per day.” Other time-bounded qualifiers might include “per night,” “per trip,” “per hour” or “at one time,” depending on the circumstances.

3. Expressed as a probability. In many cases, it will be advantageous to include in the standard of quality a tolerance for some percentage of the time that a particular condition will be unavoidably unacceptable; in other words, the standard would include a probability that conditions will be at standard or better. For example, a standard might specify, “no more than three encounters with other groups per day along trails for 80% of days in the summer use season.” The 80% probability of conditions being at or above standard allows for random or unusual events that might prevent management from attaining these conditions 20% of the time. This incorporates the complexity and randomness inherent in visitor use patterns. In the example of encounters along a trail, several hiking parties might depart from a trailhead at closely spaced intervals on a given day. These groups are likely to encounter each other on the trail several times during the day. On another day, the same number of groups might depart from the trailhead at widely spaced intervals and thereby rarely encounter each other. Similarly, it might be wise to incorporate a tolerance in standards for peak use days, holiday weekends or other days of exceptionally high visitation. A standard might be set at “50 people at one time at Wild Arch for 90% of the days of the year.” The amount of tolerance needed depends on the unpredictability of each individual situation and the degree to which management can consistently control conditions.
4. Impact-oriented. Standards of quality should focus directly on the impacts that affect the quality of the visitor experience, not the management action used to keep impacts from violating the standards. For example, an appropriate standard might be, “no more than 10 encounters with other groups on the river per day.” This could be a good standard because it focuses directly on the impact that affects the quality of the visitor experience—the number of other groups encountered. Alternatively, “a maximum of 20 groups per day floating the river” would not be as good a standard of quality because it does not focus as directly on the impact of concern—visitors experience encounters with other groups more directly than they experience total use levels. Basing standards of quality on management techniques rather than on impacts can also limit the potential range of useful management practices. For example, limiting the number of boats to 20 per day might be used to ensure 10 or fewer encounters per day, but other actions, such as more tightly scheduling launch times, could also ensure an appropriate encounter rate and could be less restrictive on the level of visitation to the river.
5. Realistic. Standards should generally reflect conditions that are realistically attainable. Standards that limit impacts to extremely low levels may set up unrealistic expectations in the minds of visitors, may be

politically infeasible and may unfairly restrict visitor use to very low levels.

Potential Standards of Quality—A growing number of studies have been conducted to help define standards of quality. Most of these have adopted the normative methods described earlier in this section. Findings from these studies are compiled in table 3. These studies have addressed a variety of recreation settings and potential indicators of quality. They have also used alternative question formats and wording, different response scales and other methodological variations. However, at least eight general conclusions can be derived from this growing body of literature.

First, normative standards can be measured for a variety of potential indicators of quality. While many studies have addressed encounter and other crowding-related variables, other studies have measured norms for widely ranging variables. Norms have been measured for a variety of ecological and social variables representing two of the three components of the basic three-fold framework of outdoor recreation.

Second, most respondents are able to report or specify norms for most variables included in most studies. This issue is sometimes referred to as “norm prevalence” (Kim and Shelby 1998). For example, 87% of canoeists in the Boundary Waters Canoe Area Wilderness reported a norm for the maximum acceptable number of other groups seen each day at the lake or river where they spent the most time (Lewis and others 1996a). There are some exceptions to this generalization. For example, a study of floaters on the New River in West Virginia, found that between 29% and 66% of respondents reported a norm for several indicator variables under three alternative types of recreation opportunities (Roggenbuck and others 1991). Other visitors chose one of two other response options, indicating that the potential indicator of quality did not matter to them, or that it did matter, but they couldn't specify a maximum amount of impact acceptable. Why visitors may not be able to report norms is discussed below.

Third, visitors tend to report norms more often in wilderness or backcountry situations than in frontcountry or more developed areas. Moreover, such wilderness-related norms tend to be more highly crystallized. For example, standard deviations of encounter norms for floaters on three Western rivers were found to increase as the recreation opportunity described moved from “wilderness” to “semi-wilderness” to “undeveloped recreation” (Shelby 1981). Moreover, the percentage of floaters on the New River who reported a series of encounter-related norms decreased across a similar spectrum of recreation opportunities (Roggenbuck and others 1991).

Fourth, norms tend to be lower (or less tolerant) in wilderness or backcountry areas than in frontcountry or more developed areas. This finding is reflected in many studies included in table 3.

Fifth, there is some consistency in norms within similar types of recreation areas or opportunities. For instance, a study of visitor norms for a variety of potential indicators of quality found broad agreement across all four wilderness areas addressed (Roggenbuck and others 1993). Moreover, a number of studies suggest that norms for encountering other groups during a wilderness experience are quite low (about three to five per day) and that most wilderness visitors prefer to camp out of sight and sound of other groups.

Sixth, norms generally fall into one of three categories or types: no-tolerance, single-tolerance and multiple-tolerance. For example, a study of boaters on the Deschutes River in Oregon, measured norms for a number of potential indicators of quality and found all three types of norms, as shown in figure 4 (Whittaker and Shelby 1988). The norm curve for human waste represents a no-tolerance norm: The majority of respondents report that it is never acceptable to see signs of human waste along the river. Other indicators of quality for which no-tolerance norms were reported included selected types of discourteous behavior and jetboat encounters for non-jetboaters. No-tolerance norms tend to be characterized by a mode at zero impact, high intensity and high crystallization.

The norm curve for time in sight of others represents a single-tolerance norm: The vast majority of respondents were willing to tolerate some time in sight of others, but they were unwilling to accept such impact beyond a certain level (two hours out of four in sight of others). Other indicators of quality for which single-tolerance norms were reported included jetboat encounters for jetboaters, launch waiting times, fishing disturbances, fishing competition, camp sharing and camp competition. Single-tolerance norms tend to be characterized by a mode at some level of impact greater than zero and a sharp decline in the percentage of respondents reporting tolerances for impacts greater than the modal value.

The norm curve for fire-ring impacts represents a multiple-tolerance norm: Multiple “peaks” along the norm curve indicate that there are at least two groups of respondents with distinctly different normative standards for this indicator of quality.

Seventh, encounter-related norms often vary with visitor characteristics, characteristics of those encountered, and situational variables. For example, a variety of norms have been found to be related to selected visitor characteristics, including organizational affiliation—activity groups versus environmental organizations— (Shelby and Shindler 1992), level of involvement with wilderness recreation (Young and others 1991), country of origin (Vaske and others 1995, 1996) and ethnicity (Heywood 1993a, Heywood and Engelke 1995). Research on effects of the characteristics of those encountered has focused primarily on type of activity. Encounter-related norms have been found to vary, depending on whether those encountered are fishers, canoers or tubers (Vaske and others 1986); boaters or bank fishers (Martinson and Shelby 1992); or hikers or bikers (Manning and others 1997). Finally, norms have been found to vary in relation to a number of situational or locational variables, including along the river versus campsites (Shelby 1981), type of recreation area (Shelby 1981, Vaske and others 1986), use level (Hall and Shelby 1996, Lewis and others 1996b, Shelby and others 1988b) and periphery versus interior locations (Martin and others 1989).

Eighth, the normative standards of visitors can vary from those of managers. For example, a study of norms for wilderness campsite impacts found that visitors reported more restrictive norms for the presence of fire rings and tree damage than managers did (Martin and others 1989). However, managers reported more restrictive norms for bare ground impacts.

Table 3—Normative standards of quality.

| Study/area/respondents | Indicator of quality | Normative standard | |
|--|---|--------------------|------------------------|
| | | Mean | Median |
| Stankey 1973 | Encounters with paddling canoeists | | 3.5 |
| Boundary Waters | Encounters with motor canoeists | | 0.0 |
| Canoe Area, MN, Visitors | Encounters with motorboats | | 0.0 |
| Three wilderness areas, Visitors | Encounters with backpacking parties | | 2.5 |
| | Encounters with horse parties | | 1.8 |
| Stankey 1980a, | Encounters with backpacking parties | | 4.0 |
| Desolation Wilderness, CA, Visitors | Encounters with large parties | | 2.6 |
| | Parties camped within sight or sound | | 2.4 |
| Spanish Peaks Wilderness, MT, Visitors | Encounters with backpacking parties | | 4.5 |
| | Encounters with horse parties | | 3.5 |
| | Encounters with large parties | | 1.8 |
| | Parties camped within sight or sound | | 1.9 |
| Shelby 1981, Colorado River, Grand Canyon National Park, AZ, Boaters | Encounters per day | | .9/2.4/40 ^a |
| | Hours in sight of others each day | | .5/7/1.5 |
| | Number of stops out of 10 with encounters | | .7/2.0/3.8 |
| | Chances of meeting 10-30 people at popular place on the river | | 9%/23%/41% |
| | Number of nights out of 10 camped near others | | 0/1.3/3.0 |
| Rogue River, OR, Boaters | Encounters per day | | 1.5/2.9/4.4 |
| | Hours in sight of others each day | | .5/1.0/1.9 |
| | Number of nights out of 5 camped near others | | .6/1.6/2.3 |
| | | | 0/1.1/2.1 |
| Illinois River, OR, Boaters | Encounters per day | | .7/2.0/2.7 |
| | Hours in sight of others each day | | .4/9/1.6 |
| | Number of stops out of 5 with encounters | | .2/1.3/1.8 |
| | Number of nights out of 3 camped near others | | 0/.2/1.7 |
| Heberlein and others 1986 | Number of boats moored at Anderson Bay | | 11.0 |
| Apostle islands National Lakeshore, WI, Boaters | Number of boats moored at Quarry Bay | | 11.0 |
| Vaske and others 1986 | Encounters with fishers | 7.2 | |
| Brule River, WI, Floaters | Encounters with canoers | 5.7 | |
| | Encounters with tubers | 2.3 | |
| Shelby and others 1988a | Encounters per day on river | 5.7 | |
| Rogue River, OR, Boaters | Number of nights out of 5 camped near others | 1.4 | |
| Shelby and others 1988b | Maximum size of fire rings | | |
| Mt. Jefferson Wilderness, OR, Campers | -Hunts Lake | 20 inches | |
| | -Russell Lake | 34 inches | |
| | Maximum area of bare ground | | |
| | -Hunts lake | 750 sq. ft | |
| | -Bays Lake | 750 sq. ft | |
| | -Scout lake | 1450 sq. ft | |
| Whittaker and Shelby 1988 | Hours in sight out of four | | 1.8-2.2 ^b |
| Deschutes River, OR, Boaters | Incidents of discourteous behavior per day | | 0.1-0.2 |
| | Number of stops out of 4 where human waste is seen | | 0.1-0.3 |
| | Jetboats encountered per day | | 0.3-1.3 |
| | Boats per hour passing anglers | | 4.0-4.7 |
| | Fishing holes passed up out of 4 due to competition | | 1.3-1.7 |
| | Minutes waiting to launch | | 10.3-14.9 |
| | Nights out of 4 camped with other groups | | 1.4-1.9 |
| | Nights out of 4 camped near other groups | | 0.4-0.9 |
| | Camps passed up out of 4 due to competition | | 1.1-1.2 |
| | Camps out of 4 with fire rings present | | 0.5-1.1 |
| Patterson and Hammitt 1990, | Encounters at trailhead | 3.9 | 3.0 |
| Great Smoky Mountains National Park, NC/TN, Backpackers | Encounters on trail | 5.5 | 4.0 |
| | Encounters at campsite | 2.7 | 2.0 |
| Roggenbuck and others 1991 | Number of boats seen | | |
| New River, WV, Floaters | -Wilderness whitewater | 10.1 | |
| | -Scenic whitewater | 20.4 | |
| | -Social recreation | 33.4 | |
| | Percent of time in sight of other boats | | |
| | -Wilderness white water | 18.3 | |
| | -Scenic whitewater | 32.3 | |
| | -Social recreation | 48.1 | |

(con.)

Table 3—Con.

| Study/area/respondents | Indicator of quality | Normative standard | | |
|--|--|---|-----------------------|--|
| | | Mean | Median | |
| Young and others 1991, Chutta Wilderness, GA, Visitors | Number of rapids having to wait | 1.2 | | |
| | -Wilderness whitewater | 2.4 | | |
| | -Scenic whitewater | 4.0 | | |
| | -Social recreation | | | |
| | Number of people hiking on trail in a day | 11.5 | | |
| | Number of large groups hiking on trail in a day | | 3.4 | |
| | Number of hiker groups camped in sight or sound of campsite | | 2.2 | |
| | Number of hiker groups walking past campsite in a day | | 3.7 | |
| | Number of horse groups seen on trail in a day | 2.4 | | |
| | Number of horse groups camped in sight or sound of campsite | | 1.7 | |
| Martinson and Shelby 1992 3 rivers, Salmon fishers | Percent of time other people are in sight while on trail | | 13.9 | |
| | Number of groups of hikers seen on trail in a day | | 3.9 | |
| | Number of horse groups that travel past my campsite | | 1.2 | |
| | Encounters with bank fishers | | | |
| | Preferred | | | |
| | -Klamath | | — | |
| | -Waimakariri | | 3.6 | |
| | -Lower Rakaia | | 3.5 | |
| | -Upper Rakaia | | <1.0 | |
| | Tolerable | | 12.6 | |
| Shelby and others 1992b Colorado River, Grand Canyon National Park, AZ, Guides and trip leaders | -Klamath | | 6.9 | |
| | -Waimakariri | | 9.5 | |
| | -Lower Rakaia | | 3.8 | |
| | -Upper Rakaia | | | |
| | Minimum stream flow | 10,000 cfs | | |
| | Maximum stream flow | 45,000—50,000 cfs | | |
| | Williams and others 1992, wilderness areas, Visitors | Encounters with hiking groups along trail | 8.7-11.6 ^c | |
| | | Encounters with horse groups along trail | 5.1-6. | |
| | | Encounters with large groups along trail | 5.8-7.1 | |
| | | Hiker groups camped within sight or sound | 3.8-6.9 | |
| Horse groups camped within sight or sound | | 3.1-3.8 | | |
| Hiker groups passing by camp | | 5.5-7.9 | | |
| Horse groups passing by camp | | 5.4-7.4 | | |
| Roggenbuck and others 1993, 4 wilderness areas, Visitors | Number of pieces of litter I can see from my campsite | | 0-2 ^c | |
| | Percent of trees around a campsite that have been damaged by people | | 0-5 | |
| | Number of horse groups that camp within sight or sound of my campsite | | 1-2 | |
| | Number of hiker groups that camp within sight or sound of my campsite | | 3 | |
| | Number of large groups (more than 6 people) that I see along the trail | | 3-5 | |
| | Percent of vegetation loss and bare ground around the campsite | | 10-20 | |
| | Ewert and Hood 1995, Ewert 1998, San Gorgonio Wilderness, CA; John Muir Wilderness, CA, Visitors Hammitt and Rutlin 1995, Ellicott Rock Wilderness, SC/NC/GA, Visitors | Encounters per day | | |
| -For urban-proximate wilderness | | 9.0 | | |
| -For urban-distant wilderness | | 7.7 | | |
| Encounters at trailhead | | | | |
| -Ideal | | 3.8 | | |
| -Maximum | | 8.7 | | |
| Encounters on trail | | | | |
| -Ideal | | 3.2 | | |
| -Maximum | | 6.6 | | |
| Encounters at destination site | | | | |
| Ideal | | 1.0 | | |
| -Maximum | | 2.5 | | |
| Encounters at all three sites combined | | | | |
| -Ideal | | 2.7 | | |
| -Maximum | | 5.9 | | |

(con.)

Table 3—Con.

| Study/area/respondents | Indicator of quality | Normative standard | |
|--|--|------------------------------------|--------|
| | | Mean | Median |
| Shelby and Whittaker 1995, Dolores River, CO, Boaters | Maximum stream flow | | |
| | -Large rafts | ≈ 900 cfs | |
| | -Small rafts | ≈ 750 cfs | |
| | -Canoes | ≈ 300 cfs | |
| Shindler and Shelby 1995, Rogue River, OR, Boaters | -Kayaks | ≈ 900 cfs | |
| | Encounters with float parties | | |
| | -1977 | 5.7 | |
| | -1991 | 7.4 | |
| | Encounters with jetboats | | |
| | -1977 | 1.5 | |
| | -1991 | 1.5 | |
| | Hours in sight of other parties | | |
| | -1977 | 1.3 | |
| | -1991 | 1.4 | |
| | Acceptable number of stops out of five to meet another group | | |
| | -1977 | 1.88 | |
| | -1991 | 1.88 | |
| | Acceptable number of nights out of five to camp within sight or sound of another party | | |
| -1977 | 1.4 | | |
| -1991 | 1.2 | | |
| Watson 1995, Boundary Waters Canoe Area, MN, Canoers | Encounters with paddling groups | 5.8-8.5 ^d | |
| | Number of nearby campers | 2.5-5.7 | |
| | Encounters with other groups | 5.6 | 4.0 |
| Hall and Shelby 1996, Eagle Cap Wilderness, OR, Visitors | Encounters with other boaters | 7.5/10.4 ^e | 6/8 |
| | Percent of time in sight of other boaters | 49.4/46.4 | 50/50 |
| | Number of minutes waiting at launch | 16.1/18.1 | 15/15 |
| Lewis and others 1996b, Boundary Waters Canoe Area, MN, Canoers | Encounter with canoe parties on periphery lakes and rivers | 5.1 | 3.1 |
| | Encounters with canoe parties on interior lakes and rivers | 3.8 | 2.5 |
| | Encounters with canoe parties on all lakes and rivers | 4.2 | 2.6 |
| Manning and others 1995a, b, Manning and Lime 1996, Manning and others 1996b, c, Arches National park, UT, Visitors | PAOT at Delicate Arch | 28 | |
| | PAOT at North Window | 20 | |
| Vaske and others 1995, 1996, Columbia Ice Field, Jasper National Park, Canada, Snowcoach riders and hikers | PAOT at attraction site for snowcoach riders | | |
| | -Canadian | 96.2 | |
| | -Anglo-American | 100.5 | |
| | -Japanese | 114.6 | |
| | -German | 104.4 | |
| | -British | 84.5 | |
| | PAOT at attraction site for hikers | | |
| | -Canadian | 47.3 | |
| | -Anglo-American | 55.6 | |
| | -German | 42.1 | |
| | -British | 41.3 | |
| | Manning and others 1997, Acadia National Park, ME, Carriage road users | Persons per viewscape ^f | |
| Visual approach | | | |
| Long form | | | |
| -Hikers only | | 17 | |
| -Bikers only | | 12 | |
| -Even distribution of hikers and bikers | | 14 | |
| Short form | | | |
| -Acceptability | | 11 | |
| -Tolerance | | 25 | |
| -Acceptability for "others" | | 15 | |
| -Management actions | | 18 | |
| Numerical approach | | | |
| -Hikers only | | 16 | |
| -Bikers only | | 13 | |
| -Even distribution of hikers and bikers | 18 | | |

(con.)

Table 3—Con.

| Study/area/respondents | Indicator of quality | Normative standard | |
|--|--------------------------------------|--------------------|--------|
| | | Mean | Median |
| Tarrant and others 1997, Nantehala River, NC, Floaters | Maximum encounters tolerable | | |
| | Rafters | | |
| | With rafts | | |
| | -On the river | 28.4 | |
| | -At put-in | 12.3 | |
| | -At rapids | 9.3 | |
| | With kayaks/canoes | | |
| | -On the river | 18.4 | |
| | -At put-in | 9.2 | |
| | -At rapids | 6.8 | |
| | Kayakers/Canoers | | |
| | With rafts | | |
| | -On the river | 37.4 | |
| | -At put-in | 14.1 | |
| | -At rapids | 10.3 | |
| | With kayaks/canoes | | |
| -On the river | 39.9 | | |
| -At put-in | 15.5 | | |
| -At rapids | 12.1 | | |
| Kim and Shelby 1998, 2 national park campgrounds in Korea, Campers | Quiet time in evening | | |
| | Baemasagol Campground | 10-11 | 10:00 |
| | Second Campground | 11-12 | 12:00 |
| | Incidences of inconsiderate behavior | | |
| | Baemasagol Campground | 0.69 | 0 |
| | Second Campground | 1.76 | 2 |
| | Number of campers | | |
| | Baemasagol Campground | 71.6 | 60 |
| | Second Campground | 158.1 | 150 |
| | Number of tents | | |
| | Baemasagol Campground | 28.9 | 23 |
| | Second Campground | 55.1 | 50 |
| | Distance between tents (meters) | | |
| | Baemasagol Campground | 2.59 | 2 |
| | Second Campground | 2.15 | 1 |
| | Number of sightings of litter | | |
| | Baemasagol Campground | 1.44 | 0 |
| | Second Campground | 2.15 | 1.5 |
| Waiting time for restroom (minutes) | | | |
| Baemasagol Campground | 2.54 | 1.75 | |
| Second Campground | 2.95 | 2 | |
| Waiting time for water supply (minutes) | | | |
| Baemasagol Campground | 3.14 | 2.5 | |
| Second Campground | 3.67 | 3 | |

^aFor wilderness, semi-wilderness, and undeveloped recreation.

^bRange over three river segments.

^cRange over four wilderness areas.

^dRange over visitors using four entry points.

^eRange over two question formats.

^fNumber of visitors per 100-meter trail segment.

