Visitor Use Density and Wilderness Experiences: A Historical Review of Research

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Abstract—Considerable research on the relationship between use density and wilderness visitor experiences has been conducted over the past four decades. This paper focuses on early work on this topic, tracing the development and languishing of different research themes suggested by this early work. Research—particularly that conducted in the normative tradition—has contributed useful information to managers grappling with the imposition of use limits. However, traditional research approaches need to be supplemented with research conducted at both smaller and larger scales. Research on the opinions of communities of onsite recreation users needs to be complemented by research capable of better articulating the nature of the recreation experience, differentiating between subpopulations of users, and placing individual protected areas within larger regional contexts.

For a long time, researchers have been interested in the relationship between use density and visitor experiences and the policy implications of this relationship. This theme was among the first explored by social scientists interested in recreation and the resultant literature is large. Some of this research is primarily conceptual in nature (for example, much of the work on carrying capacity); some of it is empirical. Much of it is applied, being driven by a desire to help managers make better decisions about appropriate use levels in recreation areas.

This paper provides an historical review. I begin with early writings on the concept of carrying capacity and principles to guide the management of use density. A section on empirical research follows. Prominent themes are identified in early research—some of which have been well developed by subsequent research and some of which have been largely neglected. Progress is traced over time and significant conclusions are highlighted. The emphasis is on applied research and research conducted in wilderness settings, although I recognize the value of basic knowledge that can be gained by better understanding visitor experiences and their relationship to use density. Finally, I comment on the ability of science to contribute to management decisions about appropriate use densities and use limits and suggest research approaches capable of making worthwhile contributions.

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The Concept of Recreation Carrying Capacity

Although alluded to since the 1930s, the concept of recreation carrying capacity was first developed in detail in the early 1960s. Reflecting early conceptions of carrying capacity, LaPage (1963) asserted that the central issue was one of quality *versus* quantity—the choice between restricting "the number of persons using a given area, in an attempt to maximize present individual satisfaction" and accommodating "more people currently, at the expense of a reduction in the quality of individual experience, in an attempt to maximize total satisfaction" (p. 34). Anticipating future findings and even terminology, he noted that "an increase in numbers of people accommodated may not necessarily result in a linear decrease in the quality of the individual experience" (p. 33) and asked questions such as "what are the indicators that carrying capacity has been exceeded?" (p. 34) and "what are the 'critical levels' of satisfaction…which must be exceeded" (p. 36) for the experience to be acceptable?

Early Writings

Wagar (1964) developed the first formal exploration of the recreation carrying capacity concept. Based on his 1961 doctoral dissertation, this monograph laid the conceptual groundwork for much subsequent research and writing. Among the important ideas presented were the following: (1) In contrast to earlier characterizations of carrying capacity as an inherent property of a place that can be determined, carrying capacity is not an absolute value; (2) Carrying capacity depends on the needs and values of people and can only be defined in relation to some management objective; and (3) The conflict between quality and quantity—the need to limit use—can be reduced through other management actions such as zoning, engineering, persuasion, and the management of biotic communities.

Once it was agreed that carrying capacity was not an inherent property of a place—something that could be determined—the term lost much of its intuitive meaning. Consequently, Wagar (1974) and numerous other authors have suggested that the term was a bad choice and should be dropped. This advice has never been followed. The term continues to be used in legislative and policy mandates by managers and even some scientists. So, as Manning (1999) notes we will probably have to live with it—despite the problems it causes. Today, most scientists refer to carrying capacity more as a topical heading than a property of a place or even a management tool.

Even as a topical heading, there is considerable confusion about what carrying capacity is. In the writings of some early

scientists, such as George Stankey and Dave Lime, the topic of carrying capacity is treated very broadly. Lime (1976), for example, says that carrying capacity is about "how to plan and manage a particular recreation resource" (p. 123). Many early articles about carrying capacity are either reviews of research on recreation impacts and management techniques (for example, Lime and Stankey 1971) or lists of extremely general principles and propositions (for example, Lime 1976). Such treatments did much to organize information about recreation impacts and management techniques. Particularly helpful were the discussions of the numerous approaches for managing recreation use—only one of which is use limitation.

More germane to this paper are articles that confined the topic of carrying capacity to the issue of prescribing appropriate use levels, an approach that is more in line with the original meaning of the term in wildlife and range management. For example, Wagar (1974), in his further writings on carrying capacity, felt that the salient issue was clearly one of use limitation—when they are appropriate and how one could decide what they should be. Insightful early writings about carrying capacity by Heberlein (1977), Schreyer (1979), and Shelby and Heberlein (1986) also focused primarily on building a conceptual and/or empirical basis for setting use limits.

