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Role of Nonmarket Economic Values in Benefit-Cost Analysis of Public Forest Management

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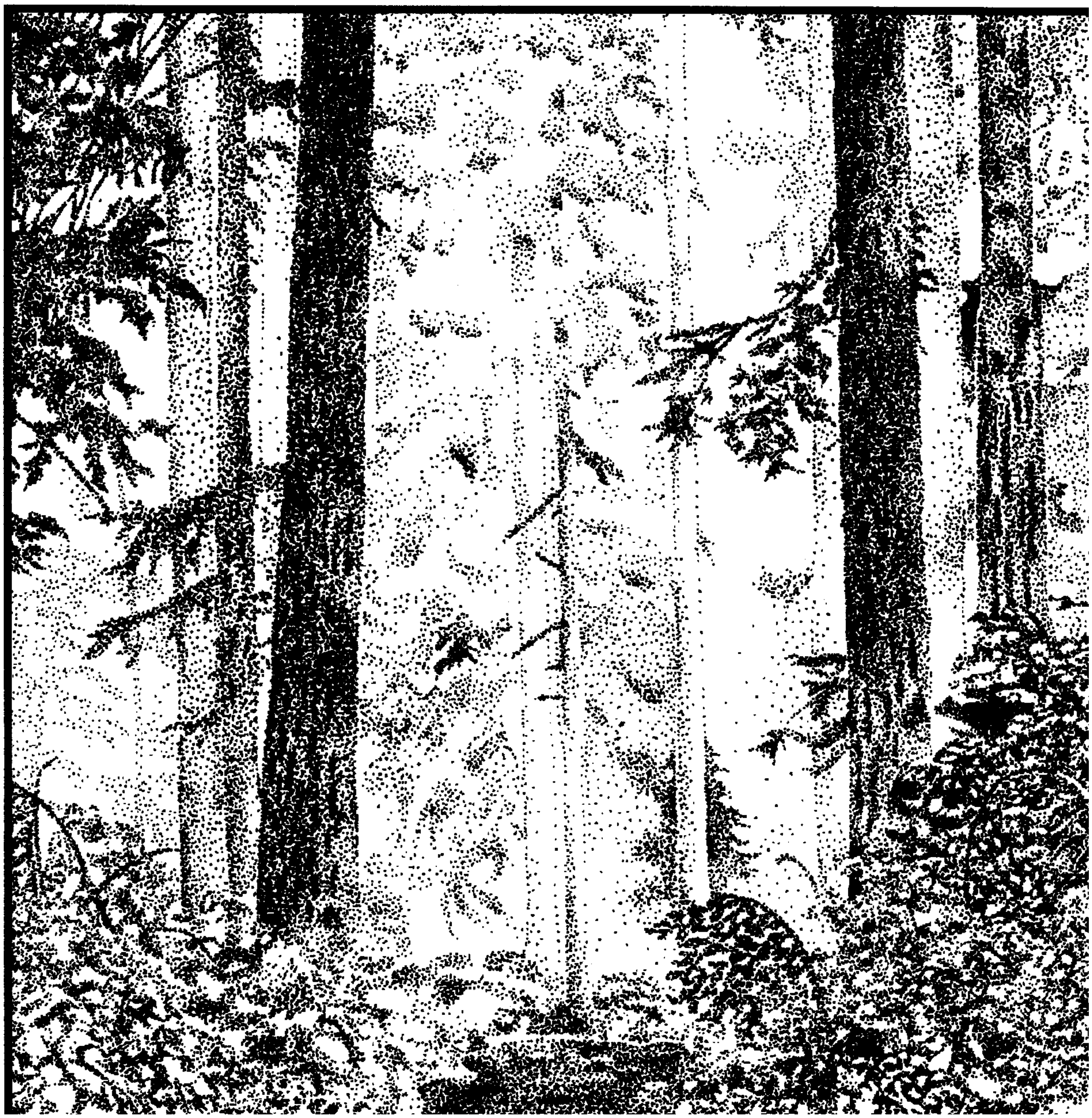

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Abstract

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Recreation in the Pacific Northwest is a valuable resource. A method is described that translates recreation on USDA Forest Service and U.S. Department of the Interior Bureau of Land Management lands in northern California, western Oregon, and western Washington into economic value. By assigning recreation to land use type (using the Forest Service recreation opportunity spectrum classification), the economic value associated with various land use changes can be identified. Results indicated that those land use changes resulting in more nonroaded recreational opportunities provide the greatest economic benefits. This is encouraging given the move toward ecosystem management that many agencies are making because, more nonroaded opportunities will become available. The paper also considers values associated with maintaining old-growth and wildlife and fisheries resources regardless of current or future recreation use existence values.

Keywords: Recreation, nonmarket economic values, benefit-cost.

Contents

Introduction

In natural areas in the Pacific Northwest, the beauty of majestic old-growth trees and the thrill of sighting a northern spotted owl or seeing wild salmon running the falls lead many citizens to call for protection of the things that they value. The issue, however, is not the desirability of protection but rather how to select the optimum level of protection and then how to deal with who gains and who loses when one value is preferred over another. For an area such as the Pacific Northwest, where communities traditionally derived income from commodity extraction of natural resources, a shift to an ecosystem management framework or an amenity value economy may seem daunting, particularly when the benefits of amenities are not always expressed in financial transactions, they accrue to individuals outside the impacted area, and the costs of protection seem formidable.

Market price provides a measure of the value of some goods and services. The price of a can of green beans or a piece of lumber is easy to determine. Unfortunately, for other goods and services, various factors prevent normal market operations from determining their value via price. These factors are referred to as market failures. If adjustments are not made for these factors, basing economic decisions on observed prices (if they exist at all) will result in an inefficient allocation of resources. Many of the benefits of natural areas, such as recreational, ecological, biological, or intergenerational values, are subject to these market failures. Why a certain good or service is subject to market failure often can be linked to the nonexclusive or nonrival nature of the particular good or service. When one person's consumption of a good (viewing northern spotted owls [Strix occidentalis caurina]) does not diminish another's consumption (nonrival use) or it is not feasible to exclude anyone else (nonexclusive use) from consuming the good (viewing a distant mountain), then the market process cannot establish a monetary value. Fortunately, methods exist to derive the value associated with nonrival or nonexclusive resources. By valuing such things as clean water, wilderness recreation, or biological diversity, a common framework can be applied to determine the most economically efficient mix of ecosystem preservation, commodity production, and recreational opportunity.

We identify the economic objectives of Federal land management and the role played by benefit-cost analysis. Economic analysis is just one input into the decisionmaking process; biological factors (endangered species) and equity considerations (local job loss) are other factors that enter into any land use decision. This is followed by a discussion of the measurement of economic values and the importance of differentiating between financial and economic measures of value. From this we move into a detailed discussion of the components of nonmarket values and how both market and nonmarket values are measured. Finally, empirical estimates of nonmarket values in the Pacific Northwest are summarized and then the various options are discussed in the context of meeting future recreational demand.

Economic Objectives of Federal Land Management

The National Forest Management Act of 1976 and the Federal Land Policy and Management Act of 1976 (provides direction to the Bureau of Land Management [BLM]) stress that these lands are to be managed for multiple use and sustained yield. The National Forest Management Act is most specific, requiring that the lands be managed to maximize "net public benefits" (USDA Forest Service 1982: 43206). Net public benefits is the sum of the benefits to all citizens of the United States minus the costs. The benefits and costs are broadly defined and are not limited to financial values (fig. 1). The laws regarding public ownership of National Forests and BLM lands stress the inadequacies of private ownership in supplying the full range of potential public benefits from these lands. Therefore, it would be inconsistent with the

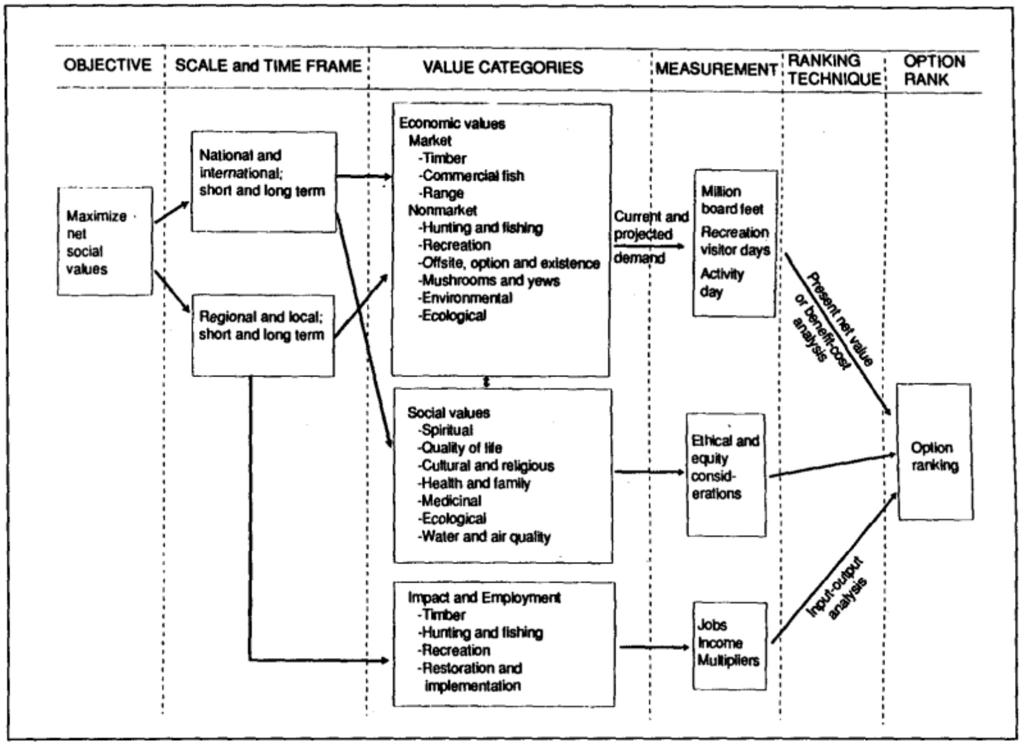

Figure 1-Analysis of a social and economic framework for options.

public land laws to adopt a private financial analysis. In addition, all U.S. citizens are stakeholders in the management of their public lands, regardless of whether they live adjacent to these lands or not. In policy analysis, this is referred to as a national accounting stance. This is also the typical accounting stance used by other Federal agencies such as the Bureau of Reclamation and U.S. Army Corps of Engineers in analyzing their projects (U.S. Water Resources Council 1979, 1983). Of course, it is important when possible to show how the national benefits are distributed both geographically across regions of the United States and by various socioeconomic strata.

