

# Wildland Economics: Theory and Practice

Pete Morton

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**Abstract**—Since passage of the Wilderness Act, economists have derived the total economic valuation framework for estimating wildland benefits. Over the same time period, policies adopted by public land management agencies have been slow to internalize wilderness economics into management decisions. The lack of spatial resolution and modeler bias associated with the FORPLAN model, combined with asymmetrical budget shortfalls, procedural errors and the overestimation of stumpage prices have contributed to a commodity bias in public land allocation decisions. This bias has spurred some economists to advocate privatization of public land management. Market forces cannot, however, be relied upon to adequately supply wilderness resources, and non-market alternatives are preferable for addressing the shortcomings identified.

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The 1964 Wilderness Act (Section 4b) recognizes the multiple benefits of wilderness areas: “wilderness areas shall be devoted to the public purposes of recreational, scenic, scientific, educational, conservation, and historical uses.” While the act provides a basic framework of wilderness uses, it does not begin to enumerate all of the uses and benefits of wilderness areas (Driver and others 1987; Reed 1989; Rolston 1986). Since passage of the Wilderness Act, economists have expanded and refined their methods for estimating the total economic benefits of wilderness. Unfortunately, public land managers have undervalued wildland resources resulting in a bias toward commodity production in both land and resource allocation decisions. The paper begins by examining wilderness economic research and how that research has been applied in practice on the public estate. Following a discussion of free markets, market failure and the role of public lands in sustaining our wildland resources, the paper ends with nonmarket recommendations for internalizing wilderness benefits into public land management.

## Wilderness Economics in Theory

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Wildland ecosystems represent natural capital capable of producing a wide range of goods and services for society. Some of these outputs, such as timber, are freely exchanged in formal markets. Value is determined in these markets through exchange and quantified in terms of price. However, many other outputs—watershed protection, carbon storage,

scenic beauty, trophy caliber wildlife and native fish, for example—contribute to our quality of life and support our market economy, but are without formal markets and therefore without prices.

The fact that wilderness benefits are not priced does not mean they lack value, only that market indicators of the value do not exist. Economists must therefore estimate the nonmarket benefits of the goods and services jointly produced by wildlands when consumers are unable to express their preferences and willingness to pay via the marketplace. Nonmarket benefits should be included in the economic analysis used to inform public land management decisions. An economic analysis must account for nonpriced benefits and costs, as well as those more readily observed and measured in market prices (Loomis and Walsh 1992; Pearse 1990). An economic analysis is conducted from the viewpoint of society, which should also be the viewpoint of managers of the public estate. In contrast, a financial analysis only examines costs and benefits as measured by market price; it is the viewpoint of private industry and is more concerned with profits or losses.

To account for the full array of goods and services generated by wildlands, economists have derived the total economic valuation framework (Loomis and Walsh 1992; Peterson and Sorg 1987; Randall and Stoll 1983). A total economic valuation framework is the appropriate measure when comparing wilderness benefits to its opportunity costs (Loomis and Walsh 1992). The total economic benefits generated by wildlands are conceptually summarized in [figure 1](#), based mostly on research by Driver and others (1987), Krutilla (1967), McCloskey (1990), Rolston (1986), and Walsh and Loomis (1989). The seven categories of wildland benefits include direct use, community, scientific, off-site, biodiversity conservation, ecological services and passive use benefits (Morton 1999a).

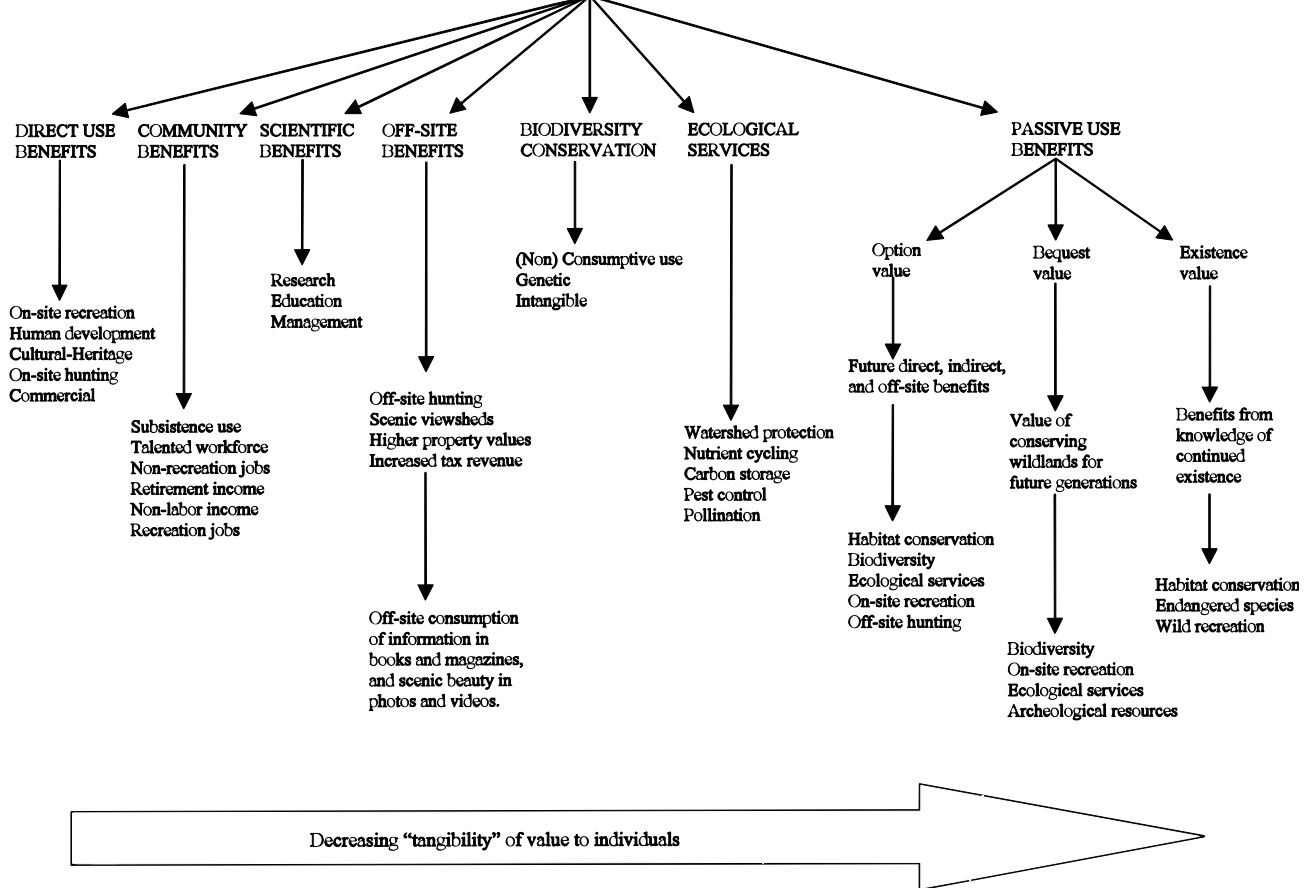
Wildland recreation results in a variety of individual and social benefits including: personal development (spiritual growth, improved physical fitness, self-esteem, self-confidence and leadership abilities); social bonding (greater family cohesiveness and higher quality of family life); therapeutic and healing benefits (stress reduction helping to increase worker productivity and reduce illness and absenteeism at work); and social benefits (increased national pride) (Driver 1976; Driver and Brown 1986; Haas and others 1980; West 1986; Williams and others 1989). Wilderness is a place for spiritual experiences and has inspired the creation of art, photography, literature, poetry and music. Wilderness is also a place to restore mental and physical health, stimulate creativity, achieve self-realization and improve group leadership skills (McCloskey 1990). Wildlands provide current and future generations of Americans with a frontier-like environment to reclaim their cultural identity and feed their soul (McCloskey 1989; Reed 1989).

