Toward the Integration of Economics And Outdoor Recreation Management

By

Alan Jubenville
Scott C. Matulich
William G. Workman

Agricultural and Forestry Experiment Station
School of Agriculture and Land Resources Management
University of Alaska-Fairbanks
James V. Drew, Dean and Director

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Alan Jubenville
Associate Professor, Resource Management
School of Agriculture and Land Resources Management
University of Alaska-Fairbanks

Scott C. Matulich
Associate Professor, Agricultural Economics
Agricultural Economics Department
Washington State University

and

William G. Workman
Professor, Economics
Agricultural and Forestry Experiment Station
and
Department of Economics
University of Alaska-Fairbanks

Agricultural and Forestry Experiment Station
School of Agriculture and Land Resources Management
University of Alaska-Fairbanks

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Preface

The general theme of this bulletin is that improved management of public-sector recreational resources is a multidisciplinary task. To this end, we attempt to integrate elements of outdoor recreation management theory and economics. The bulletin is written for both resource managers and researchers. For the former, our intent is to emphasize the importance of being aware of economic implications—at least conceptually—of management actions that influence the character and availability of recreational opportunities. To researchers involved in developing recreation management theory, we draw attention to the parallel between recreation management theory and the traditional managerial economic model of the firm. To economists, particularly those involved in developing and applying nonmarket valuation techniques, we draw attention to the types of decisions faced by resource managers.

We argue that the most important resource allocation issues are of the incremental variety, so nonmarket valuation should also yield incremental values. These values alone, however, are not sufficient economic input into rational public choice analysis. The missing link, or nexus, between outdoor recreation management theory and economic analysis is the integration of supply and demand, as called for by traditional managerial economics. Collaborative research to develop recreation supply response functions akin to agricultural production functions is an essential step that is missing from both literatures. Theoretical and applied work assume greater practical importance if they feed information into this broadened framework. It is our hope that this bulletin will bring the disciplines closer to that realization.

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Introduction

The generic role of the recreation resource manager is to provide opportunities to potential users through the allocation of resources. Implicit in this view is the distinct role of the user in producing his own experience, given the opportunity presented. While this may seem to suggest that the user's choice of a site is exogenous to the manager, it is not. The resource manager has some control over biophysical and managerially determined attributes such as improved access and facility development. These controllable inputs, taken together, presumably contribute to the value of the recreationist's experience on the land. The link between potential recreational value and a site's inherent and managerially determined characteristics must be known if management is to maximize a site's contribution to visitor welfare. Armed with this knowledge, managers are in a position to dedicate for recreational or multiple use those sites which, due to their natural attractors, have a comparative advantage in producing desired recreational services. Societal well-being can be enhanced through the managerially determined attributes of the site.

That the characteristics of a resource influence its productivity and capitalized value comes as a surprise to no one. This linkage is readily observable in markets for all classes of natural and capital resources from farmland and oil tracts to parking lots. Private entrepreneurs are aware of causal relationships between the conditions of resources, their productivity, and, ultimately, market values. Economists employ standard production economics techniques to analyze the implications of various private resource allocation options. Consider, for example, a rancher who contemplates spraying sagebrush on his pasture to increase its grazing potential. The traditional production economics treatment of this situation starts with the biological response function of forage to the spraying treatment and ends with an assessment of the change in net returns associated with the optimal level of treatment. The decision of whether or not and how much to spray hinges on (a) the biological response of forage to the introduced chemical; (b) the cost of various levels of treatment; (c) the value of the associated yields; (d) identification of the most advantageous level of treatment based on costs and returns; (e) computation of added annual net returns (rents) associated with this optimal treatment; and, possibly, (f) the computation of the capitalized value of the investment.

If the rancher's range land has alternative uses (e.g., cattle grazing and elk habitat) and if these uses are competitive over some of the range, the resource allocation decision process is slightly more complicated. It involves maximization of net returns or rents from the combination of enterprises, assuming the rancher can capture the benefits from availability of increased elk numbers. The traditional production economics treatment begins with the physical trade-offs among enterprises as they compete for resources and culminates in the identification of a solution to a net returns maximizing problem that yields the highest capitalized value of the land.[1]

The public-sector, recreation resource manager faces a decision-making situation very much like that which confronts the rancher; efficient resource allocation requires maximizing expected flows of economic surpluses (net benefits), only now the decision process is confounded by two special circumstances. First, while benefits of private sector allocations are captured by both private consumers and sellers, pricing policies for most publicly provided recreational opportunities allow the bulk of any economic surplus to accrue only to visitors. Nonmarket valuation techniques are essential to measure these consumer benefits. Second, measurement of biophysical responses to management is more difficult. Fundamental biological relationships such as mule deer population response to bitterbrush enhancement or salmon stock response to spawning gravel enhancement are not well developed. User response to altered biophysical conditions, access routes, or regulations also are not well understood.

It is our view that outdoor recreation research has often failed to yield a cohesive decision tool that facilitates effective recreational planning.

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[1] Empirical measurement of physical tradeoffs has proven elusive when one of the products is a nonmarket good. But as long as the benefits from elk usage can be internalized by the rancher, explicit or implicit tradeoffs are considered.

There has been no unifying effort to integrate the separate contributions of recreation management theory and economics. This bulletin advances the managerial economics model as an appropriate analytical framework to discipline and unify the contributions of both professions. Elements of recreation management theory and economics are combined to illuminate the linkage between the recreation experience realized and the role of management in creating the quantity and quality of that experience.

Initially, developments in recreation management theory are reviewed to illustrate the potential congruence with the managerial economics framework. While much of recreation management theory has evolved as a social-psychological inquiry into recreation user behavior, there is also a small core of literature that acknowledges the role of the manager in creating recreation opportunities. Together they may be regarded as a "demand-and-supply" view of outdoor recreation.