Federal lands provide commodities such as timber and minerals as well as recreation, water, wildlife, fisheries, old-growth forests, biodiversity, and so forth. These multiple uses provide people with products or services of value. Timber is converted to lumber, firewood, and paper. Wldlife is used for hunting, viewing, and photography. Water as it flows down forest streams to the private lands is used for boating, fishing, swimming, irrigation, and domestic consumption. Many benefits arise from direct on-site hiking, bird watching, or hunting, and other benefits occur downstream, such as some water uses. In some cases old-growth forests as habitat for unique plant or animal species provide benefits to people who do not even visit the forest itself. Such people derive enjoyment and satisfaction just knowing that remnants of the original old-growth forest ecosystems are preserved and they will be available for future generations to enjoy. These two types of values are called bequest values-those derived by people who want resources available for future generations-and existence values-benefits that some people receive from just knowing a natural resource exists, even if they do not visit it. Existence values can be quantified into dollars (see later discussion). When this has been done, the aggregate values across the population can be quite large. Evidence of the presence (but not the magnitude) of existence values is readily apparent in the contributions to nongame check-offs on income tax forms, contributions to The Nature Conservancy, and letters written to preserve tropical rain forests or the Arctic National Wildlife Refuge, two resources that most people will never visit.

Cash need not change hands for there to be a benefit provided to the public from Federal lands. People are allowed to raft or swim without charge in rivers within and flowing from National Forests. Just because they are not charged for these activities does not make the activity less beneficial to a person than the timber, which society has chosen to sell from the Forests. The choice of what to charge and not charge for often is a political or legal decision influencing the distribution of benefits, but not the amount of benefits. For example, under the Mineral Leasing Act of 1920, the Federal government charges lease and royalty rates for the production of coal or oil from Federal lands. Yet under the 1872 Mining Law, the Federal government charges a minimal $2.50 per acre for patenting of mining claims and receives no royalty from the actual extraction of gold, silver, uranium, and other minerals. These types of minerals have economic value, but the decisions on leasing and low fees were political. The same logic applies to visitor days in Wilderness Areas. Just because Congress has precluded the Forest Service from charging does not mean that these lands have no economic value. Techniques for inferring the economic value of uses of Federal lands are discussed later.

To make the process of maximizing net public benefits operational requires that all economic benefits and costs be described and, where possible, quantified. To make the comparison of economic benefits and costs comparable, they need to be expressed in equivalent or commensurate units. Part of the inability to find solutions to endangered species conflicts arises because comparisons have involved unlike units such as number of animals gained and income foregone. Benefit-cost analysis allows one to calculate the social benefits and costs in economic (not financial) value terms. Economic values include financial returns but also include other benefits that have documented economic values. In general, the economic values derived from bird watching, hiking, and fishing can be determined from human actions, such as market transactions, number of recreational trips taken, and housing locations. Although not all values can be expressed in economic terms (for example, religious and cultural values), quantifying as many as possible provides a clearer picture of land use tradeoffs and their impact on net public benefits.

What Is Formal Benefit-Cost Analysis?

Benefit-cost analysis is a process of comparing in common units all the gains and losses resulting from some action. A complete benefit-cost analysis compares alternative actions to determine which action provides society with the most economically efficient use of its resources. The analysis accomplishes this by calculating a single index of the overall effect of a given alternative on both present and future consumers and producers.

A carefully done benefit-cost analysis will shed much light on three central features of a public management action, project, or policy: (1) the comparative benefits of alternative management emphasis, including the particular mix of multiple uses offered in the alternative; (2) the optimal size or scale of a public land management action, such as acreage of critical habitat units; and (3) the optimal timing for implementing the components of the management action or policy.

Conceptual Foundation of Benefit-Cost Analysis

One overall objective of a benefit-cost analysis is to determine which combinations of resource uses produce the greatest net economic gain to society. These gains and losses are measured from the viewpoint of individual members in society. Most people prefer more to less, so reallocations of resources that increase the benefits to one individual without reducing the benefits to anyone else would be preferred.

Valuation approach-The magnitude of the benefits received is determined by each individual's own, judgment of how much better off he or she is. We can indirectly determine how much better off people are with different management alternatives by observing the actual or intended choices by people of different levels of old-growth preservation. We measure an individual's benefits from a particular resource as the maximum amount of income the person would be willing and able to pay for the resource rather than go without. This is the sum of money about which the individual becomes indifferent when choosing between paying it and having access to the resource (for example, timber or old-growth forests) or keeping the money and foregoing the resource.

Income as a proxy for sacrifice of other goods-Willingness to pay in the form of income could, however, be a proxy for willingness to give up other goods and services to have the resource or project; that is, to substitute the new good for the old good. For example, a person who really likes bird watching might be willing to give up three trips to the beach to have one additional bird watching trip. In this sense, the individual is not directly foregoing income but is foregoing three beach trips to gain one bird viewing trip. To have a dollar measure of what is foregone, we must convert the beach trips into their income equivalent in dollars. In this way we can compare the value of the bird watching trip to the cost the individual must incur to have the bird watching opportunity.

From individual benefits to social benefits-Now that we have an idea of what resource management benefits are for an individual, how does this relate to the larger society? To answer this, we need to adopt the general democratic principle that what is best for society is best for each individual in society; that is, society's benefits are the simple sum individual benefits (both positive and negative). If we add individual valuations together, we can determine which forest management alternative has the largest sum or total. The highest valued alternative means that under no other alternative could the beneficiaries compensate the losers and still have any gain left over. This is sometimes referred to as a compensation test. This does not suggest that the compensation actually be paid. Compensation requires the losing party to have well-defined property rights to the resource, something that the multiple-use mandates do not provide any one group.

As in evaluating market outcomes, society certainly is concerned about equity in the ranking of alternatives in benefit-cost analyses. How the total benefits are distributed may be as important to social well being as the amount of total benefits. The distributional implications of economically efficient resource allocations are best handled by displaying not only the total net benefits, but also how the benefits are distributed across different income, age, or ethnic groups. The political system can thus choose to weight benefits to different groups differently if it so desires. Any differential weighing system is a value judgment that should be reserved for the political system and not be carried out by the analyst unless the analyst is explicitly given weights to do this.

Net Benefits, Accounting Stance, and Jobs

We will follow standard practice used in Federal benefit-cost procedures (U.S. Water Resources Council 1979, 1983) and weight all individual dollars equally.

An often confused issue in calculating benefits and costs is the treatment of jobs gained or lost. For management actions that make long-term (5- to 50-year) changes in availability of resources, the jobs gained or lost are not economic benefits or costs. Equity issues aside, labor is mobile and retrainable. If there is a real demand for lumber that cannot be met on public lands in the Pacific Northwest, it will be met somewhere else. In those other areas (the Southeastern United States, for example), the demand for labor will rise. Because workers cannot be created, this increase in demand for labor will be met by workers moving to that area. In the long term, jobs simply reflect a transfer of economic activity from one region of the country to another

Wages paid workers reflect a cost, not a benefit. Outside of recessionary downturns and accounting for the effect of unions and discrimination, labor is scarce and wages paid will reflect this scarcity. Given that the labor supply is fixed in the short term, a gain in jobs in one region reflects a transfer of the economic activity from one place in the United States to another, not a net gain. What one needs in benefit-cost analysis is the net gain; that is, the gain net of regional transfers. This convention is consistent with textbooks on benefit-cost analysis (Mishan 1976, Sassone and Schaffer 1978) and Federal benefit-cost procedures (U.S. Water Resources Council 1979, 1983).

Local interests or laws such as the National Environmental Policy Act, which governs preparation of environmental impact statements, oftentimes require that the employment related to a public land management action be displayed. Thus, it may be appropriate to translate direct changes in project employment into total employment by including spinoff employment in support sectors of the economy induced by the project. In the same way, it may be important to calculate the change in personal incomes in a given county or region that results from an increase in economic activity induced by the project. Both the induced employment and personal income generated by a project that uses fully employed resources are transfers, but there often is interest in knowing the magnitude of those transfers.

The economic impact analysis can serve at least two useful purposes. First, it can help local government planners plan the infrastructure of roads, schools, hospitals, housing, and parks needed to accommodate the additional workers and their families. Second, politicians may desire to stimulate selected regional economies at the expense of other areas. For example, expanding job opportunities in rural areas and increasing the tax base in rural economies may be a distributional goal. Even though this rural gain may be offset by a loss of the same economic activity in an urban area, politicians may wish to stimulate rural economies to maintain their viability. The techniques for computing income and employment effects of projects via multiplier analysis (using input-output models) are discussed in depth by the Forest Ecosystem Management Assessment Team (FEMAT;/1993) for timber, recreation, and commercial fisheries and therefore are not quantified here.

Measurement of Economic Efficiency Benefits

Now that we know what we wish to measure, the next step is to determine how to measure it. The methodology chosen to measure the benefits of resources must allow us to compare marketed resources and nonmarketed resources. To obtain consistency in valuation for both marketed and nonmarketed resources, economists rely on values measured from consumer demand curves and business supply or cost curves. In both cases, however, net willingness to pay is the appropriate measure of benefits.

For most goods or resources, consumers receive a surplus or gain in excess of what they pay (this is called consumer surplus). For goods and services consumable in small units (hamburgers or cans of soda), it is only the last unit purchased that is worth just what the consumer paid. Because the last unit has value to the consumer exactly equal to what he or she paid, there is usually no consumer surplus on the last unit bought. For public natural resources, such as preservation of endangered species, which is close to an "all or nothing" decision, there can be significant consumer surplus.

Consumer Surplus as Real Income

How real is this consumer surplus? We all have experienced receiving consumer surplus. Think about a time when you decided to buy something at its full retail price. You went to the cash register prepared to pay this price, and the sale price was lower than you expected to pay. That difference between what you would have paid for the good and what you did pay was a tangible gain in your real income. You bought the good at the sale price and retained the consumer surplus as added real income.

