WILDERNESS MANAGEMENT IN AUSTRALIA

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THE APPLICATION OF THE CARRYING CAPACITY CONCEPT TO WILDERNESS AND OTHER LOW-DENSITY RECREATION AREAS

by

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INTRODUCTION

Carrying capacity is perhaps one of the most central concerns of many wilderness and recreation managers today. It is of similar interest to researchers; the number of articles and papers dealing with the issue grows steadily (Stankey and Lime, 1973). Yet, a satisfactory resolution of the carrying capacity question remains elusive. Difficulty in dealing with the concept, in fact, has led some observers to conclude that it cannot be made operational (Wagar, 1974; Bury, 1976).

That carrying capacity is complex is not disputed. However, it is my contention that the underlying concept is integral to effective recreation and wilderness management. Moreover, it appears that much of the difficulty encountered in applying carrying capacity is linked to some serious misconceptions about the concept. Thus, the initial objective of this paper is to clarify the carrying capacity concept - what its role as a management strategy ought to be as well as the limitations regarding its applicability. Then, we will turn to an examination of how managers might attempt to apply the concept. Finally, we will look at some of the management actions that might be instituted to hold use at prescribed capacity levels.

THE CONCEPT OF CARRYING CAPACITY

Carrying capacity, a fundamental concept in natural resource management, is the limitation on use of an area, set by various natural factors of environmental resistance (e.g. food, shelter, or water). Beyond this natural limit, no major increases in the dependent population can occur (Odum, 1959). For example, a particular range might be capable of supporting 100 deer. In other words, when 100 deer live on the range, there is a balance between animal numbers and available food, shelter and water. If that balance is upset, perhaps by a substantial growth in numbers of deer, the productive capabilities of the range suffer. Food resources become depleted and perhaps even destroyed as animals search for nutrition. In such a situation, herd numbers exceed the range's carrying capacity and its ability to maintain deer will decline, even though a temporary increase in population might have occurred. In extreme cases, the imbalance may lead to long-term environmental impacts that are virtually irreversible.

As defined above, carrying capacity is seemingly uncomplicated. In fact, it is not. For instance, our example above involved deer; if another species had been involved, the numbers of animals capable of being supported on the same range would have been quite different. So, we can see that capacity limits vary according to the type of *consumer* we are talking about. Also, the limits were those naturally imposed. Had management intervened (e.g. by supplemental feeding or irrigation of natural forage), the range would have been capable of supporting a greater number of animals. Thus, carrying capacity is not an inherent, fixed value of the land. It can be diminished by unregulated overuse or enhanced by thoughtful management.

In recreation management terminology, carrying capacity has become a common, if not altogether well understood, term (Chubb and Ashton, 1969). Generally, it is used in two different ways. First, it is used to describe the ability of the physical-biological environment to withstand recreation use. Various studies have been

made of the impact of use on vegetation and soils (Willard and Marr, 1970), water (Barton, 1969), and wildlife (Schultz, 1975). Second, carrying capacity has been used to express the amount of use that is consistent with some measure of *quality* in the recreational experience (Wagar, 1964). Studies of *social carrying capacity* have focused on such things as the impacts of increasing use on the recreational experience (Shelby and Neilson, 1975) and on the impacts of conflicts between user groups (Lucas, 1964).

Efforts to measure the carrying capacity of recreation lands have been pursued with considerable enthusiasm, at least partially with the belief that once the number was found, the task of recreation management would be easier (Wager, 1968). But just as carrying capacity is not a simple notion for the range or wildlife manager, neither is it for the recreation manager. For instance, recreation lands are used by many different people *(consumers)* seeking many, different, and sometimes conflicting, experiences. Some want solitude, others look for companionship; what is appropriate for one represents congestion or loneliness to another. Thus, theoretically at least, there would be a different carrying capacity for every type of experiences provided.

Impacts on physical-biological resources are not precise indicators of overuse, either. Any use of an area produces some change; in fact, studies measuring resource impacts from recreation use generally report that light use produces substantial unnatural change (Frissell and Duncan, 1965; Wager, 1964; Merriam et al, 1973). Thus, if a manager elects to allow only use that will produce little or no change, it will be necessary to restrict use at very low levels (Wager, 1968). Capacity, considered from either the biological or the social perspective, is a function of more than simple numbers of users. In fact, use intensity by itself seems to be a fairly poor predictor of impact (Stankey, 1973); variables such as seasonality of use (LaPage, 1967) and habitat type (Helgath, 1975) are more effective in predicting impacts on resources, while type of use encountered (Lucas, 1964; Lime, 1975) and the location of encounters (Stankey, 1973) are particularly important in assessing impacts on users.

A suggestion of a useful definition of carrying capacity, in the context of wilderness, is the capability to produce wilderness - dependent experiences. Our focus is on the human experience for it is, after all, the ultimate produce of all resource management programmes (Wagar, 1974). Those experiences related to enjoying, appreciating and learning about the historic, natural processes that shaped the physical-biological community deserve emphasis in management, as do those linked to relatively low-density use conditions and non-mechanized styles of recreation use. Thus, wilderness capacity represents those *use configurations*[1] consistent with the long-term maintenance of opportunities for wilderness-dependent experiences.

