



THE ECONOMIC BENEFITS OF WILDLANDS IN THE EASTERN SIERRA NEVADA REGION OF CALIFORNIA

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CONTENTS

Preface	1
Executive Summary	3
Introduction	7
Economic Benefits Provided by Wilderness and Natural Areas	11
Direct-use Benefits	13
Community Impacts	17
Scientific Benefits	21
Off-site Benefits	23
Educational Benefits	25
Biological Diversity Benefits	27
Ecological Services Benefits	31
Passive-use Benefits	33
Conclusion	35
References	37
Appendix: Special Status Plants and Animals in Mono and Inyo counties, California	A-1

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For more information about Eastern Sierra Nevada forests and other forests in California and Nevada, contact The Wilderness Society, California/Nevada Regional Office, Presidio Building 1016, P.O. Box 29241, San Francisco, CA 94129 Phone: 415-561-6641

PREFACE

On behalf of The Wilderness Society, we are pleased to make available *The Economic Benefits of Wildlands of the Eastern Sierra Nevada Region of California*. The Society has made a long-term commitment to the Sierra Nevada and is working at several levels to ensure that its natural landscape and natural resources are protected and managed wisely. One overall goal is to secure science-based land and resource stewardship in the region by making available the best information possible.

This economic report demonstrates that wilderness and other natural areas provide direct and indirect benefits to humans. The study found that the Eastern Sierra wild lands contribute total economic benefits of over \$700 million per year and support more than 2,800 jobs in Mono and Inyo Counties.

We believe there is a growing public realization that a high quality of life, open spaces, and outdoor recreation opportunities provide the foundations for the region's competitive advantage. To help facilitate decision-making that recognizes this important link, we will distribute this report to Eastern Sierra local boards of supervisors, chambers of commerce, planning departments, planning commissions and other interested groups.

The Wilderness Society works to protect America's wilderness and to develop a nationwide network of wild lands through public education, scientific analysis and advocacy. Our goal is to ensure that future generations enjoy the clean air and water, beauty, wildlife, and opportunities for recreation and spiritual renewal provided by the nation's pristine forests, rivers, deserts, and mountains.

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THE WILDERNESS SOCIETY

EXECUTIVE SUMMARY

The Wilderness Act of 1964 established the National Wilderness Preservation System, which currently comprises 644 designated wilderness areas on 105 million acres across the United States. The Act directs that certain lands be protected "in their natural condition... for the American people of present and future generations" to "secure the benefits of an enduring resource of wilderness" (Wilderness Act, 1964). The Act further states that wilderness areas provide opportunities for "solitude and a primitive or unconfined type of recreation" and that they "contain ecological, geological, or other features of scientific, educational, scenic, or historical value." The Act requires that wilderness areas be managed in such a way as to leave them "unimpaired for future use and enjoyment as wilderness."

Wildlands provide numerous direct and indirect economic benefits to society. This study measured the economic value of wildlands in the Eastern Sierra Nevada region of California and found that wildlands in Mono and Inyo counties contribute a total economic benefit of approximately \$700 million per year and support more than 2,800 jobs.

Congress, in passing the Wilderness Act, recognized that wilderness areas provide many benefits to society and that they embody ecological values, as do many other natural areas with characteristics similar to those of wilderness areas.

The designation of wilderness areas, as well as management decisions regarding the protection of other federal lands, often results in economic impacts to counties and communities. This study was motivated by an interest in determining the value of the economic benefits of wildlands to nearby counties. California's Eastern Sierra Nevada region was selected as the study area, and the geographic scope of the study was limited to Mono and Inyo counties. The data used in this analysis are secondary data; no primary data were collected. The study makes reference to existing or published studies of wildlands in California and other regions of the United States.

Wildlands are defined to include all designated wilderness areas currently under management by the Forest Service (FS), Bureau of Land Management (BLM), and National Park Service (NPS) in the region; FS inventoried roadless areas; BLM wilderness study areas (WSAs); and specific public land designations that share many of the same characteristics as wilderness (i.e., they are generally roadless and offer opportunities for solitude and primitive recreation). The areas under review in this study total almost 5.5 million acres in the Eastern Sierra Nevada region—nearly one million acres in Mono County (Table ES-1) and more than 4.4 million acres in Inyo County (Table ES-2).

Table ES-1: Wilderness and Natural Areas in Mono County, California

Mono County	Land Designation	Total Acres
USDA Forest Service	Toiyabe NF - Wilderness	39,168
	Toiyabe NF - Roadless	72,700
	Inyo NF - Wilderness	101,656
	Inyo NF - Roadless	423,058
	Inyo NF - Natural Areas	120,156
National Park Service	Devils Postpile National Monument	800
Bureau of Land Management	Wilderness Study Areas	<u>226,112</u>
Total: Mono County		983,650
Sources: Toiyabe and Inyo National Forests, National Park Service, Bureau of Land Management		

Table ES-2: Wilderness and Natural Areas in Inyo County, California

Inyo County	Land Designation	Total Acres
USDA Forest Service	Inyo NF - Wilderness	314,099
	Inyo NF - Roadless	353,296
	Inyo NF - Natural Areas	28,892
National Park Service	Death Valley National Park	3,128,000
Bureau of Land Management	Wilderness	590,002
	Wilderness Study Areas	<u>31,526</u>
Total: Inyo County		4,445,815
Sources: Toiyabe National Forest, Inyo National Forest; National Park Service, Bureau of Land Management		

Approximately 30 distinct economic benefits of wilderness and natural areas were categorized in eight groups. They were shown to have an estimated economic value between \$666.2 million and \$784.2 million per year, to contribute more than \$98.1 million in annual income to the counties, and to support more than 2,800 jobs (Tables ES-3 and ES-4).

Table ES-3: Economic Benefits of Wilderness and Natural Areas in the Eastern Sierra Nevada Region of California

Category of Economic Benefits	Mono County	Inyo County	Regional Total
	----- \$ million / year -----		
Direct-use Benefits (recreation)	\$66.5 - \$84.3	\$58.5 - \$86.7	\$124.9 - \$170.9
Scientific Benefits	n.a.	n.a.	\$2.1
Off-site Benefits	\$84.5	\$100.7	\$185.1
Educational Benefits	n.a.	n.a.	\$1.1
Ecological Services Benefits	\$15.3 - \$52.5	\$14.4 - \$49.2	\$33.2 - \$105.2
Passive-use Benefits	\$58.1	\$262.6	\$320.7
Total	\$224.4 - \$279.4	\$436.2 - \$499.2	\$667.1 - \$785.1

n.a. = quantitative estimate not available; see text for discussion of these benefits.