Next the role of economics is reviewed in the context of the most common types of decisions confronting recreation managers. It is argued that the most frequently used "all-or-none" nonmarket valuation or demand techniques will yield little information that is useful in the typical marginal allocation decision. It is further argued that the historically singular focus on valuation will ensure continued failure to integrate managerial contributions with user choices, i.e., supply with demand. Supply-oriented analysis is essential to realizing the potential of the managerial economic model. Efficient production of recreational opportunities is no more the exclusive domain of recreation management specialists than crop production is that of agronomists.

Recreation Management Theory

Recreation management theory is rooted deeply in social psychological concepts. Many of the theories proposed to explain user behavior have been tied to the motivation of the visitor (Driver and Brown 1978, Tinsley and Kass 1978). Typically, motivational studies have been funded by management agencies under the assumption that a better understanding of the user's motivations/behavior should help to improve the quality of the management programs. These investigations have defined output as the recreational experience of the individual, assuming that specific motivations lead to specific experiences and, ultimately, to benefits. Brown and Driver (1978) synthesized this idea into a demand-based theoretical framework for examining (1) activities, (2) situational attributes, (3) psychological outcomes, and (4) benefits.

Some scientists such as Clark and Stankey (1979) and Driver and Brown (1978) have suggested that we also look at the supply, or management, side of the issue. Clark and Stankey (1979) focused on six situational attributes that management could manipulate to produce various recreational opportunities. The concept of providing opportunities by mixing the managerially controlled inputs was quickly adopted by federal agencies into a "cook-book" inventory process under the title Recreational Opportunity Spectrum, or ROS (USDA-Forest Service 1981). Most scientists in recreation management have continued to focus almost exclusively on the demand or user side. Consequently, our understanding of supply and the interaction of demand and supply has not been advanced.

Differentiating the Roles of User and Manager

What seems to be needed is a conceptual framework that recognizes the recreational experience as a common interest of the user and the manager, yet differentiates their roles in the production of the experience.

Figure 1 identifies four categories of inputs into the production of the recreational experience. The first category, *Social Inputs,* is what the user brings to the site, i.e., demand-related inputs. The user's choice of sites is directed by his motives and perceptions given that the actual choice set is constrained by personal antecedent conditions such as time, money, and social roles. Within these constraints, actual choices are translated into specific on-site behavior. Motives and perceptions are imbedded in what the economist terms the *utility function* of the individual. Choice of site and on-site behavior reflect attempts to maximize personal utility. Personal antecedent conditions serve as constraints to achieving maximum utility.

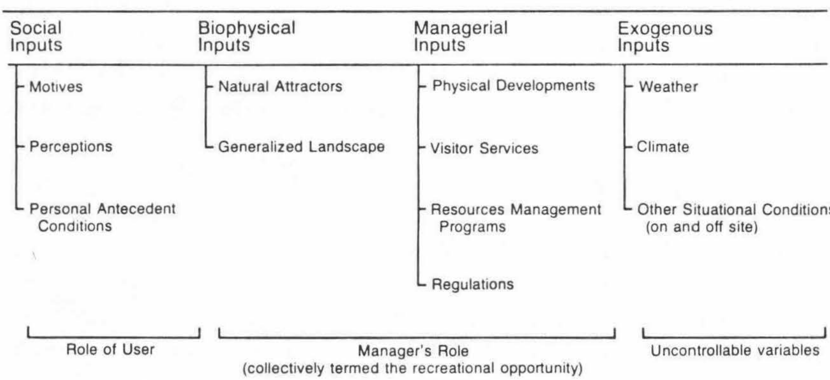

Figure 1. Model of Inputs to the Recreational Experience.

The *Biophysical and Managerial Inputs* reflect the supply-related factors and are the responsibility of the manager. The generic role of the manager is to provide opportunities to recreate. While the manager does not create the Biophysical Inputs, it is his responsibility to evaluate, dedicate, and manage sites for specific uses. From a recreational perspective, every acre is not of equal value; specific natural attractors tend to be of greater value than the generalized landscape within which they occur. For example, bodies of water, prime wildlife habitat, and natural movement in the landscape such as waterfalls are more attractive to the user than the surrounding generalized landscape. The generalized landscape is important for visual continuity (Litton and Twiss 1967), e.g., a waterfall would lose its attractiveness if the surrounding landscape were denuded. A rustic visitor center may be perceived as aesthetically pleasing and appropriate to a setting accessed by road, but inappropriate in a roadless area with primitive trail access.

The Managerial Inputs are the specific management actions that may be applied to a site to attract certain user types, to protect or enhance the resource attributes, or to maintain opportunities for specific experiences. These are the devices that can be used to alter the value of the site to the user.

The last category is *Exogenous Inputs*—ones that potentially affect the recreational experience but are external to control by either the manager or the user. Examples include an irate grizzly bear in camp, continual rain during a week on the river, or a collapsed foot bridge due to flooding. This category of inputs has not been given much consideration in the literature but can, in a given situation, exert more influence over the quality and quantity of the recreational experience than all others.

In summary, there are three sources of influence over the recreational experience: those inputs under control of the user or individual demanding a given experience, those inputs under control of the manager supplying the recreational opportunity, and uncontrollable or exogenous factors that mitigate both the user-determined and managerially influenced recreational opportunities. The basic premise of this framework is that the user is in charge of his own experience, choosing a site and participating within whatever personal or nonsite constraints are present to produce a satisfying outcome. Collectively these user inputs define demand. The manager, on the other hand, mixes the various Biophysical and Managerial Inputs to produce the opportunity or the generalized recreational experience obtainable at the site.