The lack of any definitive index of overuse underlies much of the dissatisfaction with carrying capacity found among some. However, this dissatisfaction stems from an unrealistic expectation about what it is carrying capacity can do for the manager. The concept is not a formula to produce some objective estimate of *how much is too much*. As long as we look to it for such answers, we will be disappointed. More importantly, we will miss the true utility of the concept and the value it has for making decisions about the relationships among users, resources and experiences. The following four propositions about the nature of carrying capacity will perhaps clarify how the concept ought to be used.

The determination of carrying capacity is ultimately a judgemental decision.

Perhaps the most fundamental point to be made about carrying capacity is that it is a produce of management judgement rather than a precisely defined measure or scientific concept - it is a decision making concept rather than a scientific concept. Whether we are

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1 Use, which is more than a matter of simple numbers, varies also by type, time, space, and behaviour. We use the term *use configuration* to refer to some specific combination of these variables (Frissell and Stankey, 1972).

measuring physical-biological impact or social impact, the relationships between use and the resultant impact are typically described by continuous curves, which lack abrupt and clearly define changes (Frissell and Duncan, 1965; Wagar, 1964; Stankey, 1973). Information about use impacts will not define capacity limits; it will describe the consequences associated with different use conditions. Such decisions must rest on the judgement of managers as to whether these consequences, either actual or anticipated, are acceptable.

Such a situation clearly limits the role of the researcher or scientist in the capacity calculation. The researcher, rather than prescribing *how much is too much*, is the source of information about the stream of consequences of alternative use configurations on the ecological, physical, and social elements of a setting. From such information, standards can be formulated and criteria prescribed for identifying factors that might limit use (Pfister and Frenkel, 1975). As far as possible, these standards should be measurable or quantifiable conditions in order that logical and defensible decisions about use limitations can be made.

Although the establishment of carrying capacity standards should have a base in scientific knowledge, the judgemental nature of the carrying capacity definition still leaves open the possibility of decisions that are arbitrary or illogical. Our second qualification deals with this concern.

Carrying capacity decisions depend on clear management objectives.

Management objectives - the definition of the environmental and social conditions that have been chosen to prevail at a specified location - provide the basis from which carrying capacity determinations are made. As Wagar has noted (1974), decisions about objectives involve value choices based on normative judgements of what ought or should be, as opposed to technical decisions about what can be. Being value judgements, they are less dependent on the technical expertise of resource management professionals than on their agreement with broad social goals defined as desirable by public consensus.

Only when these goals are reduced to specific area *management objectives* - formal statements of the environmental and social conditions that management either seeks to maintain or to restore - can logical carrying capacity decisions be made. Statements of management objectives should thus be precise and site specific so they can serve as criteria for making carrying capacity decisions.

In making carrying capacity decisions, the range of available alternative opportunities must be taken into account.

Decision about carrying capacity, like similar judgemental decisions, should be considered in the context of a broad spectrum of outdoor recreation and leisure opportunities. Such decisions should be resolved in light of other opportunities existing within a regional area. Only when wilderness is viewed as one part of a broader outdoor opportunity system is there an equitable and defensible rationale for preserving the relatively low-density use commonly associated with wilderness. In order to adequately meet the diverse tastes of people, a range of opportunties is needed, varying in terms of such things as interpersonal contact, access and development (Lloyd and Fischer, 1972). Carrying capacity thus represents a general management strategy for maintaining a particular set of conditions within a system of recreational opportunities (Lime and Stankey, 1971) - a strategy that is a direct consequence of the decision(s) to preserve a range of different opportunities. But the maintenance of these conditions, particularly when direct limitations on use may have to be implemented can be justified only if alternative settings meet people's needs for other kinds of experiences. In my view, maintaining carrying capacities for wilderness without providing and managing for other non-wilderness opportunities will be, in the long run, politically unacceptable.

Carrying capacity is a probabilistic concept, not an absolute measure.

Our fourth qualification is that carrying capacity can be stated only in terms of what is probable, not in terms of what can be assured. This generalization simply points out that in no way

can all the contingencies affecting capacity decisions be predicted or accommodated. The vagaries of weather, changing user behaviour and so forth will always mean that unanticipated impacts will occur. Carrying capacity is not intended to anticipate all such events. Rather, it is intended to serve as a framework that accommodates the most probable pattern of events.

As an example, capacity calculations might be made assuming that normal weather patterns will prevail. However, a sudden spell of unseasonably rainy weather that turns trails into muddy mires will obviously upset these calculations and force managers to reassess the anticipated use impacts on trails. Thus, while the carrying capacity determination for an area serves as a basic outline of the use-impact relationship managers can reasonably expect to occur, it does not eliminate the need for continuous monitoring of conditions or the need for good professional judgement in the face of changing conditions. Establishing carrying capacity standards for an area will not give managers an impersonal formula to which they can turn in order to make difficult decisions (Wagar, 1968).