One of the few specific theoretical frameworks for assessing carrying capacity was presented by a National Park Service policy officer, Rendel Alldredge (1973). In the tradition of LaPage's observation that carrying capacity decisions involve a choice between quantity and quality, Alldredge proposed a means of setting carrying capacity based on the economic concept of marginal utility. He hypothesized that total satisfaction (aggregated across all visitors) should increase as more visitors enter an area but that the individual satisfaction of each user should decline due to increased crowding. If the rate of decrease in individual satisfaction is great enough, there will come a point when total satisfaction starts to decline as use increases. This would be a logical point to restrict use. The fundamental assumption of this theory is that experience quality will decline substantially with increases in use density.

Wagar (1974) also drew on analysis of marginal utility to discuss how limits might be set. In contrast to Alldredge, however, he asserted that the difference in quality between low and high density recreation sites would never be substantial and, therefore, "mass use would always appear to be justified (in terms of maximizing human benefits) if we examine one area at a time" (p. 276). Numerous empirical tests have supported Wagar's assertion. They fail to show a pronounced inverse relationship between use density and satisfaction (described in a subsequent section), invalidating the central thesis of Alldredge's conceptual framework.

Wagar's primary point is not that use limits are unjustified. His point is that to make good decisions about use limits we need to enlarge the scale of analysis. "Examining one area at a time may be the trap that has caused so much confusion about use limits for specific areas." (Wagar 1974: 276). He goes on to show how the concept of decreasing marginal utility can be used to conclude that benefits are optimized by providing some low-density recreational opportunities within a system dominated by high-density opportunities.

Points of Agreement

Most students of carrying capacity agree on several important points. First, recreation carrying capacity is not an inherent value; it must reflect value judgments. Decisions about appropriate use must include what Shelby and Heberlein (1986) call an evaluative component. These evaluations can be explicit or implicit. Managers are making subjective judgments—reflecting their values or those of others—even if they decide not to limit use. Limits on use can be set without specifying desired ecological and social outcomes and without much understanding of the relationship between use density and ecological and social conditions. Examples include decisions to limit use to current levels (as was done on the Colorado River in Grand Canyon) or to the number of currently available campsites (as has been done in the backcountry of many national parks) or to some other density, such as the one launch per day allowed on the Selway River.

Alternatively, use limits can be based on explicit evaluative decisions about conditions that are or are not acceptable. In this context, use limits are means rather than ends; they represent the limits that must be set in order to maintain specified acceptable conditions. This is the approach that has been advocated by most recreation researchers. Such evaluative descriptors are usually called standards (Shelby and others 1996) and are the basis of recent "carrying capacity" processes, such as Limits of Acceptable Change (LAC) (Stankey and others 1985) and Visitor Experience and Resource Protection (VERP) (Manning and others 1996a). Clearly, research can be helpful to management if it provides descriptive information that can be used by managers making decisions about acceptable conditions. As described in a later section, considerable attention has been devoted to research designed to provide such information.

A second point of agreement is that because any decision about use limits will favor certain users and certain types of experiences (Schreyer 1979), decisions must be made about which recreation users and which experiences should be favored in any given place. This suggests the value of science that helps managers of individual parks and wilderness areas make decisions about which users and experiences to favor in their area. It also suggests that research needs to give managers insight into the attitudes and preferences of a variety of different potential interest groups. Unfortunately, little research of this type has been conducted.

The important implication of this second point is not that managers need to give preference to certain users. Rather, it demonstrates the importance of a third point of agreement. In order to avoid giving unfair preference to certain users and experiences, managers need to make use limitation decisions within the context of a large system perspective. As Schreyer (1979) notes, the systems approach is important because "the equity of any allocation decision is dependent upon a broad picture in which one seeks to maximize as wide a range as possible of individual definitions of quality" (p. 264). A decision to give preference to one user group over another is less discriminatory if the other user group is given preference somewhere else. This suggests that science directed at regional analyses should be particularly helpful in making decisions about which users and experiences to favor and, therefore, in making decisions

about acceptable conditions and appropriate use levels. Again, little research taking a regional perspective has been conducted.

Empirical Research

The first substantial empirical study of use densities and visitor experiences in wilderness was Bob Lucas' (1964) study in the Boundary Waters Canoe Area. Despite the lack of any formal theoretical foundation, this study is remarkable in the degree to which it laid the foundation for further work. Lucas asked different user groups to decide where "the wilderness began" on their trip. He then correlated the percentage of groups that perceived a lake to be wilderness with actual use of that lake. This allowed him to assess the effect of use density on experience, without having to ask visitors directly about crowding or their response to other people (avoiding concerns about leading questions and the ability of respondents to adequately assess their personal responses and evaluations).

This relationship varied depending on which user group was assessed and what type of user was encountered (paddle canoeist, motor canoeist, or motorboater). For lakes without motorboats, almost all canoeists felt themselves to be "in wilderness" if use of that lake was under about 300 groups per 3-month season. Lucas also asked visitors for their personal evaluations, asking questions about (1) whether they were bothered by crowding, (2) the number of groups seen and whether the number seen was too many, about right, or too few, and (3) how many groups "could you meet in a day before you would feel there was too much use." A majority of canoeists felt they had seen too many people when they encountered more than five groups of canoeists per day.