ROS—An Attempt to Integrate The User and Manager

Driver and Brown (1978) and Brown et al. (1978) attempted to integrate the roles of the user and the manager by developing a recreation resource inventory classification scheme known as the Recreation Opportunity Spectrum (ROS). The ROS framework recognizes the link between the environmental setting and the experiences or psychological outcomes that users realize. It is based on the notion that recreationists choose to participate in those activities that are consistent with a particular environmental setting and that the setting may be managerially influenced to alter the recreation opportunities. Thus, ROS was intended as a "fundamental [aid] to multiple use natural resource planning and management decision" (Brown et al. 1978).

A separate but simultaneous development of ROS by Clark and Stankey (1979) is credited with operationalizing ROS as an applied framework for recreation management and planning. They suggest that ROS includes four areas of application: "(1) allocating and planning recreational resources, (2) inventorying recreational resources, (3) estimating the consequences of management decisions on recreational opportunities, and (4) matching experiences recreationists desire with available opportunities."

Both the Driver and Brown (1978) and Clark and Stankey (1979) conceptualizations of a resource-based opportunity spectrum advance the notion that the ROS planning and management process involves two steps:

> (1) inventory ORR's [outdoor recreation resources] in terms of their inherent potential to provide both activity and experiences opportunities, and (2) set management objectives that specify what types of activity and experience opportunities will be provided at a particular location. (Driver and Brown 1978)

In other words, the manager chooses the target or anchor point along the continuum and then, holding the Biophysical Inputs constant, mixes the Managerial Inputs to achieve that point. This recommended procedure raises two related questions that have not been addressed adequately in the ROS literature: (1) What criterion is or should be employed in the selection of the anchor point? and (2) To the extent that a given anchor point can be achieved through various mixes of Managerial Inputs, which mix should be chosen? Despite assertions like

> The ROS is a helpful concept for determining the types of recreational opportunities that should be provided. And after a basic decision has been made about the opportunity desirable in an area, the ROS provides guidance about the appropriate planning

approaches—standards by which each factor should be managed (Clark and Stankey 1979)

there is little evidence that ROS is anything more than an inventory classification scheme. It describes recreation opportunities that exist or are planned, but does not offer a prescriptive or choice framework required for management. To that end, measures of quality that are consistent with visitor perceptions of value must be related to the spectrum of possible outputs or recreational opportunities. These qualitative measures then must be related to a consistent, well-defined managerial objective that facilitates optimizing that objective subject to biophysical, political, and economic constraints.

Clark and Stankey (1979) recognized that quality is a relevant notion across the entire spectrum but argued, along with much of the profession, that an objective of diversity assures quality. This ill-founded notion is rooted in the belief that recreational quality is so highly personal that management should not be dominated by mass or average tastes. As noted by Davis (1963a), it is one of those "conceptual weeds that have grown up (and gone to seed) in the outdoor recreation movement." The fundamental problem with diversity is that it offers no criteria by which to judge management performance.

The use of diversity as a managerial criterion within ROS would be analogous to a farmer's assessing land/soil quality, compiling a list of potential crops that could be produced, and then producing all of them to satisfy the diverse tastes and preferences of the market. While an inventory of output potentials is an important step in planning, it falls far short of rational resource allocation. Farmers need to know how to produce and what to produce. That is, they need to know what combination and intensity of inputs promote optimal (profit-maximizing) quantities of each crop per unit of land, and what mix of crops will maximize profits for the entire farm. Such is the case with recreation managers as well.

One analytically tractable recreation management criterion is economic efficiency. A more or less traditional managerial economics approach to recreation resource planning and allocation would suggest that any given anchor point along the ROS continuum should be associated with a least-cost combination of Managerial Inputs. The efficient anchor point (or combination of anchor points) is that which maximizes net benefits to recreationists. Viewed in this manner, the ROS framework has an element of consistency with the decision-making apparatus of managerial economics and involves integrating considerations of cost/supply and value/demand in establishing an objective choice criterion.[2]

Visitor Perception of the Site

Perceptions of opportunities affect individual choice and ultimately the value to the individual (Brookshire 1983). It follows that a user's perception of site attributes affects choice of recreation sites. However, the manager can influence user perception by altering the recreational environment. The inherent biophysical attributes of a site are in general what can make it attractive, but managerial inputs determine who is actually attracted to the site. Together, the biophysical attributes and managerial inputs contribute to site value. From the perspective of user perception, it is important to maintain the biophysical attributes regardless of the management action taken to attract a particular clientele group. Unfortunately, most recreation studies have focused exclusively on user motives and perceptions of the total recreational experience rather than user response to specific site attributes including management actions (Graefe et al. 1984).

Little is known about how people respond to various attributes of a site. Rather than hypothesizing some hierachy of attributes in relation to visitor perception, we have divided them into two groups, direct and indirect attributes. The *direct attributes* are those that constitute the obvious, tangible elements of the site, i.e., the Biophysical Inputs and Physical Developments. Recreationists respond initially to the direct attributes that constitute the essence of the site. Use tends to concentrate at the more valued portion of the site, and the actual type of user and level of use at those locations generally reflect the type and level of ac-

[2] We recognize that economic efficiency is not the sole criterion used in public sector resource allocation decisions. It may be, for example, that agencies willingly sacrifice some amount of net benefits (economic efficiency) in order to advance an equity goal or to offer a wider variety of recreational opportunities in a given location. Such a tradeoff ought to be deliberate, though.

cess and associated facilities (Jubenville and Becker 1983). From a perceptual standpoint, the physical developments become inherent qualities of the site.

The *indirect attributes* (visitor services, resource management programs, and regulations) are less-tangible elements of the site and are often ignored in the literature or treated as insignificant in terms of their impacts on the participant's choice of sites. Recent research, however, has speculated that indirect attributes can have a significant effect on the perception of the site. As an example, Becker et al. (1981) attributed user displacement to increased information services. Behavior modification of wilderness users also has been measured in response to the impact of a permit system on the recreational experience (Plager and Womble 1981, Van Wagtendonk and Benedict 1980.) Thus, while the direct attributes may represent the essence of the site, the indirect attributes ultimately can affect choice and value. Perceptions of both direct and indirect attributes must be considered in choosing the particular anchor point on the spectrum of opportunities.