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## TOTAL ECONOMIC VALUE OF A WILDLAND NETWORK



**Figure 1**—A total economic valuation framework for estimating wilderness benefits based on seven categories arranged from left to right in order of decreasing tangibility to humans.

The amenity-based development occurring throughout the American West is partially based on the environmental, recreational and scenic amenity resources generated by public wildlands (Power 1996; Rasker 1994, 1995; Rudzitis and Johansen 1989,1991; Whitelaw and Niemi 1989). Wildlands enhance the quality of life for local residents and indirectly benefit rural communities by attracting and retaining nonrecreation businesses and retirees (Decker and Crompton 1990; Johnson and Rasker 1995; Lorah in press). Hunting and fishing outfitters gain commercial benefits from wildlands by providing a primitive environment for their clients. Wildlands also directly create jobs for wilderness rangers, agency planners and administrators, as well as agency and university researchers (Rudzitis and Johnson in press).

There is also growing recognition of the scientific and management value of a network of wildlands (Stankey 1987). By limiting motorized access, wildlands provide valuable protection of archeological and paleontological resources for future scholars. Wildland vegetation is rich in historical information on disturbance regimes, composition, structure and function of natural communities—information that is prerequisite for successful ecosystem management. Wildlands generate off-site benefits by providing habitat for mountain lion, black bear and other charismatic megafauna that may be hunted or viewed outside wildlands (Loomis

1992). Wildlands also serve as valuable scenic backdrops for resorts and residences on adjacent lands – enhancing property values and tax revenues (Phillips in press).

Wildlands help conserve biological diversity, which includes the full array of native species, the genetic information they contain, the communities they form and the landscapes they inhabit. Genetic diversity allows increases in the productivity and disease resistance of crops and the generation of new medicinal products. Wild plant and animal species are estimated to account for 4.5 percent of the nation’s gross domestic product (Prescott-Allen and Prescott-Allen 1986).

Wildlands generate ecological services, including climate moderation, pollination, seed dispersal, watershed protection, natural pest control services and carbon sequestration (Ecological Society of America 1997). Wildland watersheds protect private property from floods and lowers water treatment and reservoir maintenance costs for downstream communities. Watershed protection is an important role for public lands because wildlands contain the headwaters of many of America’s rivers, and controlling development, road construction and hence erosion on private lands is more difficult due to concerns over private property rights.

Sustaining public wildlands with habitat for natural predators is economically rational (Morton and others 1994) as

natural predation plays an important role in ending and lengthening the time between pest outbreaks (Ecological Society of America 1997), and natural predation contributes \$17 billion per year to the United States economy (Pimental and others 1997). Another service of wildland ecosystems is the storage of carbon; a service necessary to address scientific concerns over atmospheric carbon dioxide levels. Although older forests have lower growth rates, higher mortality rates favor accumulation of woody debris and increased carbon storage in the litter layers (Turner and others 1995). The economic benefits of storing carbon in a wildland network could play a significant role in protecting the temperate rain forests—on the Tongass National Forest, for example, where up to 75 percent of forest carbon is stored in the soils (Joyce 1995). Protected by the forest canopy, soil carbon can be stored indefinitely (subject to fluctuations caused by natural disturbances) if these forests are reserved in a wildland network. If the forests are logged, however, the soils can quickly decompose and lose their carbon through exposure to increased sunlight, temperature and wind.

Economists and the courts have also recognized that wildlands generate substantial passive use benefits, including option, existence and bequest values (Clawson and Knetsch 1966; Walsh and Loomis 1989). Option value is like an insurance premium that people are willing to pay over and above their expected recreation benefits to maintain the option, for themselves or for their children, of visiting wildlands in the future (Krutilla 1967; Weisbrod 1964). Existence value is the psychic value a person enjoys from just knowing that wildlands exist—regardless of whether the person will ever visit an area (Krutilla and Fisher 1985). Bequest value represents what the current generation might be willing to pay to bequest wildlands to future generations. Researchers have found that the passive use benefits of wilderness are typically greater than the other benefits included in the total economic valuation framework (Walsh and Loomis 1989; Walsh and others 1984; Walsh and others 1996).