Why Actual Expenditures Are Not a Measure of Net Benefits

Though use of consumer surplus as a measure of the economic efficiency benefits to the consumer seems quite straightforward, some people become confused over how to deal with the actual money spent by the consumer. Reliance on expenditures as a measure of benefits unfortunately is a common mistake in resource decisions. It is a particularly easy mistake to make when actual expenditures are readily observable in the market place and consumer surplus can be inferred only after the product's demand curve is statistically estimated. The temptation is great to use expenditures rather than go to the trouble of statistically estimating demand curves. But, much as in the case of jobs, expenditures represent a transfer, not a net economic gain: that is, if the opportunity to go salmon fishing were lost, the fishing trip expenditures would not be lost to the national economy. The money would be spent by the individual elsewhere in the economy. It might be a loss to the local economy if an individual travels to another state to go fishing, but the national economy would experience no loss because the expenditure would be transferred elsewhere.

Benefits to the Producer

To calculate the producer's estimated willingness to pay, or the producer surplus, and to see its relation to a firm's profit, is to recognize that the producer surplus is the difference between a firm's total revenue and total variable cost. If for example, the total revenue to a rancher is $3,000 and the total variable cost of production is $2,000, then the producer surplus is $1,000 ($3,000 minus $2,000). Just as in the case of the consumer, producer surplus is the gain over and above the firm's actual expenditures. The firm's expenditures are the cost of inputs. The use of inputs by this rancher results in an opportunity cost to society because society must forego whatever else the inputs would have produced in their next best use.

Changes in the supply of marketed outputs usually generate producer surplus but no changes in consumer surplus. This is because the change in marketed output is usually so small relative to the market that there is no change in the price of the output to consumers. If there is no change in price, there is no change in consumer surplus and hence no net economic efficiency benefits to the consumer. In essence, this small additional amount of the marketed product is added at the margin where price equals gross willingness to pay. This contrasts with the case of supplying public goods such as temperate rain forest or endangered species, in which the entire national supply is found in one area.

Benefits of Environmental Improvement to Recreational Visitors

Demand curves reflect an inverse relation between the quantity demanded and price, when all other factors are held constant. One of the factors held constant is the quality of the good. It makes little sense to estimate a demand curve for cars that lumps Audis and BMWs together with Chevrolet Novas or Volkswagens.[1] Much like demand shift induced by changes in income, the demand curve will shift when the quality of the goods changes.

In the case of recreation, the quality of the recreational experience depends on the quality of the natural and environmental resources at the recreation site. If water quality or quantity changes, the demand for recreation will shift accordingly. As Maier (1974) demonstrated, we can use the area between these shifted demand curves as a measure of the benefits that visitors to the site derive from the change in resource quality.

A simple example illustrates the point. Figure 2 shows how the demand curve for sport fishing would shift if a habitat improvement project increased the typical angler's catch rate. At present the angler's demand curve is given by $D_{without}$. At the angler's current cost of travel to the site, $10 (the price paid to recreate if entrance fees are zero), he or she takes six trips. The without-project benefits are $90 (area under $D_{without}$ but above trip costs). If angler fish catch rates rise as a result of the improvement project, this increases the enjoyment from fishing at this particular site and shifts the demand curve outward to $D_{with\ project}$. This demand shift has two main effects. First, the angler receives more satisfaction from the current number of trips taken. The gain in consumer surplus on the existing six trips is shown in figure 2 as area A1, or $120 ($60 minus $40 multiplied by six trips). In addition, the higher enjoyment and satisfaction when coupled with the original trip price of $10 implies that taking more fishing trips is optimal. The angler increases the number of trips taken over the season from 6 to 10. There is $40 of additional consumer surplus (area A2 in fig. 2) on these additional four trips. Thus, the total benefits to the typical angler from the fishery enhancement is areas A1 + A2, or $160.

We can calculate exactly the same answer for project benefits if we subtract the with-project total consumer surplus from the without-project consumer surplus. The with-project consumer surplus in figure 2 is $250 ($60 minus $10, multiplied by 10 trips, and divided by two). The without-project consumer surplus is $90. The gain in angler benefits is $160, just as before. The gain in benefits can be compared to the management costs of implementing the project. If the benefit is greater than the cost, then the project is worthwhile from the standpoint of economic efficiency.

Comparing Value of Changes

A typical public land allocation issue often involves comparing the value of a change in quantity in some marketed output (timber, minerals, beef) with a change in quantity or quality of a nonmarketed goods (recreation, fishing, sightseeing). The marketed commodity is often traded in national or international markets. If the marketed good provides a substantial part of market supply, then price will change when public land allocation shifts and consumer surplus must be included in a benefit-cost analysis. Typically, the public land area under consideration contributes only a small amount of output to this national market (recall the case of livestock grazing on public land that in total contributes only 7 percent of the U.S. supply). As such, whether this particular

[1] The use of trade or firm names in this publication is for reader information and does not imply endorsement by the U.S. Department of Agriculture of any product or service.

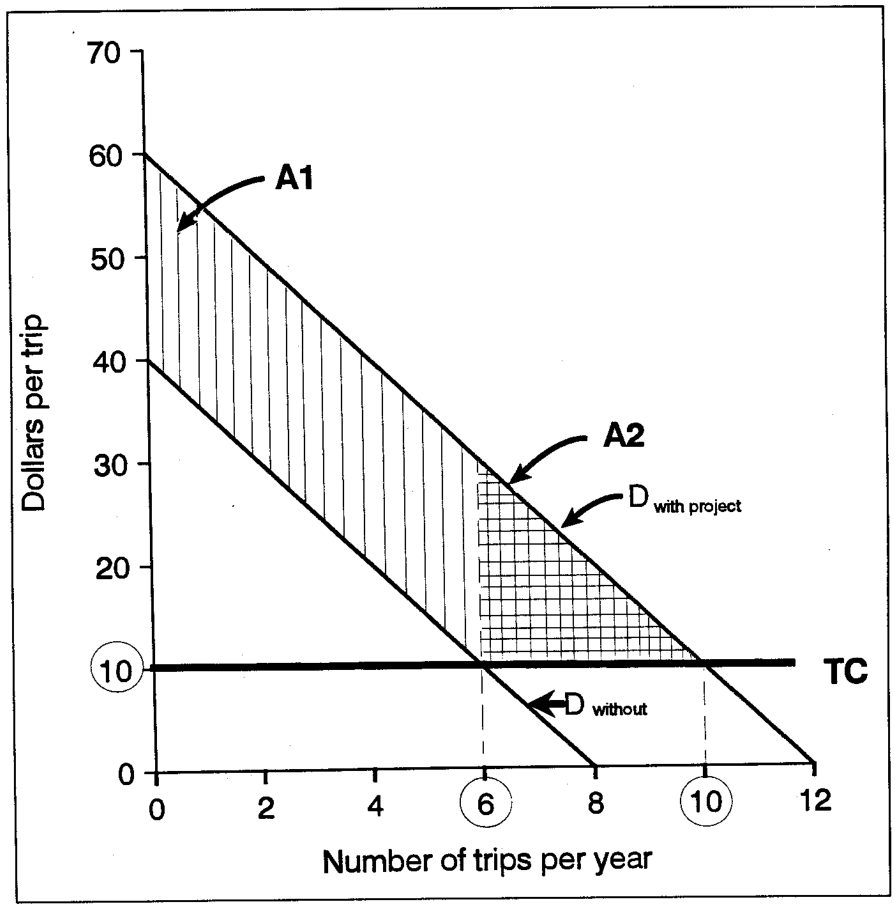

Figure 2-Demand curve for sport fishing shows how environmental quality affects visitors.

public land area supplies zero or its maximum potential output of the marketed output, it will not affect the price of the marketed commodity. In essence, the demand curve for marketed outputs from this tract of public land is horizontal at the market price, just as the demand curve facing an individual rancher would be. Price therefore can be used as a measure of gross willingness to pay for one more unit of commodity output. The net benefits of producing the marketed output from this tract of public land would be determined by subtracting the costs of producing that marketed good from this gross willingness to pay, or total revenue. The benefits of commodity production are simply the producer surplus or change in net income realized. There is no consumer surplus to be added to the commodity production in this case, even though the first few units of the good traded in the market do provide a consumer surplus. The reason no consumer surplus exists in this case is that the change in supply is so small that it does not change the price. If there is no change in price of the good to consumers, there can be no change in consumer surplus. In essence, consumers continue to receive the same amount of consumer surplus they had without the project. If the with-project and without-project consumer surplus is the same, no change in consumer surplus can be attributed to this land management action.

This same logic would hold if the area of public land provided an identical mix of recreational activities (in the same environmental setting) and of the same quality that could be found at other public lands located exactly the same distance from all visitors as the given area. Thus, if there were numerous uncongested, perfect substitute sites available at the same price (distance) and having the same quality (setting, aesthetics, and so forth), then the addition or deletion of one such recreation area would result in little change in consumer surplus (that is, people will not be willing to pay anything additional for this site compared to existing sites).

Rarely, however, are there uncongested, perfectly identical, substitute recreation areas located at the same distance from users. In general, if commodity production at one area results in the loss of a recreation area, there will be a price increase for consumers who lived closest to that site; that is, these consumers will now have to travel farther to obtain that same type of recreation. As such, the price increase translates into a loss in consumer surplus, just as any other price increase would. In cases where the substitute sites are so congested that they are rationed by advance reservation or permits, no new visitors can be accommodated and the entire existing consumer surplus is lost. This situation is typical of East Coast States and a few Western States, such as California. If the other site does not restrict entry of visitors, the additional recreationists often may impose congestion costs on existing visitors to these sites and hence indirectly reduce the quality at the sites.

Because loss of a recreation site or changes in recreation quality result in nonmarginal changes affecting prices or quality, there is a change in consumer surplus. This arises in part because recreation is not a homogeneous product traded in national markets. Because of the high travel costs associated with recreation, 80 to 90 percent of visitors travel from within a few hours to most recreation sites; that is, the sites have localized markets.

There is no inconsistency here in terms of using market price to derive stumpage values (that is, producer surplus) for timber and then using consumer surplus for recreation. Both producer and consumer surplus are measures of willingness to pay. Price is a measure of gross willingness to pay at the margin for one more unit of the good. Thus, all resources are compared through the same conceptual measures of value and willingness to pay.