Lucas (1964) went on to suggest how such data could be used to inform decisions about use limits. He began with several explicit assumptions—that paddling canoeists were the recreational group whose opinion was most critical and that a wilderness experience was the appropriate experience for the Boundary Waters. He justified these assumptions by asserting that the type of recreation to emphasize (wilderness canoeing) should be the type with the fewest alternative possibilities. This assertion would be supported by a regional marginal utility analysis, as Wagar (1974) proposed. Lucas concluded that "full wilderness" could be maintained (all canoeists would perceive such places to be wilderness) where there were less than about 300 groups per year. Places with less than 600 groups per year would seem like wilderness to 50 percent of canoeists, but not to the other 50 percent. Finally, he suggested that density ought to vary, particularly in relation to proximity to access points. These "capacities" would be much lower on lakes where the groups encountered were in motorboats; they would be much higher if the area were to be managed according to the preferences of motorboaters.

Lucas clearly recognized that capacity decisions must begin with decisions about which interest groups' opinions to favor and what type of experience to provide. In his analysis, he decided that canoeists were the group to be favored and a "wilderness experience" was the type to be provided. So he used research to describe how use density affected the wilderness experience of canoeists and based his analysis on this information. He used a regional systems analysis to justify his decision about which group and experience to favor. Motorboaters, auto campers, and resort guests had many alternative places to obtain nonwilderness experiences. And he built further diversity of opportunity into the system by suggesting spatial variation within the Boundary Waters Canoe Area itself.

Relationship Between Use Density and Experience Quality

The fundamental goal of this line of research is to answer questions about how important use density (or measures of social interaction such as encounters) is to experience quality and visitor satisfaction. The value of use limits seemingly should increase to the extent that encounters have a pronounced and negative effect on the quality of visitors' experiences. Most studies of this topic have (1) used survey techniques, (2) been conducted after the trip—often as much as two weeks or more, and (3) required visitors to generalize about the entire trip—as opposed to individual events. Despite this reliance on post-trip questionnaires, three different approaches to this topic have been taken, with differences reflecting the dependent variable selected and whether relationships are assessed under hypothetical or actual conditions.

Studies have also varied as to whether the ultimate independent variable is use density or some measure of interaction between groups (encounters). Although these variables are usually correlated, use density is likely to be less directly related to experiences than actual interactions. Therefore, this review will emphasize the relationship between encounters and experience quality.

The first approach involves assessing, under actual conditions, the extent to which quality of the entire experience (often referred to as total satisfaction) declines as encounters increase. Shelby's study of boaters on the Colorado River at Grand Canyon (Shelby and Nielsen 1975; Shelby 1976, 1980; Shelby and Heberlein 1986) was the first of a number of studies of the density/encounters-satisfaction relationship based on actual experiences in wilderness-like environments. For Colorado River boaters, there was no evidence of a relationship between encounters and satisfaction with the total experience. Subsequent studies in other places have generally come to the same conclusion (see reviews by Kuss and others 1990; Manning 1999). In a few cases there is a statistically significant inverse relationship, but the magnitude of effect is never pronounced. Where r^2 has been used, density and encounter measures have never explained more than 10 percent of the variation in total satisfaction. Lucas (1980) used gamma as a measure of association in a study of visitors to nine wilderness areas. He found that the percent of variation in satisfaction explained by encounters exceeded 10 percent in six of nine wilderness areas, with one value as high as 31 percent. It is unclear, however, whether this very different result reflects differences in instrumentation and statistical analysis or differences in the relationship between encounters and satisfaction in these wilderness areas.

The second approach, also based on evaluations of actual conditions experienced on each visitor's trip, uses a more

elaborate "crowding model." Crowding is a personal negative evaluation of interaction with other people. Theoretically, more encounters should result in increased levels of crowding, which, in turn, should be associated with reduced experience quality or satisfaction. Numerous studies—beginning with Shelby's work in the Grand Canyon—report either no relationship or a weak relationship between encounters and perceived crowding. Again, in park and wilderness settings, density or encounters typically explain less than 10 percent of the variation in crowding (Kuss and others 1990; Manning 1999). Antecedent variables (expectations and feelings about crowding) typically have a greater influence on perceived crowding than density or encounters (for example, Shelby 1980). Stronger relationships between encounters and crowding (r^2 as high as 0.36) have been found in a few studies of heavily-used rivers (Heberlein and Vaske 1977; Hammitt and others 1984; Tarrant and others 1997), but not in wilderness-like settings. Moreover, most studies report little or no relationship between crowding and experience quality.

In a variation on this approach, Hammitt and Rutlin (1995) explored the relationship between encounters and "privacy achieved" among visitors to Ellicott Rock Wilderness. They reported an inverse relationship between encounters and privacy achieved, but provided no statistical data to help interpret the consistency of this relationship. They also did not attempt to assess the extent to which privacy achieved was an important aspect of visitors' experiences.

