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The Economic Benefits of Wilderness: Theory and Practice

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THE ECONOMIC BENEFITS OF WILDERNESS: THEORY AND PRACTICE

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In wildness is the preservation of the world.[1]

I am afraid that I don't see much hope for a civilization so stupid that it demands a quantitative estimate of the value of its own umbilical cord.[2]

INTRODUCTION

How can we put a dollar value on the wild experience of being high atop a mountain peak, alone with nature, miles from the sounds and stresses of modern civilization? Why is it necessary to quantify the benefits from the exhilarating auditory experience of bugling elk on a cool autumn eve? And, why is it necessary to estimate the economic value of the ecological processes necessary to sustain earth's life support system? Aren't some of life's necessities, pleasures and experiences invaluable—beyond quantification by "dismal scientists?" While many folks may find it unethical to place a dollar value on wilderness and wildness, it is important to at least recognize qualitatively the economic value of the ecological, personal and societal benefits of wilderness. The main justification for discussing and perhaps quantifying wildland economic benefits is to level the playing field with the more easily quantifiable benefits associated with marketable commodities (e.g., timber). While steadfastly acknowledging that the economic benefits of wilderness will never be fully quantified, without at least qualitatively describing and understanding these benefits, politicians and public land managers will continue to make policy decisions that shortchange wilderness in public land management decisions.

The Wilderness Act of 1964[3] recognizes the multiple benefits of wilderness areas: "[W]ilderness areas shall be devoted to the public pur-

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1. HENRY DAVID THOREAU, *Walking*, *in* THE PORTABLE THOREAU 592, 609 (Carl Bode ed., 1947).

2. T. H. Watkins, *The Worth of the Earth*, AUDUBON, Sept. 19, 1997, at 128, 128 (quoting Conservation Biologist David Ehrenfeld).

3. Pub. L. No. 88-577, 78 Stat. 890 (codified as amended at 16 U.S.C. §§ 1131–1136 (1994)).

poses of recreational, scenic, scientific, educational, conservation, and historical uses."[4] 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.[5] In the thirty-five years since the passage of the Wilderness Act, economists have refined their methods for estimating the economic benefits of wildland conservation. Whereas much of the original focus was on the benefits generated through recreation use in wilderness areas, the array of benefits is now expanded to include conservation of biological diversity, ecological services, and passive-use benefits such as existence value. Although economic advancements have been made in quantifying the full array of wilderness benefits, in practice, policy decisions by public land management agencies have at best undervalued and at worst excluded wilderness benefits when developing land and resource management plans.

The objective of this article is to illustrate the apparent disconnection between the theory behind the economic benefits of wilderness and how those benefits have been used in practice on the public estate. The article begins with a brief introduction and review of some basic wilderness economic concepts to facilitate a better understanding of the discussion that follows. Next is a discussion of seven theoretical categories of wilderness benefits followed by a cursory review of how wilderness benefits have been applied in practice by public land management agencies, focussing specifically on the national forests.[6] The article ends with a brief discussion of the role of public lands in sustaining our wildland resources and the potential of applying safe minimum standards in national forest planning in an effort to internalize wilderness benefits into public land management.

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4. Wilderness Act § 4(b), 16 U.S.C. § 1133(b).

5. *See* B.L. Driver et al., *Wilderness Benefits: A State-of-Knowledge Review*, *in* FOREST SERV., U.S. DEP'T AGRIC., PROCEEDINGS—NATIONAL WILDERNESS RESEARCH CONFERENCE: ISSUES, STATE-OF-KNOWLEDGE, FUTURE DIRECTIONS 294, 296 (Robert C. Lucas ed., 1987). *See generally* HOLMES ROLSTON, III, PHILOSOPHY GONE WILD: ENVIRONMENTAL ETHICS 73–142 (1989) (discussing the various values of nature); P. Reed, Perspectives on Beginning Research in Nonrecreational Values of National Forest Wilderness (1989) (paper presented at Society of American Foresters Annual Convention, Spokane, Wash.).

6. The Wilderness Act did not direct the Bureau of Land Management (BLM) to consider wilderness benefits in the administration of its land. *See* H. Michael Anderson & Aliki Moncrief, *America's Unprotected Wilderness*, 76 DENV. U. L. REV. 413, 425 (1999). In general, the BLM has been slow to internalize wilderness benefits into land and resource management decisions.

I. WILDERNESS ECONOMICS: BASIC CONCEPTS

The purpose of studying economics is not to learn a set of ready made conclusions about how to manage the world but instead to avoid being deceived by economists.[7]

A. *Wilderness, Natural Capital, and Market Failure*

Wildland ecosystems represent natural capital capable of producing a wide range of goods and services for society.[8] Some of these outputs, such as timber, are freely exchanged in formal markets.[9] 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, but are without formal markets and therefore without prices. Although highly valued by society, the benefits of nonmarket goods and services are typically underestimated in production and consumption decisions—i.e., underproduced by private markets.[10] The underproduction of nonmarket resources is an example of a market failure[11] and provides economic justification for public ownership of a wildland network.[12]

Resource economists recognize that some public goods and services produced by wildlands have characteristics that make them unprofitable

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7. JOAN ROBINSON, *Marx, Marshall and Keynes*, *in* 2 COLLECTED ECONOMIC PAPERS 1, 17 (1960).

8. Capital is typically defined in business terms as accumulated goods devoted to the production of other goods. The concept of capital can also be applied to wildland ecosystems, where natural capital produces ecological goods and services essential to human survival. The natural capital in wildland ecosystems includes the soil organic matter and nutrient cycles, climate, topography, and the plant and animal species that together form the productive basis of wild ecosystems.

9. A market may be defined as the place, time, persons, and circumstances involved in the exchange of a good or a service for a price. *See* WILLIAM A. DUERR, FUNDAMENTALS OF FORESTRY ECONOMICS 279 (1960).

10. *Cf.* JOHN LOOMIS, INTEGRATED PUBLIC LANDS MANAGEMENT 70 (1993); RICHARD A. MUSGRAVE & PEGGY B. MUSGRAVE, PUBLIC FINANCE IN THEORY AND PRACTICE 54–74 (3d ed. 1980); John C. Bergstrom, *An Introduction to Nonmarket Valuation As a Tool for Assessing Public Policy*, *in* THE GEORGIA AGRICULTURAL EXPERIMENT STATION, UNIVERSITY OF GEORGIA, SPECIAL PUBLICATION 59, 1–3 (1989); Paul A. Samuelson, *The Pure Theory of Public Expenditure*, *in* 36 THE REVIEW OF ECONOMICS AND STATISTICS 387, 388–89 (1954).

11. A market failure occurs when market forces do not maximize net social benefits by equating marginal social benefits with marginal social costs. *See* JAMES R. KAHN, THE ECONOMIC APPROACH TO ENVIRONMENTAL AND NATURAL RESOURCES 14 (1995). For wilderness, market failure exists because markets fail to provide the socially optimal level of wildland resources.

12. The core landscape in a network of wildlands includes designated wilderness, semiprimitive, nonmotorized areas, and roadless areas on public land managed by the Forest Service and the BLM, as well as the national parks and national monuments. Supplementing federally managed lands are the thousands of acres of forests, parks, and open space under state, county, or community jurisdiction. In addition, private lands—including land designated as a nature reserve, managed by a land trust, subject to a conservation easement, or simply undeveloped—play a critical role in a nationwide network of wildlands.

to private enterprises.[13] The aesthetic value of a wilderness viewshed, for example, would be difficult to divide up and sell to individual consumers. It would also be difficult to exclude "free riders"—people who consume the scenic beauty but are unwilling to pay for it.[14] As such, private firms have little incentive to produce wildland viewsheds and market forces cannot be relied upon to produce an adequate supply of wilderness, even though additional wilderness may be economically rational and socially desirable. Without adequate production of public goods and services, society as a whole is less wealthy, and many of us as individuals are worse off.[15]

B. *Financial Versus Economic Analysis*

The underproduction of nonmarket goods and services is partially due to private industry conducting a financial or cash flow analysis rather than an economic analysis. A financial analysis only examines costs and benefits as measured by market price, and is more concerned with narrowly defined profits or losses. A more appropriate framework for evaluating public land management is an economic analysis conducted from the point of view of society as a whole.[16] An economic analysis considers not only the cash flow, but the nonmarket costs and benefits generated by a wildland network. A thorough economic analysis from the viewpoint of society must account for non-priced benefits and costs as well as those that are more readily observed and measured in market prices.[17]

C. *Market Information, Consumer and Producer Surplus*

The exchange of goods in the competitive marketplace generates information on the relative value of goods and services—expressed in terms of market prices—and on the amount of goods and services to be produced and consumed. Competitive markets establish a market or equilibrium price where the supply and demand curves intersect. Figure 1 shows a

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13. Public goods are distinguished from private goods because they are nonrival and nonexcludable in consumption. Public goods are nonrival because one person's consumption does not diminish the amount of the good available for others to consume. Nonexcludability means that while one person consumes the good, others cannot be excluded from also consuming the good. The most common example of a public good is national defense. The passive use values of wilderness are examples of pure public goods. Everyone can consume the existence of the Bob Marshall Wilderness Area, for example, without generating congestion. *See* John Loomis & Richard Walsh, *Future Economic Values of Wilderness*, *in* FOREST SERV., U.S. DEP'T AGRIC., PROCEEDINGS: THE ECONOMIC VALUE OF WILDERNESS 82 (C. Payne et al. eds., 1992) [hereinafter FOREST SERV., THE ECONOMIC VALUE OF WILDERNESS].

14. *See* PETER H. PEARSE, INTRODUCTION TO FORESTRY ECONOMICS 66 (1990).

15. *See* G.L. Peterson, *Ethical Dilemmas in Economics*, *in* FOREST SERV., U.S. DEP'T AGRIC., 1990 SOUTHEASTERN RECREATION RESEARCH CONFERENCE 84 (Daniel Hope ed., 1991).

16. *See* Loomis & Walsh, *supra* note 13, at 81.

17. *See* PEARSE, *supra* note 14, at 66. Without public interest intervention (e.g., government regulation) private industry has no incentive to consider the broader perspective provided by an economic analysis.

supply and demand curve intersecting at the equilibrium price (P*).[18] The supply curve represents the minimum price a producer would be willing to accept for a good or service. The minimum acceptable price typically covers the fixed and variable costs of production including a profit margin.[19] The demand curve represents the willingness to pay on the part of consumers. Moving from left to right on the horizontal axis indicates increasing quantities of goods. As more goods are consumed (quantity increases) the benefits received by consumers from each additional good are less than the previous good (i.e., diminishing marginal returns). As the benefits decrease, the willingness to pay also decreases which results in a downward sloping demand curve. Conversely, when goods are scarce (quantity decreases), consumers receive the highest benefits and their willingness to pay (demand) for the goods increases.

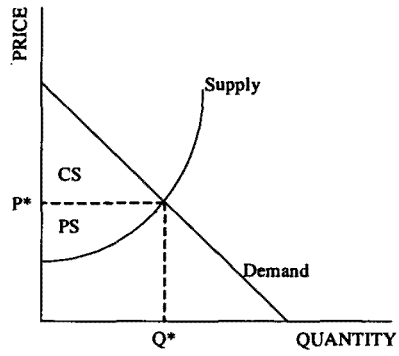


FIGURE 1

The lower section of the supply curve (below P*) indicates that some firms can produce goods at a cost that is less than the market price. The difference between the market price received by the purchaser and the minimum price they are willing to accept (their marginal supply cost) is called producer surplus. Graphically, producer surplus (PS) is the area below the equilibrium market price and above the supply (marginal cost)

18. At this price the area under the demand curve and above the supply curve (i.e., social welfare) is maximized. Theoretically, if all economic assumptions are met (e.g., the markets are perfectly competitive, perfect information is available to all parties, and spillover costs and benefits (externalities) are internalized), the resulting allocation of resources will be socially optimal. The "social" referred to here concerns only economic efficiency and assumes that the existing distribution of wealth is fair and equitable. *See* E-mail from George Peterson, Project Leader for the Identification and Valuation of Wildland Benefits Research Unit, U.S. Dep't of Agric., Forest Serv. Rocky Mountain Research Station, Fort Collins, Colo. to Pete Morton, The Wilderness Society (1998) (on file with author) [hereinafter Peterson Communication]. The quantitative measure used by economists to estimate the social well-being is termed social economic welfare. Social economic welfare measures the net economic benefits received by both producers and consumers as a result of exchanging goods and services in a competitive market structure. Quantitatively, social economic welfare equals the sum of consumer and producer surplus.

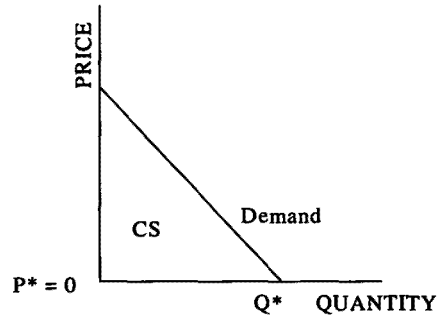
19. The supply curve is also referred to as the marginal cost curve.

curve.[20] The upper section of the demand curve indicates that some consumers are willing to pay more for the good than the market price. The difference between the market price a consumer paid for a good and the maximum price a consumer would be willing to pay is called consumer surplus (CS). Consumer surplus is the area above the equilibrium market price and below the demand curve.[21] Consumer surplus is widely accepted by economists as the appropriate measure relevant to social decisions.[22] For economic analysis of public policies, consumer surplus is the proper measure of the economic value of nonmarket goods and services.[23]

D. *Nonmarket Resources and Consumer Surplus*

When goods and services are not exchanged in the market place, information on their relative value or price is not specified by market prices. The lack of a market price, however, does not necessarily indicate that the goods or services have no economic value. Figure 2 illustrates a good which is provided free (i.e., market price = 0). In this case the entire value of the good is represented by the consumer surplus underneath the demand curve.[24] In other words, all the economic value of nonmarket goods is in the form of consumer surplus. Although the price paid is zero, consumers would be willing the pay more.[25]

FIGURE 2



20. Producer surplus can be viewed as the economic benefit earned by producers in excess of a "normal" profit margin.

21. To help understand these concepts consider the following example. A wilderness outfitter estimates the minimum price she would be willing to accept for a wilderness hunting trip is $50—which covers the costs of a permit, labor, overhead, plus a profit margin. However, because it is prime hunting season, she asks and receives $80 for the trip—earning $30 in producer benefit (surplus). The wilderness hunter paid the $80 fee but was actually willing to pay $100. As such, he enjoys an untaxed consumer benefit (surplus) of $20 for which he did not have to pay. Although this was for a single transaction, the theoretical concept holds for market-wide transactions.

22. *Cf.* RICHARD E. JUST ET AL., APPLIED WELFARE ECONOMICS AND PUBLIC POLICY 69–83 (1982); PAUL A. SAMUELSON, ECONOMICS 449–62 (9th ed. 1973).

23. *See* John R. Stoll et al., *A Framework for Identifying Economic Benefits and Beneficiaries of Outdoor Recreation*, 7 POL'Y STUD. REV. 445, 445–48 (1987).

24. *See* PEARSE, *supra* note 14, at 67.

25. The consumer surplus referred to here is the "net value to the consumer." This should not be confused with "net value to society." In order to derive the net economic value to society, net supply costs must be accounted for. While price paid by the consumer is zero, the supply cost to society may not be zero. *See* Peterson Communication, *supra* note 18.

The fact that wilderness benefits are not priced does not mean they have no value, only that market indicators of the value do not exist. It is therefore important to estimate the demand curve and consumer surplus for the nonmarket goods and services generated by public wildlands. Economists use indirect methods to estimate wilderness benefits when consumers are unable to express their preferences and willingness to pay via the marketplace. The two methods most commonly used are the survey-based contingent valuation method and the expenditure-based travel cost model.[26] Economists have used these methods to estimate willingness to pay (demand) curves and calculate the consumer surplus below those curves for a variety of nonmarket goods and services including recreation, wilderness, air and water quality, wildlife and the scenic beauty. The use of indirect methods provides information on the relative values of wildland goods and services. This information is needed by forest planners in order to estimate the optimal production of jointly produced goods and services.

E. *Modeling the Joint Production of Wildland Benefits with FORPLAN*

The ability of wildlands to simultaneously produce more than one good or service—e.g., habitat for endangered species, scenic beauty, and watershed protection—is termed joint production.[27] Although the ability of wildlands to jointly produce goods and services is advantageous, it can be problematic because of competing uses; the production of one output may affect the ability of wildlands to produce another output.[28] For example, forest land used for timber production cannot be used for wilderness. So, in addition to poor information on relative values, the decision of which forest outputs to jointly produce complicates public land and resource allocation decisions.

During the first round of forest planning, the Forest Service used management science to model the joint production of forest resources. Specifically FORPLAN, a linear programming model, was used to allocate resources and develop forest management plans.[29] A linear program is a constrained optimization model where an objective function is optimized subject to a set of linear constraints. The workings of FORPLAN can be explained graphically using a simple joint production example.[30]

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26. *See* John B. Loomis, *Shifting and Broadening the Economic Paradigm Toward Natural Resources*, *in* A NEW CENTURY FOR NATURAL RESOURCES MANAGEMENT 221, 225 (Richard L. Knight & Sarah F. Bates eds., 1995).

27. The annual joint production of goods and services can be thought of as the interest earned through maintenance and investment in the natural capital. The rate of harvest should be one that does not lower the productive capability of the remaining natural capital (i.e., harvest interest, not capital).

28. *See* PEARSE, *supra* note 14, at 93–96.