Valuation of Marketed Natural Resources

As discussed earlier, the market price of a good often can be used to value small changes in the supply of that good. Nonetheless, it is important to understand how that market price is determined and what it represents in the case of resources produced from public lands. Even though many of the commodities sold from public lands have prices, they are not always expressed in exactly the same way as traditional market prices. The market price for most goods, such as clothing, have a price per unit posted in the store, and buyers can purchase as many or as few items as they want at that price. On the other hand, timber is not often sold from public lands with an explicit posted price per board foot with many different buyers purchasing as little or as much as they want at that price. Rather, the cutting rights to an entire area of forested land are offered for bid, and the highest bidder is awarded the rights to cut the entire area. The same is true for mineral leases. Firms cannot buy 5 tons of coal at a price per ton from a tract of public land, but rather must bid on the mineral rights of land as large as several hundred acres.

Other public land commodities are not themselves sold in formal markets but rather exchanged as part of a package of natural resources to a select group of buyers. For example, unlike private and some state lands, where grazing privileges are auctioned off pasture by pasture, grazing privileges on most Federal lands are not put out to bid. Rather, only "qualified" ranchers (those owning nearby ranches that are considered "base property") can request these grazing privileges. In most cases, the grazing privileges are retained by those ranchers who acquired the historic grazing privileges decades earlier or by whoever bought the entire base property. One cannot buy 100 animal unit months of public land grazing in a formal market. Often times, the only way to acquire the grazing privileges is to buy a ranch that has those grazing privileges. To make valuation even more difficult, the price the Federal government charges for the grazing privilege is set by an administrative formula that results in a grazing fee about one-third that of the market clearing price where comparable bidding exists (USDA Forest Service 1990).

Much of this discussion about market structure for public land grazing also applies to the valuation of water from western public lands. The amount of water withdrawn for irrigated agriculture, domestic use, and industrial use often is based on historic appropriation, sometimes characterized as "first in time, first in right." Once again, historic users have priority over more recent uses. Formal market exchanges of water rights themselves are beginning to occur more frequently, but they are not frequent enough to constitute what we might call a competitive market. Certain water "uses" such as in-stream flow, pollution dilution, or fisheries habitat also have many "public good" characteristics. Even the most competitive markets will generally fail to recognize the full value of these public good attributes of water. In the case of water, an added challenge is that, unlike grazing that takes place directly on public lands, it is often difficult to identify from several ownerships of public land which public lands produced a given amount of water that is consumed several hundred miles downstream.

Nonetheless, as the following sections illustrate, there exists a well-developed and conceptually sound foundation for valuing natural resources from public lands. This is true whether the natural resource's values are revealed directly through markets or through quasi-markets. This is also true whether the values are inferred from consumers' behavior when visiting recreation sites or from responses to surveys about the value of natural environments. We hope that by the time readers have finished these sections they will avoid thinking that "economists assign values" to natural resources. Economists, with the help of other social scientists and statisticians, merely record and organize information about the behavior of people to quantify in dollars the values people already possess.

Common Methodological Approaches

In valuing water, timber, minerals, and animal unit months of livestock forage produced from public lands, there are at least four common approaches: (1) market or transactions evidence, (2) demand estimation, (3) residual valuation, and (4) change in net income (Davis and Johnson 1987, Gray and Young 1984).

1. Market or transactions evidence requires observation of similar sales of resources in competitive markets to infer a value for the resource of interest in this particular public land setting. For example, to value animal unit months of forage in public lands, the analyst might look at bids for animal unit months of forage in private or state land leases. The key requirement for accurate valuation with this approach is finding comparable sales in terms of characteristics of the resource in the private sale to those in the public land case.

2. A demand curve approach can be employed if there is a large enough number of past sales or a data series of prices and quantities sold over time or across the country to statistically estimate a demand function. This has been performed for regional and national timber demand (Adams and Haynes 1980) and for municipal demand for water (Beattie and Foster 1979, Young 1973).

3. Residual valuation involves subtracting from the total value of the output produced all costs of inputs except the "unpriced" public land input, such as water or forage. The value remaining after all other costs (including a normal profit, return to management, capital, and so forth) is then attributed to the unpriced or underpriced public land input. Thus, the irrigation value of unpriced water flowing from a National Forest is the value of the agricultural crop produced minus all priced inputs, such as land, seed, fertilizer, machinery, labor, and management. The key assumptions here are that all other inputs are priced and that total value of output can be apportioned according to the marginal product of the inputs (Gray and Young 1984). This approach is commonly used to value water and timber and will be discussed in more detail below.

4. Change in net income involves simulation of a firm's or producer's net income with and without additional quantities of the public land resource. For example, the value of additional animal unit months of forage to a rancher frequently is calculated by simulating how the ranch enterprise would modify its herd size or ranch operation if it had an additional 100 animal unit months of public land forage at a given time of the year in its current grazing allotment. Often times this simulation is performed by using ranch budget data and linear programming models.

Given these general techniques, it is worthwhile to briefly examine how they are applied to calculate economic values for each of these marketed or quasi-marketed resources. Once we have done this, we will turn to valuation of nonmarketed uses of public land resources, such as recreation, fisheries, wildlife, and wilderness.

Valuation of Timber

Timber on public lands often is referred to as stumpage. It is, in essence, the trees "on the stump" that are being valued. The Forest Service is required to appraise the standing timber prior to sale. As mentioned above, this method starts with the value of an intermediate product, such as lumber, and then subtracts the milling and logging costs. The result of the appraisal process is a price for timber that reflects resource and market conditions near the time of the offering.

Market prices for Federal timber are established through some form of competitive bidding, either oral or sealed. This price, called the "sold" or bid price, is not always a good measure of the value of timber because the sales often are not harvested in the same year. A better measure of the value of timber in a given year is the average value of timber harvested (from the pool of uncut volume under contract) in that year.

Harvest prices for National Forest timber frequently are used as the measure of regional prices for all owners because of the substitutability of public timber for private timber. This is discussed in more detail in Adams and Haynes (1991).

Considerable debate has centered on whether the complete cost of building the roads should be charged to the timber sale because sometimes the access road will benefit other resources, such as roaded recreation or livestock grazing. To muddy the cost accounting further, Federal agencies such as the Forest Service frequently offer a "purchaser road credit" for road building. This does not change the amount of the cost, and as long as this cost is netted out, no error results. Unfortunately, the Forest Service sometimes shows stumpage prices derived that include the purchaser road credit, thereby substantially inflating the net economic value of the timber (USDA Forest Service 1990).

Note that these timber sales yield a value per sale based on actual market transactions. The conversion of this total sale value into prices for specific tree species is computed from the volumes of each species and assumptions about product prices by species. For example, a bid of $100,000 for a sale with 4,000 Mbf (million board feet) of Douglas-fir (Pseudosuga *menziesii* (Mirb.) Franco) and 1,000 Mbf of ponderosa pine *(Pinus ponderosa D*ougl. ex Laws.) might be apportioned based on volume and relative end lumber product prices. It is worthwhile to keep in mind that these species "prices" are derived and are not a typical posted price whereby the buyer can purchase as few or as many board feet of a given tree species on the stump as the buyer would like. Although these derived prices by species often are used as normal market prices, they may reflect more of an average producer surplus per unit output than a typical price at the margin. These species stumpage prices are still directly useful in timber valuation for benefit-cost analyses and in forest planning optimization models; however, they are not the pure measure of market price per unit they often are made out to be. For a detailed discussion of valuing stumpage see Davis and Johnson (1987).

Valuation of Minerals

The residual valuation approach frequently is used in determining the net economic value of minerals on public lands. Much like the timber appraisal method, this technique starts with the product price as given. This is especially appropriate for minerals where the prices of most minerals are set in national and international markets (USDA Forest Service 1990, Vogely 1984). From these prices, the costs of ore or mineral processing, mining, transportation, and a normal rate of return are subtracted to yield a net economic value of the minerals in the ground. The U.S. Bureau of Mines provides estimates of the cost of milling and mining different ores. In some cases where competitive bidding is used to sell the mining rights for certain leasable minerals, such as coal or oil, the bids can be used as a source of information to derive the net economic value of the mineral resources in the ground. Like timber, these mineral "prices" per unit derived by either approach reflect an average price over some lease area or deposit rather than a posted price per unit. For a more detailed discussion of valuation of minerals see Vogely (1984).

Valuation of Water

Valuation of water begins our transition from marketed natural resources to non-marketed natural resources. The first challenge in valuing water flows from public lands is determining to which of the many uses this incremental flow will be allocated. Will the additional water be used in irrigated agriculture? by municipal uses? or be left in the river to add to instream flow? In general, additions to existing water supplies usually are assumed to go to the lowest valued use of water, such as irrigated pasture or irrigated agriculture. The reason is that higher valued municipal and industrial uses of water can normally be purchased from those who held lower valued use permits. This is not always the case, however, as rigidities in the prior appropriation doctrine of water law gives historic senior rights to the first uses rather than to the highest valued uses.

After determining which water uses are most likely, the next step is to determine which of the four techniques to use. This usually is based on the type of water use to be valued. If the water use is irrigated agriculture, a change in net income or residual valuation approach often is used. Here, farm budgets are used to simulate the increase in crop values stemming from additional water. The cost of putting this additional water to use and associated farm inputs, such as additional seed, fertilizer, tractor time, and so forth, are subtracted from the change in crop values to yield the change in net income.

If the use of water to be valued is municipal, then demand estimation or market transactions will frequently be employed to calculate a value of water in this use. For a discussion of valuing water see Gray and Young (1984) or Colby-Saliba and Bush (1987).

Of course, if the additional water is to be left in the stream to enhance fisheries or recreational boating, then in most areas of the United States slightly different techniques for valuation of water must be used. We say "slightly different" because the first technique discussed basically falls under the category of demand estimation. This technique is called the travel cost method and will be discussed in the next section on valuing recreation.

Valuation of Nonmarketed Natural Resources

Why Nonmarket Valuation?

As we discussed in previous sections, a big difference exists between a financial cash flow and economic value to society. This distinction arises for public goods and for many uses of natural resources that are not traded in markets. While the economic forces underlying nonmarketed natural resources, such as sport, fish, wildlife, and Wilderness Areas, are similar to those economic forces for any natural resource or good, some important differences should be noted, particularly, the nonrival and nonexcludable nature of consumption of pure public goods. The fact that the producer cannot exclude nonpayers from consuming public goods almost always makes optimum supply financially unprofitable even if it is economically viable to society. Unfortunately without an explicit market, direct observation of willingness to pay (benefits) is difficult. And thus the need arises for techniques to reveal the demand and value for publicly provided natural resources.