Theoretical and Methodological Issues

The literature on normative standards in wilderness and outdoor recreation has given rise to a number of theoretical and methodological issues. First, attention has focused on the theoretical foundation of norms and their application to outdoor recreation (Heywood 1993a,b, 1996a,b; McDonald 1996; Noe 1992; Roggenbuck and others 1991; Shelby and Vaske 1991; Shelby and others 1996). As noted in the beginning of this section, the concept of norms originated in the fields of sociology and social psychology. In this context,

norms traditionally address behaviors that are based on a sense of obligation and have social sanctions associated with them to help ensure broad compliance (Biddle 1986; Blake and Davis 1964; Cancian 1975; Homans 1950; Rossi and Berk 1985). However, as applied in the field of outdoor recreation, norms have been defined more broadly as “standards that individuals use for evaluating behavior, activities, environments, or management proposals as good or bad, better or worse” (Shelby and others 1996). In this context, recreation-related norms address conditions that are the result of behavior and measure the degree to which

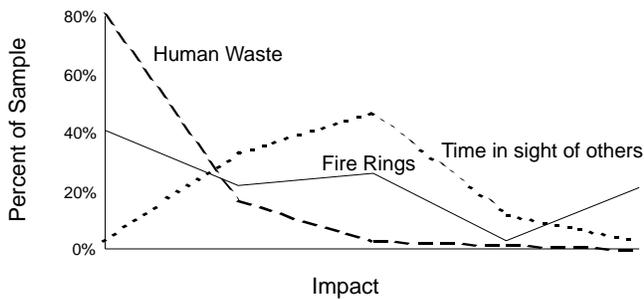


Figure 4—Three types of social norms (from Whittaker and Shelby 1988).

selected conditions “ought” to exist. While this may represent an expansion or extension of the traditional concept of norms, the studies in this section suggest that normative theory and methods can be useful in formulating indicators and standards of quality in wilderness and outdoor recreation. To avoid confusion and uncertainty in terminology, it may be wise to refer to the types of data described in this section as “personal evaluative standards” and “social evaluative standards,” rather than personal and social norms. However, the term norms has become widely used in the wilderness and outdoor recreation literature.

Second, several studies have focused attention on the issue of norm salience. Early in this section, salience was defined as the importance of potential indicators of quality in determining the quality of the recreation experience. The issue of salience may help explain why some respondents do not report personal norms (Shelby and others 1996). When relatively large percentages of respondents do not report norms, it may be that the indicator of quality or impact under study is not important in determining the quality of the recreation experience. Several studies suggest the role of salience in recreation-related norms. As noted earlier, relatively low numbers of floaters on the New River reported norms for encounter-related indicators of quality when compared to other river recreation studies (Roggenbuck and others 1991). However, the New River is a relatively high-use area and encounter-related indicators of quality may be less important or salient in this context. This reasoning is supported by other studies, described earlier, which found that higher percentages of respondents reported norms for wilderness or backcountry areas than for frontcountry areas. Many of the indicators of quality addressed in these studies are encounter-related and may simply be less important or salient in frontcountry than in wilderness.

A closely related issue concerns how indicators of quality or impacts are perceived and manifested by recreation visitors. Measurement of recreation-related norms should focus as directly as possible on impacts that are relevant to visitors. In this way, visitors are more likely to be able to report norms, norms are likely to be more highly crystallized, and management will be focused more directly on issues of concern to visitors. Data from several studies support the importance of this issue. For example, in the New River study, a higher percentage of respondents reported a norm for waiting time to run rapids (while other boats took their turn) than for number of other boats seen

(Roggenbuck and others 1991). Similarly, visitors to the Clackamas River in Oregon, another relatively high-use area, reported norms more often for percentage of time in sight of other boats than for number of other boats seen (Hall and others 1996). In relatively high-use areas, use levels may be perceived or manifested differently than in relatively low-use areas. Moreover, it may simply not be feasible to estimate or evaluate large numbers of encounters with other groups in high-use areas. Several studies have explored alternative expressions of use-related indicators of quality, including physical proximity of fishers along streams (Martinson and Shelby 1992), the number of people at one time (PAOT) at destination or attraction sites (Manning and others 1995a,b,c; Manning and Lime 1996, Manning and others 1996b,c; Manning and others 1997; Vaske and others 1996), persons per viewscape along trails (Manning and others 1997) and waiting times for essential services (Kim and Shelby 1998).

Third, visual approaches to measuring standards of quality have been explored in a number of studies (Heywood 1993a; Hof and others 1994; Manning and others 1995a,b,c; Manning and Lime 1996; Manning and others 1996b,c; Manning 1997, Manning and others 1998; Martin and others 1989; Shelby and Harris 1985; Shelby and others 1992a). These have included artistic renderings and photographs. For example, a series of 16 computer-enhanced photographs showing a range of visitors at an attraction site was used in a study of crowding-related norms at Arches National Park, Utah (Manning and others 1996c). Respondents rated the acceptability of each photograph and a norm for the maximum PAOT was determined. In certain situations, visual approaches may portray alternative levels of impact more realistically than written descriptions. The study at Arches also included a more traditional written measure of norms for the maximum acceptable PAOT. This norm was substantially lower than the one derived from the visual approach. It may be that the written approach to norm measurement draws conscious attention to each person or group encountered, whereas in the visual approach, some persons or groups who are perceived as similar to the respondent in terms of activity, behavior and appearance are processed less consciously and do not contribute as heavily to perceived crowding. The potential importance of perceptions of “alike-ness” in crowding has been emphasized in the recreation literature (Adelman and others 1982; Cheek and Burch 1976; Lee 1972). In this respect, visual approaches may result in more realistic or “valid” measures of crowding-related norms in certain situations than written or narrative approaches.

Fourth, studies of recreation norms have used a variety of evaluative dimensions. When respondents are asked to evaluate impacts of a range of conditions for potential indicators of quality, the response scale may include terminology specifying “preference,” “favorableness,” “pleasantness,” “acceptability,” “tolerance” or some other concept. These alternative evaluative dimensions may have substantially different meanings to respondents and may result in dramatically different norms. Study findings support this assumption. Several studies have included measures of both preferred (or “ideal”) conditions and acceptable (or “maximum” or “tolerable”) conditions (Hammitt and Rutlin 1995; Watson 1995; Young and others 1991). In all cases, preferred

conditions for encounter-related variables are substantially lower—less than half—than acceptable conditions. The literature on norm theory has suggested that norm measurement questions adopt more explicitly normative concepts and terminology (Heywood 1996a). This might include the condition that managers “should” maintain and respondents’ beliefs about what “other visitors” feel is acceptable. An initial test of these concepts found that they yielded significantly higher encounter-related norms than acceptability to respondents (Manning and others 1997, 1999). None of these evaluative dimensions may be more “valid” than any others, but researchers and managers should be conscious of this issue and exercise appropriate care and caution in interpreting and applying study findings. For example, standards of quality based on preference-related norms may result in very high-quality recreation experiences, but may restrict access to a relatively low number of visitors. In contrast, standards of quality based on acceptability or tolerance may result in recreation experiences of only marginal quality, but allow access to a larger number of visitors. Studies that employ multiple evaluative dimensions may result in findings that enrich the information base on which standards of quality might be formulated.

Fifth, studies of recreation norms have also used alternative question-and-response formats. Early in this section, it was noted that norms are sometimes measured using a repetitive-item (or “long”) format, in which respondents are asked to evaluate a range of alternative conditions. An open-ended (or “short”) version of this question format has also been employed, in which respondents are asked to specify the maximum acceptable level of impact. Only one study has used both question formats, and this found that the short-question format yielded a lower encounter-related norm (Manning and others 1997, 1999). Several studies have explored the range of response options that might be included in norm measurement questions (Hall and Shelby 1996; Hall and others 1996; Roggenbuck and others 1991). In particular, these studies addressed the issue of whether respondents should be presented with an option which indicates that the indicator of quality is important to them, but that they cannot specify a maximum number that is acceptable. The principal argument in favor of this option suggests that respondents should not be “forced” into reporting a norm in which they have little confidence. The principal argument against this option is that it may simply present some respondents with a convenient way to avoid a potentially difficult question. The only empirical tests directed at this issue found that respondents who chose this option were more like respondents who reported a norm (with respect to reactions to impacts and attitudes toward management) than those who reported that the indicator of quality was not important to them (Hall and Shelby 1996). Moreover, use of this response option did not affect the value of the norm derived, although it did affect the variance or crystallization of the norm (Hall and others 1996). Thus, use of this response option may not be an important consideration.

Sixth, crystallization of norms is an important research and management issue. As noted earlier in this section, crystallization refers to the level of agreement or consensus about recreation norms. The more agreement about norms, the more confidence managers might have in using such data to formulate standards of quality. Most norm-related

studies have reported some measure of crystallization. Standard deviations of mean and median values of norms are used most frequently, but coefficients of variation and semi-interquartile ranges have also been recommended to allow comparisons across variables and reduce the effects of extreme values (Hall and Shelby 1996; Roggenbuck and others 1991). However, there are no statistical guidelines or rules of thumb to indicate what constitutes high or low levels of agreement or consensus, and there is disagreement in the literature concerning how recreation-related norms should be interpreted. Ultimately, some degree of judgment must be rendered by managers. If there appears to be moderate to high levels of agreement over norms, managers can incorporate study findings into their decisions with relative confidence. If there does not appear to be much agreement over norms, managers might focus on resolving conflicts among visitors, consider zoning areas for alternative recreation experiences or formulate norms based on other considerations.

Seventh, as research on norms has matured, attention has focused on the issue of norm congruence, sometimes called “norm-impact compatibility” (Shelby and Vaske 1991). This issue concerns the extent to which respondents evaluate relevant aspects of the recreation experience in keeping with their normative standards. If recreation norms are to be used in formulating standards of quality, research on norm congruence is important to test the internal consistency or “validity” of such norms. A number of studies have addressed this issue across a variety of activities, indicator variables and areas (Hammitt and Patterson 1991; Hammitt and Rutlin 1995; Lewis and others 1996b; Manning and others 1996c,d; Patterson and Hammitt 1990; Ruddell and Gramann 1994; Vaske and others 1986, 1996; Williams and others 1991). Nearly all have found support for the concept of norm congruence; that is, when conditions violate visitor norms, respondents tend to judge such conditions as less acceptable or more crowded and adopt behaviors to avoid them. Only one study has not supported norm congruence (Patterson and Hammitt 1990). However, this study was conducted in a relatively high-use area, where encounter norms may not have been salient or highly crystallized.

Eighth, a variety of statistics are available for measuring, analyzing and interpreting norms (Shelby and Heberlein 1986; Shelby and others 1996; Vaske and others 1986; Whittaker and Shelby 1988). Each has advantages and disadvantages, and these should be considered when selecting appropriate statistical approaches. Norms are generally reported and described in terms of medians and means. Median values have intuitive appeal because they represent the level of impact that half of respondents find acceptable. Mean values are more intuitively straightforward and are easier to calculate, but they are easily skewed by outlying or extreme values and may be misleading in the case of multiple-tolerance norms. Norm curves like those illustrated in figures 2 and 4, as well as frequency distributions which show the level of agreement associated with each impact level, are less parsimonious, but they offer considerably more information in a graphic and less technical way. Statistical measures of norm crystallization were discussed earlier in this section.

Ninth, research methods used to measure norms have varied widely across the studies reviewed in this section. This applies especially to question format and wording.

Experimentation in research approaches is clearly warranted to identify and address emerging issues and to test the effectiveness of alternative methodological approaches. However, when possible, replication and standardization of research approaches are desirable to enable comparisons across studies and over time. A compendium of frequently used norm-related questions is contained in Donnelly and others (1992) and may be useful in moving toward more consistent research approaches, when advisable.

Tenth, the stability of recreation norms over time has received little research attention, but may become increasingly important. Do norms change or evolve over time? If so, should such changes be incorporated into how wilderness and related areas are managed? The answer to the first question is a technical issue, while the second is more philosophical. Few studies have addressed the variability of norms over time. Those that have have generated mixed or inconclusive results. For example, a 1977 study of encounter norms for boaters on the Rogue River in Oregon, was replicated in 1984 (Shelby and others 1988a). No statistically significant difference was found for the number of acceptable river encounters. However, camp encounter norms were found to be significantly higher or more tolerant in the latter study. A similar study conducted in three wilderness areas over a longer interval found few clear, consistent trends in tolerance for inter-group contacts (Cole and others 1995). Two other studies have found substantial stability of norms over time; however, these studies cover only a two-to-three-year time period (Kim and Shelby 1998; Manning and others 1999).

Arguments about whether changes in norms should be incorporated into management plans are divided. The underlying rationale of indicators and standards of quality is that they should be set and maintained for some extended period of time, usually defined as the life of the management plan for which they are formulated. Thus, during this time period, standards of quality probably should not be revised substantially. However, management plans are periodically reformulated to reflect the changing conditions of society. It seems reasonable to reassess recreation norms as part of this process and incorporate these findings within long-term planning processes.

Finally, two organizational frameworks have been suggested to help guide development of indicators and standards of quality and subsequent monitoring and management action. An “importance-performance” framework has been suggested as an aid to formulating indicators and standards of quality (Hollenhorst and others 1992; Hollenhorst and Stull-Gardner 1992; Hollenhorst and Gardner 1994; Mengak and others 1986). Visitors are first asked to rate the importance of potential indicator variables, and these results are plotted along a vertical axis, as shown in figure 5. Second, visitors are asked a series of normative questions regarding standards of quality for each indicator variable. These data are then related to existing conditions and plotted on a horizontal axis, as shown in figure 5. The resulting data provide a graphic representation of the relationship between importance and performance of indicator variables, and where management action should be directed. The data in figure 5, for example, are derived from a survey of visitors to the Cranberry Wilderness in West Virginia, and suggest that indicator variable “A” (“number of

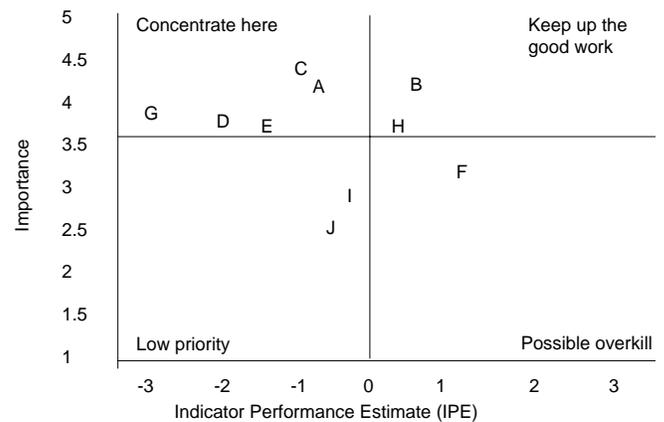


Figure 5—Importance-performance analysis (from Hollenhorst and Gardner 1994).

parties of people I see each day”) is important to visitors, but that visitors currently see more parties of people per day than their standard of quality (Hollenhorst and Gardner 1994). These findings suggest that managers should concentrate their attention on this indicator of quality.

An outdoor recreation “threats matrix” is another framework that might be applied to indicators and standards of quality (Cole 1994; Leopold and others 1971; Manning and Moncrief 1979). A matrix model of outdoor recreation impacts can be created by arraying important attributes of outdoor recreation to form the rows of a matrix and arraying potential threats to those attributes as the columns of the matrix. Each cell within the resulting matrix represents the various impacts that each threat causes to each attribute. An example of such a matrix is shown in figure 6. This example was developed to determine the significance of threats to wilderness areas within the Northern Region of the U.S. Forest Service (Cole 1994). This example applies to wilderness very broadly, but can be developed more specifically for outdoor recreation. Such a matrix can be

| Attributes of wilderness character | Wilderness Threats | | | | | | | |
|------------------------------------|--------------------|-----------|--------|------|----------------|----------------|------------------------|----------------|
| | Recreation | Livestock | Mining | Fire | Exotic species | Water projects | Atmospheric pollutants | Adjacent lands |
| Air | 1 | 1 | 1 | 2 | 1 | 1 | 4 | 3 |
| Aquatic systems | 4 | 3 | 3 | 4 | 4 | 3 | 4 | 3 |
| Rock/landforms | 1 | 2 | 2 | 1 | 1 | 2 | 1 | 1 |
| Soils | 3 | 3 | 2 | 5 | 2 | 2 | 4 | 2 |
| Vegetation | 3 | 3 | 2 | 5 | 4 | 3 | 4 | 2 |
| Animals | 4 | 2 | 2 | 4 | 3 | 2 | 2 | 4 |
| Ecosystems/landscapes | 2 | 3 | 2 | 5 | 3 | 2 | 4 | 5 |
| Cultural resources | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| Wilderness experiences | 4 | 3 | 2 | 3 | 2 | 2 | 2 | 3 |

Figure 6—Wilderness threats matrix. Matrix values are significance ratings for the impacts of each potential threat on each wilderness attribute for all wilderness areas in the U.S. Forest Service’s Northern Region. Ratings range from 1 (low) to 5 (high) (from Cole 1994).

useful for identifying potential indicators of quality (important attributes of outdoor recreation that are impacted by potential threats) and the extent to which such indicator variables are threatened and, therefore, need monitoring and management attention.

Managing Wilderness Recreation

The wilderness recreation management frameworks described at the beginning of this paper specify that management action must be taken to ensure that standards of quality are maintained. But what management actions are available to managers? Moreover, how effective are these alternative management practices? This section of the paper outlines a series of alternative management practices and reviews a growing number of studies designed to evaluate their effectiveness. Based on this review, a number of guidelines and related insights are developed on managing outdoor recreation in wilderness and related areas to protect the quality of the recreation experience.

Alternative Management Practices

Many writers have suggested a variety of management practices that might be applied to wilderness and related outdoor recreation. It is useful to organize these practices into classification systems to illustrate the broad spectrum of alternatives available to wilderness managers.

One classification system defines alternatives on the basis of management strategies (Manning 1979). Management

strategies are basic conceptual approaches to management that relate to achievement of desirable objectives. Four basic strategies can be identified for managing outdoor recreation, as illustrated in figure 7. Two strategies deal with supply and demand: The supply of recreation opportunities may be increased to accommodate more use, or the demand for recreation may be limited through restrictions or other approaches. The other two basic strategies treat supply and demand as fixed and focus on modifying either the character of recreation, to reduce its adverse impacts, or the resource base, to increase its durability.

There are a number of sub-strategies within each of these basic management strategies. The supply of outdoor recreation areas, for example, can be increased in terms of both space and time. With respect to space, new areas may be added, or existing areas might be used more effectively through additional access or facilities. With respect to time, some recreation use might be shifted to off-peak periods.

Within the strategy of limiting demand, restrictions might be placed on the total number of visitors that are allowed or their length of stay. Alternatively, certain types of use that have demonstrably high social and/or environmental impacts might be restricted.

The third basic management strategy suggests reducing the social or environmental impacts of existing use. This might be accomplished by modifying the type or character of use or by dispersing or concentrating use according to user compatibility or resource capability.

A final basic management strategy involves increasing the durability of the resource. This might be accomplished by hardening the resource itself (through intensive maintenance, for example) or developing facilities to accommodate use more directly.

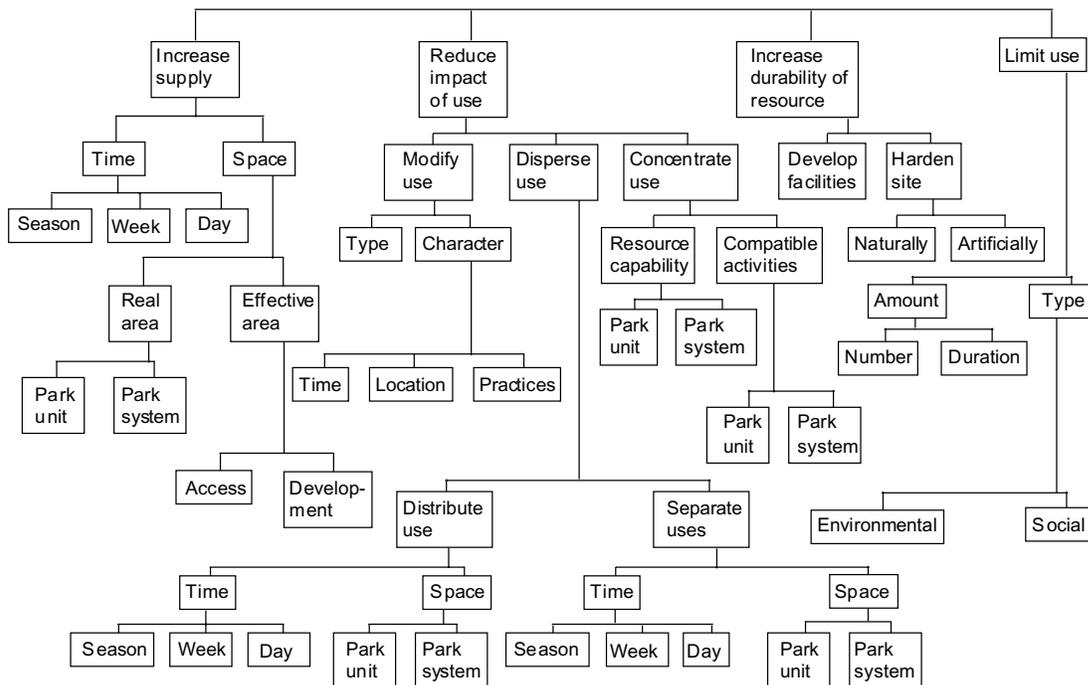


Figure 7—Strategies for managing outdoor recreation (from Manning 1979).

A second system of classifying management alternatives focuses on tactics or actual management practices. Management practices are direct actions or tools applied by managers to accomplish the management strategies described above. Restrictions on length of stay, differential fees and use permits, for example, are management practices designed to accomplish the strategy of limiting recreation demand. Management practices are often classified according to the directness with which they act on visitor behavior (Chavez 1996; Gilbert and others 1972; Lime 1977c, G. Peterson and Lime 1979). As the term suggests, direct management practices act directly on visitor behavior, leaving little or no freedom of choice. Indirect management practices attempt to influence the decision factors on which visitors base their behavior. A conceptual diagram illustrating direct and indirect recreation management practices is shown in figure 8. As an example, a direct management practice aimed at reducing campfires in a wilderness environment would include both a regulation barring campfires and enforcement of this regulation. An indirect management practice would be an education program designed to inform visitors of the undesirable ecological and aesthetic impacts of campfires and to encourage them to carry and use portable stoves instead. A series of direct and indirect management practices is shown in table 4.