Table ES-4: Additional Economic Benefits of Wilderness and Natural Areas in the Eastern Sierra Nevada Region of California

Additional Economic Benefits	Mono County	Inyo County	Regional Total
Community Impacts			
- employment	1,511 jobs	1,301 jobs	2,812 jobs
- income	\$51.8 million	\$46.3 million	\$98.1 million
- output	\$69.4 million	\$61.8 million	\$131.2 million
Biological Diversity Benefits:	Two of three eco-regions protected as wilderness; 37% of old-growth forests protected as wilderness		

INTRODUCTION

While economic factors should not be the driving force in wilderness designations or wilderness management (Loomis, 2000), the decision to designate wilderness or to protect natural areas most certainly involves economic trade-offs between wilderness uses and commodity uses (or, in many cases, other recreation uses). Wildlands provide numerous economic benefits to society beyond the value of recreation uses, including scientific benefits and ecological services. In addition, wilderness often has an impact on the economy of neighboring communities, which can be measured by the effect on jobs and/or income to an area.

The wilderness areas and other natural areas investigated in this analysis are all on federal land and are managed by federal agencies using federal tax revenues. These agencies are ultimately concerned with the social well-being of the national society. Nevertheless, public land decisions may affect regional economies in the provision of opportunities for recreation and impacts on the natural environment.

This study is an attempt to estimate the regional economic benefits generated by designated wilderness and natural areas in the Eastern Sierra Nevada region of California, which, for these purposes is defined to include Mono and Inyo counties. The study area includes all designated wilderness areas currently under management by the Forest Service (FS), Bureau of Land Management (BLM), and the National Park Service (NPS) in the region, as well as all FS inventoried roadless areas and BLM wilderness study areas (WSAs), which possess the characteristics of designated wilderness areas (i.e., the areas are roadless, retain their natural character, provide opportunities for solitude and primitive recreation) and are managed as such by their respective agencies.

In addition, the study area is expanded to include several other specific public lands that share many of the same features and characteristics as designated wilderness areas. The particular areas under consideration and their respective acreage are presented in Tables 1 and 2. There are more than 140,000 acres of designated wilderness in Mono County and more than four million acres of designated wilderness in Inyo County (including Death Valley National Park). When the roadless areas, wilderness study areas, and other public land designations defined for this study are included, the total acreage under consideration equals nearly one million acres in Mono County and exceeds 4.4 million acres in Inyo County for a total in both counties of 5,429,465 acres.

Table 1: Wildlands in Mono County, California

Public Land Agency	Area	Acres
Toiyabe National Forest (FS)	Hoover Wilderness	39,168
	Hoover Additions (roadless area)	72,700
Inyo National Forest (FS)	Ansel Adams Wilderness	38,218
	Boundary Peak Wilderness*	10,509
	Hoover Wilderness	9,433
	John Muir Wilderness	43,496
	Mono Basin NF Scenic Area	116,273
	Harvey Monroe Hall Research Natural Area	3,883
	Inventoried Roadless Areas	423,058
Bureau of Land Management	Volcanic Tablelands WSA	12,499
	Fish Slough WSA	15,331
	Chidago Canyon WSA	20,365
	Casa Diablo WSA	8,959
	White Mountains WSA	11,200
	Granite Mountain WSA	58,238
	Mormon Meadow WSA	8,354
	Walford Springs WSA	13,006
	Excelsior WSA	9,383
	Mount Biedeman WSA	13,146
	Bodie Mountain WSA	25,944
	Bodie WSA	16,814
	Masonic Mountain WSA	6,605
Slinkard WSA	6,268	
National Park Service	Devils Postpile National Monument	<u>800</u>
Total: Mono County		983,650

* Although Boundary Peak Wilderness Area is in Nevada, it is managed by Inyo National Forest staff.

Table 2: Wildlands in Inyo County, California

Public Land Agency	Area	Acres
Inyo National Forest (FS)	Golden Trout Wilderness	51,240
	Inyo Mountains Wilderness	72,534
	John Muir Wilderness	180,366
	South Sierra Wilderness	9,959
	Ancient Bristlecone Pine Forest*	28,892
	Inventoried Roadless Areas	353,296
Bureau of Land Management	Saddle Peak Hills Wilderness	1,440
	Funeral Mountains Wilderness	28,110
	Inyo Mountains Wilderness	132,442
	Argus Range Wilderness	74,890
	Coso Range Wilderness	50,520
	Darwin Falls Wilderness	8,600
	Malpais Mesa Wilderness	32,360
	Surprise Canyon Wilderness	29,180
	Manly Peak Wilderness	16,105
	Owens Peak Wilderness	74,060
	Sacatar Trail Wilderness	51,900
	Sylvania Mountains Wilderness	17,820
	Piper Mountain Wilderness	72,575
	Independence Creek WSA	6,458
	Symmec Creek WSA	8,717
Crater Mountain WSA	7,551	
Great Falls Bainb WSA	8,800	
National Park Service	Death Valley National Park**	<u>3,128,000</u>
Total: Inyo County		4,445,815

* Although the Ancient Bristlecone Pine Forest is in both Mono and Inyo counties, primary access is in Inyo County.

** Death Valley National Park covers more than 3.3 million acres. Under the California Desert Protection Act (1994), roughly 95% (3,128,00 acres) of the park area was designated as wilderness.

ECONOMIC BENEFITS PROVIDED BY WILDERNESS AND NATURAL AREAS

Preserving natural environments such as wilderness provides a wide array of economic benefits to society (Krutilla and Fisher, 1975), including recreation uses, scientific research, and community benefits. Although lands need not be formally preserved to provide these benefits, some form of land protection is necessary to ensure that these benefits are provided into the future (Loomis and Richardson, 2000).

Wilderness and natural areas protect many values. According to the Wilderness Act of 1964, wilderness areas provide opportunities for a "primitive and unconfined type of recreation" as a defining characteristic. But the Act indicates that Wilderness areas "...may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value." Generally, wilderness areas, as well as other natural areas under review in this study, are roadless, have retained their natural character, and offer opportunities for solitude and primitive recreation. Today, scientists and public land managers consider additional values such as protection of biodiversity and endangered species, as well as the sustainability of the uses of natural resources. It is apparent that wilderness provides numerous direct and indirect benefits to humans (often called anthropocentric values), and also embodies ecological values. Many of the values humans receive from wilderness and natural areas can be quantified and measured in monetary or economic terms. In these cases, economics also provides a way to communicate the natural and social values of wilderness to public officials who must ultimately decide whether an area is designated or not and, once designated, how it should be managed.

The decision to designate certain public lands as wilderness is often contentious. The designation of a parcel of land as wilderness ensures that wilderness values will be preserved, but at the cost of foregoing other uses of the land parcel, which in some cases includes logging, mining, and motorized vehicle access. There is occasionally some concern that the designation of a new wilderness area would somehow "lock up" public resources and exclude access, but such a designation is intended to protect the benefits that are specifically generated by wilderness areas. Public land managers, through the land management planning process, are authorized to provide an array of land designation types in order to maximize the benefits that each designation provides.