Secondary Impacts of Management

Concern with economic efficiency ought not to be a myopic management criterion. Decisionmakers must be cognizant of secondary or unintentional consequences of their actions that may affect both overall program efficiency and the distribution of benefits and costs. Managerially induced changes in the mix of users who choose a site are particularly important considerations. Jubenville and Becker (1983) and Schreyer (1979) note that changing managerial inputs, even those affecting indirect attributes can cause social succession, the consequences of which should be quantified in any net benefit evaluation.

There are six prominent user responses to managerially induced change. (1) *No response:* the change in the input mix had no effect on the user's perception. (2) *Enhancement:* an improvement in the site which increases or enhances the satisfaction and value to the present user. (3) *Amelioration:* a behavioral adjustment in which the present user alters his behavior to maintain his desired experience, such as floating a river during a period when permits are not required. While we know amelioration takes place, we are often unaware of how program net benefits are affected by such adjustments. (4) *Adaptation:* the lowering of expectations of the site. In this case, the original attributes may be sufficiently intact as to attract the original user. However, the user must adapt to site changes such as altered access or permit requirements. One would assume lower value to be associated with reduced expectations of the site. (5) *Displacement:* the altered site is no longer attractive to the user so he voluntarily displaces himself to other, more highly valued sites that better suit his requirements. (6) *Attraction:* new users are attracted to the new mix of inputs.

The site, taken as an aggregate of attributes, is what the user responds to in terms of personal decision-making, realizing that there will be variation in user response based on tolerance to introduced change (Jubenville 1985). In this regard, there appears to be considerable variation in tolerance limits along the Recreational Opportunity Spectrum. The users of a site at the primitive end of the Spectrum tend to be less tolerant to introduced change than those in the intermediate portions (e.g. Hendee et al. 1968, Stankey 1973, and Schreyer and Roggenbuck 1978). While not specifically addressed in the literature, recreation activity in the modern portion of the spectrum is closely tied to the presence of some facility, e.g., a building, a swimming pool, or a tennis court, and associated services. Thus, there appears to be less specificity in the intermediate portion of the Spectrum and consequently less impact of introduced changes in the site.

Since the anchor point that the manager chooses represents the aggregate of the management objectives, one would assume that shifting that anchor point would represent a change in management objectives. The economic question to ask is "How does this management-induced change affect the aggregate *net* benefits to society or the aggregate value of the site?"

The Role of Economics

Much of the impetus for assessing the economic value of outdoor recreation came as an attempt to improve benefit-cost ratios of federal water projects. Valuation usually involved assignment of some arbitrary unit-day value for each visit times the projected number of visits. Beginning with Hotelling as cited by Prewitt (1949), economists devoted substantial effort to developing nonmarket benefit valuation methodologies that were more rigorously anchored in economic theory.

Hotelling suggested that travel costs be used as a means of estimating recreation demand curves for the purpose of project valuation and use projection. Apart from tying benefits to observed behavior, Hotelling's "travel cost method" (TCM) measures the value of a recreation site as consumers' surplus, i.e., the area under the demand curve. Davis (1963 a,b) endorsed this site valuation notion, but offered an alternative procedure to estimate consumers' surplus. The "contingent valuation method" (CVM) introduced by Davis establishes value through surveys and direct questioning of recreationists and potential recreationists about their willingness to pay under alternative price scenarios.

The early TCM and CVM techniques, and subsequent methodological refinements that continue today, have had profound impacts on two classes of public policy: *ex ante* project feasibility analysis intended to assist in design choice among alternative projects, and *ex post* construction audits designed to determine whether programmatic expenditures were warranted. These policy contributions are similar in that they center on discrete, often dichotomous, decisions—decisions markedly different from those most commonly addressed in the 1980s.

The watchword in state and federal resource agencies has shifted from project construction to multiple-use management. Thus, it is not surprising that policymakers confronted with multiple-use and even dedicated, single-use management decisions often fail to see the connection between nonmarket valuation and resource allocation. Even in the context of discrete project analysis, economists' measures of social welfare change have not been widely accepted. McConnell (1979) offered two explanations for this lack of acceptance. First, he suggested that the mercantilist attitudes of many public decisionmakers motivate them to choose projects on the basis of total expenditures rather than net benefits. Moreover, he argued that narrowly defining welfare changes in terms of pure Pareto efficiency ignores distributive impacts that also concern decisionmakers.

McConnell's comments beg the question "What function has economics served in its tradition of nonmarket valuation?" Apart from theoretical and methodological advancements, the answer appears to be that most economists have fallen into the mercantilists' trap by providing aggregate valuation or surplus measures that help to support (improve) feasibility studies or buttress agency budgetary requests concerning discrete, often mutually exclusive alternatives. These nonmarket valuation studies assume as given some prior optimization that fixes project design(s). As such, aggregate measures of benefits are not well suited to address the broader social-welfare questions involving optimum scale and mix of resource uses.

To some, this criticism may be an unfair indictment of nonmarket valuation research. Perhaps it is better to raise the question "When is the appropriate time to seek economic analysis?" Surely it is not after project designs are already decided. Maximizing social welfare from public investment and resource allocation decisions depends upon integrating nonmarket benefit measurements with scale and resource mix decisions. There are two types of recreational resource allocation decisions implied by recreation management theory and managerial economics: 1) allocation of resources under different management intensities and/or configurations for a single dedicated use, and 2) allocation of resource endowments among alternative multiple uses.