The other need for valuation of natural resources is that, institutionally, most Western States have taken ownership of sport fish and wildlife out of the free market. Most game animals are owned by the states and they cannot be legally bought and sold as livestock is. In addition, the states do not ration access to wildlife based on market-determined prices. In the case of wilderness, Congress has specifically instructed all Federal agencies that they cannot charge for access to Wilderness Areas, let alone establish a market for Wilderness Area permits.

Thus, while society has chosen not to allocate access to these resources through the market, economic forces are still present: There are still scarcities of these natural resources, excess demand at these zero or below-cost prices, and competing market uses of these resources (for example, forage is demanded by ranchers for livestock instead of for wildlife, and timber is demanded rather than wilderness recreation). Given the scarcity, excess demand, and competing demand, allocation decisions about uses of these nonmarketed natural resources are still required. If society is interested in receiving the most benefit possible from these nonmarketed resources, some attention to benefits and costs is necessary. Net economic benefits (benefits minus costs) is not the only criterion for allocating natural resources on public lands, but it is one of the criteria given emphasis in many public land laws.

Methods For Estimating Recreation Demand and Benefits

Travel cost method-Unlike marketed goods that are shipped to the consumer, consumers must ship themselves to a recreational resource. People face substantially different market prices for a recreation site depending on where they live. As a result, we can trace a demand curve for the recreation site and then calculate the net willingness to pay, or the consumer surplus from it. The travel cost method uses variation in residents' travel costs to a site along with the quantity of trips they make to trace out a demand curve for recreation. From this demand curve, the net willingness to pay for recreation can be computed. Although this method can be quite involved (see Ward and Loomis 1986), it essentially involves cross-section regression analysis of visitation data. The approach has been applied to valuing recreation since 1959, and it is one of the two preferred techniques for valuing recreation in Federal benefit-cost analyses (U.S. Water Resources Council 1979).

Contingent valuation method-This method is a survey technique that constructs an exchange situation to measure willingness to pay or accept compensation for different levels of nonmarketed natural and environmental resources. The contingent valuation method is capable of not only measuring the value of outdoor recreation under alternative levels of wildlife and fish abundance, crowding, instream flow, and so forth, but also is the only method currently available to measure other resource values such as the benefits the general public receives from continued existence values of unique natural environments or species.

The basic notion of the contingent valuation method is that a realistic exchange situation for "buying" use or preservation, or both, of a nonmarketed natural resource can be credibly communicated to an individual. Then the individual expresses his or her valuation of the resource.

The natural or environmental resource to be valued can be described to the respondent through words, drawings, photographs, charts, or maps. Often times some combination of these approaches is used depending on the nature of the environmental change being communicated. For changes in air quality or water quality, photographs frequently are used. For changes in lake levels, river levels, or acreage of wilderness, simple maps or drawings usually suffice. For changes in hunting or fishing success, a narrative will work because hunters and anglers often are quite familiar with the resource to be valued. The key in any of these cases is to provide a short and neutral description of the resource. The regional or national significance of the good can also be described as part of the survey.

Obviously, design of the survey is critical to obtaining credible results. See Cummings and others (1986), Mitchell and Carson (1989), and Peterson and others (1992) for complete discussions.

Advantages of the contingent valuation method-A key advantage of this method for critical habitat analyses relates to use of its hypothetical nature as an asset; that is, decisionmakers need information about how people value a variety of irreversible public land management scenarios before they make the decision. These situations call for information on intended behavior about possible alternatives rather than extrapolation based on past behavior.

Perhaps one of the strongest advantages of the contingent valuation method is in valuing those resources for which recreation is but a small part of the social benefits. Many unique natural environments and species are rarely visited or seen by people, yet many people derive a substantial amount of enjoyment or satisfaction just in knowing they exist. For example, many people value knowing the spotted owls, whooping cranes *(Grus americana),* wolves *(Canis sp.),* condors *(Gymnogyps califomianus)* and grizzly bears (Ursus *horribilis)* exist, even though they may never see them in the wild. This "existence value" often is reflected in a person's contribution to conservation organizations to save these species or natural environments. In addition, some people are willing to pay to preserve areas for future generations. This "bequest value" is an additional motivation. Lastly, some people are willing to pay a premium over their future use value to ensure that natural environments or wildlife species exist so that they can visit them in the near future. This is sometimes referred to as "option value."

These existence, bequest, and option values capture much of what is called the public trust values of natural resources. Others refer to these as preservation values or offsite or nonuse values. In any case, the contingent valuation method is currently the only one for measuring these values in dollar terms and one of the few approaches for ecosystem valuation. Therefore, in cases where the public land decisions involve relatively unique environments or irreversible decisions, these-values are often empirically important. A contingent valuation method study of these preservation values for protecting additional roadless areas in Colorado, for example, found these values made up about 50 percent of the total value to society (Walsh and others 1984); that is, these preservation values were as least as large as the recreation values provided by protection of areas such as Wilderness. For more discussion of the use of this method for determining existence values see Mitchell and Carson (1989). And for some of the best examples of valuing entire ecosystems rather than specific species, see Walsh and others (1984) and Loomis (1989).

Validity and reliability of the contingent valuation method-Some people might reasonably question the accuracy of answers to hypothetical markets as compared to real markets where cash actually changes hands. Would people really pay the dollar amounts they state in these surveys? The empirical evidence to date indicates that when people are asked about willingness to pay (rather that willingness to accept), they actually would pay approximately what they state in the surveys. This conclusion is based on several comparisons of real cash markets with hypothetical markets used in contingent valuation studies (Bishop and Heberlein 1979, Brookshire and others 1982, Welsh 1986). The essence of all these comparisons is that respondents to a survey do attempt to relay their true value of the resource. The behavior exhibited and statements of value sometimes understate that value and, in other cases, slightly overstate the value. The degree of overstatement, when it occurs, seems to be reasonably small. Based on these studies, one can have some confidence that statements of willingness to pay elicited in contingent value surveys bear a close resemblance to the behavior that would actually occur if the described situation in the survey arose in a real market.

Use of the Two Methods by Federal and State Agencies

Both the travel cost method and the contingent valuation method are widely accepted by government agencies for valuing recreation and other nonmarketed benefits of environmental resources. Both methods have been recommended twice by the U.S. Water Resources Council (1979, 1983) under two different administrations as the preferred methods for valuing outdoor recreation in Federal benefit-cost analyses.

The U.S. Department of the Interior (1986) recently endorsed both methods as preferred for valuing the nonmarketed natural resources damaged by oil spills and other toxic events. The U.S. Bureau of Reclamation and the National Park Service relied on the contingent valuation method to determine in dollar terms the recreational fishing and rafting effects of alternative hydropower water releases from Glen Canyon Dam into the Grand Canyon. The Montana Department of Fish, Wildlife, and Parks relied on a contingent value survey of the benefits of viewing and hunting elk when justifying its purchase of additional elk winter range outside Yellowstone National Park. Several other state fish and game agencies (for example, Arizona, California, Idaho, Maine, Missouri, Nevada, and Oregon) use both methods for valuing fish- and wildlife-related recreation.

In January 1992, a panel chaired by two Nobel Prize economists, Kenneth Arrow and Robert Solow, concluded that the contingent valuation method was sufficiently reliable as a starting point in judicial and administrative proceedings for the existence values of natural resources (Arrow and others 1992).

In summary, we see that there is a well-developed and conceptually sound basis for deriving values for both marketed and nonmarketed natural resources. In most cases, these values stem from people's actual behavior in buying products made from natural resources or from visiting recreation sites. The techniques discussed here simply allow the analyst to measure those values in dollar terms to compare benefits to costs of alternative uses of those natural resources. In this way, the public and the manager can determine if resource allocations or management actions are economically efficient and therefore the best use of taxpayers dollars and public lands.

Empirical Measurement of Recreation Benefits in the Pacific Northwest

The management options for old-growth forests in the Pacific Northwest presented in the biological assessment of FEMAT (1993) are based on analyzing acres of critical habitat for various terrestrial and aquatic species. The key factor that differs with management option is the location and number of acres that fall within designated conservation areas in western Washington and Oregon and northern California. To assess the ability of the various habitat management options to meet future recreation demand on Forest Service and Bureau of Land Management (BLM) land, recreation use must be expressed in terms consistent with these habitat options; that is, on a per-acre-equivalent measure. Adoption of these conservation areas will result in a change in the mix of management options within the area that will directly affect the mix of recreational opportunities provided. To allow consideration of a range of recreational opportunities and also incorporate the change in resource setting that will result from adoption of the conservation areas, recreation-use numbers were translated into acre equivalents by using the recreation opportunity spectrum (USDA Forest Service 1981). This is a recreation land management classification system that takes into account the natural setting, acres of allocation, and quality of experience associated with a recreational visit. With these criteria, all land is classified into six categories: primitive, semiprimitive nonmotorized, semiprimitive motorized, roaded natural, roaded modified, and rural. These classifications lie along a continuum with primitive and semiprimitive nonmotorized representing large areas of unmodified natural environment where motorized vehicles are not permitted. In the middle of the continuum is semiprimitive motorized and roaded natural, which possess natural appearing environments but where there is evidence of human use and motorized access is permitted. At the other end is roaded natural and rural where extensive resource modification occurs, including developed recreational facilities and high user density. For this analysis, roaded natural and rural were combined and primitive was assumed to include wilderness. By translating recreation use into recreational opportunity spectrum acre equivalents, it was possible to quantify the recreation value associated with adopting various conservation acres.