29. The new version of FORPLAN, called SPECTRUM, provides a graphical user interface that makes it easier for inexperienced planners to run the model.

30. *Cf.* J. EDWARD DE STEIGUER ET AL., FOREST SERV., U.S. DEP'T AGRIC., SOUTHERN APPALACHIAN TIMBER STUDY 1–2 (1989); PEARSE, *supra* note 14, at 217.

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 economic objective is to determine how resources should be allocated in order to maximize net public benefits. Net public benefits are estimated using timber prices derived from market information and nonmarket estimates of consumers' willingness to pay for wilderness. The relative values of timber and wilderness determine the slope of the exchange or total benefits line (BB). The optimal allocation occurs at point E, where the total benefits line (BB) is tangent to the production possibility curve (PP)—since no other possible combination will yield higher total benefits. At this tangency point the slopes are just equal: the marginal rate of transforming one acre of timber to one acre of wilderness (slope of PP) is just equal to the ratio of their relative values (slope of BB). This results in the economically optimal production of T acres of timber and W acres of wilderness.[31]

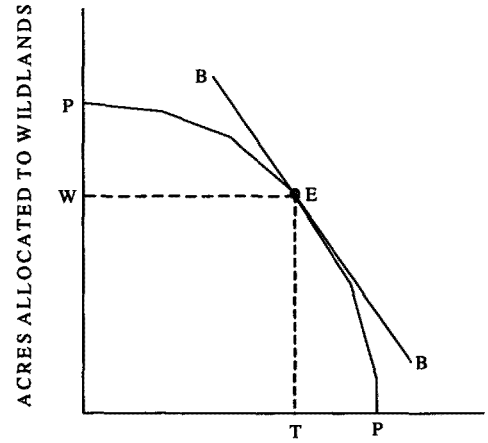

FIGURE 3

Planners used the FORPLAN model to estimate net public benefits based on the potential outputs and responses possible if a forest was optimally managed under a given set of goals and objectives. In order for the model to maximize net public benefits, economists must estimate the relative values of the goods and services jointly produced by the wilderness landscape.

31. While the FORPLAN models run by national forest planners are much more complex than illustrated here, the basic concept is the same.

II. WILDERNESS BENEFITS IN THEORY

The value of wilderness has evolved over time in response to changing societal preferences. Early Americans saw wilderness as an economic bad—the "hideous and desolate wilderness" as described by one Pilgrim.[32] Although some individuals and lobbyists for the resource extractive industries may still view wilderness as bad, the majority of Americans now view wilderness as an economic good.[33] This majority view is held even though wilderness provides a primitive experience with attributes typically valued as economic bads.[34] Puzzling over the recreation value of wilderness, Raymond B. Cowles suggested that "the intense pleasure of the wilderness experience seems to be commensurate with the amount of effort and even discomfort involved."[35] Pain and effort, typically viewed as costs, are benefits when it comes to valuing wildland recreation. Correctly estimating and internalizing dis-amenities as benefits is just one of the many challenges the wilderness resource presents to resource economists.

The need for a network of wildlands is partially based on the realization that wild natural capital and managed natural capital are not perfect substitutes.[36] For example, certain functions or services produced by wild, natural forest capital are not produced by managed forest capital. Monocultures created with market-driven forestry are less biologically and ecologically diverse,[37] but may be more efficient at producing quantities of wood fiber (at least in the short term) than natural forests. In contrast, natural forests are more efficient at producing many of the nonmarket goods and services valued by society. Wild landscapes produce many goods and services that historically have been grossly undervalued by economists and public land management agencies. It may therefore be necessary to single out natural forest capital for protection in a network of wildlands.[38]

To facilitate informed investment decisions about publicly owned wildlands, economic analysis must take into consideration both market

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32. RODERICK NASH, WILDERNESS AND THE AMERICAN MIND 23–24 (3d ed. 1982).

33. Poll after poll show strong public support for wilderness on public land managed by the Forest Service and the BLM. *See* Gregory H. Aplet, *On the Nature of Wildness: Exploring What Wilderness Really Protects*, 76 DENV. U. L. REV. 347, 348 & n.6 (1999).

34. *See* Garrett Hardin, *Wilderness, A Probe into "Cultural Carrying Capacity,"* 10 POPULATION & ENV'T 5–13 (1987).

35. *See generally* RAYMOND B. COWLES, DESERT JOURNAL: A NATURALIST REFLECTS ON ARID CALIFORNIA (1977).

36. *See* Peter A. Morton & Jeffrey T. Olson, *Forging the Link Between Natural Forest Systems, Environmental Quality and Community Development*, *in* THE GEORGE WRIGHT SOCIETY, 7TH CONFERENCE ON RESEARCH & RESOURCE MANAGEMENT IN PARKS AND ON PUBLIC LANDS 245, 245–46 (1992).

37. *Cf.* A.J. Hansen et al., *Conserving Biodiversity in Managed Forests: Lessons from Natural Forests*, 41 BIOSCIENCE 382, 386 (1991).

38. *See* Michael A. Toman & P. Mark S. Ashton, *Sustainable Forest Ecosystems and Management: A Review Article*, 42 FOREST SCI. 366, 375–76 (1996).

and nonmarket goods and services. For this article, the total economic benefits generated by a network of wildlands will be discussed based on seven categories, aggregated based mostly on the thoughts, observations, and research of other folks.[39] The categories of wildland benefits are direct use, community, scientific, off-site, biodiversity conservation, ecological services, and passive use benefits. To account for the full array of market and nonmarket wildland benefits, economists have derived the total economic valuation framework.[40] TEV is the appropriate measure to use when comparing wilderness benefits to its opportunity costs.[41] The seven categories of wildland benefits are conceptually summarized in Figure 4, using a TEV framework.[42]

39. *See generally* ROLSTON, *supra* note 5 (considering the philosophy of nature); John V. Krutilla, *Conservation Reconsidered*, 57 AM. ECON. REV. 777, 777–86 (1967) (suggesting a basis for decision making in the conservation context); Michael McClosky, *Evolving Perspectives on Wilderness Values: Putting Wilderness Values in Order*, *in* FOREST SERV., U.S. DEP'T AGRIC., PREPARING TO MANAGE WILDERNESS IN THE 21ST CENTURY: PROCEEDINGS OF THE CONFERENCE 13 (P.C. Reed comp., 1990) (proposing a taxonomy of wilderness values); Richard G. Walsh & John B. Loomis, *The Non-Traditional Public Valuation (Option, Bequest, Existence) of Wilderness*, *in* FOREST SERV., U.S. DEP'T AGRIC., GTR SE-51, WILDERNESS BENCHMARK 1988: PROCEEDINGS OF THE NATIONAL WILDERNESS COLLOQUIUM 181 (Helen R. Freilich ed., 1989) (discussing the hypothesis that society is willing to pay for the preservation of unique environments).

40. *Cf.* Loomis & Walsh, *supra* note 13, at 81. *See generally* Alan Randall, *The Total Value Dilemma*, *in* FOREST SERV., U.S. DEP'T AGRIC., TOWARD THE MEASUREMENT OF TOTAL ECONOMIC VALUE 2, 3–6 (1987) (discussing the CVM as they relate to the concept of total value); Alan Randall & John R. Stoll, *Existence Value in a Total Valuation Framework*, *in* MANAGING AIR QUALITY AND SCENIC RESOURCES AT NATIONAL PARKS AND WILDERNESS AREAS 265, 265–273 (Robert D. Rowe & Lauraine G. Chestnut eds., 1983) (discussing the components of total value).

41. *See* Loomis & Walsh, *supra* note 13, at 81–82.

42. While the focus of this article is on the demand side benefits of wildlands, the supply side costs of wildlands should not be forgotten. The demand for wildlands involves long- and short-run supply costs. In the long-run, the decision to set aside wildlands may involve opportunity costs to society by foregoing alternative development and production of man-made capital. In the short-run, there may be management costs and/or depreciation of natural capital due to human disturbance by on-site recreation.

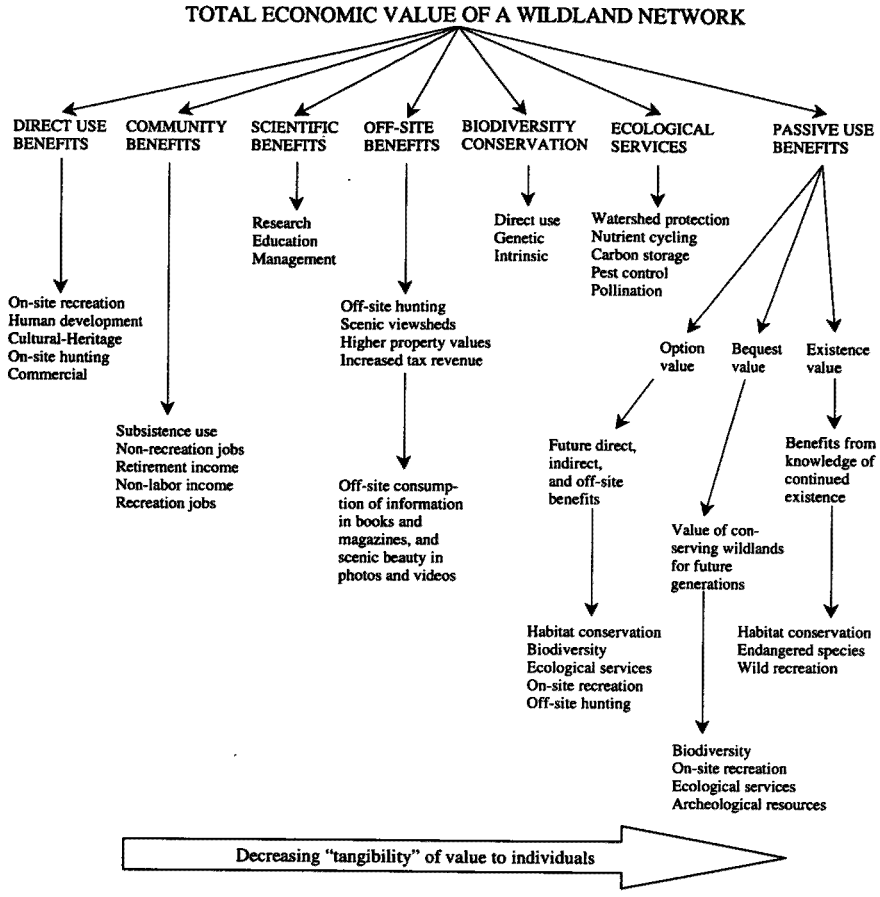

FIGURE 4

A. *Direct Use Benefits*

1. On-Site Recreation

While expenditures by recreationists measure the economic contribution from recreation to the regional economy, they do not fully represent the total economic benefits to society from public recreation. This distinction is often not recognized in policy discussions. As Power notes, there is little connection between the "job and income" definition of economic value used by local residents and many decision makers, and the "willingness to pay" measure typically used by professional economists.[43] The willingness to pay estimate of recreation benefits includes market as well as nonmarket benefits that may not directly generate jobs and income.

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43. Thomas Michael Power, *The Economics of Wildland Preservation: The View from the Local Economy*, *in* FOREST SERV., THE ECONOMIC VALUE OF WILDERNESS, *supra* note 13, at 175, 175.

Recreation is an experience that provides the user with satisfaction or economic utility.[44] Wildland recreation results in a variety of individual and social benefits,[45] which include 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 other social benefits (decreased social deviance, increased national pride).[46] These are the perceived benefits of users, but rejecting them because they cannot be assigned a monetary value would be counterintuitive. Given the considerable amount of time, effort, and other personal resources people commit to outdoor recreation, they "either gain sizeable benefits or are quite foolish."[47]

Research indicates that people participate in outdoor recreation to satisfy certain motives[48] identified and ranked by the Recreation Experience Preference scales.[49] Table 1 displays motives for recreation, ranked in order of importance, from studies conducted in three wilderness areas in North Carolina.

Sorg and Loomis conducted a meta-analysis of the research literature and determined wilderness recreation benefits ranged from $13 to $74 per activity day (1982 dollars).[50] Walsh et al. updated that meta-analysis and

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44. *See* John R. Stoll, *Methods for Measuring the Net Contribution of Recreation to National Economic Development, in* A LITERATURE REVIEW: THE PRESIDENT'S COMMISSION ON AMERICAN OUTDOORS at Values-19, 19 (1986).

45. *See generally* George L. Peterson & Thomas C. Brown, *The Economic Benefits of Outdoor Recreation, in* A LITERATURE REVIEW: THE PRESIDENT'S COMMISSION ON AMERICAN OUTDOORS, *supra* note 44, at Values-11, 11–15 (describing how economics offers a framework for measuring benefits derived from outdoor recreation).

46. *See* Beverly L. Driver, *Quantification of Outdoor Recreationalists' Preferences, in* RESEARCH, CAMPING AND ENVIRONMENTAL EDUCATION 165, 165–82 (Betty van der Smissen ed., 1976); Beverly L. Driver & Perry J. Brown, *Probable Personal Benefits of Outdoor Recreation, in* A LITERATURE REVIEW: THE PRESIDENT'S COMMISSION ON AMERICAN OUTDOORS, *supra* note 44, at Values-63, 64–66; Patrick C. West, *Social Benefits of Outdoor Recreation: Sociological Perspectives and Implications for Planning and Policy, in* A LITERATURE REVIEW: THE PRESIDENT'S COMMISSION ON AMERICAN OUTDOORS, *supra* note 44, at Values-93, 93–95; *see also* G.E. Haas et al., *Measuring Wilderness Recreation Experiences, in* PROCEEDINGS OF THE WILDERNESS PSYCHOLOGY GROUP ANNUAL CONFERENCE 20, 20–37 (L.K. Cannon ed., 1980) (discussing other social benefits resulting from a variety of wildland recreation activities).

47. Driver & Brown, *supra* note 46, at 65.

48. *See* Robert E. Manning, *Social Research in Wilderness: Man in Nature, in* WILDERNESS BENCHMARK 1988: PROCEEDINGS OF THE NATIONAL WILDERNESS COLLOQUIUM, *supra* note 39, at 120, 121.

49. Driver, *supra* note 46, at 165; Driver & Brown, *supra* note 46, at 65; Haas et al., *supra* note 46, at 30.

50. *See* CINDY F. SORG & JOHN B. LOOMIS, FOREST SERV., U.S. DEP'T AGRIC., GTR RM-107, EMPIRICAL ESTIMATES OF AMENITY FOREST VALUES: A COMPARATIVE REVIEW 19–20 (1984).

determined the net economic value of wilderness recreation ranged from $11 to $106 per day (1987 dollars), with an average value of $25.[51]

RECREATION EXPERIENCE PREFERENCE DOMAINS—RANKED BY USER IN THE LINVILLE GORGE, SHINING ROCK AND JOYCE KILMER WILDERNESS AREAS IN NORTH CAROLINA[52]

1. ENJOY NATURE A. Scenery B. General nature experience C. Undeveloped natural areas 2. PHYSICAL FITNESS 3. REDUCE TENSION A. Tension release B. Slow down mentally C. Escape role overloads D. Escape daily routine 4. ESCAPE NOISE AND CROWDS A. Tranquility/solitude B. Privacy C. Escape crowds D. Escape noise E. Isolation 5. OUTDOOR LEARNING A. General learning B. Exploration C. Learn geography of the area D. Learn about nature 6. SHARE SIMILAR VALUES A. Be with friends B. Be with people having similar values 7. INTROSPECTION A. Spiritual B. Personal values	8. INDEPENDENCE A. Independence B. Autonomy C. Being in control 9. ACHIEVEMENT/STIMULATION A. Reinforcing self-confidence/self image B. Social recognition C. Skill development D. Competence testing E. Seeking excitement or stimulation F. Self-reliance 10. BE WITH CONSIDERATE PEOPLE 11. FAMILY KINSHIP 12. PHYSICAL REST 13. TEACH/LEAD OTHERS A. Teaching/sharing skills B. Leading others 14. RISK TAKING 15. MEET NEW PEOPLE A. Meet new people B. Observe new people 16. RISK REDUCTION A. Risk moderation B. Risk prevention 17. NOSTALGIA

TABLE 1

2. Human Development

Wilderness is a place to restore mental and physical health, stimulate creativity, achieve self-realization, and improve group leadership skills. Wilderness is a place for spiritual experiences and has inspired the creation of art, photography, literature, poetry, and music.[53] Individuals with psychological, social, and physiological disorders derive therapeutic benefits from participating in wilderness camping programs.[54] Wildlands have an important role in human development as they represent a rich and potent source of personal, national, cultural, and biological identity

51. *See* Richard G. Walsh et al., *Review of Outdoor Recreation Economic Demand Studies with Nonmarket Benefit Estimates, 1968–1988, in* COLORADO WATER RESOURCES RES. INST., TECH. REPT. 54 at 23, 23 (1988).

52. The preference domains (numbered) are the reasons for recreating. Associated scales (lettered) are also in order of value. The information contained within this table is adapted from Driver & Brown, *supra* note 46, at 64–66.

53. *Cf.* McCloskey, *supra* note 39, at 13, 15, 18.