Both allocation decisions require some form of nonmarket valuation that recognizes perceptions of value as a function of both inherent and managerially influenced site attributes. Recent contributions have been made along these lines. Major implications for recreation management are highlighted below. It is not our intent to present a comprehensive, state-of-the-art review of nonmarket valuation techniques. Readers interested in such reviews should see Mendelsohn and Brown (1983) and Desvousges et al. (1983).

Nonmarket Valuation

Explicit recognition of the role of resource characteristics and management actions in influencing recreation values is found in Clawson and Knetsch's (1966) seminal contribution. They observe, for example, "The physical characteristics of these natural elements of the landscape affect their use for outdoor recreation, but they become resources for outdoor recreation only as they are useful for this purpose." Later they write "The number of visits to a recreation area is generally influenced by the intensity of management...." And again, "A change in access or management creates a somewhat different recreation 'product.'"

Despite the existence of this Lancaster-like (1966) perspective on recreation demand some twenty years ago, the economics profession has been slow in its adoption. However, there are a number of contributions to the literature that note the need to take stock of empirical methods used in recreation resource valuation and, in particular, to evaluate their utility to the resource manager. Gum and Martin (1975) recommended a de-emphasis of the development of improved methods of estimation and advocated that we instead concentrate on interpretation of (benefit) estimates in studies of resource allocation. This recommended pause to reflect upon whether techniques yield useful, as well as accurate, information, and the integrability of the economists' tool kit and resource management issues is also the theme of Batie and Shabman's (1979) review of recent methodological advances in nonmarket valuation. Specifically, they write "economists have not established relative values for policies and inputs over which agencies have control (e.g., habitat management and fish stocking), and instead have focused research efforts on establishing values for recreational services." They add that "collectively economists have paid too little attention to the physical production and transformation linkages between public policies and recreation values."

Mendelsohn and Brown's (1983) recent assessment of revealed preference approaches to recreation valuation, however, seems more optimistic. They see such various techniques as simple travel cost, household production function, and advanced travel cost, e.g., demand system (Burt and Brewer 1971); own price/quality (Vaughn and Russell 1982, Freeman 1979); and hedonic travel cost (Brown and Mendelsohn 1980) yielding useful information to resource managers. They conclude that, in the final analysis, "The principal factor in choosing among the approaches is the policy question to be answered." The perspective of the Mendelsohn and Brown evaluation is that the focus of valuation should be on the "quality and quantity of the public good, the recreation site." In this setting they find the simple travel cost method well suited only for determining the all-or-none value of a single-site in an unchanging environment. Quantitative and qualitative change in site attributes, on the other hand, are best attacked with one of the advanced travel cost methods. The Mendelsohn and Brown view of the household production function approach is that it is "an unnecessarily cumbersome approach to measure the value of sites or their qualities" since its aim is to value such products as kill, catch, etc.[3]

The Mendelsohn and Brown emphasis on site valuation and the use of the advanced travel cost methods seems appropriate for a wide range of resource allocation issues. The efficient mix of livestock grazing, recreation pursuits, and timber-harvesting activities on a tract of BLM, Forest Service, or other public lands is a case in point. Similarly, when conflicts exist between recreation and mining activities in and along a clear-water stream, the issue of which combination of uses maximizes the capitalized value of the resource site should be an important focal point for management agency discussion. The costs and benefits of variations in design and scale of a public campground and the regulations that govern its use can also be summarized in the estimates of site value associated with the different configurations and, as argued by Mendelsohn and Brown, techniques that yield estimated values of changing site characteristics show the greatest promise.

There are other instances, however, in which attention to site value may be less compelling. Consider a salmon stock that may be harvested in various combinations by commercial fishermen in salt water or by sport fishermen in fresh water along the route to the spawning stream. The fisheries management agency naturally faces pressures from both interest groups for larger shares of the allowable catch. In this case the efficient allocation of salmon is not usefully reflected in a site-value com-

[3] Mendelsohn and Brown also summarize some potentially serious econometric problems and the stringent assumptions regarding production technologies that are associated with this framework.

putation but rather in the combined magnitudes of net benefits captured by the competing user groups at various harvest allocations.

Regarding the commercial fishing group, the contribution of a larger stock allocation will be reflected in the greater net income flows.[4] Recreational fishermen may experience changes in expected number and size of fish caught with varied allocative arrangements. It seems that the appropriate linkage to focus on in this case is that between the managerially determined allocation, the expected quality of fishing, and the benefits of the fishing experience. Strong and Hueth (1983), for example, used the household production function framework to examine the effect of variation in catch on the value of steelhead recreational trips in Oregon.

Turning briefly to the contingent valuation method (CVM), it seems that, in principle, considerable flexibility exists with this technique to evaluate a wide range of management actions and variations in resource characteristics. Questions may be written to yield data appropriate for conducting marginal analysis or to address all-or-none issues concerning environmental quality (Brookshire et al. 1976), site values (Hammack and Brown 1974), or the allocation of a flow resource such as water (Daubert and Young 1981). In the presence of the increased use of CVM in natural resource valuation, however, there remains a widespread skepticism concerning its validity due to the suspected presence of a number of biases associated with its use (Rowe and Chestnut 1983). For our purpose here, however, we note the potential for contingent valuation procedures to yield the kinds of information that are useful for managerial decisions.

The upshot of our review is that the most useful nonmarket valuation procedures from a recreation resource management perspective are those that will feed data to a traditional managerial economics framework. In evaluating the efficiency and distributional aspects of site selection and alteration and of shifts in allocations of fish and wildlife stocks and other resource services among user groups, managers require estimates of the value of marginal productivities of the resource inputs and regulatory instruments at their disposal. Whether it is the intention to

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[4] These rents may also be reflected in the value of vessels or limited-entry permits or in resource taxes, depending on the institutions governing commercial fishing.

look for variations in net benefits as changes in capitalized site values or in the form of contributions to recreation experiences, the neoclassical model of the firm can appropriately discipline the structure of our analysis so that we are addressing the right questions in our valuation research.