The relative advantages and disadvantages of direct and indirect recreation management practices have received substantial attention in the recreation literature. Generally, indirect management practices are favored when and where they are believed to be effective (G. Peterson and Lime 1979, McCool and Christensen 1996). This is particularly true for wilderness and related types of outdoor recreation

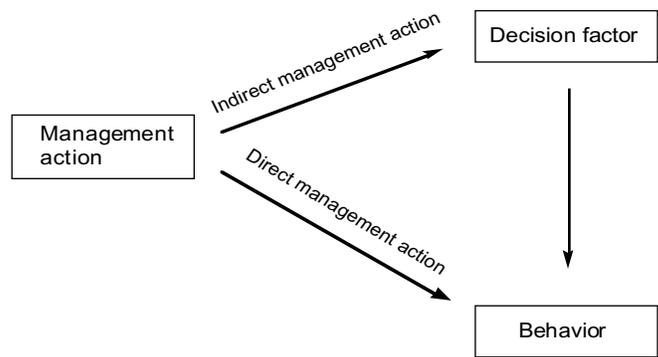


Figure 8—Diagram of direct versus indirect management tactics (adapted from G. Peterson and Lime 1979).

opportunities (Clark and Stankey 1979, Hendee and others 1990). Indirect management practices are favored for several reasons (McCool and Christensen 1996). First, legislation and management agency policies applied to wilderness and related areas often emphasize provision of recreation opportunities that are “unconfined.” Thus, direct regulation of visitor behavior may be inconsistent with such management objectives. Second, recreation is a form of leisure activity connoting freedom of choice in thought and actions. Regulations designed to control visitor behavior can be seen as antithetical to the very nature of recreation. Especially in the context of wilderness and related areas, recreation and visitor regulation have been described as “inherently contradictory” (Lucas 1982). Third, many studies indicate that,

Table 4—Direct and indirect management practices (adapted from Lime 1977c and 1979).

| Type | Example |
|---|--|
| Direct (Emphasis on regulation of behavior; individual choice restricted; high degree of control.) | Impose fines Increase surveillance of area Zone incompatible uses spatially (hiker only zones, prohibit motor use, etc.) Zone uses over time Limit camping in some campsites to one night, or some other limit Rotate use (open or close roads, access points, trails, campsites, etc.) Require reservations Assign campsites and/or travel routes to each camper group in backcountry Limit usage via access point Limit size of groups, number of horses, vehicles, etc. Limit camping to designated campsites only Limit length of stay in area (maximum/minimum) Restrict building of campfires Restrict fishing or hunting |
| Indirect (Emphasis on influencing or modifying behavior; individual retains freedom to choose; control less complete, ore variation in use possible.) | Improve (or not) access roads, trails Improve (or not) campsites and other concentrated use areas Improve (or not) fish and wildlife populations (stock, allow to die out, etc.) Advertise specific attributes of the area Identify the range of recreation opportunities in surrounding area Educate users to basic concepts of ecology Advertise underused areas ad general patterns of use Charge consistent entrance fee Charge differential fees by trail, zone, season, etc. Require proof of ecological knowledge and recreational activity skills |

given the choice, visitors prefer indirect over direct management practices (Lucas 1983). Finally, indirect management practices may be more efficient because they do not entail the costs associated with enforcement of rules and regulations.

Emphasis on indirect management practices, however, has not been uniformly endorsed (Cole 1993; McAvoy and Dustin 1983; Shindler and Shelby 1993). It has been argued that indirect practices may be ineffective. There will always be some visitors, for example, who will ignore management efforts to influence the decision factors that lead to behavior. The action of a few may, therefore, hamper attainment of management objectives. It has been argued, in fact, that a direct, regulatory approach to management can ultimately lead to more freedom rather than less (Dustin and McAvoy 1984). When all visitors are required to conform to mutually agreed-on behavior, management objectives are more likely to be attained and a diversity of recreation opportunities preserved. There is empirical evidence to suggest that, under certain circumstances, direct management practices can enhance the quality of the recreation experience (Frost and McCool 1988; Swearingen and Johnson 1995). Moreover, research suggests that visitors are surprisingly supportive of direct management practices when they are needed to control the impacts of recreation use (D. Anderson and Manfreda 1986, Shindler and Shelby 1993).

An analysis of management problems caused by visitors suggests that both direct and indirect management practices can be applicable depending upon the context (Alder 1996; Gramann and Vander Stoep 1987). There are several basic reasons why visitors may not conform to desired standards of behavior. These range from lack of knowledge about appropriate behavior to willful rule violations. Indirect management practices, such as information and education programs, seem most appropriate in the case of the former, while direct management practices, such as enforcement of rules and regulations, may be needed in the case of the latter.

It has been suggested that there is actually a continuum of management practices that range from indirect to direct (Hendricks and others 1993, McCool and Christensen 1996). As an example, an educational program on the ecological and aesthetic impacts of campfires would be found toward the indirect end of a continuum of management practices. A regulation requiring campers to use portable stoves instead of campfires would be a more direct management practice. Aggressive enforcement of this regulation with uniformed rangers would clearly be a very direct management practice. This suggests that management practices might also be viewed as ranging along two dimensions, as illustrated in figure 9. Not only can management practices be direct or indirect, they can also be implemented in an obtrusive or unobtrusive manner. It has also been suggested that direct and indirect management practices are not mutually exclusive and that, in fact, they can often complement each other (Alder 1996, Cole and others 1997a). For example, a regulation banning campfires (a direct management practice) should be implemented in conjunction with an educational program explaining the need for such a regulation (an indirect management practice).

Classification of management practices might be based on many factors or concepts. The approaches described above simply illustrate the array of alternatives available for

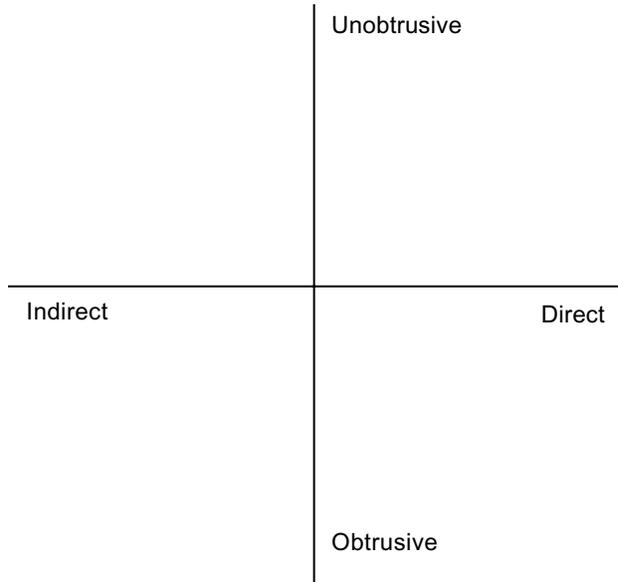


Figure 9—Two dimensions of recreation management practices (adapted from McCool and Christensen 1996).

wilderness recreation management. For any given problem, there are likely several potential solutions. Explicit consideration should be given to this variety of approaches rather than relying on those that are familiar or administratively expedient.

Evaluating Management Practices

A growing body of literature has focused on the potential effectiveness of selected recreation management practices. This literature can be organized into several broad categories of management approaches, including (1) visitor information and education programs, (2) use rationing and allocation, and (3) other recreation management practices.

Information and Education—Substantial research and management attention have focused on information and education programs as a recreation management practice. This practice is generally seen as an indirect and “light-handed” management approach. As a recreation management practice, information and education programs are designed to persuade visitors to adopt behaviors that are compatible with recreation management objectives. Research suggests that recreation visitors tend to view this approach very favorably (McCool and Lime 1989; Roggenbuck and Ham 1986; Roggenbuck 1992, Stankey and Schreyer 1987; Vander Stoep and Roggenbuck 1996).

A conceptual application of information and education to recreation management problems is illustrated in table 5. This table classifies problem behaviors in wilderness and related outdoor recreation into five basic types and suggests the potential effectiveness of information and education on each. At the two ends of the spectrum, problem behaviors can be seen as either deliberately illegal (for example, theft of Indian artifacts) or unavoidable (for example, disposal of human waste). In these instances, information and educa-

Table 5—Application of information and education to recreation management problems (adapted from Hendee and others 1990, Roggenbuck 1992 and Vander Stoep and Roggenbuck 1996).

| Type of problem | Example | Potential effectiveness of information and education |
|---------------------|--|--|
| Illegal | Theft of Indian artifacts. Invasion of wilderness by motorized off-road vehicles | Low |
| Careless actions | Littering. Nuisance activity (e.g., shouting) | Moderate |
| Unskilled actions | Selecting improper camping spot. Building improper campfire | High |
| Uninformed actions | Selecting a lightly used campsite in the wilderness. Using dead snags for firewood. Camping in sight or sound of another party | Very high |
| Unavoidable actions | Human body waste. Loss of ground cover vegetation in the campsite | Low |

tion may have little or no effectiveness. However, the other three types of problem behaviors—careless actions (such as littering), unskilled actions (such as selecting an improper campsite) and uninformed actions (such as using dead snags for firewood)—may be considerably more amenable to information and education programs.

A second conceptual approach to the application of information and education is based on theories of moral development and is illustrated in table 6. This approach builds on two prominent theories of moral development suggested by Kohlberg (1976) and Gilligan (1982). Both theories suggest that people tend to evolve through a series of stages of moral development, ranging from those that are very self-centered to those that are highly altruistic and are based on principles of justice, fairness and self-respect. Individual visitors to wilderness areas may be found at any of the stages of moral development shown in table 6. The management implications of this conceptual approach suggest that information and education programs should be designed to reach visitors at each of these stages of moral development. For example, to reach visitors at lower levels of moral development,

managers might emphasize extrinsic rewards and punishments for selected types of behavior. However, communicating with visitors at higher levels of moral development might be more effective by means of emphasizing the rationale for selected behaviors and a sense of altruism, justice and fairness.

Application of communication theory to outdoor recreation suggests that the potential effectiveness of information and education depends on a number of variables associated with visitors and the content and delivery of messages (Basman and others 1996; Bright and others 1993; Bright and Manfredo 1995; Manfredo 1989; Manfredo and Bright 1991; Manfredo 1992; Roggenbuck and Ham 1986; Roggenbuck 1992; Stankey and Schreyer; 1987; Vaske and others 1990). For example, visitor behavior is at least partially driven by attitudes, beliefs and normative standards. Information and education programs aimed at “connecting” with or modifying relevant attitudes, beliefs or norms may successfully guide or change visitor behavior. Moreover, the substance of messages and the media that deliver them may also influence the effectiveness of information and education programs.

Table 6—Stages of moral development (from H. Christenson and Dustin 1989).

| Kohlberg's six stages of moral development | | Gilligan's perspectives on moral development | |
|--|---|--|---|
| Stage | Overriding concern | Perspective | Overriding Concern |
| Preconventional morality | | | |
| 1 | Fear of punishment | 1 | Reference and relation to self; survival; self-oriented; similar to Kohlberg's 1 and 2 |
| 2 | Minimizing pain/ Maximizing pleasure | | |
| Conventional morality | | | |
| 3 | What significant others think | 2 | Reference and relation to others; pleasing others is important; somewhat similar to Kohlberg's 3 and 4 |
| 4 | What society thinks | | |
| Postconventional morality | | | |
| 5 | Justice and fairness | 3 | Reference and relation to self and others; integration of 1 and 2 above; caring is the highest value; departs from Kohlberg at this point |
| 6 | Self-respect | | |

From a theoretical standpoint, information and education can be seen to operate through three basic models (Roggenbuck 1992). The first is applied behavior analysis. This approach to management focuses directly on visitor behavior rather than antecedent variables such as attitudes, beliefs and norms. For example, visitors can be informed of rewards or punishments that depend on visitor behavior. Applied behavior analysis is the simplest and most direct theoretical model of information and education. However, since it does not address underlying behavioral variables such as attitudes, beliefs and norms, its effectiveness may be short term and dependent upon continued management action.

A second theoretical model of information and education is the central route to persuasion. In this model, visitors' relevant beliefs are modified through delivery of substantive messages. New or modified beliefs then lead to desired changes in behavior. While this is a less direct and more complex model, it may result in more lasting behavioral modification.

A third theoretical model of information and education is the peripheral route to persuasion. This model emphasizes nonsubstantive elements of information and education messages, such as message source and medium. For example, messages from sources considered authoritative or powerful by visitors may influence behavior, while other messages may be ignored. This model may be especially useful in situations where it is difficult to attract and maintain the attention of visitors, such as at visitor centers, entrance stations and bulletin boards, all of which may offer multiple and competing information and education messages. However, like applied behavior analysis, the peripheral route to persuasion may not influence antecedent conditions of behavior and, therefore, may not have lasting effects.

A relatively large number of empirical studies have examined the effectiveness of a variety of information and education programs. These studies fall into several categories, including (1) those designed to influence recreation use patterns, (2) studies focused on enhancing visitor knowledge, especially knowledge related to minimizing ecological and social impacts, (3) studies aimed at influencing visitor attitudes toward management policies, and (4) studies that address depreciative behavior such as littering and vandalism.

Recreation Use Patterns—Recreation use patterns are often characterized by their uneven spatial and temporal nature (Cole 1996; Cole and others 1997a; Glass and others 1991; Glass and Walton 1995; Hendee and others 1976; Leonard and others 1978; Lime 1977b; Lucas 1980; Manning and Cormier 1980; Manning and others 1984; Manning and Powers 1984; M. Peterson 1981; Plumley and others 1978; Roggenbuck and Lucas 1987; Stankey and others 1976). Problems such as crowding may be reduced if use patterns can be redistributed to some degree. Using computer-based simulation models, a number of studies have documented the effectiveness of spatial and temporal use redistribution in reducing contacts among recreation groups (deBettencourt and others 1978; Gilbert and others 1972; McCool and others 1977; Manning and Ciali 1979; Manning and Potter 1982, 1984; G. Peterson and others 1977; G. Peterson and deBettencourt 1979; G. Peterson and Lime 1980; Potter and Manning 1984; Romesburg 1974; Rowell 1986; Schecter and

Lucas 1978; Smith and Krutilla 1974, Smith and Headly 1975, Smith and Krutilla 1976; Underhill and others 1986, Van Wagtenonk and Coho 1986; Wang and Manning 1999). It has been shown, for example, that a nearly 20% cut in total use would be required to achieve the same reduction in contacts obtainable through use redistributions (Potter and Manning 1984).

Several studies have explored the potential effectiveness of information and education programs as a means of redistributing recreation use. An early study examined the use of roadside signs to redistribute use and found them effective (P. Brown and Hunt 1969). Similarly, the use of positively and negatively oriented trail signs were found to redistribute use at Rocky Mountain National Park in Colorado (Ormrod and Trahan 1977). Even simple designation of a site as an "official" park or wilderness area can lead to increased use (Becker 1981). Another early study explored the effectiveness of providing visitors with information on current use patterns as a way to alter future use patterns (Lime and Lucas 1977). Visitors who had permits for the most heavily used entry points in the Boundary Waters Canoe Area were mailed an information packet that included a description of use patterns, noting in particular heavily used areas and times. A survey of a sample of this group who again visited the study area the following year found that three-fourths of respondents felt this information was useful, and about one-third were influenced in their choice of entry point, route, or time of subsequent visits.

A study in the Shining Rock Wilderness Area of North Carolina experimented with two types of information programs designed to disperse camping away from a heavily used meadow (Roggenbuck and Berrier 1981, 1982). Two treatment groups were created. A brochure explaining resource impacts associated with concentrated camping and showing the location of other nearby camping areas was given to one treatment group, while the other was given the brochure along with personal contact with a wilderness ranger. Both groups dispersed their camping activity to a greater degree than a control group, but there was no statistically significant difference between the two treatment groups.

A similar experiment was conducted on trail use in the backcountry of Yellowstone National Park (Krumpe and Brown 1982). Before obtaining a backcountry permit, a sample group of hikers was given a guidebook that described the attributes of lesser-used trails. A later survey and examination of permits found that 37% of this group had selected one of the lesser-used trails in the trip planning process compared to 14% of a control group. Results also indicated that the earlier the information was received, the more influence it had on behavior. Studies employing user-friendly microcomputer-based information approaches have also been found to be effective in influencing recreation use patterns (Alpert and Herrington 1998; D. Harmon 1992; Huffman and Williams 1986, 1987; Hultsman 1988).

Hikers in the Pemigewasset Wilderness of New Hampshire were studied to determine the influence of wilderness rangers as a source of information and education (C. Brown and others 1992). Only about 20% of visitors reported that the information received from wilderness rangers influenced their destination within the study area. However, visitors who were less experienced and who reported that

they were more likely to return to the study area were more likely to be influenced by the information provided, suggesting that the information program may be more effective over time.

Potential problems in using information and education programs to influence recreation use were illustrated in a study in the Selway-Bitterroot Wilderness of Montana (Lucas 1981). Brochures describing current recreation use patterns were distributed to visitors. Follow-up measurements indicated little effect on subsequent use patterns. Evaluation of this program suggested three limitations on its potential effectiveness: (1) many visitors did not receive the brochure, (2) most of those who did receive the brochure received it too late to affect their decision-making, and (3) some visitors doubted the accuracy of the information contained in the brochure.

Visitor Knowledge—A second category of studies has focused primarily on enhancing visitor knowledge through information and education programs. Most of these studies have examined knowledge associated with reducing the potential ecological and social impacts caused by recreation. Two early studies focused on distinct types of users—backpackers in Rocky Mountain National Park (Fazio 1979b) and motorists in a New York state park (Feldman 1978). The study of backpackers provided information on low-impact camping practices through a series of media: a brochure, a trailhead sign, a slide and sound exhibit, a television program and a newspaper feature article. Not enough visitors were exposed to the latter two media to evaluate their effectiveness. However, exposure to the slide/sound exhibit, the slide/sound exhibit plus the brochure, and the slide/sound exhibit plus the trailhead sign resulted in significant increases in visitor knowledge. Exposure to the trailhead sign and brochure were not found to be very effective. The study of motorists also found that exposure to two types of information/education media—a brochure and a cassette tape—both increased the knowledge level of respondents.

More recent studies have also found significant effects of information and education programs on visitor knowledge and subsequent behavior. For example, a sample of day hikers to subalpine meadows in Mount Rainier National Park in Washington was given a short, personal interpretive program on reasons for and importance of complying with guidelines for off-trail hiking (Kernan and Drogin 1995). Visitors who received this program and those who did not were later observed as they hiked. Most visitors (64%) who did not receive the interpretive program did not comply with off-trail hiking guidelines, while most visitors (58%) who did receive the interpretive program complied with the guidelines.

Bulletin boards at trailheads have also been found to be effective in enhancing visitor knowledge about low-impact hiking and camping practices (Cole and others 1997b). Wilderness visitors exposed to low-impact messages at a trailhead bulletin board were found to be more knowledgeable about such practices than visitors who were not. However, increasing the number of messages posted beyond two did not result in increased knowledge levels.

Workshops and special programs delivered to organizations can also be effective in enhancing knowledge levels, as well as intentions to follow recommended low-impact practices. The effectiveness of these types of information and

education programs have been demonstrated in two studies aimed at Boy Scouts (Dowell and McCool 1986) and a volunteer group associated with the Boundary Waters Canoe Area Wilderness (Jones and McAvoy 1988). In both cases, treatment groups scored higher than control groups on tests of knowledge and behavioral intentions administered immediately after the programs and at a later date. Research also suggests that commercial guides and outfitters can be trained to deliver information and education programs to clients that are effective in enhancing visitor knowledge (Roggenbuck and others 1992; Sieg and others 1988) and that trail guide booklets can also be effective (Echelberger and others 1978).

Not all research has found information and education programs to be as effective as indicated in the above studies. A study of the effectiveness of interpretive programs at Great Smoky Mountains National Park, in North Carolina and Tennessee found mixed results (Burde and others 1988). There was no difference in knowledge about general backcountry policies between backcountry visitors exposed to the Park's interpretive services and those who were not exposed. However, the former group did score higher on knowledge of park-related hazards. A test of visitor compliance rates with campground regulations in Acadia National Park in Maine found no difference between time periods when a special brochure was and was not used (Dwyer and others 1989). Finally, a test of the effect a special brochure on appropriate behavior relating to bears found only limited change in actual or intended behavior of visitors (Manfredo and Bright 1991). Visitors requesting information on wilderness permits for the Boundary Waters Canoe Area Wilderness were mailed the special brochures. In a follow-up survey, only 18% of respondents reported that they had received any new information from the brochure, and only 7.5% reported that they had altered their actual or intended behavior.

Visitor Attitudes—A third category of studies on the potential effectiveness of information and education programs has examined their influence on visitor attitudes toward a variety of management agency policies (Bright and others 1993; Cable and others 1987; Manfredo and others 1992; Nielson and Buchanan 1986; Olson and others 1984; Ramthun 1996; Robertson 1982). These studies have found that information and education programs can be effective in modifying visitor attitudes to become more supportive of recreation and related land management policies. For example, visitors to Yellowstone National Park were exposed to interpretive messages designed to influence their beliefs about fire ecology and the effects of controlled-burn policies (Bright and others 1993). These messages were found to influence both beliefs about fire ecology and attitudes based on those beliefs.

Depreciative Behavior—A fourth category of studies on the potential effectiveness of information and education as a management practice has focused on depreciative behavior, especially littering. A number of studies have found that a variety of information and education messages and related programs can effectively reduce littering behavior and even clean up littered areas (Burgess and others 1971; H. Christensen 1981; H. Christensen and Clark 1983; H. Christensen 1986; H. Christensen and others 1992; Clark and others 1971; Clark and others 1972a,b; Horsley 1988;

Marler 1971; Muth and Clark 1978; Oliver and others 1985; Powers and others 1973; Roggenbuck and Passineau 1986; Taylor and Winter 1995; Vander Stoep and Gramman 1987; Wagstaff and Wilson 1988). For example, samples of visitors to a developed campground were given three different treatments: a brochure describing the costs and impacts of littering and vandalism, the brochure plus a personal contact with a park ranger, and these two treatments plus a request for assistance in reporting depreciative behaviors to park rangers (Oliver and others, 1985). The brochure plus the personal contact was the most effective treatment; it reduced the number of groups who littered their campsite from 67% to 41% and reduced the number of groups who damaged trees at their campsite from 20% to 4%. Types of messages and related purposes found to be effective in a number of studies include incentives to visitors to assist with clean-up efforts and the use of rangers and trip leaders as role models for cleaning up litter.

Other Studies—Several other types of studies, while not directly evaluating the effectiveness of information and education, also suggest the potential of information and education as a recreation management practice. First, studies of visitor knowledge indicate that marked improvements are possible which could lead to improved visitor behavior. For example, campers on the Allegheny National Forest in Pennsylvania were tested for their knowledge of rules and regulations that applied to the area (Ross and Moeller 1974). Only 48% of respondents answered six or more of the ten questions correctly. A similar study of visitors to the Selway-Bitterroot Wilderness Area tested knowledge about wilderness use and management (Fazio 1979a). Only about half of the 20 questions were answered correctly by the average respondent. However, there were significant differences among types of respondents, type of knowledge and the accuracy of various sources of information, providing indications of where and how information and education programs might be channeled most effectively.