The third approach has been to ask visitors directly, but in a hypothetical manner, how they think different levels of interaction would affect their experience. This has been operationalized in several different ways. Visitors have been asked about preferred numbers of encounters and maximum acceptable numbers of encounters. They have been asked to assess their likely response to different numbers of encounters, presented either verbally (Stankey 1973) or visually (Manning and others 1996b). They have been asked to give their highest tolerable contact level (Shelby 1981). Analyses of such data, referred to variously as satisfaction curves, preference curves, acceptability curves, or encounter norms, show that most visitors prefer relatively low use densities and encounter levels. They perceive that their experience quality would be negatively influenced by increased encounters.

These are the sorts of results originally anticipated by managers and many researchers, given that some people complain about encountering too many other people. However, it is important to note that (1) these are hypothetical self-reports, the validity of which has been questioned (Lee 1977; Williams and others 1992) and (2) the dependent variable in this approach is "satisfaction with the number of people seen rather than satisfaction with the entire experience" (Shelby 1980: 47). There is still no empirical evidence that encountering more people than one prefers has a substantial adverse effect on the quality of most visitors' experiences.

Numerous reasons for the apparent weak relationship between encounters and experience quality have been advanced. One potential explanation is that there are important mediating variables, mostly beyond the control of managers (such as weather or expectations regarding encounters) that have not been included in the analysis. While this is likely the case and such variables are clearly of academic interest, this explanation has little management application. If manipulation of use levels has little effect on experience quality—regardless of why this is the case—managers need to be careful that the costs of limiting use do not exceed the benefits.

Other explanations have been methodological criticisms—particularly about lack of variation in total satisfaction measures, lack of variation in number of encounters, the need to remember how one felt several weeks ago, the need to condense an evaluation of an entire trip into a single rating, and, particularly, the limitations of generalizing across different individuals. Wilderness visitors vary greatly in motivations, expectations and other characteristics likely to influence their response to any setting attribute such as use density. The cross-sectional research designs used to address this issue have been unable to "factor out" all this variation. In essence, all the variation between individuals becomes "error," making it very difficult to detect relationships, within individuals, between density and experience quality.

In a recent study at Grand Canyon (Stewart and Cole 2000, in press), many of these methodological shortcomings were mitigated, with the use of onsite, daily diaries. Analysis of resultant data showed highly consistent relationships between encounters and crowding, crowding and experience quality, and encounters and experience quality. The magnitude of influence was small, however. For example, for 60 percent of respondents there was a significant negative relationship between number of groups encountered and experience quality—assessed using a five-item measure modified from Ditton and others (1981). For 20 percent of respondents, there was a positive relationship between encounters and experience quality. For the average person with a negative relationship, encounters per day would have to increase from 1 to 80 per day to reduce quality 50 percent (the independent variable was square root of encounters/day). Only 5 percent of respondents had strong negative relationships (arbitrarily defined as a slope steeper than –1.0, equivalent to a 50 percent reduction in quality if encounters increased from 1 to 16 per day).

This study provides increased insight into the relationship between use density and experience quality but does not alter earlier conclusions. For a few people, meeting increasing numbers of people has a strong adverse effect on experience quality. A few others respond positively as encounters increase. Most wilderness visitors are adversely affected by meeting many other people but the effect of meeting many people on the overall quality of their experience is minor. Most people prefer to see few people—as the results of hypothetical studies indicate—but are not highly bothered when they cannot have their preferred experience.

Different factions of the research community have interpreted these results in different ways. Some largely dismiss these results as irrelevant, asserting that satisfaction or overall experience quality is the wrong dependent variable to examine. Shelby and Heberlein (1986) state, for example, that although people are equally satisfied at low and high use levels, managers should not forget about carrying capacity. They and others (Manning 1999) note that high satisfaction among current users may result from coping behaviors

such as visitor displacement, rationalization and "product shift." They conclude that the result of managing for satisfaction "will be loss of diversity in outdoor recreation opportunities, particularly low use alternatives" (Manning 1999: 120). These researchers assume that crowding is a problem that must be managed and have turned to the "normative approach" (discussed below) as an empirical basis for setting use limits.

Other researchers have criticized this search for "scientifically determined restrictions" (Burch 1981: 223). Burch (1981) goes so far as to suggest that the situation is one of "organized irresponsibility where managers point to the 'scientific' data as reason enough for preferred decisions, and the scientists have the pleasure of both defining and 'proving' the value of certain wildland policies held by personally compatible social strata" (p. 224). These critics suggest that managers should be concerned about denying visitors access to recreational opportunities, particularly when available empirical evidence suggests that denying access will not result in higher quality experiences—just different experiences. Both Burch (1984) and Becker and others (1984)—echoing Wagar (1974)—argue that better justifications for carrying capacity decisions lie in systems analyses, "placing the characteristics of a specific site into a regional context and…(arriving) at an agreement as to what a specific site could and should reasonably be" (Becker and others 1984: 482). Several of the stronger critics also suggest that more insight might be gained by studying how visitors *behave* when experiencing different use densities (Lee 1977; Burch 1984)—a recommendation first made by Alldredge (1973).