Current Situation

The current recreational land base for the 13 National Forests and six BLM units in Oregon and Washington covers 23 million acres and is characterized by the recreational activities listed in table 1. In total, the recreational activities listed provided $1.6 billion in net public benefits and resulted in $2.8 billion of recreation-related expenditures in 1990. In 1990, activity was greatest for motorized travel, which accounted for 74.95 million visits and $299.8 million in annual net benefits. The lowest activity day numbers occurred in snowmobiling with 1.2 million visits. It must be remembered that observing what activities individuals participated in (and where) does not necessarily fully reflect what activity or how much of an activity an individual would prefer. The activity visit numbers reflect current availability of recreational opportunities and therefore only fully meet demand where that activity opportunity is fully supplied. It may be the case that 4.6 million visits for nonconsumptive wildlife viewing reflect demand being fully met, or it may be that wildlife viewing opportunities are scarce (and at site capacity) and not all demand is being met. Counting the number of activity days may reflect site capacity for viewing opportunities (that is, people could not participate at preferred levels). If more opportunities had been available, visits would have been higher. Counting activity days therefore may more closely reflect supply of recreation rather than demand for activities. This becomes especially critical when projecting future recreation demand. One cannot merely look at current use numbers and apply a growth factor; the relation between supply and demand must be incorporated.

Translating Recreational Activities Into Recreation Opportunity Spectrum Equivalents

Table 2 displays total available acres by recreation opportunity spectrum class for the 23 million Forest Service and BLM acres being considered. Roaded natural (8.7 million acres) contains the most acres and semiprimitive motorized (1.6 million acres) the least.

To allow an economic assessment of recreational use for the various land options, the recreational activities and their associated net benefits must be assigned to the appropriate recreation opportunity spectrum setting and a value per acre by recreation opportunity spectrum estimated. Once activities are assigned to a setting, projections of recreation demand and value by recreation opportunity spectrum acre can be made and compared to recreation opportunity spectrum supply by option. To do this, recreational use and net benefits first must be expressed per acre. This was accomplished as follows: (1) current recreational use was allocated to the recreation opportunity spectrum settings where they occurred, (2) total annual benefits were estimated by recreation opportunity spectrum, and (3) recreational values per acre were estimated for each setting.

Activities take place in various settings, so it is not possible to take the activity list in table 1 and directly assign activity days to a recreation opportunity spectrum setting. To account for the variety of settings, each activity was apportioned across settings based on the weighting factors reported in the Oregon recreational needs bulletin (Oregon State Parks and Recreation Department 1991). For example, the report found that 16.7 percent of fishing occurs in a semiprimitive setting. As such,

Table 1-Recreational visits to 6 Bureau of Land Management and 17 National Forests[a]

Recreation use category	Number of visits: BLM	Number of visits: Forest Service	Number of visits: Total BLM + FS	Value per visit[b]	Annual benefits	Expenditure per visit per day[c]	Total expenditures
				Dollars			
Offroad visits (motorcycling off roads, all terrain vehicle, 4-wheel drive, dune buggy)	497,200	1,576,675	2,073,875	$10.39	$21,547,561	$21.91	$45,438,60
Motorized travel visits (sightseeing and exploring)	1,629,980	73,324,42	74,954,401	4.00	299,817,604	21.91	1,642,250,925
Nonmotorized visits (hiking, backpacking, visiting the beach, beachcombing, trail cycling, horseback riding)	1,252,930	9,550,082	10,803,012	35.86[d]	213,428,767	8.53	92,149,693
Camping visits (all modes)	693,740	10,833,131	11,526,871	11.00	126,795,581	27.17	313,185,085
Hunting visits (big game, bow hunting, birds and small game)	345,370	2,258,443	2,603,813	39.08	101,757,012	20.69[e]	53,872,891
Nonconsumptive wildlife viewing	1,103,585	3,472,497	4,576,082	26.06	119,252,697	22.44[e]	102,687,280
Other land-based visits (nature study, photography, picnicking, visiting interpretive displays)	1,103,585	13,599,159	14,702,744	20.00	294,054,880	13.50	198,487,044
Fishing visits (fishing from boat or bank, fresh water)	567,380	5,274,896	5,842,276	42.92	291,646,418	30.65[e]	179,065,759
Boating visits (river, nonmotorized as rowboat, canoe, raft)	253,450	1,668,932	1,922,382	6.00	11,534,292	22.73	43,695,743
Other water-based visits (swimming or wading at beach, lake, or river)	264,490	1,907,111	2,171,601	3.00	6,514,803	4.56	9,902,501
Winter sports visits (cross-country, snowshoe, snowboarding, sledding, general snowplay)	91,350	2,132,502	2,223,852	33.69	74,921,574	22.41	49,836,523
Snowmobiling visits	9,400	1,193,901	1,203,301	33.69	40,539,211	22.41	26,965,975
Total	6,998,260	126,791,750	133,790,010		$1,601,810,400		$2,757,538,021

[a] 1990 visits as reported in Forest Service resource management plans.

[b] Resource pricing and valuation procedures for the recommended 1990 Resource Planning Act program, USDA Forest Service, Washington DC.

[c] Except where noted, expenditure values are based on Johnson and others (1990).

[d] Visits to wilderness areas were valued at $35.86.

[e] U.S. Fish and Wildlife Service 1991 survey of hunting, fishing, and wildlife associated recreation.

Table 2-Recreational visits and values by recreation opportunity spectrum setting, Bureau of Land Management and Forest Service sites, 1990

Category	Total acres[a]	Recreation visits[b]	Annual benefits	Value per acre	Visits per acre
			— — — — Dollars	— — —	
Primitive	3,855,925	3,900,578	$116,225,978	$30.14	1.01
Semiprimitive nonmotorized	1,607,879	3,937,768	77,270,710	48.06	2.45
Semiprimitive motorized	1,577,960	11,593,122	123,092,206	78.01	7.35
Roaded natural	8,685,829	79,697,130	797,698,760	91.84	9.18
Roaded modified rural	7,614,591	33,680,983	356,494,142	46.82	4.42
Total	23,342,183	132,809,585	$1,470,781,796		

[a] Acres by recreation opportunity spectrum as reported by Bureau of Land Management and Forest Service site managers. For the sites not reporting, it was assumed that they contained the same percentage allocation.

[b] Based on activity settings reported in Oregon State Parks and Recreation Department (1991).

16.7 percent of the total 5.8 million activity days were assigned to the semiprimitive setting. This procedure was followed for all activities, and the results are reported in table 2. The most visits took place in the roaded natural category (79.7 million visits) and the least in primitive (3.9 million visits). This procedure was applied to the value per activity day (USDA Forest Service 1990) to derive an annual economic benefit by recreation opportunity spectrum setting. These values also are reported in table 2. Annual benefits were greatest for the roaded natural category ($798 million).

Value per acre was estimated by dividing annual spectrum benefits by the number of acres in that setting. These values also are reported in table 2. This value per acre incorporates the effect of user density. Roaded natural is valued at $91.84 and primitive at $30.41. This does not mean roaded natural is more valuable to an individual recreational experience; rather, more individuals are reflected in the value per acre. Table 2 shows the value of $30.14 per acre, which reflects one visit per acre; $91.84 is a weighted sum value of nine visits per acre. Therefore, on an individual visit basis, primitive is three times more valuable than roaded natural.

With a value per acre by recreational opportunity spectrum setting, future recreational demand and supply relations can be addressed for the various options.

Future Forecast of Recreation Demand and Supply

Four sets of demand projections were reviewed to assess future increases in recreation use: BLM data (USDI BLM 1992), USDA Forest Service 1993 updated Resource Planning Act assessment (English and others 1993), and Oregon State Parks and Recreation Department (1991) and Washington State (Interagency Committee for Outdoor Recreation 1990) comprehensive outdoor recreation plans. All four studies used changes in demographics (especially population) as one of the key determinants.

The major recreational activity expected to see the largest increase is nature-based recreation such as wildlife viewing and photography. Estimated increases in use by 2000 range from 43 percent for nonconsumptive use on the Pacific Coast (English and others 1993) to 60 percent for Oregon (Oregon State Parks and Recreation Department (1991). Washington expects a 44-percent increase in this category (Interagency Committee for Outdoor Recreation 1990). Wildlife observation and backpacking were recreational activities identified as two of the 10 fastest growing over the next 50 years.

Given the projected growth in various recreational activities, the resource setting in which they take place, and adjusting for changing demographics, the Oregon State Parks and Recreation Department (1991) forecasts the number of acres needed by recreation opportunity spectrum class in 2000 to meet projected recreation demand in National Forests in Oregon. From the recreation opportunity spectrum projections for land base demand for western Oregon, these percentages were applied to the analysis area to estimate acres needed by the spectrum for 2000. These acres are reported in table 3. To meet projected demand in 2000, we will need 5.9 million acres of primitive, 7.6 millions acres of semiprimitive nonmotorized, 1.8 million acres of semiprimitive motorized, 3.3 million acres of roaded natural, and 4.7 million acres of roaded modified.

These forecasts represent the demand for these outdoor recreation categories. These must be compared to supply capability to meet the demand. The recreation opportunity spectrum preference allows comparison of land supply capability to demand projections; that is, the demand by preferred spectrum class can be compared to the availability of land by spectrum, acre by acre. Specifically, the amount of land needed

Table 3--Supply and demand by recreation opportunity spectrum under various management options

	Primitive	Semiprimitive nonmotorized	Semiprimitive motorized [a]	Roaded natural [a]	Roaded modified rural[a]	Total
Current allocation:						
Current acres	3,855,925	1,607,879	1,577,960	8,685,829	7,614,591	23,342,183
Recreation value per acre (dollars)	$30.14	$48.06	$78.01	$91.84	$46.82	na
Demand in 2000 (acres) [b]	5,858,888	7,609,552	1,820,690	3,314,590	4,748,463	23,342,183
Unmet demand (acres)	2,002,963	6,001,673	242,730	(5,371,239)	(2,876,128)	na
Acres meeting demand	3,855,925	1,607,879	1,577,960	3,314,590	4,738,463	na
Recreation value (dollars)	$116,225,978	$77,270,710	$123,092,206	$304,408,971	$221,841,774	$842,839,639
Forest plan implementation:						
National Forest plans acres [b]	3,244,563	1,237,136	490,186	6,815,918	11,554,382	23,342,183
Unmet demand (acres)	2,614,325	6,372,416	1,330,504	(3,501,328)	(6,815,919)	na
Acres meeting demand	3,244,563	1,237,136	490,186	3,314,590	4,738,463	na
Recreation value (dollars)	$97,798,204	$59,453,730	$38,238,028	$304,408,971	$221,841,774	$721,740,707
Option 7: [c]						
National Forest plans (acres)	3,933,626	811,278	2,211,486	7,343,830	9,045,412	
Unmet demand (acres)	1,925,262	6,798,274	(393,796)	(4,029,240)	(4,306,949)	
Acres meeting demand	3,933,626	811,278	1,820,690	3,314,590	4,738,463	
Recreation value (dollars)	$118,568,066	$38,988,036	$142,026,896	$304,408,971	$221,841,774	$825,833,743
Option 1: [c]						
National Forest plans (acres)	3,959,785	974,582	2,875,906	7,003,607	8,543,122	
Acres meeting demand	3,959,785	974,582	(1,820,690)	(3,314,590)	(4,738,463)	
Recreation value (dollars)	$119,356,555	$46,836,027	$142,026,896	$304,408,971	$221,841,774	$834,470,223
Option 1 with recreation emphasis: [c]						
Acres	3,959,785	2,552,542,	1,897,946	6,403,607	8,543,122	
Acres meeting demand	3,959,785	2,552,542	1,897,946	3,314,590	4,738,463	
Recreation value (dollars)	$119,356,555	$122,668,925	$148,053,419	$304,408,971	$221,841,773	$916,329,643

na = not available.