54. *See* Lynn Levitt, *Therapeutic Value of Wilderness, in* WILDERNESS BENCHMARK 1988: PROCEEDINGS OF THE NATIONAL WILDERNESS COLLOQUIUM, *supra* note 39, at 156, 158.

information. Wildlands play a significant and valuable role in self-definition on all three levels of human functioning.[55] Many of these benefits are expressed in Driver's Recreation Experience Preference scales.[56]

3. Cultural Heritage

Wildlands will also continue to have cultural value as "communit[ies] of life . . . untrammeled by man."[57] The wilderness experience makes a unique contribution to our cultural and national heritage; one that should not be trivialized. Wilderness is a reminder of America's frontier heritage, a chance for society to glimpse back in time and get a sense of an untamed continent much as our ancestors saw and experienced it.[58] As Nash observed, "Our national ego is fed by both preserving and conquering wilderness."[59] A network of wildlands will provide current and future generations of Americans with a frontier-like environment to reclaim their cultural identity and feed their soul.

4. Commercial

Wildlands can also provide commercial benefits for private industry. For example, while most salmon harvesting occurs outside wilderness, salmon require the fresh water located in upper pristine reaches of wild river systems for spawning and rearing habitat.[60] Hunting and fishing outfitters gain commercial benefits from wildlands by providing a primitive environment for their clients to experience. Wildlands are also a source of genetic material for propagators collecting seeds and tissue.[61] Harvesting nontimber forest products from public wildlands has become a big business on national forests. Nationwide, nontimber forest products support a $130 million industry that employs over 10,000 people.[62] Unfortunately, one of the drawbacks is in controlling the harvest of wild

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55. *See* Daniel R. Williams et al., *The Role of Wilderness in Human Development, in* WILDERNESS BENCHMARK 1988: PROCEEDINGS OF THE NATIONAL WILDERNESS COLLOQUIUM, *supra* note 39, at 169, 169.

56. *See* Beverly L. Driver, *Item Pool for Scales Designed to Quantify the Psychological Outcomes Desired and Expected from Recreation Participation, in* FOREST SERV., U.S. DEP'T AGRIC., ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION 38 (1977).

57. NASH, *supra* note 32, at 5 (quoting the Wilderness Act of 1964 § 2(c), 16 U.S.C. § 1132(c) (1994)).

58. *Cf.* Michael McCloskey, *Understanding the Demand for More Wilderness, in* WILDERNESS BENCHMARK 1988: PROCEEDINGS OF THE NATIONAL WILDERNESS COLLOQUIUM, *supra* note 39, at 38, 39–41 (discussing the reasons behind the demand for wilderness protection).

59. Roderick Nash, *The Cultural Significance of the American Wilderness, in* WILDERNESS AND THE QUALITY OF LIFE 66, 72 (Maxine E. McCloskey & James P. Gilligan eds., 1969).

60. *Cf.* Ronald J. Glass & Robert M. Muth, *Commodity Benefits from Wilderness: Salmon in Southeast Alaska, in* FOREST SERV., THE ECONOMIC VALUE OF WILDERNESS, *supra* note 13, at 141, 141.

61. *See* McCloskey, *supra* note 39, at 18.

62. *Cf.* James H. Johnson, *The Secret Harvest*, AM. FORESTS, Mar.–Apr. 1992, at 28, 28–29.

species to a sustainable rate, especially since many wild species do not propagate easily.[63]

B. *Community Benefits*

At one end of the community economic development spectrum are communities where subsistence harvest of wildland products is an important component. Sustaining wildlands may be especially important for sustaining these communities. In Alaska, subsistence use of wild resources for food, clothing, and shelter is a customary and traditional use of the wildland resource.[64] Kruse and Muth estimated that thirty percent of the villagers in southeast Alaska get at least fifty percent of their meat and fish from subsistence harvesting.[65] In addition to basic resources, subsistence use provides Southeast Alaskan residents with a number of psychological, social, and cultural benefits.[66] Subsistence use is intertwined with cultural and spiritual beliefs, and the sharing of resources enforces the social fabric of the village. Unfortunately, subsistence use is not reflected in government economic data, and history suggests that native villagers have been marginalized in economic analysis.

At the other end of the community economic development spectrum, wildland recreation directly generates thousands of jobs in local communities. Although many retail and service jobs associated with wildland recreation are low-paying and seasonal, they do provide local residents with employment opportunities in less skilled jobs for supplementing household income, helping to alleviate rural poverty. Retail and service businesses also generate important employment opportunities for women. In contrast, the timber industry provides women with very few employment opportunities. Wildland recreation generates convenient employment opportunities for high school students and those home from college during the summer. And sometimes, these jobs simply allow folks to live in a place they love. Recreation jobs also support additional jobs, as the economic impact from visitor spending "multiplies" through a community.[67] A perhaps more important role is the indirect role wildlands play in diversifying the economies of rural communities.

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63. Pricing methods for nontimber resources harvested on the national forests also need to be evaluated and formalized. In the southern Appalachians, the Forest Service has sold Pink Lady's slippers, a wild orchid that is difficult to propagate, for $.25 per plant, a price that is well below replacement costs. *See* Peter A. Morton, *Charting a New Course: National Forests in the Southern Appalachians*, THE WILDERNESS SOC'Y 65, 65 (1994) [hereinafter Morton, *Charting a New Course*].

64. In recognition of this, section 802 of the Alaska National Interest Lands Conservation Act of 1980 (ANILCA), Pub. L. No. 96-487, § 802, 94 Stat. 2371, 2422 (codified as amended at 16 U.S.C. § 3112 (1994)), allows subsistence uses to continue, even in designated wilderness.

65. *See* JOHN A. KRUSE & ROBERT M. MUTH, SUBSISTENCE USE OF RENEWABLE RESOURCES BY RURAL SOUTHEAST ALASKA RESIDENTS 18 (1990).

66. *See generally* ROBERT M. MUTH & RONALD J. GLASS, WILDERNESS AND SUBSISTENCE-USE OPPORTUNITIES: BENEFITS AND LIMITATIONS (1989).

67. Employment and income multipliers measure the total indirect and induced effects of export employment and income on a regional economy. For each dollar injected into the local econ-

There is a growing body of literature suggesting that future diversification of rural economies is dependent on the ecological and amenity services provided by public wildlands.[68] According to Whitelaw and Niemi, "the economic-development process is increasingly characterized, not by jobs-first-then-migration, but by the reverse."[69] In other words, a rural development strategy can capitalize on the qualitative features of the wild landscape to attract a high quality work force and new businesses to an area.[70] The extraction of publicly owned market resources should not degrade the long-term production of nonmarket goods and ecological services by wildlands on the public estate. It is the wildland-generated goods and services such as scenic landscapes and wildlife habitat that improve quality of life for local residents and drive the amenity based development currently occurring throughout the nation.[71]

The environmental, recreational, and scenic amenity resources generated on public wildlands improve quality of life for local residents and indirectly benefit rural communities by attracting and retaining businesses. Advances in telecommunications have allowed light manufacturers and "knowledge-based" business firms (e.g., computer programmers, engineers, and stockbrokers) to locate in relatively remote locations with desirable lifestyles. For many of these "footloose" businesses, information is the commodity exported (as opposed to a region's natural resources) and proximity to markets is a less important factor than in the past. Results from surveys on business location criteria indicate that scenic amenities, quality of life, and access to recreation are some of the most important reasons, relative to other more traditional economic criteria, for businesses to locate and stay in a rural region.[72] Amenity factors have been deemed

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omy, three or four dollars may be earned by local residents as the export dollars are cycled through local businesses. *See* THOMAS MICHAEL POWER, LOST LANDSCAPES AND FAILED ECONOMIES: THE SEARCH FOR A VALUE OF PLACE 7 (1996). The more self-sufficient a community is, the larger the multiplier because export dollars stay in town longer by circulating through a diversity of local businesses. Although job and income multipliers for recreation jobs may be lower than timber multipliers, the large number of direct recreation jobs compensate for the lower multipliers.

68. *Cf. id.* at 159–62 (discussing the multiple economic benefits of natural forests); Morton, *supra* note 63, at 65. *See generally* Raymond Rasker, *A New Look at Old Vistas: The Economic Role of Environmental Quality in Western Public Lands*, 65 U. COLO. L. REV. 369 (1994) (exploring different options for looking at the role of public lands).

69. E. Whitelaw & E.G. Niemi, *Migration, Economic Growth, and the Quality of Life*, *in* PROCEEDINGS OF THE TWENTY-THIRD ANNUAL PACIFIC NORTHWEST REGIONAL ECONOMIC CONFERENCE 35, 36 (1989).

70. *See* Ray Rasker, *Dynamic Economy Versus Static Policy in the Greater Yellowstone Ecosystem*, *in* FOREST SERV., THE ECONOMIC VALUE OF WILDERNESS, *supra* note 13, at 201, 205.

71. The 227 counties containing wilderness have experienced more rapid growth than other counties, and the presence of wilderness was an important reason why 60% of migrants moved to the wilderness county, and why 45% of the long-term residents stay. *See* Gundars Rudzitis & Harley E. Johansen, *How Important Is Wilderness? Results from a United States Survey*, 15 ENVTL. MGMT. 227, 231 (1991).

72. *See* Jerry D. Johnson & Raymond Rasker, *The Role of Economic and Quality of Life Values in Rural Business Location*, 11 J. RURAL STUD. 405, 406, 412–14 (1995); Susan Kask &

particularly important in the location decisions of four types of companies: corporate headquarters, high-technology, research and development, and services.[73]

Regional economic development is fostered by the migration and retention of local businesses, and the attraction and retention of a high-quality workforce. States, counties, and communities pursuing economic development are increasingly competing to attract human and financial capital. Whereas many rural communities have to make capital investments in their "amenity infrastructure," public wildlands provide rural communities with a rich endowment of amenity resources. These amenity resources are owned by the American public and managed by public land management agencies at very little cost to local communities. A majority of the financing needed to manage public lands is provided by taxpayers outside the local area. The wildland resources on public land, if properly conserved, can provide rural and urban communities with a comparative advantage over other areas for diversifying their economy.[74] The implications for managers of public land is that they should no longer feel compelled to focus on extracting a steady flow of resources as the only method of generating employment in rural communities. Rather they should recognize the economic importance to rural communities of conserving wildland resources on public lands.

The allure of the amenity and recreation resources available on public wildlands is illustrated by rural migration patterns. During the 1970s and 1980s, rural areas experiencing rapid population growth were highly concentrated in areas adjacent to large tracts of public lands that offered recreational and scenic amenities.[75] Many of the migrants are amenity seeking retirees who may have first visited public lands as recreationists or tourists. In general, retirement communities evolve from areas with recreation and tourism.[76] The typical amenity-seeking retiree is married, well educated,

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Peter A. Morton, Quality of Life and Natural Resource Amenities in Business Location and Retention Decisions 11, 13 (1998) (unpublished manuscript on file with author).

73. *See* Jill M. Decker & John L. Crompton, *Business Location Decisions: The Relative Importance of Quality of Life and Recreation, Park, and Cultural Opportunities*, 8 J. PARK & RECREATION ADMIN. 26, 27, 37–38 (1990).

74. According to Birch, "[t]he successful, innovation-based company will, in general, settle in an environment that bright, creative people find attractive." DAVID L. BIRCH, JOB CREATION IN AMERICA: HOW OUR SMALLEST COMPANIES PUT THE MOST PEOPLE TO WORK 9 (1987). And, in order to retain a quality workforce, firms must provide a setting with a high "quality of life." *Id.* A network of wildlands can help firms with that goal by sustaining a high quality of life in adjacent communities. *See generally* Rasker, *supra* note 68 (discussing the evolving role of public lands in the economy of the western United States); Raymond Rasker, A New Home on the Range: Economic Realities in the Columbia River Basin 15, 22–23 (1995) (unpublished manuscript on file with author).

75. *See* Timothy P. Duane, Exodus to Exurbia: The Threat of Population Growth in Rural "Buffer Zone" Regions to the Conservation of Biological Diversity 11–12 (paper presented to the Soc'y of Conservation Biology, June 12, 1993).

76. *See* CHARLES F. LONGINO, RETIREMENT MIGRATION IN AMERICA 13 (R. Alan Fox ed., 1995).

newly retired, in good health, has ample financial resources,[77] and more frequently lives in counties with public land. The economic contribution of migrating retirees to rural economies is significant.[78] Retirees moving to rural communities buy or build houses, require medical assistance, and may need local banking services (e.g., mortgages) and investment advice. These needs translate into employment opportunities in construction, services (especially health services), retail, finance, insurance, and real estate. In addition, amenity-seeking retirees tend to increase county revenues while keeping costs low. For example, retirees increase the tax base for public schools and police services but they do not attend or send children to school, and they generally do not commit crimes.[79] Retirement income is also less sensitive to the business cycle, which can stabilize the economic base and improve a community's ability to adjust to changing economic conditions.[80]

In general, a public network of wildlands can attract new residents, stimulate economic development, provide local residents with a wider choice of jobs, and diversify the local economy. These factors provide a stabilizing influence for communities associated with extractive industries, such as timber and mining, which are prone to boom and bust cycles.

C. *Scientific Benefits*

Scientific benefits are often cited as one justification for a network of wildlands. As Stankey stated: "[T]here remains the persuasive argument that science and scientific inquiry offer an important way of justifying the significant investment that society has made in the wilderness system."[81] For this article, scientific benefits will be discussed in three categories: research, education, and management.

1. Research

There is a growing recognition of the value of large natural areas for scientific study of how natural systems function. Although studies in laboratories and degraded ecosystems have merit, ecological studies that collect baseline data on, and improve knowledge of how natural ecosystems function is essential to appraising and mitigating adverse effects on

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77. *See* P.B. Siegel & F.O. Leuthold, *Economic & Fiscal Impacts of a Retirement/Recreation Community: A Study of Tellico Village, Tennessee*, 25 J. OF AGRIC. & APPLIED ECON. 134, 134–47 (1993).

78. *See* LONGINO, *supra* note 76, at 83–84.

79. *See id.*

80. *See* Robert D. Plotnick, *Small Community Economic Development: Can Income Transfers Help?*, *in* A NORTHWEST READER: OPTIONS FOR RURAL COMMUNITIES 55, 57–58 (1989).

81. George H. Stankey, *Scientific Issues in the Definition of Wilderness*, *in* PROCEEDINGS—NATIONAL WILDERNESS RESEARCH CONFERENCE: ISSUES, STATE-OF-KNOWLEDGE, FUTURE DIRECTIONS, *supra* note 5, at 47, 51.

the environment.[82] Although the Forest Service maintains research forests, many of them are too small to fully observe natural processes. Historically, agency research has focused on improving forest production or minimizing the impacts of production, and not necessarily on examining ecological processes. Large natural areas provide an opportunity to study intact ecosystems and gather the information necessary to manage forest ecosystems responsibly. As Nash states: "[W]ilderness holds answers to questions man has not yet learned to ask."[83]

2. Education

Wilderness provides educational opportunities to study plant and animal species, ecological and evolutionary processes, and a place to develop wilderness skills, such as orienteering.[84] Wilderness provides an opportunity for liberation from the predominantly left brain analytical orientation of modern society. The education benefits of wilderness experience include clearing the mind for the creative, visualizing, and intuitive functions of the right brain.[85]

3. Management

In order to successfully implement ecosystem management or restoration forestry, more information on how natural forest ecosystems function is essential (i.e., What is it that we are trying to mimic or restore?). Wildlands represent a continuous source of information on the structure and function of natural communities, information that is prerequisite for successfully implementing ecosystem management. Estimating the historic range of variability depends on our ability to derive presettlement dynamics from the natural landscape. The composition and structure of existing vegetation in wildlands is rich in information about the historical patterns and processes necessary for sustaining biodiversity outside the wildland network.

Taking an adaptive, experimental approach to management requires reference areas or "controls" against which to compare the success of

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82. *See* Sarah E. Greene & Jerry F. Franklin, *The State of Ecological Research in Forest Service Wilderness*, *in* WILDERNESS BENCHMARK 1988: PROCEEDINGS OF THE NATIONAL WILDERNESS COLLOQUIUM 113, *supra* note 39, at 113, 113.

83. NASH, *supra* note 32, at 23.

84. *See* McCloskey, *supra* note 39, at 17.

85. *Cf.* John C. Hendee & M.H. Brown, *How Wilderness Experience Programs Work for Personal Growth, Therapy and Education: An Explanatory Model*, *in* THE HIGHEST USE OF WILDERNESS: PROCEEDINGS OF A SPECIAL PLENARY SESSION AT THE 4TH WORLD WILDERNESS CONGRESS 5 (John C. Hendee ed., 1987); Edwin E. Krumpe, *Managing Wilderness for Education and Human Development: A Bane or a Blessing?*, *in* PREPARING TO MANAGE WILDERNESS IN THE 21ST CENTURY: PROCEEDINGS OF THE CONFERENCE, *supra* note 39, at 83, 85. Improving right brain functions can stimulate flexibility in the human thought process. Flexibility is considered an important trait for workers to succeed in the labor marketplace.

management experiments outside the wildland network.[86] Controls are essential to evaluate the effects of innovative approaches to terrestrial and aquatic ecosystem management. Wilderness provides the base datum of normality from which to demonstrate how normal, healthy land sustains its capacity for self-renewal.[87] Finally, the lessons of history constantly remind us that we do not and we will not know all we need to know about the natural world. The current paradigm shift in land management is in direct response to greater understanding of the complexity of ecosystems and the negative impacts of past management practices. Ecosystem managers will require wilderness reserves for the long-term storage of ecosystem information and a needed reminder of our perpetual knowledge gap.[88]

D. *Off-Site Benefits*

Wilderness economic research has focused on recreation benefits of wilderness, specifically on recreation that occurs on-site. However, wilderness benefits both recreationists and non-recreationists who are off-site, outside wilderness areas. For example, wilderness provides habitat for trophy elk that may be consumed either through hunting or viewing (i.e., watchable wildlife) outside wilderness areas. Wilderness areas serve as valuable scenic backdrops for resorts and residences on adjacent lands, thus enhancing property values and tax revenues.[89] In the southern Appalachians, wilderness areas provide many of the spectacular viewsheds for drivers on the Blue Ridge Parkway. In both time and space, wilderness benefits are not limited to visitors actually setting foot in wilderness.[90]

E. *Biodiversity Conservation Benefits*

Biological diversity, or biodiversity, includes the full array of species, the genetic information they contain, the communities they form, and the landscapes they inhabit. Although biodiversity conservation obviously provides society with significant economic benefits, it is difficult to assign measurable values when evaluating wilderness proposals. For this article, the economic benefits from conserving biological resources can be arbitrarily divided into three categories: direct use benefits, genetic, and intrinsic conservation benefits.