## Wilderness Benefits in Practice

The 1974 Forest and Rangeland Renewable Resources Planning Act (RPA) required that preparation of the RPA Assessment, used by planners developing management plans, include willingness-to-pay estimates for nonmarket resources. The 1976 National Forest Management Act (NFMA) legislatively acknowledged wilderness as a multiple-use resource. Agency regulations developed in response to NFMA include an explicit management objective for the national forests to maximize net public benefits (Loomis 1993; Swanson and Loomis 1996). Net public benefits are defined as “the overall long-term value to the nation of all outputs and positive effects (benefits) less all associated inputs and negative effects (costs) whether they can be quantitatively valued or not” (USDA Forest Service 1982).

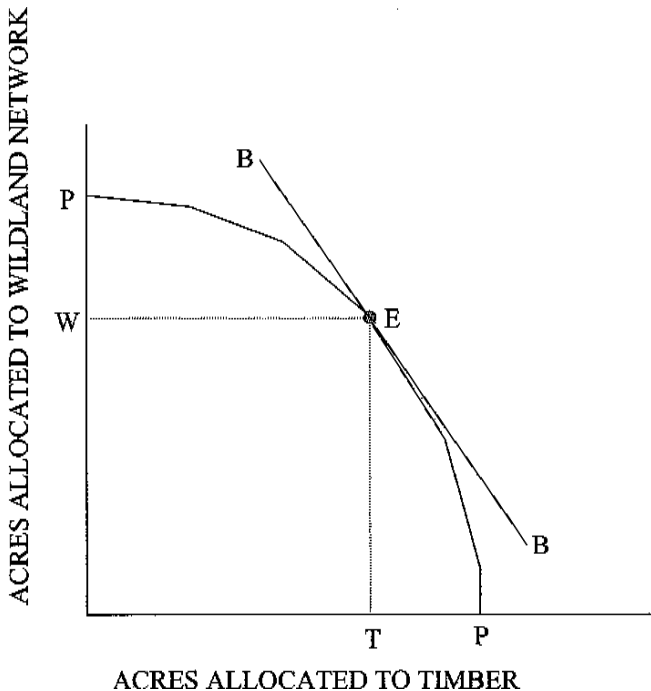
Under the rules established pursuant to NFMA, the Forest Service adopted a three-stage process to determine the land allocation that maximizes net public benefits. In the first stage, the agency identifies land withdrawn from or that is physically unsuitable for timber production. The remaining land is termed the tentatively suitable timber

base. In the second stage planners analyze and rank stands based on the financial return from timber production. The actual land allocation, however, does not occur until the third stage where the agency relies on the FORPLAN model to estimate the suitable timber base that maximizes net public benefits.

## FORPLAN Follies

The ability of wildlands to simultaneously produce more than one output—habitat for endangered species, scenic beauty and watershed protection, for example—is termed joint production. During the first round of forest planning, which started in 1979, the Forest Service modeled joint production with FORPLAN, a constrained optimization model that estimates how land and resources should be allocated in order to maximize net public benefits. Net public benefits were estimated using timber prices derived from market information and nonmarket estimates of consumers’ willingness to pay for wilderness, recreation and other nonmarket resources.

The workings of FORPLAN can be explained graphically using a simple joint production example (figure 2; de Steiguer and others 1989; Pearse 1990). The area under the production possibility curve PP represents all possible combinations of timber and wilderness that can be produced on a national forest given natural resources and the planned budget. The optimal allocation occurs at point E, where the



**Figure 2**—The workings of the FORPLAN model illustrated with a production possibility curve. The allocation of land and resources that maximizes net public benefits occurs at the tangency point E—since no other possible combination yields higher total benefits. At this tangency point the slope of the benefits line (BB) is equal to the slope of the production possibility curve (PP).

total benefits line (BB) is tangent to the production possibility curve (PP)—since no other possible combination will yield higher total benefits—and results in the production of T acres of timber and W acres of wilderness. While the FORPLAN models run by national forest planners are much more complex than illustrated here, the basic concept is the same. Whether FORPLAN actually maximizes net public benefits is subject to debate. The new version of FORPLAN is called SPECTRUM and will be available to forest planners during the second round of forest planning. SPECTRUM, while an improvement over FORPLAN, still suffers from many of the same problems identified below.

**FORPLAN Is a Non-Spatial Model**—One of the most significant problems with FORPLAN is the lack of attention to spatial details, making it nearly impossible to implement the FORPLAN-generated management plan. This is a significant shortcoming, as the arrangement of an ecosystem's pieces in time and space profoundly affects the values and benefits that can be derived from the landscape (Crow 1993). For example, the juxtaposition of wildlife forage, hiding cover, thermal cover and birthing areas is critical to the viability of wildlife populations. The use of a non-spatial model also leads to inaccurate predictions of forest growth and yield which lead to unsound decisions, especially the overestimation of sustainable harvest levels. The lack of attention to spatial relations in SPECTRUM is now widely understood to be a fatal flaw in historical approaches to modeling forest outputs. The Office of Technology Assessment (1992) concluded:

...[L]imited spatial details lead FORPLAN (and all other optimization models) to overestimate the feasible outputs. This happens because implementation requires local adjustments and site-specific tradeoffs that cannot be included in FORPLAN ...the use of FORPLAN to establish output targets in the forest plan can lead to planned targets that exceed the feasible productive capacity of the forest.

The importance of spatial detail for evaluating the benefits from conserving biodiversity and ecological services, combined with the potential to overestimate sustainable output levels draws into question whether net public benefits can be maximized with a nonspatially explicit optimization model.