While the benefits of wilderness tourism and recreation are important to the economies of local communities, there are numerous other wilderness benefits that are valued by the general public. In a 1995 survey of U.S. residents, nearly 80% of respondents said that the protection of wilderness for each of the purposes of air and water quality, wildlife habitat, and endangered species was "very" or "extremely" important (Cordell, 1998). Only 23% indicated that the benefits of wilderness tourism were as important. This suggests that the national society attaches great significance to some of the ecological values protected by wilderness areas in addition to the financial benefits they may provide. More than 55% of the survey respondents said that the present amount of designated wilderness is "not enough," while only 2.5% said that it is "too much."

DIRECT-USE BENEFITS

Direct uses of wildlands include on-site recreation and the enjoyment of cultural and heritage sites. Wilderness and other natural areas provide opportunities for non-motorized recreation, including hiking, horseback riding, backpacking, camping, wildlife viewing, fishing, and hunting. According to agency recreation-use data, these areas in the Eastern Sierra Nevada region host nearly three million visitor days per year (USDA Forest Service, National Park Service, Bureau of Land Management, 1998).

The economic benefit of recreation use is defined as users' net willingness to pay over and above travel costs (also known as consumer surplus; Loomis and Walsh, 1997). Economists have developed two methods for quantifying the economic value of recreation uses to visitors, and both methods are accepted by federal agencies for valuing recreation—and other benefits for which no market exists. Both methods have been recommended by the U.S. Water Resources Council (1983) for valuing outdoor recreation and by the U.S. Department of the Interior (1986, 1994) for estimating the value of natural resource damages.

The travel-cost method uses visitation data and variations in travel costs to statistically estimate the net benefits of the recreation experiences at a particular site (Loomis and Walsh, 1997). This methodology is based on the assumption that visitors who travel longer distances (and thus incur greater travel costs) to visit a recreation site must perceive higher benefits from the recreation experience, as revealed by their willingness to pay higher travel costs. The contingent-valuation method is a survey technique that relies on a hypothetical market to quantify the willingness of visitors to pay for recreation experiences for which there is no market. Survey respondents are asked to state their maximum willingness to pay for the recreation experience described in the survey.

It is clear that the values of recreation are significant for the Eastern Sierra Nevada region. In a California Department of Transportation survey of vehicle passengers on the U.S. 395 corridor, respondents were asked to specify the main purpose of their trip; 39% of winter travelers and 60% of summer travelers indicated that recreation was the main purpose of their trip (CALTRANS, 2000). In a 1999-2000 study conducted by Applied Development Economics of visitors to the town of Mammoth Lakes, 40% of summer visitors indicated they participated in national forest hiking, 39% participated in fishing or hunting, 30% went camping, and 16% went horseback riding (ADE, 2001). In a survey conducted by Klages and Associates of Mammoth Lakes visitors, more than 61% of summer visitors said they participated in hiking while visiting the area, 42% said they participated in fishing, 49% said they visited Devils Postpile National Monument, and nearly 10% indicated they visited Death Valley National Park (Klages, 1995). This study reported that more than 16% of winter visitors went hiking, and 6% went cross-country skiing.

It is impossible to extract from these data the portion of tourists who participated in these activities in designated wilderness or other natural areas. But given the composition of public lands in the region and the known primary uses of those lands, one can conclude that wilderness recreation is an important component of the array of available recreation options.

Estimating the economic benefits from wildland recreation requires data on both the economic benefits per visitor and the number of visitors. For this study, recreation-use data were collected from wilderness managers of the Toiyabe and Inyo National Forests, the Bishop field office of the BLM, and databases maintained by the National Park Service. Federal agencies measure recreation use of designated wilderness areas, but not for other land designations considered in this study due to the costs and effort that would be required. Therefore, in order to estimate the economic benefits of recreation in wilderness and natural areas in the Eastern Sierra Nevada region, recreation use at certain sites was estimated using data from sites in the region for which use data were available.

Loomis (1999) studied the recreation impact of the designation of additional wilderness to determine whether designation results in additional use or simply spreads existing use across a greater range of wilderness recreation choices. He found that the designation of additional wilderness areas does result in an overall increase in wilderness recreation use, at a rate of elasticity of 0.89 (i.e., a 10% increase in designated wilderness would result in an average increase in visitor use of 8.9%). He developed a model to statistically estimate recreation use by relating visitation data with acreage. The model was used in this study to estimate recreation use where recreation data were not available.¹

Table 3 provides annual visitation data for the wildlands under review in this study. Where available, data represent an average of annual visitation between 1998 and 2000. Visitation is measured in Recreation Visitor Days (RVDs). One RVD is equivalent to a 12-hour visit (thus, one RVD may represent one person for a 12-hour visit or two people visiting for six hours, etc.).

Public Land Agency	Mono County	Inyo County	Regional Total
Toiyabe NF—Wilderness	13,356	n.a.	13,356
Toiyabe NF—Roadless Areas	5,256	n.a.	5,256
Inyo NF—Wilderness	60,460	408,971	469,431
Inyo NF—Roadless Areas	148,023	123,614	271,636
Inyo NF—Natural Areas	1,176,784	21,481	1,198,265
National Park Service	54,506	723,045	777,551
BLM—Wilderness	n.a.	63,079	63,079
BLM Wilderness Study Areas	77,219	10,954	88,173
Total	1,535,603	1,351,143	2,886,747

Sources: USDA Forest Service, National Park Service, Bureau of Land Management—1998

¹ The model's estimates of recreation use follow the assumption that designated wilderness areas host more recreation visitor days per acre than do FS Inventoried Roadless Areas and BLM WSAs.

More than 20 empirical studies of the economic value of recreation in wilderness areas (and other primitive areas in the United States) were compiled by Loomis et al. (1998). The studies valued recreation benefits at areas throughout the United States, and revealed an average value of wilderness recreation per day of \$43.28. When this value is applied to the estimate of 2.9 million recreation visitor days at wilderness and natural areas in the Eastern Sierra Nevada region, the aggregate value of recreation benefits is \$124.9 million per year (\$66.5 million in Mono County; \$58.5 million in Inyo County).

Alternately, a more specific estimate of recreation-use value can be obtained by using benefit transfer, a concept which refers to the adaptation and use of economic information from specific sites to other sites with similar resource and policy conditions (Rosenberger and Loomis, 2001). In this context, benefit-transfer data may be used by applying day values (for the Pacific Coast Area, defined to include the States of Washington, Oregon, and California) for specific recreation activities to recreation-use data for the Eastern Sierra Nevada region. Table 4 provides a summary of the activity day values and the corresponding estimates of recreation value for wilderness and natural areas in the Eastern Sierra Nevada region.