[a] Excess supply is shown in parentheses.

[b] Based on Oregon State Parks and Recreation Department (1991).

[c] Forest Ecosystem Management Assessment Team (1993) option.

in the primitive category to meet forecasted growth in demand for recreation activities can be compared to the supply of recreation opportunity spectrum land in the primitive category. If the amount of land needed to accommodate that growth in demand is unavailable, demand will not be met and aggregate economic value will be less than the maximum that could be achieved. Not meeting this demand may result in strict rationing systems (quotas, first-come-first served) or implicit rationing through deterioration in the quality of the experience so as to make the activity less attractive (selfrationing). In either case, there is a loss in the economic value of recreation to the participants as well as a reduction in recreation-related expenditures in that area. Alternatively, if more roaded natural is being supplied than will be needed to meet future growth in demand, there is an excess supply. Adding acres of a spectrum class in excess supply simply provides additional unused capacity, and these added acres provide no added economic value.

With an estimate of acres demanded by the recreation opportunity spectrum, we can now look at the supply by recreation opportunity spectrum under various land management options. Forest plan implementation will be used as the benchmark for comparing the various land options, because that is the land management that would prevail without the current controversy surrounding the Pacific Northwest. The future land management options that we compared to the Forest plan implementation benchmark included (1) continuation of current land allocation, (2) option 7 (existing Forest plans with designated spotted owl conservation areas overlaid), (3) option 1 (existing Forest plans with LS/OG1, LS/OG2, LS/OG3,[2] and owl additions), and (4) option 1 with a recreational emphasis (see FEMAT 1993).

Recreational Benefits Under Various Land Management Options

Forest Plan Implementation

To compare the recreational benefits resulting from the various land management options and conservation set asides, it is necessary to have a benchmark for comparing alternatives. Economists refer to this benchmark as the "without" alternative; that is, if we did nothing to the current land allocation process, what would the resulting recreational benefits be? The current land allocation is best described by full Forest plan implementation. The Oregon State Parks and Recreation Department (1991) projects land allocations in 2000 if Forest plans were implemented in Oregon. We took the recreation opportunity spectrum acre percentage projections for western Oregon and applied them to the management area under consideration to estimate the supply of spectrum acres in 2000. These projections are shown in table 3 and figure 3. Under these assumptions, 3.2 million acres of primitive and 11.6 million acres of roaded modified recreation would be supplied. Because the underlying demand for recreation would not change, the result would be meeting less of the recreation demand for primitive, semiprimitive nonmotorized, and semiprimitive motorized than is currently provided. The added acres of roaded natural and roaded modified would not contribute to additional benefits because the demand for these opportunities has already been fully met. As shown in table 3 and figure 4, total recreation benefits of implementing forest plans is equal to $721.7 million.

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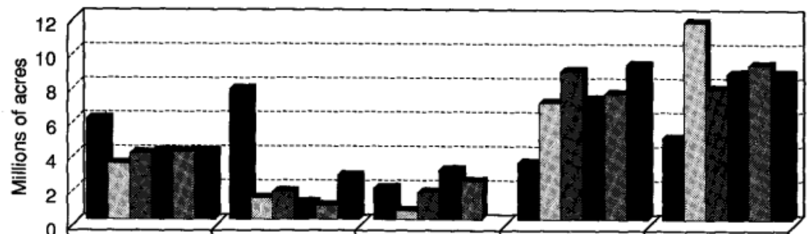
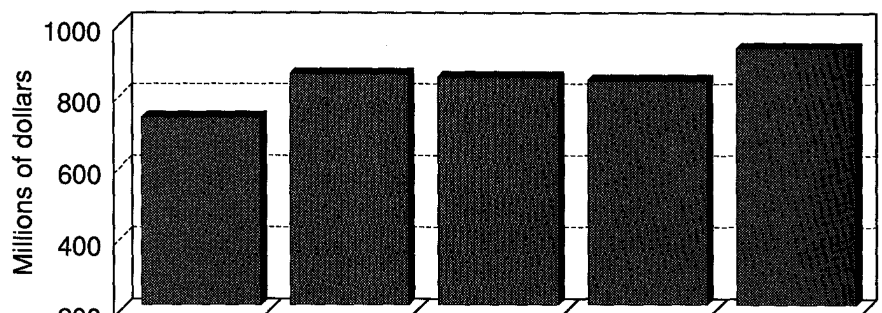
[2] LS/OG1 is late successional/old growth: category 1, which includes relatively large areas containing ecologically significant old growth. LS/OG2, the second category, includes smaller, more fragmented ecologically significant old growth. LS/OG3, the third category comprises isolated patches or highly fragmented parcels of old growth that have ecological importance to some species



	P	SPNM	SPM	RN	RM
Demand 2000	5.858	7.609	1.820	3.314	4.748
Forest plan	3.244	1.237	0.490	6.816	11.554
Current	3.856	1.608	1.578	8.686	7.615
Option 1	3.960	0.975	2.876	7.004	8.543
Option 7	3.934	0.811	2.211	7.343	9.045
Option 1, rec.	3.960	2.553	1.898	6.404	8.543

Figure 3-Combined recreation acres for Forest Service and Bureau of Land Management lands by recreation opportunity spectrum category: P = primitive, SPNW = semiprimitive nonmotorized, SPM = semiprimitive motorized, RN = roaded natural, RM = roaded motorized.

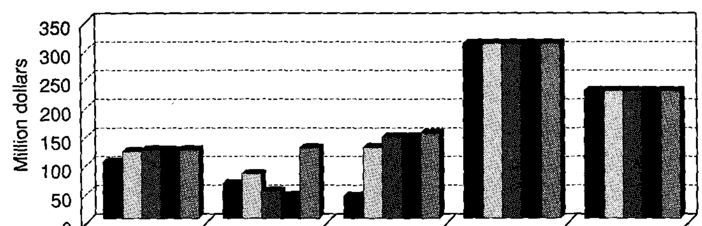


	FP	Curr	Opt 1	Opt 7	Option 1, rec. emphasis
$ Benefits	721.74	842.84	834.47	825.834	916.33

Figure 4-Recreation benefits, by option, on Forest Service and Bureau of Land Management lands combined.

Continuation of Current Land Allocations

The first comparison to forest plan implementation we consider is the continuation of current land allocation; that is, all acres remain in their current allocation. If land allocations remain the same in 2000, as shown in table 3 and figure 3, then 3.9 million acres of primitive would be supplied and 5.9 million acres demanded, resulting in excess demand for 2.0 million acres (we are not supplying enough primitive recreation opportunities). At the other end, 7.6 million acres of roaded modified is supplied with 4.7 million acres being demanded, which leaves excess supply of 2.9 million acres. This translates into a loss of recreational benefits on 2.0 million acres of primitive (at an annual value loss of $60.4 million) and a zero net gain of benefits on 2.9 million acres of roaded modified. Table 3 and figure 3 show the acres of unmet demand and excess supply for the other spectrum classes under current conditions. Figure 5 shows the resulting yearly benefits of keeping the current land allocation when spectrum values per acre are applied to those acres where supply meets demand. For roaded natural, all demand is met on 3.3 million acres, thereby resulting in a value of $304 million. For semiprimitive nonmotorized, demand is met on 1.6 million acres, thereby resulting in a value of $77.3 million in yearly benefits. It is obvious from figure 3 that continuing the current land allocation will result in a critical shortage of semiprimitive nonmotorized recreation by 2000. Total yearly recreation benefits in 2000 under current land allocations equal $843 million (table 3 and fig. 4). If supply met all demand, yearly benefits would be $951 million. This is less than under current benefits because semiprimitive nonmotorized and semiprimitive motorized are undersupplied and roaded natural and roaded modified are oversupplied. Note, however, that continuation of current land allocation provides greater recreational benefit than does Forest plan implementation because the latter supplies additional roaded recreation that is not demanded.



	P	SPNM	SPM	RN	RM
Forest plan	97.798	59.454	38.238	304.409	221.842
Current	116.226	77.271	123.092	304.409	221.842
Option 1	119.357	46.836	142.027	304.409	221.842
Option 7	118.568	38.988	142.027	304.409	221.842
Option 1, rec.	119.357	122.669	148.053	304.409	221.842

Figure 5-Combined total recreation benefits on Forest Service and Bureau of Land Management land by recreation opportunity spectrum category: P = primitive, SPNW = semiprimitive nonmotorized, SPM = semiprimitive motorized, RN = roaded natural, RM = roaded motorized.

Option 7: Forest Plans With Designated Conservation Areas

The current land management strategy calls for implementing Forest plans with an overlay for designated conservation areas, as detailed in the "Final Draft Recovery Plan for the Northern Spotted Owl" (FEMAT 1993). The allocation by recreation opportunity spectrum within these conservation areas is reported in table 4. For example, 2.5 million acres of roaded modified is found within the designated conservation areas. To predict land allocations by recreation opportunity spectrum for 2000, we assumed that limited management options within the designated conservation areas would result in each set of recreation opportunity spectrum acres reverting back by one class; that is, by 2000, those acres in roaded modified and rural would become roaded natural, those 1.99 million acres of roaded natural would become semiprimitive motorized, and so on. Final land allocations are given in table 3 and figure 3. Under this management option more primitive and semiprimitive motorized demand is met, but there is less semiprimitive nonmotorized as compared to Forest plan implementation. Annual benefits are greater than under Forest plan implementation ($826 million versus $722 million, respectively) but less than maintaining current land allocations ($843 million). This results from an increase of roaded modified under option 7 compared to the current amount. The comparison of annual benefits is shown in figure 4.