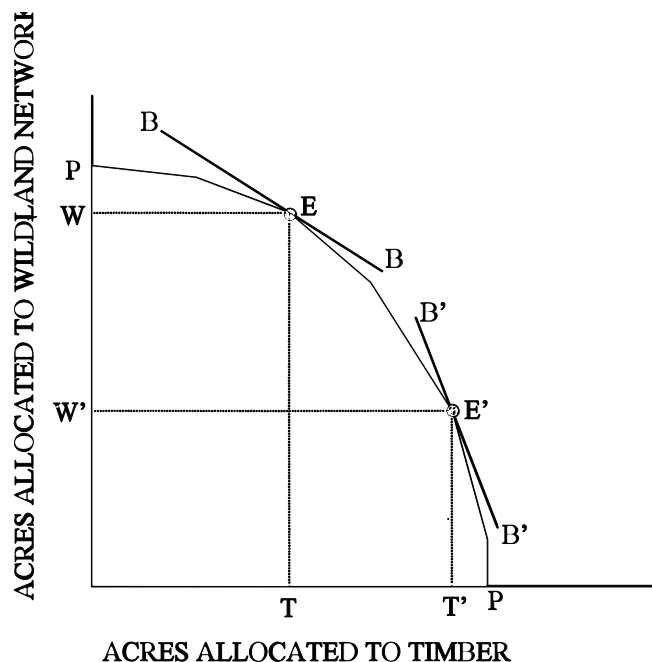
**Structural Problems**—The FORPLAN model optimizes an objective function subject to a set of constraints. During the first round of planning, agency officials chose not to include nonmarket benefits in the objective function. Instead they ran FORPLAN with an objective function that maximized net present value of marketable commodities subject to constraints reflecting concern for nonmarket resources. Including nonmarket resources only as constraints on production implies that sustaining ecosystems is a constraint and not a goal for managing our national forests (U.S. Congress Office of Technology Assessment 1992). Thus, the basic structure of FORPLAN used during forest planning was a questionable approach for maximizing net public benefits.

**Coefficients Difficult to Estimate**—The data required to develop a FORPLAN model are also suspect—especially for coefficients estimating the impact of management actions on nonmarket, wildland resources. FORPLAN requires information on: 1) the response of aquatic populations

to sediment loading of streams; 2) the response of wildlife populations to forest fragmentation; 3) the impact of logging on watershed protection, carbon sequestration, visual quality and existence value. Insufficient research on basic ecological, economic and sociological responses to forest management activities make model coefficients particularly difficult to estimate—and they are frequently left out of the model.

**Wildland Recreation Benefits Reduced**—As part of the 1985 RPA Assessment, Sorg and Loomis (1984) conducted a meta-analysis of the nonmarket literature to generate average willingness-to-pay values for wildland resources. A panel of reviewers assisted them in developing procedures and reviewing results. After publication of the report, Forest Service administrators decided the recreation values were too high and that a downward adjustment of approximately 45 percent was needed (Duffield 1989). The procedures used by the Forest Service to make the downward adjustment in the RPA values appear to be at odds with basic economic theory and practice. As Duffield (1989) concluded: “The overall picture appears to be one of higher echelon administrators determined to reduce the values assigned to recreation.”

Reducing wilderness recreation benefits can bias the allocation of land and resources in the FORPLAN model (figure 3) by shifting the total benefits line and changing the production mix against wilderness. The shift in the total benefits line is illustrated by line segment B'B' and a new point of tangency E'. Lowering the value of wilderness recreation results in the allocation of more acres to timber production (T') and fewer acres to wilderness (W').



**Figure 3**—The change in land and resource allocation by the FORPLAN model resulting from a lowering of wilderness recreation benefits. Lowering wilderness recreation benefits shifts the total benefits line (from BB to B'B') and results in the allocation of fewer acres to a wildland network.

### Modeler Bias Influenced the “Optimal” Solution—

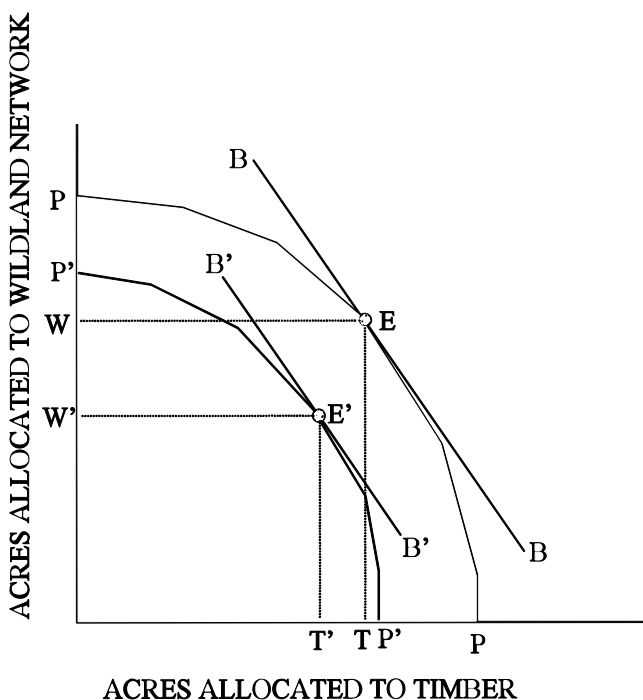
Botkin and Devine (1988) analyzed the sensitivity of the FORPLAN model used by planners on the Chattahoochee National Forest by doubling demand for semi-primitive recreation and increasing the willingness to pay for semi-primitive recreation by a factor of 10. Results of their sensitivity analysis revealed no significant change in the land and resource allocation that maximized net public benefits. The researchers concluded that “the basic FORPLAN management choices were determined by one initial decision: whether to harvest timber” (that is, meet the timber target). In this case, modelers decided not to include a decision variable allowing semi-primitive, non-motorized acres to increase by closing and obliterating existing roads. FORPLAN was insensitive to increases in demand and willingness to pay for semi-primitive recreation, even though the forest had an excess of roaded lands and a shortage of semi-primitive lands (Botkin and Devine 1988).

**Asymmetrical Budget Shortfalls**—While funding received by the USDA Forest Service has been less than the budgets required to fully implement forest plans (U.S. Government Accounting Office 1991), the budget shortfall has not been passed on to resource programs in a symmetrical manner. For example, the recreation programs on the southern Appalachian national forests received approximately 47 percent of the planned budget. In contrast, the timber program received 97 percent of the planned budget (Morton 1997). The lower-than-planned recreation funding led to a significant backlog of trail construction, reconstruction and maintenance on most national forests.