Table 4: Value of Annual Recreation Benefits of Wilderness and Natural Areas in the Eastern Sierra Nevada Region of California

Activity	Value per Person	Mono County		Inyo County		Total Value
		Recreation Use	Recreation Value	Recreation Use	Recreation Value	
Camping	\$86.96	231,154	\$20,101,155	581,554	\$50,571,954	\$ 70,673,109
Cross-country skiing, snowshoe hiking	\$40.32	178	\$ 7,173	153	\$ 6,172	\$ 13,345
Fishing	\$36.97	2,215	\$ 81,883	597	\$ 22,082	\$ 103,965
Hiking	\$26.71	45,587	\$ 1,217,622	93,482	\$ 2,496,914	\$ 3,714,536
Sightseeing	\$50.64	1,216,643	\$61,610,799	643,021	\$32,562,571	\$94,173,370
Other wilderness	\$31.29	39,826	\$ 1,246,167	32,336	\$ 1,011,787	\$ 2,257,954
Total		1,535,603	\$84,264,799	1,351,143	\$86,671,480	\$170,936,279

These data indicate that the benefit-transfer method yields an estimate for total recreation-use value for wilderness and natural areas of \$84.3 million in Mono County and \$86.7 million in Inyo County, amounting to a total for the region of \$170.9 million. Because the data collection methods differ among the various agencies that manage these lands, the categorization of recreation use by activity may not reflect the actual activity usage. Thus, the valuation estimates should be interpreted as approximations of recreation-use value.

Table 5 provides a summary of the range of estimated recreation benefits of wildlands in the Eastern Sierra Nevada region.

Table 5: Annual Direct-use Benefits of Wildlands in the Eastern Sierra Nevada Region

County	Recreation-use Days	Direct-use Benefits (\$ million / year)
Mono	1,535,603	\$ 66.5 - \$ 84.3
	1,351,143	\$ 58.5 - \$ 86.7
Regional Total	2,886,746	\$ 124.9 - \$ 170.9

COMMUNITY IMPACTS

Wilderness and other natural areas affect their surrounding human communities in a variety of ways (Rudzitis and Johnson, 2000). Public land agencies employ rangers who are directly involved in the management of wilderness areas. Recreation visitors, as well as scientists and students studying wildlands, often make purchases in towns and communities near such areas that support jobs and generate income for local residents.

Moisey and Yuan (1992) compared the expenditures of wildland and non-wildland recreation visitors to Montana and found that wildland-based visitors (backpacking, fishing, and nature study) spent more money for their trips and stayed about twice as long as non-wildland recreation visitors. In addition, it has been found that the recreation and environmental amenities of wilderness and other natural areas contribute to the quality of life of nearby residents and attract new residents, retirees, and firms who wish to locate near such places.

Rudzitis et al. (1996) found that "among the fastest growing counties in the nation are those adjacent to federally designated wilderness areas." They noted that the population of wilderness counties increased six times faster than the national average for other non-urban counties in the 1980s and nearly twice as fast as other non-urban counties in the western United States.

Some community benefits of wildlands can be estimated with the use of an input-output model. Spending by recreation and non-recreation visitors on lodging, food, and supplies has a direct effect on local businesses that provide such goods and services to tourists. These expenditures have indirect or multiplier effects on the overall economy through the increased demand of these businesses for the goods and services they purchase from other local firms. Linkages between local industries and the resulting multipliers for the Eastern Sierra region were calculated using IMPLAN (MIG, 1997). IMPLAN is an input-output model that was originally developed by the U.S. Forest Service to estimate the direct and indirect economic impacts of agency actions on regional income and employment.

Estimating the community benefits of wilderness and other natural areas requires data on visitor expenditures (categorized by economic sector) and visitor use. The IMPLAN model then uses these data to calculate the direct and indirect effects of visitor spending, and estimates the income (personal wages, business profits) and jobs supported by the expenditures.

There are few studies of estimates of wilderness visitor expenditures. Table 6 indicates that the average expenditures per day of wilderness visitors are similar across different types of ecosystems (Rudzitis and Johnson, 1999). The average daily expenditures across all studies equals \$39.47.

Table 6: Average Daily Expenditures of Wilderness Visitors

Location of Study	Expenditures / person / day (\$000)
Montana wilderness (backpacking)	\$39.10
Montana wilderness (fishing)	\$42.83
Montana wilderness (nature study)	\$35.06
Utah wilderness (Box Death Canyon)	\$38.44
Utah wilderness (Dark Canyon)	\$47.02
Utah wilderness (Grand Gulch)	\$37.66
Utah wilderness (Paria Canyon)	\$36.16
Average	\$39.47

Source: Rudzitis and Johnson, 1999

Visitors to wilderness and natural areas spend their money in a variety of ways. The data collected in the studies mentioned above were used to calculate an average distribution of expenditures among the various sectors of the local economy. Table 7 provides the average distribution of visitor expenditures among local industries.²

Using these estimates of average daily expenditures per person and of wildland visitor use in the region, the IMPLAN input-output model estimates that visitors to such areas support 2,812 jobs (15.0% of total jobs), \$98.1 million in total income (11.9%), and \$131.2 million in output (10.6%) for the two-county region. Table 8 presents these community impact estimates by county.

The local industries most affected by wildland visitors are those listed in Table 7 (i.e., gasoline stations, food stores, restaurants, lodging, etc.). However, because of the indirect and induced effects, there are estimated impacts to numerous other sectors, including transportation, construction, communication, health services, business services, and government.

A study funded by the National Science Foundation surveyed people who had recently moved into counties with federally designated wilderness in the past ten years, as well as longer-term residents of these counties (Rudzitis and Johansen, 1991). The results indicated that 72% of new residents considered wilderness a "major factor" in their decision to move to the county, while 55% of longer-term residents stated that wilderness was an important reason for living in the area. More than one-third of all residents indicated that they use wilderness areas at least 12 times a year.

Concerns have been raised in the past that wilderness designation will somehow result in a loss of jobs for a region. However, empirical evidence does not support these concerns.

² While these expenditure estimates may appear low, they are averages and represent a range of visitor activity.

Table 7: Average Expenditures of Wilderness Visitors By Category of Purchase

Industry	Average Expenditures / person / day
Gasoline	\$ 8.22
Groceries	\$ 8.23
Restaurant/Bar	\$ 6.78
Lodging and Campground	\$ 6.47
Auto/RV Rental	\$ 1.56
Licenses/Admissions	\$ 1.14
Recreation Equipment / Outfitter / Guide	\$ 1.59
Retail	\$ 5.48
Total	\$39.47

Source: Rudzitis and Johnson, 1999

Table 8: Regional Employment, Income, and Output Supported by Visitors to Wilderness and Natural Areas in the Sierra Nevada Region of California

Regional Impact	Mono County	Inyo County	Region Total
Employment Impact	1,511 jobs	1,300 jobs	2,812 jobs
Total Employment	8,663 jobs	10,032 jobs	18,695 jobs
% of Total	17.4%	13.0%	15.0%
Income Impact (\$million)	\$ 51.8	\$ 46.3	\$ 98.1
Total Income (\$million)	\$393.9	\$427.2	\$ 821.1
% of Total	13.1%	10.8%	11.9%
Output Impact (\$million)	\$ 69.4	\$ 61.8	\$ 131.2
Total Output (\$million)	\$585.1	\$654.7	\$1,239.8
% of Total	11.9%	9.4%	10.6%

SCIENTIFIC BENEFITS

Wilderness and natural areas provide natural benchmarks or control sites for studying the effects of human development on natural systems and for understanding unfettered ecological systems (Loomis and Richardson, 2001). Wilderness has been the focus of study for more than 400 scientific journal articles in the natural and social sciences, as well as for several hundred federal agency research publications. Publications such as these contribute to scientific progress and often, in turn, to greater efficiency in policy-making, productivity improvements, and overall increased human well-being.