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86. *See* MERRILL R. KAUFMANN ET AL., FOREST SERV., U.S. DEP'T AGRIC., GTR RM-246, AN ECOLOGICAL BASIS FOR ECOSYSTEM MANAGEMENT 7 (1994).

87. *See* ALDO LEOPOLD, A SAND COUNTY ALMANAC WITH ESSAYS ON CONSERVATION FROM ROUND RIVER 258, 274 (1966).

88. *See* Gregory H. Aplet, *Ecosystem Management White Paper*, THE WILDERNESS SOC'Y (1996).

89. *See* McCloskey, *supra* note 39, at 16.

90. *See* Patrick Reed et al., *Management Principles for a 1990's Wilderness Revolution*, *in* MANAGING AMERICA'S ENDURING WILDERNESS RESOURCE: PROCEEDING OF A CONFERENCE 250, 253 (David W. Lime ed., 1989).

1. Direct Use

Direct uses of biodiversity, both consumptive and non-consumptive, include bird watching, viewing wildflowers or scenic vistas, fishing, hunting, and other pursuits. Harvesting nontimber forest products from public land, including flowers, mosses, ferns, mushrooms, ginseng and other herbs, pine cones and rocks, has become a big business on national forests in the Pacific Northwest, for example.

2. Genetic

One of the most promising areas of science and technology lies in our increasing understanding of genetics, the raw data of life itself. Genetic diversity can increase the productivity and disease resistance of crops, and generate new medicinal products.[91] Approximately twenty-five percent of prescription drugs sold in the United States contain at least one component derived directly or through chemical modeling, from flowering plants.[92]

The conservation of species for their genetic benefits should extend to multiple populations in order to sustain the full breadth of diversity.[93] Different populations provide different economic benefits (e.g., medicinal compounds) as a result of genetic variability between populations.[94] For example, research indicates substantial variation in taxol content between populations of Pacific yew.[95] This suggests the need for, and the potential economic benefits from conserving wildland habitat for genetically distinct populations of a species. As our knowledge increases and more information becomes available, species (or populations of a species) previously believed to be undesirable may in fact be viewed as beneficial. Once discovered as useful, a species generates a positive stream of benefits for future generations. Elimination of species inflicts a cost in the form of lost benefits on every subsequent human generation.[96]

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91. Prescott-Allen and Prescott-Allen conducted a detailed analysis of the contribution wild species of plants and animals made to the American economy and concluded that 4.5% of the gross domestic product was attributable to wild species. *See* CHRISTINE PRESCOTT-ALLEN & ROBERT PRESCOTT-ALLEN, THE FIRST RESOURCE: WILD SPECIES IN THE NORTH AMERICAN ECONOMY 408 (1986).

92. *See id.* at 100–48 (discussing the types and amounts of natural ingredients in medicine).

93. *See* Peter A. Morton et al., *Sustaining Biological Resources on the Southern Appalachian National Forests*, *in* PROCEEDINGS: 1994 SOUTHERN FOREST ECONOMICS WORKSHOP, D.B. WARNELL SCHOOL OF FOREST RESOURCES, UNIVERSITY OF GEORGIA 344, 345–46 (1994).

94. *See generally* MARGERY L. OLDFIELD, THE VALUE OF CONSERVING GENETIC RESOURCES (1984) (discussing the advantage of genetic diversity in several areas of resource development, including food production, tree resources, and natural sources for industrial oils and waxes).

95. Pacific yew is a tree species with low value for wood products that was traditionally burned in slash piles. Taxol, a natural substance extracted from the bark, is an effective drug for treating ovarian cancer. This illustrates the need to manage forest ecosystems for all species, not just the species currently valuable as commercial wood products.

96. *See* Alan Randall, *An Economic Perspective of the Value of Biological Diversity*, *in* CONTRACT PAPERS, PART E: VALUATION OF BIOLOGICAL DIVERSITY 5, 14–15 (1986).

As Shaffer notes: "To assume another species has no value is to assume that what we know today is all we will ever know."[97]

3. Intrinsic

Protecting biodiversity provides a number of intrinsic or passive-use benefits such as existence, bequest, option and quasi-option values. Existence value is that part of total value that derives from the psychic or spiritual importance a person attaches to knowing that a species exists, regardless of whether that person will ever consume the species. People may value the existence of wood thrushes, hellbender salamanders, or gray wolves even though they may never see them. Existence value is related to the altruistic motivations of humans to protect their planet and its inhabitants, combined with the knowledge gained from direct use of the species.[98]

People may also be willing to pay to insure that a species will exist for future generations to enjoy. Such bequest values have been found to be higher for older persons who, motivated by benevolence, receive utility from the transfer of resources to future generations.[99] Preserving biodiversity also maintains the option to utilize a resource in the future. Because it is irreversible, extinction necessarily results in the loss of option value. The option value of protecting a resource is lower if substitutes exist,[100] but since no species or population of a species is a perfect substitute for another, all species and populations of species have some positive option value.

Quasi-option value is the benefit received from future information that is conditional on protecting wildland resources from irreversible damage today. Quasi-option value is clearly relevant to wildland management given the wealth of biological resources on public land. Preserving biological resources maintains the possibility that new uses may be discovered later, increasing the value of those resources.[101] Developing a wildland network conserves biodiversity, helps maintain society's options for the future, and may be an economically rational use of publicly owned resources.

F. *Ecological Services*

Wildlands play an essential role in sustaining natural capital and ecological services that comprise our global life support system.[102] The

97. Mark Leslie Shaffer, *Beyond the Endangered Species Act: Conservation in the 21st Century*, *in* THE WILDERNESS SOC'Y 6 (1992).

98. *See* Walsh & Loomis, *supra* note 39, at 185.

99. *See id.*

100. *See id.*

101. *Cf.* Randall, *supra* note 96, at 31.

102. *See generally* EUGENE P. ODUM, ECOLOGY AND OUR ENDANGERED LIFE-SUPPORT SYSTEMS (2d ed. 1993) (discussing the principles of modern ecology).

functioning of the earth's biosphere and hence the maintenance and enhancement of human life depend on a complex series of ecological processes or services. These ecological services can be global cycles (e.g., water, carbon, nitrogen, and oxygen), as well as more localized processes such as soil formation, pollination of crops, watershed protection, storage and cycling of nutrients, absorption and breakdown of pollutants, and maintenance of stream flows.[103] Ecological services consist of flows of materials, energy, and information from natural capital stocks that combine with manufactured and human capital services to generate human welfare.[104] The many nonmarket benefits provided by ecological services are not priced, are only partially understood, and their value is just starting to be recognized. The economic benefits to human welfare of sustaining natural capital and ecological services in the aggregate are significant.[105]

1. Watershed Protection

An example of an ecological service with some historical precedent is watershed protection. The Organic Administration Act of 1897[106] stated that one of the purposes of national reserves was "for the purpose of securing favorable conditions of water flows"[107] (i.e., watershed protection). Watershed protection provides several economic benefits including (1) topsoil and nutrients remain on the site, helping to maintain ecosystem productivity; (2) decreased sedimentation maintains the water quality required by many native fish; (3) clean water lowers water treatment and reservoir maintenance costs for downstream communities; (4) clean water can be bottled and sold; and (5) watershed protection protects property values by controlling flood damage on private property. Watershed protection is an important service because public wildlands contain the headwaters of many of America's rivers. Watershed protection is an important role for public lands because controlling development, road construction, forest management practices, and hence erosion on private lands is more difficult due to concerns over private property rights.

2. Natural Pest Control

For years, foresters have relied on the natural regeneration service provided by "seed trees" left in the forest. Recognizing ecological services simply requires foresters and resource managers to extend the con-

103. *See* JEFFREY A. MCNEELY ET AL., CONSERVING THE WORLD'S BIOLOGICAL DIVERSITY 17–22 (1990).

104. *Cf.* Robert Costanza et al., *The Value of the World's Ecosystem Services and Natural Capital*, 387 NATURE 253, 253 (1997) (discussing data gathered to estimate the value of many ecosystem services).

105. Costanza estimated the economic benefits of the world's ecosystem services and natural capital average $33 trillion per year. In contrast, global gross national product totals equal $18 trillion per year. *See id.* at 253.

106. Organic Act of June 4, 1897, ch. 2, 30 Stat. 11, 34 (codified as amended at 16 U.S.C. §§ 473–482, 551 (1994)).

107. 16 U.S.C. § 475.

cept to other species and processes that provide significant yet unheralded, nonmarket benefits. Birds and ants, for example, provide important biological pest control services to managed forests outside the wildland network. One of the costs of managing for high crop (timber) yields is the increasing cost and environmental disruption when chemical pest controls replace natural controls that no longer work.[108] Natural predation plays an important role in ending pest epidemics and in lengthening the periods between pest outbreaks.[109] A wildland network providing a diversity of habitats for natural predators may be a prudent defense against future pest epidemics.

The economic benefits of biological pest control can be estimated based on the pesticide and insecticide costs avoided.[110] Takekawa and Garton estimated that the benefit of avian predators in controlling spruce budworm was similar to using chemical insecticides costing at least $4,700 per square mile treated.[111] It has been estimated that biological pest control services contribute $17 billion per year to the United States economy.[112] Sustaining habitat for populations of native keystone predators may be more efficient at sustaining ecosystem health than continual applications of greater quantities and concentrations of pesticides. Unlike pesticides that tend to become less effective with time, birds, insects, fungi, and microorganisms co-evolve with pests and thus maintain their effectiveness over time. In economic terms, pesticide use has decreasing returns to scale, whereas natural predation provides constant returns to scale. This suggests the potential long-term benefits from natural pest control may be substantial and that sustaining a wildland network that contains habitat for natural predators may be economically rational.[113]

3. Carbon Storage

The scientific and political concerns over increasing levels of atmospheric carbon dioxide make carbon sequestration a highly relevant ecological service of wildlands. The Kyoto Protocol[114] specifically recog-

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108. *Cf.* ODUM, *supra* note 102, at 31.

109. *Cf.* M. MCMANUS ET AL., FOREST SERV., U.S. DEPT. OF AGRIC., GYPSY MOTH, FOREST INSECT AND DISEASE LEAFLET 162 (1989), *available at* <http://willow.ncfes.umn.edu/fidl-gypsy/gypsy.htm> (visited Dec. 8, 1999); H. Smith, *Wildlife and Gypsy Moth*, WILDLIFE SOC'Y BULL. 13, 166–74 (1985). Although a non-native species, the many predators of gypsy moths that include wasps, flies, beetles, ants, many species of spider, several birds such as chickadees, blue jays, nuthatches, and towhees, and fifteen or more species of common woodland mammals such as white-footed mice, shrews, chipmunks, squirrels and raccoons provide a case in point.

110. *See* John Y. Takekawa & Edward O. Garton, *How Much Is an Evening Grosbeak Worth?*, 82 J. FORESTRY 426, 426–27 (1984).

111. *See id.*

112. *See* David Pimentel et al., *Economic and Environmental Benefits of Biodiversity*, 47 BIOSCIENCE 747, 748 (1997).

113. *See* Morton et al., *supra* note 93, at 349.

114. The Kyoto Protocol on climate change (signed by 163 countries in December 1997) established target reductions for net emissions of greenhouse gases including carbon dioxide and meth-

nized the role of forests in reducing carbon emissions, partially because of the potential to increase carbon storage in forests. As a market for carbon is created in response to the Kyoto Protocol, carbon storage in wildlands could become an increasingly valuable ecological service.[115]

Carbon storage provides an emerging economic argument for protecting the slow growing forests in Colorado and the huge carbon stores in the ancient forest wildlands of the Pacific Northwest.[116] Although older forests have lower growth rates, higher mortality rates favor accumulation of woody debris and increased carbon storage in the litter layers.[117] This may be significant for Colorado's high-elevation spruce-fir forests, for example, where deep litter layers accumulate during the long (five hundred year) intervals between disturbances.[118]

While the scientific and political debate has focused on above ground forest biomass as a carbon store (i.e., bole, branches, and needles of a tree), the role of forest soils in storing carbon has been mostly overlooked.[119] Soil carbon has been ignored even though forty to seventy-five percent of global carbon is in the soil,[120] and forest management typically reduces soil carbon and associated productivity. The economic benefits of storing carbon in the soils of a wildland network could play a significant role in protecting the temperate rain forests of Alaska, for example, where up to seventy-five percent of forest carbon is stored in the soils.[121] Protected by the forest canopy, soil carbon can be stored indefinitely

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ane. In order to meet emission targets, the federal government may auction emission allowances that can be traded in the marketplace. *See Kyoto Protocol to the United Nations Framework Convention on Climate Change* (visited Mar. 8, 1999) <http://www.cnn.com/SPECIALS/1997/global.warming/stories/treaty/>.

115. Norway, for example, recently paid $2 million to Costa Rica as part of a joint implementation agreement to sequester 200,000 tons of carbon from Costa Rican forests.

116. Timberland in the Rocky Mountains contains 4060 million metric tons of carbon. *See* R.A. Birdsey et al., *Carbon Changes in U.S. Forests*, *in* FOREST SERV., U.S. DEP'T AGRIC., PRODUCTIVITY OF AMERICA'S FORESTS AND CLIMATE CHANGE 56, 67 (Linda A. Joyce ed., 1995). The Interior Columbia Basin Assessment estimated the value of carbon sequestered at $65 per ton. *See* Richard W. Haynes & Amy L. Horne, *Economic Assessment of the Basin*, *in* 4 AN ASSESSMENT OF ECOSYSTEM COMPONENTS IN THE INTERIOR COLUMBIA BASIN AND PORTIONS OF THE KLAMATH AND GREAT BASINS 1715 (Thomas M. Quigley & Sylvia J. Arbelbide eds., 1997) [hereinafter COLUMBIA BASIN ASSESSMENT]. This would suggest that carbon stored in Rocky Mountain timberland has substantial economic value.

117. *Cf.* David P. Turner et al., *A Carbon Budget for Forest of the Conterminous United States*, ECOLOGICAL APPLICATIONS, May 1995, at 421, 429–33.

118. *See generally* Gregory H. Aplet et al., *Patterns of Community Dynamics in Colorado Engelmann Spruce-Subalpine Fir Forests*, 69 ECOLOGY 312 (1989) (discussing the importance of the role of disturbance in spruce-fir forest dynamics).

119. *See* Peter A. Morton et al., Linking Soil Nutrient Recapitalization and Sustainable Forestry: A Modeling Approach (1999) (unpublished manuscript on file with author).

120. *See* J.N. Walker & J.A. DeShazer, *Sequestration and Reduction*, AGRIC. ENGINEERING, Sept. 1992, at 17, 17; *cf.* Paul Schroeder, *Can Intensive Management Increase Carbon Storage in Forests?*, 15 ENV'T MGMT. 475, 475 (1991).

121. *See* R.A. Birdsey et al., *Carbon Changes in U.S. Forests*, *in* FOREST SERV., U.S. DEP'T AGRIC., PRODUCTIVITY OF AMERICA'S FORESTS AND CLIMATE CHANGE 56, 61 (Linda A. Joyce ed., 1995).

(subject to fluctuations caused by natural disturbances) if these forests are reserved in a wildland network. If the forests are logged, however, these soils can quickly decompose and lose their carbon through exposure to increased sunlight, temperature, and wind.

Although some ecosystem services, such as storing carbon, benefit humankind on a global scale, many ecosystem services are of greatest benefit to those communities closest to the ecosystem.[122] For example, the national forests in Colorado provide more services to the citizens of Denver in terms of modifying the microclimate, protecting watersheds, or removing air pollutants, than do the national forests located in the southern Appalachians. The continual flow of these services from public wildlands has improved the quality of the environment in local communities, which in turn has stimulated regional economic development in Colorado's Front Range as well as the Western Slope.

G. *Passive-Use Benefits*

Wildland recreation also generates significant passive-use benefits. Walsh and Loomis attach passive use benefits, such as existence, option, and bequest values,[123] to an insight first provided by Clawson and Knetsch, who explained outdoor recreation as a five phase experience.[124] The five phases are anticipation, travel to the site, on-site recreation activity, return travel, and recollection.[125] The anticipation phase includes the option benefits of possible future recreation use.[126] The recollection phase includes both the existence value of knowing the recreation resource is protected and the bequest value of endowing future generations with the resource.[127]

Weisbrod first suggested "option value" as an important benefit of protecting wildland environments.[128] His logic was that people were willing to pay some premium over and above their expected recreation benefits to maintain the option, for themselves or for their children, of visiting a natural area in the future.[129] Krutilla and Fisher discussed the likelihood that people who may never visit or intend to visit a unique natural area might still gain satisfaction from knowing that a network of

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122. *See* Morton & Olson, *supra* note 36, at 247.

123. *See* Walsh & Loomis, *supra* note 39, at 182.