Although budget shortfalls reduce net public benefits, this reduction was not reflected when net public benefits were estimated with FORPLAN during the first round of forest planning because budget constraints were not included in the model. Budget shortfalls shift the production possibility curve in toward the origin (line segment P’P’ in figure 4), resulting in the production of less timber (T’ to T) and fewer acres of wild recreation (W’ to W). Without acknowledgment of budget constraints and the asymmetrical reduction in programmatic budgets, the net public benefits estimated with FORPLAN were illusory. The shortfall in predicted production created public dissatisfaction when national forest recreational opportunities and timber supplies were less than planned. The failure to consider budgets constraints during the first round of forest planning probably exacerbated the tension between the agency, loggers and environmentalists (Morton 1997).

## Nonmarket Benefits and Costs Lack Credibility

Forest Service policy decisions continue to exclude the passive-use benefits associated with wildland conservation (Loomis 1995; Morton 1994), despite the growing body of literature suggesting that these benefits are significant (Loomis and Walsh 1992). An environmental impact statement (EIS) recently prepared by Forest Service planners in Idaho and Washington provided the following justification for not considering nonmarket benefits and costs in economic analyses (USDA Forest Service 1999):



**Figure 4**—The change in land and resource allocation by the FORPLAN model when budgets are less than planned. Budget shortfalls shift the production possibility curve in toward the origin resulting in the production of less timber (T to T’) and fewer wildland acres (W to W’) than predicted in national forest management plans.

Non-commodity values were not included in this analysis. Title 40, Code of Federal Regulations for NEPA (40 CFR 1502.23) indicated that “For purposes of complying with the Act, the weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations.

Despite this claim, the NEPA Compliance Manual (Freeman and others 1994) describes quantitative impacts as impacts that can be measured. Title 40, therefore, may not relieve the agency from quantifying the impacts of proposed management alternative on noncommodity values because many of these impacts are quantifiable.

## Technical and Procedural Errors Occurred

Past Forest Service procedures for estimating wilderness benefits failed to account for the higher valued recreation activities (such as hunting, fishing) jointly produced by wilderness areas (Loomis 1987, 1992). As a result, wilderness benefits were significantly underestimated, generally resulting in biases against wilderness designation (Langer 1992). Botkin and Devine (1989), Loomis (1987) and Morton (1992) reported technical errors in agency procedures that resulted in the underestimation of wilderness benefits. Public land management agencies also lack systematic and accurate visitor counts (Loomis in press), especially for wilderness (Morton 1994).



## Stumpage Price Trends Overestimated

The pressure to financially justify elevated timber targets provides planners with an incentive to inflate future stumpage prices (the value of standing timber) in order to increase the financial return from expanding the suitable timber base. For example, pressure to inflate stumpage prices was evident on the Nantahala-Pisgah National Forest (NPNF) when, after ignoring the conclusions of de Steiguer and others (1988), agency officials made a policy decision to use a regression equation, calibrated with timber sale data from a 13-year period of largely declining stumpage prices, to project increasing stumpage prices for 50 years (figure 5). Besides being highly optimistic, the confidence interval of the regression became increasingly wide after 13 years (the data range used to calibrate the regression), resulting in too much variation to accurately forecast 50-year price trends (Morton 1994). The agency has a history of overestimating stumpage price trends (Clawson 1979; Hagenstein 1990; O'Toole 1992, 1997)—a history that has provided financial justification for road building and logging in thousands of acres of potential wilderness.

## Discussion

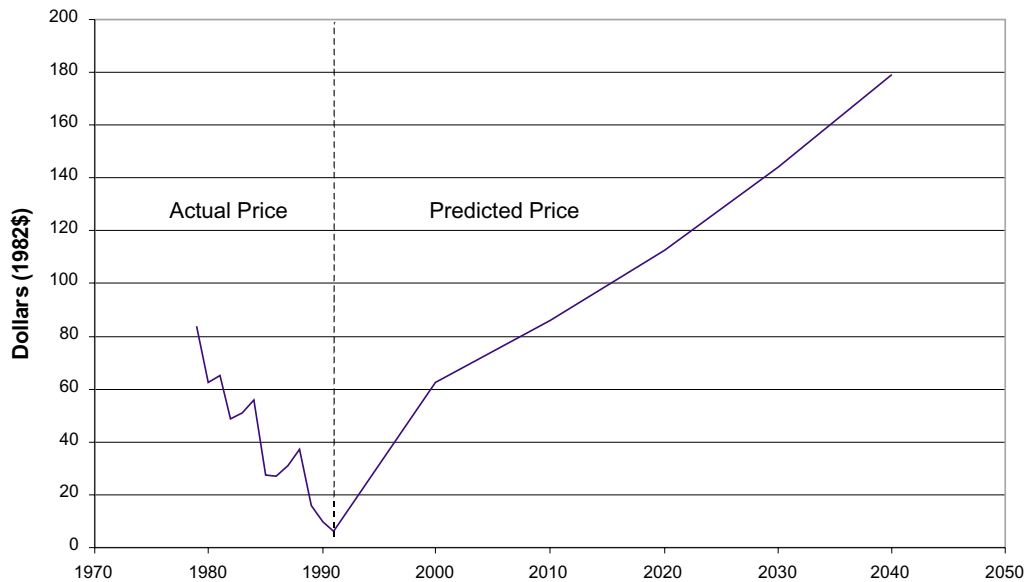
While examples from only a few national forests were presented here, there appears to be a disconnect between research and application, as the economic analyses completed to help inform national forest policy decisions do not fully account for wilderness benefits. This is consistent with observations by Duffield (1992):

In the past, economic valuation of natural resource policy or specific developmental projects has sometimes been more of a justification for market uses rather than a comprehensive and valid economic comparison of alternatives.