Second, several studies indicate that current information and education programs could be substantially improved (Cockrell and McLaughlin 1982; Fazio 1979b; Fazio and Ratcliffe 1989). Evaluation of literature mailed in response to visitor requests has found several areas of needed improvements, including more timely response, more direct focus on management problems and issues, greater personalization, more visual appeal and reduction of superfluous materials.

Third, a survey of wilderness managers has identified the extent to which 25 visitor education techniques are used (Doucette and Cole 1993). Study findings are shown in table 7. Only six of these education techniques—brochures, personnel at agency offices, maps, signs, personnel in the backcountry and displays at trailheads—are used in a majority of wilderness areas. Managers were also asked to rate the perceived effectiveness of education techniques. It is clear from table 7 that personnel-based techniques are generally considered more effective than media-based techniques.

Related studies have examined the sources of information used by outdoor recreation visitors for trip planning (Uysal and others 1990, Schuett 1993). Many respondents report using information sources that are not directly produced by

management agencies, such as outdoor clubs, professional outfitters, outdoor stores, guidebooks, newspaper and magazine articles and travel agents. This suggests that management agency linkages with selected private and commercial organizations may be an especially effective approach to information and education.

Studies on information and education as a recreation management practice are relatively numerous, but highly diverse, employing a variety of message types and media and addressing a variety of issues and target audiences. Generally, these studies suggest that information and education can be an effective recreation management practice. Moreover, a number of guidelines for using information and education can be developed from this literature (Roggenbuck and Ham 1986, P. Brown and others 1987, Manfredi 1989, 1992, Roggenbuck 1992, Doucette and Cole 1993, Bright 1994, Basman and others 1996, Vander Stoep and Roggenbuck 1996). These guidelines include:

1. Use of multiple media to deliver messages is often more effective than use of a single medium.
2. Information and education programs are generally more effective with visitors who are less experienced and less knowledgeable. Young visitors may be an especially attractive target audience.
3. Brochures, personal messages and audiovisual programs may be more effective than signs.
4. Messages may be more effective when delivered early in the recreation experience, such as during trip planning.
5. Messages from sources judged highly credible may be most effective.
6. Computer-based information systems can be an effective means of delivering information and education.
7. Knowledgeable volunteers, outfitters and commercial guides can be effective and efficient in communicating information and education to visitors.
8. Information on the impacts, costs and consequences of problem behaviors can be an effective information and education strategy.
9. Role modeling by park and wilderness rangers and volunteers can be an effective information and education strategy.
10. Personal contact with visitors by rangers or other employees, both before and during the recreation experience, effectively communicate information and education.
11. Messages should be targeted at specific audiences to the extent possible. Target audiences that might be especially effective include those who request information in advance and those who are least knowledgeable.

Use Rationing and Allocation—Substantial attention has been focused on the management practice of limiting the amount and/or type of use that parks, wilderness and related areas receive. Use rationing is controversial and is generally considered to be a management practice of “last resort” because it runs counter to the basic objective of providing public access to wilderness and related areas (Behan 1974; Behan 1976; Dustin and McAvoy 1980; Hendee and Lucas 1973; Hendee and Lucas 1974). However, limits on use may be needed to maintain the quality of the recreation experience and to protect the integrity of critical resources.

Table 7—Use and perceived effectiveness of 25 education techniques in wilderness areas (adapted from Doucette and Cole 1993).

| Technique | Percentage used | Mean perceived effectiveness rating ^a |
|------------------------------------|-----------------|--|
| Brochures | 74 | 2.5 |
| Personnel at agency office | 70 | 2.7 |
| Maps | 68 | 2.1 |
| Signs | 67 | 2.3 |
| Personnel in backcountry | 65 | 3.8 |
| Displays at trailheads | 55 | 2.6 |
| Displays at agency offices | 48 | 2.7 |
| Posters | 48 | 2.3 |
| Personnel at school programs | 47 | 2.9 |
| Slide shows | 36 | 2.9 |
| Personnel at campgrounds | 35 | 2.9 |
| Personnel at public meetings | 34 | 2.8 |
| Personnel at trailheads | 29 | 3.3 |
| Personnel at visitor centers | 26 | 3.0 |
| Videos | 21 | 2.6 |
| Agency periodicals | 18 | 2.3 |
| Displays at visitor centers | 18 | 2.5 |
| Guidebooks | 13 | 2.5 |
| Interpreters | 11 | 3.6 |
| Computers | 11 | 1.9 |
| Commercial radio | 9 | 1.9 |
| Commercial periodicals | 8 | 2.4 |
| Movies | 7 | 2.6 |
| Commercial television | 4 | 2.3 |
| Agency radio | 1 | 2.4 |
| Mean of personnel-based techniques | | 3.1 |
| Mean of media-based techniques | | 2.4 |
| Mean of all techniques | | 2.6 |

^aEffectiveness scale: 1 = "not effective"; 5 = "highly effective"

Use Rationing and Allocation Practices—Five basic management practices have been identified in the literature to ration and allocate recreation use (Fractor 1982; McLean and Johnson 1997; Shelby and others 1989a; Stankey and Baden 1977). These include 1. reservation systems, 2. lotteries, 3. first-come, first-served or queuing, 4. pricing and 5. merit. A reservation system requires potential visitors to reserve a space or permit in advance of their visit. A lottery also requires potential visitors to request a permit in advance, but allocates permits on a purely random basis. A first-come, first-served or queuing system requires potential visitors to "wait in line" for available permits. A pricing system requires visitors to pay a fee for a permit, which may "filter out" those who are unable or unwilling to pay. A merit system requires potential visitors to "earn" the right to a permit by virtue of demonstrated knowledge or skill.

Each of these management practices has potential advantages and disadvantages. For example, reservation systems may tend to favor visitors who are willing and able to plan ahead, but these systems may be difficult and costly to administer. Lotteries are often viewed as eminently "fair," but can also be difficult and costly to administer. First-come, first-served systems may favor visitors who have more leisure time or who live relatively close to a park area, but they are relatively easy to administer. Pricing is a commonly used practice in society to allocate scarce resources, but may discriminate against potential visitors with low incomes.

Merit systems are rarely used, but may lessen the environmental and social impacts of use.

Several principles or guidelines have been suggested for considering and applying use rationing and allocation practices (Stankey and Baden 1977). First, emphasis should be placed on the environmental and social impacts of recreation use rather than the amount of use per se. Some types of recreation use may cause more impacts than others. To the extent that such impacts can be reduced, rationing use of recreation areas can be avoided or at least postponed. Second, as noted above, rationing use should probably be considered a management practice of last resort. Less direct or "heavy-handed" management practices would be more desirable where they can be demonstrated to be effective. Third, good information is needed to implement use rationing and allocation. Managers must be certain that social and/or environmental problems dictate use rationing and that visitors are understood well enough to predict the effects of alternative allocation systems. Fourth, combinations of use rationing systems should be considered. Given the advantages and disadvantages of each use-allocation practice, hybrid systems may have special application. For example, half of all wilderness permits might be allocated on the basis of a reservation system and half on a first-come, first-served basis. This would serve the needs of potential visitors who can and do plan vacations in advance, as well as those who engage in more spontaneous trip planning. Fifth,

use rationing should establish a linkage between the probability of obtaining a permit and the value of the recreation opportunity to potential visitors. In other words, visitors who value the opportunity highly should have a chance to “earn” a permit through pricing, advance planning, waiting time or merit. Finally, use-rationing practices should be monitored and evaluated to assess their effectiveness and fairness. Use rationing for recreation is relatively new in many locations and is likely to be controversial. Special efforts should be made to ensure that use-rationing practices accomplish their objectives.

Fairness—A critical element of use-rationing and allocation practices is “fairness” (Dustin and Knopf 1989). Wilderness and related recreation areas administered by federal, state and local agencies are public resources. Use-rationing and allocation practices must be seen as both efficient and equitable. But how are equity, fairness and related concepts defined? Several studies have begun to develop important insights into this issue. These studies have outlined several alternative dimensions of equity and measured their support among the public.

One study identified four dimensions of an overall theory of “distributive justice” (Shelby and others 1989a). Distributive justice is defined as an ideal whereby individuals obtain what they “ought” to have based on criteria of fairness. A first dimension is “equality” and suggests that all individuals have an equal right to a benefit like access to wilderness. A second dimension is “equity” and suggests that benefits be distributed to those who “earn” them through some investment of time, money or effort. A third dimension is “need” and suggests that benefits be distributed on the basis of unmet needs or competitive disadvantage. A final dimension is “efficiency” and suggests that benefits be distributed to those who place the highest value on them.

Insights into these dimensions of distributive justice were developed through a survey of river runners on the Snake River in Hell’s Canyon, Idaho (Shelby and others 1989b). Visitors were asked to rate the five use allocation practices described above—reservation; lottery; first-come, first-served; pricing; and merit—on the basis of four criteria: perceived chance of obtaining a permit, perceived fairness of the practice, acceptability of the practice and willingness to try the practice. Results suggest that visitors use concepts of both fairness and pragmatism in evaluating use-rationing practices. However, pragmatism—the perceived ability on the part of the respondent to obtain a permit—had the strongest effect on willingness to try each of the allocation practices. These findings suggest that managers have to convince potential visitors that proposed use allocation practices are not only “fair,” but that they will provide them with a reasonable chance to obtain a permit.

A second series of studies has examined a more extended taxonomy of equity dimensions that might be applied to provision of a broad spectrum of park, wilderness and related services (Wicks and Crompton 1986, Wicks 1987, Wicks and Crompton 1987, Crompton and Wicks 1988, Wicks and Crompton 1989, 1990, Crompton and Lue 1992). Eight potential dimensions of equity are identified as shown in figure 10. A first dimension is compensatory and allocates benefits on the basis of economic disadvantage. The second two dimensions are variations of equality and they allocate

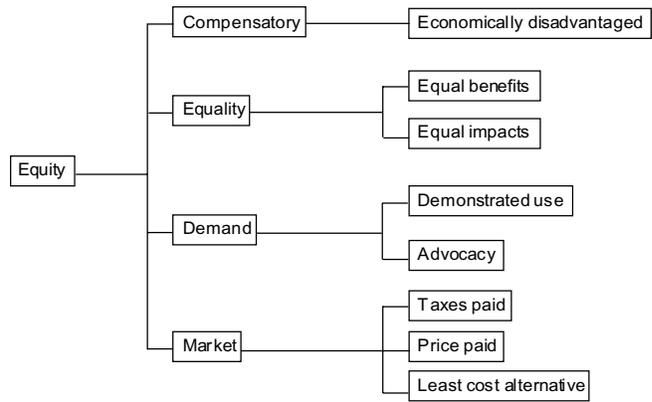


Figure 10—Dimensions of equity for allocating park and recreation benefits (adapted from Crompton and Lue 1992).

benefits to all individuals equally or ensure that all individuals ultimately receive equal total benefits. The fourth and fifth dimensions are based on demand, and they allocate benefits to those who make greatest use of them or those who advocate most effectively for them. The final three dimensions of equity are market-driven and distribute benefits based on amount of taxes paid, the price charged for services or the least-cost alternative for providing recreation services.

These dimensions of equity were described to a sample of California residents, and respondents were asked to indicate the extent to which they agreed or disagreed with each dimension of equity as a principle for allocating public park and recreation services to residents (Crompton and Lue 1992). A majority of the sample agreed with only three of the dimensions. These dimensions were, in decreasing order, demonstrated use, price paid and equal benefits.

Visitor Attitudes and Preferences—Despite the complex and controversial nature of use rationing and allocation, there is considerable support for a variety of such management practices among visitors to wilderness and related areas (Fazio and Gilbert 1974; Glass and More 1992; Lucas 1980; Lucas 1985; McCool and Utter 1981; McCool and Utter 1982; , Schomaker and Leatherberry 1983; Shelby and others 1982, 1989b; Stankey 1973, 1979; Utter and others 1981; Watson 1993; Watson and Niccolucci 1995). Research suggests that even most individuals who have been unsuccessful at obtaining a permit continue to support the need for use rationing (Fazio and Gilbert 1974; McCool and Utter 1982; Stankey 1979). A study of visitors to three wilderness areas in Oregon found that support for use restrictions was based on concerns for protecting both resource quality and the quality of the visitor experience (Watson and Niccolucci 1995). Support by day hikers was influenced most strongly by concerns with crowding, while support by overnight visitors was influenced by concern for both crowding and environmental impacts.

Preferences among alternative use rationing practices have been found to be highly variable, based on both location and type of user (Glass and More 1992; Magill 1976; McCool and Utter 1981; Shelby and others 1982, 1989b). Support for a particular use-allocation practice appears to be related primarily to which practices respondents are familiar with

and the extent to which they believe they can obtain a permit. A study of river managers found that first-come, first-served and reservation systems were judged the two most administratively feasible allocation practices and were also the most commonly used practices (Wikle 1991).

In keeping with the generally favorable attitude toward use limitation described above, most studies have found visitor compliance rates for mandatory permits to be high, ranging from 68% to 97% with most areas in the 90% range (Godin and Leonard 1977a; Lime and Lorence 1974; Parsons and others 1982; Plager and Womble 1981; Van Wagtenonk and Benedict 1980). Moreover, permit systems that have incorporated trailhead quotas have been found to be effective in redistributing use both spatially and temporally (Hulbert and Higgins 1977, Van Wagtenonk 1981, Van Wagtenonk and Coho 1986).

A common precursor to mandatory permit systems in wilderness and related areas is voluntary self-registration. Visitors are asked to register themselves at trailheads as a measure of use for management purposes. Compliance with this management practice has been found considerably less uniform than with mandatory permits: Registration rates have been found to vary from 21% to 89%, with most in the 65% to 80% range (James and Schreuder 1971; James and Schreuder 1972; Leatherberry and Lime 1981; Lucas and others 1971; Lucas 1975; Lucas and Kovalicky 1981; Scotter 1981; Wenger 1964; Wenger and Gregerson 1964). Several types of visitors have especially low registration rates, including day users, horseback riders and single-person parties.

Pricing—Among the use-rationing and allocation practices described above, pricing has received special attention in the literature. Pricing is the primary means of allocating scarce resources in a free-market economy. Economic theory generally suggests that higher prices will result in less consumption of a given good or service. Thus, pricing may be an effective approach to limiting use of wilderness and related areas. However, park, wilderness and recreation services in the public sector have traditionally been priced at a nominal level or have been provided free of charge. The basic philosophy underlying this policy is that access to parks, wilderness and related areas is important to all people and no one should be “priced out of the market.” Interest in instituting or increasing fees at wilderness and related areas has generated a considerable body of literature, ranging from philosophical to theoretical to empirical (F. Anderson and Bonsor 1974; M. Anderson and others 1985; Bamford and others 1988; Becker and others 1985; Bowker and Leeworthy 1998; N. Christensen and others 1993; Cockrell and Wellman 1985a, b; Daniels 1987; Driver 1984; Dustin 1986; Dustin and others 1987; Emmett and others 1996; Fedler and Miles 1989; Gibbs 1977; Harris and Driver 1987; Kerr and Manfredo 1991; Leuschner and others 1987; Lundgren 1996; McCarville 1996; McCarville and Crompton 1987; McCarville and others 1986; McDonald and others 1987; Manning and Baker 1981; Manning and others 1984; Manning and Koeneemann 1986; Manning and Zwick 1990; Manning and others 1996f; Martin 1986; G. Peterson 1992; Reiling and others 1988, 1992; Reiling and Cheng 1994; Reiling and others 1996; Reiling and Kotchen 1996; Rosenthal and others 1984, Schreyer and Knopf 1984; Schultz and others 1988; Scott and Munson 1994; Stevenson 1989; Walsh 1986).

Studies of pricing have tended to focus on several issues related to its potential as a wilderness management practice. First, to what extent does pricing influence use of parks and wilderness areas? Findings have been mixed. For example, a study of day users at six recreation areas administered by the Army Corps of Engineers found that 40% of respondents reported they would no longer use these areas if a fee was instituted (Reiling and others 1996). However, other studies have shown little or no effects of pricing on recreation use levels (Becker and others 1985; Leuschner and others 1987; Manning and Baker 1981; Rechisky and Williamson 1992). The literature suggests that the influence of fees on recreation use depends on several factors, including:

1. The “elasticity of demand” for a park or wilderness area. Elasticity refers to the slope of the demand curve that defines the relationship between price and quantity consumed. This issue is illustrated in figure 11. The demand for some recreation areas is relatively elastic, meaning that a change in price has a comparatively large effect on the quantity consumed (or visitation). The demand for other recreation areas is relatively inelastic, meaning that a change in price has a comparatively small effect on the quantity consumed (or visitation).
2. The significance of the area. Parks and wilderness areas of national significance, such as Yellowstone National Park, generally have a relatively inelastic demand, suggesting that pricing is not likely to be effective in limiting use unless price increases are quite dramatic. Parks and wilderness areas that are less significant are likely to be characterized by more elastic demand, and pricing may be an effective use-allocation practice.
3. The percentage of total cost represented by the fee. In cases where the fee charged represents a relatively high percentage of the total cost of visiting a wilderness area, pricing is likely to be a more effective use-limiting approach. However, where the fee charged represents only a small percentage of the total trip cost, pricing is not likely to be an effective use-limiting approach.
4. The type of fee instituted. Pricing structure can be a potentially important element in determining the effectiveness of fees as a management practice. For example, a daily use fee might be more effective in

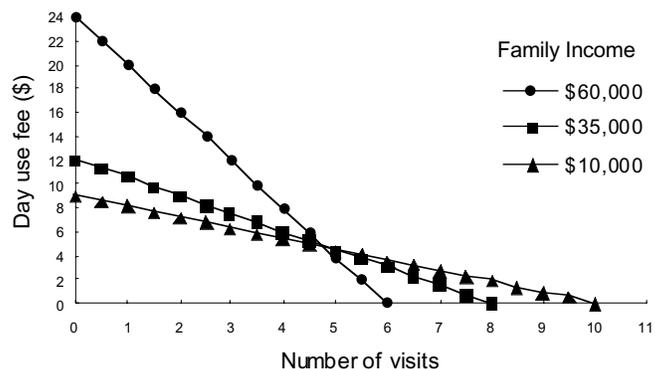


Figure 11—Demand curves for day use recreation areas by income level (from Reiling and others 1996).

limiting total use than an annual pass that allows unlimited use opportunities for a flat fee.

A second issue addressed in the literature is the acceptability of fees to potential visitors. Again, study findings are mixed, although they often suggest that there is a substantial willingness to pay for access to park and wilderness areas. However, research suggests that the acceptability of fees depends at least partially on several factors, including:

1. Dispensation of resulting revenues. If revenues derived from fee programs are retained by the collecting agency and reinvested in recreation facilities and services, fees are often judged to be more acceptable by visitors.
2. Initiation of fee or increase in existing fee. Public acceptance of new fees where none were charged before tends to be relatively low compared to increases in existing fees.
3. Local or nonlocal visitors. Local visitors tend to be more resistant to new fees or increased fees than nonlocal visitors. As described above, this is probably because fees represent a larger percentage of the total cost of visiting a wilderness area for local visitors. Moreover, local residents are likely to visit a given wilderness area more often than nonlocal residents.
4. Provision of comparative information. Visitor acceptance of fees is likely to be greater when information is provided on the costs of competing or substitute recreation opportunities and when visitors are made aware of the costs of providing recreation opportunities.

A third issue concerns the potential for pricing to discriminate against certain groups in society, particularly those with low incomes. Once again, research on this issue is mixed. For example, one study examined the socioeconomic characteristics of visitors to two similar outdoor recreation areas in Virginia, one of which charged an entrance fee, and the other did not (Leuscher and others 1987). No differences were found in income levels, suggesting that the fee had no discriminatory effect. However, two studies of willingness to pay fees at state parks and Army Corps of Engineers day-use areas found that lower income visitors had a more elastic demand curve than did high-income users, as illustrated in figure 11 (Reiling and others 1992, 1994). This suggests that pricing may discriminate against lower income visitors.

A final issue concerns the use of differential pricing to influence recreation use patterns. Differential pricing consists of charging higher or lower fees at selected times and locations. It was noted earlier that outdoor recreation tends to be characterized by relatively extreme "peaking." That is, certain areas or times are used very heavily, while other times or areas are relatively lightly used. Can pricing be used to even out such recreation use patterns? Research suggests the potential of this use of pricing (LaPage and others 1975; Manning and others 1982; Willis and others 1975). For example, studies of experimental differential campsite pricing at Vermont state parks documented significant shifts in campsite occupancy patterns (Manning and others 1984, Bamford and others 1988).

Other Wilderness Recreation Management Practices—As suggested earlier in this section, a number of

other practices are available to manage wilderness recreation. Most tend to be direct management practices. Beyond information/education programs and limiting use, four broad categories of management practices addressed in the literature include 1. rules and regulations, 2. law enforcement, 3. zoning and 4. site design and management.

Rules and Regulations—Rules and regulations are commonly used recreation management practices, although their use can sometimes be controversial (Lucas 1982, 1983). Common applications of rules and regulations in outdoor recreation include group size limitations, assigned campsites and/or travel itineraries, area closures, length of stay limitations and restrictions on and/or prohibition of campfires. The importance of encouraging visitors to comply with rules and regulations is emphasized in a recent study of the national park system, which found that visitors who did not comply with rules and regulations caused extensive damage (Johnson and Vande Kamp 1996).

As noted earlier in this section, research indicates that visitors are often unaware of rules and regulations (Ross and Moeller 1974). This suggests that managers must effectively communicate rules and regulations to visitors using the principles and guidelines described in the section on information and education programs. In particular, visitors should be informed of the reasons why applicable rules and regulations are necessary, sanctions associated with failure to comply with rules and regulations, and alternative activities and behaviors that can be substituted for those not allowed.