Visitor Assessments of Appropriate Use Levels and Conditions

The first attempt to obtain visitor opinions about appropriate use levels in wilderness—what has come to be called the normative approach—was Lucas' (1964) study in the Boundary Waters Canoe Area. He asked visitors "how many other groups could be met in a day before you would feel there was too much use?" Most canoeists wanted to encounter no motorboats and zero to five canoes. Stankey (1973), in the second such attempt, asked a different type of question. He asked visitors to evaluate their feelings—on a five-point scale from "very pleasant" to "very unpleasant"—about meeting increasingly large numbers of groups. He found that, for a majority of overnight users in four different wilderness areas, experiences were no longer reported to be "pleasant" once more than two or three other groups were encountered. He also illustrated how such evaluations varied between user groups (canoeists, motorboaters, hikers, and horseback riders), as well as with the type of group encountered.

In describing his results, Stankey (1973) casually described them as "norms regarding use encounters" (p. 23). It was Heberlein (1977), however, who proposed that a formal normative approach might be a worthwhile perspective for carrying capacity research. He promoted Jackson's (1965) return potential curve as a model for portraying visitor opinions about appropriate use levels as norms. Despite recommending that return potential curves be generated, Heberlein (1977: 76) noted this was not necessary:

> By going to various groups and asking if the contacts are too few or too many, the manager can get a rough idea of the described curves. It is *very* important, however, that a variety of potential users and nonusers (such as managers) be consulted. It is also necessary that this input be presented according to the various user groups rather than by simply adding them all together in a 'vote'. This will give the manager a sense of the variety of norms that exist for visitor density in a particular setting, for a particular activity.

Heberlein and Vaske (1977) subsequently modified Stankey's question and developed return potential curves (later called impact acceptability curves) from visitor assessments of the "pleasantness" of encountering different numbers of groups on the Brule River. The point at which these curves crossed the neutral line—where the mean response to that number of encounters was neither pleasant nor unpleasant—was interpreted as the encounter norm. This metric was proposed to represent the upper limit of what people will tolerate or accept (Vaske and others 1992; Manning 1999), an interpretation that has been adopted in many subsequent research projects. This interpretation has been widely criticized, however, for reasons ranging from questions about whether respondents are providing valid self-assessments (Williams and others 1992) to concerns about whether such assessments are really norms (Heywood 1996) to criticism of the use of the neutral line to define the norm rather than some other point on the curve.

Numerous subsequent refinements to this "normative" approach have been developed. Among the more important refinements was Shelby's (1981) attempt to develop different encounter norms for different potential experience types that might be provided in Grand Canyon. He asked respondents to think about the Grand Canyon as offering three different types of experience: a wilderness, a semiwilderness, and an undeveloped recreation area experience. Then respondents were asked to state the highest number of encounters they could tolerate before the experience would no longer be that kind of experience. Unfortunately, the value of the resultant data is limited by the fact that each of these three types of experience was defined in the questionnaire using terms that suggest appropriate levels of social interaction. Results would have been more useful if a richer and more varied vocabulary had been used to describe each experience. Roggenbuck and others (1991) asked people to state the maximum number that would be acceptable, replacing the notion of tolerance with the notion of acceptability and reflecting the terminology of LAC-type processes even more precisely.

In Shelby's (1981) study, respondents were given the response option "encounters make no difference to me." This option is now commonly given. Interestingly, when it comes to analysis, such respondents are typically excluded, as if they have no tolerance level. For some applications, at least, it seems more appropriate to assume that respondents who do not care how many people they meet have an extremely high tolerance—and adjust median responses upward accordingly. Roggenbuck and others (1991) went a step further and also provided the option to state that encounters do make a difference, "but I don't feel I can suggest an acceptable number." Including this option can substantially reduce the number of respondents who say "encounters make no difference to me" (Hall and others 1996).

Many of these refinements—particularly recent ones—are described in Manning (1999, this proceedings). Examples of various types of question formats are presented in Donnelly and others (1992). Studies have evaluated variation in the norms derived from different question formats (Hall and others 1996; Manning and others 1999a).

Much of the controversy about the normative approach concerns the prescriptive utility of resultant metrics. When Lucas (1964) first asked people for their opinions about how many people they could meet before they would feel there was too much use, he clearly viewed the resultant data as self-assessments of likely responses to encounters. He presented these data as being descriptive (what is) more than evaluative (good versus bad) and certainly not as prescriptive data (what ought to be). He referred to the question as an "informal" one, suggesting little confidence in the results.