124. *See* MARION CLAWSON & JACK L. KNETSCH, ECONOMICS OF OUTDOOR RECREATION, 33–36 (1966).

125. *See id.*

126. *See id.* at 33.

127. *See id.* at 34–35.

128. Burton A. Weisbrod, *Collective-Consumption Services of Individual-Consumption Goods*, 78 Q. J. ECON. 471, 472 (1964).

129. *See id.*

wildlands exists and is protected.[130] Existence value is the psychic value a person enjoys from just knowing that a wildland network exists—regardless of whether the person will ever visit an area. Krutilla also suggested that the current generation might be willing to pay something to bequest wildlands to future generations.[131]

Natural resource economists currently employ the contingent valuation method (CVM) to estimate total economic benefits, as this is the only method capable of estimating passive-use benefits. Walsh compared recreation use values and passive-use values of Colorado households from increasing wilderness acres in Colorado.[132] The results indicate that passive-use benefits captured by wilderness increased from about $15.3 million for 1.2 million acres up to $35 million for 10 million acres.[133] At all levels of wilderness expansion, passive-use values were a substantial part of the total economic value of wilderness.[134]

A recent study on the value of eastern forests illustrates that passive-use benefits are not limited to western wildlands.[135] Gilbert estimated that eighty-five percent of the respondents' willingness to pay for wilderness in the East was attributed to passive-use existence benefits.[136] People valued the existence of eastern wilderness more than their expected use of the wilderness.[137] These results are consistent with research by Walsh indicating that western residents have an average willingness to pay of $49 to protect unroaded areas.[138] Survey respondents ranked unroaded areas high in use values (e.g., educational and scientific study, as well as for the option to use them in the future) and passive-use, existence values (e.g., protecting species, protecting air and water quality, knowing that natural areas exist for their own sake, and knowing that future generations will have natural areas).[139]

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130. *See* JOHN V. KRUTILLA & ANTHONY C. FISHER, THE ECONOMICS OF NATURAL ENVIRONMENTS: STUDIES IN THE VALUATION OF COMMODITY AND AMENITY RESOURCES 15 (1985).

131. *See* Krutilla, *supra* note 39, at 780–81, 785.

132. *See* Richard G. Walsh et al., *Valuing Option, Existence, and Bequest Demands for Wilderness*, 60 LAND ECON. 14, 16–28 (1984).

133. *See id.* at 25.

134. *See* Walsh & Loomis, *supra* note 39, at 181, 183.

135. *See* A. Gilbert et al., *Valuation of Eastern Wilderness: Extramarket Measures of Public Support*, *in* FOREST SERV., THE ECONOMIC VALUE OF WILDERNESS, *supra* note 13, at 57, 61–62.

136. *See id.* at 61.

137. *See id.* at 57, 61.

138. *See* Richard G. Walsh et al., *Regional Household Preference for Ecosystem Restoration and Sustained Yield Management of Wilderness and Other Natural Areas*, *in* BENEFITS AND COSTS TRANSFER IN NATURAL RESOURCE PLANNING 42, 42 (J. Bergstrom ed., 1996).

139. *See id.*

III. WILDERNESS BENEFITS IN PRACTICE

[I]t is hereby declared to be the policy of Congress to secure for the American people of present and future generations the benefits of an enduring resource of wilderness.[140]

Forest Service employees were early leaders in recognizing the importance of wilderness as a land use designation. In 1919, Arthur Carhart (a landscape architect) 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 made most likely 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."[141]

In 1960, Congress passed the Multiple-Use Sustained-Yield Act (MUSYA),[142] which defined sustained yield as "the achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various renewable resources of the national forests without impairment of the productivity of the land."[143] The passage of MUSYA formally extended sustained yield to include nonmarket, nontimber resources. MUSYA specifically recognized six multiple uses permitted on the National Forests: outdoor recreation, range, timber, watershed, wildlife, and fish.[144] Expanding the definition of sustained yield to include all resources was a persuasive reason for congressional support for MUSYA.[145]

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140. Wilderness Act of 1964 § 2(a), 16 U.S.C. § 1131(a) (1994). This quotation is an example of a policy statement (and enactment) of a long-run value at the institutional level, not necessarily based on a quantified economic efficiency analysis. Economic efficiency analysis strives to maximize benefits, but says nothing about the fairness or equity of how the benefits are distributed. Informed public policy decisions often ignore economic efficiency in favor of equity considerations and due process of law. *See* Peterson Communication, *supra* note 18.

141. Stephen F. McCool & Robert C. Lucas, *Managing Resources and People in Wilderness: Accomplishments and Challenges*, *in* MANAGING AMERICA'S ENDURING WILDERNESS RESOURCE: PROCEEDINGS OF A CONFERENCE, *supra* note 90, at 67.

142. Pub. L. No. 86-517, 74 Stat. 215 (1960) (codified as amended at 16 U.S.C. §§ 528–531 (1994)).

143. MUSYA § 4(b), 16 U.S.C. § 531(b).

144. *See* MUSYA § 1, 16 U.S.C. § 528; CHARLES F. WILKINSON & H. MICHAEL ANDERSON, LAND AND RESOURCE PLANNING IN THE NATIONAL FORESTS 29–30 (1987).

145. *See* OFFICE OF TECH. ASSESSMENT, U.S. CONG. OTA-F-505, FOREST SERVICE PLANNING: ACCOMMODATING USES, PRODUCING OUTPUTS, AND SUSTAINING ECOSYSTEMS 38 (1992) [hereinafter ACCOMMODATING USES].

In 1974, the Forest and Rangeland Renewable Resources Planning Act (RPA)[146] established a strategic planning process at the national level by which the Forest Service would address long range renewable resource conditions structured around four documents: the RPA Assessment, the RPA Program, the Presidential Statement of Policy, and the Annual Report.[147] The RPA Assessment includes willingness to pay estimates for a variety of nonmarket resources produced on the national forest and serves as a source book for agency planners developing management plans for individual national forests.[148] The "RPA values" are used in the forest planning process established under the 1976 National Forest Management Act (NFMA).[149]

The NFMA expanded the multiple-use list, legislatively acknowledging wilderness areas as a multiple-use resource, and established a strategic planning process at the local and national forest level.[150] Planning regulations developed by the agency in response to NFMA included an explicit management objective for the national forest to maximize net public benefits.[151] 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."[152] Estimating net public benefits requires an economic analysis that accounts for the consumer surplus generated by

146. Forest and Rangeland Renewable Resources Planning Act of 1974, Pub. L. No. 93-378, 88 Stat. 476 (codified as amended at 16 U.S.C. §§ 1600–1687 (1994)).

147. The RPA Assessment is produced every ten years and examines resource supply and demand, as well as trends in resource conditions. *See* RPA § 2(a); 16 U.S.C. § 1601(a). The RPA Program is published every five years and establishes a direction for Forest Service management based on trends and opportunities identified in the RPA Assessment. *See* RPA § 3, 16 U.S.C. § 1602. The Presidential Statement of Policy guides the annual budget requests, and the Annual Report assesses Forest Service accomplishments and progress in implementing the RPA Program. *See* RPA § 7(a), (c), 16 U.S.C. § 1606(a), (c); *see also* ACCOMMODATING USES, *supra* note 145 (providing a comprehensive discussion and analysis of Forest Service planning).

148. *See* ACCOMMODATING USES, *supra* note 145, at 9.

149. Pub. L. No. 94-588, 90 Stat. 2949 (codified as amended in scattered sections of 16 U.S.C.). The NFMA was an amendment to the RPA and although primarily a procedural law, NFMA did establish standards and guidelines for planning and resource protection. *Cf.* NFMA § 6, 16 U.S.C. § 1604; *see also* ACCOMMODATING USES, *supra* note 145, at 3. The NFMA also directs the Forest Service to prepare long-term (i.e., 50 years) forest management plans for each national forest, to be revised at least every 15 years. *See* NFMA § 6, 16 U.S.C. § 1604. The NFMA also requires the Forest Service to conduct an economic analysis of forest management alternatives. *See* NFMA § 2, 16 U.S.C. § 1600.

150. *See* NFMA § 6, 16 U.S.C. § 1604.

151. *Cf.* LOOMIS, *supra* note 10, at 43; CINDY SORG SWANSON & JOHN B. LOOMIS, FOREST SERV., U.S. DEP'T OF AGRIC., PNW-GTR 361, ROLE OF NONMARKET ECONOMIC VALUES IN BENEFIT-COST ANALYSIS OF PUBLIC FOREST MANAGEMENT 1 (1996).

152. National Forest System Land and Resource Management Planning, 47 Fed. Reg. 43,026–52 (1982).

wildland resources. Consumer surplus is a subset of net public benefits, and in most forests makes up a large part of the total.[153]

A. *FORPLAN Follies*

The Forest Service chose the FORPLAN linear programming model to help allocate timber and nontimber forest resources in a way that maximized long term net public benefits. FORPLAN functions as a constrained optimization model that allocates resources based on the relative values of various forest resources jointly produced. Whether FORPLAN actually maximizes net public benefits depends on several factors, including: data quality, the variables included in the model, the structure of the model, and the selected constraint set.

1. Structural Problems

An appropriate method for maximizing net public benefits with FORPLAN would be to include nonmarket, wildland benefits in the objective function of the model. This objective function could then be maximized subject to management and resource constraints. During the first round of planning, agency officials made a policy decision and chose not to include nonmarket benefits in the objective function of the FORPLAN model. Instead planners typically ran FORPLAN with an objective function that maximized net present value[154] of marketable commodities (e.g., timber) subject to constraints that attempted to take nonmarket resources into consideration. Including nonmarket resources (preserving endangered species, visual quality, etc.) only as constraints on production implies that sustaining ecosystems is a constraint and not a goal for managing our national forests.[155] Thus, the basic structure of FORPLAN, as modeled during the first round of forest planning, was a questionable approach for maximizing net public benefits.

2. 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 goods and services. For example, developing a FORPLAN model requires information on (1) the response of aquatic populations to harvesting and sediment loading of streams, (2) the response of wildlife populations to forest fragmentation, (3) the impact of logging operations on soil nutrient cycling and carbon sequestra-

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153. *See* LOOMIS, *supra* note 10, at 128–31. From a taxpayer's perspective, consumer surplus generated by a network of wildlands can be viewed as "untaxed" benefits provided by government management of the public estate.

154. Net present value, an economic tool for evaluating forest management alternatives, is calculated by subtracting the discounted management costs from the discounted management benefits. The practice of discounting (the opposite of compounding) is required to compare costs and benefits that occur at different points in time over the 50 year planning period.

155. *See* ACCOMMODATING USES, *supra* note 145, at 135.

tion, and (4) the impact of forest management on watershed protection, visual quality, scenic amenities and existence value. There is simply insufficient research available on basic ecological, economic and sociological responses to forest management activities to construct an accurate and representative model for maximizing net public benefits as required by law. The wildland benefits most easily measured are those associated with recreation. However, there has been a general reluctance on the part of the agency to accept these theoretical values in practice.

3. Wildland Recreation Benefits Reduced

Pursuant to the 1974 RPA, the Forest Service estimates average willingness to pay values for resource outputs for use in developing national forest plans.[156] For the 1985 RPA Assessment, the Forest Service contracted with Sorg and Loomis to conduct a meta-analysis of the nonmarket literature.[157] A panel of formal reviewers was also commissioned to assist them in developing their procedures and to review their results.[158] After publication of the report, Forest Service administrators in Washington, D.C. decided the recreation values estimated by Sorg and Loomis were too high and that some adjustment was needed.[159] When the final 1985 RPA documents were published, the nonmarket recreation benefits were forty-five percent lower than the values estimated by Sorg and Loomis. The adjustment methods used by Forest Service officials were unorthodox at best. According to John Duffield:

> The recreational values selected for the 1985 RPA program were inconsistent with the literature review undertaken by Loomis and Sorg in 1982. The latter, while necessitating considerable judgement, was done to high professional standards. The procedures used by the Forest Service staff to establish the final RPA values included simple but major mechanical errors as well as ad hoc adjustments. The adjustments were unsupported and appear to be at odds with basic economic theory and practice.[160]

Duffield concluded: "The overall picture appears to be one of higher echelon administrators determined to reduce the values assigned to recreation."[161]

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156. The willingness to pay values can be used as coefficients in the FORPLAN model.

157. *See generally* SORG & LOOMIS, *supra* note 50 (detailing the results of their meta-analysis).

158. *See* John H. Duffield, *RPA Values for Recreation: Theory and Practice*, 10 PUB. LAND L. REV. 105, 112 (1989).

159. *See id.* at 115.

160. *Id.* at 128.

161. *Id.* at 120. In defense of the downward adjustment, a Forest Service economist stated that the principal reason for adjusting the values was the inability to represent a collectable price or user fee in a competitive market. *See id.* at 117.

4. Passive-Use Benefits Lack Credibility

For the 1990 RPA, the Forest Service estimated recreation benefits based on two accounting stances, market clearing price and market clearing price plus consumer surplus. In most cases, adding consumer surplus to the market price substantially increased the recreation benefits estimated. For example, the hiking category increased from $3.41 to $22.39 when consumer surplus was included. The 1990 RPA included the following discussion about adding consumer surplus to market clearing prices when measuring economic value:

> This measure of value, typically referred to as the average "willingness to pay" in technical literature, has gained strong support from economic theorists as a concept relevant to many social decisions . . . . Critics of the concept object to it on the basis that is does not represent "real wealth"—that is, money does not change hands. However, most economists agree that consumer surplus is relevant to many social decisions.[162]

Unfortunately, these arguments were not persuasive to national forest planners. For example, on the heavily recreated Nantahala and Pisgah National Forests, planners following policy directives excluded consumer surplus when estimating recreation benefits in the recent plan amendment.[163]

The disdain for nonmarket benefit valuations continues today in national forest management plans[164] and in the recently completed Southern Appalachian Assessment.[165] The Southern Appalachian Assessment estimated recreation benefits using travel costs models. Although travel costs are a reliable method for estimating recreation use benefits of wilderness, they are incapable of capturing passive-use values. The contingent valuation method is the only method available for estimating passive-use benefits.[166] Travel cost studies must be supplemented with contingent valuation studies on passive-use values to capture the full array of wildland benefits.

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162. SAMUELSON, *supra* note 22, at 449.

163. *See* Peter A. Morton, *Review of Stumpage Prices and Recreation*, *in* THE DRAFT SUPPLEMENT TO THE FINAL ENVIRONMENTAL IMPACT STATEMENT FOR THE NANTAHALA AND PISGAH NATIONAL FORESTS 6, 6–7, 18–22 (1992) [hereinafter Morton, *Review of Stumpage Prices*]; Peter A. Morton, Review of the Final Environmental Impact Statement and Management Plan for the Nantahala and Pisgah National Forests 18 (1994) (a report prepared for The Wilderness Society et al.) [hereinafter Morton, Review of the Final Environmental Impact Statement] (on file with author).

164. *See* Morton, *Review of Stumpage Prices*, *supra* note 163, at 18–19; *see also* Loomis, *supra* note 26, at 288–89.

165. *Southern Appalachian Man and the Biosphere*, *in* FOREST SERV., U.S. DEP'T AGRIC., THE SOUTHERN APPALACHIAN ASSESSMENT 18 (1996).

166. *See generally* DANIEL W. MCCOLLUM ET AL., FOREST SERV., U.S. DEP'T AGRIC., THE NET ECONOMIC VALUE OF RECREATION ON THE NATIONAL FORESTS: TWELVE TYPES OF PRIMARY ACTIVITY TRIPS ACROSS NINE FOREST SERVICE REGIONS (analyzing use values based on travel cost statistics); Peter H. Pearse & Thomas P. Holmes, *Accounting for Nonmarket Benefits in Southern Forest Management*, 17 S.J. APPLIED FORESTRY 84 (1993).

The exclusion of passive-use wildland benefits has the potential to bias the allocation of resources during the national forest planning/revision process. This can be illustrated graphically with a production possibility curve (Figure 5). Underestimating wilderness recreation benefits lowers the relative value of wilderness. As a result, the slope of the total benefits line shifts resulting in a change in the production mix. The shift in the total benefits line due to the decrease in the value of recreation 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, hence, acres allocated to wilderness (W') drop.

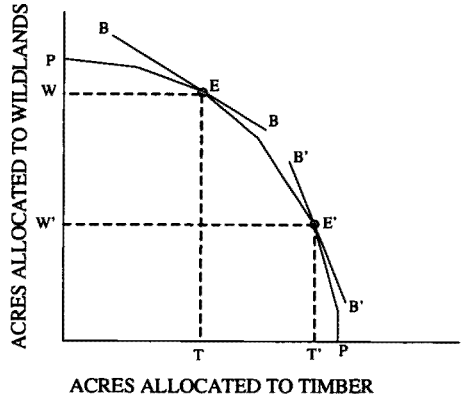

FIGURE 5

Forest Service researchers recently acknowledged the significant passive-use benefits from conserving wildlands in the Pacific Northwest. A Forest Service report on the regional economy of the Interior Columbia Basin provides evidence of the importance of sustaining wildland resources for rural economic development.[167] The authors conclude that "the existence of unroaded areas is by far the most valuable output from FS and BLM-administrated lands in the basin today, and will continue to be so in the year 2045."[168] The same is likely true for wildlands across the nation.

5. Modeler Bias Influenced the "Optimal" Solution

In order to maximize net public benefits, FORPLAN models must have a flexible structure that allows the model to be sensitive to changes in wilderness benefits or demand. Unfortunately, modeler bias can lead to FORPLAN models that are insensitive to changes in wilderness benefits or recreation demand. Botkin and Devine analyzed the FORPLAN

167. *See* Richard W. Haynes & Amy L. Horne, *Economic Assessment of the Basin*, *in* 4 COLUMBIA BASIN ASSESSMENT, *supra* note 116, at 1715.