In summary, carrying capacity is ultimately a judgemental determination rather than the product of some absolute and measurable characteristic of the environment. In specifying carrying capacity, we are prescribing the use of configuration consistent with the social and ecological conditions we wish to prevail at a location. These conditions are formalized in area management objectives derived from managerial judgement and citizen input, and tempered by various constraints, such as laws. Definitions of appropriate capacity levels need to be derived in light of a spectrum of outdoor opportunities in order that diversity and equity be achieved. Finally, capacity is a probabilistic concept; it is neither possible nor necessary that all contingencies be accommodated.

RESEARCH ON CARRYING CAPACITY

As suggested above, carrying capacity has been the focus of a number of research efforts, both by physical-biological scientists and social scientists. These studies confirm the notion that generally no conclusive level of input exists that defines *the* capacity.

Physical-biological impact is a complex phenomena. It does not bear a direct linear relationship to use; in fact, use intensity is less helpful than other variables (e.g. method of travel, season of use) in explaining the degree of impact sustained. With the onset of recreation impact, substantial alterations in vegetation and soil occur. Several studies (Wagar, 1964; Frissell and Duncan, 1965; Merriam and Smith, 1974) have reported the presence of a curvilinear relationship between use and impact on vegetation and soils, with substantial amounts of impact occurring with only light use. Frissell and Duncan found that over 80 percent of the ground cover was lost at campsites in the Quetico-Superior with only light recreation use. (They defined light use as from 0 to 30 days per season.) In a five-year study of impact on newly opened sites in the Boundary Waters Canoe Area, Merriam and Smith (1974) reported that most site impact occurred within the first two years, then stabilized. At this equilibrium point, there is typically a major shift in the composition of the vegetation, with delicate and fragile species disappearing, to be replaced by hardier, more resistant species (Verburg, 1974). Thus, ecosystems can adapt to recreation pressures through a process of succession. However, while this kind of adaptation could aid managers of developed campgrounds (e.g. see Magill, 1970 and Merriam and Smith, 1974), such succession is a major problem in wilderness where management objectives often emphasize the preservation of natural conditions.

In general, our knowledge of other ecological consequences associated with recreation use is poor. Impacts on wildlife behaviour, air quality, or water quality are understood in only

descriptive terms. We lack the ability to predict, in quantitative terms, the consequences of alternative levels, types and patterns of use on the physical-biological environment, a serious shortcoming in our efforts to develop the potential of the carrying capacity concept.

Our knowledge of social carrying capacity is also inadequate. However, a review of the literature does point to several important conclusions. A variety of use-related variables must be examined in order to accurately measure the consequences of use on the wilderness experience. While increasing use is clearly one of the important variables, other use dimensions must also be examined and may be more significant than total use. As was the case with ecological impact, use intensity is best described as a necessary, but not sufficient variable, in the determination of the social impact of wilderness use. Violations of acceptable behaviour and conflicts over appropriate styles and methods of use often will be the critical variables on which managers must focus their attention. As Lee (1975) notes, social relations between wilderness campers is often more important to the satisfaction of those users than the condition of the physical environment. Therefore, encouraging appropriate wilderness behaviour might be the most important action managers can undertake.

The research on visitor perceptions of crowding and overuse must be carefully interpreted. Much of the research on the effects of increasing use on visitor satisfaction has involved hypothetical situations and questions of preferred, rather than actual, contact. Studies reporting responses to use levels actually encountered, have generally reported little association between the level of contact and visitor satisfaction. This work has been done in a variety of wildland settings; Lee (1977) in the Yosemite National Park backcountry, Shelby and Neilson (1975) on the Grand Canyon of the Colorado, and Lucas (Forthcoming) in the Desolation Wilderness. Each of these investigators have found little statistical or substantive relationship between the amount of use visitors actually encountered and the level of satisfaction they reported with their experience. Does this mean that crowding is not a problem in wilderness?

The lack of an observed relationship between use and satisfaction has several potential explanations, not necessarily exclusive of one another. The level of contact with other people is only one of the components of the wilderness experience and its relative importance surely varies among users. Also, even for those to whom solitude is important, it may be that other aspects of the wilderness experience compensate (in a sense, increase in their relative importance) when use levels are high enough that solitude is difficult to find. Thus, although the level of use might be fairly high, there are other features of the trip that make it worthwhile: new acquaintances were made, the scenery was superb, the hike was challenging, and so forth.

We need to also recognize that the investigations of visitor ideas about crowding may be simply missing those users to whom solitude is especially important. For these people, conditions may have already exceeded some critical threshold of sensitivity; they have already sought other places where use conditions are still consistent with their desires. These *displaced* persons represent a measure of the cost involved when a carrying capacity constraint is not imposed.