This interpretation changed, however, when it was asserted that such data could be used to identify social norms, defined as societally shared judgments of what conditions "*ought to* or *should be"* (Vaske and others 1992). In recent dialogue responding to criticism of the norms approach, Doug Whittaker and Bo Shelby asserted that questions about acceptability measure norms rather than attitudes and that "norms are about degrees of should/should not…while attitudes are about degrees of good/bad" (Heywood 2000: 261). This assertion has not been tested, however. It is quite possible that visitors are merely responding in terms of good or bad, even though they were asked to evaluate acceptability. While this may appear to be largely a semantic argument, this debate has important implications for how such data are interpreted and used.

Ever since processes like LAC and VERP emerged as recommended frameworks for resource management, managers have struggled with developing the prescriptive standards that are the foundation of such processes. They have been uncomfortable making subjective judgments about what ought to be. Proponents of the normative approach often represent norms as providing an empirical basis for developing management standards (Shelby and others 1996). The terminology used and the way norms and standards are described often leave the impression that data, such as that first collected by Lucas, if analyzed and displayed as an impact acceptability curve (Vaske and others 1986) can be translated directly into management standards.

LAC-type management standards are clearly prescriptive in nature. They represent carefully crafted compromises between conflicting goals (Cole and McCool 1997)—such as concern for providing access and concern for protecting wilderness experiences. In setting a standard, such as a maximum number of encounters per day, managers must consider the management actions that will be needed to comply with standards. An understanding of the costs of such a standard, such as reduced access, is as important to the process of defining standards as an understanding of beneficial effects of meeting fewer people on experiences.

The "social norms" derived from asking visitors about the acceptability of conditions, though often referred to as standards and presented in units identical to LAC standards (such as maximum number of encounters per day), are very different. Visitors are not presented with conflicting goals and asked to make tradeoffs. Instead, they are asked to evaluate acceptability without any explicit information about the costs of alternative choices. Such unconstrained choices provide, at best, only half of the equation—information about how visitors evaluate the effect of density on their experience—needed to set LAC standards. These data can inform the subsequent prescriptive process. However, the difficult decision—how to balance concerns about experiences with concerns about access—still remains.

In a study of day-hikers at Grand Canyon, Manning and others (1999b) attempted to interject a more prescriptive element by asking visitors about the maximum number of people "the National Park Service should allow on this section of trail. In other words, at what point should hikers be restricted from using this trail." Norms derived from this question were compared with norms from a traditional question about the maximum number of people that would be acceptable, where "acceptable" was not defined. For hikers on the wilderness-like threshold trails, the mean response, when a consequence was stated, was more than 50 percent higher than the mean response to the traditional question. The mean respondent felt the National Park Service should allow a use density substantially higher than the current density, if access might have to be restricted in order to keep densities within acceptable levels.

Visitor Opinions About and Responses to Use Limits

Further insight into the effects of use density on experiences can be gleaned from studies that asked visitors about their support for use limits. Typically, visitors support restricting the number of visitors to an area "if it is being used beyond its capacity" (Lucas 1980). However, visitors are reluctant to ever conclude that an area is being used beyond its capacity. Starting with a study of three eastern wilderness areas (Roggenbuck and others 1982), visitor support for use controls has been assessed by asking them to select one of the following responses: (1) controls are needed to lower use, (2) controls are needed to hold use at current levels, (3) controls not needed now, but should be imposed in the future if overuse occurs, or (4) controls not needed now or in the future. Virtually everywhere this question has been asked, including some of the most densely used destinations in the wilderness system (Cole and others 1997), most people have responded that "controls are not needed now but should be imposed in the future if overuse occurs."

The one exception in the literature—Linville Gorge Wilderness—already has a permit system. Most visitors there also support the *status quo,* which in this case, means they think use should be held to current levels. Shortly after the implementation of use limits, visitor opinions about limits were assessed at Rocky Mountain National Park (Fazio and Gilbert 1974), Denali National Park (Bultena and others 1981), and San Gorgonio and San Jacinto Wildernesses (Stankey 1979). In each case, most people who visited these places after use limits had been imposed supported that management action. They supported the current management regime.

Hall and Cole (2000) examined visitor response to the imposition of use limits in the Obsidian Falls area of the Three Sisters Wilderness. Prior to the imposition of use limits in 1991, 60 percent of visitors opposed use limits. After

implementation of limits in 1997, 60 percent of visitors supported the use limits. One might want to interpret this as evidence that visitors changed their opinion about use limits once they experienced the benefits that accrue from a reduction in use density. This does not appear to be the case, however. Prior to the imposition of use limits, most visitors were repeat visitors. Following the imposition of use limits the clientele had changed dramatically. Most visitors were first-timers, more amenable to regulation and, interestingly, no less tolerant of encounters or ecological impacts. One of the effects of use limits was to displace many traditional users who were replaced by people who were less bothered by being regulated. Consequently, the majority of visitors supported the current management regime, regardless of what that regime was. Use limits were not imposed at Green Lakes—a nearby wilderness destination that was even more heavily used than the Obsidian Falls area. The portion opposed to use limits there increased from 60 to 70 percent between 1991 and 1997.