168. *Id.*

model used to develop the 1985 Chattahoochee National Forest plan.[169] They were interested in how sensitive the model was to changes in the demand and values assigned to semi-primitive recreation. Their hypothesis was that the amount of land allocated to semi-primitive recreation would increase as the demand and value for semi-primitive recreation increased. To test the hypotheses they doubled demand for semi-primitive recreation and increased the value of semi-primitive recreational visitor days (RVD) by a factor of ten. Results of their sensitivity analysis revealed no significant change in resource allocation. The researchers concluded that "the basic FORPLAN management choices were determined by one initial decision: whether to harvest timber."[170] The harvest level was in turn determined by the timber target assigned to the Chattahoochee by the Washington, D.C. office of the Forest Service.[171]

The fact that the timber target drove the solution was a result of both agency and modeler bias. One reason for the insensitivity was that the Chattahoochee FORPLAN model lacked a decision variable allowing semi-primitive nonmotorized acres to increase by closing and obliterating existing roads in the roaded natural areas.[172] Because semi-primitive acres could not be increased by closing roads, the model was insensitive to increase in demand (i.e., did not supply additional semi-primitive acres necessary to meet demand). Planners restricted the management options available even though the forest had an excess of roaded natural lands and a shortage of semi-primitive lands. Botkin and Devine recommend that future planning models include such an option.[173]

6. Asymmetrical Budget Shortfalls

The annual funding level appropriated by Congress provides an indication of the ability of the Forest Service to implement a forest plan. In

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169. *See* M.R. Botkin & H.A. Devine, *Outdoor Recreation Allocation in a FORPLAN Model*, J. FORESTRY, Oct. 1989, at 31, 31–37.

170. *Id.* at 37.

171. The decision to harvest timber is driven by the timber targets (resource goals) selected in the planning process required by the 1974 RPA and the 1976 NFMA. However, the resource goals do not always reflect the productive capability of individual national forests. *See* MICHAEL D. BOWES & JOHN V. KRUTILLA, MULTIPLE-USE MANAGEMENT: THE ECONOMICS OF PUBLIC FORESTLANDS 120 (1989). Timber targets not only force a significant amount of land into timber production that will require a public subsidy to bring the wood to market. Timber targets also impact wildland resource allocation by significantly influencing the FORPLAN model. When congressionally assigned timber targets drive the allocation of public resources on the national forests, the ability of the agency to maximize net public benefits is doubtful.

172. When confronted with both the high timber target assigned and the increased value for semiprimitive recreation, the Chattahoochee FORPLAN model reacted in a strange way. As semi-primitive recreation values were increased, volume of old growth harvested in semi-primitive areas increased. In other words, as the benefits of wild recreation increased, the naturalness, the acres of old-growth, and the degree of solitude in the wild decreased!

173. *See* Botkin & Devine, *supra* note 169, at 37.

general, the funding received by the Forest Service has been less than the budgets required to fully implement forest plans.[174] The overall budget shortfall was not passed onto resource programs in a symmetrical manner. For example, the recreation programs on the southern Appalachian national forests received approximately forty-seven percent of the planned budget.[175] In contrast, the timber program received ninety-seven percent of the planned budget.[176] The lower-than-planned recreation funding has led to a tremendous backlog of new trail construction and thousands of miles of trails in need of reconstruction or maintenance.[177]

Budget shortfalls directly influence the benefits jointly produced by national forests. This influence 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. When appropriated budgets are less than planned budgets, the production potential of a national forest as modeled with FORPLAN is reduced and the production possibility curve shifts in toward the origin (line segment P'P' in Figure 6).[178] As a result of this shift and holding relative benefits constant, less timber (T') and fewer acres of wild recreation (W') will be produced.

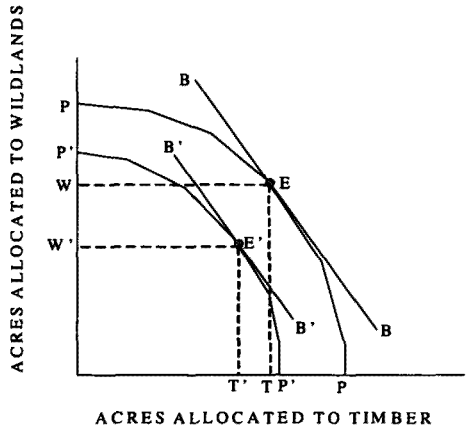

FIGURE 6

174. *See* U.S. GEN. ACCT. OFF., GAO/RCED-91-115, FOREST SERVICE: DIFFICULT CHOICES FACE THE FUTURE OF THE RECREATION PROGRAM 3 (1991).

175. *See* Peter A. Morton, *Sustaining Recreation Resources on the Southern Appalachian National Forests*, J. OF PARK & RECREATION ADMIN., Winter 1997, at 61, 62 (1997) [hereinafter Morton, *Sustaining Recreation*].

176. *See id.* The asymmetrical budget shortfalls could be a result of Forest Service managers acting as budget maximizers and responding to the managerial budget incentives tied to logging and "getting the cut out." O' TOOLE, *supra* note 196, at 56. The asymmetrical budget shortfalls could also be a result of the agency inadvertently emphasizing a financial analysis when evaluating management alternatives. Or, the asymmetrical shortfalls could be a result of conscious policy decisions made by agency officials that revenue produced by timber was more important to national welfare than benefits produced by recreation. *See* Peterson Communication, *supra* note 18.

177. *See* THOMAS HARVEY & STEPHEN HENLEY, AMERICAN HIKING SOC'Y, THE STATUS OF TRAILS IN NATIONAL FORESTS, NATIONAL PARKS, AND BUREAU OF LAND MANAGEMENT AREAS (1989).

178. *See* Morton, *Sustaining Recreation*, *supra* note 175, at 63.

Without acknowledging budget constraints and the asymmetrical reduction in programmatic budgets, the net public benefits estimated with FORPLAN are illusory and will not be attained. The shift in production brought about by the budget shortfalls created public dissatisfaction when national forest recreational opportunities and timber supplies were less than planned. As such, the failure to adequately consider budgets during the first round of forest planning may have exacerbated the tension between the agency, timber purchasers, and environmentalists.

B. *Technical and Procedural Errors Occurred*

Research by Loomis also revealed that past Forest Service analysis in Regions 1 and 2 were biased against wilderness designation because planners incorrectly valued wilderness recreation use.[179] Forest Service procedures failed to account for the economic benefits from all forms of recreation taking place in wilderness.[180] Rather than classifying and valuing wilderness recreation based on activities actually occurring in wilderness (e.g., hunting, fishing, backcountry camping, etc.), planners valued all forms of recreation based on the RPA value for the wilderness recreation category. RPA "willingness-to-pay" estimates for the wilderness recreation category are much less than the RPA estimates for the hunting and fishing categories. By failing to account for the higher valued recreation activities (e.g., hunting and fishing) jointly produced by wilderness areas, wilderness benefits were significantly underestimated, generally resulting in biases against wilderness designation.[181]

Loomis also reported substantial technical errors in Forest Service procedures used to conduct economic analysis of wilderness study areas.[182] The technical errors included valuing recreation use based on estimated recreation capacity rather than actual recreation use. Morton reported a similar error when agency procedures required planners to use projected demand (constrained by carrying capacity), instead of actual visitation, to estimate the benefits of wilderness recreation. In this case, wilderness recreation benefits were significantly underestimated because, at the time, actual wilderness visitation was five times greater than esti-

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179. *See* John B. Loomis, *Economic Efficiency Analysis, Bureaucrats, and Budgets: A Test of Hypotheses*, 12 W. J. AGRIC. ECON. 27, 29 (1987) [hereinafter Loomis, *Economic Efficiency*]; John B. Loomis, *Importance of Joint Benefits of Wilderness in Calculating Wilderness Recreation Benefits*, *in* FOREST SERV., THE ECONOMIC VALUE OF WILDERNESS, *supra* note 13, at 17 [hereinafter Loomis, *Joint Benefits*].

180. The agency also tends to analyze hunting and fishing independently of recreation when it comes to estimating recreation carrying capacity. As a result, visitation to wilderness areas (use density—RVDs/acre/year) is underestimated in forest planning. *See* Morton, *Charting a New Course*, *supra* note 63, at 65. The impact of hunting season, for example, on wilderness carrying capacity may be significant but ignored. Hunting and fishing occur in wilderness areas and should be analyzed with other forms of wildland recreation, since they most certainly impact each other.

181. *See* Linda L. Langner, *Use of Wilderness Values in Forest Service Policy and Planning*, *in* FOREST SERV., THE ECONOMIC VALUE OF WILDERNESS, *supra* note 13, at 239, 341–42.

182. *See* Loomis, *Economic Efficiency*, *supra* note 179, at 29.

mated carrying capacity.[183] Botkin and Devine also reported asymmetrical accounting of timber and recreation benefits by planners on the Chattahoochee National Forest.[184] Whereas planners accounted for the benefits of surplus timber production in excess of estimated demand, surplus production of recreation in excess of estimated demand was assigned a value of zero dollars.

C. *Demand for Wilderness Recreation Underestimated*

The 1992 draft revised management plan for the George Washington National Forest (GWNF) included an analysis of the supply and demand for wilderness.[185] Forest Service planners projected the demand for wilderness over the fifty-year planning period. Morton compared the Forest Service projections with three alternative indices for estimating future wilderness demand on the GWNF.[186] The three alternative indices were based on the 1990 RPA wilderness use projections, the 1990 RPA projections for day hiking (as day hiking was the dominant use in these wilderness areas) and historic visitation trends for wilderness on the GWNF. The results of the comparison revealed that in all three cases the wilderness demand estimated with the alternative indices was greater than the demand projections of Forest Service planners. These results strongly suggest that future wilderness demand on this national forest was underestimated during forest planning.

In the wilderness recreation analysis included in the 1992 *Draft Supplement to the Final Environmental Impact Statement for the Nantahala and Pisgah National Forests*,[187] planners admitted that the current demand for wilderness could not be met by existing wilderness areas. The agency assumed "excess" wilderness demand would be satisfied by wilderness-like settings in semi-primitive nonmotorized (SPNM) areas.[188] In order for SPNM areas to meet the excess demand for wilderness recreation, projected visitation must stay within the carrying capacity for wilderness areas over the fifty-year planning horizon. A review of the data in the *Draft Supplement to the Final Environmental Impact State-*

183. The density of wilderness use (visits per acre per year) can be estimated by dividing annual wilderness use by total wilderness acres. In this case, current wilderness density on the Nantahala and Pisgah National Forests was 2.4 RVDs per acre per year, whereas planners on another southern Appalachian national forest estimated a wilderness carrying capacity of only 0.487 RVDs per acre per year. *See* Morton, Review of the Final Environmental Impact Statement, *supra* note 163.

184. *See* Botkin & Devine, *supra* note 169, at 33–34.

185. *See* FOREST SERV., U.S. DEP'T AGRIC., GEORGE WASHINGTON NATIONAL FOREST: DRAFT REVISED LAND MANAGEMENT PLAN (1992).

186. *See* Peter A. Morton, *Analysis of the Supply and Demand for Wilderness Recreation, in* THE FINAL ENVIRONMENTAL IMPACT STATEMENT FOR THE GEORGE WASHINGTON NATIONAL FOREST (1993) (a report prepared for The Wilderness Society et al.).

187. FOREST SERV., U.S. DEP'T AGRIC., DRAFT SUPPLEMENT TO THE FINAL ENVIRONMENTAL IMPACT STATEMENT FOR THE NANTAHALA AND PISGAH NATIONAL FORESTS (1992).

188. Semi-primitive nonmotorized areas represent a land classification category of the Recreation Opportunity Spectrum (ROS). ROS categories range from urban to primitive environments, and are used by planners to categorize the recreation settings occurring on public land.

ment revealed that SPNM demand exceeded the carrying capacity during the second decade of the planning horizon.[189] In response to these comments, planners updated the recreation analysis for the *Final Supplement to the Final Environmental Impact Statement*,[190] but completely dropped the analysis of wilderness recreation. The policy decision to omit practically all discussion of wilderness recreation supply, demand, and carrying capacity obviously draws into question the adequacy of the recreation analysis in the *Final Supplement to the Final Environmental Impact Statement.*

D. *Stumpage Price Trends Overestimated*[191]

In order to evaluate forest plan alternatives and maximize net public benefits, Forest Service planners must generate fifty-year forecasts of the economic costs and benefits associated with forest management. For the timber program, stumpage prices over a fifty-year period must be estimated in order to schedule timber harvest, determine the suitable timber base, estimate revenue from the timber program, and estimate net public benefits with the FORPLAN model. Accurately estimating future stumpage prices is an important wilderness issue because projections of higher stumpage prices increase the suitable timber base and encourage logging in roadless areas. Higher stumpage prices provide the agency with financial justification to incur road costs and log more extensively, including marginally productive and steeply sloped lands in wild areas.

Accurately estimating future stumpage prices is an important economic issue because price trends have a significant effect on the financial returns estimated for the timber program.[192] If planners overestimate future stumpage prices, for example, future timber revenues, the allowable sale quantity, and the suitable base will be overestimated. Planners, under pressure to financially justify elevated allowable timber sale quantities and meet timber targets, have an incentive to inflate future stumpage prices.

Pressure on planners and economists to generate positive price trends is evident from the recent forest planning effort on the Nantahala-Pisgah National Forest in North Carolina. In order to estimate stumpage price trends for the southern Appalachian national forests, the Forest Service published the Southern Appalachian Timber Study.[193] The authors of the report concluded that real stumpage price trends were de-

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189. *Cf.* Morton, *Review of Stumpage Prices*, *supra* note 163.

190. FOREST SERV., U.S. DEP'T AGRIC., FINAL SUPPLEMENT TO THE FINAL ENVIRONMENTAL IMPACT STATEMENT FOR THE NANTAHALA AND PISGAH NATIONAL FORESTS (1994).

191. Stumpage price refers to the value of standing timber in a forest.

192. The land brought into the suitable timber base as a result of overestimating stumpage prices is typically the marginal land for timber production. Bringing marginal land into timber production should be a concern for managers and is a questionable investment of taxpayer money.

193. *See generally* DE STEIGUER ET AL., *supra* note 30 (detailing the results of the Southern Appalachian Timber Study).

clining, and that "demand has not kept pace with supply."[194] Agency officials made a policy decision to ignore the results, and instead contracted another study that used a regression[195] model to estimate stumpage price trends on the Nantahala-Pisgah. The regression was calibrated with timber sale data over a thirteen-year period (1979–1991), a time of largely declining stumpage prices. The regression was then used to project stumpage prices for fifty years (1992–2040), assuming that to be a period of increasing prices.[196] The drastic turnaround projected for Nantahala-Pisgah stumpage prices is illustrated in Figure 7. Close scrutiny of the regression equations revealed several problems.[197]

ACTUAL (1979–1991) AND PREDICTED (1992–2040) STUMPAGE PRICE FOR LOW VALUED HARDWOODS ON THE NANTAHALA-PISGAH NATIONAL FOREST[198]

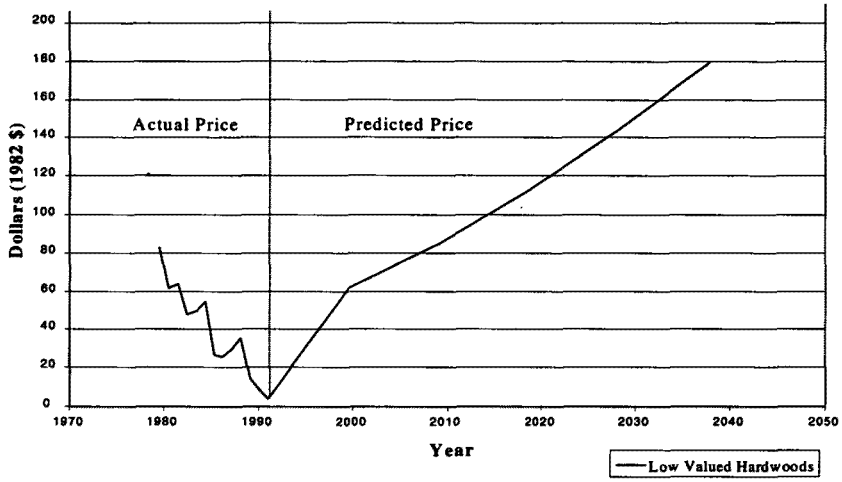

FIGURE 7

194. *Id.* at 41.

195. A regression equation attempts to establish a functional relationship by using independent variables to predict the value of a dependent variable. In this case, timber sale characteristics such as volume for each species and contract length (independent variables) were used to estimate future stumpage prices (the dependent variable).

196. Using data from a generally declining market to forecast prices in an increasing market is problematic as lumber price elasticities estimated during a declining market probably do not apply in a rising market. The fact that stumpage prices fell at a faster rate than lumber prices in a declining market does not guarantee that stumpage prices will increase at a faster rate than lumber prices in a rising market—especially over a 50 year period.

197. The regression equations included statistically insignificant variables and suffered specification problems because relevant independent variables were omitted from the regressions. By assuming that stumpage prices would increase at a faster rate than lumber prices, planners projected higher stumpage prices than most purchasers would be willing to pay. For example, after 50 years, stumpage costs for low-valued species equaled 90% of the lumber price, leaving purchasers only a 10% margin to cover transportation and conversion costs, let alone a decent profit. *See* Morton, *Review of Stumpage Prices*, *supra* note 162, at 6.