Finally, reports of satisfaction need to be understood in the context of what was expected. Where expectations are poorly defined (e.g. a first-time visitor has little basis for knowing what to expect), satisfaction with the experiences are difficult to assess. Crowding is generally recognized as a personal judgement or assessment about some physical condition measuring people per unit of space (Altman, 1975). Moreover, the context of the situation is important. Judgement about whether the number of people present per unit space (the density) is a crowd or not depends on the nature specific context. A cocktail party can have too few people; wilderness campsite can have too many, even though the same number of people might be involved in both situations. And, what is judged to be appropriate is largely a function of the norms (rules, either written or unwritten) that govern the situation. Thus, where norms are poorly defined or poorly understood (e.g. as by a novice wilderness user) the evaluation of use conditions as

being crowded, just right, or underused will be inconsistent and variable.

What the lack of association between use and satisfaction does suggest is that the notion of managing wilderness to *maximize satisfaction* is probably not a very effective or useful management idea. Why not? Satisfaction is a very general, inclusive concept; the difficulty of using it to guide carrying capacity decisions is that it will probably continue to rise over time because people will continue to report, typically, that they enjoy outdoor experience (Heberlein and Shelby, 1977). However, at the same time, we must recognize that the nature of the experience is changing constantly - there is a *shift in product* from a wilderness dependent experience to one simply enhanced or incidental to a wilderness setting.

This change in the nature of the opportunity and the kind of experiences offered is central to the carrying capacity issue. Rather than managing to maximize satisfaction or uncritically accepting the argument that solitude is not important because there is little observed relationship between increasing use levels and satisfaction, the task of wilderness managers ought to be the development of policies to insure preservation of opportunities producing wilderness-dependent experiences. Solitude is an important feature of the wilderness experience to many people. Increasing use restricts the degree to which visitors can find solitude and although there are various techniques or mechanisms that people can adopt to achieve solitude (e.g. going during the off-season, travelling cross country), the opportunity to find solitude will eventually diminish if use continues to grow. Rather than attempting to define capacity through some quantitative estimation of satisfaction, the challenge is to develop area management plans that ensure maintenance of opportunities where the ranges of inter-human contact normally prevailing is low.

APPLYING THE CARRYING CAPACITY CONCEPT TO WILDERNESS

Even though there are various definitions of carrying capacity used by biologists, range managers and others, in general the concept is used to describe the relationship between the productivity of a resource and the ability of that resource to maintain its productivity. For instance, the long term productivity is diminished as intensified grazing exceeds the natural regenerative capacity of the range.

We can apply this same basic principle to wilderness management. In wilderness, the product of management programmes is a set of human experiences that are linked to the naturalness of the environmental setting, and thus to a very low level of development and to a generally low level of contact with others. These elements appear to be basic attributes of the *wilderness* experience, even though the term refers to what is a complex and diverse set of experiences which different individuals might or might not share.

However, the qualities of naturalness and solitude are subject to change. For instance, as recreational use increases, opportunities for solitude decline while the probability of substantial modification of ecosystems increases. Excessive change might be reflected in the form of a social cost (e.g. congestion with resulting impacts on the wilderness experiences), an environmental cost (e.g. loss of water quality, vegetation impact, disturbance of wildlife population) or a combination of the two (e.g. a severely impacted campsite that represents a substantial modification of an ecosystem as well as an aesthetically unattractive scene). Any of these impacts represent a loss in wilderness carrying capacity to the extent they adversely affect the long-term capability of the resource to produce wilderness-dependent experiences.

THE ROLE OF MANAGEMENT OBJECTIVES

The key to dealing with carrying capacity lies in the specification of explicit and detailed management objectives. In the United States, a major shortcoming in most wilderness management plans is the lack of objectives that allow managers to specify the conditions they seek and to measure performance with regard to achieving those objectives. The failure to develop such objectives is also the reason that specifying wilderness carrying capacities has remained an elusive task.

Management objectives define the physical, biological and social conditions within wilderness that management programmes seek to create, restore, or maintain. They serve as criteria for management policies and actions to achieve these conditions; thus, the objectives for recreation use, trails and travel, fish and wildlife, etc., serve as the criteria for establishing carrying capacities and the policies and actions needed to hold use consistent with these capacities. Objectives are prescriptive; i.e. they tell what conditions *should* be like. This characteristic allows managers to review conditions at any given point in time in order to determine the discrepancy (if any) between the conditions desired and the conditions that exist. To the extent that a discrepancy does exist, management policies and actions can often be applied to lessen the difference. Similarly, objectives serve as criteria that allow managers to review the likely outcome of different use configurations and to judge whether the probable consequences are compatible with established objectives.

Obviously, management objectives must be both site-specific and detailed. Vague statements, such as *Management will seek to ensure preservation of native fauna* are too imprecise to permit managers to assess their progress toward that goal. The lack of precision, specificity and detail in stated objectives is the source of many management problems, and it is certainly at the root of the difficulty encountered in attempting to formulate wilderness carrying capacities.

Management objectives provide managers with several critical pieces of information. They describe the nature of the experience to be produced, they serve as the operational objectives by which all management decisions must be formulated, they define what tools and strategies are appropriate for use by managers and they serve as a check to test progress toward their achievement.

To tie these elements together, we now turn to a framework within which we can address the basic question facing wilderness managers attempting to determine carrying capacity.