Only limited research has addressed the effectiveness of rules and regulations as a recreation management practice. The literature suggests that most visitors support limitations on group size, but that group types should also be considered when promulgating such regulations (Heywood 1985; Roggenbuck and Schreyer 1977). Group size limits should not be set so low that they affect the primary social groups of visitors who may have strong motivations for social interaction. However, research indicates that social groups in wilderness areas tend to be small.

Research also suggests that regulations requiring the use of assigned campsites in wilderness or backcountry are generally not supported by visitors (D. Anderson and Manfredo 1986; Lucas 1985). An extreme version of this regulation requires backpackers to follow a fixed travel itinerary. Studies of the effectiveness of this regulation have found that visitor compliance rates are relatively low (Parsons and others 1981, 1982; Stewart 1989, 1991; Van Wagendonk and Benedict 1980). For example, 44% to 77% of backcountry campers were in full compliance with their permit itinerary across four zones of Grand Canyon National Park (Stewart 1989). Noncompliance was primarily caused by visitors using campsites other than those specified or staying in the backcountry more or fewer nights than originally specified.

Research on regulations closing selected areas to public use suggest they are supported by visitors if the underlying reason is clear and justified (Frost and McCool 1988). Most visitors would obey a regulation closing selected backcountry campsites for ecological reasons (Cole and Rang 1983). Regulations closing areas to camping in selected natural areas in Norway were also found to be effective, although the

effects of such regulations can substantially threaten traditional use and users (Vork 1998). This suggests that regulations should be used cautiously.

Law Enforcement—Little research has been conducted on law enforcement in outdoor recreation. Most of the literature in this area discusses the controversial nature of law enforcement in this context (Bowman 1971; Campbell and others 1968; Connors 1976; Hadley 1971; L. Harmon 1979; Heinrichs 1982; Hope 1971; Manning 1987; Morehead 1979; Perry 1983; Philley and McCool 1981; Schwartz 1973; Shanks 1976; Wade 1979; Westover and others 1980; Wicker and Kirmeyer 1976). However, one study focused on the use of uniformed rangers to deter off-trail hiking at Mount Rainier National Park (Swearingen and Johnson 1995); the presence of a uniformed ranger significantly reduced off-trail hiking. Moreover, visitors tended to react positively to this management practice when they understood that the ranger was needed for information dissemination, visitor safety and resource protection.

Zoning—Zoning is another basic category of recreation management practices. In its most generic sense, zoning simply means assigning certain recreation activities to selected areas (or restricting activities from areas, as the case may be). Zoning can also be applied in a temporal dimension as well as in a spatial sense. Finally, zoning can be applied to alternative management prescriptions as a way to create different types of outdoor recreation opportunities (Greist 1975, Haas and others 1987). For example, “rescue” and “no-rescue” zones have been proposed for wilderness areas, though this is controversial (Dustin and others 1986; Harwell 1987; McAvoy and Dustin 1983; McAvoy and others 1985; McAvoy 1990; D. Peterson 1987).

In its most fundamental form, zoning is widely used to create and manage a diversity of recreation opportunities. The basic concept of zoning is at the heart of the Recreation Opportunity Spectrum described earlier in this paper. Zoning is also used in outdoor recreation to restrict selected recreation activities from environmentally sensitive areas and to separate conflicting recreation uses. No primary research has been conducted on the potential effectiveness of zoning.

Site Design and Management—A final category of wilderness management practices is site design and management. Recreation areas can be designed and manipulated to “harden” them against recreation impacts and manage the use made of them. For example, boardwalks can be built to concentrate use in developed areas, and facilities can be constructed along trails to channel use in appropriate areas (Doucette and Kimball 1990; Hultsman and Hultsman 1989). Moreover, campsites can be designated and designed in ways to minimize social and ecological impacts (Echelberger and others 1983; Godin and Leonard 1976; McEwen and Tocher 1976). However, most of these management practices involve resource management activities that are beyond the scope of this paper. Moreover, such resource management practices may not be in keeping with the environmental protection objectives of wilderness areas. Hammitt and Cole (1998) and a companion paper in this proceeding by Leung and Marion provide excellent reviews of the outdoor recreation literature addressing site and resource management.

Status and Trends in Wilderness Management

What recreation management practices are used most often, and how effective are they? What are the trends in wilderness recreation management? Several studies conducted over the past two decades offer insights into these questions (Godin and Leonard 1979, Bury and Fish 1980, Fish and Bury 1981, Washburne 1981, Washburne and Cole 1983, Marion and others 1993, Manning and others 1996a). These studies have focused on wilderness and backcountry areas and have involved periodic surveys of recreation managers. The most recent study explored current recreation management practices in the national park system (Marion and others 1993, Manning and others 1996a). Managers of all national park backcountry areas were asked to indicate which of more than 100 recreation management practices were currently used and which were judged most effective. Management practices used in over half of all areas are shown in table 8, along with all management practices judged to be “highly effective.”

Comparisons across these studies can provide some insights into trends in recreation management problems and practices, at least in the context of wilderness and backcountry areas. Although the areas, management agencies and research methods varied among these studies, their primary objectives were similar—to assess recreation management problems and/or practices in resource-based recreation areas. These studies provide benchmarks at four points in time—1979, 1981, 1983 and 1993—and suggest several basic trends in wilderness recreation management problems and practices.

First, environmental impacts, primarily on trails and campsites, are the dominant recreation-related problems perceived by managers throughout these studies. In all four studies, managers tended to report site deterioration, including soil erosion and loss of vegetation, as the most frequently occurring recreation management problem.

Second, social problems of crowding and conflicting uses appear to have increased over time. The initial study in 1979 revealed no crowding problems. The study reported that user conflict was cited as a problem by 29% of wilderness managers, but this conflict was associated primarily with nonconforming uses of wilderness, such as grazing and off-road vehicles. More recent studies report substantial and increasing levels of crowding and conflict among recreation users. For example, crowding was reported as a problem “in many places” in 1983 at 10% of all areas studied, including 2% of National Park Service areas. By 1993, between 10% and 27% (depending upon location—campsite, trail, attraction site—within the area) of National Park Service areas reported crowding “in many or most areas.” Moreover, conflict between different types of users was reported as widespread in 2% of areas in 1983, but it was reported as a problem “in many or most areas” in 1993 by as many as 9% of areas.

Third, carrying capacity has become a pervasive but largely unresolved issue. The initial study in 1979 did not report carrying capacity as a significant issue. However, by 1983, recreation use was judged to exceed carrying capacity “sometimes” or “usually” in at least some areas by over half

Table 8—Most commonly used and effective recreation management practices (adapted from Manning and others 1996a.)

| Most commonly used (% of areas using) | Most effective |
|--|--|
| Educate visitors about “pack-it-in, pack-it-out” policy (91) | Campsite impacts |
| Prohibit visitors from cutting standing deadwood for fires (83) | Designate campsites |
| Educate visitors about how to minimize their impacts (77) | Prohibit campfires |
| Remove litter left by visitors (74) | Provide campsite facilities |
| Instruct visitors not to feed wildlife (74) | Restore campsites |
| Require backcountry overnight visitors to obtain permits (68) | Limit group sizes |
| Instruct visitors to bury human wastes (66) | Implement campsite reservation system |
| Require groups to limit their length of stay at campsites (64) | Trail impacts |
| Give verbal warnings to visitors who violate regulations (63) | Maintain and rehabilitate trails |
| Require groups to limit their size (62) | Use Impact monitoring system |
| Prohibit pets from the backcountry (61) | Use formal trail system and plan |
| Prohibit use of horses in selected areas (59) | Implement quotas on amount of use |
| Instruct visitors to bury human wastes away from all water sources (57) | Wildlife impacts |
| Inform visitors about potential crowding they may encounter in selected areas (56) | Temporarily close sensitive areas |
| Discourage use of environmentally sensitive areas (54) | Regulate food storage and facilities |
| Inform visitors about managers’ concerns with visitor use impacts at attraction areas (54) | Provide user education programs |
| Instruct visitors to view wildlife from a distance (53) | Restrict pets |
| Perform regular trail maintenance (52) | Provide information workshops for Commercial outfitters and guides |
| Require groups to limit their length of stay in the backcountry (51) | Water impacts |
| | Provide primitive toilets at high-use sites |
| | Visitor crowding and conflicts |
| | Implement quotas on amount of visitor use |
| | control access to backcountry with visitor transportation system |

of all managers. Carrying capacity problems in National Park Service areas were reported as equally extensive in 1983 and 1993, with 70% of managers reporting that carrying capacity is exceeded either “sometimes” or “usually” in at least some areas. Despite the apparent seriousness of the carrying capacity issue, most managers have not yet addressed it adequately. Nearly half of all areas studied in 1983 reported that they were unable to estimate carrying capacity for any portions of their areas. Moreover, the percentage of National Park Service areas unable to estimate carrying capacity rose from 36% in 1983 to 57% in 1993. Finally, despite the fact that 43% of National Park Service areas currently are able to estimate carrying capacity in at least some portions of their areas, considerably less than half of these areas make such estimates based on scientific studies.

Fourth, implementation of both direct and indirect recreation management practices have tended to increase over time. For example, overnight permits for backcountry camping were required by 41% of areas in 1983, but were required by 68% of areas in 1993. Party size limits have been imposed in increasing numbers of areas, up from 43% in 1981 to 62% in 1993. Length-of-stay limits are also imposed in increasing numbers of areas, up from 16% in 1981 to 51% in 1993. Finally, minimum-impact education programs were employed in 77% of areas in 1993, up from 35% reported in 1981. Although some of these differences may be the result of differences among management agencies, the magnitude of the differences suggests a shift in management practices.

Fifth, day use is an emerging issue that warrants more management attention. The study in 1983 was one of the first to report that a very large percentage of all wilderness-related recreation use was accounted for by day users. The average percentage of all visitor groups that are day users ranged from 44% in Bureau of Land Management areas to 83% for Fish and Wildlife Service areas. In National Park Service areas, the percentage of day users has remained relatively constant over the past decade: 62% in 1983 and 64% in 1993. The issue of day use is exacerbated by two factors (Roggenbuck and others 1994). First, managers attribute many management problems to day users. In fact, in the judgment of managers, day users are more responsible than overnight visitors for most types of management problems. Second, day users often are not targeted for management actions. For example, only 8% of National Park Service areas require a permit for day use.

Finally, management of outdoor recreation is becoming more complex and more sophisticated. This trend is reflected in the nature of the four studies examined in this section. The original study in 1979 was primarily an exploratory study asking managers to describe their primary problems. The basic concept of wilderness areas emerged as a primary issue while managers struggled with the legal and operational definitions of wilderness and related areas. The second study, reported in 1981, focused primarily on recreation management practices across several land management agencies. The third study, in 1983, adopted several objectives, including determining recreation use patterns,

recreation-related problems and recreation management practices. The fourth and most recent study incorporated the preceding objectives and added others, including investigating the perceived causes of management problems, the effectiveness of management practices and the degree to which management actions are based on scientific study. The progression of these four studies illustrates that awareness and knowledge about recreation-related problems and management practices are expanding.

Studies on alternative park and wilderness recreation management practices are beginning to be marshaled into handbooks and other types of guidelines that can be used by managers. In addition to suggesting which recreation management practices might be applied to a series of recreation-related problems, a handbook on wilderness management developed by the U.S. Forest Service offers basic information on understanding and applying each of the 37 recreation management practices identified (Cole and others 1987). A similar handbook has been developed for use by managers of national parks and related areas (D. Anderson and others 1998). Prototypes of computer-based "expert systems" are also being developed to provide recreation managers with guidance based on the scientific literature (Flekké and others 1996).

However, research suggests that recreation management is influenced by managers and the agencies they represent, as well as the expertise available to them (Bullis and Tompkins 1989; Dennis and Magill 1991; Driver and Brown 1984; Holland and Beazley 1971; Kaufman 1960; Kennedy 1985, 1987a,b; Magill 1988; Twilight and Lyden 1988, 1989; Van Meter 1988). For example, a survey of recreation managers on several national forests in California found that most were educated in the natural resources fields of study that have traditionally emphasized commodity production rather than the social sciences (Dennis and Magill 1991). Moreover, most managers reported that their training in recreation management had occurred "on the job," suggesting that traditional professional orientations and management practices were being perpetuated. Finally, the administrative structure of the management agency was found to provide relatively few opportunities for professional advancement for managers educated in the social sciences. These findings suggest that many of the social science-based issues in wilderness recreation may be difficult to address under traditional administrative structures.

Finally, wilderness management can be influenced by personal philosophy as well. A study of wilderness managers in the Southwest found that the personal wilderness philosophy of managers influenced the types of wilderness management practices undertaken (Virden and Brooks 1991). For example, managers who favor a stronger biocentric orientation to wilderness may be more likely to adopt direct recreation management practices such as regulating visitor behavior. A study of wilderness visitors has found similar relationships between environmental values and philosophy and support for wilderness management practices (Valliere and Manning 1995, Manning and Valliere 1996). These findings suggest that managers and others concerned with recreation management and related matters should be encouraged to develop thoughtful professional philosophies through academic and professional education.

Directions for Wilderness Recreation Research and Management

The research reviewed and synthesized in this paper suggests several directions for future wilderness recreation research and management. These directions include the following:

1. Indicators and standards of quality provide a useful framework for formulating wilderness management objectives and defining the quality of wilderness recreation experiences. However, additional research is needed to help identify and define a broad range of indicators of the quality of wilderness recreation experiences. Most research to date has focused on crowding-related standards of quality, and this is in keeping with the emphasis on solitude defined by the Wilderness Act. However, research suggests that the quality of wilderness recreation experiences is multidimensional, and a broader array of potential indicators of quality should be defined.
2. Research on standards of quality has relied primarily on normative theory and techniques. Findings from such studies have provided a stronger empirical basis for defining the quality of wilderness recreation experiences and setting appropriate standards of quality. However, this research should be supplemented with other theoretical and empirical approaches. In particular, research is needed to address the inherent trade-offs between standards of quality and public desire for unimpeded access to wilderness areas.
3. Research and management attention is needed on monitoring indicators of quality. Monitoring of indicator variables is an inherent and important part of contemporary park and wilderness recreation management frameworks. Monitoring determines when and where management action is needed to maintain standards of quality. However, monitoring can be time-consuming and costly, and it can challenge the personnel and financial resources of wilderness management agencies. There is little guidance to be found in the wilderness management literature on cost-efficient and effective monitoring approaches and techniques.
4. More research should be conducted on the potential effectiveness of wilderness management practices. As described in this paper, a wide range of management practices is available to maintain standards of quality. However, most research has focused on the effectiveness of only two basic management approaches: information/education programs and use rationing/allocation. While these are important management approaches and deserve continued research attention, other management practices warrant additional attention, including rules and regulations, law enforcement, zoning and site design and management.
5. The literature reviewed in this paper suggests that wilderness recreation research and management are conducted largely in isolation from one another. It may be productive to link these activities more closely.

Wilderness managers are faced with a host of recreation-related issues and respond with a variety of management practices. Designing and conducting this management approach within a more deliberate research framework might enhance learning opportunities for both managers and researchers and ultimately lead to more informed wilderness management. This closer collaboration between managers and researchers would more fully meet the spirit of the contemporary concept of adaptive management.

6. The studies reviewed in this paper suggest that there is a relatively large and growing scientific literature on defining and managing wilderness recreation experiences. However, this literature is inherently diverse and spread over a wide academic and scholarly landscape. More effort needs to be devoted to organizing and synthesizing this literature. These efforts should be designed to guide future research and provide more informed guidance to wilderness managers.

References

- Absher, J. 1989. Applying the Limits of Acceptable Change model to National Park Service wilderness: An example from Cumberland Island National Seashore. Proceedings of the 1988 Southeastern Recreation Research Conference. Athens, GA: University of Georgia: 143-152.
- Adelman, B., Heberlein, T., and Bonnicksen, T. 1982. Social psychological explanations for the persistence of a conflict between paddling canoeists and motorcraft users in the Boundary Waters Canoe Area. *Leisure Sciences*. 5: 45-61.
- Alder, J. 1996. Effectiveness of education and enforcement, Cairns Section of the Great Barrier Reef Marine Park. *Environmental Management*. 20: 541-551.
- Alpert, L. and Herrington. 1998. An interactive information kiosk for the Adirondack Park visitor interpretive center, Newcomb, NY. Proceedings of the 1997 Northeastern Recreation Research Symposium. USDA Forest Service General Technical Report NE-241, 265-267.
- Anderson, D., and Manfredo, M. 1986. Visitor preferences for management actions. Proceedings—National Wilderness Research Conference: Current Research. USDA Forest Service General Technical Report INT-212, 314-319.
- Anderson, D., Lime, D., and Wang, T. 1998. Maintaining the Quality of Park Resources and Visitor Experiences: A Handbook for Managers. St. Paul, MN: University of Minnesota Cooperative Park Studies Unit.
- Anderson, F., and Bonsor, N. 1974. Allocation, congestion, and the valuation of recreational resources. *Land Economics*. 50: 51-57.
- Anderson, M., Reiling, S., and Criner, G. 1985. Consumer demand theory and wildlife agency revenue structure. *Wildlife Society Bulletin*. 13: 375-384.
- Ashor, J., McCool, S., and Stokes, G. 1986. Improving wilderness planning efforts: Application of the transactive planning approach. Proceedings—National Wilderness Research Conference: Current Research. USDA Forest Service General Technical Report INT-212, 424-431.
- Bamford, T., Manning, R., Forcier, L., and Koenemann, E. 1988. Differential campsite pricing: An experiment. *Journal of Leisure Research*. 20: 324-342.
- Basman, C., Manfredo, M., Barro, S., Vaske, J., and Watson, A. 1996. Norm accessibility: An exploratory study of backcountry and frontcountry recreational norms. *Leisure Sciences*. 18: 177-191.
- Becker, R. 1981. User reaction to wild and scenic river designation. *Water Resources Bulletin*. 17: 623-626.
- Becker, R., Berrier, D., and Barker, G. 1985. Entrance fees and visitation levels. *Journal of Park and Recreation Administration*. 3: 28-32.
- Behan, R. 1974. Police state wilderness: A comment on mandatory wilderness permits. *Journal of Forestry*. 72: 98-99.
- Behan, R. 1976. Rationing wilderness use: An example from Grand Canyon. *Western Wildlands*. 3: 23-26.
- Biddle, B. 1986. Recent developments in role theory. *Annual Review of Sociology*. 12: 67-92.
- Blahna, D., Smith, K., and Anderson, J. 1995. Backcountry llama packing: visitor perceptions of acceptability and conflict. *Leisure Sciences*. 17: 185-204.
- Blake, J., and Davis, K. 1964. Norms, values, and sanctions. *Handbook of Modern Sociology*. Chicago: Rand McNally.
- Boteler, F. 1984. Carrying capacity as a framework for managing whitewater use. *Journal of Park and Recreation Administration*. 2: 26-36.
- Bowker, J., and Leeworthy, V. 1998. Accounting for ethnicity in recreation demand: A flexible count data approach. *Journal of Leisure Research*. 30: 64-78.
- Bowman, E. 1971. The cop image. *Parks and Recreation*. 6: 35-36.
- Bright, A., Manfredo, M., Fishbein, M., and Bath, A. 1993. Application of the theory of learned action to the National Park Service's controlled burn policy. *Journal of Leisure Research*. 25: 263-280.
- Bright, A. 1994. Information campaigns that enlighten and influence the public. *Parks and Recreation*. 29: 49-54.
- Bright, A., and Manfredo, M. 1995. Moderating effects of personal importance on the accessibility of attitudes toward recreation participation. *Leisure Sciences*. 17: 281-294.
- Brown, C., Halstead, J., and Luloff, A. 1992. Information as a management tool: An evaluation of the Pemigewasset Wilderness Management Plan. *Environmental Management*. 16: 143-148.
- Brown, P., and Hunt, J. 1969. The influence of information signs on visitor distribution and use. *Journal of Leisure Research*. 1: 79-83.
- Brown, P. 1977. Information needs for river recreation planning and management. Proceedings: River Recreation Management and Research Symposium. USDA Forest Service General Technical Report NC-28, 193-201.
- Brown, P., Driver, B., and McConnell, C. 1978. The opportunity spectrum concept in outdoor recreation supply inventories: Background and application. Proceedings of the Integrated Renewable Resource Inventories Workshop. USDA Forest Service General Technical Report RM-55, 73-84.
- Brown, P., Driver, B., Burns, D., and McConnell, C. 1979. The outdoor recreation opportunity spectrum in wildland recreation planning: Development and application. First Annual National Conference on Recreation Planning and Development: Proceedings of the Specialty Conference Vol. 2), Washington, D.C.: Society of Civil Engineers: 1-12.
- Brown, P., McCool, S., and Manfredo, M. 1987. Evolving concepts and tools for recreation user management in wilderness. Proceedings—National Wilderness Research Conference: Issues, State-of-Knowledge, Future Directions. USDA Forest Service General Technical Report INT-220, 320-346.
- Brunson, M., Shelby, B., and Goodwin, J. 1992. Matching impacts with standards in the design of wilderness permit systems. Defining Wilderness Quality: The Role of Standards in Wilderness Management—A Workshop Proceedings. USDA Forest Service General Technical Report PNW-305, 101-106.
- Buist, L., and Hoots, T. 1982. Recreation opportunity spectrum approach to resource planning. *Journal of Forestry*. 80: 84-86.
- Bullis, C., and Tompkins, P. 1989. The forest ranger revisited: A study of control practices and identification. *Communication Monographs*. 56: 287-306.
- Burch, W., Jr. 1966. Wilderness—the life cycle and forest recreational choice. *Journal of Forestry*. 64: 606-610.
- Burde, J., Peine, J., Renfro, J., and Curran, K. 1988. Communicating with park visitors: Some successes and failures at Great Smoky Mountains National Park. National Association of Interpretation 1988 Research Monograph: 7-12.
- Burgess, R., Clark, R., and Hendee, J. 1971. An experimental analysis of anti-litter procedures. *Journal of Applied Behavior Analysis*. 4: 71-75.
- Bury, R. 1976. Recreation carrying capacity—Hypothesis or reality? *Parks and Recreation*. 11: 23-25, 56-58.