As Loomis and Walsh (1992) note:

“While the theory that wilderness preservation provides more than just on-site recreation benefits is over 25 years old... the U.S. Forest Service continues to economically value only the recreation use. This practice exists despite empirical demonstration that recreation is less than 50 percent of the total economic value of wilderness nearly seven years ago.”

By solely relying on recreation use values, the total economic value of wilderness will be severely underestimated during



Source: 1992 Draft Supplemental to the Final EIS for the Nantahala-Pisgah National Forest

**Figure 5**—Actual (1979-1991) and predicted (1992-2040) stumpage price trends for low valued hardwoods on the Nantahala-Pisgah National Forest. Overly optimistic projections of stumpage prices provide financial justification for increasing the suitable timber base by road building and logging in potential wilderness areas.

the national forest planning process (Langer 1992). In general, the Forest Service's planning process is biased towards timber, ignores nonmarket values and gives little attention to sustaining ecosystems (U.S. Congress Office of Technology Assessment 1992).

While this article focused on past failings of the Forest Service, the Bureau of Land Management is arguably in worse shape. The 1999 Final EIS for the Grand Staircase-Escalante National Monument suffered many of the problems identified here, including no budget constraints, no economic analysis of nonmarket benefits and costs, underestimated projections of wildland visitation, and biases against non-motorized recreation in the economic impact analysis (The Wilderness Society 1999). The failings identified in the EIS are of some concern, as this will be the first national monument managed by the BLM and not the National Park Service, and monument status mandates a high level of protection for wildland resources.

## **A Market Solution to Government Failure?**

The historic commodity biases present in public land management agencies have prompted some economists to advocate a "market solution", or the privatization of public land management (Anderson and Leal 1991; Stroup and Baden 1983). While market forces can be harnessed to improve government efficiency, an overreliance on markets is not in the best interest of wilderness. "Free-marketeers" often point to the downfall of the former Soviet Union and its transition to a market economy as proof that central planning is doomed to fail and that market solutions are best for public land management (O'Toole 1999). However, privatizing the management of public lands will probably generate significant "transaction costs," similar to the fraud and corruption occurring in the former USSR as it makes the transition to a market economy. Recent and past problems with the Forest Service's land exchange program only underscore these problems (High Country News 1999). One of the key factors that originally lead society to advocate retention of the public estate was concern over abuses and fraud associated with land disposal programs (Loomis 1993). A market approach to public land management is fraught with other problems—problems that were also recognized long ago. The original decision to invest in the public estate was motivated by public outrage at the shortsighted destruction of the forested landscape by logging companies responding to market forces (Loomis 1993). While there are many economic reasons for advocating public ownership of wildlands, the overarching reason is market failure: the failure of markets to adequately supply wilderness resources.

## **Market Failure: The Economic Justification for Public Wildlands**

The growing scarcity of wildland resources has increased the public's desire to protect what remains, while the relative abundance and low prices of wood products have left the public indifferent to concerns about timber supply. The abundant timber supply is a result of private financial investments in the southeast United States, New Zealand

and Brazil, for example, in response to higher growth rates and projections of higher lumber prices.

Market adjustments to projections of rising lumber prices include: 1) investment in private timberland; 2) the use of substitutes by producers—e.g. kenaf, hemp; 3) consumer preference shifts toward recycled products; and 4) technological advances in efficiency of the wood products industry. Past projections of higher stumpage prices were not realized because markets, adjusting to price signals, stretched the timber supply and moderated price increases (Hyde and Newman 1991). In contrast, wildland resources lack market price information, and market adjustments in response to increasing scarcity are unlikely.

Resource economists recognize the weakness of markets because many wildland goods and services have characteristics that make them unprofitable for private enterprises to produce. The aesthetic value of a wilderness viewshed, for example, would be difficult to divide up and sell to individual consumers, and to exclude "free riders"—people who consume the scenic beauty but are unwilling to pay for it (Pearse 1990). As such, private firms have little incentive to produce wildland viewsheds.

While biodiversity is our "green infrastructure," our living natural capital necessary to sustain our life-support systems, it is undervalued by private markets because of inadequate information (Randall 1986). Without adequate information, prices and market demands are misleading or unrevealing about economic values. Market value (price) depends on accurate information and knowledge, which is currently very limited for biological resources. Information failure makes it difficult to quantify the benefits of biodiversity, let alone the long-term costs to future generations from the irreversible loss of that diversity.

Market adjustments are also less likely to occur for wildland resources because technological advances are not symmetrical: Technology is biased toward commodity extraction and marketable goods and services (Krutilla and Fisher 1985). While technology can be expected to increase the supply of timber, technology is unlikely to increase the supply of wilderness (Krutilla and Fisher 1985). While restoration activities (if properly funded) can potentially increase the supply of wildlands, a prudent policy decision is to view a reduction in wildlands as virtually irreversible.

Markets failing to adjust to the increasing scarcity of wildland resources results in what economists call market failure. A market failure occurs when incentives created in the market system fail to adequately reflect the present and future economic interests of consumers or society as a whole (Randall 1983). In the presence of a market failure, price breaks down as an efficient measure of social values, financial profits do not reflect net social benefits, and markets do not allocate resources in an economically efficient manner (McCullum and others 1992). Markets diverge in so many ways from the conditions necessary to achieve maximum social benefit that we cannot rely solely on them to determine the allocation of forest resources (Pearse 1990). As Cubbage and others (1993) note:

When one analyzes markets in forestry, virtually every neoclassical economic assumption that underlies the superiority of a pure market system is violated to some degree. All the identifiable problems with market distribution of goods

and services occur in natural resources. Wildlife and pollution have common-pool characteristics, timber markets are dominated by a few buyers, producers lack complete information, and current and future externalities abound.