> *Given the inevitability of change, what are the limits of acceptable change that may occur without the loss of those qualities that led to the delineation of this land as wilderness?*

Defining the Limits of Acceptable Change

Change is a fact of life with which wilderness managers must contend. Natural ecosystems are constantly evolving and wilderness management programmes should permit this natural evolution. Man-caused change, on the other hand, brought about either by direct impacts of man (e.g. recreation) or through management policies (e.g. fire exclusion), is something management should minimize. Similarly, the social aspects of wilderness also change. Absolute solitude (the complete absence of other people) is seldom experienced - the social environment that characterizes wilderness is usually modified. Likewise, the natural environment will almost always show some signs of modification and the human satisfactions gained from the enjoyment of pristine nature may be correspondingly lessened. In either case, excessive change alters the capability of the wilderness resource to offer the kinds of experiences associated with wilderness; in other words, it reduces wilderness carrying capacity.

Change, occurring in both the ecological and social realm, is not only continuous; it is also complex and interdependent. The biological changes (e.g. soil compaction) which have obvious

ecological implications, also affect visitor satisfaction. Likewise, social changes (e.g. increased congestion around lakes) lead to impacts of both a biological and social nature. Let's take a closer look at these ecological and social systems and attempt to bring some order to this complexity.

Establishing ecological limits of change

Ecosystems evolve with regard to both character and rate. By *character*, we mean the composition of the biological system; the species, the relative frequency of the different species, and so forth. Man's influence can affect the character of ecosystems by introducing exotic species, while eliminating others. Additionally, the composition or character of any ecosystem changes over time and the *rate* of this change can be influenced (either retarded or accelerated) by man. Man's impact, then, can lead to variations in both ecosystem character and the rate of evolution beyond what we would expect to occur under long-term averages.

Figure 1 presents this relationship. The central band labelled *Natural Variation in Rate and Character of Use* represents the natural range one would expect to occur without man's influence. But as discussed earlier, man's pervasive influence has altered the natural order. Thus, some man-caused change in both character and rate is expected and accepted. However, at some point this change becomes excessive, i.e. the conditions that prevail no longer represent wilderness. It is at this point that the ecological carrying capacity of the area has been exceeded. The definition of the point at which an area is still representative of wilderness (i.e. its carrying capacity) is incorporated within the area's management objectives and the accompanying standards established to measure performance toward achievement of those objectives.

This, of course, is a very simplified model of what in reality is very complex. Ecosystems are composed of numerous diverse components that are interrelated in ways that are

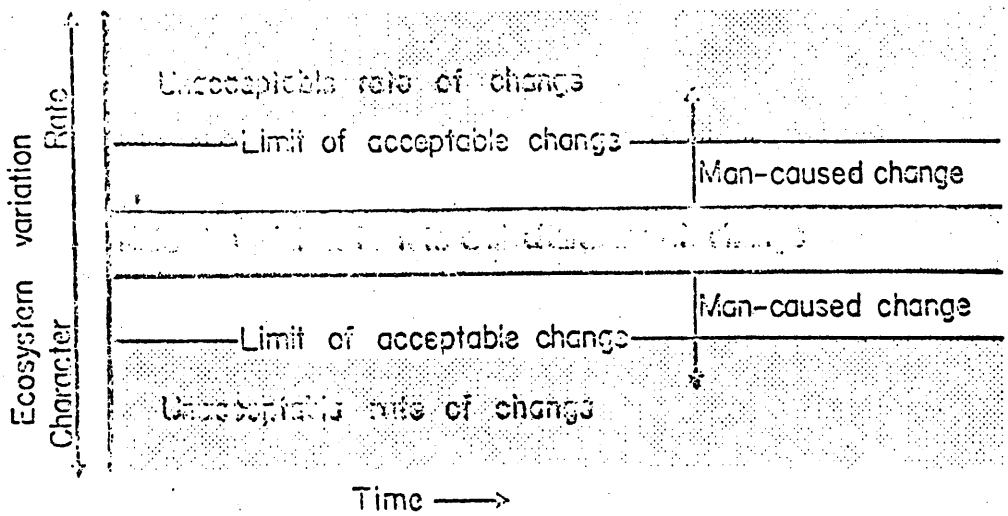


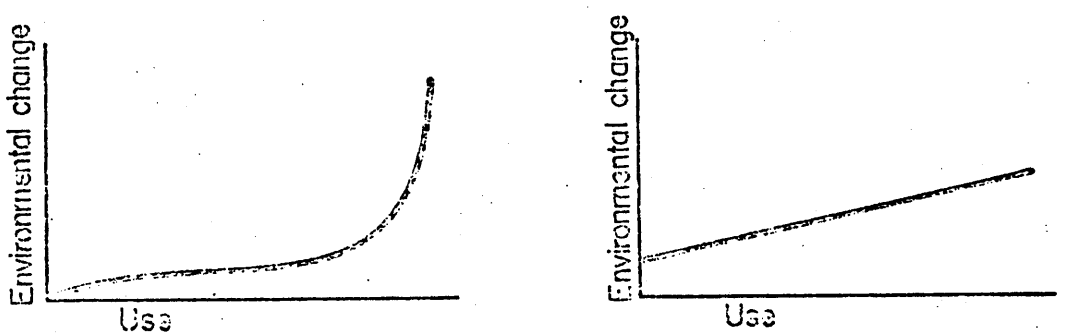
Figure I Model of Acceptable Ecological Variation in Wilderness