Wilderness and other natural areas in the Eastern Sierra Nevada region of California are used extensively for scientific research. University of California's White Mountain Research Station (WMRS) and the Sierra Nevada Aquatic Research Laboratory (SNARL) maintain ongoing scientific research projects related to the lands under consideration in this study. The Forest Service maintains several designated research natural areas (RNA), such as the Harvey Monroe Hall RNA. In its 15-year review, the White Mountain Research Station (2000) reported 1999 extramural funding of \$5.7 million for scientists conducting WMRS-related research; \$1.5 million of those funds were awarded for research directly involving WMRS (i.e., work that would have been impossible without the station). WMRS publishes an average of 60 scientific research publications per year. Total user nights at WMRS for research purposes reached nearly 2,600 in 1999, with an additional 1,050 for conference and meeting purposes. WMRS conducts research in designated wilderness areas under a 25-year special-use agreement with the Inyo National Forest. It reports that approximately 64% of direct costs of contracts and grants from 1995 to 2000 were related to wilderness. WMRS facilities such as the Summit, Barcroft, and Crooked Creek Laboratories are adjacent to wilderness or natural areas under consideration in this study.

The value of new discoveries and knowledge that arises from the opportunity to study largely unfettered ecological processes has the potential to avoid costly natural resource management mistakes that lead to expensive endangered species recovery efforts and environmental restoration activities. New knowledge can sometimes have positive spillover benefits to the rest of the economy (Romer, 1990). The advances in knowledge arise from scientific discovery and their dissemination via scientific journal articles (Black, 1996).

Wilderness has often been referred to as a benchmark of relatively unmodified natural conditions in which to observe unfettered ecological processes at work. As such, wilderness areas are often the subject of scientific research and publications. In some cases, wilderness areas are used as control areas for understanding human effects. In others, wilderness is directly used to understand the influence of natural conditions on flora, fauna and physical environments. A current WMRS research program studying sagebrush-herb dynamics in the Golden Trout Wilderness Area illustrates the role of wilderness in scientific research. The large montane meadows in that area provide an ideal system in which to study the changes in vegetation composition and the impact of cattle grazing on native species (Berlow, 1999).

OFF-SITE BENEFITS

Most research to date on the economic benefits of wilderness has focused on the value of uses that occur on site, such as recreation. However, the benefits of wilderness and other natural areas include some values generated outside of the areas. For example, wilderness areas provide scenic backdrops for resorts and residential areas on nearby lands, thereby enhancing the value of personal property and increasing tax revenues. Wilderness areas along the U.S. 395 corridor, including the Hoover, Ansel Adams, and John Muir wilderness areas (along with several Forest Service roadless areas, including the San Joaquin and Log Cabin-Saddlebag roadless areas) provide panoramic views for drivers. In a 2000 survey of occupants in vehicles traveling on U.S. 395, CALTRANS found that 56% of summer travelers and 72% of winter travelers indicated that their final destination was either in Mono or Inyo County (CALTRANS, 2000). This would suggest that the protection of the scenic viewshed along the highway is of economic importance to both counties.

While wilderness and other natural areas generate numerous off-site benefits, the value of property price enhancements attributable to proximity to wilderness areas can be estimated using the hedonic property-pricing model (Rosen, 1974). It has been demonstrated that the wilderness areas do in fact enhance, rather than diminish nearby land values. The value of private land near wilderness boundaries are expected to be higher due to the wilderness amenity value, thereby generating off-site benefits to adjacent landowners. A hedonic-pricing model was used to estimate the enhancement value of private land near Green Mountain National Forest wilderness areas in Vermont (Phillips, 1999). Parcels of land in towns³ that contain designated wilderness areas were sold for prices that are 13 percent higher than in towns without wilderness, after controlling for the presence of an alpine ski area.⁴ That is—all else being equal—a parcel that sells for \$1,000 per acre in a town without wilderness would be expected to sell for \$1,130 per acre if it were in a town that contains wilderness. The study demonstrated further that land prices decreased by 0.8 percent per acre with each kilometer of distance from the nearest wilderness boundary.

The region in Vermont under investigation in the Phillips study shares many of the same characteristics as the Eastern Sierra Nevada region of California, including the significant presence of federal lands, alpine ski areas that are a few hours' drive from metropolitan centers, designated wilderness areas, and towns containing homes of a wide range of values. The presence of Mammoth Mountain and June Mountain ski areas and the increases in personal property values generated by their proximity to private homes does not necessarily diminish the applicability of the Vermont study results. In the absence of a hedonic-pricing model specifically for the Eastern Sierra Nevada region, the similarities shared between the region and the Green Mountains region of Vermont make the results of the Phillips study a reasonable proxy for the measurement of off-site benefits of wilderness and other natural areas in the Eastern Sierra Nevada region.

³ Towns are defined as geographic areas of less than 10,000 hectares.

⁴ The combined effect of the proximity to wilderness areas and ski areas was found to be approximately 24 percent.

EDUCATIONAL BENEFITS

Natural environments such as wilderness offer a living laboratory for many high school and university courses (Loomis and Richardson, 2000). In addition, there are a number of human development programs such as Outward Bound and National Outdoor Leadership School that use wilderness and other natural areas to train managers, promote teamwork, teach coping skills, and provide various forms of emotional and physical therapy. Wilderness expedition programs have also been used with troubled youths to foster better emotional development and adaptation skills. In a survey of participants in wilderness experience programs, 88% of respondents indicated that such programs were highly or moderately dependent on the characteristics of wilderness resources (Dawson, 1998).

While no quantitative indicators exist for the use of wilderness areas for such programs, Kellert (1998) studied the impact of wilderness education on participants of such courses and found that they contribute to improved physical fitness, problem-solving abilities, intellectual capacity, and a greater concern for the natural environment. The connection between the benefits realized by course participants and overall social benefits is intuitive, but the economic methods for valuing such social values are not fully developed (Loomis and Richardson, 2000).