In the wilderness debate, the benefits of active management are perceived to be large, while the benefits of protection are typically underestimated. As a result of the incorrect signals from the market, an incorrect decision is made—that is, not to provide adequate protection of wildland resources (Dixon and Sherman 1990)—even though additional wilderness may be economically rational and socially desirable. Although highly valued by society, the benefits of conserving nonmarket goods and services are typically underestimated in production and consumption decisions—that is, they are underproduced by private markets (Bergstrom 1989; Loomis 1993; Musgrave and Musgrave 1976). The underproduction of wildland goods and services is partially due to private industry conducting a financial analysis rather than an economic analysis. It is for these reasons that Krutilla and Haigh (1978) argue that relying on market forces to guide management of public lands will actually lead to economic inefficiency.

When markets fail to adequately produce public goods and services, society as a whole is less wealthy, and many of us as individuals are worse off (Peterson 1991). When a market failure occurs, some economic correction device is required. One such device is government intervention—government provision of the goods and services underproduced in the market but desired by society. Western industrial nations have turned increasingly to governments to correct or offset weaknesses in their market economies (Pearse 1990). The underproduction of nonmarket resources provides economic justification for public ownership of a wildland network.

## Nonmarket Alternatives

The failure of markets to adequately produce wildland resources suggests that nonmarket solutions will not only avoid large transaction costs, they will provide more long-term conservation than the myopic whims of market forces. The following nonmarket alternatives may help internalize wildland benefits and costs into public land management as the Forest Service enters the second round of forest planning.

**Improve Accuracy of Wildland Visitation Information**—Spatially and temporally accurate visitation data are the foundation for tracking recreational impacts, examining carrying capacity issues, adapting management and estimating wildland recreation benefits. Site-specific visitation data, if made available to the public via a Forest Service website, may help redirect use away from crowded areas by providing wildland visitors with information on where to go to avoid crowds. Visitation information, if widely disseminated, provides a nonmarket alternative to user fees for redistributing recreation use.

**Design Wildland Network Before Running FORPLAN**—The 1976 NFMA requires planners to complete a suitability analysis during national forest planning. The three-stage process adopted by the Forest Service estimates land suitable for timber production, not land suitable for ensuring the sustainability of wildland resources. Under the current interpretation, the de facto wildland network is

the residual: Land leftover after the suitable timber base is determined in the third stage with FORPLAN. This approach is an inefficient procedure for conserving wildland resources on public land. The suitability process should be reversed: Select suitable wildlands first, and let timberland be the residual—the land leftover after conserving a network of wildlands.

The lack of spatial resolution and the difficulties encountered when estimating linear coefficients for nonlinear ecological relationships, when combined with all the other problems previously noted, provide justification for establishing a wildland network and estimating the benefits before running FORPLAN. While research by Hof and Joyce (1992) and Bevers and Hof (1999) provides improved modeling techniques for addressing the spatial shortcomings of FORPLAN, these highly complex research models are unlikely to be implemented by agency planners. Rather than modeling wildland benefits as constraints in FORPLAN, identifying a wildland network and conserving the benefits would become the goal of the suitability analysis. FORPLAN could then be used to schedule activities outside the reserves and to estimate the opportunity costs of alternative wildland reserve designs. The opportunity costs should be estimated with several metrics, including the net present value for timber harvesting currently estimated in stage 2 of the NFMA suitability analysis, per acre revenue-loss figures estimated from Forest Service accounting reports, and the estimated returns from future timber production (soil expectation value). Spatially displaying the opportunity cost metrics would provide useful information for evaluating the economics of alternative wildland reserve designs.

**Expand Wilderness System to Conserve Unique Resources**—Federal lands have the potential to conserve unique recreation opportunities and/or biological resources that cannot survive in the market-driven, fragmented landscape on private lands. Expanding wilderness areas (using Land and Water Conservation funds when needed) to include unrepresented habitats, rare communities, important migratory corridors or unique recreation opportunities would have high economic value to society.

**Improve Economic Impact Analysis**—Agency economists should consider the indirect role of wildlands in attracting a talented workforce, non-recreational businesses and retirees when completing the economic impact analysis (jobs, income, etc.) of management alternatives. This can be accomplished by combining survey work (Johnson and Rasker 1995; Kask and Morton 1998) with trend analysis of total personal income (including retirement and investment income) and employment to provide a historical perspective on job and income growth-decline in various industries (Rasker and others 1994).

**Include Budget-Cost Analyses in Management Plans and EISs**—Forest Service policies do not require planners to include budget constraints in FORPLAN, even though budget constraints are recommended by Driver and others (1994), and budget constraints can easily be included in FORPLAN-type models. Successful organizations can rarely afford to ignore budgets when developing long-term plans. According to a Council of Environmental Quality memorandum on NEPA requirements [cited in Freeman and others 1994).



[T]o ensure that environmental effects of a proposed action are fairly assessed, the probability of the mitigation measure being implemented must also be discussed. Thus the EIS and the Record of Decision should indicate the likelihood that such measures will be adopted or enforced by the responsible agencies. (Section 1502.16(h), and 1505.2)

The “probability of mitigation measures being implemented” is directly related to how the costs of mitigation compare to the expected budget. An “unlimited budget assumption” allows planners to disregard potential environmental damage to wildland resources by assuming that all mitigation activities will be fully funded, when history suggests that this will not be the case. Programmatic funding levels directly reflect the priorities of public agencies. These priorities should be presented to the public by including a comparative analysis of management-mitigation costs with expected budgets in EAs, EISs and management plans.

**Increase Programmatic Budgets for Wildland Research and Management**—Public land management agencies do not have specific budgets dedicated to wilderness research (Alkire in press). As global leaders in natural resource management, public land management agencies should take a leading research role in valuing the goods and services produced by wildlands. Past wildland research suggests that passive use benefits are significant, while the benefits from ecological services are vastly unexplored. Costanza and others (1997) estimated the benefits of global ecosystem services to be \$33 trillion. The magnitude of this estimate suggests that the benefits of sustaining wildland ecological services may match or exceed the passive use benefits from wildland conservation. Public investments in research that examines the benefits of sustaining the ecological services generated by wildlands will help test this hypothesis and should be an agency priority.