- Bury, R., and Fish, C. 1980. Controlling wilderness recreation: What managers think and do. *Journal of Soil and Water Conservation*. 35: 90-93.
- Cable, T., Knudson, D., Udd, E., and Stewart, D. 1987. Attitude changes as a result of exposure to interpretive messages. *Journal of Park and Recreation Administration*. 5: 47-60.
- Campbell, F., Hendee, J., and Clark, R. 1968. Law and order in public parks. *Parks and Recreation*. 3: 51-55.
- Cancian, F. 1975. What are Norms? A Study of Beliefs and Actions in a Maya Community. New York: Cambridge University Press.
- Chavez, D. 1996. Mountain biking: Direct, indirect, and bridge building management styles. *Journal of Park and Recreation Administration*. 14: 21-35.
- Cheek, N., Jr., and Burch, W. Jr. 1976. *The Social Organization of Leisure in Human Society*. New York: Harper and Row.
- Chilman, K., Ladley, J., and Wikle, T. 1989. Refining existing recreational carrying capacity systems: Emphasis on recreational quality. Proceedings of the 1988 Southeastern Recreation Research Conference. Athens, GA: University of Georgia: 118-123.
- Chilman, K., Foster, D., and Everson, A. 1990. Updating the recreational carrying capacity process: recent refinements. *Managing America's Enduring Wilderness Resource*. St. Paul, MN: University of Minnesota: 234-238.
- Christensen, H. 1981. Bystander Intervention and Litter Control: An Experimental Analysis of an Appeal to Help Program. USDA Forest Service Research Paper PNW-287.
- Christensen, H., and Clark, R. 1983. Increasing public involvement to reduce depreciative behavior in recreation settings. *Leisure Sciences*. 5: 359-378.
- Christensen, H. 1986. Vandalism and depreciative behavior. A Literature Review: The President's Commission on Americans Outdoors. Washington, DC: US Government Printing Office, M-73-M-87.
- Christensen, H., and Dustin, D. 1989. Reaching recreationists at different levels of moral development. *Journal of Park and Recreation Administration*. 7: 72-80.
- Christensen, H., Johnson, D., and Brookes, M. 1992. Vandalism: Research, Prevention, and Social Policy. USDA Forest Service General Technical Report PNW-293.
- Christensen, N., Stewart, W., and King, D. 1993. National Forest Campground: Users Willing to Pay More. *Journal of Forestry*. 91: 43-47.
- Clark, R., Hendee, J., and Campbell, F. 1971. Depreciative Behavior in Forest Campgrounds: An Exploratory Study. USDA Forest Service Research Paper PNW-161.
- Clark, R., Burgess, R., and Hendee, J. 1972a. The development of anti-litter behavior in a forest campground. *Journal of Applied Behavior Analysis*. 5: 1-5.
- Clark, R., Hendee, J., and Burgess, R. 1972b. The experimental control of littering. *Journal of Environmental Education*. 4: 22-28.
- Clark, R., and Stankey, G. 1979. *The Recreation Opportunity Spectrum: A Framework for Planning, Management, and Research*. USDA Forest Service Research Paper PNW-98.
- Cockrell, D and McLaughlin, W. 1982. Social influences on wild river recreationists. *Forest and River Recreation: Research Update*. St. Paul, MN: University of Minnesota Agricultural Experiment Station. Miscellaneous Publication. 18: 140-145.
- Cockrell, D., and Wellman, J. 1985a. Democracy and leisure: Reflections on pay-as-you-go outdoor recreation. *Journal of Park and Recreation Administration*. 3: 1-10.
- Cockrell, D., and Wellman, J. 1985b. Against the running tide: Democracy and outdoor recreation user fees. Proceedings of the 1985 National Outdoor Recreation Trends Symposium, Volume II. Atlanta, GA: U. S. National Park Service: 193-205.
- Cole, D., and Rang, B. 1983. Temporary campsite closure in the Selway-Bitterroot Wilderness. *Journal of Forestry*, 81, 729-732.
- Cole, D. 1987. Research on soil and vegetation in wilderness: A state-of-knowledge review. Proceedings—National Wilderness Research Conference: Issues, State-of-Knowledge, Future Directions. USDA Forest Service General Technical Report INT-220: 135-177.
- Cole, D., Peterson, M., and Lucas, R. 1987. Managing Wilderness Recreation Use. USDA Forest Service General Technical Report INT-230.
- Cole, D. 1993. Wilderness recreation management. *Journal of Forestry*. 91: 22-24.
- Cole, D. 1994. The Wilderness Threats Matrix: A Framework for Assessing Impacts. USDA Forest Service General Technical Report INT-475.
- Cole, D., Watson, A., and Roggenbuck, J. 1995. Trends in Wilderness Visitors and Visits: Boundary Waters Canoe Area, Shining Rock, and Desolation Wilderness. USDA Forest Service Research Paper INT-483.
- Cole, D. 1996. Wilderness Recreation Use Trends, 1965 Through 1994. USDA Forest Service Research Paper INT-488.
- Cole, D., Watson, A., Hall, T., and Spildie, D. 1997a. High-Use Destinations in Wilderness: Social and Bio-Physical Impacts, Visitor Responses, and Management Options. USDA Forest Service Research Paper INT-496.
- Cole, D., Hammond, T., and McCool, S. 1997b. Information quality and communication effectiveness: Low-impact messages on wilderness trailhead bulletin boards. *Leisure Sciences*. 19: 59-72.
- Connors, E. 1976. Public safety in park and recreation settings. *Parks and Recreation*. 11: 20-21, 55-56.
- Crompton, J. and Wicks, B. 1988. Implementing a preferred equity model for the delivery of leisure services in the U.S. context. *Leisure Studies*. 7: 287-304.
- Crompton, J., and Lue, C. 1992. Patterns of equity preferences among Californians for allocating park and recreation resources. *Leisure Sciences*. 14: 227-246.
- Daniels, S. 1987. Marginal cost pricing and the efficient provision of public recreation. *Journal of Leisure Research*. 19: 22-34.
- de Bettencourt, J., Peterson, G., and Wang, P. 1978. Managing wilderness travel: A markov-based linear programming model. *Environment and Planning*. 10: 71-79.
- Dennis, S., and Magill, A. 1991. Professional disposition of wildland-urban interface recreation managers in southern California: Policy implications for the USDA Forest Service. *Journal of Park and Recreation Administration*. 9: 31-41.
- Donnelly, M., Vaske, J., and Shelby, B. 1992. Measuring backcountry standards in visitor surveys. *Defining Wilderness Quality: The Role of Standards in Wilderness Management—A Workshop Proceedings*. USDA Forest Service General Technical Report PNW-305: 38-52.
- Doucette, J., and Kimball, K. 1990. Passive trail management in northeastern alpine zones: A case study. Proceedings of the 1990 Northeastern Recreation Research Symposium. USDA Forest Service General Technical Report NE-145: 195-201.
- Doucette, J., and Cole, D. 1993. Wilderness Visitor Education: Information About Alternative Techniques. USDA Forest Service General Technical Report INT-295.
- Dowell, D., and McCool, S. 1986. Evaluation of a wilderness information dissemination program. Proceedings—National Wilderness Research Conference: Current Research. USDA Forest Service General Technical Report INT-212: 494-500.
- Driver, B., and Toucher, R. 1970. Toward a behavioral interpretation of recreational engagements, with implications for planning. *Elements of Outdoor Recreation Planning*. Ann Arbor, MI: University of Microfilms: 9-31.
- Driver, B., and Brown, P. 1978. The opportunity spectrum concept in outdoor recreation supply inventories: A rationale. Proceedings of the Integrated Renewable Resource Inventories Workshop. USDA Forest Service General Technical Report RM-55: 24-31.
- Driver, B. 1984. Public responses to user fees at public recreation areas. Proceedings: Fees for Outdoor Recreation on Lands Open to the Public. Gorham, NH: Appalachian Mountain Club: 47-51.
- Driver, B., and Brown, P. 1984. Contributions of behavioral scientists to recreation resource management. *Behavior and the Natural Environment*. New York: Plenum Press: 307-339.
- Driver, B., Brown, P., Stankey, G., and Gregoire, T. 1987. The ROS planning system: Evolution, basic concepts, and research needed. *Leisure Sciences* 9: 201-212.
- Dustin, D., and McAvoy, L. 1980. "Hardening" national parks. *Environmental Ethics*. 2: 29-44.
- Dustin, D., and McAvoy, L. 1984. The limitation of the traffic light. *Journal of Park and Recreation Administration*. 2: 8-32.
- Dustin, D. 1986. Outdoor recreation: A question of equity. *Forum for Applied Research and Public Policy*. 1: 62-67.

- Dustin, D., McAvoy, L., and Beck, L. 1986. Promoting recreationist self-sufficiency. *Journal of Park and Recreation Administration*. 4: 43-52.
- Dustin, D., McAvoy, L., and Schultz, J. 1987. Beware of the merchant mentality. *Trends*. 24: 44-46.
- Dustin, D., and Knopf, R. 1989. Equity issues in outdoor recreation. *Outdoor Recreation Benchmark 1988: Proceedings of the National Outdoor Recreation Forum*. USDA Forest Service General Technical Report SE-52: 467-471.
- Dwyer, W., Huffman, M., and Jarratt, L. 1989. A comparison of strategies for gaining compliance with campground regulations. *Journal of Park and Recreation Administration*. 7: 21-30.
- Echelberger, H., Leonard, R., and Hamblin, M. 1978. The Trail Guide System as a Backcountry Management Tool. USDA Forest Service Research Note NE-266.
- Echelberger, H., Leonard, R., and Adler, S. 1983. Designated-dispersed tentsites. *Journal of Forestry*. 81: 90-91, 105.
- Emmett, J., Havitz, M., and McCarville, R. 1996. A price subsidy policy for socio-economically disadvantaged recreation participants. *Journal of Park and Recreation Administration*. 14: 63-80.
- Environment Canada and Park Service. 1991. *Selected Readings on the Visitor Activity Management Process*. Ottawa, Ontario: Environment Canada.
- Ewert, A., and Hood, D. 1995. Urban-proximate and urban-distant wilderness: An exploratory comparison between two "types" of wilderness. *Journal of Park and Recreation Administration*. 13: 73-85.
- Ewert, A. 1998. A comparison of urban-proximate and urban-distant wilderness users on selected variables. *Environmental Management*. 22: 927-935.
- Fazio, J., and Gilbert, D. 1974. Mandatory wilderness permits: Some indications of success. *Journal of Forestry*. 72: 753-756.
- Fazio, J. 1979a. *Communicating with the wilderness user*. Wildlife and Range Science Bulletin Number 28, Moscow, ID: University of Idaho College of Forestry.
- Fazio, J. 1979b. Agency literature as an aid to wilderness management. *Journal of Forestry*. 77: 97-98.
- Fazio, J., and Ratcliffe, R. 1989. Direct-mail literature as a method to reduce problems of wild river management. *Journal of Park and Recreation Administration*. 7: 1-9.
- Fedler, A., and Miles, A. 1989. Paying for backcountry recreation: Understanding the acceptability of use fees. *Journal of Park and Recreation Administration*. 7: 35-46.
- Feldman, R. 1978. Effectiveness of audio-visual media for interpretation to recreating motorists. *Journal of Interpretation*. 3: 14-19.
- Fish, C., and Bury, R. 1981. Wilderness visitor management: Diversity and agency policies. *Journal of Forestry*. 79: 608-612.
- Flekk, G., McAvoy, L., and Anderson, D. 1996. The potential of an expert system to address congestion and crowding in the national park system. *Crowding and Congestion in the National Park System: Guidelines for Research and Management*. St. Paul, MN: University of Minnesota Agricultural Experiment Station Publication: 86-1996, 132-141.
- Fractor, D. 1982. Evaluating alternative methods for rationing wilderness use. *Journal of Leisure Research*. 14: 341-349.
- Frissell, S., and Duncan, D. 1965. Campsite preference and deterioration. *Journal of Forestry*. 63: 256-260.
- Frissell, S., and Stankey, G. 1972. Wilderness environmental quality: Search for social and ecological harmony. *Proceedings of the Society of American Foresters Annual Conference*, Hot Springs, AR: Society of American Foresters: 170-183.
- Frost, J., and McCool, S. 1988. Can visitor regulation enhance recreational experiences? *Environmental Management*. 12: 5-9.
- Gibbs, K. 1977. Economics and administrative regulations of outdoor recreation use. *Outdoor Recreation: Advances in Application of Economics*. USDA Forest Service General Technical Report 100-2: 98-104.
- Gilbert, G., Peterson, G., and Lime, D. 1972. Towards a model of travel behavior in the Boundary Waters Canoe Area. *Environment and Behavior*. 4: 131-157.
- Gilligan, C. 1982. *In a Different Voice*. Cambridge, MA: Harvard University Press.
- Glass, R., Walton, G., and Echelberger, H. 1991. Estimates of recreation use in the White River drainage, Vermont. USDA Forest Service Research Paper NE-658.
- Glass, R., and More, T. 1992. Satisfaction, Valuation, and Views Toward Allocation of Vermont Goose Hunting Opportunities. USDA Forest Service Research Paper NE-668.
- Glass, R., and Walton, G. 1995. Recreation Use of Upper Pemigewasset and Swift River Drainages, New Hampshire. USDA Forest Service Research Note NE-701.
- Godin, V., and Leonard, R. 1976. Guidelines for managing backcountry travel and usage. *Trends*. 13: 33-37.
- Godin, V., and Leonard, R. 1977. Permit Compliance in Eastern Wilderness: Preliminary Results. USDA Forest Service Research Note NE-238.
- Godin, V., and Leonard, R. 1979. Management problems in designated wilderness areas. *Journal of Soil and Water Conservation*. 34: 141-143.
- Graefe, A., Vaske, J., and Kuss, F. 1984. Resolved issues and remaining questions about social carrying capacity. *Leisure Sciences*. 6: 497-507.
- Graefe, A., Kuss, F., and Loomis, L. 1986. Visitor Impact Management in wildland settings. *Proceedings—National Wilderness Research Conference: Current Research*. USDA Forest Service General Technical Report INT-212: 432-439.
- Graefe, A., Kuss, F., and Vaske, J. 1990. *Visitor Impact Management: The Planning Framework*. Washington, D.C.: National Parks and Conservation Association.
- Gramann, J., and Vander Stoep, G. 1987. Prosocial behavior theory and natural resource protection: A conceptual synthesis. *Journal of Environmental Management*. 24: 247-257.
- Gramann, J., Floyd, M., and Saenz, R. 1993. Outdoor recreation and Mexican American ethnicity: A benefits perspective. A. Ewert, D. Chavez, and A. Magill Eds. *Culture, Conflict, and Communication in the Wildland-Urban Interface*. Boulder, CO: Westview Press: 69-84.
- Greist, D. 1975. Risk zone management: A recreation area management system and method of measuring carrying capacity. *Journal of Forestry*. 73: 711-714.
- Haas, G., Driver, B., and Brown, P. 1980. Measuring wilderness recreation experiences. *Proceedings of the Wilderness Psychology Group*. Durham, New Hampshire: Wilderness Psychology Group: 20-40.
- Haas, G., Driver, B., Brown, P., and Lucas, R. 1987. Wilderness management zoning. *Journal of Forestry*. 85: 17-22.
- Hadley, L. 1971. Perspectives on law enforcement in recreation areas. *Recreation Symposium Proceedings*. Upper Darby, PA: USDA Forest Service Northeastern Forest Experiment Station: 156-160.
- Hall, T., and Shelby, B. 1996. Who cares about encounters? Differences between those with and without norms. *Leisure Sciences*. 18: 7-22.
- Hall, T., Shelby, B., and Rolloff, D. 1996. Effect of varied question format on boaters' norms. *Leisure Sciences*. 18: 193-204.
- Hammit, W., and Patterson, M. 1991. Coping behavior to avoid visual encounters: Its relationship to wildland privacy. *Journal of Leisure Research*. 23: 225-237.
- Hammit, W., and Rutlin, W. 1995. Use encounter standards and curves for achieved privacy in wilderness. *Leisure Sciences*. 17: 245-262.
- Hammit, W., and Cole, D. 1998. *Wildland Recreation: Ecology and Management*. New York: John Wiley.
- Harmon, L. 1979. How to make park law enforcement work for you. *Parks and Recreation*. 14: 20-21.
- Harmon, D. 1992. Using an interactive computer program to communicate with the wilderness visitor. *Proceedings of the Symposium on Social Aspects and Recreation Research*. USDA Forest Service General Technical Report PSW-132: 60 p.
- Harris, C., and Driver, B. 1987. Recreation user fees: Pros and cons. *Journal of Forestry*. 85: 25-29.
- Harwell, R. 1987. A "no-rescue" wilderness experience: What are the implications? *Parks and Recreation*. 22: 34-37.
- Heberlein, T. 1977. Density, crowding, and satisfaction: Sociological studies for determining carrying capacities. *Proceedings: River Recreation Management and Research Symposium*. USDA Forest Service General Technical Report NC-28: 67-76.
- Heberlein, T., Alfano, G., and Ervin, L. 1986. Using a social carrying capacity model to estimate the effects of marina development at the Apostle Island National Lakeshore. *Leisure Sciences*. 8: 257-274.

- Heinrichs, J. 1982. Cops in the woods. *Journal of Forestry*. 11: 722-725, 748.
- Hendee, J., and Lucas, R. 1973. Mandatory wilderness permits: A necessary management tool. *Journal of Forestry*. 71: 206-209.
- Hendee, J. 1974. A multiple-satisfaction approach to game management. *Wildlife Society Bulletin*. 2: 104-113.
- Hendee, J., and Lucas, R. 1974. Police state wilderness: A comment on a comment. *Journal of Forestry*. 72: 100-101.
- Hendee, J., Hogans, M., and Koch, R. 1976. Dispersed Recreation on Three Forest Road Systems in Washington and Oregon: First Year Data. USDA Forest Service Research Note PNW-280.
- Hendee, J., Stankey, G., and Lucas, R. 1990. *Wilderness Management*. Golden, CO: North American Press.
- Hendricks, B., Ruddell, E., and Bullis, C. 1993. Direct and indirect park and recreation resource management decision making: A conceptual approach. *Journal of Park and Recreation Administration*. 11: 28-39.
- Heywood, J. 1985. Large recreation group and party size limits. *Journal of Park and Recreation Administration*. 3: 36-44.
- Heywood, J. 1993a. Behavioral conventions in higher density, day use wildland/urban recreation settings: A preliminary case study. *Journal of Leisure Research*. 25: 39-52.
- Heywood, J. 1993b. Game theory; A basis for analyzing emerging norms and conventions in outdoor recreation. *Leisure Sciences*. 15: 37-48.
- Heywood, J., and Engelke, R. 1995. Differences in behavioral convention: A comparison of United States-born and Mexican-born Hispanics, and Anglo-Americans. *Proceedings of the Second Symposium on Social Aspects and Recreation Research*. USDA Forest Service General Technical Report PSW-156: 35-40.
- Heywood, J. 1996a. Social regularities in outdoor recreation. *Leisure Sciences*. 18: 23-37.
- Heywood, J. 1996b. Conventions, emerging norms, and norms in outdoor recreation. *Leisure Sciences*. 18: 355-363.
- Hof, M., Hammitt, J., Rees, M., Belnap, J., Poe, N., Lime, D., and Manning, R. 1994. Getting a handle on visitor carrying capacity—A pilot project at Arches National Park. *Park Science*. 14: 11-13.
- Hof, M., and Lime, D. 1997. Visitor experience and resource protection framework in the national park system: Rationale, current status, and future direction. *Proceedings—Limits of Acceptable Change and Related Planning Processes: Progress and Future Directions*. USDA Forest Service General Technical Report INT-371: 29-36.
- Holland, I., and Beazley, R. 1971. Personality, motivation, and education needed in professional forestry. *Journal of Forestry*. 69: 418-423.
- Hollenhorst, S., and Stull-Gardner, L. 1992. The indicator performance estimate (IPE) approach to defining acceptable conditions in wilderness. *Proceedings of the Symposium on Social Aspects and Recreation Research*. USDA Forest Service General Technical Report PSW-132: 48-49.
- Hollenhorst, S., Olson, D., and Fortney, R. 1992. Use of importance-performance analysis to evaluate state park cabins: The case of the West Virginia State Park system. *Journal of Park and Recreation Administration*. 10: 1-11.
- Hollenhorst, S., and Gardner, L. 1994. The indicator performance estimate approach to determining acceptable wilderness conditions. *Environmental Management*. 18: 901-906.
- Homans, G. 1950. *The Human Group*. New York: Harcourt, Brace.
- Hope, J. 1971. Hassles in the park. *Natural History*, LXXX: 20-23, 82-91.
- Horsley, A. 1988. The unintended effects of a posted sign on littering attitudes and stated intentions. *Journal of Environmental Education*. 19: 10-14.
- Huffman, M., and Williams, D. 1986. Computer versus brochure information dissemination as a backcountry management tool. *Proceedings—National Wilderness Research Conference: Current Research*. USDA Forest Service General Technical Report INT-212: 501-508.
- Huffman, M., and Williams, D. 1987. The use of microcomputers for park trail information dissemination. *Journal of Park and Recreation Administration*. 5: 35-46.
- Hulbert, J., and Higgins, J. 1977. BWCA visitor distribution system. *Journal of Forestry*. 75: 338-340.
- Hultsman, W. 1988. Applications of a touch-sensitive computer in park settings: Activity alternatives and visitor information. *Journal of Park and Recreation Administration*. 6: 1-11.
- Hultsman, W., and Hultsman, J. 1989. Attitudes and behaviors regarding visitor-control measures in fragile environments: Implications for recreation management. *Journal of Park and Recreation Administration*. 7: 60-69.
- Jackson, J. 1965. *Structural characteristics of norms*. Current Studies in Social Psychology. New York, NY: Holt, Rinehart and Winston, Inc.: 301-309.
- Jacobi, C., Manning, R., Valliere, W., and Negra, C. 1996. Visitor use and conflict on the carriage roads of Acadia National Park. *Proceedings of the 1995 Northeastern Recreation Research Symposium*. USDA Forest Service General Technical Report NE-218: 109-112.
- James, G., and Schreuder, H. 1971. Estimating recreation use in the San Geronio Wilderness. *Journal of Forestry*. 69: 490-493.
- James, G. and Schreuder, H. 1972. Estimating Dispersed Recreation Use Along Trails and in General Undeveloped Areas with Electric-Eye Counters: Some Preliminary Findings. USDA Forest Service Research Note SE-181.
- Johnson, D., and Vande Kamp, M. 1996. Extent and control of resource damage due to noncompliant visitor behavior: A case study from the U. S. National Parks. *Natural Areas Journal*. 16: 134-141.
- Jones, P. and McAvoy, L. 1988. An evaluation of a wilderness user education program: A cognitive and behavioral analysis. *Natural Association of Interpretation 1988 Research Monograph*: 13-20.
- Kaltenborn, B., and Emmelin, L. 1993. Tourism in the high north: Management challenges and recreation opportunity spectrum planning in Svalbard, Norway. *Environmental Management*. 17: 41-50.
- Kaufman, H. 1960. *The Forest Ranger: A Study in Administrative Behavior*. Baltimore: Johns Hopkins University Press.
- Kennedy, J. 1985. Conceiving forest management or providing for current and future social value. *Forest Ecology and Management*. 13: 121-132.
- Kennedy, J. 1987a. Early career development of foresters, range conservationists, and wildlife/fisheries biologists in two western Forest Service regions. *Western Journal of Applied Forestry*. 2: 10-14.
- Kennedy, J. 1987b. Career development of range conservationists in their first three years with the Forest Service. *Journal of Range Management*. 40: 249-253.
- Kernan, A., and Drogin, E. 1995. The effect of a verbal interpretive message on day user impacts at Mount Rainier National Park. *Proceedings of the 1994 Northeastern Recreation Research Symposium*. USDA Forest Service General Technical Report NE-198: 127-129.
- Kerr, G., and Manfredo, M. 1991. An attitudinal-based model of pricing for recreation services. *Journal of Leisure Research*. 23: 37-50.
- Kim, S., and Shelby, B. 1998. Norms for behavior and conditions in two national park campgrounds in Korea. *Environmental Management*. 22: 277-285.
- Kohlberg, L. 1976. *Moral stages and moral development. Moral Development and Behavior: Theory, Research and Social Issues*. New York: Holt, Rinehart and Winston.
- Krumpe, E., and Brown, P. 1982. Using information to disperse wilderness hikers. *Journal of Forestry*. 80: 360-362.
- Kuss, F., Graefe, A., and Vaske, J. 1990. *Visitor Impact Management: A Review of Research*. Washington, DC: National Parks and Conservation Association.
- LaPage, W. 1973. *Growth Potential of the Family Camping Market*. USDA Forest Service Research Paper NE-252.
- LaPage, W., and Ragain, D. 1974. Family camping trends—An eight-year panel study. *Journal of Leisure Research*. 6: 101-112.
- LaPage, W., Cormier, P., Hamilton, G., and Cormier, A. 1975. *Differential Campsite Pricing and Campground Attendance*. USDA Forest Service Research Paper NE-330.
- Leatherberry, E., and Lime, D. 1981. Unstaffed Trail Registration Compliance in a Backcountry Recreation Area. USDA Forest Service Research Paper NC-214.