198. Data reflected in Figure 7 is taken from the DRAFT SUPPLEMENT TO THE FINAL ENVIRONMENTAL IMPACT STATEMENT FOR THE NANTAHALA AND PISGAH NATIONAL FORESTS, *supra* note 187.

The most significant problem with stumpage price trends in general, is that estimating long term price trends with short term data is econometrically indefensible.[199] On the Nantahala-Pisgah, thirteen years of data were used to calibrate the stumpage regressions in order to estimate fifty-year price trends. However, the reliability of a regression based model decreases as the forecast goes beyond the range of data used in calibrating the regression equation. If the regressions were reliable, planners could be fairly confident using the stumpage price trends for an equivalent time period. After thirteen years, however, the opposite is true; the confidence interval becomes increasingly wide and the reliability of the regression equation decreases. The stumpage regression equations, as specified, had relatively low explanatory power to begin with, and it gets much worse after fifteen years. There is simply too much variation to accurately forecast fifty-year price trends with thirteen years of data.[200] The tendency of the agency to overestimate stumpage price trends is not an isolated problem and has provided the agency with financial justification for building roads and logging semi-primitive non-motorized (i.e., roadless) areas on many national forests.

The models used by the Forest Service to project stumpage prices have a history of overestimating future stumpage prices. Clawson, after reviewing the approximately decennial Forest Service timber projections since 1909, found that every one of them projected consumption outstripping production.[201] A comparison of price projections made in the 1980 and 1985 RPA documents reveal that in both, projected prices were overestimated when compared to actual prices.[202] The persistent trend among studies which have forecasted upward price trends is that "each succeeding report forecasts somewhat lower future prices than its predecessor."[203]

While price trends for stumpage have been exaggerated, price trends for wildland benefits have been nonexistent. As a result, past public land management decisions have been biased against nonmarket benefits, including wilderness and biodiversity conservation. This again draws into question whether Forest Service management maximizes net public benefits.

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199. Econometrics is the study of the application of statistical methods to the analysis of economic data.

200. *See* Morton, Review of the Final Environmental Impact Statement, *supra* note 163. The stumpage price projections used in the FEIS were adjusted downward from the projections included in the DEIS.

201. *See* Marion Clawson, *Forests in the Long Sweep of American History*, 204 SCIENCE 1168, 1172 (1979).

202. *See* RANDAL O'TOOLE, REFORMING THE FOREST SERVICE 56 (1988).

203. Perry Hagenstein, *Forests, in* NATURAL RESOURCES FOR THE 21ST CENTURY 78, 93 (R. Neil Sampson & Dwight Hair eds., 1990).

IV. DISCUSSION

> *The Wilderness Society is, philosophically, a disclaimer of the biotic arrogance of homo americanus. It is one of the focal points of a new attitude—an intelligent humility toward man's place in nature.*[204]

Natural resource economists have made theoretical advances in estimating the benefits of wilderness, but many of the goods and services generated by wildlands are currently beyond quantification. While examples from only a few national forests were presented here, it appears that wildland benefits had poor credibility and/or were ignored by Forest Service decision makers.[205] When nonmarket benefits are excluded, the economic value of a wildland network is underestimated and the allocation of forest resources becomes biased towards timber production. As Duffield notes:

> In the past, economic evaluation 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. This has been in part because of the difficulty of placing a value on the service flows that are not traded in a market.[206]

Forest Service policy decisions continue to exclude passive-use benefits associated with wildland conservation despite the growing body of literature suggesting that these benefits are significant.[207] In addition, a blue ribbon panel, including two Nobel Prize-winning economists, concluded that carefully designed and implemented CVM studies produce

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204. Aldo Leopold, *Why the Wilderness Society?*, 1 LIVING WILDERNESS 1,1 (1935).

205. The use of the word "ignore" implies neglect, or a refusal to take notice of wildland benefits on the part of agency decision makers. This may or may not be the case. Failure of policy decisions to be sensitive to consumer surplus may not reflect a deliberate choice by the Forest Service to ignore consumer surplus—policy decisions often contradict the economic facts. For example, policy decisions often sacrifice economic efficiency in order to achieve social equity objectives. Did the Forest Service ignore wildland values because of fallacious logic, ignorance of the fact, or did agency officials adequately consider the values in question and then consciously decide on other policy directions that make it appear as if wildland values were ignored? The results presented here provide some insight to these questions. Duffield's commentary on agency administrators "determined to reduce the values assigned to recreation" would suggest that fallacious logic was used by agency officials to adjust RPA values. *See* Duffield, *supra* note 158, at 112. Deceptive logic could also have contributed to the timber bias in the FORPLAN model examined by Botkin and Devine. *See* Botkin & Devine, *supra* note 169, at 33–34. The other problems cited about the FORPLAN model are more likely a result of policy decisions that considered wildland values but chose to not allow them to determine choice after having considered them. To more fully investigate answers to these questions, see generally MICHAEL FROME, THE FOREST SERVICE (1984); PAUL W. HIRT, A CONSPIRACY OF OPTIMISM: MANAGEMENT OF THE NATIONAL FORESTS SINCE WORLD WAR II (1996); O'TOOLE, supra note 202.

206. John W. Duffield, *Total Valuation of Wildlife and Fishery Resources: Applications in the Northern Rockies, in* FOREST SERV., THE ECONOMIC VALUE OF WILDERNESS *supra* note 13, at 97.

207. *See* Loomis & Walsh, *supra* note 13, at 81.

reliable information for judicial and administrative decisions involving passive-use or existence values.[208]

As Loomis and Walsh note:

> While the theory that wilderness preservation provides more than just on-site recreation benefits is over 25 years old (starting with Weisbrod in 1964 and Krutilla in 1967), it bears repeating as 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.[209]

By solely relying on recreation use values, the total economic value of wilderness will be severely underestimated during the national forest planning process.[210] In general, the Forest Service's planning process is biased towards timber, ignores nonmarket values and gives little attention to sustaining ecosystems.[211]

By excluding consumer surplus, the economic benefits of wildland recreation, for example, are biased downward. The downward bias in wildland recreation benefits is reflected in forest plans, annual reports, and Timber Sale Program Information Reporting System (TSPIRS) reports,[212] and results in the recreation and wilderness programs being shortchanged in the budgeting process. Much of the expanded interest in nonmarket valuation came as a result of growing pressure from both inside and outside government for improving the criteria used to base public expenditure decisions.[213]

Reasons that consumer surplus has poor credibility with public decision makers include (1) analysts sometimes measure and apply consumer surplus incorrectly; (2) consumer surplus is money not spent or captured as revenues and therefore not taxable; and (3) giving credence to consumer surplus tends to justify government expenditures that do not produce direct revenue.[214] While consumer surplus is a valid and fundamen-

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208. *Cf.* Loomis, *supra* note 26, at 229.

209. Loomis & Walsh, *supra* note 13, at 81.

210. *See* Langner, *supra* note 181, at 240.

211. *See* ACCOMMODATING USES, *supra* note 145, at 38.

212. TSPIRS is the Forest Service's annual effort to provide an accurate accounting of the benefits and costs of national forest management.

213. *See* Walsh et al., *supra* note 51, at 1–5.

214. *Cf.* Peterson, *supra* note 15, at 87. At a recent meeting attended by the author, a Forest Service economist noted that "you can't buy a beer with consumer surplus." That sentiment succinctly sums up the criticism of nonmarket benefits. Even this criticism is misplaced, however, since by definition consumer surplus is money you would have paid but did not have to pay. *See* E-mail from John Loomis, Professor of Economics, Colo. St. Univ., to Pete Morton, The Wilderness Society (Oct. 1998) (on file with author) [hereinafter Loomis Communication]. As such, consumer surplus can be viewed as income retained in your wallet and available to buy beer.

tal concept of the economic profession,[215] the fact that Forest Service policy decisions excluded consumer surplus and nonmarket benefits in national forest planning is indicative of the historical timber bias in the agency. The recent acknowledgment of the large magnitude of existence benefits from roadless areas in the Interior Columbia Basin[216] is significant and encouraging, and will hopefully influence policy decisions in the upcoming round of forest plan revisions.

Incorporating consumer surplus and wildland benefits into forest planning may help correct the timber biases present in the FORPLAN models used during the first round of forest planning. However, the actual shift in resource allocation will depend on the sensitivity of the FORPLAN model to an increase in wildland benefits. Past FORPLAN models have been unresponsive to wildland benefits because (1) wildland benefits, if considered at all, were included as constraints in the model, not in the objective function; (2) inflated stumpage price trends biased the "optimal" solution toward timber production; and (3) agency and modeler bias prevented FORPLAN from responding to increasing wildland benefits as the timber target dominated the allocation of resources.

Perhaps the most significant problem with FORPLAN (not yet discussed) is the model's lack of spatial resolution. In most cases, it is simply not possible to implement the FORPLAN-generated management plan out in the forest. This is a significant shortcoming as the juxtaposition of wildlife forage, hiding cover, thermal cover, and birthing areas are critical to the viability and productivity of wildlife populations. Sustaining biodiversity, the ecological services, and passive-use benefits of a public wildland network requires a spatially explicit model and management plan.

A. *Why a Network of Public Wildlands?*

1. Biodiversity Conservation

In 1990, the Environmental Protection Agency cited the accelerating loss of biodiversity through habitat loss and forest fragmentation as one of the principal threats to human welfare. Biodiversity is our "green infrastructure," our living natural capital, necessary to sustain our life-support systems, but undervalued by private markets. The main reasons why the value of biological diversity may not be adequately represented in formal markets are inadequate information and incomplete markets.[217] If markets are incomplete, prices and market demands are misleading or unrevealing about economic values. Market value (i.e., price) depends on accurate information and knowledge, which is currently very limited for

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215. *See generally* JUST ET AL., *supra* note 22, at 68–84; SAMUELSON, *supra* note 22, at 456–57.

216. *See* Haynes & Horne, *supra* note 68.

217. *See* Randall, *supra* note 96, at 20–23.

biological resources. Without adequate information, it is difficult to quantify the benefits of biodiversity, let alone the long term costs to future generations from the irreversible loss of that diversity.

The irreversible impact of species extinction, scientific concern over the loss of biodiversity, poor biological inventories, and inadequate information on the economic benefits of conserving wildland resources form a strong argument for a network of wildlands on the public estate. An expanded wildland reserve system is necessary if managers are to conserve biodiversity. Davis found that 157 of the United States' 261 ecosystem types recognized by Bailey were included in the national wilderness system.[218] A wildland network with full representation of ecosystem types will serve as a "coarse filter" for conserving biodiversity, as well as a continuous source of information on the structure, function, and composition of natural communities.[219]

Wildlands serve a vital short term role in the conservation of imperiled elements of biodiversity. The loss of habitat is the primary cause of species endangerment in the United States (e.g., northern spotted owl and the red-cockaded woodpecker). The protection of habitat in wildland reserves is a prudent defense against the further loss of biodiversity. Wildland reserves are not simply part of a short term strategy, they will continue to be essential long after a functional landscape has been restored. A wildland network will always be needed for the conservation of "wilderness species," such as grizzlies, wolves, and caribou, that do not tolerate contact with humans. Perpetual wildland reserves are also the most practical means of conserving rare, slow changing elements of the landscape, such as late successional forests.[220]

Developing networks of representative habitat has been recommended as an efficient means of conserving biodiversity.[221] Focusing conservation efforts at the community or landscape level is more cost effective than focusing on individual species. Once a species is endangered, conservation efforts become prohibitively expensive. Establishing reserves is proactive and provides economies of scale by sustaining habitat for a suite of species. On-site conservation efforts in wildlands are also more efficient than seed banks or botanical gardens.[222] On-site

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218. *See* G.D. Davis, *Ecosystem Representation As a Criterion for World Wilderness Designation*, WILD WINGS FOUND. (1987); Robert G. Bailey, *Description of the Ecoregions of the United States*, *in* FOREST SERV., U.S. DEP'T AGRIC., MISC. PUB. 1391 (1980).

219. Given the underrepresentation of ecosystem types, expanding the wildland network to include additional habitats and communities will have high economic value at the margin.

220. *See* Aplet, *supra* note 88.

221. *See generally* Reed F. Noss, *Indicators for Monitoring Biodiversity: A Hierarchical Approach*, 4 CONSERVATION BIOLOGY 355 (1990).

222. *Cf.* Bruce Alyward, *Appropriating the Value of Wildlife and Wildlands*, *in* ECONOMICS FOR THE WILDS: WILDLIFE, DIVERSITY AND DEVELOPMENT 34, 56–61 (Timothy M. Swanson & Edward B. Barbier eds., 1992).

conservation allows evolutionary forces to continue, maintaining the dynamic nature of an ecosystem's biological resources. Seed banks, although needed and useful, represent only a one time snapshot of biological resources. The benefits to society from protecting wildland habitat include not only savings in storage costs and future benefits from the use of biodiversity, but also the avoidance of restoration costs. Restoration is typically more expensive than conservation, and that assumes that restoration is even possible.

The National Forest Management Act of 1976[223] requires the Forest Service to "provide for a diversity of plant and animal communities."[224] Federal lands have the potential to conserve biological resources by providing wildland habitat for species that cannot survive in the market-driven, fragmented landscape on private lands. Conserving wildland habitat on public land could also benefit private landowners. If habitat protection on public wildlands keeps species from becoming threatened or endangered, pressures on private landowners to provide habitat will decrease, possibly obviating the need for land use restrictions on private land. Given increasing concerns over private property rights, this benefit may be significant. If public lands fail to provide ample habitat for certain neotropical songbirds or salamanders, for example, private landowners whose land contains critical habitat may face restrictions on future land use.[225]

2. Wild Recreation

When Congress passed the Wilderness Act, wilderness visitation was so low that little attention was given to recreation demands. If, however, projections for natural resource based outdoor recreation are indicative of the future, national forests must be managed with more emphasis on dispersed recreation.[226] Primitive camping and backpacking, hiking and horseback riding, nature study, and wildlife observation are all projected to have large shortages. Many of these recreation activities are jointly produced by wilderness areas.[227]

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223. Pub. L. No. 93-378, 88 Stat. 477 (codified as amended in scattered sections of 16 U.S.C.).

224. NFMA § 6, 16 U.S.C. § 1604.

225. *See generally* Morton et al., *supra* note 93.

226. *See* H. Ken Cordell et al., *An Analysis of the Outdoor Recreation and Wilderness Situation in the United States: 1989–2040*, *in* FOREST SERV., U.S. DEP'T AGRIC., TECHNICAL DOCUMENT SUPPORTING THE 1990 RPA ASSESSMENT 99 (1990).

227. Forest Service recreation visitation data have been criticized as being unreliable and lacking the spatial resolution required to monitor and disperse recreation use. *See* Robert C. Lucas & Stephen F. McCool, *Trends in Wilderness Recreation Use: Causes and Implications*, 14 WESTERN WILDLANDS 15, 15–21 (1988). The Forest Service maintains recreation visitation information in the Recreation Information Management System (RIM). Morton examined RIM data and found wild fluctuations in annual visitation reported for several wilderness areas in the southern Appalachian. *See* Morton, *Review of Stumpage Prices*, *supra* note 163. For example, wilderness use on the Cheoah Ranger District ranged from 45,000 RVDs in 1987, to zero RVDs in 1988, to 49,000 RVDs in 1989, and back to zero in 1990 and 1991. The drop in wilderness visitation was a result of poor data col-

As total recreational use increases, the kind of recreation in demand is evolving. The unprecedented rise in the demand for adventure based recreation[228] is an example. The increasing demand for wild recreation is readily apparent with the increased popularity of rock climbing, rafting, kayaking, backcountry hiking, skiing, and camping. Wild recreation is a distinct type of outdoor recreation experience consistent with the theory of recreation specialization. Recreation specialization is characterized by the evolution of recreational preferences toward more natural settings that hold greater challenges for enhanced skills and experience.[229] Using fishing as an example, the beginning angler may simply want to catch as many fish as possible by whatever means necessary; a seasoned veteran may release all catches, fly fish only, and prefer wild fish to stocked varieties. Each qualifies as an angler, but each seeks a different experience. The beginner desires quantity while the veteran wants a quality experience. The general thought is that people begin recreating as generalists and evolve along the continuum towards a specialist.[230]

The attraction of wilderness for adventure recreation is based on the combination of the remoteness of the setting, the demands on one's abilities to be self-sufficient, and the skills necessary to succeed in the activity.[231] The implications for public land managers, regarding the fishing example, are that developed stream sites and reservoirs stocked with hatchery-raised fish can help meet the demand for a quantity fishing experience, while wilderness and other undeveloped areas available on public land provide an opportunity for the specialized anglers, who seek a wild experience, a chance to fish a wild remote stream in search of native fish. Across the nation, public wildlands provide the majority of wild fishing opportunities.

Whether anglers, hunters, campers, or hikers demand a more primitive, adventure oriented recreational experience, public wildlands may be the only place that can fill this niche. The majority of remaining wildland exists in the public estate, and private wildlands are increasingly restricting access. The potential of private land to supply the full range of

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lection not lack of demand. The accuracy of RIM data is very questionable. In order to accurately value the recreation benefits jointly produced by wilderness better visitation data are needed. *See* Loomis, *Joint Benefits*, *supra* note 175, at 23. The need for better visitation data also applies to the BLM. *Cf.* Loomis Communication, *supra* note 214. Research increasingly suggests that recreation is not a benign activity. *See* WILDLIFE AND RECREATIONISTS: COEXISTENCE THROUGH MANAGEMENT AND RESEARCH 340–344 (Richard L. Knight & Kevin J. Gutzwiller eds., 1995). As such, improving the temporal accuracy and spatial resolution of recreation data collection and monitoring is a prerequisite for adaptively managing a sustainable recreation program. *See* Morton, *Sustaining Recreation*, *supra* note 176, at 71. Recreation data collection and monitoring programs also create additional employment opportunities for local residents.