Whereas the timber industry has a financial incentive to fund traditional timber research, no such incentive exists for

wildland research. The benefits of wildland research will never be fully captured in market prices, and the research will rarely, if ever be, funded by private industry. In other words, a market failure exists for funding wildlands research. Taxpayer supported research should therefore focus on wildland research and increasing our knowledge on nonmarket goods and services, while we can more readily rely on market forces to fund research on the production of timber and other marketable commodities.

Increased investment in wildland research also has the potential to produce global economic benefits if, for example, transferring information on the economic importance of conserving wildland watersheds results in policy changes that reduce road building and logging in tropical forests. Investing in wildland economic research is also consistent with the encouraging changes being implemented under the current leadership of Forest Service Chief Michael Dombeck.

**Improve the Economic Analysis Completed**—Passive use values should be internalized (via the RPA values, for example) into the economic analysis completed by public land management agencies. This is supported by the conclusion of a blue ribbon panel, including two Nobel Prize-winning economists, that carefully designed contingent valuation studies will produce reliable information for judicial and administrative decisions involving passive-use or existence values (Arrow and others 1993; Loomis 1995). Economic analysis by agency economists must keep up with research (much of it by agency researchers) and internalize the benefits (costs) associated with wildland conservation (damage). As Haynes and Horne (1997) note, “...recent advances in the field of economic valuation make it possible to include in a resource valuation many outputs and conditions that were once considered unquantifiable.” Potential techniques available to quantify and value ecosystem goods, services, functions, and conditions are listed in [table 1](#). The benefits of conserving and the costs of degrading nonmarket

**Table 1**—Examples of the ecosystem goods and services produced by public lands, and potential valuation-quantification techniques for estimating economic benefits or costs.

Ecosystem good or service	Valuation-quantification technique
Biodiversity	Opportunity cost, cost-effectiveness, replacement cost
Carbon storage	Replacement cost, capitalized value
Cultural/historical	Travel cost, contingent valuation
Ecosystem services	Change in productivity, opportunity cost, preventive measures
Fire danger	Fire behavior simulation models
Fish	Change in recreation benefits and willingness-to-pay, natural capitalization analysis, change in production, preventive expenditures
Game	Change in recreation benefits and willingness-to-pay, natural capitalization analysis, preventive expenditures, replacement costs
Minerals	Net mineral value
Passive use benefits (option, bequest, existence)	Contingent valuation surveys
Range	Net market value
Recreation	Travel cost model, contingent valuation surveys
Soil productivity	Replacement cost, soil ecosystem simulation modeling
Special forest and range products	Market prices where available, replacement costs
Timber	Net stumpage value
Visibility/aesthetics	Contingent valuation surveys, property value or wage differential
Water quality	Change in treatment costs, preventive expenditures, replacement costs

resources can be quantitatively estimated and should be internalized into the economic analysis evaluating management alternatives as part of the NEPA process (Morton 1999b). Quantifying the nonmarket benefits of wildland conservation may help the agency economically justify the needed increases in congressional appropriations for public land management in times of declining timber harvest levels.

**Symmetrical Application of Short Term Price-Benefit Trends**—Technological changes in the timber industry have stretched the supply and kept stumpage prices consistently lower than projected by the Forest Service. Agency planners should therefore avoid using long-term stumpage price trends. In contrast, the asymmetric influence of technology is likely to increase wildland benefits relative to commodity values. In fact, many economists believe that nonmarket resources, not timber, will be the scarce resources of the future (Hyde and Newman 1991; Krutilla 1967; Smith 1974, 1979), suggesting that positive price-benefit trends are more justified for wilderness resources than for timber resources. If planners use short term price-benefit trends, they should be applied symmetrically to all resources, not just timber.

## Conclusion

Economics provides information useful for policy discussions, but economics alone is not sufficient to promulgate policies. Economic efficiency is only one consideration when allocating multiple public resources; fairness of the process and equity considerations play more important roles (Bowes and Krutilla 1989). This is consistent with the MUSYA and NFMA definition of multiple-use that states the optimum policy is “not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output” (Culhane and Friesema 1979).

Although wildlands are highly valued by society, the benefits of wildland conservation are difficult to quantify in financial terms without formal markets. As a result, nonmarket wildland benefits are typically underestimated in private land management decisions. This is a serious shortcoming, as certain functions of nature, although they have no market value and their benefits are only partially understood, are necessary to keep the market economy running. Public lands can help correct these market failures by sustaining wildlands that cannot survive the market forces driving private land use decisions.

Forest Service employees were early leaders in recognizing the importance of wilderness as a land use designation. In 1919, Arthur Carhart convinced Forest Service managers not to develop Colorado’s Trappers Lake; in 1924, Aldo Leopold pushed the agency to classify 574,000 acres of Gila National Forest as wilderness; and in 1939, Bob Marshall issued U Regulations for wilderness management. These and other accomplishments in wilderness management were probably made without formally quantifying the economic benefits of wildlands and can be attributed principally to the dedication of wilderness managers, seasonal rangers and volunteers “working with minimum budgets and, for the most part, lacking strong support from the higher levels of agency hierarchies” (McCool and Lucas 1990).

While the Forest Service was once a leader in wildland conservation, over the past 35 years, the policies and procedures adopted by the agency have failed to adequately internalize wilderness benefits into the national forest planning process. Over the same time period, academic and agency economists have made great advances in developing methods to value wildland goods and services. Many heretofore unquantifiable wildland benefits and costs are now quantifiable and available to agency officials responsible for developing the policies and procedures for guiding public land management. The nonmarket recommendations offered here may not be sufficient to conserve public wildlands, but they at least take a step in the right direction simply by reframing the questions asked and improving the analysis completed by public land management agencies. If changes are not made, support for privatizing the management of the public estate may increase, which will be detrimental to wildland resources in the long run. The recent acknowledgment by Forest Service researchers on the economic importance of protecting wildlands is hopefully a sign of positive change on the horizon. Haynes and Horne (1997) conclude that “the existence of unroaded areas is by far the most valuable output from FS and BLM-administrated lands in the [Interior Columbia] basin today, and will continue to be so in the year 2045.” The same is likely true for public wildlands across the nation.

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