- Lee, R. 1972. The social definition of outdoor recreation places. *Social Behavior, Natural Resources, and the Environment*. New York: Harper and Row: 68-84.
- Leonard, R., Echelberger, H., and Schnitzer, M. 1978. Use Characteristics of the Great Gulf Wilderness. USDA Forest Service Research Paper NE-428.
- Leopold, L., Clarke, F., Hanshaw, B., and Balsley, J. 1971. A Procedure for Evaluating Environmental Impact. Geological Survey Circular 645. Washington, DC: U.S. Geological Survey.
- Leuschner, W., Cook, P., Roggenbuck, J., and Oderwald, R. 1987. A comparative analysis for wilderness user fee policy. *Journal of Leisure Research*. 19: 101-114.
- Lewis, M., Lime, D., and Anderson, P. 1996a. Use of visitor encounter norms in natural area management. *Natural Areas Journal*. 16: 128-133.
- Lewis, M., Lime, D., and Anderson, P. 1996b. Paddle canoeists encounter norms in Minnesota's Boundary Waters Canoe Area wilderness. *Leisure Sciences*. 18: 143-160.
- Lime, D., and Stankey, G. 1971. Carrying capacity: Maintaining outdoor recreation quality. *Recreation Symposium Proceedings*. USDA Forest Service: 174-184.
- Lime, D., and Lorence, G. 1974. Improving Estimates of Wilderness Use from Mandatory Travel Permits. USDA Forest Service Research Paper NC-101.
- Lime, D. 1977a. Principles of recreation carrying capacity. *Proceedings of the Southern States Recreation Research Applications Workshop*. Asheville, NC: 122-134.
- Lime, D. 1977b. When the wilderness gets crowded...? *Naturalist*. 28: 1-7.
- Lime, D. 1977c. Alternative strategies for visitor management of western whitewater river recreation. *Managing Colorado River Whitewater: The Carrying Capacity Strategy*. Logan, UT: Utah State University: 146-155.
- Lime, D., and Lucas, R. 1977. Good information improves the wilderness experience. *Naturalist*. 28: 18-20.
- Lime, D. 1979. Carrying capacity. *Trends*. 16: 37-40.
- Lime, D. 1995. Principles of carrying capacity for parks and outdoor recreation areas. *Acta Environmentalica Universitatis Comenianae*. 4: 21-29.
- Lucas, R. 1964. The Recreational Capacity of the Quetico-Superior Area. USDA Forest Service Research Paper LS-15.
- Lucas, R., Schreuder, H., and James, G. 1971. Wilderness Use Estimation: A Pilot Test of Sampling Procedures on the Mission Mountains Primitive Area. USDA Forest Service Research Paper INT-109.
- Lucas, R., and Stankey, G. 1974. Social carrying capacity for backcountry recreation. *Outdoor Recreation Research: Applying the Results*. USDA Forest Service General Technical Report NC-9: 14-23.
- Lucas, R. 1975. Low Compliance Rates at Unmanned Trail Registers. USDA Forest Service General Technical Report INT-200.
- Lucas, R. 1980. Use Patterns and Visitor Characteristics, Attitudes, and Preferences in Nine Wilderness and Other Roadless Areas. USDA Forest Service Research Paper INT-253.
- Lucas, R. 1981. Redistributing Wilderness Use Through Information Supplied to Visitors. USDA Forest Service Research Paper INT-277.
- Lucas, R., and Kovalicky, T. 1981. Self-issued Wilderness Permits as a Use Measurement System. USDA Forest Service Research Paper INT-270.
- Lucas, R. 1982. Recreation regulations—When are they needed? *Journal of Forestry*. 80: 148-151.
- Lucas, R. 1983. The role of regulations in recreation management. *Western Wildlands*. 9: 6-10.
- Lucas, R. 1985. Recreation trends and management of the Bob Marshall Wilderness Complex. *Proceedings of the 1985 National Outdoor Recreation Trends Symposium, Volume II*. Atlanta, GA: U.S. National Park Service: 309-316.
- Lundgren, A. Ed. 1996. *Recreation Fees in the National Park Service—Issues, Policies and Guidelines for Future Action*. St. Paul, MN: University of Minnesota Cooperative Park Studies Unit.
- Magill, A. 1976. Campsite Reservation Systems: The Campers' Viewpoint. USDA Forest Service Research Paper PSW-121.
- Magill, A. 1988. Natural resource professionals: The reluctant public servants. *The Environmental Professional*. 10: 295-303.
- Manfredo, M. 1989. An investigation of the basis for external information search in recreation and tourism. *Leisure Sciences*. 11: 29-45.
- Manfredo, M. & Bright, A. 1991. A model for assessing the effects of communication on recreationists. *Journal of Leisure Research*. 23: 1-20.
- Manfredo, J. Ed. 1992. *Influencing Human Behavior: Theory and Applications in Recreation, Tourism, and Natural Resources Management*. Champaign, IL: Sagamore Publishing, Inc.
- Manfredo, M., Yuan, S., and McGuire, F. 1992. The influence of attitude accessibility on attitude-behavior relationships: implications for recreation research. *Journal of Leisure Research*. 24: 157-170.
- Manning, R. 1979. Strategies for managing recreational use of national parks. *Parks*. 4: 13-15.
- Manning, R., and Ciali, C. 1979. The computer hikes the Appalachian trail. *Appalachia*, XL III: 75-85.
- Manning, R., and Moncrief, L. 1979. Land use analysis through matrix modeling: Theory and application. *Journal of Environmental Management*. 9: 33-40.
- Manning, R., and Cormier, P. 1980. Trends in the temporal distribution of park use. *Proceedings of the 1980 Outdoor Recreation Trends Symposium, Volume II*. USDA Forest Service General Technical Report NE-57: 81-87.
- Manning, R. and Baker, S. 1981. Discrimination through user fees: Fact or fiction? *Parks and Recreation*. 16: 70-74.
- Manning, R., and Potter, F. 1982. Wilderness encounters of the third kind. *Proceedings of the Third Annual Conference of the Wilderness Psychology Group*. Morgantown, WV: West Virginia University: 1-14.
- Manning, R., and Potter, F. 1984. Computer simulation as a tool in teaching park and wilderness management. *Journal of Environmental Education*. 15: 3-9.
- Manning, R., Powers, L., and Mock, C. 1982. Temporal distribution of forest recreation: Problems and potential. *Forest and River Recreation: Research Update*. St. Paul, MN: University of Minnesota Agricultural Experiment Station Miscellaneous Publication 18: 26-32.
- Manning, R., Callinan, E., Echelberger, H., Koenemann, E., and McEwen, D. 1984. Differential fees: Raising revenue, distributing demand. *Journal of Park and Recreation Administration*. 2: 20-38.
- Manning, R., and Powers, L. 1984. Peak and off-peak use: Redistributing the outdoor recreation/tourism load. *Journal of Travel Research*. 23: 25-31.
- Manning, R. 1985. Crowding norms in backcountry settings: A review and synthesis. *Journal of Leisure Research*. 17: 75-89.
- Manning, R., and Koeneman, E. 1986. *Differential campsite pricing: An experiment*. Campgrounds: New perspectives on Management. Carbondale, IL: Southern Illinois University: 39-48.
- Manning, R. 1987. *The Law of Nature: Park Rangers in Yosemite Valley*. Brookline, MA: Umbrella Films.
- Manning, R., and Zwick, R. 1990. The relationship between quality of outdoor recreation opportunities and support for recreation funding. *Proceedings of the 199 Northeastern Recreation Research Symposium*. USDA Forest Service General Technical Report NE-145: 13-18.
- Manning, R., Lime, D., Hof, M., and Freimund, W. 1995a. The visitor experience and resource protection process: The application of carrying capacity to Arches National Park. *The George Wright Forum*. 12: 41-55.
- Manning, R., Lime, D., and McMonagle, R. 1995b. Indicators and standards of the quality of the visitor experience at a heavily-used national park. *Proceedings of the 1994 Northeastern Recreation Research Symposium*. USDA Forest Service General Technical Report NE 198: 24-32.
- Manning, R., Lime, D., Hof, M., and Freimund, W. 1995c. The carrying capacity of national parks: Theory and application. *Proceedings of the Conference on Innovations and Challenges in the Management of Visitor Opportunities in Parks and Protected Areas*. Waterloo, Canada: University of Waterloo: 9-21.
- Manning, R., Ballinger, N., Marion, J., and Roggenbuck, J. 1996a. Recreation management in natural areas: Problems and practices, status and trends. *Natural Areas Journal*. 16: 142-146.

- Manning, R., Lime, D., and Hof, M. 1996b. Social carrying capacity of natural areas: theory and application in the U. S. National Parks. *Natural Areas Journal*. 16: 118-127.
- Manning, R., Lime, D., Freimund, W., and Pitt, D. 1996c. Crowding norms at frontcountry sites: A visual approach to setting standards of quality. *Leisure Sciences*. 18: 39-59.
- Manning, R., Johnson, D., and VandeKamp, M. 1996d. Norm congruence among tour boat passengers to Glacier Bay National Park. *Leisure Sciences*. 18: 125-141.
- Manning, R., Graefe, A., and McCool, S. 1996e. Trends in carrying capacity planning and management. Proceedings of the Fourth International Outdoor Recreation and Tourism Trends Symposium. St. Paul, MN: University of Minnesota: 334-341.
- Manning, R., LaPage, W., Griffall, K., and Simon, B. 1996f. Suggested principles for designing and implementing user fees and charges in the National Park System. *Recreation Fees in the National Park System*. St. Paul, MN: University of Minnesota Cooperative Park Studies Unit: 134-136.
- Manning, R., and Lime, D. 1996. Crowding and carrying capacity in the national park system: Toward a social science research agenda. *Crowding and Congestion in the National Park System: Guidelines for Management and Research*. St. Paul, MN: University of Minnesota Agricultural Experiment Station Publication. 86: 27-65.
- Manning, R., and Valliere, W. 1996. Environmental values, environmental ethics, and wilderness management: An empirical study. *International Journal of Wilderness*. 2: 27-32.
- Manning, R. 1997. Social carrying capacity of parks and outdoor recreation areas. *Parks and Recreation*. 32: 32-38.
- Manning, R., Valliere, W., and Jacobi, C. 1997. Crowding norms for the carriage roads of Acadia National Park: Alternative measurement approaches. Proceedings of the 1996 Northeastern Recreation Research Symposium. USDA Forest Service General Technical Report NE-232: 139-145.
- Manning, R., Jacobi, C., Valliere, W., and Wang, B. 1998. Standards of quality in parks and recreation. *Parks and Recreation*. 33: 88-94.
- Manning, R., Valliere, W., Wang, B., and Jacobi, C. 1999. Crowding norms: Alternative measurement approaches. *Leisure Sciences*. 21: 97-115.
- Marion, J., Roggenbuck, J., and Manning, R. 1993. Problems and Practices in Backcountry Recreation Management: A Survey of National Park Service Managers. US National Park Service Natural Resources Report NPS/NRVT/NRR-93112, Denver, CO.
- Marler, L. 1971. A study of anti-letter messages. *Journal of Environmental Education*. 3: 52-53.
- Martin, B. 1986. Hiker's opinions about fees for backcountry recreation. Proceedings—National Wilderness Research Conference: Current Research. USDA Forest Service General Technical Report INT-212: 483-488.
- Martin, S., McCool, S., and Lucas, R. 1989. Wilderness campsite impacts: Do managers and visitors see them the same? *Environmental Management*. 13: 623-629.
- Martinson, K., and Shelby, B. 1992. Encounter and proximity norms for salmon anglers in California and New Zealand. *North American Journal of Fisheries Management*. 12: 559-567.
- McAvoy, L., and Dustin, D. 1981. The right to risk in wilderness. *Journal of Forestry*. 79: 150-152.
- McAvoy, L., and Dustin, D. 1983. Indirect versus direct regulation of recreation behavior. *Journal of Park and Recreation Administration*. 1: 12-17.
- McAvoy, L., and Dustin, D. 1983. In search of balance: A no-rescue wilderness proposal. *Western Wildlands*. 9: 2-5.
- McAvoy, L., Dustin, D., Rankin, J., and Frakt, A. 1985. Wilderness and legal-liability: Guidelines for resource managers and program leaders. *Journal of Park and Recreation Administration*. 3: 41-49.
- McAvoy, L. 1990. Rescue-free wilderness areas. *Adventure Education*. State College, PA: Venture Publishing: 329-334.
- McCarville, R., Reiling, S., and White, C. 1986. The role of fairness in users' assessments of first-time fees for a public recreation service. *Leisure Sciences*. 18: 61-76.
- McCarville, R., and Crompton, J. 1987. Propositions addressing perception of reference price for public recreation services. *Leisure Sciences*. 9: 281-291.
- McCarville, R. 1996. The importance of price last paid in developing price expectations for a public leisure service. *Journal of Park and Recreation Administration*. 14: 52-64.
- McCool, S., Lime, D., and Anderson, D. 1977. Simulation modeling as a tool for managing river recreation. Proceedings: River Recreation Management and Research Symposium. USDA Forest Service General Technical Report NC-28: 304-311.
- McCool, S., and Utter, J. 1981. Preferences for allocating river recreation use. *Water Resources Bulletin*. 17: 431-437.
- McCool, S., and Utter, J. 1982. Recreation use lotteries: Outcomes and preferences. *Journal of Forestry*. 80: 10-11, 29.
- McCool, S., and Lime, D. 1989. Attitudes of visitors toward outdoor recreation management policy. *Outdoor Recreation Benchmark 1988: Proceedings of the National Outdoor Recreation Forum*. USDA Forest Service General Technical Report SE-52: 401-411.
- McCool, S., and Christensen, N. 1996. Alleviating congestion in parks and recreation areas through direct management of visitor behavior. *Crowding and Congestion in the National Park System: Guidelines for Management and Research*. St. Paul, MN: University of Minnesota Agriculture Experiment Station Publication 86-1996: 67-83.
- McCool, S., and Cole, D. 1997a. Proceedings—Limits of Acceptable Changes and Related Planning Processes: Progress and Future Direction. USDA Forest Service General Technical Report INT-371.
- McCool, S., and Cole, D. 1997b. Annotated bibliography of publications for LAC applications. Proceedings—Limits of Acceptable Change and Related Planning Processes: Progress and Future Directions. USDA Forest Service General Technical Report INT-371: 81-84.
- McCoy, K., Krumpke, E., Allen, S. 1995. Limits of acceptable change: Evaluating implementation by the U.S. Forest Service. *International Journal of Wilderness*. 1: 18-22.
- McDonald, C., Noe, F., and Hammitt, W. 1987. Expectations and recreation fees: A dilemma for recreation resource administrators. *Journal of Park and Recreation Administration*. 5: 1-9.
- McDonald, C. 1996. Normative perspectives on outdoor recreation behavior: Introductory comments. *Leisure Sciences*. 18: 1-6.
- McEwen, D., and Tocher, S. 1976. Zone management: Key to controlling recreational impact in developed campsites. *Journal of Forestry*. 74: 90-91.
- McLean, D., and Johnson, R. 1997. Techniques for rationing public recreation services. *Journal of Park and Recreation Administration*. 15: 76-92.
- Mengak, K., Dottavio, F., and O'Leary, J. 1986. The use of importance-performance analysis to evaluate a visitor center. *Journal of Interpretation*. 11: 1-13.
- Merigliano, L. 1990. Indicators to monitor the wilderness recreation experience. *Managing America's Enduring Wilderness Resource*. St. Paul, MN: University of Minnesota: 156-162.
- Morehead, J. 1979. The ranger image. *Trends*. 16: 5-8.
- Muth, R., and Clark, R. 1978. Public Participation in Wilderness and Backcountry Litter Control: A Review of Research and Management Experience. USDA Forest Service General Technical Report PNW-75.
- National Park Service. 1997. VERP: The Visitor Experience and Resource Protection (VERP) Framework: A Handbook for Planners and Managers. Denver, CO: Denver Service Center.
- Nielson, C., and Buchanan, T. 1986. A comparison of the effectiveness of two interpretive programs regarding fire ecology and fire management. *Journal of Interpretation*. 1: 1-10.
- Noe, F. 1992. Further questions about the management and conceptualization of backcountry encounter norms. *Journal of Leisure Research*. 24: 86-92.
- Oliver, S., Roggenbuck, J., and Watson, A. 1985. Education to reduce impacts in forest campgrounds. *Journal of Forestry*. 83: 234-236.
- Olson, E., Bowman, M., and Roth, R. 1984. Interpretation and nonformal education in natural resources management. *Journal of Environmental Education*. 15: 6-10.
- Ormrod, R., and Trahan, R. 1977. Can signs help visitors control their own behavior? *Trends*. 10: 25-27.
- Parsons, D., Stohlgren, T., and Fodor, P. 1981. Establishing backcountry use quotas: The example from Mineral King, California. *Environmental Management*. 5: 335-340.