often poorly understood. Changes occur in each individual resource element. For example, the introduction of any particular use configuration leads to change in soil bulk density, percentage of ground cover at campsites, wildlife behaviour patterns, and so forth. Thus, our model of ecological carrying capacity actually must be repeated for each of these elements as well as for other variables that can be isolated for study. The most sensitive indicator becomes the limiting factor. For example, the wilderness manager might establish a series of standards to measure performance toward achievement of the area's management objectives. These would clearly and precisely specify the environmental conditions desired at that location in order to achieve those objectives. They might indicate the maximum amount of ground cover that would be permitted to be lost at campsites, the level of coliform bacteria permissible in lakes, the extent of intrusion of exotic plant species, and so forth. Such standards might be derived from data generated in studies in the area, by interpreting from data generated

elsewhere, or from judgement based on the managers own experience.

For each environmental parameter, a *Limit of Acceptable Change* should be established (Frissell and Stankey, 1972). Managers would then be alert for a change in conditions that exceeded the established limit. Conditions that exceed limits (or give managers strong reason to believe that excessive change is imminent) would call for a change or a new emphasis in policies and actions to minimize the impact. These might range from light-handed restoration to restrictions on visitor numbers; we will look at management techniques in more detail later.

How does one go about setting *Limits of Acceptable Change?* There are no clearcut procedures. In some cases, however, managers might be able to make a relatively easy decision. Consider, for example, situation A in Figure 2, a hypothetical diagram of the relationship between total use and environmental change along a trail.



Situation A. Here an abrupt shift in the rate of change helps define the limits of acceptable change.

Situation B. Here a continuous low rate of change provides no clear evidence where the limits of acceptable change should be established.

Figure 2 Hypothetical relationship between use and environmental change

Up to a certain point, the environmental change recorded is low and relatively stable. Then, there is an abrupt shift upwards. Managers might establish standards that specify that conditions will not exceed those beyond the abrupt shift in the curve. In such a case, the basis for establishing the limit of acceptable change becomes a relatively easy task.

In many other cases, however, there will be no readily apparent point beyond which change should not be allowed. For example, change might be steady and constant in situation B of Figure 2. There is no obvious point at which an abrupt or noticeable shift occurs; managers are thus faced with establishing the limits of acceptable change in the absence of any distinct discontinuities. Management judgement thus becomes a crucial part of the carrying capacity process.

Establishing social limits of change

The model we have described for ecological carrying capacity can be repeated for establishing social limits of change. However, it is somewhat more difficult to describe our starting point for social change than for ecological change. What is loosely referred to as the *wilderness experience* is, in fact, a composite of diverse human experiences related to wilderness. For some people, solitude is the key value. For others, it is the challenge offered by an area where man is on his own. For still others, it is the opportunity to anticipate or witness the untrammeled processes of nature. Thus, rather than viewing the wilderness experience in Figure 3 as some fixed, unbending definition, it is better to think of it as a generalized and hypothetical concept.

For the purposes of discussion, let's assume that the *perfect* wilderness experience offers the user complete solitude, an opportunity to appreciate and study completely