Discussion and Conclusions

What Have We Learned?

Density Affects the Nature of the Experience More Than the Quality of the Experience—These various empirical studies present a relatively consistent picture. Most visitors prefer low-density wilderness with infrequent encounters—although some do not. If they meet lots of people—particularly if they meet many more than they expect—most visitors' experience is adversely affected. However, the magnitude of effect is small. Even in crowded situations, most wilderness visitors still have high quality experiences. We must conclude, therefore, that use density has little effect on the quality of recreation experiences. One of the implications of this conclusion is that we ought to be more careful with our terminology—avoiding reference to higher density experiences as being lower quality experiences. What density probably does affect is the nature of the experience—what the experience is like. A visit during which social interaction is nearly continuous is clearly different from one in which there is no interaction with other groups.

Decisions About Appropriate Use Limits Require Decisions About Which Type of Recreation Experience to Favor—Such decisions are best articulated in statements about appropriate conditions and in standards for setting attributes—either for density or for variables related to density. One of the important contributions of Shelby and Heberlein (1986) is their set of rules for establishing social carrying capacity. To set carrying capacity, it is critical to (1) decide which type of recreation experience to provide, (2) define this experience with specificity, using parameters such as appropriate numbers of encounters, and (3) decide who should make these decisions (who the relevant groups are). Decisions about use limits, made for individual areas, will enhance the experiences of some and eliminate opportunities for others. Some of the criteria that should be used when making such decisions include a concern for equity and consideration of aggregate benefits, both of which are best considered within a systems context.

Consequences of Choice—When the consequences of choices are made clear, current onsite visitors tend to support the current management regime and accept existing biophysical and social conditions (unless the costs of a change in management are all borne by some other user group**)**. Since density has little effect on experience quality, few visitors are willing to forego the opportunity for access in order to have fewer encounters when they do visit. Although visitors tend to support the concept of limiting use to avoid certain problems, they seldom conclude that problems are severe enough to warrant limits at this time—perhaps because they recognize that such limits would hinder their own access. Those who do not like the current management program—either the existing regulations or resultant conditions—are likely to have already gone elsewhere. They are not likely to make up a large proportion of any sample of onsite users. Therefore, if use levels are increasing and managers make decisions about tradeoffs the way that empirical studies suggest most visitors would, there will almost always be a constant evolution toward higher density experiences. This suggests that the rationale for use limits is more likely to come from some careful evaluation of legislative and administrative mandates or the unique value and purpose of any given area than from a survey of current visitors.

Visitor Response—Most visitors are willing to answer questions about appropriate experiences and setting attributes, including density and encounters. (However, there is considerable disagreement about the extent to which such responses provide an empirical basis for making decisions related to use limits). Most visitors are willing to make choices when asked whether a place ought to provide a wilderness experience or an undeveloped recreation experience. Most will also state the maximum number of encounters that is tolerable or acceptable to them. However, these numbers tend to increase dramatically when visitors are informed of the consequences of their choices. As Manning (this volume) argues, such judgments provide a rich resource for managers charged with making decisions about appropriate use levels. Such data will be most useful if all relevant interest groups are given a voice, if important subgroups within the population are differentiated, and if respondents are well informed about the possible management implications of their judgments. However, information about the opinions of current onsite users is only one of many types of information needed by decisionmakers.

What Information Should Managers Possess When Making Decisions?

Most students of the use limitation issue agree generally on the kinds of information and thought processes that should lead to good decisions about use limits. Managers need to decide which types of experience and which recreationists to favor. They need to understand how use density affects these favored experiences and to set use limits accordingly. Processes such as LAC and VERP, with their descriptions of appropriate conditions and experiences and their indicators and standards, provide a framework for documenting and implementing such decisions. Research

can contribute worthwhile information to such decisions. Progress to date, however, has been limited.

The primary research contribution to such decisions has been normative information about the opinions of current onsite users about appropriate density-related conditions. Information of this type has been gathered in innovative ways and is of considerable interest. However, such information is only a small part of the information needed to make good decisions. Consider that the range of potential use limits is dependent on decisions about which groups should make decisions, which experiences are most appropriate, and which condition or impact levels are appropriate to those experiences. Most normative research targets only the last of these three decisions—the portion of the model that probably explains the least amount of variation.

Over time, researchers have tended to forget many of the suggestions of their elders. Wagar (1974) warned against the trap of studying one area at a time. He and others (Stankey 1974; Schreyer 1979) stressed the need to base decisions on a regional perspective on recreation supply and demand. Virtually every available study, however, is confined to a single location. Several early researchers warned about excessive reliance on visitor surveys, since the validity of self-reports is difficult to verify (Alldredge 1973; Lee 1977) and because visitors are seldom likely to be fully informed about the availability of resources (Wagar 1964) or the complexities and potential prescriptive consequences of their decisions. And yet, most available information comes from self-reports and assessments derived from visitor surveys. Moreover, little attempt is made to inform visitors of the likely consequences of the alternative choices they are presented.