Facilities such as the University of California's White Mountain Research Station near Bishop, California, offer university courses for students from all of the university's campuses and more than 100 other institutions, as well as support for graduate student research and internship programs for undergraduate students (WMRS, 2000). Total user nights at WMRS for education in 1999 were nearly 5,200, many of which were related to wilderness education. University of California-Santa Barbara's Sierra Nevada Aquatic Research Laboratory (SNARL), near Mammoth Lakes, California, hosts approximately ten university-level classes annually for field studies of regional natural areas, which translates to approximately 1,100 user days for education; the Outdoor Science Education Program and Summer Lecture Series host an additional 1,100 user days per year. Youth programs at Mono Lake host approximately 17,500 user days per year; Mono Lake environmental education programs host more than 10,000 user days per year. There have been no studies to estimate the value of wilderness education, but the application of the benefit-transfer value for general wilderness recreation of \$31.29 per day to the total user days (more than 35,000 per year) for education yields a rough estimate of the value of the education benefits of wilderness and natural areas in the Eastern Sierra Nevada region of California of \$1,107,291 per year. The estimate is considered conservative because it does not account for all educational uses of wildlands in the region.

BIOLOGICAL DIVERSITY BENEFITS

Scientists and policy-makers have brought attention in recent years to the importance of preserving plant and animal biological diversity and the natural diversity of physical environments. Biodiversity includes the full array of species as well as the genetic diversity within species (Morton, 1999). Natural diversity incorporates the physical environment and climate within which species interact with biodiversity.

The economic methodology for measuring the values of biodiversity is not well developed. However, an analysis of other quantitative data can help determine where additional benefit gains to biodiversity might be realized. One approach is to assess the degree to which proportions of land types (i.e., ecosystems) are represented by wilderness protection. Another approach is to consider the number of threatened and endangered species protected by area wildlands. A final measure of biodiversity benefits would consider the degree of uniqueness of the natural environment and the irreversibility of management decisions in the protection of biological diversity.

Two methods of land management are used to target the preservation of diversity: manipulative management and preservation management (Davis, 1989). Preservation management is concerned with the inclusion of representative samples of naturally occurring ecosystems among designated wilderness areas. In its second Roadless Area Review and Evaluation (RARE II) in 1977, the U.S. Forest Service gave preference to adding areas that would increase the diversity of the National Wilderness Preservation System. The agency used the Bailer-Kuchler ecosystem classification regime to categorize areas by physical and biological factors. The Bureau of Land Management also adopted this system for its wilderness reviews.

The California Gap Analysis, a project of the Biogeography Lab of the University of California, Santa Barbara, reports that two ecoregions are located within Mono County and three ecoregions are located within Inyo County (California Gap Analysis, 1998). These ecoregions correspond roughly with the Bailey-Kuchler ecosystem classification regime, which was used by Loomis and Echohawk (1999) to quantify the extent of biodiversity protection by designated wilderness. These ecoregions, their proportions in Mono and Inyo counties, and their relative representation in the National Wilderness Preservation System (NWPS) are summarized in Table 9.

The table indicates that although the Great Basin ecoregion makes up 3.6% of land in the conterminous 48 states, only 1.4% of Great Basin lands are protected by wilderness designation. Its wilderness-to-province ratio of 0.39 suggests that additional wilderness designation in this ecoregion would yield the greatest gains in biodiversity benefits. Mono and Inyo counties contain 2.2% and 1.4% of this ecoregion, respectively. The other two ecoregions, Sierra Nevada and Mojave Desert, have ratios of wilderness-to-province of 5.17 and 7.17, respectively, suggesting that in terms of biological diversity, these regions are proportionally well represented by wilderness designation.

Table 9: Ecoregions in Mono and Inyo Counties, California

Ecoregion	Bailey's Province	Mono County % of Province	Inyo County % of Province	Province % of Wilderness	Province % of NWPS	Wilderness to Province Ratio*
Great Basin	341 Intermountain Semi-Desert and Desert	2.2%	1.4%	1.4%	3.6%	0.39
Sierra Nevada	M261-Sierran Steppe-Mixed Forest	3.4%	4.1%	11.8%	2.3%	5.17
Mojave Desert	322-American Semi-Desert and Desert	0.0%	15.4%	21.0%	2.9%	7.17

* A ratio of 1.0 means that the ecoregion has equal percentages of wilderness and conterminous U.S. land area.

California Department of Fish and Game (1999) reports that in Mono County, there is one species of vascular plants listed as a threatened species (federal) and twelve listed as species of concern. The State of California has listed two species of fish (Owens pupfish and Owens tui chub) and three species of birds (willow flycatcher, bald eagle, and great gray owl) as endangered. Three species of mammals and two species of birds have been listed as threatened (federal); sixteen other animal species have been listed as species of concern.

For Inyo County, the California Department of Fish and Game has listed three species of vascular plants as endangered (Amargosa nitrophilia, Owens Valley checkerbloom, and Sodaville milk vetch), while two others are listed as endangered at the federal level (Eureka Dunes evening primrose and Eureka Valley dune grass). Five birds (bald eagle, Inyo California towhee, least Bell's vireo, western yellow-billed cuckoo, and willow flycatcher) have been listed as endangered by California. Two mammals (Amargosa vole and California bighorn sheep) have been listed as endangered at both the state and federal levels. In addition, California has designated the California wolverine, the Mohave ground squirrel, and the desert tortoise as threatened. Two species of fish are listed as endangered (Owens pupfish and Owens tui chub), and one amphibian (mountain yellow-legged frog) has been proposed for endangered classification. See the appendix for a listing of special status plants and animals in the region.

Forested land that has not been logged is known as old growth. Limited industrial use of such areas suggests that their ecological systems remain more intact than areas where timber harvests have occurred. Thus, old-growth forests may protect the benefits of biodiversity better than areas where logging occurs or has occurred in the past. Table 10 provides data on the area of old-growth coniferous forests in the region and indicates that for both the Inyo and Toiyabe national forests, less than 40% of old-growth forests are protected by reserve designations such as wilderness (SNWI,

1999). It should be noted that logging on national forests in Mono County is of a very limited extent and has not occurred at all in Inyo County since the mid-1980s (SNWI, 1999).

Research on the economic benefits of protecting biodiversity is of limited extent. The contingent-valuation method has the potential to estimate the value of biodiversity, but such a study would be cumbersome and quite expensive. For purposes of this study, the benefits of biodiversity are merely noted, along with the limitations of economic research to estimate their values. In summary, to achieve greater biodiversity benefits, these data suggest that the greatest gains would be realized by conserving land within the Great Basin ecoregion, additional protection of habitat for endangered and threatened species, and the conservation of old-growth coniferous forests.

Table 10: Old-growth Forests in the Eastern Sierra Nevada Region of California

National Forest	Total Coniferous Forest (acres)	Old-growth Coniferous Forest (acres)	% Old Growth	Reserved Old-growth (acres)	% Old-growth Reserved
Inyo National Forest	400,200	133,923	33%	48,844	36%
Toiyabe National Forest	249,954	52,989	21%	20,298	38%

Source: SNWI, 1999

ECOLOGICAL SERVICES BENEFITS

Wilderness and other natural areas play an important role in sustaining natural resources and providing ecological services that support life on Earth (Odum, 1997). These services provide direct economic benefits to humans and indirect benefits via the support of human and non-human life. The ecological services provided by wilderness and other natural areas include watershed protection, carbon sequestration, natural pest control, nutrient cycling, and pollution absorption (Morton, 1999).