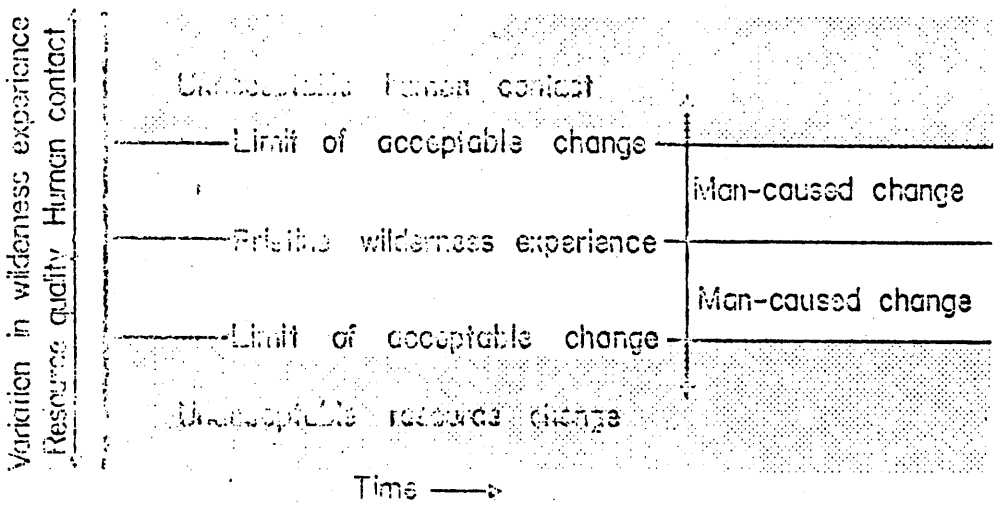


Figure 3 Model of Acceptable Variation in Wilderness Experience

undisturbed conditions, the ultimate in challenge, and the absence of facilities or aids. In reality, of course, wilderness throughout the world has been tamed in varying degrees. Nevertheless, most efforts to define wilderness are clear in terms of their general intent; wilderness should offer low intensities of use, a relatively unmodified setting, challenge and a chance for discovery. Constantly meeting others along the trail does not seem a part of the wilderness experience, nor do bare and dusty campsites and trampled vegetation. To accommodate these variables, the model in Figure 3 recognizes two important factors for establishing social use limits: human contact and visitor perception of resource quality.

As suggested above, there is probably relatively good agreement on the general nature of the essentials of the wilderness experience. The principal difficulty does not emerge until we attempt to develop more precise guidelines. At what point does contact with others change from being a pleasant and even welcome interlude to an unwelcome invasion

of privacy? The question centres on a value judgement, but whose values: users or managers? Whose judgement should predominate? These two groups often hold very different views (Hendee and Harris, 1970). Resolving in favour of the user doesn't always help because wilderness users are spread across a wide spectrum, ranging from the inveterate enthusiast to the one-time, casual drop-in. Assuming a single standard for judging acceptable change is wrong; striving for an average is also unrealistic.

Several efforts have been made to deal with the problem. Lucas (1964) argued that BWCA managers give more attention to the attitudes of canoeists than to motorboaters because their behaviour was more in keeping with area management objectives; i.e. they were canoeing, rather than using a motor, in an area established primarily to provide an opportunity for wilderness canoeing. The Outdoor Recreation Resource Review Committee wilderness report (1962) used amount of past wilderness experience as a measure of commitment. Hendee et al (1968) and Stankey (1973) used attitude scales to differentiate users on the basis of the *purity* of their attitudes toward wilderness, arguing that the standards ascribed to by those scoring high in purity should be given particular attention by decision-makers.

These examples illustrate an important management guideline; emphasize wilderness-dependent activities. The process of defining the primary clientele group is something managers cannot avoid. The principle of featuring wilderness-dependent activities offers a logical and systematic procedure for helping to define this group. By assigning first priority to the needs of users who, by their behaviour and/or attitudes reveal a dependent relationship to wilderness (that is, whose experiences can be satisfied only, or at least largely, by the primitive, unmodified, and low-use-density setting offered by wilderness), managers can most effectively utilize public input to guide carrying capacity decisions.

As with the ecological model of capacity, the social model involves a number of specific elements, any one of which might define an area's social carrying capacity. A manager will want information about total number of encounters, encounters with other kinds of users, crowding at campsites, and so forth. Judgements about acceptable limits for each element comprise standards; when these standards are reached they constitute a limit on further use. For example, managers might suggest that, on the average, wilderness parties should not meet more than three other parties per day. If data indicates that most parties encounter five other groups per day, managers might decide to remedy this through a programme of use redistribution. Such a programme would give visitors information about use conditions so that people concerned with solitude might alter their routes to achieve this personal objective. If this technique doesn't reduce encounters, direct rationing of use might have to be instituted. The point is, management actions are taken as part of a logical and visible process intended to help achieve an established objective.

MANAGING WILDERNESS USE CONSISTENT WITH CAPACITY

The prescription of carrying capacity guidelines carries with it the implication of management intervention. If conditions threaten to exceed established capacity levels, such type of action should be instituted. These actions can be broken down into three basic categories: (1) Area management objectives could be changed, thereby, in effect, raising the carrying capacity by making higher levels of use and/or resource impact acceptable; (2) Management actions to *harden* the resource (e.g. by planting impact tolerant species, paving trails, etc.) could be undertaken, thereby reducing the level of impact occurring; and (3) Actions to restrict use in some way (e.g. total amount, distribution, type, timing, etc.) could be instituted.

Changing Area Management Objectives

Changing the nature of environmental and social conditions that will prevail at a location in a purposeful and conscious manner

could be a very appropriate strategy for managers to adopt. When use pressures are high and the area small, such a technique may be virtually the only realistic alternative. The danger is that such a measure may become the easiest way out. And, in the long run, a constant reliance on changing objectives could eventually result in the loss of a particular type of outdoor opportunity and the disenfranchisement of a dependent clientele. Thus, while changing management objectives in the face of increasing use pressure is a viable alternative, its application ought to be carefully considered and limited.

Hardening the Resource

A variety of efforts to make the setting more resistant to impact could be undertaken. Extensive site modification through such actions as paving, facility development, the use of impact-resistant or -tolerant species, and so forth could help reduce the level of resource impact. However, such actions would also lead to creation of a very different type of opportunity and, subsequently, different kinds of experiences. Moreover, such engineering type solutions in an area managed primarily to protect naturalness and ecological processes seem generally inappropriate. Thus, while site hardening actions may have some role in contending with use impacts in wilderness, it would appear this role is limited.