Option 1: Forest Plans With Late Successional Old Growth and Owl Additions

Table 4 shows the recreation opportunity spectrum acres that fall within the late successional old-growth (LS/OG) and owl additions. As with option 7, we assumed that total spectrum acres within the conservation areas would shift back by one class by 2000. Therefore, as given in table 3 and shown in figure 3, primitive then would contain 3.96 million acres and roaded modified would contain 8.5 million acres. This option comes closer to meeting demand than the previous two but results in a greater excess supply of semiprimitive motorized than the previous two options. Figure 3 shows that the demand for semiprimitive nonmotorized is still much greater than the supply. Total yearly recreation benefits under this option equal $834 million and are compared to the other options in figure 4. Option 1 has the most restrictive land use activities, but it provides the greatest recreational benefits as compared to the options considered above.

Option 1 With a Recreation Emphasis

Figure 3 shows that the recreation opportunity spectrum class with the most excess demand is semiprimitive nonmotorized-6.6 million acres under option 1. Option 1, however, results in excess supply of both semiprimitive motorized and roaded natural. If standards and guidelines could be written such that additional semiprimitive motorized could be shifted to semiprimitive nonmotorized (that is, close the areas to motorized travel) and additional roaded natural shifted to semiprimitive motorized, annual recreational benefits could be increased. Assume under option 1, for example, that management practices could be implemented such that 1,577,960 acres of semiprimitive motorized shifted to semiprimitive nonmotorized and 600,000 acres of roaded natural shifted to semiprimitive motorized. Figure 5 shows that meeting additional demand for semiprimitive nonmotorized would result in a significant increase in benefits for this category. In addition, total yearly recreational benefits increase to $916 million (table 3 and fig. 4). Combining option 1 with an emphasis on recreation comes closest to realizing the $951 million of potential benefits if all demand were met.

Table 4-Recreation opportunity spectrum allocation of acres for various conservation area designations

Land category	Current	Late successional/OG1[a]	Late successional/OG2[b]	Designated conservation area[c]	Owl addition
Primitive	3,093,901	67,626	16,791	992,817	809,371
Semiprimitive nonmotorized	1,290,123	382,769	99,468	689,063	232,985
Semiprimitive motorized	1,266,117	244,091	130,705	263,205	77,872
Roaded natural	6,969,300	1,762,746	555,098	1,987,505	520,544
Roaded modified	6,025,114	1,844,530	732,060	2,508,970	434,670
Rural/urban	84,650	7,650	3,655	6,447	3,512
Total	18,729,205				

[a] Late successional/old growth: first category includes relatively large areas containing ecologically significant old growth.

[b] Late successional/old growth: second category includes smaller, more fragmented, ecologically significant old growth.

[c] Designated conservation areas: large areas sized and spaced across the landscape to provide owl habitat.

Option and Existence Values Under the Option Alternatives

The benefit analysis detailed above considered only those benefits accruing from use of the land base by recreationists. As detailed in the "Introduction," individuals are willing to pay to maintain a resource even though they have no intention of using that resource. Table 5 shows that individuals place great value on maintaining resource integrity. Take for example the study by Walsh and others (1990) where Colorado households were willing to pay $47 per year to maintain 13.6 million acres of mixed old-growth stands, and only 27 percent of this value represented the value associated with using the resource. Unfortunately, few studies of option, existence, or bequest values associated with the resources in the Pacific Northwest have been done, and therefore it is not possible to fully capture the value associated with maintaining old-growth forests under any of the options. Two studies (Hagen and others 1991, Olsen and others 1991) provide a glimpse of these values and will be considered under the various options.

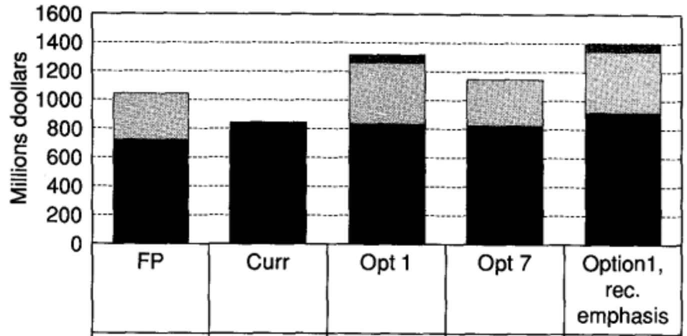
Hagen and others (1991) surveyed U.S. households to measure the value placed on old-growth forests for the protection of the northern spotted owl and found that 81 percent of U.S. households favor such protection. The study reports a mean willingness to pay of $144 per household. Although not explicit, it can be assumed that the study measured willingness to pay for a viability rating of high. Extrapolating this value to all households in Washington, Oregon, and northern California resulted in a value of $426 million. The study was based on the entire United States, so extrapolating to all U.S. households results in a value of $13,974 million. Option 1 has the highest viability rating for the northern spotted owl, and adding the value of $426 million to the recreational benefits resulted in a total annual benefit of $1,260 million (fig. 6). The options considered above were ranked by viability, and then viability probabilities were assigned to the existence value. Results are shown in figure 6.

Olsen and others (1991) surveyed households in the Columbia River Basin to derive a measure of willingness to pay to double Columbia River salmon runs. The study found 56 percent of households were nonusers of the fisheries resource but would be willing to pay $27 per year to double fish runs. (Doubling the runs in the Pacific Northwest analysis area would not guarantee 100-percent viability, and therefore the value reported is not directly comparable to the owl study, which did result in a 100-percent viability rating.) Again, the options were ranked by viability (the best being a medium-high viability rating), and these viability probabilities were assigned to the fisheries existence values for households in Oregon, Washington, and northern California. A medium-high viability rating resulted in existence values of $55 million (fig. 6). Only option 1 and option 1 with recreation management resulted in any hope of salmon viability and thus existence values.

No economic study measures the existence values of the other species groups of interest in this analysis. Therefore, the results displayed in figure 6 provide only a glimpse of the value associated with old-growth ecosystems. If we are to incorporate the values people hold for healthy, viable ecosystems, additional research on existence values is needed.

Table 5-Indicators of option, existence, and bequest economic values for reserve areas

Study	Resource valued	Value	Comments
USDI (1990)	Recreation in spotted owl reserves	$210 million/year for all users	Recreation demand associated with 7.0 million acres of old-growth forests in PNW
Walsh and others (1990)	Scenic quality of mixed old-growth stands	$47/Colorado house-hold, 1 year	13.6 million acres of Colorado mixed old growth stands. 27 percent of value is associated with use.
Rubin and others (1990)	Northern spotted owl habitat protection	$1.5 billion/year	Value to U.S. households of protecting northern spotted owl habitat: $21/WA household $37/OR household $21/CA household $15/U.S. household
Hagen and others (1991)	Northern spotted owl habitat protection	$48 to $190/household in PNW	81 percent of U.S. households favor protection of old-growth and northern spotted owls
Loomis (1989)	Recreation value of salmon/steelhead, Siuslaw NF	Loss of $1.7 million recreation benefits over 30 years	Loss of fisheries due to timber harvest of 86,700 acres
Olsen and others (1991)	Salmon/steelhead existence values for doubling Columbia River fish runs	Regional existence = $42 million/year Regional option value = $18 million/year Regional user value = $111 million/year	56 percent of regional households are nonusers, but would be willing to pay $27/year to double fish runs in Columbia River basin
Johnson and Adams (1988)	Steelhead in-stream flows and fishing success	Low catch rate, use $9.00/day Moderate catch rate, use $11.00/day High catch rate, use $14.00/day	John Day River



	FP	Curr	Opt 1	Opt 7	Option1, rec. emphasis
Salmon	0	0	55	0	55
Spotted owl	320	0	426	320	426
Recreation	721.74	842.84	834.47	825.834	916.33

Figure 6-Recreation and existence values on Forest Service and Bureau of Land Management lands combined, by option.

Conclusions

Recreation in the Pacific Northwest is a valuable resource. In 1990, recreation in western Oregon, western Washington, and northern California on Forest Service and BLM lands generated $1.6 billion of public benefits and resulted in expenditures of $2.8 billion. Under current management, recreation demand will exceed supply in primitive, semiprimitive nonmotorized, and semiprimitive motorized categories. The greatest gap in meeting demand will occur in the semiprimitive nonmotorized category. Four management scenarios were compared to Forest plan implementation, and we estimated their ability to supply recreational opportunities to meet demand. The greatest economic value is generated under option 1 when it is implemented with an emphasis on recreation, which shifts acres from roaded natural to semiprimitive motorized and from semiprimitive motorized to semiprimitive nonmotorized. Under this scenario, yearly economic benefits of $916 million are achieved. This is a decrease from the current recreation value, because projections in roaded modified show a demand for 4.7 million acres and 8.5 will be supplied. As a result, an excess supply of 3.8 million acres exists, and excess supply has no economic value.

People place value on ecosystems in the Pacific Northwest beyond being able to use them for recreational activities. Individuals are willing to pay to maintain old growth and wildlife and fish habitat regardless of plans for current or future use. These values are called option and existence values. Under a high-viability scenario (option 1), existence values associated with the northern spotted owl were estimated to equal $426 million. This value is in addition to the recreation values previously mentioned.

Metric Equivalents

1 acre = 0.405 hectare

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Recreation in the Pacific Northwest is a valuable resource. A method is described that translates recreation on USDA Forest Service and U.S. Department of the Interior Bureau of Land Management lands in northern California, western Oregon, and western Washington into economic value. By assigning recreation to land use type (using the Forest Service recreation opportunity spectrum classification), the economic value associated with various land use changes can be identified. Results indicated that those land use changes resulting in more nonroaded recreational opportunities provide the greatest economic benefits. This is encouraging given the move toward ecosystem management that many agencies are making, because more nonroaded opportunities will become available. The paper also considers values associated with maintaining old-growth and wildlife and fisheries resources regardless of current or future recreation use-existence values.

Keywords: Recreation, nonmarket economic values, benefit-cost.

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