One of the most important ecological services provided by unspoiled areas such as wilderness and natural areas is watershed protection. Road construction, mining, logging, and other industrial activities have been found to contribute to sedimentation. Watersheds protected by wilderness areas have been found to yield cost savings to water treatment facilities and highway departments from avoiding sedimentation. Drinking water requires sediment removal, mainly by filtration and by the introduction of aluminum sulfate and lime. Aluminum sulfate, or alum, bonds with the sediment and cause it to settle out of the water; lime is used to adjust for the water's natural pH level and for the influence of alum. Of particular interest to the Eastern Sierra Nevada region of California is the value of clean drinking water. The Los Angeles Department of Water and Power (LADWP) manages the Los Angeles Aqueduct System, a system of tunnels and reservoirs that delivers water to Los Angeles from the Owens River Valley and the mountain streams of the Mono Basin. The 233-mile Owens River Aqueduct was extended in 1940 to 338 miles (Mono Basin Project), and along with a second aqueduct that was completed in 1970, it transports snowmelt from the eastern slopes of the Sierra Nevada Range to the City of Los Angeles (LADWP, 2001). The capacity of the Aqueduct is about 500 million gallons per day (560,000 acre-feet per year). The LADWP reports that the median annual delivery for the Aqueduct over the next 20 years is expected to be 321,000 acre-feet per year (or 287 million gallons per day), which is estimated to satisfy about half of the city's water needs. This is particularly high-quality water that is sometimes blended with lower-quality water from groundwater and purchased water supplies. The value of the ecological benefit of watershed protection for the Eastern Sierra Nevada region is the estimated cost savings to water treatment facilities from avoiding sedimentation. Moore and McCarl (1987) found average cost estimates for water treatment of \$33.15 per million gallons of water treated, which includes the costs of alum and lime introduction and sediment removal. The application of this value to the expected usage by the City of Los Angeles of water from watersheds in Eastern Sierra Nevada wilderness and natural areas yields an estimate of nearly \$3.5 million for the value of watershed protection. This estimate is considered conservative as it does not reflect the stricter water quality standards presently in effect.

Forested areas store carbon in trees, which helps to moderate the effects of climate change (Morton, 1999). The benefits of carbon sequestration provide an economic argument for protecting the slower-growing pine and fir forests of the Eastern Sierra Nevada region. The value of the benefits of carbon sequestration can be conceptualized as either the avoided damages from potential climate change or the cost savings from storing carbon rather than reducing fossil fuel emissions. Haynes and Horne (1997) studied the benefits to society of carbon storage in the northwestern United States, and estimated a value of \$65 per ton. Birdsey and Heath (1995) estimated that an acre of public forest

sequesters about 31.45 tons of carbon just in trees (excluding the sequestration value of soil, where the majority of carbon is stored). The application of these estimates to the forested acres of wilderness and natural areas on national forests in the Eastern Sierra Nevada region yields an estimate of \$49 million for the annual value of carbon sequestration. Costanza et al. (1997) estimated that the benefits of climate regulation from temperate forests could be valued at \$35 per acre per year, which yields an estimate of \$14.9 million for the annual value of carbon sequestration. Thus, the estimated value of carbon sequestration for the region is between \$18.1 million and \$86.8 million per year (\$7.7 million to \$44.8 million for Mono County; \$7.2 million to \$42.0 million for Inyo County).

The benefits of waste treatment services by temperate forests were estimated at approximately \$35 per acre per year (Costanza, et al. 1997), which yields an estimate of the annual value of waste treatment services for the region of \$14.9 million (\$7.7 million for Mono County; \$7.2 million for Inyo County).

Table 11 provides a summary of the value of ecological services generated by wilderness and natural areas in the Eastern Sierra Nevada region. Carbon sequestration and waste treatment estimates were calculated for only the forested acres of national forest areas in the region. BLM and NPS lands reviewed in this study surely contain some forested areas, but acreage data were not available. Carbon sequestration benefits do not consider the carbon storage value of soils. Thus, the valuation estimates are likely conservative. The total value of ecological services of wilderness and natural areas in the Eastern Sierra Nevada region is estimated to be between \$33.2 million and \$105.2 million per year.

Ecological Service	Mono County	Inyo County (\$ million)	Total
Watershed Protection	n.a.	n.a.	3.5
Carbon Sequestration			
-Haynes and Horne (upper bound)	44.8	42.0	86.8
-Costanza (lower bound)	7.7	7.2	14.9
Waste treatment (Costanza)	7.7	7.2	4.9
Total	15.3 – 52.5	14.4 – 49.2	33.2 – 105.2

n.a. = quantitative estimate not available; unable to allocate the benefits of watershed protection to specific counties; regional estimate applies to both counties.

PASSIVE-USE BENEFITS

The protection of wilderness and other natural areas generates significant passive-use values as well. These values include *existence* values (the benefits of simply knowing that wilderness resources exist in a preserved state), *option* values (the benefits of maintaining the option to visit the areas in the future, and *bequest* values (the benefits of knowing that future generations will be able to enjoy the existence and/or use of wilderness) (Loomis, 1987). Passive-use values can be measured using the contingent-valuation method, a survey-based approach that quantifies the willingness of individuals to pay for the so-called "passive" uses of wilderness areas and the resources they protect. Passive-use values have been studied extensively, and are often found to comprise the majority of the total economic value of natural resources. Loomis (1989) studied the value of protecting Mono Lake, and found that the benefits of the passive uses represented 94% of total economic value, whereas the value of recreation uses at that time represented only 6%.

Using the results of previous studies of the passive-use values of wilderness areas, it is possible to estimate the annual passive-use values for the preservation of Eastern Sierra Nevada wildlands. A study by Walsh et al. (1984) measured the passive-use values for the preservation of various quantities of designated wilderness areas on lands managed by the USDA Forest Service in Colorado. The study estimated passive-use values of \$26 per household for the preservation of five million acres of wilderness. The application of this value to the roughly 12 million households in California and Nevada yields a total estimate of the passive-use values of wildlands in the Eastern Sierra Nevada region of \$321 million per year. This estimate is considered conservative, since individuals throughout the United States and the world may hold passive-use values for the wildlands considered in this study. The total value for the region can be allocated between the two counties in the region based on wildland acreage. When applied to the one million acres of wilderness and natural areas in Mono County, the estimate of passive-use values is \$58.1 million per year. When applied to the 4.4 million wildland acres in Inyo County, the estimate of passive-use values is \$262.6 million per year.