Supply—The Missing Link

Nonmarket valuation has been an end in and of itself for many practioners. Its potential in resource allocation decisions has never been realized because it has not been widely utilized in conjunction with supply-related analysis required by managerial economics. Instead, most empirical studies have assumed implicity that the recreational resource supply is perfectly inelastic or fixed. Those studies that do yield marginal values typically fail to develop or extend the scope of analysis to the fundamental allocation question confronting the manager: how to create different recreational opportunities of greater net social value by changing site attributes or altering management practices on a given site. A guiding principle for economic analysis in outdoor recreation management is that the process and outcome of management is linked directly to biological or physical responses which in turn elicit changes in individual perceptions, choices, and values of sites. In other words, value is not simply a function of user demand. It is also a function of inherent site characteristics and managerially influenced attributes, as illustrated in Figure 1. The challenge for outdoor recreation research is to marry supply and demand concepts so as to clarify the relationships between the recreation experience and the management inputs that influence the quantity and quality of that experience.

The general recreation management problem can be cast in a traditional managerial economics framework for efficient resource allocation, i.e., setting the marginal rate of product substitution (or technical substitution) equal to the inverse price ratio. Accordingly, the recreation resource planning process is akin to most agricultural production decision-making processes, except that it is complicated by two factors: (a) absence of market prices for the output(s), and (b) biophysical production processes considerably more complex than those usually characterized in empirical production economics research. The problem, then, is to define the feasible set of management activities and to establish prices of nonmarket goods so that resources can be allocated efficiently. Since most, if not all, recreation resources stem from complex causal chains and interdependencies, an important component of the linkage involves both theoretical and empirical considerations of bioeconomic modeling.

In this section, we examine the difficulties of addressing pertinent supply-related issues essential to rational resource allocation and planning. The discussion focuses on managing the physical/biological properties or site attractors, but inferences are not limited to that category of direct management inputs. Indirect management, such as instituting a limited-entry permit system, may have more profound impacts on the site, the perceived value and ultimately, the manager's allocation decision.

Issues in Modeling Recreation Supply

The concept of bioeconomics is not new. Agricultural economists have been conducting bioeconomic analyses for decades under the label of farming systems research or production economics. Early examples of bioeconomic research include plant response to fertilization and animal feed response research. These areas of study are keynoted by the development of technical or biological information which is capsulized in a production function. The production function is used to gain insight into the tradeoffs inherent to the biological system for purposes of controlling that system.

A common characteristic underlies most of the theoretical and empirical developments. Virtually all analyses involve multiple inputs and a single output. To the extent that multiple input-multiple output (joint product) research has been conducted, it has been largely theoretical. More importantly, it has focused on special cases of joint production, namely fixed proportions and separable products. Both of these situations are special forms of single products. (See Beattie and Taylor 1985, Dano 1966, Shoup 1965, and Frisch 1965 for discussions on joint products.)

The single output or separable joint products orientation stems from the direct input-output response characteristic of commercial agricultural production. The linkage between inputs applied through management and the output(s) extracted is direct; the biological/physical environment has no intrinsic value other than what it contributes to the final product. Unintentional by-products of the production process typically are assumed not to exist or are unimportant to the producer/consumer.

Outdoor recreation presents a very different scenario. Unlike production agriculture, the outdoor recreation product is, at least in part, the attractor(s) per se. The attractors are an integral part of the experience and thus, have intrinsic value. Management actions are designed either to enhance one or more biophysical attractor(s) directly or augment indirectly the recreational opportunities one can derive from the attractor(s). However, the interdependence of biological systems is almost certain to result in both intended and unwanted environmental impacts from management. Thus, a detailed understanding of the direct effects and interdependencies is essential if short- and long-run biological consequences, including unwanted side effects of management, are to be avoided or mitigated. Attempts at modeling direct biological responses to recreation management are few indeed, and almost no consideration has been given to indirect effects.[5]

How to measure empirically the highly interdependent production processes found in outdoor recreation is problematic. Lack of observational repeatability is a major operational problem that plagues bioeconomic analyses of all kinds and is probably why economic analysis of outdoor recreation has addressed only the issue of nonmarket valuation. Measurement of biological responses to incremental changes in management is confounded in natural environments. Two principal culprits are the stochastic nature of population dynamics and, in the case of fish and wildlife, the furtive nature of the resources. In contrast to production agriculture, experimentation is less controllable and environmental responses to management are not always immediately observable. Sufficient data to formally estimate production functions that capture the complex interdependencies of biological systems is uncommon. Accord-

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[5] A relatively rich literature addresses at least the theoretical dimensions of unwanted side-effects or externalities. One issue that would seem to be particularly onerous to the study of outdoor recreation is the problem of local optima and corner solutions. Baumol (1964), Baumol and Bradford (1972) and Starrett (1972) show that highly interdependent production processes can lead to either/or production choices that complicate public policy.

ingly, statistical analyses often yield to empty equivocations like 'the common heritage of mankind' when referring to environmental amenities.

Agricultural production economists did not begin to overcome similar data limitations until they began cooperating with physical and biological scientists in the design of experiments. Such cooperation is essential, yet rare, when considering systems dominated by renewable and nonrenewable resources. There seem to be significant philosophical differences in research design between the biological and economic disciplines. Biologists tend to be most concerned with designing highly controlled experiments to reduce interaction among variables in an attempt to sort out whether the means of two or more populations differ.

Much of the biological research design can be classified as analysis of variance, with variants of randomized block designs. For example, habitat management research typically is based on multiple replications of few management intensities, making inferences of marginal changes in management difficult to derive. Economists, in contrast, are interested in the entire response surface, or at least that portion of declining but positive marginal products, for purposes of prediction, explaining system behavior, and policy prescription. Unable to control the economic system, they have refined their analytical tools to extract the most from secondary time series and cross-sectional data—data which simply do not exist for most biological problems. Thus, direct use of quantitative information on biophysical impacts of proposed actions is not standard practice.