Wagar (1974) also warned that managers need the courage to override the prescriptive preferences of visitors who "may have difficulty understanding that total recreational benefits can be increased by limiting use on selected areas and forgoing certain benefits" (p. 278). When we do inform visitors of consequences and ask their opinions about prescriptions, they usually support the *status quo*. This raises serious questions about how useful such information is to deciding what is most appropriate. Heberlein (1977) stressed the need to seek the opinions of various user and nonuser groups and to keep the input of each group separate. Most normative research, in contrast, is confined to current onsite users and little attempt is made to identify the opinions of different user groups. Shelby and Heberlein (1986) stress the importance of tying standards to particular experience types and yet this too is seldom done. When visitors are asked their opinions about different experience types, the vocabulary that is used to describe experience types is impoverished. Respondents may conceive of the experience type in completely different ways or in ways that are unrelated to proposed standards.

Needed Research

Traditional research approaches, based on the normative tradition, have and can continue to contribute information useful to managers making decisions about use limits. Manning (this proceedings) describes some of the ways that line of research can be refined and extended. However, more attention needs to be given to alternative types of research, particularly research conducted at different scales. Research has focused almost exclusively on an intermediate scale of analysis, assessing the community of onsite users at a single protected area as if it were a single population. This is not surprising since it is the community of onsite users that will be managed and most research funding comes from individual parks or wilderness areas. However, this community consists of numerous individuals who might usefully be aggregated into subpopulations at a level of analysis below that of the community. Moreover, the individual protected area is part of a larger landscape of protected areas and other lands. Just as our understanding of biological systems has been enhanced by studying the biology of individual organisms, populations, communities and landscapes, our understanding of how best to manage recreation use will be enhanced through complementary work at all these levels.

If managers are to choose between alternative experiences, they must understand more about the nature of experiences and how density influences the nature of experiences. This requires more attention to the experience of individuals. Qualitative research methods provide an opportunity to more fully explore dimensions of the experience of wilderness (Borrie and Roggenbuck 1998; Patterson and others 1998). In addition to effects of density on perceived crowding, other effects of density need to be explored. Research on privacy has been initiated (Hammitt and Brown 1984), as has research on the achievement of solitude (Hollenhorst and others 1994). Density affects experiences through its effects on biophysical impacts, which represent both evidence of others and evidence of inappropriate behavior by others. Density is also likely to influence the frequency and nature of conflict between groups, which in turn influences experience.

A better understanding of visitor experiences is also likely to create a richer vocabulary with which to articulate and differentiate between alternative experiences. If we want to gather opinions about the relative appropriateness of alternative experiences, it is not very helpful to simply describe the alternatives as a wilderness experience or a semiwilderness experience. Such descriptors can be interpreted in many different ways. Moreover, when those experiences are described, the attributes used are largely confined to numbers of encounters or other density-related variables.

Finally, large-scale regional analyses of recreational supply and demand must be developed as the basis for individual areas deciding which experiences and user groups they should favor. Stankey (1974) suggests a number of criteria that might be used to make decisions about appropriate experiences: irreplaceability and relative abundance, substitutability, demand-preference relationship, complimentary-competitiveness relationship, and costs. The emerging interest in the concept and importance of place—and its implications for substitutability—has important implications for such work.

Limitations of Science

In his 1964 treatise, Wagar (p. 23) concluded with the following comment on the ability of science to provide an empirical basis for carrying capacity decisions and the dangers of overvaluing the opinions of current recreationists:

> Finally, it is concluded that, while research can provide various types of information for guidance, final definitions of recreational carrying capacity must be of an administrative nature. Ecological studies can show how biotic communities will change with use, but someone must decide how much change is acceptable. Research surveys…can measure current public opinion and analyze human motivation. But such motivation and opinion will seldom be based on a thorough understanding of availability and productivity of the resource. Someone must decide which combination of needs and desires it is most desirable to satisfy from our limited resources.
>
> On public lands…policy decisions should be by legislative directives and by public servants striving to achieve the public good. Recreational quality gained by limiting use must be weighed against values lost when such limits reduce the number of people served. Present values must be weighed against values of future generations.

In other words, science can produce helpful descriptive information. It can inform the evaluative and prescriptive stages of the decisionmaking process but it cannot make those stages any less subjective and judgmental in nature. People must decide what ought to be and someone must decide which people can participate in those decisions.

Managers are likely to continue to look to researchers for help in providing a scientific basis for management standards and use limits. Given the value-laden nature of such decisions, scientists need to be careful not to mislead managers about the utility of their empirical research. They should communicate the dangers of any analysis not done at large spatial and temporal scales. They should communicate the importance of understanding the needs and interests of diverse user and nonuser groups. If they do so and also give managers an increased appreciation of the pros and cons of alternative choices, they should contribute to better decisions.

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