CONCLUSION

Humans receive numerous direct and indirect benefits from the protection of wilderness areas and other wildlands. While such areas are used extensively for recreational purposes, they also provide opportunities for scientific research and education and generate extensive off-site benefits and passive-use values, many of which are significant. This study of the economic benefits of wildlands in the Eastern Sierra Nevada region of California found that they generate approximately \$700 million per year in economic benefits and support more than 2,800 jobs in nearby communities in Mono and Inyo counties. This estimate of economic benefits is considered conservative because it does not include many benefits for which there is no standard economic valuation method.



REFERENCES

- ADE (Applied Development Economics). 2001. Mammoth Lakes Economic Indicators Study; Mammoth Lakes Summer Visitor Survey Final Report; Mammoth Lakes Winter Visitor Survey Final Report.
- Berlow, Eric. 1999. CRB-Context-Dependent Constraints of Sagebrush-Herb Dynamics. National Science Foundation funding proposal. University of California, White Mountain Research Station, Bishop, CA.
- Birdsey, R. A. and L. S. Heath. 1995. Carbon changes in U.S. forests. In: L. Joyce (ed.). *Productivity of America's Forests and Climate Change*. General Technical Report, RM GTR-271. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.
- Bureau of Land Management. 1998. Visitation Database. Recreation Management Information System (RMIS).
- California Department of Fish and Game. 1999. Natural Diversity Database: Special Status Plants, Animals, and Natural Communities. <http://www.dfg.ca.gov/whdab/cnddb.htm>.
- California Gap Analysis. 1998. Land Ownership and Management in California. Biogeography Lab, University of California, Santa Barbara, CA.
- CALTRANS. 2000. U.S. 395 Origination and Destination Study. California Department of Transportation, District 9, Bishop, CA.
- Consumer Price Index Calculator, Federal Reserve Bank of Minneapolis, Minneapolis, MN.
- Cordell, H. K., M. A. Tarrant, B. L. McDonald, and J. C. Bergstrom. 1998. How the public views wilderness. *International Journal of Wilderness*. 4 (3): 28-31.
- Costanza, R., et al. 1997. The value of the world's ecosystem services and natural capital. *Nature*. 387: 253-260.
- Davis, G. D. 1989. Preservation of natural diversity: the role of ecosystem representation within wilderness. In: *Wilderness Benchmark 1988: Proceedings of the National Wilderness Colloquium*, 1988 January 13-14, Tampa, FL, pp. 76-82. General Technical Report GTR SE-51. U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station, Asheville, NC.
- Dawson, C. P., J. Tangen-Foster, G. T. Friese, and J. Carpenter. 1998. Defining characteristics of U.S.A. wilderness experience programs. *International Journal of Wilderness*. 4 (3): 22-27.
- Duffy-Deno, K. T. 1998. The effect of federal wilderness on county growth in the intermountain western United States. *Journal of Regional Science*, 38 (1): 109-136.
- Haynes, R. W. And A. L. Horne. 1997. Economic assessment of the Basin. In: T. M. Quigley and S. J. Arbelbide (eds.). *An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins*. General Technical Report, PNW GTR-405, v. 4. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.
- Klages and Associates. 1995. Mammoth Lakes and the Eastern Sierra, 1995 Visitor Study.
- Krutilla, J. and A. Fisher. 1975. *Economics of Natural Environments*. Resources for the Future, Washington, DC.
- LADWP (Los Angeles Department of Water and Power). 2001. Water supply fact sheet. City of Los Angeles Water Services, Los Angeles, CA.
- Loomis, J. Economic values of wilderness recreation and passive use: what we think we know at the beginning of the 21st Century. In McCool, Stephen F., Cole, David N., Borrie, William T., O'Loughlin, Jennifer, compilers. 2000. Wilderness science in a time of change conference—Volume 2: Wilderness in the context of larger systems; 1999 May 23-27; Missoula, MT. Proceedings RMRS-P-15-VOL-2: 5-13. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ogden, UT.
- Loomis, J. 1999. Do additional designations of wilderness result in increases in recreational use? *Society and Natural Resources* 12: 481-491.
- Loomis, J. 1989. Quantifying the economic value of public trust resources using the contingent valuation method: a case study of the Mono Lake decision. Trans. 54th N. A. Wildlife and natural resources conference, 1989.
- Loomis, J. 1987. Balancing public trust resources of Mono Lake and Los Angeles' water rights: an economic approach. *Water Resources Research* 23 (8): 1449-1456.

APPENDIX — Special Status Plants and Animals in Mono and Inyo Counties, California

Table A-a: Special Status Plants and Animals in Mono County, California

Mono County	Federal Status	California Status
Vascular Plants		
Fish Slough MilkVetch	Threatened	None
Fish		
Owens Pupfish	Endangered	Endangered
Owens Tui Chub	Endangered	Endangered
Lahontan Cutthroat Trout	Threatened	None
Paiute Cutthroat Trout	Threatened	None
Amphibians		
Mountain Yellow-Legged Frog	Proposed Endangered	None
Yosemite Toad	Proposed Endangered	None
Birds		
Swainson's Hawk	None	Threatened
Willow Flycatcher	None	Endangered
Bald Eagle	Threatened	Endangered
Bank Swallow	None	Threatened
Great Gray Owl	None	Endangered
Mammals		
California Wolverine	Species of Concern	Threatened
Sierra Nevada Bighorn Sheep	Endangered	Endangered
Sierra Nevada Red Fox	Species of Concern	Threatened

Source: California Department of Fish and Game, 1999.

Table A-b: Special Status Plants and Animals in Inyo County, California

Mono County	Federal Status	California Status
Vascular Plants		
Amargosa Nitrophilia	Endangered	Endangered
Ash Meadows Gumplant	Threatened	None
Eureka Dunes Evening Primrose	Endangered	Rare
Eureka Valley Dune Grass	Endangered	Rare
Fish Slough Milk Vetch	Threatened	None
Owens Valley Checkerbloom	None	Endangered
Sodaville Milk Vetch	None	Endangered
Fish		
Cottonball Marsh Pupfish	None	Threatened
Owens Pupfish	Endangered	Endangered
Owens Tui Chub	Endangered	Endangered
Paiute Cutthroat Trout	Threatened	None
Amphibians		
Black Toad	None	Threatened
Mountain Yellow-Legged Frog	Proposed Endangered	None
Yosemite Toad	Proposed Endangered	None
Birds		
Bald Eagle	Threatened	Endangered
Bank Swallow	None	Threatened
Inyo California Towhee	Threatened	Endangered
Least Bell's Vireo	Endangered	Endangered
Swainson's Hawk	None	Threatened
Western Snowy Plover	Threatened	None
Western Yellow-Billed Cuckoo	None	Endangered
Willow Flycatcher	None	Endangered
Mammals		
Amargosa Vole	Endangered	Endangered
California Wolverine	None	Threatened
Sierra Nevada Bighorn Sheep	Endangered	Endangered
Mohave Ground Squirrel	None	Threatened
Reptiles		
Desert Tortoise	Threatened	Threatened
Source: California Department of Fish and Game, 1999.		