228. *See* Alan Ewert & Steve Hollenhorst, *Testing the Adventure Model: Empirical Support for a Model of Risk Recreation Participation*, 21 J. LEISURE RES. 124, 125 (1989).

229. *Cf.* Manning, *supra* note 48, at 121.

230. *See* HOBSON BRYAN, CONFLICT IN THE GREAT OUTDOORS: TOWARD UNDERSTANDING AND MANAGING FOR DIVERSE SPORTSMEN PREFERENCES 59–86 (1979).

231. Alan Ewert, *Risk Creation Poses New Management Problems*, 8 PARK SCI. 1, 7 (1987).

recreation opportunities is limited by liability concerns, access, the desire for privacy, and development.[232] National trends indicate greater restrictions on recreation access to private lands; increased restrictions on private land translate into greater recreational pressures on public land. Public lands provide the wildland setting undersupplied by private markets, but treasured by wild recreationists of all ages.

3. Market Failure

The growing scarcity of wildland resources has increased the public's desire to protect what remains, while the relative abundance of wood products has left the public indifferent to concerns about timber supply. This indifference is partially a result of an abundant wood supply and global market influences that have kept the real price of wood low or decreasing. The abundant supply is a result of investors responding to timber markets and profit incentives. Substantial financial investments have been made in the southeast United States, New Zealand, and Brazil, for example, partially in response to concerns over a "timber famine" and projected increases in lumber prices.

Market responses to rising prices include (1) investment in timber management by private landowners—who own sixty-one percent of the forest land in the United States; (2) the use of substitutes by producers—e.g., kenaf, hemp, or stuffing pulp fibers with calcium carbonate which reduces by twenty percent the number of trees required; (3) preference shifts by consumers toward recycled products; and (4) technological advances that improve the efficiency of the wood products industry. In the past, price projections have not been realized because the projections underestimated eventual production.[233] Technological investments in response to price signals stretched the timber supply and moderated price increases. However, nontimber resources are without the market prices necessary to reflect increasing scarcity. Without price information to reflect scarcity, market adjustments similar to those for timber will not occur for wildland resources. This is an example of what economists call market failure.[234]

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.[235] In the presence of a market failure, price breaks down as an efficient measure of social values, financial

232. *See generally* B. Wright et al., Industrial and Nonindustrial Resources (1988) (paper prepared for the Benchmark 1988: A National Outdoor Recreation and Wilderness Forum).

233. *See generally* William F. Hyde & David H. Newman, Forest Economics and Policy Analysis: An Overview (1991) (World Bank Discussion Paper) (on file with author).

234. Market failures occur when (1) competition is not perfectly competitive; (2) information is imperfect; (3) public goods are involved; or (4) when external costs or benefits (unintended consequences) are not considered in market transactions.

235. *Cf.* Alan Randall, *The Problem of Market Failure*, 23 NAT. RESOURCES. J. 131, 131–48 (1983).

profits do not reflect net social benefits, and markets do not allocate resources in an economically efficient manner.[236] In forestry, the benefits of 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, i.e., not to provide adequate protection of nonmarket forest resources.[237] As Cubbage notes:

> 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.[238]

"Markets diverge in so many ways from the conditions necessary to achieve maximum social benefit that we cannot rely solely on markets to determine the allocation of [forest] resources."[239] 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.[240]

One of the reasons why market adjustments are less likely to occur for nontimber forest resources is because technological advances are not symmetrical: technology is biased toward commodity extraction and marketable goods and services.[241] While technology can be expected to increase the supply of timber, technology is unlikely to increase the supply of wilderness. Wildlands are natural environments, gifts of nature, not producible by man.[242] 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.

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236. *See* Daniel W. McCollum et al., *A Manager's Guide to the Valuation of NonMarket Resources: What Do You Really Want to Know?*, *in* VALUING WILDLIFE RESOURCES IN ALASKA 25, 27 (George L. Peterson et al. eds., 1992).

237. *See* JOHN A. DIXON & PAUL B. SHERMAN, ECONOMICS OF PROTECTED AREAS: A NEW LOOK AT BENEFITS AND COSTS 193–200 (1990).

238. FREDERICK W. CUBBAGE ET AL., FOREST RESOURCE POLICY 71 (1993).

239. PEARSE, *supra* note 14, at 38.

240. *Cf. id.* Three key factors led society to advocate retention over the public estate: (1) concern of the abuses and fraud associated with land disposal programs (i.e., government failure); (2) desire to preserve unique scenic and geologic wonders (nonmarket justifications); and (3) perhaps most importantly, public outrage at the shortsighted destructive influence of human activity on the land (responding to market forces) and the potential for resource shortages (i.e., timber famine). *Cf.* LOOMIS, *supra* note 10, at 24–25.

241. *See* KRUTILLA & FISHER, *supra* note 130, at 85–86.

242. *See id.*

Technological changes in the timber industry have stretched the supply and kept stumpage prices consistently lower than projected by the Forest Service. The asymmetric impact of technology is likely to increase wildland benefits relative to commodity values. In fact, many economists believe that nonmarket forest resources, not timber, will be the scarce resources of the future.[243] Increasing scarcity of wildland resources should induce an increase in economic value.[244] Although the Forest Service planners typically do not forecast trends for wildland benefits, projecting trends may actually be more justified for wilderness resources than for timber resources.

B. *Public Wildland Network As a Safe Minimum Standard*

The lack of information on wildland benefits combined with the apparent distrust on the part of Forest Service officials of nonmarket estimates in general and consumer surplus in particular, suggests a need to explore an alternative approach for evaluating the economics of a network of public wildlands. One alternative suggested in the writings of the late S.V. Ciriacy-Wantrup[245] and advocated by a number of scholars[246] is the safe minimum standards (SMS) management philosophy. For biodiversity conservation, a SMS approach can be defined as preserving a sufficient area of habitat to ensure the survival of species, subspecies or ecosystems.[247]

The SMS approach places greater emphasis on potential damage and risks to wildlands, and avoids some of the pitfalls of formal benefit-cost analysis including the treatment of gross uncertainty as mere risk, the false appearance of precision when estimating benefits, and the problem of discounting.[248] The SMS approach assumes wildlands produce positive benefits and makes no attempt to quantify them in an economic analysis. The benefits are discussed qualitatively, but the empirical economic question examines the opportunity cost of reserves. The economic

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243. *Cf., e.g.*, V. KERRY SMITH, TECHNICAL CHANGE, RELATIVE PRICES, AND ENVIRONMENTAL RESOURCE EVALUATION (1974); Krutilla, *supra* note 39, at 777–86.

244. Research by Loomis and Walsh indicates that passive-use benefits will likely increase in the future. *See* Loomis & Walsh, *supra* note 39, at 181. Passive-use forest benefits are positively related to income, education, and whether the household is retired or not. Socio-economic trends indicate income, education, and retirees have increased in counties adjacent to public lands and are expected to continue to increase in the future. *See* Morton, *Charting a New Course*, *supra* note 63, at 65.

245. S.V. Ciriacy-Wantrup, RESOURCE CONSERVATION: ECONOMICS AND POLICIES 251–67 (1952).

246. *Cf., e.g.*, Richard C. Bishop, *Endangered Species and Uncertainty: The Economics of a Safe Minimum Standard*, 60 AM. J. AGRIC. ECON. 10, 10–18 (1978); Randall, *supra* note 96, at 30–33; Michael A. Toman, *Defining Economics of Sustainable Forestry: General Concepts*, *in* DEFINING SUSTAINABLE FORESTRY 261, 274–77 (Gregory H. Aplet et al. eds., 1993); Toman & Ashton, *supra* note 38, at 376.

247. *See* Bishop, *supra* note 246, at 10–11, 16–18.

248. Alan Randall, *Human Preferences, Economics and the Preservation of Species*, *in* THE PRESERVATION OF SPECIES: THE VALUE OF BIOLOGICAL DIVERSITY 98 (1986).

rationale is based on the proposition that the costs of maintaining SMS are small in relation to the possible losses from irreversible declines in wildland diversity.[249] Wildland conservation should be afforded unless the opportunity cost of reserves becomes intolerably high.

In order to conserve ecosystem integrity, SMS constrain where and how logging takes place.[250] In essence, SMS shift the burden of proof from those who believe that a wildland network is needed to those who believe that conservation efforts are not necessary. SMS shift the debate from deciding whether or not a wildland network is needed to deciding how big the network should be.[251] SMS do not diminish the need for economic information, they just sets lower limits below which the economic analysis is suspended. The suspension of economic analysis remains unless the opportunity costs are intolerably high. Such a suspension is consistent with the "precautionary principle" advocated by many scientists,[252] and is an appropriate risk averse stance to take until better information on the ecological and economic benefits of wildland conservation becomes available.

A SMS approach would certainly be an improvement over the current interpretation of the suitability analysis required by NFMA and completed by planners during the first round of forest planning. The three-stage screening process adopted by the Forest Service estimates land suitable for timber production, not land required to ensure the sustainability of wildland reserves.[253] Under the current interpretation, the de facto wildland network is the residual—lands leftover after the suitable timber base has been established. The final determination of the suitable timber base is made in NFMA stage three using the FORPLAN model for timber harvest scheduling. A reserve system based on residual lands left after timber suitability is established is an inefficient procedure for conserving wildland resources on public land. The suitability process should be reversed; select suitable wildlands first and let timber 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 non-linear ecological relationships, when combined with all the other problems previously noted with the

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249. *See* Ciriacy-Wantrup, *supra* note 245, at 262.

250. *See* Toman & Ashton, *supra* note 38, at 371.

251. *See* Morton, *Charting a New Course*, *supra* note 63.

252. *See, e.g.*, Norman Myers, *Biodiversity and the Precautionary Principle*, 22 AMBIO 74, 74 (1993) (noting a "super-premium" on applying the principle).

253. Pursuant to the NFMA, the Forest Service adopted a three-stage screening process to determine the suitable timber base (land available for logging) on each national forest. The first screen withdraws land that is physically unsuitable for timber production. The second screen analyzes the financial returns from timber production but does not withdraw any land. The third screen uses FORPLAN to identify land needed to accomplish the agency's timber production goals and other objectives (i.e., the suitable timber base).

FORPLAN model provide justification for establishing a wildland network before running FORPLAN. This could be accomplished by adding a wildland suitability screen to the planning process. 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. Incorporating safe minimum standards for wildland conservation in the FORPLAN model can be illustrated graphically in Figure 8. In this figure the line segment SS reduces the decision space by setting a minimum number of acres allocated to a wildland network. FORPLAN could then be used to schedule activities for the land outside the reserves and to estimate the opportunity costs of alternative wildland reserve designs. Visually mapping and presenting the opportunity costs of alternative wildland networks could provide useful information for public meetings. Safe minimum standards represent an alternative economic analysis of wildland benefits than traditionally completed—one that will reveal the magnitude of the opportunity costs of a public wildland network.

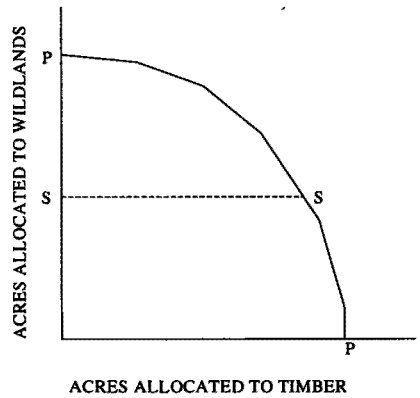

FIGURE 8

Morton et al. examined the opportunity costs of a wildland network on the southern Appalachian national forests and concluded that the opportunity costs would be relatively small.[254] The southern Appalachian national forests are at a comparative disadvantage in terms of the costs of getting logs to the market,[255] and timber production has a negative finan-

254. *See* Morton et al., *supra* note 93, at 352.

255. The southern Appalachian national forests are steeper, less accessible, and have logging costs that are $150–$200 more per acre than private lands in the region. *See Southern Appalachian Man and the Biosphere*, *supra* note 165. These findings are significant as they reject the argument put forth by many that Forest Service timber sale administrative and environmental compliance costs are entirely to blame for the national forest timber sold below costs. Although significant, these findings are not new. *See generally* WILLIAM A. DUERR, THE ECONOMIC PROBLEMS OF FORESTRY IN THE APPALACHIAN REGION (1949) (providing a detailed study of the forestry problems of the Appalachian region).

cial return on a majority of public land.[256] Timber harvested from the southern Appalachian national forests accounts for less than one percent of the total cut in the five state region. Jobs directly and indirectly attributable to national forest timber programs represent less than two percent of timber industry employment and less than one-tenth of one percent of the total employment in the eighty-eight counties surrounding the southern Appalachian national forests.[257] In contrast, the opportunity costs associated with continued widespread logging on the national forests may be quite high. As such, maintaining society's options for the future by establishing a network of wildland reserves may be an economically efficient alternative to the current management policies on these national forests. The same result may be true for wildland reserves on other national forests.

CONCLUSION

"Without the services performed by the diverse, intact communities of plants, animals and microorganisms in [wildlands], we would be starving, baking, gasping for breath and drowning in our wastes."[258] So do we really need economists to tell us how much our wildland life support system is worth? Is not that value infinitely obvious? In the past, many public investments were made without completing an economic analysis. Public assets that we take for granted, wilderness areas, national parks, wildlife refugees, Central Park, etc., would not be here today if we relied solely on markets and advice from market economists. Economics provides necessary 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.[259] This is consistent with the MUSYA and NFMA definition of multiple-use that

256. The lost timber revenues can be estimated from Forest Service planning documents. On the 625,000 acre Cherokee National Forest, only 35,553 acres (5.7%) are estimated to generate positive returns from timber production; of the 1,025,000 acres on the Nantahala and Pisgah National Forests, planners estimate that 281,500 acres (27.4%) would produce positive returns from timber production. *See* DRAFT SUPPLEMENT TO THE FINAL ENVIRONMENTAL IMPACT STATEMENT FOR THE NANTAHALA AND PISGAH NATIONAL FORESTS, *supra* note 187. Farther north, planners estimated that 272,465 acres (26%) of the 1,055,525 acres on the George Washington National Forest have positive returns from timber production. FOREST SERV., U.S. DEP'T AGRIC., INCORPORATION OF NFMA REQUIREMENTS (1993) (process paper for the revision of the George Washington National Forest). The financial returns from timber production on these national forests were estimated with the most efficient harvesting methods (typically clearcutting) and without road building costs. If other harvesting methods were used and/or road costs included, the proportion of each forest generating a positive financial return from timber production would be even lower.

257. *See* Morton, *Charting a New Course*, *supra* note 63, at 65.

258. ELLIOTT A. NORSE ET AL., THE WILDERNESS SOC'Y, CONSERVING BIOLOGICAL DIVERSITY IN OUR NATIONAL FORESTS 9 (1986).

259. *See* BOWES & KRUTILLA, *supra* note 171, at 3–5.

states the optimum policy is "not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output."[260]

Although wildlands are highly valued by society, without formal markets the benefits of wildland conservation are difficult to quantify in economic terms. 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.

The Forest Service was once a leader in wildland conservation, but over the last thirty-five years the policies and procedures adopted by the agency have failed to adequately internalize wildland 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 procedures and policies for guiding public land management. The recent acknowledgement by Forest Service researchers on the economic importance of protecting wildlands in the Pacific Northwest is encouraging and may be a sign of positive change on the horizon. As a global leader in natural resource management, the Forest Service should take a leading research role in valuing wildland resources and developing a natural resource accounting system that fully accounts for the nonmarket benefits and costs that accrue to society from public land management activities. Increasing public investments in wildland economic research could produce global benefits if the methods and results become integrated into forest management in other countries.

In the meantime, applying safe minimum standards provide a complementary approach to current forest planning procedures; an approach that avoids the difficult task of fully accounting for nonmarket, wildland benefits.[261] Management planning based on safe minimum standards is more conservative than current management but a conservative approach is an appropriate management philosophy for a public trustee and steward of our nation's natural capital. Some scientists, however, believe SMS analysis is unlikely to be useful because estimating minimum habitat

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260. 16 U.S.C. § 531(a) (1994); *see* 16 U.S.C. § 1604(e) (1994) (requiring the NFMA's definition of "multiple use" and "sustained yield" to comply with the MUSYA definitions); *cf.* Paul J. Culhane & H. Paul Friesema, *Land Use Planning for the Public Lands*, 19 NAT. RESOURCES J. 43, 43–74 (1979).

261. Adopting a SMS approach should not, however, prevent the Forest Service from actively funding the nonmarket valuation research necessary to fully account for the economic benefits and costs of national forest management.

needs of viable populations is an intractable problem.[262] While agreeing with the skeptics that the problem is large and uncertainty exists, SMS provide a complimentary approach, that if adopted, could help the agency improve wildland conservation on the national forests during the upcoming round of forest plan revisions. Although not perfect and not sufficient, adopting a SMS approach is a step in the right direction for conserving wilderness benefits simply by reframing the questions asked and the analysis completed by public land management agencies.

262. Paul R. Ehrlich & Gretchen C. Daily, *Population Extinction and Saving Biodiversity*, 22 AMBIO 64, 67 (1993).