Managing Visitor Use

The third general alternative available for holding impacts in wilderness within capacity prescription is the institution of restrictions or controls on the source of these impacts - the wilderness visitor. Here, efforts are focused on altering visitor behaviour in some way so as to reduce or eliminate undesired impacts. Obviously a wide range of possible actions could be instituted. It is helpful to think of these actions as arrayed along a continuum ranging from those which are indirect, subtle and light-handed to those more direct and authoritarian in nature (Gilbert et al, 1972; Lime and Stankey, 1971).

Some examples of the kinds of actions that might be undertaken may be helpful. Among those actions that might be described as indirect, consider the use of information. In the United States, one of the central findings emerging from a number of studies of wilderness users concerns the highly skewed distribution of use in both space and time. It is not uncommon, for example, to find 75 percent of an area's total use entering through less than 20 percent of an area's available access. The resulting congestion often detracts from many visitor's experiences.

Achieving a more even distribution could be achieved in a very authoritarian fashion, by requiring visitors to travel and camp according to an assigned itinerary. But we know such direct control on behaviour is especially onerous to wilderness visitors; much of the appeal of wilderness is associated with the very lack of such control.

Rather than instituting such an action, it may be possible to achieve close to the same result by simply providing visitors with better information about the area - about alternative entry points and routes, about zones of crowding; about times when use is higher, and so forth. We are currently experimenting with such an approach in the United States and preliminary results suggest it holds considerable potential. For example, in the Boundary Waters Canoe Area in northern Minnesota, Lime and Lucas (1977) report that about one-third of their survey respondents visited a new entry point after receiving a brochure containing information about areas and times of high use.

However, use conditions can reach the level where indirect measures such as information are simply not adequate to control the impacts associated with that use. When these conditions occur, implementation of more direct measures are needed and appropriate.

Again, there are a variety of measures that might be instituted but most represent some form of rationing. Rationing is a generic term describing a procedure for allocating access to a limited resource,

be it petrol or wilderness. The specific technique to allocate the resource could be money, as in a pricing system, or time, as in a queuing, or first-come, first-served system, or some other form of cost. The point is, whatever rationing system is imposed, there is a cost associated with it for both managers and users. Thus, there is no single, best way to ration. The most effective approach, if rationing is warranted, is to attempt to offset costs by combining different kinds of rationing systems.

For example, an advance reservation system that requires potential visitors to predetermine when and where they want to visit imposes a cost that bears unduly on those people who, for one reason or another, simply can't plan their lives ahead. Alternatively, a queue or first-come, first-served system, imposes a cost of time and thus discriminates against those to whom time has a high opportunity cost (Stankey and Baden, 1977). By combining the two, as has been done in a heavily-used wilderness in California, the respective costs are somewhat offset. People have a choice on how they will *pay*. Moreover, the combined system is a more efficient allocation of the scarce resource. Advanced reservations, as the airlines will testify, suffer from *no-shows*; i.e. reservations made and then not used. In the United States, such *no-shows* often constitute over 50 percent of the available capacity. By combining advanced reservations with a queue, unfilled reservations can be filled by the next person in line, thus assuring a more efficient use of the resource.

In the United States, wilderness management has become largely a matter of visitor management (Lucas, 1973). This seems appropriate, given the primary objective of protecting natural ecological processes. Nevertheless, recreation use of wilderness is an important aspect of wilderness preservation and there is concern as to how visitor management might alter visitor experiences. In a very real sense, management itself can become so intrusive that it actually lowers capacity by severely detracting from visitor enjoyment. Thus, there is a need for sensitivity and judgement in applying visitor management actions. Two general principles help provide some guidelines on this issue.

First, the primary concern in any management action is controlling the impact, not use *per se*. As indicated earlier, there is not a direct linear relationship between impact and use levels. Certain types of use may lead to disproportionate levels of impact. Thus, management actions ought to focus in on the specific cause of the impact, rather than attempting across-the-board cut-backs in use that may do little to reduce impact.

Second, as noted in the earlier paper on international concepts of wilderness, visitor management ought to be guided by a principle of minimum regimentation, or more plainly put, use only the minimum level of management necessary to achieve your objective. In the United States, managers in some wildernesses have instituted tightly regulated trip plans for visitors, with routes, campsites and length of stay assigned. Such a system may appear, at least theoretically, efficient. However, they tend to cut abruptly across visitor experiences; moreover, they don't work very well. But most important, they were probably unnecessary, at least at this time. It would have been more appropriate to have begun with some form of indirect control first, then moving onto more direct techniques, if the former proved ineffective.

My final observation regarding the issues of carrying capacity and visitor management is to stress the need for accurate, objective data. In the United States, too many wilderness decisions rest on impressions, unfounded assumptions, stereotypes and hunches. While the level of data collection is improving, there is still a long way to go. Data on use - how much, its composition, its spatial and temporal distribution - is usually inadequate. Similarly, data about resource conditions, and especially about the trends in those conditions, is poor or even absent. Without such data, good wilderness planning becomes coincidental.

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