In light of the data limitations, it is likely that statistical analyses of complex biological systems will be limited to high levels of aggregation that grossly simplify the production process. Detailed (microlevel) production models of nonseparable, joint biological systems may be an ideal that will never be achieved. The extent to which such research may be successful surely will depend on the use of statistical tools that can extract the most from limited data as well as development of suitable data for analysis. For example, use of prior information may be essential to improve estimator efficiency. Since many aspects of biological systems are bound by known physical laws, logit or mixed estimation models that explicitly incorporate pertinent laws may prove invaluable.

Inability to measure statistically the interdependencies between environmental attractors and management does not deny their existence. It simply requires developing alternative frameworks to model the complex causal chains. Simulation offers a potential interim alternative. It circumvents the problems of sparse data and resultant statistical properties by avoiding that aspect of the problem altogether. However, any attempt to simulate the recreation environment must contend with the usual legitimate criticisms of documentation and transferability.

Simulation: An Alternative to Statistical Analysis

A number of standardized model frameworks have been developed to overcome some of the limitations associated with simulating environmental responses to management. Although specific procedures and methods differ, there is a common conceptual process to simulating the biophysical environment. The environment is disaggregated into a hierarchy of component parts or attributes, the most aggregated component being defined in terms of less aggregated components and, ultimately, management actions. Quantification of this conceptual model entails specifying technical indicators for every component. Since direct physical measurement is possible for only the most elemental (least aggregated) components, these measurements are linked mathematically to standards of performance in terms of qualitative indexes that may be derived from hard scientific data, expert opinion, and in some cases, nonexpert opinion or perceptions of quality.

The Quantified Evaluation for Decisions (QED) (Gum et al. 1982) and the Habitat Evaluation Procedures (HEP) (U.S. Fish and Wildlife Service 1981) are two simulation frameworks that perform the same basic functions and process the same general types of information, but for quite different applications. QED was developed to measure the achievements of environmental quality objectives and to analyze the economic consequences of environmental improvement programs/actions. Accordingly, it consists of two submodels: a biophysical model and a valuation model that translates attainment of environmental goals into human (economic) values or perceptions. The analytical framework was prepared in response to legislative requirements that government programs be evaluated on multiple performance criteria, thereby providing policy makers with information on achievement of societal goals and objectives (e.g., Water Resource Council Principles and Standards, Resource Conservation Act, Resource Planning Act, and the National Environmental Policy Act).

HEP, too, was developed in response to federal legislation, namely the Fish and Wildlife Coordination Act and National Environmental Policy Act, but for a more specific purpose: assessment of wildlife habitat impacts resulting from economic development projects. (See Farmer and Schamberger [1978] for a historical development of HEP.) The biophysical simulation framework of HEP was designed as an end in and of itself. It was designed as an accounting tool, and no attempt was made to link it directly to management or valuation. However, HEP has been extended successfully to assist in the general habitat planning process. Matulich et al. (1982) and Matulich et al. (1983) augmented the basic HEP framework with cost-generating management activities and an optimization framework that minimizes the cost of achieving various habitat goals. The resultant model framework simulates biophysical responses to management. An overview of this extended HEP framework is presented below. Its narrower focus supports a more systematic and more complete methodological specification than QED. Moreover, there are conceptual similarities between modeling wildlife habitats and human recreation habitats. Implications for modeling recreation supply response are presented at the end of this section.

AN OVERVIEW OF HEP

The HEP modeling process quantifies the production potential for a given habitat based on Habitat Units (HU). A stylized representation of the HEP process is presented in Figure 2. An HU has both a quality and quantity dimension. It is computed as the product of a Habitat

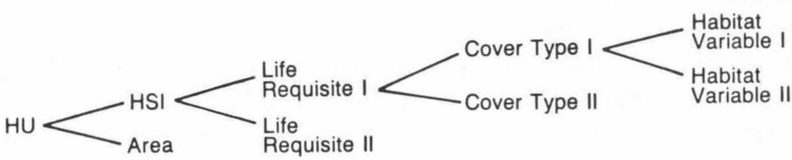

Figure 2. Stylized Diagram of the HEP Process.

Suitability Index (HSI) and the total area of available habitat. HSI, a measure of habitat quality, is an assessment of overall habitat suitability for a given wildlife species and is stated as a dimensionless value ranging from 0 to 1. Total habitat area is usually expressed in acres, though any surface area units may be used. Given a fixed habitat area, e.g., 100 acres, the HUs available may range from 0 to 100 based on the level of HSI. The lower the HSI, the fewer the HUs produced for a given area. Thus, in using HEP as a response framework, total HU production can be altered in two ways. The total habitat area can be increased or decreased, or habitat quality per unit area (HSI) can be altered by employing management actions. In either case, it is HSI that embodies the complexity of biological production in the habitat being modeled.

HSI represents the potential capacity of a given habitat to support or produce a given (target) species. For example, if an area has an HSI value of 1.0, it has potential for sustaining 100 per cent of the anticipated carrying capacity of the target species. In contrast, a low index value due to inadequate food supplies, e.g., 0.2, would yield a population level only 20 per cent of maximum potential carrying capacity (assuming linearity between HSI and carrying capacity). The index is an estimate of the potential habitat productivity.

In essence, the HEP framework compartmentalizes elementary habitat production relationships that can serve as the basis for measuring responsiveness to habitat manipulation. Overall habitat suitability (HSI) depends on the suitablity of life requisite needs. Each life requisite need may be supplied by several different cover types. Since each cover type is different, a separate set of directly measurable environmental variables (habitat variables) is required to define the adequacy or suitability of each cover type. As with HSI, each of the intermediate suitability indexes are specified as dimensionless, 0 to 1 values.