- Parsons, D., Stohlgren, T., and Kraushaar, J. 1982. Wilderness permit accuracy: Differences between reported and actual use. *Environmental Management*. 6: 329-335.
- Patterson, M. and Hammitt, W. 1990. Backcountry encounter norms, actual reported encounters, and their relationship to wilderness solitude. *Journal of Leisure Research*. 22: 259-275.
- Perry, M. 1983. Controlling crime in the parks. *Parks and Recreation*. 18: 49-51, 67.
- Peterson, D. 1987. Look ma, no hands! Here's what's wrong with no-rescue wilderness. *Parks and Recreation*. 22: 39-43, 54.
- Peterson, G., de Bettencourt, J., and Wang, P. 1977. A Markov-based linear programming model of travel in the Boundary Waters Canoe Area. *Proceedings: River Recreation Management and Research Symposium*. USDA Forest Service General Technical Report NC-28: 342-350.
- Peterson, G., and Lime, D. 1979. People and their behavior: A challenge for recreation management. *Journal of Forestry*, 77, 343-346.
- Peterson, G., and de Bettencourt, J. 1979. Flow metering of wilderness travel in the Quetico-Superior: New findings and research needs. *Modeling and Simulation*. 10: 1335-1340.
- Peterson, G., and Lime, D. 1980. Recreation policy analysis in wilderness management: A case study of the Quetico-Superior. *Proceedings of the Third Annual Applied Geography Conference*. Kent, OH: Kent State University: 4-13.
- Peterson, G. 1992. Using fees to manage congestion at recreation areas. *Park Visitor Research for Better Management: Park Visitor Research Workshop*. Canberra, Australia: Phillip Institute of Technology: 57-67.
- Peterson, M. 1981. Trends in Recreational Use of National Forest Wilderness. USDA Forest Service Research Paper INT-319.
- Philly, M., and McCool, S. 1981. Law enforcement in the national park system: Perceptions and practices. *Leisure Sciences*. 4: 355-371.
- Plager, A., and Womble, P. 1981. Compliance with backcountry permits in Mount McKinley National Park. *Journal of Forestry*. 79: 155-156.
- Plumley, H., Peet, H., and Leonard, R. 1978. Records of Backcountry Use Can Assist Trail Managers. USDA Forest Service Research Paper NE-414.
- Potter, F., and Manning, R. 1984. Application of the wilderness travel simulation model to the Appalachian Trail in Vermont. *Environmental Management*. 8: 543-550.
- Powers, R., Osborne, J., and Anderson, E. 1973. Positive reinforcement of litter removal in the natural environment. *Journal of Applied Behavioral Analysis*. 6: 579-580.
- Ramthun, R. 1996. Information sources and attitudes of mountain bikers. *Proceedings of the 1995 Northeastern Recreation Research Symposium*. USDA Forest Service General Technical Report NE-218: 14-16.
- Rechisky, A., and Williamson, B. 1992. Impact of user fees on day use attendance at New Hampshire State Parks. *Proceedings of the 1991 Northeastern Recreation Research Symposium*. USDA Forest Service General Technical Report NE-160: 106-108.
- Reiling, S., Criner, G., and Oltmanns, S. 1988. The influence of information on users' attitudes toward campground user fees. *Journal of Leisure Research*. 20: 208-217.
- Reiling, S., Cheng, H., and Trott, C. 1992. Measuring the discriminatory impact associated with higher recreational fees. *Leisure Sciences*. 14: 121-137.
- Reiling, S., and Cheng, H. 1994. Potential revenues from a new day-use fee. *Proceedings of the 1994 Northeastern Recreation Research Symposium*. USDA Forest Service General Technical Report NE-198: 57-60.
- Reiling, S., Cheng, H., Robinson, C., McCarville, R., and White, C. 1996. Potential equity effects of a new day-use fee. *Proceedings of the 1995 Northeastern Recreation Research Symposium*. USDA Forest Service General Technical Report NE-218: 27-31.
- Reiling, S., and Kotchen, M. 1996. Lessons learned from past research on recreation fees. *Recreation Fees in the National Park Service: Issues, Policies and Guidelines for Future Action*. St. Paul, MN: University of Minnesota Cooperative Park Studies Unit: 49-69.
- Reiling, S., McCarville, R., and White, C. 1994. Demand and marketing study at Army Corps of Engineers day-use areas. Vicksburg, MS: U.S. Army Corps of Engineers Waterways Experiment Station.
- Ritter, D. 1997. Limits of acceptable change planning in the Selway-Bitterroot Wilderness: 1985-1997. *Proceedings—Limits of Acceptable Change and Related Planning Processes: Progress and Future Directions*. USDA Forest Service General Technical Report INT-371: 25-28.
- Robertson, R. 1982. Visitor knowledge affects visitor behavior. *Forest and River Recreation: Research Update*. St. Paul, MN: University of Minnesota Agricultural Experiment Station Miscellaneous Publication. 18: 49-51.
- Roggenbuck, J., and Schreyer, R. 1977. Relations between river trip motives and perception of crowding, management preference, and experience satisfaction. *Proceedings: River Recreation Management and Research Symposium*. USDA Forest Service General Technical Report NC-28: 359-364.
- Roggenbuck, J., and Berrier, D. 1981. Communications to disperse wilderness campers. *Journal of Forestry*. 75: 295-297.
- Roggenbuck, J., and Berrier, D. 1982. A comparison of the effectiveness of two communication strategies in dispersing wilderness campers. *Journal of Leisure Research*. 14: 77-89.
- Roggenbuck, J., and Ham, S. 1986. Use of information and education in recreation management. *A Literature Review: The President's Commission on Americans Outdoors*. Washington, D. C.: U.S. Government Printing Office, M-59-M-71.
- Roggenbuck, J. and Passineau, J. 1986. Use of the field experiment to assess the effectiveness of interpretation. *Proceedings of the Southeastern Recreation Research Conference*. Athens, GA: University of Georgia Institute of Community and Area Development: 65-86.
- Roggenbuck, J., and Lucas, R. 1987. Wilderness use and users: A state-of-knowledge review. *Proceedings: National Wilderness Research Conference: Issues, State-of-Knowledge, Future Directions*. USDA Forest Service General Technical Report INT-220: 204-245.
- 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.
- Roggenbuck, J. 1992. Use of persuasion to reduce resource impacts and visitor conflicts. *Influencing Human Behavior: Theory and Applications in Recreation, Tourism, and Natural Resources*. Champaign, IL: Sagamore Publishing: 149-208.
- Roggenbuck, J., Williams, D., and Bobinski, C. 1992. Public-private partnership to increase commercial tour guides' effectiveness as nature interpreters. *Journal of Park and Recreation Administration*. 10: 41-50.
- Roggenbuck, J., Williams, D., and Watson, A. 1993. Defining acceptable conditions in wilderness. *Environmental Management*. 17: 187-197.
- Romesburg, H. 1974. Scheduling models for wilderness recreation. *Journal of Environmental Management*. 4: 159-177.
- Rosenthal, D., Loomis, J., and Peterson, G. 1984. Pricing for efficiency and revenue in public recreation areas. *Journal of Leisure Research*. 16: 195-208.
- Ross, T., and Moeller, G. 1974. Communicating Rules in Recreation Areas. USDA Forest Service Research Paper NE-297.
- Rossi, P., and Berk, R. 1985. Varieties of normative consensus. *American Sociological Review*. 50: 333-347.
- Rowell, A. 1986. A wilderness travel simulation model with graphic presentation of trail data. *Proceedings—National Wilderness Research Conference: Current Research*. USDA Forest Service General Technical Report INT-212: 478-482.
- Ruddell, E. and Gramann, J. 1994. Goal orientation, norms, and noise induced conflict among recreation area users. *Leisure Sciences*. 16: 93-104.
- Schechter, M., and Lucas, R. 1978. *Simulation of Recreational Use for Park and Wilderness Management*. Baltimore: Johns Hopkins University Press.
- Schomaker, J., and Leatherberry, E. 1983. A test for inequity in river recreation reservation systems. *Journal of Soil and Water Conservation*. 38: 52-56.
- Schomaker, J. 1984. Writing quantifiable river recreation management objectives. *Proceedings of the 1984 National River Recreation Symposium*: 249-253.
- Schreyer, R., and Knopf, R. 1984. The dynamics of change in outdoor recreation environments—Some equity issues. *Journal of Park and Recreation Administration*. 2: 9-19.

- Schultz, J., McAvoy, L., and Dustin, D. 1988. What are we in business for? *Parks and Recreation*. 23: 52-53.
- Schuett, M. 1993. Information sources and risk recreation: The case of whitewater kayakers. *Journal of Park and Recreation Administration*. 11: 67-72.
- Schwartz, E. 1973. Police services in the parks. *Parks and Recreation*. 8: 72-74.
- Scott, D., and Munson, W. 1994. Perceived constraints to park usage among individuals with low incomes. *Journal of Park and Recreation Administration*. 12: 79-96.
- Scotter, G. 1981. Response rates at unmanned trail registers, Waterton Lakes National Park, Alberta, Canada. *Journal of Leisure Research*. 13: 105-111.
- Shafer, C., and Hammitt, W. 1994. Management conditions, and indicators of importance in wilderness recreation experiences. *Proceedings of the 1993 Southeastern Recreation Conference*. USDA Forest Service General Technical Report SE-90: 57-67.
- Shanks, B. 1976. Guns in the parks. *The Progressive*. 40: 21-23.
- Shelby, B. 1981. Encounter norms in backcountry settings: Studies of three rivers. *Journal of Leisure Research*. 13: 129-138.
- Shelby, B., Danley, B., Gibbs, M., and Peterson, M. 1982. Preferences of backpackers and river runners for allocation techniques. *Journal of Forestry*. 80: 416-419.
- Shelby, B., and Heberlein, T. 1984. A conceptual framework for carrying capacity determination. *Leisure Sciences*. 6: 433-451.
- Shelby, B., and Harris, R. 1985. Comparing methods for determining visitor evaluations of ecological impacts: Site visits, photographs, and written descriptions. *Journal of Leisure Research*. 17: 57-67.
- Shelby, B., and Heberlein, T. 1986. *Carrying Capacity in Recreation Settings*. Corvallis, OR: Oregon State University Press.
- Shelby, B., Bregenzer, N., and Johnson, R. 1988a. Displacement and product shift: Empirical evidence from Oregon rivers. *Journal of Leisure Research*. 20: 274-288.
- Shelby, B., Vaske, J., and Harris, R. 1988b. User standards for ecological impacts at wilderness campsites. *Journal of Leisure Research*. 20: 245-256.
- Shelby, B., Whittaker, D., and Danley, M. 1989a. Idealism versus pragmatism in user evaluations of allocation systems. *Leisure Sciences*. 11: 61-70.
- Shelby, B., Whittaker, D., and Danley, M. 1989b. Allocation currencies and perceived ability to obtain permits. *Leisure Sciences*. 11: 137-144.
- Shelby, B., and 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., Brown, T., and Taylor, J. 1992a. *Streamflow and Recreation*. USDA Forest Service General Technical Report RM-209.
- Shelby, B., Brown, T., and Baumgartner, R. 1992b. Effects of streamflows on river trips on the Colorado River in Grand Canyon, Arizona. *Rivers*. 3: 191-201.
- Shelby, B., and Shindler, B. 1992. Interest group standards for ecological impacts at wilderness campsites. *Leisure Sciences*. 14: 17-27.
- Shelby, B., and Whittaker, D. 1995. Flows and recreation quality on the Dolores River: Integrating overall and specific evaluations. *Rivers*. 5: 121-132.
- Shelby, B., Vaske, J., and Donnelly, M. 1996. Norms, standards and natural resources. *Leisure Sciences*. 18: 103-123.
- Shindler, B. 1992. Countering the law of diminishing standards. *Defining Wilderness Quality: The role of Standards in Wilderness Management—A Workshop Proceedings*. USDA Forest Service General Technical Report PNW-305: 53-60.
- Shindler, B., and Shelby, B. 1992. User assessment of ecological and social campsite attributes. *Defining Wilderness Quality: The Role of Standards in Wilderness Management—A Workshop Proceedings*. USDA Forest Service General Technical Report PNW-305: 107-114.
- Shindler, B., and Shelby, B. 1993. Regulating wilderness use: An investigation of user group support. *Journal of Forestry*. 91: 41-44.
- Shindler, B., and Shelby, B. 1995. Product shift in recreation settings: Findings and implications from panel research. *Leisure Sciences*. 17: 91-104.
- Sieg, G., Roggenbuck, J., and Bobinski, C. 1988. The effectiveness of commercial river guides as interpreters. *Proceedings of the 1987 Southeastern Recreation Research Conference*. Athens, GA: University of Georgia: 12-20.
- Smith, V., and Krutilla, J. 1974. A simulation model for the management of low density recreational areas. *Journal of Environment Economics and Management*. 1: 187-201.
- Smith, V., and Headly, R. 1975. *The use of computer simulation models in wilderness management*. Management Science Applications to Leisure Time. Amsterdam: North Holland.
- Smith, V., and Krutilla, J. 1976. *Structure and Properties of a Wilderness Travel Simulator*. Baltimore, MD: Johns Hopkins University Press for Resources for the Future, Inc.
- Stankey, G. 1973. *Visitor Perception of Wilderness Recreation Carrying Capacity*. USDA Forest Service Research Paper INT-142.
- Stankey, G., and Lime, D. 1973. *Recreational Carrying Capacity: An Annotated Bibliography*. USDA Forest Service General Technical Report INT-3.
- Stankey, G., Lucas, R., and Lime, D. 1976. Crowding in parks and wilderness. *Design and Environment*. 7: 38-41.
- Stankey, G., and Baden, J. 1977. *Rationing Wilderness Use: Methods, Problems, and Guidelines*. USDA Forest Service Research Paper INT-192.
- Stankey, G. 1979. Use rationing in two southern California wildernesses. *Journal of Forestry*. 77: 347-349.
- Stankey, G. 1980a. *A Comparison of Carrying Capacity Perceptions Among Visitors to Two Wildernesses*. USDA Forest Service Research Paper INT-242.
- Stankey, G. 1980b. *Wilderness carrying capacity: Management and research progress in the United States*. *Landscape Research*. 5: 6-11.
- Stankey, G., Cole, D., Lucas, R., Peterson, M., Frissell, S., and Washburne, R. 1985. *The Limits of Acceptable Change (LAC) System for Wilderness Planning*. USDA Forest Service General Technical Report INT-176.
- Stankey, G., and Manning, R. 1986. *Carrying capacity of recreation settings. A Literature Review: The President's Commission on Americans Outdoors*. Washington, D.C.: U.S. Government Printing Office, M-47-M-57.
- Stankey, G., and Schreyer, R. 1987. *Attitudes toward wilderness and factors affecting visitor behavior: A state-of-knowledge review*. *Proceedings—National Wilderness Research Conference: Issues, State-of-Knowledge, Future Directions*. USDA Forest Service General Technical Report INT-220: 246-293.
- Stevenson, S. 1989. A test of peak load pricing on senior citizen recreationists: A case study of Steamboat Lake State Park. *Journal of Park and Recreation Administration*. 7: 58-68.
- Stewart, W. 1989. Fixed itinerary systems in backcountry management. *Journal of Environmental Management*. 29: 163-171.
- Stewart, W. 1991. Compliance with fixed itinerary systems in water-based parks. *Environmental Management*. 15: 235-240.
- Swearingen, T., and Johnson, D. 1995. Visitors' responses to uniformed park employees. *Journal of Park and Recreation Administration*. 13: 73-85.
- Tarrant, M., Cordell, H., and Kibler, T. 1997. Measuring perceived crowding for high-density river recreation: The effects of situational conditions and personal factors. *Leisure Sciences*. 19: 97-112.
- Taylor, D., and Winter, P. 1995. Environmental values, ethics, and depreciative behavior in wildland settings. *Proceedings of the Second Symposium on Social Aspects and Recreation Research*. USDA Forest Service General Technical Report PSW-156: 59-66.
- Twight, B., and Lyden, F. 1988. Multiple-use vs. organizational commitment. *Forest Science*. 34: 474-486.
- Twight, B., and Lyden, F. 1989. Measuring forest service bias. *Journal of Forestry*. 87: 35-41.
- Underhill, H., Xaba, A., and Borkan, R. 1986. The wilderness use simulation model applied to Colorado River Boating in Grand Canyon National Park, USA. *Environmental Management*. 10: 367-374.
- Utter, J., Gleason, W., and McCool, S. 1981. User perceptions of river recreation allocation techniques. *Some Recent Products of River Recreation Research*. USDA Forest Service General Technical Report NC-63: 27-32.

- Uysal, M., McDonald, C., and Reid, L. 1990. Sources of information used by international visitors to U.S. parks and natural areas. *Journal of Park and Recreation Administration*. 8: 51-59.
- Valliere, W., and Manning, R. 1995. Environmental ethics and wilderness management: An empirical study. *Proceedings of the 1994 Northeastern Recreation Research Symposium*. USDA Forest Service General Technical Report NE-198: 195-198.
- Vander Stoep, G., and Gramann, J. 1987. The effect of verbal appeals and incentives on depreciative behavior among youthful park visitors. *Journal of Leisure Research*. 19: 69-83.
- Vander Stoep, G., and Roggenbuck, J. 1996. Is your park being "loved to death?": Using communication and other indirect techniques to battle the park "love bug." *Crowding and Congestion in the National Park System: Guidelines for Research and Management*. St. Paul, MN: University of Minnesota Agricultural Experiment Station Publication 86-1996: 85-132.
- Van Meter, D. 1988. Educating natural resource managers for the 21st century. *Journal of Forestry*. 86: 64.
- Van Wagtendonk, J., and Benedict, J. 1980. Wilderness permit compliance and validity. *Journal of Forestry*. 78: 399-401.
- Van Wagtendonk, J. 1981. The effect of use limits on backcountry visitation trends in Yosemite National Park. *Leisure Sciences*. 4: 311-323.
- Van Wagtendonk, J. and Coho, P. 1986. Trailhead quotas: Rationing use to keep wilderness wild. *Journal of Forestry*. 84: 22-24.
- Vaske, J., Graefe, A., Shelby, B., and Heberlein, T. 1986. Backcountry encounter norms: Theory, method, and empirical evidence. *Journal of Leisure Research*. 18: 137-153.
- Vaske, J., Donnelly, M., and Deblinger, R. 1990. Norm activation and the acceptance of behavioral restrictions among over sand vehicle users. *Proceedings of the 1990 Northeastern recreation Research Symposium*. USDA Forest Service general Technical Report NE-145: 153-59.
- Vaske, J., Donnelly, M., and Shelby, B. 1992. Establishing management standards: Selected examples of the normative approach. *Defining Wilderness Quality: The Role of Standards in Wilderness Management—A Workshop Proceedings*. USDA Forest Service General Technical Report PNW-305: 23-37.
- Vaske, J., Donnelly, M., and Shelby, B. 1993. Establishing management standards: Selected examples of the normative approach. *Environmental Management*. 17: 629-643.
- Vaske, J., Donnelly, M., Doctor, R., and Petrucci, J. 1995. Frontcountry encounter norms among three cultures. *Proceedings of the 1994 Northeastern Recreation Research Symposium*. USDA Forest Service General Technical Report NE-198: 162-165.
- Vaske, J., Donnelly, M., and Petrucci, J. 1996. Country of origin, encounter norms and crowding in a frontcountry setting. *Leisure Sciences*. 18: 161-176.
- Virden, R., and Brooks, R. 1991. Wilderness managers in the southwest: The relationship between wilderness philosophy, experience, and practice. *Journal of Park and Recreation Administration*. 9: 71-84.
- Vork, M. 1998. Visitor response to management regulation—A study among recreationists in southern Norway. *Environmental Management*. 22: 737-46.
- Wade, J. 1979. Law enforcement in the wilderness. *Trends*. 16: 12-15.
- Wagar, J. 1964. The carrying capacity of wild lands for recreation. *Forest Science Monograph 7*, Washington, DC: Society of American Foresters.
- Wagstaff, M., and Wilson, B. 1988. The evaluation of litter behavior modification in a river environment. *Proceedings of the 1987 Southeastern Recreation Research Conference*. Athens, GA: University of Georgia: 21-28.
- Walsh, R. 1986. *Recreation Economic Decisions*. State College, PA: Venture Publishing.
- Wang, B., and Manning, R. 1999. Computer simulation modeling for recreation management: A study on carriage road use in Acadia National Park, Maine, USA. *Environmental Management*. 23: 193-203.
- Warren, G. 1997. Recreation management in the Bob Marshall, Great Bear, and Scapegoat Wildernesses: 1987-1997. *Proceedings—Limits of Acceptable Change and Related Planning Processes: Progress and Future Directions*. USDA Forest Service General Technical Report INT-371: 21-24.
- Washburne, R. 1981. Carrying capacity assessment and recreational use in the national wilderness preservation system. *Journal of Soil and Water Conservation*. 36: 162-166.
- Washburne, R., and Cole, D. 1983. *Problems and Practices in Wilderness Management: A Survey of Managers*. USDA Forest Service Research Paper INT-304.
- Watson, A. 1993. Characteristics of Visitors Without Permits Compared to Those With Permits at the Desolation Wilderness, California. *USDA Forest Service Research Note INT-414*.
- Watson, A. 1995. Opportunities for solitude in the Boundary Waters Canoe Area Wilderness. *Northern Journal of Applied Forestry*. 12: 12-18.
- Watson, A., and Niccolucci, M. 1995. Conflicting goals of wilderness management: Natural conditions vs. natural experiences. *Proceedings of the Second Symposium on Social Aspects and Recreation Research*. USDA Forest Service General Technical Report PSW-156: 11-15.
- Wenger, W., Jr. 1964. A Test of Unmanned Registration Stations on Wilderness Trails: Factors Influencing Effectiveness. *USDA Forest Service Research Paper PNW-16*.
- Wenger, W., Jr., and Gregersen, H. 1964. The Effect of Non-Response on Representativeness of Wilderness-Trail Register Information. *USDA Forest Service Research Paper PNW-17*.
- Westover, T., Flickenger, T., and Chubb, M. 1980. Crime and law enforcement. *Parks and Recreation*. 15: 28-33.
- Whittaker, D., and Shelby, B. 1988. Types of norms for recreation impact: Extending the social norms concept. *Journal of Leisure Research*. 20: 261-273.
- Whittaker, D. 1992. Selecting indicators: Which impacts matter more? *Defining Wilderness Quality: The role of Standards in Wilderness Management—A Workshop Proceedings*. USDA Forest Service General Technical Report PNW-305: 13-22.
- Whittaker, D., and Shelby, B. 1992. Developing good standards: Criteria, characteristics, and sources. *Defining Wilderness Quality: The Role of Standards in Wilderness Management—A Workshop Proceedings*. USDA Forest Service General Technical Report PNW-305: 6-12.
- Wicker, A., and Kirmeyer, S. 1976. What the rangers think. *Parks and Recreation*. 11: 28-30, 42.
- Wicks, B., and Crompton, J. 1986. Citizen and administrator perspectives of equity in the delivery of park services. *Leisure Sciences*. 8: 341-365.
- Wicks, B. 1987. The allocation of recreation and park resources: The courts' intervention. *Journal of Park and Recreation Administration*. 5: 1-9.
- Wicks, B., and Crompton, J. 1987. An analysis of the relationships between equity choice preferences, service type and decision making groups in a U.S. city. *Journal of Leisure Research*. 19: 189-204.
- Wicks, B., and Crompton, J. 1989. Allocation services for parks and recreation: A model for implementing equity concepts in Austin, Texas. *Journal of Urban Affairs*. 11: 169-188.
- Wicks, B., and Crompton, J. 1990. Predicting the equity preferences of park and recreation department employees and residents of Austin, Texas. *Journal of Leisure Research*. 22: 18-35.
- Wikle, T. 1991. Comparing rationing policies used on rivers. *Journal of Park and Recreation Administration*. 9: 73-80.
- Williams, D., Roggenbuck, J., and Bange, S. 1991. The effect of norm-encounter compatibility on crowding perceptions, experience, and behavior in river recreation settings. *Journal of Leisure Research*. 23: 154-172.
- Williams, D., Roggenbuck, J., Patterson, M., and Watson, A. 1992. The variability of user-based social impact standards for wilderness management. *Forest Science*. 38: 738-756.
- Willis, C. Canavan, J., and Bond, R. 1975. Optimal short-run pricing policies for a public campground. *Journal of Leisure Research*. 7: 108-113.
- Young, J., Williams, D., and Roggenbuck, J. 1991. The role of involvement in identifying users' preferences for social standards in the Cohutta Wilderness. *Proceedings of the 1990 Southeastern Recreation Research Conference*. USDA Forest Service General Technical Report SE-67: 173-183.