Incorporating the influence of management on habitat suitability requires specification of actions that alter the overall habitat conditions in some observable way. There are two general categories of management activities: those actions that maintain or enhance existing habitat and those actions that convert habitat from one type to another. Maintenance actions may be construed as variable cost activities, whereas conversion of one cover type to another often (though not always) requires some form of capital cost or construction activity. Conversion may, in turn, require maintenance of the new condition.

Specification of all management activities must include the relevant actions to be taken, the resulting habitat impacts, restrictions applicable to each action, and cost estimates for employing each action. In specifying the habitat impacts, it is necessary to incorporate both the baseline habitat conditions when no action is taken, and the anticipated changes in habitat conditions when various levels of management are employed.

The expanded HEP model framework outlined above comprises a set of nested linear and nonlinear equations, where the most aggregated component is a function of several lower-ordered aggregations. Collectively, these equations define the management-linked biophysical response or production relationships. A cost function may be derived by minimizing the cost of management subject to the biophysical response model and two additional sets of constraints: political/land use constraints and resource limitations. Cost-effective management strategies are obtained by systematically varying the HU (biological output) constraint.

Implications for Recreation Management

A parallel HEP-like application may be conceived for a recreation site. The Recreation Opportunity Spectrum, discussed earlier, identifies somewhat different recreation products that could occur on a given site. For any given point or product along the spectrum, the potential suitability and overall quantity can be altered through management. An expanded HEP-like framework can be used to evaluate the mix and intensity of various management actions required to achieve a given recreation product of any technically feasible quality or suitability. Qualitatively different recreation opportunities will be reflected in both inherent value and use levels, i.e., demand. Thus, the cost minimization framework outlined above is easily modified to maximize net benefits. Incremental valuation data from appropriate nonmarket valuation studies feed into the optimization model. Habitat units, whether human or wildlife, must be converted to population or use estimates, and the objective function must change from minimizing management cost to maximizing the difference between the value of enhanced biological output and the cost of generating that output.

Other Considerations

The analytical framework presented above couches the recreational resource allocation problem in a comparative statics context. No consideration was given to potentially critical dynamic aspects of managerially induced changes in costs or benefits. Important dynamic considerations for recreational resource management involve the impacts of recreation (consumption) in one period on site attributes or resource stocks in subsequent time periods. Examples of dynamics are abundant in the renewable resource economics literature, particularly as they apply to commercial fisheries, though more limited in the context of recreational resource management. Hammack and Brown (1974) and more recently Keith and Lyon (1984) are two notable exceptions that address optimal wildlife management strategies over time. Both casis attempt to link changes in species stock size to resultant recreation opportunities and thus, changes in social welfare. In both, the major shortcoming was the inability to develop a reasonable cost function needed to link management actions to the welfare analyses. While inclusion of intertemporal implications should be regarded as important, integrating nonmarket valuation with bioeconomic supply functions represents a more essential research agenda.

Another consideration not fully developed in this bulletin is the analytical significance of social succession. The key economic aspect of this phenomena is manifested in the proper accounting of costs (lost benefits) incurred by recreationists displaced by management actions. For example, improved access to a fishing site may increase users to the point of forcing some preimprovement fishermen to other, presumably more distant, sites that mirror the limited access experience. Though benefit-cost analysis addresses this situation through with-and-without scenarios, nonmarket valuation of the displaced or negatively impacted user groups often is not conducted. Longitudinal data required for this type of analysis typically are not collected. Whenever displacement or adaptation is likely to occur, conventional nonmarket valuation analysis may miss the distributional impacts and also bias efficiency measurements.

Summary and Conclusion

The general theme of this bulletin has been that improved management of public sector recreational resources is a multidisciplinary task. We have argued, however, that much of the research by both recreation management theorists and economists has focused on demand issues without sufficient attention paid to resource characteristics and to the regulations and inputs over which managing agencies have control. Recreation management theory, for example, has emphasized social-psychological underpinnings of visitor motivations and perceptions in attempting to explain recreation visitor behavior. Lacking has been any systematic attempt to understand the influence that management actions may have on user behavior.

Similarly, economists' contributions have focused on demand; nonmarket valuation procedures typically have yielded information useful only for all-or-none types of allocation decisions in benefit-cost analyses. Despite elegant theoretical advancements and ingenious estimation procedures, little effort has been made to isolate the effect of resource characteristics and management actions on either the benefits that visitors enjoy or the costs of associated management decisions. The traditional managerial economics framework of business firm decision-making calls for due consideration of both demand (value) and supply (cost) in its prescriptions for efficient resource allocation. Adaptation of this framework to recreation resource management is consistent with contemporary problems calling for incremental choices.

The basic precept of recreation management is that the manager supplies the recreational opportunity from which the user produces and consumes the recreational experience. The optimal (efficient) point along the spectrum of recreation opportunities is that which generates the greatest net benefits to society. This depiction of the management system conceptually fits the managerial economics framework, and it is this framework that can discipline the structure of future research efforts. Emerging theoretical developments in nonmarket valuation procedures promise more useful demand-side valuation. Even with marginal value estimates, decisionmakers will be deprived of adequate information to render efficient resource allocation decisions unless correlative supply response/cost functions are available. The usual assumption of perfectly inelastic supply is indeed a convenient artifice for most nonmarket valuation research but one that is untenable for public or private recreation policy analysis. Development of statistical supply response functions is certain to encounter serious obstacles. However, simulation seems to offer an interim framework capable of piecing together essential supply response relationships. Managers require estimates of both costs and values of marginal resource productivities and of regulatory instruments, if efficiency and distributional consequences of allocation decisions are to be evaluated.

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